Attachment A

Salmon Habitat Plan 2021 Update

MAKING OUR WATERSHED FIT FOR A KING

GREEN/DUWAMISH AND CENTRAL PUGET SOUND WATERSHED

Water Resource Inventory Area 9 (WRIA 9)

Approved by the WRIA 9 Watershed Ecosystem Forum on February 11, 2021

Salmon Habitat Plan 2021 Update

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On behalf of the Green Duwamish and Central Puget Sound Watershed (WRIA 9) Watershed Ecosystem Forum, we are pleased to present this update to the 2005 WRIA 9 Salmon Habitat Plan, "Making Our Watershed Fit for a King" (2005 Plan). The 2021 WRIA 9 Salmon Plan Update (Plan Update) represents a renewed commitment to salmon recovery efforts in WRIA 9 and provides a science-based framework for identifying, prioritizing and implementing salmon recovery actions over the next 10-15 years. It refines and adds key recovery strategies based on new science and ensures resources will continue to be directed to where they provide the greatest benefit for Chinook salmon.

The original 2005 Plan translated science into actions. Plan implementation by multiple WRIA 9 entities in the last 15 years helped leverage over $200 million of local, state and federal funding to realign more than 2 miles of levees to reconnect floodplains, restore over 4,500 feet of marine shoreline and revegetate 500 acres of riparian habitat. While we recognize these achievements, we also acknowledge that salmon recovery is a long-term endeavor that requires continued coordinated action. Chinook salmon numbers remain critically low and human population growth and climate change are only magnifying the challenges we face in salmon recovery.

Chinook salmon are an integral part of our regional identity. The Watershed Ecosystem Forum - a regional partnership of 17 local governments, state resource agencies, business interests and non-profit organizations – is collectively committed to implementing actions that will improve watershed conditions for our salmon populations. Plan implementation supports more than just salmon recovery; it supports tribal treaty rights, community flood hazard reduction, water quality improvement, open space protection, and outdoor recreation.

While the Green/Duwamish and Central Puget Sound Watershed has faced numerous challenges, we are optimistic about the future of our watershed. The downstream fish passage facility at Howard Hansen Dam, clean-up of the Lower Duwamish Waterway Superfund sites, and a regional commitment to integrated floodplain management reflect a projected investment of hundreds of millions of dollars over the next 10-15 years. As we work towards an improved future, we are reminded of a quote from a historical planning guide for the Green River corridor:

As we look at the Green River corridor, we must say, 'This is the way the people want it to be.' Therefore, in each locality, someone should steadily be asking, 'is this the way we want it to be, now and in the future?' The ultimate condition of the Green River Basin should be the result of informed and far-sighted public decisions.

River of Green, 1978

We look forward to collaborating with all our local, state, federal, and tribal partners in realizing our collective vision for this watershed and welcoming back ever stronger runs of salmon.

Sincerely,

Councilmember Lisa Herbold
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Executive Summary

This document updates the 2005 Green/Duwamish and Central Puget Sound Watershed (WRIA 9), Making Our Watershed Fit for a King, Salmon Habitat Plan. The 2005 Plan served as the blueprint for salmon habitat recovery in WRIA 9 for 15 years. It is fitting that the Puget Sound Regional Council awarded the original 2005 Plan a Vision 2020 Award. Although the Plan Update reflects over a decade of new science regarding salmon conservation and recovery since the award, the core recovery strategies and underlying scientific framework remain largely valid today and continue to provide an important foundation for salmon recovery. The Plan Update – designed to be a stand-alone document – is intended to update, not replace, the 2005 Plan. The two documents, along with the 2014 Duwamish Blueprint and the 2016 Re-green the Green, provide a science-based framework for identifying, prioritizing and implementing salmon recovery actions.

This document provides a status update for Green River Chinook salmon using the National Oceanic and Atmospheric Administration (NOAA)-approved viable salmon population (VSP) criteria. Over 20 years have passed since the listing of the Puget Sound Chinook salmon evolutionarily significant unit (ESU) under the Endangered Species Act (ESA). Despite significant investments and large-scale restoration projects, Green River Chinook salmon remain listed as Threatened. Population abundance, productivity, diversity and spatial distribution have not improved, and in some cases have continued to decline.

A Strategic Assessment Update summarizes new research findings that address important data gaps identified in the 2005 Plan. New information related to habitat use and fish productivity, climate change, temperature, and contaminants supported a reassessment of functional linages between priority stressors, habitat conditions, and VSP parameters. This information serves as the foundation for the other core elements of the Plan Update.

Although the Plan Update maintains existing NOAA-approved VSP goals, it introduces new 10-year habitat goals (implementation targets) that represent continued progress towards the long-term necessary future conditions for achieving a viable salmon population, as outlined in 2005 Plan. The numerical targets for key habitats serve as a benchmark for evaluating plan implementation over time and informing ongoing adaptive management.

The Plan Update outlines a portfolio of 12 recovery strategies – including embedded policies and programs – to address priority pressures; increase salmon abundance, productivity, and diversity; and build long-term population resiliency. Successful

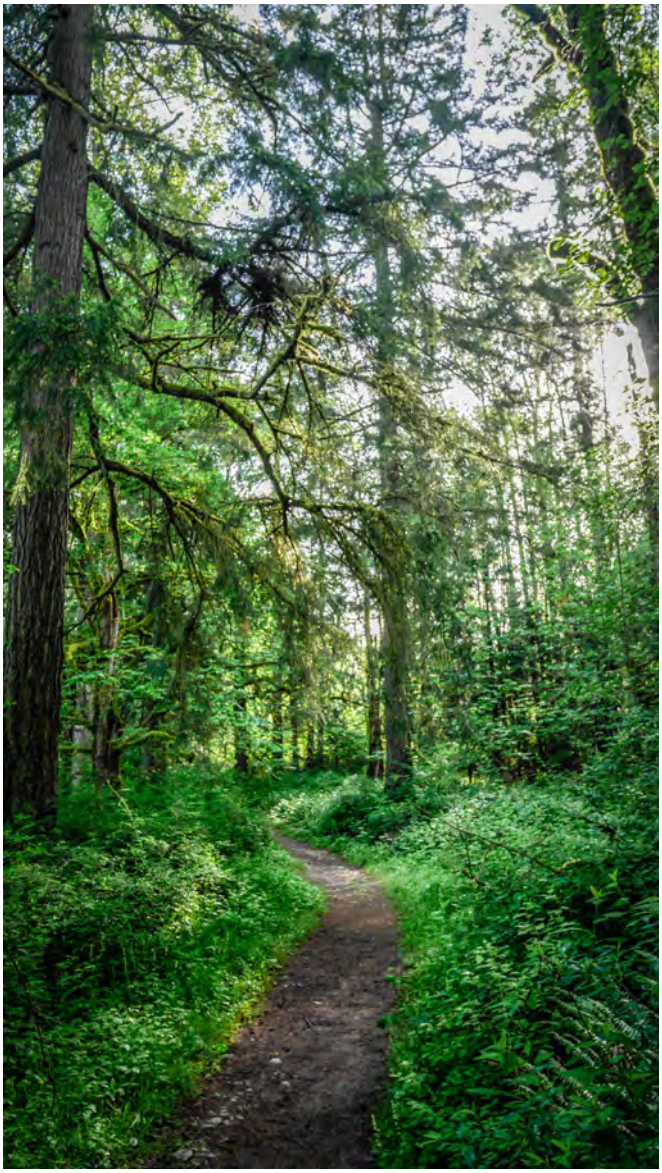


PHOTO: ELI BROWNELL Green River Natural Area

implementation hinges on partner coordination and investment to ensure local land use planning, capital investment programs, and community outreach messaging are consistent with identified watershed priorities.

An updated list of capital projects was developed in partnership with interlocal agreement member jurisdictions, non-profit partners, state agencies, and others engaged in salmon recovery. The updated project list identifies 127 capital habitat projects across the five subwatersheds. Individuals projects are ranked within their specific subwatershed – not across subwatersheds. Projects are tiered based on overall benefit towards recovery and to provide context for the level of financial need. Tier 1 projects have significant potential to advance recovery and substantively contribute to habitat goals. Tier 2 and Tier 3 have moderate and limited potential, respectively, to advance recovery and contribute to achieving habitat goals.

The Monitoring and Adaptive Management Plan (MAMP) outlines monitoring priorities intended to help evaluate progress and inform strategic adaptation of the recovery strategies. The MAMP establishes a framework for (1) tracking implementation goals, (2) assessing project effectiveness, (3) evaluating habitat status and trends, (4) evaluating the population status of Green River Chinook salmon, and (4) prioritizing research and monitoring investments. This framework will guide data collection to support regular assessment of progress and allow the WRIA to reassess prioritization and sequencing of recovery actions.

Chapter 1: Background

The 2005 Green/Duwamish and Central Puget Sound Watershed Salmon Habitat Plan, Making Our Watershed Fit for a King, represented the culmination of over five years of technical reconnaissance, research, and policy development. The Plan was a local watershed-based response to the federal government's 1999 listing of Puget Sound Chinook salmon as "threatened" under the Endangered Species Act. The 2005 Plan – which received a Puget Sound Regional Council Vision 2020 Award – translated a tremendous wealth of science into discrete policy recommendations and management actions necessary to support recovery of natural origin Green River Chinook salmon.

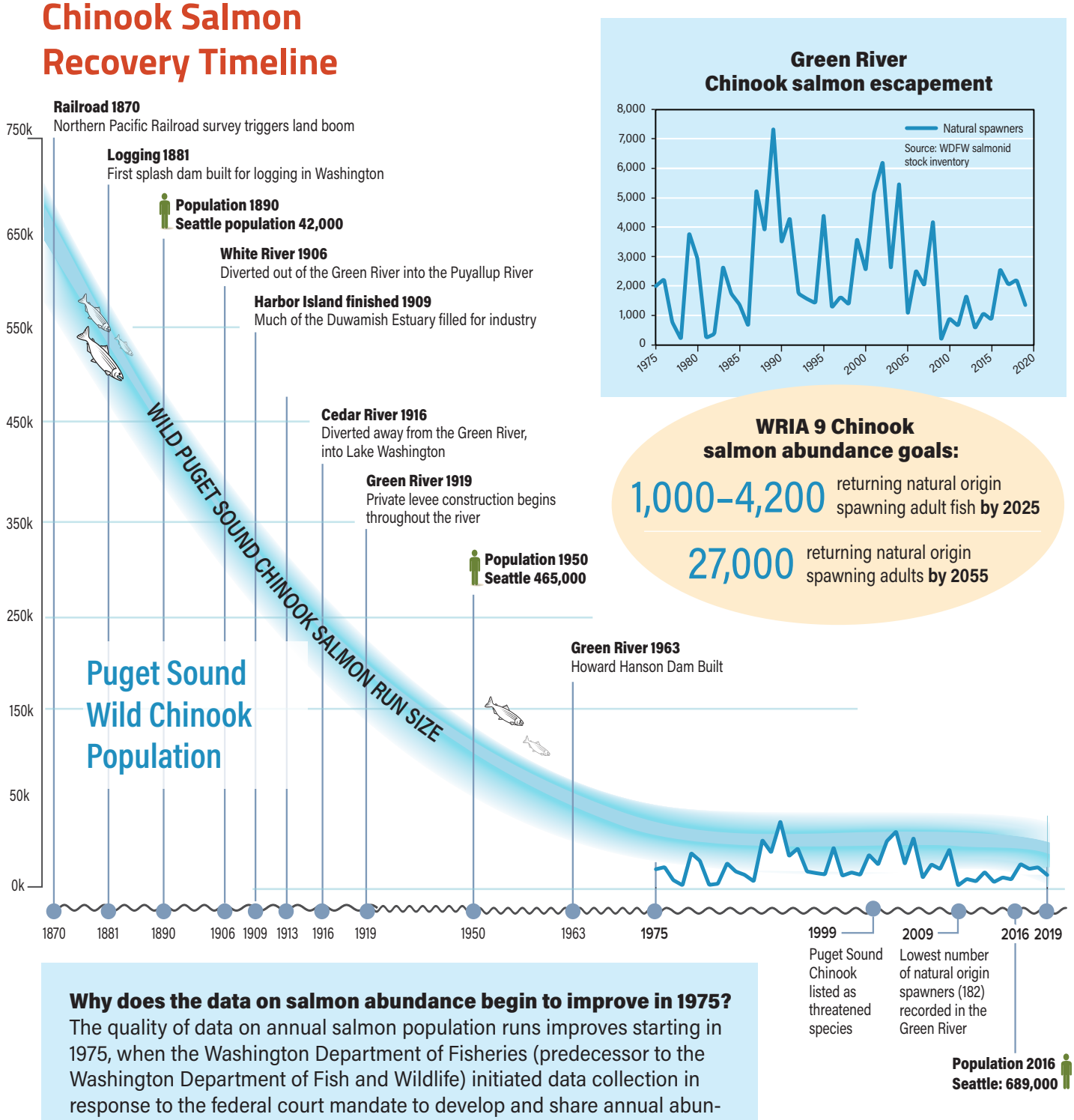
The 2005 Plan provided the blueprint for Chinook salmon recovery in the Green/Duwamish and Central Puget Sound for 15 years. It helped watershed partners leverage upwards of $200 million dollars of local, state and federal funding for salmon recovery. Plan implementation resulted in nearly 2 miles of levee setbacks, over 4,500 feet of marine shoreline restoration, and approximately 500 acres of revegetation. Despite of these accomplishments, the continued decline of Chinook salmon – both locally and regionally – highlights the urgent need for expanding and accelerating recovery efforts.

This Salmon Habitat Plan Update represents the next chapter of salmon recovery efforts in the Green/Duwamish and Central Puget Sound Watershed. It provides a science-based framework for identifying, prioritizing and implementing salmon recovery actions over the next 10-15 years. The integration of over a decade of new science informed important refinements to recovery priorities and investment strategies outlined in the 2005 Plan. These refinements reflect the watershed's commitment to adaptive management and ensure that limited resources are directed to where they can provide the greatest benefit towards Chinook salmon recovery. Although the focus of this plan is on Chinook salmon recovery, implementation will also provide parallel benefits to other salmon and steelhead.

Regional Salmon Recovery Context

This addendum updates the Green/Duwamish and Central Puget Sound watershed chapter of the National Oceanic and Atmospheric Administration (NOAA)-approved 2007 Puget Sound Salmon Recovery Plan. The Green River Chinook salmon population is one of six Chinook salmon populations in the Central/South sub-basin and one of 22 remaining populations in the Puget Sound Chinook salmon evo-

***Figure 1**. Green/Duwamish and Central Puget Sound Chinook salmon recovery timeline.*



Why does the data on salmon abundance begin to improve in 1975?
The quality of data on annual salmon population runs improves starting in 1975, when the Washington Department of Fisheries (predecessor to the Washington Department of Fish and Wildlife) initiated data collection in response to the federal court mandate to develop and share annual abundance of salmon returning to individual rivers in Puget Sound.

lutionary significant unit (ESU). NOAA ESU recovery criteria require status improvement in all populations and two to four viable populations in each of the sub-basins.

The Puget Sound Partnership (Partnership), the state agency leading the region's collective effort to restore and protect Puget Sound, serves as the regional salmon organization for the 15 lead entities within the Puget Sound, advised by the Puget Sound Salmon Recovery Council. The Partnership co-manages the Puget Sound Acquisition and Restoration Fund and works in partnership with the Governor's Salmon Recovery Office and Recreation and Conservation Office (RCO) on statewide salmon recovery issues. The Salmon Recovery Funding Board, facilitated by the RCO, is a Governor-appointed 10-person board with a primary responsibility for making grants and loans for salmon habitat projects and salmon recovery activities. This salmon recovery infrastructure, and the grant and loans for habitat project implementation, is supported through state and federal funds from NOAA's Pacific Coast Salmon Recovery Fund and the State Salmon Recovery Funding. Additionally, within Puget Sound, salmon recovery is supported by the Puget Sound Acquisition and Restoration Fund.

WRIA 9 Organizational Structure

Water Resource Inventory Area (WRIA) 9 serves as a lead entity for salmon recovery under the State of Washington's watershed-based framework for salmon recovery established under RCW 77.85. It is a watershed-based organization comprised of local, state and federal partners, non-profit organizations, business interests, and citizens. Per statute, WRIA 9 is mandated to "compile a list of habitat projects, establish priorities for individual projects, define the sequence for project implementation, and submit these activities as the habitat project list. The committee shall also identify potential federal, state, local, and private funding sources."

The 17 local governments within the Green/Duwamish and Central Puget Sound Watershed (WRIA 9) formalized a partnership under an interlocal agreement (ILA) (WRIA 9 ILA) in 2000. The initial ILA (2000–2005) funded a strategic, science-based assessment of the watershed and a long-term, comprehensive recovery plan for the Green River Chinook salmon population. Following approval of the 2005 Salmon Habitat Plan, the local government partners forged a 10-year ILA from 2007–2017 intended to guide plan implementation and adaptive management. The ongoing commitment to watershed-based salmon recovery was renewed in 2017. The current ILA extends through 2025.

The WRIA 9 Watershed Ecosystem Forum (WEF) serves as the advisory body for plan implementation and adaptive management. It is comprised of elected officials from the ILA partners and other watershed stakeholders. The Management Committee serves as the executive committee to the WEF. It directs work plan development and manages the ILA budget. The Implementation Technical Committee (ITC) is a technical- and policy-focused subcommittee that supports plan implementation and adaptive management. The ITC defines monitoring and research priorities, interprets new technical information as it relates to salmon recovery, and provides science-based recommendations to WEF.

Equity and Social Justice

Salmon recovery efforts within the Green/Duwamish and Central Puget Sound watershed overlap with numerous communities experiencing deeply entrenched social, economic, and environmental inequities. Race and place influence opportunity and quality of life. People of color, immigrants, and low-income residents experience inequities in access to key determinants of equity – including access to parks and natural resources. Although best available science drives project identification and prioritization, equity and social justice (ESJ) issues should be carefully considered. Applying an ESJ lens to habitat projects can help ensure salmon recovery efforts align with ESJ initiatives and do not inadvertently reinforce existing inequities. Integrating residents and community-based organizations into project design can help build community support and achieve multi-benefit outcomes that advance equity in the watershed.

Chapter 2: Green/Duwamish and Central Puget Sound Watershed – A Snapshot

The Green/Duwamish and Central Puget Sound Watershed spans 575 square miles of diverse landscape, ranging from an industrial waterfront to preserved old growth forest. This section provides a high-level overview of the five subwatersheds (Upper Green, Middle Green, Lower Green, Duwamish, and Nearshore) that serve as an overarching framework for salmon recovery. It also provides context for the strategies and actions outlined in subsequent chapters. For a more comprehensive review, please refer to the Chapter 3 of the 2005 Salmon Habitat Plan.

The Upper Green Subwatershed extends upstream of Howard Hanson Dam, river mile 64.5, and represents approximately 45 percent of the Green/Duwamish River watershed. Historically, the Upper Green provided important spawning and freshwater rearing habitat for Chinook salmon. It encompasses between 78-165 miles of suitable instream habitat, although fish passage has been blocked by a combination of the Tacoma Headworks Diversion Dam and Howard Hanson Dam since 1911.

Checkered ownership in the subwatershed complicates coordinated land management. Although the primary land use is commercial forestry, the Upper Green also serves at the primary municipal water supply for the City of Tacoma. Additionally, a road and railroad alignment have constrained the river in places, the Upper Green Subwatershed is largely undeveloped and contains relatively high-quality, yet currently inaccessible, aquatic habitat. Long-term recovery of Chinook salmon depends on providing fish passage to the Upper Watershed.

The Middle Green Subwatershed extends between river miles 64.5 and 32. It includes the two largest tributaries to the Green River – Soos and Newaukum Creeks. Low-velocity habitats, including off-channel habitats, sidechannels, floodplain wetlands, and river edge, provide important rearing and refuge habitat for juvenile Chinook.

Land use in the Middle Green is characterized predominantly by agricultural lands and rural residential development. Land use development adjacent to river and tributaries has resulted in loss of riparian habitat contributing to elevated instream temperatures. Modified flow regimes have disrupted natural transport of large wood and sediment. In addition, a network of training levees designed to restrict lateral channel migration – as opposed to prevent flooding – have simplified channel complexity along some reaches. Restoring floodplain connectivity and expanding rearing habitat capacity are critical to increasing Chinook salmon productivity.

The Lower Green River Subwatershed flows from river mile 32 downstream to river mile 11. It serves as an important migratory corridor for adult upstream migration and juvenile downstream migration. Available rearing and high-flow refuge habitat is limited compared to the Middle Green – many reaches currently lack large wood, side channels, sloughs, and slow-water edge habitats. The Lower Green River also supports Chinook salmon spawning upstream of approximately river mile 25.

The Lower Green River valley is the second largest warehouse and distribution center on the west coast. The floodplain is heavily developed and characterized by a combination of industrial, commercial, and urban residential development. The 1906 diversion of the White River left the floodplain perched above the mainstem channel and disconnected historic off-channel habitats. An extensive network of flood control facilities (27 miles of levees and revetments) currently restricts floodplain connectivity and limits channel complexity. A corresponding loss of riparian tree canopy contributes to elevated instream temperatures. An integrated, multi-benefit approach to floodplain management is needed to balance fish habitat needs with flood risk reduction and other community priorities in this subwatershed.

The Duwamish Subwatershed extends from river mile 11 at the Black River Pump Station downstream to the north end of Harbor Island. The extent of salt influence – as depicted by the saltwater wedge – varies based on flows and tide, but can extend upstream as far as the Foster Bridge (RM 10.2) during low flows and high tides. Juvenile Chinook rear in the estuarine waters of the Duwamish as they undergo the physiological transition from fresh to saltwater habitats.

Extensive dredge and fill of the Duwamish has transformed the estuary into an industrial waterway, characterized by straightened channel with armored banks and a lack of riparian tree canopy. More than 98 percent of the historical tidal wetlands have been transformed into commercial and industrial land uses. The U.S. Environmental Protection Agency declared the Lower Duwamish Waterway a "Superfund" site in 2001 due to legacy contamination, and clean-up is not expected to be complete for another decade. Sediment cleanup and restoration of estuarine habitat are essential to increasing juvenile Chinook salmon survival.

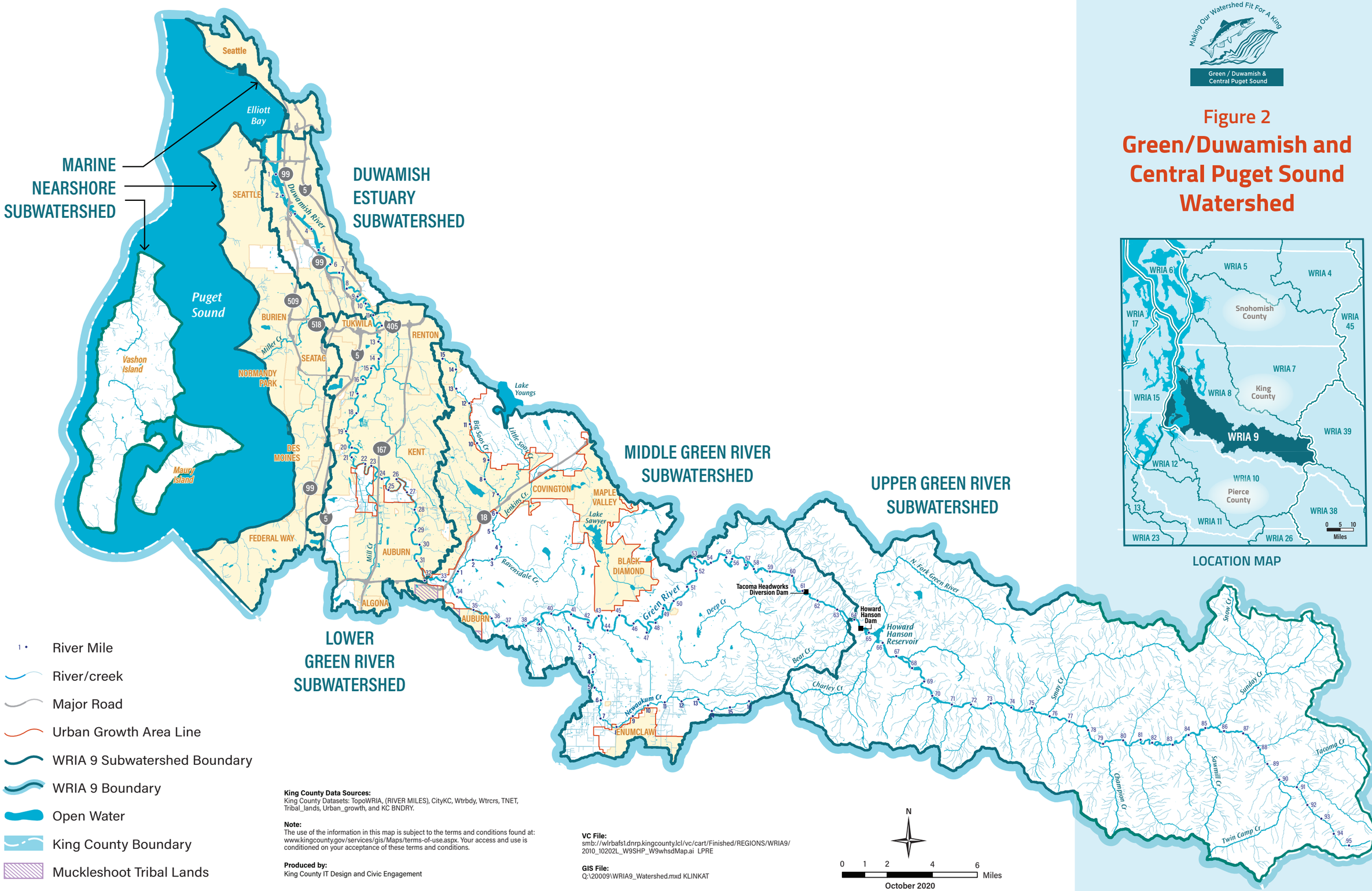
The Nearshore Subwatershed extends 92 linear miles from Elliott Bay south to the Pierce County boarder, including Vashon Island. It represents the interface of upland and aquatic habitats; shallow productive zone and deep water habitats; and fresh and marine waters. The nearshore is a dynamic environment – shaped by wave energy and sediment transport that support high species diversity. A variety of habitats, including beaches, eelgrass beds, and pocket estuaries, provide important foraging habitat and a migratory corridor to the Pacific Ocean for juvenile Chinook salmon.

Development along the marine shorelines has altered significant stretches of the nearshore ecosystem. Approximately two-thirds of WRIA 9 shoreline is armored, which has disrupted natural sediment delivery and transport. The intensity of shoreline development varies substantially across the watershed. The highest intensity development is located along the industrial and commercial shores of Elliott Bay. The mainland shoreline from Seattle south to Federal Way is predominantly residential. Vashon Island is predominantly rural. Improving nearshore habitat is essential to increasing juvenile salmon residence times, growth rates, and overall marine survival.

Making Our Watershed Fit For A King

Green / Duwamish & Central Puget Sound

Figure 2
Green/Duwamish and Central Puget Sound Watershed



LOCATION MAP

King County Data Sources:
King County Datasets: TopoWRIA, (RIVER MILES), CityKC, Wtrbdy, Wtrcrs, TNET, Tribal_lands, Urban_growth, and KC BNDRY.

Note:
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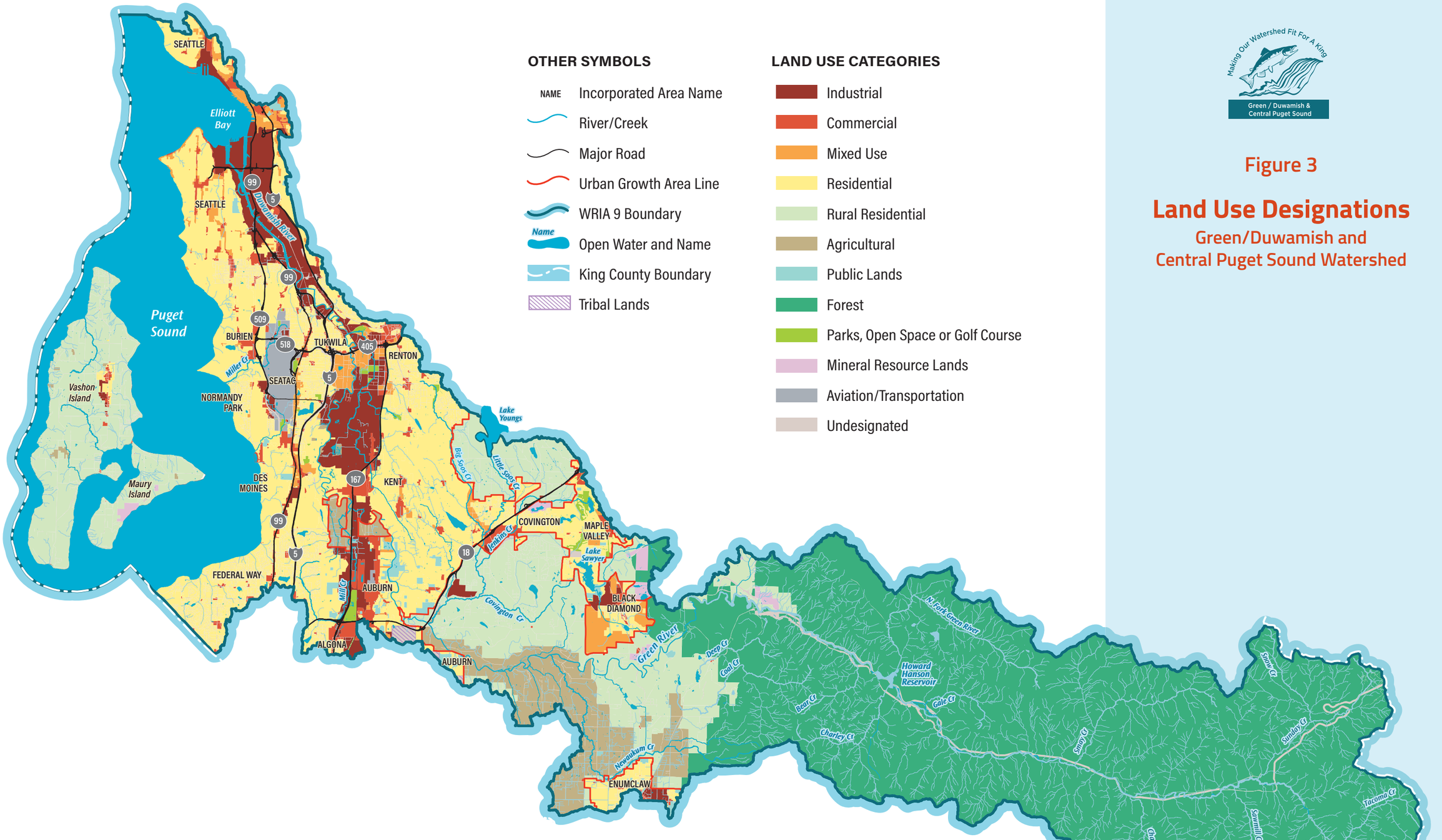
October 2020



OTHER SYMBOLS

- NAME — Incorporated Area Name
- River/Creek
- Major Road
- Urban Growth Area Line
- WRIA 9 Boundary
- Name — Open Water and Name
- King County Boundary
- Tribal Lands

LAND USE CATEGORIES

- Industrial
- Commercial
- Mixed Use
- Residential
- Rural Residential
- Agricultural
- Public Lands
- Forest
- Parks, Open Space or Golf Course
- Mineral Resource Lands
- Aviation/Transportation
- Undesignated

Making Our Watershed Fit For A King
Green / Duwamish & Central Puget Sound

Figure 3

Land Use Designations

Green/Duwamish and Central Puget Sound Watershed

King County Data Sources:
Similar land use designations were combined and derived from King County GIS Center land use coverage LANDUSE_KC_CONSOL_20 based on multi-jurisdictional zoning data. Other King County datasets include TopoWRIA, (RIVER MILES), CityKC, Wtrbdy, Wtrcrs, TNET, Tribal_lands, Urban_growth, and KC BNDRY.

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October 2020


CHRIS GREGERSON

Chapter 3: The Chinook Salmon Life Cycle – Connecting a Diverse Watershed

The Green/Duwamish and Central Puget Sound Chinook salmon life cycle provides a common thread linking together a diverse watershed. Each of the five distinct subwatersheds plays a critical role in the Chinook salmon life cycle. Recovery of a viable salmon population hinges on collective action across the watershed to improve aquatic habitat. The conceptual life cycle model presented in the 2005 Salmon Habitat Plan remains an important tool for assessing aquatic habitat needs in relationship to priority stressors that adversely impact survival at distinct life history stages and across different life history types. Understanding aquatic habitat needs throughout the life cycle and how they relate observed bottlenecks in survival allows recovery managers to strategically focus limited resources where they are expected to provide the largest benefit to recovery objectives. Figure 5 highlights the relationship between the subwatersheds and specific life history phases.

Adult Upstream Migration/ Spawning

Chinook salmon enter the Green/Duwamish between July and October. Timing of river entry and upstream migration is impacted by water temperature and flow. Spawning generally occurs mid-September through October, between approximately river miles 25 and 61. Spawning primarily occurs within the Lower and Middle Mainstem Green River and Newaukum Creeks. Additional spawning occurs in Soos, Burns and Covington Creeks. Fish passage to the upper watershed has been blocked by a combination of the Tacoma Headworks Diversion Dam (1911) and Howard Hanson Dam (1961). Although fish passage was provided at the Tacoma facility in 2007, a downstream fish passage facility has not been completed at Howard Hanson Dam. The dams also block natural gravel delivery and transport; however, available spawning habitat does not appear to be a limiting factor in Chinook recovery.

Egg Incubation/Emergence

Egg incubation and alevin emergence generally occurs September through January within the same reaches where spawning occurs. Timing is variable and influenced by water temperatures – warmer temperatures drive an earlier emergence. High-flow events and sedimentation during this critical development period can scour redds and result in high mortality. As a result, flow management at Howard Hanson Dam influences incubation/ emergence success.

Juvenile Freshwater Rearing/ Migration

Juvenile Chinook salmon rear in the Lower and Middle Green subwatershed from mid-December to mid-July. The length of the freshwater rearing period varies among life history types (Figure 5) and is influenced by habitat availability and flows. Subyearling Chinook rely on low-velocity habitats, including mainstem river margins, pools, and off-channel habitats. Rearing habitat availability is a limiting factor for Chinook productivity. Extensive flood control facilities and floodplain development have disconnected floodplain habitats, reduced habitat complexity, and eliminated much of the historic freshwater rearing habitat. Instream flows influence accessibility of off-channel rearing habitats. During low-flow periods, off-channel habitats and floodplain wetlands may become disconnected from the mainstem. In contrast, high-flow events may flush juvenile Chinook downstream if they are unable to access suitable refuge habitat. Given the connection to instream flows, flow management at Howard Hanson Dam can impact habitat connectivity/ availability during the rearing period.

Juvenile Estuary Rearing

Subyearlying Chinook salmon generally migrate downstream into the Duwamish estuary between February and July, with fry-type life histories predominantly entering earlier in the year (Feb-Mar) than parr (May-Jun). Residence times in the Duwamish vary considerably, with some fish spending days and others (i.e., estuarine reared fry) spending weeks to months in the estuary. The Duwamish Estuary – specifically the transition zone (RM 1-9) – is critical for juvenile salmon making the physiological transition from fresh to salt water. Juvenile Chinook salmon rely on shallow, low gradient habitats (e.g., marshes, mudflats, and tidal sloughs) to escape stronger currents and support efficient foraging and growth prior to entering Puget Sound. Extensive industrial development along the Duwamish has transformed the estuary to an industrial waterway, resulting in extensive loss of slow water rearing habitats and contamination of sediments. The lack of high-quality habitat may contribute to accelerated downstream migration and reduced survival upon entry into Puget Sound.

Figure 4. *The Salmon Cycle*

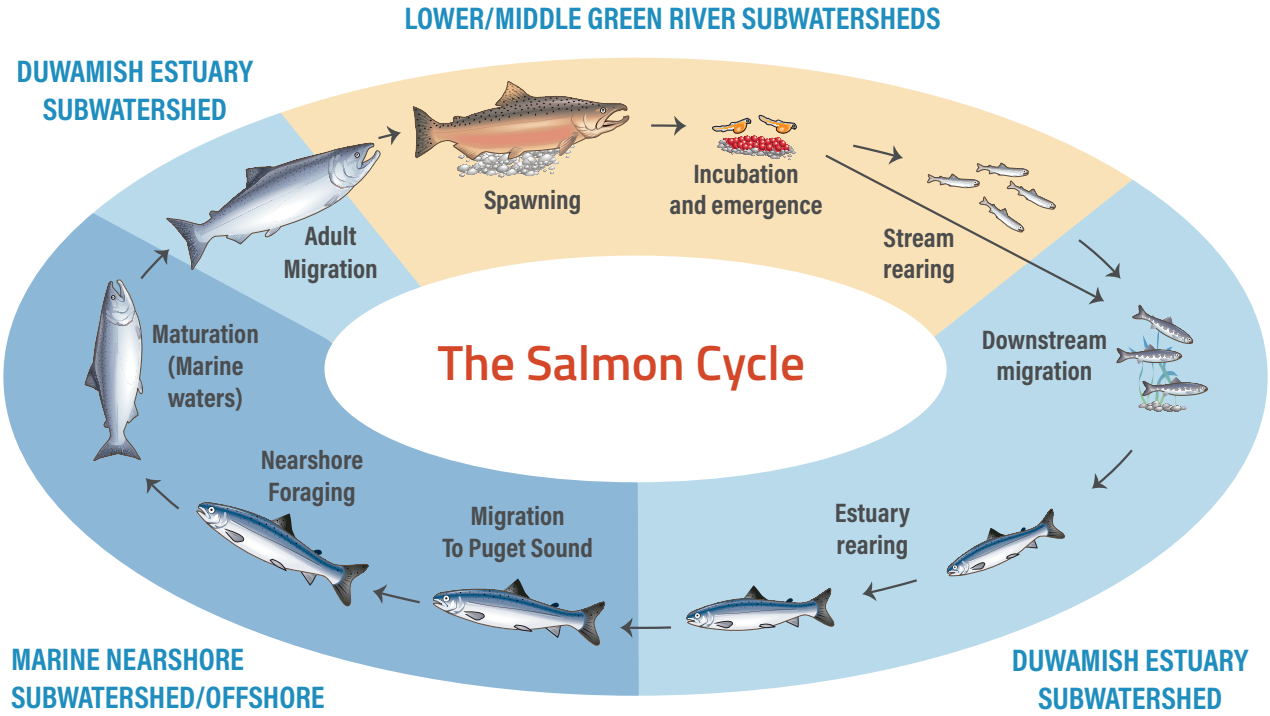
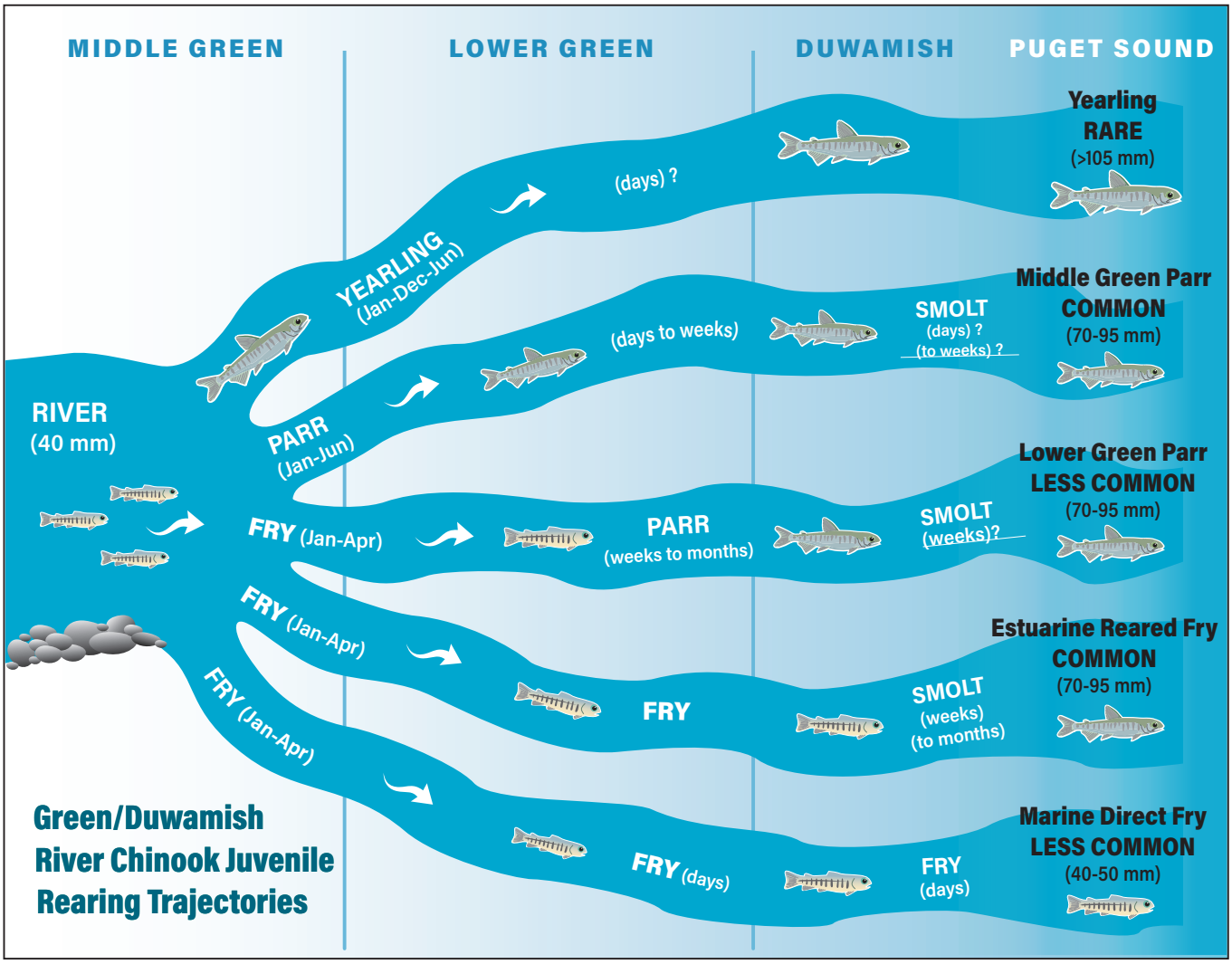


Figure 5. *Primary Chinook salmon life history types in the Green River (updated and modified from Ruggerone and Weitkamp 2004).*



Marine Nearshore Rearing

Juvenile Chinook salmon generally rear in the Puget Sound nearshore from later winter through fall. Shallow nearshore habitats support foraging, growth, and refuge from predators, while also providing a migratory corridor to offshore waters. Although considerable uncertainty surrounds marine nearshore habitat use by juvenile Chinook salmon, it is widely accepted that the early marine rearing period is a critical period of growth that strongly influences long-term survival. The Central Puget Sound marine nearshore waters not only support Green River Chinook, but also at least eight different stocks of Puget Sound Chinook salmon. Shoreline development has extensively modified nearshore habitat and processes in WRIA 9. The most intense shoreline modifications are located in urbanized Elliott Bay, with more natural shorelines located along the largely rural Vashon Island.

Ocean Migration

By fall, most Green River Chinook exit the Strait of Juan de Fuca and migrate north along the outer coast of Vancouver Island. While Chinook salmon may spend up to five years in marine waters, most Green River Chinook spend two to three years at sea before returning to spawn. In addition to predators, Chinook salmon are subject to various commercial fisheries during their marine migration.

ROGER TABOR

Chapter 4: Current Population Status and Recovery Goals

Recovery goals provide a framework from which to evaluate both plan implementation and overall progress towards Chinook recovery. Tracking population metrics and habitat conditions provides important data used to evaluate current population status and overall habitat conditions. This information serves as a key input for informing ongoing adaptive management.

Viable Salmon Population Criteria – Current Status and Goals

The Viable Salmon Population[1] (VSP) concept – as defined by National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) – provides the foundation for all established recovery goals for Chinook salmon within the Green/Duwamish and Central Puget Sound Watershed. NMFS defines a viable salmon population as a population that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe (McElhany et al. 2000). The VSP goals outlined in this section remain unchanged from the 2005 Plan and are presented in Table 1. They are based on recovery planning targets developed by a team of scientists (Puget Sound Technical Recovery Team) appointed by NOAA to support the original 2007 Recovery Plan for Puget Sound Chinook.

Four parameters are used to assess the viability of salmon populations: abundance, productivity, spatial structure and diversity. These parameters are reasonable predictors of extinction risk, reflect general processes important to all salmon populations, and measurable over time.

Abundance

Abundance is the number of individuals in the population at a given life stage or time. The number of natural origin Green River Chinook spawners is the primary abundance indicator. Chinook abundance indicates an overall decline since before the first plan was adopted in 2005 (Figure 6 and Table 1). In 2009, the number of Natural Origin Spawners (NOS) was the lowest ever recorded, with less than 200 fish. For five of the past 10 years (2010–2019), the number of NOS has been below the planning target range (1,000 -4,200 NOS) for WRIA 9.

1 NOAA technical Memorandum NMFS-NWSSC-42: Viable salmonid populations and the recovery of evolutionarily significant units.

Table 1. *Viable Salmon Population (VSP) Goals*

VSP Parameter	Indicator	2006-2010 (average)	2011-2015 (average)	2016-2019 (average)	10-Year Goal	50-100 Year Goal
Abundance	Natural Origin Spawners	1975 (average)	963 (average)	2041 (average)	1000-4200[2]	27,000
Productivity	Egg-to-Migrant Survival	2.9%	8.7%	5.3%[a]	>8%	>8%
Diversity	Percent Hatchery Origin	56.4%	60.6%	68.2%	Decreasing	<30%
	Proportion 5-6 yr-old Spawners	19.2	9.6%	N/A	Increasing	>15%
	Relative Abundance of Parr	46%	30.6%	32.8%[a]	No Target[3]	No Target
Spatial Diversity	Spawning Distribution	Spawning in Green River mainstem (below Howard Hanson Dam), Newaukum Creek and Soos Creek			Spawning above Howard Hanson Dam	Maintain spawning distribution

Data Source: WDFW Salmonid Stock Inventory and NOAA Salmon Population Summary Database

[a]2016-2018

2 A range is used because the productivity of each year's run varies depending on a variety of factors. If fish are experiencing high productivity, fewer adults are needed to reach future targets than if they are experiencing low productivity, which would require more fish returning to reach future targets.

3 No target established because it is not considered a reliable metric of diversity. However, relative abundance of fry and parr does provide important information for projecting future abundance.

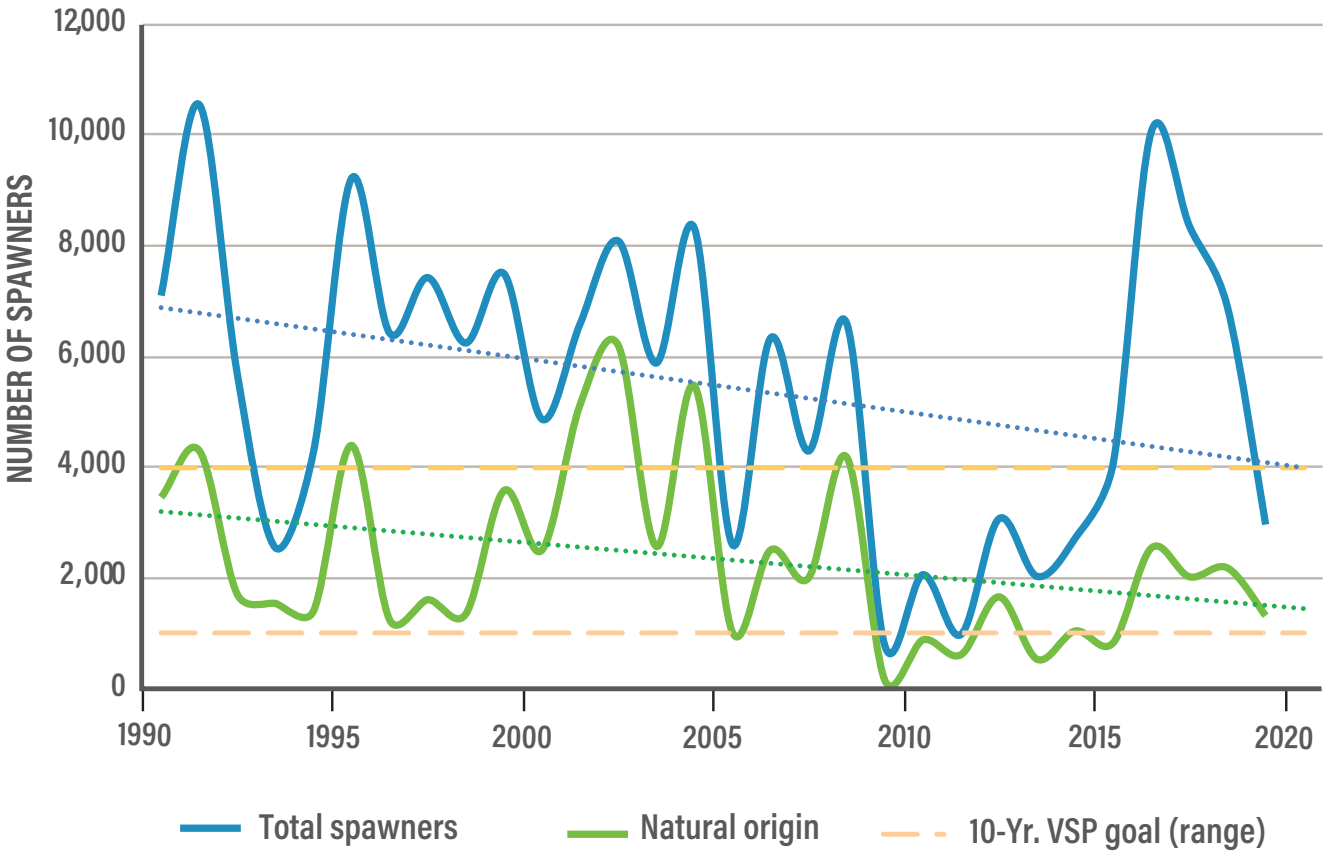
Productivity

Productivity or population growth rate is the ratio of abundance in the next generation as compared to current abundance. The WRIA uses WDFW data to track egg-to-migrant survival rates as a primary means of evaluating productivity (WRIA 9 ITC 2012). Egg-to-migrant survival rate is defined as the proportion of fertilized eggs that survive to migrate as fry or parr into the Lower Green, as quantified by the Washington Department of Fish and Wildlife (WDFW) smolt trap at river mile 34. Although, the average rate for wild Chinook populations is 10.4 percent (Quinn 2005), the WRIA set a target of 8 percent because the elevated proportion of hatchery fish on the spawning grounds is assumed to reduce reproductive fitness (see VSP diversity metric below). Between 2006 and 2018, the survival rate has ranged from 0.09 percent to 11 percent, with an average of 5.7 percent (Table 1). While the long-term average is below the target, the egg-to-migrant survival rate has exceeded the 8 percent target in five of the last 10 years of data.

VSP-Spatial Structure

The WRIA has not directly tracked a specific indicator or metric for spatial structure. However, natural origin adults predominantly spawn in Newaukum Creek and the mainstem Green River. Recent changes to hatchery operations will maintain the area in Soos Creek above the weir as a natural production emphasis area with only natural-origin adults passed above the weir. Adult Chinook will not be passed upstream of Howard Hanson Dam (HHD) in order to access the upper watershed until downstream fish passage is provided at HHD. A 2019 Biological Opinion (BiOp) issued by the National Oceanic and Atmospheric Administration (NOAA) found that the construction of a downstream fish passage facility at HHD was necessary for the recovery of Chinook salmon, steelhead, and Southern resident orcas. It sets a 2030 deadline for construction and operation of a downstream fish passage facility. For the spatial structure of the population to improve, natural origin spawners are needed within both of these areas that were part of their historic range.

Figure 6. *Green River Chinook salmon escapement.*



Data Source: WDFW Salmonid Stock Inventory and NOAA Salmon Population Summary Database.

VSP-Diversity

Diversity is the variety of life histories, sizes, and other characteristics expressed by individuals within a population. WRIA 9 has used three metrics to measure diversity:

- Percentage of hatchery origin spawners. The target is for fewer than 30 percent hatchery origin Chinook spawners (HSRG 2004). The target has not been met since 2002, and since plan adoption in 2005, the proportion of hatchery fish on the spawning grounds has ranged from 35 percent to 75 percent and has appeared to be increasing (Table 1);
- Percentage of juvenile Chinook that outmigrate as parr. Based on recent analyses, this indicator is influenced by basic habitat capacity, the number of natural origin spawners, and the streamflows experienced during rearing (Anderson and Topping 2018). As such, tracking the percentage of parr is no longer recommended as a reliable metric for evaluating diversity of the population. However, the metric does continue to provides important population-level information related to productivity; and
- Proportion of natural origin adults that return as five- and six-year old fish, with a simple target of an increasing percentage of older fish returning over time. Since 2005, there have been no six-year old fish, thus monitoring data reflect only five-year old Chinook. Excluding 2009, which was an outlier year with the lowest return of adults on record, the proportion of five-year olds has ranged from a high of 17 percent to a low of 1 percent (Table 1). The average percent return from 2006 to 2015, 14.4 percent, is similar to the average over the last 46 years of 15.4 percent.

Habitat Goals – Implementation Targets

Habitat goals outline both the necessary future ecological conditions to support a viable salmon population and shorter term implementation targets designed to assess plan implementation progress. WRIA 9 developed goals for key ecological indicators that reflect priority habitat needs and environmental stressors that span all life stages of Chinook salmon – adult migration, spawning, incubation and emergence, stream rearing, downstream migration, estuary rearing, and nearshore foraging. The indicators and associated goals presented in Table 2 are organized by subwatershed. This Plan Update does not outline specific goals related to marine migration outside of WRIA 9 boundaries.

WRIA 9 developed long-term goals – or necessary future conditions – during the development of the 2005 plan using scientific guidance developed by the Puget Sound Technical Recovery Team. The 2004 WRIA 9 Strategic Assessment and 2005 Salmon Habitat Plan summarize the full suite of necessary future conditions to support a viable salmon population in the Green/Duwamish and Central Puget Sound Watershed. They were not amended as part of this Plan Update. The subset of necessary future conditions outlined in Table 2 represents a strategic subset that can be readily assessed related to project implementation across shorter intervals of time.

Table 2 also outlines updated short term – 10 year – habitat targets used to directly track plan implementation. The 10-year targets were developed by the WRIA 9 Implementation Technical Committee based on a review priority stressors, limiting factors, implementation progress under the 2005 Plan, and a review of common indicators proposed for regional tracking by the Puget Sound Partnership. Specific targets are intended to be aspirational and reflect the significant level of investment needed to substantively advance recovery within the watershed. The *Monitoring and Adaptive Management* chapter summarizes recommended methodology and timelines for periodic assessments of these and other longer-term status and trends indicators (e.g., water temperature, contamination).

Table 2. *Green/Duwamish and Central Puget Sound Habitat Goals.*

Necessary Future Conditions and Implementation Targets				
Habitat Indicator	**Necessary Future Cond. (2005 Plan)**	**10-year Target 2005 Plan (achieved)**	**Current Condition**	**Recommended 10-year Target (2030)**
Marine Nearshore				
Shoreline Armor	65% of shoreline in natural condition	Restore 13,500 ft of shoreline (1500 ft restored – net gain of 70 ft of armor).	36%/33 mi of shoreline in natural condition	Remove 3,000 ft of hard armor and achieve a net reduction in hard armor.
Marine Riparian Vegetation	65% of marine shoreline characterized by riparian tree cover	No target developed	40%/36 mi of shoreline has riparian tree cover	Revegetate 60 ac and/or 3.25 mi (~3.5% gain) of shoreline.
Shoreline Conservation	Not applicable	Protect 5 mi of shoreline. (4 mi protected).	9.5 mi of adjacent upland protected as natural lands	Acquire 2 mi of shoreline for permanent protection, prioritizing beaches and feeder bluffs.
Duwamish				
Shallow Water Habitat	173 ac of shallow water habitat in the transition zone (RM 1-10) (30% of historic)	Restore 26.5 ac of shallow water habitat (~6 ac restored)	Unknown	Create 40 ac of shallow water habitat between RM 1-10.
Riparian Forest	65% of each bank of the river has > 165 ft of riparian tree cover-age (586 ac total)	No target was developed	69 ac/12% of 165 ft buffer contains tree cover	Revegetate 170 ac (~29% of 165-ft buffer)/9.8 mi of streambank.
Lower Green				
Off-Channel Habitat	45% of historical off-channel habitat. Restore 2.8 mi of side channels, 450 ac of floodplain wetlands, and 5,039 ac of connected 100-yr floodplain habitat (total of 8,839 ac of connected 100-yr floodplain).	Restore 16.5 ac of reconnected off-channel and riparian habitat (20.7 ac restored)	3,800 ac of connected 100-yr floodplain that is accessible to juvenile fish	**Restore 240 ac of floodplain habitat.** **Side Channels:** 550-ft high flow/ 3,740-ft low flow **Floodplain Tributaries:** 3,080 ft **Backwater:** 75 ac **Floodplain Wetland:** 66 ac **Other 100-yr Floodplain:** 99 ac
Riparian Forest	75% of each bank of the river to >165 ft wide (828 ac total)	No target was developed	222 ac/27% of 165-ft buffer contains tree cover	Revegetate 250 ac (~30% of 165-ft buffer)/ 8.52 mi of high-priority, unforested shoreline

(continued on next page)

Table 2. *Green/Duwamish and Central Puget Sound Habitat Goals. (Continued)*

Necessary Future Conditions and Implementation Targets, continued				
Habitat Indicator	**Necessary Future Cond. (2005 Plan)**	**10-year Target 2005 Plan (achieved)**	**Current Condition**	**Recommended 10-year Target (2030)**
Lower Green, continued				
Large woody debris	1,705 pieces per mi (21 key pieces)	No target developed.	**2004**: 54 pieces/mi. **2014:** 48.5 pieces/mi.	Achieve 425 pieces/mi.
Bank armor	No new, decreasing amount	No new, decreasing amount	**2014:** 42 mi of river bank armored (17.7-mi levees; 9.8 mi maintained revetments; 14.5 mi of semi-armored roads acting like levees and natural banks)	Set back 1 mi of levee.
Middle Green				
Floodplain connectivity/lateral channel migration	Floodplain subject to lateral channel migration represents 65% of historical conditions	Restoration of 50 ac of off-channel habitat and riparian vegetation (45 ac restored)	**2017:** 1,751 ac or 55% of historic floodplain connected	Reconnect 200 ac of floodplain as measured by area subject to lateral channel migration.
Riparian forest	> 65% of Channel Migration Zone (1,424 of 2,190 ac) and up to 165 ft wide where possible	No target developed	**2005:** 50.3% **2009:** 50.5% of the Channel Migration Zone forested	Revegetate 175 ac (8% of Channel Migration Zone).
Large wood debris	10 jams/mi	No target developed	**2006:** 2.2 jams/mi **2015:** 3.8 jams/mi	Achieve 5 jams/mi.
Bank armor	No new, decreasing amount	No new, decreasing amount (>1% reduction)	**2004**: 25% armored **2009**: 24% armored	Set back 1 mi of revetment/levee.
Upper Green				
Fish passage	Up and downstream fish passage at Howard Hanson Dam	Fish passage provided (upstream passage provided)	Upstream passage facility complete. Downstream passage not complete.	Provide downstream passage at Howard Hanson Dam.
Bank armor	No new, decreasing amount	No new, decreasing amount	**2004:** 15% armored **2009:** 15% armored	Remove/setback 0.5 mi of bank armoring.

Chapter 5: Strategic Assessment Update - New Science on Priority Pressures

The 2005 Strategic Assessment provided the scientific foundation for the Salmon Habitat Plan. Although the majority of science remains relevant today, new research findings have refined our understanding of priority pressures and limiting factors related to Viable Salmon Population (VSP) criteria. The 2005 Strategic Assessment evaluated functional linkages between priority pressures; habitat conditions; and Chinook abundance, diversity, productivity and spatial structure. The functional linkages were used to create a series of conservation hypotheses that outlined how improvements in habitat conditions and natural processes will drive changes in VSP parameters.

From 2017-2018, WRIA 9 produced a series of white papers as addendums to summarize new research and address priority data gaps in the original 2005 Strategic Assessment. White papers included *Fish Habitat Use & Productivity* (Higgins 2017)*; Water Temperature* (Kubo 2017)*; Contamination* (Colton 2018)*; and Climate Change* (Engel, Higgins and Ostergaard 2017). This chapter provides a summary of the highlights of those papers as they relate to priority pressures impacting Chinook salmon in the Green/Duwamish Watershed. These refinements in our understanding of priority pressures informed both the recovery strategies presented in Chapter 6 and the prioritization of capital projects in Chapter 7.

Priority Pressures (Basin of Focus)

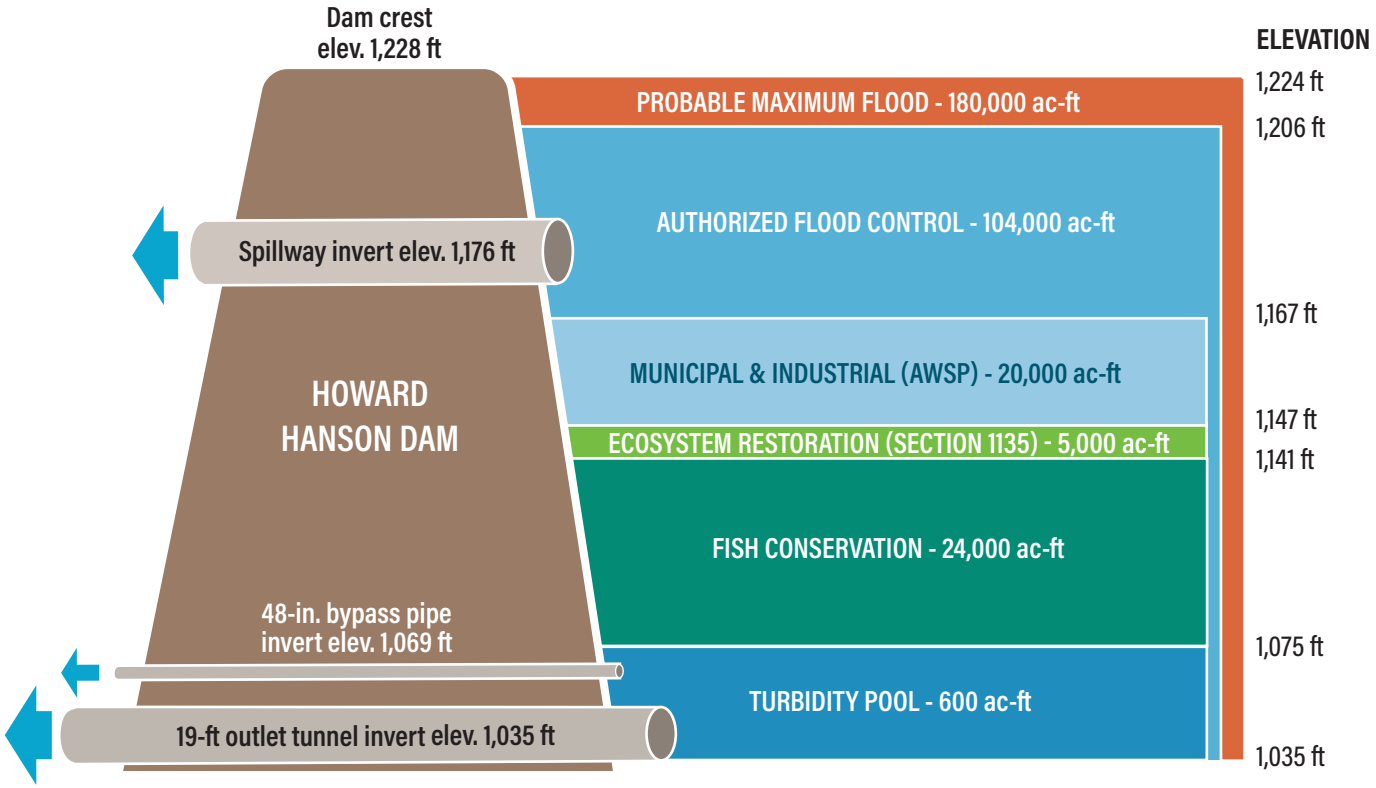
Addressing priority habitat stressors is critical to restoring a viable salmon population in the Green/Duwamish and Central Puget Sound Watershed. The following stressors have clear functional linkages to one or more VSP parameters (abundance, productivity, diversity, and spatial structure). Applicable research and monitoring information is highlighted to reflect new research and best available science since the 2005 Plan.

Altered Instream Flows (Middle Green, Lower Green)

Watershed Status

Operations at Howard Hanson Dam (HHD) and the Tacoma Headworks diversion dam regulate instream flows within the mainstem Green River below river mile 64.5. Water storage, diversion, and release are jointly managed by the U.S. Army Corps and Tacoma Water utility. Although flood risk reduction is the primary mission of HHD, water storage also supports Tacoma municipal and industrial uses, and fish conservation uses. In 2007, Tacoma Water's Additional Water Storage Project provided capacity to store an addition 20,000 acre-feet (ac-ft) for municipal use.

Figure 7. *Howard Hanson Dam spring water storage and allocation.*



Source: United States Army Corps of Engineers, Seattle District.

Water capture and storage generally occur between late February and June 1. Figure 7 depicts how a spring water storage target of 49,000 ac-ft is legally allocated between municipal and fish conservation uses. Phase 2 of the Additional Water Storage Project (to be completed at a later date following downstream fish passage) would raise the conservation pool to 1,177 feet and store an additional 12,000 ac-ft of water. The U.S. Army Corps convenes a bi-weekly Green River Flows Management Coordination Committee to inform water capture and a subsequent flow augmentation period that extends from July 15 to November depending on fall rainfall. Augmentation of flows is intended to support Chinook salmon migration and spawning, maximize summer rearing habitat, and minimize dewatering of steelhead redds. Limited Fish Conservation and Ecosystem Restoration allotments frequently require tradeoffs among these ecological benefits – especially in dry and/or warm years with low snowpack. The Tacoma Water Habitat Conservation Plan establishes a minimum stream flow of 225 cubic feet per second (cfs) at the Auburn gauge. During the summer of 2015, the minimum flow at the Auburn gauge reached 226 cfs.

Although flows are not regulated in tributaries, in-streams flows are impacted by stream withdrawals and groundwater wells used to support residential and agricultural uses. In 2018, the Washington Legislature passed the Streamflow Restoration Law to offset the impacts of future permit exempt domestic groundwater withdrawals and help restore instream flows. The law was in response to a 2017 Washington State Supreme Court decision (Hirst Decision) that restricted building permits for new residential homes that would be reliant on permit-exempt wells. The legislature appropriated $300 million over 15 years to support implementation of projects to improve stream flows across the state. The Washington State Department of Ecology is developing a Watershed Restoration and Enhancement Plan to identify and prioritize water offset projects in WRIA 9.

Research/Monitoring

Flow management at HHD dictates instream habitat conditions within the mainstem Green River. As a result, water storage and subsequent release timing not only impacts natural hydraulic processes, but also influences available salmon habitat and productivity. Maintaining minimum instream flows of 250 cfs during dry summer months provides important benefits to available fish habitat. However, associated water capture and storage has reduced the frequency and magnitude of high – habitat forming – flows while prolonging the duration of moderate flows (Higgins 2017). Moderate flows between 5000-8000 cfs are not sufficient to drive process-based habitat formation, but do have the potential to scour redds (R2 Resource Consultants 2014).

Flows above 8,800 cfs are needed to initiate lateral channel migration and support creation of off-channel habitats that are critical for juvenile Chinook rearing (Konrad et al. 2011).

Long-term juvenile Chinook outmigration data collected by WDFW highlights the function relationship between instream flows and Chinook productivity (Anderson and Topping 2018). High flows (between ~8,000–10,000 cfs) from November through mid-January appear to scour eggs, sharply reducing the overall productivity of the number of juveniles per spawner. High flows (~6,000-8,000 cfs) during the typical fry outmigration period (mid-January through the end of March) reduce the number of parr produced in the Middle Green, likely because fish are flushed into habitats downstream of the trap. The frequency of spring flows (April through June) above 1,200 cfs appears to increase the number of parr produced. This is likely due to increased connectivity to off-channel habitats, like side-channels. A separate study (R2 Resource Consultants 2013) showed that, at flows below 1,200 cfs, side channel habitats become less connected to the mainstem and overall habitat complexity decreases.

Climate Change (Watershed-wide)

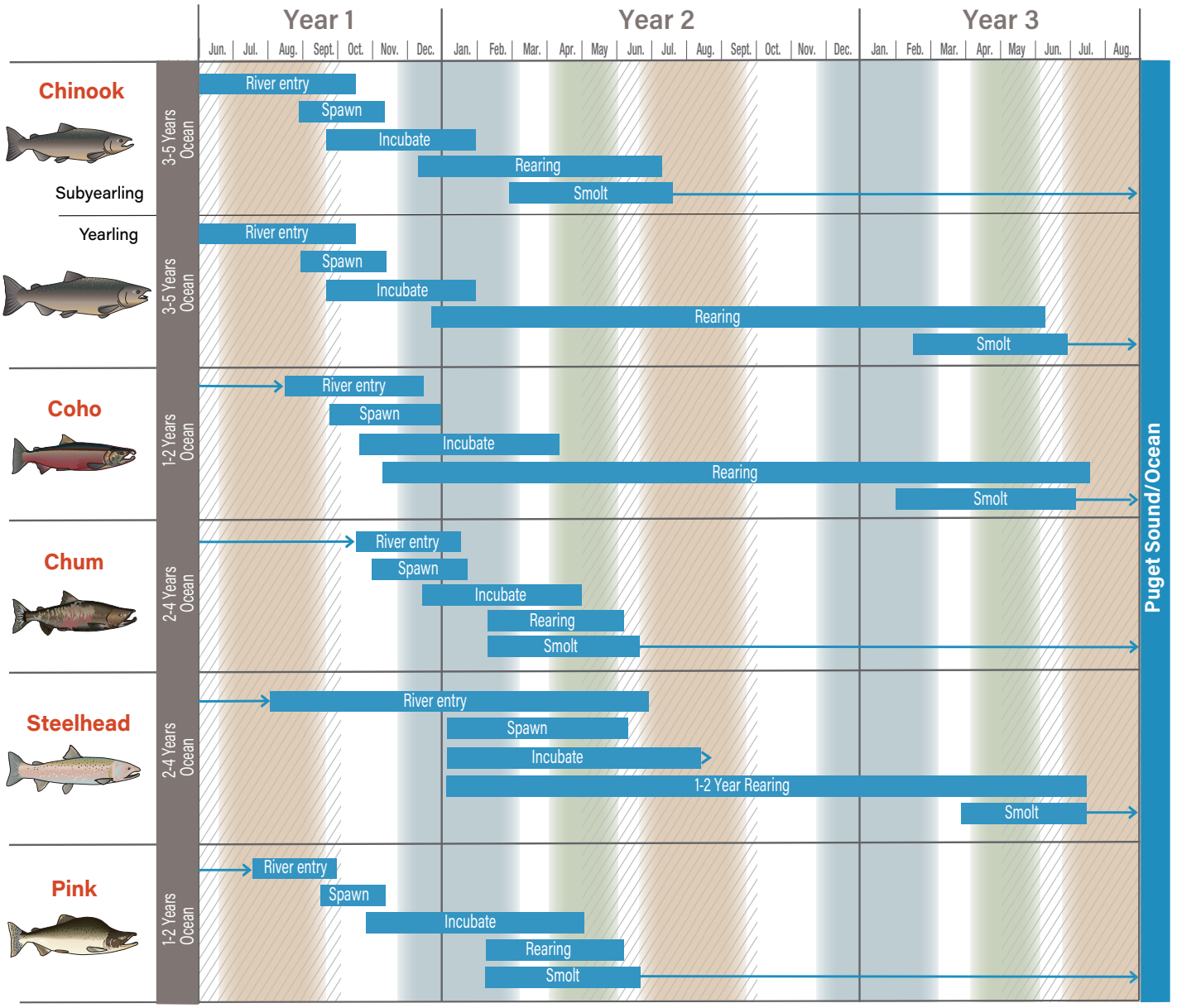
Watershed Status

Climate change science was not incorporated into the 2005 Plan because future climate scenarios were unclear. However, climate change has been the focus of intense research, both global and regional, over the last decades. This research highlights the need to prepare for the current and future impacts of climate change and incorporate what we know about climate change into salmon recovery actions.

Climate change will directly impact salmon recovery work in the Green/Duwamish and Central Puget Sound watershed. The UW Climate Impacts Group (Mauger et al. 2015) and others predict that Pacific Northwest precipitation patterns will change, bringing warmer, wetter falls, winters, and springs. Floods will be more intense and more frequent, with peak flows expected to increase by 28-34 percent by 2080. As winters become warmer and wetter, the watershed is projected to shift from mixed rain and snow to a rain-dominated basin with less mountain snow melting earlier in the spring. The decrease in amount and earlier disappearance of the snow pack will exacerbate drought-like summer low flow conditions in currently snow-dominated areas of the watershed. Summertime rain is expected to decrease by ~22% by 2050. A projected 4-5°F increase in air temperatures will increase water temperature in both rivers and the ocean. Nearshore and estuary areas will be impacted by sea level rise, food web alteration and ocean acidification. A changing climate will exacerbate typical climate variability, causing environmental conditions that will negatively impact our salmonids and their habitat. The potential impacts to various life histories of salmonids, including Chinook salmon, as a result of climate change are summarized in Figure 8.

Climate Change Impacts on WRIA 9 Salmonids

Adapted from Beechie et al. (2012). Fish timing represents typical fish behavior.



Increased summer temperature may decrease growth or kill juvenile salmon where temperatures are already high and block/delay migration. May also decrease spawning fecundity (e.g. Chinook).

Increased winter floods may increase scour of eggs, or increase mortality of rearing juveniles where flood refugia are not available, displace juveniles to less desira ble habitats.

Decreased summer low flow may contribute to increased temperature, decrease rearing habitat capacity for juvenile salmonids, and decrease access to or availability of spawning areas.

Loss of spring snowmelt may decrease or eliminate spawning opportunities for steelhead, may alter survival of eggs or emergent fry for other salmonid species, cause early dewatering of off-channel and side channel habitats, and reduce connectivity to the floodplain.

Figure 8. *Projected impacts to Green/Duwamish and Central Puget Sound salmon as a result of climate change.*

Research/Monitoring

A changing climate will exacerbate typical climate variability causing environmental conditions that will negatively impact our salmonids and their habitat. The summer of 2015 likely provided a glimpse of the future ecological conditions in the Green/Duwamish watershed. A warm, wet winter with extreme low snowpack levels, coupled with a dry, hot summer, created dire conditions for salmon. (DeGasperi 2017) The Muckleshoot Indian Tribe reported adult Chinook salmon dying in the stream just below the Soos Creek hatchery (H. Coccoli, pers. comm.), and Washington Department of Fish and Wildlife (WDFW) data indicated higher than typical numbers of female Chinook mortality with high egg retention (pre-spawn mortality) (Unpublished WDFW data). Other sublethal impacts associated with temperatures in excess of 17°C can include developmental abnormalities, altered growth rates, and non-fertilization of eggs; altered migration timing; altered predator/prey relationship; and reduced disease resistance.

Sea level in Puget Sound rose 20 centimeters from 1900-2008 and scientists project sea level will rise an additional 0.6 meters by 2100. A 1-foot increase in water surface elevation means an order of magnitude increase in high water events—so a 100-year event turns into a two year event (Mauger et al. 2015). Sea level rise will have myriad effects on the marine nearshore habitats, including increased bank/bluff erosion, landslides, and lost nearshore habitats (e.g., eelgrass, forage fish spawning habitat, estuary mudflats, etc.) due to the "coastal squeeze" adjacent to armored shorelines. In addition, increased risk of erosion could contribute to a growing demand for additional shoreline armoring.

Water temperatures as measured on July 4, 2015, exceeded the potential lethally threshold (22°C) for salmonids downstream of the Green River Gorge (DeGasperi 2017).

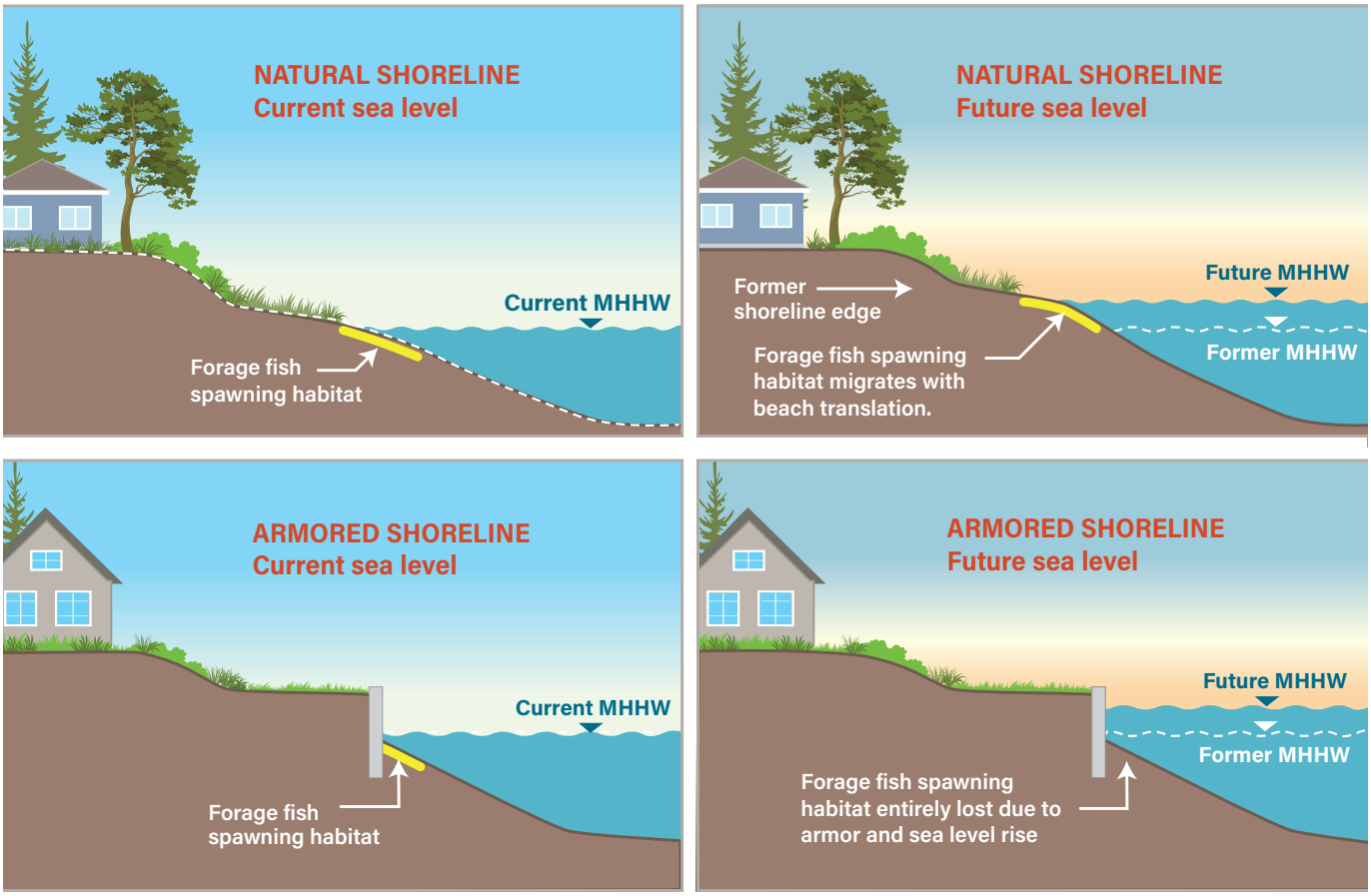


***Figure 9**. Coastal squeeze in nearshore graphic along the Puget Sound Nearshore refers to the shallow areas where forage fish spawn and are being squeezed out of existence by shoreline armoring and sea level rise (Coastal Geologic Services).*

A growing body of research is focusing on the potential impacts of ocean acidification on the Puget Sound ecosystem. Ocean acidification is driven by the absorption of carbon dioxide and is expected to impact survival, growth and behavior of marine organisms. In addition to observed impacts to calcifying organisms (e.g., oysters and crab) there is more recent evidence that ocean acidification may impair sense of smell in salmon, impede growth in herring and other species, and alter plankton populations – which may have a cascading impact on marine food webs. Experiments have shown that coho salmon's ability to avoid predators declines and risk of being eaten increases in low pH waters (Dunagan 2019). Although considerable uncertainty surrounds the potential impacts of ocean acidification on salmon, there is potential for it to exacerbate the issue of marine survival.

Elevated Water Temperatures (Watershed-wide)

Watershed Status

Water temperature is a key determinant of the biological integrity of a river – especially as it relates to cold-water dependent salmonids. High water temperatures can act as a limiting factor for the distribution, migration, health and performance of salmon. Washington State's water quality standards are protective of viable salmonid habitat in the Green River by assigning a numeric criterion of 16°C, above which the water body is considered impaired (WAC 173-201A-602). A supplemental criterion of 13°C, in effect between September 15 and July 1 further protects salmonid habitat. The widespread removal of tall, native trees along the riparian corridor – especially in the middle and lower Green River – allows solar-atmospheric radiation to rapidly warm water as it moves downstream below HHD. As a result, large stretches of the Green River, Soos Creek and Newaukum Creek regularly exceed established water quality standards for temperature. In 2011, the Washington State Department of Ecology developed total maximum daily loads (TMDLs) for the Green River and Newaukum Creek that outlined an implementation plan for improving temperatures. Another TMDL for Soos Creek is under development.

The Green/Duwamish experienced widespread potentially lethal water temperatures in 2015 (DeGasperi 2017). In response, WRIA 9 led the development of the *Re-Green the Green: Riparian Revegetation Strategy* (2016) to emphasize the critical need for increasing riparian canopy and to prioritize revegetation efforts within the watershed. The strategy was adopted as an addendum to the 2005 Salmon Habitat Plan. It incorporated solar aspect shade maps published in 2014 by the Muckleshoot Indian Tribe to prioritize areas where increased tree canopy – and thus shade – could provide the largest benefit to preventing elevated water temperatures. It also established revegetation goals that were directly incorporated into this Plan Update. WRIA 9 developed a Re-green the Green grant program using Cooperative Watershed Management funds from the Flood Control District to accelerate revegetation efforts across the watershed.

Research/Monitoring

In addition to periodic exceedances of potential lethal water temperatures, a review of 7-DMax water temperatures at Whitney Bridge (RM 41.5) shows that instream temperatures regularly exceed established thresholds for sublethal impacts to salmon. Figure 10 shows 7-DMax temperatures from 2001-2016 in relation to key Chinook salmon life history stages. These data suggest migration, early spawning, egg incubation, yearling and parr rearing all potentially subject to sublethal impacts associated with elevated water temperatures.

A literature review completed for WRIA 9 (Kubo 2017) provides a summary of potential temperature-related impacts to Chinook salmon. Adult fish migrating upstream may be subject to increased metabolic demand, delayed migration, increased disease exposure, decreased disease resistance, and even direct mortality. Spawning fish may experience reduced gamete quality and quantity and reduced fertilization success. Chinook eggs may be subject to reduced embryo survival, decreased hatching-emergence condition, increased abnormalities, and altered metabolic rates. Juveniles and outmigrants may be subject to reduced feeding and growth rates, increased disease susceptibility, and accelerated onset of smoltification and desmoltification. Although many impacts may be sublethal, they can contribute to an increase in delayed mortality.

Protecting and restoring mature riparian tree canopy, protecting cold water sources, and promoting hyporheic exchange between the river/floodplain and the alluvial aquifer are essential to build ecological

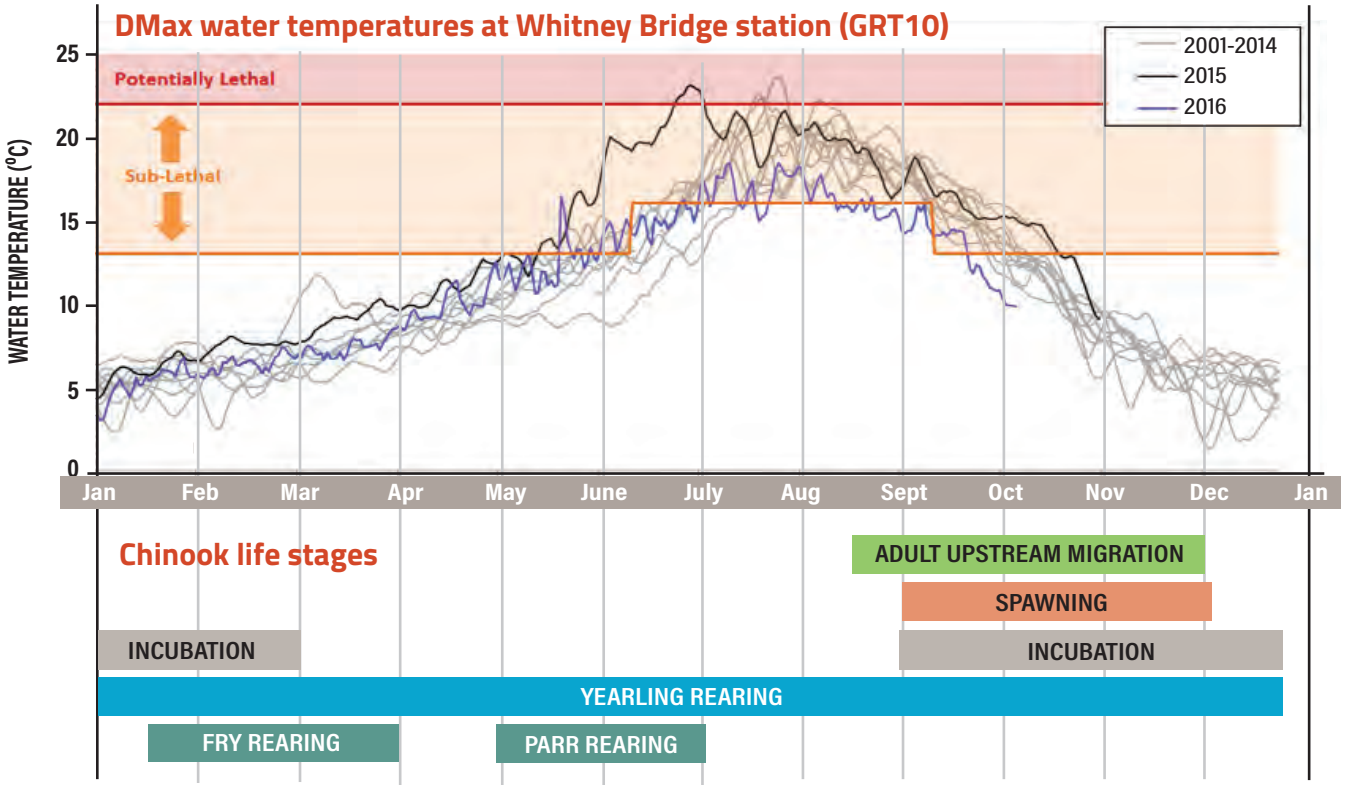


Figure 10. Plot of 7-DMax water temperatures for the 2015 and 2016 calendar years measured by King County at the Whitney Bridge station (GRT10) compared to 7-DMax temperatures measured from 2001-2014. State standards for designated uses are noted by the orange line and potentially lethal impacts are indicated by the red line. State standards for designated uses include core summer salmonid habitats (July 1 – September 15) as well as spawning and incubation periods (September 16 – July 1). Timing of specific Green River Fall Chinook lifestages included below.

Source: Adapted from King County 2016.

resilience to rising temperatures and moderate the impacts associated with climate change. By 2080, it is expected that the number of river miles exceeding salmonid thermal tolerances (>18°C) will increase by 70 miles in the Green/Duwamish watershed (G. Mauger 2016). One study suggests that warming of 2-5.5°C could result in the loss of 5-22 percent of salmon habitat by 2090 (O'Neal 2002).

Predicted temperature increases, lower summer flows and altered precipitation patterns are likely to exacerbate temperature-related stress for Chinook salmon.

Fish Passage Barriers (Watershed-wide)

Watershed Status:

Fish passage barriers are a critical obstacle to Chinook salmon recovery in the watershed. The presence of Howard Hanson Dam and the Tacoma Headworks Diversion facility block access to approximately 40 percent of the historical Chinook salmon spawning and rearing habitat (NOAA 2019). This barrier alone blocks access to somewhere between 78-165 miles of suitable fish habitat. The 2005 Plan assumed fish passage would be provided by 2015. Tacoma completed an upstream trap and haul facility at the headworks facility in 2007; however, downstream fish passage at Howard Hanson Dam has not been completed.

In 2019, the NOAA Fisheries released a biological opinion (BiOp) that concluded U.S. Army Corps operations at Howard Hanson Dam would "jeopardize the continued existence of ESA-listed Puget Sound (PS) Chinook salmon, PS steelhead, and Southern Resident killer whales (SRKW), and that the proposed action is likely to result in the adverse modification of these three species' critical habitat designated under the ESA." In issuing the jeopardy opinion, NOAA stated that without fish passage the population's abundance, productivity, and spatial diversity could not achieve established viability criteria, thus increasing the risk of extirpating the population.

In order to avoid jeopardizing ESA-listed Chinook, the BiOp concluded that the U.S. Army Corps must provide operational downstream fish passage no later than February 2031. The resulting facility would be required to satisfy established performance criteria, including achieving 98 percent survival of all fish passing through the facility. The BiOp states that if established performance standards are satisfied, the Upper Green watershed could support self-sustaining populations of Chinook salmon and steelhead, "dramatically improving the likelihood that the Chinook salmon population would achieve a highly viable status."

In addition to HHD, an unknown number of smaller fish passage barriers impact Chinook salmon movements within the watershed. There is a growing recognition that a number of barriers associated with smaller tributaries adjacent to roads, revetments and flood control structures block juvenile access to critical rearing habitats. One of the larger existing barriers is the Black River Pump Station. The pump station is a flood control facility built in 1970, located near the mouth of the Black River. While the facility was originally constructed with both upstream and downstream fish passage facilities, they are outdated and currently do not meet federal fish passage criteria (Jacobs 2020). In its current state, the facility limits both upstream and downstream fish passage and restricts access to over 50 miles of stream, including Springbrook Creek, Panther Lake Creek, Garrison Creek, and Mill Creek. Although the majority of stream habitat is primarily suitable for coho and steelhead, Chinook salmon have been found in the system, and the area immediately upstream of the facility could provide important rearing and refuge habitat for juvenile Chinook.

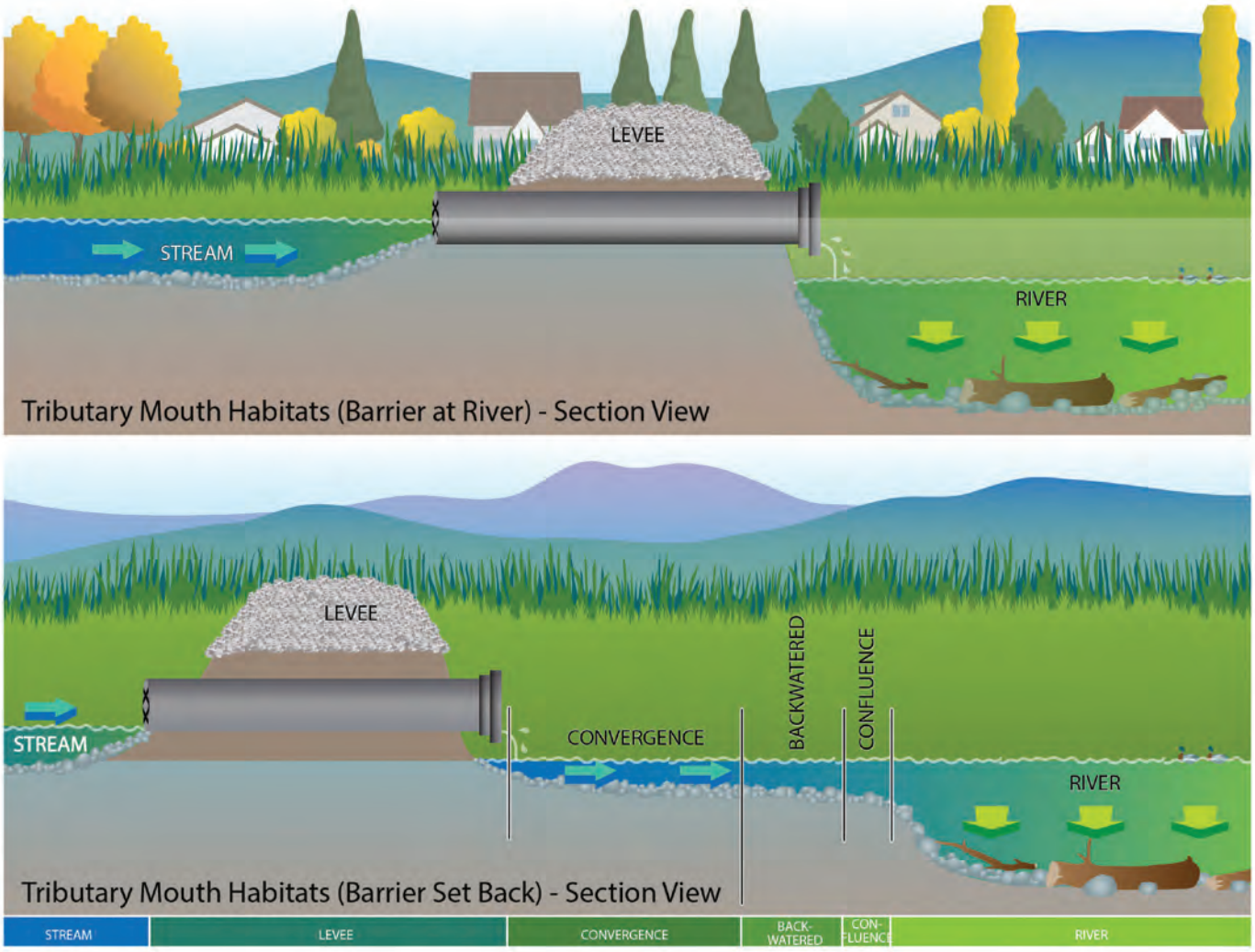
Research/Monitoring

A 2019 study evaluating the use of small non-natal tributaries (streams that do not support Chinook spawning) by juvenile Chinook highlighted the importance of these habitats for both juvenile rearing and flood refuge. Juvenile Chinook were identified in eight of the nine tributaries sampled in the Lower Green River basin and were found up to 480 meters above the confluence with the Green River. The results demonstrated (1) widespread use of non-natal tributaries for extended lengths of time; (2) heavily urbanized streams with a large amount of impervious surfaces appear capable of supporting non-natal juvenile rearing; (3) juvenile upstream passage is an important consideration for fish barriers; and (4) variability in flapgate performance for juvenile fish passage (King County 2019). A follow-up study was funded by WRIA 9 in 2019 to assess flapgate performance and identify potential retrofit and replacement options to improve juvenile passability.

Non-natal tributaries provide important rearing and refuge habitat in the Lower Green subwatershed.

Long-term fish-in fish-out monitoring by WDFW indicates that Chinook salmon population productivity is limited by available rearing habitat and that parr outmigrants disproportionately contribute to the abundance of returning adults (Anderson and Topping 2018). Restoration of non-natal tributaries has the potential to complement ongoing restoration efforts in the Lower Green River mainstem to provide additional capacity to support fry growth into parr prior to outmigration to the Duwamish estuary. Larger (basins >100 acres), low-gradient (<2%) tributaries likely provide a large amount of rearing habitat and support higher densities of juvenile Chinook (King County 2019; Tabor et al. 2011; Tabor and Moore 2018; Tabor, Murray and Rosenau 1989; Scrivener et al. 1994; Bradford et al. 2001).

Figure 11. *Representative tributary mouth habitats associated with flapgate flood control structures.*



Source: King County, 2019: Juvenile Chinook Use of Non-natal Tributaries in the Lower Green River

Land Conversion (Watershed-wide)

Watershed Status

Located within the greater Seattle metropolitan area, population growth and economic development have significantly modified the watershed, its underlying hydrology, and the salmon habitat within it. In addition to legacy impacts (Chapter 3 of 2005 Plan), the watershed experienced tremendous population growth and development in the 15 years since the 2005 Salmon Plan. The population of King County population swelled approximately 25 percent, adding an additional 444,000 residents (U.S. Census Bureau 2019; King County 2006). During the same timeframe, 46,000 new housing units were constructed in the watershed (WA Dept. of Commerce 2017).

The extensive development pressures within the watershed – especially in the Nearshore, Duwamish and Lower Green watershed – have degraded large portions of the watershed from natural conditions. In addition to direct habitat loss, land conversion contributes to increased impervious coverage and stormwater runoff. Refer to the Stormwater section in this chapter for additional information on stormwater impacts on salmon. Approximately 32 percent of the watershed is located within established urban growth areas (UGAs). Competition for scarce available land contributes to high restoration/acquisition costs and the loss of restoration priorities to redevelopment pressures.

Research/Monitoring

Despite the tremendous growth and development pressure, growth management efforts have concentrated new housing construction within urban growth areas. Only about 3 percent of housing units constructed in the watershed since the 2005 Plan have occurred outside of UGAs (WA Dept. of Commerce 2017). While this is a positive outcome, a compree hensive assessment of changes in forest cover and impervious surfaces has not been completed since 2006. In addition, the basin-wide effectiveness of critical area and shoreline protections has not been assessed. A WRIA 9-funded study of marine shoreline development from 2016-2018 observed a net increase in shoreline armoring and permit compliance rates below 50 percent (King County 2019). Additional information about the status of marine shorelines is presented in the Shoreline Armoring section.

Levees and Revetments (Middle and Lower Green)

Watershed Status

An extensive network of flood containment and training levees and revetments protect economic development and agricultural land in the Lower and Middle Green River valleys. In total. there are approximately 36 miles of levees and revetments in the watershed. Over 27 miles of facilities provide flood protection for the Lower Green River valley – the second largest warehouse and distribution center on the west coast. The valley contains $7.3 billion of structures and associated content, supports over 100,000 jobs, and generates an annual taxable revenue of $8 billion (Reinelt 2014).

Flood control facilities degrade floodplain function and reduce habitat complexity. They disconnect large portions of the historical floodplain, off-channel habitats, and tributaries – all important juvenile salmon rearing and refuge habitats. Associated vegetation maintenance standards limit riparian revegetation and contribute to elevated instream temperatures. Facilities also disrupt sediment delivery and filtration, water storage and recharge, and large wood input to the river channel. In addition to the direct impacts of the facilities, they also support land use development on historic floodplains habitats.

Due to the diversion of the White and Black rivers, much of the "connected" floodplain is perched above the river channel and only connected during very high flows. Current flows with a 100-year flood event equate to an historic two-year event (King County 2010). At these flows, only 18 percent (3,518 of 19,642 acres) of the historic Lower Green River floodplain is connected (Higgins 2017). The loss of juvenile Chinook salmon-rearing habitat reduces juvenile survival and overall population productivity. Restoration of floodplain habitat in the Lower Green River valley not only requires levee setbacks, but also requires extensive fill removal to reconnect perched floodplains across a larger range of flows.

Research/Monitoring

Since the 2005 Plan, studies have shown higher growth rates for Chinook salmon accessing floodplains when compared to fish rearing exclusively in the mainstem. Increased growth likely results from increased food availability and foraging efficiency in floodplain habitats (Henning 2004; Sommer et al. 2001; Jeffres, Opperman and Moyle 2008; and Lestelle et al. 2005). This research also suggests that any increased risk of stranding during retreating flows is offset by the potential for increased growth rates. These studies emphasize how important floodplain habitats are to juvenile Chinook growth and provide an important context for understanding how the magnitude of habitat loss in the Lower Green and to a lesser extent in the Middle Green have impacted juvenile Chinook production locally.

Analysis of juvenile life history success in adult Green River Chinook salmon (2015-2017) found parr outmigrants disproportionately contribute to adult returns relative to their abundance. Although parr comprised 3-56 percent of the out-migrating juveniles, more than 97 percent of returning adults were found to have exhibited the parr life history. In comparison, the parr life history is reflected in 64 and 76 percent, respectively, of the adult returns in the Skagit and Nooksack watershed (Campbell and Claiborne 2017; Campbell et al. 2019). These data indicate that Chinook salmon life history success varies between watersheds and that productivity (adult spawner abundance) in the Green is currently driven by parr production, as juveniles exhibiting the fry life history rarely survive to adulthood.

An analysis of long-term juvenile outmigration data collected by WDFW identified a density-dependent relationship between adult spawner abundance and relative parr abundance (Anderson and Topping 2018). Figure 6 shows that adult escapements in excess of 3,000 fish did not generally result in increased parr production. In contrast, fry production was observed to be density independent. Juvenile Chinook require rearing and refuge habitats (e.g., off-channel habitats, side-channels, etc.) to grow into parr prior to outmigration. When considered in concert with the Campbell and Claiborne studies, these results highlight the importance of reconnecting floodplains and restoring rearing habitat to increasing Chinook returns.

Sediment Contamination (Duwamish)

Watershed Status

Industrial and commercial development in the Duwamish estuary not only led to dredge and fill of historical estuarine wetlands, but also left a legacy of persistent contaminants within the working waterfront. Two Superfund sites require additional clean-up in the Duwamish, the Lower Duwamish Waterway (LDW) and Harbor Island/East Waterway (EW). Both sites contain elevated levels of polychlorinated biphenyls (PCBs), arsenic, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), as well as dioxins and furans. The EPA's Record of Decision for the LDW (2014) outlines the cleanup plan for the 412 acre site, which includes 105 acres of dredging or partial dredging, 24 acres of capping, 48 acres of enhanced natural remediation and 235 acres of monitored natural attenuation. Although early action areas (Slip 4, Terminal 117, Boeing Plant 2/Jorgensen Forge, Diagonal Combined Sewer Overflow [CSO], and Norfork CSO) resulted in cleanup of approximately 50 percent of PCB contamination, cleanup will not be completed until after 2031. Cleanup options for the EW site are under development.

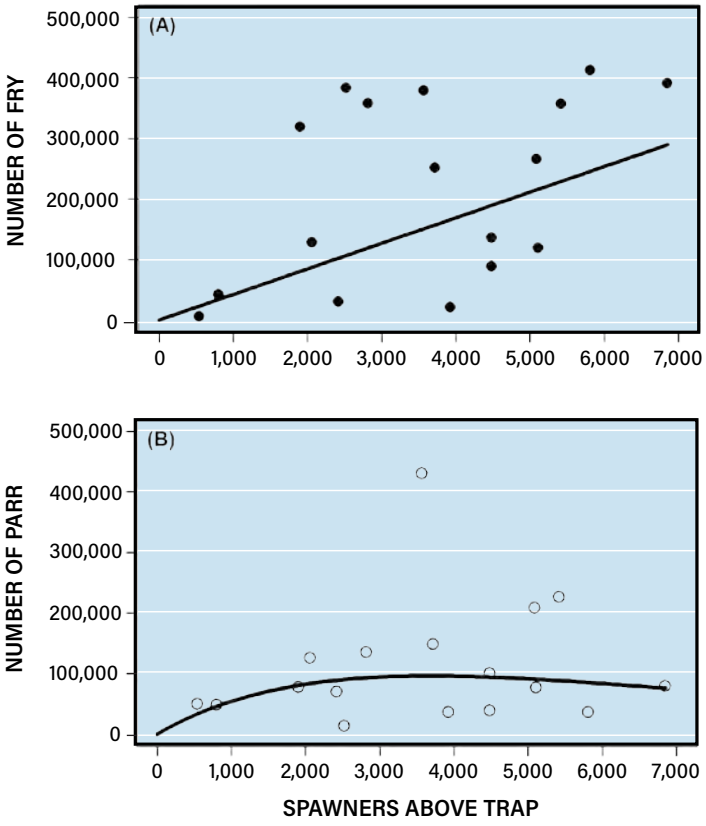


***Figure 12**. Spawners-recruit plots showing abundance of fry and parr produced based on estimated adult Chinook salmon escapement (Anderson and Topping 2017).*

Productivity in the Green/Duwamish is currently constrained by available rearing habitat in the Lower and Middle Green rivers.

Transport pathways carry contaminants from sources to surface waters, as well as within surface waters. Contaminants reach the Green/Duwamish receiving waters via point discharges (permitted industrial, stormwater and CSOs discharges), overland flow (stormwater runoff), groundwater, and direct atmospheric deposition, as well as by spills/leaks and bank erosion. Fish are exposed to chemicals through multiple routes including water passing through their gills and/or its ingestion, direct sediment contact and/or its ingestion, and/or through consumption of contaminated prey. Chinook experience greater chemical exposure during the juvenile phase than during the adult phase due to the comparatively different lengths of time they spend in the Duwamish during these life stages (Colton 2018).

Although the 2005 Salmon Plan hypothesized that sediment cleanup would benefit Chinook salmon, limited scientific data were available on the potential impacts of sediment contamination on productivity at the time.

Research/Monitoring

A growing body of research findings suggests that contaminant exposure for juvenile Chinook salmon in the Duwamish and Elliott Bay is affecting juvenile Chinook salmon growth, disease resistance, and immunosuppression, and ultimately marine survival. Juvenile Chinook salmon rearing in industrial estuary and nearshore habitats (e.g., Duwamish, Puyallup and Snohomish) contain elevated levels of organic contaminants as compared to those rearing in less developed watersheds (Skagit and Nisqually) (O'Neil et al. 2015; Varanasi et al. 1993). Juvenile Chinook salmon whole body PCB tissue concentrations from the Duwamish and associated nearshore areas have exceeded adverse impact thresholds (O'Neil et al. 2015; Johnson 2007). PCB levels in wild fingerlings have also been shown to have significantly higher PCB levels than their hatchery counterparts, suggesting that wild Chinook have a longer residence time within the Duwamish estuary (Nelson, et al. 2013).

An examination of 37 years of hatchery data from 20 hatcheries across 14 watersheds found 45 percent lower smolt-to-adult survival rates for hatchery Chinook that outmigrate through contaminated estuaries as compared to uncontaminated estuaries (Meador 2014). The study evaluated the findings against the total amount of estuary habitat, length of freshwater habitat between each hatchery and estuary, as well as growth rates and did not find these factors could explain observed variation in survival rates. Because wild Chinook – especially the fry outmigrant life history type – are more dependant on and have longer residence times in estuarine habitat, the observed decline in survial may be more pronounced in wild Chinook salmon.

A recent study by scientists at the NOAA Northwest Fisheries Science Center estimated the potential impact remediation of the Lower Willamette River Superfund site would have on Chinook salmon recovery (Lundin et al. 2019). The study used a combination of field and laboratory-collected exposure, growth, and disease resistance data to estimate acute and delayed mortality rates for juvenile Chinook. These estimates were then incorporated into a life cycle model that estimated sediment remediation could improve juvenile survival by 54 percent and increase population abundance by 20 percent. This study provides a population-scale assessment of the potential impacts of legacy pollutants on Chinook salmon and suggests that remediation in the Duwamish could be a significant driver for Chinook recovery.

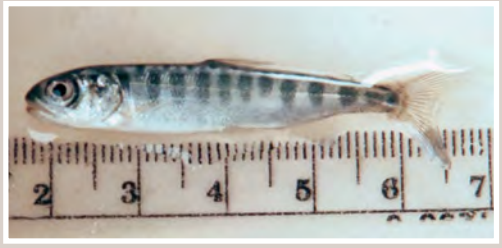


Figure 13. *Chinook salmon that enter the estuarine waters as fry (< 60 mm) experience very low marine survival rates. In contrast to less developed watersheds, estuarine-reared fry in the Green/Duwamish are not contributing significantly to adult returns.*

The research on potential adverse impacts to juvenile Chinook as a result of contaminant exposure is consistent with a recent analysis of juvenile life histories expressed by adult Chinook salmon in the Green/Duwamish River. Analysis of otoliths from returning adult salmon allow resource managers to back-calculate size upon entry in marine waters, allowing differentiation between parr and fry migrants. Otolith collection from adult Chinook salmon (2015-2017) indicate that less than 3 percent of fish returning to the watershed entered marine waters as a fry migrant, despite representing between 44 and 97 of the total juvenile outmigrants (Campbell and Claiborne 2017; Campbell et al. 2019). Additional research is needed to assess the relative importance of contamination in relation to other stressors (i.e., existing estuarine habitat quality and capacity) in contributing to poor marine survival.

Research suggests that juvenile Chinook that enter the Duwamish as fry – as opposed to parr – experience very low survival and do not substantively contribute to population abundance as measured by adult escapement.

Chemicals of emerging concern (CECs) are another area of emerging research. The EPA defines CECs as "chemicals and other substances that have no regulatory standard, have been recently 'discovered' in natural streams (often because of improved analytical chemistry detection levels), and potentially cause deleterious effects in aquatic life (e.g., endocrine disrupters) at environmentally relevant concentrations" (EPA 2008). CECs include hormones, pharmaceuticals and personal care products (PPCPs), and industrial process chemicals. An analysis of juvenile Chinook whole body tissue in several Puget Sound estuaries detected 37 of 150 surveyed PPCPs (Meador et al. 2016). Metabolic disruption consistent with starvation was also observed in juvenile Chinook collected adjacent to waste water treatment plants in Sinclair Inlet and the Puyallup River (Meador 2018). The potential impacts to Chinook salmon growth, reproduction, and behavior are not well understood.

Stormwater (Nearshore, Duwamish, Lower and Middle Green)

Watershed Status

Stormwater runoff and associated hydrological modifications resulting from forest conversion and land use development within the Green/Duwamish watershed adversely impact water quality and salmon habitat. Approximately 59 and 24 percent, respectively, of the 165-foot riparian buffer in the Duwamish and Lower Green is characterized by impervious surfaces (King Co. unpublished data, 2013). Although watershed-wide data are not available, the impacts associated with the loss of forest cover and increase in impervious surfaces are not confined to riparian areas. At the basin-wide scale, these levels of impervious coverage can contribute to a two-three fold increase in stormwater runoff above natural conditions (Paul and Meyer 2001). Increased runoff contributes to rapid changes in flows, with larger peak flows and lower low flows; increased pollutant transport and degradation of water quality; shifts in benthic macroinvertebrates communities; elevated water temperatures; increased bank erosion and sediment transport capacity; and altered channel morphology and hydraulics.

The majority of the development within the watershed – and across Puget Sound – predates existing critical area ordinances and low-impact development standards designed to mitigate impacts to aquatic ecosystems. As a result, stormwater runoff is recognized within the region as one of the more significant challenges facing both salmon and Puget Sound recovery efforts.

Research/Monitoring

Since the 2005 Plan, a significant body of research has focused on stormwater toxicity impacts to salmon in urban creeks. Consistently high levels of mortality (up to 90 percent) in adult coho salmon have been observed in urban watersheds, with the extent of mortality rate related to an urbanization gradient and, more specifically, density of motor vehicle traffic (Scholz 2011; Feist 2017). More recent studies have connected observed mortality events to pollutants associated with highway runoff (Scholz 2016; Peter 2018).

Although Chinook salmon do not appear vulnerable to acute toxicity as a result of roadway runoff exposure (Scholz 2019), more research is needed to evaluate potential sublethal impacts.

Although studies have shown treatment of runoff can prevent acute toxicity, the large capital expenditures associated with stormwater retrofits have precluded widespread implementation. A comprehensive needs and cost assessment for stormwater retrofit within the Green/Duwamish and Central Puget Sound watershed was completed in 2014. The study evaluated 278 square miles of the watershed, excluding Seattle and areas upstream of Howard Hanson Dam. An estimated $210 million per year would need to be spend over the next 30 years to build necessary regional facilities, retrofit roads and highways, and retrofit non-forested lands not redeveloped within the next 30 years (King County 2014).

Shoreline Armoring (Nearshore)

Watershed Status

The Green/Duwamish and Central Puget Sound watershed encompasses 92 linear miles of marine shoreline. Associated nearshore habitats provide not only important rearing and migratory habitat for juvenile salmon, but also spawning habitat for forage fish (e.g., sand lance and surf smelt), which are important prey items for salmon, birds and marine mammals. Delivery of sediment and trees from natural bluffs helps sustain nearshore habitat complexity (beaches, spits, eelgrass beds, etc.) and shoreline resilience to coastal erosion and sea level rise.

The degradation of marine shorelines and associated ecological functions has implications not only for Chinook salmon recovery, but also for the ESA-listed southern resident orca population. Shoreline armor – especially along feeder bluffs – disrupts sediment supply and transport, altering nearshore habitat quantity and quality. Shoreline land use ranges from commercial and industrial waterfront in Elliott Bay, urban residential between Seattle and Federal Way, to rural residential and undeveloped shorelines along Vashon Island. Approximately 65 percent of the shoreline is currently armored and only 22 of 52 drift cells have greater than 50 percent of historical feeder bluffs intact (King County 2019; WRIA 9 2012).

Figure 14. *Shoreline modification identified during Marine Shoreline Monitoring and Compliance Project (Ecology).*

Research/Monitoring

Recent research reinforces assumptions in the 2005 Plan about the importance of nearshore habitats to salmon. The range of physical and biological impacts in response to shoreline armoring varies across spatial and temporal scales. Shoreline armoring impacts wrack and log accumulation, juvenile fish utilization, forage fish spawning, beach profiles, sediment grain size, and marine riparian vegetation. In particular, drift cells with a high proportion of armoring tend to be characterized by skinnier beaches, coarser sediments, fewer drift logs, fewer prey species (Dethier et al. 2016).

Natural shorelines convey important benefits to juvenile Chinook salmon. Small juvenile salmon preferentially use low-gradient, unarmored shorelines (Munsch, Cordell and Toft 2016). Riparian vegetation associated with unarmored beaches provide a source of terrestrial prey items for juvenile Chinook and benefit forage fish egg survival by moderating substrate temperatures and maintaining humidity (Rice 2006; Toft, Cordell et al. 2007). Even small-scale beach restoration projects (i.e., Olympic Sculpture Park) have resulted in measurable increases in larval fish abundance, juvenile salmon, and invertebrate diversity as compared to adjacent armored shorelines (Toft, Ogston et al. 2013).

The magnitude of unpermitted shoreline modifications threatens to negate investments in shoreline restoration and undermine the goal of "no net loss" established within the Shoreline Management Act. From 2013-2018, the watershed saw a net increase of 364 feet of shoreline armor despite armor removal and restoration of 382 feet shoreline during the same timeframe. Only 42 percent of observed shoreline modifications were permitted by local governments prior to construction (King County 2019).

Although juvenile Chinook from the Green/Duwamish River have been observed to use the marine shorelines throughout Central Puget Sound, considerable uncertainty surrounds the relative importance of non-natal coastal streams and pocket estuaries. A study in the Whidbey Basin found abundant use of non-natal coastal streams (32 of 63 streams) by juvenile Chinook. The presence of juvenile Chinook was influenced by (1) distance to nearest natal Chinook salmon river; (2) stream channel slope; (3) watershed area; and (4) presence and condition of a culvert at the mouth of a stream. The importance of non-natal coastal streams to juvenile Chinook salmon dropped significantly beyond 7 km from the mouth of a Chinook bearing river (Beamer, et al. 2013). Additional research is needed to prioritize non-natal coastal streams in WRIA 9 with respect to potential contribution towards Chinook salmon recovery.

Despite the recognized importance of natural shorelines and significant regional investment in armor removal, WRIA 9 continues to experience a net increase in shoreline armoring.

Chapter 6: Recovery Strategies

WRIA 9 developed 11 overarching recovery strategies to organize watershed priorities and guide future investments. These strategies outline priority areas of focus intended to advance salmon recovery over the next 10-20 years. Recovery strategies are not prioritized. Implementation across the portfolio of recovery strategies is necessary to address priority pressures; increase salmon abundance, productivity, and diversity; and build long-term population resiliency. Successful implementation hinges on partner coordination and investment to ensure local land use planning, capital investment programs, and community outreach messaging are consistent with identified watershed priorities.

WRIA 9 hosted a series of subwatershed workshops to review and update policies and programs from the 2005 Salmon Habitat Plan. Revised policies and programs are organized by recovery strategies – as opposed to subwatershed – to reduce redundancy and improve alignment with other Puget Sound salmon plan updates. This structure is intended to provide project sponsors and other recovery partners a streamlined communication tool for a shared understanding of what needs to happen, where, and what policy considerations are necessary at the local and regional level to advance Chinook salmon recovery.

Strategy: Restore and Improve Fish Passage

Location: All Subwatersheds

Fish passage barriers block access to important spawning and rearing habitat and can exacerbate localized flooding issues. Legacy transportation and flood control infrastructure were not regularly designed for fish passage and/or elevated flood flows associated with climate change. Although addressing fish passage barriers was a priority in the 2005 Plan, a 2018 U.S. Supreme Court ruling affirmed that the State has a treaty-based obligation to address culverts under state-maintained roads in order to preserve tribal harvest rights within their usual and accustomed areas. This ruling has reinforced the need and elevated the urgency for addressing identified barriers in a systematic and strategic manner.

Figure 15. *Juvenile fish passage barriers block juvenile Chinook salmon access to important rearing habitat in non-natal tributaries. Photos: Mike Perfetti.*

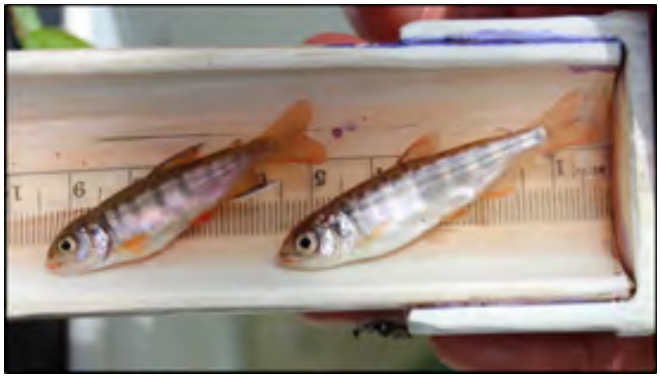


Figure 16. *Healthy juvenile Chinook (right) and coho (left) salmon sampled from a non-natal tributary in 2018. Photo: Chris Gregersen.*

Programs

» Fish Passage Barrier Removal

WRIA 9 partners should work towards a comprehensive inventory of fish passage barriers in the Green/Duwamish and Central Puget Sound Watershed, and prioritize barrier removal across the watershed to maximize the benefit of fish passage investments. Although the majority of existing barriers in the watershed impact coho salmon and steelhead, special consideration should be given to removing barriers to non-natal tributary rearing habitats. Recent fish monitoring studies have demonstrated the importance of non-natal tributaries to juvenile Chinook and remedying these barriers will expand available rearing habitat and increase Chinook productivity. Recent fish monitoring studies have demonstrated the importance of non-natal tributaries to juvenile Chinook (King County 2019; Tabor and Moore 2018) and remedying these barriers will expand available rearing habitat and increase Chinook productivity.

Many partner jurisdictions do not have the capacity to implement a programmatic approach to barrier identification and removal; instead, barrier removal is driven by infrastructure repair needs and local capital improvement programs. Some, such as the City of Seattle, have an inventory and prioritized list of fish passage barriers but lack sufficient funding for implementation. To support a more comprehensive approach to fish passage, WRIA 9 partners should leverage available technical assistance from Washington Department of Fish and Wildlife (WDFW) Fish Passage and King County Fish Passage Restoration Programs to assess and prioritize barriers for removal outside of their scheduled capital improvement programs to expedite high-priority barrier removals. Jurisdictions should apply for funding for high-priority projects through the Brian Abbott Fish Barrier Removal Board. Regional coordination among WRIA 9 partners on fish barrier removal priorities should help identify synergies and accelerate barrier removal in priority subwatersheds. Programmatic improvements within the County Fish Passage Restoration Program may support increased efficiencies within other jurisdictions. Fish passage accomplishments and lessons learned should be shared regularly to expedite barrier identification and increase coordination across the watershed.

Policies

» **Fish Passage (FP) 1:** Provide efficient and safe fish passage where built infrastructure (e.g., road crossings and flood control facilities) intersects instream habitats. Fish passage design considerations should not only facilitate adult upstream migration, but also ensure juvenile salmonid access to rearing habitat provided in non-natal tributaries. Project sponsors should use WDFW Water Crossing Design Guidelines (2013) to assess feasibility and support alternative development.

Strategy: Protect, Restore and Enhance Floodplain Connectivity

Location: Lower and Middle Green

The process of channel migration within the floodplain creates side channels, back-water sloughs, and other off-channel habitats that are critical for juvenile salmon rearing and refuge. Floodplains also facilitate an exchange of nutrients and organic material between land and water, and provide important flood storage capacity that can mitigate flood damages to adjacent communities. The historic loss of floodplain habitat within the Green/Duwamish watershed resulted in a loss of habitat complexity, increased peaks flows and water velocities, and a loss of groundwater storage and important cold water recharge during summer months. Flow regulation at Howard Hanson Dam and the diversion of the White River into the Puyallup River has reduced the frequency and magnitude of flood events and left much of the floodplain perched well above the current river channel. Reconnecting floodplains and restoring floodplain habitats is essential to increasing both the available rearing habitat and corresponding salmon productivity of the system.

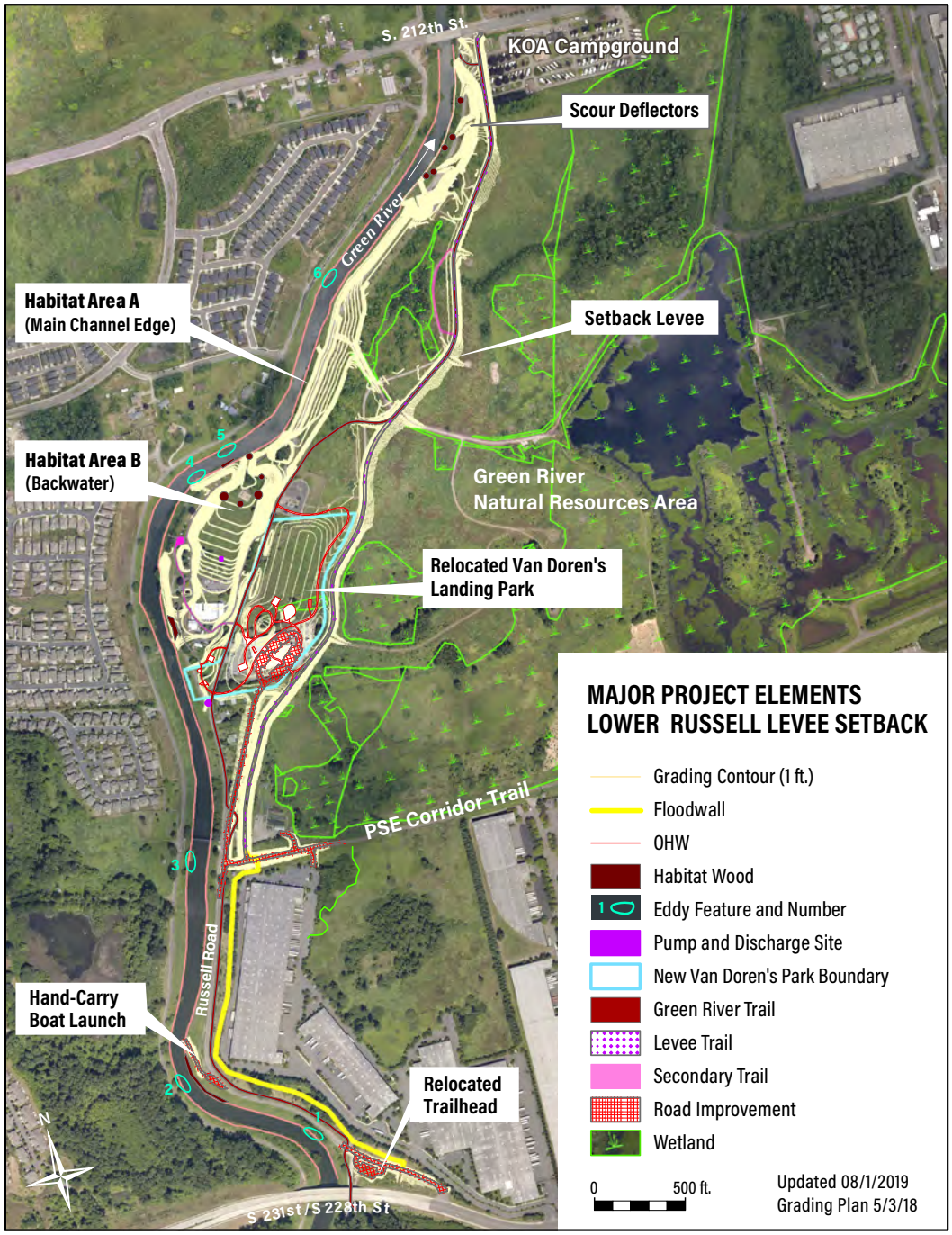


Figure 17. *The Lower Russell Road Levee Setback Project is a multi-benefit project that provides flood risk reduction, habitat restoration, and recreational enhancements.*

Programs

None identified. Implementation relies on individual capital projects that will be identified in project list.

Policies

» **Floodplain Connectivity (FC) 1:** Support multi-benefit flood risk reduction projects that also enhance salmon habitat by allowing rivers and floodplains to function more naturally. Multi-benefit projects can (1) reduce community flood risk; (2) provide critical salmon habitat; (3) increase floodplain storage; (4) improve water quality; (5) replenish groundwater; (6) expand public recreation opportunities; and (7) strengthen community and ecological resilience to extreme weather events due to climate change.

» **FC2:** Wherever possible, flood protection facilities should be (re)located away from the river edge to reconnect floodplains and re-establish natural riverine processes. During conceptual design of alternatives, project sponsors should evaluate opportunities to pursue relocation of existing infrastructure and real estate acquisition to support levee setbacks. A process-based approach to restoration is ideal for species recovery; however, where a levee setback is infeasible due to the constraints of past land use activity, alternative facility designs (e.g., levee laybacks) should strive to incorporate planting benches and wood structures that mimic lost ecosystem services and improve critically needed edge habitat.

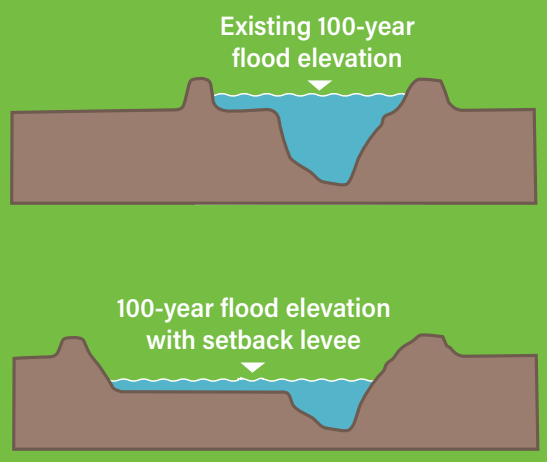
» **FC3:** Local government should utilize critical areas and shoreline regulations and associated land use policies to protect creek riparian areas and associated floodplains to increase the flood storage capacity of these areas.

» **FC4:** Vacating and relocating roads should be evaluated as tools to support salmon restoration priorities where impacts are negligible and/or can be mitigated. Coordinating transportation infrastructure improvements with salmon habitat needs (e.g., floodplain reconnection and fish passage) can improve outcomes and reduce project costs. Road vacation policies should be updated to consider level of use and road standards.

Strategy: Protect, Restore, and Enhance Channel Complexity and Edge Habitat

Location: Lower, Middle and Upper Green

Flood protection facilities (e.g., Howard Hanson Dam, revetments, and levees) and loss of riparian habitat have disrupted sediment transport, simplified habitat complexity, contributed to a loss of rearing and refuge habitat, and impeded natural recruitment of spawning gravels. Although process based restoration is preferred, ongoing intervention is necessary to replace/mimic natural processes where they cannot be restored.



Setback:
Relocation of the toe of the levee/revetment landward of ordinary high water to provide for increased erosion and channel migration.

Programs

» **Middle Green River Gravel and Wood Supplementation Program**

The U.S. Army Corps of Engineers and Tacoma Public Utilities should continue gravel and wood supplementation in the Middle Green River to account for disruption of natural sediment transport and wood recruitment caused by Howard Hanson Dam. Up to 14,000 tons of spawning gravels are deposited annually at two sites located near river mile 60, just downstream of the Tacoma Headworks Facility. High flows during the winter months engage the deposited gravel and naturally distribute it downstream. Regular monitoring of gravel distribution should inform quantity, size gradation, and timing to maximize benefits for salmonids.

The U.S. Army Corps Corps should continue to transport large wood (> 12 in. diameter; > 20 ft. in length; >4 ft. diameter root ball) that is stranded in the reservoir to below the Tacoma Headworks Facility. Large wood increases channel complexity, provides habitat for juvenile fish, and provides nutrients and substrate for aquatic insects. The upper watershed is heavily forested and large wood is transported to the reservoir during high flow events, but is unable to move downstream of the dam without intervention. Existing quantities of large wood downstream of the dam remain significantly below recommended wood volumes (Fox and Bolton 2007) to support salmon recovery. Periodic surveys should be completed to monitor large wood volumes and ensure project success.

Policies

Channel Complexity (CC) 1: Project designs should incorporate best available science related to climate change predictions and anticipated changes to seasonal instream flow patterns to enhance channel complexity and edge habitat across a range of flows. Lower spring and summer flows could make restored rearing habitat inaccessible during juvenile Chinook outmigration. Special consideration should be given to project designs that ensure juvenile salmon rearing habitat remains accessible in low flow years.

» **CC2:** For habitat restoration projects calling for the addition of large woody debris, placement of wood should consider risk to river users, such as boaters and swimmers.

Strategy: Protect, Restore, and Enhance Riparian Corridors

Location: All Subwatersheds

Healthy riparian corridors provide a critical role in providing cool and clean water for salmon. Riparian vegetation shades instream habitat and moderates water temperatures; reduces erosion by stabilizing streambanks; captures rainwater and filters sediment and stormwater pollutants; provides terrestrial nutrient and food inputs; and is a source of large wood, which is critical to habitat complexity. Restoring riparian corridors is essential to addressing high summertime water temperatures and building long-term resilience to predicted changes associated with climate change. The Washington State Department of Ecology (Ecology) developed total maximum daily loads (TMDLs) for the Green River and Newaukum Creek in 2011 that outlined an implementation plan for improving temperatures. Another TMDL for Soos Creek is under development. Refer to the "Integrate Agricultural Protection and Salmon Recovery Initiatives" strategy for a discussion of riparian corridors within agricultural lands.

Programs

» **Re-Green the Green Revegetation Program**

The 2016 Re-Green the Green Strategy prioritizes riverine, estuarine and marine areas for revegetation, establishes interim goals, and outlines strategies for securing necessary funding. Riparian revegetation priorities are based on the solar aspect shade maps developed by the Muckleshoot Indian Tribe (2014). This effort identified and prioritized shorelines where shade is critically needed to reduce instream water temperatures that frequently exceed water quality standards.

WRIA 9 should continue to run an annual grant program that supports program implementation across priority shoreline areas. As of 2020, approximately $500,000 of annual Cooperative Watershed Management Funds provided by the King County Flood Control District have been set aside to support Re-Green the Green project implementation by WRIA 9 partners. This funding is intended to provide a baseline level of revegetation funding that can be leveraged to access other sources of funding. Riparian revegetation projects help improve water quality, lower water temperatures, stabilize shorelines, contribute insects (prey) for juvenile salmonids, increase stormwater infiltration, and improve aquatic habitat quality when trees fall into the river.

» **Implement coordinated and comprehensive approach to noxious/invasive weed removal along river and marine shorelines**

WRIA 9 partners should coordinate with the King County Noxious Weed Removal Program to prioritize and sequence weed removal efforts through the watershed. Noxious weed control should be conducted in parallel with priority riparian revegetation efforts. Ongoing invasive removal on restoration sites is critical until native plants become established (~ five years).

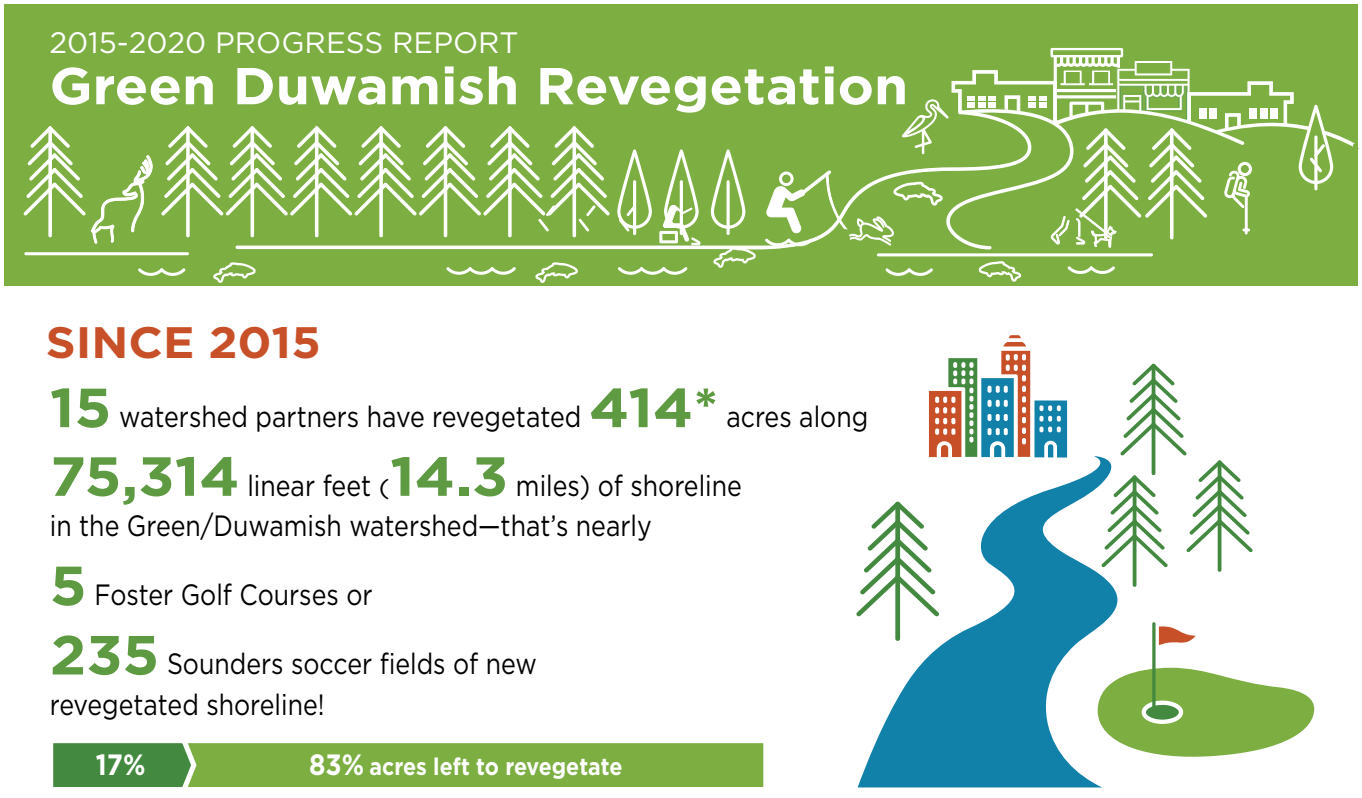
Invasive plants spread quickly, impede growth and establishment of natives, and degrade riparian habitats by destabilizing riverbanks and reducing tree canopy needed to help maintain cool water temperatures. Priority species impacting the riparian community in the Green/Duwamish include knotweed species (Class B), purple loosestrife (Class B), policeman's helmet (Class B), English ivy (Class C), Himalayan blackberry (Class C), and reed canary-grass (Class C).

» **Long-term Restoration Site Stewardship and Maintenance**

WRIA 9 partners should explore potential funding sources for a professional stewardship/maintenance crew to provide long-term site maintenance of restoration sites across the watershed. Salmon recovery funding generally does not provide for site maintenance beyond several years, and maintenance typically falls outside the scope of regular park maintenance operations. A shared maintenance crew would provide cost savings to jurisdictions for maintenance of the growing portfolio of restoration sites.

Priority tasks for a crew would include invasive species removal, planting as needed, and litter cleanup. In addition to these basic functions, this crew could play an important role in helping to manage the growing challenge of encampments within the Green River corridor. This program would ensure a regular staff presence at restoration sites to assist with outreach and public safety in addition to enhancing long-term ecological outcomes. In

Figure 18. *Progress towards the watershed revegetation goals established in the WRIA 9 Re-Green the Green Strategy.*



*414 (17%) acres out of the 2,384 acre goal established in the 2016 Re-Green the Green Strategy. The goal reflects a proportion of the total riparian buffer (developed and undeveloped) that has less than 50% tree cover.

addition, a shared crew would address stewardship and maintenance needs at sites that are not suitable for citizen volunteers.

Policies

» **Riparian Corridor (RC) 1:** Protect and enhance riparian corridors to help achieve temperature water quality standards established to protect salmon migration, spawning and rearing. Local governments should support implementation of the Green River and Newaukum Creek TMDLs by protecting and re-establishing mature riparian vegetation within established stream buffers.

» **RC2:** Revisit levee vegetation guidelines to improve revegetation opportunities along flood facilities. Guidelines must balance the critical need for riparian shade (i.e., Ecology TMDL) with the need to inspect the structural integrity of facilities and maintain public safety. Remote sensing (i.e., ground-penetrating radar, drones, or boat inspections) may provide a viable alternative to traditional visual inspections that require a clear zone.

» **RC3**: Project sponsors who receive WRIA 9 funding should request funding for up to three years post-construction maintenance funding for plant establishment, and should document the ability to maintain habitat restoration and protection projects to ensure long-term objectives are achieved. Maintenance may include, but is not limited to, noxious weed and invasive plant control, revegetation, and deterrence of undesired uses such as dumping and occupancy that can damage habitat.

» **RC4:** River corridor trails should be compatible with salmon recovery priorities. Trail design standards should balance the need for riparian tree canopy to maintain cooler water temperatures with needs for important recreational view corridors and sightlines for user safety. Trail design/placement should also not preclude reconnection of critically needed floodplain habitats. Trails offer residents an opportunity to connect with the river; interpretive signage should highlight the presence of salmon and the ecological importance of riparian and floodplain habitat.

» **RC5:** Encourage regional efforts to develop a Bonneville Power Authority (BPA) mitigation program for power transmission impacts across Puget Sound. The BPA has a significant footprint within the Upper Watershed and the Soos Creek Basin where vegetation management and tree removal under transmission lines precludes adequate riparian canopy cover. Although the BPA has established mitigation programs for Columbia basin operations, a comparable program does not exist within Puget Sound.

Strategy: Protect, Restore, and Enhance Sediment and Water Quality

Location: All Subwatersheds

Clean, cold water is essential for salmon growth and survival. A growing body of evidence suggests clean-up of legacy industrial contamination and stormwater pollution control may improve early marine survival and increase Chinook productivity. Recent scientific literature suggests contaminant exposure pathways (e.g., legacy industrial contamination, stormwater runoff, municipal wastewater discharges, etc.) are having sublethal and lethal impacts on juvenile Chinook salmon. Although the acute toxicity of stormwater runoff to coho salmon in urban watersheds is well documented, potential sublethal impacts to juvenile Chinook salmon as a result of contaminate exposure pathways are not well understood.

Programs

Green/Duwamish Watershed Pollution Loading Assessment (PLA)

Ecology should continue to lead development of a pollutant loading assessment (PLA) that will (1) include a watershed-based model to evaluate cumulative effects of pollution; (2) assess relative contribution of toxic pollutants from different sources/pathways in the watershed; and (3) help prioritize source control efforts. The PLA is essential to maximizing effectiveness of Lower Duwamish Waterway cleanup and avoiding subsequent recontamination.

The PLA is an interim strategy for improving water quality – it is not a TMDL or another regulatory

instrument. It represents a foundational effort that will inform future actions to address source control issues. Following its completion, WRIA 9 partners should coordinate with Ecology to address priority pollutant sources within their jurisdictions.

Implement Pollution Identification and Control (PIC) Programs

The Vashon-Maury Pollution Identification and Control (PIC) program provides incentives (technical support and financial) to replace or repair failing septic systems, and address other pollution sources (e.g., animal waste) contributing to water quality degradation in the marine nearshore. Failing or inappropriately sited septic systems have resulted in water quality concerns and closure of beach and shellfish harvest areas – especially within Quarter Master Harbor. While the direct impact on shellfish harvesting is a human health concern, the water quality pollution can negatively affect various parts of the nearshore ecosystem that supports Chinook salmon.

Although the 2005 Salmon Plan focused on Quarter Master Harbor, PIC programs should be expanded to other nearshore areas as warranted to identify pollution sources, provide technical support, and offer financial incentives to remedy failing septic systems and other sources of pollution. Over the last decade, investments made by Public Health—Seattle & King County and other partners have resulted in improved water quality and reopening of 493 acres of shellfish harvest areas.

Creosote Removal Program

WRIA 9 organizations should partner with the Washington Department of Natural Resources Creosote Removal Program to identify and remove creosote-treated debris and derelict structures from marine and estuarine waters. Creosote structures leach chemicals and can create toxic conditions for organisms that live within beach and marine sediments, as well as disrupt the marine foodweb. Studies have found creosote exposure can contribute to mortality of herring eggs and alter growth and immune function of juvenile salmonids. Derelict structures can also interrupt sediment transport and displace aquatic vegetation.

Since adoption of the 2005 Plan, the program has removed over 21,000 tons of creosote debris and 8.0 acres of overwater structures from Puget Sound. However, thousands of derelict creosote pilings remain within Puget Sound. WRIA 9 partners should continue efforts to inventory and prioritize focus areas based on concentration of creosote debris and potential impacts to forage fish and juvenile salmon rearing.

Policies

» **Water Quality (WQ) 1:** Promote Low-Impact Development (LID) and green infrastructure (natural and engineered systems) to address stormwater runoff. Given the magnitude of development constructed prior to existing stormwater controls, extensive stormwater retrofits are needed to address legacy sources of water pollution. LID techniques should mimic, where possible, pre-disturbance hydrological processes of infiltration, filtration, storage, evaporation and transportation. LID techniques include:

- *Vegetation conservation:* native vegetation and small-scale treatment systems;
- *Site design:* clustering of buildings and narrower and shorter roads;
- *Retention systems:* bioretention, bio-swales, rain gardens, wetlands and vegetated roofs;
- *Porous or permeable paving materials:* sidewalks, trails, residential driveways, streets, and parking lots; and
- *Rainwater catchment:* rain barrels and cisterns.

Green Infrastructure: Green infrastructure is an approach to water management that protects, restores, or mimics the natural water cycle. Green infrastructure is effective, economical, and enhances community safety and quality of life.

– American Rivers

» **WQ2**: Support local and regional watershed-based stormwater management initiatives (e.g., Our Green Duwamish, STORM, etc.) that prioritize programs and projects that can effectively demonstrate large-scale, watershed-wide, water quantity and water quality improvements that benefit salmon recovery. Potential priorities include:

  - Collaborative source control strategies such as education and outreach, business inspections, pollution prevention, and programmatic maintenance;
  - Regional retrofit programs focused on restoring natural hydrology and the removal of toxics; and
  - Green Stormwater Infrastructure (GSI) incentive programs that promote the voluntary use of GSI.

» **WQ3:** Source control efforts across multiple sectors (commercial, industrial, and agricultural) should ensure that water and sediment quality support salmon growth and survival. Source control sufficiency is a critical milestone that must be achieved to initiate contaminated sediment cleanup. Ensuring implementation, maintenance, and enforcement, where necessary, of source control best management practices will help reduce pollutant loading into water bodies and ensure pollutants don't undermine sediment cleanup efforts in the Duwamish. Incentives to promote effective source control include spill prevention and response, technical support, and hazardous waste vouchers to local businesses.

» **WQ4:** Protect and enhance rural and urban forests, which provide diverse social, economic and ecological benefits. In Rural Areas of King County, at least 65 percent of each sub-basin should be preserved as natural forest cover and impervious coverage should not exceed 10 percent of a sub-basin. Where forest cover exceeds this threshold, the goal of no net loss in forest cover should be pursued. In Urban Growth Areas, local governments should adopt goals to achieve 30-40 percent ecologically healthy urban tree canopy coverage and reduce impervious surfaces. Adopting goals specific to riparian canopy could help prioritize riparian restoration. Local education, outreach, and incentive programs should be supported to increase urban forestry programs and associated tree canopy coverage.

Figure 19. *Stormwater-induced mortality in coho salmon in Miller Creek, Normandy Park. Although stormwater toxicity is not lethal to Chinook salmon, potential sublethal impacts are not well understood. Photo: Matt Goehring.*

» **WQ5:** Ensure cost-share agreements between the U.S. Forest Service, Washington Department of Natural Resources, Tacoma Water, and private landowners are maintained and that road maintenance and abandonment plans achieve sediment reduction goals. Support opportunities to abandon unnecessary forest roads as they are identified to reduce overall road density.

» **WQ6:** Support regional and state legislative efforts to reduce the risk of oil spills in Puget Sound and ensure the state remains a leader in oil spill prevention and response. Over 20 billion gallons of oil are transported through Washington each year by vessel, pipeline and rail. A catastrophic spill could cost the region over $10 billion and impact over 150,000 jobs. It would also cause significant harm to aquatic ecosystems and disrupt maritime industry, recreation, and tourism.

» **WQ7:** Local governments should adopt the Interagency Regional Road Maintenance Endangered Species Act Program Guidelines, as amended, for maintenance of existing infrastructure. Governments should participate in the associated Regional Forum to support ongoing adaptive management to improve outcomes.

Strategy: Protect, Restore and Enhance Marine Shorelines

Location: Marine Nearshore

Marine nearshore habitats, including beaches, pocket estuaries, eelgrass beds, inlets, and deltas, provide important rearing and migration habitat for juvenile Chinook salmon and many other animals in Puget Sound. They are also critical spawning habitat for forage fish – a key prey species for Chinook salmon. Decades of alteration and armoring of the Puget Sound marine shoreline has reduced shoreline length and habitat complexity, disrupted sediment supply and transport, and eliminated forage fish spawning habitat. Restoring natural shorelines will increase nearshore productivity and salmon growth and survival in the marine environment.

Programs

» **Develop/maintain a "Toolbox" of Shore Friendly Alternatives for Privately-Owned Shorelines (aka Do-it-yourself approach for residential shoreline improvement)**

WRIA 9 partners should develop a "shoreline toolbox" to provide shoreline owners guidelines for implementing shore friendly alternatives that clearly outline stewardship concepts and best management practices for private shorelines. It should not only outline the range of alternatives for different shoreline types (e.g., beach and bluffs), but also highlight important design, feasibility, maintenance, and permitting considerations when considering shoreline improvements. Topic areas should include native shoreline vegetation, erosion control, shoreline access, docks, and stormwater management.

The toolbox should be designed to supplement shoreline workshops and technical assistance programs and could be made available online to provide guidance to property owners who may elect to take a "do-it-yourself approach" to shoreline management. It should be tailored to reach private landowners and contractors and connect them with available local and regional resources. The toolbox should draw from regional efforts such as WDFW's Marine Shoreline Design Guidelines, the Shore Friendly King County collaborative, Green Shores for Homes, and Green Shorelines for Lake

Figure 20. *Before and after Phase II restoration of Seahurst Park in the City of Burien. Construction was completed in 2014. Photos: Hugh Shipman.*

Washington and Lake Sammamish, and highlight local examples of shore-friendly approaches within WRIA 9.

» **Expand Shore-Friendly Technical Assistance and Cost-Share Programs to Accelerate Armor Removal and Soft Shoreline Protection (aka Supported Approach for Residential Shoreline Improvement)**

Access to technical information about shoreline erosion and protection alternatives and the financial costs associated with marine shoreline armor removal have been identified as key barriers to motivating shoreline landowners to consider soft shoreline protection. Soft shoreline protection is less preferred than outright removal, but preferable to traditional hard armor in that it helps maintain and enhance some natural marine shoreline functions (e.g., sediment transport and delivery). Bulkhead removal is expensive and site-specific erosion risk is not conducive to the use of standard models or templates for soft shore protection. In addition, many landowners and consultants are unfamiliar with how to design/implement successful soft shoreline protection projects. Technical assistance to help landowners better understand risk, to provide design and permitting support, and to assist with access to cost-share funding should help to overcome existing barriers to armor removal on private property and promote expansion of soft shoreline protection alternatives.

The King Conservation District (KCD) has historically provided technical assistance on environmentally friendly ways to manage shoreline properties, including shore-friendly alternatives to traditional bulkheads. The KCD also has a cost-share incentive program to encourage revegetation and removal of existing armor and/or soft shore protection designs where site-specific conditions allow. In 2020, KCD established a Shore Friendly King County collaborative between multiple partners. This program is seen as part of a local adaptation of the regional Shore Friendly approach to reducing marine shoreline armoring. Although this is an existing program, additional resources are needed to expand capacity. Landowners are identified through parallel marine shoreline landowner workshops. Priority should be given to currently unarmored shorelines and armored properties where site-specific factors (e.g., structure location, fetch, bank/bluff geology, etc.) make armor removal and/or soft shoreline protection alternatives feasible.

» **Implement Acquisition Strategy to Protect and Restore Functioning Nearshore Habitats**

Acquisition of priority marine shorelines supports conservation and restoration of critical nearshore processes and rearing habitats used by multiple stocks of juvenile Chinook – including Green/Duwamish Chinook. A number of planning efforts have identified and prioritized conservation of nearshore habitats within WRIA 9, including the Prioritization of Marine Shorelines of WRIA 9 for Juvenile Salmon Habitat Protection and Restoration (2006), Vashon-Maury Island Greenprint (2007), and the Puget Sound Nearshore Ecosystem Restoration Project Strategies for Nearshore Protection and Restoration in Puget Sound (2012). Although many of the highest priority sites have been specifically identified as unique projects within the Habitat Plan, WRIA 9 should support opportunistic acquisition of other functioning nearshore habitats if they become available.

Although the bulk of the acquisition opportunities for functioning habitats are located on Vashon-Maury Islands, additional opportunities exist on the mainland nearshore. Successful implementation of a nearshore acquisition strategy requires consistent outreach to landowners and operational flexibility to capitalize on acquisition opportunities before they are lost. The sale of properties previously unavailable for decades frequently can represent a once in a generational opportunity to protect a priority stretch of marine shoreline. Individual acquisition opportunities should be evaluated based on ecological value/potential of nearshore habitat and risk of development. Available funding sources to support acquisition include King County Conservation Futures, King County Flood Control District Cooperative Watershed Management Program and Coastal Erosion Program, Washington Department of Fish and Wildlife Estuary and Salmon Restoration Program, and various Washington State Recreation and Conservation Office grant programs.

Policies

» **Nearshore (NS) 1:** Avoid shoreline infrastructure or stabilization except where demonstrated to be necessary to support or protect a legally-established primary structure, critical public infrastructure, or shoreline use in danger of loss or substantial damage. Support armor removal and alternative approaches to shoreline stabilization (e.g., setbacks and relocations) where feasible to reduce impacts to existing natural shoreline processes. Protection and restoration of important sediment sources (e.g., feeder bluffs) is needed to restore nearshore processes and sediment transport. Where the need for bank stabilization is supported by analysis of a geotechnical engineer, "soft" shoreline stabilization techniques (e.g., bioengineering techniques and vegetation enhancement) should be required where feasible. "Soft" stabilization measures should be designed to preserve or restore natural shoreline processes (e.g., sediment transport). "Hard" shoreline stabilization should only be allowed where softalternatives do not provide adequate protection. Refer to WDFW Marine Shoreline Design Guidelines, Green Shores for Homes, Integrated Streambank Guidelines, and Stream Habitat Restoration Guidelines for additional guidance.

Primary Structure: Structural improvement that is essential to the primary use of the property. Structures that function as secondary or subordinate to the primary use of a property are considered an accessory use.

» **NS2:** Encourage multiple family/neighborhood use of docks, boat ramps, and beach access stairs. Local jurisdictions should minimize impacts to the nearshore marine environment by encouraging consolidation/joint-use of structures that could serve multiple landowners. Opportunities to pursue joint-use should be evaluated during development and redevelopment. Boat docks, ramps and beach access stairs can shade aquatic vegetation, disrupt juvenile salmon migration and foraging, alter nearshore sediment transport and degrade nearshore habitats (e.g., eelgrass). Possible incentives include permit streamlining, fee reductions, and dimensional incentives (e.g., increased length, width, etc.).

» **NS3:** Jurisdictions should promote derelict vessel prevention and coordinate with Washington State Department of Natural Resources (WADNR) on derelict vessel removal. Derelict vessels can contribute to contamination of aquatic lands, degrade water quality, and damage sensitive aquatic habitats (e.g., eelgrass). Although the WADNR Derelict Vessel Removal Program has removed more than 580 vessels from marine waters, local efforts are critical to ensuring effective prevention and rapid response.

» **NS4:** Support beach nourishment, where appropriate, to offset interruption of natural sediment supply and transport caused from extensive shoreline modifications (e.g., bulkheads, etc.). Beach nourishment has been used successfully to protect shorelines, restore natural beach profiles, and enhance nearshore habitats.

» **NS5:** Support regional efforts to identify and test actions to increase juvenile survival during outmigration through Puget Sound and increase local efforts to stabilize or improve foodweb function such as forage fish habitat protection and restoration.

Strategy: Protect, Restore and Enhance Estuarine Habitat

Location: Duwamish

The Duwamish estuary provides critical rearing habitat for juvenile salmon as they make the physiological transition from fresh to saltwater habitats. Industrial development within the Duwamish valley drove extensive fill of tidal wetlands, armoring of shorelines, and navigational dredging. The modifications

straightened the estuary and eliminated 98 percent of the historic wetlands. Despite the magnitude of loss of habitat, the Duwamish continues to play a critical role in supporting juvenile Chinook salmon. Both cleanup of legacy industrial contamination within the Lower Duwamish Superfund Site and restoration of shallow water rearing habitat are needed to increase juvenile salmon survival and overall productivity within the watershed.

Program

» **Implement and Adaptively Manage the Duwamish Blueprint**

The Duwamish Blueprint outlines strategic guidance for governments, businesses, non-profit organizations and citizen groups working to improve the estuarine ecosystem and increase juvenile salmonid productivity. It identifies approximately 100 acres of shallow water habitat restoration potential within the Duwamish estuary transition zone (RM 1-10). Many of the habitat opportunities are conceptual and have not been prioritized. Periodic evaluation of conceptual opportunities is needed to elevate and refine project ideas as the Duwamish landscape changes (e.g., Superfund cleanup, Natural Resource Damage Assessment [NRDA], and real estate availability).

Restoration in the Duwamish is complex, expensive, and will require flexibility, innovation, and extensive coordination and collaboration to be successful. The former Duwamish Blueprint Working Group, which was convened to develop the Blueprint, would provide a framework to facilitate coordination across key partners. WRIA 9 partners should leverage the Blueprint Working Group to identify opportunities to enhance partnerships to (1) pursue larger project footprints; and (2) overcome barriers to implementation. Given limited land availability, WRIA 9 should opportunistically evaluate potential acquisitions and consider elevating conceptual projects as part of adaptive management based on habitat benefit, acquisition feasibility, and readiness.

Policies

» **Duwamish Estuary (DE) 1:** Engage in the Lower Duwamish Waterway (LDW) Superfund cleanup process to coordinate and sequence potential salmon habitat projects with Superfund activities to maximize benefits to salmon recovery. Strategic acquisition should be prioritized over habitat project construction prior to competition of the LDW cleanup to avoid potential contaminated sediments and minimize potential for re-contamination.

» **DE2:** Engage with NRDA trustees and potentially liable parties to inform project development and design and maximize potential benefit to salmon recovery. NRDA settlements within the Duwamish will result in large capital investments in habitat restoration that should provide a significant lift to salmon recovery. Coordination with the NRDA process will also support identification of potential synergistic opportunities, and help identify and resolve barriers to maximize restoration outcomes. For example, it may be possible to leverage NRDA settlements to expand existing and/or planned restoration projects.

Figure 21. *Duwamish Gardens created 1.3 acres of shallow water rearing habitat in a critically important transition zone of the Duwamish Estuary. Subsequent monitoring has documented extensive use of the site by juvenile Chinook salmon. Photo: Mike Perfetti.*

Although NRDA has a broader scope than Chinook salmon recovery, priority NRDA habitats significantly overlap with salmon recovery needs in the Duwamish (e.g., estuarine marshes, intertidal mudflats, and riparian habitats). Tracking NRDA project implementation will be important to understanding the status of habitat restoration efforts in the Duwamish. Given the existing uncertainty associated with juvenile Chinook survival in the Duwamish, WRIA 9 should engage with the trustees to share emerging research, exchange lessons learned in restoration, inform adaptive management of restored sites, and identify priority sites for restoration.

» **DE3:** Encourage the U.S. Army Corps of Engineers and the Port of Seattle to identify strategies for dredging that: (1) minimize impacts to salmon habitat and (2) improve salmon habitat through use of beneficial re-use where suitable. Soil contamination may limit opportunities for re-use.

Strategy: Protect, Restore and Enhance Instream Flows and Cold Water Refugia

Location: Lower, Middle and Upper Green

Green River flows are regulated to support both flood control and water supply needs. The Tacoma Water Habitat Conservation Plan requires maintenance of minimum instream flows during summer months. Although water capture and storage behind Howard Hanson Dam (HHD) support maintenance of minimum instream flows and periodic flow augmentations during summer and early fall, it can also reduce the frequency of high flow events that drive lateral channel migration (i.e., habitat forming flows) and availability of juvenile Chinook rearing habitat throughout spring. Low snowpack and drought conditions exacerbate already difficult tradeoffs in timing of water release designated for fish conservation purposes. Water temperatures also regularly exceed established water quality standards for Salmon Core Summer Habitat and Spawning Habitat.

Climate change forecasts predict the watershed will experience reduced snowpack, lower summer time flows, and elevated instream temperatures. These changes will impact the already difficult reservoir refill strategies at HHD, potentially putting greater stress on refilling earlier and having a bigger impact on juvenile Chinook habitat. Prolonged low flows can cutoff access to critical rearing habitats and exacerbate high instream temperatures. High water temperatures can delay adult migrations, contribute to increased susceptibility to disease, and even be lethal above 23°C. Protecting instream flows and cold water refugia is essential to strengthening watershed resilience to climate change. Cold-water refugia are characterized as being at least 2°C colder than the daily maximum temperature of adjacent waters.

Programs

» **Develop Watershed Management Plan to Address Permit-Exempt Well Development**

WRIA 9 partners should coordinate on development of the Ecology's Watershed Restoration and Enhancement Plan to assess and offset potential consumptive impacts of new rural, domestic water use on stream flows in the Green/Duwamish watershed. Maintaining legally established minimum instream flows has proven challenging during recent years with below average precipitation. Climate change models indicate that changes in precipitation patterns could exacerbate streamflow issues and further stress salmon.

Implementation of the plan is required to not only offset permit exempt domestic water use, but also provide for a net ecological benefit. The legislature plans to direct $300 million in funding through 2035 to benefit fish and streamflows. WRIA 9 should position itself to leverage this funding source to support implementation of appropriate projects in this plan that meet the flow or net ecological benefit guidance and/or develop additional project elements that do so. If instream flows remain problematic in the future, additional consideration should be given to integrating other categories of water use into an expanded Watershed Management Plan and implementation program.

» **Develop a Strategy to Protect and Restore Habitat in the Upper Green River and its Tributaries**

Conduct a planning effort to develop a long-term, comprehensive approach to protecting and restoring ecosystem processes in the Upper Green River subwatershed. Current checkerboard ownership

Figure 22. *Before (2013) and after (2019) restoration photos of the Big Springs Creek. The project protected cool waters from a natural spring.*

complicates land management and a strategic approach is needed to leverage the relatively intact upper watershed to maximize benefits for salmon and steelhead recovery. Access to the upper watershed has long been identified as critical to long-term salmon recovery. However, the delay of fish passage and the degraded condition of the lower watersheds have resulted in limited investments in the upper watershed.

Projected shifts in temperature and precipitation patterns associated with climate change further emphasize the critical importance of this landscape to long-term salmon recovery. A number of assessments should be completed to inform a strategic approach to management of the upper watershed, including:

- Visualizing Ecosystem Land Management Assessments (VELMA): Quantify long-term effects of forest management and climate scenarios on salmon habitat (i.e., hydrological flow regimes and instream temperatures);
- Model intrinsic habitat value of stream segments within the upper watershed to inform conservation and restoration priorities;
- Beaver Assessment: Assess current activity, model potential benefits, and explore potential reintroduction if warranted; and
- Assess important wildlife migratory corridors and key landscape level linkages to inform acquisition priorities.

The results of these assessments should be used to prioritize salmon recovery investments in the upper watershed with respect to potential land consolidation, land use management changes, and potential road abandonment.

Policies

» **Stream Flows (SF)1:** Support reevaluation of the U.S. Army Corps of Engineers water storage schedule and Fish Conservation Guide Curve at HHD to increase benefits for salmonids while maintaining downstream flood control benefits. The current water capture period overlaps the juvenile Chinook rearing period and impacts accessibility and/or amount of important rearing habitats during outmigration. Utilize the existing Green River Flow Management Coordination Committee to assess fish habitat needs based on best-available science and basin-specific climate change projections.

» **SF2:** Protect existing cold water refugia and enhance water storage and hyporheic exchange by reconnecting historic floodplain habitats to instream habitats. These habitats facilitate heat dissipation and provide an influx of cooler waters to moderate seasonal fluctuations in stream tem-

peratures and flows, providing physiological and ecological benefits for cold-water salmonids.

» **SF3:** Support forest management and harvest rotation programs that increase hydrologic function and improve base flows to minimize impacts on salmonid habitat, support climate change resiliency, and maintain viable silviculture. Additional research is necessary to quantify potential benefits.

» **SF4:** Manage groundwater in conjunction with surface water withdrawals to provide instream flows and water temperatures that support adult salmonid spawning and juvenile rearing. Local governments, water purveyors, and state and federal regulators should:

- Protect groundwater resources and critical aquifer recharge areas;
- Manage groundwater and surface water withdrawals seasonally to maximize the benefits to salmonid habitat;
- Develop drought management plans to supply safe and reliable drinking water while minimizing impacts to salmonids during periods of drought;
- Ensure rural domestic use does not adversely impact salmonid habitat;
- Support water rights acquisition programs that can augment chronic low flows; and
- Limit or preclude mining and other significant excavation activities that could adversely impact groundwater hydrology.

» **SF5:** Support expansion of reclaimed/recycled wastewater to reduce demands on stream and ground withdrawals. Reclaimed wastewater can be used safely and effectively for non-drinking water purposes such as landscape and agricultural irrigation, heating and cooling, and industrial processing. Reclaimed water is available year-round, even during dry summer months or when drought conditions can strain other water resources.

See also policies SW4-6 above.

Strategy: Expand Public Awareness and Education

Location: All subwatersheds

Education and outreach are fundamental to protecting and restoring salmon. It raises awareness, builds political support, and promotes positive behaviors that benefit salmon. Long-term salmon recovery will not be successful without public support. Broad-based community support provides political leverage to protect and expand local, state and federal investments in habitat restoration. It is also helps promote positive behavior change and minimize behaviors that can negatively impact salmon or undermine recovery investments. For example, ecological gains associated with marine shoreline restoration in WRIA 9 have been predominantly offset by new armor installations. General outreach is not sufficient to drive widespread and long-lasting behavior change. Targeted social marketing strategies must identify and overcome both real and perceived barriers to promote positive behaviors that contribute to salmon recovery.

Programs

» **Implement a Comprehensive Communications Plan to Promote Behavior Change that Expedites Salmon Recovery in WRIA 9**

Integrate lessons learned from the regional Shore Friendly programs into a locally adapted communication plan designed to increase implementation of behaviors that support salmon recovery. Key outcomes include:

- Increased public recognition of the urgency around salmon recovery and connection to southern resident orcas;
- Improved public understanding and stewardship of riverine and nearshore ecosystem processes that support salmon and forage fish;
- Technical assistance provided to interested shoreline residents;
- Target audiences make informed decisions based on knowledge of Shore Friendly practices, climate resilience, and adaptation;
- A suite of tools and incentives developed to address identified barriers to adoption of desired behaviors;

- Messaging and outreach tailored to contractors and realtors;
- The value of riparian vegetation is communicated to the public, including riverside landowners, elected officials, and trail/park users; and
- Partners conducting outreach and education receive positive reinforcement and feedback from the salmon recovery community.

Additional effort is needed to refine target audiences and develop associated social marketing approaches. The intent of the communication plan should be to build awareness, expand stewardship, and promote advocacy. A regional Social Marketing Strategy to Reduce Puget Sound Shoreline Armoring was developed for the Washington Department of Fish and Wildlife in 2015. A Green/Duwamish River Revegetation Outreach and Engagement Plan was developed in 2019. These plans provide an existing framework that can be expanded to integrate other priority salmon recovery issues.

» **Expand Volunteer Stewardship**

Increase citizen participation through new stewardship programs and by expanding and supporting existing stewardship programs that engage volunteers in restoring, maintaining, and monitoring habitat protection and restoration projects. These projects not only benefit salmon recovery, but also improve stormwater retention, carbon sequestration and wildlife habitat and include important themes and messages for participants to change behavior at home. Local volunteer programs should:

- Foster environmental stewardship and personal connection to salmon recovery;
- Educate people about threats to salmon and the role of habitat in salmon recovery;
- Leverage additional resources to implement recovery actions; and
- Expand the constituency to advocate for salmon recovery.

The Green/Duwamish Watershed has a number of volunteer stewardship programs that play an instrumental role in invasive vegetation removal and native revegetation. Many of these programs provide long-term stewardship of large capital restoration sites. Traditional salmon recovery funding is not available to fund long-term (beyond two to three years) stewardship and maintenance of restoration sites. As a result, local funding or creative partnerships are essential to ensure restoration projects achieve desired outcomes into the future.

» **Expand Community Science Monitoring**

Develop and implement community science programs to address data gaps and foster watershed stewardship among residents. Community science programs can provide capacity to collect important long-term monitoring data while serving as an outreach tool to educate residents about local natural resource issues. They can also create opportunities to introduce students to scientific research and provide important data for resource managers.

Since 2005, citizen science programs include:

- Beach Nearshore Ecology Team (BeachNet): The Vashon Nature Center coordinates a forage fish monitoring program that collects data on forage fish presence/absence, spawning timing, beach substrate preferences, and intertidal and upland habitat conditions within the marine reserve. Data are shared with WDFW and is used to inform protection of spawning beaches. BeachNet also contributes to shoreline restoration monitoring in partnership with University of Washington, King County, and the Washington State Department of Natural Resources.
- Miller-Walker Basin Community Salmon Investigation (CSI): The CSI program has conducted 10 years of salmonid spawning surveys to assess long-term trends in salmon abundance and the urban runoff mortality syndrome in coho salmon. Data are shared with local jurisdictions and resource managers. A partnership with the UW Tacoma Center for Urban Waters has helped identify both the suite of toxic chemicals contributing to coho mortality and priority areas within this watershed to focus future stormwater improvements.

» **Shoreline Workshops and Technical Assistance**

Implement workshops to educate target audiences (landowners, landscapers, contractors) about shoreline stewardship and common misconceptions about shoreline erosion. Promote alternative approaches to shoreline management that provide for the use and enjoyment of property in a manner that benefits fish and wildlife. Priority focus areas include:

- Shoreline processes and salmon habitat;
- Erosion control;
- Noxious/invasive weed control;
- Revegetation guidance;
- Natural yard care; and
- Stormwater management.

Workshops should connect target audiences with local and regional resources (e.g., technical assistance) designed to overcome barriers to improving shoreline stewardship. Materials and messaging should be tailored to specific subwatersheds and groups of landowners to increase effectiveness. The Green Shores for Homes program developed in 2015 is an available tool to guide the design of improved shoreline conditions for Puget Sound properties.

Policies

» **Education and Stewardship (ES)1**: Support educational programs that integrate watershed science and salmon into problem-based learning exercises for school children. These programs instill a sense of place, encourage appreciation of natural resources, and promote environmental literacy among the next generation of future decision makers.

» **ES2:** Support diverse outreach and education programs that promote awareness of salmon recovery and positive behavior change. Programs should employ community-based social marketing to identify and overcome barriers to targeted behaviors. Priority focus areas include shoreline stewardship, riparian revegetation, and stormwater management.

Strategy: Integrate Agricultural Protection and Salmon Recovery Initiatives

Location: Lower and Middle Green

Salmon recovery and the preservation of viable agriculture are two regional priorities that intersect in the Middle and Lower Green floodplain and along Newaukum Creek. King County designated over 16,295 acres of land within the Green River watershed for agriculture within three Agricultural Production Districts (APD). Some additional, but relatively small amounts of agricultural activities occur within the cities of Kent and Auburn. Over 5,763 acres of land within the APD have been enrolled within the Farm-

Figure 23. *A community volunteer examines a salmon carcass as part of the Miller/Walker Basin Community Salmon Investigation. The program has leveraged community support and a partnership with the University of Washington to advance our understanding of stormwater runoff impacts on local salmon. Photo: Miller/Walker Stewardship Program.*

land Preservation Program (FPP). Restrictive covenants on FPP properties are designed to permanently protect agricultural use and open space.

The 2005 Plan acknowledged that salmon recovery and agricultural production operate within a shared landscape along the Green River valley. It prioritized sequencing of restoration projects over the first 10 years of plan implementation to focus first on existing public lands, then on lands within the rural and urban growth areas, and finally on lands within the APD, but not enrolled in the FPP. The plan acknowledged that projects that negatively impact tillable surface may need to be reconsidered at a later date.

This Plan Update acknowledges that the implementation of high-priority salmon projects critically needed to advance salmon recovery will result in localized loss of existing farmland. Research indicates that rearing habitat availability in the Lower and Middle Green River is the primary limiting factor for Chinook productivity within the watershed. Collaboration between agricultural and salmon recovery interests will be necessary to identify and advance shared priorities and ensure salmon and agriculture can coexist productively within a shared landscape. Lessons learned from other watersheds should be reviewed for applicability within the Green River watershed.

Programs

» **Farm Conservation Planning**

Farm conservation plans can help landowners protect natural resources while achieving their land use goals. They can also help access and leverage agricultural incentives to improve conservation practices on agricultural lands. Priorities include stream and wetland buffer revegetation and livestock management. Agriculture is widespread throughout the Middle and Lower Green and farmland preservation is a regional priority. Expanding riparian buffer revegetation on Green River valley farms has the potential to greatly benefit salmon recovery, especially where agricultural lands overlap with high priority areas identified by the Muckleshoot solar aspect shade maps (2014). Limiting livestock access to stream buffers can also greatly improve water quality and riparian conditions.

Available incentive programs include:

- King Conservation District rural services programs (e.g., Land Owner Incentive Program, Farm Conservation Technical Assistance, and Agricultural Drainage Program)
- King County Small Habitat Restoration Program
- USDA Farm Service Agency Conservation Reserve Enhancement Program
- King County Livestock Program (i.e., BMP cost share)

Landowner recruitment is essential to program success. Additional resources and strategies are needed to expand participation.

Policies

» **AG1:** Protect, enhance, and restore high quality salmon habitat in the Agricultural Production Districts in a manner that strives to reduce loss of viable agricultural land and ensure the long-term viability of agriculture. Projects that displace tillable farmland should strive to provide benefits to adjacent farm lands in attempt to offset impacts.

Local governments, state and federal agencies, non-profits, and special purpose districts should work with agricultural landowners in the Agricultural Production Districts to:

- Correct water quality problems resulting from agricultural practices;
- Implement best management practices for livestock and horticulture;
- Prevent additional degradation or clearing of forested riparian buffers;
- Encourage landowners to pursue voluntary sustainable actions for fish, farms, and soils;
- Conduct compliance monitoring and regulatory enforcement where necessary to protect critical habitats;
- Identify opportunities where salmon recovery projects can provide parallel benefits (e.g., flood risk reduction and drainage improvements) to adjacent agricultural lands; and
- Limit the extent of actively farmed lands displaced by priority salmon restoration projects.

» **AG2:** Evaluate the effectiveness of the regulatory flexibility given to agricultural landowners that obtain a farm plan from the KCD. If the flexibility leads to better habitat and water quality outcomes, other opportunities should be explored to provide additional flexibility. If the flexibility has not led to better outcomes, the County should evaluate if there are improvements to the regulatory structure (e.g. require some amount of the farm plan be implemented versus implementation being voluntary) that would improve the outcomes of the flexible approach.

Strategy: Integrate Salmon Recovery into Land Use Planning

Location: All Subwatersheds

Historical population growth and development within the watershed displaced habitat, altered natural hydrology, and polluted local waters. Local land use plans should provide a blueprint for future growth and development that is consistent with salmon recovery. Land use decisions should reinforce the importance of preservation of intact, functional habitats and provide a pathway for restoration of priority habitats. While the Salmon Habitat Plan is not a regulatory document, integration of identified recovery strategies and habitat priorities within local land use plans, policy and decision-making can accelerate implementation and ultimately dictate success of recovery efforts within the Green/Duwamish.

Programs

» **Incentivize Voluntary Restoration Practices**

Local governments and state agencies should promote landowner adoption of voluntary conservation and restoration actions through implementing associated incentive programs. Regulatory complexity, fees, access to technical assistance, and project costs have all been identified as barriers to expanding adoptions of voluntary best management practices on private property. Priority areas to address include invasive removal and native revegetation along shorelines, soft shoreline stabilization, and green stormwater infrastructure. Jurisdictions should review existing barriers and evaluate incentive opportunities, including:

- Streamlined permitting process;
- Reduced fees for restoration projects;
- Free technical assistance (e.g., engineering, planting plans, etc.);
- Cost share/financing programs; and
- Regulatory flexibility.

Voluntary adoption of best management practices by private landowners has been sporadic. Additional targeted investments are needed to expand implementation beyond early adopters. Improving coordination and consistency across regulatory jurisdictions (i.e., local, state and federal governments) is also needed to improve consistency and reliability of the permitting process and increase adoption of best management practices. A coordinated effort across the watershed to identify targeted practices and assess best practices related to available incentives could reduce costs and improve efficiency. Using the Green Shores for Homes or similar programs as an incentive-based program to increase the number of properties that voluntarily improve shoreline conditions on their property should be explored.

» **Regulatory Compliance Monitoring and Associated Enforcement**

Jurisdictions should assess regulatory compliance with shoreline master programs, critical area protections, floodplain regulations, and agricultural regulations (e.g., Livestock Management Ordinance) to assess and improve protection of salmon habitats. Regulatory compliance is fundamental to achieving no net loss of ecological function along marine and freshwater shorelines and to ensuring that ongoing impacts to salmon habitat do not undermine salmon recovery investments. Periodic compliance monitoring should be used to assess the status of jurisdictions and the status of local regulatory implementation and to inform a strategic approach to address shortcomings. If a regulatory framework is not achieving intended outcomes, local jurisdictions should assess changes to staffing levels, outreach and education, technical training for staff, interagency coordination, and enforcement to improve compliance rates.

A WRIA 9 Marine Shoreline Monitoring and Compliance Project (2018) found that only 42 percent of shoreline modifications between 2013-2018

obtained local permits. Even fewer shoreline modifications obtained a WDFW Hydraulic Project Approval. Furthermore, more new shoreline armor (mostly unpermitted) was constructed than removed through restoration projects. These results indicate that unpermitted shoreline modifications are undermining salmon recovery investments and overall efforts to achieve "no net loss of ecosystem function" as required through the Shoreline Management Act. Jurisdictions should take a programmatic approach to identify and address barriers (e.g., permit fees, regulatory uncertainty/confusion) to improve shoreline compliance rates and achieve outcomes that protect salmon habitat. Coordination and sharing of lessons learned across jurisdictions and the larger Puget Sound are recommended to improve efficiency.

Policies

» **Land Use (LU)1:** Ensure salmon recovery priorities are integrated into long-range planning efforts, including Shoreline Master Programs, Comprehensive Plans, and Open Space and Parks Plans. Planning documents should be consistent with the Salmon Habitat Plan and support implementation of habitat protection and restoration priorities. WRIA 9 should provide technical assistance to promote compatibility.

» **LU2:** Land use development, annexation, and capital improvement programs within the watershed should be consistent with the salmon recovery plan and promote progress towards achieving the necessary future conditions (and associated implementation targets) for a viable salmon population. Development proposals should be evaluated with respect to impacts on key habitat indicators and identified habitat projects for the respective subwatershed.

» **LU3:** Local governments should use comprehensive plans and associated land use policies to direct growth and development within existing Urban Growth Areas (UGAs) to protect ecologically important landscapes in rural areas. Specifically, avoid future expansions to existing UGAs that could result in additional land conversion and landscape degradation.

» **LU4**: Strictly apply and improve compliance with critical area, shoreline, vegetation conservation, floodplain, and agricultural regulations designed to protect important ecological habitats. Avoid use of variances in priority areas identified for protection and restoration in the salmon habitat plan.

» **LU5:** Local governments should support flexible development tools that encourage protection and/or restoration of ecologically important salmon habitat. Possible tools include, but are not limited to, transferable development rights, mitigation banking/reserve programs, incentive zoning, Green Shores for Homes, and Public Benefit Rating System tax programs.

» **LU6:** WRIA 9 partners should incorporate sea level rise projections into long-range planning documents, habitat project designs, and development standards to promote long-term ecosystem resiliency. Nearshore habitats adjacent to armored shorelines could be lost as water levels rise (i.e., coastal squeeze) if shorelines remain fixed. Low-lying shoreline areas should be identified to support landward migration of nearshore habitat as sea levels rise where appropriate.

» **LU7:** Encourage certified development standards (e.g., Built Green, Salmon-Safe Certification, and Green Shores for Homes) that minimize the impacts of urban development on the natural environment. Incentives could include reductions in flexible development standards, expedited permitting, and reduced or waived permit costs.

» **LU8**: Incorporate Salmon-Safe Certification standards into best management practices for park and grounds maintenance procedures. Certification is available for parks system, golf courses, and urban development. Salmon-Safe Certification is a peer-reviewed certification and accreditation program that promotes practices that protect water quality, improve watershed health and restore habitat.

» **LU9:** Local governments should evaluate shorelines and critical areas, open space (e.g., parks and golf courses), and public lands with respect to identified salmon habitat priorities and notify WRIA 9 staff prior to approving significant land use conversion, or pursuing sale/exchange of public lands.

» **LU10:** Incorporate Green Shores for Homes Certification standards into best management practices for residential shoreline development. The WRIA should support municipal efforts to establish a Green Shores for Homes certification process during permit review to help expedite permitting. Green Shores for Homes is an EPA-funded certification and accreditation program that was developed by technical Shore Friendly design of shoreline properties.

Plan Implementation and Funding

Location: All Subwatersheds

The WRIA 9 2016-2025 Interlocal Agreement provides a framework for managing and coordinating implementation of the Salmon Habitat Plan. It recognizes that salmon recovery transcends political boundaries and calls for strong collaboration between local, state, and federal partners. Success hinges on strong relationships, strategic coordination, and collective action. Working effectively across such a diverse landscape as the Green/Duwamish and Central Puget Sound requires creative partnerships with non-traditional partners. Leveraging shared resources to implement multi-benefit projects will help overcome land availability constraints and high restoration costs.

Programs

» **Basin Stewardship**

Support and expand existing basin stewardship programs across the Green/Duwamish subwatersheds. Basin stewards are instrumental to implementation of the salmon habitat plan. They advocate for salmon recovery, coordinate across diverse stakeholders, and build on-the-ground relationships that facilitate large capital restoration projects. Key tasks for basin stewardship include:

- Coordinating and implementing restoration projects;
- Coordination and collaboration across jurisdictions;
- Securing grant funding (including grant writing) for restoration and acquisition projects;
- Promoting voluntary stewardship on private property;
- Responding to citizen inquiries concerning watershed issues; and
- Expanding public education and outreach opportunities

Basin stewardship covers the Middle and Lower Green River sub-basins, Miller and Walker Creek basins, and Vashon Island. Priorities for expansion include mainland nearshore and Duwamish sub-basins.

» **Land Conservation Initiative (LCI)**

The LCI represents a coordinated effort to preserve river corridors, urban open space, trails, natural lands, farmland and forestlands. It is a regional collaboration between King County, cities, business people, farmers, environmental partners, and others to strategically preserve our last, most important places. The initiative sets forth the goal of conserving and preserving 65,000 acres of high conservation value lands throughout King County within the next 30 years. The primary funding source is the Conservation Futures Tax (CFT) fund, which is a property tax on all parcels in the county.

The LCI is an important funding source for pursuing open space acquisitions throughout the Green/Duwamish watershed. WRIA 9 partners should leverage the LCI to execute high-priority land acquisitions within the Green River Corridor to improve hydrological integrity, support salmon recovery, and expand recreational opportunity. Much of WRIA 9 is mapped as an "opportunity area" where households lack access to open space. Implementation of the LCI has the potential to align salmon recovery investments with needed investments to address equitable access to open space throughout the watershed.

» **U.S. Army Corps Green/Duwamish Ecosystem Restoration Program (ERP)**

WRIA 9 partners should continue to engage U.S. Army Corps leadership to advocate for appropriation of funding to implement ERP projects. The original collaborative effort resulted in identification of 45 projects, 29 of which were carried forward in the 2005 Salmon Habitat Plan. U.S. Congress authorized $113 million in 2000 to be cost shared between the federal (65%) and local partners (35%). Since the 2005 Plan, 13 of the original projects have

been completed, with seven completed under the ERP authorization (e.g., North Winds Weir, Codiga Farms, Riverview Side Channel) and six completed by local sponsors (e.g., Porter Levee Setback, Fenster levee Setback, and Gale Creek).

The Congressionally authorized ERP represents an important federal resource to support critically needed and underfunded salmon restoration work in the watershed. As of 2016, the ERP has only been allocated 8.25 percent of the authorized amount. A 2018 Green/Duwamish ERP Comprehensive Cost Update removed 12 projects based on the ratio of perceived habitat value to cost and the presence of hazardous materials. However, the recommended "de-scoped" plan still includes a number of high-priority projects including NE Auburn Creek and the Hamakami, Turley, and Lones levee setback projects. The cost update for the modified ERP scope is $260 million and the congressionally authorized cost adjusted for inflation is $269 million.

Policies

» **Implementation (I)1**: The WRIA 9 2016-2025 Interlocal Agreement outlines the governance, funding, and decision-making structure for coordination and implementation of the Salmon Habitat Plan.

» **I2:** Process-based habitat restoration – where feasible – is preferable to other approaches that rely on more intensive human intervention. However, the magnitude of alteration within portions of the watershed render true restoration of degraded processes infeasible in some locations. Rehabilitation and substitution projects require additional monitoring and maintenance to ensure desired functions are achieved. WRIA 9 should support periodic investments in adaptive management of completed projects to ensure maximize long-term ecological benefits.

» **I3:** Support use of mitigation funds to implement priority salmon habitat enhancement projects. Offsite mitigation programs (e.g., in-lieu fee and mitigation banking) can help improve ecological function in critical locations (e.g., Chinook Wind in the Duwamish Transition Zone) as a means of offsetting unavoidable impacts in less sensitive areas of the watershed. Development of mitigation opportunities should be coordinated with the WRIA to ensure proposals are consistent with and do not preclude identified salmon recovery priorities. The WRIA should explore the potential for innovative partnerships that could combine mitigation and restoration funding to expand the overall ecosystem benefit of habitat projects. However, habitat improvements

Figure 24.
The Riverview Park Project created approximately 800 ft of side channel to increasing juvenile Chinook rearing and refuge habitat in the Lower Green River. The project, sponsored by the City of Kent, was constructed in 2012 in partnership with the U.S. Army Corps of Engineers under the Green/Duwamish Ecosystem Restoration Project.

Photo: City of Kent.

associated with mitigation funds must be tracked as separate and discrete from those achieved with restoration-based grant funding.

» **I4:** Salmon recovery planning and habitat project development should integrate social justice and equity considerations. Public access and recreational improvements should be considered where demonstrated need exists and when compatible with salmon recovery goals. WRIA 9 should seek multiple benefit solutions that consider displacement and social justice issues.

» **I5**: Coordinate Salmon Habitat Plan implementation with other watershed-wide and regional initiatives to identify synergies, leverage available funding, avoid conflicts, and improve salmon recovery outcomes. Existing watershed-wide and regional initiatives include the King County Flood Hazard Management Plan, King County Flood Control District Lower Green River Corridor Plan, Lower Duwamish Waterway Superfund Cleanup, Puget Sound Action Agenda, Our Green Duwamish, WRIA 9 Watershed Restoration Enhancement Committee, and the Puget Sound South Central Action Area Local Integrating Organization.

» **I6:** Support examining new funding sources and financing strategies for implementing priority habitat projects and programs throughout Puget Sound. The WRIA 9 Watershed Forum will seek representation on regional committees tasked with the examination of public and private funding strategies at the local and regional level.

» **I7: Salmon recovery funding** should support adaptive management of previously constructed projects where monitoring data shows design changes are necessary to improve habitat function.

Chapter 7: Capital Projects

Salmon recovery capital projects preserve, enhance, create or restore the habitats and physical processes that support salmon. Projects include acquisition, restoration, and/or enhancement approaches.

Although significant progress has been made implementing projects identified in the 2005 Salmon Habitat Plan, many projects remain unfunded and under-resourced. Since 2005, 165 projects have been completed or are in progress, totalling over $160 million of investments. While many of the remaining projects identified within the 2005 Plan are still viable, other opportunities have been lost to development and/or a change in ownership.

This update provides a current, comprehensive list of potential capital projects that align with established goals for Chinook salmon recovery in WRIA 9. A couple of plan amendments added new projects to the 2005 Plan, including: a 2007 plan amendment; and the 2014 Duwamish Blueprint. As part of the 2020 update, all projects described in the plan (and its amendments) or the appendices of the plan were evaluated for inclusion in updated project list.

WRIA 9 staff developed an updated list of capital projects in partnership with ILA member jurisdictions, non-profit partners, state agencies, and others engaged in salmon recovery. Partners were asked to submit projects and provide specific project information including a project sponsor, location, scope, goals, alignment with recovery strategies, and projected habitat gains. In some cases, an identified project did not have a clear sponsor, but was included due to the perceived importance of the project. The request for projects primarily targeted Chinook salmon-focused projects, but several coho salmon projects were accepted.

A few additional project guidelines were developed in refining the project list:

- **Policies and Programs –** Project submittals were not required for actions that fell within the scope of larger programmatic actions (e.g., fish barrier removal).
- **Discrete footprint –** Projects were required to articulate a specific project footprint to support evaluation of feasibility and magnitude of ecological benefit.
- **Implementable within 10–15 years** – Project sponsors were directed to submit projects that could be implemented within a 10–15-year timeframe, provided adequate funding and landowner willingness.

Project Prioritization

A team of subject matter experts was recruited to review, evaluate and tier projects for inclusion in the Plan. This four-person prioritization team brought expertise in restoration ecology, fish biology, and habitat project management, and over 50 years of knowledge from working in the Green/Duwamish River and Central Puget Sound. A balance of interests was represented to eliminate bias for specific projects. The review process evaluated all conceptual projects based on their full potential to provide habitat lift. Future constraints identified during design and feasibility could impact overall project scope and associated benefits.

Project prioritization was based on subject matter expert evaluation of:

- **Habitat Quality (lift):** the relative importance and value of a specific proposed habitat; and
- **Habitat Quantity (size):** the potential amount (acreage and shoreline length) of habitat created or enhanced based on the entire project footprint.

The scoring process was weighted so that habitat quality comprised 75 percent of the score and habitat quantity comprised 25 percent of the score. The tiering process assumes habitat benefits are positively correlated with size. Larger projects not only provide more habitat, they allow increased habitat heterogeneity. Smaller, more homogeneous habitats, are less resilient to perturbations, and site constraints can be problematic for optimizing habitat. A small modifier was added to allow consideration of high-value geographic locations (e.g., proximity to existing restoration sites, feeder bluff, etc.). Potential lift reflects the projected immediate and long-term habitat benefits to addressing limiting factors for Chinook salmon recovery. Processed-based restoration was considered to provide more certainty of long-term benefits.

A total of 118 projects were submitted and ranked as part of the project solicitation process. Projects were ranked within a specific subwatershed – not across subwatersheds. Given the large number of projects, projects were tiered based on overall benefit and to provide an indication of priority for financial support from the WRIA. Tiers were defined as follows:

- **Tier 1 -** high potential; substantially contribute to recovery goals in each subwatershed.
- **Tier 2 -** moderate potential; clear alignment with Chinook salmon recovery goals.
- **Tier 3** - limited potential; associated with Chinook recovery (or not primary species impacted); compliments broader recovery efforts in the subwatershed.

A simplified scoring methodology based on habitat quantity and quality provides a foundation for long-term planning by setting high-level implementation priorities within each subwatershed. Tiers were assigned to projects by identifying natural breakpoints in the full list of projects within a subwatershed. These established breakpoints serve as a scoring baseline for projects received through future biennial calls for projects. Future proposed projects will be scored under the same criteria and assigned a tier. The proposed project will be added to the tiered list for future funding, with near-term funding priority given to those projects previously identified as in need of funding.

The final list of projects was approved unanimously by the Implementation Technical Committee and Watershed Ecosystem Forum in 2019 and will serve as the comprehensive list of recovery actions that help achieve recovery goals, and ultimately toward the delisting of Chinook salmon in Puget Sound.

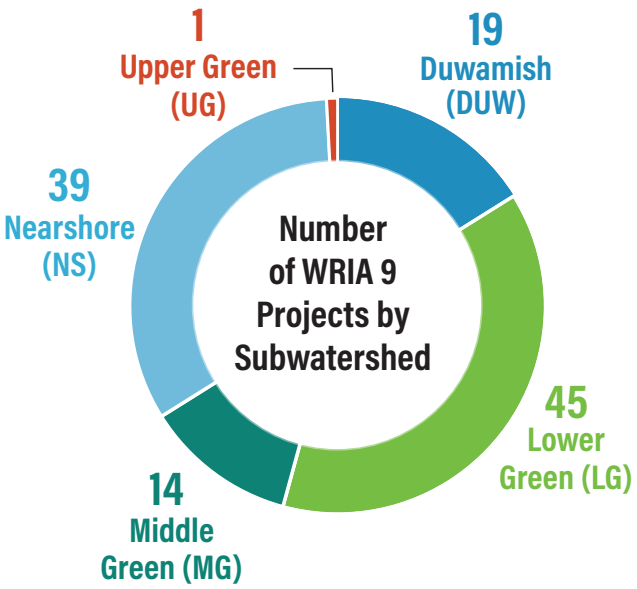
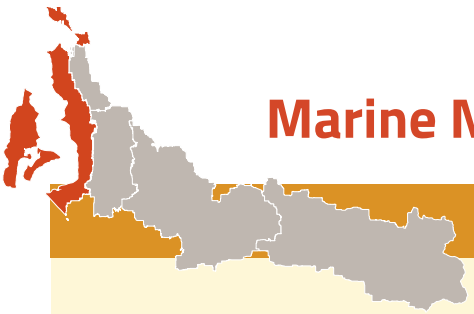


Figure 25. *Number of projects by subwatershed.*

Capital Project Information by Subwatershed containing:

- Subwatershed project location maps
- Subwatershed project listings with tier rankings
- Project fact sheets with site maps



Marine Nearshore Subwatershed

39 projects

Tier 1 (Score 18+) 17 projects

NS-7.....Cove Creek Pocket Estuary Restoration

NS-8 .....Dillworth and Gorsuch Creek Pocket Estuaries

NS-11.....Beaconsfield on the Sound

NS-15.....McSorley Creek Pocket Estuary and Feeder Bluff restoration

NS-21.....Corbin Beach Acquisition and Restoration

NS-23.....Point Heyer Nearshore Acquisitions

NS-24.....Cross Landing Pocket Estuary Restoration

NS-28.....Big Beach Reach Acquisition and Restoration

NS-29.....Maury Island Natural Area Revegetation and Reclamation

NS-43.....Dockton Reach Preservation and Restoration

NS-45.....Tahlequah Creek Mouth Restoration

NS-49.....Arroyos Park Bulkhead Removal

NS-53.....Perkins Lane Protection and Restoration

NS-61.....Manzanita Reach Acquisition and Restoration

NS-62.....Spring Beach Acquisition and Restoration

NS-63.....Green Valley Creek Acquisition and Restoration

NS-66.....Camp Kilworth Protection

Tier 2 (Score 7-18) 8 projects

NS-13.....Massey Creek Pocket Estuary and Fish Passage Project

NS-14.....Raab's Lagoon Acquisition and Restoration

NS-25.....Judd Creek Pocket Estuary

NS-27.....Piner Point Acquisition and Restoration

NS-31.....Discovery Park Feeder Bluff Protection and Restoration

NS-44.....Portage Salt Marsh Restoration

NS-60 .....Ellisport Creek Mouth Restoration

NS-67.....Des Moines Creek Estuary Restoration

Tier 3 (Score <7) 14 projects

NS-2.....Myrtle Edwards Park Pocket Beach Shallow Water Habitat

NS-16.....Dash Point State Park Estuary Restoration and Water Quality Improvements

NS-22.....Smith Cove Shallow Water Rehabilitation

NS-35.....Lower Shinglemill Creek habitat restoration

NS-39.....Walker Creek Headwaters Land Acquisition

NS-40 .....Salmon Creek Fish Barrier Removal

NS-42.....Miller Creek Regional Detention Facility

NS-54.....West Galer Street/32nd St. Boat Ramp Shoreline Armor Removal and Restoration

NS-58.....Tsugwalla Creek Pocket Estuary Restoration Project

NS-59.....Mileta Armor removal and shoreline restoration

NS-68.....Longfellow Creek Fish Passage and Floodplain Restoration

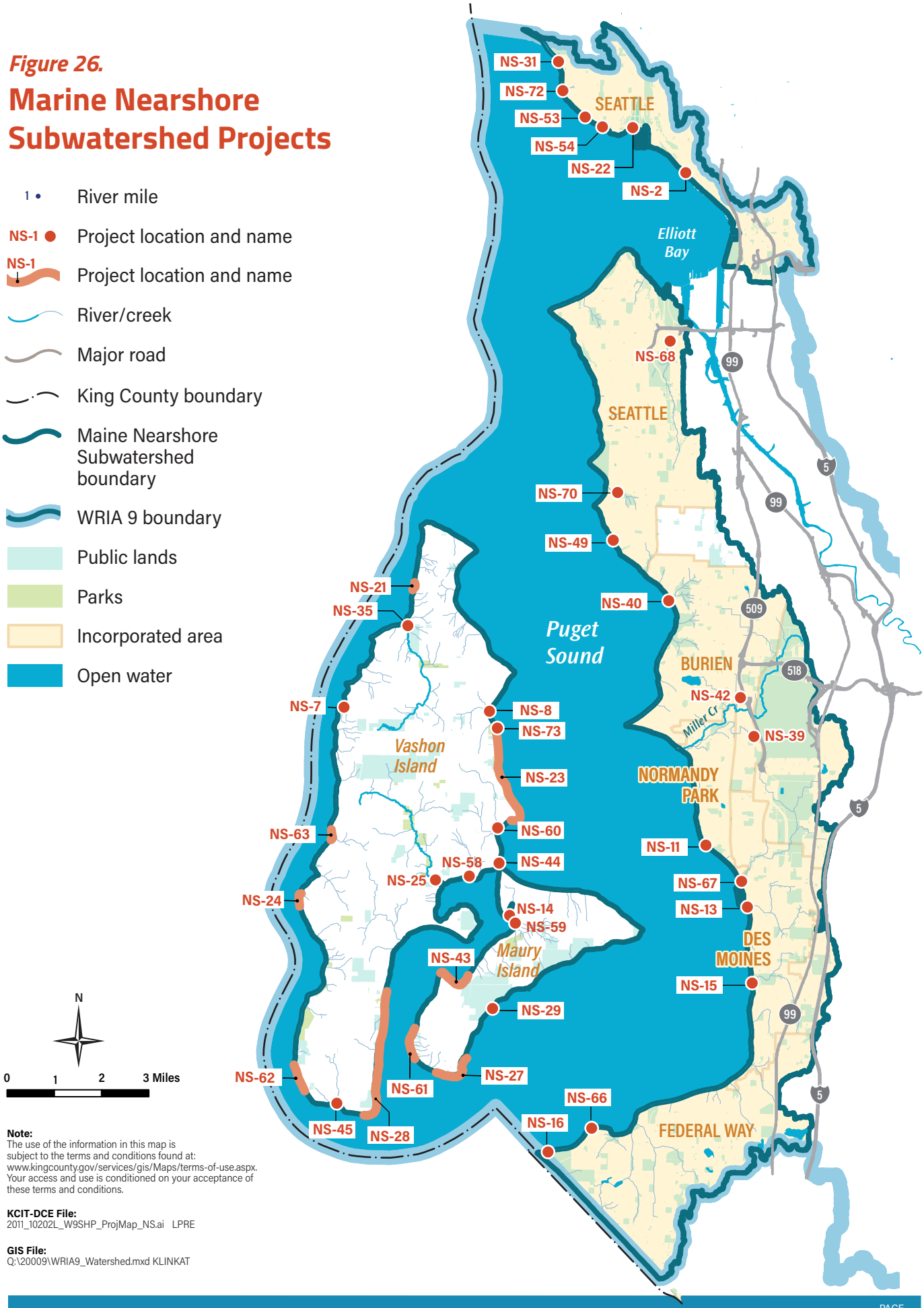
NS-70 .....Fauntleroy Creek Fish Passage

NS-72 .....Perkins Lane Protection and Restoration Project/Perkins Lane Utility Access Road

NS-73 .....Beall Creek Salmon Habitat Project

Figure 26.

Marine Nearshore Subwatershed Projects



Note:
The use of the information in this map is subject to the terms and conditions found at: www.kingcounty.gov/services/gis/Maps/terms-of-use.aspx. Your access and use is conditioned on your acceptance of these terms and conditions.

KCIT-DCE File:
2011_10202L_W9SHP_ProjMap_NS.ai LPRE

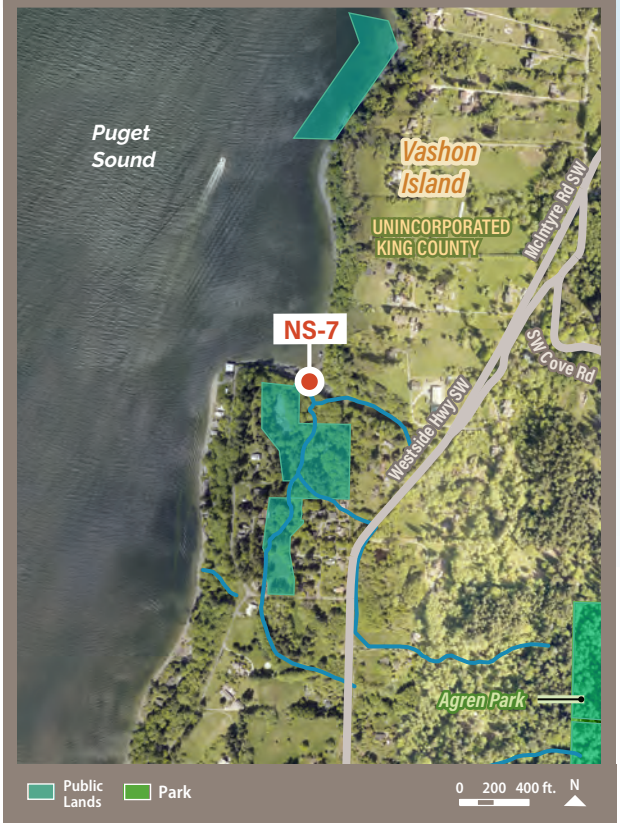
GIS File:
Q:\20009\WRIA9_Watershed.mxd KLINKAT

Tier 1 Project: NS-7

Cove Creek Pocket Estuary Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury Island
(KI – 13-28; KI - 11-7)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$600,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

Nearshore Pocket Estuary

PROJECT DESCRIPTION:

Protect and improve riparian vegetation, improve tributary access, remove armoring and fill, increase vegetated shallow nearshore and marsh habitats, protect and enhance pocket estuaries and tributary stream mouths.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-8

Dillworth and Gorsuch Creek Pocket Estuaries

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury
(KI - 12 - 4)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$3,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

PROJECT DESCRIPTION:

Acquire properties at the mouth of Dillworth and Gorsuch Creeks to restore stream delta and pocket estuary habitat.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Increased rearing habitat
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-11

Beaconsfield on the Sound

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Normandy Park (KI-7-3)

Bankside jurisdiction:
Normandy Park

Project sponsor:
Normandy Park

Budget:
$600,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

PROJECT DESCRIPTION:

Protect and restore 1085 ft. of active feeder bluff along mainland marine nearshore.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Reconnect historic feeder bluffs
- Shoreline armor reduction

Contribution to goals metrics:

- Shoreline armor

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-15

McSorley Creek Pocket Estuary and Feeder Bluff Restoration

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Des Moines (KI - 8 - 3)

Bankside jurisdiction:
Des Moines

Project sponsor:
King County/
State Parks

Budget:
$20,838,000

PROJECT TYPE:

- Acquisition
- Enhancement/ Planting
- Monitoring & Assessment
- Planning/ Design
- Restoration

KEY HABITAT:

- Nearshore Feeder Bluff
- Nearshore Pocket Estuary

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Restore historic pocket estuary, protect feeder bluffs, remove marine shoreline armoring and enhance low-impact recreational activities.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Recreation opportunities
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor

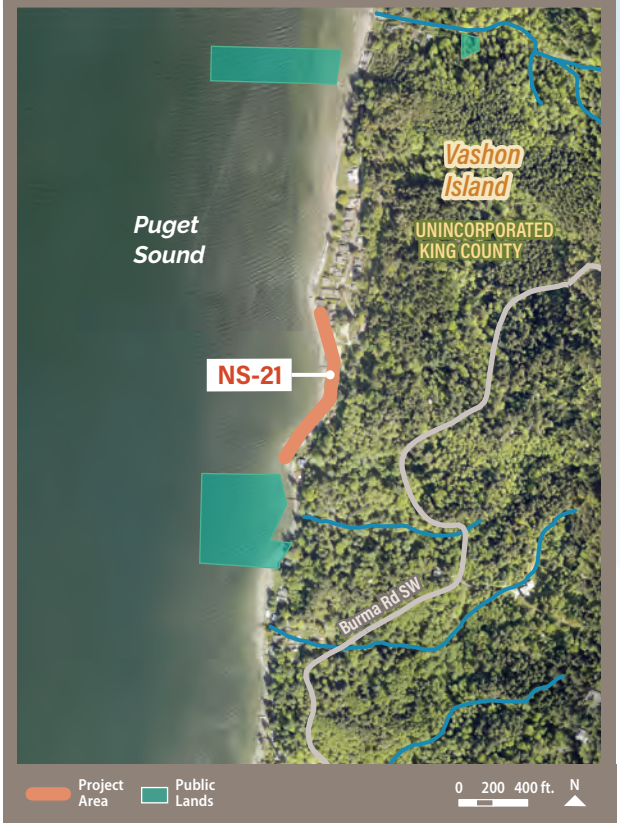
Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-21

Corbin Beach Acquisition and Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury Island (KI 11-2)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$3,500,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

PROJECT DESCRIPTION:

Acquire to protect and restore nearshore habitat by removing shoreline debris, hard armor, and derelict docks.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Reconnect historic feeder bluffs
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-23

Point Heyer Nearshore Acquisitions

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury
(KI - 13 - 2)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$10,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

Riparian

PROJECT DESCRIPTION:

Acquire properties to protect and restore beach feeding processes and salt marsh at spit.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Habitat preservation
- Recreation opportunities
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-24

Cross Landing Pocket Estuary Restoration

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury
(KI – 13 – 23)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$3,500,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Acquire beach feeding parcels, remove fill, restore salt marsh, remove road, and reroute road drainage.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Shoreline armor reduction

Contribution to goals metrics:

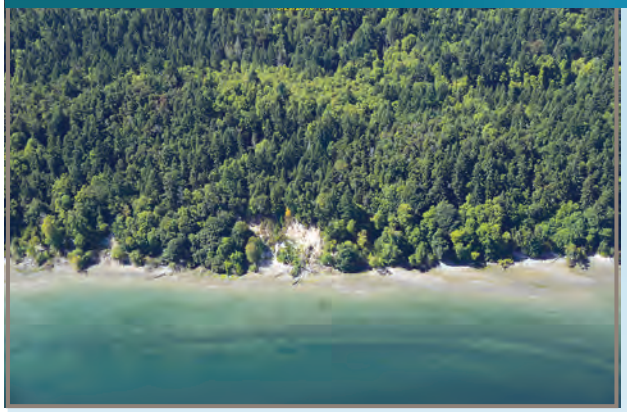
- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-28

Big Beach Reach Acquisition and Restoration

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury Island (KI 13-20)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$15,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore
Feeder Bluff

PROJECT DESCRIPTION:

Acquire to protect and restore about 209 acres of upland and nearshore habitat with approximately 4615 feet of bluff-backed beach shoreline.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Reconnect historic feeder bluffs
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-29
Maury Island Natural Area Revegetation and Reclamation

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury
(KI - 14 - 2)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$1,050,000

PROJECT TYPE:

Restoration

KEY HABITAT:

Nearshore
Feeder Bluff

PROJECT DESCRIPTION:

Remove invasive species, add topsoil, and revegetate about a mile of marine shoreline.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Recreation opportunities
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-43

Dockton Reach Preservation and Restoration

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury
(KI - 13 - 8)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$2,600,000

PROJECT TYPE:

Acquisition

Restoration

Scoping/ Reconnaissance

KEY HABITAT:

Nearshore Feeder Bluff

Riparian

PROJECT DESCRIPTION:

Restore 2000 feet of marine shoreline in the Maury Island Aquatic Reserve.

PROJECT AREA MAP

LOCATION MAP

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Making Our Watershed Fit For A King

Tier 1 Project: NS-45

Tahlequah Creek Mouth Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury Island
(KI - 13 - 21, KI - 13 - 22)

Jurisdiction:
Vashon/Maury

Project sponsor:
Vashon/Maury

Budget:
$7,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

Nearshore Pocket Estuary

Riparian

PROJECT DESCRIPTION:

Acquire properties, restore creek meander and fish passage, remove bulkhead, and restore nearshore, estuary and marsh habitat.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Shoreline armor reduction

Contribution to goals metrics:

- Marine riparian vegetation
- Shoreline armor

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-49

Arroyos Park Bulkhead Removal

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
City of Seattle (KI -5 - 1)

Bankside jurisdiction:
City of Seattle

Project sponsor:
Seattle Parks and Recreation

Budget:
$2,500,000

PROJECT TYPE:

Planning/ Design

Restoration

KEY HABITAT:

Nearshore

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Remove approximately 700 feet of rip rap and timber bulkhead along the shoreline.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Habitat preservation
- Recreation opportunities
- Shoreline armor reduction

Contribution to goals metrics:

- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

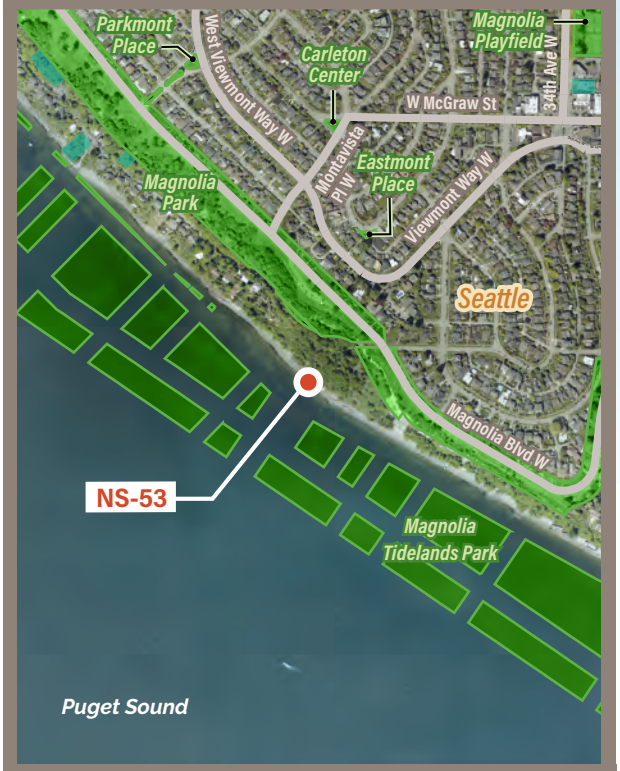
Making Our Watershed Fit For A King

Tier 1 Project: NS-53

Perkins Lane Protection and Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
City of Seattle (KI - 3 - 2)

Bankside jurisdiction:
City of Seattle

Project sponsor:
Seattle Parks and Recreation

Budget:
TBD

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore
Feeder Bluff

PROJECT DESCRIPTION:

Acquire properties to remove old bulkheads and fill.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Habitat preservation
- Reconnect historic feeder bluffs
- Shoreline armor reduction

Contribution to goals metrics:

- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Making Our Watershed Fit For A King

Tier 1 Project: NS-61

Manzanita Reach Acquisition and Restoration

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury (KI - 10 - 3)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$15,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

PROJECT DESCRIPTION:

Acquire properties to remove old bulkheads and fill.

PROJECT AREA MAP

LOCATION MAP

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Reconnect historic feeder bluffs
- Shoreline armor reduction

Contribution to goals metrics:

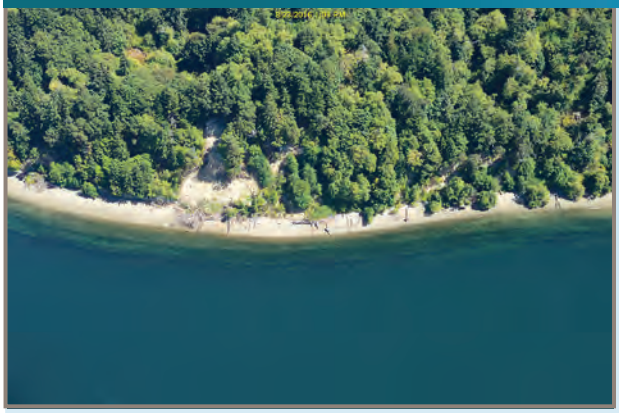
- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-62

Spring Beach Acquisition and Restoration

Green / Duwamish & Central Puget Sound



PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury (KI - 10 - 3)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$5,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Acquire to protect and restore shoreline and forage fish habitat.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Shoreline armor reduction

Contribution to goals metrics:

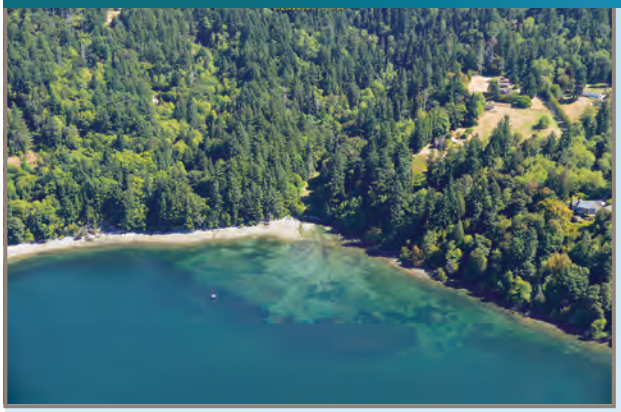
- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-63

Green Valley Creek Acquisition and Restoration

Green / Duwamish & Central Puget Sound



PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Vashon/Maury (KI - 13 - 26)

Bankside jurisdiction:
Vashon/Maury

Project sponsor:
King County

Budget:
$4,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Acquire undeveloped lots along the Green Valley Creek, restore creek mouth, and remove hard shoreline armor.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Reconnect historic feeder bluffs
- Shoreline armor reduction

Contribution to goals metrics:

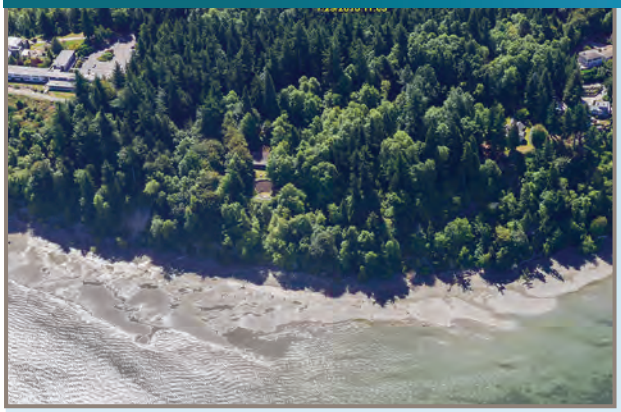
- Marine riparian vegetation
- Shoreline armor
- Shoreline conservation

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: NS-66

Camp Kilworth Protection

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Drift cell:
Federal Way (KI - 10 - 3)

Bankside jurisdiction:
Federal Way

Project sponsor:
Forterra and Kilworth Environmental Education Preserve (KEEP)

Budget:
$3,100,000

PROJECT TYPE:

Acquisition

KEY HABITAT:

Nearshore Feeder Bluff

PROJECT DESCRIPTION:

Protect 900 feet of active feeder bluffs that occurs in the first third of the drift cell.

Primary strategy

Protect, restore and enhance marine shorelines.

Benefits:

- Improved forage fish spawning habitat
- Reconnect historic feeder bluffs

Contribution to goals metrics:

- Shoreline armor

Project Area Map: Ortho2019KCNAT aerial photo Site photo: WDOE Shoreline Photo Viewer Images, 2020
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 2 Project: NS-13

Massey Creek Pocket Estuary and Fish Passage Project

PROJECT FACTS

Subwatershed:
Nearshore (NS)

Nearshore jurisdiction:
Nearshore KI - 8 - 2

Bankside jurisdiction:
City of Des Moines

Project sponsor:
City of Des Moines

Budget:
$3,000,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Nearshore Pocket Estuary
- Riparian

KCIT-DCE VC folder: 2010_10202w_NS-13.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Acquire and restore the stream, create fish passage, remove the jetty and rock from the south bank, and create a pocket estuary.

Tier 2 Project: NS-14

Raab's Lagoon Acquisition and Restoration

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 13 - 9

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
TBD

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Nearshore Pocket Estuary
- Riparian

KCIT-DCE VC folder: 2010_10202w_NS-14.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Acquire vacant lots, restore riparian forest habitat and connectivity by removing the weir and bulkhead.

Tier 2 Project: NS-25

Judd Creek Pocket Estuary

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 0 - 1

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$6,000,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Nearshore Feeder Bluff
- Nearshore Pocket Estuary
- Riparian

PROJECT DESCRIPTION:

Restore habitat with wood placement, removal of derelict barge, and additional vegetation near mouth of Judd Creek.

KCIT-DCE VC folder: 2010_10202w_NS-25.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: NS-27

Piner Point Acquisition and Restoration

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 13 - 8

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$1,500,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Nearshore Feeder Bluff
- Riparian

PROJECT DESCRIPTION:

Acquire remaining properties, remove bulkheads, and restore feeder bluffs.

KCIT-DCE VC folder: 2010_10202w_NS-27.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: NS-31

Discovery Park Feeder Bluff Protection and Restoration

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 3 - 2

Bankside jurisdiction:
City of Seattle

Project sponsor:
Seattle Parks and Recreation

Budget:
TBD

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

KCIT-DCE VC folder: 2010_10202w_NS-31.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Acquire remaining properties, remove bulkheads, and restore feeder bluffs.

Tier 2 Project: NS-44

Portage Salt Marsh Restoration Project

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 13 - 6

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$2,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Feeder Bluff

Riparian

KCIT-DCE VC folder: 2010_10202w_NS-44.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Install bridge or box culverts, restore fish access, and restore habitat to salt marsh.

Tier 2 Project: NS-60

Ellisport Creek Mouth Restoration

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 13 - 4; KI - 13 - 5

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$3,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

KCIT-DCE VC folder: 2010_10202w_NS-60.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:
Acquire and restore habitat at Ellisport Creek stream mouth, and allow for fish passage.

Tier 2 Project: NS-67

Des Moines Creek Estuary Restoration

PROJECT FACTS

Subwatershed:
Nearshore

Nearshore jurisdiction:
Nearshore KI - 8 - 2

Bankside jurisdiction:
City of Des Moines

Project sponsor:
City of Des Moines

Budget:
TBD

PROJECT TYPE:

Planning/ Design

Restoration

KEY HABITAT:

Nearshore Pocket Estuary

Riparian

KCIT-DCE VC folder: 2010_10202w_NS-67.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:
Remove approximately 500 feet of hard shoreline armor and pull back fill material to create a more natural shoreline and stream transition.

Table 3.

Marine Nearshore Subwatershed Tier 3 Projects

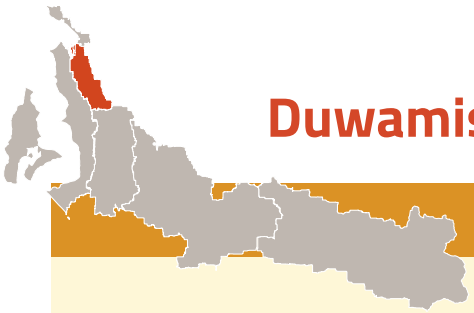
Project No.	Project Name	Project Type	Project Description		Sponsor	River mile and Bank side/Nearshore jurisdiction	Primary Strategy (pick 1)	Jurisdiction	Goal alignment
NS-2	**Myrtle Edwards Park Pocket Beach Shallow Water Habitat**	• Planning/Design • Restoration • Scoping/Reconnaissance	Remove shoreline armor and restore natural beach adjacent to a previously created pocket beach.		Seattle Parks and Recreation	Nearshore KI - 4 - 1 - NAD	Protect, restore and enhance marine shorelines	City of Seattle	• Marine riparian vegetation • Shoreline armor
NS-16	**Dash Point State Park Estuary Restoration and Water Quality Improvements**	• Restoration • Scoping/Reconnaissance	Project will remove armoring to restore estuary and re-align creek to more sinuous route. Improve water quality in park through parking lot improvements, reduce erosion associated with stormwater runoff, creosote-treated pedestrian bridge replacement, and wetland enhancement.		Washington State Parks & Recreation	Nearshore KI - MA - 014	Protect, restore and enhance marine shorelines	City of Federal Way	LG- Off-channel habitat
NS-22	**Smith Cove Shallow Water Rehabilitation**	Planning/Design	Remove some level of shoreline armor and plant native vegetation along a stretch of barren riprap. The riprap leads to a protected sandy pocket beach that exists at all tidal elevations. There may be additional opportunity for nearshore restoration on adjacent Port property. The Port also has a marine habitat restoration pilot site adjacent to this project.		Seattle Parks and Recreation	Nearshore KI - 3 -2/3 - 3 - NAD, KI - 3 - 3	Protect, restore and enhance marine shorelines	City of Seattle	• Marine riparian vegetation • Shoreline armor
NS-35	**Lower Shinglemill Creek Habitat Restoration**	Restoration	Add LWD into stream reach west of Cedarhurst Road.		King County	Nearshore KI - 11 - 4	Protect, restore and enhance marine shorelines	Vashon/Maury	• Marine riparian vegetation • Shoreline conservation

(continued on next page)

Table 3.

Marine Nearshore Subwatershed Tier 3 Projects, continued

Project No.	Project Name	Project Type	Project Description		Sponsor	River mile and Bank side/Nearshore jurisdiction	Primary Strategy (pick 1)	Jurisdiction	Goal alignment
NS-39	**Walker Creek Headwaters Land Acquisition**	• Enhancement/Planting • Restoration & Acquisition • Scoping/Reconnaissance	The project plan is to seek partnership or acquisition opportunities with the property owners within the project area, with the goal of acquiring and restoring additional contiguous areas beyond the current city-owned wetland parcels within the project site.		City of Burien	Nearshore KI - 7 - 3	Protect, restore and enhance marine shorelines	City of Burien	Shoreline conservation
NS-40	**Salmon Creek Fish Barrier Removal**	• Planning/Design • Restoration	The project plan is to seek a partnership or acquisition opportunities with the property owners within the project area, with the goals of removing the fish-barrier weir at the mouth of the creek, and removing and replacing a culvert with a modern fish passable one.		City of Burien	Nearshore KI - 5 - 1	Protect, restore and enhance marine shorelines	City of Burien	• Marine riparian vegetation • Shoreline armor • Shoreline conservation
NS-42	**Miller Creek Regional Detention Facility**	Planning/Design	The project plan is to identify one or more large commercial properties in Burien that have no existing stormwater treatment or flow control, and partner with them to construct regional stormwater facilities on their site(s).		City of Burien	Nearshore KI - 7 - 3	Protect, restore and enhance sediment and water quality	City of Burien	Shoreline conservation
NS-54	**West Galer Street/32nd St. Boat Ramp Shoreline Armor Removal and Restoration**	• Planning/Design • Restoration • Scoping/Reconnaissance	Remove/reduce shoreline armoring, remove fill, relocate an SPU-owned pump station if feasible, and re-vegetate shoreline. Potential acquisition of adjacent properties.		Seattle Public Utilities	Nearshore KI - 3 - 2	Protect, restore and enhance marine shorelines	City of Seattle	Shoreline armor
NS-58	**Tsugwalla Creek Pocket Estuary Restoration Project**	Restoration & Acquisition	Restore fish passage and salt marsh habitat at mouth of creek.		King County	Nearshore KI - 13 - 15 / KI - 13 - 14	Protect, restore and enhance marine shorelines	Vashon/Maury	• Marine riparian vegetation • Shoreline armor • Shoreline conservation
NS-59	**Mileta Armor Removal and shoreline restoration**	Restoration	Remove shoreline armoring, evaluate and improve fish passage.		King County	Nearshore KI - 13 - 10	Protect, restore and enhance marine shorelines	Vashon/Maury	• Marine riparian vegetation • Shoreline armor • Shoreline conservation
NS-68	**Longfellow Creek Fish Passage and Floodplain Restoration**	• Acquisition • Planning/Design • Restoration • Restoration & Acquisition • Scoping/Reconnaissance	This project will evaluate restoration opportunities at five sites along a 1.7-mile section of Longfellow Creek. Future restoration may include: floodplain reconnection, fish passage improvements (culvert replacements or daylighting), stream channel realignment, stream channel and riparian restoration, wetland creation and/or enhancement.		Seattle Public Utilities	RM 0 / left bank	Protect, restore, and enhance riparian corridors	City of Seattle	DUW - Riparian forest
NS-70	**Fauntleroy Creek Fish Passage**	• Acquisition • Planning/Design • Restoration • Restoration & Acquisition	Replace two aging fish passage barrier culverts with new culverts that meet fish passage standards. Includes partial daylighting and stream channel restoration.		Seattle Public Utilities	Nearshore / KI - 5 - 1	Restore and improve fish passage	City of Seattle	• Marine riparian vegetation • Shoreline armor
NS-72	**Perkins Lane Protection and Restoration Project/Perkins Lane Utility Access Road**	• Planning/Design • Restoration • Scoping/Reconnaissance	Assess feasibility of modifying the utility service road and sewer access points in order to remove shoreline armor and restore to a natural beach.		Seattle Public Utilities	Nearshore KI - 3 - 2	Protect, restore and enhance marine shorelines	City of Seattle	• Marine riparian vegetation • Shoreline armor • Shoreline conservation
NS-73	**Beall Creek Salmon Habitat Project**	Restoration	Replace current surface water extraction system with a fish friendly system to allow for the return of salmon and other salmonids		Water District 19	2923039086/Water District 19	Protect, restore and enhance marine shorelines	Water District 19	• Marine riparian vegetation • Shoreline armor • Shoreline conservation



Duwamish Estuary Subwatershed

19 projects

Tier 1 (Score 18+) 8 projects

DUW-2.....Rendering Plant
DUW-7 .....Chinook Wind
DUW-7a....Chinook Wind - Extension
DUW-25 ...Desimone Oxbow Restoration
DUW-29 ...Seattle City Light North/Hamm Creek
DUW-32 ...Duwamish River People's Park & Shoreline Habitat (Terminal 117)
DUW-64 ...U-Haul River Project
DUW-66 ...Terminal 25 South

Tier 2 (Score 7-18) 9 projects

DUW-3.....Seattle LA Freight Revetment Setback
DUW-18 ....Codiga Off-channel Habitat Expansion
DUW-22 ...Cecil Moses
DUW-24 ...Carrossino Restoration
DUW-26 ...S 104th St. Bank Stabilization/Restoration
DUW-60 ...Herring's House Park Fish Access Improvement
DUW-61 ....George Long
DUW-63 ...S. 115th St. Road Setback
DUW-67.....Codiga to TCC Corridor

Tier 3 (Score <7) 2 projects

DUW-14 ....Duwamish Waterway Park
DUW-19 ....Southgate Creek Restoration

Figure 27.

Duwamish Estuary Subwatershed Projects

Note:
The use of the information in this map is subject to the terms and conditions found at: www.kingcounty.gov/services/gis/Maps/terms-of-use.aspx. Your access and use is conditioned on your acceptance of these terms and conditions.

KCIT-DCE File:
2011_20202L_W9SHP_ProjMap_DUW.ai LPRE

GIS File:
Q:\20009\WRIA9_Watershed.mxd KLINKAT

Making Our Watershed Fit For A King

Tier 1 Project: DUW-2

Rendering Plant

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish RM 10.1 - 9.7/ right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $9,730,000

PROJECT DESCRIPTION:

Acquire and restore seven + acres with side channel and backwater habitat enhancements and reforestation.

PROJECT TYPE:

- Planning/ Design
- Scoping/ Reconnaissance
- Acquisition
- Restoration

KEY HABITAT:

- Backwater
- Edge
- Duwamish Mudflat
- Duwamish Marsh
- Floodplain
- Riparian
- Side Channel

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased rearing habitat
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Riparian forest
- DUW - Shallow water habitat

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth, 2020
KCIT-DCE file: 2010_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

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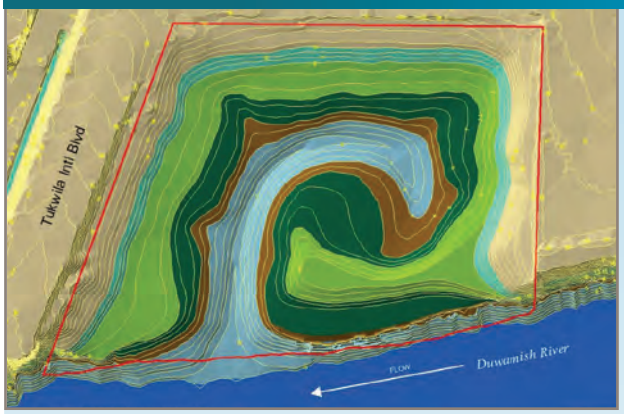
Tier 1 Project: DUW-7
Chinook Wind

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish RM 6.7/ right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
King County

Budget: $14,900,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Duwamish Mudflat

Duwamish Marsh

Riparian

PROJECT DESCRIPTION:

Expand and enhance low velocity, shallow water rearing rearing habitat (shallow subtidal and intertidal) in the Duwamish transition zone.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased habitat connectivity
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Riparian forest
- DUW - Shallow water habitat

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: DUW-7a

Chinook Wind Extension

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish RM 6.8/ right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $1,418,000

PROJECT TYPE:

Acquisition

Restoration

Planning/ Design

KEY HABITAT:

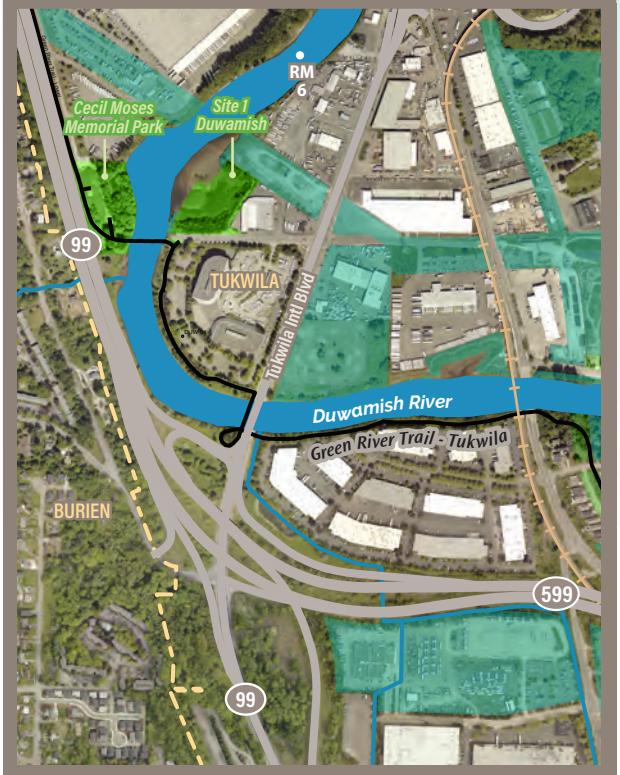
Duwamish Mudflat

Duwamish Marsh

Edge

Riparian

PROJECT AREA MAP



LOCATION MAP

PROJECT DESCRIPTION:

Expand and enhance the land between Chinook Wind Mitigation and Duwamish Gardens to create a unified park and rest.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased habitat connectivity
- Recreation opportunities
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Riparian forest
- DUW - Shallow water habitat

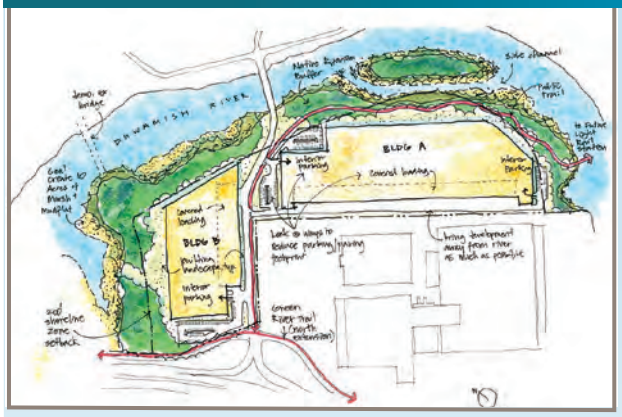
Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2010_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Making Our Watershed Fit For A King

Tier 1 Project: DUW-25

Desimone Oxbow Restoration

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish RM 6.5 - 5.3/left bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
Unknown

Budget: $84,193,945

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration
- Acquisition

KEY HABITAT:

- Backwater
- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Riparian
- Side Channel

PROJECT DESCRIPTION:

Acquire and restore 45.4-acre site located on the western shore of the Duwamish River between river miles 5 and 6 resulting in 23.6 acres of marsh created, 10.8 acres of vegetation, and 34.4 acres refuge habitat created.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased rearing habitat
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Riparian forest
- DUW - Shallow water habitat
- LG - Off-channel habitat

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

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Tier 1 Project: DUW-29

Seattle City Light North/Hamm Creek

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish RM 5.0 - 4.8/ left bank

Bankside jurisdiction:
City of Seattle

Project sponsor:
Seattle City Light

Budget:
TBD

PROJECT TYPE:

Restoration

KEY HABITAT:

Backwater

Tributary

Nearshore Pocket Estuary

PROJECT DESCRIPTION:

Create off channel habitat and shallow water esturarine habitat in the area north of the existing Duwamish 230 kV - 26 kV substation.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased rearing habitat
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Shallow water habitat

Site Photo: Wash. Dept. of Ecology
KCIT-DCE file: 2011_10202L LPRE

Project Area Map: Ortho2019KCNAT aerial photo
GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: DUW-32

Duwamish River People's Park & Shoreline Habitat (Terminal 117)

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish 4.5 - 4.1 / left bank

Jurisdiction:
Port of Seattle

Project sponsor:
Port of Seattle

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration

KEY HABITAT:

- Duwamish Marsh
- Duwamish Mudflat
- Edge

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Restore approximately 13.5 acres and 2,050 linear feet of upland and aquatic habitats. The project will expand off-channel habitat as well as establish marsh vegetation and riparian forest, restore estuarine shoreline via removal of armoring, and add large wood.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased habitat connectivity
- Recreation opportunities
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Shallow water habitat

Site Photo: Wash. Dept. of Ecology
KCIT-DCE file: 2011_10202L LPRE

Project Area Map: Ortho2019KCNAT aerial photo
GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

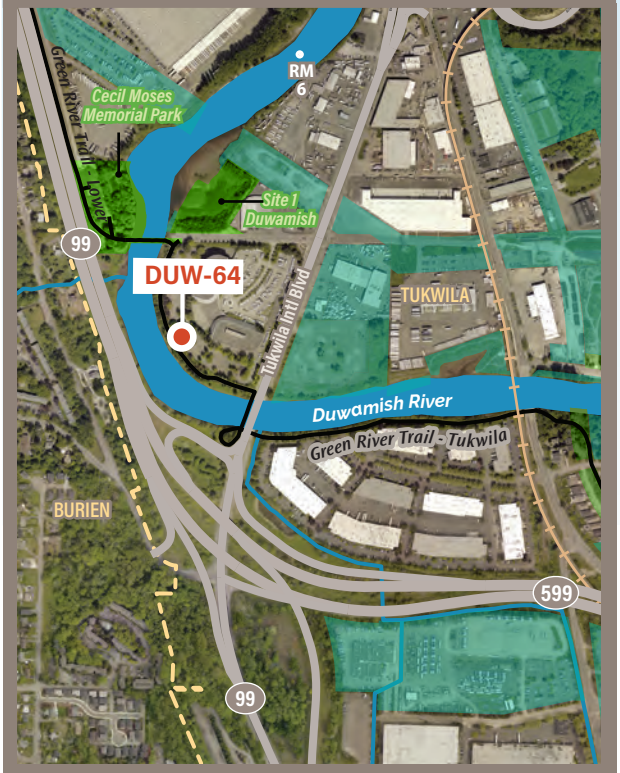
Making Our Watershed Fit For A King

Tier 1 Project: DUW-64

U-Haul River Project

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish RM 6.5 - 6.3/ right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $11,770,000

PROJECT TYPE:

- Acquisition
- Restoration
- Planning/ Design
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Duwamish Mudflat
- Duwamish Marsh
- Edge
- Riparian

PROJECT DESCRIPTION:

Acquire and restore 4.4-acre parcel by creating off-channel mudflat, marsh, and riparian habitat.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased rearing habitat
- Recreation opportunities
- Sediment quality improvement

Contribution to goals metrics:

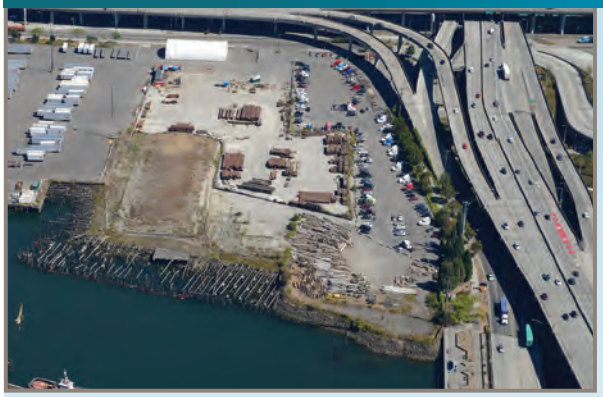
- DUW - Riparian forest
- DUW - Shallow water habitat

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth, 2020
KCIT-DCE file: 2010_10202L_LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: DUW-66

Terminal 25 South

Green / Duwamish & Central Puget Sound



PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
Duwamish 0.4 / right bank

Jurisdiction:
Port of Seattle

Project sponsor:
Port of Seattle

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration

KEY HABITAT:

- Backwater
- Duwamish Marsh
- Duwamish Mudflat
- Edge

PROJECT AREA MAP

LOCATION MAP

PROJECT DESCRIPTION:

Restore critically needed estuarine in the East Waterway. Project will expand off-channel habitat as well as establish marsh vegetation and riparian forest, restore estuarine shoreline via removal of armoring & creosote pile, and add large wood.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased rearing habitat
- Sediment quality improvement

Contribution to goals metrics:

- DUW - Shallow water habitat

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L_LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 2 Project: DUW-3

Seattle LA Freight Revetment Setback

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
RM 9.7- 10.1 / right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$5,230,000

PROJECT TYPE:

- Enhancement/Planting
- Planning/ Design
- Restoration
- Acquisition
- Scoping/ Reconnaissance

KEY HABITAT:

- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Floodplain
- Riparian

PROJECT DESCRIPTION:

Acquire properties, setback the revetment, create shallow water edge habitat with backwater refuge for salmonids, and improve shoreline conditions in this freight district in Tukwila.

KCIT-DCE VC folder: 2010_10202w_DUW-3.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-18

Codiga Off-channel Habitat Expansion

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
RM 8.6/right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $642,000

PROJECT TYPE:

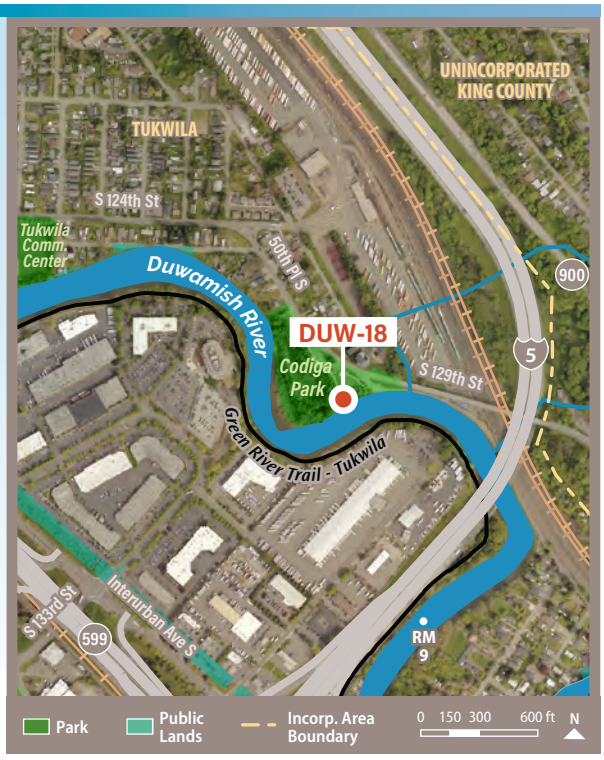
- Planning/ Design
- Restoration

KEY HABITAT:

- Duwamish Marsh
- Duwamish Mudflat
- Floodplain
- Riparian
- Side Channel

PROJECT DESCRIPTION:

Expand Codiga Park habitat restoration project by turning the backwater area into a side channel to increase rearing and refuge for salmon during higher flows.



KCIT-DCE VC folder: 2010_10202w_DUW-18.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-22

Cecil Moses

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
RM 6.3 / left bank

Bankside jurisdiction:
King County

Project sponsor:
Seattle Parks and Recreation

Budget: $5,000,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Duwamish Marsh
- Duwamish Mudflat

PROJECT DESCRIPTION:

Enhance access to and expand existing off-channel habitat to increase quality and quantity of available rearing habitat in the transition zone by expanding existing inlet/outlet, removal of tire revetment, and potential acquisition and restoration of adjacent downstream creek parcel.

KCIT-DCE VC folder: 2010_10202w_DUW-22.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-24

Carrossino Restoration

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
6 - 6.1 / right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $16,304,000

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration
- Acquisition

KEY HABITAT:

- Backwater
- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Riparian

PROJECT DESCRIPTION:

Acquire properties and create shallow mudflat, marsh, and backwater habitats.

KCIT-DCE VC folder: 2010_10202w_DUW-24.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-26

S. 104th St. Bank Stabilization/Restoration

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
5.6 / right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $5,930,000

PROJECT TYPE:

- Planning/ Design
- Restoration
- Acquisition
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Riparian

PROJECT DESCRIPTION:

Acquire properties, abandon and remove the road, and create shallow water edge and backwater habitat in the transition zone.

KCIT-DCE VC folder: 2010_10202w_DUW-26.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-60

Herring's House Park Fish Access Improvement

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
RM 1.1 / left bank

Bankside jurisdiction:
City of Seattle

Project sponsor:
Seattle Parks and Recreation

Budget: $1,250,000

PROJECT TYPE:

- Planning/ Design
- Restoration

KEY HABITAT:

- Nearshore Pocket Estuary
- Riparian
- Side Channel

PROJECT DESCRIPTION:

Adaptively manage an older restoration project to increase fish use by expanding channel opening width, removing shoreline armor and considering a bridge over the channel for recreational access.

KCIT-DCE VC folder: 2010_10202w_DUW-60.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-61

George Long

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
10.4 / left bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget: $9,500,000

PROJECT TYPE:

- Enhancement/ Planting
- Restoration
- Acquisition
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Riparian

PROJECT DESCRIPTION:

Create backwater refuge and riparian habitat at the uppermost limit of the transition zone.

KCIT-DCE VC folder: 2010_10202w_DUW-61.ai GIS file Q:\200091\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-63

S. 115th St. Road Setback

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
RM 7 / right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$4,699,000

PROJECT TYPE:

- Restoration
- Scoping/ Reconnaissance

KEY HABITAT:

- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Side Channel

PROJECT DESCRIPTION:

Relocate local road and create shallow water edge, backwater mudflat, marsh, and riparian habitat as part of the Duwamish Hill Preserve Master Plan.

KCIT-DCE VC folder: 2010_10202w_DUW-63.ai GIS file Q:\200091\WRIA9_ProjectMaps.mxd

Tier 2 Project: DUW-67

Codiga to TCC Corridor

PROJECT FACTS

Subwatershed:
Duwamish (DUW)

River mile:
RM 8.1-8.3/
right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$12,525,000

PROJECT TYPE:

- Acquisition
- Restoration
- Education & Outreach
- Enhancement/ Planting
- Planning/ Design
- Scoping/ Recon.

KEY HABITAT:

- Backwater
- Edge
- Duwamish Marsh
- Duwamish Mudflat
- Riparian

KCIT-DCE VC folder: 2010_10202w_ DUW-18.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

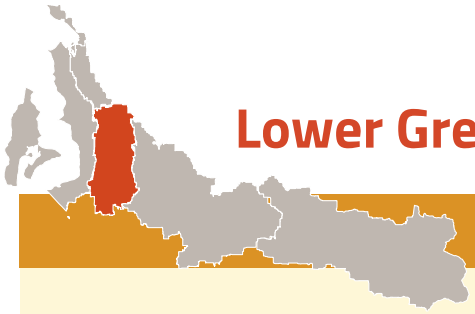
PROJECT DESCRIPTION:

Acquire properties to create a public greenbelt and shallow water and riparian habitat extending from Codiga Park to the Tukwila Community Center.

Table 4

Duwamish Estuary Subwatershed Tier 3 Projects

Proj#	Project Name	Project Type	Project Description		Sponsor	River mile and Bank side/Nearshore jurisdiction	Primary Strategy (pick 1)	Jurisdiction	Goal Alignment
DUW-14	**Duwamish Waterway Park**	• Acquisition • Planning/Design • Restoration • Scoping/Reconnaissance	Acquire adjacent properties, pull back bank armoring, revegetate. incorporate recreational uses.		Seattle Parks and Recreation	RM 3.6/left bank	Protect, restore and enhance marine shorelines;	City of Seattle	Marine riparian vegetation Shoreline armor Shoreline conservation
DUW-19	**Southgate Creek Restoration**	• Other • Planning/Design • Restoration • Acquisition • Scoping/Reconnaissance	This project would improve fish passage, water quality and flooplain/flood-control in Southgate Creek, which is piped and channelized through most of its lower reach; the confuence of the Green would be improved for off-channel, tributary Chinook use. Studies are required.		City of Tukwila	RM 7.90/left bank	Protect, restore and enhance instream flows and cold water refugia	City of Tukwila	DUW - Riparian forest DUW - Shallow water habitat



Lower Green River Subwatershed

45 projects

Tier 1 (Score 18+) 13 projects

LG-3 ..... Horsehead Restoration Project
LG-6 ..... Wrecking Yards Restoration Project
LG-8 ..... Lower Mill Creek Channel Restoration
LG-22 ..... Wetland Floodplain Off-Channel Habitat Reconnection
LG-28 ..... North Green River Park
LG-29 ..... North of Veteran's Drive Floodplain Reconnection
LG-33 ..... Midway Creek Wetland Complex
LG-34 ..... Johnson Creek Floodplain Project
LG-35 ..... P-17 Stormwater Pond Connection
LG-39 ..... Port of Seattle Mitigation Site Floodplain Connection
LG-40 ..... Downey Side Channel Restoration
LG-42 ..... Lower Russell Road: Habitat Area A
LG-45 ..... Teufel Off Channel Habitat Restoration

Tier 2 (Score 7-18) 19 projects

LG-1 ..... Reddington Habitat Creation
LG-5 ..... Northeast Auburn Creek Restoration
LG-7 ..... Mullen Slough
LG-10 ..... Boeing Levee Setback Habitat Rehabilitation
LG-12 ..... Briscoe Park Off-channel Habitat
LG-17 ..... Fort Dent Revetment Setback
LG-18 ..... Black River Marsh
LG-19 ..... Lower Springbrook Reach Rehabilitation
LG-23 ..... 8th Street Bridge to 104th Ave Park Off-Channel Habitat
LG-26 ..... Valentine Revetment Setback
LG-27 ..... 8th Street Acquisitions
LG-30 ..... Mill Creek to Washington Ave Bridge Acquisitions and Restoration
LG-31 ..... South of Veteran's Drive Floodplain Reconnection
LG-32 ..... Foster Park Floodplain Reconnection
LG-37 ..... Strander Boulevard Off-channel Habitat Creation
LG-46 ..... Mill Creek Protection and restoration near Emerald Downs
LG-49 ..... Horseshoe Bend Levee Riparian Habitat Improvements
LG-51 ..... Milwaukee 2 Improvements
LG-55 ..... Frager Road Levee Setback

Tier 3 (Score <7) 13 projects

LG-2 ..... Olson Creek Restoration
LG-15 ..... Nelsen Side Channel
LG-16 ..... Gilliam Creek Fish Passage and Riparian Rehabilitation
LG-20 ..... Riverview Plaza Off-channel Habitat Creation
LG-21 ..... Best Western Revetment Setback
LG-38 ..... Fenster Slough Wetland Connection
LG-43 ..... Panther Creek at East Valley Road Improvement Project
LG-52 ..... Panther Creek at Talbot Road South Fish Passage Improvement
LG-53 ..... Signature Pointe Levee Improvements
LG-54 ..... SR 516 to S 231st Way Levee
LG-56 ..... Kent Airport Levee Setback
LG-57 ..... Barnaby Truong Off-Channel Habitat Creation
LG-58 ..... Briscoe Levee Riparian Habitat Improvements

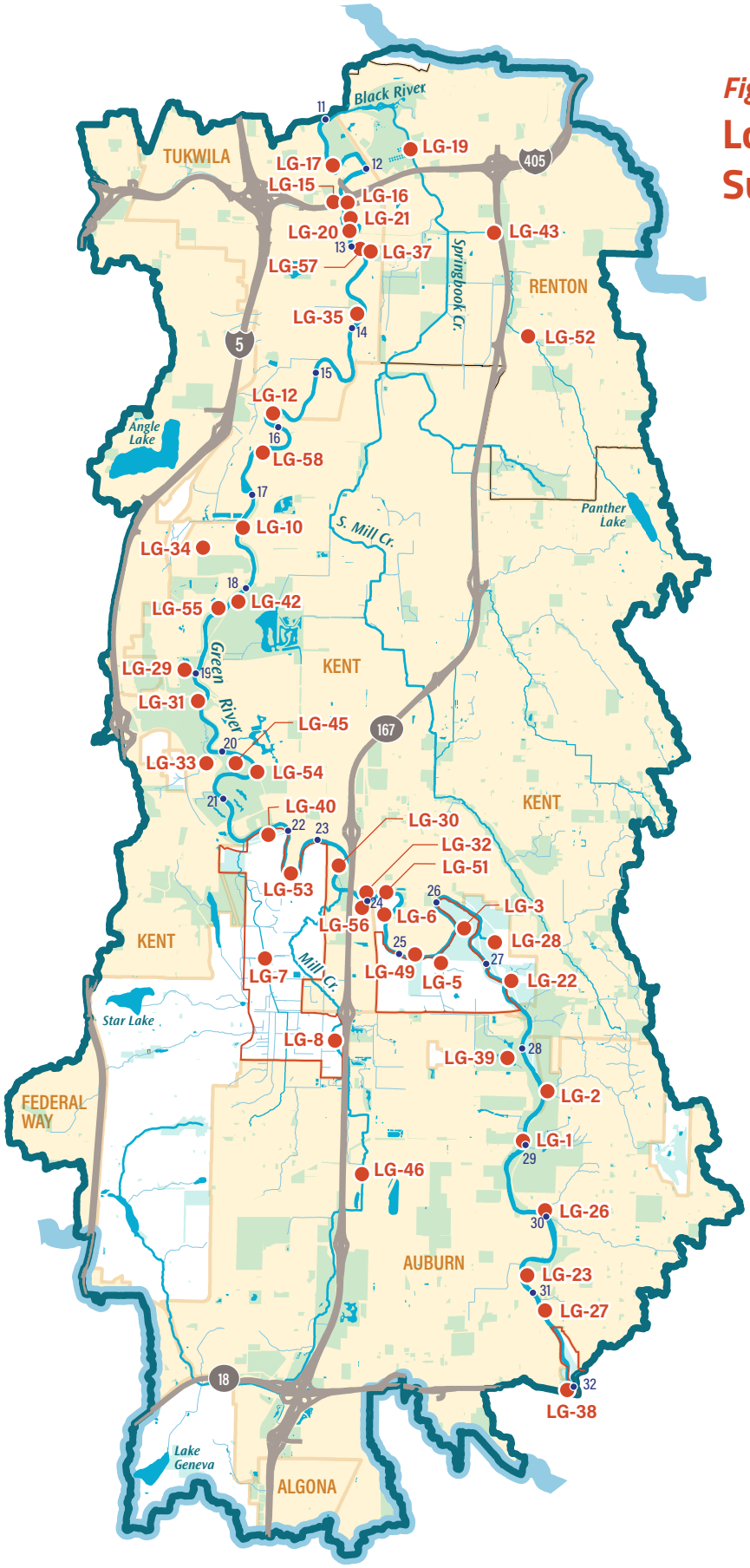


Figure 28.

Lower Green River Subwatershed Projects

Note:
The use of the information in this map is subject to the terms and conditions found at: www.kingcounty.gov/services/gis/Maps/terms-of-use.aspx. Your access and use is conditioned on your acceptance of these terms and conditions.

KCIT-DCE File:
2011_20202L_W9SHP_ProjMap_LGR.ai LPRE

GIS File:
Q:\20009\WRIA9_Watershed.mxd KLINKAT

Tier 1 Project: LG-3

Horsehead Restoration Project

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
25.7 - 26.5 / left bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget: $11,100,000

PROJECT TYPE:

Restoration

KEY HABITAT:

Backwater

Floodplain

Edge

Riparian

PROJECT DESCRIPTION:

Create approximately 13 acres of backwater habitat and revegetate 3,000 feet of river bank.

PROJECT AREA MAP

LOCATION MAP

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- LG - Large woody debris
- LG - Off-channel habitat
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo
VC file: 2010_10202L_W9SHRPfact_HORSEHEAD.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Making Our Watershed Fit For A King

Tier 1 Project: LG-6

Wrecking Yards Restoration

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
24.1 - 24.9 / left bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$37,000,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Backwater

Edge

Floodplain

Riparian

Side channel

Wetland

PROJECT DESCRIPTION:

Acquire, remediate and restore wrecking yards with side channels and backwater features.

PROJECT AREA MAP

LOCATION MAP

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- LG - Off-channel habitat
- LG - Riparian forest

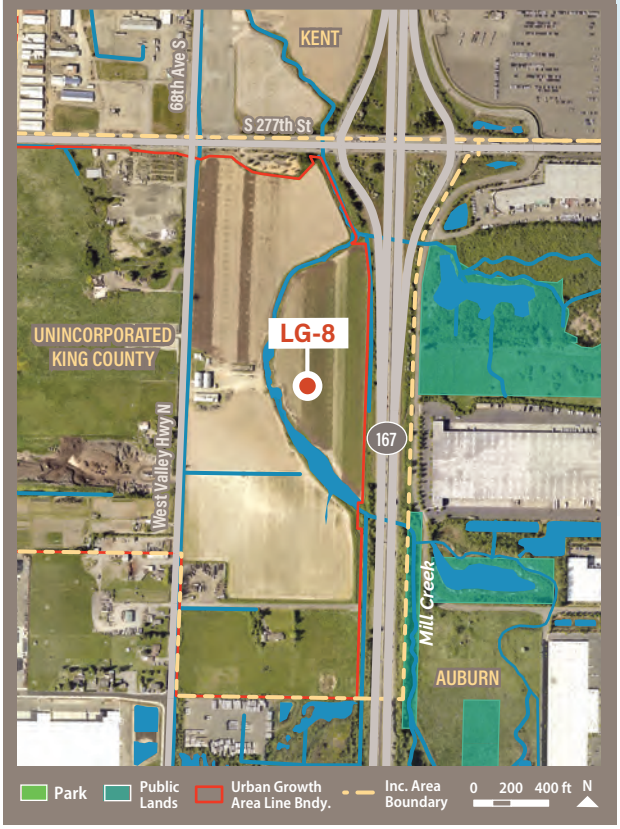
Site Photo: Google Earth Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L_LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-8

Lower Mill Creek Channel Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 23.7/left bank
(Mill Creek 0.3-2.3)

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$23,900,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Tributary

Edge

Floodplain

PROJECT DESCRIPTION:

Improve aquatic habitat by remeandering the tributary channel, revegetating, and adding large wood to the creek channel.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- LG - Large woody debris
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L_LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-22

Wetland Floodplain Off-channel Habitat Reconnection

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
27.2 - 27.6 /
right bank

Jurisdiction:
King County

Project sponsor:
King County

Budget:
$1,165,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Edge

Floodplain

Riparian

Side channel

Tributary

Wetland

PROJECT DESCRIPTION:

Acquire and restore approximately 30 acres of floodplain wetlands and provide access to 2,000 feet of non-natal tributary rearing habitat. Project would address an existing fish barrier at the mouth of the creek and setback 1,800 feet of Green River Road. Project design will need to consider future location of the Green River Trail.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Habitat preservation
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Off-channel habitat
- LG - Riparian forest

Site Photo: Google Earth Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Making Our Watershed Fit For A King

Tier 1 Project: LG-28

North Green River Park

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
26.5 - 27.3 /
right bank

Jurisdiction:
King County

Project sponsor:
King County

Budget:
$17,100,000

PROJECT TYPE:

Acquisition
Restoration

KEY HABITAT:

Backwater
Edge
Floodplain
Riparian
Side channel
Tributary
Wetland

PROJECT DESCRIPTION:

Restore floodplain habitat by removing revetments, restoring reconnecting floodplain wetland, creating side channels and backwater features, and integrating stream channel from the adjacent project (LG-22). Project design will need to preserve or relocate important regional recreational amenities (i.e., soccer fields and Green River access).

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Bank armor
- LG - Off-channel habitat

Site Photo: Google Earth Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L_LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-29

North of Veterans Drive Floodplain

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 18.9 - 19.2/
left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

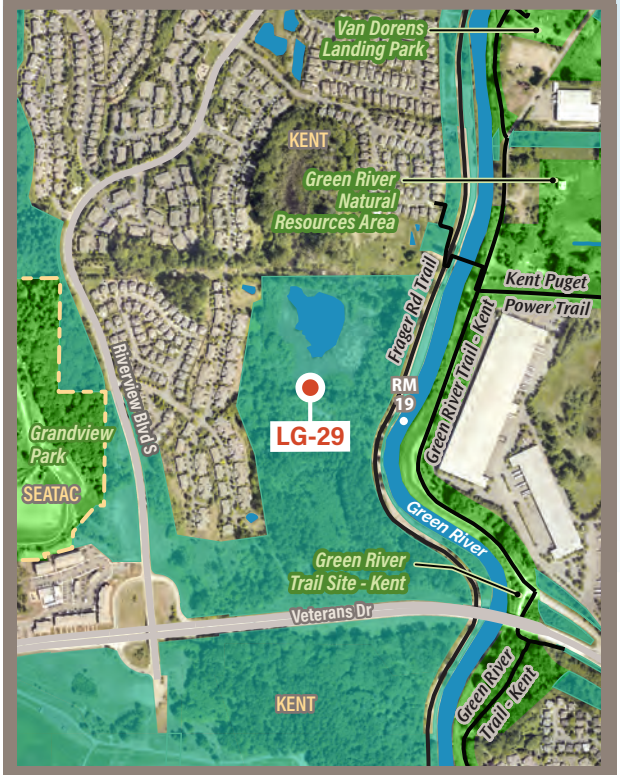
PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration

KEY HABITAT:

- Floodplain
- Riparian
- Wetland

PROJECT AREA MAP



LOCATION MAP

PROJECT DESCRIPTION:

Reconnect floodplain wetland to river, improve wetland area, while preserving Frager Road Trail's connection to the Green River.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Recreation opportunities

Contribution to goals metrics:

- LG - Off-channel habitat

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

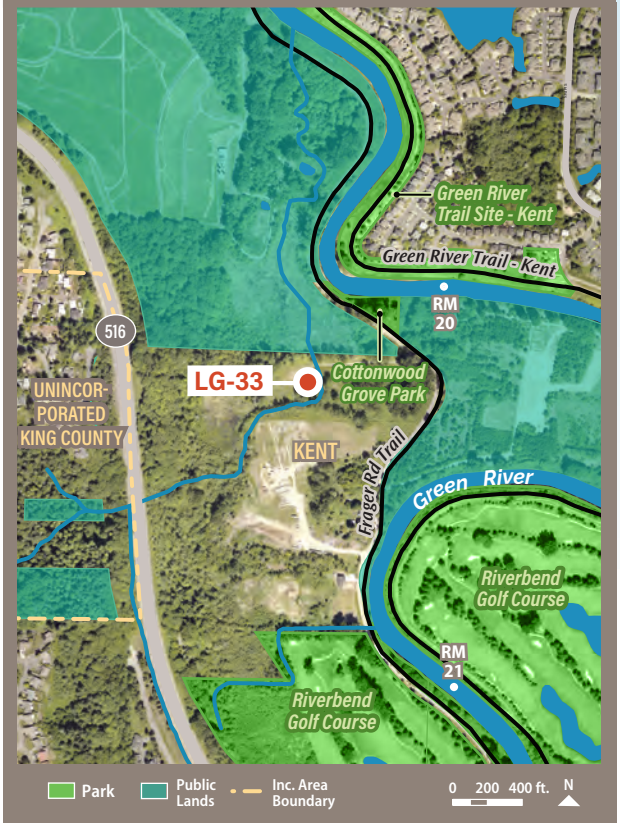
Making Our Watershed Fit For A King

Tier 1 Project: LG-33

Midway Creek Wetland Complex

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 19.6 - 21.1/ left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Acquisition
- Enhancement/ Planting
- Planning/ Design
- Monitoring & Assessment
- Restoration
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Floodplain
- Riparian
- Side channel
- Wetland

PROJECT DESCRIPTION:

Restore Midway Creek and floodplain wetland complex by removing wetland fill and improving fish passage to enhance connectivity between the Midway Creek and the Green River. Project design should maintain/enhance regional trail connectivity.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- LG - Off-channel habitat
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-34

Johnson Creek Floodplain

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 17.2 - 17.8/ left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Education & Outreach
- Enhancement/ Planting
- Monitoring & Assessment
- Planning/ Design
- Restoration

KEY HABITAT:

- Floodplain
- Riparian
- Tributary

PROJECT DESCRIPTION:

Acquire properties, setback road and trail, reconnect floodplain, and create off-channel habitat to improve water quality and increase fish access.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Off-channel habitat
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

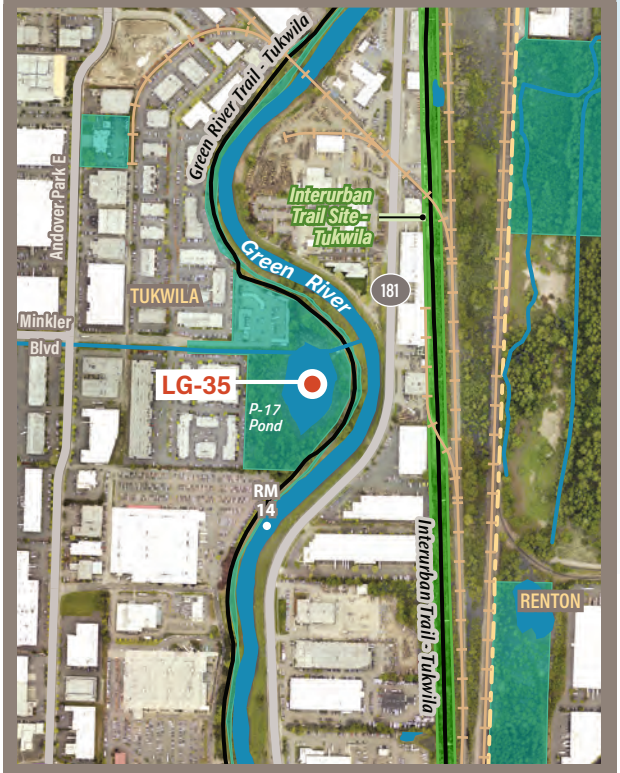
Making Our Watershed Fit For A King

Tier 1 Project: LG-35

P-17 Pond Connection Reconnection

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 13.7- 13.9/
left bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$37,000,000

PROJECT TYPE:

- Acquisition
- Restoration
- Planning/ Design
- Scoping/ Reconnaissance

KEY HABITAT:

- Floodplain
- Riparian
- Side channel

PROJECT DESCRIPTION:

Relocate the City of Tukwila's stormwater pond; clean and connect the existing pond to the river, setback the levee to create up to 7 acres of off channel habitat.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Off-channel habitat

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Making Our Watershed Fit For A King

Tier 1 Project: LG-39

Port of Seattle Mitigation Site Floodplain Connection

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
27.9 - 28.2 / left bank

Jurisdiction:
City of Auburn

Project sponsor:
Port of Seattle

Budget:
TBD

PROJECT TYPE:

Restoration

KEY HABITAT:

Floodplain
Riparian
Backwater
Wetland

PROJECT DESCRIPTION:

Connect the Port of Seattle's existing wetland mitigation site with the 100-year floodplain. Within the ~78 acres of reconnected floodplain, approximately 11 acres would be available as regularly inundated off-channel rearing habitat for Chinook salmon. The Port also owns an adjacent 34 acre site to the west which could support restoration of additional wetland habitat and further enhance floodplain connectivity. Project Design will need to address future Green River Trail alignment around this project area.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Off-channel habitat

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-40

Downey Side Channel Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 21.5 - 22/
left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
$6,800,000

PROJECT TYPE:

Monitoring & Assessment

Restoration

KEY HABITAT:

Side channel

PROJECT DESCRIPTION:

Create network of side channels to provide rearing habitat and increase flood storage capacity, add large wood to create habitat complexity, cover and refuge, and lower peak flood elevations during 100-year flood events.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Large woody debris
- LG - Off-channel habitat
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-42

Lower Russell Road: Habitat Area A

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 17.9 - 18.3/ right bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Monitoring & Assessment
- Restoration

KEY HABITAT:

- Edge
- Floodplain
- Side channel

PROJECT DESCRIPTION:

Create off-channel habitat by grading and reshaping the bank, widening the channel, restoring channel complexity and meanders, excavating low benches, installing large wood, and planting native vegetation.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Large woody debris
- LG - Off-channel habitat
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: LG-45

Teufel Off Channel Habitat Restoration

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
20 - 20.8 /
left bank

Jurisdiction:
Kent

Project sponsor:
King County Flood Control District

Budget:
$12,525,000 - $33,975,000

PROJECT TYPE:

Enhancement/ Planting
Planning/ Design
Restoration

KEY HABITAT:

Backwater
Edge
Floodplain
Riparian
Side channel
Tributary
Upland
Wetland

PROJECT DESCRIPTION:

Restore 36 acres by creating side channel and backwater habitat on a largely undeveloped shoreline in City of Kent.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Flood risk reduction
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

- LG - Large woody debris
- LG - Off-channel habitat
- LG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 2 Project: LG-1

Reddington Habitat Creation

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
28.6 - 28.2 /
left bank

Jurisdiction:
King County

Project sponsor:
King County

Budget:
TBD

PROJECT TYPE:

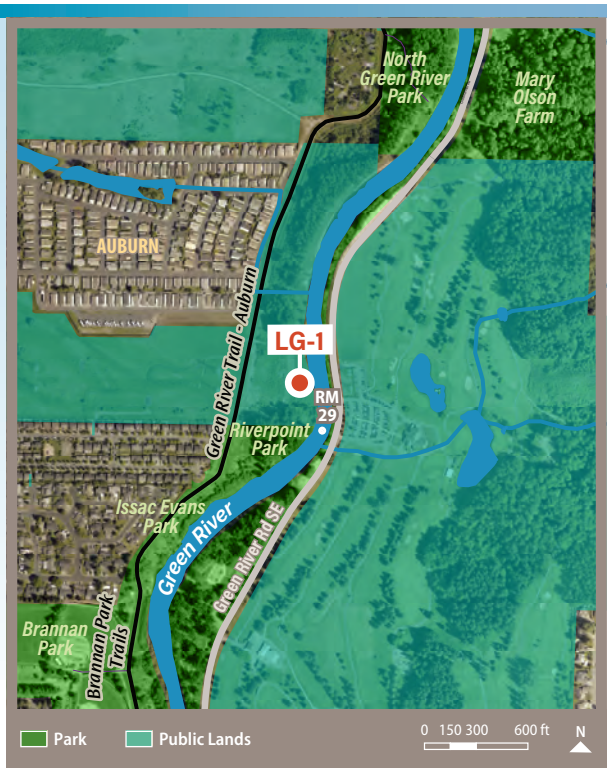
Restoration

KEY HABITAT:

Backwater, Floodplain, Edge, Side Channel

PROJECT DESCRIPTION:

The previous Reddington Levee Setback project was done with a focus on flood risk reduction benefits and left two areas waterward of the levee that have room for side channel and/or backwater type habitats. This project would design and create additional habitat integrated with the existing habitat features on site.



KCIT-DCE VC folder: 2010_10202w_LG-1.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-5

Northeast Auburn Creek Rehabilitation

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
25.3 / left bank

Jurisdiction:
King County

Project sponsor:
King County

Budget:
$5,500,00

PROJECT TYPE:

Restoration

KEY HABITAT:

Edge, Floodplain, Riparian, Tributary, Wetland

PROJECT DESCRIPTION:

Enhance floodplain and stream habitat by creating off channel rearing and high flow refuge habitat for juvenile salmon. Project will improve fish passage, which is currently partially obstructed by a flapgate at the mouth of the creek.

KCIT-DCE VC folder: 2010_10202w_LG-5.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-7

Mullen Slough

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
21.5 / left bank (Mullen Slough 1 - 2)

Jurisdiction:
King County

Project sponsor:
King County

Budget:
$9,600,000

PROJECT TYPE:

- Restoration
- Acquisition

KEY HABITAT:

- Edge
- Floodplain
- Riparian
- Tributary

PROJECT DESCRIPTION:

This project would remeander and revegetate the tributary, increasing quantity and quality of aquatic habitat.

KCIT-DCE VC folder: 2010_10202w_LG-7.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-10

Boeing Levee Setback Habitat Rehabilitation

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
17 - 17.8 / right bank

Jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Restoration
- Scoping/ Reconnaissance

KEY HABITAT:

- Edge
- Floodplain
- Riparian

PROJECT DESCRIPTION:

Balance future habitat, flood protection and recreation on the site. Explore opportunities to add alcove habitat, excavate low benches and alcoves, install large wood, and plant native riparian vegetation, while maintaining/enhancing the recreational trail user experience.

KCIT-DCE VC folder: 2010_10202w_LG-10.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-12

Briscoe Park Off-channel Habitat

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 15.6 - 16.1 / right bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Restoration

KEY HABITAT:

- Edge
- Floodplain
- Riparian

PROJECT DESCRIPTION:

Create off-channel habitat at Briscoe Park by removing bank armor, excavating perched floodplain, installing large wood, and planting riparian vegetation. Project design needs to address potential impacts to recreational amenities at Briscoe Park.

KCIT-DCE VC folder: 2010_10202w_LG-12.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-17

Fort Dent Revetment Setback

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 11 - 11.8 / right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$4,699,000

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Edge
- Floodplain
- Riparian

PROJECT DESCRIPTION:

Setback portions of the Fort Dent revetment to create shallow water habitat, riparian forest, and off-channel habitat.

KCIT-DCE VC folder: 2010_10202w_LG-17.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-18

Black River Marsh

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 11 - 11.8 /
right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$4,699,000

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration
- Acquisition
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Duwamish Marsh
- Duwamish Mudflat
- Edge
- Riparian

PROJECT DESCRIPTION:

Create an island at the confluence of the Black, Green, and Duwamish Rivers, and increase edge habitat, flood storage, and off-channel refuge. Revegetate the shoreline along the Black River up to the Black River Pump Station.

KCIT-DCE VC folder: 2010_10202w_LG-18.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-19

Lower Springbrook Reach Rehabilitation

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 11 /
right bank

Bankside jurisdiction:
City of Renton

Project sponsor:
City of Renton

Budget:
$20,000,000

PROJECT TYPE:

- Monitoring & Assessment
- Planning/ Design
- Restoration
- Acquisition
- Scoping/ Reconnaissance

KEY HABITAT:

- Edge
- Riparian
- Tributary
- Wetland

PROJECT DESCRIPTION:

Improve the aquatic and riparian habitat for Lower Springbrook Creek with riparian plantings, large woody debris, pool construction, channel branch excavation, and potential two-stage channel.

KCIT-DCE VC folder: 2010_10202w_LG-19.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-23

8th Street Bridge to 104th Ave Park Off-Channel Habitat

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 30.4 - 31.1 / right bank

Bankside jurisdiction:
City of Auburn

Project sponsor:
City of Auburn

Budget:
TBD

PROJECT TYPE:

- Acquisition
- Enhancement/ Planting
- Planning/ Design
- Restoration

KEY HABITAT:

- Floodplain
- Riparian
- Side Channel

PROJECT DESCRIPTION:

Acquire private properties and restore off-channel and riparian habitat, including up to 0.25 miles of potential side channel.

KCIT-DCE VC folder: 2010_10202w_LG-23.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-26

Valentine Revetment Setback

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 30.1 - 29.8 / right bank

Bankside jurisdiction:
City of Auburn

Project sponsor:
City of Auburn

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration
- Acquisition

KEY HABITAT:

- Floodplain
- Riparian
- Tributary

PROJECT DESCRIPTION:

Setback the existing revetment and relocate Green River Road to the north, away from the river. Realign the unnamed fish stream into the historic channel and install a fish friendly culvert.

KCIT-DCE VC folder: 2010_10202w_LG-26.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-27

8th Street Acquisitions

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 31.1 - 31.4 / right bank

Bankside jurisdiction:
City of Auburn

Project sponsor:
City of Auburn

Budget:
TBD

PROJECT TYPE:

- Acquisition
- Planning/ Design
- Restoration

KEY HABITAT:

- Floodplain
- Riparian

KCIT-DCE VC folder: 2010_10202w_LG-27.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Acquire properties and restore off-channel and riparian habitat.

Tier 2 Project: LG-30

Mill Creek to Washington Ave Bridge Acquisitions and Restoration

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 23.2- 23.7 / left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Edge
- Floodplain
- Riparian

KCIT-DCE VC folder: 2010_10202w_LG-30.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Acquire left bank properties from Mill Creek (Auburn) to Washington Ave. S. bridge and install native plantings.

Tier 2 Project: LG-31

South of Veterans Drive Floodplain Reconnection

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 19.4 - 19.3 / left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration

KEY HABITAT:

- Floodplain

KCIT-DCE VC folder: 2010_10202w_LG-31.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Create off-channel habitat in small triangle of flat land behind Frager Road.

Tier 2 Project: LG-32

Foster Park Floodplain Reconnection

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 23.9 - 24 / right bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Scoping/ Reconnaissance
- Planning/ Design

KEY HABITAT:

- Edge
- Floodplain
- Riparian

KCIT-DCE VC folder: 2010_10202w_LG-32.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Restore off-channel habitat within the park, while balancing flood protection and recreation.

Tier 2 Project: LG-37

Strander Boulevard Off-Channel Habitat Creation

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 13.1 / right bank

Bankside jurisdiction:
City of Tukwila

Project sponsor:
City of Tukwila

Budget:
$10,000,000

PROJECT TYPE:

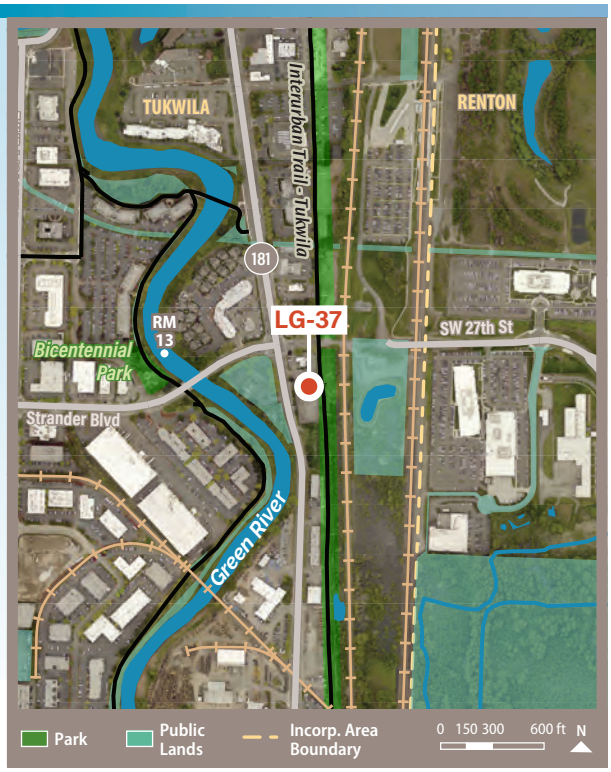
- Planning/ Design
- Scoping/ Reconnaissance

KEY HABITAT:

- Backwater
- Floodplain
- Riparian
- Wetland

PROJECT DESCRIPTION:

This project would connect an isolated wetland area in between two railroad tracks with the river creating floodplain connection and use for salmonid rearing and refugia.



KCIT-DCE VC folder: 2010_10202w_LG-37.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-46

Mill Creek Protection and Restoration Near Emerald Downs

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 23.7 / left bank (Mill Creek RM 3.0 - 4.4)

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
TBD

PROJECT TYPE:

- Restoration
- Acquisition

KEY HABITAT:

- Floodplain
- Riparian
- Tributary
- Wetland

PROJECT DESCRIPTION:

Acquire property and restore creek meander of the existing channel, revegetate the riparian zone and associated wetland habitat, and increase channel capacity to reduce existing flood risks.

KCIT-DCE VC folder: 2010_10202w_LG-46.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-49

Horseshoe Bend Levee Riparian Habitat Improvements

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
24.25 - 26.25 /
right bank

Jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

- Enhancement/ Planting
- Planning/ Design
- Restoration
- Scoping/ Reconnaissance

KEY HABITAT:

- Edge
- Floodplain
- Riparian

PROJECT DESCRIPTION:

Setback levee segments, and install large wood structures along the riverbank to provide salmon habitat.

KCIT-DCE VC folder: 2010_10202w_LG-49.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-51

Milwaukee 2 Improvements

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
24.0 - 24.3 /
left bank

Jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

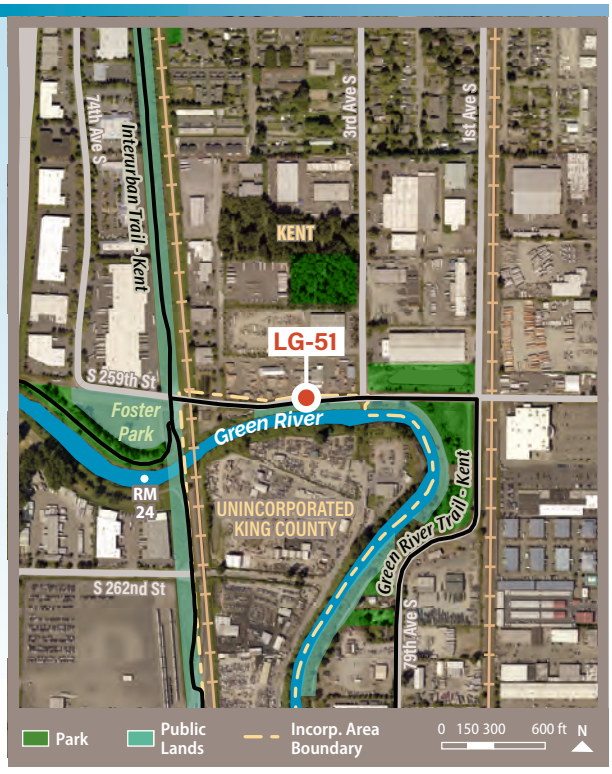
- Enhancement/ Planting
- Planning/ Design
- Restoration
- Acquisition

KEY HABITAT:

- Edge
- Floodplain
- Riparian
- Upland

PROJECT DESCRIPTION:

Excavate a backwater channel, remove all invasive vegetation and hardscape, and replace with native plants and trees. Place large wood within the project area. The project increases rearing and refuge habitat for salmon. The project must balance flood protection and recreation goals, including regional trail improvements.



KCIT-DCE VC folder: 2010_10202w_LG-51.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

Tier 2 Project: LG-55

Frager Road Levee Setback

PROJECT FACTS

Subwatershed:
Lower Green (LG)

River mile:
RM 17.25 - 18.75 / left bank

Bankside jurisdiction:
City of Kent

Project sponsor:
City of Kent

Budget:
TBD

PROJECT TYPE:

Restoration

KEY HABITAT:

Edge

Riparian

KCIT-DCE VC folder: 2010_10202w_LG-55.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

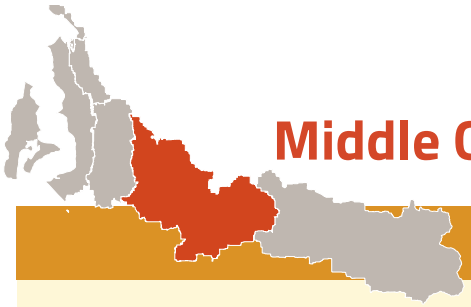
PROJECT DESCRIPTION:

Reconstruct the toe, slope and levee crest to a stable configuration with a fully bioengineered solution, including a vegetated bench.

Table 5

Lower Green River Subwatershed Tier 3 Projects

Proj#	Project Name	Project Type	Description		Sponsor	River mile and Bank side/ Nearshore jurisdiction	Primary Strategy (pick 1)	Jurisdiction	Goal Alignment
LG-2	**Olson Creek Restoration**	Restoration	Improve quality of aquatic habitat through setting back the banks, adding large wood to channel, and expanding riparian vegetation along the creek. Increase amount and quality of flood refuge habitat by reconnecting southern grassy area at lower flows and restoring as a wetland. This project will build off of a KCDOT project to fix the fish passage barrier at the mouth in 2020.		King County	RM 28.4 / right bank	Protect, restore and enhance instream flows and cold water refugia	City of Auburn	LG - Large woody debris LG - Off-channel habitat LG - Riparian Forest
LG-15	**Nelsen Side Channel**	• Acquisition • Enhancement/Planting • Planning/Design • Restoration	This project reconnects a segment of the former river channel that was disconnected with construction of I-405 and rerouting of the river.		City of Tukwila	RM 12.5 /right bank	Protect, restore, and enhance channel complexity and edge habitat	City of Tukwila	LG - Large woody debris LG - Off-channel habitat LG - Riparian Forest
LG-16	**Gilliam Creek Fish Passage and Riparian Rehabilitation**	• Enhancement/Planting • Planning/Design • Restoration	This project will replace a large flapgate that inhibits salmonid usage of the Gilliam Creek tributary, and restore nearly 300 lineal feet of the lowest stretch of Gilliam Creek.		City of Tukwila	RM 12.5 / left bank	Restore and improve fish passage	City of Tukwila	LG - Off-channel habitat
LG-20	**Riverview Plaza Off-channel Habitat Creation**	• Enhancement/Planting • Planning/Design • Restoration	This City-owned parcel once had a modest picnic area for viewing, but those have since been removed. There are several, large cottonwood trees in this low bank area with opportunities to create shallow water habitat while preserving most or all of the trees. It is waterward of the levee and Green River Trail.		City of Tukwila	RM 12.7 / left bank	Protect, restore, and enhance channel complexity and edge habitat	City of Tukwila	LG - Large woody debris LG - Off-channel habitat LG - Riparian Forest
LG-21	**Best Western Revetment Setback**	• Acquisition • Restoration	This project would setback this revetment to the extent possible. There is a hotel 80' landward; setting it back somewhat could create some edge habitat. Should look for opportunities in the event of property redevelopment.		City of Tukwila	RM 12.7 / right bank	Protect, restore and enhance floodplain connectivity	City of Tukwila	1. Off-channel habitat 2. Riparian 3. Large Woody Debris Forest
LG-38	**Fenster Slough Wetland Connection**	• Enhancement/Planting • Planning/Design • Restoration	Reconnect approximately 1/2 acre of wetland area to the Green River that is currently cut off by the Fenster II Levee. The area has the potential to provide backwater/off-channel and riparian habitat functions.		City of Auburn	RM 40 / left bank	Protect, restore and enhance floodplain connectivity	City of Auburn	LG - Off-channel habitat
LG-43	**Panther Creek at East Valley Road Improvement Project**	• Acquisition • Enhancement/Planting • Planning/Design • Restoration	The project is intended to provide daylighting and habitat improvements of Panther Creek from river mile 0.5 to 0.0 and the adjacent East Valley wetlands. This includes improving hydrologic and hydraulic function through repairing and/or replacing the existing culverts at East Valley Road and Lind Ave SW.		City of Renton	RM 1 1 / right bank	Restore and improve fish passage	City of Renton	LG - Off-channel habitat
LG-52	**Panther Creek at Talbot Road South Fish Passage Improvement**	• Acquisition • Other • Planning/Design	The project intends to provide fish passage and improved conveyance through a culvert replacement along Panther Creek at the Talbot Road South culvert.		City of Renton Surface Water Utility	RM 11 / right bank	Restore and improve fish passage	City of Renton	LG - Off-channel habitat
LG-53	**Signature Pointe Levee Improvements**	• Enhancement/Planting • Planning/Design • Restoration • Acquisition	Setback levee segments and slope. Install large wood and native riparian plants. Address potential for recreational impacts of moving the trail further from the river and closer to residential units.		City of Kent	RM 23.15 - 21.75 / left bank	Protect, restore, and enhance channel complexity and edge habitat	City of Kent	LG - Bank Armor LG - Large woody debris LG - Off-channel habitat
LG-54	**SR 516 to S 231st Way Levee**	• Planning • Scoping/ • Reconnaissance	Balance habitat, flood protection, and recreation. Set back existing levee to allow for more flood storage and habitat improvements. These potential improvements include flatter riverbank side slopes, log jams along the river, and increased riparian plantings.		City of Kent	RM 21.75 - 19.2 5/ left bank	Protect, restore and enhance floodplain connectivity	City of Kent	LG - Bank Armor LG - Off-channel habitat LG - Riparian Forest
LG-56	**Kent Airport Levee Setback**	• Planning/Design • Restoration • Acquisition	Setback the levee, incorporate current stormwater pond into riparian buffer, and install native plants.		City of Kent	RM 24.1 - 23. 8/ left bank	Protect, restore, and enhance channel complexity and edge habitat	City of Kent	LG - Riparian Forest
LG-58	**Briscoe Levee Riparian Habitat Improvements**	• Enhancement/Planting • Planning/Design • Restoration	Re-grade side slopes that are overly steep, remove non-native invasive plant species, and plant new native vegetation in areas that have not already been improved. The project also includes installation of large wood structures along the river's edge throughout the length of the levee reach where feasible.		City of Kent	RM 17.0 - 16.1 / right bank	Protect, restore, and enhance channel complexity and edge habitat	City of Kent	LG - Off-Channel Habitat



Middle Green River Subwatershed

14 projects

Tier 1 (Score 18+) 8 projects

MG-3..... Flaming Geyser Floodplain Reconnection

MG-9 ..... Lones Levee Restoration

MG-11..... Turley Levee Setback

MG-13..... Hamakami Levee Setback

MG-19..... Lower Soos Creek Channel Restoration

MG-21..... Whitney Bridge Reach Acquisition and Restoration

MG-24.... Meyer/Imhof Levee Setback

MG-26.... Newuakum Creek Tributary Acquisition and Restoration

Tier 2 (Score 7-18) 5 projects

MG-6 ..... Middle Newaukum Creek Riparian Planting and Large Woody Debris Placement

MG-10..... Burns Creek Restoration

MG-16..... Ray Creek Restoration

MG-20.... Auburn Narrows Floodplain Restoration

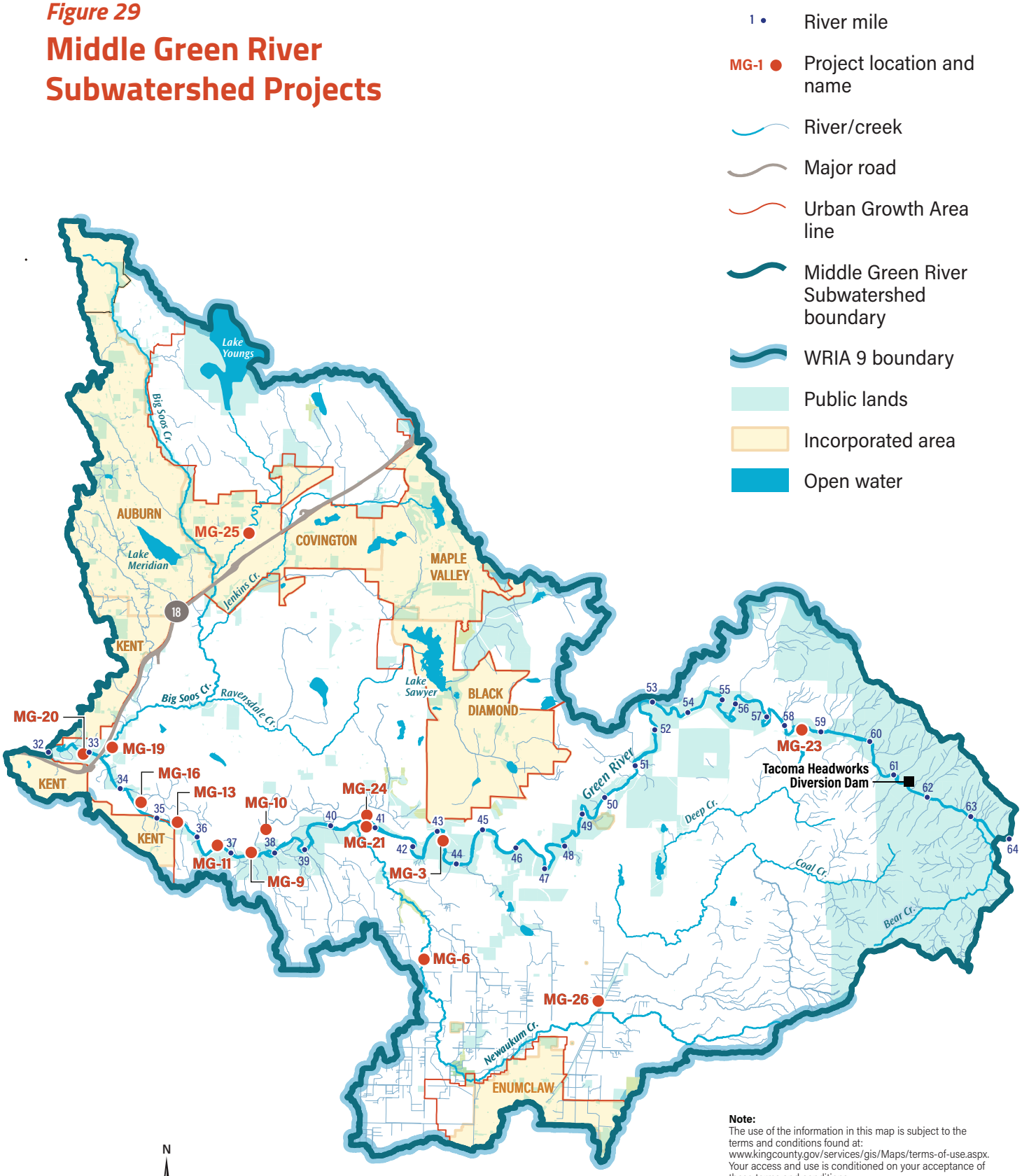
MG-22.... Kanaskat Reach Restoration

Tier 3 (Score <7) 1 project

MG-25.... Little Soos Restoration - Wingfield Neighborhood

Figure 29

Middle Green River Subwatershed Projects



Note:
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KCIT-DCE File:
2011_10202L_W9SHP_ProjMap_MGR.ai LPRE

GIS File:
Q:\20009\WRIA9_Watershed.mxd KLINKAT

Tier 1 Project: MG-3

Flaming Geyser Floodplain Reconnection

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 42-44/both banks

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$6,000,000

PROJECT TYPE:

Planning/ Design

Restoration

KEY HABITAT:

Side channel

Tributary

PROJECT DESCRIPTION:

Remove levee, relocate gravel in the levee under-structure into the river channel, place large wood in river channel and associated wetland, and extensively the revegetate riparian zone throughout state park.

PROJECT AREA MAP

LOCATION MAP

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Water temperature reduction

Contribution to goals metrics:

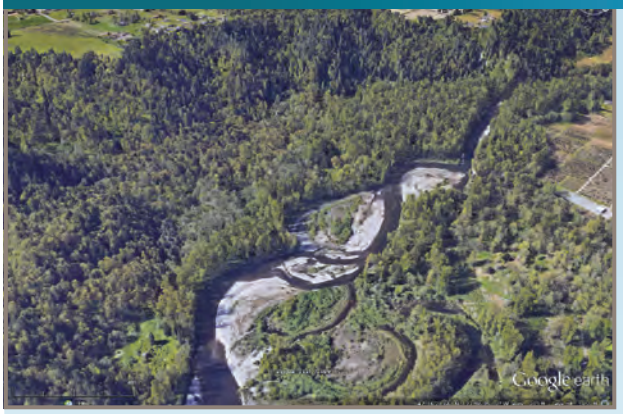
- MG - Bank armor
- MG - Floodplain connectivity/lateral channel migration
- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: MG-9

Lones Levee Restoration

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 38/right bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$5,500,000

PROJECT TYPE:

Restoration

KEY HABITAT:

Backwater, Riparian, Side channel, Tributary, Wetland

PROJECT DESCRIPTION:

Remove existing levee, install setback feature to protect agricultural land, place large wood in river channel and remnant river channel, and reintroduce gravel from remnant levee into river channel.

Primary strategy

Protect, restore and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- MG - Bank armor
- MG - Floodplain connectivity/lateral channel migration
- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: MG-11

Turley Levee Setback

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 37 / left and right bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$6,000,000

PROJECT TYPE:

Acquisition, Restoration

KEY HABITAT:

Backwater, Floodplain, Riparian, Side channel, Tributary, Wetland

PROJECT DESCRIPTION:

Acquire land, remove existing levee, setback new revetment away from river channel, and increase complexity with large wood in river channel and associated wetland.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- MG - Bank armor
- MG - Floodplain connectivity/lateral channel migration
- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: MG-13

Hamakami Levee Setback

Green / Duwamish & Central Puget Sound

PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 35/right bank

Bankside Jurisdiction:
King County

Project sponsor:
King County

Budget:
$6,000,000

PROJECT TYPE:

Acquisition
Restoration

KEY HABITAT:

Backwater
Riparian
Side channel
Tributary
Wetland

PROJECT DESCRIPTION:

Acquire land, remove levee, relocate gravel in the levee under-structure into the river channel, construct revetment away from river, and place large wood in river channel and associated wetland.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

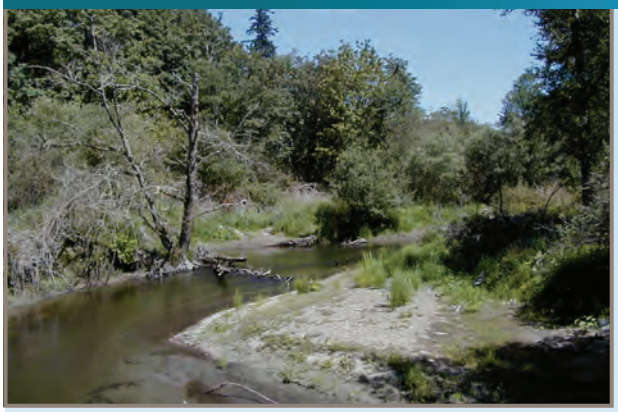
- MG - Bank armor
- MG - Floodplain connectivity/lateral channel migration
- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: MG-19

Lower Soos Creek Channel Restoration

Green / Duwamish & Central Puget Sound



PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 33.3/right bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$1,500,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Riparian

Side channel

Tributary

Wetland

PROJECT DESCRIPTION:

Restore habitat and increased water quality with placement of large trees in streams and associated wetlands, and plant native trees and shrubs along riparian edge.

PROJECT AREA MAP

LOCATION MAP

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Water temperature reduction

Contribution to goals metrics:

- MG - Large woody debris
- MG - Riparian forest

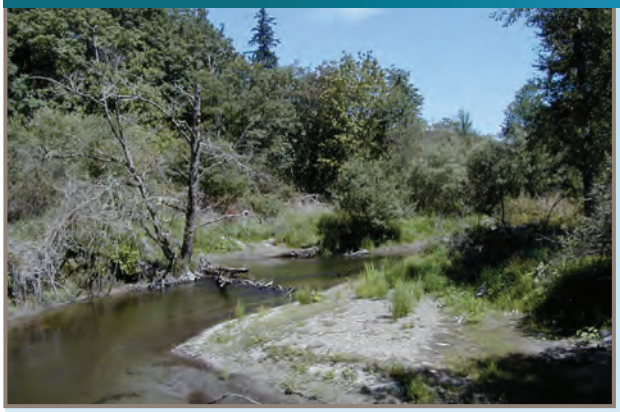
Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Making Our Watershed Fit For A King

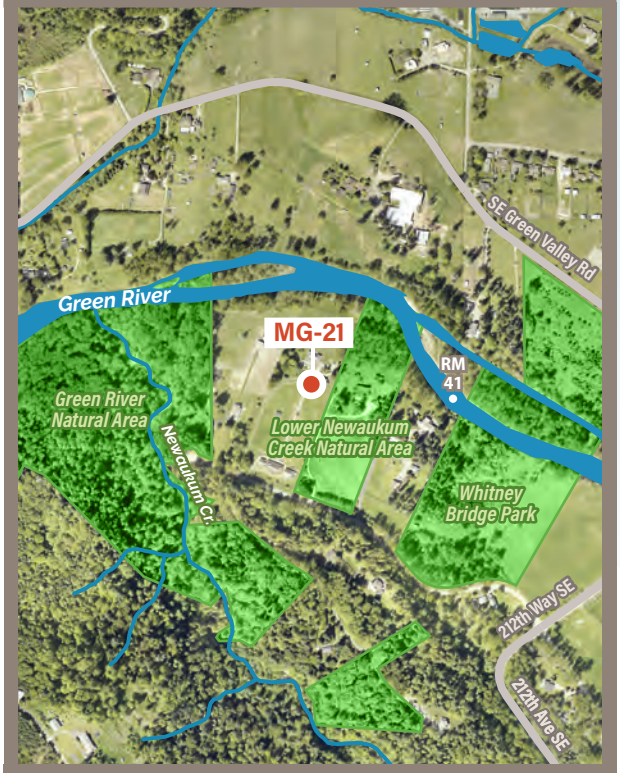
Tier 1 Project: MG-21

Whitney Bridge Reach Acquisition and Restoration

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP



LOCATION MAP

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
41 / left and right bank

Jurisdiction:
King County

Project sponsor:
King County

Budget:
TBD

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Floodplain

Riparian

PROJECT DESCRIPTION:

Acquire approximately 40 acres, and install several hundred pieces are large wood on ~3,500 lineal feet of river.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Habitat preservation
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

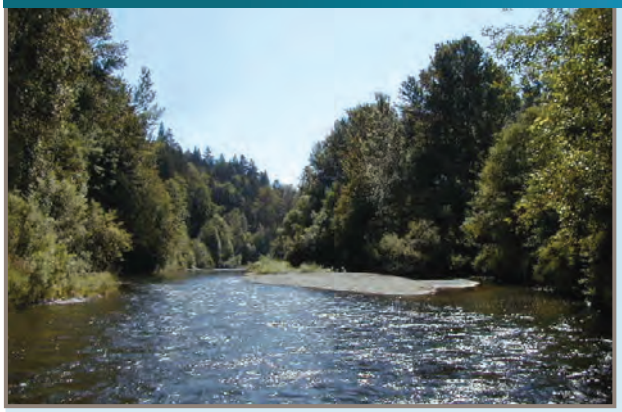
- MG - Floodplain connectivity/lateral channel migration
- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: MG-24

Meyer/Imhof Levee Setback

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
40.5 - 41.5 / right bank

Jurisdiction:
King County

Project sponsor:
King County

Budget:
$1,500,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Floodplain

Riparian

Wetland

PROJECT DESCRIPTION:

Acquire land, remove levee, construct set-back structure away from the River, add wood to floodway, and revegetate with native plants.

Primary strategy

Protect, restore, and enhance floodplain connectivity.

Benefits:

- Habitat preservation
- Increased habitat connectivity
- Increased rearing habitat

Contribution to goals metrics:

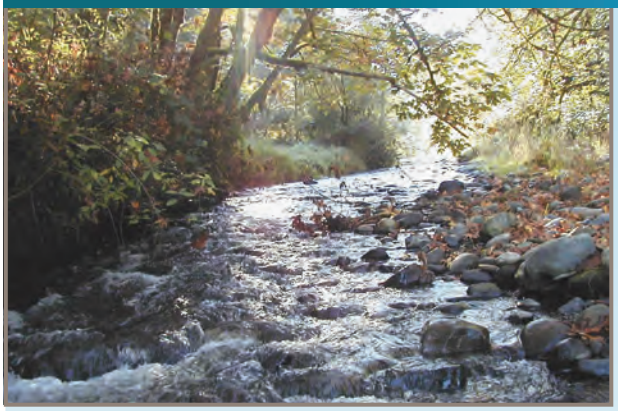
- MG - Bank armor
- MG - Floodplain connectivity/lateral channel migration
- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 1 Project: MG-26

Newuakum Creek Tributary Acquisition

Green / Duwamish & Central Puget Sound



PROJECT AREA MAP

LOCATION MAP

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 40.4/left bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$3,500,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Riparian

Side channel

Tributary

Wetland

PROJECT DESCRIPTION:

Restore habitat and improve water quality with placement of large wood in the stream channel and associated wetlands, revegetating the riparian area.

Primary strategy

Protect, restore, and enhance channel complexity and edge habitat.

Benefits:

- Habitat preservation
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- MG - Large woody debris
- MG - Riparian forest

Project Area Map: Ortho2019KCNAT aerial photo
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Tier 2 Project: MG-6

Middle Newaukum Creek Riparian Planting and Large Woody Debris Placement

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 40 / left bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$2,500,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Riparian
- Side Channel
- Tributary
- Wetland

KCIT-DCE VC folder: 2010_10202w_MG-6.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Place large wood in the stream channel between RM 6 - 10 and remove hardened streambanks.

Tier 2 Project: MG-10

Burns Creek Restoration

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 33 / right bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$1,500,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Floodplain
- Riparian
- Tributary
- Wetland

KCIT-DCE VC folder: 2010_10202w_MG-10.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:

Restore lower two miles of Burns Creek by acquiring several parcels or portions of parcels, place large trees with rootwads attached in streams and associated wetlands, plant native trees and shrubs to significantly improve fish and wildlife habitat, wetlands, and water quality in an area which is very important for over-wintering salmon.

Tier 2 Project: MG-16

Ray Creek Restoration

PROJECT FACTS

Subwatershed:
Middle Green (MG)

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$1,500,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Floodplain
- Riparian
- Tributary
- Wetland

KCIT-DCE VC folder: 2010_10202w_MG-16.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:
Acquire several conservation easements of at least 100' buffers, place large wood in stream, and plant native trees and shrubs in riparian buffer. Build fencing for livestock exclusion to immediately improve of fish and wildlife habitat, wetlands, water quality in a degraded area.

Tier 2 Project: MG-20

Auburn Narrows Floodplain Restoration

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 33 / left bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$350,000

PROJECT TYPE:

- Acquisition
- Restoration

KEY HABITAT:

- Floodplain
- Riparian
- Wetland

KCIT-DCE VC folder: 2010_10202w_MG-20.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:
Remove gravel road in floodway, expand notch of previously-constructed side channel, add large wood, and plant native vegetation.

Tier 2 Project: MG-22

Kanaskat Reach Restoration

PROJECT FACTS

Subwatershed:
Middle Green (MG)

River mile:
RM 59 / left bank

Bankside jurisdiction:
King County

Project sponsor:
King County

Budget:
$600,000

PROJECT TYPE:

Acquisition

Restoration

KEY HABITAT:

Riparian

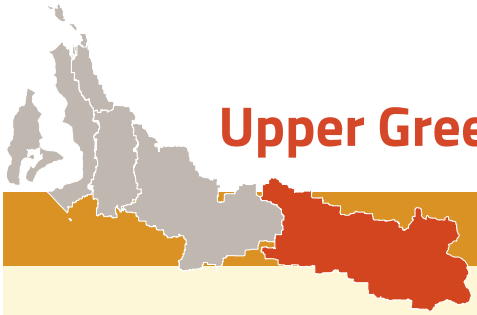
KCIT-DCE VC folder: 2010_10202w_MG-22.ai GIS file Q:\20009\WRIA9_ProjectMaps.mxd

PROJECT DESCRIPTION:
Acquire about 3.5 acres, remove large house/garage/ septic, convert 3,300 lineal foot gravel road to backcountry trail, and extensively revegetate site.

Table 6

Middle Green River Subwatershed Tier 3 Projects

Proj. No.	Project Name	Project Type	Project Description		Sponsor	River mile and Bank side/Nearshore jurisdiction	Primary Strategy (pick 1)	Jurisdiction	Goal alignment
MG-25	**Little Soos Restoration - Wingfield Neighborhood**	• Education and outreach • Planning/design • Restoration • Scoping/reconnaissance	Little Soos Creek at stream mile 1 runs through City of Covington owned open space through the Coho Creek development. The stream historically has been armored, disconnected from its floodplain and a paved trail adjacent to the creek is often flooded in the winter. There is an opportunity to restore in stream and floodplain habitat in the stream through reconnecting the creek to its floodplain, restoring side channels, removing artificial armoring, adding large wood, and revegetating the riparian zone.		Mid Sound Fisheries Enhancement Group	RM 33.3/right bank	Protect, restore, and enhance riparian corridors;	City of Covington	• MG - Floodplain connectivity/lateral channel migration • MG - Riparian forest



Upper Green River Subwatershed

1 project

Tier 1 (Score 18+) 1 project

UG-4 ..... Howard Hanson Downstream Fish Passage

Figure 30

Upper Green River Subwatershed Projects

1 • River mile

UG-1 ● Project location and name

River/creek

Major road

Urban Growth Area line

King County boundary

Upper Green River Subwatershed boundary

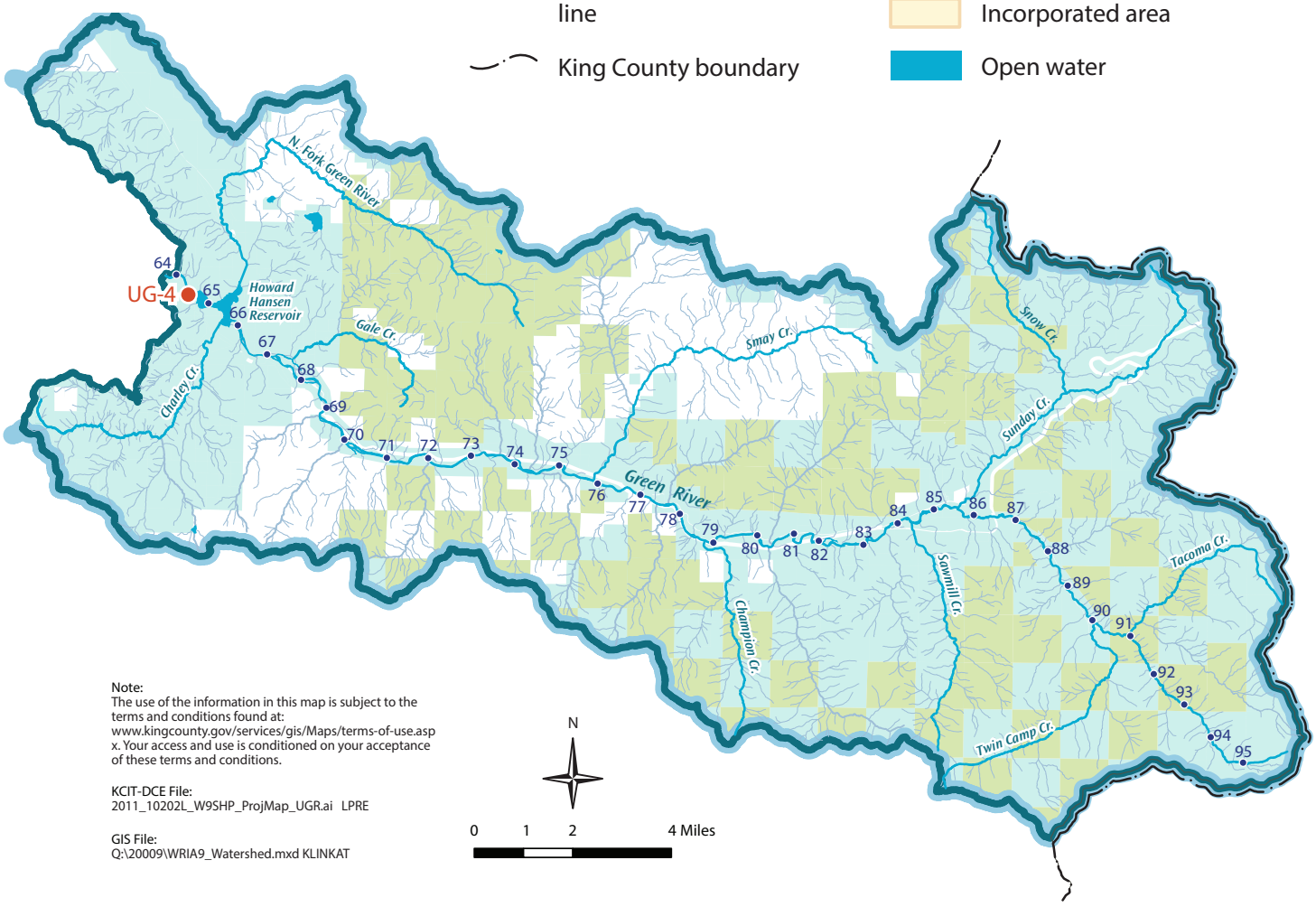
WRIA 9 boundary

Public lands

Parks

Incorporated area

Open water



Note:
The use of the information in this map is subject to the terms and conditions found at: www.kingcounty.gov/services/gis/Maps/terms-of-use.aspx. Your access and use is conditioned on your acceptance of these terms and conditions.

KCIT-DCE File:
2011_10202L_W9SHP_ProjMap_UGR.ai LPRE

GIS File:
Q:\20009\WRIA9_Watershed.mxd KLINKAT

Tier 1 Project: UG-4

Howard Hanson Downstream Fish Passage

Green / Duwamish & Central Puget Sound

PROJECT FACTS

Subwatershed:
Upper Green (UG)

River mile:
King County (RM 64)

Bankside jurisdiction:
King County

Project sponsor:
King County/Army Corps of Engineers

Budget:
Unknown

PROJECT TYPE:

Planning/ Design

Scoping/ Reconnaissance

KEY HABITAT:

Edge

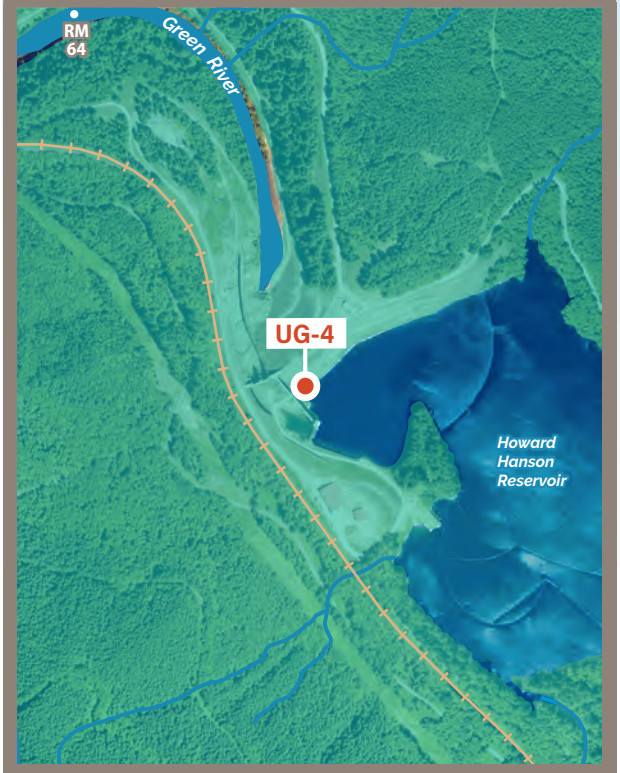
Riparian

Side channel

Tributary

Upland

PROJECT AREA MAP



LOCATION MAP

PROJECT DESCRIPTION:

Creation of downstream fish passage at the Howard Hanson dam is the highest priority project within the Green/Duwamish watershed as it would have an immediate and dramatic impact on all Viable Salmonid Population (VSP) parameters of Chinook and steelhead.

Primary strategy

Restore and improve fish passage.

Benefits:

- Increased habitat connectivity
- Increased rearing habitat
- Water temperature reduction

Contribution to goals metrics:

- UG - Bank armor

Project Area Map: Ortho2019KCNAT aerial photo Site photo: Google Earth
KCIT-DCE file: 2011_10202L LPRE GIS file Q:\20009\WRIA9_ProjectMaps.mxd KLINKAT

Chapter 8: Implementation Strategy

There are three major funding sources that support implementation of the projects and programs prioritized within the Salmon Habitat Plan – Salmon Recovery Funding Board (SRFB), Puget Sound Acquisition and Restoration Fund (PSAR), and King County Flood Control District Cooperative Watershed Management (CWM) grants. The WRIA also supports project sponsors in seeking funding from various other local, state and federal sources.

Annual Funding Package

WRIA 9 develops an annual funding package of projects based on anticipated allocations. The proposed funding package is reviewed and approved by the WRIA 9 Implementation and Technical Committee (ITC) and Watershed Ecosystem Forum (WEF). This funding package serves as the WRIA 9 Lead Entity's habitat project list, as defined in RCW 77.85.050.

Several factors are considered when building the annual project list for funding. Primarily, the WRIA supports projects from the list that demonstrate readiness to proceed and have a high likelihood of success, and where WRIA funding is critical to moving the project forward. Project tiering (Chapter VII) will assist the ITC and WEF in making tough funding choices when there are more projects in need than funding available. Project planning efforts with partners have allowed the WRIA to project out-year project funding needs which provides time to anticipate funding shortfalls and seek outside support. This long-term planning effort also allows sponsors to align salmon projects with other jurisdictional priorities, like those within their jurisdiction's Capital Improvement Plans and Transportation Improvement Plans, as well as realistically phase large projects that span multiple years.

Yearly, project sponsors assess the status of their projects and funding needs and notify the WRIA 9 Habitat Project Coordinator of their intent to apply for WRIA funding, and for how much. Projects undergo a technical review by WRIA staff and the ITC. For those projects competing for SRFB funding, projects undergo an additional rigorous technical review by the SRFB review panel.

Salmon Recovery Funding

Salmon Recovery Funding Board (SRFB) funding is administered through the Recreation and Conservation Office (RCO). It is a fund source of combined state salmon funds and federal Pacific Coast Salmon Recovery Funding (PCSRF). This annual fund is allocated by a SRFB approved interim allocation formula based in NOAA's Chinook delisting criteria. For several years, the Green/Duwamish watershed has received $295,895 annually to support implementation of the Plan.

Puget Sound Acquisition and Restoration Fund (PSAR) is co-managed by the Puget Sound Partnership and the RCO. This is a Puget Sound specific fund source appropriated through the State budget process, within RCO's budget request. In 2007, Governor Christine Gregoire formed PSAR in direct response to the growing need to restore habitat for salmon and other wildlife within Puget Sound. The Green/Duwamish has received just over $1.1 million biennially to support implementation of the Plan. RCO serves as the fiduciary for both PSAR and SRFB funding, so all projects funded through SRFB and PSAR are reviewed and approved through the SRFB process.

King County Flood Control District Cooperative Watershed Management Funds (CWM) are provided by the King County Flood Control district (KCFCD). The KCFCD is a special purpose government created to provide funding and policy oversight for flood protection projects and programs in King County. Funding for CWM is a small portion of the tax assessment to support salmon recovery projects within the four WRIAs in King County. In 2020, CWM funding was doubled, and WRIA 9 now receives $3.63 million annually to support high priority projects and programs. The FCD approves project lists annually.

Other Local, State and Federal Funding Sources – In addition to these funding programs, sponsors are encouraged to compete for other local, state and federal funds. It typically takes multiple funding sources to implement projects due to project complexity and cost. Many projects are initiated with and sustained by local funding provided by the sponsoring jurisdiction. Other state and regional grant programs that support salmon recovery include, but are not limited to, the Estuary and Salmon Restoration Program (ESRP), Floodplains by Design (FbD), Brian Abbott Fish Barrier Removal Board (FBRB), Aquatic Lands Enhancement Account (ALEA), and Washington Wildlife and Recreation Program (WWRP). Additionally, many of the projects within King County are supported through the County's Conservation Futures Tax (CFT), a program passed by the Washington State Legislature in the 1970s to ensure citizens have are afforded the right to a healthy and pleasant environment. This fund specifically protects urban parks and greenways, watersheds, working forests, and salmon habitat as well as critical links connecting regional trails and urban greenbelts.

WRIA 9 CWM Funding Allocation

High-Priority Capital Projects – CWM funding (> 65%) and all SRFB/PSAR capital funding. The WRIA invests the majority of annual funding on high priority capital projects that protect and restore critical habitats. These projects are identified through planning efforts like the Duwamish Blueprint, Middle Green Blueprint, and the Lower Green River Corridor planning process. More recently, projects incorporated in this Plan Update were solicited from partner organizations.

Regreen the Green small grant program - Up to $500,000 of CWM funding. This grant program originated in 2016 after the completion of the "Re-Green the Green Revegetation Strategy" to support implementation of the priority sites identified in the plan. It has served as a primary source of funding to those focusing on revegetation efforts along critical areas in the Green/Duwamish. Additionally, this program has supported successful coalition building, landowner outreach campaigns, and network development that helps achieve broader Plan engagement goals.

Monitoring, Research and Adaptive Management – Up to 10% of CWM funding. This funding is essential to informing adaptive management and maximizing return on investment with respect to salmon recovery. This funding allocation also supports the Green River smolt trap managed by Washington Department of Fish and Wildlife.

Stewardship, Engagement and Learning – Up to 5% of CWM funding. This funding supports Stewardship, Engagement and Outreach efforts designed to increase awareness around salmon recovery and promote positive behavior change.

Outyear Project Planning (6-year HCPIP)

WRIA 9 maintains a Habitat Capital Project Implementation Plan (HCPIP) that identifies all projects with expected funding needs for three biennium (6 years). While these numbers are estimates they provide a sense of the magnitude of funding needed per year. This implementation plan supports staff in working with partners to properly sequence and support projects throughout the project life cycle, and to seek out additional funding to compliment WRIA directed funds. In many cases, WRIA directed funding sources are inadequate to support the full scope of a project but enable project sponsors to leverage other local, state and federal funds. The HCPIP will be updated annually based on evolving project needs, and will be published beinnially along with a call for projects.

To ensure projects acquire, restore, rehabilitate, or create the type and amount of habitat that they was described in the original project description for the 2020 Salmon Habitat Plan capital project solicitation (or subsequent calls for projects), project sponsors will be required present to the ITC or project workgroup (below) for at least one of the significant milestones of the project design process.

This team will support ranking and tiering of any new proposed large capital restoration projects and provide input on design for WRIA funded projects.

Performance Management

Projects receiving funding through grants directed by WRIA 9 are often subject to various pressures from other local, state, and regional funders, stakeholders, and interested parties during project development. In order to make sure projects acquire, restore, rehabilitate, or create the type and amount of habitat that they described in the projects original description for the Salmon Habitat Plan, project sponsors will be required to present to the ITC or project workgroup (below) for at least one of the significant milestones of the project design process. For very large projects that will likely seek PSAR Large Capital funding, or large-scale complex projects with multiple objectives, the WRIA may request sponsor design teams include a WRIA technical representative to support WRIA 9 salmon recovery project priorities.

An ad hoc project workgroup will be established to support elements of project development, made up of three to five members of the ITC. This team will rank and tier newly proposed large capital restoration projects and provide input on design for WRIA-funded projects. The goal of this workgroup would be to provide feedback that will maximize salmon benefits, incorporate lessons learned from previous projects, ensure projects meet the highest possible outcomes for salmon, and help reduce project costs by addressing issues early in design.

It is anticipated that project sponsors will work with the Habitat Project Coordinator to present to the project workgroup or the ITC as follows, or if major changes/updates were made to the design:

1. Alternatives analysis - Project Workgroup
2. 30% design - Full ITC
3. 90% design - Full ITC

Project sponsors are expected to maintain fidelity to the original habitat deliverables. Naturally projects will evolve as more is learned about project design and feasibility. The project sponsor is responsible for alerting the WRIA if substantive modifications to the original scope are required. Modifications to the scope of the project may invoke a full project team review to affirm the project tier and may require subsequent approval from the ITC or WEF. Failure to notify the WRIA of these changes, or use of funding outside of the approved scope, could result in the withholding of future funding or constitute a breach of contract.

Chapter 9:
Monitoring and Adaptive Management

Adaptive Management Framework

The 2005 Salmon Habitat Plan outlined a science-based blueprint for prioritizing Chinook salmon recovery efforts in the Green/Duwamish and Central Puget Sound Watershed. This Plan Update reflects an ongoing commitment to adaptive management to ensure prioritization and sequencing of investments reflect best available science and maximize benefits to Chinook salmon, in terms of established viable salmon population criteria. WRIA 9 convenes a regular Implementation and Technical Committee (ITC) to oversee monitoring and adaptive management of the Salmon Habitat Plan. The ITC informs monitoring priorities, evaluates plan implementation and recovery progress, and makes formal policy and funding recommendations to the Watershed Ecosystem Forum.

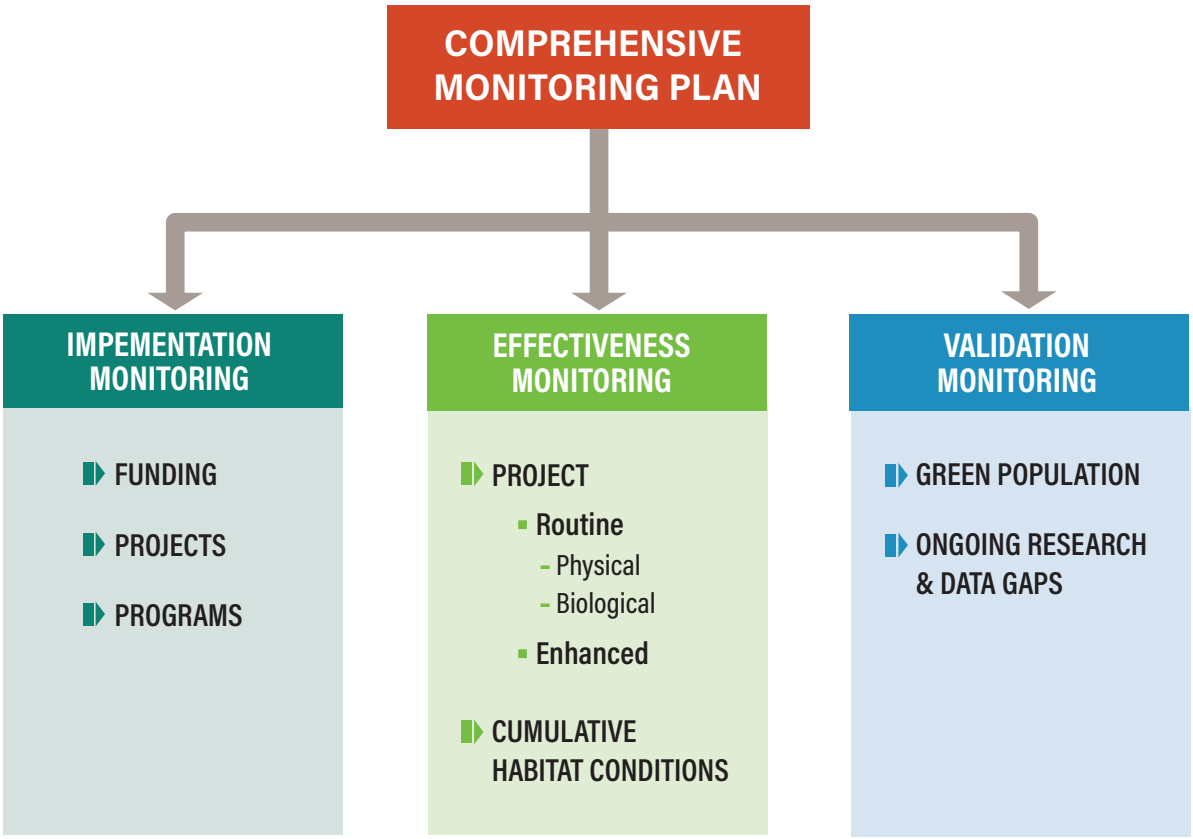
In 2020, WRIA 9 developed a Monitoring and Adaptive Management Plan (Appendix F) that outlines a framework to:

- Prioritize research and monitoring investments to address important data and knowledge gaps;
- Support status and trends monitoring to assess established habitat-related recovery goals and viable salmon population metrics;
- Promote collaboration among partners engaged in research and monitoring within the watershed; and
- Guide adaptive management of the Salmon Habitat Plan.

The WRIA 9 Monitoring and Adaptive Management Plan (MAMP) outlines three categories of monitoring intended to help evaluate and inform strategic adaptation of recovery efforts (Figure 31). Each category of monitoring is intended to answer underlying questions related to implementation progress, effectiveness of actions, and overall impact on Chinook recovery.

- **Implementation Monitoring:** Is the plan being implemented as intended? Are we on track to meet established habitat targets?
- **Effectiveness Monitoring:** Are habitat projects functioning as expected? Are habitat status and trends improving throughout the watershed?
- **Validation Monitoring:** Are salmon recovery efforts benefiting the Green River Chinook salmon population (i.e., VSP criteria)? Are the underlying scientific assumptions of the plan accurate?

Figure 31. *Types of monitoring used to evaluate management strategies and adapt them as necessary.*



Periodic assessment of these questions allows watershed partners to reassess plan implementation, underlying recovery strategies, and/or reallocate resources to maximize outcomes.

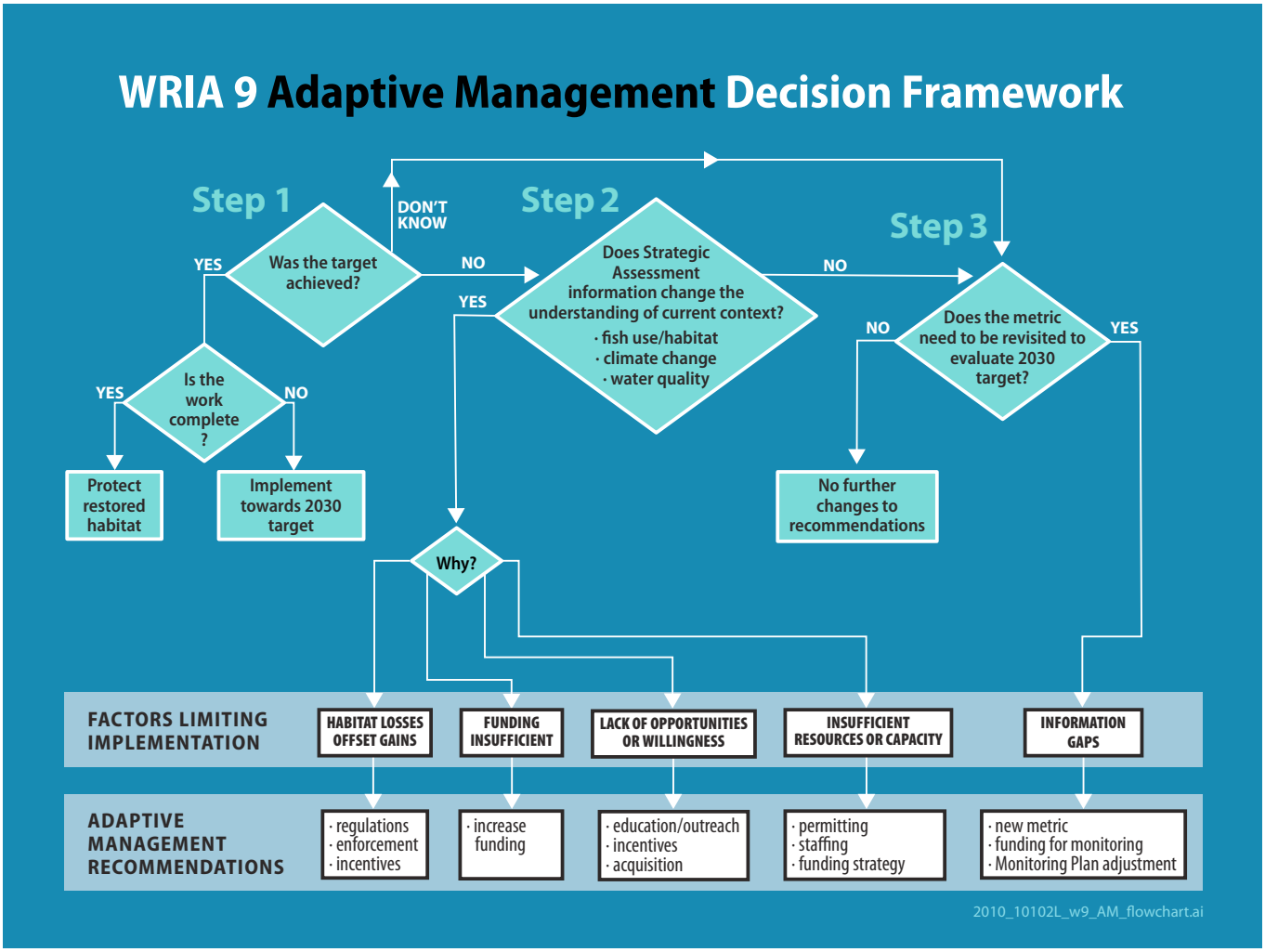
Implementation Monitoring

The Plan Update outlines numeric targets for key habitats (Table 2, Chapter IV) linked to Chinook salmon productivity and recovery. The targets are intended to inform tracking and assessment of plan implementation (i.e., projects constructed, specific habitat gains, funding secured) in relation to established long-term goals. Regular evaluation of implementation progress feeds into an adaptive management decision framework (Figure 32). This framework connects decision makers (i.e., Watershed Ecosystem Forum) with important monitoring and research findings, informing corrective actions to recovery strategies when necessary.

Effectiveness Monitoring

Effectiveness monitoring is designed to assess if habitat restoration projects are functioning as intended and achieving physical and biological performance standards. It includes both project-level and cumulative habitat conditions. Capital habitat project implementation can take over a decade from conceptual design to construction and costs millions of dollars. Effectiveness monitoring is essential to ensure large capital investments maximize benefits to salmon and help identify potential design improvements and cost efficiencies that can be adapted into future projects.

Figure 32. *Adaptive management decision framework.*



Routine Monitoring

Routine project effectiveness monitoring evaluates whether restored habitat is functioning the way it was intended 3-10 years after the project is built. Project specific monitoring plans should be designed to assess project-specific goals and objectives. Project sponsors are encouraged to begin development of a monitoring plan at the project's 30 percent design milestone to allow for pre-project monitoring that can be essential for verifying if future changes are due to the project's actions or natural variability. The MAMP (Appendix F, Table 2) outlines routine physical and biological monitoring recommendations based on project type and subtype. The highlighted indicators and metrics are designed to be relatively affordable and consistent with regulatory permit monitoring requirements. Project sponsors are generally expected to undertake routine monitoring for WRIA-funded projects and report monitoring results to the ITC.

Enhanced Fish Monitoring

Enhanced monitoring is focused on understanding how fish use a restoration project type. Unlike routine project monitoring, which asks whether a certain type of habitat was created and sustained, enhanced monitoring is meant to evaluate how fish utilize the habitat, and which restoration techniques convey the most benefit. Projects should be evaluated with a combination of Before-After Control-Impact or reference/control sites research designs. Enhanced fish monitoring is outside the scope of monitoring for many project sponsors, nor is it frequently required by regulatory agencies. Due to the costs associated with enhanced monitoring, WRIA 9 intends to continue to financially support enhanced fish monitoring of select projects. The MAMP (Appendix F, Table 3) also outlines a prioritization framework (certainty of benefit, process-based vs. engineered design, project type frequency, and project cost) for WRIA-directed invest-

ments to support enhanced monitoring. Monitoring results should be reported to the ITC and inform necessary maintenance and/or design modifications.

Cumulative Habitat Conditions

The Salmon Habitat Plan outlines a suite of projects, programs, and policies intended to improve cumulative habitat conditions across the watershed. Monitoring status and trends in cumulative habitat conditions allows us to assess the overall effectiveness of plan implementation. It provides data on the net change (improving, no change, degrading) in specific habitat conditions over time that supports evaluation of habitat restoration in relation to ongoing impacts to, and loss of, habitat. This information will help identity any gaps in the watershed's approach to salmon recovery and help (re)direct partner resources to potential areas of concern. The MAMP (Appendix F, Table 4) outlines priority habitat metrics recommended for inclusion as part of a periodic cumulative habitat assessment that are consistent with the WRIA 9 Status and Trends Report 2005-2011 (ITC 2012). The WRIA 9 ITC should complete a cumulative habitat conditions every five years.

Validation Monitoring

Viable Salmon Population Criteria

The National Oceanic and Atmospheric Administration (NOAA) developed the viable salmon population (VSP) concept as a tool to assess the conservation status of a population. NOAA defines a viable salmonid population as "an independent population of any Pacific salmonid (genus Oncorhynchus) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100- year time frame" (McElhany, et al. 2000). Four parameters are used to assess population status: abundance, productivity; spatial structure, and diversity. These measures of population status indicate whether the cumulative recovery actions in our watershed are improving the population's overall viability and long-term resilience.

The MAMP (Appendix F, Table 5) outlines recommended metrics to evaluate VSP criteria that should be monitored to assess the population status of the Green River Chinook salmon population. Additional NOAA-approved VSP targets are presented in Chapter IV, Table 1. Although VSP parameters are not a direct measurement of habitat conditions, habitat availability, distribution and quality are inherently reflected in VSP criteria. Tracking trends in the recommended VSP parameters allows resource managers to evaluate how the population is responding overtime to the net impact of conservation actions and ongoing land use development activity in the watershed. Over a long enough timeframe, results can also inform recalibration of recovery strategies if the conservation status of the population does not improve or continues to decline.

The VSP concept – and conservation status of Green River Chinook salmon – is influenced by a variety of factors outside the scope of this plan (i.e., habitat). The Puget Sound Salmon Recovery Plan emphasizes that the conservation status of the Puget Sound Chinook salmon Evolutionary Significant Unit is ultimately linked to the "Four H's" – habitat, hydropower, hatcheries and harvest. "Each of these factors independently affects the (Shared Strategy Development Committee 2007) status of salmon populations, but they also have cumulative and synergistic effects throughout the salmon life cycle. The achievement of viability at the population and ESU level depends on the concerted effort of all three factors working together, not canceling each other out, and adjusting over time as population conditions change" (Shared Strategy Development Committee 2007).

Research and Data Gaps

The Salmon Habitat Plan Update reflects an update to the scientific framework (i.e., Strategic Assessment) of the original 2005 Plan. New scientific data improved our understanding of the functional linkages between environmental stressors, habitat, and population productivity, abundance, diversity and spatial distribution. This information is reflected in updates to the WRIA 9 recovery strategies and embedded projects, policies, and programs. Best avilable science is used to recalibrate the magnitude and sequencing of our strategic investments, maximizing the effectiveness of our investments.

Numerous data gaps and uncertainties remain. Ongoing investments in research and monitoring will be essential to informing adaptive management of recovery strategies and ensuring that plan imple-

mentation and associated funding decisions remain science driven. Additional information on research priorities and data gaps can be found in the Habitat Use and Productivity, Temperature, Climate Change, and Contaminant white papers in Appendices A-D. These papers build on the existing 2004 WRIA 9 Chinook Salmon Research Framework which utilized a conceptual life-cycle model to organize and prioritize research efforts to inform recovery planning.

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Salmon Habitat Plan 2021 Update

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