Nisqually Watershed Response to the 2018 Streamflow Restoration Act (RCW 90.94)

Addendum to the
Nisqually Watershed Management Plan

Prepared for the Nisqually Indian Tribe
and Nisqually Watershed Planning Unit

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List of Acronyms

AFY – Acre Feet per Year
ASR – Aquifer Storage and Recovery
BoCC – Board of County Commissioners
BoH – Board of Health
CFS – Cubic Feet per Second
CIP – Capital Improvement Project
EDT – Ecosystem Diagnosis and Treatment
ESA – Endangered Species Act
FERC – Federal Energy Regulatory Commission
GIS – Geographic Information System
GMA – Growth Management Act
GPD – Gallons Per Day
IRPP – Instream Resource Protection Program
JBLM – Joint Base Lewis-McChord
LAMIRD – Limited Area of More Intensive Rural Development
MAR – Managed Aquifer Recharge
MGSA – McAllister Geologic Sensitive Area
NEB – Net Ecological Benefit
NIT – Nisqually Indian Tribe
OFM – Office of Financial Management
PSRC – Puget Sound Regional Council
PUD – Public Utility District
RCW – Revised Code of Washington
RM – River Mile
SFR – Single-Family Residential
TRPC – Thurston Regional Planning Council
UGA – Urban Growth Area
USGS – United States Geological Survey
WAC – Washington Administrative Code
WRIA – Water Resource Inventory Area
WWT – Washington Water Trust

Executive Summary

Introduction

Under the leadership of the Nisqually Indian Tribe, the Nisqually Watershed Planning Unit reconvened in July of 2018 to address the requirements of the Streamflow Restoration Act (RCW 90.94.020) with an Addendum to the 2003 Nisqually Watershed Management Plan. The Act requires the Planning Unit to provide estimates of consumptive water use from domestic permit-exempt well connections in the watershed over the next 20 years and identify mitigation actions to offset the potential impacts of forecasted permit-exempt water use on instream flows and senior water right holders. Overall mitigation is expected to provide a Net Ecological Benefit (NEB) to the entire watershed. The Washington State Department of Ecology (Ecology) is tasked with making a final determination of NEB.

The watershed includes parts of Thurston, Pierce and Lewis Counties. The Counties and Planning Unit have forecast rural growth and water use through 2040 (2018 – 2040) in order to better match growth projections used in the counties' comprehensive planning work. Therefore, the consumptive use mitigation offsets proposed in this document actually address 22 rather than 20 years of permit-exempt well use associated with rural growth in WRIA 11.

Due to the very short timeframe the Nisqually Planning Unit had to provide a response to the Hirst legislation, this Addendum offers conceptual frameworks and quantification for priority habitat and other mitigation projects that can both supply streamflow benefits and forward the goals of salmon recovery and sustainable community development. The Implementing Governments (Thurston, Pierce, and Lewis Counties and the Nisqually Indian Tribe) will undergo a public outreach and adoption process after submittal to Ecology on February 1, 2019. The Planning Unit intends to continue to meet to address funding and implementation of the projects identified in this Addendum, to work with Ecology to track mitigation and ensure it is keeping pace with rural development, and to adaptively manage mitigation needs as they evolve.

RCW 90.94.020 does not address implementation, funding or adaptive management associated with this process. It simply requires that potential projects and other associated mitigation strategies that will offset forecast impacts of permit-exempt well connections be identified. However, the intent of the legislation was that implementation of the projects identified herein would fulfill counties' obligations under the Growth Management Act to ensure that water is available for rural growth. While the Nisqually Planning Unit's aggressive timeframe did not allow development of a detailed funding strategy, the Planning Unit notes that the intent is for strategies in this plan to be funded in large part by state funding mechanisms, including funding provided under the Streamflow Restoration Act. County permitting mitigation fees may be a partial source of funding for mitigation strategies in the future; however, the Planning Unit does not expect county permitting fees to financially support the ambitious recovery approach set out in this plan.

Plan Addendum Organization

This Plan Addendum includes the following Chapters:

1. Introduction and Background: Addressing Planning Unit Agreement, context for the Hirst Response by the WRIA 11 PU, explanation of the complex regulatory flow regime in WRIA 11, Sub-basin delineation and summary of the Nisqually Planning Unit's overall approach to mitigation.
2. Watershed Features that Influence Mitigation Alternatives: Addressing physical and regulatory features of the watershed and sub-basins that were considered in the context of water use forecasts and mitigation.
3. Water Use Forecasts: By county, by sub-basin and for the full watershed. Three different water use forecasts were generated; 1) actual annual average consumptive use based on Thurston PUD data, 2) actual annual average consumptive use based on Ecology methodology, and 3) an estimate of the consumptive portion of the legal right to the water (3000 gpd).
4. Salmon Habitat Projects: Addressing larger scale salmon recovery initiatives and the projects within them that provide instream flow and net ecological benefits (macro-mitigation).
5. Mitigation Strategies in the Nisqually Watershed: Addressing sub-basin scale mitigation strategies tailored for each sub-basin in WRIA 11.
6. County Strategies: Including overviews of the permitting process and possible implementation strategies for the three counties.
7. Mitigation Offsets by Sub-basin: Providing a quantitative summary of the mitigation offsets, identified for each project by sub-basin and by full watershed. Table 7-2 summarizes all of the proposed mitigation strategies that have been quantified and Table 7-3 compares those mitigation offsets to actual consumptive use estimated for each sub-basin in WRIA 11.
8. Implementation and Adaptive Management: Identifying implementation responsibilities as understood by the Planning Unit and an approach to adaptive management that recognizes that the Planning Unit will continue to work toward implementation.

This Addendum is a companion document to the 2003 Nisqually Watershed Management Plan and 2007 Phase IV Implementation Plan. Relevant background information and associated figures from the 2003 plan are referenced and, unless of specific benefit, are not repeated in the Addendum.

Summary of Results

Table 7-2 in Chapter 7 (see Figure 5) presents a summary of the mitigation strategies and associated water offsets considered for this Plan Addendum. Table ES-1, below, provides an estimated minimum and maximum flow benefit associated with the application of each of those strategies to the sub-basins in which they are applicable. The table also provides a comparison of proposed mitigation offsets to the more conservative of two annual average consumptive use forecasts for 2040 by both sub-basin and for the entire watershed. On a watershed scale, the minimum identified mitigation offsets (4.22 cfs) are significantly greater than the total forecast consumptive use (1.03 cfs). Flow benefits realized from salmon recovery efforts in the Mashel sub-basin provide 82% of the minimum mitigation offset for the entire watershed, although the consumptive water use in the Mashel is forecast to be only 0.1% of the total watershed. On the other hand, sub-basin specific offsets will require more than the minimum mitigation in Thompson/Yelm and Lackamas/Toboton/Powell sub-basins in Thurston County, and the Prairie Tributaries sub-basin in Pierce County.

Planned mitigation actions include several key elements that impact the demand for mitigation offset. Mitigation estimates in the Thompson/Yelm sub-basin include the removal of 95% of the forecast permit-exempt well connections within the Yelm UGA (240.5 AFY), which would be serviced by city water if Yelm's water right is

approved. Aside from the flow benefits associated with the Mashel forest acquisition, this Yelm water right strategy provides the greatest flow benefit for a single mitigation strategy in the watershed. Also viewed as a demand offset, the Planning Unit's regulatory interpretation of the Upper Nisqually sub-watershed is that the upper sub-basin is not closed. The projected consumptive demand of 49 AFY in the Upper Nisqually therefore does not require mitigation offset.

In addressing Net Ecological Benefit (NEB), the Planning Unit has prioritized its recommendations based on a long-term approach that balances development, agricultural and industrial needs with the goal of restoring a self-sustaining, salmon-supporting watershed ecosystem. The highest priority mitigation actions in this Addendum are major investments in salmon recovery efforts that will restore seasonal streamflow and safeguard habitat and water quality in systems most critical to listed salmonid populations. Implementing Governments may choose to pursue more local mitigation actions, including possible building permit process changes, as needed, to offset permit-exempt well impacts within sub-basins. The Planning Unit's goal, however, is to satisfy NEB at the watershed scale to achieve the desired outcome for salmon recovery with the minimum necessary impact on rural development.

Table ES-1: Actual Forecast Consumptive Use in 2040 (Ecology Method) Compared to Minimum and Maximum Estimated Mitigation

Sub-basin	ECY Method Annual PE Consumptive Use (AFY)	ECY Method Annual PE Consumptive Use (cfs)	Mitigation Actions Identified - annual AF (MIN)	Mitigation Actions Identified - annual AF (MAX)	Mitigation Actions (cfs) MIN	Mitigation Actions (cfs) MAX
McAllister	39	0.054	TBD	TBD	TBD	TBD
Thompson/Yelm	390	0.539	349.02	762.1	0.47936	1.0496
Lackamas/Toboton/Powell	107	0.148	84.17	504.57	0.116208	0.69708
Lower Nisqually	0.5	0.001	0	200	0	0.552
Mashel River	5	0.007	1922	4281	3.48	7.27
Prairie Tributaries	149	0.206	41.7	1290	0.0576	2.058
Ohop Creek	7	0.009	24	1336	0.017	2.105
Upper Nisqually (Pierce, Lewis, Thurston)	49	0.067	49	249	0.067	0.619
TOTAL	**747**	**1.03**	**2470**	**8623**	**4.22**	**14.35**

Chapter 1 Introduction and Background

1.1 Nisqually Watershed Planning and the Hirst Response

The Nisqually Watershed Planning Unit continues to work collaboratively to address water resource issues within the Nisqually Watershed (Water Resource Inventory Area [WRIA] 11). Acting under authority of the 1998 Watershed Management Act (chapter 90.82 RCW), with the Nisqually Indian Tribe as the Lead Agency, the Nisqually Planning Unit adopted in October 2003 the *Nisqually Watershed Management Plan* (Golder, 2003). Acting at a joint meeting held April 13, 2004, Lewis, Pierce and Thurston counties unanimously approved that plan. Continuing its collaborative work, the Nisqually Planning Unit in February 2007 adopted the *Phase IV Nisqually Implementation Plan* (Golder, 2007), further identifying actions to be taken to implement the 2003 Plan.

In January 2018, the Washington State Legislature adopted Engrossed Substitute Senate Bill 6091 (later codified as chapter 90.94 RCW, the Streamflow Restoration Act) to address a 2016 Washington Supreme Court decision (*Whatcom County vs. Western Washington Growth Management Hearings Board*; commonly referred to as the "Hirst Decision"). The Hirst Decision required counties to independently verify, when issuing a building permit, that impacts from proposed new domestic permit-exempt wells required for development applications would not impair senior water rights, including established minimum instream flows. The Legislature adopted chapter 90.94 RCW to provide clarity to counties and a path forward for allowing rural domestic development that relies on permit-exempt well connections for a water source.

The Streamflow Restoration Act directs the Washington State Department of Ecology (Ecology) to work with Initiating Governments and Planning Units to identify potential impacts of permit-exempt well use, identify evidence-based conservation measures and identify projects and actions to improve watershed health and offset potential impacts to instream flows associated with permit-exempt domestic water use. The law also requires that each county in WRIA 11 record restrictions or limitations associated with water supply with the property title, collect a fee of $500 from each building permit applicant ($350 of which is transmitted to Ecology), record the number of building permits and transmit an account of building permits and subdivision approvals subject to the law annually, and limit the withdrawal exemption for an applicant to a maximum annual average of 3000 gpd/connection.

1.2 Scope of this Addendum and Agreements

The Streamflow Restoration Act (the Act) mandated that the Nisqually Planning Unit, acting under authority of RCW 90.82, update the Nisqually Watershed Management Plan to explicitly address future permit-exempt domestic groundwater withdrawals over the next 20 years, the potential impacts of those forecasted withdrawals on minimum streamflows and other senior water rights, and strategies to mitigate for those impacts. The mandated deadline for this activity is February 1, 2019. The Nisqually Planning Unit reconvened in July of 2018, and under the leadership of the Nisqually Indian Tribe, crafted a formal Working Agreement under which to operate while addressing the requirements of the Act. The Working Agreement, included as Appendix A, describes the decision framework for approval of this Watershed Plan Addendum by the Planning Unit.

While most watersheds subject to the requirements of the RCW 90.94 have over two years to respond to the requirements of the Act, the Nisqually Watershed Planning Unit had less than one year. There are three counties located within the watershed, all of which may consider implementing changes to their current building

application process to address rural water use. Due to the short timeframe, some mitigation strategies that are being developed to offset potential streamflow impacts from permit-exempt well withdrawals need further development and quantification after the mandated February 1, 2019 plan update.

Thurston, Pierce and Lewis Counties are laying the groundwork for mitigation strategies that may be applied and further developed for other watersheds in their responses to chapter 90.94 RCW. Thurston County is involved in Streamflow Restoration Act processes in WRIAs 13, 14, 22 and 23; Pierce County in WRIAs 10, 12 and 15; and Lewis County in WRIAs 13 and 23. The Planning Unit has structured an adaptive management approach that will continue after February 1, 2019 to enable Implementing Governments to fully develop mitigation actions and implement potential code or ordinance changes to enable offsets if needed. Detailed evaluation of habitat projects and technologies that will more specifically quantify streamflow benefits will also occur during this adaptive management period. Chapter 8 addresses the Planning Unit's adaptive management approach.

The Planning Unit recognizes that the process set up by the legislation and the strategies of the plan address only a small portion of water use in the watershed; that attributed to future domestic permit-exempt wells. The plan does not address historic impacts, nor does it attempt to quantify or address potentially larger impacts to streamflows from factors such as non-domestic uses, climate change, and changes to land cover. Adaptive management is an important principle in ensuring that managing for the impacts of permit-exempt wells takes place in the context of larger water use and environmental issues in the watershed.

This document serves as an Addendum to the 2003 Phase III Nisqually Watershed Management Plan (Golder, 2003) and the 2007 Phase IV Nisqually Implementation Plan (Golder, 2007) and is narrowly focused specifically to address the requirements of the Streamflow Restoration Act. The Act requires the Nisqually Watershed Planning Unit to prepare a plan update that provides mitigation for the projected impacts of domestic use of new permit-exempt wells on instream flows occurring between 2018 and 2040. This Addendum provides forecasts of consumptive water use from domestic permit-exempt groundwater connections in the watershed and recommends actions to offset those impacts. The actions have been developed such that they provide a net ecological benefit (NEB) to instream resources within the entire Nisqually Watershed (WRIA 11).

This Addendum is considered a companion document to the 2003 Nisqually Watershed Management Plan and 2007 Phase IV Implementation Plan. Relevant background information and associated figures from the 2003 plan are referenced and, unless of specific benefit, are not repeated herein.

The original Nisqually Watershed Planning Unit defined five key challenges in their 2003 Watershed Management Plan (Golder, 2003). Three of those challenges directly address the nexus between growth management and rural water supply. The 2007 Nisqually Implementation Plan provided four recommendations to the Department of Ecology to address permit-exempt well use and the consumptive impacts of that use on local instream resources (Golder, 2007, p. 15). These included:

GW-7 (EW) This plan recommends that Ecology provide more thorough oversight of exempt wells (see WAC 173-511-070). The issuance of a start card (notice of intent to drill) for an exempt well by well drillers and Ecology's database of start cards should be consistent with available information on Coordinated Water System Plan service area boundaries, available hydrogeologic information on local aquifers, and cumulative effects of exempt wells.

GW-7a (EW) The Department of Ecology should study the cumulative impacts of exempt wells and consider setting a basin-wide standard for the number of houses allowable per exempt well. This plan

recommends that Ecology increase their enforcement of the exempt well statute[1] and develop an Exempt Well Action Plan to achieve compliance with the intent of the exempt well withdrawal statute. (See page 43 in the Plan for details.) *The Planning Unit will identify areas for characterization in this study as a 2006 work task.*

GW-7b (EW) Once sufficient information is gathered on the cumulative impacts of exempt wells as directed in GW-7a (EW), the Planning Unit may wish to consider avenues to address the drilling of exempt wells in areas where technical data indicate they may have impact on surface water systems. In sensitive areas, this might include the option of drilling in deeper aquifers that are more protective of surface water, if available.

GW-8 (EW) Develop a policy to transfer exempt well water rights within a water service area or urban growth area to a water purveyor and submit to Ecology for water right credit. Define how much credit should be granted for taking exempt wells off line as part of this policy.

The four recommendations (above) made by the Nisqually Planning Unit in their Watershed Implementation Plan recognized the need to account for the impacts of permit-exempt groundwater uses on streamflow, particularly in sub-basins with adopted instream flow rules. However, implementation of those recommendations was directed to the Department of Ecology (Ecology). The Hirst decision and subsequent legislation interprets the Growth Management Act (GMA) as requiring that the counties exercise their own independent statutory responsibility to make a determination about the physical availability and legal availability of water. It is the counties' duty under GMA to protect water availability, particularly in water-short areas. This includes ensuring that the cumulative impacts of one or more new permit-exempt wells do not impair minimum instream flows or other senior water rights.

1.3 Sub-Basin Delineation

Consistent with Ecology guidance for developing water use estimates to delineate the WRIA into "suitably sized [areas] to allow meaningful determinations" (Ecology, 2018a), WRIA 11 was divided into eight areas referred to as aggregated sub-basins. The aggregated sub-basins are based on previous watershed planning delineations, an understanding of differing hydrogeologic regimes, and political boundaries that delineate specific counties. Watershed hydrogeology is described by sub-watershed in Section 4.2 of the 2003 Watershed Plan (Golder, 2003). A brief summary of physical sub-basin characteristics related to mitigation strategies is provided for each sub-basin in Chapter 2 of this Addendum. The aggregated sub-basins are listed in Table 1-1 and shown on Figure 1.

Table 1-1: WRIA 11 Aggregated Sub-Basins

Aggregated Sub-Basin	County
McAllister	Thurston
Thompson/Yelm	Thurston
Lackamas/Toboton/Powell	Thurston
Lower Nisqually	Pierce
Mashel River	Pierce
Prairie Tributaries	Pierce
Ohop Creek	Pierce
Upper Nisqually (Lewis, Pierce, Thurston)	Portions of Lewis, Pierce and Thurston

[1] *2007 Ecology comments stated that they have selectively enforced the permit-exempt well laws as resources have permitted.*

1.4 Established Instream Flows in WRIA 11

Minimum instream flow regulations have been established in WRIA 11 by Ecology under the Instream Resource Protection Program (IRPP) and are described in Chapter 173-511 of the Washington Administrative Code (WAC). Instream Flows and closures in the Nisqually Watershed have a priority date of February 1981, when they were adopted as administrative rule. WAC 173-511 was then revised in 1988. The full text of the administrative code is included as Appendix B. Water bodies affected by instream flow regulations are shown on Figure 2.

Flow regulations in WRIA 11 consist of minimum instream flow levels and sub-basin closures to further consumptive use. In WAC 173-511, instream flow levels were set for four segments of the Nisqually River, each with a specific flow control or measuring site (above Alder reservoir, below the LaGrande Powerhouse, the bypass reach and below the Centralia Powerhouse) and for the Mashel River, measured at the USGS gauge on the Mashel River (Figure 2). Additional minimum instream flow requirements are in place year-round for the bypass reach, the reach below LaGrande Powerhouse, and the reach below the LaGrande Dam, established by the Federal Energy Regulatory Commission (FERC) as license requirements for the Tacoma Public Utilities Nisqually Hydroelectric Project and the City of Centralia's Yelm Hydroelectric Project.

In addition to these minimum flows, 20 tributaries and lakes and two segments of the Nisqually mainstem have been closed, at least seasonally, to further allocation. The closures are shown on Figure 2. Some stream closures identified in the IRPP were established by earlier administrative actions dating back as far as 1944. These closures also have a priority date of 1981, when they were "re-adopted" as administrative rule. Since these older closures do not specify a period of closure, it is assumed that the closure is applied year-round.

These instream flow rules provide a water right for each subject stream or river segment with an associated date that is senior to any permit-exempt well use initiated subsequent to that date. Much of the Nisqually Watershed is administratively closed to new water appropriation due to the establishment of instream flows under WAC 173-511-030 and closures established under WAC 173-511-040. Water bodies impacted by these rules are shown in Figure 2. The Nisqually River segment above Tacoma's hydroelectric project and tributaries to that segment (the Upper Nisqually sub-basin of this plan) were not closed to further appropriation by the IRPP.

Although the 2003 Nisqually Watershed Plan recognized the impacts of permit-exempt well use on local streamflow and recommended that actions be taken by Ecology to address those impacts, the Plan did not create a water reservation for rural growth to address the minimum streamflows and closures previously adopted under Chapter 173-511 WAC for the watershed. Hence WRIA 11 is subject to the requirements of the 2018 Streamflow Restoration Act (Chapter 90.94 RCW) and must address potential impairment to an instream flow from future domestic permit-exempt well use.

1.5 Nisqually Approach to Mitigation

The Nisqually Planning Unit is taking a two-part approach to mitigating the impacts of future rural growth on streamflows in the watershed. Sub-basin specific offsets or "micro-mitigation" will take the form of projects involving aquifer recharge, use of deeper aquifers to minimize impacts to local surface water bodies and water right acquisition, and policies that reduce rural water use and track mitigation credits as part of County building permit approval. These sub-basin specific micro-mitigation strategies are intended to restore streamflows impacted by permit-exempt groundwater use within sub-basins over the next 20 years. Micro-mitigation actions can, in most cases, be implemented as specific offsets within sub-basins, via a mitigation credit bank or other accounting system available to new development applicants. Some sub-basin-specific offsets are also generated by

local habitat projects. These projects are strategically linked to large-scale habitat initiatives addressing Net Ecological Benefit for the watershed, but the streamflow benefits they provide are applied at a sub-basin scale.

Larger, watershed-scale habitat projects that provide a Net Ecological Benefit (NEB) for the entire watershed are referred to as "macro-mitigation" and provide both flow benefits and ecological benefits essential to native salmon populations. The Planning Unit views these watershed-scale macro-mitigation goals as essential to the broader goals of the Streamflow Restoration Act to protect instream flows and salmon populations in an era of increasing development and changing climate. Withdrawals from domestic permit-exempt wells are one relatively small component of the water use challenges facing the Nisqually Watershed in the coming decades. As climate change impacts precipitation and hydrologic patterns, meeting the water needs of the growing communities of the middle and lower watershed basins will depend on long-term conservation actions taken throughout the watershed. This Addendum discusses macro-mitigation streamflow actions in the context of major salmon recovery habitat initiatives and providing sustainable NEB that supports this central goal of the Nisqually Watershed community.

Macro-mitigation projects and the NEB they provide at a watershed scale are discussed in the context of Salmon Recovery in Chapter 4. Micro-mitigation projects and policies and the mitigation they provide to offset the direct impact of permit-exempt wells on local streamflow at a sub-basin scale are discussed in Chapters 5 and 6.

1.6 Funding for Mitigation

While the Nisqually Planning Unit's legislatively-directed aggressive timeframe did not allow development of a detailed funding strategy, the Planning Unit notes that the intent is for strategies in this plan to be funded in large part by state funding mechanisms, including funding provided under the Streamflow Restoration Act. This is particularly true for the macro-mitigation strategies. County permitting mitigation fees may be a partial source of funding for both macro and micro strategies in the future; however, the Planning Unit wishes to make clear that applicable fees directed by the Streamflow Restoration Act in their present form cannot and should in no way be expected to financially support the ambitious recovery approach set out in this plan.

Chapter 2 Watershed Features that Influence Mitigation Alternatives

2.1 Watershed Overview in the Context of Mitigation

The Nisqually Watershed Planning Unit has divided the watershed into eight sub-basins in which to address sub-basin specific mitigation strategies (Figure 1). The goal of this plan Addendum is to identify the likely impacts of new permit-exempt well connections on streamflows in each sub-basin over the next 20 years, and to identify actions that will mitigate those impacts. Mitigation options are not "one size fits all" within the WRIA. The hydrologic character and development trends in each sub-basin speak to the type of mitigation that will most appropriately provide instream flow benefits to offset impacts from forecast domestic permit-exempt well withdrawals, as well as non-streamflow net ecological benefits to salmon.

This chapter describes the physical characteristics of the watershed and specific sub-basins in the context of appropriate mitigation alternatives. Each sub-basin discussion includes the current state of knowledge about the sub-basin including basic hydrogeology, stream and aquifer flows, salmon usage, historic land use trends and the regulatory instream flow status.

2.2 Watershed Hydrology and Geology

The geology and streamflows of various Nisqually sub-basins have been described in detail in the 2003 Watershed Plan and numerous other studies (Golder, 2003; Pringle, 2008). This section provides a general summary of the watershed's hydrogeology as background to identifying viable strategies to mitigate the streamflow impacts of new permit-exempt wells for domestic use. Chapter 4.2 of the 2003 Watershed Plan provides in-depth background and references for specific sub-basin geology, hydrogeology, and hydrologic continuity. Figure 8 of the 2003 Watershed Plan (included as Figure 3 in this Addendum) provides a hydrogeologic cross section showing the alternating geologic units that create the multiple aquifers and aquitards underlying the watershed. The underlying geology of a sub-basin influences to a large extent the movement and availability of groundwater in the area. It also has a large influence on the hydraulic continuity between streams and groundwater, and hence, between well withdrawals and groundwater. Because this Addendum is a companion document to the 2003 Plan, this section summarizes this material briefly as needed to address the impacts of permit-exempt well water use.

The Nisqually Watershed has two primary broad geological structures and, as a result, two types of streams. The first, located in the Ohop, Mashel and Upper Nisqually sub-basins in the upper part of WRIA 11, consists of hills, low mountains and Mount Rainier underlain primarily by bedrock. In most years even the lower elevations of these uplands receive snow, with significant snow accumulations in upper elevations. Streams in the upper watershed can flow with high volume and velocity, especially following rain on snow events.

There is a total blockage to salmon migration at approximately river mile 40 of the Nisqually River at Alder Dam. Thus, the Planning Unit has divided this eastern area into the Upper Nisqually (the area above salmon access) and two sub-basins with salmon access and upper elevation geology – the Mashel and Ohop sub-basins. Regardless of location, the primary land use in the eastern area of the watershed is commercial timber, with almost all of the land being forested. Virtually all of this area is in Pierce and Lewis counties.

The second broad geological area is west of the Eatonville/Route 161 line and includes almost all of the Thurston County portion of the watershed and parts of Pierce County. This is the area of the county that was impacted by

the Continental glaciers, commencing over 100,000 years ago until the most recent Vashon Stage of the Fraser Glaciation began approximately 15,000 years ago. As the glaciers advanced and then retreated, many times over thousands of years, they left geological layers of alternating outwash sand and gravel, and layers of thick glacial till and other low-hydraulic conductivity. The sand and gravel layers contain water and these layers are generally referred to as aquifers. The glacial till layers wholly or partially confine portions of the aquifers. However, there is typically some degree pf hydraulic connection (continuity) between the aquifers. These deposits differ dramatically in composition and thickness in each of the sub-basins, resulting in some areas with prolific supplies of groundwater while others have minimal supply. The USGS and others have conducted extensive studies characterizing the hydrogeology of southern Pierce County and Northwest Thurston County (Jones et al, 1999; Dion et al, 1994; Drost et al, 1999; CDM, 2001; CDM, 2002). These studies are summarized in the Nisqually Management Watershed Plan (Golder, 2003; see Section 4.2).

Within these areas in the western part of the watershed, rainfall percolates into the ground very rapidly. Therefore, streams in this area are small relative to the size of the drainage area and many streams are intermittent in that they only flow at some times during the year. Before being otherwise developed, these areas were vast prairies with significant tree growth found only in wetland areas and along stream corridors.

Most of the streams in the western part of the watershed, characterized by rural residential development (including Lackamas/Toboton/Powell, Yelm/Thompson and Prairie Tributaries sub-basins), are intermittent streams – streams that are in close contact with the upper, or near-surface, aquifer. These streams lose flow as the aquifer water levels diminish in dry months and gain flow as the aquifer is recharged with the fall and winter rains. Section 4.2.1 of the 2003 Watershed Plan describes sub-basin groundwater availability in detail. Because of this intermittent flow pattern, these streams exhibit low flows that are expected to be exacerbated by new permit-exempt wells in the shallow, or surface, aquifer. Therefore, this plan Addendum includes a focused discussion of mitigation options for these prairie streams (see Chapter 5).

It is important to note that major streamflow changes occur because of both seasonal effects and diversions or withdrawals of surface/groundwater. In WRIA 11 in Thurston County alone, at least 3,655 wells are currently pumping, with a combined estimated actual groundwater withdrawal of 17,502 AFY. Existing wells' effects are not considered in this plan Addendum because they are not part of Streamflow Restoration Act requirements. Existing diversions and withdrawals, however, form the context for prior effects on streamflow.

2.3 Sub-Basin Characteristics

The following sections provide background on physical and regulatory characteristics of each sub-basin in the Nisqually watershed.

2.3.1 McAllister Sub-Basin – Thurston County

The major part of the McAllister Sub-Basin, located in Thurston County, consists primarily of the lower Nisqually Valley, downstream of the Nisqually Indian Reservation. Other than the Nisqually River itself, the major stream in the area is McAllister Creek, an independent stream that discharges directly into the Nisqually Estuary. This sub-basin also includes the Lake Saint Clair watershed, a small independent watershed of one stream, Eaton Creek, which discharges into the lake. The lake itself discharges to the aquifer.

Geology

The underlying geology of the McAllister Sub-Basin is entirely glacial and post-glacial. The broad lower Nisqually Valley, carved by the continental glacier, consists of riverine sand and sediment deposited over the past 10,000

years by the Nisqually River. The bluffs surrounding the valley consist of sand, gravel and clay deposits left by the glacier as it retreated. As they retreated, the glaciers left extensive outwash areas of sand and gravel, some near the surface and others buried more deeply. The glacier also deposited thick layers of sediment that, when compressed, become hard clay (glacial till).

Water

The major stream of this sub-basin is the Nisqually River, which drains the 786-square mile watershed and brings abundant sediment to the lower Nisqually Valley. There are two independent streams, McAllister and Eaton creeks, that derive flow from springs discharging from aquifers as the stream course and aquifer intersect.

Most of the rainfall landing in this sub-basin discharges not as surface flow in streams but rather to Puget Sound through the several deeper aquifers underlying the sub-basin. A significant quantity of groundwater flow in the Qva (Vashon advance outwash) and Qc (pre-Vashon glacial unit) aquifers appear to converge toward McAllister/Abbot Springs and McAllister Creek in the northern portion of the McAllister sub-basin. The 2003 Watershed Plan describes this highly productive aquifer as the "Nisqually Aquifer". Because these aquifers are important regional sources of drinking water, they have been studied extensively (Dion et al, 1994; Drost et al, 1999; City of Olympia and Nisqually Indian Tribe, 2008). All these studies indicate that there are several aquifer layers, usually at least three: the shallow Qva, and intermediate and deep aquifers; the Qc aquifer and the TQu deposits that are considered undifferentiated deposits underlying the underlying the Qc. In this sub-basin, the Qc aquifer and TQu are considered part of the "Nisqually Aquifer" and are below sea level and discharge primarily to Puget Sound.

Salmon Usage

The Nisqually River is the major migration corridor for all salmon species entering or leaving the Nisqually Watershed. McAllister Creek and its tributaries, as an independent drainage, receive some salmon spawning of various species every year. However, these spawning runs are relatively minor and are not managed separately. Eaton Creek has no connection with Puget Sound.

Land Use and Development

The McAllister sub-basin has the most varied land use in the watershed, including highly urbanized areas, rural areas, and large open space and recreation. The western portion of the sub-basin lies within the Lacey Urban Growth Area (UGA) or the incorporated City of Lacey. Development in the Lacey UGA, which includes moderate-density residential use and the Martin Way Corridor, will likely depend on the City of Lacey for municipal water service. New low-density rural residential development that uses permit-exempt wells as a water source is most likely to be developed in areas zoned as Rural Residential 1/5 or Rural Residential Resource 1/5. However, many of these areas may also be within the boundary of one of the 21 existing Group B public water systems in the sub-basin (personal communication, Thurston PUD).

One fifth of the sub-basin is zoned as McAllister Geologic Sensitive Area (MGSA), a low-impact zoning designation created to protect the City of Olympia's water source, which has restrictive development regulations. Approximately 1,000 acres is zoned for long-term agriculture; many of the available development rights associated with parcels in the Nisqually Agriculture zoning district were purchased and retired in the late 1990s, and thus will not experience further development. The southern portion of the sub-basin falls within Joint Base Lewis-McChord and is zoned as a Military Reservation – no additional residential development is anticipated in this area. Because of the extensive glacial-origin deposits, there are and likely will continue to be relatively large sand and gravel mining operations in this sub-basin.

Regulatory History

The Nisqually River in this sub-basin has a minimum flow requirement but is not closed for future out-of-stream water appropriations (see the Instream Resources Protection Program [IRPP] for the Nisqually Watershed, adopted in 1981, Chapter 173-511 WAC) (Appendix B). Therefore, because of their very minor flow impacts, new domestic permit-exempt wells adjacent to the Nisqually River can likely be permitted without explicit mitigation offsets.

Because of the substantial out-of-stream irrigation in the valley, a stream closure of Eaton Creek by administrative action was put in place in 1953. This closure was confirmed by the IRPP in 1981. Neither the 1952 closure nor the IRPP placed any explicit restrictions on future groundwater withdrawals. Lake Saint Clair was also closed to future water appropriations by this 1981 program. For McAllister Creek, the 1981 IRPP closes the stream to out-of-stream water allocations.

2.3.2 Thompson/Yelm Sub-Basin – Thurston County

The Thompson/Yelm sub-basin, located in Thurston County, includes the City of Yelm and its UGA, and surrounding rural areas. There are two independent streams in this sub-basin but they are merged into one sub-basin because of their unity within the general Yelm area and the relatively high growth rate they have experienced in recent years.

Geology

Understanding the geology and geological history of this sub-basin is essential to understanding and addressing its streamflow patterns, possible impacts of permit-exempt wells and possible approaches to mitigating those impacts. Over the past 100,000 years this part of Thurston County was subject to multiple glacial advances and retreats, the most recent of which ended a little over 10,000 years ago. As they advanced and then retreated, the glaciers left extensive outwash areas of sand and gravel, some near the surface and others buried more deeply. The glacier also deposited thick layers of sediment that, when compressed, become glacial till or “hard pan”. Thus, we have surficial and buried layers of sand and gravel that hold water (these layers are termed “aquifers”) and glacial till layers that hinder connections between the aquifer layers (these layers are called “aquitards”).

Water

The streams in this sub-basin (with the exception of the Nisqually River itself) are relatively small. Most of the rainfall in this sub-basin actually percolates into the aquifer rather than running off the land and forming streams. Very commonly these so-called prairie streams flow across the land on a clay layer, only to infiltrate into the aquifer when the stream crosses over coarser material. Most of the streams in the sub-basin are characterized as intermittent. It is not clear whether these prairie streams were historically intermittent or were affected by diversions and withdrawals by permitted and permit-exempt water users. These intermittent streams are in direct contact with the surface aquifer (recessional outwash deposits or Qvr) and their flow depends directly on the condition of this aquifer. When the upper aquifer is full, the streams flow throughout their length and even gather flow at sites along their length from springs, places where the aquifer discharges into surface streams (Ericksen, 1998).

The Thompson/Yelm sub-basin is dominated by glacial till, undifferentiated glacial drift and Vashon advance outwash deposits (Qva). The Qva and Qc (water-bearing Salmon Springs Drift, penultimate deposits and other coarse-grained deposits) are used extensively as a source of groundwater in the Yelm sub-basin. Groundwater in the Qc unit is found primarily under confined conditions. The deeper TQu undifferentiated deposits underlie the Qc and are the proposed source of the City of Yelm’s current water right application.

Most of the rainfall landing in this sub-basin, after entering the ground, discharges as both surface flow in streams and directly to Puget Sound through the several deeper aquifers underlying the sub-basin. Because these aquifers are important regional sources of drinking water, they have been studied extensively and additional studies are ongoing (Dion et al, 1994; Drost et al, 1999). All these studies indicate that there are three primary aquifer layers, shallow (or unconfined surface), intermediate and deep aquifers.

Yelm's wastewater treatment system is designed to produce treated wastewater of sufficient quality to permit its use for irrigation and aquifer infiltration. Thus, a portion of Yelm's treated wastewater, originally drawn from the aquifer underlying the city, is returned to that aquifer. This offers mitigation potential for wastewater drawn from the deeper aquifer and returned via infiltration to the shallow aquifer (see Section 5.1.1 for discussion of Yelm's water right application and mitigation options arising from it).

Salmon Usage

The largest stream in this sub-basin is Yelm Creek. Although it is an intermittent stream at several places in its upper reaches, the lowest half mile of stream receives water from Silver Springs and has some flow year-around. That part of Yelm Creek annually receives hundreds and some years thousands of spawning salmon of several species. It is a vital stream for chum spawning in early winter and serves as one of the index areas to determine chum salmon spawning escapement. Thompson Creek has little salmon spawning habitat and has an impassible waterfall at about river mile 0.2.

Land Use and Development

Because it exhibited open natural prairies, this sub-basin was one of the first to be developed as farm land in Thurston County. A number of Donation Land Claims were filed in this area beginning in the 1850s and it has a long history of agricultural development. In 1912 an irrigation system was developed for the Yelm area with water withdrawn from the Nisqually River and distributed by ditch throughout the area. The system was abandoned in 1952 due to financial difficulties. Traces of its ditch system are still visible in places.

This sub-basin consists of the City of Yelm and the rural area surrounding it. Most of the water connections within Yelm are served by its water utility. Currently Yelm's UGA is designated at a lower density residential (Rural Residential 1/5 and Urban Reserve) with the expectation that these areas will be rezoned at higher densities after they are annexed by the City and connected to urban services. Density for these zones is limited to one unit per five acres, and most development (70%) relies on a permit-exempt well because the existing municipal water utility does not have the capacity to extend service to much of its UGA.

The majority of the sub-basin is zoned as Rural Residential Resource 1 unit per 5 acres. There are two Limited Areas of More Intense Rural Development (LAMIRDs) near the Nisqually River, where a pattern of higher density development predates the Growth Management Act. These rural areas have permitted densities higher than 1/5, but are largely built out. There are also a number of areas zoned as Long-term Agriculture, where density is limited to a minimum 20 acres. An additional 5% of the sub-basin is within Joint Base Lewis-McChord, where future residential development is not expected.

Regulatory History

Because of low flow conditions, stream closures for future out-of-stream water appropriations were established by administrative action for both Thompson Creek (in 1951) and Yelm Creek (in 1953). These closures were confirmed by the IRPP in 1981. Neither the 1950s closures nor the IRPP placed any restrictions on future groundwater withdrawals.

2.3.3 Lackamas/Toboton/Powell Sub-Basin – Thurston County

The Lackamas/Toboton/Powell sub-basin, located in Thurston County, includes three small independent tributaries to the Nisqually River. Since these streams and their underlying geology are similar, they are merged into one sub-basin for this plan.

Geology

As with most other areas of Thurston County, the geology of this sub-basin was determined primarily by glacial processes. The glacier stopped its southward migration on the margin of this area and the hills immediately to the south. The western portion of this sub-basin, generally drained by Lackamas Creek, has characteristics in common with the prairie streams and is likely underlain by aquifers at several depths.

Water

This sub-basin and its streams are relatively short. Streamflow is derived from groundwater discharge as baseflow, from springs and from lake discharge. Hydraulic and geologic studies suggest that is this sub-basin receives groundwater discharge from the neighboring watershed to the south, the Deschutes River. The headwaters of the Deschutes is located in low, un-glaciated hills to the south. When the flow from the upper Deschutes encounters the glacial outwash materials, a portion of the flow enters the groundwater, then flows north toward the Nisqually River.

The aquifers in the eastern area of the sub-basin are limited to small areas near the fractures and joints in bedrock. The western end of the sub-basin has areas of coarse-grained deposits that can support highly productive wells. Detailed hydrogeologic studies have not been completed for this sub-basin. The Powell Creek watershed, specifically, does not exhibit as much groundwater flow as the other streams in this sub-basin. Its base flow was measured this autumn as 1.7 cfs (personal communication, Nisqually Indian Tribe Natural Resources). Therefore, it is vulnerable to diminished flow from up-gradient land use activities and new permit-exempt well development.

Salmon Usage

As their size suggests, these streams themselves are not major salmon spawning and rearing streams. The primary species utilizing them are coho salmon and steelhead. However, because their flow comes from groundwater discharge from upland sources, they do flow year-round (in contrast to the intermittent prairie streams). Powell Creek feeds a large wetland complex near its confluence with the Nisqually River that is of high importance for coho and steelhead rearing.

Land Use and Development

This sub-basin is entirely rural and divided between low-density residential and timber uses. There are very few existing Group A or B water systems in this sub-basin, so most new residential development would be likely to rely on a permit-exempt well. Nearly half the sub-basin is zoned for Long-Term Forestry which limits development to one unit per 80 acres. An additional 40% is zoned as Rural/Residential/Resource one unit per five acres, including the areas around Lackamas and Toboton Creeks. The higher-density developed area around Clear Lake (called Clearwood) at the headwaters of Toboton Creek is designated as a LAMIRD, with an underlying density of two units per acre. Future development in the Clear Lake area is likely to be limited and, when developed, would be served by the large existing Group A water system (personal communication, Thurston County Planning).

Regulatory History

The IRPP closed two streams, Toboton and Lackamas creeks, to future surface water appropriations from April 1 to November 30. The IRPP placed no explicit restriction on future groundwater withdrawals. No regulatory action

concerning closure or minimum flows is in place for Powell Creek and therefore water rights are available for this stream, at least under the current regulatory regime.

2.3.4 Lower Nisqually River Sub-Basin – Pierce County

Virtually all of this sub-basin is within the boundary of Joint Base Lewis-McChord (JBLM). The land is used for military training purposes and, from the point of view of water usage, is essentially undeveloped and expected to remain that way for the foreseeable future. A very small area north of Interstate-5 (I-5) is developed as a rural residential area.

Geology

This entire sub-basin was glaciated during the last glacial period and its geology was determined by glacial activity. Much of this area is prairie and contains geological features similar to that described for the Yelm/Thompson and Lackamas/Toboton/Powell sub-basins.

Water

Other than the Nisqually River itself there are virtually no streams within this sub-basin. All the precipitation falling in the sub-basin percolates into the aquifer and discharges either to springs, shallow aquifers, or to Puget Sound for the deeper aquifers. Springs with various flow characteristics arise along the bluff where the upland intersects with the Nisqually River. One of these spring complexes, called Clear Creek, located on the Nisqually Indian Reservation and JBLM, has been developed as a federal salmon hatchery, operated by the Nisqually Indian Tribe.

One stream, called Red Salmon Creek, arises from several springs located just north of I-5 and discharges to the Nisqually Delta. The creek's freshwater course is less than one mile. Although estuarine and not subject to future water rights appropriations, this plan notes that the lower portion of the Red Salmon Creek watershed is within the Billy Frank Jr. Nisqually National Wildlife Refuge and is of regional importance for protecting salmon and wildlife habitat values.

Salmon Usage

Most years Red Salmon Creek receives small numbers of coho and chum salmon spawning. The stream is so small that it receives no specific salmon management attention. Its primary contribution to salmon production is through its flow into the Nisqually Estuary itself.

Springs discharge at various places along the Nisqually River in this sub-basin. Some of these springs may receive salmon spawning and, in total, they provide some salmon rearing sites when they are ponded, such as adjacent to I-5.

Land Use and Development

Approximately 98% of this sub-basin is within the boundary of JBLM and is essentially undeveloped. The remainder of the sub-basin, north of I-5, is divided into a series of 5-acre lots, most of which are developed. There is one remaining farm, now owned by the Nisqually Indian Tribe, and one small sub-division served by a private Group A water system. The headwaters of the Red Salmon Creek drainage are within the City of DuPont and water for development is provided by a large Group A system with its source outside of the Nisqually Watershed.

Regulatory History

The IRPP closed Red Salmon Creek for future surface water appropriations from April 1 to October 31. The IRPP placed no restriction on future groundwater withdrawals.

2.3.5 Prairie Tributaries Sub-Basin – Pierce County

Because of similar underlying geology, several independent watersheds in this part of Pierce County from Tanwax Creek in the south to Muck Creek in the north have been combined into one sub-basin, the Prairie Tributaries Sub-basin. These streams are treated as a single sub-basin primarily because they are connected through the underlying aquifers, and because the streamflow issues are essentially identical throughout the area.

Geology

The geology of this sub-basin is similar to that described for the Thompson/Yelm Sub-basin above. Both are natural prairie environments.

Water

The description of the intermittent nature of the prairie streams and the regional hydrogeology in the Prairie Tributaries Sub-basin is similar to that described for the Thompson/Yelm Sub-basin in Section 2.3.2 above. The sub-basin is generally underlain by glacial deposits of substantial thickness. One such hydrogeologic unit, referred to as Qc1 in Sinclair (2001), is generally confined advanced outwash material and used extensively as a source of groundwater that is found primarily under confined conditions in this sub-basin.

In 2001, the Washington Department of Ecology conducted a study of the surface and groundwater interchange in the Muck Creek watershed (Sinclair, 2001). Groundwater in the Qc1, or advanced outwash material (Qva), in this sub-basin is generally confined except where the unit outcrops along the southern margin of Muck Creek channel and provides water to seeps and springs. It is not clear whether these prairie streams were historically intermittent or were affected by diversions and withdrawals by permitted and permit-exempt users.

Salmon Usage

Muck Creek is an intermittent stream. In most years it begins flowing in November and provides important spawning habitat for a large portion of the Nisqually River chum salmon run. Nisqually chum return later in the season than any other Pacific Coast chum run and seem to be adapted to the late-flowing intermittent streams. Winter steelhead also spawn in Muck Creek, rearing in areas with year-round flow and then migrating out during subsequent high flows.

There are several smaller intermittent spring-fed streams in this sub-basin that, in some years, receive spawning salmon. With the exception of Tanwax Creek, they are of minor importance. Tanwax Creek receives spawning primarily from Coho salmon and steelhead. Tanwax Creek has several lakes as its headwaters and has year-around flow. In many places along this stream there are beaver dams that create pools, ideal for juvenile salmon and steelhead rearing.

Land Use and Development

Because it exhibited open natural prairies, this sub-basin was one of the first developed as farmland in Pierce County. A number of Donation Land Claims were filed in this area beginning in the 1850s and agricultural development is still common in the sub-basin. In 1917 a portion of the Muck Creek area, including 3,300 acres of the Nisqually Indian Reservation, was condemned and donated to the United States for creation of Fort Lewis (now Joint Base Lewis-McChord [JBLM]). The portion of JBLM in the Nisqually Watershed is entirely undeveloped.

There is only one municipal area in the sub-basin, the City of Roy. Other than Roy, there are no Urban Growth Areas in the sub-basin. However, over the years various small rural communities have developed, many served by a privately owned Class A water system. In the past 20 years, more and more small ranches or rural homes have

also been permitted in the sub-basin. Because of this relatively slow but steady development pattern, this sub-basin has the largest projected demand for new permit-exempt connections in Pierce County in WRIA 11.

Regulatory History

For Tanwax Creek: The Instream Resources Protection Program (IRPP) for the Nisqually Watershed was adopted in 1981 (WAC-173-511). In addition, various streams in this sub-basin were closed by administrative action to future out of stream water allocations: Horn Creek (1974); unnamed tributary streams to the Nisqually River (1944); Harts Lake and outlet streams (1944, minimum flow bypass established). These various actions were confirmed by the IRPP for the Nisqually Watershed. Neither the various administrative closures nor the IRPP placed any restrictions on future groundwater withdrawals.

At the request of the Washington Department of Fisheries, Muck Creek and all tributaries were closed by administrative action to future out of stream water allocations in 1948. This closure was confirmed by the Nisqually IRPP (adopted in 1981, WAC Chapter 173-511). Neither the 1948 closure nor the IRPP placed any explicit restrictions on future groundwater withdrawals.

2.3.6 Ohop Creek Sub-Basin – Pierce County

The Ohop Creek Sub-basin, in Pierce County, is unique within the Nisqually Watershed. Much of its upper reaches are long-term forestlands with salmon access blocked by impassible waterfalls. The stream itself occupies a wide floodplain carved by the prehistoric stream draining the front of the Vashon Glacier some 11,000 years ago.

Geology

Ohop Creek gains all its flow from upland tributaries in geology similar to that described for the Mashel sub-basin below. Ohop Creek, a relatively small stream, occupies a large valley, much larger that it could have created on its own. During glacial times this valley contained a large glacial melt water stream that flowed southwest through the valley, then west along the base of the Bald Hills, ultimately discharging into the Pacific Ocean. Ohop Creek in general marks the divide within the watershed separating the glacial-influenced geology from the volcanic-origin uplands.

Water

A USGS streamflow gauge was placed in service on Ohop Creek in 1993 and has been in continuous use since. In addition, the USGS record contains various miscellaneous records from earlier years. Along the bluff above Ohop Creek, the continental glacier deposited an outwash ridge that directs most surface water away from the stream. Ohop Creek, through a tributary, also receives stormwater runoff from the Town of Eatonville. Eatonville is considering stormwater projects that would redirect this flow back to the Mashel River through passive infiltration (see Section 4.2.2). Since 2009, when the Nisqually Indian Tribe's Salmon Recovery Program began major habitat restoration on Ohop Creek, groundwater monitoring wells have been recording data at locations across the restored floodplain, providing a robust database by which to assess streamflow benefits (see Appendix E).

Salmon Usage

Ohop Creek is a major spawning and rearing tributary stream for the Nisqually River, providing habitat for coho, pink and fall Chinook salmon and steelhead, two of which are Endangered Species Act (ESA) listed species. The Nisqually Fall Chinook and Steelhead recovery plans identify a number of limiting factors affecting the recovery of ecosystem functions to support self-sustaining salmon runs in individual tributaries (see Chapter 4). One limiting factor for Ohop Creek is the limited good-quality instream habitat in the lower five river miles, due to straightening and ditching of the channel to drain fields for agricultural production. Since 2009, the Nisqually Indian Tribe's Salmon Recovery Program has led major investments in habitat protection and restoration actions in this sub-

basin. The restoration plan restores the creek to its meandering floodplain for a total of about four stream miles. The first step was the acquisition of soon-to-be-abandoned farm land. Then, in phases, the stream has been re-meandered and instream habitat features added to the channel. This work is planned in four phases, with the first two already being completed, Phase III underway, and Phase IV preparing for implementation (see Chapter 4).

Land Use and Development

The Ohop sub-basin is about 40 square miles, with 80% managed as commercial forestland. Of the remaining area, Ohop Lake occupies about three miles, and much of the remainder consists of rural farmland, rural residential and a portion of the Town of Eatonville. In the past 20 years many of the active commercial farms in the Ohop Valley have been abandoned. Some farms are still used for pasture but a substantial portion of the Ohop Creek Valley has been reclaimed to its natural state and its channel restored through the salmon recovery habitat projects discussed above.

Regulatory History

Because of the substantial out-of-stream irrigation in the valley, the Washington Department of Fisheries requested a stream closure and in 1952 Ohop Creek and all tributaries were closed by administrative action to future out of stream water allocations. This closure was confirmed by the 1981 IRPP. Neither the 1952 closure nor the IRPP placed any explicit restrictions on future groundwater withdrawals. In 1966, as the result of administrative action, the lake level for Ohop Lake was set at 523 feet, implemented by a stop log dam.

2.3.7 Mashel River Sub-Basin – Pierce County

The Mashel Sub-Basin, located in Pierce County, consists of the Mashel River and its tributaries. It is the largest tributary to the Nisqually River and its major salmon spawning tributary. The headwaters of the Mashel are in upper elevation (over 4,000 feet) hills. These uplands receive snow most winters.

Geology

The geology of the Mashel sub-basin is volcanic in origin, containing the remnants of ancient volcanoes. Over the last 40 million years, there have been volcanic eruptions, followed by erosion and then further eruptions. Remnants of these volcanoes are the dominant rock or sediment that underlies most of the Mashel sub-basin. The youngest erosion deposits are termed the Mashel Formation and consist of dense clay layers and more loosely consolidated layers of rock and sand. The downstream portion of the sub-basin also were impacted by continental glaciers.

Water

There is a very long period of record documenting Mashel River flows. The first USGS streamflow gauge was established in 1940. After a break in the record in 1957, the gauge was reinstalled in 1991 and has been recording flows continuously since that date. The watershed is 80.7 square miles and its average discharge is about 220 cfs; minimum flow, recorded in 1992, was 2.3 cfs.

Because of concerns about low flows in the Mashel River and possible conflicts between meeting Eatonville's future drinking water needs and summer minimum streamflows, the Nisqually Watershed Planning Unit contracted in 2005 for two technical reports (Nisqually Indian Tribe, Mashel River Instream Flow Study, April 2006; Nisqually Indian Tribe, Mashel River Hydraulic Continuity Study, April 2006).

Salmon Usage

The Mashel River is a major spawning and rearing tributary stream for the Nisqually River, providing habitat for Fall Chinook and steelhead, two ESA-listed species, as well as other salmon species. The Nisqually Fall Chinook and

Steelhead recovery plans identify various limiting factors that need to be addressed to restore properly function conditions and recover these species. One limiting factor for the Mashel is its low flow condition in the summer months. In recent years several million dollars have been invested in habitat protection and restoration actions in this sub-basin, including engineered logjams and riparian tree plantings to restore long-term ecosystem functions disrupted by a century of heavy logging. One major protection/restoration action is the acquisition of large tracts of commercial timberland and the imposition on those lands of a long-rotation forest management regime that, according to research models, will provide substantially improved base streamflows over time (Hall et al, 2018).

Land Use and Development

Over 70% of the Mashel watershed is forested and managed primarily as commercial forestland. The remaining area consists of rural farmlands, rural residential development, and the Town of Eatonville. Eatonville sits on the crest between the Mashel and Ohop sub-basins. However, it takes its drinking water supply from wells in direct contact with the Mashel River. It also has a wastewater treatment plant and discharges its treated wastewater back to the Mashel.

Regulatory History

The 1981 IRPP established minimum instream flows for the Mashel River and closed it to future surface water appropriations from June 1 to October 31 each year. The IRPP placed no explicit restriction on future groundwater withdrawals.

2.3.8 Upper Nisqually Sub-Basin – Lewis, Pierce, and Thurston Counties

This is the portion of the Nisqually Watershed above the Tacoma Power's Hydroelectric Project and above anadromous fish access. It includes all of the Lewis County portion of the watershed, a significant part of the Pierce county portion, and a very small part of Thurston County. Because the watershed issues are similar, the three counties are merged into one sub-basin.

Geology

The geology of the Upper Nisqually sub-basin is volcanic in origin, containing the remnants of ancient volcanoes. All the tributary streams initiate in upper elevations and generally receive snowfall. The Nisqually River itself has its origin in glacier fields on the southwest flank of Mount Rainier.

Water

Because Tacoma Power is located at the terminus of this sub-basin, there is a very long period of record documenting streamflows and downstream discharge. The first USGS streamflow gauge was established in 1910. In 1942 Tacoma obtained water rights to impound the flow of the Nisqually River at river mile 44 (Alder Dam). Because of its water rights and storage abilities, Alder Reservoir essentially re-regulates the downstream flow of the Nisqually River, storing water during some periods and releasing greater-than-natural flows during others.

Salmon Usage

Tacoma Power's hydroelectric dams block salmon access to the Upper Nisqually sub-basin. Access was likely blocked prior to the dams by an impassible waterfall that is no longer visible. Tacoma Power has supported Kokanee salmon populations for sport fishing in Alder Reservoir with some Kokanee spawning documented for various tributary streams in the upper sub-basin.

Land Use and Development

Over 90% of the Upper Nisqually sub-basin is forested and, for the most part, managed as commercial forestland. Much of the uppermost part of the area is within Mount Rainier National Park. Major timber landowners include

the Washington Department of Natural Resources and the U.S. Forest Service. A small portion of the Upper Nisqually is rural residential, with a few scattered small farms, and some commercial development along the highway leading to the national park.

Lewis County's portion of the Nisqually watershed is entirely in the Upper Nisqually sub-basin, and is primarily characterized by forestry land uses. Small settlements are located at Mineral and at Paradise Estates, with a large number of the homes used for seasonal or vacation purposes. Vacation homes and seasonal residences are expected to continue as the predominant non-forestry land use in the future, and outdoor water use including gardens and lawns for these structures will be minimal. The area contains approximately 722 single-family residences, two duplexes, one multi-family structure and one mobile home park.

The Pierce County portion of the Upper Nisqually sub-basin includes land within the Mount Rainier National Park, designated Forest Lands, rural residential (R10, R40), rural farm, parks and recreation, Tourist Commercial, Village Residential and Village Center, and Agricultural Resource lands. Although most is classified as vacant by Pierce County Assessor-Treasurer Department, about eighty percent of the 26,880 rural acres in the sub-basin could theoretically be subdivided with a maximum of 2,314 additional lots. Twenty percent of the rural land in the sub-basin is served by a Group A water system, covering 1,161 parcels on 5,336 acres with a maximum of 1,344 additional lots (58 percent of total).

The Thurston County portion of the Upper Nisqually sub-basin is entirely zoned as Long-Term Forestry. Very limited additional development is anticipated in this area with an underlying density limited to one unit per 80 acres.

Regulatory History

The 1981 IRPP established instream minimum flows for the Upper Nisqually River but did not close it for future surface water appropriations. It also commemorated the 1964 closure of all Alder Lake tributaries to future out-of-stream appropriations. The IRPP placed no explicit restriction on future groundwater withdrawals. Because regulatory instream flows are set on the upper reach of the Nisqually, any new future permit-exempt well use or water right appropriation would be subject to interruption in the case that actual flows fall below regulatory flows.

Chapter 3 Water Use Forecasts

Chapter 90.94.020 RCW requires an assessment of the anticipated number of domestic permit-exempt wells and associated connections in the Nisqually Watershed over the next 20 years and the expected consumptive impacts of those wells. This information was developed to meet the requirements set forth in RCW 90.94.020, and for development and planning of actions to offset estimated future consumptive water use associated with these forecasted wells by sub-basin. Similarly, the information in this chapter addresses the first element of Ecology's *Interim Guidance for Determining Net Ecological Benefit* (June 2018b) in that it "characterizes and quantifies potential impacts to instream resources from proposed 20-year new domestic permit-exempt water use at a scale that allows meaningful determinations of whether proposed offsets will be in-time and/or in the same sub-basin."

This chapter presents estimates of potential consumptive water use associated with permit-exempt wells forecasted to be installed for domestic indoor and outdoor use in WRIA 11 between 2018 and 2040, by sub-basin. A map of the sub-basins is presented in Figure 1. Section 3.1 provides an overview of land use considerations affecting rural growth and associated permit-exempt water use for each county within the watershed. Methods used to forecast rural growth and the corresponding number of domestic permit-exempt wells and connections differ for Lewis, Thurston and Pierce Counties, and are outlined by County in Section 3.2. Assumptions and results associated with the calculation of both the actual expected and the upper legal limit consumptive water use by permit-exempt connections between 2018 and 2040 are presented in Section 3.3.

3.1 Land and Water Use Background

Rural growth and development and associated permit-exempt well use are driven by many factors including land use and zoning practices by local governments. A summary of the growth trends in rural areas as they impact water use is provided below by County. Chapter 2 provides a more in-depth discussion of each sub-basin including land use considerations as they pertain to rural growth and water use. Figure 4 presents the general land use in the watershed.

3.1.1 Thurston County

Thurston County was the third fastest-growing county in Washington State over the past ten years, and looking ahead, Thurston County is projected to grow by 42% between 2018 and 2040, increasing in population by more than 100,000 people countywide. Within the Nisqually Watershed portion of the county, population is projected to grow 71%, from 42,000 to 72,000 (TRPC Populations Estimates Work Program, 2018). The vast majority of that growth is likely to be in urban areas, with only 11% of population growth predicted to be located in rural areas, where new homes would be more likely to rely on permit-exempt wells. This is a slightly lower proportion of rural growth than seen countywide (14%); however, development within Yelm, the fastest growing urban area within the watershed, is likely to depend heavily on the availability of water, either through permit-exempt domestic wells or a municipal utility.

Future land use and zoning designations for areas under Thurston County jurisdiction generally are set by the Thurston County Comprehensive Plan. Specific areas within the Nisqually Watershed are governed by the Joint Plan for the Lacey Urban Growth Area, the Joint Plan for the Yelm Urban Growth Area, or the Nisqually Subarea Plan. Development within an urban growth area is permitted through Thurston County, but land use in these areas is governed by Joint Planning agreements between the county and respective city.

The Nisqually Subarea Plan sets the land use vision and policies for a portion of the Nisqually watershed that is generally east of Lacey, west of the Nisqually River, and north of Joint Base Lewis-McChord. This rural area is characterized by agriculture, low density residential, and resource use, including several gravel mines. The Subarea Plan was adopted in 1992 and is being updated in 2018 and 2019. Population within the Subarea is projected to grow by 20% between 2018 and 2040.

3.1.2 Lewis County

The Upper Nisqually sub-basin in Lewis County is primarily composed of forestlands, though two settlements, Mineral and Paradise Estates, and some dispersed homes are present. The vast majority of the sub-basin is situated in the Gifford Pinchot National Forest, or is zoned for long-term forestry with 80-acre minimum lot sizes. The large required lot sizes and distance from major population centers limits the development of the area. Growth in the Upper Nisqually sub-basin is expected to continue to be slow through 2040.

Where homes do exist within the sub-basin, many are for seasonal/vacation use. The seasonal nature of these habitations likely contributes to lower overall water use than a typical residence, because seasonal residents typically use less water inside the home (on an annual basis) and tap less water for outdoor activities such as gardening and the irrigation of lawns. The forested nature of the sub-basin similarly limits the water demand associated with the irrigation of lawns.

3.1.3 Pierce County

The population growth projected for the rural areas in the Pierce County Comprehensive Plan is approximately 18,000 people during the 2010-2030 20-year planning horizon. Growth has not yet been projected out to 2040. Rural areas in the Pierce County portion of the Nisqually Watershed are characterized by low densities with scattered residential sites and moderate to large open acreages for farm or forest use. Commercial and non-commercial agricultural and forestry and other natural resource-based practices are consistent with rural areas. Rural areas are characterized by having individual services and/or by district services and having minimal roads. Allowed densities in the rural areas of the Nisqually Watershed range from a low of one unit per 80 acres in the Forest Lands designation to one unit per five acres in the Rural 5 designation. There is a very limited area of Village Center zoning in Ashford and Elbe areas of the Upper Nisqually Sub-basin that allows for 3 units per acre.

Since the adoption of the Washington State Growth Management Act (GMA) in 1990, rural areas incrementally experienced less growth. The 2014 Pierce County Buildable Lands Report shows that between 2006 and 2012 only 9% of countywide platted lots and 25% of countywide permitted housing units were in the rural area. The percent of permitted units tends to be higher due to lots that were vested pre-GMA. In contrast, the 2002 Pierce County Buildable Lands Report shows a countywide average of 34% platted lots and 31% permitted units in the rural area. Less growth in the rural area equates to decreased water use. Future increases in water use would primarily be related to new single-family residences and resource uses such as forestry.

3.2 Forecast of Future Domestic Permit-Exempt Well Connections/Wells in WRIA 11

The following three sections present each County's methodology and forecasts of rural population growth and associated permit-exempt well use in rural areas in WRIA 11 aggregated by sub-basin. Consideration was given to existing public water systems and private Group A and B systems with available connections.

3.2.1 Thurston County

Methodology

Thurston County used the following methodology to calculate the number of new connections to permit-exempt wells for domestic water use over the period 2018-2040:

1. Estimate total number of new households (dwelling units)
2. Estimate number of new households likely to rely on permit-exempt water connection
    a. Urban areas – calculate proportion of new development on permit-exempt wells, based on past development patterns
    b. Rural areas – subtract number of available connections to existing larger Group A and B water systems from the estimated number of new households (dwelling units)

A summary of the methodology used to estimate domestic permit-exempt connections in Thurston County is presented in this chapter. A detailed description of the methods used to estimate household growth and future permit-exempt well use in Thurston County can be found in Appendix C.

1. Estimate total number of new households

Thurston County calculated the change in population and dwelling units between 2018 and 2040 using estimates developed by Thurston Regional Planning Council (TRPC). TRPC, a public agency governed by a 22-member council, develops population and employment forecasts for the Thurston Region to meet the monitoring and evaluation provisions of the Growth Management Act through a Buildable Lands Program. TRPC develops countywide forecasts consistent with those prepared by the Washington State Office of Financial Management (OFM); their population and households forecast is based on demographic trends, labor force participation, migration patterns, zoning regulations, and buildable land supply.

As shown in Table 3-1, population and dwelling unit forecasts were estimated by sub-basin (Thurston County portion of watershed only), and by jurisdiction: city, urban growth area (UGA), Indian Reservation, rural county. Dwelling unit estimates were also broken into type of household: single family, multifamily, or manufactured homes. Estimates were rounded.

Table 3-1: Population & Dwelling Unit Change by Sub-Basin, 2018-2040, Thurston County portion of WRIA 11

Sub-basin	Jurisdiction	Pop. change, 2018-2040	Dwelling Units Change, 2018-2040			
			Total	Single-Family	Multi-family	Man. Homes
McAllister						
	Lacey (City)	150	100	10	90	0
	Lacey UGA	5,350	2,280	1,940	340	0
	Reservation	520	125	123	0	2
	Rural	690	315	410	20	-115
Thompson/Yelm						
	Yelm (City)	16,130	6,620	4,391	2,231	-2
	Yelm UGA	4,220	1,720	1,480	242	-2
	Rural	1,740	650	1,110	40	-500
Lackamas/Toboton/Powell						
	Rural	970	470	500	10	-40
Upper Basin (Thurston County)						
	Rural	0	0	0	0	0
Total		**29,770**	**12,280**	**9,964**	**2,973**	**-657**

Source: TRPC, 2015. Analysis conducted July 2018.

Assumptions and Considerations

TRPC's population forecast model includes the following assumptions:

- Zoning densities achieved in the future are assumed to be similar to those for projects that are currently in the development pipeline.
- Critical areas and associated buffers are deducted from calculations of available land supply and density of projected development. In urban areas, deductions are also made based on requirements for open space, stormwater, and road rights-of-way.
- Incorporated cities will be able to provide water and other capital facilities services to most of the areas designated as urban growth areas, unless constrained by topography, existing land use patterns, or environmental barriers. As discussed in more detail below, this assumption may lead to a higher estimate of projected growth in the Yelm UGA than may be serviced by the municipal water utility currently.
- Multifamily developments include duplexes and triplexes, as well as higher density developments.
- Manufactured homes show a decline over the planning period, especially in the Thompson/Yelm sub-basin. The negative numbers reflect a projected change in housing demand over time that is built into the estimates as a percentage of manufactured homes being converted into single-family homes. This pattern is most noticeable in the rural portion of the Thompson/Yelm sub-basin because several Mobile Home Parks are in this area. Manufactured homes that convert to single-family homes were presumed to not require a new water connection in future steps of the analysis.
- Additional information on the methods and assumptions of TRPC's data program can be found in the following reports, available at https://www.trpc.org/480/Population-Housing-Employment-Data:
- *Population and Employment Land Supply Assumptions for Thurston County*, November 2012
- Assumptions for Type of Housing by Zoning District
- Zoning Assumptions by Jurisdiction
- Calibration Reports

2. Estimate number of new households likely to rely on permit-exempt water connection

Thurston County used different methodologies for estimating the number of new domestic permit-exempt connections in urban areas and rural areas to better address different development patterns and regulatory requirements between urban and rural areas.

a) Urban areas

Within incorporated city boundaries, Thurston County assumed that all future growth will be served by a municipal water utility. This same assumption could be made for Urban Growth Areas (UGAs), which are identified for future annexation by the cities within the planning period and are often served by municipal utilities even before they are annexed. However, development that relies on permit-exempt wells is permitted in the UGAs, provided that the applicant can demonstrate that a public utility is not available. The extent of this available infrastructure varies considerably among the different UGAs in Thurston County.

Within UGAs, Thurston County looked at the number of estimated new single-family units for each sub-basin, and calculated a percentage that likely would rely on a permit-exempt well. This rate was calculated by looking at patterns among past development as analyzed using the county's permitting system. More detailed information regarding this analysis can be found in Appendix C.

Based on this analysis, a very low proportion of development in the Lacey UGA historically has relied on permit-exempt wells (2%). A much higher proportion of development in the Yelm UGA (70%) relies on permit-exempt wells. Table 3-2 applies these proportions to future projected development for each UGA within the WRIA 11 watershed.

Table 3-2: Permit-exempt Connections, Urban Growth Areas, Thurston County portion of WRIA 11

Sub-basin	UGA	Single-Family Units, 2018-2040	% Permit-Exempt	UGA PE Connections
McAllister	Lacey UGA	1,940	2%	39
Thompson/Yelm	Yelm UGA	1,480	70%	1,036
Total		**3,420**		**1,075**

Assumptions and Considerations

- All units within the incorporated boundaries of a city will be served by a public water system.
- Multifamily units in a UGA will be served by a public water system.
- The proportion of development using a permit-exempt well was calculated for the full area of each UGA, rather than only for the portion within the Nisqually watershed or within each sub-basin. This was done both to account for the small number of developments in some areas, which might not be representative, and to enable the same percentage to be used in other watershed planning processes.
- For additional background on the water use and pumping rates used to generate the equivalent water service connections in Table 3-2, refer to:
    - Thurston County Water Resources, Technical Memorandum #1: *Water Use and Wastewater Generation in Rural/Suburban Areas of Thurston County, Washington* (November 2018; updated August 2018).
    - Thurston County Water Resources, Technical Memorandum #8: *Methods Used to Calculate the Pumping Rates, Locations, and Open Intervals of Active Groundwater Wells in Thurston County, Washington* (July 2018).

b) Rural areas

Outside UGAs, new households are likely to rely on a permit-exempt well for a domestic water source, unless the new development is within the boundary of a water system that has available connections to its service. Thurston County identified 81 public water systems (Group A and larger Group B) that are at least partially within the WRIA 11 watershed and reviewed the Washington State Department of Health's Sentry database to calculate the number of available connections for each system. More than a third of the systems (n=29) did not have a specified number of approved connections; because of this, for these systems, no number of available connections could be calculated. Another third of the systems (n=25) have available, approved connections. For water systems with boundaries that were partially outside the watershed, the number of available connections was adjusted according to the proportion of area within the watershed. Data for Group A and B systems used in this analysis is presented in Appendix C.

To calculate the number of permit-exempt domestic connections for rural areas, the number of adjusted available connections from Group A and B systems was subtracted from the projected dwelling units in each sub-basin (Table 3-1). Table 3-3 presents the resulting estimate of rural permit-exempt domestic connections forecast to occur through 2040 in the Thurston County portion of the Nisqually Watershed.

Table 3-3: Permit-exempt Connections, Rural Areas, Thurston County portion of WRIA 11

Sub-basin	Total New Rural Dwelling Units	Available Water System Connections (Adjusted)	New Rural PE Connections
McAllister	315	199	116
Thompson/Yelm	650	124	526
Lackamas, Toboton, Powell	470	40	430
Upper Nisqually	0	0	0
Total	**1,435**	**363**	**1,072**

Assumptions and Considerations

- This analysis does not consider the number of potential connections to water systems with an "unspecified" number of available connections in the Washington Department of Health Sentry Database. DOH gives an "unspecified" designation when there is enough source and system capacity, and water rights, to add connections within their approved service area. These systems are likely to have the most existing capacity to serve new connections, and, because they are not included, this analysis underestimates the amount of available water system connections.
- Assumes no new Group A or larger Group B systems will be permitted over the 20-year planning period.
- Assumes no existing systems will be permitted to expand their service area boundaries over the 20-year planning period, and no additional connections will be available beyond the currently specified "available connections" within the DOH Sentry database. As noted above, this is likely an underestimate of the number of available connections, given the high proportion of systems that did not have information on approved connections ("unspecified"). In addition, some water systems may have water rights that exceed the number of connections that are currently approved, and thus may be able to expand without needing to apply for additional water rights.
- New development will connect to existing public water systems when connections are available. This assumption is only likely if new development is located within water system boundaries, and if all available connections are made available to new domestic uses.

Results

In summary, Thurston County estimates a baseline demand for slightly more than 2,000 new permit-exempt connections in the Nisqually watershed through 2040 (Table 3-4). Averaged over the 22-year planning period, this equates to approximately 100 new permit-exempt connections per year.

Table 3-4: Total Estimated Permit-exempt Connections, Thurston County portion of WRIA 11, 2018-2040

Sub-basin	UGA PE Connections	Rural PE Connections	Total PE Connections
McAllister	39	116	155
Thompson/Yelm	1,036	526	1,562
Lackamas/Toboton/Powell	-	430	430
Upper Nisqually	-	0	0
Total	**1,075**	**1,072**	**2,147**

Discussion of Results

The number of estimated permit-exempt connections in Thurston County is almost evenly split between rural areas and UGAs, with the largest proportion in the Thompson/Yelm sub-basin. The large number of permit-exempt connections in urban areas is due to the limitations of the City of Yelm's water utility, which at this time does not have the service area or available connections to provide water to much of the UGA. Were Yelm's utility able to provide water service at the same proportion as the City of Lacey (i.e., were 98% of new housing units able to hook up to a water utility rather than only 30%), this would address nearly half of the projected new connections for the Thurston County portion of the watershed.

Even considering only new rural connections, however, the Thompson/Yelm sub-basin stands out as the area with the greatest forecasted demand on groundwater, with more than 500 projected new permit-exempt connections. The Lackamas/Toboton/Powell sub-basin has the second highest number of projected permit-exempt connections, however this estimate is likely high considering that available connections to the largest water system in the sub-basin, Clearwood, could not be calculated. Clearwood's Group A system would likely serve new development around Clear Lake, which is the most densely developed portion of the sub-basin.

3.2.2 Lewis County

Methodology

To determine the likely amount of development through 2040, Lewis County compared three different projections for the growth of the area: the TRPC Transportation Model to 2040 (TRPC, 2017), and two straight-line projections that used historic growth trends to estimate potential growth. Lewis County assumed that the growth would fall somewhere within the range of the three projections.

The use of straight-line projections in the analysis presumed that future growth will mirror previous growth patterns. Absent factors driving significant growth within the surrounding areas, the straight-line projections should tend to hold fairly true. A safety factor of 11% was also added to consider any potential mapping errors.[2]

The use of TRPC Transportation Model data (TRPC, 2017) presumed that, rather than necessarily following historic trends, future growth will respond to a variety of factors including the relative proportion of the existing housing in the county, zoning restrictions, and proximity to employment centers.

Based on the limited amount of capacity available on existing community water systems and the relatively large lots required, Lewis County assumed that all the new residential development within the sub-basin would occur on permit-exempt wells.

Results

Of the three projections, the high growth straight-line projection, based on the rate of development from 2000 to 2008, forecasted the greatest amount of new development – 181 new units (or roughly 7.4 new housing units per year when including the safety factor). The slow growth straight-line projection, based on development from 2008 to 2018, forecasted the lowest amount of growth – 138 new housing units. The TRPC Transportation Model fell between the two straight-line projections (Table 3-5).

Table 3-5: Dwelling Unit Change, by Sub-basin 2018-2040, in Upper Nisqually Sub-basin, Lewis County portion of WRIA 11

Proposed Range of Projected Development	New Housing Units
High – Straight-Line, High Growth Projection (Based on Growth from 2000 to 2008)	181
Medium (Based on TRPC Transportation Model, 2017)	145
Low – Straight-Line, Slow Growth Projection (Based on Growth from 2008 to 2018)	138

Discussion of Results

The range of 138 to 181 new units projects a limited amount of development overall for the Lewis County portion of the Upper Nisqually sub-basin.

3.2.3 Pierce County

Methodology

Pierce County used a combination of methods, as described below, to project the number of permit-exempt domestic well connections through the year 2040. Two types of connections were estimated: a) individual permit-exempt well connections; and b) Group B permit-exempt well connections. A low and high projection of individual

[2] *Lewis County utilized an 11 percent safety factor to reflect the difference in total permits within the permit system and the number of permits mapped in the analysis. Looking at the discrepancy between the numbers, it was clear that several mapped permits were accounted for in the permitting software multiple times.*

permit-exempt well connections was developed based on historic trends. Group B permit-exempt well connections were projected based on existing data, and then combined with the low and high individual permit-exempt connections projections.

The 2018 population for each sub-basin was estimated using Esri GIS data developed from 2010 Census Data (Esri, 2018). The population growth rate was estimated using the annual population growth rate between 2010 and 2030, based on the 2010 census population estimates and the 2030 population targets adopted in Pierce County Ordinance #2017-24s. The 2030 targets were based on the Puget Sound Regional Council (PSRC) VISION 2040 Regional Growth Strategy. The annual growth rate was multiplied by 22 years to represent the percent growth from 2018 to 2040 and used to determine the total projected population growth for the five sub-basins, as shown in Table 3-6.

Table 3-6: Projected Population Growth, Pierce County portion of WRIA 11 (2018-2040)

Sub-basin	Jurisdiction	2018 Population Estimate	Percent Population Growth 2018-2040	Projected Population Growth 2018-2040
Lower Nisqually				
	Rural	80	12.5%	10.0
	DuPont	7,394	34.2%	2,528.7
	JBLM	7,625	0.0%	-
Mashel River				
	Rural	2,384	12.5%	298.0
	Eatonville	1,488	12.8%	190.5
Prairie Tributaries				
	Rural	40,314	12.5%	5,039.25
	Roy	817	28.5%	232.85
	JBLM	2	0.0%	-
Ohop Creek				
	Rural	2,764	12.5%	345.50
	Eatonville	1,488	12.8%	190.46
Upper Nisqually River				
	Rural	1,179	12.5%	147.38
	Incorp	-	0.0%	-
Total		**65,535**		**8,982.6**

Individual Permit-Exempt Well Connections

1. Low Projection

The number of individual permit-exempt well connections between 2018 and 2040 was projected by assessing 26 years of historic development data. The development data compared the number of new individual permit-exempt well connections to the total number of building permits in each of the sub-basins between 1991 and 2016. The result was used to estimate the percentage of single-family residential (SFR) permit-exempt wells per total building permits for each of the sub-basins as shown in Table 3-7. The Pierce County portion of the Nisqually River Basin is primarily rural, and most individual permit-exempt wells serve SFR structures.

Table 3-7: Percent Permit-Exempt Wells, Pierce County portion of WRIA 11 – 26-Year Historic Trend (1991-2016)

Sub-basin	Individual Permit-Exempt Wells 1991-2016	Building Permits 1991-2016	Percent Individual Permit-Exempt Wells/ Total Building Permits
Lower Nisqually	2	1,890	0.1%
Mashel River	78	536	14.6%
Prairie Tributaries	1,599	8,347	19.2%
Ohop Creek	89	446	20.0%
Upper Nisqually River	39	242	16.1%
Total	**1,807**	**11,461**	**15.8%**

The projected population growth from 2018 to 2040 for each of the sub-basins shown in Table 3-6 was converted to the number of SFRs using a 2.5 persons-per-SFR conversion factor per Ecology guidance (Ecology, June 2018a), then multiplied by the percent of permit-exempt wells-per-total building permits shown in Table 3-7. The resulting number of domestic permit-exempt wells forecast between 2018 and 2040 is shown by sub-basin in Table 3-8. Note that the rural population growth will account for almost all of the new permit-exempt wells, but a few additional permit-exempt wells were added for the rare case they may be utilized within a municipal service area.

Table 3-8: Projected Individual Permit-Exempt Wells (2018 – 2040), Pierce County Portion of WRIA 11 – Low Projection using 26-Year Historic Trend

Sub-basin	Projected SFR Growth 2018-2040	Percent Individual PE Wells/Building Permit	Individual PE Wells Low Projection 2018-2040
Lower Nisqually	4	0.1%	2.0
Mashel River	119.2	14.6%	18.4
Prairie Tributaries	2,015.7	19.2%	388.0
Ohop Creek	138.2	20.0%	28.6
Upper Nisqually River	59.0	16.1%	9.5
Total	**2,336.1**		**446.6**

2. High Projection

To determine the high-range projection for individual permit-exempt well connections, 10 years of permit-exempt well data from 2007 to 2016 was analyzed within the sub-basins to determine an annual growth rate, as shown in Table 3-9.

Table 3-9: Percent Permit-exempt Wells, Pierce County Portion of WRIA 11 – 10-Year Historic Trend (2007-2016)

Sub-basin	Individual PE Wells 2007-2016	Years	Individual PE Wells/Year
Lower Nisqually	-	10	-
Mashel River	8	10	0.80
Prairie Tributaries	222	10	22.20
Ohop Creek	11	10	1.10
Upper Nisqually River	5	10	0.50
Total	**246**	**10**	**24.6**

The number of annual individual permit-exempt well connections from Table 3-9 was multiplied by 22 years to estimate the number of individual permit-exempt well connections between 2018 and 2040 for each of the sub-basins, as shown in Table 3-10. Note that rural population growth will account for almost all of the new permit-exempt wells, but a few additional permit-exempt wells were added for the rare case they may be installed within a municipal service area.

Table 3-10: Projected Individual Permit-Exempt Wells (2018 – 2040), Pierce County Portion of WRIA 11 – High Projection Using 10 Year Historic Trend

Sub-basin	10 Year Trend PE Wells/Year	Years	IPE Wells - High Projection
Lower Nisqually	-	22	2.00
Mashel River	0.8	22	18.60
Prairie Tributaries	22.2	22	489.40
Ohop Creek	1.1	22	25.20
Upper Nisqually River	0.5	22	11.00
Total			**546.20**

This method was simplistic but based on observed trends rather than the aspirational targets in VISION 2040 and produced perhaps a more realistic result. This method also considers installation of new permit-exempt wells for existing SFRs that replace older non-conforming wells.

Group B Permit-Exempt Well Connections

Group B permit-exempt well connections were projected using data from the Tacoma-Pierce County Health Department for the five Pierce County sub-basins. The current number of active connections was compared to the 2018 population estimate in each of the sub-basins, as shown in Table 3-11.

Table 3-11: Existing Connections to Permit-Exempt Group B Wells, Pierce County Portion of WRIA 11

Sub-basin	Jurisdiction	Current Group B PE Well Connections	2018 Population Estimate	Percent Group B PE Connections
Lower Nisqually				
	Rural	4	80	5.0%
	DuPont	0	7,394	0.0%
	JBLM	0	7,625	0.0%
Mashel River				
	Rural	12	2,384	0.5%
	Eatonville	0	1,488	0.0%
Prairie Tributaries				
	Rural	851	40,314	2.1%
	Roy	0	817	0.0%
	JBLM	0	2	0.0%
Ohop Creek				
	Rural	12	2,764	0.4%
	Eatonville	0	1,488	0.0%
Upper Nisqually River				
	Rural	26	1,179	2.2%
	Incorp	0	-	
Total		**905**	**65,535**	**1.4%**

The percent of Group B permit-exempt well connections was then applied to the projected rural population growth presented in Table 3-6. The projected Group B permit-exempt well connections are shown in Table 3-12.

Table 3-12: Future Connections to Permit-Exempt Group B Wells, Pierce County Portion of WRIA 11

Sub-basin	Projected Population Growth 2018-2040	Percent of Group B PE Connections	Number of Group B PE Connections 2018 -2040
Lower Nisqually	10	5.0%	0.5
Mashel River	298.0	0.5%	1.5
Prairie Tributaries	5,039.3	2.11%	106.3
Ohop Creek	345.5	0.43%	1.5
Upper Nisqually River	147.4	2.21%	3.3
Total	**5,840.2**		**113.1**

Assumptions and Considerations

- It is assumed that JBLM has no permit-exempt wells per discussions with the Tacoma-Pierce County Health Department.
- New permit-exempt wells are not allowed within Group A water system boundaries without written permission from the purveyor, so it was estimated that minimal permit-exempt wells would be allowed in the incorporated areas of the Nisqually River Basin within the cities of DuPont, Eatonville, and Roy.
- It is assumed there will be an average of 2.5 people per SFR.
- It is assumed that all current Group B permit-exempt well connections occurred outside the cities. The cities within the studied area were entirely included in Group A water system boundaries.
- Although more data exists, the previous 10 years of new well data versus total building permits for the individual permit-exempt well high projection was used. Using this data eliminated a higher trend that existed within the basin prior to the adoption of the Washington State Growth Management Act in 1990. The past 10 years of data included the recession; however, peaks and valleys within the industry are common. The 10 years of data also included the last peak and start of the current upsurge in construction.
- Assume the well data used represents individual residential wells with a single connection.

Results

The total low and high projections of individual permit-exempt well connections through 2040 for each sub-basin are presented in Tables 2-13 and 2-14. The number of Group B permit-exempt well connections was combined with the low and high individual permit-exempt wells projections to develop a low and high forecast, respectively.

Table 3-13: Future Connections, Pierce County Portion of WRIA 11 – Low Projection

Sub-basin	Individual PE Wells Low Projection 2018-2040	Group B PE Connections 2018-2040	Total PE Connections Low Projection 2018 - 2040
Lower Nisqually	2	0.50	2.5
Mashel River	18.4	1.50	19.9
Prairie Tributaries	388.0	106.40	494.4
Ohop Creek	28.6	1.50	30.1
Upper Nisqually River	9.5	3.30	12.8
Total	**446.5**	**113.2**	**559.7**

Table 3-14: Future Connections, Pierce County Portion of WRIA 11 – High Projection

Sub-basin	Individual PE Wells High Projection 2018-2040	Group B PE Connections 2018-2040	Total PE Connections High Projection 2018 - 2040
Lower Nisqually	2	0.50	2.5
Mashel River	18.6	1.50	20.1
Prairie Tributaries	489.4	106.40	595.8
Ohop Creek	25.2	1.50	26.7
Upper Nisqually River	11.0	3.30	14.3
Total	**546.2**	**113.2**	**659.4**

Discussion of Results

The low projection for total permit-exempt well connections within the Nisqually River Basin was 559.7 versus the high projection of 659.4. Most permit-exempt well connections in Pierce County are likely to occur in rural areas within the Prairie Tributaries Sub-basin. Table 3-14 shows that 595.8 of the total high projection of 659.4 permit-exempt well connections, or 90.3%, will occur within the Prairie Tributaries.

3.2.4 Three-County Summary of Results – Total Forecast Connections in WRIA 11

Table 3-15 summarizes the total number of connections to domestic permit-exempt wells forecast to occur between 2018 and 2040 by sub-basin for the entire WRIA 11. Table 3-15 also summarizes the breakout between anticipated connections in the urban growth areas (UGAs) of the watershed and rural areas. This forecast includes estimates from Thurston (Section 3.2.1), the high forecast from Lewis County (Section 3.2.2) and the high forecast for Pierce County (Section 3.2.3).

Table 3-15: Total Projected New Domestic Permit-Exempt Connections by Aggregated Sub-basin, WRIA 11 (2018-2040)

Sub-basin	UGA Connections	Rural Connections	Total Connections
McAllister	39	116	155
Thompson/Yelm	1,036	526	1,562
Lackamas/Toboton/Powell	-	430	430
Lower Nisqually		2	2
Mashel River		20	20
Prairie Tributaries		596	596
Ohop Creek		27	27
Upper Nisqually (Lewis, Pierce, Thurston)		195	195
Total	**1,075**	**1,912**	**2,987**

3.3 Water Use Estimates – Domestic Permit-Exempt Connections 2018-2040

3.3.1 Overview

The Department of Ecology (Ecology) has provided recommendations for estimating water use from permit-exempt well connections for purposes of complying with the provisions in ESSB 6091, codified as 90.94.020 RCW (Ecology, June 2018a). These recommendations involve the estimation of actual indoor and outdoor water use by

each permit-exempt well connection anticipated between 2018 and 2040. However, ESSB 6091 and the associated 90.94.020 RCW restrict the maximum annual average withdrawal from a connection to a permit-exempt well in WRIA 11 to 3,000 gallons per day (gpd) averaged over the entire year. This legal limit of 3,000 gpd is likely much greater than actual annual average indoor and outdoor domestic water use. The Nisqually Planning Unit has chosen to estimate both the actual annual average water use associated with a permit-exempt well connection and the legal right to the full water use as specified under 90.94.020 RCW. This approach quantifies a range of potential impacts to instream flows that can be addressed by a combination of sub-basin specific offsets and larger scale projects that provide a net ecological benefit for the entire watershed. Furthermore, two methods were used to estimate actual water use. One used Ecology guidance to estimate outdoor use based on irrigation requirements (Ecology, 2018a) and the other was based on actual data from 58 Group A and B water systems managed by the Thurston PUD (Appendix D).

Estimates of water use by future permit-exempt domestic wells under 90.94.020 RCW are required to account for the portion of water that is "consumptively" used. Because most connections to permit-exempt domestic wells rely on individual septic systems and most indoor water that is discharged via septic systems is returned to the groundwater system, (Ecology, June 2018a) states that it is reasonable to assume that 10 percent of indoor domestic water use is consumed. Most outdoor water is lost to evapotranspiration; and although the percentage of outdoor water that is consumed (lost to the atmosphere) is variable based on climate, soil type, etc., it can be assumed that approximately 80% of outdoor domestic water is consumed in WRIA 11 (e.g., not returned to the local groundwater system and not available for recharge to local streams). This Addendum to the WRIA 11 Watershed Plan addresses mitigation for the impacts of the consumptive portion of indoor and outdoor domestic water use by permit-exempt wells on local streamflows.

Estimates of consumptive domestic groundwater use by permit-exempt wells forecast for the Thurston, Lewis and Pierce County portions of the Nisqually Watershed were evaluated by sub-basin. It should be noted that sub-basins represent surface water divides, which may not necessarily parallel groundwater divides. Permit-exempt wells draw from groundwater sources, and can therefore impact areas that extend beyond sub-basin boundaries that are defined by surface water features. For this analysis, it is assumed that any permit-exempt well located within a sub-basin will impact tributaries within that sub-basin.

3.3.2 Estimated Actual Consumptive Water Use

Indoor Water Use: Average annual indoor use was assumed to be 150 gallons per day (gpd) per connection for new households in the watershed (Thurston, Lewis and Pierce Counties). Per Department of Ecology guidance (Ecology, June 2018a), it was assumed that 10% of all indoor water use is consumptive and 90% is non-consumptive, in that it returns to the subsurface hydrologic system via septic system discharge. The 150 gallons per day assumption (per Ecology guidance) was compared to the actual indoor water use of 58 group A and B systems managed by the Thurston Public Utility District (PUD). Indoor water use averaged 129 gallons per day per connection for the PUD's group A and B systems over the month of February of 2017 (personal communication, Thurston PUD, October 2018). Permit-exempt wells owners are not subject to water system rate structures designed to incentivize conservation and may therefore consume more indoor and outdoor water. Therefore, the 150 gallons per day assumption was found to be relevant and justifiable. For the purposes of this Addendum, actual indoor, consumptive water use is assumed to be 10% of 150 gallons per day, or 15 gallons per day.

Outdoor Water Use: Two methods were used to estimate outdoor water use, Method 1 was based on actual data from 58 Group A and B water systems managed by the Thurston PUD (Appendix D), and Method 2 used Ecology

guidance (Ecology, June 2018a) to estimate outdoor use based on basin-specific irrigation requirements and monthly precipitation.

Method 1: To estimate average annual outdoor water use, the Planning Unit assessed actual water usage data for Group A and B water systems operated by the Thurston PUD in 2015, 2016 and 2017 (see Appendix D). On average, those water systems used a total of 183 gpd/household connection per year over the three-year time period. After subtracting the PUD's estimated indoor water use, annual outdoor water use is, on average, approximately 50 gpd/household for the Group A and B Systems managed by the Thurston PUD between 2015 and 2017. Drought conditions occurred in 2015 and could have impacted estimates of water use in one of two ways: summer water use could have been higher than usual, or more stringent conservation rates applied by Thurston PUD may have incentivized conservation. Planning Unit members felt that it was important to consider excess use by permit-exempt well owners who are not subject to PUD rates, but are subject to the costs of pumping. The Planning Unit assumed average annual outdoor water use associated with permit-exempt wells is double that observed by the PUD. Therefore, for this analysis, it is assumed that each household utilizes 100 gpd/household connection for outdoor uses on an annual average (100% more than their Group A and B counterparts). Per Ecology guidance (Ecology, June 2018a), 80% of that outdoor use is considered consumptive, as that water is not directly returned to the groundwater system.

Method 2: The Planning Unit also applied Ecology guidance (Ecology, June 2018a) to provide a second estimate of outdoor consumptive use based on standard crop irrigation requirements. Assumptions for this method included average irrigated acreage, irrigation efficiency and irrigation requirements using information from the Olympia climate station (Natural Resource Conservation Service, 1997). Application of this methodology to WRIA 11 assumed that an average of 0.2 acres of turf or pasture were irrigated per permit-exempt well connection, and that irrigation efficiency in rural areas of WRIA 11 was 90%. The estimate of 0.2 irrigated acres per parcel is drawn from a study done for Whatcom County using satellite imagery to estimate areal extent of irrigation (RH2 Engineering, August 2018). This study found that the average irrigated lawn/garden size for a home served by a permit-exempt well for domestic purposes in Whatcom County was 0.2 acres.

Rationale for the 90% irrigation application rate efficiency include:

- For rural land uses, there are generally less impermeable surfaces.
- Not all the water landing on a sidewalk is evaporated, some will runoff and infiltrate.
- Temperatures in WRIA 11 are generally lower than eastern Washington areas such as Spokane where 75% application efficiency has been used.
- There is generally less wind in WRIA 11 than in areas in eastern Washington resulting in less evaporation.
- Many permit-exempt well users use rainbird-type sprinklers or drip irrigation rather than the pop-up type on automatic irrigation systems that result in more spray, resulting in less overall evapotranspiration.

Per connection indoor use, and outdoor use calculated using both methods described above are summarized in Table 3-16.

Table 3-16: Nisqually Watershed: Actual Water Usage Assumptions

	Average Annual Indoor Use Per connection		Average Annual Outdoor Use per connection Method 1 Thurston PUD data		Method 2 Ecology Irrigation Guidance	
	AF/Year	gpd	AF/Year	gpd	AF/Year	gpd
Total Use	0.170	150	0.112	100	0.292	261
Consumptive Use	0.0168	15	0.0896	80	0.233	208

3.3.3 Consumptive Portion of the Legal Right to Water

To be conservative and to account for any potential future activity or situation where one's legal right to water is maximized, consumptive water use associated with the legal limit of 3,000 gpd for a permit exempt well as established under RCW 90.94 was also considered as part of this Watershed Plan Addendum addressing permit-exempt well impacts on instream flows.

Using the data provided by Thurston PUD, the Planning Unit assumed that a similar proportion of indoor and outdoor use would occur as occurred in July 2017 for the PUD's Group A and B Systems (approximately 36 percent of the water would be used inside a house and 64 percent of the water would be used outside). This results in an estimated 1,920 gpd of the 3,000 gpd used for outdoor use and 1080 gpd for indoor use. The same consumptive use factors were applied (10 % consumptive indoors and 80% consumptive outdoors). The assumptions and quantities used to evaluate the legal limit of consumptive use in WRIA 11 are shown in Table 3-17.

Table 3-17: Nisqually Watershed: Legal Limit Water Usage Assumptions

	Legal Indoor Use per connection		Legal Outdoor Use per connection	
	AF/Year	gpd	AF/Year	gpd
Total Use	1.210	1,080	2.15	1920
Consumptive Use	0.121	108	1.72	1536

3.3.4 Consumptive Use Results

Estimates of actual annual average consumptive water use by domestic permit-exempt connections forecasted to be installed between 2018 and 2040 to service rural growth in the Nisqually Watershed is summarized by sub-basin using Method 1 (outdoor use based on observed Thurston PUD data) in Table 3-18 and Method 2 (outdoor use based on Ecology guidance on irrigation requirements) in Table 3-19.

Table 3-18: Projected Actual Annual Average Consumptive Use of Domestic Permit-Exempt Wells, Nisqually Watershed, WRIA 11 (2018-2040) – Thurston PUD Data Source

Sub-Basin	Total PE Connections	Annual Consumptive Use (AFY)	Cubic Feet/ Second (CFS)	CFS per connection	AFY per connection
McAllister	155	16	0.023		
Thompson/Yelm	1,562	166	0.230		
Lackamas/Toboton/ Powell	430	46	0.063		
Lower Nisqually River	2	0	0.000		
Mashel River	20	2	0.003		
Prairie Tributaries	596	63	0.088		
Ohop Creek	27	3	0.004		
Upper Nisqually (all counties)	195	21	0.029		
Total	**2,987**	**318**	**0.439**	**0.000147**	**0.1064**

Table 3-19: Projected Actual Annual Average Consumptive Use of Domestic Permit-Exempt Wells, Nisqually Watershed, WRIA 11 (2018-2040) – Ecology Guidance Method

Sub-Basin	Total PE Connections	Annual Consumptive Use (AFY)	Cubic Feet/Second (CFS)	CFS per connection	AFY per connection
McAllister	155	39	0.054		
Thompson/Yelm	1,562	390	0.539		
Lackamas/Toboton/ Powell	430	107	0.148		
Lower Nisqually River	2	0	0.001		
Mashel River	20	5	0.007		
Prairie Tributaries	596	149	0.206		
Ohop Creek	27	7	0.009		
Upper Nisqually (all counties)	195	49	0.067		
Total	**2,987**	**747**	**1.032**	**0.000345**	**0.25**

Estimates of the consumptive portion of the legal right to water from a permit-exempt well (assuming one connection per well) are indicated by sub-basin in Table 3-20.

Table 3-20: Projected Legal Consumptive Water Use of Domestic Permit-Exempt Wells, Nisqually Watershed, WRIA 11 (2018-2040)

Sub-Basin	Total PE Connections	Annual Consumptive Use (AFY)	Cubic Feet/ Second (CFS)	CFS per connection	AFY per connection
McAllister	155	285	0.394		
Thompson/Yelm	1,562	2,876	3.973		
Lackamas/Toboton/ Powell	430	792	1.094		
Lower Nisqually River	2	4	0.005		
Mashel River	20	37	0.051		
Prairie Tributaries	596	1,098	1.516		
Ohop Creek	27	50	0.069		
Upper Nisqually (all counties)	195	359	0.496		
Total	**2,987**	**5,501**	**7.598**	**0.002544**	**1.84**

Discussion of Results

Tables 2-18, 2-19 and 2-20 indicate that potential impacts to streamflow from future domestic permit-exempt well use are likely to be greatest in the Thompson and Yelm Creek tributaries in Thurston County and the Prairie Stream Tributaries in Pierce County. These estimates relied on the forecasting methods that yielded the highest, or most conservative, estimates of rural population growth in Pierce and Lewis County. Lewis County also included an 11 percent safety factor to account for uncertainty due to mapping errors. Thurston County estimates of new exempt-well connections were also conservative based on assumptions made regarding availability of rural Group A and B water connections when actual data were unavailable. In total, the actual number of forecast rural permit-exempt connections in all three counties in WRIA 11 through 2040 are likely to be less than that shown in Tables 2-18, 2-19 and 2-20.

Forecasted average annual water use by permit-exempt wells in all of WRIA 11 is expected to range between 318 and 747 AF/Year or 0.44 and 1.03 cfs based on the two methods used for estimating outdoor consumptive water use. Actual average annual water use is estimated to be 0.000147 to 0.000345 cfs or 0.106 to 0.25 AFY per connection. It should be noted that actual use fluctuates over the year and is highest in the warm summer months and lowest in winter months when little to no outdoor irrigation occurs.

Chapter 4 Salmon Habitat Projects with Instream Flow and Net Ecological Benefits

4.1 Net Ecological Benefit and Salmon Recovery Goals

4.1.1 Defining Net Ecological Benefit for the Nisqually Watershed

In its *Interim Guidance for Determining Net Ecological Benefit* (Publication 18-11-009, Ecology 2018b), the Department of Ecology established criteria for determining if "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". The guidance further specifies that net ecological benefit (NEB) may be achieved by a combination of water offset projects with direct flow benefits, and non-water offset projects, providing "ecological benefits by enhancing aquatic systems to improve capacity to support viable populations of native species." Water offset projects and policies are discussed in Chapters 5 and 6 through sub-basin-specific micro-mitigation strategies to restore streamflows impacted by new permit-exempt well development within sub-basins over the next 20 years. This chapter addresses the broader question of NEB through "macro" or watershed-scale habitat projects with both flow benefits and ecological benefits essential to native salmon populations.

Given the critical state of salmon recovery in the Nisqually, the Planning Unit understands the Streamflow Restoration Act's NEB requirement as a mandate for a long-term approach to water planning that balances development, agricultural and industrial needs with the imperative of restoring a self-sustaining, salmon-supporting watershed ecosystem. Addressing this central issue required the Planning Unit to think about NEB at a watershed-wide scale beyond the twenty-year timeframe. Permit-exempt well use is one relatively small component of the challenge the Nisqually Watershed will face in balancing its water budget for salmon and human uses over the coming decades, as climate change alters precipitation, storage, and flow patterns for the entire basin. As in previous watershed planning efforts, the macro-mitigation strategies in this Addendum are aligned with longer-term efforts to manage water resources effectively in the face of these growing challenges, including the *Forest and Water Climate Adaptation Plan for the Nisqually Watershed* (Greene, 2014) and the Nisqually Community Forest's *Upper Busy Wild Unit Forest Management Plan* (Nisqually Community Forest, 2016), along with the *Nisqually Chinook Recovery Plan* (Nisqually Chinook Recovery Team, 2001) and *Draft Nisqually Steelhead Recovery Plan* (Nisqually Steelhead Recovery Team, 2014). Of these, the Chinook and Steelhead Recovery Plans provide the most comprehensive scientific framework, as well as the underlying rationale, for watershed-wide and basin-specific actions necessary to restore and sustain functioning riparian ecosystems for salmon.

The Nisqually Indian Tribe is signatory to the Medicine Creek Treaty of 1854, in which they reserved the right to fish, hunt, and gather forever. The promise made to the Tribe was that salmon and salmon fishing would continue to be available into the future as it had been in the past. But over the past 160 years the region has changed dramatically, including loss and impacts to the fresh and marine habitats that are critical to the survival of salmon, to the point where the runs of salmon are less than 10% of historic levels. The decline of wild Chinook and steelhead has been so precipitous that they are both listed as Threatened under the Endangered Species Act.

The Tribe's fishing seasons have decreased along with the demise of the various runs of salmon in the Nisqually River. In the years immediately following the federal court decision upholding treaty rights in *United States v. Washington* (1974), known as the Boldt decision, the Nisqually Tribe fished sustainably for eight months of the

year on the various runs of salmon returning to the Nisqually River. The fishery reached its all time low in terms of time on the river in 2015, when the Tribe fished a total of eight days.

The Nisqually Tribe has led the effort to develop and implement recovery plans for Fall Chinook and steelhead. There are number of actionable elements in these plans that focus on habitat protection and restoration from the Nisqually estuary to the headwaters of the Mashel River. These plans have identified summer streamflow in several critical tributaries in the watershed (the Mashel River and Ohop, Muck, and Yelm Creeks) that are vital to the recovery of both listed species. The Tribe is interested in defining net ecological benefit at a scale and focus that will help resolve the issues around salmon recovery which severely constrain their treaty fishing rights, and the Planning Unit concurs with this approach.

4.1.2 Aligning Salmon Recovery Habitat Initiatives with Streamflow Restoration Planning

The benefits associated with the macro-scale projects described in this chapter contribute to the mitigation of future permit-exempt wells. However, recovering salmonid populations and the ecosystem functions necessary to support them is an effort that goes beyond managing for the effects of new permit-exempt water withdrawals through 2040. The Planning Unit's intent is to address NEB by integrating the requirements of the Streamflow Restoration Act with existing watershed and Endangered Species Act (ESA) recovery plans, namely the *Nisqually Chinook Recovery Plan* (Nisqually Chinook Recovery Team, 2001) and *Draft Nisqually Steelhead Recovery Plan* (Nisqually Steelhead Recovery Team, 2014). The Nisqually Indian Tribe is the Lead Entity for salmon recovery in the watershed and has worked closely with partners to develop comprehensive and holistic approaches to achieving salmonid populations with long-term viability. This is consistent with the 2003 Nisqually Watershed Management Plan, which deferred to the Nisqually Chinook Recovery Plan for addressing the majority of habitat components in the Plan (see Golder, 2003, Section 11.2.2).

The Tribe's strategy is based on the Ecosystem Diagnosis and Treatment (EDT) model, which identifies key factors limiting salmon populations, including abundance, spatial diversity, genetic diversity, and productivity, in each reach of the watershed. Recovery projects are developed and ranked at the reach and sub-basin level where EDT indicates the greatest possible return on investment for the two ESA-listed salmon populations. The highest priority habitat efforts in the Nisqually Watershed are currently focused on its major salmon-bearing tributaries. The mainstem Nisqually River is of less concern for streamflow and salmonid habitat than are the tributaries. Mainstem flows below Tacoma Power's Nisqually Hydroelectric Project (Alder and LaGrande dams) are set by federal license requirements and managed season to season by the Nisqually River Coordinating Committee. Reaches above the dams do not support anadromous fish populations. Likewise, mainstem habitat is well-protected, with 75% of shoreline in the anadromous zone (below LaGrande Dam) in permanent stewardship. Major tributaries, in contrast, contain critical salmon habitat in significant need of ongoing protection and restoration to enhance streamflow, water quality, and habitat diversity. The Mashel River and Ohop, Tanwax, Yelm and Muck Creek basins are all historically important salmon-bearing systems and continue to face challenges from historical and ongoing groundwater withdrawals, logging, channel modifications, and stormwater runoff, with basin-wide effects on salmon populations. Achieving NEB for the Nisqually Watershed must address habitat availability and access challenges in these sub-basins, in some cases as a higher priority than projects in sub-basins that may experience more growth in permit-exempt well demand but are less critical for salmon recovery.

The Salmon Recovery Program's current Habitat Project Ranking Guidance outlines 17 recovery initiatives focused on ecosystem-level functions (NIT Salmon Recovery Program, 2018). The Planning Unit identified and ranked nine of these initiatives likely to provide either significant streamflow benefit to tributary basins, and/or habitat

benefits to salmon in areas affected by low or intermittent seasonal flows. These are summarized in Table 4-1 and attached as a more detailed summary in Appendix F-1.

The four top-ranked streamflow initiatives address forestry, base flow, instream habitat, and riparian floodplain objectives in the Mashel and Ohop sub-basins. The Salmon Recovery Program has invested 15 years of ongoing work in these watersheds, aimed at full restoration of ecosystem functions critical to salmon. These four initiatives are expected to return large-scale flow benefits at full implementation and have projects ready to implement now. Because they offer the most significant method for delivering NEB at the watershed scale, these projects (and two associated projects expanding community forest conservation management into the Ohop and Lackamas/Toboton/Powell sub-basins) are addressed as macro-mitigation strategies in this chapter.

Smaller-scale streamflow projects under the remaining three initiatives (Muck Creek Recovery, Prairie Tributaries Recovery[3], and Barrier Removal) are being considered as local mitigation options within sub-basins in Thurston and Pierce County. The initiatives are included here to demonstrate the alignment with salmon recovery planning, and potential projects are discussed and quantified in Chapter 5 as county-led micro-mitigation.

Table 4-1: Salmon Recovery Habitat Initiatives with Streamflow and Net Ecological Benefit

Salmon Recovery Initiative	Priority	Sub-Basin	Key Actions
Mashel Watershed Recovery/ Community Forest	1	Mashel	Acquire commercial forestland to place in conservation management for streamflow enhancement
Ohop Watershed Recovery/ Community Forest	7	Ohop	Acquire commercial forestland to place in conservation management for streamflow enhancement
Bald Hills Watershed Recovery/ Community Forest	8	Lack/Tob/Powell	Acquire commercial forestland to place in conservation management for streamflow enhancement
Mashel Base Flow	2	Mashel	Implement Town of Eatonville stormwater and infrastructure improvements
Ohop Valley Floodplain Restoration	3	Ohop	Restore 3.1 miles of channelized stream and 710 acres of riparian and floodplain habitat
Mashel River Riparian Corridor Protection and Restoration	4	Mashel	Protect riparian corridor and restore habitat complexity through log jams and riparian plantings
Muck Creek Recovery*	5	Prairie Tributaries	Restore up to 60 miles of impaired streams and surrounding floodplain/wetland habitat; maintain hydrologic function of prairie ecosystem through prescribed burns
Prairie Tributaries Recovery*	6	Prairie Tributaries, Thom/Yelm, Lack/Tob/Powell	Restore up to 20 miles of impaired streams and surrounding floodplain/wetland habitat; maintain hydrologic function of prairie ecosystem through prescribed burns
Barrier Removal*	9	Multiple	Remove fish passage barriers

*Projects and quantification estimates discussed in Section 5.1.4 under county-led mitigation strategies.

Aligning streamflow NEB objectives with salmon recovery initiatives gives the Planning Unit a feasible and adaptive framework to ensure that instream flow impacts are offset in ways best targeted to achieve NEB for salmon recovery. The streamflow benefits estimated to occur as a result of the projects listed above are addressed in Section 7 and Table 7.2). Due to the limited time available to develop site-specific quantitative models for this Addendum, and the risks of driving up acquisition costs from listing potential mitigation sites, this approach offers

[3] *The Salmon Recovery Program initiatives are categorized using different sub-basin groupings than those used in this Addendum. The Prairie Tributaries Salmon Recovery Initiative includes prairie-type streams in both Pierce and Thurston Counties, while Muck Creek Recovery is a separate initiative.*

a more consistent benchmark and avoids the high degree of uncertainty for any list of projects over a decades-long implementation horizon. The initiatives and template projects described below will allow Ecology and the Implementing Governments to track progress towards maximum NEB, while preserving flexibility to manage adaptively and act on emergent opportunities. This approach is also consistent with typical salmon recovery project planning, in which detailed site-specific modeling and project designs are not generally developed in advance of secured funding for implementation. Using the same initiative framework will allow Governments to dovetail funding requests for streamflow restoration under ESSB 6091 with resources from the Salmon Recovery Funding Board and other sources, maximizing the likelihood that these initiatives can be fully implemented.

Finally, the initiative framework informs the Planning Unit's prioritization of projects by taking a long-term view of salmon recovery and sustainable ecological benefits. While they will provide substantial mitigation for permit-exempt wells within sub-basins, the projects that fall under these macro-mitigation initiatives are prioritized within the WRIA as a whole, targeting broader ecological impacts by enhancing flows and improving ecological processes in upper-watershed basins, with more substantial benefits realized on a longer timeframe. The Planning Unit's top priority initiative in this category is the Mashel Watershed Recovery/Community Forest. At full implementation, this initiative will generate between 2 and 5 cfs in average late summer streamflow in the Mashel River, more than offsetting the forecasted actual water use from permit-exempt wells, using either calculation method (see Chapter 3), in the entire watershed (Hall et al., 2018 [Appendix G-2]). EDT analysis also ranks this initiative as the highest priority outside of estuarine restoration for furthering salmon recovery (NIT Salmon Recovery Program, 2018). This initiative requires decades of managing forestlands for longer harvest rotations and streamflow enhancement, meaning that these efforts must begin today in order to realize those benefits as soon as possible. Likewise, the process of restoring the channel, reconnecting floodplains, and rebuilding riparian forests in the Ohop sub-basin, the Planning Unit's second highest priority, has been ongoing since 2009 and is approximately half completed (NIT Salmon Recovery Program, 2018).

This long-range and watershed-wide focus underlies the Planning Unit's decision to prioritize urgent action on Community Forest acquisitions in the Mashel sub-basin and continued restoration work in the Ohop Valley, where current investments will yield the greatest return in benefits for salmon populations and flow enhancement throughout the watershed. Initiatives discussed in Chapter 5 address similar possible flow and habitat restoration activities in the Yelm/Thompson, Prairie Tributaries, and Lackamas/Toboton/Powell sub-basins, where greater impacts from permit-exempt wells are expected to occur. The Planning Unit anticipates that the Implementing Governments and other partners will identify actionable projects for further refinement and quantification within all listed initiatives, with ongoing collaboration to prioritize those with the highest NEB impacts.

4.1.3 Approach to Quantifying Impacts of Salmon Recovery Initiatives

The Salmon Recovery strategy defines quantitative geospatial metrics for each initiative: shoreline miles protected, feet of ditched channel treated, acres of floodplain connected, acres of forestland protected, etc. (NIT Salmon Recovery Program, 2018). Existing modeling, and results from previous restoration work, reliably demonstrate attainable positive streamflow impacts from implementing these selected habitat initiatives (Hall et al, 2018; Perry and Jones, 2016; Pollock et al, 2003). The Planning Unit has also conducted preliminary modeling for stream restoration initiatives based on groundwater data collected following ditch removal and floodplain reconnection in the Ohop Valley (Appendix E). This model is used as a template to estimate streamflow benefits for an upcoming shovel-ready Ohop project discussed in this chapter, and is also applied to estimate flow benefits for county-led projects in similar prairie-type streams discussed in Chapter 5.

The Planning Unit expects to continue refining quantitative streamflow benefit estimates through the implementation process and adaptive management following Addendum adoption (see Chapter 8). For those initiatives where detailed local streamflow models have not yet been developed, the restoration metrics in the salmon recovery strategy provide a basis for quantifying NEB results correlated to restoration activities. Salmon recovery EDT metrics, including access to habitat, presence of log jams, habitat diversity, and water quality, are expected to show quantifiable improvement as a result of implementing the initiatives.

4.2 Nisqually Watershed Macro-Mitigations

4.2.1 Community Forest Acquisition for Conservation Management

Aligned Salmon Recovery Initiatives: Mashel Watershed Recovery/Community Forest, Ohop Watershed Recovery/Community Forest, Bald Hills Watershed Recovery/Community Forest

Flow Restoration Priority: 1 (Mashel)

Sub-Basins: Mashel (active), Ohop and Lackamas/Toboton/Powell (anticipated)

Flow Benefit: 2.5-7.5 cfs (1,779.5-5,396 AFY)

Net Ecological Benefit: Community forest management will increase the quantity and quality of critical salmon habitat for ESA-listed Chinook and steelhead.

Mashel Watershed Recovery/Community Forest Initiative

The upper Mashel River watershed experienced massive clear-cut logging in the first half of the 20th century, and has been damaged by extensive sediment loads filling pools and spawning gravel, reduced water retention, elevated stream temperatures, and poor large-woody-debris recruitment (NIT Salmon Recovery Program, 2018). Much of the upper basin, particularly the Busy Wild sub-basin, remains in intensive commercial forestry, with continued negative impacts on streamflow and habitat.

Projects to implement this initiative will consist primarily of acquiring parcels of commercial forestland in the upper Mashel Watershed for the Nisqually Community Forest, with a medium term goal of owning 30,000 total acres of forestland under a conservation management regime to maximize flow and other ecological benefits. Streamflow enhancement is a primary goal of Nisqually Community Forest management (Nisqually Community Forest, 2016). The Community Forest partners have conducted management simulations using the Visualizing Ecosystem Land Management Assessments (VELMA) ecohydrological model, which dynamically simulates the interaction of hydrological and biogeochemical processes at plot, hillslope, and watershed scales (see Appendix G-2, Hall et al, 2018). Based on VELMA modeling, increasing stand age by lengthening harvest rotations from 40 years to 100 years would raise base flows in the Mashel watershed by up to 9 cfs (Hall et al, 2018). To date, just over 1,920 acres of forestland in the Mashel watershed (4% of a total of approximately 60,000 acres) are currently protected and managed by the Nisqually Community Forest. Approximately 22,140 acres are owned by the Washington State Department of Natural Resources, leaving approximately 30,821 acres, or 57%, currently held as commercial timberlands potentially available for acquisition and conservation management (Justin Hall, Nisqually Community Forest, personal communication, January 2019).

For this Addendum, the VELMA model was used to estimate the streamflow impacts from expanding the Nisqually Community Forest targeting parcels with an average stand age of at least 40 years. The model indicates that the critical threshold for forest stand age for streamflow benefit is at 40 years: younger, fast growing trees take up groundwater at higher rates (one reason that regular clearcutting and replanting on short schedules negatively

impacts streamflow) (Perry and Jones, 2016). Conversely, flow benefits continue to compound each year for mature stands over 40 years' average age. Two rates of acquisition were assumed, described in Tables 4-2 and 4-3 below: a minimum scenario based on the rate of past acquisitions, and a very aggressive rate that assumes acquiring all parcels over an average of 40 years old in the Mashel and other sub-basins. The priority target for acquisition are stands that are currently an average of at least 40 years old, which will maximize the flow benefit that can be realized from purchases over the 20-year planning horizon of the Streamflow Restoration Act (Hall et al, 2018 and Appendix G-2). However, the Planning Unit also endorses purchases of younger stands whenever opportunities present themselves. It is the Nisqually Indian Tribe's position that acquisition of any stand for conservation management will prevent ongoing flow losses from scheduled clear-cuts and continue to shorten the lead time to increase stand age across the Mashel basin. The more rapidly forestland is acquired, the more rapidly flow and ecological benefits will accrue.

Ohop Watershed and Bald Hills Watershed Recovery/Community Forest

In the long term, the Community Forest's goal is to place 70,000-100,000 acres of forestland in conservation management, comprising almost all of the commercial forestland in the entire Nisqually watershed. Planned actions include working with the Washington Department of Natural Resources regarding management of the Elbe and Mineral State Forests (32,600 acres total), as well as direct acquisitions and securing conservation management through deed of right or other binding agreements. Ultimately, the targeted area for conservation management includes approximately 16,402 acres in the Ohop Watershed, 9,393 acres in the Bald Hills Watershed, and 36,522 acres in the Upper Nisqually basin.[4] As forestlands are acquired, additional projects may also include active forestland restoration efforts, including riparian enhancements to improve salmon spawning habitat, with potential benefits to streamflow and storage.

Expanding the Nisqually Community Forest's holdings to timberlands in the Ohop and Lackamas/Toboton/Powell sub-basins will have similar substantial long-term benefits to baseflows in these basins. While a full VELMA model has not yet been created for these sub-basins, Thurston County has estimated flow benefits for conservation management of forestlands in these sub-basins using comparable stand ages based on the VELMA model for the Mashel watershed (see Appendix G-1 for full analysis). Implementing this initiative will involve further modeling and targeted priority parcels for acquisition and management under the Community Forest's longer harvest rotations. An initial parcel of 240 acres (with average stand age over 80 years) in the Powell Creek drainage, currently scheduled for clearcutting, is a high priority for acquisition to avoid the loss of up to 3 cfs in streamflow by retaining mature forests.

Table 4-2 and 4-3 summarize streamflow benefits accruing over the next 20 years of implementation, assuming a very conservative minimum acquisition scenario and a very broad maximum scenario of parcels averaging at least 40 years old. The minimum scenario assumes rates of acquisition based on past acquisitions, which have been concentrated in the Mashel. The maximum was calculated based on assuming the Community Forest acquires every parcel at 40 years' average stand age or older, including parcels in the Ohop and Lackamas-Toboton-Powell basins.[5] For both scenarios, the rate of purchase was assumed to be linear beginning in year one, with flow benefits accruing and compounding based on the number of 40+ year-old parcels in conservation management (see Appendix G-1). While achieving the maximum scenario is unlikely, due to uncertainties in funding and opportunity to purchase every parcel above 40 years average age, it is included to represent the upper bound of flow benefits attainable through forest management in the Nisqually's substantial timberlands. The Planning Unit expects to update benefit models to reflect actual conditions as this plan moves into implementation, and

[4] *Acreages given are approximate based on LandTrendr parcel data, accessed January 2019.*

[5] *Parcels in the Upper Nisqually sub-basin were also included in the analysis in Appendix G-1, which almost doubles the potential acreage. The Upper Nisqually is not included here or in the total summary of mitigation in Chapter 7 (Table 7-2 and sub-basin-specific summaries), because it does not support anadromous fish populations and is in less need of mitigation at this time.*

encourages adaptive management decisions to diversify purchasing priorities according to real-time needs and opportunities. Real acquisitions may include parcels with stands averaging less than 40 years to avoid further flow loss from continued short-rotation harvest intervals and the negative ecological and streamflow impacts of clearcutting. While acquiring recently clear-cut parcels may decrease streamflow in the near term, it will avoid the continued impacts that would occur if forestlands remain in intensive 40-year harvest rotations. These scenarios establish broad parameters for estimating streamflow benefits, with the possibility of more refined estimates available given additional time for modeling.

The Community Forest initiative is the highest priority for the Tribe in effecting Net Ecological Benefit and making real progress towards protecting salmon into the long-term future. The Tribe has encouraged the Planning Unit to make forest management a primary mitigation and NEB strategy and expects this initiative to play a large role in adaptive management, adjusting acquisition rates and target stands to changing mitigation needs.

Table 4-2: Acquired Acres and Annual Streamflow Gain for Community Forest Lands – Minimum Scenario (based on acquisition rate to date)

Sub-Basin	Mashel	Ohop	Lackamas-Toboton-Powell
Forestry Area (acres)	13,440	0	640
Mitigation (AFY)	1,698.6	0	80.9
Total Annual Mitigation at 20 years (AFY):	**1,779.5**	**Total Annual Mitigation at 20 years (cfs)**	**2.456**

Table 4-3: Acquired Acres and Annual Streamflow Gain for Community Forest Lands – Maximum Scenario (acquiring all parcels averaging 40 years or older in 2019; Upper Nisqually parcels not included in this table)

Sub-Basin	Mashel	Ohop	Lackamas-Toboton-Powell
Forestry Parcel Areas (acres)	24,725	7,591	2,756
Mitigation (AFY)	3,797.8	1,112	486.5
Total Annual Mitigation at 20 years (AFY):	**5,396**	**Total Annual Mitigation at 20 years (cfs)**	**7.448**

The implementation metric tracked by the Nisqually Salmon Recovery Team for progress on this initiative is acres of commercial forestland placed in conservation management. Monitoring of stream gauges and adaptive modeling will allow for adaptive management decisions by the Planning Unit and Salmon Recovery partners.

4.2.2 Eatonville Water System Improvements for Mashel Base Flow

Aligned Salmon Recovery Initiative: Mashel Base Flow

Sub-Basin: Mashel and Ohop

Flow Restoration Priority: 2

Flow Benefit: 1.133-1.473 cfs enhanced summer baseflows; 222.5-283.038.5 AFY average year-round benefit. Stormwater and other infrastructure projects will increase summer baseflow by 0.333-0.673 cfs by recharging groundwater through stormwater infiltration. Substituting surface water withdrawal for the Town's drinking water from Mashel River with an alternative source will result in an additional 0.8 cfs increase in summer base flows (see Appendices H and I).

Net Ecological Benefit: Implementing the Eatonville Comprehensive Stormwater Plan will address water quality concerns as well as low summer streamflows affecting listed and non-listed salmon populations in the Ohop and Mashel sub-basins. Some projects may reduce Mashel River flows during the winter months to supply additional water for summer months when baseflows are critically low, resulting in overall ecological benefit for salmon.

Implementation Projects

Stormwater Capital Improvement Projects and Conservation Efficiencies

The Town of Eatonville, located between the Mashel River and Lynch Creek in south Pierce County, produced an updated Comprehensive Stormwater Plan in consultation with the Nisqually Indian Tribe in 2013 (AHBL, 2013). The Plan includes six capital improvement projects (CIPs) to address water quality and drainage issues in Eatonville negatively affecting salmon habitat in the Mashel River and Ohop Creek, the highest priority salmon-bearing tributaries to the Nisqually River. Currently, most of Eatonville's stormwater is directed away from the Mashel River and sent untreated into Ohop Creek, via Lynch Creek. Lynch Creek has been listed by the Department of Ecology for fecal coliform exceedance, and flagged by Pierce County monitoring for high total nitrates, phosphorus, fecal coliform, and turbidity and low dissolved oxygen (NIT Salmon Recovery Program, 2018). Meanwhile, the Mashel River is listed for temperature exceedance in the summer months, when critically low flows and high temperatures pose a danger for young salmon and impede adult migration to spawning grounds. These CIPs include bioretention trenches, infiltration ponds, and drywells to enable gradual infiltration of stormwater into the Mashel River, improving water quality in both sub-basins and boosting critical low-flow periods in the summer by 0.128 cfs (38.7 AFY). In addition, a 2012 report identified significant loss from leakages in Eatonville's water system and Water Treatment Plant. Projects to improve water conservation in Eatonville's system could restore up to 0.096 cfs (69.6 AFY) to the Mashel River.

Aquifer Storage and Recovery

Eatonville has also conducted a preliminary study of aquifer storage and recovery (ASR) to supplement summer water use, potentially increasing summer flows in the Mashel River between 0.11-0.45 cfs (Golder, 2010). While aquifer storage would reduce winter flows in the Mashel by 0.07-0.25 cfs, the net ecological benefit obtained for salmon survival during the low flow period in the summer merits serious consideration (see Appendix H). Additional study is needed to assess the cost and feasibility of implementing ASR for NEB.

Alternate Water Supply

In addition to completing the Comprehensive Stormwater Plan, this initiative aims to develop an alternate water supply for the Town of Eatonville that does not derive from groundwater depleting baseflows in the Mashel River. The Town's 400,000 gallon per day drinking water comes from the Mashel River and four adjacent groundwater wells, which puts a strain on the base flows of the river. This is especially true in summer months when flows are low during critical spawning and rearing periods for listed salmonids. A report to the Town of Eatonville in 2012 estimated that relocating the Town's surface water diversion to Alder Lake or the Nisqually River would increase Mashel River flows by 0.8 cfs during the low-flow summer period, with benefits likely exceeding the impacts of withdrawing from an alternate location (RH2, 2012). Specific proposals for an alternate water supply have not been developed at this time. Table 4-4 summarizes flow benefits from implementation of these projects. See Appendices H and I (Streamflow Mitigation resulting from the Town of Eatonville's Projects and Water Conservation in the Town of Eatonville).

Table 4-4: Town of Eatonville Stormwater Projects (Appendices H and I)

Action	Calculated seasonal streamflow benefit (cfs)	Calculated year-round average streamflow benefit (AFY)
CIP #1 (400-ft bioretention trench)	0.046*	13.843
CIP #2 (infiltration pond at sewage lagoon)	0.002*	0.659
CIP #3 (400-ft bioretention trench)	0.019*	5.629
CIP #4 (800-ft bioretention trench)	0.038*	11.578
CIP #5 (drywell for infiltration)	0.013*	3.870
CIP #6 (400-ft bioretention trench)	0.010*	3.104
CIP Total benefit	*0.128**	*38.683*
Treatment Plant Efficiency	0.079**	57.695
Water System Efficiency	0.016**	11.66
Conservation Efficiencies Total Benefit	*0.096***	*69.355*
Aquifer Storage and Recovery	0.11 - 0.45***	20 - 80
Alternate Water Supply (conceptual)	0.8**	95
All Projects Total	**1.133 – 1.473**	**223.038 – 283.038**

*Assumes increased baseflow from infiltration and recharge between May and September only (6 months).
**Assumes year-round benefit.
***Assumes increased baseflow from stored water use between June and October (5 months), with reduced baseflows from water captured between November and May.

4.2.3 Ohop Valley Floodplain Restoration

Aligned Salmon Recovery Initiative: Ohop Valley Floodplain Restoration

Sub-Basin: Ohop

Flow Restoration Priority: 3

Flow Benefit: 0.0173 cfs; 24.4 AFY. Fully restoring 710 acres of floodplain in the Ohop Valley (approximately 50% complete) will promote groundwater recharge and wetland formation, contributing to increased baseflows.

Net Ecological Benefit: Ohop Creek restoration will increase the quantity and quality of critical salmon habitat, including ESA-listed Chinook and steelhead.

Project Background and Template for Benefit Analysis

Ohop Valley was farmed intensively, including channelization of 3.5 miles of the creek in the 1930s (Liddle, 1998). Due to channelization, ditching, and agricultural practices, the channel lacked diversity of habitat types and experienced high summertime stream temperatures, and other water quality impacts, and was physically disconnected from the floodplain and adjacent wetland habitats.

The restoration of Ohop Creek began in 2009 with the re-meandering of 1 mile of stream (Phase I and II),[6] restoring a portion of the channelized Ohop Creek. Lower Ohop Creek Restoration Phase III restored an additional

[6] *Ohop Creek restoration projects are referred to by their phase titles in the Salmon Recovery Habitat Work Schedule through the Washington State Recreation and Conservation Office. Phases I, II, and III have restored 2.4 stream miles of Ohop Creek, with an additional 1.8 stream miles planned for Phase IV.*

1.4 miles of stream suitable for salmon. Final implementation of these first three project phases is ongoing with continued riparian plantings, but are not counted toward the expected offsets for this plan. Groundwater monitoring wells were installed along the restored area during Phases I-III, with data collected from 2008-2018 (beginning prior to construction of Phase I). Analysis of the groundwater data was conducted by Thurston County for the Nisqually Planning Unit and found an estimated 9.8 AFY increase in streamflow attributable to ditch removal in the restored areas, along with an additional 2.5 AFY flow increase from beaver introduction. Appendix E describes this impact analysis, and applies the results from these previous Ohop projects as a template to estimate flow benefits expected from future ditch removal, floodplain reconnection, and beaver introduction projects in similar streams.

Table 4-5: Per-Mile Benefits from Ohop Restoration Template (Appendix E)

Average benefit per mile:	Ditch Removal	Beaver Introduction
Additional streamflow	0.0096 cfs	0.0009 cfs
Additional Recharge	13.57 AFY	N/A

Projects quantified using this Ohop Template include Ohop Phase IV (below), Muck Creek Recovery and Prairie Tributaries Recovery in this chapter, and small habitat projects in Thurston and Pierce Counties in Chapter 5.

Ohop Phase IV Project

The next implementation project, Ohop Phase IV, is shovel-ready and will restore a further 1.8 miles of ditched channel and protect 360 acres of floodplain, upstream from restoration Phases I-III. Using the model developed using prior Ohop restoration groundwater data (see Appendix E), an estimated 0.0173 cfs/24.4 AFY in additional streamflow is estimated from implementing Phase IV.

Table 4-6: Ohop Restoration Phase IV Streamflow Benefit

Sub-Basin	Stream	Ditch removal (ft)	Ditch removal (miles)	Calculated streamflow benefit (AFY)	Calculated streamflow benefit (cfs)
Ohop	Ohop Creek	9,504	1.80	24.4	0.0173

Juvenile Chinook utilize lower Ohop Creek for rearing and refuge from Nisqually River flood flows, taking advantage of available side channels and adjacent wetlands. Juvenile coho and steelhead would use this habitat year-round, while pink and chum salmon typically move downstream soon after emergence to rear in estuarine areas. Based on the EDT model, the life stages that are most affected by impacts to Ohop Creek are egg incubation, rearing, and pre-spawning holding. The impacts include changes in channel stability, flow, habitat diversity, sediment loading and key habitat quantity.

The goal of this initiative is to treat 100% percent of the remaining ditched channel, reconnecting the floodplain and restoring native vegetation throughout the valley. Implementation metrics tracked by the Salmon Recovery Team are floodplain acres protected (currently, 312 acres/44% protected), miles of ditched channel treated (1.9 miles/56% treated), and acres of impaired floodplain restored with native plantings (currently, 212 acres/35% planted).

Application of Ohop Template to Other Prairie Stream Projects

In the near term, counties are expected to lead restoration projects on prairie-type streams (in the Prairie Tributaries, Lackamas/Toboton/Powell, and Thompson/Yelm sub-basins) with similar actions and impacts to the Ohop initiative. Conceptual examples of these projects are analyzed in Chapter 5, using the template developed for Ohop Creek. Any implemented projects will also be tracked through the Salmon Recovery Program's Muck Creek

Recovery and Prairie Tributaries Recovery initiatives, using metrics including shoreline miles and floodplain acres protected and restored (NIT Salmon Recovery Program, 2018).

An additional action recommended in the salmon recovery strategy for intermittent or low-flow prairie systems is maintenance of prairie ecosystem conditions through regular prescribed burns. Research on the colonization of Puget Sound prairies by Douglas firs, resulting from decrease in the frequency of fires and disruption of natural prairie ecosystems, indicates that young fir trees draw up large quantities of water otherwise available for instream flows (Peter and Harrington, 2014). Maintaining prairie habitat through prescribed burns and other management strategies is also recommended as a method to maintain and enhance flows in these basins. While not addressed as a quantitative strategy in this Addendum, the Planning Unit encourages monitoring of prairielands and possible maintenance strategies through adaptive management.

4.2.4 Mashel River In-Stream Habitat Improvement Projects

Aligned Salmon Recovery Initiative: Mashel River Riparian Corridor Protection and Restoration

Sub-Basin: Mashel

Flow Restoration Priority: 4

Flow Benefit: Not yet quantified. In-channel storage and increased infiltration opportunities from construction of Engineered Log Jams (ELJs) are likely to provide small flow increases.

Net Ecological Benefit: ELJs will create increased pool habitat, providing preferred spawning areas for ESA-listed salmon, habitat complexity, and increased channel volume during low summer flow periods critical for juvenile salmon.

Project Background and Template for Benefit Analysis

Logging activities in the Mashel sub-basin have significantly impacted the habitat quality and instream flow patterns in the Mashel River. Extensive timber harvesting over the last 100 years has greatly decreased the input of large wood into the Mashel Basin. The reach designated for treatment in this initiative has lost 50% of its pool habitat. In addition, destabilizing slopes and increasing erosion contribute to high levels of sedimentation and flashy flow patterns, both detrimental to Chinook salmon and steelhead (Watershed Professionals Network, 2004). Since 2006, watershed partners have installed 52 ELJs in the Mashel River, accompanied by riparian plantings to improve channel stability and complexity. A total of 75 ELJs are planned for the Mashel River by the Salmon Recovery Team (Mashel Eatonville Restoration Project Phase III, 2015). Long-term streamflow impacts from ELJs have not been thoroughly studied, but increasing pool habitat will also increase channel volume, promoting groundwater infiltration, and provide critical deeper habitat for juvenile Chinook and steelhead during summer periods of low baseflows (Pollock et al, 2015; Beechie et al, 2010).

Importantly, monitoring of the installed ELJs in the Mashel River has revealed that they are not recruiting new wood as quickly as predicted, meaning they are not yet self-sustaining with natural ecosystem resources and require ongoing maintenance. Until protection of upstream habitat can be guaranteed and forests are given the opportunity to mature, there will be a constant need to introduce wood into the system. This initiative works in concert with the Mashel Watershed Recovery/Community Forest Initiative (Section 4.2.1), providing immediate critical habitat benefits for listed salmon populations that will require less continued maintenance as upper watershed forests mature and begin supplying natural woody debris in larger quantities.

Groundwater and instream flow monitoring may be implemented along with future projects to quantify the streamflow impact of ELJs in the Mashel River. The main metric for initiative implementation is the number of ELJs in place and functional in the Mashel River (currently 52 out of 75 planned). In addition, the Salmon Recovery Team tracks miles of shoreline and acres of floodplain under protection in the lower reaches of the Mashel

Chapter 5 Mitigation Strategies in the Nisqually Watershed

Mitigation strategies and recommendations in this plan Addendum follow the "actual consumptive" versus "legal consumptive" distinction, a distinction we are terming micro and macro. The macro-mitigation approach discussed in Chapter 4 involves large-scale initiatives to provide mitigation and Net Ecological Benefit within existing salmon recovery strategies. The micro-mitigation strategies outlined in this chapter provide approaches to mitigating within sub-basins as needed to offset permit-exempt well use. At least some of these strategies are site specific and all are sub-basin specific. The micro-mitigation strategies discussed below will require further work to analyze benefits and develop implementation strategies at the county or municipal level. The quantity of mitigation necessary under the micro-mitigation strategy will also depend upon further analysis of ecological benefits that are realized as macro-mitigation projects are funded and implemented.

5.1 Specific Micro-Mitigation Strategies

The same glacial geology that results in hydraulic continuity between shallow groundwater and streamflow (and explicit mitigation need) also provides potential mitigation options that, either alone or in tandem, would mitigate some impacts of well withdrawals on streamflow. Some of the options discussed below could actually benefit streamflow in sub-basins in the western part of the watershed because withdrawal of groundwater from deeper aquifer systems will introduce more surface flow beyond simply mitigating for the well withdrawal.

5.1.1 Mitigation Approach in Prairie Environments

Throughout sub-basins characterized by prairie streams (Thompson/Yelm, Lackamas/Toboton/Powell, and Prairie Tributaries sub-basins), there are several aquifers, each somewhat confined and each deeper than the next (Figure 3). The uppermost water bearing unit, Qvr, is unconfined and interacts with the streamflows of the prairie tributaries. Underlying Qvr is a confining layer of glacial till and below that, an aquifer referred to as Qva. A deeper aquifer, Qc, (referred to as the Sea Level aquifer) underlies the prairies at an even greater depth and beneath that, the Undifferentiated deposits referred to as TQu. The Qc and TQu are below sea level and discharge to the Puget Sound. Because they are major sources of drinking water, the deeper aquifers have been well studied. Figure 3 presents a cross section from Drost et. al., 1999 that illustrates the aquifer layers underlying prairie areas of Thurston County. A similar aquifer system underlies the Pierce County aquifers.

Thus, if future wells are finished in deeper aquifers, they not only avoid the direct impact to the unconfined outwash deposits of the upper aquifers and associated tributaries, but actually may contribute water to the uppermost water bearing units. This plan Addendum proposes several approaches to accomplishing mitigation by drawing water from the deeper aquifers. These approaches are quantified on a per-well basis, rather than a water use quantification, with every new individual permit-exempt well in a shallow aquifer being offset by removing an existing permit-exempt well from shallow aquifer withdrawals or by finishing the new permit-exempt well in a deeper aquifer. It should be noted that this proposed method of mitigation depends on a feasibility study to ensure that specific well withdrawals in deeper systems will have adequate water quality and quantity.

The Planning Unit's rationale for this per-well quantification approach is as follows: Using Ecology guidance, each new permit-exempt well that is finished in the upper or unconfined aquifer may be assumed to remove an average

of 382 gpd from that aquifer and return 159 net gallons (non-consumptive portion of the domestic use), resulting in a net use, and thus mitigation need, of 223 gpd/0.249 AFY per connection (see Chapter 3 for detailed discussion). Water use estimates using Thurston PUD data could also be used in this example). Finishing that same exempt well in a deeper aquifer results in the removal of the same 382 gallons, but from a deeper aquifer that is otherwise discharging to Puget Sound. Given modeling done to date on the aquifers underlying the prairie areas of the Nisqually watershed, it is reasonable to conclude that not only is the use of water (223 gpd) fully mitigated, but that some portion of the return water (159 gal/day) will be retained in the upper aquifer and provide a net benefit to streamflows (City of Olympia and Nisqually Indian Tribe, 2008). For purposes of this Addendum, the Nisqually Planning Unit proposes that every permit-exempt well removed from the shallow aquifer provides a 223 gpd mitigation offset. Although there is likely an additional streamflow benefit from utilizing groundwater from deeper systems, the Planning Unit is not proposing that benefit be counted as offset.

This approach is supported by data developed for Yelm's water rights application and system expansion (discussed below) and research conducted by the USGS for the Kitsap Peninsula, an area with multiple hydrogeologic units similar to those found in the lower (glaciated) portion of the Nisqually Watershed (Frans and Olsen, 2016). In summary, this USGS modeling effort determined that moving well withdrawal to a deeper aquifer resulted in a net gain to the upper aquifer and streamflows.

Deep Groundwater Option 1 – Finish new permit-exempt wells in deeper aquifer

If counties choose to pursue this option, an individual permit-exempt well proponent who finishes a new well in a lower aquifer could be credited for offsetting a large portion of the projected consumptive use for that connection, depending on location and depth. Enforcement of the commitment may be accomplished through permitting review coordinated by the county issuing the building permit and the certifying government of the well drilling record (see Chapter 6 for more detailed description of this process). Enforcement and other specifics of that permitting process are to be determined by the county in implementation through its own required public process.

Deep Groundwater Option 2 – Retire existing permit-exempt wells from upper aquifer

Another mitigation opportunity is to retire wells that currently draw from the surface aquifer in continuity with local streams. The simplest approach is retiring an existing permit-exempt well when the well owner has opportunity to connect to a Group A or B system. The retirement of one existing well would constitute mitigation credit for one new permit-exempt well in the same sub-basin. This mitigation strategy would be especially effective in the Thompson/Yelm sub-basin, and is explained below in the discussion of the City of Yelm's water right application.

Deep Groundwater Option 3 – Deepen or upgrade Group A systems to offset individual permit-exempt wells

Another approach recommended by the Planning Unit is to work with existing Group A water systems to invest in system upgrades, such as a deeper well or more efficient conveyance infrastructure, expand to more connections, or other design upgrades or strategies to reduce and offset impacts to streamflows. Investment in small water systems first requires investigation to determine feasibility of completing one or more new Group A wells in a deeper aquifer. Initial inquiry suggests that this approach might be of interest for one or more of the Group A systems, especially ones that are currently experiencing water system issues. A technical feasibility study for each system, including analysis of mitigation, is currently beyond the financial capability of an individual Group A system and therefore some type of grant or loan program will likely be needed for investigation and implementation. The Planning Unit recommends that the Implementing Governments work with the Thurston PUD and other entities as appropriate to investigate the feasibility of this approach, including exploring grant or loan programs to support system improvements (implementation is addressed in Chapter 8). If feasible, this approach would offer mitigation offsets for multiple new permit-exempt wells.

A variation of this option involves older systems and would target smaller public water systems in Thurston County established prior to May 1, 1994 that are considered provisionally adequate, but do not meet the current design standards of the Thurston County Sanitary Code (Article III), WAC 246-290 or WAC 246-291. This type of program could also be made available to other water systems that could benefit from efficiency upgrades and could be funded, in part, by the fees collected through the permitting strategy described in Section 6.1. Upgrading these antiquated systems would not only provide possible mitigation credits to offset the impacts of new permit-exempt wells but could also benefit the users of these older systems by improving water quality and reliability.

The Thurston PUD has identified three Group A water systems that could be candidates for potential infrastructure improvements (one in Pierce County in the Prairie Tributaries sub-basin, one in Thurston County in the Thompson/Yelm sub-basin, and one in Thurston County in the uppermost part of Lackamas/Toboton/Powell sub-basin). Combined, the three systems currently have 45 active connections out of 84 authorized connections. However, prior to drilling, the PUD requires initial funding assistance for a hydrogeologic assessment to determine the probability that the water would be available in sufficient quality and quantity in deeper aquifers, and to assess impacts on streamflow. The PUD is requesting funding be available to conduct the hydrogeological analysis prior to commencement of any drilling activities. A letter from the Thurston PUD providing details regarding the three water systems is included as Appendix J.

Drilling to a deeper aquifer would result in a change in the "water source" associated with the existing Group A water right. Therefore, if found to be technically feasible for a small Group A system, implementing this action would require a modification to the Group A's existing water right or a new water right, supported by studies to evaluate the impacts of these changes.

Examples of Deep Groundwater Offsets

The City of Yelm currently provides drinking water within its service area, which includes Yelm's Urban Growth Area (UGA), from the shallow Vashon Advance (Qva) aquifer. With a limited number of new connections available without additional water rights, it is Yelm's policy to reserve its existing water connections to serve vacant properties within the current city limits. Consequently, most new residential development in the Yelm UGA relies on permit-exempt wells (70%, as detailed in the water forecast Chapter 3).

Yelm is in the process of applying for water rights (under Water Right Control Number G2-29085) that would support a new well drilled deep in the lower (TQu) aquifer. The Yelm water right is a water resource mitigation pilot project identified in RCW 90.94.090, and will be processed under this pilot project authority. If approved, Yelm's capacity to provide water service would increase 950 AFY, from around 700 AFY to 1650 AFY. This single action would provide multiple potential benefits to streamflow in the Nisqually Watershed:

1. Connecting new development to City Water Service that otherwise would have relied on a permit-exempt well – shifting the water use from the shallow aquifer to the deeper aquifer. This single action reduces the projected consumptive use for the entire Thompson/Yelm sub-basin by 62%.
2. Connecting existing development on a permit-exempt well within the UGA and City boundary to City Water Service – shifting water use from the shallow aquifer to the deeper aquifer.
3. Enabling reclaimed water that infiltrates into the shallow aquifer – currently used to mitigate for impacts of the shallow well – to offset impacts to the shallow aquifer of permit-exempt wells.

The benefits that each of these actions provide are further described below. The Planning Unit strongly supports approval of Yelm's water right application subsequent to meeting full mitigation requirements.

Yelm Action 1 – Connect New Development in Yelm UGA to City Water Service (Deep Well)

This action does not offset forecasted permit-exempt well use, but rather reduces consumptive demand requiring offset. Future growth in the City (and UGA) could be served by a new well drilled deep in the lower (TQu) aquifer. Yelm's proposed mitigation for their water right application includes reclaimed water discharged into the shallow aquifer. When these new water rights are approved, Yelm will be in the position to serve properties with existing wells located within both its retail service area (the current city limits) and future water service area (the UGA).

Table 3-2 of the Water Forecast Chapter estimates that 1,036 new domestic permit-exempt well connections in the Yelm UGA would be needed to support predicted residential growth between 2018 and 2040, should the current status of Yelm's water service area not change over that period.

Alternatively, should Yelm's water right be approved, and a deeper well permitted to serve new connections in the UGA, it is feasible that only 5% of those new single-family units would rely on a permit-exempt well (for comparison, only 2% of units in the Lacey UGA rely on a permit-exempt well, because Lacey's water service area is able to serve its entire UGA). This would mean only 74 new domestic permit-exempt connections predicted for the Yelm UGA between 2018 and 2040; 962 fewer connections than under the current conditions calculated in Chapter 3, or 62% of all the new permit-exempt connections estimated for the Thompson/Yelm sub-basin.

Depending on the water use methodology used, this action would result in a decrease in the required consumptive use offsets originally forecasted in Chapter 3 by 103-240 AFY, depending on the water use methodology (see Table 5-1 below). This offset is not in the form of mitigation for permit-exempt wells, but reduces the original impact by 62%. This water use is instead mitigated through Yelm's municipal water system and its approved water right.

Table 5-1: Reducing Impact from PE Wells by Approval of Yelm's Water Right for Deeper Municipal Well

Thompson/ Yelm Sub-basin	Estimated new Units, 2018-2040	% Permit-Exempt	PE Connections	Actual Water Use				Legal Water Use	
				PU Method		Ecology Method			
				AFY	CFS	AFY	CFS	AFY	CFS
Total Sub-basin	n/a		1,562	166	0.23	390	0.59	2,876	3.97
Yelm UGA – Current forecast	1,480	70%	1,036	110.85	0.15	259	0.36	1,907	2.63
Yelm UGA – New WR/well	1,480	5%	74	7.92	0.01	18.50	0.03	136	0.19
Yelm UGA – Offset[7]	**n/a**		**962**	**102.93**	**0.14**	**240.50**	**0.33**	**1,771**	**2.45**

Yelm Action 2 (Offset) – Connect Existing Development on Permit-exempt Wells in Yelm UGA to City Water Service and Abandon permit-exempt Wells

In addition to serving new development, existing permit-exempt wells in the city and UGA could be removed from service as properties within the Yelm service area connect to city water. The City would receive credit for the permit-exempt well coming offline. This credit could be held in trust by the City or appropriate agency and used for full mitigation of a new permit-exempt well in the Thompson/Yelm Creek basins. Implementation of a credit system is currently being explored and is discussed in Chapter 8 addressing Implementation and Adaptive Management.

[7] *Offset here is the calculated difference between the consumptive water use under current, predicted conditions forecast in Chapter 3 and consumptive water use if a high proportion of new development in the Yelm UGA is connected to the city's water service. This action's offset is not in the form of mitigation, but reduces the original impact by 62%. This water use would instead be mitigated through Yelm's municipal water system and its approved water right.*

Thurston County estimates there are currently approximately 450 domestic connections to permit-exempt wells in the Yelm UGA. Transfer from existing permit-exempt wells to City water service within the UGA would be voluntary. The number of existing connections that could be transferred to the Yelm municipal water service within the planning period will depend on many factors, including the construction of water infrastructure in relation to the location of existing development and incentives to property owners. For every permit-exempt well connection replaced by City service, there will be a mitigation offset of 223 gpd (0.249 AFY) (Ecology methodology). A conservative estimate is that 10% of existing connections would be converted in the 22-year planning period – if used to mitigate 42 new permit-exempt wells in the rural areas of the Thompson/Yelm sub-basin, this action would result in an offset of 4.4-10 AFY, depending on the methodology used to calculate water use (see Table 5-2 below).

Table 5-2: Water Use Offset by Existing Permit-Exempt Wells in Yelm UGA Connected to Expanded Yelm Water Service

Yelm UGA Est. existing Permit-exempt connections	% Connected to Yelm water service	PE Connections Offset	Actual Water Use Offset				Legal Water Use	
			PU Method		Ecology Method			
			AFY	CFS	AFY	CFS	AFY	CFS
415	10%	42	4.44	0.0061	10.38	0.014	76.4	0.11

Yelm Action 3 (Offset) – Use a Portion of the City's Infiltrated Reclaimed Class A Wastewater as Mitigation

The City of Yelm is in the process of expanding its ability to re-use highly-treated wastewater as Class A reclaimed water. Appendix L describes the current understanding of Class A Reclaimed Water availability. Reclaimed water infiltrated to avoid impacts to Yelm Creek as identified in Yelm's water rights mitigation plan would not be eligible to offset impacts of permit-exempt wells, as it will be required to offset impacts from pumping the water in the first place. The City anticipates in its conceptual water rights mitigation plan the need to infiltrate up to 70 acre feet in order to mitigate impacts to Yelm Creek from pumping 942 acre feet from the deep aquifer. However, additional reclaimed water infiltrated above this requirement could potentially be used as an offset for water use from permit-exempt wells in the Thompson/Yelm sub-basin.

In 2016, Yelm pumped a total groundwater volume of 714 AF (DOH Sentry database Water Use Efficiency Report for 2016). City of Yelm records report a total reclaimed water re-use in 2016 of 406 AF. This means that up to 57% of Yelm's total groundwater pumped was eventually reclaimed.

According to 2016 totals, this reclaimed water is:

- Sold for irrigating parks and playfields: 71 AF in 2016
- Recharged into the Qva (Vashon advance) aquifer, slightly upgradient from the point of withdrawal at Cochrane Park: 62 AF in 2016
- Discharged to the Centralia Power Canal (primary point of discharge) or the Nisqually River (secondary point): 273 AF in 2016
- **Total Class A Reclaimed water used in 2016: 406 AF**

Once the City obtains additional water rights and places its deeper well in production, this infiltrated reclaimed water could provide a direct net benefit to the shallow aquifer that most affects streamflow in the watershed. Assuming the proportion of water reclaimed remains the same, the amount of annual reclaimed water available for use would increase to 537 AFY – 57% of the new well pumping rate of 942 AFY. Of this, 70 AFY will be needed as mitigation for the new, deeper well. This leaves 466 AFY. Table 5-3 below calculates the potential offset of this

reclaimed water for permit-exempt wells, using the same proportions of uses from 2016. The portion of reclaimed water used for irrigation would be reduced by an 80% consumption factor due to evapotranspiration. It should be noted that, under the new pumping scenario, 313 AFY of the estimated streamflow benefit is discharged directly to the Nisqually River and Centralia Power Canal at the downstream end of the sub-basin (see assumption 5 below). 71 AFY is infiltrated to groundwater and 16 AFY from irrigation recharges groundwater (total of 87 AFY of local recharge) in the vicinity of the Yelm Creek and will have more direct benefit to tributary flow.

Table 5-3: Potential Mitigation Benefit of Yelm's Reclaimed Water Program to Shallow Aquifer

Reclaimed Water Use	% of Total Reclaimed Water Use[8]	CURRENT WELL		New Water Right (Deep Aquifer)	
		AFY	Streamflow Benefit[9] (AFY)	AFY	Streamflow Benefit (AFY)
Irrigation of parks and playfields	17%	71	14	81	16
Direct recharge to Qva (in Yelm)	15%	62	62	71	71
Discharged to canal/river	67%	273	273	313.5	313.5
TOTAL	**100%**	**406**	**349**	**466**	**401**

This potential offset is calculated with the following assumptions:

- **Assumption #1: 100% mitigation will be required for the City of Yelm's expanded water right.** Department of Ecology water rights permit negotiations for the expansion of the City of Yelm's water right permits (the so-called 'Yelm Pilot Project') outcome will result in a '100% mitigation' requirement of the City of Yelm's pumped groundwater. Yelm anticipates this need to be approximately 70 acre feet per year.
- **Assumption #2: The City of Yelm's proportion of Class A reclaimed water remains the same.** Data for 2016 indicate that approximately 57% of Yelm's current pumped water returns as wastewater. This is based on a total pumped groundwater volume of 714 AF for 2016 (DOH Sentry database Water Use Efficiency Report for 2016) and a total reclaimed water re-use of 406 AF in 2016 from City of Yelm records noted above.
- **Assumption #3: Engineering, permitting, cost and other feasibility questions can establish a means for expanding use of this water for mitigation.** Significantly expanded aquifer recharge would be required, with unanswered questions regarding its feasibility.
- **Assumption #4**: Current (2016) Class-A Reclaimed Water production is an indicator of future availability and proportions of use.
- **Assumption #5: Reclaimed water discharged to the Centralia Power Canal or to the Nisqually River benefits streamflows.** Minimum mitigation estimates for Yelm Action 3 (offset) assumes that the reclaimed water discharged to the Nisqually River and Centralia Power Canal does not qualify as mitigation, maximum mitigation estimates assume that this water does qualify as an offset for the Thompson/Yelm sub-basin (see Table 7-2).
- **Alternatively, the City of Yelm could cease using reclaimed water for irrigation and surface discharge.** Under this alternative, all 466 AFY of reclaimed water could be used for offsetting permit-exempt wells' consumption.

[8] *Based on City of Yelm report of 2016 water use.*

[9] *Recharged to the aquifer or discharged directly (not evaporated through outdoor irrigation)*

Despite these assumptions, there is strong potential for the City of Yelm's Class A reclaimed water to form a significant part of the mitigation requirement for permit-exempt wells in the Thompson/Yelm sub-basin. Irrigation and other uses of reclaimed water claimed for streamflow benefit apply only within Yelm city limits. Thurston County's Critical Areas Ordinance currently does not permit large-scale infiltration of reclaimed water (defined as "application to the land's surface above agronomic rates") (TCC 24.10.190), until additional information from the Regional Groundwater Recharge Scientific Study and other sources can be considered. Thurston County could reconsider this limitation in light of information that may have come available since the adoption of that policy, in order to increase options for mitigating streamflows in unincorporated Thurston County. Any proposed changes to Thurston County development regulations would require a legislative decision by the county that follows the requirements of the Growth Management Act and the County's public review process.

5.1.2 Water Right Acquisition

Acquiring existing certificated water rights is also a strategy to offset streamflow impacts from permit-exempt well use. A 2010 Feasibility Analysis for a Nisqually Water Bank (Washington Water Trust and Ecosystem Economics, 2010) addressed water rights as a potential source of supply for mitigation and restoration. At the time, it was determined that, while there was clear demand for mitigation and restoration, driving forces for a water bank in WRIA 11 were not present because there was no need to mitigate for permit-exempt wells. The study identified a number of rural farming areas that were likely using irrigation water drawn from wells and streams.

At the request of the WRIA 11 Planning Unit in late 2018, the Washington Water Trust (WWT) expanded upon their 2010 work, and conducted a rapid water rights assessment to identify and provisionally rank potential water rights within the Prairie Tributaries sub-basin in Pierce County according to their likelihood of beneficial use and seasonality. These prairie streams include Muck-Murray, Upper Tanwax Creek, Lower Tanwax Creek and Kreger Creek. The projects identified could range from full season permanent acquisition to changed irrigation practices that may prove more efficient, require less withdrawal and focus agricultural operations on the most productive land. Some changed irrigation practices may be accompanied by an actual source switch from a small tributary to a mainstem river or surface to groundwater, which would not only provide mitigation but also restoration benefit.

WWT built upon the analysis of water rights identified in 2010 and reviewed 362 non-duplicate water right documents with a source originating within the Prairie Tributaries sub-basin, identified areas from 2013, 2015, and 2017 NAIP (USDA) photos with at least 10 acres of cultivation and potential irrigation, and subsequently ranked them according to estimated acres and annual quantities of potential beneficial use. The Prairie Tributaries portion of the Nisqually watershed has not been adjudicated and the rights are represented by a mixture of claims, certificates, and permits from sources both ground and surface (Appendix K).

Twenty-two water rights have been identified in this rapid assessment, comprised of an estimated 1,508 beneficially used acres with an approximate 2,283 acre-feet per year (AFY) of water. These water rights have been prioritized 1-4, with 1 being the most confident of having been beneficially used in the period evaluated, and 4 being the least confident of a robust beneficial use record (see Table 5-4). Tier 1 is comprised of six water rights with an estimated 705 beneficially used acres with 673 AFY, 595 AFY of which is groundwater. Tier 2 has four water rights with an estimated 304 beneficially used acres with 632 AFY, with 312 AFY from groundwater sources. Tier 3 has nine water rights with an estimated 409 beneficially used acres with 802 AFY, 267 AFY from groundwater. Tier 4 has three water rights with an estimated 90 acres with 176 AFY, 137 AFY from groundwater.

Table 5-4: Preliminary Water Rights Assessment of Prairie Tributaries Sub-basin

Water Right Priority*	Number of Water Rights	Estimated Beneficially Used Acreage (Acres)	Estimated Beneficial Use Groundwater (AFY)	Estimated Beneficial Use Surface Water (AFY)	Total Estimated Beneficial Use (AFY)
Tier 1	6	705	595	78	673
Tier 2	4	304	312	320	632
Tier 3	9	409	267	535	802
Tier 4	3	90	137	39	176
TOTAL	22	1508	1311	972	2283

*Confidence in having been put to beneficial use (Tier 1 being the most confidence, Tier 4, the least).

All potential projects require further substantial investigation prior to project development and ultimately landowner/water right holder willingness to participate in a project. It will require substantial and costly further investigation to determine whether this amount of irrigation (or even a portion of it) might be available for acquisition. However, if found to be feasible, this approach could meet a significant portion of the mitigation need for the Prairie Tributaries sub-basin, offering mitigation certification for multiple new permit-exempt wells and possibly leading to a mitigation "bank" of some type. Table 7-2 provides a minimum and maximum estimated mitigation offset associated with water right acquisition. The minimum assumes that no water rights are acquired for the Prairie Tributary sub-basin and the maximum assumes that all Tier 1 water rights identified in Table 5-4 are acquired.

5.1.3 Aquifer Recharge

City of Yelm Groundwater Recharge Using Reclaimed Water

The City of Yelm will be using a portion of their reclaimed Class A wastewater to infiltrate the Qva shallow aquifer. The use of this infiltration as sub-basin mitigation is described above in Section 5.1.1, Yelm Action 3 (Offset).

Managed Aquifer Recharge Projects

Ecology's Water Resources Program has tentatively identified nine potential opportunities for developing managed aquifer recharge (MAR) projects in WRIA 11 (see Appendix M). MAR projects typically involve a diversion of high-flow season streamflow to spreading basins or other infiltration facilities in the adjacent floodplain or uplands. These projects are intended to augment streamflows by increasing surficial aquifer discharges to streams during low-flow times of the year. They can serve as relatively low tech, low maintenance and monitoring methods to capture water to benefit streams during low flow times.

There are more than a dozen MAR projects currently operating in Washington, annually storing over 7,000 acre-feet of water. Developing MAR projects requires gaining access to land in suitable MAR locations from a hydrogeologic perspective. Property that is publicly owned may have the best potential for development of mitigation opportunities in WRIA 11 to offset consumptive water use from permit-exempt wells.

The potential MAR projects identified by Ecology can be considered possible sites in the Nisqually Watershed. All of them are in the floodplains of the Nisqually River, the Mashel River, Ohop Creek, and Muck Creek. No field investigations have been conducted and no discussions with the property owners have occurred. These are conceptual projects and included as a placeholder to be included in the portfolio of projects needed to offset the consumptive domestic uses likely to be developed in the coming twenty years.

Individual projects could potentially store several hundred to a few thousand acre-feet per year. The actual volume available for recharge, storage and mitigation will depend on site-specific factors. For the purposes of this Addendum it was assumed that each of 5 sub-basins could store up to 200 AFY through managed aquifer recharge, hence each sub-basin would have a 0 - 200 AF MAR benefit occurring over a six-month period (summer-fall). This equates to a full watershed benefit of 1000 AF per year, occurring over a six-month period, yielding a 2.7626 cfs benefit during those months.

5.1.4 Local Habitat Strategies

Floodplain Restoration Projects – Prairie Stream Restoration Templates

Several types of projects that could improve instream flows, habitat, and riparian corridors are aggregated under the umbrella term "Floodplain Restoration." The elements of these projects often include one or more of the following:

1. Ditch removal with related off-channel storage
2. Beaver re-introduction
3. Floodplain reconnection and channel re-meandering
4. Engineered Log-jams
5. Re-vegetation

Floodplain restoration projects in prairie stream basins are recommended as implementation actions under several Nisqually Salmon Recovery Habitat Initiatives discussed in Chapter 4 of this Addendum (Muck Creek Recovery and Prairie Tributaries[10] Recovery Initiatives specifically). While these initiatives are currently ranked as lower priority for recovering ESA-listed Chinook and steelhead populations and do not have significant active projects through salmon recovery funds at this time, they offer streamflow enhancement potential for sub-basin specific mitigation. Thurston and Pierce Counties have developed conceptual project frameworks for small-scale habitat restoration activities aligned with salmon recovery strategy in prairie-type streams that address these micro-mitigation needs.

The Ohop Restoration template developed from groundwater data in previous phases of Ohop Creek stream corridor restoration is used here to anticipate potential benefits from similar prairie stream restoration projects (Appendix E). The Ohop project sites had a long history of groundwater data collection that allowed a more extensive analysis of benefits than is possible with the limited local data in other targeted sub-basins. Based on these groundwater data, floodplain restoration projects are assumed to generate an average of 13.57 AFY of additional groundwater recharge per mile of ditch removed, or 0.0096 cfs of additional streamflow. Appendix E (Table A3) calculates flow benefits in acre feet per year based on the full length of restored stream channels, and in cubic feet per second based on half the length of restored channel, to account for the potential one-sided benefits of ditch removal. The estimates presented in Table 5-5 and in estimating total mitigation options in Chapter 7 use the halved rate for both AFY and cfs to provide the most conservative benefit. An additional 0.0009 cfs of streamflow is calculated for beaver introduction per treated stream mile (Appendix E).

Table 5-5: Per-Mile Benefits from Ohop Restoration Template (Appendix E)

Average benefit per mile:	Ditch Removal	Beaver Introduction
Additional streamflow	0.0096 cfs	0.0009 cfs
Additional Recharge	13.57 AFY	N/A

[10] *The Salmon Recovery Program initiatives are categorized using different sub-basin groupings than those used in this Addendum. The Prairie Tributaries Salmon Recovery Initiative includes prairie-type streams in both Pierce and Thurston Counties, while Muck Creek Recovery is a separate initiative. For the purposes of this section addressing county-led streamflow mitigation projects are organized by Planning Unit sub-basins.*

The selected project concepts in Thurston and Pierce Counties meet the following criteria for applicability to the Ohop template:

1. Similar hydrology: known or probable ditching of the stream to straighten/move the streambed. This is typically associated with a 'compressed' meander width and an incised stream bed;
2. Similar vegetation;
3. Similar geology;
4. Similar precipitation;
5. Upland stream reaches, where new recharge would wet a longer stream reach;
6. Mapped presence of wetlands, hydric soils or seasonal ponded water;
7. Located on large land parcels, with either one owner or a small number of owners.

Because these projects are still largely conceptual and may vary from the Ohop template model, the quantified flow benefits from implementation are approximate and will be further refined as specific projects move forward. Additionally, substantial literature exists to demonstrate the effectiveness of these restoration approaches for salmonid recovery. Even when the streamflow benefits may be non-quantifiable at a particular project site, these projects support the overall net ecological benefit goals for salmon recovery in the watershed. These sub-basin-scale projects could be funded, in part, by the fees collected through the permitting strategy described herein and by Streamflow Restoration Grant funds.

Thurston County Habitat Restoration Projects

Thurston County has identified 19 candidate stream reaches totaling 18.2 stream miles within the Thurston County portion of WRIA 11 where floodplain restoration-type projects could be considered. Some candidate stream reaches are already-planned projects; others are newly-identified projects. Specific locations for these reaches are not presented at this time, pending funding availability and further project-specific evaluations. Targeted reaches fall in the Thompson/Yelm and Lackamas/Toboton/Powell sub-basins.

In practical terms, it is likely that only a portion of the 19 candidate projects in Thurston County will actually be constructed. Thurston County estimated the benefit if only a small number of these candidates will result in constructed projects benefitting streamflow – limited by funding availability, site feasibility, and landowner willingness, among other factors. Flow benefits estimated from implementing 100%, 30%, and 10% of Thurston County restoration projects are summarized in Table 5-6.

Pierce County Habitat Restoration Projects

The streams in the Prairie Tributaries sub-basin in Pierce County are known to have a high proportion of degraded habitat, but the basin is currently understudied (Nisqually Steelhead Recovery Team, 2014). It is believed that these systems historically had a large percentage of beaver ponds and complex off-channel pools, providing water storage and juvenile salmon habitat during the portion of the year when intermittent prairie streams do not flow (Pollock et al, 2003). Ditching and other agricultural impacts have left significant portions of prairie streams disconnected from historical floodplains. Pierce County has not yet identified specific candidate reaches for project implementation, but is exploring areas where beaver introduction or beaver dam analogs, log jams, and groundwater channels may be pursued to improve streamflows and floodplain connectivity (see Appendix N). The Ohop Restoration template was applied to the entire stream length of Muck Creek, its main tributary Lacamas Creek, and Tanwax Creek as a preliminary estimate of potentially achievable streamflow benefits. Because of the lack of project-specific information and local data, these estimates have a high degree of uncertainty. In addition to uncertainty about the number and scale of potential projects on privately-held or protected lands in Pierce County, substantial reaches of Muck Creek fall within Joint Base Lewis-McChord, which may affect restoration

plans. Table 5-6 shows a range of estimated flow impacts for Pierce County streams, assuming restoration projects could be implemented treating 10%, 30%, and 100% of stream miles in these tributaries.

Table 5-6: Floodplain Restoration Streamflow Benefit Estimates – Potential Projects (Appendix E)*

Sub-Basin	Potential treatable stream miles	Calculated Streamflow benefits (AFY)			Calculated streamflow benefits (cfs)		
		100%	30%	10%	100%	30%	10%
Prairie Tributaries	60	417	124.5	41.7	0.573	0.172	0.057
Thompson/Yelm	16	111.2	33.3	11.1	0.153	0.046	0.015
Lackamas/Toboton/ Powell	2.3	15.9	5.0	1.6	0.022	0.007	0.002

*Assumes one-sided (50%) benefit from ditch removal and floodplain reconnection.

Barrier Removal Projects

The Washington Department of Fish and Wildlife's Barrier Assessment lists 203 known human-made barriers in the Nisqually watershed. Project identification and implementation will be primarily led by county governments or the Nisqually Indian Tribe, with small streamflow benefits expected in sub-basins as a result of culvert and ditch upgrades improving floodplain connectivity. The Ohop Project Template is used as a basis for estimating the impact of ditch removal and culvert replacement on a per-foot basis in the Thurston County Peissner Road project below, and can be applied to similar projects as they are developed.

Barrier Removal is included as an initiative in the Nisqually Salmon Recovery strategy (see Chapter 4), with potential projects also providing net ecological benefit to any salmon-bearing stream in the watershed. Removing fish passage barriers will provide immediate access to available salmon habitat and increase ecosystem connectivity. Access to habitat is vital to realizing the ecological benefits to salmonids from flow enhancement and habitat restoration efforts. Habitat connectivity to floodplains and wetlands is also essential for salmon populations in systems experiencing low or intermittent streamflows. Quantifiable streamflow benefits from barrier removal projects will be applied to sub-basin mitigation totals, while the additional ecological benefits support salmon recovery initiative goals.

Toboton Creek at Peissner Road

This project would replace three parallel culverts at Peissner Road that are a current fish barrier and contribute to low summer flows in Toboton Creek. Replacing the current culverts with a 16-foot box culvert would open upstream habitat to fish use. Because this project will re-open the upper reaches of Toboton Creek to habitat, future phases of this project could continue stream restoration upstream (southwest) of Peissner Road SE to Bald Hills Road SE. This will re-open approximately 1,283 feet of largely ditched stream channel.

Thurston County forecasts a streamflow improvement of 0.0023 cfs (or 1.7 AFY) in Toboton Creek using the Ohop Restoration template. These improvements come primarily from re-connection of the entire floodplain from removal of the current ditched and over-steepened present channel. We expect that the floodplain re-connection and ditch removal will incrementally raise the groundwater levels along this reach and increase baseflow seepage in dry-season months. Beaver re-introduction may be an option, after further study, and consultation with private landowners, for some additional streamflow benefit.

5.2 Summary of Sub-Basin Mitigation Options

In summary, this plan proposes to mitigate streamflow impacts with a combination of mitigation alternatives:

i. Finishing new permit-exempt well(s) in a deeper aquifer
ii. Retiring one or more existing permit-exempt wells
iii. Re-drilling existing Group A well(s), or other grandfathered systems, to finish them to draw from deeper aquifers
iv. Retiring all or part of an existing water right currently drawing water from the upper aquifer or directly from flow impaired tributaries.
v. Aquifer Recharge
vi. Small scale habitat restoration projects within specific tributaries that provide local flow benefits.

In addition, the ability of the City of Yelm to acquire a new water right and extend their water system to service the Yelm UGA will reduce the 22-year consumptive use forecast for the Thompson/Yelm Sub-basin by 962 connections or 62%.

Many of the approaches to offset streamflow impacts of permit-exempt well use in Prairie environments would require the tracking of mitigation resulting from well replacement with Group A or B water system hook-up, well rehabilitation efforts, water right acquisition, and benefits from aquifer recharge and small habitat projects, as described above. This need for tracking could be met with a mitigation credit system or ”bank” of some type. The Planning Unit expects to work with Ecology and Implementing Governments to develop tracking and implementation for a mitigation credit system as needed. County-specific strategies are discussed in Chapter 6. The next steps toward implementing WRIA-wide mitigation tracking are addressed in Chapter 8.

Chapter 6 County Strategies

In addition to the Department of Ecology, the Nisqually Indian Tribe, and other partners, the three counties (Thurston, Pierce and Lewis) will be responsible for implementing some aspects of the mitigation strategies developed in the Plan Addendum through their processes for issuing building permits. This chapter summarizes the existing regulatory framework of the counties and initial approaches to implementation.

RCW 90.94.020 currently requires Counties to do the following:

(a) Record relevant restrictions or limitations associated with water supply with the property title;
(b) Collect applicable fees, as described under this section;
(c) Record the number of building permits issued under chapter 19.27 RCW or subdivision approvals issued under chapter 58.17 RCW subject to the provisions of this section;
(d) Annually transmit to the department three hundred fifty dollars of each fee collected under this subsection;
(e) Annually transmit an accounting of building permits and subdivision approvals subject to the provisions of this section to the department;
(f) Until rules have been adopted that specify otherwise, require the following measures for each new domestic use that relies on a withdrawal exempt from permitting under RCW 90.44.050:

(i) An applicant shall pay a fee of five hundred dollars to the permitting authority;
(ii) An applicant may obtain approval for a withdrawal exempt from permitting under RCW 90.44.050 for domestic use only, with a maximum annual average withdrawal of three thousand gallons per day per connection.

Section 6.1 addresses development of Thurston County policy. Much of Thurston County has similar hydrogeology as the portion of the County located in the Nisqually Watershed. Therefore, Thurston County has devoted considerable staff time to developing its implementation strategy and its draft strategy might serve as a suitable model for other counties as they move forward in implementing strategies developed through the streamflow restoration and enhancement process.

Section 6.2 and 6.3 of this chapter summarize regulatory and implementation information from Pierce and Lewis Counties, respectively. Pierce and Lewis County plans are less detailed at this time, pending further assessment of needs in the Nisqually and other watersheds in these counties.

The Planning Unit has reviewed the implementation strategies developed by the counties and endorses them for inclusion in this Watershed Plan Addendum, recognizing that this Plan Addendum does not supplant the legislative authority of local governments and that any specific obligations or changes to county codes, fees, or processes will be determined during future implementation phases that include any required public review process.

6.1 Thurston County

Thurston County regulates new development through the Thurston County Code (Titles 14-26), adopted by the Board of County Commissioners (BoCC), and regulates water supplies under Article III of the Thurston County Sanitary Code, adopted by the Board of Health (BoH).

Applicants for a new residential structure are required to complete a Certificate of Water Availability (COWA) before the county will issue a building permit. The COWA is used to assess whether the applicant has a potable water supply that meets the requirements of chapter 19.27 RCW and the Thurston County Sanitary Code.

Applicants who wish to rely on a permit-exempt well must attach a well driller's report showing that the well can pump enough capacity to meet their water needs (e.g., 400 gallons per day for a single-family residence) and that the water coming from the well meets water quality standards. The County does not currently review how the proposed water use would affect other nearby water right holders.

With few exceptions, applicants cannot choose to use a permit-exempt well as their water source if they are within the service area of an existing water system. Section 5.2.3 of Article III of the Thurston County Sanitary Code states that:

"No new water source shall be located in areas where water is available from an existing public water system. The health officer may exempt an applicant from this requirement if the applicant demonstrates all of the following:

> *(a) The water source meets all standards for isolation and construction without variances or waivers; and*
> *(b) The location of the new source is consistent with all other applicable water supply requirements, land use plans, and ground water management plans; and*
> *(c) The applicant receives approval from the jurisdictional Hearings Examiner on an appeal or variance from the priority of service per the applicable Thurston County Coordinated Water System Plan."*

In many cases, a well has been drilled before the applicant approaches the county for a building permit – sometimes many years prior. The county is typically notified when a new well is constructed by well drillers and the Department of Ecology issues a start card; however, the well at this time is not necessarily associated with any development that might require a county permit.

The following are regulatory strategies that are being considered or developed by Thurston County at this time. They will be fully developed as Thurston County participates in the other WRIAs addressing RCW 90.94.030.

6.1.1 Thurston County Water Availability Permitting Process Review

Under this strategy, Thurston County would consider amending its review process for building permits and establishing a fee and credit system for new residential development that relies on a permit-exempt well.

In addition to legislative action by the county, this strategy would require Ecology to conduct rulemaking, as specified in RCW 90.94 (2)(e), to replace the $500 fee established by RCW 90.94 (5)(f)(i) with a system of charges based on the estimated impact of the development determined through assessment of the actual annual average consumptive use, based on available local water use information (such as that provided by Thurston PUD). As with the current fee structure, applicants that connect to an existing public water system (Group A or state-permitted Group B) or that otherwise provide evidence of a water right would not be subject to this fee.

The applicant would pay a reduced fee by submitting a hydrogeologic report that meets county standards and demonstrates impact to streamflows from the proposed development below the average annual standard set by the county. Alternatively, the applicant would pay a reduced fee if they commit to certain measures in their building application, such as:

- Attending a pre-submission conference to review requirements with county staff
- Submitting a hydrogeologic report that meets department standards and demonstrates limited or no impact
- Finishing well in a deeper aquifer with less connection to surface water flows
- Installing water conserving fixtures or other infrastructure to minimize water use, as approved by county standards

- Installing infiltration facilities above what is required through the Drainage Design and Erosion Control Manual (TCC 15.05.010)
- Use rainwater harvesting/cisterns to augment water supply, as permitted by county standards
- Other strategies as determined appropriate by the Thurston County reviewing authority

Fees would be used to fund streamflow restoration projects in the basins where they are collected (such as those described in Chapters 4 and 5) and administration of the water availability program. Additional details, including the appropriate fee structure, program administration, and necessary changes to the Thurston County development code and Sanitary Code will be determined after additional investigation.

Any changes to Thurston County code would be reviewed through the county's standard public process and be subject to adoption by its legislative authority (Board of County Commissioners/Board of Health), as appropriate.

The quantitative benefit of this action on streamflows will depend on the number of permit-exempt well connections that are processed under the new rules. Chapter 3 estimates 2,147 future permit-exempt well connections for Thurston County over the 22-year planning period (see Section 3.2.1), with an Actual annual consumptive water use estimated at 230 acre feet per year (see Section 3.3.2). This is the estimated maximum amount of benefit. However, this total depends on the outcomes of other actions identified throughout this Addendum and would be affected by several factors:

- The length of time it takes to develop and implement a revised permitting and fee system. Development applications submitted in the interim would continue to be subject to the state-mandated well fee, required by RCW 90.94.
- Whether the City of Yelm is able to provide water service to new residential development in its Urban Growth Area (UGA). As outlined in Section 5.1.1, if Yelm's deeper well is approved, the amount of water use from permit-exempt wells could be reduced by nearly 1,000 connections.
- Whether other public water systems are able to expand and/or serve more connections than predicted, due to incentives or upgrades.
- Whether development patterns change, due to economic or social drivers, including the fees set through this program.

The quantitative benefit for this action will be in direct proportion to the number of residential building permits approved under the revised permitting process, and on the details of that process. In addition, this action could help to fund some local floodplain restoration projects identified and quantified in Section 5.1.4.

6.1.2 Revolving Loan and Grant Fund for Small Public Water Systems

Thurston County would investigate the feasibility of establishing and operating a revolving loan fund for public water systems to increase the efficiency of such systems and reduce impacts to streamflows. The fund would be used to enable small water systems to invest in system upgrades, such as a deeper well or more efficient conveyance infrastructure, establish a tiered rate system, expand to more connections, establish professional management, minimize connection fees, or other design upgrades or strategies to reduce and offset impacts to streamflows (see Chapter 5.1.1). The fund would primarily target smaller public water systems in Thurston County established prior to May 1, 1994 that are considered provisionally adequate, but do not meet the current design standards of the Thurston County Sanitary Code (Article III), WAC 246-290 or WAC 246-291. The program may also be made available to other water systems that could benefit from efficiency upgrades. This program could be funded, in part, by the fees collected through the permitting strategy described above.

The quantitative benefit of this action on streamflows in the Nisqually watershed depends on the number and type of improvements funded, and the amount of funding generated by permitting fees or other funding sources. Benefits funded by permitting fees alone are included in the calculated benefit for Section 6.1.1.

The Planning Unit endorses Thurston County's proposed approach as meeting the intent of RCW 90.94.020 recognizing that it requires Ecology rule making, county legislation, and further evaluation as it proceeds through other watershed planning processes. The Planning Unit urges the other counties to consider adopting a similar county regulatory approach.

6.1.3 Stormwater Management

Under this element of the Plan Addendum, Thurston County would continue to explore ways to account for consumptive water use across typical development, including quantifying benefits of existing and expanded stormwater management policies that increase onsite infiltration and result in groundwater recharge. Initial estimates indicate that certain types of development in the Nisqually Watershed can result in a net benefit to groundwater recharge when considering stormwater management requirements under state guidelines and the Thurston County Drainage Design and Erosion Control Manual, including core requirements for low impact development and flow control (Thurston County Stormwater Utility Memorandum, 2018). Stormwater facilities approved through Thurston County's development permitting process, including those that promote increased infiltration through low impact development, must meet the specifications of the Drainage Design and Erosion Control Manual (TCC 15.05.010), which include long-term operation and maintenance (Core Requirement #9). For many facilities, acceptance of a maintenance plan is required prior to final project approval, and such facilities are regularly monitored and inspected under Thurston County's Stormwater Utility programs in order to meet the County's obligations under the Phase II Municipal stormwater permit for Western Washington.

The quantitative benefit of this action on streamflows depends on additional research and policy development – any benefits from this action would be rolled into the calculated benefit for Section 6.1.1.

6.2 Pierce County

The Tacoma Pierce County Health Department regulates the drilling of new individual wells within Pierce County under Chapter 3 of the Tacoma-Pierce County Health Department Environmental Health Code (Tacoma-Pierce County Board of Health Resolution No. 2010-4221). The Pierce County Comprehensive Plan contains a policy that no new individual wells are allowed in the Urban Growth Area except for special circumstances. In order to implement that policy, Pierce County land use regulations required an applicant wishing to construct an individual well within an urban growth area to obtain written consent for the construction of the well from Pierce County Planning and land Services Department prior to approval of the well by the Tacoma Pierce County Health Department. However, most of WRIA 11 in Pierce County is outside the Urban Growth Area.

Other Tacoma Pierce County Health Department regulations and policies pertaining to individual wells include the following:

- An individual well must produce at least 400 gallons of water per day to be considered adequate with respect to quantity, and;
- If a parcel is part of a subdivision or short subdivision that gained approval subject to the provision of public water, or if the parcel's building permit was conditioned upon the use of public water, then a new individual well on the parcel may not be approved. (Tacoma Pierce County Board of Health Resolution No. 2010-4221).
- Tacoma-Pierce County Health Department requires notification 48 hours prior to any well construction from a well driller. This notification must include a Notice-of-Intent number provided by the Washington State Department of Ecology.
- The Health Department may not grant approval for new wells that demonstrate an adverse impact on other nearby wells or to the resource.

The Tacoma Pierce County Health Department regulates Group B water systems operating within Pierce County. In regards to new developments proposing to utilize a Group B water system as the source of water, the following regulations apply:

- If the proponent of a project proposes the creation of a new Group B Water System to serve the project, then the proponent shall assign and record an allocation of water of at least 750 gallons per day for each newly created lot;
- No newly formed Group B Water System may have more than six connections without demonstrating approval of water rights by the Washington State Department of Ecology and;
- Maximum number of lots for a proposed subdivision cannot exceed the following criteria: Proposed Group B water system – 6 lots. Proposed individual wells – 12 lots.

Pierce County regulates the issuance of building permits and sent out an Industry Notice on January 22, 2018 in response to ESSB 6091 with the following changes:

- The county will no longer require a hydrogeologic study associated with permit-exempt well applications (County Policy DW2016-02: Building Permits/Subdivisions on New Permit-Exempt Wells is no longer in effect)
- Building/Subdivision Permits in the Nisqually Water Resource Inventory Area (WRIA 11) proposing to use permit-exempt wells:
    - Limited to 3,000 gallons per day (maximum annual average use and no metering required)
    - New fee of $500 ($350 to Ecology, $150 to County for reporting requirements)
    - Requires recording of restrictions on title (additional recording fee)
- Building/Subdivision Permits in the #10 Puyallup-White, #12 Chambers-Clover, and #15 Kitsap WRIAs proposing to use permit-exempt wells:
    - Limited to 950 gallons per day (maximum annual average use and no metering required)
    - New fee of $500 ($350 to Ecology, $150 to County for reporting requirements)
    - Requires recording of restrictions on title (additional recording fee)

The new fee will be required for the following activities with drilled "permit-exempt" wells:

- All new residential building permit applications, including accessory dwelling units
- Commercial building permit applications (historical water estimates reviewed and accepted prior to permit issuance)
- Subdivisions of land

Position on proposed permit-exempt well site specific mitigation approaches/strategies

Given the short amount of time to review the mitigation approaches and strategies, and with uncertainty as to whether or not they are necessary, Pierce County can only commit to working with stakeholders and investigating the following as optional approaches/strategies. It must be understood that site-specific mitigation may not be necessary if other watershed projects have sufficient benefit to offset the impacts of future permit-exempt wells.

6.2.1 "Cafeteria" Menu Approach

If it is determined that identified projects do not meet necessary offsets, Pierce County could further investigate an incentive based "cafeteria" mitigation credit concept. This concept may entail a menu of possible choices that the property owner may pursue, including the option to purchase a share in a larger sub-basin wide mitigation project. If this concept is pursued, it needs refinement to address the total credits needs and credits associated with individual menu items. The menu may include, but is not limited to:

- Drilling new wells in a deeper aquifer.
- Decommissioning existing permit-exempt wells in the same general sub-basin.
- Installing meter on new well to monitor water usage.
- Agreement to limit daily water use.
- Agreement to report metered water use

If necessary, further development of this "Cafeteria Menu" approach will be addressed as part of the Adaptive Management Process (see Chapter 8).

6.2.2 Other Potential Mitigation Strategies

If additional projects are necessary to mitigate permit-exempt wells, other potential mitigation projects may be investigated to determine the benefits and costs. These projects may be those in which individual property owners may, through the "Cafeteria" approach, purchase a share of the project. The type of projects may include, but are not limited to:

- Near-stream "storage-and-release" projects
- Move pumping of Group A or Group B water system(s) into deeper aquifer(s)
- Purchasing Conservation Easements/Establishment of Water Bank
- Retiring existing water rights.

It should be recognized that these types of projects may have unintentional consequences if not fully evaluated. "Storage-and-release" projects must be designed to avoid warming the stream's water temperature. The potential impacts to promoting an economically viable agricultural industry must be recognized if pursuing the retirement of water rights or purchasing water easements.

6.3 Lewis County

Given the fact that a small amount of development is projected in Lewis County's portion of the Upper Nisqually watershed, and the fact that none of the streams in the area are closed to further appropriation, Lewis County does not propose any set mitigation approaches for the area. Future development that does occur will likely be seasonally occupied by visitors and will require limited water for consumptive use. The forested landscape and seasonal nature of the homes will limit the need for irrigation and the associated water that is lost to evapotranspiration. Overall, the impacts to streamflow associated with development in the area are anticipated to be minimal.

As Lewis County participates in the planning for other watersheds (particularly WRIA 23 – the Upper Chehalis watershed), the County will consider changes to the countywide building and/or development standards to address water usage and policies for permit-exempt wells. As the policies are implemented in the other basins, Lewis County may also elect to have the policies applied to Lewis County's portion of the Upper Nisqually basin.

Chapter 7 Mitigation Offsets by Sub-Basin

7.1 Projected Consumptive Water Use for Micro and Macro Mitigation

Chapter 3 of this Addendum presents the projected average annual water use from domestic wells between 2018 and 2040 by sub-basin. Water use was projected for three different sets of forecasts:

(1) The actual average annual consumptive use estimated using a multiplier on Thurston PUD data for Group A and B systems in WRIA 11;

(2) The average annual consumptive use calculated using Ecology guidance based on the assumption that every permit-exempt connection irrigates 0.2 acres of lawn or garden; and

(3) The consumptive portion of the legal water use allowed under current state law (i.e. 3,000 gal/day) for each permit-exempt well.

Tables 3-18, 3-19 and 3-20 in Chapter 3 present forecasted consumptive use for each of these approaches, respectively, by sub-basin.

These three use projections provide a range of targets for mitigation. The actual consumptive use calculated both using a multiplier on actual Thurston PUD data and using Ecology guidance informs the "micro" mitigation needed within each sub-basin to offset projected streamflow impacts. The legal consumptive use informs "macro" mitigation needed to meet Net Ecological Benefit (NEB) for the Nisqually Watershed as a whole. A watershed-wide comparison of the three approaches is presented below in Table 7-1. Tables 7-2, 7-6, 7-8, 7-10, 7-12, 7-14, 7-16, 7-18, and 7-20, summarizing mitigation options for each sub-basin, follow at the end of this section. A large-format version of Table 7-2, summarizing all mitigation for the entire Nisqually Watershed, is included as Figure 5.

Table 7-1: Comparison of Consumptive Use Estimates in WRIA 11 (2018-2040)

Method	Total PE Connections	Annual Consumptive Use (AFY)	Cubic Feet/ Second (CFS)	CFS per connection	AFY per connection
Actual PE Well Use (Thurston PUD Data Source)	2,987	318	0.439	0.000147	0.106
Actual PE Well Use (Ecology Methodology)	2,987	747	1.032	0.000345	0.249
Consumptive Portion of Legal Right to Water	2,987	5501	7.598	0.002544	1.842

All comparisons of actual consumptive use to mitigation strategies in this chapter utilize the Ecology Methodology shown in Table 7-1 and assume that each new permit-exempt connection consumptively utilizes 0.249 AFY and each permit-exempt well connection abandoned provides a 0.249 AFY offset.

7.2 Summary of Watershed Mitigation Options

Table 7-2 summarizes three types of mitigation options or strategies proposed for the Nisqually Watershed; projects or regulatory situations that reduce the consumptive demand forecast, micro-mitigation strategies that are applied on a sub-watershed scale (Chapter 5), and larger scale salmon recovery projects associated with specific salmon recovery initiatives (Chapter 4). The total minimum and maximum mitigation expected from each of these strategies and for the entire watershed are also shown in Table 7-2. The timing of some mitigation benefits is year-round, while others are targeted summer and fall benefits.

Table 7-2: Summary of Watershed Mitigation Options (see end of chapter and Figure 5 for large-scale version)

County-wide policies affecting water availability for rural residential development continue to be considered as part of other WRIA processes and are not yet available to be included in these sub-basin and watershed wide totals of mitigation offsets. Deep Groundwater Options 1 through 3 will be quantified on a project specific and well-specific basis and are also not included in the total mitigation offset shown in Table 7-2. It is expected that 0.249 AFY per well will be credited for each well associated with most projects. The Planning Unit expects that the current projects that have been quantified in Table 7-2 will achieve full mitigation of domestic consumptive use by forecast permit-exempt well connections in the watershed.

Table 7-3 provides a comparison of the consumptive use estimates using the Ecology method and the minimum and maximum estimated mitigation offset by sub-basin. Table 7-4 summarizes the comparison of the legal consumptive use (the consumptive portion of 3,000 gpd/connection) and estimated mitigation offset by sub-basin. As discussed above, this is not the total estimated mitigation for the watershed as it does not consider future county regulatory policy that may require permit applicants to assist with mitigation, nor does it include any of the Deep Groundwater offset options. Because many of the mitigation options are preliminary and conceptual in nature, a range of values is shown between the minimum and maximum amount of mitigation potentially available.

Table 7-3: Actual Consumptive Use (Ecology Method) Compared to Minimum and Maximum Estimated Mitigation*

Sub-basin	ECY Method Annual PE Consumptive Use (AFY)	ECY Method Annual PE Consumptive Use (cfs)	Mitigation Actions Identified - annual AF (MIN)	Mitigation Actions Identified - annual AF (MAX)	Mitigation Actions (cfs) MIN	Mitigation Actions (cfs) MAX
McAllister	39	0.054	TBD	TBD	TBD	TBD
Thompson/Yelm	390	0.539	349.02	762.1	0.479	1.050
Lackamas/Toboton/Powell	107	0.148	84.17	504.57	0.116	0.697
Lower Nisqually	0.5	0.001	0	200	0	0.552
Mashel River	5	0.007	1922	4281	3.48	7.27
Prairie Tributaries	149	0.206	41.7	1290	0.058	2.058
Ohop Creek	7	0.009	24	1336	0.017	2.105
Upper Nisqually (Pierce, Lewis, Thurston)	49	0.067	49	249	0.067	0.619
TOTAL	**747**	**1.03**	**2470**	**8623**	**4.22**	**14.35**

*Figures are rounded and may not calculate correctly in conversions. Full values are available by request from the Planning Unit.

Table 7-4: Legal Consumptive Use Compared to Minimum and Maximum Estimate Mitigation*

Sub-basin	Legal Annual PE Consumptive Use (AFY)	Legal Annual PE Consumptive Use (cfs)	Mitigation Actions Identified - annual AF (MIN)	Mitigation Actions Identified - annual AF (MAX)	Mitigation Actions (cfs) MIN	Mitigation Actions (cfs) MAX
McAllister	285	0.394	TBD	TBD	TBD	TBD
Thompson/Yelm	2,876	3.973	1946	2359	2.7	3.3
Lackamas/Toboton/Powell	792	1.094	84.2	504.6	0.116	0.697
Lower Nisqually	4	0.005	0.00	200	0.00	0.552
Mashel River	37	0.051	1922	4281	3.48	7.27
Prairie Tributaries	1,098	1.516	41.7	1290	0.058	2.058
Ohop Creek	50	0.069	24	1336	0.017	2.10
Upper Nisqually (Pierce, Lewis, Thurston)	359	0.496	359	559	0.496	1.048
TOTAL	**5,501**	**7.60**	**4377**	**10530**	**6.86**	**16.99**

*Figures are rounded and may not calculate correctly in conversions. Full values are available by request from the Planning Unit.

7.2.1 Demand Reduction

There are two factors that can be used to adjust consumption and reduce demand in WRIA 11: The City of Yelm's water right and the regulatory status of the Upper Nisqually Sub-basin.

After approval of their pending water right permit application, the City of Yelm intends to serve new domestic uses within their water service area that would otherwise be served by permit-exempt wells. Approval of the City's water right will include adequate mitigation, therefore domestic uses that are served by the City's water right will be fully mitigated. Removing the estimated demand for the domestic uses to be served by the City reduces the total consumptive use in the Thompson/Yelm sub-basin and the entire watershed by 240.5 AFY or 0.33 cfs using the Ecology methodology for calculating actual consumptive use for domestic permit-exempt well connections.

The regulatory status of the Upper Nisqually sub-basin includes instream flow values but it is not closed. Because this sub-basin is above reservoirs that release flow to meet instream flows, permit-exempt uses in the Upper Nisqually will not impair instream flows. Therefore, consumptive use estimates for the upper Nisqually (49 AFY, 0.067 cfs per Ecology methodology) can also be viewed as mitigation demand reduction.

7.3 Water Use and Mitigation Options by Sub-Basin

Results for individual sub-basins are provided in this section, along with mitigation options for offsetting consumptive uses. As County policies are developed to address rural water use through the building permit application process, additional consumptive use offset is expected. Tables of mitigation by sub-basin are included at the end of this chapter.

7.3.1 McAllister Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Because of the varied landscape of the sub-basin, it is uncertain exactly where the new connections would be located. A portion are expected to be within the Eaton Creek drainage.

Table 7-5: Consumptive Use Estimates – McAllister Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	155	16	0.023
Actual PE Well Use (Ecology Methodology)	155	39	0.054
Consumptive Portion of Legal Right to Water	155	285	0.394

Mitigation Options

Table 7-6 (see end of chapter) provides a summary of mitigation options for the McAllister Sub-basin. None of the mitigation options are quantified at this time.

Discussion

As noted in Chapter 2, because this portion of the Nisqually River is not closed for future out-of-stream water appropriations, it is possible that new permit-exempt wells that tap groundwater in connection with the Nisqually River may be permitted without the expectation of offset mitigation. For the McAllister Creek area, virtually all the land in the Nisqually Valley is zoned long-term agricultural, with development rights purchased through conservation easements. The tributary to McAllister Creek is within the Lacey UGA and the water supply for any future development will be met by connection to a Group A water system.

For the Eaton Creek area and Lake St. Clair, there is the possibility for a small number of future permit-exempt wells. For impact mitigation, this plan recommends that permit applicants consider offset options through the Thurston County Building permit process. The three Deep Groundwater mitigation options that apply to prairie stream environments as described in Section 5.1.1 are applicable and are quantified on a per-well basis.

7.3.2 Thompson/Yelm Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-7: Consumptive Use Estimates – Thompson/Yelm Sub-basin

Forecast Method	PE Connections (UGA)	PE Connections (Rural)	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data)	1,036	526	1,562	165.6	0.2287
Actual PE Well Use (Ecology Method)	1,036	526	1,562	388.9	0.5372
Consumptive Portion of Legal Right to Water	1,036	526	1,562	2877.2	3.9742

Mitigation Options

Table 7-8 (see end of chapter) provides a summary of mitigation options for the Thompson/Yelm Sub-basin.

Discussion

The Thompson/Yelm sub-basin has the potential for significant offset of mitigation demand through the expansion of the City of Yelm's public water system. The City of Yelm, a large Group A system, has applied for water rights in the deeper TQu aquifer to expand its system capabilities. Final approval of this new water right and system expansion has been delayed by litigation concerning the adequacy of the mitigation offered by Yelm. The City is

addressing this mitigation issue and expects to gain initial re-approval for its water right permit application in 2019. Once approved, the water used by this deeper municipal system will be fully mitigated, with additional mitigation benefits available to apply to streamflow restoration. Treated wastewater discharged directly into the Nisqually River mainstem or the Centralia Power Canal may not be eligible for mitigation credit, whereas water infiltrated higher in the sub-basin is eligible as a benefit; further study and evaluation is necessary. The minimum streamflow benefit associated with this strategy includes only irrigation from parks and playfields and direct recharge to the Qva in Yelm. The maximum also includes reclaimed water discharged to the Nisqually River and Centralia Power Canal.

Approval of this water right and initiating its well and delivery system will have multiple mitigation benefits. First, because of expanded water availability, a portion of the demand for new permit-exempt wells projected for this sub-basin will be met instead by the expanded Yelm system. Thus, overall demand will be significantly reduced. Second, some number of existing permit-exempt wells within the city's water delivery area may be added to the Group A system and the existing well retired (assumed to be 10% for purposes of this Addendum). Each existing exempt well retired offers mitigation for a new permit-exempt well within the Thompson/Yelm Sub-basin (see Chapter 5.1.1).

The City of Yelm will also be infiltrating reclaimed water from the deeper aquifer system. The non-consumptive component of this recharge that is not already allocated to mitigation to Yelm's water right is also available as a mitigation offset in the Thompson/Yelm sub-basin.

In summary, the single largest mitigation action to be taken for this sub-basin (in the form of a demand reduction rather than an offset) is the approval of Yelm's water right for its new well. To accomplish this, this plan Addendum encourages Yelm to identify and implement sufficient additional mitigation for its new well and system and that the Department of Ecology, upon receipt of Yelm's additional mitigation information, proceed immediately with review of the Yelm water right application. The plan also recommends that Yelm proceed to implement all prior mitigation agreements that it negotiated concerning expansion of its water rights.

Other sub-basin mitigation recommendations follow those specific to prairie stream environments as specified in Chapter 5.1.1. As each of the three Counties develop a regulatory approach to water availability certification and mitigation, we expect those approaches will be integrated into county policy as needed.

7.3.3 Lackamas/Toboton/Powell Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-9: Consumptive Use Estimates –Lackamas/Toboton/Powell Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	430	46	0.063
Actual PE Well Use (Ecology Methodology)	430	107	0.148
Consumptive Portion of Legal Right to Water	430	792	1.094

Mitigation Options

Table 7-10 (see end of chapter) provides a summary of mitigation options for the Lackamas/Toboton/Powell Sub-basin.

Discussion

Powell Creek has no associated water rights nor is it encumbered by a stream closure, meaning that new permit-exempt wells likely could be permitted in this drainage without further mitigation. In addition, this plan recommends acquisition for permanent protection and long-term forest management a 240-acre commercial forest parcel located at the confluence of Powell Creek and its major tributary, the Elbow Lake outlet stream. This acquisition, when implemented, will protect the stream from negative forest practice harvest and replanting impacts, and will better maintain and enhance associated wetlands. Average stand age in this parcel is over 80 years, placing it in the highest-priority category for protection to maintain and enhance streamflow benefits (see Chapter 4). Protecting it will avoid an immediate loss of flow from the scheduled clear-cut of the parcel, a benefit that can be maintained in the long term by managing it through the Nisqually Community Forest for flow enhancement. This project will provide sufficient water mitigation for any future permit-exempt well development in the aggregated sub-basin.

Additional small habitat projects with flow and ecological benefits may be identified through the prairie stream restoration templates described in Chapter 5. Thurston County has identified the Peissner Road fish passage barrier removal on Toboton Creek as an initial option, and may implement future projects using this framework.

7.3.4 Lower Nisqually Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-11: Consumptive Use Estimates – Lower Nisqually River Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	2	0	0.000
Actual PE Well Use (Ecology Methodology)	2	0	0.001
Consumptive Portion of Legal Right to Water	2	4	0.005

Analysis performed for this plan Addendum determined that through 2040 the expected demand for only two new wells in this sub-basin.

Mitigation Options

Table 7-12 (see end of chapter) provides a summary of mitigation options for the Lower Nisqually Sub-basin.

Discussion

For the Red Salmon Creek there is the possibility of small streamflow impacts of future permit-exempt wells. Also, since the Red Salmon Creek area is directly adjacent to the Billy Frank Jr. Nisqually National Wildlife Refuge, it might be feasible to avoid streamflow impacts by purchasing undeveloped lots in fee or through non-development easements. The Lower Nisqually also has good potential for managed aquifer recharge (Appendix M).

7.3.5 Prairie Tributaries Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-13: Consumptive Use Estimates – Prairie Tributaries Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	596	63	0.088
Actual PE Well Use (Ecology Methodology)	596	149	0.206
Consumptive Portion of Legal Right to Water	596	1,098	1.516

Mitigation Options

Table 7-14 (see end of chapter) provides a summary of mitigation options for the Prairie Tributaries Sub-basin.

Discussion

This sub-basin is one of prairie streams and mitigation for future permit-exempt wells here should follow one or more of the mitigation strategies found in Chapter 5.1.1 specific to the hydrogeologic characteristics of Prairie stream systems (Deep aquifer options 1 through 3). In addition, Pierce County will consider exploring habitat restoration projects (ditch removal, beaver introduction, revegetation, and related strategies) to implement in Muck, Lacamas, and Tanwax Creeks. The Washington Water Trust has also explored potential for acquisition of agricultural water rights in this sub-basin.

As estimates for habitat and other mitigation projects in Pierce County sub-basins are further refined, the County may consider additional approaches as needed to address mitigation needs.

7.3.6 Ohop Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-15: Consumptive Use Estimates – Ohop Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	27	3	0.004
Actual PE Well Use (Ecology Methodology)	27	7	0.009
Consumptive Portion of Legal Right to Water	27	50	0.069

Mitigation Options

Table 7-16 (see end of chapter) provides a summary of mitigation options for the Ohop Sub-basin.

Discussion

Hydrogeologic analysis of the flow impacts of the restored Ohop Creek channel indicate that the restoration activities themselves have substantial instream flow benefit. For the lower area, about 60% of the total restoration length proposed, the streamflow benefit has been 49.5 AFY and 0.0351 cfs. Assuming these flow benefit calculations hold true for the remaining 1.8 miles of restoration, the additional streamflow benefit from

completing the restoration project upstream should be approximately 24.4 AFY and 0.0173 cfs, easily exceeding the projected water demand, above. Therefore, the plan recommends that the small flow impacts to Ohop Creek instream flows be mitigated through the funding and implementation of Phase 4 of the Ohop Creek salmon habitat recovery plan. With this and other salmon recovery projects being implemented steadily over the next 20 years, there will be a substantial net ecological benefit to the Nisqually Watershed.

In addition, streamflow in Ohop Creek has improved over the past 20 years with the acquisition of former agricultural land for conservation and stream habitat restoration. There was no effort to place the water rights in a water bank; the land use change is included here simply to document that the land use and irrigation patterns that produced the stream closures in earlier decades have changed considerably.

7.3.7 Mashel Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-17: Consumptive Use Estimates – Mashel Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	20	2	0.003
Actual PE Well Use (Ecology Methodology)	20	5	0.007
Consumptive Portion of Legal Right to Water	20	37	0.051

Mitigation Options

Table 7-18 (see end of chapter) provides a summary of mitigation options for the Mashel Sub-basin.

Discussion

Summer low flows are the critical environmental and water supply issue for the Mashel sub-basin. Although the projected flow impacts from future permit-exempt wells is relatively modest, because of the current critical low flows and the importance of this sub-basin for salmon habitat, mitigating the flow impacts and actually enhancing summer low flows is critically important to meet the Net Ecological Benefit required at a watershed scale for the Nisqually WRIA.

There are two substantial mitigation projects proposed for implementation in this sub-basin, discussed in detail in Chapter 4. Because these projects benefit the recovery of endangered salmon species, they are likely to be implemented through streamflow restoration and salmon recovery funding. When implemented, these projects are expected to mitigate all future new permit-exempt well impacts and, in addition, will offer a substantial NEB for the Nisqually Watershed by supporting cornerstone salmon recovery efforts. In addition, Community Forest management offers local economic benefits, supporting sustainable community development goals in rural areas of the watershed (Nisqually Community Forest, 2013).

The first is implementing the Town of Eatonville's stormwater management plan. Currently much of the rainfall in the town is diverted into a collection system and then channeled toward Lynch Creek, an Ohop Creek tributary. The new plan would reverse this, infiltrating stormwater and ultimately providing flow enhancement for the Mashel River. The Planning Unit recommends that the Town of Eatonville and the Nisqually Indian Tribe, as lead

agency for watershed planning and salmon recovery, pursue funding to study the feasibility of adding water from another sub-basin to supplement streamflows and meet Eatonville's future water needs.

The second project involves forest management in the upper reaches of the sub-basin. Research indicates that when commercial forests are managed on longer rotations (60 to 80 years rather than the current 30-40 years), there is a new benefit to streamflow. Acquiring and managing forest lands in this sub-basin will require substantial investment over a number of years but will result in a long-term improvement of streamflows.

Either or both of these projects will mitigate the relatively small impacts projected for future permit-exempt wells. Also, acquiring forestland for long-term rotation management is scalable, meaning a portion of the larger conservation forest could be acquired using streamflow restoration funding and therefore offset the anticipated impacts of new permit-exempt wells in the sub-basin.

As noted above, the Town of Eatonville get its water supply from groundwater under the influence of surface water – the Mashel River. Eatonville has no viable plan, at present, to meet its long-term demand for water. Should an out-of-sub-basin water source be identified and made available, that action would potentially benefit both Eatonville and the Mashel River's streamflows.

7.3.8 Upper Nisqually Sub-Basin

Projected Water Demand from Permit-Exempt Wells

Table 7-19: Consumptive Use Estimates – Upper Nisqually Sub-basin

Forecast Method	Total PE Connections	Annual Consumptive Use (AFY)	Annual Consumptive Use (CFS)
Actual PE Well Use (Thurston PUD Data Source)	195	21	0.029
Actual PE Well Use (Ecology Methodology)	195	49	0.067
Consumptive Portion of Legal Right to Water	195	359	0.496

Water use forecasts developed for the Upper Nisqually Sub-Basin utilized the same assumptions regarding indoor and outdoor consumptive use as was applied to the rest of the watershed. However, for reasons discussed in Chapters 2 and 3 (e.g., highly forested, season and vacation use of homes), the outdoor water use in the Upper Nisqually is anticipated to be significantly smaller than for other sub-basins.

Mitigation Options

Table 7-20 (see end of chapter) provides a summary of mitigation options for the Upper Nisqually Sub-basin.

Discussion

Neither the Nisqually River nor any of the named tributary streams in the Upper watershed are closed for out-of-stream water appropriation and the impacts themselves are extremely small. Instream flows have been set for this reach of the Nisqually and are typically met, however, any new uses could be subject to interruption if actual flows fall below regulatory flows. Furthermore, streamflow below this reach of the Nisqually is controlled by operations at the Nisqually Hydroelectric Project under Tacoma Power's FERC license and not by activities occurring in the Upper Nisqually Watershed. Because of the small projected streamflow impacts and because the streams in the upper Nisqually above Alder reservoir are not closed to out-of-stream appropriations, the Planning Unit has

determined there is no need for mitigation to offset future permit-exempt well use in the Upper Nisqually sub-basin beyond any Lewis and Pierce County policies if they are further developed as Lewis County participates in Streamflow Restoration and Enhancement processes in other watersheds, particularly WRIA 23, the Upper Chehalis and Pierce County participates in WRIAs 10, 12 and 15.

7.4 Limitations and Uncertainty

Schedule and resource constraints limited the ability to conduct detailed analyses of many of the identified mitigation opportunities in WRIA 11, which led to increased uncertainty. RCW 90.94.020 requires a strict timeframe (February 1, 2019) for adoption of the WRIA 11 Watershed Plan update, leaving only a few months to identify projects and conduct the technical analyses to quantify net ecological benefits used to develop the preliminary draft of the WRIA 11 Watershed Plan update.

Several sources of uncertainty affect the quantification of consumptive use from permit-exempt wells as well as the ability of projects and actions intended to mitigate those impacts, including:

- Uncertainty in number, spatial distribution, and timing of consumptive use associated with future permit-exempt wells and their actual impact on streamflow
- Uncertainty in magnitude, spatial distribution, and timing of offsets from mitigation actions
- Uncertainty regarding land acquisition and access to build projects
- Uncertainty regarding permitting and regulatory actions
- Uncertainty in obtaining funding, implementation, effectiveness and permanence of mitigation actions
- Uncertainty regarding the underlying assumptions and analysis methods used to quantify consumptive use and the effectiveness of mitigation actions.

To the extent that mitigation actions have been quantified, most of the offsets are associated with projects that are in conceptual or preliminary status and thus offer a lower level of implementation and effectiveness certainty. The project list has been recently developed, the level of detail available varies by project, and information about project benefits is especially limited for conceptual projects.

Several of the projects are non-water offset that provide ecological benefits that are qualitative rather than quantitative. Several of the water-offset projects, such as replacing shallow wells with deeper wells or managed aquifer recharge are dependent on hydrogeology and site-specific characteristics that cannot be evaluated without site-specific information at a project level. There is uncertainty in project locations and when they could be built. Finally, there is a high degree of uncertainty that mitigation offsets will be successful, especially for conceptual projects, due to uncertain funding sources and feasibility.

Analysis methods also introduce uncertainties into the calculation of the volume, location and magnitude of consumptive use impacts and offsets. Values for consumption and mitigation were determined using assumptions and models and are based on annual averages which are likely different than seasonal values. Although the values generated can be considered reasonable estimates, model results have limitations and potentially a high degree of uncertainty. Another potential source of uncertainty is the assumption that groundwater withdrawals will only impact streams in the sub-basin they occur. Although this is generally supported, impacts could propagate across sub-basins, or even watershed divides.

Because of the uncertainty associated with estimating both streamflow impacts and mitigation offsets, consumptive use estimates can be considered mitigation targets. As projects are funded and implemented, this

uncertainty will be reduced through permit tracking, project implementation, site characterization, data collection and monitoring. Measures to decrease uncertainty include:

- Building permit tracking regarding new permit-exempt uses;
- Monitoring to assess permit-exempt water use, climate, groundwater levels and streamflow;
- Continuing to identify mitigation projects and opportunities that total more than the estimated consumptive use mitigation target to create a buffer to ensure that mitigation projects are adequate to cover actual consumptive uses;
- Adopting policies and management programs that:
    - Adequately track new permit-exempt uses;
    - Secure adequate funding for building, monitoring and maintaining projects;
    - Avoid or minimize consumptive use impacts such as reducing withdrawals and water conservation;
    - Conducting adequate site characterization at project locations;
    - Metering as needed, and monitoring where appropriate;
    - Reduce uncertainty in project implementation and effectiveness by using adaptive management programs that adjust to future conditions and factors through potential tracking and monitoring.

Tracking and monitoring of mitigation offsets are addressed in Chapter 8 and will be further explored by the Planning Unit in concert with the Department of Ecology as part of the Adaptive Management process.

Table 7-2: Summary of WRIA 11 Watershed Mitigation Options

	Mitigation Strategy	Description	Sub-Basin(s)	Timing of Benefits	Project Assumptions	Annual AF Benefit (AF) MIN	Annual AF Benefit (AF) MAX	Streamflow Benefit (cfs) MIN	Streamflow Benefit (cfs) MAX	Ecological Benefits	Uncertainties	Reference
Demand Reduction	**Yelm Offset Action 1**	Connect new development in Yelm UGA to City water service using deep well	Thompson/Yelm	Year-Round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	240.5	240.5	0.33	0.33	Streamflow increases equal to the amount of consumptive water saved.	Water right permitting	Section 5.1.1 Appendix L
	Upper Nisqually Sub-basin regulatory status	Mitigation not required because sub-basin is not closed and ISFs are normally met	Upper Nisqually	Year-Round	49 Acre-Feet	49	49	0.067	0.067		Drought conditions could result in ISFs not being met	Section 3.3.8 Appendix B
Micro Mitigation Sub-Basin Strategies	**Deep Groundwater Option 1**	Complete new P-E wells only in deeper aquifers	All Sub Basins	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).					Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits	Section 5.1.1
	Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).					Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits	Section 5.1.1
	Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).					Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions	Section 5.1.1
	Water Right Acquisition	Purchase and retire water rights	Prairie Tributaries	Irrigation season	Water right specific - Tier 1 only	0	673	0	0.93	Streamflow increases equal to the amount of consumptive water saved.	Funding for analyses and purchases, consumptive use volumes, water right owner willingness to sell.	Section 5.1.2 Appendix K
	Yelm Offset Action 2	Connecting existing Permit-Exempt uses to Yelm's water service	Thompson/Yelm	Year-round	10% of existing wells replaced, consumptive use portion is credited (0.249 AF per connection).	10.4	10.4	0.014	0.014	Streamflow increases equal to the amount of consumptive water saved.	Assume 10 % of existing wells in service area, funding permitting	Section 5.1.1
	Yelm Offset Action 3	Infiltration of reclaimed Class A water to provide mitigation	Thompson/Yelm	Year-round	Additional recharge of reclaimed water	87	400	0.12	0.552	Streamflow increases equal to the amount of reclaimed water discharged to the shallow aquifer.	Funding, permitting, reclaimed water volume, site-specific factors	Section 5.1.1
	Pierce County Stream Restoration	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnetion and stream meandering, re-vegetation	Prairie Tributaries	Year-round	Assume 0.0096 cfs/mile of linear channel and 6-60 miles	41.7	417	0.0576	0.576	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions	Section 5.1.4 Table 5-6 Appendix E
	Thurston County Stream Restoration - Thompson/Yelm	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnetion and stream meandering, re-vegetation	Thompson/Yelm	Year-round	Assume 0.0096 cfs/mile of linear channel and 1.6-16 miles	11.12	111.2	0.01536	0.1536	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions	Section 5.1.4 Table 5-6 Appendix E
	Thurston County Stream Restoration - Lackamas/Toboton/ Powell	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnetion and stream meandering, re-vegetation	Lackamas/Toboton/Powell	Year-round	Assume 0.0096 cfs/mile of linear channel and .23-2.3 miles	1.6	15.9	0.002208	0.02208	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions	Section 5.1.4 Table 5-6 Appendix E
	Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Mashel, Ohop, Prairie Tribs, Upper Nisqually, Lower Nisqually	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit	0	1000	0	2.7626	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors	Secton 5.1.3 Appendix M
	Barrier Removal Projects	Culvert Replacement	Lackamas/Toboton/Powell	Year-round	Peissner Road Project 3.03 Acre-Feet (0.0023 cfs)	1.67	1.67	0.0023	0.0023	Re-open stream reaches & habitat, increase low flows	Funding, analyses, permitting	Section 5.1.4 Table 5-6
Salmon Recovery Strategies	**Mashel Watershed Community Forest**	Forest Management, protection, acquisition, restoration	Mashel	Year-round	rate of purchase is linear and begins in year 1 - and compounds	1699	3798	2.347	5.246	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
	Eatonville Capital Improvement Projects	Implementation of highest priority stormwater comprehensive plan projects	Mashel/Ohop(1)	Summer - Fall	0.659 - 1.843 AFY[2]	38.7	38.7	0.128	0.128	Increased streamflow, improved water quality	Funding, modeling uncertainties	Section 4.2.2 Table 4-4 Appendix H
	Eatonville Water System Conservation	Leak detection and repair	Mashel	Year-round	N/A	69.35	69.35	0.096	0.096	Increased streamflow	Funding, unauthorized water uses	Section 4.2.2 Table 4-4 Appendix I
	Eatonville ASR	Capture high winter flows, recharge and store in the volcanic aquifer for recovery during high-demand season	Mashel	Summer - Fall	20 - 80 Acre-Feet [2]	20	80	0.11	0.45	Increased streamflow	Funding, aquifer hydraulic properties, groundwater quality, ability to store water, impacts during recovery	Section 4.2.2 Table 4-4 Appendix H
	Eatonville Alternative Water Supply	Relocate Eatonville's water intake from Mashel River near town to mouth of Mashel River or Alder Lake	Mashel	Summer	95 Acre-Feet (0.8 cfs)	95	95	0.8	0.8	Increased streamflow	Funding, property ownership, right-of-way access, water quality	Section 4.2.2 Table 4-4 (Golder, 2010)
	Ohop Phase IV Floodplain Restoration & Protection	Floodplain reconnection and stream meandering, engineered log jams, re-vegetation	Ohop	Year-round	24.4 Acre-Feet/yr	24.4	24.4	0.0173	0.0173	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow season.	Project funding and land secured - low uncertainty	Section 4.2.3 Table 4-5 Appendix E
	Ohop Watershed Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Ohop	Year-round	rate of purchase is linear, benefits are non-linear-begins in year 1 - and compounds	0	1112	0	1.5356	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
	Bald Hills Watershed Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Toboton/Lackamas/Powell	Year-round	rate of purchase is linear, benefits are non-linear-begins in year 1 - and compounds	80.9	487	0.1117	0.6727	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
	Upper Nisqually Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Upper Nisqually	Year-round	rate of purchase is linear, benefits are non-linear-begins in year 1 - and compounds	0		0		Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties	Section 4.2.1 Tables 4-2 and 4-3 Appendix G
TOTAL						**2470**	**8623**	**4.22**	**14.36**			

[1]All Eatonville CIP Projects are accounted for in Mashel Sub-basin (In actuality CIP 1&2 are in Mashel; 3&4 are in Ohop; 5&6 are on the divide between the two sub-basins)

[2] Seasonal flow benefit only. CFS shows maximum seasonal benefit; Annual AF shows total benefit averaged over one year. See Chapter 4 and Appendices for assumptions.

Table 7-6: McAllister Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Deep Groundwater Option 1	Complete new P-E wells only in deeper aquifers	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits
Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits
Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions
TOTAL Mitigation				**TBD**	**TBD**	**TBD**	**TBD**	**Actual Consumptive Use (ECY method, AFY): 39**	

Table 7-8: Thompson/Yelm Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Yelm Offset Action 1	Connect new development in Yelm UGA to City water service using deep well	Year-Round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	240.5	240.5	0.33	0.33	Streamflow increases equal to the amount of consumptive water saved.	Water right permitting
Deep Groundwater Option 1	Complete new P-E wells only in deeper aquifers	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits
Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits
Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions
Yelm Offset Action 2	Connecting existing Permit-Exempt uses to Yelm's water service	Year-round	10% of existing wells replaced, consumptive use portion is credited (0.249 AF per connection).	10.4	10.4	0.014	0.014	Streamflow increases equal to the amount of consumptive water saved.	Assume 10% of existing wells in service area, funding permitting
Yelm Offset Action 3	Infiltration of reclaimed Class A water to provide mitigation	Year-round	Additional recharge of reclaimed water	87	400	0.12	0.552	Streamflow increases equal to the amount of reclaimed water discharged to the shallow aquifer.	Funding, permitting, reclaimed water volume, site-specific factors
Thurston County Stream Restoration - Thompson/ Yelm	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnection and stream meandering, re-vegetation	Year-round	Assume 0.0096 cfs/mile of linear channel and 1.6-16 miles	11.12	111.2	0.01536	0.1536	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions
TOTAL Mitigation				**349.02**	**762.1**	**0.47936**	**1.0496**	**Actual Consumptive Use (ECY method, AFY): 390**	

Table 7-10: Lackamas/Toboton/Powell Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Deep Groundwater Option 1	Complete new P-E wells only in deeper aquifers	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits
Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits
Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions
Thurston County Stream Restoration - Lackamas/ Toboton/ Powell	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnection and stream meandering, re-vegetation	Year-round	Assume 0.0096 cfs/mile of linear channel and .23-2.3 miles (see Appendix E)	1.6	15.9	0.002208	0.02208	Increased groundwater storage in floodplain, in-stream habitat, water quality improvements, streamflow during low flow/intermittent flow season	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions
Bald Hills Watershed Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Year-round	Rate of purchase is assumed linear, benefits are non-linear-begins in year 1 - and compounds (see Appendix G)	80.9	487	0.1117	0.6727	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties
Barrier Removal Projects	Culvert Replacement	Year-round	Peissner Road Project (see Section 5.1.4 and Appendix E) 3.03 Acre-Feet (0.0023 cfs)	1.67	1.67	0.0023	0.0023	Re-open stream reaches & habitat, increase low flows	Funding, analyses, permitting
TOTAL Mitigation				**84.17**	**504.57**	**0.116208**	**0.69708**	**Actual Consumptive Use (ECY method, AFY): 107**	

Table 7-12: Lower Nisqually Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Deep Groundwater Option 1	Complete new P-E wells only in deeper aquifers	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits
Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits
Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions
Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit (See Section 5.1.3 and Appendix M)	0	200	0	0.552	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors
TOTAL Mitigation				**0**	**200**	**0**	**0.552**	**Actual Consumptive Use (ECY method, AFY): 0.5**	

Table 7-14: Prairie Tributaries Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Deep Groundwater Option 1	Complete new P-E wells only in deeper aquifers	Year-round	The consumptive use portion for each new P-E use would be reduced, depending on location and depth (up to 0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, regulations, quantifying volume and timing of actual benefits
Deep Groundwater Option 2	Replace shallow P-E well withdrawals with withdrawals from deeper aquifers	Year-round	The consumptive use portion for each P-E use that is replaced (0.249 AF per connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Permitting, quantification of impacts and benefits
Deep Groundwater Option 3	Deepen PUD-managed Group A water system groundwater withdrawals.	Year-round	The consumptive use portion for the Group A use would be reduced, depending on location and depth (up to 0.249 AF/connection).	TBD	TBD	TBD	TBD	Streamflow increases equal to the amount of consumptive water saved.	Funding, hydrologic conditions
Water Right Acquisition	Purchase and retire water rights	Irrigation season	Water right specific - Tier 1 only (See Section 5.1.2)	0	673	0	0.93	Streamflow increases equal to the amount of consumptive water saved.	Funding for analyses and purchases, consumptive use volumes, water right owner willingness to sell.
Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit (See Section 5.1.3 and Appendix M)	0	200	0	0.552	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors
Pierce County Stream Restoration	Ditch removal with off channel storage, Beaver reintroduction, floodplain reconnection and stream meandering, re-vegetation	Year-round	Assume 0.0096 cfs/mile of linear channel and 6-60 miles (see Appendix E)	41.7	417	0.0576	0.576	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow/intermittent flow season.	Funding, land availability and access, limited data on potentially restorable areas and hydrologic conditions
TOTAL Mitigation				**41.7**	**1290**	**0.0576**	**2.058**	**Actual Consumptive Use (ECY method, AFY): 149**	

Table 7-16: Ohop Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit (See Section 5.1.3 and Appendix M)	0	200	0	0.552	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors
Ohop Phase IV Floodplain Restoration & Protection	Floodplain reconnection and stream meandering, engineered log jams, re-vegetation	Year-round	24.4 Acre-Feet/yr (see Appendix E)	24.4	24.4	0.0173	0.0173	Increase groundwater storage in floodplain, increased in-stream habitat, water quality improvements, increased streamflow during low flow season.	Project funding and land secured - low uncertainty
Ohop Watershed Recovery/Community Forest	Forest Management, protection, acquisition, restoration	Year-round	rate of purchase is linear, benefits are non-linear- begins in year 1 - and compounds (see Appendix G)	0	1112	0	1.5356	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties
TOTAL Mitigation				**24**	**1336**	**0.017**	**2.105**	**Actual Consumptive Use (ECY method, AFY): 7**	

Table 7-18: Mashel Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit	0	200	0	0.552	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors
Mashel Watershed Community Forest	Forest Management, protection, acquisition, restoration	Year-round	rate of purchase is linear and begins in year 1 - and compounds	1699	3798	2.35	5.25	Streamflow, habitat, ecosystem benefits, woody debris and sediment supply, erosion control	Funding, modeling uncertainties
Eatonville Capital Improvement Projects	Implementation of highest priority stormwater comprehensive plan projects	Summer - Fall	0.659 - 1.843 AFY	38.7	38.7	0.128	0.128	Increased streamflow, improved water quality	Funding, modeling uncertainties
Eatonville Water System Conservation	Leak detection and repair	Year-round	N/A	69.35	69.35	0.096	0.096	Increased streamflow	Funding, unauthorized water uses
Eatonville ASR	Capture high winter flows, recharge and store in the volcanic aquifer for recovery during high-demand season	Summer - Fall	20 - 80 Acre-Feet	20	80	0.11	0.45	Increased streamflow	Funding, aquifer hydraulic properties, groundwater quality, ability to store water, impacts during recovery
Eatonville Alternative Water Supply	Relocate Eatonville's water intake from Mashel River near town to mouth of Mashel River or Alder Lake	Summer	95 Acre-Feet (0.8 cfs) See Golder (2010)	95	95	0.8	0.8	Increased streamflow	Funding, property ownership, right-of-way access, water quality
TOTAL Mitigation				**1922**	**4281**	**3.481**	**7.272**	**Actual Consumptive Use (ECY method, AFY): 5**	

Table 7-20: Upper Nisqually Sub-Basin Mitigation

Mitigation Strategy	Description	Timing of Benefits	Project Assumptions	Annual Benefit (AF) MIN	Annual Benefit (AF) MAX	Flow Benefit (cfs) MIN	Flow Benefit (cfs) MAX	Ecological Benefits	Uncertainties
Upper Nisqually Sub-basin regulatory status	Mitigation not required because sub-basin is not closed and ISFs are normally met	Year-Round	49 Acre-Feet	49	49	0.067	0.067	N/A (demand reduction)	Drought conditions could result in ISFs not being met
Managed Aquifer Recharge	Diversion of higher winter streamflow for infiltration and storage	Summer-Fall	Project Specific - assume 0 -5 projects in 5 sub-basins @ 200 AF per project and 6 month benefit (See Section 5.1.3 and Appendix M)	0	200	0	0.552	Reduction in high flows, increases in low flows	Land availability, funding, permitting, water quality, site specific factors
TOTAL Mitigation				**49**	**249**	**0.067**	**0.619**	**Actual Consumptive Use (ECY method, AFY): 49**	

Chapter 8 Implementation and Adaptive Management

8.1 Implementation

Although action funding and implementation is not addressed under RCW 90.94.020, it is included in this Addendum in the form of next steps. This section addresses implementation of this Watershed Plan Addendum including policy recommendations and project actions; detailed implementation of individual actions will be addressed through implementation plans and implementation monitoring.

Implementation of the activities specified in this Nisqually Watershed Management Plan Addendum (Addendum) will commence following its adoption by Ecology. The deadline for adoption by Ecology is February 1, 2019, as set forth in RCW 90.94.020(7)(b). The projects and regulatory processes considered in this Addendum are in various stages of development. As part of Implementation, the Nisqually Planning Unit will continue to work together to further develop projects (including feasibility studies and additional streamflow modeling), assist County governments as necessary in evaluating potential changes to regulatory policy, and garner funding for implementation after the statutory deadline for submittal. It is assumed the proposed projects will be funded under Ecology's Streamflow Restoration grants or Salmon Recovery funding.

While most watersheds subject to the requirements of the RCW 90.94.020 have over two years to respond to the requirements of the Act, the Nisqually Watershed Planning Unit has had less than eight months. There are three counties located within the watershed that will review and could potentially implement changes to their current building application process to address rural water use. Due to the short timeframe, some mitigation strategies that are being developed to offset potential streamflow impacts from permit-exempt well withdrawals need further development and quantification after the mandated February 1, 2019 plan update. During implementation, the Planning Unit may request rule-making to address modifications to the domestic permit-exempt well connection fees and/or the water use quantities set forth in RCW 90.04.020(5)(f) that are enacted through Ecology.

Thurston, Pierce and Lewis Counties are continuing to explore regulatory strategies to offset permit-exempt well impacts, if additional mitigation beyond streamflow and habitat projects is determined to be necessary. These strategies will be applied and further developed for other watersheds in their responses to RCW 90.94.020 and RCW 90.94.030. Thurston County will be applying methodology from the Nisqually process to WRIAs 13, 14, 22 and 23; Pierce County to WRIAs 10, 12 and 15; and Lewis County to WRIAs 13 and 23. The Planning Unit has structured an adaptive management approach that will continue after February 1, 2019 to enable Implementing Governments to fully develop mitigation actions and implement potential code or ordinance changes in parallel with other watersheds. Detailed evaluation of habitat projects and technologies that will more specifically quantify streamflow benefits will also occur during this adaptive management period. Section 8.2 below addresses the Planning Unit's adaptive management approach.

The Planning Unit is currently discussing several actions that would require future rule-making. At this time there is consensus on the Planning Unit to maintain flexibility until these options can be further explored. Potential future rule-making could include:

- A reduction in water use quantities (3,000 gpd per connection) per RCW 90.94.020(5)(f).
- Consideration of metering as part of a voluntary program associated with a building permit application process (metering to qualify as mitigation credit or reduction in fees)

- Amendment of well connection fees set forth in RCW 90.04.020(5)(f) or implementation of a fee system accounting for specific mitigation (see Chapter 6).

The Planning Unit's next steps toward implementation of the strategies to offset rural water use and achieve net ecological benefit in WRIA 11 are outlined below:

Table 8-1: Summary of Planned Implementation Actions for WRIA 11

Entity	Implementation Action	Funding Source
Nisqually Indian Tribe	1. Extend Ecology contract past March 31, 2019 to enable Planning Unit to continue implementation 2. Manage future efforts of the Nisqually Planning Unit to further develop and implement actions in this Watershed Plan Addendum.	Ecology
Nisqually Planning Unit	3. Continue discussions regarding a reduction in water use quantities (3000 gpd per connection) per RCW 90.94.020(5)(f). 4. Consider metering as part of a voluntary program associated with building permit application process (metering to qualify as mitigation credit or reduction in fees) 5. Further explore water right acquisition or partial acquisition as a follow-on to the work performed for the PU in Dec 2018. 6. Consider alternative methods for tracking abandonment of permit-exempt wells, replacement of permit-exempt wells with water service from a water system drawing from a deeper aquifer, and mitigation credits for a number of other strategies as presented in Chapters 5 and 6 (permit-exempt well mitigation credit system or bank). 7. Support Thurston PUD by way of grant funding application efforts to explore feasibility of rehabilitating several Group A water systems 8. Explore potential for development of one or more of nine Managed Aquifer Recharge sites that Ecology has identified in the Watershed	Ecology and in-kind from Planning Unit members
Nisqually Indian Tribe, Nisqually Community Forest, and Salmon Recovery Habitat Workgroup partners	9. Community Forest (basin-wide): develop additional modeling with more refined estimates of streamflow benefits at various acquisition rates and average stand ages. 10. Mashel Watershed Recovery/Community Forest: acquire timberland to shift into flow enhancement management regime 11. Mashel Base Flow: implement six Capital Improvement Projects from Eatonville's Comprehensive Stormwater Plan; further explore water system efficiencies, ASR and alternate water source options for Town of Eatonville 12. Ohop Valley Floodplain Restoration: implement Phase IV of Ohop restoration from Nisqually Salmon Recovery's Four Year Work Plan 13. Mashel River Riparian Corridor Protection and Restoration: install and maintain at least 30 additional Engineered Log Jams in the Mashel River; monitor storage and flow impacts 14. Muck Creek Recovery: identify restorable stream reaches and design and implement restoration projects; further study intermittent flow dynamics and impact on salmonids 15. Prairie Tributaries Recovery: identify restorable stream reaches and design and implement restoration projects; further study intermittent flow dynamics and impact on salmonids 16. Ohop Watershed Recovery/Community Forest: acquire timberland to shift into flow enhancement management regime 17. Bald Hills Watershed Recovery/Community Forest: acquire timberland to shift into flow enhancement management regime	Ecology (Streamflow Restoration, Clean Water State Revolving Fund) Salmon Recovery Funding Board Puget Sound Acquisition and Recovery Fund Thurston and Pierce County Conservation Futures Funds

	18. Barrier Removal: identify priority barriers blocking access to available restored or natural salmonid habitat and remove or upgrade	
Thurston County	19. Board of County Commissioners approve Plan Addendum and commit to support implementation. 20. Continue to develop building permit process to ensure and account for rural water offsets while working in WRIAs 13, 14, 22 and 23. 21. Review of regulatory process and consider request to amend fee system. Any proposed changes to the Thurston County development code would follow the following process: a. Background research – internal staff and stakeholder review that leads to the development of a proposal and options. b. Planning Commission review and public hearing. Planning Commission makes a recommendation to the Board of County Commissioners. c. Board of County Commissioners/Board of Health review. BoCC holds a public hearing and makes a final decision. 22. Develop administrative and financial structure to implement fee-based mitigation as determined by the code review and update (Step 3 above). 23. Apply for funding and implement local habitat restoration projects in lower sub-basins (floodplain restoration, barrier removal)	Thurston County
Dept. of Ecology	24. Support additional development and implementation of the Plan Addendum through an extension of participation funding to the Planning Unit lead and participating entities beyond February 1, 2019. 25. Prioritize funding proposals that address strategies identified in this approved Plan Addendum (including future rounds of Streamflow Restoration funding). 26. Conduct rulemaking if specified by the Planning Unit during implementation – this could include amendments related to fees and water use restrictions established in RCW 90.94. 27. Work with the Planning Unit to monitor and report on progress in implementation of the strategies in this plan Addendum	Ecology
Lewis County	28. Continue to develop building permit process to ensure and account for rural water offsets while working in WRIAs 13 and 23.	Lewis County
Pierce County	29. Continue to record and report permit-exempt well connections associated with the building permit process to account for rural water offsets per RCW 90.94.020(5). 30. Continue review of regulatory process and consideration of fee system amendments as part of WRIA 10, 12, and 15 processes. 31. Identify, apply for funding and implement local habitat restoration projects in Prairie Tributaries Sub-basin	Pierce County
City of Yelm	32. Develop a tracking system to track the number of permit-exempt wells that are replaced by water system hookup once new municipal well is on line with water rights. Include tracking of the quantity of non-consumptive portion of reclaimed water infiltrated by the City into the shallow Qva aquifer.	City of Yelm

Thurston PUD	33. Work with WRIA 11 Planning Unit on grant application efforts to fund a feasibility study to rehabilitate and/or enhance water system infrastructure for several Group A water systems in the lower watershed.	Revolving Loan and Grant Fund for Small Water Systems, Ecology streamflow restoration
To Be Determined	34. Project tracking, permit-exempt well offset tracking, mitigation credit tracking	To Be Determined

8.2 Adaptive Management

This Addendum to the Nisqually Watershed Plan identifies mitigation strategies and preliminary policy recommendations designed to offset the impacts that new permit-exempt wells may have on streamflows or other senior water rights. It also, in coordination with the Nisqually Salmon Recovery strategy, makes recommendations for habitat projects that will, in combination with the mitigation strategies, provide a Net Ecological Benefit (NEB) for streamflows in the Nisqually Watershed.

The Planning Unit, in adopting these recommendations, has good confidence that they will meet their mitigation offset and NEB/salmon recovery goals. However, they also recognize that estimates of rural growth and subsequent consumptive use may need to be modified and that some mitigation recommendations may yield different streamflow benefits than expected. To address these uncertainties, the Planning Unit supports adaptive management: short- and long-term evaluation of the success of the recommendations and a commitment to modify, replace or supplement as needed, over the 20-year planning horizon, to meet the mitigation and NEB goals established in this plan Addendum. Adaptive management recommendations from the Planning Unit to Implementing Governments, Ecology or other entities are subject to public review and approval through County legislative processes.

This plan Addendum is composed of both Salmon Recovery strategies and streamflow mitigation strategies that were specifically developed to address the Streamflow Restoration Act (RCW 90.94.020). There is a robust adaptive management protocol developed and administered by the Nisqually Lead Entity for large-scale salmon recovery projects identified in this Addendum (Nisqually Indian Tribe Salmon Recovery Program, 2018). The Lead Entity process for adaptive management as related to habitat projects is discussed below in Section 8.2.1. Adaptive Management of the mitigation strategies and policies addressing RCW 90.94.020 is addressed below in Section 8.2.2.

8.2.1 Habitat Projects

The Planning Unit's core strategy of major habitat projects providing NEB mitigation is structured with built-in flexibility and expectations for ongoing adaptive management. This is because it is aligned with salmon recovery goals over the implementation period, specifically through the Nisqually Salmon Recovery Habitat Project Ranking Guidance (2018; see Appendix F-3).

Salmon recovery project proposals, including those with streamflow benefits discussed in Chapter 4 of this Addendum, are submitted annually to the Nisqually Indian Tribe's Salmon Recovery Program (the Nisqually Lead Entity). The Lead Entity gives each project a technical analysis score based on its expected impact on Chinook and steelhead populations, including benefit to streamflows. The Nisqually Habitat Project Ranking Guidance (2018) details the Ecosystem Diagnosis and Treatment model used to identify reaches with maximum habitat benefit for

listed salmon, and from there to develop measurable implementation metrics for the large-scale initiatives advanced by each project. The highest scoring projects are those with the greatest expected percent change to the key implementation metric. Projects are then scored based on readiness, cost-effectiveness, and timing/sequencing by the Nisqually Salmon Recovery Habitat Work Group and ranked for funding and implementation priority accordingly.

Ranking is based on the two current ESA-listed species in the watershed (Chinook and steelhead). These listings drive the prioritization of projects expected to deliver maximum benefit to these species, with primary focus on habitat in the Mashel River and Ohop Creek. Nisqually winter chum salmon are not currently listed under the ESA, but because of the run's unique timing, it may be considered for listing at a future date. ESA listing of chum or other species could create adaptive management changes to the prioritization of habitat restoration initiatives and projects. The Planning Unit's goal for NEB is to support the Nisqually Lead Entity in managing current listed populations and any future listed species according to the best available science at the watershed scale.

8.2.2 Sub-Basin Mitigation Strategies

Often adaptive management programs are designed to directly monitor impacts as a measure of success. In the case of mitigation, the estimated per-connection consumptive use impacts are very small and it may not be possible to measure success directly (e.g., by measuring tributary streamflow). Therefore, the Planning Unit recommends a system of compliance monitoring.

The Planning Unit's first priority mitigation strategy is to fully implement salmon recovery projects with streamflow benefits. It has also outlined a range of local micro-mitigation strategies that would work in concert with watershed-scale habitat initiatives to provide offsets for new permit-exempt wells within specific sub-basins. The Planning Unit expects to work with the Department of Ecology throughout the implementation period to track and adjust both demand forecasts and mitigation estimates, and to support Ecology and Implementing Governments in addressing a changing landscape.

Some of these micro-mitigation strategies may depend on policy development and implementation actions by the three counties. The Nisqually Planning Unit acknowledges that our earlier deadline means some of these actions will be further developed in coordination Streamflow Restoration Act processes in other WRIAs. It is likely that the counties may adopt an approach to mitigation that differs from this plan Addendum. Approaches identified through these other WRIA processes that meet the same mitigation goals and offset targets identified in this plan Addendum would fall within the Planning Unit's understanding of adaptive management. As these county-level approaches take shape, the Nisqually Planning Unit supports the inclusion of monitoring protocols and benchmarks to inform adaptive decision-making.

References

Abdelnour, A., Stieglitz, M., Pan, F., & McKane, R. (2011). Catchment hydrological responses to forest harvest amount and spatial pattern. Water Resources Research, 47(9).

Abdelnour, A., McKane, R., Stieglitz, M., Pan, F., & Cheng, Y. (2013). Effects of harvest on carbon and nitrogen dynamics in a Pacific Northwest forest catchment. *Water Resources Research*, *49*(3), 1292-1313.

AHBL (October 2013). *Town of Eatonville Comprehensive Stormwater Plan Update.* Eatonville, WA.

Anchor QEA, LLC (October 2010). *Initial Acquisition and Restoration Assessment of the Smith Ranch*. Prepared for Cities of Lacey, Olympia, and Yelm. Seattle, WA.

Beechie, Timothy J.; Sear, David A.; Olden, Julian D.; Pess, George R.; Buffington, John M.; Moir, Hamish; Roni, Philip; Pollock, Michael M. (2010). Process-based principles for restoring river ecosystems. BioScience. 60(3): 209-222.

Borgen, E., Cronin, A., and Aylward, B. (June 2010). *Feasibility Analysis for a Nisqually Water Bank*. Seattle: Washington Water Trust and Ecosystem Economics. Document in preparation.

CDM (2001). *McAllister Baseline Monitoring Program: Final Report*. Vol. 1-3. Prepared for the City of Olympia Public Works Department by: Camp, Dresser, and McKee, Water Resources Group. Gig Harbor, WA.

CDM (April 2002). *Interim Report, Model Construction, and Steady-State Calibration, McAllister Wellfield Numerical Model*. Prepared for the City of Olympia Public Works Department by: Camp, Dresser, and McKee, Water Resources Group. Gig Harbor, WA.

City of Olympia and Nisqually Indian Tribe (September 2008). *McAllister Wellfield Mitigation Plan*. Olympia, WA.

City of Yelm (2001). Yelm Comprehensive Flood Management Plan. Yelm, WA.

Dion, N. P., Turney, G. L., and Jones, M. A. (1994). *Hydrology and Quality of Ground Water in Northern Thurston County, Washington*. USGS Water Resources Investigation Report 92-4109.

Drost, B. W., Ely, D.M., and Lum, W.E. (1999). *Conceptual Model and Numerical Simulation of the Ground-Water-Flow System in the Unconsolidated Sediments of Thurston County, Washington*. USGS Water Resources Investigation Report 99-4165.

Erickson, D. (1998). *Yelm Groundwater Baseline Sampling*. Washington Department of Ecology, Water Body No. WA-11-1010GW. Publication No. 98-301.

Esri (2018). *Updated Demographics, 2018 Population, households, and housing.* Retrieved from http://doc.arcgis.com/en/business-analyst/web/data.htm.

Frans, L.M. and Olsen, T.D. (2016). Numerical simulation of the groundwater-flow system of the Kitsap Peninsula, west-central Washington (ver. 1.1, October 2016): U.S. Geological Survey Scientific Investigations Report 2016–5052, 63 p., http://dx.doi.org/10.3133/sir20165052

Golder Associates (October 2003). *Nisqually Watershed Management Plan*. Olympia, WA: Nisqually Indian Tribe. Retrieved from https://fortress.wa.gov/ecy/publications/documents/0311018.pdf.

Golder Associates (February 2007). *Nisqually Watershed Detailed Implementation Plan*. Olympia, WA: Nisqually Indian Tribe. Retrieved from https://fortress.wa.gov/ecy/publications/documents/0711054.pdf.

Golder Associates (March 2010). *Phase I Storage Evaluation, Town of Eatonville*. Eatonville, WA.

Golder Associates (March 2011) City of Yelm Southwest Well 1A Development Report. Yelm, WA.

Greene, M. & Thaler, T., Griffith, G., Crossett, T., Perry, J.A.; (Eds) (2014). *Forest and Water Climate Adaptation: A Plan for the Nisqually Watershed*. Model Forest Policy Program in association with the Nisqually River Foundation and the Cumberland River Compact; Sagle, ID.

Hall, J., Kane, J., Swedeen, P., Blair, G., Webster, M., Hodgson, S., Ellings, C., Benson, L., Stonington, D., McKane, R., Barnhart, B., Brookes, A., Halama, J., Pettus, P., and Djang, K. (May 2018). *Nisqually Community Forest VELMA modeling to evaluate effects of forest management scenarios on streamflow and salmon habitat.* Manuscript in preparation.

Hoenig, L. (2012). McAllister Wellfield Mitigation Plan (December 2010). 2012 Annual Report to the Department of Ecology. Olympia, WA: Submitted by City of Olympia and Nisqually Indian Tribe.

Jones, M.A., Orr, L.A., Ebbert, J.C. and Sumiola, S.S. (1999). *Ground-Water Hydrology of the Tacoma-Puyallup Area, Pierce County, Washington*. USGS Water Resources Investigation Report 99-4013.

Kennedy, R. E., et al. (2018). An empirical, integrated forest biomass monitoring system. *Environmental Research Letters*, 13(2), 025004.

Kennedy, R. E., Yang, Z., Braaten, J., Thompson, C., Antonova, N., Jordan, C., and Nelson, P. 2015. Attribution of disturbance change agent from Landsat time-series in support of habitat monitoring in the Puget Sound region, USA. Remote Sensing of Environment 166:271-285.

Liddle, Janet A. (1998). Ohop Valley, Celebration of the Natural and Cultural Resources of Ohop Valley. Eatonville, WA.

LOTT Wastewater Alliance (January 2004). Hawks Prairie Reclaimed Water Satellite. Final Groundwater Flow Modeling Results. Retrieved from https://lottcleanwater.org/wp-content/uploads/2015/10/hpGroundwater.pdf

May, C. W. (July 2002). *Measures of Ecological Integrity for Salmonid Streams on Department of Defense Facilities in the Pacific Northwest: Current Watershed Conditions and Management Recommendations* (Technical Report APL-UW TR 0104). Seattle: Applied Physics Laboratory, University of Washington. Retrieved from https://apps.dtic.mil/docs/citations/ADM001435.

McKane, R., Halama, J., Pettus, P., Barnhart, B., Brookes, A,. Djang, K., Blair, G., Hall, J., Kane, J., Swedeen, P., and Benson., L. (May 2018). *How Visualizing Ecosystem Land Management Assessments (VELMA) modeling quantifies co-benefits and tradeoffs in Community Forest Management*. Presentation at 2018 Northwest Community Forest Forum, Astoria, OR.

Moore, G. W., Bond, B. J., Jones, J. A., Phillips, N., & Meinzer, F. C. (2004). Structural and compositional controls on transpiration in 40-and 450-year-old riparian forests in western Oregon, USA. *Tree physiology*, *24*(5), 481-491.

Nisqually Chinook Recovery Team (August 2001). *Nisqually Chinook Recovery Plan.* Olympia, WA.

Nisqually Community Forest (February 2016). *Upper Busy Wild Unit Forest Management Plan*.

Nisqually Community Forest (May 2013). Nisqually Community Forest Phase One Project Summary. Retrieved from http://nisquallylandtrust.org/nisqually-wp/wp-content/uploads/2014/03/NisquallyCommunityForestPhaseISummaryReportLarge.pdf

Nisqually Indian Tribe (April 2006a). *Mashel River Instream Flow Study.*

Nisqually Indian Tribe (April 2006b). *Mashel River Hydrologic Continuity Study.*

Nisqually Indian Tribe Salmon Recovery Program (2018). *Nisqually Habitat Project Ranking Guidance.* Developed for 2018 Salmon Recovery Funding Board/Puget Sound Acquisition and Restoration Grant Round.

Nisqually Steelhead Recovery Team (July 2014). *Nisqually River Steelhead Recovery Plan*. Seattle, WA. Document in preparation.

Natural Resource Conservation Service (1997). Washington Irrigation Guide (WAIG). U.S. Department of Agriculture. Retrieved from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wa/technical/engineering/?cid=nrcs144p2_036314

Perry, T.D. and Jones, J. A. (August 2016). Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. *Ecohydrology*, doi: 10.1002/eco.1790.

Peter, D. H. and Harrington, T. B. (2014). Historical Colonization of South Puget Sound Prairies by Douglas-Fir at Joint Base Lewis-McChord. *Washington Northwest Science*, 88(3): 186-205.

Pierce County (June 2014). *Pierce County 2014 Buildable Lands Report*. Retrieved from https://www.piercecountywa.gov/DocumentCenter/View/30444/Final-Draft-2014-Pierce-County-Buildable-Lands-Report.

Pierce County (September 2018). *Pierce County Comprehensive Plan*. Ordinance #2015-40 as amended by Ordinances 2016-34s, 2017-23, and 2018-39s. Retrieved from https://www.piercecountywa.gov/DocumentCenter/View/38483/ADOPTED-Comprehensive-Plan-with-no-Community-Plans-Effective-9-1-2018.

Pierce County (July 2017). *Pierce County Countywide Planning Policies Appendix A - Adopted 2030 Housing, Population, Employment Targets for Pierce County and its Cities and Towns*. Ordinance #2017-24s. Retrieved from https://www.co.pierce.wa.us/DocumentCenter/View/23902/Appendix-A-CPPs.

Pollock, M., Heim, M. and Werner, D. (2003). Hydrologic and Geomorphic Effects of Beaver Dams and Their Influence on Fishes. *American Fisheries Society Symposium*.

Pollock, M.M., G. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Editors) 2015. The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. Version 1.02. Portland, OR: United States Fish and Wildlife Service.
Pringle, P. (2008). *Roadside Geology of Mount Rainier National Park and Vicinity.* Olympia, WA: Washington Division of Geology and Earth Resources, Information Circular 107.

RH2 Engineering, Inc. (November 2012). *Town of Eatonville Alternative Water Source Investigation Report.* Eatonville, WA.

RH2 Engineering, Inc (August 2018). *Technical Memorandum: Potential Consumptive Use Impacts of Domestic Groundwater Permit-Exempt Wells Over the Next 20 Years in WRIA 1 – FINAL UPDATED.* Prepared for the Washington State Department of Ecology. August 21, 2018.

Shannon & Wilson Inc (February 2011). Groundwater Modelling to Support Revised Water Rights Mitigation Planning. City of Yelm, WA.

Sinclair, K. (December 2001). *Assessment of Surface Water and Groundwater Interchange within the Muck Creek Watershed, Pierce County*. Washington State Department of Ecology Publication No. 01-03-037. Olympia, WA.

Tacoma-Pierce County Health Department (March 2018). *Group A Wells*. GIS (SDE) Database.

Tacoma-Pierce County Health Department (March 2018). *Group B Wells*. GIS (SDE) Database.

Tacoma-Pierce County Health Department (March 2018). *Individual Wells*. GIS (SDE) Database.

Thurston County (November 2004). *Thurston County Comprehensive Plan. Resolution No. 13224 as amended by Resolutions 13833 (2007), 13885 (2007), 14034 (2008), 14180 (2008), 14254 (2009), 14401 (2010), 14739 (2012), 14845 (2013), 14847 (2013), and 15019 (2014).* Retrieved from https://www.thurstoncountywa.gov/planning/Pages/comp-plan-current.aspx

Thurston County (November 2018). *Stormwater Utility Memorandum: Aquifer Recharge Comparison Between Predeveloped and Developed Lots in Thurston County*. Document in preparation.

Thurston County Water Resources (November 2017; updated August 2018). Technical Memorandum #1: *Water Use and Wastewater Generation in Rural/Suburban Areas of Thurston County, Washington.*

Thurston County Water Resources (July 2018). Technical Memorandum #8: *Methods Used to Calculate the Pumping Rates, Locations, and Open Intervals of Active Groundwater Wells in Thurston County, Washington*.

Thurston Public Utility District (October 2018). Water Use Records for Group A and B Water System Customers from 2015-2017.

Thurston Regional Planning Council Population (July 2018). Estimates Work Program. Retrieved from https://www.trpc.org/480/Population-Housing-Employment-Data

Thurston Regional Planning Council (2015). Population and Employment Forecast. Retrieved from https://www.trpc.org/480/Population-Housing-Employment-Data

Thurston Regional Planning Council (2017). 2040 Regional Transportation Plan. Retrieved from https://www.trpc.org/662/2040-RTP

United States v. State of Washington, 384 F. Supp. 312 (W.D. Wash. 1974).

Watershed Professionals Network, LLC (June 2004). Mashel River Restoration Design Technical Memorandum. Puyallup, WA: Pierce Conservation District.

Washington Administrative Code Chapter 173-511. Instream Resources Protection Program – Nisqually River Basin, Water Resource Inventory Area (WRIA) 11.

Washington State Department of Ecology (June 2018a). *ESSB 6091 Streamflow Restoration – Recommendations for Water Use Estimates.* Publication 18-11-007. Retrieved from https://fortress.wa.gov/ecy/publications/documents/1811007.pdf

Washington State Department of Ecology (June 2018b). *Interim Guidance for Determining Net Ecological Benefit for streamflow restoration planning and water permit mitigation pilots under the 2018 Streamflow Restoration Act.* Publication 18-11-009. Retrieved from https://fortress.wa.gov/ecy/publications/summarypages/1811009.html

Washington Water Trust and Ecosystem Economics. June 2010. Feasibility Analysis for a Nisqually Water Bank, Final Draft. Prepared by: Erik Borgen, Ecosystem Economics, Amanda Cronin, Washington Water Trust, Bruce Aylward, Ecosystem Economics.

Weber, N., Bouwes, N., Pollock, M. M., Volk, C., Wheaton, J. M., Wathen, G., Wirtz, J., & Jordan, C. E. (2017). Alteration of stream temperature by natural and artificial beaver dams. PloS one, 12(5), e0176313.