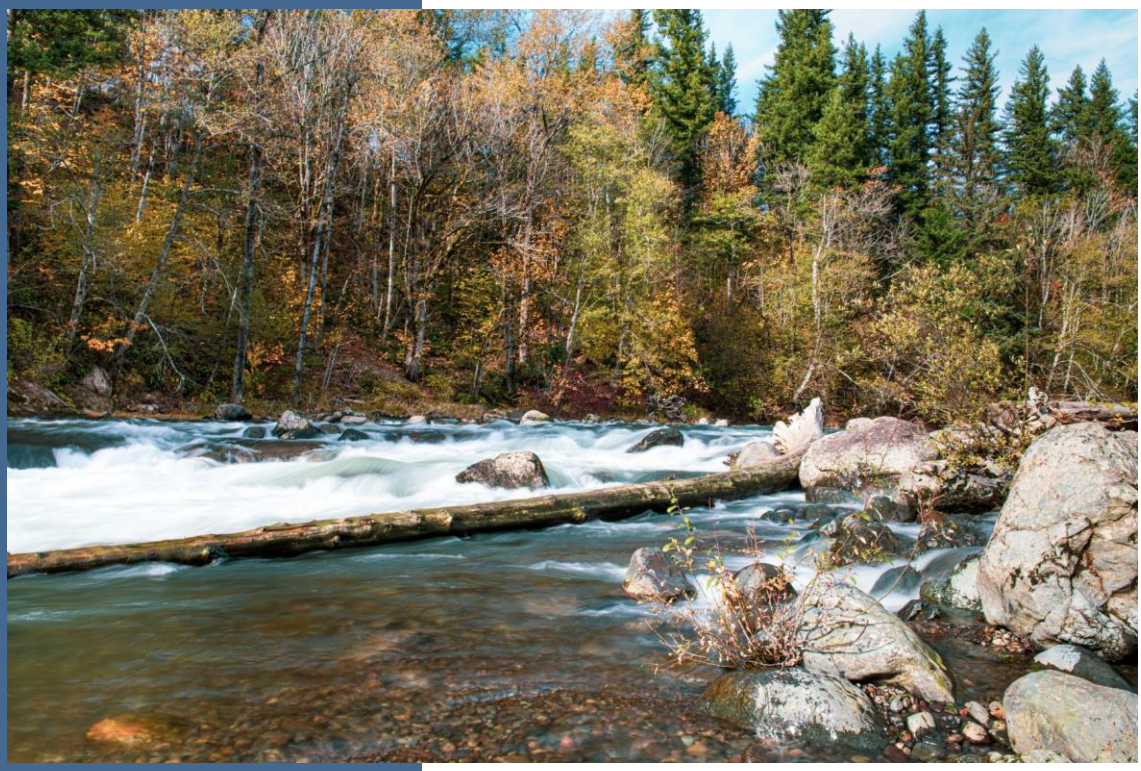

# Watershed Restoration and Enhancement Plan
# WRIA 9 – Duwamish-Green Watershed

**Approved Plan**
**February 2021**

DEPARTMENT OF ECOLOGY
State of Washington

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# Acronyms

| Acronym | Definition |
|---|---|
| AE | Application Efficiency |
| AFY | Acre-Feet per Year |
| CFS | Cubic Feet per Second |
| CU | Consumptive Use |
| CUF | Consumptive Use Factor |
| GPD | Gallons per Day |
| GIS | Geographic Information System |
| IR | Irrigation Requirements |
| LIO | Local Integrating Organization |
| MAR | Managed Aquifer Recharge |
| NEB | Net Ecological Benefit |
| PE | Permit-Exempt |
| RCW | Revised Code of Washington |
| WAC | Washington Administrative Code |
| WDFW | Washington Department of Fish and Wildlife |
| WRE | Watershed Restoration and Enhancement |
| WRIA | Water Resource Inventory Area |
| WWT | Washington Water Trust |

# Acknowledgements

This watershed plan was written in collaboration with Department of Ecology, the WRIA 9 Committee, and the technical consultants. We express our sincere gratitude to those that supported the development of the plan and supplemental materials.

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# Executive Summary

In January 2018, the Washington State Legislature passed the Streamflow Restoration law (Revised Code of Washington (RCW) 90.94). The law clarifies how local governments issue building permits for homes intending to use a permit-exempt well for their domestic water supply and requires local watershed planning in 15 water resource inventory areas (WRIAs), including the Duwamish-Green watershed (WRIA 9). The law directs the Department of Ecology to lead Watershed Restoration and Enhancement Committees to develop Watershed Restoration and Enhancement Plans (watershed plans). Watershed plans must estimate the potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over 20 years (2018-2038), identify projects and actions to offset those impacts, and provide a net ecological benefit to the WRIA. This Watershed Restoration and Enhancement Plan meets the requirements of the law.

The Department of Ecology (Ecology) established the Duwamish-Green (WRIA 9) Watershed Restoration and Enhancement Committee (Committee) in October 2018 and invited representatives from the following entities in the watershed to participate: tribal governments, county governments, city governments, Department of Fish and Wildlife, the largest non-municipal water purveyor, and interest groups. The WRIA 9 Committee met for over 2 years to develop a watershed plan.

Ecology issued the Final Guidance on Determining Net Ecological Benefit (Final NEB Guidance) (Ecology 2019) to ensure consistency, conformity with state law, and transparency in implementing RCW 90.94. The Final NEB Guidance describes the minimum planning requirements: include clear and systematic logic, delineate subbasins, estimate new consumptive water use, evaluate impacts of new consumptive water use, and describe and evaluate projects and actions for their offset potential.

The WRIA 9 Committee divided WRIA 9 into 12 subbasins for purposes of assessing consumptive use and project offsets, as shown in Figure ES.1.

The WRIA 9 Committee projects that a total of 632 new permit-exempt domestic wells (PE wells) will be installed within WRIA 9 during the 20-year planning horizon. The WRIA 9 Committee used this 20-year PE well projection to estimate 247.7 acre-feet per year (AFY), or 0.34 cubic feet per second (cfs), of new consumptive water use in WRIA 9 that this watershed plan must address and offset.

The WRIA 9 Committee sought projects to offset at least 495.4 AFY of water per year to account for uncertainties in the PE well projection and consumptive use estimate, including higher rates of water use that could result from climate change and changing development patterns. The WRIA 9 Committee developed the water offset target by doubling the 247.7 AFY consumptive use estimate. The offset target of 495.4 AFY also accounts for uncertainties related to project implementation.

The watershed plan includes three water rights acquisitions projects, two managed aquifer recharge projects, and one streamflow augmentation projects to offset consumptive use. If implemented, these six water offset projects will provide an estimated offset of 1,075 AFY and

exceed the offset target. A total of ten habitat projects are included in the watershed plan. Ecological benefits associated with these projects are myriad and include floodplain restoration, wetland reconnection, availability of off-channel habitat for juvenile salmonids, increase in groundwater levels and baseflow, and increase in channel complexity. The ecological and streamflow benefits from habitat projects are supplemental to the quantified water offsets and contribute to achieving a net ecological benefit.

The WRIA 9 Committee has recommended adaptive management measures in the plan for the purpose of addressing uncertainty in plan implementation. Adaptive management measures include PE well tracking, project implementation tracking, and periodic watershed plan implementation reporting, with recommended adjustments to the plan. 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 9 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 2019).

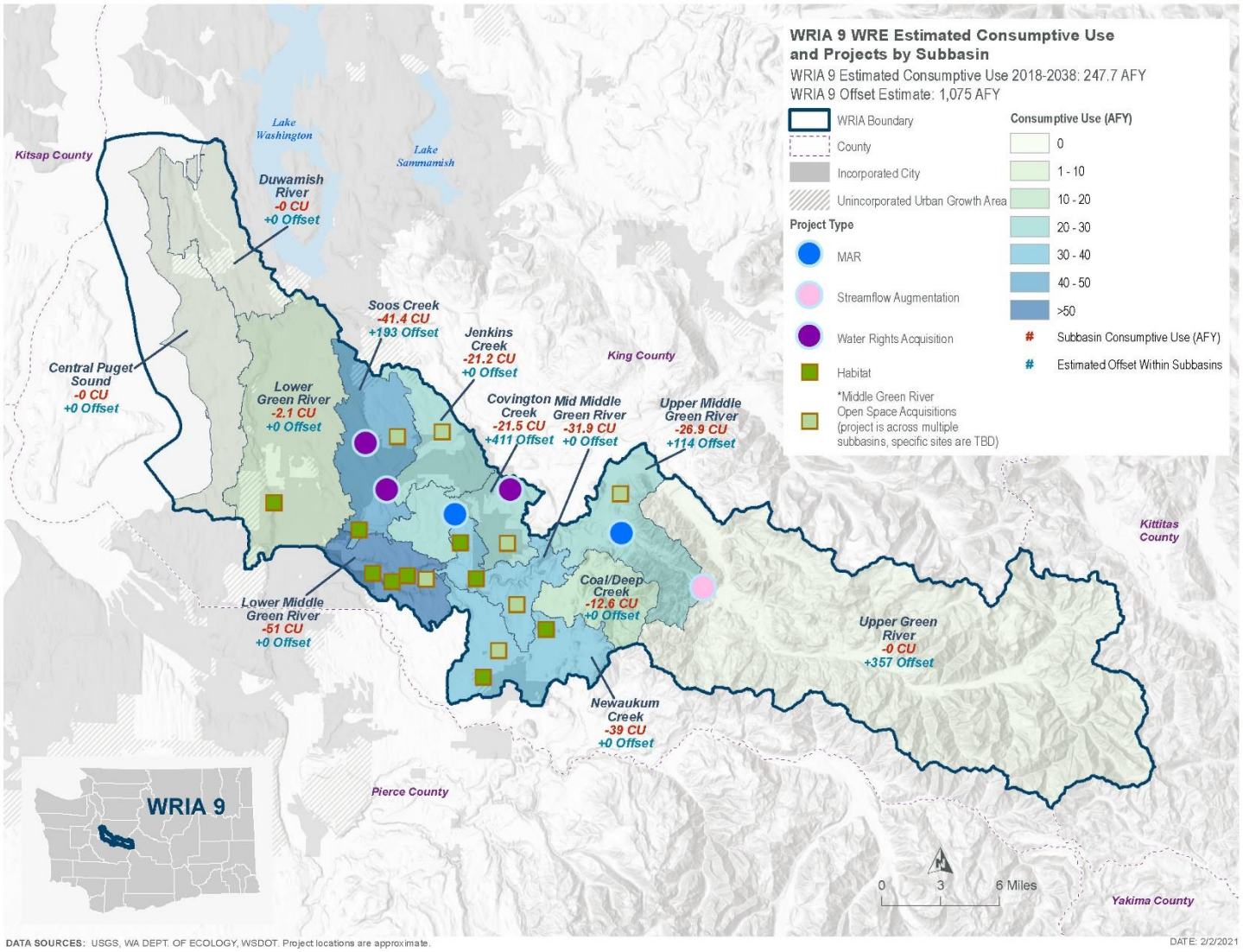



Figure ES.1: WRIA 9 Estimated Consumptive Use and Projects by Subbasin

# Chapter One: Plan Overview

## 1.1 Plan Purpose and Structure

The purpose of the Water Resource Inventory Area (WRIA) 9 Watershed Restoration and Enhancement Plan is to offset the impacts of new permit-exempt domestic wells (PE wells) to streamflows. The plan is one requirement of RCW 90.94.030. The law clarifies how local jurisdictions issue building permits for homes that use a permit-exempt well for a water source. Watershed Restoration and Enhancement Plans (watershed plans) must estimate the potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over 20 years (2018-2038), identify projects and actions to offset those impacts, and provide a net ecological benefit to the WRIA. The law requires that local watershed planning take place in 15 WRIAs across the state, including in the Duwamish–Green watershed (WRIA 9). The WRIA 9 Watershed Restoration and Enhancement Plan is coordinated with 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. 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 (Culhane et al. 1995). Projects and actions to offset new consumptive water use associated with permit-exempt domestic wells have become a focus to minimize future impacts to instream flows and restore streamflow.

While this watershed plan is narrow in scope and is not intended to address all water uses or related issues within the watershed, successful completion of the plan by the WRIA 9 Watershed Restoration and Enhancement Committee (Committee) represents a noteworthy achievement regarding a technically and politically complex issue.

This watershed plan is divided into 7 Chapters:

1. Overview of the plan purpose and scope and plan development process;
2. Overview of the watershed, including land use and salmon presence, other planning efforts, hydrology and hydrogeology;
3. Summary of the subbasins;
4. Permit-exempt well projections and consumptive water use estimates;
5. Description of the recommended projects and actions identified to offset future permit-exempt domestic water use in WRIA 9;
6. Explanation of recommended adaptive management and implementation measures; and
7. Evaluation and consideration of the net ecological benefits.

### 1.1.1 Legal and Regulatory Background for the WRIA 9 Watershed Restoration and Enhancement Plan

In January 2018, the Washington State Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 (session law 2018 c 1). This law was enacted in response to the State Supreme Court's 2016 decision in Whatcom County vs. Hirst, Futurewise, et al. (commonly referred to as the "Hirst decision"). As it relates to this Committee's work, the law, now primarily codified as RCW 90.94, clarifies how local governments can issue building permits for homes intending to use a permit-exempt well for their domestic water supply. The law also requires local watershed planning in 15 WRIAs, including WRIA 9.

### 1.1.2 Permit-Exempt Domestic Wells

This Watershed Restoration and Enhancement Plan, the law that calls for it, and the Hirst decision are all concerned with the effects of new permit-exempt domestic water use on streamflows. Several laws pertain to the management of groundwater permit-exempt wells in WRIA 9 and are summarized in brief here for the purpose of providing context for the WRIA 9 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. It is important to note that 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, these withdrawals of water are subject to the prior appropriations scheme as are any other water uses. There is still regulatory oversight, including from local jurisdictions. Specifically, in order for an applicant to receive a building permit from their local government for a new home, the applicant must satisfy the provisions of RCW 19.27.097 for what constitutes evidence of an adequate water supply.

RCW 90.94.030 adds to the management regime for new homes using permit-exempt domestic well withdrawals in WRIA 9 and elsewhere. For example, local governments must, among other responsibilities relating to new permit-exempt domestic wells, collect a $500 fee for each building permit and record withdrawal restrictions on the title of the affected properties. Additionally, this law restricts new permit-exempt domestic withdrawals in WRIA 9 to a maximum annual average of 950 gallons per day per connection (which may be curtailed to 350 gallons per day per connection for indoor use only during drought), subject to the five thousand gallons per day and ½-acre outdoor irrigation of non-commercial lawn/garden limits established in RCW 90.44.050. Ecology has published its interpretation and implementation of RCW 19.27.097 and RCW 90.94 in Water Resources POL-2094 (Ecology 2019a). The WRIA 9 Committee directs readers to those laws and policy for comprehensive details and agency interpretations.

### 1.1.3 Planning Requirements under RCW 90.94.030

While supplementing the local building permit requirements, RCW 90.94.030(3) goes on to establish the planning criteria for WRIA 9. In doing so, it sets the minimum standard for Ecology's collaboration with the WRIA 9 Committee in the preparation of this watershed plan. In practice, the process of plan development was one of integration, collectively shared work, and a striving for consensus described in the WRIA 9 Committee's adopted operating principles, which are further discussed below and in Appendix D.

In addition to these procedural requirements, the law and consequently this watershed plan, is concerned with the identification of projects and actions intended to offset the anticipated impacts from new permit-exempt domestic groundwater withdrawals over the 20 year planning horizon 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 9 Committee's approach to selecting projects and actions, the law also speaks to "high and lower priority projects." The WRIA 9 Committee understands that, as provided in the Final Guidance on Determining Net Ecological Benefit, "use of these terms is not the sole critical factor in determining whether a plan achieves a [net ecological benefit] NEB…and that plan development should be focused on developing projects that provide the most benefits…regardless of how they align with [these] labels" (Ecology 2019, p. 12). It is the perspective of the WRIA 9 Committee that this locally approved 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 Duwamish-Green watershed for the sole purpose of developing a Watershed Restoration and Enhancement Plan in collaboration with the WRIA 9 Committee. Ecology determined that the intent was best served through collective development of the watershed plan, using an open and transparent setting and process that builds on local needs.

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

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 RCW 90.94. The Final Guidance on Determining Net Ecological Benefit (hereafter referred to as Final NEB Guidance) 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 minimum planning requirements identified in the Final NEB Guidance include the following (Ecology 2019, pp 7-8):

1. Clear and Systematic Logic: Watershed plans must be prepared with implementation in mind.
2. Delineate Subbasins: The committee must divide the WRIA into suitably sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets.
3. Estimate New Consumptive Water Use: Watershed plans must include a new consumptive water use estimate for each subbasin, and the technical basis for such estimate.
4. Evaluate Impacts from New Consumptive Water use: Watershed plans must consider both the estimated quantity of new consumptive water use from new permit-exempt domestic wells initiated within the planning horizon and how those impacts will be distributed.
5. Describe and Evaluate Projects and Actions for their Offset Potential: Watershed plans must, at a minimum, identify projects and actions intended to offset impacts associated with new consumptive water use.

The law requires that all members of the WRIA 9 Committee approve the plan prior to submission to Ecology for review. Ecology must then determine that the plan's recommended streamflow restoration projects and actions will result in a net ecological benefit to instream resources within the WRIA after accounting for projected use of new permit-exempt domestic wells over the 20-year period of 2018-2038.

## 1.3 Overview of the WRIA 9 Committee

### 1.3.1 Formation

The Streamflow Restoration law instructed Ecology to chair the WRIA 9 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 publicly-owned water purveyor providing water within the WRIA that is not a municipality.
- The largest irrigation district within the WRIA.[1]

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

[1] There are no irrigation districts located in WRIA 9.

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 WRIA 9 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 WRIA 9 Committee.

The WRIA 9 Committee members are included in Table 1.1. This list includes all of the members identified by the Legislature that agreed to participate on the WRIA 9 Committee.[2]

Table 1.1: WRIA 9 Entities and Membership

| **Entity Name** | **Representing** |
|---|---|
| King County | County government |
| City of Auburn | City government |
| City of Black Diamond | City government |
| City of Enumclaw | City government |
| City of Kent | City government |
| City of Normandy Park | City government |
| City of Seattle | City government |
| City of Tukwila | City government |
| Muckleshoot Indian Tribe | Tribal government |
| Washington Department of Ecology | State agency |
| Washington Department of Fish and Wildlife | State agency |
| Covington Water District | Water utility |
| King County Agriculture Program | Agricultural interest |
| Master Builders Association of King and Snohomish Counties | Residential construction |
| Center for Environmental Law and Policy | Environmental interest |
| WRIA 9 Watershed Ecosystem Forum – ex officio | Salmon Recovery Lead Entity |
| Tacoma Water – ex officio | Municipal water purveyor |

The WRIA 9 Committee roster with names of representatives and alternates is available in Appendix C.

The WRIA 9 Committee invited the WRIA 9 Watershed Ecosystem Forum and Tacoma Water to participate as “ex officio” members. Although not identified in the law, the ex officio members provide valuable information and perspective as subject matter experts. The ex officio members are active but non-voting participants of the WRIA 9 Committee.

## 1.3.2 Committee Structure and Decision Making

The WRIA 9 Committee held its first meeting in October 2018. Between October 2018 and February 2021, the WRIA 9 Committee held 22 committee meetings open to the public. The WRIA 9 Committee met monthly or every other month, and as needed to meet deadlines.

[2] The law did not require invited entities to participate, and some chose not to participate on the Committee.

The two and a half years of planning consisted of planning group formation, data gathering, and developing plan components. WRIA 9 Committee members had varying degrees of understanding concerning hydrogeology, water law, salmon recovery, and rural development. Ecology technical staff, WRIA 9 Committee members, and partners presented on topics to provide context for components of the plan.

In addition to playing the role of WRIA 9 Committee chair, Ecology staff provided administrative support and technical assistance, and contracted with consultants to provide facilitation and technical support for the WRIA 9 Committee. The facilitation team from Cascadia Consulting supported the WRIA 9 Committee's discussions and decision-making. The technical consultants from GeoEngineers and Northwest Hydraulic Consultants developed products that informed WRIA 9 Committee decisions and development of the plan. The technical consultants developed all of the technical memorandums referenced throughout this plan.

Cities had the option of participating in the Committee through a caucus, with one person attending the Committee meetings as the caucus representative. Black Diamond, Normandy Park, and Tukwila decided to form a cities caucus with the WRIA 9 Watershed Ecosystem Forum representative serving as the caucus representative. The caucus representative's attendance and vote represented the participation and vote of all members of the caucus. The caucus had one collective vote on decisions that did not require approval by all Committee members. For decisions that required approval by all Committee members (adopting or amending the operating principles, final plan approval), each caucus member voted individually.

The WRIA 9 Committee established a technical workgroup to support planning efforts and to achieve specific tasks. The workgroup was open to all WRIA 9 Committee members as well as non-Committee members that brought capacity or expertise to the Committee. The workgroup made no binding decisions, but presented information to the Committee as either recommendations or findings. The WRIA 9 Committee acted on workgroup recommendations, as it deemed appropriate.

During the initial WRIA 9 Committee meetings, members developed and agreed to operating principles.[3] The operating principles set forward a process for meeting, participation expectations, procedures for voting, structure of the WRIA 9 Committee, communication, and other needs in order to support the WRIA 9 Committee in reaching agreement on a final plan.

This planning process, by statutory design, brought diverse perspectives to the table. The authorizing legislation requires all members of the Committee to approve the final plan prior to Ecology's review.[4] It was important for the Committee to identify a clear process for how it made decisions. The Committee strived for consensus for interim decisions because consensus on decisions during plan development served as the best indicator of the Committee's progress toward an approved plan. Consensus was reached on all interim decisions. The chair and facilitator documented agreement and dissenting opinions in meeting summaries, as outlined

[3] Approved and signed operating principles can be found in Appendix D and on the WRIA 9 Committee webpage.
[4] "…all members of a Watershed Restoration and Enhancement Committee must approve the plan prior to adoption" RCW 90.94.030(3).

in the Committee's operating principles. The Committee did not make any decisions by two-thirds majority.

The WRIA 9 Committee reviewed components of the watershed plan and the draft plan on an iterative basis. Once the WRIA 9 Committee reached initial agreement on the final draft of the watershed plan, broader review and approval by the entities represented on the WRIA 9 Committee was sought, as needed. The WRIA 9 Committee reached final agreement on the Watershed Restoration and Enhancement Plan on February 23, 2021.

# Chapter Two: Watershed Overview

## 2.1 Brief Introduction to WRIA 9

The Duwamish-Green watershed is one of the 62 designated major watersheds in Washington State, formed as a result of the Water Resources Act of 1971. The Duwamish-Green watershed is located in King County, Washington and is approximately 482 square miles in area. It includes all the lands drained by the Duwamish-Green River, including marine nearshore areas that drain directly to Puget Sound. WRIA 9 is bounded on the north by WRIA 8 (Cedar-Sammamish), on the west by Puget Sound, on the south by WRIA 10 (Puyallup-White), and on the east by WRIA 38 (Naches) and WRIA 39 (Upper Yakima).

The upper portion of the watershed contains Howard Hanson Dam, an earthen dam on the Green River constructed for flood control. The City of Tacoma operates a diversion facility approximately three miles downstream from Howard Hanson Dam for municipal water supply. Lower portions of the watershed contain Lake Sawyer and Lake Youngs. Numerous smaller lakes, ponds, and wetlands are present throughout the watershed. Over the last 200 years, construction of dams, levees, and other flood control projects, and development of the Duwamish Estuary altered the watershed from its pre-development state (WRIA 9 Steering Committee 2005). The Duwamish River, and the lower portion of the Green River, have been extensively channelized.

The watershed includes one major river, the Duwamish-Green River. The Green River originates in the Cascade Range south of Snoqualmie Pass and flows in a generally northwest direction before becoming the Duwamish River at the historical confluence with the Black River near the City of Tukwila. The Duwamish River is highly channelized and flows northwest before discharging to Elliott Bay in the City of Seattle. The overall length of the Duwamish-Green River system is 93 miles. The mean annual flow in the Green River is 1,350 cubic feet per second measured near Auburn (U.S. Geological Survey 2020). Tributaries within the system include Coal Creek, Deep Creek, Newaukum Creek, and Soos Creek (Covington Creek and Jenkins Creek flow into Soos Creek).

### 2.1.1 Land Use in WRIA 9

The eastern or upland portion of the watershed extending from the Tacoma Headworks Diversion Dam on the west, to the eastern boundary of WRIA 9, is the Green River Municipal Watershed. Tacoma Public Utilities manages the Green River Municipal Watershed for municipal water supply under a Habitat Conservation Plan (Tacoma Public Utilities 2001) and a 1995 agreement with the Muckleshoot Indian Tribe. This portion of the watershed consists of forestland and has limited public access. Land uses shift to agriculture, suburban developments, and small urban centers such as Black Diamond and Enumclaw in the foothills of the Cascade Mountains. Extending from the cities of Auburn and Kent to the cities of Burien, Tukwila, Renton, and Seattle, the northwest portion of WRIA 9 is highly urbanized, characterized by a combination of residential, industrial, commercial, transportation, communication, and utility land covers. Approximately 30 percent of the watershed is within a city or designated urban growth area.

The Duwamish-Green watershed is one of the most heavily populated watersheds in Washington. Industry, agriculture, commercial facilities, individual residences, and municipalities compete for a limited water supply, causing a strain on water availability. These out of stream uses compete with instream water needs, including providing water for salmon and other aquatic resources.

### 2.1.2 Tribal Reservations and Tribal Treaty Rights

Federally Recognized Indian Tribes are sovereign nations with rights over natural resources, including enough water to fulfill the purposes of their reservations. Some of the ancestral lands and use areas of the people of the Muckleshoot Indian Tribe, and the lands of the Muckleshoot Indian Reservation are located in WRIA 9. The Muckleshoot Indian Tribe holds reserved treaty rights to fish, hunt, and gather throughout WRIA 9 and claims the earliest (most senior) priority rights to water within the Duwamish-Green watershed. While unquantified, federally reserved water rights intended to serve current and future uses may be reserved by and protected in treaties, executive orders, and federal court decisions. The Tribe's water rights can extend to instream flows and minimum lake levels necessary to protect resources in all areas where the Tribe may have reserved rights. Treaty rights to fish can support claims for fish habitat, including instream flow. Nothing in this plan can alter tribal rights.

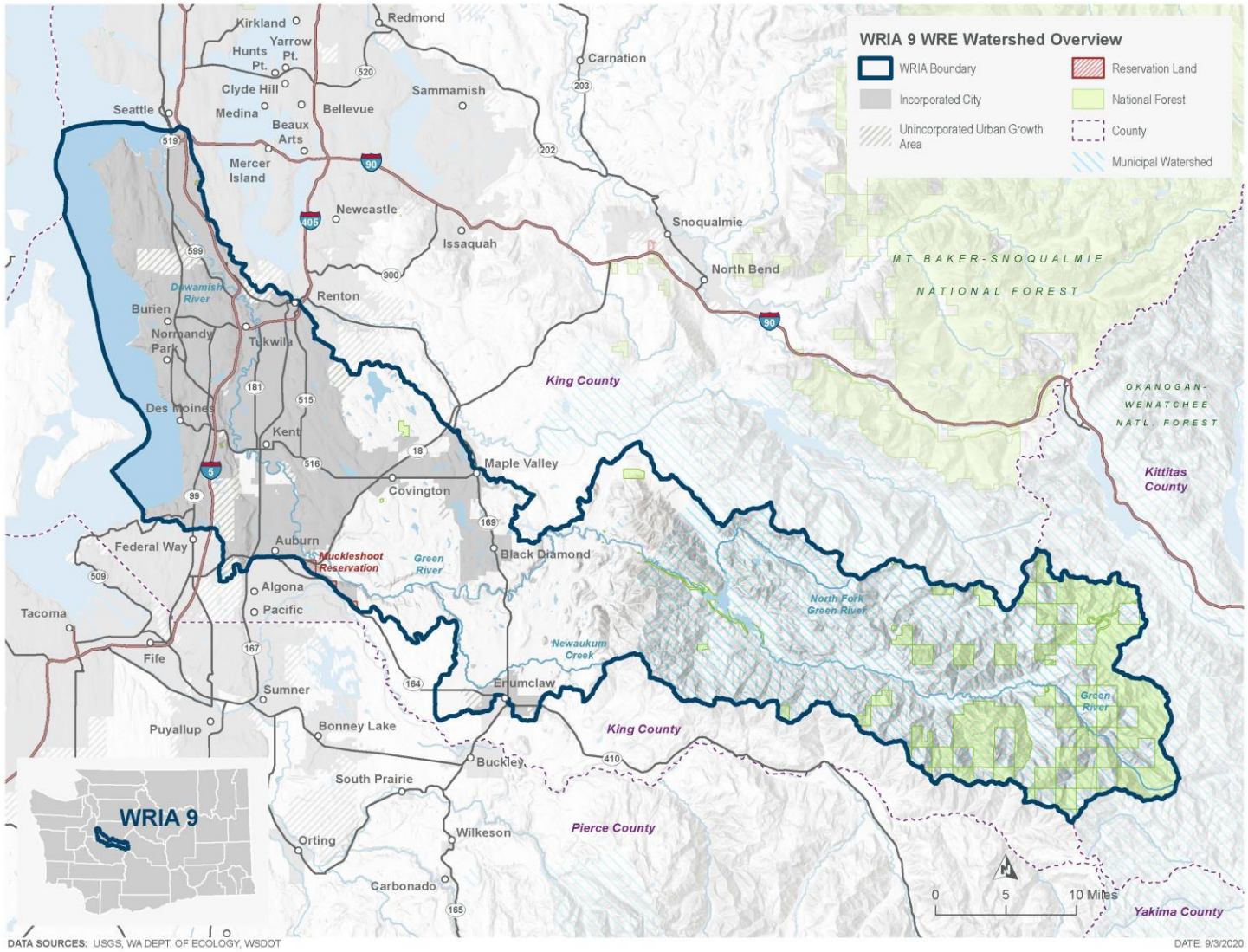



Figure 2.1: WRIA 9 Watershed Overview

## 2.1.3 Salmonids in WRIA 9

The Duwamish-Green watershed is an important and potentially productive system for salmonids. Several tributaries provide spawning and rearing habitat for salmon, steelhead, and bull trout. These streams often experience low streamflows during critical migration and spawning time. In addition, levees, dams, migration barriers, and other flood control and navigation measures have further limited habitat along the river and tributaries. The quality and quantity of spawning and rearing habitat, water quality, including water temperature, and low streamflows all affect local salmon populations (WRIA 9 Steering Committee 2005).

The Soos Creek system, Newaukum Creek, and Crisp Creek are also important systems for both natural and hatchery salmon resources. The state's Soos Creek Hatchery is located near the mouth of the creek and has just undergone a major rehabilitation. The Keta Creek Hatchery is located on Crisp Creek and owned and operated by the Muckleshoot Indian Tribe, who work with Washington Department of Fish and Wildlife (WDFW) and other tribes on fish propagation programs.

### Salmon Presence (Fish Population and Life Histories)

The Duwamish-Green watershed has anadromous salmon runs that include four of the five North American Pacific salmon species (WDFW Salmonscape 2020, SWIFD 2020). Chinook (*Oncorhynchus tshawytscha*), Coho (*Oncorhynchus kisutch*), Chum (*Oncorhynchus keta*), and Pink salmon (*Oncorhynchus gorbuscha*) migrate in and out of the Duwamish-Green watershed from Puget Sound. There is no established run of Sockeye salmon (*Oncorhynchus nerka*) within the watershed; however, stray individuals have been observed in the basin. Steelhead trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarkii clarkii*), rainbow trout (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*) also inhabit the watershed.

The Puget Sound evolutionarily significant unit (ESU) of Chinook salmon was designated as threatened under the Endangered Species Act (ESA) on May 24, 1999. Designated critical habitat for Chinook salmon includes marine nearshore and freshwater habitats within WRIA 9 (70 FR 52629-52858). The Puget Sound distinct population segment (DPS) of steelhead trout was designated as threatened under ESA on May 7, 2007. Final designated critical habitat (DCH) for Puget Sound steelhead includes freshwater and estuarine habitat in Puget Sound, Washington (81 FR 9251-9325) including areas within WRIA 9. The Coastal-Puget Sound Distinct Population Segment (DPS) of bull trout was designated as threatened under ESA on December 1, 1999. Critical habitat has been designated for bull trout and includes both freshwater and saltwater aquatic habitat within WRIA 9 (75 FR 63898-64070). Table 2.1 below lists the species present in the Duwamish-Green watershed and their regulatory status.

Table 2.1: Salmonids Present within the Duwamish-Green Watershed

| Common Name | Scientific Name | Evolutionary Significant Unit | Critical Habitat | Regulatory Agency Status |
|---|---|---|---|---|
| Chinook salmon | *Oncorhynchus tshawytscha* | Puget Sound Chinook | Yes/2005 | NMFS/ Threatened/ 1999 |

| Common Name | Scientific Name | Evolutionary Significant Unit | Critical Habitat | Regulatory Agency Status |
|---|---|---|---|---|
| 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 |
| Sockeye salmon | *Oncorhynchus nerka* | 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 clarkii clarkii* | No listing | No listing | No listing |
| Rainbow trout | *Oncorhynchus mykiss* | No listing | No listing | No listing |

Table 2.2 below lists the run timing and life stages of anadromous salmon and trout present throughout the watershed. Watershed specific data concerning salmonid life history and timing was largely summarized from the 2000 King County Habitat Limiting Factors and Reconnaissance Assessment for Salmon Habitat (Kerwin 2000).

Table 2.2: Salmonid Life History Patterns within the Duwamish-Green Watershed

| Species | Freshwater Life Phase | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Subbasin Presence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sockeye[1] | Upstream migration | | | | | | ■ | ■ | ■ | ■ | ■ | | | Duwamish River<br>Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Upper Middle Green River<br>Newaukum Creek<br>Soos Creek |
| | Spawning | | | | | | | | | ■ | ■ | ■ | ■ | |
| | Fry emergence | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | |
| | Juvenile rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Smolt outmigration | | | | ■ | ■ | ■ | ■ | | | | | | |
| Chinook (fall) | Upstream migration | | | | | | | ■ | ■ | ■ | ■ | | | All |
| | Spawning | | | | | | | | | ■ | ■ | ■ | ■ | |
| | Incubation | ■ | ■ | ■ | ■ | | | | | | ■ | ■ | ■ | |
| | Juvenile rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| | Juvenile outmigration | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| Coho | Upstream migration | | | | | | | | | | ■ | ■ | ■ | Central Puget Sound<br>Duwamish River<br>Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Upper Middle Green River<br>Upper Green River<br>Newaukum Creek<br>Soos Creek<br>Jenkins Creek<br>Covington Creek |
| | Spawning | ■ | ■ | | | | | | | | | ■ | ■ | |
| | Incubation | ■ | ■ | ■ | ■ | | | | | | | | ■ | |
| | Juvenile rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Smolt outmigration | | | | ■ | ■ | ■ | ■ | | | | | | |
| Chum | Upstream migration | | | | | | | | | | ■ | ■ | ■ | Central Puget Sound<br>Duwamish River<br>Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Upper Middle Green River<br>Upper Green River<br>Newaukum Creek<br>Soos Creek<br>Covington Creek |
| | Spawning | | | | | | | | | | | ■ | ■ | |
| | Incubation | ■ | ■ | ■ | ■ | | | | | | | ■ | ■ | |
| | Juvenile rearing | | | ■ | ■ | ■ | ■ | | | | | | | |
| | Juvenile outmigration | | | ■ | ■ | ■ | ■ | | | | | | | |
| Pink | Upstream migration | | | | | | | | ■ | ■ | | | | Duwamish River |

| Species | Freshwater Life Phase | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Subbasin Presence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Spawning | | | | | | | | | ■ | ■ | | | Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Newaukum Creek<br>Soos Creek |
| | Incubation | ■ | ■ | ■ | ■ | ■ | | | | | ■ | ■ | ■ | |
| | Juvenile rearing | | | ■ | ■ | ■ | ■ | | | | | | | |
| | Juvenile outmigration | | | | ■ | ■ | ■ | | | | | | | |
| Bull trout[2] | Upstream migration | | | | | | | ■ | ■ | ■ | | | | Duwamish River<br>Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Upper Middle Green River |
| | Spawning | | | | | | | | | ■ | ■ | ■ | | |
| | Incubation | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Coastal Cutthroat trout[3] | Upstream migration | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | All |
| | Spawning | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Incubation | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Juvenile rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Smolt outmigration | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Steelhead trout (winter) | Upstream migration | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Central Puget Sound<br>Duwamish River<br>Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Upper Middle Green River<br>Upper Green River<br>Newaukum Creek<br>Soos Creek<br>Jenkins Creek<br>Covington Creek |
| | Spawning | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Incubation | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Juvenile rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Smolt outmigration | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Steelhead trout (summer) | Upstream migration | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Duwamish River<br>Lower Green River<br>Lower Middle Green River<br>Mid Middle Green River<br>Upper Middle Green River<br>Soos Creek |
| | Spawning | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Incubation | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Juvenile rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| | Smolt outmigration | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |

| Species | Freshwater Life Phase | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Subbasin Presence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainbow trout[4] | Spawning | | | ■ | ■ | ■ | ■ | | | | | | | Lower Green River<br>Lower Middle Green River<br>Upper Middle Green River<br>Upper Green River |
| | Incubation | | | | ■ | ■ | ■ | ■ | | | | | | |

Notes:

1. There is no established run of Sockeye within the Basin. This data reflects stray individuals observed within the basin. Information on sockeye life history specifically within the Green and Duwamish watershed is either unavailable or extremely limited. Sockeye life history patterns for the Puget Sound Region were used within this report (Gustafson et al. 1997).
2. Information on bull trout life history specifically within the Green and Duwamish watershed is either unavailable or extremely limited. Bull trout life history patterns for the Puget Sound Region were used within this report (King County 2000).
3. Information on coastal cutthroat trout life history specifically within the Green and Duwamish watershed is either unavailable or extremely limited. Coastal cutthroat trout life history patterns for the Puget Sound Region were used within this report (Johnson et al. 1999).
4. Information on rainbow trout life history specifically with the Green and Duwamish watershed is unavailable. Rainbow trout life history patterns for the Puget Sound Region were used within this report (Blanton et al. 2011).

## Current Habitat Conditions

Habitat conditions within the Duwamish-Green watershed were abstracted from the 2000 King County Habitat Limiting Factors and Reconnaissance Assessment for Salmon Habitat (Kerwin 2000). The Duwamish-Green watershed has been severely impacted by a variety of land uses ranging from commercial forestry in the Upper Green River, a mix of residential and agricultural land uses within the Middle Green River, to a mix of dense residential, industrial, and commercial development in the Lower Green River (King County 2000). Fundamental historical changes to WRIA 9 include the diversion of the White River from the Green River to the Puyallup River (1911), the diversion of the Black and Cedar Rivers from the Duwamish River to Lake Washington (1916), the filling, draining or dredging of the Duwamish estuary tidelands (1900-1940), the channelization and diking of the Duwamish-Green River (1945-2000), and the construction of the Howard Hanson Dam (1962).

The Habitat Limiting Factors and Reconnaissance Assessment (Kerwin 2000) lists the following primary limiting factors and impacts within the Duwamish-Green watershed:

- Dams and other fish passage barriers
- Loss of riparian habitat
- Excessive sedimentation
- Decreased water quality (pollution and elevated water temperatures)
- Altered mainstem and tributary hydrology
- Gravel starvation and scouring
- Disconnected floodplain habitat and loss of associated rearing habitats
- Introduction of non-native plant and animal species
- Loss of estuarine habitat
- Reduction of large woody debris and channel complexity
- Alteration/loss of marine nearshore habitat

Although there are some common issues across WRIA 9, habitat conditions vary within the watershed's subbasins and are described below.

### Upper Green River

Areas around the Upper Green River have been extensively logged and the region is a mix of old-growth, second-growth, and recently logged areas. Logging practices around tributaries to the Upper Green River have resulted in reduced riparian habitat functions, creation of fish passage barriers, increased sedimentation, decreased water quality, and altered stream hydrology. However, the Upper Green River represents relatively intact habitat compared to river reaches below the Howards Hanson Dam. The dam, located at RM 64.5, is a barrier to upstream fish migration, although some salmonids are manually transported above the dam, providing access to quality habitat upstream.

### Upper Middle Green River, Mid Middle Green River, Lower Middle Green River

The Middle Green River was separated into three distinct subbasins separated by the river confluences with Newaukum and Franklin Creeks. The Middle Green River and its tributaries are mainly affected by residential and agricultural land uses. Levees and revetments have altered natural flow regimes, reduced side-channel and off-channel habitats, and constrained channel migration. Development has also created fish passage barriers, reduced in-channel large woody debris, increased impervious surfaces, and reduced and degraded riparian habitat. The Middle Green River is also affected by low streamflows (Lombard and Somers 2004).

### Lower Green River

The Lower Green River subbasin combines the Lower Green River downstream from the Soos Creek confluence, the Black River, and Mill Creek. The Lower Green River is bordered by dense residential, commercial, and industrial development. Revetments and levees within the system have disconnected most side channels and tributaries from the active floodplain and degraded or eliminated riparian habitat. The Lower Green River is also affected by low streamflows (Lombard and Somers 2004; King County 2009).

### Coal/Deep

The Coal/Deep subbasin combines the Coal Creek and Deep Creek watersheds and is characterized by a mixture of land uses including commercial forestry, rural residential development, and agriculture. Wildfires and commercial logging have degraded riparian habitat throughout the subbasin. Both creeks drain into small lakes without outlets; there is no surface water connection between this subbasin and the Green River. However, water likely seeps underground, and these lakes are considered important cold water sources to the Green River.

### Newaukum Creek

The Newaukum Creek subbasin drains to the Green River and is dominated by agricultural development. The subbasin is an important source of spawning gravel to the mainstem Green River and supports healthy populations of Steelhead trout, and Coho and Chinook salmon. Intense agricultural development has severely degraded riparian habitat and eliminated off-channel and wetland habitat within the subbasin. Other stressors include a lack of large woody debris (LWD), numerous fish passage barriers, high levels of fecal coliform bacteria, high turbidity, and numerous bank modifications. Newaukum Creek is also affected by low streamflows (Lombard and Somers 2004; King County 2009).

### Covington Creek, Jenkins Creek, Soos Creek

The Covington Creek and Jenkins Creek subbasins both drain to the Soos Creek subbasin which drains to the Green River. These subbasins are characterized by a mix of agriculture, urban, suburban, and rural residential or commercial development. Fish passage barriers, low instream flows, and high water temperatures limit upstream migration of adult salmonids in these subbasins. Erosion and sedimentation problems have been identified across the subbasins. Although these subbasins have some of the largest wetland areas in the Green River basin, past and current trends of drainage and filling wetlands limits this potential off-channel habitat.

Urbanization and development pressures are expected to increase demands on habitat within these subbasins. The Big Soos Creek system, including Jenkins and Covington Creeks, is also affected by low streamflows (Lombard and Somers 2004; King County 2009).

#### Duwamish River

The Duwamish River subbasin includes the Duwamish River and Longfellow Creek. This subbasin has been highly impacted by residential, commercial, and industrial development resulting in poor habitat quality. Over 97 percent of the original wetlands and sub-tidal habitats associated with the estuary have been filled over the last 100 years. Decreased water quality and increased sedimentation are both issues within the Duwamish River and Elliot Bay.

#### Central Puget Sound

The Central Puget Sound subbasin includes marine nearshore areas and independent tributaries to Puget Sound within WRIA 9. This subbasin has been substantially impacted by residential, commercial, and industrial development. Few natural areas or parks remain on the marine shoreline. Tidal flats and marshes have been filled or dredged. Salmonid habitat in these areas has been destroyed, altered, and degraded.

### Priority Actions

The WRIA 9 Salmon Habitat Plan (WRIA 9 Steering Committee 2005) recommends a combination of projects and programs to protect, restore, rehabilitate, and substitute salmonid habitat and stream processes. Projects include excavating shallow water habitat in estuarine and marine nearshore habitats, installation of large woody debris in freshwater habitats, planting native vegetation and control of invasive weeds throughout the watershed, levee setbacks on the Green River mainstem, introduction of spawning gravel in the Green River mainstem, side channel reconnection, and the removal of bulkheads in marine nearshore habitats.

## 2.2 Watershed Planning in WRIA 9

Citizens and local, state, federal, and tribal governments have collaborated on watershed and water resource management issues in WRIA 9 for decades. A brief summary of broad watershed planning efforts as they relate to the past, present, and future water availability in the Duwamish-Green watershed is provided below.

### 2.2.1 Other Planning Efforts in WRIA 9

This watershed plan builds on many of the past efforts to develop comprehensive plans for the entire watershed. For example, the South Central Action Area Caucus Group (South Central Local Integrating Organization) developed an ecosystem recovery plan, as part of the Action Agenda for Puget Sound Recovery. The planning process to develop an ecosystem recovery plan is community based with engagement by local, state, and federal agencies. The approach is holistic, addressing everything from salmon to orca recovery, stormwater runoff, and farmland and forest conservation.

The WRIA 9 Watershed Ecosystem Forum is the Salmon Recovery Lead Entity, a collaboration of local government, state and federal agencies, non-profits, and businesses interests focused on improving watershed health and salmon habitat recovery. The Watershed Ecosystem Forum developed the Green/Duwamish and Central Puget Sound Salmon Habitat Plan in 2005. Since 2005, the WRIA 9 Watershed Ecosystem Forum has worked to implement the Salmon Habitat Plan (WRIA 9 Steering Committee 2005).

The South Central LIO and WRIA 9 Watershed Ecosystem Forum include many of the same organizations and individuals that participate in the WRIA 9 Watershed Restoration and Enhancement Committee. This history of collaborative planning and shared priorities has supported the success of the Watershed Restoration and Enhancement Plan development in WRIA 9.

Coordinated Water System Plans (CWSPs) are mandated by the Public Water System Coordination Act of 1977. King County passed ordinances ratifying four CWSPs (East King County, Skyway, South King County, and Vashon). These plans ensure 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 connection to a water system is available, or the new homes will need to rely on an alternative water source, most likely new permit-exempt domestic wells. Within their designated retail service area(s), water purveyors are given first right of refusal for new connections. The purveyor may decline to provide service if water cannot be made available in a 'reasonable and timely' manner. However, it can be the case that a new permit-exempt well is drilled without making any inquiries with the county or with the local water system.

### 2.2.2 Coordination with Existing Plans

Throughout the development of this watershed plan, Ecology streamflow restoration staff engaged with staff from the WRIA 9 Watershed Ecosystem Forum, South Central LIO, and the Puget Sound Partnership, providing briefings on the streamflow restoration law, scope of the watershed plan, and plan development status updates. Throughout the planning process, the WRIA 9 Committee has coordinated closely with the WRIA 9 Watershed Ecosystem Forum, including inviting lead entity staff to join the WRIA 9 Committee as an ex officio member, and selecting habitat projects based on information from the Salmon Habitat Plan.

King County planning staff contributed to the plan development to ensure consistency with the county's Comprehensive Plan. The comprehensive plan sets policy for development, housing, public services and facilities, and environmentally sensitive areas, among other topics. The comprehensive plan identifies King County's urban growth areas, sets forth standards for urban and rural development, and provides the basis for zoning districts.

## 2.3 WRIA 9 Geology, Hydrogeology, Hydrology, and Streamflow

### 2.3.1 Geologic Setting

Understanding the geologic setting of WRIA 9 helps to characterize surface and groundwater flow through the watershed. The relationships between surface water flow and deeper groundwater are important to understanding how to manage surface water resources and can be helpful in identifying strategies to offset the impacts of pumping from permit-exempt wells.

Within WRIA 9, bedrock forms mountain ranges and uplands and generally consists of igneous and sedimentary rocks. Within drainages and lowland areas, bedrock is overlain by glacial and alluvial sediments (Washington State Department of Natural Resources 2020). A minimum of four major glaciations covered the lower portion of the watershed during the Pleistocene Epoch (about 11,700 years to 2.6 million years ago), the most recent occurrence being the Vashon Stade of the Frasier Glaciation (Jones 1998; Vaccaro et al. 1998; Booth et al. 2003). The present topography and drainage network in WRIA 9 was shaped during the advance and retreat of the Vashon ice sheet (Evans 1996). These processes resulted in glacially-derived ridges and lakes linked by drainage channels (Booth and Goldstein 1994; Evans 1996). Pleistocene-age glacial and interglacial processes resulted in the deposition of a complex assemblage of sedimentary deposits in lowland areas. These glacial deposits consist of glacial till, recessional and advance outwash, and glaciolacustrine deposits. Glacial till deposits generally consist of dense, silty sand with gravel and silt lenses. Outwash deposits generally consist of sand and gravel with locally abundant wood debris and peat. Glaciolacustrine deposits generally consist of silt and clay. This sequence of glacial deposits is hundreds to thousands of feet thick within the lower portions of the watershed (Jones 1996).

Recent alluvial deposits are generally associated with channel and overbank deposits from the modern Duwamish and Green Rivers and their tributaries. These sediments generally consist of stratified silt, sand, gravel, and minor amounts of clay.

Deposits associated with the Osceola Mudflow outcrop are found in the south-central portion of the watershed, near the Cities of Enumclaw and Auburn (Washington State Department of Natural Resources 2020). The Osceola Mudflow is a sequence of lahar deposits that originated in eruptions and avalanche events that occurred at Mount Rainer approximately 5,600 years ago (Vallance and Scott 1997) .

### 2.3.2 Hydrogeologic Setting

The U.S. Geological Survey identified six hydrogeologic units within the sequence of Puget Sound glacial and alluvial sediments within WRIA 9 (Vaccaro et al. 1998). The hydrogeologic units typically alternate between aquifer units and semi-confining to confining layers (aquitards which lack sufficient permeability to form aquifers).

Within the upper portion of the watershed, glacial and alluvial sediments occur within the Green River valley and drainages associated with area tributaries. Glacial and alluvial sediments are widespread within the lower portion of the watershed and reach thicknesses exceeding 2,000 feet (Jones 1996; Vaccaro et al 1998). Shallow glacial and alluvial aquifers are generally

unconfined (under water-table conditions) except where overlain by low permeability confining layers (generally till or glaciolacustrine deposits). Transmissivity (a hydraulic property related to the rate of groundwater flow through an aquifer) and storativity (a hydraulic property related to the capacity of an aquifer to store/release water) of these aquifers vary significantly with depositional environment and are generally the highest in sands and gravels of glacial outwash and alluvial origin and lowest in fine-grained alluvial and glaciolacustrine deposits. Glacial and alluvial aquifers are characterized by a shallow depth to the groundwater table and, where applicable, a direct hydraulic connection with adjacent surface water.

Bedrock aquifers underlay the entire watershed. However, within the lower portions of the watershed, glacial and alluvial sediments are frequently hundreds of feet thick and bedrock aquifers are seldom targeted by water supply wells. Thickness of the glacial and alluvial hydrogeologic units generally thin to the east within WRIA 9. Much of the watershed southeast of Renton is underlain by relatively shallow and frequently outcropping bedrock.

Bedrock aquifers are generally of relatively low transmissivity and storativity. Wells completed within bedrock aquifers typically do not have high enough capacity for municipal use. However, they can be valuable aquifers for residential water uses, and in specific areas are an important target aquifer for permit-exempt wells.

Recharge to glacial, alluvial, and bedrock aquifers within WRIA 9 is primarily associated with precipitation, applied irrigation, septic systems, leakage from surface water within losing reaches (where streamflow infiltrates to groundwater), through leakage from adjacent aquifers, and mountain front recharge. Watershed aquifers discharge to water supply wells, adjacent aquifers, gaining reaches of streams, springs, wetlands, lakes, and Puget Sound. Summer base flows in WRIA 9 rivers and tributaries are sustained by groundwater (baseflow) on most of the lower-elevation tributaries.

Regionally, groundwater flow direction within watershed aquifers generally is perpendicular to the westerly slope of the Cascade Range, although groundwater flow in shallow aquifers is more influenced by surface topography and streamflow within the watershed and is directed to the northwest. This groundwater flow paradigm is complicated throughout the watershed by aquifer boundaries, aquifer heterogeneities, topography, the influence of gaining and losing stream reaches, well pumping, and other factors.

### 2.3.3 Hydrology and Streamflow

The Green River and its headwaters are located in a snowmelt transition region where the rivers are fed by both snowmelt and rainfall. Within low elevation portions of the watershed, mean annual precipitation ranges from about 30 to 40 inches per year. Mean annual precipitation increases with topographic elevation and can exceed 120 inches within the Cascade Range (MGS Engineering Service and Oregon Climate Service 2006). Most precipitation occurs during the late fall and winter. Precipitation is lowest during the summer when water demands are highest. During these low precipitation periods, streamflow is highly dependent upon groundwater inflow (baseflow).

Washington Administrative Code (WAC) 173-509 set minimum instream flows for the Green River and closed tributaries to the Green River and other streams to further consumptive appropriations.

The U.S. Army Corps of Engineers operates Howard Hanson Dam and regulates flow in the Green River in coordination with the Green River Flow Management Committee (Tacoma Public Utilities 2001). The Green River Flow Management Committee consists of representatives from the Army Corps, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Muckleshoot Indian Tribe, Washington Department of Fish and Wildlife, Washington Department of Ecology, King County Department of Natural Resources, and Tacoma Water. A 1995 agreement between Tacoma and the Muckleshoot Indian Tribe includes provisions for instream flows (Tacoma Water 2018). The City of Tacoma operates a diversion facility for municipal supply approximately three miles downstream from Howard Hanson Dam.

Duwamish River and Green River streamflow conditions are summarized by the following:

- USGS stream gage 12105900 (Green River below Howard Hanson Dam): At this upper watershed location, mean daily discharge ranges from 270 cubic feet per second (cfs) in August to 1,620 cfs in January (U.S. Geological Survey 2020).
- USGS stream gage 12113000 (Green River near Auburn): At this lower watershed location, mean daily discharge ranges from 311 cfs in August to 2,350 cfs in January, for the period from January 1962 through December 2019. This gage is one of the compliance points for instream flows in WAC 173-509, as well as the agreement between Tacoma Public Utilities and the Muckleshoot Indian Tribe. This is the furthest downstream gage not affected by tides.
- The USGS stream gage 12112600 (Soos Creek): This gage is on Big Soos Creek above the hatchery. Mean daily discharge ranges from 33 cfs in August to 253 cfs in January, for the period from October 1966 to July 2019.
- The USGS stream gage 12108500 (Newaukum Creek): This gage is on Newaukum Creek. For the period of record from July 1944 to September 2019 the mean daily flows were 19 cfs in August and 112 cfs in January.
- King County gages Jenkins Creek and Covington creeks (26A and 09A, respectively).

Anticipated future climate impacts will result in continued loss of snow in the Cascade Range, 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 9. These climate impacts are expected to drive changes in seasonal streamflows, increasing winter flooding, while intensifying summer low flow conditions. For the Green River, climate modeling predicts average minimum flows to be 16 percent lower (range: -21 to -7 percent) by the 2080s for a moderate warming scenario, relative to 1970 to 1999 (Mauger et al. 2015).

Pumping from wells can reduce groundwater discharge to springs and streams by capturing water that would otherwise have discharged naturally. Groundwater pumping may diminish surface water flows. Consumptive water use (that portion not returned to the immediate water

environment) potentially reduces streamflow, both seasonally and as average annual recharge. A well drawing from an aquifer connected to a surface water body either directly or through an overlying aquifer can either reduce baseflow or increase the quantity of water leaking out of the river (Culhane et al. 1995).

# Chapter Three: Subbasin Delineation

## 3.1 Introduction to Subbasins

Water Resource Inventory Areas are large watershed areas formalized under Washington Administrative Code for the purpose of administrative water management and planning. WRIAs encompass multiple landscapes, hydrogeologic regimes, levels of development, and variable natural resources. To allow for meaningful analysis of the relationship between new consumptive use and offsets per Ecology's Final NEB Guidance,[5] the WRIA 9 Committee divided WRIA 9 into subbasins. This was helpful in describing the location and timing of projected new consumptive water use, the location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. In some instances, subbasins did not correspond with hydrologic or geologic basin delineations (e.g. watershed divides).[6]

## 3.2 Approach to Develop Subbasins

The WRIA 9 Committee divided WRIA 9 into 12 subbasins for purposes of assessing consumptive use and project offsets. The WRIA 9 Committee based their subbasin delineation on existing subwatershed units. The Committee used King County drainage basin boundaries (King County 2018) and applied the following guiding principles to delineate subbasins:

- Use hydrologic boundaries;
- Combine King County drainage basins within the Urban Growth Area with lower expected growth of new homes using PE wells; and
- Delineate subbasins at a finer scale in the area of the watershed expected to have the most homes using PE wells (the Middle Green River).

The WRIA 9 subbasin delineations are shown in Figure 3.1 and summarized below in Table 3.1. A more detailed description of the subbasin delineation is in the technical memo available in Appendix E. The technical memo also describes other adjustments made to align the subbasin boundaries with the WRIA 9 planning boundary.

[5] "Planning groups must divide the WRIA into suitably sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets. Subbasins will help the planning groups understand and describe location and timing of projected new consumptive water use, location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. Planning at the subbasin scale will also allow planning groups to consider specific reaches in terms of documented presence (e.g., spawning and rearing) of salmonid species listed under the federal Endangered Species Act." Final NEB Guidance p. 7 (Ecology 2019).

[6] 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 90.94.030(3)(b).

Table 3.1: WRIA 9 Subbasins

| Subbasin Name | Primary Rivers and Tributaries | County |
|---|---|---|
| Central Puget Sound | Streams draining directly to Puget Sound between the City of Federal Way and the City of Seattle, including Seola Creek, Salmon Creek, Miller Creek, and Des Moines Creek | King County |
| Duwamish River | Longfellow Creek and Duwamish River | King County |
| Lower Green River | Green River below river mile 32, including Black River and Mill Creek | King County |
| Soos Creek | Soos Creek | King County |
| Jenkins Creek | Jenkins Creek | King County |
| Covington Creek | Covington Creek | King County |
| Lower Middle Green River | Green River starting at river mile 32 to the confluence with Newaukum Creek | King County |
| Mid Middle Green River | Green River between the confluence with Newaukum Creek and confluence with Franklin Creek | King County |
| Upper Middle Green River | Green River between the confluence with Franklin Creek and Howard Hanson Dam | King County |
| Newaukum Creek | Newaukum Creek | King County |
| Coal/Deep Creek | Coal Creek and Deep Creek | King County |
| Upper Green River | Green River above Howard Hanson Dam | King County |

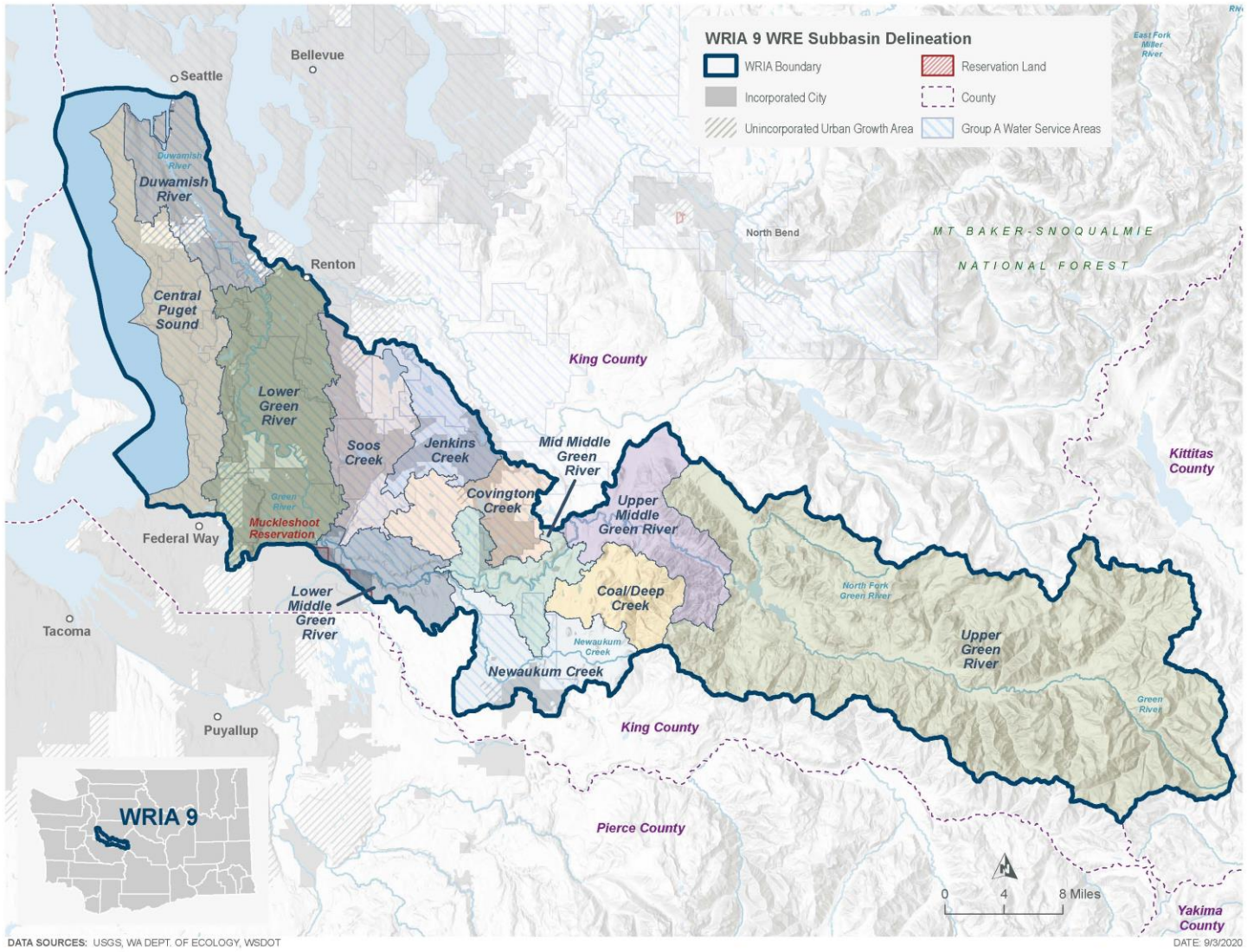



Figure 3.1: WRIA 9 Subbasin Delineation

# 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" (pg. 7). This chapter provides the WRIA 9 Committee's projections of new permit-exempt domestic well connections (PE wells) and their associated consumptive use for the 20-year planning horizon.[7] This chapter summarizes information from the technical memos (Appendices F and G) prepared for, and reviewed by, the WRIA 9 Committee.

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

The WRIA 9 Committee projects 632 PE wells over the planning horizon. Most of these wells are likely to be installed outside of the Urban Growth Area in the following subbasins: Soos Creek, Lower Middle Green River, Mid Middle Green River, Upper Middle Green River, and Newaukum Creek.

The WRIA 9 Committee developed a method that they agreed was appropriate to project the number of new PE wells over the planning horizon in WRIA 9, in order to estimate new consumptive water use. This method, referred to as the PE well projection method, is based on recommendations from Appendix A of Ecology's Final NEB Guidance (Ecology 2019). The following sections provide the 20-year projections of new PE wells for each subbasin within WRIA 9, the methods used to develop the projections (PE well projection method), and uncertainties associated with the projections.

### 4.2.1 Permit-Exempt Well Connections Projection by Subbasin

This WRIA 9 watershed plan compiles the King County PE well projection data at both the WRIA scale and by subbasin. The projection for new PE wells in WRIA 9 by subbasin is shown in Table 4.1 and Figure 4.1.

[7] New consumptive water use in this document is from projected new homes connected to permit-exempt domestic wells associated with building permits issued during the planning horizon. Generally, new homes will be associated with wells drilled during the planning horizon. However, new uses could occur where new homes are added to existing wells 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 4.1: Number of PE Wells Projected between 2018 and 2038 for the WRIA 9 Subbasins

| Subbasins | King County | Urban Growth Areas | Total PE Wells per Subbasin |
|---|---|---|---|
| **Central Puget Sound** | 0 | 0 | 0 |
| **Duwamish River** | 0 | 0 | 0 |
| **Lower Green River** | 0 | 4 | 4 |
| **Soos Creek** | 72 | 11 | 83 |
| **Jenkins Creek** | 44 | 1 | 45 |
| **Covington Creek** | 41 | 0 | 41 |
| **Lower Middle Green River** | 81 | 3 | 84 |
| **Mid Middle Green River** | 100 | 0 | 100 |
| **Upper Middle Green River** | 110 | 0 | 110 |
| **Newaukum Creek** | 102 | 1 | 103 |
| **Coal Deep Creek** | 62 | 0 | 62 |
| **Upper Green River** | 0 | 0 | 0 |
| **Totals** | **612** | **20** | **632** |

The total projection for WRIA 9 is 632 new PE wells. King County projects approximately 612 new PE wells over the planning horizon within WRIA 9 portions of unincorporated King County. The King County method did not account for potential PE wells in cities or UGAs so the WRIA 9 Committee completed an analysis of potential new PE wells within the UGAs and projected 20 new PE wells (UGA Well Log Spot Check).

## 4.2.2 Methodology

The WRIA 9 Committee conferred with King County to identify an appropriate method of projecting PE wells within its jurisdiction. King County used historical building data to project new potential PE wells, assuming the rate and general location of past growth will continue over the 20-year planning horizon. Using past building permits to predict future growth is one of the recommended methods in the Final NEB Guidance (Ecology 2019). Due to data availability, King County considered historical rates of connection to water service within water service area boundaries to estimate the number of homes that would be served by community

water systems and municipalities, and remove those from the PE well projection.[8] King County completed the analyses in-house and the methods are described in detail in Appendix F.

The WRIA 9 Committee also looked at potential PE wells within the UGAs using data from Ecology's Well Report Viewer database.

King County completed a PE Well Potential Assessment which identified potential parcels where development could occur within rural King County. The PE Well Potential Assessment results were used to assess whether a subbasin (as identified by the Committee) has the capacity to accommodate the number of PE wells projected over the 20-year planning horizon.

All methods are summarized in the sections below. The WRIA 9 Growth Projections Technical Memorandum provides a more detailed description of the analysis and methods (Appendix F).

### King County PE Well Projection Methodology

King County used historical residential building permit and parcel data from 2000 through 2017 to project the number of new PE wells for the planning horizon in unincorporated King County (referred to as the past trends analysis). This data set considers economic and building trends over an 18-year period and the method assumes that past trends will continue.

King County projected the number of new PE wells over the planning horizon using the following steps:

1. Gather historical building permit and parcel data (2000–2017) for new residential structures.[9]
2. Assess the total number of permits and average number of permits per year for WRIA 9.
3. Link building permit and parcel data to determine water source for each building permit/parcel and separate into public, private, and other water source categories. Consider a building permit with water source listed as "private" as a PE well.
4. Calculate the number and percentage of building permits for each type of water source (public, private, or other) inside and outside water services areas by subbasin, and for the WRIA overall.

The WRIA 9 Committee used the King County past trends analysis to develop PE well projections by subbasin using the following steps:

5. Calculate the projected number of PE wells per year for each subbasin by multiplying the average number of building permits per year by the percentage of building permits

[8] Water service area boundaries include areas currently served by existing water lines and may also include areas not yet served by water lines. King County used historic rates of connection to water service to predict future rates of connection because King County does not have County-wide information on the location of water lines.
[9] King County used the time period 2000 through 2017 because that data was available. The building permit data for 2000 through 2017 includes both periods of high growth and periods of low growth. King County compared these data with information from the Vision 2040 regional plan and population data and is confident in using the average of this time period to project into the future.

per subbasin, and percentage of building permits using a private water source (well) per subbasin.

6. Multiply the projected number of PE wells per year per subbasin by 20 to calculate the total of PE wells projected over the 20-year planning horizon for each subbasin.
7. Add 6% to 20-year PE well projection per subbasin to account for gaps in the building permit and parcel data (6% error is based on the percentage of building permits with "other" as the water source).
8. Tabulate the total PE wells projected over the 20-year planning horizon, including the 6% error, for each subbasin and sum to get the total of PE wells projected over the 20-year planning horizon in rural unincorporated King County.

### Urban Growth Area PE Well Projection Methodology

The King County PE well projection methods do not account for potential PE wells within cities or UGAs. However, the WRIA 9 Committee recommended looking at the potential for PE well growth within UGAs. The WRIA 9 Committee completed an analysis of potential PE well growth within the incorporated and unincorporated UGAs using data from Ecology's Well Report Viewer database (referred to as the UGA well log spot check).

The general method included using Ecology's Well Report Viewer database (1998–2018) to query water wells with characteristics of a domestic well[10] within UGAs. The Committee randomly reviewed a subset of the water well reports and calculated the number and percentage of each type of well (domestic, irrigation, other and incorrect) located within the UGAs. They then multiplied the percentage of wells identified as domestic (assumed to be PE wells) by the total number of wells located within UGAs to estimate the number of PE wells installed over the past 20-year period. The Committee also cross-checked the physical address of the wells with the UGA boundaries to determine which subbasin the domestic wells were located in. The Committee used the total number of domestic wells per subbasin over the past 20 years to project the number of PE wells located within the UGAs over the planning horizon for each WRIA 9 subbasin. A more detailed methodology is included in Appendix F.

### King County PE Well Potential Assessment

King County completed an assessment of parcels available for future residential development in unincorporated King County (referred to as the PE well potential assessment). The Committee used the PE Well Potential Assessment to assess whether a subbasin has the capacity to accommodate the number of PE wells projected over the 20-year planning horizon.

King County used screening criteria to identify parcels with potential for future residential development by subbasin. The total number of parcels and dwelling units[11] (DUs) per subbasin

[10] Ecology's complete Well Report Viewer database was filtered for water wells 6 to 8 inches in diameter and greater than 30 feet deep, which are typical dimensions and depths for domestic wells. The Ecology Well Report Viewer database does not have the ability to filter for permit-exempt domestic wells.

[11] A dwelling unit is a rough estimate of subdivision potential based on parcel size and zoning (e.g. a 22-acre parcel zoned RA-5 is assumed to have 4 dwelling units).

were determined and labeled as inside or outside the water district service boundaries. King County then projected the water source for each parcel (public water or PE well) based on historic rates of connection to water service inside water district service boundaries. King County used historic rates of connection to water service because the County does not have County-wide information on the location of water lines. The WRIA 9 Committee compared the 20-year PE well projection to the PE well potential assessment. In areas where the number of projected PE wells exceeded the potential parcels available, the Committee reallocated those PE wells to the nearest subbasin with parcel capacity and similar growth patterns. The WRIA 9 Committee redistributed 20 wells from the Newaukum Creek subbasin to the Mid Middle Green River subbasin. A more detailed methodology and list of assumptions is included in Appendix F.

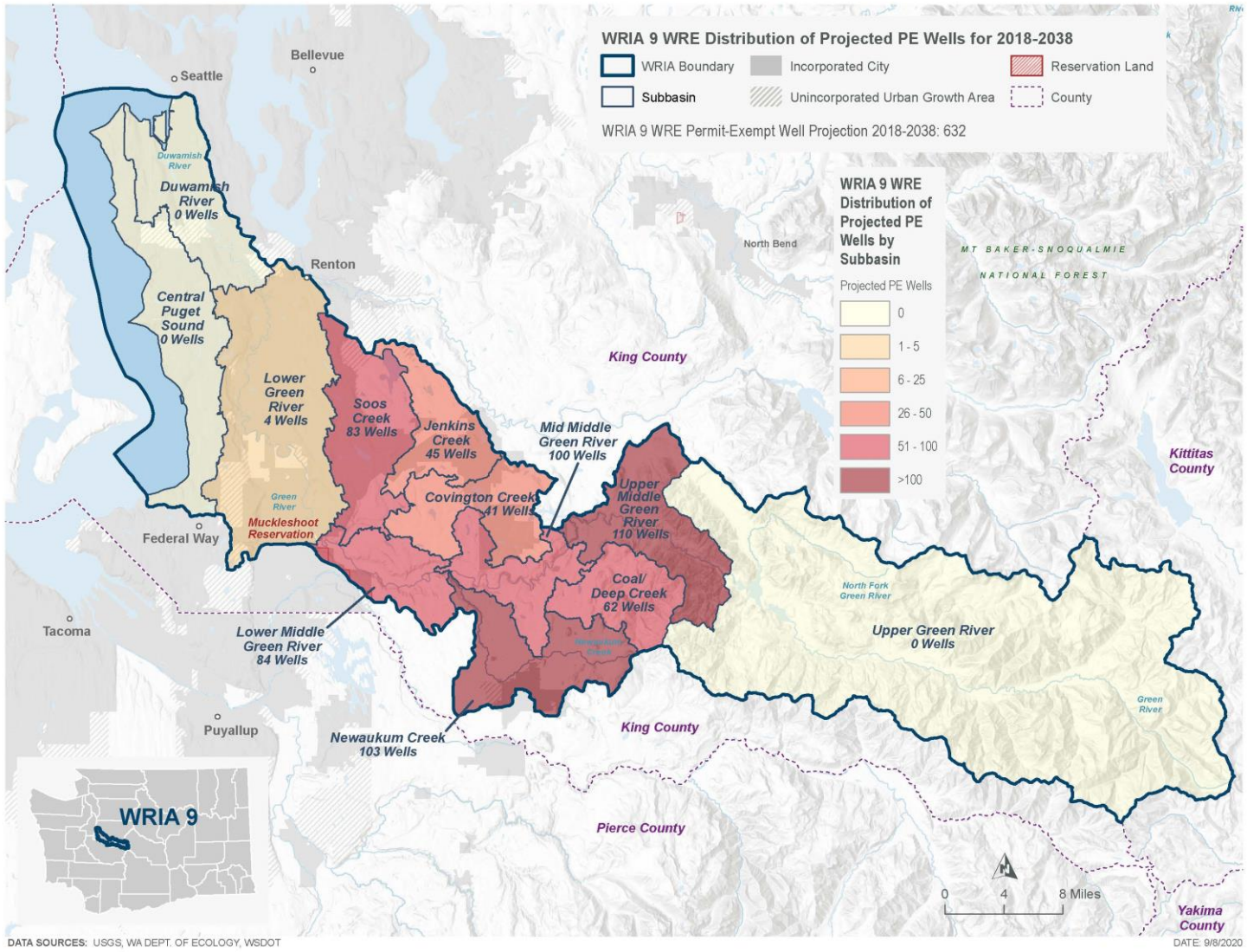



Figure 4.1: WRIA 9 Distribution of Projected PE Wells for 2018-2038

## 4.3 Impacts of New Consumptive Water Use

The WRIA 9 Committee used the 20-year projection for WRIA 9 of new PE wells (632) to estimate the new consumptive water use (consumptive use) that this watershed plan must address and offset. The WRIA 9 Committee estimates 247.7 acre-feet per year (AFY) (0.34 cfs) of new consumptive water use in WRIA 9. The WRIA 9 Committee added a safety factor to the consumptive use estimate to account for uncertainties in the PE well projections and consumptive use estimate, including higher rates of water use that could result from climate change and changing development patterns. The WRIA 9 Committee sought projects to offset at least 495.4 AFY (hereafter referred to as the offset target), a safety factor of two times the consumptive use estimate of 247.7 AFY.

This section includes an overview of the methods used by the WRIA 9 Committee to estimate new consumptive water use and an overview of the anticipated impacts of new consumptive use in WRIA 9 over the planning horizon. The WRIA 9 Consumptive Use Estimates Technical Memorandum provides a more detailed description of the analysis and alternative scenarios considered (Appendix G).

### 4.3.1 Methods 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. Also, the portion of water that is consumptive varies for indoor and outdoor water use. Appendix A of the Final NEB Guidance (Ecology 2019) describes a method (referred to as the Irrigated Area Method) which assumes average indoor use per person per day, and reviews aerial imagery to provide a basis to estimate irrigated area of outdoor lawn and garden areas. The Irrigated Area Method accounts for indoor and outdoor consumptive use variances by using separate approaches to estimate indoor and outdoor consumptive use.

To develop the consumptive use estimate, the WRIA 9 Committee used the Irrigated Area Method and relied on assumptions for indoor use and outdoor use from Appendix A of the Final NEB Guidance. This chapter provides a summary of the technical memo which is available in Appendix G.

Consistent with the Final NEB guidance (Appendix B, pg. 25), the Committee assumed 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 well locations and depths across varying hydrogeological conditions

The WRIA 9 Committee looked at other scenarios for estimating consumptive use, including (1) assuming each home has 0.5-acre irrigated lawn area (legal maximum per PE well[12]) and (2) assuming each home uses 950 gallons of water per day (legal withdrawal limit per PE well

[12] Per RCW 90.44.050

connection[13]). The Committee chose a consumptive use estimate based on the irrigated area method. The technical memo in Appendix G includes the additional consumptive use scenarios and results.

### New Indoor Consumptive Water Use

Indoor water use refers to the water that households use in kitchens, bathrooms, and laundry (Ely and Kahle 2012). The WRIA 9 Committee used the Irrigated Area Method and Ecology's recommended assumptions for indoor daily water use per person, local data to estimate the average number of people per household, and applied Ecology's recommended consumptive use factor to estimate new indoor consumptive water use (Ecology 2019). The assumptions the WRIA 9 Committee used to estimate household consumptive indoor water use are:

- 60 gallons per day (gpd) per person.
- 2.73 persons per household assumed for rural portions of King County.
- 10% of indoor use is consumptively used (or a consumptive use factor (CUF) of 0.10), based on the assumption that homes on PE wells are served by onsite sewage systems (septic). Onsite sewage systems return most wastewater back to the immediate water environment; a fraction of that water is lost to the atmosphere through evaporation in the drainfield.

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

60 gpd x 2.73 people per house x 365 days x .10 CUF

This results in an annual aggregated average of 0.0183 AF[14] (16.4 gpd or 0.000025 cfs[15]) indoor consumptive water use per day per well.

### New Outdoor Consumptive Water Uses

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

The WRIA 9 Committee used aerial imagery to measure the irrigated areas of 211 parcels in eight[16] WRIA 9 subbasins to develop an average outdoor irrigated area per subbasin. Parcels

[13] Legal withdrawal limits from PE wells in WRIA 9 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).

[14] 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. 1 acre-foot per year is equal to 893 gallons per day.

[15] 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. 1 cubic foot per second is equal to 646,317 gallons per day.

[16] The analysis covered 8 of the 9 subbasins in WRIA 9 with projected PE well connections. The Lower Green River subbasin (with 4 projected PE wells) did not have any recent building permits for sites without purveyor-provided

used for the irrigated footprint analysis were selected based on recent (2006-2017) building permits for new single-family residential homes not served by public water. All new home building permit sites in WRIA 9 were included in the analysis. The average irrigated area for 211 parcels, when aggregated across subbasins, was 0.30 acres per parcel.

The WRIA 9 Committee used the following assumptions, recommended in Appendix A of the Final NEB Guidance, to estimate household outdoor consumptive water use:

- The amount of water needed to maintain a lawn varies by subbasin due to varying temperature and precipitation across the watershed. The Committee used the Washington Irrigation Guide (WAIG) (NRCS-USDA 1997) station in Seattle-Tacoma, Kent, and surrounding stations to develop a weighted average crop irrigation requirement (IR) for turf grass in each subbasin (the WRIA average IR is 14.62 inches). This value represents the amount of water needed to maintain a green lawn.
- The irrigation application efficiency (AE) used for WRIA 9 was the Ecology-recommended value of 75%. This increases the amount of water used to meet the crop's irrigation requirement.
- Consumptive use factor (CUF) of 0.8, reflecting 80% consumption for outdoor use. This means 20% of outdoor water is returned to the immediate water environment.
- Outdoor irrigated area per subbasin based on the irrigated footprint analysis (the WRIA average irrigated area size is 0.30 acres per PE well).

IR by subbasin (inches) ÷ 0.75 AE x average irrigated area by subbasin (acres) x 0.80 CUF

First, water loss is accounted for by dividing the crop irrigation requirement by the application efficiency. Next, the total water depth used to maintain turf is multiplied by the area which is irrigated. Finally, the volume of water is multiplied by 80 percent to produce the outdoor consumptive water use. To convert the equation from inches to acre-feet, divide the result by 12.

The result is total outdoor consumptive water use per PE well per subbasin ranging from 0.19 AFY in the Coal/Deep subbasin to 0.59 AFY in the Lower Middle Green River subbasin. The outdoor consumptive use varies by subbasin due to differences in average outdoor irrigated area size and irrigation requirements across the watershed. This is the total annual estimated consumptive use, however the Committee expects that more water use will occur in the summer than in the other months.

## 4.4 Consumptive Use Estimate for WRIA 9 and by Subbasin

The total consumptive use estimate for WRIA 9 is 247.7 AFY per year (0.34 cfs). The total consumptive use estimate for WRIA 9 is the number of PE wells projected by subbasin (see section 4.3) multiplied by the total indoor and outdoor consumptive use per PE well. Table 4.2

water service, so the average irrigated area for the adjacent Soos Creek subbasin was applied to the Lower Green River subbasin for purposes of consumptive use estimates.

summarizes the estimated indoor and outdoor consumptive use by subbasin using the Irrigated Area Method. The highest consumptive use is expected to occur in the subbasin with the largest irrigated area per PE well and the most anticipated new PE wells, as presented in Figure 4.2.

Table 4.2: Consumptive Use (CU) Estimate Based on Irrigated Areas Method (1 Home + Subbasin Average Lawn)

| Subbasin | Projected PE wells | Average lawn size (acres) | Indoor CU per well (AFY) | Outdoor CU per well (AFY) | Total CU/year per well (AFY) | Total CU 2018-2038 (AFY) |
|---|---|---|---|---|---|---|
| **Central Puget Sound** | 0 | - | - | - | - | 0 |
| **Duwamish River** | 0 | - | - | - | - | 0 |
| **Lower Green** | 4 | 0.3 | 0.0183 | 0.51 | 0.53 | 2.1 |
| **Soos Creek** | 83 | 0.3 | 0.0183 | 0.48 | 0.50 | 41.4 |
| **Jenkins Creek** | 45 | 0.3 | 0.0183 | 0.45 | 0.47 | 21.2 |
| **Covington Creek** | 41 | 0.4 | 0.0183 | 0.51 | 0.52 | 21.5 |
| **Lower Middle Green River** | 84 | 0.4 | 0.0183 | 0.59 | 0.61 | 51.0 |
| **Mid Middle Green River** | 100 | 0.3 | 0.0183 | 0.30 | 0.32 | 31.9 |
| **Upper Middle Green River** | 110 | 0.2 | 0.0183 | 0.23 | 0.24 | 26.9 |
| **Newaukum Creek** | 103 | 0.3 | 0.0183 | 0.36 | 0.38 | 39.0 |
| **Coal/Deep Creek** | 62 | 0.2 | 0.0183 | 0.19 | 0.20 | 12.6 |
| **Upper Green River** | 0 | - | - | - | - | 0 |
| **WRIA 9** | **632** | **0.3** | **0.0183** | **0.42** | **0.43** | **247.7** |

Note: Values in table have been rounded.

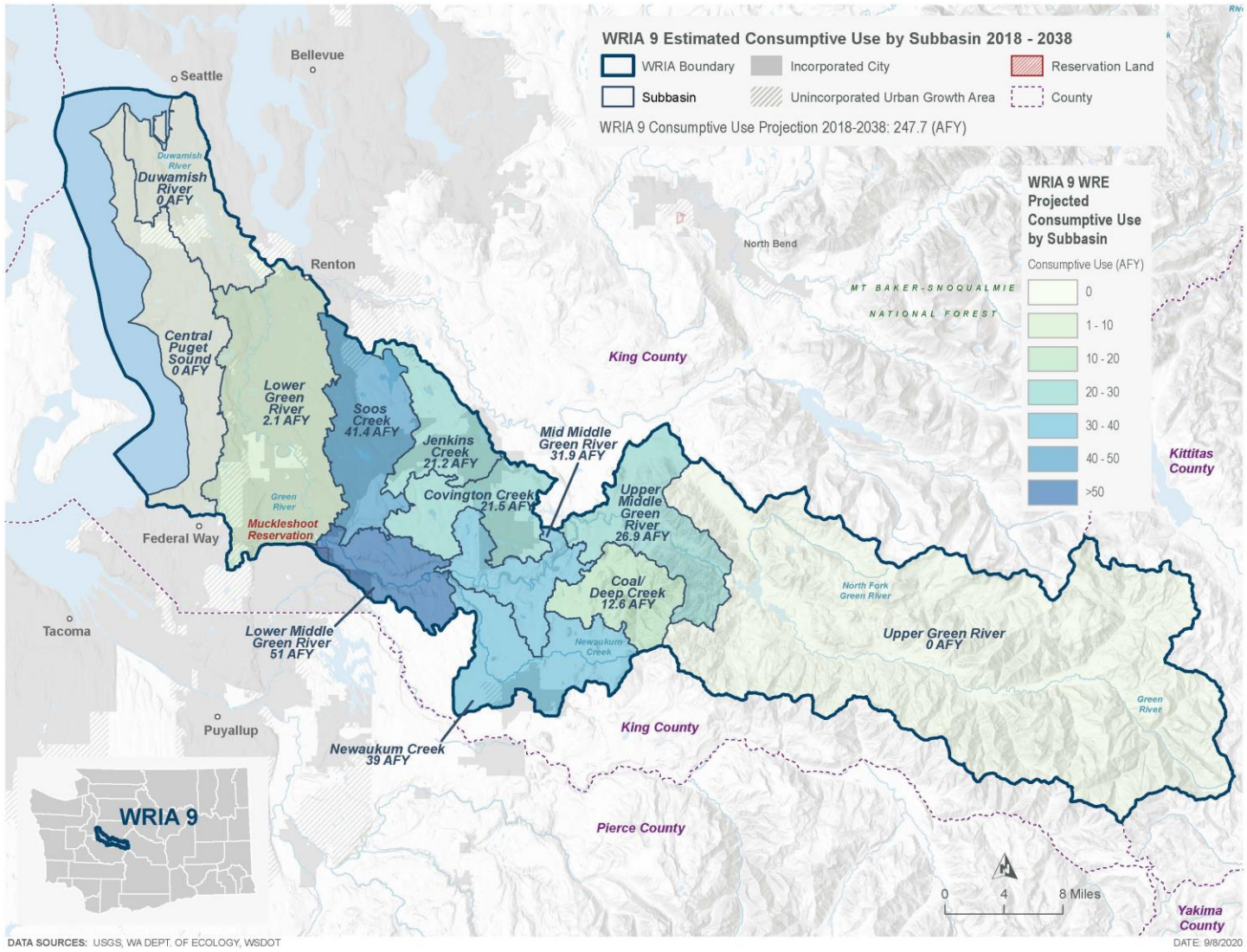



Figure 4.2: WRIA 9 Estimated Consumptive Use by Subbasin 2018-2038

## 4.5 Summary of Uncertainties and Scenarios

The methods described in Section 4.3 for projecting new PE wells include a number of uncertainties, which were discussed by the WRIA 9 Committee. The Committee recognized uncertainties as inherent to the planning process and addressed uncertainties where feasible. The uncertainties are shared here to provide transparency in the planning process and deliberations of the Committee.

Historical data on the number and location of PE wells within WRIA 9 was not available to inform PE well projections. Therefore, the WRIA 9 Committee relied on building permit data, and agreed on assumptions about the water source, in order to estimate the numbers of past and future PE wells.

Another example of uncertainty is that the County projected new PE wells within unincorporated areas and omitted PE wells installed within city limits, including PE wells installed for lawn watering purposes. Although most cities require new homes to connect to water systems, some allow exceptions if a connection is not available (for instance, if a home is more than 200 feet from a water line), or allow a home to install a PE well for outdoor water use. The WRIA 9 Committee addressed this uncertainty by including a projection for new PE wells within the UGAs.

King County relied on historical data and assumed that these historical building trends will continue into the future. However, water service areas and water lines continue to grow and expand. Water line data was not readily available in King County, so the WRIA 9 Committee was not able to compare actual water lines with the historical data to see if and how the water service has expanded. Additionally, future building trends may not mirror historical building trends as the county and cities continue to direct growth to urban areas (with access to public water service) to preserve rural and resource lands and protect critical areas.

RCW 90.94 requires counties to collect fees for new homes that rely on PE wells and provide a report and portion of those fees to Ecology. King County shared information on the fees collected since those requirements went into effect in January of 2018. King County reported 24 building permits with PE wells identified as the water source within the WRIA 9 portion of unincorporated King County between January 2018 and June 2020. Twenty-four new wells over the 30-month period averages to around 10 new PE wells per year. The WRIA 9 Committee projected approximately 32 new PE wells per year.

The Irrigated Area Method used to estimate consumptive use (described in Section 4.3.1) contains a number of uncertainties and limitations. Measurement of consumptive water use in any setting is difficult, and it is virtually impossible for residential groundwater use, which must account for both indoor and outdoor use. PE wells are generally unmetered, so supply to each home is usually unknown, let alone the amount that is lost to the groundwater system. Therefore, the WRIA 9 Committee was limited to estimating consumptive use based on projections of future growth, local patterns and trends in water use, and generally accepted and reasonable assumptions.

The outdoor consumptive use calculation contains the most uncertainty. In aerial photos used to calculate average irrigated area, many parcels did not demonstrate a clear-cut distinction

between irrigated and non-irrigated lawns and other landscaped areas. It appears that many homeowners irrigate enough to keep lawns alive but not lush (or comparable to quality of commercial turf grass). The WRIA 9 Committee addressed uncertainty and ensured consistency by applying conservative methods that err on the side of a higher irrigated area and having one Geographic Information System (GIS) analyst evaluate all of the selected parcels in the WRIA. Assumptions for the aerial imagery analysis are described in detail in Appendix G.

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 (e.g., watering at rates that meet crop irrigation requirements per the WAIG). 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. The method also assumes that residential pop-up sprinkler systems irrigate the lawns with an efficiency of 75%. In reality, households apply water to their lawns and gardens in many different ways, some more efficient than a 25% water loss. The WRIA 9 Committee discussed these uncertainties and scenarios and recognized that there is a range of water use across the watershed and individual PE well owners.

The consumptive use estimate assumes that current rural residential landscaping practices and outdoor water use will continue over the 20-year planning horizon. Because of uncertainty inherent in estimating growth patterns, domestic PE well pumping rates, and potential changes in outdoor watering practices, the WRIA 9 Committee determined that the conservative assumptions used to estimate consumptive use based on the Irrigated Area Method, and assumptions for outdoor water use in particular, are justified.

To further address uncertainty and have a point of comparison, the Committee developed two additional consumptive use scenarios. One additional scenario assumed each home has the legal maximum 0.5-acre irrigated lawn area per PE well and resulted in a consumptive use estimate of 398.4 AFY for WRIA 9. The second additional scenario assumed each home withdraws the legal limit of 950 gallons per day for indoor and outdoor use and resulted in a consumptive use estimate of 456.9 acre-feet per year for WRIA 9. The technical memo in Appendix G includes the additional consumptive use scenarios and results.

The Committee also compared the Irrigated Area method to local water purveyor data, taking into consideration several factors: customers connected to public water supply may have incentive to conserve water, in order to reduce their water bill; purveyor data represents total water use (not consumptive use) and does not separate indoor and outdoor water use to account for different consumptive use factors; and water purveyors also serve areas that are more dense and urban. Especially in portions of the watershed with older homes, homes and lawns are smaller and less water is used for irrigation; so a lower water use on average over the service area is expected. The technical memo in Appendix G includes the water purveyor data.

The WRIA 9 Committee developed a water offset target of 495.4 acre-feet per year to account for uncertainties in the PE well projection and consumptive use estimate, including higher rates of water use that could result from climate change and changing development patterns. The WRIA 9 Committee developed the water offset target by doubling the 247.7 acre-feet

consumptive use estimate. This number was compared with the consumptive use scenario that assumes all of the projected PE wells withdraw the legal limit of 950 gallons per day for indoor and outdoor use (456.9 AFY). The offset target of 495.4 AFY also accounts for uncertainties related to project implementation, further discussed in Chapters 5, 6, and 7.

The streamflow restoration law requires PE well users to manage stormwater runoff on-site to the extent practicable by maximizing infiltration, including using low-impact development techniques (RCW 90.94.030(4)(a)(vi)(C)). The benefits from these stormwater infiltration and low-impact development techniques are complex and hard to quantity. However, these unquantified benefits provide an additional factor of safety for the consumptive use estimate.

The WRIA 9 Committee also included plan implementation and adaptive management recommendations to address uncertainties related to the consumptive use estimate and project implementation (see Chapter 6).

# Chapter Five: Projects and Actions

## 5.1 Approach to identify and select projects

Watershed plans must identify projects that offset the potential impacts future PE wells will have on streamflows and provide a net ecological benefit to the WRIA. RCW 90.94.030(3)(b) requires the plan to offset consumptive use at the watershed scale, and states that "the highest priority recommendations must include replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary. Lower priority projects include projects not in the same basin or tributary and projects that replace consumptive water supply impacts only during critical flow period."

This chapter provides recommendations from the WRIA 9 Committee for projects and actions to offset consumptive use and meet NEB. The projects are described in this chapter as water offset projects and habitat projects. Water offset projects have a quantified streamflow benefit and contribute to offsetting consumptive use. Habitat projects contribute toward achieving NEB by 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 is difficult to quantify with a high degree of certainty. Therefore, the Committee did not rely on habitat projects to contribute toward offsetting consumptive use, however recognized they are still of value and therefore should be included in the plan.

The WRIA 9 Committee identified priorities for project types and locations to guide decisions on which projects to include in the plan. The Committee identified water rights acquisitions projects as a priority for inclusion in the plan. The Committee prioritized those water offset projects in subbasins in the Middle Green area with higher projected PE wells and consumptive use: Soos, Jenkins, Covington, Lower Middle Green, Mid Middle Green, Upper Middle Green, and Newaukum. The Committee identified priority habitat projects in subbasins with both a higher potential impact from PE wells and critical salmon habitat needs: Lower Green, Soos, Lower Middle Green, Mid Middle Green, Upper Middle Green, and Newaukum.

To identify the projects summarized in this chapter, the WRIA 9 Committee assembled a project inventory to capture and track all project ideas throughout the planning process. The project inventory consisted of previously proposed projects as well as new project concepts and ideas.

Technical consultants supported the Committee's development of projects described in this chapter through researching project concepts, analyzing estimated water offset for projects, contacting project sponsors, and developing project descriptions. Initially, Ecology and the technical consultants identified projects with potential streamflow benefit from the WRIA 9 salmon recovery lead entity four-year workplans, the Puget Sound Action Agenda, streamflow restoration grant applications, and other ongoing planning efforts. These projects were assigned a project type consistent with the three project type examples listed in the Final NEB Guidance (Ecology 2019). These project types included: (a) water right acquisition offset projects; (b) non-acquisition water offset projects; and (c) habitat and other related projects.

The WRIA 9 Committee also distributed a Call for Projects to request information on water offset and habitat projects at all stages of development from Committee members and partners in WRIA 9.

Non-acquisition water offset projects were underrepresented within the WRIA 9 project inventory, which consisted largely of habitat and other related projects. Development of new non-acquisition water offset projects with quantifiable streamflow benefits became necessary in order for the plan to achieve the consumptive use offset. These projects are largely centered around changes in how and when water is diverted, withdrawn, conveyed, or used to benefit streamflow and instream resources. Examples include streamflow augmentation and managed aquifer recharge projects.

Non-acquisition water offset project development occurred through three main phases: (1) initial identification through brainstorming sessions during technical workgroup and Committee meetings; (2) prioritization and further analysis; (3) and development of project descriptions for projects included in the plan. Project progression from one phase to the next occurred after the Committee agreed to move the project to the next phase. The three non-acquisition water offset projects that the Committee selected for the plan are described below in section 5.2.1.

In a separate effort, Ecology contracted with Washington Water Trust (WWT) to identify opportunities for water right acquisition water offset projects within WRIA 9, including source switches to municipal water and reclaimed water. In coordination with the WRIA 9 Committee, WWT developed a water right selection criterion based on the unique local nature of water rights and water use in WRIA 9. 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 the Committee. WWT developed eleven water right acquisition project opportunity profiles for consideration by the Committee. The three water rights acquisitions projects that the Committee selected for the plan are described below in section 5.2.1.

The technical workgroup initially developed a list of habitat projects by selecting projects that were in subbasins with higher projected PE wells, projects that are likely to have streamflow benefits, and projects located in areas with habitat critical for salmon. The technical workgroup recommended habitat projects to the Committee for review and the Committee decided to include those habitat projects in the plan. The ten habitat projects that the Committee selected for the plan are described below in section 5.2.2.

After selecting projects to include in the plan, the Committee used the following criteria to organize the list into tiers to reflect the location of the project with respect to subbasin priorities and the likelihood that the project will be implemented. Tier 1 projects provide benefits to priority subbasins and are more likely to be implemented and provide benefits in the near-term. Tier 2 projects are in lower priority subbasins, or are expected take longer to implement, because they may need additional outreach to key stakeholders. Water offset projects and habitat projects were tiered separately. For water offset projects, this evaluation considered the following: magnitude of water offset benefit; timing of water offset benefit; location of water offset benefit with respect to water offset priority subbasins; certainty of

implementation; certainty of benefit and effectiveness; resiliency; and durability. For habitat projects, this evaluation considered the following: location of benefit with respect to water offset priority subbasins and habitat priority subbasins; projects which provide multiple benefits; certainty of implementation; certainty of benefit and effectiveness; resiliency; and durability. Since the projects were in different stages of development, with some still conceptual and some ready for implementation, the process to apply the tiering criteria and to create a tiered project list was subjective. The Committee relied on the technical workgroup to develop a recommendation on tiering based on their knowledge of the proposed projects as well as assumptions based on the design and performance of similar projects in the region. The tiering results are included in Table 5.1 and Table 5.2. The WRIA 9 Committee did not use tiering to indicate priorities for funding, and recommends funding for all projects included in the plan, with the water offset projects the highest priority for funding.

Water offset and habitat projects that the Committee selected to offset consumptive use and achieve NEB are summarized below in section 5.2.1 and 5.2.2. Detailed project descriptions and project profiles are included in Appendix H.

In addition to the water offset and habitat projects listed below, section 5.2.3 describes the types of projects and actions that the Committee supports for further development and implementation in the future.

## 5.2 Projects and Actions

The projects presented below have water offset and/or ecological benefits and the WRIA 9 Committee identified these projects as contributing toward offsetting consumptive use and achieving NEB. The WRIA 9 Committee recommends implementation of all projects included in this chapter.

### 5.2.1 Water offset projects

Table 5.1 provides a summary of the six water offset projects identified by the Committee to offset consumptive use and contribute toward NEB. The total offset potential for WRIA 9 is 1,075 acre-feet per year. Offset benefits are anticipated in the subbasins listed in Table 5.1 as well as downstream of the respective project locations. Figure 5.1 is a map of the watershed that shows the location of the projects listed in Table 5.1.

The WRIA 9 Committee supports the acquisition of the valid quantity of water for the water right acquisition projects included in the plan. However, to estimate the offset potential for each water right acquisition project, the WRIA 9 Committee used the estimate generated by WWT for the consumptively used portion of the water right. The estimated return flow portion of the water right is not counted as an offset as that portion of water returns to groundwater. Before water rights are acquired and put into the Trust Water Rights Program, Ecology will conduct a full extent and validity analysis to determine the actual quantity available for acquisition and the consumptive use offset component. Since this analysis generally happens after the water right holder has agreed to sell, the Committee relied on the WWT evaluations to estimate the offset volumes listed in Table 5.1. The WRIA 9 Committee recommends that

water rights acquisitions projects include removal of water conveyance infrastructure that is no longer needed (e.g. wells, surface water diversions).

The tier 1 water offset projects included in the plan all have project sponsors and are in priority subbasins. Initial conversations with water right holders have occurred for tier 1 water offset projects that include water right acquisitions. Tier 2 projects have more uncertainty related to project implementation.

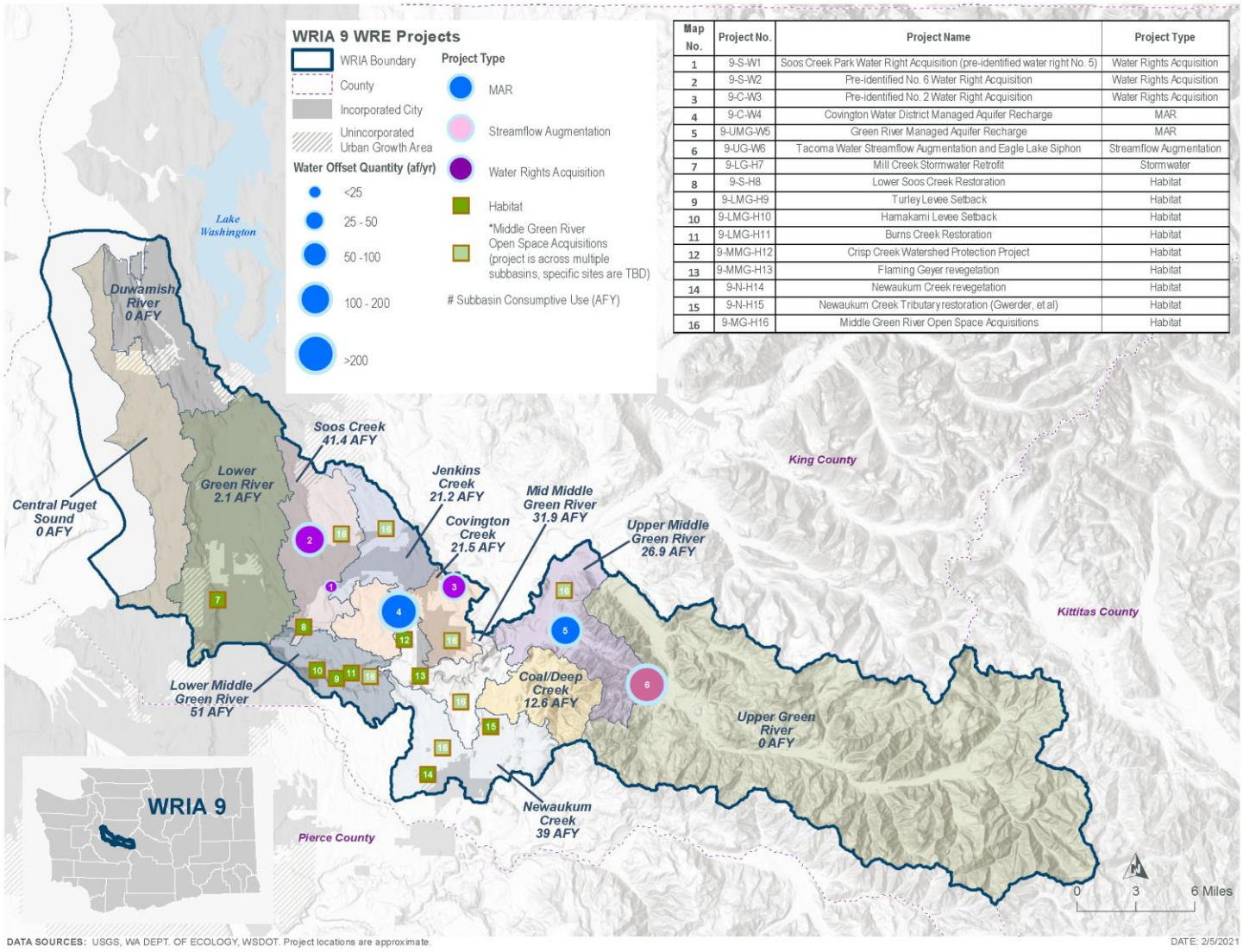
A summary description for each project is provided below. More detailed water offset project descriptions are provided in Appendix H.

Table 5.1: WRIA 9 Water Offset Projects

| Project Number | Project Name | Project Type | Subbasin(s) | Water Offset (Annual AF) | Project Sponsor | Estimated project cost | Project tier |
|---|---|---|---|---|---|---|---|
| 9-S-W1 | Soos Creek Park Water Right Acquisition (Pre-Identified Water Right No. 5) | Water right acquisition | Soos | 11 | King County | $28,300 | 1 |
| 9-S-W2 | Pre-Identified No. 6 Water Right Acquisition | Water right acquisition | Soos | 182 | Washington Water Trust | $467,900 | 2 |
| **Soos Creek Subbasin Subtotal** | | | | **193** | | | |
| 9-C-W3 | Pre-Identified No. 2 Water Right Acquisition | Water right acquisition | Covington | 54 | Washington Water Trust | $138,800 | 1 |
| 9-C-W4 | Covington Water District Managed Aquifer Recharge | Water storage and retiming - MAR | Covington | 357 | Covington Water District | $1,228,800 | 1 |
| **Covington Creek Subbasin Subtotal** | | | | **411** | | | |
| 9-UMG-W5 | Green River Managed Aquifer Recharge | Water storage and retiming - MAR | Upper Middle Green | 114 | Washington Water Trust | $1,125,500 | 1 |
| **Upper Middle Green River Subbasin Subtotal** | | | | **114** | | | |
| 9-UG-W6 | Tacoma Water Streamflow Augmentation and Eagle Lake Siphon | Streamflow augmentation | Upper Green | 357 | Tacoma Water | $400,000 | 1 |
| **Upper Green River Subbasin Subtotal** | | | | **357** | | | |

| Project Number | Project Name | Project Type | Subbasin(s) | Water Offset (Annual AF) | Project Sponsor | Estimated project cost | Project tier |
|---|---|---|---|---|---|---|---|
| **WRIA 9 Total Water Offset (Cumulative from above)** | | | | **1,075** | | **$3,389,300** | |
| **WRIA 9 Consumptive Use Estimate** | | | | **247.7** | | | |
| **WRIA 9 Offset Target** | | | | **495.4** | | | |

Notes:
[1] Tier 2 water rights acquisition projects do not have detailed project descriptions in Appendix H.




| Map No. | Project No. | Project Name | Project Type |
|---|---|---|---|
| 1 | 9-S-W1 | Soos Creek Park Water Right Acquisition (pre-identified water right No. 5) | Water Rights Acquisition |
| 2 | 9-S-W2 | Pre-identified No. 6 Water Right Acquisition | Water Rights Acquisition |
| 3 | 9-C-W3 | Pre-identified No. 2 Water Right Acquisition | Water Rights Acquisition |
| 4 | 9-C-W4 | Covington Water District Managed Aquifer Recharge | MAR |
| 5 | 9-UMG-W5 | Green River Managed Aquifer Recharge | MAR |
| 6 | 9-UG-W6 | Tacoma Water Streamflow Augmentation and Eagle Lake Siphon | Streamflow Augmentation |
| 7 | 9-LG-H7 | Mill Creek Stormwater Retrofit | Stormwater |
| 8 | 9-S-H8 | Lower Soos Creek Restoration | Habitat |
| 9 | 9-LMG-H9 | Turley Levee Setback | Habitat |
| 10 | 9-LMG-H10 | Hamakami Levee Setback | Habitat |
| 11 | 9-LMG-H11 | Burns Creek Restoration | Habitat |
| 12 | 9-MMG-H12 | Crisp Creek Watershed Protection Project | Habitat |
| 13 | 9-MMG-H13 | Flaming Geyer revegetation | Habitat |
| 14 | 9-N-H14 | Newaukum Creek revegetation | Habitat |
| 15 | 9-N-H15 | Newaukum Creek Tributary restoration (Gwerder, et al) | Habitat |
| 16 | 9-MG-H16 | Middle Green River Open Space Acquisitions | Habitat |

Figure 5.1: WRIA 9 Projects

## Soos Creek Subbasin

**Project Name**: Soos Creek Park Water Right Acquisition (Pre-Identified Water Right No. 5) (9-S-W1)

**Project Description**: The Soos Creek Park Water Right Acquisition Project proposes to acquire one surface water certificate in the Soos Creek subbasin for an estimated 11 acre-feet annually of consumptively used water. The source is an unnamed spring and the purpose of use is fish propagation and irrigation. This certificate refers to a surface water right that was temporarily donated (from 2020 to 2025) to the Trust Water Rights Program managed by Ecology. The place of use associated with the water right was previously used as a park with ponds and irrigation. Current use appears to be park/open space without ponds or irrigation.

WWT utilized irrigation delineation analysis to estimate consumptive use of 11 AFY. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

Initial conversations have occurred between Ecology and King County regarding a transfer of this water right into the Trust Water Rights Program for permanent streamflow benefit. Additional information is included in the project profile in Appendix H.

**Project Name**: Pre-Identified No. 6 Water Right Acquisition (9-S-W2)

**Project Description:** The Pre-Identified Water Right Project No. 6 proposes to acquire three groundwater certificates in the Soos Creek subbasin for an estimated 182 acre-feet annually of consumptively used water. These certificates refer to groundwater rights associated with irrigation of a total of 120 acres. The place of use associated with the water right is a golf course. Water right documentation indicates that there are a total of four groundwater supply wells associated with these water right certificates.

WWT utilized irrigation delineation analysis to estimate consumptive use of 182 AFY. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

WWT initiated outreach to this water right holder and, as of the time of this plan, did not receive a response.

## Covington Creek Subbasin

**Project Name**: Pre-Identified No. 2 Water Right Acquisition (9-C-W3)

**Project Description:** The Pre-Identified Water Right Project No. 2 proposes to acquire one surface water certificate in the Covington Creek subbasin for an estimated 54 acre-feet annually of consumptively used water. The source is Ravensdale Lake and the purpose of use is industrial/processing of mineral products. The place of use associated with the water right is a former sand and gravel mining operation.

The water right holder considered donating this water right certificate to the Trust Water Rights Program three years ago but did not proceed. At that time, Ecology reviewed a beneficial use assessment conducted on behalf of the water right holder. Ecology confirmed the assessment,

which specified an associated beneficial use of as much as 106 AFY, with a consumptive portion of 54 AFY.

Initial outreach was completed by WWT and the water right holder is open to further discussions. Additional information is included in the project profile in Appendix H.

**Project Name**: Covington Water District Managed Aquifer Recharge (9-C-W4)

**Project Description**: Covington Water District (CWD) is proposing the placement of a managed aquifer recharge (MAR) infiltration facility on their property in King County, Washington. The project concept includes diverting water annually from CWD's existing drinking water pipeline, which runs along the northern site boundary, between approximately November 1 and April 30 when water is available using existing water rights. Diverted water would be conveyed from CWD's existing pipeline and piped to a constructed MAR facility. This diverted water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges to Covington Creek as re-timed groundwater baseflow. The goal of the project is to increase baseflow to Covington Creek, a tributary to Soos Creek and the Green River, by recharging the aquifer adjacent to the creek and providing additional groundwater discharge to the creek through MAR.

Initial calculations indicate the CWD MAR project could infiltrate approximately 357 acre-feet annually. Additional information is included in the project description in Appendix H.

### Upper Middle Green River Subbasin

**Project Name**: Green River Managed Aquifer Recharge (9-UMG-W5)

**Project Description:** The Green River MAR project concept includes diverting surface water annually from the Green River during high flow periods when excess water may be available. Diverted water would be conveyed through a collector well adjacent to the river (e.g. Ranney Collector well) or through an instream surface water intake and piped to a constructed MAR facility. This diverted surface water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges back to surface water as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the Green River by recharging the aquifer adjacent to the river and providing additional groundwater discharge to the river through MAR.

Several potential sites were identified in WRIA 9, including the Tacoma Water Green River Filtration facility and Kanaskat-Palmer state park.

The Committee chose 114 AFY as the offset volume to account for uncertainties related to diversion rate, period of diversion, and timing of streamflow benefits. Additional information is included in the project description in Appendix H.

### Upper Green River Subbasin

**Project Name**: Tacoma Water Streamflow Augmentation and Eagle Lake Siphon (9-UG-W6)

**Project Description:** The Tacoma Water Streamflow Augmentation and Eagle Lake Siphon project would augment streamflow through the release of 2 cubic foot per second (cfs) of raw, untreated water for a period of 90 days (during the summer low-flow period) into the mainstem Green River using Tacoma Water's existing water rights. Tacoma Water envisions this

could be done by requesting the Army Corps of Engineers release 2 cfs more water than what Tacoma Water withdraws as part of regular Howard Hanson Dam flow coordination. The commitment to release an additional 2 cfs to the Green River would be contingent on Tacoma Water securing a water right for up to 1,000 AFY of dead storage out of Eagle Lake to use as needed.

This project is expected to improve streamflows in the Green River in summer when surface flows are generally lowest. The anticipated water offset is up to 357 acre-feet per year. Additional information is included in the project description in Appendix H.

### 5.2.2 Habitat Projects

Table 5.2 provides a summary of ten habitat projects identified by the Committee to provide ecological benefits to WRIA 9. The habitat projects included in the plan are all tier 1 projects because they are in priority subbasins, have project sponsors, and are expected to be implemented within the planning horizon. More detailed habitat project descriptions are provided in Appendix H.

Although many of these projects have potential streamflow benefits, the Committee has elected not to quantify water offsets from habitat projects.

To ensure that all instream and floodplain management habitat projects meet hydrological performance standards, a Beaver Management Plan should be included, when appropriate. A Beaver Management Plan[17] should identify key flood levels (long and short term allowable flooding elevations and onsite/offsite key protected infrastructure flood level elevations); and standards for when, where, and what methods of beaver deterrence should be used that comply with state and county requirements. In areas where multiple projects are proposed, the benefit of funding multiple projects to maximize biological benefit should be addressed.

[17] Contact the local WDFW Habitat Biologist for more information on Beaver Management Plans.

Table 5.2: WRIA 9 Habitat Projects

| Project Number | Project Name | Project Description | Subbasin(s) | Anticipated Ecological Benefits | Project Sponsor | Estimated Cost | Project Tier |
|---|---|---|---|---|---|---|---|
| 9-LG-H7 | Mill Creek Stormwater Retrofit | Stormwater infiltration retrofits or enhancements to redirect surface runoff to groundwater, delaying contribution to streamflow and protecting and restoring water quality. | Lower Green | Protect and restore water quality, increase groundwater recharge. | King County | Unknown | 1 |
| 9-S-H8 | Lower Soos Creek Restoration | Stream, riparian, and wetland restoration on Lower Soos Creek, including wood placement. | Soos | Increase hydraulic diversity, restore native vegetation, restore water temperature, provide erosion abatement. | King County | $1,500,000 | 1 |
| 9-LMG-H9 | Turley Levee Setback | Acquire land, remove levee, and construct revetment away from river to create 40 acres of new floodplain habitat. Restoration includes installation of riparian plantings, large woody debris (LWD), and gravel substrate within river channel. | Lower Middle Green | Floodplain restoration, improve spawning and rearing habitat. | King County | $6,000,000 | 1 |

| Project Number | Project Name | Project Description | Subbasin(s) | Anticipated Ecological Benefits | Project Sponsor | Estimated Cost | Project Tier |
|---|---|---|---|---|---|---|---|
| 9-LMG-H10 | Hamakami Levee Setback | Acquire land, remove levee, and construct revetment away from river to create 35 acres of new floodplain habitat. Restoration includes installation of riparian plantings, LWD, and gravel substrate within river channel. | Lower Middle Green | Floodplain restoration, improve spawning and rearing habitat. | King County | $6,000,000 | 1 |
| 9-LMG-H11 | Burns Creek Restoration | Property acquisition, installation of LWD and riparian plantings. The estimated acreage of restored riparian zone: 28. | Lower Middle Green | Restoration of fish and wildlife habitat, wetlands, and water quality in an area which is very important for over-wintering salmon. | King County | $2,000,000 | 1 |
| 9-MMG-H12 | Crisp Creek Watershed Protection Project | Property acquisition of undeveloped forest lands to benefit the hydrologic integrity of the subbasin and protect the water supply and water rights for the Muckleshoot Indian Tribe's Keta Creek Hatchery. | Mid Middle Green | Protect hydrologic integrity of the basin. | Muckleshoot Indian Tribe | Unknown | 1 |

| Project Number | Project Name | Project Description | Subbasin(s) | Anticipated Ecological Benefits | Project Sponsor | Estimated Cost | Project Tier |
|---|---|---|---|---|---|---|---|
| 9-MMG-H13 | Flaming Geyer Revegetation | Restoration includes installation of riparian plantings, LWD and gravel substrate within river channel. The total project area proposed for restoration is approximately 42 acres. | Mid Middle Green | Increased shade will moderate water temperatures, reduce evaporation, and enhance fish habitat. | King County | $1,500,000 | 1 |
| 9-N-H14 | Newaukum Creek Riparian Revegetation and Beaver Colonization | Restoration along Newaukum Creek at three sites: Brandjes, Gaddy, and Gwerder. Removing structures and installation of riparian plantings. This project will plant native trees and shrubs across 61 acres of riparian zone/wetland habitat. | Newaukum | Maintain streamflows, moderate water temperature, reduce evaporation and create habitat. | King County | Unknown | 1 |
| 9-N-H15 | Newaukum Creek Tributary Restoration (Gwerder, et al) | Excavation and restoration of wetland and stream channels of Newaukum Creek. Includes installation of LWD and riparian vegetation. Total acreage proposed for riparian and wetland restoration is approximately 50 acres. | Newaukum | Maintain streamflows, moderate water temperature, reduce evaporation and create habitat. | King County | Unknown | 1 |

| Project Number | Project Name | Project Description | Subbasin(s) | Anticipated Ecological Benefits | Project Sponsor | Estimated Cost | Project Tier |
|---|---|---|---|---|---|---|---|
| 9-MG-H16 | Middle Green River Open Space Acquisitions | Property acquisitions to protect the hydrologic integrity of the basin. If acquired land was previously developed, structures would be removed including homes, septic systems, and wells. | Soos, Jenkins, Covington, Lower Middle Green, Mid Middle Green, Upper Middle Green, Newaukum | Protect hydrologic integrity of the basin. | King County | Unknown | 1 |

### 5.2.3 Prospective Projects and Actions

In addition to the projects described in this chapter, the WRIA 9 Committee supports projects and actions that achieve the following goals:

- Acquisitions of water rights to increase streamflows and offset the impacts of PE wells. Water rights should be permanently and legally held by Ecology in the Trust Water Rights Program to ensure that the benefits to instream resources are permanent.

  The WRIA 9 Committee acknowledges that all water rights transactions rely on willing sellers and willing buyers. The WRIA 9 Committee recognizes the importance of water availability for farmers and the limited available water supply within the Agricultural Production Districts. The WRIA 9 Committee supports the current King County policy to encourage the maintenance and preservation of agriculture water rights for agriculture purposes, and supports the acquisition of irrigation water rights within designated Agricultural Production Districts if the properties underlying the water rights have access to an alternative water source, such as reclaimed water, that can be reliably supplied to the properties at a rate that is comparable to the cost of current irrigation management.

- Projects or programs that support connections to public water systems. Projects could provide financial incentives for homes using PE wells to connect to public water service and decommission the well; and/or provide financial support for water purveyors to extend water distribution systems further into their individual service areas, particularly where PE wells are concentrated or rapid rural growth is anticipated.

- Projects or programs that provide outreach and incentives to rural landowners with wells in order to lower indoor and outdoor water use through water conservation best practices, and comply with drought and other water use restrictions. Programs would encourage the following types of water conservation strategies and best practices: natural lawn care; irrigation efficiency; rainwater catchment and storage; drought resistant and native landscaping; smaller lawn sizes; forest, meadow and wetland conservation; indoor water conservation; and voluntary metering. Conservation and water use efficiency projects that involve water rights should permanently convey the saved water to Ecology to be held in the Trust Water Rights Program for instream flow purposes.

- Projects that beneficially switch the source of withdrawal from surface to groundwater, or other beneficial source exchanges such as a source switch to reclaimed water. The benefits of a source exchange project may depend on the connection between the sources, benefits to instream resources (e.g., a surface to groundwater source switch may have negative impacts on fish if the groundwater baseflow provides refuge areas in streams with high water temperature issues), and should take into consideration the possible consequences of unsustainable withdrawals from the affected aquifer.

- Projects that provide streamflow and habitat benefits by returning stream habitat to a more natural state, such as through levee setback or removal, river-floodplain restoration, and instream habitat restoration.
- Projects that enable the development and use of reclaimed water to provide an alternative source to permit-exempt wells or other water rights and for streamflow restoration projects, other than direct stream augmentation.
- Projects that contribute to offsetting consumptive use in the following subbasins with higher projected PE wells and consumptive use: Soos, Jenkins, Covington, Lower Middle Green, Mid Middle Green, Upper Middle Green, Newaukum, and Coal/Deep.
- A voluntary five-year program in one or more WRIA 9 subbasins to meter permit-exempt wells (indoor and outdoor residential use). A non-profit organization, university, or government agency could pilot a voluntary PE well metering program and collect data to 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. 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 efforts. The voluntary metering program should be combined with a robust education and community engagement program about water consumption and conservation, described above.
- Projects that monitor Puget Sound Chinook abundance, and juvenile productivity within streams or rivers in the Green River watershed to assess the cumulative effects, trends, and recovery actions on juvenile salmon abundance, health, and productivity over time.

## 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 Committee estimated 247.7 AFY of consumptive use from new PE wells over the planning horizon. As discussed in section 4.5, the Committee developed an offset target of 495.4 AFY to address uncertainty in the consumptive use estimate and project implementation, and ensure that projects and actions in the plan would offset consumptive use.

The plan includes three water rights acquisitions projects, two managed aquifer recharge projects, and one streamflow augmentation projects to offset consumptive use. These water

offset projects included in Table 5.1 provide an estimated offset of 1,075 AFY and exceed the offset target.

A total of ten habitat projects have been identified by the Committee and are included in Table 5.2. Ecological benefits associated with these projects are myriad and 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.

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

Per RCW 90.94.030(3)(d), this watershed plan must include an evaluation or estimation of the cost of offsetting new domestic water uses over the subsequent twenty years. To satisfy this requirement, the Committee relied on Ecology to develop cost estimates for each of the water offset projects listed in Table 5.1. The Committee also included costs estimates for habitat projects in Table 5.2, when that information was provided by the project sponsor.

Cost estimates for water offset projects included in the plan are planning level cost estimates only. Ecology developed the cost estimates by reviewing recent streamflow restoration program grant applications for similar project types and recently completed water right acquisitions. For all water right acquisitions, an extent and validity determination will need to be completed to establish the quantity of water that can be permanently protected through transfer to Ecology's Trust Water Rights program. The price for these water rights will be negotiated between the willing seller and the willing buyer. Project costs for other water offset project types will be further developed after the plan is submitted, when the project sponsors seek funding and prepare grant applications.

The total estimated cost for implementing the water offset projects listed and described in this chapter is $3,389,300.

The estimated cost for implementing individual habitat projects range from $1.5 million to $6 million, with several of the project costs unknown.

### 5.3.3 Certainty of Implementation

The WRIA 9 Committee used a tiering process to identify the projects that are more likely to be implemented in the short term. Tier 1 projects are more likely to be implemented and provide benefits in the near-term because those projects have project sponsors. For water rights acquisitions included in tier 1, initial outreach to water right holders has occurred and those water right holders indicated interest in further discussions. For the tier 2 water right acquisition project (Pre-Identified Water Right No. 6), Washington Water Trust initiated outreach to the water right holder, but at the time of this plan, did not receive a response. The habitat projects included in the plan are all tier 1 projects because they are in priority subbasins, have project sponsors, and are expected to be implemented within the planning horizon.

The WRIA 9 Committee identified funding availability, especially for larger capital projects, as an implementation challenge. The WRIA 9 Committee recommends projects that infiltrate water (e.g. managed aquifer recharge projects and stormwater projects) include estimated operations and maintenance costs in applications for streamflow restoration funding.

The WRIA 9 Committee also developed adaptive management recommendations to increase reasonable assurance that the projects and actions in the plan will be implemented.

# Chapter Six: Adaptive Management and Implementation Recommendations

## 6.1 Plan Implementation and Adaptive Management Recommendations

The WRIA 9 Committee recommends an adaptive management process for implementation of the WRIA 9 watershed plan. Adaptive management is defined in the Final NEB Guidance as "*an iterative and systematic decision-making process that aims to reduce uncertainty over time and help meet project, action, and plan performance goals by learning from the implementation and outcomes of projects and actions*."

Adaptive management is intended to help address uncertainty, provide more reasonable assurance for plan implementation, and to ensure that 1) water use from new permit exempt (PE) wells is adequately offset, as required by RCW 90.94.030, and 2) implementation of the watershed plan produces a net ecological benefit to the watershed, as required by RCW 90.94.030. The periodic review in this adaptive management process will provide a verifiable process for plan monitoring and ensure transparency in plan implementation.

### Existing Challenges

The WRIA 9 Committee identified the following challenges in the planning process and seeks to address these challenges through monitoring and adaptive management:

- The watershed plan includes projected, not actual, PE well water use by subbasin. 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. Monitoring the number of new PE wells, actual PE well water use, and associated consumptive water use would provide data for comparison and adjustments, as needed, in planning for ongoing offsets to ensure the mandates of RCW 90.94 are being met.

- The watershed plan includes water offset and habitat projects, and estimated benefits associated with each, by subbasin. The WRIA 9 Committee used a tiering process to identify projects with greater implementation certainty, however that will likely change over time. Measuring and tracking project implementation and actual water offsets and habitat benefits by subbasin, to the extent possible, can be used to verify intended streamflow benefits.

- Our global climate is changing. While the effects of climate change over the 20-year life of this plan cannot be precisely known, shifts in climatic conditions will influence the hydrologic regime in the watershed and will impact instream flows. Rainfall, snowmelt, and evapotranspiration have been identified as the primary natural mechanisms driving changes in groundwater storage. These mechanisms will be affected by a changing

climate. Air and water temperatures will increase and summer streamflows will be reduced. Groundwater pumping and indirect effects of irrigation and land use changes will impact groundwater resources and the availability for future water supply and instream flows. The Committee recognizes that a successful plan must acknowledge that climate is changing and include recommendations to ensure that the statutory requirements to offset water withdrawals by new PE wells and provide a net ecological benefit will be met under future climatic conditions. Monitoring actual water use and the amount of offset water actually generated will inform this determination.

- Projects identified in the plan are expected to increase groundwater storage, augment streamflows, and provide aquatic habitat benefits. Water offset projects should be monitored in order to ensure that they continue to function as designed, and generate instream water to offset new PE wells, under a changing climate. Habitat projects should be analyzed for their resilience to changing conditions. The WRIA 9 Committee chose to apply an overall safety factor to help address these concerns. 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, the WRIA 9 Committee added a margin of safety to the consumptive use estimate and recommends the following adaptive management strategies.

### 6.1.1 Tracking and Monitoring

The WRIA 9 Committee recommends that the Washington Department of Ecology (Ecology) monitor watershed plan implementation, in consultation with the Washington Department of Fish and Wildlife (WDFW), and King County. Specifically, the Committee recommends that Ecology, in consultation with WDFW and King County, review actions resulting from watershed plans to ensure the mandates of RCW 90.94 are being met, including;

- Track annual new permit-exempt wells by subbasin;
- Track project implementation and the actual amount of offset water generated, or reasonably certain to be generated, by subbasin; and
- Develop a process to adaptively manage implementation if net ecological benefit is not being met as envisioned by the watershed plan.

Tracking streamflow restoration projects and new permit-exempt domestic 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, and

- Provide a template for adaptively managing emergent restoration needs.

The WRIA 9 Committee recommends WDFW, in collaboration with Ecology and the Recreation and Conservation Office (RCO), pilot the Salmon Recovery Portal (https://srp.rco.wa.gov/about), managed by RCO, for tracking streamflow restoration projects and new permit-exempt domestic wells.[18] To improve harmonization of streamflow restoration with ongoing salmon recovery efforts, local salmon recovery Lead Entity Coordinators shall be consulted prior to entering streamflow restoration projects into the portal. While input and oversight is welcomed, no commitment of additional work is required from Lead Entity Coordinators. University of Washington data stewards will be employed to conduct data entry, quality assurance, and quality control.

Using the Salmon Recovery Portal to track streamflow restoration projects and new permit-exempt domestic wells will:

- Provide a centralized database that includes project status and costs, sources of funding, and project sponsors.
- Facilitate project reporting and public outreach.
- Encourage collaboration and coordination between projects by geographic area.

Table 6.1 summarizes the entities responsible for carrying out this recommendation and associated funding needs.

Table 6.1: Implementation of Tracking and Monitoring Recommendation

| **Action** | **Entity or Entities Responsible** | **Funding Considerations** |
|---|---|---|
| Track building permits issued with permit-exempt wells. | Ecology (via reporting from counties and cities[19]) | 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. |
| 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. |

[18] See Supplemental Document: Project Tracking for WRE Plans for further details on project tracking procedures using the Salmon Recovery Portal.

[19] Ecology provided guidance on the timing and details to include in the annual reporting to local jurisdictions in WRIA 9.

### 6.1.2 Oversight and Adaptation

The WRIA 9 Committee recommends Ecology issue four watershed plan implementation reports, one each in 2027, 2032, 2037, and 2042 detailing the successes, challenges, and gaps related to implementation of the watershed plan. Each report should cover the five-year period occurring immediately prior to the year of issuance, except the first reporting period, which should start when the plan is adopted by Ecology. The report should include information on whether the watershed plan is on track to achieve the expected net ecological benefit and water offsets as well as streamflow conditions, including identifying subbasins with known impacts that have not yet implemented water offset or habitat projects. In addition, the report should include an estimate of the anticipated costs required to implement water offset projects in subbasins with an offset deficit (subbasins with more consumptive use impacts than offsets). The report should also include information on any discretionary programs that were implemented, including for example, water conservation education and outreach, incentives for public water service connections, and voluntary PE well metering.

Ecology's report should include recommendations to adjust the projects and actions if the adopted goals of the watershed plans are not on track to being met in the plan's 20-year timeframe. A notice of action to adjust the plan should be sent to members of the WRIA 9 Committee to comment. Members of the WRIA 9 Committee may reconvene, if needed. However, members of the WRIA 9 Committee are not expected to reconvene after approving the plan. Final adjustments and amendments shall be at the sole determination of Ecology after public input.

The report should be sent to all members of the WRIA 9 Committee, King County Council, 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 projects in subbasins that have not offset permit-exempt water use.

Table 6.2 summarizes the entities responsible for carrying out this recommendation and associated funding needs.

Table 6.2: Implementation of Oversight and Adaptation Recommendation

| **Action** | **Entity or Entities Responsible** | **Funding Considerations** |
|---|---|---|
| Develop and distribute Watershed plan implementation report, including any recommended adjustments to projects and actions | Ecology | Ecology may need additional funding to support development of the report. |

| Action | Entity or Entities Responsible | Funding Considerations |
|---|---|---|
| Revise Streamflow Restoration Grant Guidance to prioritize projects in subbasins that have not offset permit-exempt water use | Ecology | No additional funding is needed. |

### 6.1.3 Funding

The WRIA 9 Committee recommends funding plan implementation and adaptive management from a variety of sources including the 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 urges a collaborative approach to fund Ecology and WDFW to ensure plan implementation and monitoring, streamflow health, water offsets, net ecological benefit, and full compliance with the mandates found in RCW 90.94.

## 6.2 Policy and Regulatory Recommendations

The Streamflow Restoration law lists optional elements committees may consider including in the plan to manage water resources for the WRIA or a portion of the WRIA (RCW 90.94.030(3)(f)). The WRIA 9 Committee initially identified potential policy and regulatory recommendations to include in the plan. After iterative rounds of discussion, the Committee did not have full support for including policy and regulatory recommendations in the plan.

# Chapter Seven: Net Ecological Benefit

## 7.1 Introduction to Net Ecological Benefit Evaluation

Watershed Restoration and Enhancement Plans must identify projects and actions to offset the potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over 20 years (2018-2038) and provide a net ecological benefit to the WRIA. The Final NEB Guidance establishes Ecology's interpretation of the term "net ecological benefit" as "the outcome that is anticipated to occur through implementation of projects and actions in a plan to yield offsets that exceed impacts within: a) the planning horizon; and, b) the relevant WRIA boundary" (Ecology 2019).

The Final NEB Guidance states that "planning groups are expected to include a clearly and systematically articulated NEB evaluation in the watershed plan" and provides guidance for planning groups on what to include in the NEB evaluation (Ecology 2019). The Final NEB Guidance also states that "a watershed plan that includes a NEB evaluation based on this guidance significantly contributes to the reasonable assurances that the offsets and NEB within the plan will occur. Ecology will review any such plan with considerable deference in light of the knowledge, insights, and expertise of the partners and stakeholders who influenced the preparation of their plan. Ecology will make the NEB determination as part of this review" (Ecology 2019).

The WRIA 9 Committee completed a NEB evaluation for the watershed plan and the results of that evaluation are included in this chapter.

## 7.2 Water Offsets

The WRIA 9 Committee projects that a total of 632 new PE wells will be installed within WRIA 9 during the planning horizon. The WRIA 9 Committee used this 20-year PE well projection to estimate 247.7 AFY of new consumptive water use in WRIA 9, as described in detail in Chapter 4. The WRIA 9 Committee sought projects to offset at least 495.4 AFY, a safety factor of two times the consumptive use estimate. This offset target accounts for uncertainties in the planning process related to the PE well projection, consumptive use assumptions, and project implementation. If the plan is implemented, the WRIA 9 Committee projects a total water offset of 1,075 AFY from 6 water offset projects (described in Chapter 5 and listed in Table 7.1), a surplus offset of 827.3 acre-feet above the consumptive use estimate and 579.6 acre-feet above the offset target. Through this comparison, the WRIA 9 Committee has determined that this plan, if implemented, succeeds in offsetting consumptive use impacts at the WRIA scale.

Table 7.1: Summary of WRIA 9 Water Offset Projects included in NEB analysis

| Project Number | Project Name | Project Short Description | Subbasin | Estimated Water Offset Benefits (AFY) | Timing of Benefit[1,2] | Project Tier |
|---|---|---|---|---|---|---|
| 9-S-W1 | Soos Creek Park Water Right Acquisition (Pre-Identified Water Right No. 5) | Acquisition of one surface water certificate previously used for fish propagation and irrigation | Soos | 11 | Irrigation Season | 1 |
| 9-S-W2 | Pre-Identified No. 6 Water Right Acquisition | Acquisition of three groundwater certificates used for golf course irrigation | Soos | 182 | Year-round | 2 |
| 9-C-W3 | Pre-Identified No. 2 Water Right Acquisition | Acquisition of one surface water certificate used for industrial/ processing of mineral products | Covington | 54 | Year-round | 1 |
| 9-C-W4 | Covington Water District Managed Aquifer Recharge | Diversion of water from an existing drinking water pipeline for infiltration at a constructed MAR facility | Covington | 357 | Year-round | 1 |
| 9-UMG-W5 | Green River Managed Aquifer Recharge | Diversion of water from the Green River for infiltration at a constructed MAR facility | Upper Middle Green | 114 | Low flow period (typically summer and early fall)[3] | 1 |
| 9-UG-W6 | Tacoma Water Streamflow Augmentation and Eagle Lake Siphon | Release of raw, untreated water during the summer low-flow period into the mainstem Green River | Upper Green | 357 | 90 days during summer low flow period | 1 |

| Project Number | Project Name | Project Short Description | Subbasin | Estimated Water Offset Benefits (AFY) | Timing of Benefit[1,2] | Project Tier |
|---|---|---|---|---|---|---|
| | | | **Tier 1 subtotal** | **893** | | |
| | | | **Total** | **1,075** | | |

Notes:

[1] The water right project profiles in Appendix H indicate the period of use associated with the water right. For water rights that rely on surface water, the timing of benefit is assumed to be the same as the period of use. For water rights that rely on groundwater, the timing of benefit is assumed to be year-round, due to the lag time between well pumping and streamflow impact. Irrigation season is typically April through October, but the specific period of use is different for each water right.

[2] Managed Aquifer Recharge Projects are expected to provide benefits year-round. Streamflow augmentation benefits will continue to discharge to the river after each year's storage window closes because of the lag time of water moving through an aquifer and the distance of the flow path to the river. The temporal distribution and absolute value of those benefits will be estimated during the feasibility study that has to be conducted before a MAR project can proceed to construction and operation.

[3] The Green River Managed Aquifer Recharge Project is expected to increase streamflow year-round. However, the goal of the project is to increase baseflow to the Green River during the low flow period (typically late summer and early fall).

The WRIA 9 Committee used a tiering process to identify projects with greater implementation certainty (tier 1). Tier 1 projects all have project sponsor. For tier 1 water rights acquisitions projects, discussions were initiated with the water right holders. The tier 1 projects provide a water offset of 893 AFY.

Estimated consumptive use and potential water offset are compared at the subbasin scale in Table 7.2 for both tier 1 and tier 2 projects. Surplus water offset is achieved in a total of four subbasins (Soos Creek, Covington Creek, Upper Middle Green River, and Upper Green River), ranging from 87.1 AFY in the Upper Middle Green River subbasin to 389.5 AFY in the Covington Creek subbasin. Neutral water offset occurs in the Central Puget Sound and Duwamish River subbasins, both with 0 estimated consumptive use. A deficit in water offset occurs in a total of six subbasins (Lower Green River, Jenkins Creek, Lower Middle Green River, Mid Middle Green River, Newaukum Creek, and Coal/Deep Creek), ranging from 2.1 AFY in the Lower Green River subbasin to 51.0 AFY in the Lower Middle Green River subbasin. However, the Committee assumes that the water offset projects in the Upper Green and Upper Middle Green subbasins will contribute to offsetting consumptive use downstream, in the Mid Middle Green, Lower Middle Green, and Lower Green River subbasins. See Figure 5.1 in Chapter 5 for a map of water offset projects by subbasin.

Table 7.2: Subbasin Water Offset Totals Compared to Permit-Exempt Well Consumptive Use Estimate

| **Subbasin** | **Offset Project Totals (AFY)** | **Permit-Exempt Well Consumptive Use (AFY)[1]** | **Surplus/Deficit (AFY)[2,3]** |
|---|---|---|---|
| **Central Puget Sound** | 0 | 0 | 0 |
| **Duwamish River** | 0 | 0 | 0 |
| **Lower Green River** | 0 | 2.1 | -2.1 |
| **Soos Creek** | 193 | 41.4 | +151.6 |
| **Jenkins Creek** | 0 | 21.2 | -21.2 |
| **Covington Creek** | 411 | 21.5 | +389.5 |
| **Lower Middle Green River** | 0 | 51.0 | -51.0 |
| **Mid Middle Green River** | 0 | 31.9 | -31.9 |
| **Upper Middle Green River** | 114 | 26.9 | +87.1 |
| **Newaukum Creek** | 0 | 39.0 | -39.0 |
| **Coal/Deep Creek** | 0 | 12.6 | -12.6 |
| **Upper Green River** | 357 | 0 | +357 |

| Subbasin | Offset Project Totals (AFY) | Permit-Exempt Well Consumptive Use (AFY)[1] | Surplus/Deficit (AFY)[2,3] |
|---|---|---|---|
| **WRIA 9 Total Consumptive Use** | **1,075** | **247.7** | **+827.3** |

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.
[3] Water offset projects in the Upper Green and Upper Middle Green subbasins will contribute to offsetting consumptive use downstream, in the Mid Middle Green, Lower Middle Green, and Lower Green River subbasins.

The higher offset target (2 times the consumptive use) and potential water offset from tier 1 and tier 2 projects are compared at the subbasin scale in Table 7.3.

Table 7.3: Subbasin Water Offset Totals Compared to Offset Target

| Subbasin | Offset Project Totals (AFY) | Offset Target: 2x Consumptive Use (AFY)[1] | Surplus/Deficit (AFY)[2,3] |
|---|---|---|---|
| **Central Puget Sound** | 0 | 0 | 0 |
| **Duwamish River** | 0 | 0 | 0 |
| **Lower Green River** | 0 | 4.2 | -4.2 |
| **Soos Creek** | 193 | 82.8 | +110.2 |
| **Jenkins Creek** | 0 | 42.4 | -42.4 |
| **Covington Creek** | 411 | 43 | +368 |
| **Lower Middle Green River** | 0 | 102 | -102 |
| **Mid Middle Green River** | 0 | 63.8 | -63.8 |
| **Upper Middle Green River** | 114 | 53.8 | +60.2 |
| **Newaukum Creek** | 0 | 78 | -78 |
| **Coal/Deep Creek** | 0 | 25.2 | -25.2 |
| **Upper Green River** | 357 | 0 | +357 |
| **WRIA 9 Total Consumptive Use** | **1,075** | **495.4** | **+579.6** |

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.
[3] Water offset projects in the Upper Green and Upper Middle Green subbasins will contribute to offsetting consumptive use downstream, in the Mid Middle Green, Lower Middle Green, and Lower Green River subbasins.

The water offset projects listed in Table 7.1 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 9, additional benefits could include the following:

- Water right acquisition projects: Aquatic habitat improvements during key seasonal periods; reduction in groundwater withdrawals and associated benefit to aquifer resources; and/or beneficial use of reclaimed water.
- MAR projects: Aquatic habitat improvements during key seasonal periods; increased groundwater recharge; reduction in summer/fall stream temperature; increased groundwater availability to riparian and near-shore plants; and/or contribution to flood control.
- Streamflow Augmentation: Aquatic habitat improvements during key seasonal periods.

## 7.3 Habitat Benefits

A total of ten habitat improvement projects are included within the plan, as summarized in Table 7.4 and shown in Figure 5.1 in Chapter 5. The habitat projects are all tier 1 because they have project sponsors, and are expected to be implemented within the planning horizon. Habitat improvement tactics associated with these projects include a combination of aquatic habitat restoration, riparian vegetation plantings, land acquisition, levee removal, LWD installation, beaver colonization, and stormwater management. Many of the habitat improvement projects include more than one of these elements. Project distribution is summarized by the following:

Table 7.4: Summary of Habitat Projects by Subbasin

| Subbasin | Habitat Projects | Benefiting Stream |
|---|---|---|
| **Central Puget Sound** | | |
| **Duwamish River** | | |
| **Lower Green River** | 1 project: 9-LG-H7 | Green River |
| **Soos Creek** | 2 projects: 9-S-H8 and 9-MG-H16 | Soos Creek |
| **Jenkins Creek** | 1 project: 9-MG-H16 | Jenkins Creek |
| **Covington Creek** | 1 project: 9-MG-H16 | Various |
| **Lower Middle Green River** | 4 projects: 9-LMG-H9, 9-LMG-H10, 9-LMG-H11, and 9-MG-H16 | Green River |

| Subbasin | Habitat Projects | Benefiting Stream |
|---|---|---|
| **Mid Middle Green River** | 3 projects: 9-MMG-H12, 9-MMG-H13, and 9-MG-H16 | Green River |
| **Upper Middle Green River** | 1 project: 9-MG-H16 | Various |
| **Newaukum Creek** | 2 projects: 9-N-H14 and 9-N-H15 | Newaukum Creek |
| **Coal/Deep Creek** | | |
| **Upper Green River** | | |

Note: Project 9-MG-H17 is within the general Green River watershed, potentially benefitting a number of subbasins and associated streams.

If implemented, these projects are expected to provide additional benefits to instream resources that, together with direct water offsets, are beyond those necessary to offset the impacts from new consumptive water use within the WRIA. These additional benefits include increased hydraulic/aquatic habitat diversity, restored native vegetation, restored water temperature, erosion abatement, improved spawning and rearing habitat, and water quality benefits, among other benefits.

Table 7.5: Summary of WRIA 9 Habitat Improvement Projects

| **Project Number** | **Project Name** | **Project Short Description** | **Subbasin** | **River Miles Benefitted** | **Other Benefits with Quantifiable Metric** (e.g. structures per mile) | **Habitat Limiting Factor(s) Addressed**[1, 2] |
|---|---|---|---|---|---|---|
| 9-LG-H7 | Mill Creek Stormwater Retrofit | Stormwater retrofit to protect and restore water quality by reducing stormwater impacts from existing infrastructure and development | Lower Green | Lower Green River | -Increase in recharge/ groundwater levels (monitoring)<br>-Infiltration volume (10 to 100 AFY)<br>-Stormwater retrofit area treated (acres) | -Decreased water quality (pollution and elevated water temperature)<br>-Altered hydrology and stream flows |
| 9-S-H8 | Lower Soos Creek Restoration | Stream, riparian, and wetland habitat restoration on Lower Soos Creek | Soos | 3 miles of Lower Soos Creek | -Increased hydraulic diversity (mapping of structures)<br>-Restored native vegetation (acres)<br>-Restored water temperature (monitoring)<br>-Erosion abatement (mapping) | -Loss of riparian habitat<br>-Decreased water quality (elevated water temperature)<br>-Altered stream hydrology<br>-Disconnected floodplain habitat<br>-Introduction of non-native plant and animal species<br>-Reduction of LWD and channel complexity |

| **Project Number** | **Project Name** | **Project Short Description** | **Subbasin** | **River Miles Benefitted** | **Other Benefits with Quantifiable Metric** (e.g. structures per mile) | **Habitat Limiting Factor(s) Addressed[1, 2]** |
|---|---|---|---|---|---|---|
| 9-LMG-H9 | Turley Levee Setback | Land acquisition, levee removal, and revetment construction away from river to create 40 acres of new floodplain habitat | Lower Middle Green | 1,300 feet of Turley Levee on right bank of Green River | -Aquatic habitat restoration (40 acres)<br>-Levee removal (1,300 feet long by 50 feet wide)<br>-Gravel installation (cubic feet)<br>-LWD installation (mapping of structures)<br>-Improved spawning and rearing habitat (mapping) | -Loss of riparian habitat<br>-Gravel starvation and scouring<br>-Altered stream hydrology<br>-Disconnected floodplain habitat<br>-Reduction of LWD and channel complexity |
| 9-LMG-H10 | Hamakami Levee Setback | Land acquisition, levee removal and revetment construction away from river to create 35 acres of new floodplain habitat. | Lower Middle Green | 1,200 feet of levee removal on right bank of Green River | -Aquatic habitat restoration (40 acres)<br>-Levee removal (1,200 feet long by 50 feet wide)<br>-Gravel installation (cubic feet)<br>-LWD installation (mapping of structures)<br>-Improved spawning and rearing habitat (mapping) | -Loss of riparian habitat<br>-Gravel starvation and scouring<br>-Altered stream hydrology<br>-Disconnected floodplain habitat<br>-Introduction of non-native plant and animal species<br>-Reduction of LWD and channel complexity |

| **Project Number** | **Project Name** | **Project Short Description** | **Subbasin** | **River Miles Benefitted** | **Other Benefits with Quantifiable Metric** (e.g. structures per mile) | **Habitat Limiting Factor(s) Addressed**[1, 2] |
|---|---|---|---|---|---|---|
| 9-LMG-H11 | Burns Creek Restoration | Property acquisition, installation of LWD and riparian planting of approximately 28 acres | Lower Middle Green | Lower 2 miles of Burns Creek | -Restoration of fish and wildlife habitat (acres)<br>-LWD installation (mapping of structures)<br>-Wetland restoration (acres)<br>-Water quality benefit (monitoring) | -Loss of riparian habitat<br>-Decreased water quality (elevated water temperature)<br>-Altered stream hydrology<br>-Disconnected floodplain habitat<br>-Introduction of non-native plant and animal species<br>-Reduction of LWD and channel complexity |
| 9-MMG-H12 | Crisp Creek Watershed Protection Project | Property acquisition of undeveloped forest lands to benefit the hydrologic integrity of the subbasin and protect the water supply and water rights for the Muckleshoot Indian Tribe's Keta Creek Hatchery | Mid Middle Green | Numerous parcels of forest land within Crisp Creek Watershed | -Property acquisition and protection (in excess of 400 acres) | -Loss of riparian habitat<br>-Decreased water quality (pollution and elevated water temperature)<br>-Altered hydrology and stream flows |
| 9-MMG-H13 | Flaming Geyer Revegetation | Installation of riparian plantings, LWD and gravel substrate within river channel | Mid Middle Green | Green River at Flaming Geyser State Park | -Riparian planting (42 acres)<br>-Moderation of water temperatures (monitoring)<br>-Enhanced fish habitat (acres) | -Loss of riparian habitat<br>-Decreased water quality (elevated water temperature)<br>-Introduction of non-native plant and animal species |

| **Project Number** | **Project Name** | **Project Short Description** | **Subbasin** | **River Miles Benefitted** | **Other Benefits with Quantifiable Metric** (e.g. structures per mile) | **Habitat Limiting Factor(s) Addressed**[1, 2] |
|---|---|---|---|---|---|---|
| 9-N-H14 | Newaukum Creek Riparian Revegetation and Beaver Colonization | Removal of structures and installation of riparian plantings along Newaukum Creek at three sites: Brandjes, Gaddy, and Gwerder | Newaukum | Newaukum Creek in King County, north of City of Enumclaw | -Riparian planting (161,000 trees on 61 acres)<br>-Moderation of water temperatures (monitoring)<br>-Enhanced fish habitat (acres)<br>-Streamflow maintenance (monitoring) | -Loss of riparian habitat<br>-Decreased water quality (pollution and elevated water temperature)<br>-Introduction of non-native plant and animal species |
| 9-N-H15 | Newaukum Creek Tributary Restoration (Gwerder, et al.) | Excavation and restoration of wetland and stream channels of Newaukum Creek | Newaukum | Newaukum Creek in King County, north of City of Enumclaw | -Riparian planting (75 acres)<br>-Moderation of water temperatures (monitoring)<br>-Enhanced fish habitat (acres)<br>-Streamflow maintenance (monitoring) | -Loss of riparian habitat<br>-Decreased water quality (elevated water temperature)<br>-Altered stream hydrology<br>-Disconnected floodplain habitat<br>-Introduction of non-native plant and animal species<br>-Reduction of LWD and channel complexity |

| **Project Number** | **Project Name** | **Project Short Description** | **Subbasin** | **River Miles Benefitted** | **Other Benefits with Quantifiable Metric** (e.g. structures per mile) | **Habitat Limiting Factor(s) Addressed[1, 2]** |
|---|---|---|---|---|---|---|
| 9-MG-H16 | Middle Green River Open Space Acquisitions | Property acquisitions to protect the hydrologic integrity of the basin | Soos, Jenkins, Covington, Lower Middle Green, Mid Middle Green, Upper Middle Green, Newaukum | Green River watershed | -Property acquisition and protection (acres) | -Loss of riparian habitat<br>-Decreased water quality (pollution and elevated water temperature)<br>-Altered hydrology and stream flows |

Notes:

[1] Habitat limiting factors are described in section 2.3.1 Salmonids in WRIA 9.

[2] Altered hydrology includes both high flows and low flows. Decreased water quality includes elevated water temperatures.

## 7.4 Adaptive Management Recommendations

The WRIA 9 Committee identified a number of challenges related to plan implementation, described in Chapter 6. These challenges include uncertainty in consumptive use estimates, uncertainty in offsets associated with specific project types, project implementation, climate change, and other factors. The WRIA 9 Committee has recommended adaptive management measures in the plan for the purpose of addressing uncertainty in plan implementation. Adaptive management measures include PE well tracking, project implementation tracking, and periodic watershed plan implementation reporting, with recommended adjustments to the plan. As part of adaptive management, the WRIA 9 Committee supports the development and implementation of additional water offsets in the following subbasins with an offset deficit: Lower Green River, Jenkins Creek, Newaukum Creek, and Coal/Deep Creek. These measures, in addition to the surplus water offset and supplemental habitat improvement projects described above, provide reasonable assurance that the plan will adequately offset new consumptive use from PE wells anticipated during the planning horizon.

## 7.5 NEB Evaluation Findings

The WRIA 9 watershed plan is intended to provide a path forward for offsetting an estimated 247.7 AFY of new consumptive water use in WRIA 9. The plan primarily achieves this offset through a total of 6 water offset projects with a cumulative offset projection of 1,075 AFY. This projected total water offset yields a surplus offset of 827.3 AFY above the consumptive use estimate of 247.7 AFY in WRIA 9. The projected total water offset exceeds the offset target of 495.4 AFY that the Committee developed to account for uncertainties in the planning process.

Within this plan, water offset projects are complimented by a total of 10 habitat improvement projects, which provide numerous additional benefits to aquatic and riparian habitat. While many of these habitat improvement projects have potential streamflow benefits, the WRIA 9 Committee chose to exclude any associated water offset from the plan's accounting due to uncertainty regarding magnitude, reliability, and timing of streamflow benefits.

The WRIA 9 Committee has additionally recommended adaptive management measures to provide reasonable assurance that the plan will adequately address new consumptive use impacts anticipated during the planning horizon, despite inevitable challenges that will arise during project implementation, operation, and maintenance.

Based on the information and analyses summarized in this plan, the WRIA 9 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 2019).

# Appendix

**WRIA 9 Duwamish-Green Watershed**

**Approved Plan**
**February 2021**

# Appendix A – References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# Appendix B – Glossary

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

**Adaptive Management**: An iterative and systematic decision-making process that aims to reduce uncertainty over time and help meet project, action, and plan performance goals by learning from the implementation and outcomes of projects and actions. (NEB)

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

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

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

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

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

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

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

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

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

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

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

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

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

**Home:** A general term referring to any house, household, or other Equivalent Residential Unit. (Policy and Interpretive Statement)

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

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

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

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

**Instream Resources**: Fish and related aquatic resources. (NEB)

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

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

**Listed Species**: Before a species can receive the protection provided by the Endangered Species Act (ESA), it must first be added to the federal lists of endangered and threatened wildlife and plants. The List of Endangered and Threatened Wildlife (50 CFR 17.11) and the List of Endangered and Threatened Plants (50 CFR 17.12) contain the names of all species that have been determined by the U.S. Fish and Wildlife Service (Service) or the National Marine Fisheries Service (for most marine life) to be in the greatest need of federal protection. A species is added to the list when it is determined to be endangered or threatened because of any of the following factors: the present or threatened destruction, modification, or curtailment of its

habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or manmade factors affecting its survival. (USFWS)

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

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

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

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

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

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

**Net Ecological Benefit Evaluation**: A planning group's demonstration, using NEB Guidance and as reflected in their watershed plan, that their plan has or has not achieved a NEB. (NEB)

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

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

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

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

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

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

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

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

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

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

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

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

RCW 90.44 **(Groundwater Regulations)**: RCW 90.44 details regulations and policies concerning groundwater use in Washington state, and declares that public groundwaters belong to the

public and are subject to appropriation for beneficial use under the terms of the chapter. The rights to appropriate surface waters of the state are not affected by the provisions of this chapter.

RCW 90.44.050 **(Groundwater permit exemption)**: This code states that any withdrawal of public groundwaters after June 6, 1945 must have an associated water right from the Department of Ecology. However, any withdrawal of public groundwaters for stock-watering purposes, or for the watering of a lawn or of a noncommercial garden not exceeding one-half acre in area, or for single or group domestic uses in an amount not exceeding five thousand gallons a day, or for an industrial purpose in an amount not exceeding five thousand gallons a day, is exempt from the provisions of this section and does not need a water right.

RCW 90.54 (**Water Resources Act of 1971**): This act set the stage for the series of rules that set instream flow levels as water rights, as well as a compliance effort to protect those flows.

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

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

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

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

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

**Section 202 or Section 020**: Refers to Section 202 of ESSB 6091 or Section 020 of RCW 90.94 respectively. The code provides policies and requirements for new domestic groundwater withdrawals exempt from permitting with a potential impact on a closed water body and potential impairment to an instream flow. This section includes WRIAs 1, 11, 22, 23, 49, 59 and

55, are required to update watershed plans completed under RCW 90.82 and to limit new permit-exempt withdrawals to 3000 gpd annual average.

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

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

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

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

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

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

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

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

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

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

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

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

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

**Watershed Restoration and Enhancement Plan (WRE Plan)**: The Watershed Restoration and Enhancement Plan is directed by Section 203 of ESSB 6091 and requires that by June 30, 2021, the Department of Ecology will prepare and adopt a watershed restoration and enhancement plan for WRIAs 7, 8, 9, 10, 12, 13, 14 and 15, in collaboration with the watershed restoration and enhancement committee. The plan should, at a minimum, offset the consumptive impact of new permit-exempt domestic water use, but may also include recommendations for projects and actions that will measure, protect, and enhance instream resources that support the recovery of threatened and endangered salmonids. Prior to adoption of an updated plan, Department of Ecology must determine that the actions in the plan will result in a "net

ecological benefit" to instream resources in the WRIA. The planning group may recommend out-of-kind projects to help achieve this standard.

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

# Appendix C – Committee Roster

Table C.1: WRIA 9 Committee Roster

| **Entity Representing** | **Primary Representative** | **Alternates** |
|---|---|---|
| City of Auburn | Lisa Tobin | Jeff Tate<br>Susan Fenhaus |
| City of Black Diamond<br>(cities caucus) | Mona Davis | Mayor Carol Benson |
| City of Enumclaw | Scott Woodbury | Chris Searcy<br>Jeff Lincoln |
| City of Kent | Evan Swanson | Shawn Gilbertson<br>Mike Mactutis |
| City of Normandy Park<br>(cities caucus) | Mark Hoppen | |
| City of Seattle | Kathy Minsch | Susan Saffery |
| City of Tukwila<br>(cities caucus) | Mike Perfetti | Ryan Larson |
| King County | Josh Kahan | Joan Lee |
| Muckleshoot Indian Tribe | Henry Martin | Carla Carlson |
| Covington Water District | Tom Keown | Steve Lee<br>Brad Lake |
| Washington Department of Fish and Wildlife | Stewart Reinbold | Larry Fisher |
| Master Builders Association of King and Snohomish Counties | Jennifer Anderson | Gina Clark |
| King County Agriculture Program | Rick Reinlasoder | Melissa Borsting |

| Entity Representing | Primary Representative | Alternates |
|---|---|---|
| Center for Environmental Law and Policy | Trish Rolfe | Dan Von Seggern |
| Washington Department of Ecology | Stephanie Potts | Stacy Vynne McKinstry |
| WRIA 9 Watershed Ecosystem Forum, ex officio | Matt Goehring (cities caucus rep) | Doug Osterman |
| Tacoma Water, ex officio | Greg Volkhardt | Tyler Patterson |

# Appendix D – Operating Principles

**Watershed Restoration and Enhancement Committee**

**Duwamish-Green Water Resource Inventory Area (WRIA 9)**

**Operating Principles**

Approved the February 26, 2019

Effective March 6, 2019

## *CONTENTS*



## *SECTION 1. PURPOSE*

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

## *SECTION 2. ESTABLISHING AND AMENDING OPERATING PRINCIPLES*

The formal establishment of an agreement to the operating principles will take place via a member vote, with all members of the watershed restoration and enhancement committee approving the operating principles. Participants will work in good faith to participate productively in the development of the

operating principles. By approving the operating principles, members of the Committee agree to uphold the principles as outlined in this document.

The Committee may review and amend the operating principles as needed. Any member of the Committee may bring forward a recommendation for review and amendment to the operating principles by requesting the chair to add the discussion to the meeting agenda. Amendments will be brought for discussion when a quorum[1] is present and take effect only if approved unanimously by the full Committee.

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

## *SECTION 3. COMMITTEE MEMBERSHIP*

Ecology invited each entity identified in the legislation to participate on the Committee (see RCW 90.94.030[2]). The Duwamish-Green (WRIA 9) Watershed Restoration and Enhancement Committee is composed of entities who responded indicating their commitment to participate (see Appendix A). Committee members shall provide to the chair, in writing, a representative and up to two alternates to participate on the Committee.

The chair will provide a seat at the table for one representative for each Committee member and chairs around the room for additional representatives and alternates and members of the public. Representatives at the table may call on alternates to speak for their entity at any time during the meeting.

**Alternates**

If the primary representative cannot attend a meeting, they should, if possible, send an alternate and notify the Committee chair and the facilitator as early as possible. It is the responsibility of the primary representative to brief the alternate on previous meetings and key topics arising for discussion in order for the alternate to participate productively.

If the primary representative and/or alternates are no longer able to participate in the process (e.g., due to staffing change or ongoing scheduling conflicts), the government or organization shall notify the chair and quickly identify a new representative from the same government or organization. If no new representative is available from the same government or organization, the current Committee member may propose an alternate entity that can represent the same interest on the Committee. Alternate entities must be approved by the chair before joining the Committee. New Committee members will be subject to latecomers provisions described below.

[1] See definition of quorum in Section 6

**Caucuses**

Cities have the option of participating in the Committee through a caucus, with one person attending the Committee meetings as the caucus representative. The caucus members will agree, in writing, to participate in the Committee via a caucus and share that documentation with the Committee. The caucus representative's attendance and vote will represent the participation and vote of all members of the caucus. The caucus will have one vote on decisions that do not require approval by all Committee members. The caucus members will determine their internal voting procedures and share caucus voting procedures with the Committee.

For decisions that require approval by all Committee members (adopting or amending the operating principles, final plan approval), each caucus member will have one vote, which can be provided directly to the chair, through the caucus representative, or in person at the meeting.

A caucus participant can decide to leave the caucus and resume individual participation in the Committee by sending notification in writing to the caucus representative and chair at least two weeks in advance of the next meeting.

**Ex Officio Members**

*Ex Officio* members sit at the Committee table and participate in discussions and review of documents, but will not participate in voting or in the final Committee approval of the plan.[2] Any Committee member can suggest that an ex officio member be added to the Committee. Suggestions for ex officio members will be made to the chair and brought before the Committee for discussion. The Committee will decide, by consensus, whether to add ex officio members.[3]

**Ad hoc Participants**

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

**Latecomers**

Ecology has invited all governments and organizations identified in RCW 90.94.030 to participate on the Committee. Invited entities that choose not to participate in the committee shall provide written acknowledgement that they are forfeiting their seat within 30 days following final notice for participation. In the case that an entity is nonresponsive to requests to confirm their participation on the Committee, or an entity is selected to replace another entity, the following latecomer conditions

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

[3] See Section 6 for a description of consensus and voting

shall apply. Invited entities that originally decided not to participate on the Committee (per written acknowledgement) are allowed to join the Committee until April 15, 2019, and subject to the following latecomer conditions.

1. The entity cannot veto, request a re-vote, or revisit items previously decided on by the Committee;
2. The entity signs an intent to participate, provides a primary and alternate Committee member; and
3. The entity agrees to and abides by the operating principles.

## *SECTION 4. PARTICIPANT EXPECTATIONS, REMOTE PARTICIPATION, AND GROUND RULES*

**Participation expectations**

All members of the Committee are expected to work together to make decisions and recommendations to support the preparation of a watershed restoration and enhancement plan that all Committee members support by Ecology's adoption deadline of June 30, 2021. To achieve this goal, Committee members will, in good faith and using their best professional judgement:

- Attend and actively participate in Committee meetings;
- Review materials in preparation for the meetings;
- Review materials following the meetings;
- Engage in workgroups (if applicable);
- Come prepared for discussions and to vote (when applicable); and
- Commit to implementing the Committee ground rules (see below).

The chair will consult with the Committee to ensure that adequate time is given for review of materials. The chair will provide meeting materials at least 7 days before meetings, with additional time given for longer documents. The chair recognizes that members may need to discuss decisions within their organization/government prior to bringing forward a decision to the Committee and the chair and facilitator will work with Committee members to establish reasonable review time for materials prior to reaching a decision. Members of the Committee will actively work with their decision making authorities to receive feedback on decisions in a timely manner as to not delay decisions coming before the Committee. When possible, Committee members will provide the chair reasonable notice if additional review time is needed prior to a vote.

Committee meetings will take place on a monthly basis for an initial period, with the interval of meetings being modified as needed to meet the deadlines (either more or less frequently). The chair will hold meetings at a convenient location within the watershed. Meetings are expected to last for approximately 4 hours, with the length modified as needed to meet deadlines.

The chair or facilitator will attempt to contact Committee members that did not send a representative or alternate to the meeting. If a Committee member does not participate for 3 consecutive meetings (through sending the representative or alternate), the chair or facilitator will contact the Committee

member to ask if they will continue to participate or forfeit their seat. Committee members will be asked to provide written acknowledgement when forfeiting their seat.

**In Person Attendance and Remote Participation**

It is the expectation that Committee representatives shall attend all meetings in person. In person participation is essential to efficiency, clarity, and honest communication and is preferred to remote participation.

Although it should not be routine, remote participation can be accommodated when necessary to facilitate Committee member participation and when possible given the technology available in the meeting room. Representatives participating remotely will be recognized by the chair/facilitator and asked for input at least once during each agenda item discussion. Due to the difficulties with remote participation and the size of the Committees, they likely will not be able to participate in the free flow of the conversation.

Representatives participating remotely may take part in voting, except in the case of votes that require approval by all members (i.e., approval of the operating principles and approval of the final plan).[4] For these decisions representatives are expected to vote in person. The chair will allow remote participants to take part in votes that require approval by all members only in unforeseen circumstances (i.e., illness, extreme weather, traffic incident, or other unforeseen circumstances as determined by the chair). Representatives are strongly encouraged to attend in-person to vote on decisions that will be included in the plan (see Appendix B).

Upcoming votes will be communicated to the Committee as early as possible. Items requiring a vote will be identified on the agenda, which will be distributed at least a week in advance of the meeting.

In general, Committee representatives will notify the chair at least a week before the meeting if they anticipate a need for remote participation. This is so technology options can be assessed, and a plan for participation made. Preference will be given for remote participation technology that includes video (e.g., skype), if feasible.

If remote participation is needed in unforeseen circumstances (for example, illness, weather, traffic delay), representatives are asked to notify the chair as soon as possible and efforts will be made to support the remote participation within the limits of the technology available.

**Ground rules**

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

[4] See discussion on voting in Section 6

- Be patient, direct, and honest in respectful consideration of each other's views
- Take responsibility for our own issues and problems
- Be sensitive to different communication styles and needs
- Come prepared to use meeting time productively
- Be present and engaged throughout the meeting
- Provide sufficient notice if unable to make a scheduled meeting
- Strive to reach common ground
- It is okay to agree to disagree
- Allow one person to speak at a time
- Speak clearly to ensure everyone at the table can hear

**Conflict resolution**

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

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

## *SECTION 5. ROLE OF THE CHAIR AND COMMITTEE SUPPORT*

RCW 90.94.030 (2b) states that "The department shall chair the watershed restoration and enhancement committee…" Ecology's streamflow restoration implementation lead chairs the Committee on behalf of the agency. The chair shall vote on all items coming before the Committee.[5] The role of the chair is to help the Committee complete the plan with the goal to attain full agreement from the Committee members. If full agreement cannot be obtained, the chair shall ensure all opinions inform future decision making for the final plan. In the event that the chair is unable to attend a scheduled meeting due to illness or other unanticipated absence, the Ecology alternate will serve as

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

interim chair to avoid cancelling the meeting. The Ecology alternate may vote on decisions scheduled to come before the Committee.

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

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

The chair, with assistance from Ecology technical staff, contractors, and members of the Committee, will prepare the watershed restoration and enhancement plan for the Committee's review, comment, and approval.

## *SECTION 6. DECISION MAKING*

This planning process, by statutory design, brings a diversity of perspectives to the table. It is therefore important the Committee identifies a clear process for how it will make decisions. The Committee shall always strive for consensus. The reason why the Committee will strive for consensus is that the authorizing legislation requires that the final plan must be approved by all members of the Committee prior to Ecology's review (RCW 90.94.030[3] "…all members of a watershed restoration and enhancement committee must approve the plan prior to adoption"). Therefore, it follows that consensus during the foundational votes, or decisions, upon which the plan is constructed will serve as the best indicators of the Committee's progress toward an approved plan. In the event consensus is not reached on foundational elements of the plan in time to keep the process moving forward consistent with deadlines, the Committee can make decisions with supermajority approval. Throughout the plan development process, the chair and facilitator will document agreement and dissenting opinions.

### Quorums and Voting

A quorum is established when two-thirds of the entities represented on the Committee are present (either in person or on the phone). All members of the cities caucus will be considered present if a cities caucus representative is present. For the WRIA 9 Committee, the number required for a quorum is included in Appendix A. A quorum must be present for voting to occur.

### Voting Protocol

Items anticipated for voting will be clearly identified as such in advance on the Committee agenda. When voting occurs, the chair or facilitator will call for the vote. Committee members will signal their vote in the following ways:

- Thumbs up – approval
- Thumbs down – disapproval

- Thumbs sideways – ambivalent to approve, but will not disapprove
- Five fingers – abstain

The chair or facilitator will record all votes.

**Consensus**

Consensus is a group process where the input of everyone is carefully considered and an outcome is crafted that best meets the needs of the group as a whole. The root of consensus is the word consent, which means to give permission to. When members consent to a decision, they are giving permission to the group to go ahead with the decision. Ideally, consensus represents whole-hearted agreement and support by all Committee members; however, it can be achieved with less than this level of support. Some members may disagree with all or part of a decision, but based on listening to everyone else's input, might agree to let the decision go forward because it is the best decision the entire group can achieve at the current time. For purposes of this effort, consensus is defined as an outcome that all Committee members can "live with" and agree not to oppose, even if it is not their preferred choice. The Committee will consider consensus achieved if all Committee members present vote to approve, are ambivalent, or abstain (thumbs up, thumbs sideways, or five fingers, as described in "voting protocol").

**Approval by Supermajority**

Votes that do not require consensus can be approved if two-thirds of Committee members are either thumbs up or thumbs sideways. Members abstaining will be counted as present for purposes of the quorum, but abstentions will not be included in calculating the two-thirds required for approval.

The chair or facilitator will record all votes and, where there are dissenting votes, will record who dissents and the reasons for the dissent or remaining concerns.

**Voting on Routine Decisions**

Routine Committee items such as meeting summaries can be approved with a supermajority approval and no further decision making needed.

**Voting on Elements Foundational to the Plan**

The Committee has a strong preference to reach consensus on foundational elements of the plan (e.g., growth scenarios, inclusion of individual projects, etc. – See Appendix B) in order to facilitate agreement on the final plan. In recognition that consensus can be difficult to achieve and decisions need to be made in a timely way to stay on track to meet deadlines, foundational decisions leading up to the plan may be voted on as a way of assessing and recording the extent of agreement and remaining items to be resolved. If consensus on a foundational element of the plan is not achieved within the necessary timeline, the chair or facilitator may call for a vote and move forward on decisions that obtain supermajority approval. These votes will be advisory in nature and will serve to clearly document areas of agreement and remaining differences. When there is not consensus on a foundational element of the plan, the chair and facilitator will document dissenting opinions and the Committee will make a plan for

when and how to revisit this element and how to reach consensus. At the end of the process, all entities participating on the Committee must approve the plan for Ecology to accept it for net ecological benefit review and potential adoption.

**Voting to Support Projects Seeking Funding**

The Committee may decide to send a letter of support for a project seeking funding from the Streamflow Restoration Implementation Grant Program or another funding source. Procedures described in "Approval by Supermajority" will be used to make these decisions.

**Parking Lots**

A "parking lot" may be used to capture ideas that the group cannot agree on or would like to return to at a later date for further discussion; however this will not jeopardize meeting deadlines by postponing issues which must be resolved so deliberations can move forward. Committee members will work together to establish schedules and deadlines to ensure that final plans can be completed on time.

**Conflicts of Interest**

Committee members shall abstain from voting on plan elements if they have a personal financial interest in a decision (i.e., the representative would have a personal financial gain if a proposed project is included in the plan or receives funding).

**Electronic voting**

In the case a decision is needed prior to the next Committee meeting, the chair can request an electronic vote via email or survey. This approach will only be used for time-critical items or when a quorum was not present to vote. The chair will allow a minimum of 3 working days for responses. A non-response is considered an "abstention" vote.[6] An electronic vote is invalid if fewer than 2/3 of Committee members respond, excluding cities participating in a caucus.

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

**Informal Voting**

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

[6] If an 'out of office' message is received for the primary representative, the alternate representative(s) will be contacted to cast their vote. The chair and facilitator will make at least 3 points of contact with each Committee member before marking their vote as an abstention (e.g., phone, email, text).

**Voting on the final approval of the plan**

RCW 90.94 (3) states that "… all members of a watershed restoration and enhancement committee must approve the plan prior to adoption." Approval will be assessed by voting. If all Committee members vote "yes" in support of the plan it will be considered approved and provided to Ecology for "net ecological benefit" review and potential adoption. If the plan is not approved, the facilitator or chair will document agreement and disagreement on the plan elements and the matter will go to Ecology to establish a plan through rulemaking.

The vote on the final plan approval will be shown by hands:

Voting:

- Thumbs up – approval
- Thumbs down – disapproval

The chair or facilitator will record all votes.

## *SECTION 7. USE OF MATERIALS DEVELOPED BY CONTRACTORS*

As needed and agreed to by the Committee, Ecology may hire outside consultants to develop studies or reports.

The Committee shall recognize that the materials are for the sole and exclusive purpose of providing the background information necessary to assist the committee with developing the Watershed Restoration and Enhancement Plan. Materials developed by other contractors (e.g., Committee member's contractors) may be shared with the Committee if provided to Ecology with an adequate time to review, provide any necessary feedback, and integrate into the appropriate meeting agenda.

## *SECTION 8. PUBLIC COMMENTS AND PUBLIC MEETING NOTICE*

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

## *SECTION 9. ESTABLISHMENT OF WORKGROUPS, ADVISORY GROUPS, AND SUBCOMMITTEES*

The Committee may establish workgroups or subcommittees as it sees fit. Workgroups may be temporary, established to achieve a specific purpose within a finite time frame, or a standing workgroup addressing the goals of the Committee. The decision to form a workgroup is a procedural decision, as it is not required by the legislature, and may be developed at the discretion of the Committee or the chair in order to support Committee decision making. All Committee workgroups are workgroups of the whole, meaning their role is to support the efforts of the Committee and all Committee members are

welcome to participate in any workgroup formed by the Committee. The chair or Committee may also engage established workgroups in the watershed or invite non-Committee members to participate on the workgroups if they bring capacity or expertise not available on the Committee. No binding decisions will be made by the workgroups; all issues discussed by workgroups shall be communicated to the Committee as either recommendations or findings as appropriate. The Committee may, or may not, act on these workgroup outcomes as it deems appropriate.

## *SECTION 10. COMMITTEE AND MEDIA COMMUNICATION*

To support clear communication with the Committee, Ecology will:

1. Operate an email list for Committee members and interested parties.
2. Develop and manage a website for members of the Committee to access documents such as agendas, meeting summaries, technical reports, calendar, and other items as requested by the Committee.
3. Distribute meeting agendas and materials at least a week in advance of the meeting.

The facilitator and chair shall prepare a written meeting summary for each Committee meeting within 10 business days of the last Committee meeting. The chair will distribute a draft meeting summary to the Committee via an email and the facilitator or chair will post the summary on the Committee webpage. The summary, at a minimum, will include a list of attendees, decisions, discussion points, assignments, and action items. If comments are cited in such summaries, each speaker will be identified. Meeting summaries will capture areas of agreement and disagreement within the group. The Committee will have time to review and provide comments on the draft meeting summary. The Committee will approve the final meeting summary by a vote at the following meeting. Meeting summaries will be considered draft, and labeled as such, until they are approved by a vote of the Committee.

**Communication with the media**

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

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

## *APPENDICES*[7]

### APPENDIX A: GOVERNMENT AND ORGANIZATIONAL MEMBERSHIP IN THE DUWAMISH-GREEN (WRIA 9) WATERSHED RESTORATION AND ENHANCEMENT COMMITTEE[8]

- Department of Ecology
- Muckleshoot Indian Tribe
- Washington Department of Fish and Wildlife
- King County
- City of Auburn
- City of Black Diamond
- City of Enumclaw
- City of Kent
- City of Normandy Park
- City of Seattle
- City of Tukwila
- Covington Water District
- Master Builders Association of King and Snohomish Counties, representing the residential construction industry
- Center for Environmental Law and Policy, representing environmental interests
- King County Agriculture Program, representing agricultural interests
- WRIA 9 Watershed Ecosystem Forum, ex officio
- Tacoma Water, ex officio

Cities Caucus members: City of Black Diamond, City of Normandy Park, and City of Tukwila

Number of Committee members required for a quorum: 9, including the cities caucus representative

Number of Committee members required to vote in favor or ambivalent (thumbs up or thumbs sideways) for supermajority approval: 9 (the 3 cities caucus members = 1 vote)

Entities that declined the Ecology invitation to the Committee:

- City of Algona
- City of Burien
- City of Covington
- City of Federal Way
- City of Maple Valley
- City of Renton
- City of SeaTac
- Highline Water District
- The Suquamish Tribe

[7] The chair may revise the Appendices without requiring an amendment or vote on the Operating Principles. The chair will notify the Committee of any changes to the Appendices.

[8] Updated 2/16/2021

## APPENDIX B: ANTICIPATED MAJOR DECISION POINTS TO BE BROUGHT FORWARD FOR VOTING BY THE COMMITTEE[9]

2018 – Operating Principles

2019 – Sub basins/Geography, 20-year rural growth, estimated water use for projected new permit-exempt wells (i.e., consumptive use)

2020 – Projects to offset water use

2020 or 2021 – Plan approval

### PLAN DEVELOPMENT TIMELINE (PROPOSED, for informational purposes only)

| Minimum Deliverables | 2018 | 2019 Q1 | 2019 Q2 | 2019 Q3 | 2019 Q4 | 2020 Q1 | 2020 Q2 | 2020 Q3 | 2020 Q4 | 2021 Q1 | 2021 Q2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Committee forms, orientation | x | | | | | | | | | | |
| Approval of operating principles | x | x | | | | | | | | | |
| Committee trainings and field visits | x | x | x | | | | | | | | |
| Decision on geography (if appropriate) and sub basins | | x | x | | | | | | | | |
| Decision on growth projection scenarios | | | x | | | | | | | | |
| Decision on 20 year growth | | | x | | | | | | | | |
| Decision on consumptive use formula | | | x | | | | | | | | |
| Decision on consumptive use amount to offset | | | | x | | | | | | | |
| Orientation to project types and field visits | | | | x | x | x | | | | | |
| Project identification and development | | | | | x | x | x | | | | |
| Determination if projects offset consumptive use and initial net ecological benefit review/ determination (if possible) | | | | | | x | x | x | | | |
| Local jurisdiction review and vetting | | | | | | | | x | x | | |
| Final approval of plan by Committee | | | | | | | | | x | | |
| Ecology net ecological benefit review and determination | | | | | | | | | | x | x |

[9] Initial list as of 1/30/19. Other major items may be brought to vote by the Committee such as recommending changes to instream flow rules, recommending change in building permit fee or daily water use allowance.

## *SIGNATURES OF AGREEMENT*

The Duwamish-Green (WRIA 9) Watershed Restoration and Enhancement Committee Operating Principles have been approved this 26th day of February, 2019 by the parties below.

COMMITTEE CHAIR, REPRESENTATIVE FOR THE WASHINGTON STATE DEPARTMENT OF ECOLOGY

Signature: SPotts

Name and Title: Stephanie Potts, Streamflow Restoration Implementation Lead

Date: 2/26/19

REPRESENTATIVE FOR THE MUCKLESHOOT INDIAN TRIBE

Signature: Carla V Carlson

Name and Title: Water Resources Analyst

Date: Feb. 26, 2019

REPRESENTATIVE FOR THE WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Signature: Stewart S Reinbold

Name and Title: Stewart G Reinbold
Assistant Regional Program Manage-

Date: 2/26/2019

REPRESENTATIVE FOR KING COUNTY

Signature: [signature]

Name and Title: JOSH KAHAN, GREEN RIVER BASIN STEWARD

Date: 2-26-19

REPRESENTATIVE FOR THE CITY OF AUBURN

Signature: [signature]

Name and Title: Lisa D. Tobin, Utilities Engineering Manager

Date: 2/26/19

REPRESENTATIVE FOR THE CITY OF BLACK DIAMOND

Signature: B K

Name and Title: Barbara Kincaid, Director of Community Development

Date: March 6, 2019

REPRESENTATIVE FOR THE CITY OF ENUMCLAW

Signature: Scott Woodbury

Name and Title: Scott Woodbury, Assistant Public Works Direct

Date: 2/26/19

REPRESENTATIVE FOR THE CITY OF KENT

Signature: [signature]

Name and Title: Michael MacInnis, Environmental Eng. Mgr.

Date: 2/28/19

REPRESENTATIVE FOR THE CITY OF NORMANDY PARK

Signature: _____

Name and Title: MARK E. HOPPEN

Date: 2-26-19

REPRESENTATIVE FOR THE CITY OF SEATTLE

Signature: Katherine Minsch

Name and Title: Katherine Minsch, Regional Liaison

Date: 2/26/19

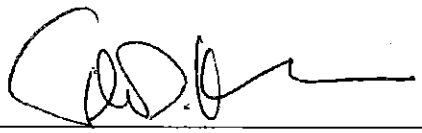
REPRESENTATIVE FOR THE CITY OF TUKWILA

Signature: [signature]

Name and Title: Mike Perfetti, Habitat Project Mngr.

Date: 02/26/19

REPRESENTATIVE FOR COVINGTON WATER DISTRICT

Signature: 

Name and Title: Thomas D. Keever, General Manager

Date: 3/13/19

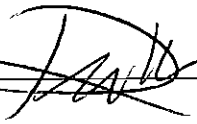
REPRESENTATIVE FOR THE MASTER BUILDERS ASSOCIATION OF KING AND SNOHOMISH COUNTIES, REPRESENTING THE RESIDENTIAL CONSTRUCTION INDUSTRY

Signature: 

Name and Title: Jennifer Anderson, Government Affairs Manager

Date: 2/26/2019

REPRESENTATIVE FOR THE CENTER FOR ENVIRONMENTAL LAW AND POLICY,
REPRESENTING ENVIRONMENTAL INTERESTS

Signature: 

Name and Title: DAN VON SEGGERN, STAFF ATTORNEY

Date: 2/26/2019.

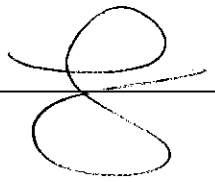
REPRESENTATIVE FOR THE KING COUNTY AGRICULTURE PROGRAM,
REPRESENTING AGRICULTURAL INTERESTS

Signature: Rick Reinlasoder

Name and Title: Rick Reinlasoder
Livestock Program Specialist

Date: February 26, 2019

REPRESENTATIVE FOR THE WRIA 9 WATERSHED ECOSYSTEM FORUM,
*EX OFFICIO* NON-VOTING MEMBER

Signature: 

Name and Title: Matt Boehning, WRIA 9

Date: 2/26/19

REPRESENTATIVE FOR TACOMA WATER,
*EX OFFICIO* NON-VOTING MEMBER

Signature: Gregory C. Volkhardt

Name and Title: Gregory C. Volkhardt, Asst Water Div Mgr

Date: 2/26/19

# Appendix E – Subbasin Delineation Memo

GeoEngineers

# Memorandum

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

**To:** Stephanie Potts, Washington State Department of Ecology

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

**Date:** August 20, 2020

**File:** 0504-161-00

**Subject:** WRIA 9 Subbasin Delineations


## INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) Committees for Water Resource Inventory Areas (WRIAs) 7, 8 and 9. This memorandum provides a summary of the deliverable for Work Assignment GEO102, Task 2, WRIA 9 Subbasin Delineations.

## BACKGROUND AND CONTEXT

The Streamflow Restoration law (Revised Code of Washington [RCW] Chapter 90.94) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Duwamish-Green Watershed (WRIA 9). The Duwamish-Green (WRIA 9) Watershed Restoration and Enhancement Plan (watershed plan must address impacts on streamflows from consumptive use from new domestic permit-exempt wells (PE wells[1]) anticipated between January 19, 2018 and January 18, 2038. Dividing WRIA 9 into subbasins is an essential step in developing a plan that complies with the law. RCW 90.94.030(3)(b) states "The highest priority recommendations must include replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary." The *Final Guidance for Determining Net Ecological Benefit* (Ecology 2019) states that, "Planning groups must divide the WRIA into suitably-sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets. Subbasins will help the planning groups understand and describe location and timing of projected new consumptive water use, location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. Planning at the subbasin scale will also allow planning groups to consider specific reaches in terms of documented presence (e.g., spawning and rearing) of salmonid species listed under the federal Endangered Species Act."

WRIA 9 includes the Duwamish River, Green River and associated tributaries. It also includes streams draining directly to Puget Sound between the City of Federal Way and the City of Seattle. The methods used to delineate subbasins in WRIA 9 are summarized below.

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

## SUBBASIN DELINEATION METHODS

GeoEngineers worked with the WRIA 9 Committee to delineate subbasins for WRIA 9. The WRIA 9 Committee considered existing subwatershed units to develop their subbasin delineations, including King County drainage basins. King County drainage basins are a boundary layer developed by King County using LIDAR technology to delineate drainage basins. There are 23 King County drainage basins in WRIA 9.

### Subbasin Selection Considerations

The WRIA 9 Committee used existing King County drainage basins and applied the following guiding principles to develop subbasin delineations:

- Use hydrologic boundaries.
- Combine King County drainage basins within the Urban Growth Area (UGA) with lower expected growth of new homes using PE wells.
- Delineate subbasins at a finer scale in the area of the watershed expected to have the most homes using PE wells (the Middle Green River).

### WRIA 9 Subbasin Delineation

The WRIA 9 subbasin boundaries are based on King County drainage basin boundaries. GeoEngineers used existing drainage basin shapefiles from King County (King County 2018) to develop a map and GIS shapefile for the WRIA 9 Committee's subbasins. The WRIA 9 subbasin delineations are shown on Figure 1.

### WRIA 9 Subbasins

- Central Puget Sound: The Lower Puget Sound tributaries are combined. This includes the following King County drainage basins:
  - Lower Puget Sound (LPS) Seattle, Seola Creek, Salmon Creek, LPS Burien South, LPS Burien North, Miller Creek, LPS Normandy Park, Des Moines Creek and LPS Des Moines/Federal Way.
- Duwamish River: Longfellow Creek and Duwamish River drainage basins are combined into one subbasin.
- Lower Green River: Lower Green River West, Black River, Mill Creek, and Lower Green River East drainage basins are combined into one subbasin.
- Soos Creek: Soos Creek drainage basin is one subbasin.
- Jenkins Creek: Jenkins Creek drainage basin is one subbasin.
- Covington Creek: Covington Creek drainage basin is one subbasin.
- Lower Middle Green River: The Middle Green River drainage basin below the confluence with Newaukum Creek.
- Mid Middle Green River: The Middle Green River drainage basin between the confluence with Newaukum Creek and the confluence with Franklin Creek.

- **Upper Middle Green River**: The Middle Green River drainage basin between the confluence with Franklin Creek and Howard Hanson Dam.
- **Newaukum Creek**: Newaukum Creek drainage basin is one subbasin.
- **Coal/Deep Creek**: Coal Creek and Deep Creek drainage basins are combined into one subbasin.
- **Upper Green River**: Upper Green River drainage basin is one subbasin.

### WRIA 9 Subbasins – Additional Considerations

There are some land areas included in the Ecology WRIA 9 boundary that are not included in the King County drainage basin boundaries. This discrepancy is because the King County drainage basin map used more accurate LIDAR technology to delineate drainage basins and watersheds. Watershed plans must address all of the land within the Ecology WRIA boundary. Therefore, the WRIA 9 Committee decided to include the following hatched land areas on the map into WRIA 9 subbasins for WRE planning purposes (see Figure 2):

- Area A (hatched area north of Upper Middle Green River): Included in the Upper Middle Green River subbasin where PE well growth is likely to occur, rather than adding this area to the protected Upper Green River subbasin.
- Area B (hatched area south of Newaukum Creek): Included in the Newaukum Creek subbasin.
- Area C (hatched area north of Jenkins Creek): Included in the Jenkins Creek subbasin. GeoEngineers recommended including Area C into the Jenkins Creek subbasin based on how that area is addressed in salmon recovery planning.
- Area D (hatched areas north of Duwamish): Included in the Duwamish River subbasin.
- Several other minor adjustments were made by GeoEngineers along the fringes of WRIA 9 where the King County LiDAR based boundaries do not exactly match the Ecology WRIA boundary. Those areas were included in the adjacent subbasin. Those areas are hatched in blue on the map but were not uniquely identified due to their small size and location adjacent to or within one distinct subbasin.

## NEXT STEPS

- The WRIA 9 Committee agreed to use 12 subbasins to project PE well growth and consumptive use by subbasin.

## REFERENCES

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

Washington State Department of Ecology (Ecology), 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131. http://leg.wa.gov/JointCommittees/WRM/Documents/EcologyFinalGuidanceForDeterminingNEB.pdf.

BA:JTM:tt

Attachments:
Figure 1. WRIA 9 Subbasin Delineations
Figure 2. WRIA 9 Subbasin Delineations with Discrepancy Areas

Duwamish River

Centra Puget Sound

Lower Green River

Soos Creek

Creek

## Legend

- WRIA 9 Boundary
- WRIA 9 Subbasins
- WA DOH Group A Service Areas

**Washington State City Urban Growth Areas 2018**

- Unincorporated
- Incorporated

## Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N W E S

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Miles

**WRIA 9 Subbasin Delineations**

Watershed Restoration and Enhancement Plan
King County, Washington

GeoEngineers

**Figure 1**

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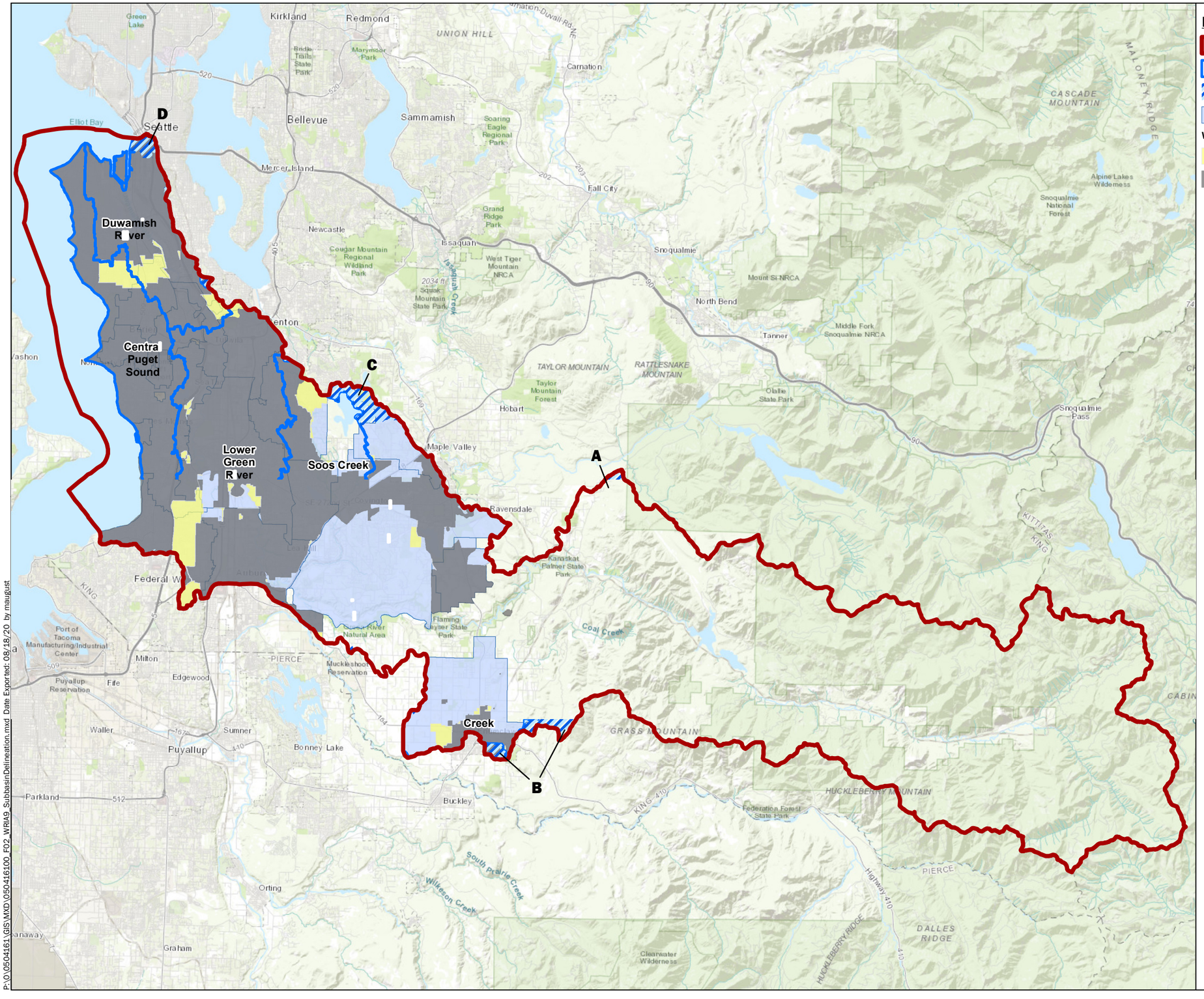


## Legend

- WRIA 9 Boundary
- WRIA 9 Subbasins
- Discrepancy Basin Areas
- WA DOH Group A Service Areas

**Washington State City Urban Growth Areas 2018**

- Unincorporated
- Incorporated

### Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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**WRIA 9 Subbasin Delineations with Discrepancy Areas**

Watershed Restoration and Enhancement Plan
King County, Washington

GeoEngineers

**Figure 2**

P:\0\0504161\GIS\MXD\0504161000_F02_WRIA9_SubbasinDelineation.mxd Date Exported: 08/18/20 by maugust

# Appendix F – Permit-Exempt Well Projections Memo

GeoEngineers

# Memorandum

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

| | |
|---|---|
| **To:** | Stephanie Potts, Washington State Department of Ecology |
| **From:** | Bridget August, LG, LHG and John Monahan, FP-C (GeoEngineers, Inc.) |
| **Date:** | November 16, 2020 |
| **File:** | 0504-161-00 |
| **Subject:** | WRIA 9 PE Well Projections |


## INTRODUCTION

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

## BACKGROUND AND CONTEXT

The Streamflow Restoration law (Revised Code of Washington [RCW] 90.94) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Duwamish-Green Watershed (WRIA 9). The Duwamish-Green (WRIA 9) Watershed Restoration and Enhancement Plan (watershed plan) must address impacts on streamflows from consumptive use caused by new domestic permit-exempt wells (PE wells[1]) anticipated between January 19, 2018 and January 18, 2038.

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

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

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

WRIA 9 includes parts of unincorporated King County and 15 incorporated cities. The methods used to estimate the number and location of new PE wells in unincorporated and incorporated areas in WRIA 9 are summarized below.

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

## PE WELL GROWTH PROJECTION METHODS

GeoEngineers worked with the Duwamish-Green Watershed Restoration and Enhancement Committee to define PE well growth projection methods and PE well growth projections for WRIA 9. The WRIA 9 PE well growth projection methods included using King County historical building permit data to project PE well growth over the 20-year planning horizon. This methodology assumes that the rate and location of past growth will continue over the 20-year planning horizon. Using past building permits to predict future growth is one of Ecology's recommended methods (Ecology 2019). Projecting future PE well growth involves accounting for populations that will be served by community water systems and municipalities (Ecology 2019). Due to data availability, King County considered rates of connection to water service within water service area boundaries.[2] King County completed the analysis in-house and the methods and assumptions are described in detail in Attachment A and summarized below.

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

In addition, King County also completed a PE Well Potential Assessment which identified potential parcels where growth could occur within rural King County. The PE Well Potential Assessment results were used to assess whether a subbasin, as identified by the WRIA 9 Committee (GeoEngineers 2020), has the capacity to handle the number of PE wells in the 20-year growth projection. In those areas where the number of projected PE wells exceeded the potential parcels available, the wells were reallocated to the nearest subbasin with similar growth patterns and parcel capacity. The King County PE Well Potential Assessment methods and assumptions are described in Attachment A and summarized below.

### King County PE Well Projection Methodology

King County does not have a growth target for the unincorporated rural area and therefore decided to use building permit data as its chosen method to project future growth. King County elected to complete the WRIA 9 historic growth analysis in-house using 2000 to 2017 building permit data for new residential structures from the King County Assessor's office. The analysis estimated the number of recently built homes that relied on PE wells as their water source in unincorporated King County, both inside and outside of water service areas. King County used historic rates of connection to water service because the County does not have county-wide information on the location of water lines.

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

King County used the results from the historic growth analysis to determine the projected number of PE wells per year and over the 20-year planning horizon for unincorporated King County. GeoEngineers then used the King County historic growth results to project new PE wells per subbasin over the 20-year planning horizon.

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

King County historic growth and PE well projection methods and data tables are provided in Attachment A for reference. This methodology assumes that the rate and location of past growth will continue over the 20-year planning horizon. This method is referred to as the King County Past Trends Analysis and the general methodology used was as follows:

**King County:**

- Obtain available King County building permit and parcel data for new residential structures (2000 to 2017).
- Use centroid of parcel to determine location relative to other boundaries (e.g. WRIA, inside or outside water district service areas, King County drainage basin, WRIA 9 subbasin, etc.).
- Assess the total number of permits and average number of permits per year for the WRIA.
- Link building permits and parcel data layers to determine water source for each building permit/parcel. The parcel database indicates the water source as "public" (pub) for buildings connected to water service, "private" (pvt) for buildings relying on a permit-exempt well, and "other" (unknown/null). The "other" category includes parcels listing their water source as "unknown," referring to parcels with no assigned water source (likely vacant land or unoccupied structure) or "null," referring to building permits that did not link to existing parcels. King County used the "other" category to calculate an error of 6 percent (of the total number of building permits).[3]
- Determine the number of building permits/parcels inside and outside the water service areas that have a water source as:
    - Public water (pub)
    - Private water (PE wells) (pvt)
    - Other (unknown/null)
- Calculate the percentage of building permits for each type of water source (pub, pvt or other) by subbasin and the WRIA overall.
- Use the annual average number of permits per year multiplied by the percentage of permits/parcels on private water (pvt) to determine the projected number of PE wells per year.
- Multiply the number of PE wells per year by 20 to calculate the total PE wells projected over the 20-year planning horizon for unincorporated rural King County.

**GeoEngineers:**

- Use the annual average number of permits per year multiplied by the past percentage of growth per subbasin and percentage of building permits using a private water source (well) per subbasin to determine a projected number of PE wells per year for each subbasin.

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

- Multiply the number of PE wells per year per subbasin by 20 to calculate the total of PE wells projected over the 20-year planning horizon for each subbasin.
- Add 6 percent error to projected number of PE wells per year per subbasin (error is based on the "other and null" categories as described above).
- Tabulate the total growth projected over the 20-year planning horizon, including the 6 percent error, for each subbasin and sum to get the total of PE wells projected over the 20-year planning horizon in rural unincorporated King County.

### Urban Growth Area PE Well Projection Methodology

As described above, the King County Past PE well projection methods focused on the potential for PE wells to be installed within rural, unincorporated King County. The King County method does not account for potential PE wells in cities or UGAs. However, early in the growth projection planning process, the WRIA 9 Committee recommended looking at the potential for PE well growth within UGAs. GeoEngineers completed an analysis of projected PE well growth within the incorporated and unincorporated UGAs using Ecology's Well Report Viewer database (referred to as the UGA Well Log Spot Check). UGA well log spot check data tables are included in Attachment C. The general methodology used was as follows:

- Obtain tabular and spatial data from Ecology's Well Report Viewer database (1998 through 2018). Ecology's complete Well Report Viewer database was filtered for water wells 6 to 8 inches in diameter and greater than 30 feet deep, which are typical dimensions and depths for domestic wells. PE wells greater than 8 inches in diameter are cost prohibitive and uncommon. Similarly, wells shallower than 30 feet are more susceptible to contamination and are also uncommon, especially in urban areas. Ecology does not have the ability to filter for permit-exempt domestic wells. Information in the database is based on records submitted by the well driller.
- Filter database for wells located within UGAs. Note that well locations were estimated to the nearest quarter-quarter section.
- Review randomly selected water well reports and note the well type (e.g. domestic, industrial, municipal, irrigation, test well, or other), and well location (physical address and/or parcel number).
- Determine the number of wells that were:
    - Domestic (assumed to be PE wells)
    - Irrigation
    - Other (test, municipal, dewatering, industrial, mitigation, underground injection control [UIC], deepened or refurbished wells)
    - Incorrect (location, date, etc.)
- Calculate the percentage of each type of well (domestic, irrigation, other and incorrect).
- Multiply the percentage of spot-checked wells that were identified as domestic wells (assumed to be PE wells) by the total number of wells located within UGAs to estimate the number of domestic wells installed over the past 20-year period within WRIA 9.
- Cross-check the physical address of the wells with the UGA boundary to determine in which subbasin the spot-checked domestic wells were located.
- Use the estimated number of domestic wells per subbasin over the past 20 years to project the number of PE wells located within the UGAs over the planning horizon for each WRIA 9 subbasin.

### King County PE Well Potential Assessment

King County also completed a PE Well Potential Assessment which evaluated the parcels available for future growth in unincorporated King County. The purpose of the PE Well Potential Assessment was to determine if there would be enough parcels to accommodate the 20-year growth projection at the WRIA and subbasin level. In those areas where the number of projected PE wells exceeded the potential parcels available, GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. King County used historic rates of connection to water service because the County does not have county-wide information on the location of water lines. King County PE Well Potential Assessment data tables are included in Attachment A. The general methodology used was as follows:

#### King County:

- Use assumptions and screening criteria to identify parcels with potential for future growth by subbasin. A list of assumptions made by King County is provided in Attachment A.
- Use centroid of parcel to determine location information (e.g. WRIA, inside or outside water district service areas, WRIA 9 subbasin, etc.).
- Use King County parcel attribute data to determine total number of parcels and dwelling units per subbasin. A dwelling unit (DU) is a rough estimate of subdivision potential based on parcel size and zoning (e.g. a 22-acre parcel zoned RA-5 is assumed to have 4 dwelling units).
- Determine the number of parcels and dwelling units that would be inside or outside water district service boundaries.
- Calculate water source projections for public connections and PE sourced parcels:
    - Public connection parcels would be those located within water district service boundaries and were calculated based on historic rates of connection to public water within each subbasin.
    - The remaining number of parcels located within water district service boundaries that exceeded the historic rate of public water connection were assigned to be PE sourced (e.g. served by a PE well).
    - PE sourced parcels were calculated based on the number of parcels located outside water district service boundaries plus the remaining parcels from “inside” water district boundaries, as described above.
- Calculate the shortfall or surplus of available parcels to be sourced by PE wells by taking the total PE sourced DUs minus the 20-year PE well growth projection from the King County past trends analysis.

#### GeoEngineers:

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

## PE WELL GROWTH PROJECTON RESULTS

The King County Past Trends Analysis and GeoEngineers UGA Well Log Spot Check results were combined to determine the total number of projected PE wells per subbasin within WRIA 9. Using the King County PE Well Potential Assessment, GeoEngineers compared the total available PE sourced parcels (i.e. DUs and HUs) per subbasin with the projected PE well growth per subbasin. In those areas where the number of projected PE wells exceeded the potential parcels available, GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. The results are summarized in Table 1 and shown on Figure 1. GeoEngineers estimates 632 new permit-exempt domestic well connections in WRIA 9 over the 20-year planning horizon. The following is a brief summary of the calculations used to complete the WRIA 9 growth projection analysis:

- King County used the average number of building permits per year (79) for the 18-year period from 2000 to 2017, multiplied by the historic percentage of homes using PE wells (36.4 percent) to determine a projected number of new PE wells per year (29) in the WRIA 9 portion of rural unincorporated King County. The number of PE wells per year (29) was then multiplied by 20 to determine the estimated total of PE wells projected over the 20-year planning horizon (578) for rural unincorporated King County. (Note that due to rounding, the total number is 578 vs. 580).
- To estimate the 20-year PE well projection per subbasin, GeoEngineers used the average number of building permits per year (79), multiplied by the historic distribution of growth per subbasin. The average building permits per subbasin was then multiplied by the historic percentage of homes using PE wells to estimate the average number of PE wells per year per subbasin. The number of PE wells per year per subbasin was then multiplied by 20 to calculate the estimated total of PE wells over a 20-year period per subbasin. A 6 percent error was then added to each subbasin total. The total number of estimated PE wells, including the 6 percent error, is 612. See Attachment A for detailed results.
- GeoEngineers also completed a UGA Well Spot Check for wells from the Ecology Well Report Viewer database that plot within the Urban Growth Area. Of the wells that plotted in WRIA 9, 93 wells were located within the UGA for 1998 through 2018. GeoEngineers checked about 70 percent of the wells by looking at the well logs and noting whether the wells were identified as being for domestic, irrigation, or other purposes (e.g. test, industrial, errors, etc.). According to the well logs, about 23 percent of the wells were for domestic use.
- GeoEngineers took the number and distribution of wells from the 1998-2018 data and projected the same rate and distribution per subbasin for the 20-year planning horizon. The estimated number of PE wells within the UGA over the 20-year period is 20. (Note that due to rounding, the total number is 20 vs. 21). See Attachment B for detailed results.
- King County also completed a PE Well Potential Assessment to determine whether a subbasin has capacity for the number of wells in the 20-year projection.
- The PE Well Potential Assessment shows a capacity shortfall of 20 wells in the Newaukum subbasin. Those 20 wells were reallocated to the Mid Middle Green subbasin because it has parcel capacity, is adjacent and has similar growth patterns.

**TABLE 1. NUMBER OF PE WELLS PROJECTED BETWEEN 2018 AND 2038 FOR THE WRIA 9 SUBBASINS**

| Subbasins[1] | King County Past Trends[2] | UGA Well Log Spot Check[3] | Total PE Wells[4] per Subbasin[5] |
|---|---|---|---|
| Central Puget Sound | 0 | 0 | 0 |
| Duwamish River | 0 | 0 | 0 |
| Lower Green River | 0 | 4 | 4 |
| Soos Creek | 72 | 11 | 83 |
| Jenkins Creek | 44 | 1 | 45 |
| Covington Creek | 41 | 0 | 41 |
| Lower Middle Green River | 81 | 3 | 84 |
| Mid Middle Green River | 100 | 0 | 100 |
| Newaukum Creek | 102 | 1 | 103 |
| Upper Middle Green River | 110 | 0 | 110 |
| Coal Deep Creek | 62 | 0 | 62 |
| Upper Green River | 0 | 0 | 0 |
| **Totals** | **612** | **20** | **632** |

Notes:

1 = Subbasins from proposal approved at July 23, 2019 WRIA 9 Committee meeting.

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

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

4 = "PE Wells" is used to refer to new homes associated with new permit-exempt wells and also new homes added to existing wells on group systems relying on permit-exempt wells.

5 = Includes redistribution of 20 wells from Newaukum Creek subbasin to Mid Middle Green River subbasin.

## NEXT STEPS

- The WRIA 9 Committee agreed to move forward with the WRIA planning process using 632 as the WRIA 9 20-year PE well growth projection to develop consumptive use estimates.

## REFERENCES

GeoEngineers, Inc. (GeoEngineers), 2020. WRIA 9 Subbasin Delineations. Technical memorandum prepared for Washington State Department of Ecology. August 2020.

Washington State Department of Ecology (Ecology), 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131. http://leg.wa.gov/JointCommittees/WRM/Documents/EcologyFinalGuidanceForDeterminingNEB.pdf.

Attachments:
Figure 1. WRIA 9 Distribution of Projected Permit-Exempt Wells 2018-2038
Attachment A. King County PE Well Growth Projections and PE Well Potential Assessment Methods, Assumptions Data Tables
Attachment B. GeoEngineers UGA Well Log Spot Check Data Tables

Duwamish River 0

Central Puget Sound 0

Lower Green River 4

Soos Creek 83

Jenkins Creek 45

Covington Creek 41

Lower Middle Green River 84

Mid Middle Green River 100

Newaukum Creek 103

Coal/Deep Creek 62

Upper Middle Green River 110

Upper Green River 0

## Legend

- WRIA 9 Boundary
- WRIA 9 Subbasins

**Projected Permit-Exempt Wells 2018-2038**

- 0
- 1 - 5
- 6 - 25
- 26 - 50
- 51 - 100
- >100

Projected WRIA 9 PE Well Total = 632

### Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N W E S

5 0 5

Miles

**WRIA 9 Distribution of Projected Permit-Exempt Wells 2018-2038**

Watershed Restoration and Enhancement Plan
King County, Washington

GeoEngineers

**Figure 1**

P:\0\0504161\GIS\MXD\0504161100_F01_GrowthProj_Memo.mxd Date Exported: 11/16/20 by maugust

# ATTACHMENT A

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

King County
**Water and Land Resources Division**
Department of Natural Resources and Parks
King Street Center
201 South Jackson Street, Suite 704
Seattle, WA 98104-3855
**206-477-4800** Fax 206-296-0192
TTY Relay: 711

# TECHNICAL MEMORANDUM

December 12, 2019

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

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

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

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

## Introduction

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

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

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

## Principles

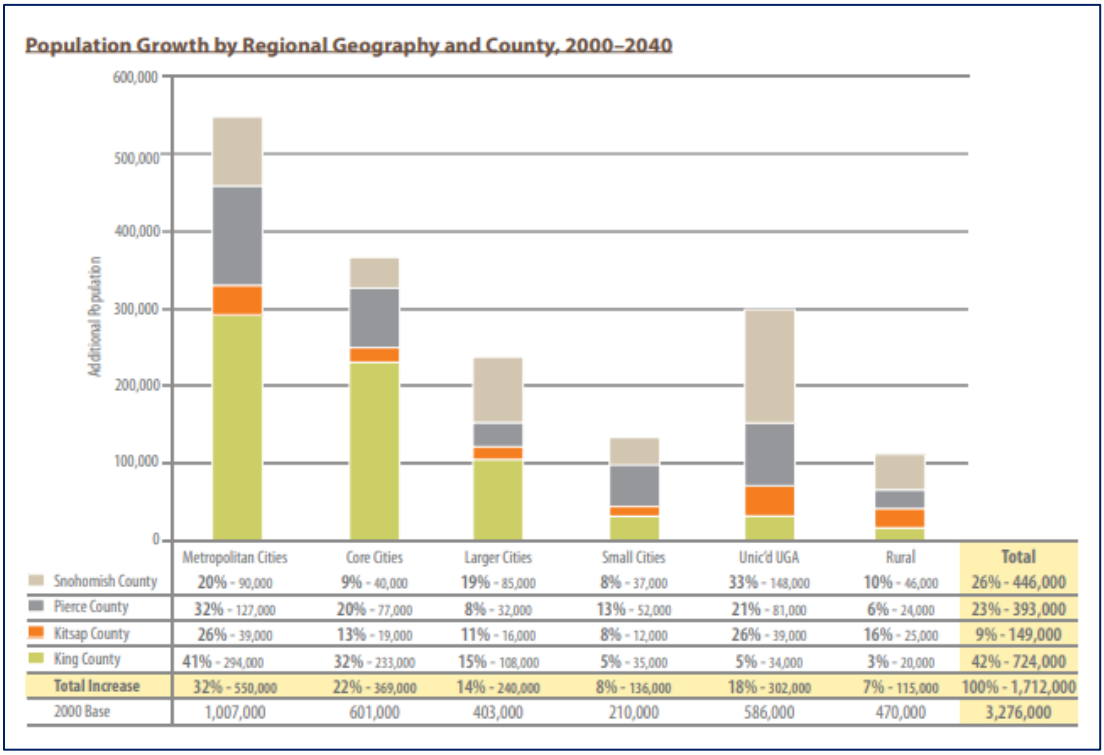
King County does not have growth targets for unincorporated rural areas in the county. All growth targets are for the urban growth area (UGA). No changes to the UGA boundary are intended during the 20-year planning period.

The following are highlights from planning policies:

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

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

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




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

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

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

## Methods

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

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

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

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

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

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

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

**Table 2. Building permits by WRIA**

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

* = WRIA boundaries are delineated by Ecology coverage

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

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

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

**Table 3. Water source by parcel/permit**

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

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

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

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

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

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

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

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

The following are the assumptions used to refine the parcels:

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

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

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

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

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

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

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

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

## References

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

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

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

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

## WRIA 9 - Green-Duwamish

*Draft 9/23/19*

| WRIA (Ecology Coverage) | (KC building permiting data) 2000-2009 | 2010-2017 | | total | permits per year |
|---|---|---|---|---|---|
| 9 | 1152 | 278 | | 1430 | 79 |

% of county-wide total: 24%

| WRIA 9 Future Permit-Exempt wells | PE/yr | 20 yr est |
|---|---|---|
| | 29 | 578 |

| District info | 2000-2009 | 2010-2017 | | total |
|---|---|---|---|---|
| total | 1152 | 278 | | 1430 |
| wtr dst (inside water district) | 831 | 219 | | 1050 |
| no dst (outside water district) | 321 | 59 | | 380 |

| Water service info | (derived from KC parcel attribute data) | | | |
|---|---|---|---|---|
| pub (water service) | 708 | 115 | | 823 |
| pvt (well) | 436 | 84 | | 520 |
| other | 8 | 79 | | 87 |
| total | 1152 | 278 | | 1430 |

| Ag PD | permits | % of WRIA total |
|---|---|---|
| WRIA 9 | 125 | 9% |

| Forest PD | permits | % of WRIA total |
|---|---|---|
| WRIA 9 | 43 | 3% |

| Existing | 2000-2009 | 2010-2017 | Total |
|---|---|---|---|
| PE wells | 436 | 84 | 520 |
| error | 1% | 28% | 6% |

| Historic Percentages | | |
|---|---|---|
| | pub | 0.576 |
| | pvt | 0.364 |

## WRIA 9 - Green-Duwamish - Historic Growth and Water Use by Subbasin

Sub-basin delineations *v. 9/23/19*

| Sub-basin w/ permits | Number of permits | Distribution of growth |
|---|---|---|
| Central Puget Sound | Urban | 0% |
| Duwamish | Urban | 0% |
| Lower Green | 3 | 0% |
| Soos subbasin | 167 | 12% |
| Jenkins subbasin | 154 | 11% |
| Covington subbasin | 235 | 16% |
| Lower Middle Green | 250 | 17% |
| Middle Middle Green | 256 | 18% |
| Newaukum subbasin | 172 | 12% |
| Upper Middle Green | 121 | 8% |
| CoalDeep | 72 | 5% |
| Upper Green Subbasin | 0 | 0% |
| total | 1430 | 100% |

Water use by basin

| pub | pvt | oth | %pub | %pvt |
|---|---|---|---|---|
| 0 | 0 | 0 | 0% | 0% |
| 0 | 0 | 0 | 0% | 0% |
| 3 | 0 | 0 | 100% | 0% |
| 96 | 61 | 10 | 57% | 37% |
| 109 | 37 | 8 | 71% | 24% |
| 189 | 35 | 11 | 80% | 15% |
| 168 | 69 | 13 | 67% | 28% |
| 157 | 68 | 31 | 61% | 27% |
| 60 | 104 | 8 | 35% | 60% |
| 26 | 93 | 2 | 21% | 77% |
| 15 | 53 | 4 | 21% | 74% |
| 0 | 0 | 0 | 0% | 0% |
| 823 | 520 | 87 | total | 1430 |

## WRIA 9 - 20 year PE Well Projection by Subbasin

permits/year 79 — Added by GeoEngineers:

| Average bldg. permits per year | Average wells per year (pvt) | Total wells in 20 years | Total wells in 20 years + 6% error | **Total Rounded** | Sub-basins | Distribution of PE |
|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 | **0** | Central Puget Sound | 0% |
| 0.0 | 0.0 | 0.0 | 0.0 | **0** | Duwamish | 0% |
| 0.2 | 0.0 | 0.0 | 0.0 | **0** | Lower Green | 0% |
| 9.3 | 3.4 | 67.8 | 4.1 | **72** | Soos subbasin | 12% |
| 8.6 | 2.1 | 41.1 | 2.5 | **44** | Jenkins subbasin | 7% |
| 13.1 | 1.9 | 38.9 | 2.3 | **41** | Covington subbasin | 7% |
| 13.9 | 3.8 | 76.7 | 4.6 | **81** | Lower Middle Green | 13% |
| 14.2 | 3.8 | 75.6 | 4.5 | **80** | Middle Middle Green | 13% |
| 9.6 | 5.8 | 115.5 | 6.9 | **122** | Newaukum subbasin | 20% |
| 6.7 | 5.2 | 103.3 | 6.2 | **110** | Upper Middle Green | 18% |
| 4.0 | 2.9 | 58.9 | 3.5 | **62** | CoalDeep | 10% |
| 0.0 | 0.0 | 0.0 | 0.0 | **0** | Upper Green Subbasin | 0% |
| **79.4** | **28.9** | **577.7** | **34.7** | **612** | | |

## WRIA 9 - Permit-Exempt Well Potential Assessment

Assessment of potential parcels for future growth

| Sub-basins | Number of parcels | Number of Dwelling Units (DU) |
|---|---|---|
| Central Puget Sound | Urban | Urban |
| Duwamish | Urban | Urban |
| Lower Green | 3 | 3 |
| Soos subbasin | 197 | 232 |
| Jenkins subbasin | 176 | 234 |
| Covington subbasin | 207 | 316 |
| Lower Middle Green | 152 | 237 |
| Middle Middle Green | 212 | 451 |
| Newaukum subbasin | 106 | 123 |
| Upper Middle Green | 161 | 208 |
| CoalDeep | 122 | 170 |
| Upper Green Subbasin | 0 | 0 |
| total | 1336 | 1974 |

| Water district boundaries: Inside parcels | Inside DU | Outside parcels | Outside DU | subbasin |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | Central Puget Sound |
| 0 | 0 | 0 | 0 | Duwamish |
| 3 | 3 | 0 | 0 | Lower Green |
| 196 | 231 | 1 | 1 | Soos subbasin |
| 175 | 233 | 1 | 1 | Jenkins subbasin |
| 207 | 316 | 0 | 0 | Covington subbasin |
| 127 | 210 | 25 | 27 | Lower Middle Green |
| 130 | 294 | 82 | 157 | Middle Middle Green |
| 53 | 60 | 53 | 63 | Newaukum subbasin |
| 0 | 0 | 161 | 208 | Upper Middle Green |
| 0 | 0 | 122 | 170 | CoalDeep |
| 0 | 0 | 0 | 0 | Upper Green Subbasin |
| 891 | 1347 | 445 | 627 | |
| total parcels | 1336 | total parcels | 1974 | |

| Water Use Projection: public connection parcels | public connection DU | PE sourced parcels | PE sourced DU | **20 year well projection (incl error)** | Shortfall *(red if present)* in 20 year well projection | **Redistribution - 20 year well projection** |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | **0** | 0 | **0** |
| 0 | 0 | 0 | 0 | **0** | 0 | **0** |
| 3 | 3 | 0 | 0 | **0** | 0 | **0** |
| 113 | 133 | 84 | 99 | **72** | 27 | **72** |
| 124 | 165 | 52 | 69 | **44** | 25 | **44** |
| 166 | 254 | 41 | 62 | **41** | 21 | **41** |
| 85 | 141 | 67 | 96 | **81** | 15 | **81** |
| 80 | 180 | 132 | 271 | **80** | 191 | **100** |
| 18 | 21 | 88 | 102 | **122** | -20 | **102** |
| 0 | 0 | 161 | 208 | **110** | 98 | **110** |
| 0 | 0 | 122 | 170 | **62** | 108 | **62** |
| 0 | 0 | 0 | 0 | **0** | 0 | **0** |
| 590 | 897 | 746 | 1077 | 612 | -------- | 612 |
| total parcels | 1336 | total parcels | 1974 | | | |

20 year Permit Exempt well total 612

**Notes:**

The King County 20 year PE well projections are revised because of a correction to the historic growth by subbasin data. Number of permits in Covington subbasin revised from 237 in WRIA9-GrowthProjectionSummary_082319.xls to to 235 in this version, which changes total building permits for 18 year period to 1430.

The Permit-Exempt Well Potential Assessment is outlined in red

Columns in yellow include redistribution of wells in the 20 year growth projection, based on the permit-exempt well potential assessment done by King County.

**Red numbers** indicate a shortfall (more projected PE wells than parcels/DU)

**Blue numbers** indicate redistribution of PE projected numbers

# ATTACHMENT B
## GeoEngineers UGA Well Log Spot Check Data Tables

# GeoEngineers - WRIA 9 Urban Growth Area PE Well Projection

| GeoEngineers - UGA Well Log Spot Check | | | | | | |
|---|---|---|---|---|---|---|
| **Period** | **Total Wells** | **Total Wells Spot Checked** | **Domestic wells (includes Group B wells)** | **Irrigation wells** | **Other (Test, Municipal, Dewatering, Industrial, Mitigation, UIC, Deepened or Refurbished)** | **Incorrect (Location, Date, etc.)** |
| 1998-2007 | 58 | 41 | 7 | 19 | 11 | 4 |
| 2008-2018 | 35 | 24 | 8 | 10 | 1 | 5 |
| Totals | 93 | 65 | 15 | 29 | 12 | 9 |
| Percent of Total | | 70% | 23% | 45% | 18% | 14% |
| *Potential number of new wells based on percentage of past 20 year total (93)* | | | | | | |
| **WRIA 9** | | | **21** | 41 | 17 | 13 |

*Developed 8/21/19*

Notes:

Total domestic well numbers have been revised after cross-checking well address with the UGA boundary.

Wells located outside of the UGA have been removed from the domestic well total.

The remaining domestic wells that have been spot checked are located in the following UGAs: King County (2), Kent (3), Auburn (5), Covington (3), Maple Valley (1) and Enumclaw (1).

Service Area/City Policy Notes:

Covington WD - incentivizes hookups, only 1 PE well in last 4 years in service area

Tacoma Water (Cumberland) - allows wells until service reaches new homes

Auburn - Allows PE wells until water service reaches new homes. Short plats must hookup.

only 1 new well in last 5 years

Tukwila - PE wells not allowed. No known wells in use.

# GeoEngineers - WRIA 9 Urban Growth Area PE Well Projection

| Subbasins | Spot Checked 1998-2007 | Spot Checked 2008-2018 | Total | Total Potential Wells in UGA in 20 years | Total Rounded | City UGA |
|---|---|---|---|---|---|---|
| Central Puget Sound | 0 | 0 | 0 | 0.00 | **0** | |
| Duwamish | | 0 | 0 | 0.00 | **0** | |
| Lower Green | 1 | 2 | 3 | 4.20 | **4** | King Co, Kent and Auburn UGAs |
| Soos subbasin | 5 | 3 | 8 | 11.20 | **11** | Kent, Covington, King Co, and Auburn UGAs |
| Jenkins subbasin | 0 | 1 | 1 | 1.40 | **1** | Maple Valley UGA |
| Covington subbasin | 0 | 0 | 0 | 0.00 | **0** | |
| Lower Middle Green | 1 | 1 | 2 | 2.80 | **3** | Auburn UGA |
| Mid Middle Green | 0 | 0 | 0 | 0.00 | **0** | |
| Newaukum subbasin | 0 | 1 | 1 | 1.40 | **1** | Enumclaw UGA |
| Upper Middle Green | 0 | 0 | 0 | 0.00 | **0** | |
| Coal Deep | 0 | 0 | 0 | 0.00 | **0** | |
| Upper Green Subbasin | 0 | 0 | 0 | 0.00 | **0** | |
| **Totals** | 7 | 8 | 15 | 21.00 | **20** | |

*Developed 8/21/19*

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

# Appendix G – Consumptive Use Memo

nhc
GeoEngineers
17245 NE Union Hill Road, Suite 250, Redmond, Washington, 98052 Telephone: 425.861.6000, Fax: 425.861.6050

**Memorandum**

www.geoengineers.com

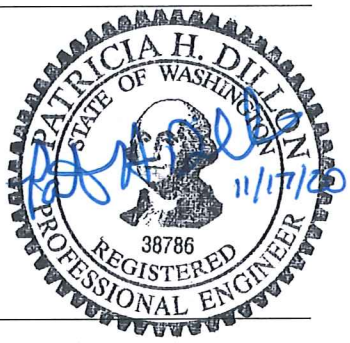
**To:** Stephanie Potts, Washington State Department of Ecology

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

**Date:** November 17, 2020

**File:** 0504-161-00

**Subject:** WRIA 9 Consumptive Use Estimates




## INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) Committees for Water Resource Inventory Areas (WRIAs) 7, 8 and 9. This memorandum provides a summary of the deliverable for Work Assignment GE0102, Task 4, WRIA 9 Consumptive Use Estimates.

## BACKGROUND AND CONTEXT

The Streamflow Restoration law (Revised Code of Washington [RCW] 90.94) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Duwamish-Green Watershed (WRIA 9). The Duwamish-Green (WRIA 9) Watershed Restoration and Enhancement Plan (watershed plan) must include projects and actions that offset the new consumptive water use (consumptive use) from future domestic permit-exempt wells (PE wells[1]). Consumptive use is water that is evaporated, transpired, consumed by humans, or otherwise removed from an immediate water environment. For watershed planning purposes, consumptive use is water that is drawn from groundwater via a domestic PE well and not replaced through the septic system, irrigation return flow, or other means.

Projections for number and location of new PE wells within WRIA 9 were developed by King County and GeoEngineers (GeoEngineers 2020b) for purposes of the watershed plan. This memorandum summarizes the methods used to estimate consumptive use associated with the new PE well connections and provides results for three water use scenarios. Methodology is based on Appendix A of Ecology's Final Guidance for Determining Net Ecological Benefit (Final NEB Guidance) (Ecology 2019) and documented in further detail in the Consumptive Use Estimates Workplan prepared by the GeoEngineers team (GeoEngineers 2019).

## CONSUMPTIVE WATER USE METHODOLOGY

Measurement of consumptive water use in any setting is difficult, and it is virtually impossible for residential groundwater use, which must account for both indoor and outdoor use. PE wells are generally unmetered, so

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

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

The two categories of household consumptive use are indoor water use and outdoor water use. The methodologies used to estimate these quantities for WRIA 9 are described in the following sections.

### Indoor Consumptive Use

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

- Amount of total water used. The Final NEB Guidance recommends an assumption of 60 gallons per person per day as a reasonable estimate of indoor water use. To estimate indoor usage per well, the per capita usage was multiplied by the average rural household size, estimated by King County as 2.73 people per household.
- Percentage of total water used that is consumptive. The Final NEB Guidance recommends that 10 percent of the total indoor water use is considered consumptive when a home is on a septic system. (All indoor water use is considered consumptive for homes with sewer connections.) Areas projected to be served by PE wells are outside of sewer service areas, so the 10 percent assumption was applied for all projected indoor water use.

### Outdoor Consumptive Use

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

### Irrigated Footprint Analysis

The GeoEngineers team conducted an aerial photo-based analysis of irrigated lawn and garden area for 211 parcels in eight of the WRIA 9 delineated subbasins (GeoEngineers 2020a). Parcels used for the irrigated footprint analysis were selected based on recent (2006 to 2017) building permits for new single-family residential homes not served by public water. All new home building permit sites in WRIA 9 were included in the analysis; permits for accessory dwelling units (ADUs) or reconstruction/remodel were excluded.

Each parcel was evaluated visually in Google Earth for irrigated lawn areas. Google Earth's historical imagery collection allowed for clearer identification of irrigated areas by comparing aerial photos spanning multiple seasons and years. Late summer imagery was particularly helpful in determining boundaries of irrigated (green) versus non-irrigated (brown) grass areas. More often than not, the parcels did not demonstrate such a clear-

cut distinction between green and brown spaces. It appears that many homeowners irrigate enough to keep lawns alive but not lush (or comparable to commercial turf grass/golf course green). Delineating these irrigated spaces is subjective, and the GeoEngineers team tried to ensure consistency in the interpretation and results by having one geographic information system (GIS) analyst evaluate all of the permit parcels in the WRIA. The irrigated area was delineated for each parcel based on several key assumptions:

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

Figure 1 shows examples of irrigated area delineation for two parcels in the Covington Creek subbasin. On each photo, the parcel boundary is shown in orange and the area identified as irrigated in white. For the example on the left, photos at different times of year showed a clear break between irrigated and non-irrigated grass.

Figure 1. Example Irrigated Area Delineations

Results of the irrigated footprint analysis are summarized in Table 1. The analysis covered eight of the nine subbasins in WRIA 9 with projected PE well connections. The Lower Green River subbasin (with four projected PE well connections) did not have any recent building permits for sites without purveyor-provided water service, so the average irrigated area for the adjacent Soos Creek subbasin was applied to the Lower Green River subbasin for purposes of consumptive use estimates.

**TABLE 1. WRIA 9 IRRIGATED FOOTPRINT SUMMARY**

| Subbasin | Parcels Analyzed | Total Irrigated Area (ac) | Average Irrigated Area (ac) |
|---|---|---|---|
| Coal/Deep Creek | 21 | 3.6 | 0.17 |
| Covington Creek | 13 | 5.2 | 0.40 |
| Jenkins Creek | 24 | 8.1 | 0.34 |
| Lower Middle Green River | 29 | 12.8 | 0.44 |
| Mid Middle Green River | 21 | 5.2 | 0.25 |
| Newaukum Creek | 38 | 11.7 | 0.31 |
| Soos Creek | 31 | 10.6 | 0.34 |
| Upper Middle Green River | 34 | 7.1 | 0.21 |
| **Full Analysis** | **211** | **64.2** | **0.30** |

### Crop Irrigation Requirements

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

Using the two WAIG stations within WRIA 9 (Seattle-Tacoma and Kent) and surrounding stations to the north, south, and east, the GeoEngineers team spatially interpolated crop irrigation requirements (CIRs) across WRIA 9 by creating a triangulated irregular network (TIN) surface between the WAIG station points. Since there are no stations east of Snoqualmie Falls, a lower value was imposed along the Cascade crest to enforce continued reduction in CIR with increasing precipitation. A value of 8 inches per year was used for the boundary value; this is believed to be a conservative value based on nearby Cascade foothill station estimates from an unpublished irrigation data set being developed by Washington State University (Peters et al. 2019). Values from the resulting TIN surface were averaged over each subbasin to estimate the irrigation requirement for each subbasin. This analysis was performed for both annual and summer (June-July-August) irrigation requirements to provide information to compare peak summer water use to annual use estimates. Figure 2 shows the locations of WAIG irrigation data stations and the interpolated distribution of annual turf irrigation requirements across WRIA 9. Table 2 summarizes the average values for both annual and summer CIRs for subbasins with projected PE well connections. Annual values were used for the consumptive use calculations described in this memo.

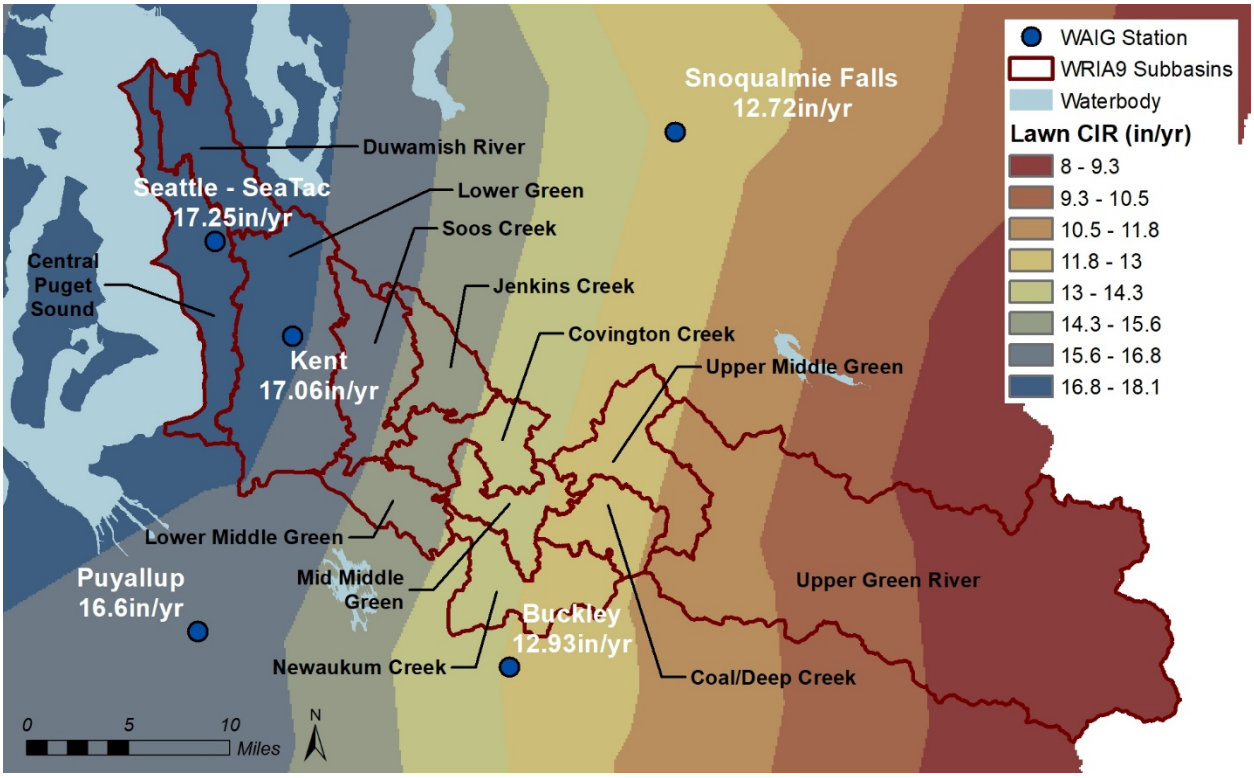



Figure 2. Spatial Distribution of Annual Turf Irrigation Requirement

**TABLE 2. WRIA 9 CROP IRRIGATION REQUIREMENTS**

| Subbasin | Annual Turf CIR (in) | Summer (JJA) Turf CIR (in) |
|---|---|---|
| Coal/Deep Creek | 12.26 | 10.57 |
| Covington Creek | 14.24 | 11.69 |
| Jenkins Creek | 14.99 | 12.16 |
| Lower Green River | 16.85 | 13.15 |
| Lower Middle Green River | 15.06 | 12.08 |
| Mid Middle Green River | 13.55 | 11.29 |
| Newaukum Creek | 13.07 | 11.00 |
| Soos Creek | 15.89 | 12.64 |
| Upper Middle Green River | 12.1 | 10.48 |
| **WRIA Average*** | **14.62** | **11.90** |

*Spatial average for subbasins with projected PE wells only

The CIR is the net amount of external water required by the crop, accounting for precipitation inputs. Since irrigation systems are not 100 percent efficient, additional water must be supplied to ensure that crop needs are met. The application efficiency varies by the type of system (drip irrigation, microsprinklers, pivot sprinklers, etc.). For WRIA 9, the Ecology-recommended value of 75 percent was used to determine the water applied for irrigation (Ecology 2019).

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

## TOTAL CONSUMPTIVE USE

The methods described above were used to compute indoor and outdoor consumptive use per PE well connection. Totals for each subbasin were then computed by multiplying per home values by the projected number of PE well connections in each subbasin. The GeoEngineers team developed a consumptive use calculator (Excel spreadsheet) to compute consumptive use for projected PE well connections for each subbasin and the WRIA as a whole. Table 3 summarizes the consumptive use estimate, which assumes one home with the measured subbasin-average yard area per PE well. The consumptive use estimate for WRIA 9 is 247.7 acre-feet per year, as shown on Figure 3.

**TABLE 3. ANNUAL CONSUMPTIVE USE FOR ONE HOME WITH SUBBASIN AVERAGE YARD**

| Subbasin ID | # PE Wells Anticipated in Subbasin | Irrigated Area per Well (ac) | Per Well Consumptive Use (gpd) | | | Total Consumptive Use (af/yr) |
|---|---|---|---|---|---|---|
| | | | Indoor | Outdoor | Total | |
| Coal/Deep Creek | 62 | 0.17 | 16.4 | 165.4 | 181.8 | 12.6 |
| Covington Creek | 41 | 0.40 | 16.4 | 452.0 | 468.4 | 21.5 |
| Jenkins Creek | 45 | 0.34 | 16.4 | 404.4 | 420.8 | 21.2 |
| Lower Green River | 4 | 0.34† | 16.4 | 454.6 | 471.0 | 2.1 |
| Lower Middle Green River | 84 | 0.44 | 16.4 | 525.8 | 542.2 | 51.0 |
| Mid Middle Green River | 100 | 0.25 | 16.4 | 268.8 | 285.2 | 31.9 |
| Newaukum Creek | 103 | 0.31 | 16.4 | 321.5 | 337.9 | 39.0 |
| Soos Creek | 83 | 0.34 | 16.4 | 428.7 | 445.1 | 41.4 |
| Upper Middle Green River | 110 | 0.21 | 16.4 | 201.6 | 218.0 | 26.9 |
| **WRIA 9 Aggregated** | **632** | **0.30** | **16.4** | **333.4** | **349.8** | **247.7** |

Note: Values in table have been rounded.
†P Representative measured value not available; uses Soos Creek subbasin average irrigated area.

## CONSUMPTIVE WATER USE SCENARIOS

The consumptive use calculator was also used to explore additional consumptive use scenarios. “Default” input parameters and values discussed in the methods section above can be modified to explore the effect of changes or uncertainties in individual assumptions. Based on requests from the technical workgroup and WRIA 9 Committee, two additional scenarios were computed, and annual consumptive use results are summarized in Table 4 and Table 5:

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

**TABLE 4. ANNUAL CONSUMPTIVE USE FOR ONE HOME WITH 0.5-AC YARD**

| Subbasin ID | # PE Wells Anticipated in Subbasin | Irrigated Area per Well (ac) | Per Well Consumptive Use (gpd) | | | Total Consumptive Use (af/yr) |
|---|---|---|---|---|---|---|
| | | | Indoor | Outdoor | Total | |
| Coal/Deep Creek | 62 | 0.5 | 16.4 | 486.4 | 502.8 | 34.9 |
| Covington Creek | 41 | 0.5 | 16.4 | 565.0 | 581.3 | 26.7 |
| Jenkins Creek | 45 | 0.5 | 16.4 | 594.7 | 611.1 | 30.8 |
| Lower Green River | 4 | 0.5 | 16.4 | 668.5 | 684.9 | 3.1 |
| Lower Middle Green River | 84 | 0.5 | 16.4 | 597.5 | 613.9 | 57.8 |
| Mid Middle Green River | 100 | 0.5 | 16.4 | 537.6 | 554.0 | 62.1 |
| Newaukum Creek | 103 | 0.5 | 16.4 | 518.5 | 534.9 | 61.7 |
| Soos Creek | 83 | 0.5 | 16.4 | 630.4 | 646.8 | 60.1 |
| Upper Middle Green River | 110 | 0.5 | 16.4 | 480.1 | 496.4 | 61.2 |
| **WRIA 9 Aggregated** | **632** | **0.5** | **16.4** | **546.3** | **562.7** | **398.4** |

Note: Values in table have been rounded.

**TABLE 5. ANNUAL CONSUMPTIVE USE FOR ANNUAL AVERAGE 950 GPD WATER USE PER CONNECTION**

| Subbasin ID | # PE Wells Anticipated in Subbasin | Irrigated Area per Well (ac) | Per Well Consumptive Use (gpd) | | | Total Consumptive Use (af/yr) |
|---|---|---|---|---|---|---|
| | | | Indoor | Outdoor | Total | |
| Coal/Deep Creek | 62 | 0.56 | 16.4 | 629.0 | 645.3 | 44.8 |
| Covington Creek | 41 | 0.52 | 16.4 | 629.0 | 645.3 | 29.6 |
| Jenkins Creek | 45 | 0.49 | 16.4 | 629.0 | 645.3 | 32.5 |
| Lower Green River | 4 | 0.47 | 16.4 | 629.0 | 645.3 | 2.9 |
| Lower Middle Green River | 84 | 0.51 | 16.4 | 629.0 | 645.3 | 60.7 |
| Mid Middle Green River | 100 | 0.54 | 16.4 | 629.0 | 645.3 | 72.3 |
| Newaukum Creek | 103 | 0.58 | 16.4 | 629.0 | 645.3 | 74.5 |
| Soos Creek | 83 | 0.48 | 16.4 | 629.0 | 645.3 | 60.0 |
| Upper Middle Green River | 110 | 0.55 | 16.4 | 629.0 | 645.3 | 79.5 |
| **WRIA 9 Aggregated** | **632** | **0.53** | **16.4** | **629.0** | **645.3** | **456.9** |

Note: Values in table have been rounded.

Daily usage rates shown in Table 3 through Table 5 represent annual average values. While indoor use generally does not vary much from month to month, outdoor water needs range from zero during the winter rainy season to more than three times the annual average during the peak of the summer. Since streamflows are lowest in late summer for most western Washington streams, the WRIA 9 Committee may consider peak summer water use along with annual use when developing the watershed plan. It is important to remember that pumping rates are likely not equivalent to consumptive use impacts on stream depletion. While the Final NEB Guidance recommends considering stream depletion impacts to be a steady-state equivalent, there may be circumstances within a watershed where that is not appropriate.

### Total Water Use and Comparison to Water Purveyor Data

Water use data from water purveyors serving rural areas in the central Puget Sound were obtained as one benchmark for comparison with estimated PE well usage. Covington Water District, serving about 18,000 customers in southern King County, and Snohomish County Public Utilities District #1 (Snohomish County PUD), serving about 20,000 customers in central and northern Snohomish County, each provided metered water use data from 2015 and 2017. In addition, Snohomish County compiled annual water demand forecasts from water system plans for 17 water purveyors operating in the county. Table 6 summarizes the available water purveyor data. Reported values are total water use, not consumptive use. For the two metered systems providing data, the average annual use is approximately 220 gallons per day (gpd) per household. About 160 gpd is attributed to indoor uses (year-round) and 50 to 70 gpd (averaged over twelve months) to outdoor uses. Note that outdoor use is typically concentrated over about 3 months during the summer, which equates to rates of 150 to 200 gpd of outdoor watering for those 3 months.[2]

**TABLE 6. WATER PURVEYOR HOUSEHOLD WATER USE DATA**

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

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

[2] 50 gpd over 12 months is equivalent to 200 gpd over 3 months, both totaling about 18,000 gallons.

Since most water purveyors charge customers by the amount of water delivered (not just consumptively used)—and in some cases at increased rates as water use goes up—metered water users may exhibit more water conservation behaviors than unmetered users. Total water use breakdowns for the projected PE well scenarios are presented in Table 7. Estimated indoor use of 164 gpd for the PE well scenarios is very consistent with the water purveyor data (based on metered winter water use), between 150 and 170 gpd.

Average annual total use for PE wells estimated from this analysis (see Table 7) are considerably higher, however, due to outdoor use estimates 6 to 8 times greater than average metered use: 420 gpd estimated for PE wells versus 50 to 70 gpd for metered users on an average annual basis or 1,400 gpd estimated for PE wells versus 150 to 200 gpd[3] for metered users on average during the summer. The magnitude of this difference seems unlikely to be accounted for strictly by price pressures and thus suggests that assumptions in this analysis regarding watering behavior are generally conservative. For example, studies have shown that most residential lawn watering is conducted at a deficit level to maintain some growth and green color (Water Research Foundation 2016), versus the assumption of watering for optimal growth of commercial crops (like a sod farm for turf grass) implicit in the WAIG crop irrigation requirements. Because of the uncertainty inherent in estimating growth patterns, domestic PE well pumping rates, and potential changes in outdoor watering practices, conservative assumptions for future new household water use, and outdoor water use in particular, are justified.

**TABLE 7. ESTIMATED PERMIT-EXEMPT WELL TOTAL WATER USE**

| Scenario | Average Annual Water Use (gpd) | Average Indoor Use (gpd) | Average Annual Outdoor Use (gpd) | Average Summer Outdoor Use (gpd) |
|---|---|---|---|---|
| 1 home, average measured yard | 581 | 164 | 417 | 1,361 |
| 1 home, 0.5 ac yard | 847 | 164 | 683 | 2,246 |
| 1 home using 950 gpd (annual average) | 950 | 164 | 786 | n/a |

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

## REFERENCES

GeoEngineers, Inc. (GeoEngineers). 2019. Draft Work Plan, Consumptive Water Use Estimates. Work Plan prepared for WRIA 9 WREC Technical Workgroup. October 2019.

GeoEngineers. 2020a. WRIA 9 Subbasin Delineations. Technical memorandum prepared for Washington State Department of Ecology. August 2020.

GeoEngineers. 2020b. WRIA 9 PE Well Projections. Technical memorandum prepared for Washington State Department of Ecology. November 2020.

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

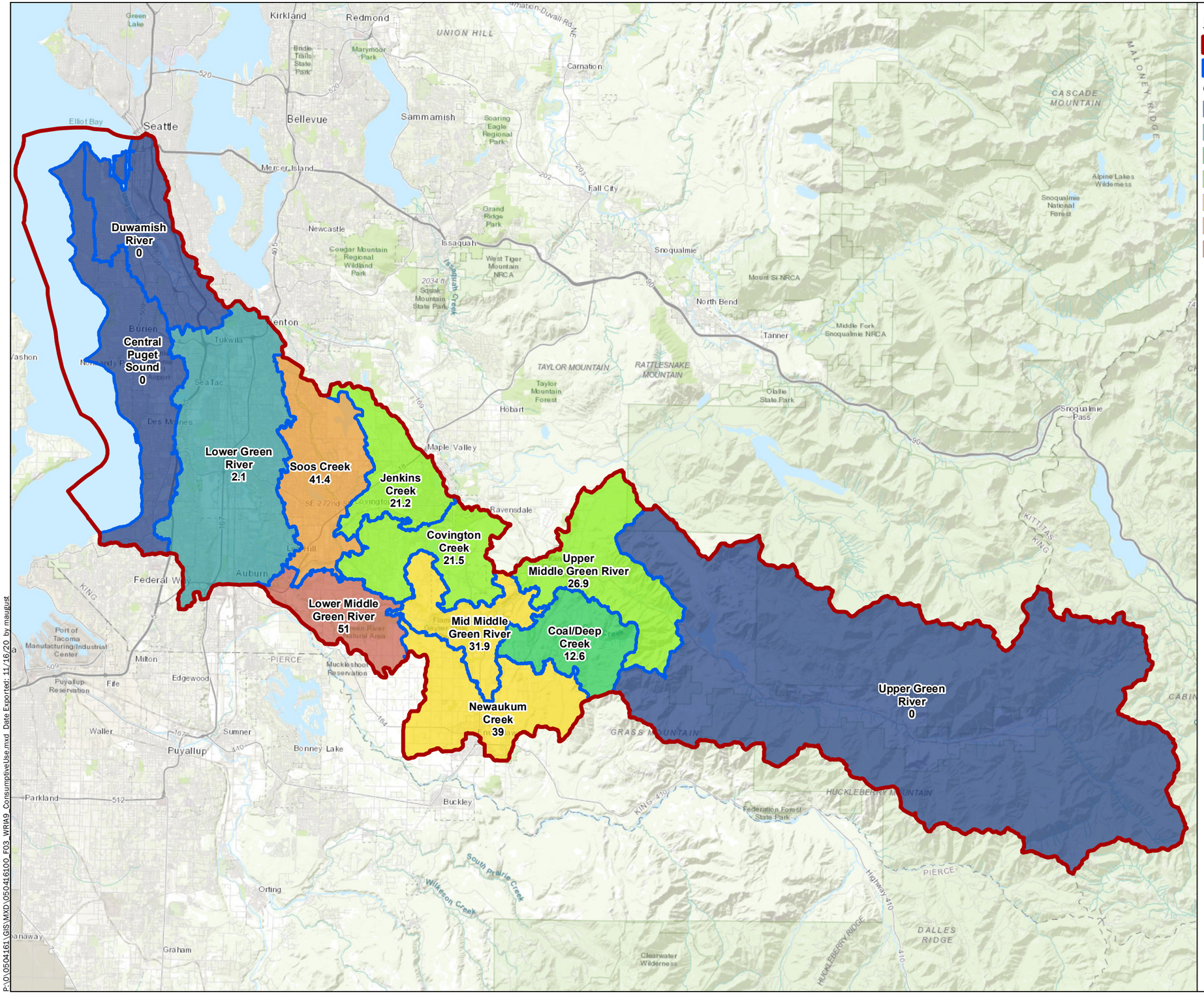
[3] Metered summer usage for several individual homes in the Covington Water District showed outdoor usage ranging from 25 gpd to 2,693 gpd for July-August 2015.

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

Washington State Department of Ecology (Ecology). 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131. http://leg.wa.gov/JointCommittees/WRM/Documents/EcologyFinalGuidanceForDeterminingNEB.pdf.

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

Attachment:
Figure 3. WRIA 9 Estimated Consumptive Use from Projected Permit-Exempt Wells 2018-2038




**Legend**

- WRIA 9 Boundary
- WRIA 9 Subbasins

**Consumptive Use Estimate (acre-feet/year)**

- 0
- 1 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- >50

Projected WRIA 9
Consumptive Use Total = 247.7 acre-feet per year

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N W E S

5 0 5

Miles

**WRIA 9 Estimated Consumptive Use from Projected Permit-Exempt Wells 2018-2038**

Watershed Restoration and Enhancement Plan
King County, Washington

GeoEngineers

**Figure 3**

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# Appendix H – Projects

# **WRIA 9** - Water Right Project Opportunity Profile
# Soos Creek Park (Pre-Identified No. 5)

## Project Summary (9-S-W1)

**Update: 10/7/2020**


*FLOW BENEFIT:* Additional 0.10 cfs in 2.1 miles in Big Soos Creek and 30 miles in Green River.

*PRIORITY SUBBASIN:* Soos Creek Subbasin

*ESTIMATED OFFSET:* 11 afy consumptive

*PRIORITY DATE(S):* 04/24/1959

*SOURCE AND PURPOSE:* Surface water for irrigation and fish propagation.

*PERIOD OF USE:* Seasonally from April 15th – October 1st.

*WRIA 9 INSTREAM FLOW RULE (1980):* There is a surface water closure on all tributaries to the Green River.[1]

*ESA LISTED FISH:* Puget Sound Chinook Salmon (Threatened) and Puget Sound Steelhead (Threatened) and Bull Trout (Threatened)

*OUTREACH STATUS:* Interested

## Project Description

The Pre-Identified No. 5 water right was included in the WRIA 9 water rights analysis at Ecology's request and WREC review. The land underlying the water right was formerly used as a park with ponds and irrigation, while currently appears to continue to be used as a park/open space without ponds and irrigation. The property is located approximately 5.5 miles southeast of Kent, WA. There is one surface water right associated with this project that was temporarily donated from 2020 to 2025 to the Trust Water Rights Program (TWRP) managed by Ecology.

### *Watershed*

Big Soos Creek is part of the Soos Creek subbasin. Big Soos Creek flows into Lower Middle Green River at approximately RM 30. Big Soos Creek is closed to future surface water appropriations but does not have an instream flow established in Chapter 173-509 WAC.

[1] WAC 173-509-040

### *Land Use & Ownership*

According to the King County Assessor, the current land use is Vacant Single Family. The property is zoned Rural Area 5, one dwelling unit per 5 acres. The land underlying Pre-Identified No. 5 includes one parcel under public ownership for the period of King County online parcel data record, while a second parcel has been under public ownership since 2015. There is only one landowner and water right holder that manages two adjacent parcels, totaling approximately 64 acres. A review of the WSDA 2019 Agricultural Land Use map, identifies commercial tree as the crop type on the properties. This assessment does reflect the prior use of the park as a commercial Christmas tree farm until converted to the current use as public park in 2015. Yet, the land use is currently a park. Irrigation delineation estimates as much as 0.9 irrigated acres in 2013 and 2019, Table 1. It is possible that the irrigated areas were covered by tree canopy, the difference of estimated irrigated acres between years analyzed maybe explained as the result of the timing of the aerial photograph, specific water use practices or from sufficient causes for non-use (RCW 90.14.140), which would be best understood through direct conversation with the water user.

**Table 1: Delineated irrigation in each year (2013, 2015, 2017, 2019)**

| Year | Total Irrigated Acres (Med/High Confidence) |
|---|---|
| 2013 | 0.9 |
| 2015 | 0 |
| 2017 | 0 |
| 2019 | 0.9 |

## Water Right

**Table 2: Current Water Rights**

| Document Type | Qa | Qi | Priority Date | Purpose of Use | WR Acres | Source |
|---|---|---|---|---|---|---|
| Certificate | 20 afy | 0.10 cfs | 4/24/1959 | Fish Propagation and Irrigation | 10 | Unnamed Springs |

These quantities only reflect what is shown on the water right document, and do not represent any beneficial use assessment by Ecology.

### *Water Right History:*

The original certificate was issued for fish propagation and irrigation from unnamed surface water springs feeding nearby Big Soos Creek. This water right has a priority date of 4/24/1959, listed purpose of use of irrigation with a Qi of 0.10 cfs and 20 acre-feet per year as the Qa. In 2020, the water right holder donated the entire the water right, accepted by Ecology, into the TWRP through 2025.

***Metering Records:***

Metering records are not available in the Ecology Water Resources Explorer database or in the water right record. Instead, a detailed beneficial use assessment was found in the file record.

## Conclusion

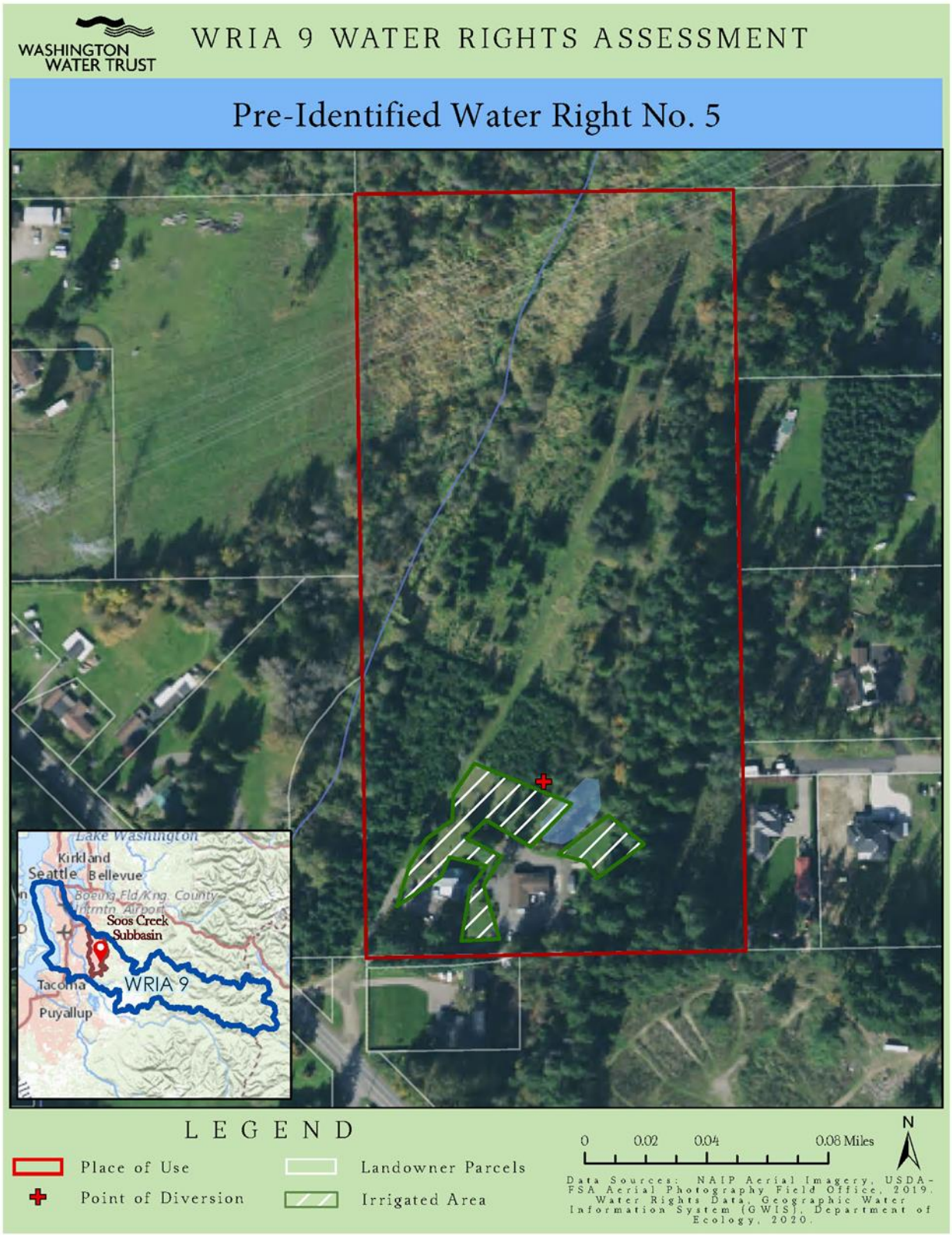
This project was identified by Ecology and the WREC as a potential acquisition opportunity. The current land use is Vacant Single Family. Four years of irrigation delineations were undertaken (2013, 2015, 2017, 2019) which estimate as much as 0.9 irrigated acres on these parcels; however, according to the file record it appears that this water right is subject to a Chapter 90.14 RCW nonuse exemption and actual historic irrigation was in the 7-10 acre range. An estimate of crop consumption was developed based on the Washington Irrigation Guide, Appendix A, Kent, WA station using pasture/turf crop irrigation requirement as the surrogate baseline crop (17.06 inches/acre) using an assumed sprinkler irrigation application efficiency of 75%, a consumptive application factor of 10%, resulting in a total consumptive use of 85%.

- Based on an irrigation assumption of 7 acres and assuming turf and sprinkler irrigation application, 11 afy consumptive is the estimated quantity[2]
- Based on an irrigation assumption of 10 acres and assuming turf and sprinkler irrigation application, 16 afy consumptive is the estimated quantity.

The Pre-Identified No. 5 water right priority date of 4/24/1959, is senior to the establishment of the Green-Duwamish River Basin Instream Resources Protection Program in 1980, but junior to the administrative closure of all tributaries of Green River dated 08/19/1953.

[2] This is only an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition. If the prior use was commercial tree farm, the anticipated consumptive use is likely lower than this estimate.

**Project Map**


WASHINGTON WATER TRUST
WRIA 9 WATER RIGHTS ASSESSMENT
Pre-Identified Water Right No. 5
Lake Washington
Kirkland
Seattle
Bellevue
Boeing Fld/King County Intrntn Airport
Soos Creek Subbasin
WRIA 9
Tacoma
Puyallup
LEGEND
Place of Use
Point of Diversion
Landowner Parcels
Irrigated Area
0
0.02
0.04
0.08 Miles
N
Data Sources: NAIP Aerial Imagery, USDA-FSA Aerial Photography Field Office, 2019. Water Rights Data, Geographic Water Information System (GWIS), Department of Ecology, 2020.

# **WRIA 9** – Water Right Project Opportunity Profile
# **Pre-Identified No. 6**

## Project Summary (9-S-W2)

Tier 2 water rights acquisition projects do not have a detailed project description.

# WRIA 9 – Water Right Project Opportunity Profile
# Pre-Identified No. 2

## Project Summary (9-C-W3)

Updated: 10/7/2020


*FLOW BENEFIT:* Additional 2.7 cfs in 3.5 miles of Covington Creek tributaries (Ravensdale Lake/Creek and Lake Sawyer), 6 miles of Covington Creek, 2.5 miles of Big Soos Creek, and 30 miles of Green River.

*PRIORITY SUBBASIN:* Covington Creek Subbasin

*ESTIMATED OFFSET:* 54 afy consumptive

*PRIORITY DATE:* 6/02/1967

*SOURCE AND PURPOSE:* Surface water for mining.

*PERIOD OF USE:* Year-round.

*WRIA 9 INSTREAM FLOW RULE (1980):* There is a surface water closure on all tributaries to the Green River.[3]

*ESA LISTED FISH:* Puget Sound Chinook Salmon (Threatened), Puget Sound Steelhead (Threatened), Bull Trout (Threatened)

*OUTREACH STATUS:* Initial

## Project Description

The Pre-Identified No. 2 water right was included in the WRIA 9 water rights analysis at Ecology request and WREC review. The land and appurtenant water right are part of a former sand and gravel mining operation. The parcels comprising the property underlying the water right, appear to have been in the same ownership since the late 1990s according to the King County online parcel data record. The water right holder had considered a trust water donation 3 years ago but did not proceed. Washington Water Trust has initiated outreach to the water right holder.

### *Watershed*

Ravensdale Lake/Creek is a part of the Covington Creek subbasin. Ravensdale Lake/Creek drains into Lake Sawyer, Lake Sawyer is the headwaters of Covington Creek, which Covington Creek flows into Big Soos Creek, and Big Soos Creek joins the Lower Middle Green River at approximately RM 30.

[3] WAC 173-509-040

Covington Creek and tributaries have a closure to future surface water appropriations but do not have an instream flow established in Chapter 173-509 WAC.

### *Land Use & Ownership*

According to the King County Assessor, the current land uses under the place of use are Mining/Quarry/Ore Processing, Single Family and Vacant Land, Mobile Home and Vacant Commercial. The properties are zoned Rural Area 10, one dwelling unit per 10 acres, Mineral and Forest. The land underlying Pre-Identified No. 2 appears to have been in the same ownership since the late 1990s according to the King County online parcel data record. There are four landowners and water right holders that manage 5 parcels, totaling approximately 163 acres. Review of aerial imagery shows approximately 24 acres of what appears to be leech ponds active until approximately 2014, following 2014 the prevalence of vegetation may indicate inactivity at the site, but approximately 6 acres of driveways and gravel piles appear active with little to no vegetative cover.

## Water Right

**Table 1: Current Water Rights**

| Document Type | Qa | Qi | Priority Date | Purpose of Use | WR Acres | Source |
|---|---|---|---|---|---|---|
| Certificate | 744 afy | 2.7 cfs | 6/02/1967 | Industrial/Processing mineral products | - | Ravensdale Lake |

These quantities only reflect what is shown on the water right document, and do not represent any beneficial use assessment by Ecology.

### *Water Right History:*

The original certificate was issued for "processing mineral products" from Ravensdale Lake. This water right has a priority date of 6/02/1967, listed purpose of use as processing mineral products, with 2.7 cfs identified as the Qi and 744 afy as the Qa.

### *Metering Records:*

Metering records are not available in the Ecology Water Resources Explorer database or in the water right record. At the time of Ecology's site visit in 2017 a meter was installed but it appears that data was not obtained or available.

## Conclusion

This project was identified by Ecology and the WREC as a potential acquisition opportunity. The current land uses are Mining/Quarry/Ore Processing, Single Family and Vacant Land, Mobile Home and Vacant Commercial. Due to the year-round industrial nature of this water right, the actual fact pattern of beneficial use and products produced dictate quantification of consumptive use. This water right holder had considered participating in a trust water right donation 3 years ago but did not proceed. At that time,

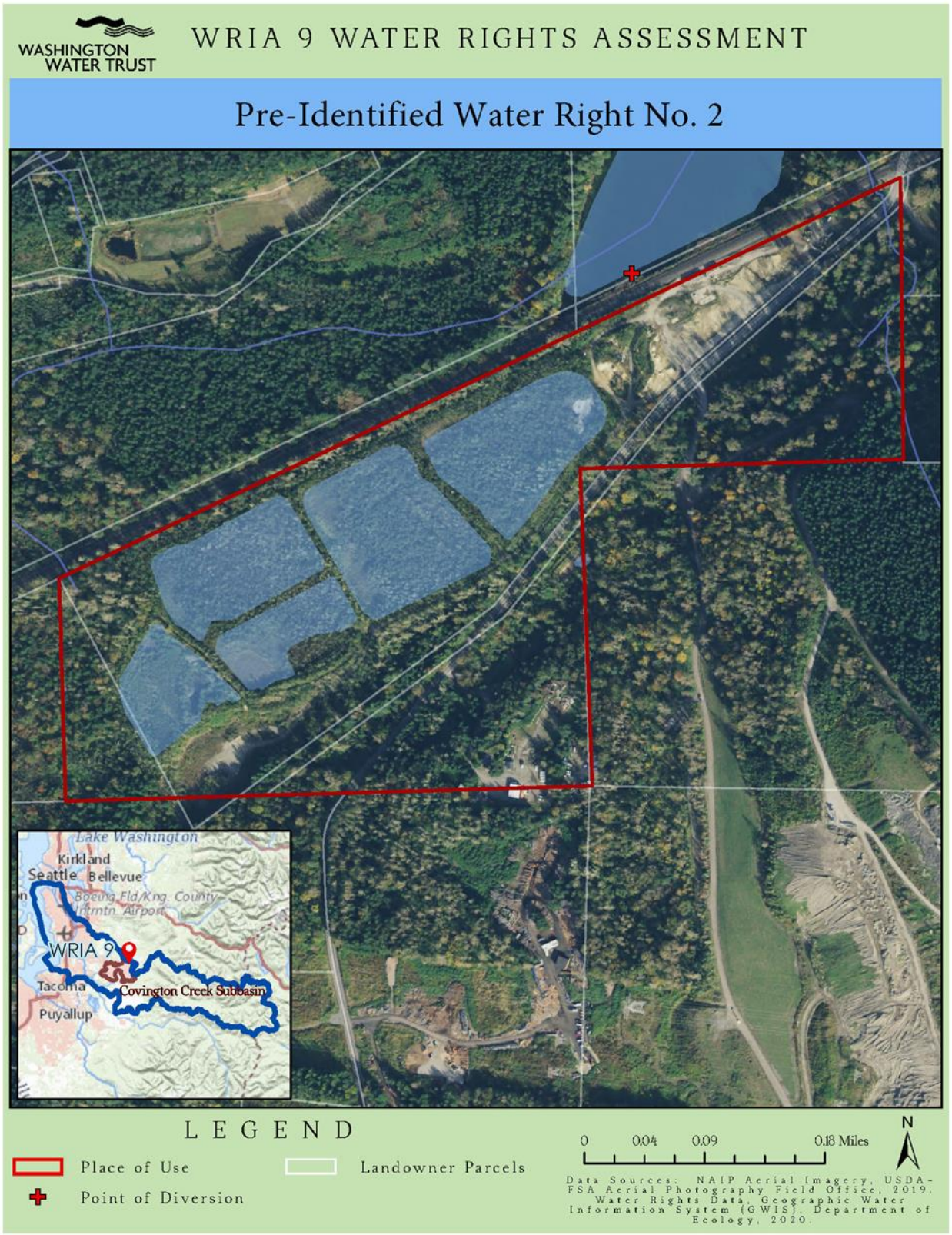
Ecology had opportunity to review a beneficial use assessment conducted on behalf of the water right holder by a consultant in 2017, and confirmed the estimates provided at that time.

- Based on a beneficial use assessment produced by a 3rd-Party consultant and confirmed by Ecology staff, it was determined that there was as much as 106 afy of beneficial use of water with 54 afy consumptive use in 2017.[4]

The Pre-Identified No. 2 water right priority date of 6/02/1967, is senior to the establishment of the Green-Duwamish River Basin Instream Resources Protection Program in 1980 but junior to the administrative closure of all tributaries of Green River dated 08/19/1953.

[4] This is only an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

**Project Map**


WASHINGTON WATER TRUST
WRIA 9 WATER RIGHTS ASSESSMENT
Pre-Identified Water Right No. 2
Lake Washington
Kirkland
Seattle
Bellevue
Boeing Fld/King County Intrntn Airport
WRIA 9
Tacoma
Covington Creek Subbasin
Puyallup
LEGEND
Place of Use
Landowner Parcels
Point of Diversion
0
0.04
0.09
0.18 Miles
N
Data Sources: NAIP Aerial Imagery, USDA-FSA Aerial Photography Field Office, 2019. Water Rights Data, Geographic Water Information System (GWIS), Department of Ecology, 2020.

# WRIA 9 - Project Description
# Covington Water District Managed Aquifer Recharge

October 14, 2020

## Project Name and Number
Covington Water District Managed Aquifer Recharge (9-C-W4)

## WRIA 9 WRE Subbasin
Covington Creek

## Water Offset
~357 acre-feet/year (AF)

## Narrative Description
Covington Water District (CWD) is proposing the placement of a Managed Aquifer Recharge (MAR) infiltration facility on their property in Covington, Washington. This project would augment stream flows by increasing surficial aquifer discharge (baseflow) to Covington Creek, a tributary to Soos Creek and the Green River, above what occurs under existing conditions. The project concept includes diverting water annually from CWD's existing drinking water pipeline, which runs along the northern site boundary, between approximately November 1 and April 30 when water is available using existing water rights. Diverted water would be conveyed from CWD's existing pipeline and piped to a constructed MAR facility. This diverted water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges to Covington Creek as re-timed groundwater baseflow. The goal of the project is to increase baseflow to Covington Creek by recharging the aquifer adjacent to Covington Creek and providing additional groundwater discharge to the stream through MAR.

The proposed project site is a 54-acre undeveloped property owned by CWD located west of Lake Sawyer in the WRIA 9 Covington Creek subbasin. The site is currently covered by forest and vegetation. The property is located in Section 9, Township 21 North, Range 6 East (Willamette Meridian) and is bounded to the north by Kentlake High School, Druids Glen golf course to the west, and Covington Creek to the east and south.

## Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits. Show how offset volume(s) were estimated.
The proposed MAR facility will result in streamflow benefits to Covington Creek by diverting and temporarily storing excess water into the shallow alluvial aquifer. The project is currently conceptual but CWD anticipates the ability to divert water from their existing water supply and water rights at a rate of approximately 1 cubic foot per second (cfs) for up to six months (November 1 through April 30). The goal is to increase streamflow. The proposed MAR facility will infiltrate potable water into the shallow aquifer and provide increased baseflow to Covington Creek and its tributaries. The anticipated offset volume for this project is 357 acre-feet (AF) per year. The offset volume is calculated based on the quantity of water infiltrated annually, as described below.

United States Geologic Survey mapping in the area suggests that glacial outwash plain deposits are present at the proposed location (Mullineax 1965). United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soil maps indicate the site is underlain by Everett very

gravelly sand loam (EvC) soils with an average saturated hydraulic conductivity (Ksat) of 3.97 inches per hour (USDA 2020). For planning purposes, Ksat is assumed to be equivalent to infiltration rate. Site-specific data were not available so a safety factor of two was applied to the raw Ksat value to derive a corrected infiltration rate of 1.95 inches per hour. Assuming water will be diverted between November 1 and April 30 every year (180 days), the annual diversion volume is estimated to be 357 AF per year using Equation 1:

Annual Volume = Diversion Rate x Duration of Diversion Equation 1

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

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

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

The approximate site location is shown below.

### Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in Covington Creek. Based on the estimated diversion volume, it is possible that streamflow benefits could also be observed in Soos Creek.

#### Location relative to future PE well demand

The consumptive use estimate for the WRIA 9 Covington Creek subbasin is 21.5 AF per year (GeoEngineers 2019).

### Performance goals and measures.

The performance goals are to increase water storage in the alluvial aquifer adjacent to Covington Creek by infiltrating 357 AF per year through the MAR facility to improve baseflow in the Covington Creek. The increase in baseflows should reduce water temperatures in Covington Creek.

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

The Covington Creek subbasin is inhabited by coho, fall chinook, fall chum, coastal cutthroat, and winter steelhead (WDFW 2020a and 2020b).

### Identification of anticipated support and barriers to completion.

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

The project sponsor owns of the land and will rely on existing water rights to implement the project, thereby reducing uncertainties related to land acquisition and permitting.

The barriers to completion include funding for construction and O&M costs. In addition, the water available for diversion from CWD's existing pipeline is treated drinking water. It is anticipated that water quality will be evaluated and a geochemical compatibility analysis will be conducted to ensure no water quality degradation, and/or water will be treated to mitigate any environmental impacts.

### Potential budget and O&M costs.

To be determined.

### Anticipated durability and resiliency.

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

- The water source would be reliable, based on a certificated water right, and the seasonal storage volume should always be available.
- The rate of diversion would be precisely maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate would be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- The anticipated range in regional groundwater elevation fluctuation would not impact the groundwater flow field in a manner that significantly reduces the project offset.

- Land use changes external to the project site would have negligible impact on project function.

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

- Project function would not be impacted by summer drought conditions.
- The project diversion can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the MAR site and surrounding area would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

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

CWD is the project sponsor. Sponsor contact: Steve Lee, Engineering Manager. The sponsor is willing to proceed with scoping, reconnaissance, and project management support. Implementation will be dependent on several factors, including funding.

### Documentation of sources, methods, and assumptions.

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

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

Geoengineers, Inc. (GeoEngineers). 2020. WRIA 9 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. February 2020.

Mullineaux, D.R. 1965. Geologic Map of the Black Diamond Quadrangle, King County, Washington. USGS Geologic Quadrangle Map GQ-407, Scale 1:24,000.

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

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

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

# WRIA 9 –Project Description
# Green River Managed Aquifer Recharge at Kanaskat Palmer State Park

October 21, 2020

## Project Name and Number
Green River Managed Aquifer Recharge (9-UMG-W5)

## WRIA 9 WRE Subbasin
Upper Middle Green River

## Water Offset
114 acre-feet/year (AF)

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

Kanaskat-Palmer State Park occupies approximately 320 acres in the WRIA 9 Upper Middle Green River subbasin and is currently covered by forest and vegetation. The site property is located in Section 10, Township 21 North, Range 7 East (Willamette Meridian) and is bounded to the north by the Green River and surrounded by forest in all other directions.

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

## Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits. Show how offset volume(s) were estimated.
The proposed MAR facility will result in streamflow benefits to the Green River by diverting and temporarily storing a portion of seasonal high flows into the shallow alluvial aquifer. This project is currently conceptual but, for planning purposes we anticipate the ability to divert surface water from the Green River at a rate of approximately 1 cubic foot per second (cfs) for up to five and a half months (December 1 through May 15). This is a preliminary estimate of the quantity of water diverted and timing of diversion, which needs further analysis through a site-specific feasibility study.

The goal of the project is to increase streamflow. For planning purposes, the Committee assumed that 327 acre-feet (AF) per year would be infiltrated annually (as described below) and based the offset volume on expected streamflow benefits during periods when flows are typically lower: late summer and early fall. The Committee used the USGS streamflow depletion software called STRMDEPL08 to estimate offset volume of approximately 114 AF for the time period June 1 through October 31, because recent streamflow data showed a significant decrease in flows during those months. The Committee chose 114 AF as the offset volume to account for uncertainties related to diversion rate, period of diversion, and timing of streamflow benefits.

USGS mapping in the area suggests that terrace gravel and stratified drift deposits (Qt) are present at the proposed location (Vine 1969). United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soil maps indicate the site is underlain by Barneston gravelly ashy coarse sandy loam with an average saturated hydraulic conductivity (Ksat) of 12.4 inches per hour (USDA 2020). For planning purposes, Ksat is assumed to be equivalent to infiltration rate. Site-specific data were not available so a safety factor of two was applied to the raw Ksat value to derive a corrected infiltration rate of 6.2 inches per hour. The annual diversion volume is calculated using Equation 1:

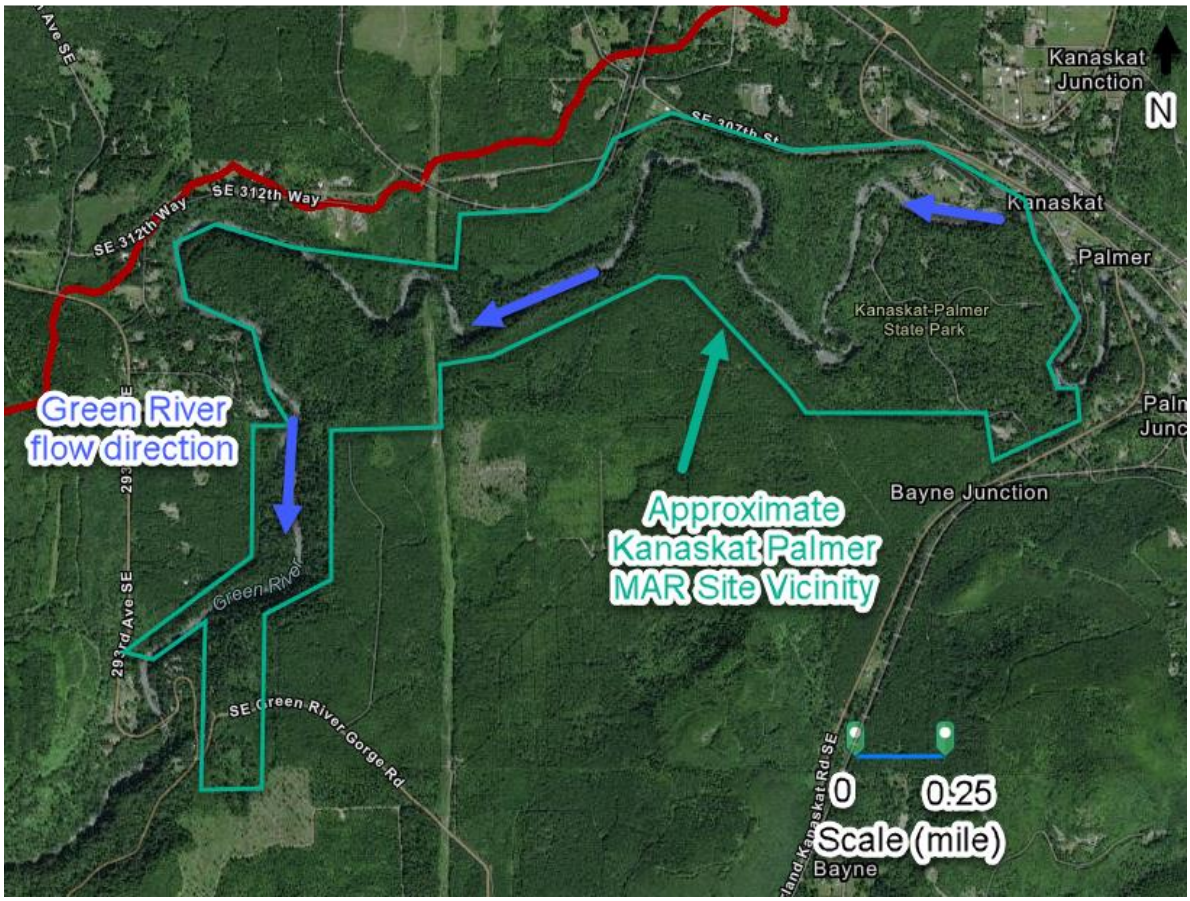
Annual Volume = Diversion Rate x Duration of Diversion Equation 1

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

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

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

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




## Description of the anticipated spatial distribution of likely benefits.

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

## Location relative to future PE well demand.

The consumptive use estimate for the WRIA 9 Upper Middle Green River subbasin is 26.9 AF per year (GeoEngineers 2019). This project would also contribute to offsetting 85 AF per year of estimated consumptive use in the following downstream subbasins: Mid Middle Green, Lower Middle Green, Lower Green, and Duwamish.

## Performance goals and measures.

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

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

The Green River is inhabited by sockeye, fall chinook, coho, chum, bull trout, and winter and summer steelhead (WDFW 2020a and 2020b). Chinook and steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

## Identification of anticipated support and barriers to completion.

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

GeoEngineers initiated outreach to the landowner (Washington State Department of Parks and Recreation) to evaluate their level of support for the project and they expressed support for the project concept.

The barriers to completion include funding for construction and O&M costs and obtaining a water right from the Green River or the adjacent aquifer for beneficial use at the MAR facility.

## Potential budget and O&M costs.

To be determined.

## Anticipated durability and resiliency.

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

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

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

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

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

Washington Water Trust is a potential project sponsor.

## Documentation of sources, methods, and assumptions.

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

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

Geoengineers, Inc. (GeoEngineers). 2020. WRIA 9 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. February 2020.US Department of Agriculture (USDA). 2020. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Vine, J.L. 1969. Geology and Coal Resources of the Cumberland, Hobart, and Maple Valley Quadrangles, King County, Washington. USGS Professional Paper PP-624, scale 1:24,000.

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

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

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

# WRIA 9 – Project Description
# Green River Managed Aquifer Recharge at Tacoma Water Filtration Facility

October 21, 2020

## Project Name and Number
Green River Managed Aquifer Recharge (9-UMG-W5)

## WRIA 9 WRE Subbasin
Upper Middle Green River

## Water Offset
114 acre-feet/year (AF)

## Narrative Description
One of the potential Managed Aquifer Recharge (MAR) sites identified by Ecology is located on Tacoma Water property near Palmer, Washington. The site is located approximately ½-mile downstream of Tacoma Water's Green River Filtration Facility. This project would augment stream flows by increasing surficial aquifer discharge (baseflow) to the Green River above what occurs under existing conditions. The project concept includes diverting surface water annually from the Green River during high flow periods when excess water may be available. Diverted water would be conveyed through a collector well adjacent to the river (e.g. Ranney Collector well) or through an instream surface water intake and piped to a constructed MAR facility. This diverted surface water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges back to surface water as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the Green River during the low flow period (typically late summer and early fall) by recharging the aquifer at the infiltration site and providing additional groundwater discharge to the river through MAR.

The site is located in the WRIA 9 Upper Middle Green River subbasin and is currently covered by forest and vegetation. The site is located in Section 13, Township 21 North, Range 7 East (Willamette Meridian) and is bounded to the north by SE Green River Headworks Road, to the south by Burlington Northern Santa Fe railroad by forest to the east and west.

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

## Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits. Show how offset volume(s) were estimated.
The proposed MAR facility will result in streamflow benefits to the Green River by diverting and temporarily storing a portion of seasonal high flows into the shallow alluvial aquifer. This project is currently conceptual but, for planning purposes we anticipate the ability to divert surface water from the Green River at a rate of approximately 1 cubic foot per second (cfs) for up to five and a half months (December 1 through May 15). This is a preliminary estimate of the quantity of water diverted and timing of diversion, which needs further analysis through a site-specific feasibility study.

The goal of the project is to increase streamflow. For planning purposes, the Committee assumed that 327 acre-feet (AF) per year would be infiltrated annually (as described below) and based the offset volume on expected streamflow benefits during periods when flows are typically lower: late summer and early fall. The Committee used the USGS streamflow depletion software called STRMDEPL08 to estimate offset volume of approximately 114 AF for the time period June 1 through October 31, because recent streamflow data showed a significant decrease in flows during those months. The Committee chose 114 AF as the offset volume to account for uncertainties related to diversion rate, period of diversion, and timing of streamflow benefits.

USGS mapping in the area suggests that alluvium aquifer material should be present at the proposed location (Jones 1999). United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) soil maps indicate the site is underlain by udifluvent gravelly sandy loam soils with an average saturated hydraulic conductivity (Ksat) of 3.97 inches per hour (USDA 2020). For planning purposes, Ksat is assumed to be equivalent to infiltration rate. Site-specific data were not available so safety factor of two was applied to the raw Ksat value to derive a corrected infiltration rate of 1.98 inches per hour. The annual diversion volume is calculated using Equation 1:

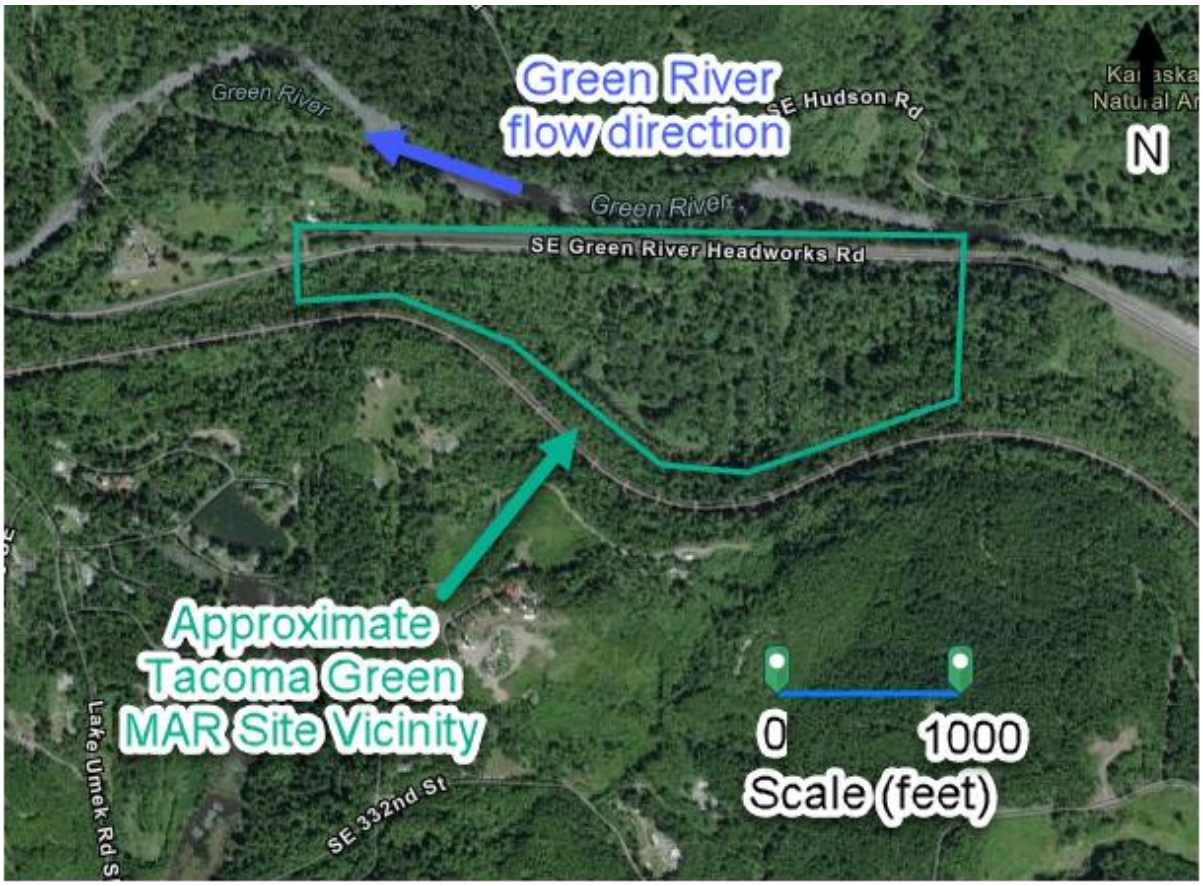
Annual Volume = Diversion Rate x Duration of Diversion (days)  Equation 1

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

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

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

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




### Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the mainstem of the Green River and in downstream subbasins.

### Location relative to future PE well demand.

The consumptive use estimate for the WRIA 9 Upper Middle Green River subbasin is 26.9 AF per year (GeoEngineers 2019). This project would also contribute to offsetting 85 AF per year of estimated consumptive use in the following downstream subbasins: Mid Middle Green, Lower Middle Green, Lower Green, and Duwamish.

### Performance goals and measures.

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

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

The Green River is inhabited by sockeye, fall chinook, coho, chum, bull trout, and winter and summer steelhead (WDFW 2020a and 2020b). Chinook and steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

## Identification of anticipated support and barriers to completion.

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

Ecology conducted outreach to Tacoma Water regarding the location of this project on their Green River filtration facility and Tacoma Water expressed support for the project concept.

The barriers to completion include funding for construction and O&M costs, and obtaining a water right from the Green River or the adjacent aquifer for beneficial use at the MAR facility.

## Potential budget and O&M costs.

To be determined.

## Anticipated durability and resiliency.

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

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

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

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

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

Washington Water Trust is a potential project sponsor.

## Documentation of sources, methods, and assumptions.

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

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

Geoengineers, Inc. (GeoEngineers). 2020. WRIA 9 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. February 2020.

Jones, M.A. 1999. Geologic Framework for the Puget Sound Aquifer System, Washington and British Columbia. USGS Professional Paper PP-1424-C, scale 1:100,000.

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

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

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

# WRIA 9 - Project Description
# Tacoma Water Streamflow Augmentation and Eagle Lake Siphon

October 12, 2020

## Project Name and Number
Tacoma Water Streamflow Augmentation and Eagle Lake Siphon (9-UG-W6)

## WRIA 9 WRE Subbasin
Upper Green River

## Water Offset
357 acre-feet per year (AF/yr)

## Narrative Description
This project would augment streamflow through the release of 2 cubic feet per second (cfs) of raw, untreated water for a period of 90 days (during the summer low-flow period) into the mainstem Green River using Tacoma Water's existing water rights. If this project is constructed, Tacoma Water envisions this could be done by requesting the Army Corps of Engineers release 2 cfs more water than what Tacoma Water withdraws as part of regular Howard Hanson Dam flow coordination.

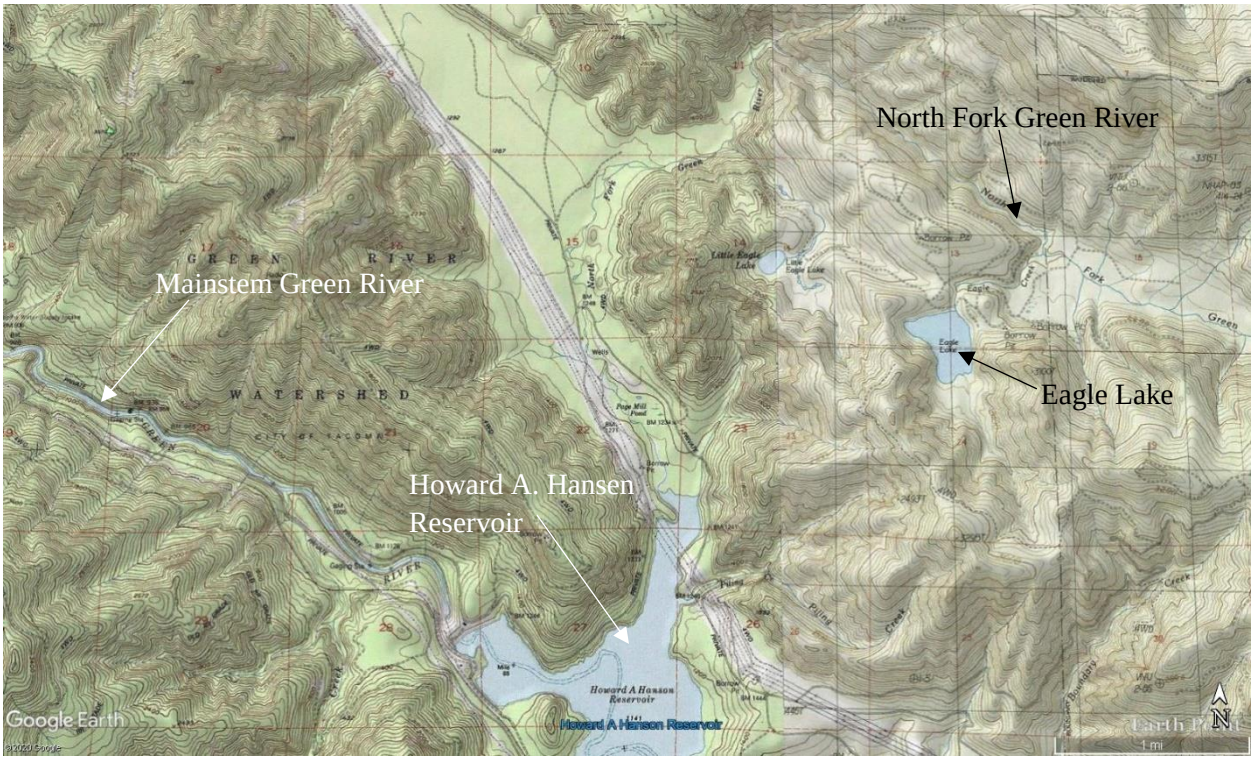
The commitment to release an additional 2 cfs to the Green River would be contingent on Tacoma Water securing a water right for up to 1,000 acre-feet (AF) per year of dead storage out of Eagle Lake to use as needed. This commitment would also be contingent on securing grant funding to construct the Eagle Lake Siphon project and any additional infrastructure required. This project is expected to improve streamflows in the Green River in summer when surface flows are generally lowest.

The streamflow benefits from this project would be additive and measurable, and go above Tacoma Water's existing instream flow commitments.

## Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits. Show how offset volume(s) were estimated.
The proposed streamflow augmentation project will result in benefits to the Green River by releasing an additional 2 cfs of water from behind Howard Hanson Dam for a period of 90 days. The anticipated offset volume for this project is 357 AF per year using Equation 1:

$$\text{Annual Volume} = \text{Release Rate} \times \text{Duration of Diversion (days)} \qquad \text{Equation 1}$$

## Conceptual-level map and drawings of the project and location.
The project site is shown in relation to surrounding physical features on the below conceptual-level map.




## Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the mainstem of the Green River within the following subbasins: Upper Green River, Upper Middle Green River, Mid Middle Green River, Lower Middle Green River, Lower Green River, and the Duwamish River.

### Location relative to future PE well demand

There is no forecast consumptive use for the WRIA 9 delineated Upper Green River subbasin (GeoEngineers 2020). This project would contribute to offsetting 111.9 AF per year of estimated consumptive use in the following downstream subbasins: Upper Middle Green, Mid Middle Green, Lower Middle Green, Lower Green, and Duwamish.

## Performance goals and measures.

The performance goals are to increase streamflow within the Green River by releasing 2 cfs of additional water during the summer low flow period. The performance measures will be an increase in streamflow in summer in the Green River.

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

The Green River is inhabited by sockeye, fall chinook, coho, chum, bull trout, and winter and summer steelhead trout (WDFW 2020a and 2020b).

## Identification of anticipated support and barriers to completion.

Tacoma Water has agreed to sponsor and commit to this project with the following conditions:

1. This commitment would be contingent on Tacoma Water securing a water right for up to 1000 AF per year of dead storage out of Eagle Lake to use as needed.

2. This commitment would be contingent on securing grant funding to construct the Eagle Lake Siphon project and any additional infrastructure required.

### Potential budget and O&M costs.

The project proponent estimates the total cost for pre-design, design, permitting, and construction of the Eagle Lake Siphon project will be approximately $315,000. The application process for securing a new water right is estimated to be $85,000, for a total project cost of approximately $400,000. Annual O&M costs are estimated to be approximately $10,000.

### Anticipated durability and resiliency.

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

- The project would be actively managed by Tacoma Water.
- The water source would be reliable and not subject to interruption.
- The project relies primarily on infrastructure that is already in place and maintained for the purposes of flood control and drinking water storage.
- The rate of release would be maintained through engineering controls and conveyed with minimal loss to the river.
- Seasonal streamflow variation would have negligible impact on project function.
- Land use changes would have negligible impact on project function.

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

- The ability to use water from dead storage in Eagle Lake will increase resiliency to drought or other climatic conditions.

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

The identified project sponsor is Tacoma Water. The sponsor contact is Greg Volkhardt, Water Division Manager. The sponsor is willing to proceed with scoping, reconnaissance, and project management support. Implementation will be dependent on several factors, including funding.

### Documentation of sources, methods, and assumptions.

GeoEngineers, Inc. and NHC. 2020. WRIA 9 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. February 21, 2020.

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

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

# WRIA 9 - Project Description
# Mill Creek Tributary 51 Basin Retrofit

November 9, 2020

## Project Name and Number
Mill Creek Stormwater Retrofit (9-LG-H7)

## WRIA 9 WRE Subbasin
Lower Green River

## Narrative Description
King County is conducting a retrofit planning project in the Mill Creek Tributary 51 drainage basin west of Auburn. The project will identify potential stormwater retrofit sites and select one concept to advance to 90% design.

This project will help protect and restore water quality by reducing stormwater impacts from existing infrastructure and development within the basin. The Mill Creek Tributary 51 watershed is identified by Ecology's map of target watersheds for stormwater retrofit as having an "integrity score" of 9-. This is the highest score possible and suggests that retrofit actions within the watershed will have a greater probability of contributing to the recovery and stability of a functioning aquatic ecosystem.

If constructed, this project will meet King County's sustainability infrastructure scorecard by: implementing erosion and sedimentation control best management practices, using on-site materials in construction as best as possible and enhancing riparian conditions, planning for efficient construction delivery and staging, and reusing native soils and, to the extent possible, angular rock on-site.

## Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable.
Infiltration retrofits or enhancements redirect surface runoff to groundwater, delaying contribution to streamflow. The project design will be determined by the study so potential offsets cannot be determined at this time. Infiltration offsets will depend on the pond design and infiltration capacity, size of the contributing area, and local hydrogeology.

A rough estimate of potential infiltration for a typical project can be made using assumed project characteristics (infiltration area and rate) and rainfall frequency characteristics to estimate availability of inflow for infiltration. Assuming a pond infiltration footprint of 3,000 square feet and an average of 800 hours of rain per year, on the order of 2 to 14 acre-feet could be infiltrated per year on average, depending on infiltration rate.

## A map and drawings of the project location.
Watershed map and proposed location map provided at end of description.

## Description of the spatial distribution of likely benefits.
Primary benefits expected for Mill Creek Tributary 51. Benefits may carry down to Mill Creek.

## Performance goals and measures.
To be determined.

### Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

Coho, chum, and winter steelhead have been observed spawning in Mill Creek. Juvenile coho, chum, winter steelhead, cutthroat, and Chinook have been captured in the creek (Kerwin and Nelson, 2000). The Lower Green River Baseline Habitat Survey Report (Anchor Environmental, 2004) provides detailed information about fisheries habitat conditions in the Mill Creek area. Chinook and Steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

### Identification of anticipated support and barriers to completion.

To be determined.

### Estimate of capital costs and reoccurring O&M costs.

To be determined.

### Project durability and resiliency.

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

- Stormwater infrastructure would be maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate would be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- The subject river reach is perennially gaining and the anticipated range in regional groundwater elevation fluctuation would not impact the groundwater flow field in a manner that impacts the project offset.
- Land use changes external to the project site would have negligible impact on project function.
- The water source likely would lack the predictability inherent to other types of managed aquifer recharge projects because it relies on the timing, rate, and volume of area precipitation.

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

- The project water source is not tied to the water right permitting process and is not subject to regulatory or other anthropogenic interruption.
- The project does not remove water from surface water, and therefore is not reliant on minimum streamflow requirements.
- The project does not remove water from a groundwater body, and therefore is not subject to well interference.
- The project diversion can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the stormwater infiltration site and surrounding area likely would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

- Project function could be impacted by a decrease in summer precipitation, drought conditions, an increase in the frequency and/or intensity of storm events, an increase in evaporation, or other climatic factors.

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

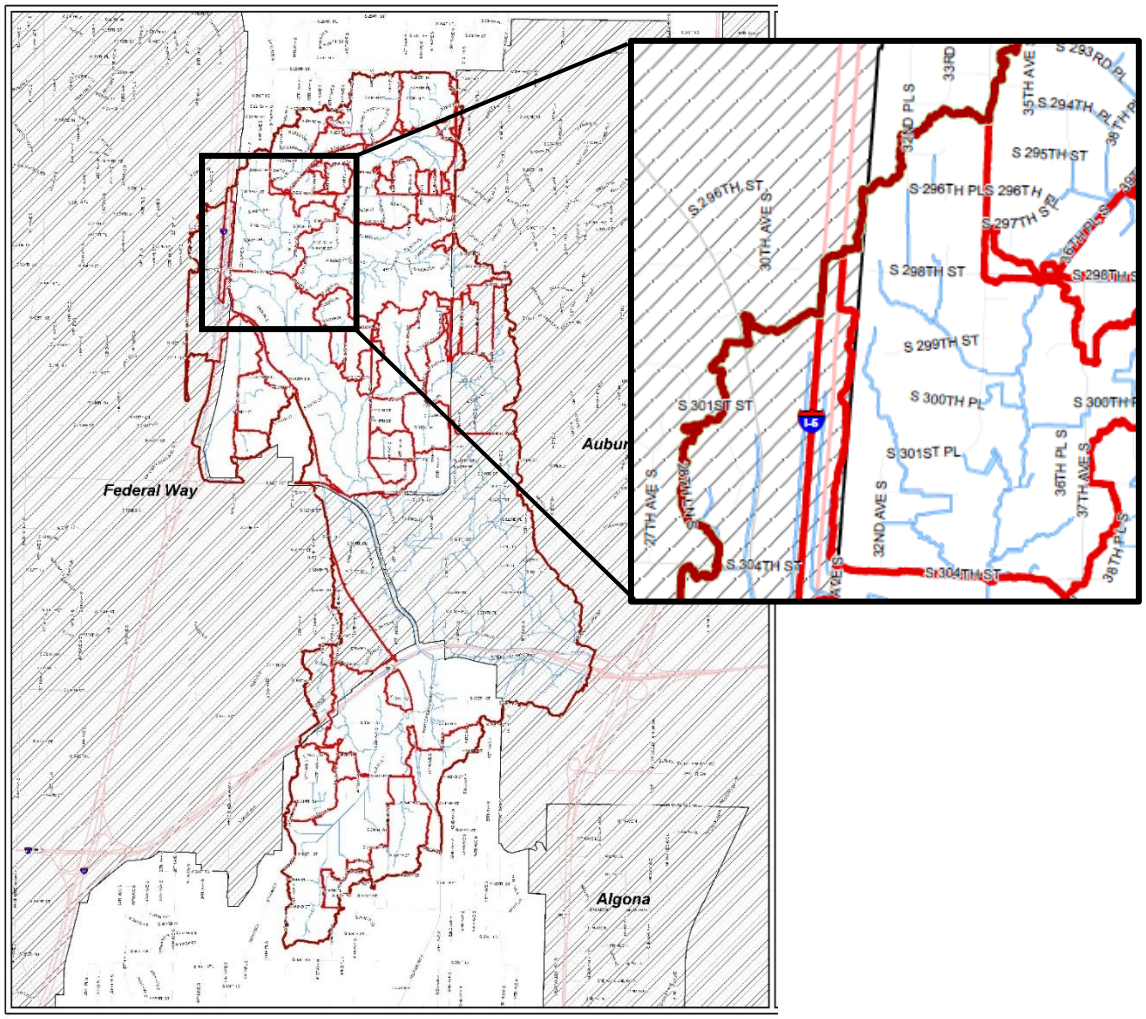
King County is the likely project sponsor. Project has not yet been identified and would not be implemented until 2022 at the earliest.

## Documentation of sources.

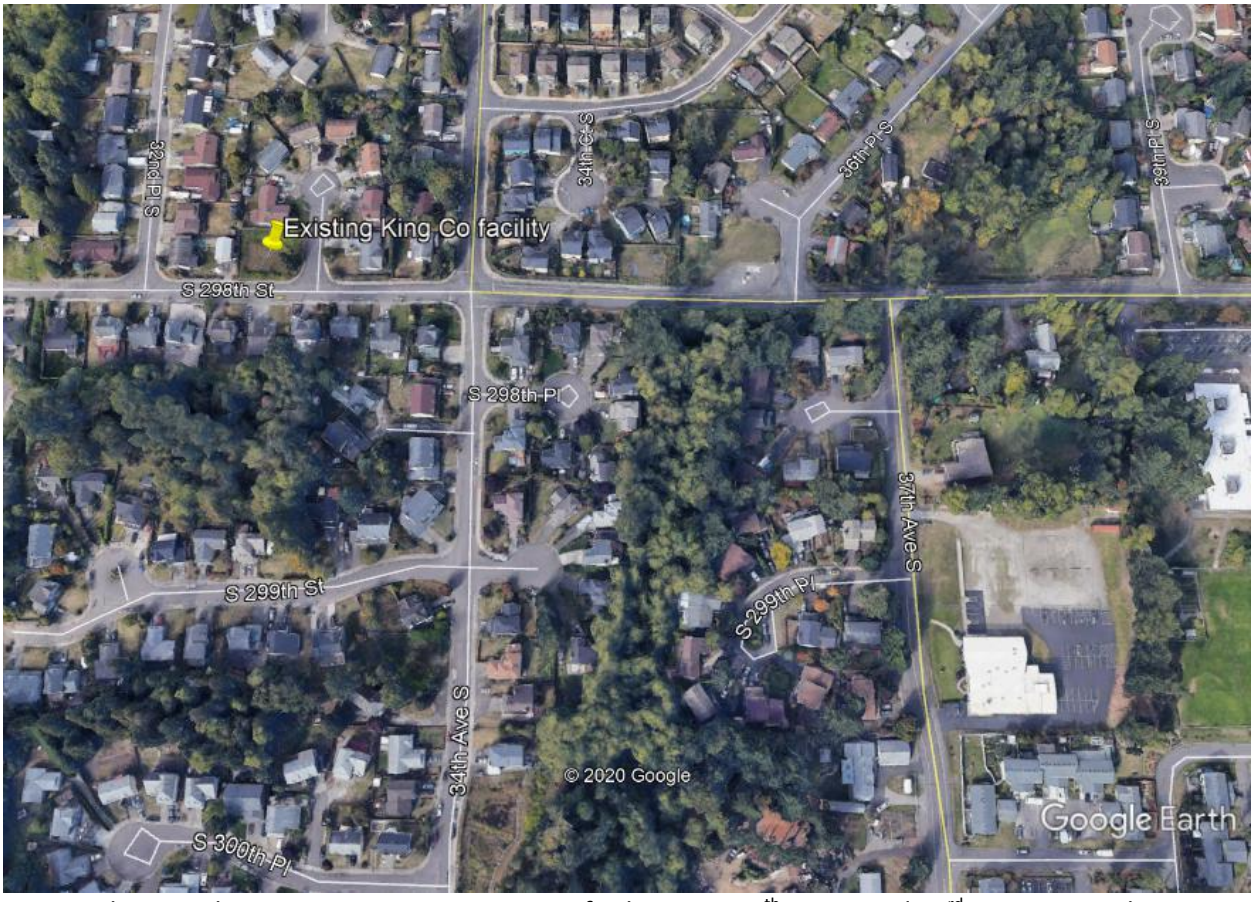

Anchor Environmental, L.L.C. 2004. Lower Green River Baseline Habitat Survey Report. Report prepared for WRIA 9 Technical Committee and King County Department of Natural Resources.

Kerwin, John and Nelson, Tom S. (Eds.). December 2000. "Habitat Limiting Factors and Reconnaissance Assessment Report, Green/Duwamish and Central Puget Sound streams-data (WRIA 9 and Vashon Island)." Washington Conservation Commission and the King County Department of Natural Resources.

King County Water and Land Resources Division. January 2019. Project Charter: Mill Creek Tributary 51 Small Basin Retrofit Planning & Design, Project Number 1129500, 15 January 2019.


Tributary 51 drainage basin with project area inset



Proposed project location – existing stormwater facility at S 298th Street and 33rd Avenue S, Auburn. (Google Earth image)

# WRIA 9 - Project Description
# Lower Soos Creek Restoration

October 16, 2020

## Project Name and Number
Lower Soos Creek Restoration (9-S-H8)

## WRIA 9 WRE Subbasin
Soos Creek

## Narrative Description
This project includes land acquisition, design and permitting, and restoration actions along Lower Soos Creek, a tributary to the Green River, east of Auburn, Washington. Collectively, these proposed actions will improve the aquatic, riparian and wetland habitat. The project is located within the WRIA 9 Soos Creek subbasin.

This proposed restoration actions include acquiring land adjacent to the stream, removing structures from floodplain, placing large woody debris (LWD) in the stream channel and wetlands and revegetating the stream and wetland areas with native trees and shrubs. These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Pink, Sockeye, Bull Trout and resident Cutthroat Trout that utilize the Green River as rearing habitat. Chinook, Steelhead, and Bull Trout are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
The proposed project will restore three miles of stream. Installation of LWD has several ecological functions including managing flows, creating deeper pools that provide refugia for fish, preventing bank erosion, and trapping organic material that provides nutrients for insects and invertebrates which are a prey source for fish. Planted native trees and shrubs will provide instream shade to protect salmon and other fish species that utilize this habitat.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves restoration of aquatic, riparian and wetland habitats along three miles of Lower Soos Creek within the Soos Creek subbasin east of Auburn, Washington.

## Performance goals and measures.
Acres acquired, structures removed, large logs installed instream, and number of trees and shrubs planted.

## Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.
These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Pink, Sockeye, Bull Trout and resident Cutthroat Trout that utilize Lower Soos Creek and the Green River. Chinook,

Steelhead, and Bull Trout are priority species, protected under the ESA. Specifically, salmonids have been documented as using this stream section for spawning and rearing. LWD and riparian plantings will directly benefit prey availability, spawning success as well as survival of pre-migrant and out-migrating juvenile salmonids.

### Identification of anticipated support and barriers to completion.

The acquisition and restoration efforts will be supported by King County, WDFW, and NGOs such as the Green River Coalition, Soos Creek Area Response, and Friends of Soos Creek. The only barrier to completion pertains to a lack of funding.

### Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels, design and permit, and revegetate stream and wetland areas is anticipated to be approximately $1.5 million.

### Anticipated durability and resiliency.

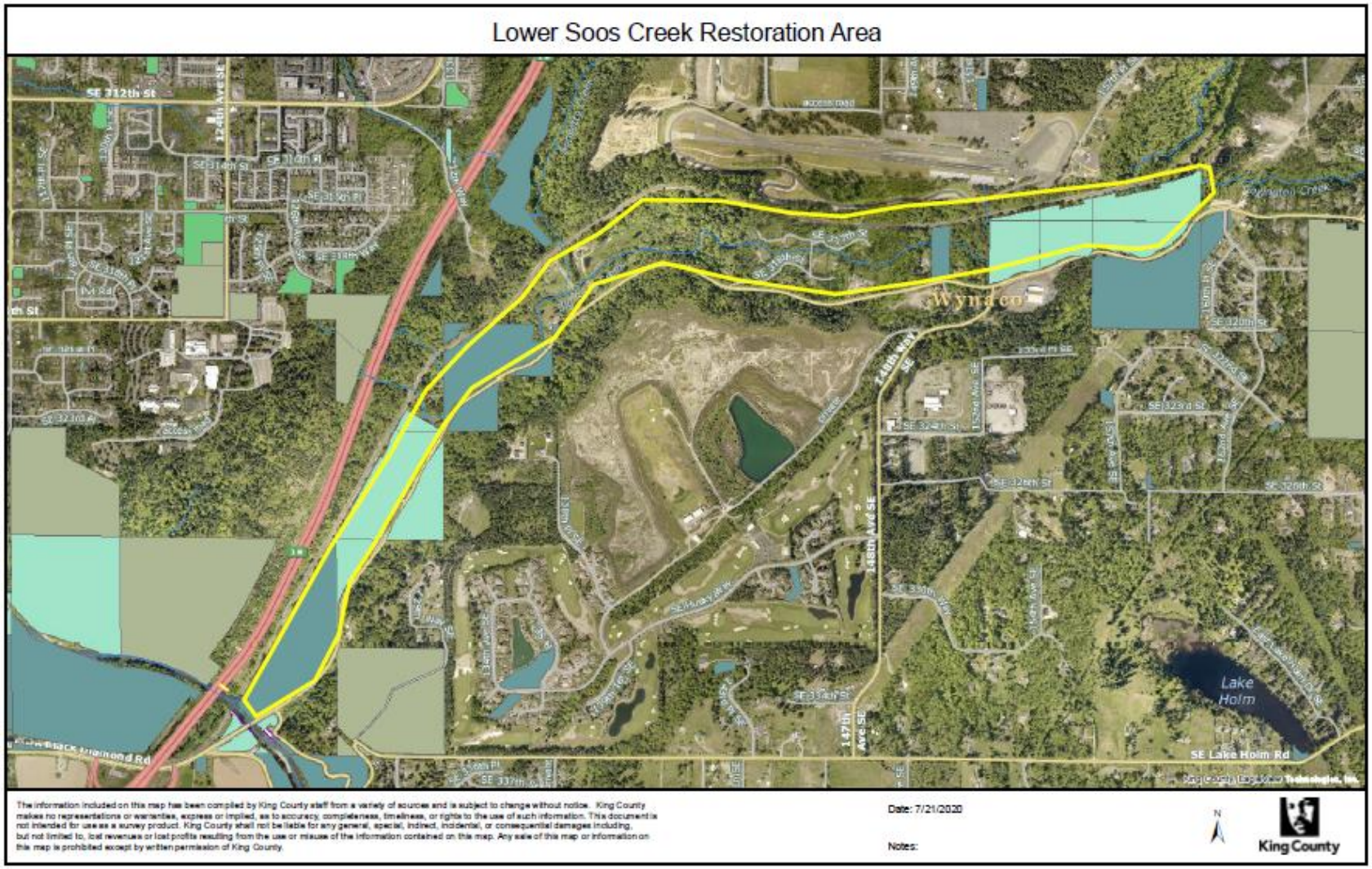
Once the native plants are installed, irrigation and maintenance will be required to ensure plant survival and to manage non-native/invasive plant species. Monitoring plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for a minimum of five years post-project implementation.

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

King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with scoping and reconnaissance immediately.

### Documentation of sources.

None




Site Plan for Lower Soos Creek Restoration Area

# WRIA 9 - Project Description
# Turley Levee Setback

October 16, 2020

## Project Name and Number
Turley Levee Setback (9-LMG-H9)

## WRIA 9 WRE Subbasin
Lower Middle Green River

## Narrative Description
This project includes land acquisition, design and permitting to setback 1,000 feet of the Turley Levee, located along the Green River east of Auburn, Washington. Collectively, these efforts will improve floodplain connectivity and create 40 acres of aquatic habitat as the river traverses an unconstrained floodplain. The project is located within the WRIA 9 Lower Middle Green River subbasin.

This proposed project will remove the levee and relocate gravel in the levee under-structure into the river channel. The setback levee will be constructed away from the river. This project includes installation of dozens of large trees with root wads in the river channel and remnant river channel, which currently lack large woody debris (LWD). In addition, hundreds of native trees and shrubs will be planted within the riparian and wetland habitats created. These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Pink, Sockeye, Bull Trout and resident Cutthroat Trout that utilize the Green River as rearing habitat. Chinook, Steelhead, and Bull Trout are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Quantitatively, this project includes removal of the current levee, which is 1,300-feet long by 50-feet wide, installation of dozens of large trees with root wads into the river channel and associated floodplain wetlands, and planting hundreds of native trees and shrubs. The setback levee will be approximately 1,000-feet long. The total project area is 53 acres and is projected to create 40 acres of salmon rearing habitat as the river reestablishes the floodplain within this area.

The addition of gravel material from the levee under-structure into the river will improve spawning and rearing habitat. Installation of LWD has several ecological functions including managing flows, creating deeper pools that provide refugia for fish, preventing bank erosion, and trapping organic material that provides nutrients for insects and invertebrates, which are a prey source for fish. Planted native trees and shrubs will provide instream shade to protect salmon and other fish species that utilize this habitat.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves setting back the Turley Levee located along the right bank of the Green River within the Lower Middle Green River subbasin east of Auburn, Washington. The total project area proposed for restoration is approximately 53 acres, with creation of 40 acres of aquatic habitat for rearing salmonids.

The length of Turley Levee is 1,800 feet. This proposed project would remove the existing levee and construct a setback feature for erosion control a substantial distance from the river (over 800').

### Performance goals and measures.

Performance goals and measures will be based on length of levee removed, area of floodplain reconnected to the river, number of large wood structures placed in the floodplain, and number of trees and shrubs planted.

### Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Pink, Sockeye, Bull Trout and resident Cutthroat Trout that utilize the Green River. Chinook, Steelhead, and Bull Trout are priority species, protected under the ESA. Specifically, salmonids have been documented as using this river section for spawning and rearing habitat. Levee setback will expand existing aquatic habitat by 40 acres. Gravel placement, LWD and riparian plantings will directly benefit prey availability, spawning success as well as survival of pre-migrant and out-migrating juvenile salmonids.

### Identification of anticipated support and barriers to completion.

Funding is primary barrier, along with landowner willingness and King County's Farmland Preservation Program covenants which makes it challenging to build habitat restoration projects.

### Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels, design, and permit, remove levee structure, replace levee and replant will be approximately $6 million.

### Anticipated durability and resiliency.

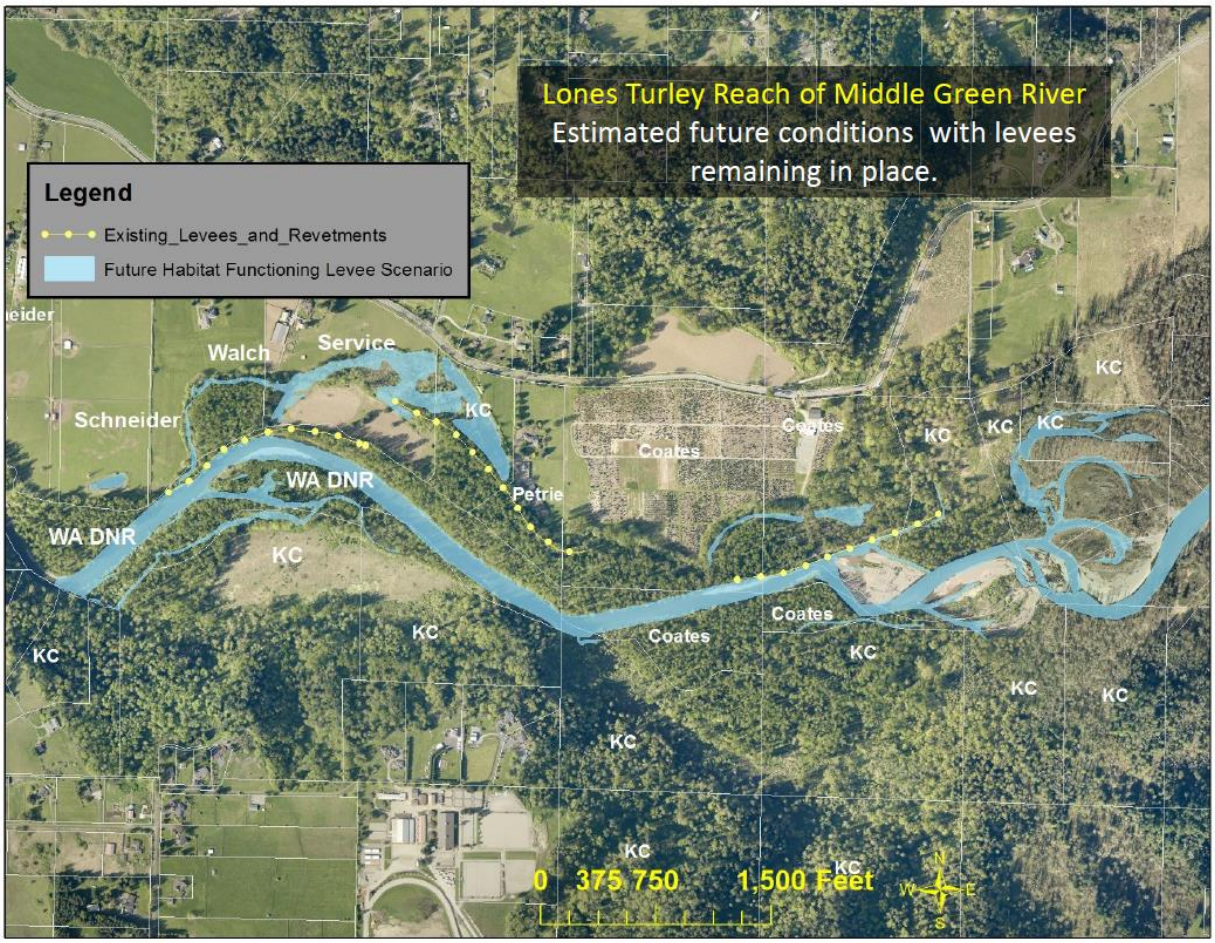
Once the native plants are installed, irrigation and maintenance will be required to ensure plant survival. Monitoring of plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for five years.

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

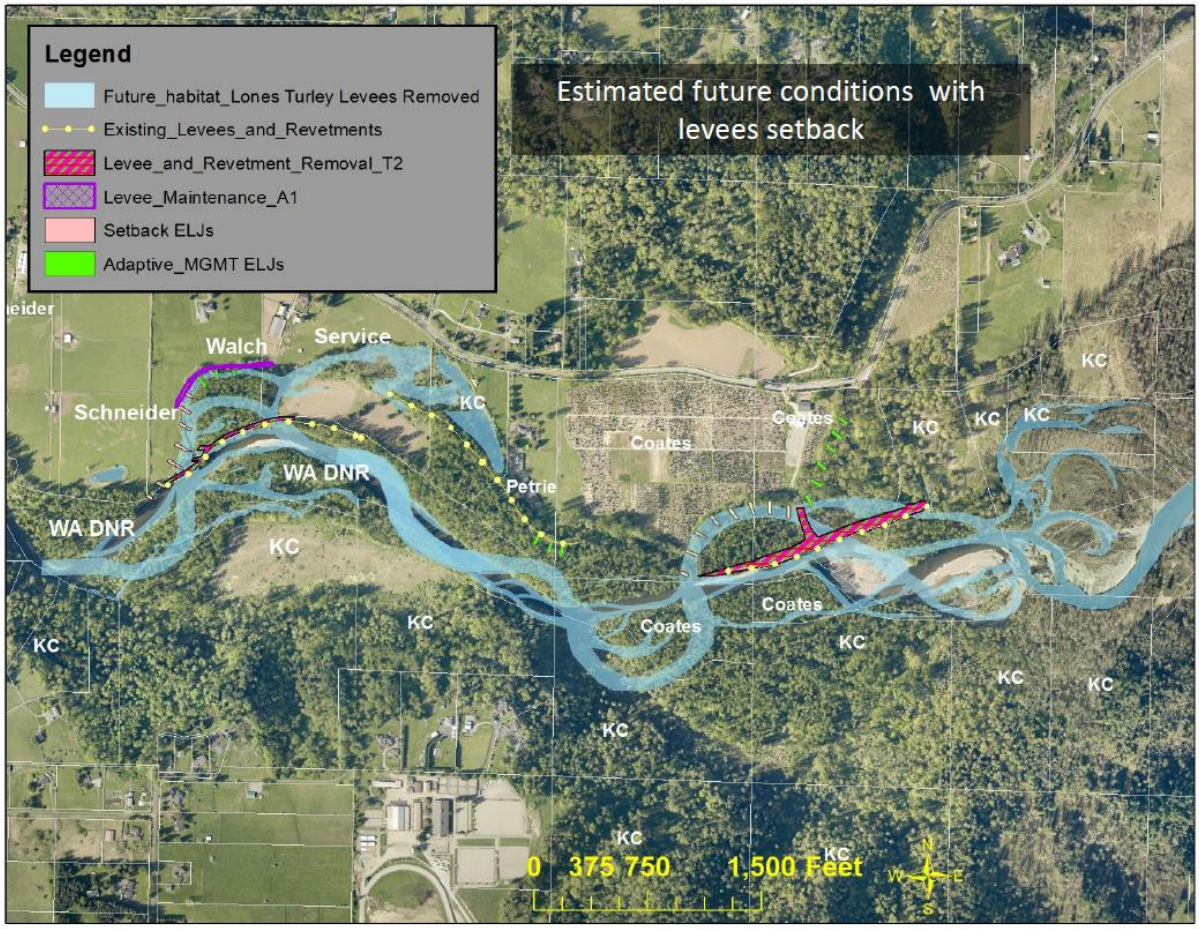
King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with scoping and reconnaissance immediately.

### Documentation of sources.

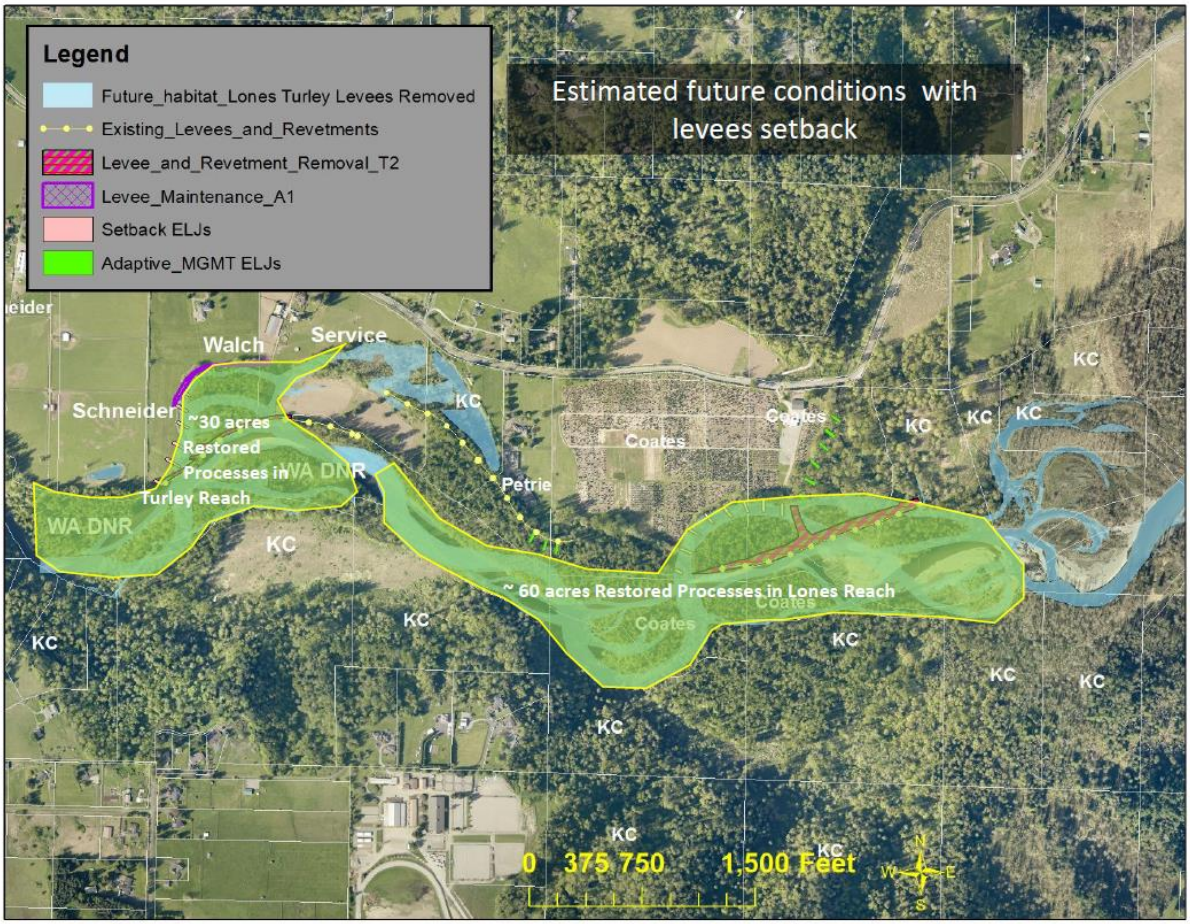
None



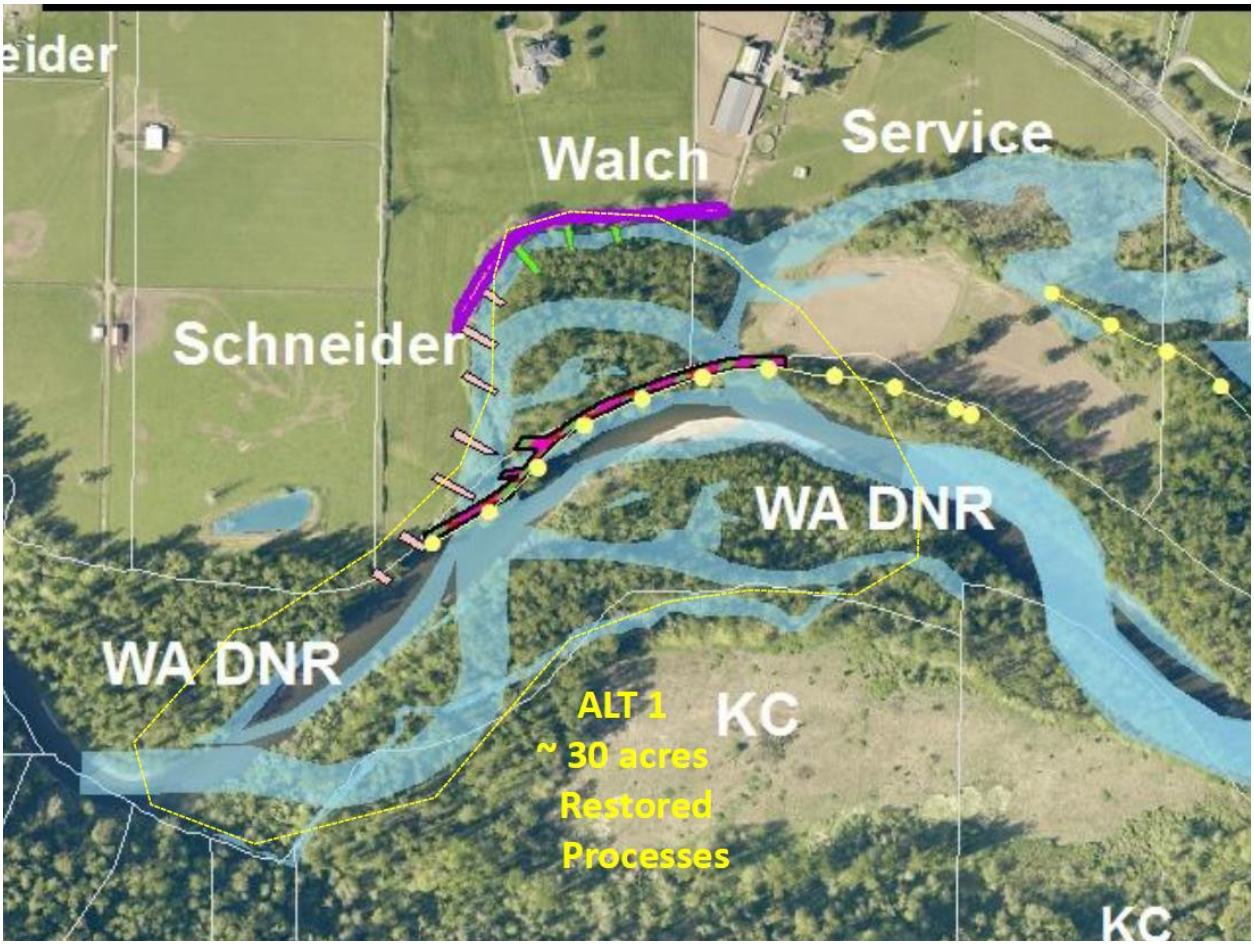

Site Plan for Turley Levee Setback – Estimated Future Conditions with Levees Remaining in Place



Site Plan for Turley Levee Setback -Estimated Future Conditions with Levees Setback




Site Plan for Turley Levee Setback -Estimated Future Conditions with Levees Setback



Site Plan for Turley Levee Setback -Estimated Future Conditions with Levees Setback

# WRIA 9 - Project Description
# Hamakami Levee Setback

October 16, 2020

## Project Name and Number
Hamakami Levee Setback (9-LMG-H10)

## WRIA 9 WRE Subbasin
Lower Middle Green River

## Narrative Description
This project includes land acquisition, design and permitting to setback the Hamakami Levee located along the Green River east of Auburn, Washington. Collectively, these efforts will improve floodplain connectivity and create 40 acres of aquatic habitat as the river traverses an unconstrained floodplain. The project is located within the WRIA 9 Lower Middle Green River subbasin.

This proposed project will remove the levee and relocate gravel in the levee under-structure into the river channel. The setback levee will be constructed away from the river. This project includes installation of dozens of large trees with root wads in the river channel and remnant river channel, which currently lack large woody debris (LWD). In addition, hundreds of native trees and shrubs will be planted within the riparian and wetlands habitats created. These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Pink, Sockeye, Bull Trout and resident Cutthroat Trout that utilize the Green River as rearing habitat. Chinook, Steelhead, and Bull Trout are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Quantitatively, this project includes removal of the current levee which is 1,200-feet long by 50-feet wide, installation of dozens of large trees with root wads into the river channel and associated floodplain wetlands, and planting hundreds of native trees and shrubs. The setback levee will be at least 1,200-feet long. The total project area is 47 acres and is projected to create 35 acres of salmon rearing habitat as the river reestablishes the floodplain within this area.

The addition of gravel material from the levee under-structure into the river will improve spawning and rearing habitat. Installation of LWD has several ecological functions including managing flows, creating deeper pools that provide refugia for fish, preventing bank erosion, and trapping organic material that provides nutrients for insects and invertebrates which are a prey source for fish. Planted native trees and shrubs will provide instream shade to protect salmon and other fish species that utilize this habitat.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves setting back the Hamakami Levee located along the right bank of the Green River within the Lower Middle Green River subbasin east of Auburn, Washington. The total project area proposed for restoration is approximately 47 acres, with creation of 35 acres of aquatic habitat for rearing salmonids.

### Performance goals and measures.
Performance goals and measures will be based on length of levee removed, area of floodplain reconnected to the river, number of large wood structures placed in the floodplain, and number of trees and shrubs planted.

### Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.
These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Pink, Sockeye, Bull Trout and resident Cutthroat Trout that utilize the Green River. Chinook, Steelhead, and Bull Trout are priority species, protected under the ESA. Specifically, salmonids have been documented as using this stream sections for spawning and rearing habitat. Levee setback will expand existing aquatic habitat by 35 acres. Gravel placement, LWD and riparian plantings will directly benefit prey availability, spawning success as well as survival of pre-migrant and out-migrating juvenile salmonids.

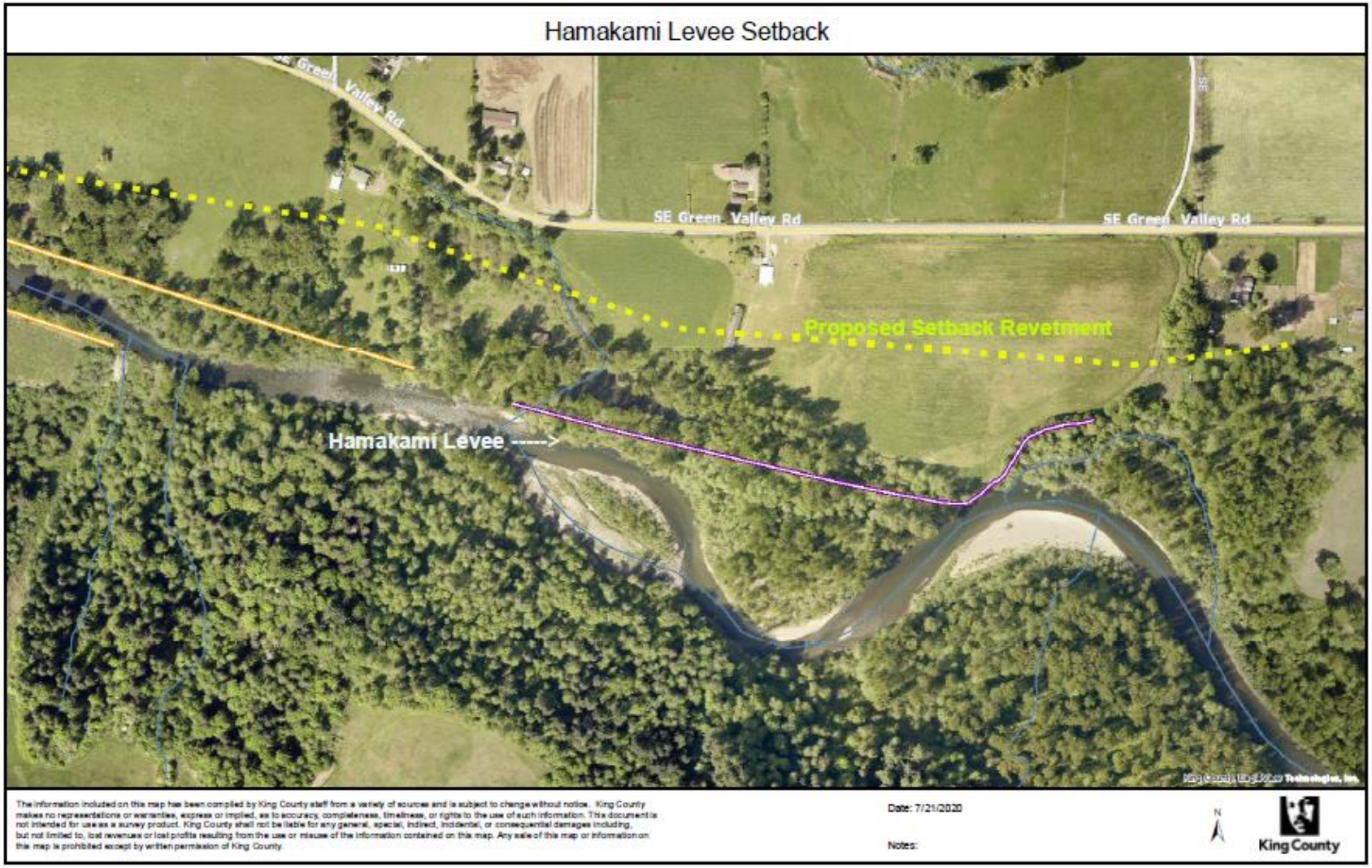
### Identification of anticipated support and barriers to completion.
Funding is primary barrier, along with landowner willingness and King County's Farmland Preservation Program covenants which makes it challenging to build habitat restoration projects.

### Estimate of capital costs and reoccurring O&M costs.
Estimated total cost to acquire target parcels, design and permit, remove levee structure, replace levee and replant will be approximately $6 million.

### Anticipated durability and resiliency.
Once the project is implemented, long-term ecological monitoring will take place for at least 10 years.

### Project sponsor(s) (if identified) and readiness to proceed/implement.
King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with scoping and reconnaissance immediately.

### Documentation of sources.
None




Site Plan for Hamakami Levee Setback

# WRIA 9 - Project Description
# Burns Creek Restoration

October 5, 2020

## Project Name and Number
Burns Creek Restoration (9-LMG-H11)

## WRIA 9 WRE Subbasin
Lower Middle Green River

## Narrative Description
This project includes acquisition of several parcels or portions of parcels of land, and construction of associated habitat restoration along the lower two miles of Burns Creek, a tributary to the Green River, located east of Auburn, Washington. This project is located within the WRIA 9 Lower Middle Green River subbasin.

This proposed project will install hundreds of large trees with root wads in the stream and wetlands, as these habitats are almost completely lacking in-channel large woody debris (LWD). In addition, thousands of native trees and shrubs will be planted within the riparian and wetlands habitats created. These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, and resident trout that utilize these streams as spawning and rearing habitat. Chinook and Steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Quantitatively, the project includes acquiring several parcels along Burns Creek, installing of large logs with root wads into the stream and associated wetlands, and planting thousands of native trees and shrubs along the lower two miles of stream.

Large instream wood has several ecological functions including managing flows, creating deeper pools that provide refugia for fish, preventing bank erosion, and trapping organic material that provides nutrients for insects and invertebrates which are a prey source for fish. Planted native trees and shrubs will provide shade in stream sections which currently reach temperatures that are approximately 6˚ C above the threshold for protection of designated aquatic life use for Core Summer Salmonid Habitat.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves work along the lower two miles of Burns Creek, a tributary to the Green River, just east of Auburn, Washington. Estimated acreage of restored riparian zone: 28.

### Performance goals and measures.

Acres acquired and protected, large log structures installed instream, and number of trees and shrubs planted in the Burns Creek riparian zone.

### Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, and resident trout that utilize Burns Creek. Chinook and Steelhead are priority species, protected under the ESA. Specifically, salmonids have been documented as using this lower section of Burns Creek for spawning and rearing habitat. LWD and riparian and wetland plantings will directly benefit prey availability, spawning success as well as survival of pre-migrant and out-migrating juvenile salmonids.

### Identification of anticipated support and barriers to completion.

Funding and landowner willingness to sell their property.

### Estimate of capital costs and reoccurring O&M costs.

Total cost to acquire target parcels, remove structures and replant is estimated at $2,000,000.

### Anticipated durability and resiliency.

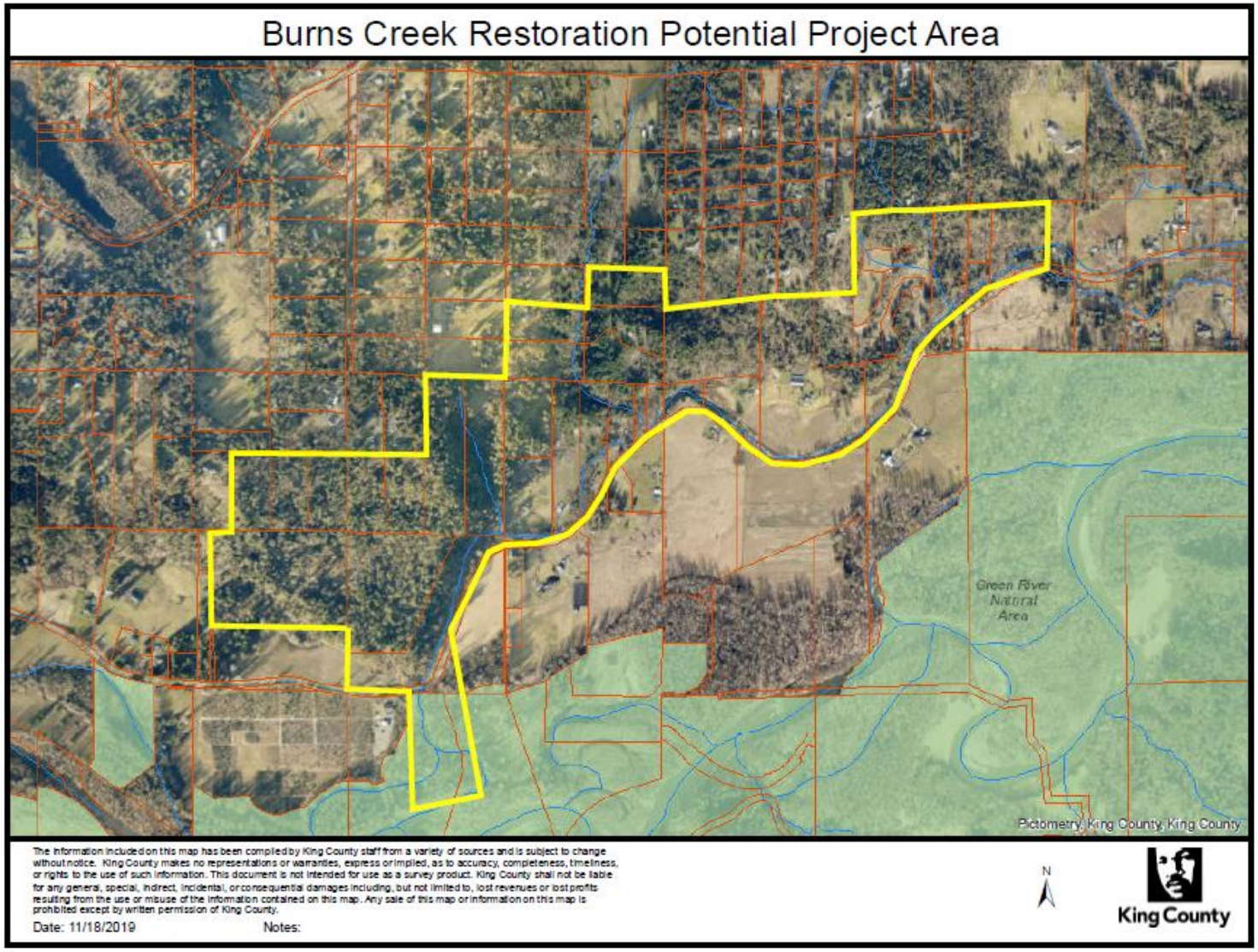
Once the native plants are installed, irrigation and maintenance will be required to ensure plant survival. Monitoring of plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for a minimum of five years post-planting.

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

King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with the acquisition process immediately upon receipt of funding.

### Documentation of sources.

None




Site Plan for Burns Creek Restoration Area

# WRIA 9 - Project Description
# Crisp Creek Watershed Protection Project

October 6, 2020

## Project Name and Number
Crisp Creek Watershed Protection Project (9-MMG-H12)

## Narrative Description
This project supports an ongoing effort within the Crisp Creek watershed to acquire undeveloped forest lands which would benefit the hydrologic integrity of the WRIA 9 Mid Middle Green River subbasin and protect the water supply and water rights for the Muckleshoot Indian Tribe's Keta Creek Hatchery. The Crisp Creek watershed is located in South King County between the cities of Black Diamond and Maple Valley, Washington and Crisp Creek is an important tributary to the Green River. Watershed protection through land acquisition is important to the Class A Diamond Springs Water Association's water supply. Crisp Creek is one of the highest quality streams in King County and provides cold, clean water to the Green River. This project would be phased in over time and would involve preserving over 400 acres. Protection of the hydrologic function within the Crisp Creek watershed will benefit both hatchery and wild salmon in the Green River including Chinook, Coho, Steelhead, and Chum. Chinook and Steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Acquiring undeveloped forest land within the Crisp Creek watershed protects the long-term hydrologic integrity of the basin, the water quality of Crisp Creek, and the fisheries and aquatic resources of the Green River.

## A map and drawings of the project location.
The project area is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves acquisition of numerous parcels of undeveloped forest land within the Crisp Creek watershed. Distribution of benefits is dependent on the location of acquired parcels within the watershed, but all parcels will be within the Mid Middle Green River subbasin.

## Performance goals and measures.
To be determined.

## Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.
Protection of the hydrologic function through acquisition of developed or undeveloped land within the Green River Watershed has the potential to benefit salmon, including Chinook, Coho, Steelhead, and Chum. Chinook and Steelhead are priority species, protected under the ESA.

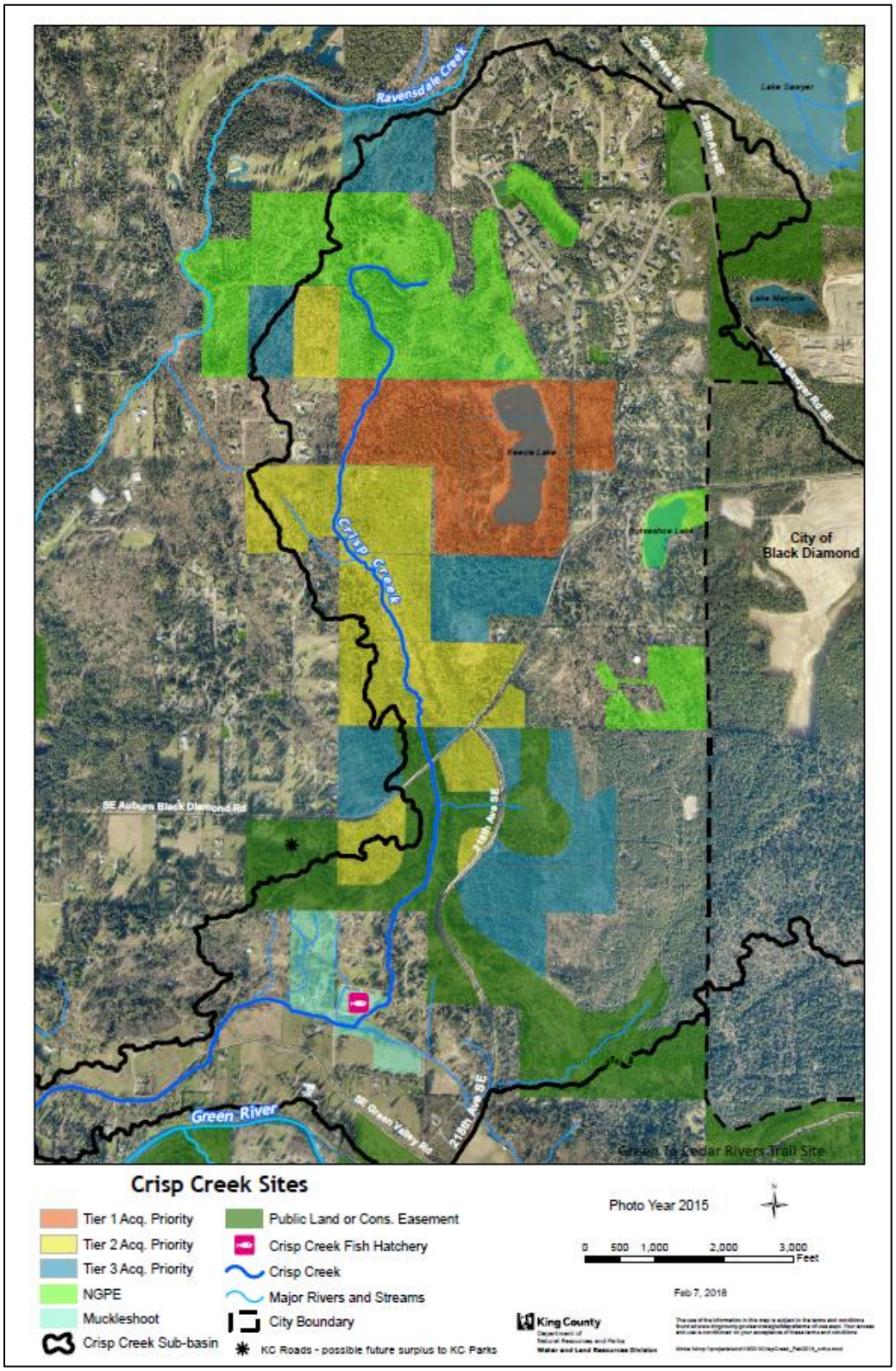
## Identification of anticipated support and barriers to completion.
To be determined.

### Estimate of capital costs and reoccurring O&M costs.
Estimated total cost to acquire target parcels is currently unknown.

### Anticipated durability and resiliency.
The acquisition and protection of land in the Crisp Creek sub-watershed will provide increased resiliency for the basin to provide continual cold, clean water to the downstream fish hatchery and to the Green River salmon resources.

### Project sponsor(s) (if identified) and readiness to proceed/implement.
Muckleshoot Indian Tribe and King County. Sponsor contact: Carla Carlson, Carla.Carlson@muckleshoot.nsn.us. The sponsor is ready to proceed with scoping and reconnaissance immediately. There are only a few landowners in the upper portion of the Crisp Creek basin, each owning substantial land.

### Documentation of sources.
None




Site Plan for Crisp Creek Restoration Area

# WRIA 9 - Project Description
# Flaming Geyser Revegetation

October 16, 2020

## Project Name and Number
Flaming Geyser Revegetation (9-MMG-H13)

## WRIA 9 WRE Subbasin
Mid Middle Green River

## Narrative Description
This project includes revegetating the Green River riparian zones and floodplain wetland within Flaming Geyser State Park which is located about eight miles east of Auburn, Washington. This effort will improve shade and overhanging cover to the river which will moderate water temperatures, reduce evaporation, and enhance fish habitat. The project is located within the WRIA 9 Mid Middle Green River subbasin.

These restoration actions will benefit Chinook, Coho, steelhead, chum, pink, and sockeye salmon, and cutthroat trout that use the Green River for spawning and rearing habitat. Chinook and Steelhead are protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Planting thousands of native trees and shrubs will provide instream shade to the river to moderate water temperatures and protect salmon and other fish species that use this habitat. Post planting, the trees and shrubs will be monitored and maintained for a minimum of five years.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves planting the riparian zone of the Green River as it flows for two miles through Flaming Geyser State Park which is currently mostly unvegetated. The total project area proposed for restoration is approximately 42 acres.

## Performance goals and measures.
Acres and stream miles revegetated and number and percentage of trees and shrubs that survived after five years.

## Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.
The proposed revegetation action will benefit Chinook, Coho, Steelhead, Chum, Pink, and Sockeye salmon, along with resident Cutthroat Trout. Chinook and Steelhead are protected under the ESA. Specifically, salmonids have been documented as using this river section for spawning and rearing habitat.

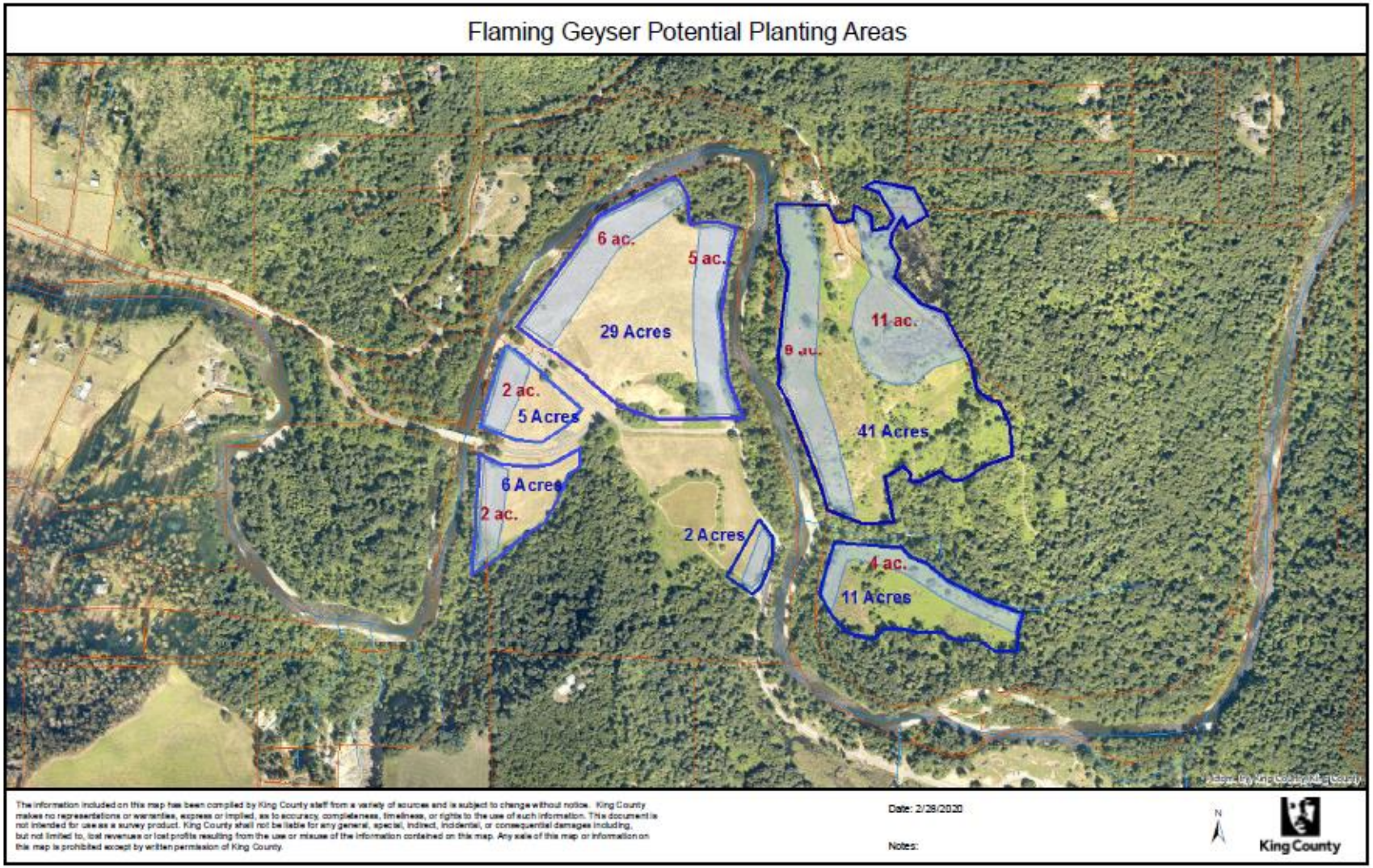
### Identification of anticipated support and barriers to completion.
Funding is our only limiting factor at this point.

### Estimate of capital costs and reoccurring O&M costs.
Estimated total cost to revegetate the 42 acres of riparian habitat and monitor and maintain the sites is approximately $1.5 million.

### Anticipated durability and resiliency.
Once native plants are installed, irrigation and maintenance will be required to ensure plant survival. Monitoring and maintenance of planted vegetation will be performed for five years.

### Project sponsor(s) (if identified) and readiness to proceed/implement.
King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with scoping and reconnaissance immediately.

### Documentation of sources.
None




Site Plan for Flaming Geyser Potential Planting Area.

# WRIA 9 - Project Description
# Newaukum Creek Riparian Revegetation and Beaver Colonization

October 16, 2020

## Project Name and Number
Newaukum Creek Riparian Revegetation and Beaver Colonization (9-N-H14)

## WRIA 9 WRE Subbasin
Newaukum Creek

## Narrative Description
This project includes acquisition of several parcels along Newaukum Creek and Big Spring Creek located in the City of Enumclaw, Washington. The project is located within the WRIA 9 Newaukum Creek subbasin.

This project targets sections of Newaukum Creek and Big Spring Creek that currently have low effective shade with corresponding high water temperatures. This proposal includes removing structures (buildings, fences, septic infrastructure, etc.) along these stream sections and planting 160,000 native trees and shrubs on 61 acres. These streams flow through active agricultural lands and a livestock exclusion fence will be constructed at one of the sites. These actions will attract beaver colonization, which occurred at a nearby restoration site along Big Spring Creek. Beavers will construct dams and maintain streamflows by ponding water. Shade from installed riparian vegetation will moderate water temperature, reduce evaporation and create habitat. This could be particularly beneficial to documented Chinook, Coho, Steelhead, Chum, Sockeye and resident trout that utilize these streams as spawning and rearing habitat. Chinook and Steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Quantitatively, this project will include planting 160,000 native trees and shrubs on 61 acres along Newaukum Creek and Big Spring Creek. Approximately four miles of stream (one side of creek) will be planted as part of this project.

Native trees and shrubs will provide shade along these stream sections which currently reach temperatures that meet or exceed the threshold for protection of designated aquatic life use of Core Summer Salmonid Habitat. Beaver colonization will result in dams, which will slow water and produce ponds of deeper, cooler water for fish. Newly planted trees will serve as a food supply to attract and support beaver colonization.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

### Description of the spatial distribution of likely benefits.

This project involves three sites along Newaukum Creek: Brandjes, Gaddy and Gwerder. All three project sites are in the City of Enumclaw, Washington. The Brandjes site is 14 acres, Gaddy site is 9 acres and the Gwerder site is 38 acres, for a total project area of 61 acres along Newaukum Creek and Big Spring Creek. This project will plant native trees and shrubs across 61 acres of riparian zone/wetland habitat.

### Performance goals and measures.

Acres and stream miles revegetated. Also, localized flooding as a result of beaver dam construction will have to be monitored and addressed, if necessary, by King County.

### Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Sockeye, and resident trout that utilize these streams. Chinook and Steelhead are priority species, protected under the ESA. Specifically, salmonids have been documented as using these stream sections for spawning and rearing habitat. Improving streamflows and water temperatures through beaver colonization and riparian plantings will directly benefit spawning success as well as survival of pre-migrant and out-migrating juvenile salmonids.

### Identification of anticipated support for and barriers to completion.

Funding is our only limiting factor at this point.

### Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels, remove structures and replant is currently unknown.

### Project durability and resiliency.

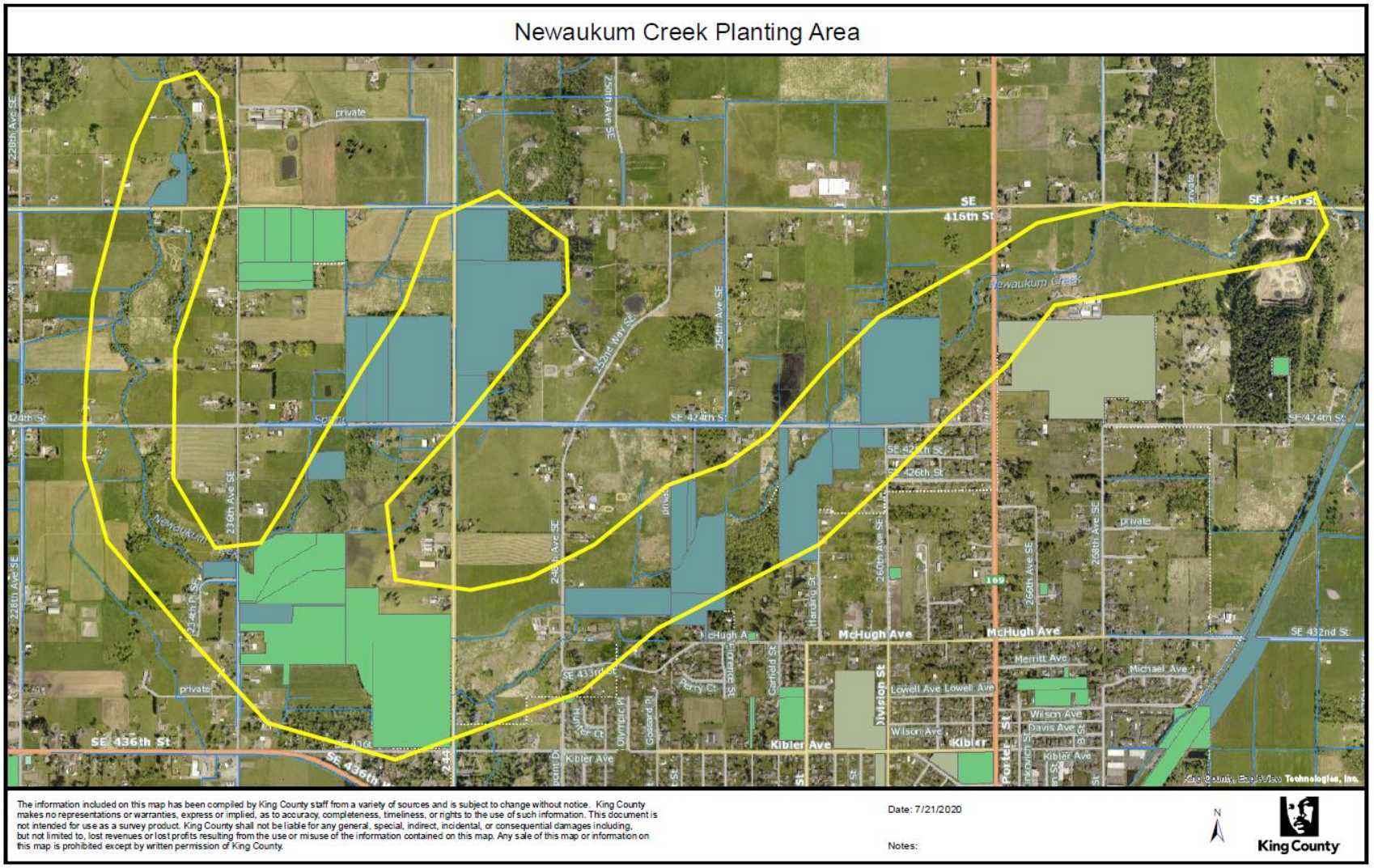
Once the native plants are installed, maintenance (weed control, watering, and plant replacement) will be required to ensure a high plant survival rate. Monitoring plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for at least the first five years post-implementation.

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

King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with implementation immediately upon receipt of project funding.

### Documentation of sources.

Non




Site Plan of Newaukum Creek Planting Area

# WRIA 9 - Project Description
# Newaukum Creek Tributary Restoration (Gwerder, et al.)

October 16, 2020

## Project Name and Number
Newaukum Creek Tributary Restoration (Gwerder, et al) (9-N-H15)

## WRIA 9 WRE Subbasin
Newaukum Creek

## Narrative Description
This project includes excavation and restoration of wetlands and stream channels of Newaukum Creek tributaries located within the City of Enumclaw, Washington. The project is located within the WRIA 9 Newaukum Creek subbasin. This proposed project will install hundreds of large trees with rootwads in the streams and wetlands, as these habitats are almost completely lacking in-channel large woody debris (LWD). In addition, tens of thousands of native trees and shrubs will be planted within the riparian and wetland habitats created. These restoration actions will benefit documented Chinook, Coho, Steelhead, Chum, Sockeye and resident trout that utilize these streams as spawning and rearing habitat. Chinook and Steelhead are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Quantitatively, this project includes installation of hundreds of large trees with rootwads into streams and wetlands and planting tens of thousands of native trees and shrubs on approximately 75 acres. Approximately 0.5 miles of stream will be planted as part of this project.

LWD has several ecological functions including managing flows, creating deeper pools that provide refugia for fish, preventing bank erosion, and trapping organic material that provides nutrients for insects and invertebrates which are a prey source for fish. Planted native trees and shrubs will provide shade in stream sections which currently reach temperatures that are approximately 6˚ C below the threshold for protection of designated aquatic life use for Core Summer Salmonid Habitat.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves work at the Gwerder site located along the right bank of Stonequarry Creek, a tributary to Newaukum Creek, located within the City of Enumclaw, Washington. The total acreage proposed for riparian and wetland restoration is approximately 50 acres.

## Performance goals and measures.
To be determined.

### Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

This project is expected to improve stream habitat with the installation of LWD and reduce in-stream temperatures through shade created by installed native trees and shrubs. These restoration actions will directly benefit documented Chinook, Coho, Steelhead, Chum, Sockeye and resident trout that utilize these streams. Specifically, Chinook, Coho, Steelhead, and Chum are documented as using these stream sections for spawning habitat. Chinook and Steelhead are priority species, protected under the ESA.

### Identification of anticipated support and barriers to completion.

Funding and landowner willingness to sell property are the major barriers to completion.

### Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels, remove structures and replant is currently unknown.

### Anticipated durability and resiliency.

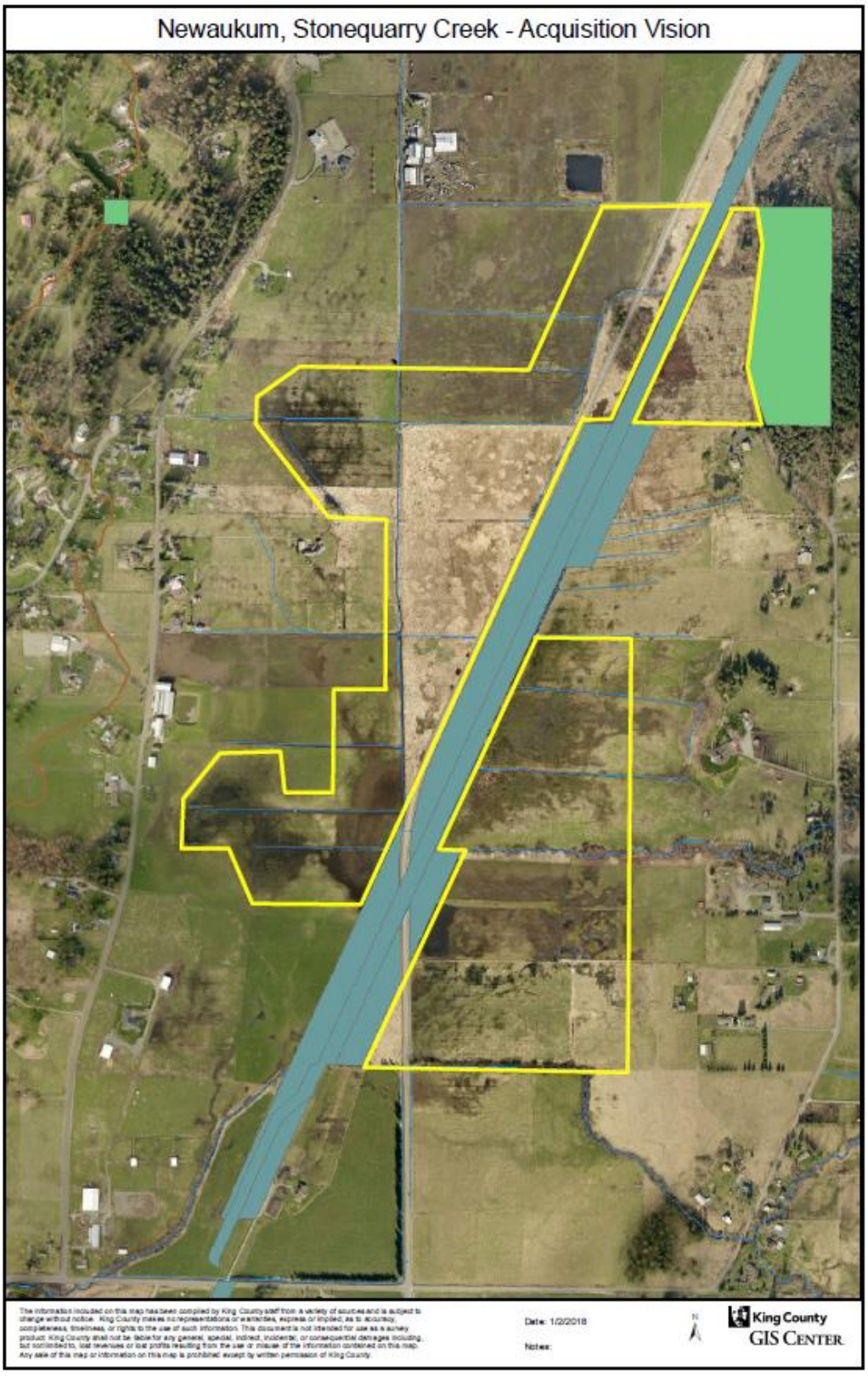
Once the native plants are installed, irrigation and maintenance will be required to ensure plant survival. Monitoring of plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for a minimum of five years post-construction.

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

King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with acquisition, design, and permitting immediately.

### Documentation of sources.

None




Site Plan for Newaukum Creek Tributary Restoration Site

# WRIA 9 - Project Description
# Middle Green River Open Space Acquisitions

October 16, 2020

## Project Name and Number
Middle Green River Open Space Acquisitions (9-MG-H16)

## WRIA 9 WRE Subbasin
Soos Creek, Jenkins Creek, Covington Creek, Lower Middle Green River, Mid Middle Green River, Newaukum Creek, and Upper Middle Green River

## Narrative Description
This project supports an ongoing effort within the Green River Watershed to acquire developed or developable land which would benefit the hydrologic integrity of the basin. If acquired land was previously developed, structures would be removed including homes, septic systems, and wells. Protection of the hydrologic function within the Green River Watershed has the potential to benefit salmon, including, Chinook, Coho, Steelhead, Chum, as well as Bull Trout and resident trout. Chinook, Steelhead, and Bull Trout are priority species, protected under the U.S. Endangered Species Act (ESA).

## Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Acquiring developed or developable land within the Green River watershed protects the long-term hydrologic integrity of the basin.

## A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan.

## Description of the anticipated spatial distribution of likely benefits.
This project involves acquisition of land within the Green River Watershed. Distribution of benefits is dependent on the location of acquired parcels within the watershed. The pertinent Middle Green River subbasins include: Soos Creek, Jenkins Creek, Covington Creek, Lower Middle Green River, Mid Middle Green River, Newaukum Creek, and Upper Middle Green River.

## Performance goals and measures.
To be determined.

## Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.
Protection of the hydrologic function through acquisition of developed or undeveloped land within the Green River Watershed has the potential to benefit salmon, including, Chinook, Coho, Steelhead, Chum, as well as Bull Trout and resident trout. Chinook, Steelhead, and Bull Trout are priority species, protected under the ESA.

## Identification of anticipated support and barriers to completion.
The only barriers to completion are funding and landowner willingness to sell property.

### Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels is currently unknown. King County will match funding on a 1:1 basis.

### Project durability and resiliency.

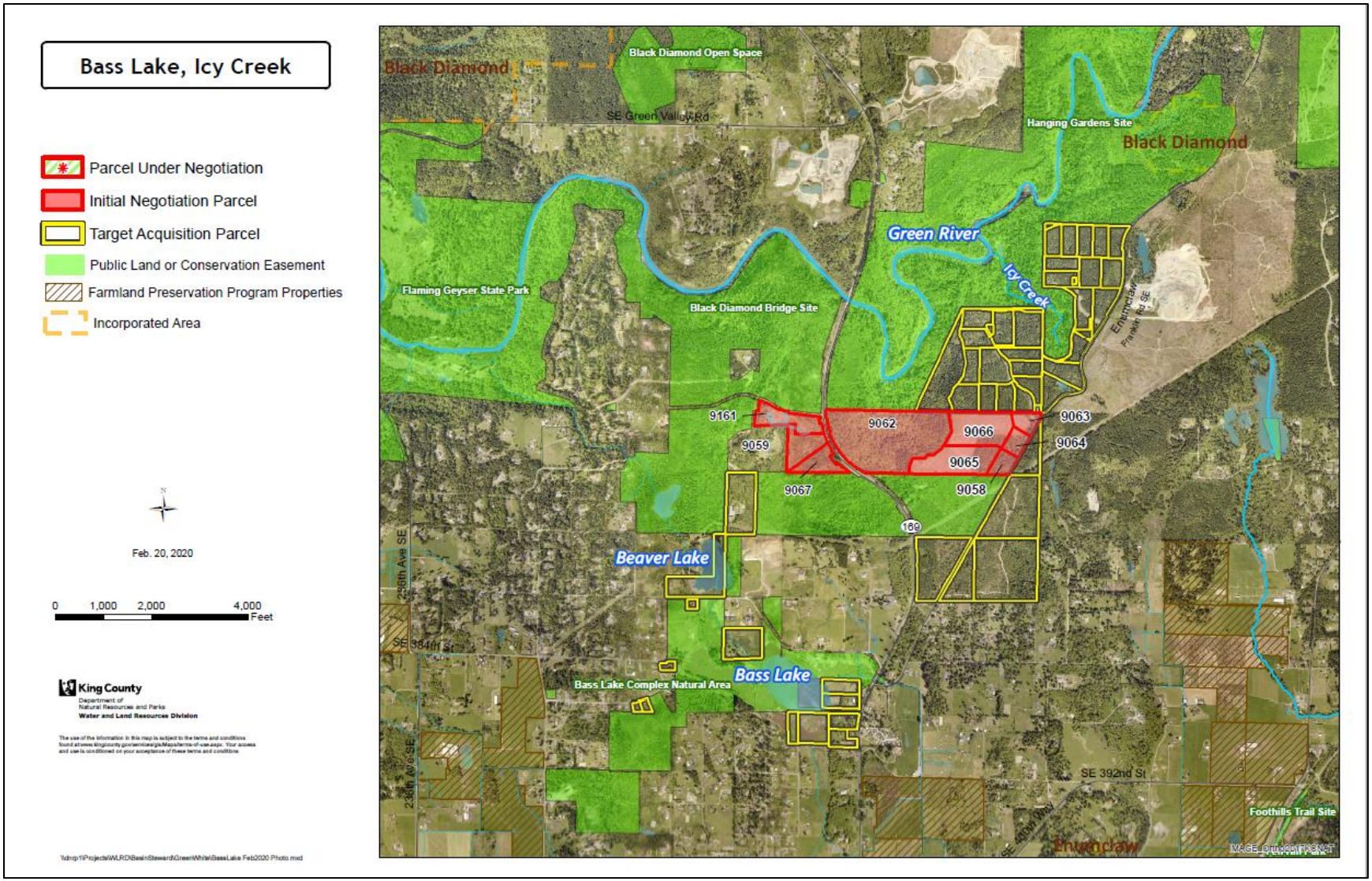
The acquisition, restoration and long-term protection of land provides watershed hydrological durability and resiliency.

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

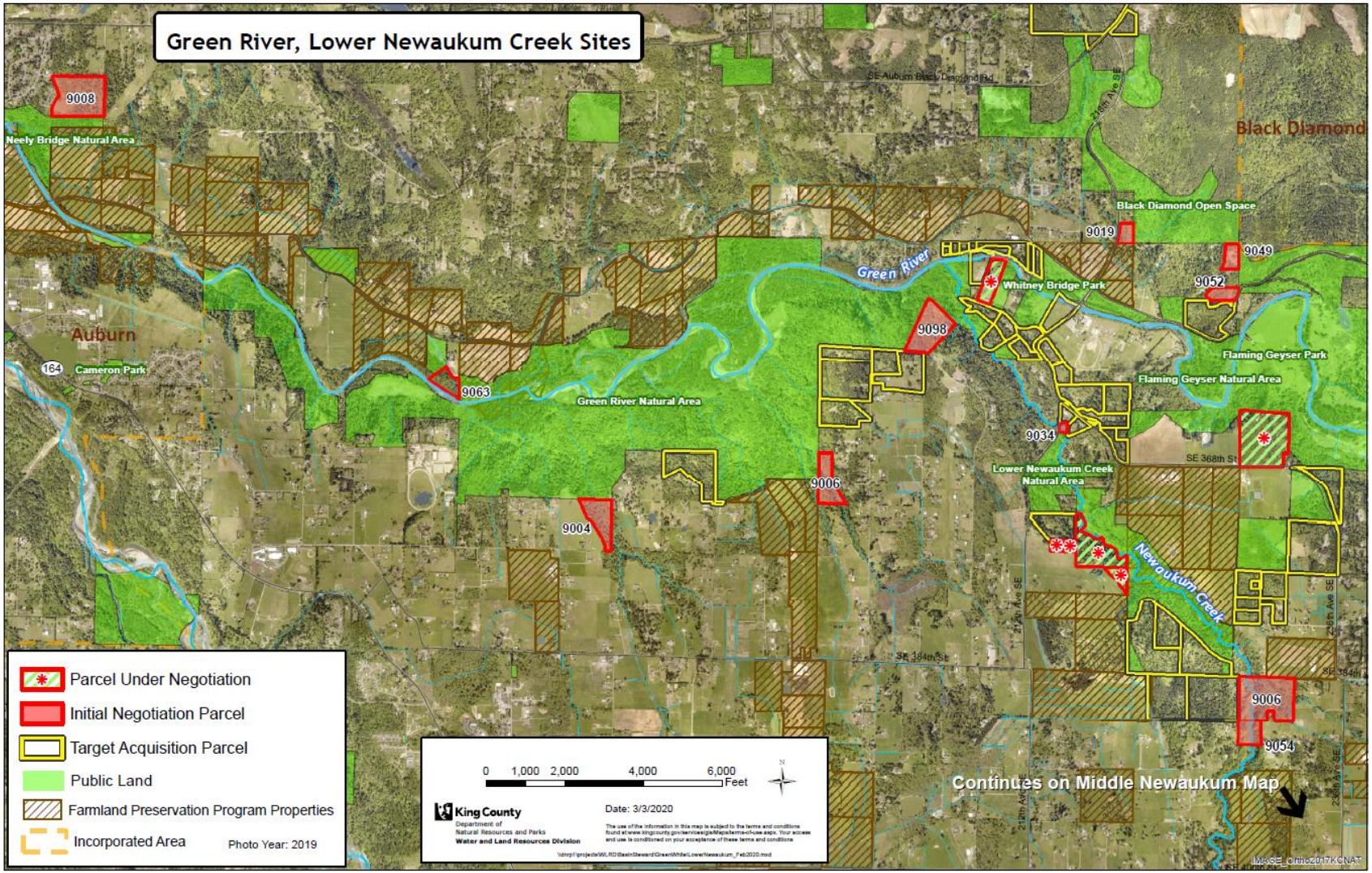
King County. Sponsor contact: Josh Kahan, Josh.Kahan@kingcounty.gov. The sponsor is ready to proceed with Implementation if funding is provided.

### Documentation of sources.

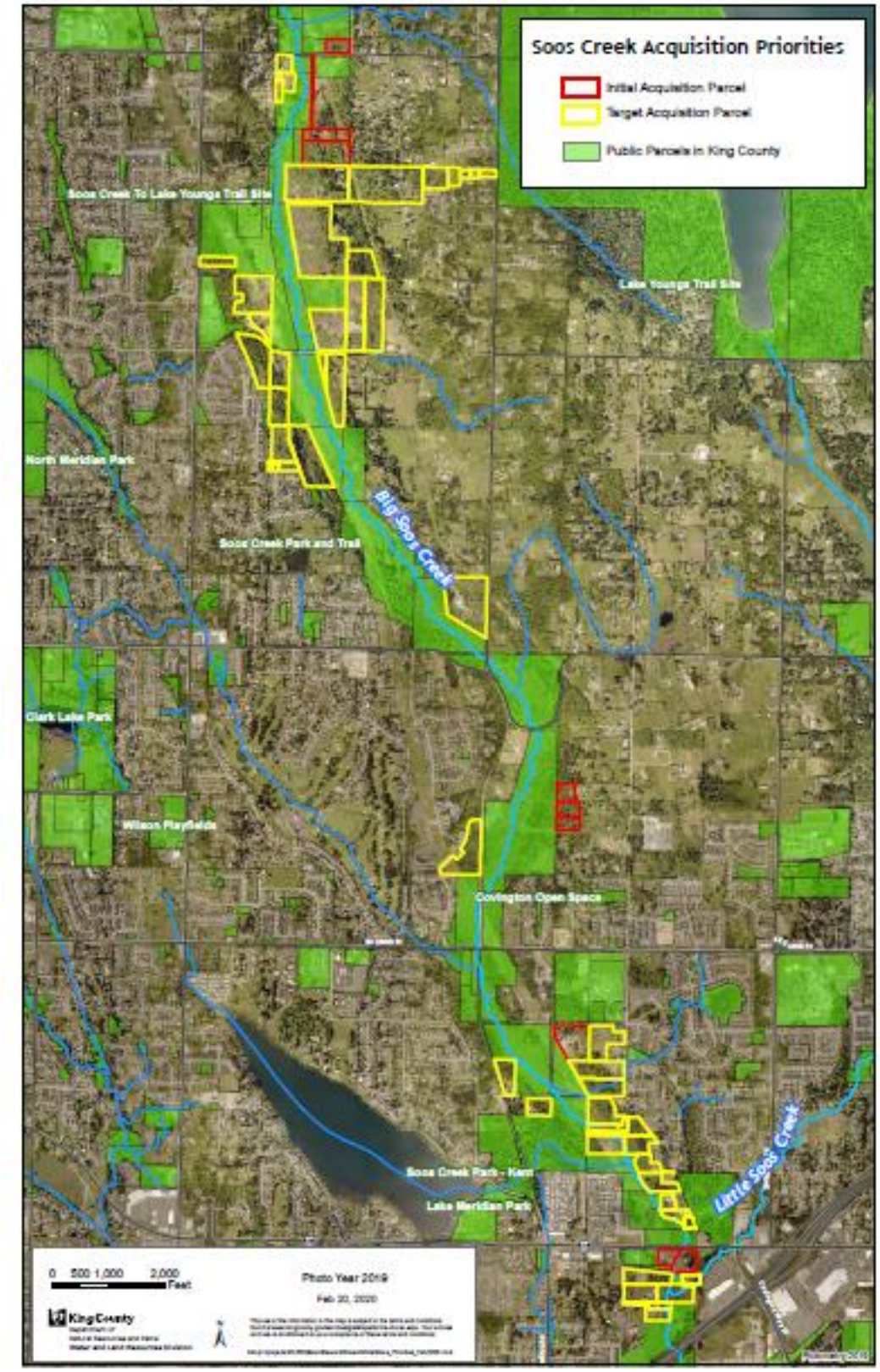
None.




Site Plan for Middle Green River Open Space Acquisitions – Bass Lake and Icy Creek




Site Plan for Middle Green River Open Space Acquisitions – Lower Newaukum Creek Sites




Site Plan for Middle Green River Open Space Acquisitions – Little Soos Creek Sites