



JOINT ENVIRONMENTAL TECHNICAL ADVISORY
COMMITTEE &
UTILITY ADVISORY COMMITTEE
SPECIAL MEETING
WEDNESDAY, JANUARY 6, 2021
5:30 PM
ZOOM MEETING

THE ENVIRONMENTAL TECHNICAL ADVISORY AND UTILITY
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AGENDA

1. CALL TO ORDER / ROLL CALL / ACCEPT OR MODIFY AGENDA / CONFLICT OF
INTEREST DISCLOSURE
5:30 PM
2. INTRODUCTIONS -5 MIN.
3. STAFF PRESENTATION - 15 MIN.
4. QUESTION & ANSWER - 100 MIN.
5. ADJOURNMENT
7:30 PM



[insert WRIA 15 photo]

Watershed Restoration and Enhancement Draft Plan

**WRIA 15
Kitsap Watershed**

December 11, 2020 [insert final date once approved]

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- [tbd]

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[insert Spanish translation]

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Acronyms

Acronym	Definition
AE	Application Efficiency
AF/yr	Acre-Feet per Year
CFS	Cubic Feet per Second
CU	Consumptive Use
CUF	Consumptive Use Factor
GPD	Gallons per Day
GIS	Geographic Information System
IR	Irrigation Requirements
LID	Low Impact Development
LIO	Local Integrating Organization
MAR	Managed Aquifer Recharge
NEB	Net Ecological Benefit
PE	Permit-Exempt
RCW	Revised Code of Washington
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Areas

Acknowledgements

This watershed plan was written as a collaboration between the Department of Ecology, the WRIA 15 Committee, and the technical consultants. We express our sincere gratitude to those that supported the development of the plan and supplemental materials.

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Thank you also to Tribal, city and county staff, Kitsap Public Health District, and USGS for providing resources and presentations throughout this process.

¹David Nash, formerly with Kitsap County, is now deceased.

²No longer at entity.

³Withdrew from Committee.

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Executive Summary

Commented [VMSJ(1): Please note that we are continuing to work on the following for the final plan:

1. Formatting of headings
2. Formatting of captions
3. Confirming in-text table and figure citations.
4. Consistency with format of in-text references.
5. Cross-referencing in-text references with final reference list.
6. Consistent formatting of final reference list.

In January 2018, the Washington State Legislature passed the Streamflow Restoration law (RCW 90.94) to help support robust, healthy, and sustainable salmon populations while ensuring rural communities have access to water. The law directs the Department of Ecology to lead local planning Committees to develop Watershed Restoration and Enhancement Plans that identify projects to offset potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over the next 20 years (2018 – 2038) and provide a net ecological benefit to the watershed. The WRIA 15 Committee believes that this Watershed Restoration and Enhancement Plan meets the requirements of the law.

The Department of Ecology (Ecology) established the Watershed Restoration and Enhancement Committee to collaborate with tribes, counties, cities, state agencies, and special interest groups in the Kitsap watershed, also known as Water Resource Inventory Area (WRIA) 15. The WRIA 15 Committee met for over 2 years to develop a watershed plan.

As required by the law, and to allow for meaningful analysis of the relationship between new consumptive use and offsets, the WRIA 15 Committee divided the watershed into seven subbasins. Subbasins help describe the location and timing of projected new consumptive water use, the location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects.

This watershed plan projects 5,568 permit exempt (PE) well connections over the 20-year planning horizon. The projects and actions in this watershed plan will address and offset the consumptive water use from those 5,568 PE well connections. The projected new consumptive water use associated with the new PE well connections is 766.4 acre-feet per year (1.06 cubic feet per second [cfs] or 684,150 gallons per day [gpd]) in WRIA 15. This watershed plan also presents a higher goal for project implementation of 1,218 acre-feet per year (1.68 cfs or 1.087 million gallons per day) in order to support streamflows.

This watershed plan includes projects that provide an anticipated offset of **xx acre-feet per year** to benefit streamflows and enhance the watershed. Additional projects in the plan include benefits to fish and wildlife habitat, such several thousand feet of streambed improvements, dozens of acres of restoration and protection, and many miles of riparian restoration across WRIA 15.

To increase the reasonable assurance for plan implementation and tracking progress, this watershed plan includes policy and regulatory recommendations and an adaptive management process. The eleven policy and regulatory recommendations are included to contribute to the goals of this watershed plan, including streamflow restoration and meeting net ecological benefit. These recommendations enhance water conservation efforts; improve research, monitoring, and data collection; support beaver habitat conservation; plan for better drought response; and finance plan implementation. The watershed plan describes an adaptive

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44 management approach, which identifies a lead organization to coordinate an ongoing
45 implementation group to support implementation, a tracking and reporting structure to assess
46 progress and make adjustments as needed, and a funding mechanism to adaptively manage
47 implementation.
48

49 Based on the information and analyses summarized in this plan, the WRIA 15 Committee finds
50 that the suite of projects in this plan, if successfully implemented, would achieve a net
51 ecological benefit, as required by RCW 90.94.030 and defined by the Final NEB Guidance.

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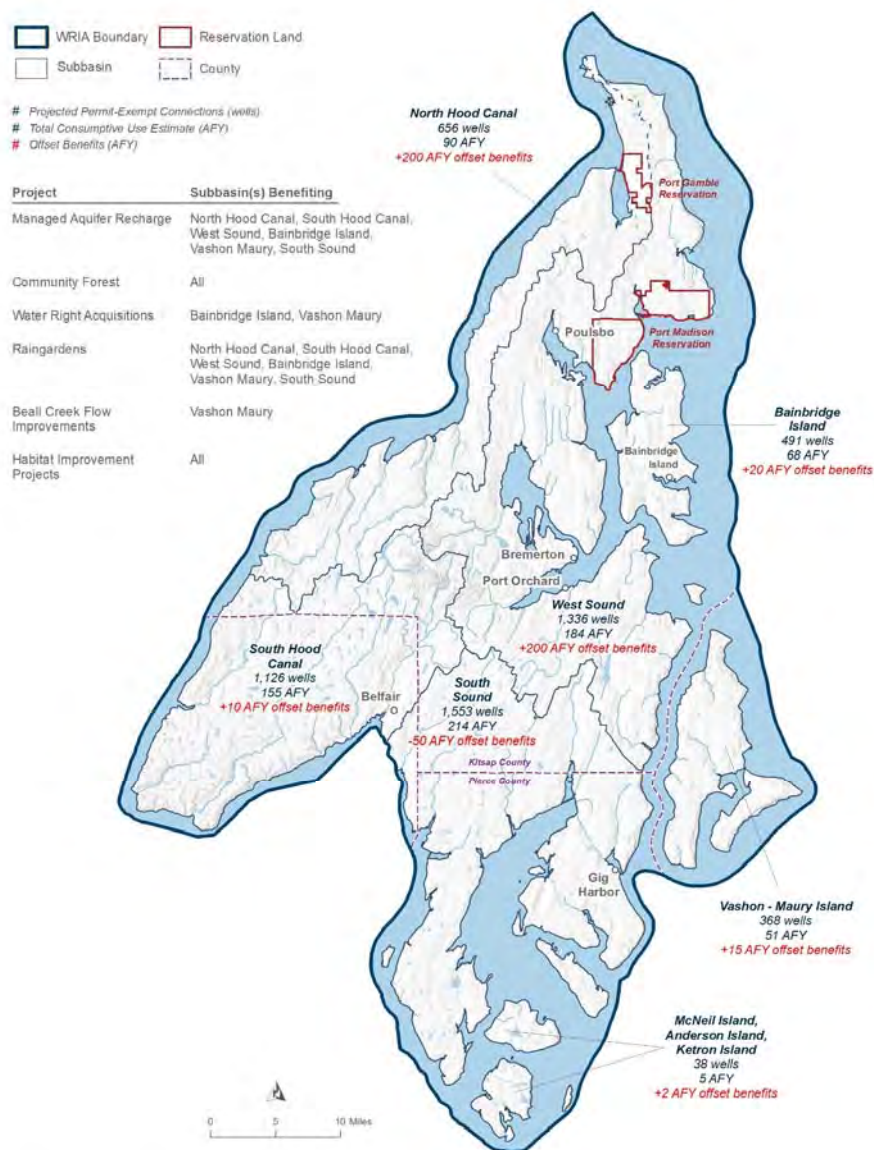


Figure ES 1: Summary of findings of the WRIA 15 Watershed Restoration and Enhancement Plan, including estimates for new domestic permit exempt well growth, consumptive use estimates, and project offset benefits.

Commented [VMSJ(2): This is a MOCK UP figure to include in the Executive Summary. Seeking feedback.

Chapter 1 – Plan Overview

1.1 WRIA 15 Watershed Plan Purpose and Structure

The purpose of the Water Resource Inventory Area (WRIA) 15 Watershed Restoration and Enhancement Plan is to identify projects and actions intended to offset the impacts of new domestic permit-exempt wells to streamflows. The Watershed Restoration and Enhancement Plan is one requirement of RCW 90.94.030. Watershed Restoration and Enhancement Plans must identify projects to offset the projected consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over 20 years (2018-2038) and provide a net ecological benefit to the WRIA. The WRIA 15 Watershed Restoration and Enhancement Plan (watershed plan) considers priorities for salmon recovery and watershed recovery, while ensuring it meets the intent of the law.

Pumping from wells can reduce groundwater discharge to springs and streams by capturing water that would otherwise have discharged naturally, reducing flows (Barlow and Leake, 2012). Consumptive water use (the portion not returned to the aquifer) reduces streamflow, both seasonally and as average annual recharge. A well pumping from an aquifer connected to a surface water body can either reduce the quantity of water discharging to the river or increase the quantity of water leaking out of the river (Barlow and Leake, 2012).

While this watershed plan is narrow in scope and not intended to address all water uses or related issues within the watershed, it may provide a path forward for future water resource planning.

[Language to be included when appropriate]: The WRIA 15 Committee, by completing the watershed plan, has developed, and come to agreement on, a technically and politically complex issue in water resource management. That success may set the stage for improved coordination of water resources and overall watershed health in our WRIA.

This watershed plan includes Seven Chapters:

1. Plan overview;
2. Overview of the watershed's hydrology, hydrogeology, and streamflow;
3. Summary of the subbasins;
4. Growth projections and consumptive use estimates;
5. Description of the recommended projects identified to offset the future permit-exempt domestic water use in WRIA 15;
6. Explanation of recommended policy, monitoring, adaptive management, and implementation measures; and
7. Evaluation and consideration of the net ecological benefits.

1.1.1 Legal and Regulatory Background for the WRIA 15 Watershed Restoration and Enhancement Plan

In January 2018, the Washington State Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 (session law 2018 c 1). This law was enacted in response to the State Supreme Court's 2016 decision in Whatcom County vs. Hirst, Futurewise, et al. (commonly referred to as the "Hirst decision"). As it relates to this Committee's work, the law, now primarily codified as RCW 90.94, clarifies how local governments can issue building permits or approve subdivisions for homes intending to use a permit-exempt well for their domestic water supply. The law also requires local watershed planning in fifteen WRIAs across the state, including WRIA 15.²

1.1.2 Domestic Permit-Exempt Wells

This Watershed Restoration and Enhancement Plan, the law that calls for it, and the Hirst decision are all concerned with the effects of new domestic permit-exempt water use on streamflows. Several laws pertain to the management of groundwater permit-exempt wells in WRIA 15 and are summarized in brief here for the purpose of providing context for the WRIA 15 watershed plan.

First and foremost, RCW 90.44.050, commonly referred to as "the Groundwater Permit Exemption," establishes that certain small withdrawals of groundwater are exempt from the state's water right permitting requirements, including small indoor and outdoor water use associated with homes. Although these withdrawals do not require a state water right permit, the water right is still legally established by the beneficial use. Even though a water right permit is not required for small domestic uses under RCW 90.44.050, there is still regulatory oversight, including from local jurisdictions. Specifically, in order for an applicant to receive a building permit from their local government for a new home, the applicant must satisfy the provisions of RCW 19.27.097 for what constitutes evidence of an adequate water supply.

RCW 90.94.030 adds to the management regime for new homes using domestic permit-exempt well withdrawals in WRIA 15 and elsewhere. For example, local governments must, among other responsibilities relating to new permit-exempt domestic wells, collect a \$500 fee for each building permit and record withdrawal restrictions on the title of the affected properties. Additionally, this law restricts new permit-exempt domestic withdrawals in WRIA 15 to a maximum annual average of up to 950 gallons per days per connection, subject to the five thousand gallons per day and ½-acre outdoor irrigation of non-commercial lawn/garden limits established in RCW 90.44.050. Ecology has published its interpretation and implementation of RCW 19.27.097 and RCW 90.94 in Water Resources POL 2094 (Ecology, 2019a). For additional

Commented [VMSJ(3): See footnote below. This is directly from ESSB 6091 to identify the other laws that were modified. Inserted per Squaxin Island Tribe's request and approved by management.

² [ESSB 6091](#) includes the following: "AN ACT Relating to ensuring that water is available to support development; amending RCW 19.27.097, 58.17.110, 90.03.247, and 90.03.290; adding a new section to chapter 36.70A RCW; adding a new section to chapter 36.70 RCW; adding a new chapter to Title 90 RCW; creating a new section; providing an expiration date; and declaring an emergency." (p. 1)

information, readers can review those laws and policy for comprehensive details and agency interpretations.

1.1.3 Planning Requirements Under RCW 90.94.030

While supplementing the local building permit requirements, RCW 90.94.030(3) goes on to establish the planning criteria for WRIA 15. In doing so, it sets the minimum standard of Ecology’s collaboration with the WRIA 15 Committee in the preparation of this watershed plan. In practice, the process of plan development was one of broad integration, collectively shared work, and a striving for consensus described in the WRIA 15 Committee’s adopted operating principles, which are further discussed below.

In addition to these procedural requirements, the law and consequently this watershed plan, is concerned with the identification of projects and actions intended to offset the anticipated impacts from new permit-exempt domestic groundwater withdrawals over the next 20 years and provide a net ecological benefit.³ In establishing the primary purpose of this watershed plan, RCW 90.94.030 (3) also details both the required and recommended plan elements. Regarding the WRIA 15 Committee’s approach to selecting projects and actions, the law also speaks to “high and lower priority projects.” The WRIA 15 Committee understands that, as provided in the Final Guidance on Determining Net Ecological Benefit (Ecology, 2019b), “use of these terms is not the sole critical factor in determining whether a plan achieves a NEB... and that plan development should be focused on developing projects that provide the most benefits... regardless of how they align with [these] labels” (page 12). For WRIA 15, this watershed plan recognizes the goal of protecting fish stocks and aquatic life, regardless of listing status. In order to provide a benefit to the greatest length of stream channel, the highest priority projects are those in that provide protection or restoration of headwater streamflows. It is the perspective of the WRIA 15 Committee that this watershed plan satisfies the requirements of RCW 90.94.030.

1.2 Requirements of the WRIA 15 Watershed Restoration and Enhancement Plan

³ The planning horizon for planning to achieve a NEB is the 20 year period beginning with January 19, 2018 and ending on January 18, 2038. The planning horizon only applies to determining which new consumptive water uses the plan must address under the law. The projects and actions required to offset the new uses must continue beyond the 20-year period and for as long as new well pumping continues. (Ecology, 2019b; page 7)

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151 RCW 90.94.030 of the Streamflow Restoration law
152 directs Ecology to establish a Watershed Restoration
153 and Enhancement Committee in the Kitsap watershed
154 and develop a watershed plan in collaboration with the
155 WRIA 15 Committee. Ecology determined that the
156 intent was best served through collective development
157 of the watershed plan, using an open and transparent
158 setting and process that builds on local needs.

159 At a minimum, the watershed plan must include
160 projects and actions necessary to offset projected
161 consumptive impacts of new permit-exempt domestic
162 groundwater withdrawals on streamflows and provide
163 a net ecological benefit (NEB) to the WRIA.

164 Ecology issued the Streamflow Restoration Policy and
165 Interpretive Statement (POL-2094) and Final Guidance
166 on Determining Net Ecological Benefit (GUID-2094) in
167 July 2019 to ensure consistency, conformity with state
168 law, and transparency in implementing RCW 90.94. The
169 Final Guidance on Determining Net Ecological Benefit
170 (hereafter referred to as Final NEB Guidance)
171 establishes Ecology’s interpretation of the term “net
172 ecological benefit.” It also informs planning groups on
173 the standards Ecology will apply when reviewing a
174 watershed plan completed under RCW 90.94.020 or
175 RCW 90.94.030. The minimum planning requirements
176 identified in the Final NEB Guidance include the
177 following (pages 7-8):

- 178 1. Clear and Systemic Logic. Watershed plans must
179 be prepared with implementation in mind.
- 180 2. Delineate Subbasins. [The Committee] must
181 divide the WRIA into suitably sized subbasins to
182 allow meaningful analysis of the relationship
183 between new consumptive use and offsets.
- 184 3. Estimate New Consumptive Water Uses.
185 Watershed plans must include a new
186 consumptive water use estimate for each
187 subbasins, and the technical basis for such
188 estimate.

[Streamflow Restoration law RCW
90.94.030\(3\)](#)

(b) At a minimum, the plan must include those actions that the committee determines to be necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use. The highest priority recommendations must include replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary. Lower priority projects include projects not in the same basin or tributary and projects that replace consumptive water supply impacts only during critical flow periods. The plan may include projects that protect or improve instream resources without replacing the consumptive quantity of water where such projects are in addition to those actions that the committee determines to be necessary to offset potential consumptive impacts to instream flows associated with permit-exempt domestic water use.

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

(d) The watershed restoration and enhancement plan must include an evaluation or estimation of the cost of offsetting new domestic water uses over the subsequent twenty years, including withdrawals exempt from permitting under RCW 90.44.050.

(e) The watershed restoration and enhancement plan must include estimates of the cumulative consumptive water use impacts over the subsequent twenty years, including withdrawals exempt from permitting under RCW 90.44.050.

4. Evaluate Impacts from New Consumptive Water Use. Watershed plans must consider both the estimated quantity of new consumptive water use from new domestic permit-exempt wells initiated within the planning horizon and how those impacts will be distributed.

5. Describe and Evaluate Projects and Actions for Their Offset Potential. Watershed plans must, at a minimum, identify projects and actions intended to offset impacts associated with new consumptive water use. Offset benefits must continue as long as the anticipated consumptive use impacts, which are assumed to be in perpetuity.

It is the WRIA 15 Committee's intent that the WRIA 15 watershed plan is prepared to ensure full implementation. The law requires that all members of the WRIA 15 Committee approve the plan prior to submission to Ecology for review. Ecology must then determine that the plan's recommended streamflow restoration projects and actions will result in a NEB to instream resources within the WRIA after accounting for projected use of new permit-exempt domestic wells over the 20-year period of 2018-2038.

RCW 90.94.030 (6). This section [90.94.030] only applies to new domestic groundwater withdrawals exempt from permitting under RCW [90.44.050](#) in the following water resource inventory areas with instream flow rules adopted under chapters [90.22](#) and [90.54](#) RCW that do not explicitly regulate permit-exempt groundwater withdrawals: 7 (Snohomish); 8 (Cedar-Sammamish); 9 (Duwamish-Green); 10 (Puyallup-White); 12 (Chambers-Clover); 13 (Deschutes); 14 (Kennedy Goldsborough); and 15 (Kitsap) and does not restrict the withdrawal of groundwater for other uses that are exempt from permitting under RCW [90.44.050](#).

1.3 Overview of the WRIA 15 Committee

1.3.1 Formation

The Streamflow Restoration law instructed Ecology to chair the WRIA 15 Committee, and invite representatives from the following entities in the watershed to participate in the development of the watershed plan:

- Each federally recognized tribal government with reservation land or usual and accustomed harvest area within the WRIA.
- Each county government within the WRIA.
- Each city government within the WRIA.
- Washington State Department of Fish and Wildlife.
- The largest publicly owned water purveyor providing water within the WRIA that is not a municipality.
- The largest irrigation district within the WRIA.

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- 224 Ecology sent invitation letters to each of the entities named in the law in September of 2018.
 225 Note that WRIA 15 does not have an irrigation district.
- 226 The law also required Ecology to invite local organizations representing agricultural interests,
 227 environmental interests, and the residential construction industry. Businesses, environmental
 228 groups, agricultural organizations, conservation districts, and local governments nominated
 229 interest group representatives. Local governments on the WRIA 15 Committee voted on the
 230 nominees in order to select local organizations to represent agricultural interests,
 231 environmental interests, and the residential construction industry. Ecology invited the selected
 232 entities to participate on the WRIA 15 Committee.
- 233 The WRIA 15 Committee members are included in Table 1. This list includes all of the members
 234 identified by the Legislature that agreed to participate on the WRIA 15 Committee.⁴
- 235 Table 1: WRIA 15 Committee Participating Entities

Entity Name	Representing
Kitsap County	County government
King County	County government
Mason County	County government
Pierce County	County government
Puyallup Tribe	Tribal government
Skokomish Tribe	Tribal government
Squaxin Island Tribe	Tribal government
Suquamish Tribe	Tribal government
Port Gamble S'Klallam Tribe	Tribal government
City of Port Orchard	City government
City of Bremerton	City government
City of Gig Harbor	City government
City of Bainbridge	City government
Kitsap Public Utility District	Water utility
Department of Fish and Wildlife	State agency
Department of Ecology	State agency
Kitsap Building Association	Residential construction industry
Kitsap Conservation District	Agricultural interest group
Great Peninsula Conservancy	Environmental interest group
Mason-Kitsap Farm Bureau - ex officio	Not applicable
Washington Water Service - ex officio	Not applicable

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⁴ All participating entities committed to participate in the process and designated representatives and alternates to sit on the WRIA 15 Committee. A roster with the names of the representatives is available in Appendix A. The City of Poulsbo originally participated in the process but withdrew from the Committee in October 2020.

The WRIA 15 Committee invited the Mason-Kitsap Farm Bureau and the Washington Water Service to participate as “ex-officio” members. Although not identified in the law, the ex-officio members provide valuable information and perspective as subject matter experts. The ex-officio members are active but non-voting participants of the WRIA 15 Committee.

The law does not identify a role for the Committee following development of the watershed plan.

1.3.2 Committee Structure and Decision Making

The WRIA 15 Committee held its first meeting in October 2018. Between October 2018 and January 2021 [insert appropriate end date], the WRIA 15 Committee held 26 Committee meetings.⁵ All Committee and workgroup meetings were open to the public. The WRIA 15 Committee met monthly, and as needed, to meet deadlines.

The two and a half years of planning consisted of training, research, and developing plan components. Ecology technical staff, WRIA 15 Committee members, and partners presented on topics to provide context for components of the plan, such as an overview of WRIA 15 hydrogeology, water law, tribal treaty rights, salmon recovery, and local planning processes.

Ecology staff chaired the WRIA 15 Committee and provided administrative support and technical assistance. Ecology contracted with consultants to provide facilitation and technical support for the WRIA 15 Committee. The facilitator supported the WRIA 15 Committee’s discussions and decision-making and coordinated recommendations for policy change and adaptive management. The technical consultants developed products that informed WRIA 15 Committee decisions and development of the plan. Examples include working with counties on growth projections, calculating consumptive use based on multiple methods, preparing maps and other tools to support decisions, and researching project ideas. The technical consultants brought a range of expertise to the Committee including hydrogeology, GIS analysis, fish biology, engineering, and planning. The technical consultants developed the technical memorandums referenced throughout this plan.

The WRIA 15 Committee established two workgroups to support planning efforts and to achieve specific tasks. The Technical Workgroup focused on preparing recommendations for permit-exempt well projections and consumptive use estimates. The Project Workgroup focused on developing and reviewing projects within the Committee’s project inventory (additional workgroups that met only one time covered topics such as beaver management, policies, and adaptive management). The workgroups were open to all WRIA 15 Committee members as well as non-Committee members that brought capacity or expertise not available on the Committee. The workgroups made no binding decisions but presented information to the Committee as either recommendations or findings. The WRIA 15 Committee acted on workgroup recommendations, as it deemed appropriate.

Commented [VMSJ(4): Through Jan 7. Update as needed for mtgs after 1/7

⁵ This includes regular Committee meetings and special Committee meetings where most representatives attended. This does not include project workgroup, technical workgroup, or one-time workgroup meetings.

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During the initial WRIA 15 Committee meetings, members developed and agreed to operating principles.⁶ The operating principles set forward a process for meeting, participation expectations, procedures for voting, structure of the WRIA 15 Committee, communication, and other needs in order to support the WRIA 15 Committee in reaching agreement on a final plan.

This planning process, by statutory design, brought a diversity of perspectives to the table. Therefore, it was important for the Committee to identify a clear process for how it made decisions. The WRIA 15 Committee strived for consensus, and when consensus could not be reached, the chair and facilitator documented the Committee members' positions. All agreements and dissenting opinions were documented in meeting summaries that were reviewed and agreed upon by the Committee. The Committee recognized that flexibility was needed in terms of timeline, and if a compromise failed to reach consensus within the identified timeline, the Committee agreed to allow the process for developing the plan to move forward while the work towards consensus continued. The Committee agreed to revisit decisions where consensus was not reached. The reason why the Committee strived for consensus is that the authorizing legislation requires that final plan itself must be approved by all members of the Committee prior to Ecology's review (RCW 90.94.030[3] "...all members of a Watershed Restoration and Enhancement Committee must approve the plan prior to adoption"). Therefore, consensus on the foundational decisions during plan development served as the best indicators of the Committee's progress toward an approved plan.

The WRIA 15 Committee reviewed components of the watershed plan iteratively throughout the process in addition to reviewing the draft plan as a whole. **[Language to be included when appropriate]:** The WRIA 15 Committee reached final agreement on the Watershed Restoration and Enhancement Plan on THIS DATE 2021.

⁶ Complete operating principles can be found on the WRIA 15 Committee EZ View webpage and in Appendix B: https://www.ezview.wa.gov/site/alias_1962/37327/watershed_restoration_and_enhancement_-_wria_15.aspx

Chapter Two: Watershed Overview

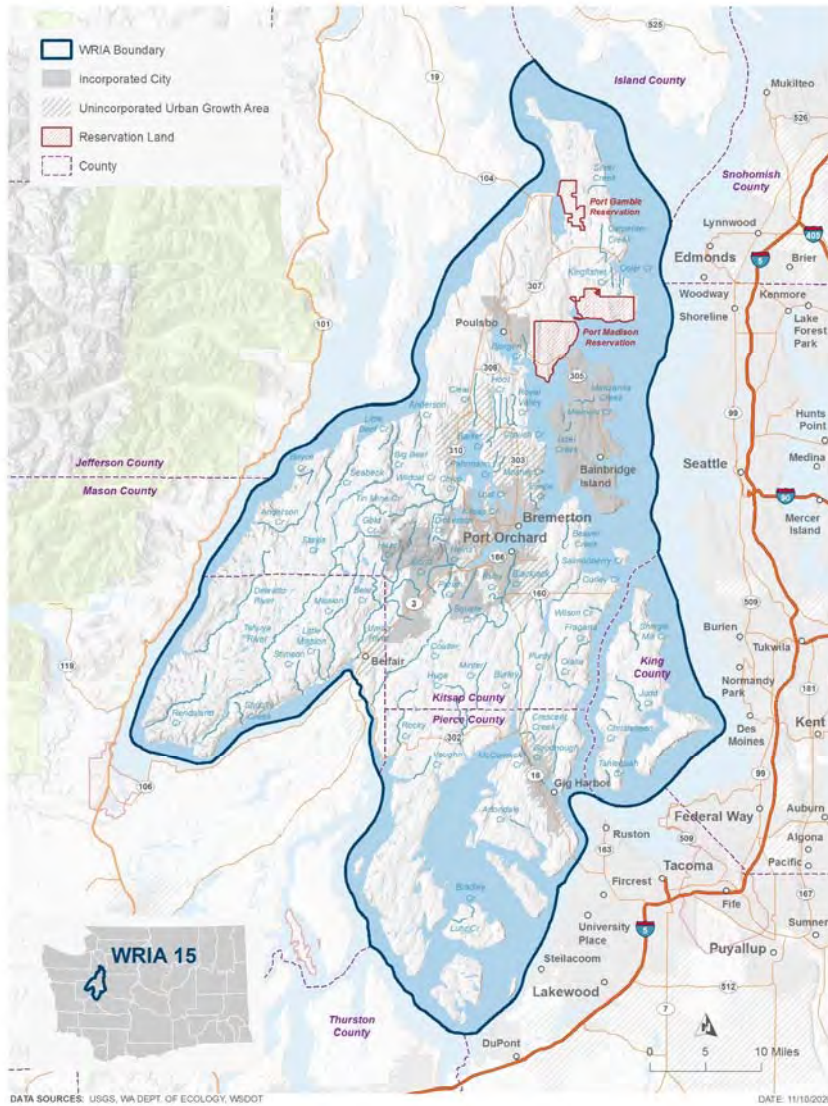
2.1 Brief Introduction to WRIA 15

Water Resource Inventory Areas (WRIAs) are large watershed areas formalized under Washington Administrative Code (Water Resources Code of 1971) for the purpose of administrative management and planning. WRIAs encompass multiple landscapes, hydrogeological regimes, levels of development, and variable natural resources. WRIA 15, also referred to as the Kitsap Watershed, is one of the 62 designated major watersheds in Washington State. WRIA 15 encompasses the entire Kitsap peninsula and surrounding islands, is 676 square miles, and includes Kitsap County and portions of Pierce, Mason, and King Counties (Figure 1). Major rivers of WRIA 15 include Union River, Tahuya River, and Dewatto River. All of these major rivers are located in the western part of the watershed and drain to Hood Canal. These rivers are home to Chinook, Summer Chum, and Steelhead, which are listed under the Endangered Species Act. Most of the area is drained by short streams that discharge directly into the surrounding marine waters of Puget Sound and Hood Canal.

2.1.1 Land Use in WRIA 15

Approximately 10 percent of the watershed is within a designated urban growth area. Major cities in WRIA 15 include Bremerton, Port Orchard, Bainbridge Island, Gig Harbor, Poulsbo, Silverdale (unincorporated), Belfair, and Kingston (unincorporated). The area's port districts are important as centers for commerce and military installations and as critical hubs for marine transportation (West Central LIO, 2017). The area connects to Seattle by several ferry routes, and local jurisdictions anticipate increased growth with the designation of several high capacity transit communities (Puget Sound Regional Council, 2019). Many people move to the area for its rural feel and choose to live outside of the incorporated areas (West Central LIO, 2017).

Federal ownership makes up approximately two percent of the watershed. A number of naval installations occur in WRIA 15, including the active Puget Sound Naval Shipyard (part of the Naval Base Kitsap) at Bremerton. Approximately 12 percent of the watershed is under state ownership, primarily by Washington Department of Natural Resources and Washington Department of Fish and Wildlife. The largest areas of forestland use are in the southern and western Tahuya Peninsula in Mason County.



325
326 Figure 1: Water Resource Inventory Area 15 Overview

2.1.2 Tribal Reservations and Usual and Accustomed Fishing Areas

The Port Gamble S’Klallam Tribe Reservation occupies approximately 1,200 acres and the Port Madison Indian Reservation (Suquamish Tribe) occupies approximately 7,458 acres within WRIA 15. Tribes with usual and accustomed fishing areas within WRIA 15 include the Suquamish, Port Gamble S’Klallam, Squaxin Island, Skokomish, Nisqually, and Puyallup Tribes (NWIFC, 2019). Within WRIA 15, these Tribes hold Treaty reserved senior water rights and fishing rights under the federal government (Treaty of Medicine Creek, Treaty of Point No Point, Treaty of Point Elliot).

The Tribes hold Treaty-reserved federal water rights in WRIA 15 in quantities that are necessary to support healthy salmon populations. These water rights are necessary to carry out the purposes of their Treaties, which include the guarantee of a self-sustaining homeland and sufficient water to support the fishing right. These rights operate outside of the state water rights system and have the most senior priority date. While these water rights have not yet been quantified by a court, they likely exceed the amounts that are established by state instream flow rules. Indian water rights are property rights held in trust by the United States for the benefit of Indian Tribes.

Language provided by WRIA 15 Tribes.

Commented [VMSJ(5): Separate review path with ECY management and WRIA 15 Tribes.

Commented [VMSJ(6): This format is proposed for Tribal Review

2.1.3 Salmon Distribution and Limiting Factors

WRIA 15 includes numerous small lowland stream systems draining to both Puget Sound and Hood Canal. The subbasins (further described in Chapter 3) that drain to Puget Sound are West Sound, South Sound, Bainbridge Island, Vashon-Maury Island, and McNeil-Anderson-Ketron Islands (also referred to as South Sound Islands). The North Hood Canal and South Hood Canal subbasins drain to Hood Canal. Primary streams in the West Sound subbasin include Olalla, Blackjack, Chico, and Grovers creeks. Primary streams in the South Sound subbasin include Coulter, Rocky, Burley, Purdy, Minter, and Crescent creeks. Primary streams in the North Hood Canal subbasin include Big Beef, Anderson, Gamble, and Stavis creeks. Primary rivers in the South Hood Canal subbasin include Dewatto River, Union River, and Tahuya River and Mission Creek (a more complete list of rivers and streams by subbasin is available in Chapter 3). The island subbasins generally have very small streams with only minor salmonid presence or use. The Puget Sound and Hood Canal drainages are described separately as different salmonid populations occupy the two areas.

The Puget Sound subbasins within WRIA 15 have anadromous salmon runs that include three of the five Pacific salmon species (WDF 1975, WDFW 2020); Chinook (*Oncorhynchus tshawytscha*), Coho (*Oncorhynchus kisutch*), and Chum salmon (*Oncorhynchus keta*). Chinook Salmon have been documented in Coulter, Rocky, Burley, Purdy, Curley, Crescent, Minter, Olalla, Blackjack, Gorst, Clear, Chico, Royal Valley, Barker, and Dogfish creeks (WDFW 2020), although spawning is only known in Burley, Purdy, Olalla, Curley, Blackjack and Gorst creeks. Both summer and fall-run Chum Salmon are present, with summer Chum Salmon occurring in Rocky, Coulter, Burley,

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Curley, and Blackjack creeks (WDFW 2020). Puget Sound subbasins are also inhabited by Steelhead Trout (*Oncorhynchus mykiss*) and Cutthroat Trout (*Oncorhynchus clarki clarki*).

The Hood Canal subbasins have anadromous salmon runs that include Chinook, Coho, Chum, and Pink (*Oncorhynchus gorbuscha*) salmon and Steelhead and Cutthroat trout. Both summer and fall-run Chum Salmon are present. Pink Salmon are only present in the Dewatto River and Union River (WDFW 2020).

Of these populations, three are federally listed as threatened species, Puget Sound Chinook Salmon, Puget Sound Steelhead Trout, and Hood Canal Summer Chum Salmon. Table 2 below lists the species present in WRIA 15 and their regulatory status.

Table 2: Salmonid Species and Status in WRIA 15

Common Name	Scientific Name	Population ¹	Critical Habitat	Regulatory Agency Status
Puget Sound				
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Puget Sound Chinook	Designated in 2005; does not include Kitsap Basin	NMFS/Threatened/1999
Chum Salmon	<i>Oncorhynchus keta</i>	Puget Sound Chum	No	Not listed
Coho Salmon	<i>Oncorhynchus kisutch</i>	Puget Sound/Strait of Georgia Coho	No	NMFS/Species of Concern/1997
Steelhead Trout	<i>Oncorhynchus mykiss</i>	Puget Sound Steelhead	Yes/2016	NMFS/Threatened/2007
Coastal Cutthroat Trout	<i>Oncorhynchus clarki</i>	No listing	No listing	No listing
Hood Canal				
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Puget Sound Chinook	Designated in 2005; does not include Kitsap Basin	NMFS/Threatened/1999
Chum Salmon	<i>Oncorhynchus keta</i>	Hood Canal Chum	Yes/2005	NMFS/Threatened/1999
Coho Salmon	<i>Oncorhynchus kisutch</i>	Puget Sound/Strait of Georgia Coho	No	NMFS/Species of Concern/1997
Steelhead Trout	<i>Oncorhynchus mykiss</i>	Puget Sound Steelhead	Yes/2016	NMFS/Threatened/2007
Coastal Cutthroat Trout	<i>Oncorhynchus clarki</i>	No listing	No listing	No listing

Note: 1. Population indicates Evolutionary Significant Unit.

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378 Table 3 below lists the run timing and life stages of anadromous salmon and trout present
379 throughout WRIA 15.

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380 Table 3: Salmonid Presence and Life History Timing in Kitsap Basin

Species	Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Presence
Chinook (fall)	Upstream migration													Puget Sound -- Coulter, Rocky, Burley, Purdy, McCormick, Curley, Crescent, Judd, Minter, Olalla, Blackjack, Gorst, Clear, Crouch, Chico, Royal Valley, Barker, and Dogfish creeks Hood Canal -- Dewatto, Tahuya, and Union rivers, Mission, Anderson, Boyce, Big Beef creeks
	Spawning													
	Incubation													
	Juvenile rearing													
	Juvenile outmigration													
Coho	Upstream migration													All
	Spawning													
	Incubation													
	Juvenile rearing													
	Smolt outmigration													
Chum (summer)	Upstream migration													Puget Sound -- Rocky, Coulter, Burley, Curley, and Blackjack creeks Hood Canal --
	Spawning													

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Species	Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Presence
	Incubation													Dewatto, Tahuya and Union rivers; Anderson and Big Beef creeks
	Juvenile rearing													
	Juvenile outmigration													
Chum (fall)	Upstream migration													All
	Spawning													
	Incubation													
	Juvenile rearing													
	Juvenile outmigration													
Pink	Upstream migration													Hood Canal - Dewatto and Union rivers
	Spawning													
	Incubation													
	Juvenile rearing													
	Juvenile outmigration													
Coastal Cutthroat	Upstream migration													All
	Spawning													

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Species	Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Presence
	Incubation													
	Juvenile rearing													
	Smolt outmigration													
Steelhead (winter)	Upstream migration													All
	Spawning													
	Incubation													
	Juvenile rearing													
	Smolt outmigration													

381 Table Data Sources: Heard 1998; Johnson 1999; Wydoski & Whitney 2003; HCCC 2005; NSD & ICF 2014; WDFW 2020

Limiting Factors

Development and population growth in the Puget Sound lowlands region has substantially altered WRIA 15 from its historic conditions and natural stream habitat forming processes. These lowland stream systems are rainfall dominated systems and many were historically sustained throughout the year by extensive wetland systems or lakes in their headwaters. Development has resulted in the removal of forest canopy cover, filling and draining of wetlands, channelization of streams, numerous road crossing and fish passage barriers, and created substantial areas of impervious surfaces, resulting in habitat loss and degradation.

In general, the primary limiting factors in freshwaters of WRIA 15 include the following (Kuttel, 2003; May & Peterson, 2003):

- Channel and streambed degradation
- Increased peak flows
- Low streamflow
- Loss of upland forest cover
- Loss of riparian forest
- Loss of floodplain connectivity and habitats
- Degradation of wetland and shoreline habitats
- Conversion of wetlands to open water habitats
- Fish passage barriers
- Lack of large wood
- Fine sediment

Past timber harvest and ongoing residential and commercial development have removed forest and riparian cover and increased impervious surfaces in most areas of the Kitsap Basin. This reduces infiltration and storage of groundwater and can contribute to reduced streamflow and increases runoff during storms that can scour streambeds and contribute to bank erosion and instability. Loss of functioning riparian corridors combined with low flows in summer results in high water temperatures that can reduce habitat suitability and cause sublethal physiological changes in adult and juvenile salmonids or even cause mortality at high temperatures (Shared Strategy, 2007).

Roads and various land uses have straightened and constrained many streams leading to a loss of floodplain connectivity and off-channel habitats and simplification of in-stream habitats. Road crossings create fish passage barriers in many locations.

Commented [VMSJ(7)]: Outstanding Comment from Alison: Add discussion regarding hydrologic maturity and the effects on evapotranspiration and streamflows. We know that young forests use more water than mature forests.

Commented [VMSJ(8R7)]: Emailed to seek feedback on the edit.

To address low streamflow, the Instream Resources Protection Program (IRPP) for WRIA 15 (Ecology, 1981) through WAC173-515 set minimum instream flows for 21 streams and closed 54 streams and their tributaries including lakes to further appropriation of surface water. An additional 14 streams and their tributaries are closed to further appropriation of surface water for part of the year. A discussion of instream flows is contained in Section 2.3.3.

The *East Kitsap Salmon Habitat Restoration Strategy Summary* (Kitsap County, 2005) identifies protection and/or restoration of hydrologic and riparian functional integrity as the highest priority for freshwater areas. Tier 1 streams of focus include Chico, Minter, and Rocky creeks. The *East Kitsap Steelhead Recovery Plan* (ESA and Suquamish Tribe, 2020) prioritizes Blackjack, Chico, Clear, Curley, Gorst and Grovers creeks for water quantity and quality protection and restoration. The *Kitsap Salmonid Refugia Report* (May & Peterson, 2003) identify Chico and Stavis creeks and the Dewatto River and Tahuya River as the highest quality refugia for salmonids that should be protected, especially for hydrologic functions. The *Hood Canal Summer Chum Salmon Recovery Plan* (HCCC, 2005) identifies loss of channel complexity, lack of riparian forest, and high water temperatures as primary limiting factors in the Union River and Tahuya River. The Union River is home to ESA listed Chinook, Summer Chum, and Steelhead. Coho are a species of concern, and also spawn in this river. For the Dewatto River, Anderson, and Big Beef creeks the significant change in hydrology (increased peak flows, reduced low flows), channel instability and erosion, loss of channel complexity, and loss of floodplain habitats are primary limiting factors. Salmon recovery lead entities provide additional information on limiting factors and priorities for WRIA 15.⁷

2.1.4 Water System Distribution and Impacts in WRIA 15

Groundwater is the primary source of drinking water for most of the population of the Kitsap Watershed and demand for groundwater increases with population growth (Frans and Olsen, 2016). According to the USGS, the quantity of usable groundwater is likely limited, mostly because of the geography and the potential for declines in water levels, decreases in groundwater discharge to streams, and seawater intrusion as groundwater usage increases (Frans and Olsen, 2016).

The USGS estimates 14 percent of the population (43,400 people) on the Kitsap Peninsula are supplied by permit-exempt wells and the remainder (268,800 people) by water purveyors under Group A and Group B systems (Welch, et. al., 2014). No estimates are available for WRIA 15 areas outside of the Kitsap Peninsula. Casad Dam, located above McKenna Falls on the Union River, is the only major surface water diversion structure in Kitsap County. The Union River Reservoir, behind the dam, provides approximately 65 percent of Bremerton's drinking water (City of Bremerton, 2020).

⁷ More information on salmon recovery planning in Puget Sound, watershed plans, and limiting factors available here: <https://www.psp.wa.gov/salmon-recovery-watersheds.php>.

Pumping from wells can reduce groundwater discharge to springs and streams by capturing water that would otherwise have discharged naturally. Surface water may be influenced by groundwater pumping such that flows are diminished. Consumptive water use (the portion not returned to the aquifer) potentially reduces streamflow, both seasonally and as average annual recharge. A well pumping from an aquifer connected to a surface water body can either reduce the quantity of water discharging to the river or increase the quantity of water lost to the river (Barlow and Leake, 2012).

2.2 Watershed Planning in WRIA 15

Citizens and local, state, federal, and tribal governments have collaborated on watershed and water resource management issues in WRIA 15 for decades. A brief summary of broad watershed planning efforts as they relate to the past, present, and future water availability in the Kitsap Watershed is provided in Section 2.2.1.

2.2.1 Current watershed planning efforts in WRIA 15

The WRIA 15 watershed plan builds on many previous and current watershed planning efforts, including previous watershed planning efforts under RCW 90.82. Other efforts include ecosystem recovery planning by local integrating organizations (LIOs) and salmon recovery planning by salmon recovery lead entities. WRIA 15 crosses boundaries with the West Central LIO (now merged with the West Sound Lead Entity and referred to as the West Sound Partners for Ecosystem Recovery), the Alliance for a Healthy South Sound, South Central LIO and the Hood Canal Coordinating Council. The LIOs have completed ecosystem recovery plans as part of the Action Agenda for Puget Sound Recovery and are actively working to implement holistic approaches to recovery including projects on salmon and orca recovery, stormwater runoff, shellfish protection, and forest conservation.⁸

Several salmon recovery lead entities⁹ cross boundaries with WRIA 15, including the West Sound Partners for Ecosystem Recovery (previously known as West Sound Lead Entity), Hood Canal Lead Entity and Regional Organization, WRIA 9 Lead Entity (Green Duwamish), Puyallup Lead Entity, Nisqually Lead Entity, and South Sound Lead Entity. Each of the salmon recovery lead entities facilitates implementation of their watershed recovery chapter as part of the Puget Sound Salmon Recovery Plan and the Puget Sound Steelhead Recovery Plan. The Hood Canal Lead Entity and Regional Organization is also responsible for facilitating implementation of the Hood Canal Summer Chum Recovery Plan. The salmon recovery lead entities are actively working with local governments, tribal governments, and other partners to implement salmon recovery actions across WRIA 15.

⁸ More information on local integrating organizations and their efforts to recovery Puget Sound is available here: <https://www.psp.wa.gov/LIO-overview.php>.

⁹ Salmon recovery lead entities in Puget Sound were established under RCW 77.85.050. More information on their roles as well as links to the recovery plan and watershed chapters is available here: <https://www.psp.wa.gov/salmon-recovery-overview.php>.

Commented [VMSJ(9): Paul working on additional GMA/CAO language for review by Ecology and counties. May be covered by footnote above quoting ESSB 6091 but need to confirm.

The LIOs and salmon recovery lead entities include many of the same organizations and individuals that participated in the WRIA 15 Committee.¹⁰ Because the WRIA 15 Committee was a newly established committee and brought in entities involved in many other planning efforts, the Committee invested time in developing relationships and understanding priorities of the various entities participating in the watershed planning process.

The Public Water System Coordination Act of 1977 created Critical Water Supply Service Areas (CWSSA).¹¹ This Act requires each water purveyor in a CWSSA to develop a water system plan for their service area, with boundaries in compliance with the provision of the Act. The Washington State Department of Health is primarily responsible for the water system plan approval; however, local governments ensure consistency with local growth management plans and development policies. Pierce County, Kitsap County, and King County have adopted water system plans that focus on the Group A water systems. This Act and the water system plans are important for the WRIA 15 watershed planning process as water system service areas and related laws and policies can set stipulations regarding timely and reasonable service as to whether new homes connect to water systems or rely on new permit-exempt domestic wells.¹²

2.2.2 Coordination with existing plans

Throughout the development of the watershed plan, Ecology streamflow restoration staff have engaged with staff from the salmon recovery lead entities and the Puget Sound Partnership, providing briefings on the streamflow restoration law, scope of the watershed plan, and plan development status updates. The Committee chair conducted outreach to the lead entities in WRIA 15 regarding coordination with the Committee to ensure alignment of salmon recovery priorities and the streamflow planning process. While none of the lead entities participated as ex-officio members of the Committee, they reviewed project lists and provided feedback to the Committee.

County comprehensive planning under the Growth Management Act of 1990 identifies where and how future population, housing, and job growth is planned. The comprehensive plans set policy for development, housing, public services and facilities, and environmentally sensitive areas, among other topics. In WRIA 15 counties, comprehensive plans identify Kitsap, Pierce, Mason, and King counties' urban growth areas, set forth standards for urban and rural development, and provide the basis for zoning districts. Because of the overlap in planning for twenty years of growth, the WRIA 15 county representatives helped ensure content of the

Commented [VMSJ(10): Add language about legal requirements for critical areas and the Counties' adoption of critical area ordinances. Stacy needs to work with counties on this – there are other recommendations that need to be addressed in upcoming comm mtgs.

Commented [VMSJ(11R10): Paul working on draft language; Stacy added footnote language from ESSB 6091 in the introduction.

¹⁰ See map of the LIO and lead entities here: xxx [is this necessary? If so, I can ask PSP for a map]

¹¹ RCW 70.116.070

¹² Water system planning information for each county is available.

Kitsap County: <https://kitsappublichealth.org/environment/files/regulations/CWSP2005.pdf>

Pierce County: <https://www.co.pierce.wa.us/951/Coordinated-Water-System-Planning>

Mason County: <https://www.co.mason.wa.us/health/environmental/drinking-water/public-water-systems.php>

King County: <https://www.kingcounty.gov/depts/dnpr/utilities-technical-review-committee/coordinated-water-system-plans.aspx>

WRIA 15 watershed plan was coordinated with the Kitsap, Pierce, Mason and King counties' comprehensive plans.¹³

2.3 Description of the Watershed – Geology, Hydrogeology, Hydrology, and Streamflow

2.3.1 Geologic setting

Pleistocene glaciation (2.6 million to 11,700 years ago) played an important role in sculpting the landscape of the Puget Sound Lowlands. Reaching a maximum extent during the Vashon stage of the Fraser Glaciation approximately 16,000 years ago, an ice sheet advanced southward into present day Puget Sound (Pringle, 2008). Multiple advances and retreats of the ice sheet formed the Puget Sound Lowlands, depositing a complex sequence of glacial and inter-glacial sediments on top of older sediments.

The landforms and subsurface area of WRIA 15 are dominated by a sequence of unconsolidated glacial and interglacial deposits. Depth to bedrock ranges from exposed at ground surface near the center of the WRIA to more than 2,000 feet below land surface (Welch et al., 2014).

Understanding the geologic setting allows characterization of surface and groundwater flow through the basin. Defining the relationships between surface water flow and deeper groundwater are important to understanding how to manage surface water resources and can be helpful in identifying strategies to offset the impacts of pumping from permit-exempt wells.

2.3.2 Hydrogeologic setting

The U.S. Geological Survey (USGS) described the hydrogeology of WRIA 15 in a hydrogeologic framework report for the Kitsap Peninsula titled *Hydrogeologic Framework, Groundwater Movement, and Water Budget of the Kitsap Peninsula, West-Central Washington* (Welch et al., 2014). The study area covered all of WRIA 15, except for the southern Key Peninsula; Anderson, McNeil, and Ketron Islands; and Vashon-Maury Island. The hydrogeologic units of the area are described as being either water-bearing ("aquifer") or non-water-bearing ("aquitard" or "confining layer") sediments, without regard to geologic origin or age. Major groundwater aquifers are found in the unconsolidated glacial and interglacial sediments. Building on the hydrogeologic framework, USGS developed a numerical groundwater flow model to further understanding of water resources on the Kitsap Peninsula (Frans and Olsen, 2016).

¹³ Comprehensive planning under GMA is available from each county:

King County: <https://www.kingcounty.gov/depts/executive/performance-strategy-budget/regional-planning/king-county-comprehensive-plan/2020-Executive-Recommended-Plan.aspx> [see Chapter 5, p. 5-42; Chapter 9, p 9-19]

Kitsap County: <http://compplan.kitsapgov.com/Pages/home.aspx>

Pierce County: <https://www.co.pierce.wa.us/950/Comprehensive-Plan>

Mason County: <https://www.co.mason.wa.us/community-services/planning/2036-comp-plan-update/index.php>

Groundwater in the aquifers generally flows radially outward from the peninsula to Puget Sound or Hood Canal. These generalized flow patterns are complicated by the presence of low permeability confining units and bedrock that separate discontinuous bodies of aquifer material and act as local groundwater-flow barriers (Welsh, et al, 2014). Summer base flows in the watershed are sustained by groundwater.

The USGS describes the hydrogeology of the watershed as 12 hydrogeologic units, typically alternating between aquifer and non-aquifer layers. All aquifer and confining units other than the Vashon Recessional Aquifer (Qvr) are present throughout the area, except in the center of the WRIA where bedrock is at or near ground surface. The five aquifer units defined by the USGS are summarized in Appendix C: Aquifer Units within WRIA 15. Of these, the relatively shallow and laterally extensive Vashon Advance Aquifer (Qva) and Sea Level Aquifer (QA1) are the most heavily used and most likely sources for new permit-exempt wells. The upper three aquifer units (Qvr, Qva, QC1) are also the main source of direct recharge or baseflow to the surface water system.

Given the proximity to Puget Sound or Hood Canal for much of the watershed, saltwater (or seawater) intrusion has been raised as a potential issue (Economic and Engineering Services, Inc., 1997). Kitsap County has not noted specific areas where saltwater impacts are known, but manages coastal areas with this issue in mind. Likewise, Tacoma Pierce County Health Department manages a program focused on the Key Peninsula and the Gig Harbor areas where risks of saltwater intrusion may be higher. The largest risks are found on small, privately-owned housing lots found along many coastal areas. Individual wells in such areas may be closely spaced and are often shallow, tapping water table aquifers that could be subject to saltwater intrusion if over used or impacted by drought conditions. A summary of water resources (Suquamish Tribe, 2016) noted that thus far no widespread or serious saltwater intrusion problems have been recognized.

The potential risks of saltwater intrusion due to municipal withdrawals on Bainbridge Island were modeled by the U.S. Geological Survey in 2011 (Frans, L.M. et al., 2011). The study found no risk of saltwater intrusion to the aquifers of interest through the year 2035. A more recent study (Kitsap PUD, et al., 2018) on the Seabold Water Association on Bainbridge Island concludes that elevated chloride levels measured at a well (an early warning indicator of saltwater intrusion) is localized and not a regional problem. The elevated chloride levels may have been caused by disposal of water treatment brine.

2.3.3 Hydrology and Streamflow

Due to its irregular configuration, relatively small size, and geologic and topographic characteristics, the Kitsap Peninsula is drained by hundreds of relatively small lowland stream and river systems. Most of the area is drained by short streams that discharge directly into surrounding marine waters. Over 580 streams and 180 lakes, reservoirs, ponds, and marshes have been inventoried in WRIA 15 (Garling, et al, 1965). WRIA 15 is unique hydrologically, as

Commented [VMSJ(12): We received a lot of comments on this section. Bob did some further research and provided some edits. Please review and provide specific, additional revisions if necessary.

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581 only 12 streams in the area have surface drainage areas that exceed 10 square miles, and most
582 are less than one square mile.

583 Addressing the complexity of groundwater and surface water systems in WRIA 15 requires
584 analysis at many different hydrologic scales depending on the needs of the studies. Examples
585 include the subbasins (discussed in Chapter 3), and USGS Hydrologic Units, such as Hydrologic
586 Unit Code 12 (HUC-12) boundaries. In addition, there is evidence that some aquifers are
587 continuous beneath several drainage basins (Ecology, 1981; Kitsap Public Utility District, 1997).
588 At the time of writing, a City of Port Orchard modeling project is underway and demonstrates
589 xxx

Commented [VMSJ(13): Currently no results to share (per conversation with City and consultant). May be able to add information in January if appropriate.

590 Temperatures rarely drop below freezing in WRIA 15; therefore, snowfall accumulation is
591 minimal. There is no contribution from upstream watersheds because WRIA 15 is surrounded
592 by marine waters. Because all streams are contained in the WRIA, upstream sources, snow, and
593 snowpack are not influencing factors in the watershed, precipitation as rainfall is the dominant
594 natural input of fresh water to the basin and streamflows are extremely sensitive to areal and
595 seasonal variation in precipitation (Golder Associates, 2004).

596 Annual precipitation varies considerably, ranging from an average of less than 30 inches in the
597 northern tip of the peninsula to more than 80 inches along Hood Canal in the southwest
598 portion of the WRIA. Most of the WRIA receives an average of 40 to 60 inches of precipitation
599 annually (Kitsap PUD, 2020). In general, precipitation increases by one inch for every mile
600 southward from the northern tip of the Peninsula. On average, July is the driest month and
601 December is the wettest month (Golder Associates and EES, 2002).

602 In addition to directly contributing to streamflow maintenance, precipitation also contributes to
603 storage in lakes and groundwater aquifers that serve as natural reservoirs, helping to moderate
604 extreme high and low flows. Groundwater provides the majority of late summer flow to area
605 streams. Practically all streams in WRIA 15 are augmented by groundwater discharge and many
606 would go dry if groundwater recharge during precipitation became insufficient to maintain
607 streamflow during dry periods (Ecology, 1981). Small streams draining the east shore of Hood
608 Canal typically originate in lakes and wetlands, have moderate gradients, and exhibit low flows
609 in late summer and early fall (Kuttel, 2003).

610 WAC173-515 set minimum instream flows for 21 streams and closed 54 streams and their
611 tributaries including lakes to further appropriation of surface water. An additional 14 streams
612 and their tributaries are closed to further appropriation of surface water for part of the year.
613 Some of the streams with partial closures are in basins which also have minimum instream
614 flows set (Ecology, 1981). Streams subject to minimum instream flows are Union River, Tahuya
615 River, Rendsland Creek, Dewatto River, Anderson Creek, Stavis Creek, Big Beef Creek, Anderson
616 Creek (different creek than previously listed), Grover's Creek, Steel Creek,
617 Strawberry/Kochs/Cooks Creek, Dickerson Creek, Chico Creek, Gorst Creek, Curley Creek, Ollala
618 Creek, Crescent Creek, Purdy Creek, Lackey Creek, Rocky Creek, and Coulter Creek.

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The background of how instream flows and closures were set are described in the Instream Resources Protection Program (IRPP) for WRIA 15 (Ecology, 1981). Instream flows were set for streams where continuous flow records existed or correlations of flow to other stream gages were possible and where average annual flows exceeded five cfs. Streams closed by the WAC were previously closed pursuant to water right recommendations or had average annual flows less than five cfs and a known high value for fish production, aesthetics, and other environmental values.

The IRPP does not describe the instream flow setting technique; instream flows are believed to have been set using a combination of Physical Habitat Simulation (PHABSIM), which is a suite of hydraulic and habitat models that compute an index to habitat suitability and discharge, and the toe-width method to determine a habitat based instream flow recommendation. The instream flow recommendations tended to use the 40-50 percent exceedance as a hydrologic limit to the habitat-based instream flow recommendation (Pacheco, 2020).

In establishing instream flows by regulation, Ecology recognized that the recommended regulatory flows have not, and probably have never been met, 100 percent of the time. However, the intent of the regulation was to protect streams from further depletion (e.g., through subsequent appropriations) when flows approach or fall below the recommended discharges (Ecology, 1981). In Chico Creek, for example, minimum instream flows are often not met. Figure 2 shows the flow exceedance for Chico Creek plotted against the regulatory minimum instream flow. Minimum instream flows are greater than the median flow (50 percent exceedance) from March until September and exceed dry year (90 percent exceedance) flows for most of the year. Since Chico watershed has one of the largest salmon runs in Kitsap County, not meeting minimum flows during migration periods can negatively impact many fish species and result in massive pre-spawn mortalities of salmon.¹⁴ The inability to meet minimum instream flows similarly impacts Grovers Creek (Suquamish Tribe, 2016).

¹⁴ Several species of fish migrate through the Chico Watershed, including chum and coho salmon, steelhead, and sea-run cutthroat trout.

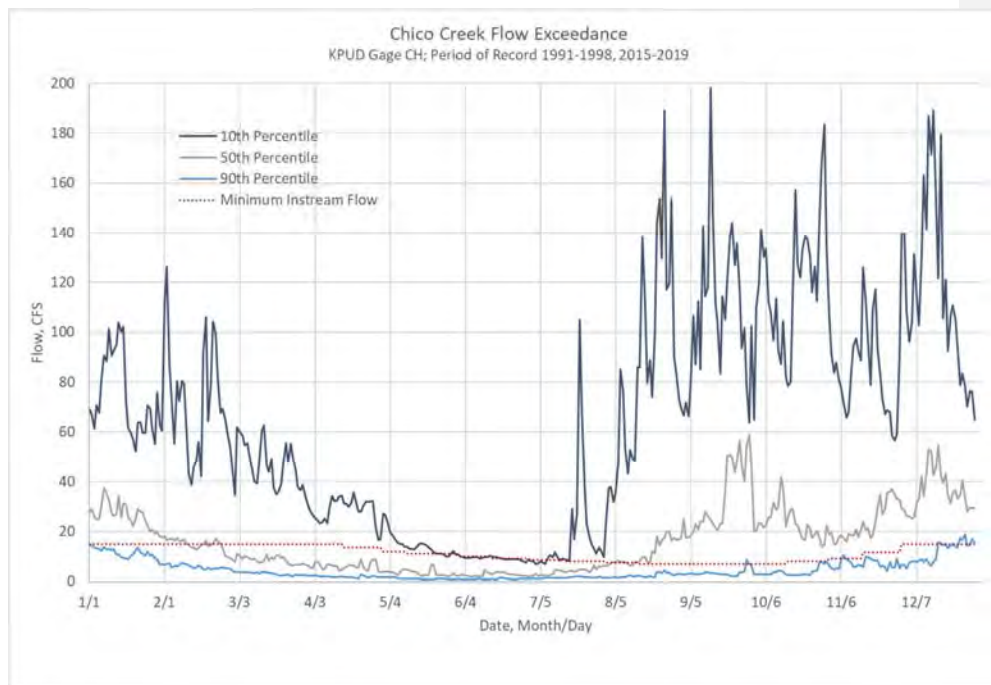


Figure 2. Chico Creek Flow Exceedance.

Due to the sensitivity of the watershed to precipitation, the salmonid habitat in the streams of WRIA 15 are highly susceptible to hydrologic changes resulting from stormwater runoff (West Sound Watershed Council, 2005). The increase in impervious surfaces associated with residential and commercial development increases surface runoff and the frequency, duration, and magnitude of peak stream flows.¹⁵ The result is that less water is available to sustain flows through the dry months, and the increased peak flows result in increased bank and streambed instability, channel scour, and loss of instream habitat diversity, which may adversely affect salmonid production (West Sound Watershed Council, 2005).

Predictions of change in climate are available from The Climate Toolbox (climatetoolbox.org). The Climate Mapper on the website was used to obtain forecasts of changes in temperature and precipitation over WRIA 15 under future conditions. The Climate Mapper allows a comparison of future conditions to present conditions under assumptions of which Representative Concentration Pathway (RCP) greenhouse gas concentration trajectory is assumed, and which future time frame is selected. Assuming the RCP 8.5 pathway and a

Commented [VMSJ(14): We worked on some language here to recognize potential limitations, but need feedback to see if addressed concerns from Suquamish Tribe.

¹⁵ Note that RCW 90.94.030 does require developments associated with new building permits to have stormwater management and LID.

baseline of 1971-2000, mean annual precipitation is projected to increase by 2.2-2.6 percent for the 2010-2039 timeframe and 3.7-5.6 percent for the 2040-2069 timeframe. Precipitation is projected to increase in fall, winter and spring and decrease in summer. Mean annual temperatures will increase by 2-2.6° F in the 2010-2039 timeframe and 4.6-6° F in the 2040-2069 timeframe. Temperatures will increase in all seasons. In addition, heavy rainfall events are projected to become more severe and occur more frequently (Mauger et. al. 2015).

The Climate Impacts Group prepared climate forecasts for streamflow in the Puget Sound basin (Krosby et. al, 2018). No streams in WRIA 15 had forecasts; the closest stream with forecasts is the North Fork Skokomish River (located in WRIA 16).¹⁶ Comparison of July through September streamflows between 1992 and 2011 with projections of streamflow for climate forecasts for 2070 – 2099 project a decline of 30 to 40 percent in streamflow during the low flow season (Krosby et. al., 2018). It is likely with a reduction in summer precipitation and increases in temperature, streams in WRIA 15 will also experience declines in streamflow during summer although the extent of decline has not been predicted. Water temperatures are also expected to rise which will impact salmonid survival, growth, and fitness.

2.3.4 Water Quality

Ecology evaluates surface waters in WRIA 15 every two years with a water quality assessment. The assessment evaluates existing water quality data and classified waterbodies into the following categories:

- Category 1: Meets tested standards for clean waters.
- Category 2: Waters of concern; waters in this category have some evidence of a water quality problem, but not enough to show persistent impairment.
- Category 3: Insufficient Data.
- Category 4: Impaired waters that do not require a total maximum daily load (TMDL):
 - o Category 4a: already has an EPA-approved TMDL plan in place and implemented.
 - o Category 4b: has a pollution control program, similar to a TMDL plan, that is expected to solve the pollution problems.
 - o Category 4c: is impaired by causes that cannot be addressed through a TMDL plan. Impairments in these water bodies include low water flow, stream channelization, and dams.
- Category 5: Polluted waters that require a water improvement project.

Commented [RM15]: Can add in reference to chico creek study here except I didn't find one -- just a GIS site that will show results in the future
<https://www.aregis.com/home/item.html?id=b9643df0269545b4ae9ca67b963dc382>

Commented [VMSJ(16):
Waiting on feedback from Alison on what revisions or footnotes she wants

¹⁶ Modeling has not been completed for the smaller stream systems in WRIA 15, and therefore the projections for larger river systems may have limited applicability.

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691 The latest water quality assessment classified many waterbodies in WRIA 15 (Ecology 2020a).
692 Category 4 and 5 assessment results are listed in Appendix D. Category 5 listings are based on
693 exceedance of water temperature, dissolved oxygen, pH, bacteria, copper, lead, and total
694 phosphorus water quality standards. Of the Category 4 and 5 results, 62 waterbodies are listed
695 for either temperature, dissolved oxygen, total phosphorus, or pH. These parameters are
696 sensitive to low flows and could be improved with streamflow restoration.

697 Three TMDL studies have been prepared in WRIA 15 to address water quality impairments. All
698 of the TMDLs address fecal coliform and are 1) Liberty Bay Tributaries, 2) Sinclair and Dyes
699 Inlets, and 3) Union River Tributaries (Ecology 2002, 2012, 2014). The table is available in
700 Appendix E.

Chapter Three: Subbasin Delineation

3.1 Introduction

To allow for meaningful analysis of the relationship between new consumptive use and offsets, and per Ecology’s Final NEB Guidance (Ecology, 2019b), the WRIA 15 Committee divided WRIA 15 into subbasins.¹⁷ This division was helpful in describing the location and timing of projected new consumptive water use, the location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. In some instances, subbasins may not correspond with hydrologic or geologic basin delineations (e.g., watershed divides). This chapter is based on the Subbasin Delineation Technical Memorandum (Appendix F), which was finalized by the WRIA 15 Committee at the June 4, 2020 meeting.

3.2 Approach to Develop Subbasins

The WRIA 15 Committee divided WRIA 15 into seven subbasins for purposes of assessing projections for new permit-exempt wells, consumptive use, and project offsets.¹⁸ The basic considerations of the WRIA 15 Committee in delineating subbasin boundaries for this planning process were:

- WRIA 15 was initially divided into seven “regions” as an early delineation of subbasins. The Committee later agreed to accept the region delineations as subbasin boundaries.
 - The subbasins are part of a nested approach –with further subdivision at the HUC12 and Puget Sound Watershed Assessment Unit scales—where projects will be placed as close to impacts as possible.
 - Subbasin boundaries were used for generating growth projections and consumptive use estimates.
 - Isolated areas like islands without connectivity should be included as their own subbasins.
- Other considerations were:
- Right-sizing subbasins such that offset projects have some geographic relevance to the location of withdrawal (e.g., an offset project in Seabeck bears little relevance to withdrawals in Longbranch).

¹⁷ The term “subbasin” is used by the WRIA 15 Committee for planning purposes only and to meet the requirements of RCW 90.94.030 (3)(b).

¹⁸ This is consistent with Final NEB Guidance that defines subbasins as a geographic subarea within a WRIA. A subbasin is equivalent to the words “same basin or tributary” as used in RCW 90.94.020(4)(b).

- 729 • Surface water flows and rain flow patterns should be included.
- 730 • Rural growth pattern projections will likely drive project and impact locations.
- 731 • Priority areas for salmon recovery should be included.

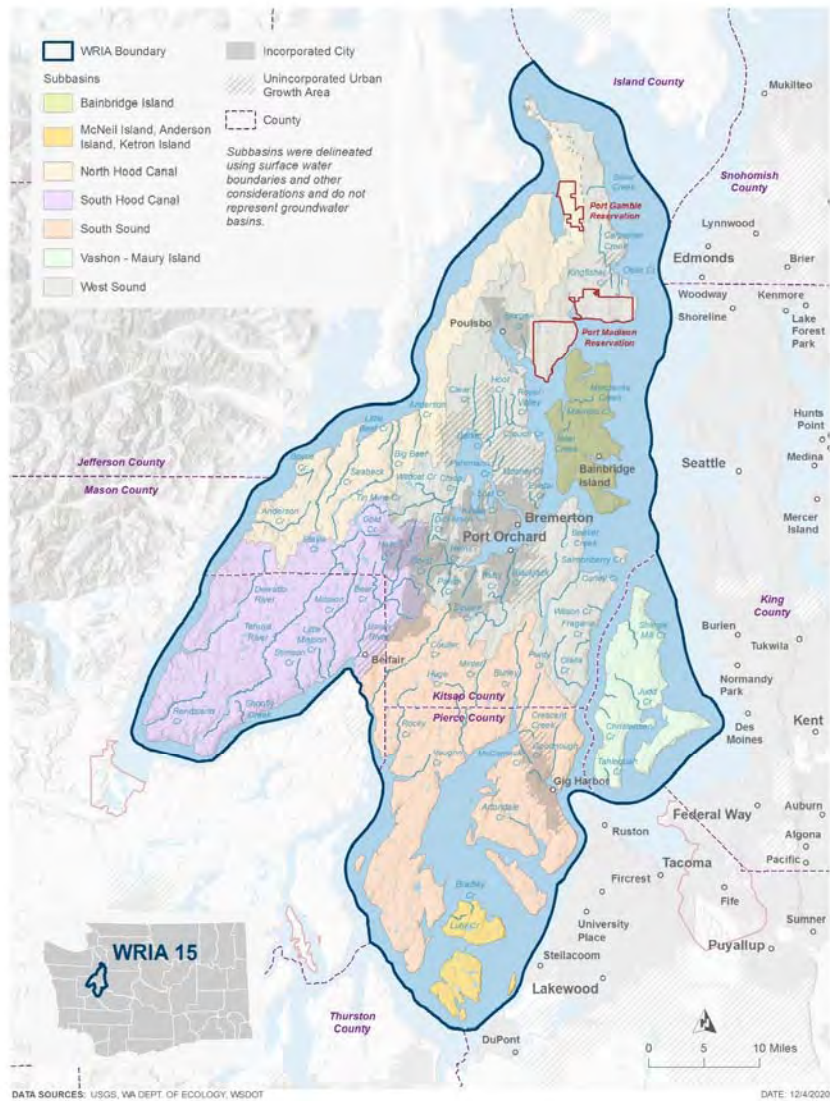
732 For some Committee members, it was also important to consider alignment of subbasins with
733 Tribal Usual and Accustomed fishing areas and county jurisdiction. A more detailed description
734 of the subbasin delineation is in the WRIA 15 Subbasin Delineation Technical Memorandum
735 available in Appendix F.

736 3.3 WRIA 15 Subbasins

737 The WRIA 15 subbasin delineations are shown on Figure 3 and summarized below in Table 4.

Commented [AP17]: PGST: The Port Gamble S'Klallam Tribe was uncomfortable with an administrative watershed boundary along its reservation, as it exists on a narrow peninsula with limited available groundwater resources. However, for the purposes of the plan, the delineation presents a workable framework to meet the needs of the statute.

Commented [VMSJ(18R17): Is a revision requested?



738

739 Figure 3: WRIA 15 Subbasin Delineation for the Watershed Restoration and Enhancement Plan.

740 Table 4: WRIA 15 Subbasins

Subbasin Name	Primary Rivers and Tributaries	County
Bainbridge Island	Manzanita Creek, Issei Creek, Miemois Creek, Springbrook Creek, Murden Creek, Macs Dam Creek	Kitsap
McNeil Island, Anderson Island, Ketron Island	Luhr Creek, Bradley Creek, Schoolhouse Creek	Pierce
North Hood Canal	Boyce Creek, Anderson Creek, Stavis Creek, Seabeck Creek, Big Beef Creek, Little Beef Creek, Port Gamble Creek, Martha John Creek, Kinman Creek	Kitsap
South Hood Canal	Rendsland Creek, Dewatto River, Tahuya River, Stimson Creek, Mission Creek, Union River, Bear Creek, Hazel Creek, Tin Mine Creek	Kitsap and Mason
South Sound	Vaughn Creek, Rocky Creek, Coulter Creek, Huge Creek, Artondale Creek, Crescent Creek, Burley Creek, Purdy Creek	Pierce and Kitsap
Vashon - Maury Island	Judd Creek, Tahlequah Creek, Christensen Creek, Green Valley Creek, Shingle Mill Creek	King
West Sound	Olalla Creek, Fragaria Creek, Curley Creek, Wilson Creek, Salmonberry Creek, Beaver Creek, Black Jack Creek, Ruby Creek, Parish Creek, Lost Creek, Kitsap Creek, Wildcat Creek, Chico Creek, Mosher Creek, Enetai Creek, Pahrman Creek, Silver Creek, Carpenter Creek, Osier Creek, Clear Creek, Crouch Creek, Barker Creek, Salmon Creek, Grovers Creek, Clear Creek, Crouch Creek, Illahee Creek, Steele Creek, Big Scandia Creek, Johnson Creek, Dogfish Creek, Bjorgen Creek, Klebeal Creek, Sam Snyder Creek, Gorst Creek	Kitsap

Chapter Four: New Consumptive Water Use Impacts

4.1 Introduction to Consumptive Use

The Final NEB Guidance states, “watershed plans must include a new consumptive water use estimate for each subbasin, and the technical basis for such estimate” (Ecology, 2019b, page 7).¹⁹ This chapter provides the WRIA 15 Committee’s projections of new domestic permit-exempt well connections (hereafter referred to as PE wells) and their associated consumptive use (CU) for the 20-year planning horizon. This chapter summarizes information from the technical memorandums prepared for and approved by the WRIA 15 Committee on June 4, 2020 and included in Appendix G.

4.2 Projection of Permit-Exempt Well Connections (2018–2038)

The watershed plan addresses new consumptive water use from projected new homes connected to PE wells. Generally, new homes are associated with wells drilled during the planning horizon. However, new uses can occur where new homes are added to existing wells serving group systems under RCW 90.44.050. The well use addressed in this plan refers to both these types of new well use. PE wells are used to supply houses and, in some cases, other equivalent residential units (ERUs) such as small apartments. For the purposes of this document, the terms “house” or “home” refer to any permit-exempt domestic groundwater use, including other ERUs.

To estimate new consumptive water use, the counties or technical consultants (depending on the county) developed projections for the number of new PE wells over the planning horizon in WRIA 15. The methods for projections were based on recommendations from Appendix A of the Final NEB Guidance. The Committee accepted the recommendations for projections from the counties or technical consultants. The WRIA 15 Committee chose to include projections for low, moderate, and high numbers of PE wells, for select counties. WRIA 15 is predominantly rural and projections demonstrate a wide distribution of PE wells throughout the watershed.

¹⁹ Though the statute requires the offset of “consumptive impacts to instream flows associated with permit-exempt domestic water use” (RCW 90.94.020(4)(b)) and 90.94.030(3)(b)), watershed plans should address the consumptive use of new permit exempt domestic withdrawals. Ecology recommends consumptive use as a surrogate for consumptive impact to eliminate the need for detailed hydrogeologic modeling, which is costly and unlikely feasible to complete within the limited planning timeframes provided in chapter 90.94 RCW. RCW 90.94.020 and 90.94.030 have various references to how watershed plans are to project, offset, or account for “water use.” Ecology interprets these subsections of the law (RCW 90.94.020(4)(b), 90.94.020(4)(c), 90.94.030(3)(b), 90.94.030(3)(c), 90.94.030(3)(d), and 90.94.030(3)(e)) to relate to the consumptive water use of new permit-exempt domestic withdrawals that come online during the planning horizon. (Ecology, 2019a, page 7)

The following sections provide the 20-year projections of new PE wells for each subbasin within WRIA 15, the methods used to develop the projections, and the uncertainties associated with the projections.

Addressing Uncertainties, Assumptions, and Limitations Associated with Projections for Growth and Consumptive Use. Uncertainties and limitations are inherent with any planning process. Understanding the limitations of the available data (and analyses that use that data) are important, as well as acknowledging the uncertainties associated with the analysis. The WRIA 15 Committee recognized and discussed uncertainties associated with projecting new PE well connections, models and methods used to calculate consumptive use associated with the PE well connections, as well with project implementation. Chapter 4 presents projections based on the best information available at the time. The WRIA 15 Committee recommends that if new information, modeling, or data becomes available, adjustments are made through adaptive management to provide greater certainty that this plan continues to meet NEB. The Committee has aimed to understand uncertainty in order to be protective of the resources and to help meet the goals of streamflow restoration. Uncertainty is offset through the development of an extensive project list and robust adaptive management and implementation plan. This chapter does not describe uncertainty in detail, but instead identifies the assumptions used in making the projections to better inform adaptive management in the future.

Commented [VMSJ(19): Added language based on conversation at December 3 meeting. Please provide feedback/revisions.

4.2.1 Projections of Permit-Exempt Well Connections by Subbasin

The WRIA 15 watershed plan compiles the growth projection data both at the WRIA scale and by subbasin. This section presents WRIA 15 growth projection data for Kitsap, King, Mason, and Pierce counties. Table 5 and Figure 4 show the projected number of new PE wells per subbasin and their distribution across WRIA 15. To capture the various projections for PE wells, this watershed plan refers to lower estimates, moderate estimates, and higher estimates of growth.

The moderate estimate for the number of new PE wells in unincorporated areas of the four counties:

- 2,921 new PE wells are projected in the unincorporated portions of Kitsap County in WRIA 15 over the planning horizon.
- 368 new PE wells are projected in the unincorporated portions of King County in WRIA 15 over the planning horizon.
- 1,301 new PE wells are projected in the unincorporated portions of Mason County in WRIA 15 over the planning horizon.
- 978 new PE wells are projected in the unincorporated portions of Pierce County in WRIA 15 over the planning horizon.

The total moderate estimate is 5,568 PE wells over the planning horizon, the lower estimate is 4,861 PE wells, and the higher estimate is 6,152 PE wells.

4.2.2 Methodology

The WRIA 15 Committee gave deference to each county for identifying the most appropriate method of projecting PE wells. Different methods were used for calculating the projections for each county:

- Kitsap County’s method is based upon a land capacity analysis, using the OFM 2040 moderate growth projections, and historical wells. Kitsap County and Kitsap Public Utility District developed the projections. The high and low projections are based on a five percent estimated margin of error.
- King County’s method is based upon historical building permit data. King County developed the projections.
- Mason County’s method is based upon Office of Financial Management (OFM) 2040 moderate growth population forecasts.²⁰ The technical consultant team developed the projections.
- Pierce County projections are based on historical well permit data. The technical consultant team developed the projections. The high and low projections are based on different historical periods.

The WRIA 15 Permit-Exempt Growth and Consumptive Use Summary (HDR 2020) provides more detail on each of the growth projection methods.

²⁰ Note that some Committee members requested a high growth projection for Mason County, but that projection was not included as part of this watershed plan.

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822 Table 5: Number of Permit-Exempt Connections Projected between 2018 and 2038

Subbasin	Moderate Estimate					Higher Estimate					Lower Estimate				
	Kitsap	Pierce	Mason	King	Total	Kitsap	Pierce	Mason	King	Total	Kitsap	Pierce	Mason	King	Total
West Sound	1,336				1,336	1,403				1,403	1,142				1,142
North Hood Canal	656				656	689				689	561				561
South Hood Canal	49		1,077		1,126	52		1,077		1,128	42		1,077		1,119
Bainbridge Island	491				491	516				516	491				491
South Sound	389	940	224		1,553	406	1,360	224		1,992	332	602	224		1,158
Vashon-Maury Island				368	368				368	368				368	368
South Sound Islands		38			38		56			56		22			22
Total	2,921	978	1,301	368	5,568	3,066	1,416	1,301	368	6,152	2,568	624	1,301	368	4,861

823

4.2.3 Distribution of New PE Wells

The WRIA 15 Committee mapped potential locations of new PE wells in the watershed based on parcels available for residential development dependent on PE wells. The resulting heat map (Figure 4) shows the most likely areas where new residential development dependent on PE wells will occur.

4.2.4 Summary of Assumptions

The methods described in Appendix A of the Final NEB Guidance for projecting new PE wells include several assumptions. The assumptions shared here provide transparency in the planning process and deliberations of the Committee to support any future adaptive management undertaken by entities implementing the plan. The WRIA 15 Permit-Exempt Growth and Consumptive Use Summary (HDR 2020) provides a detailed listing of the assumptions used to project new PE wells.

Kitsap, King, and Pierce counties relied on historical data, and assumed that these historical trends will continue into the future. To provide greater certainty in the assumption, this watershed plan includes additional PE well scenarios using different periods in the historical Tacoma-Pierce County Health Department (TPCHD) well database. The high-growth scenario uses the 1999–2008 data, which was a time of relatively healthy economic growth resulting in more rapid rural development. The low-growth scenario uses the 2009–2018 data, which was a time of relatively slower rural development and corresponds with the recession and housing downturn. The technical consultants applied a plus or minus five percent to calculate the high- and low-growth scenarios for Kitsap County. Five percent is the assumed margin of error in the County's land capacity analysis. Mason and King County requested no high- or low-growth scenarios calculations. All three growth scenarios were used in the deliberations by the Committee to determine the most likely consumptive use estimate for the planning horizon.

To estimate the distribution of PE wells in Kitsap County, it was assumed growth in each subbasin is based upon the proportion of the historical number of building permits for each subbasin for the period of 2002-2019. Assumptions were made as to the developable parcels that would use PE wells by only counting parcels greater than 0.75 acre that are outside a 200-foot water or sewerline buffer. Within King County, the percentage of houses with PE wells was assumed to be equal to the time period of 2000-2017. Within Mason County it was assumed the proportion of houses with PE wells is equal to the proportion of buildout capacity in rural areas compared to urban growth areas. In Pierce County, it was assumed that the same historic growth rate in PE wells by subbasin would occur in the future.

4.2.5 Projected Growth Map

Below are figures representing the distribution of new PE wells under the moderate estimate (Figure 4).



Figure 4. WRIA 15 Projected New Permit-Exempt Wells (number and likely area) Under the Moderate Estimate Growth Scenario 2018-2038. The “heat” map is generated based on modeled growth projections that considers zoning, land use, and distance from existing water lines. The results are highly generalized but help illustrate the approximate location and relative growth of new domestic permit exempt wells.

Commented [VMSJ(20): We are confirming accuracy of heat map with HDR.

4.3 Impacts of New Consumptive Water Use

The watershed plan used the 20-year projections of new PE wells to estimate the consumptive water use that this watershed plan must address and offset. As above, this section uses “new PE wells” as a shorthand for new domestic permit-exempt well connections unless otherwise described. This section includes an overview of the methods to estimate new consumptive water use (consumptive use), an overview of the anticipated impacts of new consumptive use in WRIA 15 over the planning horizon, and other considerations by the WRIA 15 Committee, such as assumptions. The WRIA 15 Permit-Exempt Growth and Consumptive Use Summary provides a more detailed description of the analysis and alternative scenarios considered (Appendix G).

The Committee considered all three growth scenarios (lower estimate, moderate estimate, and higher estimate) as well as three methods for estimating consumptive use. Based on the deliberations of the Committee, this watershed plan recommends a consumptive use estimate of 766.4 acre feet per year (684,150 gallons per day [gpd]). This estimate is based on the moderate growth projection for the irrigated area method and is viewed as the most likely consumptive use. Based on data presented, some members of the Committee supported a lower consumptive use estimate and others supported a higher number, but the Committee ultimately agreed that 766.4 acre-feet per year (AF/yr) should be the consumptive use estimate. Section 4.3.4 provides additional information on the consumptive use estimate as well as considerations for a higher offset goal of 1,218 AF/yr (1.087 million gallons per day [mgd]) to achieve through project implementation. This section provides an overview and results from the various methods used to estimate consumptive use.

4.3.1 Methodology to Estimate Indoor and Outdoor Consumptive Water Use

To calculate indoor and outdoor consumptive use, the technical consultants presented three different methods to the Committee for consideration: Metered Data Method, USGS Groundwater Model Method, and the Irrigated Area Method. This section presents an overview and results on the three methods. While the consumptive use estimate presented in this plan relies on the irrigated area method, some members of the Committee preferred the alternative methods. All three methods are presented here to provide transparency and for future considerations around adaptive management. Additional information is available in Appendix G.

Metered Data Method

HDR estimated consumptive use using metered connections from water systems. HDR requested data from Committee members for water systems that use (or have used) a flat rate billing structure and were similar in character to the rural environments in which households may connect to PE wells. In WRIA 15, Kitsap PUD provided consumption data for all Kitsap PUD water systems for years 2017 and 2018.

This method assumed that average daily use in December, January, and February is representative of year-round daily indoor use. Average daily system-wide use was divided by the

Commented [VMSJ(21): Please continue to provide feedback on the framing of the CU estimate and higher offset goal.

Commented [VMSJ(22): Please provide feedback on justification for including all three methods in the body of the plan.

number of connections (assuming all connections are residential), to estimate average daily indoor use per connection. It was also assumed that 10 percent of the indoor use is consumptively used. That factor was applied to the average daily use in the winter months to determine the consumptive portion of indoor water use per connection.

Average daily indoor use was multiplied by the number of days in a year to estimate total annual indoor use. Total annual indoor use was subtracted from total annual use by a water system to estimate total annual outdoor use. It was assumed 80 percent of the outdoor use is consumptively used. That factor was applied to estimate the consumptive portion of outdoor use.

Outdoor consumptive use was also estimated on a seasonal basis. The Washington Irrigation Guide reports irrigation requirements between the months of April and September for representative weather stations in WRIA 15. Therefore, seasonal outdoor water use was assumed to occur over a period of six months. Average daily indoor use was multiplied by the number of days in the irrigation season to calculate total indoor use for the irrigation season. Total irrigation season indoor use was then subtracted from total season use to determine total outdoor use for the irrigation season. The value was proportionally allocated to each month in the irrigation season using the requirements from the Washington Irrigation Guide.

The annual average consumptive use values are 0.0138 acre-foot (AF)²¹ (0.000019 cubic foot per second [cfs]) for indoor use per well and 0.0233 AF (0.000032 cfs)²² for outdoor use per well. The corresponding values in gallons are 4,470 gallons for indoor consumptive use and 7,590 gallons for outdoor consumptive use per well per year.

USGS Groundwater Model Method

The USGS Groundwater Model method refers to water use data collected for a groundwater-flow model of the Kitsap Peninsula.²³ A report prepared by the USGS (Welch, Frans, and Olsen, 2014) provides a survey of consumption from select water utilities serving more than 221,700 people with more than 88,500 residential connections on the Kitsap Peninsula. The USGS study differentiated between the indoor and outdoor portions of use. Estimated indoor use (based on November–April pumping values) was 66 gallons per person per day. Outdoor use was estimated for the outdoor growing season and varied by month from four gallons per person per day in May to 97 gallons per person per day in September. Estimates for average annual outdoor use are 26 gallons per person per day. For the purposes of groundwater modeling USGS assumed the consumptive use rate for indoor domestic use is 10 percent in non-sewered areas, and the consumptive use rate for outdoor use is 90 percent.

²¹ Acre-foot (AF) is a unit of volume for water equal to a sheet of water one acre in area and one foot in depth. It is equal to 325,851 gallons of water. One acre-foot per year (AF/yr) is equal to 893 gallons per day (gpd).

²² Cubic feet per second (cfs) is a rate of the flow in streams and rivers. It is equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. One cubic foot per second is equal to 646,317 gallons per day.

²³ Note that the water use data is from water system data which is metered with a fee structure based on water use. PE wells in WRIA 15 are not metered and have no associated fee structure.

The annual average consumptive use values are 0.0185 acre-foot (AF) (0.000026 cubic foot per second [cfs]) for indoor use per well and 0.0262 AF (0.000036 cfs) for outdoor use per well. The corresponding values in gallons are 6,023 gallons for indoor consumptive use and 8,540 gallons for outdoor consumptive use per well. These are annual averages, and the Committee expects that outdoor use will occur mainly in summer.

Irrigated Area Method

Appendix A of the Final NEB Guidance describes the Irrigated Area method that assumes average indoor use per person per day, and reviews aerial imagery to provide a basis to estimate irrigated area of outdoor lawn and garden areas. Use patterns for indoor uses versus outdoor uses are different. Indoor use is generally constant throughout the year, while outdoor use occurs primarily in the summer months. In addition, the portion of water use that is consumptive varies for indoor and outdoor water uses. The Irrigated Area method accounts for indoor and outdoor consumptive use variances by using separate approaches to estimate indoor and outdoor consumptive use.

To develop the consumptive use estimate, the WRIA 15 Committee used the Irrigated Area method and relied on assumptions for indoor use and outdoor use from Appendix A of the Final NEB Guidance. This chapter provides a summary of the technical memo, which is available in Appendix G of the watershed plan.

Consistent with the Final NEB Guidance (Final NEB Guidance Appendix B), the Committee assumed that impacts from consumptive use on surface water are steady-state, meaning impacts to the stream from pumping do not change over time. The wide distribution of future well locations and depths across varying hydrogeological conditions led to this assumption.

New Indoor Consumptive Water Use

Indoor water use refers to the water that households use (such as in kitchens, bathrooms, and laundry) and that leave the house as wastewater (USGS, 2012). The Technical Consultants used Ecology's recommended assumptions for indoor daily water use per person and local data to estimate the average number of people per household, and applied Ecology's recommended consumptive use factor (CUF) to estimate new indoor consumptive water use (Ecology, 2019b):

- 60 gpd per person, as recommended by Ecology.
- 2.5 persons per household assumed for rural portions of WRIA 15, based on the Office of Financial Management and County data.
- 10 percent of indoor use is consumptively used (or a CUF of 0.10), based on the assumption that homes on PE wells are served by onsite sewage systems. Onsite sewage systems percolate back to groundwater; a fraction of that water is lost to the atmosphere through evaporation in the drain field.

The equation used to estimate household consumptive indoor water use is:

$$60 \text{ gpd} \times 2.5 \text{ people per house} \times 365 \text{ days} \times 0.10 \text{ CUF}$$

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This results in an annual average of 0.0168 AF (0.000023 cfs, 5,475 gallons) indoor consumptive water use per year per well.

[New Outdoor Consumptive Water Uses](#)

Most outdoor water is used to irrigate lawns, gardens, and landscaping. To a lesser extent, households use outdoor water for car and pet washing, exterior home maintenance, pools, and other water-based activities. Water from outdoor use does not enter onsite sewage systems, but instead infiltrates into the ground or is lost to the atmosphere through evapotranspiration (Ecology, 2019b, page 19).

The WRIA 15 Committee used aerial imagery to measure the irrigated areas of 80 randomly selected parcels served by PE wells to develop an average outdoor irrigated area. This analysis returned more than one-half of the parcels with no visible irrigation, resulting in irrigated area values of zero. The average irrigated area for the 80 randomly selected parcels was 0.08 acre. The Committee believes that 0.08 acre represents the irrigated areas for PE wells in WRIA 15 and adopted that value for consumptive use calculations. This decision is based on the understanding that the consumptive use calculation likely overestimates water use and the independent analyses performed to confirm the measurements of irrigated acreage.

The WRIA 15 Committee used the following assumptions, recommended in Appendix A of the Final NEB Guidance, to estimate outdoor consumptive water use:

- Crop irrigation requirements (IR) for turf grass according to Washington Irrigation Guide (WAIG) (NRCS-USDA 1997): 16.84 inches per year for the Bremerton WAIG station. This value was rounded up to 17 inches (1.42 feet) per year and used to estimate the amount of water needed for outdoor irrigation.
- An irrigation application efficiency (AE) to account for water that does not reach the turf: 75 percent. This increases the amount of water used to meet the crop's IR by 25 percent.
- CUF of 0.8, reflecting 80 percent consumption for outdoor use. This means a return of 20 percent of outdoor water to the immediate water environment.
- Outdoor irrigated area based on existing homes using PE wells: 0.08 acre.

The equation used to estimate household consumptive outdoor water use is:

$$\text{Household Outdoor CU} = \left(\frac{1.42 \text{ feet}}{0.75 \text{ AE}} \right) \times 0.08 \text{ acre} \times 0.8 \text{ CUF}$$

First, water loss is accounted for by dividing the IR by the AE. Next, the total water volume used to maintain turf is multiplied by the area that is irrigated. Finally, the volume of water is multiplied by 80 percent to produce the outdoor consumptive water use.

This results in 0.121 AF/yr (0.00017 cfs, 39,400 gallons) average outdoor consumptive water use per PE well for the WRIA. This is an average for the year; however, the Committee expects that more water use will occur in the summer and less in winter as outdoor water use will occur

mainly in summer. The outdoor consumptive use will vary by subbasin because of differences in temperature and precipitation across the watershed. The same IR for turf grass is used to simplify the calculations. The outdoor consumptive use equals 43.2 gpd per person.²⁴

4.3.2 Assumptions with Calculating Consumptive Use

The law calls for an estimate of “consumptive water use impacts” (RCW 90.94.030(3)(e)). However, the process of estimating impacts is complex, and therefore the Committee agreed to use the estimated amount of new consumptive use for the offset amount and the impacts of that use. This approach is consistent with Appendix A of the Final NEB Guidance (Ecology, 2019b).

Below is a discussion of assumptions for each method. An assumption used in all three methods is an average household size of 2.5 people. The household size may vary across the WRIA and may change over time. In addition, all three methods considered future indoor and outdoor water use per household to be the same as estimated for current conditions. While the Committee recognized that climate change may lead to more frequent hotter and drier summers, calculations of consumptive use were based on data available.²⁵ More information on uncertainties and limitations is presented in the technical memo available in Appendix G.

Metered Data Method

This method uses data collected by Kitsap PUD for all connections (about 15,700) within their service area in Kitsap County. Use of this method in calculating consumptive use for PE wells assumes that water use data for metered connections is comparable to PE wells with no meter. As the KPUD data covers Kitsap County, it is assumed the data are applicable to Pierce and Mason County areas in WRIA 15. The Metered Data Method uses an assumption that the indoor water use is consistent throughout the year in order to estimate outdoor water use. Assumptions on the consumptive portion of water use (10 percent for indoor, 80 percent for outdoor) are also used.

Commented [VMSJ(23): We worked on a number of revisions to this section and above based on comments and discussion at the December meeting. Bob also did some additional research.

²⁴ The estimated outdoor consumptive use equals 43.2 gpd per person, or 108 gpd per household. The outdoor non-consumptive use is 27 gpd (using 80 percent consumptive use factor), giving a total outdoor water use of 135 gpd per household. Washington Department of Ecology compiled information on existing PE well metering programs across the state for the purpose of policy and project discussions at Committee meetings (Ecology, 2020c). Six different well metering programs are described. The average water use amongst the six programs varied from 114 to 241 gpd per household. That value includes outdoor and indoor water use. The highest values were for a small group of eight wells in King County. Data from Lummi Peninsula, Dungeness and Kittitas represented over 90 percent of the metered data obtained. The range of water use in those areas was 114 – 124 gpd. The total outdoor water use estimate using the irrigated area method of 135 gpd per household exceeds the average water use in the metered areas. Adding indoor use of 150 gpd per household the irrigated area method may predict twice the average water use of other areas in Washington State with PE wells with metering data.

²⁵ The Squaxin Island Tribe calculation of increased evapotranspiration (and therefore water use) due to temperature increases suggested eight percent more water demand in 20 years.

1035 **USGS Groundwater Model Method**

1036 USGS collected data from select water utilities serving more than 221,700 people with more
1037 than 88,500 residential connections on the Kitsap Peninsula. Use of this method in calculating
1038 consumptive use for PE wells assumes that water use data for metered connections is
1039 comparable to PE wells with no meter. As the USGS study did not include the Key Peninsula or
1040 the islands of Vashon Maury, Fox, Anderson, McNeil and Ketron, this method also assumes the
1041 data from Kitsap Peninsula is relevant to those areas. Assumptions on the consumptive portion
1042 of water use (10 percent for indoor, 90 percent for outdoor) are also used.

1043 **Irrigated Area Method**

1044 The irrigated area method relies on a measured factor and assumed values from literature or
1045 research to estimate consumptive water use, as described in Section 4.3.1. The measured factor
1046 is the average outdoor irrigated area per parcel. The average outdoor irrigated area estimate
1047 relies on a sample size of 80 parcels distributed by location and property values. The WRIA 15
1048 Committee recognized the small sample size and to further test the assumption that the 80
1049 parcels was fairly representative of outdoor irrigation in WRIA 15, Kitsap Public Utility District
1050 (PUD) and the Suquamish Tribe performed independent analyses on the list of parcels to
1051 confirm the findings of the irrigated area analysis. HDR compared the results of the analysis
1052 with similar analyses undertaken by other Watershed Restoration and Enhancement
1053 Committees (GeoEngineers and HDR, 2020). While the results showed that on average, HDR's
1054 methods resulted in a lower outdoor irrigation estimate, the Committee concluded that the
1055 results were in line with its knowledge of water use in the WRIA.

1056 The outdoor consumptive use calculation uses assumptions about irrigation amounts and
1057 irrigation efficiencies. The outdoor consumptive use calculation for the Irrigated Area method
1058 assumes that homeowners water their lawns and gardens at the rate needed for commercial
1059 turf grass (i.e., watering at rates that meet crop IR per the WAIG). This assumption likely results
1060 in an overestimate, as the irrigated area analysis demonstrated that many people irrigate their
1061 lawns enough to keep the grass alive through the dry summers, but not at the levels that
1062 commercial turf grass requires. The method also assumes that residential pop-up sprinkler
1063 systems irrigate lawns with an efficiency of 75 percent. In reality, households apply water to
1064 their lawns and gardens in many different ways, some more efficient than a 25 percent water
1065 loss, and some less efficient. Assumptions on the consumptive portion of water use (10 percent
1066 for indoor, 80 percent for outdoor) are also used. Members of the WRIA 15 Committee
1067 conducted their own analysis to evaluate assumptions and uncertainties with the consumptive
1068 use methods.²⁶

²⁶ In order to help reduce consumptive use uncertainty when considering both the USGS Groundwater Model and the Irrigated Area Methods, some members of the Committee developed their own analyses. The Skokomish Tribe and Aspect Consulting conducted an assessment of how, or if, precipitation variability across geography and time would affect outdoor irrigation consumptive use estimates in WRIA 15. The study used up to date climatological data from AgWeatherNet and PRISM to compare to values using the Irrigated Area Method. This was undertaken to address concerns that these methodologies may be not conservative enough or too conservative (respectively) and whether or not a "safety factor" needed to be factored in. This assessment can be found in the

Commented [VMSJ(24): Skokomish and Squaxin Island Tribes – please review footnote below and provide edits. Materials can be included in Compendium.

4.3.3 Summary of Consumptive Use Estimates

Below is a summary of consumptive use estimates by method.

Metered Data Method

The total consumptive use estimate for WRIA 15 is the number of PE wells projected (see Section 4.2) multiplied by the total indoor and outdoor consumptive use per PE well. The combined indoor and outdoor consumptive use per PE well for the baseline growth projection is .072 AF/yr (.0001 cfs, 64 gpd). The total consumptive use estimate for WRIA 15 for the medium-growth projection using the Metered Data Method is 401 AF/yr (0.55 cfs, 357,700 gpd). The total consumptive use for the low-growth projection is 350 AF/yr (0.48 cfs, 312,300 gpd) and for the high-growth projection is 443 AF/yr (0.61 cfs, 395,300 gpd). Table 6 summarizes the estimated indoor and outdoor consumptive use by subbasin for the moderate estimate of growth projection. Table 7 summarizes the consumptive use by subbasin for the lower and higher estimates for growth projections. The Committee expects the highest consumptive use to occur in the South Sound subbasin, which has the most projected new PE wells, as presented in Table 7.

Table 6. Indoor and Outdoor Consumptive Use Estimates by Subbasin for 2038: Moderate Estimate for Growth Projection and Metered Data Method

Subbasin	Projected PE wells	Indoor CU		Outdoor CU		Total CU in 2038	
		(AF/yr	GPD	AF/yr	GPD	AF/yr	GPD
West Sound	1,336	18.3	16,366	77.8	69,472	96.2	85,838
North Hood Canal	656	9.0	8,036	38.2	34,112	47.2	42,148
South Hood Canal	1,126	15.5	13,794	65.6	58,552	81.0	72,346
Bainbridge Island	491	6.7	6,015	28.6	25,532	35.3	31,547
South Sound	1,553	21.3	19,024	90.5	80,756	111.8	99,780
Vashon-Maury Island	368	5.0	4,508	21.4	19,136	26.5	23,644
South Sound Islands	38	0.5	466	2.2	1,976	2.7	2,442
Total	5,568	76.4	68,208	324.3	289,536	400.8	357,744

Compendium. The analysis provided similar results to the Irrigated Area method. The study also suggests that water use in dry years is substantially higher, pointing to the likelihood of increased water use as climate change makes the dry season longer, hotter, and drier. The Squaxin Island Tribe also evaluated evapotranspiration rates under hotter and drier conditions.

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1087 Table 7. Indoor and Outdoor Consumptive Use Estimates by Subbasin for 2038: Lower- and Higher-Estimates for Growth Projections
1088 and Metered Data Method.

Subbasin	Lower Estimate					Higher Estimate				
	Projected PE wells	Indoor CU (AF/yr)	Outdoor CU (AF/yr)	Total CU in 2038		Projected PE wells	Indoor CU (AF/yr)	Outdoor CU (AF/yr)	Total CU in 2038	
				(AF/yr)	GPD				(AF/yr)	GPD
West Sound	1,142	15.7	66.5	82.2	73,374	1,403	19.3	81.7	101.0	90,143
North Hood Canal	561	7.7	32.7	40.4	36,044	689	9.5	40.1	49.6	44,268
South Hood Canal	1,119	15.4	65.2	80.5	71,896	1,128	15.5	65.7	81.2	72,474
Bainbridge Island	491	6.7	28.6	35.3	31,547	516	7.1	30.1	37.1	33,153
South Sound	1,158	15.9	67.5	83.3	74,402	1,992	27.3	116.0	143.4	127,986
Vashon-Maury Island	368	5.0	21.4	26.5	23,644	368	5.0	21.4	26.5	23,644
South Sound Islands	22	0.3	1.3	1.6	1,414	56	0.8	3.3	4.0	3,598
Total	4,861	66.7	283.2	349.9	312,319	6,152	84.4	358.4	442.8	395,266

1089

USGS Groundwater Model Method

The total consumptive use estimate for WRIA 15 is the number of PE wells projected (see Section 4.2) multiplied by the total indoor and outdoor consumptive use per PE well. The combined indoor and outdoor consumptive use per PE well is .084 AF/yr (.000116 cfs, 75 gpd). The total consumptive use estimate for WRIA 15 for the medium-growth projection using the USGS Groundwater Model Method is 468 AF/yr (0.65 cfs, 417,600 gpd). The total consumptive use for the lower estimate for growth projection is 408 AF/yr (0.57 cfs, 364,600 gpd) and for the higher estimate for growth projection is 517 AF/yr (0.72 cfs, 461,400 gpd). Table 8 summarizes the estimated indoor and outdoor consumptive use by subbasin for the moderate estimate for growth projection. Table 9 summarizes the consumptive use by subbasin for the lower and higher estimates. The Committee expects the highest consumptive use to occur in the South Sound subbasin, which has the most projected new PE wells, as presented in Table 6.

Table 8: Indoor and Outdoor Consumptive Use Estimates by Subbasin for 2038: Moderate Estimate for Growth Projection and USGS Groundwater Model Method

Subbasin	Projected PE wells	Indoor CU		Outdoor CU		Total CU in 2038	
		(AF/yr)	GPD	AF/yr	GPD	AF/yr	GPD
West Sound	1,336	24.7	22,044	87.6	78,156	112.2	100,200
North Hood Canal	656	12.1	10,824	43.0	38,376	55.1	49,200
South Hood Canal	1,126	20.8	18,579	73.8	65,871	94.6	84,450
Bainbridge Island	491	9.1	8,102	32.2	28,724	41.3	36,825
South Sound	1,553	28.7	25,625	101.8	90,851	130.5	116,475
Vashon-Maury Island	368	6.8	6,072	24.1	21,528	30.9	27,600
South Sound Islands	38	0.7	627	2.5	2,223	3.2	2,850
Total	5,568	102.9	91,872	364.9	325,728	467.8	417,600

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1106 Table 9: Indoor and Outdoor Consumptive Use Estimates by Subbasin for 2038: Lower and Higher Estimates for Growth Projections
1107 and USGS Groundwater Model Method

Subbasin	Lower Estimates					Higher Estimates				
	Projected PE wells	Indoor CU (AF/yr)	Outdoor CU (AF/yr)	Total CU in 2038		Projected PE wells	Indoor CU (AF/yr)	Outdoor CU (AF/yr)	Total CU in 2038	
				(AF/yr)	GPD				(AF/yr)	GPD
West Sound	1,142	21.1	74.8	95.9	85,650	1,403	25.9	91.9	117.9	105,225
North Hood Canal	561	10.4	36.8	47.1	42,075	689	12.7	45.2	57.9	51,675
South Hood Canal	1,119	20.7	73.3	94.0	83,925	1,128	20.8	73.9	94.8	84,600
Bainbridge Island	491	9.1	32.2	41.3	36,825	516	9.5	33.8	43.4	38,700
South Sound	1,158	21.4	75.9	97.3	86,850	1,992	36.8	130.5	167.4	149,400
Vashon-Maury Island	368	6.8	24.1	30.9	27,600	368	6.8	24.1	30.9	27,600
South Sound Islands	22	0.4	1.4	1.8	1,650	56	1.0	3.7	4.7	4,200
Total	4,861	89.8	318.6	408.4	364,575	6,152	113.7	403.2	516.9	461,400

1108

1109 Irrigated Area Method

1110 The total consumptive use estimate for WRIA 15 is the number of PE wells projected (see
 1111 Section 4.2) multiplied by the total indoor and outdoor consumptive use per PE well. The
 1112 combined total indoor and outdoor consumptive use is 0.138 AF/yr (.00019 cfs, 123 gpd). The
 1113 total consumptive use estimate for WRIA 15 for the medium-growth projection is 766 AF/yr
 1114 (1.06 cfs, 684,200 gpd). The total consumptive use for the lower estimates for growth
 1115 projection is 669 AF/yr (0.93 cfs, 597,300 gpd) and for the higher estimates for growth
 1116 projection is 847 AF/yr (1.17 cfs, 755,900 gpd). Table 10 summarizes the estimated indoor and
 1117 outdoor consumptive use by subbasin for the moderate estimates for growth projection. Table
 1118 11 summarizes the consumptive use by subbasin for the lower and higher estimates. The
 1119 Committee expects that highest consumptive use to occur in the South Sound subbasin, which
 1120 has the most projected new PE wells, as presented in Table 11.

1121 Table 10: Indoor and Outdoor Consumptive Use Estimates by Subbasin for 2038: Moderate
 1122 Estimate for Growth Projection and Irrigated Area Method

Subbasin	Projected PE wells	Indoor CU		Outdoor CU		Total CU in 2038	
		(AF/yr	GPD	AF/yr	GPD	AF/yr	GPD
West Sound	1,336	22.4	19,987	161.5	144,175	183.9	164,161
North Hood Canal	656	11.0	9,814	79.3	70,792	90.3	80,606
South Hood Canal	1,126	18.9	16,845	136.1	121,513	155.0	138,358
Bainbridge Island	491	8.2	7,345	59.4	52,986	67.6	60,332
South Sound	1,553	26.0	23,233	187.7	167,592	213.8	190,825
Vashon-Maury Island	368	6.2	5,505	44.5	39,713	50.7	45,218
South Sound Islands	38	0.6	568	4.6	4,101	5.2	4,669
Total	5,568	93.3	83,297	673.1	600,872	766.4	684,170

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1125 Table 11: Indoor and Outdoor Consumptive Use Estimates by Subbasin for 2038: Lower and Higher Estimates for Growth
1126 Projections and Irrigated Area Method

Subbasin	Lower Estimate					Higher Estimate				
	Projected PE wells	Indoor CU (AF/yr)	Outdoor CU (AF/yr)	Total CU in 2038		Projected PE wells	Indoor CU (AF/yr)	Outdoor CU (AF/yr)	Total CU in 2038	
				(AF/yr)	GPD				(AF/yr)	GPD
West Sound	1,142	19.1	138.1	157.2	140,324	1,403	23.5	169.6	193.1	172,394
North Hood Canal	561	9.4	67.8	77.2	68,933	689	11.5	83.3	94.8	84,661
South Hood Canal	1,119	18.8	135.3	154.0	137,497	1,128	18.9	136.4	155.3	138,603
Bainbridge Island	491	8.2	59.4	67.6	60,332	516	8.6	62.4	71.0	63,404
South Sound	1,158	19.4	140.0	159.4	142,290	1,992	33.4	240.8	274.2	244,768
Vashon-Maury Island	368	6.2	44.5	50.7	45,218	368	6.2	44.5	50.7	45,218
South Sound Islands	22	0.4	2.7	3.0	2,703	56	0.9	6.8	7.7	6,881
Total	4,861	81.5	587.6	669.1	597,297	6,152	103.1	743.7	846.8	755,929

1127

4.3.4 Summary of Consumptive Use Estimate

This watershed plan uses a consumptive use estimate of 766.4 AF/yr. This estimate is based on the moderate estimate for growth projection for the irrigated area method and is viewed as the most likely consumptive use. Figure 5 shows the distribution of consumptive use across the WRIA. The other methods used produced lower estimates of consumptive use. The metered data method produced an estimate of 400.8 AF/yr and the USGS groundwater model method 467.8 AF/yr. Use of the irrigated area method produces consumptive use estimates that are 64–91 percent higher than the other methods. Based on data presented, some members of the Committee supported a lower consumptive use estimate and others supported a higher number, but the Committee ultimately agreed that 766.4 AF/yr should be the consumptive use estimate.

Some members of the WRIA 15 Committee believed that a higher consumptive use estimate of 1,218 AF/yr is necessary to ensure that offsets are met and streams are benefited. While there was not consensus on using the higher number for the consumptive use estimate, the Committee did agree that reaching an offset target of 1,218 AF/yr would be beneficial to streams. To obtain the consumptive use estimate of 766.4 AF/yr, HDR used the measured average of 0.08 acres for the outdoor irrigated area along with the moderate growth estimate. The area appears low due to a high number of non-irrigated parcels. The higher number of 1,218 AF/yr is based on a higher estimate for growth projections and a substitution of 0.12 acres for the average irrigated area under the irrigated area method. HDR performed statistical analyses of the irrigated acreage to characterize the potential range in the irrigated area measurements. The 0.12 acre number was obtained by substituting 0.05 acre for every parcel with no irrigated acreage measured and recalculating the mean and upper confidence limits (95 percent). The 0.12 acre number is the upper confidence limit. The substitution of 0.05 acre for parcels with no irrigated acreage measured was made to account for a minimum amount of outdoor irrigation that might occur but not be observable on aerial photos.

As data on actual growth, climate change and water use, experience with project implementation and new information is collected over time, adaptive management of plan implementation will need to support adjustments of the proposed approach and water offsets in order to meet NEB.

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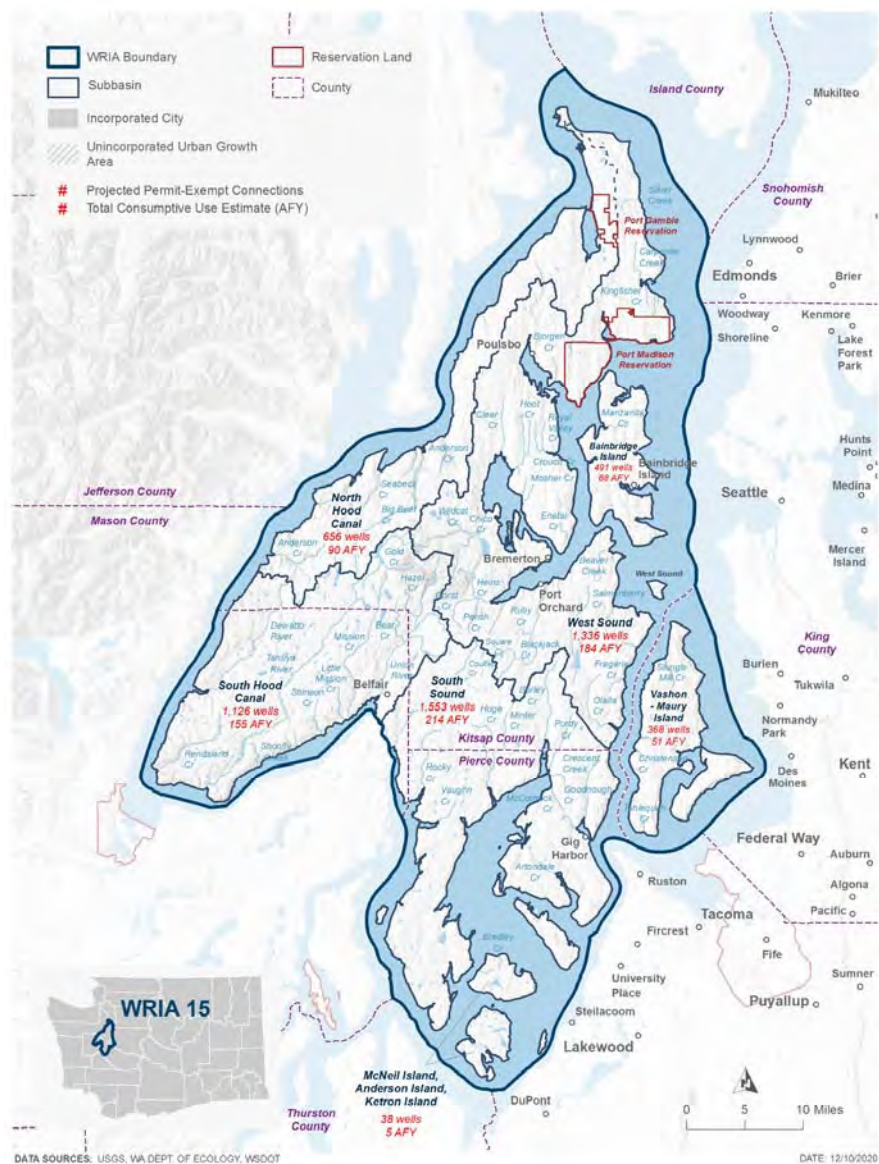


Figure 5. WRIA 15 Estimated Consumptive Use based on Moderate Estimate for Growth Projections and Irrigated Area Method, 2018-2038

Chapter Five: WRIA 15 Projects

5.1 Description and assessment

Watershed plans must identify projects that offset the potential impacts future PE wells will have on streamflows and provide a net ecological benefit to the WRIA.²⁷ This chapter provides recommendations for projects to offset consumptive use and meet NEB²⁸ and describes water offset projects and habitat projects. Water offset projects have a quantified streamflow benefit and contribute to offsetting consumptive use. Habitat projects contribute toward achieving NEB by improving the ecosystem function and resilience of aquatic systems, supporting the recovery of threatened or endangered salmonids, and protecting instream resources including important native aquatic species. Habitat projects may also result in an increase in streamflow, but the water offset benefits for these projects is difficult to quantify. Therefore, this watershed plan does not rely on habitat projects to contribute toward offsetting consumptive use.

To identify the projects summarized in this chapter, as well as the complete project inventory in Appendix H, Committee members and WRIA 15 partners brought project suggestions forward to the project workgroup and Committee for discussion. Ecology and the technical consultants also identified projects with potential streamflow benefit from the Puget Sound Action Agenda near term actions, salmon recovery lead entity four-year workplans, streamflow restoration grant applications, and public works programs. The Committee used a project inventory to capture and track all project ideas, no matter their phase of development, throughout the planning process. To receive feedback on project alignment with other planning processes and identify any projects of concern for inclusion in the watershed plan, Ecology distributed the project inventory to conservation districts, LIOs and salmon recovery lead entities in WRIA 15. At any point in the process, Committee members or WRIA 15 partners could identify projects of concern for inclusion in the watershed plan and recommend removal of the project from the project inventory. Ecology and the technical consultants reached out to all identified project sponsors prior to including the project in the watershed plan.

Based on initial information available on projects, the Committee identified a subset of offset projects that showed promise for quantitative streamflow benefits. The technical consultants

²⁷ The NEB Guidance defines “projects and actions” as “General terms describing any activities in watershed plans to offset impacts from new consumptive water use and/or contribute to NEB.” (Ecology, 2019b, page 5) This watershed plan uses the term “projects” for simplicity to encompass both projects and actions as defined by the NEB guidance.

²⁸ In 2015 the State Supreme Court issued a decision on Foster v. Ecology, City of Yelm, and Washington Pollution Control Hearings Board. The decision, frequently referred to as the “Foster decision,” reaffirmed and reinforced that instream flows adopted in a rule must be protected from impairment. The Legislature established the Joint Legislative Task Force on Water Resource Mitigation (Task Force) in RCW 90.94.090 to understand impacts of the 2015 Foster decision. In that law, Ecology is authorized to issue permit decisions for up to five water mitigation pilot projects using a stepwise mitigation approach that can include out of kind mitigation. The City of Port Orchard is one of the entities undertaking a pilot project. As of January 2020, the pilot project work is still ongoing. More information about the Task Force, including their 2019 report to the legislature, can be accessed on their webpage: <http://leg.wa.gov/JointCommittees/WRM/Pages/default.aspx>. (Ecology, 2020b)

1189 developed detailed analysis on the subset of projects and the Committee determined the offset
1190 value to attribute to each project. This chapter presents summaries of those projects.

1191 In a separate effort, Ecology contracted with Pacific Groundwater Group (PGG) to support
1192 identification of water right acquisition opportunities for WRIA 15. In coordination with the
1193 Committee, PGG narrowed down the list of opportunities. The Committee provided input on
1194 the revised list of projects for PGG to develop detailed project descriptions for water right
1195 acquisition opportunities that appeared the most valid. For each water right acquisition project,
1196 the Committee used the estimate generated by PGG for their consumptive use portion of the
1197 right. Before these rights are acquired and put into Trust, they will go through a full extent and
1198 validity analysis to determine the consumptive use offset component. As this analysis cannot
1199 happen until the owner of the right has agreed to sell, the Committee is relying on the PGG
1200 evaluations to estimate the offset volumes described in section 5.2.

1201 For projects that did not provide a measurable streamflow benefit, the WRIA 15 Committee
1202 chose not to invest technical consultant resources to further develop the projects during this
1203 planning period. Information presented on these projects is based on available information
1204 from WRIA 15 partners. The Committee instead focused the technical resources and expertise
1205 on finding projects that provide quantifiable offset benefits.

1206 The projects identified in this plan are consistent with the project type examples listed in the
1207 Final NEB Guidance: (a) water right acquisition offset projects; (b) non-acquisition water offset
1208 projects; and (c) habitat and other related projects (Ecology, 2019b). This watershed plan
1209 presents projects in the following four categories:

- 1210 I. Water right acquisition offset projects and non-acquisition water offset projects that
1211 are ready to proceed. These projects provide a quantitative streamflow benefit.
- 1212 II. Projects that provide habitat and streamflow benefits, but streamflow benefits are
1213 difficult to quantify.
- 1214 III. Projects that primarily benefit habitat.
- 1215 IV. Projects that currently are not implementable (e.g., legal restriction) or are highly
1216 conceptual.

1217 Projects in Category I are presented in this chapter. All other projects are presented in the
1218 project inventory in Appendix H. The WRIA 15 Committee recommends implementation of
1219 projects in this chapter as well as in Appendix I in order to meet the offset need and NEB for
1220 WRIA 15. Many of the projects in this plan are conceptual, as Committee members and
1221 partners brought the ideas forward during the planning process. The Committee recognizes
1222 that once these projects are further developed, some may no longer be feasible. Through the
1223 adaptive management process recommended in Chapter 6, an implementation group and
1224 project sponsors may need to find alternative projects that provide the same types of benefits
1225 in the same locations as the projects identified in this Chapter and the project inventory.

Commented [VMSJ(28): Suggestion to add this language, to make it clear that we know that many of the projects are conceptual, but opens up opportunity for similar projects to come forward for funding and to meet NEB. To we want to go further to state that we support these types of projects coming forward?

5.2 Category I Projects

The WRIA 15 Committee set a goal of meeting the offset target by subbasin. The projects presented below have quantifiable streamflow benefit and the Committee identified these projects as having the greatest potential for implementation and achieving the required offset need. It is recognized that some of these project benefits may span across subbasins, but detailed modeling of streamflow benefits was not completed during this planning process. Detailed descriptions of each of the projects presented in Section 5.2. are available in Appendix I. A summary of projects and offset benefits by subbasin are presented at the end of this section in Tables 16-22.

COMMENT: PLEASE NOTE THAT WE ARE WORKING ON ADDITIONAL PROJECT IDEAS FOR SOUTH SOUND AND SOUTH HOOD CANAL SUBBASIN. WE WILL DISTRIBUTE INFORMATION ON PROJECTS SEPARATELY TO THE COMMITTEE IN DECEMBER.

5.2.1 Managed Aquifer Recharge Package

Managed Aquifer Recharge (MAR) projects are being considered in WRIA 15 as a method to increase infiltration to aquifers to improve streamflow and to offset the water use from future permit exempt (PE) wells in the watershed. A detailed description of the project is available in Appendix I.

There are different types of MAR projects.²⁹ Aquifer Storage and Recovery (ASR) projects are a type of MAR project that actively inject water into aquifers for storage and recovery through pumping later. Passive MAR projects infiltrate water into shallow aquifers, with the intent that water discharges from the shallow aquifer into streams on a delayed basis and improves streamflow during low-flow periods (see Figure 6). For WRIA 15, only passive MAR projects are being considered. The source of water for the passive MAR projects in WRIA 15 may be recycled water (highly treated wastewater), stormwater, or diverted surface water.

Commented [AP29]: Suquamish Tribe: Need to be consistent with project categories in table, text and definitions.

Commented [VMSJ(30R29)]: Has this been addressed?

Commented [VMSJ(31)]: Outstanding Comment: for each project, add description on climate resiliency.

Commented [VMSJ(32R31)]: I believe this was addressed with the general statement supporting projects that address climate resiliency

Commented [VMSJ(33)]: Below is an example of how to present the “packages” of projects. Seeking feedback.

Commented [VMSJ(34)]: Placeholder graphic. Working with John to get new one.

²⁹ More information on these project types is available from Ecology: <https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-recovery-solutions/Aquifer-storage-recovery-recharge>

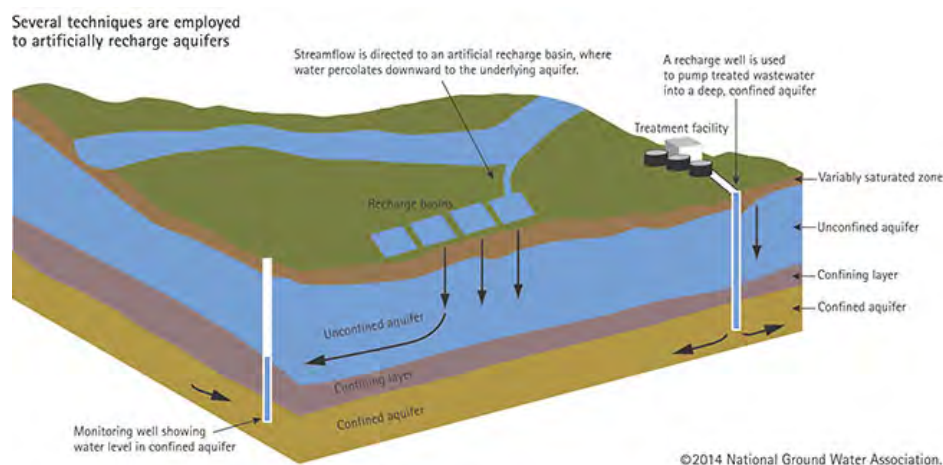


Figure 6. Place holder for MAR diagram.

The planning, implementation and operations and maintenance of MAR projects is complex, leading to uncertainty as to their potential use as water offset projects and inclusion in the watershed plan. This watershed plan addresses uncertainty by including a portfolio of MAR projects that have different locations, project sponsors, water sources, and size. Uncertainty is also addressed by qualitatively assessing the potential for implementation on a high, medium, and low basis and then assigning a probability to the potential offset from each project. The overall potential for MAR in WRIA 15 is the sum of the potential offsets multiplied by their probability. MAR projects in WRIA 15 have been identified through different sources and are estimated to have a total potential water offset of 1,424 AF/yr. The overall potential, accounting for likelihood of implementation, is estimated to be 578 AF/yr. Considering MAR projects that can be implemented within the next 10 years, the estimated potential offset is 520 AF/yr. The remaining MAR projects would likely take longer than 10 years to implement. Table 12 provides a summary of the MAR projects identified in WRIA 15 and Table 13 a summary of water offsets adjusted by probability of implementation. More detailed descriptions of the projects are available in Appendix I. A description of the work required to implement a MAR project is provided in the detailed project descriptions.

Table 12. Managed Aquifer Recharge Package

Subbasin	MAR Project Name (sponsor, if identified)	Potential Offset (AF/yr)	Estimated Timeframe for Implementation	Relative Certainty of Implementation (High, Medium, Low)
West Sound	Kingston Treatment Plant Recycled Water (Kitsap County)	328	5 years	High

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Subbasin	MAR Project Name (sponsor, if identified)	Potential Offset (AF/yr)	Estimated Timeframe for Implementation	Relative Certainty of Implementation (High, Medium, Low)
	Grovers Creek MAR	20 ¹	>10 years	Low
	Central Kitsap Treatment Plant ² (Silverdale Water District)	167	5 years	Medium
North Hood Canal	Central Kitsap Treatment Plant, includes Asbury Parcel ² (Silverdale Water District)	333	5 years	Medium
South Hood Canal	Tahuya River MAR	200	5-10 years	Low
Bainbridge Island	M & E Farms Storage, MAR	17	5-10 years	Medium
	Johnson Farms Storage, MAR	90	>10 years	Low
	Miller Rd MAR	19	>10 years	Low
South Sound	Port Orchard Airport MAR	100	>10 years	Low
	Belfair WWTP MAR	70	>10 years	Low
	Coulter Creek Heritage Park MAR (may be multiple projects)	20 ¹	>10 years	Low
	Minter Creek MAR	20 ¹	>10 years	Low
	Rocky Creek between Wye and Koeneman Lakes MAR	20 ¹	>10 years	Low
Vashon – Maury Island	Judd Creek MAR	20 ¹	>10 years	Low
South Sound Islands	-	-	-	-
Totals		328		High Relative Certainty
		517		Medium Relative Certainty
		579		Low Relative Certainty

1271

1272 Table 13. Water Offsets from MAR Package

Relative Certainty of Implementation (High, Medium, Low)	Total Estimated Offset (acre-feet/year)	Probability	Adjusted Offset (acre-feet/year)
High Relative Certainty	328	80%	262
Medium Relative Certainty	517	50%	258
Low Relative Certainty	579	10%	58
Totals			578

1273

1274 5.2.2 Community Forest Package

1275 Community Forest projects entail the acquisition of forest lands or change in forest
 1276 management practices to preserve stands or emphasize a longer harvest interval. Preserving or
 1277 maintaining forests with stand ages more than 40 years can increase dry-season low flows.

1278 To meet the consumptive use offset for the entire WRIA, Community Forest of about 5,500 to
 1279 8,700 acres would need to be acquired or managed to emphasize a longer harvest interval.
 1280 Since there are other projects that will provide water offsets, that area of community forest is
 1281 not required for the plan. Table 14 presents the acreage of potential community forest projects
 1282 identified by sponsors by subbasin, as well as a target acreage in each subbasin that will provide
 1283 water offsets to help meet the Watershed Plan goal of offsetting future consumptive use within
 1284 each subbasin. The total target acreage is 1,723 acres, which will provide an estimated 241
 1285 acre-feet of water offset. More detailed descriptions of the projects are available in Appendix I.
 1286 The projects identified by sponsors need further confirmation to determine whether the
 1287 projects would meet the criteria of having forest stands greater than 40 years old and subject
 1288 to harvest.

1289

1290 Table 14. Package of Community Forest Type Projects in WRIA 15

Subbasin	Project Name (Sponsor, if known)	Acreage	Potential Streamflow Restoration Increase (Acre-feet/year)
Bainbridge Island	Springbrook Creek Protection and Restoration (Bainbridge Island Land Trust)	22.85	3.2
North Hood Canal	Community Forest Projects, including: - Crabapple Creek Habitat Acquisition and Restoration - Little Anderson Creek Habitat Protection - Divide Block Habitat Acquisition and Restoration	Approx. 2100 acres has been identified as potential projects by sponsors, target for Community	70

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Subbasin	Project Name (Sponsor, if known)	Acreage	Potential Streamflow Restoration Increase (Acre-feet/year)
	- West Port Gamble Block Habitat Protection - Port Gamble Heritage Park Timber Rights Acquisition - Gamble Creek Parcel - Boyce Anderson DNR Parcel - Seabeck DNR Parcel - Grovers Creek Mainstem protection and restoration (Sponsors may be Great Peninsula Conservancy and Port Gamble S'Klallam Tribe)	Forest in this subbasin is 500 acres	
South Hood Canal	Community Forest Projects, including: - Bear Creek Protection - Tahuya Headwaters (Sponsors may be Great Peninsula Conservancy and others)	Target is 500 acres in South Hood Canal Subbasin	70
South Sound	Community Forest Projects, including: - Rocky Creek Preserve - Coulter Creek Overton Lands - Key Peninsula Forest Lands (Sponsors may be Great Peninsula Conservancy and others)	Target is 500 acres in South Sound Subbasin	70
Vashon Maury	Community Forest Projects, including: - Judd Creek Headwaters - Shinglemill Creek Headwaters - Mileta Creek Headwaters - Christiansen Creek Headwaters - Fisher Creek Headwaters - Tahlequah Creek Headwaters (Sponsors may be Vashon-Maury Island Land Trust or King County)	Target is 100 acres in Vashon Maury Subbasin	14
West Sound	Community Forest Projects, including: - East Branch Ostrich Bay Creek along Skylark Drive W. - Strawberry and L. Anderson Creek Parcel (Sponsors may be Great Peninsula Conservancy and others)	Target is 50 acres in West Sound Subbasin	7
South Sound Islands	Anderson Island Community Forest Projects - Near Idie Ulsh Park (40 acres total) - Near Saint Anne's Park (6.68 acres)	Target is 50 acres in South Sound Islands Subbasin	7

Subbasin	Project Name (Sponsor, if known)	Acreage	Potential Streamflow Restoration Increase (Acre-feet/year)
	Other areas (Sponsors may include Anderson Island Parks District, Great Peninsula Conservancy, Nisqually Land Trust)		
Totals		Overall Target is 1,723 acres	241

1291

1292 5.2.3 Rain Garden and Low Impact Development Package

Commented [VMSJ(35)]: This description needs updating.

1293 This project entails installing Rain Garden and Low Impact Development (LID) projects at
 1294 existing homes and driveways, roadways, parking lots and other impervious areas that generate
 1295 stormwater. A detailed project description is available in Appendix I. The projects would focus
 1296 on critical WRIA 15 stream basins in which permit exempt well (PEW) numbers are projected to
 1297 be high. The techniques include rain gardens and other low impact development practices such
 1298 as bio-infiltration swales, permeable pavement, and reductions in the footprint of roadways
 1299 and replacement with permeable surfaces.

1300 Kitsap Conservation District (KCD) has a Rain Garden and Low Impact Development (LID)
 1301 Program that works cooperatively with county services, landowners, and local communities to
 1302 expand knowledge and use of LID practices throughout Kitsap County. Since 2010, the KCD Rain
 1303 Garden and LID cost-share program has helped landowners fund and install 320 rain gardens.
 1304 Pierce Conservation District (PCD) and Mason Conservation District (MCD) have similar
 1305 programs but do not implement as many projects per year as KCD.

1306 KCD can implement 50 projects a year with existing staff resources provided funding for the
 1307 program is obtained. The capacity of PCD and MCD is less, but with funding is assumed to be 25
 1308 per year per district. The total number of projects that can be implemented per year would be
 1309 100, if sufficient funding is available. The average offset will vary with precipitation, soils and
 1310 other factors but is likely about 0.10 acre-foot per residential rain garden. Other LID practices
 1311 can infiltrate more water, depending on the impervious surface treated.

1312 Table 15 presents a recommended target and distribution of rain garden projects per year and
 1313 potential range of water offsets over the life of the plan (18 years).

1314

1315 Table 15. [Placeholder] Target Number of Raingarden and LID Projects

Subbasin	Number of Projects over 18 years	Estimated Total Water Offset, acre-feet per year
North Hood Canal	180	18
West Sound	360	36
Bainbridge Island	90	9
South Sound	720	72

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Subbasin	Number of Projects over 18 years	Estimated Total Water Offset, acre-feet per year
South Hood Canal	450	45
Totals	1,800	180

Commented [VMSJ(36): We are still working on calculations, this is a placeholder but do note the reduction in potential benefit.

5.2.4 Vashon-Maury Island Water Right Acquisition Package

This project is the acquisition (fee and conservation easements) of sensitive habitats and water rights in the Vashon-Maury Island sub-basin with the intent of enhancing instream flows and mitigating out of stream uses (i.e., reductions in flows associated with permit-exempt wells). Assuming property acquisition is coupled with water right acquisition, associated habitat benefits could include removal of structures and impervious surfaces, wetland and riparian protection and restoration, and decommissioning permit exempt wells. A description of this project is included in Appendix I.

The range of potential offset benefit from the water right acquisition opportunities on Vashon Maury is approximately 56 to 279 AF/yr. The Committee accounts for 10 percent of the total potential available water rights as the offset benefit, or 27.9 AF/yr (10 percent was applied for the water right acquisition opportunities in the Nisqually plan).

5.2.5 Beall Creek Flow Improvement

The Beall Creek project is located on Vashon Island, in the Vashon-Maury Island Subbasin. The outcome of this project will a more accurate measurement of the Water District 19 water requirements at their diversion on Beall Creek. This project will improve bypass flow at the diversion, resulting in flow improvements to Beall Creek at a rate of an estimated 26 AF/yr. A more detailed project description is provided in Appendix I.

5.2.6 Bainbridge Island Water Right Acquisitions

This project is the acquisition of two water rights on Bainbridge Island. The water rights identified as targets for acquisition total 75 acre-feet. This watershed plan accounts for 10 percent of the total potentially available water rights as the offset benefit, or 7.5 AF/yr. This watershed plan does not present the details of the potential water rights in order to protect the privacy of the water right holders.

1341 Table 16. West Sound Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	Kingston Treatment Plant Recycled Water	Use recycled water for irrigation on a golf course and infiltrate groundwater to improve streamflow. Benefits Grovers Creek.	262.4	Kitsap County/Suquamish Tribe	\$13.65M	Funding and agreement on O&M needed.
	Central Kitsap Water Treatment Plant	Use recycled water to infiltrate near Newberry Road. Could benefit West Sound and North Hood Canal subbasins. Possible benefits to Johnson, Wildcat, and Chico creeks.	83.5	Silverdale Water District		Funding needed and Water Quality issues need resolution.
	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	36	Kitsap Conservation District		Ready to proceed; some additional funding may be necessary.
	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 50 acres.	7	Great Peninsula Conservancy and others		Funding needed.

Commented [VMSJ(37): Is this detail sufficient for committee? How much info desired for readiness to proceed? Need to add in additional information on project costs.

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Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
WRIA 15 Total Water Offset for West Sound Subbasin			388.9			
WRIA 15 Consumptive Use Estimate for West Sound Subbasin			183.9			

1344

1345 Table 17. Bainbridge Island Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	M&E Farms Storage	MAR, will benefit Manzanita Creek	9	Friends of the Farm	\$270,000	Funding needed.
	Miller Road	MAR, will benefit Manzanita Creek	10	City of Bainbridge Island	\$270,000	Funding needed.
	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	9	Kitsap Conservation District		Ready to proceed; some additional funding may be needed.
	Water Rights	Acquire water rights	60	Washington Water Trust		Further analysis and water right holder agreement needed.
	Community Forest Package	Acquire forest lands to preserve stands. 22.85 acres identified.	3.2	Bainbridge Island Land Trust		Funding needed.

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Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
WRIA 15 Total Water Offset for Bainbridge Island Subbasin			91.2			
WRIA 15 Consumptive Use Estimate for Bainbridge Island Subbasin			67.6			

1346

1347 Table 18. North Hood Canal Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 500 acres.	70	Great Peninsula Conservancy, Jamestown S’Klallam Tribe and others		Funding needed.
	Central Kitsap Water Treatment Plant	Use recycled water to infiltrate near Newberry Road. Could benefit West Sound and North Hood Canal subbasins. Possible benefits to Little Anderson, Anderson and Big Beef creeks.	167	Silverdale Water District		Funding needed and Water Quality issues need resolution.
	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	36	Kitsap Conservation District		Ready to proceed; some additional funding may be necessary.
WRIA 15 Total Water Offset for North Hood Canal Subbasin			273			

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Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
WRIA 15 Consumptive Use Estimate for North Hood Canal Subbasin			90.3			

1348

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1349 Table 19. South Hood Canal Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	36	Mason Conservation District		Ready to proceed; some additional funding may be necessary.
	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 500 acres.	70	Great Peninsula Conservancy and others		Funding Needed.
	Tahuya River MAR	MAR, will benefit Tayuha River	20			Conceptual.
WRIA 15 Total Water Offset for South Hood Canal Subbasin			126			
WRIA 15 Consumptive Use Estimate for South Hood Canal Subbasin			155.0			

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1350 Table 20. Vashon Maury Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	Beall Creek	Water management to improve streamflow in Beall Creek	26	Water District 19		Funding needed.
	Judd Creek MAR	MAR, could benefit Judd Creek and other streams	2			Conceptual
	Water Right Acquisition Package	Acquire property and water rights, could benefit multiple streams	28	Vashon Maury Island Land Trust, King County, others		Funding needed
WRIA 15 Total Water Offset for Vashon Maury Subbasin			56			
WRIA 15 Consumptive Use Estimate for Vashon Maury Subbasin			50.7			

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1351 Table 21. South Sound Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	MAR Package including • Port Orchard Airport MAR • Belfair WWTP MAR • Coulter Creek Heritage Park MAR (may be multiple projects) • Minter Creek MAR • Rocky Creek between Wye and Koeneman Lakes MAR	MAR, could benefit multiple streams	23			Conceptual
	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a	70	Great Peninsula		Funding needed.

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Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
		longer harvest interval. Target is 500 acres.		Conservancy and others		
	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	36	Kitsap Conservation District, Pierce Conservation District		Ready to proceed; some additional funding may be necessary.
WRIA 15 Total Water Offset for South Sound Subbasin			129			
WRIA 15 Consumptive Use Estimate for South Sound Subbasin			213.8			

1352

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1353 Table 22. South Sound Islands Subbasin Category I Projects.

Project Number/ Priority?	Project Name	Project Type and Description	Estimated Water Offset AF/yr	Project Sponsor	Estimated Project Cost	Readiness to Proceed
	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 50 acres.	7	Nisqually Land Trust, Great Peninsula Conservancy and others		Funding needed.
WRIA 15 Total Water Offset for South Sound Islands Subbasin			7			
WRIA 15 Consumptive Use Estimate for South Sound Islands Subbasin			5.2			

1354

5.3 Category II-IV Projects

The WRIA 15 watershed plan includes an inventory of additional projects to meet the offset needs and NEB for the watershed. The remaining categories include the following:

- II. Projects that provide habitat and streamflow benefits, but streamflow benefits are difficult to quantify.
- III. Projects that primarily benefit habitat.
- IV. Projects that currently are not implementable (e.g., legal restriction) or are highly conceptual.

The projects include habitat restoration and protection, stream augmentation, riparian restoration, reclaimed water expansion, storage, and other project types. The projects are presented in the project inventory in Appendix H.

Table 23 provides a summary of the number of projects per category by subbasin and estimated quantitative benefits provided by projects by subbasin.

Table 23. Summary of habitat benefits from Category II-IV projects. Does not include habitat benefits of Category I projects.

Subbasin	Number of Category II-IV Projects	Contains Projects with Anticipated Streamflow Benefits	Anticipated Stream Feet Restored ¹	Anticipated Riparian Miles Restored ¹	Anticipated Acreage Protected ¹	Anticipated Acreage Restored ¹
Bainbridge Island	3	Yes	-	-	-	Yes
North Hood Canal	5	Yes	1600	-	Yes	10+
South Hood Canal	3	Yes	-	3	-	-
South Sound	27	Yes	-	9	Yes	Yes
South Sound Islands	2	No	Yes	Yes	No	Yes
Vashon Maury	4	Yes	-	-	-	-
West Sound	22	Yes	2832	Yes	106.5	141

Commented [VMSJ(38):

Insert summary of the anticipated benefits from the remaining projects as well as summary tables by subbasin. Example here for review and input.

Commented [VMSJ(39): This is an example table. Stacy work on after okay'd by committee

¹ Many projects are conceptual or do not currently have quantified habitat benefits. These columns include the sum of information provided or “yes” if benefits anticipated from projects. Anticipated to be underestimate.

5.2.3 Prospective Projects and Actions

In addition to the projects described in this chapter and the project inventory in Appendix H, the WRIA 15 Committee supports future projects and actions in the following categories:

Climate Adaptation and Resiliency. The WRIA 15 Committee recognizes the potential impacts of climate change on streamflow. The WRIA 15 Committee recommends that projects and actions themselves are resilient to the impacts of climate change and that projects include components that help improve the resiliency of our stream systems.³⁰

Water Right Acquisitions. The WRIA 15 Committee supports the full and partial acquisition of water rights to increase streamflows and offset the impacts of PE wells. Water rights should be permanently and legally held by Ecology in the Trust Water Rights Program to ensure that the benefits to instream resources are permanent. The WRIA 15 Committee acknowledges that all water right transactions rely on willing sellers and willing buyers. The WRIA 15 Committee recognizes the importance of water availability for producers and the limited available water supply.

Land Acquisitions and Conservation Easements. The WRIA 15 Committee supports acquisitions and conservation easements of land to increase streamflows and offset the impacts of PE wells. The WRIA 15 Committee recommends focusing acquisitions and easements in areas with wetlands and headwaters, for the purposes of preventing new permit exempt wells, decommissioning old permit exempt wells, and for extending time between harvest of timber.

Managed Aquifer Recharge and Other Storage Projects. The WRIA 15 Committee supports projects such as managed aquifer recharge that re-time flood-level flows to provide streamflow benefits during low-flow periods. The WRIA 15 Committee encourages storage projects in the headwaters or high in the system, as well as those that provide multiple benefits (e.g., flood reduction, habitat benefits). See section 5.2.1 above on more information regarding MAR projects.

Commented [VMSJ(40): Committee asked for more details and diagram. Included in project description above.

³⁰ For more information, see Beechie et al, 2012. Restoring Salmon Habitat for a Changing Climate. River Restoration and Application. 29: 939-960.

For more information, see Puget Sound Partnership, Adaptation International, and EcoAdapt, 2017. Planning for the Effects of Climate Change on Protection and Restoration Projects. Available at : <https://www.psp.wa.gov/salmon-recovery-overview.php> (Accessed December 2020).

5.3 Project Implementation Summary

5.3.1 Summary of Projects and Benefits

As specified in Chapter 4, this watershed plan estimates 766.4 AF/yr of new consumptive use from new PE wells over the planning horizon. The projects included in Tables in section 5.1 provide an estimated offset of XX AF/yr and exceed the offset need.

A total of xx projects with quantified streamflow benefit, unquantified streamflow benefit, and habitat improvement, have been identified by the Committee and are included in Chapter 5.1 Appendix H and I. The ecological and streamflow benefits from habitat projects are supplemental to the quantified water offsets required by RCW.90.94.030.

5.3.2 Cost Estimate for offsetting new domestic water use over 20 Year Planning Horizon

Per RCW 90.94.030(3)(d), this watershed plan must include an evaluation or estimation of the cost of offsetting new domestic water uses over the subsequent twenty years. To satisfy this requirement, the technical consultants developed planning-level cost estimates for each of the water offset projects listed in Section 5.1. The technical consultants also included costs estimates for project inventory when that information was readily available.

The estimated cost for implementing individual water offset projects range from XXX for YYY project to AAA for BBB project. The total estimated cost for implementing the water offset projects listed and described in this chapter is \$XXXX. Assuming xx AF/yr of water offset is achieved through implementation of these projects, the average cost per AF/yr \$XXX.

The estimated cost for implementing individual habitat projects range from XXX for YYY project to AAA for BBB project. The total estimated cost for implementing the habitat projects listed and described in this chapter is \$XXX. No metric has been established by the Committee to derive a relative cost for implementing habitat projects.

5.3.3 Certainty of Implementation

The watershed plan also provides adaptive management recommendations (see Chapter 6) to increase reasonable assurance that the projects and actions in the plan will be implemented.

Commented [VMSJ(41)]: This section needs to be completed once projects are finalized. Placeholder language pulled from WRIA 8.

Chapter 6. Additional Plan Recommendations

6.1 Policy and Regulatory Recommendations

The Streamflow Restoration law lists optional elements Committees may consider including in the plan to manage water resources for the WRIA or a portion of the WRIA (RCW 90.94.030(3)(f)). The WRIA 15 Committee included “policy and regulatory recommendations” in the watershed plan to show support for programs, policies, and regulatory actions that would contribute to the goals of this watershed plan, including streamflow restoration and meeting NEB. All projects the WRIA 15 Committee intended to count toward the required consumptive use offset or NEB are included in Chapter 5 and Appendix H: Project Inventory.³¹ When similar concepts arose from multiple Watershed Restoration and Enhancement Committees, the WRIA 15 Committee coordinated with those other Committees to put forward common language for inclusion in the watershed plans, when appropriate. Coordination also occurred for jurisdictions that cross multiple watersheds.

As required by the NEB Guidance, the WRIA 15 Committee prepared the 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” (Ecology 2019a). The identification and listing of these policy and regulatory recommendations is directly from the WRIA 15 Committee members and is not endorsed or opposed by Ecology.

The WRIA 15 Committee initially identified a list of potential recommendations based on proposals brought forward by members of the Committee. After iterative rounds of discussion and feedback during Committee meetings, in one on one conversations, and using a survey tool, the Committee narrowed the recommendations to those presented below. Unless otherwise specified, the proposed implementing entity is not obligated by this plan to implement the recommendation; however, the WRIA 15 Committee requests consideration of each recommendation by the identified implementing entity.

The WRIA 15 Committee provides the following recommendations. Please note that these are not listed in order of priority:

Commented [VMSJ(42)]: Open to suggestions to rename.

Commented [AP43]: Pierce County: Edit the language to state “policy and regulatory recommendations do not contribute to the calculated consumptive use estimate.” rather than stating the projects and actions are used to calculate the offset. While earlier text states that the policy recommendations “shows support” for streamflow restoration...what is the benefit of including these policy recommendations?

Commented [VMSJ(44R43)]: Attempted to address with edit above

³¹ “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

1. Track the number and location of permit-exempt wells

Proposed implementing entity: Department of Ecology

Recommendation: Change Department of Ecology's well tracking system in the following ways, in order to track the number and location of permit-exempt wells in use:

- Collect latitude and longitude of wells on well report forms;
- Identify permit-exempt wells on well log form; and
- Provide Well ID Tag numbers to older wells, and associate well decommissioning, replacement, or other well activities with the Well ID Tag.

Purpose: Accurate tracking of the locations and features of permit-exempt wells will support the WRIA 15 Committee's desire to engage in monitoring and adaptive management after plan adoption.

Funding source: If Ecology does not have capacity do this work with existing staffing and resources, the Committee recommends the legislature provide additional funding.

2. Monitoring and Research

Proposed implementing entity: Multiple agencies would likely be involved in monitoring. Ecology would coordinate the development of the strategy.

Recommendation: Develop a research and monitoring strategy for WRIA 15 that addresses the following:

- Streamflow monitoring
- Groundwater monitoring
- Precipitation and drought conditions
- Water usage and water supply data

Given the cost and effort involved in developing a comprehensive strategy, this effort may need to be phased and prioritized to address most urgent needs first.

Purpose: The WRIA 15 Committee desires comprehensive monitoring data on the overall health of the watershed, including status and trends.

Funding source: Funding is needed either through legislative appropriations, grants, pooling of resources by Committee members and other stakeholders, or other means.

3. Annual Report on Monitoring

Proposed implementing entity: Department of Ecology, with support from Kitsap Public Utility District, Squaxin Island Tribe, and any other jurisdictions collecting flow data under an approved Quality Assurance Project Plan.

Recommendation: Annually compile monitoring data on the status of water resources and water quality in the basin over the past year that has been collected by Ecology or provided by Partner jurisdictions. Partner jurisdictions are encouraged to provide relevant data to Ecology for inclusion. Monitoring of streamflows, groundwater, precipitation and drought conditions, water usage, and water supply could be included. This information should be provided to the WRIA 15 Committee or a new implementation group if established.

Purpose: This provides additional information on water resources that will provide context for addressing adaptive management.

Funding source: It is assumed this can be completed with existing resources.

4. Report on Additional Water Resource Information

Proposed implementing entity: Department of Ecology

Recommendation: By September of 2026, Ecology reports the following information with the support of the State Department of Health and local jurisdictions:

- Estimates of:
 - The total number of connections to PE wells currently in use, as described in RCW 90.94.030(3)(b).
 - The number domestic and municipal water rights in use and their current quantity of use, including estimates of inchoate water remaining in municipal water rights, and categorized by whether they are mitigated or not and which subbasin they are in, as described in RCW 90.94.030(3)(c).
 - The cumulative consumptive water use impacts on instream flows from all pre-2018 PE wells and unmitigated municipal water rights, as described in RCW 90.94.030(3)(d)(e).
- An evaluation of the costs of offsetting all new domestic water uses over the next 20 years, as described in RCW 90.94.030(3)(d). The initiation of adjudication would be considered an acceptable substitute for this study.

Purpose: This provides additional information on water resources that will provide context for addressing adaptive management.

Funding source: Grant funding or a legislative appropriation will be necessary to hire consultant assistance to Ecology for this effort.

5. South Sound Planning Study

Proposed implementing entity: State, local and tribal governments in WRIA 15

Recommendation: Prepare a study of how planning and permitting by Counties and local governments influences water management within WIRA 15, and potential opportunities to improve:

- 1) Water management outcomes that support aquatic habitat and human needs.
- 2) Efficiencies and potential cost savings. and
- 3) Information sharing among the various governmental entities.

The study should focus on how management can protect and enhance streamflows, groundwater recharge, and other water resource management efforts that support aquatic habitat and water supply.

Purpose: This study could identify opportunities for improved outcomes at potentially lower costs.

Funding source: Grant funding or a legislative appropriation will be necessary to hire consultants to complete this study.

6. Drought Response Planning

Proposed implementing entity: Local governments

Recommendation: Local governments develop and implement a drought response plan if they do not already have one. Local governments review existing drought response plans for potential updates.

- Ecology and Department of Health provide technical assistance.
- The plans should include an education and outreach program to educate and notify the public about water conservation and drought water use limitations and practices.

Purpose: Drought response will be an important component of protecting streamflows. Clear plans and education by all local governments will better prepare the watershed for droughts.

Funding source: Grant funding or other funding may be needed by some local governments.

7. Recycled Water

Proposed implementing entity: Washington State Legislature and/or Department of Ecology

Recommendation: Enact state policies that encourage the development and use of reclaimed water.

Purpose: Using reclaimed water will:

- Offset water that would otherwise be diverted from rivers and streams, thus preserving natural high-quality instream flow;
- Reduce the amount of treated wastewater that is discharged into receiving water bodies; and
- Create water supply options, which makes the water supply system more resilient against drought and climate change.

Funding source: Funding is needed either through legislative appropriations, grants, pooling of resources by Committee members and other stakeholders, or other means. Individual projects and construction components will have to be funded with a market-based approach.

8. Water Conservation Education

Proposed implementing entity: Ecology and counties; with support from conservation districts and non-governmental organizations.

Recommendation: Ecology should partner with counties and conservation districts to develop and implement outreach and incentives programs that encourage rural landowners with 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 PE well water usage has on (1) groundwater levels and (2) the connection to streams and rivers. Supplement water offset and restoration projects.

Funding source: Funding is needed either through legislative appropriations, grants, pooling of resources by Committee members and other stakeholders, or other means.

9. Water Conservation Statewide Policy

Proposed implementing entity: Ecology and/or local governments

Recommendation: Implement mandatory water conservation measures in unincorporated areas of the state during drought events. Measures would focus on limiting outdoor water use, with exemptions for growing food.

Purpose: Reduce water usage in key sub-basins, especially during drought; reduce impacts on stream flows; and increase climate change resilience.

Funding source: Funding is needed either through legislative appropriations, grants, pooling of resources by Committee members and other stakeholders, or other means.

10. Beaver Habitat and Streamflow

Proposed implementing entity: Varies; see details below.

Recommendation: The Committee recommends three elements:

1. **Map and protect likely beaver habitat:** The Committee recommends a pilot project with Kitsap County and Great Peninsula Conservancy to identify potential easements to purchase and protect as beaver habitat. The Committee recommends combining mapping and modeling to understand both the water holding potential and beaver habitat suitability of selected areas. The Committee recognizes that easements would be purchased on a voluntary basis and that certain areas of the WRIA need to be protected for drinking water.
2. **Education & outreach:** The Committee recommends a partnership between local organizations to develop and implement an education and outreach program to landowners regarding beavers and beaver management. The partners could also reach out to entities to

1601 address known concerns (e.g., tree loss, hazard trees, encroaching on farmland, change of
1602 vegetation, flooding) associated with beavers and discuss management options.
1603 3. **Monitoring & research:** The Committee recommends developing a monitoring program for
1604 beaver habitats which may including collecting information on fish passage, groundwater
1605 levels, vegetation types, permits, BDA vs natural beaver habitat. Streamflow and habitat
1606 benefits should be quantified where possible to help define the benefit from a surface
1607 water / habitat perspective (e.g., temperature, streamflows, salmon, riparian vegetation,
1608 etc.). Implementing entities could include local jurisdictions, Tribes, federal or state
1609 agencies.

1610 **Purpose:** Beaver habitat can provide benefits to streamflows. A multi-faceted approach would
1611 provide additional tools for jurisdictions and landowners to help manage beavers.

1612 **Funding source:** Funding is needed either through legislative appropriations, grants, pooling of
1613 resources by Committee members and other stakeholders, or other means.

1614 11. Financing

1615 **Proposed implementing entity:** Legislature and/or Committee Members or other stakeholders

1616 **Recommendation:** The WRIA 15 Committee recommends the Legislature provides funding for
1617 plan implementation, monitoring and adaptive management of the plan, including:

- 1618 • Annual tracking of new PE wells and project implementation by subbasin.
- 1619 • Staffing for the ongoing Committee.
- 1620 • Ongoing Committee member participation; and
- 1621 • Developing a process to adaptively manage implementation if NEB is not being met as
1622 envisioned by the watershed plan (e.g., identification and development of alternative
1623 projects, etc.).

1624 If necessary, the Committee may also recommend additional funding, including grants, fees,
1625 shared contributions from members and other stakeholders, and other sources that may
1626 emerge.

1627 **Purpose:** Plan implementation is key to success and it will take ongoing funding.

1628 **Funding source:** Legislature or others.

1629 6.2 Adaptive Management Recommendations

1630 The WRIA 15 Committee recommends an adaptive management process for implementation of
1631 the WRIA 15 watershed plan. Adaptive Management is defined in the Final NEB Guidance as
1632 *“an interactive and systematic decision-making process that aims to reduce uncertainty over
1633 time and help meet project, action, and plan performance goals by learning from the
1634 implementation and outcomes of projects and actions”* (Ecology, 2019b).

1635 Adaptive management will:

- 1636 • Help address uncertainty.
- 1637 • Ensure that the goals of this plan are being met.
- 1638 • Provide more reasonable assurance for plan implementation.
- 1639 • Provide information to improve implementation of streamflow restoration projects
- 1640 and actions.
- 1641 • Track implementation costs and developing grant funding opportunities; and
- 1642 • Adaptively manage emerging plan implementation needs.

1643 To support implementation of the watershed plan, RCW 90.94 includes a statement on the
1644 Legislature's intent. RCW 90.94 Intent—2018 c 1: "The legislature intends to appropriate three
1645 hundred million dollars for projects to achieve the goals of this act until June 30, 2033. The
1646 department of ecology is directed to implement a program to restore and enhance streamflows
1647 by fulfilling obligations under this act to develop and implement plans to restore streamflows to
1648 levels necessary to support robust, healthy, and sustainable salmon populations." [2018 c 1 §
1649 304.]"

Commented [VMSJ(45): This section of the law included at the request of Skokomish Tribe, with support from the committee. Included in AM section as opposed to introduction. Please let me know if appropriate.

1650 1. Project, Policy, and Permit-Exempt Well Tracking

1651 The WRIA 15 Committee recommends tracking the growth of permit-exempt (PE) wells in the
1652 watershed as well as the projects and policies that were planned to offset the impacts of these
1653 PE wells. This data will allow the Committee to determine whether planning assumptions were
1654 accurate and whether adjustments to plan implementation are needed.

- 1655 A. The WRIA 15 Committee recommends tracking the following information on an ongoing
1656 basis:
- 1657 • New building permits issued that include permit-exempt wells.
 - 1658 • Status of implementation for each project included in the plan.
 - 1659 • Status of policy recommendations included in the plan.
 - 1660 • An ongoing list of new PE wells in the WRIA since the enactment of RCW 90.94.
 - 1661 ○ The lists of building permits and projects will be organized by subbasin, and if
 - 1662 feasible represented on a map that includes subbasin delineations. Counties
 - 1663 are encouraged to provide parcel or other geographic information in their
 - 1664 reports to Ecology to support mapping by subbasin.
- 1665
- 1666 B. To assess the status of project implementation, the Committee recommends using the
- 1667 Salmon Recovery Portal (<https://srp.rco.wa.gov/about>), managed by the Washington
- 1668 State Recreation and Conservation Office (RCO), to support project tracking.
- 1669 • The Washington Department of Fish & Wildlife (WDFW), in collaboration with
 - 1670 the Washington Department of Ecology and RCO, will coordinate the
 - 1671 implementation of project tracking through the Salmon Recovery Portal.
 - 1672 • Project sponsors are expected to support project tracking efforts and data
 - 1673 sharing.

- Local salmon recovery Lead Entity Coordinators will not be expected to provide ongoing support for project entry, maintenance, or reporting. To improve harmonization of streamflow restoration with ongoing salmon recovery efforts, local salmon recovery Lead Entity Coordinators will be consulted prior to initial data uploads.
- University of Washington data stewards, contracted by WDFW, will conduct data entry, quality assurance, and quality control. If this approach changes, WDFW will propose an alternative method for completing this task.
- Entities with representation in the WRIA 15 Committee (or an implementation group, if created) are encouraged to assist as needed with coordination, data gathering and input, and tracking.

Table 24 summarizes the entities responsible for implementing the tracking and monitoring recommendation and associated funding needs.

Table 24. Implementation of Tracking and Monitoring Recommendation

Action	Entity or Entities Responsible	Funding Considerations
Track building permits issued with PE wells.	Ecology (via reporting from counties and cities).	The number of building permits and associated fees are transmitted to Ecology annually. No additional funding is needed.
Maintain an ongoing list and map of new PE wells within each sub-basin.	Ecology	Information included with data on new PE wells, provided by local governments. No additional funding is needed.
Maintain a summary of the status of implementation for each project.	Ecology via the Salmon Recovery Portal, with support from WDFW, RCO, and project sponsors	WDFW may need additional funding to support maintaining the Salmon Recovery Portal.
Maintain a summary of the status of each policy recommendation.		

Commented [VMSJ(46)]: Look for suggestions to fill out the rest of the table.

2. Reporting and Adaptation

The Committee recommends that Ecology provides the data collected above to all entities represented on the Committee and other interested parties through annual reporting and a self-assessment as described below. These reports and assessments will help determine whether the plan's recommendations are being implemented and whether they are having the intended impacts.

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- A. The WRIA 15 Committee recommends annual reporting as follows:
- By September of each year, Ecology will prepare an annual report that includes:
 - o A list of total building permits issued in the prior calendar year along with the total number of associated new domestic PE wells, using the information provided to Ecology by the local jurisdictions.
 - o A brief description of the status of WRIA 15 projects and actions included in this plan (descriptions may be drawn from the Salmon Recovery Portal, if available).
 - If the project as implemented differs significantly from the original description and assumptions included in the plan, the annual report will also include an estimate of changes to the offset benefit.
 - o Other implementation actions to date, including any changes in approach since the last report and any challenges identified that may require adaptation in plan implementation.
 - o The lists of building permits and projects will be organized by subbasin, and if feasible represented on a map that includes subbasin delineations. Counties are encouraged to provide parcel or other geographic information in their reports to Ecology to support mapping by subbasin.
 - The first annual report should include an estimate of expenses necessary for plan implementation and associated funding options. Funding options could include:
 - o Local or state fees, including PE well fees
 - o Grants
 - o State funding
 - o Other options
 - Ecology will share the report with Committee members and other interested parties.
- B. The WRIA 15 Committee recommends preparing a self-assessment every five years as follows:
- By September of 2026, and every five years thereafter during the planning horizon period, Ecology will compile and report based on available information from previous reports and partners:
 - o All cumulative information required in the annual report.
 - o Estimated water offset quantities, consumptive use, and instream flow benefits, realized through implementation of projects and actions identified in this plan.
 - o A comparison of each item above to the original assumptions included in the plan and a summation of overall ecological benefit (i.e., greater than expected, less than expected, or about the same as expected).
- C. The WRIA 15 Committee believes a group of engaged stakeholders and tribal representatives are needed to continue collaboration on the implementation of this plan. The Committee recommends continuing to meet as needed, with participation from all interested WRIA 15 representatives.

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- Interested WRIA 15 Committee members, or a new implementation group if established, will convene annually via telephone to:
 - o Review and discuss the annual report.
 - o Share updates on project and policy implementation.
 - o Discuss or develop recommendations for revisions, additions, or deletions to planned projects or actions.
- Every five years interested WRIA 15 Committee members, or a new implementation group if established, will hold a series of meetings to conduct the self-assessment, which includes:
 - o Reviewing the five-year assessment report from Ecology.
 - o Developing recommendations to adapt projects and actions to meet NEB.
 - o Updating data and assumptions.
 - o Other items identified by Committee members.
- Additional meetings may be scheduled as needed.
- The Kitsap PUD has offered to play the role of coordinating an implementation group for WRIA 15. Kitsap PUD will use existing capacity as well as seek funding opportunities to support their role, Kitsap PUD will convene interested member entities of the WRIA 15 Committee to form the implementation group in the summer of 2021. This group will consider the following activities related to plan implementation:
 - o Redefining the WRIA 15 Committee, which could include a new name, charter, and supporting interlocal agreement.
 - o Identifying project development lead(s) and supporting project development;
 - o Identifying triggers for adaptive management and developing responses to emerging challenges;
 - o Coordinating monitoring and research;
 - o Coordinating reporting;
 - o Identifying funding mechanisms to provide capacity for the Committee members and facilitator; and
 - o Other tasks as needed.

Commented [VMSJ(47)]: New – based on discussion at 12/7 subgroup meeting

Table 25 summarizes the entities responsible for carrying out the reporting and adaptation recommendation and associated funding needs.

Table 25. Implementation of Reporting and Adaptation Recommendation

Action	Entity or Entities Responsible	Funding Considerations
Annual Reports	• Local jurisdictions provide building permit information to Ecology.	• Local jurisdictions are already required to provide building permit

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Action	Entity or Entities Responsible	Funding Considerations
	- Ecology compiles information on project status, drawn from the Salmon Recovery Portal. - Entities provide monitoring data to Ecology for inclusion in reports. - Ecology combines monitoring data from within the agency with data provided by other entities. - Ecology compiles information into a single report for distribution to the Committee and other interested parties.	- information to Ecology (no additional funding needed). - Ecology staff would compile reports using existing resources. - WDFW may need additional funds to manage the Salmon Recovery Portal.
Five-Year Self-Assessment:	- Local jurisdictions provide building permit information to Ecology. - Ecology compiles information on project status, drawn from the Salmon Recovery Portal. - Entities provide monitoring data to Ecology for inclusion in reports. - Ecology combines monitoring data from within the agency with data provided by other entities. - Ecology prepares estimates of the quantity of water, instream flow, and habitat benefits realized through implementation of projects and actions identified in this plan. - Ecology compiles information into a single report for distribution to Committee and other interested parties. - WRIA 15 Committee convenes to prepare adaptation recommendations on changes to planned projects or actions.	- Local jurisdictions are already required to provide building permit information to Ecology (no additional funding needed). - Ecology may need funding to complete the estimate of realized benefits. - State funding or staff support will be needed to reconvene a group to prepare recommendations. - Committee members who cannot participate in meetings using existing resources will need additional funding. - KPUD may need additional funding to support their role in convening the implementation group.

3. Funding

The WRIA 15 Committee recommends ongoing implementation oversight and a process to adaptively manage the plan as new information emerges. The Committee recommends the Legislature provides funding for monitoring and adaptively managing the plan, including:

- Annual tracking of new PE wells and project implementation by subbasin.

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- 1782 • Staffing for the ongoing Committee.
1783 • Ongoing Committee member participation; and
1784 • Developing a process to adaptively manage implementation if NEB is not being met as
1785 envisioned by the watershed plan (e.g., identification and development of alternative
1786 projects, etc.).

1787 Table 26 summarizes the entities responsible for carrying out this recommendation and
1788 associated funding needs.

1789

1790 Table 26. Summary of WRIA 15 Adaptive Management Funding Recommendation.

Action	Entity or Entities Responsible	Funding Considerations
Funding of Adaptive Management	Legislature	The legislature should provide funding and authorize plan implementation to adaptively manage implementation if NEB is not being met as envisioned by the watershed plan.

1791

6.3 Assurance of Plan implementation

WRIA 15 Committee members and participating entities strongly advocate for implementation of the watershed plan. Members of the Committee provided the following statements voluntarily:

[the list below is a series of place-holders for each entity to add text]

- Washington Department of Ecology
 - o Ecology follows NEB Guidance in reviewing the watershed plan and considering plan adoption.
 - o Ecology administers the streamflow restoration competitive grant program as authorized under RCW 90.94.060 and Chapter 173-566 WAC.
 - o Ecology considers watershed plan recommendations where Ecology is identified as the lead.
 - o Ecology reports to the legislature as required under RCW 90.94.050 in 2020 and 2027.
- Washington Department of Fish & Wildlife
- King County
- Kitsap County
- Mason County
- Pierce County
 - o Pierce County adopts this watershed plan by ordinance, formalizing our support of the plan contents.
 - o Watershed plan becomes one of the guiding project implementation plans for the Surface Water Improvement Plan (SWIP).
 - o Pierce County evaluates and prioritizes capital projects included in this plan for placement into the Capital Facilities Plan.
 - o Pierce County supports and participates in implementation activities as staff capacity allows, including:
 - Participating in annual implementation group meetings.
 - Coordination between meetings, including:
 - ❖ Supporting project development and seeking project opportunities;

Commented [VMSJ(48)]: DRAFT

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- 1823 ❖ Seeking and supporting funding opportunities to achieve
1824 implementation; and
- 1825 ❖ Tracking implementation and identifying areas for improvement.
- 1826 • City of Bainbridge Island
- 1827 • City of Bremerton
- 1828 • City of Gig Harbor
- 1829 • City of Port Orchard
- 1830 • Kitsap Building Association
- 1831 • Kitsap Conservation District
- 1832 • Kitsap Public Utility District
- 1833 • Great Peninsula Conservancy
- 1834 • Puyallup Tribe
- 1835 • Port Gamble S’Klallam Tribe
- 1836 • Skokomish Tribe
- 1837 • Suquamish Tribe
- 1838 • Squaxin Island Tribe
- 1839 o Participating in implementation group meetings
- 1840 o Support project development and seek project opportunities
- 1841 o Seek and support funding opportunities that support implementation
- 1842 o Monitor implementation and identify areas for improvement

Chapter Seven: Net Ecological Benefit Evaluation

7.1 Water Offsets

The WRIA 15 Committee projects that a total of 5,568 new PE wells will be installed within WRIA 15 during the planning horizon resulting in an estimated 766.4 AF/yr of new consumptive water use in WRIA 15. However, the Committee sought projects to offset at least 1,218 AF/yr, a conservative offset target that reflects use of the high growth projection combined with the 95 percent upper confidence limit of the average measured irrigated area with adjustments for parcels with no discernable irrigated acreage in aerial photos (results in an average irrigated area of 0.12 acres per well). This additional factor of safety ensures offsets are met and streams are benefited. Although there was not consensus around the higher number, the Committee agreed that reaching an offset target of 1218 AF/yr would be beneficial to streams.

The projects identified in this plan are consistent with the project type examples listed in the Final NEB Guidance: (a) water right acquisition offset projects; (b) non-acquisition water offset projects; and (c) habitat and other related projects (Ecology, 2019b). Chapter 5 presents projects in the following four categories:

- I. Water right acquisition offset projects and non-acquisition water offset projects that are ready to proceed. These projects provide a quantitative streamflow benefit.
- II. Projects that provide habitat and streamflow benefits, but streamflow benefits are difficult to quantify.
- III. Projects that primarily benefit habitat.
- IV. Projects that currently are not implementable (e.g., legal restriction) or are highly conceptual.

Projects in Category I are described in Chapter 5 and used to estimate a total water offset For WRIA 15. Projects in Categories II-IV are presented in the project inventory in Appendix H. The WRIA 15 Committee recommends implementation of projects in Chapter 5 as well as in Appendix H in order to meet the offset need and NEB for WRIA 15.

The WRIA 15 Committee projects a total water offset of 1071 AF/yr from Category I water offset projects (described in Chapter 5 and listed in Tables 16-22), a surplus offset of 304.7 AF/yr above the consumptive use estimate and 146.9 AF/yr below the higher offset target. [Through this comparison, the WRIA 15 Committee has determined that this plan succeeds in offsetting consumptive use impacts at the WRIA scale.]

Commented [VMSJ(49): DRAFT placeholder text. Will need further development once projects are finalized.

Commented [VMSJ(50): Is this an appropriate framing of the numbers for the NEB chapter?

Commented [VMSJ(51): We will revise these numbers and statements as project list is finalized. Is this the appropriate way to frame meeting the 1218 higher goal?

Commented [LDW52]: Assuming you find a few more projects to meet the 1218 number in order to meet the higher target.

1874 **Table x. Summary of WRIA 15 Water Offset Projects (Category I) included in NEB analysis**

Subbasin	Project Name	Project Short Description	Tributary Benefit	Estimated Offset Benefits (AF/YR)
West Sound	Kingston WTP Recycled Water	Use recycled water for irrigation on a golf course and infiltrate groundwater to improve streamflow.	Grovers Creek	262.4
West Sound	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 50 acres.	Varies	7
West Sound	Central Kitsap Water Treatment Plant Recycled Water	Use recycled water to infiltrate near Newberry Road. Could benefit West Sound and North Hood Canal subbasins.	Possible benefits to Johnson, Wildcat, and Chico creeks	83.5
West Sound	KCD Rain Gardens and LID Applications	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	Varies	36
North Hood Canal	Silverdale Water District Recycled Water (includes Asbury Parcel)	Use recycled water to infiltrate near Newberry Road. Could benefit West Sound and North Hood Canal subbasins.	Possible benefits to Little Anderson, Anderson, and Big Beef creeks.	167
North Hood Canal	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 500 acres.	Varies	70
North Hood Canal	KCD Rain Gardens and LID Applications	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces.	County-wide: Kitsap County	36

Commented [VMSJ(53): This table is pretty repetitive of Chapter 5. Do we want to just include a summary by subbasin?

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South Hood Canal	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	County-wide: Mason County	36
South Hood Canal	Tahuya River MAR	Managed Aquifer Recharge	Tahuya	20
South Hood Canal	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 500 acres.	Bear Creek and Others	70
Bainbridge Island	M & E Farms Storage	Managed Aquifer Recharge	Manzanita Creek	9
Bainbridge Island	Miller Rd	Managed Aquifer Recharge	Manzanita Creek	10
Bainbridge Island	Water Right Acquisition Package	Acquire water rights	Manzanita Creek	75
Bainbridge Island	Community Forest Package	Acquire forest lands to preserve stands. 22.85 acres identified.	Springbrook Creek	3.2
Bainbridge Island	KCD Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	County-wide: Kitsap County	9
South Sound	MAR Package including: • Port Orchard Airport MAR • Belfair WWTP MAR • Coulter Creek Heritage Park MAR • Minter Creek MAR	Managed Aquifer Recharge	Multiple Streams and Creeks	23

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	• Rocky Creek between Wye and Koeneman Lakes MAR			
South Sound	Raingarden and LID Projects	Install residential raingardens and LID projects to infiltrate water from existing impervious surfaces	County wide: Pierce, Kitsap Counties	36
South Sound	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 500 acres.		70
Vashon-Maury	Beall Creek Stream Restoration	Water management to improve streamflow in Beall Creek	Beall Creek	26
Vashon-Maury	Water Right Acquisition Package	Acquire property and water rights, could benefit multiple streams	Island Wide	28
Vashon-Maury	Judd Creek MAR	Managed Aquifer Recharge	Judd Creek	2
South Sound Islands	Community Forest Package	Acquire forest lands or change forest management practices to preserve stands or emphasize a longer harvest interval. Target is 50 acres.		7
		TOTAL Project Offsets for WRIA 15		1071.1
		Consumptive Use Estimate for WRIA 15		766.4
		Higher Offset Target for WRIA 15		1218

Commented [VMSJ(54): Is this the appropriate way to refer to this number?

1875 ¹All projects in Table x have a high certainty of implementation – Category I

1876

1877 Consumptive use and the higher offset target are compared to project offsets at the subbasin
 1878 scale in Table y. Surplus water offset is achieved in a total of 2 subbasins (North Hood Canal and
 1879 West Sound). When looking at the higher offset target, a deficit in water offset occurs in a total

1880 of 5 subbasins (Bainbridge Island, South Sound Islands, South Hood Canal, South Sound and
1881 Vashon-Maury Island).

1882 **Table y. Subbasin Water Offset Totals from Category I Projects Compared to Permit-Exempt**
1883 **Well Consumptive Use Estimates and Offset Targets**

Commented [VMSJ(55)]: Do we want to just include this table and not the one above.

Subbasin	Offset Project Totals (AF/YR)	Permit-Exempt Well Consumptive Use (AF/YR) ¹	CU Estimate Surplus/ Deficit (AF/YR) ³	Higher Offset Target – (AF/YR) ²	Higher Target Surplus/ Deficit (AF/YR) ³	County
Bainbridge Island	91.2	67.9	23.3	107.9	-16.7	Kitsap
South Sound Islands	7	5.2	2.8	8.3	-1.3	Pierce
North Hood Canal	273	90.3	182.7	143.5	+129.5	Kitsap
South Hood Canal	126	155.0	-29	246.3	-120.3	Kitsap and Mason
South Sound	129	213.8	-84.8	339.8	-210.8	Pierce and Kitsap
Vashon - Maury Island	56	50.7	5.3	80.6	-24.6	King
West Sound	388.9	183.9	205	292.3	+96.6	Kitsap
WRIA 15 Total	1071	766	305	1218	-147	

1884 Notes:

1885 ¹Values in table have been rounded, which is why totals may differ. AF/Yr in 2038

1886 ²Offset Target is equivalent to PE consumptive use associated with high growth scenario and increased irrigated
1887 acreage to reflect uncertainty in estimates

1888 ³Surplus water offset is associated with a positive value and a deficit in water offset is associated with a negative
1889 value. Surplus and Deficit equal to Offset Project Totals less Offset Target.

1890

1891 The water offset projects listed in **Table x** provide additional benefits to instream resources
1892 beyond those necessary to offset the impacts from new consumptive water use within the

1893 WRIA. For the project types planned in WRIA 15, additional benefits could include the
1894 following:

- 1895 • Water right acquisition projects: Aquatic habitat improvements during key seasonal
1896 periods; reduction in groundwater withdrawals and associated benefit to aquifer
1897 resources; and/or beneficial use of reclaimed water.
- 1898 • MAR projects: Aquatic habitat improvements during key seasonal periods; increased
1899 groundwater recharge; reduction in summer/fall stream temperature; increased
1900 groundwater availability to riparian and near-shore plants; and/or contribution to flood
1901 control.
- 1902 • Community Forests Projects: - (add potential habitat benefits)
- 1903 • Recycled water infiltration projects: - (add potential habitat benefits)
- 1904 • Raingarden and LID, projects: - (add potential habitat benefits)
- 1905

Commented [LDW56]: Bob/Stacy, please address from project descriptions

1906 7.2 Habitat Benefits

1907 The WRIA 15 watershed plan includes an inventory of additional projects to meet the offset
1908 needs and NEB for the watershed. The remaining categories include the following:

- 1909 II. Projects that provide habitat and streamflow benefits, but streamflow benefits are
1910 difficult to quantify.
- 1911 III. Projects that primarily benefit habitat.
- 1912 IV. Projects that currently are not implementable (e.g., legal restriction) or are highly
1913 conceptual.

1914 The projects include habitat restoration and protection, stream augmentation, riparian
1915 restoration, reclaimed water expansion, storage, and other project types. **Table z** summarizes
1916 the habitat benefits of Category II and III projects that are described in further detail in Chapter
1917 5 and Appendix H. The number and distribution of habitat improvement projects by subbasin is
1918 also shown in **Table w** in Chapter 5.

1919 A total of 23 Category II and III habitat improvement projects are included within the plan, as
1920 summarized in in Chapter 5 Table 23. Habitat improvement attributes associated with these
1921 projects include a combination of aquatic habitat restoration and protection, stream
1922 augmentation, riparian restoration, reclaimed water expansion, managed aquifer recharge,
1923 stormwater management and other types of projects.

1924 These projects provide additional benefits to instream resources that, together with direct
1925 water offsets, are beyond those necessary to offset the impacts from new consumptive water
1926 use within the WRIA. These additional benefits include increased hydraulic/aquatic habitat
1927 diversity, restored native vegetation, restored water temperature, erosion abatement,

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1928 improved spawning and rearing habitat, improved passage, and water quality benefits, among
1929 others.

1930 Add Additional Text to Further Addressing Limiting factors here

1931 Highest priority for freshwater areas such as Chico, Minter, Rocky Creeks is to protect and/or
1932 restore hydrologic and riparian functional integrity. In Hood Canal subbasins, the loss of
1933 channel complexity, lack of riparian forest and high water temperatures in Union and Tahuya
1934 Creeks are of most concern. While in Creeks such as Dewatto, Anderson and Big Beef, loss of
1935 floodplain habitat and channel complexity, hydrologic regime, and channel instability and
1936 erosion are the most limiting for species recovery.

Commented [LDW57]: Please review in context of projects in Table 4

Commented [LDW58]: Limiting factors include:

- Channel and streambed degradation
- Increased peak flows
- Low streamflow
- Loss of upland forest cover
- Loss of riparian forest
- Loss of floodplain connectivity and habitats
- Degradation of wetland and shoreline habitats
- Conversion of wetlands to open water habitats
- Fish passage barriers
- Lack of large wood
- Fine sediment

Commented [VMSJ(59): Tables below- need to populate final column then will further develop limiting factors section.

1937 **Table z Summary of Category II and III WRIA 15 Habitat Improvement Projects included in NEB Analysis**

Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
III	Bainbridge Island	Fletcher Stream Restoration	Reconnect side channel habitat and minor flood plain restoration. (Part of a larger barrier removal project.)	47°38'35.0" N 122°34'02.5 "W	Floodplain/Wetl and Habitat no Offset	
II	North Hood Canal	Big Beef Creek Restoration	Restore wetlands, floodplain, and riparian along this ditched segment of upper Big Beef Creek. Acquisition likely needed.	Upper Big Beef Creek - Multiple Parcels (hidden for privacy)	Habitat with Offset	

Commented [VMSJ(60): Do we want this full table?
Fairly repetitive of project inventory.
We could group the projects by type (e.g. floodplain
restoration, stream channel restoration) and then describe the
limiting factors they benefit.

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	North Hood Canal	Grovers Creek and Leyman Wetland Restoration	Stream channel and wetland restoration are proposed on 1,600 feet of Grovers Creek and 10 acres of wetlands. Two parcels owned by the Robinson and Duncans were historically farmed, reed canary grass established and stream channel ditched. Funding for final design and construction are needed.	Robinson and Duncans parcels	Floodplain/Wetland and Habitat with Offset 1600 ft of stream restoration; 10 acres wetland	The project will improve fish passage, establish wetland and riparian vegetation, enhance water infiltration, and improve floodplain function. BENEFITs Coho, Chum, steelhead, and cutthroat habitat.
II	North Hood Canal	Hansville Wetland Enhancement	Degraded wetland could be restored.	Hansville	Floodplain/Wetland Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	South Hood Canal	Tahuya Headwaters	Purchase of fee and/or easement of up to 3 miles of riparian corridor in the upper Tahuya River and tributaries. Floodplain restoration including potential for LWD placement and BDA. Currently under one timberland owner.	Tahuya River (South Kitsap) and tributaries	Conservation Habitat with Offset Up to 3 miles of protection Floodplain restoration – potential for LWD placement	
II	South Sound	Coulter Creek Protection	Coulter Creek. Protection (acquisition of fee or easement) of riparian buffer and floodplain restoration of 3-5 mile riparian corridor owned by single landowner.	Coulter Creek	Preservation Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
III	South Sound	Gig Harbor Golf Club Artondale Creek Habitat Improvement	A portion of Artondale Creek and approximately 2 acres of the floodplain would be restored by replacing two existing bridges to open up the floodplain and plantings to increase shade, improve instream habitat, reduce stream temperature, and improve riparian buffers and upland habitat conditions. The restoration project may also be extended downstream if needed to improve fish passage to the project site. The project is located in the South Sound subbasin of WRIA 15 on the Gig Harbor Peninsula.	Artondale Creek	Habitat with Offset	
III	South Sound	Rocky Creek Protection and Riparian Buffer	Rocky Creek. Protection (acquisition of fee or easement) of riparian buffer and floodplain restoration of ~4 mile riparian corridor owned by single landowner.	Rocky Creek	Habitat no Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	South Sound Islands	Schoolhouse Creek Restoration	The Anderson Island Parks District and Pierce County has been working on this Creek for many years. The County replaced two culverts in 2013. There are two remaining barriers on County road that the County is seeking funding from the fish barrier removal board for and one partial barrier on a private road. The Parks District has also been looking for funding to creek meandering and wetland restoration on a section of creek that was previously ditched and used for agriculture.	Anderson Island, Schoolhouse Creek	Habitat with Offset	
II	South Sound Islands	East Oro Bay Barrier Removal	There is an earthen dam that impounds the top of the estuary in East Oro Bay.	Anderson Island, East Oro Bay near Jacobs Point Park	Habitat with Offset	
II	West Sound	Mid Olalla Creek Floodplain/Wetland restoration	Restore wetlands, floodplain, and riparian along this segment of Olalla Creek that has been ditched and drained. Acquisition likely needed also.		Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	West Sound	Ruby Creek Restoration	Approximately .44 miles of stream will be enhanced by excavating reed canary grass from the channel which is also inhibiting fish passage in this stream section. Installation of LWD, excavation of planting mounds and riparian planting are also proposed. The overall project involves restoration and enhancement of 11.7 acres of stream and wetland habitat. Chum, Coho, cutthroat trout and steelhead are documented in this reach of Ruby Creek. Design is complete and funding is needed for construction. Part of a larger fish barrier removal project.		Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	West Sound	Dogfish Creek Wetland Restoration	This project involves enhancement of 2,832 feet of Dogfish Creek and enhancement of 24 acres of mapped wetland. The 80 acres owned by Malone was historically farmed, reed canary grass established, and stream channel ditched. The project will enhance beaver activity and establish wetland and riparian vegetation. This project will also improve stream flow and floodplain function. This project will benefit Coho, Chum, steelhead, and cutthroat habitat. Funding for restoration design has been obtained and preliminary design is in progress. Funding for final design and construction are needed. Part of a larger fish barrier removal project.		Habitat no Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	West Sound	Lower Blackjack Creek Subbasin Restoration and Remediation Actions	This project proposes restoration and remediation of stream corridor habitat within the lower Blackjack Creek Subbasin as a subset of the Foster Pilot program within WRIA 15. Each restoration and remediation action has been identified and vetted by the Suquamish Tribe in their Blackjack Creek Watershed Protection and Restoration Plan composed in December 2017.		Habitat with Offset	
II	West Sound	Clear Creek Wetland and Floodplain Restoration			Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	West Sound	Lower Blackjack Creek Infrastructure Removal and Habitat Remediation	Assess the feasibility, perform due diligence, then construction/remediation of infrastructure in Blackjack Creek. This is part of the WRIA 15 Foster Pilot program. Projects include: 1. Rehabilitating an existing water main crossing over the creek by directionally drilling the water main to cross underneath the creek and removing the old infrastructure 2. Cleaning up debris from abandoned transient camps and replanting 3. Update old storm drainage to creek/tributary with LID principles		Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
II	West Sound	Blackjack Watershed Protection & Restoration Feasibility Plan	This project will build on the 2017 "Blackjack Creek Watershed Assessment, Protection, and Restoration Plan", and identify the highest priority tax parcels for protection or restoration based on a systematic evaluation of their value to salmon recovery. This evaluation will include a literature review of existing studies and GIS desktop analysis to identify the riparian and wetland habitats with the most value to salmon, highest connectivity to other salmon habitat, and greatest threat of development. The project will use this evaluation to rank parcels, and conduct outreach to landowners of the highest ranked parcels.		Habitat with Offset	
III	West Sound	Salmonberry Creek and Wetland Protection Project	Great Peninsula Conservancy (GPC) will protect 90 acres of riparian, wetland, and fish habitat through purchasing a conservation easement on property on Salmonberry Creek in Kitsap County. Salmonberry Creek is located in an ESSB 6091 prioritized basin (WRIA 15), and contains Endangered Species Act-listed steelhead trout.		Habitat no Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
III	West Sound	Floodplain Restoration Upstream of Navy RR Trestle	This action will aim to restore floodplain connectivity, riparian processes, and instream habitat conditions. Restoration actions should focus on removal of artificial fill along the abandoned road grade constricting the channel at RS 11100, restoring riparian forest conditions, and targeted wood placements to increase channel complexity and restore natural stream grade. Restoration of riparian processes will require negotiation of conservation easements or acquisition of the streamside parcel along the northern (left) bank. The parcel totals 6 acres and has an assessed value of \$240,000 per 2012 tax records. This action is constrained, in part, by channel confinement at the Navy RR trestle. The channel reach upstream of this segment flows through parcels that are part of the Mountaineers Foundation Rhododendron Preserve, where riparian conditions are more intact, instream wood is more abundant, and a broader floodplain exists due to the lack of bank protection.		Habitat with Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
III	West Sound	Curley Creek Acquisition	This project will build upon work done through the SRFB Curley Creek Estuary Acquisition and Curley Creel Feasibility study. Project will acquire highest quality remaining Chinook and steelhead habitat available on lower Curley Creek.		Habitat no Offset	
III	West Sound	Instream Habitat Enhancement at the Confluence with Chico Creek	Large wood placements to create additional complexity near the tributary confluence will improve habitat conditions in the near term while concurrent efforts to set back constraints to floodplain processes can be implemented.		Habitat no Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
III	West Sound	Grovers Creek Protection Phase II	Great Peninsula Conservancy's Lower Grovers Creek Habitat Protection Project aims to protect and restore 10.5 acres of riparian and wetland habitat along Grovers Creek and Miller bay in north Kitsap County for the benefit of people, salmon, and other wildlife. This project includes two properties in the Grovers Creek Watershed of north Kitsap County, including the 1.5-acre Tucker property and 9-acre Grovers Creek Durham Preserve Project owned by GPC. The Puget Sound Nearshore Ecosystem Restoration Project has prioritized the Grovers Creek Watershed as a "Protect High" watershed under its Coastal Inlet Strategy due to the fact that it remains relatively undeveloped.		Habitat no Offset	

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Category	Subbasin	Project Name	Project Short Description	Project Location/ River Reach Benefitted	Benefits with Quantifiable Metric	Limiting Factor(s) Addressed
III	West Sound	Curley Creek prioritized restoration	In November 2017, the Suquamish Tribe released a completed watershed assessment and protection and restoration plan for Curley Creek, one of the three high priority freshwater streams in the East Kitsap shoreline. This Near Term Action proposes to use this plan to work with partners to identify which of the high priority protection and restoration actions are feasible to move forward to implementation and then to carry out that work.		Habitat no Offset	

1938

7.3 Adaptive Management

The WRIA 15 Committee has recommended adaptive management measures in the plan for the purpose of addressing uncertainty in plan implementation (See Chapter 6.2). Adaptive management measures include annual PE well tracking and reporting, recommended monitoring and research, project implementation tracking, and watershed plan implementation reporting. These measures, in addition to the surplus water offset, policy and regulatory measures, and supplemental habitat improvement projects described above, provide reasonable assurance that the plan will adequately offset new consumptive use from PE wells anticipated during the planning horizon.

7.4 NEB Evaluation Findings

The WRIA 15 watershed plan is intended to provide a path forward for offsetting both an estimated 766.4 AF/yr of new consumptive water use and a more conservative offset target of 1218 AF/yr developed to account for uncertainties in the consumptive use estimate in WRIA 15. The plan primarily achieves this offset through a total of [redacted] water offset projects with a cumulative offset projection of [redacted] AF/yr. This projected total water offset yields a surplus offset of [redacted] AF/yr above the consumptive use estimate of 766 AF/yr and a surplus/deficit of [redacted] above/below the more conservative offset target of 1218 AF/yr in WRIA 15.

Within this plan, water offset projects are complimented by a total of 23 habitat improvement projects, which provide numerous additional benefits to aquatic and nearshore habitat. While many of these habitat improvement projects have potential streamflow benefits, the WRIA 15 Committee chose to exclude any associated water offset from the plan's accounting due to uncertainty in quantifying the benefit. Water offset projects are further complimented by the policy and regulatory recommendations addressed in Chapter 6.

The WRIA 15 Committee has additionally recommended adaptive management measures to provide reasonable assurance that the plan will adequately address new consumptive use impacts anticipated during the planning horizon, despite inevitable challenges that will arise during project implementation, operation, and maintenance.

Based on the information and analyses summarized in this plan and the assumption that projects in the plan will be implemented, the WRIA 15 Committee finds that this plan achieves a net ecological benefit, as required by RCW 90.94.030, and defined by the Final NEB Guidance (Ecology, 2019b).

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Glossary

Acre-feet (AF): A unit of volume equal to the volume of a sheet of water one acre in area and one foot in depth. ([USGS](#))

Adaptive Management: An iterative 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. ([NEB](#))

Annual Average Withdrawal: [RCW 90.94.030](#) (4)(a)(vi)(B) refers to the amount of water allowed for withdrawal per connection as the annual average withdrawal. As an example, a homeowner could withdraw 4,000 gallons on a summer day, so long as they did not do so often enough that their annual average exceeds the 950 gpd.

Beaver Dam Analogue (BDA): BDAs are man-made structures designed to mimic the form and function of a natural beaver dam. They can be used to increase the probability of successful beaver translocation and function as a simple, cost-effective, non-intrusive approach to stream restoration. ([From Anabran Solutions](#))

Critical Flow Period: The time period of low streamflow (generally described in bi-monthly or monthly time steps) that has the greatest likelihood to negatively impact the survival and recovery of threatened or endangered salmonids or other fish species targeted by the planning group. The planning group should discuss with Ecology, local tribal and WDFW biologists to determine the critical flow period in those reaches under the planning group's evaluation. ([NEB](#))

Cubic feet per second (CFS): A rate of the flow in streams and rivers. It is equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second (about the size of one archive file box or a basketball). ([USGS](#))

Domestic Use: In the context of Chapter [90.94 RCW](#), "domestic use" and the withdrawal limits from permit-exempt domestic wells include both indoor and outdoor household uses, and watering of a lawn and noncommercial garden. ([NEB](#))

ESSB 6091: In January 2018, the Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 in response to the Hirst decision. In the [Whatcom County vs. Hirst, Futurewise, et al. decision](#) (often referred to as the "Hirst decision"), the court ruled that the county failed to comply with the Growth Management Act requirements to protect water resources. The ruling required the county to make an independent decision about legal water availability. ESSB 6091 addresses the court's decision by allowing landowners to obtain a building permit for a new home relying on a permit-exempt well. ESSB 6091 is codified as Chapter [90.94 RCW](#). ([ECY](#))

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2138 Evolutionarily Significant Unit (ESU): A population of organisms that is considered distinct for
2139 purposes of conservation. For Puget Sound Chinook, the ESU includes naturally spawned
2140 Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River
2141 (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of
2142 Georgia. Also, Chinook salmon from 26 artificial propagation programs. ([NOAA](#))

2143 Foster Pilots and Foster Task Force: To address the impacts of the 2015 Foster decision, Chapter
2144 [90.94 RCW](#) established a Task Force on Water Resource Mitigation and authorized the
2145 Department of Ecology to issue permit decisions for up to five water mitigation pilot projects.
2146 These pilot projects will address issues such as the treatment of surface water and groundwater
2147 appropriations and include management strategies to monitor how these appropriations affect
2148 instream flows and fish habitats. The joint legislative Task Force will (1) review the treatment of
2149 surface water and groundwater appropriations as they relate to instream flows and fish habitat,
2150 (2) develop and recommend a mitigation sequencing process and scoring system to address
2151 such appropriations, and (3) review the Washington Supreme Court decision in Foster v.
2152 Department of Ecology. The Task Force is responsible for overseeing the five pilot projects.
2153 ([ECY](#))

2154 Four Year Work Plans: Four year plans are developed by salmon recovery lead entities in Puget
2155 Sound to describe each lead entity's accomplishments during the previous year, to identify the
2156 current status of recovery actions, any changes in recovery strategies, and to propose future
2157 actions anticipated over the next four years. Regional experts conduct technical and policy
2158 reviews of each watershed's four year work plan update to evaluate the consistency and
2159 appropriate sequencing of actions with the Puget Sound Salmon Recovery Plan. ([Partnership](#))

2160 Gallons per day (GPD): An expression of the average rate of domestic and commercial water
2161 use. 1 million gallons per day is equivalent to 1.547 cubic feet per second.

2162 Group A public water systems: Group A water systems have 15 or more service connections or
2163 serve 25 or more people per day. Chapter [246-290 WAC](#) (Group A Public Water Supplies),
2164 outlines the purpose, applicability, enforcement, and other policies related to Group A water
2165 systems. (WAC)

2166 Group B public water systems: Group B public water systems serve fewer than 15 connections
2167 and fewer than 25 people per day. Chapter [246-291 WAC](#) (Group B Public Water Systems),
2168 outlines the purpose, applicability, enforcement, and other policies related to Group B water
2169 systems. (WAC)

2170 Growth Management Act (GMA): Passed by the [Washington Legislature](#) and enacted in 1990,
2171 this act guides planning for growth and development in Washington State. The act requires
2172 local governments in fast growing and densely populated counties to develop, adopt, and
2173 periodically update comprehensive plans.

2174 Home: A general term referring to any house, household, or other Equivalent Residential Unit.
2175 ([Policy and Interpretive Statement](#))

2176 Hydrologic Unit Code (HUC): Hydrologic unit codes refer to the USGS's division and sub-division
2177 of the watersheds into successively smaller hydrologic units. The units are classified into four
2178 levels: regions, sub-regions, accounting units, and cataloging units, and are arranged within
2179 each other from the largest geographic area to the smallest. Each unit is classified by a unit
2180 code (HUC) composed of two to eight digits based on the four levels of the classification in the
2181 hydrologic unit system (two digit units are largest, and eight digits are smallest). ([USGS](#))

2182 Impact: For the purpose of streamflow restoration planning, impact is the same as new
2183 consumptive water use (see definition below). As provided in Ecology WR POL 2094 "Though
2184 the statute requires the offset of 'consumptive impacts to instream flows associated with
2185 permit-exempt domestic water use' (RCW 90.94.020(4)(b)) and 90.94.030(3)(b)), watershed
2186 plans should address the consumptive use of new permit-exempt domestic well withdrawals.
2187 Ecology recommends consumptive use as a surrogate for consumptive impact to eliminate the
2188 need for detailed hydrogeologic modeling, which is costly and unlikely feasible to complete
2189 within the limited planning timeframes provided in chapter [90.94 RCW](#). " ([NEB](#))

2190 Instream Flows and Instream Flow Rule (IFR): Instream flows are a specific flow level measured
2191 at a specific location in a given stream. Seasonal changes cause natural stream flows to vary
2192 throughout the year, so instream flows usually vary from month to month rather than one flow
2193 rate year-round. State law requires that enough water in streams to protect and preserve
2194 instream resources and uses. The Department of Ecology sets flow levels in administrative
2195 rules. Once instream flow levels are established in a rule, they serve as a water right for the
2196 stream and the resources that depend on it. Instream flow rules do not affect pre-existing, or
2197 senior, water rights; rather, they protect the river from future withdrawals. Once an instream
2198 flow rule is established, the Department of Ecology may not issue water rights that would
2199 impair the instream flow level. ([ECY](#))

2200 Instream Resources Protection Program (IRPP): The IRPP was initiated by the Department of
2201 Ecology in September 1978 with the purpose of developing and adopting instream resource
2202 protection measures for Water Resource Inventory Areas (WRIAs) (see definition below) in
2203 Western Washington as authorized in the Water Resources Act of 1971 (RCW 90.54), and in
2204 accordance with the Water Resources Management Program ([WAC 175-500](#)).

2205 Instream Resources: Fish and related aquatic resources. ([NEB](#))

2206 Large woody debris (LWD): LWD refers to the fallen trees, logs and stumps, root wads, and piles
2207 of branches along the edges of streams, rivers, lakes and Puget Sound. Wood helps stabilize
2208 shorelines and provides vital habitat for salmon and other aquatic life. Preserving the debris
2209 along shorelines is important for keeping aquatic ecosystems healthy and improving the
2210 survival of native salmon. ([King County](#))

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2211 Lead Entities (LE): Lead Entities are local, citizen-based organizations in Puget Sound that
2212 coordinate salmon recovery strategies in their local watershed. Lead entities work with local
2213 and state agencies, tribes, citizens, and other community groups to adaptively manage their
2214 local salmon recovery chapters and ensure recovery actions are implemented. ([Partnership](#))

2215 Listed Species: Before a species can receive the protection provided by the [Endangered Species](#)
2216 [Act](#) (ESA), it must first be added to the federal lists of endangered and threatened wildlife and
2217 plants. The [List of Endangered and Threatened Wildlife \(50 CFR 17.11\)](#) and the [List of](#)
2218 [Endangered and Threatened Plants \(50 CFR 17.12\)](#) contain the names of all species that have
2219 been determined by the U.S. Fish and Wildlife Service (Service) or the National Marine Fisheries
2220 Service (for most marine life) to be in the greatest need of federal protection. A species is
2221 added to the list when it is determined to be endangered or threatened because of any of the
2222 following factors: the present or threatened destruction, modification, or curtailment of its
2223 habitat or range; overutilization for commercial, recreational, scientific, or educational
2224 purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other
2225 natural or manmade factors affecting its survival. ([USFWS](#))

2226 Local Integrating Organizations (LIO): Local Integrating Organizations are local forums in Puget
2227 Sound that collaboratively work to develop, coordinate, and implement strategies and actions
2228 that contribute to the protection and recovery of the local ecosystem. Funded and supported
2229 by the Puget Sound Partnership, the LIOs are recognized as the local expert bodies for
2230 ecosystem recovery in nine unique ecosystems across Puget Sound. ([Partnership](#))

2231 Low Impact Development (LID): Low Impact Development (LID) is a stormwater and land-use
2232 management strategy that tries to mimic natural hydrologic conditions by emphasizing
2233 techniques including conservation, use of on-site natural features, site planning, and distributed
2234 stormwater best management practices (BMPs) integrated into a project design. ([ECY](#))

2235 Managed Aquifer Recharge (MAR): Managed aquifer recharge projects involve the addition of
2236 water to an aquifer through infiltration basins, injection wells, or other methods. The stored
2237 water can then be used to benefit stream flows, especially during critical flow periods. ([NEB](#))

2238 National Pollutant Discharge Elimination System (NPDES): The NPDES permit program
2239 addresses water pollution by regulating point sources that discharge pollutants to waters of the
2240 United States. Created by the Clean Water Act in 1972, the EPA authorizes state governments
2241 to perform many permitting, administrative, and enforcement aspects of the program. ([EPA](#))

2242 Net Ecological Benefit (NEB): Net Ecological Benefit is a term used in ESSB 6091 as a standard
2243 that watershed plans (see below for definition) must meet. The outcome that is anticipated to
2244 occur through implementation of projects and actions in a plan to yield offsets that exceed
2245 impacts within: a) the planning horizon; and, b) the relevant WRIA boundary. See *Final*
2246 *Guidance for Determining Net Ecological Benefit - Guid-2094 Water Resources Program*
2247 *Guidance*. ([NEB](#))

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2248 Net Ecological Benefit Determination: Occurs solely upon Ecology’s conclusion after its review
2249 of a watershed plan submitted to Ecology by appropriate procedures, that the plan does or
2250 does not achieves a NEB as defined in the Net Ecological Benefit guidance. The Director of
2251 Ecology will issue the results of that review and the NEB determination in the form of an
2252 order. ([NEB](#))

2253 Net Ecological Benefit Evaluation: A planning group’s demonstration, using NEB Guidance and
2254 as reflected in their watershed plan, that their plan has or has not achieved a NEB. ([NEB](#))

2255 New Consumptive Water Use: The consumptive water use from the permit-exempt domestic
2256 groundwater withdrawals estimated to be initiated within the planning horizon. For the
2257 purpose of RCW 90.94, consumptive water use is considered water that is evaporated,
2258 transpired, consumed by humans, or otherwise removed from an immediate water
2259 environment due to the use of new permit-exempt domestic wells. ([NEB](#))

2260 Office of Financial Management (OFM): OFM is a Washington state agency that develops official
2261 state and local population estimates and projections for use in local growth management
2262 planning. ([OFM](#))

2263 Offset: The anticipated ability of a project or action to counterbalance some amount of the new
2264 consumptive water use over the planning horizon. Offsets need to continue beyond the
2265 planning horizon for as long as new well pumping continues. ([NEB](#))

2266 Permit exempt wells: The Groundwater Code ([RCW 90.44](#)), identified four “small withdrawals”
2267 of groundwater as exempt from the permitting process. Permit-exempt groundwater wells
2268 often provide water where a community supply is not available, serving single homes, small
2269 developments, irrigation of small lawns and gardens, industry, and stock watering.

2270 Permit-exempt uses: Groundwater permit exemptions allow four small uses of groundwater
2271 without a water right permit: domestic uses of less than 5,000 gallons per day, industrial uses of
2272 less than 5,000 gallons per day, irrigation of a lawn or non-commercial garden, a half-acre or
2273 less in size, or stock water. Although exempt groundwater withdrawals don’t require a water
2274 right permit, they are always subject to state water law. ([ECY](#))

2275 Planning groups: A general term that refers to either initiating governments, in consultation
2276 with the planning unit, preparing a watershed plan update required by Chapter 90.94.020 RCW,
2277 or a watershed restoration and enhancement committee preparing a plan required by Chapter
2278 90.94.030 RCW. ([NEB](#))

2279 Planning Horizon: The 20-year period beginning on January 19, 2018 and ending on January 18,
2280 2038, over which new consumptive water use by permit-exempt domestic withdrawals within a
2281 WRIA must be addressed, based on the requirements set forth in Chapter 90.94 RCW. ([NEB](#))

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2282 Projects and Actions: General terms describing any activities in watershed plans to offset
2283 impacts from new consumptive water use and/or contribute to NEB. ([NEB](#))

2284 Puget Sound Acquisition and Restoration (PSAR) fund: This fund supports projects that recover
2285 salmon and protect and recover salmon habitat in Puget Sound. The state legislature
2286 appropriates money for PSAR every 2 years in the Capital Budget. PSAR is co-managed by the
2287 Puget Sound Partnership and the Recreation and Conservation Office, and local entities identify
2288 and propose PSAR projects. ([Partnership](#))

2289 Puget Sound Partnership (Partnership): The Puget Sound Partnership is the state agency leading
2290 the region's collective effort to restore and protect Puget Sound and its watersheds. The
2291 organization brings together hundreds of partners to mobilize partner action around a common
2292 agenda, advance Sound investments, and advance priority actions by supporting partners.
2293 ([Partnership](#))

2294 Puget Sound Regional Council (PSRC): PSRC develops policies and coordinates decisions about
2295 regional growth, transportation and economic development planning within King, Pierce,
2296 Snohomish and Kitsap counties. ([PSRC](#))

2297 [RCW 90.03 \(Water Code\)](#): This chapter outlines the role of the Department of Ecology in
2298 regulating and controlling the waters within the state. The code describes policies surrounding
2299 surface water and groundwater uses, the process of determining water rights, compliance
2300 measures and civil penalties, and various legal procedures.

2301 [RCW 90.44 \(Groundwater Regulations\)](#): RCW 90.44 details regulations and policies concerning
2302 groundwater use in Washington state, and declares that public groundwaters belong to the
2303 public and are subject to appropriation for beneficial use under the terms of the chapter. The
2304 rights to appropriate surface waters of the state are not affected by the provisions of this
2305 chapter.

2306 [RCW 90.54 \(Groundwater permit exemption\)](#): This code states that any withdrawal of public
2307 groundwaters after June 6, 1945 must have an associated water right from the Department of
2308 Ecology. However, any withdrawal of public groundwaters for stock-watering purposes, or for
2309 the watering of a lawn or of a noncommercial garden not exceeding one-half acre in area, or for
2310 single or group domestic uses in an amount not exceeding five thousand gallons a day, or for an
2311 industrial purpose in an amount not exceeding five thousand gallons a day, is exempt from the
2312 provisions of this section and does not need a water right.

2313 [RCW 90.82 \(Watershed Planning\)](#): Watershed Planning was passed in 1997 with the purpose of
2314 developing a more thorough and cooperative method of determining what the current water
2315 resource situation is in each water resource inventory area of the state and to provide local
2316 citizens with the maximum possible input concerning their goals and objectives for water
2317 resource management and development.

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2318 [RCW 90.94 \(Streamflow Restoration\)](#): This chapter of the Revised Code of Washington codifies
2319 ESSB 6091, including watershed planning efforts, streamflow restoration funding program and
2320 the joint legislative task force on water resource mitigation and mitigation pilot projects (Foster
2321 task force and pilot projects).

2322 [Reasonable Assurance](#): Explicit statement(s) in a watershed plan that the plan's content is
2323 realistic regarding the outcomes anticipated by the plan, and that the plan content is supported
2324 with scientifically rigorous documentation of the methods, assumptions, data, and
2325 implementation considerations used by the planning group. ([NEB](#))

2326 [Revised Code of Washington \(RCW\)](#): The revised code is a compilation of all permanent laws
2327 now in force for the state of Washington. The RCWs are organized by subject area into Titles,
2328 Chapters, and Sections.

2329 [Salmon Recovery Funding Board \(SRFB\)](#): Pronounced "surfboard", this state and federal board
2330 provides grants to protect and restore salmon habitat. Administered by a 10-member State
2331 Board that includes five governor-appointed citizens and five natural resource agency directors,
2332 the board brings together the experiences and viewpoints of citizens and the major state
2333 natural resource agencies. For watersheds planning under Section 203, the Department of
2334 Ecology will submit final draft WRE Plans not adopted by the prescribed deadline to SRFB for a
2335 technical review ([RCO](#) and [Policy and Interpretive Statement](#)).

2336 [Section 202 or Section 020](#): Refers to Section 202 of ESSB 6091 or [Section 020 of RCW 90.94](#)
2337 respectively. The code provides policies and requirements for new domestic groundwater
2338 withdrawals exempt from permitting with a potential impact on a closed water body and
2339 potential impairment to an instream flow. This section includes WRIAs 1, 11, 22, 23, 49, 59 and
2340 55, are required to update watershed plans completed under RCW 90.82 and to limit new
2341 permit-exempt withdrawals to 3000 gpd annual average.

2342 [Section 203 or Section 030](#): Refers to Section 203 of ESSB 6091 or [Section 030 of RCW 90.94](#)
2343 respectively. The section details the role of WRE committees and WRE plans (see definitions
2344 below) in ensuring the protection and enhancement of instream resources and watershed
2345 functions. This section includes WRIAs 7, 8, 9, 10, 12, 13, 14 and 15. New permit-exempt
2346 withdrawals are limited to 950 gpd annual average.

2347 [SEPA and SEPA Review](#): SEPA is the State Environmental Policy Act. SEPA identifies and analyzes
2348 environmental impacts associated with governmental decisions. These decisions may be related
2349 to issuing permits for private projects, constructing public facilities, or adopting regulations,
2350 policies, and plans. SEPA review is a process which helps agency decision-makers, applications,
2351 and the public understand how the entire proposal will affect the environment. These reviews
2352 are necessary prior to Ecology adopting a plan or plan update and may be completed by
2353 Ecology or by a local government. ([Ecology](#))

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2354 Subbasins: A geographic subarea within a WRIA, equivalent to the words “same basin or
2355 tributary” as used in RCW 90.94.020(4)(b) and RCW 90.94.030 (3)(b). In some instances,
2356 subbasins may not correspond with hydrologic or geologic basin delineations (e.g. watershed
2357 divides). ([NEB](#))

2358 Trust Water Right Program: The program allows the Department of Ecology to hold water
2359 rights for future uses without the risk of relinquishment. Water rights held in trust contribute to
2360 streamflows and groundwater recharge, while retaining their original priority date. Ecology uses
2361 the Trust Water Right Program to manage acquisitions and accept temporary donations. The
2362 program provides flexibility to enhance flows, bank or temporarily donate water rights. ([ECY](#))

2363 Urban Growth Area (UGA): UGAs are unincorporated areas outside of city limits where urban
2364 growth is encouraged. Each city that is located in a GMA fully-planning county includes an
2365 urban growth area where the city can grow into through annexation. An urban growth area
2366 may include more than a single city. An urban growth area may include territory that is located
2367 outside of a city in some cases. Urban growth areas are under county jurisdiction until they are
2368 annexed or incorporated as a city. Zoning in UGAs generally reflect the city zoning, and public
2369 utilities and roads are generally built to city standards with the expectation that when annexed,
2370 the UGA will transition seamlessly into the urban fabric. Areas outside of the UGA are generally
2371 considered rural. UGA boundaries are reviewed and sometimes adjusted during periodic
2372 comprehensive plan updates. UGAs are further defined in [RCW 36.70](#).

2373 WAC 173-566 (Streamflow Restoration Funding Rule): On June 25, 2019 the Department of
2374 Ecology adopted this rule for funding projects under RCW 90.94. This rule establishes processes
2375 and criteria for prioritizing and approving grants consistent with legislative intent, thus making
2376 Ecology’s funding decision and contracting more transparent, consistent, and defensible.

2377 Washington Administrative Code (WAC): The WAC contains the current and permanent rules
2378 and regulations of state agencies. It is arranged by agency and new editions are published every
2379 two years. ([Washington State Legislature](#))

2380 Washington Department of Ecology (DOE/ECY): The Washington State Department of Ecology is
2381 an environmental regulatory agency for the State of Washington. The department administers
2382 laws and regulations pertaining to the areas of water quality, water rights and water resources,
2383 shoreline management, toxics clean-up, nuclear and hazardous waste, and air quality.

2384 Washington Department of Fish and Wildlife (WDFW): An agency dedicated to preserving,
2385 protecting, and perpetuating the state’s fish, wildlife, and ecosystems while providing
2386 sustainable fish and wildlife recreational and commercial opportunities. Headquartered in
2387 Olympia, the department maintains six regional offices and manages dozens of wildlife areas
2388 around the state, offering fishing, hunting, wildlife viewing, and other recreational
2389 opportunities for the residents of Washington. With the tribes, WDFW is a co-manager of the
2390 state salmon fishery. ([WDFW](#))

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2391 Washington Department of Natural Resources (WADNR or DNR): The department manages
2392 over 3,000,000 acres of forest, range, agricultural, and commercial lands in the U.S. state of
2393 Washington. The DNR also manages 2,600,000 acres of aquatic areas which include shorelines,
2394 tidelands, lands under Puget Sound and the coast, and navigable lakes and rivers. Part of the
2395 DNR's management responsibility includes monitoring of mining cleanup, environmental
2396 restoration, providing scientific information about earthquakes, landslides, and ecologically
2397 sensitive areas. ([WADNR](#))

2398 Water Resources (WR): The Water Resources program at Department of Ecology supports
2399 sustainable water resources management to meet the present and future water needs of
2400 people and the natural environment, in partnership with Washington communities. ([ECY](#))

2401 Water Resources Advisory Committee (WRAC): Established in 1996, the Water Resources
2402 Advisory Committee is a forum for issues related to water resource management in Washington
2403 State. This stakeholder group is comprised of 40 people representing state agencies, local
2404 governments, water utilities, tribes, environmental groups, consultants, law firms, and other
2405 water stakeholders. ([ECY](#))

2406 Watershed Plan: A general term that refers to either: a watershed plan update prepared by a
2407 WRIA's initiating governments, in collaboration with the WRIA's planning unit, per RCW
2408 90.94.020; or a watershed restoration and enhancement plan prepared by a watershed
2409 restoration and enhancement committee, per RCW 90.94.030. This term does not refer to RCW
2410 90.82.020(6). ([NEB](#))

2411 Watershed Restoration and Enhancement Plan (WRE Plan): The Watershed Restoration and
2412 Enhancement Plan is directed by [Section 203 of ESSB 6091](#) and requires that by June 30, 2021,
2413 the Department of Ecology will prepare and adopt a watershed restoration and enhancement
2414 plan for WRIAs 7, 8, 9, 10, 12, 13, 14 and 15, in collaboration with the watershed restoration
2415 and enhancement committee. The plan should, at a minimum, offset the consumptive impact
2416 of new permit-exempt domestic water use, but may also include recommendations for projects
2417 and actions that will measure, protect, and enhance instream resources that support the
2418 recovery of threatened and endangered salmonids. Prior to adoption of an updated plan,
2419 Department of Ecology must determine that the actions in the plan will result in a "net
2420 ecological benefit" to instream resources in the WRIA. The planning group may recommend
2421 out-of-kind projects to help achieve this standard.

2422 WRIA: Water Resource Inventory Area. WRIAs are also called basins or watersheds. There are
2423 62 across the state and each are assigned a number and name. They were defined in 1979 for
2424 the purpose of monitoring water availability. A complete map is available here:
2425 <https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-availability/Watershed-look-up>

Appendices

Still in development and need cross referencing with text.

2428 **Appendix A – Committee Roster**

Entity Representing	Primary Representative Name	First Alternate Name
Kitsap County	Dave Ward	Kathy Peters
Mason County	Randy Neatherlin	Kevin Shutty, David Windom
Pierce County	Dan Cardwell	Austin Jennings
Puyallup Tribe	David Winfrey	
Skokomish Tribe	Alex Gouley	Seth Book, Dana Sarff
Squaxin Island Tribe	Jeff Dickison	Paul Pickett
Suquamish Tribe	Leonard Forsman	Alison O'Sullivan
Port Gamble S'Klallam Tribe	Sam Phillips	Paul McCollum
City of Port Orchard	Jacki Brown	Mark Dorsey, Zach Holt
City of Bremerton	Teresa Smith	Allison Satter
City of Gig Harbor	Trent Ward	Jeff Langhelm, Brienn Ellis
City of Bainbridge	Michael Michael	Christian Berg
Kitsap Public Utility District	Joel Purdy	Mark Morgan
Department of Fish and Wildlife	Brittany Gordon	Nam Siu
Department of Ecology	Stacy Vynne McKinstry	Stephanie Potts
King County	Greg Rabourn	
Kitsap Building Association	Russ Shiplet	Ellen Ross-Cardoso
Kitsap Conservation District	Joy Garitone	Brian Stahl
Great Peninsula Conservancy	Nathan Daniel	Erik Steffens
Mason-Kitsap Farm Bureau <i>ex officio</i>	Larry Boltz	
Washington Water Service <i>ex officio</i>	Shawn O'Dell	

Appendix B – Operating Principles

Watershed Restoration Enhancement Committee

Water Resource Inventory Area (WRIA) 15

Operating Principles

Approved Version Sent for Signature February 12, 2019

Revised and Approved August 6, 2020

SECTION 1: PURPOSE

The purpose of the operating principles is to establish the watershed restoration and enhancement committee, as authorized under RCW 90.94.030, for the purpose of developing the watershed restoration and enhancement plan. The document sets forward a process for meeting, participation expectations, procedures for voting, structure of the Committee, communication and other needs in order to support the Committee in reaching agreement on a final plan.

SECTION 2. AGREEMENT AND AMENDMENTS TO THE OPERATING PRINCIPLES

The formal establishment of an agreement to the operating principles will take place via a member decision, with all members of the watershed restoration and enhancement committee (Committee) approving the operating principles. Participants will work in good faith to participate productively in the development of the operating principles. By approving the operating principles, members of the Committee agree to uphold the principles as outlined in this document.

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 decided on unanimously by the full Committee for inclusion in the operating principles.

Nothing contained herein or in any amendment developed under the Agreement shall prejudice the legal claims of any party hereto, nor shall participation in this planning process abrogate any party's authority or the reserved or other rights of tribal governments, except where the obligation has been accepted in writing.

SECTION 3. PARTICIPATION EXPECTATIONS AND GROUND RULES

Participation expectations

Each entity invited by Ecology to participate on the Committee, and which has responded indicating their commitment to participate, shall identify a representative and up to two alternates to participate on the Committee. Committee members will, in good faith and using their best professional judgement:

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- 2460 • Actively participate in Committee meetings;
 - 2461 • Review materials in preparation for the meetings;
 - 2462 • Review materials following the meetings;
 - 2463 • Engage in workgroups (if applicable);
 - 2464 • Come prepared for discussions and decisions (when applicable); and
 - 2465 • Commit to implementing the Committee ground rules (see below).
- 2466 The chair will consult with the Committee to ensure that adequate time is given for review of materials.
- 2467 The chair will provide meeting materials at least 7 days before meetings, with additional time given for
- 2468 longer documents. The chair recognizes that members may need to discuss decisions with their
- 2469 organizations prior to bringing forward a decision to the Committee and the chair and facilitator will
- 2470 work with Committee members to establish reasonable review time for materials prior to reaching a
- 2471 decision. Members of the Committee will actively work with their decision making authorities to receive
- 2472 feedback on decisions in a timely manner as to not delay decisions coming before the Committee. When
- 2473 possible, Committee members will provide the chair reasonable notice if additional review time is
- 2474 needed prior to making a decision.
- 2475 Committee meetings will take place on a monthly basis for an initial period, with the interval of
- 2476 meetings being modified as needed to meet the deadlines (either more or less frequently). The chair will
- 2477 hold meetings at a convenient location in the watershed. Meetings are expected to last for
- 2478 approximately 4 hours, with the length modified as needed to meet deadlines.
- 2479 The chair or facilitator will contact Committee members that miss meetings. A lack of participation does
- 2480 not mean the process to develop the plan will be stalled. However, it is recognized that if a quorum is
- 2481 not present, meetings may be cancelled or decisions postponed which may impact the overall timeline
- 2482 for plan approval. If an entity misses multiple meetings, the chair or facilitator will work with the entity
- 2483 to identify reasonable accommodations to support reengagement.
- 2484 ***Remote Participation***
- 2485 It is the expectation that Committee representatives shall attend all meetings in person. In person
- 2486 participation is essential to efficiency, clarity, and honest communication. Although it should not be
- 2487 routine, remote participation can be accommodated when necessary to facilitate Committee member
- 2488 participation and when possible given technology availability. Remote participants may engage in
- 2489 decision-making; however the primary purpose of remote participation is listening to the Committee
- 2490 meeting, as it may be difficult to fully participate in discussion. If there are difficulties with technology,
- 2491 the chair's priority is to continue the meeting with the in-person participants and not delay the meeting
- 2492 to address technology challenges. Representatives are strongly encouraged to attend meetings in-
- 2493 person.
- 2494 The Committee chair will allow for remote participation (e.g. via phone, web, video conference) if:
- 2495 • Notice is provided to the chair or facilitator at least 1 week in advance of the meeting (except in
 - 2496 the case of emergencies such as illness, weather event, etc.), AND

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- 2497 • Representative and alternates are not available to attend in person, AND
2498 • Meeting room accommodates remote participation.
2499 If extraordinary events, such as a pandemic or natural disaster, require the committee to meet
2500 remotely, all meetings will be held remotely and the operating procedures will remain in force, except
2501 portions that assume in-person versus remote participation.

2502

2503 **Ground rules**

2504 Water management is inherently complicated and the Committee is striving for consensus on the
2505 watershed restoration and enhancement plan. Therefore, given the range of members' diverse
2506 perspectives, the Committee has established the following to ensure good faith and productive
2507 participation amongst its members:

2508 **1. Be Respectful**

- 2509 • Listen when others are speaking. Do not interrupt and do not participate in side
2510 conversations. One person speaks at a time.
2511 • Recognize the legitimacy of the concerns and interests of others, whether or not you
2512 agree with them.
2513 • Cooperate with the facilitator to ensure that everyone is given equitable time to state
2514 their views. Present your views succinctly and try not to repeat or rephrase what others
2515 have already said.
2516 • Silence cell phones and limit use of cell phones and laptops during the meeting.
2517 • Respect other communication styles and needs.
2518 • Assume good intent of other Committee members.

2519 **2. Be Constructive**

- 2520 • Participate in the spirit of giving the same priority to solving the problems of others as
2521 you do to solving your own problems.
2522 • Share comments that are solution focused. Avoid repeating past discussions.
2523 • Do not engage in personal attacks or make slanderous statements. Do not give
2524 ultimatums.
2525 • Ask for clarification if you are uncertain of what another person is saying. Ask questions
2526 rather than make assumptions.
2527 • Work towards consensus. Identify areas of common ground and be willing to
2528 compromise.
2529 • Minimize the use of jargon and acronyms. Attempt to use language observers and
2530 laypersons will understand.
2531 • It is okay to disagree, but strive to reach common ground.

2532 **3. Be Productive**

- 2533 • Adhere to the agenda. Respect time constraints and focus on the topic being discussed.

2534 **4. Bring a Sense of Humor and Have Fun.**

2535

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2536 ***Interpersonal conflict resolution***

2537 In the event a conflict arises amongst members or established workgroups of the Committee, the
2538 following steps should be taken by individuals:

- 2539 1. Communicate directly with the person or persons whose actions are the cause of the conflict.
- 2540 2. If the circumstance is such that the person with a conflict is unable or unwilling to communicate
2541 directly with the person or persons whose actions are the cause of the conflict, the person shall
2542 speak with the Committee chair and facilitator.
- 2543 3. The conflict should first be brought up verbally. If this does not lead to satisfactory resolution,
2544 the impacted parties should describe the conflict in writing to the chair.
- 2545 4. If such matters are brought to the chair and facilitator, the chair in consultation with the
2546 facilitator, will address the conflict as appropriate and may seek outside or independent
2547 assistance as needed.

2548 **SECTION 4. ALTERNATES, EX OFFICIO MEMBERSHIP AND WORKGROUPS**

2549 ***Alternates***

2550 Committee members shall provide to the chair, in writing, up to two designated alternate committee
2551 members from their organization or government. Committee members shall inform the chair in writing
2552 of any changes to the main representative or alternates. If the primary representative cannot attend a
2553 meeting, they should, if possible, send the designated alternate and notify the Committee chair and the
2554 facilitator as early as possible. It is the responsibility of the primary representative to brief the alternate
2555 on previous meetings and key topics arising for discussion in order for the alternate to participate
2556 productively.

2557 Representatives may call on alternates that attend the meeting at any time to speak. Only one
2558 representative from the government or entity shall sit at the table and participate in a decision. If the
2559 primary representative and alternates are no longer able to attend (staffing change, ongoing scheduling
2560 conflicts), the government or organization shall work with the chair to quickly identify alternative
2561 representation from the same government or organization. If no alternative representative is available
2562 from the government or organization, an alternate entity that can represent the same interest is
2563 allowed and shall be brought forward by the departing entity to the chair for approval. Replacement
2564 members are subject to latecomer provisions.

2565 ***Latecomers***

2566 Ecology invited all entities identified in 90.94.030 to participate on the Committee and all entities in
2567 WRIA 15 have accepted the invitation to participate. A replacement entity is allowed to join the
2568 Committee at a later date under the following conditions:

- 2569 1. The entity cannot request to revisit items previously decided on by the Committee;
- 2570 2. The entity signs an intent to participate, provides primary and alternate Committee
2571 representatives;
- 2572 3. The entity agrees to and abides by the operating principles; and

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4. The entity joins the Committee and participates in meetings no later than six months prior to final plan approval.

Removal from the Committee

Entities must participate in the committee process after September 1, 2020 to retain membership on the committee. If an entity does not attend at least one committee or workgroup meeting over any three-month period it will be assumed they have withdrawn from the committee and will be removed as members, unless the member provides a written explanation and requests to remain on the committee. The Chair, via electronic communication, will inform any committee member who has not been participating for two months with this information to provide a minimum of one-month notice before removal.

Resignation from the Committee

If an entity no longer wishes to participate in the committee process or the final plan approval, they should send written notice (electronic or mailed notice) to the chair as early as possible prior to their resignation. Advance notice will support the chair and facilitator in managing consensus building and voting procedures.

Ex-Officio and Ad-Hoc Members

The Committee may decide by full consensus to invite an additional entity to join the Committee as an *ex officio* non-voting member. *Ex Officio* members are invited to sit at the Committee table and participate actively in discussions and review of documents, but shall not make decisions on any items.³² Ex-officio members shall adhere to the operating procedures.

The Committee may decide by consensus to invite an individual or organization to participate in select meetings or agenda items where additional expertise or perspective is desired. Ad hoc members will be invited by the chair to sit at the Committee table, participate actively in discussions, and review of documents for the specified agenda items. They shall not make decisions on any items.

Workgroups and Advisory Groups

The Committee may establish workgroups or subcommittees as it sees fit. Workgroups may be temporary, established to achieve a specific purpose within a finite time frame, or a standing workgroup addressing the goals of the Committee. The decision to form a workgroup is not required by the legislation and may be developed at the discretion of the Committee or the chair in order to support Committee decision making. All Committee workgroups are workgroups of the whole, meaning their role is to support the efforts of the Committee and all Committee members are welcome to participate in any workgroup formed by the Committee. The chair or Committee may also engage established workgroups in the watershed or invite non-Committee members to participate on the workgroups if they bring capacity or expertise not available on the Committee. No binding decisions will be made by

³² Ecology leadership has determined that additional voting members will not be invited to join the committees in order to stay true to the legislation and keep the Committee size manageable. However, the Committee may decide to include non-voting members if they choose.

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2606 the workgroups; all issues discussed by workgroups shall be communicated to the Committee as either
2607 recommendations or findings as appropriate. The Committee may, or may not, act on these workgroup
2608 outcomes as it deems appropriate.

2609 SECTION 5. ROLE OF THE CHAIR AND COMMITTEE SUPPORT

2610 RCW 90.94.030 (2b) states that “The department shall chair the watershed restoration and
2611 enhancement committee...” Ecology’s streamflow restoration implementation lead chairs the
2612 Committee on behalf of the agency. In the event that the chair is unable to attend a scheduled meeting
2613 due to illness or other unanticipated absence, Ecology will designate an interim chair to avoid cancelling
2614 the meeting. The interim chair may make decisions coming before the Committee.

2615 The chair shall make decisions on all items coming before the Committee.³³ The role of the chair is to
2616 help the Committee complete the plan with the goal to attain full agreement from the Committee
2617 members. If full agreement cannot be obtained, the chair shall ensure all opinions inform future
2618 decision making for the final plan.

2619 The chair, with assistance from Ecology technical staff, contractors, members of the Committee, and/or
2620 workgroups, shall prepare the watershed restoration and enhancement plan for the Committee’s
2621 review, comment, and approval.

2622 Ecology may provide the Committee a facilitator. The role of the facilitator is to focus on process and
2623 support the Committee in productive discussions and decision-making. Ecology will provide
2624 administrative support for the Committee as well as technical assistance through Ecology staff and
2625 consultants.

2626 Ecology may provide the Committee with technical support in the form of Ecology staff or hired
2627 consultants. Ecology will seek input from the Committee on consultant selection prior to entering into
2628 contract.

2629 SECTION 6. DECISION MAKING

2630 This planning process, by statutory design, brings a diversity of perspectives to the table. It is therefore
2631 important the Committee identifies a clear process for how it will make decisions. Committee members
2632 shall always strive for consensus, and when consensus cannot be reached, the chair and facilitator will
2633 document agreement and dissenting opinions. The reason why Committee members will strive for
2634 consensus is that the authorizing legislation requires that final plan itself must be approved by all
2635 members of the Committee prior to Ecology’s review (RCW 90.94.030[3] “...all members of a watershed
2636 restoration and enhancement committee must approve the plan prior to adoption”). Therefore it

³³ RCW 90.94 (3) states that “the department shall prepare and adopt a watershed restoration and enhancement plan for each watershed listed under subsection (2)(a) of this section, in collaboration with the watershed restoration and enhancement committee. Except as described in (h) of this subsection, all members of a watershed restoration and enhancement committee must approve the plan prior to adoption.” Based on input from the Attorney General’s office, because Ecology is a member of the Committee and must ultimately vote on whether or not to approve the plan, Ecology shall vote on all items coming before the Committee.

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2637 follows that consensus during the foundational decisions upon which the plan is constructed will serve
2638 as the best indicators of the Committee's progress toward an approved plan.

2639 ***Quorum***

2640 A quorum is constituted when two-thirds of the entities represented on the Committee are present
2641 (either in person or on the phone). A quorum must be present for decisions to occur. Each member of
2642 the Committee may record a single formal opinion.

2643 ***Decisions leading up to the final plan approval***

2644 In recognition that consensus can be difficult to achieve and in some cases decisions need to be made
2645 within a limited period of time to stay on track to meet the plan deadline, the following process will be
2646 used to make decisions leading up to plan approval:

2647 1. The Committee will strive toward consensus.³⁴ The levels of consensus include:

2648 • I can say an unqualified "yes"!

2649 • I can accept the decision.

2650 • I can live with the decision.

2651 • I do not fully agree with the decision; however, I will not block it.

2652 2. The Committee will spend adequate time³⁵ for substantive discussion of issues prior to asking
2653 for a decision. After substantive discussion, the chair will ask consensus.

2654 3. When consensus cannot be reached, the facilitator will identify the members in disagreement³⁶
2655 at the meeting. The chair and/or facilitator will support coordination of the following actions,
2656 but the responsibility is on the disagreeing members. Disagreeing members agree to:

2657 a. meet within seven days of the meeting;

2658 b. develop a summary paper on the issue and needs; and

2659 c. develop a draft timeline for resolution or a recommendation back to the Committee.

2660 As appropriate, the chair and/or facilitator will work with the parties in disagreement to reach a
2661 resolution using whatever means are necessary and within reason (in person meetings,
2662 conference calls, identifying additional research needs, etc.). Members unable to reach
2663 consensus must agree to work cooperatively with the chair and facilitator in this process. The
2664 Committee recognizes that flexibility is needed in terms of timeline and presentation of

³⁴ Definition of Consensus: Consensus is a group process where the input of everyone is carefully considered and an outcome is crafted that best meets the needs of the group as a whole. The root of consensus is the word consent, which means to give permission to. When members consent to a decision, they are giving permission to the group to go ahead with the decision. Some members may disagree with all or part of the decision, but based on listening to everyone else's input, all members agree to let the decision go forward because the decision is the best one the entire group can achieve at the current time.

³⁵ The chair will identify definitive deadlines by which decisions need to be made in order to stay on track to meet the plan deadline.

³⁶ If much of the group is in agreement and only one or two members are in disagreement, individuals may be selected to negotiate on behalf of the larger group.

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2665 resolution depending on the nature of the disagreement. If requested, Ecology may provide a
2666 facilitator to help develop the compromise language.

2667 4. If the compromise fails to reach consensus within the identified timeline, the Committee will
2668 agree to allow the process for developing the plan to move forward while the work toward
2669 consensus continues. The Committee agrees to revisit decisions where consensus is not reached
2670 at a later date.

2671 5. Throughout the process, the chair and facilitator will ensure that areas of concern and
2672 disagreement are documented within meeting summaries and other materials as necessary.

2673 **Decision process**

- 2674 • Thumbs up – approval
- 2675 • Thumbs down – disapproval
- 2676 • Thumbs sideways – (accept, can live with, will not object)
- 2677 • Five fingers – abstain

2678 The facilitator will record all decisions and, where there are dissenting or ambivalent opinions, the
2679 meeting summary will document the concerns.

2680 **Conflict of Interest**

2681 Committee members shall abstain from making a decision if they have a vested personal financial
2682 interest in a decision. The committee acknowledges that each entity represents stakeholders that have
2683 an interest in the outcomes of this process.

2684 **Electronic decision making**

2685 In the case a decision is needed prior to the next Committee meeting, the chair can request a opinion or
2686 decision via email or survey. This approach will only be used for time-critical items or when a quorum
2687 was not present to come to a decision. The chair will allow a minimum of 3 working days for responses.
2688 A non-response is considered an “abstention”.³⁷

2689 The result of an electronic decision will be reported at the next Committee meeting and the chair or
2690 facilitator may request a decision to reaffirm the electronic decision.

2691 **Straw poll**

2692 From time to time, the chair or the facilitator may ask for a straw poll to gather information on group
2693 needs. These polls do not need to follow the formal decision-making protocols of this section. Informal
2694 polls will be used solely for information-gathering and will not result in a decision.

³⁷ If an ‘out of office’ message is received for the primary representative, the alternate representative(s) will be contacted. The chair and facilitator will make at least 3 points of contact with each Committee member and alternates before marking them as an abstention (e.g. phone, email, text).

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2695 ***Letters of Support for Projects***

2696 The Committee may choose to submit a letter of support for streamflow restoration projects applying
2697 for funding through Ecology’s Streamflow Restoration Funding program or other sources. The decision
2698 to submit a letter of support on behalf of the Committee shall be by consensus. If the Committee does
2699 not approve a letter of support for a project, individual Committee representatives may submit a letter
2700 of support from their entity or government.

2701 ***Final approval of the plan***

2702 RCW 90.94 (3) states that “... all members of a watershed restoration and enhancement committee
2703 must approve the plan prior to adoption.” This means that each and all committee members get to
2704 record their decision (quorum is not applicable for final approval) and that all committee members must
2705 support the plan in order for it to be approved and provided to Ecology for “net ecological benefit”³⁸
2706 review and potential adoption by Ecology.³⁹

2707 The final plan approval will be shown by hands:

- 2708 • Thumbs up – approval
- 2709 • Thumbs down – disapproval

2710 The final plan approval may also be given verbally or in writing when in-person participation is not
2711 possible:

- 2712 • Approve
- 2713 • Disapprove

2714 The facilitator will record all decisions.

2715 **SECTION 7. PUBLIC COMMENTS AND PUBLIC MEETING NOTICE**

2716 The agenda will provide time for public comment at each meeting. Members of the public may only
2717 speak during public comment. The chair and facilitator will determine the time and extent of the public
2718 comment period based on the agenda for each meeting, with input from the Committee. While the
2719 Committee is not explicitly required to follow the requirements of the Open Public Meetings Act,
2720 reasonable efforts will be made to post information and materials on the pertinent website in a timely
2721 manner to keep the public informed.

2722 **SECTION 8. COMMITTEE AND MEDIA COMMUNICATION**

2723 To support clear communication with the Committee, Ecology will:

³⁸ Per RCW 90.94, Ecology shall review the watershed restoration and enhancement plan to ensure it meets net ecological benefit. Ecology shall provide the Committee with a definition and guidance of net ecological benefit.

³⁹ RCW 90.94.030 does not require local jurisdiction approval prior to plan adoption.

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- 2724 1. Operate a listserv for Committee members and interested parties;
2725 2. Develop and manage a website for members of the Committee to access documents such as
2726 agendas, meeting summaries, technical reports, calendar, and other items as requested by the
2727 Committee;
2728 3. Conduct briefing calls with the Committee ahead of each meeting; and
2729 4. Conduct follow up calls with Committee members unable to attend meetings or with differing
2730 opinions.

2731
2732 The facilitator and Ecology shall prepare, distribute and post on the Committee webpage a written
2733 meeting summary for each Committee meeting within 10 business days of the last Committee meeting.
2734 The summary, at a minimum, will include a list of attendees, decisions, discussion points, assignments,
2735 and action items. If comments are cited in such summaries, each speaker will be identified as
2736 appropriate or requested. Meeting summaries will capture areas of agreement and disagreement within
2737 the group. The Committee will approve the meeting summary at the following meeting.

2738 ***Communication with the media***

2739 When speaking to the media or other venues, the Committee members will clearly identify any opinions
2740 expressed as their personal opinions and not necessarily those of the other Committee members or the
2741 Committee as a whole. The Committee members will not attempt to speak for other members of the
2742 group or to characterize the positions of other members to the media or other venues. Comments to
2743 the media will be respectful of other Committee members.

2744 Following significant accomplishments, the Committee may request Ecology to issue formal news
2745 releases or other media briefing materials. All releases and information given to the media will
2746 accurately represent the work of the Committee. Ecology will make every effort to provide the
2747 Committee with materials in advance for input, recognizing that media timelines may not allow for
2748 adequate review by the Committee.

Appendix C – Aquifer Units within WRIA 15

Aquifer	Description	Typical Thickness
Qvr – Vashon Recessional Aquifer	Found at land surface where present, this aquifer consists of sand, gravel, and silt, with lenses of silt and clay derived from recessional glacial outwash. Presence is limited to former outwash channels, primarily found along major surface water drainages in the WRIA.	Thickness, where present, ranges from a few feet up to about 120 feet with an average of about 22 feet.
Qva – Vashon Advance Aquifer	This aquifer is mainly composed of deposits from the Vashon advance outwash (Qva). The deposits are usually well-sorted sand or sand and gravel, sometimes with lenses of silt or clay. The unit is generally unconfined, but confining conditions exist where the aquifer is fully saturated and overlain by the Vashon Till confining unit (Qvt).	The thickness typically ranges from 20 to about 240 feet, with some areas exceeding 300 feet.
QA1 – Sea-Level Aquifer	This aquifer consists primarily of glacial (pre-Vashon) sand and gravel with silt interbeds. This unit is generally confined by the overlying Upper Confining Unit (QC1). The upper surface of this aquifer ranges from several hundred feet below sea level to 300 feet above sea level, with an average elevation of about 20 feet.	The thickness typically ranges from 50 to about 250 feet, with an average of about 84 feet.
QA2 – Glaciomarine Aquifer	Composition of this aquifer ranges from sand and gravel to silt. This unit is confined by the overlying Middle Confining Unit (QC2). Few wells tap this aquifer, given its greater depth and lower productivity than the overlying Qvr and QA1 aquifers. The upper surface of this aquifer ranges from 600 feet below sea level to less than 200 feet below sea level.	The thickness typically ranges from less than 20 to more than 300 feet, with an average of about 85 feet.
QA3 – Deep Aquifer	This aquifer consists mostly of sand and gravel with silt interbeds. This unit is confined by the overlying Lower Confining Unit (QC3). The upper surface of this aquifer ranges from more than 900 feet below sea level to slightly more than 200 feet below sea level.	The thickness typically ranges from 50 to 350 feet, with an average of about 128 feet.

2752 **Appendix D – Surface Water Quality Assessments Category 4**
2753 **and 5 Listings in WRIA 15**
2754
2755

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WATERBODY	CURRENT CATEGORY	PARAMETER	TMDL_NAME	MEDIUM_NAME
ANDERSON CREEK	4C	Fish And Shellfish Habitat		Habitat
ANNAPOLIS CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
BARKER CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
ARRANTES CREEK	5	Temperature		Water
	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
BEAR CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Bear, Burley, and Purdy Creeks 4b Project	Water
BEAVER CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
BELFAIR CREEK	4A	Bacteria	Union River Bacteria TMDL	Water
BIG ANDERSON CREEK	5	pH		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
BIG BEEF CREEK	5	Temperature		Water
		Dissolved Oxygen		Water
		pH		Water
BIG MISSION CREEK	5	Temperature		Water
BIG SCANDIA CREEK	5	Temperature		Water
		Dissolved Oxygen		Water
BIG SCANDIA CREEK	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
BJORGEN CREEK	5	Dissolved Oxygen		Water
		Temperature		Water
	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
BLACKJACK CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
BOYCE CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
BURLEY CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Bear, Burley, and Purdy Creeks 4b Project	Water
CARPENTER CREEK	5	Dissolved Oxygen		Water

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WATERBODY	CURRENT CATEGORY	PARAMETER	TMDL_NAME	MEDIUM_NAME
	5	Temperature		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
CHICO CREEK	5	Dissolved Oxygen		Water
	5	Temperature		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
CLEAR CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
CLEAR CREEK, W.F.	5	Dissolved Oxygen		Water
COULTER CREEK	5	Dissolved Oxygen		Water
	5	pH		Water
COWLING CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
CURLEY CREEK	5	Dissolved Oxygen		Water
		Temperature		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
DANIELS CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
DEWATTO RIVER	4B	Bacteria	Kitsap County Bacteria 4B	Water
DICKERSON CREEK	5	Temperature		Water
		Dissolved Oxygen		Water
DOGFISH CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Dogfish Creek 4b Project	Water
DOGFISH CREEK, E.F.	5	Dissolved Oxygen		Water
	4B	Bacteria	Dogfish Creek 4b Project	Water
DOGFISH CREEK, S.F.	4B	Bacteria	Kitsap County Bacteria 4B	Water
DUNCAN CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
ENETAI CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
FISHER CREEK	5	Temperature		Water
GAMBLE CREEK	5	Temperature		Water
		Dissolved Oxygen		Water

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WATERBODY	CURRENT CATEGORY	PARAMETER	TMDL_NAME	MEDIUM_NAME
GORST CREEK	5	Dissolved Oxygen		Water
GROVERS CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
HUGE CREEK	5	Dissolved Oxygen		Water
ILLAHEE CREEK	5	Dissolved Oxygen		Water
INDIANOLA CREEK	4B	Bacteria	Kitsap County Bacteria 4B	Water
JOHNSON CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
JUDD CREEK	5	Temperature		Water
JUMPOFF JOE CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
KARCHER CREEK	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
KEYPORT CREEK	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
KINMAN CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
KITSAP CREEK	5	Dissolved Oxygen		Water
		Temperature		Water
	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
KITSAP LAKE	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
LAGOON CREEK	5	pH		Water
LEMOLO CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
LITTLE MINTER CREEK	5	Bacteria		Water
LITTLE MISSION CREEK	5	Bacteria		Water
LITTLE SCANDIA CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
LOFALL CREEK	4B	Bacteria	Kitsap County Bacteria 4B	Water
LONG LAKE	5	Total Phosphorus		Water
	4C	Invasive Exotic Species		Habitat
MARTHA-JOHN CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Martha John and Gamble Creeks 4b Project	Water

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WATERBODY	CURRENT CATEGORY	PARAMETER	TMDL_NAME	MEDIUM_NAME
MAYO CREEK	5	Bacteria		Water
		Temperature		Water
MINTER CREEK	5	Bacteria		Water
		Dissolved Oxygen		Water
MISSION LAKE	4C	Invasive Exotic Species		Habitat
MURDEN CREEK	4B	Bacteria	Kitsap County Bacteria 4B	Water
OSTRICH BAY CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria		Water
OSTRICH BAY CREEK, W.B.	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
PAHRMANN CREEK	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
PERRY CREEK	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
PHINNEY CREEK	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
PICNIC CREEK	5	Bacteria		Water
		pH		Water
PRIVATE CREEK	5	Bacteria		Water
		pH		Water
PURDY CREEK	5	Bacteria	Bear, Burley, and Purdy Creeks 4b Project	Water
		Dissolved Oxygen		Water
RAVINE CREEK	5	Bacteria		Water
	5	Bacteria		Water
RIDGETOP CREEK	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
ROSS CREEK	5	Dissolved Oxygen		Water
	4A	Bacteria		Water
ROYAL VALLEY CREEK	4B	Bacteria	Kitsap County Bacteria 4B	Water
SACCO CREEK	5	pH		Water
	4A	Bacteria		Water
SALMONBERRY CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria		Water
SEABECK CREEK	5	Dissolved Oxygen		Water
SHOOFLY CREEK	5	Bacteria		Water
SPRINGBROOK CREEK	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
SQUARE LAKE	4C	Invasive Exotic Species		Habitat

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WATERBODY	CURRENT CATEGORY	PARAMETER	TMDL_NAME	MEDIUM_NAME
STATE PARK CREEK	5	Dissolved Oxygen	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
	4A	Bacteria		Water
STAVIS CREEK	5	Dissolved Oxygen		Water
STEELE (CROUCH) CREEK	5	Dissolved Oxygen	Kitsap County Bacteria 4B	Water
	4B	Bacteria		Water
STEELE CREEK	5	Dissolved Oxygen	Kitsap County Bacteria 4B	Water
	4B	Bacteria		Water
STRAWBERRY CREEK	5	Dissolved Oxygen	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
	4A	Bacteria		Water
TAHUYA LAKE	4C	Invasive Exotic Species		Habitat
TAHUYA RIVER	5	Dissolved Oxygen		Water
		Temperature		Water
		Dissolved Oxygen		Water
UNION RIVER	5	Dissolved Oxygen		Water
		Temperature		Water
	4A	Bacteria	Union River Bacteria TMDL	Water
UNNAMED CREEK (IN THE ANDERSON CREEK SYSTEM)	4C	Fish And Shellfish Habitat		Habitat
UNNAMED CREEK (IN THE BIG BEEF CREEK SYSTEM)	4C	Fish And Shellfish Habitat		Habitat
UNNAMED CREEK (IN THE BOYCE CREEK SYSTEM)	4C	Fish And Shellfish Habitat		Habitat
UNNAMED CREEK (IN THE HARDING CREEK SYSTEM)	4C	Fish And Shellfish Habitat		Habitat
UNNAMED CREEK (IN THE LITTLE ANDERSON CREEK SYSTEM)	4C	Fish And Shellfish Habitat		Habitat
UNNAMED CREEK (IN THE STAVIS CREEK SYSTEM)	4C	Fish And Shellfish Habitat		Habitat
UNNAMED CREEK (TRIB TO AMSTERDAM BAY)	5	Bacteria		Water
UNNAMED CREEK (TRIB TO BANGOR TRIDENT LAKE OUTLET CREEK)	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water
UNNAMED CREEK (TRIB TO DOGFISH CREEK)	4B	Bacteria	Kitsap County Bacteria 4B	Water
UNNAMED CREEK (TRIB TO DUTCHER COVE)	5	Bacteria		Water
UNNAMED CREEK (TRIB TO FILUCY BAY)	5	Bacteria		Water
UNNAMED CREEK (TRIB TO GREAT BEND/LYNCH COVE)	5	Bacteria		Water
UNNAMED CREEK (TRIB TO HOOD CANAL)	5	Bacteria		Water
UNNAMED CREEK (TRIB TO KITSAP LAKE)	4A	Bacteria	Sinclair & Dyes Inlets Tributaries Bacteria TMDL	Water

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WATERBODY	CURRENT CATEGORY	PARAMETER	TMDL_NAME	MEDIUM_NAME
	4B	Bacteria	Kitsap County Bacteria 4B	Water
UNNAMED CREEK (TRIB TO LIBERTY BAY)	5	Temperature		Water
UNNAMED CREEK (TRIB TO LIBERTY BAY)	4A	Bacteria	Liberty Bay Watershed Bacteria TMDL	Water
UNNAMED CREEK (TRIB TO NORTH CREEK)	5	Lead		Water
		Copper		Water
UNNAMED CREEK (TRIB TO ORO BAY)	5	Bacteria		Water
UNNAMED CREEK (TRIB TO UNION RIVER)	5	Dissolved Oxygen		Water
		Temperature		Water
UNNAMED CREEK (TRIB TO VAUGHN BAY)	5	Bacteria		Water
VAUGHN CREEK	5	Bacteria		Water
WILSON CREEK	5	Dissolved Oxygen		Water
	4B	Bacteria	Kitsap County Bacteria 4B	Water
WYE LAKE	4C	Invasive Exotic Species		Habitat

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2757 **Appendix E – TMDL Table for WRIA 15**

2758 Category 5, 303(d) listed streams in WRIA 15

WATERBODY_NAME	Temp	DO	pH	Bacteria	Copper	Lead	TP
ANNAPOLIS CREEK		X					
BARKER CREEK		X					
BARRANTES CREEK	X						
BEAR CREEK		X					
BEAVER CREEK		X					
BIG ANDERSON CREEK			X				
BIG BEEF CREEK	X	X	X				
BIG MISSION CREEK	X						
BIG SCANDIA CREEK	X	X					
BJORGEN CREEK	X	X					
BLACKJACK CREEK		X					
BOYCE CREEK		X					
BURLEY CREEK		X					
CARPENTER CREEK	X	X					
CHICO CREEK	X	X					
CLEAR CREEK		X					
CLEAR CREEK, W.F.		X					
COULTER CREEK		X	X				
COWLING CREEK		X					
CURLEY CREEK	X	X					
DANIELS CREEK		X					
DICKERSON CREEK	X						
DOGFISH CREEK		X					
DOGFISH CREEK, E.F.		X					
DUNCAN CREEK		X					
ENETAI CREEK		X					
FISHER CREEK	X						
GAMBLE CREEK	X	X					
GORST CREEK		X					
GROVERS CREEK		X					
HUGE CREEK		X					
ILLAHEE CREEK		X					
JOHNSON CREEK		X					
JUDD CREEK	X						
JUMPOFF JOE CREEK		X					
KINMAN CREEK		X					
KITSAP CREEK	X	X					
LAGOON CREEK			X				
LEMOLO CREEK		X					
LITTLE MINTER CREEK				X			
LITTLE MISSION CREEK				X			

WATERBODY_NAME	Temp	DO	pH	Bacteria	Copper	Lead	TP
LITTLE SCANDIA CREEK		X					
LONG LAKE							X
MARTHA-JOHN CREEK		X					
MAYO CREEK	X			X			
MINTER CREEK		X		X			
OSTRICH BAY CREEK		X					
PICNIC CREEK			X	X			
PRIVATE CREEK			X	X			
PURDY CREEK		X		X			
RAVINE CREEK				X			
ROSS CREEK		X					
SACCO CREEK			X				
SALMONBERRY CREEK		X					
SEABECK CREEK		X					
SHOOFLY CREEK				X			
STATE PARK CREEK		X					
STAVIS CREEK		X					
STEELE (CROUCH) CREEK		X					
STEELE CREEK		X					
STRAWBERRY CREEK		X					
TAHUYA RIVER	X	X					
UNION RIVER	X	X					
TRIB TO AMSTERDAM BAY				X			
TRIB TO DUTCHER COVE				X			
TRIB TO FILUCY BAY				X			
TRIB TO GREAT BEND/LYNCH COVE				X			
TRIB TO HOOD CANAL				X			
TRIB TO LIBERTY BAY	X						
TRIB TO NORTH CREEK					X	X	
TRIB TO ORO BAY				X			
TRIB TO UNION RIVER	X	X					
TRIB TO VAUGHN BAY				X			
VAUGHN CREEK				X			
WILSON CREEK		X					

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Technical Memorandum

WRE Committees Technical Support



To: Stacy Vynne McKinstry, Washington State Department of Ecology
From: Bob Montgomery, Anchor QEA; Chad Wiseman, HDR
Date: February 12, 2020 (original); May 27, 2020 (revised)
Subject: WRIA 15 Subbasin Delineation
(Work Assignment WA-01, Task 2)

1.0 Introduction

HDR is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) committee for Water Resource Inventory Area (WRIA) 15. The Streamflow Restoration law (Revised Code of Washington [RCW] Chapter 90.94) requires that WRE plans include actions to offset new consumptive-use impacts associated with permit-exempt domestic water use. 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.” Therefore, delineations must be developed for the subbasins in WRIA 15 that will be used as a spatial framework for growth projections, consumptive-use estimates, and priority offset projects. The Net Ecological Benefit (NEB) evaluation will also be based on this framework. This technical memorandum addresses the basis for subbasin delineation in WRIA 15 (Kitsap).

2.0 Subbasin Delineation

This section explains the initial and final delineations for WRIA 15. The term “subbasin” is used by the WRIA 15 WRE committee for planning purposes only and to meet the requirements of RCW 90.94.030 (3)(b).

2.1 Initial Delineation

The WRIA 15 workgroup (a subcommittee of the WRE committee) was tasked to delineate subbasin boundaries for discussion at WRE committee meetings. An initial discussion was held at the April 4, 2019, workgroup meeting and Pierce County, the Kitsap Public Utility District (PUD), and the Squaxin Tribe subsequently developed maps of proposed subbasin boundaries and provided those to Ecology and the WRE committee.

The initial, general considerations included the following:

- Subbasins should be neither too big nor too small.
- Surface water flows and rain flow patterns should be included.
- Anticipated rural growth and where there is little growth will likely drive projects and impacts.
- Priority areas for salmon recovery should be included.

- Isolated areas like islands without streamflow connectivity to the mainland should be included as their own subbasin (for example, the South Sound Islands are grouped based on relatively low projected growth and proximity to Pierce County mainland).
- There should be recognition that the WRE committee can revise subbasins throughout the process.

The maps were further discussed at the May 2, 2019, WRE committee meeting and the workgroup meeting that immediately followed that meeting.

The result of the discussion on May 2, 2019, was a proposal that divides WRIA 15 into “regions” that are an initial delineation of subbasins that will be revisited as the watershed planning process continues. The key points discussed are as follows:

- Considerations for subbasins include starting large, using a nesting approach, and ensuring that there is justification for offset projects outside of a subbasin.
- The workgroup is committed to finding projects closest to the impact and revisiting subbasin delineations throughout the process.
- The regions map will be used for generating growth projections and consumptive use. The counties shared that they can project growth at any level but recognize that the smaller the subbasins are, the less reliable the data are. It is helpful for the counties to have the proposed size of regions for providing their growth projections.
- Some workgroup members are interested in using smaller assessment areas as well, such as Hydrologic Unit Code 12 (HUC12) boundaries, to look at particular stream impacts.
 - Workgroup members also suggesting using Assessment Units¹ (from Ecology’s Puget Sound Watershed Characterization Project) as a starting point for mitigation.
- The Squaxin Tribe would like to see a road map of how the subbasin delineations will be revisited throughout the process.

Further discussion of the regions approach occurred in the June 4, 2019, workgroup meeting and the June 6, 2019, WRE committee meeting. Agreement was reached on proceeding with use of the regions with the following caveats:

- The regions approach is a nested approach where regions are essentially a “do not cross” line for finding projects to offset impacts.
- Projects should be closest to the anticipated impact and provide benefit to streams. Using a nested approach, the potential for offsets will be evaluated first at the assessment unit scale, then at the HUC 14 scale, and finally at the subbasin scale. In other words, the committee will look for projects at the finest scale possible first. If the offsets are not achievable at the small or

¹ Assessments Units are described in the Puget Sound Watershed Characterization Project (Department of Ecology, 2013). Each WRIA is made up of subwatersheds, called watershed management units, which are further divided into Assessment Units. A variety of watershed assessment results are presented for each assessment unit, including: water flow (for delivery, surface storage, recharge, and discharge processes); water quality processes (for five parameters: sediment, phosphorus, nutrients, pathogens, and metals); and fish and wildlife habitats (for terrestrial, freshwater and marine habitats).

intermediate unit scale, justification will be provided (for example, there is greater relative benefit in a larger project in a stream of importance).

- The WRE committee will continue to revisit delineation of subbasins once growth projections and projects are developed.

The June proposal included three main regions: South Sound, West Sound, and Hood Canal. The boundary between the West Sound region and the Hood Canal region in the northern Kitsap Peninsula was left flexible with the recognition that projects in one region could benefit streams in the other region. The other regions are Bainbridge Island, Vashon-Maury Island, and the three south Puget Sound islands (McNeil, Anderson, and Ketron).

2.2 Revision to Hood Canal Region

The Skokomish Tribe proposed to revise the region delineation by dividing the Hood Canal region into North Hood Canal and South Hood Canal regions. The reason is differing precipitation amounts, development and status of fish species. The proposal was first presented to the WRIA 15 Committee in October who passed it to the workgroup for discussion. A subset of workgroup members reviewed the proposal and recommended the proposal be accepted. The proposal was further discussed at the November 7, 2019 WRIA 15 Committee meeting. There was agreement amongst all Committee members present to accept the revision to the Hood Canal region.

2.3 Final Delineation

Agreement was reached at the March 5, 2020 WRIA 15 committee meeting to accept the region delineations as the subbasin boundaries. Figure 1 presents the subbasins as agreed to at that meeting.

3.0 Conclusion

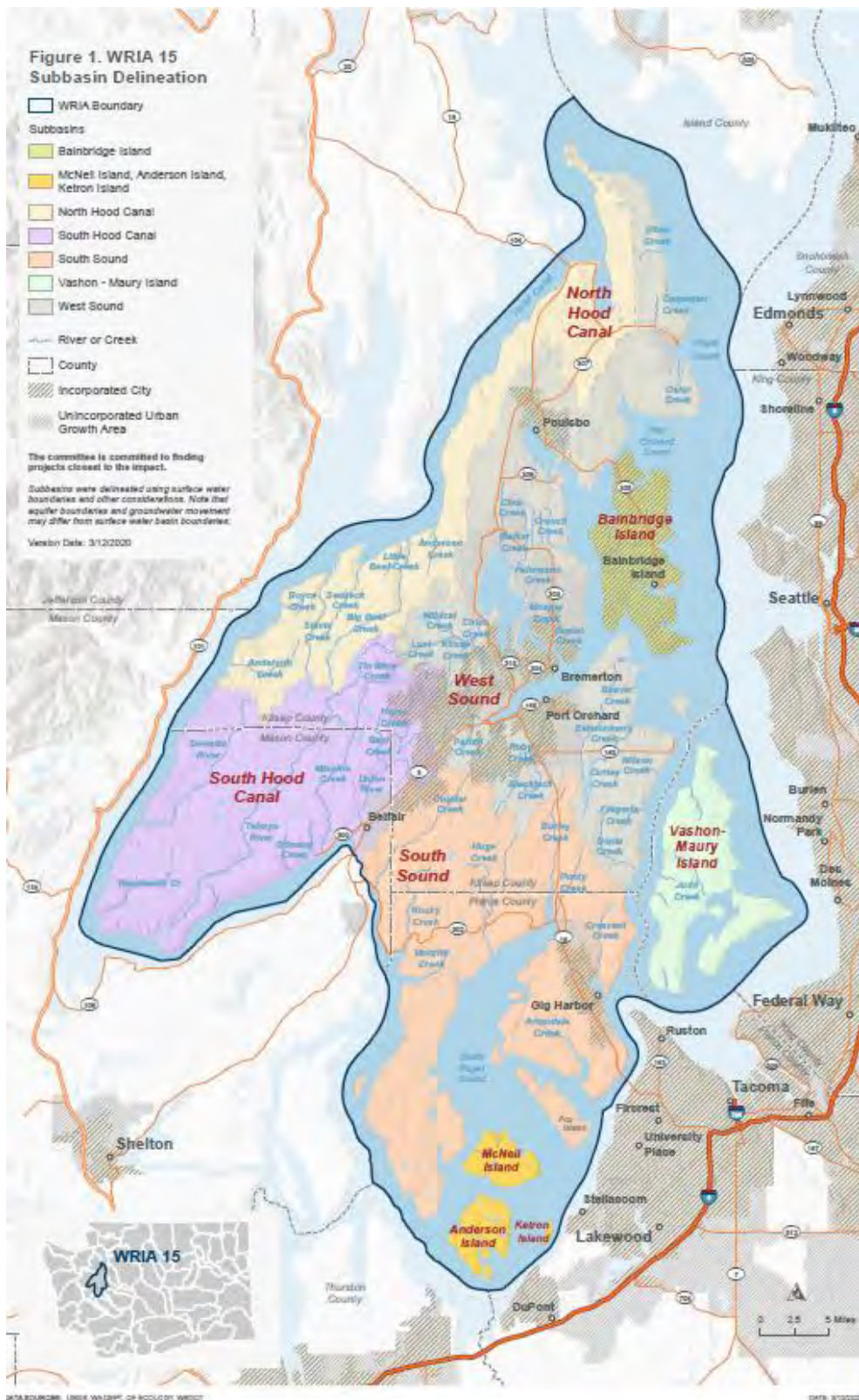
The WRIA 15 WRE committee delineation of subbasins will be used as an organizational framework for growth projection and consumptive-use scenarios. References

Revised Code of Washington (RCW). 2019. Watershed Planning, Chapter 90.82 RCW. Accessed on June 23, 2019, at <https://app.leg.wa.gov/rcw/default.aspx?cite=90.82>.

RCW. 2019. Streamflow Restoration, Chapter 90.94 RCW. Accessed on June 23, 2019, at <https://app.leg.wa.gov/RCW/default.aspx?cite=90.94>.

U.S. Geological Survey and U.S. Department of Agriculture, Natural Resources Conservation Service (USGS). 2013. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4 ed.): Techniques and Methods 11–A3, 63 p., <https://pubs.usgs.gov/tm/11/a3/>.

Figure 1. WRIA 15 subbasin delineation



2766 **Appendix G – Growth Projections and Consumptive Use**
2767 **Memo**

To: Stacy Vynne McKinstry, Washington State Department of Ecology
From: Chad Wiseman, HDR and Bob Montgomery, Anchor QEA
Date: February 13, 2020 (original); May 27, 2020 (revised)
Subject: WRIA 15 PE Growth and Consumptive Use Summary
(Work Assignment 2, Tasks 2 and 3)

1.0 Introduction

HDR 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) 10, 12, 13, 14, and 15.

Under RCW 90.94, consumptive water use by permit-exempt domestic wells and connections (PE wells) occurring over the 20 year period of 2018-2038 (planning horizon) must be estimated to establish the water use that watershed restoration plans and plan updates are required to address and offset. This memorandum summarizes PE wells and related consumptive use of groundwater that is projected to impact WRIA 15 over the planning horizon.

This memorandum includes:

- A summary of WRIA 15 baseline, low, and high PE growth scenarios.
- A summary of WRIA 15 baseline, low, and high scenario consumptive use using three different methods.

2.0 WRIA 15 PE Growth Projection Methods

Portions of Mason, Pierce, and King Counties and all of Kitsap County are located within WRIA 15. The WRIA 15 WRE committee agreed to develop high and low growth projection scenarios based on varying the Kitsap and Pierce County projections. At this time, Mason County and King County growth projections remained the same for the baseline high and low scenario projections; however the Squaxin Island Tribe has expressed interest in possibly seeing a higher growth scenario or safety factor for Mason County. Mason County wants to ensure that the adaptive management component of the plan considers the results of the census for changes in population growth (available in 2022).

2.1 Kitsap County

Two methods were used to project growth over the planning horizon for Kitsap County. Both the Kitsap County Land Capacity Analysis, completed by County staff, and the Historical Wells Method, completed by Kitsap Public Utility District (Kitsap PUD), result in similar numbers:

Kitsap County Land Capacity Analysis

- 1) Identify 20-year growth projections from the Kitsap Regional Coordinating Council growth projections (conversion to single-family residences based on assumed people per household and rural growth target).

- 2) Allocate growth by subbasin based on proportion of historical building permits by subbasin from 2002 to 2019.
- 3) Conduct a land capacity analysis. Determine vacant parcels within each subbasin that is within and outside of the waterline or sewerline 200-foot buffer. Assume that all parcels greater than 0.15 acre are buildable if they are within the 200-foot buffer. Buildout capacity for parcels greater than 0.75 acre outside of a 200-foot waterline buffer is assumed to be served by PE wells. Assume that that growth occurs along the waterline areas first, and that the forecasted number of PE wells is less than the forecasted number of single family residences as some wells may have multiple connections.
- 4) Multiply the growth for each subbasin (step 2) by the proportion of growth expected to be served by PE wells(step 3).
- 5) The application of this method to City of Bainbridge Island results in no new PE wells. An alternative method for City of Bainbridge Island was performed which assumes one PE well connection per parcel, regardless of parcel size. It was also assumed that growth occurs along the waterline areas first with the remaining growth occurring on parcels needing PE wells.

Kitsap County developed three iterations of growth projections in rural areas based on varying the minimum parcel size to be suitable for a PE well in the land capacity analysis (Step 3). The versions included 0.25 acre, 0.75 acre, and 1.0 acre. The final version recommended by the county assumed a minimum acreage for PE wells of 0.15 acre in their land capacity analysis and also used additional data on water lines and sewer lines (as a proxy for water lines). This version was provided to HDR on November 22, 2019. Kitsap County provided a flow chart of the land capacity analysis and heat map (HDR 2019a).

Historical Wells Method:

- 1) Calculate historical growth rates of PE wells using County records of wells drilled (2003-2018). Note this is all wells drilled, not just PE wells.
- 2) Forecast growth of future PE well connections for the 20-year planning horizon, based on the historical growth rate.
- 3) Allocate growth of PE wells within each subbasin spatially, based upon land capacity analysis (i.e., parcel must be outside of UGA, not in a water and wastewater system boundary, not already built upon, or must have zoning category that allows for domestic use).

2.2 King County

The following methods were used to project growth over the planning horizon:

- 1) Use historical building permit data (2000–2017) to project future growth.
- 2) Define if each historical building permit used for growth projections is public or private (aka PE well) water service.
- 3) Multiply the annual (projected) number of building permits per year by the percentage of permits using private water to determine a projected number of PE well connections per year to yield the annual rate of PE well connections.

- 4) Multiply the rate of annual PE well connections by 20 for the estimated total of PE well connections over a 20-year period.
- 5) Overlay subbasins to determine number of new PE well connections in each subbasin.
- 6) Remove the portion of the wells that are projected to be inside of the water district service boundaries.

The King County method is described in more detail in a technical memo provided by the county dated December 16, 2019 (HDR 2019a). King County growth projections did not change from the initial projections on July 31, 2019.

2.3 Mason County

The following methods were used to project growth during the planning horizon:

- 1) Develop 20-year growth projections based on the Mason County Comprehensive Plan (the Comprehensive Plan is based on Office of Financial Management medium population growth estimates, and conversion to dwelling units based on assumed people per dwelling unit).
- 2) Determine available land for single-family domestic units and determine proportion of buildout capacity by county urban growth areas (UGAs) and rural lands.
- 3) Apply growth projections to buildable lands.
- 4) Remove projected development unlikely to connect to a PE well (i.e., parcel is located within a water system service area; parcel is smaller than 1 acre).
- 5) Overlay subbasins to determine new PE connections in each subbasin.

Initial growth projections for Mason County were updated because of 1) updates to county parcel attributes and 2) a request from the WRIA 14 and WRIA 15 WRE committees to account for PE wells within water system service areas. Parcel data were updated to correct for circumstances where the zoning and land use attributes identified a parcel as buildable but were also associated with a feature that was incompatible with building (e.g., on top of a waterbody). The initial methods assumed zero PE well growth within water system service areas in both the urban growth areas (UGAs) and rural areas. HDR developed a method that allocates PE well growth in rural water systems proportional to the number of parcels in each water system not currently served by the water system.

The method is comprised of the following steps:

- 1) Assume future growth is proportional to buildable parcels with available water system hookup and parcels that would require a PE well or connection for development.
- 2) Define total buildable parcels per county buildable lands analysis that are contained within each respective water system service area. The water system service areas are defined by the Washington State Department of Health (DOH) as polygons in the Geographic Information Service (GIS) platform.
- 3) Define active and total approved (active + available) water system connections from the DOH Sentry database.

- 4) Calculate buildable parcels with an available water system hookup (total approved minus active water system connections)
- 5) Calculate buildable parcels that would require a PE well or connection for development (total buildable parcels minus total approved connections).
- 6) Calculate ratio of buildable parcels that would require a PE well or connection (step 5) to the parcels with an available water system hookup (step 4) and multiply by the number of dwellings predicted to occur in that water system service area.

2.4 Pierce County

The following methods were used to project growth over the planning horizon:

- 4) Calculate historical growth rates of PE wells for each subbasin using the Tacoma-Pierce County Health District (TPCHD) well database (1999–2018).
- 5) Forecast growth of future PE well connections for the planning horizon, based on the subbasin-specific historical growth rate.
- 6) Allocate growth of PE wells within each subbasin spatially, based upon a parcel assessment for PE well potential (i.e., parcel must be outside of UGA, not in a water and wastewater system boundary, not already built upon, or must have zoning category that allows for domestic use).

No changes were made to the growth projection methods or results occurred since the initial growth projection on July 31, 2019.

2.5 High and Low Growth Scenarios

Because of the uncertainty in the projections, the WRIA 15 Committee evaluated additional permit-exempt well scenarios using different periods in the historical TPCHD well database. The high growth scenario uses the 1999–2008 data, which was a time of relatively healthy economic growth resulting in more rapid rural development. The low growth scenario uses the 2009–2018 data, which was a time of a relatively slower rate of rural development and corresponds with the recession and housing downturn. For Kitsap County, a plus or minus five percent was used to calculate the high and low growth scenario. The five percent is based on the margin of error between the County's rural growth projections and actual growth. High and low growth scenarios were not calculated for Mason or King Counties at the Counties' request.

3.0 WRIA 15 Consumptive Use Methods

Consumptive use of water from projected PE well growth was estimated using three different methods; 1) the Irrigated Area Method; 2) the Water System Data Method and; 3) the USGS Groundwater Model Method

3.1 Irrigated Area Method

Consumptive use was calculated using Ecology's recommended assumptions for indoor and outdoor consumptive use (Ecology 2018; 2019).

3.1.1 Indoor Consumptive Use – Irrigated Area Method

Ecology (2018; 2019) recommends the following assumptions for estimating indoor consumptive water use:

- 60 gallons per day per person within a household
- 2.5 persons per household (or as otherwise defined by the Counties)
- 10 percent of indoor use is consumptively used
 - o Most homes served by a PE well use septic systems for wastewater. This method assumes 10 percent of water entering the septic system will evaporate out of the septic drain field and the rest will be returned to the groundwater system.

The above assumptions were used to estimate indoor consumptive water use by occupants of a single dwelling unit. Assuming that there is one PE well connection per dwelling unit, a “per PE well connection” consumptive use factor was applied to the growth projections forecast in each subbasin to determine total indoor consumptive use per subbasin. This method is summarized by the following equation:

$$HCIWU \text{ (gpd)} = 60 \frac{\text{gal}}{\text{day} * \text{person}} * 2.5 \frac{\text{people}}{\text{household}} * CUF$$

Where:

HCIWU = Household Consumptive Indoor Water Use (gpd)

CUF= Consumptive use factor; assumed to be 10% (factor expressed as 0.10)

This estimate of indoor per household per day can be annualized and converted to acre-feet per year or cubic feet per second.

3.1.2 Outdoor Consumptive Use – Irrigated Area Method

Ecology (2018; 2019) recommends estimating future outdoor water use based on an estimate of the average outdoor irrigated area for existing homes served by PE wells. To calculate the consumptive portion of total outdoor water required per parcel/connection over a single growing season, Ecology recommends:

- Estimating the average irrigated lawn area (pasture/turf grass) per parcel in each WRIA,
- Applying crop irrigation requirements,
- Correcting for application efficiency (75 percent efficiency recommended by Ecology guidance) to determine the total outdoor water required over a single growing season, and
- Applying a percentage of outdoor water that is assumed to be consumptive (80 percent outdoor consumptive use recommended).

WRE Committees were given the opportunity to adjust variables used in the analysis when applicable to the specific WRIA. WRIA 15 opted not to adjust variables.

The average irrigated area in WRIA 15 was estimated by measuring areas of visible irrigation (i.e. green lawns relative the surrounding, gardens, managed landscaping) in using aerial imagery in 80 random parcels with existing dwellings that have a PE well or connection (Figure 1). The average irrigated area was 0.08 acres (Table 1). Most parcels evaluated did not have visible signs of irrigation in the aerial imagery (Figure 2). Detailed methods and results are defined in the consumptive use methods technical memorandum and report (HDR 2019b).

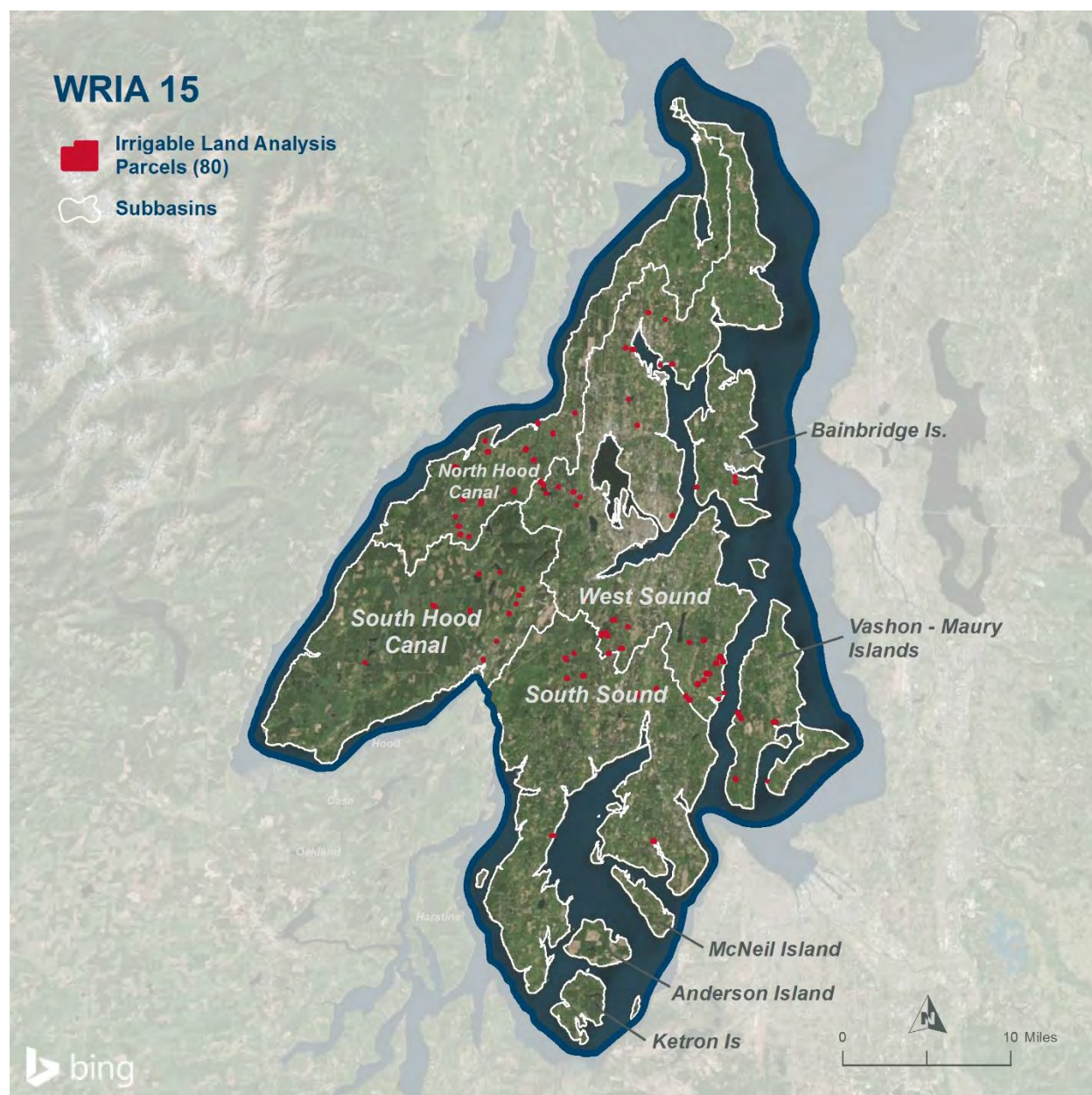


Figure 1. Parcels selected in WRIA 15 with existing PE well that were delineated for apparent irrigated areas.

Table 1. Irrigated acreage delineation results.

Statistic	WRIA 15
PE Parcel Sample Pool	8,987
Sample Size	80
Mean (acres)	0.08
Standard Deviation (acres)	0.13
95% UCL (acres)	0.14

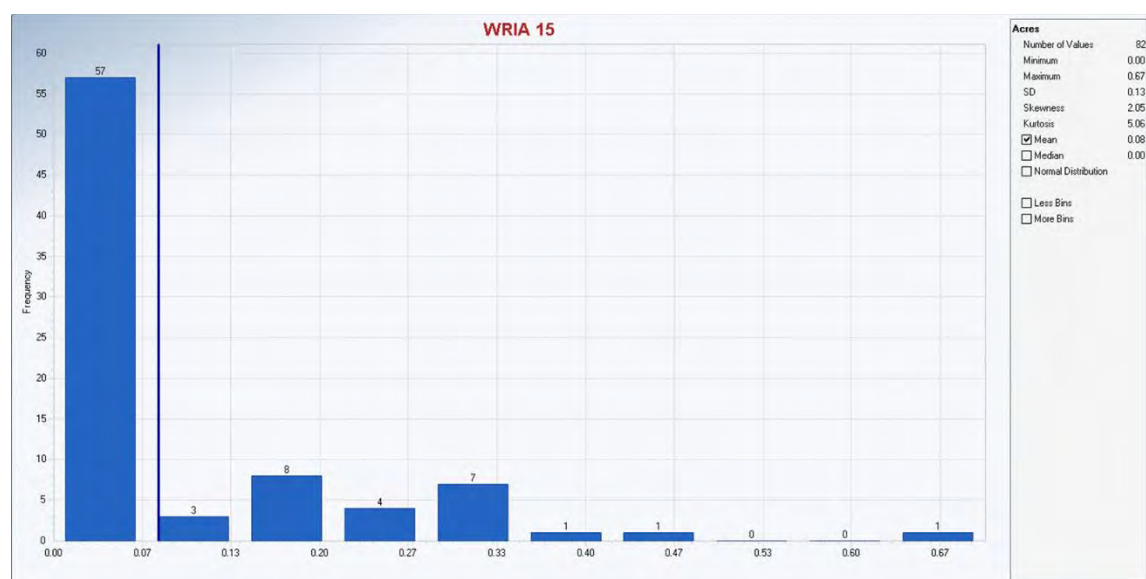


Figure 2. Histogram of WRIA 15 irrigated acreage delineation results.

Once average irrigable acreage per connection was determined for a WRIA, water use was calculated based on irrigation requirements and application efficiency. Crop irrigation requirements were estimated for pasture/turf grass from nearby stations as provided in the Washington Irrigation Guide (NRCS-USDA, 1997). An irrigation application efficiency was applied to account for water that does not reach the turf. Ecology (2018; 2019) recommends using a 75 percent application efficiency factor. The consumptive portion of total amount of water used for outdoor use was assumed to be 80 percent of the total. This method is summarized in the following equation:

$$HCOWU (gpd) = A (acres) * IR(feet) * AE * CUF * CF$$

Where:

HCOWU = Household Consumptive Outdoor Water Use (gpd)

A = Irrigated Area (acres)

IR = Irrigation Requirement over one irrigation season (feet)

AE = Application efficiency; assumed to be 75% (factor expressed as 1/0.75)

CUF= Consumptive use factor; assumed to be 80% (factor expressed as 0.80)

CF = Conversion Factor to convert afy to gpd; 1 afy = 892.742 gpd

Uncertainty in Irrigated Area Calculations

The irrigated area measurements were performed using a set of 80 parcels distributed throughout WRIA 15. The number of parcels selected was based on the budget for this task as agreed to by HDR and Ecology. Concern was expressed by some members of the Committee that a repeatable, spatially distributed, and statistically valid subset of parcels was not used. While this concern was recognized and acknowledged, ultimately the Committee determined that the results were representative of the WRIA.

The parcels analyzed were selected using the following procedure:

- Define the available pool of parcels with existing PE wells using Tacoma-Pierce County Health Department data for Pierce County and in Mason, Kitsap and King counties using assessor's data and water system boundary data to locate existing residences not served by water systems
- Classify parcels by value (less than \$350,000, \$350-600,000, greater than \$600,000)
- From the available pool of parcels, randomly select a subset of parcels throughout WRIA 15, while ensuring the distribution of parcel values is like that of the entire WRIA 15

The parcel selection procedure provided a spatially distributed and representative sample of parcels with PE wells.

After measuring irrigated area for the subset of 80 parcels, the results were presented to a WRIA 15 workgroup. Kitsap PUD and the Suquamish Tribe performed analyses to independently verify the results. The two independent analyses confirmed the findings of the irrigated area analysis. This indicates the procedure was repeatable. The Committee, with their knowledge of the WRIA, stated that the results were in line with water use in the WRIA. In addition, the technique used to delineate irrigated area was subject to a quality assurance check by another consultant, GeoEngineers, at the request of Ecology (GeoEngineers and HDR, 2020).

The average irrigated area measured for the 80 parcels is 0.08 acres. The area is low due to a high number of non-irrigated parcels. HDR performed statistical analyses of the irrigated acreage to estimate the upper confidence limits and to determine the sample size of parcels required to estimate a mean value of irrigated acreage for error margins ranging from 0.01 acre to 0.06 acre. It was found the set of 80 parcels allows the mean to be calculated within a 0.03-acre error margin.

The Committee reviewed the irrigated area calculations and chose not to adjust the calculations by assuming a base amount of irrigation instead of zero for non-irrigated parcels. The Committee believes that 0.08 acres is representative of the irrigated areas for PE wells in WRIA 15 and adopted that value for consumptive use calculations. Factors in that decision are the conservative nature of the consumptive use calculation when applied to the irrigated area and the independent analyses performed to confirm the measurements of irrigated acreage.

At the request of Committee members, the consultant team considered other approaches to measuring and calculating average irrigated area. Measurement techniques using remote sensing data were considered but it was determined that it would be more costly and time-consuming than the method employed by HDR. Additional parcels for analysis were delineated and provided to Committee members for additional analysis for further verification of average irrigated area. No additional analysis was received from Committee members.

3.2 Water System Data Method

Consumptive use by PE wells and connections may also be estimated using metered connections from water systems. HDR requested data from WRE Committee members for water systems that use (or have used) a flat rate billing structure and were similar in character to the rural environments in which households may connect to PE wells. In WRIA 15, Kitsap PUD provided consumption data for all Kitsap PUD water systems for years 2017 and 2018.

3.2.1 Indoor Use

Average daily use in December, January, and February is representative of year-round daily indoor use. Average daily system-wide use is divided by the number of connections (assuming all connections are residential), to determine average daily indoor use per connection. A 10 percent consumptive use factor was applied to the average daily use in the winter months to determine the consumptive portion of indoor water use per connection.

3.2.2 Outdoor Water Use

Average daily indoor use was multiplied by the number of days in a year to estimate total annual indoor use. Total annual indoor use was subtracted from total annual use by a water system to estimate total annual outdoor use. An 80 percent consumptive factor was applied to determine the consumptive portion of outdoor use.

3.2.3 Seasonal Outdoor Water Use

Outdoor consumptive use was also estimated on a seasonal basis. The Washington Irrigation Guide reports irrigation requirements between the months of April and September for representative weather stations in WRIA 15. Therefore, seasonal outdoor water use was assumed to occur over a period of six months. Average daily indoor use was multiplied by the number of days in the irrigation season to calculate total indoor use for the irrigation season. Total irrigation season indoor use was then subtracted from total season use to determine total outdoor use for the irrigation season. The value was proportionally allocated to each month in the irrigation season using the requirements from the Washington Irrigation Guide. An 80 percent consumptive factor was applied to determine the consumptive portion of outdoor use.

3.3 USGS Groundwater Model Method

A groundwater-flow model was developed by the USGS to improve understanding of water resources on the Kitsap Peninsula. The study area did not include WRIA 15 areas of Key Peninsula, and Vashon, Fox, Anderson, McNeil and Ketron Islands. The first step in the modeling process was to characterize the groundwater-flow system on the Kitsap Peninsula and to prepare a water budget for the study area, which are contained in the report titled *Hydrogeologic Framework, Groundwater Movement and Water Budget of the Kitsap Peninsula, West-Central Washington* (Welch, Frans, and Olsen, 2014). The report provides a survey of consumption from select water utilities serving more than 221,700 people with more than 88,500 residential connections on the Kitsap Peninsula. The USGS study differentiated between the indoor and outdoor portions of use. Estimated indoor use (based on November–April pumping values) was 66 gallons per person per day. Outdoor use was estimated for the outdoor growing season and varied by month from 4 gallons per person per day in May to 97 gallons per person per day in September. The average annual outdoor use was estimated to be 26 gallons per person per day. For the purposes of groundwater modeling USGS set the consumptive use rate for indoor domestic use at 10 percent in nonsewered areas, and the

consumptive use rate for outdoor use at 90 percent. The water use values and consumptive use rates for the USGS study area are used in this report to develop an additional estimate of consumptive use per permit-exempt connection for the entire WRIA 15. To differentiate this method from the water system data method that uses Kitsap PUD managed water system data, it is termed the USGS groundwater model method.

4.0 Results

4.1 PE Connection Growth

Baseline PE connection growth is projected to be 5,568 connections (Table 2). The high PE growth scenario is projected to have 584 additional connections, for a total of 6,152 PE connections. The low PE growth scenario is projected to have 707 fewer connections than the baseline scenario, for a total of 4,861 PE connections. PE connection growth is expected to be greatest in the “South Sound” subbasin.

4.2 Consumptive Use

The irrigated area method yielded a total consumptive use per PE connection of 122.9 gpd.

The water system data method yielded a total consumptive use per PE connection of 64.3 gpd. The USGS model method yielded a total consumptive use per PE connection of 75 gpd.

The estimates of consumptive use in WRIA 15 over the 20 year planning horizon using the irrigation area method was 1.06 (baseline), 0.93 (low growth), and 1.17 cfs (high growth).

The estimates of consumptive use in WRIA 15 over the planning horizon using the water system data method were 0.55 cfs (baseline), 0.48 cfs (low growth), and 0.61 cfs (high growth).

The estimates of consumptive use in WRIA 15 over the planning horizon using the USGS model method were 0.65 cfs (baseline), 0.57 (low growth), and 0.72 (high growth).

For WRIA 15 scenarios, the estimates of consumptive use using the irrigation area method estimates are approximately 1.9 times higher than the water system data method. Consumptive use is 1.1 times higher in the high growth scenario than the baseline scenario, and approximately 1.7 times higher than the USGS model method. Consumptive use is approximately 1.14 times higher in the baseline scenario than the low growth scenario.

Table 2. Annualized Average Consumptive Use Estimates for WRIA 15 – Baseline Growth

Annualized Consumptive Use Estimates for WRIA 15 (2020–2040) – Baseline Growth Projection; 0.75 acre minimum threshold										
Subbasin	Projected PE Well Connections	Annual Consumptive Use: Water System Estimate			Annual Consumptive Use: USGS Estimates			Annual Consumptive Use: Irrigated Area Estimate (per Ecology Guidance)		
		AFY	GPM	CFS	AFY	GPM	CFS	AFY	GPM	CFS
West Sound	1,336	96.2	59.6	0.1331	112.2	69.6	0.1553	183.9	114.0	0.2545
Hood Canal	656	47.2	29.3	0.0653	55.1	34.2	0.0763	90.3	56.0	0.1249
South Hood Canal	1,126	81.0	50.2	0.1121	94.6	58.6	0.1309	155.0	96.1	0.2145
Bainbridge Island	491	35.3	21.9	0.0489	41.3	25.6	0.0571	67.6	41.9	0.0935
South Sound	1,553	111.8	69.3	0.1547	130.5	80.9	0.1805	213.8	132.5	0.2958
Vashon – Maury Island	368	26.5	16.4	0.0367	30.9	19.2	0.0428	50.7	31.4	0.0701
McNeil Island, Anderson Island, Ketron Island	38	2.7	1.7	0.0038	3.2	2.0	0.0044	5.2	3.2	0.0072
Totals	5,568	400.8	248.4	0.5545	467.8	290.0	0.6473	766.4	475.1	1.0605

Table 3. Annualized Average Consumptive Use Estimates for WRIA 15 – Low Growth

Annualized Consumptive Use Estimates for WRIA 15 (2020–2040) - Low Growth Projection; 0.75 acre minimum threshold										
Subbasin	Projected PE Well Connections	Annual Consumptive Use: Water System Estimate			Annual Consumptive Use: USGS Estimates			Annual Consumptive Use: Irrigated Area Estimate (per Ecology Guidance)		
		AFY	GPM	CFS	AFY	GPM	CFS	AFY	GPM	CFS
West Sound	1,142	82.2	51.0	0.1137	95.9	59.5	0.1328	157.2	97.4	0.2175
Hood Canal	561	40.4	25.0	0.0559	47.1	29.2	0.0652	77.2	47.9	0.1068
South Hood Canal	1,119	80.5	49.9	0.1114	94.0	58.3	0.1301	154.0	95.5	0.2131
Bainbridge Island	491	35.3	21.9	0.0489	41.3	25.6	0.0571	67.6	41.9	0.0935
South Sound	1,158	83.3	51.7	0.1153	97.3	60.3	0.1346	159.4	98.8	0.2206
Vashon – Maury Island	368	26.5	16.4	0.0367	30.9	19.2	0.0428	50.7	31.4	0.0701
McNeil Island, Anderson Island, Ketron Island	22	1.6	1.0	0.0022	1.8	1.1	0.0026	3.0	1.9	0.0042
Totals	4,861	349.9	216.9	0.4841	408.4	253.2	0.5651	669.1	414.8	0.9258

Table 4. Annualized Average Consumptive Use Estimates for WRIA 15 – High Growth

Annualized Consumptive Use Estimates for WRIA 15 (2020–2040) - High Growth Projection; 0.75 acre minimum threshold										
Subbasin	Projected PE Well Connections	Annual Consumptive Use: Water System Estimate			Annual Consumptive Use: USGS Estimates			Annual Consumptive Use: Irrigated Area Estimate (per Ecology Guidance)		
		AFY	GPM	CFS	AFY	GPM	CFS	AFY	GPM	CFS
West Sound	1,403	101.0	62.6	0.1397	117.9	73.1	0.1631	193.1	119.7	0.2672
Hood Canal	689	49.6	30.7	0.0686	57.9	35.9	0.0801	94.8	58.8	0.1312
South Hood Canal	1,128	81.2	50.3	0.1123	94.8	58.8	0.1311	155.3	96.2	0.2148
Bainbridge Island	516	37.1	23.0	0.0514	43.4	26.9	0.0600	71.0	44.0	0.0983
South Sound	1,992	143.4	88.9	0.1984	167.4	103.8	0.2316	274.2	170.0	0.3794
Vashon – Maury Island	368	26.5	16.4	0.0367	30.9	19.2	0.0428	50.7	31.4	0.0701
McNeil Island, Anderson Island, Ketrion Island	56	4.0	2.5	0.0056	4.7	2.9	0.0065	7.7	4.8	0.0107
Totals	6,152	442.8	274.5	0.6127	516.9	320.4	0.7152	846.8	524.9	1.1717

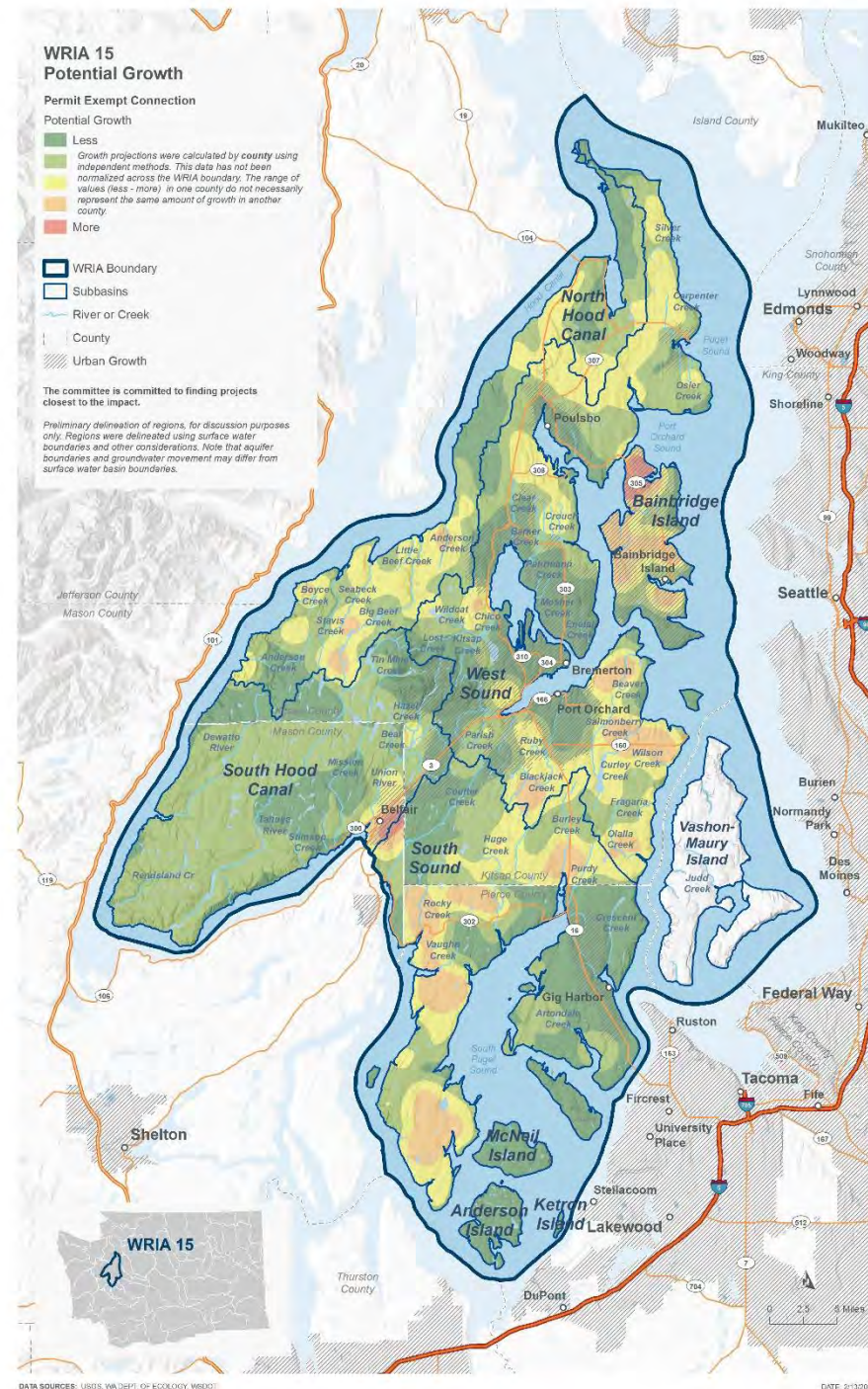


Figure 3. WRIA 15 projected PE connection growth.

5.0 Seasonal Use

Monthly outdoor water use was calculated as part of the consumptive use analysis for the Irrigated Area method. Seasonal water use by month is reported by subbasin and scenario (Table 4). The month of July has the highest irrigation requirement, resulting in the highest monthly consumptive use impact. This information may be used when evaluating projects designed to offset subbasin- and season-specific impacts.

Table 4: WRIA 15 Monthly Consumptive Water Use

Subbasin	Projected No. PE Wells (Baseline)	Consumptive Use by Month (cfs)											
		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
West Sound	1,336	0.0311	0.0311	0.0311	0.0311	0.3316	0.7239	0.9879	0.7585	0.3726	0.0311	0.0311	0.0311
Hood Canal	656	0.0153	0.0153	0.0153	0.0153	0.1628	0.3555	0.4851	0.3724	0.1829	0.0153	0.0153	0.0153
South Hood Canal	1,126	0.0262	0.0262	0.0262	0.0262	0.2795	0.6101	0.8327	0.6393	0.3140	0.0262	0.0262	0.0262
Bainbridge Island	491	0.0114	0.0114	0.0114	0.0114	0.1219	0.2661	0.3631	0.2788	0.1369	0.0114	0.0114	0.0114
South Sound	1,553	0.0361	0.0361	0.0361	0.0361	0.3855	0.8415	1.1484	0.8817	0.4331	0.0361	0.0361	0.0361
Vashon – Maury Island	368	0.0086	0.0086	0.0086	0.0086	0.0914	0.1994	0.2721	0.2089	0.1026	0.0086	0.0086	0.0086
McNeil Anderson, Ketron	38	0.0009	0.0009	0.0009	0.0009	0.0094	0.0206	0.0281	0.0216	0.0106	0.0009	0.0009	0.0009
Totals	5,568	0.1295	0.1295	0.1295	0.1295	1.3822	3.0171	4.1174	3.1612	1.5527	0.1295	0.1295	0.1295
Subbasin	Projected No. PE Wells (Low Growth)	Consumptive Use by Month (cfs)											
		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
West Sound	1,142	0.0266	0.0266	0.0266	0.0266	0.2835	0.6188	0.8445	0.6484	0.3185	0.0266	0.0266	0.0266
Hood Canal	561	0.0130	0.0130	0.0130	0.0130	0.1393	0.3040	0.4148	0.3185	0.1564	0.0130	0.0130	0.0130
South Hood Canal	1,119	0.0260	0.0260	0.0260	0.0260	0.2778	0.6064	0.8275	0.6353	0.3120	0.0260	0.0260	0.0260
Bainbridge Island	491	0.0114	0.0114	0.0114	0.0114	0.1219	0.2661	0.3631	0.2788	0.1369	0.0114	0.0114	0.0114
South Sound	1,158	0.0269	0.0269	0.0269	0.0269	0.2875	0.6275	0.8563	0.6574	0.3229	0.0269	0.0269	0.0269
Vashon – Maury Island	368	0.0086	0.0086	0.0086	0.0086	0.0914	0.1994	0.2721	0.2089	0.1026	0.0086	0.0086	0.0086

McNeil Anderson, Ketron	22	0.0005	0.0005	0.0005	0.0005	0.0055	0.0119	0.0163	0.0125	0.0061	0.0005	0.0005	0.0005
Totals	4,861	0.1130	0.1130	0.1130	0.1130	1.2067	2.6340	3.5946	2.7598	1.3555	0.1130	0.1130	0.1130
Subbasin	Projected No. PE Wells (High Growth)	Consumptive Use by Month (cfs)											
		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
West Sound	1,403	0.0326	0.0326	0.0326	0.0326	0.3483	0.7602	1.0375	0.7965	0.3912	0.0326	0.0326	0.0326
Hood Canal	689	0.0160	0.0160	0.0160	0.0160	0.1710	0.3733	0.5095	0.3912	0.1921	0.0160	0.0160	0.0160
South Hood Canal	1,128	0.0262	0.0262	0.0262	0.0262	0.2800	0.6112	0.8341	0.6404	0.3145	0.0262	0.0262	0.0262
Bainbridge Island	516	0.0120	0.0120	0.0120	0.0120	0.1281	0.2796	0.3816	0.2930	0.1439	0.0120	0.0120	0.0120
South Sound	1,992	0.0463	0.0463	0.0463	0.0463	0.4945	1.0794	1.4730	1.1309	0.5555	0.0463	0.0463	0.0463
Vashon – Maury Island	368	0.0086	0.0086	0.0086	0.0086	0.0914	0.1994	0.2721	0.2089	0.1026	0.0086	0.0086	0.0086
McNeil Anderson, Ketron	56	0.0013	0.0013	0.0013	0.0013	0.0139	0.0303	0.0414	0.0318	0.0156	0.0013	0.0013	0.0013
Totals	6,152	0.1430	0.1430	0.1430	0.1430	1.5272	3.3336	4.5493	3.4928	1.7155	0.1430	0.1430	0.1430

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2784 **Appendix H – Project Inventory**
2785 **WRIA 15 Project Inventory for Inclusion in the Watershed Restoration and Enhancement Plan**
2786 CATEGORIES (does not reflect prioritization)
2787 I. Ready to implement and provides quantitative offset value (see Chapter 5).
2788 II. Ready to implement and provides habitat benefit and un-quantifiable streamflow benefit.
2789 III. Provides habitat only benefit.
2790 IV. Unable to implement at this time because the project is highly conceptual or not currently
2791 legal.

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
Bainbridge Island Subbasin												
III	Springbrook Creek Bridge	Habitat no Offset	47°38'35.0"N 122°34'02.5"W	Reconnect side channel habitat and minor flood plain restoration. (Part of a larger barrier removal project.)					City of Bainbridge Island/Bainbridge Island Land Trust	Final Design / Construct	\$1,200,000 (includes barrier removal costs)	\$200,000
IV	Transfer surface water right to groundwater for public farmland	Water Rights Acquisition	47°37'50.8"N 122°33'27.9"W	Switch irrigation source from surface reservoir to existing or new well to re-time stream flows and improve stream temperature issues.	TBD				City of Bainbridge Island/Friends of the Farms	Feasibility		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	KPUD Stream Augmentation Project	Offset no Habitat		Kitsap Public Utility District (KPUD) currently owns and operates 54 public water systems throughout rural Kitsap County. KPUD is proposing to augment streams that are located near water mains of their systems. The water would be produced from either existing water-supply wells or new wells installed to be dedicated only for stream augmentation. The objective of the project is to provide “water-for-water” offset for future permit-exempt wells (PEWs) by discharging water indirectly into the stream to augment streamflow. KPUD has systems located in West Sound, North Hood Canal and Bainbridge Island subbasins of WRIA 15. Some members of the WRIA 15 Committee support further exploration of this project through feasibility studies. There are a number of concerns, including impact on deep aquifers and water quality. If KPUD decides to pursue this project, close coordination with the WRIA 15 Tribes and WRIA 15 partners is recommended.	67.6			Kitsap PUD		Conceptual	\$10,000 per site plus \$8000 annual O&M	
North Hood Canal Subbasin												
II	Big Beef Creek Restoration	Habitat with Offset	Multiple Parcels (hidden for privacy)	Restore wetlands, floodplain, and riparian along this ditched segment of upper Big Beef Creek. Acquisition likely needed.						Scoping		\$667,092

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
II	Grovers Creek and Leyman Wetland Restoration	Habitat with Offset	Robinson and Duncans parcels	Stream channel and wetland restoration are proposed on 1,600 feet of Grovers Creek and 10 acres of wetlands. Two parcels owned by the Robinson and Duncans were historically farmed, reed canary grass established and stream channel ditched. The project will improve fish passage and establish wetland and riparian vegetation. The project will also enhance water infiltration and improve floodplain function. This project will benefit Coho, Chum, steelhead and cutthroat habitat. Funding for restoration design has been obtained and preliminary design is in progress. Funding for final design and construction are needed.		1600 ft of stream restoration ; 10 acres wetland		Kitsap Conservation District (KCD)		Design	\$300,000	
II	Hansville Wetland Enhancement	Habitat with Offset	Hansville	Degraded wetland could be restored.			Link			Conceptual		
IV	Big Beef Refugia Acquisitions	Habitat no Offset						Kitsap County		Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	KPUD Stream Augmentation Project	Offset no Habitat		Kitsap Public Utility District (KPUD) currently owns and operates 54 public water systems throughout rural Kitsap County. KPUD is proposing to augment streams that are located near water mains of their systems. The water would be produced from either existing water-supply wells or new wells installed to be dedicated only for stream augmentation. The objective of the project is to provide “water-for-water” offset for future permit-exempt wells (PEWs) by discharging water indirectly into the stream to augment streamflow. KPUD has systems located in West Sound, North Hood Canal and Bainbridge Island subbasins of WRIA 15. Some members of the WRIA 15 Committee support further exploration of this project through feasibility studies. There are a number of concerns, including impact on deep aquifers and water quality. If KPUD decides to pursue this project, close coordination with the WRIA 15 Tribes and WRIA 15 partners is recommended.	90.3			Kitsap PUD		Conceptual	\$10,000 per site plus \$8000 annual O&M	
South Hood Canal Subbasin												
II	Tahuya Headwaters	Habitat with Offset	Tahuya River (South Kitsap)	Purchase of fee and/or easement of up to 3 miles of riparian corridor in the upper Tahuya River and tributaries. Floodplain restoration including potential for LWD placement and BDA. Currently under one timberland owner.		3 miles riparian corridor protected				Acquisition		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Bremerton Reclaimed Water/Water Reuse Feasibility Study	Offset no Habitat		Pursue feasibility studies for reclaimed and reuse water opportunities.								
IV	Mason County Rooftop Runoff Infiltration Project-	Offset no Habitat	County Wide	Mason County has proposed a possible modification of the County building code to require capture of roof runoff from new rural residential (RR) development, typically on 5 acre parcels or greater, with direct connection to home site infiltration facilities (i.e., parcel dry wells, infiltration trenches, infiltration galleries, or rain gardens). This proposed code revision would typically require infiltration facilities that achieve recharge of 85 percent of the annual average rooftop runoff for new RR parcel development roof, with some reduction possible in less permeable soils to limit infiltration facility sizes.	72			Mason County				
South Sound Subbasin												
II	Coulter Creek Protection	Habitat with Offset	Coulter Creek	Coulter Creek. Protection (acquisition of fee or easement) of riparian buffer and floodplain restoration of 3-5 mile riparian corridor owned by single landowner.		3-5 miles riparian protection and restoration		GPC		Acquisition		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
III	Gig Harbor Golf Club Artondale Creek Habitat Improvement	Habitat with Offset	Artondale Creek	A portion of Artondale Creek and approximately 2 acres of the floodplain would be restored by replacing two existing bridges to open up the floodplain and plantings to increase shade, improve instream habitat, reduce stream temperature, and improve riparian buffers and upland habitat conditions. The restoration project may also be extended downstream if needed to improve fish passage to the project site. The project is located in the South Sound subbasin of WRIA 15 on the Gig Harbor Peninsula.		Improve instream and floodplain habitat conditions; improve water temperatures.			Gig Harbor Golf Club, Pierce Co, Tribe	Conceptual	\$500,000 (with offset improvements)	
III	Rocky Creek Protection and Riparian Buffer	Habitat no Offset	Rocky Cr	Rocky Creek. Protection (acquisition of fee or easement) of riparian buffer and floodplain restoration of ~4 mile riparian corridor owned by single landowner.		4 miles riparian corridor protection and restoration		GPC		Acquisition		
IV	Upper Little Minter Creek watershed acquisition and floodplain/wet land restoration project	Habitat with Offset	Little Minter Creek - 15311 and 12521 94TH AV NW	Reconnecting ditches, more sinuosity, beaver habitat; potential water right.						Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Upper Burley Creek Floodplain/ Wetland Restoration	Habitat with Offset	East of Bethel Burley Road, south of Holman Road. Kitsap Co Parcels: 242301-3-016-2006, 242301-3-017-2005, 252301-2-009-2006, 252301-2-038-2001, 252301-2-039-2000, 252301-2-047-2000	Restore wetlands, floodplain, and riparian along this segment of Burley Creek that has been ditched and drained. Acquisition likely needed also.						Conceptual		
IV	Mid Burley Creek Floodplain/ Wetland Restoration	Habitat with Offset	East of Bethel Burley Road, south of Swofford Lane. Kitsap Co Parcels: 362301-2-004-2008, 362301-2-003-2009, 9000-010-192-0008, 362301-2-021-2007, 362301-2-022-2006, 362301-2-012-2008, 362301-2-005-2007, 362301-2-014-2006, 362301-3-021-2005, 362301-3-020-2006	Restore wetlands, floodplain, and riparian along this segment of Burley Creek that has been ditched and drained. Acquisition likely needed also.						Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	360 Trails/Gateway Park	Habitat with Offset	Minter Creek - E of Gateway Park, N of SR 302, W of 94th Ave NW	Education/outreach, land acquisition, conservation easement, beaver enhancement opportunity.					WDFW or Kitsap Conservation District	Conceptual		
IV	Burley Creek Drainage Floodplain and Ag Restoration	Habitat with Offset	North of Bethel Burley and Burley Olalla intersection.							Conceptual		
IV	Pierce County parcels near Belfair - 186th Ave	Habitat with Offset	Pierce County property - undeveloped woodland/riparian on Rocky Creek. 13711 186th Ave NW, Gig Harbor	Assess riparian area for floodplain or wetland enhancement						Conceptual		
IV	Filucy Bay Floodplain Enhancement	Habitat with Offset		Restore/improve floodplain and surrounding wetlands on a Pierce Co owned property.						Scoping		
IV	Coulter Tree Farm	Habitat with Offset	Coulter Creek							Conceptual		
IV	Pierce County parcel near Belfair - Elgin Clifton Road	Habitat with Offset	Pierce County property - undeveloped woodland near south branch of Rocky Creek	Assess wetland area for enhancement or beavers						Conceptual		
IV	Floodplain enhancement on multiple sites	Habitat with Offset	Rocky, Curley, L. Anderson, Irene, Grovers	Floodplain restoration on existing properties owned by GPC. Large Woody Debris placement on Rocky Creek, Curley Creek, Little Anderson Creek, Irene Creek. Beaver Dam Analogs on Rocky Creek and Grovers creek preserves.				Great Peninsula Conservancy		Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Artondale Creek Preservation	Habitat no Offset	Parcel removed for privacy.	Identified in the Wild Fish Conservancy (WFC) watershed typing exercise for potential preservation. Land owner is interested.					Great Peninsula Conservancy; Wild Fish Conservancy	Conceptual		
IV	Pierce County parcel near Belfair - Elgin Clifton Road	Offset no Habitat	Pierce County property - public works site. https://epip.co.pierce.wa.us/cfapps/atr/epip/summary.cfm?parcel=0022244000	Stormwater retrofit or MAR at sand/gravel pit.	TBD					Conceptual		
IV	Pierce County parcel near Belfair - Elgin Clifton Road	Offset no Habitat	Pierce County property - undeveloped woodland near south branch of Rocky Creek	Preserve forest for infiltration benefit (conservation easement in trust).						Conceptual		
IV	Pierce County parcel near Home - 18th St NW	Offset no Habitat	Pierce County property - undeveloped woodland. Corner of 18th St NW and 180th Ave NW	Preserve forest for infiltration benefit (conservation easement in trust).						Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Burley Creek Watershed Mine Reclamation Options	Offset no Habitat	West of Bethel Burley Rd, north of High Ridge Ct. Kitsap Co Parcels: 4799-000-009-0008, 4799-000-001-0303, 4799-000-020-0102, 262301-1-039-2001, 262301-1-041-2007, 262301-1-013-2001	Review mine reclamation plan and determine whether infiltration or wetland restoration are options.						Conceptual		
IV	Horseshoe Lake Golf Course Water Use Options	Water Rights Acquisition	Parcel: 5349-000-007-0002	Review water use at Horseshoe Lake Golf Course and consider options for water use reductions, transfer of water rights, etc.						Scoping		
IV	Trophy Lake Golf Course Water Use Options	Water Rights Acquisition	Parcel: 202301-3-010-2006	Review water use at Trophy Lake Golf Course and consider options for water use reductions, transfer of water rights, etc.						Scoping		
IV	Coulter Creek / Estuary		Coulter / Estuary	Opportunities for land acquisition and habitat restoration.			Acquisition + Develop natural storage on GPC properties		Great Peninsula Conservancy	Acquisition	\$350,000	\$0
IV	Burley Creek		Burley Ck	Opportunities for land acquisition and habitat restoration.			Acquisition + Develop natural storage on GPC properties		Great Peninsula Conservancy	Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Purdy Creek		Purdy Ck	Opportunities for land acquisition and habitat restoration.			Acquisition + Develop natural storage on GPC properties		Great Peninsula Conservancy	Conceptual		
IV	Minter Creek		Minter Ck	Opportunities for land acquisition and habitat restoration.			Acquisition + Easement to increase average stand age for higher baseflows		Great Peninsula Conservancy	Acquisition	\$225,000	\$105,000
IV	Rocky Creek		Rocky Creek	Opportunities for land acquisition and habitat restoration.			Develop natural storage on GPC properties		Great Peninsula Conservancy	Conceptual		
IV	Mason County Rooftop Runoff Infiltration Project	Offset no Habitat	County Wide	Mason County has proposed a possible modification of the County building code to require capture of roof runoff from new rural residential (RR) development, typically on 5 acre parcels or greater, with direct connection to home site infiltration facilities (i.e., parcel dry wells, infiltration trenches, infiltration galleries, or rain gardens). This proposed code revision would typically require infiltration facilities that achieve recharge of 85 percent of the annual average rooftop runoff for new RR parcel development roof, with some reduction possible in less permeable soils to limit infiltration facility sizes.	7				Mason Co			

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Filucy Bay projects		Filucy Bay tributaries (Schoolhouse Ck)	Opportunities for land acquisition and habitat restoration.			Develop natural storage on GPC properties		Great Peninsula Conservancy	Conceptual		
South Sound Islands Subbasin												
II	Schoolhouse Creek Restoration	Habitat with Offset	Anderson Island	The Anderson Island Parks District and Pierce County has been working on this Creek for many years. The County replaced two culverts in 2013. There are two remaining barriers on County road that the County is seeking funding from the fish barrier removal board for and one partial barrier on a private road. The Parks District has also been looking for funding to creek meandering and wetland restoration on a section of creek that was previously ditched and used for agriculture.						Construction		
II	East Oro Bay Barrier Removal	Habitat with Offset	Anderson Island, East Oro Bay near Jacobs Point Park	There is an earthen dam that impounds the top of the estuary in East Oro Bay.						Construction		
Vashon Maury Subbasin												
IV	Maury Island Initiative	Water Rights Acquisition	Maury	Property associated with the WR first acquired in 2008 and later in 2019. Portion of the WR may have already been forfeited and remaining portion may be small. Likely .05 CFS instantaneous flow certificate for group domestic supply; Parcel numbers 3222039011, 3222039027	TBD					Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Frog Holler Forest Water Right Acquisition	Water Rights Acquisition	South Vashon	Forest was acquired by VLT in 2016. There may be a water right associated with the property that is at risk of relinquishment in 2021. Likely 6 irrigated acres. Beneficial Use is for irrigation and domestic; Long Claim; Parcel Number 2522029016	6?				King County or Vashon Maury Island Land Trust	Conceptual		
IV	Piner Point	Water Rights Acquisition	South Vashon	Property was acquired by King County Parks in 2014. There is a small cabin on the property and the water right supports domestic water supplies across three properties. Small, but may be important since V-M is a single source aquifer. Est at 1.5 annual acre feet. Parcel 6175800300; Certificate: Domestic Use Multiple	1.5					Conceptual		
IV	Forest Glen Natural Area	Water Rights Acquisition	Vashon	Property acquired in 2014 and converted into a park owned by King County. May be forfeited already or coming up in 2022; Long Claim for domestic supply and irrigation; 16 annual acre feet; 10 GPM instantaneous flow	16					Conceptual		
West Sound Subbasin												
II	Mid Olalla Creek Floodplain/Wetland restoration	Habitat with Offset	Parcels removed for privacy	Restore wetlands, floodplain, and riparian along this segment of Olalla Creek that has been ditched and drained. Acquisition likely needed also.						Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
II	Ruby Creek Restoration	Habitat with Offset	Ruby Creek	Approximately .44 miles of stream will be enhanced by excavating reed canary grass from the channel which is also inhibiting fish passage in this stream section. Installation of LWD, excavation of planting mounds and riparian planting are also proposed. The overall project involves restoration and enhancement of 11.7 acres of stream and wetland habitat. Chum, Coho, cutthroat trout and steelhead are documented in this reach of Ruby Creek. Design is complete and funding is needed for construction. Part of a larger fish barrier removal project.		Open access to 3.5 miles; improve 11.7 acres of stream and wetland habitat			Kitsap Conservation District	Construction		635000 (includes barrier removal)
II	Dogfish Creek Wetland Restoration	Habitat no Offset	Malone parcel	This project involves enhancement of 2,832 feet of Dogfish Creek and enhancement of 24 acres of mapped wetland. The 80 acres owned by Malone was historically farmed, reed canary grass established and stream channel ditched. The project will enhanced beaver activity and establish wetland and riparian vegetation. This project will also improve stream flow and floodplain function. This project will benefit Coho, Chum, steelhead and cutthroat habitat. Funding for restoration design has been obtained and preliminary design is in progress. Funding for final design and construction are needed. Part of a larger fish barrier removal project.		Enhance 2832 feet of creek and 24 acres of wetland		Kitsap Conservation District (KCD)		Design		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
II	Lower Blackjack Creek Subbasin Restoration and Remediation Actions	Habitat with Offset	Lower Blackjack Cr	This project proposes restoration and remediation of stream corridor habitat within the lower Blackjack Creek Subbasin as a subset of the Foster Pilot program within WRIA 15. Each restoration and remediation action has been identified and vetted by the Suquamish Tribe in their Blackjack Creek Watershed Protection and Restoration Plan composed in December, 2017.				Port Orchard Public Works		Design	\$2,133,500	
II	Clear Creek Wetland and Floodplain Restoration	Habitat with Offset						Kitsap County Public Works		Design	\$3,743,045	
II	Lower Blackjack Creek Infrastructure Removal and Habitat Remediation	Habitat with Offset	Lower Blackjack Cr	Assess the feasibility, perform due diligence, then construction/remediation of infrastructure in Blackjack Creek. This is part of the WRIA 15 Foster Pilot program. Projects include: 1. Rehabilitating an existing water main crossing over the creek by directionally drilling the water main to cross underneath the creek and removing the old infrastructure 2. Cleaning up debris from abandoned transient camps and replanting 3. Update old storm drainage to creek/tributary with LID principles				Port Orchard Public Works		Feasibility	\$3,130,000	

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
II	Blackjack Watershed Protection & Restoration Feasibility Plan	Habitat with Offset		This project will build on the 2017 "Blackjack Creek Watershed Assessment, Protection, and Restoration Plan", and identify the highest priority tax parcels for protection or restoration based on a systematic evaluation of their value to salmon recovery. This evaluation will include a literature review of existing studies and GIS desktop analysis to identify the riparian and wetland habitats with the most value to salmon, highest connectivity to other salmon habitat, and greatest threat of development. The project will use this evaluation to rank parcels, and conduct outreach to landowners of the highest ranked parcels.				Great Peninsula Conservancy		Planning/Design	\$200,000	\$0
III	Salmonberry Creek and Wetland Protection Project	Habitat no Offset	Salmonberry Creek	Great Peninsula Conservancy (GPC) will protect 90 acres of riparian, wetland, and fish habitat through purchasing a conservation easement on property on Salmonberry Creek in Kitsap County. Salmonberry Creek is located in an ESSB 6091 prioritized basin (WRIA 15), and contains Endangered Species Act-listed steelhead trout.		90 acres protection		Great Peninsula Conservancy		Acquisition	\$420,000	

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
III	Floodplain Restoration Upstream of Navy RR Trestle	Habitat with Offset	Link	This action will aim to restore floodplain connectivity, riparian processes, and instream habitat conditions. Restoration actions should focus on removal of artificial fill along the abandoned road grade constricting the channel at RS 11100, restoring riparian forest conditions, and targeted wood placements to increase channel complexity and restore natural stream grade. Restoration of riparian processes will require negotiation of conservation easements or acquisition of the streamside parcel along the northern (left) bank. The parcel totals 6 acres and has an assessed value of \$240,000 per 2012 tax records. This action is constrained, in part, by channel confinement at the Navy RR trestle. The channel reach upstream of this segment flows through parcels that are part of the Mountaineers Foundation Rhododendron Preserve, where riparian conditions are more intact, instream wood is more abundant, and a broader floodplain exists due to the lack of bank protection.		6 acres restoration				Construction		\$255,000
III	Curley Creek Acquisition	Habitat no Offset	Link	This project will build upon work done through the SRFB Curley Creek Estuary Acquisition and Curley Creel Feasibility study. Project will acquire highest quality remaining Chinook and steelhead habitat available on lower Curley Creek.						Feasibility		\$200,000

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
III	Instream Habitat Enhancement at the Confluence with Chico Creek	Habitat no Offset		Large wood placements to create additional complexity near the tributary confluence will improve habitat conditions in the near term while concurrent efforts to set back constraints to floodplain processes can be implemented.						Conceptual		
III	Grovers Creek Protection Phase II	Habitat no Offset		Great Peninsula Conservancy's Lower Grovers Creek Habitat Protection Project aims to protect and restore 10.5 acres of riparian and wetland habitat along Grovers Creek and Miller bay in north Kitsap County for the benefit of people, salmon, and other wildlife. This project includes two properties in the Grovers Creek Watershed of north Kitsap County, including the 1.5-acre Tucker property and 9-acre Grovers Creek Durham Preserve Project owned by GPC. The Puget Sound Nearshore Ecosystem Restoration Project has prioritized the Grovers Creek Watershed as a "Protect High" watershed under its Coastal Inlet Strategy due to the fact that it remains relatively undeveloped.		10.5 acres protection	-	Great Peninsula Conservancy		Acquisition	\$685,650	

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
III	Curley Creek prioritized restoration	Habitat no Offset		In November 2017 the Suquamish Tribe released a completed watershed assessment and protection and restoration plan for Curley Creek, one of the three high priority freshwater streams in the East Kitsap shoreline. This Near Term Action proposes to use this plan to work with partners to identify which of the high priority protection and restoration actions are feasible to move forward to implementation and then to carry out that work.				Midsound Fisheries Enhancement Group		Planning/Design	\$625,000	\$0
IV	Floodplain Restoration Upstream of Kitsap Lake	Habitat no Offset								Conceptual		
IV	Acquisition of Johnson Creek headwaters	Habitat no Offset		The headwater wetlands of Johnson Creek (a salmon stream) in Poulsbo is relatively intact and undeveloped, however it is at risk of being developed. There is opportunity to acquire for preservation (GPC) or recreation (Parks).						Conceptual		
IV	Lower Strawberry Creek Restoration Design	Habitat no Offset	Strawberry Creek - Dyes Inlet							Design		
IV	Mid-Upper Blackjack Creek Floodplain/Wetland Restoration	Habitat with Offset	Parcels removed for privacy	Restore wetlands, floodplain, and riparian along this segment of Blackjack Creek that has been ditched and drained. Acquisition likely needed also.						Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	Remove infrastructure from outlet of Kitsap Lake	Offset no Habitat	Link	Remove infrastructure from the channel at the lake outlet to prevent future manipulation of lake levels. Fish screens at the outlet of Kitsap Lake previously restricted anadromous fish passage. The screens were removed in 1999; however, the concrete pieces that supported the screens remain in the channel. At times, this infrastructure has been altered by local residents to control the lake level without authorization. Such action results in rapid drawdown of streamflow in downstream segments of Kitsap Creek.						Conceptual		
IV	Long Lake Augmentation	Offset no Habitat	Long Lake	Potential flow augmentation and BDAs.						Conceptual		

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
IV	KPUD Stream Augmentation Project	Offset no Habitat		Kitsap Public Utility District (KPUD) currently owns and operates 54 public water systems throughout rural Kitsap County. KPUD is proposing to augment streams that are located near water mains of their systems. The water would be produced from either existing water-supply wells or new wells installed to be dedicated only for stream augmentation. The objective of the project is to provide “water-for-water” offset for future permit-exempt wells (PEWs) by discharging water indirectly into the stream to augment streamflow. KPUD has systems located in West Sound, North Hood Canal and Bainbridge Island subbasins of WRIA 15. Some members of the WRIA 15 Committee support further exploration of this project through feasibility studies. There are a number of concerns, including impact on deep aquifers and water quality. If KPUD decides to pursue this project, close coordination with the WRIA 15 Tribes and WRIA 15 partners is recommended.	183.9			Kitsap PUD		Conceptual	\$10,000 per site plus \$8000 annual O&M	

Category	Project Name	Type of Project	Project Location	Project Description	Estimated Water Offset Amount (acre feet)	Habitat Value (no set value)	Project Hyperlink (if applicable)	Existing Sponsor	Potential Sponsor (Where No Existing Sponsor Exists)	Project Stage	Estimated Cost	Existing Funding (as of Dec 2020)
	Koch Creek Regional Stormwater facility	Offset no Habitat	Location Information Latitude: 47.6477 Longitude: -122.641	This project includes enlarging and reconstructing a small existing storm pond. The new larger facility will collect stormwater runoff from 53 acres of housing, industrial areas and roads. The pond will capture and release runoff gradually over time, reducing the flow of water entering Koch Creek, located in the Dyes Watershed of Kitsap County, and allowing pollutants to settle out. These pond improvements will reduce flooding during storm events and improve water quality to Koch Creek.	TBD			Kitsap County		Planning/Design	\$850,000	\$350,000
	Ridgetop Blvd Green Street LID Retrofit Phase III	Offset with Habitat	Silverdale	Kitsap County Public Works is currently constructing Phase I & II of the overall Ridgetop Blvd green street project. Phase I and II projects are supported by Ecology grant/loan funding. Phase III of the Ridgetop Blvd project would extend the green street (median full-infiltration bioretention) from the end of Phase II to Silverdale Way. Phase III would be constructed using the same street cross-section, median bioretention, and traffic calming designs used in the first two phases.	TBD			Kitsap County Public Works		Construction	\$2,000,000	

Commented [VMSJ(61)]: Do we want to include these?
Received no feedback

2792 **Appendix I – Detailed Project Descriptions**

2793 **Managed Aquifer Recharge Project Portfolio for WRIA 15**

2794 **Summary**

2796 Managed Aquifer Recharge (MAR) projects are being considered in WRIA 15 as a method to
2797 increase infiltration to aquifers to improve streamflow and to offset the water use from future
2798 permit exempt (PE) wells in the watershed. The planning and implementation of MAR projects
2799 is complex, leading to uncertainty as to their potential use as water offset projects and inclusion
2800 in the Watershed Restoration and Enhancement Plan. A potential approach to addressing
2801 uncertainty is to include a portfolio of MAR projects that have different locations, project
2802 sponsors, water sources, and size. Uncertainty is addressed by qualitatively assessing the
2803 potential for implementation on a high, medium, and low basis and then assigning a probability
2804 to the potential offset from each project. The overall potential for MAR in WRIA 15 is the sum
2805 of the potential offsets multiplied by their probability. MAR projects in WRIA 15 have been
2806 identified through different sources and are estimated to have a total potential water offset of
2807 1,424 acre-feet/year. The overall potential, accounting for uncertainty, is estimated to be 578
2808 acre-feet/year. Considering MAR projects that can be implemented within the next 10 years,
2809 the estimated potential offset is 520 acre-feet/year. The remaining MAR projects would likely
2810 take longer than 10 years to implement.

2811 **WRIA 15 MAR Projects**

2813 There are different types of MAR projects. Aquifer Storage and Recovery (ASR) projects are a
2814 type of MAR project that actively injects water into aquifers for storage and recovery by
2815 pumping later. Passive MAR projects infiltrate water into shallow aquifers, with the intent that
2816 water discharges from the shallow aquifer into streams on a delayed basis and improves
2817 streamflow during low-flow periods. For WRIA 15, only passive MAR projects are being
2818 considered. The source of water for the passive MAR projects in WRIA 15 may be recycled
2819 water (highly treated wastewater), stormwater or diverted surface water.

2820
2821 MAR projects have the potential to recharge a significant volume of water into shallow
2822 aquifers, greater than the estimated consumptive use of PE wells forecast for the next 20 years.
2823 The estimated consumptive use for future PE wells in WRIA 15 is in the range of 669 to 847
2824 acre-feet per year. However, the planning and implementation of individual MAR projects is
2825 complex, leading to uncertainty as to their potential use as water offset projects and inclusion
2826 in the Watershed Restoration and Enhancement Plan. Proposing a portfolio of potential MAR
2827 projects is an approach which will provide projects in most subbasins in WRIA 15, have different
2828 water sources, different scales and different implementing entities. Table 1 lists the current
2829 portfolio of MAR projects and includes the potential water offset, the estimated timeframe for
2830 implementation and the relative certainty of implementation. The estimated timeframe is
2831 included to address whether the project can provide water offsets on a timely basis consistent
2832 with growth in PE connections. The relative certainty of implementation is a qualitative

2833 assessment based upon the project sponsor's ability to perform the project, the relative cost,
 2834 and potential issues in design, permitting and funding.

2835
 2836 **Table 1. Portfolio of Potential Managed Aquifer Recharge Projects**

Subbasin	MAR Project	Potential Sponsor	Potential Offset (ac-ft/year)	Estimated Timeframe for Implementation	Relative Certainty of Implementation (High, Medium, Low)
West Sound	Kingston Treatment Plant Recycled Water*	Kitsap County Public Works	328	5 years	High
	Grovers Creek MAR	Unknown	20 ¹	>10 years	Low
	Silverdale Recycled Water ² *	Silverdale Water District	167	5 years	Medium
North Hood Canal	Silverdale Recycled Water, includes Asbury Parcel ² *	Silverdale Water District	333	5 years	Medium
South Hood Canal	Tahuya River MAR	Unknown	200	5-10 years	Low
Bainbridge Island	M & E Farms Storage*		17	5-10 years	Medium
	Johnson Farms Storage*		90	>10 years	Low
	Miller Rd MAR*		19	>10 years	Low
South Sound	Port Orchard Airport MAR*		100	>10 years	Low
	Belfair WWTP MAR*		70	>10 years	Low
	Coulter Creek Heritage Park MAR (may be		20 ¹	>10 years	Low

	multiple projects)				
	Minter Creek MAR		20 ¹	>10 years	Low
	Rocky Creek between Wye and Koeneman Lakes MAR		20 ¹	>10 years	Low
Vashon – Maury Island	Judd Creek MAR		20 ¹	>10 years	Low
McNeil Island, Anderson Island, Ketron Island	None				
Totals			328		High Relative Certainty
			517		Medium Relative Certainty
			579		Low Relative Certainty

2837 ¹Potential offset not estimated yet; 20 acre-feet/year assumed based upon ¼ acre total size infiltration
2838 basin at each project site. ²Silverdale Recycled Water Project could provide water offsets to both West
2839 Sound and North Hood Canal Subbasins. An assumption of the split in benefits was made (2/3 North
2840 Hood Canal, 1/3 West Sound). ***Detailed project description available at end of document.**

2841 One MAR project, the Kingston Recycled Water Project, is thought to have a high relative
2842 certainty. The potential water offset from the project is 328 acre-feet per year. Three potential
2843 MAR projects are thought to have a medium relative certainty. Those projects have a potential
2844 water offset of 517 acre-feet per year. The remainder have a low relative certainty but should
2845 remain on the list until more is found out about those projects.

2846 A method of predicting outcomes from the portfolio of projects is to assign a probability to
2847 each level of relative certainty and multiply that probability by the potential offset. That
2848 calculation is shown in Table 2. Probabilities of 80 percent, 50 percent, and 10 percent are used
2849 in the calculation to represent high through low relative certainty. Using this calculation, the
2850 likely offset that will occur from pursuing a portfolio of MAR projects is 568 acre-feet per year.

2851 The calculation can be adjusted by changing the relative certainty of a project or by using a
2852 different probability to represent the different levels of relative certainty.

2853 **Table 2. Water Offsets Adjusted by Probability of Implementation**

Relative Certainty of Implementation (High, Medium, Low)	Total Estimated Offset (acre-feet/year)	Probability	Adjusted Offset (acre-feet/year)
High Relative Certainty	328	80%	262
Medium Relative Certainty	517	50%	258
Low Relative Certainty	579	10%	58
Totals			578

2854

2855 The high and medium relative certainty projects could be implemented in the next ten years,
2856 providing an estimated potential offset of 520 acre-feet/year. The remaining MAR projects
2857 would likely take longer than 10 years to implement.

2858 **Work Required to Implement a MAR Project**

2859 The successful implementation of a MAR project is complex and involves several critical steps
2860 prior to actual construction (Covert, 2019):

- 2861 • Identification of potential locations that:
- 2862 o Have available aquifer capacity such that water infiltration can occur without
- 2863 creating overflows to the surface,
- 2864 o Have soils and underlying geology with suitable hydraulic properties,
- 2865 o Are located such that enough infiltrated water will discharge to surface water
- 2866 during low streamflow periods, and
- 2867 o Are available for permanent use through acquisition or easements.
- 2868 • Identification of a physically and legally available water source.
- 2869 • Characterization and evaluation of site-specific hydrogeologic properties.
- 2870 • Assessment of source water and aquifer compatibility, potential water quality changes
- 2871 during infiltration, and other water quality considerations.
- 2872 • Development of preliminary MAR project designs and implementation cost estimates.
- 2873 • Identification of project permitting requirements and potential hurdles.

- 2874 • Assessment of ongoing operation and maintenance (O&M) costs, and identification of
2875 potential funding sources to support O&M.

2876 **References**

2877 Covert, John. Presentation to Watershed Restoration and Enhancement Committee. Managed
2878 Aquifer Recharge Opportunities, January 14, 2019

2879 **Detailed Descriptions for Larger MAR Projects**

2880

2881 Kingston Treatment Plant Recycled Water And Managed Aquifer Recharge Project- West
2882 Sound Subbasin

2883 *Description*

2884 Kitsap County is proposing to produce Class A recycled water at the existing Kingston Treatment
2885 Plant, which would be used for summer irrigation at the White Horse Golf Course (WHGC) and winter
2886 indirect groundwater recharge to the area north of WHGC. The stated objective of the County for the
2887 project is to “treat water as a resource rather than a waste stream” to address water quality and
2888 quantity concerns specific to Kingston, and other related water resource issues throughout the
2889 county. This project is in the West Sound subbasin of WRIA 15.

2890 *Quantitative or qualitative assessment of how the project will function, including anticipated offset*
2891 *benefits, if applicable. Show how offset volume(s) were estimated.*

2892 Currently, irrigation water for WHGC is purchased from the Kitsap Public Utility District (KPUD) and
2893 is sourced from groundwater wells in the area that pump from a sea-level aquifer. Quantity of
2894 usable groundwater is limited and, eventually, as the local demand for groundwater supplies
2895 increases, this water source could decline because it is not being adequately replenished.
2896 Additionally, with increased withdrawals from the sea-level aquifer, there is a concern of saltwater
2897 intrusion and the associated impacts to groundwater quality over time. Delivery of recycled water to
2898 WHGC would preserve 29 million gallons per year (89 acre-feet) of potable water from
2899 KPUD’s groundwater supply system and eliminate the stress to the supply system imposed by
2900 large swings in potable water system demands during the irrigation season. Recycled water use will
2901 also decrease the risk of saltwater intrusion within the regional sea-level aquifer and extend the
2902 useful life of existing potable water infrastructure. The proposed Project would infiltrate about 107
2903 million gallons per year (328 acre-feet) of highly treated recycled water into the shallow aquifer that
2904 provides baseflow to Grovers Creek and its tributaries. Assuming an average infiltration volume of 0.3
2905 million gallons per day, the Project could increase baseflow in Grovers Creek by roughly 0.5 cfs. The
2906 water use and infiltration numbers are obtained from the Kingston Recycled Water Plan (Brown &
2907 Caldwell, 2019).

2908 The water offset quantity for the WRIA 15 Watershed Plan would be 328 acre-feet per year.

2909 *Conceptual-level map and drawings of the project and location.*

2910 Figure 1 shows the location of the facilities proposed for the project. Additional maps and drawings
2911 can be obtained in the Kingston Recycled Water Facility Plan.



Figure 1. Location of pipeline to WHGC and to infiltration area (from Brown & Caldwell, 2019)

Description of the anticipated spatial distribution of likely benefits

Water infiltration at the White Horse Golf Course could increase groundwater levels over approximately 500 acres of the headwaters of the South Fork of Grovers Creek and provide increased groundwater inputs and flows into nearly three miles of perennial streams (Grovers Creek and SF Grovers Creek) and up to 1.5 miles of intermittent streams (tributaries to Grovers Creek and SF Grovers Creek). Water infiltration could also enhance or restore wetlands associated with the creeks or headwater areas.

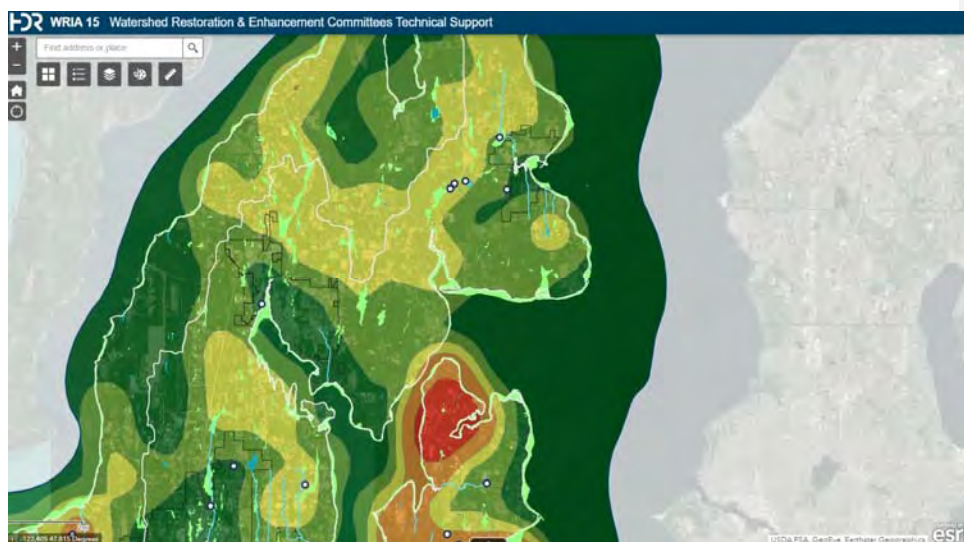
Location relative to future PE well demand

The forecast consumptive use for the West Sound subbasin using the irrigated area method and baseline growth assumptions is listed in Table 1.

Table 1. Forecast PE Consumptive Use Demand for West Sound Subbasin

Acre-feet per year	Gallons per minute	Cubic feet per second
183.9	114.0	0.2545

A copy of the PE growth heat map from the WRIA 15 webmap is shown in Figure 2.



Source:

<https://hdr.maps.arcgis.com/apps/webappviewer/index.html?id=d7d02dedb57241aa81dd7eb376c8625a>

Figure 2. WRIA 15 PE Growth Heat Map

Performance goals and measures.

The performance goals are to reduce groundwater use by 89 acre-feet per year during summer by switching the source of supply from Kitsap PUD to recycled water and to increase infiltration by 328 acre-feet per year to improve baseflow in Grovers Creek. The measures will be an increase in baseflow in summer in Grovers Creek and South Fork Grovers Creek by about 0.5 cfs. The increased baseflow should reduce water temperatures in those streams.

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

The Washington Department of Fish and Wildlife (WDFW 2020) has identified that coho salmon are present in both Grovers Creek and the SF Grovers Creek; the Endangered Species Act (ESA) listed Puget Sound winter steelhead are present in Grovers Creek (although Grovers Creek is not listed as critical habitat); and chum salmon are present at the mouth of Grovers Creek below the fish hatchery weir/dam operated by the Suquamish Tribe near Miller Bay Road (barrier ID: 930696), for Grovers Creek Hatchery. The Washington Stream Catalog (WDF 1975) indicates that both coho and chum salmon were historically present in Grovers Creek. These North Kitsap streams were noted in the

2946 Stream Catalog (WDF 1975) as having good steady base flows at the time (likely due to the glacial
2947 outwash soils and infiltration of water).

2948 Increased base streamflow and reduced water temperatures would primarily benefit juvenile
2949 salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat.
2950 This would improve both productivity and survival of juveniles. The alteration of natural stream
2951 hydrology has been identified as a high priority limiting factor in WRIA 15 (NOAA 2007) and
2952 streamflow is important for supporting riparian vegetation and wetlands that provide shading, food
2953 web support, and flood and sediment attenuation functions.

2954 *Identification of anticipated support and barriers to completion.*
2955 A stakeholder coordination and public involvement program was completed and is described in the
2956 Water Facility Plan. Support was expressed for the recycled water, WHGC irrigation and winter
2957 infiltration option. The project is also believed to be in alignment with the broader goals of Ecology,
2958 Governor Jay Inslee's Shellfish Initiative, West Central Local Integrating Organization, and the Puget
2959 Sound Partnership's Strategic Initiatives to prevent pollution, protect and restore habitat, and recover
2960 shellfish beds. The main barrier to completion is funding for construction and O&M costs.

2961 *Potential budget and O&M costs.*
2962 The total construction costs of water treatment, conveyance, irrigation and infiltration are estimated
2963 to be \$13.65 million (includes engineering and construction costs). The construction costs for
2964 conveyance and infiltration basins total \$3.3 million and infrastructure needed for irrigation at WHGC
2965 is \$1.6 million. An additional 35 percent would be added for design, construction services and
2966 administrative costs. The annual O&M cost for winter infiltration and summer irrigation is estimated
2967 to be \$151,000.

2968 *Anticipated durability and resiliency.*
2969 The project would have lasting benefits as it would be actively managed by Kitsap County Public
2970 Works, O&M would likely be funded through ratepayers, and the source of water (domestic
2971 wastewater) will increase with increasing population and will not vary substantially from year to year
2972 due to climate factors.

2973 *Project sponsor(s) (if identified) and readiness to proceed/implement.*
2974 The project sponsors would be Kitsap County Public Works Department and the Suquamish Tribe. A
2975 pre-design study was completed (Brown & Caldwell, 2019). In addition, stakeholder coordination and
2976 public involvement was performed and there is general support for this project. The project sponsors
2977 are discussing

2978 *References*
2979 Brown and Caldwell, November 14, 2019. Kingston Recycled Water Facility Plan. Prepared for
2980 Kitsap County Public Works.

- 2981 NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service),
2982 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine
2983 Fisheries Service, January 19, 2007.
- 2984 WDF (Washington Department of Fisheries), 1975. "A Catalog of Washington Streams and
2985 Salmon Utilization, WRIA 15." Accessed at: https://www.streamnetlibrary.org/?page_id=95.
- 2986 WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish
2987 distribution. Available at: <http://apps.wdfw.wa.gov/salmonscape/>

2988 Silverdale Water District No. 16 Recycled Water Project – North Hood Canal and West
2989 Sound Subbasins

2990 Description

2991 Silverdale Water District No. 16 (SWD) is building infrastructure to move recycled water throughout
2992 most of their service area. The source of the recycled water is wastewater that originates from
2993 surrounding communities of Poulsbo, Bangor, Silverdale, and Central Kitsap, and flows to the
2994 Central Kitsap Treatment Plant (CKTP). Currently, the treated effluent discharges into Puget Sound
2995 approximately 3,200 feet offshore at Port Orchard Bay. The average daily rate of discharge is about
2996 3.4 million gallons per day (MGD). The goal for the project is for zero discharge into Puget Sound.

2997 The CKTP will produce recycled water ("Class A" reclaimed water⁴⁰) using a sand filtration system
2998 with a capacity of 4 MGD. SWD will distribute the recycled water for various uses, including
2999 irrigation, dual-plumbing (flushing toilets), construction, streamflow augmentation and aquifer
3000 recharge. SWD has installed 7.4 miles of the planned 13.7 miles of purple pipe, the universal color
3001 for recycled water pipes. When completed, SWD will have the ability to move 3.5 MGD through the
3002 system.

3003 The stated objective of the project is to provide "water-for-water" offset for future permit-exempt
3004 (PE) wells. This can be accomplished by infiltrating water and indirectly augmenting streamflow or
3005 by direct augmentation to a surface water body such as a stream or wetland. The key element of
3006 SWD's recycled water infrastructure pertinent to an offset for PE wells is the pipeline that runs
3007 along Newberry Hill Road. By extending this portion of pipeline and connecting it to the recycled
3008 water source, the recycled water would reach three potential infiltration sites that could indirectly
3009 augment streams. These are the sand and gravel facilities at Dickey Road, the Asbury Soils site and
3010 a stormwater retention pond along Newberry Hill Road at the end of the pipeline. The benefitting
3011 streams are within the West Sound and North Hood Canal subbasins of WRIA 15. They are
3012 potentially Little Anderson, Anderson, Big Beef, Strawberry, Wildcat, and Chico creeks. Direct
3013 augmentation could also occur along the pipeline route. Strawberry Creek is along the path of a
3014 recycled water pipeline and is a candidate for direct augmentation. In other parts of SWD's service
3015 area with recycled water pipelines Clear and Barker creeks are candidates for direct augmentation.
3016 For this project description only the infiltration projects along Newberry Hill Road are described.

3017 *Quantitative or qualitative assessment of how the project will function, including anticipated offset*
3018 *benefits, if applicable. Show how offset volume(s) were estimated.* SWD estimates the total amount
3019 available for stream augmentation through infiltration at the Newberry Hill Road sites is
3020 approximately 0.5 MGD, equivalent to 0.77 cubic feet per second (CFS), 560 acre-feet per year (AFY)

Commented [VMSJ(62): From Kitsap County (needs to be addressed): 1) The water initially planned to be produced at CKTP will not meet the standards necessary to indirectly or directly infiltrate the water (state ground water quality standards). This use would require additional treatment beyond what we have constructed at CKTP and hence would cost much more than described in the proposal. (I would guess order of magnitude of \$10-25M in capital.) 2) The project description erroneously assumes we can remove the outfall at CKTP. The Ecology recycled water rule requires a method to get rid of water that does not meet reuse standards. There really is no room to store it on site, so it would be discharged via the outfall.

⁴⁰ "Class A reclaimed water" means a water resource that meets the treatment requirements of chapter 173-219 WAC, including, at a minimum, oxidation, coagulation, filtration, and disinfection.

3021 and 347 gallons per minute (GPM). The reclaimed water system will be equipped with a Supervisory
3022 Control and Data Acquisition (SCADA) system that includes weather monitoring and forecasting.
3023 The SCADA systems will allow SWD to regulate flow at all points of discharge/augmentation.

3024 *Map of the project and location.*

3025 Figure 1 shows the location of existing and proposed recycled water system pipe within the SWD
3026 service area, the three potential sites along the proposed Newberry Hill Road pipeline, and the
3027 costs for future elements of the planned recycled water system.

3028 *Description of the anticipated spatial distribution of likely benefits*

3029 The potential infiltration site at the Dickey gravel pit would likely benefit Strawberry Creek in the
3030 West Sound subbasin. The Asbury infiltration site would likely benefit Johnson, Wildcat and Chico
3031 Creek in the West Sound subbasin. The stormwater retention pond along Newberry Road would
3032 likely benefit Little Anderson Creek in the North Hood Canal subbasin and could enhance the
3033 nearby wetland at the headwaters of Anderson Creek and a tributary to Big Beef Creek.

3034 *Locations relative to future PEW demand*

3035 The estimated consumptive use for future PE wells for the West Sound and North Hood Canal
3036 subbasins are provided in Table 1. The quantities assume the median growth estimate and use of
3037 the irrigated area method.

3038 **Table 1. Estimated Future Consumptive Use Quantity Using Median Growth Estimate and**
3039 **Irrigated Area Method**

Subbasin	Estimated Future Consumptive Use (AFY)
West Sound	183.9
North Hood Canal	90.3

3040

3041 The potential water offset quantity for this project is much greater (285 AFY greater) than the PE
3042 well consumptive use estimates for the West Sound and North Hood Canal subbasins combined.
3043 Additional recycled water could be available for Clear and Barker Creeks,

3044 The Anderson Creek subbasin appears to have a relatively high concentration of PE wells just north
3045 of the project area. The stormwater retention pond augmentation site at the headwaters of Little
3046 Anderson Creek would address is located in an area with especially high potential for future PE
3047 wells.

3048 A copy of the PE well growth heat map from the WRIA 15 webmap is shown in Figure 2.

3049

3050

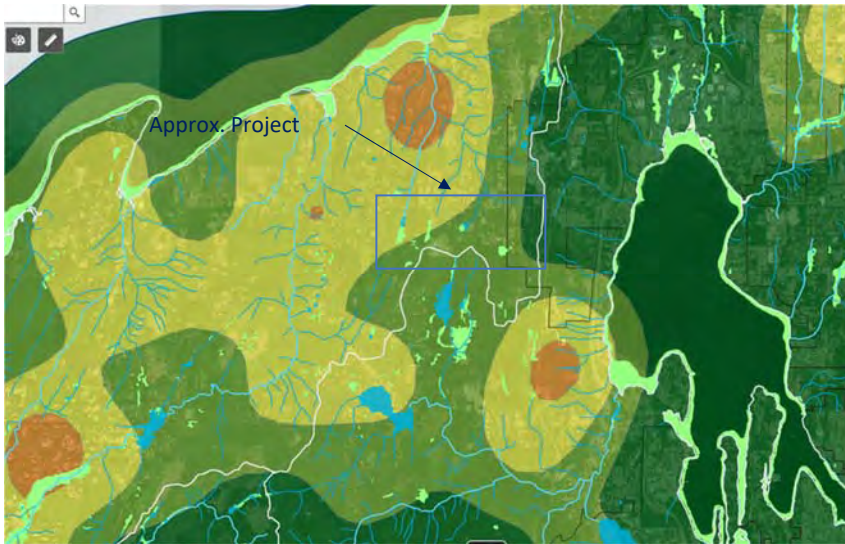


Figure 2. WRIA 15 PE Growth Heat Map

Performance goals and measures.

The stream augmentation amount will be measured and recorded using totalizing flow meters. The performance goals are to augment streams that are located near the infiltration sites. KPUD currently maintains 29 stream gaging stations in Kitsap County. KPUD's monitoring of Little Anderson Creek is on a monthly basis, not continuously, because of the stream channel conditions and access. KPUD does not currently monitor Strawberry Creek. However, the indirect augmentation may not be obviously detectible or measurable at a stream gage that is typically located near the mouth given the variability of stream flow in Kitsap County that is dependent on the timing and amount of precipitation (daily, monthly, seasonally, year-to-year) in these drainage basins. The increased baseflow should be most detectible in the upper reaches of the stream if the augmentation occurs near the headwaters of the stream. The increased baseflow, although small, should reduce water temperatures in those streams.

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

The Washington Department of Fish and Wildlife (WDFW 2020) has identified that coho and chum salmon and the Endangered Species Act (ESA) listed Puget Sound winter steelhead are present in both Anderson Creek and Strawberry Creek; Big Beef Creek and Wildcat Creek contain these species plus the ESA-listed Puget Sound Chinook salmon.; and chum salmon are present at the mouth of

3075 Koch Creek below Highway 3. The Washington Stream Catalog (WDF 1975) indicates that both coho
3076 and chum salmon were historically present in all of these creeks, although due to their size, only Big
3077 Beef Creek produced large numbers of salmon. These streams (except Big Beef Creek) were noted in
3078 the Stream Catalog (WDF 1975) as having substantial low flow problems including intermittent flows.

3079
3080 Big Beef Creek is listed for high water temperatures on Ecology's 303(d) list of impaired waterbodies
3081 and Strawberry Creek is listed for dissolved oxygen and bacteria (Ecology 2020).

3082
3083 Increased base streamflow and reduced water temperatures would benefit both adult migrants to
3084 spawning grounds and juvenile salmonid rearing habitats by providing increased area and quality of
3085 summer stream rearing habitat. This would improve survival of adults and both productivity and
3086 survival of juveniles. The alteration of natural stream hydrology has been identified as a high priority
3087 limiting factor in WRIA 15 (NOAA 2007) and streamflow is important for supporting riparian
3088 vegetation and wetlands that provide shading, food web support, and flood and sediment
3089 attenuation functions.

3090
3091 The headwaters of Big Beef Creek and Anderson Creek include wetland areas that could also benefit
3092 from increased groundwater levels, further supporting cold water volumes to the creek.

3093
3094 *Identification of anticipated support and barriers to completion.*

3095 SWD is the stakeholder who will coordinate the operations and maintenance of the
3096 infiltration/augmentation sites. SWD will collect, compile, share and report the metering data.

3097 The primary barrier is the availability of funding for the construction and operations and
3098 maintenance (O&M) costs. Other barriers include water quality issues (concerns regarding trace
3099 chemicals, such as pharmaceuticals and personal care products) and the feasibility of infiltration.
3100 Feasibility issues would need to be studied and addressed during a feasibility study phase.

3101 *Potential budget and O&M costs.*

3102 As of today, the construction costs for building the elements to get the reclaimed water to the end
3103 of the Newberry Hill section is \$12.8 million. These costs include \$5.1 million for the conveyance
3104 and metering along Newberry Hill Road. The annual O&M cost for the reclaimed water system is
3105 estimated to be \$100,000. Additional costs for feasibility studies, design, permitting and
3106 construction management would be incurred, typically 15-20 percent of the construction cost, or
3107 \$1.92 - \$2.56 million. The total implementation costs would be approximately \$14.7 million to \$15.4
3108 million.

3109 *Anticipated durability and resiliency.*

3110 The project would have lasting benefits. SWD will manage the augmentation. The SCADA system
3111 will allow for adaptive management of the augmentation rate. It is proposed to use only a portion

Commented [VMSJ(63)]: Is the cost estimate for the treatment or the conveyance? We should specify the cost of the conveyance for the purpose of augmentation.

3112 of the recycled water available, ensuring a reliable supply. Assuming an O&M funding source is
3113 found, SWD will manage the infiltration and provide a reliable, long-term operator.

3114 *Project sponsor(s) (if identified) and readiness to proceed/implement.*

3115 SWD would sponsor the project. The project is in agreement with their plans for recycled water and
3116 is a continuation of pipeline already constructed. A feasibility study is needed to analyze and plan
3117 for conditions at the sites, as well as work through easements or acquisitions of sites suitable for
3118 infiltration. The overall feasibility, planning, permitting and design stage would take up to 2 years.
3119 Funding for the project will also need to be secured. As this project will help remove a wastewater
3120 outfall into Puget Sound, we assume the Departments of Ecology and Health will support it and
3121 provide grant funding for implementation.

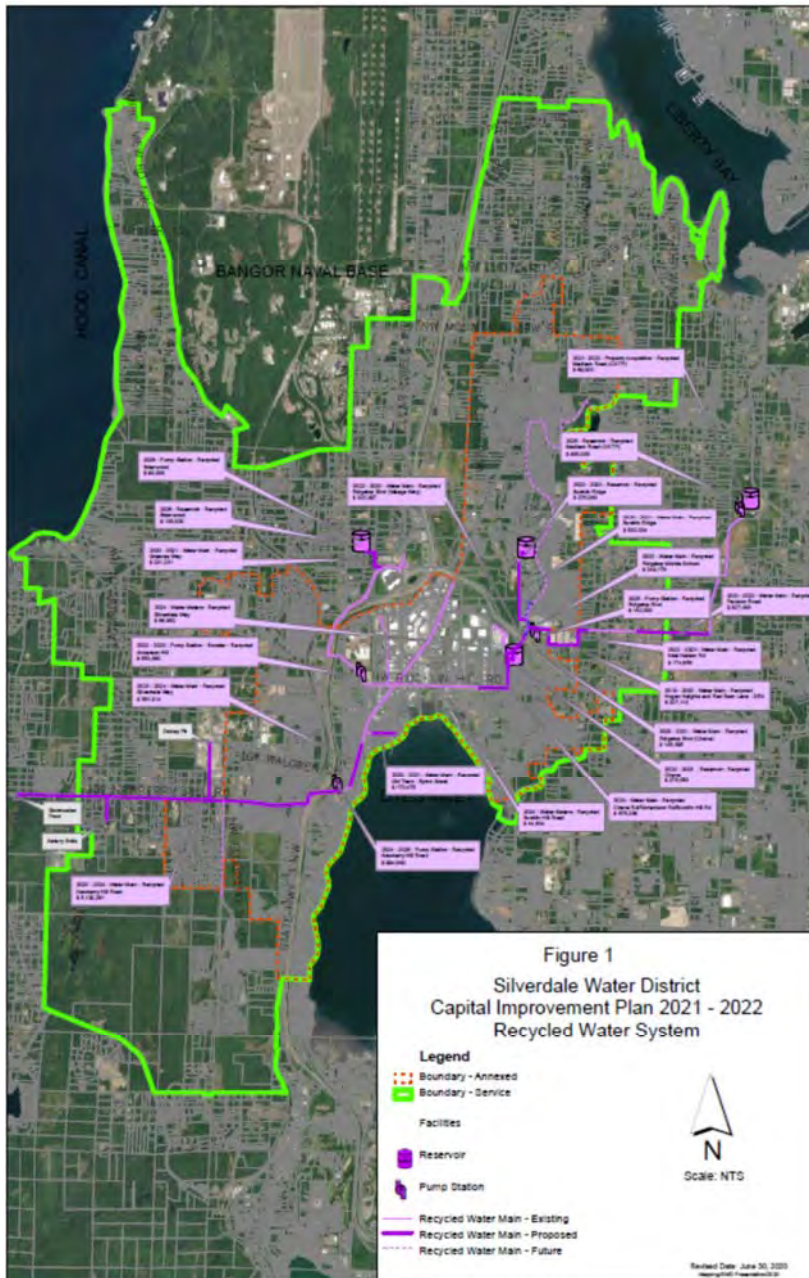
3122 *Sources of Information*

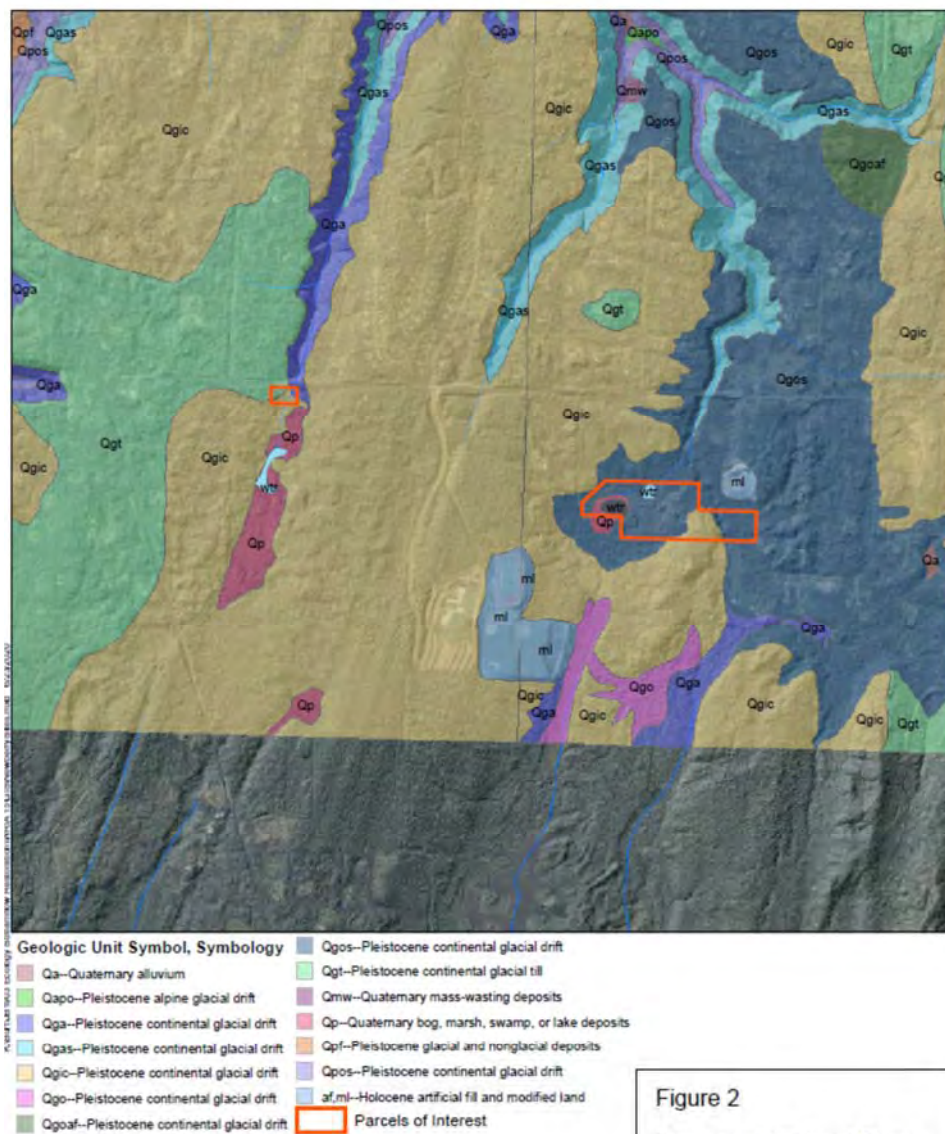
3123 Ecology (Washington Department of Ecology), 2020. 303(d) Listed Waterbodies. Available at:
3124 [https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-](https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d)
3125 [of-state-waters-303d](https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d)

3126 NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service),
3127 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine
3128 Fisheries Service, January 19, 2007.

3129 WDF (Washington Department of Fisheries), 1975. "A Catalog of Washington Streams and
3130 Salmon Utilization, WRIA 15." Accessed at: https://www.streamnetlibrary.org/?page_id=95.

3131 WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish
3132 distribution. Available at: <http://apps.wdfw.wa.gov/salmonscape/>





3135 Port Orchard Airport Stormwater Infiltration Project – South Sound Subbasin

3136 *Description*

3137 The proposed project would divert stormwater from the 104-acre Port Orchard Airport to a nearby
3138 infiltration facility which could be at several locations, including the airport, off-site at a nearby Kitsap
3139 County-owned parcel or off-site at an area south of the airport.

3140 Future development at the airport would increase stormwater runoff and can provide the
3141 opportunity to construct stormwater facilities that could infiltrate stormwater or convey stormwater
3142 to an off-site infiltration facility. The airport site is located along Sidney Road SW in Port Orchard and
3143 was rezoned as REC – Rural Employment Center in 2016. This zone provides for isolated areas of
3144 industrial and commercial type uses in the rural areas of Kitsap County and are designated to
3145 promote the rural economy by providing and creating jobs close to where people live. This zoning
3146 allows future development at the airport including a wider range of commercial, industrial, and
3147 institutional uses such as offices, retail, and restaurants.

3148 The project is in the South Sound subbasin of WRIA 15. The site is mostly within a Category II Critical
3149 Aquifer Recharge Area (CARA), with a small area of Category I CARA at the southerly end of the site.
3150 The streams that could potentially benefit are Minter and Burley creeks and their tributaries in the
3151 vicinity of the project site.

3152 *Quantitative or qualitative assessment of how the project will function, including anticipated offset*
3153 *benefits, if applicable. Show how offset volume(s) were estimated.*

3154 The project would function by collecting stormwater runoff from future developed and impervious
3155 surfaces and conveying it to an infiltration facility. Water quality treatment of the stormwater would
3156 also be required before infiltration to settle out fine particles which may plug an infiltration facility.
3157 Three potential areas for infiltration and groundwater recharge have been identified. They are on-site
3158 at the south end of the airport, east of the airport at a County-owned parcel that was used as a
3159 gravel pit and south of the airport. Although there are active gravel pits adjacent to the airport, use
3160 of those pits for infiltration is not proposed as an option as it is believed those pits will be in
3161 operation for years and will be reclaimed by backfilling with fill material which is not likely to be
3162 suitable for infiltration.

3163 Figure 1 provides a conceptual plan view for the project and Figure 2 provides a geologic map
3164 clipped from the WRIA 15 web map. An initial geologic review of an infiltration project was
3165 performed and indicated there is potential for groundwater recharge. A more detailed geotechnical
3166 evaluation would be required to confirm the site suitability and provide recommendations on the
3167 design of the infiltration facility.

3168 To estimate the volume of stormwater runoff that may be available for recharge, streamflow data on
3169 Burley Creek from Kitsap PUD was used (KPUD 2020). Average monthly flows in Burley Creek were

Commented [VMSJ(64)]: Need to address comments from
Kitsap Co re: permitting and backfill

3170 multiplied by the ratio of the drainage area at the point of diversion to the Burley Creek drainage
3171 area. Table 1 summarizes the anticipated average monthly yield at the project site based on the area-
3172 discharge relationship from Burley Creek. This is a conservative (low) estimate of stormwater runoff
3173 as impervious surfaces will generate much more runoff per acre than that of the Burley Creek basin.

3174 **Table 1**
3175 **Estimated Average Monthly Yield at Port Orchard Airport (acre-feet)**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
44	35	38	31	24	19	17	16	16	25	38	40

3176
3177 Two assumptions were made in estimating the potential groundwater recharge. The first is the
3178 infiltration facility would operate in the winter and early spring (November to March) and the second
3179 is 50 percent of the runoff could be infiltrated. The quantity that can be infiltrated will not be known
3180 until more detailed hydrological and geotechnical investigations are completed. With those
3181 assumptions, up to 98 acre-feet per year could be recharged. The average rate of recharge would be
3182 0.33 cfs (148 gpm). Averaged throughout the entire year, the average rate of recharge would be
3183 0.135 cfs (61 gpm).

3184 The water offset quantity for the WRIA 15 Watershed Plan is preliminarily estimated to be up to 98
3185 acre-feet per year. If suitable infiltration areas are identified, it is likely additional water would be
3186 available for recharge to groundwater.

3187 *Conceptual-level map and drawings of the project and location.*

3188 Figure 1 shows the locations of the potential infiltration facilities proposed for the project.

3189 *Description of the anticipated spatial distribution of likely benefits*

3190 Stormwater storage and infiltration could provide additional groundwater input and flows to the
3191 Minter and Burley Creek stream systems. Water infiltration could also enhance or restore wetlands
3192 associated with groundwater discharge areas. Depending on the location of the infiltration facility,
3193 there is approximately 5 miles of tributaries to Burley Creek and Burley Creek that could benefit from
3194 groundwater recharge, or approximately 4.5 miles of tributaries to Minter Creek and Minter Creek
3195 that could benefit.

3196 **Location relative to future PE well demand**

3197 The forecast consumptive use for the South Sound subbasin using the irrigated area method and
3198 baseline growth assumptions is listed in Table 2.

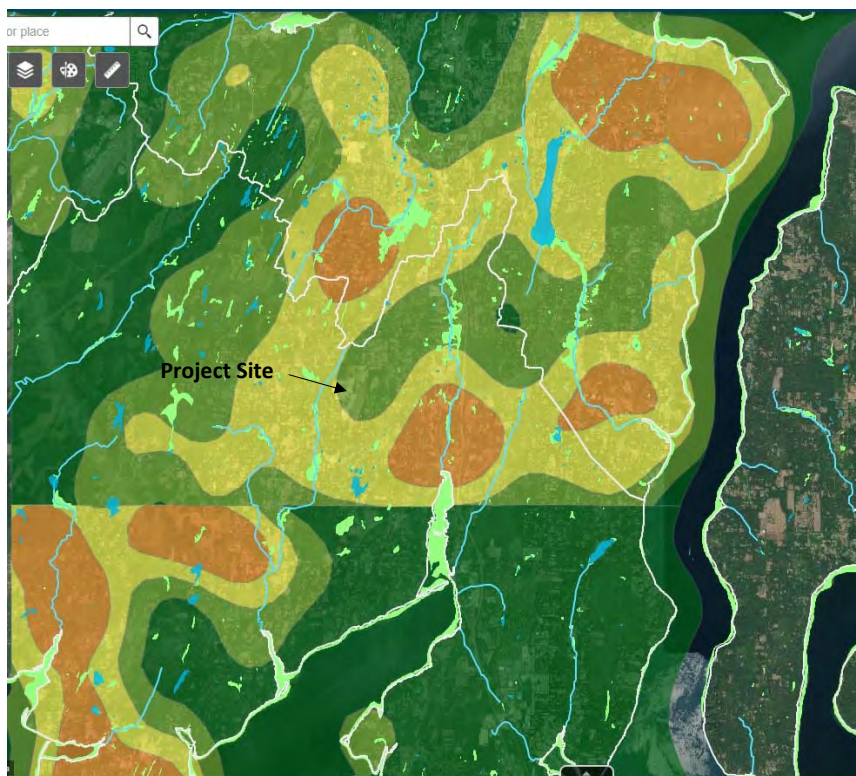
3199

3200

3201 **Table 2. Forecast PE Consumptive Use Demand for South Sound Subbasin**

Acre-feet per year	Gallons per minute	Cubic feet per second
213.8	132.5	0.2958

3202 A copy of the PE growth heat map from the WRIA 15 webmap is shown in Figure 3. The project site is
3203 in an area predicted to have a lesser level of growth in PE wells, however higher levels of growth is
3204 predicted in both the Minter Creek and Burley Creek basins. The estimated water offset benefit of 98
3205 acre-feet per year is 46 percent of the offset estimated for the South Sound subbasin.



Source: <https://hdr.maps.arcgis.com/apps/webappviewer/index.html?id=d7d02dedb57241aa81dd7eb376c8625a>

Figure 3. WRIA 15 PE Growth Heat Map

Performance goals and measures.

The performance goals are to increase groundwater recharge by 98 acre-feet per year to improve baseflow in Minter and Burley Creeks. The measures will be an increase in baseflow in summer in the creeks by about 0.13 cfs, assuming the water infiltrated discharges to creeks at a steady-state rate equal to the annual average recharge. The average flow in Burley Creek from July to September is 17 cfs, with low flows about 9 cfs. There is less streamflow data available for Minter Creek, however data reviewed indicates streamflow levels about the same as Burley Creek. The increased streamflow from recharge will be a very small increase in either stream but may benefit tributaries receiving increased groundwater discharge relatively more.

3219 *Descriptions of the species, life stages and specific ecosystem structure, composition, or function*
 3220 *addressed.*

3221 Minter and Burley creeks support a variety of species and life stages including the Endangered
 3222 Species Act-listed Puget Sound winter steelhead and its critical habitat (NOAA, 2016). Tributaries of
 3223 the East Kitsap Peninsula are part of the Central and South Puget Sound Demographically
 3224 Independent Population (DIP; NOAA, 2019). Other anadromous salmonid species found in the
 3225 watershed that would benefit from this project include Coho, coastal cutthroat trout, fall and summer
 3226 chum, and fall Chinook salmon (WDFW, 2020).

3227 The salmonids and other aquatic species in the Burly/Minter watershed are subject to degraded
 3228 ecosystem function due to limiting factors present at the site. In the Puget Sound Salmon Recovery
 3229 Plan, NOAA identifies the alteration of natural stream hydrology as a high priority limiting factor in
 3230 WRIA 15 (NOAA 2007), and streamflow is important for supporting riparian vegetation and wetlands
 3231 that provide shading, food web support, and flood and sediment attenuation functions. Increased
 3232 base streamflow and reduced water temperatures would primarily benefit juvenile salmonid rearing
 3233 habitats by providing increased area and quality of summer stream rearing habitat. This would
 3234 improve the survival of juveniles. Addressing the streamflow limiting factor and improving habitat
 3235 conditions would help support salmonids at various life stages and increase presence, recruitment,
 3236 and survival in the area of the project. Along with the habitat restoration actions and regional
 3237 planning efforts already undertaken in the Minter/Burly watersheds, addressing increasing base
 3238 streamflow could contribute to the VSP parameters of abundance, productivity, spatial structure, and
 3239 diversity for the ESA-listed Distinct Population Segment of Puget Sound winter steelhead.

3240 *Identification of anticipated support and barriers to completion.*

3241 The project was proposed by members of the Watershed Restoration and Enhancement Committee
 3242 as a potential project that would fit the goals of the committee. There is not currently a sponsor. The
 3243 most likely entity to construct and operate the facility is Kitsap County Public Works. The primary
 3244 barrier would be the availability of funding for the construction and operations and maintenance
 3245 (O&M) costs. Other barriers include the feasibility of infiltration and whether the timing of
 3246 development and subsequent project matches the time frame for water offsets. Owners of the
 3247 airport also have not been contacted to ascertain their interest in a project.

3248 It is anticipated that the project would be supported by both the Minter Creek Watershed Strategies
 3249 Group, the Puget Sound Partnership, and the West Sound Watersheds Council (the lead entity in this
 3250 region of WRIA 15). The Minter Creek Watershed Strategies Group (MCWSG) conducted a regional
 3251 planning effort for the Minter/Burley Creek basin. The goals of this project to increase base
 3252 streamflows and reduce temperatures in the basin align with the priorities for land use identified in
 3253 the MCWSG's 2014 report, Minter Creek Watershed Strategies: A Coordinated Approach to Land Use
 3254 Planning in the Watershed (MCWSG, 2014). Section 8 of the same plan identifies intersections with
 3255 the Puget Sound Partnership's Action Agenda, with which this project also aligns. West Sound

3256 Watersheds Council aligns salmon strategies with Puget Sound Salmon Recovery Plans and
3257 implements the Puget Sound Partnership's Action Agenda in coordination with the West Central
3258 Local Integrating Organization. The West Central Local Integrating Organization's 2016 Ecosystem
3259 Recovery Plan identifies actions in the basin to implement salmon recovery actions. Two theories of
3260 change identified in this plan are directly addressed by the proposed project: "7.2 Decrease water
3261 withdrawal, diversion, per capital water use," and "10.3 Fix problems caused by development"
3262 (WCLIO, 2016). Minter and Burley creeks are not directly identified in the plan, but the project fits
3263 into general strategies for improving streamflow and habitat conditions for salmonids in WRIA 15.
3264 The project also addresses strategies identified in NOAA's Recovery Plan for Puget Sound Steelhead
3265 (NOAA, 2019). Recovery Strategy 3.3.2 specifically identifies improving hydrologic conditions and
3266 restoring groundwater recharge areas as important to improving survival for steelhead in South
3267 Puget Sound.

3268 *Potential budget and O&M costs.*

3269 The construction costs of an infiltration facility separate from stormwater facilities constructed for
3270 future development at the airport is estimated to be around \$400,000. An additional 35 percent
3271 would be added for design, construction services and administrative costs, for a total of \$540,000.
3272 The annual O&M cost is estimated to be \$30,000. All costs are based upon a conceptual level of
3273 understanding of the project and will change once additional feasibility studies are completed. The
3274 size of the infiltration facility will have the largest effect on construction costs. No entity that will pay
3275 the annual O&M costs has been identified. It is assumed project costs would be covered through
3276 grants.

3277 *Anticipated durability and resiliency.*

3278 The project would have lasting benefits if it is managed by Kitsap Public Works. The source of water
3279 (stormwater runoff) will vary from year to year due to climate factors, however the project benefits
3280 were described assuming a conservative amount of stormwater is captured and infiltrated.

3281 *Project sponsor(s) (if identified) and readiness to proceed/implement.*

3282 Kitsap County Public Works is the most suitable project sponsor but has not committed to assuming
3283 the project sponsor role. The project is also in a very conceptual level of detail and additional studies
3284 will be needed to determine its feasibility or arrangement.

3285 *References*

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3295 [steelhead-distinct-population-segment-oncorhynchus](https://www.fisheries.noaa.gov/resource/document/esa-recovery-plan-puget-sound-steelhead-distinct-population-segment-oncorhynchus)

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3297 Fish Distribution. Available at:
3298 [http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0?geometry=-](http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0?geometry=-122.777%2C47.430%2C-122.518%2C47.471)
3299 [122.777%2C47.430%2C-122.518%2C47.471](http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0?geometry=-122.777%2C47.430%2C-122.518%2C47.471)

3300 Belfair Wastewater Reclamation Facility – South Sound Subbasin

3301 *Description*

3302 A potential project was identified that would use recycled water from the Belfair Wastewater and
3303 Water Reclamation Facility and infiltrate the water to provide an offset. Research into the operations
3304 of the current treatment facility is summarized below.

3305 The Belfair Wastewater and Water Reclamation Facility is authorized to distribute Class A reclaimed
3306 water to public and private entities for commercial and industrial uses, to apply reclaimed water to
3307 land for irrigation at agronomic rates, and/or for groundwater recharge by surface percolation at
3308 locations listed in the permit. Current authorized uses are shown in the following table.

3309

Customer	Use	Location	Average Monthly Flow
Mason County – Forest Irrigation Field	Irrigation and groundwater recharge	39-acre irrigation site just east of reclamation plant	0.125 MGD
Mason County – Belfair Reclamation Plant	Supply to hose bibs, equipment wash, toilet flushing, plant processes, fire flow, and irrigation	25200 NE State Route 3	

3310

3311 The irrigation site is in the West Fork Coulter Creek basin. Currently, the plant is at about ½ capacity
3312 and treats/irrigates about 70 acre-feet per year.

3313 **Issues**

3314 Potential issues with this project are:

- 3315 • The irrigation site is already in operation and has capacity to treat the remainder of the plant
3316 capacity.

3317 Johnson Farm Springbrook Creek Managed Aquifer Recharge Project – Bainbridge Island
3318 Subbasin

3319 *Description*

3320 The Johnson Farm property has an existing storage pond that is used to supply irrigation water to
3321 the farm during the summer. The property has a surface water right to withdraw 0.2 cfs and 40 acre-
3322 feet to irrigate 20 acres. The period of use is June 1 to September 30.

3323 The Johnson Farm site has the potential for additional surface water storage, for infiltration of stored
3324 water and for transfer of an existing surface water source to a groundwater source. For this project
3325 description, only the potential for infiltration and groundwater recharge, along with a source switch,
3326 is described as they have the potential for providing water offsets to fit the goals of the Watershed
3327 Restoration and Enhancement Committee. **This project is currently not feasible due to legal**
3328 **restrictions.**

3329 *Quantitative or qualitative assessment of how the project will function, including anticipated offset*
3330 *benefits, if applicable. Show how offset volume(s) were estimated.*

3331 The project would function by diverting water from an existing storage pond to an area on the farm
3332 for infiltration during the winter and early spring season (November to March). During the summer
3333 months, groundwater would be used in lieu of surface water for irrigation. There will be a benefit to
3334 groundwater from infiltration and benefit to surface water during summer by allowing surface water
3335 to flow through or around the pond instead of being used for irrigation. The project would require
3336 reconfiguration of the existing pond to allow water to be routed around the pond in summer and to
3337 provide a source of water by gravity or pumping to an infiltration basin. Figure 1 provides a
3338 conceptual plan view for the project and Figures 2-4 provide geologic maps prepared to review the
3339 initial feasibility of an infiltration project. The initial geologic review indicated there is potential for
3340 groundwater recharge. A more detailed geotechnical evaluation would be required to confirm the
3341 site suitability and provide recommendations on the design of the infiltration facility.

3342 To estimate the volume of stormwater runoff that may be available for recharge, streamflow data on
3343 Springbrook Creek from the City of Bainbridge Island (Berg 2020) was used. Average monthly flows
3344 in Springbrook Creek were multiplied by the ratio of the pond drainage area to the Springbrook
3345 Creek drainage area. Table 1 summarizes the anticipated average monthly yield at the project site
3346 based on the area-discharge relationship from Springbrook Creek.

3347 **Table 1**
3348 **Estimated Average Monthly Yield at Johnson Farm (acre-feet)**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
28	51	42	25	15	7	4	4	4	17	38	23

3349

3350 Two assumptions were made in estimating the potential groundwater recharge. The first is the
3351 infiltration facility would operate in the winter and early spring (November to March) and the second
3352 is 50 percent of the runoff could be infiltrated. The quantity that can be infiltrated will not be known
3353 until more detailed hydrologic and geotechnical investigations are completed. With those
3354 assumptions, up to 91 acre-feet per year could be recharged. The average rate of recharge would be
3355 0.31 cfs (138 gpm). Averaged throughout the entire year, the average rate of recharge would be
3356 0.126 cfs (57 gpm). It is not known at this time whether it is feasible to infiltrate at that rate.

3357 In addition to groundwater recharge, removing the surface water discharge would improve
3358 streamflow by up to 0.2 cfs during summer. High temperatures and low dissolved oxygen have been
3359 measured at the existing pond discharge during warmer months. If the existing pond were bypassed
3360 during summer, the project would also improve instream water quality by reducing stream
3361 temperatures and increasing dissolved oxygen.

3362 The water offset quantity for the WRIA 15 Watershed Plan is preliminarily estimated to be up to 91
3363 acre-feet per year.

3364 *Conceptual-level map and drawings of the project and location.*

3365 Figure 1 shows a conceptual plan view of the project.

DRAFT

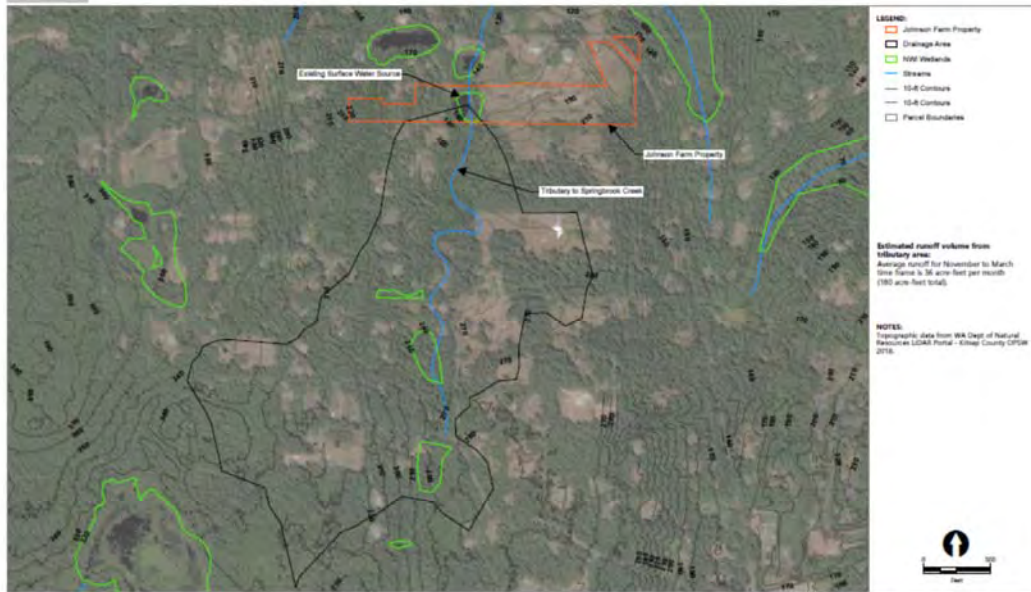


Figure 1
Johnson Farm, Springbrook Creek - Stormwater Infiltration
Sheet 15
Watershed Restoration and Enhancement

3366



Figure 2
Bainbridge Sites

pgg

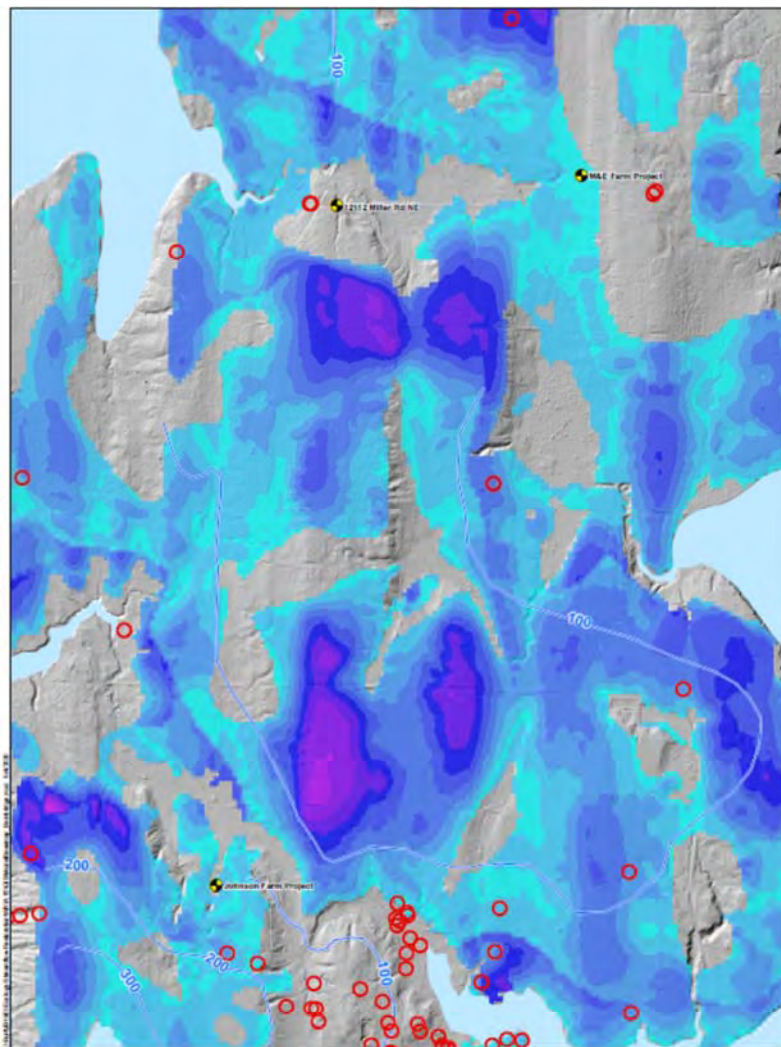


Figure 3

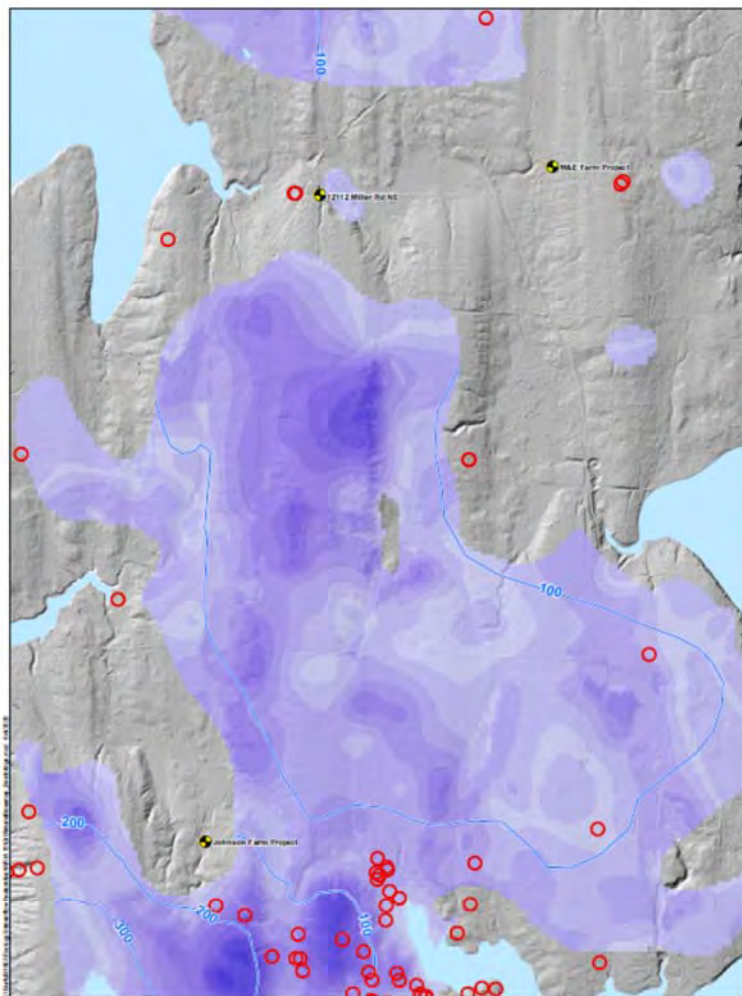
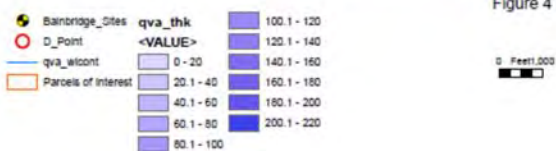


Figure 4



3371 Replacement of the surface water source with a new groundwater source at Johnson Farm could
3372 improve water quality in Springbrook Creek and its tributary that runs through the property. Water
3373 storage and infiltration at the Johnson Farm Property could increase groundwater levels in the
3374 headwaters of Johnson Creek and provide increased groundwater inputs and flows into Springbrook
3375 Creek. The length of stream potentially benefitting is 1.4 miles (from the site to the mouth of
3376 Springbrook Creek). Detailed groundwater evaluations would be required to estimate how much
3377 benefit to Springbrook Creek would occur. Water infiltration could also enhance wetlands associated
3378 with groundwater discharge areas.

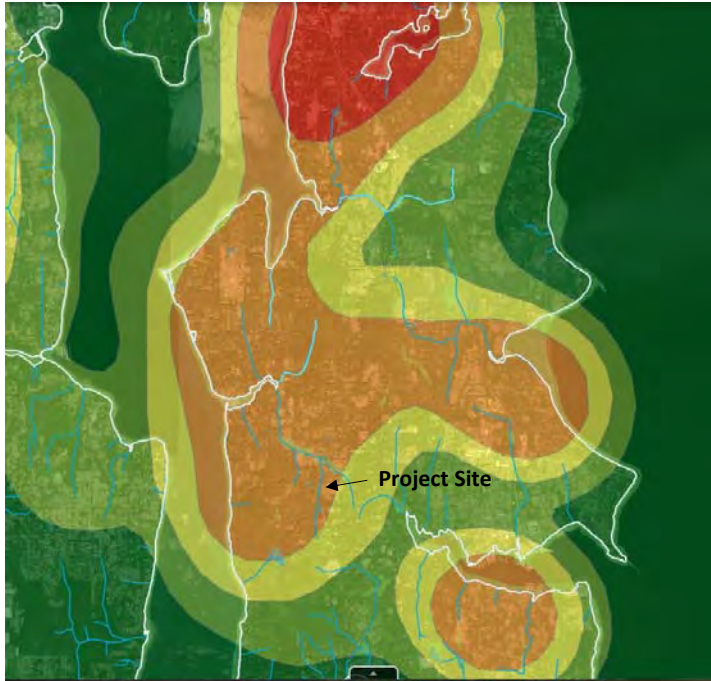
3379 *Location relative to future PE well demand*

3380 The forecast consumptive use for the Bainbridge Island subbasin using the irrigated area method
3381 and medium growth assumptions is listed in Table 1.

3382 **Table 1. Forecast PE Consumptive Use Demand for Bainbridge Island Subbasin**

Acre-feet per year	Gallons per minute	Cubic feet per second
67.6	41.9	0.0935

3383 A copy of the PE growth heat map from the WRIA 15 webmap is shown in Figure 5. The project site is
3384 located in an area predicted to have a moderate amount of PE well growth compared to other areas
3385 in Kitsap County. Much of the Springbrook Creek watershed is in an area predicted to have a
3386 moderate amount of PE well growth so this project would provide a water offset where additional
3387 consumptive use is predicted. The estimated water offset benefit of 91 acre-feet per year exceeds the
3388 total offset estimated for the Bainbridge Island subbasin using the irrigated area method and
3389 medium growth prediction.



Source:

<https://hdr.maps.arcgis.com/apps/webappviewer/index.html?id=d7d02dedb57241aa81dd7eb376c8625a>

Figure 5. WRIA 15 PE Growth Heat Map

Performance goals and measures.

The performance goals are to reduce surface water use by up to 40 acre-feet per year during summer by switching the source of supply to a new onsite groundwater source and to increase infiltration by up to 91 acre-feet per year to improve baseflow in Springbrook Creek. The measures will be an increase in baseflow in summer in Springbrook Creek by about 0.3 cfs, assuming the water infiltrated discharges to Springbrook Creek at a steady-state rate equal to the annual average recharge. The flow in Springbrook Creek in July-September averages about 0.5 cfs with annual low flows of less than 0.4 cfs (Berg 2020). The groundwater recharge could increase baseflows by 75 percent. Increased baseflow and bypass of the existing pond during summer could also slightly reduce water temperatures in the stream.

3405 *Descriptions of the species, life stages and specific ecosystem structure, composition, or function*
3406 *addressed.*

3407 Springbrook Creek is one of the most productive fish-bearing streams on Bainbridge Island. It
3408 supports cutthroat trout, coho salmon, chum salmon, sculpin, lamprey, and historically supported
3409 ESA-listed Puget Sound winter steelhead (BILT, 2018). Springbrook Creek also contains one of two
3410 reaches on Bainbridge Island that are designated as critical habitat for Puget Sound steelhead (BILT,
3411 2018).

3412 The salmonids and other aquatic species in Springbrook Creek are subject to degraded ecosystem
3413 function due to limiting factors present at the site. In the Puget Sound Salmon Recovery Plan, NOAA
3414 identifies the alteration of natural stream hydrology as a high priority limiting factor in WRIA 15
3415 (NOAA 2007), and streamflow is important for supporting riparian vegetation and wetlands that
3416 provide shading, food web support, and flood and sediment attenuation functions. Increased base
3417 streamflow and reduced water temperatures would primarily benefit juvenile salmonid rearing
3418 habitats by providing increased area and quality of summer stream rearing habitat. This would
3419 improve the survival of juveniles. Addressing the streamflow limiting factor and improving habitat
3420 conditions would help support salmonids at various life stages and increase presence, recruitment,
3421 and survival in the area of the project.

3422 *Identification of anticipated support and barriers to completion.*

3423 The project was proposed by the City of Bainbridge Island as a potential project that would fit the
3424 goals of the Watershed Restoration and Enhancement Committee. Friends of the Farms is the land
3425 manager and could be the project sponsor. Either the City or Friends of the Farm could construct,
3426 operate and maintain the pond and infiltration facilities as they own the property. Even the City does
3427 not operate the farm they are the water resources manager for Bainbridge Island and would have the
3428 resources to manage the project. The primary barrier would be the availability of funding for the
3429 construction and operations and maintenance (O&M) costs. Other barriers include the feasibility of
3430 infiltration. Feasibility issues would need to be studied and addressed during a feasibility study
3431 phase.

3432 *Potential budget and O&M costs.*

3433 The total construction costs of the pond reconfiguration, piping and infiltration facility is estimated
3434 to be around \$400,000. An additional 35 percent would be added for design, construction services
3435 and administrative costs, for a total of \$540,000. The annual O&M cost is estimated to be \$30,000. All
3436 costs are based upon a conceptual level of understanding of the project and may change once
3437 additional feasibility studies are completed. The costs would also change if the project is scaled back.

3438 *Anticipated durability and resiliency.*

3439 The project would have lasting benefits as it would be actively managed by the City of Bainbridge
3440 with O&M funded by the City using existing staff. The source of water could vary substantially from

3441 year to year due to climate factors, however the project benefits were described assuming a
3442 conservative amount of stormwater is captured and infiltrated.

3443 *Project sponsor(s) (if identified) and readiness to proceed/implement.*

3444 The City of Bainbridge Island is the most suitable project sponsor but has not committed to
3445 assuming the project sponsor role yet. The project is also in a very conceptual level of detail and
3446 additional hydrologic and geotechnical studies will be needed to determine its feasibility or
3447 arrangement.

3448 *References*

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3461 M&E Farm Manzanita Creek Infiltration Project-Bainbridge Island

3462 *Description*

3463 The proposed project at the historic M&E Tree Farm site would collect stormwater runoff from an
3464 adjacent residential area for infiltration and groundwater recharge in a constructed infiltration facility.
3465 The project is located in the Manzanita Creek watershed on Bainbridge Island in the Bainbridge
3466 Island subbasin.

3467 *Quantitative or qualitative assessment of how the project will function, including anticipated offset*
3468 *benefits, if applicable. Show how offset volume(s) were estimated.*

3469 The project would function by collecting stormwater from an adjacent area and directing it to a city-
3470 owned parcel (historic M&E Tree Farm) near the upper reaches of Manzanita Creek. An infiltration
3471 facility would be constructed on that site to recharge groundwater. A stormwater pond may be
3472 required for flow equalization and settling out fine particles which may plug an infiltration facility.
3473 Figure 1 provides a conceptual plan view for the project and Figures 2-4 provide geologic maps
3474 prepared to review the initial feasibility of an infiltration project. The initial geologic review indicated
3475 there is potential for groundwater recharge. A more detailed geotechnical evaluation would be
3476 required to confirm the site suitability and provide recommendations on the design of the infiltration
3477 facility.

3478 To estimate the volume of stormwater runoff that may be available for recharge, streamflow data on
3479 Manzanita Creek from Kitsap PUD was used. Average monthly flows in Manzanita Creek were
3480 multiplied by the ratio of the stormwater collection area to the Manzanita Creek drainage area. Table
3481 1 summarizes the anticipated average monthly yield at the project site based on the area-discharge
3482 relationship from Manzanita Creek.

3483 **Table 1**
3484 **Estimated Average Monthly Yield at M&E Tree Farm Site (acre-feet)**

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
13	6.4	3.3	3.9	1.4	0.9	0.6	0.5	0.6	1.4	4.3	8.3

3485
3486 Two assumptions were made in estimating the potential groundwater recharge. The first is the
3487 infiltration facility would operate in the winter and early spring (November to March) and the second
3488 is 50 percent of the runoff could be infiltrated. The quantity that can be infiltrated will not be known
3489 until more detailed geotechnical investigations are completed. With those assumptions, up to 17.6
3490 acre-feet per year could be recharged. The average rate of recharge would be 0.06 cfs (27 gpm).
3491 Averaged throughout the entire year, the average rate of recharge would be 0.024 cfs (11 gpm).

3492 The water offset quantity for the WRIA 15 Watershed Plan is preliminarily estimated to be up to 17.6
3493 acre-feet per year.

3494 *Conceptual-level map and drawings of the project and location.*

3495 Figure 1 shows a conceptual plan view of the project.

3496



3497

3498



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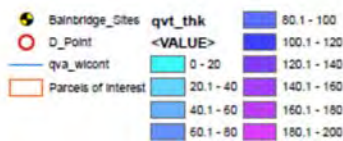
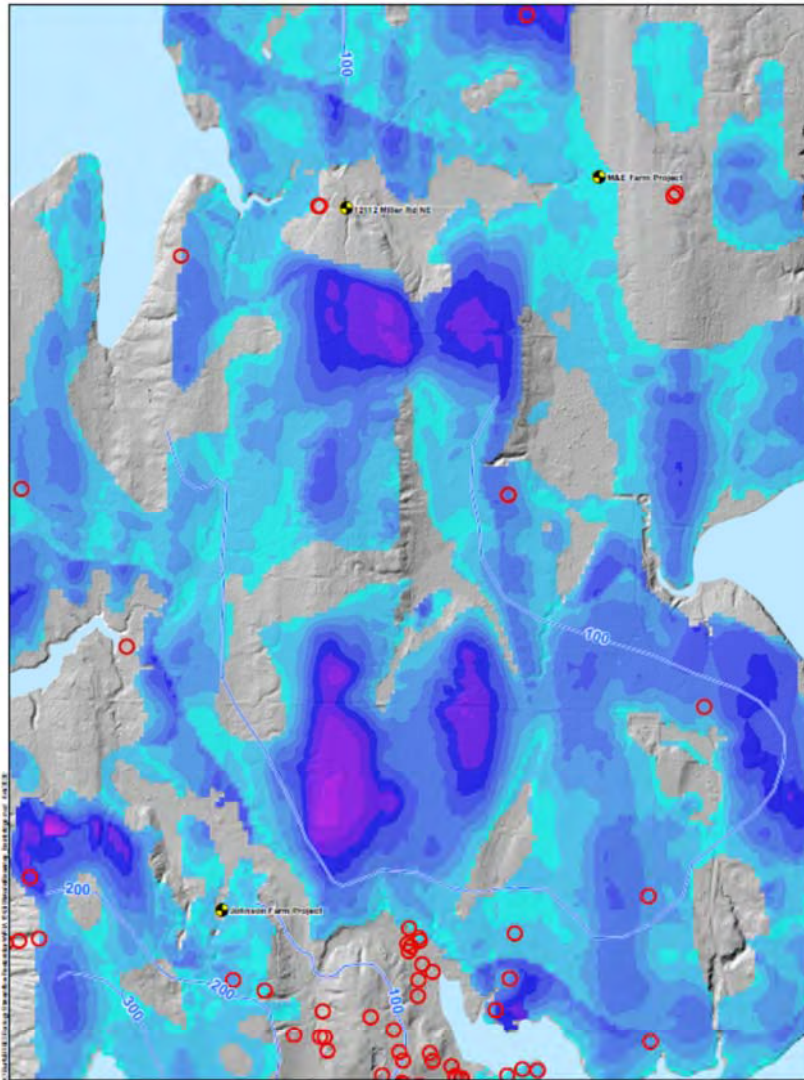


Figure 3

0 Feet 1,000

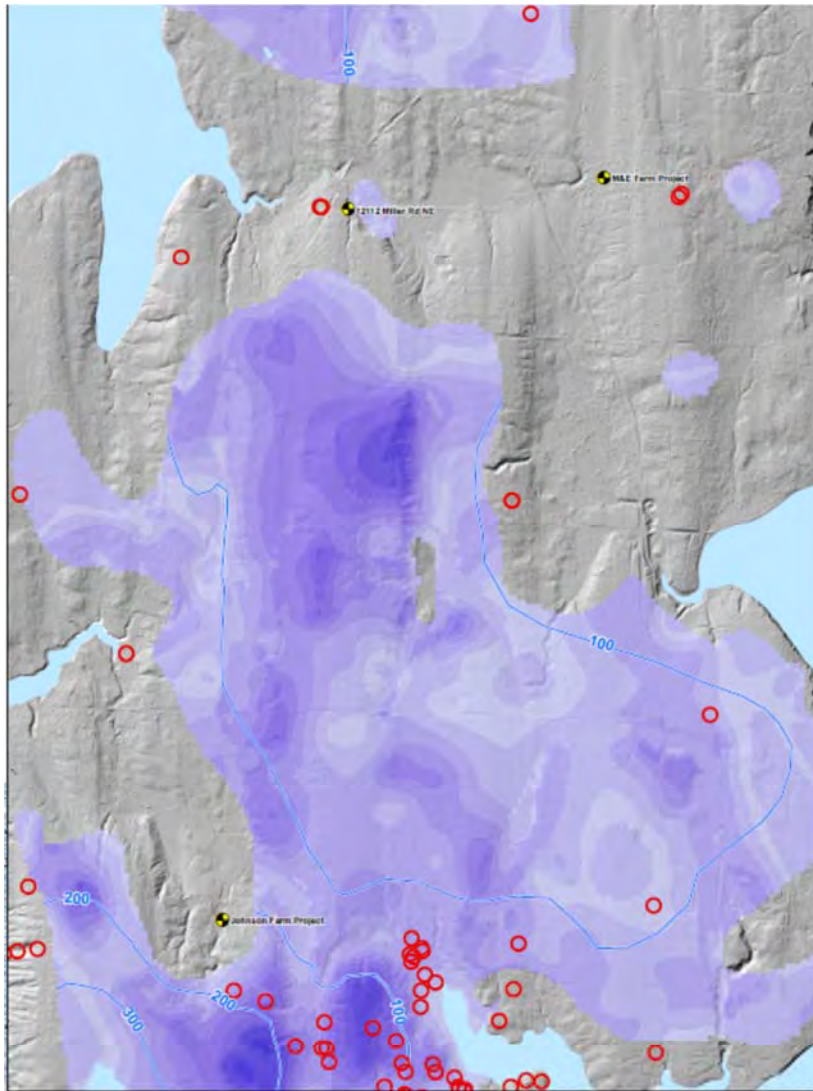


Figure 4

0 Feet 1,000

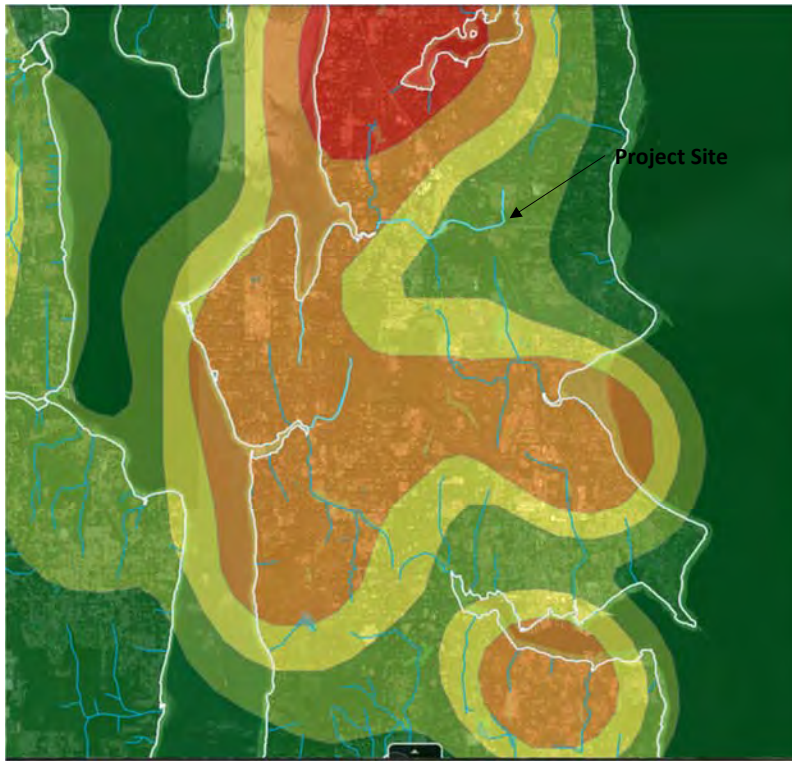
3502 *Description of the anticipated spatial distribution of likely benefits*
3503 Water storage and infiltration at the historic M&E Tree Farm Property could increase groundwater
3504 levels in the headwaters of Manzanita Creek and provide increased groundwater inputs and flows
3505 into Manzanita Creek. Detailed groundwater evaluations would be required to estimate how much
3506 benefit to Manzanita Creek would occur. Water infiltration could also enhance wetlands associated
3507 with groundwater discharge areas.

3508 *Location relative to future PE well demand*
3509 The forecast consumptive use for the Bainbridge Island subbasin using the irrigated area method
3510 and baseline growth assumptions is listed in Table 1.

3511 **Table 1. Forecast PE Consumptive Use Demand for Bainbridge Island Subbasin**

Acre-feet per year	Gallons per minute	Cubic feet per second
67.6	41.9	0.0935

3512 A copy of the PE growth heat map from the WRIA 15 webmap is shown in Figure 5. The project site is
3513 located in an area predicted to have less growth in PE wells, however more growth is predicted
3514 northwest of the site in the Manzanita Creek watershed along the North Fork Manzanita Creek. The
3515 estimated water offset benefit of 17.6 acre-feet per year is 26 percent of the offset estimated for the
3516 Bainbridge Island subbasin.



Source: <https://hdr.maps.arcgis.com/apps/webappviewer/index.html?id=d7d02dedb57241aa81dd7eb376c8625a>

Figure 5. WRIA 15 PE Growth Heat Map

Performance goals and measures.

The performance goals are to increase groundwater recharge by 17.6 acre-feet per year to improve baseflow in Manzanita Creek. The measures will be an increase in baseflow in summer in Manzanita Creek by about 0.02 cfs, assuming the water infiltrated discharges to Manzanita Creek at a steady-state rate equal to the annual average recharge. The flow in Manzanita Creek in July-September averages about 0.3 cfs with annual low flows of 0.11 to 0.18 cfs (KPUD). The groundwater recharge could increase baseflows by 8-20 percent. Increased baseflow could also slightly reduce water temperatures in the stream.

3528 *Descriptions of the species, life stages and specific ecosystem structure, composition, or function*
3529 *addressed.*

3530 The Washington Department of Fish and Wildlife (WDFW 2020) has identified that coho salmon are
3531 present in both Manzanita Creek and the SF Manzanita Creek; the Endangered Species Act (ESA)
3532 listed Puget Sound winter steelhead are present in Manzanita Creek (although Manzanita Creek is
3533 not listed as critical habitat); and chum salmon are present at the mouth of Manzanita Creek below
3534 the fish hatchery weir/dam operated by the Suquamish Tribe near Miller Bay Road (barrier ID:
3535 930696), for Manzanita Creek Hatchery. The Washington Stream Catalog (WDF 1975) indicates that
3536 both coho and chum salmon were historically present in Manzanita Creek. These North Kitsap
3537 streams were noted in the Stream Catalog (WDF 1975) as having good steady base flows at the time
3538 (likely due to the glacial outwash soils and infiltration of water).

3539 The salmonids and other aquatic species in Manzanita Creek are subject to degraded ecosystem
3540 function due to limiting factors present at the site. In the Puget Sound Salmon Recovery Plan, NOAA
3541 identifies the alteration of natural stream hydrology as a high priority limiting factor in WRIA 15
3542 (NOAA 2007), and streamflow is important for supporting riparian vegetation and wetlands that
3543 provide shading, food web support, and flood and sediment attenuation functions. Increased base
3544 streamflow and reduced water temperatures would primarily benefit juvenile salmonid rearing
3545 habitats by providing increased area and quality of summer stream rearing habitat. This would
3546 improve both productivity and survival of juveniles. The alteration of natural stream hydrology has
3547 been identified as a high priority limiting factor in WRIA 15 (NOAA 2007) and streamflow is
3548 important for supporting riparian vegetation and wetlands that provide shading, food web support,
3549 and flood and sediment attenuation functions. Increased base streamflow and reduced water
3550 temperatures would primarily benefit juvenile salmonid rearing habitats by providing increased area
3551 and quality of summer stream rearing habitat. This would improve the survival of juveniles.
3552 Addressing the streamflow limiting factor and improving habitat conditions would help support
3553 salmonids at various life stages and increase presence, recruitment, and survival in the area of the
3554 project. Addressing increased base streamflow could contribute to the VSP parameters of
3555 abundance, productivity, spatial structure, and diversity for the ESA-listed Distinct Population
3556 Segment of Puget Sound winter steelhead.

3557 *Identification of anticipated support and barriers to completion.*

3558 The project was proposed by the City of Bainbridge Island as a potential project that would fit the
3559 goals of the Watershed Restoration and Enhancement Committee. Friends of the Farms is the land
3560 manager and could be the project sponsor. The City would likely construct, operate and maintain the
3561 stormwater collection and infiltration facilities. The primary barrier would be the availability of
3562 funding for the construction and operations and maintenance (O&M) costs. Other barriers include
3563 the feasibility of infiltration. Feasibility issues would need to be studied and addressed during a
3564 feasibility study phase.

3565 It is anticipated that the project would be supported by the Puget Sound Partnership, the West
3566 Sound Watersheds Council (the lead entity in this region of WRIA 15), and other local partners. The
3567 West Sound Watersheds Council aligns salmon strategies with Puget Sound Salmon Recovery Plans
3568 and implements the Puget Sound Partnership's Action Agenda in coordination with the West Central
3569 Local Integrating Organization. One of the Near-Term Actions in the Action Agenda is a planning
3570 and design project to conduct the following:

3571 "Watershed-scale planning in two highest priority salmon-habitat basins on Bainbridge
3572 Island, working in collaboration with stakeholders through the Bainbridge Island Natural
3573 Resources Management Team (City departments of planning and public works, Kitsap County
3574 planning, WDFW, local Land Trust, local Watershed Council, Puget Sound Restoration Fund,
3575 Mid Sound Fisheries Enhancement Group, Metro Parks and Recreation, Suquamish Tribe,
3576 Kitsap Conservation District, and Kitsap Public Health District)" (PSP, 2020).

3577 The proposed project could fit into this watershed-scale planning effort which would include
3578 Manzanita Creek. The West Central Local Integrating Organization's 2016 Ecosystem Recovery Plan
3579 also identifies actions in the basin to implement salmon recovery actions. Two theories of change
3580 identified in this plan are directly addressed by the proposed project: "7.2 Decrease water
3581 withdrawal, diversion, per capital water use," and "10.3 Fix problems caused by development"
3582 (WCLIO, 2016). Manzanita Creek is not directly identified in the plan, but the project fits into general
3583 strategies for improving streamflow and habitat conditions for salmonids in WRIA 15. The project
3584 also addresses strategies identified in NOAA's Recovery Plan for Puget Sound Steelhead (NOAA,
3585 2019). Recovery Strategy 3.3.2 specifically identifies improving hydrologic conditions and restoring
3586 groundwater recharge areas as important to improving survival for steelhead in South Puget Sound.

3587 *Potential budget and O&M costs.*

3588 The total construction costs of an interceptor ditch, stormwater pond and infiltration facility is
3589 estimated to be around \$200,000. An additional 35 percent would be added for design, construction
3590 services and administrative costs, for a total of \$270,000. The annual O&M cost is estimated to be
3591 \$20,000. All costs are based upon a conceptual level of understanding of the project and may change
3592 once additional feasibility studies are completed.

3593 *Anticipated durability and resiliency.*

3594 The project would have lasting benefits as it would be actively managed by the City of Bainbridge
3595 with O&M funded by the City using existing staff. The source of water could vary substantially from
3596 year to year due to climate factors, however the project benefits were described assuming a
3597 conservative amount of stormwater is captured and infiltrated.

3598 *Project sponsor(s) (if identified) and readiness to proceed/implement.*
 3599 The City of Bainbridge Island is the most suitable project sponsor but has not committed to
 3600 assuming the project sponsor role yet. The project is also in a very conceptual level of detail and
 3601 additional geotechnical studies will be needed to determine its feasibility or arrangement.

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3620 Gig Harbor Golf Club Project-South Sound Subbasin

3621 *Description*

3622 The proposed project would replace a surface water diversion on Artondale Creek with a new
3623 groundwater well to provide irrigation water for Gig Harbor Golf Club and restore habitat over a 600-
3624 foot reach of Artondale Creek. A portion of Artondale Creek and approximately 2 acres of the
3625 floodplain would be restored by replacing two existing bridges to open up the floodplain and
3626 plantings to increase shade, improve instream habitat, reduce stream temperature, and improve
3627 riparian buffers and upland habitat conditions. The restoration project may also be extended
3628 downstream if needed to improve fish passage to the project site. The project is located in the South
3629 Sound subbasin of WRIA 15 on the Gig Harbor Peninsula. **This project is not currently feasible**
3630 **due to legal restrictions.**

3631 *Quantitative or qualitative assessment of how the project will function, including anticipated offset*
3632 *benefits, if applicable. Show how offset volume(s) were estimated.*

3633 The project would function by removing a surface water diversion and constructing a new well to
3634 replace the water supply for the golf course. The golf club has a Certificate of Surface Water Right of
3635 0.27 cfs and 70 acre-feet per year to irrigate 35 acres. The priority date is May 7, 1958. The period of
3636 use is April 15 to October 1. By switching to a groundwater source, there would be an immediate
3637 surface water increase in Artondale Creek of up to 0.27 cfs during the April 15 – October 1 time
3638 frame. The average increase (70 acre-feet/165 days) would be 0.21 cfs. There would be a
3639 corresponding increase in groundwater use and a new well would need to withdraw from a deep
3640 aquifer to minimize the potential effect on surface water. However, since the golf club is on a
3641 peninsula and close to Wollochet Bay, the impact to surface water is likely minimal. Groundwater
3642 analyses are required to design a new well to minimize surface water impacts.

3643 Stream restoration elements and the removal of two bridges would increase floodplain connection
3644 and improve riparian habitat conditions, providing beneficial habitat impacts to fish and other
3645 aquatic species.

3646 *Conceptual-level map and drawings of the project and location.*

3647 Figure 1 shows the location of the stream restoration elements and new groundwater well source for
3648 irrigation water.

DRAFT



Figure 1
Gig Harbor Golf Course
WRIA 15
Watershed Restoration and Enhancement

3649

3650 **Figure 1. Conceptual Project Description.**

3651 *Description of the anticipated spatial distribution of likely benefits*
3652 The project could result in an increased streamflow of up to 0.27 cfs and up to 70 acre-feet during
3653 the late Spring to early fall period in Artondale Creek. The increased streamflow would benefit 0.6
3654 miles of Artondale Creek between the golf course and the head of Wollochet Bay.

3655 **Location relative to future PEW demand**

3656 The estimated consumptive use for future PE wells for the South Sound subbasin is 213.8 acre-feet,
3657 assuming the median growth estimate and use of the irrigated area method.

3658 The project site is located in an area of relative moderate amount of predicted PE well growth. A copy
3659 of the PE well growth heat map from the WRIA 15 webmap is shown in Figure 2.



3660
3661 **Figure 2. WRIA 15 PE Growth Heat Map**

3662 *Performance goals and measures.*
3663 The performance goals are to decrease surface water use by up to 0.27 cfs and 70 acre-feet per year
3664 to improve streamflow in Artondale Creek and improve instream and floodplain habitat conditions.
3665 The increased streamflow and increased shade from riparian plantings should also reduce water
3666 temperatures in the stream.

3667 *Descriptions of the species, life stages and specific ecosystem structure, composition, or function*
3668 *addressed.*
3669 Artondale Creek supports a variety of species and life stages, similar to the other small streams
3670 within the Gig Harbor Peninsula area. The primary anadromous species found in Artondale Creek are
3671 coho and chum salmon, and cutthroat trout have also been observed. Specifically, Artondale Creek

3672 and its east branch support runs of coho salmon and cutthroat trout and Artondale Creek supports a
3673 run of chum salmon (Pierce County, 2015). The salmonids and other aquatic species in Artondale
3674 Creek are subject to degraded ecosystem function due to limiting factors present at the site. In the
3675 Puget Sound Salmon Recovery Plan, NOAA identifies the alteration of natural stream hydrology as a
3676 high priority limiting factor in WRIA 15 (NOAA 2007), and streamflow is important for supporting
3677 riparian vegetation and wetlands that provide shading, food web support, and flood and sediment
3678 attenuation functions. Increased base streamflow and reduced water temperatures would primarily
3679 benefit juvenile salmonid rearing habitats by providing increased area and quality of summer stream
3680 rearing habitat. This would improve the survival of juveniles. Addressing the streamflow limiting
3681 factor and improving habitat conditions would help support salmonids at various life stages and
3682 increase presence, recruitment, and survival in the area of the project.

3683 *Identification of anticipated support and barriers to completion.*

3684 A preliminary meeting was held with Board members of the Gig Harbor Golf Club and they were
3685 receptive of the project. Input from WDFW, tribes, Pierce County and other stakeholders is needed
3686 before developing the project any further. If support is obtained from those stakeholders, the main
3687 barrier to completion would be obtaining funding.

3688 The West Sound Watersheds Council, which is the Lead Entity in this region of WRIA 15, aligns
3689 salmon strategies with Puget Sound Salmon Recovery Plans and implements the Puget Sound
3690 Partnership's Action Agenda in coordination with the West Central Local Integrating Organization.
3691 The West Central Local Integrating Organization's 2016 Ecosystem Recovery Plan identifies actions in
3692 the Gig Harbor basin to implement salmon recovery actions. Two theories of change identified in this
3693 plan are directly addressed by the proposed project: "7.2 Decrease water withdrawal, diversion, per
3694 capital water use," and "10.3 Fix problems caused by development" (WCLIO, 2016). Artondale Creek
3695 is not directly identified in the plan, but the project fits into general strategies for improving
3696 streamflow and habitat conditions for salmonids in WRIA 15.

3697 The Gig Harbor Basin Plan, which was written by Pierce County Public Works and Utilities and
3698 adopted in 2005, is a comprehensive guide to surface water management in the Gig Harbor Basin
3699 (Pierce County, 2005). It identifies surface water management issues in the basin and recommends
3700 actions to reduce flood hazards, improve water quality, improve fish passage, and improve riparian
3701 habitat in the Gig Harbor Basin. Artondale Creek is described in this plan as having more than 50
3702 percent fair or poor fish habitat in addition to problem areas such as fish passage barriers. The reach
3703 of Artondale Creek which extends through the project area has the least valuable habitat for fish and
3704 wildlife than any other reach in Artondale Creek due to channelization and removal of riparian
3705 vegetation. The proposed project directly addresses this degraded habitat and aligns with the Gig
3706 Harbor Basin Plan.

3707 *Potential budget and O&M costs.*
 3708 No detailed estimate of implementation costs has been prepared but a conceptual level cost of
 3709 about \$500,000 is estimated. That includes costs of drilling, testing and permitting a new well,
 3710 restoration of 2 acres of floodplain and stream, construction of a traffic bridge at the entrance to the
 3711 golf club and a lighter duty bridge to cross the stream near a tee box, engineering and permitting. A
 3712 contingency of 25 percent was added because of the conceptual level of detail available at this stage.
 3713 The O&M costs of the well and bridges would likely be paid for by the golf course as part of their
 3714 maintenance activities.

3715 *Anticipated durability and resiliency.*
 3716 The project would have lasting benefits as it would be actively managed by Gig Harbor Golf Club
 3717 with O&M likely performed by existing golf course maintenance and grounds staff. The new
 3718 groundwater well source for irrigation should provide more reliability and less variability from year to
 3719 year due to climate factors.

3720 *Project sponsor(s) (if identified) and readiness to proceed/implement.*
 3721 A project sponsor has not yet been identified but could be the Gig Harbor Golf Club, Pierce County, a
 3722 tribe, the lead entity or another restoration organization in Pierce County and WRIA 15.

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3742 **Community Forest Projects Portfolio in WRIA 15**

3743 **Summary**

3744 This streamflow restoration action is the acquisition of forest lands or change in forest
3745 management practices to preserve stands or emphasize a longer harvest interval. Preserving or
3746 maintaining forests with stand ages more than 40 years can increase dry-season low flows. A
3747 portfolio of projects is presented along with an estimate of the potential increase in
3748 streamflow. To date, 20 projects have been identified and streamflow increases of over 1,000
3749 acre-feet/ year are estimated assuming the forest stands are more than 40 years old and
3750 subject to harvest. Potential streamflow benefits were estimated using average values of
3751 streamflow increase per acre estimated from the VELMA hydrologic model for similar projects
3752 in the Nisqually Watershed (WRIA 11). As projects move forward for funding considerations,
3753 further hydrologic modeling would need to be performed for WRIA 15 Community Forest
3754 projects to estimate potential increases in streamflow.

3755 **Description of Community Forest Projects**

3756 Hydrologic modeling performed for Community Forest Projects in the Nisqually Watershed
3757 show that forest management practices that emphasize longer harvest intervals (>80 years),
3758 forest thinning and robust riparian buffers can significantly increase dry-season low flows. The
3759 hydrologic modeling was performed using the VELMA model and the results are consistent with
3760 available observed long-term monitoring data in the Pacific Northwest region (Perry and Jones
3761 2016, Segura et al 2020). Recent empirical studies in western Oregon have established that
3762 young, rapidly growing forests can transpire over three times more water than mature
3763 forests. These studies were conducted at relatively small scales, ranging from individual trees
3764 and stands of trees (Moore et al. 2004) to small headwater catchments (Perry and Jones 2016).

3765 An estimate of the potential streamflow increase with implementation of Community Forest
3766 projects was prepared using information contained in the Nisqually Watershed Response to the
3767 2018 Streamflow Restoration Act (Nisqually Watershed Planning Unit 2019). In that plan, the
3768 average streamflow benefit is 0.14 acre-feet per year per acre of Community Forest acquired.
3769 That assumes the forest stands acquired have an average age of 40 years. The value for WRIA
3770 15 may differ because of differing hydrologic conditions and would need to be modeled to
3771 select an appropriate value. In some cases for WRIA 15, the value may be higher because of
3772 permanent protection.

3773 Maintaining mature forest cover also provides significant habitat benefits that grow with stand
3774 complexity and age. Older trees provide a wider range of niche habitats and create long-term
3775 habitat benefits of snags and large woody debris.

3776 The estimated consumptive use for future PE wells in WRIA 15 is 766.4 acre-feet per year, with
3777 a higher goal of 1218 acre feet per year. To meet the consumptive use offset for the entire
3778 WRIA, Community Forest of about 5,500 to 8,700 acres would need to be acquired or managed
3779 to emphasize a longer harvest interval. Since there are other projects that will provide water
3780 offsets, that area of community forest is not required for the plan. However, the Watershed
3781 Committee wants to include Community Forest Projects in the Watershed Plan. Table 1
3782 presents the acreage of potential community forest projects identified by sponsors by subbasin,

3783 as well as a target acreage in each subbasin that will provide water offsets to help meet the
3784 Watershed Plan goal of offsetting future PE well demand within each subbasin. The total target
3785 acreage is 1,723 acres, which will provide an estimated 241 acre-feet of water offset. The
3786 projects identified by sponsors need further confirmation to determine whether the projects
3787 would meet the criteria of having forest stands greater than 40 years old and subject to harvest.
3788 In some cases, thinning is expected to occur on the properties.

3789 The cost of acquiring community forest is likely in the range of \$10,000 - \$15,000 per acre.⁴¹
3790 The total acquisition cost for 1,723 acres would likely be in the range of \$17.2 – \$25.8 million.
3791 This does not include restoration costs.

3792 Additional information about Community Forest type projects was prepared by Paul Pickett of
3793 the Squaxin Tribe and is located on Box at
3794 <https://app.box.com/file/690715571320?s=98rgsj14yxzhakbmkl7y1j4euminkp0b>

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⁴¹ Current costs in North Hood Canal per acre are approximately \$9000. The larger range takes into account variations across the WRIA and future pricing. This estimate is only for the acquisition and does not include any potential restoration work that may occur on some properties.

3807 Table 1. Portfolio of Community Forest Type Projects in WRIA 15

Subbasin	Project Name (Sponsor, if known)	Description	Acreage	Potential Streamflow Restoration Increase (Acre-feet/year)
Bainbridge Island	Springbrook Creek Protection and Restoration (Bainbridge Island Land Trust)	Purchase of 22.85 acres of intact stream, wetland, riparian and forest habitat and removal of fish passage barrier culvert in high priority protection site as identified in Springbrook Creek Watershed Assessment (2018) and Department of Ecology Watershed Characterization.	22.85	3.2
North Hood Canal	Community Forest Projects, including: • Crabapple Creek Habitat Acquisition and Restoration • Little Anderson Creek Habitat Protection • Divide Block Habitat Acquisition and Restoration • West Port Gamble Block Habitat Protection • Port Gamble Heritage Park Timber Rights Acquisition • Gamble Creek Parcel • Boyce Anderson DNR Parcel • Seabeck DNR Parcel • Grovers Creek Mainstem protection and restoration (Sponsors may be Great Peninsula Conservancy, Kitsap County and Port Gamble S’Klallam Tribe)	Community forest projects will protect forested land from development or change timber harvest practices and restore streams, riparian areas, wetlands	Approx. 2,100 acres has been identified as potential projects by sponsors, target for Community Forest in this subbasin is 500 acres	70
South Hood Canal	Community Forest Projects, including: • Bear Creek Protection • Tahuya Headwaters	Community forest projects will protect forested land from development or change timber harvest practices and restore streams, riparian areas, wetlands	Target is 500 acres in South Hood Canal Subbasin	70

Subbasin	Project Name (Sponsor, if known)	Description	Acreage	Potential Streamflow Restoration Increase (Acre-feet/year)
	(Sponsors may be Great Peninsula Conservancy and others)			
South Sound	Community Forest Projects, including: - Rocky Creek Preserve - Coulter Creek Overton Lands - Key Peninsula Forest Lands (Sponsors may be Great Peninsula Conservancy and others)	Community forest projects will protect forested land from development or change timber harvest practices and restore streams, riparian areas, wetlands	Target is 500 acres in South Sound Subbasin	70
Vashon Maury	Community Forest Projects, including: - Judd Creek Headwaters - Shinglemill Creek Headwaters - Mileta Creek Headwaters - Christiansen Creek Headwaters - Fisher Creek Headwaters - Tahlequah Creek Headwaters (Sponsors may be Vashon-Maury Island Land Trust or King County)	Community forest projects will protect forested land from development or change timber harvest practices and restore streams, riparian areas, wetlands	Target is 100 acres in Vashon Maury Subbasin	14
West Sound	Community Forest Projects, including: - East Branch Ostrich Bay Creek along Skylark Drive W. - Strawberry and L. Anderson Creek Parcel (Sponsors may be Great Peninsula Conservancy and others)	Community forest projects will protect forested land from development or change timber harvest practices and restore streams, riparian areas, wetlands	Target is 50 acres in West Sound Subbasin	7
South Sound Islands	Anderson Island Community Forest Projects - Near Idie Ulsh Park (40 acres total) - Near Saint Anne's Park (6.68 acres) (Sponsors may include Anderson Island Parks District, Great Peninsula Conservancy, Nisqually Land Trust, Forterra)	Community forest projects will protect forested land from development or change timber harvest practices and restore streams, riparian areas, wetlands	Target is 50 acres in South Sound Islands Subbasin	7

3808

Subbasin	Project Name (Sponsor, if known)	Description	Acreage	Potential Streamflow Restoration Increase (Acre-feet/year)
Totals			Overall Target is 1,723 acres	241

3809 **Conservation District Rain Garden And Low Impact Development**
3810 **Programs**

3811 **Description**

3812 The Rain Garden and Low Impact Development (LID) Program at the Kitsap Conservation District
3813 (KCD) works cooperatively with county services, landowners, and local communities to expand
3814 knowledge and use of LID practices throughout Kitsap County. With funding from Clean Water
3815 Kitsap, the KCD helps landowners to protect local water resources by providing information,
3816 technical assistance, and financial incentives toward the installation and maintenance of rain
3817 gardens and other LID solutions. Within this program, the KCD offers free site visits to any
3818 landowner in unincorporated Kitsap County to assess and discuss what LID projects are feasible for
3819 their property.

3820 Since 2010, the KCD Rain Garden and LID cost-share program has helped landowners fund and
3821 install 320 rain gardens (KCD 2020; KCD, Pers. Comm., September 29, 2020).⁴² In 2014, the program
3822 expanded to include a number of new LID options in addition to rain gardens, such as rain barrels,
3823 lawn modification, soakage trenches, and native plants. 163 of these practices have been installed
3824 (KCD 2020, Appendix A). Rain gardens (RG) are designed to collect and filter water that flows off
3825 hard surfaces, like roofs and roads. Low impact development focuses on ways that we can adapt
3826 human-constructed landscapes to reduce harmful impacts on natural resources and the
3827 environment. Based on 9 years of data, the KCD Rain Garden and Low Impact Development
3828 Program has conservatively put 257 acre-feet of water back into the ground. The KCD estimates
3829 that they will continue to implement 50 practices (40 RG plus 10 other practices) per year with a
3830 total average offset of 29 acre-feet per year (KCD, Pers. Comm., September 29, 2020).

3831 The goal of this project would be to support the implementation of RGs and LIDs across Kitsap
3832 County (Figure 1). The implementation of specific projects would focus on critical Kitsap County
3833 streams in which permit exempt wells (PEW) are projected to be high (Figure 2).

3834 **Quantitative or qualitative assessment of how the project will function, including**
3835 **anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.**

3836 The KCD estimates that the Rain Garden and Low Impact Development Program has put 257 acre-
3837 feet of water back into the ground. The average RG or LID project is estimated to put 0.70 acre-feet
3838 of water into the ground on an annual basis. The KCD intends to implement 50 practices (40 RG
3839 plus 10 other practices) per year with an average offset of 29 acre-feet per year (KCD, Pers. Comm.,
3840 September 29, 2020). It is recommended that KCD targets the percent of applications per subbasin

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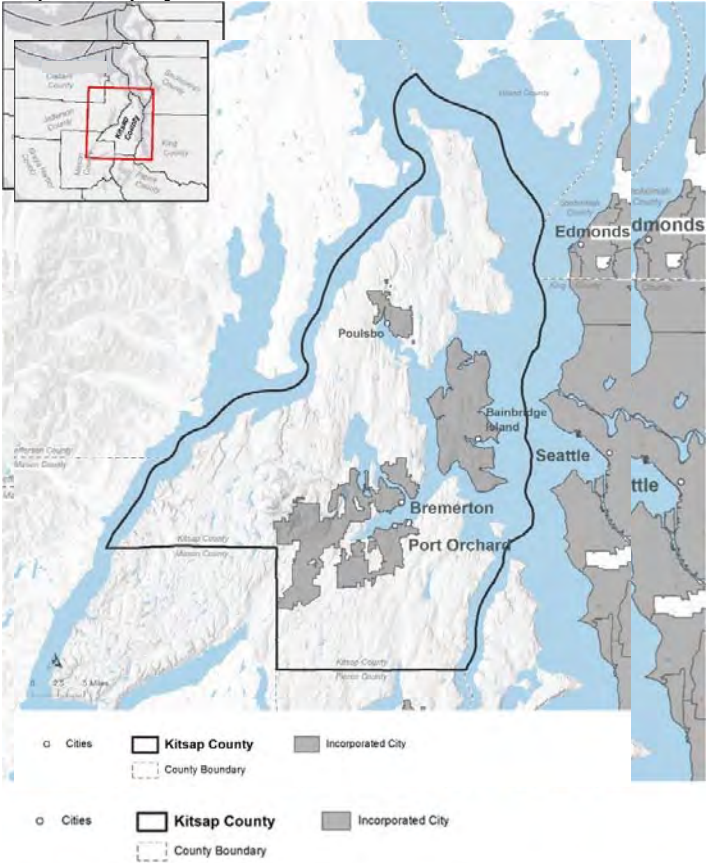
⁴² Installations include projects within the cities of Poulsbo, Bremerton and Bainbridge Island.

3841 per year as presented in Table 1.

3842 Table 1. Target Percent of Applications per Subbasin per Year

Subbasin	Target % of Applications	Total Amount of Potential Offset Benefit by 2038
North Hood Canal	20%	116 acre feet per year
West Sound	40%	232 acre feet per year
Bainbridge Island	10%	58 acre feet per year
South Sound	20%	116 acre feet per year

3843 Map of the project and location.

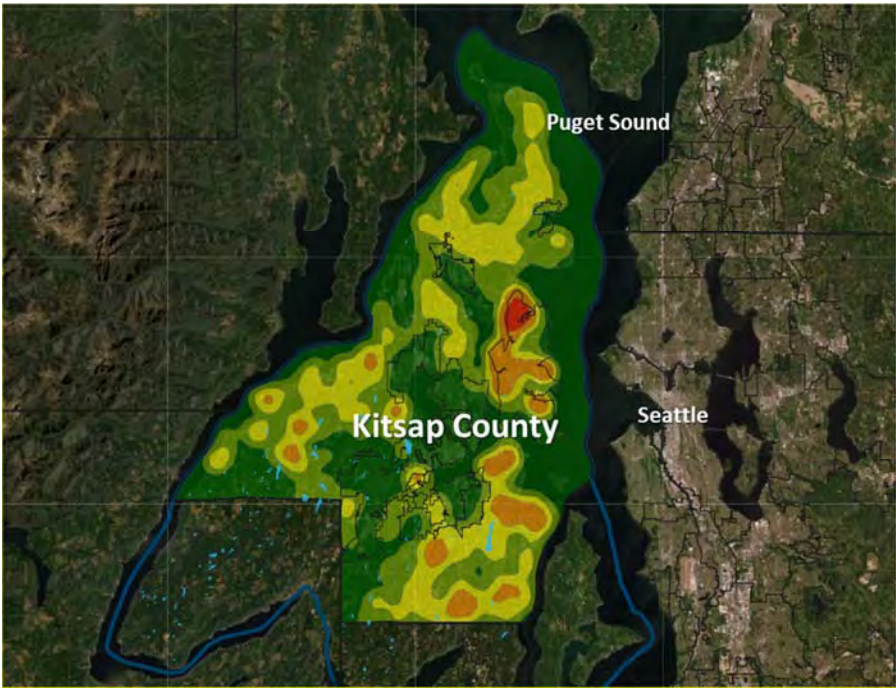


3844 Figure 1. Kitsap County with incorporated portions of the county highlighted in dark grey.
3845

3846 Figure 1 above shows the location of Kitsap County. Future RGs and LIDs would occur throughout
3847 unincorporated portions of the county. Existing RG and LID locations are provided as attachments.

3848 **Description of the anticipated spatial distribution of likely benefits**

3849 The spatial distribution of likely benefits from this project would occur throughout Kitsap County
3850 with priority towards critical Kitsap County streams in which permit exempt wells are projected to
3851 be high which are identified by orange and red in Figure 2.



3852
3853 **Figure 2. Kitsap County permit exempt connections potential growth. Red shading indicates**
3854 **high future projected growth and green shading indicates low future projected growth.**
3855

3856 **Performance goals and measures.**

3857 This project would be measured by the number of functional RGs and LIDs installed within Kitsap
3858 County above the average number of the practices installed annually by KCD (e.g. average 33 per
3859 year since 2010).

3860 **Descriptions of the species, life stages and specific ecosystem structure, composition,**
3861 **or function addressed.**

3862 The Washington Department of Fish and Wildlife has identified that Fall Chinook, Coho Salmon,
3863 Summer Chum, Fall Chum, Winter steelhead, and Pink Salmon are present in Kitsap County (WDFW
3864 2020).

3865 Increased base streamflow and reduced water temperatures would benefit both adult migrants to
3866 spawning grounds and juvenile salmonid rearing habitats by providing increased area and quality of
3867 summer stream rearing habitat. This would improve survival of adults and both productivity and
3868 survival of juveniles. The alteration of natural stream hydrology has been identified as a high priority
3869 limiting factor in WRIA 15 (NOAA 2007) and streamflow is important for supporting riparian
3870 vegetation and wetlands that provide shading, food web support, and flood and sediment
3871 attenuation functions.

3872
3873 **Identification of anticipated support and barriers to completion.**

3874 The KCD is the project sponsor who will coordinate the operations and maintenance of the RGs and
3875 LIDs infiltration/augmentation sites. KCD will collect, compile, share and report data.

3876 The primary barrier is the availability of funding for the construction of RGs and LIDs. Other barriers
3877 include private landowner willingness and partnerships with the county and cities to focus in
3878 particular areas.

3879
3880 **Potential budget and O&M costs.**

3881 The average size for a residential rain garden is around 100-120 square feet. The average
3882 construction cost for a RG or LID is ~\$10-15 per square foot if using a landscape contractor for
3883 installation. (Cost can be much higher if the whole project is done by a contractor as opposed
3884 to KCD employees.) The average cost per residential rain garden is \$1375. It is assumed that the
3885 landowner would be responsible for the O&M costs. For larger commercial site applications, using
3886 a general contractor, the estimated cost per square foot would be \$20-35.

3887 **Anticipated durability and resiliency.**

3888 The project would have lasting benefits. The KCD will manage the implementation of RGs and LIDs
3889 in partnership with the landowner.

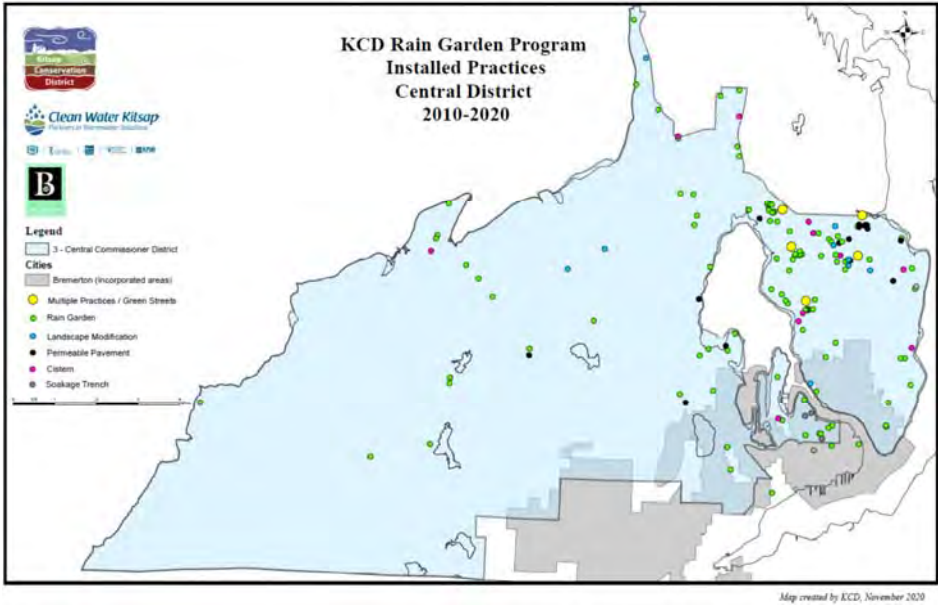
3890 **Project sponsor(s) (if identified) and readiness to proceed/implement.**

3891 The KCD is a willing project sponsor and is ready to proceed immediately. The KCD has been
3892 successfully installing RG and LIDs since 2010 with increased complexity beginning in 2014 (KCD
3893 2020). If funding is increased, the primary barrier would be private landowner willingness to install
3894 RGs and LIDs as well as partnerships with the county and cities to focus in particular areas.

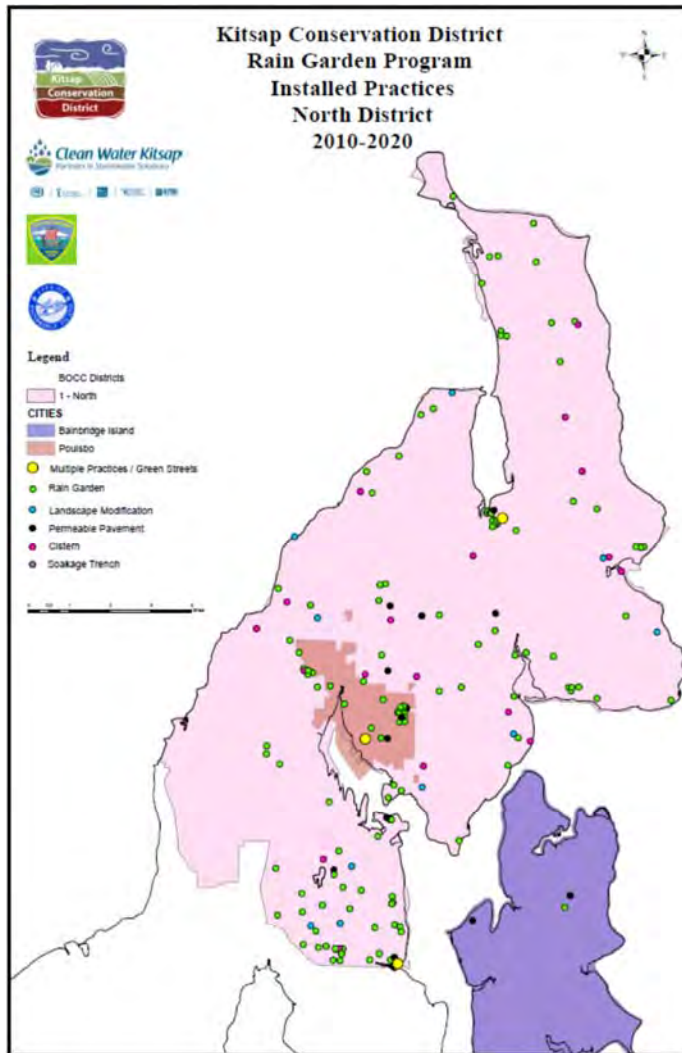
3895

3896 **Sources of Information**

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- 3903 WDF (Washington Department of Fisheries), 1975. “A Catalog of Washington Streams and
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- 3905 WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish
3906 distribution. Available at: <http://apps.wdfw.wa.gov/salmonscape/>

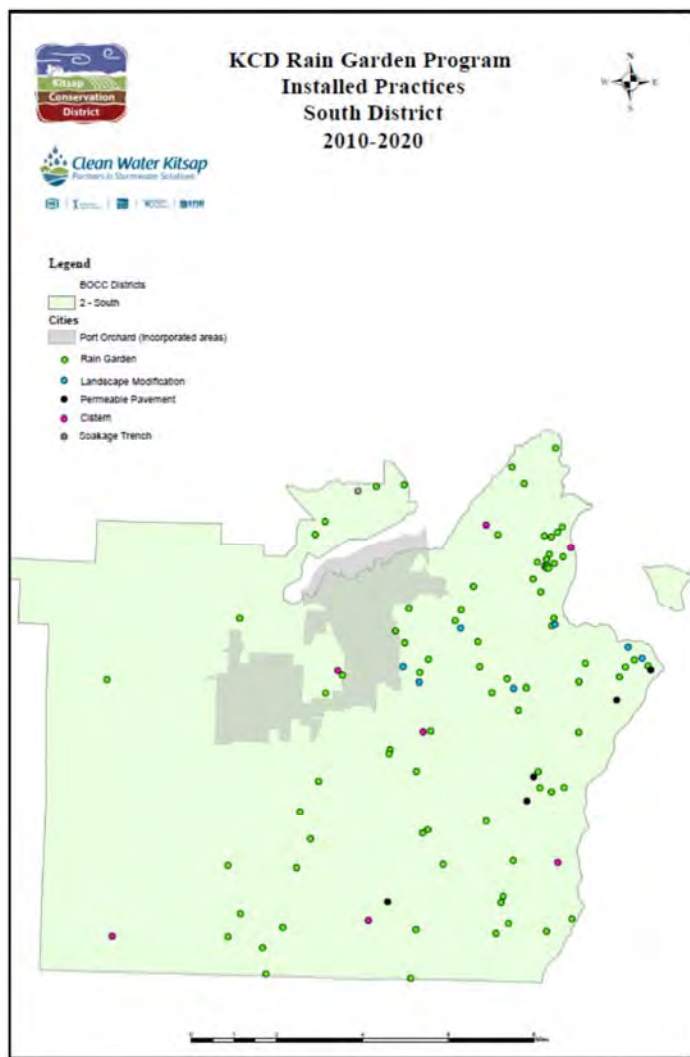


3908
3909 Figure A-1. KCD Rain Garden program installed practices in Central District (2010-2020).



3910

3911 Figure A-2. KCD Rain Garden program installed practices in North District (2010-2020).



3912

3913 Figure A-3. KCD Rain Garden program installed practices in South District (2010-2020).

3914 Proposed Water Offset for Typical Kitsap Conservation District **Raingarden**

3915 **Draft** – December 1, 2020

3916

3917 Introduction

3918 The purpose of this document is to estimate the water offset for future Kitsap Conservation District rain
3919 garden projects. Calculations of the annual recharge are presented that are based upon hydrologic
3920 modeling performed by HDR for the Mason County Rooftop Infiltration Project (HDR, 2020). For these
3921 calculations it was assumed rain gardens will be installed on houses that are currently connected to a
3922 storm drainage system, so that the entire infiltration volume will be counted as a water offset. A lesser
3923 infiltration volume and water offset would be realized for houses that are not currently connected to a
3924 storm drainage system as roof downspouts may splash onto the ground and partially or totally infiltrate.
3925 That calculation will be provided in a separate document.

3926

3927 Calculations

3928 Calculations are provided using a range of potential rain garden sizes. KCD data shows the average rain
3929 garden they have constructed since 2010 has an infiltration trench area of about 200 square feet (sf) and
3930 captures approximately 1,900 sf of impervious surface. Their installation experience includes areas of
3931 larger impervious surfaces in commercial areas and the median infiltration trench area is 140 sf, which is
3932 more typical for their residential home installations. Infiltration volumes are calculated using rain garden
3933 sizes of 100, 140, and 200 sf, as well as impervious surfaces of 1,600, 1,900 and 2,800 sf. The Mason
3934 County Rooftop Infiltration Project assumed 2,800 sf as the impervious surface that would be captured,
3935 based upon an average roof size. The infiltration rate used in the calculations corresponds to Group B
3936 soils as rain gardens use amended soils which are similar to Group B. The infiltration rate used for Group
3937 B soils is 2 inches/hour.

3938

3939 HDR's hydrologic modeling estimated the average annual recharge for an infiltration trench that is 80 sf
3940 to be 0.14 acre-feet/year. That was part of their calculation of baseline conditions assuming a minimum
3941 trench size of 80 sf under current regulations. The modeling was performed using an annual average of
3942 70 inches precipitation, which occurs in Mason County. The average annual recharge equates to 26
3943 inches per year over the assumed 2,800-sf impervious surface.

3944

3945 A larger infiltration trench will infiltrate more water; there is a proportional relationship between
3946 infiltration area and infiltration capacity. There is also a proportional relationship to the amount of
3947 runoff to the impervious area, assuming all the runoff is captured. A limit to the amount of infiltration is
3948 the volume of annual precipitation minus potential losses due to evaporation. To estimate the amount
3949 of water that will be infiltrated in a KCD rain garden the HDR results were proportionally scaled up by
3950 the amount of infiltration area (100 – 200 sf) and scaled down by the amount of impervious area (1,600
3951 – 2,800 sf). Those calculations are summarized in Table 1.

Commented [VMSJ(66): Will merge with above project description

3952 **Table 1. Percentage Change in Infiltration Capacity and Corresponding Infiltration Volume**
 3953

Impervious Surface Captured, sf	Infiltration Trench Size, sf/Infiltration Volume, acre-feet							
	80 (Mason County Study)		100		140		200	
	%	Volume	%	Volume	%	Volume	%	Volume
1,600	64%	0.090	80%	0.113	113%	0.158	161%	0.225
1,900	68%	0.095	85%	0.119	119%	0.166	170%	0.238
2,800	100%	0.140	125%	0.175	175%	0.245	250%	0.350

3954
 3955 The equivalent values in terms of rainfall infiltrated is provided in Table 2.
 3956

3957 **Table 2. Volume of Rainfall Potentially Infiltrated**
 3958

Infiltration Trench Size, sf			
80 (Mason County Study)	100	140	200
26 inches	32.7 inches	45.7 inches	65.3 inches

3959
 3960 The calculations indicate that the rain gardens KCD is installing have, on average, the capacity to
 3961 infiltrate 65.3 inches of precipitation, or about 0.23 acre-ft per installation per year. For the median
 3962 infiltration trench area of 140 sf the infiltration capacity will be about 45.7 inches, or about 0.17 acre-
 3963 feet per year.
 3964

3965 The volume of infiltration is limited by the amount of precipitation in some areas of Kitsap County as
 3966 precipitation can be less than the capacity. Table 3 provides infiltration volumes for varying precipitation
 3967 volumes varying from 40 inches to 70 inches, the average and median trench area in a KCD project, and
 3968 assuming a 1,900 sf impervious area. To be conservative, 10 percent loss due to evaporation or other
 3969 losses are assumed.
 3970

3971 **Table 3. Estimate of Annual Volume Infiltrated for KCD Rain Garden Projects**
 3972

Average Annual Precipitation, inches	200 sf trench		140 sf trench	
	Annual Volume Infiltrated, Inches	Annual Volume Infiltrated, acre- feet	Annual Volume Infiltrated, Inches	Annual Volume Infiltrated, acre- feet
40	36	0.131	36	0.131
50	45	0.164	45	0.164
60	54	0.196	45.7	0.166
70	63	0.229	45.7	0.166

3973
 3974 For a typical residential rain garden project with 140 sf infiltration trench, the average annual volume
 3975 infiltrated would range from 0.16 acre-feet in areas with precipitation greater than 50 inches to 0.13
 3976 acre-feet in areas with precipitation of 40 inches. These volumes can be used as estimates of the water
 3977 offset quantity for future KCD rain garden projects. The actual values will need to be tracked during
 3978 implementation, but the quantities shown in Table 3 provide a planning-level estimate of water offsets
 3979 from KCD projects.

3980 For every 20 rain gardens constructed at sites that are currently connected to storm drainage systems,
3981 they will collectively infiltrate about 3 acre-feet per year. This volume will be redirected into the shallow
3982 groundwater system instead of being directly discharged to surface water sources through their existing
3983 storm drainage systems. This groundwater recharge eventually contributes to increases in groundwater
3984 baseflow discharge back to streams that can be counted as water offset for RCW 90.94 purposes.
3985

3986 **Vashon-Maury Island Land Conservation And Water Rights**
3987 **Acquisition Project**

3988
3989 **Description**

3990 One set of potential projects being evaluated by the Watershed Restoration & Enhancement
3991 Committee (Committee) for Water Resources Inventory Area (WRIA) 15 is the acquisition (fee and
3992 conservation easements) of sensitive habitats and water rights in the Vashon-Maury Island sub-
3993 basin with the intent of enhancing instream flows and mitigating out of stream uses (i.e., reductions
3994 in flows associated with permit-exempt wells). Assuming property acquisition is coupled with water
3995 right acquisition, associated habitat benefits could include removal of structures and impervious
3996 surfaces, wetland and riparian protection and restoration, and decommissioning permit exempt
3997 wells (PEWs).

3998 To support identification of potential water right acquisition projects, the Department of Ecology
3999 (Ecology) queried their Water Rights Tracking System (WRTS) database and provided tables and
4000 associated GIS data of all active water rights within WRIA 15 to the Committee. Inactive water
4001 rights (e.g., previously approved changes, cancelled or withdrawn applications) were excluded from
4002 the data provided by Ecology. The tables of active water rights included over 8,500 water right files
4003 within WRIA 15. As an initial screening, water rights under consideration were limited to certificates
4004 and permits that included commercial and Industrial (CI), stockwater (ST), or irrigation (IR) uses. The
4005 list of active water right permits and certificates was further reduced by removing any with a
4006 priority date later than the July 24, 1981 adoption date of Chapter 173-515 WAC, the instream flow
4007 rule for WRIA 15. Over 1,000 water rights in WRIA 15 met these screening criteria, including 86
4008 water rights (70 surface water and 16 groundwater) in the Vashon-Maury Island sub-basin.

4009 The Committee identified priority streams in the Vashon-Maury Island sub-basin for land
4010 conservation and restoration activities, including water right acquisition. Going generally north to
4011 south, priority streams include Shinglemill, Beall, Judd, Fisher, Christiansen, and Tahlequah creeks
4012 on Vashon Island and Mileta Creek on Maury Island (Figure 1). These stream basins are priority due
4013 to their flows and salmon use, but additional water rights and may occur on smaller tributaries. The
4014 water right list was then reviewed to identify water rights with points of diversion or withdrawal
4015 within the drainages of the priority streams, with a focus on water rights located near the
4016 headwaters of the streams. Based on the Committee's review, and specifically review by the King
4017 County representative, selected water rights excluded from the initial screening (e.g., claims and
4018 rights with purposes of use other than CI, ST, and IR) were added back to the list of water rights for
4019 further evaluation. Twenty-seven water rights were identified in the priority stream drainages.
4020 Twenty-six of the water rights authorize surface water diversions and one authorizes a groundwater
4021 withdrawal. This list of rights represents the set of potential water right acquisition projects in the
4022 Vashon-Maury Island sub-basin. Table 1 provides a summary of the number of selected water

4023 rights per priority stream sub-basin and the dominant purpose of use⁴³.

4024 **Table 1. Summary of Selected Water Rights in Priority Stream Sub-Basins**

Stream Sub-Basin	Number of Rights by Dominant Purpose of Use		
	IR	DG/DM/DS	ST
Beall	1	0	0
Christiansen	2	1	0
Fisher	3	1	0
Judd	3	3	0
Mileta	2	0	0
Shinglemill	3	3	1
Tahlequah	2	2	0
Total	16	10	1

4025 Notes:

4026 IR – Irrigation

4027 DG/DM/Ds – Domestic General, Domestic Multiple, Domestic Single

4028 ST - Stockwater

4029 These rights authorize a combined instantaneous diversion rate (Qi) of 1.569 cubic feet per second
4030 (cfs). Only 13 of the 27 selected water rights list the annual authorized quantity (Qa). The
4031 stockwater right does not list an annual quantity. Three of the ten domestic water rights list the Qa,
4032 with quantities of 1 to 2 acre-feet per year (afy). Ten of the 16 irrigation water rights list the Qa,
4033 with a combined quantity of 184 afy for irrigation of 89.5 acres, or approximately 2 afy per acre.
4034 The remaining 6 irrigation water rights list a combined acreage of 50 acres. Assuming a water use of
4035 2 afy per acre, similar to the other irrigation water rights in the sub-basin, 50 acres would equate to
4036 an additional annual irrigation use of 100 afy. .

4037 Benefits to instream flow would be realized by acquiring all or a portion of a given water right and
4038 placing it into the state Trust Water Right Program (TWRP) for instream flow purposes. Quantitative
4039 benefits to instream flow would depend on the purpose of use and the manner in which the right is
4040 currently used. For example, a domestic water right that diverts from a stream for indoor uses only
4041 may have a consumptive use of about 10 percent of total use. If the septic return flows from this
4042 use return to the same stream from which the water was diverted, placing this water right into the

⁴³ Water rights may include more than one purpose of use. For this summary, water rights with an irrigation component among the authorized uses are included in the IR column; rights with a stockwater component and no irrigation use are included in the ST column; and rights with domestic uses and no stock or irrigation uses are included in the DG/DM/DS column.

4043 TWRP would have only limited benefit to instream flows. Conversely, an IR water right may have a
4044 consumptive use of about 80 percent of total use (assuming reasonably efficient irrigation
4045 practices) and placing this water right into the TWRP would result in greater benefits. The period of
4046 use, or seasonality, will also affect when instream flow benefits would occur.

4047 **Quantitative or qualitative assessment of how the project will function, including**
4048 **anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.**

4049 Direct benefits to instream flow in a priority stream would be realized through nonuse of the
4050 acquired water rights. Depending on the specific opportunity, nonuse would be achieved through
4051 fallowing of irrigated fields, reduced hay harvest, changing to an alternate crop that does not
4052 require irrigation, removal of livestock, or provision of an alternate source of supply. The acquired
4053 water right would be placed into the state TWRP and dedicated to instream flow purposes. By
4054 placing it into the TWRP, increases in instream flows realized by a project would be protected from
4055 future appropriation or use.

4056 The potential instream flow offset realized by a project would be limited to the consumptive impact
4057 on instream flows under the existing water right uses. A general discussion of the potential
4058 consumptive use associated with irrigation, stockwater, and domestic uses is provided in the
4059 following paragraphs. More detailed evaluation would be required once a specific project or
4060 projects are selected to accurately quantify consumptive uses and assess the timing and location of
4061 instream flow offsets associated with placing a right into the TWRP.

4062 The timing and location of instream flow offsets will depend on several factors, including:

- 4063 • The period of use of the water right (seasonal or continuous). A seasonal diversion may
4064 only affect stream flows for part of the year, while a continuous diversion (e.g., for
4065 domestic uses) would likely affect stream flows year-round.
- 4066 • Whether the right is for surface water or groundwater. The effect of groundwater
4067 withdrawals on surface water flows tend to lag behind the pumping period, such that the
4068 effects of seasonal pumping persist for weeks or months after pumping ceases. The
4069 location of effects on surface water flows may also be more dispersed and the peak impact
4070 lower with groundwater pumping. Conversely a surface water diversion will affect stream
4071 flow instantaneously and directly.
- 4072 • Hydrogeologic conditions and the location of the place of use. Only a portion of water
4073 diverted for use is consumed, the remaining quantity that recharges groundwater and/or
4074 discharges back to surface water is termed the return flow. The timing and location of
4075 where return flows would return to an affected stream depend on the location where water
4076 is used, how water is managed (e.g., domestic septic systems versus sewer systems), and
4077 hydrogeologic conditions between the place of use and the surface water.

4079 For an irrigation water right, annual consumptive use can be estimated based on the State of
4080 Washington Irrigation Guide (WIG) and Ecology Water Resources Program Guidance 1210 –
4081 Determining Irrigation Efficiency and Consumptive Use (Ecology, 2005). The WIG lists the crop
4082 irrigation requirement (CIR) for a variety of crops at stations throughout the state. The CIR is the
4083 amount of water needed from irrigation to support crop growth that is not provided by
4084 precipitation or stored soil moisture. Using the Bremerton station, CIRs in WRIA 15 range from
4085 about 4.51 inches (0.375 feet) for strawberries to 22.3 inches (1.86 feet) for raspberries. The CIR for
4086 grass/pasture, the most likely crop grown, is 16.8 inches (1.4 feet).

4087 Guidance 1210 provides typical irrigation application efficiencies (Ea) and percent consumptive use
4088 (%CU) associated with different irrigation methods. The CIR divided by the application efficiency
4089 provides the total irrigation water requirement (TIR). Multiplying the TIR by the %CU provides the
4090 consumptive use. Assuming sprinkler irrigation with an average Ea of 75 percent, TIRs per acre in
4091 WRIA 15 could range from about 0.5 feet to 2.5 feet, with a likely amount of 1.9 feet. Assuming a
4092 %CU of 80 percent if the TIR, consumptive use per acre could range from 0.4 to 2 feet per acre of
4093 irrigated land, with a likely value of 1.5 feet. The total consumptive use for a water right can then be
4094 estimated as the irrigated acreage times the consumptive use per acre.

4095 Table 2 provides a summary of irrigated acreage and the potential range of associated
4096 consumptive use, based on the consumptive use per acre described above and the authorized
4097 irrigated acreage listed in the water rights. Site-specific evaluations of crop type, irrigation
4098 methods, and irrigated acreage would be needed to determine the potential consumptive use that
4099 could be available to support instream flows by placing a given water right into the TWRP.

4100 **Table 2. Summary of Authorized Irrigated Acreage and Consumptive Use by Priority Stream**
 4101 **Sub-Basins**

Stream Sub-Basin	Authorized Acreage	Low-End CU in AFY	High-End CU in AFY	Likely CU in AFY
Beall	8	3.2	16	12
Christiansen	19	7.6	38	28.5
Fisher	42	16.8	84	63
Judd	30	12	60	45
Mileta	7	2.8	14	10.5
Shinglemill	11.5	4.6	23	17.3
Tahlequah	22	8.8	44	33
Total	139.5	55.8	279	209.3

4102 The period over which consumptive use impacts occur would generally be the irrigation season, or
 4103 about May through September, although as discussed above accounting for the lag associated
 4104 with groundwater pumping impacts and the timing of return flows would affect this period. As an
 4105 example, retiring about 3 acre-feet of consumptive use would equate to an average instream flow
 4106 benefit of about 0.01 cfs during the irrigation season.

4107 Typical indoor domestic uses are expected to be about ten percent consumptive. The domestic
 4108 water rights in the property drainages authorize use of less than 2 afy each, such that annual
 4109 benefits to instream flow would be less than 0.2 afy per domestic water right. Acquiring domestic
 4110 water rights would likely require providing an alternate source of supply (e.g., hookup to a public
 4111 water system) or acquisition of the residential properties served by the water right. For ST rights the
 4112 benefits would depend on the specific stock operation, including water uses and management and
 4113 discharge of effluent. Although more limited in the potential amount of water that could be
 4114 realized by retiring these water rights, domestic and ST water rights are expected to provide
 4115 opportunities for year-round instream flow benefits not presented by the IR water rights.

4116 **Map of the project and location.**

4117 Figure 1 (attached) shows the location of priority streams within the Vashon-Maury Island sub-
 4118 basin.

4119 **Description of the anticipated spatial distribution of likely benefits**

4120 Water right acquisition would be focused on stream headwaters or above known areas of fish
 4121 habitat. By acquiring a water right, discontinuing uses, and placing the right into the TWRP
 4122 historical consumptive use associated with the right would be allowed to remain instream. The

4123 instream flow represented by the water right in the TWRP would be protected from future
4124 appropriation or use by others allowed to remain instream from the historic point of diversion to
4125 the point of discharge to marine waters, benefiting aquatic habitat through the entire downstream
4126 reach.

4127 **Performance goals and measures.**

4128 The range of potential offset benefit from the water right acquisition opportunities on Vashon
4129 Maury is approximately 56 to 279 acre feet per year. We recommend counting 10 percent of the
4130 total potentially available water rights as the offset benefit presented in the WRIA 15 plan, or 27.9
4131 acre-feet per year (10 percent was applied for the water right acquisition opportunities in the
4132 Nisqually plan).

4133 **Descriptions of the species, life stages and specific ecosystem structure, composition,
4134 or function addressed.**

4135 The Washington Department of Fish and Wildlife (WDFW 2020a; WDFW 2020b) has identified that
4136 coho and chum salmon are present in Judd and Shinglemill creeks, and the Endangered Species Act
4137 (ESA) listed Puget Sound fall Chinook are present in Judd Creek, the ESA-listed Puget Sound winter
4138 steelhead are present in Judd, Christensen, and Shinglemill creeks, and cutthroat trout are likely
4139 present in all Vashon and Maury Island creeks that have perennial flow (noted as present in Fisher,
4140 Tahlequah, Shinglemill, Christensen, and Mileta creeks). The Washington Stream Catalog (WDF 1975)
4141 indicates that both coho and chum salmon were historically present in Judd Creek and other creeks
4142 on Vashon Island, although there had been limited surveys of fish populations at that time. East
4143 Kitsap creeks were generally noted in the Stream Catalog (WDF 1975) as having substantial low flow
4144 problems, lack of riparian cover, and fine sediment inputs from forestry and agricultural land uses. An
4145 impassable fish barrier culvert is present at about rivermile 1 on Judd Creek and an impassable dam
4146 is present on Beall Creek (WDFW 2020a).

4147
4148 Judd and Fisher creeks are listed as Category 5 for high water temperatures on Ecology's 303(d) list
4149 of impaired waterbodies; Judd and Shinglemill creeks are listed as Category 5 and Christensen Creek
4150 is listed as a Category 2 for bioassessment (poor quality based on macroinvertebrate sampling); and
4151 Shinglemill and Tahlequah creeks are listed as Category 1 for water temperature (Ecology 2020).

4152
4153 Increased base streamflow and riparian and wetland restoration would contribute to reducing water
4154 temperatures that would benefit both adult migrants to spawning grounds and juvenile salmonid
4155 rearing habitats by providing increased area and quality of summer stream rearing habitat. This
4156 would improve survival of adults and both productivity and survival of juveniles. The alteration of
4157 natural stream hydrology has been identified as a high priority limiting factor in WRIA 15 (NOAA
4158 2007) and streamflow is important for supporting riparian vegetation and wetlands that provide
4159 shading, food web support, and flood and sediment attenuation functions.

4160

4161 The headwaters of Judd, Fisher, and Shinglemill creeks include numerous wetland areas that could
4162 also benefit from increased groundwater levels, further supporting cold water volumes to the
4163 creeks.

4164

4165 Land conservation and restoration activities may provide habitat benefits in addition to streamflow
4166 restoration. Those habitat benefits would derive from removal of structures and impervious
4167 surfaces, decommission of PE wells, wetland and riparian protection and restoration.

4168

4169 **Identification of anticipated support and barriers to completion.**

4170 The primary barrier is the willingness of water right holders to sell their water rights and land. A
4171 secondary barrier is the availability of funding for water right acquisition and permitting.

4172 **Potential budget and O&M costs.**

4173 Water right acquisition costs are location and market specific. As a planning-level assumption,
4174 costs per consumptive acre-foot of irrigation water or stockwater could be in the \$1,000 to \$5,000
4175 range. As discussed above, consumptive use per acre could range from about 0.4 to 2.0 acre-feet.
4176 Costs for acquisition of domestic water rights are likely to be strongly affected by the costs of
4177 providing an alternate water supply. These costs could be highly variable, depending on the
4178 availability and location of an alternate supply. Following water right acquisition and permitting
4179 there are expected to be no ongoing O&M costs associated with water right acquisition.

4180 Budgets and O&M costs for property acquisition and associated habitat benefits through removal
4181 of structures and impervious surfaces, wetland and riparian protection and restoration, and
4182 decommissioning of PEWs will depend on the specific project opportunities and are not included in
4183 here.

4184 **Anticipated durability and resiliency.**

4185 Water right acquisition projects would have long-lasting benefits and would require minimal future
4186 management once permitting is complete. The durability and resiliency of other habitat
4187 improvement projects associated with property acquisition will depend on the specific projects and
4188 are not included in here.

4189 **Project sponsor(s) (if identified) and readiness to proceed/implement.**

4190 King County and Vashon-Maury Island Land Trust are potential sponsors of the projects. Both
4191 entities have extensive experience with implementing similar projects and would be ready to
4192 proceed once funding is secured.

4193 **Sources of Information**

4194 Ecology (Washington Department of Ecology), 2020. 303(d) Assessed Waterbodies. Available at:
4195 <https://apps.ecology.wa.gov/waterqualityatlas/StartPage.aspx>

- 4196 WDF (Washington Department of Fisheries), 1975. "A Catalog of Washington Streams and Salmon
4197 Utilization, WRIA 15." Accessed at: https://www.streamnetlibrary.org/?page_id=95.
- 4198 WDFW (Washington Department of Fish and Wildlife), 2020a. Salmonscape. Available at:
4199 <http://apps.wdfw.wa.gov/salmonscape/map.html>
- 4200 WDFW, 2020b. Priority Habitats and Species on the Web. Available at:
4201 <https://geodataservices.wdfw.wa.gov/hp/phs/>

4202 **Beall Creek Bypass Flow Improvement**

4203 **Draft** Project Description

4204 November 17, 2020

4205

4206 **Description**

4207 Beall Creek is a first order stream along the eastern shore of Vashon Island in King County with a
4208 drainage basin of 211 acres (Figure 1). Historically, Beall Creek likely had a fish community that
4209 included Cutthroat Trout, Coho Salmon, and steelhead trout. Juvenile coastal cutthroat have been
4210 observed utilizing Beall Creek (Salmonscape 2020). The focus of this project for the WRIA 15
4211 watershed plan is to more accurately measure the Water District 19 water requirements at the
4212 Water District 19 (District) diversion. To accomplish that the existing diversion, which is a fish
4213 passage barrier, will be replaced. This project will improve bypass flow at the diversion, resulting
4214 in flow improvements to Beall Creek at a rate of an estimated 26 acre feet per year.

4215 **Fish Barriers on Beall Creek**

4216 A plastic sheet pile dam across Beall Creek impounds water for the District's irrigation diversion at
4217 river mile (RM) 0.30 (Figure 2). The District withdraws as much as 350 gallons per minute from the
4218 spring-fed creek (a type-two water supply) for community water supply. There are no fish passage
4219 facilities at the District's irrigation diversion which results in a complete barrier to upstream fish
4220 passage at this location (Kerwin and Nelson 2000, Salmonscape 2020). The Washington
4221 Department of Fish and Wildlife (WDFW) identified the District's irrigation diversion as a complete
4222 fish passage barrier in June 2017 (Salmonscape 2020). A partial fish passage at Beall Creek RM 0.02
4223 was also identified in June 2017. There are currently no plans to address the partial barrier at RM
4224 0.02.

4225 **Previous Project Development**

4226 In May 2018, a Preliminary Design Report for the Beall Creek Fish Passage project was completed
4227 for the District's upstream irrigation diversion at RM 0.30 (Fisheries Engineers 2018). The report
4228 included a number of proposed modifications to the District's Beall Creek diversion including:

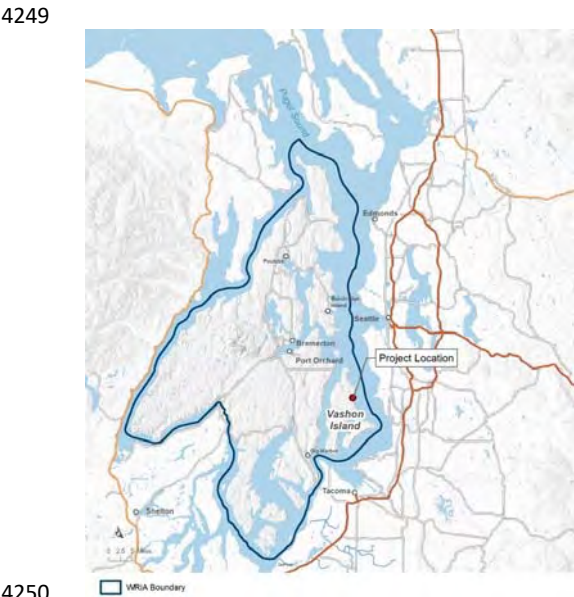
- 4229
- 4230 • A new concrete dam to be built flush with the existing stream channel;
 - 4231 • A proposed roughened channel for upstream fish passage;
 - 4232 • A means to measure and control the water supply diversion and release of bypass flow;
 - 4233 • A new vertical plate fish screen installed within the existing water intake basin to physically
4234 exclude fish from the pumped water intake;
 - 4235 • A sand and silt sluicing system to facilitate the District's maintenance of the water supply
4236 intake; and
 - A new water delivery system to Water Treatment Plant 1 (Fisheries Engineers 2018).

4237 Some members of the WRIA 15 Committee do not support including offset benefits from fish
4238 barrier removal projects. Therefore, the streamflow benefit considered for this project are
4239 modifications to the diversion to improve flow in Beall Creek.

4240 **Quantitative or qualitative assessment of how the project will function, including**
4241 **anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.**

4242 If this Beall Creek Bypass Flow Improvement project were completed, the improved measuring
4243 capabilities would ensure a minimum flow in the stream of 48 gallons per minute and a more
4244 accurate diversion of water supply requirements thereby bypassing more flow than they currently
4245 do. The estimated offset benefit would be the minimum flow during the dry season when water
4246 demands and diversions by the District is highest. Assuming a 4-month dry season (June-
4247 September), the offset quantity would be 26 acre-feet.

4248 **Map of the project and location.**



4250 **Figure 1. Location of Vashon Island and Beall Creek (red circle).**



Figure 2. Beall Creek with a partial fish passage barrier at river mile 0.02 (yellow) and a complete fish passage barrier at river mile 0.30 (red). Both locations are associated with Water District 19. This project is focused on flow improvements at river mile 0.30.

Description of the anticipated spatial distribution of likely benefits

This project would put more water in the last 0.3 miles of Beall Creek to support aquatic life downstream. The fish barrier removal component of the project would open up ~0.6 miles of stream habitat for migratory fishes in Beall Creek, upstream of the District's irrigation diversion (Figure 2). However, a partial fish passage at Beall Creek RM 0.02 remains unaddressed so fish distribution throughout Beall Creek may remain limited even if the project is completed.

Performance goals and measures.

The project will be measured by the presence of a minimum 48 gallons per minute bypass flow to allow fish passage through the roughened channel and preserve aquatic life downstream of the diversion.

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

WDFW has identified that resident Coastal Cutthroat trout are present in Beall Creek (Salmonscape 2020). The proposed roughened channel would allow for upstream fish passage and the new vertical plate fish screen installed within the existing water intake basin would physically exclude fish from the pumped water intake, reducing or eliminating fish mortality. As a whole, this project supports all life stages of the resident Coastal Cutthroat trout.

4274 **Identification of anticipated support and barriers to completion.**

4275 Water District 19 is the primary stakeholder for the bypass flow improvement project. The District
4276 will collect, compile, share and report project data. The project is supported by the Washington
4277 Department of Fish and Wildlife, the Washington Department of Ecology, and the Puyallup Tribes
4278 of Indians.

4279 The primary barrier is the availability of funding for project construction and operations. The
4280 preliminary design and cost estimate was developed in 2018 (Fisheries Engineers 2018) however
4281 the District has been unable to obtain funds for the project.

4282 **Potential budget.**

4283 As of October 2019, the estimated costs for both the barrier removal and the flow improvements
4284 was \$110,000 (Fisheries Engineers 2018, Water District 19 2019). This cost estimate includes
4285 \$82,000 for construction, \$8,000 for Final Project Design, \$6,000 for Project Permits, and \$14,000
4286 for Construction Management (Fisheries Engineers 2018).

4287 **Anticipated durability and resiliency.**

4288 The project would have lasting benefits. The project would likely improve the District's maintenance
4289 capabilities for the water diversion system integrated with the fish passage facilitates (Fisheries
4290 Engineers 2018) providing a more reliable bypass flow.

4291 **Project sponsor(s) (if identified) and readiness to proceed/implement.**

4292 The District would sponsor the project. Funding for the project will also need to be secured.

4293 **Sources of Information**

4294 Kerwin, John and Nelson, Tom S. (Eds.). December 2000. Habitat Limiting Factors and
4295 Reconnaissance Assessment Report, Green/Duwamish and Central Puget Sound
4296 Watersheds (WRIA 9 and Vashon Island). Washington Conservation Commission and the
4297 King County Department of Natural Resources.

4298 Fisheries Engineers. 2018. Beall Creek Fish Passage Project Preliminary Design Report. Prepared
4299 for Water District 19. June 2018.

4300 Water District 19. 2019. Water District 19 meeting minutes from October 8, 2019.
4301 <http://www.water19.com/wp-content/uploads/2019/12/Comm-Meeting-100819-FINAL.pdf>

4302 WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish
4303 distribution. Available at: <http://apps.wdfw.wa.gov/salmonscape/>

SENT BY ELECTRONIC MAIL

December 7, 2020

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Re: Squaxin Island Tribe's comments on draft WRIA 12-14 Streamflow Restoration Plans

Dear Mary:

The comments in this letter apply to four draft watershed plans in WRIAs 12-15 being developed as part of the process created by ESSB 6091 and the Streamflow Restoration Act (the "Act", codified as RCW 90.94). (These plans are sometimes referred to as "Streamflow Restoration" or "Watershed Restoration and Enhancement" Plans.) These comments address the Squaxin Island Tribe's ("Tribe" or "Squaxin") expectations for the plans in context of the appropriate legal framework. The Tribe has invested, and will continue to invest, significant effort in the ESSB 6091 watershed planning process. WRIAs 12-15, which are covered by Section 203 of the Streamflow Restoration Act ("Act"), overlap with most of the Tribe's usual and accustomed fishing areas ("U&As") in South Puget Sound. Accordingly, the Tribe is focusing its efforts on developing plans that actually protect, restore and enhance fish-bearing waters. This is what the Act mandates.

We are quite concerned, however, that the four emerging draft plans fall far short of the mandates of the Act and other state laws, and violate the Tribe's federally-reserved water rights. The plain language of the Act requires more than noncommittal statements about offsetting twenty years of domestic permit-exempt wells. These plans must actually restore and enhance streamflows. In some basins, creeks are currently dewatered by existing permit-exempt wells, especially during low flow times (summer, fall) that are critical for fish spawning and rearing. In other places, water systems growing into inchoate state water rights will dewater fish-bearing streams. These harms are compounded by the predicted water scarcity that accompanies climate change in Western Washington. These plans, if properly devised, can help avoid delaying important water management decisions, avoid curtailments, and bring longer certainty to South Puget Sound.

This letter provides comments that apply to all four plans, covering the legal issues and our expectations for the Plans:

- Section A: Status of WRIA 12-15 Watersheds

- Section B: Correct Legal Framework for Plans
- Section C: Ecology's mandate to amend the rules for WRIAs 12-15.
- Section D: Criteria for Successful Plans

We want to be clear that the Tribe has engaged in the planning process in the spirit of cooperation and compromise. Our positions in the Committee meetings were motivated by that spirit, but do not necessarily reflect our legal views in the event that we are in future litigation.

For example, in meetings our representative Paul Pickett has made comments or declined to place blocks on plan actions and projects that contain non-binding, discretionary language (like "should" and "could"). Even when we accept non-binding plan language as part of a collaborative process, we still expect binding commitments from Committee members and from Ecology, including commitments enshrined in rule amendments. Interim decisions or agreements where we "stand aside" or agree to one element of the plan, out of a willingness to compromise and keep the process moving, do not necessarily mean approval of the plan as a whole, or even approval of the item we agreed to.

We reserve our rights to address the legal shortcomings of the planning process, despite Squaxin plan comments that allow the inclusion of plan elements that we believe do not meet the language and intent of the Act. Should we find the plan otherwise acceptable to approve, we expect to articulate this view in a signing statement to be included in the plan.

A. Status of WRIA 12-15 Watersheds

Most precipitation in these WRIAs arrives during the winter months when water demands are the lowest. During the summer there is little rain, and naturally low stream flows are dependent on groundwater inflow. This means that groundwater and surface water are least available when water demands are the highest. This is especially true in hot, dry years, and increasingly true with climate trends.

Much of the water supply in these watersheds is now compromised or controlled by the owners of claims, permits, rights, and permit-exempt wells. Increased demands from population growth, low summer and early fall streamflow levels, and impacts from climate change add to the challenge of finding new water supplies in these WRIAs. There is limited water available for new uses in parts of these WRIAs, especially given that river levels need to be maintained to ensure adequate water quality and fish migration. This reality is explicitly acknowledged by RCW 90.45.005(2)(a) ("The legislature finds that: . . . The state of Washington is faced with a shortage of water with which to meet existing and future needs, particularly during the summer and fall months and in dry years when the demand is greatest; . . .").

In the 1980's, Ecology adopted instream flow rules for many streams in these four WRIAs. These rules close, partially close, or set instream flow levels in numerous streams. For

those streams with gages, records indicate the streams are frequently not meeting instream flows during the late summer and early fall periods that are critical for salmon. *See, e.g., Ecology, Focus on Water Availability for WRIs 13, 14.*

For years, Ecology has shirked its duty in these WRIs to ensure that senior water rights, including instream flows, closures, and the Tribe's rights, are protected by enforcement of the laws and rules. Ecology in recent years has taken the incorrect position that these WRI rules do not limit the use of permit-exempt wells, inviting a free-for-all that contravenes the governing statutes.

B. Correct Legal Framework for Plans

1. The draft plans exclude elements mandated by the Act, and/or make it impossible for Ecology to adopt without violating the Act.

Ecology's position is that it can adopt plans that only offset 20 years of "new" domestic permit-exempt wells and achieve net ecological benefit ("NEB"). This interpretation is incorrect. It ignores mandatory language in RCW 90.94.030. First, the statute, both implicitly and explicitly, mandates that offsets must at minimum include both permit-exempt domestic uses dating back to the date of WRI rule adoption and new domestic permit-exempt wells. RCW 90.94.030(3)(b). Second, the law mandates that Ecology, before adopting the plan, "must" determine that actions identified in the plan, after accounting for all new projected uses of water over the subsequent twenty years – i.e., not just new, domestic permit-exempt wells – will result in a net ecological benefit ("NEB") to instream resources within the WRI. RCW 90.94.030(c). Third, the plan "must" include an evaluation or estimation of the cost of offsetting all new domestic water uses over 20 years, not just new, domestic permit-exempt wells. RCW 90.94.030(d). Finally, the plan "must" estimate 20 years of all cumulative consumptive water use impacts – not just new domestic permit-exempt withdrawals. RCW 90.94.030(e).

2. Guaranteed plan implementation is mandatory, not optional.

As envisioned by the Act, Ecology-adopted watershed plans (with or without unanimous committee votes) can meet the Act's mandates by:

- (1) ensuring the offsetting of (a) existing domestic permit-exempt wells that are junior to instream flow rules, and (b) future domestic permit-exempt wells through 2038 (RCW 90.94.030(3)(b));
- (2) beginning to restore flows where instream flows are unmet;
- (3) assuring implementation; and
- (4) being enforceable.

See RCW 90.04.030(3)(b). That outcome, however, appears highly unlikely given the current nature of the draft plans.

ESSB 6091 allows streamflow impacts from new domestic permit-exempt wells – impacts that are highly likely to occur – provided adequate offsets are realized and NEB is achieved. ESSB 6091 accomplished this through the Act itself, as well as amending the Building and Subdivision codes and the Growth Management Act (“GMA”)¹. The Act authorizes new domestic permit-exempt wells to impair instream flows and impact closures “through compliance with the requirements [of RCW 90.94.030], unless instream flow rules specify otherwise. RCW 90.94.030(1). Among other things, RCW 90.94.030 requires plans that offset impacts and achieve NEB.

Ecology’s position effectively means that impacts can occur even if the projects and actions intended to offset permit-exempt wells and achieve NEB are not implemented. Ecology’s guidance states that the Act “does not predicate the issuance of building permits on the implementation of watershed plans or any projects and actions in those plans.” Ecology, *Streamflow Restoration Policy and Interpretive Statement*, POL-2094 at p. 10 (July 31, 2019) (Ecology POL-2094). We expect local governments to take the position that they can approve streamflow-impactful buildings and subdivisions because these approvals are consistent with the watershed plans, permit-exempt well law, and/or instream flow rules, even if implementation is not at all certain to occur or never occurs.

Compliance with RCW 90.94.030, however, requires implementation of offsets and NEB that is comprehensive, timely, and effective. Nowhere does the Act absolve Ecology or any other entity of the duty to ensure implementation of the projects and actions. Rather, it is clear that the Legislature directed Ecology to implement a program that restores and enhances streamflows. For all plans, regardless of whether the committees unanimously adopt them, Ecology must make a specific determination that requires guaranteed implementation. RCW 90.94.030(3)(c), (_). Ecology can therefore not legally adopt a plan that fails to ensure that the impacts from new domestic permit-exempt wells and domestic permit-exempt wells constructed after the date of the ISF rule will be offset and that NEB will occur. There is no indication that the Legislature intended to sanction streamflow-impacting development while allowing Ecology to adopt plans that may never be implemented and thus fail to actually offset the impacts and achieve NEB.

Moreover, ESSB 6091 did not amend a host of water laws that recognize instream flows as water rights and prohibit junior withdrawals from impairing instream flows. Those laws, combined with recent Washington Supreme Court decisions that confirm instream flows as senior rights and prohibit impairment by junior uses, provide an important backdrop for analyzing the Act. See *Swinomish Indian Tribal Community v. Department of Ecology*, 178

¹ ESSB 6091 amended RCW 19.27.097, 58.17.110, 90.03.247, and 90.03.290; added a new section to chapter 36.70A RCW; added a new section to chapter 36.70 RCW; and created the new chapter 90.94 RCW.

Wash.2d 571, 311 P.3d 6 (2013); *Foster v. Washington State Dept. of Ecology*, 184 Wash.2d 465, 362 P.3d 959 (2015).

Ecology has proposed that watershed plans should contain “reasonable assurances” as to implementation. See Ecology, *Final Guidance for Determining Net Ecology Benefit*, GUID 2094 at p. 6 (July 31, 2019). It is unclear where this term came from and exactly what it means. It is clear, however, that reasonable assurance does not equate to certain implementation given Ecology’s repeated statements elsewhere that no one has a duty to implement. Accordingly, the plans’ predicted success must actually occur. In addition, the criteria for making this determination should include the incorporation of a monitoring plan to gauge effectiveness and a corrective action strategy if the benefits fail to accrue.

Finally, SEPA requires that Ecology interpret its laws in accordance with SEPA’s environmentally-protective policies and requires a heightened level of certainty for implementation. See, e.g., RCW 43.21C.030 (mitigation measures must be “reasonable and capable of being accomplished”). Since it appears that the watershed plans will result in significant impacts, Ecology will have to prepare EIS’s and mitigate the impacts. See, generally, RCW Ch. 43.21C.060.

3. The Plans, if adopted without the mandatory offsets, NEB and implementation, will interfere with the Tribe’s federally reserved water rights.

Tribes’ federally-reserved water rights have been litigated and found to exist under the longstanding *Winans* and *Winters* doctrines. See, e.g., *Aquavella II*, 121 Wash.2d 257, 850 P.2d 1306 (Wash. 1993). *Winans* rights are based on the doctrine that the treaties were “not a grant of rights to the Indians, but a grant of rights from them – a reservation of those [rights] not granted.” *United States v. Winans*, 198 U.S. 371, 381 (1905). *Winans* rights preserve pre-existing uses, and impress a servitude that runs against the state of Washington. The priority date for these rights is “time immemorial.” A water right for fishing “consists of the right to prevent other appropriators from depleting the streams waters below a protected level in any area where the non-consumptive rights applies.” *United States v. Adair*, 723 F.2d 1394, 1411 (9th Cir. 1983).

Winters rights are federally created and arise when the federal government reserves land for a particular purpose. *Winters v. United States*, 143 F. 740, 742 (9th Cir. 1906); *Arizona v. California*, 373 U.S. 546 (1963). Creation of an Indian reservation carries an implied right to unappropriated water to the extent needed to accomplish the purposes of the reservation. The priority date is when the reservation was established.

Both types of rights exist and predate all rights created by state law. These rights include the right to prevent appropriators from using water so as to deplete water sources below levels that damage the habitat of fish that the Tribes have a right to take. Finally, the rights cannot be given away or diminished by state law.

There is no question that Squaxin has reserved water rights to instream flows. The historical record and case law confirm that the Squaxin people have been a fishing people since time immemorial; and that the purposes of the Squaxin Island Reservation were: (1) to create a sustainable, permanent homeland for the Squaxin people; and (2) to ensure the Squaxin people's access to and harvest of healthy fish populations to continue their fishing way of life.

This is consistent with the Ninth Circuit's ruling in the culverts case:

"Thus, even if Governor Stevens had made no explicit promise, we would infer, as in *Winters* and *Adair*, a promise to "support the purpose" of the Treaties. That is, even in the absence of an explicit promise, we would infer a promise that the number of fish would always be sufficient to provide a "moderate living" to the Tribes. *Fishing Vessel*, 443 U.S. at 686, 99 S.Ct. 3055. Just as the land on the Belknap Reservation would have been worthless without water to irrigate the arid land, and just as the right to hunt and fish on the Klamath Marsh would have been worthless without water to provide habitat for game and fish, the Tribes' right of access to their usual and accustomed fishing places would be worthless without harvestable fish."

9th Cir. Culverts decision, 853 F.3d 946, 965 (9th Cir. 2017); *see also id.* at 964 ("[The Stevens Treaties'] principal purpose was to secure a means of supporting themselves once the Treaties took effect"; "[The Indians] reasonably understood that they would have, in Stevens' words, "food and drink ... forever.").

When these rights are adjudicated, it is highly likely that the quantities of reserved rights will exceed many of the instream flows established in Ecology's rules. Accordingly, it defies common sense and the law to adopt watershed plans that sanction streamflow diminishment by permit-exempt wells or unsupported or non-guaranteed projects, when the Tribe (and public) have a legal right to those waters.

Finally, nothing in RCW Ch. 90.94 allows Ecology to violate federal law or exclude it from consideration when adopting these plans. Nor could it. *See, e.g.*, RCW 90.82.120(1) ("Plan parameters. (1) Watershed planning developed and approved under this chapter shall not contain provisions that: (a) Are in conflict with . . . federal laws, or tribal treaty rights . . .").

4. Successful South Sound plans and outcomes require significant Ecology engagement.

Successful WRIA 12-15 plans require Ecology to significantly engage in water management in the South Sound. The Tribe has proposed for the WRIA plans the appointment of a "water steward" with water master and groundwater supervisor responsibilities. This position could:

- (1) Help track plan activities vis-à-vis the salmon recovery database, measure plan outcomes, and determine if plan goals are being achieved;
- (2) support technical analyses of watershed conditions, including monitoring flows;
- (3) help to resolve disputes;

- (4) enforce use limits and senior rights;
- (5) take steps to avoid impairment of senior instream flow rights by junior users;
- (6) provide education/outreach;
- (7) participate and supporting committee meetings; and
- (8) coordinate drought responses.

See RCW 90.03.060(1); RCW 90.44.200. An additional reason to appoint a South Sound Water Steward is to improve Ecology's implementation and enforcement of the WRIA 12-15 rules. Ecology should actively seek resources and assign staff to serve in this position or its equivalent. This could include reassignment of existing resources and advocacy in the legislature for additional funding.

5. Potential consequences if plans fail to ensure offsets and NEB

If Ecology adopts a plan that fails to comply with RCW 90.94.030 (e.g., the plan lacks ensured implementation of offsets and NEB), and either refuses to rule-make or rule-makes with an overly narrow scope, then Ecology should understand the potential consequences. Local government(s) would be prohibited from approving streamflow-impactful buildings and subdivisions pending compliance. Until compliance is achieved, applicants would have to provide evidence of legal and physical water availability.

C. Ecology's mandate to amend the rules for WRIAs 12-15.

1. Why rules are defective and should be amended

Instream flow rules for WRIAs 12-15 are outdated, contain illegal provisions that are inconsistent with the governing statutes, don't explicitly regulate permit-exempt wells, and are rarely if ever enforced by Ecology. Among other things, these rules are illegal because Ecology lacks statutory authority to, by rule, exempt domestic and stock watering uses from instream flows. Instream flows are water rights with priority dates (the date of rule adoption); and apply to all junior groundwater withdrawals (permitted and permit-exempt) and surface water diversions.

Table 1 summarizes key problems with the exemptions in WRIA 12-15 rules.

For the following reasons, Ecology has a duty to amend these defective rules. First, leaving them in place will result in more impairment of instream flows. This is because the Act allows authorizes new domestic permit-exempt wells to impair instream flows and to impact closures "through compliance with the requirements [of RCW 90.94.030], unless instream flow rules specify otherwise. RCW 90.94.030(1). It does not appear that "instream flow rules" for WRIAs 12-15 "specify otherwise" – i.e., expressly provide an alternative path for offsetting new domestic permit-exempt wells and achieving NEB. In fact, Ecology's recent position (*see Hirst*) is that permit-exempt wells are exempt from instream flows when WRIA rules don't expressly address permit-exempt wells.

Table 1. Key problems with exemptions in the WRIA 12-15 rules

WRIA	Does the rule expressly regulate permit-exempt wells?	Does the rule implicitly regulate permit-exempt wells?	Does rule expressly state that water is unavailable for permit-exempt wells in specific area(s)?	Does rule contain illegal exemptions for permit-exempt wells?
WRIA 12 (WAC Ch. 173-512)	No.	Yes.	No.	Yes. Exempts from closures stock watering use, except as related to feed lots. (-060(2))
WRIA 13 (WAC Ch. 173-513)	No.	Yes.	No.	Yes. Exempts from the chapter (i.e., ISFs & closures) domestic use for a single residence and stock watering, except as related to feedlots, if no alternative source is available. If the cumulative effects of numerous single domestic diversions would seriously affect the quantity of water available for instream uses, then only domestic in-house use is exempt. (-070(2))
WRIA 14 (WAC Ch. 173-514)	No.	Yes.	No.	Yes. Exempts from the chapter (i.e., ISFs & closures) single domestic and stockwatering use, except as related to feedlots. If the cumulative impacts of numerous single domestic diversions would significantly affect the quantity of water available for instream uses, then only single domestic in-house use is exempt if no alternative source is available. (-060(2))
WRIA 15 (WAC Ch. 173-515)	No.	Yes.	No.	Yes. Exempts from the chapter (i.e., ISFs & closures) domestic use for a single residence, and stockwatering use except that related to feedlots. If the cumulative effects of numerous single domestic diversions would seriously affect the quantity of water available for instream uses, then domestic in-house use is exempt if no alternative source is available. (-070(3), (4))

Accordingly, to the extent that Ecology adopts watershed plans that fail to guarantee mandatory offsets and NEB (which in itself would violate the Act), Ecology must amend the WRIA 12-15 rules to achieve these outcomes. Put another way, Ecology lacks authority to both (1) adopt plans that do not guarantee offsets and NEB, and (2) fail to amend instream flow rules.

Second, Ecology cannot allow defective instream flow rules to remain in place because the Act allows local governments to rely on WRIA rules when planning and approving development that will interfere with instream flows. Again, leaving these defective rules in place will result in impaired flows and impacted closures. That is because ESSB 6091 amended the GMA, Building and Subdivision Codes to allow local governments, for purposes of complying with the GMA's provisions relating to surface and groundwater resources, to rely on ISF rules. RCW 90.36A.590; RCW 19.27.097, RCW 58.17.110.

Third, other statutory and regulatory provisions mandate that Ecology fix the WRIA 12-15 rules. For example, the 1971 Water Resources Act mandates that Ecology is “directed to modify existing regulations and adopt new regulations, when needed and possible, to insure that existing regulatory programs are in accord with the water resource policy of this chapter and the program established in subsection (1) of this section. RCW 90.54.040(2) (emphasis added). For the above reasons, rule-making is “needed” and “possible”.

See also Ecology's implementing regulations in WAC 173-500-010(4) (“The [1971 Water Resources Act] further directed [E]cology to modify existing regulations and adopt new regulations to insure that existing regulatory programs are in accord with the water resource policies of the act.”); WAC 173-500-070 (“[E]cology shall initiate a review of the rules established in this chapter whenever new information, changing conditions, or statutory modifications make it necessary to consider revisions.”). (Emphases added.) *See also* Ecology's regulations governing reservations of water for future water supply; WAC 173-590-010(5) (“The [1971 Act] further directs the [E]cology to modify existing regulations and adopt new regulations to insure that existing regulatory programs are in accord with the water resource policies of the act.”) (emphasis added).

Additionally, provisions in the rules for WRIs 12-15 mandate that Ecology “shall initiate a review” of rules “whenever new information, changing conditions, or statutory modifications make it necessary to consider revisions.” WAC 173-512-080, WAC 173-513-100, WAC 173-514-090, WAC 173-515-100 (emphases added).

Ecology takes a constricted position as to rulemaking that is inconsistent with its statutory and regulatory mandates, including its obligations as a steward of public water

resources. RCW 90.03.010 ("Subject to existing rights all waters within the state belong to the public, and any right thereto, or to the use thereof, shall be hereafter acquired only by appropriation for a beneficial use and in the manner provided and not otherwise; and, as between appropriations, the first in time shall be the first in right."). Ecology's position is that it must adopt rules to incorporate plan provisions only if: (1) the adopted plan recommends a change to the fee or the water use restriction prescribed in RCW 90.94.030(_); or (2) Ecology fails to adopt a plan by the statutory timeline. Ecology POL 2094, *Streamflow Restoration Policy and Interpretive Statement* at pp. 10-11 (July 31, 2019). Ecology's position is to avoid rulemaking unless a plan contains recommendations that "require it" to rulemake. Even if Ecology decides to engage in rulemaking, its stated policy is to avoid addressing anything outside the scope of the Act.

2. Areas where rule-making is needed.

The Tribe has found, from experience in past water resources issues and the current WRIA planning process, that specific areas of the current rules need revision. Table 2 lists some of the revisions that we believe are necessary.

Table 2. List of proposed rule changes for WRIAs 12-15

Section/topic	Changes needed
Purpose	Update to current standards and goals
Establishment of Instream flows	Review all streams in WRIA and identify streams with salmon habitat depending on flow
Establishment of Instream flows	Conduct ISF studies for all salmon streams and either update ISF levels for streams in the rule or add ISF flows for streams lacking them.
Establishment of Instream flows	Remove exemption for ground water withdrawals that "would not interfere significantly with stream flow" in streams listed in the rule.
Establishment of Instream flows	Acknowledge seniority of Tribal water rights and update language for consultation with Tribes
Surface water source limitations to further consumptive appropriation	Close all streams with salmon habitat during the low flow season
Surface water source limitations to further consumptive appropriation	Add language to protect tributaries to closed streams
Surface water source limitations to further consumptive appropriation	Add language to expressly prohibit loss of flow during stream closures
Groundwater	Add section prohibiting impacts on ISF flows and closures from ground water withdrawals

Section/topic	Changes needed
Permit-exempt groundwater for future domestic uses.	Add a section similar to WAC 173-501 with fee requirements, including increased fees to support implementation.
Permit-exempt groundwater for future domestic uses.	Add a section similar to WAC 173-501 with water use limits and metering that apply to all PE wells.
Future surface and groundwater appropriations, including PEWs	Provide all Group A systems a "right of first refusal" for new connections. Require all new water connections within Group A service areas to hook up if connections is "timely and reasonable". Prohibit PE wells where timely and reasonable connection is available. Set a statewide standard for "timely and reasonable".
Future surface and groundwater appropriations, including PEWs	Add limitations to new surface and ground water appropriation similar to Quilcene Rule.
Future surface and groundwater appropriations, including PEWs	Establish setback requirements (depth and horizontal distance) for any new well from a stream listed in the rule
Future surface and groundwater appropriations, including PEWs	Require access to wells and meters for authorized Ecology, Dept. of Health, or county staff.
Mitigation	Set standards for mitigation
Mitigation	Mitigation for interties that affect instream flows and do not have existing mitigation.
Drought response	Counties must establish and ecology approve mandatory water conservation and drought response programs for all PE wells.
Drought response	Establish drought water use limits which go into effect during a drought declaration. Exemptions for food production, fire protection (approved by fire marshal), and approved environmental projects.
Exemptions	Remove any exemptions for single domestic wells and stock watering. Revise and update. Allow limited use of peak flows for environmental and low flow augmentation projects.
Enforcement	Ecology shall establish enforcement guidelines, which include halting building permits for development with PE wells if offset projects are insufficient to exceed PE well growth within a limited amount of time, such as 5 years.

Section/topic	Changes needed
Enforcement	Ecology will develop enforcement guidelines for complaint response and water users not following rules
Rule harmonization	Provide requirements that align water resources rules with GMA requirements such as comp plans and critical areas, with the goal of increasing recharge and reducing water withdrawals.
Reopener	Include standards for reviewing and revising the rule on a regular schedule (for example, every 5 years), or if new information or trends indicate loss of effectiveness.

D. Criteria for Successful Plans

After two years at the table in four WRIA Planning committees, our criteria for a successful plan are becoming clear. Ecology should support the Tribe to ensure these elements are included in each Plan:

1. **PE CU: A conservative (high) estimate of permit-exempt well consumptive use (PE CU) set as a target for offsets.**
 - Estimates for the future consumptive use of permit-exempt wells that provide the target for offsets and define the success of the plan must be based on conservative assumptions that ensure that water produced by successful offset projects will address potential consumptive use levels under all reasonable future scenarios of high growth and use. This “precautionary principle” approach is needed because once wells are installed they will not be removed, and there needs to be a high level of confidence that offset projects will exceed future PE CU under reasonable scenarios of higher use that are foreseeable.
 - To protect senior water rights, the CU estimate must be high enough to ensure certainty that PE well use will be offset under all reasonable potential future situations. This will also ensure that streamflow restoration is likely to be an additional benefit.
2. **Projects: Strong list of projects with good water quantities, reasonable certainty, identified sponsors, willing landowners, and covering areas of high PE well impacts and important salmon areas.**

- Projects are going to be uncertain, whether in an approved plan or in Ecology’s plan and rule. Most are undeveloped concepts that will need sponsors, willing landowners, feasibility studies, funding, permits, and when completed may not perform as expected. Projects with a reasonable likelihood of success are those that are well defined and have an identified sponsor. In addition, plans need to identify projects in areas where PE wells are most likely to have an impact and where increased flows in streams are most likely to benefit salmon habitat. And overall, strong implementation is necessary to increase the likelihood of effective projects getting done and the mandates of the Act being met.

3. Policies: Policy and regulatory recommendations that show good faith effort to meet legal requirements and provide additional streamflow benefits.

- The Tribe has proposed a variety of policy and regulatory recommendations that contribute to protecting and restoring streamflow (see Table 3). The Plan should propose the adoption and enhancement of a significant number of these policies. These are key elements of the Plan that both help reduce PE well impacts and increase water recharging ground water and supporting summer baseflows.
- Ecology and local governments, through the plan, should commit to policies that are certain to supplement the offset of past and future PEWs and achieve NEB, in addition to the offset projects. Implementation of innovative policies included in the plan will add benefits that increase the likelihood of streamflow restoration. In addition, some project proposals can address disputes over the legal requirements for plan content and make legal disagreements moot.

4. ISF Rule: Identification in the Plan of rule-making necessary to implement the Plan and for other reasons.

- As discussed above, there are many reasons for Ecology to initiate rule-making, both as a consequence of Plan adoption, to help ensure implementation, and because the existing South Sound WRIA rules are defective and failing to protect the water resource and fisheries. Ecology should identify the elements of each plan and other relevant needs that require rule-making and call these out in the Plan.

Table 3. List of Squaxin Island Tribe policy and regulatory proposals

Proposal Titles	Purpose
Assurance of Implementation	Document Ecology’s and Counties’ commitment to implementation

Proposal Titles	Purpose
	and adaptive management
Lead Organization for Implementation	Support long-term sustainable adaptive management
Monitoring and Research	Continue collecting data and information to support adaptive management and water management in general
Adaptive Management responses	Specify adaptive management responses if Plan implementation is falling behind
Funding for Plan Implementation	Support long-term Plan implementation and adaptive management through the lead organization
South Sound Water Steward	Provide improved and enhanced Ecology interface in the South Sound for Plan implementation and better management of instream flow rules
Water Supply Data for Comprehensive Water Planning	Provide critical data for water management and show good faith effort to comply with legal requirements
Upgrade Well Reporting	Bring Ecology's data collection on wells up to date with current technology and improve the information collected.
Water Conservation Policy - Education And Incentives Program	Provide an overarching conservation program for all permit exempt wells, in parallel with conservation plan requirements for Group A systems.
Drought limits	Address extreme hydrological events and climate change with water use limits when Ecology issues a drought declaration (like WRIA 1 rule)
ISF updates	Bring 1980s ISF rules up to date with current scientific methodology and increased protection for salmon stream.
Permit-exempt Well Withdrawal Limits	Set realistic permit-exempt well water use limits (like WRIA 1 rule).
Study of County Planning Streamflow Restoration Effectiveness	Compare how planning and permitting by local governments in the South Sound supports protecting groundwater recharge and stream flows, in order to identify successful strategies and areas for potential improvement.
Revolving Loan and Grant Fund for Small Public Water Systems	Counties can explore setting up a fund to offset the costs of connecting to a Group A system instead of a permit exempt well
County Policies to Promote Connections to Group A systems	Review "right of first refusal" in coordinated water system plans and county ordinances to find ways to discourage permit exempt wells inside water system areas.

5. Implementation and Adaptive Management: Implementation and Adaptive Management proposals that show commitment to implementation.

- Implementation of the Plan, as discussed above, is required under the law. And if a Plan is inadequately implemented and offset water is not created for existing and future PE wells that are junior to instream flows, and/or NEB is not guaranteed, both Ecology and the Counties may be at increased risk for litigation.
- But beyond that, the Tribe believes an approved Plan could provide much more vigorous, long-term implementation than if Ecology writes a plan and a rule. This could set the table for more cooperative water management, and provide future opportunities for collaboration to improve water management into the future.

6. NEB: Include an analysis of Net Ecological Benefit that actually demonstrates with high certainty that restores streamflow and enhances salmon habitat will result when projects and actions are implemented.

- As the Tribe commented during Ecology's comment period for the NEB guidance, the definition of NEB should be much broader than simply providing more offset water than expected PE well use. To fulfill the objectives of the Act, NEB must demonstrate that the plan will protect and increase streamflows, and implementation of the Plan will produce both significant benefits to salmon and no harm from effects such as geographic gaps or implementation time lags.

Conclusion

In conclusion, we ask that Ecology review the issues raised in this letter and take action to address the Tribe's concerns. We hope for the process to be a successful step forward for effective water management in the Tribe's South Sound U&A watersheds, and the beginning of adequate protections of Tribal water rights.

To reach those goals, however, Ecology needs to:

- Make immediate course corrections to improve how it is guiding the planning process and communicating with the Committees.
- Make a strong commitment to review and revise the rules for WRIAs 12-15 to ensure implementation of the plan and bring the rules up to date for protection of salmon and Tribal water rights.

This will make the difference between a future of collaborative water management or one of ongoing conflict and dispute. We hope you choose collaboration.

Sincerely,

A handwritten signature in black ink, appearing to read "Jeff Dickison". The signature is fluid and cursive, with the first name "Jeff" being more prominent than the last name "Dickison".

Jeff Dickison, Assistant Director
Squaxin Island Natural Resources Department

cc: Bennett Weinstein, Streamflow Section Manager, Department of Ecology
Rebecca Brown, Watershed Lead, WRIA 12, Department of Ecology
Angela Johnson, Watershed Lead, WRIAs 13 and 14, Department of Ecology
Stacy Vynn-McKinstry, Watershed Lead, WRIA 15, Department of Ecology
Alan Reichman, Assistant Attorney General
Andy Whitener, Director, Squaxin Island Tribe Natural Resources Department
Paul Pickett, consultant for Squaxin Island Tribe
Sharon Haensley, counsel for Squaxin Island Tribe

POL-2094

DEPARTMENT OF ECOLOGY WATER RESOURCES PROGRAM
POLICY AND INTERPRETIVE STATEMENT

STREAMFLOW RESTORATION POLICY AND INTERPRETIVE STATEMENT

Effective Date: 07/31/2019

Contact: Program Development and Operations Support

References: *Statute*: Chapters 18.104, 34.05, 90.03, 90.82, and 90.94 RCW; RCW 19.27.097, 43.83B.405, 89.08.460, and 90.44.050
Administrative Rule: Chapters 173-500, 173-531A, 173-563, and 173-566 WAC.

Purpose: To ensure consistency, conformity with state law, and transparency in the implementation of chapters 19.27 and 90.94 RCW.

Application: This policy applies to the evaluation of building permit applications under RCW 19.27.097 and the implementation of activities authorized under chapter 90.94 RCW.

This policy supersedes any previous policy statement with which it conflicts.

1. Background

In January 2018, the Washington State Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 (session law 2018 c 1). This law was enacted in response to the State Supreme Court's 2016 decision in *Whatcom County vs. Hirst, Futurewise, et al.* (commonly referred to as the "Hirst decision")¹. The law, now primarily codified in chapter 90.94 RCW, clarifies how local governments can issue building permits for homes intending to use a permit-exempt well for their domestic water supply. The law also requires that local watershed planning efforts take place in 15 WRIAs. Plans must be developed that identify projects to offset the potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over the next 20 years (2018-2038), and provide a net ecological benefit to the WRIA. Additionally, the law provides opportunities for Ecology to issue water right permits to authorize pilot projects related to the State Supreme Court's 2015 decision in *Foster vs. Ecology, City of Yelm, et al.* (commonly referred to as the "Foster decision")². Such permits may be issued if impacts on streamflows can be mitigated based on criteria provided in the new law. This document provides policy statements as it relates to Ecology's interpretation and implementation

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

² *Foster v. Dep't of Ecology*, 142 Wn.2d 465, 362 P.3d 959 (2015).

of the law. This policy applies to the interpretation and implementation of RCW 19.27.097 and chapter 90.94 RCW.

2. Acronyms

GPD – Gallons Per Day

LID – Low Impact Development

NEB – Net Ecological Benefit

RCW – Revised Code of Washington

SEPA – State Environmental Policy Act

WAC – Washington Administrative Code

WRIA – Water Resource Inventory Area³

3. Definitions

The following definitions apply in the context of this policy and the interpretation of chapter 90.94 RCW. Unless otherwise noted, Ecology does not apply these definitions to the interpretation of other statutes.

Home: A general term referring to any house, household, or other Equivalent Residential Unit.

Instream resources: Fish and related aquatic resources.

Net ecological benefit (NEB): The outcome that is anticipated to occur through implementation of projects and actions in a plan to yield offsets that exceed impacts within: a) the planning horizon; and, b) the relevant WRIA boundary.

Planning group: A general term that refers to either initiating governments, in consultation with the planning unit, preparing a watershed plan update required by RCW 90.94.020, or a watershed restoration and enhancement committee preparing a plan required by RCW 90.94.030⁴.

Planning horizon: The 20-year period beginning on January 19, 2018 and ending on January 18, 2038, over which new consumptive water use by permit-exempt domestic withdrawals within a WRIA must be addressed.

Watershed plan: A general term that refers to either: a watershed plan update prepared by a WRIA's initiating governments, in collaboration with the WRIA's planning unit, per RCW 90.94.020; or a watershed restoration and enhancement plan prepared by a watershed restoration and enhancement committee, per RCW 90.94.030. This term does not refer to RCW 90.82.020(6).

³ For the purposes of this policy, "water resource inventory area" refers to those areas described in chapter 173-500 WAC as of January 19, 2018.

⁴ Planning group roles are described in RCW 90.94.020(4)(a) and RCW 90.94.030(3)(c).

4. Applicability

RCW 19.27.097 establishes requirements as to what constitutes evidence of an adequate water supply for an applicant to receive a building permit from a local government for a building necessitating potable water.

Per RCW 19.27.097(5), water wells constructed *before* the effective date of the law (January 19, 2018) can serve as proof of adequate water supply for a building permit in WRIAs planning pursuant to RCW 90.94.020 or 90.94.030.⁵ These building permits are, therefore, not subject to requirements of chapter 90.94 RCW, regardless of whether water was put to beneficial use by operation of the well prior to January 19, 2018.

Geographic applicability is as follows:

- **In basins with instream flow rules that *do not* regulate permit-exempt groundwater withdrawals** (permit-exempt withdrawals), evidence must be consistent with the statutory requirements established in RCW 90.94.020 and 90.94.030, including requirements about a fee and water use restriction (RCW 19.27.097(1)(c)-(d)).
- **In basins with instream flow rules that *explicitly* regulate permit-exempt withdrawals**, evidence must be consistent with requirements set forth in the rule (RCW 19.27.097(1)(b)).
- **In the Yakima basin**, additional requirements may be required to satisfy adjudicated water rights (RCW 19.27.097(1)(e)).
- **In the Skagit basin**, additional requirements apply due to the *Swinomish* Supreme Court decision⁶ (RCW 19.27.097(1)(f)).
- **In the rest of the state**, a well report showing physical availability, proof of potability, and demonstration of meeting other requirements imposed by local governments of water is sufficient proof of an adequate water supply (RCW 19.27.097(1)(g)).
 - **In WRIAs tributary to the Columbia River**, a building permit application is subject to the requirements in the law relating to the respective WRIA in which the proposed well is located. If the proposed well is in an area governed by the Columbia River Rules (chapters 173-531A and/or 173-563 WAC), then RCW 19.27.097(1)(g) is applicable.
 - **In WRIAs where existing instream flow rules only cover portions of the WRIA**, requirements under chapter 90.94 RCW only apply to the geographical areas directly covered by the existing rule.
- Local governments may impose additional requirements (RCW 19.27.097(2)).

⁵ Local governments may impose additional requirements.

⁶ *Swinomish Indian Tribal Community v. Dept of Ecology*, 178 Wn.2d 571, 311 P.3d 6 (2013).

The requirements in RCW 90.94.020 and 90.94.030 only pertain to permit-exempt domestic withdrawals associated with a new building permit, and do not affect other uses exempt from permitting under RCW 90.44.050⁷.

If an applicant for a building permit or subdivision provides technical evidence that demonstrates a new permit-exempt domestic withdrawal will not cause impairment to an adopted instream flow or closure, then the applicant is relieved of having to comply with the requirements in chapter 90.94 RCW.

5. Local Government Obligations

Under RCW 90.94.020 & 90.94.030, Ecology interprets local governments in the 15 affected WRIs⁸ to have the following obligations as of January 19, 2018⁹:

- Collect a \$500 fee for each development permit authorizing a new permit-exempt domestic withdrawal regulated by chapter 90.94 RCW. The law does not specify whether local governments must collect the fee at the time of a subdivision or building permit application. Local governments are expected to annually remit \$350 from each fee collected to Ecology. The \$500 fee is in addition to existing well drilling fees required under chapter 18.104 RCW.
- Record withdrawal restrictions on the title of affected properties. Ecology recommends local governments use the following language: “Domestic water use at this property is subject to a water use limitation of a maximum annual average withdrawal of [three thousand *or* nine hundred and fifty *or* other amount specified by rule¹⁰] gallons per day, per connection, subject to the five thousand gallons per day limit in RCW 90.44.050.”

For WRIs listed in RCW 90.94.030:

- Where applicable, record withdrawal curtailment during drought emergencies on affected properties. Ecology recommends local governments use the following language: “If a Drought Emergency Order is issued pursuant to RCW 43.83B.405, domestic water use at this property may be curtailed to no more than three hundred and fifty gallons per day per connection [or other amount specified by rule], for indoor use only. Notwithstanding the drought restriction to indoor use, a fire control buffer may be maintained.”
- Require applicants to manage stormwater runoff on-site to the extent practicable by maximizing infiltration, including using LID techniques, or pursuant to stormwater management requirements adopted by the local permitting authority, if locally adopted requirements are more stringent.

⁷ See Section 6 for further details.

⁸ WRIs 1, 7-15, 22-23, 49, 55, and 59.

⁹ These are the initial directions provided in RCW 90.94.20 and 90.94.030. RCW 90.94.20 and 90.94.030 further direct that these obligations may be changed thru rulemaking. Where rulemaking modifies these obligations, they should be appropriately interpreted with the respective modifications.

¹⁰ Local governments should include the relevant volume, *i.e.* one of the amounts in the brackets.

6. Withdrawal Limits under RCW 90.94.020 and 90.94.030

RCW 90.44.050 establishes the following permit-exempt withdrawal limits:

- **Domestic** - 5,000 GPD limit
- **Non-commercial lawn or garden** – ½ acre limit (no GPD limit)
- Stockwater - no GPD limit
- Industrial - 5,000 GPD limit

The withdrawal limits under chapter 90.94 RCW further restrict the limits identified in RCW 90.44.050 for:

- **Domestic**
- **Non-commercial lawn or garden**

Collectively, the amounts for both of these are a maximum annual average of 950 or 3,000 GPD per connection¹¹

Chapter 90.94 RCW includes restrictions for new permit-exempt domestic withdrawals for “domestic use” to a maximum annual average of up to 950 GPD per connection in basins planning under RCW 90.94.030, and a maximum annual average of up to 3,000 GPD per connection in basins planning under RCW 90.94.020¹¹.

- In the context of chapter 90.94 RCW, “domestic use” and the GPD withdrawal limits include both indoor and outdoor home uses, and watering of a lawn and noncommercial garden up to ½ acre in size.
- Water restrictions are based on a maximum annual average withdrawal. Ecology interprets this to mean that a home’s withdrawals cannot exceed 950 or 3,000 GPD as the daily average over the entire year.
- Homes are still limited to a 5,000 GPD maximum limit for domestic use and ½ acre non-commercial lawn or garden, as set forth in RCW 90.44.050. As an example, under RCW 90.94.020 and RCW 90.94.030, a home could withdraw 4,000 gallons on a summer day, so long as the home did not do so often enough that their annual average exceeds the 950 or 3,000 GPD limit.

In RCW 90.94.030 during drought emergencies issued pursuant to RCW 43.83B.405, domestic withdrawals may be curtailed to no more than 350 GPD per connection, for indoor use only. Notwithstanding the drought restriction to indoor use, a fire control buffer may be maintained. A rule adopted pursuant to chapter 90.94 RCW for a specific WRIA may change the withdrawal limit(s) in that WRIA, but those limits cannot exceed limits in RCW 90.44.050.

Ecology v. Campbell & Gwinn, LLC, et al (2002)¹² specifies that a development project, such as a residential subdivision, is considered to be supplied with water by a single withdrawal of

¹¹ These are the initial volumetric limits provided in RCW 90.94.20 and 90.94.030. RCW 90.94.20 and 90.94.030 further direct that these limits may be changed thru rulemaking. Where rulemaking modifies these limits, they should be appropriately interpreted with the respective modifications.

¹² *Department of Ecology v. Campbell & Gwinn, LLC*, 146 Wash.2d 1, 9-10, 43 P.3d 4 (2002).

groundwater. Well(s) supplying water for all the homes in the project are subject to the withdrawal limits under RCW 90.44.050 in aggregate. Though the withdrawal restrictions in chapter 90.94 RCW are specified as “per connection,” the limits under *Campbell & Gwinn* also apply. Thus, while an individual home within a subdivision may withdraw a maximum annual average of 950 GPD or 3,000 GPD under chapter 90.94 RCW, the entire project is still restricted to no more than 5,000 GPD for all domestic use for all the homes in the project, and irrigation of no more than ½ acre of lawn or non-commercial garden, collectively, in the subdivision.

7. Planning under RCW 90.94.020 and 90.94.030

WRIAs planning under RCW 90.94.020

For WRIAs planning under RCW 90.94.020, Ecology will work with existing planning units and initiating governments formed under chapter 90.82 RCW, where those groups are still active. In a WRIA where a planning unit created under chapter 90.82 RCW is no longer active, Ecology will work with the respective WRIA’s initiating governments to reestablish a planning unit that includes the range of representation identified under chapter 90.82 RCW, to the extent practicable. RCW 90.94.020 does not specify that Ecology is required to follow the process in RCW 90.82.060(6) to reestablish a planning unit for the purpose of implementing RCW 90.94.020. Per RCW 90.94.020(3), the lead agency shall invite a representative from each federally recognized Indian tribe that has a usual and accustomed harvest area within the WRIA to participate as a part of the planning unit.

Minimum watershed plan requirements

RCW 90.94.020 and 90.94.030 establish requirements for updating a watershed management plan or completing a watershed restoration and enhancement plan (“watershed plans”). Watershed plans must identify projects and actions necessary that *at a minimum*, offset the consumptive use of new groundwater permit-exempt domestic withdrawals over the planning horizon¹³ and achieve NEB. Ecology has developed guidance for determining whether a watershed plan meets the NEB requirement¹⁴.

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

¹³ New consumptive water use in this document addresses new homes connected to permit-exempt domestic wells associated with building permits issued during the planning horizon. Generally, new homes will be associated with wells drilled during the planning horizon. However, new uses could occur where new homes are added to existing wells on group systems or shared wells operating under RCW 90.44.050. In this document the well use discussed refers to both these types of new well use. This does not affect withdrawals authorized under RCW 19.27.097(5).

¹⁴ *Interim Guidance for Determining Net Ecological Benefit* (Draft Publication 18-11-009; June 2018) applies to planning groups with 2019 deadlines, or planning groups which planned in accordance with the Interim NEB Guidance due to the group’s accelerated schedules with Ecology’s prior agreement; *Final Guidance for Determining Net Ecological Benefit* (GUID 2094; Publication 19-11-079; July 2019) pertains to all other WRIAs identified in chapter 90.94 RCW. Where there is any apparent conflict between this Policy and the *Final Guidance for Determining Net Ecology Benefit*, this Policy shall be considered the controlling document.

Projects and actions identified in watershed plans are not limited to those that can provide strict in-time, in-place offsets, though projects in the same sub-basin or tributary (within the same WRIA), and during the same time that the use occurs are prioritized. Projects and actions in other sub-basins or tributaries, or projects that replace water only during critical times for fish, may also be recommended.

- Though the statute requires the offset of “consumptive impacts to instream flows associated with permit-exempt domestic water use” (RCW 90.94.020(4)(b)) and 90.94.030(3)(b)), watershed plans should address the *consumptive use* of new permit-exempt domestic withdrawals. Ecology recommends *consumptive use* as a surrogate for *consumptive impact* to eliminate the need for detailed hydrogeologic modeling, which is costly and unlikely feasible to complete within the limited planning timeframes provided in chapter 90.94 RCW.
- RCW 90.94.020 and 90.94.030 have various references to how watershed plans are to project, offset, or account for “water use.” Ecology interprets these subsections of the law (RCW 90.94.020(4)(b), 90.94.020(4)(c), 90.94.030(3)(b), 90.94.030(3)(c), 90.94.030(3)(d), and 90.94.030(3)(e)) to relate to the consumptive water use of new permit-exempt domestic withdrawals that come online during the planning horizon.

SEPA review, in the form of a non-project SEPA analysis, is necessary prior to Ecology adopting a watershed plan. SEPA may be completed by Ecology or by a local government. In general, this allows for projects identified in adopted watershed plans to be implemented without further SEPA analysis. However, some individual projects or actions implemented under chapter 90.94 RCW may also need SEPA review, depending on how the project or action conforms under the criteria provided in RCW 89.08.460.

Acceptable projects and actions

Projects and actions identified in watershed plans should meet the intent of chapter 90.94 RCW for development of *new* projects and actions that benefit instream resources, offset the consumptive use of new permit-exempt domestic withdrawals projected during the planning horizon, and achieve NEB in the WRIA. In Ecology’s evaluation of watershed plans, the agency considers:

- Projects or phases of a project with a signed funding contract or agreement *after* January 19, 2018 may count towards the required consumptive use offset and/or providing NEB.
- 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.
- Projects and actions funded by Streamflow Restoration (chapter 90.94 RCW) funding may count towards the required consumptive use offset and/or providing NEB.

- Projects and actions funded by means other than Streamflow Restoration (chapter 90.94 RCW) funding may count towards the required consumptive use offset and/or providing NEB.
- Projects or actions completed *before* January 19, 2018 will *not* count towards the required consumptive use offset and/or providing NEB.
- Ecology will *not* consider mitigation required by existing environmental regulations such as critical area buffers, shoreline setbacks, stormwater/LID, floodplain management, forest practices, NPDES requirements, etc., as contributing towards the required consumptive use offset and/or NEB. Ecology understands that regulations required by other laws or programs would apply regardless of the passage of chapter 90.94 RCW. This is irrespective of whether or not a building or project had yet been constructed under the regulation.

All funding decisions for projects and actions applied for using Streamflow Restoration (chapter 90.94 RCW) funding will be made pursuant to chapter 173-566 WAC – Streamflow Restoration Funding Program.

Watershed plan approval, review, and adoption

For the purposes of chapter 90.94 RCW, Ecology defines watershed plan *approval* as an action taken on the local level (*i.e.* by the planning group) to document support for the WRIA’s respective watershed plan. Watershed plan *review* is an action taken by Ecology to examine and evaluate an approved watershed plan. Watershed plan *adoption* is a formal action taken by Ecology after review, if the agency determines the watershed plan meets the requirements of RCW 90.94.020 or 90.94.030. These steps must occur sequentially, meaning that Ecology will not begin its review until the watershed plan is formally approved by the local planning group.

For watershed plan ***approval***:

- In WRIAs planning under RCW 90.94.020, the planning group (the planning unit and initiating governments) must determine the watershed plan approval procedure. The approval procedure identified under RCW 90.82.130 is not specifically required under RCW 90.94.020, so planning groups can elect to follow different approval procedures, if preferred.

RCW 90.94.020(4)(a) states, “In collaboration with the planning unit, the initiating governments must update the watershed plan....” This means that both the planning unit and initiating governments support the approval procedures for a watershed plan.

- In WRIAs planning under RCW 90.94.030, the planning group must follow the specific approval procedures outlined in that section of the law.

For watershed plan **review**:

- Ecology will not edit or provide feedback on draft watershed plans in advance of approval by the planning group and submittal to Ecology. Ecology will base its review on what has been approved and submitted to Ecology.
- Ecology will not consider a draft watershed plan, or portions thereof, which were not approved by the planning group.
- For the WRIAs identified in RCW 90.94.020, Ecology will not review a watershed plan that has not been approved by the planning group.

For watershed plan **adoption**:

- Ecology will not adopt a watershed plan contingent upon specific revisions to the watershed plan.
- Planning groups may include components which they believe help ensure that projects/actions will be completed successfully (*e.g.* conditions to allow for adjustment of the watershed plan in the future) as an “adaptive management” element. However, Ecology cannot adaptively change statutory-defined requirements, such as water quantities or the connection fee, at some future date if certain projects or actions are not completed. Such a change requires rulemaking. Ecology could not include such a “potential conditional rulemaking” for adaptive management as part of a watershed plan adoption.
- Ecology will review approved watershed plans submitted by planning groups that provide reasonable time for Ecology review prior to the relevant statutory deadline.¹⁵
- RCW 90.94.020 and 90.94.030 require that, prior to the adoption of a watershed plan, Ecology must determine that the projects and actions identified in the plan will result in a NEB within the WRIA.
- The NEB Guidance¹⁶ notifies planning groups of the standards Ecology applies when reviewing an approved watershed plan.
- Watershed plans must, at a minimum, identify projects and actions intended to offset impacts. Planning groups may, at their discretion, opt to identify projects and actions in

¹⁵ Ecology’s lead planner assigned to each planning group will coordinate with their respective planning group to establish this “reasonable time.”

¹⁶ *Interim Guidance for Determining Net Ecological Benefit* (Draft Publication 18-11-009; June 2018) applies to planning groups with 2019 deadlines, or planning groups which planned in accordance with the Interim NEB Guidance due to the group’s accelerated schedules with Ecology’s prior agreement; *Final Guidance for Determining Net Ecological Benefit* (GUID 2094; Publication 19-11-079; July 2019) pertains to all other WRIAs identified in chapter 90.94 RCW. Where there is any apparent conflict between this Policy and the *Final Guidance for Determining Net Ecology Benefit*, this Policy shall be considered the controlling document.

their plans that offset water use and anticipated effects beyond those associated with new consumptive permit-exempt domestic withdrawals initiated over the planning horizon. However, watershed plans are not required to include such projects and actions. Any work undertaken beyond the specific planning minimums increases the likelihood that time and funds are spent on matters that will not necessarily yield a locally approvable or adoptable plan within the very tight timeframes of the law.

If Ecology does not adopt a watershed plan on or before the statutory deadline set forth in RCW 90.94.020 or 90.94.030, the agency must initiate rulemaking consistent with the provisions in the law (see Section 8).

As articulated in the *Final Guidance for Determining Net Ecological Benefit*¹⁷, watershed plans are to be prepared with implementation in mind. However, 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. Further, the law does not predicate the issuance of building permits on the implementation of watershed plans or any projects and actions in those plans.

8. Rulemaking under RCW 90.94.020 and 90.94.030

RCW 90.94.020 and 90.94.030 establish that Ecology *must* adopt rules to incorporate watershed plan provisions under the following circumstances:

- (a) If the adopted watershed plan recommends a change to the fee or the water use restriction prescribed in the law; or
- (b) If the watershed plan is not adopted by Ecology by the statutory timeline.

Ecology *may* amend or adopt rules if it believes it necessary for another reason.

If Ecology adopts a watershed plan by the prescribed deadline, Ecology may commence a rulemaking process, depending on the contents of the adopted watershed plan.

- Ecology will generally avoid rulemaking if an adopted watershed plan does not include recommendations that require it.
- Ecology will begin rulemaking if an adopted watershed plan recommends changing the statutory withdrawal limits or fees. The rulemaking may be limited to the scope of what is recommended in the watershed plan. In general, Ecology will rely on adopted watershed plan recommendations supported by legal and scientific information when proposing the rule amendments. If additional information or analysis is developed during the public rulemaking process, Ecology will use that information, and may modify rule amendments, as appropriate.

¹⁷ *Final Guidance for Determining Net Ecology Benefit* (GUID 2094; Publication 19-11-079; July 2019).

- If planning groups include measures in the adopted plan that are outside the scope of chapter 90.94 RCW, Ecology will evaluate these recommendations during rulemaking. Ecology is not obligated to include such changes in a rule.

If a watershed plan has not been adopted by the prescribed deadline, Ecology is required to commence a rulemaking process under RCW 90.94.020 or 90.94.030.

- Ecology will not write a watershed plan update for WRIAs identified in RCW 90.94.020. As required under the law, Ecology will initiate rulemaking and develop rule supporting documents that meet the intent and requirements of RCW 90.94.020. At a minimum, the rule supporting documents will include: a WRIA-wide estimate of consumptive use from new permit-exempt domestic withdrawals over the planning horizon; a list of projects and actions that Ecology is reasonably assured could be completed to offset the consumptive use; and a NEB determination.
- For the WRIAs identified in RCW 90.94.030, Ecology will follow the procedures specified in RCW 90.94.030(3)(h). Ecology will submit the final draft plan to the Salmon Recovery Funding Board for a technical review, and provide recommendations to amend the final draft plan, if necessary. Ecology shall consider the recommendations and may amend the final draft plan without committee approval prior to adoption.

9. Foster Pilot Projects

RCW 90.94.090(8) authorizes Ecology to issue permit decisions for up to five water resource mitigation pilot projects. Ecology expects the pilot projects to consist of applications for new water right permits and/or applications to change existing water rights. Ecology retains the authority and obligation to review each pilot project water right decision and approve or deny the application based on sufficiency of technical information and compliance with the law. Decisions on applications for Foster pilot project permits are appealable following the same procedure as for other water right permit decisions under the Administrative Procedures Act, chapter 34.05 RCW.

Under RCW 90.94.090, Ecology is not authorized to issue permits that will impair senior consumptive rights. Additionally, under chapter 90.03 RCW, Ecology is only authorized to issue permits for water rights that will be put to beneficial use.

Pursuant to RCW 90.94.090(8), Ecology must determine whether proposed withdrawals and diversions of water from pilot projects would impair adopted instream flows, or would otherwise impact closed surface waters. To do this, Ecology will assess whether the applicants have addressed impacts through the established mitigation sequence as described in RCW 90.94.090(8)(a)-(c) in assessing permit applications for the pilot projects. This process will be followed instead of applying the traditional test for impairment and availability of water subject to adopted instream flow water rights and closures.

The mitigation sequencing of RCW 90.94.090(8) should be followed in order. Applicants may only proceed along the sequence when the previous step was not “reasonably attainable.”

Avoiding impacts, under RCW 90.94.090(8)(a), refers only to compliance with minimum flows adopted by rule or making the water use interruptible in favor of the rule. To show that avoidance is not “reasonably attainable,” an applicant must explain why the water use cannot be subject to otherwise-applicable minimum flows.

Minimizing impacts, under RCW 90.94.090(8)(b), refers to mitigating the impacts to instream flows or closures by replacing the water supply.

- This can include acquiring existing trust water rights that are not already committed to mitigation, placing water rights into trust; or other types of replacement water supply.
- Mitigation rights that are not placed into trust should be secured with adequate legal provisions, such as permit conditions, to ensure that the water use is fully contingent on the supply of mitigation water.
- These measures must ensure both (1) no net annual increase in quantity of water diverted or withdrawn and (2) no net detrimental impacts to fish and related aquatic resources.

To show that minimizing impacts is not reasonably attainable, applicants should:

- Explain what efforts have been taken to identify replacement water rights; and
- Whether it would be technically feasible to mitigate with those rights.

If applicants attest that “water for water” mitigation is not reasonable because of cost, they should explain how the cost of potentially obtainable water was determined.

Compensation, under RCW 90.94.090(8)(c), should provide a NEB through replacement of water, habitat improvements, and/or other measures that improve instream functions and values. Under RCW 90.94.090(8)(c), Ecology will evaluate projects consistent with the published Final NEB Guidance (Final Guidance for Determining Net Ecological Benefit (GUID 2094; Publication 19-11-079; July 2019).

Ecology has sole discretion, and will use its best professional judgement, in assessing the technical merits of projected impacts of the proposed project and whether the mitigation sequence was properly followed. Ecology will document its findings in the draft Report of Examination, which must be posted for public review and comment, under RCW 90.03.290.



Mary Verner
Program Manager
Water Resources Program

Note: These policies and procedures are used to guide and ensure consistency among water resources program staff in the administration of laws and regulations. These policies and procedures are not formal administrative regulations that have been adopted through a rule-making process. In some cases, the policies may not reflect subsequent changes in statutory law or judicial findings, but they are indicative of the department's practices and interpretations of laws and regulations at the time they are adopted. If you have any questions regarding a policy or procedure, please contact the department.

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**Final Guidance for
Determining Net Ecological Benefit**

*GUID-2094 Water Resources Program
Guidance*

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Washington State Department of Ecology
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1. Purpose

The 2018 Streamflow Restoration law (Engrossed Substitute Senate Bill (ESSB) 6091), now codified primarily in chapter 90.94 RCW, requires the Department of Ecology (Ecology) to determine that a Net Ecological Benefit (NEB) will result prior to adopting:

- Watershed plan updates, as required under ESSB 6091 Section 202, now RCW 90.94.020.
- Watershed restoration and enhancement plans under ESSB 6091 Section 203, now RCW 90.94.030.
- Water resource mitigation pilot projects under ESSB 6091 Section 301, now RCW 90.94.090.

After conducting a thorough scientific literature review, Ecology has determined that NEB is not a technical term that has been defined in the natural sciences. Instead, it is a creation of the Washington State Legislature. Therefore, Ecology has prepared this guidance for interpretation and application of this term. This guidance provides supplemental information, beyond that provided expressly in the law, for those groups engaged in the watershed planning work required by RCW 90.94.020 and RCW 90.94.030. Detailed information on the use of the term in these three sections of the law is described below (see “Authorities”).

Because NEB is not a scientific term, Ecology does not have a technical basis to establish a metric or amount of appropriate benefit that the plans must identify beyond the offsetting of projected impacts from new permit-exempt domestic consumptive water use. Instead, local planning groups are best situated, and will therefore determine the appropriate amount of benefits beyond the offsetting of projected impacts for their specific Water Resource Inventory Area (WRIA).

This document establishes Ecology’s interpretation of NEB for the purposes described below, given the context in which the law introduces and uses this phrase. This document does not apply to any of Ecology’s decisions relating to competitive grants applications or any regulatory matter.

- a) Watershed Planning:¹ This guidance is to be used by planning groups preparing updated watershed plans or watershed restoration and enhancement plans required by RCW 90.94.020 or RCW 90.94.030, respectively. This guidance supersedes Ecology’s June 2018 Interim Guidance, except for the planning groups that faced 2019 deadlines, or which planned in accordance with the 2018 Interim NEB Guidance due to those planning

¹ In this Guidance the term “Watershed Planning” does not refer to the Watershed Planning process described in chapter 90.82 RCW.

groups' accelerated schedules with Ecology's prior agreement.² This guidance also supersedes Ecology's past publication on recommendations for water use estimates. This guidance controls when there are apparent inconsistencies in similar language usage between the guidance and the appendices. This guidance also notifies planning groups of the standards Ecology will apply when reviewing any watershed plan appropriately submitted to Ecology under RCW 90.94.020 and RCW 90.94.030.

- b) Pilot Projects under RCW 90.94.090: This guidance contains minor clarifications, and changes to address omissions in the information provided in the Interim Guidance for projects designed to address the Washington State Supreme Court Foster decision.

This final guidance for determining NEB was developed based on the Interim Guidance (June 2018), input received during six public meetings in October 2018, and public comments submitted on draft final guidance from May 6 to June 7, 2019.

² Ecology's June 2018 Interim Guidance for Determining Net Ecological Benefit (NEB) provided: "This interim guidance will be used to evaluate plans that are completed within the next twelve months, or later if there is prior agreement with Ecology..."

2. Authorities: Specific Provisions of RCW 90.94.020, RCW 90.94.030, and RCW 90.94.090

Chapter 90.94 RCW introduces and uses the phrase “Net Ecological Benefit” four times. This phrase is used three times in the context of watershed planning requirements under RCW 90.94.020 and RCW 90.94.030, and once in the context of pilot projects in RCW 90.94.090.

In the context of watershed planning, the law requires Ecology to determine, “prior to adoption of the... plan... that actions identified in the watershed plan, after accounting for new projected uses of water over the subsequent twenty years, will result in a net ecological benefit to instream resources within the water resource inventory area.”³ In the event a locally approved watershed plan update⁴ is not submitted to Ecology for review and adoption by February 1, 2021, Ecology is required to initiate rulemaking. In the event a watershed restoration and enhancement committee is unable to submit a locally approved plan⁵ to Ecology for review and adoption by June 30, 2021, the law requires Ecology to finalize the plan, with technical review and recommendations from the salmon recovery funding board, and then initiate rulemaking. In both of these circumstances the law applies the identical net ecological benefit requirement to Ecology’s action as it does to locally prepared plans.⁶

Proposals for each of the five pilot projects need to meet or exceed a NEB threshold, as described in RCW 90.94.090(8)(c):

“Where avoidance and minimization are not reasonably attainable, compensating for impacts by providing net ecological benefits to fish and related aquatic resources in the water resource inventory area through in-kind or out-of-kind mitigation or a combination thereof, that improves the function and productivity of affected fish populations and related aquatic habitat. Out-of-kind mitigation may include instream or out-of-stream measures that improve or enhance existing water quality, riparian habitat, or other instream functions and values for which minimum instream flows or closures were established in that watershed.”

³ RCW 90.94.020(4) (c) and RCW 90.94.030(3) (c).

⁴ RCW 90.94.020(4) (a) directs “In collaboration with the planning unit, the initiating governments must update the watershed plan”.

⁵ RCW 90.94.030 (3) (c) directs “the department shall prepare and adopt a watershed restoration and enhancement plan for each watershed listed under subsection (2)(a) of this section, in collaboration with the watershed restoration and enhancement committee.”

⁶ RCW 90.94.020(7) and RCW 90.94.030(3)(h)

3. NEB for Watershed Planning Under RCW 90.94.020 and RCW 90.94.030

3.1 Definitions

The following definitions guide the watershed planning required by RCW 90.94.020 and RCW 90.94.030:

- **Adaptive Management:** An iterative 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.
- **Critical Flow Period:** The time period of low streamflow (generally described in bi-monthly or monthly time steps) that has the greatest likelihood to negatively impact the survival and recovery of threatened or endangered salmonids or other fish species targeted by the planning group. The planning group should discuss with Ecology, local tribal and WDFW biologists to determine the critical flow period in those reaches under the planning group's evaluation.
- **Domestic Use:** In the context of chapter 90.94 RCW, “domestic use” and the withdrawal limits from permit-exempt domestic wells include both indoor and outdoor household uses, and watering of a lawn and noncommercial garden.
- **Impact:** For the purpose of this guidance impact is the same as new consumptive water use (see definition below). As provided in Ecology WR POL 2094 “Though the statute requires the offset of ‘consumptive impacts to instream flows associated with permit-exempt domestic water use’ (RCW 90.94.020(4)(b)) and 90.94.030(3)(b)), watershed plans should address the consumptive use of new permit-exempt domestic well withdrawals. Ecology recommends consumptive use as a surrogate for consumptive impact to eliminate the need for detailed hydrogeologic modeling, which is costly and unlikely feasible to complete within the limited planning timeframes provided in chapter 90.94 RCW. ”
- **Instream Resources:** Fish and related aquatic resources.
- **Net Ecological Benefit (NEB):** The outcome that is anticipated to occur through implementation of projects and actions in a plan to yield offsets that exceed impacts within: a) the planning horizon; and, b) the relevant WRIA boundary.

- **Net Ecological Benefit Determination:** Occurs solely upon Ecology’s conclusion after its review of a watershed plan submitted to Ecology by appropriate procedures,⁷ that the plan does or does not achieves a NEB as defined in this guidance. The Director of Ecology will issue the results of that review and the NEB determination in the form of an order.⁸
- **Net Ecological Benefit Evaluation:** A planning group’s demonstration, using NEB Guidance and as reflected in their watershed plan, that their plan has or has not achieved a NEB.
- **New Consumptive Water Use:** The consumptive water use from the permit-exempt domestic groundwater withdrawals estimated to be initiated within the planning horizon. Water Resources Program Policy 1020 (1991) states, “Consumptive water use causes diminishment of the source at the point of appropriation,” and that, “Diminishment is defined as to make smaller or less in quantity, quality, rate of flow, or availability.” For the purposes described here, consumptive water use is considered water that is evaporated, transpired, consumed by humans, or otherwise removed from an immediate water environment due to the use of new permit-exempt domestic wells.⁹
- **Offset:** The anticipated ability of a project or action to counterbalance some amount of the new consumptive water use over the next 20 years (2018-2038). Offsets need to continue beyond the 20-year period for as long as new well pumping continues.¹⁰
- **Planning Groups:** A general term that refers to either initiating governments, in consultation with the planning unit, preparing a watershed plan update required by RCW 90.94.020, or a watershed restoration and enhancement committee preparing a plan required by RCW 90.94.030.¹¹
- **Planning Horizon:** The 20-year period beginning on January 19, 2018 and ending on January 18, 2038, over which new consumptive water use by permit-exempt domestic withdrawals within a WRIA must be addressed.
- **Projects and Actions:** General terms describing any activities in watershed plans to offset impacts from new consumptive water use and/or contribute to NEB.

⁷ For more information on appropriate procedures see Ecology WR POL 2094 and information provided by Ecology staff to the planning group.

⁸ An order issued by the Director of Ecology is an appealable action as provided by chapter 43.21 RCW and chapter 371-08 WAC.

⁹ New consumptive water use in this document addresses new homes connected to permit-exempt domestic wells. Generally such new homes will be associated with wells that are yet to be drilled during the planning horizon. However, new uses could also occur where new homes are added to existing wells on group systems relying on permit-exempt wells. In this document the well use discussed refers to both these types of new well use.

¹⁰ In this Guidance “offset” is used as both a noun and a verb following the common practice of the planning participants.

¹¹ Planning group roles are described in RCW 90.94.020(4)(a) and RCW 90.94.030(3)(c).

- **Reasonable Assurance:** Explicit statement(s) in a watershed plan that the plan’s content is realistic regarding the outcomes anticipated by the plan, and that the plan content is supported with scientifically rigorous documentation of the methods, assumptions, data, and implementation considerations used by the planning group.
- **Subbasins:** A geographic subarea within a WRIA, equivalent to the words “same basin or tributary” as used in RCW 90.94.020(4)(b) and RCW 90.94.030 (3)(b). In some instances, subbasins may not correspond with hydrologic or geologic basin delineations (e.g. watershed divides).
- **Watershed Plan:** A general term that refers to either: a watershed plan update prepared by a WRIA’s initiating governments, in collaboration with the WRIA’s planning unit, per RCW 90.94.020; or a watershed restoration and enhancement plan prepared by a watershed restoration and enhancement committee, per RCW 90.94.030. This term does not refer to RCW 90.82.020(6).

3.2 Watershed Planning

3.2.1 Roles and Responsibilities

Planning groups will prepare a watershed plan for their WRIA. These plans will include projects and actions intended by the planning group to both offset all new consumptive water use and achieve a NEB. Planning groups will submit locally approved watershed plans within a reasonable time for Ecology review prior to the relevant statutory deadlines.¹² Planning groups are expected to include a clearly and systematically articulated NEB evaluation in the watershed plan. Section 3.2.4 below provides guidance as to how planning groups will undertake this evaluation. A watershed plan that includes a NEB evaluation based on this guidance significantly contributes to the reasonable assurances that the offsets and NEB within the plan will occur.

Ecology will review any such plan with considerable deference in light of the knowledge, insights, and expertise of the partners and stakeholders who influenced the preparation of their plan. Ecology will make the NEB determination as part of this review.

Planning groups may choose not to include a NEB evaluation. Ecology will review plans that do not include a NEB evaluation, as well as any plans that include a NEB evaluation that do not meet the standards described in this guidance. However, without this information and technical foundation, Ecology will not have benefit of the knowledge, insights, and expertise of partners and stakeholders. Consequently, Ecology will review any such plan with considerably less deference than plans that include NEB evaluations that meet the standards described in this guidance.

¹² Ecology’s lead planners assigned to each planning group will coordinate with their respective planning group to establish this “reasonable time.”

3.2.2 Minimum Geographic and Temporal Requirements

Ecology will conduct NEB determinations at the WRIA scale. In order for Ecology to evaluate NEB, each plan will need to include evaluations of different plan elements at a more refined scale. Planning groups may opt to prepare a plan that seeks to address ecological benefits at a more refined scale.

The planning horizon for planning to achieve a NEB is the 20 year period beginning with January 19, 2018 and ending on January 18, 2038. The planning horizon only applies to determining which new consumptive water uses the plan must address under the law. The projects and actions required to offset the new uses must continue beyond the 20-year period and for as long as new well pumping continues. Planning groups may opt to look at a longer planning timeline, but must include a 20-year analysis of new consumptive water use to allow for the NEB determination.

3.2.3 Minimum Planning Requirements

3.2.3.1 Clear and Systematic Logic

Watershed plans must be prepared with implementation in mind. The plans must thoroughly document the planning group's understanding of any complex mechanisms and assumptions used in the plan. The plan should also describe the planning group's methods for reaching its conclusions. Sound watershed planning also properly recognizes past related and relevant planning processes and conclusions. Therefore, planning groups will describe how their watershed plan, including the projects and actions, is linked or coordinated with other existing plans such as local salmon recovery plans, ecosystem recovery plans, or other recovery plans being developed or implemented in the WRIA.

3.2.3.2 Delineate Subbasins

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.

3.2.3.3 Estimate New Consumptive Water Uses

Watershed plans must include a new consumptive water use estimate for each subbasin, and the technical basis for such estimate. The recommended methods for estimating new consumptive water use are described in Appendix A - ESSB 6091 - Recommendations for Water Use Estimates. If planning groups choose not to carry out the level of analysis recommended in Appendix A, they will introduce uncertainty and ambiguity in the estimates of the new consumptive water use expected over the planning horizon. Approaches that increase uncertainty

will reasonably require additional quantities of offset water in watershed plans to account for the unknowns.

3.2.3.4 Evaluate Impacts from New Consumptive Water Use

Watershed plans must consider both the estimated quantity of new consumptive water use from new domestic permit-exempt wells initiated within the planning horizon (as described in Appendix A), and how those impacts will be distributed. As described in the definitions section above, for the purpose of this guidance impact is the same as new consumptive water use (see more in Appendix B - Considerations for Evaluating Hydrologic Impacts by and Offsets for Permit-Exempt Domestic Wells). As discussed in Appendix B, while planning groups should consider where, when, and how those effects will impact surface water, in most instances it is justifiable to make assumptions that will produce a simplified analysis. Specifically, in most cases, Ecology deems it reasonable to assume that the pumping effects of permit-exempt domestic withdrawals on streamflow will be steady-state, meaning impacts to the stream from pumping do not change over time. This assumption is based on the wide distribution of future well locations and depths across varying hydrogeological conditions. Therefore, planning groups may make steady-state assumptions for all or most of their watersheds. To the degree planning groups choose not to make the steady-state assumption they still may choose for their plans to include special considerations for selected areas (e.g. high concentrations of wells near critical salmon habitat).

The planning group's evaluation of impacts to instream resources due to the new consumptive water use will also consider, to the degree possible:

- 1) Habitat, including but not limited to location and length of affected stream reaches.
- 2) Fish and related aquatic species and their presence, distribution, and life stages.
- 3) Ecosystem function, structure and composition.

This evaluation will include, at a minimum, whether streamflow, or streamflow-affected traits (i.e. temperature), are a limiting factor¹³ to salmon recovery.

Information on local conditions will be crucial to understanding how to assess potential impacts. Plans should make use of information about the watershed to understand local conditions and best describe the impacts to streamflow and instream resources. Plans should also consider links to other ongoing planning work as identified in 3.2.3.1, and existing projects and actions to understand local conditions in the watershed where the new consumptive water use is projected to occur.

3.2.3.5 Describe and Evaluate Projects and Actions for their Offset Potential

Watershed plans must, at a minimum, identify projects and actions intended to offset impacts associated with new consumptive water use. Planning groups may, at their discretion, decide to

¹³ See local salmon recovery plans for this information.

address new water use beyond these minimum requirements. Such an optional approach may include, but is not limited to, new water use beyond the 20-year planning horizon, or beyond new consumptive water use, or other goals of the planning group. However, watershed plans are not required to include such projects and actions. Any work undertaken beyond the specific planning minimum requirements increases the likelihood that time and funds are spent on matters that will not necessarily yield a locally approvable or adoptable plan within the very tight timeframes of the law.

There is no minimum requirement for the number or distribution of offset projects or actions within each WRIA. Chapter 90.94 RCW allows offsets for permit-exempt domestic wells to occur anywhere within a WRIA, provided the watershed plan achieves a NEB within the given WRIA. This means planning groups have significant latitude to place offset projects at desired locations (e.g. most beneficial to fish, meet local feasibility considerations, etc.) regardless of whether these provide offsets within each of a WRIA's subbasins. For the purposes of clarification, Ecology notes here that it is crucial to keep in mind that the purpose, meaning, and operation of "offsets" for planning under chapter 90.94 RCW are fundamentally different than "mitigation" for water right permits (or other regulatory purposes) authorized by other water law statutes such as Chapter 90.03 RCW, where "mitigation" is typically required to be in-time and in-place.

Watershed plans can include specific recommended actions intended to contribute towards offsetting new consumptive water use or achieving NEB. It is presumed that such actions would include, but not be limited to, new, or amended, state regulations, or local ordinances in effect after January 19, 2018, that are enacted to contribute to the restoration or enhancement of streamflows.

A. Project and Action Description

Many projects and actions will have multiple types of potential benefits. Ecology recommends planning groups evaluate project or action benefits both in terms of how it will offset new consumptive use, and how it will translate into effects on other instream resources. Each project or action should include the following information, to the degree possible:

- 1) A narrative description.
- 2) A quantitative or qualitative assessment of how the project will function, including offset benefits, if applicable.
- 3) A map and drawings of the project location.
- 4) Description of the spatial distribution of likely benefits.
- 5) Performance goals and measures.
- 6) Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.
- 7) Identification of support and barriers to completion.

8) Documentation of sources, methods, and assumptions.

For regulatory actions: Describe state rule or local ordinance that would be changed to provide benefits as part of plan. Ecology will only consider recommended state rule or local ordinance changes that were approved after January 19, 2018 and established to contribute to the local watershed plan, not another regulatory requirement. For other actions: description and information requirements should be discussed on a case by case basis with Ecology.

B. Examples of Projects

There are many different types of projects that could address the new consumptive water use and achievement of a NEB. Below are some examples of some projects, as well as some relevant considerations, for planning groups to consider, if they choose. The category headers provided here are suggestive and not prescriptive.

- **Water Right Acquisition Offset Projects.** Ecology acquires water rights and holds the rights in the Trust Water Rights Program (chapter 90.42 RCW) to protect them from relinquishment. These trust water rights are managed by Ecology for the benefit of instream and out-of-stream uses.
 - Water rights that Ecology acquires on behalf of planning groups must be permanently and legally held by Ecology in the Trust Water Rights Program to ensure that the benefits to instream resources are permanent. Water right acquisitions intended to offset new consumptive use will be contingent upon a water right change under RCW 90.03.380. Any acquisition project must identify the volume and instantaneous rate being acquired and the stream reaches or aquifers that would benefit from the water right acquisition.
 - Developing and assessing potential water right acquisitions is highly uncertain. Ecology will assist planning groups considering these projects in their plan.
- **Non-Acquisition Water Offset Projects.** These types of water offset projects will typically involve retiming high flow season surface waters. The streamflow benefits of some types of these water projects might be straightforward to analyze because of the specific attributes of the project and because benefits would be immediate. However, the benefits from other types of these projects will be more difficult to analyze. For NEB evaluations, plans should include the assumptions and methods used to estimate streamflow benefits for all these projects. Below are some examples of projects that improve streamflow that planning groups can consider:
 - Managed aquifer recharge projects involving the addition of water to an aquifer through infiltration basins, injection wells, or other methods. The stored water can then be used to benefit stream flows, especially during critical flow periods.
 - Projects that switch the source of withdrawal from surface to groundwater, or other beneficial source exchanges. The estimation of benefits of a source exchange project may depend on the connection between the sources and should

take into consideration the possible consequences of unsustainable withdrawals from the affected aquifer.

- Streamflow augmentation projects that involve pumping groundwater and discharging it into a stream. As with source switching, estimates of benefits may depend on the connection between groundwater and the stream and should take into consideration the possible consequences of unsustainable withdrawals from the affected aquifer.
- Off-channel storage projects that capture and store water for release back into the stream channel at other times, such as during critical flow periods.
- **Habitat and Other Related Projects.** Many people think of projects that are not water right acquisition or non-acquisition water offset projects as habitat projects, but there are a wide range of potential projects that might be included in this category in a watershed plan. These projects will contribute toward achieving NEB by focusing on actions that improve the ecosystem function and resilience of aquatic systems, support the recovery of threatened or endangered salmonids, and protect instream resources including important native aquatic species. These projects may also result in an increase in streamflow, but (by design) they prioritize the habitat benefits. It may also be difficult to quantify the offset benefits for these projects, potentially increasing uncertainty in calculating water offset quantities for the plan, and therefore potentially increasing uncertainty in the plan's conclusions and assurances. Examples of habitat projects include:
 - Projects that focus on returning stream habitat to a more natural state such as through river-floodplain restoration, instream habitat restoration, beaver reintroduction, and beaver dam analogs.
 - Projects that protect current habitats through riparian or upland conservation and management, forest management, or water conservation.
 - Projects that increase connectivity and fish passage between habitats such as fish barrier removal, or reconnection of off-channel habitat.

C. Individual Project and Action Evaluation for Offset Projects

Projects and actions included by planning groups in a watershed plan designed to offset new consumptive water use must do so by:

- 1) Replacing new consumptive water use during the same time and in the same subbasin as the impacts occur (i.e. high priority projects); or

- 2) Replacing new consumptive water use elsewhere within the WRIA, or only during critical flow periods (i.e. lower priority projects).¹⁴

While the law describes “high and lower priority projects,” use of these terms is not the sole critical factor in determining whether a plan achieves a NEB. For example, a project involving acquisition of surface water irrigation right may be very beneficial to salmon and very important toward achieving a NEB even though it technically is a “lower priority” project since it might only provide water during part of the year. Therefore, plan development should be focused on developing projects that provide the most benefits to salmon regardless of how they align with priority labels.

In the event a planning group wishes to use priority labels project descriptions need to:

- Include information about the location in the WRIA where the offset will occur relative to impacts, and
- Identify critical flow periods relative to fish presence and distribution (as applicable). This should describe anticipated effects on ecosystem composition, structure, and function in the context of the historic hydrograph.

D. Individual Project and Action Evaluation for Habitat and Other Projects

As discussed above in section 3.2.3.5 B, habitat and other projects and actions included by planning groups in a watershed plan are assumed to primarily contribute toward achieving a NEB. Because it will be difficult to quantify the water offsets for these projects Ecology will apply a conservative approach in assessing the estimated water offset quantity relying on the substantial technical analysis provided by planning group.

E. Project and Action Benefit Summary to Support Implementation

Watershed plans must include an accounting of the offsets from the projects and actions described in the watershed plan.¹⁵ The accounting of offsets must include a well-organized and transparent evaluation of benefits from projects.

As discussed above in section 3.2.3.5 A.7, Planning groups must also include an assessment of the likelihood that project and action benefits will occur, including local support, and any possible barriers to implementation. Planning groups may want to consider addressing some of the common factors that could either facilitate or hinder plan implementation, such as:

- Cost of implementation.
- Technical feasibility of implementation.

¹⁴ Chapter 90.94 RCW authorizes plans to include lower priority projects—those that do not occur in the same subbasin or that only replace water during critical flow periods. See Ecology Water Resources Program POL 2094 for additional information.

¹⁵ See RCW 90.94.020(4)(b) and 90.94.030(3)(b)

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

For the purposes of competitive funding under Chapter 173-566 WAC (the streamflow restoration grant funding rule) watershed plans are recommended to include the planning group's "sequencing" of projects in order of most to least estimated project benefit contributing to achieving NEB. This sequencing is anticipated to be one of a series of factors that inform competitive grant funding decisions. This sequencing, if the planning groups so choose, may also take into account the categories of high and lower priority as defined in the law, however this is not required.

F. Adaptive Management

Planning groups may want to consider adaptive management. An adaptive management component of the plan helps demonstrate the watershed planning group's intent that the plan will be implemented, thereby bolstering the plan's reasonable assurances. Ecology will not interpret adaptive management provisions in a plan as an obligation of the planning group to continue its work or for Ecology to continue to fund the planning group.

3.2.4 NEB Evaluation

As noted in section 3.2.1. Roles and Responsibilities, Ecology expects that watershed plans clearly and systematically describe the planning group's NEB evaluation. The following details will help the planning groups prepare their NEB evaluation.

As noted above, in order for Ecology to make a NEB determination on a locally approved watershed plan, the planning group must submit it with adequate time for Ecology review. Ecology's review and adoption must occur prior to the relevant statutory deadlines.

3.2.4.1 Additional NEB Methods and Considerations

The State of Washington Water Research Center at Washington State University (WSU), under contract to Ecology, produced a document discussing potential methods and considerations for determining NEB. A key finding was that there are many potential ways to evaluate whether or not any individual watershed plan will produce a NEB. Each approach has strengths and

weaknesses, especially regarding data availability, complexity of the analysis, and technical resources required to complete the NEB analysis. For the purposes of watershed planning under chapter 90.94 RCW, the WSU document is provided in Appendix C for reference purposes only. This document looks beyond the statutory requirements and constraints of chapter 90.94 RCW, and therefore many of the conclusions are not directly relevant or analogous to this planning process. Ecology has also provided a preface with more information in that appendix.

In the event a watershed plan's number and/or types of projects make the NEB evaluation challenging, planning groups may, at their discretion, opt to engage in a "tiering" exercise. Projects could be organized into groups or "tiers" that reflect the likelihood that individual projects will be implemented and/or the certainty that the benefits will occur. In instances where plans only require a subset of projects to achieve a NEB, planning groups may find this approach helpful as this will enable the bulk of their analyses to focus on just those projects that are needed to provide reasonable assurance that their plan will achieve a NEB. Ecology may incorporate this type of analysis in our NEB determination.

3.2.4.2 Specific Elements of a NEB Evaluation

Ecology recommends that planning groups consider the following steps in completing a NEB evaluation.

- 1) NEB evaluations should begin by comparing the total projected impact from new consumptive water use in all the subbasins in the WRIA with the total amount of water offset benefits generated by all of the planned projects and actions in the WRIA.
- 2) Next the evaluation should describe the projected impacts and any offsets within each of the subbasins. Because all impacts at a minimum must be offset at the WRIA level, the evaluation should determine if the plan has succeeded in offsetting the impacts at the WRIA level. This means there may be instances where the amount of offsets provided in certain subbasins will be more or less than the projected new consumptive water use there. This is acceptable because the offsets are provided within the WRIA and in sufficient quantities.
- 3) The planning group then needs to identify the projects and actions that provide the additional benefits to instream resources beyond those necessary to offset the impacts from new consumptive water use within the WRIA boundary. The degree to which the plan must exceed this minimum offset is a matter for the planning group to decide, along with any margin of error they choose to include in the plan. Inclusion of the planning group's reasoning that supports the amount of exceedance and any associated margins of error included will be useful during Ecology's review of the plan.
- 4) Adaptive management conditions can also be included to address uncertainty.
- 5) The evaluation should include a clear statement of the planning group's finding that the combined components of the plan do or do not achieve a NEB.

4. NEB for Projects Under RCW 90.94.090

RCW 90.94.090 establishes a joint legislative task force to (1) review the treatment of surface water and groundwater appropriations as they relate to instream flows and fish habitat, (2) develop and recommend a mitigation sequencing process and scoring system to address such appropriations, and (3) review the Washington Supreme Court decision in *Foster v. Department of Ecology*. This section also authorizes Ecology to approve up to five pilot projects, and authorizes Ecology to issue permit decisions and water right changes in reliance upon water resource mitigation projects under a prescribed mitigation sequence. Proposals for each of the five pilot projects need to follow the mitigation sequence in RCW 90.94.090(8). It is the intent of the legislature to use the pilot projects to inform the legislative task force process while also enabling the processing of water right applications that address water supply needs. The department is authorized to issue permits and approve changes in reliance upon water resource mitigation of impacts to instream flows and closed surface water bodies under the following mitigation sequence:

- (a) Avoiding impacts by: (i) Complying with mitigation required by adopted rules that set forth minimum flows, levels, or closures; or (ii) making the water diversion or withdrawal subject to the applicable minimum flows or levels; or
- (b) Where avoidance of impacts is not reasonably attainable, minimizing impacts by providing permanent new or existing trust water rights or through other types of replacement water supply resulting in no net annual increase in the quantity of water diverted or withdrawn from the stream or surface water body and no net detrimental impacts to fish and related aquatic resources; or
- (c) Where avoidance and minimization are not reasonably attainable, compensating for impacts by providing net ecological benefits to fish and related aquatic resources in the water resource inventory area through in-kind or out-of-kind mitigation or a combination thereof, that improves the function and productivity of affected fish populations and related aquatic habitat. Out-of-kind mitigation may include instream or out-of-stream measures that improve or enhance existing water quality, riparian habitat, or other instream functions and values for which minimum instream flows or closures were established in that watershed.

4.1 Elements of NEB Analyses in Section 301 Pilot Project Proposals

RCW 90.94.090 NEB evaluations first need to demonstrate that water offset projects were not reasonably attainable. Then, pilot projects must provide a structured and transparent analysis for Ecology to use as the basis for making a NEB determination. This analysis should quantitatively compare any negative habitat and instream resource impacts of the proposed withdrawal project(s) or water resource management actions to the proposed mitigation's benefits to the habitat and resources. All consumptive use impacts to instream resources must be quantified.

Proposals must describe the amount, location, and timing of all of the water being provided through water offset projects. Benefits from proposed mitigation projects must be described in detail and quantified to the maximum extent practicable.

The water permit application and NEB analysis should contain the following elements:

- Structure the analysis in the form of a ledger or matrix that describes all the impacts to water and in-kind water offsets in detail and sums up the benefits in a quantitative or semi-quantitative manner.
- Describe any ecological impacts that are not offset through in-place and in-kind replacement of consumptive water use.
- Include an evaluation of impacts and offsets based on a detailed hydrological analysis, conceptual model, or numerical model.
- Document financial, institutional controls, and other assurances that the mitigation will be fully implemented and remain in place for the full duration of the new water use (likely in perpetuity).
- Include monitoring and evaluation plans that describe or detail maintenance needed to ensure lasting benefits.
- Include contingency plans or corrective actions to be taken if goals and measures are not achieved.
- Include information that describes the level of support for the proposed mitigation pilot from tribal, state and local resource managers (which may be in the form of letters of support or agreement).
- Identify and document scientific sources and methods of analysis.

Appendices

Appendix A. Chapter 90.94 RCW – Streamflow Restoration Recommendations for Water Use Estimates

This document provides the Department of Ecology’s recommendations for estimating water use by permit-exempt domestic wells to meet the intent of chapter 90.94 RCW. The methods described are not requirements, and planning units and watershed restoration and enhancement committees can modify these methods based on credible, location- specific information, with Ecology concurrence.

The purpose of estimating the consumptive use portion of new permit-exempt domestic withdrawals is to establish the amount of new projected water that watershed plans must address. Plans must include estimates of the cumulative consumptive water use over the twenty years beginning January 19, 2018 to determine which water use must be addressed under chapter 90.94 RCW.

Ecology Water Resources Program POL 2094 and the Guidance for Determining Net Ecology Benefit (NEB) contains information on how Ecology interprets the requirements of chapter 90.94 RCW, and for definitions of terms including new consumptive water use and subbasins.

New consumptive water use in this document addresses new homes connected to permit-exempt domestic wells associated with building permits issued during the planning horizon. Generally, new homes will be associated with wells drilled during the planning horizon. However, new uses could occur where new homes are added to existing wells on group systems or shared wells operating under RCW 90.44.050. In this document the well use discussed refers to both these types of new well use.¹⁶ Permit-exempt domestic wells may be used to supply houses, and in some cases other Equivalent Residential Units (ERUs) such as small apartments. For the purposes of this document, the terms “house” or “home” refer to any permit-exempt domestic groundwater use, including other ERUs.

Estimating the Number of Future Permit-Exempt Domestic Wells

There are many ways to predict consumptive use of new permit-exempt domestic wells for WRIs or subbasins. The best methods rely on building permit data, population data, and county comprehensive plans. Ideally more than one method will be used and the results compared.

One method for predicting future permit-exempt domestic wells involves conducting a Geographic Information System (GIS) analysis of county building permits, zoning, and parcel information. Once these data have been segregated into WRIs or subbasins, single-family building permit data can be evaluated to determine the number of building permits issued over some previous time period (e.g. the past 10 years). Those results can then be used to project

¹⁶ This does not affect withdrawals authorized under RCW 19.27.097(5).

permit-exempt domestic wells over the subsequent 20 year period, based on zoning restrictions, information on undeveloped parcels, assumptions regarding how many of those building permits translate into permit- exempt domestic wells, etc.

Another method of predicting future permit-exempt domestic wells relies on population data. The Washington State Office of Financial Management (OFM) website provides estimates of past and current populations by WRIA, and projected future household populations on a county basis. One way to predict future populations is to look at populations for two different years (e.g. 2007 and 2017), then use that rate of increase to predict future populations. Upon request, OFM can also prepare 2000-2017 small area estimates. Planning groups can provide OFM GIS shapefiles for their subbasins, then a similar method can be used to predict future populations for individual subbasins. An alternate method of using the OFM data is to use current populations for a given subbasin or WRIA as a base, then increase that number based on county population projections. This latter method requires some subjectivity, however, since all of the WRIsAs span two or more counties, and this method requires looking at projections for multiple counties, then inferring reasonable assumptions for each subbasin or WRIA.

- [OFM population by WRIA](https://www.ofm.wa.gov/washington-data-research/population-demographics/population-estimates/small-area-estimates-program) 2000 through 2017 is available at:
<https://www.ofm.wa.gov/washington-data-research/population-demographics/population-estimates/small-area-estimates-program>
- [OFM projected growth rate by county](https://ofm.wa.gov/sites/default/files/public/dataresearch/pop/GMA/projections17/gma_2017_1yr_2050.xlsx) 2010–2050 by one-year intervals is available at:
https://ofm.wa.gov/sites/default/files/public/dataresearch/pop/GMA/projections17/gma_2017_1yr_2050.xlsx

County comprehensive plans also provide population projection information, which often is based on OFM data.

Once future WRIA populations have been estimated, those populations that will be served by community water systems and municipalities must be removed. This can be done relying on available information on the distribution/growth rate patterns of populations served by water systems. Other methodologies may be used, so long as clear technical documentation is provided by the planning group. Finally, future populations that will be served by permit-exempt domestic wells can be divided by the average number of people per household currently (U.S. Census Bureau Quick Facts or other County-derived sources) to estimate the number of future permit-exempt domestic wells.

An additional potential method relies on [spatial data for well reports](#) (logs) available from Ecology (<https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/GIS-data>). However, estimates of future wells relying on well log data tends to not be as reliable as the methods described above due to such things as: failure to submit logs; only partially complete submitted forms; new wells replacing existing wells and not representing new uses; poor location accuracy (generally just to quarter-quarter), etc.

Total Water Use versus Consumptive Water Use

Estimates of water use by future permit-exempt domestic wells must account for the portion of water that is consumptively used. To do this, water use estimates can be divided into indoor and outdoor water use, then those estimates adjusted to identify the portion of water that will return to the hydrologic system.

In general, most houses on permit-exempt domestic wells are connected to individual septic systems. For those houses, indoor water that is discharged via septic system mostly returns to the groundwater system, and the water used outdoors is mainly lost to evapotranspiration. The percentage of water consumed (lost to the atmosphere) during these processes is a function of climate, soil type, aspect, etc., and varies across the state.

A reasonable assumption for much of Washington is that about 10 percent of indoor domestic water use from homes on septic systems is consumed, and about 80 percent of outdoor domestic water use is consumed (Culhane and Nazy, 2015). A consumptive use rate of 10 percent for indoor domestic use is in keeping with recent groundwater models constructed by the U.S. Geological Survey (USGS) for the Kitsap peninsula (Frans and Olsen, 2016) and the Chamokane Creek basin (Ely and Kahle, 2012), the Chimacum Basin (Jones, et al, 2013), and the Yakima River Basin (Vaccaro and Olsen, 2007). The USGS used a 13 percent indoor domestic consumptive use rate assumption in their Chambers-Clover watershed modeling report (Johnson et al., 2011). For outdoor consumptive use the USGS has used various percentages. For their Kitsap peninsula model, the consumptive use rate for outdoor use was estimated at 90 percent, and for their Colville model (Ely and Kahle, 2004), irrigation consumptive use was estimated at 88%. The USGS assumed landscape irrigation efficiency of 60 percent during their modeling of the Chambers-Clover watershed (Johnson et al., 2011) and the Spokane Valley-Rathdrum Prairie Aquifer (Hsieh et al., 2007). However, the Spokane Valley-Rathdrum Prairie Aquifer is associated with Missoula glacial outburst flood deposits that are unusually highly transmissive.

If houses are connected to sewer systems that discharge water outside of or near the mouth of a watershed, it can be assumed that 100 percent of the indoor water use is consumptive.

Watershed planning groups can use assumptions other than 10 percent and 80 percent for indoor and outdoor water consumption, respectively, if technical justification is provided. However, ultimately, Ecology will need to use these results to determine the total quantity of water consumed by new permit-exempt domestic wells, so substitutions of different percentages need to have Ecology concurrence.

Consumptive Water Use Analyses

Estimates of the consumptive use by future permit-exempt domestic wells can be made by looking at the anticipated increases in population and/or permit-exempt domestic wells, then making a series of assumptions regarding indoor and outdoor consumptive water use.

When developing or updating watershed plans, planning groups may decide to review and potentially recommend limits on the numbers of wells and/or the amounts of water those wells

can pump within a specific subbasin or entire WRIA, in order to reduce the amount of water use impacts that must be offset. As such, it may be helpful for planning groups to generate more than one estimate of consumptive water use, using different sets of assumptions for outdoor water use, so this information will be available when developing watershed plan alternatives.

The following describes steps to produce estimates for entire WRIsAs or individual subbasins.

A. Consumption due to Indoor Water Use

To estimate the impacts of indoor water use, the population to be served by future permit-exempt domestic wells can be multiplied by assumed water use. A 2016 study by the Water Research Foundation (DeOreo, et al., 2016) determined an average per capita water use of 59 gallons per day (gpd) in homes provided municipal water in 23 areas across the U.S. and Canada. This result is based on actual flow monitoring and survey responses from 737 homes. The 59 gpd average is down 15.4 percent from results found during a 1999 American Water Works Association Research Foundation study (Mayer and DeOreo, 1999). Some homes supplied by Tacoma Water were monitored for the 2016 report, producing an average 51 gpd per capita indoor water use. Bearing in mind that homes supplied by municipal water are more likely to be fitted with water saving appliances¹⁷, an assumption of 60 gpd per capita seems reasonable when estimating water use for permit exempt wells.

To produce a result in acre-feet per year (AF/YR), estimated daily water use can be multiplied by 365 days per year, then converted to units of AF/YR, then multiplied by an assumed amount of water use that is consumptive. Different assumptions apply to homes connected to sewer systems versus those on septic systems. If homes are connected to sewer systems that discharge water outside of or near the mouth of a watershed, the assumption is that indoor water use is 100 percent consumptive. If homes are connected to septic systems, the estimated total annual water use for permit-exempt domestic wells can be multiplied by an assumed consumptive use factor, such as 10 percent, since most of this water will return to the ground via septic systems.

B. Consumption due to Outdoor Water Use

Under RCW 90.44.050, there is a maximum limit of one-half acre of outdoor watering for non-commercial lawn or garden associated with the state's permit-exemption law. However, the average outdoor water use area in any given area will likely be less. The preferred method of estimating future outdoor water use is based on an estimate of the average outdoor watering area for existing homes on permit-exempt domestic wells based on analyses using GIS and satellite imagery. Such analyses involve scanning images to get a sense of the outdoor lawn/garden areas associated with existing homes, to provide a basis to estimate the irrigated footprint of outdoor lawn/garden areas during the irrigation season for a representative samples of recently built homes.

¹⁷ WAC 246-290-800 fulfills a legislative mandate that all municipal water suppliers create a water use efficiency program (<https://apps.leg.wa.gov/WAC/default.aspx?cite=246-290-800>). These efficiency programs are not a requirement for individual, domestic, permit-exempt well owners.

If planning groups choose not to perform this level of analysis and, for example, simply assume one-half acre of outdoor watering area associated with every future permit-exempt domestic well, this will introduce uncertainty and ambiguity in the estimates of the new consumptive water use expected over the planning horizon. Approaches like this that increases uncertainty will reasonably require additional quantities of offset water in watershed plans to account of the unknowns.

Once an outdoor water use area has been selected, future permit-exempt domestic outdoor water use can be estimated using an assumed crop type (e.g. pasture/turf grass) and relying on crop use estimates for nearby station(s), such as those available in Appendix A in the Washington Irrigation Guide (WAIG) (U.S. Department of Agriculture, 1997). This number can then be multiplied by an assumed outdoor watering area, as well as factors to account for both irrigation inefficiency and the amount of water that is unused and returns to the ground.

C. Use of Other Data

In some instances, additional location-specific information may exist to supplement or replace portions of the method. One example would be actual water use data for small- to medium-sized water systems within a county. Depending on the nature and distribution of such data, extrapolations might be used to either verify or modify the above estimates. However, one caution is that water system estimates may be low if users pay fees that include built-in incentives to conserve water.

In all instances, any significant variances from the above methods need to be well documented with reasons why the changes are justified.

D. Method Example

Assuming the methods described above are used, an estimate of the consumptive water use for permit-exempt domestic withdrawals during the planning horizon might look like the following:

Household Consumptive Indoor Water Use (HCIWU):

Depending on the methods used to predict the number of future permit-exempt domestic wells (see above), the population using wells may already have been determined. If an estimate of the number of future permit-exempt domestic wells relied on county building permit data or Ecology's water-well report spatial data, that number of wells can be multiplied by an average number of people per household to estimate increased population. Estimates of average household numbers are available from the U.S. Census Bureau, County data, or OFM, however, some inference will be required to convert these from a county to a WRIA basis.

For the example here, it will be assumed that there are 2.5 people per household. Given that assumption, and assuming per capita water use of 60 gpd and that only 10 percent of indoor water use is consumptive, an example of a consumptive indoor water use per house calculation in acre-feet per year (AF/YR) would be:

$$\text{HCIWU} = 60 \text{ gpd} \times 2.5 \text{ people per house} \times 365 \text{ days} \times 0.00000307 \text{ AF/gal.} \times 10\% \text{ cons. use} = 0.017 \text{ AF/YR}$$

Household Consumptive Outdoor Water Use (HCOWU):

To estimate consumptive outdoor water use per household, domestic lawn/garden irrigation requirements can be estimated using information for a nearby station found in Appendix A of the Washington Irrigation Guide (WAIG) (U.S. Department of Agriculture, 1997). For a hypothetical pasture/turf grass example, the WAIG irrigation requirements (inches) might look something like:

Table A1. Irrigation requirement example

	May	June	July	August	September	Total
Irrigation requirements (inches)	0.63	2.72	4.11	2.75	0.9	11.11

The irrigation requirement can then be divided by 12 to convert from inches to feet, and then multiplied by an assumed outdoor watering area, which for this example is 0.4 acre:

$$\text{Irrigation Requirements (in.)} = 11.11 \text{ inches} / 12 \text{ inches per foot} \times 0.4 \text{ acres} = 0.37 \text{ AF/YR}$$

When consumptive water use for irrigation is calculated in accordance with Water Resources Program Guidance 1210, it includes a step to account for water lost during the water application process (e.g. water sprayed on a sidewalk instead of a lawn). Therefore, if the efficiency for a residential pop-up sprinkler system is assumed at 75 percent, the required water amount would be:

$$0.37 \text{ acre-feet} \div 75\% \text{ application efficiency} = 0.49 \text{ acre-feet}$$

The method in Guidance 1210 then subtracts out the amount of water that is not consumed and returns to groundwater or the surface water system. Therefore, for this example assuming the consumptive loss associated with outdoor water use is 80 percent, the estimated total consumptive outdoor water use per house during the irrigation season would be:

$$0.49 \text{ acre-feet} \times 80\% \text{ consumed (20\% return flow)} = 0.39 \text{ acre-feet}$$

Therefore, under this scenario Household Consumptive Outdoor Water Use (HCOWU) equals 0.39 acre-feet.

Basin-wide Household Consumptive Water Use (BHCWU):

Consumptive water use by future permit-exempt domestic wells for a WRIA or subbasin can then be estimated by:

$$\text{BHCWU} = \text{number of houses served by permit-exempt domestic wells} \times (\text{HCIWU} + \text{HCOWU})$$

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Appendix B. Chapter 90.94 RCW – Considerations for Evaluating Hydrologic Impacts by and Offsets for Permit-Exempt Domestic Wells

This appendix provides considerations for planning groups when evaluating consumptive water use by new permit-exempt domestic wells, and projects aimed at offsetting impacts from those wells. The conclusion of this appendix is that in most instances pumping impacts associated with new permit-exempt domestic withdrawals will be quite small, well dispersed, and nearly steady-state with respect to streams. Also, in general it will not be possible and is unnecessary to evaluate the impacts of pumping at individual locations. Planning groups can assume the impacts from new permit-exempt domestic withdrawals over the planning horizon will be steady-state. In the NEB Guidance, Ecology makes the assumption that impact is the same as new consumptive water use, therefore these terms of used interchangeably. This should free up planning groups to focus their efforts on identifying water offset and habitat projects that are most beneficial for fish. In rare instances, some planning groups may opt to include special considerations for selected areas where high concentrations of wells are anticipated in close proximity to critical salmon habitat, however, such exceptions, if any, are expected to be rare.

This appendix does not provide requirements, and planning groups have latitude regarding their analyses. However, any methods used and assumptions made need to be credible and well vetted, since the analyses provided will affect Ecology’s determination of whether or not implementation of watershed restoration plans and plan updates (referred to as “plans” in this appendix) will achieve a Net Ecological Benefit (NEB).

Appendix A, titled, “Chapter 90.94 RCW – Streamflow Restoration, Recommendations for Water Use Estimates”, recommends methods for estimating the consumptive water use anticipated from permit-exempt domestic wells over the specified 20-year period. This Appendix discusses how to take those consumptive water use estimates and combine them with an understanding of an area’s hydrogeology in order to understand the distribution and timing of the impacts of permit-exempt domestic wells on surface water.

Ecology Water Resources Program POL 2094 and the Guidance for Determining Net Ecology Benefit (NEB) contains information on how Ecology interprets the requirements of chapter 90.94 RCW, and for definitions of terms including new consumptive water use and subbasins.

Background

Chapter 90.94 RCW defines that the highest priority offset projects in plans replace the quantity of new consumptive water use initiated over the planning horizon in-time and in the same subbasin. The law also defines lower priority projects as those projects not in the same subbasin and projects that replace new consumptive water use impacts only during critical flow periods. In reality the distinction between higher priority projects and lower priority projects may not be critical in determining whether or not a plan achieves a NEB. For example, a project that involves acquisition of a surface water irrigation right in a subbasin that is significant to salmon

may be critical to a plan achieving NEB even though that project provides water only during critical times (i.e. it is not in-time). However, in order to determine the significance of water offset projects it will be necessary to consider the distribution and timing of new consumptive water use as well as projects aimed at offsetting those impacts.

The requirements to offset new consumptive water use from permit-exempt domestic withdrawals under chapter 90.94 RCW are fundamentally different from mitigation requirements for permitted water rights in Washington under chapter 90.03 RCW. In the case of water right permits where new water uses will affect surface waters with legal use restrictions, mitigation is typically required and usually that mitigation must be in-time and in-place. However, under the requirements of chapter 90.94 RCW offset projects for the new consumptive water use from permit-exempt domestic wells can occur anywhere within a WRIA provided the watershed plan achieves a NEB.

Most water consumptively used for domestic use is pumped at higher volumes during the summer months due to outdoor watering. So, theoretically, in order for projects to provide benefits that are in-time, these must provide year-round replacement of water at variable rates equal to the variable, year-round, consumptive use rates of houses. Offset projects involving such things as retiring seasonal surface water irrigation rights improve flows only during the months when the water was historically used, and thus do not provide year-round benefits. Moreover, many offset projects that involve groundwater sources, such as retiring seasonal groundwater irrigation rights or developing managed aquifer recharge projects using high flow diversions, may provide year-round flow benefits to surface water sources, but may include seasonal variations depending on site-specific aquifer properties and distances from streams.

Analysis of Consumptive Water Use Impacts

Estimating the timing of groundwater impacts from permit-exempt domestic wells on streams can be complicated due to potential lags between when wells are pumped and when pumping impacts propagate to rivers or streams. If a shallow well pumps an unconfined aquifer directly adjacent to a stream, impacts created by that pumping can be almost instantaneous. However, if a well pumps a confined aquifer some distance from a stream, smaller impacts can occur down gradient and over much longer periods.

To fully analyze timing of the impacts of groundwater pumping requires taking into account an area's hydrogeology, as well as the location, timing and magnitude of new well pumping. However, in some instances simplifications can be made that have little effect on the outcome of analyses. For example, unless a well is completed in bank storage right next to a stream, pumping groundwater at 50 gallons per minute (gpm) for one hour per day (say, for lawn watering) may have almost the same impact as pumping a well at 5 gpm for 10 hours per day.

For all analyses the place to start will be to construct a conceptual groundwater model that factors in hydrogeology, geographic distribution, and depths of the wells. In water resources terms conceptual groundwater models generally include spatial delineations of recharge and discharge areas, identification of pathways from unsaturated zones through saturated zones to

groundwater receptors (e.g. streams and rivers), and estimates of time scales of flow and impacts of groundwater pumping.

As stated above, in most instances, it is reasonable to assume that the impacts of pumping on streamflow depletion will essentially be steady-state. This is because the magnitude of a pumping pulse within an aquifer decays over distance and time as the effects spread out. This is illustrated in U.S. Geological Survey (USGS) Circular 1376 - Streamflow Depletion by Wells—Understanding and Managing the Effects of Groundwater Pumping on Streamflow (Barlow and Leake, 2012), which relied on analytical modeling results to demonstrate the effects of a pumping withdrawal during a 3-month irrigation season on nearby streams of varying distances to that well. A figure in that report (Figure B1 below) depicts how pumping pulses change at distance and over time. These changes range from distinct pump-on – pump-off patterns, to a relatively constant impact that approaches the annualized, steady-state rate that produces an equivalent water volume.

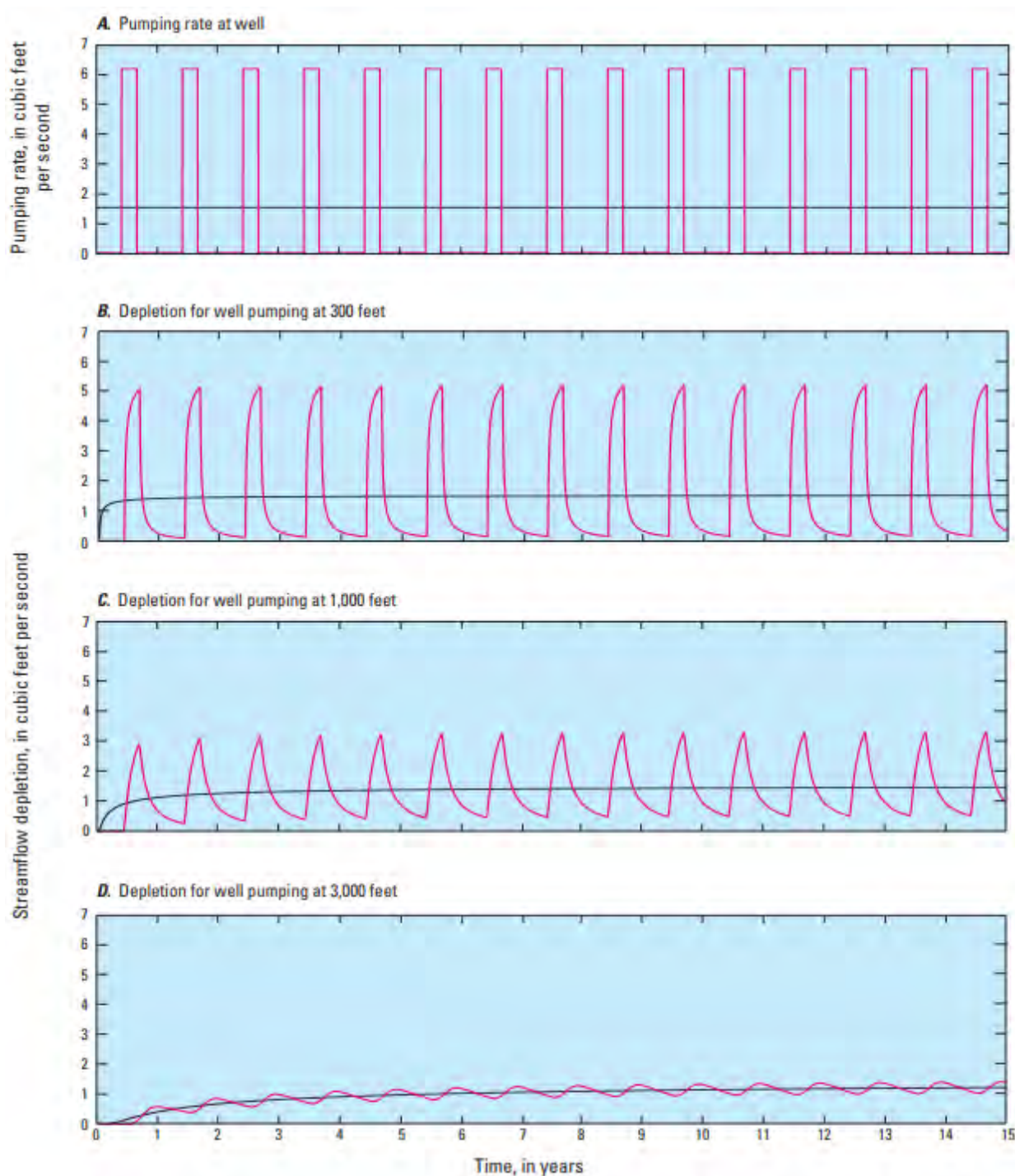


Figure B1. Patterns of streamflow depletion at varying distances from USGS Circular 1376. Patterns of streamflow depletion for both seasonal and constant pumping rates. A, The constant pumping rate, shown by the black line, is 1 million gallons per day (1.55 cubic feet per second); the seasonal pumping rate, shown by the magenta line, is approximately 4 million gallons per day (6.14 cubic feet per second) during June, July, and August. Depletion rates are shown for a well pumping at, B, 300 feet; C, 1,000 feet; and D, 3,000 feet from the river. Streamflow-depletion rates for the constant pumping rate are shown by the solid black lines and for the seasonal pumping rate by the magenta lines. The hydraulic diffusivity of the aquifer is 10,000 feet squared per day.

The graphs in Figure B1 were generated using an analytical model based on equations that rely on a number of assumptions. As with all groundwater models the assumptions simplify the mathematics involved and those assumptions are never fully met in the real world. Some of the assumptions lead to an overestimation of the impacts of pumping on nearby surface water, while other assumptions lead to an underestimation of impacts. Despite these challenges the results help us understand the interconnections between groundwater pumping and surface water depletion.

The model input parameters used by the USGS in developing Figure 1B were not chosen to represent Washington state aquifers. However, a comparison suggests these values are fairly similar to those for the Puget Sound region. For example, these results in Figure 1B are based on calculations using an assumed diffusivity of 10,000 feet squared per day (ft²/d). Since diffusivity equals transmissivity divided by storativity, a diffusivity of 10,000 ft²/d and a storativity of 0.1 suggests a transmissivity of 1,000 ft²/d. By comparison, USGS professional Paper 1424-D Hydrogeologic Framework of the Puget Sound Aquifer System, Washington and British Columbia (Vaccaro, et al., 1998) reports that regional transmissivity values generally range from about 50 to 2,000 ft²/d, and average about 500 ft²/d. Such values suggest that the modeled results displayed in Figure B1 are generally applicable for wells completed in unconsolidated glacial materials around Puget Sound. Furthermore, lower aquifer diffusivity values would increase the attenuation, thus increasing the tendency of pumping effects at distance to approach steady-state.

Although most of the 15 WRIAs specified in chapter 90.94 RCW fall within or are located nearby Puget Sound, three are not. Those three watersheds, Okanogan, Colville, and Little Spokane, are all located in eastern Washington. Domestic wells in these watersheds will be completed in unconsolidated materials, basalts, or other bedrock aquifers and will be a mixture of both unconfined and confined aquifers. While aquifer parameters will vary for different wells, groundwater use tends to flatten out the streamflow depletion impacts of peak seasonal pumping in most aquifers.

Due to hydrogeologic variability, uncertainty regarding where new well uses will occur during the next 20 years, available money, and available time, it is unrealistic for planning groups to model the impacts of anticipated pumping from the new wells. However, what the above figure suggests is that wells located 1000 feet from adjacent streams show peak depletion effects that are reduced by half of the instantaneous pumping rate (compare C to A in Figure B1) and that effects are more spread out over the entire water year. Furthermore, depletion effects from wells located 3,000 feet from adjacent streams (just over one-half mile) approach an attenuated, steady-state impact (see D in Figure B1).

Analysis of Water Offsets

Evaluations of individual water offset projects should include a determination of the magnitude and timing of hydrologic changes resulting from those projects. Projects such as permanent transfers of surface-water irrigation rights to instream flows should have fairly well-defined benefit periods. However, other projects, such as retiming of flows through managed aquifer

recharge or floodplain restoration, will require various assumptions and analyses to estimate when stream flows may increase and/or decrease. Whenever project analyses require making a significant numbers of assumptions and the results carry a significant degree of uncertainty, the plan should document and describe those limitations.

As with the estimation and distribution of new consumptive water use impacts, planning groups should consider how the benefits of water offset projects will be distributed in time and space. Additionally, some projects such as managed aquifer recharge projects will not just retime flows, but also to some extent redistribute water within given streams. In those cases, both annual and seasonal impacts of water offset projects should be considered.

Significance of Scale

When evaluating the hydrologic impacts of well uses or water offset projects on surface water, two important considerations are: (1) which surface water bodies will be affected and where, and (2) what will the magnitude of those impacts or benefits be relative to the size of the water bodies. For example, the significance of a 0.4 cfs impact created by new, permit-exempt domestic well pumping will depend in part on the size of the affected surface water body. If new houses are dispersed such that any one tributary will experience the impacts of pumping from a small fraction of the homes anticipated, the full impact will only occur on larger, downstream river segments where the significance of that impact will be much smaller. By contrast, if a 0.4 cfs impact is anticipated to specifically occur on a stream with a low flow of 4 cfs and that stream is critical to fish, it would be advantageous to locate a water offset project such that it will improve flows on that effected reach if at all possible.

Limitations of Monitoring

Planning groups should not expect to physically monitor the impacts of pumping or the benefits of water offset projects to assure compliance, and instead it will be more productive to focus their efforts on accounting for impacts and offsets in conceptual ways. In most instances, the consumptive use impacts from new well uses and/or the benefits produced from water offset projects will comprise a small fraction of flows in mainstem rivers - even during summer low-flow periods. As such, it will not be possible to physically measure changes in streamflow with conventional monitoring equipment. Even the best streamflow measurements are only accurate to within +/- 5%, which is generally much larger than anticipated effects. In small tributaries where the summer low flows may be in the single digits, it is unrealistic to expect to conventionally monitor new permit-exempt domestic withdrawal impacts or flow benefits from most water offset projects. In addition, lag times resulting from either will often manifest themselves in ways that cannot be separated from other changing flow conditions.

Putting It All Together

In most cases it is anticipated that the wide distribution of future well locations and depths, and the hydrogeological conditions, will make it reasonable to assume that the pumping impacts associated with new well use on streamflow will essentially be steady-state. However, even if

planning groups make steady-state assumptions, they will need to consider the distribution of pumping impacts throughout the watershed.

Due to a myriad of conditions involving such things as well distributions and well depths, confined versus unconfined conditions, gaining versus losing stream reaches, etc., it is unrealistic to expect planning groups to develop and use detailed information on how permit-exempt domestic withdrawals will affect streams. Therefore other approaches are appropriate. One option is for planning groups to make a simplifying assumption throughout most of their watersheds, but allow for exceptions. For most of their watershed that assumption could be that all pumping impacts will remain within the subbasin where they occur and that they will be distributed fairly evenly to the surface water bodies found within. However, in rare instances, such as where a high concentration of wells is anticipated near a particular stream, a different assumption could be made that depletion impacts are attributed to the stream located closest to the nearby pumping wells.

Conceptually it would be optimum to have sufficient water offset projects located in each subbasin to compensate for groundwater pumping impacts within those subbasins. However, in most cases that will not be possible. Instead, the approach allowed under chapter 90.94 RCW focuses on (1) making sure there are sufficient offset projects to replace the volume of consumptively used water of new permit-exempt domestic withdrawals in the planning horizon at the WRIA scale, and (2) that the portfolio of water offset and habitat improvement projects, as a whole, produce a NEB within the WRIA. The main purpose of the hydrologic effects analyses is to reasonably understand how groundwater pumping effects will manifest in the watershed in order to make a NEB determination. Since most pumping effects will be quite small, very dispersed, and steady-state with respect to streams, in most cases it is unnecessary to evaluate with precision the effects of pumping at single locations. Therefore, in general, watershed planning groups should be freed up to focus their efforts on identifying water offset and habitat projects that are most beneficial for fish – which should ultimately should help in producing watershed plans that achieve a NEB.

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Appendix C. WSU, Technical Supplement: Determining Net Ecological Benefit

Ecology Preface on WSU Technical Supplement

Planning groups are charged with the task of developing a set of projects and actions “necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use” (RCW 90.94.020(4)(b) and RCW 90.94.030(3)(b)). Ecology believes that the WSU Technical Supplement’s introduction provides a good introduction for NEB discussions, and some of the methods discussed may be of value to planning groups.

Section 1-D explains the benefits of coordinating with other plans and actions and provides a valuable list of natural resource management groups that conduct and coordinate planning efforts. This section outlines some of the technical issues planning units will face when developing a narrative description and evaluating their plans. The issue of uncertainty is particularly important. If there is not a multiplier of project benefits to the projected impacts to account for offset uncertainty or a divisor to account for the uncertainty in the timescale response, the technical review team will be looking for a similarly defensible rationale to account for uncertainty.

Chapter 2 looks at issues common to all NEB approaches. All are important to consider, but the comparison of out-of-kind offsets in Section 2-4 is of particular importance and highlights the most difficult issue concerning NEB. That issue involves the relative value, or weight, of habitat type or species losses relative to gains that may be “sufficient” to compensate for the losses. The approach that WSU took involves data that the planning groups likely won’t have time to develop in the timeframe allowed under chapter 90.94 RCW.

Chapter 3 details five general approaches to determine NEB, but based on the amount of data and analysis required, some may not be available. Therefore watershed groups should take inventory of all the available information on watershed-specific factors including: hydrogeology, stream flow conditions, fish populations and life histories, fish habitat studies, and current habitat conditions. In general, only two of these approaches (A and C) appear to be compatible with the constraints of the chapter 90.94 RCW planning process. The five approaches include:

- A. IN-KIND/IN-PLACE HABITAT REPLACEMENT (AREA/TYPE): This approach relies on hydrogeological analysis to estimate flow offset amounts in-time and in-subbasin or even in-place or better. Such analyses could potentially be used to evaluate MAR projects and groundwater right purchases for specific projects. However, for overall plan evaluations this method probably will not be viable.
- B. REPLACING HABITAT FUNCTION: This approach looks at how impacts to certain habitat features could be replaced with some combination of features at different locations that would on balance provide the same ecological function. An example of habitat function replacement would be Habitat Equivalency Analysis (HEA). However, this type of analysis requires pre-impact monitoring to develop testable metrics of the

baseline habitat services and that need, along with the data necessary for a secondary production analysis, are not compatible with the constraints of the chapter 90.94 RCW planning process.

- C. **REPLACING HABITAT CAPACITY FOR SPECIFIC SPECIES:** This approach involves producing quantitative estimates of habitat loss that could be compared to anticipated amounts of habitat gained from offsets projects. The amount of habitat area would then become a comparable currency for impact and offset to provide a NEB determination. An example of habitat replacement could come from the suite of PHABSIM types of analyses. This approach is flexible in that the WUA can accommodate changes in general habitat amount (area) as well as specific habitat quality for targeted species and life stages. This flexibility is particularly useful in the case where offsets are not located at the impact area or if the offset's ecological result is different from the impact. Due to this flexibility this approach may be useful to some planning units.
- D. **REPLACING FISH ABUNDANCE:** This approach is similar to habitat capacity replacement in that it requires similar information on habitat in order to forecast offsets, but it also requires more detailed information on fish abundance. Since the WRIAs are unlikely to have previous EDT assessments that included habitat qualities and fish survival, this option is probably not compatible with our timescale.
- E. **REPLACING FISH PRODUCTION:** This approach relies on population production metrics to evaluate NEB. Reliance on productivity has a number positive attributes, including direct measures of the productive capacity of a given habitat unit, but data needs are often more intensive and population-level assessments must rely on models and methods that are often complicated and technically challenging. Therefore once again in most instances this option likely would not be useful.

Technical Supplement: Determining Net Ecological Benefit

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1. INTRODUCTION

A. CONTEXT

The 2018 law (Engrossed Substitute Senate Bill (ESSB) 6091, codified as RCW 90.94, required the Department of Ecology (Ecology) to determine that a **Net Ecological Benefit (NEB)** will result when adopting and approving:

- Watershed plan updates, as required under RCW 90.94.020.
- Watershed restoration and enhancement plans under RCW 90.94.030.
- Water resource mitigation pilot projects under RCW 90.94.090.

Interim guidance (Ecology, June 2018) was developed to inform and evaluate plans that are completed within the following twelve months, or later if there is prior agreement with Ecology, and for pilot projects being conducted under RCW 90.94.090. To assist the agency in their development of a final guidance, Ecology developed a consultation with an academic research team affiliated with the Washington Water Research Center at Washington State University to support the technical aspects of the interim guidance. This report is the product of the academic team. The final NEB guidance will be used to evaluate the remaining plans submitted to Ecology later in 2019 through 2021.

Under RCW 90.94.020 and RCW 90.94.030, the completed plans must, at a minimum, recommend actions to offset the potential consumptive impacts of new permit-exempt domestic water uses to instream flows. Before plans are adopted, Ecology must determine that actions identified in a plan, after accounting for new projected domestic uses of water within a water resource inventory area (WRIA) over the next twenty years, will result in a NEB to instream resources within that WRIA.

RCW 90.94.090 authorizes Ecology to issue permit decisions for a series of water resource mitigation pilot projects. Those pilot project proposal evaluations involve issuance of municipal water right permits rather than permit exempt wells. Therefore, the content of this report will focus on planning and evaluations conducted under RCW 90.94.020 and RCW 90.94.030 only.

B. THE NEB DETERMINATION

In essence, the NEB process under RCW 90.94 is a **transaction**; plans will be evaluated to see if, given a forecast environmental impact from consumptive water withdrawals, there are sufficient forecast offsets from management actions, to meet or exceed those water withdrawals. Specifically in the Interim Guidance Ecology defines NEB as:

*“A **Net Ecological Benefit** determination means anticipated benefits to instream resources from actions designed to restore streamflow will offset and exceed the projected impacts to instream resources from new water use.”*

Thus, the transaction will amount to a comparison in the quantity and quality of anticipated instream resources prior to water withdrawals and following the deployment and maturation of offset projects. To evaluate this transaction we need to be clear regarding what instream resources are relevant, and how to structure the assessment of the transaction.

Ecology defines instream resources as:

*“Ecology interprets **“instream resources”** in the context of this provision of ESSB 6091 to include the instream resources and values protected under RCW 90.22.010 and RCW 90.54.020(3)(a), with an emphasis on measures to support the recovery of threatened and endangered salmonids.”*

The references to existing rules add the following:

From RCW 90.22.010: The department of ecology may establish minimum water flows or levels for streams, lakes or other public waters for the purposes of protecting fish, game, birds or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to establish the same.

From RCW 90.54.020(3)(a): Perennial rivers and streams of the state shall be retained with base flows necessary to provide for preservation of wildlife, fish, scenic, aesthetic and other environmental values, and navigational values. Lakes and ponds shall be retained substantially in their natural condition. Withdrawals of water which would conflict therewith shall be authorized only in those situations where it is clear that overriding considerations of the public interest will be served.

While the available language potentially encompasses a diversity of ecosystem goods and services (e.g. “recreational or aesthetic values”), the evaluation of instream resources will focus on endangered salmonids.

This is emphasized in the proposed rule for Chapter 173-566 WAC – Streamflow Restoration Funding, which will establish process and criteria for funding projects under Chapter 90.94 RCW which includes the following definition:

“Instream resources” for the purposes of this chapter means fish and related aquatic resources.

In Washington State, consideration of instream flow generally focuses on salmon and trout to a significant extent, as well as on other instream values. Salmon and trout are the most evident native fish in most Washington freshwaters and have high cultural, economic, and recreational importance, as well as being important ecologically (food for other wildlife, transporters inland of marine-derived nutrients that fertilize riparian vegetation (Ben-David et al. 1998; Helfield and Naiman 2001; Naiman et al. 2002; Shaff 2005), and as geomorphic modifiers (Kondolf and Wolman 1993; Macdonald et al. 2010). Based on this focus, this technical supplement will likewise focus on fish and fish habitat aspects of evaluating instream resources.

C. PURPOSE OF THIS DOCUMENT

This document primarily serves as **technical supplement** to the Department of Ecology's final NEB guidance, and does not supersede information provided in Ecology's final guidance. Ecology intends to distribute final NEB guidance that will inform diverse issues related to the development of proposals, and may include objectives for and descriptions of the planning process, requirements for proposals and process for proposal evaluation. This document in contrast, will not address requirements, and is only intended to provide technical support for the ecological assessments that are part of the NEB process. In particular, while this document describes what information content ***may*** be included in the proposals, it does not require specific information be present in all proposals, and indeed, does not define adequacy nor standards for what will be deemed sufficient by and for the Department of Ecology.

It is also a critical distinction that this document is intended to inform and support proposals and planning in response to RCW 90.94, rather than the implementation process for those plans. This distinction has a number of implications. Clearly each subbasin presents unique sets of opportunities and constraints in terms of managing instream resources that need to be examined by each planning group. Each planning group will know its basin best and it is impossible for this planning document to anticipate all of those opportunities and constraints ahead of time. Most importantly however, the role of monitoring and adaptive management will differ between planning and implementation. In the planning process scientific information, presumably collected with effective monitoring, can inform the models, forecasts and assessments in an NEB determination. However, once plans are implemented, additional monitoring may be required to evaluate project effectiveness, validate that performance targets are met, and inform the decision to deploy contingencies in the event that performance targets are not met (Crawford 2007). The incorporation of monitoring into a management loop consisting of: performance target identification, project implementation, monitoring, and management course correction based on monitoring, is termed adaptive management (Walters 1986, 1997) and is likely to be an important component of implementation. Although planning is distinct from implementation, there are both roles for the information produced with monitoring and opportunities for efficiencies in planning that come from consideration of monitoring in the planning process. Therefore, this report includes a brief discussion of monitoring and adaptive management below.

The framework for this document is derived from work produced for the Canadian Science Advisory Secretariat (CSAS) that sought to provide guidance on evaluating offsets from fisheries-related management in relation to any harm development projects may cause to fish and fisheries (Bradford et al. 2014). That report describes an approach to assessing "equivalency" from impacts and offsets, and applied several approaches to evaluating equivalency. The notion of equivalency is similar to NEB, but it derives from statutes which are themselves different in Washington and Canada. Therefore, we do not coopt the technical definition of equivalency in this document. However, Bradford et al (2014) do provide a number

of useful insights. Specifically, they recognize the general distinction of In-kind/In-place/In-time offsets on the one hand, to a diversity of approaches to out-of-kind/place offsets on the other¹.

Across the regulatory and research literature on environmental impact mitigation the terms “in-time” and “in-place” are commonly used. However, each regulatory situation may impose unique definitions based on jurisdictional and planning constraints. In Washington State relative to water right permits, the term “in-place” refers to mitigation that is located in the same place as the pumping impacts. However, RCW 90.94 applies to permit-exempt wells and not permitted wells, and relative to offsets for permit-exempt wells in this law does not have in-time or in-place requirements. RCW 90.94 does describe highest priority offset actions as being capable of “replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary”, and Ecology has referred to this latter locational constraint as meaning within the same sub-basin. Thus, within the law “Lower priority projects include projects not in the same basin or tributary and projects that replace consumptive water supply impacts only during critical flow periods”. However, beyond this, RCW 90.94 allows great latitude in where offset projects can be located and what the timing of the benefits will be - provided that collectively the plan will achieve a Net Ecological Benefit.

Therefore the spatial domain used in RCW 90.94 is larger than other uses of the term “in-place” -particularly in the research literature broadly, and Bradford et al. (2014) specifically. For the purposes of this document, there are places where the terminology “In-place” is used equivalent to “same basin or tributary” consistent with RCW 90.94, and there are other places where the term “in-place” is used in same sense as the research literature more broadly – with the text noting areas where one or the other situation applies.

Bradford et al. (2014) recognize the diversity of out-of-kind/place/time approaches based on offset goals and modeling frameworks. We have leveraged these insights here and adopted their organization of offset approaches in this document. We use this definition and the conceptual foundations provided by Bradford et al. 2014 within the context of the decades of salmonid research done in the U.S. Pacific Northwest. As such, this discussion outlines pathways forward for developing scientifically defensible plans to estimate 1) the harm new development may inflict on fish, and 2) the efficacy of proposed offset projects towards preventing, reducing or offsetting harm in Washington State.

Given the unique challenges and opportunities present in each watershed in Washington State, and the diversity of approaches to NEB determination described below, this document does not dictate specific actions to be taken. Rather, this document is meant to provide a scientific framework from which planners and regulators can understand the current state of knowledge. We attempt to identify the most scientifically rigorous method in a given area for estimating the

¹ Separate from defining the spatial boundary of “In-Place”, the meaning of In-Kind/In-place is meaningful only if mitigation is contemporaneous or performed over relevant time scales. The ecological responses of habitat to mitigation may operate on different time scales than the impacts of water withdrawals and if those scales are very different, it may be difficult to associate responses with impacts in the same place and of the same response type. Therefore, while In-Kind/In-Place is used here to be consistent with other nomenclature, it should be understood to be In-Kind/In-Place/In-Time unless otherwise noted.

potential harm and potential benefits to endangered salmonids, other fishes and other instream resources despite continued watershed development.

The following sections outline the steps needed to estimate NEB and discuss anticipated issues associated with monitoring and diverse spatial scales, as well as the rationale for making out-of-kind NEB comparisons. These are followed by a review of five approaches for establishing NEB and the merits and limitations of each. These five approaches include: 1) In-kind/In-place Habitat Replacement, 2) Habitat Function Replacement, 3) Habitat Capacity for Single Species Replacement, 4) Fish Abundance Replacement and 5) Fish Production Replacement².

The authors of this report do not have detailed knowledge concerning the level of resources, expertise and research sophistication available to each planning unit. Our professional experience suggests that the resources and expertise available to the planning units will vary widely. For example, the Pacific Northwest is one of the most sophisticated natural resource management domains on this planet, with research, monitoring and evaluation expertise built on Endangered Species Act, Northwest Power Planning Act, Northwest Forest Plan and other regulatory framework legacy experiences. Therefore, in some cases the capacity to perform sophisticated NEB determinations may be quite high. At the same time RCW 90.94 addresses a new framework, with new expectations, and some planning units may find they do not currently possess the tools to perform a detailed, demanding NEB determination as described below. In these cases, planners may perceive the information that follows in this report to be somewhat demanding. We feel however, that it is important to describe the approaches to NEB determination that would represent a contemporary and comprehensive approach, with the understanding that some groups may not exploit that comprehensiveness, rather than compose a report that was narrow in approach, based on lower expectations for regional expertise, and fail to provide guidance to planning groups that did possess more capacity.

In the past, when subbasin planning or recovery planning groups and agencies have lacked expertise or access to appropriate monitoring data, detailed research products have been substituted with subjective assessments, often labelled “best professional judgement” or similar. It is likely that in the case of NEB determinations performed under the RCW 90.94 process this will also be the case for some planning groups. Planning units and the Department of Ecology will need to resolve what expectations are appropriate for each planning group, and where the recruitment of additional expertise is justified and available.

D. STEPS IN A NET ECOLOGICAL BENEFITS DETERMINATION

NEB determination is composed of four key parts as defined by the Interim Guidance:

1. **Characterize and quantify potential impacts to instream resources from the projected 20-year new domestic permit-exempt water use at a scale that allows meaningful determinations of whether the proposed offset is in-time and/or in the same subbasin.**
2. **Describe and evaluate individual offset projects.**

² Fish Production Replacement refers to the productivity of fish in the habitat. It does not refer to hatchery supplementation of fish.

3. **Explain how the planned projects are linked or coordinated with other existing plans and actions underway to address existing factors impacting instream resources.**
 4. **Provide a narrative description and quantitative evaluation (to the extent practical) of the net ecological effect of the plan.**
- 1) Characterize and quantify potential impacts to instream resources from the projected 20-year new domestic permit-exempt water use at a scale that allows meaningful determinations of whether the proposed offset is in-time and/or in the same subbasin**

Planning groups must evaluate “potential impacts to instream resources” as the losses that must be counterbalanced by the proposed offsetting measures. Of particular interest are those spatially- and temporally-dependent changes in stream flow resulting from consumptive use withdrawals that may have impacts on fish and fish habitat. Impacts on fish may not be uniform across space, time or fish life-stage (e.g. decreases in flow can have a positive impact on some life-stages of fish but negative impacts on others, or mitigation actions may take multiple years to take effect—see below). Thus, estimates of *net* impacts should be determined and quantified for each impact type in each phase of a proposed activity across the forecasted 20-year time horizon. This may include determining the extent, duration, and magnitude of the impacts on fish and fish habitat in terms of the reduced fish numbers, area of habitat lost, area of habitat permanently altered and degree of alteration. There are several approaches to making these forecasts (see below); this document outlines the benefits and limitations of these available methods.

2) Describe and evaluate individual offset projects.

All proposed offsetting measures should include details about the design, implementation, and desired outcomes for the NEB determination. The desired outcomes should be determined by the forecasted potential impacts to instream resources in Part 1 of this section. The NEB determination should include clearly defined measures of success that are linked to the desired outcomes of the offset projects, and be expressed as metrics that can be monitored to evaluate effectiveness.

Potential designs for offset project metadata are provided in an accessory appendix (Appendix 1). The metadata dictionary provides examples of metrics for describing the magnitude, location, and extent of each offset project and a rationale for the key information needs listed.

The steps involved in describing and evaluating projects are discussed in Ecology’s Interim Guidance. Once all of the projects have thus been characterized, it is useful to distinguish between those that are “in-time” and “in-same-subbasin” versus those that are “out-of-time and out of-same-subbasin”. RCW 90.94 establishes a hierarchy of priority for actions (projects) aimed at offsetting the impacts of consumptive domestic permit-exempt well use:

- Highest priority are projects that replace consumptive domestic water use impacts during the same time and in the same subbasin as the impacts occur.
- Lower priority are projects that replace consumptive domestic water use impacts elsewhere within the WRIA or only during critical flow periods.

“In-time and In-same subbasin” offsetting refers to situations in which the water used for permit exempt domestic well consumptive use is replaced by the same quantity and quality of water in the same place—where place is defined as the same subbasin. Additional habitat offsetting may potentially be required to account for uncertainty and time lags. The benefits of in-kind offsetting are assumed to accrue to the fish populations affected by the project. In these situations, balancing the losses to fish and fish habitat caused by a project with the benefits that result from offsetting measures can be a straight-forward calculation. The calculation is based on the impacts, water use, and the comparability of offsets both in terms of the metrics used to describe them and the affected fish populations.

With “out-of-same-subbasin” or “out-of-time” offsets, offset projects address factors limiting fish productivity in a given area, but not by replacing what has been lost. Rather, offsets meet or exceed those losses with increased production elsewhere. Out-of-same subbasin/time offsetting measures may include the restoration or creation of habitat types that are different from the habitat type that was lost, or other types of measures. This is sometimes referred to as off-site mitigation. Measuring and comparing losses with offsetting gains can be more complicated in out-of-same subbasin/time offsets, as the transaction relies on a correct understanding of the relationship between habitat alterations in a given location and a fish productivity response. This has been challenging to demonstrate and it is an important limiting assumption (see Locke et al. 2008 and Monitoring and Evaluation section below).

3) Explain how the planned projects are linked or coordinated with other existing plans and actions underway to address existing factors impacting instream resources.

This step is principally an administrative activity, and the Interim Guidance provides additional details and rationale for coordination within other management plans as well as with other ongoing habitat and fish management within their WRIA’s and sub- WRIA planning units. Planned offset projects may indeed benefit in terms of greater environmental benefit if they are planned, designed and implemented in coordination with partners. Effective coordination is likely to leverage a larger set of resources and reduce overall cost per unit ecological benefit.

Notwithstanding the desired outcome that more coordination will produce greater environmental benefit, it is also likely that in some cases there will be a state of diminishing returns. For example, if water temperature is a critical concern for salmon in a given WRIA, and 100 out of 130 miles of the riparian corridor have been addressed previously with restoration, then the next 10 miles may not be as effective in increasing fish populations as the first 10 miles of riparian revegetation, nor as effective as 10 miles of riparian revegetation in a different corridor that has been untreated.

In any case, siting offset projects in the context of historical habitat management and coordinating with on-going management will be critical for supporting the forecasts of potential impact and offsets described in each NEB Determination.

Each WRIA-based planning group is likely aware of much of the habitat management actions occurring within their WRIA. However, additional sources of information on planned and implemented projects can be obtained from known data holders on the following list:

Data Holder	Location	Phone	Web url
Columbia Basin Fish and Wildlife Authority - CBFWA	851 SW 6th Ave # 250, Portland, OR 97204	(503) 229-0191	https://www.cbfish.org/
Nisqually Indian Tribe	Nisqually Tribe 4820 She-Nah-Num Drive S.E. Olympia, WA 98513	(360) 456-5221	http://www.nisqually-nsn.gov/index.php/administration/tribal-services/natural-resources/habitat-restoration/
NOAA – Pacific Coast Salmon Recovery Fund	7600 Sand Point Way, Seattle, WA 98115	(503) 230-5419	https://www.westcoast.fisheries.noaa.gov/protected-species/salmon-steelhead/recovery-plan/implementation/pacific-coastal-salmon-recovery-fund.html
NOAA Fisheries Community Based Restoration Center	7600 Sand Point Way, Seattle, WA 98115	(360) 902-2603	https://www.fpir.noaa.gov/HCD/hcd_restoration.html
NOAA Restoration Center	7600 Sand Point Way, Seattle, WA 98115	(360) 902-2603	https://www.westcoast.fisheries.noaa.gov/habitat/restoration-on-the-wc.html
NOAA Pacific Northwest Salmon Habitat Project Database	Northwest Fisheries Science Center 2725 Montlake Blvd. East Seattle, WA 98112	(206) 860-3362	https://www.webapps.nwfsc.noaa.gov/apex/f?p=409:13:::
Nooksack Salmon Enhancement Association	3057 E. Bakerview Road Bellingham, WA 98226	(360) 715-0283	http://www.n-sea.org/contact (also see: https://wdfw.wa.gov/about/volunteer/rfeg/)
Ocean Trust	1000 Padre Blvd. Suite 528 South Padre Island, TX 78597	(703) 434-1444	https://www.oceantrust.org/contact/
South Puget Sound Salmon Enhancement Group	6700 Martin Way East, Suite 112 Olympia, WA 98516	(360) 412-0808	http://spsseg.org/contact-us/
Stillaguamish-Snohomish Fisheries Enhancement Task Force	425.252.6686 PO Box 5006, 2723 Hoyt Ave Everett, WA 98206	(425) 252-6686	http://www.stillysnofish.org/
United States Army Corps of Engineers	PO Box 3755 Seattle, WA 98124-3755	(206) 764-3742	https://www.nws.usace.army.mil/
United States Bureau of Land Management	Bureau of Land Management 333 S.W. 1st. Avenue Portland, OR 97204	(503) 808-6002	https://www.blm.gov/or/programs/fisheries/salmon-habitat-mgmt.htm
United States Fish and Wildlife Service	911 NE 11th Avenue Portland, OR 97232	(509) 548-2985	https://www.fws.gov/pacific/fisheries/HabitatRestorationMain.cfm

United State Forest Service – Regional Ecosystem Office	1220 SW 3rd Avenue Portland, Oregon 97204	(503) 808-2851	https://www.fs.fed.us/r6/reo/nwfp/
Washington State Department of Fish and Wildlife – Habitat Program		(360) 902-2534	https://wdfw.wa.gov/conservation/habitat/
Washington State Salmon Recovery Funding Board (SRFBD)	1111 Washington Street S.E. Olympia, Washington 98501	(360) 902-3000	https://www.rco.wa.gov/boards/srfb.shtml

4) Provide a narrative description and quantitative evaluation (to the extent practical) of the net ecological effect of the plan.

Similar to the forecasts of potential impacts to instream resources identified in Step 1 of this section, planning groups will also need to forecast anticipated net ecological effect of their planned offset projects. Also similar to Step 1, these forecasts can be performed with a variety of approaches, some of which are identified below. Importantly, each approach must address the following technical issues:

- a) The forecasted benefits from offset projects need to meet or exceed the potential environmental impacts to stream resources;
- b) Recognition that uncertainties exist on several scales
 - a. *Uncertainty in offset magnitude*: Given that the magnitude of offset effects are uncertain, the magnitude of total planned offsets may need to be increased in the plans in order to increase likelihood that net offsets exceed impacts of withdrawals;
 - b. *Uncertainty in timescale of response*: Recognizing that although not explicitly considered under the streamflow law, there may be time lags between the implementation of a project and when the potential benefits to instream resources may manifest, but the negative impacts of consumptive water withdrawals may occur in the near-term, the magnitude of the offset projects may need to be increased. For example, if the impacts of a set of withdrawals occur over years 1-20, but the benefits from offsets are only manifest in years 10-20, then the magnitudes of the offsets would need to be larger than the impacts at any moment in time for the NEB to net out positive at the end of the planning horizon;
- c) Contingency measures for the event that offsets are not reaching performance targets, timelines for evaluating triggers for those contingencies, and management decision process for employing those contingencies should also be identified if the offsetting measures do not meet expectations.

2. ISSUES COMMON TO ALL NEB DETERMINATION APPROACHES

1) Monitoring

As mentioned above, this guidance is intended to address planning rather than implementation needs. However, we can anticipate opportunities and constraints presented by implementation feeding back into the planning process. One of those issues is monitoring and adaptive management. It is appreciated that that monitoring is a key component of management action implementation, but it may be less clear how monitoring fits into planning exercises prior to management action deployment.

Plans that anticipate the realities of implementation, such as uncertainty, risk and management decision making, are most likely to be successful. Monitoring is a critical tool in addressing these realities, and is most effective when incorporated into an adaptive management framework. As mentioned above, there are several scales of uncertainty in forecasting NEB both in terms of impacts of water withdrawals and the impacts of offset projects. The potential that planned projects will not generate a positive NEB is an important risk associated with these uncertainties. Monitoring of offset impacts informs evaluation of progress in meeting plan objectives, and when invested in a framework for making management decisions can determine if plans need to be modified to reach targets. Importantly, monitoring of offsets can determine if performance targets are not being reached and triggers for contingencies are required prior to an unsuccessful project completion. Incorporating monitoring into this loop of performance target identification, project implementation, monitoring, and management course correction based on monitoring, is termed adaptive management (Walters 1986, 1997; Katz et al. 2007). By allowing informed course corrections over the 20 year time horizon of the NEB process, monitoring is a critical to reducing the risk that NEB will be negative.

For these reasons, projects that include an explicit effectiveness monitoring plan³ should garner greater deference in determining project benefits. In addition, the State of Washington and the region more broadly have recognized the critical role of monitoring in validating fish-habitat response models as well as validating the effort and significant investments in habitat management across the Pacific Northwest. The precepts behind monitoring across the region are summarized in the ***Coordinated Habitat Action Effectiveness Monitoring*** guidance from the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), to which Ecology is a partner agency. The following is an excerpt that underscores the role of, and commitment to, effectiveness monitoring:

“Habitat action effectiveness monitoring is a critical component of performance tracking and adaptive management needs of the Pacific Coastal Salmon Recovery Fund (PCSRF), the Columbia Basin Fish and Wildlife Program, the 2008 NOAA Federal

³ Action effectiveness studies [=effectiveness monitoring] look at “cause and effect” relationships between management actions and improvements to fish survival and/or environmental conditions. In other words, these studies help evaluate whether actions for fish are achieving their biological objectives. <https://www.salmonrecovery.gov/Evaluation/ActionEffectiveness.aspx>

Columbia River Power System (FCRPS) Biological Opinion, several other regional Biological Opinions, and several federal, state and tribal mitigation programs. The current habitat action effectiveness monitoring and assessment strategies being implemented under these Programs requires a combination of project implementation monitoring, project level and watershed scale effectiveness monitoring, along with habitat/fish status and trend monitoring. This information will support a tool box of various habitat and fish population relationships and models that can be used to make assessments and inferences about the effectiveness of various actions. For these strategies to succeed, the components need to be coordinated with compatible and well documented metrics, methods, and designs and balanced across different categories of action types within limited budgeting available for this type of information.” PNAMP 2010⁴

Effectiveness monitoring plans should include:

- Clearly articulated models of the managed system, where ‘model’ refers to a description of the environmental system that includes hydrologic and ecological process and allows a specific forecast for the effect of the implemented management action in terms that can be monitored with current methods.
- Clearly defined and reportable benchmarks of success and time lines that can be used to determine success in reaching NEB, as well as recognizing when NEB is not being achieved and contingencies must be triggered.
- Methods and designs consistent with effectiveness monitoring guidelines or plans in place across the region (e.g. PNAMP).
- The same level of transparency present in other aspects of the NEB determination.
- Coordination with other status and trends and effectiveness monitoring programs within their planning domain and in adjacent planning domains to ensure interoperability and maximal efficiency with respect to multiple NEB determinations.

Although monitoring has been described here in the context of validating the performance of offsets, it is also likely that monitoring will inform some of the estimates of impacts. However, the degree to which monitoring influences the estimates of impacts from water withdrawals will be highly variable among the approaches to NEB determination described below. This variability makes it difficult to specify the characteristics of monitoring for this objective. However, if monitoring is a component of impact assessment as well as offset forecasts, that monitoring should be designed to generate data that is interoperable between those activities.

2) Accuracy, Precision & Transparency

⁴ Crawford, B., J. O’Neal, M. Newsom and J. Geiselman. (2010). Coordinated Habitat Action Effectiveness Monitoring. PNAMP Available at <https://www.pnamp.org/document/3039> (accessed Nov. 5, 2018)

The RCW 90.94 interim guidance indicates that plans should characterize relevant uncertainties in their estimates of impacts and offsets in each NEB determination. This direction is specific:

“Uncertainty of benefits should be identified and quantified to the extent possible.”

How then to characterize uncertainty? Every model is a simplification of a true and complicated process. As such, it is important to understand both the sources and magnitudes of uncertainties that are part of any model prediction. Uncertainty in this context can actually arise from several aspects of the analyses used to forecast impacts and offsets.

In general, there are two primary elements to uncertainty that one needs to consider: accuracy and precision (fig 1). **Precision is how close predictions or observations are to each other.** Models that make predictions that are tightly clustered together are said to have high precision, and this is expressed statistically as low “variance”. **Accuracy on the other hand, is how close a prediction is to the truth.** Models that make predictions that are consistently close to the true values are said to have high accuracy, and this is expressed statistically as low “bias”. It is important to keep these sources of uncertainty distinct for several reasons. They are statistically different, they affect interpretations differently, and they have different origins such that minimizing one or the other requires different alterations to our methods. For example, there are times when increasing the amount of data can increase precision, but it usually has no effect on accuracy. As a consequence, there are times when no amount of more data will get an answer with more accuracy. In addition, it must be recognized that they are independent in that either one or both can be high or low at the same time. This is illustrated in figure 1 below.

An ideal model has both high accuracy and high precision, but in practice this rarely happens. Especially with models, there are good reasons for the presence of trade-offs among the two. Relatively simple models may have fairly high precision, but low accuracy, especially when applied to novel data. Increasing the complexity of models can increase accuracy, but at the cost of decreased precision.

Several features of the interaction between precision and accuracy can be illustrated with the following simple example of fitting a curve to estimate an underlying process. Consider a simple relationship, or process, in the environment (gray line in each panel of fig 2a-c), that we observe at a sample of X values (indicated by black dots). The values of the dots are determined by the process and a little bit of uncertainty, or error in the data. So the black dots are the data in hand, and the process is what we are trying to model, and in each panel of the figure they are the same. Now if we fit the data with a simple linear model with 2 parameters (the slope and intercept) we get the straight red line in figure 2a. The points deviate from the red line quite a lot (low precision), but the line represents the underlying process fairly accurately; the overall trend is going down with increasing X over this range of X values. In the far right panel the process is estimated with a much more complex model that has 7 parameters (6 polynomial exponents and an intercept). Here the red line goes through all the points, and so is very precise (indicated by the high value of r^2), but the red line is not a very accurate description of the process given all the diversions and “waviness”. In the middle, we fit the data with a polynomial with 4 parameters.

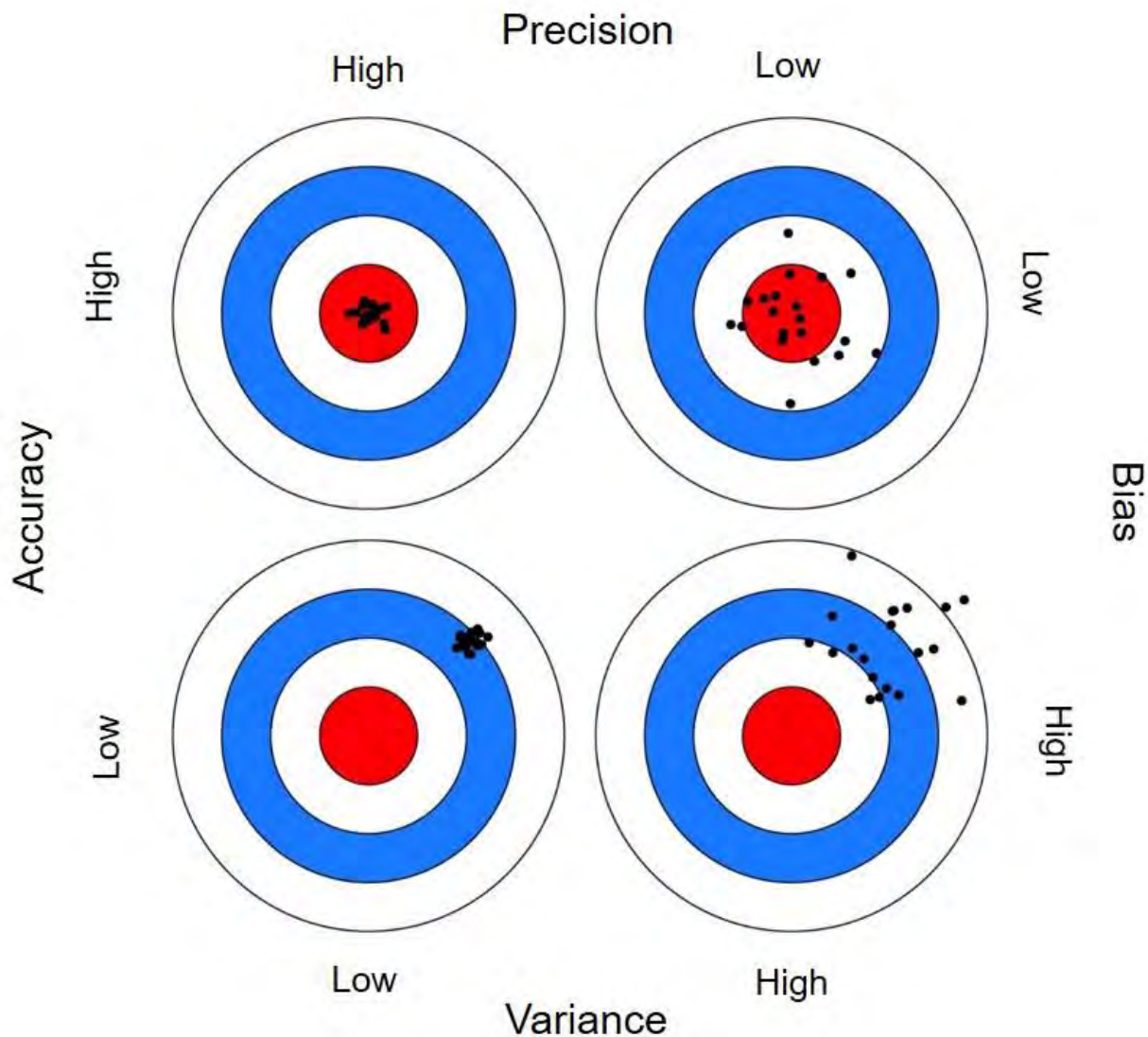


Figure 1 Diagrammatic representation of accuracy and precision. The distribution of holes in the targets is an expression of the statistical properties of accuracy and precision in order to convey 1) that they are independent properties in that either may be high or low regardless of the other, and 2) that they have different impacts on how model forecasts are viewed. In this framework, the bull's eye on the targets represent what is happening in reality, and the bullet holes represent the model descriptions of that reality. In the best of all outcomes, models would be accurate and precise and the bullet holes would all be clustered closely at the center of the target (model=reality). The fact that precision and accuracy are separate and independent means that models can be poor reflections of reality in multiple ways.

This example of a trade-off illustrates a general principle. As model complexity increases, precision generally increases, but accuracy may decrease. The interpretation is that the more complex models are better at approximating all the data, but they perform more poorly at estimating the underlying process. In between is an optimum where the Total Error arising from both imprecision and inaccuracy are at a minimum. This trade-off is graphically summarized in figure 2d. A second implication of the trade-off in figure 2d is that while there is a minimum Total Error, it never goes to zero. So our models will never be free from uncertainty; the

question is can we develop useful models and can we make choices among models that get us as close to the minimum as

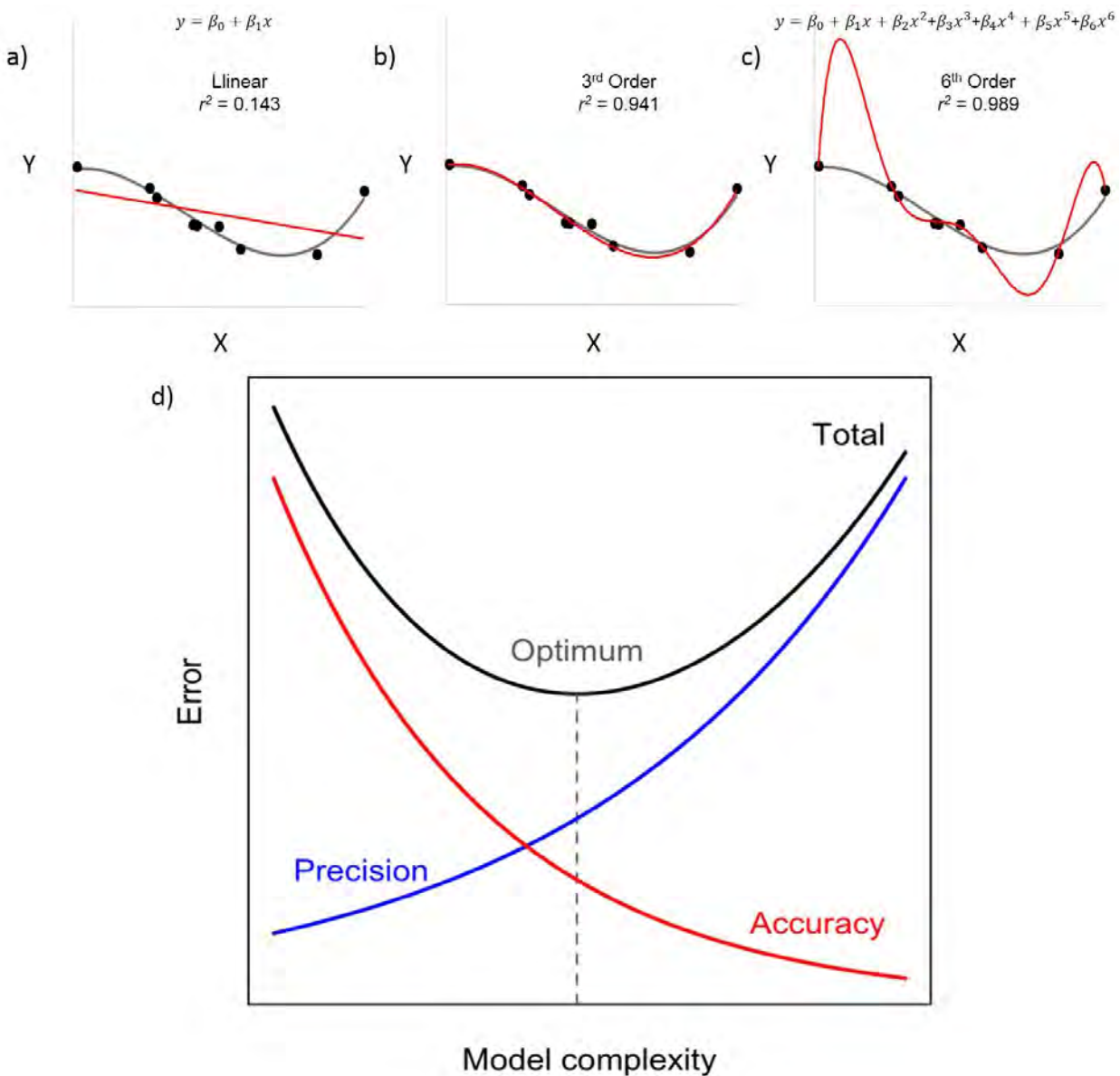


Figure 2 Illustrations of relationship between model complexity and total uncertainty or error. A) A simple process (gray line) observed at various values of X (black dots), and fit with a linear regression model (red line). The form of this most simple model is above the curve. B) The same process and observations as in A, but fit with a 3rd order polynomial as a model of intermediate complexity. C) The same process and observations as in A and B, but fit with a 6th order polynomial as a model of high complexity. The form of this most complex model is above the curve. D) The generic trade-off between errors due to loss of accuracy and increased precision as model complexity increases (total error is the sum of the other two components). The dashed vertical line indicates the optimum level of model complexity.

possible. In practice, the optimum is often wide—a range of complexity will give similar total error—and spending large efforts to acutely optimize model complexity is not a useful expense of effort. However, especially in the context of fish-habitat association modeling and salmon

recovery very complex models are in use with potentially profound inaccuracies. Therefore, planners and reviewers need to be conscious of the choices they make with respect to approaches to NEB determination, and then be clear on how they report those choices.

In the context of NEB determination, this trade-off has an additional important implication. As stated above, ideally we would like both precision and accuracy. In many research contexts however, one is likely interested in describing the data in hand and so precision is very important. In this case, one may tolerate a more complex model to achieve a better “fit” to the data. In contrast, in the present context NEB determinations need to project impacts and offsets out into the future and so one must prioritize a better understanding of the underlying process. The most complex models in use can make very precise forecasts (i.e. 165,500 Coho salmon from a given sub basin), and this is often seductive in a management context where future ecological status is at stake. But those same models can make wildly inaccurate forecasts because of that same complexity. In fig. 2c for example, the model fits the data well, but the 6th order polynomial deviates wildly from the process; would it be prudent to use the red line to make a forecast of where the gray line is going to be at some far outlying value of X? Likely not.

This discussion of precision and accuracy has focused on the implications of model complexity at the level of making choices among NEB determination approaches (see below). Once one has decided on a specific approach to NEB determination, it is possible to then continue to evaluate the complexity of models and tactics to increase precision and accuracy that are related to data quality, sampling design and statistical estimation techniques. All of which are potentially important, but which are also likely to vary quite widely from WRIA to WRIA. That level of model selection and optimization will involve location-specific detail that exceeds the scope of this guidance. However, it is likely that at small scales the benefits of an intensive optimization process will be marginal, and the decisions regarding specific choice of impact and offset forecast will be made based on the data, expertise and other resources at hand to make the determination.

These uncertainties are important, and the design choices that are made have interacting implications for total uncertainty in the impact and offset forecasts, but at the same time planners will need to make judgments about what they need and what they can do to develop their NEB determinations. This reality makes it important to be transparent with respect to what choices are made and how. The interim guidance states:

*“... plans will provide a **transparent**, structured evaluation to be used in Ecology’s NEB analysis to determine whether the requirement in ESSB 6091 has been met. If the planning group concludes that the planned projects recommended in the plan will achieve NEB, the plan should include a clear explanation and justification for that conclusion.” (emphasis added)*

In this context, transparent means that all methods and assumptions are reported. This would include descriptions, sources and magnitude of bias and uncertainties that affect the impact and offset forecasts. At a minimum, this would include the uncertainties that arise from data, model choice and estimation methods. As noted above and various places in this guidance however,

some of the choices made on adopting one approach or another involve complex trade-offs between technical issues, but also practical constraints. Therefore, a transparent description of the methods and approaches taken should also identify where choices were made and what constraints may have been in place to guide those decisions. As demonstrated in figure 2d, it may not be possible to reduce uncertainty to zero, therefore it is critical to document what efforts were taken to address uncertainty throughout the NEB determination process.

3) Ecological Context, Scale and Critical flow periods

The interim guidance defines high and low priority projects, and instructs planners that viability of proposed projects will be evaluated in an ecological context. Ecological context in this case refers to the scales, environmental conditions and scope of biodiversity relevant to the fish affected by consumptive water withdrawals. Specifically, the guidance includes:

“Where highest priority projects are not feasible, ESSB 6091 authorizes plans to include lower priority projects—those that do not occur in the same subbasin or tributary (but are within the same WRIA) or only replace water during critical flow periods. To determine the viability of a lower priority water offset project, planning groups will need to determine critical flow periods. The critical flow period determinations should consider fish presence and distribution, and the historic hydrograph (synthesized hydrograph if necessary).”

Ecological context matters to NEB determinations in a number of ways. Location and setting will be important for both high and low priority projects. Location and scale are important both to correctly account for the ecological system being managed, but also because the approaches to NEB determination described below all have dependencies on data and data aggregation that are affected by location, timing and scale. For high priority projects (i.e. In-the same subbasin and In-time), a clear description of the extent of water use and offset is needed to evaluate the offset equivalence, and determine NEB. The guidance also refers to different opportunities for offsets at scales from the tributary to the subbasin and WRIA scales. Therefore, planners need to be clear about the spatial extent of their projects and impacts if their plans are to be evaluated appropriately. For low priority projects, location and scale will be similarly important as environmental conditions subject to proposed offsets are heterogeneously distributed across the landscape. Accounting for habitat capacity or fish production equivalence and substitution will require habitat descriptions of similarly high detail to capture that heterogeneity.

In addition to the scale dependencies of ecological data, ecological context can also affect the scale of ecological process that impacts instream flow. For example, a specific reduction in stream flow (e.g. 0.75 cubic feet per second, cfs) is likely to have a larger impact on a smaller tributary than a larger river. Alternatively, a given withdrawal may have a larger impact on habitat (i.e. the environmental correlates of stream flow) if taken higher in the watershed than closer to the confluence of the tributary to a large stream. Yet the effect of a withdrawal can also be diminished as other tributaries or groundwater are added downstream.

In addressing ecological process, planners may need to aggregate withdrawals along tributaries, weighted by the tributary stream flow, catchment size, geomorphology and adjacent withdrawals. It is hard to predict how complex such schemes are likely to get across the diversity of stream networks within the geographic range of Washington WRIA's, but planners will need to incorporate at least the basic watershed characteristics listed above in their plans.

Figure 3 is a map of the state of Washington that identifies the watersheds covered under this planning process. These watersheds cover a wide swath of the state and the ecological conditions are distinct among them. These ecological differences will affect the impacts of consumptive water withdrawals from permit exempt wells.

As mentioned above, the magnitude of stream flow changes are anticipated to vary widely from WRIA to WRIA, with some obvious and others almost imperceptible. If one is evaluating withdrawal impacts on a large tributary the effect of a fraction of a cfs change is likely to be very small and perhaps technically challenging to demonstrate. WRIA's dominated by rain inputs in the western portion of the state (e.g. WRIAs 12, 14, 22 & 23), may commonly experience localized areas of low flow in the late summer and fall. Here a small cfs reduction could have large impacts seasonally. On the other hand, the Little Spokane and Colville subbasins (WRIAs 55 & 59), while having regulated flows do not support listed salmonids, and so the determination of NEB will likely be made on a basis other than anadromous fish impacts (see RCW 90.22.010 and 90.54.020). This is an additional component to ecological context, and it will create both challenges and opportunities for NEB determinations.

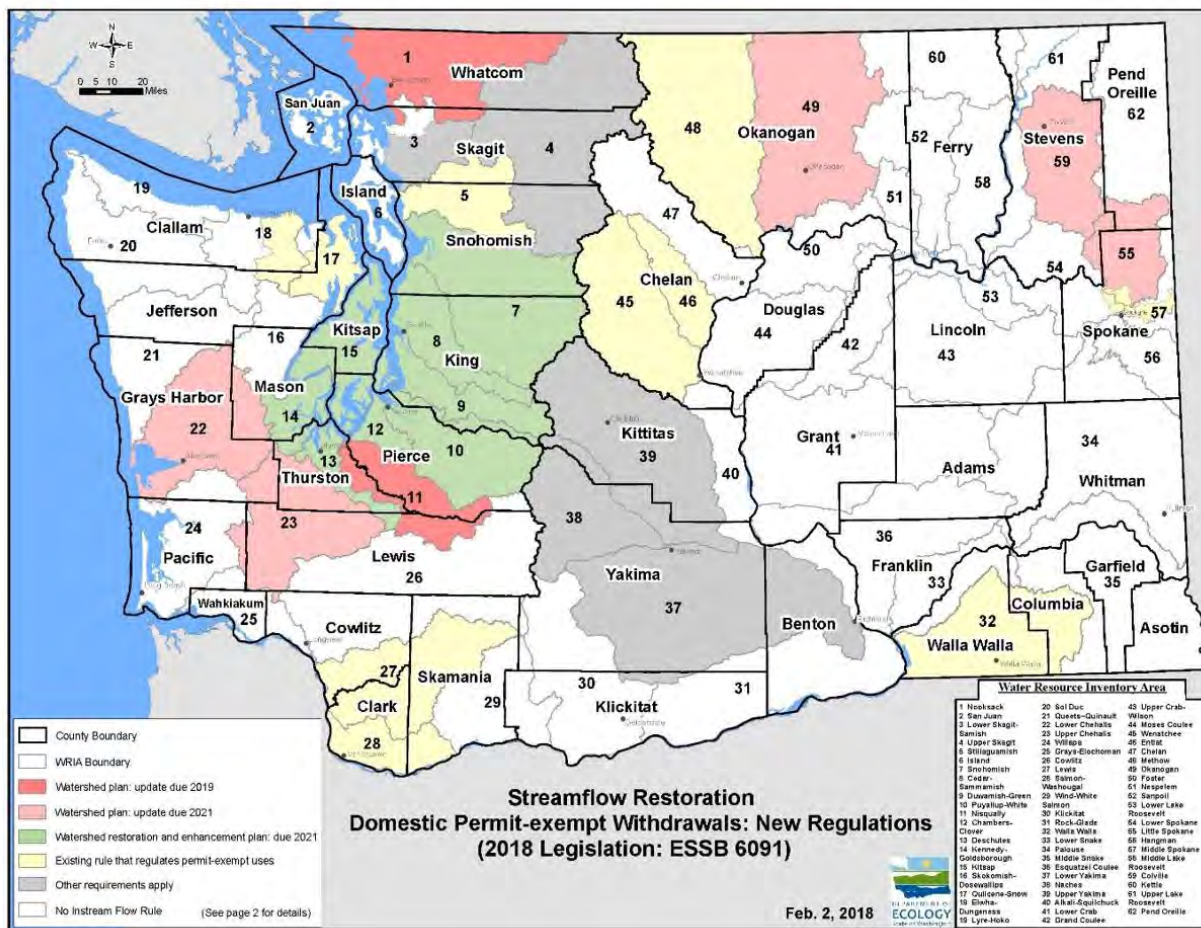


Figure 3 Planning Watersheds under RCW 90.94. The WRIAs submitting plans under section 202 are in red and pink based on timing. WRIAs submitting plans under section 203 are in green.

In several places, the interim guidance refers to critical flows as an acknowledgement that the magnitude of stream flows can change significantly during different seasons. In general, stream flows are highest in the winter when precipitation is highest and are lowest in the late summer when precipitation is low or zero and flows are supplied by snow melt, groundwater, or reservoir release. These seasonal patterns are often expressed in the characteristic hydrograph for the stream under study. Periods of low flow are likely to be critical periods for fish. However, it is an oversimplification to suggest that critical flows are times of low stream flow. Anadromous fish life histories are diverse, and involve complex patterns where different species use different habitat at different life stages for different ecological objectives. This makes it difficult to identify a single time and circumstance that is uniquely “critical”.

While the literature on differential habitat use by different species is voluminous and summarized in detail elsewhere (Groot and Margolis 1991), highlighting some specific patterns of fish-habitat relationships can help give context to how withdrawal decisions and fish production may be linked.

Salmon and trout spawn in gravel, burying their eggs below the surface of the gravel, where the eggs stay for a number of weeks or months (depending on temperature) as they develop. Flow generally changes during this incubation period while they develop. If adults spawn in a deeper, mid-channel area because they spawned while flow was unusually low and a flood occurs during incubation, many eggs could be lost to flood scour, resulting in lower production (Tripp and Poulin 1985; Thorne and Ames 1987; DeVries 1997, 2000; Lapointe et al. 2000; Ames and Beecher 2001). Conversely, flow reduction during incubation could result in no water going through the egg pocket in the gravel, a risk that is greatest if incubation occurs during declining flows or if spawning occurred when flows were particularly high (Hawke 1978; Becker et al. 1982, 1983; Reiser and White 1983; Reiser 1990; Connor and Pflug 2004). Given that the volume of groundwater withdrawal by new permit-exempt domestic wells are anticipated to be relatively small, impacts to fish spawning in small streams (e.g. cutthroat trout, coho salmon, some chum salmon) are the most likely to be negatively impacted.

Riffles, the shallowest areas along the length of streams, can be sufficiently shallow to hinder or even halt migration when stream flow is at its lowest (Locke et al. 2008; Grantham 2013). When flow reduction at riffles coincides with upstream spawning migration of salmon and trout, adults can be blocked from reaching spawning areas (Thompson 1972; Smith 1973; Locke et al. 2008; Warren et al. 2015; Holmes et al. 2016), and mortality can be increased through exposure to predation, energy depletion, and injury and infection. Pink salmon, summer chum salmon, fall Chinook salmon, and bull trout may all migrate upstream during late summer and early fall when flows can be lowest.

Lowering stream flow can also impact young fish prior to out migration. Stream flow reduction can impact rearing fish by (1) reducing suitable habitat area and volume, (2) reducing overall system productivity and food transport, and (3) reducing water quality. Coho salmon and cutthroat trout that rear in small streams through summer low flows can be adversely impacted by flow reductions (Brown and Hartman 1988; Beecher et al. 2010; Vadas Jr et al. 2016). Steelhead and Chinook salmon rear in somewhat larger streams, but they are also sensitive to flow reduction. As habitat area and volume are reduced, fish crowding may result in density-dependent reduction in growth and condition, leading to lower survival (Harvey and Nakamoto 1996; Bailey et al. 2010). When flow reduction coincides with higher temperature, water quality (including dissolved oxygen) can also be adversely affected by flow reduction (Elliott 2000). This is particularly true in riparian wetlands, with large surface areas and shallow depths, but

which provide important rearing habitat for coho salmon (Brown and Hartman 1988; Swales and Levings 1989; Henning et al. 2006; Jeffres et al. 2008; Rosenfeld et al. 2008; Katz et al. 2017).

Here the major associations between species, life history stage, stream order and usage are summarized in the following table (sources listed above, summarized in Groot and Margolis, 1991):

Species & lifestage	Small streams	Medium streams	Large streams	Very large streams	Largest streams
Pink salmon adult migration		Early fall	Early fall	Early fall	
Pink salmon spawning & onset of incubation		Early fall	Early fall	Early fall	
Pink salmon incubation		Fall & winter	Fall & winter	Fall & winter	
Pink salmon fry emergence & seaward migration		Early spring	Early spring	Early spring	
Chum salmon adult migration	Late fall (fall chum salmon)	Early (summer chum salmon – Hood Canal, eastern Straits) & late fall (fall chum salmon)	Early (summer chum) & late fall (fall chum)	Late fall (fall chum)	Late fall (fall chum)
Chum salmon spawning & onset of incubation	Late fall (fall chum)	Early (summer chum) & late fall (fall chum)	Early (summer chum) & late fall (fall chum)	Late fall (fall chum)	Late fall (fall chum)
Chum salmon incubation	Winter	Fall (summer chum) & winter (both)	Fall (summer chum) & winter (both)	Winter (fall chum)	Winter (fall chum)
Chum salmon fry emergence & seaward migration	Spring	Spring	Spring	Spring	Spring
Sockeye salmon adult migration	Fall	Fall	Fall	Fall	Fall
Sockeye salmon spawning & onset of incubation	Fall	Fall	Fall	Fall	

Sockeye salmon incubation	Winter	Winter	Winter	Winter	
Sockeye salmon fry emergence & lakeward migration	Spring	Spring	Spring	Spring	
Sockeye salmon rearing in lake	Year-round	Year-round	Year-round	Year-round	
Sockeye salmon smolt migration from lake to sea	Spring	Spring	Spring	Spring	Spring
Coho salmon adult migration	Late fall	Late fall	Late fall	Late fall	Fall
Coho salmon spawning & onset of incubation	Late fall	Late fall			
Coho salmon incubation	Winter	Winter			
Coho salmon fry emergence	Spring	Spring			
Coho salmon rearing	Year-round	Year-round	Year-round	Year-round	Year-round
Chinook salmon adult migration		Spring, summer, early fall	Spring, summer, early fall	Spring, summer, early fall	Spring, summer, early fall
Chinook salmon spawning & onset of incubation		Summer, early fall	Summer, early fall	Summer, early fall	Summer, early fall
Chinook salmon rearing		Year-round	Year-round	Year-round	Year-round
Steelhead adult migration		Spring, summer, fall, winter; spring	Spring, summer, fall, winter; spring	Spring, summer, fall, winter; spring	Spring, summer
Steelhead spawning & incubation		Spring	Spring	Spring	
Steelhead rearing		Year-round	Year-round	Year-round	Year-round
Cutthroat trout adult migration	Winter; spring	Winter; spring	Winter; spring	Winter; spring	Winter; spring

Cutthroat trout spawning & incubation	Spring				
Cutthroat trout rearing	Year-round	Year-round	Year-round	Year-round	Year-round
Bull trout adult migration		Summer, fall	Summer, fall	Summer, fall	Summer, fall
Bull trout spawning & onset of incubation		Fall	Fall		
Bull trout incubation		Winter	Winter		
Bull trout rearing	Year-round	Year-round	Year-round	Year-round	Year-round
Bull trout downstream migration for migratory fish		Spring	Spring	Spring	Spring

4) Basis for comparison for out-of-kind offsets for NEB determination

Offset projects that can be demonstrated to provide benefits in the same subbasin and time with available stream flow (i.e. “in-same subbasin/in-time”) make NEB determination conceptually simple.

When out-of-kind/time/place offsets are proposed, a comparison of impact and offset will necessarily entail implicit or explicit use of relative values, or weights, to complete the NEB determination. Here we illustrate concepts for evaluating these more complex comparisons of impact on instream resources drawn from the field of resource economics. Examples of questions that might arise when perfect water-for-water replacement is not possible include:

1. Does a (set of) project(s) that provides 0.5 cfs in May in one sub-basin compensate for 0.5 cfs loss in May in an adjoining sub-basin; or in August in another sub-basin?⁵
2. Does a set of projects that augments one species’ habitat (such as an ESA-listed steelhead trout) in one basin offset losses of habitat for another species’ habitat (such as a non-listed coho salmon)? How is this tradeoff considered as a part of calculating NEB?

The answer to question 1 likely depends, in part, on the relative importance in each particular watershed of stream flow across time and space, and how instream resources are affected by changes in stream flow. In this case it is likely that the functional effect of stream flow changes on instream resources (including fish) will be treated as similar in character. Question 2

⁵ The magnitudes here are only for comparison purposes, and may not necessarily reflect values seen in each planning domain.

however, necessarily requires assessing the *relative value* of changes in the target populations. The basic elements of such a comparison are described next.

Imagine the following simple scenario from question 2 (Fig 4). Projected increases in permit-exempt wells around the Yellow River are expected to lead to lower summer flows, measurable at point A, reducing spawning habitat for Coho salmon, a non-listed and harvested population

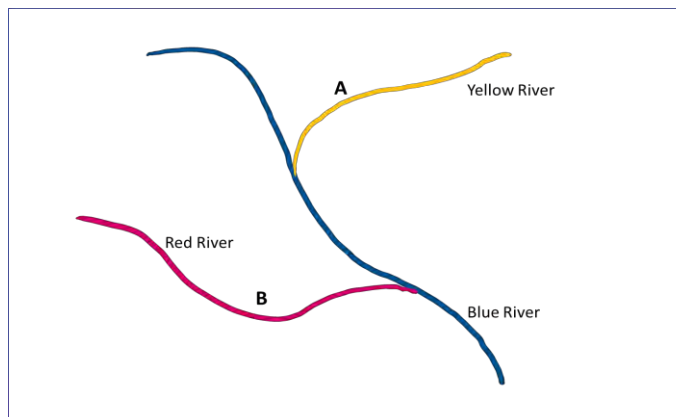


Figure 4: Hypothetical river basin

(suppose this is the only environmental impact). Suppose also that there is no feasible way to replace “water for water” during the critical summer flows in the Yellow River basin. The proposal instead is to provide mitigation along the Red River that increases habitat capacity for the population of ESA-listed steelhead trout in that tributary (again suppose no additional ecological benefits). Do the projected gains in steelhead at point B “outweigh” the lost coho at point A, and provide a “net ecological benefit”?

A little mathematical structure will be used to clarify concepts. Define a generic ecological endpoint condition modeled at location x as $Q_x(S_x, T_x, P_x)$. The endpoint condition Q could be the abundance of steelhead or coho, and is a function of the species affected (S_x , where S_A =coho and S_B =steelhead), the timing of habitat changes (T_x , where T_A could be critical summer flows and T_B could be year-round), and the place (P_x , where P_A is point A in Yellow River and P_B is point B in Red River). One could also think of the time dimension on a longer time-scale: the decline in coho will happen in the next 3 years, but the steelhead populations may not reach full capacity for 30 years.

An NEB determination will assess *changes* in these endpoint conditions, or ΔQ_x . In our example, what is the (positive) gain in steelhead (ΔQ_B), and what is the loss in coho (ΔQ_A , a negative amount) from a watershed perspective, given both losses in streamflow from groundwater use and the offsetting effect of mitigation projects? Because ΔQ_B and ΔQ_A vary in the three dimensions (timing, place, and species) even in this simplistic example, the answer to these questions is complicated and generally uncertain, and is the focus of the majority of this technical document.

Comparing net impacts to steelhead with net impacts to Coho is like comparing apples and oranges. Is the gain in one species due to plan implementation sufficient to offset the loss due to exempt-well-induced streamflow reductions in another species? To answer this question, we need more information. In addition to changes in resources, (ΔQ_B and ΔQ_A), we also need to place a relative value, or weight, on each species to decide whether the gains are “sufficient” to compensate for the losses.

To make this determination we add one more level of mathematical structure. Define $V(\Delta Q_B)$ as the value that affected households in the region place on the gain in steelhead. What is the minimum acceptable increase in steelhead abundance (“willingness to accept”) due to the proposed plan necessary to mitigate for the failure to mitigate losses to coho yield in the Yellow river $V(\Delta Q_A)$? A simple economic decision rule might be that if $V(\Delta Q_B) > -V(\Delta Q_A)$, the combined growth in exempt wells and mitigation projects should be acceptable if this metric is deemed appropriate for NEB determination. The simplest possible representation of such a comparison is provided in Textbox 1. It is not unreasonable to think of placing a “price” or value on each unit (each fish), and multiply the change in each by that price. These “prices” need not reflect market prices, but instead reflect what people are willing to give up (or accept) for an increase or decrease in Q_A and Q_B (even in the absence of a relevant market). Therefore, this is not inherently or necessarily a process of “monetizing” the fish, rather it is a way of formally representing tradeoffs. Below we provide some more context and guidance for how to estimate and compare environmental impacts in an economic framework.

In general, environmental economists have well-developed tools to answer questions of relative value such as these, though the information required to answer them is often difficult and costly to acquire. The most relevant for this application is a “stated preference” approach to surveying the relevant constituent members of the public. A prominent recent example was a survey to assess the damages (at \$17.2B) caused by the 2010 Deepwater Horizon oil spill⁶. The Deepwater study team spent over 3 years at great expense developing, testing and refining their survey.

Less costly approaches to valuation include “benefits transfer” approaches in which researchers attempt to find studies already undertaken in a different place with *a similar environmental context and a package of changes* as similar as possible to ΔQ_B and

Text box 1: A course workflow for value comparisons.

- 1) Estimate the physical changes due to streamflow changes and mitigation projects (ΔQ_A and ΔQ_B).
- 2) Estimate the value of individual units of Q_A and Q_B . Call these P_A and P_B .
- 3) The value of changes in Q_A and Q_B could be estimated as

$$V(\Delta Q_A) = P_A \times \Delta Q_A$$

and

$$V(\Delta Q_B) = P_B \times \Delta Q_B$$

⁶ Bishop, B.R.C., K.J. Boyle, R.T. Carson, D. Chapman, W. Michael, B. Kanninen, R.J. Kopp, J.A. Krosnick, J. List, R. Paterson, S. Presser, V.K. Smith, R. Tourangeau, M. Welsh, J.M. Wooldridge, M. Debell, C. Donovan, M. Konopka, and N. Scherer. 2017. “Putting a value on injuries to natural assets: The BP oil spill.” *Science* 356(6335).

ΔQ_A . The benefits transfer would also include an adjustment for factors that we expect would shift overall willingness-to-pay, like differences in income or general environmental attitudes between the study site and our Blue River Basin site. There are a number of environmental consulting firms that can provide input for such benefit transfer studies; Earth Economics in Tacoma specializes in part on this type of analysis. ECONorthwest is another regional consulting firm with expertise in this area. The Natural Capital project at Stanford University is another useful source for relevant primary studies⁷. Table A1 in Appendix 1 provides a complete (to our knowledge) list of studies estimating the value the public places on changes in anadromous fish populations.

However, the valuation task at hand in our example is not as simple as laid out above. The comparison $V(\Delta Q_B) > -V(\Delta Q_A)$ was simplified for illustration, but each ΔQ_A depends on *timing* (T), *place* (P) and *species* (S). For example, Mansfield et al (2012) asked survey respondents whether they would be willing to make hypothetical, annual payments over 20 years through federal taxes to increase wild salmon populations in the Klamath River Basin from 30 – 150% based on change in extinction risks (low, moderate, high, very high). In this example, timing (20 years), place (Klamath) and species (wild salmon) are all held constant; the only varying attribute is the change in quantity/abundance. In our example, this would be like answering the question of changing coho returns only at point A, at the same point in time. This complexity manifests in several ways; in each case the trade-offs can be identified, but we are unaware of any existing studies examining willingness to pay or consistency in perception and weighting for such complex tradeoff, or explicit trade-offs of different species. One response to this complexity would be to incorporate a stated preference study into the proposals submitted under RCW 90.94, and tailor the scenarios given to respondents to precisely target the package of changes in our decision problem. Done correctly, this would provide a defensible information set to guide an economic decision rule.

To supplement this conceptual summary, we have included an annotated bibliography in Appendix 1 of selected relevant journal articles that may be of use as context for NEB determination.

3. APPROACHES TO NEB DETERMINATION

There are a variety of approaches to NEB determination, with different strengths and weaknesses, demands for data, assumptions and key uncertainties (Table 1). In addition, different constraints on how impacts of consumptive water withdrawals and offset benefits are forecasted will also vary based on the approach taken. For instance, in some cases it may be possible for impacts to be assessed empirically, but forecasting benefits from offset actions over the 20 year planning horizon will most likely rely on calculated projections. Therefore, planners should choose their approach to NEB determination based on data availability and planning goals. The following is a suite of approaches to NEB determination that planners may pursue. Each approach includes a discussion describing the data needs and methods, the assumptions

⁷ <https://naturalcapitalproject.stanford.edu/>

required/used, and the sources of uncertainty. These approaches to determining NEB resulting from planned offset to consumptive water use from permit exempt wells were derived from Bradford et al. (2014), and include:

- In-kind/In-place Habitat Replacement
- Habitat Function Replacement
- Habitat Capacity for Single Species Replacement
- Fish Abundance Replacement
- Fish Production Replacement

The most appropriate approach for any planning unit will depend on the different needs, opportunities, and constraints in each situation. Deciding the right approach requires evaluating what technical or ecological data and expertise are available, but also practical in terms of the size of ecological impacts, and the benefits and the values attributed to those impacts and benefits in each case. Given the uniqueness of each planning unit, it is impossible to set out a single technical NEB determination “recipe” that will work in all cases, nor is it the role of a technical team to decide for planners what approach they must, or even should take given the constraints confronting each planning group.

At the same time, the technical team is conscious of the need for some guidance in this regard, at least to the extent of considerations of how such a decision may be made. In responding to this, this technical report has developed the following decision tree to help planners identify the most appropriate approach to NEB determinations. This decision tree is based on commonly encountered constraints, such as the types and richness of available data, presence of monitoring programs, and the complexity of analysis demanded in each approach. In the decision tree below (fig. 5), the end points are in rectangles; one starts with the need to perform an NEB determination, and arrives at one of the approaches outlined here.

Using the decision tree, planners would evaluate decisions within each diamond. For example, in the first diamond at the top, if the answer is “YES” that water-for-water replacement is possible, then there is no need to perform more complicated modeling exercises to estimate the impacts on instream resources in the execution of the NEB determination. Planners would implement the In-the-same –subbasin/In-kind habitat replacement approach to NEB determination. However, if In-the-same –subbasin/In-kind habitat replacement is not possible (i.e., the answer is “NO”), and one lacks specific information about the fish species of interest in the relevant ecological context (e.g. species and life stage of fish, see above), then one is limited to making the NEB determinations in terms of the habitat as the instream resources being offset for consumptive water use, and extending this to fish contingent on the availability of reliable habitat-fish associations (habitat function or habitat capacity for single species replacement). This can be in the form of modelled or experimentally derived relationships (e.g., Habitat Function Replacement or Habitat Capacity for Single Species Replacement). On the other hand, if fish population data are available, then one can perform the NEB determination on the basis of either fish abundance or productivity replacement depending on the degree to which correlated habitat data are available to inform these approaches. As pointed out in more

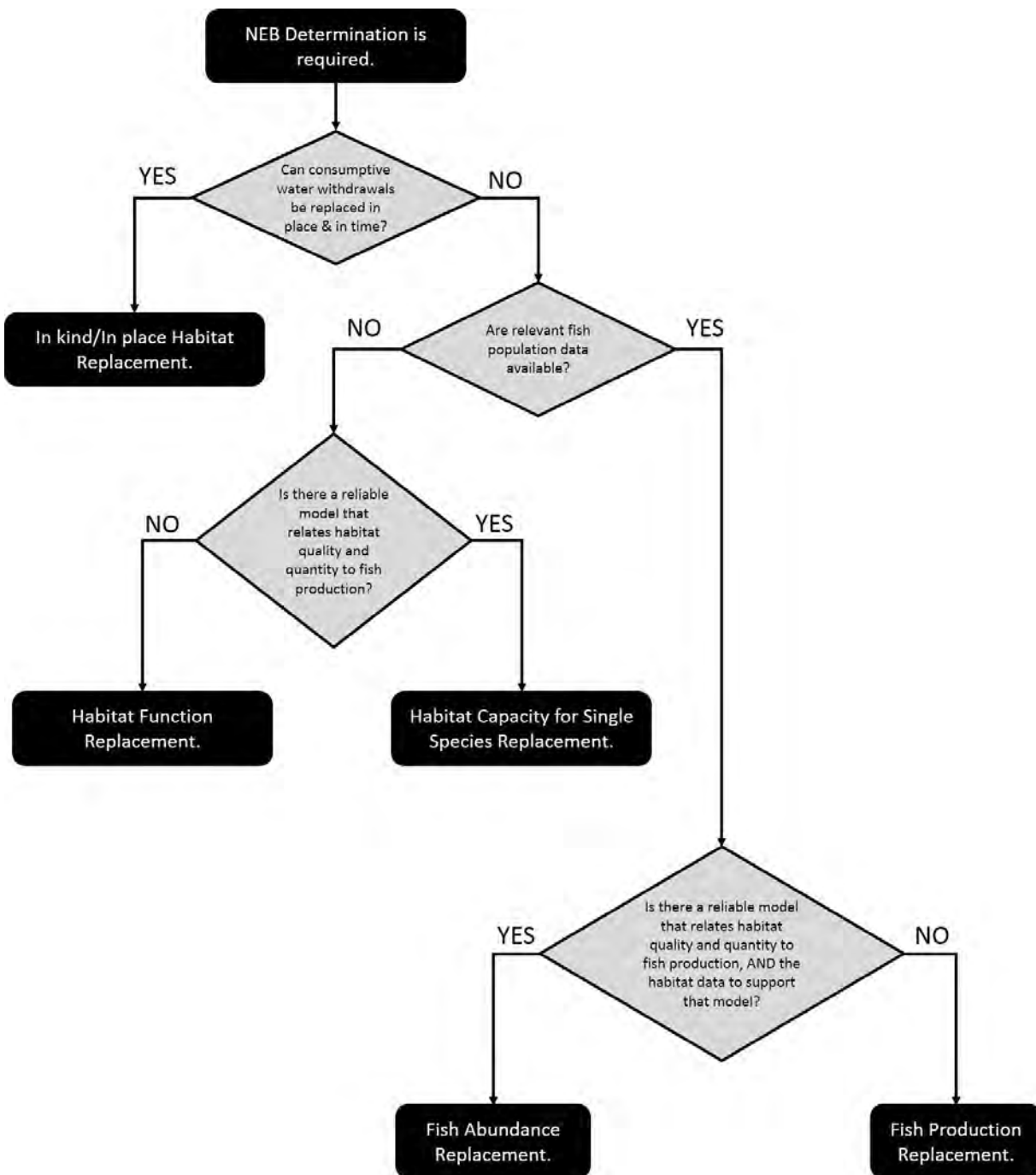


Figure 5 Decision Tree for approaches to NEB determination. Starting and ending points are black rectangles with white text, and decisions are made in diamonds on the basis of answers to the contained questions. Users should keep in mind these are sufficient, but not necessary criteria for making the decision of NEB determination approach. Other considerations may include available funding, time and expertise (see text).

detail for each approach below, if one has long-term time series data (i.e. multiple generations of fish) on fish and habitat at a population scale, then one might be inclined to adopt the fish production replacement approach, such as modeling spawner-recruit relationships, or run reconstructions with habitat metrics as cofactors influencing the production process. However,

if fish and habitat data were more limited in time, but at high spatial resolution, then one might be inclined to adopt a fish abundance replacement approach, such as the Ecosystem Diagnosis and Treatment model (EDT).

To use this decision tree effectively, the user should follow the tree to choose an appropriate approach to NEB determination, and then find the description below for that approach. For each tier, there is a secondary work flow chart that indicates the conceptual steps to performing each respective approach. Conceptual steps include where data of different types enter the assessment process, what estimation is performed in each assessment, and where various kinds of outputs exit the assessment process.

This decision tree is offered in an effort to be helpful and promote transparency in decision making, but all users must be conscious that the answers to the questions are **sufficient**, but **not necessary** conditions for selecting an NEB determination approach. For example, if one doesn't have any data on fish at the scale of the affected unit of fish (population, Evolutionary Significant Unit = ESU, etc.), then one is not likely to generate a credible fish production replacement-based NEB determination. However, even if one has high quality fish population monitoring data, there may be reasons why a planning group would opt for a habitat function replacement assessment. For example, if the costs of the requisite modeling is perceived as excessive, the analytical expertise is not readily accessible, or the available data inventory of habitat units and their net ecological services is seen as superior in quality to available fish data (see HEA description below), then planners might opt for habitat function replacement in spite of this decision tree.

A. IN-KIND/IN-SAME-SUBBASIN HABITAT REPLACEMENT (AREA/TYPE)

Under RCW 90.94, a disruption or detraction of fish habitat, resulting from reductions in stream flow consequent to consumptive use withdrawals must be balanced by some form of mitigation or redesign to achieve the goal of a positive Net Ecological Benefit. The highest priority (i.e. "most preferred") mechanism, within a range of offset mechanisms, are projects that replace consumptive domestic water use impacts during the same time and in the same subbasin as where the impacts occur. This option is supported by the assumption that keeping impacts and benefits comparable in type, extent and location is most likely to maintain the existing productivity and integrity of the ecosystem; this assumption is broadly relied upon, but is an assumption none the less (Moilanen et al. 2009; McKenney and Kiesecker 2010).

In-kind/In-place offsets are the simplest offset mechanism since the equivalence of habitat for habitat is the most straight-forward. However, establishing that the offsets are indeed In-kind/In-place offsets may become difficult as the area becomes larger and increased habitat diversity makes it difficult to validate that offsets are truly "In-kind". Therefore In-kind/In-place offsets are best suited for smaller habitat units and do not include habitat conversion (e.g., river to reservoir or confined (bank-hardened) to unconfined channels). The biggest advantage of In-kind/In-place offsets is the ease of establishing equivalency as the determination is based on water for water in the same units. This is the most direct comparison and the easiest NEB determination. However, the largest risk in assessing this form of offset is the assumption that the replacement

habitat and the associated fisheries productivity will be equivalent to that lost. For example, if the area considered has multiple and diverse habitat types, the benefits to each fish species/life-stage may be different for a given change in stream flow.

a. Data and Methods

The primary metric for in-kind habitat replacement is stream flow (e.g., cfs). Since the units are the same for in-kind/in-place offsets, it is not necessary to determine NEB by assessing fish productivity. Calculation of environmental impact is made by measuring consumptive water use, and establishing offsets. In some cases, particularly in low flow locations where a very small change in stream flow at a critical time can be the difference between passage and no passage for out-migrating juvenile fish, continued stream flow monitoring may be warranted.

b. Assumptions and Implications

In-kind/In-place offsets assumes that habitat and environmental variables (e.g., macrophytes, depth, substrate, nutrients, temperature etc.) will respond to quantities of stream flow equivalently among different locations within a planning unit, and further that responses in habitat variables can be considered surrogates of fish productivity. It also assumes that new habitat generated by the offset will have the same ecological characteristics and associated production values (e.g. primary and secondary production). This assumption may not be supported (Bull et al. 2013), and therefore should be validated with appropriate monitoring.

Because replacing habitat in-kind/in-place is not expected to alter the total habitat available to fish (given that the new location will be in proximity to the lost habitat) it is not anticipated to change fish population dynamics. However, the result of where stream flows are offset may have an impact on that new location's potential productivity. Specifically, in making an NEB determination it is the marginal increase in productivity at the offset location that must meet or exceed the production lost at the impact locations. The offset locations may have had some prior intrinsic productivity under baseline conditions that would be expected to continue in the absence of the offset, and this should not contribute to the estimate of NEB in the planning scenario.

c. Sources of Uncertainties

Replacing stream flow in-kind and in-place relies on relatively common and well understood measurement methods and consequently have relatively little uncertainty in the measurements themselves. Assuming the nature of in-kind and in-place can be validated, the associated benefits to habitat and productivity are also relatively low uncertainty. However, the validity of these assumptions are more certain for well-studied habitat types (e.g. spawning gravels Fitzsimons 2014). Uncertainty increases for less-well studied habitat types, or especially highly unstable or typically mobile or dynamic habitat types (e.g., gravel bars or pools created and maintained by log-jams that migrate under typical conditions, Abbe et al. 2003; Pess et al. 2012).

B. REPLACING HABITAT FUNCTION

When in-kind/in-time/in-place offsets are not possible, plans will need to determine NEB based upon more complex assessments of equivalence between locations of impact and offset. The

first among these offset mechanisms are cases where offsets are based upon replacing the ecological function of certain habitat features with some different combination of features at different locations that would on balance provide the same ecological function. These are called service-to-service equivalency analysis (e.g. NOAA 2000; Lipton et al. 2008). Ideally, these functions relate to fish production, and would include some multivariate description of the habitat, such as habitat structure, cover, or substrate type. Alternatively a description of the habitat might be integrated by measures such as secondary production. Because the NEB determination is made based on the ecological function, the specific habitat provided as offset could be different from the habitat that is impacted, as long as the NEB nets out positive.

Habitats are multifaceted and complex, and a clear mapping of habitat features to fish production can be complex, if it is possible at all (McMillan et al. 2013). Therefore, it is often important to rely on metrics that express some level of integration of habitat features, rather than the features themselves. One example of such integration that expresses ecosystem function is secondary production (i.e., the rate of incorporation of organic matter into body tissue of invertebrate mass per unit time and area (e.g., Cusson and Bourget 2005). Production, manifesting a rate of energy exchange across trophic levels, is a better indicator of ecological function than standing stock of macroinvertebrate biomass (Benke et al. 1984; Benke 1993). Secondary production can integrate across life stages and generations of invertebrate fauna, and will do so over temporally variable environmental conditions. Thus, secondary production has been suggested as a valid proxy for ecological function. Relationships between secondary production and commercial, recreational, Aboriginal (CRA) fisheries can be determined using productivity-state response curves (Koops et al. 2013).

NEB determination via ecological function replacement can also be complicated by the ecological context. For example, where ecological function that impacts one life stage of fish is replaced with ecological function that impacts a different life stage of fish, those different life stages may not be equally limiting to total population growth. In the case of steelhead, Hall et al. (2016) showed a considerable diversity of life history trajectories that might better accommodate out-of-kind mitigation than a species with a more rigid life history. Given the RCW 90.94's focus on fish, some accounting of fish life history should be part of the assessment of ecological function replacement.

Making an NEB determination based on ecological function is suitable for not only situations with designed offsets to balance the functions lost to impacts, but also situations where alternative functions are preferred in the context of other available habitat in the planning unit. When the intent of offsets is to replace the same ecological function, determining the offset may be as straightforward as the in-kind/in-place. However, if the impacted habitat provides a non-critical ecological function, it may be preferable to design offsets that provide a rate-limiting or rare ecological function.

A specific example of habitat function replacement is Habitat Equivalency Analysis (HEA). HEA is a method developed to determine the compensation for damages to natural resources such as oil discharges, hazardous waste release or physical damage to resources from ship groundings (NOAA 2000). Consequent to statutory requirements, when damage to natural

resources occurs, responsible parties are asked to pay damages to cover “compensatory restoration”, where the offsets provided by habitat function at least balance those lost due to the original damage. Thus, the context for its development was principally as a regulatory tool rather than a scientific research tool. Similar to RCW 90.94, restoration plans must determine and quantify injury, develop restoration alternatives that consist of actions that at least match the injury. HEA is a not-In-kind/place approach to evaluate the services provided by the lost habitat, offset habitat and the balance between them. The steps in an HEA determination are:

1. Document and estimate the duration and extent of injury, from the time of injury until the resource recovers to baseline, or possibly to a maximum level below baseline;
2. Document and estimate the services provided by the compensatory project, over the full life of the habitat;
3. Calculate the size of the replacement project for which the total increase in services provided by the replacement project equals the total interim loss of services due to the injury; and
4. Calculate the costs of the replacement project, or specify the performance standards where implementing the compensatory habitat project.

In steps 1 and 2 numerical values for the ecological goods and services provided by each impacted and offset habitat unit must be generated. When aggregated across all the relevant habitat units, injury and offset can be evaluated for net ecological benefit (See fig. 6).

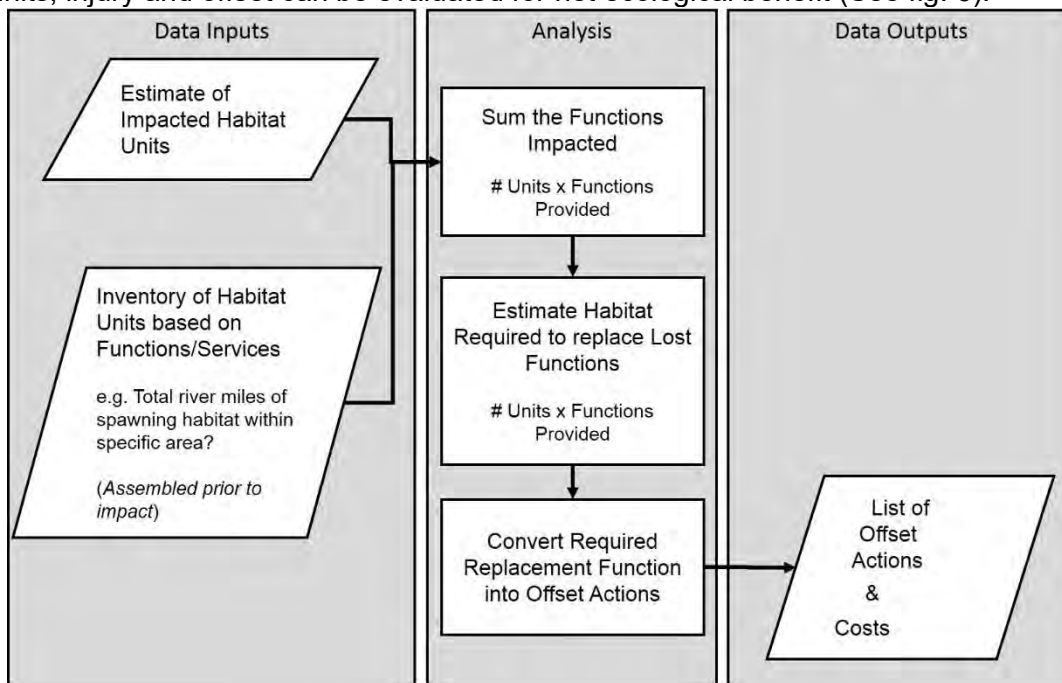


Figure 6 Workflow for Habitat Equivalency Analysis. User data enters the analysis in the form of 1) an inventory of the habitat with the ecological functions or services provided by each habitat unit (e.g. “river miles of Chinook spawning habitat for unit X.”) and 2) an estimate of which habitat units will be impacted by changes in stream flow. The impacts are then added up as number of units times the functions supplied. This number then has to be balanced by the ecological functions or services generated by the habitat offset projects. The inventory of habitat services is prepared ahead of time and can be informed by monitoring data, but is often based on best professional judgement.

HEA has been used in a variety of ecological damage determinations and many lessons have been learned with respect to its strengths and weaknesses (e.g. Dunford et al. 2004; Desvousges et al. 2018). In particular, HEA has a number of critical assumptions that may be difficult to justify: e.g. a design that imposes a preference for offsets to provide the same services that were injured, as well as a constant ratio of habitat services to habitat value, and a constant real value of services and injuries over time (Desvousges et al. 2018). HEA has also been criticized for reducing complex ecological services to a single metric, and for failing to properly account for ecological injuries that continue having incremental or marginal effects over time (Desvousges et al. 2018). In practice, natural resource agencies assemble inventories of their management habitat units and attribute a numerical score for the net services supported by those units. In the absence of targeted monitoring, these scores are assigned based on professional judgement, which can be problematic. Professional judgement by itself is prone to high variability, low and untestable accuracy and hidden bias (e.g. Burgman et al. 2011). Therefore, where habitat function replacement is deployed for NEB determination, significant resources should be applied if possible to pre-impact monitoring to develop testable metrics of the baseline habitat services being replaced (Kennedy and Cheong 2013).

a. Data and Methods

Examples of common indicators associated with habitat function include measures of substrate type and characteristics, densities of riparian or aquatic macrophytes or quantity of large wood. Regionally there are numerous standardized protocols for monitoring and reporting these metrics including:

- CHaMP (<http://www.monitoringresources.org/Document/Protocol/Details/2235>)
- Washington Dept. of Ecology: (<https://ecology.wa.gov/Research-Data/Monitoring-assessment/River-stream-monitoring/Habitat-monitoring/Habitat-monitoring-methods>)
- AREMP (https://www.fs.fed.us/pnw/pubs/pnw_gtr625.pdf)
- EPA-EMAP (<http://www.epa.gov/emap/html/pubs/docs/groupdocs/surfwatr/field/ewwsm01.html>)
- USGS NWQA (<http://water.usgs.gov/nawqa/protocols/OFR02-150/OFR02-150.pdf>)

Indicators for characterizing secondary production in stream macroinvertebrates include the density and biomass of the entire community of secondary producers (Plotnikoff 1994). The taxonomic level required for this approach can be quite coarse. Methods for sampling secondary consumers are available for many of the same sources of information on metrics for habitat features above.

If the approach is to characterize secondary production it is critically important that methods distinguish between production and biomass. As mentioned, most archived data are reported as biomass, but there are reasons why there would not be a one-to-one mapping of biomass onto productivity (Jenkins 2015). Therefore, NEB determinations should clearly indicate if they are adopting biomass as a proxy for productivity, and if not what model they rely on to convert. Examples include models that relate production to biomass via metabolic energetics, regressions of observed data or reliance on literature benchmarks (Schwinghamer et al. 1986; Tumbiolo and Downing 1994; Wong et al. 2011).

b. Assumptions and Implications

Making a NEB determination on the basis of service-to-service equivalency makes a number of important assumptions. First, it assumes that substitution of equivalent ecological function will result in equivalent fish production. Even if this assumption may work conceptually, salmonid fishes in particular are highly locally adapted (Taylor 1991; Waples 1991, 2006) and the same services provided in a different ecological context may influence fish production differently. In addition, if the substituted ecological functions are different than those impacted, a significant amount of pre-treatment baseline data, benchmarks and models will be required to justify a favorable NEB. In the case of habitat-feature for habitat-feature substitution (equivalent amount and type of structure/cover/substrate) the assumptions and implications are similar for in-kind/in-place above. However, for non-in-kind/in-place mechanisms, there are additional considerations including:

- a) **Source Data Quality**—raw field data are presumed to be accurate, but it is also very site specific, and collecting it over a large domain results in high data density. Therefore, field habitat data are often compiled or aggregated into indexes. Compiled data may do a better job describing a large assessment domain, but may mask the detailed relationships among multivariate data that actually determine fish production. The choice of data type (raw, aggregated, derived, etc.) may be subject to constraints that limit flexibility one way or the other, but planners need to be aware of the character and limitations of source data in this context.
- b) **Data Interpretation**—aggregation can occur in space and time, but also in terms of what ecological feature is being represented. For example, were one to perform a NEB determination on the basis of secondary production, the taxonomic resolution of the consumers can change the interpretation of net biomass. Biomass changes can reflect net energy flow through foodwebs, but animals have food preferences and the details may or may not matter in different ecological contexts.
- c) **Model structure**—relating biomass to productivity will be affected by the structure of the model used and roles that the empirical data, standardized benchmarks and professional knowledge play in the process. Model design choice should reflect a model most similar to the ecological context in the planning unit.

These implications are important, and if NEB determination is to be performed via habitat function substitution, plans should provide details for each of these implications and how they will be addressed to be consistent with the expectation of transparency in the interim guidance.

c. Sources of Uncertainties

There are several sources of critical uncertainty here. As mentioned above, if the offset is designed as ecological function for ecological function, then the uncertainty is dependent on how the service is expressed with a metric or metrics, where the different metrics have different data-related uncertainties. This metric uncertainty is likely to be greater for habitat variables than for stream flow, and will increase rapidly as metrics are built from multivariate habitat features. In addition, the assumption that one will see a given benefit for a given level of service provided generates a model-based uncertainty. When offsets are achieved with services different than those impacted, there are additional uncertainties related to correctly forecasting

the effectiveness of projects for those different services. Some locations will be relatively information-rich with respect to the well-researched relationship between habitat features and fish productivity (e.g. Intensively Monitored Watersheds, IMW's). However, many planning units will be information-poor in this regard and NEB determinations will increasingly rely on the scientific literature, expert knowledge, productivity-state curves, and pathways of indicators models. Each of these alternatives can significantly increase uncertainty in the final NEB determination.

C. REPLACING HABITAT CAPACITY FOR SPECIFIC SPECIES

The second NEB approach among the non In-kind/In-place offset mechanisms are cases where offsets are based on applying models of habitat-fish relationships to the amount of available, suitable habitat for selected species. All things being equal, we have good evidence from empirical studies in specific locations that some combinations of habitat features including water depth, water velocity, substrate type and vegetation cover are suitable, and in some cases preferred by specific life-stages and species of fish (Orth and Maughan 1982; Beecher et al. 1993; Thomas and Bovee 1993). If we were to add up all the habitat of the preferred type (including stream flow), we could quantify potential capacity of a given habitat unit within an assessment area. In the present application, quantitative estimates of habitat loss from consumptive use withdrawals could be measured against anticipated amounts of habitat gained from offsets to provide an NEB determination.

Habitat capacity models have been applied to both lake and stream systems. In particular, there is a rich diversity of models that have related stream habitat to fish capacity that include: PHABSIM (Stalnaker et al. 1995), River2D (Katopodis 2003), and MesoHABSIM (Parasiewicz 2001; Parasiewicz and Walker 2007). Many sockeye salmon are lake spawning, and "spawners per hectare" of lake-bottom has also been used as a method to evaluate the environmental benefits of reservoir enhancements (Goodlad et al. 1974; U.S. Department of the Interior Bureau of Reclamation and State of Washington Department of Ecology 2012; ECONorthwest et al. 2012). In either habitat type, the amount of habitat area becomes a comparable currency for impact and offset, but in both cases as well, it is based on the critical assumption that capacity of habitat will be realized by the target species.

PHABSIM and some of its extensions have been used in a diversity of situations to evaluate associations between fish and hydrology (Gallagher and Gard 1999; Parasiewicz and Walker 2007; Beecher et al. 2010; Reiser and Hilgert 2018). PHABSIM (Physical HABitat SIMulation) is part of a family of approaches called the Instream Flow Incremental Methodology (IFIM; Bovee et al. 1998). IFIM is a broad conceptual toolbox that considers a variety of aspects of stream ecology. PHABSIM relates hydraulics to hydrology and to specific components of fish habitat. Other tools in IFIM can integrate PHABSIM results with hydrology over time.

PHABSIM consists of a hydraulic model which is linked with habitat suitability criteria (HSC) to map habitat quality for specified life-stages of target species at different discharges. Several options for hydraulic models are available within PHABSIM. The most common options are step-backwater modeling, depth and velocity regression on transects, and two-dimensional hydraulic modeling based on channel roughness and flow routing. With a hydraulic framework

in hand, the amounts of habitat weighted by habitat quality (as indicated by habitat suitability criteria [HSC]) can be integrated across a stream reach at discharges of interest to produce a metric called weighted usable area (WUA). This is accomplished by applying HSCs for each species life-stage of interest to each location within a specific stream network across a range of discharges. This applied weighting is then summed for each discharge and species life-stage to generate a WUA value (e.g., for juvenile Chinook salmon at 300 cfs). The workflow for PHABSIM is illustrated in Fig. 7. Traditional use of PHABSIM incorporates microhabitat (depth, velocity, substrate and/or cover), using HSC for each species life-stage for each microhabitat variable, but consideration of mesohabitat or macrohabitat can be included with appropriate study design. The output allows comparison of the relative habitat value of different discharges for a particular species life-stage.

Experience with PHABSIM has revealed a number of important lessons and constraints to its use. The weightings applied to the area of habitat rely on a representative stream reach (or a critical reach if one is identified) for assessment of impacts of hydrologic changes to fish or other aquatic organisms. Where multiple reaches are expected to be affected by water withdrawal, it may be necessary to model multiple reaches. In either case, there is a critical need to validate that each representative reach where the fish/habitat relationships are developed is truly representative of the locations where the WUA estimates are going to be made. Validation of the HSC's and WUA can be accomplished with field measurements at one or more known discharges. Resources for such validation should be included in plans that perform NEB determinations via habitat capacity replacement.

This approach to NEB determination is flexible in that the WUA can accommodate changes in habitat amount as well as quality. This flexibility is particularly useful in the case where offsets are not located at the impact area or if the offset's ecological result is different from the impact. Of particular importance in this context, there may not be any available water to offset loss of stream flow from consumptive use in the same time and place, and the ecological mechanism of offset has to be of a different kind, such as habitat improvement (McKenney and Kiesecker 2010). The fact that there is a quantitative basis for determining NEB also makes it attractive, but it must be kept in mind that there are good reasons that model predictions may not always be realized in terms of fish numbers. For example, in order for fish-habitat capacity models to be applied generally, the underlying relationship between observed fish preference must reflect a global, or population-wide preference rather than fish making the best of what habitat variability is available (McMillan et al. 2013). Indeed, uncertainty over HSCs has received considerable critique and is discussed elsewhere. Critiques have also challenged if the variables used to construct HSCs are the variables most relevant in the case of changes in stream discharge (Railsback 2016).

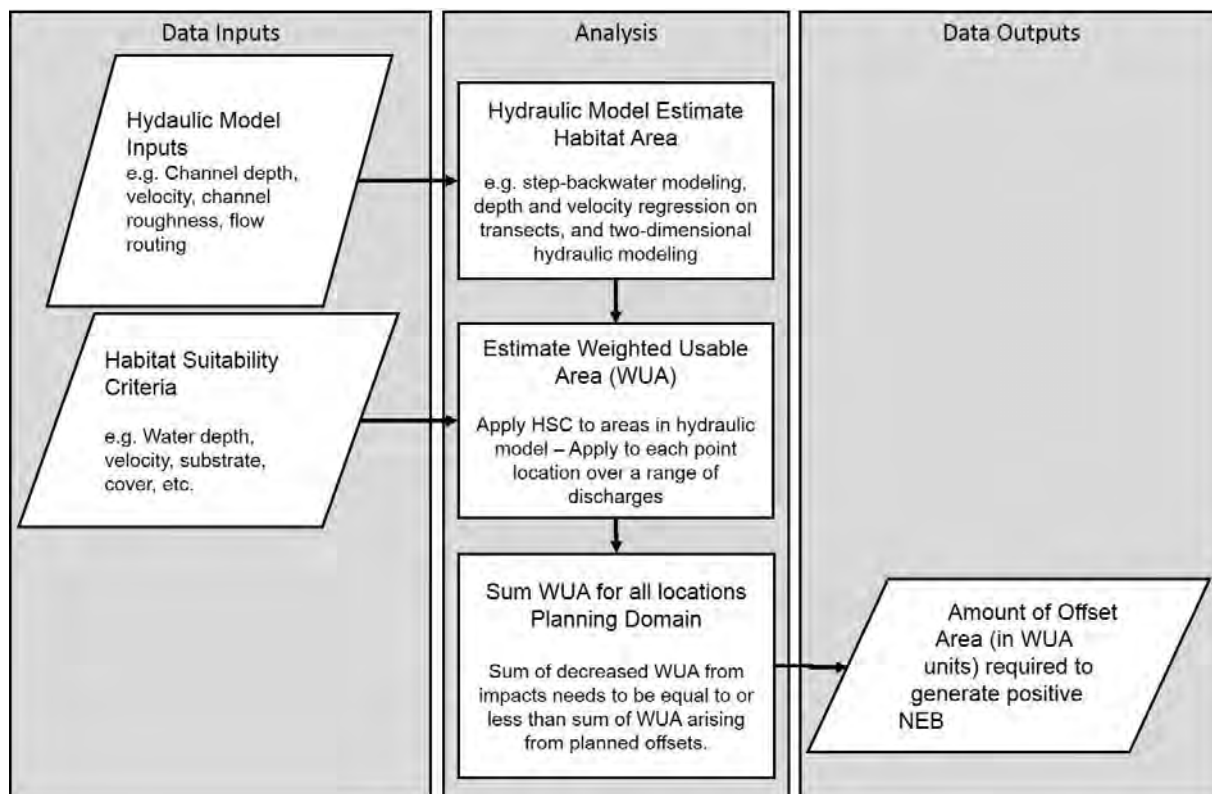


Figure 7 PHABSIM workflow. User data enters the analysis in the form of output from an hydraulic model that provides a framework of a map of stream habitat amount (= area), to which habitat data is applied. User data also enters in the form of Habitat Suitability Criteria (HSC), which are based on a relationship between habitat characteristics and fish preference. HSCs can be derived from other modeling or field monitoring, but should be validated for the planning domain in either case. Modelled areas are weighted by the HSCs and produce an estimate of WUA for each unit across a range of river discharges. This is then summed to get a measure of impact or offset. NEB can be estimated by subtraction.

a. Data and Methods

Habitat capacity has two parts: the suitability or preference of habitat units by fish, and the amount of those units. Measures of suitability or preference are weights that are multiplied by the area of the units producing the WUA metric that is species and life stage specific. Characterizing stream units to characterize their suitability often relies on the lower level, unit-specific data described for the habitat substitution approach above. Examples of these data types include combinations of water depth, water velocity, substrate type and vegetation cover. As described above there are numerous standardized protocols for monitoring and reporting these metrics across the region. Collecting these data is often expensive and labor intensive, but these same regional sources offer data collection protocols that provide the greatest degree of reliability, interoperability and transferability to other locations.

The data needs of the NEB determination based on habitat capacity depends on the choice to estimate both parts of the WUA metric. In many cases, the characterization of habitat suitability (e.g. HSC) is taken from the literature or other studies and the quantification of habitat capacity in a specific case amounts to measuring the amount of that habitat type. Indeed, the Departments of Ecology and Fish and Wildlife have collaborated in compiling composite HSC

for most WA salmonids. While these data may vary substantially, the range of values may put some bounds on the variability one may encounter in actual implementations.

These methods have been forcefully criticized. In particular, the transportability of HSC's from one location to another is an assumption that has been challenged (Railsback 2016). As a result, the NEB determination may include developing the fish-habitat relationships directly for each stream. In one example where HSC were critically evaluated, a mismatch between HSC and coho salmon response was recognized (Beecher et al. 2010). This led to an updated method of estimating HSC that included estimates of food intake HSC and habitat scale bioenergetics, and resulted in an improved match between fish response & model (Rosenfeld et al. 2016). The performance of the HSC was improved at the cost of additional data, modeling and validation effort. In this event, data needs will include fish density data over a large number of habitat units within the NEB determination area, and the development of quantitative associations between habitat metrics and fish density (e.g. regression, canonical correspondence, etc.). Importantly, HSC will be species and life stage specific, and so fish density data required to evaluate HSC will likewise need to be for the appropriate species and life stages.

b. Assumptions and Implications

Habitat capacity approaches have been criticized for having a number of unrealistic assumptions and for being overly data intensive for the level of precision achieved. In the case of developing study-specific HSC, the demand for both habitat and fish data is intensive and is often viewed as expensive. Among the assumptions that are viewed as problematic are those related to the habitat being oversimplified over a given assessment unit, static in time, independent of species or life stage and equivalent across assessment units (Parasiewicz 2007; Railsback 2016).

These approaches have also been critiqued for issues related to scale of analysis. The hydraulic flow models that are commonly combined with environmental habitat data to evaluate changes in capacity are often developed over different and potentially incompatible scales (Wu and Li 2006). In addition, since one is accumulating habitat units to estimate WUA, the WUA metric may apply over many habitat units, that could each vary greatly. This variance among habitat units may be differentially important to different species and their life-stages, but is missed in most habitat capacity approaches, arguing perhaps for smaller scale assessments. Parasiewicz (2007) however, argues that larger assessment units (10^3 - 10^5 m²) are more appropriate for this type of assessment because it is the relevant unit from the management point of view and more fairly represent the concept of "Functional Habitat".

There is also an important assumption that the fish-habitat association represented by HSC reflects a global preference for habitat characteristics, rather than the best of whatever is available. Across a watershed with numerous tributaries and diverse habitat conditions one could sample all the habitat units and correlate the density of fish with the local habitat conditions to develop an HSC rule set. However, in order for fish density in that process to be a true signal of habitat preference, the fish sampled would need to know that the habitat

conditions where they are located is more preferable than the possible range of conditions elsewhere across the watershed where the rules were being developed. In reality this is never the case; salmon emerge from gravel and sample a very small subset of habitat conditions in their local surroundings and likely choose the most preferred from the available options. Indeed, when this assumption was tested, the fish made choices within the limits of their local environment and no global rules emerged (McMillan et al. 2013). Over evolutionary time intervals, it is likely globally preferred habitat will have higher net fish productivities, but over that same time the habitat is evolving (e.g. log jam washouts, sediment transport, etc., DeVries et al. 2001; Pess et al. 2012; Fremier et al. 2018). Thus, the pattern of fish density observed at any moment in time is a snap shot of interactions between hydraulic, habitat and biological processes that may or may not permit use of the assumption that HSC are transportable across time and space.

c. Sources of Uncertainties

Habitat capacity models carry large amounts of uncertainty from several sources. Most of the sources of uncertainty are related to the assumptions discussed above, and in particular fish-habitat associations. Uncertainty can be significant with respect to the portability of the fish-habitat relationships to new locations (Freeman et al. 1997; Williams et al. 1999; Railsback 2016), and inappropriate inferences drawn from fish-habitat data (Rose 2000; Minns and Moore 2003; McMillan et al. 2013). There are also potentially large uncertainties from mismatch of scale in the data used to develop WUA measures as hydraulic modeling on one scale married to finer scale habitat data can misrepresent fish preference (Bovee 1986; Railsback 2016). The uncertainties related to habitat preferences being species and life-stage dependent can also be large, especially when preference differences among life stages of fish interacts with seasonal variability in in-stream habitat conditions (Heggenes et al. 1996).

Responding to these uncertainties lies along two lines. On a technical basis, the implementation of NEB determinations should include validations (e.g. Studley et al. 1996; Gallagher and Gard 1999; Beecher et al. 2010), where relationships between flow and fish production are validated in the location where the offsets are implemented. On a policy basis however, the magnitudes of these uncertainties and species dependence may be large, but not addressable. For example, in a watershed with both listed and unlisted salmonids, failure of the assumptions related to the non-listed fish may impact instream resources in the context of fisheries yield, but failure related to the listed fish is a regulatory issue and the Endangered Species Act may impose constraints that one cannot address with a trade-off of habitat functions. It is also possible that the listed fish is in smaller numbers and uncertainties in estimating fish abundance could include zero fish, where the unlisted fish may occur in larger abundance, making mistakes in estimating abundance less costly. Resolving what “large uncertainty” means and how it is handled may represent a policy choice rather than a technical or scientific choice reflecting case-specific, and potentially competing, values.

D. REPLACING FISH ABUNDANCE

In fish abundance replacement, NEB determinations are based on fish abundance in offset areas equaling or exceeding the abundance of fish lost from impact areas. This is one version

of a general set of resource-to-resource equivalency analyses (REA, Kim et al. 2017; Holmes and Lipton 2018). This approach expresses NEB in terms of abundance of fish of the same type. For salmonid fishes, this would be fish of the same population group within their Evolutionary Significant Unit (DSP & ESU, Waples 1991, 2006).

Fish abundance replacement approaches to NEB determination are similar to habitat capacity replacement to the extent that it requires similar information on habitat in order to justify the forecast offsets, but more complicated in that it also requires more detailed information on fish abundance. In addition, this more detailed information will be required for both the impacted and offset locations. While it may be possible to acquire some of this more detailed information in pre-treatment monitoring at the impact site, the offsets will usually require forecasts. The challenge is that the forecasts usually must rely on analogs, expert opinion or models that can become quite complex; the dividend is that the detailed information inform the design of a relevant effectiveness monitoring program.

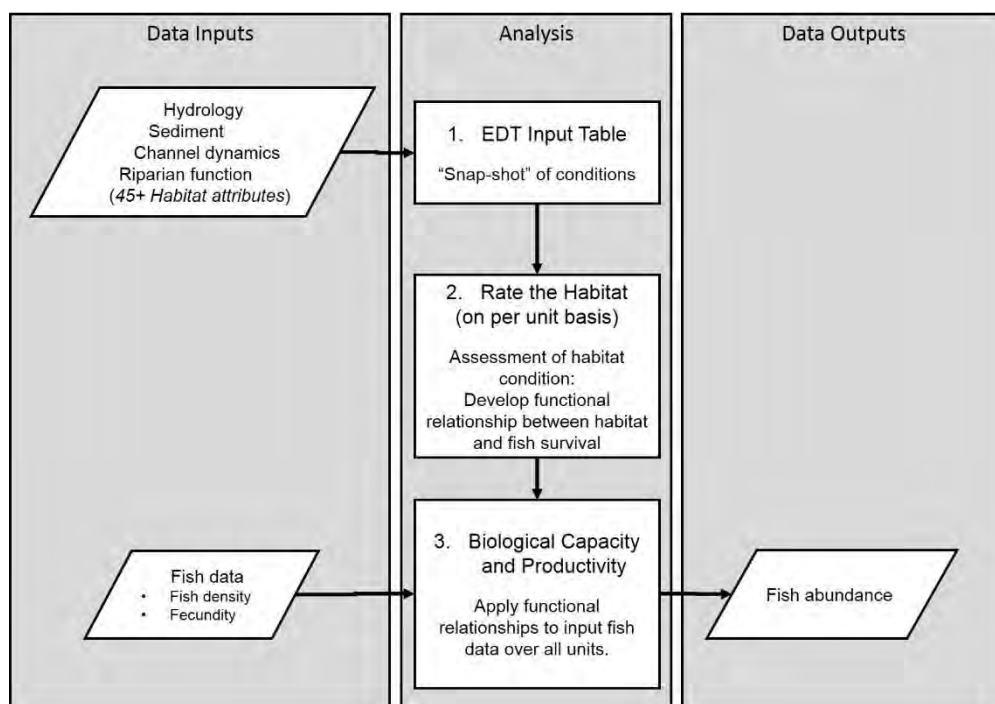


Figure 8 EDT Workflow. User data enters the analysis in the form of habitat data on a per habitat unit basis (e.g. pool) to establish a snap shot of the habitat. In step 2, those data are applied to functional relationships between habitat condition and fish responses. These relationships can be based on empirical monitoring, but are more often based on best professional judgement. In step 3, these functional relationships are applied to additional input data on current or historical fish production and used to generate forecasts of fish abundance. Given the functional relationships and habitat current condition "snap-shot", one can estimate where habitat improvements are likely to generate the greatest fish population response. However, these estimates may not be sufficiently certain to support NEB determination. In addition, much of step 3 is proprietary and requires contracting with the EDT copyright holders.

Quantifying fish abundance becomes increasingly hard as the assessment area gets larger. This is in part due to ecological issues including movement of individuals, but more so due to

the logistical aspects of sampling including the expense of sampling a large number of times and the time it takes to conduct monitoring. Therefore, fish numbers-for-fish numbers substitution is better suited to smaller assessment units.

As fish abundance replacement approaches to NEB determination rely on outcomes (numbers of fish) rather than mechanism of achieving those outcomes, they can be quite flexible. Offsets can be achieved through a diversity of habitat alterations, and in quite different ways than at impact locations. Fish abundance replacement is similar to habitat capacity replacement in this flexibility, however it is distinct in that the response metrics are direct measures of fish, rather than relying simply on habitat.

A specific example of habitat function replacement is Ecosystem Diagnosis and Treatment (EDT) model. In principle, EDT works on the premise that each habitat unit has intrinsic qualities that affect the survivorship of the fish that encounter it. These qualities can vary across units, and their functional responses can vary across the life history stages and species of fish; a specific feature of a given pool (e.g. temperature, depth) might positively affect the parr of one species, but negatively affect smolts of a different species. In principle, one could start with a number of eggs in a salmon redd or redds, and then serially apply the survivorships for all units across all life stages of each species and forecast the abundance of fish at the time of the next spawning. This framework is dependent on having detailed, quantitative associations between habitat qualities and fish survival (see fig. 8). This is a strength in that with this information in hand it allows one to evaluate alternative habitat improvement scenarios and prioritize projects; it is a weakness to the extent that all of these relationships are rarely available a priori and EDT often requires significant subjective human input as a substitute. Conceptually however, the idea of net survivorship as a product of many small survivorship steps is a rational approach.

EDT has been used widely across the Pacific Northwest and we have learned a lot about how it works and about a number of limitations. Many of these limitations have been summarized elsewhere (Paine et al. 2001; McElhany et al. 2010) and so here will not be repeated in detail but discussed only as a list of relevant highlights. From a statistical point of view, this approach is a multi-regression with many (many hundreds to thousands, McElhany et al. 2010) parameters used to estimate survival at each point, with the results for all habitat units in the life history applied to the result from the prior habitat unit. This is widely recognized as over-parameterization, and it results in the generation and propagation of errors and generating untestable predictions (Freedman and Freedman 1983; Freedman et al. 1988; Burnham and Anderson 2003; Leinweber 2007). In addition, this approach makes demands on the habitat quality data far in excess of available monitoring data. For those many EDT parameters for which fish and habitat data are lacking, experts are polled for their opinions on what the actual values are likely to be. Thus, much of EDT products result from an “expert-panel” process rather than a data-based, scientific process. As such, many of the uncertainties that exist within the process that might otherwise influence our characterization uncertainty in the ultimate forecasts are subjective, based on opinion rather than data, and ultimately unknowable. Due to its high spatial resolution, EDT does provide very specific forecasts, although its uncertainties mean its accuracy cannot be evaluated. This is an important distinction, that EDT is an expert-

panel process does not make its predictions wrong, but it does limit the ability for a scientific review to test its predictions, and is therefore not transparent. That said, the limited literature that attempts to characterize the reliability of EDT forecasts has indicated that it has relatively poor performance and is not useful for forecasting population sizes based on habitat assessment (McElhany et al. 2010).

a. Data and Methods

Fish abundance is expressed and monitored in a variety of ways. The choice of measure has technical implications for how the information is collected and interpreted, and for methods and uncertainties. Common ways that abundance is expressed include total abundance, density, biomass and catch per unit effort (CPUE). Some of these measures are more common in fisheries assessments than in conservation assessments and the choice of method may depend on the motivation for the assessment as well as available technical resources and data. Total abundance is the result of a census or probabilistic sample (Courbois et al. 2008). Total abundance is desirable as a metric as it is a direct answer to the question of abundance; however, it is often expensive or otherwise difficult to obtain in practice.

Density of fish is a measure of abundance within a specific area of habitat and at a specific time. The area is commonly the habitat unit being sampled (e.g. pool area or reach length), and expressed unit of measure is number of individuals per area. Samples that are part of large scale sampling designs often consist of individual density measures, and so density measures are among the most common indexes of fish abundance. It must be kept in mind however, that density of fish, particularly juvenile salmonids can vary greatly habitat unit to habitat unit (e.g. McMillan et al. 2013). Therefore, density measures are often highly location and time dependent and extrapolating from density measures at a limited set of locations can impart large biases to an estimate of abundance (e.g. Courbois et al. 2008).

Fish enumeration is a common activity within fisheries and there are standard methods for enumerating fish. Across the region there are numerous references on methods for enumerating or estimating fish abundance (e.g. Bonar et al. 2000, 2009; Crawford 2007). Additional information on abundance measures is available from Ecology at:

<https://ecology.wa.gov/Research-Data/Monitoring-assessment/River-stream-monitoring/Intensively-monitored-watersheds>

In addition to estimating some measure of fish abundance, NEB determinations via abundance substitution will require some method to relate or forecast management actions in the watershed plans to future abundances. Therefore, the habitat impacts or baselines, and offset forecasts will need to be characterized, and a method or model that relates offset scenarios with future fish abundance is required. Given the history of habitat management across the Pacific Northwest and the long-term investments in habitat restoration, there is a broad expectation that specific forecasts of fish responses from habitat manipulation are at hand (Roni et al. 2008). However, in practice such expectations for specific habitat types and actions come with large uncertainties (see below).

b. Assumptions and Implications

Given that fish abundance replacement relies on outcomes (numbers of fish) rather than mechanism of achieving those outcomes, the number of assumptions may be less. Nevertheless, there are specific assumptions associated with fish abundance that are similar to assumptions related to habitat capacity replacement. Fish abundance also relies on the assumption that the future ecosystem is similar to the current ecosystem. For example, as water temperatures rise over the next 20 years and centrarchid fishes replace salmonid fishes (Isaak et al. 2015; Rubenson and Olden 2016), the habitat management one would put in place may not be beneficial for centrarchids as they may have been for salmon.

It is also important to remember that the fish are wild, rather than domestic. The relevance to fish-for-fish, or habitat-for-habitat replacement is that human activity can reduce the numbers of fish deterministically (harvest, habitat loss, etc.), but cannot force the production of new wild fish. The foundational assumption of a restoration-based substitution is that by reducing the contribution to mortality from specific sources, such as lost or degraded habitat quality, we will see a consequent increase in the number of wild fish. This may not be unreasonable, but we have to keep in mind that the mechanisms are passive and even if the habitat alteration is successful, there are reasons why that may not correlate with increasing numbers of fish. If current abundances of fish are below the current carrying capacity of the habitat for example, then it suggests something else is limiting population size and increasing habitat capacity further via restoration is unlikely to increase population size. An ecological illustration is the middle fork of the Salmon River; the Frank Church River of No Return wilderness has near-pristine habitat quality and suggesting the need for actions to increase the quality and quantity of habitat is not reasonable. However, Chinook salmon in that area are below carrying capacity and listed as endangered under the ESA.

c. Sources of Uncertainties

Management planning that alters habitat to achieve natural resource responses will have uncertainties. Recent approaches to using the fish abundance metrics to evaluate habitat management and planning (e.g. EDT) have demonstrated a number of critical uncertainties. McElhany et al. (2010) performed an extensive simulation analysis of EDT to evaluate the significance of these issues. That analysis indicated that EDT estimates of fish productivity and habitat capacity were not reliable due to internal parameter uncertainty. However, prioritization of reaches for preservation or restoration based on EDT forecasts were somewhat more robust to given input uncertainties. The interpretation was that EDT may be better as a relative index of where important habitat is, rather than in making specific estimates of fish produced from a given habitat improvement scenario. Like all complex models, EDT outputs are subject to large uncertainties, and therefore it is important to explicitly incorporate the uncertainty and sensitivity analyses into any analyses. Sensitivity analyses should be performed to evaluate the precision of any forecast made with complex models such as EDT (McElhany et al. 2010). As mentioned, much of EDT's products are heavily influenced by subjective, "expert-panel" inputs, rather than data-based, scientific process. Uncertainties introduced with this approach generally have been shown to be highly imprecise, untestable, non-transparent and unreliable (e.g. Burgman et al.

2011). Given the magnitude of these uncertainties, a transparent use of EDT for NEB determination will require an evaluation of the sensitivity of the forecasts to subjective opinion.

E. REPLACING FISH PRODUCTION

Rather than relying on fish abundance, a fish production replacement approach to NEB determination uses population production metrics to evaluate NEB. This amounts to replacing lost fish production in impact areas with equivalent or greater production in offset areas through management actions that are believed to change population growth rate or mortality. As such, this can be viewed as another example of resource-for-resource replacement (Lipton et al. 2008; Clarke and Bradford 2014). Reliance on productivity has a number positive attributes, including direct measures of the productive capacity of a given habitat unit, feeding directly into fisheries-related yield estimates, and in some cases estimation from smaller, less extensive sampling than abundance. However, data needs are often more intensive (one needs more detailed information, albeit from perhaps fewer samples), and population-level assessments must rely on models and methods that are often complicated and technically challenging. Therefore, this approach is likely to be most appropriate when the assessment units are large and heterogeneous.

Estimating fish productivity requires developing a relationship between current abundance of “parent” fish (spawners) and the numbers of “offspring” fish that will return in the future (recruits). In salmon and steelhead trout management, a common approach to estimating productivity are spawner-recruit models. There are a number of familiar formulations of these models that include Ricker, Beverton-Holt, Schaefer or Fox models. Once a particular model is chosen, the parameters must be estimated from the data.

In particular, a Ricker model has been a popular choice due to the ease with which it can be formulated as a linear regression model, such that

$$\log_e(R_t / S_t) = a - b \times S_t + e_t,$$

where R_t is the total number of surviving recruits from brood year t , S_t is the number of spawners in brood year t , a is the intrinsic productivity (i.e., the number of recruits per spawner in the absence of density dependence), b is the per capita strength of density dependence, and e_t is the observation error in brood year t . From a set of R_t and S_t values the log of R_t / S_t is regressed on S_t ; the intercept is a and the slope is b in the equation above. The Ricker model is particularly convenient in that the carrying capacity and intrinsic productivity of the population are estimated directly from this regression.

Before beginning with the model fitting, however, R_t must be estimated. For organisms that breed once and all at the same age, the number of recruits is the number of breeding organisms surviving from a prior brood year. In most cases, and in salmonid fishes certainly, the animals that join breeding populations can be from several different years’ production, each with a different survivorship. In these cases we need to evaluate the regression above for recruits that

may accumulate over several subsequent years. This is often done with a brood table or run reconstruction, which in turn is derived from combining observed age composition and total spawner counts.

Productivity varies year to year, and so this approach requires multiple years of data to provide reasonable estimates. Indeed, the intrinsic variability in production can, in many cases, require many years of data. It is fortunate that salmon monitoring in the Pacific Northwest has been intensive and ongoing for many years. This is in contrast to many of the fish abundance replacement approaches which rely on a snap shot in time, but extensive data in space. However, if time series data are available it is also possible to evaluate the degree to which co-varying habitat conditions affect the estimates of a and b , and in so doing develop an estimate of how engineered changes in habitat may alter fish production. This is one approach to forecasting the anticipated positive effects of offset projects for NEB. The workflow for a fish production estimate is illustrated in Fig. 9.

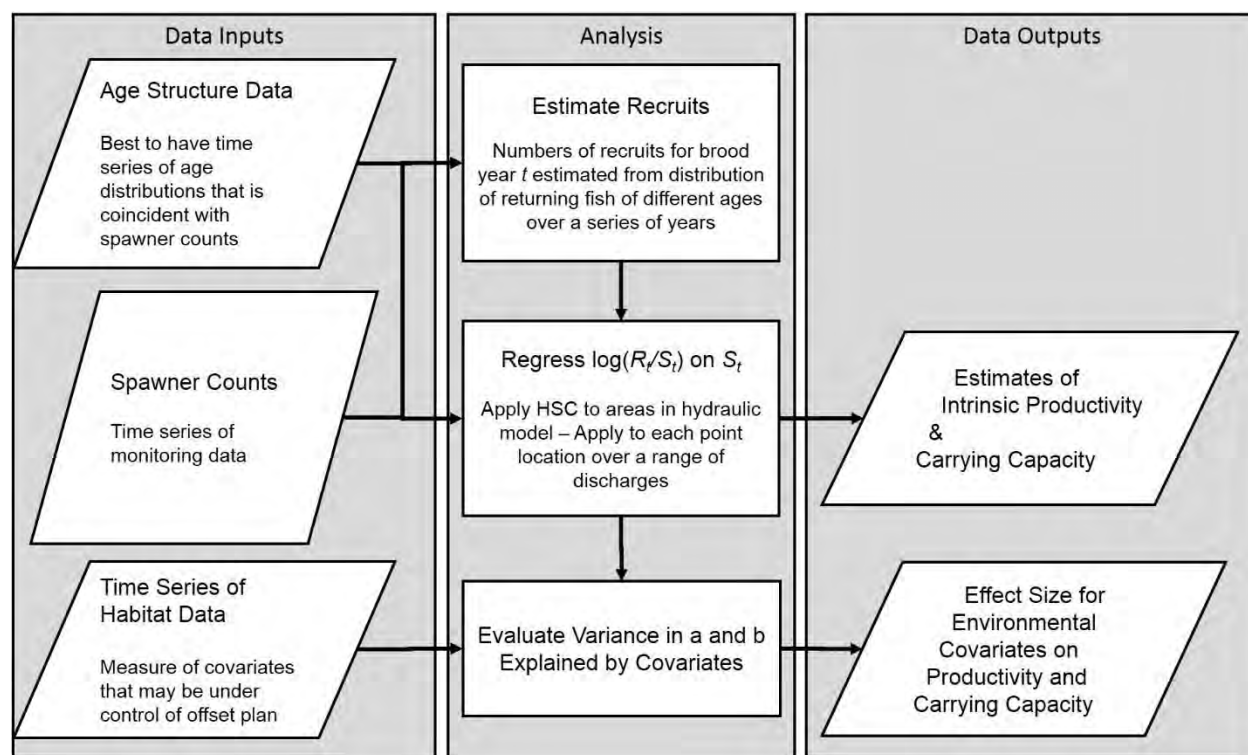


Figure 9 Fish Production replacement workflow. User data enters the analysis in the form time series of spawner counts, age distributions and environmental covariates. Spawner counts from prior years are combined with age structure data to estimate a time series of returning recruits. Production and Carrying capacity estimates for the planned habitat unit are estimated with a linear regression model in the case of a Ricker approach. Slightly different mathematical formulations are used in alternatives to the Ricker model. The outputs from the regression are the principal Data Outputs. If time series data of habitat covariates are available these can be used to explain variation in the productivity and carrying capacity estimates in order to forecast the changes in future production from habitat management actions performed now.

Although convenient, there are a number of inherent challenges when estimating the model parameters in this manner. First, the available raw data are used inefficiently, in that information

is lost when summarized into brood tables to calculate demographic rates. Second, the spawner and age data are rarely, if ever, comprehensive or error free due to imperfect detection, misidentification, and non-exhaustive sampling in collecting field data. When not appropriately addressed, these errors in population census may underestimate recruitment (Sanz-Aguilar et al. 2016) or overestimate the strength of density dependence (Knape and de Valpine 2012). Third, failure to acknowledge trade-offs among parameters and the fact that any given type of data (e.g., age structure) may contain information on multiple aspects of population dynamics (e.g., recruitment and survival) can lead to biased parameter estimates.

a. Data and Methods

Fish production rate is the net generation of new biomass in a stock per unit time, whether or not it survives to the end of that time (Ricker 1975). The time unit used to represent the rate can be a variety of units, but in salmon and other fish that have a strong seasonality to their presence in fresh water, the most common time unit is annual. Therefore, the unit of measure for expressing fish production is most often either fish in numbers/year or biomass in kg/year. Consequently, there is an immediate need for data on fish numbers and size. Data on fish abundance and size (i.e. annual estimates of adults and/or biomass) can be collected directly in impacted areas using the methods described above, but estimates of fish abundance for the offset areas will have to be obtained from modeling or other forecasts. The models used in this approach to forecast population responses to habitat management are increasing in use, but remain somewhat rare, and are often complicated. Regardless of the modeling approach, it should include explicit metrics that can be deployed in effectiveness monitoring to allow forecast validation as well as inform the triggering of contingencies for failure to meet forecast goals.

Approaches in use to characterize population productivity in fish include metrics based on and derived from:

- Population structure (e.g. distributions of body size, Productivity: Biomass Ratios),
- Size structure,
- Habitat Productivity Index (HPI) is the product of P:B ratio and seasonal biomass (Randall and Minns 2000, 2002).
- Individual vital rates including growth, survival, fecundity

Methods for implementing these approaches to assessing population productivity are presented in numerous fisheries texts including:

- Hilborn, Ray, and Carl J. Walters, eds. Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Springer Science & Business Media, 2013.
- Gulland, John Alan. Fish stock assessment: a manual of basic methods. Vol. 425. New York: Wiley, 1983.
- Pauly, Daniel, and G. R. Morgan, eds. Length-based methods in fisheries research. Vol. 13. WorldFish, 1987.
- Haddon, Malcolm. Modeling and quantitative methods in fisheries. CRC press, 2010.

There are a number of modeling approaches that can be used to investigate the mechanistic relationships between habitat and production. Two of the more common are stock-recruitment models and stage structured habitat supply models.

Stock-recruitment models were originally developed for harvest management and extractive fisheries (e.g. Ricker 1954). Although the techniques have evolved and developed into more general population modeling schemes, the data needs, assumptions and challenges to use remain, as do debates regarding the choice of model form in any given application (e.g. how density dependence is represented in Beverton-Holt vs. Ricker formulations). Stock-recruitment models have high utility in that they incorporate estimates of recruitment, intrinsic growth rates, survival, fecundity and environmental carrying capacity, and they produce estimates of surplus production and sustainability targets for harvest. All of these population properties have wide utility in fisheries management (e.g. Gibson 2006; Parken et al. 2006), although it is less clear that they have similar utility in conservation and habitat-population management scenarios. Most estimation approaches rely on linearizing the stock-recruitment relationship with a log transform of the data, estimation of the parameters and then transform back to linear space where the parameters are reported. While this provides conceptual simplicity and useful outputs (Clark et al. 2009), it results in very large uncertainties in the estimates of recruitment (Ludwig and Walters 1981; Hilborn and Walters 2013), and many of the assumptions are problematic (Walters and Ludwig 1981; Walters 1985, 1987; Kehler et al. 2002; Kope 2006).

Stage-structured models are an alternative that recognizes that fish will encounter different sources of mortality at different times in their life histories. The modeling approach is to take the entire life history of the fish and divide it into a number of stages; the net survivorship is the resulting cumulative probability of survival at each of the steps or life-stage transitions over the lifetime of the fish (Nickelson 1998; Nickelson and Lawson 1998). In salmon, where there is a protracted fresh water period with several recognized developmental stages, it has been possible to construct life cycle models with many survivorship steps. The net survival of fish is calculated as a long series of multiplications of numbers between zero and one (survival probabilities range from 0 to 1), and for the whole life history it can be a very long series. As a consequence, even if survivorship for a specific step is high, or made high by a specific management action, the net survivorship works out close to zero. This is not a surprise when we remember that female fish may lay 3,000 to 7,000 eggs in a salmon redd (Groot and Margolis 1991), but only two fish survive to reproduce if the population is just replacing itself. The other consequence however, is that our sensitivity to detect small changes at specific life history steps is relatively low when we are looking at a population level outcome, such as numbers of returning adult fish

Much of the current paradigm for endangered fish recovery is based on a life-cycle concept. In principle, if we change the mortality at a specific step with a habitat restoration project for example, we could increase the net overall production of fish and put the population on a trajectory to recovery. Unfortunately, this paradigm has an important limitation in that the effect of any change in survival itself is probabilistic. We can't specify how many fish will survive passing a given dam, or other threat, we can only say what the probability of survival is and if

sufficient monitoring data exists, what change in the probability is likely for a given management action. The good news is that while we cannot predict the fate of an actual fish, the probabilistic nature of survival provides a mechanism to estimate our uncertainty in any estimate.

b. Assumptions and Implications

Both life cycle and stock recruitment modeling approaches rely on many of the same data types as the other NEB determination approaches. Therefore, this approach has similar assumptions and constraints as the other methods with respect to data. In addition, the modeling approaches currently in use can become quite complicated. For example, life cycle models in particular can have many steps with different values of survival for each. This is problematic both because the model complexity/bias uncertainty rises and also because there is less monitoring data and empirical studies to support the estimate of survival in a specific habitat and fish life history context. In many of these cases of low empirical data availability, planners have resorted to expert opinion and this introduces additional problems of transparency and model validations (McElhany et al. 2010).

Because production approaches are built on our understanding of a population process, its relevance is greater on the scale over which the survivorship or stock recruitment processes operate. This is usually a large scale, and in the case of endangered anadromous salmon, the scale is the whole population (Bradford et al. 2014). For example, the premise of a habitat restoration project is that by improving habitat-related survivorship we will see an increase in the number of wild fish. This may be a reasonable hypothesis, but we have to keep in mind that the mechanisms are passive—we are not making new fish—and even if the habitat alteration is successful, there are reasons why improved habitat may not correlate with increased fish production. Indeed, in the Columbia River there are a large number of potential sources of mortality occurring outside the basin, with as little as 34 to 64% of mortality occurring in the freshwater life history of anadromous salmonids (Bradford et al. 2014). Thus, improvements in early life survivorship due to actions in the NEB determination may be entirely successful, but out of basin mortality may prevent any of that success from being measurable into the future.

c. Sources of Uncertainties

Uncertainties from this approach to NEB determination arise both from the data and metrics, as well as the modeling approaches chosen to forecast offsets. With respect to data and metrics, the uncertainties are similar to the other approaches to NEB determination that rely on fish abundance and habitat condition measures. Life cycle models have the additional complication that these same data are required for possibly many life stages and habitat conditions.

When any of these approaches to fish production replacement are linked to habitat there are important uncertainties related to ecological context. Empirical measures of habitat affecting life stage survival may be just as site-specific as habitat preference described above. In cases where fish population responses are inferred from localized studies, the lack of transferability of the estimated relationships between habitat and survival may be just as uncertain as habitat capacity modeling.

Perhaps the largest uncertainty is the complex nature of productivity models as forecast tools for the NEB determination. As mentioned above, these models are generally some of the more complex models in fisheries and conservation use, and this complexity exists in models that do not make explicit linkages to habitat metrics as covariates or drivers of population processes. This model complexity imparts large uncertainties to any forecast made that bases fish production from habitat changes. Also important is that the uncertainties in the data that goes into the models and the uncertainties arising from the models themselves may interact in more than a simple additive manner and produce unexpectedly large uncertainties in the forecast results (Caputi 1988). Therefore, if NEB determination is to be made with a fish production replacement approach, large increases in proposed offsets may be needed to increase the likelihood that NEB will be net positive by the end of the planning period. Certainly, monitoring, validation metrics, timelines and triggers for contingencies in the event of failure to reach validation targets will be prudent components for watershed plans developed under RCW 90.94.

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Table 1.

NEB Determination Approach Comparison Summary					
Type of Environmental Offset	In-Kind, In-Place	Out of-Kind, Out of-Place			
	In-Kind Replacement Water for Water	Habitat Function Substitution	Habitat Substitution for Specific Species	Fish Abundance	Fish Production
Example	Water for Water	HEA	PHABSIM	EDT Fish-Flow curves	Life-Cycle Modeling
Basic Information Outputs					
Produces Quantitative Measures of flow? (Will it connect consumptive withdrawals to quantitative changes in instream flow?)	Yes	No	No	No	No
Produces Quantitative Estimates of Habitat Response?	No	Yes	Limited, does estimate hydraulic condition at different flows. However, some professional judgment or input from other model or framework is required to relate hydraulic condition to quantitative habitat responses (e.g. step-backwater modeling, depth and velocity regression on transects, or two-dimensional hydraulic modeling based on channel roughness and flow routing for hydraulic component)	Yes, depending on scale and dimensions and input of habitat variables (cover, mesohabitat, other options)	No
Produces Quantitative Estimates of Fish Population Response?	No	No (associated estimates are from external judgment or model)	Yes, but based upon flow-habitat input	No – requires interpretation of habitat response via model or judgement.	Yes
Estimates responses in other Ecosystem	No	Yes	No	No	No

Goods and Services? (e.g. Recreational, Aesthetic, etc.)					
Qualities of Information Produced					
Data and Methods					
What data are required to perform the assessment?	Streamflow	Impacted habitat estimate; multivariate description of the habitat, such as habitat structure, cover, or substrate type;	Suitability or preference metrics at microhabitat (or meso/macro habitat) level incl. depth, velocity, substrate, roughness and/or cover) for each species life-stage	Hydrology, sediment, channel dynamics, riparian/habitat function, total fish abundance as count, density, fecundity, biomass, catch per unit effort	Fish age structure (e.g., growth, survival, fecundity), spawner information (e.g. number or biomass per time), habitat productivity, Productivity: Biomass ratios.
Spatial Issues					
Transferability	No	No	No	No	No
If we have data for one location, can you extend developed inferences to other locations?		<i>In all cases, there have been implementations where fish:habitat relationships have been developed in one place and deployed elsewhere. This is done, but it is difficult to support technically, and if done, should be accompanied by extensive validation monitoring.</i>			
Spatial Extent	Stream reach	Arbitrary	Typically a representative reach scale (Can be expand to larger segment-scales if habitat weighting is used. Modeled results have been used to inform watershed-scale decisions for planning and policy purposes.)	Can be made up of very small scale – how close do you want to space measurement points, and at the cost of time and effort	Limited to domain over which the supporting data are relevant. Commonly the distinct population segment (DSP).
Spatial Resolution		Arbitrary (Commonly determined by the spatial resolution of the inventory of habitat units)	Commonly 100 meter reaches	Reach (Although, the resolution is the reach, supporting data at that scale are often unavailable, and supplemented with expert opinion.)	Limited to domain over which the supporting data are relevant. Commonly the distinct population segment (DSP).
Assumptions and Statistical properties of Ecological Benefits Forecast					

Assumptions	That water quantity is a surrogate for habitat metrics and population response	Assumes ecological function is equivalent to fish production	Assumes stationarity in a number of aspects: - that all space are equivalent - static in time, independent of species/life stage, fish have a global knowledge of site suitability	Assumes future ecosystem is similar to the current ecosystem; restoration efforts are directly correlated with wild fish recovery	Ability to accurately model multiple fish life stages; relies on empirical data or expert opinion
Implications	Any Net benefit from new habitat will have to meet or exceed the lost function in excess of the existing production in the offset location.	Aggregated data may mask detail among data that actually determine fish production; results will depend on structure of the model used and data used.	The pattern of fish density observed at any moment in time is a snap shot of interactions between hydraulic, habitat and biological processes that may or may not permit use of the assumption that HSC are transportable across time and space	Difficult to account for environmental changes associated with a changing climate; restoration activities may not be sufficient to increase wild fish population (other factors may play a role)	Models provide a better understanding for larger scale/process-level estimation, while specific habitat alterations may exact a more local scale response
Uncertainties					
Where do critical uncertainties lie?	Habitat for habitat on a quantity basis is low uncertainty; establishing habitat for habitat on a quality basis is less certain.	Degree of uncertainty is metric-dependent-greater uncertainty for metrics representing complex features (e.g. habitat) and information-poor metrics; reduces complex ecological services to a single metric; does not account for injuries that	Assumptions of fish-habitat associations; portability of fish-habitat relationships; mismatches of scale and/or data;	Estimates of fish productivity and habitat capacity are estimated using other parameters with varying uncertainty; depend heavily on "expert-panel" inputs	Assumptions of fish-habitat associations; portability of fish-habitat relationships; Empirical measures of habitat affecting life stage survival may be just as site-specific as habitat preference; complex models do not make explicit linkages to habitat metrics as covariates or drivers of population processes.

		accumulate over time			
Does it produce a measure of precision of forecast? (What is the uncertainty?)	Lower for well-studied systems when using common/well-understood measurement methods	Can require data aggregation which can mask more detailed/ nuanced relationships	No- hydraulic modeling on one scale married to finer scale habitat data can misrepresent fish preference	Not as currently done, although it could be built in, particularly where hydraulic models are based on regression. Suitability criteria input could also be developed with estimates of precision, but would require extensive work	Estimates may be more robust at the larger/process-based scale
Does it produce a measure of accuracy in the forecast? (How far from the forecast is the truth?)	Higher when modeled as described above	Dependent on data quality	If quantitative habitat:fish models are used, estimates of forecast accuracy are possible. However, as commonly deployed, these approaches rely extensively on expert judgement which does not allow a quantitative assessment of accuracy (see above). As such, resolving what constitutes an estimate of accuracy and how it is handled may represent a policy choice rather than a technical or scientific choice reflecting case-specific, and potentially competing, values.	No, but see above- while EDT does provide specific forecasts, its uncertainties mean its accuracy cannot be evaluated.	Yes, However, uncertainties arising from models being sensitive to data variance can be large. In addition, uncertainties arising from the models themselves may interact in more than a simple additive manner and produce unexpectedly large uncertainties in the forecast results
Is it transparent? (Are all data sources, assumptions and methods documentable and inform estimates of accuracy and precision?)	Yes in principle.	Aggregation and expert opinion can reduce transparency	Yes in principle.	No. As currently implemented, relies extensively on expert opinion, which may be subjective or imprecise.	Yes in principle.

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5. APPENDICIES

Appendix 1: Economic valuation

1) Table A1

Table II: Comparison of Willingness-to-Pay Estimates for Anadromous Salmon in the United States, Post- 1990												
Year	Type	Authors	Study location	Sample size	Payment Period	Payment Frequency	Baseline (in 1000s fish)	Change (in 1000s fish)	Amount	Payment vehicle	Survey method	Income elasticity
1990	CVM - DC	Hanemann, Loomis, Kanninen	CA, OR, WA	1003	NS	annual	0.1	15	\$324	taxes	mult	NR
1991	CVM - OE	Olson, Richards, Scott	WA, OR, ID, MT	1400	one-time	month	2500	2500	\$49 - \$137	electric bill	phone	NR
1991	CVM - DC	Stevens et al	MA	1000	5 years	annual	NA	complete loss	\$13 (Atlantic salmon only)	trust fund	mail	NR
1992	CVM - OE	Duffield and Patterson	MT	796	one-time	lump sum	NS Status Quo	NS	\$31	trust fund	mail	NR
1996	MA	Loomis & White	NA	NA	NA	NA	NA	NA	\$100	NA	NA	NR
1996	CVM - DC	Loomis	WA & USA	1174	10 years	annual	50	350	\$91 - \$113	taxes	mail	NR
2001	CVM - R	Layton, Brown, Plummer	WA & OR	1611	20 years	month	2000	3000	\$167	utility bill	mail	NR
2003	CVM - DC	Bell, Huppert, Johnson	WA & OR	2209	5 years	annual	64 - 69	64 - 146	\$101 - \$162 (WA)	taxes	mult	NR
2006	WTP - MC	Montgomery and Helvoigt	OR	5300	NS	month	SQ	NS	\$15 - \$46 (mode)	utility bill	mail	NR
2007	BT (LBP 1999)	Goodstein and Matson	OR & WA	NA	NA	NA	NA	33 - 66% decrease	\$33-\$144	NA	NA	0.3
2008	MA	Martin-Lopez et al	NA	NA	NA	NA	NA	NA	\$76 - \$149	NA	NA	NR
2009	MA	Richardson, L. and Loomis, J.	NA	NA	NA	NA	NA	NA	\$92	NA	NA	NR
2009	BT (Loomis 1999)	Helvoigt and Charlton	OR	NA	NA	NA	NA	NA	\$33	NA	NA	NR
2009	CVM - CE	Rudd, M.	Canada	2761	20 years	annual	SQ	50 - 200% increase	\$86	taxes	online	NR
2012	CVM - CE	Johnston et al	RI	522	NS	annual	SQ	NS	NA	taxes	mail	NR
2012	CVM - CE	Wallmo, K. and Lew, D. K.	US	8476	10 years	annual	SQ	De-list as threatened	\$40	taxes	online	NR
2012	CVM - CE	Mansfield et al	OR & CA	3,372	20 years	Annual	SQ	30 - 150% increase	\$121 - \$213	Taxes	mail	Constant real income

2) Annotated Bibliography

Willingness to Pay

Hanemann, M., Loomis, J., & Kanninen, B. (1991). Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American journal of agricultural economics*, 73(4), 1255-1263.

The authors conduct a survey of 1,003 residents in Colorado, Oregon, Washington and California to compare willingness-to-pay for various environmental improvement programs in California's San Joaquin Valley. One of those programs is a salmon improvement program. Bid amounts range from \$45 - \$225 with hypothetical payments made through annual taxes. On average, respondents are willing-to-pay \$324 each year to increase fish populations from 100 to 14,900. The authors compare results obtained through both one round and two rounds of "yes/no" questions posed to respondents. The authors concluded that the sequential survey question format provides more efficient estimates of willingness to pay than those obtained through a single question.

Olsen, D., Richards, J., & Scott, R. D. (1991). Existence and sport values for doubling the size of Columbia River basin salmon and steelhead runs. *Rivers*, 2(1), 44-56

The authors estimate the existence value of doubling Columbia basin salmon runs from 2,500,000 to 5,000,000 fish. A mail survey is used to solicit responses from 1,400 residents of Idaho, Montana, Oregon and Washington, exactly half of which are participants in the commercial fishing industry. Hypothetical payments are made through annual increases in electric bills, and the authors use an open-ended question format. Total economic value is reported as approximately double the non-use values. Non-users of the Columbia basin fishery express an annual willingness-to-pay of \$49 per household; for people who may fish at some point in the future, \$108; for those who currently participate in the sport or commercial fishing industry, \$137.

Stevens, T. H., Echeverria, J., Glass, R. J., Hager, T., & More, T. A. (1991). Measuring the existence value of wildlife: what do CVM estimates really show?. *Land Economics*, 67(4), 390-400.

The authors conduct a survey of 1000 New England residents soliciting willingness-to-pay to avoid funding cuts for species preservation programs. A sequence of two "yes/no" questions was posed to respondents asking if they would be willing to pay specific amounts between \$5 and \$150 to a trust fund for the purpose of protecting specific species, including Atlantic salmon. Individuals were told that species would not survive unless the fund was created. Average values for Atlantic salmon were reported as \$13 per person. Only 12% of respondents had reported seeing Atlantic salmon. 52%

of respondents did not think their opinion would matter for policy decisions. 64% of respondents expressed a willingness-to-pay of \$0.

Duffield, J. W., & Patterson, D. A. (1992). Field testing existence values: comparison of hypothetical and cash transaction values. *Benefits and Costs in Natural Resource Planning, Oregon State University*.

Authors examine the importance of “hypothetical bias” when it comes to valuing instream flows. Hypothetical bias is the tendency of respondents to overstate willingness-to-pay when payments are not actually made. The authors conduct a mail survey of 796 individuals with registered fishing licenses in Montana, approximately half of which are state residents and half non-residents. One version of the survey solicited one-time, actual cash donations to finance a fund for instream flows that would be established through the Montana Nature Conservancy. A second version was identical except that trust fund donations were hypothetical. A final version was similar to the hypothetical version, except that it was delivered through a separate mailing from the University of Montana. Respondents were asked to express Willingness to Pay (WTP) through payment cards in amounts from \$10 - \$250. Response rates to the actual payment program were only 10%, though the authors did not conduct re-contact respondents for any mailing sent through the Nature Conservancy. Of TNC mailings, the average contributions made by residents to the actual trust program was \$31.34 (adjusted to reflect \$2012). To the hypothetical program, WTP was reported as \$26.25. For non-residents, WTP was reported as \$50.04 (actual) and \$56.06 (hypothetical).

Loomis, John B. "Measuring the economic benefits of removing dams and restoring the Elwha River: results of a contingent valuation survey." *Water Resources Research* 32.2 (1996): 441-447.

The author conducts a survey of 1,174 residents in Washington State and other US residents. Respondents are asked to express willingness-to-pay to remove two dams on the Elwha River in order to restore river runs to a natural, pre-dam state. Hypothetical payments were made through annual federal taxes over a period of 10 years and reflect non-use values associated with wild salmon, as opposed to generic salmon populations that include both wild and hatchery fish. Available bid amounts range from \$3 to \$190 and are solicited through a dichotomous choice, voter referendum format. It is assumed that dam removal would increase salmon populations from 50,000 to 350,000. On a per household basis, the mean annual WTP in Clallam County, WA is \$91 mean annual WTP; for rest of Washington State, \$113; for the rest of the United States, \$105.

Bell, K. P., Huppert, D., & Johnson, R. L. 2003. Willingness to pay for local coho salmon enhancement in coastal communities. *Marine Resource Economics*, 18(1), 15-32.

The authors examine the willingness-to-pay of coastal residents in Oregon and Washington for various coho salmon enhancement programs. The estimates presented are more variable than those of other studies. In total 2,209 respondents were recruited from Grays Harbor, WA; Willapa Bay, WA; Coos Bay, OR; Tillamook Bay, OR; and Yaquina Bay, OR. Questions were posed through a voter referendum format conducted through a combined mail and telephone survey approach. Costs of the programs ranged from \$5 to \$500 in annual tax payments over a period of 5 years. Fish population increases in Washington ranged from 200% to 400%. In Oregon, residents were asked to value fish population increases of sufficient size to de-list Coho as a threatened species under the Endangered Species Act. The authors find wider variation in willingness-to-pay between the Oregon locations than for Washington, and they report a *lower* willingness-to-pay for conservation programs that would result in *higher* increases in coho populations. They also find that participation in the local sport fishing industry is significantly associated with willingness-to-pay, and affiliation with environmental groups is affiliated with greater willingness-to-pay for some, but not all survey locations. For the Washington survey locations, average annual household WTP ranges from \$101 - \$162.

Montgomery, C. A., & Helvoigt, T. L. (2006). Changes in attitudes about importance of and willingness to pay for salmon recovery in Oregon. *Journal of Environmental Management*, 78(4), 330-340.

Since 1996, the biennial Oregon Population Survey has two questions regarding salmon restoration efforts. First, “as you may know, salmon runs are declining in Oregon. How important do you feel it is to improve salmon runs in Oregon?” Second, “How much per month would you be willing to pay to for water quality and habitat improvement efforts to help improve salmon runs in Oregon?” Oregon residents have become less supportive of salmon recovery efforts from 1996- 2002, and the authors attempt to explain those changes. More than 30% of respondents were willing to pay \$1-\$3 per month in 2002 (the largest category for each survey year). Greater willingness to pay is reported for younger and unmarried respondents, males, American Indians, those with higher levels of education, people living in urban areas or areas that are less economically depressed. Long-term trends are not clear, as “an important portion of the decline in expressed support for salmon recovery and salmon recovery efforts is not explained by [socioeconomic information]” (p.2006, p.338).

Wallmo, K., & Lew, D. K. (2012). Public Willingness to Pay for Recovering and Downlisting Threatened and Endangered Marine Species. *Conservation Biology*, 26(5), 830-839.

The authors conduct an online survey of 8,476 randomly selected U.S. households to estimate willingness to pay to downlist eight threatened and endangered species. Hypothetical payments would be made annually so that species could be de-listed 50 years in the future. Respondents expressed a willingness to pay of \$40.65 (\$37.94, \$43.19) for Chinook salmon in the Willamette River and \$40.49 (\$37.91, \$42.87) for those in Puget Sound. The survey took the form of a choice experiment. Responses were dropped for individuals who either unsure about their feeling regarding threatened and endangered species or not confident in their answers. The authors caution against using the estimates in benefit transfer applications to value more than three species at once.

Johnston, R. J., Schultz, E. T., Segerson, K., Besedin, E. Y., & Ramachandran, M. (2012). Enhancing the content validity of stated preference valuation: the structure and function of ecological indicators. *Land Economics*, 88(1), 102-120.

While the public has expressed a willingness to pay to protect fish populations, the authors test whether values are sensitive to alternative ecological indicators of fish population changes. Indicators include the amount of river acres that are made accessible (1), the probability that a restored fish run will still exist in 50 years (2), changes in harvest (3), the amount of wildlife (4), and the overall ecological condition of a watershed as measured through a biological index (5). Public access to enhanced streams is associated with an additional \$20 per household per year compared with streams with no public access. One percentage point increases in both biological quality index scores and the number of new acres made accessible to migratory fish is associated with an \$0.80 increase in annual, per household values. This is approximately twice the effect of a one percent increases in harvest and one percent increase in the probability of fish survival 50 years later. Results were obtained from a 2008 mail survey of Rhode Island residents and a review of the existing scholarly literature. See also Johnston et al (2005) and Zhau et al (2013).

Mansfield, Carol, Van Houtven, George, Amy Hendershott, Patrick Chen, Jeremy Porter, Vesall Nourani, and Vikram Kilambi. Klamath River Basin Restoration Nonuse Value Survey. RTI International, 2012.

Mansfield and colleagues estimate the total economic value of salmon restoration in the Klamath River Basin of southern Oregon and northern California. The study was commissioned by USBR and asks respondents to express preferences between the status quo and the proposed alternative Klamath River Basin Agreement, a river restoration project that would remove four dams. Respondents are asked to make hypothetical, annual payments over 20 years through federal taxes. The survey asks

respondents to value increases in wild salmon populations from 30 – 150% and changes in extinction risks (low, moderate, high, very high). The survey was administered through the mail in June 2011, but respondents had the option to complete the survey online. The sample was stratified into three geographic zones, oversampling residents in the 12-county area closest to the Basin. The overall response rate was 32.8%. The survey included cheap talk and followed up the valuation question by asking respondents how sure they were about their response. The authors estimate annual household WTP for the project in the amount of \$121 for Klamath area households; \$213 for all other U.S. households. A reduction in extinction risk for coho salmon from “very high” to “high” is associated with an annual WTP of \$70 for Klamath-area households, \$54 for households in the rest of Oregon and California; and \$78 for households in the rest of the U.S.

Meta-Analyses

Loomis, J. B., & White, D. S. (1996). Economic benefits of rare and endangered species: summary and meta-analysis. *Ecological Economics*, 18(3), 197-206.

The authors conduct a meta-analysis similar to Richardson and Loomis (2009). They use the same variables to explain willingness-to-pay estimates, though they do not control for survey mode. The authors review 20 studies from both the published and non-published literature and report “best” estimates where multiple estimates are reported from a single study. They report an annual household willingness-to-pay (in \$1993) for Pacific salmon/ steelhead of \$49 - \$140 (average \$100); for Atlantic salmon \$11 - \$13 (average \$13). Neither survey response rate nor study date was found to have a significant influence on willingness-to-pay estimates in any model estimated. Over 50% of the variation in willingness-to-pay estimates is explained by payment frequency, change in population size, species type, and whether respondents are visitors or residents. They argue that economic values are insensitive to the format of questions posed to respondents.

Johnston, R. J., Besedin, E. Y., Iovanna, R., Miller, C. J., Wardwell, R. F., & Ranson, M. H. (2005). Systematic Variation in Willingness to Pay for Aquatic Resource Improvements and Implications for Benefit Transfer: A Meta-Analysis. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, 53(2-3), 221-248.

Meta-analysis is used to determine the importance of contextual variables on estimates of total economic value of water quality and habitat improvements that benefit aquatic species. In total the authors use 81 observations from 34 studies conducted

from 1973 – 2001, two of which include salmon and steelhead (Olsen et al, 1991; Loomis, 1996). The preferred specification assumes a semi-log form, where all right hand side variables are additive. Multilevel models are used reject random effects that might explain willingness-to-pay estimates through unobservable, study specific characteristics. Willingness-to-pay increases with the number of waterbodies affected and water quality enhancements.

The authors distinguish between valuations for large and small fish population increases (greater or less than 50%). Estimates vary by region and methodological approach, with lower estimates reported in the Pacific Northwest and higher values associated with both mandatory payments and higher response rates. The authors find that most studies express WTP in terms of annual payments of an indefinite duration. Where the duration is reported, a short time horizon is most common (i.e. 3-5 years).

MARTÍN-LÓPEZ, Berta., Montes, C., & Benayas, J. 2008. Economic valuation of biodiversity conservation: the meaning of numbers. *Conservation Biology*, 22(3), 624-635.

The authors conduct a systematic review of 60 articles valuing different indicators of biodiversity in an attempt to explain variation in the reported estimates. Two studies relate to values for Atlantic salmon (Stevens et al, 1991; Bulte and Kooten, 1999) and two studies relate to values for Pacific salmon/ steelhead (Hanemann et al, 1991; Olsen et al, 1991). In per household terms, the authors report an average annual willingness to pay for Chinook salmon of \$76 and for steelhead, \$149. Results largely confirm the findings of previous meta-analyses (Loomis and White, 1996; Richardson and Loomis, 1999) that explain variation in willingness to pay estimates from multiple studies.

Richardson, L., & Loomis, J. (2009). The total economic value of threatened, endangered and rare species: an updated meta-analysis. *Ecological Economics*, 68(5), 1535-1548.

The authors conduct a meta-analysis of 31 estimates of public willingness-to-pay for threatened and endangered species from academic studies published from 1984-2001. Updated from Loomis and White (1996), the study reviews four previous estimates for Pacific Salmon (Olsen et al, 1991; Loomis, 1996; Layton et al, 2001; Bell et al, 2003) and one for Atlantic salmon (Stevens et al, 1991). Average error of the willingness-to-pay model compared with individual study estimates ranges from 34-45%. Willingness-to-pay increases with changes in population size (1), payment frequency (2), dichotomous choice survey formats (3), respondents who are visitors rather than residents (4), more recent study years (5), mammals compared to other species types (6), “charismatic” species (7), phone and in person surveys compared to mail survey

modes (8), and lower response rates (9). An indicator of survey quality, higher response rates tend to be associated with lower WTP estimates. LBP is the only study to use a variation of traditional contingent valuation methods, which the authors refer to as conjoint technique. The authors point out that this technique tends to generate higher WTP estimates (Stevens et al, 2001) and “drives a lot of the difference between new and old studies” (2009, p.1542). The annual economic value of salmon/ steelhead ranges from \$11 to \$158 (average \$92) per household in 2012. The authors prefer a double log specification that includes a variable for study year (model 3, p.1545). Using this model, a 1 year increase is associated with an 8% increase in economic value.

Other Benefit-Transfer Studies

Goodstein, Eban, and Laura Matson. "Climate change in the Pacific Northwest: Valuing snowpack loss for agriculture and salmon." *Frontiers in Ecological Economic Theory and Application*. Northampton, MA: Edward Elgar (2007).

The authors review previous estimates of the non-use values associated with anadromous salmon and report a range in annual, per household willingness-to-pay from \$33 - \$144. They then estimate the total willingness-to-pay for Oregon and Washington residents to avoid a one-third decrease in the size future salmon populations as \$398 million. They interpret this amount as the required compensation for the public to be “made whole.” As a basis for the estimate, the authors use a modified version of the valuation model presented in Layton, Brown and Plummer (1999).

Helvoight T. and Charlton, D. 2009. The Economic Value of Rogue River Salmon. ECONorthwest. Accessed online 6 December 2013 from <http://www.americanrivers.org/assets/pdfs/wild-and-scenic-rivers/RogueSalmonFinalReport0130090e8f.pdf>

In a report commissioned by the Save the Wild Rogue Campaign, ECONorthwest analyzed the economic value of salmon and steelhead in Oregon’s Wild & Scenic Rogue River. Citing Goodstein and Matson (2007), the authors argue that Washington and Oregon residents are typically willing to pay \$30 - \$130 per year for salmon recovery programs. Using fish count data from the Oregon Department of Fish and Wildlife and estimates from academic studies, the authors then estimate a range of values associated with salmon use. The per fish economic value of commercial caught salmon ranges from \$13 - \$68 with sport – caught values ranging up to \$900 per fish (Meyer Resources, 1986). To estimate non-use values associated with Rogue River salmon, the authors apply a marginal willingness-to-pay function from Loomis (1999). They

calculate the total annual non – use willingness to pay for the Rogue River salmon fishery at \$1.5 billion, or \$32.67 per person per year. The authors assume a salmon population size of 830,000 based on escapement numbers.

Niemi, C.L., E. G., Buckley, M., Neculae, C., & Reich, S. (2009). An Overview of Potential Economic Costs to Washington of a Business-As-Usual Approach to Climate Change.

The authors provide an overview of potential costs that climate change may impose on Washington State residents under a status quo management scenario. With a total projected cost to Washington State residents of \$530 million per year in 2020 and growing to \$3 billion per year in 2080, decreases in future salmon populations are one of the three largest climate-related costs out of 18 cost categories considered (the other two, estimated for 2020, are \$1.3 billion in annual health-related costs and \$220 million in energy costs). The authors use the model presented by Layton, Brown and Plummer (1999) as the basis for salmon-related costs, though they assume that the status quo would result in a 22% reduction in the size of salmon runs by 2090.

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Appendix 2: Restoration Metadata Needs for Assessing impacts of Water Plans under RCW 90.94

A. Implementation tracking information

The Streamflow Restoration Act, RCW 90.94, calls for plans to be developed to evaluate the impacts and responses to consumptive water use, and in particular the in-stream impacts of ground water withdrawals. Those plans will include four key functionalities that follow directly from the Act and the interim guidance. When assembled, these four functions form a workflow that addresses the following questions:

1. What are the specific plans for consumptive withdrawals of water (projected new wells in context of existing withdrawals)?
2. What are the forecasted environmental outcomes of the water use described in part 1?
3. What are the planned mitigation/restoration actions anticipated to produce environmental benefits in response to the environmental outcomes identified in part 2?
4. Do the net environmental benefits in part 3 outweigh the outcomes in part 2, or result in a positive NEB?

As a consequence, RCW 90.94 requests planners to draw ***inferences*** regarding the environmental impacts (in the form of forecasts in parts 2 & 4 above) of water withdrawals and management actions in response (parts 1 & 3). Here we describe the types of ***information*** concerning the actions taken that are needed to draw those inferences (see below for rationale). Those information needs, and their technical specification, are relevant to both the forecasting of impacts and the possible monitoring of action effectiveness. Critically, ***information*** in this context is distinct from ***data***; in any given case, different kinds of data (e.g. latitude/ longitude) could convey the same information need (*where is it?*). This distinction also highlights that the need for information follows from the inferences defined in RCW 90.94, but they are not specified by RCW 90.94 itself.

Regardless of the origin of the information need, this document describes the kinds of relevant metadata for actions proposed or undertaken as part of RCW 90.94 planning or assessment, but it does not provide a specific prescription for minimum requirements regarding planning and monitoring data systems. Recognizing that new calls for data and reporting are often perceived as onerous and demanding, where they exist we

provide pointers to existing data systems across the region that can deliver those informational needs, and we provide an example data dictionary in the Appendix below that could be used to address these information needs. However, this document avoids specifying a single data system that constitutes a minimum requirement under RCW 90.94.

B. Common information needs consistent with RCW 90.94

There are common information needs for management actions regardless of whether one is planning future actions, or assessing existing actions. The needs derive from the questions being asked and the assessment techniques deployed, and amount to specific information on the *who*, *what kind*, *how much*, *where* and *when* of the restoration or mitigation that has occurred or is planned for the near term. The specific technical questions raised in any water management plan will be implementation and location specific. However, there are several overarching classes of questions that are likely to be encountered (Katz et al., 2007):

- Q1. How does a single restoration action alter environmental resources?
- Q2. How does a diverse set of restoration actions implemented within some spatial domain, such as a watershed or subbasin alter environmental resources?
- Q3. How does a given class of similar restoration projects alter environmental resources?

In each case, “alter environmental resources” is contextual and must be defined in a manner relevant to the project and the study (and for the purposes of RCW 90.94 is considered elsewhere). In one case, it might refer to alterations in habitat quantity, while in another it could refer to responses seen in a population of salmon that are impacted by a change in some habitat character. For example, to address question Q2, we would need to know about all restoration projects in a particular basin, including their type, extent and abundance. We also appreciate that actions take time to implement, and their immediate impacts on things like salmon may take several years to be realized due to the complex life cycle of those fish. Thus, we would also need to know projects’ planning and implementation dates. In addition, we would also need to connect this information to a functional model that links the impacts of actions to changes in habitat, and perhaps in turn to changes in the net productivity of fish. Information about the distribution of restoration projects and productivity in adjacent basins would provide contrast and thereby separate the impact of those restoration actions from some other large-scale driver of the system such as climate variability. More explicitly, the *who*, *what when*, *where* and *how much* information should include:

- Spatially explicit data on project location (i.e. the work-site), not the location of the project contract (which has been common for project metadata in the past—see Katz et al., 2007). If the planned actions are to be connected to a model of environmental response and ultimately fish response, project data will need to be linked to spatially explicit environmental data. To identify the relevant habitat data to analyze these projects in a particular reach or stream unit, such as stream gradient, vegetation cover type and so on, the geographic coordinates for the restoration project are needed. There are a number of potential data types to express this information including latitude and longitude or LLID (latitude-longitude identification; <https://www.oregon.gov/deq/Data-and-Reports/Pages/default.aspx>) and stream mile. However, while larger scale spatial data, such as HUC or County, can be easily generated given a latitude and longitude, the converse is not true – given only a County, one cannot translate that into specific locations for the purposes of supporting these assessments. Fortunately, any spatially explicit coordinate system (e.g. latitude and longitude in decimal degrees or LLID and Stream km), the others can be generated in an automated data system. This recommendation is consistent with the Best Practices for Reporting Location and Time Related Data developed by the Northwest Environmental Data-network (NED 2006).
- Project level data on all implementations—not just projects undertaken as part of RCW 90.94. Characterizing the net impact of diverse restoration actions, and clearly identifying areas that are unimpacted by adjacent restoration actions, require knowledge of all restoration actions in the watershed or relevant spatial domain. In the former case one needs to accurately model or forecast the net magnitude of the treatments, while in the latter, one needs to identify the presence of potentially confounding treatments. Therefore, both the design and analysis of net restoration or mitigation require information about RCW 90.94-specific as well as all the other existing projects, regardless of funding source (e.g., SRFB, CBFWA, TNC). Fortunately, there are publicly-available data systems that provide information on pre-existing and non-RCW 90.94 projects (e.g. the Pacific Coast Salmon Recovery Fund (PCSRF), the Pacific Northwest Salmon Habitat Project Tracking Database (PNSHPTD)), so planners have resources to address this need at hand.
- Measures of magnitude or extent of treatment for each action proposed or implemented. These measures of treatment magnitude are useful in several contexts.
 - o To identify the net management effect from a diversity of individual project effects, the level of treatment is critical. One would not compare the effect of 10 fencing projects that excluded cattle from 5 miles of stream

length each, with 10 projects that excluded cattle from $\frac{1}{4}$ mile of stream length each.

- o Many forecasts of environmental effects for the purposes of satisfying RCW 90.94 will amount to comparisons of levels of treatment with levels of environmental response. This is illustrated in the figure below (Fig. A2-1), although the actual statistical comparison may be more sophisticated and complicated (e.g. multivariate and/or non-linear or saturating responses), on a conceptual level the comparison is straight forward. If projects are to be forecast as having a net ecological benefit, one expects to see more recovery (e.g. # of fish) with more treatment (e.g. # of culverts), although there may be reasons this relationship would have an upper or lower limit. Therefore, some measure of treatment extent needs to be incorporated into a water plans in response to RCW 90.94.

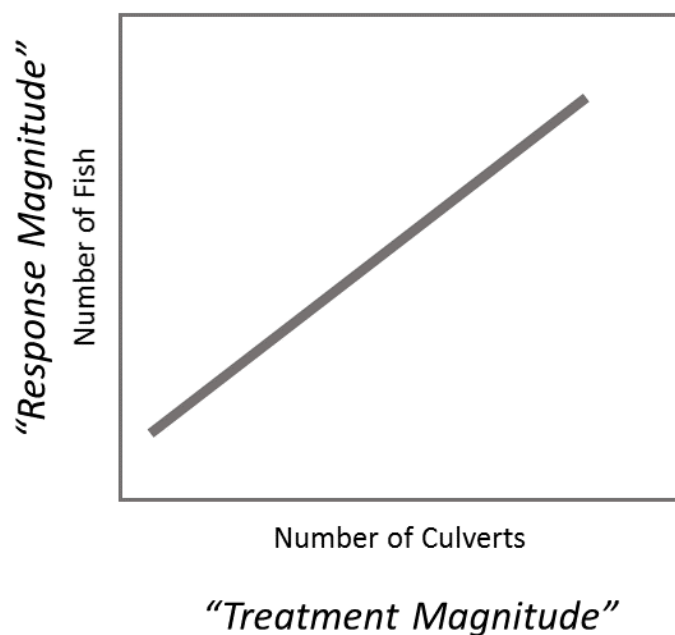


Figure A2-1 Conceptual application of project inventory to assessment of project impact. Conceptually forecasts will amount to estimates of response for a given amount of treatment. Given the lack of simple systems with single restoration types, the actual statistical analysis will require more sophistication.

- o Prioritizing project placement – Planning and prioritizing restoration has often occurred at local levels (Beechie et al., 2008). If prior effectiveness monitoring and evaluation efforts are to inform the prioritization of new action implementation at any scale, then some measure of implemented treatments must be available to planners. Historically, project tracking and planning systems in the Pacific Northwest have not included explicit measures of project extent and this has been a significant impediment to regional coordination (Katz et al., 2007; Barnas and Katz, 2010), .

There is a diversity of specific metrics one could employ to express project extent. Indeed, different project types will have different metrics that are relevant to only those projects. For example, change in instream flow is unlikely to be useful to express the extent of a riparian fencing project. Thus, the relevance of a given metric may be case-specific. However, there are existing data management systems that capture and organize information in a manner that is portable across regional planning, funding and monitoring programs (e.g. the Pacific Coast Salmon Recovery Fund (PCSRF), the Pacific Northwest Habitat Restoration Project Tracking Database (PNSHPTD)), and would represent cost-effective data management to satisfy data needs for NEB planning and assessment under RCW 90.94. Appendix A & B are example data definitions from the PNSHPTD data system that is widely deployed across the states of Washington, Oregon and Idaho that provides an example of how these information needs have been interpreted in data structures and metrics. It is intended to be an example of how these data may be defined, but not presented as a requirement.

C. Specific information needs associated with RCW 90.94

There are different sets of management actions that could be undertaken in different parts of the above workflow. Part 1 of the workflow addresses a limited variety of water withdrawals, but the restoration/mitigation actions that are possible in response, and referenced in part 3, include a much larger diversity of mitigation possibilities in terms of type, location and coincidence in time with the consumptive use withdrawal. The actions specific to the context of RCW 90.94 are not covered under other regional guidance, and so are described here. In the interim guidance, these additional actions include:

1. Water right acquisitions (including period of use, instantaneous and annual volume as ac-ft/yr, and source location); and
2. Other projects that provide flow benefits such as:
 - Shallow aquifer recharge;
 - Floodplain restoration/levee removal;

- Floodplain reconnection;
 - Switching the source of withdrawal from surface to ground, or other beneficial source of withdrawal change;
 - Streamflow augmentation;
 - Off-channel storage.
3. In addition, plans may recommend other actions that may or may not be eligible for funding under 90.94 to protect instream resources or offset potential impacts to instream flows such as:
- Specific conservation requirements for new water users to be adopted by local or state permitting authorities;
 - Requesting rule-making to establish standards for water use quantities that are less than authorized RCW 90.44.050, or more or less than authorized under RCW 90.94;
 - Requesting rule-making to modify fees established under RCW 90.94;
 - Subbasin scale stormwater management strategies to protect or restore hydrologic processes.

This last set of new actions includes in part regulatory decisions (e.g. “conservation requirements”, “rule-making”, etc.) and are therefore outside the scope of this guidance. As such, they will not be covered here.

Current information tracking systems for habitat management actions do not cover all of these project types (e.g. PCSRF or PNSHPTD). Therefore, in meeting the information needs for these actions, some new information will be required. In Table 2 of the appendix below, there are definitions for project types and examples of metrics for water and non-water control projects identified in RCW 90.94 that could satisfy the information needs identified above for projects generally. These are offered as examples of data that, if collected, would be consistent with the conceptual information needs identified in RCW 90.94 and the interim guidance. Indeed, this is true for all of the metrics provided in the appendix; they do not represent a minimum requirement.

D. References

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E. Reportable Metrics

Part 1: Project-Level information Common to All Projects.

Information on the location, timing and contact is needed for all restoration/mitigation actions. Table A2.1 provides examples of project metadata and data definitions that would provide that information. This is one example mechanism to acquire that information in a manner that would be consistent with ESSB 6091 and the interim guidance.

Table	Definition	format (units) for proposed actions and field length	format (units) for completed actions
Project identification number	This is the number given to the project by the State or Tribe	text field	not applicable
Project Grantee	This the official Grantee (State or Tribal group)	Lookup Value	
Primary Subgrantee	The Tribe or State Agency that will assign the project work to be completed (i.e. NWIFC member tribe, CRITFC member tribe, KRITFWC member tribe, OR state agencies, WA state agencies)	Lookup Value	
Project name	This is the name given to the project by the State or Tribe	text field	not applicable
Project start date	The date that the project lead/subgrantee proposes to start the project.	mm/dd/yyyy	not applicable
Project end date	The date that the project's lead/subgrantee contract is completed	mm/dd/yyyy	mm/dd/yyyy
Project description	Short description of the project. The fish stock(s) and or ESUs targeted by the project should be identified as a part of this description.	Narrative, limited to 1000 char. Additional documentation can be attached (e.g. project plans).	Narrative, limited to 1000 char. Additional documentation can be attached (e.g. project plans).
Project Contact(s)	Contact person/people for the project.	Lookup List	
Everything below can be populated automatically once spatial location of worksite is provided.			
State	State that worksite is located in.	Lookup Value	
County	County that worksite is located in.	Lookup Value	
Latitude	The Latitude coordinate value for the worksite. Value should be reported as a positive number from	Number (0-180 Degrees and up to 8 Decimal Places)	
Longitude	The Longitude coordinate value for the worksite. Value should be reported as a negative number from 0 to -180 degrees with up to 8 decimal places.	Number (0-180 Degrees and up to 8 Decimal Places)	
Streamname	The name of the stream where the worksite is located. This name should be taken from the stream data layer provided by StreamNet, so that this name is consistent.	Varchar Text (60 Char.)	
LLID	The LLID of the stream where the worksite is located. An LLID is a stream number method used only in the Northwest region that is based on Latitude/Longitude coordinates of the stream confluences.	Number (25 Char.)	
Begin Ft.	This marks where on a stream network a worksite begins. Begin Ft is a distance measure on a stream network from the confluence.	Number	
End Ft.	This marks where on a stream network a worksite ends. End Ft is a distance measure on a stream network from the confluence.	Number	

Township	A public land surveying unit of 36 sections or 36 square miles. This displays the Township where the worksite is located.	Varchar Text (20 Char.)	
Range	A north-south strip of townships, each six miles square, numbered east and west from a specified meridian in a U.S. public land survey. This displays the Range within a Township that the worksite is located in.	Varchar Text (20 Char.)	
Section	A land unit equal to one square mile (2.59 square kilometers), 640 acres, or 1/36 of a Township. This displays the Section that the worksite is located in.	Varchar Text (20 Char.)	
3rd Field HUC	H.U.C. is an acronym for Hydrologic Unit Codes. Hydrologic unit codes are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units). A drainage basin is an area or region.	Lookup Value	
4th Field HUC	H.U.C. is an acronym for Hydrologic Unit Codes. Hydrologic unit codes are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units). A drainage basin is an area or region.	Number (25 Char.)	
5th Field HUC	H.U.C. is an acronym for Hydrologic Unit Codes. Hydrologic unit codes are a way of identifying all of the drainage basins in the United States in a nested arrangement from largest (Regions) to smallest (Cataloging Units). A drainage basin is an area or region.	Number (25 Char.)	
Targeted ESU (Evolutionary)		Lookup Value	
Geographic area name	On land the Geographic Area Name is defined as the name of the 5th field Hydrologic Unit (HUC). For ocean/estuarine areas not covered by 5th field HUC's the Geographic Area is the name of the water body as shown on NOAA charts or the name of the statistical area. The NWFSC will provide web access to a set of NOAA nautical charts.	text field	not applicable
Geospatial reference/location	This is locational data for each treatment site where the project work is done. Report as a point, line or polygon for all treatment locations. Latitude and longitude from GPS is preferred.	Point, line or polygon. Latitude/ longitude from GPS is preferred. Beginning and end points of stream segment can also be provided if available.	Point, line or polygon. Latitude/ longitude from GPS is preferred. Beginning and end points of stream segment can also be provided if available.

PART 2: Project-Level information Common to All Projects

In addition to information on the location, timing and contact for each action, information is needed on what kind of action is taken and how extensive it is. Table A2.2 provides example action metadata and data definitions for project type and extent metrics. In practice, those reporting the data would not report all of these metrics, but rather only those metrics that are specific to the project type undertaken – everything from the top of part 1 and one element from part 2. These metadata definitions are not provided to indicate a minimum standard, but rather to provide examples of what would be consistent with ESSB 6091 not only in terms of information needs as described above, but also in terms of the expectation in ESSB 6091 that where possible, actions undertaken as part of ESSB 6091 will be coordinated and consistent with other state and regional programs.

Table A2.2

Type	Type Definition	Subtype	Subtype Definition	Metric	Metric Definition
Water Projects (Highest Priority from Funding Guidance)					
Instream Flow	Projects that maintain and/or increase the flow of water to provide needed habitat conditions. These can include releases of water from dams or impoundments or water conservation projects to reduce stream diversions or extractions.	Water leased or purchased	Purchase of water rights. These water allocations are not withdrawn from the stream.	Annual volume as ac-ft/yr, cfs _a , cfs _i	Water volume proposed for lease or purchase and actually leased or purchased should be reported in (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis.
		Irrigation practice improvement	Installation of a headgate with water gauge that controls water flow into irrigation canals and ditches. Regulates flow on previously unregulated diversions. Also the addition of other water sources (wells etc.) so that water from diversion is less needed or improvement in irrigation systems eg. Replacing open canals with pipes to reduce water loss to evaporation.	cfs _a , cfs _i	The flow of water returned to the stream (not including water that is maintained in the stream) (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis
		Shallow aquifer recharge	Reclaimed water, stormwater collection projects directing water to shallow water aquifer via rock gallery, beaver relocation, beaver dam analogs or direct pumping located near a body of surface water in need of flow and temperature improvements.	cfs _a , cfs _i	The flow of water returned to the stream (not including water that is maintained in the stream). (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis
		Switch to ground water withdrawal	Switching the source of withdrawal from surface to ground, or other beneficial source of withdrawal change	cfs _a , cfs _i	The flow of water returned to the stream (not including water that is maintained in the stream). (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis
		Streamflow augmentation	Reclaimed water, stored water, reduction of surface diversions, or other means that are redirected with an ecologically relevant water quality (temperature & chemistry for affected species), back to a natural channel directly or via an infiltration gallery or shallow aquifer recharge.	cfs _a , cfs _i	The flow of water returned to the stream (not including water that is maintained in the stream). (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis

		Off-channel storage	Off channel storage that diverserts high flows from surface waters, either through gravity or pumping into off channel holdings. This project category also includes stormwater projects designed to slow and treat residential or urban runoff stored for later release to surface waters.	cfs _a , cfs _i	The flow of water returned to the stream (not including water that is maintained in the stream). (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis
Non-Water Projects (Lower Priority from Funding Guidance)					
Fish Screening	Projects that result in the installation or improvement of screening systems that prevent Salmonids from passing into areas that do not support salmonid survival, for example into irrigation diversion channels.	Fish Screen Installed Fish Screen Replaced	to an unscreened diversion to keep juveniles from being diverted. Replacement, repair or improvement of an existing fish screen	#, cfs _a , cfs _i #, cfs _a , cfs _i	A total count of screens proposed for installation and actually installed, recognizing that a project may install more than one screen. The flow rate at the screened diversion(s) from the water right. (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis A total count of screens proposed for installation and actually installed, recognizing that a project may install more than one screen. The flow rate at the screened diversion(s) from the water right. (CFS to nearest 0.01 CFS), on both an annual and instantaneous basis
Fish Passage	Projects that affect or provide fish migration up and down stream including road crossings (bridges or culverts), barriers (dams or log jams), fishways (ladders, chutes or pools), and weirs (log or rock). Barriers may be complete or partial.	Fish Ladder Improved	Improvement or upgrade of an existing fish ladder	#, target species	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Fish Ladder Installed	Installation of a fish ladder where there was not one previously	#, target species	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Fishways (chutes or pools) Installed	Placement of an engineered way around a barrier (usually a side channel/ or pool) or any by-pass that isn't specified as a fish ladder that is used by salmon migrating upstream; or a chute, used to ease salmon migrating downstream over a dam.	#, target species	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Barriers (dams or log jams)	Removal of a dam other than a push-up or diversion dam; or removal of a naturally formed log or debris jam that created a passage barrier	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Diversion Dam/ push up dam removal	Removal of a push-up dam (earthen dam), or removal of a diversion dam (permanent structure)	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Road Crossings in stream bed	Establishment of engineered passage associated with road placement that may include placement of a bridge.	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Culvert Improvements or	Improve, upgrade or replace an existing culvert	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.

		Culvert Installation	Add a passable culvert where none previously existed.	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Culvert Removal	Removal of culvert (often replaced by a non-blocking structure, bridge etc. or removed because the structure it was associated with was removed, a road etc.)	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.
		Weirs (Incomplete dams)	Placement, modification or removal of an incomplete dam that is a passage barrier to fish	#	There may be more than one fish passage installation per project. Report a count of all blockages that are proposed for removal or improvement and those that are actually removed or improved as part of this project. Latin name of target species.

Instream Habitat	Projects that increase or improve the physical conditions within the stream environment (below the ordinary high water mark of the stream) to support an increased salmonid population.	Streambank Stabilization	The use of rock barbs, log barbs, revetments, gabions etc. to stabilize stream banks	length treated in miles	The number of miles of treatment. Add length treated on both sides when both sides are stabilized. Add one side when one side is treated. (miles to .01 miles)
		Channel Connectivity	Increasing channel connectivity between stream channels, wetlands, and/ or off-channel habitat and floodplain channels. May include increase of historic or new channels.	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Channel reconfiguration	Changes in channel morphology, e.g. pools added/created, meanders added, former channel bed	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Deflectors/ barbs	Placement of triangular structures of rock or logs that extend into the stream to narrow and deepen the channel	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Log weirs	Placement of logs to collect and retain gravel for spawning habitat, to deepen existing resting/jumping pools, to create new pools above and/or below the structure, to trap sediment, aerate the water, or promote deposition of organic debris.	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Off channel habitat	Creation of off-channel habitat consisting of side-channels, backwater areas, alcoves or side-pools, off-channel pools, off- channel ponds, and oxbows.	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Plant Removal/ Control	The removal or control of aquatic non-native plants and noxious weeds growing in the stream channel.	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Rock Weirs	The placement of rocks to collect and retain gravel for spawning habitat, to deepen existing resting/jumping pools; and/or to create new pools, to trap sediment, aerate the water, and to promote deposition of organic debris.	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Spawning Gravel Placement	Addition of spawning gravel to the channel	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Large Woody Debris	Placement of individual logs in the stream that are not part of engineered structures or log jams or other large woody debris not specified as rootwads	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.

		Boulders	Addition of large rocks or boulders to a stream channel	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Rootwads	Placement of a stump with roots attached extending into the stream. Root wads are a type of large woody debris.	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Wood Structure/ Log Jam	Placement of Wood Structure/Log Jam with multiple logs fastened together to form increasing instream habitat	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.
		Beaver Introduction	The introduction or management of beavers to add natural stream complexity (beaver dams, ponds,	# of beavers introduced	# of beavers introduced to increase instream structure/ complexity
Instream-Wetland	Projects designed to protect, create or improve connected wetland areas (that meet the standard for federal delineation) that are known to support salmonid production. For example salmonid populations, especially juveniles, can benefit from access to connected wetland areas where conditions provide food supply, protection from high flows and protection from predators.	Wetland Creation	Creation of wetland area where it did not previously exist	area treated (acres)	Acres of artificial wetland proposed to be created and actually created from an area not formerly a wetland. (Acres to nearest whole acre)
		Wetland Improvement/ Enhancement	Improvements or enhancements to an existing wetland	area treated (acres)	Acres of wetland proposed for treatment and actually treated. (Acre to nearest whole acre)
		Wetland Restoration	Restoration of existing or historic wetland	area treated	Acres of wetland proposed for treatment and actually treated. (Acre to nearest whole acre)
		Wetland Vegetation Planting	Planting of native wetland species in wetland areas.	area treated	Acres of wetland proposed for treatment and actually treated. (Acre to nearest whole acre)
		Wetland Invasive/Noxious Weed Species Removal	Remove or control Non-native species and/or noxious weeds in wetland area	area treated (acres)	The acreage of invasive species proposed for treatment and actually treated in the wetland project. The proposed project area may only be a portion of an existing wetland such as removing an area of purple loosestrife. (Acres)
Riparian	Projects that change areas (above the ordinary high water mark of the stream and within the flood plain of streams) in order to improve the environmental conditions necessary to sustain Salmonids throughout their life cycle.	Livestock Water Development	Provision of water supply for livestock that is out of the riparian zone. Also called livestock water development or livestock water supply.	# of installations	# of installations, may be more than 1 per project
		Water Gap Development	Provision of a fenced livestock stream crossing	# of installations	# of installations, may be more than 1 per project
		Fencing	Creation of livestock exclusion or other riparian fencing	length of fencing	This refers to meander miles of stream bank proposed for treatment and treated. Report the actual length of proposed treatment, adding lengths of treatment on both sides if treatment was on both sides. (miles to .01 miles)
		Forestry Practices/ Stand Management	Prescribed burnings, stand thinnings, stand conversions, silviculture, vegetation management	area treated (acres)	Total acres proposed and actually treated to nearest whole acre. Examples of treatment include riparian plantings, or protection of riparian zone with a fence.
		Planting	Riparian planting, native plant establishment	Species; area treated (acres)	Species Planted (Latin name); Total riparian acres proposed and actually treated to nearest whole acre. Examples of treatment include riparian plantings, or protection of riparian zone with a fence
		Livestock Exclusion	Remove livestock from riparian areas	area treated (acres)	Total riparian acres proposed and actually treated to nearest whole acre. Examples of treatment include riparian plantings, or protection of riparian zone with a fence.
		Conservation Grazing Management	Alteration of agricultural land use practices to reducing grazing pressure for conservation. E.g. Rotate livestock grazing to minimize impact on riparian areas	area treated (acres)	Total riparian acres proposed and actually treated to nearest whole acre. Examples of treatment include riparian plantings, or protection of riparian zone with a fence.

		Weed Control	Removal and/or control of non-native species and noxious weed	Species; area treated (acres)	Invasive species (latin name); the total riparian acres proposed and actually treated to nearest whole acre. Examples of treatment include riparian plantings, or protection of riparian zone with a fence
Sediment Reduction	Projects the diminish sediment transport into streams	Road Reconstruction	Reconstruction and restoration of road in place (not a road relocation) and for a restoration purpose (e.g. road is crumbling into stream and needs to be reinforced). Road reconstruction does not include drainage improvement	miles	Proposed and actual treatments include road(s) decommissioned (closed, obliterated), upgraded, relocated or restored. (miles to .01 miles)
		Road Relocation	Abandonment of existing road in riparian or streambed area with or without rehabilitation and with a new road constructed in a less sensitive area.	Miles	Proposed and actual treatments include road(s) decommissioned (closed, obliterated), upgraded, relocated or restored. (miles to .01 miles)
		Road Stream Crossing Improvements (same as Rocked Ford)	Creation or improvement of a reinforced rock roadbed that crosses the stream without restricting the stream flow. Does not include stream crossing improvements that have a fish passage goal.	miles	Proposed and actual treatments include road(s) decommissioned (closed, obliterated), upgraded, relocated or restored. (miles to .01 miles)
		Road Drainage System Improvements	Placement of structures to contain/ control run-off from roads. Includes surface drainage, peak flow drainage improvements and roadside vegetation	miles	Proposed and actual treatments include road(s) decommissioned (closed, obliterated), upgraded, relocated or restored. (miles to .01 miles)
		Road Obliteration	Road closed with or without rehabilitation. Not a road relocation	miles	Proposed and actual treatments include road(s) decommissioned (closed, obliterated), upgraded, relocated or restored. (miles to .01 miles)
		Erosion Control Structures	Hillside stabilization, grassed waterways wind breaks, planting, conservation land management, and waterbars.	# of erosion structures	# of sediment control installations
		Sediment Control	Sediment basins, sediment ponds and sediment traps.	# of erosion structures	# of sediment control installations
Upland-Agriculture	Upland restoration activities relating to agricultural	Livestock Management	Any upland livestock management including livestock watering schedules and grazing management plans	acres	Total acres proposed for each treatment to nearest whole acre.
		Agriculture Management Best Management Practices	Implementation of best management practices eg low/ no till agriculture	acres	Total acres proposed for each treatment to nearest whole acre.
		Fencing	Placement of exclusion and non-exclusion fencing	miles	Total miles of fencing to nearest 0.01 mile
		Water Development	Irrigation and livestock water development including ditches, wells, ponds, springs etc.	type and #	Type of water development project (ditch, well, pond, etc.) and number of treatments.
Upland- Vegetation	Upland restoration activities relating to vegetation, includes forestry	Planting	Upland plant installation, seeding, and revegetation	area treated	Total acres for each treatment to nearest whole acre.
		Invasive Plant Control	Removal and control of non-native plants and noxious weeds	area treated	Total acres for each treatment to nearest whole acre.
		Vegetation/ Stand Management	Prescribed burns, stand thinning, stand conversion, silviculture, vegetation management, selective thinning, hazard reduction	area treated (acres)	Total acres for each treatment to nearest whole acre.
		Slope Stabilization	Implementation of slope stabilization methods including landslide reparation and terracing.	area treated	Total acres for each treatment to nearest whole acre.
Upland Wetland	Projects designed to protect, create or improve connected wetland areas (that meet the standard for federal delineation)	Wetland Creation	Wetland area created where it did not previously exist	area treated	Acres of artificial wetland created from an area not formerly a wetland. (Acres to nearest whole acre)
		Wetland Improvement/ Enhancement	Changes to an existing wetland	area treated	Acres of wetland actually treated. (Acres to nearest whole acre)

		Wetland Restoration	Restoration of existing or historic wetland	area treated	Acres of wetland actually treated. (Acres to nearest whole acre)
		Wetland Vegetation Planting	The planting of native wetland species in wetland areas.	area treated	Acres of wetland actually treated. (Acres to nearest whole acre)
		Wetland Invasive Species Removal	Removal and/or control of non-native species and/or noxious weeds in a wetland area.	area treated (acres)	The acreage of invasive species actually treated in the wetland project. The proposed project area may only be a portion of an existing wetland such as removing an area of purple loosestrife. (Acres to nearest whole acre)
Water Quality Improvement	Projects that result in an improvement of water quality conditions for example through improved water quality treatment, capture toxic highway runoff, reduction in the use of herbicides, pesticides and fertilizers, and other point sources.	Return Flow Cooling	All projects with a goal of directly reducing or directly limiting increase in water temperature. Most are return flow cooling projects which generally consist of replacing old open return ditches with underground PVC pipe. The primary benefits are eliminate nutrient and thermal loading, by filtering flows underground where they cool before returning to the river.	water temp	Water temp before and after project completion (if at a point source then avg water temp before at after of point source emission) in degrees Celsius to nearest whole degree.
		Refuse Removal	Removal of garbage in the waterway	lbs of trash collected	Pounds of trash collected from stream and wetland areas to nearest 100 pounds.
		Sewage Clean-up	Clean up of sewage outfall, etc.	Toxin, area treated (acres)	Name of Toxic species, element or material Total acres, wet and/or dry for each cleaned up to nearest whole acre.
		Toxic Clean-up	Clean up/prevention of mine tailings, herbicide, pesticide, toxic sediments, etc.	Toxin, area treated (acres)	Name of Toxic species, element or material Total acres, wet and/or dry for each cleaned up to nearest whole acre.
Outmigrant Survival Improvement (Estuary)	Projects that result in improvement of or increase in the availability of estuarine habitat such as tidal channel restoration, floodplain connectivity, floodgate fish passage or diked land conversion. This habitat is important for salmonid out migration where juvenile Salmonids begin the transition from fresh to salt water environments and where predatory pressures are known to be high. Estuarine habitat is distinct from other wetland habitat in being tidally influenced.	Invasive Species Treated	Control or removal of invasive or exotic estuarine species e.g. Spartina alterniflora	Invasive species, area treated (acres)	Invasive species (latin name); Acres of estuary proposed for treatment and actually treated to nearest whole acre.
		Creation of new estuarine habitat	Creation of an estuarine area where one did not exist previously	area created (acres)	Acres of estuary proposed for treatment and actually treated to nearest whole acre.
		Restoration/Rehabilitation of estuarine habitat	Restoration of existing or historic estuarine habitat	area created (acres)	Acres of estuary proposed for treatment and actually treated to nearest whole acre.
		Removal of existing fill material	Removal of fill that isn't associated with a dike e.g. removal of tideflat fill.	area treated	Acres of estuary proposed for treatment and actually created to nearest whole acre.
		Channel Modification	Deepening or widening existing tidal channel	Type of modification length treated in miles	Type of channel modification and Length of channel modified in miles to nearest 0.01 miles)
		Dike Breaching/ Removal	Removal or breaching of a barrier constructed to contain tidal flooding. Breaching/ removal allows for natural flow/flood regime and potential for off-channel habitat usage.	#; length of treatment (miles)	Number of Dikes breached or removed, total aggregate length of dike reconfigured in miles to .01 miles.
		Tidegate Alteration/ Removal	Removal or changes to tidegate that allows water to flow freely when the tide goes out, but which prevents the water from flowing in the other direction. Changes are generally made to allow fish passage at low and high tide.	#	Number of tide gaits removed or altered
		Dike Reconfiguration	Modification of location or design of an embankment to confine or control water flow.	#, length of treatment (miles)	Number of reconfigurings, total aggregate length of dike reconfigured in miles to .01 miles.
Land Protected, Acquired, or	Projects that involve the acquisition or lease of land or riparian areas.	Streambank Protection	Protection of section of streambank from further degradation or development through purchase, lease, negotiated agreement, statute or other mechanism.	meander miles	This refers to meander miles (to nearest 0.01 mile) of stream bank proposed for protection and actually protected by acquisition, easement or lease. Count miles on both sides of stream if both sides are acquired. Count on one side if only one side is acquired.

Leased		Wetland or Estuarine Area Protection	Protection of wetland or estuarine area from further degradation or development through purchase, lease, negotiated agreement, statute or other mechanism.	acres	The acreage reported should be the total acreage proposed for protection and actually protected regardless of whether all of the habitat is applicable to the desired goals for acquisition. (Acres to nearest whole acre)
Nutrient Enrichment	Projects to add marine derived nutrients back into the system	Fertilizer	Nutrients placed in stream to increase nutrient availability	Weight of fertilizer, area treated (acres)	Total of fertilizer delivered (pounds to nearest 100 pounds); Total acres of each treatment to nearest whole acre
		Carcass Analog	Fish meal bricks placed in the stream to increase nutrient availability	Weight of fertilizer, area treated (acres)	Total of fertilizer delivered (pounds to nearest 100 pounds); Total acres of each treatment to nearest whole acre.
		Carcass Placement	Dead salmon added to stream	area treated (acres), weight of carcasses	Total acres of each treatment to nearest whole acre, total weight of salmon carcasses placed in the stream
Project Maintenance	Projects that maintain the functionality of Salmonid Restoration Projects	Site Maintenance	Maintenance of the restoration project site eg. replanting trees that failed to survive	length treated in miles	This refers to meander miles of instream habitat treatments. Count actual stream length treated to nearest 0.01 miles.