Washington State Department of Ecology

Water Resources Program

Technical Review of

Nisqually Watershed Response to the 2018 Streamflow Restoration Act (RCW 90.94) – January 16, 2019 Addendum to the Nisqually Watershed Management Plan

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I. VERIFICATION OF COMPLIANCE WITH SUBMITTAL REQUIREMENTS OF RCW 90.94.020

Ecology has reviewed the WRIA 11 Watershed Plan Addendum in light of the requirements of RCW 90.94.020 and affirms that the document was submitted by the WRIA 11 Planning Unit prior to the February 1, 2019 deadline and that the planning process followed the statutory process outlined in the law.

II. RCW 90.94.020 TECHNICAL REVIEW

1. OVERVIEW

The Nisqually Watershed Planning Unit has produced and approved an Addendum to the Nisqually Watershed Management Plan, dated January 16, 2019, that addresses the requirements of RCW 90.94. This Ecology document provides a technical review of that Addendum.

In addition to the coordination and technical assistance provided by Ecology to the WRIA 11 Planning Unit, Ecology provided two specific documents to help them address the requirements of RCW 90.94:

> Interim Guidance for Determining Net Ecological Benefit for streamflow restoration planning and water permit mitigation pilots under the 2018 Streamflow Restoration Act (Ecology Publication 18-11-009, June 2018)
>
> Streamflow Restoration Recommendations for Water Use Estimates (Ecology Publication 18-11-007 - ESSB 6091, June 2018)

The expectations presented in these two documents represent Ecology's initial recommendations regarding ways to address the requirements of RCW 90.94, issued in June 2018 to support planning units in WRIAs 1 and 11 who are required by the statute to have their plans adopted no later than February 1, 2019. Ecology's thinking regarding the implementation RCW 90.94 has evolved since the June 2018 issuance of the Interim NEB Guidance and Water Use Estimates guidance, and Ecology is in the process of replacing both of these interim guidance documents with permanent guidance by mid-2019. The permanent guidance will apply to watershed plans prepared for the remaining thirteen RCW 90.94-affected WRIAs.

Methods provided in the two above guidance documents are not rigid requirements and planning units can apply other credible methods. Ultimately, watershed plan updates must be judged against the requirements of RCW 90.94. In order to do, this Ecology's strategy is to: (1) review the actions that planning units determine to be necessary to offset potential impacts to instream flows associated with permit-exempt domestic consumptive water use; and, (2) evaluate whether the plan updates will result in a Net Ecological Benefit (NEB) to instream resources within the water resource inventory area.

It is important to acknowledge that the planning unit was provided a very short time frame to develop its Addendum (one year following passage of the bill that led to the requirements of RCW 90.94). Due to that

abbreviated time compared with most other planning units, Ecology has acknowledged that in some cases, the plan's mitigation strategy elements may require additional development after plan adoption before they can be implemented. Consequently, an adaptive management approach is appropriate.

Likewise, Ecology had a very short time to review this Addendum. Ecology received a final version of the Addendum from the planning unit on January 18, 2019, and RCW 90.94 requires final Ecology action regarding plan update adoption no later than February 1, 2019. For this reason, Water Resources staff did not provide the same level of detailed analysis for all elements in the Addendum. Instead, Ecology's detailed review focused on those elements that appear, in our professional judgment, to have the greatest potential to offset projected consumptive use impacts and achieve a basin-wide net ecological benefit.

2. CONSUMPTIVE USE ESTIMATES

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

The planning unit chose to estimate both the actual annual average consumptive water use associated with permit-exempt domestic wells, and what it termed "the legal right" to the full water use as specified in the 3,000 gpd limit under RCW 90.94.020. Furthermore, two methods were used to estimate actual water use, one relying on the method described in Ecology's ESSB 6091 – Streamflow Restoration - Recommendations for Water Use Estimates document, and the other based on data from 58 Group A and B water systems managed by Thurston PUD. Not surprisingly, results from the method involving analysis of Group A and B water system data were lower than results following Ecology's recommended methodology (0.439 cfs as opposed to 1.032 cfs collectively for the entire WRIA). This is because water system users must pay for their water and tend to use less. Throughout the remainder of this Ecology analysis of the Addendum, we will refer only to numbers that resulted from using Ecology's recommended method. To simplify discussions, we also refer to predicted quantities of consumptive use and water provided by mitigation strategies only in units of cfs (essentially an average), as opposed to both cfs and AFY.

Two assumptions that were made by the WRIA 11 planning unit during its water use estimate calculations were not well documented. Firstly, when average annual consumptive use was calculated using the Ecology recommended method, there was an assumption that every permit exempt connection irrigates 0.2 acres of lawn. Producing a representative value for that number specific to WRIA 11 would have required something like scanning satellite imagery to acquire a qualitative sense of the outdoor lawn/garden areas associated with existing homes in the WRIA. However, the WRIA 11 planning unit did no such analysis and instead simply assumed 0.2 acres. By comparison, RH2 Engineering performed an analysis for nine WRIA 1 subbasins using aerial photos and came up with a range of 0.11 to 0.32 acres of outdoor watering area. So while the 0.2 assumption by the WRIA 11 planning unit may be reasonable, no information was provided to back up this assumption.

Another assumption made while following Ecology's water use calculation recommendations involved an assumed irrigation efficiency of 90 percent. An example in Ecology's recommendations for water use estimates conservatively assumed an irrigation efficiency of 75 percent, which comes from an estimate for a residential pop-up sprinkler system provided in Ecology's Water Resources Program Guidance 1210. While it may be true that most outdoor watering associated with permit-exempt wells in WRIA 11 will not use pop up sprinklers and therefore be more than 75 percent efficient, the 90 percent assumption is less conservative and again, no information was provided to back up this assumption.

Estimates of actual annual average consumptive water use by permit-exempt domestic wells forecasted to be installed between 2018 and 2040 relying on the Ecology recommended method are summarized by subbasin in the addendum's Table 3-19.

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**

The planning unit broke WRIA 11 into seven sub-basins that are suitably sized to allow meaningful determinations of the project consumptive use impacts. In addition to analyzing the magnitude of consumptive use impacts by subbasin, Ecology's Interim Guidance suggests providing some additional information to help characterize the impacts from permit-exempt domestic well use such as describing

whether affected stream flows are identified as limiting factors to salmon recovery in a local salmon recovery plan. The WRIA 11 plan Addendum did not specifically tie limiting factors to consumptive use.

3. WATER QUANTITIES ASSOCIATED WITH OFFSET PROJECT STRATEGIES

RCW 90.94 requires planning units to develop actions "necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use." Twenty two mitigation strategies that represent those actions are described in the Addendum. Those strategies involve a wide range of activities that, to varying degrees, all have the potential to provide some streamflow benefits and contribute toward NEB. However, not all of those mitigation strategies are created equally, and some have more clearly defined consumptive use offset quantities and appear to be more feasible.

During Ecology's review, we considered the extent to which it appeared likely that particular mitigation strategies would occur and the benefits predicted for those strategies if they do occur. The degree of certainty for the projects varies considerably. In some cases, projects face technical or legal hurdles, and in other cases, strategies are speculative and the estimates of offset credits are not that reliable. In such cases, Ecology discounted the claimed flow benefits of mitigation strategies. While the flow benefits of some strategies were discounted in this manner, they still may provide other significant ecological benefits.

The descriptions and amounts of information provided for individual offset projects did not meet many of the expectations for scientific rigor described in Ecology's Interim Guidance. For example, to properly characterize benefits to instream resources, the Interim Guidance indicates that plans should list and describe each habitat project with the following information when available:

- Information on the proposed project that includes a narrative description and a quantitative and/or qualitative assessment of how the project will contribute to NEB.
- Maps and drawings of the proposal.
- Performance goals and measures (e.g. success rates, duration of expected benefits, desired future conditions, etc.).
- The species, life stages and specific ecosystem structure, composition, or function addressed by the project.
- The length of stream or river reaches affected and the relative importance of the affected reach as habitat for focal species.
- Whether the project addresses threats and limiting factors identified in the local salmon recovery plan or other recovery plans.
- Documentation of scientific sources, methods, and assumptions.

In addition, the Interim Guidance indicated that plan addendums should address factors that inform the ecological effects of the consumptive impacts and project benefits and the likelihood of projects being implemented. For example:

- What is the estimated cost of completing planned projects? Is the plan financially viable?

- What other funding sources are available to support planned projects, and what additional funding is required?
- Are the projects in the plan achievable? Are there significant barriers to completion?
- How long will the positive impacts from planned projects extend as compared to the duration of the impacts being mitigated for?
- Will the plan include metrics and monitoring plans for evaluating plan success?
- Is maintenance needed to ensure lasting benefits? Is there a commitment to provide long-term maintenance?
- Are there contingency plans to address project uncertainties, including corrective actions that will be taken in the event projects fails to provide the proposed benefit in perpetuity?

The information described in these bullets was not provided for many of the offset strategies in the Addendum. For example, for the three Pierce County and Thurston County stream restoration initiatives, specific stream reaches for project implementation were not identified; instead, results from one site on Ohop Creek were extrapolated over a distance of creeks in other subbasins based on a preliminary evaluation of the miles of ditches present. So, instead of describing and evaluating actual projects, the Addendum simply provides estimates based on the assumption that these other systems might yield similar results.

For other mitigation strategies in the Addendum, not all of the information listed in the above bullets is critical to understanding whether a project is likely to occur nor to understanding the benefits of that strategy. Yelm Offset Action 1 is an example of this. This strategy involves a reduction in the forecasted consumptive use by permit-exempt domestic wells in the Thompson/Yelm subbasin based on an assumption that Yelm will receive a new water right permit as a result of the "pilot project" portion of RCW 90.94, and that the City will be able to supply municipal water to home owners who otherwise would install exempt wells. In this case, Ecology does not need additional information to evaluate the probability this will occur or to understand the likelihood that demand side reductions will occur in a specific area of benefit (the Yelm UGA).

Chapter 4 of the Addendum discusses the nexus between current streamflow restoration planning under RCW 90.94 and existing WRIA 11 Endangered Species Act (ESA) recovery efforts currently underway. Specifically, it lists significant studies and ranking exercises that have been conducted and recovery plans that have been the result. That work achieves many of the same goals of RCW 90.94, namely addressing actions that will benefit salmon and where it will be most effective to focus future recovery efforts (as discussed in more detail in the NEB section of this document). Seventeen initiatives were identified as part of the Nisqually Tribe's previous salmon recovery efforts and the WRIA 11 planning unit has identified and ranked nine of those initiatives as being 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. Those nine initiatives are summarized in the Addendum's Table 4-1 (below). A comparison between the items in that list and the 22 offset project strategies listed in Table 7-2 indicates that all but one of the items in the former list can be found in the latter list.

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.

The following is a summary of each of the 22 offset project strategies listed in Table 7-2, followed by Ecology comments regarding how likely it appears to be that the described benefits would occur and thus contribute to the Addendum goals. Ecology's Table 1 (found at the end of this section) is a version of the Addendum's Table 7-2 that has been modified to include water quantities that Ecology has associated with the various strategies during its analyses. Those quantities have been segregated into three category tiers to reflect the probability that benefits would occur (based on certainty of a project occurring and certainty of projected benefits), as further explained in the NEB section. Similarly, habitat benefits that would result from various mitigation projects have been evaluated and then segregated into three tiers and presented in Table 2. The rationale for some of those rankings for both flow and habitat benefits are included in the following discussions. Finally, to make the analysis easier to follow, a column has been added to the table that includes letter A through V identifiers to each of the strategies.

Given the limited time available for Ecology's review and the ultimate goal of determining the extent to which mitigation project strategies may to contribute to the legal requirements of RCW 90.94, Ecology did not focus its effort evaluating and describing the extent to which individual strategies met the expectations of the Interim Guidance. Instead, where appropriate, Ecology deferred to other documents associated with Nisqually watershed and ESA salmon recovery efforts currently underway that have goals similar to the stream restoration aspects of RCW 90.94.

Discussion of Individual Mitigation Projects

A. Yelm Offset Action 1 – Connect New Development in Yelm UGA to City Water Service (Deep well)

This strategy would lead to a reduction in the forecasted consumptive use (demand side) as opposed to a supply side offset. As discussed in the Addendum starting on page 5-53, this mitigation strategy involves connecting new development within Yelm UGA to city water service derived from a well that would be approved under a future Yelm water right approved as a "Foster Pilot" project authorized under RCW 90.94.090. If this new water right is approved, Yelm could serve properties that otherwise would be developed in the future with permit exempt wells located within both its retail service area (the current city limits) and future water service area (the UGA), using water derived from a new well drilled deep in the lower (TQu) aquifer. The predictions of demand side reductions are based on the initial growth forecasts associated with the City of Yelm's UGA.

Evaluation of Approach

In general, Ecology views this approach as feasible, with the one significant caveat that this strategy hinges on assumed issuance of a future Yelm water right permit. Approval of an application for that water right is not guaranteed.

Water reduction assumed: *The addendum predicts a minimum and maximum of 0.33 cfs.*
Ecological benefits: *Ecological benefits associated with this strategy would be limited to streamflow increases equal to the amount of consumptive water saved.*

B. Upper Nisqually Sub-basin Regulatory Status

Similar to the previous strategy, this action would lead to a reduction in the forecasted consumptive use (demand side) as opposed to a supply side offset. Page 7-69 describes this strategy as follows:

> 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.

The logic behind this strategy is further described on the bottom of page 7-75 which states,

> 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. 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 subbasin beyond Lewis and Pierce County policies that will be 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. Lewis and Pierce County are currently

considering changes to the countywide building and/or development standards to address water usage and policies for permit-exempt wells.

Evaluation of Approach

There is a flaw with a fundamental assumption of this strategy – namely that affecting flows below Alder Lake does not matter. The effects of future permit-exempt well pumping in the Upper Nisqually will be small, so the effects on the main stem Nisqually River below Alder Lake will be very small as well. However, while it is true that streams above Alder Lake are not closed, Alder Lake does not impound enough water for minimum instream flows in the Nisqually River downstream to be met year-round. Therefore the assumption that there is no need to mitigate for new permit-exempt well use below the lake is not valid.

Water reduction assumed: *The addendum predicts a minimum and maximum of 0.067 cfs, but due to the concerns described above, no amount was included for Ecology's evaluation.*
Ecological benefits: *For the reasons described above, no consideration of benefits was included for Ecology's evaluation.*

C., D. and E. Deep Groundwater Option 1, Option 2, and Option 3

These three mitigation strategies involve decreasing the number of wells completed in the shallow Qvr aquifer and increasing the percentage completed in the deeper Qc and TQu aquifers, under the premise that wells withdrawing water from the shallow aquifer have a significantly greater effect on surface water. The basis of this assumption is that wells completed in the deeper aquifers capture a higher percentage of water that otherwise discharges directly to the Puget Sound. Option 1 involves finishing future permit-exempt domestic wells in the deeper aquifer. Option 2 involves replacing existing permit-exempt wells completed in the shallow aquifer with wells completed in the deeper aquifer. And Option 3 involves deepening or upgrading Group A systems wells completed in the shallow aquifer so they are completed in the deeper aquifer. Page 5-57 of the addendum states:

> 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.

Evaluation of Approach

While there would be surface water flow benefits if uses from the various wells discussed above were shifted to deeper aquifers, the watershed plan Addendum provided no details about how this would be implemented on a regulatory basis. Also, no total quantified benefit amounts are listed in Table 7-2; instead, the Addendum discusses benefits only on a per-well basis. During some of the planning unit's meetings, there was discussion

about using the City of Yelm's groundwater model to evaluate the benefits; however, none of that analysis was provided in the Addendum.

Water provided: *Since no details for implementation of these strategies was provided, and since no predictions as to the quantities of water to be produced by these strategies was provided, for Ecology's evaluation, no offset amounts were included.*
Ecological benefits: *For the reasons described above, no consideration of benefits was included for Ecology's evaluation.*

F. Water Right Acquisition

As discussed in Section 5.1.2 of the Addendum and Appendix K (a memo produced by the Washington Water Trust (WWT)), the WWT conducted a rapid water rights assessment at the request of the planning unit in late 2018. The purpose of this assessment was 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 pertinent seasonality. The objective would be to acquire one or more of these rights and transfer them to the state water right trust program for instream flow purposes to offset consumptive use from new permit-exempt groundwater wells. This information built upon the information in the WWT's 2010 Feasibility Study for a Nisqually Water Bank.

The prairie streams included were Muck-Murray, Upper Tanwax Creek, Lower Tanwax Creek, and Kreger Creek. The projects investigated ranged from full permanent acquisitions, to changed irrigation practices that could be made more efficient and require less withdrawal and/or focus agricultural operations on the most productive land. As described, some changed irrigation practices might require source switches from a small tributary to a mainstem river or surface to groundwater, which would not only provide mitigation but also provide a restoration benefit.

Twenty-two water rights were identified in this rapid assessment. Of those, six were identified in a Tier 1 category – namely those with the greatest confidence of having been beneficially used in the period evaluated. It was estimated that for the six water rights identified, there were 705 beneficially used acres, leading to 673 AFY of water use, 595 AFY of which is groundwater.

The Addendum acknowledges that all potential projects would require substantial investigation prior to project development and ultimately landowner/water right holder willingness to participate. Acquisition of any of these water rights would require substantial and costly further investigation to determine whether this amount of irrigation (or even a portion of it) might be available for acquisition.

Evaluation of Approach

At this stage, only a general "rapid water rights assessment" has been conducted by the WWT, and it is uncertain whether the planning unit will be able to acquire any of water rights identified. On the other hand, water rights acquisitions represent the best form of mitigation. It is definitely worth continuing to pursue potential water rights acquisitions, hence this strategy is included in our Tier 1 category.

Water provided: *The Addendum predicts a minimum of 0 cfs and maximum of 0.93 cfs. However, due to uncertainty that any water right acquisitions will actually occur, Ecology's evaluation assumed 10 percent of the offset quantity predicted – 0.093 cfs versus 0.93 cfs.*
Ecological benefits: *Ecological benefits associated with this strategy would be limited to streamflow increases equal to the amount of consumptive water saved.*

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

This strategy builds off the concept introduced in Strategy A - Yelm Offset Action 1, which involved connection of new development within the Yelm UGA to city water service if a "Foster Pilot" project authorized under RCW 90.94.090 allows for the production of municipal water from a deep well. Page 7-69 of the addendum describes Strategy G as follows:

> 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 water rights associated with the exempt well. This credit could be held in trust by the City or appropriate agency and used for full mitigation of a new exempt well in the Thompson/Yelm Creek basins. Implementation of a credit system is currently being explored and is discussed in Chapter 9 addressing Implementation and Adaptive Management.

Therefore, Strategy G would not address future homes that might rely on permit exempt wells within the UGA, but rather would remove some existing permit-exempt wells by supplying municipal water to homes currently dependent on those wells. The Addendum indicates that Thurston County estimates there are currently approximately 450 domestic connections to permit exempt wells in the Yelm UGA and that 10% of those existing connections could be converted in the 20-year planning period.

Evaluation of Approach
In general, Ecology views this approach as feasible, with the one significant caveat that this strategy hinges on assumed issuance of a future Yelm water right. Issuance of that water right is not guaranteed.

Water to be provided: *The Addendum predicts a minimum and maximum offset of 0.014 cfs.*
Ecological benefits: *Ecological benefits associated with this strategy would be limited to streamflow increases equal to the amount of consumptive water saved.*

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

Page 5-51 of the Addendum describes this strategy as follows:

> 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 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 potentially could be used as an offset for water use from permit-exempt wells in the Thompson/Yelm sub-basin.

And,

> 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.

Evaluation of Approach

Table 7-2 lists benefits from this strategy ranging from a minimum of 0.12 cfs to a maximum of 0.552 cfs. The 0.12 cfs minimum includes mitigation from the non-consumptive portion of irrigation water to parks and playfields and direct recharge to the Qva aquifer in Cochran Park. The 0.552 cfs maximum includes discharge of reclaimed water to the Nisqually River and Centralia Power Canal as well, but that water would be introduced downstream of the Thompson/Yelm Sub-basin. Overall this strategy is water budget neutral as far as the entire WRIA is concerned, but would place some water back in Yelm Creek where it would be more beneficial to fish than water in the mainstem Nisqually River.

Since water for streamflow benefits associated with this activity would occur on top of water from this activity that will be used as a water right offset, that appears to add some uncertainty regarding whether or not additional reclaimed water benefits would occur (since presumably use up to 70 acre feet to offset the new water right would be a higher priority).

It is not clear whether this strategy hinges on issuance of a future Yelm water right (which is not guaranteed), as with Strategy A - Yelm Offset Action 1 and Strategy G - Yelm Offset Action 2. However, it seems likely this strategy could be implemented regardless of whether or not a new Yelm water right is issued.

Water to be provided: *The addendum predicts a minimum offset of 0.12 cfs and maximum of 0.552 cfs. However, given the factors discussed above, for Ecology's evaluation, an offset of 0.12 cfs was assumed for the Thompson/Yelm Sub-basin, and conservatively a maximum of 0.336 cfs was assumed for WRIA 11 as a whole (the average of 0.12 and 0.552).*

Ecological benefits: *Ecological benefits associated with this strategy would be limited to streamflow increases equal to the amount of consumptive water saved.*

I. Pierce County Stream Restoration

Page 5-56 in the Addendum describes this strategy as follows:

> 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 Plan, 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.

Two of the appendices supplied with the Addendum apply to this strategy. Appendix N, titled "Pierce County Groundwater Habitat Projects," indicates that Pierce County has identified three project types that can be applied, including: beaver dam analogs (BDA); large woody debris (LWD) jams; and the creation of groundwater channels. That memo goes on to discuss how these project types can effect flows, but provides no quantification.

Appendix E, referred to in the document as the "Streamflow Mitigation using Floodplain Restoration (Ohop Template)," describes five elements of the Ohop stream corridor restoration efforts that the planning unit considers to be potentially applicable for other streamflow mitigation in WRIA 11, including: ditch removal with related off-channel storage, beaver re-introduction, floodplain reconnection and channel re-meandering, log-jams, and revegetation. The document goes on to estimate the streamflow benefits associated with these. The project assumptions in Table 7-2 state, "Assume 0.0096 cfs/mile of linear channel and 6-60 miles.

Evaluation of Approach

As stated in the above excerpt, Pierce County has not identified specific candidate reaches for project implementation, and is only exploring areas where beaver introduction or beaver dam analogs, log jams, and groundwater channels may be pursued to improve streamflows and floodplain connectivity. The text acknowledges that due lack of project-specific information and local data, the estimates of benefits provided have a high degree of uncertainty.

Instead of this analysis identifying and analyzing potential sites, the results rest on results from one site on Ohop Creek that were extrapolated over many miles of creeks based on a preliminary evaluation of the miles of ditches present. The information in Appendix E, "The Ohop Restoration Template," is based on field data collected for the Ohop restoration site. The analyses provided are somewhat speculative in assumptions and methods, but appear to provide a fairly reasonable method for estimating the claimed benefits. One speculative aspect of the Ohop Creek analysis is that the analyses are made for the actual restoration site, then extrapolated to a greater length of that creek. That assumption carries with it the assumption that a number of projects would occur. Once those estimates were made based on those assumptions, the results were further extrapolated to some of the creeks in the Prairie Tributaries subbasin. In short, far from describing and evaluating actual projects, the addendum speculates regarding how much of these other systems might yield viable projects.

All the habitat restoration projects are conceptual at this stage, but the subbasin has conditions similar to those in the Ohop subbasin and would have the potential to provide similarly valuable ecological benefits. The plan Addendum identifies 6-60 miles of available stream restoration. It is unlikely that all 60 miles would be feasible for restoration, but due to the sheer volume of projects available, it seems likely that at least some projects will be developed. For the purposes of determining the ecological benefit of this project, the low estimate assumes that 6 miles (10 percent of potential length) of stream would be benefitted.

Presumably, justification for the importance and effectiveness of this strategy exists in documents associated with Nisqually watershed and ESA salmon recovery efforts currently underway.

***Water to be provided:** The Addendum predicts a minimum of 0.0576 cfs offset and a maximum of 0.576 cfs. However, due the uncertainty created by the factors discussed above, for Ecology's evaluation, we chose the minimum estimate provided and ranked this project as Tier 3 (least certain).*
***Ecological Benefits:** According to Table 7-2, the ecological benefits associated with this project include: increased groundwater storage in floodplain, increased in-stream habitat, water quality improvements, and increased streamflow during low flow/intermittent flow season. For the reasons discussed above, Ecology will use an assumption of 6 miles of restored stream channels. By using one-foot widths on each bank, this equates to 1.45 acres of ecological improvement.*

J. Thurston County Stream Restoration Thompson/Yelm, and
K. Thurston County Stream Restoration Lackamas/Toboton/Powel

Page 5-59 of the Addendum describes this strategy as follows:

> 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.

Page 5-60 of the Addendum indicates that the Ohop Restoration template was applied to produce the estimated water benefits and Appendix E provides information on the Ohop Restoration template. Appendix E, referred to in the document as the "Streamflow Mitigation using Floodplain Restoration (Ohop Template)," describes five elements of the Ohop stream corridor restoration efforts that the planning unit considers to be potentially applicable for other streamflow mitigation in WRIA 11:

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

Evaluation of Approach

Thurston County has not identified specific candidate reaches for project implementation, and is only exploring areas where beaver introduction or beaver dam analogs, log jams, and groundwater channels may be pursued to improve streamflows and floodplain connectivity. Due to lack of project-specific information and local data, the estimates of benefits provided have a high degree of uncertainty. The numbers provided for these two strategies take the speculative analyses for Ohop Creek and extrapolate to some creeks in the Thompson/Yelm and Lackamas/Toboton/Powel subbasins.

Instead of this analysis identifying and analyzing potential sites, the results rest on results from one site on Ohop Creek that were extrapolated over many miles of creeks based on a preliminary evaluation of the miles of ditches present. The information in Appendix E, "The Ohop Restoration Template," is based on field data collected for the Ohop restoration site. The analyses provided are somewhat speculative in assumptions and methods, but appear to provide a fairly reasonable method for estimating the claimed benefits. One speculative aspect of the Ohop Creek analysis is that the analyses are made for the actual restoration site, then extrapolated to a greater length of that creek. That assumption carries with it the assumption that a number of projects would occur. Once those estimates were made based on those assumptions, the results were further extrapolated to some of the creeks in the Thompson/Yelm and Lackamas/Toboton/Powel subbasins. In short, far from describing and evaluating actual projects, the addendum speculates regarding how much of these other systems might yield viable projects.

All the habitat restoration projects in both these subbasins are conceptual at this stage, but have similar conditions to those in the Ohop subbasin and would have the potential to provide similarly valuable ecological benefits. The plan addendum identifies a total of 1.83 to 18.3 miles of available stream for restoration for the two subbasins. It is unlikely that all 18.3 miles would be feasible, but due to the sheer volume of projects

available it seems likely that at least some of the projects will be developed. For the purposes of determining the ecological benefit of this project, the low estimate assumption for Thompson/Yelm subbasin was that 1.6 miles (10 percent of potential length) of stream would be benefitted. For the purposes of determining the ecological benefit of this project, the low estimate assumption for Lackamas/Toboton/Powel subbasin was that 0.23 miles (10 percent of potential length) of stream would be benefitted.

Presumably justification for the importance and effectiveness of this strategy exists in documents associated with Nisqually watershed and ESA salmon recovery efforts currently underway.

Water to be provided: *The addendum predicts a minimum and maximum of 0.1536 cfs for the Thurston County Stream Restoration Thompson/Yelm strategy, and a minimum and maximum of 0.1728 cfs for the Thurston County Stream Restoration Lackamas/Toboton/Powel strategy. However, for the reasons discussed above there is a great deal of uncertainty and the benefits likely are overstated. Therefore, for Ecology's evaluation it ranked these projects as Tier 3 (least certain) reliability.*
Ecological Benefits: *According to Table 7-2, the ecological benefits associated with this project include: increased groundwater storage in floodplain, increased in-stream habitat, water quality improvements, and increased streamflow during low flow/intermittent flow season. For the reasons discussed above, Ecology will assume 1.6 miles of stream benefits for the Thompson/Yelm subbasin, and 0.23 miles of stream benefits for the Lackamas/Toboton/Powel subbasin.*

L. Managed Aquifer Recharge (MAR) Projects

The Addendum indicates that the 2.7626 cfs maximum benefit estimate derives from assuming five projects in five subbasins, and the capturing and retiming 200 AFY per project. 1000 AFY (5 X 200) converts to a 2.7627 cfs continuous rate based on a 6-month period.

Evaluation of Approach

The 2.7627 cfs number presented as a maximum benefit in Table 7-2 is based in a 6-month summer-fall projection. However, in reality a concentration of benefits to a 6-month period may be difficult to achieve. The retiming impacts of groundwater discharging back to surface water bodies is a function of aquifer properties and distance from the discharge location. As aquifer diffusivity decreases and/or distance increases, the amplitude of a seasonal recharge event's discharge back to its connected surface water source diminishes. It can rapidly approach a steady-state profile. Given that, and the fact that little work has been done to investigate the potential for these MAR projects, there is uncertainty regarding the projected flow benefits. Therefore, factoring in all of the uncertainties, for Ecology's analysis it was assumed the resultant MAR projects would be the equivalent of three 200 AFY projects. Following the other assumptions used in the Addendum, three MAR projects might be expected to yield a benefit of about 0.83 cfs on a 12-month basis or about 1.66 cfs on a 6-month basis. This same benefit could be achieved by a single project capable of retiming 600 AFY.

One final consideration is that not all of these MAR potential projects are created equally when it comes to providing fish habitat benefits. Five of the nine potential project sites are located on the mainstem Nisqually River floodplain below Alder Lake, at locations not as beneficial as the other four projects. Those four most beneficial projects would be those on the floodplain of the Nisqually River above Alder Lake, the Mashel River,

Ohop Creek, and Muck Creek. If this strategy goes forward these more advantageous projects should be pursued ahead of those sites located further downstream.

Water to be provided: *The Addendum predicts a minimum of 0 cfs and a maximum of 2.7626 cfs. However, for the reasons described above, for Ecology's evaluation an amount of 1.66 cfs was assumed.*
Ecological benefits: *Ecological benefits associated with this strategy would be limited to a reduction in high flows and increases in low flows.*

M. Barrier Removal Projects

Page 5-57 of the Addendum describes this strategy as follows:

> 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.

Evaluation of Approach

Fish barriers that must be removed under other applicable law cannot be included as part of an RCW 90.94 evaluation of mitigation for permit-exempt wells, and the Addendum makes no distinction between fish barriers that already must be removed by law and additional fish barriers that would be removed.

Additionally, the estimate of streamflow benefits seems speculative. While there are significant habitat benefits to barrier removal/culvert replacement projects, one does not generally associate flow benefits with these types of projects. The above description states, "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… ." However, Appendix E, the Ohop template, makes no mention of barrier removal or culvert replacement projects.

Water to be provided: *The Addendum predicts a minimum and maximum offset of 0.0023 cfs. However, for the reasons described above, in Ecology's evaluation no amount was included.*

Ecological benefits: *Table 7-2 indicates the ecological benefits associated with this strategy would be to re-open stream reaches & habitat, and increase low flows. However, to the extent that barrier removal/culvert replacement projects occur as part of other regulations, they cannot be counted as RCW 90.94 offsets. Therefore, for Ecology's evaluation, no consideration of benefits was included.*

N. Mashel Watershed Community Forest

Page 4-39 of the Addendum describes this strategy as follows:

> 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).

In addition, Appendix G of the Addendum included specific information regarding the analyses of the benefits of the Mashel Community Forest.

Evaluation of Approach

The citation of the study from Oregon indicates that forests with a stand age of more than 35-40 years produced more streamflow as the trees got older. However, not surprisingly, those stands experienced streamflow declines for the period between when the forests were clear cut and the older age. VELMA modeling was performed to evaluate flow benefits specific to the Mashel Watershed Community Forest, but it appears the focus of that work was mainly evaluating the benefits of 40-year-old and much older stands.

Beyond understanding the environmental benefits of having older tree stands, estimating flow benefits requires making assumptions regarding the rates of land acquisition, which would have significant bearing over the benefits accrued. Land acquisition rates are very difficult to predict.

It also appears there is a long way to go to achieve the end goal of 30,000 total acres under conservation management. The Addendum indicates that 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. It is not clear whether acquisition of the total acreage at currently-uncertain pricing will provide a cost-

effective way to mitigate the small effects of permit-exempt wells compared with the other strategies presented.

Finally, there is a concern associated with the threat of wildfire. If a wildfire ravaged the watershed at some future date, the long-term reliability of this project as an offset measure would be compromised for decades.

Despite the concerns above, this is the highest-rated project in those subbasins identified during previous salmon recovery efforts as being most critical to fish. The Salmon Recovery Program's current Habitat Project Ranking Guidance outlines 17 recovery initiatives focused on ecosystem-level functions (NIT Salmon Recovery Program, 2018), and of those initiatives, the Mashel Watershed Community Forest is ranked number one.

***Water to be provided:** The Addendum predicts a minimum offset of 2.347 cfs and a maximum of 5.246 cfs. However, for the reasons described above, for Ecology's evaluation we chose the minimum estimate provided and ranked this project as Tier 3 (least certain).*
***Ecological benefits:** Table 7-2 indicates the ecological benefits associated with this strategy would be to re-open stream reaches & habitat, and increase low flows. However, for the reasons described above, for our evaluation we ranked the ecological benefits associated with this project as Tier 3 (least certain).*

O. Eatonville Capital Improvement Projects

Page 4-42 of the Addendum describes this strategy as follows:

> 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, Appendix H describes an EA Engineering analysis of streamflow benefits from this strategy.

Evaluation of Approach

The EA Engineering analysis took a previous characterization of flow directions and infiltration potential of surface soils to estimate the infiltration rate for each CIP, then used the USGS STRMDEPL08 program to estimate increased discharge to the nearest steam. Results suggest that discharge to the streams would increase each year almost immediately after recharge begins, then continue to increase until the recharge

period ends, at which point recharge begins to drop off. The analysis provides estimates of the percentage of recharge rate that can be expected to discharge to the river/creeks between May and September. Although the memo from EA Engineering provides useful analyses, there is uncertainty in the estimated benefits that were provided based on analytical modeling.

Beyond increasing flows, the main biological benefits to this strategy involve improved surface water quality.

Although these projects clearly are beneficial, it is uncertain whether some of these might be implemented regardless of the RCW 90.94 streamflow benefits in order for Eatonville to comply with water quality regulations.

Water to be provided: *The Addendum predicts a minimum and maximum offset of 0.128 cfs. However, for Ecology's evaluation, we ranked this project as Tier 3 (least certain) due to uncertainty whether these projects would be implemented as a result of other applicable law due to water quality compliance issues, as well as uncertainty regarding the projected benefits.*
Ecological benefits: *Table 7.2 indicates the ecological benefits associated with this strategy would be increased streamflow and improved water quality.*

P. Eatonville Water System Conservation

A 1-page memo provided in Appendix I titled *Water Conservation in the Town of Eatonville* states that:

> Thurston County directed EA Engineering to review Eatonville's 2012 Alternative Water Source Investigation Report by RH2 regarding potential water conservation in Eatonville in order to quantify potential mitigation benefits to the Mashel River. The following is a summary of the findings in the Alternative Water Source Investigation Report.
>
> RH2 estimates that 16% of the water in the water system is lost to leaks and unauthorized (unmetered) uses. In order to comply with the Water Use Efficiency Rule, the target for efficiency is 10% loss. Thus, RH2 assumed that Eatonville would take actions to reduce losses in the distribution system by 6%. RH2 made assumptions about unauthorized use and water lost to evapotranspiration and calculated that by reducing losses (by finding and fixing leaks) by 6%, approximately 10,500 gpd, or 3.8 MG per year could remain in the Mashel River, rather than be diverted by Eatonville and lost in the system. This is equal to an annual average of 0.016 cfs, or 11.66 acre-feet per year.
>
> At the Water Treatment Plan, RH2 estimates that there is 19% loss between the diversion and where water enters the distribution system. This loss is assumed to occur in clear well leaks, piping leaks, treatment process leaks, and miscalibrated meters. Because the treatment plant is very close to the Mashel River it is assumed that much of the leakage at the plant infiltrates and returns to the river. However, there is a bypass reach between the diversion and where the water is expected to return to the river. RH2 assumed that Eatonville could reduce leakage in the treatment plant system by 80%. Thus, the diversion could be reduced by approximately 18.8 MG per year, which is 51,471 gpd, or 0.079 cfs, which is equal to 57.695 acre-feet per year.

Thus, total conservation efforts by Eatonville could save 0.01378 cfs or 69.3567 acre-feet per year.

Evaluation of Approach
There does not seem to be any guarantee that the water saved would not then simply be used by Eatonville to supply more houses, which would mean that a portion of the water that returns to the ground now would no longer return to the ground in the future. Theoretically, that would lead to a reduction in streamflow and not an improvement.

Water to be provided: *The Addendum predicts a minimum and maximum offset of 0.096 cfs, but due to the concerns described above, for Ecology's evaluation no amount was included.*
Ecological benefits: *Table 7.2 indicates the ecological benefits associated with this strategy would be increased streamflow, but due to the concerns described above, for Ecology's evaluation no amount was included.*

Q. Eatonville ASR
Page 12 of Appendix H titled *Stream Mitigation Resulting from the Town of Eatonville's Projects* states that:

> The Town of Eatonville completed a preliminary evaluation of ASR in 2010 (Golder, 2010). This assessment included evaluation of all potential aquifers near Eatonville for their potential use for groundwater storage. The volcanic aquifer, composed of basalt was determined to exhibit the best potential for groundwater storage, due in part to its limited hydraulic connection with the Mashel River as well as its proximity to Eatonville's water system infrastructure. The volcanic aquifer may also be capable of storing enough water to meet the Town's increasing water system demands.
>
> Because the Mashel River is closed by Chapter 173-511 WAC from June through October, capturing and storing water between November and May to supplement use in the summer months may be the best option for obtaining new water rights for the Town of Eatonville. Golder estimated that the volcanic aquifer may be capable of storing between 20 and 80 acre-feet of water. Capture and storage of 20 to 80 acre-feet would reduce winter flows in the Mashel River between 0.07 and 0.25 cfs. Withdrawal of stored groundwater in the summer months, in lieu exercising Eatonville's surface water rights, is estimated to increase summer flows in the Mashel River between 0.11 and 0.45 cfs.
>
> Uncertainties regarding the volcanic aquifer's hydraulic properties, ability to store water, and water quality issues may make ASR infeasible. However, ASR is a potential WRIA 11, summer mitigation option that can increase water supplies for the Town of Eatonville while benefitting instream resources.

Evaluation of Approach
Ecology stopped funding feasibility work for this project in 2009 due to concerns over the project's viability. Based on the work that had been conducted up to that point and due to many obstacles present at the site, Ecology concluded that a successful Eatonville ASR project was unlikely. Ecology indicated to Eatonville that should it produce additional information indicating that a suitable aquifer exists for ASR, Ecology would be interested in working with them to help implement a successful ASR project.

Water reduction assumed: *The Addendum predicts a minimum offset of 0.11 cfs and maximum of 0.45 cfs. But for the reasons discussed above, for Ecology's evaluation no amount was included.*
Ecological benefits: *Table 7-2 indicates the ecological benefits associated with this strategy would be increased streamflow. However, for the reasons described above, for Ecology's evaluation no amount will be included.*

R. Eatonville Alternate Water Supply

Page 4-42 of the Addendum describes this strategy as follows:

> 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.

The 2012RH2 Engineers *Alternative Water Source Investigation Report* describes the Nisqually River diversion as follows:

> A potential Nisqually River diversion location is from the right bank of the river just upstream of the confluence with the Mashel River. The diversion would be located downstream of the Tacoma Nisqually River Hydroelectric Project, as shown in Figure 11 and Figure 12. The potential diversion location is in the same stream management unit as if the diversion was located just downstream of the confluence with the Mashel River. The advantages of this location are that there would be no pumping impacts to the Mashel River, the wastewater treatment plant return flows would enhance the flow in the Mashel River since the source of the effluent would be water coming from out-of-basin, and access to the river is easier upstream of the Mashel River confluence. In 2011, this would have meant an increase in flow of 0.8 cfs in the Mashel River from the diversion downstream. The Nisqually alternative would pose a new impact to the reach of the Nisqually River from LaGrande Dam to the Mashel River, as shown in Table 7, but it would be in the lower-most section of that reach. Downstream from the Mashel River confluence the flow of the Nisqually River would be the same as with the existing diversion.

Evaluation of Approach

Specific proposals for this approach have not been developed at this time, so it is hard to know how likely it is that it would occur. The plan Addendum did not provide the location of the current withdrawal or an analysis of the area benefited by potential improved streamflow; however, there are definite rearing benefits for listed and other salmonids on the lower Mashel River. This project is basically water budget neutral as far as the entire WRIA is concerned, but would place water back in the Mashel River where it is much more beneficial to fish than the mainstem Nisqually River.

This project is part of one identified during previous salmon recovery efforts as being critical to fish recovery. Specifically, the Salmon Recovery Program's current Habitat Project Ranking Guidance outlines 17 recovery initiatives focused on ecosystem-level functions (NIT Salmon Recovery Program, 2018), and this initiative is part of a strategy ranked number 2 on that list.

Water to be provided: *The Addendum predicts a minimum and maximum of 0.8 cfs. Due to the concerns described above, for Ecology's evaluation this was ranked as Tier 2.*
Ecological benefits: *Table 7.2 indicates the ecological benefits associated with this strategy would be increased streamflow. If this project is implemented, it will provide benefits to the Mashel below the current diversion, so Ecology's Table 2 will indicate a Tier 2 benefit for this project.*

S. Ohop Phase IV Floodplain Restoration & Protection

Page 4-48 of the Addendum describes this strategy as follows:

> 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.

And,

> 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).

Evaluation of Approach
This is a shovel-ready project. The information in Appendix E, "The Ohop Restoration Template," is based on field data collected for the Ohop restoration site. The analyses provided are somewhat uncertain in assumptions and methods, but appear to provide a fairly reasonable method for estimating the claimed benefits. One uncertainty within the Ohop Creek analysis is that analyses are made for the actual restoration site, then extrapolated to a greater length of that creek. This assumption carries with it the assumption that a number of projects will occur.

This project was identified during previous salmon recovery efforts as being critical to fish recovery. Specifically, the Salmon Recovery Program's current Habitat Project Ranking Guidance outlines 17 recovery initiatives focused on ecosystem-level functions (NIT Salmon Recovery Program, 2018), and this initiative ranked number 3 on that list.

This 4th phase of a restoration project is to restore 1.8 additional miles of currently-ditched stream channel, and protect360 acres of floodplain. Based on the EDT model, this would improve the quantity and quality of

rearing habitat for ESA listed Chinook and Steelhead and also for Coho juveniles. The restored channel area estimates will be used in the NEB habitat benefits evaluation and this will be ranked a Tier 1 strategy.

Water to be provided: *The Addendum predicts a minimum and maximum offset of 0.0173 cfs.*
Ecological benefits: *Table 7.2 indicates the ecological benefits associated with this strategy would be increased groundwater storage in floodplain, increased in-stream habitat, water quality improvements, and increased streamflow during low flow season. For the reasons discussed above, Ecology will use an assumption of 1.8 miles of restored stream channels.*

T. Ohop Watershed Recovery/Community Forest, U. Bald Hills Watershed Recovery/Community Forest, and V. Upper Nisqually Recovery/Community Forest

Under Section 4.2.1, under the heading *Ohop Watershed and Bald Hills Watershed Recovery/ Community Forest,* the Addendum states,

> 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.

The text goes on to explain that predictions of flow benefits for the Ohop Watershed and Bald Hills Watershed community forest required further assumptions regarding the rates of acquisitions.

Regarding the Upper Nisqually Recovery/Community Forest, it appears this is discussed in the Addendum only through its listing in Table 7-2 which includes no water benefit estimates.

Evaluation of Approach
The Addendum lumps discussions about T. Ohop Watershed Recovery/Community Forest and U. Bald Hills Watershed Recovery/Community Forest together, and provides estimates of the benefits of these two projects based on rate estimates made for comparablyaged stands in the Mashel Community Forest. There is considerable uncertainty associated with those estimates as noted in the N. Mashel Watershed Community Forest discussion above.

Because estimates of benefits for these two community forests are based on estimated flow benefits for the Mashel watershed, these carry uncertainties associated with those estimates, and uncertainties whether similar results can be expected. The Addendum indicates that making predictions of flow benefits for the Ohop Watershed and Bald Hills Watershed Recovery/ Community Forest required further assumptions regarding

acquisition rates, which would have significant bearing on the benefits accrued because land acquisition rates are difficult to predict.

Despite the concerns above, both the Ohop Watershed Community Forest and the Bald Hills Watershed Community Forest were identified during previous salmon recovery efforts as being most critical to fish. Specifically, the Salmon Recovery Program's current Habitat Project Ranking Guidance outlines 17 recovery initiatives focused on ecosystem-level functions (NIT Salmon Recovery Program, 2018), and of those initiatives, these two forests rank 7 and 8.

It appears Upper Nisqually Recovery/Community Forest was not discussed in the Addendum other than its listing in Table 7-2, which includes no water benefit estimates.

***Water to be provided:** The Addendum predicts a minimum and a maximum offset of 1.5356 cfs for the T. Ohop Watershed Recovery/Community Forest, a minimum of 0.117 cfs and a maximum of 0.6727 cfs for the U. Bald Hills Watershed Recovery/Community Forest, and no flow benefits for V. Upper Nisqually Recovery/Community Forest. For the reasons described above, during Ecology's analyses only 10 percent of the value provided for the T. Ohop Watershed Recovery/Community Forest was used, a minimum value of 0.117 cfs was used for the U. Bald Hills Watershed Recovery/ Community Forest, and no flow benefits were assumed for the V. Upper Nisqually Recovery/Community Forest.*
***Ecological benefits:** Table 7-2 indicates the ecological benefits associated with these strategies would be streamflow, habitat, ecosystem benefits, woody debris and sediment supply, and erosion control. However, for the reasons described above, for our evaluation we ranked the ecological benefits associated with these projects as Tier 3 (least certain).*

Ecology Table 1. Flow mitigation offset projects - all strategies

Ecology Tracking Letter	Mitigation Strategy	Sub-Basin(s)	Timing of Benefits	Ecology Assumed Streamflow Benefits (cfs)			Ecology Comments
				Teir 1 Reliability (most certainty)	Teir 2 Reliability	Teir 3 Reliability (least certainty)	
A	Yelm Offset Action 1	Thompson/Yelm	Year-Round	0.330			
B	Upper Nisqually Sub-basin regulatory status	Upper Nisqually	Year-Round	none	none	none	Benefits not considered, since Nisqually River minimum flows not always met & no implementation strategy details.
C	Deep Groundwater Option 1	All Sub Basins	Year-round	none	none	none	Benefits not considered, since no implementation details or benefit predictions.
D	Deep Groundwater Option 2	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	none	none	none	Benefits not considered, since no implementation details or benefit predictions.
E	Deep Groundwater Option 3	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	none	none	none	Benefits not considered, since no implementation details or benefit predictions.
F	Water Right Acquisition	Prairie Tributaries	Irrigation season	0.093			Only 10% of projection considered due to uncertainty regarding water right acquisitions.
G	Yelm Offset Action 2	Thompson/Yelm	Year-round	0.014			
H	Yelm Offset Action 3	Thompson/Yelm	Year-round		0.336		In Table 3 only 0.12 cfs assumed for Thompson/Yelm Sub-basin, and 0.216 (0.336 minus 0.12) cfs credited for rest of WRIA.
I	Pierce County Stream Restoration	Prairie Tributaries	Year-round			0.058	Due to uncertainty in analysis and that projects will occur, minimum value selected.
J	Thurston County Stream Restoration - Thompson/Yelm	Thompson/Yelm	Year-round			0.015	Due to uncertainty in analysis and that projects will occur, minimum value selected.
K	Thurston County Stream Restoration - Lackamas/Toboton/Powell	Lackamas/Toboton/Powell	Year-round			0.002	Due to uncertainty in analysis and that projects will occur, minimum value selected.
L	Ecology Managed Aquifer Recharge	Mashel, Ohop, Prairie Tribs, Upper Nisqually, Lower Nisqually	Summer-Fall	1.660			Assumes 3 MAR projects.
M	Barrier Removal Projects	Lackamas/Toboton/Powell	Year-round	none	none	none	Flow benefits not considered, since projects required by other regulations.
N	Mashel Watershed Community Forest	Mashel	Year-round			2.347	Main benefits not until 40+ years, acquisition needs high, & analysis documentation unclear.
O	Eatonville Capital Improvement Projects	Mashel/Ohop(3)	Summer - Fall			0.128	
P	Eatonville Water System Conservation	Mashel	Year-round	none	none	none	Water saved might simply be used for additional houses.
Q	Eatonville ASR	Mashel	Summer - Fall	none	none	none	Based on previous work project success appears unlikely.
R	Eatonville Alternative Water Supply	Mashel	Summer		0.800		Specific proposal for approach not developed at this time.
S	Ohop Phase IV Floodplain Restoration	Ohop	Year-round	0.017			Vetted project plan already exists.
T	Ohop Watershed Recovery/Community Forest	Ohop	Year-round			0.154	Main benefits not until 40+ years, analysis weak, lower rank on priority list. No low prediction, so took 10% of high value.
U	Bald Hills Watershed Recovery/Community Forest	Lackamas/Toboton/Powell	Year-round			0.112	Main benefits not until 40+ years, analysis weak, lower rank on priority list.
V	Upper Nisqually Recovery/Community Forest	Upper Nisqually	Year-round	none	none	none	Benefits not considered, since no predictions provided.
TOTAL				2.114	1.136	2.816	

Ecology Table 2. Habitat mitigation offset projects - all strategies

Ecology Tracking Letter	Mitigation Strategy	Sub-Basin(s)	Timing of Benefits	Ecology Assumed Habitat Benefit Not Counting Streamflow			Ecology Comments
				Teir 1 Reliability (most certainty)	Teir 2 Reliability	Teir 3 Reliability (least certainty)	
A	Yelm Offset Action 1	Thompson/Yelm	Year-Round	flow benfits only	flow benfits only	flow benfits only	
B	Upper Nisqually Sub-basin regulatory status	Upper Nisqually	Year-Round	none	none	none	Bennefits not considered, since Nisqually River minimum flows not always met.
C	Deep Groundwater Option 1	All Sub Basins	Year-round	none	none	none	Benefits not considered, since no details provided for implementation strategy.
D	Deep Groundwater Option 2	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	none	none	none	Benefits not considered, since no details provided for implementation strategy.
E	Deep Groundwater Option 3	Prairie Tributaries Thompson/Yelm Lackamas/Toboton/Powell	Year-round	none	none	none	Benefits not considered, since no details provided for implementation strategy.
F	Water Right Acquisition	Prairie Tributaries	Irrigation season	flow benfits only	flow benfits only	flow benfits only	
G	Yelm Offset Action 2	Thompson/Yelm	Year-round	flow benfits only	flow benfits only	flow benfits only	
H	Yelm Offset Action 3	Thompson/Yelm	Year-round	flow benfits only	flow benfits only	flow benfits only	
I	Pierce County Stream Restoration	Prairie Tributaries	Year-round	X			There would be habitat benefits, although there is uncertainty as to where projects would occur.
J	Thurston County Stream Restoration - Thompson/Yelm	Thompson/Yelm	Year-round	X			There would be habitat benefits, although there is uncertainty as to where projects would occur.
K	Thurston County Stream Restoration - Lackamas/Toboton/Powell	Lackamas/Toboton/Powell	Year-round	X			There would be habitat benefits, although there is uncertainty as to where projects would occur.
L	Ecology Managed Aquifer Recharge	Mashel, Ohop, Prairie Tribs, Upper Nisqually, Lower Nisqually	Summer-Fall	flow benfits only	flow benfits only	flow benfits only	
M	Barrier Removal Projects	Lackamas/Toboton/Powell	Year-round	none	none	none	Projects required by other regulations.
N	Mashel Watershed Community Forest	Mashel	Year-round			X	Main benefits not until 40+ years, acquisition needs high, & analysis documentation unclear.
O	Eatonville Capital Improvement Projects	Mashel/Ohop(3)	Summer - Fall			X	
P	Eatonville Water System Conservation	Mashel	Year-round	none	none	none	Water saved might simply be used to supply additional houses.
Q	Eatonville ASR	Mashel	Summer - Fall	none	none	none	Based on previous work project success appears unlikely.
R	Eatonville Alternative Water Supply	Mashel	Summer		X		Specific proposal approach not developed at this time.
S	Ohop Phase IV Floodplain Restoration &	Ohop	Year-round	X			Clear habitat benefits & vetted project plan already exists.
T	Ohop Watershed Recovery/Community Forest	Ohop	Year-round			X	Main benefits not until 40+ years, analysis weak, lower rank on priority list.
U	Bald Hills Watershed Recovery/Community Forest	Lackamas/Toboton/Powell	Year-round			X	Main benefits not until 40+ years, analysis weak, lower rank on priority list.
V	Upper Nisqually Recovery/Community Forest	Upper Nisqually	Year-round			X	Main benefits not until 40+ years, analysis weak, lower rank on priority list.

4. Net Ecological Benefit (NEB)

Ecology's Interim Guidance states:

> A Net Ecological Benefit determination means anticipated benefits to instream resources from actions designed to restore streamflow will offset and exceed the projected impacts to instream resources from new water use.

The Guidance goes on to explain that Ecology's evaluation of NEB will incorporate existing information on watershed-specific factors that are addressed during the planning process and rely heavily on input from local, state, federal and tribal resource managers, and water resources stakeholders participating in the planning process.

I. Relationship to Existing Plans and Efforts

While the WRIA 11 watershed plan Addendum does not meet all of the expectations presented in Ecology's Interim Guidance document, it relies heavily on existing ESA salmon recovery efforts that similarly have looked at actions to benefit salmon where it would be most effective to focus future recovery efforts.

Chapter 4 of the Addendum, titled *Salmon Habitat Projects with Instream Flow and Net Ecological Benefit*, discusses the nexus between streamflow restoration planning associated with the current watershed planning effort and pre-existing WRIA 11 watershed and ESA recovery efforts currently underway. Specifically, the macro-mitigation strategies described in the 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 (2016), along with the Nisqually Chinook Recovery Plan (2001) and Draft Nisqually Steelhead Recovery Plan (2014). Detailed analyses of needs and benefits were conducted as part of development of those strategies, including Ecosystem Diagnosis and Treatment (EDT) modeling, which identifies key factors limiting salmon populations - such as abundance, spatial diversity, genetic diversity, and productivity - in each reach of the watershed. As part of those efforts, recovery projects have been 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.

Seventeen initiatives were identified as part of the Tribe's previous salmon recovery efforts and the WRIA 11 planning unit has identified and ranked nine of those initiatives as being 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. Those nine initiatives are summarized in the Addendum's Table 4-1 (see Section 3 above). A comparison between the items in that list and the 22 offset project strategies listed in Table 7-2 indicates that all but one of the items in the former list (Mashel River Riparian Corridor Protection and Restoration) can be found in the latter list.

When deciding whether a NEB will be achieved, an important consideration is the commitment by governing entities within the watershed to address the needs of ESA listed fish. The Nisqually Tribe, the lead entity for this planning effort, has long demonstrated such a commitment and this addendum builds on many years of the Tribe's efforts. One thing the addendum notes is that RCW 90.94.200 does not address implementation or adaptive management associated with the process. It instead focuses on plans that incorporate potential projects and other associated mitigation strategies that will offset forecasted impacts of permit-exempt domestic well use. However, the Addendum presents a clear commitment by the other initiating governments, as well as the Tribe, to implement actions that would not just fulfill county obligations under GMA in order to ensure that water is available for rural growth, but also address the needs of ESA-listed fish.

Therefore, while the Addendum does not follow the format provided in Ecology's Interim Guidance for evaluating how best to restore stream habitat function and achieve salmon recovery, the plan Addendum relies heavily on existing efforts that are aimed at that same goal. Therefore Ecology concludes the information that has been provided is adequate for the purposes of determining whether or not the Addendum would achieve a NEB.

II. Evaluation of Pumping Impacts Versus Mitigation Offsets

An evaluation of pumping impacts versus mitigation offsets needs to consider both the flow benefits and habitat benefits associated with the mitigation strategies. Regarding flow-related pumping impacts versus mitigation offsets, an important consideration is that the predicted consumptive use impacts are quite small relative to overall WRIA streamflow. Specifically, the prediction of 1.03 cfs of cumulative consumptive use for all new permit-exempt domestic wells anticipated over the next 20 years for the entire WRIA is equivalent to only about 462 gallons per minute (gpm of water). Considering the small uses comprising that total are distributed throughout the entire watershed, it is clear that the effect of uses at any one specific location will be quite small.

Another important consideration is the special case of impact avoidance presented by Yelm Offset Actions 1 and 2. If Yelm receives a new water right as a result of the "pilot project" portion of RCW 90.94, these two mitigation strategies would supply Yelm municipal water to home owners who otherwise would use permit-exempt wells. Therefore, these two strategies would not provide mitigation after the fact, rather would cause a reduction in the consumptive use by permit-exempt domestic wells that is projected to occur during the planning horizon. Consequently, if these two Yelm strategies are implemented, it can be anticipated that a consumptive use of 0.69 cfs (equivalent to 310 gpm) would occur throughout the entire WRIA rather than the predicted 1.03 cfs. Also, if Yelm Offset Actions 1 and 2 did occur, pumping effects in the Thompson/Yelm subbasin specifically would drop from 0.539 (242 gpm) to 0.196 cfs (88 gpm).

Ecology evaluated the likelihood that streamflow benefits would result from the various mitigation projects, then segregated the results into three tiers to reflect the probability that benefits would occur based on expected certainty of a project occurring and certainty of projected benefits (see Ecology Table 1 above). Those predictions include a mix of year-round, irrigation-season, and

summer-fall benefits. Combining benefits for different periods in order to produce WRIA-wide totals is reasonable given the bias in less-than-yearly totals toward portions of the year when fish can benefit from the water the most. Once the tier ranking in Table 1 was completed, Ecology tallied those anticipated flow benefits by subbasin (see Table 3 below).

During the Table 3 tallying exercise Ecology needed to distribute potential benefits associated with the MAR strategy. Given uncertainty for the proposed MAR projects, Ecology performed its own calculations and produced a 1.66 cfs summer-fall season MAR offset estimate. However, that still leaves open the question of which MAR projects would be built and where the benefits would occur. In order to distribute the flow benefit estimate, Ecology took the 1.66 cfs and divided by 9 for the number of potential projects (see Ecology Figure 1 located at bottom of this document). Ecology then assigned those values to the subbasins where they are proposed. One challenge in this approach was that for projects on the mainstem Nisqually River below Alder Lake, flow benefits would occur on the line separating two subbasins. So in those instances, values were divided equally between the two. Breaking up the projected benefits from the MAR strategy in this way resulted in Thompson/Yelm, Lower Nisqually, Mashel River, Ohop Creek, and Upper Nisqually receiving 0.844 cfs each, Lackamas/Toboton/Powell receiving 0.767 cfs, and Prairie Tributaries receiving 0.4611 cfs.

Regarding the Eatonville Capital Improvement Projects strategy, Table 7-2 provides a prediction of 0.128 cfs divided between the Mashel River subbasin and the Ohop Creek subbasin, so that number was divided by two within Ecology Table 3.

Ecology Table 3. Flow mitigation offsets summary by subbasin

Sub-basin	Ecology Method Annual P-E Consumptive Use (cfs)	Ecology Assumed Streamflow Benefits (cfs)			Defecit between Water Needed & Water Supplied by Teir 1 Strategies
		Teir 1 Reliability (most certainty)	Teir 2 Reliability	Teir 3 Reliability (least certainty)	
McAllister	0.054				-0.054
Thompson/Yelm	0.539	0.528	0.120	0.015	-0.011
Lackamas/Toboton/Powell	0.148	0.277		0.114	0.129
Lower Nisqually	0.001	0.184			0.183
Mashel River	0.007	0.184	0.800	2.411	0.177
Prairie Tributaries	0.206	0.554		0.058	0.348
Ohop Creek	0.009	0.202		0.218	0.193
Upper Nisqually (Pierce, Lewis, Thurston)	0.067	0.184			0.117
Balance of Strategy H that occurs below Thompson/Yelm subbasin*			0.216		
TOTAL	**1.03**	**2.114**	**0.920**	**2.816**	

***** Portion of Strategy H benefit discharged directly to the Nisqually River and Centralia Power Canal downstream of the Thompson/Yelm subbasin.

Likewise, Ecology evaluated the likelihood that other habitat benefits would result from various mitigation strategies, then segregated the results into three tiers to reflect the likelihood that benefits would occur (based on expected certainty of a project occurring and the certainty of ecological benefits) (see Ecology Table 2 above). During that analysis, habitat benefits stemming from flow increases were not included in order for the table to highlight other benefits from the mitigation strategies. Ecology then also tallied those anticipated habitat benefits by subbasin as summarized in Ecology's Table 4.

Ecology Table 4. Habitat mitigation offsets summary by subbasin

Sub-basin	Ecology Method Annual P-E Consumptive Use (cfs)	Ecology Assumed Habitat Benefit Not Counting Streamflow		
		Teir 1 Confidence (most certainty)	Teir 2 Confidence	Teir 3 Confidence (least certainty)
McAllister	0.054			
Thompson/Yelm	0.539	X		
Lackamas/Toboton/Powell	0.148	X		X
Lower Nisqually	0.001			
Mashel River	0.007		X	2X*
Prairie Tributaries	0.206	X		
Ohop Creek	0.009	X		2X*
Upper Nisqually (Pierce, Lewis, Thurston)	0.067			X
Total				

* Strategy O, Eatonville Capital Improvement Projects, is split between Ohop and Mashel subbasins.

Ecology recognizes there inevitably will be other benefits associated with some mitigation strategies not accounted in Ecology's tables. However, to allow comparisons of the different strategies with the projected effects of pumping, levels of certainty had to be addressed. The potential for other benefits from the strategies is discussed in the Uncertainty and Adaptive Management discussion below, since those less-developed strategies would provide backup contingencies in case strategies with more certainty did not materialize.

There is no requirement that the mitigation strategies provided must offset all of the impacts created by pumping permit-exempt domestic wells in time and in the same locations. However, for NEB evaluation purposes, it is significant that the information presented in Ecology Tables 3 and 4 suggests the proposed mitigation strategies do a good job of providing offsets throughout the WRIA.

Ecology's Table 3 indicates that most of the impacts from new well pumping are anticipated to occur low in the watershed, and in general the Tier 1 offsets are greatest in those areas as well. This table also indicates that there are just two subbasins, McAllister and Thompson/Yelm, where mitigation strategy quantities are not greater than the pumping impacts. In the McAllister subbasin, the predicted flow impact is small (0.054 cfs) and the subbasin is very low in the watershed where small flow reductions are not as critical to fish. In the Thompson/Yelm subbasin, the difference between the predicted flow impacts and water offset quantities being provided is also quite small (0.093 cfs), and again this subbasin does not provide as high quality habitat as that provided by the upstream subbasins. For the remainder of the subbasins, looking at the Tier 1 Reliability (most certain) column

alone, flow improvements beyond the detriments created by new well pumping (the column at the far right) range from 0.117 to 0.348 cfs (per subbasin). Overall for the entire WRIA, the Tier 1 Reliability total of 2.114 cfs exceeds the projected pumping impacts of 1.03 cfs.

The information in Ecology Tables 3 and 4 also suggests the proposed mitigation strategies do a good job of offsetting pumping impacts in subbasins identified during previous salmon recovery efforts as being most critical to fish. Specifically the Salmon Recovery Program's current Habitat Project Ranking Guidance outlines 17 recovery initiatives focused on ecosystem-level functions (NIT Salmon Recovery Program, 2018), and the WRIA 11 planning unit identified and ranked nine of those initiatives as being likely to provide significant streamflow benefits and/or habitat benefits to salmon in areas affected by low or intermittent seasonal flows. According to that ranking, the Mashel and Ohop subbasins, where multiple flow and habitat benefits are anticipated as a result of Addendum implementation, are in all four of the top four spots. One project, S. Ohop Phase IV Floodplain Restoration & Protection, would specifically improve 360 acres of Ohop subbasin floodplain.

In addition to the above analysis, the locations of various mitigation strategies were compared with a Washington Department of Fish and Wildlife (WDFW) map depicting the relative value of locations throughout the Puget Sound with respect to conservation of fish and wildlife habitats (see Ecology Figure 1 located at bottom of this document). In 2013, WDFW published the study that generated that map, which was designed to provide useful, scientifically-credible information for smart growth in the Puget Sound Basin. The overall WDFW project developed datasets to assess both water resources (flow and quality) and fish and wildlife habitats in terrestrial, freshwater, and marine shoreline environments within the entire Puget Sound. The authors divided the eighteen WRIAs that surround and contribute to the Puget Sound into 2,940 assessment units.

A straight comparison of the locations of pumping impacts, flow offset strategies, and habitat mitigation strategies with WDFW's fish and habitat conservation units is not possible for most projects, since the locations of areas affected by the former are not fully defined and often fall within multiple units depicted by the latter. However, as indicated on Ecology's Figure 1 map, in general the high value habitat areas are located within the upper half of the WRIA, within the Mashel, Ohop and Upper Nisqually subbasins. And, looking at Ecology Tables 2 and 4, those same subbasins are well positioned to receive flow mitigation and habitat mitigation benefits from the strategies proposed. Stated more plainly, while most of the consumptive use associated with new permit-exempt domestic wells will occur in the lower part of the watershed, a high percentage of the Tier 1 habitat projects are located further upstream and are connected to some of the most highly ranked habitat in the WRIA. This relationship contributes significantly to benefits associated with these projects.

Taken as a whole, the results presented in Ecology Tables 3 and 4 and other information discussed above indicate that, relative to the detriments created by future permit-exempt domestic wells anticipated in WRIA 11 over the next 20 years, the offset approaches proposed would result in a net ecological benefit.

III. Uncertainty and Adaptive Management

Whether or not the Addendum would achieve a NEB depends upon the actual impacts from future exempt-well pumping, the reasonable likelihood that mitigation strategy projects will occur, and the accuracy of projected benefits from mitigation strategy projects.

For impacts from exempt-well pumping calculated by the Ecology-recommended method, Ecology generally agrees with the methodology followed in the Addendum. However, two assumptions were made by the planning unit that were not well documented and produced uncertain, less conservative results. The Addendum calculations assume that each new domestic well will be used to irrigate a 0.2 acre outdoor watering area with an assumed irrigation efficiency of 90 percent. As discussed previously, no documentation was put forth to justify the 0.2 acres. More importantly, the assumed 90 percent irrigation differs from what is described in Ecology's recommended water use calculations method. The example in that Ecology's document assumed an irrigation efficiency of 75 percent, corresponding with residential pop-up sprinkler systems as described in Ecology's Water Resources Program Guidance 1210.

If an irrigation efficiency of 75 percent is used instead of 90 percent, the 1.03 cfs rate for consumptive use by all new exempt-well pumping WRIA-wide would go up to 1.22 cfs. If an irrigation efficiency of 75 percent is used and the outdoor watering area is assumed to be 0.25 acres, the 1.03 cfs rate for consumptive use by all new domestic exempt-well pumping WRIA-wide would go up to 1.51 cfs. If that same worst-case ratio of increase (146 percent) is used on a subbasin basis, the larger predictions are still less than the anticipated Tier 1 reliability flow benefits indicated in Ecology's Table 3, except for the McAllister subbasin (which was less prior to the increase) and the Thompson/Yelm subbasin (where the deficit is 0.142 cfs). However, it is important to recognize that the WRIA-wide estimates made by the planning unit relying on Group A and B water system data were significantly lower than estimates using the Ecology recommendation (0.439 cfs versus 1.03 WRIA-wide). This points to the uncertainty in all of these numbers, and the reason it is significant that the WRIA-wide worst case scenario of 1.51 cfs of consumptive use by all new domestic exempt-well pumping is less than the 2.114 cfs anticipated Tier 1 reliability flow benefits.

By far the most important uncertainty regarding all of the estimates relates to the mitigation strategy projects. For many of those projects, there is significant uncertainty regarding what the projected benefits will be and whether or not those projects will be realized. Ecology's Interim Guidance recommends fully evaluating the probability of projects occurring and thorough analyses of what the benefits might be. Examples of where the Addendum fails in this regard can be found with strategies C, D and E - Deep Groundwater Option 1, Option 2, and Option 3. There is some general discussion of the benefits these projects could provide, but no details for implementation of these strategies is provided and there are no predictions of the amounts of water that would be offset.

As stated previously, we acknowledge that there will be other benefits associated with some of the mitigation strategies listed as Tier 2 and Tier 3 in Ecology's tables. During our analysis, we chose to deal with the potential benefits from these strategies as backup contingencies under the presumption that to the extent these other strategies can be implemented, they will be able to provide benefits that make up for any Tier 1 strategies that fall through. As far as how this redundancy approach would be implemented, the Addendum provides for robust adaptive management as addressed on page 8-80:

> This addendum to the Nisqually Watershed Plan identifies specific mitigation strategies and 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 commits to 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.
>
> 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). Adaptive Management of the mitigation strategies and policies addressing RCW 90.94.020 is addressed below. 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. The Lead Entity process for adaptive management as related to habitat projects is discussed below.

5. CONCLUSIONS

Page 8-80 of the plan Addendum makes a clear statement that the WRIA 11 Nisqually watershed planning unit believes that a NEB will be achieved:

> This addendum to the Nisqually Watershed Plan identifies specific mitigation strategies and 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 was provided a very short time frame to develop its Addendum. Due to that abbreviated time compared with most other planning units, Ecology will provide WRIA 11 some latitude regarding the thoroughness of their plan Addendum, and allow that in some cases it may be acceptable for mitigation strategy elements to require additional development after plan adoption. While the WRIA 11 watershed plan Addendum does not adhere to Ecology's guidance documents, Ecology's Interim Guidance states:

> Ecology's evaluation of NEB will incorporate existing information on watershed-specific factors that are addressed during the planning process and rely heavily on input from local, state, federal and tribal resource managers, and water resources stakeholders participating in the planning process.

The Nisqually Tribe serves as the lead entity for this planning effort, and it has demonstrated a long-term commitment to ESA salmon recovery efforts aimed at many of the same goals as RCW 90.94. Since the Addendum relies heavily on this previous work, Ecology concludes that the information that has been provided is adequate for the purposes of determining whether or not the Addendum would achieve a NEB.

Overall, information in Ecology's NEB analysis section above suggests good spatial distribution of the mitigation strategies throughout the WRIA, and that the mitigation strategies adequately offset the pumping impacts in those subbasins identified during previous salmon recovery efforts as being most critical to fish. Taken as a whole, the results indicate that relative to the detriments created by future permit-exempt domestic wells anticipated in WRIA 11 over the next 20 years, the offset strategies proposed would result in a NEB for the watershed.

In support of Ecology's affirmative NEB determination, the plan Addendum acknowledges and accounts for the need for adaptive management. While the Planning Unit indicates that its members have confidence that they will meet their mitigation offset and NEB/salmon recovery goals, it states they also recognize that estimates of rural growth and subsequent consumptive use may need to be modified and that some mitigation strategies may yield different streamflow benefits than expected. To address these uncertainties, the Planning Unit commits to adaptive management, including 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.

6. REFERENCES

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.

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 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.

RH2 Engineers (2012) Alternative Water Source Investigation Report

Ecology Figure 1. WRIA-wide subbasins designated by planning unit, ESA-listed fish species distribution, and WDFW habitat indices.