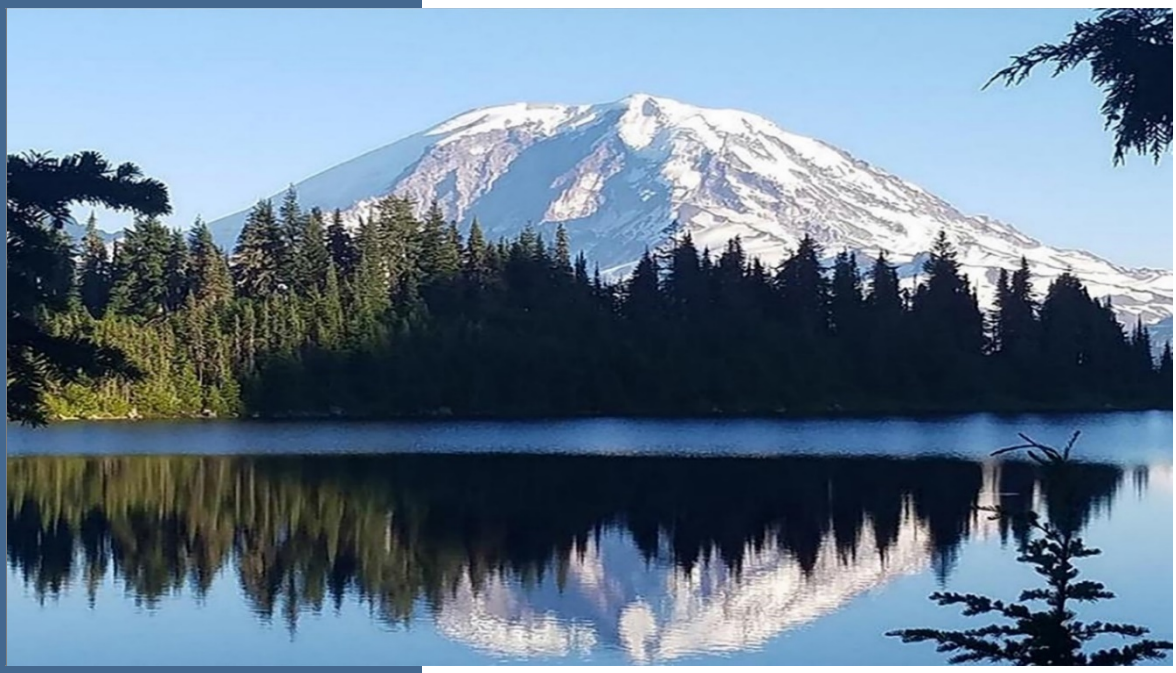

Watershed Restoration and Enhancement Plan
WRIA 10 - Puyallup-White Watershed

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Executive Summary

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

The Department of Ecology (Ecology) established the Watershed Restoration and Enhancement Committee to collaborate with tribes, counties, cities, state agencies, and special interest groups in the Puyallup-White watershed, also known as Water Resource Inventory Area (WRIA) 10. The WRIA 10 Committee met for over 2 years to develop a watershed plan.

This watershed plan projects 688 PE well connections over the 20-year planning horizon. The estimated consumptive water use associated with the new PE well connections is 277.4 acre-feet per year (0.38 cfs); equivalent to 360 gallons per day for each new PE well. The projects and actions in this watershed plan will address and offset the consumptive water use from those PE well connections.

The projects in this watershed plan include water right acquisitions, managed aquifer recharges, stormwater infiltration, and PE well decommissioning that provide an estimated offset of 788.3 acre-feet per year to benefit streamflows and enhance the watershed. Additional projects in the plan include benefits to fish and wildlife habitat, such as levee setbacks, floodplain reconnections, stream improvements, and bank stabilizations.

This watershed plan recommends an adaptive management process. The adaptive management process includes a mechanism for tracking new PE wells, tracking project implementation, periodic reporting on project status, and recommendations for response if projects implementation lags new PE well connections. These measures, in addition to the surplus water offset and supplemental habitat improvement projects, provide reasonable assurance that the plan will adequately offset new consumptive use from PE wells anticipated during the planning horizon.

Based on the information and analyses summarized in this plan, the WRIA 10 Committee finds that this plan, if implemented, achieves a net ecological benefit, as required by RCW 90.94.030 and defined by the Final NEB Guidance (Ecology 2019b).

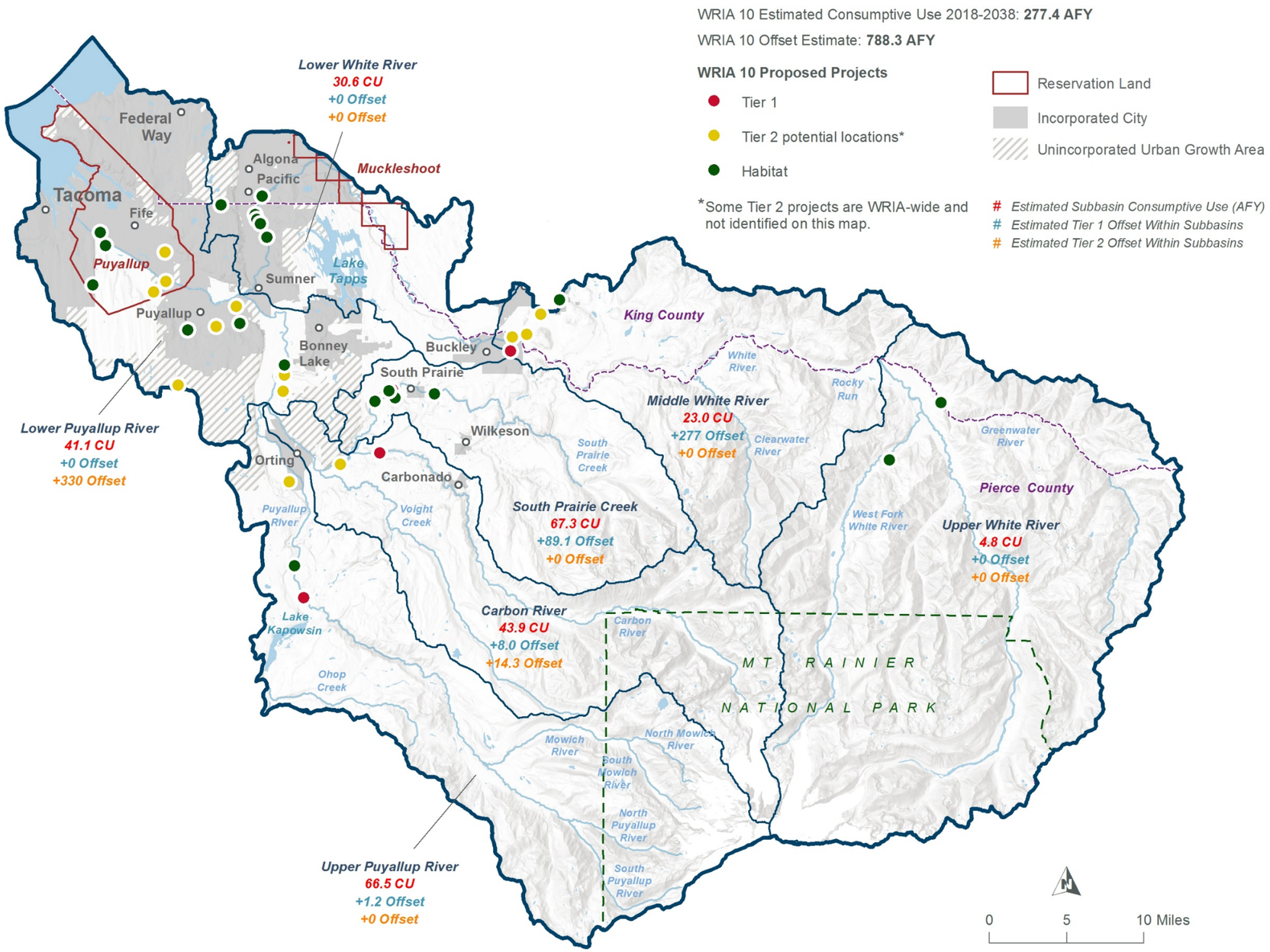

Figure 1 Summary Map of Consumptive Use, Projects, and Offsets by Subbasin.

Chapter One: Plan Overview

1.1 WRIA 10 Plan Purpose and Structure

The purpose of the Water Resource Inventory Area (WRIA) 10 Watershed Restoration and Enhancement Plan is to offset the impacts of domestic permit-exempt wells (referred to as PE wells throughout this plan) to streamflows. The watershed restoration and enhancement plan is one requirement of RCW 90.94.030. Watershed restoration and enhancement plans must identify projects and actions to offset the potential impacts of new PE wells on instream flows over 20 years (2018-2038), and provide a net ecological benefit (NEB) to the WRIA. This WRIA 10 Watershed Restoration and Enhancement Plan (watershed plan or plan) considers priorities for salmon recovery and watershed recovery, while ensuring it meets the intent of the law.

Pumping from wells can reduce groundwater discharge to springs and streams by capturing water that would otherwise have discharged naturally, reducing flows (Barlow and Leake 2012). Consumptive water use (that portion not returned to the aquifer) reduces streamflow, both seasonally and as average annual recharge. A well pumping from an aquifer connected to a surface water body can either reduce the quantity of water discharging to the river or increase the quantity of water leaking out of the river (Barlow and Leake 2012). Projects and actions that offset consumptive use associated with permit-exempt domestic water use have become a focus to minimize future impacts to instream flows and restore streamflow.

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

This watershed plan includes seven chapters:

- Plan overview.
- Overview of the watershed.
- Summary of the subbasins.
- Growth projections and consumptive use estimates.
- Description of the recommended projects and actions identified to offset the future permit-exempt domestic water use in WRIA 10.
- Explanation of recommended implementation and adaptive management measures.
- Evaluation and consideration of NEB.

1.1.1 Legal and Regulatory Background for the WRIA 10 Watershed Restoration and Enhancement Plan

In January 2018, the Washington State Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 (session law 2018 c 1) in response to the State Supreme Court's 2016 decision in Whatcom County vs. Hirst, Futurewise, et al. (commonly referred to as the "Hirst decision"). As it relates to this Committee's work, the law, now primarily codified as chapter 90.94 RCW, clarifies how local governments can issue building permits for homes intending to use a PE well for their domestic water supply. The law also requires local watershed planning in 15 different WRIAs, including WRIA 10.

1.1.2 The Local Building Permit Process and Permit-Exempt Wells

This watershed restoration and enhancement plan, the Streamflow Restoration law, and the Hirst decision are all concerned with the effects of new PE wells on streamflows. Several laws pertain to the management of PE wells in WRIA 10 and this section summarizes them to provide context for the WRIA 10 watershed plan.

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

RCW 90.94.030 adds to the management regime for new homes using domestic PE well withdrawals in WRIA 10 and elsewhere. For example, local governments must, among other responsibilities relating to new PE wells, collect a $500 fee for each building permit and record withdrawal restrictions on the title of the affected properties. Additionally, this law restricts new PE wells in WRIA 10 to a maximum annual average of 950 gallons per day per connection, subject to the 5,000 gallons per day and ½-acre outdoor irrigation of non-commercial lawn/garden limits established in RCW 90.44.050. The Washington Department of Ecology (Ecology) has published its interpretation and implementation of RCW 19.27.097 and chapter 90.94 RCW in Water Resources POL-2094 (Ecology 2019a). The WRIA 10 Committee directs readers to those laws and policy for comprehensive details and agency interpretations.

1.1.3 RCW 90.94.030's Planning Requirements

While supplementing the local building permit requirements, RCW 90.94.030(3) goes on to establish the planning criteria for WRIA 10. In doing so, it sets the minimum standard of Ecology's collaboration with the WRIA 10 Committee in the preparation of this watershed plan. In practice, the process of plan development was one of broad integration, collectively shared work, and a striving for consensus described in the WRIA 10 Committee's adopted operating principles that are further discussed in Section 1.4.

Additionally, the Streamflow Restoration law requires this watershed plan to identify projects and actions that offset the anticipated impacts from new permit-exempt domestic groundwater withdrawals over the next 20 years and provide a net ecological benefit. In establishing the primary purpose of this watershed plan, RCW 90.94.030(3) also details both the required and recommended plan elements. Regarding the WRIA 10 Committee's approach to selecting projects and actions, the law also speaks to "high and lower priority projects." The WRIA 10 Committee understands that, as provided in the Final Guidance on Determining Net Ecological Benefit (Ecology 2019b), "use of these terms is not the sole critical factor in determining whether a plan achieves a NEB… and that plan development should be focused on developing projects that provide the most benefits… regardless of how they align with [these] labels". It is

the perspective of the WRIA 10 Committee that this watershed plan satisfies the requirements of RCW 90.94.030.

1.2 Requirements of the Watershed Restoration and Enhancement Plan

RCW 90.94.030 of the Streamflow Restoration law directs Ecology to establish a Watershed Restoration and Enhancement Committee in the Puyallup - White watershed (referred to in this plan as the Committee) and collaborate with the Committee to develop this watershed plan. Ecology determined that collective development of the watershed plan, using an open and transparent setting and process that builds on local needs would best serve the intent of the law.

At a minimum, the watershed plan must include projects and actions necessary to offset potential impacts of new PE wells on streamflows and provide a NEB to the WRIA. The legislation requires the watershed plan to include the following elements:

- Recommendations for projects and actions that will measure and enhance instream resources and improve watershed functions that support the recovery of threatened and endangered salmonids (RCW 90.94.030(3)(a)).
- Actions the Committee determines necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use (RCW 90.94.030(3)(b)).
- A cost evaluation or estimation (RCW 90.94.030(3)(d)).
- An estimate of the cumulative consumptive use impacts over the twenty year period (2018-2038) (RCW 90.94.030(3)(e)).

Ecology issued the Streamflow Restoration Policy and Interpretive Statement (POL-2094) and Final Guidance on Determining Net Ecological Benefit (GUID-2094) in July 2019 to ensure consistency, conformity with state law, and transparency in implementing chapter 90.94 RCW. The Final Guidance on Determining Net Ecological Benefit (referred to as Final NEB Guidance throughout this plan) establishes Ecology's interpretation of the term "net ecological benefit." It also informs planning groups on the standards Ecology will apply when reviewing a watershed plan completed under RCW 90.94.020 or RCW 90.94.030.

The Streamflow Restoration law requires that all members of the Committee approve the watershed plan prior to submission to Ecology for review. Ecology must then determine that the plan's recommended streamflow restoration projects and actions will result in a NEB to instream resources within the WRIA after accounting for projected use of new PE wells over the 20 year planning horizon from 2018-2038.

1.3 Overview of the WRIA 10 Committee

1.3.1 Formation

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

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

Ecology sent invitation letters to each of the entities named in the law[2] in September of 2018.

The law also required Ecology to invite local organizations representing agricultural interests, environmental interests, and the residential construction industry. Businesses, environmental groups, agricultural organizations, conservation districts, and local governments nominated interest group representatives. Local governments on the Committee voted on the nominees in order to select local organizations to represent agricultural interests, the residential construction industry, and environmental interests. Ecology invited the selected entities to participate on the Committee.

The entities represented on the WRIA 10 Committee are included in Table 1. This list includes all of the entities identified by the Legislature that agreed to participate on the Committee.[3]

Table 1 WRIA 10 Membership

Entity Name	Representing
Muckleshoot Tribe	Tribal government
Puyallup Tribe	Tribal government
Pierce County	County government
City of Auburn	City government
City of Bonney Lake	City government
City of Edgewood	City government
City of Enumclaw	City government
City of Fife	City government
City of Orting	City government
City of Pacific	City government
City of Puyallup	City government
City of Sumner	City government
City of Tacoma	City government

[2] Except the irrigation district because there are no irrigation districts in WRIA 10.
[3] The law did not require invited entities to participate, and some chose not to participate on the Committee. Listed entities committed to participate in the process and designated representatives and alternates.

Entity Name	Representing
Washington Department of Fish and Wildlife	State agency
Washington Department of Ecology	State agency
Lakehaven Water and Sewer District	Water utility
Pierce County Conservation District	Agricultural interest
Master Builders Association of Pierce County	Residential building industry
Puyallup River Watershed Council	Environmental interest

Roster with names and alternates is available in Appendix C.

The Committee invited the WRIA 10/12 Salmon Recovery Entity to participate as an "ex-officio" member. Although not identified in the law, the ex-officio members provide valuable information and perspective as subject matter experts. The ex-officio members are active but non-voting participants of the Committee. The Tacoma-Pierce County Health Department (TPCHD) participated in select Committee and workgroup meetings as a technical expert on local well permitting.

1.4 Committee Structure and Decision Making

The Committee held its first meeting in October 2018. Between October 2018 and April 2021, the Committee held 27 meetings. All Committee meetings were open to the public. Some meetings were held jointly with the WRIA 12 Committee. The Committee met at least once a month, and as needed to meet deadlines.

The two and a half years of planning consisted of training, research, and developing plan components. Committee members had a range of knowledge about hydrogeology, water law, salmon recovery, and residential development. Ecology technical staff, Committee members, and partners presented on topics to provide context for components of the plan.

In addition to playing the role of Committee chair, Ecology staff provided administrative support and technical assistance, and contracted with consultants to provide facilitation and technical support for the Committee. The facilitator supported the Committee's discussions and decision-making. The technical consultants developed products that informed Committee decisions and development of the plan. The technical consultants developed all of the technical memorandums referenced throughout this plan.

The Committee established two workgroups to support planning activities and to achieve specific tasks, a technical workgroup and a subbasin workgroup. The workgroups were open to all Committee members as well as non-Committee members that brought capacity or expertise not available on the Committee. The workgroups made no binding decisions, but presented information to the Committee as either recommendations or findings. The Committee acted on workgroup recommendations, as it deemed appropriate. The technical workgroup met each month between Committee meetings, and the subbasin workgroup met twice.

During the initial Committee meetings, members developed and agreed to operating principles (see Appendix D).[4] The operating principles set forward a process for meeting, participation

[4] Complete and signed operating principles are available on the WRIA 10 Committee webpage.

expectations, procedures for voting, structure of the Committee, communication, and other needs to support the Committee in reaching agreement on a final plan.

This planning process, by statutory design, brought diverse perspectives to the table. As the legislation requires that all members of the Committee approve the final plan prior to Ecology's review,[5] it was important for the Committee to identify a clear process for making decisions. The Committee strived for consensus during foundational votes and decisions on plan development, being the best indicator of the Committee's progress toward an approved plan. When consensus could not be reached, the Committee relied on a two-thirds majority vote. The chair and facilitator documented agreement and dissenting opinions.

The WRIA 10 Committee reviewed draft plan and draft plan chapters on an iterative basis. Committee members reviewed the compiled plan and, in some cases, received direction on whether to approve the plan from the appropriate decision-makers at each entity. The full Committee voted to approve the plan unanimously on April 22, 2021.

[5] RCW 90.94.030[3] "…all members of a watershed restoration and enhancement Committee must approve the plan prior to adoption"

Chapter Two: Watershed Overview

2.1 Brief Introduction to WRIA 10

WRIAs are large watershed areas formalized under Washington Administrative Code (Water Resources Code of 1971) for the purpose of administrative management and planning. WRIAs encompass multiple landscapes, hydrogeological regimes, levels of development, and variable natural resources. WRIA 10, also known as the Puyallup-White, is one of the 62 designated WRIAs in Washington State. The 1,000 square mile Puyallup-White Watershed is within Pierce and King counties and includes all of the lands drained by the Puyallup, White, and Carbon rivers. The White and Carbon rivers are tributaries to the Puyallup River. These three river systems originate from glaciers on Mount Rainier.

The Puyallup River flows 46 miles, drains 490 square miles, and discharges into Commencement Bay and Puget Sound in Tacoma (Lead Entity 2018). The mean annual flow in the Puyallup River is 3,332 cubic feet per second (cfs) measured near Puyallup[6] (USGS 2020a). The White River runs 75 miles and has a mean annual flow rate of approximately 1,400 cfs as measured near Buckley[7] (PRWC 2014; USGS 2020b). The Carbon River runs 33 miles and has a mean annual flow of 430 cfs measured at Fairfax[8] (PRWC 2014; USGS 2020c).

2.1.1 Land Use in WRIA 10

The Puyallup-White Watershed is one of the most heavily populated basins in western Washington. The western portion of the Puyallup-White Watershed is predominantly urban, characterized by a combination of residential, industrial, commercial, agricultural, transportation, communication, and utility land uses. The most populated cities in the watershed are Tacoma, Auburn, and Federal Way (OFM 2020). Approximately 14 percent (149.7 square miles) of the watershed is within a city or designated urban growth area, and approximately 86 percent of the WRIA is outside of the urban growth areas. The confluence of the Puyallup River with Commencement Bay occurs in the urbanized and highly industrialized Port of Tacoma.

The eastern or upland portion of the watershed generally consists of commercial forest land, Mount Rainier National Park (19 percent of the WRIA), and the Baker-Snoqualmie and Gifford Pinchot national forests (26 percent of the WRIA). Washington State agencies manage about 3% of the WRIA. Land uses shift to agriculture, suburban developments, and small urban centers in the foothills of the Cascade Mountains. Rural residential development has primarily occurred in the foothills outside of the urban centers (see Figure 2).

[6] USGS stream gage 12101500
[7] USGS stream gage 12099200
[8] USGS stream gage 12094000

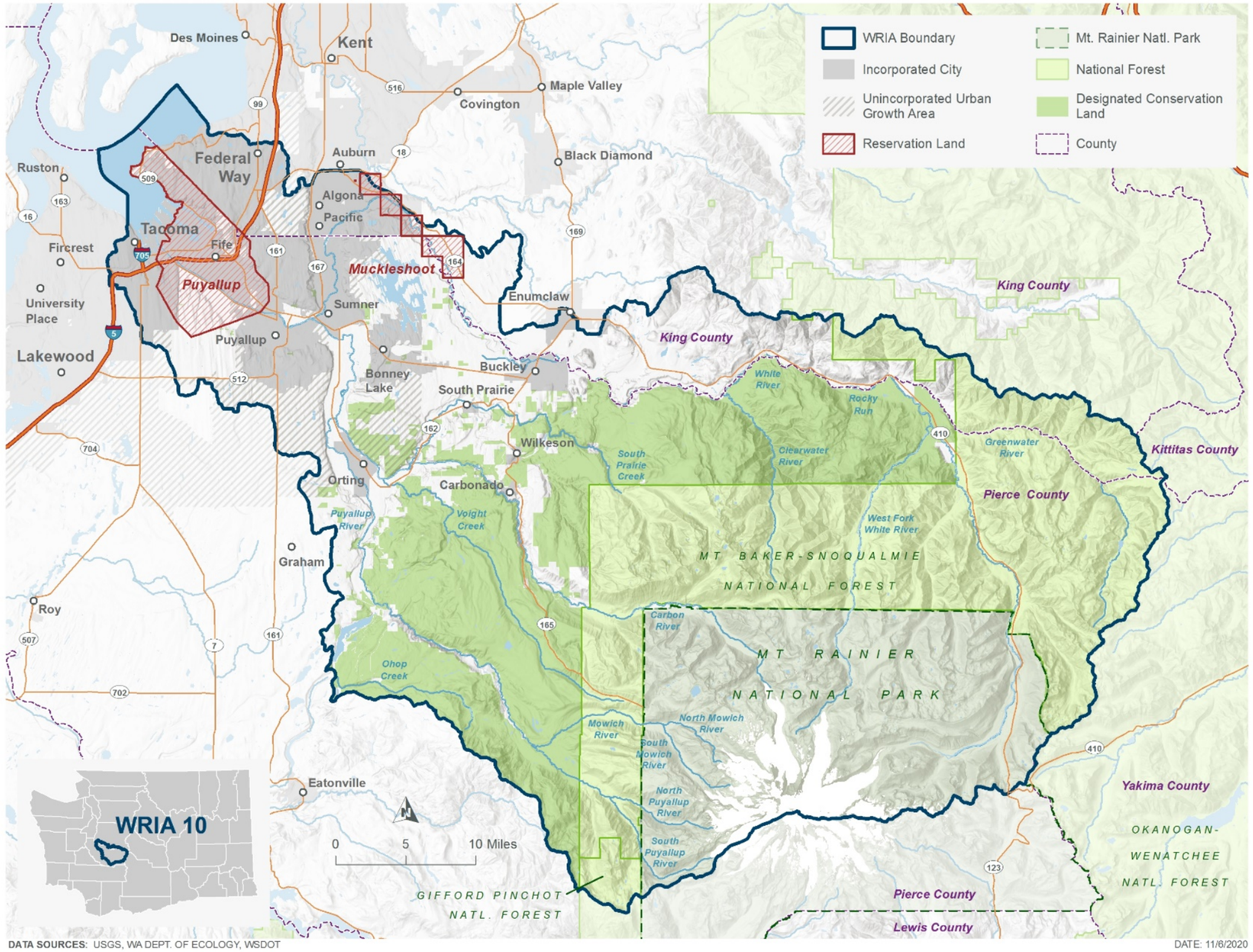

Figure 2 WRIA 10 Vicinity Map with Land Uses

2.1.2 Tribal Reservations and Usual and Accustomed Fishing Areas

The Puyallup Tribe of Indians' Reservation occupies 18,000 acres on the lower Puyallup River and Commencement Bay. The Muckleshoot Indian Reservation occupies 3,600 acres along the lower reaches of the White River. The ancestral lands and use areas of the people of the Muckleshoot Indian Tribe and the lands of the Muckleshoot Indian Reservation are partially located in WRIA 10. The Puyallup and Muckleshoot tribes are sovereign nations with rights over natural resources, including enough water to fulfill the purposes of their reservations.

The Tribes hold Treaty-reserved water rights in WRIA 10 under federal law that are necessary to support healthy salmon populations; to support and maintain hunting, fishing and cultural resource harvesting right; and to meet all homeland purposes reserved by the Treaties. These reserved water rights are necessary to fulfill the promises and purpose of the Treaties. Federal Indian water rights retain a senior priority date over all other federal and state water rights holders and state instream flow rules. Although federal Indian water rights in WRIA 10 have yet to be adjudicated, these rights are senior to all other rights and have not been accounted for by the State of Washington in the way in which the State determines water availability, over appropriation, and instream flow rules.[9]

2.1.3 Salmon in WRIA 10

The Puyallup-White Watershed is an important and productive system for salmonids listed as threatened under the Endangered Species Act (ESA). Several tributaries provide spawning and rearing habitat for Chinook, Coho, Pink, Sockeye, and Chum salmon, as well as steelhead and bull trout. The watershed supports the last spring Chinook salmon run in the South Puget Sound (Salmon Habitat Recovery 2018). Spawning tributaries often experience low streamflows during critical migration and spawning periods (PRWC 2014). Many people depend on the salmon fishery. This includes tribes with usual and accustomed fishing areas that overlap with the Puyallup-White watershed, such as the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe (NWIFC 2014).

2.1.4 Water System Distribution and Impacts in WRIA 10

Communities in WRIA 10 rely on a mix of both groundwater and surface water. Water systems distribute most water in the watershed. The Washington Department of Health classifies water systems by the number of connections and the number people served each day. Group A water systems serve 15 or more connections and 25 or more people per day and require a water right from Ecology. Group B water systems serve fewer than 15 connections and 25 people per day (WA Department of Health 2020). The size of the Group B system determines whether it requires a water right. Usually Group B systems serving fewer than six connections are exempt from permitting because they can meet the requirements of RCW 90.44.050. In Pierce County,

[9] Paragraph provided by WRIA 10 Tribes.

wells serving between two and fifteen connections are considered Group B systems. Most PE wells are located in unincorporated rural areas, where water systems are unavailable.

2.2 Watershed Planning in WRIA 10

Citizens and local, state, federal, and tribal governments have collaborated on watershed and water resource management issues in WRIA 10 for decades. This section provides a brief summary of broad watershed planning activities as they relate to the past, present, and future water availability and salmon recovery in the Puyallup-White Watershed.

2.2.1 Current Planning Efforts in WRIA 10

This watershed plan is building on many of the past and ongoing activities to further develop comprehensive plans for the entire watershed. For example, the Puyallup White River Local Integrating Organization (PWR-LIO) is developing an Ecosystem Recovery Plan, which will set local priorities and inform the next Action Agenda for Puget Sound Recovery.[10] The planning process to develop an ecosystem recovery plan is community based with engagement by residents, nonprofits, and local, state, and federal agencies. The approach is holistic, addressing everything from salmon and orca recovery, stormwater runoff, equity, climate change, and farmland and forest conservation. The PWR-LIO has engaged the community in a collaborative planning process to develop local priorities and support the health and sustainability of the watershed.

The Salmon Recovery Lead Entity, a collaboration of local governments, state, federal, and tribal partners, and nonprofit organizations, is focused on protecting and enhancing wild salmon populations. In 2018, the Lead Entity updated the Salmon Habitat Protection and Restoration Strategy for Puyallup and Chambers Watersheds. [11]

The PWR-LIO and Salmon Recovery Lead Entity include many of the same organizations and individuals that participate in the Committee. This history of collaborative planning and shared priorities has supported the success of the watershed restoration and enhancement plan development in WRIA 10. This history of collaboration will also lead to successful implementation of this plan.

The Pierce County Coordinated Water System Plan (CWSP) was created for water utilities to coordinate planning and construction programs with water utilities and other local jurisdiction programs.[12] The plan, established in 1988, provides the foundation for how to meet public drinking water needs with consideration for future growth. A limited update was completed in

[10] The PWR-LIO boundaries mirror the WRIA 10 boundaries, except for a small area in Tacoma. More information on local integrating organizations and their efforts to recovery Puget Sound is available here: https://www.psp.wa.gov/LIO-overview.php.

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

[12] More information on Pierce County Coordinated Water System Planning is available here: https://www.co.pierce.wa.us/951/Coordinated-Water-System-Planning

2001, but it did not address changes associated with water resources, water supply, and land use planning. The County completed a more significant update in 2020.

This planning ensures that water system service areas are consistent with local growth management plans and development policies. The location of new homes in relation to and within designated retail water system service areas and related policies determine if homes connect to water system or rely on new PE wells. Within their designated retail service area(s), Group A water purveyors are given first right of refusal for new connections. The purveyor may allow an individual well if they are unable to provide service in a 'reasonable and timely' manner.

2.2.2 Coordination with Existing Plans

Throughout the development of this watershed plan, Ecology streamflow restoration staff have engaged with staff from the Salmon Recovery Lead Entity, PWR-LIO, and the Puget Sound Partnership, providing briefings on the streamflow restoration law, scope of the watershed plan, and plan development status updates. The Committee chair conducted outreach to the WRIA 10 Salmon Recovery Lead Entity to align salmon recovery priorities and the streamflow planning process. Throughout the planning process, Ecology has coordinated closely with the lead entity and PWR-LIO, including inviting lead entity to take part as an ex-officio member on the Committee, selecting priority streams based on information from the Salmon Recovery Strategy, and incorporating priority salmon recovery projects in the watershed plan.

This watershed plan incorporates assumptions that reflect the Pierce County and King County Comprehensive Plan goals and policies. The counties' Comprehensive Plans set policy for development, housing, public services and facilities, and environmentally sensitive areas, among other topics. The Comprehensive Plans identify where and how future population, housing, and job growth is planned. The plan uses the Pierce and King county zoning districts and Group A water system service areas as the basis for estimating the likely areas of future PE wells.

As a component of a comprehensive plan, a capital facilities plan identifies public facilities that will be needed to ensure service levels keep pace with expected development. It includes projects from a range of county functions, including: airport/ferries, emergency management, general administration, parks, roads, sewer, sheriff/court/correctional facilities, and surface water management. The capital facilities plan must identify the location and cost of capital facilities, as well as the sources of revenue used to fund them. The counties update capital facilities plans annually and appropriate funding for the following year. If the costs exceed the revenue, the county must reduce its level of service, reduce costs by implementing noncapital alternatives or other methods, or modify the land use element to bring development into balance with available or affordable facilities.

Projects may also fall under the noncapital category. Noncapital alternatives include programs, strategies, and methods other than 'brick and mortar'-type capital improvement to achieve the county's required level of service. This category includes programs like education and outreach, improvements to existing facilities, and projects to improve natural drainage as an alternative to engineered solutions (e.g., levees and dikes).

The counties may evaluate and prioritize capital projects (structures or engineered improvements to land) identified through the watershed plan for placement into the capital facilities plan. Most projects will fall under the category of surface water management. Pierce County's Surface Water Management Division (SWM) uses the Surface Water Improvement Plan (SWIP) as its primary basis for project implementation planning. Not all projects listed in the SWIP make it into the capital facilities plan, but the SWIP does inform which projects are incorporated. The SWIP is also a six-year plan that the County updates bi-annually. Projects come from existing, County-approved plans and the County ranks for their ability to address flooding, water quality, habitat, and other factors. Limited available funding and new mandatory obligations also factor into capital project prioritization. If approved, the watershed plan will become one of the guiding project implementation plans for the SWIP.

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

2.3.1 Geologic Setting

The lowland geology of WRIA 10 is dominated by a broad drift plain formed from a sequence of unconsolidated glacial and interglacial deposits, intersected by several expansive river valleys. Volcanic and sedimentary rocks form the foothill and mountainous foothill terrains of the Cascade Range in the eastern watershed, but they also underlie the unconsolidated sediments to the west. Depths to bedrock in the lowlands can exceed 2,000 feet (Welch et al. 2015).

Pleistocene glaciation (2.6 million to 11,700 years ago) played an important role in sculpting the landscape of both the Puget Sound Lowlands and the Cascade Mountain Range. Reaching a maximum extent during the Vashon stage of the Fraser Glaciation approximately 16,000 years ago, an ice sheet (the Puget Lobe) advanced southward into present day Puget Sound (Pringle 2008). Multiple advances and retreats of the ice sheet formed the Puget Sound Lowlands, depositing a complex sequence of glacial and inter-glacial sediments. The advancement of the alpine glaciers from Mount Rainier carved out the characteristic U-shaped valleys that form the upper and middle reaches of the present-day White, Puyallup, and Carbon river valleys (PRWC 2014).

The geologic setting lays the foundation for surface and groundwater flow through the basin. The relationships between surface water flow and deeper groundwater are important to understanding how to manage surface water resources and can be helpful in identifying strategies to offset the impacts of pumping from PE wells.

2.3.2 Hydrogeologic Setting

The U.S. Geological Survey (USGS) described the hydrology of WRIA 10 in a hydrogeologic framework report for the Puyallup River Watershed based on previous studies and published reports for both King and Pierce counties (Welch et al. 2015). The hydrogeologic units of the area are described as being either water-bearing ("aquifer") and non-water-bearing ("aquitard" or "confining layer") sediments, without regard to geologic origin or age. Major groundwater aquifers are found in the unconsolidated glacial and interglacial sediments throughout the central and lower regions of the watershed.

Groundwater in the aquifers generally flows to the northwest towards Puget Sound, and to the north and northeast towards the Puyallup River, White River, and Green River valleys. These generalized flow patterns are complicated by the presence of low permeability confining units and bedrock that separate discontinuous bodies of aquifer material and act as local groundwater-flow barriers (Welch et al. 2015). Summer base flows in the rivers and tributaries are sustained by groundwater on most of the lower-elevation tributaries, and on glacier and snow melt on the mainstem rivers (Puyallup, Carbon, and White) that drain from Mount Rainier (PRWC 2014).

USGS breaks the hydrogeology of the watershed into 12 units, typically alternating between aquifer and non-aquifer layers. The upper seven layers of the USGS definitions include four aquifer units that are present throughout the majority of the lower and central areas of the watershed (see Appendix E). These aquifers are the most likely sources for new PE wells. They are also the main source of direct recharge or baseflow to the surface water system.

The remaining five units become thinner or are not present in large portions of the central or eastern areas of the watershed. Future PE wells are therefore unlikely to access water from these layers.

2.3.3 Hydrology and Streamflow

The Puyallup, White, and Carbon rivers are located in a snowmelt transition region where the rivers are fed by both snowmelt and rainfall. Annual precipitation near the city of Tacoma ranges from approximately 30 to 40 inches per year, while over 120 inches of precipitation can fall in the Cascades. Most precipitation occurs during the winter (PRWC 2014). During the summer, when water demands are highest, streamflows are dependent upon glacier melt and groundwater inflow (Ecology 2020).

Anticipated future climate impacts will result in continued loss of snow and glacial volumes in the Cascades, combined with rising temperatures and changes in precipitation. Earlier spring snowmelt, lower snowpack, increased evaporative losses, and warmer and drier summer conditions will intensify summer drought conditions and low flow issues in WRIA 10. These climate impacts are expected to drive changes in seasonal streamflows, increasing winter flooding, while intensifying summer low flow conditions (Whitely Binder et. al. 2019). Climate modeling predicts average minimum flows[13] to be 27 percent lower[14] by the 2080s for a moderate warming scenario, relative to 1970-1999 (Mauger et al. 2015).

Glacial melting is a significant factor in maintaining streamflow during dry months. The lowest monthly flow normally occurs in September in most of WRIA 10. However, in higher elevations the lowest flows are often recorded in March, just prior to the beginning of peak snowmelt but before glacial melt water from the alpine areas of Mount Rainier contributes to summer flows.

[13] Average minimum flows, or 7Q10 flows, are the lowest 7-day average flow that occurs on average once every 10 years.
[14] Range: -39 to -16 percent.

Once snowpack is depleted, usually by the end of June, streamflow is then sustained by groundwater contribution and glacial melting (Ecology 1980).

Runoff contribution for most of the basin are measured at a downstream gaging station on the Puyallup River in Puyallup, and indicate a mean annual flow of 3,332 cfs at the USGS stream gage near Puyallup.

There are three water quantity diversion/control structures in the Puyallup-White watershed:

- Mud Mountain Dam is a flood control dam on the White River at river mile (RM) 29.6 operated by the U.S. Army Corps of Engineers (USACE). The dam was constructed solely as a flood control structure, and since 1948 it has provided a mechanism for flood control on the lower Puyallup.
- The Buckley diversion dam[15] is located on the White River at RM 24.3 and diverts water to Lake Tapps and also traps adult salmon to be hauled upstream of Mud Mountain Dam. The diversion dam is operated by the USACE.
- The Electron diversion dam, operated by Electron LLC, diverts water for power generation on the upper Puyallup River near Kapowsin.

The WRIA 10 Instream Resources Protection Program (chapter 173-510 WAC) established instream flows on the Puyallup and Carbon Rivers. The rule protects the river from new permitted water rights by setting minimum flow levels, which are like water rights for the stream. Instream flows do not put water in the streams and do not affect existing (senior) water rights. The rule also creates flow limitations and year-round closures for most streams within the watershed, protecting existing flows from new appropriations.

2.3.4 Salmon Presence and Limiting Factors

The Puyallup River Basin, including the White and Carbon Rivers, have anadromous salmon runs that include four of the five Pacific salmon species (Kerwin 1999; Lead Entity 2018; SWIFD 2020; WDFW 2020). Chinook (*Oncorhynchus tshawytscha*), Coho (*Oncorhynchus kisutch*), Chum (*Oncorhynchus keta*) and Pink salmon (*Oncorhynchus gorbuscha*) migrate in and out of the Puyallup River watershed from Puget Sound. The watershed is also inhabited by Steelhead Trout (*Oncorhynchus mykiss*), Cutthroat Trout (*Oncorhynchus clarki clarki*), and Bull trout (*Salvelinus confluentus*). These Puget Sound salmonids are keystone species that provide a gauge of the health of our watersheds and Puget Sound ecosystem (Kerwin 1999; Lead Entity 2018).

Of these populations, Chinook Salmon and steelhead are federally listed as threatened under the ESA of 1973 (70 FR 37160; 72 FR 26722). Bull Trout are also federally listed by the U.S. Fish and Wildlife Service throughout their range (64 FR 58910). Spring Chinook at the Muckleshoot Tribe's White River Hatchery are also included in the listing (64 FR 14308, March 24, 1999). Table 2 below lists the species present in the Puyallup/White watershed and their regulatory status.

[15] A multimillion dollar project is currently underway to improve fish passage at the Buckley diversion dam.

Table 2 Salmonid Species and Status in the Puyallup River Watershed

Common Name	Scientific Name	Evolutionary Significant Unit	Critical Habitat	Regulatory Agency Status
Chinook Salmon	*Oncorhynchus tshawytscha*	Puget Sound Chinook[16]	Yes/2005	NMFS/Threatened/ 1999
Chum Salmon	*Oncorhynchus keta*	Puget Sound Chum	No	No listing
Coho Salmon	*Oncorhynchus kisutch*	Puget Sound/Strait of Georgia Coho	No	NMFS/Species of Concern/1997
Pink Salmon	*Oncorhynchus gorbuscha*	No listing	No listing	No listing
Steelhead Trout	*Oncorhynchus mykiss*	Puget Sound Steelhead	Yes/2016	NMFS/Threatened/ 2007
Bull Trout	*Salvelinus confluentus*	Puget Sound Dolly Varden/Bull Trout	Yes	USFWS/Threatened/ 1999
Coastal Cutthroat Trout	*Oncorhynchus clarki ssp.*	No listing	No listing	No listing

Table source: Puyallup and Chambers Watersheds Salmon Recovery Lead Entity 2018.

All anadromous salmonid species in the lower Puyallup River migrate out to Puget Sound as juveniles and return upstream as spawning adults. The subbasins within WRIA 10 have various passage and habitat conditions that distribute the species throughout subbasins and tributaries.

Table 3 lists the run timing and life stages of anadromous salmon and trout present throughout the watershed. The following sections describe the general distribution of salmonids in each of these subbasins.

[16] Includes Puyallup River Fall Chinook and White River Spring Chinook.

Table 3 Salmonid Presence and Life History Timing in Puyallup Watersheds

Species	Salmonid Life History and Habitat Utilization in Puyallup Watersheds Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subbasin Presence
Chinook (spring)	Upstream migration													Upper White River Middle White River
	Spawning													
	Incubation													
	Juvenile rearing													
	Fry outmigration													
	Juvenile outmigration													
Chinook (fall)	Upstream migration													All
	Spawning													
	Incubation													
	Juvenile rearing													
	Juvenile outmigration													
Coho	Upstream migration													All
	Spawning													
	Incubation													
	Juvenile rearing													
	Smolt outmigration													
Chum	Upstream migration													Lower White River Lower Puyallup

Species	Salmonid Life History and Habitat Utilization in Puyallup Watersheds Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subbasin Presence
	Spawning													Upper Puyallup Carbon South Prairie Creek
	Incubation													
	Juvenile rearing													
	Juvenile outmigration													
Pink	Upstream migration													Lower White River Lower Puyallup Upper Puyallup Carbon South Prairie Creek
	Spawning													
	Incubation													
	Juvenile rearing													
	Juvenile outmigration													
Bull Trout	Upstream migration													All
	Spawning													
	Incubation													
Coastal Cutthroat Trout	Upstream migration													All
	Spawning													
	Incubation													
	Juvenile rearing													
	Smolt outmigration													
Steelhead Trout (winter)	Upstream migration													All
	Spawning													

Species	Salmonid Life History and Habitat Utilization in Puyallup Watersheds Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subbasin Presence
	Incubation													
	Juvenile rearing													
	Smolt outmigration													

Limiting Factors

Development and population growth in the Puget Sound region has dramatically altered the Puyallup-White Watershed from its historic conditions and natural stream habitat forming processes. The exception is Mount Rainier National Park and the upper Puyallup, White, and Carbon rivers which are predominantly within U.S. Forest Service and private commercial timberlands and have not been developed and urbanized compared to the Puget Sound lowlands. Shoreline armoring has blocked most of the historic nearshore area, estuarine river delta, floodplain, riparian, and forested habitat in the Puyallup-White Watershed. Large expanses of development have introduced impervious surfaces, heavy industry, commercial logging, mining, agriculture, and one of the largest marine ports on the west coast to the area, resulting in habitat loss and degradation.

In general, the primary limiting factors in the Puyallup Watershed include the following:

- Loss of floodplain habitat, wetlands, and connectivity to hyporheic zone.
- Loss of off-channel and side-channel habitat.
- Loss of natural habitat-forming flow regimes.
- Loss of upstream, downstream, and lateral fish passage.
- Loss of riparian corridors, including marine riparian, and floodplain forests.
- Loss of instream habitat complexity and connectivity.
- Loss of large wood.
- Increase in river channelization.
- Loss of spawning and rearing habitat.
- Loss of estuarine and nearshore habitat, including bluffs.
- Loss of good water quality, including appropriate temperature.
- Increase in contamination of water, sediment, and prey resources.

Past and present timber harvest practices in both the upper Puyallup and upper White River watersheds have reduced the ability for riparian areas to provide wood and shade to the river and stream channels and continue to contribute fine sediments from road construction and landslides (Kerwin 1999). Loss of functioning riparian corridors combined with low flows in summer results in high water temperatures that can cause migration barriers and stress that can be lethal to adult and juvenile salmonids, as well as some of their prey resources (Lead Entity 2018).

Revetment and levee systems on portions of the White, Carbon, and Puyallup rivers have removed spawning and rearing habitat for salmon species. Other fish passage barriers including culverts, tide gates, diversion dams, and two hydroelectric facilities located throughout the watershed have further reduced available spawning and rearing habitats (Lead Entity 2018).

The watershed is crisscrossed with railroads, highways, roads, bridges, culverts, and tide gates that further impact habitat. These developments impact water quality via air-borne pollutants, industrial wastewater, stormwater runoff, and contaminated sediments from both past and current industrial activities. Altered flow regimes and extraction of groundwater, increased water temperatures, low dissolved oxygen, pH, nutrients, high turbidity and fine sediments further alter water quality (PRWC 2014).

Chapter Three: Subbasin Delineation

3.1 Introduction

WRIAs are large watershed areas formalized under Washington Administrative Code for the purpose of administrative management and planning. WRIAs encompass multiple landscapes, hydrogeologic regimes, levels of development, and variable natural resources. To allow meaningful analysis of the relationship between new consumptive use and offsets,[17] the plan divides WRIA 10 into subbasins. The plan uses the subbasins to describe the location and timing of projected new consumptive water use, the location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. In some instances, subbasins may not correspond with hydrologic or geologic basin delineations (e.g. watershed divides) (Ecology 2019b).

3.2 Approach to Develop Subbasins

The plan divides WRIA 10 into seven subbasins to assess population growth, consumptive use, and project offsets.[18] The basic considerations in delineating subbasin boundaries for this planning process were:

- Areas of anticipated rural growth.
- Areas where few PE wells are expected.
- Surface hydrology and/or hydrogeology.

Other considerations were:

- Too few subbasins reduce the understanding of relationships between where pumping effects occur and where benefits of offset projects and actions occur.
- Too many subbasins can make it unwieldly to evaluate all of the offset projects and actions needed to achieve a NEB for the WRIA.
- Existing or concurrent planning efforts may have already delineated subbasins.
- Hydrogeologic subbasins (based on groundwater divides instead of surface water divides) can be more complex to delineate, since water in different aquifer units can travel in different directions, and a complete understanding of hydrogeology is lacking.
- Priority areas for salmon recovery.
- Lake Tapps and the location of the intake on the White River.

[17] "Planning groups must divide the WRIA into suitably sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets. Subbasins will help the planning groups understand and describe location and timing of projected new consumptive water use, location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects and actions. Planning at the subbasin scale will also allow planning groups to consider specific reaches in terms of documented presence (e.g., spawning and rearing) of salmonid species listed under the federal Endangered Species Act." Final NEB Guidance p. 7.

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

The plan divides WRIA 10 into seven subbasins, as described in Section 3.3. A more detailed description of the subbasin delineation is in the technical memo available in Appendix F.

3.3 Subbasins

The WRIA 10 subbasin delineations are shown on Figure 3 and summarized below in Table 4:

Table 4 WRIA 10 Subbasins

Subbasin Name	Primary Rivers and Tributaries	County
Carbon River	Carbon River and Voight Creek	Pierce County
Lower Puyallup River	Puyallup River, Fennel Creek, Rody Creek, Clear Creek, Wapato/Simons Creek	Pierce County
Lower White River	White River	Pierce County and King County
Middle White River	White River, Clearwater River, Boise Creek	Pierce County and King County
South Prairie Creek	South Prairie Creek, Wilkeson Creek	Pierce County
Upper Puyallup River	Mowich River, North Puyallup River, South Puyallup River, Ohop Creek, Puyallup River. Kapowsin Creek	Pierce County
Upper White River	West Fork White River, Greenwater River	Pierce County and King County

The following section contains a brief description of the subbasins, salmonid presence, and limiting factors.

3.3.1 Carbon River

The Carbon River subbasin produces Chinook, Pink, Chum, and Coho Salmon and contains spawning areas for each of these species. Steelhead and Cutthroat Trout spawning, rearing, and migration are also present (SWIFD 2020; WDFW 2020). Bull Trout are present in the Carbon River subbasin; WDFW documented some spawning in the upper watershed in the mountains (Kerwin 1999; WDFW 2020).

Poorly designed and/or constructed culverts act as barriers to adult and juvenile salmonid migration on a few tributaries and act as total passage problems. Some are the result of low flows or represent partial barriers based upon water velocities (Kerwin 1999). Historical timber harvest activities have resulted in the loss of riparian old growth conifer trees that served as the source of short and long-term recruitment of functional sized wood pieces. The virtual lack of large woody debris is believed to be a limiting factor in providing channel stability and habitat necessary for successful salmonid production (Kerwin 1999; Puyallup River Watershed Council 2014).

3.3.2 Lower and Upper Puyallup

The lower and upper Puyallup River subbasins are inhabited by Chinook, Coho, Chum, and Pink salmon, as well as steelhead, Cutthroat Trout, and Bull Trout (SWIFD 2020; WDFW 2020). The Puyallup River Fall Chinook salmon and the White River Spring Chinook salmon use the Puyallup River, including the Puyallup River estuary and nearshore areas of Commencement Bay. Salmonids are present in habitat that supports their critical life history phases throughout the Puyallup-River in every month of the year (see Table 3).

The lower Puyallup River is generally contained in formal channelized banks and extensive levees with little to no bank cover or overhanging vegetation. Tidal influence extends about seven miles upstream from the mouth. Channelization and the loss of riparian and off-channel habitats have extensively altered the lower Puyallup River (Lead Entity 2018). Large woody debris is virtually absent in the lower Puyallup subbasin and river habitat lacks complexity. The extensive channelized nature of the mainstem of the Puyallup River through this reach serves as a salmonid transportation corridor with only limited rearing habitats available to salmonids (Kerwin 1999).

3.3.3 Lower, Upper, and Middle White

The White River is inhabited by Chinook, Coho, Chum, and Pink salmon, as well as steelhead, Cutthroat Trout, and Bull Trout (SWIFD 2020; WDFW 2020). The White River Spring Chinook is the only remaining spring Chinook salmon stock found in the South Puget Sound (PRWC 2014; Lead Entity 2018). The majority of documented spawning occurs in the larger clear water tributaries to the White River, including the Greenwater and Clearwater rivers, and Huckleberry and Boise creeks (PRWC 2014).

Downstream of Mount Rainier National Park boundary, the mainstem and many tributaries flow through industrial forestlands. There is a high road density in this timber production area. High road density can contribute to increased sedimentation, landslides, slope failures, changes in hydrology, and culverts preventing upstream migration in affected drainages (Marks et al. 2016). Mud Mountain Dam impedes natural habitat forming processes by blocking downstream input of large wood that starves the lower watershed of crucial habitat building materials (PRWC 2014).

3.3.4 South Prairie Creek

South Prairie Creek is one of the most important tributaries for salmon production in the Puyallup-White watershed (PRWC 2014). The South Prairie Creek subbasin contains important remaining spawning habitat for the watershed. Steelhead trout, Chinook, Pink, Coho and Chum Salmon all successfully reproduce within this subbasin (SWIFD 2020; WDFW 2020).

The lower 5 miles of South Prairie Creek and a 1-mile segment on Wilkeson Creek in the town of Wilkeson have been channelized and contained within levees (Kerwin 1999). These diked reaches have caused increased water velocities on the lower South Prairie and Wilkeson Creek channels and degraded salmonid habitat.

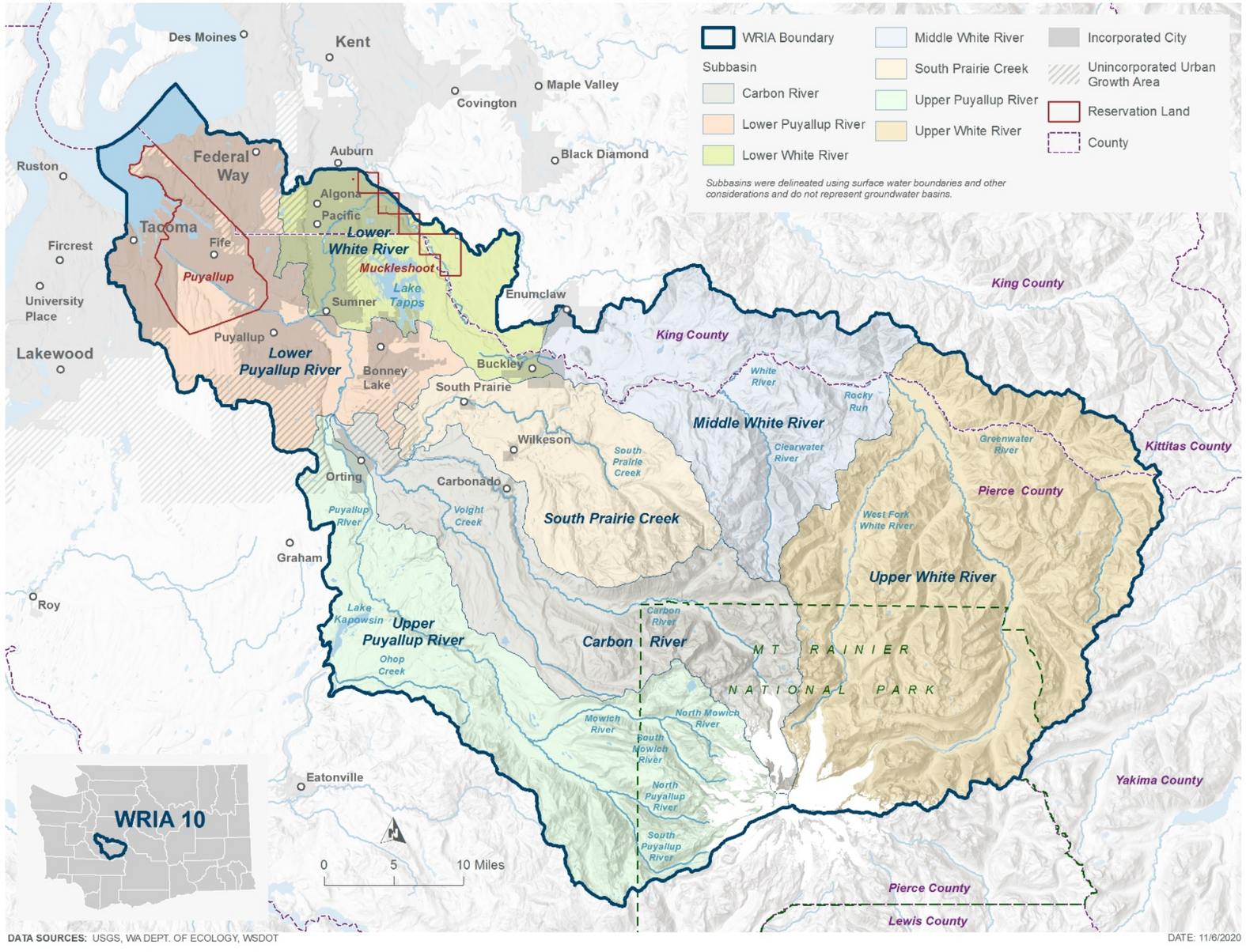

Figure 3 WRIA 10 WRE Subbasin Delineation

Chapter Four: New Consumptive Water Use Impacts

4.1 Introduction to Consumptive Use

The Streamflow Restoration law requires watershed plans to include "estimates of the cumulative consumptive water use impacts over the subsequent twenty years, including withdrawals exempt from permitting under RCW 90.44.050" (RCW 90.94.030(3)(e)). The Final NEB Guidance states that, "Watershed plans must include a new consumptive water use estimate for each subbasin, and the technical basis for such estimate". This chapter describes the projections of new PE well connections and their associated consumptive use for the planning horizon.[19] This chapter summarizes information from the technical memos (Appendices F and G) prepared for this plan.

4.2 Projection of PE Well Connections (2018–2038)

The plan projects 688 PE wells over the planning horizon. Installation of most of these wells is likely to occur in the urban fringe of the watershed between Enumclaw and Orting, and east of Lake Tapps.

The new PE wells projected over the planning horizon in WRIA 10 is part of the formula to estimate new consumptive water use. The methods were based on recommendations from Appendix A of Ecology's Final NEB Guidance. The following sections provide the 20-year projections of new PE wells for each subbasin within WRIA 10, the methods used to develop the projections, and the uncertainties associated with the projections.

4.2.1 PE Well Connections Projection by Subbasin

This watershed plan compiles growth projection data for Pierce and King counties at both the WRIA scale and by subbasin. The projection for new PE wells in WRIA 10 by subbasin is shown in Table 5 and Figure 4.

[19] New consumptive water use in this document is from projected new homes connected to PE wells associated with building permits issued during the planning horizon. Generally, new homes will be associated with wells drilled during the planning horizon. However, new uses could occur where new homes are added to existing wells serving group systems under RCW 90.44.050. In this document, the well use discussed refers to both these types of new well use. PE wells may be used to supply houses, and in some cases other Equivalent Residential Units (ERUs) such as small apartments. For the purposes of this document, the terms "house" or "home" refer to any permit-exempt domestic groundwater use, including other ERUs.

Table 5 Number of PE Wells Projected between 2018 and 2038 for the WRIA 10 Subbasins

Subbasin	King County	Pierce County	Total
Carbon River	--	109	109
Lower Puyallup River	--	102	102
Lower White River	24	52	76
Middle White River	57	--	57
South Prairie Creek	--	167	167
Upper Puyallup River	--	165	165
Upper White River	--	12	12
WRIA 10 Total	**81**	**607**	**688**

Growth projections resulted in approximately 81 new PE wells in unincorporated King County within WRIA 10 and approximately 607 PE wells within incorporated cities and unincorporated areas of WRIA 10 in Pierce County over the planning horizon. The total projection for WRIA 10 is 688 new PE wells.

4.2.2 Methodology

This plan uses a different method for calculating the PE well projections within each county based on available data and county preference. The King County-based projections use historical building permit data and the Pierce County-based projections use historical well permit data. Both of these methods are summarized in this section. WRIA 10 Permit-Exempt Growth and Consumptive Use Summary (Appendix G) offers a more detailed description of the methods incorporated into this plan.

Growth Projection Methodology within King County

Historical building permit data from 2000 through 2017 were used to project the number of new PE wells for the planning horizon in unincorporated King County. This data set considers economic and building trends over an 18-year period and the methodology assumes that past trends will continue.

The number of new PE wells over the planning horizon using the following steps summarized from the King County Growth Projections Memo 2019 (Appendix G):

1. Compile 18 years (2000-2017) of building permit data for new residential structures and separate into public, private, and unknown water sources. Consider a building permit with water source listed as “private” as a PE well.
2. Calculate the annual average number of PE wells.
3. Estimate the total number of PE well connections anticipated over the 20-year planning horizon by multiplying the annual average number of PE wells by 20.
4. Allocate the new PE wells within each subbasin. Use GIS to assess potential areas for future residential development dependent on PE wells.

Growth Projection Methodology within Pierce County

The method for Pierce County used PE well installation data from the Tacoma-Pierce County Health Department (TPCHD) between 1999 and 2018 to project the number of new PE wells in the planning horizon. This method has several advantages:

- The TPCHD location data is accurate to parcel level and includes individual, shared, and Group B wells.[20]
- The database includes all wells in the county, including wells constructed within city limits and within Group A water service area boundaries.
- This dataset includes attributes such as the year the well was installed and the parcel on which the well was installed.

The following steps to project growth of PE well connections over the planning horizon were used:

1. Calculate historical growth rates of PE wells for each subbasin using the TPCHD well database (1999–2018).
2. Project future PE wells by subbasin for the planning horizon, based on the subbasin-specific historical growth rate.

4.2.3 Summary of Uncertainties and Scenarios

The methods described above for projected new PE wells include a number of uncertainties and limitations. The Committee discussed these uncertainties and recognized that uncertainties are inherent to the planning process. This section presents the uncertainties and limitations considered during the planning process and the steps taken to address or acknowledge the uncertainties.

One limitation is that the projection for King County does not account for PE wells installed within city limits. Although most cities require new homes to connect to water systems, they allow exceptions (for instance, if a home is more than 200 feet from a water line). This limitation is counteracted by the understanding that water lines and water service areas continue to expand. This limitation did not apply in Pierce County because PE well data included both incorporated and unincorporated areas.

The projections for both Pierce and King Counties relied on historical data. Areas that were not served by public water in 2000 might be served now or within the planning horizon, shrinking the areas where PE wells can still be installed. Since water line data is not readily available, the Committee was not able to compare actual water lines with the historical data to see where the water service has expanded in the past 20 years.

[20] The TPCHD permits PE wells during the subdivision and building permit process. TPCHD imposes limits on well withdrawals that are lower than the 950 gallon limit for subdivision projects. Based on their information, average water use is 400 gallons per day. TPCHD allows up to 12 lots in a subdivision if each lot is served by an individual well. Those wells are limited to using 400 gallons per day. Subdivisions served by Group B PE wells can have up to six connections and each connection can use up to 750 gallons per day.

The methods assumed that historical growth trends would continue into the future. However, many factors play into homebuilding trends. To acknowledge this uncertainty, the Committee developed PE well growth rates using different time-periods in the historical TPCHD well database. These time periods reflected the rapid rural development from 1999-2008 and the slower rural development from 2009-2018 (Table 6). Ultimately, this plan uses the projection based on the full historical record (1999-2018) because this moderate projection captured likely variations of development trends over the planning horizon.

Table 6 Number of PE Well Connections Projected between 2018 and 2038

Subbasin	Moderate Growth (1999-2018)			High Growth Scenario (1999-2008)			Low Growth Scenario (2009-2018)		
	King	Pierce	Total	King	Pierce	Total	King	Pierce	Total
Carbon River	--	109	109	--	142	142	--	87	87
Lower Puyallup River	--	102	102	--	153	153	--	53	53
Lower White River	24	52	76	24	67	91	24	42	66
Middle White River	57	--	57	57	--	57	57	--	57
South Prairie Creek	--	167	167	--	229	229	--	122	122
Upper Puyallup River	--	165	165	--	242	242	--	104	104
Upper White River	--	12	12	--	4	4	--	20	20
Total	**81**	**607**	**688**	**81**	**838**	**919**	**81**	**429**	**510**

4.2.4 Spatial Distribution of New PE Wells

This plan maps potential locations of new PE wells in the watershed based on parcels available for rural residential development to validate the PE well projection. These parcels are outside of Urban Growth Areas, outside of water and wastewater system boundaries, vacant, currently zoned for residential development, and not located within a commercial or national forest. The resulting map (Figure 4) shows the most likely areas that new residential development dependent on PE wells will occur. Most opportunity for new PE wells is within the unincorporated areas adjacent to the urban growth areas.

4.2.5 Projected Growth Map

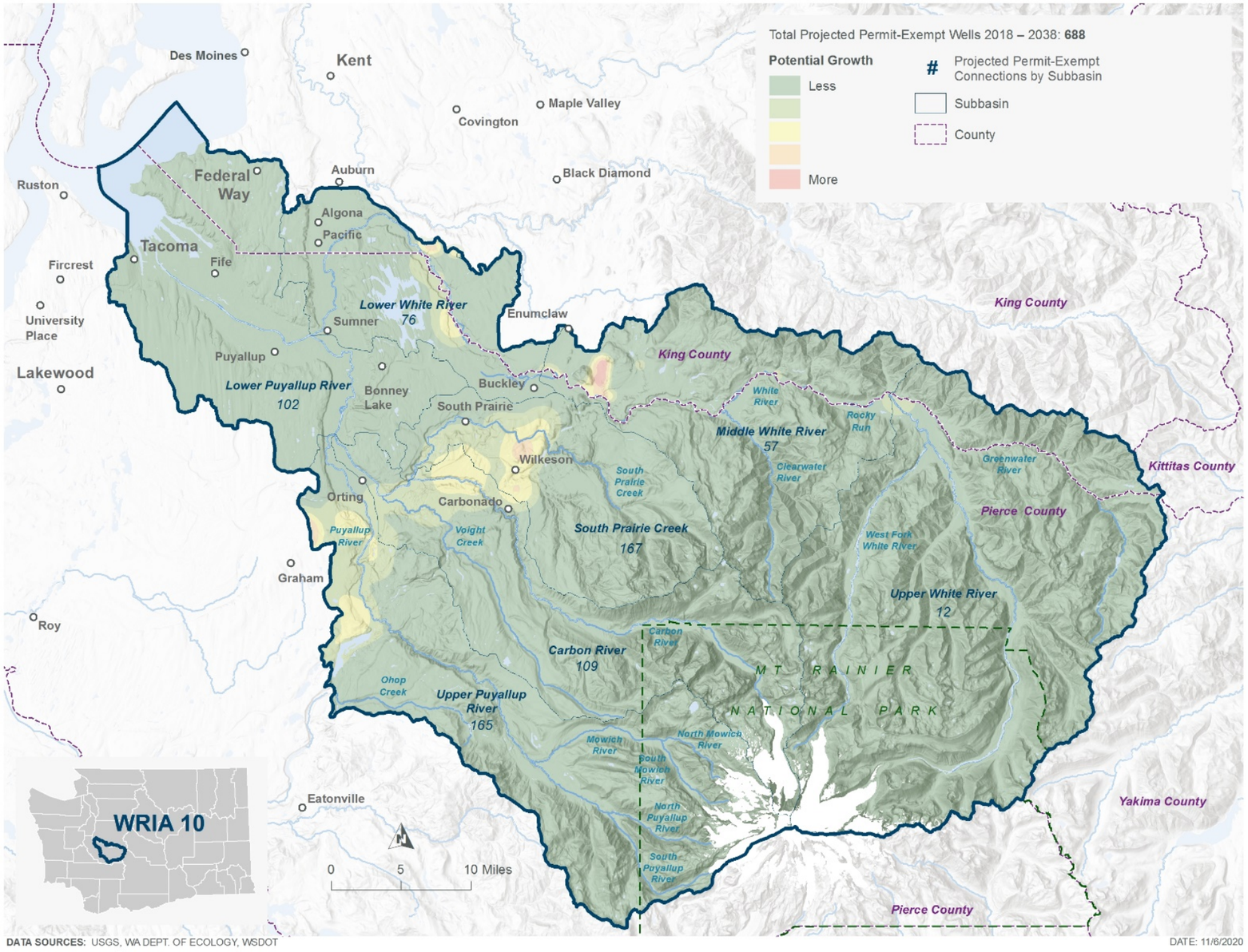

Figure 4 WRIA 10 WRE Distribution of Projected PE Wells

4.3 Impacts of New Consumptive Water Use

The plan uses the moderate projection of new PE wells (688) to estimate the consumptive water use that this watershed plan must address and offset. At the end of the planning horizon (i.e., 2038) the analysis estimated 277.4 acre-feet per year (0.38 cfs) of new consumptive water use in WRIA 10. This section includes an overview of the method used to estimate new consumptive PE well water use (consumptive use), an overview of the anticipated impacts of new consumptive PE well use in WRIA 10 over the planning horizon, and other considerations, such as assumptions and uncertainties.

Consistent with the Final NEB guidance, the plan assumes impacts from consumptive use on surface water are steady-state, meaning impacts to the stream from pumping do not change over time. This assumption is based on the wide distribution of future PE well locations and depths across varying hydrogeological conditions. As Appendix B of the Final NEB Guidance notes, the lag time between when the pumping occurs and when it impacts the stream makes estimating the temporal impacts of PE wells complicated to estimate.

The WRIA 10 Permit-Exempt Growth and Consumptive Use Summary provides a more detailed description of the analysis and alternative scenarios considered (Appendix G).

4.3.1 Methodology to Estimate Indoor and Outdoor Consumptive Water Use

Indoor water use patterns differ from outdoor water use. Indoor use is generally constant throughout the year, while outdoor use occurs primarily in the summer months. The portion of water that is consumptive varies for indoor and outdoor water use. Appendix A of the Final NEB Guidance describes a method (referred to in this plan as the Irrigated Area Method) which assumes average indoor water use per person per day, and reviews aerial imagery to provide a basis to estimate irrigated area of outdoor lawns and gardens. The Irrigated Area Method accounts for indoor and outdoor consumptive use variances by using separate approaches to estimate indoor and outdoor consumptive use.

To calculate the consumptive use estimate, the analysis used the Irrigated Area Method and relied on assumptions for indoor use and outdoor use from Appendix A of the Final NEB Guidance (Ecology 2019b).

To understand the full range of potential water use in WRIA 10, the analysis includes consumptive use estimates based on water system data and the legal withdrawal limit.[21] Some individual homeowners use water approaching or surpassing the legal limit during irrigation season.[22] Other homeowners do not irrigate at all. The Committee determined that these calculations did not accurately portray PE well water use in the watershed. The Committee considered the legal withdrawal limit was too much water for most homeowners to use each

[21] Legal withdrawal limits from PE wells in WRIA 10 are defined in RCW: "an applicant may obtain approval for a withdrawal exempt from permitting under RCW 90.44.050 for domestic use only, with a maximum annual average withdrawal of nine hundred fifty gallons per day per connection" RCW 90.94.030(4)(a)(vi)(B)

[22] Covington Water System data shows individuals using up to 2,673 gallons per day during the irrigation season.

day. Since there are costs associated with water systems, and water systems actively employ water conservation incentives, the Committee assumed that the water system data was most likely an underestimate of PE well water use. These calculations are provided in Appendix G.

New Indoor Consumptive Water Use

Indoor water use refers to the water that households use in kitchens, bathrooms, and laundry (USGS 2012). The plan uses Ecology's recommended assumptions for indoor daily water use per person and local data to estimate the average number of people per household, and then applied Ecology's recommended consumptive use factor (CUF) to estimate new indoor consumptive water use (Ecology 2019b).

- 60 gallons per day (gpd) per person.
- 2.5 persons per household assumed for rural portions of WRIA 10 (OFM 2020).
- 10 percent of indoor use is consumptively used (or a CUF of 0.10), based on the assumption that homes on PE wells are served by on-site sewage systems. On-site sewage systems return most wastewater back to the immediate water environment; a fraction of that water is lost to the atmosphere through evapotranspiration in the drainfield.

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

60 gpd x 2.5 people per house x 365 days x 0.10 CUF

This calculation results in an annual average of 15 gpd, or 0.017 AF[23] (0.000023 cfs[24]) indoor consumptive water use per PE well.

New Outdoor Consumptive Water Uses

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

Aerial imagery was used to measure the irrigated areas of 80 randomly selected parcels served by PE wells to develop an average outdoor irrigated area. This analysis returned a large number of parcels with no visible irrigation; these parcels were assigned irrigated area values of zero. To account for undetected irrigation or potential outdoor water use other than irrigation, the analysis replaced the zero values with a value of 0.05 acres. An imputed value of 0.05 acres was used because that was the lower end (i.e., < 10th percentile) of measurable irrigated areas in WRIA 10. Using the replacement value of 0.05 acres, the average (sample mean) irrigated area for the 80 randomly selected parcels was 0.21 acres. The analysis then calculates the 95 percent

[23] Acre-Foot is a unit of volume for water equal to a sheet of water one acre in area and one foot in depth. It is equal to 325,851 gallons of water. One acre-foot per year is equal to 893 gallons per day.
[24] Cubic feet per second (cfs) is a rate of the flow in streams and rivers. It is equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. One cubic foot per second is equal to 646,317 gallons per day.

upper confidence limit (UCL)[25] of the sample mean to account for uncertainty associated with the limited survey of parcels with existing PE wells. The 95 percent UCL equaled 0.27 acre. This method is further described in Appendix G.

The analysis used following assumptions, recommended in the NEB Guidance, to estimate outdoor consumptive water use:

- Crop irrigation requirements (IR) for turf grass according to Washington Irrigation Guide (WAIG) (NRCS 1997): 16.01 inches per year (weighted average of Buckley and Puyallup WAIG stations). This value represents the rate of watering needed for commercial growth turf grass (see Section 4.3.2 for further discussion).
- An irrigation application efficiency (AE) to account for water that does not reach the turf: 75 percent. This increases the amount of water used to meet the crop's irrigation requirement by 25 percent.
- Consumptive use factor of 0.8, reflecting 80 percent consumption for outdoor use. This means 20 percent of outdoor water is returned to the immediate water environment.
- Outdoor irrigated area based on existing homes using PE wells: 0.27 acre (95 percent UCL from the statistical analysis of irrigated area of existing homes).

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

16.1 IR (inches)/12 (inches per foot)/(0.75 AE) x 0.27 (acre) x 0.80 CUF

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

This calculation results in an annual average of 345 gpd, or 0.386 AF (0.000535 cfs) outdoor consumptive use per PE well.

The annual average consumptive water totals 360 gpd or 0.403 AF (0.00056 cfs) per PE well for the WRIA. This is an average for the year, however the plan expects that more outdoor water use will occur in the summer than in the other months. The outdoor consumptive use varies by subbasin due to different irrigation requirements across the watershed.

4.3.2 Uncertainties and Limitations

The Irrigated Area Method contains a number of uncertainties and limitations. The Committee discussed these uncertainties and limitations and accepted that the estimates produced by the analysis were satisfactory for projecting consumptive water use in the WRIA. This section describes the uncertainties and limitations, and the actions taken to resolve, address, or acknowledge those uncertainties and limitations.

[25] The 95 percent UCL is the sample mean plus the 95 percent confidence error. Therefore, there is a 95 percent chance that the true mean is equal to or less than the 95 percent UCL.

To reduce uncertainty, the analysis relied on existing data to the extent possible, such as the average number of people per household and information from studies that estimate average indoor water use per person.

The outdoor consumptive use calculation contains the most uncertainty. Some Committee members voiced concern on the lack of scientific rigor in the outdoor irrigated area analysis. The average outdoor irrigated area analysis relied on a sample size of 80 parcels distributed by location and property values. This small sample size relative to the number of parcels within WRIA 10 could lower the scientific certainty of the results. To acknowledge the concern, the Committee calculated the 95 percent upper confidence limit under the assumption that the average irrigated area would likely be lower than the 95 percent upper confidence limit. Using the 95 percent upper confidence limit likely resulted in a conservative estimate of consumptive use.

Other factors of uncertainty in the outdoor consumptive use calculation are the assumptions about irrigation amounts and irrigation efficiencies. The calculation assumes that homeowners water their lawns and gardens at the rate needed for commercial turf grass (i.e., watering at rates that meet crop irrigation requirements according to the Washington Irrigation Guide). The irrigated area analysis demonstrated that many people irrigate their lawns enough to keep the grass alive through the dry summers, not at the levels that commercial turf grass requires. Therefore, this plan assumes that the analysis for outdoor consumptive use was likely an overestimate.

The analysis accounted for the uncertainties, assumptions, and limitations in this method by using outdoor irrigation values at the high end of their ranges. This included assigning an irrigated lawn size of 0.05 acres to parcels with no detected irrigation, using the upper limit of the 95 percent confidence interval for outdoor irrigated area, and assuming water use rates necessary for commercial growth of turf grass. This approach provides assurance that if projects and actions in the plan are successfully implemented, the projects will offset more than the actual water consumed.

4.3.3 Summary of Consumptive Use Estimates

The total consumptive use estimate for WRIA 10 is 277.4 acre-feet per year and 0.38 cubic feet per second. This amount is equivalent to 360 gallons per day per PE well. The total consumptive use estimate for WRIA 10 is the PE well projection (Section 4.2) multiplied by the total indoor and outdoor consumptive use per PE well. Table 7 summarizes the estimated indoor and outdoor consumptive use by subbasin. The highest consumptive use is expected to occur in the subbasin with the most projected new PE wells, as presented in Figure 5.

Table 7 Indoor and Outdoor Consumptive Use Estimates by Subbasin

Subbasin	Projected PE wells	Indoor CU		Outdoor CU		Total CU/year in 2038	
		Acre-feet per year	Gallons per day	Acre-feet per year	Gallons per day	Acre-feet per year	Gallons per day
Carbon River	109	1.83	1,634	42.11	37,593	43.9	39,191
Lower Puyallup River	102	1.71	1,527	39.41	35,183	41.1	36,692
Lower White River	76	1.28	1,143	29.36	26,211	30.6	27,318
Middle White River	57	0.96	857	22.02	19,658	23.0	20,533
South Prairie Creek	167	2.81	2,509	64.52	57,600	67.3	60,082
Upper Puyallup River	165	2.77	2,473	63.75	56,912	66.5	59,367
Upper White River	12	0.20	179	4.64	4,142	4.8	4,285
TOTAL	**688**	**11.6**	**10,356**	**265.8**	**237,291**	**277.4**	**247,647**

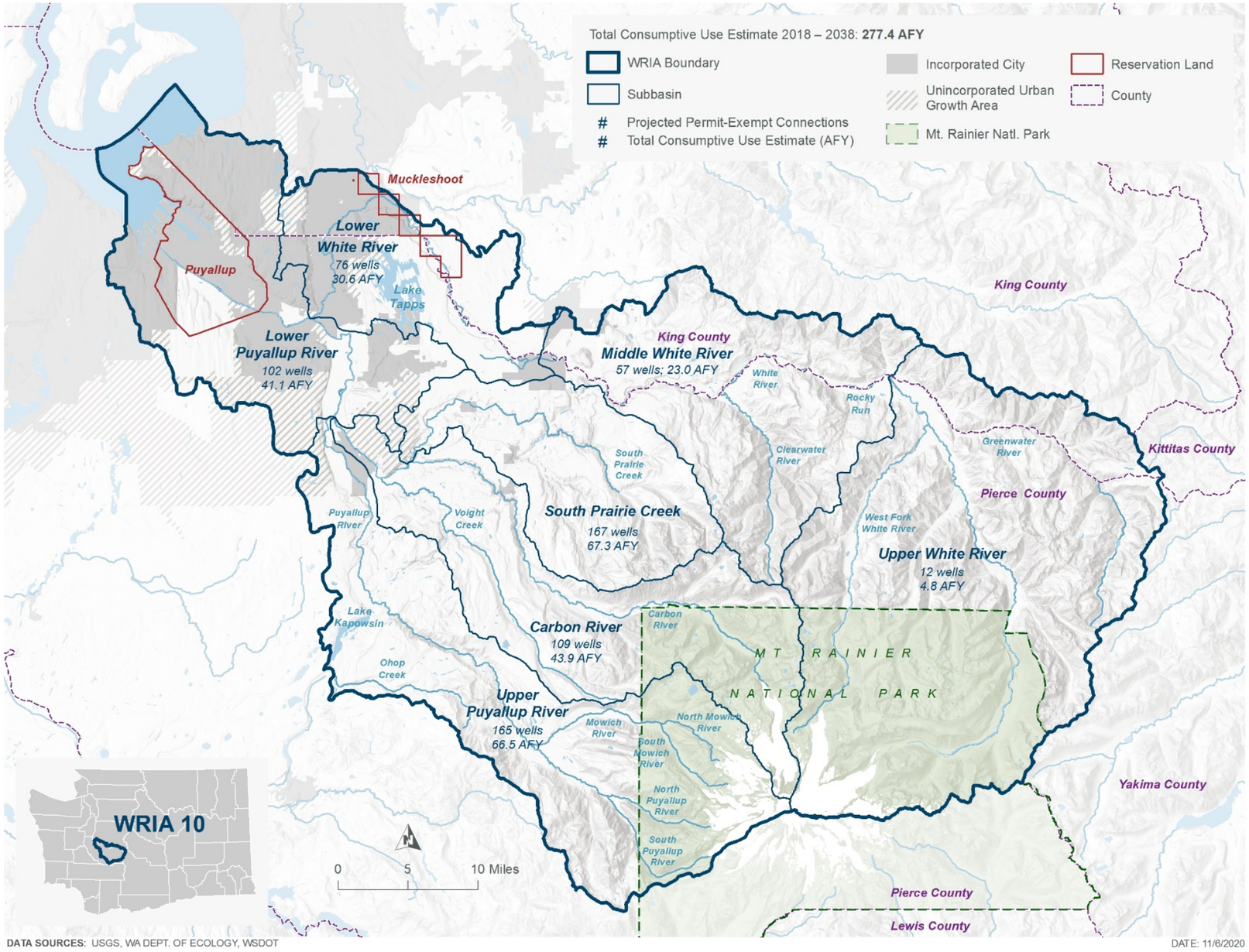

Figure 5 WRIA 10 Consumptive Use Estimate by Subbasin

Chapter Five: Projects and Actions

5.1 Description and Assessment

Watershed plans must identify projects that offset the potential impacts future PE wells will have on streamflows, and provide a NEB to WRIA 10. This chapter classifies projects as water offset projects, habitat projects, and programmatic actions. Water offset projects contribute to offsetting consumptive use. Habitat projects contribute toward achieving NEB by focusing on actions that improve the ecosystem function and resilience of aquatic systems, support the recovery of threatened or endangered salmonids, and protect instream resources including important native aquatic species. Habitat projects may also result in an increase in streamflow, but the water offset benefits for these projects are difficult to quantify with a high degree of certainty. Therefore, the plan does not rely on habitat projects to contribute toward offsetting consumptive use, however it recognizes they are still of value and therefore should be included in the plan. Programmatic actions are non-capital projects that are implemented at a subbasin or larger scale, increase knowledge of water use in the WRIA, and contribute to water conservation. While some of the programmatic actions may contribute to a lower overall consumptive use in the watershed, the benefits of these actions are widely dispersed and difficult to quantify. This chapter provides recommendations for projects to offset consumptive use and meet NEB.

To identify the projects summarized in this chapter, as well as the complete project inventory in Appendix H, Committee members and partners brought project suggestions forward to the workgroup and Committee for discussion. Potential projects with likely streamflow and habitat benefits came from the Puget Sound Action Agenda and salmon recovery lead entity four-year work plans. The Committee tracked all project ideas, no matter their phase of development, throughout the planning process. Ecology sought feedback on projects that align with other planning processes from Committee members that also represented the conservation district, PWR-LIO, and salmon recovery lead entity in WRIA 10.

The plan focuses on water right acquisition projects and other direct water replacement projects when available. Section 5.2.1 provides details on these water offset projects. The Committee focused on projects or project phases planned for future construction, and removed projects that did not directly contribute to water offset or NEB. The plan does not include projects that conflicted with current laws, rules, or case law. At any point in the process, Committee members or partners could identify concerns and recommend removal of specific projects from the project inventory. The Committee identified a subset of projects (at least one in each subbasin) for the technical consultants to develop detailed analysis on, including the offset value to attribute to each project as applicable.

5.2 Projects

The projects presented below have quantifiable streamflow benefit or habitat improvement and the Committee identified these projects as having the greatest potential for implementation and meeting NEB. The complete project inventory in Appendix H includes other projects that benefit streamflow and habitat in WRIA 10, but which the Committee did not have

the time and resources to further develop and assess within the given timeline. The Committee recommends implementation of all projects included in this chapter and Appendix H.

5.2.1 Water Offset Projects

This plan includes projects that the WRIA 10 Committee members support and consider feasible to accomplish within the planning horizon. Table 8 provides a summary of the water offset projects considered necessary to offset the consumptive use from PE wells over the planning horizon.

The plan focuses primarily on water right projects because water rights placed in permanent trust provide reliable, durable, and legally protected offsets. Several Committee members and partners identified potential water right acquisition opportunities throughout the watershed that would provide sufficient offset. The Tribes, WDFW, and salmon recovery lead entity developed a list of 10 priority streams to focus water right acquisition assessments (Appendix J).

Ecology contracted with Washington Water Trust (WWT) to identify opportunities for water right acquisition water offset projects within WRIA 10 and to develop information on Committee-identified water rights. In coordination with the Committee, WWT developed a water right selection criterion based on the unique local nature of water rights and water use in WRIA 10. The assessment focused on water rights within the 10 priority streams and outside of the agriculture and rural resource zoning districts. The water rights assessment consisted of four categories of potential projects: irrigation water rights in priority subbasins, irrigation water rights near existing reclaimed water infrastructure, water rights in the Trust Water Rights Program as a temporary donation, and specific water right acquisition opportunities identified by Committee members. WWT developed eleven water right acquisition project opportunity profiles for plan consideration.

Committee members conducted outreach to water right acquisition opportunities to assess the interest of the water right holder to be included in the project list. Due to the sensitive nature of water rights, only water rights with ongoing outreach are referred to by a project name. Several water rights within this list are in the process of being transferred to the project sponsor or associated with properties identified for acquisition as part of long-term planning processes.

This project list includes several levee setback and floodplain reconnection projects. While these projects may involve some additional infiltration and water storage during high flows, the Committee expressed concerns about estimating the storage and offset benefit, and opted not to count those benefits toward the project offset. However, the Committee recognized that these projects include large property acquisitions and decommissioning of existing PE wells. This plan counts the removal and decommissioning of PE wells towards the offset total.

Finally, the Committee searched for opportunities for Managed Aquifer Recharge (MAR) and other infiltration projects. MAR projects capture water from seasonal high flows and allow the water to slowly infiltrate through groundwater back to the stream, augmenting streamflows

during low flows. A search within the Carbon and Upper Puyallup subbasins[26] for geology favorable for MAR infiltration did not yield any suitable sites. After much consideration, the Committee looked at the possibility of using municipal water as a source for MAR projects, and basing potential locations at gravel pits along the Tacoma Water pipeline. This search yielded three potential locations for an MAR project.

The water offset projects listed in this plan are sorted into tiers. Tier 1 projects represent projects with the greatest certainty of being implemented. These projects have specific locations, project sponsors, and in some cases are already underway. Tier 2 projects have less certainty because they are less developed, lack project sponsors, or lack specific locations at this time. The Tier 1 projects will offset the consumptive use in WRIA 10. The water offset estimates from the Tier 2 projects provide reasonable assurance that the plan can meet NEB if Tier 1 offsets are not realized. The projects in this plan provide an estimated 788.3 acre-feet per year in offsets, more than double the consumptive use estimate of 277.4 acre-feet per year. Tier 1 projects provide an estimated 375.3 acre-feet per year in offsets. Figure 6 shows the locations within the watershed of the Tier 1 and Tier 2 projects.

[26] The Upper Puyallup and Carbon Rivers are not closed to surface water appropriation per WAC 173-510

Table 8 WRIA 10 Offset Projects

Project Number	Project Name	Project Type and Brief Description	Water Offset (AFY)	Timing of Water Offset	Additional Benefits	Project Sponsor	Tier
Carbon River (CR)							
10-CR-W4	Alward Road	Levee Setback. Property acquisition and restoration of 150 acres of floodplain. Includes decommission of 20 PE wells	8	Year-round	Restoration of 150 acres of floodplain, flood hazard reduction	Pierce County	1
10-CR-W3	Carbon River Levee Setback and Acquisition	Water Right and Levee Setback. Purchase a property as part of a larger levee setback project and acquire associated water right.	14.3	Irrigation Season	Habitat restoration.	Pierce County	2
Lower Puyallup (LP)							
10-LP-W6	Potential MAR	MAR. Construct an MAR in a gravel pit supplied with Tacoma Water. Three potential locations are identified in the Lower Puyallup.	300	Year-round		TBD	2
10-LP-W10	Bond	Water Right. Acquire water right as part of a larger property transfer and protection with the City of Puyallup	30	Irrigation Season		City of Puyallup	2
Middle White (MW)							
10-MW-W7	CWA purchase	Water Right. Acquire a portion of the Cascade Water Alliance water right to place in trust.	277	Year-round		Potential: Ecology or partners	1
South Prairie Creek (SPC)							
10-SPC-W2	Old Inglin Dairy	Water Right. Floodplain restoration of former dairy, and place water rights into trust after plants are established.	89.09	Irrigation Season	Floodplain restoration/reconnection, habitat enhancement.	Pierce Conservation District	1
Upper Puyallup (UP)							

Project Number	Project Name	Project Type and Brief Description	Water Offset (AFY)	Timing of Water Offset	Additional Benefits	Project Sponsor	Tier
10-UP-W1	Orville Road Revetment Phase 2C Year 1	Floodplain Reconnection/Levee Setback. Purchased and decommission a PE well that served 3 homes as part of this project.	1.2	Year-round	Habitat restoration. 1,500 Linear Feet of setback revetment, 19 engineered log jams.	Pierce County	1
WRIA-Wide (WW)							
10-WW-W8	Green Stormwater Infrastructure	Stormwater infiltration. Support Green Stormwater Infrastructure retrofits for both individual property owners and jurisdictions. Goal of 10 projects per year.	27	Year-round	Water quality improvements	Pierce Conservation District	2
10-W9-W17	WWT assessment	Water Right. Acquire 10% of the water rights identified through Washington Water Trust assessment. These rights are listed individually in this table.	41.71	Irrigation Season		TBD	2
		WRIA 10 Total Water Offset	**788.3**				
		WRIA 10 Consumptive Use Estimate	**277.4**				
		Tier 1 Offsets	**375.3**				

Carbon River Subbasin

Project Name: Alward Road Acquisition and Restoration

Project Description: Pierce County proposes to acquire property, construct a setback levee and make other restoration improvements which will reconnect 150 acres of floodplain adjacent to the Carbon River. The acquisition area of the proposed project is located between river miles 6.8 and 8.0 of the Carbon River. Proposed actions at the site include removing approximately 8,925 linear feet of existing levee located along the left (south) bank of the Carbon River. An armored levee of approximately 9,850 linear feet would be constructed and set back from the Carbon River to the south, encompassing an area of approximately 142 acres. Engineered log jams (ELJs) would be constructed alongside Alward Road to protect it from erosion. Riparian restoration would also occur in floodplain areas. The habitat benefits of this project include reconnecting previously disconnected floodplain, increasing fish habitat diversity in the lower Carbon River, and restoring channel forming processes in the reach.

A total of 30 properties will be acquired as part of this project. Outreach has occurred and landowner agreements have been signed for 10 properties in Phase 3 of the project. Additional outreach will occur in subsequent phases. An estimated 20 residential structures will be acquired and removed, providing an estimated water offset benefit equal to 20 new PE wells, or 8 acre-feet per year. This project is Tier 1 because it is underway and expected to continue to be implemented.

Project Name: Carbon River Future Levee Setback and Acquisition.

Project Description: Pierce County is currently conducting a feasibility study to increase flood protection and improve fish habitat conditions on the Carbon River near Bridge Street and Voights Creek. Elements of this project include selecting a preferred alternative, designing the project, acquiring properties, building a setback levee, adding habitat elements in the floodplain, and removing the existing levee. The habitat benefits of this project include reconnecting previously disconnected floodplain, increasing fish habitat diversity in the lower Carbon River, and restoring channel forming processes in the reach.

As part of the project, Pierce County anticipates acquiring a property and associated water rights upstream of river mile 4.4. The property is associated with a water right certificate. WWT used irrigation delineation analysis to estimate 9.71 acres have been irrigated in recent years. Using the same calculation that estimated this plan's consumptive use, this water right would be able to offset an estimated 14.3 acre-feet per year. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology is required to determine the actual quantity available for acquisition.

This project is Tier 2 because landowner outreach has lost momentum. Due to the sensitive nature of property and water right acquisition negotiations and the timing of this plan, this plan does not identify the specific location or property owner. Pierce County as expressed interest in placing the water right in permanent trust once the property is acquired.

Lower Puyallup Subbasin

Project Name: Managed Aquifer Recharge

Project Description: This project would construct a passive MAR project using source water from Tacoma Water pipeline to recharge a significant volume of water into shallow aquifers. In WRIA 10, a review of potential sites focused on gravel pit sites near the City of Tacoma pipeline. All of the potential sites are located in the Lower Puyallup River subbasin.

Preliminary calculations of the potential size and infiltration capacity if a suitable gravel pit site is located were performed. A MAR facility may only need a footprint of 2 acres to infiltrate 300 acre-feet per year. It was assumed that diversion and infiltration would occur during winter months as the City of Tacoma pipeline has excess capacity during winter. A flow rate of 1 cfs (450 gallons per minute) would be required from the City of Tacoma pipeline to infiltrate 300 acre-feet during the winter season. If several sites are feasible, the selection of how many are used and how much water is infiltrated at each would be a decision of the project sponsor. MAR facilities provide year-round benefits. A MAR project can be scaled to the desired water offset or streamflow benefit. The amount and timing of water infiltrated can also be adjusted to time streamflow benefits to maximize benefits for fish. This project is Tier 2 because it is conceptual and does not yet have a sponsor or specific location.

Project Name: Bond Water Right

Project Description: The City of Puyallup proposes to purchase a water right as part of a larger property transfer to the city for conservation and protection purposes. The property has been used in the past as a berry farm. In 1970, Ecology issued a groundwater water right certificate for 150 gallons per minute and 30 acre-feet a year from May 1 to October 1 to irrigate 25 acres.

The City of Puyallup has conducted initial outreach to the water right holder and has expressed interest in placing the water right into permanent trust once the property transfer is complete. This project is Tier 2 because the water use history is unknown. An extent and validity determination by Ecology is required to determine the actual quantity available for acquisition.

Middle White Subbasin

Project Name: CWA Water Right Acquisition

Project Description: This project would acquire and place into trust a portion of the municipal water right from the Cascade Water Alliance (CWA). CWA supplies water for several municipalities in King County. CWA has expressed willingness in working with Ecology for the purchase and transfer into permanent trust a small portion of their water right. The water is diverted from the White River at river mile 24.3, held in Lake Tapps and released at river mile 3.6.

This project is Tier 1 because the water right went through extent and validity in 2000. Ecology is currently in discussion with CWA on acquiring a small portion of the water right. The barriers to completion are negotiation of the acquisition and funding to purchase the water right. The project would have lasting benefits as the Trust Water Right would be held in perpetuity.

South Prairie Creek Subbasin

Project Name: Old Inglin Dairy Restoration and Water Right Acquisition

Project Description: The Pierce Conservation District (PCD) proposes to restore the Old Inglin Dairy property, located near the town of South Prairie, to functioning floodplain of South Prairie Creek. The restoration phase of the project includes planting and other habitat enhancements. Once the plants are established (about 3-5 years after planting), PCD proposes to place two water right certificates into permanent trust. South Prairie Creek is the source of both water rights and the purpose is irrigation. PCD currently uses the water right to irrigate plants in preparation and maintenance of riparian and floodplain plants.

WWT used irrigation delineation analysis to estimate consumptive use of 89.09 acre-feet per year. An extent and validity determination by Ecology is required to determine the actual quantity available for acquisition. This project is Tier 1 because PCD has expressed interest in selling the water rights into permanent trust once the restoration project is established, which will occur in three to five years.

Upper Puyallup Subbasin

Project Name: Orville Road Revetment Phase 2C Year 1

Project Description: Pierce County will continue a setback revetment project along left bank of the Puyallup River between river miles 27.8 and 28.2. Work under this phase will add 1,500 linear feet of setback revetment and 19 engineered log jams. This project will also decommission one PE well that served three homes, providing an offset of 1.2 acre-feet a year, or 0.4 acre-feet a year per home. This project is Tier 1 since this project is underway, the County has purchased the property, and there is high certainty that this offset will occur.

WRIA-Wide Offset Projects

Project Name: Various Water Right Acquisitions

Project Description: Acquire water rights included in the Washington Water Trust (WWT) water right assessment. WWT conducted a rapid water rights assessment on eleven rights that fit the criteria identified by the WRIA 10 Committee. The assessment estimated that these eleven water rights would provide a total offset of 417.1 acre-feet per year. This project is Tier 2 because no project sponsor or outreach has been conducted on these water rights, although some WRIA 10 Committee members have expressed willingness to sponsor a project or conduct outreach when an opportunity arose.

To account for the uncertainty and the state of outreach for these water rights, this plan only counts ten percent of the total offset estimate, or 41.7 acre-feet per year. The WWT assessment report is included in Appendix I.

Project Name: Rain Gardens and Green Stormwater Infrastructure

Project Description: Pierce Conservation District has proposed to implement a program of rain garden and Green Stormwater Infrastructure (GSI) construction. This type of project could be applied to existing roofs and driveways, roadways, parking lots and other impervious areas that generate stormwater. The techniques include rain gardens, planter boxes, bio-infiltration swales, permeable pavement and reducing the footprint of roadways and replacing with GSI (green streets).

The Pierce Conservation District is ready to proceed immediately if the program was supported and funded. The number of facilities may vary depending on finding suitable areas to retrofit, funding, and capacity of Pierce Conservation District, which is why this project is a Tier 2 project. This plan assumes 10 facilities installed per year. Assuming an offset volume of 0.15 acre-foot per rain garden, this project would provide an offset value of 27 acre-feet per year after 18 years of installing facilities.

Map No.	Project No.	Project Name	Water Offset (ac-ft)	Project Type
A	10-UP-W1	Orville Road Revetment Phase 2C Year 1	1.2	Tier 1
B	10-SPC-W2	Old Inglin Dairy	89.1	Tier 1
C	10-CR-W4	Alward Road	8.0	Tier 1
D	10-MW-W7	CWA Transaction	277.0	Tier 1

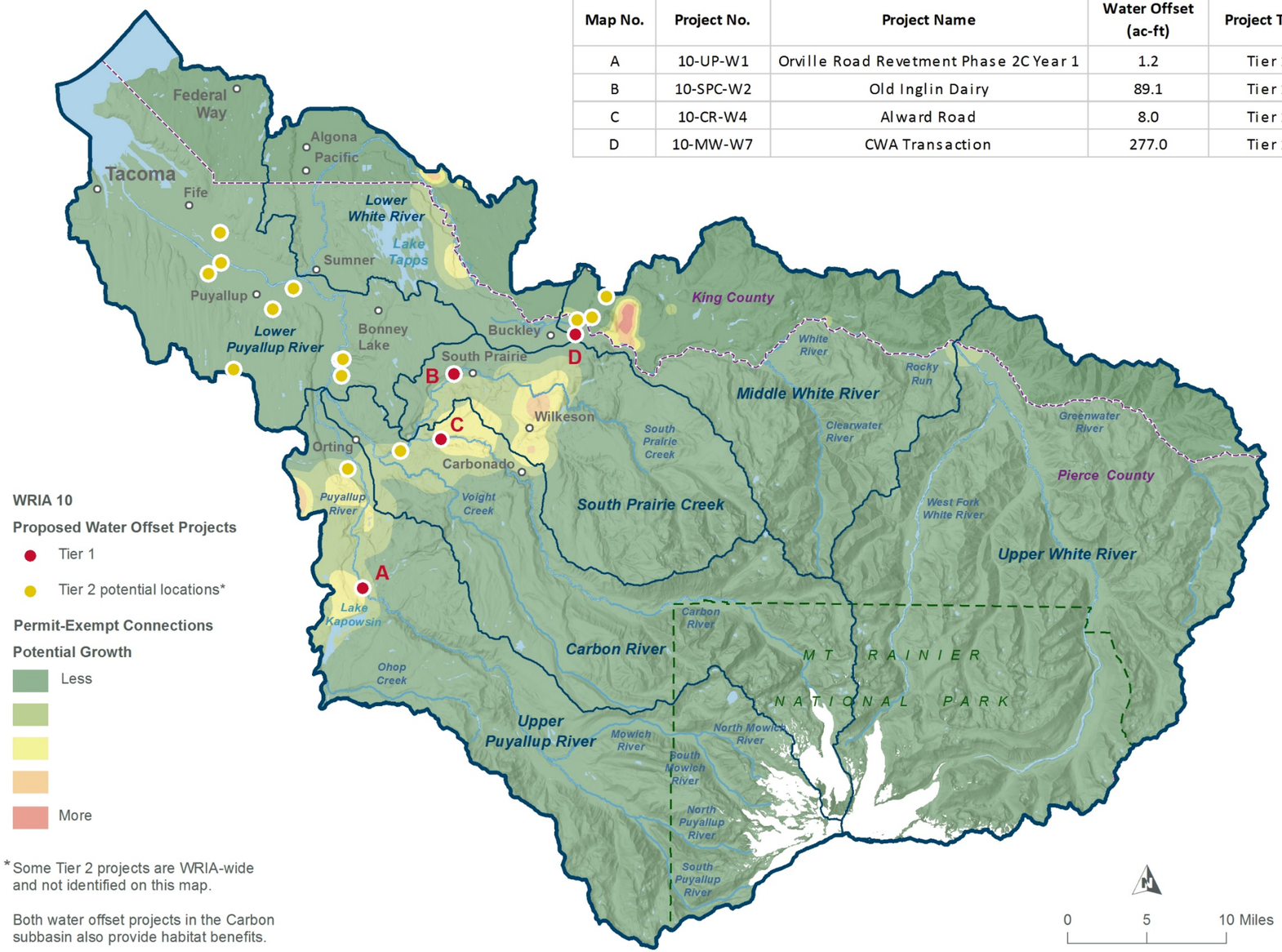

Figure 6 WRIA 10 Water Offset Projects

5.2.2 Habitat Projects

The Committee set the goal of including in the plan at least one habitat project in each subbasin. Table 9 lists the habitat projects. The Committee selected several habitat projects to provide more detail for this plan. Some of these projects were selected because they have the potential to contribute water offset, and others were selected to highlight the types of habitat projects included in this plan. This section includes a summary of those descriptions and Appendix H includes the detailed project descriptions. The Committee did not tier the habitat projects. The full project inventory is in Appendix H. Although they are not included on Table 9, the water offset projects in the South Prairie Creek, Carbon River, and Upper Puyallup subbasins include a habitat restoration component and contribute towards the goal of one habitat project per subbasin. Figure 7 shows the locations of habitat projects listed in this plan.

Most of these habitat projects are listed as Near-Term Actions by the Salmon Recovery Lead Entity. While several of these projects may produce a marginal water offset benefit by increasing seasonal storage, the benefits were too small and too complex to estimate. In general, these projects increase stream complexity, reconnect floodplains, and enhance natural processes that had been lost to the benefit of salmonids and other aquatic species.

Habitat restoration projects are durable as they restore natural processes to a stream. Given changing climate conditions that anticipates increases in winter precipitation and flood peaks and decreasing summer flow, restoration projects that increase floodplain connectivity and provide increased cover and habitat and more ways to hold and recharge water are important solutions to provide resiliency from a changing climate.

Table 9 WRIA 10 Habitat Projects

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Sponsor
Lower Puyallup (LP)				
10-LP-H5	Deer Creek Stream Bed Relocation	Relocate the creek bed to allow for a better connection to the floodplain, restore habitat in the adjacent areas.	Improve habitat and provide flood storage.	City of Puyallup
10-LP-H6	Swan Creek Channel and Bank Stabilization	In-channel stabilization and restoration measures including installation of woody material and streambed gravel.	Restore 2.5 miles of Swan Creek.	Pierce County and Puyallup Tribe
10-LP-H7	Silver Creek bank Stabilization	Restoration. Stabilize slopes of Silver Creek to stop channel incision.	Habitat restoration.	City of Puyallup
10-LP-H8	Puyallup River (Union Pacific) Setback Levee (RM 2.6-3.0) - Acquisition	Levee setback. Acquire up to 30 acres of floodplain and former intertidal habitat.	Habitat restoration.	Pierce County
10-LP-H9	Clear Creek RM 2.9 Acquisition and Levee	Levee setback and floodplain reconnection. Construct a new 13,600' levee along Clear Creek and remove flood gate. Reconnect up to 500 acres of floodplain.	Habitat restoration.	Pierce County
10-LP-H10	Fennel Creek Phase 3	Floodplain restoration This project will restore the Fennel Creek right bank floodplain to a more natural state. Project may include a small offset by removing existing PE wells.	Restore 14 acres of floodplain.	Pierce County
Lower White (LW)				
10-LW-H14	Jovita Creek Habitat Project	Restoration actions to address channel confinement, and that restore habitat and habitat forming processes.	Habitat restoration.	City of Edgewood

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Sponsor
10-LW-H15	Pacific Right Bank	Levee setback The proposed project will remove a levee and other artificial floodplain fill, allowing for off-channel habitat and floodplain restoration. The total project area available for restoration is estimated at 32 acres.	Habitat restoration, floodplain reconnection.	King County Flood Control District
10-LW-H16	White River LB RM 2.9-4.2 Restoration	Habitat restoration. White River Restoration will restore sustainable instream, floodplain, and wetland habitats within a 170 acre area along the Lower White River between river miles 2.9 and 4.2. The tailrace between RM 3 and RM 3.5 is part of the Foster Pilot Project and not included as part of the offset and NEB accounting.	Restore sustainable instream, floodplain, and wetland habitats within a 170 acre area along the Lower White River between river miles 2.9 and 4.2.	City of Sumner
10-LW-H17	White river bridge (Stewart Road) replacement RM 4.9	The project will consist of replacing the existing Stewart Road Bridge with a new bridge. The existing bridge is a restriction along the river, and a new bridge will allow the river more room to move naturally, allowing better utilization of instream habitat beneath the bridge. The current bridge also limits the flow of large woody debris, while a new bridge will let them large woody debris flow downstream and accumulate naturally through the rest of the lower White River.	Habitat restoration.	City of Sumner
10-LW-H18	White River Setback LB RM4.4-4.8 Stewart	The project consists of a levee setback on the left bank between RM 4.4 - RM 4.8. This project will improve rearing opportunity by creating slow water habitat, increased number/depth of pools, engaged floodplain food webs. The project will result in better high flow refuge with floodplain wetlands, and greater main channel roughness. Restore riparian forests. The project will reconnect about 20 acres of floodplain.	Habitat restoration. Reconnect 20 acres of floodplain.	City of Sumner

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Sponsor
10-LW-H19	Pacific Pointbar	The project consists of a levee setback on the left bank between RM 4.4 - RM 4.8. This project will improve rearing opportunity by creating slow water habitat, increased number/depth of pools, engaged floodplain food webs. The project will result in better high flow refuge with floodplain wetlands, and greater main channel roughness. Restore riparian forests. The project will reconnect about 25 acres of floodplain.	Habitat restoration. Reconnect 25 acres of floodplain.	City of Sumner
Middle White (MW)				
10-MW-H13	Enumclaw Golf Course Restoration	Stream restoration to move Boise Creek back to its historic channel adjacent to the Enumclaw Golf Course.	Increased habitat complexity and channel roughness.	City of Enumclaw and Puyallup Tribe
South Prairie Creek (SPC)				
10-SPC-H2	Implement habitat projects based on SPC study.	Habitat improvement projects. Identify and design protection and restoration actions for the lower 15.5 miles of South Prairie Creek and the lower 6 miles of Wilkeson Creek.	Habitat restoration, water quality improvements, fish passage improvements.	Pierce Conservation District, Puyallup Tribe
10-SPC-H3	Stubbs Project	In-channel stabilization and restoration measures including installation of woody material and streambed gravel. Slight chance of a water right acquisition included in this project.	Habitat restoration.	Pierce Conservation District

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Sponsor
10-SPC-H4	South Prairie Creek RM 4.0-4.5 Floodplain Planting	Habitat improvement. Continue planting on the South Prairie Creek Preserve property between river mile 4.0 and 4.5 to maintain and in-fill existing plantings on the property.	Habitat restoration and establishment of 50-55 acres of forested floodplain.	Pierce Conservation District, South Puget Sound Salmon Enhancement Group (SPSSEG)
10-SPC-H22	South Prairie Creek Floodplain Reconnection, RM 2.7-2.8 Phase 1	Floodplain restoration. Acquire 73 acres and implement a multi-benefit floodplain reconnection project that would reduce flood risk and maintenance costs, restore vital salmon habitat, and keep the property in agricultural production.	Habitat restoration. Water quality improvements.	Pierce Conservation District
Upper Puyallup (UP)				
10-UP-H1	Orville Road Revetment at Kapowsin Creek	This project will construct a setback revetment along the left bank Puyallup River near RM 26.3 from Kapowsin Creek confluence upstream. May allow for re-connection of approximately 25-acres of forested floodplain between Puyallup River and Orville Road.	Habitat restoration. Reconnect 25 acres of floodplain.	Pierce County
Upper White (UW)				
10-UW-H11	Greenwater Phase 4 Implementation	Reach scale restoration to restore instream complexity and floodplain connectivity.	Restore 1.2 miles of Greenwater River.	SPSSEG
10-UW-H12	West Fork White Floodplain Project	Floodplain restoration project to restore habitat and habitat-forming processes.		SPSSEG
WRIA-Wide (WW)				

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Sponsor
10-WW-H20	Land acquisition, water right acquisition, and restoration	Seek out opportunities for land and water right acquisitions, large scale habitat restoration (including beaver-related projects where appropriate), and floodplain reconnection/levee setbacks.	Habitat restoration, habitat protection.	Multiple
10-WW-H21	Levee setbacks	Implement projects included on the Pierce County Levee Setback Feasibility Study as opportunities arise. The study lists levees in Pierce County that may be set back to improve floodplain function and habitat. Any of these levee setback projects would contribute to NEB as well as small but difficult to calculate water offsets by allowing for additional infiltration during high flow events.	Floodplain reconnection, habitat restoration.	Pierce County

Lower Puyallup Subbasin

Project Name: Deer Creek Stream Bed Relocation

Project Description: The City of Puyallup is proposing to relocate Deer Creek from its current straightened and ditched configuration to a more natural channel that mimics historic conditions and reconnects the creek to its floodplain. This project would restore habitat in lower Deer Creek, providing opportunities for salmonids to spawn, rear, and forage in a tributary to the lower Puyallup River.

Project Name: Swan Creek Channel and Bank Stabilization

Project Description: Pierce County Surface Water Management and the Puyallup Tribe propose to implement in-channel stabilization and restoration measures along Swan Creek, within the Lower Puyallup River sub-basin (WRIA 10). In the lower reaches of Swan Creek, the channel is incised and eroding the streambanks due to increased stormwater runoff, undersized culverts, and insufficient stormwater detention and loss of flood storage. This project proposes to use a combination of woody material, streambed gravel, and plantings to stabilize streambeds and banks and provide sediment recruitment capacity within the channel. The intention is to slow erosion and allow the channel to return to a more natural state. The proposed project reach begins immediately downstream of the 64th Street East culvert crossing and extends to Pioneer Way.

Pierce County and the Puyallup Tribe are ready to implement the project as soon as funding is available. No estimate of the potential water offset was provided at this time as monitoring is proposed that would determine the offset.

Project Name: Silver Creek Bank Stabilization

Project Description: The City of Puyallup is proposing to stabilize Silver Creek. The channel is incised and eroding the streambanks due to increased stormwater runoff, undersized culverts, and insufficient stormwater detention and loss of flood storage. This project proposes to use a combination of woody material, streambed gravel, and plantings to stabilize the streambed and banks and provide sediment recruitment capacity within the channel. The intention is to slow erosion and allow the channel to return to a more natural state. The City of Puyallup constructed a similar project on Clarks Creek.

Project Name: Puyallup River (Union Pacific) Setback Levee (RM 2.6-3.0) - Acquisition

Project Description: In Pierce County's the levee report, an identified levee setback site is located at river mile 2.6 – 3.0 on the lower Puyallup River. Elements of this project include acquiring properties, designing the project, building a setback levee, and adding habitat elements in the floodplain. The potential habitat benefits of this project include reconnecting previously disconnected floodplain, increasing intertidal area in the lower River, and increasing fish habitat diversity.

Project Name: Clear Creek RM 2.9 Acquisition and Levee Setback

Project Description: The primary objective of this project is to minimize the impact of flooding related to the backwater created where Clear Creek and the Puyallup River meet. The project

also provides refuge and habitat for juvenile salmon and other associated wildlife in the lower Puyallup River system. The lower Puyallup River and Clear Creek combined floodplain is currently managed by two flood/tide gates underneath State Route 167/River Road. The project will reconnect 250-590 acres of floodplain. The project will allow the floodplain to react more naturally with the creek and the river.

This project is expected to take at least 10 years to complete. The first phase will focus on property acquisitions from willing sellers in the area. Once property acquisitions are completed, a new levee system to protect infrastructure outside of the property purchase area will be constructed.

Project Name: Fennel Creek Phase 3

Project Description: Pierce County partnered with Forterra to acquire a 14-acre property adjacent to Fennel Creek. The site is adjacent to the first two project phases. Remaining project elements include demolishing buildings and roads, removing previous fill-areas, and installing plantings and fish habitat features. Property acquisition was completed by Forterra in 2020. Demolition will be completed in 2021 and 2022. Habitat improvements and project construction planned for 2023. This project will restore fish habitat and 14 acres of floodplain in lower Fennel Creek.

Pierce County is ready to implement the restoration project as soon as funding is secured. Along Fennel Creek, upstream from its confluence with the Puyallup River, Pierce County is continuing to improve flood plain connectivity and fish habitat. Previous phases included; property acquisition, a 40+acre floodplain restoration project, and 1,900+ linear feet channel restoration project.

Lower White Subbasin

Project Name: Jovita Creek Habitat Project

Project Description: The City of Edgewood proposes to identify potential and implement multi-benefit restoration project(s) that restore habitat and habitat forming processes in Jovita Creek. An assessment will focus on evaluating geomorphic impacts from Jovita Boulevard (which is adjacent to the stream), channel bed and bank restoration in the mainstem of Jovita Creek, and replacement of a fish passage barrier (culvert at 114th street) on a tributary to Jovita Creek.

One primary issue in Jovita Creek is channel confinement due to Jovita Boulevard, causing channel erosion from high velocities. Restoration actions that address this channel confinement would function by providing space for the creek to meander, wood to stabilize the creek bed and connection to the limited amount of off-channel habitat in the floodplain. Depending on the results of the feasibility study, benefits to stream processes may occur in the project area upstream of the culvert at highway 167. Salmonids in Jovita Creek and its tributaries have the potential to benefit from restoration actions.

Project Name: Pacific Right Bank

Project Description: The King County Flood Control District proposed a levee setback project located on the right bank floodplain of the White River in the City of Pacific extending from the BNSF Railway (RM 6.3) south to the King-Pierce County boundary line (RM 5.5). The

proposed project will remove a levee and other artificial floodplain fill, allowing for off-channel habitat and floodplain restoration. The total project area available for restoration is estimated at 32 acres. The final project will restore off-channel rearing habitat for ESA-listed Chinook salmon and improve other wildlife habitat.

Project work to date has focused on property acquisitions from willing sellers, installation and maintenance of the temporary floodwater barriers, and some feasibility studies for the future levee setback project. The project is expected to take 5 years to complete.

Project Name: White River LB RM 2.9 – 4.2 Restoration

Project Description: The City of Sumner proposed a levee setback project located on the left bank floodplain of the White River on the City owned golf course property and adjacent open space (RM 2.9 – 4.2). The proposed project will create/restore side channels, lower floodplain for better connectivity, and create wetland habitats within a 170 acre area along the Lower White River. The tailrace between RM 3 and RM 3.5 is part of the Foster Pilot Project and not included as part of the offset and NEB accounting.

Project work to date has included finalizing the design for the project. The City of Sumner has submitted for permits and is ready to implement the restoration project as soon as funding is secured.

Project Name: White River Bridge (Stewart Road) Replacement RM 4.9

Project Description: The City of Sumner proposed the project to replace the existing Stewart Road Bridge with a new bridge. The existing bridge is undersized and is a constriction on the Lower White River. The new bridge will be longer, higher, and have less piers within the channel. This will allow river migration under the bridge, greater connectivity between the Countyline setback and the RM 4.4-4.8 setback, and allow for large woody debris (that currently gets stuck on existing bridge) to accumulate downstream naturally.

Project Name: White River Setback LB RM 4.4 – 4.8 Stewart

Project Description: The City of Sumner proposed a levee setback project located on the left bank floodplain of the White River at RM 4.4 – 4.8. The project will reconnect about 20 acres of floodplain. This project would improve salmonid rearing opportunities in the lower White River by creating slow water habitat, re-establishing floodplain wetlands, and restoring riparian forests. When the Stewart Road bridge is replaced, this project will also be connected to the Countyline setback project.

Project Name: Pacific Pointbar

Project Description: The project consists of a levee setback on the right bank of the White River between RM 4.4 - RM 4.6. This project will improve rearing opportunity by creating side channel, slow water habitat, increasing number/depth of pools, and engaging floodplain food webs. The project will improve high flow refuge with floodplain wetlands and greater main

channel roughness. The project will reconnect about 25 acres of floodplain and restore riparian forests.

The City of Sumner has acquired several properties within the project area and is continuing to conduct outreach with landowners.

Middle White Subbasin

Project Name: Enumclaw Golf Course Restoration

Project Description: The City of Enumclaw and the Puyallup Tribe propose reach-scale stream restoration actions in Boise Creek. This project would move Boise Creek back to its historic channel adjacent to the Enumclaw Golf Course. Additionally, large woody material would be added to increase habitat complexity and channel roughness, diversifying habitats available to fish. The project will function by restoring the natural channel and improving habitat conditions, which will allow natural processes to develop in Boise Creek. The project is proposed to occur from river miles 3.7 to 4.2.

The Puyallup Tribe is ready to implement the project as soon as funding is secured, and property owner permissions are obtained. A 30% design was completed for this project in 2010, and the proposed project would include finalizing the design and moving forward with construction.

South Prairie Creek Subbasin

Project Name: Implement habitat projects based on SPC study

Project Description: The project will use existing information from past and present assessments and evaluations to identify and design protection and restoration actions for the lower 15.5 miles of South Prairie Creek and the lower 6 miles of Wilkeson Creek. Project elements will include landowner outreach to parcels identified as high priority for protection in the 2002 South Prairie Creek Action Plan that have not yet been conserved, development of preliminary designs for up to 4 reach-scale floodplain restoration projects, and detailed site specific recommendations for: other properties to be acquired, areas for improved forestry management, restoration of drainage ditches, tributary confluences, groundwater seeps, and wall based channels, fish passage improvements, beaver reintroduction and installation of beaver dam analogues. This project will design actions to create and maintain necessary habitat functionality, thermal diversity, hydrologic stability, and geomorphic structure to support adult to juvenile out-migrant survival, and productivity for the salmonid species.

South Puget Sound Salmon Enhancement Group is planning these projects.

Project Name: Stubbs Project

Project Description: Forterra and partners acquired 33.6 acres much of it floodplain along South Prairie Creek (Parcel Number 0519123054). The goal of this project is to protect the property from development, as well as to provide opportunities to restore and improve salmon habitat and floodplain. Restoration would benefit in-stream habitat, off-channel habitat, riparian function, and floodplain connectivity to increase the overall capacity of this stream reach to support salmonids. The acquisition and conceptual restoration design will integrate the

subject property restoration with restoration activities being conducted on the adjacent property South Prairie Creek Preserve property. This project would likely include in-channel stabilization and restoration measures including installation of woody material and streambed gravel.

Forterra received funding in 2019 to acquire the Stubbs property and develop a conceptual restoration design.

Project Name: South Prairie Creek RM 4.0 – 4.5 Floodplain Planting

Project Description: This project includes continuing riparian planting on the South Prairie Creek Preserve property between river miles 4.0 and 4.5 on South Prairie Creek (13518 Pioneer Way E Orting). The goal of the project is to maintain and in-fill existing riparian plantings on the property in order to ensure long term survival and establishment of 50-55 acres of forested floodplain. Planting began in 2005 and continue to the present day. Enhancing and planting the riparian area and floodplain on the property has many habitat benefits including shade, cover for juvenile fish, and increased food.

A habitat project on this property was completed in 2020 by the South Puget Sound Salmon Enhancement Group. The project included side-channel creation, woody material installation, and floodplain reconnection.

Project Name: South Prairie Creek Floodplain Reconnection RM 2.7 – 2.8 Phase 1

Project Description: The project will entail acquiring 73 acres on river mile 2.7 – 2.8 of South Prairie Creek. The goal of this project is to protect the property from development, as well as to provide opportunities to restore and improve salmon habitat and floodplain. Restoration would benefit in-stream habitat, off-channel habitat, riparian function, and floodplain connectivity to increase the overall capacity of this stream reach to support salmonids. This project would likely include in-channel stabilization and restoration measures including installation of woody material and streambed gravel.

The Pierce Conservation District is the project sponsor.

Upper White Subbasin

Project Name: West Fork White Floodplain Project

Project Description: South Puget Sound Salmon Enhancement Group (SPSSEG) proposes to implement reach-scale floodplain restoration actions in the West Fork White River. This project would complete assessment, feasibility, design, and construction of a floodplain restoration project on the lower 6 miles of the West Fork White River. Initial work would focus on a reach-scale assessment of the lower White River from river miles 2.4 to 5.7. The assessment would evaluate geomorphic threats from a road (which is adjacent to the stream) to floodplain processes, instream flow velocities, and habitat structure and the assessment would prescribe and implement restoration treatments to remove fill and armor and restore habitat and habitat forming processes.

Benefits to river processes will occur in the project area between river miles 2.4 to 5.7; side channel and other habitat features formed as a result of this project will benefit a variety of

salmonid species as described in the next paragraph. Salmonids in the West Fork White River and in the White River will benefit from increased habitat and reduced peak flow and sediment input. The potential for the project to increase groundwater recharge has not been estimated.

Project Name: Greenwater Phase 4 Implementation

Project Description: South Puget Sound Salmon Enhancement Group proposes to implement reach-scale restoration actions in the Greenwater River between river mile 2 and 4 to restore instream complexity and floodplain connectivity. This proposed phase 4 project builds upon work completed in 2010, 2011, and 2014 (phases 1-3) on upper sections of the Greenwater River between river mile 6 and 8. As part of the proposed phase 4 project, road and fill would be removed and log jams would be installed in the 2-mile project reach, increasing the functional habitat on the Greenwater River. These structures will provide relatively stable, instream structure currently lacking in the Greenwater system due to a legacy of aggressive timber harvest practices between the late 1950s to early 1970s.

The project will create large stable structures that will trap mobile debris and sediment, increase floodplain connectivity and off channel habitat, increase number of pools with overhead cover, decrease median substrate size, and overall improve spawning and rearing conditions for salmonids in the Greenwater River. The proposed structures will accelerate and maintain system-wide natural processes while providing habitat for fish. Removing roads, fill, and armor will additionally allow natural processes to develop in a large floodplain. There are no anticipated offset benefits related to the project because the potential for the project to increase groundwater recharge has not been estimated.

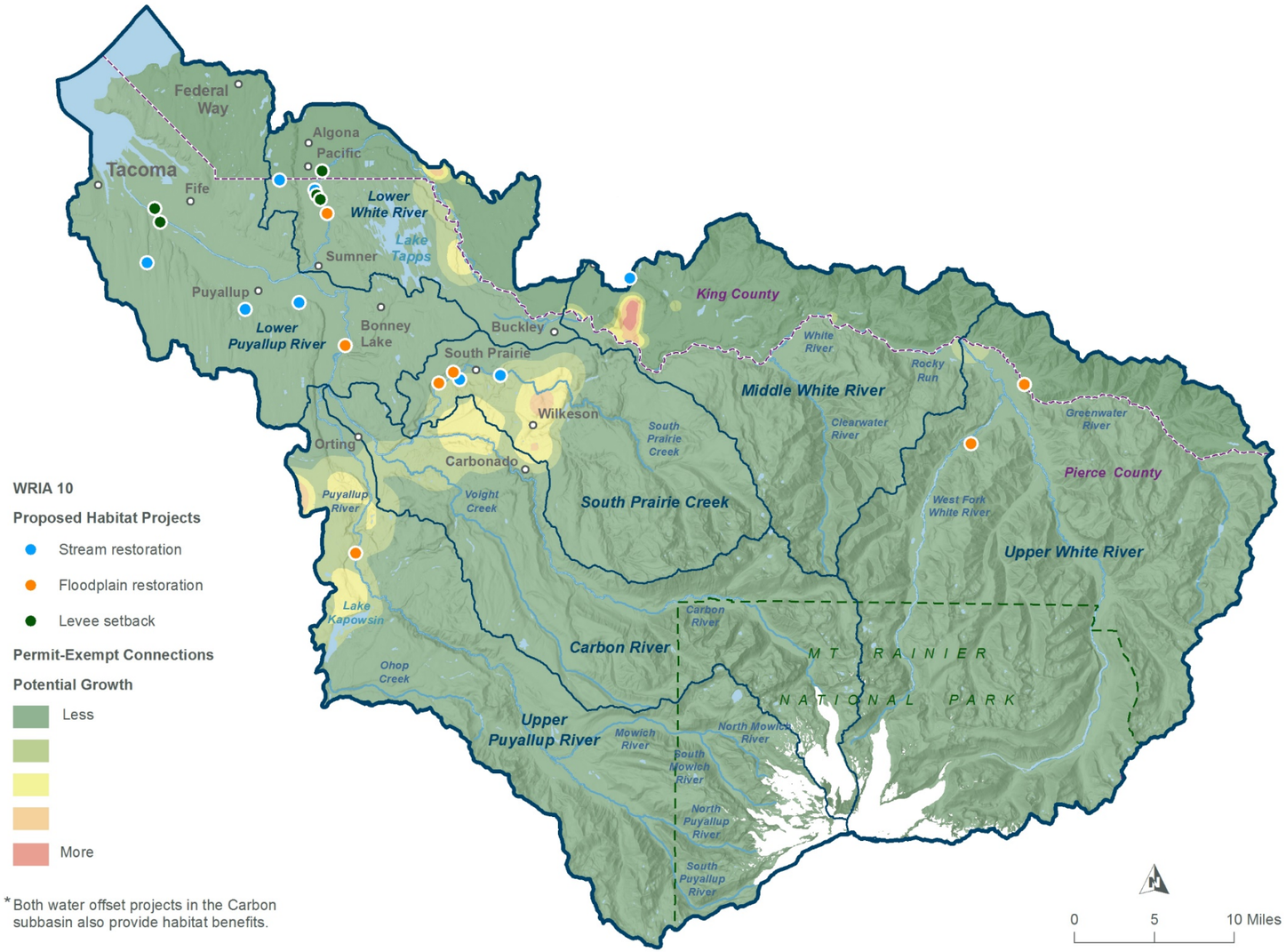

Figure 7 WRIA 10 Habitat Projects

5.2.3 Programmatic Actions

In addition to the projects described above, the plan identifies programmatic actions that will increase the knowledge of PE well water use in the watershed and increase water conservation throughout the WRIA. These programmatic actions do not have specific locations, but would improve PE well water management through voluntary actions and improved data collection.

Water Conservation Education and Incentives Program

This plan recommends Ecology partner with Pierce and King Counties, the Pierce Conservation District, and the Tacoma-Pierce County Health Department to develop and implement outreach and incentives programs that encourage rural landowners with PE wells to (1) reduce their indoor and outdoor water use through water conservation best practices; and (2) comply with drought and other water use restrictions.

This program would raise awareness of the impacts PE well water usage has on groundwater levels and the connection to streams and rivers. This program would supplement water offset and restoration projects, especially in subbasins critical for fish and where water offsets were difficult to find.

Potential funding sources could include: new funding from Washington State Legislature; grants (e.g., Ecology's Streamflow Restoration Grant Program); allocation of Ecology resources; contributions from local governments and tribes; part of county or conservation district ongoing education, outreach, and incentive program.

Voluntary PE Well Metering Pilot Project

This plan encourages a non-profit organization, university, or government agency to pilot a voluntary five-year program in one or more WRIA 10 subbasins to meter PE wells (indoor and outdoor residential use). The voluntary metering program would be supplemented with a robust education and community engagement program about water consumption and conservation.

This program would increase confidence in assumptions made regarding the average water use of individual PE well users to inform the adaptive management process and future water management and planning activities. Data could inform (1) growth policies and patterns, (2) where to target incentives and education/outreach programs, and (3) where to place resources across subbasins to help improve streamflow, water levels, and temperature.

Update Ecology's Well Log Database

The Committee recommends that Ecology make the following changes to Ecology's well data tracking system in order to track the number and location of PE wells in use:

- Implement a web-based well report form that mimics the current well report forms, and that uploads directly to Ecology's database with Ecology verification.
- Require coordinates (latitude and longitude) of wells on well report forms, and implement an intuitive web tool for well drillers which automatically provides the Public Lands Survey (PLS) location and coordinates for a new well.

- Identify PE wells on well report forms.
- Provide Well ID Tag numbers to older wells, and associate well decommissioning, replacement, or other well activities with the Well ID Tag.

Accurate tracking of the locations and features of PE wells will support Committee's desire to monitor plan success and respond with adaptive management measures after plan adoption.

5.3 Project Implementation Summary

5.3.1 Summary of Projects and Benefits

Per RCW 90.94.030(3), this plan must include actions necessary to offset potential impacts to instream flows associated with new PE well water use and result in a net ecological benefit to instream resources within the WRIA.

As specified in Chapter 4, the plan estimates 277.4 acre-feet per year of consumptive use from new PE wells over the planning horizon. The projects included in Table 8 provide an estimated offset of 788.3 acre-feet per year and exceed the consumptive use estimate.

Twenty-two habitat projects are included in Table 9. Ecological benefits associated with these projects include floodplain restoration, wetland reconnection, availability of off-channel habitat for juvenile salmonids, increase in groundwater levels and baseflow, and increase in channel complexity. While many of these projects have potential streamflow benefits, water offset from habitat projects are not accounted for in this plan. The ecological and streamflow benefits from habitat projects are supplemental to the quantified water offsets. A description of how the water offset and habitat projects result in a net ecological benefit to instream resources in WRIA 10 is provided in Chapter 7.

Three programmatic actions are included in section 5.2.3. These actions will measure, track, and contribute offset by reducing the amount of water used.

5.3.2 Cost Estimate for Offsetting New Domestic Water Use Over 20 Year Planning Horizon

Per RCW 90.94.030(3)(d), this watershed plan must include an evaluation or estimation of the cost of offsetting new domestic water uses over the subsequent twenty years. To satisfy this requirement, planning-level cost estimates for each of the water offset projects are listed in Table 10. Costs estimates for habitat projects, when that information was readily available, are displayed in Table 11.

The costs for water offset projects range from $3,100 for the offset portion of the Orville Road Revetment Phase 2C Year 1 project to $1.1 million for the MAR project. The total estimated cost for implementing the water offset projects listed and described in this chapter is $2.6 million. Several of the water offset projects are part of larger restoration projects, such as levee setback and floodplain reconnections. The full cost of the water offset projects, including the habitat components, is over $18.9 million.

Table 10 WRIA 10 Water Offset and Habitat Projects Cost Estimates

Project Number	Project Name	Subbasin(s)	Estimated Cost
10-CR-W3	Carbon River Future Levee Setback and Acquisition	**Carbon River**	$37,000 (water offset) full project value unknown
10-CR-W4	Alward Road	**Carbon River**	$21,000 (water offset) $14 million (full project)
10-LP-W6	Potential MAR	**Lower Puyallup**	$1.1 million
10-LP-W10	Bond	**Lower Puyallup**	$80,000
10-MW-W7	CWA purchase	**Middle White**	$750,000
10-SPC-W2	Old Inglin Dairy	**South Prairie Creek**	$230,000
10-UP-W1	Orville Road Revetment Phase 2C Year 1	**Upper Puyallup**	$3,100 (water offset) $2.2 million (full project)
10-WW-W8	Green Stormwater Infrastructure	**WRIA-wide**	$900,000
10-WW-W9	WWT assessment	**WRIA-wide**	$110,000
Water Offset Project Costs **Full Project Costs**			$3.23 million $19.41 million

The costs for habitat projects range from $250,000 for the initial study for the Jovita Creek Habitat Project to $79 million for the Pacific Right Bank project. The total estimated cost for implementing the habitat projects listed and described in this chapter is over $191 million.

Table 11 Habitat Project Cost Estimates

Project Number	Project Name	Project Type and Brief Description	Estimated Total Project Cost
10-LP-H5	Deer Creek Stream Bed Relocation	Lower Puyallup	TBD
10-LP-H6	Swan Creek Channel and Bank Stabilization	Lower Puyallup	$3.7 million
10-LP-H7	Silver Creek bank Stabilization	Lower Puyallup	TBD
10-LP-H8	Puyallup River (Union Pacific) Setback Levee (RM 2.6-3.0) - Acquisition	Lower Puyallup	$8.5 million
10-LP-H9	Clear Creek RM 2.9 Acquisition and Levee	Lower Puyallup	$5.5 million
10-LP-H10	Fennel Creek Phase 3	Lower Puyallup	$1.7 million
10-LW-H14	Jovita Creek Habitat Project	Lower White	$250,000
10-LW-H15	Pacific Right Bank	Lower White	$79 million
10-LW-H16	White River LB RM 2.9-4.2 Restoration	Lower White	$25 million
10-LW-H17	White river bridge (Stewart Road) replacement RM 4.9	Lower White	$30 million
10-LW-H18	White River Setback LB RM4.4-4.8 Stewart	Lower White	$7 million
10-LW-H19	Pacific Pointbar	Lower White	$18 million
10-MW-H13	Enumclaw Golf Course Restoration	Middle White	$2.3 million
10-SPC-H2	Implement habitat projects based on SPC study.	South Prairie Creek	$469,000
10-SPC-H3	Stubbs Project	South Prairie Creek	TBD
10-SPC-H4	South Prairie Creek RM 4.0-4.5 Floodplain Planting	South Prairie Creek	$369,000
10-SPC-H22	South Prairie Creek Floodplain Reconnection, RM 2.7-2.8 Phase 1	South Prairie Creek	$1.2 million
10-UP-H1	Oroville Road Revetment at Kapowsin Creek	Upper Puyallup	$3.8 million
10-UW-H11	Greenwater Phase 4 Implementation	Upper White	$1.5 million
10-UW-H12	West Fork White Floodplain Project	Upper White	$3 million

Project Number	Project Name	Project Type and Brief Description	Estimated Total Project Cost
10-WW-H20	Land acquisition, water right acquisition, and restoration	WRIA-Wide	TBD
10-WW-H21	Levee setbacks	WRIA-Wide	TBD
Total Habitat Project Costs			**$191 million**

5.3.3 Certainty of Implementation

WRIA 10 Committee members have a track record of success in working together and implementing projects. An example is the Puyallup and Chambers Salmon Recovery Lead Entity whose participants overlap with the WRIA 10 Committee. The history of successful collaboration provides certainty to implementation of projects contained in this plan. Chapter 6 describes the adaptive management recommendations that will increase reasonable assurance that the projects and actions in the plan will be implemented.

Chapter Six: Plan Implementation and Adaptive Management

6.1 Plan Implementation and Adaptive Management Recommendations

This plan recommends an adaptive management process for implementation of the watershed plan. The Final NEB Guidance defines adaptive management as "*an interactive and systematic decision-making process that aims to reduce uncertainty over time and help meet project, action, and plan performance goals by learning from the implementation and outcomes of projects and actions*."

Adaptive management is intended to help address uncertainty, provide more reasonable assurance for plan implementation, and to ensure that 1) water use from new PE wells is adequately offset and 2) implementation of the watershed plan produces a net ecological benefit to the watershed. The periodic review in this adaptive management process will provide a verifiable process for plan monitoring and ensure accountability in plan implementation.

Opportunities

The following opportunities to develop more understanding of PE well water use in the watershed during the planning process were identified during the planning process. Seeking out these opportunities will improve monitoring and adaptive management of the plan:

- The watershed plan includes projected PE well water use by subbasin. Monitoring the number of new PE wells, actual PE well water use, and associated consumptive water use would provide data for comparison and adjustments.
- The watershed plans include water offset and habitat projects, and estimated benefits associated with each, by subbasin. Measuring and tracking actual water offsets by subbasin, to the extent possible, can be used to verify intended benefits.
- Many factors could influence the consumptive water use from new PE wells in the future, including water system infrastructure expansion, policies or programs to require or incentivize homes to connect to public water systems, and programs that provide education and incentives for homeowners to conserve water. Ongoing monitoring could track these related factors.
- Projects identified in the plan are expected to increase groundwater storage, augment streamflows, and provide habitat benefits. Water offset projects should be monitored in order to ensure that they continue to function as designed under a changing climate. Habitat projects should be analyzed for their resilience to changing conditions. The adaptive management recommendations in this plan will help to monitor and assess the validity of the projections identified, to determine whether projects are functioning as designed even under climate change conditions, and to allow for course corrections where needed.

To address the above challenges, this plan recommends the following adaptive management strategies.

6.1.1 Tracking and Monitoring

This plan recommends that Ecology monitor watershed plan implementation, in consultation with the WDFW, and project sponsors. Ecology, in consultation with WDFW and project sponsors, should review projects and actions in this watershed plan to ensure projects are offsetting PE water use:

- Track annual new PE wells by subbasin.
- Track project implementation by subbasin.
- Develop a process to adaptively manage implementation if NEB is not being met as envisioned by the watershed plan.

This plan recommends Ecology change the Ecology well tracking system in the following ways, in order to efficiently and transparently track the number and location of PE wells in use:

- Implement a web-based well report form that mimics the current well report forms, and that uploads directly to Ecology's database with Ecology verification.
- Require coordinates (latitude and longitude) of wells on well report forms, and implement an intuitive web tool for well drillers which automatically provides the Public Lands Survey (PLS) location and coordinates for a new well.
- Identify PE wells on well report forms.
- Provide Well ID Tag numbers to older wells, and associate well decommissioning, replacement, or other well activities with the Well ID Tag.

These updates would directly and efficiently address identified shortcomings in Ecology's existing well tracking database and reporting protocols. Accurate tracking of the locations and features of PE wells will support the Committee's desire to engage in monitoring and adaptive management after adoption of the watershed plan.

This plan recommends WDFW, in collaboration with Ecology and the Recreation and Conservation Office (RCO), pilot the Salmon Recovery Portal,[27] managed by RCO, for tracking streamflow restoration projects. To improve harmonization of streamflow restoration with ongoing salmon recovery actions, local salmon recovery Lead Entity Coordinators will be consulted prior to initial data uploads. University of Washington data stewards will be employed to conduct data entry, quality assurance, and quality control.[28]

Tracking streamflow restoration projects and new domestic PE wells will:

- Improve the capacity to conduct implementation monitoring of streamflow restoration projects and actions.
- Build grant funding opportunities and track streamflow restoration associated costs.
- Provide a template for adaptively managing emergent restoration needs.

[27] https://srp.rco.wa.gov/about
[28] More details on the Project Tracking proposal are available on the WRIA 10 webpage: https://www.ezview.wa.gov/site/alias__1962/37323/watershed_restoration_and_enhancement_-_wria_10.aspx

Table 12 summarizes the entities responsible for carrying out this recommendation and associated funding needs.

Table 12 Implementation of Tracking and Monitoring Recommendation

Action	Entity or Entities Responsible	Funding Considerations
Track building permits issued with PE wells.	Ecology (via reporting from counties and cities)	The number of building permits and associated fees are transmitted to Ecology annually. No additional funding is needed.
Maintain an ongoing list and map of new PE wells within each subbasin.	Ecology	Update the existing Ecology well report tracking database. No additional funding is needed.
Update well tracking system.	Ecology	Additional funding may be needed from the Washington State Legislature to increase capacity for Ecology to verify well reports.
Maintain a summary of the status of implementation for each project.	WDFW using the Salmon Recovery Portal	WDFW may need additional funding to support maintaining the Salmon Recovery Portal.

6.1.2 Oversight and Adaptation

This plan recommends Ecology leverage the 2027 report to the legislature[29] for adaptive management. Ecology will share the report with WRIA 10 Committee member jurisdictions and other interested parties in advance of reporting to the Legislature and allow for review and comment. This plan recommends that Ecology develop similar reports in 2032 and 2037.

The report should include:

- A list of completed projects that benefit instream resources and other directly related watershed improvements conducted in coordination with the restoration and enhancement planning process.
    - Include projects implemented in the reporting period and projects expected to be implemented in the next reporting period.
    - A detailed summary of actual project costs from completed projects.
    - Amount of Streamflow Restoration Fund grants received for projects in the WRIA.
- Total number of new PE wells each year for the reporting period (2018-2027, 2018-2032, and 2018-2037) and estimated consumptive use associated with the new PE wells.
    - Compare total number of new PE wells with PE well projections within this plan, representing the cumulative number of PE wells at the time of reporting.

[29] 90.94.050 requires Ecology to report to the legislature by December 31, 2027.

- A description of potential or planned projects, included projected costs and anticipated streamflow, water supply, and watershed health benefits.
- A comparison between the amount of instream benefit from completed projects and estimated consumptive use associated with new PE wells.

Ecology's report should recommend actions if water offsets and NEB are not on track to being achieved within the planning horizon. These actions may:

- Elevate Tier 2 projects to a priority status by conducting outreach, encouraging potential or likely sponsors to lead a project, and provide case studies of other similar, successful projects.
- Estimate water offsets of habitat, programmatic, or conceptual projects.
- Revise the Ecology Streamflow Restoration Grant Guidance to prioritize or give preference to projects in watersheds that have not offset PE well water use.
- Identify barriers to project completion.
- Develop a target implementation schedule for projects.

A notice of action to prioritize projects and estimate offsets should be sent to member jurisdictions of the WRIA 10 Committee for comment. Ecology may offer a webinar to collect questions and comments and WDFW may offer orientations on the project tracking system. However, members of the WRIA 10 Committee are not expected to reconvene after approving the plan. Neither Ecology nor Committee members will make changes to the plan after its adoption. Final prioritization, estimates, outreach activities, and amendments to the grant guidance shall be at the sole determination of Ecology after member jurisdiction input.

Ecology should send the report to all member jurisdictions of the WRIA 10 Committee, all local jurisdictions within the watershed, and any additional stakeholders identified at the time of reporting.

Preference for funding of new projects should be given to watersheds that have not offset PE well water use.

Table 14 summarizes the entities responsible for carrying out this recommendation and associated funding needs.

Table 13 Implementation of Oversight and Adaptation Recommendation

Action	Entity or Entities Responsible	Funding Considerations
Develop and distribute report, including any recommended adjustments to projects and actions.	Ecology	Ecology may need additional funding to support development of the 2032 and 2037 reports.
Revise Streamflow Restoration Grant Guidance to prioritize projects in watersheds that have not offset PE well water use.	Ecology	No additional funding is needed.

6.1.3 Funding

The Committee recommends funding implementation and adaptive management from a variety of sources, including the Streamflow Restoration Grant Program administered by Ecology, Washington State Legislature, and other sources of public and private funding. Funding and staffing at local, county, and state levels is likely to see continued shortfalls due to COVID-19 related impacts over the next several years.

The Committee recognizes that no single source of funding is available that could implement every project contained in this plan and multiple funding sources will be required. The funding sources may have objectives different than solely streamflow restoration, such as habitat restoration, flood reduction, water quality, open space protection, and others. The Committee also urges the legislature to fund Ecology and WDFW to ensure plan implementation and monitoring, streamflow benefits, water offsets, and NEB.

Chapter Seven: Net Ecological Benefit

7.1 Water Offsets

This plan uses a moderate growth scenario to project a total of 688 new PE wells installed within WRIA 10 during the planning horizon. This plan uses this PE well projection to estimate 277.4 acre-feet per year of new consumptive water use in WRIA 10, as described in detail in Chapter 4. This consumptive use estimate reflects the use of a moderate growth projection combined with the 95 percent upper confidence limit of the average measured irrigated area with adjustments for parcels with no discernable irrigated acreage in aerial photos (resulting in an average irrigated area of 0.12 acres per well). Irrigation requirements were assumed to be for that of commercial turf grass. The more conservative estimate of consumptive use from irrigation provides a water offset target that accounts for uncertainties in the planning process related to the PE well projection, consumptive use assumptions, and project implementation.

The projects identified in this plan are consistent with the project type examples listed in the Final NEB Guidance: (a) water right acquisition offset projects; (b) non-acquisition water offset projects; and (c) habitat and other related projects (Ecology, 2019b). Offset projects focus on water right acquisition, Managed Aquifer Recharge (MAR), Green Stormwater Infrastructure (GSI), and decommissioning PE wells as part of levee setback and floodplain reconnection projects.

This plan estimates a total water offset of 788.3 acre-feet per year from nine water offset projects (described in Chapter 5 and listed in Table 14), a WRIA-wide surplus offset of 510.9 acre-feet per year above the consumptive use offset target. Four of the most highly implementable projects (Tier 1) account for 375.3 acre-feet per year of offset, a surplus offset of 97.9 acre-feet per year above the consumptive use target. These offsets will occur either year-round to offset the year-round impact of PE well consumptive use, or during the irrigation season to offset the anticipated higher consumptive use during the irrigation season. The WRIA 10 Committee has determined that this plan succeeds in offsetting consumptive use impacts at the WRIA scale from implementation of the projects listed in Table 14.

Table 14 Summary of WRIA 10 Water Offset Projects included in NEB analysis

Project Number	Project Name	Project Type and Brief Description	Water Offset (AFY)	Timing of Water Offset	Additional Benefits	Tier
Carbon River (CR)						
10-CR-W4	Alward Road	Levee Setback. Property acquisition and restoration of 150 acres of floodplain. Includes decommission of 20 PE wells	8	Year-round	Restoration of 150 acres of floodplain, flood hazard reduction	1
10-CR-W3	Carbon River Levee Setback and Acquisition	Water Right and Levee Setback. Purchase a property as part of a larger levee setback project and acquire associated water right.	14.3	Irrigation Season	Habitat restoration.	2
Lower Puyallup (LP)						
10-LP-W6	Potential MAR	MAR. Construct an MAR in a gravel pit supplied with Tacoma Water. Three potential locations are identified in the Lower Puyallup.	300	Year-round		2
10-LP-W10	Bond	Water Right. Acquire water right as part of a larger property transfer and protection with the City of Puyallup	30	Irrigation Season		2
Middle White (MW)						
10-MW-W7	CWA purchase	Water Right. Acquire a portion of the Cascade Water Alliance water right to place in trust.	277	Year-round		1
South Prairie Creek (SPC)						

Project Number	Project Name	Project Type and Brief Description	Water Offset (AFY)	Timing of Water Offset	Additional Benefits	Tier
10-SPC-W2	Old Inglin Dairy	Water Right. Floodplain restoration of former dairy, and place water rights into trust after plants are established.	89.09	Irrigation Season	Floodplain restoration/reconnection, habitat enhancement.	1
Upper Puyallup (UP)						
10-UP-W1	Orville Road Revetment Phase 2C Year 1	Floodplain Reconnection/Levee Setback. Purchased and decommission a PE well that served 3 homes as part of this project.	1.2	Year-round	Habitat restoration. 1,500 Linear Feet of setback revetment, 19 engineered log jams.	1
WRIA-Wide (WW)						
10-WW-W8	Green Stormwater Infrastructure	Stormwater infiltration. Support Green Stormwater Infrastructure retrofits for both individual property owners and jurisdictions. Goal of 10 projects per year.	27	Year-round	Water quality improvements	2
10-W9-W17	WWT assessment	Water Right. Acquire 10% of the water rights identified through Washington Water Trust assessment. These rights are listed individually in this table.	41.71	Irrigation Season		2
		WRIA 10 Total Water Offset	**788.3**			
		WRIA 10 Consumptive Use Estimate	**277.4**			
		Tier 1 Offsets	**375.3**			

The WRIA 10 Committee tiered the projects to identify projects with greater implementation certainty based on information available. Tier 1 projects all have specific locations, project sponsors or champions, and in some cases are already underway. Some Tier 1 projects are components of larger projects that are high priority for the project sponsor. The Tier 1 projects will offset the consumptive use in WRIA 10. Tier 2 projects are less developed, lack project sponsors or lack specific locations at the time of plan writing. The water offset estimates from the Tier 2 projects provide reasonable assurance that the plan can meet NEB if Tier 1 offsets are not realized. The projects in this plan provide an estimated 788.3 acre-feet per year in water offsets, more than double the consumptive use estimate of 277.4 acre-feet per year. Tier 1 projects provide a water offset of 375.3 acre-feet per year.

Consumptive use and project water offset are compared at the subbasin scale in Table 15. Surplus water offset is achieved in a total of three subbasins (Lower Puyallup, Middle White, and South Prairie Creek), ranging from 21.8 acre-feet per year in the South Prairie Creek subbasin to 288.9 acre-feet per year in the Lower Puyallup subbasin. A deficit in water offset occurs in a total of four subbasins (Carbon River, Lower and Upper White, and Upper Puyallup), ranging from 4.8 acre-feet per year in the Upper White subbasin to 65.30 acre-feet per year in the Upper Puyallup subbasin. However, there are two projects that are specified as "WRIA-wide" that have not been located in a specific subbasin. Those projects would provide an additional offset of 68.7 acre-feet per year in yet to be determined locations in the watershed. The highest projected growth in PE wells is expected in the South Prairie Creek subbasin and the lower portions of the Middle White and Upper Puyallup subbasins. All of the offset projects listed in Table 14 are located within these growth areas or downstream of the growth as shown in Figure 6 in Chapter 5. Each project contributes to offsetting consumptive use in the subbasin where it is located and downstream where impacts of low streamflow are propagated. For example, the surplus offset from the Middle White subbasin will benefit the Lower White.

Table 15 Subbasin Water Offset Totals Compared to Permit-Exempt Well Consumptive Use Estimate

Subbasin	Offset Project Totals (AFY)	Tier 1 Offsets (AFY)	Tier 2 Offsets (AFY)	Permit-Exempt Well Consumptive Use (AFY)[1]	Surplus/ Deficit (AFY) [2]
Carbon River	22.3	8	14.3	43.9	-21.6
Lower Puyallup River	330	0	330	41.1	+288.9
Lower White River	0	0	0	30.6	-30.6
Middle White River	277	277	0	23.0	+254
South Prairie Creek	89.1	89.1	0	67.3	+21.8
Upper Puyallup River	1.2	1.2	0	66.5	-65.3

Subbasin	Offset Project Totals (AFY)	Tier 1 Offsets (AFY)	Tier 2 Offsets (AFY)	Permit-Exempt Well Consumptive Use (AFY)[1]	Surplus/ Deficit (AFY) [2]
Upper White River	0	0	0	4.8	-4.8
WRIA-wide projects	68.71	0	68.7	-	+68.71
WRIA 10 Total	**788.3**	**375.3**	**413**	**277.4**	**+510.9**

Notes:
[1] Values in table have been rounded, which is why totals may differ.
[2] Surplus water offset is associated with a positive value and a deficit in water offset is associated with a negative value.

The water offset projects listed in Table 14 provide additional benefits to instream resources beyond those necessary to offset the impacts from new consumptive water use within the WRIA. For the project types planned in WRIA 10, additional benefits could include the following:

- **Water right acquisition projects:** Aquatic habitat improvements during low-flow periods; reduction in groundwater withdrawals and associated benefit to aquifer resources; and/or beneficial use of reclaimed water; permanent offset.
- **MAR projects:** Aquatic habitat improvements during low-flow periods; increased groundwater recharge; reduction in summer/fall stream temperature; and/or increased groundwater availability to riparian and near-shore plants.
- **Levee Setback and Floodplain Reconnection projects:** Aquatic habitat improvements; reduction in stream temperature; flood hazard reduction; PE well decommissioning (permanent offset); and/or additional infiltration.
- **Green Stormwater Infrastructure (GSI) projects:** Aquatic habitat improvements during low-flow periods; increased groundwater recharge; reduction in summer/fall stream temperature; flood hazard reduction; water quality improvements.

The water right acquisition and the PE well decommissioning projects will provide permanent offsets. The infrastructure projects, such as the MAR projects and the GSI projects will likely require periodic maintenance for offset benefits to continue.

7.2 Habitat Benefits

The Committee set the goal of including in the plan at least one habitat project in each subbasin. This plan achieves that goal. Table 16 lists the habitat projects selected by the Committee. Although they are not included on Table 16, the water offset projects in the Carbon River subbasin include a habitat restoration component and contribute towards the goal of one habitat project per subbasin. Many of the habitat projects are listed as Near-Term Actions by the Salmon Recovery Lead Entity. Some may produce a marginal water offset benefit, however, benefits were too small and too complex to estimate and are not included in the offset totals.

Twenty-two habitat improvement projects are summarized in Table 16 and shown in Figure 7 in Chapter 5. In general, these habitat improvement projects increase stream complexity, reconnect floodplains and enhance natural processes, previously lost, to the benefit of salmonids and other aquatic species. These projects are varying stages of development and implementation, from conceptual to in progress. The project details in Chapter 5 and the full project inventory in Appendix H provide more information about the stage of each project at the writing of this plan.

These habitat projects address many of the salmonid limiting factors described in Chapter 2.3.5. Table 16 indicates a 'project type' for each habitat project, used to group the projects as the projects address many of the same limiting factors. The project types are levee setbacks, stream restoration and floodplain reconnection. Many projects fall into multiple project types, however only the primary project type is listed in Table 16. Table 17 lists the limiting factors addressed by each habitat project type.

Table 16 Summary of WRIA 10 Habitat Improvement Projects included in NEB Analysis

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Type
Lower Puyallup (LP)				
10-LP-H5	Deer Creek Stream Bed Relocation	Relocate the creek bed to allow for a better connection to the floodplain, restore habitat in the adjacent areas.	Improve habitat and provide flood storage.	Stream restoration
10-LP-H6	Swan Creek Channel and Bank Stabilization	In-channel stabilization and restoration measures including installation of woody material and streambed gravel.	Restore 2.5 miles of Swan Creek.	Stream restoration
10-LP-H7	Silver Creek bank Stabilization	Restoration. Stabilize slopes of Silver Creek to stop channel incision.	Habitat restoration.	Stream restoration
10-LP-H8	Puyallup River (Union Pacific) Setback Levee (RM 2.6-3.0) - Acquisition	Levee setback. Acquire up to 30 acres of floodplain and former intertidal habitat.	Habitat restoration.	Levee setback
10-LP-H9	Clear Creek RM 2.9 Acquisition and Levee	Levee setback and floodplain reconnection. Construct a new 13,600' levee along Clear Creek and remove flood gate. Reconnect up to 500 acres of floodplain.	Habitat restoration.	Levee setback
10-LP-H10	Fennel Creek Phase 3	Floodplain restoration This project will restore the Fennel Creek right bank floodplain to a more natural state. Project may include a small offset by removing existing PE wells.	Restore 14 acres of floodplain.	Floodplain restoration
Lower White (LW)				
10-LW-H14	Jovita Creek Habitat Project	Restoration actions to address channel confinement, and that restore habitat and habitat forming processes.	Habitat restoration.	Stream restoration

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Type
10-LW-H15	Pacific Right Bank	Levee setback The proposed project will remove a levee and other artificial floodplain fill, allowing for off-channel habitat and floodplain restoration. The total project area available for restoration is estimated at 32 acres.	Habitat restoration, floodplain reconnection.	Levee setback
10-LW-H16	White River LB RM 2.9-4.2 Restoration	Habitat restoration. White River Restoration will restore sustainable instream, floodplain, and wetland habitats within a 170 acre area along the Lower White River between river miles 2.9 and 4.2. The tailrace between RM 3 and RM 3.5 is part of the Foster Pilot Project and not included as part of the offset and NEB accounting.	Restore sustainable instream, floodplain, and wetland habitats within a 170 acre area along the Lower White River between river miles 2.9 and 4.2.	Floodplain restoration
10-LW-H17	White river bridge (Stewart Road) replacement RM 4.9	The project will consist of replacing the existing Stewart Road Bridge with a new bridge. The existing bridge is a restriction along the river, and a new bridge will allow the river more room to move naturally, allowing better utilization of instream habitat beneath the bridge. The current bridge also limits the flow of large woody debris, while a new bridge will let them large woody debris flow downstream and accumulate naturally through the rest of the lower White River.	Habitat restoration.	Stream restoration

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Type
10-LW-H18	White River Setback LB RM4.4-4.8 Stewart	The project consists of a levee setback on the left bank between RM 4.4 - RM 4.8. This project will improve rearing opportunity by creating slow water habitat, increasing number/depth of pools, engaging floodplain food webs, improving high flow refuge with floodplain wetlands, and greater main channel roughness. Restore riparian forests. The project will reconnect about 20 acres of floodplain.	Habitat restoration. Reconnect 20 acres of floodplain.	Levee setback
10-LW-H19	Pacific Pointbar	The project consists of a levee setback on the left bank between RM 4.4 - RM 4.8. This project will improve rearing opportunity by creating slow water habitat, increasing number/depth of pools, engaging floodplain food webs, improving high flow refuge with floodplain wetlands, and greater main channel roughness. Restore riparian forests. The project will reconnect about 25 acres of floodplain.	Habitat restoration. Reconnect 25 acres of floodplain.	Levee setback
Middle White (MW)				
10-MW-H13	Enumclaw Golf Course Restoration	Stream restoration to move Boise Creek back to its historic channel adjacent to the Enumclaw Golf Course.	Increased habitat complexity and channel roughness.	Stream restoration
South Prairie Creek (SPC)				
10-SPC-H2	Implement habitat projects based on SPC study.	Habitat improvement projects. Identify and design protection and restoration actions for the lower 15.5 miles of South Prairie Creek and the lower 6 miles of Wilkeson Creek.	Habitat restoration, water quality improvements, fish passage improvements.	Stream restoration

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Type
10-SPC-H3	Stubbs Project	In-channel stabilization and restoration measures including installation of woody material and streambed gravel. Slight chance of a water right acquisition included in this project.	Habitat restoration.	Stream restoration
10-SPC-H4	South Prairie Creek RM 4.0-4.5 Floodplain Planting	Habitat improvement. Continue planting on the South Prairie Creek Preserve property between river mile 4.0 and 4.5 to maintain and in-fill existing plantings on the property.	Habitat restoration and establishment of 50-55 acres of forested floodplain.	Floodplain restoration
10-SPC-H22	South Prairie Creek Floodplain Reconnection, RM 2.7-2.8 Phase 1	Floodplain restoration. Acquire 73 acres and implement a multi-benefit floodplain reconnection project that would reduce flood risk and maintenance costs, restore vital salmon habitat, and keep the property in agricultural production.	Habitat restoration. Water quality improvements.	Floodplain restoration
Upper Puyallup (UP)				
10-UP-H1	Orville Road Revetment at Kapowsin Creek	This project will construct a setback revetment along the left bank Puyallup River near RM 26.3 from Kapowsin Creek confluence upstream. May allow for re-connection of approximately 25-acres of forested floodplain between Puyallup River and Orville Road.	Habitat restoration. Reconnect 25 acres of floodplain.	Floodplain restoration
Upper White (UW)				
10-UW-H11	Greenwater Phase 4 Implementation	Reach scale restoration to restore instream complexity and floodplain connectivity.	Restore 1.2 miles of Greenwater River.	Floodplain restoration
10-UW-H12	West Fork White Floodplain Project	Floodplain restoration project to restore habitat and habitat-forming processes.		Floodplain restoration

Project Number	Project Name	Project Type and Brief Description	Additional Benefits	Project Type
WRIA-Wide (WW)				
10-WW-H20	Land acquisition, water right acquisition, and restoration	Seek out opportunities for land and water right acquisitions and large scale habitat restoration and floodplain reconnection/levee setbacks.	Habitat restoration, habitat protection.	Floodplain restoration Levee setback Stream restoration
10-WW-H21	Levee setbacks	Implement projects included on the Pierce County Levee Setback Feasibility Study as opportunities arise. The study lists levees in Pierce County that may be set back to improve floodplain function and habitat. Any of these levee setback projects would contribute to NEB as well as small but difficult to calculate water offsets by allowing for additional infiltration during high flow events.	Floodplain reconnection, habitat restoration.	Levee setback

Table 17 Limiting Factors Addressed by Habitat Improvement Project Type

Project Type[1]	Limiting Factor(s) Addressed by Project Type[2]
Levee Setback	• Loss of floodplain habitat, wetlands, and connectivity to hyporheic zone • Loss of riparian corridors, including marine riparian, and floodplain forests • Increase in river channelization • Loss of large wood • Loss of instream habitat complexity and connectivity due to large wood • Increase in river channelization
Floodplain Restoration	• Loss of floodplain habitat, wetlands, and connectivity to hyporheic zone • Loss off-channel and side-channel habitat • Loss of riparian corridors, including marine riparian, and floodplain forests • Increase in river channelization • Loss of large wood • Loss of instream habitat complexity and connectivity • Loss of spawning and rearing habitat • Loss of good water quality, including appropriate temperature
Stream Restoration	• Loss of off-channel and side-channel habitat • Loss of riparian corridors, including marine riparian, and floodplain forests • Increase in river channelization • Loss of large wood • Loss of instream habitat complexity and connectivity • Loss of spawning and rearing habitat

[1]Note that WRIA-wide land and water right acquisition projects that provide restoration opportunities do not fall directly into one of these project type categories, however, acquisitions do address a number of limiting factors depending on location and acquisition type.

[2] Habitat projects of a specific project type may address all or some of the limiting factors listed in column 2.

7.3 Adaptive Management

The Committee identified a number of challenges related to plan implementation, described in Chapter 6. These challenges include uncertainty in growth projections, uncertainty in consumptive use estimates, uncertainty in offsets associated with specific project types, project implementation, climate change, and other factors. The Committee has recommended adaptive management measures in Chapter 6 of the plan for the purpose of addressing uncertainty in plan implementation. Adaptive management measures include PE well tracking, offset and habitat project implementation tracking, and periodic watershed plan implementation reporting, with recommended actions if offsets are not being achieved. These measures, in addition to the surplus water offset and supplemental habitat improvement projects and programmatic actions described above, provide reasonable assurance that the plan will offset consumptive use from new PE wells during the planning horizon.

7.4 NEB Evaluation Findings

This watershed plan provides a path forward for offsetting an estimated 277.4 acre-feet per year of new consumptive water use in WRIA 10. The plan achieves this offset through a total of four Tier 1 projects and five Tier 2 water offset projects with a cumulative offset projection of 788.3 acre-feet per year, WRIA-wide. This projected total water offset yields a surplus offset of 510.9 acre-feet per year above the consumptive use estimate of 277.4 acre-feet per year in WRIA 10. Tier 1 projects alone account for a water offset of 375.3 acre-feet per year, a surplus offset of 97.9 acre-feet per year.

Within this plan, water offset projects are complimented by a total of 22 habitat improvement projects, which provide numerous additional benefits to aquatic and nearshore habitat. While many of these habitat improvement projects have potential streamflow benefits, the Committee excluded any associated water offset from the plan's accounting. Additional programmatic actions as described in Chapter 5 include a Water Conservation Education and Incentives Program, Voluntary PE Well Metering Pilot Project, and a recommendation to update the Ecology Well Log Database.

The Committee has additionally recommended adaptive management measures, as described above and in Chapter 6, to provide reasonable assurance that the plan will adequately address new consumptive use impacts anticipated during the planning horizon, despite inevitable challenges that will arise during project implementation, operation, and maintenance. WRIA 10 has demonstrated successful collaboration and project implementation through similar processes, such as the WRIA 10/12 Salmon Recovery Lead Entity. This history of successful collaboration is expected to continue.

Based on the information and analyses summarized in this plan and the assumption that projects and programmatic actions in the plan will be implemented, the WRIA 10 Committee finds that this plan achieves a net ecological benefit, as required by RCW 90.94.030 and defined by the Final NEB Guidance (Ecology 2019b).

Appendices

WRIA 10 Puyallup-White Watershed

The following appendices are linked to this report as an Appendices file at:

https://apps.ecology.wa.gov/publications/SummaryPages/2111010.html

Appendix A – References

Appendix B – Glossary

Appendix C – Committee Roster

Appendix D – Operating Principles

Appendix E – Aquifer Units in WRIA 10

Appendix F – Subbasin Delineation Memo

Appendix G – Permit-exempt Growth and Consumptive Use Summary

Appendix H – Projects

Appendix I – Washington Water Trust Report

Appendix J – Priority Streams for Water Right Acquisitions