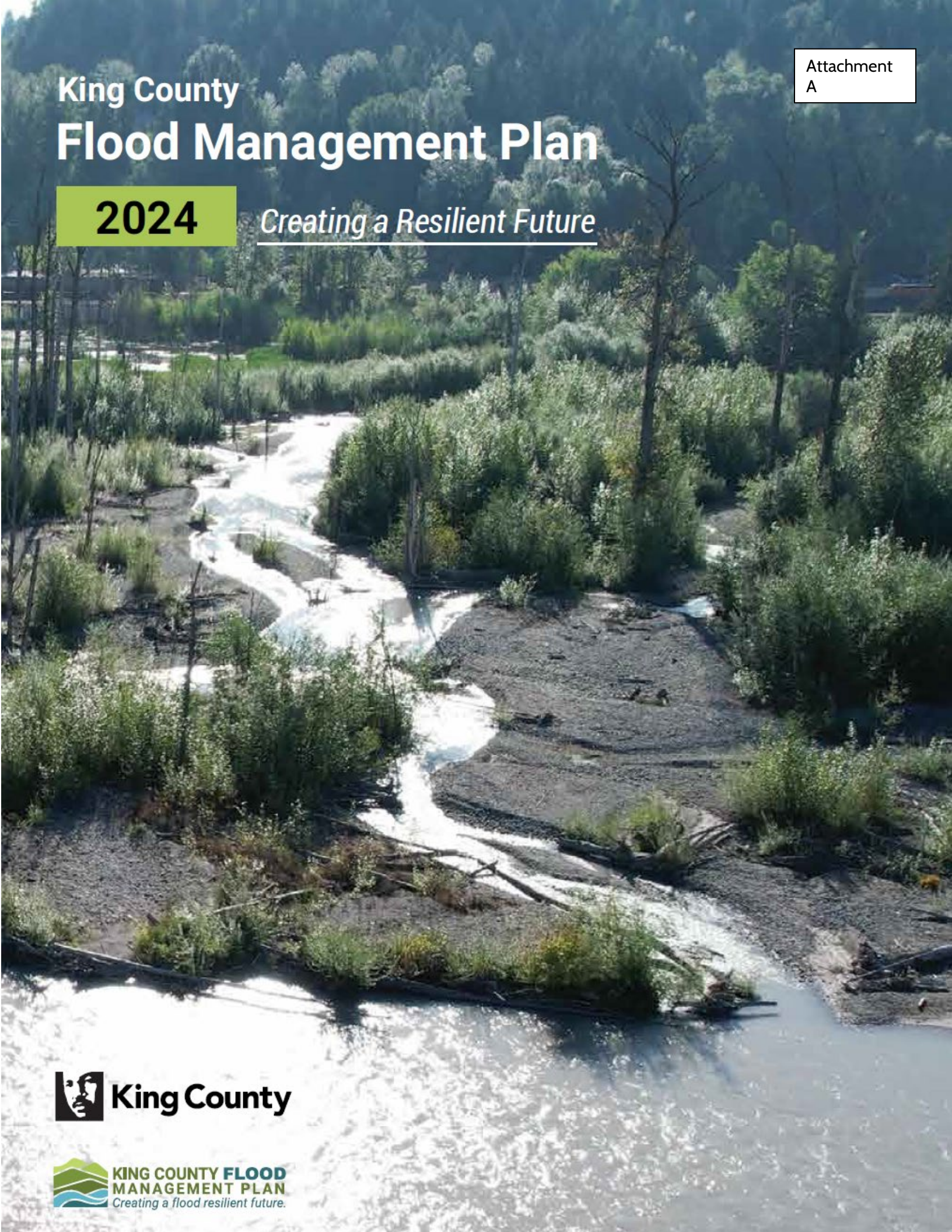
Attachment A

King County
Flood Management Plan

2024

Creating a Resilient Future



King County

KING COUNTY FLOOD MANAGEMENT PLAN
Creating a flood resilient future.

2024 KING COUNTY FLOOD MANAGEMENT PLAN

King County Water and Land Resources Division
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Seattle, WA

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EXECUTIVE SUMMARY

Flooding is the costliest and most frequent natural disaster in King County. The effects of flooding and flood-related hazards affect residences, commercial and industrial properties, farms, parks, and open space. Floods affect small neighborhood access roads and major highways, and they impact property owners and renters alike. Due to climate change, King County now experiences flooding in places that have not historically flooded.

While flooding can produce negative consequences and threaten public safety and property, flooding itself is a natural occurrence. In areas where floodplains and watercourses remain connected or have been reconnected, periodic floods help to create and maintain channel networks, floodplain wetlands, and vital and productive habitats. These habitats provide benefit to salmonids, such as Puget Sound Chinook salmon, which are central to the cultures and identities of Native American tribes and are listed as threatened under the Endangered Species Act.

It is not possible to entirely prevent flooding, but it is possible to greatly reduce flood risks to people and property. This 2024 King County Flood Management Plan (Flood Plan) seeks to establish a shared regional vision for comprehensive flood hazard management in King County that reduces risk to people and property from flooding and channel migration and supports resilient communities and ecosystems. The Flood Plan identifies strategies for addressing the risks caused by flooding along the county's rivers and streams, in coastal areas, and in urban areas. The recommended policies, programs, and projects focus on reducing risk in ways that protect public safety while also elevating other beneficial outcomes, such as safe and accessible transportation routes, protecting and restoring natural habitat, preserving green spaces, and supporting jobs and the economy.

King County developed the Flood Plan with three primary themes at the forefront of the planning effort: laying the groundwork for achieving **multi-benefit outcomes**, promoting **climate resilience**, and ensuring that flood risk reduction activities are developed and implemented with a focus on **equity and social justice**. King County consulted with tribal governments during the planning process to gather their input on tribal rights and tribal resources. Community members and partners also informed the development of this plan, and the input shared with King County is reflected throughout this plan and informed the plan's approaches and recommendations.

The goals for this Flood Plan—the vision for what the plan hopes to achieve—are:

1. To reduce risks from flooding and channel migration and support resilient, viable communities and economies.
2. To achieve multi-benefit flood risk reduction outcomes that preserve, restore, and enhance the natural functions of flood-prone areas; improve floodwater storage and conveyance; contribute to habitat restoration; honor tribal sovereign rights, including treaty-reserved fishing, hunting, and gathering rights; and meet other needs identified by local communities.

3. To implement flood risk reduction solutions that are comprehensive, community-based, and climate-resilient, and that reduce long-term costs of flood risk reduction.

The 2024 Flood Plan reflects the reality that multiple governments and community partners are necessary to achieve flood risk reduction on a large scale, and the flood risk reduction activities identified in this plan are intended to promote coordinated implementation of activities that will reduce flood risk and provide other beneficial outcomes on a countywide scale. By recommending holistic solutions that address the range of flood-related hazards in King County, this Flood Plan will lay the foundation for equitable, climate-resilient, multi-benefit flood risk reduction and provide near-term guidance to King County and its partners.

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I. Review of Categories of Floodplain Management Activities

ACRONYMS AND OTHER ABBREVIATIONS

Acronym or Abbreviation	Definition
ADAP	Agricultural Drainage Assistance Program
APD	Agriculture Production District
BAS	Best Available Science
BIPOC	Black, Indigenous, and other People of Color
BMPs	Best Management Practices
BRIC	Building Resilient Infrastructure and Communities Grant Program
cfs	cubic feet per second
CFT	Conservation Futures Tax
CIP	Capital Improvement Plan
Corps	U.S. Army Corps of Engineers
CoSMoS	Coastal Storm Modeling System
CRS	Community Rating System
CRT	Cedar River Trail
CWHH	Clean Water Healthy Habitat
DNRP	Department of Natural Resources and Parks
DS	Determination of Significance
Ecology	Washington Department of Ecology
EIS	Environmental Impact Statement
ELST	East Lake Sammamish Trail
EOC	Emergency Operations Center
ESA	Endangered Species Act
FCD	Flood Control District
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance Grant Program
GIS	geographic information system
GMA	Growth Management Act
GSI	green stormwater infrastructure
HMA	Hazard Mitigation Assistance Grant Program
HPPD	High Hazard Potential Dam Grant Program
I-90	Interstate 90

Acronym or Abbreviation	Definition
IDP	Integrated Drainage Program
IPCC	Intergovernmental Panel on Climate Change
LCI	Land Conservation Initiative
LiDAR	Light Detection and Ranging
MHHW	mean higher high water
NDAP	Neighborhood Drainage Assistance Program
NDF	Natural Drainage Flooding
NFIP	National Flood Insurance Program
NGO	non-governmental organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
OEM	Office of Emergency Management
PL	Public Law
PPI	Program for Public Information
PSCZ	Puget Sound Convergence Zone
PWR LIO	Puyallup-White River Local Integrating Organization
RCW	Revised Code of Washington
SCAP	Strategic Climate Action Plan
SEPA	State Environmental Policy Act
SMP	Site Management Program
SODO	South of Downtown
SPU	Seattle Public Utilities
SRIP	Sammamish River Improvement Project
SRT	Sammamish River Trail
SVI	Social Vulnerability Index
SWIF	System Wide Improvement Framework
SWM	King County Surface Water Management
SWMP Plan	Stormwater Management Program Plan
TMDL	Total Maximum Daily Load
TPU	Tacoma Public Utilities
UGA	Urban Growth Area

Acronym or Abbreviation	Definition
USGS	U.S. Geological Survey
UW CIG	University of Washington Climate Impacts Group
WAC	Washington Administrative Code
WCM	Water Control Manual
WDFW	Washington Department of Fish and Wildlife
WLRD	King County Water and Land Resources Division
WRF	Weather Research and Forecasting
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WSRT	West Sammamish River Trail
WY	Water Year

GLOSSARY

Term	Definition
Alluvial	Characterized by or referring to deposits of clay, silt, sand, and gravel left by flowing streams in a river valley or delta, typically producing fertile soil.
Alluvial fan	A fan-shaped mass of alluvium deposited as the flow of a river decreases in velocity.
Alpine glaciation	A glacier that is confined by surrounding mountain terrain.
Avulsion	A sudden change in the course of a river, especially by flooding.
Base flood	A flood having a 1 percent chance of being equaled or exceeded in any given year, which is often referred to as the "1 percent annual chance flood" or "100-year flood."
Basin (or subbasin)	A geographic area that drains to a stream or a non-flowing waterbody (such as a named lake or marine area) named and noted on common maps.
Bioengineering	The use of vegetation and other natural materials, such as soil, wood, and rock to stabilize soil, typically to prevent or protect against slides and streamflow erosion.
Channel migration	The movement of a river or stream channel across a landscape through erosion, which can happen gradually over time or abruptly. Both gradual and abrupt migration present risks, and abrupt migration, called an avulsion, can pose especially dangerous risks to people and property.
Channel migration zone	The area within the lateral extent of likely stream channel movement that is subject to risk due to stream bank destabilization, rapid stream incision, stream bank erosion, and shifts in the location of stream channels, as shown on King County's Channel Migration Zone maps.
Climate change	A change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of solar cycles, volcanic eruptions, and persistent anthropogenic (human-caused) changes in the composition of the atmosphere or in land use.
Community Rating System (CRS)	Voluntary program under the National Flood Insurance Program (NFIP) that provides incentives to participating communities to implement activities that exceed the minimum requirements of the NFIP.
Compensatory storage	New, excavated storage volume equivalent to any flood storage that is eliminated by building, filling, or grading within a floodplain.

Term	Definition
Confluence	The junction of two rivers.
Conifers	Evergreen trees, such as Douglas fir and western hemlock.
Convective storms and flooding	Convective storms involve heavy rainfall, thunder, lightning, and/or hail and are often spatially small, intense, and quick moving. Convective storms can contribute to flooding in small basins and in areas where urban stormwater systems can be overwhelmed and may lead to flash flooding.
Critical facility or critical infrastructure	A facility or infrastructure deemed necessary to protect the public health, safety, and welfare.
Equity	As defined by King County's Equity and Social Justice Strategic Plan, is the full and equal access to opportunities, power, and resources so that all people achieve their full potential and thrive.
Flash flooding	Rapid flooding of low-lying areas, usually caused by very intense periods of precipitation.
"Flashy" hydrology	Refers to floodwaters that rise quickly with minimal infiltration, which results in higher, shorter duration floods than prior to urban development and which may lead to flash flooding.
Flood protection facility	A structure that safeguards against flood damage. Flood protection facilities include, but are not limited to, dams or water diversions; flood containment facilities such as levees, dikes, berms, walls, and raised banks, including pump stations and other supporting structures; and bank stabilization structures, often called revetments.
Flood resilience	The ability to prepare for, respond to, and recover from flooding, thus reducing vulnerability to flooding so that future impacts are reduced.
Flood risk reduction	Any work intended to reduce the impact of hazards to people, property, and infrastructure associated with flooding. Human intervention cannot eliminate flooding, but humans can take measures to reduce the risks that result when flooding occurs.
Flooding	A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters or the unusual and rapid accumulation of runoff of surface waters from any source. For the purposes of this Flood Plan, flooding could be caused by rivers or streams; surface water runoff; tides, wave action, or sea level; or blockage of a pathway of flowing water due to landslides or erosion.
Floodplain	Any land area susceptible to being inundated by floodwaters from any source.
Floodplain management	A community-based effort to reduce the risk of flooding, resulting in a more resilient community.

Term	Definition
Hazard	An event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, and other types of loss or harm.
Integrated floodplain management	As described by Ecology (2021), involves bringing together multiple interests to find common agreement on local floodplain visions, strategies, and actions that achieve multiple benefits.
Levee	A human-made structure, usually an earthen embankment, designed and constructed to contain, control, or divert the flow of water to provide protection from temporary flooding.
Moraine	A mass of rocks and sediment carried down and deposited by a glacier, typically as ridges at its edges or extremity.
Multi-benefit (or multiple benefits)	The suite of outcomes that can be achieved through efforts to reduce flood risk, such as enhancing habitat for fish and wildlife, increasing resilience to climate change, providing open space and recreational opportunities, supporting viable agriculture and commerce, and meeting the needs of local communities.
National Flood Insurance Program (NFIP)	The federal program under which flood-prone areas are identified and flood insurance is made available to property owners and tenants in participating communities.
Outburst flooding	Catastrophic flooding caused by the sudden release of a large amount of water (such as in a dam break).
Pluvial	Relating to or characterized by rainfall.
Redd	Refers to the spawning bed (nest) of salmon or trout in a river or stream.
Repetitive loss area	A portion or portions of a community that includes buildings on FEMA's list of repetitive losses and also any nearby properties that are subject to the same or similar flooding conditions.
Repetitive loss property	Any insurable building for which the NFIP paid two or more claims of more than $1,000 within any 10-year rolling period since 1978.
Revetment	A facing of stone, rock, or other material placed on a stream bank or slope to minimize erosion by moving water.
Risk	The estimated impact that a hazard could have on people, services, facilities, and structures in a community.
Shoreline armoring	Lining perimeters of rivers, streams, lakes, or marine areas with rock or concrete to stabilize the shoreline and prevent erosion or channel migration.
Sinuosity	Refers to the degree of meandering within a river channel, defined as the ratio of stream length to valley length. More simply, it is the amount of curvature of a river.

Term	Definition
Swale	A shallow channel with sloping sides. Swales can be either natural or human-made. Artificial swales are often designed to manage stormwater runoff.
Water Resource Inventory Areas (WRIAs)	Formalized under Washington Administrative Code (WAC) 173-500-040[1] and authorized under the Water Resources Act of 1971, Revised Code of Washington (RCW) 90.54,[2] these administrative and planning areas are delineated by major river watersheds.
Watershed	An area of land that drains into a single outlet and is separated from other drainage basins by a divide.

1 Water Resource Inventory Areas; https://app.leg.wa.gov/wac/default.aspx?cite=173-500-040.

2 Water Resources Act of 1971; https://app.leg.wa.gov/rcw/default.aspx?cite=90.54.

CHAPTER 1
Introduction

White River Countyline Floodplain Reconnection project, September 2023

Flooding is the costliest and most frequent natural disaster in King County. Since 1956, King County has experienced 29 presidentially declared flooding disasters resulting in millions of dollars of property damage. Smaller floods are no less significant for those who are affected by them. More than 50,000 people live in King County's mapped flood hazard areas, and many thousands more people work and travel through areas subject to flooding. Over the course of 30 years, the length of a typical home mortgage, someone living in the 1 percent annual chance floodplain (also referred to as the 100-year floodplain) faces a 26 percent chance of experiencing flooding.

Flooding affects residences, commercial and industrial properties, farms, parks, and open space. It affects small neighborhood access roads and major highways, and it impacts property owners and renters alike. Due to climate change, King County now experiences flooding in places that have not historically flooded. Flood events are a natural occurrence that cannot be prevented, but it is possible to greatly reduce flood risks to people and property.

King County has had active flood risk reduction programs for decades. Since the 1970s, the County's policies and programs have focused on preventing new at-risk development in flood and erosion hazard areas through development regulations. Recognizing that rivers are dynamic, and that the

location and extent of flood-related hazards can change over time (and in some cases rapidly), King County was one of the first local governments in Washington to map and regulate channel migration hazards. The County also made early use of federal grants to acquire flood-prone property in order to remove risk to people and structures in areas subject to flooding and channel migration.

More recently, the County and partners have successfully designed and implemented projects along the county's waterways that reduce the risk of flooding while providing additional benefits. These benefits include improving habitat for salmon, improving or expanding open space and recreational access, improving water quality, protecting and ensuring agricultural viability, supporting economic development and transportation, and improving the overall quality of life for county residents.

The purpose of this 2024 King County Flood Management Plan (Flood Plan) is to establish a shared regional vision for comprehensive flood hazard management in King County that reduces risk to people and property from flooding and channel migration and supports resilient communities and ecosystems. The Flood Plan brings multi-benefit approaches, climate change, and equity to the forefront of flood risk reduction in King County and promotes solutions that preserve, restore, and enhance the natural functions of flood-prone areas wherever possible.

Given the geography of King County, which extends from the Cascade Mountains to Puget Sound, flooding takes several forms and has numerous interrelated causes. Likewise, the solutions to reduce risks from flood-related hazards should be multifaceted and recognize the possibilities for achieving multiple benefits for county residents in ways that are effective and efficient. The Flood Plan addresses flooding along the county's mainstem rivers as well as coastal flood hazards, lake flooding, urban flooding, and tributary flooding. In addition to describing types of flooding and flood-related risks, the Flood Plan recommends policies, programs, and projects focused on reducing risk and increasing community resilience to floods, and the plan is intended to guide all county agencies that work at the intersection of flooding.

This plan was informed by an extensive community outreach and engagement effort. County staff attended community events and meetings, visited immigrant farming operations, hosted online surveys, partnered with a community-based organization, convened a planning committee of partners and community members, held public meetings and workshops, and used various types of media to advertise and promote opportunities to contribute input to the development of this plan. The input shared, and the ways the input informs this plan's approaches and recommendations, are presented throughout the plan.

The 2024 Flood Plan updates and supersedes the 2006 King County Flood Hazard Management Plan and the 2013 King County Flood Hazard Management Plan Update and Progress Report. Like those previous plans, this Flood Plan was developed following the Federal Emergency Management Agency's (FEMA) Community Rating System (CRS) 10-step planning process. In addition to advancing the goals of the National Flood Insurance Program (NFIP), the Flood Plan is consistent with the Revised Code of Washington (RCW) 86.12.200[3] and was further guided by the principles outlined in the Washington Department of Ecology's (Ecology) *Comprehensive Planning for Flood*

3 https://app.leg.wa.gov/RCW/default.aspx?cite=86.12.200.

Hazard Management: A Guidebook (Ecology 2021)[4]. Moreover, King County's obligation under the Endangered Species Act (ESA)—and specifically, to restore habitat for salmon listed as threatened under the ESA—was a primary planning consideration, alongside other King County initiatives related to equity and social justice, climate change, local food production, and clean water and healthy habitat.

1.1 Roadmap for this Flood Plan

Flooding is a complicated problem with many intersecting causes and solutions, and flooding characteristics can differ dramatically depending on location. This Flood Plan attempts to present these complex topics simply. The Flood Plan examines flooding throughout King County, yet the nature of flooding and drainage issues are extensive, and this Flood Plan does not address every flooding situation across the entire landscape. Instead, the Flood Plan characterizes the different types of flood hazards and flood problems across the county and details various strategies to address identified problems to improve the resilience of county communities.

The Flood Plan is structured as follows:

- **Chapter 1 – Introduction** (this chapter)
  - Plan purpose, themes, and geographic scope, including identification of new topics and focus areas for this Flood Plan.
  - Goals, objectives, and guiding principles that provide the vision for flood risk reduction in King County.
  - Policies that guide decision-making around flood risk reduction activities, including flood hazard management planning, programs, and projects.
  - Overview of the planning process.
  - Summary of the State Environmental Policy Act (SEPA) review process.
  - Regulatory drivers and other factors and initiatives that influence or relate to the Flood Plan.
- **Chapter 2 – Overview of Flooding in King County**
  - Countywide context.
  - Summary of existing conditions, flooding characteristics and risks, and additional information about flooding, presented by geography (i.e., watershed).
  - Summary of countywide flood hazard and risk assessment.
- **Chapter 3 – Review of Flood Risk Reduction Activities**
  - Discussion of the range of options that could be used to prevent or reduce the severity of the flooding problems identified in Chapter 2.
- **Chapter 4 – Comprehensive Risk Mitigation Strategy and Action Plan**

[4] https://apps.ecology.wa.gov/publications/documents/2106019.pdf.

  - Comprehensive review of the various projects and programs that can be used to address flood risk, including King County's Action Plan.
- **Chapter 5 –Implementation Plan**
  - Summary of financial approaches and partnerships to achieve the goals of this Flood Plan.
  - Description of annual reports, 5-year update, and adaptive management.
- **Appendices** (presented in separate volume):
  - Appendix A: Planning Committees
  - Appendix B: Implementation Status of 2013 Action Plan: 2013 – 2023
  - Appendix C: Flood Plan Community Engagement Overview and Synthesis
  - Appendix D: Levee Failure
  - Appendix E: Dam Failure
  - Appendix F: King County 2023 Repetitive Loss Area Analysis Progress Report
  - Appendix G: Public Information Activities
  - Appendix H: Status of Flood Hazard Mapping and Studies
  - Appendix I: Review of Categories of Floodplain Management Activities

1.2 Scope and Purpose of the Flood Plan

The purpose of the 2024 Flood Plan is to establish a shared regional vision for comprehensive flood hazard management in King County that reduces risk to people and property from flooding and channel migration and supports resilient communities and ecosystems. Multi-benefit outcomes, climate change, and equity were primary planning considerations, and the plan is predicated on achieving the desired outcomes through collaborative approaches. Integrated floodplain management concepts were at the core of the Flood Plan development process and are reflected throughout the plan.

King County's most recent flood plans (2006 and 2013) primarily focused on flooding along the county's major rivers. This 2024 Flood Plan is more comprehensive, describing the different types of flooding and flood risks present throughout the county, including coastal hazards, urban and rural stream flooding, and stormwater runoff. Where appropriate, the Flood Plan outlines strategies or next steps for addressing the risks caused by all types of flooding and recommends policies, programs, and projects focused on reducing risk in ways that advance the goals of the NFIP and the ESA. The Flood Plan also supports and elevates the goals of related King County plans and initiatives—including, but not limited to, the following:

- King County Comprehensive Plan[5]

[5] https://kingcounty.gov/en/dept/council/governance-leadership/county-council/topics-of-interest/comprehensive-plan/2024.

- King County Equity and Social Justice Strategic Plan[6]
- King County Strategic Climate Action Plan[7]
- King County Clean Water Healthy Habitat Strategic Plan[8]
- King County Land Conservation Initiative[9]
- King County Local Food Initiative[10]

The scope of the 2024 Flood Plan is countywide. It characterizes the types of flooding throughout the county, regardless of jurisdiction, and it reflects the reality that multiple governments and community partners carry out flood risk reduction actions. The King County Comprehensive Plan describes the comprehensive scope of the County's flood risk reduction and floodplain management activities, and the connection to this Flood Plan, by specifying that King County's floodplain management program will protect lives and property, minimize damage to infrastructure and critical facilities, protect and restore the natural functions of floodplains, deliver multiple benefits including benefits to frontline communities, promote resilience to climate change, and ensure that new development does not result in new flood risks.[11]

Multi-Benefit Focus

King County has an established track record of implementing projects along the county's waterways that reduce the risk of flooding while providing additional benefits. Recent examples include the Fall City Floodplain Reconnection Project on the Snoqualmie River, the Čakwab Levee Setback and Floodplain Restoration Project on the Green River, the Countyline Levee Setback Project on the White River, and the Riverbend Levee Setback and Floodplain Restoration Project on the Cedar River.

King County can point to many examples of multi-benefit project successes, yet more can be done. The current approach to multi-benefit project planning, development, scoping, and design is not standardized. A concerted effort is needed to bridge different programs and funding sources, each of which have their own objectives (e.g., salmon recovery, open space, flood risk reduction, stormwater management, road improvement, parks, agriculture). Funding restrictions can also present a barrier.

Community members, tribal and local government partners, and other participants in the planning process expressed broad support for multi-benefit flood risk reduction efforts. Common themes shared with King County include providing safe and accessible transportation routes, protecting and restoring natural habitat, preserving green spaces, and supporting jobs and the economy. Despite

6 https://kingcounty.gov/en/legacy/elected/executive/equity-social-justice/strategic-plan.

7 https://kingcounty.gov/en/legacy/services/environment/climate/actions-strategies/strategic-climate-action-plan.

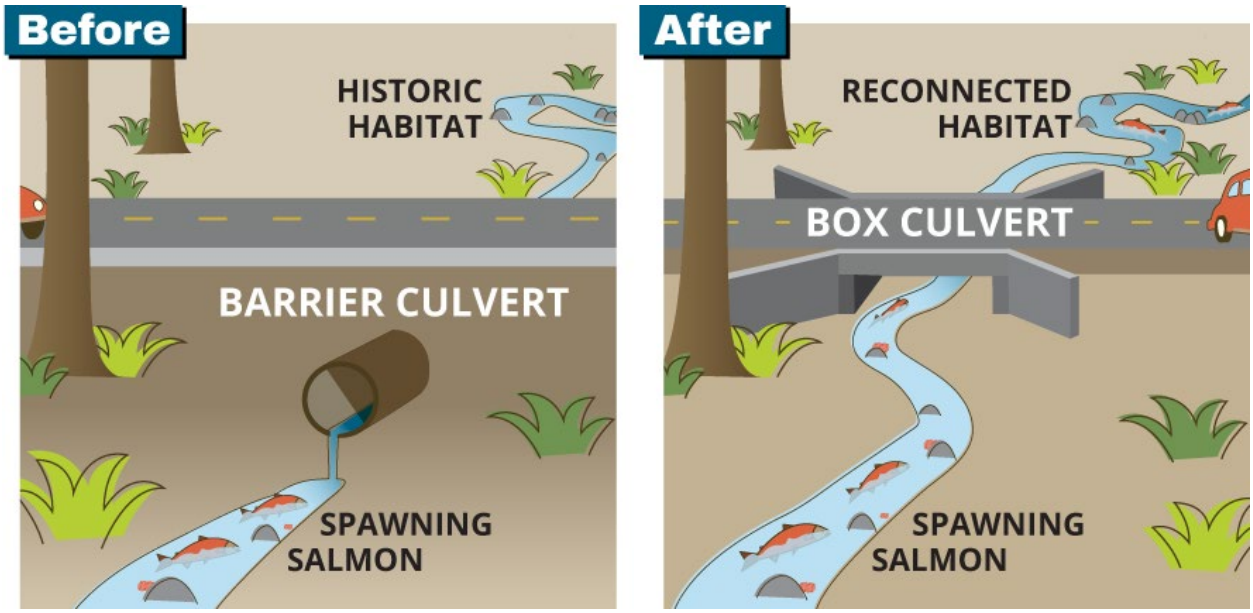
8 https://kingcounty.gov/en/dept/dnrp/about-king-county/about-dnrp/sustainability-commitments/clean-water-healthy-habitat.

9 https://kingcounty.gov/en/legacy/services/environment/water-and-land/land-conservation.

10 https://kingcounty.gov/en/legacy/elected/executive/constantine/initiatives/local-food-initiative.

11 Policy E-499 in the Executive Proposed 2024 King County Comprehensive Plan: https://cdn.kingcounty.gov/-/media/king-county/depts/council/comprehensive-plan/2024/2023-0440-attachment-a.pdf?rev=84d600c276534543ac4e72ccdfff0a9e&hash=CFCCC4E17D42B996AC44CD7BE471930D.

strong support for multi-benefit solutions, partners identified challenges to implementing these strategies, including competing land uses, the costs of habitat enhancement in urban areas, and balancing nature-based flood risk reduction projects with the protection of agricultural lands. Some partners and community members also highlighted the significant flood risk reduction benefits provided by existing flood control structures, especially for agriculture, ports, and water-dependent business.



King County's culvert replacement efforts have multiple benefits, including restoring access to fish habitat and increasing flow capacity of culverts

Each project is unique, and delivering multiple benefits may not be feasible in all cases. However, this Flood Plan presents an opportunity to establish a framework for how to systematically and holistically approach the planning and development of projects to achieve multi-benefit objectives. In addition to considering adjustments to capital project planning and development, the plan also recognizes programmatic opportunities to enhance delivery of multi-benefit outcomes.

Resilience to Climate Change

Flooding and climate change are inextricably linked. The Pacific Northwest is expected to see changes in weather patterns that will make flooding more frequent, more severe, and with potentially greater consequences. Flooding may get worse where it already occurs, and flooding may happen in places that have not flooded before. Some changes already occurring include shifts in rainfall timing and intensity and an increase in the frequency of intense rainfall events.

King County's *Strategic Climate Action Plan* (SCAP), adopted in 2021, outlines ways to integrate climate change into all areas of the County's operations, including work King County does with cities, partners, and communities. A fundamental strategy in the SCAP to prepare for the impacts of climate change is to incorporate potential climate impacts into policies and plans and to implement climate-resilient solutions. The Flood Plan incorporates this strategy by drawing on the latest climate change science to inform the County's understanding of flooding. Recommendations in this plan promote

climate resilience by emphasizing the need to develop solutions that are based on future, not present, conditions.

In an online survey distributed as part of this planning effort and described later in this chapter and in Appendix C, planning for future impacts of climate change received the largest number of community responses for how King County can create a flood-resilient future. Communities along King County's marine shoreline and in urban areas are expected to face increased flood risk due to climate change. Community members reported seeing an increasing frequency of storm surge and high-tide flood impacts in coastal areas, such as overtopping roads, property damage, erosion, reduced effectiveness of pumping systems, and extended periods of inundation. Likewise, input shared that overtopping of roads, impacts on businesses, and sediment accumulation in urban areas are occurring due to inadequate capacity of stormwater infrastructure to manage increasing precipitation volumes.

The flood mitigation activities included in King County's 2006 and 2013 flood plans mostly focused on mainstem river flooding. This 2024 Flood Plan addresses changing river flooding conditions, and by also including coastal, urban, and tributary flooding, this Flood Plan is responsive to projected climate-driven changes that could pose increased risks to larger areas of the county. As a result, this Flood Plan lays out a more comprehensive approach to reducing flood risk and building resilience, including resilience in the face of climate change.

Equity and Social Justice

Long-standing and persistent inequities exist throughout King County, and these inequities threaten the collective prosperity throughout the region. King County's *Equity and Social Justice Strategic Plan* outlines an array of strategies to move toward the vision of making King County a place where all people have equitable opportunities to thrive. It calls for focusing on where impacts have been the most harmful, centering on Black, Indigenous, and other People of Color (BIPOC) experiences, addressing root causes or problems, and being responsive, adaptive, transparent, and accountable.

King County's past flood planning efforts approached flood risk reduction from the perspective of physical risk and the need for repair and maintenance of existing facilities that provide protection from flooding or erosion. The County conducts community outreach and engagement during the design of capital projects, but priorities for investment are driven primarily by the location of existing flood protection infrastructure and the physical risk associated with failure of that infrastructure. While the County has taken steps to make information about flood risks and flood preparedness more accessible to people who do not speak English as their first language, the County can do more to engage with the communities most vulnerable to flooding to understand their needs and their capacity to prepare for, respond to, and recover from flooding.

In embarking on this Flood Plan, it was imperative that equity was at the forefront of the County's efforts. For this reason, King County conducted demographic research early in the process to identify who lives in flood hazard areas and how to best reach them. From this understanding, the County developed a community engagement strategy to bring those communities into the planning process. By hearing and considering the needs of those whose voices have not been at the table before, the County will be better able to meet the needs of the most vulnerable communities. Under the plan,

King County can shift away from a state of "informing" people of its decisions and toward the "co-creation" of potential solutions to flooding problems.

King County engagement materials at Washington State Coalition of African Community Leaders Fifth Annual Summit

During the planning process, community members and interested parties identified the scarcity of information and support provided to all communities as equity and social justice concerns, especially for communities for whom English is not the primary language and lower income populations. Beyond providing translated text, input highlighted that some communities would benefit from culturally relevant examples and graphics. Many community members discussed the importance of proactive engagement of vulnerable and historically impacted communities to increase their preparedness and improve resilience.

1.3 Relationship of Flood Plan to Other Jurisdictions

Floodwaters do not follow jurisdictional boundaries, so actions taken by individual local governments can influence conditions in neighboring jurisdictions. For this reason, partnerships and coordination with cities and other government agencies are essential to achieving the objectives of integrated floodplain management. Coordinated approaches to addressing flood-related risks can help achieve the implementation of holistic solutions that provide multiple benefits.

Many implementers of flood risk reduction activities exist in King County. Furthermore, King County government provides regional services to support and complement the services provided by cities and other governments. The County developed this Flood Plan with the expectation that it will continue to be a strong partner and collaborator in reducing flood risks.

The King County Flood Control District (FCD), a countywide special-purpose district formed in 2007, works to protect lives and property by providing funding to improve the County's aging flood protection infrastructure. The FCD levies a countywide property tax to fund its work and is governed by a Board of Supervisors, which consists of the elected members of King County Council. The King County Executive has no role in establishing the budget or work plan for the FCD.

King County and the FCD maintain an interlocal agreement in which King County is the primary service provider for many FCD services, such as annual monitoring and maintenance of flood and erosion control facilities, flood preparedness and warning services, flood hazard studies and mapping, flood hazard planning and outreach, and implementation of the FCD capital improvement program. The work plan of the FCD is subject to direction by the FCD's Board of Supervisors and set as part of their annual budget adoption.

King County led the development of this Flood Plan and coordinated with the FCD during the process. While the recommendations of the plan have the potential to inform the work of the FCD, the FCD maintains its own budget and decision-making processes separate from the budget and decision-making of King County. This Flood Plan does not direct the work of the FCD in any way.

1.4 Goals and Objectives

Feedback provided through the collaborative efforts of the Flood Plan Partner Planning Committee and an interdepartmental Internal Staff Planning Committee (described later in this chapter), as well as input shared through community engagement, informed the development of the goals and objectives for the 2024 Flood Plan. The following long-term goals and specific objectives set the vision for what King County hopes to achieve and how to go about reducing flood risks to people and property in the county and, in turn, build flood resilience.

The goals for the Flood Plan are:

1. To reduce risks from flooding and channel migration and support resilient, viable communities and economies.
2. To achieve multi-benefit flood risk reduction outcomes that preserve, restore, and enhance the natural functions of flood-prone areas; improve floodwater storage and conveyance; contribute to habitat restoration; honor tribal sovereign rights, including treaty-reserved fishing, hunting, and gathering rights; and meet other needs identified by local communities.
3. To implement flood risk reduction solutions that are comprehensive, community-based, and climate-resilient, and that reduce long-term costs of flood risk reduction.

The Flood Plan's objectives for achieving the above goals are:

1. Apply principles of integrated floodplain management as outlined in Ecology's *Comprehensive Planning for Flood Hazard Management: A Guidebook* to guide flood risk reduction activities.
2. Use the best available science to identify, assess, and monitor flood-related and channel migration hazards, and determine how climate and other future changes may affect risk.
3. Promote public awareness of flood hazards, the actions individuals can take to improve their resilience to flooding, and emergency response programs.
4. Engage local communities, partners, and others in the identification and prioritization of actions and programs that increase resilience and reduce flood risks to life, property, public infrastructure, and public health.
5. Develop flood risk reduction solutions that will be effective over the long term, minimize adverse impacts, are set in a watershed-based context, and consider potential impacts from climate change. Where flood protection facilities already exist, consider feasible multi-benefit alternatives and prioritize the most appropriate long-term solutions.
6. Adopt, consistently implement, and enforce land use management policies and development regulations that prevent the creation of new flood-related and channel migration risks, while preserving or enhancing natural floodplain functions and preventing further habitat degradation.
7. Coordinate regionally with agencies, cities, tribes, nongovernmental organizations (NGOs), and special-purpose districts to assess risk and vulnerability and provide flood monitoring and warning, disaster response, and recovery services.
8. Where other risk mitigation options are not viable or desired, proactively acquire developed or undeveloped properties and permanently remove structures from harm to prevent flood-related and channel migration risks and support multi-benefit goals.
9. Improve access to programs that help county residents, businesses, and other institutions prepare for and recover from flooding beyond traditional flood insurance.
10. Collaborate regionally to identify funding sources to implement flood risk reduction activities and identify opportunities, strategies, and partnerships to leverage grant funding and partner investments.
11. Use adaptive management to adjust actions based on scientific and technological advances, including best available information on floodplain and flood management practices and principles, project effectiveness monitoring information, understanding of risk, and equity considerations.
12. Use data related to social vulnerability, land use, jobs, and business activity to inform how, when, and where flood risk reduction activities are prioritized and implemented.

1.5 Guiding Principles

Guiding principles are statements that describe King County's technical understanding of conditions or characteristics that inform and provide direction to flood risk reduction activities. The guiding principles represent a shared understanding of the context surrounding flooding and the actions the County can take to reduce risk and increase resilience. The collaborative work of the Partner Planning Committee, the Internal Staff Planning Committee, and community engagement input informed the development of these statements. The Flood Plan's 15 guiding principles, divided into four categories, are summarized in the following sections.

Equity and Community Priorities

1. Factors that influence social vulnerability, such as age, race, health, education, mobility, and income, must be considered and applied when monitoring hazards, identifying risks, and developing flood risk reduction solutions.
2. King County's floodplains and flood-prone areas exhibit many different activities and land uses and include developed areas with homes, farms, businesses, industry, recreation amenities, and infrastructure that are valued by King County and its communities. Scoping and evaluation of flood risk reduction strategies should consider the existing development and land use context.

Natural Environment

3. Federal and state guidance from FEMA and Ecology prioritize working with natural systems, finding nonstructural solutions to flood problems, and restoring ecological functions as an element of flood risk reduction. King County recognizes that flooding and erosion are natural processes that sustain biological productivity and diversity, acknowledges the ecological and bank stability benefits of riparian vegetation, and prioritizes nature-based flood risk reduction solutions where possible.
4. Protecting and enhancing natural processes can provide environmental benefits, increase climate change resilience, and reduce flood risks to people and property in a less costly manner than structural flood control approaches.
5. Rivers and streams and their floodplains, coastal areas, and riparian areas provide habitat for salmonids, including several that are listed as threatened under the ESA. Salmon are intricately connected to Native American culture and tribal rights.

Risk Management

6. Areas behind levees, downstream of dams, or outside of mapped flood hazard areas have a residual risk of flooding (for example, from potential levee failure).
7. Flooding and channel migration are influenced by past and current land use and land management decisions (including actions in upland portions of watersheds), stormwater flows, and climate change.
8. Flood control methods can reduce some flood damage, but those methods require maintenance, do not eliminate all risk, and may not be adaptable to changing conditions.

Best Practices

9. Actions to address flood risk to existing development must consider the existing land use context, other land uses and interests (such as urban development, fish and wildlife habitat, open space, agriculture, recreation, and transportation), climate change, and other future landscape changes.
10. Flood damage creates public and private financial costs, and effective flood risk reduction reduces long-term flood damage costs.
11. Consultation with tribes and engagement with and involvement of residents, resource management agencies, flood-vulnerable communities, and public and private landowners are vital in developing and implementing risk reduction strategies and a responsible, equitable, and effective Flood Plan.
12. Coordination and cooperation among local, regional, state, and federal agencies are essential for the success of long-term comprehensive flood hazard management. Where possible, seek to harmonize overlapping and sometimes conflicting regulations and standards that apply to flood hazard areas.
13. Evaluation of capital project design alternatives must carefully consider off-site flood impacts, equity and social justice implications, ecological consequences, impacts on ESA-listed salmon, and long-term costs of action or no action.
14. Identifying flood risks and selecting the most effective flood risk reduction solutions for the long term should be informed by the best available science, best practices in floodplain management, multi-objective and multi-benefit considerations, and community engagement.
15. Scoping and evaluation of alternatives to address flood and channel migration risks should actively seek opportunities to achieve multi-benefit outcomes and net ecological gain.

1.6 Policies

This Flood Plan outlines a countywide vision for flood hazard management and flood risk reduction and addresses various types of flooding, such as river, tributary, coastal, and urban flooding. This comprehensive Flood Plan emphasizes a coordinated, adaptive, and innovative approach to managing flood hazards and reducing risk, preserving the viability of communities and economies, and enhancing ecosystem functions. The Flood Plan strives to build flood resilience for King County and its communities and seeks to leverage the necessary resources and support for multiple benefits associated with flood risk reduction efforts.

The Flood Plan is adopted by King County Council as a functional plan of the King County Comprehensive Plan, meaning that it augments and helps implement the Comprehensive Plan and guides daily management decisions. The Flood Plan details King County's policies for the protection of frequently flooded areas and floodplain management, and the Comprehensive Plan, in policy E-499r,[12] states that King County's floodplain land use and management activities will be carried out according to the policies, programs, and projects included in the Flood Plan.

[12] From Executive Proposed 2024 King County Comprehensive Plan: https://cdn.kingcounty.gov/-/media/king-county/depts/council/comprehensive-plan/2024/2023-0440-attachment-a.pdf?rev=84d600c276534543ac4e72ccdfff0a9e&hash=CFCCC4E17D42B996AC44CD7BE471930D.

The following 22 policies provide the framework for King County's decision-making about flood risk reduction and floodplain management and provide guidance for project- and program-level decisions by King County agencies and recommended approaches countywide.

Equity

King County acknowledges that social, economic, and environmental inequities threaten the collective prosperity of the region. King County also acknowledges the presence of factors beyond physical risk that can influence people's vulnerability to flooding and their ability to recover from flood impacts. This Flood Plan identifies ways to increase flood preparedness and build flood resilience countywide, especially for those communities that are most vulnerable to the effects of flooding. The following is a list of county policies that address the issue of equity in flood reduction efforts:

1. Consistent with King County Comprehensive Plan policies RP-205 and F-202a,[13] King County shall apply equity and social justice principles throughout the planning and implementation of the King County Flood Management Plan to ensure that property owners and residents are given equitable access to flood risk reduction services.
2. The identification, prioritization, design, and implementation of flood risk reduction activities, including preparedness and emergency services, shall consider the needs of and impacts on vulnerable populations that may face barriers to accessing services and programs based on age, income, disability, English language proficiency, race, ethnicity, or other factors affecting social vulnerability.
3. When considering flood risk reduction alternatives that involve property acquisition, King County shall evaluate whether there will be impacts on renters, low-income communities, and communities of color, including displacement. King County shall work with the affected community through open and transparent communication to identify how to increase flood resilience while avoiding displacement and adverse impacts on housing affordability and supply.
4. King County shall implement community engagement focused on flood resilience and shall partner with and build capacity within community-based organizations supporting or led by historically underserved populations to achieve mutually beneficial outcomes, such as flood preparedness education, flood warning, and flood risk reduction projects.

Natural Systems

Historical practices for flood risk reduction removed wood and sediment from waterways; built flood risk reduction infrastructure such as dams, levees, and revetments that disconnected rivers from their floodplains; reduced active channel areas; armored shorelines; and, in turn, severely damaged aquatic and riparian habitat and food webs that are dependent on these natural processes. Scientific advances have demonstrated that flood risk reduction methods that rely on heavily engineered solutions are often expensive, provide only temporary, short-term relief from flooding, and can encourage development in at-risk areas. Climate change exacerbates these concerns.

[13] From Executive Proposed 2024 King County Comprehensive Plan.

Some floodplain areas in King County, particularly within more developed or urbanized areas, contain development that is unlikely to be removed or relocated, but some amount of environmental enhancement is often possible in these locations. Additionally, flood-prone areas in less developed parts of the county provide opportunities for floodplain reconnection and restoration. Integrated floodplain management seeks to restore natural, habitat-forming processes and ecosystem function while maximizing flood risk reduction. This approach recognizes that natural systems provide flood risk reduction benefits by slowing runoff and storing, infiltrating, and conveying floodwaters. King County flood risk reduction policies that reflect the importance of protecting natural systems include the following:

5. King County shall seek to preserve and enhance natural functions of flood hazard areas and promote natural hydrologic function at the watershed scale to build resilience to changing precipitation patterns in a changing climate.
6. When scoping alternatives for repairing or rebuilding existing flood protection facilities, King County shall evaluate opportunities to relocate existing flood protection facilities farther from the water's edge and implement associated buffers to increase flood storage and conveyance to reduce risk, allow sediment and wood deposition and other natural processes to occur, and support resilience to climate change.
7. King County shall look for opportunities to improve the resilience of existing infrastructure, including decommissioning or removing infrastructure that no longer serves its intended purpose. Further, the County shall prioritize decommissioning or removing such infrastructure in locations that enable restoration of natural processes that reduce flood risk and provide other multi-benefit outcomes.
8. King County shall engage property owners and renters of at-risk properties to identify viable strategies for flood risk reduction. These strategies shall include acquisition and long-term maintenance of flood-prone property as a tool to reduce or permanently eliminate localized flood risk, improve management of surface water or runoff, implement multi-benefit flood risk reduction projects, or advance of the goals of King County's Land Conservation Initiative, Clean Water Healthy Habitat Initiative, Water Resource Inventory Area (WRIA) salmon recovery plans, or other adopted basin, stormwater, agricultural, or open space plan.
9. King County shall only pursue gravel or sediment removal for flood risk reduction purposes as part of congressionally authorized projects, multi-benefit projects that provide a net gain in habitat functions and values, or to prevent or address threats to critical infrastructure. As much as possible, King County should only remove gravel or sediment from inactive river and stream channels.
10. King County acknowledges that the presence of natural wood in rivers and streams and their floodplains is integral to sustaining the ecological functions critical for salmon and aquatic ecosystems, and, consistent with salmon recovery plans, the County should allow as much natural wood as possible to function as part of these dynamic systems to support critical habitat for salmon species listed as threatened under the ESA.

Multiple Benefits

King County recognizes that flood-prone areas exhibit diverse land uses that are valued by King County and its communities, including developed landscapes that support regional economic activity.

King County also acknowledges that flooding and erosion are natural processes that sustain biological productivity and diversity. Consistent with King County Countywide Planning Policies EN-2 and EN-3,[14] effective flood risk reduction increases floodwater storage, infiltration, and conveyance; reduces flood damages; and increases the resilience of King County's communities and economies while also supporting and enabling a range of other beneficial outcomes as described in the following policies:

11. King County should seek to achieve comprehensive flood hazard management that effectively addresses flood risk reduction needs while also honoring tribal sovereign rights, including treaty-reserved fishing, hunting, and gathering rights; seeking opportunities to protect and restore natural floodplain functions; and supporting the interrelated interests and needs of the communities and land uses in which the work takes place. Outcomes shall center on equity and environmental justice and will aim to be achieved through partnership with local governments, tribes, special-purpose districts, community groups, and other entities. Specific multi-benefit outcomes could include:
    - Communities, public infrastructure, and functioning ecosystems that are resilient to climate change.
    - Habitat protection and restoration for fish and wildlife, including salmon.
    - Productive, viable agriculture.
    - Safe and sustainable development.
    - Jobs and sustainable livelihoods and economic development.
    - Clean water.
    - Open space conservation.
    - Recreation and other opportunities to connect people with nature.
12. King County shall identify floodplain reconnection and multi-benefit flood risk reduction projects and actively include multi-benefit considerations in scoping and alternatives analysis for flood risk reduction projects, including identifying opportunities to provide benefits beyond flood risk reduction in developed landscapes that are consistent with public safety goals.

Climate Change

As outlined in King County's SCAP, climate change is expected to produce shifts in weather patterns in the Pacific Northwest that will alter flooding characteristics and very likely increase flooding risk. This will result in additional impacts on the regional economy, public health and safety, and the environment. King County acknowledges that currently mapped flood hazard area boundaries are based on historic flooding and likely understate risk, making it of paramount importance to manage flood risks with future conditions in mind using the best available science (consistent with

[14] 2021 King County Countywide Planning Policies, https://kingcounty.gov/~/media/depts/executive/performance-strategy-budget/regional-planning/CPPs/2021_CPPs-Adopted_and_Ratified.ashx?la=en.

Countywide Planning Policy EN-8). Policies that consider the potential future impacts of climate change include the following:

13. King County shall develop and implement a climate change capital planning strategy for flood risk reduction projects and communicate potential future risk in flood preparedness and community engagement.
14. King County shall continue to expand its understanding of the potential implications of a changing climate on flood conditions and other natural hazards that may affect flooding. King County shall use the best available science about climate change to identify potential future flood and flood-related hazards and risks and to inform land use planning and regulations, flood preparedness and flood warning services, flood mitigation services, and other infrastructure and development decisions. This will include changes in freshwater flooding conditions and changes resulting from sea level rise.
15. Given the uncertainty associated with climate change impacts, King County shall include additional factors of safety in flood hazard area regulations and apply additional factors of safety to the design standards for flood risk reduction, stormwater, and other critical infrastructure projects.

Coastal flooding of Dockton Park on Maury Island, December 2022

Land Use and Regulatory Compliance

King County regulates development in flood hazard areas in unincorporated King County through the Critical Areas Ordinance (King County Code Chapter 21A.24[15]). Flood hazard areas covered by King County's regulations include the floodplain, FEMA Special Flood Hazard Area, King County zero-rise flood fringe and zero-rise floodway, and channel migration zones. The best way to avoid impacts from flooding and flood-related hazards is to avoid development within flood hazard areas, yet King County allows some development to occur within these zones. Also, the boundaries of mapped flood hazard areas periodically change to include developed properties not previously mapped as flood hazard areas. Development standards are intended to minimize risks to people and property and to avoid risk to other properties upstream or downstream of the development. King County's flood hazard reduction policies, as they relate to land use and regulatory compliance, are as follows:

16. Consistent with prerequisites for FEMA's CRS program, King County shall exceed the minimum standards of the NFIP and be consistent with the NFIP Biological Opinion and habitat restoration obligations under the ESA.
17. King County shall regulate development that occurs in flood-prone areas to avoid and minimize damage to life and property and necessary public infrastructure, support other Washington State Growth Management Act (GMA) and King County Comprehensive Plan policy goals, accommodate preferred land uses outlined by the Shoreline Management Act (described later in this chapter), and recover salmon species listed under the ESA.
18. King County should look for opportunities to improve, modify, or relocate existing county roads to ensure safe ingress and egress during flood events.

Integrated Floodplain Management

King County values innovation and is committed to understanding and reducing the adverse impacts associated with flooding. The County also recognizes the need for location-specific solutions depending on existing land uses and seeks to integrate flood risk reduction efforts with other community needs and objectives within watersheds and at geographic scales larger than a specific project site. Areas of emphasis include equitable and inclusive collaboration and coordination involving cities, counties, tribes, special-purpose districts, salmon recovery planning groups, and state and federal agencies to ensure comprehensive and effective alignment of flood management across jurisdictions. Integrated floodplain management policies include the following:

19. Consistent with federal and state guidance, King County's flood risk reduction strategies shall focus first on hazard mapping and preventative risk avoidance, followed by preparedness and mitigation actions to reduce vulnerability and protect public health and safety. King County shall also develop expertise and tailored strategies that meet the unique needs and characteristics of the region, including nonstructural alternatives and ecological restoration, and all county departments shall implement activities consistent with the policies in this Flood Plan.
20. King County's flood risk reduction efforts shall be planned and implemented in close coordination with cities, counties, tribes, special-purpose districts, salmon recovery planning

15 https://kingcounty.gov/en/legacy/council/legislation/kc_code/24_30_Title_21A.aspx.

groups, and state and federal agencies. King County shall also coordinate with other local governments and encourage regional collaboration so that risks are not transferred from one jurisdiction to another.

21. King County shall coordinate with dam owners and operators on communication of downstream risks associated with high-hazard dams. King County shall also participate in dam relicensing, review of proposals for new dams and impoundments, and other efforts related to operational procedures of dams to promote the multi-benefit objectives articulated in this Flood Plan.
22. King County shall implement flood risk reduction measures that reduce flood damages and long-term costs and shall leverage revenues through funding partnerships with other agencies and through diverse funding streams and grants that support multiple benefits.

CRS 10-Step Flood Management Plan Process

1. **Organize to prepare the plan**: Determine who will be involved in developing the plan.
2. **Involve the public**: Provide opportunities to contribute to the planning process for members of the public, through committees, public meetings, and other means.
3. **Coordinate**: Work with other agencies and organizations to incorporate their plans and efforts into the flood management plan.
4. **Assess the hazard**: Review, analyze, and summarize data on flood characteristics.
5. **Assess the problem**: Collect and summarize data on flood impacts, including repetitive losses, experienced by the community.
6. **Set goals**: Develop goals that address flood impacts identified in Step 5.
7. **Review possible activities**: Discuss pros and cons of a wide array of flood risk reduction activities.
8. **Draft an action plan**: Select appropriate risk reduction actions that the community can commit to implementing.
9. **Adopt the plan**: The governing body of the community adopts the official plan.
10. **Implement, evaluate, revise**: Monitor implementation progress and evaluate opportunities to improve implementation.

Source: CRS Coordinator's Manual (FEMA 2017)

1.7 Planning Process

King County participates in the NFIP's CRS program, which encourages communities to exceed the minimum standards of the NFIP. By doing so, renters and property owners within unincorporated King County are eligible for flood insurance premium discounts (the amount of the discount being determined by the class rating). As a CRS Class 2 community, all policy holders in unincorporated King County receive a 40 percent discount on flood insurance premiums. King County developed the 2024 King County Flood Management Plan consistent with the CRS 10-step planning process described in CRS Activity 512.a. The planning process also followed the guidance provided in Ecology's *Flood Hazard Management Planning Guidebook*.

During the project pre-planning phase, King County developed a structure to engage a wide range of partners and community members in the planning process to ensure that engagement was central to the development of the Flood Plan. The main elements included the formation of a Partner Planning Committee, an Internal Staff Planning Committee, and a Coordinating Committee; facilitation of topic-specific workshops; and direct community engagement, each of which is described in more detail below.

Partner Planning Committee

King County established the Flood Plan Partner Planning Committee in 2022 as the primary committee to support and inform the development of the Flood Plan. The committee served as a central venue for sharing information and ideas about flooding and flood risk reduction countywide, and it fulfilled FEMA's CRS Step 2 requirement that the planning process involve the public.

The committee advised and provided input and direction on topics such as updating goals, objectives, and guiding principles; discussing approaches to address priority floodplain and flood hazard management issues; and developing appropriate floodplain management strategies and actions to address expected flood risks. The committee met 10 times from October 2022 through February 2024 to discuss these topics.

Committee members represented local and state governments, tribal government, NGOs, interest groups, floodplain residents, and community members. This diverse representation of community members, governments, and interests throughout King County was integral to developing a Flood Plan that thoughtfully addresses the needs of vulnerable populations, natural and cultural resources, urban and rural areas, and an array of industries. King County staff also participated in this committee, including the County's Floodplain Administrator, CRS Coordinator, and staff representing various disciplines. A full list of committee members is provided in Appendix A.

Internal Staff Planning Committee

Given the breadth of King County work programs either affected by or with a connection to flooding and floodplains, the County established an Internal Staff Planning Committee. This committee provided a forum for county work program priorities to be shared and heard, potential conflicts identified, and policy implications of various options considered. This cross-departmental team served as a sounding board for key policy and regulatory challenges and helped identify options for resolving these challenges. The committee met nine times from early 2022 through 2023. Participants represented King County permitting, river and floodplain management, emergency management, road services, parks and recreation, stormwater services, agriculture, land acquisition, ecological restoration, climate change, and science programs. A full list of committee members is provided in Appendix A.

Coordinating Committee

The King County Flood Control District (FCD) is a special-purpose district independent from King County government, and coordination between the FCD and the County occurred through an intergovernmental team called the Coordinating Committee. This team provided advice on scope, schedule, and approach for updating the Flood Plan, particularly on issues where King County and FCD policies, funding, and decision-making roles intersect. The committee also helped to anticipate and plan for Executive, Council, and FCD Board review and consideration of the Flood Plan. The committee met 11 times from early 2022 through 2023.

Topic-Specific Workshops

Since flooding and flood-related hazards extend beyond King County's mainstem rivers to include tributaries, coastal shorelines, and urban areas, King County hosted a series of workshops to gather perspectives from tribes, partners, and community members on tributary, coastal, and urban flooding (two workshops for each topic). King County structured the workshops to hear from participants about flood hazards, specific problem areas, impacts associated with those problems, and potential solutions to consider in the Flood Plan.

Tribal Consultation

King County consulted with tribal governments during the planning process to ensure that the Flood Plan incorporates proper consideration of tribal rights and tribal resources. County staff briefed tribal natural resources program staff, invited tribes to participate on the Flood Plan Partner Planning Committee and in topic-specific workshops, and requested tribal comment on the SEPA review (described later in this chapter).

Community Engagement Strategy

King County acknowledges that past flood planning public involvement opportunities did not do enough to remove barriers to participation or support community-led solutions. To address these issues, King County developed a comprehensive community engagement strategy (see Appendix C). The strategy served as a roadmap for how King County would improve opportunities for community engagement in the development of the Flood Plan.

The community engagement strategy is based on feedback from the public, community organizations, agency management, academic research, responses to an online survey, informational interviews with eight community group leaders who represent underserved communities in King County, and five floodplain management-focused government agencies.

King County desires to reduce the impacts of flooding and help people recover from flooding more quickly. By developing a comprehensive community engagement strategy, King County was able to identify concrete steps to raise community awareness of flooding issues, local flood risk, and opportunities to reduce flood risk and build flood resilience for communities, households, and businesses. The strategy also identified approaches to gather public feedback related to flooding in a way that centers people and communities most impacted by flooding.

King County used the following engagement strategies to gather community input into the draft Flood Plan, as well as to raise awareness about flooding issues and resources available to increase flood resilience:

- **Community partnerships**: King County invited community-based organizations and individuals who are connected to priority communities to enter a contracted and funded partnership with the County. Partnership focused on collaborative co-design and implementation of customized outreach and engagement plans targeting one or more priority communities.

- **Community visits**: King County solicited invitations to local events and meetings to reach priority audiences based on demographic characteristics and geographic representation.
- **Online polling and email network**: An online engagement hub, including a three-phase online survey, was available throughout most of the Flood Plan development process. Email was used for sharing monthly announcements and updates.
- **Public meetings and workshops**: King County hosted virtual meetings and workshops, including two public kickoff meetings at the beginning of the planning process and at a point when the focus of planning was shifting into seeking input on strategies.
- **Targeted and paid advertising**: As an alternative way to reach priority communities and drive people to resources about flooding and the Flood Plan, King County implemented two advertising approaches. One involved running an ad campaign with an ethnic media company serving African American and immigrant populations, while the second involved signs and posters on King County Metro buses in east and south county areas, on Sound Transit light rail trains, and at three public transit stations.

Messaging, graphics, and communication products supported meaningful engagement throughout the planning process. Products focused on audiences new to the topic of floodplain management and were deployed in multiple settings. In most cases, these materials were translated into several languages.

Community outreach at Pacific Days festival, July 2023

1.8 Integration with State Environmental Policy Act (SEPA)

The Washington State Environmental Policy Act (SEPA) governs the process to identify and analyze environmental impacts associated with governmental actions and decisions. To identify and evaluate the potential environmental impacts of the new Flood Plan and comply with SEPA requirements, King County prepared an Environmental Impact Statement (EIS). An EIS is a tool that describes proposed actions and analyzes how those actions may affect the environment.

Through the Flood Plan EIS, King County analyzed potential impacts of the Flood Plan on threatened or endangered species, water quality, historical and cultural resources, transportation, and other elements of the environment. Additionally, given that King County expanded the focus of this Flood Plan beyond mainstem rivers, the EIS serves as a tool to evaluate how this broader scope could affect natural and built environments throughout all of King County.

The Flood Plan SEPA process followed the requirements established by Chapter 43.21C RCW[16] and guidance outlined in Ecology's *State Environmental Policy Act Handbook*. The 2024 King County Flood Management Plan is a "non-project proposal" under SEPA, which entails high-level review of impacts, alternatives, and mitigation measures for a broad program of actions, as opposed to detailed evaluation of specific project actions. A "non-project proposal" provides a foundational environmental analysis for future review of specific projects that can help to reduce the burden of environmental review for each project.

King County issued a scoping notice and Determination of Significance (DS) in November 2022. The scoping notice included a description of the alternatives that would be analyzed in the EIS and a list of the elements of the natural and built environment that the EIS would consider. All cities in King County, all tribes, and state and federal agencies were notified. The scoping period was also announced through a news release to local media and was distributed to a large email list. Scoping carried a 30-day public comment period, and 18 comment letters were submitted. Following the consideration of scoping comments, the County prepared a Draft EIS. King County released the Draft EIS for public comment in early 2024, concurrent with the Draft Flood Plan.

1.9 Other Regulatory Drivers and Commitments

In addition to SEPA (as described above), the Flood Plan was developed to comply with several regulatory requirements, as well as to fulfill other, nonregulatory commitments and obligations.

National Flood Insurance Program (NFIP) and Community Rating System (CRS)

FEMA manages the NFIP, which provides federally backed flood insurance to property owners, renters, and businesses located in some flood hazard areas. This insurance coverage helps those affected by flooding recover faster following flood damage. For this coverage to be available to community members, the local government must be a participating community, which requires that

16 https://app.leg.wa.gov/rcw/default.aspx?cite=43.21c.

the community adopt and implement certain floodplain management regulations designed to reduce future flood risk. King County is an NFIP-participating community and, as such, the recommendations in this Flood Plan must meet minimum NFIP standards to ensure that NFIP flood insurance remains available to county residents.

FEMA's CRS is a voluntary program that encourages floodplain management activities that exceed NFIP minimum standards. Under the program, flood insurance policyholders who live in jurisdictions that implement floodplain management activities that exceed NFIP minimums may receive a discount on their insurance premiums. King County has been among the highest-rated counties in the nation in CRS for several years and, at the time of plan development, King County's CRS rating is Class 2 (which provides a 40 percent flood insurance premium discount to policyholders in unincorporated areas). To maintain King County's standing in the program, this Flood Plan followed the CRS 10-step planning process described in CRS Activity 512.a (see the sidebar on page 1-18, as well as the CRS Coordinator's Manual[17] for more information).

State Planning Requirements

RCW 86.12.210[18] authorizes the legislative body of any county to adopt a comprehensive flood hazard management plan for any drainage basin located wholly or partially within the county. Washington Administrative Code (WAC) 173-145-040[19] outlines the requirements for comprehensive flood control management plans and specifies Ecology's role in approving these plans.

A comprehensive flood hazard management plan must also be developed within King County's planning framework, which implements the requirements of the Washington State GMA. The Flood Plan is adopted as a functional plan under the umbrella of the King County Comprehensive Plan. As such, the Flood Plan outlines the policies for protecting frequently flooded areas, as required by GMA.

Endangered Species Act (ESA)

The ESA is a federal law that prohibits the importation, exportation, taking, and commercialization of fish, wildlife, and plants listed as threatened or endangered species. Flood hazard management activities must balance risk reduction with protection of listed species, as well as their habitats and components of the ecosystem upon which they rely. Protection of threatened and endangered aquatic species is particularly relevant to flood hazard management activities because activities that change water bodies and floodplains can have harmful impacts on habitat, water quality, and food sources relied upon by aquatic species.

In Puget Sound, Chinook salmon, steelhead, and bull trout are listed as threatened under the ESA. All major rivers in King County, many tributaries, Lake Washington, Lake Sammamish, and the entire marine shoreline of Puget Sound comprise critical habitat for these listed species. Additionally, salmon (in particular, Chinook salmon) are a primary prey resource for southern resident orca, listed as endangered under the ESA since 2005. Flood risk reduction capital projects, which often affect

17 https://crsresources.org/manual/.

18 https://app.leg.wa.gov/RCW/default.aspx?cite=86.12.210.

19 https://app.leg.wa.gov/wac/default.aspx?cite=173-145-040.

water bodies, shorelines, and floodplains, influence habitat in positive or negative ways. Flood risk reduction projects and salmon habitat are inextricably linked.

The Puget Sound Salmon Recovery Plan was drafted in 2005 and adopted by the National Oceanic and Atmospheric Administration (NOAA) in 2007 as a path to recover threatened and endangered Puget Sound salmonid species. The Puget Sound Salmon Recovery Plan aims to achieve self-sustaining salmon populations that would support delisting of Puget Sound salmonid species, tribal fishing rights, economic vitality, and environmental health (NMFS 2007). Watershed-based recovery plans are components of the regional plan, and their implementation is guided by watershed forums comprised of partners from local, state, and federal governments, tribes, and NGOs. Through this integrated, highly collaborative framework, King County protects species and the ecosystems they rely on and actively leads an array of restoration efforts that support recovery.

Clean Water Act

The Clean Water Act is a federal law that regulates pollutants and the quality of water that enters surface waters. The Clean Water Act dictates requirements for the management of public and private stormwater and wastewater systems. King County implements a Phase I Municipal Stormwater National Pollutant Discharge Elimination System (NPDES) permit and associated activities for compliance with Clean Water Act regulations that aim to reduce runoff, while improving the treatment and storage of stormwater and wastewater. As climate change results in more extreme precipitation, managing stormwater runoff will be critical to both mitigating urban flooding and meeting permitting requirements under the Clean Water Act to limit the discharge of untreated water from combined stormwater and sewer systems.

Shoreline Management Act

The State of Washington's Shoreline Management Act (Chapter 90.58 RCW[20]) requires all counties in the state to develop Shoreline Master Programs, which are sets of regulations that dictate land use, environmental protection, and public access standards for shoreline areas. The Shoreline Management Act applies to marine waters, streams, rivers, lakes, and wetlands, as well as areas within 200 feet of these water bodies and the 1 percent annual chance floodplain. Shoreline Master Programs outline preferred land uses for shoreline areas, including single-family residences, shoreline recreational uses, ports, water-dependent industrial and commercial uses, and other developments providing public access opportunities. The Shoreline Management Act is structured to protect natural resources and requires mitigation to offset environmental impacts from allowable shoreline land uses. Shoreline Master Programs must also provide for public access to publicly owned shorelines and support access to public waters and tidelands.

King County's Shoreline Master Program aligns with the integrated floodplain management approach to this Flood Plan. The protection of habitat and ecological functions, including those in floodplains, supports natural processes that mitigate flood risk and balances the interests of water-dependent industries, shoreline property owners, and recreational users.

20 https://apps.leg.wa.gov/rcw/default.aspx?cite=90.58.

Local Requirements and Commitments

In addition to the regulatory drivers identified above, King County is committed to achieving a range of other outcomes that directly or indirectly relate to floodplains, flood hazard areas, and some of the above-referenced regulations. A summary of these is as follows:

- **Clean Water Healthy Habitat** – Adopted in 2020, King County's Clean Water Healthy Habitat (CWHH) Strategic Plan is intended to guide investments to improve water quality and aquatic habitat conditions. Of the six primary goal areas identified in the plan, five goal areas directly relate to topics addressed in this Flood Plan: healthy forests and more green spaces, cleaner and controlled stormwater runoff, functional river floodplains, better fish habitat, and resilient marine shorelines. For example, if CWHH is successful, there will be a 3,000-acre net increase in connected floodplain with native vegetation.
- **Climate Change** – The 2020 King County Strategic Climate Action Plan (SCAP) outlines actions the County can take to increase resilience to the effects of climate change. Flood risk reduction activities—especially capital projects implemented to address flood risks—can directly improve on-the-ground conditions in ways that enhance the ability of ecosystems to accommodate and adjust to changes in climate conditions.
- **Land Conservation** – King County's Land Conservation Initiative (LCI) is a regional collaboration among King County, cities, businesses, farmers, environmental partners, and others to preserve the most important remaining natural lands and urban green spaces over the next 30 years. One of the six priority land categories targeted under this initiative is river corridors, with a focus on reducing flooding and sustaining salmon runs.
- **Local Food** – King County launched the Local Food Initiative in 2014, and it supports farmers and protects farmland in the county. Part of the overall strategy behind the Local Food Initiative is to ensure the continued viability of agriculture in King County. Many of the most productive agricultural lands in the county are located within river floodplains, and part of the reason they are so productive is because of flooding and the natural deposition of nutrient-rich sediment in these areas. As a result, this Flood Plan has a direct connection to the needs of farming communities.
- **Fish Passage Restoration Program** – Fish passage barriers limit the ability of native salmon to reach their spawning grounds, and removing those barriers is one of the most straight-forward habitat improvements that can be made to ensure the continued survival of salmon. King County's Fish Passage Restoration Program is focused on restoring passage at barriers that block access to the best habitats. Doing so will not only improve instream conditions for fish but may also reduce risk of roadway damage due to water backing up behind undersized or blocked culverts.
- **King County Regional Hazard Mitigation Plan** – The 2020 King County Regional Hazard Mitigation Plan[21] is a multi-hazard plan that assesses natural and human-caused hazards that can impact the Puget Sound region and outlines strategies to reduce risks from those hazards and build resilience. The plan includes flooding as one of the many hazards addressed, yet the Flood Plan contains more detailed discussions of flooding and flood risk reduction solutions.

[21] https://kingcounty.gov/en/legacy/depts/emergency-management/emergency-management-professionals/regional-hazard-mitigation-plan.

CHAPTER 2
Flooding in King County

This chapter describes the types of flooding and flood-related hazards most-often observed in King County. Flooding occurs in many locations in the county, and the types of flooding and the risks it presents to people, property, and infrastructure are numerous and vary by location. This chapter is divided into seven sections. The first section (Section 2.1) provides an overview of the types of flooding addressed by this Flood Plan. The four sections that follow describe the primary flood and flood-related hazards and risks by King County's four major river watersheds:

- South Fork Skykomish/Snoqualmie River (Section 2.2)
- Lake Washington/Cedar/Sammamish River (Section 2.3)
- Green/Duwamish River (Section 2.4)
- White River (Section 2.5)

Section 2.6 describes the flooding characteristics for three new areas of focus for King County's flood planning: tributary flooding, urban flooding, and coastal flooding. The final section (Section 2.7) summarizes the impacts of flooding at the countywide scale and summarizes the results of the countywide flood hazard risk assessment performed using FEMA's Hazus Risk Assessment Platform.

2.1 County Context: Primary Flooding Types Considered by this Flood Plan

River Flooding

King County's floodplains reflect a geologic present and past that include large-scale tectonic and volcanic processes that occurred over tens of millions of years; several periods of extensive glaciation, the latest of which ended about 15,000 years ago (Booth et al. 2003); and at least one major mudflow, the Osceola Mudflow, which occurred roughly 5,700 years ago. Tectonic and volcanic processes created large-scale landforms, such as the Cascade and Olympic Mountain ranges, the Olympic Peninsula, and Puget Sound. More recent glaciers and mudflows shaped many of the lowland surface features apparent today, including the topography and soils of King County's lowland river valleys. Alpine glaciers are still present in headwater basins of the White, Snoqualmie, and South Fork Skykomish rivers, and the character of glaciers is changing as climate change increases their melting and as glacial recession exposes new sediment sources.

Lower Snoqualmie River flooding near Duvall, December 2015

Earthquakes occur periodically along active faults within several fault zones in King County and have the potential to cause tsunamis and compound flood hazards when they occur during flood events. Earthquakes may also induce landslides that dam rivers, resulting in upstream flooding. These processes and events have influenced the length, width, steepness, sediment load, and channel forms of King County's large rivers and major tributaries and continue to shape the region today.

The headwaters and middle reaches of rivers in King County are typically steep and dominated by bedrock, boulders, and landslides. These areas are major sources of sediment transported downstream by rivers and streams, and floodplains in these reaches are often narrow or absent. Middle reaches are less developed than the river systems in lowland areas, but mountain valley roads and small residential communities in these areas can be impacted by erosion and fast flows from river and tributary flooding. When the rivers eventually reach the Puget Sound lowlands, they flatten out, deposit sediments carried down from upstream, and form floodplains that are often broad, ecologically complex, and biologically productive.

Native American tribes have had a continuous, active presence in what is now King County for thousands of years. These lands provide critical habitats for fish and wildlife, and hunting and gathering have occurred in the region since time immemorial. In the relatively brief time since Euro-American settlement began in the Puget Sound basin, development has extensively altered the region's river floodplains—perhaps nowhere more so than in King County. Early land-clearing and installation of drainage systems to support farming, mining, and transportation transitioned throughout the 20th century to more extensive modifications that allowed for ever-expanding

residential, commercial, and industrial development. These efforts disconnected formerly forested and vegetated floodplains from watercourses and converted them to developed land uses. Rivers and streams were entirely rerouted, wood was removed from floodplains and channels, banks were armored with rock, and dams were constructed for water supply, flood control, and hydropower.

Alterations to the region's floodplains caused substantial losses of natural floodplain functions, including floodwater storage and conveyance, as well as changes in sediment transport processes. The reduction or elimination of riparian and floodplain habitats produced catastrophic consequences for native salmonid populations. Channelization of rivers and streams led to an increase in erosive water velocities. Dams and other channel changes altered the natural hydrology and disrupted the flow of sediment and wood through river and stream systems. What were formerly hydraulically complex systems of braided and meandering channels and wide floodplains became high-energy, single-thread channels, sometimes in a matter of years.

At present, intensive residential, commercial, and industrial land uses occupy most of the floodplains in the lower reaches of King County's rivers and streams (land uses in the county are illustrated in **Figure 2.1-1**). In turn, floodplain management must grapple with the conflicts presented by development and the costs associated with mitigating risk to developed areas.

King County is home to six major river systems—the South Fork Skykomish, Snoqualmie, Sammamish, Cedar, Green/Duwamish, and White rivers. Using Washington's Water Resource Inventory Area (WRIA) framework, these rivers fall within four WRIAs: WRIA 7 (Snohomish River basin, which includes the South Fork Skykomish and Snoqualmie rivers), WRIA 8 (Lake Washington/Cedar/Sammamish watershed, which includes the Sammamish and Cedar rivers), WRIA 9 (Green/Duwamish and Central Puget Sound watershed, which includes Vashon-Maury Island), and WRIA 10 (Puyallup-White watershed). The watersheds and subbasins are illustrated in **Figure 2.1-2** and **Figure 2.1-3**, respectively.

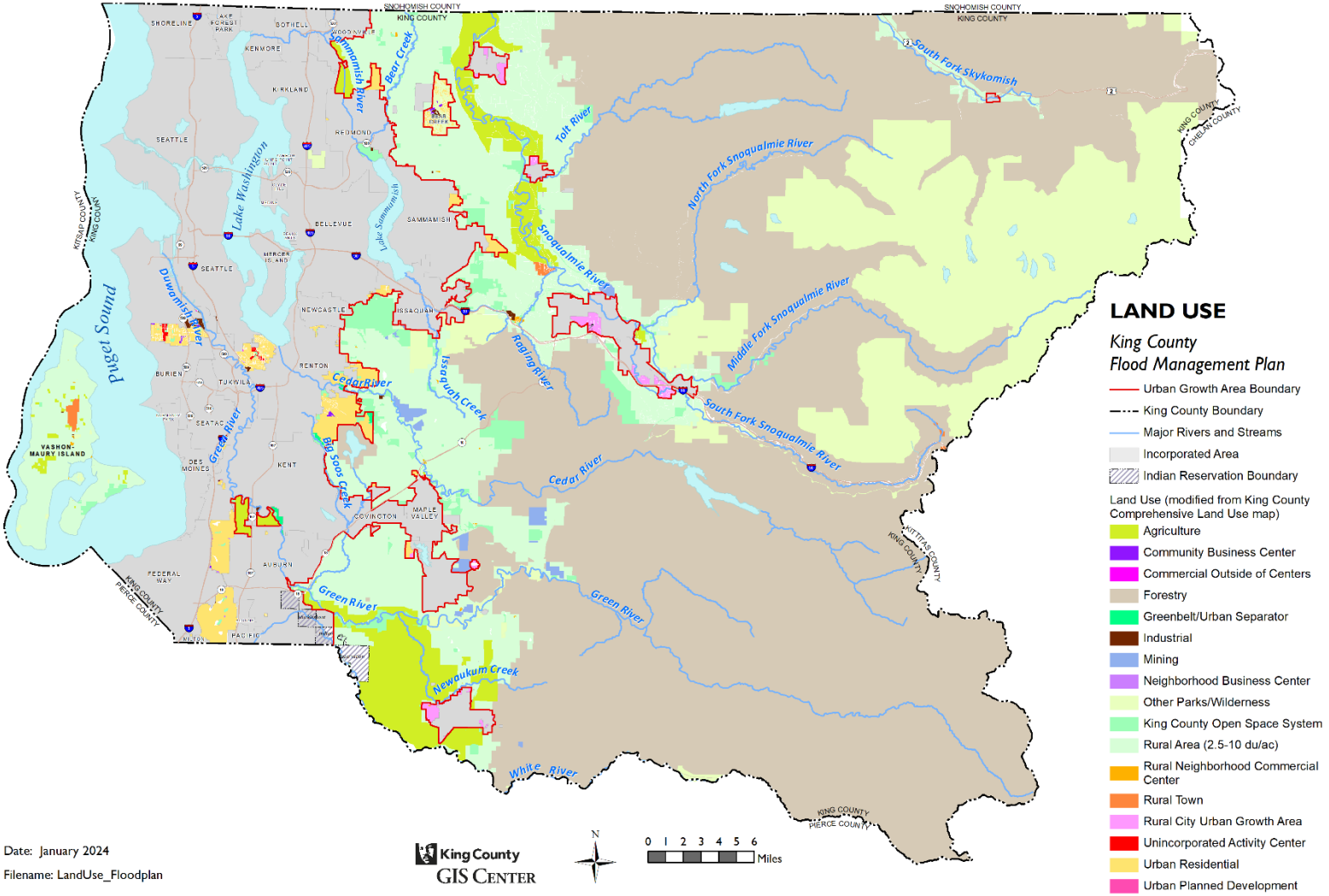


Figure 2.1-1
Land Use in King County

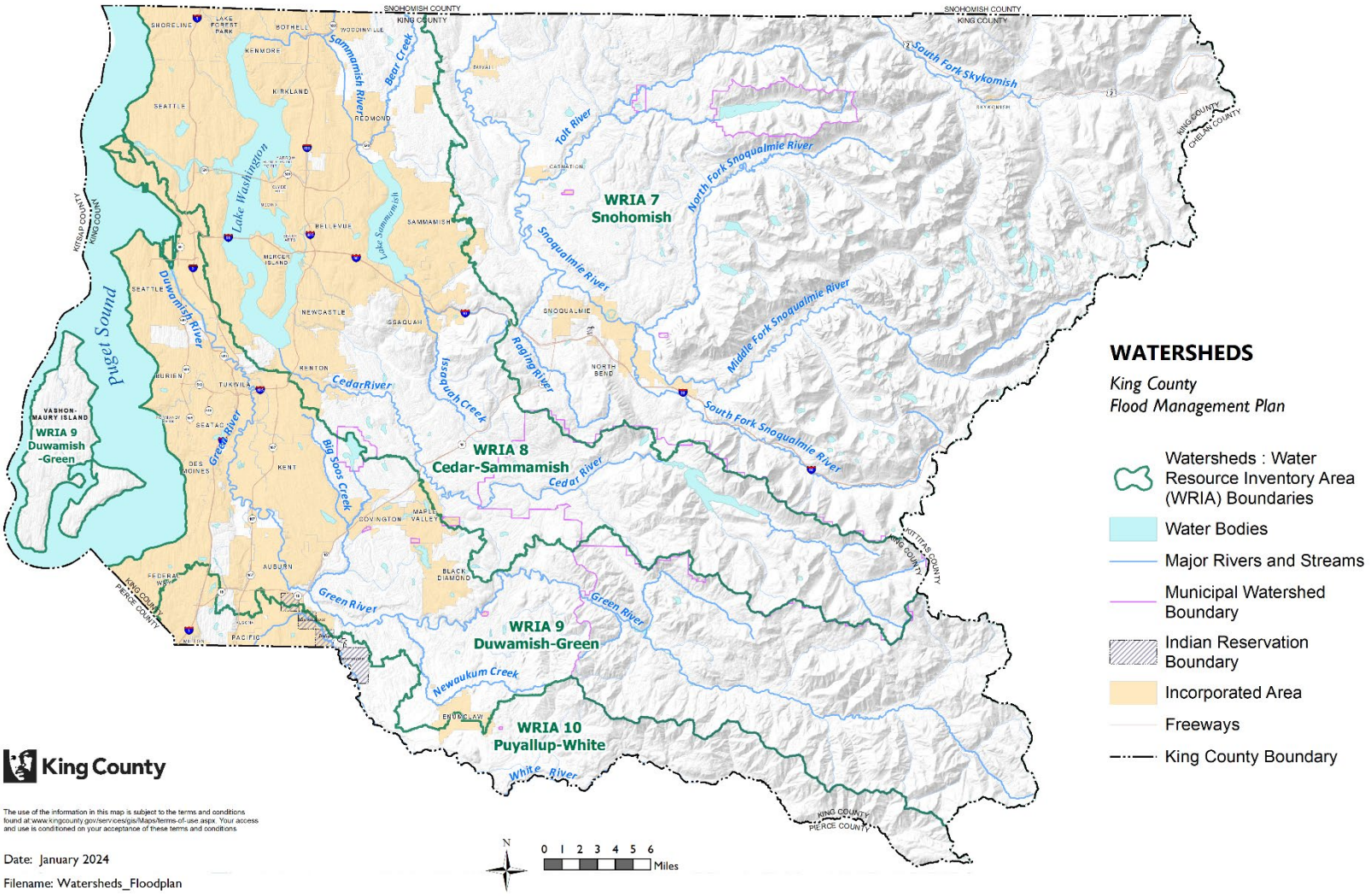


Figure 2.1-2
King County Watersheds

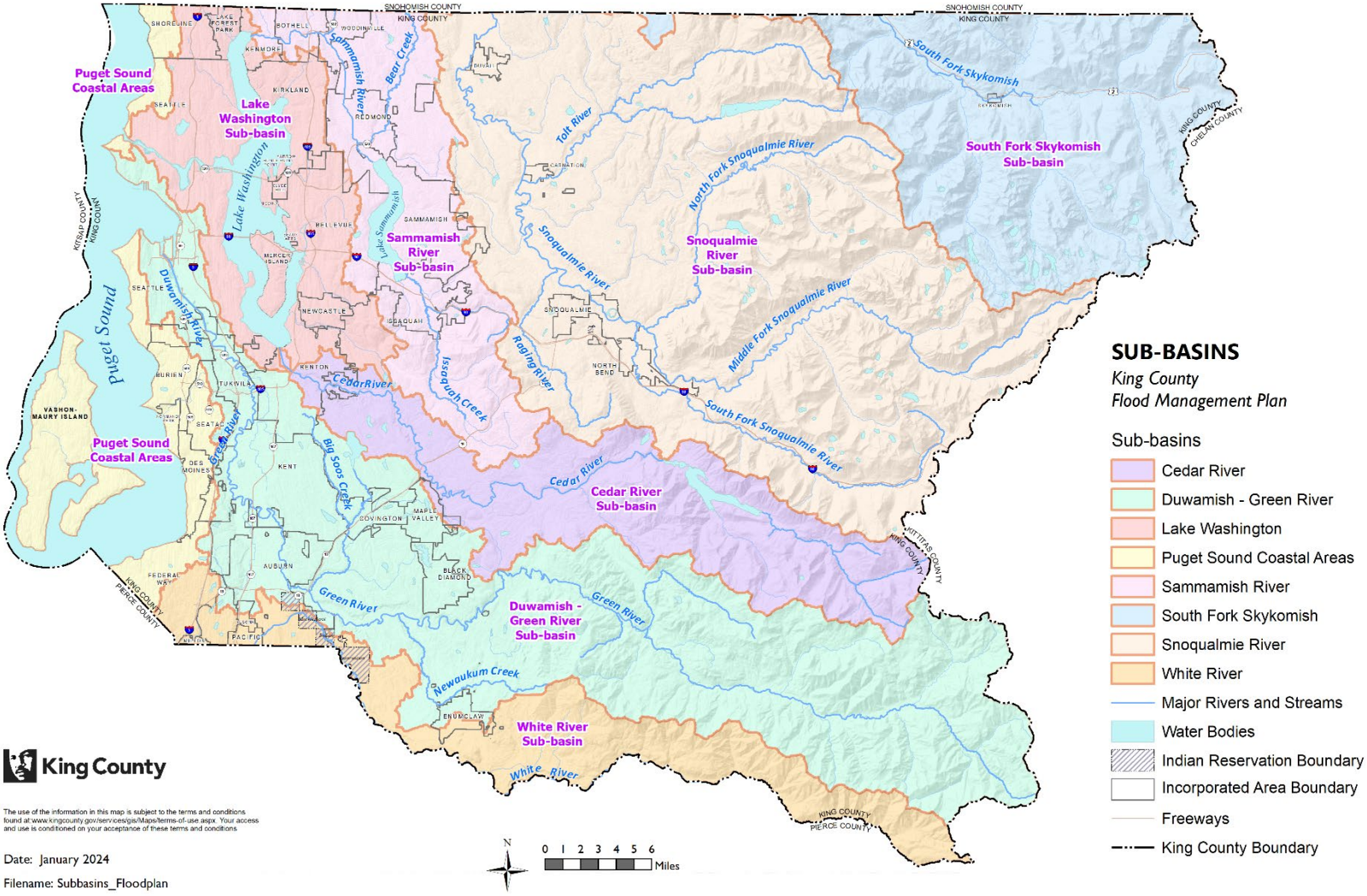


Figure 2.1-3
King County Subbasins

The character of each of the watersheds presented in Figure 2.1-2 is quite different, as summarized below (more extensive discussion of each basin's characteristics is provided in Sections 2.2 through 2.5 of this plan).

- **South Fork Skykomish/Snoqualmie River Watershed** – The Snoqualmie River and the South Fork Skykomish River, in the northeast portion of King County, are part of the larger Snohomish River watershed. The Snoqualmie River Valley is the most flood-prone area of King County, and flooding typically results in inundation by deep, slow-moving floodwaters, with some areas of deep and fast flows, especially along certain tributaries. The placename "Snoqualmie" is used in many places within this plan. The term takes its name from the sduk^{w}albix^{w}, Snoqualmie People, who have lived in these lands since time immemorial. The South Fork Skykomish River generates deep, fast-moving flood flows capable of severe bank erosion.
- **Lake Washington/Cedar/Sammamish River Watershed** – The Lake Washington/Cedar/Sammamish watershed has two rivers—the Cedar and Sammamish—which connect to Puget Sound via a lake and a manmade system of channels, including the Hiram Chittenden (Ballard) Locks. The Cedar River experiences fast, erosive flows, whereas the Sammamish River experiences very little overbank flooding. Flooding occurs in other areas of the watershed, including "flashy" flows along Issaquah Creek and other urban streams and elevated water levels along the shoreline of Lake Sammamish. ("Flashy" hydrology refers to floodwater flows that can rise quickly during storms with minimal infiltration.)
- **Green/Duwamish River Watershed** – The Green River becomes the Duwamish River at the Black River confluence (River Mile 11.0). Flooding along the Green River can be fast flow in areas and slow-moving overbank inundation in others. The Duwamish River is characterized primarily by slow-moving inundation. The Howard Hanson Dam in the upper reaches of the Green River, built and managed by the U.S. Army Corps of Engineers (Corps), provides flood control to the highly developed downstream areas of the river corridor. Flooding on the Green River is primarily precipitation-driven, and the Duwamish River in the lower watershed faces compound flood risk arising from precipitation and tidal influence.
- **White River Watershed** – The White River in King County is lightly populated through much of its length. The river flows through the Muckleshoot Indian Tribe reservation before reaching more developed areas in the most downstream part of the river. These developed areas face significant flood risk due to being in a depositional reach of the river. The river carries the most significant sediment load of any river in King County, and reduced channel capacity arising from ongoing sediment deposition is a primary flood risk in this watershed.

Tributary Flooding

A tributary is a smaller stream or river that flows into a larger river; for example, Tokul Creek flows into the Snoqualmie River and is therefore a tributary of the Snoqualmie. King County has an extensive network of smaller tributary streams. Some of these are tributaries to the mainstem rivers described above, some flow into lakes (such as Lake Washington and Lake Sammamish), and some flow directly from their point of origin into Puget Sound. Despite their smaller size than rivers, tributaries experience flooding that can affect King County communities in significant ways.

Erosion from tributary flooding on Issaquah Creek, January 2021

Tributary flooding can be similar in character to riverine flooding: overbank flows and channel migration result in impacts that resemble those that occur along rivers, albeit on a smaller scale. Like larger rivers, tributaries have been modified by humans in ways that can exacerbate flooding. Streams have been rerouted, piped, straightened, dredged, armored, and otherwise changed in ways that limit the natural ability of the stream to convey large volumes of water. In addition to being disconnected from their floodplains, wetland habitats that served as reservoirs for higher flows have been lost or highly modified in many locations.

Tributaries are especially sensitive to changing precipitation patterns. Due to their smaller size, they typically have less capacity to handle extreme rainfall or increased runoff from impervious surfaces. They also can transport and deposit sediment in ways that exacerbate localized flooding problems or present risk in new or unexpected ways. One such way this occurs is through alluvial fans, which typically form accumulations of sediment at the base of steeper slopes. These features can displace water and cause flooding in areas that may not have previously been known to experience flooding. Streams on alluvial fans can experience seasonal or year-round flows, landslides and debris flows, avulsions, and flooding from beaver dam outbursts. This is recognized as a unique type of flood hazard in certain King County communities. As precipitation events become more extreme with climate change, and with increased development that creates more impervious surfaces, flood risk associated with tributaries will continue to be a problem in King County.

Coastal Flooding

King County has 103 miles of saltwater shoreline, including incorporated areas along the east side of Puget Sound and the unincorporated areas of Vashon and Maury islands. Coastal flooding results when high tides and storm surges inundate or cause damaging erosion to normally dry areas along the marine shoreline (FEMA 2023). An additional factor affecting King County communities is referred to as compound flooding, which is when high tides, storm surges, and inland factors—such as saturated soils and large volumes of freshwater inflow—combine to exacerbate flooding conditions, such as what can occur along the lower Duwamish River.

Coastal flooding and coastal erosion are not new phenomena in King County, but mitigating coastal flood risk has, historically, not been a focus of King County's flood risk reduction program. King County has mapped a coastal high-hazard area and has regulations in place to guide allowable activities within this area, but the County has only sporadically implemented other coastal flood risk mitigation activities.

Waterfront road flooding on Maury Island, December 2022

In addition to current coastal flood risk, sea level rise has profound implications for future risk along marine shorelines and in other tidally influenced areas, especially those that are highly developed (e.g., lower Duwamish River). To account for uncertainties in coastal flooding depths due to sea level

rise, King County has identified a sea level rise risk area for the Vashon and Maury Island shorelines and developed accompanying regulations for this area, which extends landward to an elevation of 3 feet above the base flood elevation of the mapped coastal high-hazard area. The scientific knowledge about sea level rise continues to evolve, and King County and cities within the county need to prepare now to address what will very likely be increasing flood risk in coastal areas.

Although rare, tsunami inundation of Puget Sound coastal areas is another type of coastal flood hazard. Research indicates that a rupture along the Seattle Fault Zone resulted in a tsunami along the coastline at the West Point Wastewater Treatment Plant. A similar event would inundate Puget Sound coastlines and portions of the Duwamish River shoreline with very little warning time.

Urban Flooding

Flooding in urban areas may result from rivers, smaller streams, and coastal factors, but for the purposes of this Flood Plan, urban flooding refers to flooding caused by stormwater runoff or flooding resulting from overwhelmed urban storm sewer systems.

Urban flooding, City of Seattle (Photo Credit: Seattle Public Utilities)

Extensive development in the urban areas of King County, coupled with aging infrastructure and climate change, make urban flooding an especially challenging problem. While flood hazard areas of some waterbodies in urban areas are delineated and regulated, flood hazards associated with flooding from runoff and overwhelmed stormwater infrastructure are not delineated or regulated. Predicting where and when urban flooding will occur is exceedingly difficult due to the number of

intersecting factors that drive the problem. Also, since water does not follow jurisdictional boundaries, overlapping authorities can make mitigation of urban flooding issues difficult, although stormwater regulations under the Clean Water Act provide some consistency across jurisdictions.

Less Frequent Flood Hazards

In addition to the flooding types discussed above—river, tributary, coastal, and urban flooding—this plan also presents information on less frequent hazards.

Levees are present in all of King County's major river watersheds. While levees provide some flood protection, they are not guaranteed to be entirely floodproof, and they do not eliminate the risk to people, property, and infrastructure. Overtopping of levees can occur when floodwaters exceed levee design capacity. Levee failure—while rare—can also occur. The watershed sections in this chapter discuss risks to the levee systems in those watersheds, and a more detailed discussion of levees as a less frequent flood hazard is presented in **Appendix D**.

Dam failure is a low probability, high consequence hazard that can result in loss of life, property and infrastructure damage, public health impacts, impacts to safe drinking water, and environmental degradation. King County has high hazard dams on the Green, White, Cedar, and South Fork Tolt rivers. Additionally, Culmback Dam, which is in Snohomish County, would flood parts of the lower Snoqualmie Valley in King County if it failed. Each of the watershed-focused sections that follow in this chapter discusses the role of dams on hydrology and flooding conditions as applicable, and an assessment of dam failure as a less frequent flood hazard is presented in **Appendix E**.

Natural and Beneficial Functions of Flooding

The remaining sections of this chapter provide an overview of conditions across King County's major watersheds and other flood hazard areas, but some of the beneficial functions of flooding are the same regardless of location.

Periodic flooding helps to create river floodplains that contain unique and productive habitats. Because of floods and movement of river channels, floodplains are highly dynamic, and the ecosystems within them are adapted to and dependent on periodic inundation. For example, some riparian plants depend on floods for seed dispersal and establishment, and many bird and fish species rely on annual inundation of floodplain habitats for foraging and growth.

In areas where floodplains and watercourses remain connected or have been reconnected, periodic floods help to create and maintain channel networks, floodplain wetlands, and off-channel habitats, such as side channels, backwaters, and ponds. All these habitat types are especially important for juvenile salmonids (including those listed as threatened under the ESA). Floods can provide organisms (such as fish and birds) with access to productive floodplain habitat and connectivity between aquatic, riparian, floodplain, and wetland habitats, which are again crucial for species like salmon (juvenile salmon, in particular) that depend on these habitats for growth. Connected floodplains also provide areas of refuge for juvenile salmon, where they can escape the high velocity of the main channel until the flood levels subside.

Floods can also move materials that are natural building blocks for salmon habitat. High flows can deliver nutrients to floodplain habitats, increasing ecological productivity. Flooding can recruit and transport large wood within river and stream channels, which supports the complex habitat needed for fish and other aquatic organisms. Flooding also moves sediment in ways that are beneficial to fish habitat, including delivery of spawning gravels to waterways through bank erosion, transporting gravel from upstream, or depositing material in locations that connect riverine and floodplain habitat. High flows during flooding can drive scour and erosion around large wood, log jams, and riverbanks, creating pools and diverse habitat. Sediment transport during floods can also help build and maintain estuary habitats (in systems with intact estuaries). These biodiversity hot spots are critical rearing habitat for juvenile Chinook salmon.

In addition to the beneficial functions of flooding itself, the floodplains created by periodic flooding provide additional advantages. Naturally vegetated and connected floodplain ecosystems in which artificial drainage networks have been removed can slow and store floodwaters and disperse energy, reducing flood stages and erosion potential. Healthy floodplain vegetation and soil microbes can improve water quality by removing pollutants and excess sediment or nutrients from runoff or river water, and stream bank vegetation can resist erosion. Connected and naturally drained floodplains can increase connections with groundwater and can supplement stream base flows in dry times of year. Floodplains can also store sediment and reduce the rates of sediment transport downstream.

Climate Change

As noted in King County's 2020 Strategic Climate Action Plan, the effects of climate change are already being felt in the county. Since 1900, average annual air temperature in the Puget Sound region has increased 1.3 degrees Fahrenheit.[22] Heavy rain events are getting heavier,[23] the region is experiencing a long-term decline in snow and ice in the Cascades and Olympic mountains,[24] and sea level has risen more than 9 inches in Seattle since 1899.[25]

Climate change is projected to increase the potential for river and coastal flooding in King County. While results will vary by location and flood interval, river flooding is expected to increase due to the combined effects of wetter winters, more intense heavy rain events, and more winter precipitation falling as rain rather than snow in mountain watersheds. The potential effects of these factors on flooding conditions in each of the county's WRIAs and other environmental contexts are detailed in Sections 2.2 through 2.6. In addition to changes in flooding conditions, climate change will likely also produce negative effects for native salmon populations.

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22 Chapter 2 in Mauger, G.S., J.H. Casola, H.A. Morgan, R.L. Strauch, B. Jones, B. Curry, T.M. Busch Isaksen, L. Whitely Binder, M.B. Krosby, and A.K. Snover. 2015. State of Knowledge: Climate Change in Puget Sound. Report prepared for the Puget Sound Partnership and the National Oceanic and Atmospheric Administration. Climate Impacts Group, University of Washington, Seattle. doi:10.7915/CIG93777D.

23 Rath, J., S. Roy, and J. Butcher. 2017. Intensity Duration Frequency Curves and Trends for the City of Seattle. Technical Memorandum prepared for Seattle Public Utilities.

24 Mote, P.W., S. Li, D.P. Lettenmaier, et al. 2018. Dramatic declines in snowpack in the western US. npj Clim Atmos Sci 1, 2. https://doi.org/10.1038/s41612-018-0012-1.

25 Sea Level Trends - NOAA Tides & Currents.

Sea level rise will also increase the frequency and extent of coastal flooding. Sea level in King County is projected to rise approximately 1 to 2 feet by mid-century and 2 to 5 feet by 2100 under a high greenhouse gas scenario.[26] This expected increase may also exacerbate compound flooding in coastal drainages as noted above in the section on coastal flooding, which could impact public health, life, and safety.

Tribal Context

King County has a large and diverse population of indigenous people who contribute a unique history, strength, and vibrancy to the community. Since time immemorial, Coast Salish speaking people cared for the lands of the Salish Sea basin. They developed culture, stewarded land and water, and established communities. As the United States expanded its borders and Washington achieved statehood, federal and state actions forced indigenous people to relinquish their ancestral homelands and relocate to consolidated reservations. These forced actions threatened the relationship indigenous people had with the land, causing harm to native cultures and tribes. Coast Salish descendants and other indigenous people have endured, however, and have revitalized indigenous peoples' relationship with the land and Coast Salish peoples' relationship with this place.

Approximately 22,697 King County residents self-identify as American Indian / Alaska Native. Of that demographic group, 3,900 residents are members of local Indian tribes who are indigenous to this place. King County routinely interacts with six indigenous tribal organizations, including: Duwamish Tribal Services, Muckleshoot Tribe, Puyallup Tribe, Snoqualmie Tribe, Suquamish Tribe, and Tulalip Tribes. Tribal reservations in King County are illustrated on **Figure 2.1-4**.

Five of these tribal organizations, including Muckleshoot, Puyallup, Snoqualmie, Suquamish, and Tulalip, have been formally recognized by the United States as Indian tribes. Pursuant to such recognition, each of these tribes has established a constitutional form of government and corporate form of business. King County has a government-to-government relationship with these five Indian tribes premised on their sovereign right to self-governance.

Four of these tribal organizations, including Muckleshoot, Puyallup, Suquamish, and Tulalip, have been adjudicated to be the successors in interest to tribal people who signed the Treaties of Medicine Creek and/or Point Elliott. Federal courts have concluded that these tribes used and occupied land and marine territory throughout what is now King County and retain rights to fish, hunt, gather, and travel to and from certain of their traditional harvest areas. As treaty tribes, Muckleshoot, Puyallup, Suquamish, and Tulalip Tribes are co-managers with the State of Washington regarding fish and wildlife and related habitat.

Two of these tribal organizations, including Muckleshoot and Snoqualmie, have federally protected reservations located in King County. Three others, including Puyallup, Suquamish, and Tulalip, also have reservations located in adjacent counties.

[26] Washington Coastal Resilience Project online data tool, http://www.wacoastalnetwork.com/washington-coastal-resilience-project.html.

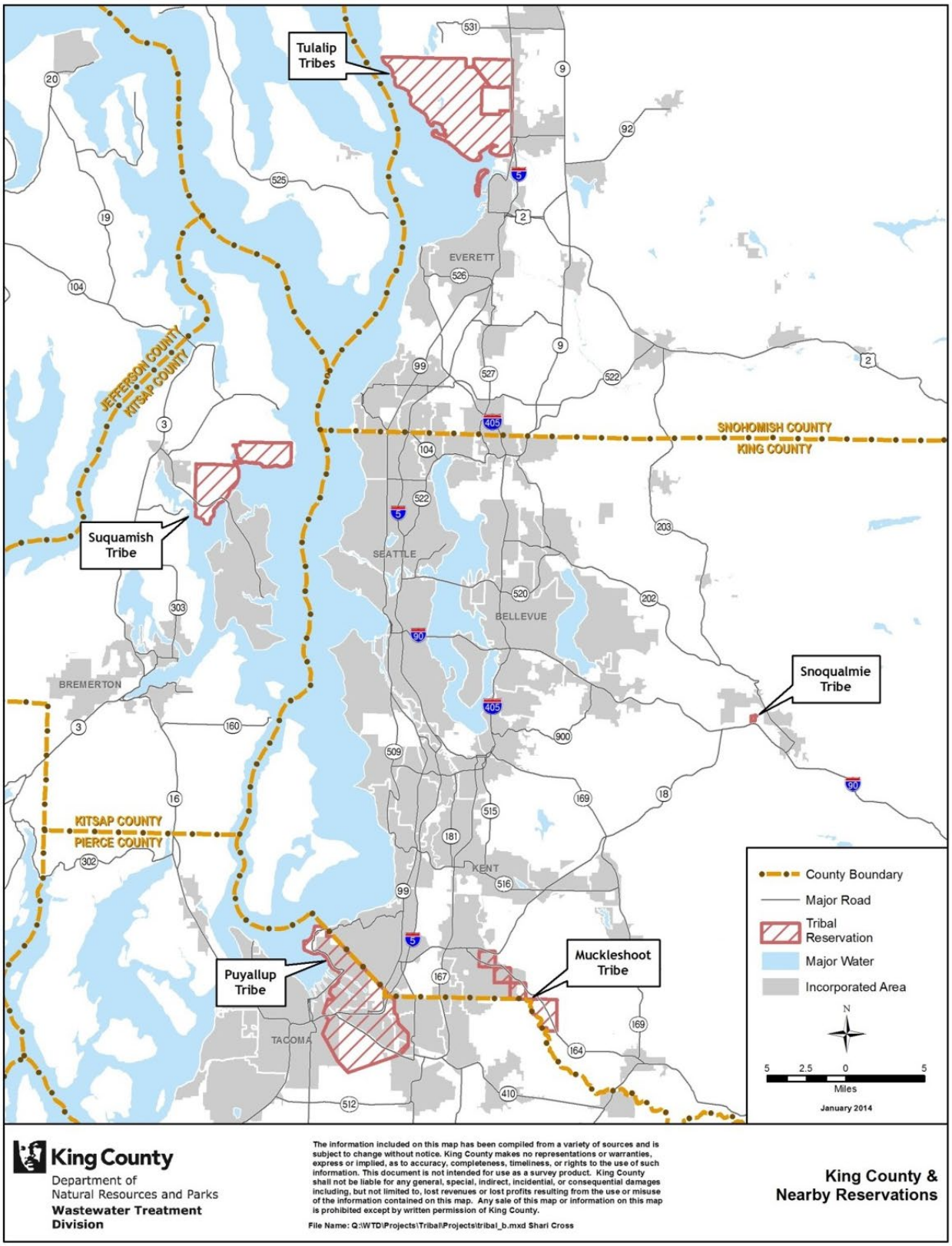

Figure 2.1-4
Tribal Reservations in King County

King County routinely consults with all five of the local federally recognized tribes, including Muckleshoot, Puyallup, Snoqualmie, Suquamish, and Tulalip, and the County will also occasionally confer with Duwamish Tribal Services, a tribal organization that is not a federally recognized Indian tribal government.

Demographics and Social Vulnerability of King County Flood Hazard Areas

Factors such as race, age, gender, educational attainment, health, economic status, and housing status are elements that collectively influence "social vulnerability." The concept of social vulnerability relates to how risks are experienced and provides an avenue to understand risk beyond that which arises from physical hazards. Acknowledging social vulnerability reflects the reality that certain groups may experience and recover from disasters differently than others and is a first step toward identifying strategies to build flood resilience among the most vulnerable communities.

The Centers for Disease Control created the Social Vulnerability Index (SVI), which is a tool to help understand the social vulnerability of every census tract in the United States.[27] Understanding social vulnerability through the SVI can help local governments identify communities that will most likely need support before, during, and after a hazardous event. King County assembled SVI information for subbasins in flood hazard areas, as shown in **Figure 2.1-5**. The SVI uses a 0–1 scale, where higher numbers indicate greater levels of social vulnerability. The flood hazard areas demonstrating the highest vulnerability using the SVI are the lower Cedar River in Renton, the lower White River, and the lower Green/Duwamish River.

King County conducted a demographic analysis to support the development of this Flood Plan, which identified 57,737 people living in areas with mapped flood hazards, including those along the marine shoreline and on small coastal creeks that drain into Puget Sound. Of the 57,737 residents living in mapped flood hazard areas, approximately 41 percent are Black, Indigenous, and other People of Color (BIPOC). The Green/Duwamish watershed is the only major river watershed in King County in which more BIPOC residents (59 percent) than white residents (41 percent) reside in mapped flood hazard areas, largely due to the high percentage of BIPOC (63 percent) and large population (13,800) residing in the lower Green/Duwamish River subbasin. Other watersheds exhibiting a high percentage of BIPOC community members residing in flood hazard areas include the Sammamish (43 percent), Cedar (36 percent), and White River watersheds (38 percent).

[27] More information available at: https://www.atsdr.cdc.gov/placeandhealth/svi/index.html.

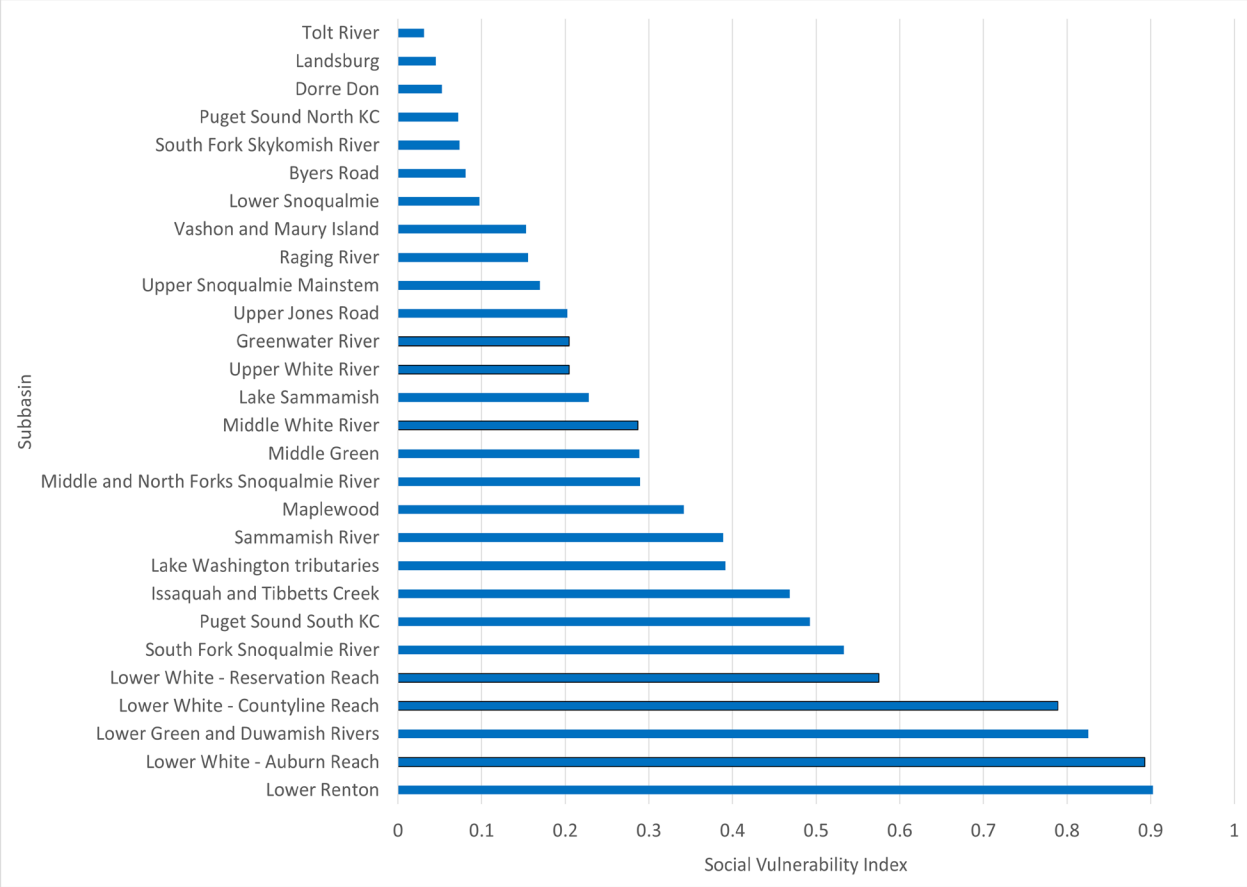

Figure 2.1-5
Social Vulnerability Index Scores for Flood Hazard Area Subbasins

Approximately 47 percent of King County's total population is BIPOC, and, as noted above, BIPOC communities comprise 41 percent of those living in the county's flood hazard areas. For the BIPOC population living in the county's flood hazard areas, racial demographics are as follows (and as illustrated in **Figure 2.1-6**):

- Asian – 13 percent
- Hispanic or Latino – 13 percent
- Black – 5 percent
- American Indian or Alaska Native – 1 percent
- Hawaiian or other Pacific Islander – 1 percent
- Two or more races – 7 percent
- Other race – 1 percent

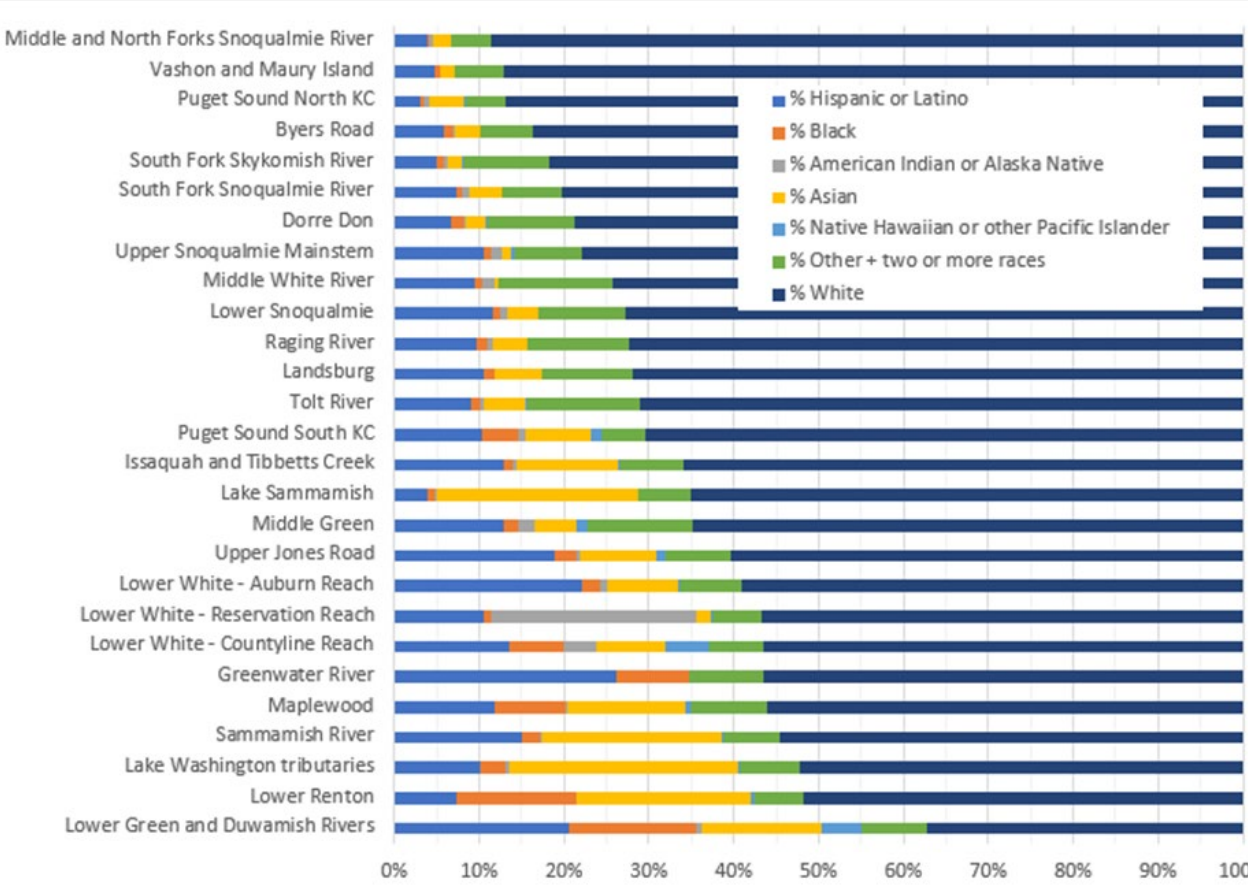

Figure 2.1-6
Racial Distribution of Populations in King County Flood Hazard Areas, by Subbasin

Interestingly, each of these percentages is lower than the racial percentages for the King County population as a whole, with the exception of Hispanic or Latino. Those identifying as Hispanic or Latino comprise approximately 10.5 percent of King County's total population, yet 13 percent of those living in the county's flood hazard areas identify as Hispanic or Latino.

By applying the SVI concept, demographic data can be used to estimate a population's relative vulnerability to better understand who will be impacted by or benefit from floodplain management activities. The data can help to identify communities that might have the greatest relative social vulnerability and can suggest needs that may inform overarching strategies for engaging or planning with those communities. Broad race categories, however, do not reflect the diversity of nationalities, cultures, and perspectives represented. In addition, while some people may share demographic characteristics, that does not mean they have the same needs. These data are a starting point for understanding who lives throughout King County's flood hazard areas and should not replace more direct interaction and engagement to better understand the needs of the people served by the County.

Potential Risk and Damages from Flooding

While developing this Flood Plan, King County performed a flood risk assessment using FEMA's Hazus Risk Assessment Platform (Version 6.0, Level 2 analysis). The purpose of this assessment was to identify the number of structures exposed to flood events of different magnitudes and to estimate the potential dollar value of damages associated with those events. The assessment evaluated the risk associated with the 10, 5, 2, 1, and 0.2 percent annual chance flood events. Results were generated for general building stock (all structures), critical facilities,[28] and repetitive loss properties. Flood hazard areas are illustrated in **Figure 2.1-7**, critical facilities are mapped in **Figure 2.1-8**, channel migration zones[29] are mapped in **Figure 2.1-9**, repetitive loss areas are mapped in **Figure 2.1-10**, and landslide hazard areas are mapped in **Figure 2.1-11**.

Results from the flood hazard risk assessment are further explained in each of the remaining sections of this chapter (Sections 2.2 through 2.6), accompanying the relevant geography to which they apply, and Section 2.7 presents countywide results. Briefly introducing the county-level information here, the risk assessment identified the following:

- Across King County, 10,885 structures (not including critical facilities) could be exposed to a 1 percent annual chance riverine flood event, and 860 structures could be exposed to a 1 percent annual chance coastal flood event.
- While flood events do not occur uniformly across the landscape, the assessment estimated that potential damages from a 1 percent annual chance riverine flood event could exceed $368 million countywide. Potential damages from a 1 percent annual chance coastal flood event could exceed $113 million.
- In total, 498 critical facilities could be exposed to the 1 percent annual chance riverine flood event, and 26 critical facilities could be exposed to the 1 percent annual chance coastal flood event. Potential damages could exceed $114 million for a 1 percent annual chance riverine flood event and approach $500,000 for a 1 percent annual chance coastal flood event.

Chapter Organization

The following sections of this chapter share insights about flooding characteristics, flooding problems, and other attributes of flood hazard areas in King County, organized by watershed or WRIA listed above. Areas included in the flooding overview include risk associated with special flood hazard areas, repetitive loss areas, areas not mapped as special flood hazard areas but that have flooded in the past, and other known surface flooding issues. Additionally, this chapter and other portions of the Flood Plan contain information on less-frequent events that contribute to flood risk, as well as flood problems that may get worse in the future because of the effects of climate change or changes in land use and development.

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28 For this analysis, King County defined critical facilities as those structures or facilities identified by FEMA as "community lifelines," which FEMA defines as *"enabl[ing] the continuous operation of critical government and business functions and [are] essential to human health and safety or economic security."* More information about community lifelines can be found at: https://www.fema.gov/emergency-managers/practitioners/lifelines.

29 The channel migration zone, or CMZ, is the area within the lateral extent of likely stream channel movement that is subject to risk due to stream bank destabilization, rapid stream incision, stream bank erosion, and shifts in the location of stream channels.

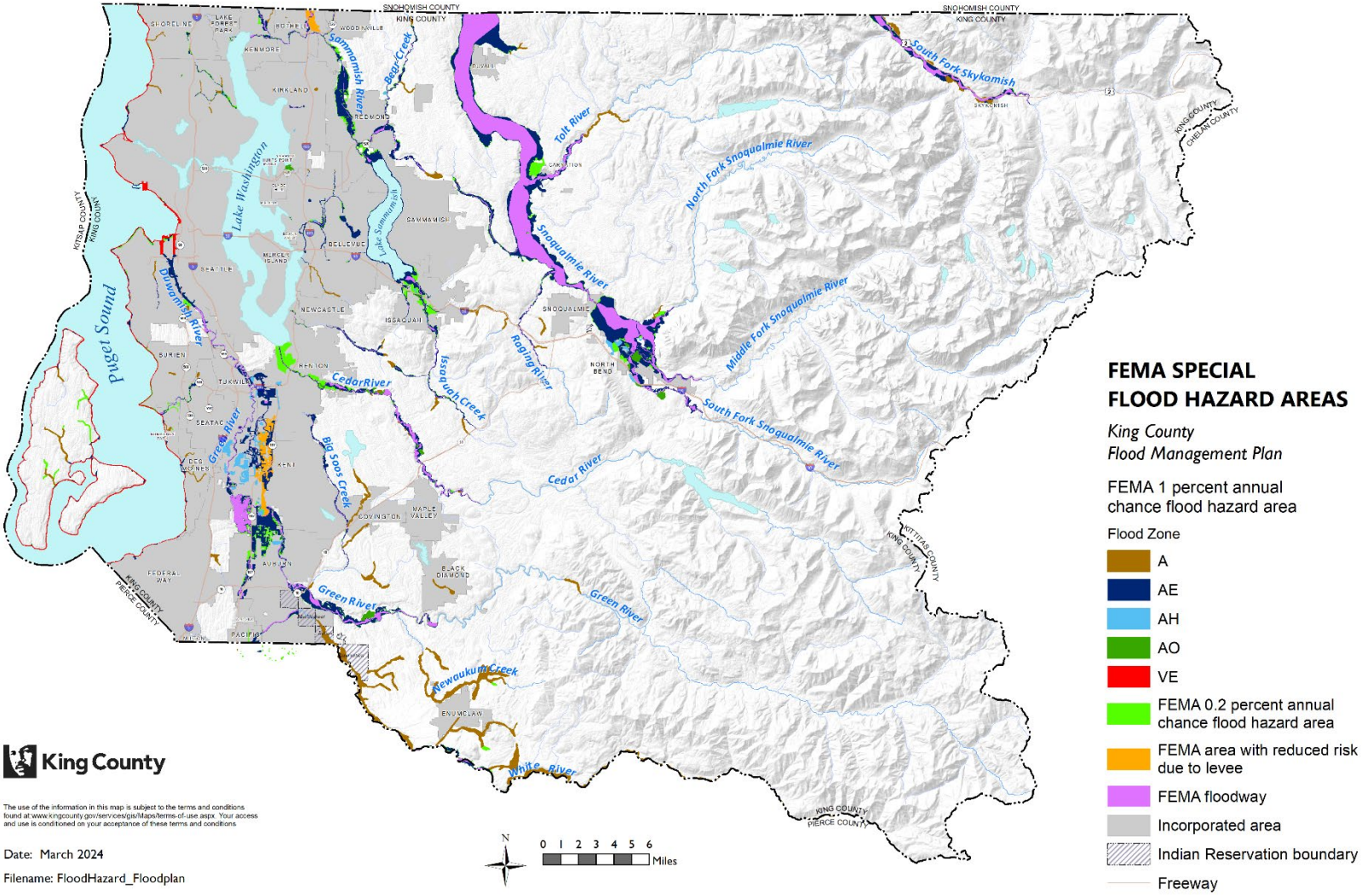


Figure 2.1-7
Flood Hazard Areas in King County

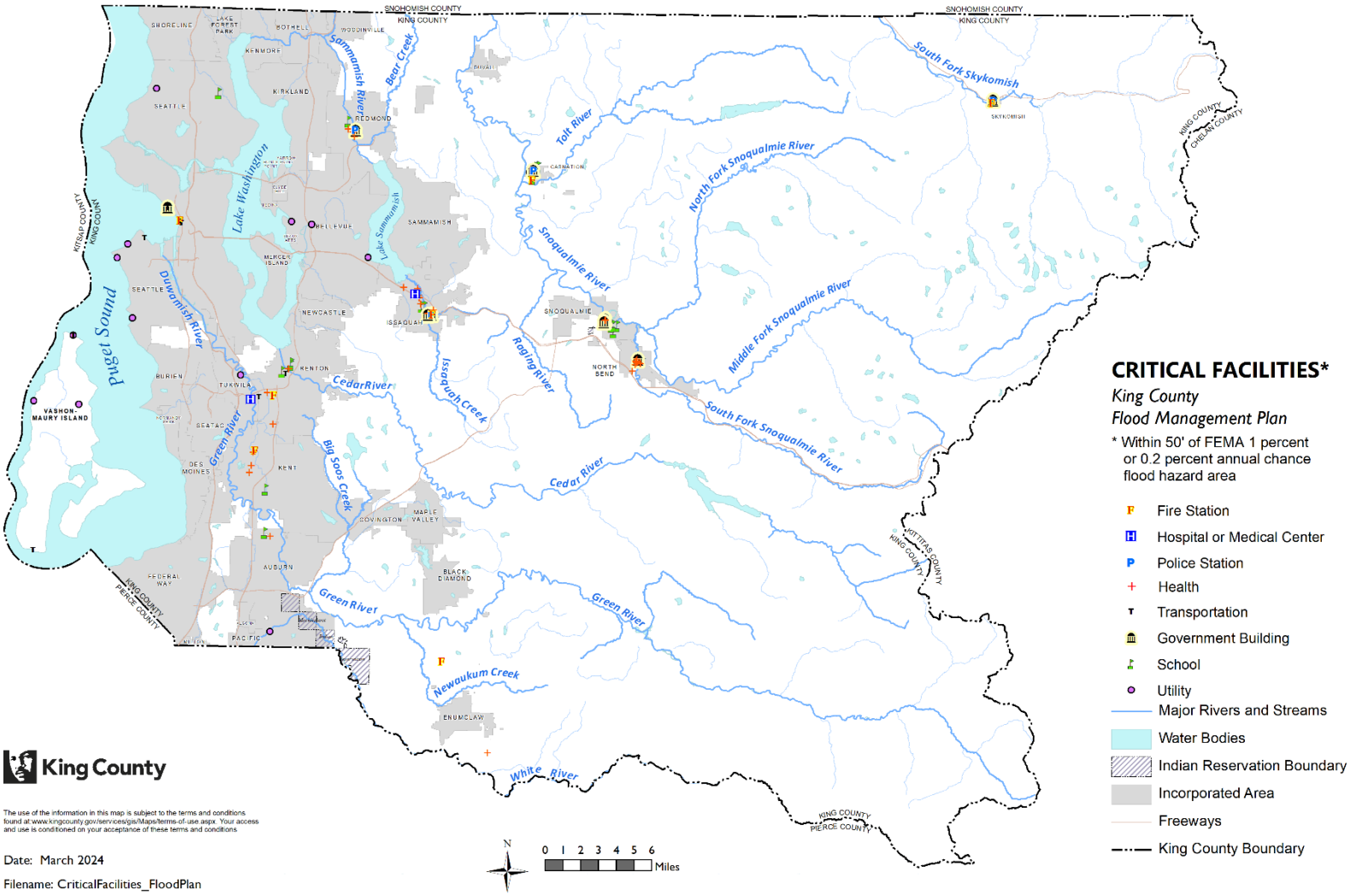


Figure 2.1-8
Critical Facilities in King County

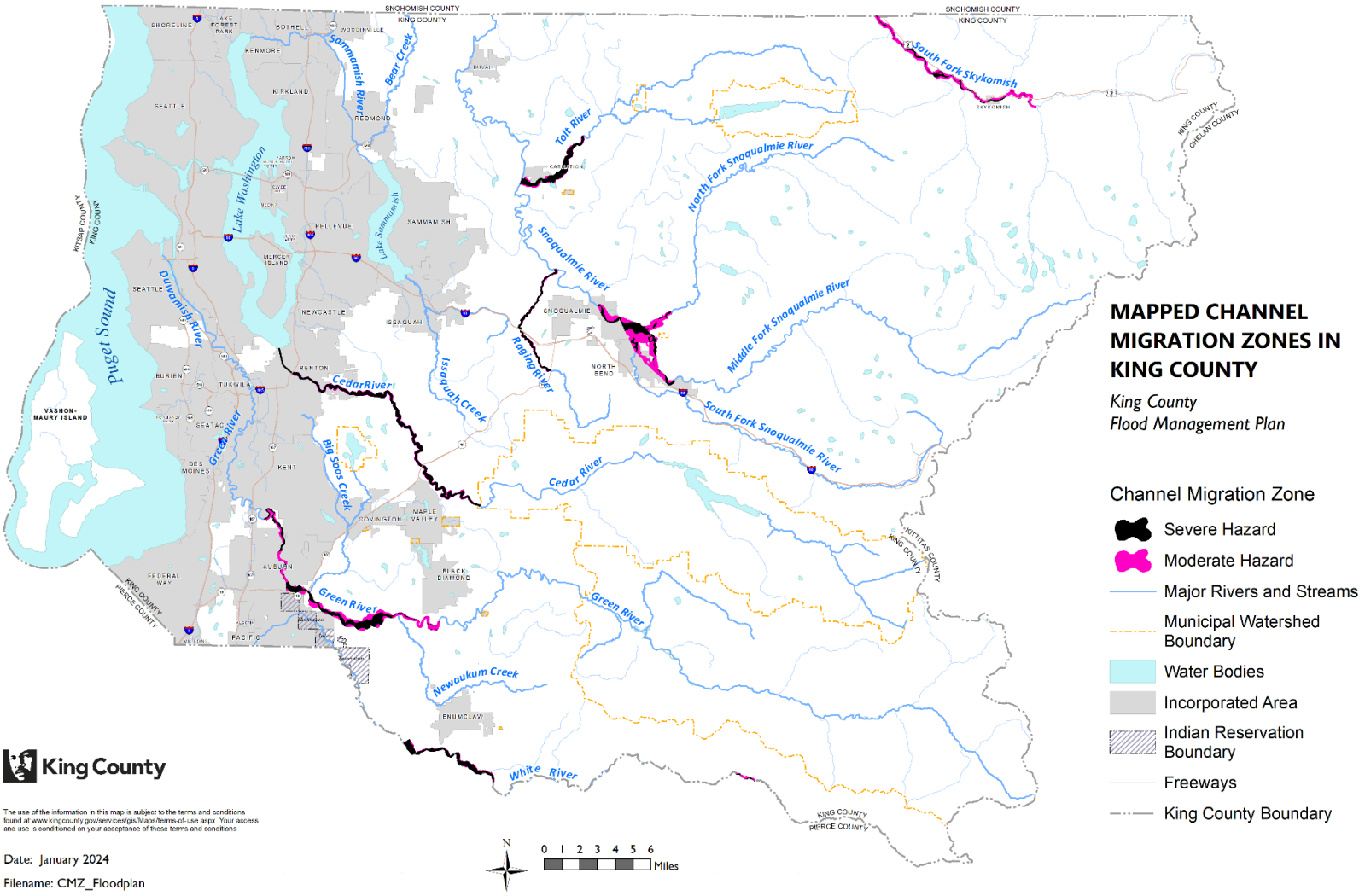


Figure 2.1-9
Channel Migration Zones in King County

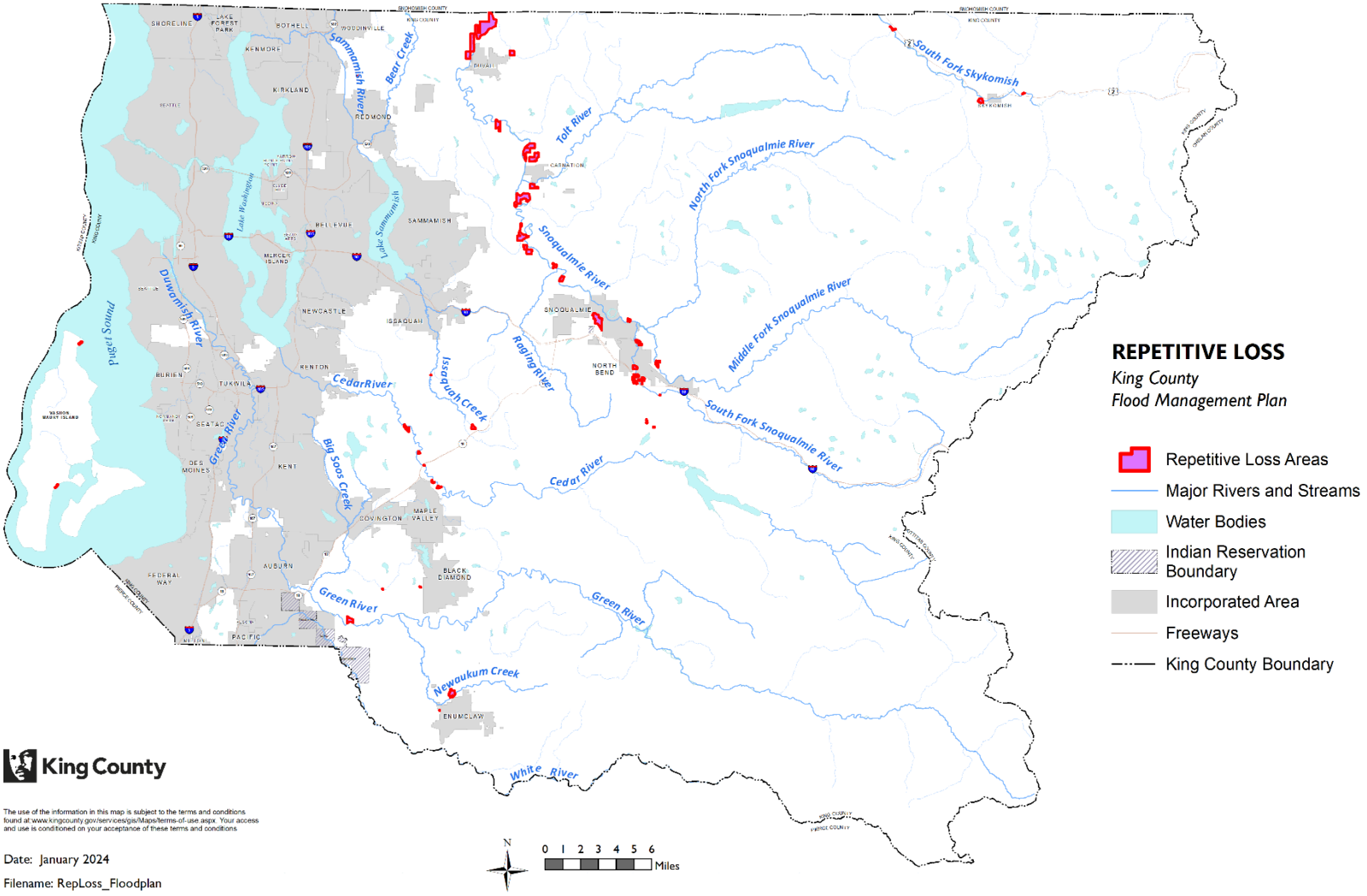


Figure 2.1-10
Repetitive Loss Areas in King County

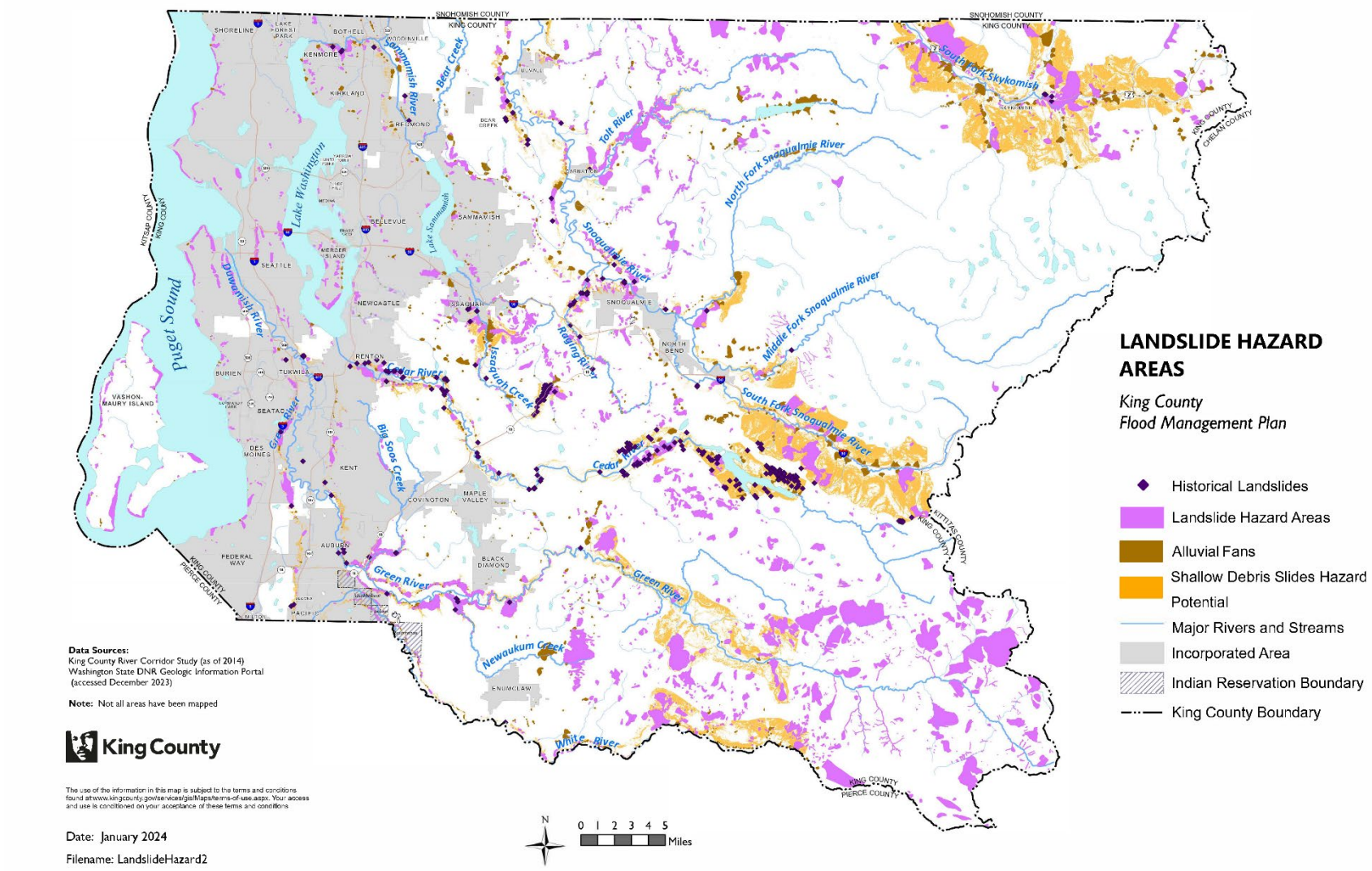


Figure 2.1-11
Landslide Hazard Areas in King County

2.2 South Fork Skykomish/Snoqualmie Watershed

Watershed at a Glance – South Fork Skykomish/Snoqualmie Watershed

WRIA	• WRIA 7
River systems/reaches included	• South Fork Skykomish River • Upper Snoqualmie River (above Snoqualmie Falls) • Lower Snoqualmie River (below Snoqualmie Falls) • Tolt River • Raging River
Basin size	• 938 square miles
Key tributaries	• Beckler, Foss, Miller, Pratt, Taylor, and Tye rivers; Boxley, Clough, Ribary, Kimball, Tokul, Patterson, Griffin, Harris, Tuck, and Cherry creeks
Dams/major infrastructure	• Snoqualmie Falls • South Fork Tolt Dam • Several low-head hydroelectric dams
Key flood years	• 1951, 1959, 1986, 1990, 2006, 2009
Key issues in the basin	• Snoqualmie River Valley is the most flood-prone area of King County • SF Skykomish River generates deep, fast-moving flood flows capable of severe bank erosion • Flood risk to extensive agricultural production district in the lower Snoqualmie River basin • Community isolation due to roadway flooding
Salmonid species present	• Chinook, coho, chum, pink, sockeye, steelhead, coastal and westslope cutthroat trout, rainbow trout, bull trout, Dolly Varden, eastern brook trout, mountain whitefish
Estimated economic damage from a 1 percent annual chance flood	• $205,161,278

In the northeast portion of King County, the Snoqualmie River and a portion of the South Fork Skykomish River watersheds originate in the Cascade Mountains and are part of the larger Snohomish River watershed. The two watersheds encompass 938 square miles, and the Snoqualmie and Skykomish rivers combine north of King County to form the Snohomish River, which discharges into Puget Sound in Everett. The placename “Snoqualmie” is used throughout this section. The term takes its name from the sduk^{w}albix^{w}, Snoqualmie People, who have lived on these lands since time immemorial.

Snoqualmie River flooding of State Route 202 near Fall City, November 2006

The Snoqualmie River is the most flood-prone watershed in King County. The Snoqualmie River watershed is typically divided into the upper and lower Snoqualmie, split by Snoqualmie Falls. These lands hold great importance to the Snoqualmie and Tulalip Tribes, such as Snoqualmie Falls for the Snoqualmie Tribe.

- The **upper Snoqualmie River** watershed includes the river's three forks (North, Middle, and South), which join upstream of the falls to become the mainstem Snoqualmie River. The upper valley is home to the cities of North Bend and Snoqualmie, which are primarily residential and commercial centers with a mixture of development densities, and the Snoqualmie Tribe reservation and other tribal trust lands. Extensive federal and state forests and recreational areas are in the upper reaches of the basin.
- In the wide, flat **lower Snoqualmie River** Valley, land use is primarily agricultural, with residential and commercial centers in the cities of Carnation and Duvall, and unincorporated Fall City. The Tolt River and Raging River are significant tributaries located in the lower valley.
- The **South Fork Skykomish River** basin is primarily characterized by forest production and recreation on federal- and state-owned forest lands, with a residential and commercial center in the Town of Skykomish and rural residential land use in the unincorporated Town of Baring and the communities of Timberlane Village, Grotto, and Miller River. Residential and commercial development is limited by the narrow river valley, access and distance to more populated areas, and zoning.

- Major employers in this watershed that could be directly or indirectly affected by flooding include Nintendo, Snoqualmie Valley School District, Snoqualmie Valley Hospital, and the North Bend Premium Outlets mall. Flooding can also affect businesses of various sizes in the downtown areas of North Bend, Snoqualmie, Carnation, and Skykomish. The extensive agricultural operations in the lower Snoqualmie Valley routinely experience flooding.

The primary subbasins in the watershed are described below: South Fork Skykomish River, upper Snoqualmie River, lower Snoqualmie River, Tolt River, and Raging River.

Public and Partner Input on Flooding in the South Fork Skykomish/Snoqualmie

Much of the input provided about flooding in the South Fork Skykomish/Snoqualmie River watershed related to the influence of flooding on the landscape and land use of the watershed. Identified problems include impacts on agriculture and recurring and prolonged instances of deep flooding. Community members and partners noted erosion impacts on farms and roads in the basin as disruptive and damaging. One of the most-raised concerns was flooding of roadways, which presents risks to safe evacuation and limits the ability for people to reach their homes. Flooding in neighborhoods, drainage issues in developed areas, and stormwater runoff from development were cited as factors contributing to worsening flood impacts throughout the watershed. In the lower Snoqualmie Valley, community members and partners described sediment deposition causing tributaries to overtop their banks or avulse as a problem, especially in agricultural areas, and potentially exacerbated by stormwater runoff.

Overview of the South Fork Skykomish River Basin

The South Fork Skykomish River begins at the confluence of the Tye and Foss rivers, about 13 river miles upstream of the King and Snohomish county line. The river flows through the Town of Skykomish, which is located between the major tributaries of the Beckler and Miller rivers. Development is sparse in the watershed, concentrated in a few locations along the river in the Town of Skykomish; the unincorporated communities of Timberlane Village, Baring, Grotto, and Miller River; and along the lowermost reaches of the larger tributaries.

The South Fork Skykomish headwaters and tributaries are high in the Cascades, and the river has a drainage area of 120 square miles above the confluence with the North Fork (in Snohomish County). The river flows west and crosses into Snohomish County downstream of Baring. In Snohomish County, near the Town of Index, the South Fork Skykomish and the North Fork Skykomish meet to form the mainstem Skykomish River. The Skykomish River joins the Snoqualmie River to form the Snohomish River, which empties into Puget Sound in Everett (in Snohomish County).

Geology and Geomorphology

The South Fork Skykomish River drains steep and rugged mountains composed of bedrock eroded and shaped by continental and alpine glaciation. The river valley walls are composed of bedrock, landslide and rockfall debris, and unconsolidated glacial sediments with shallow soil development. The river is a single-thread, meandering channel and has a moderately well-developed alluvial

floodplain, but, in places, the South Fork Skykomish River and tributaries are confined within bedrock channels.

The channel is relatively steep and naturally confined compared to that of other large King County rivers, particularly from the confluence of the Foss and Tye rivers to the Town of Skykomish. The floodplain widens downstream to the county line as the gradient decreases.

Hydrology and Hydraulics

There are no dams or reservoirs on the South Fork Skykomish or its tributaries. With its steep upper basin slopes in high-elevation terrain forming the entire watershed, significant runoff can be delivered directly to the flood hazard management corridor along the South Fork Skykomish River. Precipitation at these high elevations can generate flooding from snowmelt and rain-on-snow events.

Floodplain mapping for the South Fork Skykomish River was updated in 2021, and King County submitted draft maps to FEMA for review and approval. **Table 2.2-1** lists the flow quantiles developed for the flood study update (Watershed Science & Engineering 2021). Quantiles are based on data from gages within the basin, with varying periods of record from 1903 to the present. The increase from the South Fork (SF) near Skykomish gage to the SF Skykomish at Skykomish gage reflects the inflow from the Beckler River, which joins the South Fork Skykomish between those locations. The increase from the SF Skykomish at Skykomish gage to the SF Skykomish near Index gage reflects the inflows from Maloney Creek, Miller River, Money Creek, and Index Creek, all of which flow into the South Fork Skykomish River between those gage locations. **Table 2.2-2** shows recent high-flow events for the SF Skykomish River at Skykomish gage to illustrate the extent of recent flooding in the subbasin.

TABLE 2.2-1
FLOW QUANTILES FOR THE SOUTH FORK SKYKOMISH RIVER AT SELECT LOCATIONS IN CUBIC FEET PER SECTION (CFS)

Percent Annual Chance Exceedance	Return Period	SF Skykomish near Skykomish (cfs)	SF Skykomish at Skykomish (cfs)	SF Skykomish near Index (cfs)
50	2-year	7,200	13,500	23,300
10	10-year	14,600	26,700	44,300
4	25-year	18,900	34,500	56,100
2	50-year	22,400	40,800	65,400
1	100-year	26,100	47,400	75,000
0.2	500-year	35,600	64,500	99,200

TABLE 2.2-2
RECENT HIGH FLOWS AT THE SOUTH FORK SKYKOMISH RIVER AT SKYKOMISH GAGE (U.S. GEOLOGICAL SURVEY [USGS] 12131500), INSTALLED IN 2016

Date	Flows
2022-11-12	16,200 cfs
2020-02-01	20,400 cfs
2017-11-23	19,100 cfs

Ecological Context and Salmonid Use

The South Fork Skykomish River watershed is in good ecological condition relative to other King County drainages. Most of the area—predominantly in federal ownership—is managed for natural resources or is relatively unmanaged as wilderness (King County 2006). However, forestry-related uses throughout this basin have affected downstream channel conditions. These impacts include altered basin hydrology, increased erosion and sediment inputs to the river caused by timber removal and forest roads, and reduced amounts of large wood.

Residential development in these areas, while rural in nature, often encroaches on riverbanks and floodplains. In many places, riverside development has reduced the quantity and quality of riparian forests and resulted in bank hardening. These impacts alter natural rates of erosion, sediment delivery and storage, instream velocities, channel migration, and large wood recruitment (King County 2013).

Most of the South Fork Skykomish River was historically used only by resident fishes due to impassable falls in Snohomish County at approximately River Mile 1.9. The Washington Department of Fish and Wildlife (WDFW) began a trap-and-haul program in 1958 to move fish around Sunset Falls and Eagle Falls into the upper basin, which established local populations of Chinook and coho salmon, summer run steelhead, and bull trout (King County 2013).

Floodplain modifications, especially fill and armoring associated with roads and residential development, have adversely affected the river and its tributaries. Where roads are near stream channels and bridges cross channels, the stream banks are often armored with rock, limiting natural rates of erosion, channel migration, and large wood recruitment. For example, many reaches of the Beckler River are armored to protect Forest Service roads that access campgrounds, trailheads, and private roads that lead to private forestry operations. Likewise, fill and armor in the alluvial fan of the Miller River have adversely affected the river by reducing the amount of aquatic habitat available for spawning, rearing, and other essential life stages for salmonids, and by preventing natural processes related to water, sediment, and large wood. Alluvial fans are explained in the *Glossary* that precedes Chapter 1.

Historically, large wood was removed from channels and floodplains in conjunction with timber harvesting to allow for transport of logs downstream, and to increase flow capacity. Large wood removal in the watershed has altered channel morphology and caused lower pool frequency and higher velocities, negatively impacting spawning and rearing habitat (Haring 2002).

Beneficial functions of flooding and connected floodplains include recruitment of large wood, creation and maintenance of side channel habitat, routing and storage of coarse sediment, and connection to floodplain habitat for multiple aquatic species.

The Snohomish Watershed Forum (WRIA 7), the Lead Entity for salmon restoration in the Skykomish River in King County, identified six habitat enhancement projects to improve salmon conditions in the Skykomish River basin in its 2015-2025 project list. Two of these six (Beckler River Confluence Large Wood Project and Alpine Baldy Road Decommissioning) have now been completed as of 2023 (Zyla et al. 2022). In addition, King County has incorporated habitat elements into recently completed flood protection facility repair projects.

Primary Flood and Erosion Hazards and Risks

The steep and narrow South Fork Skykomish River Valley generates deep, fast-moving flood flows capable of severe flooding and bank erosion. Observed flood depths in the basin vary from less than 1 foot to 6 feet, and warning times are unavailable. Floodplain mapping for the South Fork Skykomish River was updated in 2021 to provide more up-to-date information about flood hazards on the South Fork Skykomish River and Maloney Creek based on updated hydrology, more accurate topography, and refined modeling methods. Draft maps have been submitted to FEMA for review and approval.

King County mapped channel migration and landslide hazard areas in 2017 and 2016, respectively, within the South Fork Skykomish River to identify the potential impacts on flooding and risk to people and infrastructure within the river corridor (King County 2016a, 2017). Channel migration hazards generally are greatest on the outsides of meander bends in the river and in locations where one side of the river valley is bedrock and the opposite bank is alluvial floodplain material. King County has implemented several actions to address channel migration hazards in the Timberlane Village and Baring neighborhoods, including property acquisition, outreach, and hazard communication.

The landslides active within the river corridor include rockfall, debris flows with alluvial fans, and deep-seated, complex landslide features (King County 2016a, 2018). These landslide and alluvial fan hazards have the potential to impact flood and channel migration hazards on the mainstem South Fork Skykomish River and its tributaries by delivering large volumes of sediment and wood to the channel and potentially damming the river, redirecting floodwaters across the floodplain. Debris flow hazards can also deliver large volumes of sediment and wood to the channel; because of these factors, infrastructure and structures in the floodplain and on alluvial fans are subject to flooding and channel migration hazards, including reach-length avulsions.

Roads in this basin typically run along, near, or over the river or lower portions of its tributaries, as well as across associated floodplains and historical channel migration areas (King County 2013). The location of roads presents flood and channel migration risk to roadways.

The Miller River is a tributary that enters the South Fork Skykomish at approximately River Mile 14.0. The Miller River delivers sediment to an alluvial fan that is building as the Miller River emerges into the valley of the South Fork Skykomish River. This area is highly prone to channel migration. The Old Cascade Highway and the BNSF Railway cross this active alluvial fan area of the Miller River and

disconnect all of the fan except for the main Miller River channel from the South Fork Skykomish River.

In January 2011, the Miller River avulsed (i.e., abandoned its channel for a new route) into a new channel to the west of its former alignment, resulting in the destruction of 150 feet of the Old Cascade Highway. Formerly a through road that paralleled U.S. Route 2, the Old Cascade Highway was permanently closed because of this event. Because the river created a new flow path, the Miller River bridge no longer spans the river. U.S. Route 2 now provides the sole east-west travel route through the area, and access to the Miller River community and recreation areas via Money Creek Road now relies on a single bridge over the South Fork Skykomish River. In 2023, King County completed a project to improve traffic safety and flooding on the remaining portions of Old Cascade Highway.

In September 2022, the Bolt Creek wildfire on the north side of the South Fork Skykomish River threatened the community of Grotto. If the wildfire had progressed to reach the sole-access Old Cascade Highway bridge, Miller River community members could potentially have been stranded on the south side of the river for an undetermined period. Nine alluvial fans on the slope affected by the Bolt Creek fire were determined to have moderate to high debris flow hazards following the Bolt Creek fire (Mickelson and Allen 2022), a level of hazard that is higher than it was prior to the fire. King County actively monitors the area for debris flows during times of intense rainfall and runoff to determine whether warnings and potential evacuations may be needed.

Overview of the Upper Snoqualmie River Basin

The three forks of the Snoqualmie River (North, Middle, and South) begin in the high peaks of the Cascades, follow steep watercourses through the mountains, and combine to form the mainstem Snoqualmie River north of the City of North Bend. The river flows through the City of Snoqualmie and over Snoqualmie Falls. The drainage area upstream of the falls is referred to as the upper Snoqualmie River basin, which is approximately 367 square miles.

The South Fork Snoqualmie River basin drains 85 square miles and flows into the Snoqualmie River mainstem at River Mile 41.8, just downstream of the Middle and North Fork confluence in the Three Forks Natural Area. Upstream of Interstate 90 (I-90), land use is a mix of rural residential and forest lands. As the river approaches North Bend, land use transitions to low-density commercial and residential development. As the river moves north past North Bend, the river is largely unconfined and flows through a mix of rural residential and public lands.

The Middle Fork Snoqualmie River and North Fork Snoqualmie River basins drain 104 and 170 square miles, respectively. The Middle Fork generally flows west and then north at the base of Mount Si to its confluence with the North Fork. The two forks combine within Three Forks Park to form the mainstem Snoqualmie River and the South Fork joins just downstream.

Predominant land uses in the area are managed forests, parks and other public lands, and rural residential. The Snoqualmie Tribe reservation and other tribal trust lands are in this basin. Several small tributaries drain directly into the mainstem of the Snoqualmie River above Snoqualmie Falls, with Kimball Creek being the largest.

Confluence of Middle and North Fork Snoqualmie River, December 2023

Geology and Geomorphology

Each of the three forks of the Snoqualmie River within the flood hazard corridor is in a post-glacial valley that has incised into glacial sediments deposited during continental glaciation. The confluence of the three forks forms a complex alluvial fan that combines sediment deposition from the glacial runoff, the three fork rivers, and tributary streams, including Boxley, Clough, Ribary, and Kimball creeks. Much of the gravel and cobble sediment load in the upper Snoqualmie River is deposited upstream of Snoqualmie Falls where gradient and sediment-transport capacity decreases (Booth et al. 1991).

The headwaters of the South Fork Snoqualmie River are steep bedrock-dominated slopes and terrain derived from alpine glaciations. Above Twin Falls, at River Mile 10.0, material from glacial sediments and modern alluvium and colluvium make up the channel substrate (Bethel 2004). Below Twin Falls, the river channel and morphology transition to a shallower gradient, and the channel form becomes braided with multiple small channels and frequently shifting gravel bars. Near North Bend, the South Fork Snoqualmie River emerges onto a broad alluvial fan where sediment from both the South and Middle forks is deposited (Reid and Dunne 1996).

Intermittent revetments from River Mile 9.5 to River Mile 5.0 and the continuous levee system from River Mile 5.2 to River Mile 2.1 limit the potential for channel migration of the South Fork. The riverbed material is dominated by boulders, cobble, and gravel upstream of the levees. The riverbed in the leveed reach is dominated by gravel and cobble with significant local gravel bar accumulations.

Downstream of River Mile 2.0, the lack of bank armoring allows the channel to widen, meander, and freely migrate. The bed material in this reach is dominated by gravel, sand, and silt. The deposition of bedload downstream of River Mile 2.0 combined with new sediment inputs from local bank erosion and wood loading contribute to rapidly changing channel locations.

Along most of their length, the North Fork Snoqualmie and Middle Fork Snoqualmie rivers flow primarily through unconsolidated deposits of boulders, cobble, gravel, sand, and silt that have been laid down and reworked by the rivers as they cut through glacially derived sediments. In places, the rivers abut older geologic materials at the edge of the valley floor, including older glacial deposits and the bedrock escarpment of Mount Si. Glaciers shaped the upper basin, including steering the North Fork southward to its confluence with the Middle Fork. The forks emerge from steep boulder and bedrock-dominated slopes and channels in the mountains and deposit their coarse sediment load on a broad, gently sloping valley floor (Booth et al. 1991). Intermittent levees and revetments along the two forks limit channel migration in places.

Hydrology and Hydraulics

The three forks of the Snoqualmie River (North, Middle, and South) begin in the high peaks of the Cascades, follow steep watercourses through the mountains, and combine to form the mainstem Snoqualmie River north of the City of North Bend. The river then flows through the City of Snoqualmie and over Snoqualmie Falls. Flows along the three forks are unregulated, with no major reservoirs in the system. Several hydroelectric facilities divert flows, including a dam operated by Puget Sound Energy immediately above Snoqualmie Falls. None of these hydroelectric facilities contain sufficient storage volume to influence downstream flooding. **Table 2.2-3** lists the flow quantiles developed from various gages on the Snoqualmie River system for FEMA floodplain mapping of the North, Middle, and South Forks of the Snoqualmie River. The period of record for the gages was from 1909 to 1997. More recent data with a longer period of record may result in different values.

TABLE 2.2-3
FLOW QUANTILES FOR THE NORTH FORK, MIDDLE FORK, AND SOUTH FORK OF THE SNOQUALMIE RIVER (IN CUBIC FEET PER SECOND)

Percent Annual Chance Exceedance	Return Period	North Fork at Mouth (cfs)	Middle Fork at Mouth (cfs)	South Fork at Mouth (cfs)
10	10-year	18,600	26,900	10,100
2	50-year	24,600	34,800	16,500
1	100-year	27,200	38,600	20,200
0.2	500-year	32,800	46,900	28,600

Ecological Context and Salmonid Use

All three forks of the upper Snoqualmie River drain a combination of wilderness and public and private timberlands in their uppermost reaches, much of which has been extensively logged. The upper reaches of the Middle and North Forks have relatively stable channels that flow through

forested floodplains and support natural ecosystem functions, yet these rivers are still affected by the legacy of logging activities. Once the three forks leave the timberlands, residential development in the floodplain and channel migration zone increases, and segments of the once-dynamic channels are now armored and locked in place by levees and revetments that contribute to degraded ecological conditions. Natural river processes are more evident in the three forks area.

Riparian conditions vary greatly above Snoqualmie Falls. Headwater riparian areas are densely vegetated, mostly with conifers. On the valley floor, riparian vegetation becomes dominated by deciduous trees, and a range of rural to urban development has encroached on the river channels, often in old swales once occupied by one of the forks or the mainstem river (King County 2006).

The natural barrier of Snoqualmie Falls prevents any migration of anadromous salmonids into the upper Snoqualmie River basin. Salmonid use above Snoqualmie Falls is limited to cutthroat and rainbow trout, mountain whitefish, and non-native brook trout. Although appropriate habitat is present and there are anecdotal reports of bull trout, a concerted survey effort to detect them following American Fisheries Society protocols in 2000 did not find any bull trout (King County 2006). The Middle Fork Snoqualmie River contains the most robust trout population and greatest abundance of large trout in the upper portion of the Snoqualmie River system (King County 2013).

Some beneficial functions of flooding and connected floodplains include the creation and maintenance of and access to floodplain off-channel habitat for multiple aquatic species, food web support, recruitment of large wood, routing and storage of coarse sediment, and access to off-channel habitats.

King County, in partnership with others, has completed numerous projects in the upper Snoqualmie basin that improve habitat conditions. The Snoqualmie Tribe recently completed an Upper Snoqualmie Resilient River Corridor Management Plan to improve fish and wildlife conditions and increase connectivity with the river in the upper Snoqualmie (above the falls). This Flood Plan identifies numerous projects that the tribe and partners will work to complete.

Since anadromous fish cannot reach the upper Snoqualmie River, the WRIA 7 salmon recovery Lead Entity does not prioritize projects in the upper basin (although three are listed in their 10-year 2015–2025 plan, including one to remove knotweed from the upper basin).

Primary Flood and Erosion Hazards and Risks

In the upper Snoqualmie River Valley, flooding is typically overbank inundation by deep, slow-moving floodwaters, with some areas of deep and fast flows. Depth of flooding may be 6 feet or greater with measurable velocity, and warning times are approximately 2 to 4 hours. Severe flooding has a return period of approximately 4.5 years (22 percent annual probability) (King County 2016b). Flooding and channel migration pose a risk to commercial and residential areas in the cities of Snoqualmie and North Bend and to residential areas in unincorporated King County. Significant areas within North Bend and Snoqualmie are in the mapped FEMA floodplain, and the City of Snoqualmie has the highest number of flood insurance claims in Washington state.

The lower reaches of the Middle and North Forks are subject to flooding and channel migration where rural residential development and agricultural land use are present. The discontinuous revetments and levees in this area provide some flood and erosion protection, but not flood containment. Levees in these reaches require frequent maintenance and repairs.

Upstream of I-90 are discontinuous levees and revetments along both banks of the South Fork Snoqualmie River. Approaching North Bend, a series of continuous levees begins along both banks and continues through the city, which protect low-density commercial and residential development. The levees were designed asymmetrically, with higher levees on the right bank, where the North Bend city center is located. The levees on both banks were designed to contain floodwater flow of 13,000 cubic feet per second (cfs), a flow which has an approximately 3 percent annual chance of being exceeded.

The geometry of the alluvial fan at the confluence of the three forks results in overbank floodwaters from the Middle Fork flowing toward the South Fork (King County 2014). An analysis of the network of channels on the alluvial fan indicates significant potential for enlargement. Enlargement of these channels would increase risks of erosion, channel migration, and avulsion (Perkins 1996). The potential for rapid relocation of channels and associated hazards on alluvial fans is difficult to quantify.

Sediment accumulating in reaches of all three forks affects local flooding and channel migration hazards by periodically reducing channel capacity and influencing changing channel positions and erosion patterns. Channel migration, including lateral bank erosion and channel avulsion, occurs in these reaches. Potential avulsion channels between the Middle Fork and South Fork are frequently activated by groundwater and sometimes by surface water from the Middle Fork, highlighting mapped channel migration hazards. On the North Fork, dramatic changes in channel position near its confluence with the Middle Fork increased risk to the 428th Avenue SE bridge abutments and levee setback capital projects constructed on both sides of the channel.

King County mapped landslide hazards active within the river corridor that could impact flooding and channel migration hazards (2016). These include rockfall, debris flows with alluvial fans, and deep-seated, complex landslide features. Fan, debris flow, and rockfall hazards extend along South Fork Snoqualmie River and the I-90 corridor to the river's headwaters at Snoqualmie Pass. Rockfall debris from Mount Si is present in and controls the channel of the North Fork Snoqualmie River. In addition to flood and channel migration hazards from the three forks and mainstem Snoqualmie River, Kimball Creek presents flood risks to the City of Snoqualmie, and Ribary Creek presents flood risks in the City of North Bend.

Overview of the Lower Snoqualmie River Basin

The lower Snoqualmie River basin begins at Snoqualmie Falls at River Mile 38.5, with the river generally flowing north toward Snohomish County. The lower Snoqualmie River meanders through a broad valley floodplain, flowing past the unincorporated community of Fall City and the cities of Carnation and Duvall. The river crosses into Snohomish County and continues for approximately 5.5 miles before it joins the Skykomish River near Monroe, forming the Snohomish River, which flows into Puget Sound in Everett.

Several tributaries join the lower Snoqualmie River, including the Tolt and Raging rivers, and Tokul, Patterson, Griffin, Harris, Tuck, and Cherry creeks. Most of these tributaries have relatively steep gradients until they meet the flat valley floor of the Snoqualmie River. The Tolt and Raging rivers are the largest tributaries, and both input large amounts of sediment into the Snoqualmie River, which provides important salmon spawning habitat at and downstream of their confluences.

Aside from the residential and commercial centers of Fall City, Carnation, and Duvall, most of the land use in the lower Snoqualmie River Valley is currently agricultural and low-density residential. Approximately 87 percent of the lower Snoqualmie River floodplain currently falls within the Snoqualmie Agricultural Production District, lands which were historically critical habitat for fish and wildlife and hunting and gathering areas for the Snoqualmie Tribe.

Future development in unincorporated King County in the lower Snoqualmie Valley is restricted by the FEMA floodway and zoning laws. Development is increasing in unincorporated Fall City, where most of the residential and commercial buildings are outside the regulatory floodplain. A proposed business district septic system will allow some limited additional commercial growth in this area. The system is not designed to accommodate full build-out of all lots in the commercial district, and at present it will allow for approximately 15 percent growth.

The City of Carnation is similar in population and development to Fall City, but future development is limited primarily by available undeveloped property. Many of the remaining developable properties are in the process of building medium to large residential developments. The City of Duvall is almost entirely outside of the floodplain, with most of the developed area located on the hillside above the river.

Geology and Geomorphology

Snoqualmie Falls forms the upstream boundary of the lower Snoqualmie River watershed, where the Snoqualmie River flows over a 286-foot escarpment of resistant volcanic bedrock. Downstream from the falls, the Snoqualmie River transitions from a confined bedrock channel to an alluvial channel and wide floodplain. The broad, low-gradient valley currently occupied by the lower Snoqualmie River was formed by glacial runoff (Booth 1994). As river sediments were deposited adjacent to the channel within the valley, the elevation of riverbanks increased several feet higher than the surrounding floodplain, resulting in the formation of alluvial ridges (Collins et al. 2003b; Collins and Montgomery 2011). With riverbanks at a higher elevation than much of the valley floor, even relatively small overbank flows can result in valley-wide flooding.

Much of the sediment load in the lower Snoqualmie River is contributed from high-gradient tributaries, including the Tolt and Raging rivers (Booth et al. 1991) and smaller creeks. The Tolt and Raging rivers deposit alluvial fans where they enter the valley of the lower Snoqualmie River near Carnation and Fall City, respectively, and these fans influence the mainstem Snoqualmie River channel course. Alluvial fans also formed where smaller tributary streams enter the relatively flat lower Snoqualmie River Valley. Tokul, Griffin, Harris, Adair, and Cherry creeks and other smaller tributaries all have alluvial fans present at their outlets to the Snoqualmie Valley bottom and historically contributed sediment to the river system.

Lower Snoqualmie River flooding, December 2015

Many tributaries to the Snoqualmie River have been heavily modified into straightened channels as they traverse the floodplain to the mainstem river, and these channels can also accumulate sediment. Much of the coarse sediment delivered from the larger tributaries is stored in the mainstem channel within a few miles downstream of their confluences, and some sediment remains in the fans on the floodplain. These sediment inputs affect the channel gradient of the lower Snoqualmie River both upstream and downstream of the confluences. Upstream of the confluences, the Snoqualmie River channel gradient is lower, and coarse sediment transport is limited. At the confluence and downstream from these alluvial fans, channel gradient and substrate size first increase and then progressively decrease, and the lower Snoqualmie River transitions from a cobble- and gravel-bedded river with multiple gravel bars and secondary channels to a sand- and silt-bedded, single-threaded meandering river.

Channel migration of the lower Snoqualmie River is limited by levees and revetments constructed at the beginning of the 20th century. The most dynamic segments of the lower Snoqualmie River are downstream of the alluvial fans of the Raging and Tolt rivers due to increased coarse sediment delivery, resulting in lateral migration and shifting by avulsion. In other meandering reaches of the river, lateral migration proceeds more slowly and avulsions, although infrequent, are a primary mode of channel change, which contributes to the formation of the oxbow lakes present throughout the lower Snoqualmie River Valley (Collins and Sheikh 2002; Collins et al. 2003b).

Hydrology and Hydraulics

Peak-flow hydrology of the lower Snoqualmie River is largely unregulated by dams and driven by runoff from fall and winter storms and snowmelt during the spring. Three run-of-the-river dams divert water for hydroelectric projects within the Snoqualmie River watershed at Snoqualmie, Twin, and Weeks falls, but do not have any flood storage capacity. Only the South Fork Tolt Dam, which impounds the South Fork Tolt Reservoir for the City of Seattle's municipal water supply and hydroelectric power generation, maintains storage capacity within the lower Snoqualmie River watershed. Seattle uses this storage capacity to provide limited regulation of the magnitude and duration of floods during the fall and winter flood season for the Tolt and lower Snoqualmie rivers. **Table 2.2-4** lists the flow quantiles developed for FEMA floodplain mapping of the lower Snoqualmie River. The quantiles are based on gage data with a period of record from 1930 to 2003. More recent data with a longer period of record may result in different values. **Table 2.2-5, Table 2.2-6, Table 2.2-7,** and **Table 2.2-8** show recent high-flow events and the highest flows recorded for the Snoqualmie River at two gage locations (Carnation and Snoqualmie) to illustrate the extent of recent and possible flooding in the subbasin.

TABLE 2.2-4
FLOW QUANTILES FOR THE LOWER SNOQUALMIE RIVER

Percent Chance Exceedance	Return Period	At Duvall (cfs)	At Carnation (cfs)	Near Snoqualmie (cfs)
10	10-year	53,400	58,200	51,700
2	50-year	75,800	82,400	71,000
1	100-year	84,600	91,800	79,100
0.2	500-year	99,700	113,300	95,200

TABLE 2.2-5
RECENT HIGH FLOWS, SNOQUALMIE RIVER NEAR SNOQUALMIE GAGE (USGS 12144500)

Date	Flows
2022-11-05	36,700 cfs
2022-03-01	36,400 cfs
2019-10-22	46,900 cfs
2015-12-09	49,500 cfs
2015-11-17	48,000 cfs
2015-01-05	50,100 cfs

TABLE 2.2-6
HIGHEST FLOWS RECORDED AT THE SNOQUALMIE GAGE SINCE PEAK MEASUREMENTS BEGAN IN 1958

Date	Flows
1990-11-24	74,300 cfs
1959-11-23	61,000 cfs
2009-01-07	60,700 cfs

TABLE 2.2-7
RECENT HIGH FLOWS, SNOQUALMIE RIVER NEAR CARNATION GAGE (USGS 12149000)

Date	Flows
2022-03-01	46,900 cfs
2020-02-07	49,200 cfs
2015-12-09	56,200 cfs
2015-11-18	46,600 cfs
2015-01-06	53,900 cfs

TABLE 2.2-8
HIGHEST FLOWS RECORDED SINCE CARNATION GAGE WAS INSTALLED IN 1929, DURING SPECIFIC FLOOD EVENTS

Date	Flows
2009-01-08	82,900 cfs
2006-11-7	71,800 cfs
1990-11-24	65,200 cfs

Ecological Context and Salmonid Use

The lower Snoqualmie River has a wide valley floor that is approximately 1 mile wide, except for just south of the King-Snohomish boundary, where it is more than 2 miles wide. The valley floor contains numerous large, old oxbow ponds, side channels, and shallow swales, marking where the river once flowed. Tributaries meander along the valley floor for a significant distance before emptying into the mainstem river (King County 2006).

The lower Snoqualmie River supports the freshwater life-stages of various salmonids, including wild populations of Chinook, chum, coho, and pink salmon; mountain whitefish; and rainbow-steelhead, cutthroat, and non-native brook trout. A riverine form of sockeye salmon has also been found in the lower Snoqualmie River (King County 2006, 2018). Anadromous fish use the entire length of the Snoqualmie River below Snoqualmie Falls, as well as many of the river's tributaries.

The presence of many abandoned oxbows indicates that, historically, the Snoqualmie River migrated across its floodplain, creating and maintaining diverse aquatic habitats. Construction of levees and

revetments along the mainstem river, combined with land clearing to support extensive agricultural development, reduced natural floodplain function and the quantity and quality of instream salmon habitat. Additionally, access to many off-channel habitats and tributaries has been eliminated or impaired by the combination of culverts, bank armoring, and mainstem channel incision (Haring 2002).

Observations from 2017 indicated that stream banks were armored across more than 40 percent of the lower Snoqualmie River, large wood abundance was found to be low, and most wood was relatively small. Since the adoption of the 2005 Snohomish River Basin Salmon Conservation Plan (2005 Salmon Plan), stream bank vegetation has increased, and the percentage of tree coverage has grown across the riparian corridor, but riparian conditions are still quite degraded compared to historic conditions (King County 2018). Likewise, while large wood abundance (pieces/mile) has increased, it remains significantly less than historic conditions. Large wood placement and side channel creation and restoration are considered integral short-term measures to support habitat-forming processes until restored riparian forests can support large wood recruitment (King County 2018).

The Snohomish Salmon Recovery Forum and Snoqualmie Watershed Forum have identified and are guiding implementation of numerous salmon enhancement projects in the lower Snoqualmie River basin to address primary limiting factors. A total of 19 habitat restoration projects are identified in their 10-year plan (2015-2025) directly along or within the lower Snoqualmie River, and the long process of habitat restoration remains ongoing.

Primary Flood and Erosion Hazards and Risks

The lower Snoqualmie River Valley is prone to extensive and somewhat regular flooding, with multiple flood events that inundate farmland and low-lying roads in most years. With riverbanks at a higher elevation than much of the valley floor, even relatively small overbank flows can result in valley-wide flooding. Depth of flooding varies depending on location, with flooding of 3 to 6 feet in the vicinity of Carnation and depths of 6 feet or greater with measurable velocity in the vicinity of Fall City and Duvall. Approximate warning times range from 4 hours at Fall City to 12+ hours at Carnation to 24 hours at Duvall. Property owners and residents can sometimes be isolated for days by floodwater. Due to the widespread nature of flooding and the frequency that roads are inundated, driving into flood areas is one of the greatest risks to public safety.

Four major roads cross the floodplain of the Snoqualmie River and are subject to flooding: NE Tolt Hill Road, NE Carnation Farm Road, NE 124th Street, and NE Woodinville Duvall Road. NE Tolt Hill Road and NE 124th Street are the first two of these roads to close and may close during even relatively minor flooding. Flooding of NE Carnation Farm Road and NE Woodinville Duvall Road does not typically occur until flooding is significant. When these routes are closed, it can limit access to and from communities on the east side of the Snoqualmie Valley and isolate these communities from services and places of employment.

Lower Snoqualmie River flooding in Duvall, December 2015

Many areas of the Snoqualmie River floodplain typically experience low-velocity floodwaters; however, local conditions, such as changes in floodplain or channel gradient or the overtopping of levees or roads, can contribute to higher velocities that pose hazards to public and private infrastructure. Larger flood events can cause high-velocity flows in developed areas, potentially posing risks to structures and public safety if individuals are isolated by floodwaters.

Many revetments, both public and private, and a few levees are present along the lower Snoqualmie River. The function of this infrastructure is primarily to limit local bank erosion and channel migration. While a few flood protection facilities reduce the limits of inundation during smaller floods, they do not provide containment at higher flows. Many revetments adjacent to the lower Snoqualmie River were constructed to protect roads, highways, or other public infrastructure adjacent to the channel, maintain the channel alignment through bridges, or protect agricultural areas.

Flood hazards in alluvial fan areas where steep tributaries discharge onto the flat Snoqualmie River floodplain, particularly at the mouths of the Tolt River near Carnation and the Raging River near Fall City, are influenced by high rates of sediment deposition, which cause increased rates of erosion and channel migration. Flooding patterns at these large tributary confluences are complicated and highly influenced by the timing and relative magnitude of tributary and mainstem flooding.

Overview of Tolt River Basin

The Tolt River is the largest tributary of the Snoqualmie River below Snoqualmie Falls. It enters the Snoqualmie River from the east, near the City of Carnation. The Tolt River drains a total area of about 100 square miles, with headwaters at the crest of the Cascades and an elevation change of over 4,000 feet from crest to the Snoqualmie River. The North Fork Tolt and South Fork Tolt rivers join near River Mile 8.4.

The upper Tolt River basin is mostly within a forest production district, where ongoing timber harvesting has occurred since the early 1900s. The City of Seattle owns the timberland surrounding the South Fork Tolt Reservoir and Dam, which is managed primarily to protect water quality and quantity for municipal water supply. Land use in the Tolt River Valley downstream of River Mile 6.0 is primarily residential development that ranges from low density in the upstream end to higher density near the downstream end in Carnation.

Geology and Geomorphology

The steep, high-relief headwaters of the Tolt River basin are primarily underlain by volcanic and intrusive bedrock of the Cascade Range. Advances of alpine glaciers carved the main upper valleys of the North and South Forks of Tolt River (Bethel 2004), including the part inundated by the South Fork Tolt Reservoir. The South Fork Tolt Dam at the outlet of the South Fork Tolt Reservoir was constructed along a moraine (a mass of rocks and sediment carried down and deposited by a glacier). Both forks of the Tolt River incised deep, confined valleys and narrow gorges into unconsolidated glacial sediments and underlying volcanic bedrock (Dragovich et al. 2010).

The mainstem Tolt River flows 8.4 miles from the confluence of the North and South Forks of the Tolt River to its confluence with the Snoqualmie River south of Carnation. From River Mile 8.4 to River Mile 6.0, the Tolt River is confined within a deeply incised valley that has cut a trough through glacial sediments (Dragovich et al. 2010). The Tolt River emerges from its steeper and confined reaches at River Mile 6.0 to flow through a relatively narrow valley floor that widens downstream to the confluence with the Snoqualmie River. Along this reach, steep valley walls consist mostly of glacial and non-glacial deposits, with extensive large, deep-seated landslide deposits along both valley walls. Similar landslides are present in the portion of the river above the Snoqualmie River floodplain. A tall, shallow landslide is also active on the left valley wall of the Snoqualmie River directly opposite the Tolt-Snoqualmie confluence. These landslides serve as a major source of both suspended and bedload sediment where the river migrates and erodes the toe of the slides.

The lower Tolt River Valley opens to the broader Snoqualmie River Valley near River Mile 2.0. The City of Carnation is on the alluvial fan built by the Tolt River across the Snoqualmie River floodplain. At the eastern edge of the Snoqualmie River Valley, the surface of the fan stands 30 to 40 feet above the underlying valley floor. The elevated topography of the alluvial fan has effectively confined the Snoqualmie River to the western edge of the Snoqualmie Valley.

From approximately River Mile 5.0 to the confluence with the Snoqualmie River, the Tolt River is highly susceptible to high rates of lateral erosion, meander migration, and channel avulsions. These processes are now limited by the levee system in the Carnation reach. Historical references, such as

General Land Office maps from 1873 and 1936 aerial photography, indicate that, prior to European settlement, this reach of the river was a highly mobile, more sinuous, multiple-threaded channel and major adjustments, such as down-valley meander migration and channel avulsions, were common.

Hydrology and Hydraulics

The Tolt River is characterized by a mixed rainfall-snowmelt hydrologic regime with elevated runoff during the fall and winter flood season and the spring freshet. About 20 percent of the overall Tolt River basin is regulated by the South Fork Tolt Dam, located 8 miles upstream of the confluence of the North and South Forks of the Tolt River. The South Fork Tolt Dam impounds a 56,000-acre-foot reservoir, which the City of Seattle has managed since 1964 to supply about 30 percent of the drinking water for 1.5 million people in and around Seattle. In 1996, a 16.8-megawatt hydroelectric facility was completed along the South Fork Tolt River and is operated by Seattle City Light.

The South Fork Tolt Dam, completed in 1963, operated by the City of Seattle and located 16 miles upstream of Carnation on the South Fork Tolt River, is the only dam within the Tolt and Snoqualmie river basins with storage capacity during the flood season. The South Fork Tolt Dam is not operated primarily for flood control; however, during winter flood season, the reservoir is operated to maintain a flood storage volume to minimize risks to the dam. Hydrologic analyses have demonstrated that the effect of reservoir management is that flood magnitudes for a 1 percent annual chance flow and a 50 percent annual chance flow are reduced approximately 20 percent and 30 percent, respectively (Watershed Science and Engineering 2015). If the reservoir is full prior to a storm event, however, it does not provide any flood reduction benefit.

Table 2.2-9 lists the flow quantiles developed for FEMA floodplain mapping of the Tolt River for a period of record from 1938 to 1993. More recent data or a longer period of record may result in different values. **Table 2.2-10** and **Table 2.2-11** illustrate recent high flows and the highest flows recorded on the Tolt River.

TABLE 2.2-9
FLOW QUANTILES FOR THE TOLT RIVER

Percent Chance Exceedance	Return Period	At Mouth (cfs)	USGS Gage 12148500 near Carnation (cfs)
10	10-year	13,900	11,900
2	50-year	19,500	16,700
1	100-year	22,000	18,800
0.2	500-year	27,800	23,800

TABLE 2.2-10
RECENT HIGH FLOWS, TOLT RIVER NEAR CARNATION GAGE (USGS 12148500)

Date	Flows
2020-02-01	9,740 cfs
2015-01-05	9,340 cfs
2009-01-08	13,800 cfs

TABLE 2.2-11
HIGHEST PEAK FLOWS RECORDED AT TOLT RIVER NEAR CARNATION GAGE (USGS 12148500) SINCE MEASUREMENTS BEGAN AT THE GAGE IN 1929

Date	Flows
1959-12-15 (before South Fork Dam was built)	17,400 cfs
1951-02-09 (before South Fork Dam was built)	16,800 cfs

Ecological Context and Salmonid Use

The Tolt River is the largest tributary to the lower Snoqualmie River and is by far its greatest source of coarse sediment, including salmonid spawning gravel. This sediment forms a delta that is among the most heavily used reaches for salmonid spawning in the Snohomish River basin. The Tolt River delta exerts a great influence on the larger Snoqualmie River channel, constricting and steepening it enough to create a diversity of habitats, including large pools and gravel-bedded spawning riffles that differ greatly from the majority of the Snoqualmie River's low-gradient, sand- and silt-bedded, meandering channel (King County 2006). Observations from 2017 indicated that the banks were armored along more than 30 percent of the lower section of the Tolt River (King County 2018). Reaches in the Tolt River without levees have many more side channels than leveed reaches and much greater complexity (Haring 2002).

The Tolt River is used by all the same salmonids that use the lower Snoqualmie River, including Chinook, chum, coho, and pink salmon; mountain whitefish; and rainbow-steelhead and cutthroat trout (King County 2006). Bull trout and Dolly Varden may also utilize this area, but sightings are extremely rare (Haring 2002). The lower Tolt River supports high-quality habitat for both juvenile and adult salmonids and is important for the persistence of both ESA-listed and non-listed salmonid populations in the Snoqualmie River watershed (King County 2018).

The lower Tolt River suffers from reduced large wood recruitment and accumulation, alteration and loss of riparian habitats, floodplain modification, and disconnection of off-channel and side channel habitats via levees and bank hardening (Haring 2002). Research has found that off-channel habitats away from the mainstem of the river are crucial for providing juvenile salmon with shallow, slow-water habitat, especially during floods (King County 2018). Salmon recovery efforts in the watershed have identified seven high-priority salmon enhancement projects in the 2015-2025 10-year plan along the Tolt River.

Primary Flood and Erosion Hazards and Risks

The Tolt River basin is relatively steep, generating fast and erosive flows. Depth of flooding ranges from shallow flooding to 6 feet with measurable velocity, and the approximate warning time is 2 hours. Landslide hazards are common in the portion of the river above the Snoqualmie River floodplain, upstream of Carnation. Severe flooding has a return period of approximately 2.8 years (or 35 percent probability) on the Tolt River (King County 2016b).

King County mapped channel migration and landslide hazard areas in 2017 and 2016, respectively, within the Tolt River to identify the potential impacts on flooding and risk to people and infrastructure within the river corridor (King County 2016a, 2017b). The 2017 channel migration mapping updated 1996 mapping by King County for the Tolt River. The landslide hazard mapping identifies several locations where the active river channel is in contact with the toe of a large, deep-seated landslide. These areas are especially hazardous because of the potential for channel migration to destabilize the landslide and the potential for the landslide to partially or completely block the river channel.

Upstream of the City of Carnation, Tolt River Road NE on the north side of the river is a sole access road ending at River Mile 6.0 in the Rio Vista neighborhood. In this steep reach, the river flows between steep, landslide-prone valley walls, and the floodplain gradually widens downstream. The Tolt River in this reach is highly susceptible to high rates of bank erosion, lateral channel migration, and channel avulsions. Land use in this reach includes low-density residential development.

In 2019, King County completed a project to reduce flood risks and improve fish and wildlife habitat in the former San Souci neighborhood, near River Mile 4.0. This neighborhood was in a dynamic stretch of the Tolt River, with active flood, erosion, and landslide hazards. Property acquisitions from willing sellers began in the early 1990s to move people and residential structures out of harm's way. The project removed 16 at-risk homes from an area that frequently flooded and reconnected the Tolt River with 33 acres of floodplain.

Flood Patrol on the Tolt River, February 2021

From River Mile 2.0 to the Snoqualmie River, the Tolt River is within its historical alluvial fan and is referred to as the leveed reach. The river historically migrated across the extent of the alluvial fan but is now incised into a channel that is largely confined by the existing levee system on both banks. Land use includes residential, commercial, and agricultural properties in the City of Carnation and

unincorporated King County. Flooding is primarily caused when floodwaters overtop or damage the Tolt levees or Snoqualmie River flooding backs into the lower reach of the Tolt River and adjacent lands. Surrounding lands can be affected by inundation and by fast, erosive flows. Work is underway to set back the Lower Frew Levee in this reach, with construction expected within the next five to 10 years. Other levees are identified for improvement or future setback projects by the King County Flood Control District's (FCD) Tolt River Capital Investment Strategy (King County 2017).

Although unlikely, the South Fork Tolt River Dam and Reservoir has the potential to fail, causing widespread flooding to the City of Carnation. The City of Seattle maintains an advanced dam failure warning system, including monitoring instruments at the site, cameras at strategic locations, and sirens along Tolt River Road and within the City of Carnation. The warning system is automated and monitored by operators in the Seattle Public Utilities (SPU) Operations Control Center 24 hours a day, 7 days a week (City of Seattle 2023).

Overview of the Raging River Basin

The Raging River flows into the Snoqualmie River at the unincorporated community of Fall City about 4 miles downstream of Snoqualmie Falls. The Raging River drains an area of about 33 square miles. There is an overall elevation change of about 3,500 feet from the headwaters southeast of Tiger Mountain to the mouth, with a mainstem channel length of about 15 miles. There are no major dams in this basin.

The entire basin is in unincorporated King County. The unincorporated communities of Preston, downstream of I-90 near River Mile 4.5, and Fall City, at the confluence of the Raging and Snoqualmie rivers, are centers of residential and commercial land use. Levees line both banks along the lower 1.5 miles of the river. Much of Fall City is built on the Raging River's alluvial fan. Upstream of Fall City, rural residential development exists along much of the Raging River. Timber harvest has been the main land use in the upper two-thirds of the Raging River basin since the early 1900s. Most of the timberland in the basin headwaters area is publicly owned.

Geology and Geomorphology

The Raging River is a relatively short, steep, dynamic river. Prominent peaks within the steep headwaters of the Raging River, including Tiger, Taylor, and Rattlesnake mountains, are largely underlain by sedimentary and volcanic bedrock, whereas unconsolidated glacial sediments comprise most of the lower watershed. The steep, narrow channel incised into a watershed with a narrow valley, forested mountain headwaters, and steep valley slopes. Landslides and debris flows occur frequently in the unconsolidated glacial sediments that line the valley walls.

At about River Mile 8.3, the Raging River emerges from the steep and narrow upper valley to flow across a still-relatively narrow alluvial floodplain. From River Mile 8.3 to River Mile 4.9 at I-90, the mainstem channel flows generally northwest and becomes increasingly wider, less confined, more sinuous, and more depositional. This reach upstream of I-90 exhibits the highest degree of lateral migration, although it is restricted by bank armoring in some locations.

At I-90, the river turns abruptly to the northeast and flows through a confined inner gorge. The river from I-90 to River Mile 1.5 is steeper and narrower than the reach upstream of I-90. Here the river's active floodplain is generally only a few hundred feet wide and bounded by alluvial terraces or the landslide-prone valley wall. The channel bed is largely boulder-dominated.

The Raging River exits the inner gorge near River Mile 1.5, where the broader Snoqualmie Valley opens, allowing the river to build a broad alluvial fan at its confluence with the Snoqualmie River. Much of Fall City is located on the alluvial fan built by the Raging River. The river channel is on the far right (east) side of this alluvial fan. This lower reach is confined by levees along both banks, effectively eliminating channel migration and any potential for the channel to move across the alluvial fan or interact with its floodplain to create and maintain side channels or other floodplain habitats.

The Raging River channel pattern has small-radius, open meander bends, and flows in a single-thread channel through most of its unleveed length, whether within the tightly confined gorge downstream of I-90 or within the relatively narrow floodplain upstream of I-90. Although relatively small, steep, and confined, the Raging River has a rapidly migrating channel (King County 2019; Shannon and Wilson 1991). Historical aerial photographs indicate that, prior to the establishment of the levee network on the alluvial fan, the Raging River in the Fall City reach was a highly mobile, more sinuous, multiple-threaded channel, likely also exhibiting rapid rates of adjustment such as lateral channel migration and channel avulsions.

Hydrology and Hydraulics

Flood hydrology of the Raging River is driven by rainfall during storms from November through February. Unlike the watersheds of the adjacent Cedar and Snoqualmie rivers that originate in the Cascade Range, the Raging River watershed drains relatively low-elevation foothills of the Cascade Range that do not develop an appreciable winter snowpack. Overall relief of the Raging River's small 33-square-mile watershed reaches only 3,500 feet. The resultant basin geometry contributes to flashy, short-duration floods that rise and recede quickly and high-velocity and erosive flows within its steep channel and confined floodplain.

King County and other agencies use the USGS gage 12145500 near Fall City for flood monitoring on the Raging River. This gage is located at River Mile 2.8 and records runoff from 93 percent of the basin. Peak-flow magnitudes and recurrence intervals were calculated for the FEMA Flood Insurance Study based on flows measured at this gage for the period of record from 1945 to 1992, plus an historic event in 1932. Because no gage exists at the Raging River mouth, peak-flow magnitudes at that location are estimated by the ratio of drainage areas at the mouth and at USGS gage 12145500. **Table 2.2-12** lists the flow quantiles developed for FEMA floodplain mapping of the Raging River. More recent data with a longer period of record may result in different values. **Table 2.2-13** and **Table 2.2-14** list recent high flows and the highest flows recorded for the Raging River.

TABLE 2.2-12
FLOW QUANTILES FOR THE RAGING RIVER

Percent Chance Exceedance	Return Period	At Mouth (cfs)	USGS Gage 12145500 (cfs)
10	10-year	4,031	3,790
2	50-year	6,286	5,910
1	100-year	7,413	6,970
0.2	500-year	10,465	9,840

TABLE 2.2-13
RECENT HIGH FLOWS, RAGING RIVER NEAR FALL CITY GAGE (USGS 12145500)

Date	Flows
2020-02-06	3,280 cfs
2015-12-09	3,520 cfs

TABLE 2.2-14
HIGHEST PEAK FLOWS RECORDED AT RAGING RIVER NEAR FALL CITY GAGE (USGS 12145500) SINCE GAGE WAS INSTALLED IN 1945

Date	Flows
1990-11-24	6,220 cfs
1986-11-23	5,330 cfs
1990-01-09	4,640 cfs

Ecological Context and Salmonid Use

The Raging River is the second largest and second most ecologically influential tributary to the lower Snoqualmie River. It is a major contributor of gravel to the lower Snoqualmie River, with its delta locally constricting and steepening the lower Snoqualmie River channel. This constriction creates a river reach much different from most of the lower Snoqualmie River and results in high-quality spawning and rearing conditions for salmonids in the mainstem lower Snoqualmie River. Its proximity to the upper extent of anadromous fish use at Snoqualmie Falls (located about 4 miles upstream) and its distance from the Tolt River (about 11 miles downstream) provides spatial separation of salmonid spawning habitats that may be helpful in maintaining geographic distribution and genetic diversity, two important factors in maintaining viable salmon populations.

Observations from 2017 indicated that stream banks are armored across more than 40 percent of the lower Raging River, impairing riverine and floodplain processes and degrading juvenile salmon-rearing habitat conditions. Within the riparian zone, primary land cover consisted of trees with secondary land cover consisting of impervious surfaces and shrubs (King County 2018).

The lower Raging River is used by Chinook, chum, and coho salmon, rainbow trout (including winter steelhead), cutthroat trout, mountain whitefish, and, rarely, bull trout. Historically, pink salmon were abundant, but since the 1950s they have mostly disappeared. It is also possible that a riverine form of sockeye salmon spawn in the lowermost reaches of the river, as they have been found elsewhere in the Snoqualmie River. The Raging River is in the highest tier of Chinook salmon use, and it contains at least 12 percent of the total spawning escapement for the Snohomish River basin (Haring 2002, King County 2006).

The lower third of the 15 total miles of the Raging River exhibits highly constrained and degraded channel and floodplain conditions. Levees from the mouth to River Mile 1.4 cut off wetlands and prevent the channel from meandering and side channels from developing. Mature riparian forests are lacking, which limits the potential for large wood recruitment along the Raging River. This lack of large wood results in few pools and simplified salmon habitat (Haring 2002; King County 2006). Fish passage barriers exist on tributaries, and levees limit access to off-channel floodplain habitat (Haring 2002; King County 2018).

Primary Flood and Erosion Hazards and Risks

The Raging River basin is relatively steep and short, producing floods that peak and recede quickly and have fast and erosive flows along the steep channel and narrow floodplain. Depth of flooding ranges from shallow flooding to 6 feet with measurable velocity, and warning time is unavailable. The river basin, from the end of Upper Preston Road SE near River Mile 8.3 downstream to I-90 at River Mile 4.9, has a moderate gradient and, because of relatively limited confinement by flood protection infrastructure, has high rates of lateral migration. Low-density residential development is impacted by flood inundation, bank erosion, and landslide and debris flows, and is also at risk from channel migration and avulsion. Preston-Fall City Road SE runs the length of the river valley from I-90 downstream to Fall City. Flood protection infrastructure, which requires monitoring and recurrent repairs, protects the bank where the road is adjacent to the channel between River Miles 3.0 and 4.0.

King County mapped channel migration and landslide hazard areas in 2019 and 2016, respectively, within the Raging River to identify the potential impacts on flooding and risk to people and infrastructure within the river corridor (King County 2016a, 2019). The 2019 channel migration mapping was an update of earlier mapping done by King County in 1991 (Shannon and Wilson 1991).

Although the rates of channel migration are lower than upstream of I-90, the active channel is eroding into the valley margin in several locations, posing risks to private and public infrastructure due to bank erosion. Local irregularities in geologic conditions appear to contribute to complex subsurface drainage pathways that also cause local settlement and hill-slope instability.

In its downstream reach, the Raging River historically migrated across the extent of its alluvial fan but is now largely confined throughout by continuous levees on both banks, which are intended to limit channel migration and damage caused by flooding. Flooding in this reach is caused when the levees are overtopped or damaged and by mainstem Snoqualmie River flooding, leading to flooding of residential and commercial properties and impacts to buildings and their contents.

Upper Preston Road damage on the Raging River, November 2006

Potential Impacts from Climate Change and Other Future Changes

South Fork Skykomish River

By the 2080s, the 10-year and 100-year peak flow events for the South Fork Skykomish River near Index (USGS ID: 12133000) are projected to increase 34 percent (range of 1 to 85 percent) and 40 percent (range of -11 to +123 percent), respectively, under a high greenhouse gas emissions scenario, relative to the 1970–1999 average (CIG Phase 2 report).[30] Changes in peak flows are influenced by both the declines in snowpack and by higher intensity heavy rain. Impacts from these changes may include increases in the size and frequency of risks posed by flooding and channel migration hazards. Larger and more frequent floods increase the risk of levee and revetment damage, bank erosion, inundation of floodplain areas, damage to public and private infrastructure, and isolation of communities that can be cut off by road flooding. Any increase in development in flood or channel migration hazard areas will increase flood risks.

30 Results based on an ensemble average of 12 regional climate model scenarios (using the Weather Research and Forecasting [WRF] model) and a high greenhouse gas scenario (RCP 8.5) from the UW Climate Impacts Group (CIG) Phase 2 assessment, completed in June 2020 and updated in November 2020 (Mauger and Won 2020). Phase 3 of the CIG study, scheduled for completion in 2024, will update these projections and may result in higher projected changes than that shown here.

The heavily forested condition of the South Fork Skykomish River watershed makes it susceptible to wildfires, which are increasing in frequency and severity in drier regions of the western U.S. due to the accumulation of fuels from wildfire suppression in the 20th century combined with the effects of climate change. In 2022, the Bolt Creek fire burned more than 14,000 acres in the basin, which started on the west bank of the Beckler River and spread to the slopes above the South Fork Skykomish River for about 3 miles in the vicinity of the communities of Grotto and Baring. Nine alluvial fans on the slope affected by the Bolt Creek fire were determined to have moderate to high debris flow hazards following the fire (Mickelson and Allen 2022) and are being actively monitored during the flood season.

Upper Snoqualmie River

By the 2080s, average streamflow for October through March is projected to increase by 15 to 33 percent for the Snoqualmie River near Snoqualmie (USGS ID: 12144500), relative to the 1970–1999 average. Changes in peak flows are influenced by both the declines in snowpack and by higher intensity heavy rain (CIG Phase 1 Report, Lee et al. 2018). Impacts from these changes may include increases in the size and frequency of risks posed by flooding and channel migration hazards. Larger and more frequent floods increase the risk of levee breaching, levee and revetment damage, bank erosion, inundation of floodplain areas, damages to public and private infrastructure, and isolation of communities that can be cut off by road flooding. Any increase in development in flood or channel migration hazard areas will result in an increase in flood risks.

Lower Snoqualmie River

By the 2080s, the 10-year and 100-year peak flow events for the Snoqualmie River near Carnation (USGS ID: 12149000) are projected to increase 24 percent (range of -10 to 92 percent) and 40 percent (range of -18 percent to +103 percent), respectively, under a high greenhouse gas emissions scenario, relative to the 1970–1999 average (Mauger and Won 2020). Changes in peak flows are influenced by both the declines in snowpack and by higher intensity heavy rain (Lee et al. 2018). Impacts from these changes may include increases in the size and frequency of risks posed by flooding and channel migration hazards. Larger and more frequent floods increase the risk of levee and revetment damage, bank erosion, inundation of floodplain areas, damages to public and private infrastructure, impacts on agricultural production, and isolation of communities that can be cut off by road flooding. Any increase in development in flood or channel migration hazard areas will increase flood risks.

Tolt River

By the 2080s, the 10-year and 100-year peak flow events for the Tolt River near Carnation (USGS ID: 12148500) are projected to increase 11 percent (range of -12 to +69 percent) and 43 percent (range of -11 to +119 percent), respectively, under a high greenhouse gas emissions scenario, relative to the 1970–1999 average (Mauger and Won 2020). Changes in peak flows are influenced by both the declines in snowpack and by higher intensity heavy rain (Lee et al. 2018). Impacts from these changes may include increases in the size and frequency of risks posed by flooding and channel migration hazards. Larger and more frequent floods increase the risk of levee breaching, levee and revetment damage, bank erosion, inundation of floodplain areas, damages to public and private infrastructure, and isolation of communities that can be cut off by road flooding. Any increase in development in flood or channel migration hazard areas will result in an increase in flood risks.

Raging River

By the 2080s, the 10-year and 100-year peak flow events for the Raging River near Fall City (USGS ID: 12145500) are projected to increase 10 percent (range of -6 to +58 percent) and 24 percent (range of -22 to +96 percent), respectively, under a high greenhouse gas emissions scenario, relative to the 1970–1999 average (Mauger and Won 2020). Due to the relatively low elevation of the Raging River basin compared to other parts of the Snoqualmie River watershed, changes in peak flows are influenced primarily by projected increases in higher intensity rain events (Lee et al. 2018). Impacts from these changes may include increases in the size and frequency of risks posed by flooding and channel migration hazards. Larger and more frequent floods increase the risk of levee and revetment damage, bank erosion, inundation of floodplain areas, damage to public and private infrastructure, and isolation of communities that can be cut off by road flooding. Any increase in development in flood or channel migration hazard areas will result in an increase in flood risks.

Risk Assessment

A flood hazard risk assessment using Hazus evaluated the effects of riverine flooding on over 38,000 total structures in the South Fork Skykomish/Snoqualmie River watershed. This analysis revealed the following:

- In the entire watershed, 3,381 structures were found to be exposed to the 10 percent annual chance flood, 5,285 structures were found to be exposed to the 1 percent annual chance flood, and 5,692 structures were identified as exposed to the 0.2 percent annual chance flood.
- Of the 747 critical facilities located in the watershed, 143 are exposed to the 10 percent annual chance flood, 194 are exposed to the 1 percent annual chance flood, and 202 are exposed to the 0.2 percent annual chance flood.
- An estimated 127 of the 140 repetitive loss structures are exposed to the 10 percent annual chance flood, 132 are exposed to the 1 percent annual chance flood, and 133 are exposed to the 0.2 percent annual chance flood.

From the numbers of structures identified as exposed to flooding, Hazus generated estimates of potential flood damages. **Table 2.2-15** illustrates the resulting potential flood damages in the watershed for three different return intervals.

TABLE 2.2-15
SUMMARY RESULTS FROM HAZUS ANALYSIS OF POTENTIAL RIVERINE FLOOD DAMAGES IN THE SOUTH FORK SKYKOMISH/SNOQUALMIE RIVER WATERSHED

Percent Chance Exceedance	Return Period	Potential Structure and Contents Damage – All Structures	Potential Structure and Contents Damage – Critical Facilities
10	10-year	$30,866,442	$11,335,489
1	100-year	$185,786,961	$19,374,317
0.2	500-year	$625,463,491	$35,851,264

2.3 Lake Washington/Cedar/Sammamish River Watershed

Watershed at a Glance – Lake Washington/Cedar/Sammamish Watershed

WRIA	• WRIA 8
River systems/reaches included	• Cedar River • Sammamish River • Issaquah Creek
Basin size	• 692 square miles
Key tributaries	• Rex River; Taylor, Peterson, and Rock creeks; Bear, Little Bear, North, and Swamp creeks; Tibbetts, and Laughing Jacobs creeks; Holder, Carey, Fifteenmile, and McDonald creeks; the North and East Forks of Issaquah Creek
Dams/major infrastructure	• Ballard Locks • Chester Morse Lake • Masonry Dam • Overflow Dike • Landsburg Diversion Dam • Sammamish River Transition Zone
Key flood years	• 1906, 1911, 1951, 1990, 1996, 2006, 2009, 2020
Key issues in the basin	• Cedar River experiences fast, erosive flows • Fast, flashy flows along Issaquah Creek and other urban streams • Lakeshore flooding along Lake Sammamish • Urban flooding in City of Redmond
Salmonid species present	• Chinook, sockeye, steelhead and rainbow trout, coho, kokanee, bull trout, cutthroat trout, whitefish
Estimated economic damage from a 1 percent annual chance flood	• $4,733,843,730

The Lake Washington/Cedar/Sammamish watershed is the most populated watershed in Washington state, and it has a history of human modification to support its extensively developed character. Most significantly, the construction of the Ballard Locks and the Lake Washington Ship Canal between Lake Washington and Puget Sound resulted in significant changes throughout the watershed, lowering the elevation of Lake Washington by 9 feet, the abandonment of its outlet to the Duwamish River via the Black River, and rerouting of the Cedar River to flow into Lake Washington at Renton.

Unique among the other major river watersheds in King County, the major rivers (Cedar and Sammamish) of the watershed flow into a lake prior to entering the marine environment of Puget Sound. Human modifications in the early 20th century to the watershed's rivers and Lake Washington were designed to create a freshwater-to-saltwater connection that would support commerce and navigation.

- The **Cedar River** flows from protected headwaters in the Cascades through residential communities before entering the City of Renton and Lake Washington.

- The **Sammamish River** connects Lake Sammamish and Lake Washington. It is a slow-moving river with flood protection extending along its entire length. Bear, Little Bear, North, and Swamp creeks are primary tributaries that enter the river.
- **Issaquah Creek** is the most substantial tributary that flows into Lake Sammamish. It begins in unincorporated King County before flowing through the City of Issaquah and then the lake. It has experienced damaging flood events in recent years.
- Several tributaries empty into **Lake Sammamish** before it flows into the Sammamish River, and flooding of yards and docks along the lakeshore has been increasing in frequency since the mid-1990s.
- The water level in **Lake Washington** is strictly controlled by a locks system to protect a valuable freshwater port and does not see the same types of flooding impacts as Lake Sammamish, but several tributaries to the lake present their own flooding challenges.
- Major employers in the watershed that could be affected by flooding include a Boeing manufacturing facility and the Renton Municipal Airport along the lower Cedar River, the headquarters of Costco Wholesale in the Issaquah Creek basin, Microsoft and Nintendo in the Sammamish Watershed, and numerous agricultural operations in the Sammamish River Agricultural Production District.

Public and Partner Input on Flooding in the Lake Washington/Cedar/Sammamish River Watershed

The Lake Washington/Cedar/Sammamish River watershed spans a wide variety of landscapes, including multiple rivers, large tributaries, and two large lakes, which result in a variety of reported flood impacts. Identified issues include sediment deposition impacting reaches of the Sammamish River, Cedar River, and Issaquah Creek, especially in downstream locations. Community members and partners described sediment deposition as reducing channel or conveyance capacity, impacting water quality, and increasing flood risks along numerous tributary streams, the Cedar River, and the Sammamish River. Stormwater runoff was often described as a primary issue affecting flooding in this watershed. In addition to riverine and tributary flooding impacts, community members highlighted flooding that affects waterfront properties along Lake Sammamish and indicated this flooding is exacerbated by upstream development, wave action during storm events, and insufficient lake outflow.

Overview of Cedar River Basin

The Cedar River drains 188 square miles of the central Cascade Range and flows 45 miles from its high-relief headwaters to its outlet at Lake Washington in Renton. The upper 78 square miles of the Cedar River drainage basin is located upstream of the outlet of Chester Morse Lake, a reservoir behind Masonry Dam that provides for municipal water supply and hydroelectric power generation by the City of Seattle. Two primary tributaries, the Cedar and Rex rivers, drain into Chester Morse Lake, and numerous small tributaries enter the Cedar River in its middle and lower reaches downstream of Chester Morse Lake.

The City of Seattle built three dams in the early 20th century on the Cedar River to provide a stable municipal water supply. These include the Masonry Dam and the Crib Dam (reconstructed as the Overflow Dike), at the outlet of Chester Morse Lake, and the Landsburg Diversion Dam. The Cedar River watershed upstream of the Landsburg Diversion Dam, which includes about two-thirds of its overall watershed, is largely undeveloped forestland managed by the City of Seattle for the primary purpose of municipal water supply and a secondary purpose of hydroelectric power generation. Downstream of the Landsburg Diversion Dam, residential, commercial, and industrial development is present within the lower Cedar River corridor. Residential development shifts downstream from rural residential to suburban single-family near Renton. Commercial and industrial development also increases downstream in proximity to Renton.

The downstream-most 5 miles of the river and its floodplain are almost entirely within the City of Renton, which has the highest population density and largest business center within the Cedar River watershed, including a Boeing manufacturing facility as a major regional employer and the Renton Municipal Airport. This area contains parks, single- and multi-family residential development, commercial development, and portions of the downtown business core. In addition to these developed areas, King County, local municipalities, and others manage hundreds of acres of open-space lands along the lower Cedar River between Landsburg Dam and the City of Renton.

Geology and Geomorphology

The Cedar River watershed is primarily underlain by bedrock of the Cascade Range and unconsolidated glacial sediments upstream and downstream of Chester Morse Lake, respectively. A glacial moraine impounded Chester Morse Lake, downstream of which the Cedar River eroded its present valley through glacial sediments. At the outlet of this valley near the City of Renton, the Cedar River deposited an alluvial fan at the southern margin of what became Lake Washington once it was impounded by this alluvial fan and separated from the Duwamish River Valley to the west (Dunne and Dietrich 1979).

Prior to European settlement in the mid-19th century, the Cedar River was a meandering, braided river with multiple secondary channels across its floodplain. The river flowed into the Black River, which flowed south from Lake Washington to the Duwamish River. Construction of the Hiram M. Chittenden (Ballard) Locks and Ship Canal by the U.S. Army Corps of Engineers (Corps) in 1916, which connected Lake Washington to Puget Sound, resulted in the water surface elevation of Lake Washington dropping by 9 feet. The Cedar River was then diverted from the Black and Duwamish rivers to flow into Lake Washington (Chrzastowski 1983).

During the 20th century, alterations to the Cedar River channel and hydrology included revetment construction, removal of large wood jams, and flow regulation, which largely constrained the Cedar River to a single-threaded, meandering channel. The Cedar River channel progressively narrowed, and channel migration rates decreased during the 20th century (Perkins 1994; Gendaszek et al. 2012).

The Cedar River transports sediment supplied to its channel from erosion of alluvial deposits and from landslides along its valley walls. During the 20th century, erosion of alluvial deposits was limited by the construction of revetments that reduced channel migration and peak-flood discharges. Upstream of the Cedar River alluvial fan at River Mile 1.7, excessive sediment deposition does not

limit channel conveyance capacity. At River Mile 1.7, the Cedar River loses gradient. When the Cedar River was diverted to flow into Lake Washington, a straightened channel was constructed across the historical alluvial fan. However, the loss of gradient persists and backwater from the lake results in continued sediment deposition within the Cedar River at Renton.

Cedar River flooding in Renton, 1996

The City of Renton, with assistance from the King County FCD and the Corps, has repeatedly dredged the deposits from this lowest portion of the river. In 1998, the City of Renton participated in a Corps 205 Flood Control Project that resulted in gravel removal and construction of floodwalls and levees along the reach of the Cedar River, passing through the City of Renton from River Mile 1.2 to its outlet at Lake Washington at River Mile 0. This substantial flood reduction project protects critical

infrastructure important to the regional and state economies, including the Boeing Renton Plant and the Renton Municipal Airport as major employers.

The City of Renton maintains the 205 Flood Control Project structures through an agreement with the Corps. Levees and floodwalls are designed to protect up to the 1 percent annual chance flood. Sediment accumulation is regularly monitored, and periodic dredging is conducted to maintain freeboard at the levees and floodwalls to contain the 1 percent annual chance flood. The most recent dredging was completed in 2016 and was funded by the FCD. The frequency of dredging in the future is expected to be on the order of every 10 to 20 years.

Hydrology and Hydraulics

Most precipitation within the Cedar River basin falls during the fall and winter as snow in the upper elevations of the basin and rain at lower elevations. Seasonally, high-intensity, focused precipitation associated with atmospheric river events, often accompanied by above-average temperatures and melting of the snowpack, has resulted in high rates of runoff and flooding throughout the basin. Most major flooding on the Cedar River has typically occurred during the fall and winter rainy season between October and March.

The magnitude and duration of floods from the Cedar River are driven by runoff from storms. Although Cedar River discharge is regulated by the City of Seattle for water-supply operations, limited flood storage capacity exists within Chester Morse Lake during the fall and winter flood season, which can be used to reduce flood peaks for downstream communities and limit scour of salmon redds, or nests, within streambed gravels. The city also augments summer low flows for the purpose of supporting salmon runs, consistent with instream flow requirements established under the Cedar River Watershed Habitat Conservation Plan prepared under the ESA (City of Seattle 2000).

While the Masonry Dam was not designed or built to serve as a flood-control dam, it has the capacity to store up to 15,000 acre-feet of floodwater. During the flood season, the dam is operated to maintain a buffer, or "flood pocket," in the reservoir whenever possible so that the peak discharge of floods can be reduced. The effect of this management practice has been a reduction in the magnitude, frequency, and severity of flooding downstream of the dam, while sometimes also increasing the duration of flood peak flows. The dam is neither intended for, nor capable of, holding back high-volume, long-duration, or back-to-back flood events that do not allow adequate time to restore Chester Morse Lake's flood pocket. So, while the dam does provide some limited flood risk reduction benefits under certain circumstances, flood-prone areas downstream remain exposed to severe flood risks.

Flow quantiles represent common flood events based on the percent chance that they will occur in any given year (percent chance exceedance) or the average interval of time that passes between similarly sized flood events (return period). Flow quantiles developed for FEMA floodplain mapping of the Cedar River are listed in **Table 2.3-1**. Projected flows for four different events at two different locations on the river are provided. The flows are based on periods of record from approximately 1920 to 2000 at Landsburg and 1946 to 2000 at Renton. **Table 2.3-2** and **Table 2.3-3** show recent high flows and the highest flows on record since gage measurements began.

TABLE 2.3-1
FLOW QUANTILES FOR THE CEDAR RIVER

Percent Chance Exceedance	Return Period	Landsburg (cfs)	Renton (USGS Gage 12119000) (cfs)
10	10-year	4,880	5,940
2	50-year	8,340	9,860
1	100-year	10,300	12,000
0.2	500-year	16,100	18,400

TABLE 2.3-2
RECENT HIGH FLOWS, CEDAR RIVER NEAR LANDSBURG GAGE (USGS 12117500)

Date	Flow
2020-02-07	7,590 cfs

TABLE 2.3-3
HIGHEST FLOWS RECORDED AT CEDAR RIVER NEAR LANDSBURG GAGE (USGS 12117500) SINCE GAGE WAS INSTALLED IN 1895

Date	Flows
1911-11-19	14,200 cfs
1906-11-15	12,400 cfs
1990-11-24	10,800 cfs

Ecological Context and Salmonid Use

Physical and ecological processes and habitat in the Cedar River watershed have been substantially altered from historical conditions via hydrologic alterations, land development, and channel modifications. The lower Cedar River contains forested areas, but bank armoring and residential land uses have reduced floodplain connectivity and led to reduced sediment and wood supply, which has simplified instream habitat (WRIA 8 2005). Geomorphic and habitat complexity are low through much of the lower watershed. Large wood volumes are low and fish habitat is dominated by riffles, with few large pools besides lateral scour pools associated with hardened banks (King County 2018).

The Cedar River supports the largest number of natural-origin Chinook in the WRIA 8 watershed and is the highest priority spawning and rearing area for WRIA 8 Chinook. The Cedar River is also the primary spawning area for Lake Washington sockeye and steelhead (WRIA 8 2018). The Cedar River is also used by coho, rainbow, and cutthroat trout, and mountain whitefish (King County 2006). The area above Chester Morse Lake contains bull trout, who use the lake and tributaries for spawning and rearing (WRIA 8 2005).

Flooding of residential development in the Cedar River floodplain, January 2009

Monitoring indicates that instream juvenile Chinook rearing is a limiting life stage in the Cedar River (WRIA 8 2018). Recent research has shown that constructed habitats in the Cedar River have increased habitat complexity, in turn increasing predicted juvenile Chinook productivity (Hall et al. 2018). Furthermore, a recent study of large wood and habitat-forming processes specific to the Cedar River indicates that levee setback projects over the past two decades have reconnected floodplains and successfully increased wood volume and associated rearing habitat features in the project reaches (King County 2023).

Flood events on the Cedar River can scour salmon redds, an impact that is exacerbated by a lack of sufficient connected floodplains (WRIA 8 2018, City of Seattle 2000). At the same time, Seattle manages streamflow to avoid redd scour during the incubation period, if possible, as well as to support adult salmon migration and spawning (WRIA 8 2018).

Where floodplains remain connected or have been reconnected, juvenile salmon can access off-channel habitat to rear and take refuge from flooding, which can also support habitat development. High flows in 2020 dramatically increased floodplain connectivity and low-velocity aquatic habitat area at the site of the Rainbow Bend floodplain reconnection project, compared to data observed in the years prior to flooding (King County 2022). The 2020 event also resulted in avulsions at two sites on the river—Dorre Don and Riverbend—which led to increased low-velocity aquatic habitat.

Flooding supports the recruitment and transport of large wood to the river, which is identified as a key habitat goal for the Cedar River watershed. Wood recruitment to the river is currently limited, and reconnected floodplain areas are critical for allowing for recruitment of wood to the river and providing areas for wood deposition and retention.

Primary Flood and Erosion Hazards and Risks

Flooding and flood damage to property and infrastructure occur throughout the basin, and the depth of flooding and warning time varies depending on location. The rural residential areas upstream of Renton can see depths of 1 to 6 feet with a warning time of 1.5 to 6 hours. Renton can experience depths of 3 to 6 feet and has a 6-hour warning time, and the lower river adjacent to Boeing can see depths of 1 – 3 feet with a 6-hour warning time. Areas of low-lying floodplain, channel banks, and active gravel bars can be inundated, eroded, or shifted by floodwaters. Flood protection infrastructure built in the last century often relied on design and construction standards that are now outdated, resulting in deterioration of older flood protection facilities. Additionally, extensive development in areas with little or no flood protection, the emergence of new flood hazard areas following major flood events, and an increase in the number of homes and infrastructure in flood hazard areas all contribute to flood risk in the basin.

Flooding in residential areas poses the greatest risk to public safety in the lower and middle reaches of the Cedar River. Even moderate floods can cause high-velocity flows around homes and over sole-access roadways. At approximately a 20 percent annual chance flood, significant overbank flooding and inundation of structures starts to occur. Between a 10 percent and 5 percent annual chance flood, homes, businesses, and infrastructure begin to experience areas of deep, fast flows and damage. Higher flows typically lead to widespread flooding, major safety concerns, evacuations, road closures, and substantial flood damage to structures and property.

The Cedar River Trail, mostly constructed along the historical grade of the Milwaukee Road railroad, follows the river for much of its length and extends from Lake Washington to Landsburg. In many locations, the river abuts the Cedar River Trail, which needs protection due to the presence of a regional fiber optic line buried within the trail prism along part of its length. Just beyond the trail is State Route 169. Protection of these important regional infrastructure assets remains a primary focus of the Cedar River flood hazard mitigation capital program.

King County mapped the channel migration zone in 2015 and 2019 and delineated severe and moderate channel migration hazard areas, including potential avulsion pathways (King County 2015; 2019). Although much of the Cedar River remains a meandering single-thread channel, partial avulsions, constructed side channels, and floodplain reconnection efforts and levee setbacks have begun to restore multi-thread, braided channels. These channels have created greater diversity than single-threaded channels and provide additional flood storage capacity in some reaches of the river. Channel migration continues to present substantial risk along the Cedar River to residential development within the mapped channel migration zone.

The Cedar River is also flanked by numerous steep, landslide-prone hillsides that contribute important sediment to the river but which have also blocked large portions of the channel during past landslide events. Landslides continue to remain a potential threat to floodwater conveyance

and pose an additional flood risk. Earthquakes have historically triggered landslides within the Cedar River Valley, including a large landslide at River Mile 5.0 triggered by the 6.8-magnitude Nisqually Earthquake on February 28, 2001, which resulted in channel avulsion and flooding upstream of the landslide.

Landslides and debris flows along steep slopes at the margins of the Cedar River Valley convey sediment to the Cedar River channel throughout its much of its corridor. King County mapped landslides within the Cedar River corridors in 2016 and identified areas of potential deep-seated landslides that are both in contact with the river and large enough to partially or completely block the river channel and affect flooding occurrence and severity (King County 2016). King County also identified smaller landslides and debris flows, which can contribute large amounts of sediment that can impact flooding locally and downstream as sediment is moved and stored within the river channel (King County 2016). It should be noted, however, that landslides are an important source of sediment to the Cedar River that help form and maintain aquatic habitat.

Overview of Sammamish River Basin

The Sammamish River flows 13.8 miles from the weir at the outlet of Lake Sammamish near the City of Redmond to its mouth in Lake Washington at the City of Kenmore, draining 240 square miles of the foothills of the Cascade Range and the Puget Lowland. Major tributaries to the Sammamish River include Bear, Little Bear, North, and Swamp creeks. Issaquah, Tibbetts, and Laughing Jacobs creeks flow into Lake Sammamish upstream of the Sammamish River. Prior to the diversion of the Cedar River to Lake Washington following the construction of the Ballard Locks and the Lake Washington Ship Canal, the Sammamish River was the largest tributary to Lake Washington.

The Sammamish River is a low-gradient river, at present losing about 14 feet in elevation over its 14-mile length. The Sammamish River's floodplain spans much of the valley floor upstream of the City of Woodinville where it occupies a broad valley north of Lake Sammamish but narrows downstream where the valley becomes more confined. The entire river is part of the Sammamish River Improvement Project (SRIP) completed by the Corps in 1964–1966, with King County designated as the local sponsor. The SRIP channelized, dredged, and straightened what was previously a highly sinuous, meandering channel and extensive floodplain wetland network (formerly called the Sammamish Slough). This project connected and completed several earlier piecemeal efforts by King County diking districts and individual landowners to allow the river's floodplain to be developed.

Much of the Sammamish River flows through incorporated areas. Starting at the mouth and moving upstream, the river passes through the cities of Kenmore, Bothell, Woodinville, and Redmond. The middle portion of the river is in unincorporated King County, with most of the land in this area protected for farming uses as an Agricultural Production District. While the valley was once used almost exclusively for agriculture, today a variety of land uses can be found along the river.

The paved, well-maintained Sammamish River Trail lines 10.1 miles of the river. The Sammamish River Trail is a major connection between several other trail and park systems, including the Burke-Gilman Trail to the City of Seattle, Wilmot Gateway Park in Woodinville, Sammamish Regional Park, Willows Run Golf Complex, and the largest active-use park in the King County Park system,

Marymoor Park. A trail extension connects the Sammamish River Trail with the East Lake Sammamish Trail via Marymoor Park.

Geology and Geomorphology

Lake Sammamish and the Sammamish River Valley are examples of a glacial trough, carved by sub-glacial meltwater during continental glaciation (Booth 1994). The lake is naturally impounded by the alluvial fan formed at the mouth of Bear Creek. The present-day river is a constructed single-thread channel with a mildly meandering pattern. Landward of the armored riverbanks is a floodplain of young alluvium, wetland deposits, and older terraces.

The historically sinuous channel that meandered through a wide, low-gradient valley bottom with sand and silt substrate is consistent with the glacial trough features seen in the lower Snoqualmie River (Collins et al. 2003). As such, naturally slow rates of lateral channel migration could be expected before the massive alterations that revised the Sammamish River channel and floodplain. With the entire river now channelized and locked in place by bank armoring, there is little likelihood of channel movement.

Hydrology and Hydraulics

Prior to European settlement, Lake Sammamish drained into Lake Washington through the old Sammamish Slough, a highly meandering, low-gradient river bordered by extensive wetlands and floodplains. The meandering course of the Sammamish Slough stretched about 30 miles from Lake Sammamish to Lake Washington and was an important transportation corridor. Following the construction of the Lake Washington Ship Canal and Ballard Locks in 1916 and the accompanying lowering of Lake Washington by 9 feet, the water surface of the Sammamish Slough lowered as well.

Property owners along the slough formed a drainage district to straighten and deepen the channel so that the adjacent lands could be developed for agriculture. Lands along the renamed Sammamish River were converted into agricultural use, but from the beginning they were subjected to almost annual flooding from spring runoff. The Corps completed the river channelization project in 1966, resulting in the present 14-mile course of the Sammamish River.

From Lake Sammamish to its outflow at Kenmore, the river was dredged, which deepened the channel approximately 5 feet and increased the channel width from approximately 15 feet to between 32 and 50 feet. A low weir at the outlet of Lake Sammamish was installed, which marks the upper boundary of the river. The weir outlet slows the release of water from Lake Sammamish during low-flow periods to maintain summer lake levels. During high flows, the weir is completely submerged by the river, acting as an uncontrolled spillway. The SRIP was designed to pass approximately a 2.5 percent annual chance springtime flood, equivalent to a 10 percent annual chance winter storm, over the weir without the water surface elevation in Lake Sammamish exceeding 29 feet.

Manufactured home community along the modified banks of the Sammamish River, October 2022

Flow quantiles represent common flood events based on the percent chance that they will occur in any given year (percent chance exceedance) or the average interval of time that passes between similarly sized flood events (return period). Flow quantiles developed for FEMA floodplain mapping of the Sammamish River are listed in **Table 2.3-4.** Flow quantiles for four different events at two different locations on the river are shown. The flow quantiles were developed by analyzing the timing of flow inputs from various tributaries and are based on a period of record from 1949 to 2009. **Table 2.3-5** and **Table 2.3-6** show recent high flow on the river and the highest Lake Sammamish water surface elevations since gage measurements began.

TABLE 2.3-4
FLOW QUANTILES FOR THE SAMMAMISH RIVER

Percent Chance Exceedance	Return Period	At Mouth (cfs)	Just Downstream of Bear Creek (cfs)
10	10-year	3,950	1,980
2	50-year	4,890	2,420
1	100-year	5,260	2,590
0.2	500-year	6,060	2,970

TABLE 2.3-5
RECENT PEAK FLOW: SAMMAMISH RIVER AT MARYMOOR WEIR (KING COUNTY 51M)

Date	Flow
2020-02-09	1,791 cfs

TABLE 2.3-6
HIGHEST RECORDED LAKE SAMMAMISH LEVELS SINCE GAGE WAS INSTALLED IN 1939, SAMMAMISH LAKE NEAR REDMOND (USGS 12122000)

Date	Flows
1951-02-12	33.44 feet
2020-02-09	31.17 feet

Ecological Context and Salmonid Use

Habitat in the Sammamish River has been dramatically altered from historic conditions. The lowering of Lake Washington and the subsequent straightening, dredging, and bank armoring of the Sammamish River have eliminated connections between the river and its floodplain and wetlands. As a result, both the quantity and quality of aquatic habitats have been reduced (King County 2006).

The Sammamish River is used by ESA-listed Chinook salmon as well as coho, sockeye, and kokanee salmon, and rainbow and cutthroat trout (Kerwin 2001). There are historical accounts of salmonid spawning in the Sammamish River prior to its modifications, but today there is little or no spawning (Mattila, pers. comm., in King County 2006). Thus, the river primarily serves as a migration and rearing corridor for salmon that spawn in streams, such as Bear, Issaquah, Little Bear, North, and Swamp creeks, and a myriad of smaller streams that still retain some salmonid use, mostly for coho salmon and cutthroat trout (King County 2006) and possibly kokanee (Lake Sammamish Kokanee Work Group 2014). These streams provide important opportunities for salmon to disperse and find suitable habitats, and many restoration efforts led by local governments and nonprofits focus on improving the quality and quantity of habitat in these systems.

Riparian areas along the river are largely lacking tall trees, although multiple recent projects (e.g., by the City of Redmond) have re-established native vegetation in select areas. As a result of degraded riparian conditions, large wood recruitment from riparian areas is reduced, which simplifies instream habitat (R2 Resource Consultants 1999; King County 2006). Additionally, the lack of riparian vegetation along the Sammamish River has resulted in extremely high water temperatures in summer and early fall, impacting salmon migration and likely contributing to pre-spawn mortality (King County 2006). Water temperatures that are both lethal and sublethal in the Sammamish River are key constraints on Chinook recovery (WRIA 8 2018).

The Sammamish River is a Tier 1 area under the WRIA 8 Chinook Conservation Plan and is one of the highest priority habitats for protection and restoration (WRIA 8 2018). WRIA 8 habitat goals for the Sammamish River include increasing riparian cover and adding thermal refugia (WRIA 8 2018). These

actions would support survival and productivity of salmon spawned in upstream areas by reducing temperature problems and increasing habitat complexity, such as pools and hiding cover, along their migratory pathway. While the engineered nature of the Sammamish River has greatly diminished (and in some cases eliminated) the beneficial functions associated with connected floodplains, some limited areas with connected floodplains do remain that provide habitat benefits. Such areas can be found in the cities of Redmond, Kenmore, and Bothell.

The shallow-water shoreline areas of Lake Sammamish are important for salmon to escape from predation and for feeding as fry (WRIA 8 2017). Most of the lakeshore is privately owned and developed, which has resulted in shoreline armoring and other modifications. Overwater structures along the lake impact prey resources and migration behavior of Chinook salmon and reduce the amount and quality of shallow water habitat (WRIA 8 2005). Predation of juvenile Chinook by native and non-native species in Lake Sammamish is suspected to limit juvenile survival in the watershed (WRIA 8 2017). Other factors limiting salmon in the lake include invasive plant species, elevated water temperatures, low dissolved oxygen, and inadequate riparian buffers (Ecology 2020).

The Lake Sammamish kokanee salmon is a freshwater species that spawns primarily in tributaries to Lake Sammamish and on lake beaches near potential groundwater upwelling areas (Lake Sammamish Kokanee Workgroup 2014). Kokanee rear and mature in Lake Sammamish before returning to the lake's tributaries to spawn, and they are significantly impacted by high water temperatures and low dissolved oxygen. The influence of water temperature and low dissolved oxygen result in severe limits to available habitat for kokanee from April through November (HDR Engineering 2009). Other limits on native kokanee salmon include low egg-to-fry survival due to scour during high-flow events and possibly predation (HDR Engineering 2009). While not listed under the ESA, Lake Sammamish kokanee are in grave decline and face a real risk of extinction.

Primary Flood and Erosion Hazards and Risks

The SRIP significantly reduced the frequency and severity of flooding risks along the Sammamish River and, when flooding occurs, it predominantly results in inundation of the agricultural and recreational lands that occupy the wide central floodplain. Depth of flooding along the Sammamish ranges from shallow flooding to 3 feet, and warning times are not available. Completed as part of the SRIP, the 1964 Sammamish River Operation and Maintenance Manual outlines maintenance practices to ensure conveyance of the design flow through the river channel. This includes annual mowing of the banks to keep them clear of all vegetation, as well as occasional dredging or channel clearing to remove any accumulated sediment or wood.

Over time, maintenance practices evolved to reflect the emergence of new environmental regulations and associated regulatory drivers (i.e., listing of salmon as threatened under the ESA in 1999). In recent years, maintenance practices have shifted away from annually mowing the banks to focus on selective vegetation thinning or removal where needed for flood conveyance. In many locations, the amount of mowing needed to control the invasive plants that dominate the riverbanks is neither practical nor necessary from a flood perspective.

King County and the Corps performed a joint inspection of the full Sammamish River in October 2022. Substantial deficiencies were identified related to scour of rock at the base of the levees, over-steepened banks, and overgrowth of riparian and aquatic weeds. Piping created by mammal burrowing is a significant issue in the City of Redmond and agricultural lands.

The weir at the uppermost end of the river retains water in Lake Sammamish during summer, when the lake sees extensive recreational use. The weir includes a low-flow notch to support passage for migratory fish. Water that leaves the outlet of Lake Sammamish flows across the weir, then through the 1,432-foot-long transition zone into the trapezoidal river channel. Through this transition zone, the river drops 6.75 feet, approximately half the total 14-foot drop over the entire 14-mile river.

In 1998, King County partnered with the Corps to redesign and rebuild the deteriorating weir structure. This work was done in concert with fish passage improvements and extensive bank stabilization and revegetation. The project covered several thousand feet of bank in Marymoor Park. More recently, the City of Redmond designed and built several habitat enhancement projects in the river corridor.

In 2011, the frequency and extent of mowing in the transition zone was increased in response to elevated winter lake levels. In addition, trimming of the willow buffer was increased to maintain a navigation channel and flow conveyance. King County and the Corps are working together to update the 1964 Operations and Maintenance Manual to codify letters of agreement on vegetation management and ensure the manual is consistent with contemporary environmental regulations. The expected completion date is 2024.

In 2022, King County engaged jurisdictions along the river to begin development of the 2024 Sammamish River Capital Investment Strategy and Implementation Plan, which seeks to update the actions recommended in the 2002 Sammamish River Corridor Action Plan (Tetra Tech 2002) while integrating updates on maintenance requirements related to the Operation and Maintenance Manual update. This work is anticipated to be complete later in 2024.

The goal of the SRIP was to protect farms in the valley from spring floods and to maintain a minimum summer water level for Lake Sammamish. The project has consistently met the outflow expectation from lake to the river after March 1 each year. The design of the project also anticipated some winter lakeshore flooding. However, as development in the basin has increased—including development of the lakeshore and development in areas that drain to the lake and river (most notably, in the Bear Creek basin)—lakeshore properties may be seeing impacts that differ from the past. Lakeshore flooding can result in damage to private docks and erosion of lakefront property, with some limited instances of flood damage to residential structures. King County continues to work with property owners and partners, including the King County Flood Control District, to identify appropriate steps to take to address lakeshore flooding through projects and planning activities.

Sammamish River and Bear Creek confluence during heavy rain, February 2020

Overview of the Issaquah Creek Basin

Issaquah Creek runs in a roughly south-north direction and flows from the foothills of the Cascade Mountains to Lake Sammamish. The 61-square-mile basin contains the mainstem of Issaquah Creek and its major tributaries (Holder, Carey, Fifteenmile, and McDonald creeks, and the North and East Forks of Issaquah Creek). Although Tibbetts Creek is not a tributary to Issaquah Creek, it shares a common floodplain in large flood events.

The middle and upper reaches of the basin are in unincorporated King County, and the creek corridor is composed primarily of riparian forest and rural residential development. The lower reaches of Issaquah Creek flow through the highly developed residential and commercial areas of the City of Issaquah before passing through Lake Sammamish State Park, where the creek enters the lake.

Existing land use in the basin includes commercial forests, parks, quarry and mining, residential, commercial, urban, and agriculture. Of the entire basin, 30 percent is zoned commercial forest production and 58 percent is rural zoning. Forests cover more than 68 percent of the entire basin, and commercial forestry continues within the Tiger Mountain State Forest. The City of Issaquah is the primary urban center and is entirely within the urban growth area.

Geology and Geomorphology

The Issaquah Creek watershed has an hourglass shape with wide valley bottoms both upstream and downstream of a bedrock-controlled constriction located approximately at River Mile 7.3. Squak and Tiger mountains are underlain by bedrock and glacial deposits. The valley floor contains a mixture of glacial sediments and alluvium that consists of reworked glacial and mass wasting deposit materials.

Landslides, including debris flows and shallow to deep-seated slumps, are present throughout the basin. Large landslides and debris flows that may interact with the creek and contribute to flood hazards were identified in the 2016 River Corridor Landslide Mapping (King County 2016). The Issaquah Creek watershed within the City of Issaquah is crossed by the Seattle Fault Zone, an active, east-west-trending regional reverse fault system (the primary fault planes dip to the south and bring land up on the south, while land to the north may drop).

Channel migration zone mapping is underway, and the map should be adopted for land use regulatory purposes in 2024. In general, observations from work completed to date on that study indicate that Issaquah Creek freely migrates at most locations. The riparian area has abundant natural large wood both in channel and available for recruitment. The creek's floodplain is actively engaged in many areas, with a highly mobile bed of sediment that contributes to a high rate of active channel migration. The creek is unregulated by any dams or major water withdrawals. The only exceptions are the Issaquah hatchery weir at River Mile 3.75 and an intake present at about River Mile 4.0 that withdraws creek water used for salmon reproduction. The water intake is protected by grade control structures placed in the channel for about 300 feet downstream of the intake structure. Bank armor is present in many areas along both banks of the creek that locally slows or redirects channel migration but does not prevent it.

Hydrology and Hydraulics

The Issaquah Flood Study is currently being updated. Hydrology for the basin will be reviewed and updated if indicated by analysis of the additional period of record from the previous study to the present. Two USGS gages are present in the basin (12121600 near Issaquah Creek mouth and 12120600 at Hobart, on the bridge at SE 252nd Drive) and have 59 and 36 years of continuous record, respectively.

Flow quantiles represent common flood events based on the percent chance that they will occur in any given year (percent chance exceedance) or the average interval of time that passes between similarly sized flood events (return period). Flow quantiles developed for the effective FEMA floodplain mapping are shown in **Table 2.3-7** and are based on a period of record from 1964 to 1999. Flows for four different events at two different locations on Issaquah Creek are listed. **Table 2.3-8** and **Table 2.3-9** show a recent high-flow event and the highest flows since gage measurements began.

TABLE 2.3-7
FLOW QUANTILES FOR ISSAQUAH CREEK

Percent Chance Exceedance	Return Period	At Mouth (cfs)	At Hobart-USGS Gage 12121600 (cfs)
10	10-year	2,890	2,890
2	50-year	3,700	3,400
1	100-year	3,960	3,560
0.2	500-year	4,490	3,940

TABLE 2.3-8
RECENT HIGH STAGE (HEIGHT) AT ISSAQUAH CREEK NEAR HOBART GAGE (USGS 12120600)

Date	Height
2020-02-06	9.53 ft

TABLE 2.3-9
HIGHEST STAGE (HEIGHT) RECORDED AT ISSAQUAH CREEK NEAR HOBART GAGE (USGS 12120600) SINCE STAGE MEASUREMENTS STARTED IN 1988

Date	Height
1990-11-24	9.9 ft
1996-02-08	9.73 ft

Ecological Context and Salmonid Use

Issaquah Creek is a significant resource for both native and hatchery salmon. Generally, the Issaquah Creek basin includes high-quality aquatic habitat and geomorphic conditions that contribute to habitat diversity within the larger Lake Sammamish-Lake Washington basin (WRIA 8 2005). Issaquah Creek is a Tier 1 area under the WRIA 8 Chinook Conservation Plan, one of the highest-priority habitats for protection and restoration (WRIA 8 2017).

Middle and upper sections of Issaquah Creek have exceptional fish habitat. Carey Creek and Holder Creek (tributaries to Issaquah Creek) also provide excellent salmon habitat (WRIA 8 2005). Issaquah Creek supports Chinook, coho, kokanee, steelhead, and potentially also bull trout. Issaquah Creek supports a naturally spawning population of Chinook, which is supplemented by hatchery fish that are propagated at the Issaquah hatchery. The hatchery also produces coho and steelhead, and in 2013 fish passage was provided at the hatchery, which restored access to 11 miles of Chinook spawning and rearing habitat. Currently, all tributaries and the mainstem of Issaquah Creek are used by Chinook, although McDonald Creek has low Chinook abundance and infrequent use (WRIA 8 2005). The North Fork and East Fork of Issaquah Creek periodically support late-run spawning of kokanee (Lake Sammamish Kokanee Workgroup 2014).

Water quality in Issaquah Creek is impaired by fecal coliform bacteria. Sources of bacterial contamination in the Issaquah Creek basin include on-site septic systems, possible sanitary sewer line leaks, agriculture, landfills, and wildlife (Ecology 2004). Lack of suitable substrate in the lower section of Issaquah Creek reduces salmonid population capacity, as well as loss of off-channel rearing refugia and lack of large wood (Kerwin 2001). WRIA 8 habitat goals for Issaquah Creek include increasing riparian cover and wood volume (WRIA 8 2017).

Primary Flood and Erosion Hazards and Risks

Flooding impacts from inundation are common in the City of Issaquah, where floods affect commercial and residential properties. Depth of flooding can be 6 to 8.5 feet with measurable velocity, and the warning time is 3 to 4 hours. The city has identified flooding resulting from insufficient stormwater system capacity or peak flow rates exceeding the normal capacity of the existing conveyance system, which can cause the creek to overtop its banks. Some localized flooding is also caused by the limited capacity of existing stormwater infrastructure or a lack of infrastructure in neighborhoods such as Olde Town (Otak 2021). Most structural flooding occurs because of development located within the floodplain.

Erosion from Issaquah Creek flooding, January 2021

In unincorporated King County, lowland and localized flooding occurs along middle Issaquah Creek, and flooding also occurs along East Fork Issaquah Creek and McDonald Creek. Channel migration can cause bank failures, undermine roads, and result in road closures of extended duration until they are repaired. Channel migration from the 2020 and 2022 flood events caused bank erosion that impacted private property and several residences in the middle and upper basin. Several small bridges are at or nearing their functional design life and at risk from channel migration of debris accumulations on bridge piers and abutments. Steep drainages on the west slope of Tiger Mountain experience high flows with high sediment loads that impact downstream channels, habitat, and road culverts.

Issaquah-Hobart Road SE plays a key regional mobility role in the county's transportation system. The road is impacted by major storm events, and debris flows from tributary drainages can block culverts under Issaquah-Hobart Road SE and result in temporary road closures. Erosion of road embankments is also a concern in multiple places.

Potential Impacts from Climate Change and Other Future Changes

Because analyses of future flows in the Cedar and Sammamish rivers have not been completed, analyses completed for the Snoqualmie and Green rivers can be used to provide some insights into what to expect for the Cedar and Sammamish rivers. By the 2080s, average streamflow for October through March is projected to increase by approximately 10 to 30 percent for these river systems, relative to the 1970–1999 average. Changes in peak flows are influenced by both the declines in snowpack and by higher intensity heavy rain events. The decline in snowpack is projected to have a corresponding decrease in the average summer flow. Because of the variability in basin characteristics across the county (e.g., elevation, snowpack area, and dam management), extrapolating these results to the Cedar and Sammamish rivers should be done with caution until the basin-specific analyses can be completed (Lee et al. 2018).

Cedar River

Larger and more frequent floods resulting from increased winter streamflow may increase the risk of bank erosion, channel migration, damage to levees and revetments, and damage to the private and public infrastructure they protect. Except for the levees along the lower 2.5 miles of the Cedar River, most of the flood facilities in the basin are revetments or training levees that do not provide containment for moderate flood events. This makes floodplain areas along the Cedar River susceptible to flood impacts from increased winter streamflow. Larger and more frequent floods increase the chance for communities to be cut off and isolated by road flooding.

An increase in the frequency, size, or duration of high-flow events on the Cedar River could have mixed effects on riverine functions. Increased high-flow events could create or sustain off-channel habitats in reconnected floodplain areas that rely on floods to keep side channels open and/or recruit large wood. Conversely, in confined channel areas, redd scour could worsen or occur more frequently. Additionally, the anticipated reduction in summer flows will shrink available habitat areas and negatively impact migrating adult and juvenile salmonids in the Cedar River.

Sammamish River

More work is needed to understand the impacts of climate change on flooding along the Sammamish River and Lake Sammamish, but it is conceivable that climate change will result in additional risk in both locations.

This basin may be particularly susceptible to impacts on salmon populations. Increasing water temperatures associated with climate change will negatively impact migrating adult and juvenile salmonids in the Sammamish River, and high water temperatures can cause pre-spawn mortality, block migration, drive egg abnormalities, increase susceptibility to parasites or disease, or change patterns of predation or prevalence of warm-water predators (WRIA 8 2018). Increasing development in the basin may increase the flashiness of high-flow events, which could increase the frequency and/or intensity of redd scour events that may limit productivity of kokanee that spawn in tributaries to the Sammamish River.

Issaquah Creek

Larger and more frequent floods from increased winter streamflow may impact Issaquah Creek in similar ways as described for the Cedar River in terms of damage to levees, revetments, and private and public infrastructure. The City of Issaquah may experience larger and more frequent impacts from flooding, particularly in the downtown area, where flooding could be exacerbated by the overwhelmed stormwater system.

Risk Assessment

A flood hazard risk assessment using Hazus evaluated the effects of flooding on more than 390,000 total structures in the Lake Washington/Cedar/Sammamish Watershed. This analysis revealed the following:

- In the entire watershed, 1,307 structures were found to be exposed to the 10 percent annual chance flood, 1,808 structures were found to be exposed to the 1 percent annual chance flood, and 4,160 structures were determined to be exposed to the 0.2 percent annual chance flood.
- Of the 3,651 critical facilities located in the watershed, 110 would be exposed to the 10 percent annual chance flood, 138 would be exposed to the 1 percent annual chance flood, and 196 are exposed to the 0.2 percent annual chance flood event.
- Of the 35 repetitive loss structures, 24 would be exposed to the 10 percent annual chance flood, 26 structures would be exposed to the 1 percent annual chance flood, and 28 are exposed to the 0.2 percent annual chance flood event.

Following from the exposure analysis, Hazus generated potential flood damages in the watershed, which are illustrated in **Table 2.3-10** for three different return intervals.

TABLE 2.3-10
SUMMARY RESULTS FROM HAZUS ANALYSIS OF POTENTIAL RIVERINE FLOOD DAMAGES IN THE LAKE WASHINGTON/CEDAR/SAMMAMISH WATERSHED

Percent Chance Exceedance	Return Period	Potential Structure and Contents Damage – All Structures	Potential Structure and Contents Damage – Critical Facilities
10	10-year	$2,271,454,913	$4,450,492
1	100-year	$4,732,706,045	$1,137,685
0.2	500-year	$9,904,063,406	$6,304,589

2.4 Green/Duwamish River Watershed

Watershed at a Glance – Green/Duwamish River Watershed

WRIA	• WRIA 9
River systems/reaches included	• Upper Green River • Middle Green River • Lower Green River • Duwamish River
Basin size	• 483 square miles
Key tributaries	• Gilliam, Johnson, Midway, Newaukum, Mill (Kent and Mill Auburn), Soos, and Springbrook creeks; Mullen Slough; Black River
Dams/major infrastructure	• Howard Hanson Dam • Extensive levee system in lower Green (approximately 28 miles of levees and revetments) • Several pump stations, including Black River
Major flood years	• 1946, 1959, 1996, 2009, 2015, 2020, 2022
Key issues in the basin	• Water quality, in particular, water temperature and the legacy effects of industrial pollution associated with the lower Duwamish Superfund site • Legacy effects of extensive engineering modifications in the watershed, including flow modifications • Extremely limited floodplain connectivity and multi-faceted flooding conditions in lower Green and Duwamish
Salmonid species present	• Chinook, coho, chum, and pink salmon; steelhead; bull trout; cutthroat trout
Estimated economic damage from a 1 percent annual chance flood	• $356,558,306

Overview

The Green/Duwamish River flows northwest about 93 miles from its headwaters in the Cascade Range to its outlet in Elliott Bay. The Green/Duwamish River basin drains 483 square miles and is bounded on the north by the Cedar-Sammamish watershed and on the south by the White-Puyallup watershed. The Green/Duwamish River basin is entirely within King County. The river flows through several cities, primarily in its lower reaches, including Auburn, Kent, Renton, Tukwila, and Seattle.

The Green/Duwamish River basin is often considered to have four subbasins:

- **The upper Green River** extends from the Cascades downstream to Howard Hanson Dam at River Mile 64.5. The upper basin is a protected watershed with limited access to protect drinking water supply. There is no development, but commercial timber harvest has occurred throughout this portion of the watershed.
- **The middle Green River** extends from the outlet of the Green River Gorge at River Mile 45 near Flaming Geyser State Park downstream to Auburn at River Mile 32. Major tributaries include Soos and Newaukum creeks.

- **The lower Green River** extends from River Mile 32 in Auburn around State Route 18 downstream to the Duwamish River at River Mile 11, near Interstate 405 (I-405). Mill Creek-Auburn, Mullen Slough, and Mill Creek-Kent are major tributaries in the lower Green River. Springbrook, Gilliam, Midway, and Johnson creeks are also in the lower Green River subbasin.
- **The Duwamish River** extends from River Mile 11 downstream to Elliott Bay. The Black River enters the Green River at River Mile 11 and conveys flows from Springbrook Creek and drainage from the right (eastern) bank of the lower Green River. Most of the Duwamish River is tidally influenced.

The lower Green/Duwamish River Valley consists of extensive commercial, industrial, and residential development, some agricultural lands around Auburn and Kent, regional transportation infrastructure, and a network of recreational trails and parks that support a vibrant economic base, where approximately 200,000 people live and work. This development was made possible by the construction of Howard Hanson Dam and the levee system that lines most of the riverbanks of the lower Green and Duwamish rivers, which combine to reduce flooding in the lower river to a fraction of its historical magnitude. Nonetheless, these areas continue to face flooding risk, and flood risk reduction in the lower watershed is inextricably linked to the multitude of human actions and land uses within the floodplain. Major employers in the watershed include the Port of Seattle, Boeing, REI, distribution centers for Amazon and Walmart, a Starbucks roasting plant, and many other companies that comprise the second largest warehouse and distribution network on the west coast.

In the middle Green River watershed, agriculture and rural residential development are the primary land uses, with significant acreage in Agricultural Production Districts. There are also sizable areas of commercial forest lands, in addition to areas of protected open space owned by King County and Washington State Parks.

Public and Partner Input on Flooding in the Green/Duwamish River Watershed

Input on the Green/Duwamish River watershed primarily focused on the lower Green River and Duwamish River. These river reaches are highly modified and have intensively developed floodplains, which present a high concentration of people and property at risk of flood impacts. Coastal flooding and sea level rise were frequently noted as an increasing concern in tidally influenced reaches of the river. Partners and community members shared a range of views, concerns, and interests about flooding in this watershed. Some expressed a desire for enhanced flood protection for industrial and commercial land uses. Others raised concerns about the public health impacts from flooding on the lower Green and Duwamish rivers, especially the potential for floodwaters to carry contaminants into surrounding communities. Several parties also commented on public health impacts of combined sewers backing up into residential basements during times of flooding in the South Park neighborhood along the Duwamish. Others highlighted the ecological impacts associated with the extensive use of structural flood control measures on the lower Green River and Duwamish River, and comments shared that these structures may not be able to withstand climate impacts and accommodate higher floodwater volumes. Other flooding reported in the watershed focused on overland flow associated with Fish Lake and nearby wetland complexes in the vicinity of the Green River Gorge.

Geology and Geomorphology

The Green River flows from its steep headwaters in the Cascade Range, through a narrow gorge and valley it carved in the Puget Lowland, to a broad, low-gradient valley eroded by subglacial runoff. The subbasins of the Green River are largely defined by the geomorphic processes that contributed to their formation.

- The upper Green River, upstream of Howard Hanson Dam, flows through bedrock valleys and is bounded downstream by the western margin of the Cascades.
- The middle Green River flows from the Cascade margin through a narrow gorge and valley the Green River carved into the Puget Lowland.
- The lower Green and Duwamish rivers flow through a broad, low-gradient valley carved by subglacial runoff.

The middle Green River established its present course by eroding unconsolidated glacial sediments and older bedrock. Downstream of the Green River Gorge, the middle Green River has maintained active migration, although channel migration rates have decreased since the construction of Howard Hanson Dam and accompanying flow regulation began in the 1960s (Perkins 1993).

The lower Green River Valley was initially a shallow marine embayment of Puget Sound, but the Osceola Mudflow redirected the sediment-laden White River into the lower Green River. This formed a large alluvial fan at Auburn and caused progressive northward movement of the lower Green River Valley above sea level (Crandell 1963; Dragovich et al. 1994).

Following a flood in November 1906, the White River was permanently redirected southward to the Puyallup River. This diversion removed the main sediment supply of the Green River, reduced the area of the Green/Duwamish watershed by 50 percent, and reduced flood discharges and baseflow within the lower Green River. The abandonment of the Black River following the lowering of Lake Washington in the early 1900s further reduced the area of the Green/Duwamish watershed to 30 percent of its historical size. Regulation of the Green River by Howard Hanson Dam in 1961 further reduced peak-flood magnitudes.

The single-threaded, meandering characteristic of the lower Green River was established prior to diversion of the White River and flow regulation by Howard Hanson Dam. Prior to its diversion, high sediment loads from the White River were deposited as natural levees adjacent to the channel. This deposition also elevated parts of the floodplain in the low-gradient Green/Duwamish Valley with features called alluvial ridges (Collins and Montgomery 2011). By the early 1900s, artificial levees were built on top of these natural levees, thus maintaining the early-1900s characteristics of the lower Green and Duwamish rivers through the present. The lower Green River adjusted its morphology, including its channel width, to a decreased peak flow regime that resulted in channel narrowing (Collins and Sheikh 2005).

Green/Duwamish River overbank flooding (left) and levee containment of floodwaters (right) in Auburn, 1996

Channel geometry throughout the lower Green River has been simplified, and bankfull width increases only slightly in the downstream direction. Actively managed levees and revetments from River Mile 32 to River Mile 11 confine the lower Green River channel and limit channel migration. Channel confinement within the lower Green River has steepened channel banks and increased streambed erosion and incision, particularly at outside bends. Over the last several decades, streambed erosion caused widespread lowering of the channel floor from 1 to 2 feet. Channel bed incision is typically exacerbated by the presence of levees and revetments that harden the banks, thereby preventing lateral slope erosion and thus increasing stress along the toe of levees (King County 2019).

Hydrology and Hydraulics

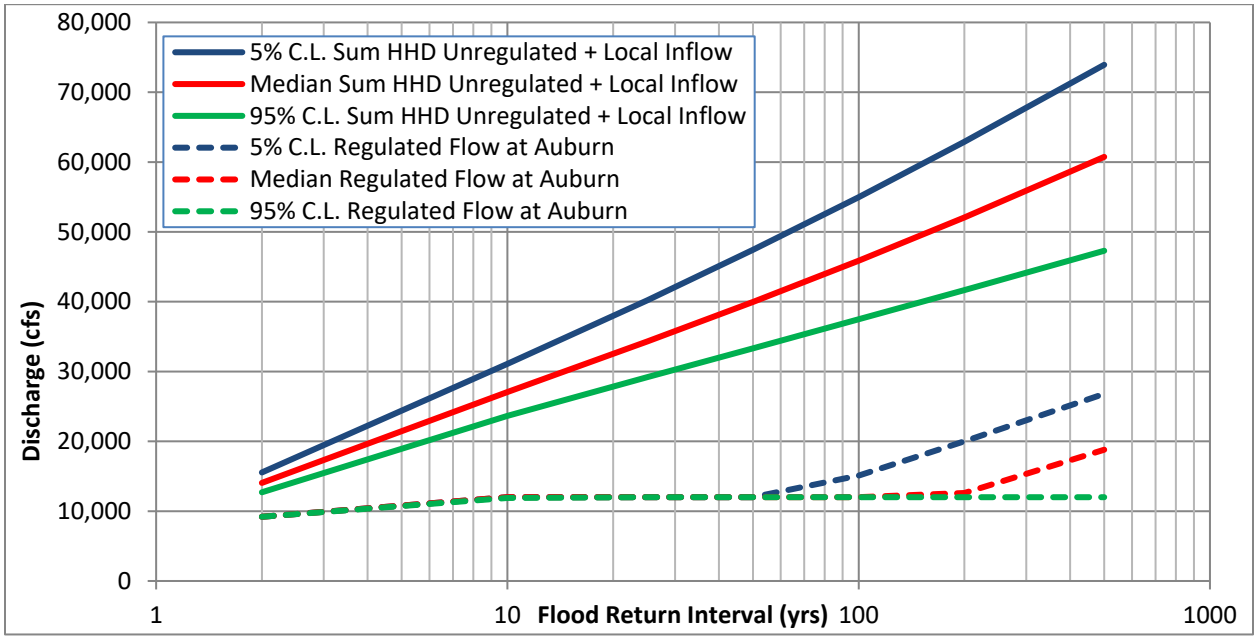
Major flood events on the Green River generally occur between November and February. Flood conditions are primarily influenced by the operation of Howard Hanson Dam. During a flood event, outflows from Howard Hanson Dam are regulated based on the hydrologic conditions at a downstream control point at the USGS gage at Auburn.

Howard Hanson Dam and the Green River's system of levees and revetments work together to reduce flood risks to the lower Green River Valley. The dam regulates outflows from the reservoir to target a maximum of 12,000 cfs as measured at the Auburn gage (RM 31.0) for most flood events. This target regulated flow rate at Auburn represents the approximate channel capacity of the leveed portions of the lower Green River Valley. Land use in this area was developed with the general understanding that flood management regulation at Howard Hanson Dam could maintain the target flow of 12,000 cfs at Auburn up to the 0.2 percent annual chance flood (equivalent to a 500-year

event). However, a 2012 Corps study concluded that the dam is capable of maintaining the 12,000 cfs target flow only for events up to a 0.7 percent flood (equivalent to a 140-year event).

Operations at Howard Hanson Dam must consider the magnitude and timing of local inflows from tributaries below the dam, such as Soos and Newaukum creeks. The 12,000 cfs target flow is the medium annual exceedance probability for the 10 percent to 1 percent annual chance floods. The median flow for a 0.5 percent annual chance flood is 12,600 cfs, and 18,800 cfs for the 0.2 percent annual chance flood.

The high degree of flow regulation provided by Howard Hanson Dam results in most of the flood hydrographs having peaks at or very close to 12,000 cfs, although the total flood volumes and peak flow durations vary widely. The discharge is shown in **Figure 2.4-1** and the variation in flood volume is reflected in **Table 2.4-1** as the duration in days that the flows are kept at an elevated level to evacuate the reservoir. **Table 2.4-1** also includes a range of flows in addition to the median expected peak flow to reflect uncertainty (high and low confidence limits) for each flood. The significance of flood volume is also reflected in the stage-discharge curves. There is a more-than-1-foot difference in the maximum channel water surface elevations between 11,900 cfs and 12,600 cfs, which can result in significant differences in the extent of inundation in the event of levee failures or levee overtopping (King County 2019). **Table 2.4-2** and **Table 2.4-3** highlight recent high flows and the highest flows recorded on the Green River.



Source: Corps 2012

Figure 2.4-1
Discharge vs. Annual Exceedance Probability & Flood Frequency at Auburn

TABLE 2.4-1
SIMULATED REGULATED FLOW AT AUBURN GAGE (USGS GAGE 1211300)

Flood Event	Confidence Level	Regulated Peak Flow (cfs)	Approximate Duration Above 12,000 cfs (days)	Approximate Duration Above 10,000 cfs (days)
0.2% AEP Flood (500-year)	Median	18,800	3.8	>13
	High Confidence Limit (5%)	26,800	4.3	>13
	Low Confidence Limit (95%)	12,000	0	11
0.5% AEP Flood (200-year)	Median	12,600	3.2	>13
	High Confidence Limit (5%)	20,000	4.3	>13
	Low Confidence Limit (95%)	12,000	0	9.4
1% AEP Flood (100-year)	Median	12,000	0	11
	High Confidence Limit (5%)	15,100	2.6	>13
	Low Confidence Limit (95%)	12,000	0	7.5
2% AEP Flood (50-year)	Median	12,000	0	9
	High Confidence Limit (5%)	12,000	0	11.7
	Low Confidence Limit (95%)	12,000	0	6.3
4% AEP Flood (25-year)	Median	12,000	0	5.7
	High Confidence Limit (5%)	12,000	0	8.9
	Low Confidence Limit (95%)	12,000	0	4.5
10% AEP Flood (10-year)	Median	12,000	0	3.5
	High Confidence Limit (5%)	12,000	0	5.7
	Low Confidence Limit (95%)	11,900	0	2.8
50% AEP Flood (2-year)	Median	9,200	0	0
	High Confidence Limit (5%)	9,900	0	0
	Low Confidence Limit (95%)	9,200	0	0

NOTE: The shaded cells indicate those flood events with peak flows greater than the target flow rate at Auburn.
Source: Corps of Engineers (2012)

TABLE 2.4-2
RECENT HIGH FLOWS AT GREEN RIVER NEAR AUBURN GAGE (USGS 12113000)

Date	Flows
2020-11-07	11,700 cfs
2015-12-09	10,900 cfs

TABLE 2.4-3
HIGHEST FLOWS RECORDED AT GREEN RIVER NEAR AUBURN GAGE (USGS 12113000) SINCE PEAK MEASUREMENTS AT THE GAGE BEGAN IN 1937

Date	Flows
1959-11-23	28,100 cfs
1946-12-11	22,000 cfs
1955-12-12	20,300 cfs

Ecological Context and Salmon Use

The middle Green, lower Green, and Duwamish rivers span a wide array of river and estuarine conditions, ranging from moderate-gradient, gravel-bedded channel segments in the middle Green River to a low-gradient, single-thread, silt- and sand-bedded channel, followed by a mix of armored and unarmored banks in the lower river and estuary areas as the river empties into Elliott Bay.

The modification and diversion of river flows, channelization, removal of vegetation, and construction and operation of Howard Hanson Dam, levees, and other flood protection infrastructure supported growth and economic development in much of the lower watershed. However, these changes have negatively affected floodplain, aquatic, and riparian habitat and water quality, which, in turn, have negatively affected salmon populations in the basin, including Puget Sound populations of Chinook salmon and steelhead listed as threatened under the ESA. The present-day lower Green/Duwamish River is highly engineered and characterized by confined channels lined with bank armoring. In this condition, instream complexity and floodplain connectivity are significantly limited.

McCoy Levee on the Green/Duwamish River in Kent, 2021

Along most of the lower Green and Duwamish rivers, the constraints presented by levees and revetments result in hydraulically simplified, flume-like conditions, a lack of large wood, and little potential for wood recruitment. There is little or no connection between the river and its floodplain habitats, except in cases where recent floodplain reconnection projects have occurred (e.g., Downey Farmstead, Lower Russell, and Riverview Park in Kent and Duwamish Gardens, and Chinook Wind in Tukwila). Human activities have nearly eliminated the shallow, slow-water edge, side channel, and wetland habitats that originally existed along the lower Green River, and the habitat that does exist is of low quality. As a result, the river sees high mortality of juvenile salmonids.

Vegetation in the lower Green and Duwamish rivers is predominantly invasive (e.g., blackberry, reed canarygrass, Japanese knotweed), aside from some patches of native trees and levee repair sites that incorporated vegetation as a bank stabilization design element. Riparian areas lack mature trees, resulting in minimal shade and elevated water temperatures. Existing water temperatures and dissolved oxygen do not meet water quality standards, and high water temperatures can reach lethal levels for salmonids during hot summer days (Ecology Total Maximum Daily Load [TMDL]). The lack of riparian trees and shrubs also reduces available food resources for juvenile salmonids.

The middle Green River subbasin includes the Green River's best salmonid habitat and is where most of the watershed's salmonid spawning occurs. Development is far less dense, and riparian and floodplain areas are much less constrained by development than in the lower portion of the watershed. The subbasin has some heavily confined reaches with levees and unconfined channels that have little or no bank armoring, active channel migration, and well-connected side channels. This portion of the watershed also contains Soos and Newaukum creeks, the two largest and most influential tributaries (Martin et al. 2004). Recently completed floodplain reconnection projects in the middle Green River that provide substantial habitat enhancement include the Čakwab Levee Setback and Porter Reach Restoration Project.

Marking the transition to the upper watershed, Howard Hanson Dam exerts a strong influence on ecological conditions downstream by stopping the passage of sediment and large wood, altering seasonal temperature and flood flow regimes, and preventing fish passage into the upper watershed (Kerwin and Nelson 2000). The dam traps coarse sediment and large wood from upstream sources and prevents their transport to reaches below the dam. By removing these building blocks for downstream habitat, the dam contributes to the loss and simplification of mainstem and side channel habitat in the middle and lower Green and Duwamish rivers.

Habitat limitations have led to a serious long-term decline in the Green River Chinook salmon population. The recent 5-year average (2015–2019) of 1,822 natural-origin spawners remains a fraction of both the historical population estimate of 37,700 and the recovery target of 27,000 (Shared Strategy 2007; Ford et al. 2022). A limiting factors analysis completed in 2000 as a precursor to the 2005 WRIA 9 Salmon Habitat Plan found that disconnection of the lower Green River from its floodplain and the subsequent loss of juvenile rearing and refuge habitat is one of the most significant factors affecting salmon. The lack of low-velocity habitat forces many juvenile salmon to migrate to Puget Sound prior to obtaining adequate growth, greatly reducing their chances for survival.

Throughout the watershed, roughly 80 percent of the historic Green/Duwamish floodplain is entirely cut off from the river. This equates to almost 25 square miles that will no longer flood and are thus no longer accessible to fish during the key juvenile rearing and outmigration period. The WRIA 9 Watershed Ecosystem Forum, in partnership with numerous other partners and funders, has pushed the completion of 34 habitat restoration projects by 2023, most of which address primary habitat limiting factors (M. Goehring, personal communication, 2023). Many other projects to address habitat deficiencies in the Green River have been proposed as part of the WRIA 9 2021 Habitat Plan Update.

The Green River System Wide Improvement Framework (SWIF) assessed aquatic, floodplain, and riparian habitat for reaches within the lower Green River. The evaluation was completed to highlight regional considerations related to habitat and environmental compliance that must be addressed as part of levee management. The assessment is intended to inform habitat restoration opportunities, levee vegetation management, and capital project design, with a focus on instream and riparian habitat enhancements and water quality improvements that would benefit salmonids.

Additionally, the U.S. Congress recently authorized $878.5 million to construct a juvenile fish passage facility through the Howard Hanson Dam (Tacoma Water previously built a trap-and-haul facility to transport adult salmon above the dam). Once completed in approximately 2030, salmon will have access to nearly 100 miles of additional habitat above the dam (TPU 2023).

Primary Flood and Channel Migration Hazards and Risks

Even with the Howard Hanson Dam and extensive flood protection infrastructure, flood risk continues to be a concern in the river corridor and valley. Flood depths are generally 1 to 3 feet in the middle Green River agricultural and rural residential areas and 1 to 6 feet in the lower Green and Duwamish rivers. Warning times range from 8 hours for the middle Green River to 12 hours for the lower Green River.

The extent of development in the floodplain and the large number of people who live, work, and transit through the lower valley mean that the potential impacts of major flooding on structures, infrastructure, the economy, and the public are substantial. Industrial, commercial, and residential development; highways, roads, utilities, and other critical infrastructure; agricultural operations; and more are subject to flood risk. With a 0.2 percent annual chance flood event (18,800 cfs), approximately 7,400 acres of the lower valley would be inundated from less than 1 foot to 6 to 10 or more feet in depth (King County 2019). The Duwamish River faces combined risk from upstream, freshwater inputs and downstream coastal and tide-related factors. The South Park neighborhood along the Duwamish River was impacted by significant flooding in December 2022 and January 2023 because of a combination of stormwater runoff, snowmelt-driven river flow overtopping the river's banks, high groundwater, king tides, and a very strong low pressure weather system, which resulted in impacts to businesses and residential properties. This neighborhood also experienced flooding in January 2022 due to some of the same conditions. Areas like the lower Duwamish River are subject to a variety of natural processes that present significant hazards to public safety and public and private property, including storm-surge flooding, waves, erosion, rainfall, wind, and sea level rise. Public health impacts associated with flooding are also of particular concern in this area due to sewer

system backups and the potential for contaminated floodwaters carrying industrial pollutants to enter vulnerable communities.

Flooding of South Park neighborhood in Seattle near mouth of Green/Duwamish River, December 2022

The lower Green River levees and existing unarmored shorelines provide variable levels of protection. Bank overtopping can occur in some locations during a 50 percent annual chance flood or 9,000 cfs event, while other armored shoreline locations are protected to upwards of 18,800 cfs, the median 0.2 percent annual chance flood event. River channel conveyance capacity for flows over 12,600 cfs (median 50 percent annual chance flood event) and the extent and depth of inundation of the floodplain and developed areas vary widely depending on the levees and floodplain conditions (King County 2019).

The magnitude and frequency of flood events and the condition of the levee system contribute to risk. While many levee rehabilitation projects have been completed in the lower Green subbasin, levees that do not meet current construction standards continue to present risk. Portions of the levee system in the lower Green River do not meet the Corps' recommended factors of safety, a common measure of engineering safety. For levees and revetments that have not been recently improved, many have over-steepened banks, areas with inadequate or deteriorating rock buttressing at the embankment toe, and incrementally slumping or sloughing riverbank slopes supporting constructed earthen levee berms. Beyond this instability, the potential for liquefaction during an earthquake is a primary concern.

While Howard Hanson Dam significantly reduces flood peaks, it results in longer durations of elevated flows. With flows confined to a narrow, leveed channel, the potential for flood scour of the riverbed is significant. Where this occurs, undermining and deterioration of the embankment toe of levees has been observed, especially on the outside of river bends. Such conditions can stress the levee and revetment system and potentially increase the occurrence and magnitude of slump failures. An evaluation of levee repair locations showed that greater than 5 feet of channel bed incision is associated with a substantial risk of future damage to adjacent levees and revetments (King County 2019).

Rapid changes in dam releases, especially a decrease in outflows, can lead to rapid drawdown of hydrostatic pressure on the river side of a levee. High pore pressure within the levee prism due to saturated soil conditions can lead to riverbank slumping that can damage the integrity of the levee core. As a result, many Green River levees require frequent maintenance, and nearly all have been identified as needing rehabilitation so that they are better suited to provide protection.

Levees and revetments along the middle Green River are scattered, discontinuous, and largely deteriorating. They are not designed to contain flood flows or prevent inundation, but rather to direct high flows and inhibit channel migration that impacts rural residential and agricultural land use. These discontinuous levees and revetments will continue to experience lateral channel migration and channel avulsion. In some locations, broad meanders and braiding channels are constantly shifting within a complex of active gravel bars, vegetated riparian floodplains, and remnant side channels.

The upper Green River basin (above Howard Hanson Dam) and portions of the middle Green River have a medium/high intermix areas (where structures and vegetation are mingled). King County mapped landslides within the river corridors, including the middle Green, in 2016 and identified areas of potential deep-seated landslides that are both in contact with the river and large enough to partially or completely block the river channel and affect flooding occurrence and severity (King County 2016). King County also identified smaller landslides and debris flows, which can contribute large amounts of sediment that can impact flooding locally and downstream as sediment is moved and stored within the river channel (King County 2016).

Post-wildfire flooding, landslides, and mudslides pose a secondary hazard from extreme wildfires in areas with steep slopes. Soils in areas burned by fire not only lose their stabilizing vegetation but can also become hydrophobic (water repelling), leading to massive water runoff that carries debris down

slopes and into nearby waterways. Post-fire flooding is a serious threat in King County, including portions of the middle and upper Green River (OEM 2020).

A failure of the Howard Hanson Dam would produce devastating consequences to the regional economy. Major employers such as Boeing, REI, distribution centers for Amazon and Walmart, and many other companies that comprise the second largest warehouse and distribution network on the west coast would be impacted by a dam failure, along with major roadways and rail lines, municipal offices, and an array of other important infrastructure.

Potential Impacts from Climate Change and Other Future Changes

By the 2080s, average streamflow for October through March is projected to increase by 10 to 22 percent for the Green River near Auburn (USGS ID: 12113000), relative to the 1970–1999 average. Changes in peak flows are influenced by both the declines in snowpack and by higher intensity heavy rain events (Lee et al. 2018).

The lower Green/Duwamish basin will continue to be developed, with much of that development occurring within the 0.2 percent annual chance floodplain. Impacts from climate change are expected from increased runoff in the basin, particularly from tributaries and creeks such as Soos, Mill, and Springbrook creeks, which are all expected to experience substantially increased flows with climate change.

In the lower portion of the watershed along the Duwamish River, larger storms and future sea level rise due to climate change have the potential to exacerbate impacts associated with coastal hazards and compound flooding, including potential public health impacts related to industrial contaminants, combined sewer overflows, and sewer backups. Near-term and long-term actions are underway to address these various issues, including King County's implementation of its third 5-year Lower Duwamish Waterway Source Control Implementation Plan, which outlines the County's efforts to keep pollutants out of the Duwamish River in support of the Duwamish Superfund Sediment Cleanup Plan, the combined sewer overflow control program, and implementation of National Pollution Discharge Elimination System (NPDES) permit requirements.

The Black River Pump Station was constructed in 1972 to address numerous drainage and river alterations. The pump station provides an outlet for Springbrook Creek and serves as a dam to keep high tides and Green River floods out of Renton and parts of Kent and Tukwila. The pump station may be impacted with sea level rise, changes in tidal influence area, and saltwater intrusion.

Risk Assessment

The flood hazard risk assessment using Hazus evaluated the effects of riverine flooding on more than 260,000 total structures in the Green/Duwamish watershed. While Hazus used the most current flood depth information available from FEMA, it is important to note that this analysis was not nearly as detailed as the modeling conducted for the Green River SWIF. Furthermore, inconsistencies in the FEMA flood insurance study data resulted in higher exposure values for the 1 percent annual chance riverine flood than the 0.2 percent annual chance riverine flood. Despite these limitations, Hazus

provides useful approximations for understanding potential risk in the watershed, and the analysis revealed the following:

- In the entire watershed, 730 structures were found to be exposed to the 10 percent annual chance flood, 3,481 structures were found to be exposed to the 1 percent annual chance flood, and 3,783 structures were found to be exposed to the 0.2 percent annual chance flood.
- Of the 3,109 critical facilities located in the watershed, 80 would be exposed to the 10 percent annual chance flood, 148 would be exposed to the 1 percent annual chance flood, and 156 are exposed to the 0.2 percent annual chance flood.
- None of the 11 repetitive loss structures would be exposed to the 10 percent annual chance flood, and three would be exposed to the 1 percent annual chance flood and to the 0.2 percent annual chance flood.

With the numbers of structures identified as exposed to flooding, Hazus generated estimates of potential flood damage. **Table 2.4-4** illustrates potential flood damages for three return intervals.

TABLE 2.4-4
SUMMARY RESULTS FROM HAZUS ANALYSIS OF POTENTIAL RIVERINE FLOOD DAMAGES IN THE GREEN/DUWAMISH RIVER WATERSHED

Percent Chance Exceedance	Return Period	Potential Structure and Contents Damage – All Structures	Potential Structure and Contents Damage – Critical Facilities
10	10-year	$17,674,045	$80,429,034
1	100-year	$156,539,380	$94,022,126
0.2	500-year	$111,136,841	$93,983,398

2.5 White River Basin

Watershed at a Glance – White River Watershed

WRIA	• WRIA 10
River systems/reaches included	• Upper White River • Middle White River • Lower White River • Greenwater River
Basin size	• 490 square miles
Key tributaries	• Greenwater River and Boise Creek in King County, and the Clearwater River, West Fork White River, and Huckleberry Creek in Pierce County
Dams/major infrastructure	• Mud Mountain Dam • Buckley Diversion Dam and Fish Passage Facility
Key flood years	• 1932, 1933, 2009, 2021, 2022
Key issues in the basin	• High sediment load from Mount Rainier • Development located in depositional reach • Diminished channel capacity
Salmonid species present	• Chinook, chum, coho, and pink salmon and bull trout, coastal cutthroat trout, and steelhead
Estimated economic damage from a 1 percent annual chance flood	• $8,826,812

Overview

More than 100 years ago, the White River was diverted to flow into the Puyallup River in Pierce County. Inclusive of King and Pierce counties, the White River drainage includes the Greenwater River, West Fork White River (entirely within Pierce County), upper White River (entirely within Pierce County), Middle White River, Clearwater River, Red Creek, Boise Creek, and lower White River drainage basins. The White River drains an area of about 490 square miles, approximately one-third of which lies within King County. Mud Mountain Dam, constructed by the Corps in the 1940s, provides flood protection to the lower White and Puyallup river valleys.

The King County and Pierce County boundary passes through the cities of Pacific and Auburn and then follows the White and Greenwater rivers as they existed in 1852, when Pierce County was formed by the Oregon Territory legislature. Areas along the river are densely developed through the cities of Sumner, Pacific, and Auburn. Upstream of Auburn, the floodplain is mostly undeveloped and contained within a canyon incised into glacial deposits. The upper portion of the watershed is primarily forested and protected within Mount Rainier National Park, with the middle portion of the watershed containing agricultural land and the southern portions of the City of Enumclaw. The Muckleshoot Reservation, as well as some off-reservation tribal lands, are located along the lower portion of the White River, which flows through the cities of Auburn and Pacific before entering Pierce County.

Public and Partner Input on Flooding in the White River Watershed

Community members and partners submitted less input about flooding in the White River watershed than the other watersheds of the county. Feedback shared with King County identified a need for more information about emergency response and evacuation resources and an interest in maintenance of the White River channel through dredging and removing instream wood. Partners also shared information about tributary flooding concerns in and around the City of Enumclaw that are arising due to channel changes, which affect residential neighborhoods, city streets, and the city's sanitary sewer system.

Geology and Geomorphology

The White River basin is geologically very young. It extends from the peak of Mount Rainier to the Puget Lowland, with headwaters that drain slopes of volcanic bedrock and glacially scoured terrain. Multiple episodes of continental glaciation that covered the Puget Lowland shaped much of the lower river valley, while glacial and volcanic processes have shaped the middle and upper river valleys.

About 5,600 years ago, the Osceola Mudflow, a clay-rich lahar from an eruption on Mount Rainier, flowed down the north flank of the volcano, filled the White River Valley, and spread out over the glacial troughs and outwash plains of the Puget Lowland. Prior to the Osceola event, the White River flowed southwest out of the Cascade Range foothills along the path of present-day South Prairie Creek to a confluence with the Carbon and Puyallup rivers. The White River carved a new channel through the Osceola deposit and underlying glacial sediments along its present course, discharging into the wide, north-south-trending glacial trough that includes the Duwamish and Stuck river valleys near present-day Auburn and Pacific.

At least three more lahars deposited material in the White River drainage after the Osceola. This young geologic history and setting of the White River is the reason that the river has the largest sediment loads of any river in King County, and the sediment strongly influences flooding and channel migration hazards.

As a result of the combined effects of glacial and postglacial alluvial processes, the White River has formed distinct reaches, from upstream to downstream: mountain valley headwaters, a canyon reach, and an alluvial fan that is progressively filling a low-gradient glacial valley. The mountain valley headwaters reach in King County includes the portion of the river upstream of Mud Mountain Dam and downstream of the dam for about 2 miles to where the river exits a bedrock-controlled gorge. The canyon reach extends downstream from the gorge outlet past the City of Enumclaw, which is elevated above the river on the Osceola plateau, and through a forested and undeveloped canyon that includes Muckleshoot Tribe lands. The alluvial fan reach begins at the outlet of the canyon reach at about River Mile 8.2 and extends to the confluence with the Puyallup River. The river crosses the King-Pierce County boundary at about River Mile 5.55.

The White River alluvial fan underlies the cities of Auburn and Pacific, and fluvial processes active on the fan were the cause of a 1906 channel avulsion that resulted in the White River abandoning its

channel flowing north to the Green River and shifting to the south to a confluence with the Puyallup River. River engineering led by the Inter-County River Improvement District and its successors built and maintained levees and a concrete wall, cleared large wood from the river, and straightened and dredged the channel until 1987. The vertical adjustments of the White River channel following the 1906 avulsion have been strongly influenced by human river management.

A recent study of sediment flux trends along the White River determined that coarse sediment delivered to the lower White River in the alluvial fan reach is sourced from the canyon reach immediately upstream (King County 2019, Anderson and Jaeger 2019). A grade break in the river channel called a knickpoint that demarcates the transition between erosion upstream and deposition downstream is located at approximately River Mile 9.5 (and migrating upstream) within a low-gradient reach on the alluvial fan. As a result of the 1906 avulsion and subsequent channel dredging, the current White River channel remains shorter and steeper than the pre-avulsion channel. Sediment will continue to deposit on the alluvial fan as the river adjusts to the avulsion and 20th century river engineering disturbances.

A primary tributary to the White River, the Greenwater River basin is in the Cascade Range at the eastern edge of the Puget Lowland, with headwaters that drain slopes of volcanic bedrock associated with Mount Rainier. Bedrock exposures in the river valley bottom exert influence on fluvial processes at the basin scale and control channel migration in a few locations. Younger geologic formations that determine the sediment regime and that are relevant to flooding and channel migration in the Greenwater River include more erodible sedimentary deposits, such as lahar deposits including the Osceola mudflows, alpine glacial deposits, and landslide debris. The Greenwater River headwaters are in a forested, nonglaciated alpine basin.

Hydrology and Hydraulics

Most major White River floods occur between November and February. With headwaters on Mount Rainier glaciers, snowmelt also increases White River flows in late summer, but typically not to a level of flood concern. The primary determinant for flooding characteristics in the White River since 1948 is the presence and flow control operations of the Mud Mountain Dam project operated by the Corps (King County 2006).

As a sole-purpose flood protection facility near River Mile 29.0, Mud Mountain Dam reduces peak flood flows and releases the stored water at a lower flow over a longer duration than would occur if the dam were not in place. The dam is Congressionally authorized with a primary purpose of controlling floods along the lower Puyallup River in Pierce County; however, the Corps also operates the dam to achieve flood benefits on the White River whenever feasible (King County 2006). A diversion dam at the City of Buckley also diverts flow to Lake Tapps that is eventually returned to the river in Sumner. Since the cessation of the Lake Tapps hydropower project in 2004, flow diversions have not had a significant effect on flows on the White River. The diversion dam and associated fish trap were replaced in 2021 with the Mud Mountain Dam Fish Passage Facility, operated by the Corps in cooperation with Cascade Water Alliance, the operator of the adjacent Lake Tapps diversion structure.

The Corps revised the Mud Mountain Dam operations through an update to the Water Control Manual (WCM) in 2004. The significant change in operations was to limit discharges to 12,000 cfs

when feasible for all events up to and including the 1 percent annual chance flood (Northwest Hydraulic Consultants 2008). The Corps again modified dam operations after flooding in January 2009. This flood event greatly affected the downstream communities of Pacific and Sumner due to high flows encountering diminished channel capacity from ongoing sedimentation in this portion of the river. Since 2009, various approved deviations from the 2004 WCM have been in effect to allow for dam operations to target lower outflows from Mud Mountain Dam, with the goal of reducing flood risks to the communities of Pacific and Auburn.

Flood hydrology below Mud Mountain Dam is expected to change as flood risk reduction projects along the lower White River are completed. The Corps revisits channel capacity below the dam over time and as flood mitigation projects are implemented. Levee setback projects completed and planned by King County and the City of Sumner are designed to increase channel capacity in the vicinity of Auburn, Pacific, and Sumner. These projects will mitigate downstream flooding such that the Corps can release larger peak flows from Mud Mountain Dam. Future peak flows are expected to more closely resemble the historic peaks from the years following dam construction. All present and future outflows from the dam are at the discretion of the Corps.

Table 2.5-1 lists the current flow quantiles developed for FEMA floodplain mapping of the White River. The flow quantiles are based on hydrologic data for the post-Mud Mountain dam period of record from 1946 to 2007. **Table 2.5-2** shows recent high flows from the White River above Boise Creek at the Buckley gage, and **Table 2.5-3** shows the highest flows recorded at the White River near the Buckley gage. The "White River near Buckley" gage operated from 1928 – 2003, at which point it was removed as part of a Tacoma Water pipeline replacement project. It was replaced with the "White River above Boise Creek at Buckley" gage in 2004, which continues to operate.

TABLE 2.5-1
FLOW QUANTILES FOR THE WHITE RIVER

Percent Chance Exceedance	Return Period	At Auburn (cfs)
10	10-year	14,000
2	50-year	15,300
1	100-year	15,500
0.2	500-year	19,000

TABLE 2.5-2
RECENT HIGH FLOWS AT THE WHITE RIVER ABOVE BOISE CREEK AT BUCKLEY GAGE (USGS 12099200)

Date	Flows
2022-03-01	6,630 cfs
2015-12-08	6,760 cfs
2012-02-23	7,290 cfs

TABLE 2.5-3
HIGHEST PEAK FLOWS RECORDED AT THE WHITE RIVER NEAR BUCKLEY GAGE (USGS 12098500) FOR THE PERIOD OF RECORD, 1928–2003

Date	Flows
1933-12 (specific date unknown)	28,000 cfs
1932-02-26	17,000 cfs
1932-11-13	16,500 cfs

Ecological Context and Salmonid Use

The White River and its tributaries provide spawning and rearing habitat for ESA-listed spring-run Chinook, winter-run steelhead, and bull trout. Non-listed species present in the watershed include coho, pink, chum, sockeye, rainbow, cutthroat, and whitefish. Pristine tributaries in Mount Rainier National Park provide most of the critical bull trout spawning/rearing habitat within the system (Marks et al. 2021). The White River spring Chinook population is the only remaining spring Chinook salmon stock in the south Puget Sound (WRIA 10 2018).

Above Mud Mountain Dam (River Mile 35.5), the river is largely unconfined by artificial structures, except where State Route 410 is adjacent to the river and at the mouth and lower section of the Greenwater River (King County 2006). Mud Mountain Dam (River Mile 29.6) is a complete barrier to upstream fish passage on the White River. Salmon are collected at the Mud Mountain Dam Fish Passage Facility, located near Buckley (River Mile 23.6), and trucked upstream (WRIA 10 2018). The 6 miles between Mud Mountain Dam and the fish passage facility are suitable habitat for salmonids, but there is only modest spawning in this reach because of lack of fish access (Marks et al. 2021).

Between the fish passage facility and River Mile 11, there are some areas of high-quality habitat, particularly on the Muckleshoot Reservation, where the channel has been allowed to migrate and damaged levees and revetments have not been repaired or replaced (King County 2006). Several large side channels and log jams in this reach provide valuable spawning and rearing habitat.

Below River Mile 11, the river is largely confined by levees and revetments, and there is substantially less habitat complexity and spawning gravel in this reach. Extensive removal of large wood and channelization in the lower river in the early to mid-1900s have greatly simplified habitat (King County 2006; WRIA 10 2018). Riparian buffers are limited along the lower White River, contributing to higher water temperatures.

Several tributaries to the White River are important for salmonids, including the Greenwater, Clearwater, and West Fork White rivers, as well as Boise and Huckleberry creeks. The West Fork White River, in particular, offers excellent salmonid habitat, while Huckleberry Creek—a tributary to the West Fork White River—consistently supports the highest densities of spring Chinook and coho spawning in its lowermost half mile.

Countyline floodplain reconnection project on the White River, November 2023

Identified limiting factors in the White River basin include a loss of floodplain and off-channel habitat, a lack of habitat-forming flow regimes, fish passage barriers, degraded riparian corridors and instream habitat complexity, and depleted large wood and prey resources (WRIA 10 2018; Kerwin 1999). Other limiting factors are identified as increased channelization and sediment loads, a loss of substrate stability, reduced spawning and rearing habitat, and impaired water quality (WRIA 10 2018). Several water bodies in the White River basin were included on the 303(d) list in 2018 for water quality impairments, including the White River (impaired for temperature, pH, and fecal coliform), Boise Creek (temperature, pH, and fecal coliform), and the Clearwater River (temperature).

Salmon recovery goals for the White River include removing levees and reconnecting floodplains, increasing riparian buffer function, and removing large physical barriers to fish movement and migration. Some of the strategies to meet these goals include protecting and restoring highly productive areas, reconnecting the floodplain along the mainstem river, removing barriers, restoring the hydrologic regime, and improving water quality (WRIA 10 2018).

King County projects on the middle and lower Boise Creek basins have improved spawning and rearing habitat conditions. Recent wood placement and floodplain reconnection projects on the Clearwater and Greenwater rivers completed by the South Puget Sound Salmon Enhancement Group have improved habitat and increased floodplain function. The King County Countyline Levee Setback

project in the lower White River also provides a large area of reconnected floodplain that is used by juvenile salmonids and provides flood conveyance. Several future projects along the lower White River are being planned by the City of Sumner, King County, and Pierce County that will reconnect additional floodplain areas and improve habitat function and flood conveyance in the reach.

Primary Flood and Erosion Hazards and Risks

The Mud Mountain Dam project, located at River Mile 29.6 of the White River, is a single-purpose project providing congressionally authorized flood control focused on a control point on the lower Puyallup River in Pierce County (50,000 cfs at the USGS Puyallup River at Puyallup gage), with secondary flood control benefits to the lower White River Valley in King County.

Flood and channel migration hazards pose risks to rural residences in the Enumclaw area and to the communities of Auburn and Pacific along the lower White River in the alluvial fan reach. Along the White River, the primary flood protection infrastructure maintained by King County is a set of levees and revetments that were built through the 1914 Inter-County River Improvement Agreement. Flood depths in the Greenwater and Boise Creek areas range from shallow flooding to 3 feet, and the lower White River sees flood depths of shallow flooding to 6 feet with some measurable velocity. The approximate warning time for the lower White River is 4 to 5 hours. Channel migration hazards have the potential to impact roads, bridges, park amenities, utilities, residential property, and other infrastructure.

White River overbank flooding near Pacific, November 2021

In and around the cities of Auburn and Pacific, flood and channel migration risk along the lower White River is being driven, in large part, by the natural accumulation of sediment. These cities are situated on a large-scale alluvial fan that receives sediment eroded from the steep channel bed and banks upstream. The decrease in channel slope at about River Mile 9.0 (where the White River flows out of the canyon reach and onto the lower gradient valley) induces sediment deposition. Where levees are present on both sides of the river, sediment is unable to be deposited across the floodplain, resulting

in concentrated deposition within the river channel. Monitoring of the channel bed elevation since 1988 documents this sediment accumulation and shows a reduction in channel capacity, which is resulting in an increased risk of overbank flooding into the cities developed on the floodplain.

The Greenwater River, a tributary to the White River, has two revetments that deter channel migration, one of which protects a sole-access bridge to King County residences on the north side of the river. These structures are at risk of overbank flooding and channel migration during large flood events. Landslides and debris flows in the upper Greenwater River watershed can also increase flood risk by delivering large amounts of sediment to the channel, thereby reducing channel capacity to carry floodwater.

King County mapped landslides within river corridors, including the White River and a portion of the Greenwater River, in 2016. This work identified areas of potential deep-seated landslides that are in contact with the river and large enough to partially or completely block the river channel and affect flooding occurrence and severity (King County 2016). King County also identified locations of potential smaller landslides and debris flows, which can contribute large amounts of sediment that impact flooding locally and downstream as sediment is moved and stored within the river channel (King County 2016).

Other tributaries to the White River with flood risk concerns include Boise Creek and Red Creek. Most of Boise Creek is a low-gradient stream on the surface of the poorly drained Enumclaw plateau. Much of the channel of Boise Creek and its tributaries has been straightened and deepened to improve drainage in rural areas. Several rural residences are present on the portion of Red Creek that runs on the White River floodplain, and the flood risk includes inundation, channel migration, and access road flooding.

Flooding could worsen water quality issues through inundating contaminated areas, particularly areas with fecal coliform bacteria (thought to be caused at least partly by failing septic systems in Boise Creek; King County 2013) and pH impairment (due to excessive algal growth stemming from excess phosphorous from both wastewater treatment plants and nonpoint sources; Ecology 2022). Also, wood accumulations on the lower White River occur on riverbanks, gravel bars, and bridge piers and abutments, and can pose a risk to infrastructure and increase flood risk in the vicinity of bridges.

Potential Impacts from Climate Change and Other Future Changes

Analysis of projected changes in flood flows for the White River will be completed in 2024. In the interim, analysis completed for the Green River can provide some insights into what to expect for the White and Greenwater rivers.

By the 2080s, the 10 percent and 1 percent annual chance peak flow events for unregulated streamflow for the Green River near Auburn (USGS ID: 12113000) are projected to increase 19 percent (range of -8 to 75 percent) and 28 percent (range of -34 to +96 percent), respectively, under a high greenhouse gas emissions scenario, relative to the 1970–1999 average (Mauger and Won 2020). The degree to which Howard Hanson Dam can mitigate these projected changes is a current area of research. Preliminary analysis suggests relatively small changes in regulated peak flows in the Green River below the Howard Hanson Dam, assuming that future regulated flows are managed in

the same way (Mauger and Won 2020). Expanded streamflow modeling to be conducted in 2024 will provide updated insights on projected changes in both regulated and unregulated flood flows for the Green River due to climate change, in addition to projected flows (regulated and unregulated) for the White River.

Higher winter streamflows and increases in flood flows are expected in the White River watershed as warmer winter temperatures drive a shift toward less snow and more rain at lower and mid-elevations.[31] Warmer winter temperatures also contribute to decreased water storage in snow and glaciers and increased glacial retreat on Mount Rainier. A 2023 study by the USGS found that glacial area around Mount Rainier declined 41.6 percent between 1896 and 2021 (Beason et al. 2023).

Loss of glaciers is expected to contribute more sediment to rivers and streams. However, an evaluation of the effects of glacial retreat from climate change on sediment supply to the White River found that a change in sediment supply to the alluvial fan reach of the river near Auburn, Pacific, and Sumner should not be expected for a period of decades, even with substantial glacial retreat (Anderson and Jaeger 2019). This conclusion was based on a sediment flux analysis that showed the majority of sediment sourced from Mount Rainier's glaciers is stored in the upper reaches of the river between the glacier's terminuses and the alluvial fan reach. As a result, the effect of glacial retreat on sediment supply in the White River—and the corresponding effect on flood risk—is uncertain.

Historically, high flows on the White River resulted in channel migration upstream of Auburn and the transport and deposition of sediment in the Pacific and Auburn reaches of the river. Consequently, the lower White River may experience an increase in sediment deposition and an accelerated loss of flood conveyance due to higher peak flows resulting from climate change. This is because higher flows can transport more sediment, of which there is an abundant supply upstream of Auburn and Pacific. The result could produce extreme consequences for communities along the lower White River as the active channel and areas of connected floodplain fill with sediment over several decades. Although raising levees can restore flood conveyance lost to sediment deposition, they can also "perch" the river above the floodplain and exacerbate shallow groundwater conditions that already impact urban flooding in portions of the City of Pacific.

Changes in high-flow frequency or duration caused by climate change may increase juvenile salmon access to off-channel floodplain habitats for rearing and refuge, although juvenile stranding could occur in response to reduced summer flows (Whitely Binder et al. 2019). Increasing summer water temperatures associated with climate change will negatively impact migrating adult and juvenile salmonids in the White River and its tributaries, as water temperatures in the lower watershed are already elevated due to insufficient riparian buffers in developed and agricultural areas. Increased water temperatures could influence behavior and migration of bull trout in particular, as bull trout require colder temperatures than many other salmonids in the White River. Under future climate change scenarios, thermal refugia provided by reconnected floodplain areas, riparian buffers, and diversity in habitat types (e.g., deep pools) will become even more important.

[31] Higher elevations that remain below freezing in a changing climate may see higher snowpack in response to projected increases in winter precipitation. However, the total amount of snowpack will still decline given the smaller amount of surface area receiving snow.

Ultimately, Mud Mountain Dam operations by the Corps will determine high flows that impact changes to both sediment transport and salmon.

Risk Assessment

A flood hazard risk assessment using Hazus evaluated the effects of riverine flooding on nearly 30,000 total structures in the King County portion of the White River watershed. This analysis revealed the following:

- In the watershed, 35 structures were found to be exposed to the 10 percent annual chance flood, 311 structures were found to be exposed to the 1 percent annual chance flood, and 352 structures were determined to be exposed to the 0.2 percent annual chance flood.
- Of the 351 critical facilities located in the watershed, two are exposed to the 10 percent annual chance flood, 18 are exposed to the 1 percent annual chance flood, and 20 are exposed to the 0.2 percent annual chance flood.
- The White River watershed has one repetitive loss structure, which is not exposed to the 10 percent annual chance flood but is exposed to the 1 percent and 0.2 percent annual chance floods.

With the numbers of structures identified as exposed to flooding, Hazus generated estimates of potential flood damages in the watershed. **Table 2.5-4** illustrates potential flood damages resulting from three return intervals.

TABLE 2.5-4
SUMMARY RESULTS FROM HAZUS ANALYSIS OF POTENTIAL RIVERINE FLOOD DAMAGES IN THE WHITE RIVER WATERSHED

Percent Chance Exceedance	Return Period	Potential Structure and Contents Damage – All Structures	Potential Structure and Contents Damage – Critical Facilities
10	10-year	$0	$0
1	100-year	$8,825,719	$1,093
0.2	500-year	$10,427,406	$1,093

2.6 Tributary, Coastal, and Urban Flooding

Overview

Flooding associated with King County's mainstem rivers, like the Cedar, Green, Snoqualmie, South Fork Skykomish, and White rivers, was the primary focus of King County's past flood plans. While natural riverine flooding and channel migration continue to present risks to county communities, property, and infrastructure, other sources of flooding also present risks. Although these are not new risks, management of these risks is becoming more challenging due to continued population growth and development, changing environmental conditions and regulations, and the potential effects of climate change. This Flood Plan is intended to represent the range of flooding and erosion hazards that pose risks across the county, so the scope of the 2024 Flood Plan includes tributary, urban, and coastal areas.

The following sections summarize, at a high level, flood or flood-related issues for tributary, coastal, and urban settings in King County. Since King County has not included these topics as deliberately in past flood planning, the planning process involved a series of workshops focused on each of these three flooding types. The workshops were structured to hear from city, tribal, special-purpose district, and nonprofit staff, as well as members of the public, about the nature of flooding caused by these sources, the impacts, and potential solutions. The information shared during these workshops directly informs the following discussion.

While each of the topics is treated separately, it is important to note that extensive overlap exists across these flooding types (for example, many coastal and tributary flood hazard areas are located within urban areas). The many linkages between these sources of flooding means that solutions must also recognize and address the overlap and be coordinated across county agencies and between King County and other local governments and partners.

Tributary Streams

Tributary streams comprise a vast drainage network that delivers water, sediment, wood, and other organic material to King County rivers, lakes, and Puget Sound. The natural function of tributary networks is vital to flood resilience, stormwater management, ecosystem health, and sustenance of threatened and endangered salmonids. The total number of named and unnamed tributary streams in cities and unincorporated King County is in the thousands.

Public and Partner Input on Tributary Flooding

Partners and community members frequently described tributary streams as causing flooding of private residential and agricultural properties and indicated that tributary flooding is getting worse. Reasons identified as possible causes of worsened tributary flooding included changing precipitation patterns, increases in impervious surface areas that produce more stormwater runoff, runoff from historic development that was not subject to modern stormwater controls, and insufficient channel capacity to manage flows of water and sediment. Comments shared with King County indicate that these conditions are driving increases in flooding in areas that did not flood or flooded infrequently. Stormwater runoff that flows into tributaries in urban areas was cited as contributing to increased flooding and sediment deposition lower in those watersheds. Many community members and partners identified inundation of roads as a problem associated with tributary flooding, arising due to a combination of insufficient channel capacity, undersized culverts, armored shorelines, and piped stretches of streams that are unable to adequately convey flows. Beaver activity was also mentioned as contributing to private property and farmland flooding. Flooding associated with May Creek (a tributary to Lake Washington) was also raised as a concern.

Geology, Geomorphology, and Hydrology of King County Tributary Streams

As it is with the larger rivers in King County, the geology and geomorphology of tributary streams are dominated by processes that were active during and immediately following continental glaciation, when many sediments were deposited. Streams take several forms, depending on the topography, aspect, and size of the watershed areas they drain. Flooding characteristics are generally specific to each type of stream.

Following are brief descriptions of the types of streams present in King County and some examples of each type:

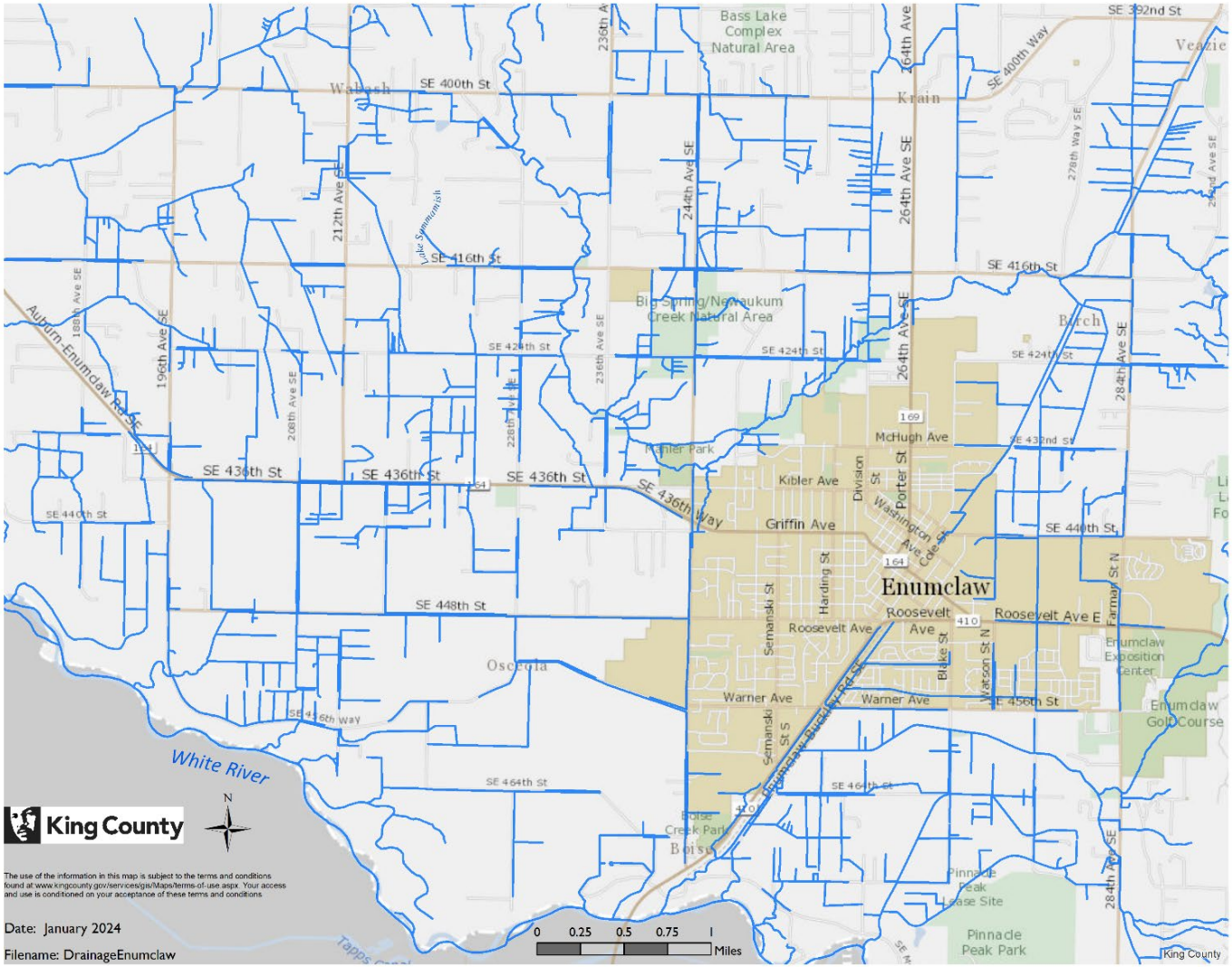
- **Post-glacial valley –** Similar to the Cedar and middle Green rivers, post-glacial valley streams are generally steep, incised into unconsolidated glacial sediments, and confined within narrow valleys with a limited-to-absent floodplain. The most downstream reaches of these streams at their confluence with a water body may contain a larger, more developed floodplain. (Examples: Coal, Willows, and Seidel creeks.)
- **Glacial valley –** These streams are situated in broad, flat valleys eroded by glaciers or glacial meltwater streams, not the modern streams themselves. These streams are now "underfit," meaning they meander across only a portion of their floodplain. Riparian wetland complexes are common within the larger valley setting, which may have once been the site of a glacier-dammed lake. (Examples: Issaquah, Bear, Cottage, Evans, Soos, and Patterson creeks.)

- **Alluvial fans –** While not a stream type, per se, alluvial fans occur with some frequency where streams discharge from a steep valley onto flatter ground (some rivers, such as the Tolt and Raging, also have alluvial fans). The term is used here to denote a feature associated with tributaries that was not identified in previous King County flood plans. An alluvial fan is a cone-shaped accumulation of sediment situated where a stream transitions from steep topography to the flatter floodplain of a larger river, a lakeshore, or the coast. The fan typically has multiple stream channels that were occupied by the stream at some point and could become active again in the future. Streams with an alluvial fan typically have a moderate-to-high sediment load and may be subject to debris flows. (Examples: Tokul, Griffin, Tuck, and Money creeks; unnamed streams along valley walls of the Green, Raging, Snoqualmie, Cedar, and Sammamish rivers.)
- **Non-alluvial –** A non-alluvial stream lacks a well-developed floodplain and tends to be steep and subject to debris flows and rapid flooding. Bedrock may be exposed in the stream or present in or near the subsurface. The stream type usually transitions to an alluvial fan at the downstream end. (Examples: Tokul, Griffin, Maloney, and Adair creeks, and many Cascade Mountain streams.)
- **Enumclaw Plateau –** Deposition of the Osceola mudflow, a coarse- to fine-grained volcanic deposit from an eruption on Mount Rainier's north side about 5,600 years ago, formed a broad plateau near Enumclaw. Flat topography and slow-draining soils characterize the Enumclaw Plateau, except for the White River and parts of Newaukum and Boise creeks, which have carved channels into the plateau through the surface of the mudflow deposits. Limited drainage within the Enumclaw Plateau resulted in a distinct natural stream pattern that was heavily modified into a network of straight, narrow, and deep stream channels and ditches constructed along road rights-of-way and property lines to provide agricultural drainage. Although this type of orthogonal drainage pattern is somewhat typical of areas modified to improve agricultural drainage, the slow-draining subsurface soils from the Osceola mudflow contribute to an exaggerated version of this pattern. **Figure 2.6-1** shows the plateau's engineered network of stream channels that flow straight and have right angle turns rather than the more gradual meanders of natural streams.

Ecological Context of Tributary Streams

Tributaries provide spawning, foraging, rearing, and overwintering habitat for salmonids (Rice et al. 2008), including tributaries that are non-natal systems (King County 2019). Small streams and tributaries are also important year-round habitat for resident salmonids like trout. Tributary mouths are known for having high ecological diversity and being very productive for salmonids. Pools formed at tributary confluences can provide holding habitat for adult salmonids, and the area between tributaries and mainstems can also increase habitat diversity and complexity (Rice et al. 2008).

Tributaries offer refugia from high mainstem flows during floods. Some tributaries provide cool water inputs, provide cold water refugia from warmer mainstem rivers in summer, and increase mainstem productivity via nutrient input (Rice et al. 2008). Tributaries vary in habitat quality and seasonal availability, but even intermittent streams and severely altered tributaries (e.g., channelized streams) support salmonid use (Lucchetti et al. 2014). Tributary streams and their associated riparian forests also provide valuable habitat for terrestrial wildlife species in King County, including many species of birds, mammals, and amphibians.



DRAINAGE PATTERN OF THE ENUMCLAW PLATEAU

King County
Flood Management Plan

Watercourses

Figure 2.6-1
Drainage Pattern of the Enumclaw Plateau

Primary Flood and Erosion Hazards and Risks for Tributary Streams

King County's previous flood plans presented limited information on tributary flood hazards and risks, focusing only on tributary streams that have county-owned and -maintained flood risk reduction facilities (such as revetments and levees). These facilities are present along very few tributaries throughout the county, yet tributary flood hazards are present in many more locations.

Typical tributary flooding includes flows exceeding stream banks, backwatering due to undersized culverts or narrow bridge abutments, and channel migration—including avulsion, bank erosion, or other forms. Tributary flooding occurs throughout the county in urban and in rural areas and is often characterized by fast flows that carry sediment and debris. This type of flooding can have erosive power that damages public and private property and infrastructure and adversely impacts a variety of land uses. Many tributaries do not have mapped FEMA Special Flood Hazard Areas, so flooding depths and velocities associated with tributary flood hazards are not always well understood.

Tributary under State Route 169 flooding from overwhelmed culvert, 2020

Tributary stream type largely determines the flooding characteristics in the vicinity of a given stream. As with rivers, tributary flooding and erosion are natural processes. Human-altered hydrology and infrastructure that was not designed or constructed to allow for natural process can exacerbate the natural tendencies of tributaries and increase flood risk. Alterations in hydrology include impervious

surfaces; the construction of dams, levees, and culverts; stormwater systems that reroute runoff; water withdrawals; and the effects of climate change. Examples of infrastructure that affect tributary flood risk are undersized culverts that do not have the capacity to convey water and roadways that were built within a floodplain, impeding natural floodplain function.

The flood hazards typical to each type of stream are as follows:

- **Post-glacial valley –** Since these streams are typically fairly steep, they carry moderate to high sediment loads and have somewhat flashy hydrology. Flooding causes these streams to carry debris, and the banks are subject to erosion and landslides. These processes cause these streams to widen as they develop floodplains. Bank erosion and channel migration can occur throughout the length of these streams, while flooding by inundation typically affects the lower stream reaches.
- **Glacial valley –** Underfit streams in broad, flat valleys tend to have very shallow gradients. These shallow gradients, combined with the fine-grained sediments that typically underlie glacial valleys, contribute to slow drainage. The streams are naturally highly sinuous and meandering. Flooding, combined with wetland environments and high groundwater tables, can extend from valley wall to valley wall. Channel migration rates are low in these streams, but local bank erosion is common, especially where the streams have been modified to improve drainage, at bridges and culverts, and on the outside of meander bends. These tributaries also may be subject to backwater flooding if they are blocked from discharging into a mainstem river or larger tributary during flooding. As a result, glacial valley stream types are highly susceptible to flooding associated with beaver dams.
- **Non-alluvial –** Similar to post glacial streams, non-alluvial streams have steep, often-straight channels with small drainage areas and minor tributary inputs. The upper reaches may have bedrock channels with low sediment loads. These streams do not have a well-developed floodplain. Floodwaters are unable to spread out, making these streams subject to debris flows.
- **Alluvial fan –** Flooding at the alluvial fan portion of a stream can take several forms. As sediment on the fan accumulates, the active stream channel on an alluvial fan may abruptly change course (avulse) to form a new channel or re-occupy a former channel. Debris flows are another type of flood risk in an alluvial fan setting and can rapidly fill the channel with sediment and debris, causing the banks to overflow and possibly leading to a channel avulsion. The risk of debris flows can be increased by the presence of beaver-dammed ponds in headwater portions of streams with alluvial fans. Culverts and bridges are constrictions on alluvial fan streams that are especially susceptible to sediment deposition, and reduced conveyance capacity at these locations can cause flooding.
- **Enumclaw Plateau flooding –** The pattern of flooding from tributaries on the Enumclaw Plateau is overbank flow of the extensive network of drainage channels and backwatering into low areas and ditches. Stormwater runoff can overwhelm the capacity of these channels, and slow-draining soils prevent infiltration, which can contribute to flooding. Stream channels that have cut through the Osceola mudflow deposits (Newaukum Creek and lower Boise Creek) to the underlying glacial deposits have alluvial floodplains and are subject to bank erosion and channel migration.

Community and partner input shared about tributary flooding during development of the Flood Plan includes the following:

- Sediment transport and aggradation, including impacts from alluvial fans, contribute to flooding issues that damage private property and reduce stream conveyance capacity, which, in turn, contributes to evolving flooding problems. Past land use regulations did not effectively restrict development on alluvial fans and, as a result, occupied structures may be located on active fans.
- Overtopping or inundation of roads, including sole-access roads.
- Legacy drainage and stormwater management infrastructure that lacks capacity to handle current and projected flood volumes, including drainage infrastructure on private lands that is not maintained by local governments. Challenges with private drainage infrastructure in the rural areas of King County tend to be related to erosion downslope of drainage structure outfalls and associated with access-road crossings.
- The inability of tributary streams to discharge to their receiving bodies (a larger tributary, mainstem river, lake, etc.), causing backwater effects due to the inability of the stream to convey flow downstream. This is a relatively common occurrence, where a tributary is conveyed through a levee or a trail or road embankment via undersized infrastructure (pipe or culvert). Some examples of these phenomena can be found along the lower Green River, in the Snoqualmie Valley, or on the White River, among other locations.
- Many culverts installed decades ago are not capable of handling current flow volumes during heavy or prolonged rainfall. The same is true for streams that were diverted into underground pipes many years ago—those systems often no longer function as well as originally intended. This may be a result of poor design (e.g., not fully understanding the channel capacity need at the time of construction), rerouting of stormwater in ways that overwhelms older systems, or an increase in nearby impervious surfaces. Failure of older culverts due to rust and corrosion is also a problem, and many culverts also limit or prevent fish passage. Several cities noted that they experience problems with undersized infrastructure along tributaries, including Lake Forest Park, Maple Valley, Newcastle, Sammamish, and Seattle.
- Beaver activity can cause long-term changes in flooding patterns. Beaver populations, which have been increasing in rural King County (King County 2022), build dams that back up water and can lead to flooding problems. At the same time, beaver dams store and slowly release water, support wetland and stream habitat functions, filter sediment and pollutants, and keep water cooler.

Coastal Flooding

Coastal flooding and erosion are natural processes, and the geologic instability of coastal bluffs, wave action, high tides, storm surge, ongoing sea level rise, inadequate stormwater controls, and clearing of vegetation on steep slopes all contribute to coastal flood hazards. In some areas of the county, urban runoff accumulation and high groundwater tables can exacerbate these coastal effects and, in turn, coastal flooding. Past development practices, such as the filling and channelization of the Duwamish River delta and other coastal estuaries, are also increasing risk under sea level rise and future climate conditions.

Public and Partner Input on Coastal Flooding

Coastal flood impacts described by community members and partners included impacts on commercial and industrial areas, waterfront residential properties, and low-lying areas farther inland, including on tidally influenced rivers. People often reported that coastal flooding is caused by multiple factors that can compound, including sea level rise, king tide events, storm surges, and heavy rainfall. Vulnerabilities include homes, businesses, access roads, sewer and on-site septic systems, and stormwater systems. Residents of Vashon-Maury Island raised concerns about flooding of the main connector road between the two islands, and community members from incorporated areas along the south county shoreline shared their observations of high water and erosion. Survey responses from those new to conversations about flooding identified coastal flooding as their greatest source of concern.

Partners shared that low-income communities and people who are not fluent in English have reported difficulties accessing support and translated information during coastal flood emergencies (such as the December 2022 flood event). Coastal property owners noted the challenges with retrofitting properties exposed to coastal flooding, in part due to environmental protections. Erosion and coastal bluff landslides are additional concerns related to coastal flooding and heavy precipitation, especially on Vashon-Maury Island. People shared concerns about the future impacts of sea level rise on infrastructure, especially in relation to the future resilience of coastal access roads and railroads, and an identified need was support for at-risk residents, including financial assistance for education and adaptation or relocation for property owners.

Geology, Geomorphology, and Hydrology of King County Coastal Areas

Marine waters of Puget Sound and large lakes, including Lake Sammamish and Lake Washington, occupy predominantly north-south-trending troughs formed during multiple glacial periods, the last of which is called the Vashon glacial period. The emergent extensions of these troughs form broad, low-gradient river valleys, including that occupied by the Duwamish River and its estuary at the southern end of Elliott Bay in Seattle.

Coastal uplands within King County are mostly underlain by layers of unconsolidated glacial sediments deposited during the last advance of the Puget Lobe ice sheet. Although local variability within these sediment layers exists, a generalized sequence of these sediments is as follows, with the youngest at the top of coastal bluffs and the oldest located progressively downslope: recessional sand, glacial till, advance outwash sand deposits, and fine-grained silt and clay underlain by older, non-glacial and glacial sedimentary units. These sediment layers are exposed and visible on the face of coastal bluffs. The till, fine-grained silt and clay, and older glacial units are more resistant to erosion than the sand. The relative impermeability of these layers causes instability and erosion above the layers, which is independent from erosion caused by wave action, tides, and storm surge. These sand deposits, along with sediment delivered to lakes and Puget Sound by rivers, are a primary source of sediment for Puget Sound beaches.

The natural geomorphic process of sediment delivery from bluffs to beaches has been disrupted by shoreline armoring, which includes bulkheads, sea walls, and riprap rock armor. The movement of sediment along beaches has also been disrupted by docks, jetties, and groins, depriving downdrift beaches of natural sediment replenishment and reducing beach ecological function and response to wave energy.

Ecological Context of Coastal Areas

Central Puget Sound is heavily urbanized, and shorelines and intertidal areas, including estuaries in King County, are degraded, altered, or lost due to dredging or filling, waste and wastewater disposal, nonpoint source pollution, shoreline armoring and development, sediment contamination, and the introduction of non-native species (Williams et al. 2001). The 103 miles of marine shorelines in King County are heavily armored with sea walls and bulkheads (King County 2020). In total, 64 percent of the county's shoreline is armored; the urban shoreline of the county is 84 percent armored, and the Vashon/Maury Island shoreline is 49 percent armored (King County 2019a). Most of the shoreline is composed of residential development, with commercial/industrial uses within Elliott Bay and the BNSF railroad along the northern shoreline making up the next largest land uses (King County 2005).

Many habitat types within the nearshore environment provide important habitat functions, including eelgrass meadows, kelp forests, tideflats, marshes, pocket estuaries, sand spits, beaches, bluffs, and marine riparian zones (Williams et al. 2001). Nearshore ecosystems support a broad variety of biological resources, including salmonids, forage fish, ground fish, rockfish, numerous invertebrates and shellfish, marine mammals, birds, and other wildlife (Williams et al. 2001).

The ecological functions provided by the marine shorelines and nearshore habitats of Puget Sound are critical for many species of fish and shellfish. These include spawning habitat for forage fish (some of which spawn directly on upper beaches), wave and current energy buffering, nutrient cycling, prey production, bird/wildlife habitat, water quality improvement, salmonid rearing, sediment sources for beaches, and bank stability and shade (riparian zones) (Williams et al. 2001, King County 2019b). Estuaries also provide a vital function for returning adult salmonids to acclimate from saltwater to freshwater environments as they migrate to their natal streams to spawn, and estuaries are important nursery areas for juvenile salmonids as they transition from their home streams to saltwater.

Primary Flood and Erosion Hazards and Risks

Many of King County's marine shorelines have houses or development located at the tops of bluffs (which face risks of landslide/erosion), on fill within the historic upper beach, or built extremely close to the shore. In the two latter cases, steep slopes are often present behind the shoreline development, meaning these structures face multiple risks. In many locations, septic systems are subject to flooding and shoreline erosion.

Dockton Park Marina king tide flooding on Maury Island, December 2022

Coastal flood hazards with the potential to impact the sheltered waters of King County include inundation, wave-generated shoreline erosion, and landslides. Coastal flooding often happens during "king tides," which refer to the highest predicted astronomical tides of the year, typically occurring from November through February.[32] King tides alone do not typically cause significant flooding, but when combined with wind-generated waves or storm surges caused by low-pressure systems, flooding of coastal areas can occur. This is especially problematic for areas that have significant fetch, like the north end of Vashon Island, the north end of Three Tree Point, or areas with lower-lying shorelines, like the Portage area on Vashon or the Lowman Beach area of West Seattle. During a storm surge, water levels and waves may run significantly higher than the predicted tide level, and these higher waters may result in flooding and erosion.

Shoreline erosion, landslides, and flooding along beaches at the base of coastal bluffs are related hazards. Natural hillslope instability within coastal bluff sediments is driven by routine weathering, wave action that erodes the toe of the bluff, and the combined effects of stormwater movement across the bluff face and groundwater movement within the sediments. Bluff erosion can steepen slopes and reduce the buttressing at the base of the bluff, thereby destabilizing the slope and

32 Associated with a full moon where the moon, the earth, and sun are aligned in a straight line.

depositing sediment on the beach. Natural wave action moves the deposited sediment along the shoreline, and seasonal variations in wind and wave energy reconfigure beaches on annual cycles.

Insufficiently managed stormwater is frequently a contributing factor to coastal landslides. Unlike in many other areas, stormwater should not be infiltrated into the ground near steep slopes and should instead be tightlined down to the beach to avoid increasing slope instability. Increased pore-water pressure at the interface of certain sediment layers forces horizontal movement of groundwater. The top of the silt and clay layer above this interface becomes a slip surface, which commonly is the cause of landslides on Puget Sound's coastal bluffs. While armoring of King County's shorelines can in some cases decrease the rate of coastal bluff erosion and landslides, it contributes to beach erosion, which, in turn, undermines typical shoreline protection structures and increases flooding by inundation.

King County has mapped a coastal high-hazard area that identifies homes and other development that face coastal flooding risk. During the flood planning process, community members and partners highlighted specific problem areas, including the Duwamish River, Vashon Island, and along the shoreline from West Seattle to Des Moines. Commonly observed flood issues include:

- Flooding during king tide and high tide events, especially near tidally influenced areas of rivers and streams where stormwater systems may be unable to discharge.
- Overtopping of roads that access beach properties, with occasional flood impacts on the waterfront properties/structures themselves.
- Overwhelmed sewer and stormwater systems in many urbanized areas, especially within the lower Duwamish River's South Park and Georgetown neighborhoods.

Concerns about future flood issues include:

- Impacts from sea level rise (see *Climate Change* section below for more information on sea level rise).
- Worsening flood impacts on the built environment along the lower Duwamish River and in the South Park neighborhood, an area that is subject to compound flooding impacts and is susceptible to the effects of sea level rise.
- Flood impacts to the Vashon-Maury Island shoreline, including road flooding that overtops both roads that connect Vashon Island with Maury Island and potential isolation of Maury Island due to coastal flooding that is expected to increase with sea level rise.
- Flooding of septic systems and wells.
- Clusters of housing and older neighborhoods that were built on the upper beach that are also backed by steep slopes, which greatly limit options to improve resilience in these locations.
- Compounded hazards, like flooding and landslides, can be difficult to assess. For example, winter storms can cause flooding and increase the likelihood of landslides through saturated steep slopes. Many houses that are at risk of coastal flooding may also face landslide risk.

Community members and partners identified a need for ongoing modeling and studies to better understand coastal flooding and compound impacts. Additionally, King County received questions about the timeline for sea level rise impacts on coastal properties and whether large areas will flood

that were previously unaffected or if the severity of flooding would mostly increase in areas that are already at risk. To address questions like this, the county is working on a project to model sea level rise and coastal flooding impacts using the USGS's Coastal Storm Modeling System (CoSMoS). The results of the modeling effort should be available in 2024 and will inform capital planning, vulnerability assessment, shoreline management, and other decisions related to preparing for and adapting to the impacts of sea level rise and increased coastal flooding.

In addition to coastal flooding and coastal erosion hazards, active faults in the Puget Lowland can generate tsunamis within Puget Sound waters and can cause coastal flooding in very unexpected ways. Although Puget Sound tsunamis are rare events, the time between the occurrence of a tsunamigenic earthquake in the Puget Sound region and the arrival of a wave will be very short—likely too short to warn residents—and their occurrence likely will be completely unexpected by the general public.

Urban Flooding

King County has extensive urban areas, most of which, but not all, are located within the county's 39 incorporated municipalities. Several urban areas are also located within unincorporated King County, including the communities of East Federal Way, North Highline, West Hill, Fairwood, East Renton, Skyway, and South Park (most of which is in the City of Seattle). Many of these urban areas experience urban flooding, which includes flooding and flood-related erosion that is not always caused by overbank flow from King County's rivers and tributary streams. This may include flooding caused by stormwater runoff, high groundwater tables, ponding following intense rainfall, and overwhelmed urban storm sewer systems.

Public and Partner Input on Urban Flooding

Community members and numerous government partners raised concerns about increased stormwater flooding. Common observations about urban flooding problems related to increased development, inadequate capacity of stormwater management infrastructure, a lack of permeability in built environments, climate change, and urban areas located in the floodplains of major rivers, tributaries, and coastal areas. Community members and partners noted that heavy precipitation is exceeding the capacity of urban stormwater management infrastructure with increasing frequency because of climate change. Sediment loads from stormwater runoff are reducing conveyance capacity for urban streams and stormwater infrastructure, often exacerbating urban flooding issues and requiring increased maintenance. Partners noted that high water levels in receiving water bodies, especially in low-lying urban areas near rivers, lakes, and Puget Sound, are leading to decreased effectiveness of gravity drainage systems and pump stations. Beaver activity and sediment accumulation in stormwater systems and streams were also discussed as exacerbating issues in some cities. Commonly reported impacts from urban flooding included inundation of roads and other transportation infrastructure.

Geology, Geomorphology, and Hydrology of Urban Areas

Urban areas are typically developed on relatively flat or gently sloping surfaces. These low-relief surfaces within the glacially formed landscape of western King County include the following, with example areas in parentheses:

- Glacial upland areas typically underlain by sandy glacial outwash or dense, low-permeability glacial till (north Seattle, Capitol Hill, Federal Way).
- Floodplains underlain by sand and gravel alluvium (such as Redmond) with low-permeability silt/clay glacial lake deposits beneath the alluvium in many areas (Renton).
- Artificially filled areas, including former wetlands and bogs (Totem Lake in Kirkland, many areas in north Seattle), estuaries (South Park), and ravines (local residential areas).

The contrasting hydraulic permeability and porosity of subsurface soil and geologic units affect rain and stormwater infiltration rates, groundwater table elevation, and subsurface flow. As urban development becomes more dense, subsurface materials that previously infiltrated rain and stormwater can become overwhelmed, causing flooding. Familiarity with subsurface geologic conditions is important to understanding the causes of urban flooding.

Alluvial valleys are groundwater discharge zones, meaning that the rainwater that falls on upland areas and infiltrates into the ground flows through the subsurface to eventually discharge to streams and rivers in the valley bottom. Intense urban development with a high percentage of impervious surface on the valley floor, such as the Kent and Tukwila portions of the lower Green River Valley, can affect groundwater movement.

Peak-flow hydrology has changed because of increased urban development. Small drainage areas common in urban settings are typically flashy, which results in higher, shorter duration floods than prior to urban development. Although current stormwater management standards aim to mitigate the impacts of stormwater runoff from development, the legacy of past development continues to impact urban hydrology.

Research has documented the effects of urbanization on small streams as well as larger rivers within urban areas (e.g., the Cedar and Green rivers) caused by hydrologic and hydraulic changes (Booth 1990; Cluer and Thorne 2013). Increased flow volumes and velocities first cause channel incision, deepening the stream and eroding and exporting sediment and wood from the system. Banks are undercut by the incision, leading to bank failure and further sediment and wood mobilization and export. As banks fail, the incised channel widens and tends to form an inset floodplain at a lower elevation than the pre-urbanization floodplain. Collectively, these have reduced the geomorphic function and degraded the ecological function of streams draining urbanized watersheds. Efforts to partially restore the original hydrology and geomorphic function of these streams may seek to add large wood, set back banks, and induce sediment deposition to reconnect the stream with the pre-urbanized floodplain.

Cedar River Flooding at Renton Airport, 1996

Ecological Context for Urban Areas

Urban areas often are locations of habitat degradation/loss. In King County, many urban areas overlap with locations that were historically floodplain or estuary that have been filled and developed. Streams in urban areas tend to have highly altered hydrology and habitats. These streams typically have lower overall salmonid productivity, and many have water quality issues related to pollutants entering the stream system through stormwater inputs.

Parks, open spaces, gardens/backyards, airports, streams, and stormwater facilities in urban areas can provide habitat for fish/wildlife—particularly species adapted to living alongside humans. Even severely impacted habitats can be used (e.g., salmonids are observed in highly channelized streams

and stormwater infrastructure). Urban areas also serve as migratory corridors for salmonids, birds, mammals, and amphibians.

Primary Flood and Erosion Hazards and Risks in Urban Areas

Flood and erosion hazards in urban areas are not new. Some urban flooding is a result of inadequate and undersized stormwater infrastructure and legacy effects, such as rerouting of runoff from one drainage basin into a different drainage basin. Surfaces such as pavement, pipes, and concrete-lined ditches deliver high-velocity flow to receiving streams with erosive force, causing excessive erosion of sediment, which is then transported downstream and deposited in urban areas.

City of North Bend commercial area and street flooding, November 2006

Urban flooding can range from shallow ponding to depths of up to several feet, which can inundate roads and flood homes and businesses. Forecasting urban flooding is very challenging, which in turn limits the ability to provide accurate urban flooding warnings. Intensely developed areas with high percentages of impervious surfaces can experience ponding, seepage through pavement and foundations, and flooding due to upward pressure from a rising groundwater table. This issue may be especially acute near streams and rivers where the groundwater would naturally discharge, but when the river is in flood stage and the ground is saturated (e.g., Tukwila and Kent), the system may be unable to accommodate the rising groundwater. In the urban communities along the lower White

River, shallow groundwater conditions are exacerbated by increased sediment deposition within the river channel and a subsequent rise in river levels, posing a flood risk to those communities. At the same time, overbank flow onto the White River floodplain is an important source of groundwater recharge that supports streamflow in summer and early fall.

Community members and partners engaged during the flood planning process identified several common urban flooding issues:

- Tributaries in urban areas overtopping their banks, especially due to high volumes of stormwater runoff.
- Large sediment loads overwhelming small streams and stormwater infrastructure.
- Flooding and backups due to inadequate capacity of stormwater infrastructure, combined sewer overflows, and culverts.
- Lack of natural drainage or floodwater storage capacity in urban areas.
- Inundation of roads and related transportation infrastructure, threatening driver and pedestrian safety.
- Intense rainfall resulting in flashy, rapidly rising water levels due to a lack of flow control, which, in turn, causes bank erosion and bank instability that can threaten properties and structures.
- Urban lakes with controlled outlets experience issues ranging from beavers damming their outlets to uncontrolled runoff inflows, which can cause flooding that affects homes and businesses.
- Undersized stormwater pipe systems, aging and failing pipes, and antiquated conveyance pipes that discharge to open channels create problems throughout urban areas in King County.
- Pump stations are often used in urban areas to reduce flood risks, even during minor flood events. Power outages at these facilities during storms can cause flooding.

Potential future flood problems identified include:

- Flooding in areas that have historically not flooded, including highly developed inland areas with significant impervious surface.
- Worsening flood impacts on private property and related economic impacts.
- Reduced effectiveness of pumping systems and increased inundation of low-lying areas due to sea level rise.
- Flood impacts in the South of Downtown (SODO) neighborhood of Seattle.

Convective storms are a mechanism contributing to flooding within small basins that may increase in the future because of climate change (see the following section for more detail). Spring and summer convective storms are rare in the Puget Sound region, and these storms—which can involve heavy rainfall, thunder, lightning, and/or hail—are often spatially small, intense, and quick moving. The intensity of rainfall associated with convective storms can overwhelm urban stormwater systems and smaller streams and result in flash flooding and localized flooding in small basins. Areas recently burned by wildfires and denuded of vegetation are also susceptible to high-intensity rainfall from convective storms, leading to flooding and debris flows.

Potential Impacts from Climate Change and Other Future Changes

Effects of Climate Change on Tributary Streams & Urban Flood Hazards

Climate change is projected to enhance existing seasonal precipitation patterns in the Puget Sound region, leading to wetter winters and drier summers. While individual model results will vary, climate modeling predicts more winter rain overall and more winter precipitation falling as rain rather than snow in upper watersheds. The Puget Sound lowlands and lower-elevation mixed rain-and-snow watersheds are particularly sensitive to these changes, given the relatively warm winter temperatures already seen in these basins. Heavy rain events (e.g., atmospheric river events) are also expected to become more intense and more frequent. These changes collectively point to an increase in the volume of winter runoff into tributary systems and an increase in urban flooding in locations where stormwater control facilities are absent or unable to keep up with runoff volumes.

More research is needed on current trends and possible future changes in the frequency, intensity, and location of convective storms in King County and Western Washington. Climate scenarios project a decrease in summer precipitation; however, warmer land temperatures could create conditions more favorable for summer thunderstorms. On the other hand, a warming climate may make the atmosphere more stable and thus reduce the chance of thunderstorms. Climate models have difficulty capturing these storms due to their small size, making it difficult to assess changes in these systems.

Similar challenges exist for projecting changes in the location and intensity of rainfall in wintertime convective storms associated with the Puget Sound Convergence Zone (PSCZ). The PSCZ is a common weather phenomenon in which storms coming in from the Pacific Ocean are split by the Olympic Mountains and then reconverge in the Puget Sound area. This can bring bands of intense localized rainfall, typically over northern King County and southern Snohomish County. The PSCZ is more likely to occur in fall and winter. Because the PSCZ is driven by large-scale atmospheric circulations, models may be able to better capture changes in the PSCZ. However, these effects have not yet been studied.

Despite the uncertainty that currently exists regarding projected changes in convective storms, these storms could be a potential driver of flooding in small basins in King County and warrant further investigation, especially since flashy flows may result in sudden flooding and a limited ability to provide adequate warning. Stormwater management efforts to account for more intense winter precipitation, including more intense rainfall associated with atmospheric river events, should help address the potential for convective flooding in all seasons.

Changes in summer conditions will also impact tributaries. Lower snowpack, earlier spring snowmelt, and warmer and drier summer conditions extend and exacerbate summer drought conditions and low-flow impacts. These include warmer stream temperatures, disconnected streams, less available habitat for juvenile salmon, and direct mortality of salmonids. For example, lower summer streamflows may reduce available spawning habitat for early Chinook spawners and lead to dewatering of steelhead redds. Warmer stream temperatures can also decrease growth rates or kill juvenile salmon outright, slow or block adult salmon migration, and reduce adult salmon productivity.

The increased potential for wildfire in Western Washington may impact tributary streams and stream flooding post-fire, depending on fire location and intensity. Wildfires can increase the potential for landslides, erosion, flash floods, sediment loading, and debris flows in rivers, lakes, and streams due to the loss of vegetation and root structures that would normally hold soils in place. This risk is most acute within the 3 years following a fire. In more severe fires, the intense heat can also form a surface layer of hydrophobic soils (those that tend to repel water) that can dramatically increase runoff rates as infiltration is reduced. This can lead to flooding in the lowlands during even moderate storm events as runoff is concentrated in tributary stream channels.

Effects of Climate Change on Coastal Flood Hazards

Global sea level has risen on average eight to nine inches since 1880 and the rate of rise is accelerating (Lindsey 2022). Many factors contribute to how much sea level rises globally (absolute sea level rise) and at a given location (relative sea level rise). Major factors at the global scale include thermal expansion of the ocean and snowmelt contributions from land-based snow and ice, particularly from Greenland and Antarctica. The relative contribution of these water sources changes over time, with contributions from land-based snow and ice becoming the dominant contributing source later in the century (Miller et al. 2018, Appendix B; NRC 2012).

Locally, changes in vertical land elevation are a major factor affecting sea level rise at a specific location. One key contributor to changes in vertical land elevation is plate tectonics. The movement of tectonic plates can cause uplift or subsidence of the land surface over time that can offset (in the case of uplift) or exacerbate (in the case of subsidence) sea level rise at a given location. Other local factors that can contribute to changes in land elevation are soil compaction in areas built on fill or with heavy groundwater extraction, human activities that reduce the transport of sediment to floodplains and estuaries (such as constructing dams and levees), and geologic rebound from the last ice age (a process known as “glacial isostatic adjustment”).

Sea level has risen more than 10 inches in Seattle since 1899 (as measured at NOAA’s tide gage at Coleman Dock) and will likely rise approximately 1 to 2 feet by mid-century and 2 to 3 feet by 2100, relative to 2000, under a high greenhouse gas scenario (Miller et al. 2018). Lower and higher amounts of sea level rise are possible, with up to 5 feet of sea level rise considered a plausible upper estimate for 2100 based on current scenarios. Inundation of low-lying areas is expected along the Puget Sound shoreline due to sea level rise and increased tidal reach. This will expose more shoreline areas to periodic or permanent flooding, wave action, erosion, and damage from saltwater corrosion, and these factors can contribute to an additional risk of displacement. See the examples presented in **Figure 2.6-2** (showing the Fauntleroy, Vashon-Maury Island, and South Park Areas), and **Figure 2.6-3** and **Figure 2.6-4**.

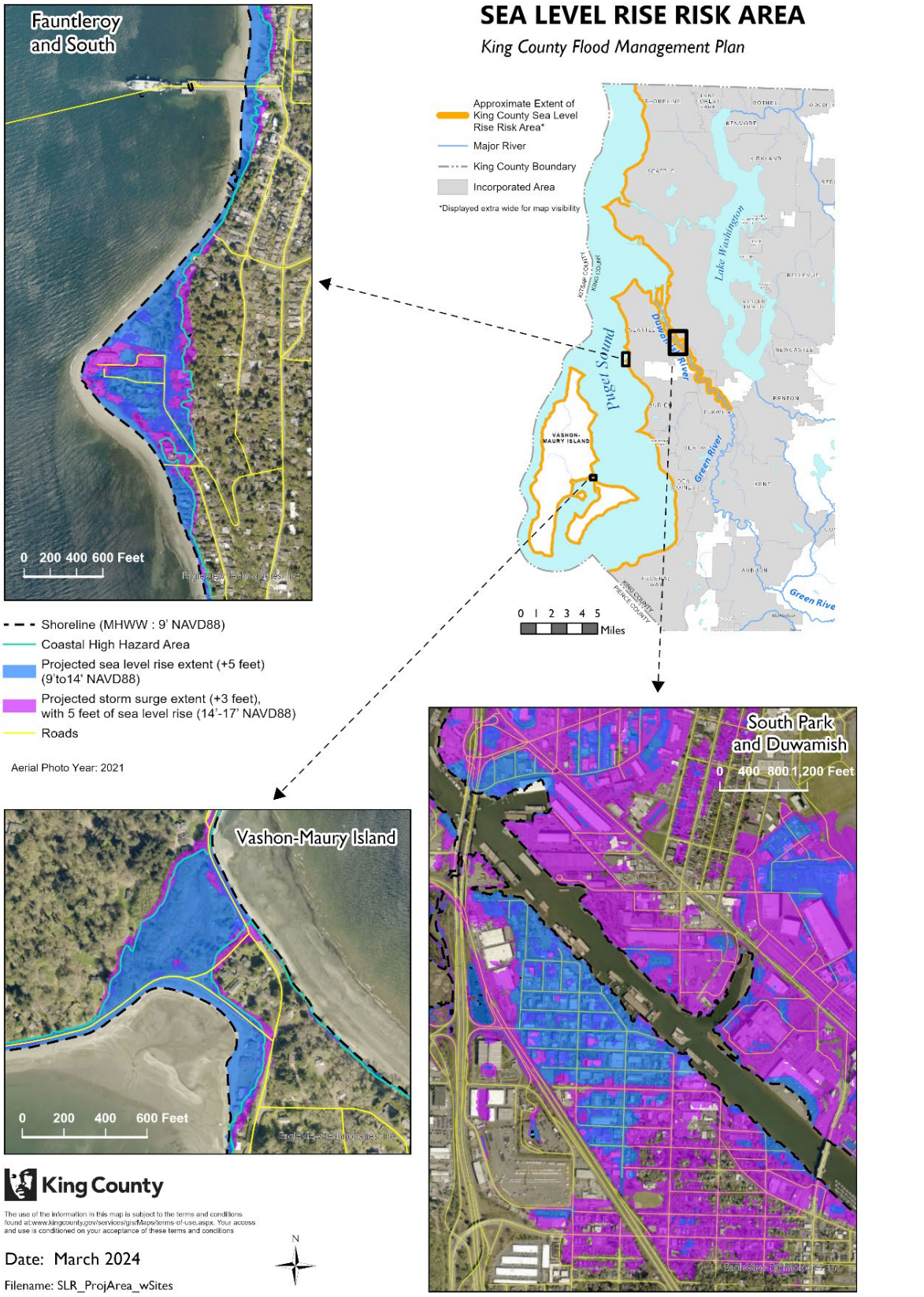


Figure 2.6-2
Sea Level Rise Risk Area

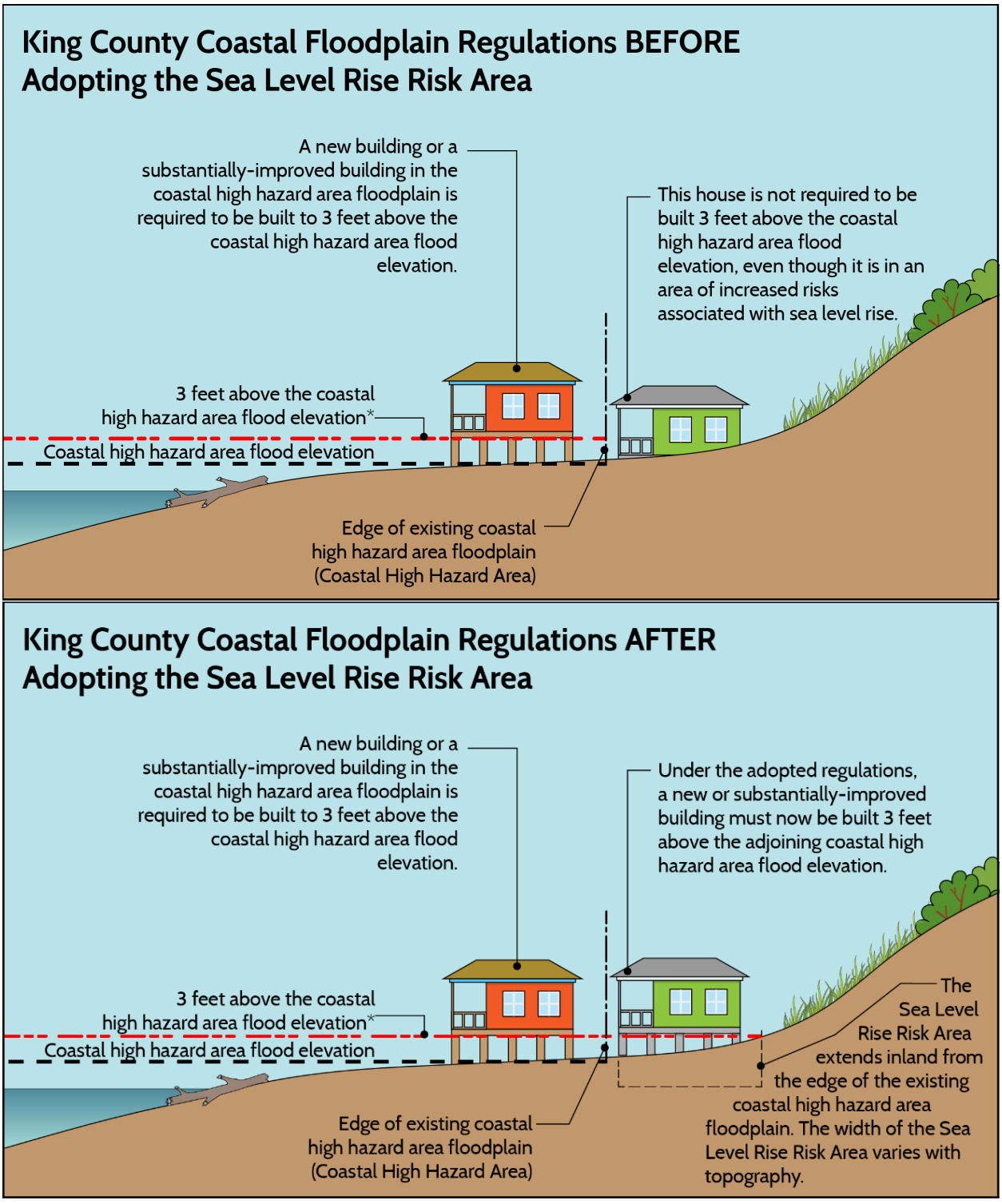


Figure 2.6-3
Comparison of Regulations (Before and After), Sea Level Rise Risk Area
This figure illustrates the boundary and associated building elevation requirements of the King County Sea Level Rise Risk Area, which applies only to Vashon-Maury Island. Additional provisions related to bluff setbacks and groundwater wells are not shown here.

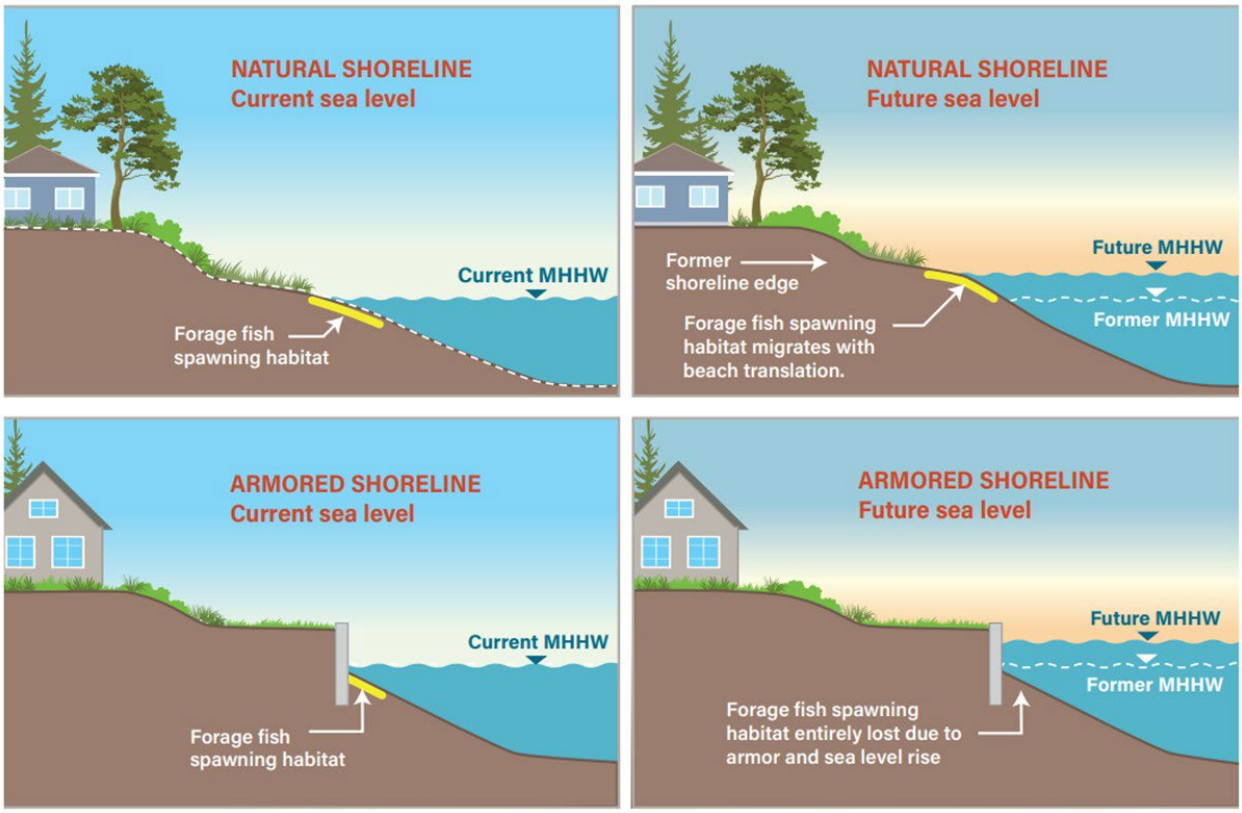


Figure 2.6-4
Coastal Squeeze in the Puget Sound Nearshore
Graphic illustrates the shallow areas where forage fish spawn and are being squeezed out of existence by shoreline armoring and sea level rise (Coastal Geologic Services).

The potential for coastal squeeze also increases with sea level rise. In undeveloped nearshore systems, beaches and coastal marsh shorelines will migrate inland as sea level rises. However, in heavily armored areas, beaches and coastal marshes tend to be restricted by infrastructure. In these cases, rising sea level will degrade and permanently inundate beach habitats along the shoreline, eventually causing the habitats to disappear or become nonfunctional, as shown in Figure 2.6-4 (Krueger et al. 2009).

Other potential impacts of sea level rise include a greater potential for erosion and landslides and exacerbation of freshwater flooding in the lower Duwamish watershed. Storm surge and storm-related wave events can overtop existing bulkheads and cause erosion of the shoreline, increasing the potential for slides. The projected increases in winter precipitation and heavy rain events noted above can further destabilize nearshore slopes. While these processes bring added risks to nearshore structures, sediment inputs from erosion, particularly from feeder bluffs, are critical to adapting the nearshore to rising seas and can be beneficial to maintaining salmon habitat in the nearshore environment.[33]

[33] Feeder bluffs are coastal bluffs that deliver sand and gravel to nearby beaches as a result of erosion. The amount of sediment delivered, and how quickly it is delivered, will depend on a variety of factors. For more on feeder bluffs, see Ecology (2023).

Finally, sea level rise can slow drainage of floodwaters, extending the duration of flooding or contributing to more widespread flooding. As noted above, more information on sea level rise and coastal flooding impacts in King County will be available in summer 2024 with completion of the USGS's CoSMoS model.

Risk Assessment

King County's Hazus assessment evaluated the exposure of structures and critical facilities to coastal flood vulnerability (see Section 2.7 for more detail). This was possible with use of King County's delineation of a coastal high-hazard area, which is reflected on effective flood insurance rate maps and is used for regulatory purposes. The scope of the analysis was countywide and included all unincorporated and incorporated areas in the watershed-based results presented in the previous sections. However, the analysis did not isolate the potential vulnerability to tributary and urban flooding due to the complexity involved in that analysis.

The analysis used best available information, which included all flood modeling available through King County or the FEMA map service center, meaning that the vulnerability results may include data beyond what is reflected in effective Digital Flood Insurance Rate Maps. This section presents coastal flood vulnerability results.

Coastal Flooding

Hazus is a tool to estimate potential losses from flooding, but it is not without limitations. Namely, the model relies on available information, is an approximation, and does not account for the unique nature of each flood event. In the case of estimating the potential impacts associated with coastal flooding, the model used the existing coastal high-hazard area and did not incorporate data on potential sea level rise scenarios.

Neither the South Fork Skykomish/Snoqualmie or White River watersheds have any coastal flood exposure. **Table 2.6-1** presents exposure as identified for the Lake Washington/Cedar/Sammamish and Green/Duwamish watersheds. Of note, there is no critical facility exposure to coastal flooding in the Lake Washington/Cedar/Sammamish watershed.

Potential coastal flood damages were also assessed using Hazus, and those results are presented in **Table 2.6-2**.

Urban and Tributary Flooding

As noted in the introduction, urban and tributary flood hazards were not analyzed separately in the Hazus analysis, as the tool is not able to easily model these flooding types separately. Urban and tributary flooding result in exposure and potential flood damages, yet these were not analyzed as part of this planning effort. Obtaining a better understanding of potential exposure to urban and tributary flooding and quantifying associated potential damages could be an area for future analysis.

TABLE 2.6-1
EXPOSURE TO COASTAL FLOODING

Flood Event	WRIA	Number Exposed (General Building Stock)	Total Structure Value Exposed (General Building Stock)	Total Content Value Exposed (General Building Stock)	Number Exposed (Critical Facilities)	Total Structure Value Exposed (General Building Stock)	Total Content Value Exposed (General Building Stock)
10% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	N/A	N/A	N/A	N/A	N/A	N/A
	Green/Duwamish	5	$4,509,914	$3,232,414	N/A	N/A	N/A
2% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	N/A	N/A	N/A	N/A	N/A	N/A
	Green/Duwamish	5	$4,509,914	$3,232,414	N/A	N/A	N/A
1% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	42	$19,791,028	$12,997,828	N/A	N/A	N/A
	Green/Duwamish	818	$685,929,108	$486,575,075	26	$25,661,291	$33,213,049
0.2% Annual Chance Coastal	Lake WA/Cedar/Sammamish	42	$19,791,028	$12,997,828	N/A	N/A	N/A
	Green/Duwamish	1,119	$910,555,296	$640,100,699	27	$26,863,436	$35,016,266

TABLE 2.6-2
POTENTIAL DAMAGES FROM COASTAL FLOODING

Flood Event	WRIA	Total Structure Value Damages (General Building Stock)	Total Content Value Damages (General Building Stock)	Total Structure Value Damages (Critical Facilities)	Total Content Value Damages (Critical Facilities)
10% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	N/A	N/A	N/A	N/A
	Green/Duwamish	$111,530	$376,163	N/A	N/A
2% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	N/A	N/A	N/A	N/A
	Green/Duwamish	$112,397	$378,858	N/A	N/A
1% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	$4,636,598	$3,524,225	N/A	N/A
	Green/Duwamish	$45,955,081	$59,544,610	$249,306	$247,803
0.2% Annual Chance Coastal Flood	Lake WA/Cedar/Sammamish	$4,677,758	$3,526,367	N/A	N/A
	Green/Duwamish	$53,937,525	$63,116,587	$89,456	$247,803

2.7 Summary of Countywide Flood Hazard and Risks

The previous sections in this chapter describe the flooding characteristics, flooding problems, and other attributes of flood hazard areas in King County. Flooding information is presented by major river watershed, reflecting the different geography, land use, and other characteristics that influence flooding conditions. Information is also presented on flooding conditions for coastal areas, urban areas, and tributary streams. This section provides a high-level summary of the potential impacts of flooding across the county, briefly recaps some of the key points presented in previous sections, and summarizes the results of the countywide flood hazard risk assessment.

Flooding Impacts in King County

Flooding and other flood-related hazards in King County can cause widespread and long-lasting damage, regardless of the source of flooding. The force of moving floodwaters can tear homes from their foundations, sweep cars off the road, and damage or destroy public infrastructure. Houses and businesses damaged by flooding may become uninhabitable, and, if they can be repaired, repairs can take many months and may displace occupants during that time. Certain types of flooding can leave buildings inundated for several days, which can further worsen property damage. Flood-damaged buildings can pose health risks, including mold and contaminated food and drinking water. In portions of the county without municipal sewer service, flooding can inundate septic systems and cause water quality issues. Additionally, and not to be overlooked, the experience of flooding can cause mental health stress for those affected.

Flooding and flood-related hazards can affect people, property, critical infrastructure, and businesses in different ways. These are summarized as follows:

- **Impacts on People** – Flooding can affect anyone who lives in or near a flood-prone area, whether it be river, coastal, urban, tributary, or another flooding source. Many flood hazard areas in King County are mapped, and people living in mapped 1 percent annual chance floodplains can expect at least a 26 percent chance of seeing floodwaters over 30 years, the length of a typical mortgage. In addition to the public health and mental health impacts listed above, flooding can threaten lives, particularly in areas where flooding happens quickly and with little warning. Driving on flooded roads presents an acute risk, as most flood-related deaths occur from people driving through floodwaters and being swept away in their cars.

  Flooding also affects those who work in flood-prone areas or commute through them. Many farmworkers are employed in the Snoqualmie, Sammamish, and Green River valleys, and when river or tributary flooding in those watersheds inundates or ruins crops, farmworkers can find themselves without jobs. Businesses in floodplains may also shut down during flooding, particularly if buildings and access roads are damaged.

  Vulnerable populations—such as those who do not speak English, do not have easy access to government resources, or cannot afford or do not have flood insurance—are particularly susceptible to the long-term impacts of flooding. Renters can be especially vulnerable in that they are far less likely to have a flood insurance policy and may not even be aware of their flood risk. Renters may also have less wealth or savings to draw from to pay for uninsured losses.

- **Impacts on Property** – Just a small amount of water inside a building can cause significant property damage and leave building owners or tenants with large repair bills. For families, damage to homes may mean difficult financial decisions, short- or long-term displacement, and lost belongings. For business owners, flood damage may mean lost economic output from closures, destroyed inventory, and the inability to pay employees.

  Throughout King County, at least $5 billion of building value is located within floodplains. Flood insurance, such as federal insurance through the National Flood Insurance Program (NFIP), is the primary way building owners financially protect property in flood-prone areas. Without flood insurance, damage can overwhelm a family's finances, and those without sufficient financial resources will be severely impacted by flood damage to their home and/or belongings.

- **Impacts on the Economy** – A 2007 economic study found that 6 percent of the county's jobs are in floodplains, floodplain businesses generate nearly 7 percent—$3.7 billion—of the county's wages and salaries, and approximately 20 percent of the county's manufacturing employment and 30 percent of the county's aerospace employment are located in floodplains (King County 2007). While new data have not been generated since that time, the study found that a major flood that would shut down economic activity in floodplains would result in at least $46 million per day in lost economic output. The figure is likely much higher today.

  The construction of extensive flood protection infrastructure along the lower Green River and lower Cedar River has allowed significant commercial and industrial development in those areas. The Green River Valley is a regionally significant logistics and distribution hub and home to Amazon and Walmart distribution centers, and Boeing has a large presence along the lower Cedar River. In the event of a flood that overtops existing flood protection, billions of dollars of economic activity and thousands of jobs are at risk.

  Agriculture is common in King County floodplains, which includes three large Agricultural Production Districts in the lower Snoqualmie Valley, the Sammamish River Valley, and the Green River Valley. Extensive agriculture is also present on parts of the Enumclaw Plateau. Flooding provides nutrients to the soil and supports productive agriculture, but flooding produces negative impacts on agricultural operations, including crop damage and loss, damage to facilities and equipment, and lost productivity.

- **Impacts on Infrastructure, Including Critical Facilities** – A primary impact of flooding in King County is on the transportation network. Certain roadways that cross the lower Snoqualmie Valley are prone to inundation, and some locations and residents can become isolated by flooding. Inundation of sole-access roads presents difficulties for emergency response and can make medical evacuations during times of flooding challenging if not impossible. Repeated roadway inundation also accelerates infrastructure deterioration and increases lifecycle costs, which presents an additional financial burden to constrained local government budgets and, in the case of King County, exacerbates the Roads Division's structural funding crisis.

  In unincorporated King County, one medical facility is located in the 1 percent annual chance floodplain, and an additional four medical facilities are in the 0.2 percent annual chance floodplain. No hospitals are in the 0.2 percent annual chance floodplain. While these five facilities are at risk, the risk from flooding to the overall healthcare and medical system is low.

  Of the 64 police stations in King County, three are in the 0.2 percent annual chance floodplain (in Skykomish, Redmond, and Issaquah). Of the 161 fire stations in King County, six are in the 0.2 percent annual chance floodplain (in Skykomish, Seattle, North Bend, Renton, Issaquah, and near Enumclaw).

Few government facilities are located within flood-prone areas in King County, so flooding does not pose a substantial risk to the continuity of government operations. Certain city buildings in Snoqualmie, North Bend, and Carnation are in flood-prone areas, but some are elevated above the base flood elevation.

Flooding presents risk to wastewater infrastructure, particularly the County's West Point Treatment Plant, which faces risk from king tides and coastal storm systems. Some city wastewater treatment plants are also located in flood-prone areas. Where utility lines cross rivers, flooding can pose problems. For example, the Tolt Pipeline, a water supply line for Seattle, faced risk from the Snoqualmie River migrating toward its alignment. In 2019, a project was completed to provide protection from that risk.

Most communications infrastructure is not vulnerable to flooding, with the primary exception being a regional fiber optic line that runs under the Cedar River Trail and along State Route 169. In some locations, the river abuts the trail, and erosion of the trail prism presents risk to this infrastructure. King County regularly monitors at-risk locations, and the King County FCD has implemented several projects to ensure the continued protection of this significant infrastructure.

Impacts of Past Floods

As mentioned in Chapter 1, King County has experienced 29 federally declared flooding disasters since 1956, the most recent being associated with the February 2020 flood event. King County experiences some flooding in most years, and many of these flood events result in minor, localized impacts. Some floods are much more severe and result in significant impacts on communities. The following summary describes large flood events occurring since 2013 (the year of the last King County flood plan) and their impacts. These events represent the type of flooding that can be expected in the future in King County.

November 2015 – The November 17-18, 2015, storm was particularly damaging to areas in the South Fork Skykomish River Valley. Extensive flooding was reported throughout the South Fork Skykomish River Valley along U.S. Route 2 in both unincorporated King County and the Town of Skykomish. River flooding was most severe in the west end of the Town of Skykomish along West Riverside Drive, resulting from a poorly designed culvert check valve system, lack of a check valve on an existing culvert, and overtopping of a low section of the containment levee. Flooding was also extensive along Maloney Creek where its banks were overtopped due to high flows, sediment, and debris. Debris accumulated on the Maloney Creek bridge, requiring immediate response to clear the blockage. Impacts from river flooding were magnified by an associated windstorm, causing many trees to fall, blocking U.S. Route 2, and resulting in long-term power outages and property damage. Students at the Skykomish School had to shelter in place overnight at school without power in the flooded west end of town. Other specific issues and damage included the following:

- Damages to six river facilities.
- Thirteen homes with living space flooding and 12 or more additional homes with basements and crawlspaces inundated in the Town of Skykomish, the Baring neighborhood, Timberlane Village, and other areas.
- Six homes sustained damage from extreme wind and weather or tributary debris flow.

- U.S. Route 2 temporarily closed during the storm, necessitating extensive repair in several locations due to scour at bridges and along roadway embankments.
- Large wood accumulated on Maloney Creek bridge, requiring a response.

December 2015 – In October 2015, White River flood flows of about 7,500 cfs passed by neighborhoods without impacting residential structures. But in December 2015, the same amount of river flow flooded the overbank areas and inundated houses in White River Estates and many commercial areas along Butte Avenue in Pierce County. The river flooding issues in the Pacific area are acute and exacerbated by the record rainfall, saturating the ground and overwhelming the storm drainage systems.

February 2017 – Significant rainfall in the Seattle area produced extremely high flows into King County's West Point Treatment Plant, and while operating at peak capacity, severe equipment failure occurred. As a result of this urban flooding event, floodwater entered the treatment plant, and a mixture of stormwater and untreated sewage discharged into Puget Sound.

October 2019 – The October 2019 flood event on the Snoqualmie River resulted in the loss of livestock, crops, and equipment in the lower Snoqualmie River Valley. A survey done by the Snoqualmie Valley Preservation Association reported flood damages on 26 farms.

January – February 2020 – On January 31, 2020, an atmospheric river arrived in the region bringing heavy and sustained rain. The Tolt River reached the highest flow in over 5 years and other rivers overflowed their banks causing widespread road closures. The more significant impact was that dams on some of King County's major rivers captured large volumes of water that are typically slowly released over several days to make room for the next storm. The next atmospheric river arrived without enough time to allow for sufficient release of water from several of these dams. The combination of prolonged rainy conditions, high river flows, saturated soils, and elevated pools behind dams caused some areas in King County to experience the most severe flooding in decades. The Green River peaked at its highest water surface elevation at the USGS gage in Auburn since the construction of the Howard Hanson Dam 58 years prior.

By the end of the storm, flooding and landslides had caused severe damage to public and private property, evacuated and displaced hundreds of people from their homes, and disrupted the lives of people throughout the region. A large area of the Green River Agricultural Production District between Kent and Auburn was inundated for approximately 2 weeks, and several Green River levees were damaged. Despite the severity and dangerous nature of the storm, no lives were lost due to flooding.

Due to the persistent rainfall and saturated antecedent conditions, the February 5–11, 2020 flood resulted in more severe lowland inundation and road closures than previous floods at similar river levels. Concerns related to the potential for significant regional road closures led Eastside Fire and Rescue to request support from the Washington National Guard, which provided a high clearance vehicle to the City of Carnation. The National Guard did not participate in any rescue activities but was on call for 24 hours. Road closures in the Snoqualmie Valley included NE Tolt Hill Road, NE 124th Street, West Snoqualmie River Road NE, and State Route 203 between Fall City and Carnation. Fall City, Carnation, and Duvall remained accessible throughout the flood.

The significant seasonal precipitation and high antecedent soil moisture conditions also contributed to landslide-prone conditions. Landslides were widespread in the Snoqualmie River basin during this event. These conditions, combined with erosive flood flows on the Raging River, led to a landslide at RM 7.14 that threatened a private residence and led to its evacuation and designation as uninhabitable.

Flows in the Cedar River during the February 5–11, 2020, flood were similar in magnitude to the 2009 flood (9,620 cfs at Renton on February 8, which is approximately a 2 percent annual chance flood or 50-year recurrence interval), but remained at a high level for twice the duration (4 versus 2 days over 5,000 cfs) compared to the 2009 flood. Longer durations of high-velocity erosive flows caused extensive flooding and flood-related damage throughout the Cedar River Valley below Landsburg Dam. The event caused the Cedar River to avulse at two locations. The loss of a portion of the Riverbend Lower Revetment at RM 6.85 allowed the river to avulse through Cavanaugh Pond and damage the upstream end of the Cedar River Trail (CRT) Site 2 Revetment. The second avulsion on the Cedar River occurred near RM 16.48 in the Dorre Don neighborhood, where the main flow of the river occupied a left floodplain side channel that could potentially increase bank erosion. Heavy rainfall triggered several landslides throughout the valley that led to temporary road closures, including State Route 169 and closure of the Cedar River Trail within the City of Renton.

Extensive flooding also occurred in the Issaquah Creek basin, resulting in road closures, flooding of homes and businesses, landslides, and damage to many King County levees and revetments throughout the basin. Issaquah Creek reached its highest stage at the Hobart gage since 1996. The downtown core of Issaquah experienced the worst flood conditions since 2009.

The Issaquah Creek basin experienced numerous road damages and closures:

- Issaquah-Hobart Road was closed for several days in both directions to repair flood damage.
- Newport Way SW from Front Street S to Wildwood Boulevard SW was closed due to flooding.
- Newport Way NW from NW Oakcrest Drive to State Route 900 was closed for approximately 1 week due to the threat of landslides.
- State Route 900 from NW Talus Drive to SE May Valley Road was closed.
- Water over Sycamore Drive SE resulted in limited access to the Sycamore neighborhood.
- Three landslides occurred between RM 7.55 and 10.4, ranging from low to high risk; the high-risk landslide resulted in a yellow-tagged home with restricted access.
- More than 200 people were evacuated from three apartment complexes in Issaquah per the City of Issaquah's direction.

Damages also resulted to homes, vehicles, and septic and well systems. This included downed trees that directed overbank flow into a residence, flooded the crawlspace, and put the wellhead at risk. Other home and outbuilding damage also occurred.

The February 2020 flood resulted in the highest recorded level on Lake Sammamish (elevation 31.2 feet) since construction of the Sammamish River flood project in 1965. Flood impacts along the Sammamish River, while minor during the February event, were more noticeable in Redmond and diminished downstream. Whereas flows in Bothell began to recede days after the peak precipitation,

flooding along the river in Redmond and in Marymoor Park persisted for nearly 1 week due to sustained inputs from Bear Creek that inhibited and delayed outflows from the lake.

December 2022 – The peak of December king tides and a very strong low-pressure system moving through Western Washington occurred simultaneously, and the result was coastal flooding with the water level of Puget Sound peaking at 3.76 feet above the normal mean higher high water (MHHW) mark. Estimates determined that the astronomical king tide produced a tide that was 1.53 feet above the normal MHHW mark, and the low-pressure system added another 2.23 feet above the predicted king tide. The resulting water level surpassed the previous record of 3.16 feet above MHHW set in January 2022 and resulted in major coastal flooding throughout the Puget Sound region. In King County, coastal flooding and compound flooding impacts were seen in numerous locations along the marine shoreline but were especially significant in the South Park neighborhood on the lower Duwamish River, which overtopped its banks, and along the shoreline of Vashon-Maury Island.

Countywide Flood Hazard Risk Assessment

To better understand flood risk within King County, a countywide flood hazard risk assessment was performed using FEMA's Hazus Risk Assessment Platform (Version 6.0, Level 2 analysis). Hazus calculates losses to structures due to inundation by looking at depth of flooding and structure types. Using historical flood insurance claim data, Hazus can estimate the percentage of damage to structures and their contents by applying established damage functions to an inventory of structures.

King County's analysis evaluated the risk from flooding for the 10-, 5-, 2-, 1-, and 0.2 percent annual chance flood events faced by the general building stock (all structures), critical facilities, and repetitive loss properties. The results of the analysis present both exposure to flooding (number of structures and dollar value of structures and contents that fall within flood hazard areas) and estimated damage from the specified flood events (dollar-value estimates of potential structure and contents damage, determined using flood depth data and known property replacement cost values). Best available data were used in the analysis, including parcel and structure information from King County's Geographic Information System (GIS) data hub,[34] the King County Assessor, and flooding information from King County and FEMA. The analysis included all incorporated and unincorporated areas within King County.

Earlier subsections in this chapter present exposure and estimated damage information by geography. The tables that follow (**Table 2.7-1** through **Table 2.7-7**) present aggregated county-level information. While these data help assess the magnitude of exposure to flooding and the potential damage that could result, it is important to keep in mind that this analysis represents general approximations and is a simplified assessment of flood risk. Furthermore, the unique nature, geographic extent, and severity of each flood event means that not all areas experience flooding in the same way each time a flood occurs. The potential exposure and loss estimates provided in the tables below are approximate and should be used only to understand relative risk.

34 https://kingcounty.gov/en/legacy/services/gis/gisdata.

TABLE 2.7-1
SUMMARY OF ASSETS IN KING COUNTY

Asset Type	Total Number of Structures	Total Structure Value	Total Content Value
General Building Stock	716,919	$529,771,821,643	$330,124,585,742
Critical Facility	7,878	$41,346,749,136	$35,150,703,096
Repetitive Loss Property	187	$80,088,352	$48,009,425

The exposure analysis determined that approximately $11.9 billion of structural value for the general building stock is at risk to the 1 percent annual chance riverine flood event, and approximately $15.3 billion of general building stock structural value is at risk to riverine flooding up to the 0.2 percent annual chance flood event. For the 1 percent annual chance riverine event, the exposure of content value exposed is approximately $10.2 billion, and for the 0.2 percent annual chance riverine event, the content value exposed is approximately $13.0 billion. Additionally, approximately $706 million of structural value is at risk to the 1 percent annual chance coastal flooding event, and these structures have a content value of approximately $500 million.

TABLE 2.7-2
COUNTYWIDE EXPOSURE OF BUILDINGS LOCATED IN KING COUNTY

Flood Event	Number of Structures Exposed	Total Structure Value Exposed	Total Content Value Exposed
10-year – Riverine	5,453	$4,860,375,948	$3,830,123,225
10-year – Coastal	5	$4,509,914	$3,232,414
50-year – Riverine	5,491	$4,874,864,605	$3,838,216,669
50-year – Coastal	5	$4,509,914	$3,232,414
100-year – Riverine	10,885	$11,907,318,847	$10,233,604,608
100-year – Coastal	860	$705,720,136	$499,572,903
500-year – Riverine	13,987	$15,334,703,166	$13,037,237,111
500-year – Coastal	1,161	$930,346,325	$653,098,527

The exposure analysis determined that approximately $1.3 billion of structural value for critical facilities is at risk to riverine flooding up to the 1 percent annual chance flood event. These critical facilities have a content value of approximately $1.6 billion. Additionally, approximately $26 million of structural value for critical facilities is at risk to coastal flooding up to the 1 percent annual chance flood event. These critical facilities have a content value of approximately $33 million.

TABLE 2.7-3
COUNTYWIDE EXPOSURE OF CRITICAL FACILITIES LOCATED IN KING COUNTY

Flood Event	Number of Critical Facilities Exposed	Total Structure Value Exposed	Total Content Value Exposed
10-year – Riverine	335	$665,248,786	$894,393,151
10-year – Coastal	0	$0	$0
50-year – Riverine	338	$665,677,786	$895,036,151
50-year – Coastal	0	$0	$0
100-year – Riverine	498	$1,268,527,576	$1,626,431,506
100-year – Coastal	26	$25,661,291	$33,213,049
500-year – Riverine	574	$1,656,824,335	$2,127,750,883
500-year – Coastal	27	$26,863,436	$35,016,266

The exposure analysis determined that approximately $70 million of structural value for repetitive loss properties is at risk to riverine flooding up to the 1 percent annual chance flood event. These repetitive loss properties have a content value of approximately $43 million. Additionally, approximately $1.6 million of structural value for repetitive loss properties is at risk to coastal flooding up to the 1 percent annual chance flood event. These repetitive loss properties have a content value of approximately $800,000.

TABLE 2.7-4
COUNTYWIDE EXPOSURE OF REPETITIVE LOSS PROPERTIES LOCATED IN KING COUNTY

Flood Event	Number of Repetitive Loss Structures Exposed	Total Structure Value Exposed	Total Content Value Exposed
10-year – Riverine	151	$64,984,603	$39,684,926
10-year – Coastal	0	$0	$0
50-year – Riverine	151	$64,984,603	$39,684,926
50-year – Coastal	0	$0	$0
100-year – Riverine	162	$70,026,646	$42,740,447
100-year – Coastal	4	$1,565,000	$782,500
500-year – Riverine	165	$71,929,896	$43,930,197
500-year – Coastal	4	$1,565,000	$782,500

Hazus estimates up to $700 million in structural damages and up to $507 million in content damages to buildings from the 0.2 percent annual chance riverine flood. Additionally, Hazus estimates up to $58.6 million in structural damages and up to $66.6 million in content damages to buildings from the 0.2 percent annual chance coastal flood. Due to data limitations in the flood depth information available to support the analysis, the results for the 1 percent annual chance flood event appear lower than the results for the 5 and 2 percent annual chance flood events. However, actual damages from a 1 percent annual chance flood event are likely to be significantly higher than for the 5 or 2 percent annual chance flood events.

TABLE 2.7-5
COUNTYWIDE DAMAGES OF BUILDINGS LOCATED IN KING COUNTY

Flood Event	Total Structure Value Damages	Total Content Value Damages
10-year – Riverine	$313,490,496	$134,430,093
10-year – Coastal	$111,530	$376,163
25-year – Riverine*	$348,870,082	$164,564,546
25-year – Coastal*	$111,855	$377,174
50-year – Riverine	$407,836,059	$214,788,636
50-year – Coastal	$112,397	$378,858
100-year – Riverine	$165,802,623	$202,700,222
100-year – Coastal	$50,591,679	$63,068,835
500-year – Riverine	$699,808,925	$507,049,406
500-year – Coastal	$58,615,284	$66,642,954

NOTE:
* 25-year flood event values were linearly interpolated between the 10- and 50-year flood results modeled for each structure.

Hazus estimates up to $84.5 million in structural damages and up to $18.3 million in content damages to critical facilities from the 2 percent annual chance riverine flood. Additionally, Hazus estimates approximately $250,000 in structural damages and approximately $250,000 in content damages to critical facilities as a result of the 1 percent annual chance coastal flood. The same data limitation described above applies to these results; thus, additional study may be useful to better understand the vulnerability of critical facilities to flooding.

TABLE 2.7-6
COUNTYWIDE DAMAGES OF CRITICAL FACILITIES LOCATED IN KING COUNTY

Flood Event	Total Structure Value Damages	Total Content Value Damages
10-year – Riverine	$83,148,718	$13,066,297
10-year – Coastal	$0	$0
25-year – Riverine*	$83,638,966	$15,016,490
25-year – Coastal*	$0	$0
50-year – Riverine	$84,456,046	$18,266,811
50-year – Coastal	$0	$0
100-year – Riverine	$39,502,277	$75,032,944
100-year – Coastal	$249,306	$247,803
500-year – Riverine	$46,921,760	$89,218,285
500-year – Coastal	$89,456	$247,803

NOTE:
* 25-year flood event values were linearly interpolated between the 10- and 50-year flood results modeled for each structure.

Hazus estimates up to $27.2 million in structural damages and up to $15.8 million in content damages to repetitive loss properties from the 0.2 percent annual chance riverine flood. Additionally, Hazus estimates up to $55,000 in structural damages and up to $23,000 in content damages to repetitive loss properties as a result of the 0.2 percent annual chance coastal flood.

TABLE 2.7-7
COUNTYWIDE DAMAGES OF REPETITIVE LOSS PROPERTIES LOCATED IN KING COUNTY

Flood Event	Total Structure Value Damages	Total Content Value Damages
10-year – Riverine	$4,815,178	$2,409,442
10-year – Coastal	$0	$0
25-year – Riverine*	$8,504,655	$4,528,211
25-year – Coastal*	$0	$0
50-year – Riverine	$14,653,784	$8,059,492
50-year – Coastal	$0	$0
100-year – Riverine	$14,899,809	$9,755,949
100-year – Coastal	$55,146	$23,262
500-year – Riverine	$27,152,762	$15,839,880
500-year – Coastal	$55,146	$23,262

NOTE:
* 25-year flood event values were linearly interpolated between the 10- and 50-year flood results modeled for each structure

CHAPTER 3
Review of Flood Risk Reduction Activities

This chapter identifies and describes various flood risk reduction tools, approaches, and strategies—collectively referred to as "activities"—that King County considered to meet the goals and objectives of this Flood Plan. FEMA identifies six categories of activities to be considered in a flood plan, as follows:

- **Prevention** – Includes floodplain mapping and regulations, open space conservation, stormwater management, building codes, and other activities intended to prevent harm or prevent existing problems from getting worse.
- **Property protection** – Acquisition, relocation, building elevation, insurance, and other activities that apply to specific parcels or buildings.
- **Natural resource protection** – Protection and restoration of natural areas and functions, improvement of water quality, and any other actions intended to preserve or restore the natural functions of floodplains and watersheds.
- **Emergency services** – Emergency preparedness and preparedness communications, emergency response planning, flood warning and response, critical facilities protection, post-disaster mitigation, and other measures taken during an emergency to minimize the impact.
- **Structural projects** – Construction or maintenance of levees, floodwalls, and revetments, or modifying channels to divert floodwaters away from specific areas.
- **Public information** – Outreach, education, technical assistance, and other means of advising property owners and community members about flood hazards, the resources available to prepare for flooding, and the actions individuals can take to improve their resilience to flooding.

The purpose of this chapter is to describe the risk reduction activities considered during the planning process to address King County's flood and channel migration hazards identified in the previous chapter, consistent with FEMA's Community Rating System, Step 7. The Flood Plan Partner Planning Committee evaluated activities for each of the six categories listed above, and during the community outreach and engagement activities, community members were asked for input on the six categories through the online survey and in-person events.

This chapter includes many activities King County currently implements and notes where currently implemented activities have room for improvement. This chapter also summarizes other ideas King County considered to address the flooding and channel migration risks identified in this Flood Plan. **Appendix I** includes additional documentation of the review of the six categories of flood risk reduction activities.

King County community engagement and education table at Sea Mar Fiestas Patrias, September 2023

3.1 Prevention

Several tools are actively used by King County and other local governments within the county to prevent flood problems from occurring or to prevent problems from getting worse. Prevention activities considered during this planning process include producing flood hazard and channel migration maps and other studies to identify the extent of flood and erosion hazards; developing, updating, and enforcing land use regulations and development standards; preserving open space; considering the effects of climate change; and managing stormwater runoff. This section describes the ways King County can use these tools, and the opportunities to modify practices to improve the efficacy of these tools.

Floodplain and Flood Hazard Mapping and Information

Technical analyses of watershed hydrology, river channel hydraulics, channel and floodplain topography and hydrography, fluvial geomorphology, and geology and soils are essential tools for flood hazard management. These analyses provide the information necessary to delineate areas subject to flooding and flood-related hazards, assess and understand risks, inform land use regulations and zoning, and develop solutions to address identified risks. Analyses can also be used to evaluate effects on and changes to flood hazard areas from proposed projects or development activities.

What King County heard

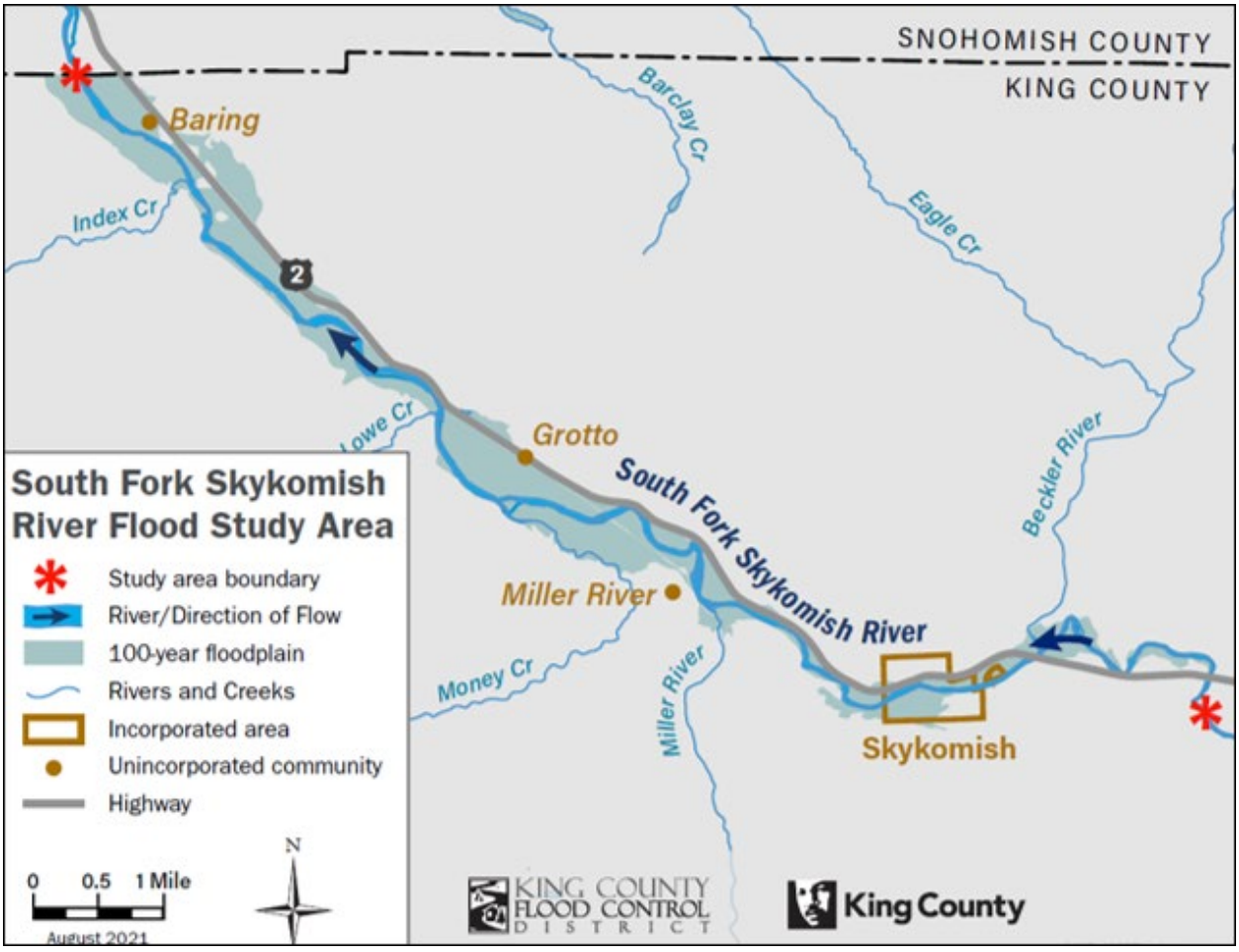
Community members and partners coupled requests for expanding existing flood hazard mapping with improved sharing of those resources. Expanded mapping focused on hazards in areas where floodplains have not been delineated. Requests for new flood hazard mapping often focused on urban areas impacted by localized flooding, which are areas not affiliated with a river, not typically mapped, and often not regulated as flood hazard areas. Other suggestions focused on mapping other hazards that relate to flooding, such as mapping alluvial fan hazards and landslide areas.

King County uses a range of technical information to characterize, quantify, and delineate flood hazards and related risks and, in turn, uses the information to develop and implement activities to reduce risk. The types of technical information that King County uses to inform flood risk reduction activities include topographic and ortho imagery data collection, hydrologic and hydraulic studies, floodplain and channel migration zone mapping, geologic studies, river channel elevation monitoring, GIS land use data, habitat studies, dam operations studies, risk assessments, and working maps of flood hazard management corridors. Ongoing coordination with state and federal agencies and academic researchers that collect and update scientific information is essential to accurate flood hazard identification and communication.

Many city governments in King County employ similar tools to understand risks along smaller tributary streams within their jurisdictions, yet smaller jurisdictions reported during the planning process that they have limited resources with which to fund extensive technical analyses. Some larger cities are in better position to fund flood-related technical analysis. In addition to studies related to the operation of the City of Seattle's water supply dams on the South Fork Tolt and Cedar rivers, the city has completed other studies focused on flooding and climate change impacts, including assessments of creek flooding, extreme weather events, and sea level rise. Where smaller jurisdictions are resource-limited, partnerships are an important way to develop and update flood maps for streams in incorporated areas.

Flood hazard area maps are tools to inform the public of potential flood hazards, and they form the basis for land use regulations focused on reducing existing risks and preventing future risks. King County continues to emphasize updating flood hazard data and mapping for the county's major rivers and some tributaries. Maps are also being developed for other tributaries as resources become available, with much of this work currently funded by the FCD. King County currently has a mapped and regulated coastal high-hazard area and sea level rise risk area, and, in 2014, amended its critical areas code (Chapter 21A-24) to establish criteria for the designation, classification, and mapping of

channel migration zones, which is an ongoing body of work. The status of flood hazard and channel migration zone mapping since the completion of the 2013 Flood Plan Update is presented in tables in **Appendix H**.



Example of flood hazard area mapping, South Fork Skykomish Flood Study 2021

When complete, flood hazard and channel migration maps are adopted by their respective regulatory agencies (local communities and/or and King County Department of Local Services) and then made available on King County's website, on the interactive King County iMap online mapping tool, and at King County libraries in hard copy.

In 2016, King County completed river corridor landslide hazard mapping (funded by the FCD) to identify areas where the occurrence and potential exists for deep-seated landslides, shallow debris slides, fans, rockfall, and rock avalanches. Where these hazards occur along river corridors, this indicates where a landslide could partially or completely block a river channel and cause unexpected and potentially catastrophic flooding. Specifically for deep-seated slides, the mapping identifies locations where deep-seated landslides are subject to toe erosion by river forces. This mapping provides emergency service providers and residents with valuable preparedness information and helps project managers understand where they need to consider risks from landslides and landslide-related flood hazards.

For areas outside of the river corridor landslide areas mapped in 2016, published geologic mapping by the Washington Geologic Survey and USGS identifies landslides, fans, and debris flow hazards that present potential flood-related landslide risks.

Climate Change Analysis

Although they are useful tools, flood hazard maps represent a snapshot in time and are often based on historical records and conditions at the time the mapping is completed. As land use and physical conditions change, modeling can become less representative of current conditions. Moreover, regional climate projections are indicating that changes in precipitation patterns in Western Washington in the future, as well as sea level rise, will likely result in larger floods than are typically considered in flood risk reduction planning. As a result, existing flood hazard area maps likely understate future flooding conditions.

As new maps are developed or existing maps are updated, incorporating new data about climate change will be essential to portray future flood risks more accurately. The current mapped 0.2 percent annual chance flood event can be used to preview what the future 1 percent annual chance flood event could look like, but expanding quantitative analysis to be more explicit about potential river or basin-scale changes in risks due to future projected flows is a needed area of investigation. During the planning process, partners and the public expressed support for increased analysis of how climate change will affect flooding.

King County Comprehensive Plan

King County's first comprehensive plan dates to 1964 and has been revised many times. Following the 1990 passage of the Washington State Growth Management Act (GMA), King County revised its comprehensive plan in 1994 for GMA consistency. Comprehensive plans adopted in accordance with GMA must manage growth so that development is directed to designated urban areas and away from rural areas. The GMA also requires jurisdictions to designate and protect critical areas, including frequently flooded areas and channel migration zones. Comprehensive plans must also identify and protect natural resource lands.

The Comprehensive Plan is developed consistent with the King County Countywide Planning Policies, which create a shared and consistent framework for growth management planning for all jurisdictions in King County. RCW 36.70A.210[35] requires the legislative authority of a county to adopt a countywide planning policy in cooperation with cities located in the county. The 2021 King County Countywide Planning Policies include several policies related to flood risk reduction and integrated approaches to environmental protection:

- EN-6: Locate development and supportive infrastructure in a manner that minimizes impacts to natural features. Promote the use of traditional and innovative environmentally sensitive development practices, including design, materials, construction, and ongoing maintenance.

35 https://app.leg.wa.gov/rcw/default.aspx?cite=36.70A.210.

- EN-7: Coordinate approaches and standards for defining and protecting critical areas, especially where such areas and impacts to them cross jurisdictional boundaries.
- EN-8: Use the best available science when establishing and implementing environmental standards.
- EN-12: Coordinate and fund holistic flood hazard management efforts through the King County Flood Control District.
- EN-13: Work cooperatively to meet regulatory standards for floodplain development as these standards are updated for consistency with relevant federal requirements including those related to the Endangered Species Act.
- EN-14: Cooperate with federal, state, and regional agencies and forums to develop and implement regional levee maintenance standards that ensure public safety and protect habitat.

The Comprehensive Plan is the County's legal framework for land use in unincorporated King County and is the guiding document for functional plans and development regulations. As of the time of the drafting of this Flood Plan, the Comprehensive Plan is undergoing a major 10-year update (2024 Update). As part of the 2024 Update, King County updated its Best Available Science (BAS) as required by GMA. The BAS update aims to ensure compliance with current GMA requirements, with a greater emphasis on achieving no net loss of critical area functions and values. It also seeks to incorporate significant state agency updates to BAS for riparian areas and wetlands while bolstering local management and protection of critical areas.

King County is using the BAS update to inform updated policies and development regulations. Regulatory updates in progress as of the drafting of this Flood Plan include updates to the critical areas regulations applied to wetlands, riparian areas, geologically hazardous areas, and frequently flooded areas. These include provisions to support multi-benefit flood risk reduction and fish passage projects, both of which are key elements of King County's salmon recovery strategy.

The Flood Plan is adopted as a functional plan of the Comprehensive Plan and, as such, it details Comprehensive Plan policies for the protection of frequently flooded areas and floodplain management. In many cases, the Comprehensive Plan points to the Flood Plan for floodplain management and flood risk reduction focused policies.

King County Code (K.C.C.) Title 20 is the planning code and is the title that adopts the County's Comprehensive Plan for compliance with the GMA. K.C.C. 20.12.480 adopts the King County Flood Management Plan as a functional plan to guide flood hazard management in King County.

Zoning Ordinance

King County's zoning ordinance (K.C.C. Title 21A) guides the application of land use regulations within each of several zoning classifications and is accompanied by zoning maps that illustrate zones for agriculture, forestry, industrial, rural areas, urban areas, regional business areas, and others. Zoning regulations describe allowable activities within each of the zones, which are then subject to additional land use and development regulations that guide activities in flood hazard areas. The zoning ordinance reduces future flood losses by establishing buffers and setbacks for aquatic areas and wetlands, requiring clustered developments away from critical areas, and creating natural open space for the conservation and natural and beneficial functions of floodplains and other critical areas. King County's zoning ordinance identifies the regulatory floodplain (including the coastal high-hazard area), channel migration zones, wetlands, and landslide hazard areas as critical areas. Cities in King County also have their own zoning ordinances to guide land use activities within their boundaries.

What King County heard

Community members uniformly stated that new development should be managed carefully to prevent making flooding worse for others, including comments in favor of tighter restrictions or limitations in incorporated towns and cities and unincorporated King County. Some specific suggestions included incentivizing more density in development outside of floodplains, increasing resilient design standards, and regulating potential future flood hazard areas. Easing permitting for home resilience improvements was also discussed by some parties.

King County's zoning code contains most of the development regulations for construction within floodplains and other critical areas. K.C.C. Chapter 21A.06 contains definitions of terms used in the zoning code. The floodplain development regulations are located within Title 9 (Surface Water Management), Title 13 (Water and Sewer Systems), Title 16 (Building and Construction Standards), and Title 21A (Zoning).

King County's Shoreline Master Program, adopted in 1975, underwent its first major update in 2011. The 2011 update included a characterization of all of King County's shorelines of the state, created new shoreline environmental designations, and developed policies for activities and uses within each designation. Regulations implementing the shoreline policies are primarily codified in K.C.C. Chapter 21A.25, and a full list of implementing regulations is in K.C.C. 20.12.200. Flood risk reduction activities must comply with the Shoreline Master Program and shoreline regulations in K.C.C. Chapter 21A.25. The zoning code is enacted to be consistent with and implement the Comprehensive Plan in accordance with Chapter 36.70A RCW.[36]

Flood Hazard Area Land Use and Development Regulations

Regulation of land uses in flood hazard areas can be one of the most effective ways of reducing the risk from flooding and channel migration. Land use regulations specify the allowable development in

[36] https://app.leg.wa.gov/rcw/default.aspx?cite=36.70a.

flood hazard areas. Development standards complement those regulations by ensuring that allowable development is done in ways that further limit risk and flood losses to structures.

Unincorporated King County's floodplain development regulations and Flood Insurance Rate Maps were adopted and enacted in 1978 when the County officially joined FEMA's National Flood Insurance Program (NFIP). King County's flood hazard area regulations for unincorporated areas are in King County's Critical Areas Ordinance, which was adopted in 2004 and is codified in K.C.C. Chapter 21A.24. The County's flood code was most recently updated in 2020. King County's flood-related land use regulations describe the types of activities that are allowed in flood hazard areas, channel migration zones, coastal high-hazard areas, and sea level rise risk areas. King County applies the Washington State Building Code, which guides how structures are to be constructed to limit the risks presented by flood-related hazards.

Allowable uses and standards under King County's regulations vary by location within the flood hazard area, but all standards are intended to reduce risk by meeting or exceeding the minimum standards of the NFIP. King County has adopted several regulations that exceed the minimum NFIP standards and effectively reduce future flood losses:

- A 3-foot freeboard (height above the base flood elevation) standard for new or substantially improved structures and critical facilities.
- Requirement to provide compensatory storage at the same elevation for fill placed in the floodplain.
- A zero-rise standard throughout the zero-rise floodway and zero-rise flood fringe to preserve flood conveyance.
- Restrictions on development in areas where depths exceed 3 feet and velocity exceeds 3 feet per second.
- Requirement for new lots to have at least 5,000 square feet outside the zero-rise floodway.
- Restrictions on nonresidential structures in the FEMA floodway, with some exceptions for agricultural buildings.
- Standards for manufactured home parks located in the floodplain.
- Requirement to remove temporary structures and hazardous materials from the floodplain during the flood season.
- Restrictions on critical facilities in the zero-rise floodway and FEMA floodway.
- Density restrictions in portions of the floodplain under land use and critical areas protection measures.
- Regulation of development within severe channel migration zones and unmapped flood hazard areas.

Additionally, in July 2020, King County adopted a Sea Level Rise Risk Area and associated changes to local land use codes for Vashon-Maury Island to reduce the risks of sea level rise on shoreline development.

Many cities in King County have mapped flood hazard areas, and 37 of the 39 incorporated municipalities participate in the NFIP (FEMA 2023). While floodplain development regulations exist in these communities, regulations are not consistent across all jurisdictions.

King County's expanded floodplain regulations beyond NFIP minimum standards (in particular, compensatory storage and the zero-rise floodway) provide enhanced protection from flooding for people and property and sometimes present conflicts with implementing multi-benefit projects, including meaningful restoration of critical habitat for salmonids protected by the Endangered Species Act (ESA). Current standards protect existing floodplain functions and habitat, but they in effect sometimes limit King County's ability to restore floodplain functions in a way that provides flood risk reduction and habitat benefits. An area for future work is collaboration with federal and state agencies, tribes, and community partners to better align federal minimum standards for flood hazard regulations with ESA requirements for protection and recovery of listed salmonid species and tribal rights. This will allow King County to continue to reduce flood risk for people and property while improving the effectiveness of salmon recovery actions.

Building Codes

K.C.C. Title 16 is the County's building and construction standards code. King County has adopted the International Building Code, the International Residential Code, the International Property Maintenance Code, the International Mechanical Code, and the International Security Code. These codes have all been amended by the state of Washington for application in the state, including amendments to ensure compliance with the Washington state floodplain management regulations.

King County has made additional amendments to these codes for application within the county to ensure that the County's higher regulatory floodplain standards are maintained. One example of a higher regulatory standard to prevent future flood losses is the requirement that under-construction elevation certificates must be certified by a professional licensed surveyor confirming the foundation's 3 feet of freeboard. Those sections of the International Codes that are inconsistent with state or local regulations have either not been adopted or have been amended. When implemented in conjunction with higher regulatory standards, King County's building codes help to ensure that structures are sufficiently resilient for current and future conditions.

Subdivision Ordinance

A subdivision ordinance regulates the development of residential, commercial, industrial, or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Subdivision design that accounts for natural hazards can dramatically reduce the exposure of future development.

K.C.C. Title 19A establishes the procedures for subdividing land, consistent with the policies of the King County Comprehensive Plan and the critical areas regulations outlined in K.C.C. Chapter 21A.24.

Per K.C.C.21A.24.240, subdivisions must be consistent with the need to minimize the potential for flood damage in flood hazard areas. Requirements for new building lots are:

- 5,000 square feet or more of buildable land must be outside of the zero-rise floodway.
- Utilities must be elevated or dry floodproofed to or above the flood protection elevation.
- Base flood elevations, required flood protection elevations, floodplain and floodway boundaries, and channel migration zone boundaries must be identified, and setbacks restrict structures to suitable buildable areas.
- Adequate drainage away from building sites must be provided.
- Notice for any site that is in a floodplain and for which emergency access may not be available during flood events must be provided.
- Taken together, these requirements serve to reduce the likelihood of flood risk for new building lots.

Stormwater Management Regulations

Stormwater runoff results when water is unable to soak into the ground due to either impervious surfaces or saturated soils that prevent infiltration. As land becomes more developed, the amount of stormwater increases. Without intervention, stormwater runoff can cause flooding that results in direct impacts on people and property, as well as damage to river and stream systems and destruction of habitat needed by fish and wildlife. Stormwater can also transport contaminants into county waterways, which can harm fish and wildlife and degrade water quality.

What King County heard

Stormwater management was a major concern among community members and partners. Low-impact development requirements and incentives, such as rain gardens, were emphasized as important strategies for reducing stormwater runoff. Stormwater runoff impacting lower watershed communities also generated discussion of the potential for stormwater management planning at a basin level, instead of at a jurisdiction-level.

An extensive regulatory landscape attempts to manage stormwater and reduce its impacts, which informs cities within the county as they implement surface water management programs. King County's *Surface Water Design Manual* is a technical guide that outlines requirements for stormwater management systems in King County. It regulates proposed surface and stormwater projects through a mixture of best management practices (BMPs), performance standards, and design standards. In unincorporated King County, drainage review and approval of designs during the permitting process ensures these standards are being applied, which are governed not only by King County Code but, to some extent, the County's National Pollutant Discharge Elimination System (NPDES) municipal stormwater permit, which contains specific requirements for drainage review and inspection of development projects. In addition to the manual's standards being applied throughout the unincorporated areas, many cities throughout King County have adopted the manual and apply its standards as part of their local permitting processes.

To comply with the Phase I Municipal Stormwater Permit under the NPDES of the Clean Water Act, King County implements a Stormwater Management Program Plan (SWMP Plan). The SWMP Plan is updated annually and guides the many activities King County implements to manage stormwater. These include mapping the municipal stormwater system, coordination among county departments to eliminate barriers to compliance with stormwater requirements, controlling runoff from new development and redevelopment, updating design standards and stormwater management regulations, and operations and maintenance of the stormwater system.

K.C.C. Title 9 is the County's Surface Water Management Code, and it supplements the King County *Surface Water Design Manual* and individual basin plans, which are adopted in Title 20. K.C.C. Title 9.04 is developed to promote the public health and safety by providing for comprehensive management of stormwater runoff and surface water and erosion control, especially to preserve the many values of the county's natural drainage system, including open space, fish and wildlife habitat, recreation, education, and urban separation.

Title 9 identifies that King County will carry out programs to reduce flooding, erosion, and sedimentation; prevent and mitigate habitat loss; enhance groundwater recharge; and prevent water quality degradation through the implementation of comprehensive and thorough permit review, construction inspection, enforcement, and maintenance. State funding authorities for stormwater management are focused on the local jurisdiction rather than watershed level, with each city or county enacting its own Surface Water Management fee, and use of that fee subject to limitations under state law. State regulatory frameworks under the Clean Water Act and NPDES are also highly localized, with accountability at the level of individual municipality. The focus of stormwater regulatory compliance and funding on individual jurisdictions can create barriers to watershed or regional approaches to addressing stormwater flooding.

Open Space Conservation

While regulations limit development in flood hazard areas, new development, even done in ways consistent with current regulations, can lead to landscape changes that may have consequences in terms of safety and damage in the future. Protecting open space, through acquisition or easement, is a proactive way to prevent future flood risks from occurring (note that acquisition of developed property is covered later, under Property Protection).

As a local government, King County has a long history of land conservation and protection. Since 1970, King County has conserved close to 200,000 acres of land to protect rivers and streams, provide habitat for wildlife, support recreational opportunities, ensure farms and working forests can remain viable, and provide open space access to local communities. While options for conserving open space within the urban growth area are somewhat limited, many local governments recognize the value of open space for flood risk reduction and general community benefit and pursue protection opportunities where they exist.

In 2016, King County launched the Land Conservation Initiative (LCI), a regional collaboration among King County, cities, businesses, farmers, environmental partners, and others to accelerate land acquisition to protect the remaining high-value conservation lands within 30 years. The LCI prioritizes the conservation of 65,000 acres across six land categories, one of which is river corridors, where

property acquisition is used to reduce flood risk and support viable populations of native Pacific salmon populations.

Open space conservation provides many flood risk reduction benefits:

- For land adjacent to rivers and streams, conservation allows room for floodwaters to spread out, dissipate, and infiltrate, which can be a valuable way to reduce flood risks to adjacent or downstream properties.
- Protecting lands in upper watershed areas can help alleviate downstream flooding impacts by moderating runoff and the timing of water reaching river and stream channels.
- Protecting and preserving intact wetlands helps moderate flood flows and provides floodwater storage.
- Open space conservation is a permanent solution. Once lands are protected through fee acquisitions, they remain protected in perpetuity. Once development rights have been removed from title, the land cannot be developed in a way that would introduce new risk, allowing the land to provide natural flood risk reduction benefits.

Property value increases throughout the county have made acquiring land much more costly in recent years, but several funding mechanisms are in place to support the acquisition of open space:

- King County Conservation Futures Tax
- King County Parks Levy
- State and federal grants
- Transfer of development rights
- In-lieu fee mitigation funding

3.2 Property Protection

Property protection measures focus on reducing risk to existing structures or removing structures from flood risk areas and are typically implemented at the parcel scale. Options to reduce risk through protection include retrofitting structures (such as elevation or floodproofing), acquisition and demolition of structures, or relocation, all of which are effective means of reducing or preventing risks to structures and their occupants without constructing or upgrading flood protection facilities. Flood insurance, while not addressing underlying risk, provides a measure of protection and supports flood resilience by providing coverage against losses. Sandbagging is a very temporary measure but can reduce immediate risk and is low cost.

Property protection activities are effective, and they can provide multiple benefits. They also can provide long-term cost savings by reducing flood insurance claims, reducing or eliminating the need for flood protection facilities, and reducing public expenditures for emergency response and the risk to emergency responders. In some cases—and especially in the case of acquisitions and relocations—these activities allow floodplain and channel migration areas to be reconnected to the river, providing opportunities for improved habitat and ecosystem function, and may reduce risk to nearby areas.

A component of King County's property protection efforts is mitigating FEMA-identified repetitive loss properties. A repetitive loss property refers to one with an insurable building that has received two or more claim payments of more than $1,000 from the NFIP within any 10-year rolling period since 1978. King County actively works to mitigate repetitive loss properties, and a Repetitive Loss Area Analysis was adopted by King County Council on September 6, 2022, by Motion 16199. The 2023 Repetitive Loss Area Analysis Annual Report is included as **Appendix F**, and a map of King County's Repetitive Loss Areas is included in Chapter 2 as Figure 2.1-10.

Elevations

Structural elevation projects involve raising the finished floor of a structure above the base flood elevation to reduce the potential for flood damage. In King County, elevations are typically implemented for residential structures, but agricultural buildings have also been elevated. K.C.C.21A.24.240 defines the requirements for development in flood hazard areas, including elevations. Participants in the home elevation program are required to exceed development standards. The lowest habitable floor must be raised at least 3 feet above the elevation of the 1 percent annual chance flood or 1 foot above the elevation of the 0.2 percent annual chance flood, whichever is higher. Home elevation projects allow property owners to maintain their homes in their existing location, thereby preserving neighborhoods and historic buildings and avoiding added pressure on housing resources.

What King County heard

Two of the most widely requested property protection actions were technical assistance to support landowners in transitioning to land uses that better accommodate flooding, and retrofitting or elevating buildings. Supporters of this strategy hoped to see more home elevations on agricultural landscapes and in coastal areas. Most community members supported acquiring at-risk properties, and some raised concerns about the negative equity impacts of these programs.

Elevation activities can provide long-term risk reduction benefits but do not eliminate risk. They are appropriate in areas where structures are subject to low-velocity floodwaters, but they are not a viable alternative in areas subject to high-velocity flows, bank erosion, channel avulsion, or landslide hazards due to the potential for stranding, undermining, collapse, or other damage to the structure. Temporary access issues may remain in the case of flooded roadways. Clean water access may be compromised, utilities (including septic systems) may flood, and emergency services may be unable to reach the residents.

Elevation projects implemented in King County have reduced flood risk, yet the program could be adjusted to expand its effectiveness. For example, home elevations are almost exclusively implemented in the Snoqualmie River basin. While parts of this basin are an ideal setting for elevations due to low-velocity, deep floodwaters, other locations in the county may also be appropriate for this mitigation activity. The program could be expanded to provide incentives for permittable home elevations in all floodplains and repetitive loss areas of King County. In some cases, demolishing and rebuilding a home may be a more suitable and financially beneficial option. This could be incentivized like home elevation projects to reduce flood risk.

Elevated home in Snoqualmie River Watershed during floods, November 2006

The program as currently implemented requires that property owners have sufficient capital to cover significant costs prior to being reimbursed. This presents equity issues since some homeowners are unable to afford the initial financial outlay. King County has assisted property owners with home elevations by securing and administering grants and loans from federal, state, and local hazard mitigation and housing assistance programs. In recent years, the FCD has been a primary source of funds for home elevations, yet property owners are limited in their ability to assemble the necessary matching funds.

While not a structural elevation, construction of farm pads—raised mounds of earth that provide refuge for livestock and storage of equipment during times of flooding—is an approach desired by famers, particularly in the Snoqualmie Valley. Some farm pads were constructed in the valley in past years, but investigation of existing floodplain conditions and compensatory storage requirements is needed to determine whether additional farm pad implementation is a possibility in the future.

Property Acquisitions

Acquiring developed property permanently eliminates risk and costs associated with flood damage prevention to at-risk structures. Acquisition allows for returning formerly developed lands to open space to support other beneficial uses, such as habitat, water quality, recreation, aesthetic

enhancements, and interpretive sites and trails. Strategically implemented acquisitions support riparian and floodplain restoration, which enhances natural floodplain functions, provides opportunities to increase flood and sediment storage and conveyance, and supports the recovery of threatened and endangered species by restoring natural river processes. Acquisitions often involve purchase of an entire property, but partial acquisitions or easement purchases are also used in certain circumstances. In some cases, easements may allow for some continued flood-compatible use of the property, such as agriculture.

King County has been acquiring flood-prone parcels from willing property owners for many years, through both fee acquisition and conservation easements. From 2013 to 2023, King County acquired 1,984 acres in the mapped 1 percent annual chance floodplain and an additional 83.5 acres in the 0.2 percent annual chance floodplain. Following the sale, structures are usually salvaged or demolished, some site restoration occurs, and the lands are maintained as open space in perpetuity. King County has also completed several significant acquisition efforts that removed many flood-prone and repetitive loss structures from hazardous areas, which then facilitated large-scale floodplain reconnection. Examples include the San Souci neighborhood on the Tolt River and Rainbow Bend and Riverbend on the Cedar River. Several cities throughout King County also acquire flood-prone properties to reduce flood risk and provide land to enable restoration projects focused on enhancing habitat for threatened salmon.

State and federal grants and some local funding sources are available to support the initial purchase and demolition of structures. Long-term maintenance and associated land management obligations typically remain with King County or the FCD, depending on custodianship.

Acquisition is a highly effective tool for flood risk reduction. It is not, however, without limitations and challenges:

- Ongoing monitoring and stewardship of publicly owned lands are necessary to prevent and address dumping, vandalism, and unauthorized encampments. Encampments in riparian corridors result in people returning to flood hazard areas and reintroducing life safety risks that acquisition was meant to mitigate. Additionally, unauthorized encampments along rivers have the potential to damage flood protection facilities and riparian habitat through vegetation clearing and can impact water quality.
- The costs of acquiring developed property increase or decrease over time depending on local market conditions, and property owners can sometimes receive a higher price more quickly on the open market. This results in risk being transferred to new owners, who may be unaware of those risks.
- Acquisition can result in inequitable effects (Shi et al. 2022). The primary financial benefits of acquisition accrue to property owners. In cases where renters occupy acquired property, King County provides relocation assistance, but careful planning is needed to ensure acquisition does not fragment communities or result in displacement. These and other factors can result in socially vulnerable populations bearing a heavier burden from acquisitions (Shi et al. 2022).

Before (top) and after (bottom): Riverbend Manufactured Home Community on Cedar River before acquisitions (2009, looking upstream) and the same site after Riverbend Levee Setback and Floodplain Restoration project (2023, looking downstream)

Acquisition can reduce vulnerability by enabling at-risk community members to relocate to safer housing. Overcoming the potential for inequitable effects of acquisition requires equitable access to

information about flood risks, acquisition opportunities, and potential relocation assistance. This information needs to be made available in multiple ways and using appropriate languages and communication methods for the given community.

King County rarely uses condemnation to acquire property. Condemnation involves using eminent domain when a mutually satisfactory negotiated settlement cannot be reached on a parcel essential to a project aimed at public benefit and is typically considered an acquisition activity of last resort.

Relocations

A relocation activity moves an at-risk structure to a new location outside the flood hazard area. The opportunity to relocate homes depends on such conditions as the desire of the occupants to keep their home, the availability of an appropriate new location for the structure, and the feasibility of moving the structure. King County does not typically make use of this flood risk reduction tool, but it could be applied in certain settings.

Relocation projects can greatly reduce future flood damage while allowing property owners to remain in their homes and possibly on their property. Since a relocation project removes a home from a current flood hazard area, measures such as construction and maintenance of a flood protection facility and emergency response services may no longer be needed. Flood storage and conveyance can be improved, benefiting neighboring properties and public facilities. Relocations also create an opportunity to enhance or restore fish and wildlife habitat on the flood-prone portion of the property and, in some cases, provide public access to the shoreline. Like many home elevation projects, relocations could be incentivized to reduce flood risk, including through relocation assistance.

While beneficial, relocations still face some level of residual risk because of climate change. A relocation should only be considered a viable, long-term mitigation solution if the receiving site for the relocated structure is sufficient to accommodate potential shifts in the flood hazard area boundary that may result because of more substantial future flooding conditions. Additionally, relocation needs to consider other risks that may be introduced. For example, moving a structure away from the coastal high-hazard area could introduce landslide risk if the structure is not located appropriately.

Flood Insurance

While insurance itself does not structurally mitigate risk, it is a tool available to help property owners and renters recover from flood damages. King County is currently a Class 2 community in the Community Rating System (CRS) because of its comprehensive and multifaceted floodplain management program. King County's CRS rating means property owners and renters in unincorporated areas are eligible for a 40 percent discount on their flood insurance premiums. Eight cities in King County also participate in CRS, but their class ratings are lower and the associated flood insurance discounts are lower than those offered in the unincorporated areas.

What King County heard

Community members strongly advocated for increased outreach to homeowners and renters on the benefits and availability of flood insurance. Direct outreach to BIPOC and immigrant communities was identified as a need.

Flood insurance is an additional policy on top of general homeowners' insurance. While many property owners may be required by their mortgage lender to acquire flood insurance, renters may not be aware of the flood risk of a property they are renting and need to be aware of their opportunity to insure their contents against flooding impacts.

Floodproofing

Floodproofing refers to structural or non-structural measures, changes, or adjustments that can reduce flood risk or flood damages. Two types of floodproofing are dry floodproofing and wet floodproofing. Dry floodproofing involves making all areas below the flood protection level watertight, whereas wet floodproofing lets water in and anything that could be damaged by a flood is removed or elevated above the base flood elevation.

Wet floodproofing is typically an approach used in combination with home elevation projects, whereby the area below the base flood elevation must be constructed of flood-resistant materials, and the area cannot be used for habitation or contain appliances, utilities, or other elements that could be damaged by flooding. Dry floodproofing has structural limitations and is only allowed for nonresidential structures and certain agricultural buildings.

As a mitigation tool, floodproofing is only appropriate in areas that experience slow moving or ponding floodwaters. Areas that experience fast flows or are subject to channel migration are not good candidates for floodproofing.

Sandbags

During flood emergencies, King County provides sand and sandbags to the public, free of charge, at several locations throughout the county in both incorporated and unincorporated areas. King County also advertises the locations of sandbag locations hosted by other King County communities.

3.3 Natural Resource Protection

Natural resource protection refers to activities that protect or restore natural areas and the natural functions and processes of river, floodplain, coastal, and watershed ecosystems. When allowed to function naturally, floodplains provide flood and sediment storage and flood conveyance benefits. Natural, fully functioning floodplains also provide valuable habitat for fish and wildlife, improve water quality, and are resilient to the effects of climate change.

In the Pacific Northwest, rivers, streams, coastal areas, and their floodplains provide habitat that is critical to the survival of Pacific salmonids, several species of which are listed on the ESA. King County has successfully collaborated with salmon recovery planning groups and other partners to implement floodplain reconnection projects that reduce flood risk to people and property while also dramatically improving habitat for salmon and providing other benefits. These projects clearly demonstrate that natural resource protection and restoration is an effective flood risk reduction activity.

What King County heard

Community members and partners strongly support working with nature to reduce flood risk. They view this as an important benefit to consider in all flood risk reduction projects. Over 75 percent of community responses to surveys and polls favored protection of upper watershed areas and wetlands to store flood waters. More than 50 percent encouraged more projects to connect rivers to their historic floodplains as well as use green stormwater techniques to reduce stormwater runoff and flooding.

Individuals and partners from cities noted there can be financial and spatial challenges to implementing natural resource-based projects in urban areas. Some community members also requested renewed river dredging and raised concerns about beavers.

This section discusses the natural resource protection activities considered during the planning process. Examples of natural resource protection projects are illustrated in **Figure 3-1** and **Figure 3-2**.

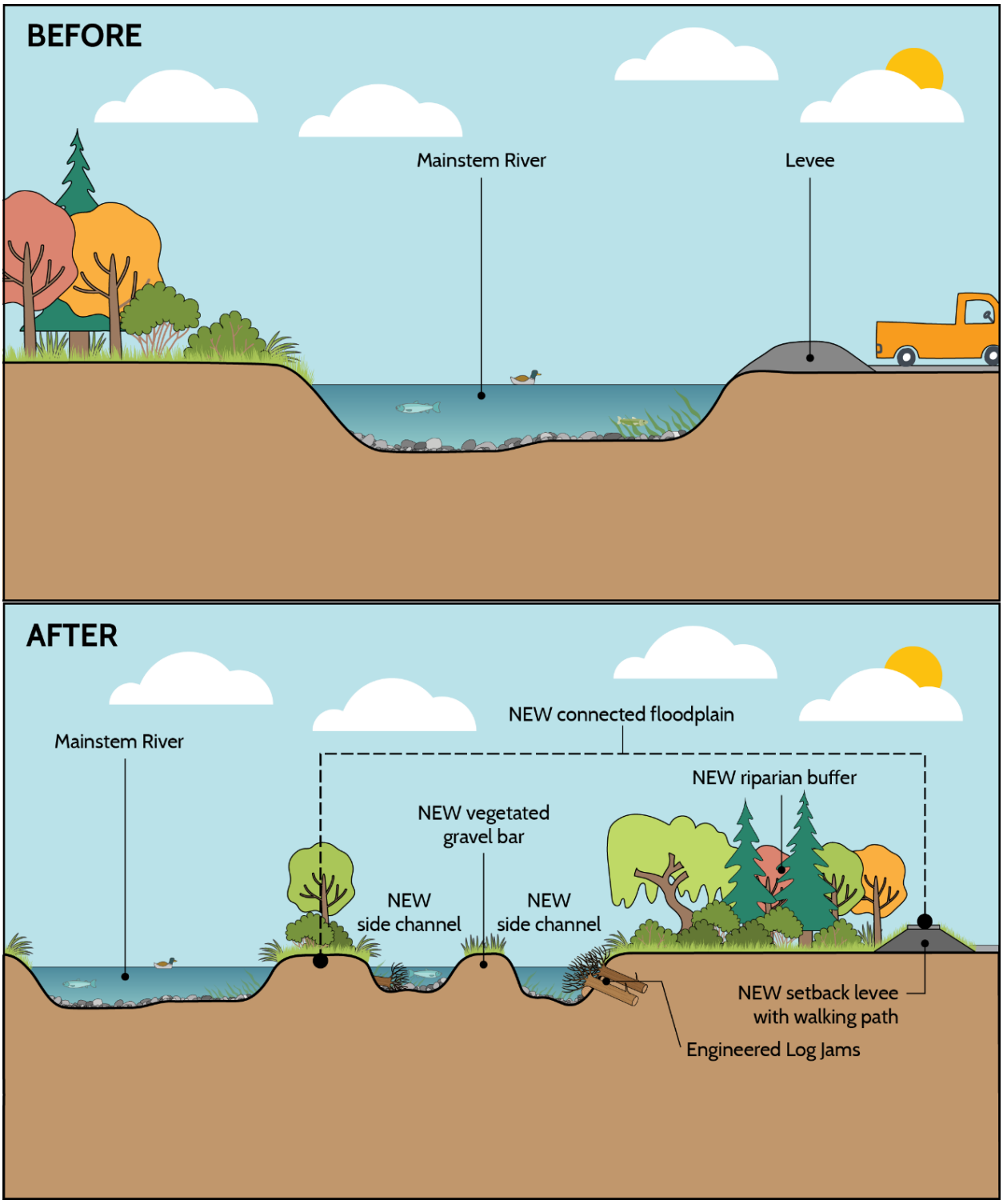


Figure 3-1
Example of a Natural Resource Protection Project (before and after)

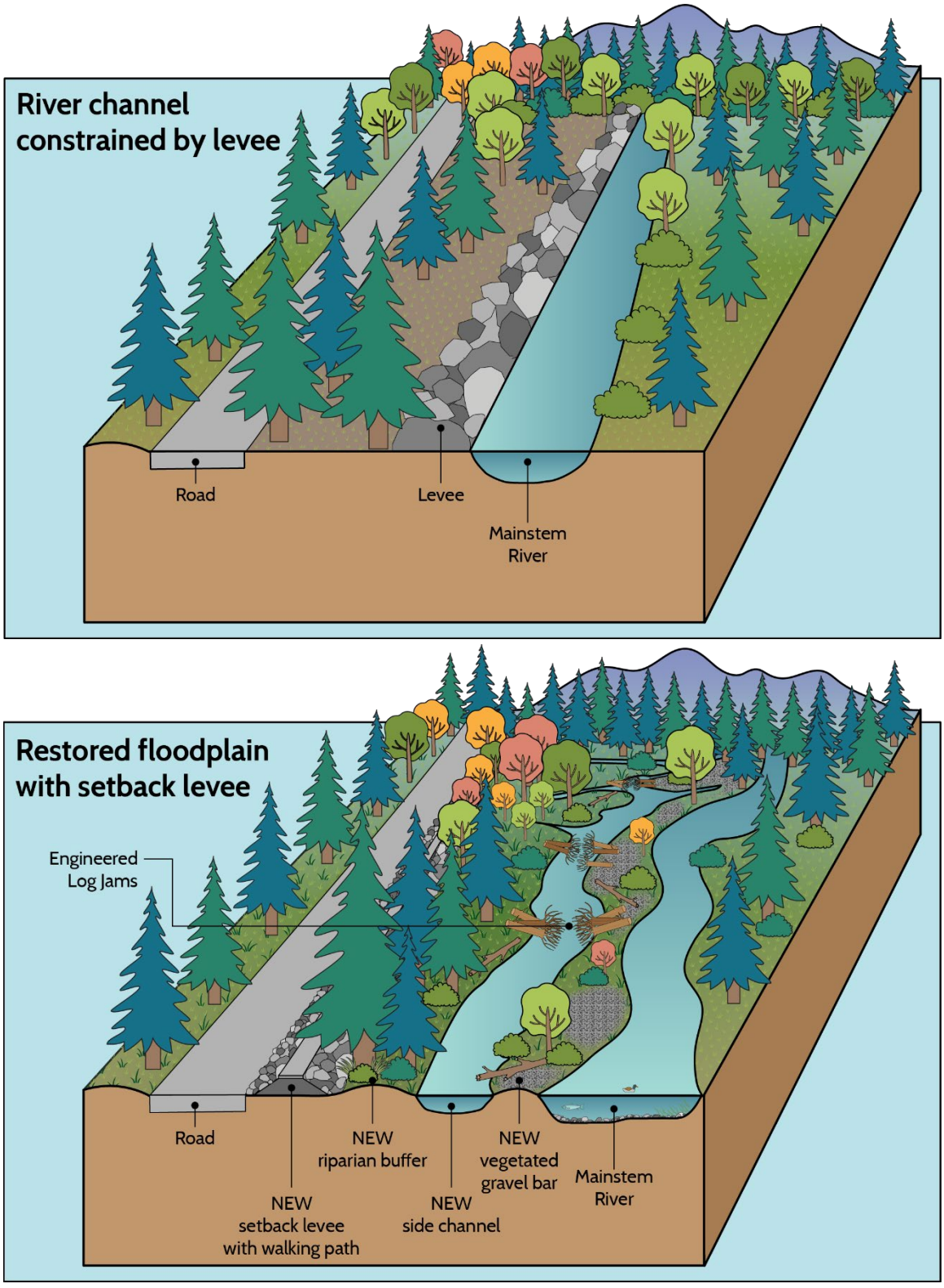


Figure 3-2
Example of a Natural Resource Protection Project, Setback Levee (before and after)

Floodplain Reconnection/Restoration Projects

The construction of levees and revetments and large-scale floodplain drainage networks in the 20th century along the rivers and streams of King County dramatically changed the nature of county rivers and floodplains. These structures allowed human development to proceed in areas that were previously subject to regular flooding. Disconnection of watercourses from their floodplains led to a substantial decrease in floodwater conveyance, storage, and habitat function. Furthermore, erosive water velocities increased due to the channelization of rivers and streams, resulting in repeated damage to many of the levees and revetments.

Reconnecting rivers and streams to their floodplains and restoring floodplain habitat is a way to allow nature to provide flood risk reduction benefits. Disconnected floodplains in King County vary in their current land use, from highly developed urban and industrial areas, to suburban and rural residential neighborhoods, to agricultural landscapes and open spaces. Reconnecting floodplains requires time and financial commitment, but the resulting projects can remove at-risk development from harm's way, provide natural flood attenuation and sediment storage, promote resilience to climate change, and dramatically improve fish and wildlife habitat.

Floodplain reconnection also allows for the reestablishment or creation of side channels and backwater channels in the floodplain. These channels enable river flow to reoccupy pre-existing or former secondary channels that were carved across the floodplain through years of historical flooding and channel migration. These floodplain remnant channels can be pathways to convey overbank flows and lower a river's flood elevations and velocities through a reach. Excavating new or connecting former floodplain channels can also provide additional flood water and sediment storage and geomorphic floodplain complexity. These types of off-channel features provide critical rearing and flood refuge habitat for juvenile salmonids and support habitat complexity that salmon need to survive.

King County has implemented several floodplain reconnection projects in recent years in each of the county's major watersheds, which have proven effective at reducing flood risk while also providing a host of other benefits to both the natural environment and local human communities. Notable examples include the Rainbow Bend and Riverbend projects on the Cedar River. These beneficial projects, however, can take 10 or more years to design and implement—longer for more complex projects with conflicting public interests. Grant funding is often needed to secure the resources needed, but relying on competitive funding for individual project phases can be problematic. Land acquisition can take decades for larger scale projects, especially those where many parcels are involved. Capital project sponsors' project timelines and funding distribution schedules do not always align with acquisition timelines.

In many locations in King County, full floodplain reconnection and restoration is not possible due to current land use and development. In such cases, finding opportunities to restore as much function as possible can provide important and critically needed habitat function. Setting back a flood protection facility, such as a levee or revetment, even a short distance from the water's edge can increase slow-water edge habitat that is vital for juvenile salmon rearing and refuge (even though such projects can be very costly). Levee and revetment setbacks can also provide more cost-effective options for scour protection than more traditional structural methods and can reduce water surface elevations, meaning the setback facilities do not need to be built as high.

Riverbend floodplain restoration and levee setback on Cedar River, January 2023

Large Wood Management

The presence of natural large wood in rivers and streams sustains ecological functions critical for salmonids and aquatic ecosystems, but the current amount of large wood in county waterways is greatly reduced from historical conditions. The need to substantially increase wood volumes in rivers and streams to support viable populations of salmonids is well-documented. All WRIA-based salmon recovery plans addressing King County watersheds (one each for WRIAs 7, 8, 9, and 10) include goals to substantially increase the amount of large wood in rivers. Tribes, resource management, and regulatory agencies strongly prefer, and sometimes require, methods supportive of these goals in river and stream projects.

In addition to natural wood, King County frequently uses large wood as a design element in flood risk reduction projects for bank stabilization and scour protection. While these wood features do not create and sustain salmonid habitat or restore river process as well as naturally occurring wood does, they provide habitat improvement over typical rock revetments by supporting the base of food webs and sometimes increasing habitat complexity. Wood elements are often required for mitigation as part of the permitting process, and WAC 220-660-130[37] encourages and may require incorporating large wood materials in bank stabilization instead of rock.

In larger flood risk reduction projects, including floodplain reconnection projects, the use of large wood may also include anchored or unanchored large wood that is designed to influence natural river processes and reduce risk. For example, wood jams may be built to deflect flows and reduce erosion risk, and placed wood can influence patterns of sediment movement and storage. Natural floodplain

[37] https://app.leg.wa.gov/wac/default.aspx?cite=220-660-130.

processes in reconnected floodplain areas, including vegetation growth and wood recruitment from channel migration, also deliver natural wood to rivers and streams. In addition, these wood pieces have benefits beyond flood risk reduction via creating and sustaining habitat for fish and wildlife.

Safety concerns raised by recreational users, public safety officials, and project-specific risk analyses have resulted in procedures and policies for naturally occurring and placed wood in King County. For wood that is placed as part of a project, King County is required to follow the procedures outlined in a 2010 Public Rule that are intended to protect public safety (Public Rule LUD 12-1, effective April 30, 2010). The procedures include assessing potential recreational uses, identifying potential project impacts on public safety, accounting for public safety in project design, performing public outreach to allow for two-way communication with the public, monitoring and adaptively managing projects following completion, and reconvening partners and interested parties to re-evaluate large wood policies every 3 years.

For naturally occurring wood, King County developed procedures in 2013 to guide the King County Department of Natural Resources and Parks (DNRP) and the King County Sheriff's Office in responding to and assessing reports of potential public safety concerns associated with naturally occurring large wood in King County rivers, including whether the naturally occurring wood should be moved or removed in response. Recent King County experience with moving naturally occurring large wood for public safety concerns resulted in substantial mitigation costs required by fishery co-managers, for which there is no identified fund source. Given the continued decline of salmonids, the value of allowing natural wood recruitment and transport processes to function uninterrupted as called for in WRIA salmon recovery plans, and the likelihood of even higher mitigation costs for modifying naturally occurring wood, there is a need to reassess the large wood procedures to clarify the County's path forward as it relates to public safety.

Headwaters Protection

Many of the headwaters areas for King County's major rivers are already in public ownership, with some protected from development. For example, much of the Snoqualmie River basin headwaters are owned by the U.S. Forest Service (with some as designated wilderness). The upper Cedar River watershed is protected for municipal water supply by the City of Seattle. The Green River above Howard Hanson Dam is a patchwork of public ownership (City of Tacoma, U.S. Forest Service, Washington Department of Natural Resources). The upper White River is federally owned (Mount Rainier National Park and U.S. Forest Service), and 43,000 acres in the upper Green River watershed and portions of the upper White River east of the City of Enumclaw is protected by a conservation easement held by King County.

What King County heard

Community members and partners expressed strong support for protection of headwaters areas, which can provide flood risk reduction benefits and other community benefits, such as clean water, fish and wildlife habitat protection and restoration, and recreational opportunities.

Even though the major river headwaters will not be developed in a way that introduces any direct flood risk, the management of these lands can influence flooding conditions downstream. While timber practices are less impactful on hydrology than the effects of impervious surfaces, timber harvest and road building can increase runoff and sediment delivery to the rivers that can affect areas downstream.

The headwaters areas of smaller tributary streams do not often have the same degree of public ownership, and the management of these areas can be influential to downstream risk. Protecting the headwaters areas of smaller streams presents an opportunity to promote infiltration and limit flashy runoff that is expected to become more common with climate change.

Wetlands Protection and Restoration

Similar to the protection of headwaters areas, wetlands protection provides natural flood risk reduction benefits. Wetlands store and infiltrate water and slow the flow of water downstream. They also provide important water quality benefits, promote aquifer recharge, and provide important habitat for fish and wildlife. While wetlands regulations are in place, some impacts are allowed if mitigated. Protecting and restoring wetlands, particularly those within the floodplain, may augment flood risk reduction actions. King County has implemented several riparian wetland restoration projects in recent years, and King County's In-Lieu Fee Mitigation Reserves Program provides funding for restoring or establishing wetland habitat when unavoidable wetland impacts occur elsewhere within the same watershed.

Beavers

Beavers are native to Washington state, and the dams they build store and infiltrate water and slow its movement through watersheds, which help reduce flooding and erosion. Beaver ponds provide habitat for fish and other aquatic species, improve water quality, keep water temperatures cool, recharge aquifers, and are a highly beneficial ecosystem component for salmon species.

What King County heard

Localized flooding due to beaver activity was identified in numerous cities and unincorporated areas of King County. Suggestions for managing beaver-related flooding included increased monitoring of beaver activity and population size, temporary relocations, beaver dam management, and information for private property owners.

While beavers provide environmental and flood risk reduction benefits, they can also present challenges for human infrastructure that did not account for the animals' activities. In some cases, beaver ponds can back up water in locations that impact human land use, and beaver dam failures, especially above steep-slope hazards including above alluvial fans, can contribute to outburst flooding. King County has developed decision-support tools to aid in management of undesirable beaver activity, and the County partners with local nongovernmental organizations to provide technical assistance and resources for beaver management. More information is available on King County's website.[38]

[38] https://kingcounty.gov/en/legacy/services/environment/animals-and-plants/beavers.aspx.

Green Stormwater Infrastructure

Green stormwater infrastructure (GSI) refers to a variety of tools or stormwater facility types that are intended to collect, treat, and slow the flow of runoff in developed areas. GSI can take many forms, including bioswales and bioretention facilities (sometimes called engineered raingardens), pervious pavement, green roofs, trees, and even some storm ponds—all of which promote infiltration, improve water quality, control flows, and limit the adverse effects of stormwater runoff.

GSI is an effective tool when used at appropriate sites and scales. GSI is often used to retrofit existing stormwater management systems and is most effective when used in conjunction with gray stormwater infrastructure. Depending on the site, community, and regional scales where it is employed, GSI can be an effective addition to a catchment to reduce flows. Scaling these facilities up so that they manage larger volumes of stormwater will enhance their ability to provide meaningful flood risk reduction. Stormwater parks, although expensive, offer promise as a potential flood risk reduction solution at scale.

Marine Shoreline Restoration

The marine shorelines of King County have been significantly altered from their natural condition, primarily through residential development and associated armoring with rock or concrete that is installed to protect landward development. While armoring can provide short-term erosion protection, it is subject to erosion and failure in the longer term and significantly reduces the ecological function of shorelines. Additionally, most of the marine shoreline armor was built to limit erosion and does not provide protection from high-water events. Of the 103 miles of marine shoreline in King County, 64 percent is armored and, for the urban shoreline, the armored figure is 84 percent.

King County's marine shorelines will face increased flood and flood-related risk in the future because of climate change and sea level rise (see *Coastal Flooding* in Section 2.6 for more detail). Restoring shorelines by removing armor and replacing it with natural elements is a way to improve ecological conditions and reduce the effects of coastal erosion, but restoring shorelines is difficult to implement due to the extent and type of shoreline development, which limit ideal settings for restoring shorelines appropriately. Moreover, reducing flood risk along the shoreline, especially in the future with sea level rise, will require development of more integrated and comprehensive solutions that include property protection measures (e.g., elevations, relocation, and acquisition) due to the proximity of many structures to the water's edge.

Before (top) and after (bottom): Maury Island Dockton Marine Shoreline Restoration, 2013–2022

3.4 Emergency Services

Emergency services include activities immediately before, during, and after a flooding emergency to minimize the impact. Activities considered include flood warning and response, critical facilities protection, and post-disaster mitigation activities.

Flood Warning Program

King County's Flood Warning Program collects and disseminates flood forecasts and alerts so that individuals and organizations can prepare for flooding and take appropriate actions to minimize flood damage. Currently, the Flood Warning Program provides services to both unincorporated and incorporated areas, primarily along the South Fork Skykomish, Snoqualmie, Tolt, Cedar, Green, and White rivers, and Issaquah Creek.

What King County heard

Uniformly, community input requested communication about flood evacuation routes and road closure information in real time, as well as improving coordination between government agencies during floods. There was also support for the need to accommodate vulnerable populations, especially people with low incomes and renters. Those who represented those communities asked for government agencies to build capacity of local organizations to respond effectively during floods. Some community members and partners noted that it can be unclear who is in charge and where they can find support during flood emergencies.

Flood warning activities are triggered whenever one or more rivers reach certain flow or stage (height) thresholds. The King County Flood Warning Center sends alerts to police, fire departments, schools, cities, first responders, and public subscribers through text messages, emails, and voice calls. Depending on the nature of the flood event, the Flood Warning Program may also deploy staff for on-the-ground assessment of flood protection facilities and investigation of potential flood risks. Flood Warning Center operations and field investigations involve a mix of King County staff, including many engineers, ecologists, project managers, and others who design and coordinate repairs for flood control facilities within King County.

The Flood Warning Program works closely with King County's Road Services Division, the King County Office of Emergency Management, and other agencies to obtain and share up-to-date information about major flood risks, road closures, evacuations, and other emergency services to provide timely flood warnings and coordinate evacuation of residents and visitors if necessary. Coordination also occurs with the U.S. Army Corps of Engineers (Corps) and Seattle Public Utilities regarding dam operations and projected dam releases.

King County's designations of flood phases are primarily based on flows at specific gages, which means the information may be less useful depending on someone's location relative to that gage. A wide network of gages is available in King County, and the Flood Warning Program could look for ways to better connect to that network to provide information at a more useful scale for local decision-making.

King County Flood Control District Flood Warning Center, November 2021

There is a growing recognition that flooding occurs in locations not served by King County's Flood Warning Program. Increasingly, smaller creeks and some coastal areas also face flood risk, but the types of predictive tools used for river flood warnings are not available for smaller stream systems or coastal areas. Because coastal flooding is driven by multiple factors—including wind-induced wave action, high tides, freshwater inflows, and elevated groundwater levels—the ability to predict coastal flooding is currently quite limited.

Exploring ways to continue to reevaluate the services provided by the Flood Warning Program is an important step to ensuring the needs of all flood-prone residents in King County are provided information to help them prepare for potential flood risk. In recognition of this need, the FCD, who provides funding for King County to implement the Flood Warning Program, in November 2023 authorized expanding the Flood Warning Program to include forecasted king tide events along the Duwamish River.

Occasionally, the Flood Warning Center receives notification that a landslide has occurred, and landslide hazard potential generally increases with intense rainfall events that also cause flooding. King County Department of Local Services also receives landslide hazard reports that impact roads and structures. Better coordination and communication among King County departments and divisions

and with external partners, including the Washington State Department of Natural Resources, is needed to improve timeliness of response to assess active landslide hazards and their impacts.

King County flood warning information is provided through multiple communication channels, and the communication methods used by King County change as behavior changes around accessing information. Near real-time river gage and flood phase data became available on King County flood warning websites in 2009. In that same year, the County introduced a flood alert system that allows people to subscribe for automated flood notifications via text message and email. A Flood Warning mobile app became available in 2012 on Apple and Android devices and is the most frequently used platform for individuals to obtain local river and flood data. The app will be replaced with a new version in 2024, which will include information in multiple languages. Additional flood warning communication methods include an interactive phone message system, blog posts, social media, and coordination with local media.

Emergency Response

When a given river reaches a certain flow threshold, the King County Office of Emergency Management activates the King County Regional Communications and Emergency Operations Center. The center's role is to assist in procuring resources and coordinating flood-related and other emergency response activities in unincorporated King County and to assist cities and special-purpose districts within King County if resources are available. Response activities include coordination with other affected entities in the region, providing emergency updates using multiple methods, and evaluating the need for and activating emergency shelters as necessary.

What King County heard

Public comments indicated that most people don't know where to obtain information about emergency supplies, emergency plans, evacuation routes, road closures, locations of shelters, and early warning systems. This suggests that current outreach efforts have been inadequate to inform community members about the existence of these available resources.

Coordination in times of emergency is key to effectively serving the public, and many cities have their own emergency management programs. Feedback provided during the planning process for this Flood Plan suggests this type of coordination between local governments should be improved to serve communities more effectively in times of emergency.

King County deploys patrol teams to monitor river conditions during flood events. The primary emphasis for these patrols is to monitor levee system performance, but they also monitor conditions at other locations, sometimes in response to information received from members of the public. Patrol teams are trained to recognize situations that warrant emergency action to preserve levee system function or otherwise reduce flood risk. Activities that King County may take or assist with to minimize flood damage include:

- Repairing damaged flood protection facilities that, because of the actual or potential consequences of their failure, must be restored as emergency actions before or during a flood event, or soon after floodwaters have receded.
- Providing information to flood response agencies engaged in flood-fighting and evacuations.

- Making flood-fighting information and flood-fighting materials available to individuals and groups actively involved in flood-fighting.
- Coordination with FEMA for flood disaster reimbursement and grants through the Public Assistance Program.

Currently, dam safety and emergency response plans are available for the City of Seattle's South Fork Tolt River Dam and Masonry Dam (Cedar River) dams, the Corps' Howard Hanson (Green River) and Mud Mountain (White River) dams, and the Snohomish Public Utility District's Culmback Dam on the Sultan River, which is in Snohomish County and would affect the lower Snoqualmie River in a dam-breach scenario. Cascade Water Alliance has prepared an Emergency Operations Plan and conducts an annual emergency drill for the levee system on Lake Tapps, which would affect the White and Puyallup rivers if a levee failure occurred.

Factoring the effects of sea level rise into emergency response activities would expand emergency services to areas at risk. King County is currently partnering with other agencies on a project to better understand the potential implications of sea level rise along the marine shorelines of King County, and the City of Seattle has analyzed its shoreline to identify areas at risk of inundation from sea level rise. This type of information could be used to develop emergency response measures that meet the needs of communities that may increasingly become vulnerable to coastal flooding.

Capacity for Community-Based Organizations to Respond to Emergencies

King County and cities within the county provide a range of emergency services to mitigate flood risk to people and property, but government is limited in its ability to help everyone, everywhere. For this reason, individual and local preparedness is key to building flood resilience. Local community groups and community-based organizations can play an important role in working with their networks to distribute information about flooding, the risks associated with flooding, and the variety of free or low-cost steps individuals can take to prepare for flooding and be ready in the case of an emergency. King County could make a concerted effort to build its capacity for emergency response with training, funded partnerships, and support, using specific knowledge learned from grassroots groups that serve the most vulnerable populations.

Technical Assistance to Property Owners and Renters for Short-Term Response Tools

Along with community capacity building to facilitate individual preparedness, King County and community groups can build individual and community resilience by helping individuals develop tools that can aid them during times of emergency. This can include making sure individuals are aware of their risk, understand where and how to obtain timely flood-related information, have a plan for what to do in times of a flooding emergency, and have appropriate emergency supplies on hand. Such technical assistance would be most effective if targeted on the most vulnerable and least resilient communities. It requires an understanding of cultural and language needs so that all communities are served effectively.

3.5 Structural Projects

Structural projects involve physical construction or maintenance of levees, floodwalls, revetments, pump stations, or otherwise physically modifying river channels and shorelines. Prior to 1993, flood risk reduction in King County relied heavily on constructed flood protection facilities to reduce and limit river flooding, erosion, and channel migration. Together, these levees, revetments, overbank channels, pump stations, and associated appurtenances paved the way for considerable economic development in flood hazard areas and floodplains.

What King County heard

Improving the flood resilience of roads and bridges throughout King County was identified as a priority, with specific mention of roads on Vashon-Maury Island, in Covington, and in May Valley. The most mentioned concerns for roads were in the Duvall and Carnation areas. There was a high demand for maintaining aging or damaged river protection facilities and considering adding new ones, including along the lower Duwamish River, as well as sharing more information about dams and dam failure planning.

Structural projects can be very effective in the short term in reducing localized flood risk, but the lifespan of the effectiveness is variable and considerable resources are required for maintenance and repairs. Additionally, some treatments may not perform as designed in the future due to climate change, yet overbuilt structural alternatives may result in undesirable ecological consequences. Areas protected by structural approaches face the potential risk that the facilities could be overtopped, resulting in serious flood damage or life safety risk. The presence of flood protection facilities can create a false sense of security among developers and property owners. Additionally, flood protection facilities in many locations have disconnected the river channel from adjacent floodplains, which has contributed to the greatly diminished quality and quantity of aquatic and riparian habitat that numerous species, including salmonids listed as threatened under the ESA, require for their survival.

King County has an extensive network of structural projects, many of which were originally built more than a half century ago, were sited without consideration of habitat impacts or equity and social justice implications, and which do not meet current design standards. Future management of the network will be most effective if management decisions are based on reach-scale or basin-scale risk-based assessments that identify the most appropriate activities considering long-term costs and benefits. These include compatibility with salmon recovery efforts and the land uses and vulnerability of the communities landward of the existing facilities.

Examples of structural projects are illustrated in **Figure 3-3**.

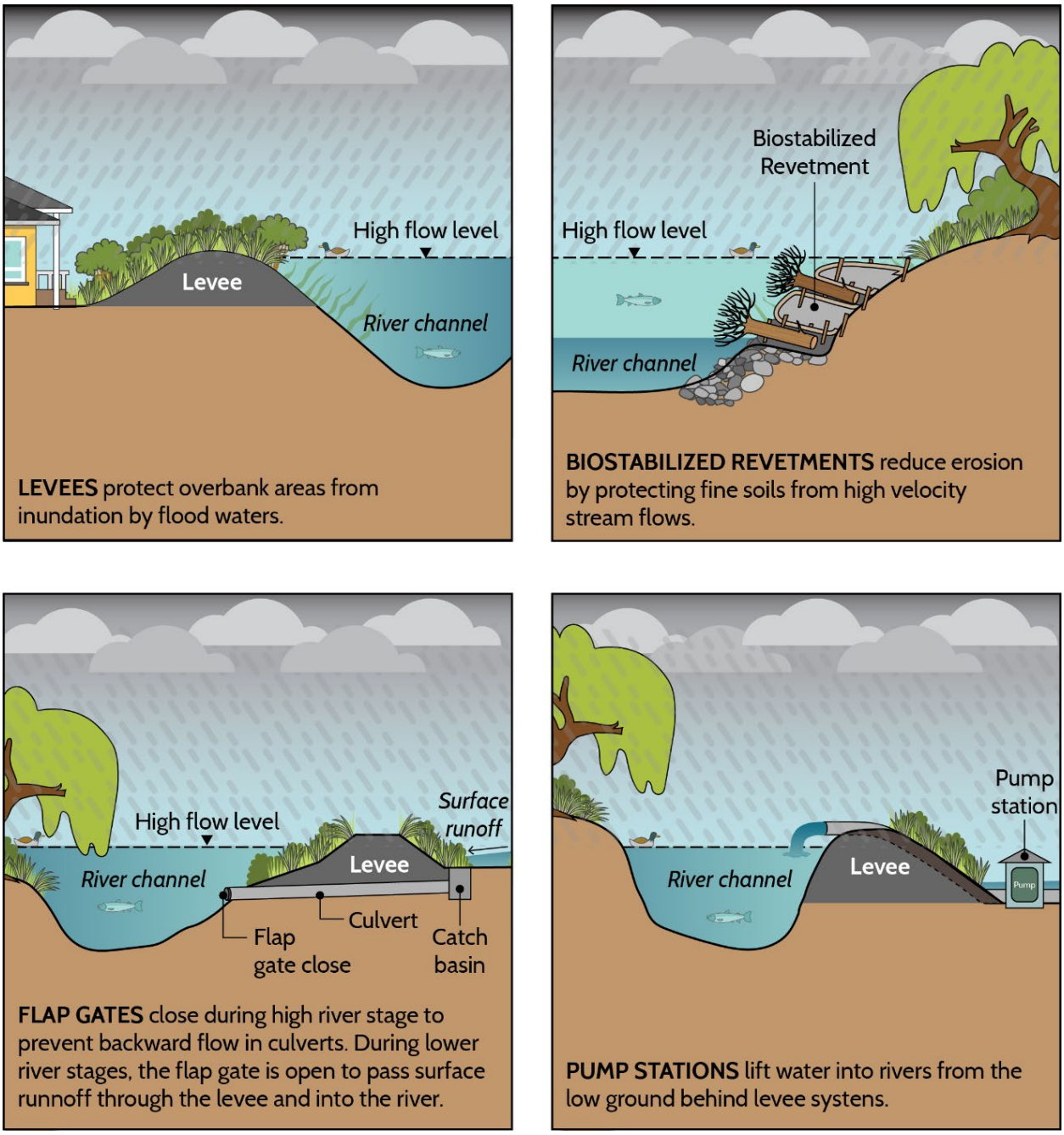


Figure 3-3
Examples of Structural Projects

Levees and Floodwalls

Levees are raised embankments built parallel to rivers to contain floodwaters. Floodwalls serve the same purpose but are constructed of steel sheet piles and/or reinforced concrete. These structures were traditionally built immediately adjacent to the channel's edge, maximizing the landward area protected and available for developed uses.

In many locations in King County, substantial residential, commercial, and industrial development is protected by containment levee systems and, to a lesser degree, floodwalls. Of regional significance are the levees along the lower Green River, which provide protection to a regional economic hub, and those along the lower Cedar River, which provide protection to structures in downtown Renton, including a Boeing manufacturing facility and airport. Other containment levees are along the South Fork Snoqualmie River in North Bend, the Tolt River near Carnation, the Raging River near Fall City, and the South Fork Skykomish River in Skykomish. Levees along the lower White River near Pacific, while not intended to provide containment, protect residents and a city park from flooding and channel migration.

Briscoe Levee construction on the Green River, September 2007

Levees are typically designed to achieve a certain level of protection, expressed either as a design containment flow rate in cfs or a return interval (e.g., protection from the 1 percent annual chance flood). The current level of protection provided by levees and floodwalls in King County varies by location, and structural flood protection will continue to be needed in places such as the lower Green and lower Cedar rivers, which calls for maintaining, repairing, and improving flood protection infrastructure.

In 2014, the FCD (FCD2014-09.1[39]) adopted a provisional level of protection goal for portions of the lower Green River of 18,800 cfs plus 3 feet of freeboard (equivalent to the 0.2 percent annual chance flood) for planned capital projects on the lower Green River. Levels of protection are also being considered elsewhere as the FCD develops Capital Investment Strategies for specific rivers. In considering the levels of protection provided by the County's levees, the goals and policies of this plan should be considered, including consideration of alternatives that enhance resilience to flooding while also supporting climate resilient, equitable, multi-benefit outcomes.

King County has partnered with the Corps' Public Law (PL 84-99) Levee Rehabilitation and Inspection Program to receive federal funding assistance to repair levees damaged during flood events. The program also includes inspections and other assistance to prepare for and respond to floods and flood-related natural disasters. A number of repairs were carried out under this program between 2008 and 2016 on the Green River, and several repairs are planned for 2024 and 2025. Approximately 23.8 miles of levees in King County are currently enrolled in the PL 84-99 Program (in the Snoqualmie and Green River basins).

In the past, one of the most significant challenges associated with the PL 84-99 program was the rigid requirement related to vegetation management on levees and conflicts this presented with ESA salmon recovery efforts promoting riparian vegetation. In 2014, the Corps issued new interim guidance for levee inspections and PL 84-99 levee eligibility. Vegetation inspection ratings no longer factor into PL 84-99 eligibility determinations unless the presence of vegetation impedes inspection of the levee, and vegetation no longer disqualifies a levee from participation in the program, the effects of which provide greater latitude for local decision-making around maintenance practices. Periodically revisiting whether to participate in this program is a prudent measure in light of various pros and cons that accompany participation.

Levees can be accredited by FEMA. Accreditation is based on certification studies that the levee meets design and construction standards (for at least the 1 percent annual chance flood) and provide adequate risk reduction for NFIP mapping purposes. Areas landward of accredited levees are mapped as being protected by levees, and in these cases, flood insurance is not mandatory. However, risk remains for these locations, especially from levee failure due to breaching or overtopping. Such an event can produce devastating economic impacts due to people being uninsured or underinsured. Approximately 1,270 acres of land is currently classified as "Zone X - Protected by Levee" within King County.

Revetments

Revetments are flood protection facilities that are designed to deter or resist bank erosion and lateral migration of a river channel and stabilize banks. Unlike levees, revetments are not designed to contain floodwaters, but rather to maintain the course of the river. Marine shoreline armoring, including seawalls, while not typically referred to as revetments, performs a similar function in that it is intended to resist erosion. Revetments and marine shoreline armoring may be built in locations that remain subject to flooding, or even in high bank areas where flooding is not an issue. Many of

[39] https://mkcclegisearch.kingcounty.gov/View.ashx?M=F&ID=3154469&GUID=E167E543-26C5-4A41-8C39-2AE1B1E712AF.

these types of features in King County protect roads, bridges, trails, parks, and other public infrastructure from being damaged or destroyed (such as the Dockton Road seawall on Vashon Island). Revetments also protect a substantial amount of private property and agricultural land from erosion and channel migration.

Revetment protecting Reinig Road on the Snoqualmie River, May 2023

Monitoring and Maintenance of Flood Protection Facilities

King County currently has an inventory of 511 flood protection facilities (levees, revetments, and a constructed channel, the Sammamish River), and the County, as a service provider to the FCD, updates information about the location and condition of facilities through regular inspections, post-flood damage assessments, development of capital investment strategies, capital project designs, modifications to facilities, and application of improved modeling and GIS location technology.

Many of King County's levees, revetments, and constructed channels were built in the mid-20th century, and some may no longer be needed. Land use changes and implementation of flood risk reduction activities are two reasons why an existing facility may not be needed today. In addition, some levees and revetments are relics from past management approaches and do not provide effective flood risk reduction consistent with the policies in the Flood Plan.

In locations where a levee or revetment has become obsolete, the removal of that structure may be useful to alleviate flooding risks upstream and downstream and to assist in restoration of river processes, natural floodplain functions, and, by extension, fish and wildlife habitat. Removal can be

done on all or just a portion of a levee or revetment, and the activity requires careful consideration of all implications of taking this action.

Pump Stations

Pump stations help drain local runoff landward of a levee into a river, and they prevent river flows from backing up into protected floodplain areas when the river stage is high. These flood protection facilities function as appurtenances to the levee system. Any levee modification or repair must address these structures as well. Currently, King County operates three larger pump stations on the lower Green River.

Culverts

Culverts convey flow, and while they are not typically considered a structural flood control measure, they influence flood conditions when they are undersized and unable to convey high flows. Many culverts constructed decades ago are seeing much higher flows than in the past due to increased impervious surfaces upstream as well as changing precipitation patterns. Backwatering behind undersized culverts causes localized flooding of roads and property. While culverts can limit the amount of flow, they can also cause channel erosion downstream of the culverts. Culverts that pass-through levees may have flap gates, which prevent the backflow of river water through culverts in the levee and into the protected area.

What King County heard

During the planning process, there was a strong demand for improved drainage of stormwater to reduce flooding in urban, suburban, and rural communities. Stormwater infrastructure is viewed as inadequate for current and future heavy rainfall events. Increasing the size of culverts, daylighting streams, and replacing culverts with fish-passable structures were widely supported as solutions to stormwater and tributary flooding.

Proper operation of these systems is frequently impaired when they are blocked by sediment or debris. Issues also exist with culverts that transfer water from the landward side of the levee to the river, many of which are constructed with corrugated metal pipe that is prone to rust-induced failure. Other culverts are constructed with jointed segments of reinforced concrete pipe, which can separate at the joints as riverbank slopes settle differentially, leading to failure. Culvert outfalls may also cause erosion if outfall protection is inadequate.

In addition to concerns with their function, flap gates are a significant barrier to juvenile fish passage into and out of tributaries that are an important habitat type for high-flow refuge and for rearing as the fish make their way from freshwater to saltwater.

Before (top) and after (bottom): Culvert replacement with fish-friendly box culvert on Ebright Creek under East Lake Sammamish Trail, 2022

Replacing outdated, undersized culverts with bridges or box culverts can aid conveyance and improve fish passage. In Washington state, a federal court injunction is requiring state governments to replace culverts that block or restrict fish passage. Restoration of fish passage is a high priority for King County. The county's Fish Passage Restoration Program has assessed all the county culverts that limit fish passage and developed a prioritized work plan to replace barriers and allow streams to flow more naturally under roads and trails. Many cities are also replacing culverts to improve fish passage and alleviate local drainage issues.

Instream Flow Deflection Structures

Instream structures constructed of a combination of large wood and rock elements embedded, anchored, tethered, or placed in a river or stream channel are used to modify hydraulic conditions to deflect flows and reduce bank scour or erosion. Their presence in the channel forces flow around them and, depending on their placement, can create areas of scour (pools) or deposition (bars) that provide habitat diversity. King County has constructed numerous structures of this type to deflect flow away from particularly sensitive locations where a larger floodplain reconnection project is not possible.

Dredging and Gravel Removal

Removing sediment from river and stream systems to provide conveyance capacity through activities like dredging and bar scalping was, at one time, a fairly common practice in flood risk reduction. However, several monitoring programs, projects, and studies have provided significant data-driven information about channel response to gravel removal (King County 2021, 2019). Additionally, permitting, monitoring, and mitigation requirements of the gravel removal sediment management activity have made the practice considerably less feasible than before. Gravel removal provides limited and temporary flood risk reduction, has highly challenging permit requirements, and is detrimental to aquatic ecosystems and salmonid habitat.

At some locations in King County—such as the lower Cedar River—periodic maintenance dredging will be needed for navigation purposes for the foreseeable future. The lower 1.75 miles of the Cedar River is a federal flood reduction project constructed under Section 205 of the Flood Control Act of 1948. The Operations and Maintenance Plan for the Cedar River project specifies periodic dredging of the river channel within the project reach to provide conveyance for the 1 percent chance annual flood event. Maintenance dredging, however, is not a practice to be employed broadly throughout the county due to its significant limitations in terms of effectiveness, permitting complexity, cost, and harm to the environment.

Sedimentation Basins

Sedimentation basins are artificial depressions dug into areas designed to collect sediment so that the material is not transported downstream. These systems can be constructed in streams or adjacent to them and, regardless of the location, require periodic maintenance to make room for continuing sedimentation. Off-channel sedimentation basins that allow maintenance under dry conditions mimic the function of an alluvial fan and, if maintained properly, are less damaging to aquatic ecology than in-stream basins. King County currently operates several sedimentation basins.

Floodplains also provide natural storage of entrained river sediment. Floodplain reconnection projects that allow greater access by a river to its floodplain also provide locations for sediment (and large wood) storage. This sediment may be re-mobilized during flood events, which is an important process to aquatic habitat renewal, including fish spawning gravel.

Stormwater Management Projects

Stormwater management projects are implemented throughout King County to address the limitations of legacy infrastructure and to improve the capability of existing systems to manage increasing amounts of surface water runoff. All cities have their own stormwater/surface water management programs that guide the activities they implement and that seek to reduce stormwater impacts. King County has three programs to address rural stormwater flooding and rural drainage in unincorporated King County:

- **The Neighborhood Drainage Assistance Program (NDAP)** was created to address localized flooding, erosion, and sedimentation problems situated within the off-road drainage system. The program provides technical assistance to property owners impacted by runoff resulting from the cumulative effects of development where flows exceed the capacity of the stormwater system or where system maintenance is lacking. The program funds small-scale capital improvements to address flooding, erosion, and sedimentation problems affecting private property in unincorporated King County, including removing pipe blockages, replacing old infrastructure with new pipes and culverts, increasing the capacity of privately owned stormwater facilities, and removing sediment on alluvial fans. Funding for this program is relatively limited and allows completion of approximately two projects per year.
- **The Agricultural Drainage Assistance Program (ADAP)** provides technical assistance for the maintenance of waterways that are used to remove excess water from farm fields to allow for cultivation of agricultural lands in unincorporated King County. Although most ADAP projects are conducted on private lands to improve private drainage infrastructure, the ADAP may take on projects that improve conditions on public property.
- **The Natural Drainage Flooding (NDF) Program** addresses chronic drainage and flooding problems associated with streams, lakes, and wetlands. NDF projects address chronic drainage and flooding problems and are typically initiated based on drainage complaints that have been assessed with feasibility studies or were identified because of the urgency and severity of the problem. Projects may include constructing new stormwater facilities, removing sediment, controlling vegetation, and other work to improve drainage or otherwise reduce flooding outside of the built environment. Other potential actions include the purchase of flood-prone property, replacement or installation of culverts, or altering stream channels to increase the effective routing of sediment and stormwater in flood-prone areas.

The ADAP program provides effective flood risk reduction services to agricultural operations. The current NDF program is a functional and effective service for rural flooding problems in the natural environment on public lands in unincorporated King County.

Given the changes to the unincorporated area, the changes in the type and scope of drainage complaints received by NDAP, and more stringent stormwater management requirements, NDAP could be refined to focus on projects that maximize benefit to the County's stormwater system.

Outside of the limited scope of ADAP on agricultural areas, King County does not currently have a program that deals with smaller-scale flooding issues on private lands in the natural environment. Examples include properties adjacent to tributary streams, on alluvial fans in agricultural areas, and on other sites with low-density land use. To address this gap and to improve habitat on privately held natural lands, King County could create a new program to specifically address these flooding issues while focusing on the delivery of multiple benefits.

Flood Storage Projects

The impacts of flooding can be reduced by temporarily storing water behind dams or in stormwater flow control facilities. In these cases, floodwaters can be stored and then released or pumped out slowly at a rate that a river or stream can accommodate without causing flooding or reducing the magnitude of flooding.

Flood control dams typically have large reservoirs that are intended to protect downstream property from flood problems. Flow control facilities, such as detention ponds and retention ponds, are built to mitigate the impacts of smaller scale stormwater runoff. King County operates and maintains many stormwater flow control facilities. These facilities require ongoing maintenance to ensure their performance.

Two large dams in King County have the primary purpose of flood risk reduction: the Howard Hanson Dam on the Green River and the Mud Mountain Dam on the White River, both of which are operated by the Corps. The Howard Hanson Dam also stores a drinking water supply to the City of Tacoma and conservation flows within the Green River to enhance habitat. The South Fork Tolt Dam on the South Fork of the Tolt River, and the Masonry Dam on the Cedar River (both operated by the City of Seattle), do not have flood risk reduction as their primary purpose, but they can reduce flood peaks in certain circumstances.

3.6 Public Information

Public information activities include outreach, education, technical assistance, and other means of advising property owners, renters, and community members about flood hazards, the resources available to prepare for flooding, and the actions individuals can take to improve their resilience to flooding. Pro-equity public information approaches also include engaging community members in the decisions that will affect them, their communities, and their families.

Flood Hazard and Flood Preparedness Education

King County provides outreach and education to increase awareness of flood risks, help communities prepare for flooding, and prevent, minimize, and recover from flood damage. King County also shares opportunities to provide input into programmatic and capital project decisions that may impact communities and individuals and provides points of contact for members of the public to obtain flood-related information in large river systems. King County translates many of the informational materials it produces into at least one and sometimes more languages (other than English) and provides interpretation services upon request for in-person activities.

What King County heard

Continuing (and expanding) existing public education efforts about flood risk reduction and flood resilience was the most popular strategy in community feedback, with uniformly positive responses. Community members shared ideas about desired types of information types, intended audiences, and ways to reach people. Suggestions included youth-based education, offering disaster preparedness drills, and sharing information about flood risks to people buying or renting properties. This indicates that a multi-pronged, proactive approach to outreach and education is needed. Multiple community members noted the importance of providing translated, culturally appropriate materials to populations that need them.

The way people access information has changed dramatically since the 2006 and 2013 flood plans, and King County is interested in working with partners to evolve its flood preparedness program and improve the provision of these services to communities throughout the county. For example, King County has prioritized offering materials in different languages and using accessible language and concepts, yet even with those advances to better serve all communities, there are additional opportunities for improvement.

A holistic program for public information with increased, regular outreach aimed at building resilient communities is one approach. This effort could include attendance at local community events to raise awareness about flooding and available resources, and it could help build trust in government. This type of program could also streamline ways to keep communities informed about activities across King County, and community partners can serve as ambassadors and educators of resilience actions. Lastly, this type of holistic, integrated program would benefit from the establishment of goals that can be monitored and adaptively managed.

Many of the following activities have been implemented for several years and are funded by the FCD.

Annual letter to repetitive loss areas and flood-prone property owners: The letter makes property owners aware of the flood hazards likely to affect their property; highlights programs, resources, and projects available to help them reduce flood-related risks; describes steps they can take to protect themselves and reduce flood damage; and provides contact numbers for more information.

King County website: Hosts extensive information about flood preparedness and local flooding conditions, including:

- River conditions and flood phase information.

- Flood warning and emergency response information.
- The King County Flood Alert subscription service, which sends automated messages via text, email, or phone when rivers reach flood phases.
- Flood safety and preparedness videos in 21 languages.
- Floodplain and channel migration zone mapping.
- Flood Photo Viewer, a map-based application with aerial photos from previous significant flood events that illustrate the severity of flooding in inundation areas.
- Home buyout program and home elevation program information.
- A flood mapping application to assist in determining whether properties are within a 1 percent annual chance floodplain, a channel migration zone, or other hazard area.
- Flooding information, such as the King County Flood Management Plan and the King County Repetitive Loss Area Analysis (King County adopted its current Repetitive Loss Area Analysis on September 6, 2022, by Motion 16199. See Appendix F for the most recent Annual Progress Report).
- Descriptions of large capital projects and studies, as well as monitoring reports that share information about project effectiveness.

In addition to the links identified in the adopted 2006 Flood Plan, the website links to King County's online mapping resource, iMap[40]. iMap is a mapping application maintained by the King County Information Technology Department that contains flood hazard information. Flood hazard map information is also accessible though the iMap website page.

Annual flood preparedness and flood response outreach: Each flood season, King County collaboratively refreshes messages to focus attention on preparation for flood hazards. The messages cover six priority topics: know your flood hazard, insure your property, protect people, protect property, build responsibly, and protect natural floodplain functions. Information on flood preparedness and response is shared before and during flood events through social media, the King County DNRP *Keeping King County Green* blog, the Office of Emergency Management's Trusted Partner Network, and articles in relevant partner newsletters. This educational campaign primarily focuses on generalized flood preparedness messages. County residents would benefit from a more diverse approach to address different types of communities, flood risk factors, and flooding types.

Flood preparedness brochures: Each year, King County assists the FCD in publishing and distributing a brochure with flood warning information. The brochure includes recommendations for flood insurance and personal preparedness, flood phases, important phone numbers, and websites. The brochures are mailed to approximately 29,000 households and businesses located within the floodplain. The brochure is translated and available in 23 different languages, and all are posted online and promoted through a news release as well as social media ads. To date, this brochure has focused on major river flooding.

40 www.kingcounty.gov/iMap.

Leveraging capital and programmatic communication: King County routinely communicates with community members to share information or gather comments about technical studies and capital projects, often via the county website or project-specific web-based engagement hubs. Often and as appropriate, education and information about flood hazards and flood insurance is included in communications to reach people in flood-prone areas. Communication methods include:

- Mailing postcards and letters to residential and commercial addresses.
- Outreach to develop topical or project-specific email or text notification lists.
- Holding virtual, hybrid, and in-person public meetings.
- In-person site visits.
- Project signage.
- Developing and maintaining project-specific, interactive web pages.
- Using targeted social media outreach.

King County has committed to communicating about changing and future flood conditions resulting from climate change in the context of individual projects.

A Program for Public Information (PPI) is a collaborative effort engaging a broad range of partners and floodplain managers to review local conditions and local public information needs and develop a strategic plan of activities. King County has not yet implemented a PPI but expects such a collaborative partnership could lead to very effective risk communication. As it is a creditable activity under CRS, a PPI consists of the following parts, which are incorporated into this Flood Plan:

- The types of local flood hazards (coastal, riverine, dam inundation, etc.).
- The property protection measures appropriate for the flood hazard.
- Flood safety measures appropriate for the local situation.
- The public information activities currently being implemented within the community, including those being carried out by nongovernment organizations.
- Specific measurable goals for the public information program.
- The outreach projects that will be done each year to reach the goals.
- The process that will be followed to monitor and evaluate the projects.

Map Information Services

General information about flooding and risk reduction resources can be helpful to many people, but oftentimes property owners and renters need more guidance to better understand the options available for their specific situation. King County provides one-on-one consultation to property owners and renters looking to better understand their unique flood risk and to explain flood hazard area regulations, permitting requirements, flood insurance, and other types of technical assistance.

CHAPTER 4
Comprehensive Risk Mitigation Strategy and Action Plan

4.1 Overview

Chapter 2 of this Flood Plan documents flood and flood-related hazards and risks throughout King County, and Chapter 3 summarizes the different types of mitigation strategies and activities that were considered during the development of this plan. This chapter presents a countywide **Comprehensive Risk Mitigation Strategy**, which includes activities to mitigate flood-related risks in King County and that will help move toward the goals and objectives outlined in this Flood Plan. From the Comprehensive Risk Mitigation Strategy, the subset of activities that will be led and implemented by King County are identified. This subset of activities comprises the 5-Year **King County Action Plan**.

Purpose of the Comprehensive Risk Mitigation Strategy

During the process to develop this Flood Plan, some partners stressed that the plan should include activities that would be led or implemented by entities other than King County. The reasons for this are primarily twofold: (1) To establish a shared understanding of the breadth of work that needs to occur to build flood resilience countywide; and (2) To document cross-jurisdictional flood risk reduction activities to promote coordinated implementation. The Comprehensive Risk Mitigation Strategy is intended to meet these needs in acknowledgment of flooding being a cross-jurisdictional problem that benefits from cross-jurisdictional solutions.

It is King County's hope that other entities share the vision this plan articulates for building flood resilience. The plan is intended to be a resource for other jurisdictions by providing a framework to facilitate collaboration and cooperation among partners. At the same time, the plan's commitments do not extend beyond King County, and the County's commitments are clearly distinguished through the King County Action Plan (described below and outlined in Section 4.5).

Developing the Comprehensive Risk Mitigation Strategy

The activities listed in the Comprehensive Risk Mitigation Strategy were either submitted voluntarily by the lead agency, identified through partner feedback during the Flood Plan process, or obtained using publicly available information. The Comprehensive Risk Mitigation Strategy is responsive to the types of desired actions shared with King County during community engagement, as described in Appendix C, as well as those shared by the Partner Planning Committee during a workshop focused on potential flood risk reduction activities.

King County evaluated each activity in the Comprehensive Risk Mitigation Strategy using criteria established in coordination with the Partner Planning Committee. Evaluation of activities was a qualitative process and did not require projects to meet a specific rating. However, all activities included must meet at least one goal of the Flood Plan (as identified in Chapter 1) and must not inherently conflict with King County's legal obligations.

The evaluation criteria included:

- **Flood Plan Goals** – The activity supports at least one of the Flood Plan goals from Chapter 1.
- **Legal Obligations** – The activity does not conflict with legal obligations of King County, including requirements under the Endangered Species Act (ESA), the Clean Water Act, and the National Flood Insurance Program (NFIP).
- **Policy Priorities** – The activity supports policy priorities from King County's strategic plans and other major initiatives related to climate, clean water, conservation, equity, and other topics.
- **Technical (Merit)** – The activity offers clear flood risk reduction benefits, is an effective approach to dealing with the identified problem, avoids negative community impacts, and supports resilience to climate change.
- **Technical (Durability of Benefit)** – The activity tends toward an approach that requires minimal maintenance needs over time.
- **Multiple Benefits** – The activity provides opportunity to realize one or more benefits in addition to flood risk reduction, such as habitat protection or restoration, productive agriculture, sustainable development, jobs and economic development, clean water, open space conservation, or recreation.
- **Financial** – The activity has funding secured, a funding strategy, or identification of additional funding that is still needed.
- **Timeline** – The activity can be completed, advanced, or initiated within 5 years.

The Comprehensive Risk Mitigation Strategy is divided into two parts: **programmatic activities** and **capital project activities**. Programmatic activities, in large measure, align with the flood risk reduction categories of prevention, property protection, emergency services, and public information. Capital project activities often involve projects focused on structural flood risk reduction or natural resource protection. The programmatic section of the Comprehensive Risk Mitigation Strategy is organized by activity type (which demonstrates how flood hazards are managed at a jurisdictional scale), while capital projects are organized by watershed (which demonstrates how flood hazards are managed at site scales or across specific landscapes).

King County Action Plan

An important component of the Comprehensive Risk Mitigation Strategy is the set of specific activities in the King County Action Plan. As detailed in Section 4.5, the Action Plan focuses exclusively on projects and activities King County is committed to advancing or implementing within the duration of the Flood Plan. These projects and activities are led by a King County department and will be funded either through King County resources, grant resources, partnerships with other governmental and non-governmental entities, or a combination of these. Collaborative

partnerships – with the FCD, WRIAs, tribes, cities, and others – are crucial for realizing the Action Plan's objectives. Some activities in the Action Plan have been historically funded by the FCD, and the Action Plan shows the FCD as a potential future funding source for these activities.

King County's Action Plan is consistent with Step 8 of FEMA's CRS planning framework. While the Action Plan is nested within the Comprehensive Risk Mitigation Strategy, it is also reflected in this chapter as a stand-alone section.

4.2 Focus Areas of the Comprehensive Risk Mitigation Strategy

The 2024 King County Flood Plan includes flood hazard topics that were not included in past flood plans and expands upon established topics that have become increasingly more relevant. The expanded scope includes climate change resilience, flood hazard solutions that provide multiple benefits, equity and social justice, and flooding from all sources. These themes were a focus throughout the development of the Flood Plan, with input from King County staff, members of the public, and government partners informing how these themes are incorporated into the plan and addressed through flood risk reduction activities.

Sources of Flooding

For capital project recommendations, past King County Flood Plans primarily focused on riverine flood hazards and major tributaries. However, flooding occurs in many other environments. Changes in development and climate since the 2006 Flood Plan have influenced flooding characteristics, which requires interventions in areas that have not historically been the focus of King County's flood hazard management efforts. The 2024 Flood Plan aims to address all predominant forms of flooding throughout the county. To effectively address all forms of flooding, King County solicited input from a wide range of audiences on various types of flood risks. This is shared throughout this Flood Plan and in Appendix C. The following sections outline how the different flooding types are represented in the Comprehensive Risk Mitigation Strategy.

Riverine Flooding

Riverine flooding continues to be a strong focus of King County's flood risk reduction program. Community and partner engagement included many discussions of riverine flood risks, many of which King County and partners have been working to address through ongoing efforts. While many riverine flood risks are rather well understood, climate change is causing risks to evolve, and much more work remains to deliver multiple benefits that improve the resilience of county communities and ecosystems. This Flood Plan continues the focus on many different types of programmatic efforts and capital projects to address riverine flood risk.

Activities that address riverine flooding are identified in the Comprehensive Risk Mitigation Strategy with the icon shown at the left.

Coastal Flooding

Previous King County flood plans had limited consideration of coastal flood risks and risk reduction activities. The 2024 Flood Plan set out with the intention of addressing coastal flooding and obtained external input to identify needs and opportunities for reducing coastal flood risks. In discussing mitigation options for at-risk coastal properties, partners revealed many challenges, and based on the input provided, King County intends to further assess coastal flooding and the impacts of climate change on coastal landscapes to determine services to provide related to emergency response, property protection, capital projects, and regulations. In particular, King County will look to other states and coastal communities to assess coastal flood resilience efforts and consider how successful interventions used elsewhere might work locally.

Activities that address coastal flooding are identified in the Comprehensive Risk Mitigation Strategy with the icon shown at the left.

Tributary Flooding

King County will prioritize preventive, natural resources protection, structural, and public information activities to reduce flood risks associated with tributaries. King County will increase monitoring and mapping efforts to better understand hazards related to sediment accumulation, including identification and mapping of alluvial fan hazard areas. The County will also undertake many conveyance capacity projects in areas with known conveyance issues to remove restrictive culverts that result in sediment and debris accumulation, excessive erosion, back-up during high streamflow events, and prevent fish passage. For more site-specific tributary flood risk reduction, King County will also provide technical assistance programs for addressing flooding on private property and agricultural lands as well as continuing to provide resources and assistance related to beavers.

Activities that address tributary flooding are identified in the Comprehensive Risk Mitigation Strategy with the icon shown at the left.

Urban Flooding

King County will use input on urban flooding to inform its Stormwater Services programs, including system maintenance, stormwater education, property owner support, emergency response, and capital programs. Recognizing the lack of data on urban flood risks due to stormwater runoff, the County will undertake efforts to better define these data gaps and identify efforts that can help to bridge these gaps and better inform stormwater management efforts.

The Flood Plan emphasizes a watershed-scale approach to flood hazard management. Protection and restoration of upland areas and wetlands will be a high priority to mitigate runoff and reduce flooding downstream. King County lacks jurisdiction in many urban areas within the county that experience stormwater flooding, but the County has a history of mutually beneficial collaborations with other jurisdictions in flood risk reduction efforts and will look to build on these in the future.

Activities that address urban flooding are identified in the Comprehensive Risk Mitigation Strategy with the icon shown at the left.

Key Themes of the Flood Plan

King County developed the 2024 Flood Plan with key themes of equity and social justice, climate change, and multi-benefit flood risk reduction at the forefront. These themes guided the development of a Flood Plan that, when implemented, will provide long-term benefits that support diverse interests and communities. The following subsections summarize how these themes informed the development of the Comprehensive Risk Mitigation Strategy.

Climate Change

The planning process considered the ways climate change could influence flood and erosion risk, including increased risk arising from extreme precipitation events, changing snowfall patterns, and sea level rise. Incorporating climate change considerations into the Flood Plan will help build a stronger understanding of potential future risks and increase resilience to future flooding and other hazards.

Climate change resilience was a major factor in considering activities to include and prioritize in the Comprehensive Risk Mitigation Strategy. King County's actions across all fields of work are guided by the County's Strategic Climate Action Plan, including planning, design, and programmatic efforts related to flood risk reduction. King County will implement a significant number of projects to improve the capacity of culverts to accommodate increased precipitation volumes due to climate change, which are already overwhelming existing stormwater infrastructure.

Modeling efforts to better understand localized climate impacts will also be a key body of work performed by the County, with a major coastal vulnerability assessment planned for Vashon-Maury Island. An adaptive management approach will be used to implement the Flood Plan, which will accommodate changes in flood risk reduction activities that may be necessitated by new climate change information or impacts. This approach will support a responsive climate resilience effort from the County.

Equity and Social Justice

The impacts of flooding often fall heaviest on historically underserved populations, who are more vulnerable to these impacts. A key consideration in the development of the Flood Plan was the identification of inequities in flood impacts and the means of reducing the burden on communities that have faced historic injustices.

Equity and social justice were key considerations in the evaluation and final selection of activities in the Comprehensive Risk Mitigation Strategy. Work performed by King County is guided by the policies and strategies outlined in its Equity and Social Justice Strategic Plan, with the prioritization of flood risk reduction activities informed by how they may support those policies, among other county initiatives.

In addition to equity and social justice being a key consideration throughout various flood risk reduction activities, King County is advancing efforts in all areas, with an emphasis on public information, technical assistance, and emergency services to address inequities. These efforts include working directly with communities most vulnerable to future flood risks and those that have faced

harm in the past to raise awareness of flooding and improve understanding of the risks faced by vulnerable communities. King County also intends to explore how it can increase its work with community organizations to co-create and implement informational campaigns that will build community capacity to increase flood resilience and will identify ways to track and measure progress in this effort.

Multiple Benefits

The provision of multiple benefits by flood risk reduction activities was a key evaluation criterion when reviewing activities for the Comprehensive Risk Mitigation Strategy. Many of the additional benefits provided by flood risk reduction activities—especially benefits that can be provided by capital projects—are priorities for other King County initiatives related to habitat, agriculture, open space, climate change, and equity.

Floodplain reconnection or other natural resource protection and restoration activities, conveyance improvement projects, and several programmatic activities account for many King County activities that will address flood risk and provide other benefits. Through these and similar projects led by other partners in the Comprehensive Risk Mitigation Strategy, the Flood Plan aims to support the identification of opportunities for collaboration on mutually beneficial activities that could increase the potential for multi-benefit flood risk reduction projects.

4.3 High-Priority Activities

This Flood Plan does not include a comprehensive prioritization of activities in the Comprehensive Risk Mitigation Strategy because the strategy includes a range of activities that various entities in the county may undertake based on their own internal priorities. King County's own priorities are reflected in the King County Action Plan in this chapter. However, based on input received from partners and from the public throughout the planning process, the following activities and types of activities have been identified as being high priority to address flood hazards in the county:

- Implementing the FCD's Capital Improvement Plan and Capital Investment Strategies, which reflect a range of capital projects that address flood hazards throughout the county, including in priority areas identified by partners and community members, such as the Snoqualmie Valley Agricultural Production District and Lake Sammamish.
- Implementing the multi-benefit framework described in Chapter 5 of this Flood Plan to ensure that capital projects moving forward are designed collaboratively and with a range of benefits beyond flood hazard reduction in mind and strategically implemented in coordinated fashion.
- Identifying and implementing activities to reduce coastal flooding risks throughout the county.
- Implementing equity-focused actions, such as the Equity Performance Measures and Monitoring programmatic action included in the King County Action Plan and continuing to incorporate equity into implementation of all activities.
- Implementing an enhanced program of public information around flooding issues, including increased outreach to historically underserved communities.

- Increasing emergency response coordination between jurisdictions and departments and taking action to empower community groups to support flood response and recovery activities.
- Implementing climate resilient activities to reduce the risk of flood and erosion damage to roads and other critical transportation infrastructure and maintain ingress and egress during times of flooding.
- Protecting undeveloped floodplain areas and preventing new development that interferes with natural floodplain function and puts people and structures in harm's way.
- Developing and implementing actions to reduce risks and damages from king tide- and sea level rise-related flooding in tidally influenced areas of the Duwamish River, including the South Park neighborhood.
- Implementing activities identified in King County's Repetitive Loss Area Analysis to mitigate repetitive loss properties.

4.4 Comprehensive Risk Mitigation Strategy–Programmatic Recommendations

The programmatic recommendations of the Comprehensive Risk Mitigation Strategy reflect the wide array of services, planning efforts, regulations, and day-to-day operations of the many governments and organizations involved in flood risk reduction in King County. Programmatic recommendations are organized by activity type because these categories often serve different goals and functions of flood risk reduction. As such, the organization of this section provides a cohesive narrative that outlines the types of flood risks identified in the planning process and how those risks are being addressed. The activity categories include preventive, property protection, natural resources, emergency services, programs supporting structural activities, and public information, all of which are divided into subcategories.

Key for the Icons Used in the Comprehensive Risk Mitigation Strategy and the Action Plan

Flooding Type	Icon	Timeline	Icon
River		Ongoing	
Tributary		1–5 years	
Coastal		5–10 years	
Urban		>10 years	

Preventive Actions

What King County heard	How this informs King County's approach in the 2024 Flood Plan
Community members and partners described preventive activities as important measures for adapting to the changing landscape and climate and how these factors affect flooding. Community input, especially among immigrant farmers and historically underserved groups, indicated that incentives or technical support to develop in low-risk areas were extremely important preventive actions. There was also widespread support for the adoption and enforcement of stricter regulations to limit development to reduce the risk of future flooding. Input also pointed to the potential for mapping and modeling to identify how these changes affect flooding, especially regarding coastal, urban, and tributary flooding. Mapping and modeling that account for changing conditions and identify floodplains in previously unmapped flood hazard areas were discussed as useful tools for developing land use regulations that address these types of flooding. Suggestions to address stormwater runoff that floods tributaries and urban areas garnered many suggestions for mitigation, including retrofits, green stormwater infrastructure (GSI), stricter land use regulations, and open space and wetland protection.	King County will continue to study flood hazards to ensure that its flood risk reduction strategies are informed by the most current conditions and best available science for future projections. These studies serve as the geographic basis of existing floodplain development regulations and may inform potential future regulations, such as regulating land use in alluvial hazard areas or projected future flood hazard areas. King County will collaborate with other jurisdictions and partners to identify hazards that could be addressed with improved upper watershed storage or infiltration, increased conveyance capacity, or stricter land use regulation in hazard areas. King County will work to incorporate multiple benefits into these activities, such as habitat protection or enhancement, recreational access, protected open space, agricultural production, and safe transportation. Activities under Preventive Actions are presented for Flood Hazard Mapping, Land Use and Regulations, Monitoring and Maintenance, Open Space Conservation, and Stormwater Management.

Flood Hazard Mapping, Assessments, and Planning

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Landslide Hazard Mapping — Expand understanding of landslide risk areas through updating maps as information changes and tracking recent landslide events and use this information to inform the development of appropriate mitigation solutions where coastal, tributary and riverine flood hazards and landslide hazards intersect.		King County	
Continue to **develop, revise, and update flood and channel migration hazard area mapping** as needed and to reflect changing conditions, including incorporating updated information about the potential effects of climate change on flooding conditions. [The status of floodplain and channel migration mapping efforts is provided in Appendix H.		King County FCD	
Topographic and Ortho Imagery Data Collection — Routine repeated data collection of high-resolution blue-green Light Detection and Ranging (LiDAR) and orthographic aerial photography for use in hazard mapping, monitoring, and capital project planning.		King County FCD	
Levee Breach Analysis — Conduct mapping and risk assessment of five levee containment systems in King County (the lower Raging, lower Tolt, South Fork Snoqualmie, South Fork Skykomish, and Cedar rivers) to evaluate vulnerability to breaching, evaluate potential impacts, and make recommendations for structural and emergency actions.		King County FCD	
Repetitive Loss Area Analysis and Mitigation Actions – Continue repetitive loss area planning and risk reduction work to address the county's unmitigated repetitive loss properties and buildings located in repetitive loss areas.		King County	
Vashon-Maury Island Coastal Hazard Vulnerability Assessment and Response Plan – Conduct a detailed assessment of the Vashon-Maury Island shoreline, including public and private infrastructure and natural systems, to better understand the locations that may face a higher risk from coastal flooding and sea level rise. Results from the study will inform long-range planning and the development of additional actions, policies, development regulations, or zoning code changes to address risks.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Analyze and map alluvial fan hazard areas.		King County	
Coastal Flooding Best Practices — Evaluate best practices from other states for coastal flood mitigation and identify options that could be applied locally.		King County	
Comprehensive Residential Mitigation Feasibility Study — Update and improve the County's Repetitive Loss Area Analysis by conducting a flood vulnerability study of all flood-prone structures in unincorporated King County and recommend mitigation actions.		King County	
Augment Hazus Analysis – Examine the loss estimates behind levees associated with possible flooding due to levee overtopping or failure. This analysis will build on the Hazus inventory created for this Flood Plan identifying buildings and critical facilities and infrastructure.		King County	
Snoqualmie Valley Major Flood Mitigation Study — Determine which major roadway(s) that cross the Snoqualmie Valley would be the most cost-effective to improve in the valley with chronic flood issues that have the potential to impact more than 25,000 daily drivers. Roadways to be studied include NE 124th Street, NE Woodinville-Duvall Road, Tolt Hill Road, and NE Carnation Farm Road.		King County FCD	
Lower Green River Corridor Plan and EIS — Provide planning services and technical support related to the environmental impact statement and flood hazard management plan.		King County FCD	
Lower Snoqualmie Valley Compensatory Storage Study — Conduct a study to identify compensatory storage capacity within a limited valley to guide decisions around development, including agricultural flood refuge, residential structures, maintenance of transportation corridors, etc.		King County FCD	
East Fork and Mainstem Issaquah Creek Stream Evaluation — Conduct a study to evaluate options for addressing stream flooding and bank erosion due to downed trees and channel migration.		City of Issaquah	
Kimball Creek Riparian Improvement Study — Identify opportunities for ecological health improvements to Kimball Creek riparian areas. Evaluate existence of unnecessary levees or revetments, non-native weed infestations, and possible stormwater improvements.		City of Snoqualmie	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Use projections of changes in future river flows **to study potential changes in river or basin-scale risks from climate change** in order to inform appropriate risk reduction and resilience actions.		King County	
Duwamish Valley Water Resilience Planning – Develop a holistic sea level rise mitigation strategy that addresses multiple benefits, including protection, open space, and maritime industrial uses.		City of Seattle	
Flood and Erosion Risk of multi-benefit actions in the upper Snoqualmie River — Conduct a flood and erosion risk analysis that includes proposed climate change and river resiliency actions.		Snoqualmie Tribe	 (or undetermined)
Upper Snoqualmie Confluence Assessment — Conduct assessment of river and floodplain crossings within the confluence reach to evaluate their impact on river and floodplain processes. This assessment should include two bridges over the Middle Fork & North Fork Snoqualmie River as well as any floodplain overflow channels and wetlands. A potential outcome of the assessment could be proposing to improve the existing bridges. Develop alternatives for restoration and preferred restoration alternative (if any).		Snoqualmie Tribe	 (or undetermined)
Develop Snoqualmie Valley Integrated Resilient Watershed Plan —Develop a watershed-based plan for the Snoqualmie Valley that looks at the unique values and issues in the basin, including a risk assessment, structural and non-structural protection alternatives, beaver management, management of headwaters and forestlands, riparian and shoreline management, compensatory storage, water availability, climate impacts, sediment and erosion, and emergency preparedness. Identify priorities and establish an implementation funding strategy.		Snoqualmie Fish, Farm, Flood	 (or undetermined)
Analysis of Farmland Erosion in the Snoqualmie Valley — Improve understanding of the extent of farmland erosion and the existence of revetments, regardless of ownership, and evaluate and prioritize options to address farmland erosion while considering tradeoffs among farm, fish, and flood objectives.		Snoqualmie Fish, Farm, Flood	 (or undetermined)

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Snoqualmie Valley Flood Risk Reduction Feasibility Study — The feasibility study is intended to help understand the effectiveness of different options for reducing the peak of fall and spring flooding and how likely it is that the options could be implemented.		Snoqualmie Valley Preservation Alliance Snoqualmie Valley Watershed Improvement District	 (or undetermined)
Boise Creek Habitat, Water Quality, and Flooding Improvements – Increasingly frequent flooding events along Boise Creek cause flooding in the City of Enumclaw, flush bacteria and nutrients into streams, and generate inflows to the sanitary sewer system, contributing to treatment plant bypasses. Collaborative efforts will help determine the actions and land use changes that are needed to holistically improve habitat, water quality, and flooding conditions in the area.		City of Enumclaw	 (or undetermined)
Boise Creek Channel Monitoring – Conduct regular surveys of the bed depth along Boise Creek from north of 252nd Avenue to the east Enumclaw city limits, in particular after large flood events, to understand if changing bed conditions pose risks to properties in the basin. Data will also inform potential flood mitigation projects.		City of Enumclaw	 (or undetermined)
Weyerhaeuser Mill Pond Flood Mitigation Benefits Evaluation – Conduct a study to evaluate the potential of a historic mill pond, which Boise Creek flows through, to provide downstream flood risk reduction.		City of Enumclaw	 (or undetermined)
Pluvial Flood Modeling — Identify modeling needs and priorities to better understand risks associated with pluvial flooding.		Identified during public process	 (or undetermined)
Urban Flooding Climate Change Models — Develop models to show the increased frequency of flash flooding and sheet flow in urban areas resulting from climate change.		Identified during public process	 (or undetermined)

Land Use and Regulations

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Collaborate with jurisdictions to identify differences in municipal flood hazard area regulations within King County, identify implications for achieving plan outcomes, and provide technical assistance to jurisdictions within King County to support strengthening local regulations where they are deemed beneficial.		King County	
Develop alluvial fan hazard regulations.		King County	
Update King County's Flood Hazard Code to ensure continued protection of life and safety, FEMA compliance, continued exceedance of NFIP minimum standards, and CRS program participation while also recognizing the value of flood hazard areas as critical habitat for ESA-listed species and allowing for efficient and effective restoration of natural floodplain functions and culvert replacement to restore fish passage.		King County	
Evaluate opportunities for code updates for flood resilience upgrades to structures that do not conflict with the County's NFIP standing.		King County	
Provide Accessible Customer Support Information — King County's exemplary floodplain regulations are complex, and permitting delays or errors can be caused by customers not understanding the purpose behind the code or permit and submittal requirements.		King County	

Monitoring and Maintenance

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Channel Monitoring and Sediment Management Program — Continue to conduct channel monitoring using survey and blue-green LiDAR data of the Middle and South Forks Snoqualmie, lower Snoqualmie, Raging, Tolt, White, and Cedar river channels as part of King County's Sediment Management Program.		King County FCD	
Implement River Site Management Program (SMP) – Continue to conduct routine maintenance including mowing, vegetation management, and deficiency maintenance for river facilities and sites. Develop and update site management plans as needed.		King County FCD	
River Facility Inspection Program — Conduct annual inspections of levees and revetments to identify maintenance or repair needs to address potential levee failure risk.		King County FCD	
Effectiveness Monitoring — Monitor projects and land management activities to evaluate performance, meet permit requirements, and provide information for the design and construction of future capital projects and long-term land management operations. Monitoring varies by project and may include assessment of project structures, flood performance, plantings, channel morphology, and fish and wildlife habitats.		King County FCD, King County	
Equity Performance Measures and Monitoring — Develop performance measures for floodplain management equity outcomes and incorporate them into King County monitoring activities.		King County	
Update *Sammamish River Flood Control Project Operations and Maintenance Manual* — Work in coordination with the U.S. Army Corps of Engineers to update agreement for maintaining the Sammamish River Flood Control Project.		King County FCD	

Open Space Conservation

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Protect headwaters of tributary streams that may be sensitive to climate change to alleviate flashy flows and mitigate downstream flood risk.		King County	
Land Conservation Acquisitions — Acquire open space for conservation and protection, and secure footprints necessary for floodplain and tributary restoration projects and stormwater retrofit projects.		King County	

Stormwater Management and Maintenance

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Pursue opportunities to support **stormwater retrofit projects** as part of scoping and designing flood risk reduction projects in unincorporated King County.		King County	
Drainage Enforcement Program — Enforce the requirements of the *King County Surface Water Design Manual*, including the attenuation of runoff from developed surfaces that would otherwise increase flood flows.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Road Drainage System Preventive Maintenance — Perform annual catch-basin inspection and cleaning to ensure drainage systems remain unclogged and functional. This activity also includes cleaning drainage ditches, mowing, and litter and debris removal.		King County	
Neighborhood Drainage Assistance Program (NDAP) — Resolve stormwater-related flooding, erosion, and sedimentation problems in unincorporated King County by designing, building, or repairing drainage systems or providing technical assistance, with a focus on projects that maximize benefit to the County's stormwater system.		King County	
Road Drainage System Reactive Maintenance — Resolve stream, ditch, or drainage system clogs within the road right-of-way without increasing fill in the floodplain or causing a rise in base flood elevations.		King County	
Road Drainage Preservation Program — This program identifies, prioritizes, and improves roadway drainage infrastructure related to surface water, groundwater, and stormwater runoff. Improvements aim to reduce flooding and mitigate property damage.		King County	
Pursue opportunities to implement stormwater retrofits that go beyond stormwater code compliance requirements through incentives programs such as the RainCity GSI Beyond Code partnership program.		Seattle Public Utilities	
Seattle Public Utilities Spot Drainage Program — Resolve small flooding problems of high priority for private property flooding or flooding in the public right-of-way.		Seattle Public Utilities	

Property Protection Actions

What King County heard	How this informs King County's approach in the 2024 Flood Plan
The types of properties at risk of flooding and their vulnerability to floods vary greatly throughout King County, resulting in a diverse range of both suggested approaches for reducing risks to properties and opinions on those approaches. Despite that variety, there was uniformly strong support to provide technical assistance to property owners in at-risk areas to transition to land uses that better accommodate flooding, as well as to support those who repeatedly experience flooding. Elevating, floodproofing, and otherwise retrofitting properties were generally popular approaches to property protection and often discussed when input was sought from community members and partners. Advocates for these approaches noted permitting as a challenge for adapting properties in the floodplain, as well as regulatory changes that are needed to support certain approaches. Some community members and partners prefer acquisition and, less frequently, managed retreat for at-risk properties, with these strategies eliminating risk, not just reducing risk. Concerns expressed included widespread acquisition of lower value properties, which can lead to displacement of populations that may be challenged to find safe, affordable housing elsewhere. This led to discussions of creative financial assistance solutions for low-income populations to help them adapt their properties or support relocation as potential remedies for disproportionate impacts.	King County has a long history of adapting and acquiring at-risk properties. The number of at-risk properties will increase as climate change worsens flooding, which necessitates King County to work with a wider array of strategies for reducing or eliminating risk. This may include new types of retrofits, financial support or incentives that minimize upfront cost burdens, and efforts to increase flood insurance adoption. Approaching property protection with equity in mind will be a key element of these activities to support populations with limited capacity to adapt. Activities under Property Protection actions are presented for Structural Elevations, Acquisitions, Relocations, and Insurance.

Structural Elevations

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Continue King County's home elevation program to support the elevation of structures in flood hazard areas.		King County FCD	
Expand King County's Home Elevation Program — Explore partnership opportunities to **expand the home elevation program** to all flood hazard areas where conditions are favorable for elevations, **provide technical assistance** to property owners to understand feasibility and funding options for home elevation, and **advertise King County's home elevation program** to all flood hazard areas where conditions are favorable for elevations.		King County	
Water-Dependent Recreation Structures Technical Assistance — Coordinate with NOAA Fisheries and the Washington Department of Fish and Wildlife (WDFW) on a technical assistance program to help mitigate risk to water-dependent infrastructure on public and private property. This is primarily an issue on Lake Sammamish, where lake level fluctuation is more than double that of Lake Washington.		King County FCD	
Farm Safety Strategy — Develop a farm safety strategy that focuses on a range of alternatives to placing fill in the valley, including, but not limited to, elevated platforms and shared farm pads; constructing farm pads out of large culverts so that water can still pass through them; and removing fill (e.g., Snoqualmie Valley Trail) to provide more capacity for farm pads, offsite storage outside floodplain, floating structures, etc.		Snoqualmie Fish, Farm, Flood	 (or undetermined)
Elevating Infrastructure in the Agricultural Production District (APD) — Explore opportunities to elevate farm infrastructure in constrained reaches of the Snoqualmie Valley. The original program was created in 2011 to help farmers elevate infrastructure, such as barns, or to design and construct other non-fill solutions, such as elevated platforms. According to the Lower Valley Needs Assessment, there are 118 barns in the APD inside the 1 percent annual chance floodplain. Opportunities could be informed by the Lower Snoqualmie Compensatory Storage Study.		Snoqualmie Valley Watershed Improvement District Snoqualmie Valley Preservation Alliance	 (or undetermined)

Acquisitions

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Ensure that management and stewardship of lands acquired for flood mitigation or multi-benefit purposes aligns with King County guidance related to encampment procedures and protocols.		King County	
Develop a pre-acquisition process for evaluating factors such as the equity implications and cultural interests affected by a potential acquisition, and the effects to neighborhoods and communities of converting private property to public open space. Incorporate geospatial decision support tool to be developed as part of recommendation under structural projects for advancing multi-benefit projects.		King County	
Evaluate whether stormwater retrofits or other resilience improvements could provide effective flood risk reduction in lieu of acquisition in areas that are not ecologically significant or not connected to a capital project need.		King County	
Countywide Strategic Acquisitions — Acquire properties to reduce flood risk and support integrated floodplain management principles, including properties that are not associated with an adopted Capital Investment Strategy or any other existing capital projects.		King County FCD	 (or undetermined)

Relocations

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Relocation Planning — Identify high-risk properties or neighborhoods where managed retreat may be preferred or necessary, including retreat from severe channel migration zones and coastal, landslide, and alluvial fan hazard areas.		King County	

Insurance

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Encourage the purchase of flood insurance and collaboratively work with partners to design a social marketing campaign or other similar effort with a goal of increasing flood insurance policies held in King County.		King County	

Natural Resource Protection Actions

What King County heard	How this informs King County's approach in the 2024 Flood Plan
Various natural resource protection actions are generally a popular approach to flood risk reduction, especially due to their ability to provide benefits that support complementary objectives, such as fish habitat, recreation, and open space access. Over 75 percent of online survey respondents supported protecting upper watershed areas and preserving wetlands to slow the flow of water downstream. Forty-one percent supported working with communities and businesses in floodplains to protect and restore the environment and find ways to incorporate natural elements into projects in the most developed areas. Community members and partners often suggested nature-based solutions for mitigating erosion, reducing stormwater runoff, increasing floodwater storage, recharging groundwater and aquifers, and reducing overall impacts on built environments. Frequently suggested approaches include open space protection, Green Stormwater Infrastructure, and floodplain reconnection, including via levee setback. Some community members expressed the perspective that natural resource protection actions are in conflict with existing land uses, such as agriculture- and water-dependent commerce. Most often in these cases, the solution was for King County to work with potentially affected property owners on agreeable strategies to support existing land uses in the floodplain.	King County recognizes that one of the best means of reducing flood risk is preserving existing ecological processes and protecting floodplains, which reduce the creation of new flood risks. Community support for natural resource protection is reflected in King County's history of voter-approved measures to fund land conservation, which have greatly enhanced King County's ability to protect critical areas, such as floodplains and river corridors. In addition to natural resource protection, King County is prioritizing capital projects with multiple benefits, such as many of the projects detailed under Structural Projects. These priorities reflect the extensive input King County heard about serving the different needs in the floodplain. The focus on integrated floodplain management during the planning process also informed the County's proposed activities in outreach and technical assistance for farmers in the floodplain, which will support multi-beneficial solutions to floodplain management. Activities under Natural Resource Protection actions are presented for Large Wood in Rivers & Streams and Habitation Protection & Restoration.

Large Wood in Rivers and Streams

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Through coordination among King County DNRP, the King County Sheriff's Office, and other agencies as necessary, **review and update King County's procedures related to naturally occurring large wood in rivers and streams**, consistent with the policies and other recommendations outlined in this Flood Plan, including the recognition that wood is an integral element of aquatic habitat necessary for ESA-listed salmon and moving wood incurs significant mitigation expense.		King County	
Review and update King County Public Rule LUD 12-1 (effective April 30, 2010), which addresses procedures for considering public safety in development and design of capital projects that include placement of wood in rivers and streams of King County.		King County	

Habitat Protection and Restoration

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Headwaters and Floodplain Acquisition and Protection — Continue annual fee and easement acquisition of natural lands, providing preventive and natural resource protection benefits. Projects occur countywide and can occur either in upland areas that add recreational and watershed function benefits or in floodplain or adjacent environments that prioritize ecological restoration and salmon recovery.		King County	
Water Resource Inventory Area (WRIA) Grants — Provide annual grant funding for salmon recovery and riverine habitat restoration.		King County FCD	
Evaluate King County's River Facility Inventory to identify facilities that no longer serve a functional purpose and develop a project portfolio for obsolete facility removal and site restoration.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Work with farmers to **implement riparian buffers, native plantings, and flood resilience measures** on agricultural lands in the floodplains.		King County	
Identify and implement **wetland restoration and protection activities** to mitigate flood risk.		King County	
King County Integrated Drainage Program (IDP) — Provide expanded drainage services to rural King County landowners in the non-built (i.e., natural) environment using a multi-objective approach to provide drainage improvements, mitigate local flood hazards, and enhance fish passage and aquatic and riparian habitats.		King County	
Open Space - River Corridors Grants — Provide annual funding to support projects that restore the natural functions of rivers, create or restore public access, and/or increase public awareness of river corridors as valuable natural resources. This program incentivizes multi-benefit projects that integrate recreation and habitat restoration with larger floodplain management efforts.		King County	

Emergency Services Actions

What King County heard	How this informs the County's approach in the 2024 Flood Plan
Much of the input King County received about emergency services indicated a desire for improved communication during emergency situations. Specifically, over 65 percent of survey responses stated that communicating flood evacuation routes and road closure information, in real time, was one of the top three important actions needed. Well over half of all community input received on the topic identified a need for improved coordination among government agencies during times of flooding. Specifically, some requested that King County's role and responsibilities during emergencies be better defined, especially related to coordination with incorporated areas. People with experience addressing local flooding emergencies and input from across the county stated that King County should increase its coordination with community organizations during emergencies, as well as build capacity for community organizations to respond to emergencies. Other topics discussed included providing equitable services and resources during emergencies, translating emergency information into multiple languages, sharing translated information in multiple ways, and providing affected low-income populations, especially renters, with additional support, if needed.	King County provides many of the services and resources that community members and partners suggested, but the input received through the 2024 Flood Plan development process indicates a higher demand for emergency flood services and the need to provide these services more equitably. King County intends to increase its efforts in emergency service provision with increased local coordination, communication that serves local needs (including translated information), and support for property owners and renters. Activities under Emergency Services actions are presented for Flood Warning & Emergency Response.

Flood Warning and Emergency Response

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Emergency Alert and Warning — Maintain the KCInform and Alert and notification system to provide real-time life-saving emergency messages to county staff, city jurisdictions, and the public.		King County	
Emergency Coordination — King County Office of Emergency Management (OEM) is the coordinating entity for county government during emergency operations in all of the five mission areas (Prevention, Protection, Response, Recovery, and Mitigation). The various county departments and other partners provide capabilities to meet the needs of the operation. During Response operations, the King County OEM, through the Emergency Operations Center, coordinates and facilitates operations activities, especially when they involve more than one county agency or more than one jurisdiction, are complex in scope or have a unique nature, or are in other situations at the request of the departments and partners. Primary roles of King County OEM include resource management and supporting situational awareness.		King County	
Emergency Public Information — Facilitate local and regional message coordination. Manage the King County Emergency Management Blog to share public information messages with partners. Coordinate the cross-jurisdictional, cross-discipline, public information/ communicators group for message collaboration.		King County	
King County Road Alerts — Provide email and text alert services for road conditions in unincorporated King County, including weather- and flood-related road closures and natural disasters. Alerts are also posted on X (formerly Twitter).		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
My Commute Website/Map — Provide public travel alerts on a web map with road closures and restrictions, including flooding or landslides. Users can select each reported location to see more information on cause and anticipated duration of closure/restriction. Users can also access the images from traffic cameras located across the county to view road conditions in real time. Most of the information is for County-managed roads in the unincorporated area, but some information is provided by other agencies such as the Washington State Department of Transportation (WSDOT).		King County	
Post-Flooding Bridge Inspection — Following high-flow events, perform safety inspections on a select set of bridges, looking for scour, road overtopping, and debris buildup in the most impacted flooded areas.		King County	
Regional Coordination — Facilitate regional coordination of emergency management activities with county agencies, other jurisdictions, and the private sector to support information-sharing and other activities, as well as lend support to minor issues. This coordination is scalable from routine operations to regional coordination and can include enhanced operations for specific threats, incidents, or special events.		King County	
Regional Flooding Exercise — Conduct annual regional flooding exercises to include multiple agencies with flood response capability, complete evaluations, and create a lessons-learned report to be submitted annually to CRS.		King County	
Roads 24/7 Helpline — This helpline is staffed with customer service agents to perform call intake of county road issues, including storm safety and flooding-related incidents.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Stormwater Emergency Response — Provide emergency response services to emergent situations in which flooding, erosion, or pollution in or along the stormwater drainage system is causing or imminently threatens to cause a severe hazard to public safety, public health, or aquatic life. The stormwater drainage system includes both natural and manmade features that convey, store, infiltrate, or otherwise manage stormwater runoff in unincorporated King County.		King County	
Continue to provide flood warning services, including operating a Flood Warning Center, performing field flood monitoring, coordinating with local emergency management offices and first responders, providing notifications to the public and media, and otherwise ensuring that information about impending or active flooding is communicated to the public, including coastal and king tide flood warnings along the Duwamish River authorized by the FCD in 2023.		King County FCD	
Periodically review and update the flood warning program to account for changing risk and to improve flood warning communication strategies to align with community preferences for receiving this information, including identifying ways to provide flood warning messages to those experiencing homelessness who live in at-risk areas.		King County FCD	
Community Sandbag Distribution — Provide sandbags to community members at scattered sites throughout King County during flood season as a preparedness measure.		King County FCD King County Seattle Public Utilities	
Identify mechanisms to improve cross-agency emergency response coordination.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Hazard Mitigation Plan Update — Maintain the King County Regional Hazard Mitigation Plan and support development of mitigation strategies aimed at reducing risk. Provide technical assistance with planning efforts and grants to mitigate flood risk.		King County	
Flood Warning Center IT Upgrades — Replace outdated Flood Warning technology with new customized systems that allow users to access critical data. The project will plan, design, and implement new systems, which includes testing, training, and documentation.		King County FCD	
Integrate Floodzilla information into King County Flood Warning Program — Floodzilla is a dynamic, distributed flood monitoring system that allows landowners to share real-time information during floods. As a resource used by the local Snoqualmie Valley community, there are opportunities for King County to use this information to augment existing flood warning services in that area.		Snoqualmie Valley Preservation Alliance	
Duwamish River Flood Preparedness (2024–2035) — Interim flood reduction, prevention, preparedness, and response activities to minimize risk and consequence of Duwamish River overtopping into South Park communities until a long-term sea level rise-related tidal flooding adaptation plan is implemented.		City of Seattle	
Support property owners with resources for on-site flood response action plans and other short-term response tools.		King County	 (or undetermined)

Structural Project Actions

What King County heard	How this informs the County's approach in the 2024 Flood Plan
Many ideas put forward through the 2024 Flood Plan development process involved new capital projects or expanded implementation of the types of capital projects already being implemented in King County. Improving the flood-resilience of roads throughout King County was identified as a priority theme across all community input. Increasing flood volumes and frequencies have overwhelmed culverts in many locations, and community members and partners suggested expanding efforts to increase conveyance capacity to reduce flooding, especially of roads. Another suggestion involved considering increased floodwater storage at existing dams, including those that are not used primarily for flood control (assessing the feasibility of this option was beyond the scope of this planning effort). A notable difference in input was that those who represented largely underserved communities wanted to explore new locations for structural projects to reduce flood risk (63 percent) and ways to improve existing drainage pumps and floodgates (67 percent).	King County will evaluate the feasibility and opportunities for implementing numerous ideas suggested during the 2024 Flood Plan development process. Identifying opportunities for stream daylighting and expanding conveyance capacity through culvert replacements builds on existing King County efforts and will be more practical to initiate, while increasing floodwater storage at federally operated dams (e.g., Howard Hanson and Mud Mountain) would be a long-term process that would depend on the feasibility and the willingness of federal partners, in addition to likely depending on dam relicensing schedules. Activities under Structural Project actions are presented for Structural Actions.

Structural Actions

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Storm Drainage Rehabilitation and Improvement Program — Annual program to replace failing and undersized conveyance infrastructure.		City of Issaquah	
Flood Risk Reduction Grants — Provide annual grants to focus on localized flooding and surface water needs not associated with King County's major rivers.		King County FCD	
Subregional Opportunity Fund — Provides funding equal to 10.23 percent of the FCD tax levy raised in each jurisdiction to allow jurisdictions to carry out local flood reduction improvements, local stormwater control improvements, and watershed management activities.		King County FCD	
Pursue opportunities to implement multi-benefit capital improvement projects that improve conveyance, address surface flooding, improve water quality and habitat, and mitigate risks to the drainage and wastewater system.		Seattle Public Utilities	
Update the King County *Water and Land Resources Project Management Manual* to include multi-benefit considerations early in the project development process (no later than alternatives analysis) so that multi-benefit opportunities are identified and considered across all projects and capital project design considers climate change projections.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Develop a geospatial project decision-support tool to inform the development of projects that will advance multi-benefit outcomes, including layers that identify different program priorities for acquisitions, capital projects, and capital project planning.		King County	
River Facility Inventory Asset Management System — Update the river facility inventory of levees and revetments in King County to a geospatial asset management system.		King County	
Improve Road Safety in Flood-Prone Areas — Assess opportunities to improve flood-safe road access, map current and possible evacuation routes, and explore feasibility of priority resilient evacuation road projects.		King County	 (or undetermined)

Public Information

What King County heard	How this informs the County's approach in the 2024 Flood Plan
Public comments uniformly requested more frequent public information linking people to information and resources. This included expanding outreach to youth, small businesses, local governments, and residents, especially those new to King County, regardless of race, income, or access to power. There was a request to maintain the engagement process used in the Flood Plan process, which included the dual goals of raising awareness about flood risk and preparedness resources and gathering public input to inform the plan itself. Community members also requested information about how climate change will affect flooding, the value of wetlands and other natural areas, and the public and environmental health impacts that occur during and soon after flooding. Public input also pointed to a need to better communicate information about flood risk through increased transparency and outreach. Many community members described the desire for transparency around property risks, including requiring flood risk disclosures when renting or buying a property and communicating risks to property owners that are in levee or dam breach flood risk areas. Promoting awareness of and encouraging adoption of flood insurance was frequently suggested as a desired public information activity. In coordination with property protection practices, community members suggested that King County provide education about resilience measures and available resources to reduce flood risk, along with providing technical assistance to aid community members in their pursuit of building resilience to flooding.	King County has multiple public information programs that conduct a wide array of education and technical assistance efforts. King County will continue these programs and update them to account for the changing nature of flood risk and the changes in how flooding is addressed. King County will also advance new or expanded efforts to increase transparency around risk, such as for those that reside in the floodplain or in dam breach risk areas, as well as promote flood resilience measures, such as purchasing flood insurance. Outreach to vulnerable populations, increasing the accessibility of flood risk information, and providing technical assistance will also be high priorities. King County will continue to provide new information about flood risk to the public as studies and modeling provide new insights. Activities under Public Information are presented for Flood Hazard and Preparedness Education and Outreach, Technical Assistance, and Community Capacity Building.

Flood Hazard and Preparedness Education and Outreach

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Provide translated educational materials and emergency information, including King County agency contacts, during times of emergency.		King County	
Flood Risk Training for Real Estate Professionals — Provide training to mortgage lenders, realtors, and insurance agents about flood risks so they can better share that information with clients.		Public/partner identified	
Improve Access to Flood Preparedness Materials — Collaboratively engage diverse audiences to co-create effective flood preparedness outreach. This may require different graphics, address broader topics, and use different methodologies to meaningfully reach different cultures and communities. Also identify tools and implement preparedness outreach to those experiencing homelessness who live in at-risk areas, specifically riparian areas.		King County	
Develop a program for public information to connect floodplain managers and partners to collaboratively create and implement more targeted outreach to change behavior and build more resilient communities.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Analyze the feasibility of map information improvements that would produce interactive web-based mapping tools to show inundation areas and flood depths at various modeled high-flow conditions on major rivers using existing information and models already available to the public, such as those used for FEMA's Flood Insurance Rate Map studies and reports.		King County	
All Hazard Public Education Program — Provide personal preparedness education to the public in unincorporated King County, as well as support hazard education with local jurisdictions.		King County	
Stormwater Education Program — This outreach program is designed to educate landowners about the importance of stormwater controls, including flow control, which contributes to reductions in downstream flooding.		King County	
Dam Safety Education Program — Provide information to communities, businesses, and jurisdictions about dam hazards. Coordinate with dam owners and operators on dam safety protocols and response activities. Work with dam owners and operators of High Hazard Dams to look at opportunities for improvements. Assist with developing grant applications for dam mitigation work.		King County	
Tidal/Riverine Flooding Connections — Provide resources about the interdependencies among riverine, tidal, and coastal influences on flooding, including potential impacts and roles and responsibilities for preparedness and response.		King County	

Technical Assistance

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Agricultural Drainage Assistance Program (ADAP) — Provide technical and financial support to agricultural property owners to improve drainage of agricultural lands without increasing flood risk or placing fill in the floodplain.		King County	
Stormwater Complaint Program — Field drainage complaints, determine whether a King County program or interest should be involved with a resolution, and provide public information.		King County	
Stormwater Engineer Review Program — Address flooding and drainage complaints requiring a deeper level of analysis than provided by the complaint program. Determine whether a King County program or interest should be involved with a resolution and/or provide technical assistance to private landowners.		King County	
Stormwater Engineer Studies Program — Address flooding and drainage complaints requiring a deeper level of analysis or with a greater breadth of scope than is provided by the Engineer Review Program. Determine whether a King County program or interest should be involved with a resolution and/or provide technical assistance to private landowners.		King County	
Develop and provide information about permitting requirements and potential strategies related to home resilience. Improved technical services are an investment that would provide more readily available information so builders, property owners, and renters could understand flood hazard-related regulations and more successfully evaluate the building of flood-safe structures.		King County	
Risk Reduction Support via Grants — Provide coordination and support to agencies and jurisdictions pursuing grants to mitigate flood related risks, such as Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Assistance (HMA), Flood Mitigation Assistance (FMA), and High Hazard Potential Dam (HHPD) Grant Program.		King County	

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Beaver Education — Provide educational information about the role of beavers in the Pacific Northwest and provide landowners with beaver management resources, management tools, and technical expertise to limit flooding and property damage from beaver activity.		King County	
Snoqualmie Valley Beaver Management Pilot Program — Develop and implement a program to mitigate beaver-caused flooding and drainage issues in the Snoqualmie Valley Agricultural Production District while supporting beaver/human coexistence. This program will: (1) provide base beaver population data; (2) deliver technical assistance and beaver-related flood reduction education to agricultural producers; (3) offer cost-sharing and free technical guidance; and (4) provide on-site management implementation, installation, and maintenance assistance.		Snoqualmie Valley Preservation Alliance	
Provide education and outreach to agricultural communities about floodplain capacity and the purpose of regulations that limit fill.		Snoqualmie Valley Preservation Alliance Snoqualmie Valley Watershed Improvement District	 (or undetermined)

Community Capacity Building

Activity Name and Description	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Flood Resilience Improvement Program — Develop a comprehensive program to raise awareness about flooding, increase flood preparedness, reduce flooding impacts, and increase community resilience. Engage with communities and community-based organizations to identify their needs in building flood resilience and provide support to achieve their flood resilience goals.		King County	

4.5 Comprehensive Risk Mitigation Strategy–Capital Projects

This section includes activities that will eventually result in on-the-ground construction work, including building flood control infrastructure, resilience improvements to the built environment, and restoration of natural environments. The activities in this section are organized by watershed location because the ways that flood hazards are managed vary by the landscapes in which they occur, the characteristics of the flood process, and the resulting impacts. In this way, the structure of this section reflects how a diverse toolkit of flood risk reduction strategies can be applied to effectively respond to the conditions of a localized area, subbasin, or watershed.

What King County heard	How this informs the County's approach in the 2024 Flood Plan
The substantial input received on capital projects spanned suggestions from restoration to new flood control facility construction, with these interventions proposed across all forms of flooding. Addressing on-road flooding through elevating roads, increasing bridge spans, or improving conveyance under and around roads were some of the most frequently discussed capital project ideas, with flooding on roads in valleys being a common hazard. While new flood control structures, such as levees or floodwalls, were not common suggestions from community members, some new structures were advocated for in high-risk areas. Community members and partners generally supported maintenance of and improvements to existing levees, dams, and other flood control structures, especially where they protect key infrastructure, industry, or agricultural land. Numerous community members and government partners supported aligning structural solutions with environmental priorities or balancing these solutions with mitigation efforts. Capital projects that provide multiple benefits were popular throughout the planning process, with many suggestions for levee setbacks, aquatic and riparian enhancements, and culvert removal, which support fish habitat, among other benefits.	King County's approach to capital project planning and implementation reflects the incorporation of input from diverse interests and support for contextually appropriate solutions to flood hazards. Many of the capital projects provide multiple benefits, especially habitat restoration, open space access, climate resilience, and locally sustainable agriculture. Priorities identified in the planning process that are proposed for implementation also include safe transportation, with road flooding being a frequently mentioned issue. Many of the capital projects support this priority through conveyance capacity increases and road elevations. Recognizing the complex challenges and potential impacts of implementing flood control infrastructure, planning processes, and alternatives studies that will work with partners to identify appropriate solutions are also integral to the Comprehensive Risk Mitigation Strategy. Restoration efforts to increase flood storage and strategic floodplain reconnection support habitat goals, agriculture, and safe transportation, which were frequently mentioned by partners and the public throughout the planning process. The many levee setbacks proposed support these priorities while also retaining flood protection to property and infrastructure. Activities under capital projects are presented below, by watershed.

South Fork Skykomish/Snoqualmie River Watershed

South Fork Skykomish River

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Timber Lane Village Acquisitions — Acquire and remove homes along a stretch of the South Fork Skykomish River that are endangered by bank erosion, channel migration, and inundation in some places. A risk assessment completed in 2014 and recent updates to channel migration and flood hazard maps provide guidance to prioritize the acquisitions.	Property protection		King County FCD	
Lower Miller River Floodplain Restoration Project — Restore up to 140 acres and several miles of Miller River mainstem, tributary, and side channel habitat to improve salmonid habitat in the South Fork Skykomish watershed.	Natural resource protection		King County	

Upper Snoqualmie River

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Circle River Ranch Risk Reduction — Design South Fork Snoqualmie River flood risk reduction project to reduce flood and channel migration risk to homes and infrastructure in the Circle River Ranch community.	Structural projects		King County FCD	
Ribary Creek Improvements — Design, permit, and construct improvements to Ribary Creek levees and culverts to reduce flooding of State Route 202 and a retail center. Potential solutions include culvert replacement, gravel removal, and levee setbacks.	Structural projects		King County FCD	
Pump Station Revetment Repair — Implement improvements to the facility to reduce future erosion risk to the pump station operated by the City of Snoqualmie.	Structural projects		King County FCD	
Floodplain Conveyance Improvements Phase 1 — Identify potential solutions to reduce impacts from Middle Fork Snoqualmie River overflow channels in North Bend.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Middle Fork Snoqualmie Residential Flood Mitigation — Acquire structures in the Middle Fork Snoqualmie River channel migration zone to reduce the risks from channel migration and bank erosion in the lower 5 miles of the river, prioritizing the 18 parcels with structures in the severe channel migration zone.	Property protection		King County FCD	
North Fork Snoqualmie Residential Flood Mitigation — Acquire flood-prone properties in the North Fork Snoqualmie basin to reduce the risk of flood, erosion, and channel migration damage and secure footprints for future capital projects.	Property protection		King County FCD	
Upper Snoqualmie Residential Flood Mitigation — Acquire flood-prone properties or elevate individual structures in the upper Snoqualmie River basin to eliminate the risk of flood damage when Snoqualmie River flows overtop the existing levees.	Property protection		King County FCD	
North Fork Snoqualmie Confluence Revetment Removal — Remove obsolete left bank riprap on North Fork (at North Fork/Middle Fork confluence). Involves a hydraulic model, demolition plan, permitting, and construction.	Natural resource protection		King County FCD Snoqualmie Tribe	
Tanner Landing Floodplain Reconnection – Analysis, design, and removal of a revetment along the left bank of the Middle Fork Snoqualmie River at the upstream end of Tanner Landing Park.	Natural resource protection		King County	
SE Reinig Road Drainage Improvement Culvert — The existing culvert on SE Reinig Road near North Fork Road SE is inadequately sized, which restricts water flow and causes annual flooding on nearby roadways and private properties. This project will replace the 40-inch corrugated metal pipe to increase water flow and provide fish passage.	Natural resource protection		King County	
Reif Road Levee Improvements — Conduct a feasibility study to determine project scope to reduce South Fork Snoqualmie River overtopping of the Reif Road levee at a 5 percent annual chance or greater flood and construction of improvements to alleviate flood risk.	Structural projects		King County FCD	
264th Avenue NE at State Route 202 Flood Abatement — Replace existing culverts near North Bend on the South Fork Snoqualmie River and raise the roadway to eliminate dangerous conditions from overtopping and roadway flooding on this sole-access road.	Structural projects		King County FCD	
Bendigo Levee Upper North Bend — Provide cost-share funding to the City of North Bend to set back the Bendigo Upper Levee to address potential levee failure risk. The project would reconnect 25 acres of floodplain and construct a new levee that meets current engineering guidelines.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Norman Creek Up Stream 2024 Culvert — Improve SE 92nd Street east of 428th Street and alleviate roadway flooding by installing a new box culvert.	Structural projects		King County FCD	
Tate Creek Scour Repair — Conduct a feasibility study for replacing or improving Tate Creek Bridge.	Structural projects		King County FCD	
North Fork Bridge #1221 Replacement (Roads CIP #1143969) — Bridge replacement project to reduce the frequency of road flooding and subsequent neighborhood isolation by raising the height of 428th Avenue SE and increasing the hydraulic opening of the bridge.	Structural projects		King County	
Floodplain Conveyance Improvements Phase 2 — Implement improvements to reduce impacts from Middle Fork Snoqualmie River overflow channels in North Bend.	Structural projects		King County FCD	
Mason Thorson Extension Risk Reduction — Identify alternatives and implement a strategy to reduce risks from a constriction on the Middle Fork Snoqualmie River at the Mason Thorson Extension levee. Potential solutions include levee modifications or setbacks to address potential levee failure risk.	Structural projects		King County FCD	
Mason Thorson Ells Risk Reduction — Identify alternatives and implement a strategy to reduce risks from a constriction of the Middle Fork Snoqualmie River at the Mason Thorson Ells levee. Potential solutions include levee modifications or setbacks to address potential levee failure risk.	Structural projects		King County FCD	
Increase Flood Storage and Conveyance — Identify and remove flood protection facilities on the Middle Fork Snoqualmie River that no longer protect infrastructure or development and take up flood conveyance and storage capacity.	Natural resource protection		King County FCD	
Nintendo Levee Setback — Leverage partnerships to set back the Bendigo Upper Left (Nintendo) levee, maximizing local South Fork Snoqualmie River storage benefits.	Natural resource protection		King County FCD	
Si View Levee Improvements — Increase level of flood protection of the Si View Levee on the South Fork Snoqualmie River to 0.2 percent annual chance flood levels by improving the levee.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
SE Mount Si Road Isolation Risk Reduction — Evaluate and implement solutions to reduce Middle Fork Snoqualmie River flooding of SE Mount Si Road, cutting off access to 415 homes.	Structural projects		King County FCD	 (or undetermined)
428th Avenue SE Road Isolation Risk Reduction — Evaluate and implement strategies to reduce Middle Fork Snoqualmie River flooding of 428th Avenue SE Road that can block access to 300 homes. Options include elevating the roadway and replacing culverts to increase conveyance.	Structural projects		King County FCD	 (or undetermined)
I-90 Flood Risk Reduction Project — Set back the McConkey levee on the South Fork Snoqualmie River upstream of I-90 and confluence with Clough Creek.	Structural projects		King County FCD	 (or undetermined)
Bendigo Bridge Replacement — Coordinate with WSDOT and the City of North Bend to replace the 150-foot span of the Bendigo Bridge with a span of at least 400 feet. The bridge currently creates a hydraulic backwater that contributes to flooding.	Structural projects		King County FCD	 (or undetermined)
Prairie Acres Right Levee — Set back, raise, or repair the Prairie Acres Right levee to reduce risk to 32 structures and City of North Bend Wastewater Treatment Plant from South Fork Snoqualmie River 0.2 percent annual chance flood flows.	Structural projects		King County FCD	 (or undetermined)
Bendigo Upper Right Bank Levee — Set back, repair, or raise the Bendigo Upper Right Bank levee to reduce risk to 18 structures and streets inundated by South Fork Snoqualmie River 0.2 percent annual chance flood flows.	Structural projects		King County FCD	 (or undetermined)
Bendigo Lower Right Levee — Setback, repair, or raise the Bendigo Lower Right Bank levee to reduce risk to 129 structures and streets inundated by South Fork Snoqualmie 1 percent annual chance or greater flows.	Structural projects		King County FCD	 (or undetermined)

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Bendigo Lower Left Levee — Setback, repair, or raise the Bendigo Lower Left Bank levee to reduce risk to five structures and NW 8th Street from South Fork Snoqualmie River 2 percent annual chance and greater flows.	Structural projects		King County FCD	 (or undetermined)
Prairie Acres Left Levee — Set back, repair, or raise the Prairie Acres Left Levee to reduce risk to forested and undeveloped agricultural lands by South Fork Snoqualmie River 5 percent annual chance or greater flows.	Structural projects		King County FCD	 (or undetermined)
Sandy Cove — Stabilize bank in public park in City of Snoqualmie along Snoqualmie River.	Structural projects		City of Snoqualmie	 (or undetermined)
Snoqualmie Riverwalk — Purchase property along Snoqualmie River to mitigate flood risk and provide economic development and recreational opportunities.	Property protection		City of Snoqualmie	 (or undetermined)
Tate Creek Floodplain Acquisitions — Acquire floodplain and channel migration zone of Tate Creek (North Fork Snoqualmie tributary) and develop related flood risk reduction project.	Property protection		Snoqualmie Tribe	 (or undetermined)
Upper Snoqualmie Left Bank Floodplain Function Protection — Plan and analysis regarding conservation/protection of well-connected left bank floodplain. Landowner outreach and potential land acquisition.	Natural resource protection		Snoqualmie Tribe	 (or undetermined)
Meadowbrook Reach Restoration Project — Restore floodplain processes within Meadowbrook Slough and adjacent floodplain.	Natural resource protection		Snoqualmie Tribe	 (or undetermined)

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
City Reach Timber Revetment Renovation — Add more wood to left bank timber revetment to increase structural integrity and improve fish habitat along bank.	Structural projects		Snoqualmie Tribe	 (or undetermined)
City Reach Channel Roughening and Enhancement — Build mid-channel log jam on bar adjacent to Sandy Cove Park to establish flow split, increase shade, and increase pool frequency and complex cover. Enhance side-channel habitat along right bank floodplain to increase channel length and shade, provide slow-velocity habitat, increase cover, and potentially add additional flood storage.	Natural resource protection		Snoqualmie Tribe	 (or undetermined)
Upper Snoqualmie Right Bank Groin Removal — Remove derelict right bank groin near River Mile 43.5. Project involves a hydraulic model, demolition plan, permitting, and construction.	Natural resource protection		Snoqualmie Tribe	 (or undetermined)

Lower Snoqualmie River

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Dutchman Road Revetment Repair — Repair approximately 300 feet of the Dutchman Road revetment. Dutchman Road at this location provides the sole access to residences and business on the west side of the Snoqualmie Valley downstream of Duvall.	Structural projects		King County FCD	
Stossel Revetment Major Repair — Investigate and implement improvements of up to 700 feet of the Stossel Bridge Right Bank revetment as the result of recent damage from two flood events. The project is located downstream of the Stossel Bridge, also known as the NE Carnation Farm Road Bridge.	Structural projects		King County FCD	
Tributary to Horseshoe Lake at Snoqualmie Valley Trail just north of NE Carnation Farm Road (FPS-2373) — Replace existing concrete culvert to improve fish passage and conveyance.	Natural resource protection		King County	
334th Avenue SE at SE 43rd Street Flood Abatement — Construct a drainage system to outfall in the Snoqualmie River where none currently exists to alleviate roadway flooding.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Fish Hatchery Road Bridge #61B — Strengthen the bridge structure to stabilize it following flood damage, rebuild the east approach roadway to protect it against major flood events in the future, and restore the eroded creek bed and riverbank profile to buffer the bridge against scour.	Structural projects		King County FCD	
Cherry Creek Floodplain Reconnection Phase II — Address the multiple impacts of alluvial fan depositions in the floodplain of the Snoqualmie Valley Agricultural Production District caused by a 2018 avulsion on Cherry Creek. The project is designed to work with and allow natural processes to continue to occur while restoring floodplain habitat for fish and reducing flood risks to down-valley agricultural land and infrastructure in Cherry Valley.	Natural Resource Protection		Snoqualmie Valley Watershed Improvement District	
Langlois Creek Culvert Replacements — Remove and replace the two farthest downstream fish barrier culverts on Langlois Creek with precast concrete box culverts to restore access to 1.23 miles of upstream habitat, potentially benefitting multiple species of native fish and salmonids. Culvert designs are intended to accommodate future increases in flow volumes, flood frequency, and bankfull widths, which will reduce flood risks in the Langlois Creek basin, which encompasses a drainage area of roughly 3 square miles.	Natural resource protection		Snoqualmie Valley Watershed Improvement District	
Langlois Creek Fish Passage Project at NE 24th Street (FPS-2130) — Fish passage project to replace one barrier culvert at a road intersection with a fish-passable structure.	Natural resource protection; structural		King County	
Ames Creek Fish Passage Projects at NE 100th (FPS-1757) and NE 80th (FPS-565) — Fish passage projects to replace two existing barrier culverts with a fish-passable structure at both locations.	Natural resource protection		King County	
Mouths of Unnamed Tributaries to the Snoqualmie River at W Snoqualmie River Road (FPS-2528 & -2529) — Fish passage projects to replace three barrier culverts/flood gates with fish-passable structures.	Natural resource protection		King County	
NE Woodinville Duvall Road at West Snoqualmie Valley Road NE — Both of these roads are major arterials, and the intersection crosses over an alluvial fan of Tuck Creek. The current structures are undersized and cause regular flooding of the nearby agricultural land. This project will add two box culverts to reduce flooding impacts and provide fish passage.	Natural resource protection		King County	
Harris Creek Fish Passage Projects on NE Stossel Creek Way (FPS-2176, -157, -638, -5670) — Fish passage projects to replace four existing barrier culverts with fish-passable structures.	Natural resource protection		King County	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Snoqualmie River Farm Floodplain Reconnection — King County will explore ways to reconnect Snoqualmie River floodplain to improve salmon habitat while also protecting farmland and farm structures at the Snoqualmie River Farm (formerly Beyers property) with a feasibility study and project design.	Natural resource protection		King County	 (or undetermined)
Basin 1 Pump Replacement — Replace a relict pump on a tributary to the Snoqualmie River in the Snoqualmie Valley Watershed Improvement District Drainage Basin 1. The drainage pump station provides flood risk reduction from increased precipitation/runoff events during shoulder farming seasons (early spring/late fall). The proposed plan is to update the energy efficiency, resiliency, and fish safety of the pump station.	Structural projects		Snoqualmie Valley Watershed Improvement District	 (or undetermined)

Tolt River

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Rio Vista Property Acquisitions — Acquire up to 16 homes in the Rio Vista neighborhood from willing sellers to remove risk of flooding from deep and/or fast flows and landslide hazards that can exacerbate flooding on the Tolt River.	Property protection		King County FCD	
Acquisition in Leveed Reach — Acquire at-risk homes from willing sellers in the leveed portion of the Tolt River.	Property protection		King County FCD	
Lower Tolt River Acquisition — Purchase property from willing sellers in a flood- and channel-migration-prone area along the lower Tolt River to reduce flood risk and allow for future levee setbacks.	Property protection		King County FCD	
Tolt Natural Area Property Acquisitions — Acquire five properties at risk from flooding, erosion, avulsion, and potential levee breach in the Tolt Natural Area on the Tolt River.	Property protection		King County FCD	
San Souci Neighborhood Buyout — Acquire homes that are at high risk for damage from channel migration and avulsion from willing sellers in the vicinity of the former San Souci neighborhood.	Property protection		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Lower Frew Levee Setback — Design and construct Lower Frew Levee setback to increase sediment storage and floodwater conveyance on the Tolt River, protect future development, reduce State Route 203 flooding and damages, address potential levee failure risk, and improve high-priority habitat.	Natural resource protection		King County FCD	
Upper Frew Levee Setback — Design and construct an Upper Frew Levee setback on the Tolt River to reduce impacts from levee overtopping and damage to the Snoqualmie Valley Trail Bridge. The project should increase sediment storage and floodwater conveyance, protect adjacent development, and reduce potential damage to trail bridge.	Structural projects		King County FCD	
Tolt River Natural Area Acquisition — Acquire up to four additional properties in the channel migration zone of the Tolt River in the vicinity of the Tolt Natural Area.	Property protection		King County FCD	
Remlinger Levee Improvements — Evaluate options to set back or repair and improve a frequently damaged section at the downstream end of the Remlinger Levee to address potential levee failure risk.	Structural projects		King County FCD	
Girl Scout Levee Setback — Set back the Girl Scout Camp Levee to reduce flood risks to the Girl Scout Camp and Remlinger Farms, improve levee integrity, increase the lateral migration area and area for ongoing sediment deposition, reduce long-term levee maintenance costs, address potential levee failure risk, and improve instream, floodplain, and riparian habitat functions.	Natural resource protection; structural		King County FCD	
Holberg Levee 2019 Repair — Repair approximately 150 linear feet of erosion on the face the Holberg Levee, discovered during the 2018 post-flood inspections.	Structural projects		King County FCD	
Tolt Dam Debris Boom Replacement — Replace the existing log boom protecting the water intake and spillway.	Structural projects		Seattle Public Utilities	
Tolt Dam Spillway Rehabilitation — Tolt Dam spillway rehabilitation to prevent erosion and downstream turbidity impacts on aquatic species.	Structural projects		Seattle Public Utilities	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
NE Tolt Hill Road Elevation and Levee Setback Feasibility Study — Conduct a feasibility study of modifying NE Tolt Hill Road and setting back the Tolt River Levee Left Bank levee downstream of State Route 203. The levee and road overtop during minor to moderate Tolt River and Snoqualmie River floods, which limits access to and from the Snoqualmie Valley and the City of Carnation during flood events.	Natural resource protection; Structural projects		King County FCD	 (or undetermined)
Levee Setbacks — Design and construct levee setbacks on the Tolt River for the Highway to Trail Bridge Levee.	Natural resource protection; Structural projects		King County FCD	 (or undetermined)
Levee Setbacks or Improvements — Design and construct levee improvements to the Holberg and Edenholm levees on the Tolt River.	Natural resource protection; Structural projects		King County FCD	 (or undetermined)
Private Revetment Removal or Improvements — Remove or modify privately constructed revetments on the Tolt River to improve protection and reduce adverse impacts.	Natural resource protection; Structural projects		King County FCD	 (or undetermined)
Lower Tolt Assessment and Planning — Assess lower Tolt confluence area for large-scale opportunities to improve river and floodplain processes, salmon habitat, and local and regional transportation and climate resiliency. This includes Hwy 203, NE Tolt Hill Road, King County Parks, Private Property, City of Carnation, and more.	Natural resource protection		Snoqualmie Tribe	 (or undetermined)

Raging River

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Alpine Manor Acquisitions — Acquire at-risk properties from willing sellers in areas where structures are at risk from channel migration or flooding.	Property protection		King County FCD	
Raging River Bridge to Bridge Assessment — Conduct assessment of river and floodplain functions, as well as dikes and levees within the Raging River bridge to bridge reach, to evaluate their impact on river and floodplain processes. Investigate acquisitions and facility setbacks and removals.	Natural resource protection		Snoqualmie Tribe	 (or undetermined)

Lake Washington/Cedar/Sammamish River Watershed

Cedar River Basin

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Cedar River Gravel Removal Renton— This project removes gravel along the lower 1.25 miles of the lower Cedar River to maintain 1 percent annual chance level of flood protection for the City of Renton. The project also includes implementation of several specific mitigation measures to offset environmental impact.	Structural projects		King County FCD	
Dorre Don Neighborhood Improvements — Evaluate options to address flood and erosion risks and acquire at-risk properties in the Dorre Don Neighborhood.	Property protection; structural projects		King County FCD	
Cedar River Pre-Construction Strategic Acquisition — Acquire properties that several large FCD capital projects depend on, namely the levee setback projects at the WPA, Rutledge-Johnson, Rhode, Getchman, Lower Jones Road, Elliott Bridge, Byers, and Rafter Park levee or revetment segments. Priorities for acquisition will be directed by the FCD.	Property protection		King County FCD, King County	
Royal Arch Reach Acquisitions — Acquire floodplain properties for future reach-scale floodplain reconnection and restoration, from State Route 169 to Highway 18.	Natural resource protection		Seattle Public Utilities	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Madsen Creek Channel Realignment — Create a single channel for Madsen Creek through Renton and King County away from private property prior to connecting to the Cedar River. The project would eliminate a sediment basin and a high-flow bypass and restore the creek to a self-sustaining channel with an alluvial fan capable of passing fine sediment. The proposed alignment would move the creek away from and reduce flood risk to properties in Renton and King County.	Natural resource protection		City of Renton	
Cedar River Lower Rutledge-Johnson Floodplain Restoration — Multi-benefit floodplain restoration project adjacent to State Route 169, Cedar River Trail, and recently completed Jan Road Levee Setback project.	Natural resource protection		King County	
Molasses Creek Barrier Removal Project — A fish passage project that will remove a fish passage barrier at the mouth of Molasses Creek.	Natural resource protection		King County	
Molasses Creek Culvert Replacement Project at SE Petrovitsky and 134th SE (FPS-1602, -650) — Replace two failing culverts with two fish-passable structures.	Structural projects		King County	
Belmondo Levee 2020 Repair — Repair approximately 100 feet of damage observed near the upstream end of the revetment. Damages include erosion and scour, which have resulted in loss of toe and bank rock, over-steepened and undercut banks, and localized bank erosion.	Structural projects		King County FCD	
Cedar River Downstream Improvements — Improve Cedar Grove Road near Byers Road SE to alleviate roadway flooding by raising the road through the application of a thick layer of overlay.	Structural projects		King County FCD	
Cedar River Trail 5 Revetment 2020 Repair — Repair the flood protection facility Cedar River Trail 5 to address erosion issues along approximately 150 feet of the 300+ foot revetment near the King County Cedar Mountain Bridge.	Structural projects		King County FCD	
Herzman to Camp Freeman Levee Setback and Repair — Remove and set back a portion of the Herzman Levee damaged by the 2020 flood event to address potential levee failure risk, located along the right (west, northwest) bank of the Cedar River in unincorporated King County, and repair damaged portions of the Camp Freeman Levee. The project will reduce erosion risks to private properties and SE Lower Jones Road and improve riparian and aquatic habitat.	Natural resource protection; Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Tabor-Crowall-Brodell Revetments — Repair the Tabor-Crowall and Brodell revetments, which have become over-steepened in recent flood events, and provide habitat improvements.	Structural projects		King County FCD	
Lower Jones Neighborhood Improvements – Acquire at-risk properties and evaluate options to address flooding of SE Jones Road that can result in temporary road closures.	Property protection; structural		King County FCD	
Byers Road Neighborhood Improvements – Acquire at-risk properties and complete a feasibility study to investigate options to address widespread flooding and channel migration risks along 1 mile of floodplain along the left bank of the Cedar River.	Property protection; structural		King County FCD	
Landsburg Dam Debris Passage Improvements — Passing large debris through Landsburg Diversion Dam is challenging and could potentially stack up fast enough against the dam to jeopardize its structural integrity by direct impacts or rapid erosion.	Structural projects		Seattle Public Utilities	
WPA Levee Setback — Remove and set back the WPA Levee along the Cedar River. This project would reconnect floodplain habitat and could reduce erosion and potential levee failure risk to the downstream Belmondo Levee.	Natural resource protection; structural projects		King County	 (or undetermined)
SE Petrovitsky Road at 151st Avenue SE – The culvert under SE Petrovitsky Road and 151st Avenue SE is failing, and the road is at risk of collapsing. Due to the failed pipe, the outlet often plugs and water overtops SE Petrovitsky Road. Replace the culvert and add a new inlet structure with a debris cage to prevent the system from plugging. This will also improve outfall from the nearby detention facility.	Structural projects		King County	 (or undetermined)
Cedar River Residential Flood Mitigation — Acquire flood-prone properties or elevate or relocate individual structures in the Cedar River basin to eliminate the risk of flood damage when river flows overtop the existing levees.	Property protection		King County FCD	 (or undetermined)

Sammamish River/Lake Sammamish Basin

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Peters Creek at West Sammamish River Trail north of NE 90th Street (FPS-941, CLO-132509) — Replace 72-inch-diameter deteriorating metal pipe with fish-passable structure. Improved conveyance.	Natural resource protection		King County	
Trib to Sammamish River at MM Dog Park (FPS-1257, CLO-114463 & FPS-1258, CLO-147289) — Replace two deteriorating culverts with fish-passable structures and improve conveyance.	Natural resource protection		King County	
Trib to Sammamish River at Sammamish River Trail near NE 143rd Steet (FPS-2076, CLO-130643) — Replace existing 24-inch-diameter corroded bottom barrel of culvert with fish-passable structure and improve conveyance.	Natural resource protection		King County	
Daniels Creek Fish Passage Projects at NE 185th (FPS-408) and NE Woodinville-Duvall Road (FPS-170) — Fish passage projects to replace two existing barrier culverts with fish-passable structures at both locations.	Natural resource protection		King County	
Bear Creek Integrated Restoration and Stormwater Projects — Integrated planning and implementation of habitat restoration and stormwater retrofit projects.	Natural resource protection		King County	
Willowmoor Floodplain Restoration — Reconfigure the outlet from Lake Sammamish to the Sammamish River to maintain or reduce current levels of flood risk in the downstream river channel and along the lake shore.	Natural Resource Protection		King County FCD	
Allen Lake Outlet Improvements — Evaluate upstream retention/detention options, study road raising options, and prepare a Concept Development Report to analyze option(s), identify the preferred option, and implement the project.	Structural projects		King County FCD	
Sammamish Capital Investment Strategy — Identify and prioritize near-, mid-, and long-term, multi-benefit capital projects and other actions for FCD funding along the Sammamish River.	Structural projects		King County FCD	
East Side Wayne Sammamish/Waynita Restoration — Restore the eastside of the former Wayne Golf Course property (back nine, 31.6 acres). The restoration approach is dependent on results from a feasibility study but could include	Natural resource protection		WRIA 8	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
enhancing Waynita Creek habitat at the mouth, Sammamish floodplain restoration, improving riparian conditions, and creating cold water refuge.				
Little Bear Creek Fish Passage at 134th Avenue NE – Replace three broken concrete pipes that are a partial fish passage barrier and could undermine a city maintenance access road.	Natural resource protection		WRIA 8	
Evans Creek Relocation — Relocate a portion of Evans Creek from an industrial area into open space to reconnect the channel with floodplain wetlands, enhance channel complexity, and restore riparian buffer function.	Natural resource protection		WRIA 8	
Cottage Lake Creek Weir Removal and Restoration — Remove privately owned weir on Cottage Lake Creek. Remove bank armoring and floodplain, add large woody debris, and restore adjacent riparian habitat.	Natural resource protection		WRIA 8	
Cottage Lake Creek Fish Passage Projects at Avondale Road NE (FPS-2098), NE 128th Way (FPS-165), NE 165th (FPS-2296), and NE Avondale & NE 144th (FPS-2099) — Fish passage projects to replace four barrier culverts with fish-passable structures.	Natural resource protection		King County	
Ebright Creek Acquisition and Enhancement – Acquire up to 6 acres along lower Ebright Creek and enhance the mouth of the creek and shoreline of Lake Sammamish.	Natural resource protection		WRIA 8	
George Davis Creek at East Lake Sammamish Trail (ELST) (FPS-2142) — Fish passage culvert replacement is part of ELST South Sammamish Phase 2 project.	Natural resource protection		King County	 (or undetermined)

Issaquah Creek Basin

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Bush Street Stormwater Improvements — Conveyance improvement project.	Structural projects		City of Issaquah	
Olde Town Stormwater Improvements — Study to understand and develop solutions to flooding, failing infrastructure, and water quality on the Olde Town area.	Structural projects		City of Issaquah	
Carey Creek Fish Passage Project at 276th SE — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
East Fork Issaquah Creek Fish Passage Project at NE High Point Way (FPS-2897) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
East Fork Issaquah Creek Floodplain Restoration Strategy — System-wide study of the benefits of restoring a 3-mile section of the creek in unincorporated King County from West Tiger Mountain at SE 88th, downstream to the High Point Way interchange off I-90.	Natural resource protection		King County	
Carey/Holder/Issaquah Creek Confluence Restoration — New project on former Bonomi farm. Feasibility completed in 2023. Coordinated planning effort between King County Agriculture, Forestry, and Incentives; Ecological Restoration and Engineering Services; Basin Steward; and Parks kicks off in 2024. Cost assumes 45 acres of restoration and 4,500 linear feet of channel work.	Natural resource protection		King County	
Fifteen Mile Creek Bridge #493C Replacement — The current bridge carries SE May Valley Road, a major arterial over Fifteen Mile Creek. The original bridge was built in 1932 and is structurally deficient with substandard rails, narrow width, and a poor hydraulic opening. This bridge replacement project will remove the existing bridge, associated fill, and stream bank armoring that is constricting the creek's flow and creating flooding, scour, and potential water-quality issues.	Structural projects		King County	
208th Avenue SE @ SE 135th Culvert — The existing culvert at 208th Avenue SE and SE 135th Street is in an area where alluvial soils and sediment build up and reduce its capacity to carry flows. This causes frequent flooding on a sole-	Natural resource protection		King County	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
access road. This project will replace the culvert to increase water flow and provide fish passage.				
Issaquah Creek Capital Investment Strategy — Identify and prioritize near-, mid-, and long-term capital projects for FCD funding along Issaquah Creek.	Structural projects		King County FCD	
Momb Revetment 2020 Repair — Repair 30 feet of erosion and 25 feet of slumped bank at the upstream end of the revetment and provide riparian habitat improvements.	Structural projects		King County FCD	
Jerome Revetment 2020 Repair — Repair damage to a revetment along Issaquah Creek damaged during the 2020 flood event. The facility protects three residential properties from bank erosion.	Structural projects		King County FCD	
Issaquah Creek Instream Restoration at Lake Sammamish State Park — Restore 6,600 linear feet of lower Issaquah Creek through Lake Sammamish State Park via extensive large wood installations and strategic floodplain excavations. Restoration will provide significant habitat benefits for Chinook and other salmonids, floodplain and side-channel connectivity, and more functional and complex refuge and foraging habitat.	Natural resource protection		WRIA 8	
Squak Valley Park South Stream and Wetland Restoration —Install log complexes in the main channel and along its banks to encourage pool formation, provide protective cover, and improve habitat diversity and quality. Restore the floodplain and side channel to increase edge habitat. Implement wetland and riparian enhancements. Pursue acquisition of lone remaining privately held parcel to enable full-scale restoration on the right bank.	Natural resource protection		WRIA 8	

Lake Washington Basin

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Juanita Drive Storm Failure at 86th Avenue NE — Resolve flooding and hazardous ice accumulation on residential driveways and roadway shoulder.	Structural projects		City of Kirkland	
Holmes Point Drive NE pipe extension at Champagne Creek — Resolve flooding along the west side of Holmes Point Drive NE.	Structural projects		City of Kirkland	
Silver Spurs Storm System Upgrade — Reduce structure and roadway flooding in a residential neighborhood.	Structural projects		City of Kirkland	
Margaret's Way Trailhead Driveway Culvert (FPS-2737) — Replace culvert with fish passage structure. Existing culvert is corroded and undersized, which causes piping around the inlet to form sinkholes. Improve conveyance.	Natural resource protection		King County	
Lower Coal Creek Drainage Bellevue — Provide feasibility and predesign analysis of possible solutions to reduce flooding problems in the City of Bellevue's Coal Creek neighborhood.	Structural projects		King County FCD	
Taylor Creek Outfall Improvements — Two drainage outfalls along the east rim of Dead Horse Canyon (Lakeridge Park) in South Seattle will be tightlined to allow water to reach Taylor Creek without continued slope erosion and sediment delivery to the creek contributing to downstream flooding. Improvements will also be made to the upstream drainage components of each outfall to reduce flooding on private property and in the right-of-way in King County and the City of Seattle.	Structural projects		Seattle Public Utilities	
98th Avenue NE and NE Juanita Drive — Reduce roadway flooding due to stormwater system surcharge.	Structural projects		City of Kirkland	 (or undetermined)
Stream Restoration at 128th Lane NE on Juanita Creek — Stream channel restoration to prevent overtopping that floods an adjacent private parking lot.	Natural resource protection		City of Kirkland	 (or undetermined)

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
25th Avenue NE Ballinger Creek Habitat Restoration and Flood Reduction Project — Ballinger Creek flooding near 25th Avenue NE and NE 195th Street impacts homes and roadways about every two years. The project would restore a 1,500-foot section of Ballinger Creek by daylighting 600 feet of currently piped stream, including 400 feet of stream within a half-acre of restored floodplain storage, installing four fish-passable box culverts, and restoring 700 feet of open channel at the foot of a failing retaining wall.	Natural resource protection		City of Shoreline	 (or undetermined)
Thornton Creek Flood Reduction — Flood risk reduction through land acquisition, upsizing of stream culverts, and associated floodplain reconnection.	Natural resource protection		Seattle Public Utilities	 (or undetermined)
Lower Taylor Creek Restoration — Address and prevent localized flooding for at least 15 properties by improving drainage infrastructure, restoring the natural drainage system function of approximately 3,000 linear feet of Taylor Creek; eliminating barriers to fish passage; rebuilding and improving natural habitat; and providing equitable opportunities to the community by expanding public access to open space.	Natural resource protection		Seattle Public Utilities	 (or undetermined)

Green/Duwamish River Watershed

Green/Duwamish River Basin

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Green River Pre-Construction Strategic Acquisition — Acquire land necessary for planned King County Flood Control District projects and programs in the Green River basin, as it becomes available.	Property protection		King County FCD	
Lower Russell Road Habitat Area A — Excavation of a new large off-channel habitat that will provide rearing and refuge habitat for juvenile Chinook salmon. This project is associated with the Lower Russell Levee Setback project, part of a larger overall flood management strategy for the lower Green River.	Natural resource protection		City of Kent	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Boeing Levee Setback Habitat Rehabilitation — Restore salmon habitat along 0.8 mile of the lower Green River (River Mile 17). A previous levee setback in the project area provides an opportunity for implementing a variety of habitat enhancements within approximately 15 acres of floodplain habitat. The overall goal is to restore floodplain function and improve habitat complexity along the heavily developed lower Green River.	Natural resource protection		City of Kent	
Chinook Wind Extension — Setback/layback shoreline between Chinook Wind Mitigation and Duwamish Gardens to expand salmon habitat and provide connected recreational trail experience.	Natural resource protection		City of Tukwila	
Nelson Creek Side Channel — Restore off-channel salmon-rearing habitat by setting back revetment and reconnecting a segment of historic river channel with the Green River, providing additional flood storage.	Natural resource protection		City of Tukwila	
Relocation of Minkler Public Works Facility — Relocate critical infrastructure to reduce flood risk.	Property protection		City of Tukwila	
S 131st Street Flood Reduction Project — Upgrade creek culverts to prevent flooding and improve habitat and water quality.	Natural resource protection; structural		City of Tukwila	
Gilliam Creek Fish Barrier Removal and Habitat Enhancement — Create fish passage and increase flood storage between Gilliam Creek and the Green River in Tukwila. Gilliam Creek is mostly inaccessible to aquatic species due to the presence of a 1960s era 108-inch-diameter flapgate at the outlet of a 207-foot-long culvert beneath 66th Avenue S.	Natural resource protection		City of Tukwila	
Cecil Moses Tire Revetment — Cecil Moses Park features a failing tire revetment, a tidally influenced backchannel, and a fish-impassable tributary culvert just upstream of the park. This project will pursue removal of the tire revetment, turning the backchannel into a side channel, and making the culvert fish-passable.	Natural resource protection		King County	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
North Fork Newaukum Creek near 284th Avenue SE (FPS-2089) — Remove fish barrier culvert and restore stream to natural process and improve conveyance.	Natural resource protection		King County	
Little Soos Creek Fish Passage Project at SE 240th Street (FPS-1997) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
Watercress Creek Fish Passage Project at SE 432nd (FPS-2123) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
Unnamed Tributary to Big Soos Creek Fish Passage Project at 156th SE & SE 240th (FPS-101, -2604, -1771) — Fish passage project to replace three barrier culverts with two fish-passable structures.	Natural resource protection		King County	
Unnamed Tributary to Covington Creek Culvert Replacement at Thomas Road SE (FPS-2129) — Replace a failing culvert with a fish-passable structure.	Natural resource protection		King County	
NE Auburn Creek Restoration — Enhance tributary confluence with Green River and create a new side channel, provide stream enhancement on public lands, replace a fish passage barrier, create flood benefits, and improve access to non-natal stream for rearing and flood refuge by juvenile Chinook salmon.	Natural resource protection		King County	
Lower Green-Duwamish Levee Vegetation Guidelines — Update lower Green-Duwamish vegetation management guidelines for maintenance and capital projects developed as part of the lower Green River System-Wide Improvement Framework (SWIF). The purpose of the update is to reflect current levee safety risk management and vegetation management best-practice recommendations from the Corps, experienced with vegetation on levees in California and through Engineering with Nature. The update will also achieve greater alignment with initiatives, such as Clean Water Healthy Habitat and WRIA 9 salmon recovery goals.	Natural resource Protection		King County	
S Langston at 125th Drainage Improvement and Flood Risk Reduction — The existing drainage system along S Langston Road and 61st Place S is poorly functioning and results in chronic flooding on public roads and private property, which damages property. This project will upgrade or replace the stormwater conveyance pipes to improve drainage issues and alleviate flooding impacts.	Structural projects		King County	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Black River Pump Station Control Building Replacement — Design and build the second phase of renovations to the Black River pump station. Major components include replacement of the control building, replacement of the trash rake system, and replacement of the screen spray system.	Structural projects		King County FCD	
Black River Pump Station Fish Passage Improvements — Design and build the fourth phase of renovations to the Black River pump station, revising and replacing the obsolete fish passage systems.	Structural projects		King County FCD	
Black River Pump Station High-Use Engines — Design and build the first phase of renovations to the Black River pump station, replacing the three smaller pump engines that run much more frequently than the other, larger pump engines.	Structural projects		King County FCD	
Black River Pump Station Large Engine Replacement — Design and replace the large engines and overhaul the large pumps at the Black River pump station.	Structural projects		King County FCD	
Black River Pump Station Seismic Upgrades — Strengthen and improve the structure and subsurface soils at the Black River Pump Station.	Structural projects		King County FCD	
Black River Pump Station Support System Upgrades — Design and build the third phase of renovations to the Black River pump station, replacing support systems such as engine control panels, cooling systems, oilers, and hoists.	Structural projects		King County FCD	
Desimone Levee Major Repair (Corps of Engineers) — Design and construct a floodwall to design elevation for 18,800 cfs plus 3 feet of freeboard, repairing slope failures, laying the levee embankment slope back, and shifting the levee alignment (and trail) landward where possible. The floodwall will connect previously constructed floodwalls at Desimone reaches 1 and 2 and will address potential levee failure risk.	Structural projects		King County FCD	
Fort Dent Levee 2020 Repair — Repair several damaged sections of the Fort Dent Levee at approximately River Mile 11 and construct riparian habitat improvements.	Structural projects		King County FCD	
Green River Improvement 2024 — Improve SE Green Valley Road near SE Auburn Black Diamond Road and alleviate roadway flooding by raising the road through the application of a thick layer of overlay.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Horseshoe Bend Breda Levee Setback Kent — Reconstruct the Horseshoe Bend Levee at the Breda reach (River Mile 24.46–24.72) to a more stable configuration to reduce flood risk to the surrounding areas and to address potential levee failure risk. The project will also raise levee crest elevations to contain the 0.2 percent annual chance flood, plus 3 feet of freeboard.	Structural projects		King County FCD	
Horseshoe Bend McCoy Realignment Kent — This Corps repair project replaces the SWIF capital project originally planned by the FCD. The repair project is anticipated to stabilize the failure of the levee slope and address potential levee failure risk, construct a ring levee around an isolated utility, and shift the alignment of the federal levee back to the City of Kent's secondary containment levee.	Structural projects		King County FCD	
Kent Airport Revetment 2022 Repair — Repair project to stabilize the over-steepened bank and rock revetment that has been undercut by rotational bank failure.	Structural projects		King County FCD	
O'Connell Revetment 2021 Repair — Stabilize the O'Connell revetment slope and move or replace the road shoulder and guardrail. Property acquisition for floodplain restoration.	Structural projects		King County FCD	
Signature Point Levee/Floodwall — Provide an increased level of protection to 18,800 cfs (0.2 percent annual chance flood) plus 3 feet of freeboard containment to 1.5 miles of the lower Green River corridor. Modify the Signature Pointe Levee to tie into the recently constructed Hawley Road Levee on the upstream end and the Meyers Golf Levee on the downstream end.	Structural projects		King County FCD	
Tukwila 205 Gunter Floodwall — Construct a flood facility to bring the Gunter segment of the Tukwila 205 Levee into compliance with certification requirements for structural stability and raise the levee to roughly the 0.2 percent annual chance flood event.	Structural projects		King County FCD	
Tukwila 205 Levee Ratolo Segment Floodwall — Construct a 0.15-mile floodwall and sloped embankment to protect adjacent businesses from flooding. The floodwall alignment (including embankment slope, factors of safety, and necessary real estate) will be finalized during the project design phase.	Structural projects		King County FCD	
Tukwila 205 Levee Corps (Gaco Western) Segment Repair — This is a Corps-led project to replace 3,500 feet of Tukwila 205 Levee in-place to bring up to 0.2 percent annual chance flood level of protection.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
South Park Conveyance — Construction of an additional phase of drainage improvements in the South Park neighborhood.	Structural projects		Seattle Public Utilities	
Little Soos Wingfield — Multi-benefit project to restore instream and floodplain habitat through reconnecting the creek to its floodplain, restoring side channels, removing artificial armoring, adding large wood, and revegetating the riparian zone.	Natural resource protection		WRIA 9	
P-17 Pond Levee Setback Feasibility Study — Study opportunity to increase flood storage, improve off-channel habitat, and upgrade the facility to 0.2 percent annual chance flood protection.	Structural projects		City of Tukwila	
S 104th Street Setback Feasibility Study — Analyze over-steepened revetment and opportunity to setback facility to create habitat and increase flood storage.	Natural resource protection; structural		City of Tukwila	
Duwamish Hill Preserve Phase III Design — Study potential to setback road or regrade shoreline to improve habitat and flood storage.	Natural resource protection; structural		City of Tukwila	
S 180th Pump Station Upgrade — Study restoring the full pump capacity that was previously lost to provide increased flood protection.	Structural projects		City of Tukwila	
Duwamish River Sea Level Rise Adaptation (2030-2040) — Planning project to define the preferred design for infrastructure to mitigate sea level rise-related tidal flooding in South Park and Georgetown.	Structural projects		City of Seattle	
Cristy Creek Fish Passage Project at 249th Avenue SE (FPS-3136) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Jenkins Creek Fish Passage Project at Kent-Black Diamond Road SE (FPS-2110) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
North Green River Park Floodplain Reconnection – Remove fish passage barrier at an existing flapgate and reconnect floodplain to increase off-channel rearing habitat for juvenile salmon.	Natural resource protection; structural		King County	
Newaukum Creek Fish Passage Project at SE 400th (FPS-1995) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
Unnamed Tributaries to Newaukum Creek Fish Passage Projects at SE 424th (FPS-365), 228th SE (FPS-374), 216th SE (FPS-912) — Fish passage projects to replace three barrier culverts with fish-passable structures.	Natural resource protection		King County	
Longfellow Flood Storage Project — Evaluate sites along Longfellow Creek for expanding and restoring the floodplain to increase the flood storage within Longfellow Creek.	Natural resource protection		Seattle Public Utilities	
Tukwila 205 Capital Improvements — Design and implement improvements to the entirety of the 4.3-mile-long Tukwila 205 Levee system to increase design containment 18,800 cfs (0.2 percent annual chance flood) plus 3 feet of freeboard. Involves improving several different segments of the levee system.	Structural projects		City of Tukwila	 (or undetermined)
Berrydale Overcrossing Bridge #3086OX Replacement and Corridor Improvements –This project replaces a fish barrier culvert at Jenkins Creek within the project corridor. This will improve the performance of the culvert and reduce the risks of neighborhood flooding.	Natural resource protection; structural		King County	 (or undetermined)

Vashon-Maury Island and Puget Sound Nearshore

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Dockton Seawall Periodic Repair — The Dockton Road timber seawall on Vashon Island was originally built in 1916, and much of the seawall has failed. Storm surges often damage the low-elevation seawall, and breaches to the wall cause shoulder and roadway erosion. There have been 15 repairs over the last 20 years, primarily to repair sinkholes but larger repair projects are also needed to rebuild the road base and seawall itself.	Structural projects		King County	
McSorley Creek — Restore habitat on the lower 450 feet of McSorley Creek and 1,000 feet of nearshore at Saltwater State Park. Remove shoreline and stream bank armoring that was placed in the 1950s. A portion of the parking lot will be excavated to create a pocket estuary. The project goal is to restore salmon and forage fish habitat and natural habitat-forming processes, while making the park more sustainable in the face of sea level rise.	Natural resource protection		WRIA 9	
Des Moines Creek Restoration — Remove approximately 500 feet of hard shoreline armor and pull back fill material to create a more natural shoreline and stream transition to benefit numerous salmon species.	Natural resource protection		WRIA 9	
California Avenue SW Culvert Replacement — Replace existing culvert with a fish-passable structure and improve the creek channel upstream and downstream of the culvert.	Natural resource protection		Seattle Public Utilities	

White River Watershed

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Unnamed Tributary to Hylebos Creek Culvert Replacement at 370th SE (FPS-2124) — Replace a failing culvert with a fish-passable structure.	Structural projects		King County	
212th Avenue SE at State Route 164 Flood Reduction — Improve the existing drainage system to reduce flooding, which may require off right-of-way improvements.	Structural projects		King County FCD	

Activity Name and Description	Mitigation Category	Types of Flooding Addressed	Source/Origin of Activity	Timeline
Charlie Jones Downstream Culvert Repair — Prepare a Concept Development Report to analyze culvert replacement and road-raising options. identify the preferred option(s), analyze upstream and downstream retention/detention impacts, and implement the project.	Structural projects		King County FCD	
Charlie Jones Upstream Culvert Repair — Prepare a Concept Development Report to analyze culvert replacement and road-raising options, identify the preferred option(s), and analyze upstream and downstream retention/detention impacts, and implement the project.	Structural projects		King County FCD	
White River Capital Investment Strategy – Identify and prioritize near-, mid-, and long-term capital projects for FCD funding along the White River.	Structural projects		King County FCD	
Unnamed Tributaries to the White River Fish Passage Projects at SE 472nd (FPS-106), 196th SE (FPS-762), and SE Mud Mtn. Dam Road (FPS-2644) — Fish passage projects to replace three barrier culverts with fish-passable structures.	Natural resource protection		King County	
Seconds Creek Fish Passage Project at 196th Avenue SE (FPS-2286) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection		King County	
Pussyfoot Creek Fish Passage Projects at 180th SE (FPS-1754), 196th SE (FPS-2499), & 212th SE (FPS-158) — Fish passage projects to replace three existing barrier culverts with a fish-passable structure at each location.	Natural resource protection		King County	
Pacific Right Bank Levee Setback — Acquire at-risk, flood-prone residential properties along the right bank of the White River within the City of Pacific to allow for the construction of a new levee setback flood protection structure to address potential levee failure risk. Acquired residential structures will be removed, temporary sand-filled flood protection barriers will be removed, artificial fill will be excavated, existing wetland areas will be enhanced, and an earthen setback levee will be constructed. A former dumpsite under Pacific Park will be cleaned up and contamination contained. A pump station will replace the existing undersized mobile pump on Government Canal.	Natural resource protection		King County FCD	

4.6 King County Action Plan

The King County Action Plan (Action Plan) is a sub-section of the Comprehensive Risk Mitigation Strategy. The Action Plan consists only of activities that King County is committed to advancing or implementing within the life of the Flood Plan, either through its own funding, by seeking external sources of funding or partnerships, or through a combination of these. The activities in the Action Plan reflect the goals, objectives, and guiding principles that are the foundation of this Flood Plan. The activities chosen for the Action Plan include initiatives with a proven history of success in reducing flood risk and new activities that will help to better address flood risk moving forward.

Programmatic Recommendations

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Road Drainage System Preventive Maintenance — Perform annual catch-basin inspection and cleaning to ensure drainage systems remain unclogged and functional. Also includes cleaning drainage ditches, mowing, and litter and debris removal.	Prevention	King County Roads	King County Roads Operating Budget		
Road Drainage Preservation Program – This program identifies, prioritizes, and improves roadway drainage infrastructure related to surface water, groundwater, and stormwater runoff. Improvements aim to reduce flooding and mitigate property damage.	Prevention	King County Roads	King County Roads Capital Budget King County Surface Water Management		
Road Drainage System Reactive Maintenance — Resolve stream, ditch, or drainage system clogs within the road right-of-way.	Prevention	King County Roads	King County Roads Operating Budget		
Landslide Hazard Mapping — Expand the County's understanding of landslide risk areas through updating maps as information changes and use the information to inform the development of appropriate mitigation solutions where coastal flood hazards and landslide hazards intersect.	Prevention	King County Water and Land Resources	King County Surface Water Management King County FCD Grants		
Collaborate with jurisdictions to identify differences in municipal flood hazard area regulations within King County, identify implications for achieving plan outcomes, and **provide technical assistance to jurisdictions** within King County to support strengthening local regulations where they are deemed beneficial.	Prevention	King County Water and Land Resources	King County Surface Water Management King County FCD		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Land Conservation Acquisitions — Acquire open space for conservation and protection, and to secure footprints necessary for floodplain restoration projects and stormwater retrofit projects.	Prevention	King County Water and Land Resources	Various state and local grants Conservation Futures Tax Parks Levy King County FCD King County Surface Water Management		
Pursue opportunities to support stormwater retrofit projects as part of scoping and designing flood risk reduction projects.	Prevention	King County Water and Land Resources	King County Surface Water Management King County FCD grants Various state and local grants		
Drainage Enforcement Program — Enforce the requirements of the *Surface Water Design Manual*, including the attenuation of runoff from developed surfaces that would otherwise increase flood flows.	Prevention	King County Water and Land Resources	King County Surface Water Management		
Protect headwaters of tributary streams that may be sensitive to climate change to alleviate flashy flows and mitigate downstream flood risk.	Prevention	King County Water and Land Resources King County Parks	King County Parks Levy Various state and local grants		
Provide technical assistance to low-income property owners so they can secure the funding needed to implement a home elevation.	Property protection	King County Water and Land Resources	Various federal and local grants		
Encourage the purchase of flood insurance and collaboratively work with partners to design a social marketing campaign or other similar effort with a goal of increasing flood insurance policies held in King County.	Property protection	King County Water and Land Resources	King County Surface Water Management Grants King County FCD		
Repetitive Loss Area Analysis and Mitigation Actions – Continue repetitive loss area planning and risk reduction work to address the county's unmitigated repetitive loss properties and buildings located in repetitive loss areas.	Property protection	King County Water and Land Resources	Grants King County FCD		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Ensure that **management and stewardship of lands** acquired for flood mitigation or multi-benefit purposes **aligns with King County guidance related to encampment procedures and protocols**.	Property protection	King County Water and Land Resources King County Parks	Custodial agency King County King County FCD		
Headwaters and Floodplain Acquisition and Protection — Continue annual fee and easement acquisition of natural lands, providing preventive and natural resource protection benefits. Projects occur countywide and can occur either in upland areas that add recreational and watershed function benefits or in floodplain or adjacent environments that prioritize ecological restoration and salmon recovery.	Natural resource protection	King County Parks King County Water and Land Resources	Conservation Futures Tax King County Parks Levy Various federal, state, and local grants		
Emergency Alert and Warning — Maintain the KCInform and Alert and notification system to provide real-time, critical, life-saving emergency messages to county staff, city jurisdictions, and the public.	Emergency services	King County Office of Emergency Management	King County Emergency Management Operating Budget		
Emergency Coordination — King County OEM is the coordinating entity for county government during emergency operations in all of the five mission areas (Prevention, Protection, Response, Recovery, and Mitigation). The various county departments and other partners provide capabilities to meet the needs of the operation. During Response operations, King County Office of Emergency Management (OEM), through the Emergency Operations Center (EOC), coordinates and facilitates operations activities, especially when they involve more than one county agency or more than one jurisdiction, are complex in scope or have a unique nature, or in other situations at the request of the departments and partners. Primary roles of the King County OEM include resource management and supporting situational awareness.	Emergency services	King County Office of Emergency Management	King County Emergency Management Operating Budget		
Emergency Public Information — Facilitate local and regional message coordination. Manage the King County Emergency Management Blog to share public information messages with partners. Coordinate cross-jurisdictional, cross-discipline public information / communicators group for message collaboration.	Emergency services	King County Office of Emergency Management	King County Emergency Management Operating Budget		
Regional Coordination — Facilitate regional coordination of emergency management activities with county agencies, other jurisdictions, and the private sector to support information sharing and other activities, as well as lend support to minor issues. This coordination is scalable from routine operations to regional coordination, or enhanced operations for specific threats, incidents, or special events.	Emergency services	King County Office of Emergency Management	King County Emergency Management Operating Budget Grants		
Regional Flooding Exercise — Conduct annual regional flooding exercises to include multiple agencies with flood response capability, and complete an evaluations, and create a lessons- learned report to be submitted annually to CRS.	Emergency services	King County Office of Emergency Management	King County Emergency Management Operating Budget King County FCD Grants		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
King County Road Alerts — Provide email and text alert services for road conditions in unincorporated King County, including weather- and flood-related road closures and natural disasters. Alerts are also posted on X (formerly Twitter).	Emergency services	King County Roads	King County Roads Operating Budget		
My Commute Website/Map — Provide public travel alerts on a web map with road closures and restrictions, including flooding or landslides. Users can select each reported location to see more information on cause and anticipated duration of closures/restrictions. Users can also access the images from traffic cameras located across the county to view road conditions in real time. Most of the information is for County-managed roads in the unincorporated area, but some information is also provided by other agencies, such as WSDOT.	Emergency services	King County Roads	King County Roads Operating Budget		
Post- Flooding Bridge Inspection — Following high-flow events, perform safety inspections on a select set of bridges, looking for scour, road overtopping, and debris buildup in the most impatched flooded areas.	Emergency services	King County Roads	King County Roads Operating Budget		
Roads 24/7 Helpline — The helpline is staffed with customer service agents to perform call intake of county road issues, including storm safety and flooding related incidents.	Emergency services	King County Roads	King County Roads Operating Budget		
Stormwater Emergency Response — Provide emergency response services to emergent situations in which flooding, erosion, or pollution in or along the stormwater drainage system is causing or imminently threatens to cause a severe hazard to public safety, public health, or aquatic life. The stormwater drainage system includes both natural and manmade features that convey, store, infiltrate, or otherwise manage stormwater runoff in unincorporated King County.	Emergency services	King County Water and Land Resources	King County Surface Water Management		
Provide translated educational materials and emergency information, including King County agency contacts, during times of emergency.	Emergency services	King County Water and Land Resources King County Office of Emergency Management	Grants King County FCD		
Neighborhood Drainage Assistance Program (NDAP) — Resolve stormwater-related flooding, erosion, and sedimentation problems in unincorporated King County by designing and building new drainage systems, repairing existing drainage systems, or providing technical assistance, with a focus on projects that maximize benefit to the County's stormwater system.	Structural	King County Water and Land Resources	King County Surface Water Management King County FCD grants		
Agricultural Drainage Assistance Program (ADAP) — Provide technical and financial support to agricultural property owners to improve drainage of agricultural lands.	Public information	King County Water and Land Resources	King County Surface Water Management		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Stormwater Complaint Program — Field drainage complaints, and determine whether a King County program or interest should be involved with a resolution, and provide public information.	Public information	King County Water and Land Resources	King County Surface Water Management		
Stormwater Engineer Review Program — Address flooding and drainage complaints requiring a deeper level of analysis than provided by the complaint program. Determine whether a King County program or interest should be involved with a resolution and/or provide technical assistance to private landowners.	Public information	King County Water and Land Resources	King County Surface Water Management		
Stormwater Engineer Studies Program — Address flooding and drainage complaints requiring a deeper level of analysis or with a greater breadth of scope than is provided by the Engineer Review program. Determine whether a King County program or interest should be involved with a resolution and/or provides technical assistance to private landowners.	Public information	King County Water and Land Resources	King County Surface Water Management		
Provide Accessible Customer Support Information —King County's exemplary floodplain regulations are complex, and permitting delays or errors can be caused by customers not understanding the purpose behind the code or permit and submittal requirements.	Prevention	King County Department of Local Services	King County permit fees		
Vashon-Maury Island Coastal Hazard Vulnerability Assessment and Response Plan – Conduct a detailed assessment of the Vashon and Maury Island shoreline, including public and private infrastructure and natural systems, to better understand the locations that may face a higher risk from coastal flooding and sea level rise. Results from the study will inform long-range planning and the development of additional actions, policies, development regulations, or zoning code changes to address risks.	Prevention	King County Water and Land Resources	Grants		
Analyze and map alluvial fan hazard areas.	Prevention	King County Water and Land Resources	King County Surface Water Management Various state and local grants		
Develop alluvial fan hazard regulations.	Prevention	King County Water and Land Resources King County Department of Local Services	King County Surface Water Management		
Coastal Flooding Best Practices — Evaluate best practices from other states for coastal flood mitigation and identify options that could be applied locally.	Prevention	King County Water and Land Resources	King County Surface Water Management Grants		
Comprehensive Residential Mitigation Feasibility Study — Update and improve the County's Repetitive Loss Area Analysis by conducting a flood vulnerability study of all flood-prone structures in flood hazard areas of unincorporated King County and recommend mitigation actions.	Prevention	King County Water and Land Resources	King County Surface Water Management King County FCD Grants		
Augment Hazus Analysis – Examine the loss estimates behind levees associated with possible flooding due to levee overtopping or failure. This analysis will build on the Hazus inventory created for this Flood Plan identifying buildings and critical facilities and infrastructure.	Prevention	King County Water and Land Resources	King County Surface Water Management Grants		
Update King County's Flood Hazard Code to ensure continued protection of life and safety, FEMA compliance, continued exceedance of NFIP minimum standards, and CRS program participation while also recognizing the value of flood hazard areas as critical habitat for ESA-listed species and allowing for efficient and effective restoration of natural floodplain functions and culvert replacements to restore fish passage.	Prevention	King County Water and Land Resources King County Department of Local Services	King County Surface Water Management King County FCD		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Evaluate opportunities for code updates for flood resilience upgrades to structures that do not conflict with the County's NFIP standing.	Prevention	King County Water and Land Resources	King County Surface Water Management King County FCD		
Equity Performance Measures and Monitoring — Develop performance measures for floodplain management equity outcomes and incorporate them into King County monitoring activities.	Prevention	King County Water and Land Resources	Grants		
Expand King County's Home Elevation Program — Explore partnership opportunities to **expand the home elevation program** to all flood hazard areas where conditions are favorable for elevations, **provide technical assistance** to property owners to understand feasibility and funding options for home elevation, and **advertise King County's home elevation program** to all flood hazard areas where conditions are favorable for elevations.	Property protection	King County Water and Land Resources	Various federal, state, and local grants Partnerships and grants		
Home Elevation Educational Materials – Create educational materials and technical assistance to help homeowners understand the feasibility and funding options for home elevation.	Property protection	King County Water and Land Resources	Various federal, state, and local grants		
Develop a pre-acquisition process for evaluating factors, such as the equity implications and cultural interests affected by a potential acquisition and the effects to neighborhoods and communities of converting private property to public open space. Incorporate geospatial decision support tool to be developed as part of recommendation under structural projects for advancing multi-benefit projects.	Property protection	King County Water and Land Resources King County Parks	King County Surface Water Management King County Parks Levy King County FCD		
Evaluate whether stormwater retrofits or other resilience improvements could provide effective flood risk reduction in lieu of acquisition in areas that are not ecologically significant or not connected to a capital project need.	Property protection	King County Water and Land Resources	King County Surface Water Management		
Evaluate the status of King County's River Facility Inventory to identify facilities that no longer serve a functional purpose and develop a project portfolio for obsolete facility removal and site restoration.	Natural resource protection	King County Water and Land Resources	Grants King County FCD		
Open Space - River Corridors Grants — Provide annual funding to support projects that restore the natural functions of rivers, create or restore public access, and/or increase public awareness of river corridors as valuable natural resources. This program incentivizes multi-benefit projects that integrate recreation and habitat restoration with larger floodplain management efforts.	Natural resource protection	King County Parks	King County Parks Levy		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
King County Integrated Drainage Program (IDP) Pilot — Provide expanded drainage services to rural King County landowners in the non-built (i.e., natural) environment using a multi-objective approach to provide drainage improvements, mitigate local flood hazards, and enhance fish passage and aquatic and riparian habitats.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management Grants		
Identify and implement **wetland restoration and protection activities** to mitigate flood risk.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management King County Mitigation Reserves Program Various state and local grants		
Review and update King County's procedures related to naturally occurring large wood in rivers and streams via coordination among King County DNRP, the King County Sheriff's Office, and other agencies as necessary. Activities should be consistent with the policies and other recommendations outlined in this Flood Plan, including the recognition that wood is an integral element of aquatic habitat necessary for ESA-listed salmon and moving wood incurs significant mitigation expense.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management King County FCD		
Review and update King County Public Rule LUD 12-1 (effective April 30, 2010), which addresses procedures for considering public safety in development and design of capital projects that include placement of wood in rivers and streams of King County.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management King County FCD		
Work with farmers to **implement riparian buffers, native plantings, and flood resilience measures on agricultural lands** in the floodplains.	Natural resource protection	King County Water and Land Resources	Conservation Reserve Enhancement Program (CREP) State and local grants		
Hazard Mitigation Plan Update — Maintain the King County Regional Hazard Mitigation Plan and support development of mitigation strategies aimed at reducing risk. Provide technical assistance with planning efforts and grants to mitigate flood risk.	Emergency services	King County Office of Emergency Management	Federal grants King County FCD		
All Hazard Public Education Program — Provide preparedness education to the public (unincorporated King County) as well as support hazard education with local jurisdictions.	Emergency services	King County Office of Emergency Management	Various federal grants		
Identify mechanisms to **improve cross-agency emergency response coordination**.	Emergency services	King County Water and Land Resources King County Office of Emergency Management	Grants King County FCD		
Update the King County *Water and Land Resources Project Management Manual* to include multi-benefit considerations early in the project development process (no later than alternatives analysis) so that multi-benefit opportunities are identified and considered across all projects.	Structural	King County Water and Land Resources	King County Surface Water Management King County FCD		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
River Facility Inventory Asset Management System – Update the river facility inventory of levees and revetments in King County to a geospatial asset management system.	Structural	King County Water and Land Resources	Grants King County FCD King County Surface Water Management		
Develop a geospatial project decision-support tool to inform the development of projects that will advance multi-benefit outcomes, including layers that identify different program priorities for acquisitions, capital projects, and capital project planning.	Structural; property protection	King County Water and Land Resources	King County Surface Water Management King County FCD		
Risk Reduction Support via Grants — Provide coordination and support to agencies and jurisdictions pursuing grants to mitigate flood-related risks (such as BRIC, HMA, FMA, HHDMG).	Public information	King County Office of Emergency Management	Various federal grants		
Dam Safety Education Program — Provide information to communities, businesses, and jurisdictions about dam hazards. Coordinate with dam owners and operators on dam safety protocols and response activities. Work with dam owners and operators of High Hazard Dams to look at opportunities for improvements. Assist with developing grant applications for dam mitigation work.	Public information	King County Office of Emergency Management	King County Emergency Management Operating Budget Various federal, state, and local grants King County FCD		
Improve Access to Flood Preparedness Materials – Collaboratively engage diverse audiences to co-create effective flood preparedness outreach. This may require different graphics, address broader topics, and use different methodologies to meaningfully reach different cultures and communities. Also, identify tools and implement preparedness outreach to those experiencing homelessness who live in at-risk areas, specifically riparian areas.	Public information	King County Water and Land Resources	Grants King County FCD King County Surface Water Management		
Develop a program for public information to connect floodplain managers and partners to collaboratively create and implement more targeted outreach to change behavior when building more resilient communities.	Public information	King County Water and Land Resources	Grants King County Surface Water Management King County FCD		
Analyze the feasibility of map information improvements that would produce interactive web-based mapping tools to show inundation areas and flood depths at various modeled high-flow conditions on major rivers using existing information and models already available to the public, such as those used for FEMA's Flood Insurance Rate Map studies and reports.	Public information	King County Water and Land Resources	Grants King County FCD King County Surface Water Management		
Develop and provide information about permitting requirements and potential strategies related to home resilience. Improved technical services are an investment that would provide more readily available information so builders, property owners, and renters could understand flood hazard- related regulations and more successfully evaluate the building of flood-safe structures.	Public information	King County Water and Land Resources King County Department of Local Services	King County Surface Water Management King County FCD Other county funds		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Beaver Education — Provide educational information about the role of beavers in the Pacific Northwest and provide landowners with beaver management resources, management tools, and technical expertise to limit flooding and property damage from beaver activity.	Public information	King County Water and Land Resources	King County Surface Water Management		
Flood Resilience Improvement Program — Develop a comprehensive program to raise awareness about flooding, increase flood preparedness, reduce flooding impacts, and increase community resilience. Engage with communities and community-based organizations to identify their needs in building flood resilience and provide support to achieve their flood resilience goals.	Public information	King County Water and Land Resources	Grants		
Stormwater Education Program — This outreach program is designed to educate landowners about the importance of stormwater controls, including flow control, which contributes to reductions in downstream flooding.	Public information	King County Water and Land Resources	King County Surface Water Management		
Tidal/Riverine Flooding Connections — Provide resources about the interdependencies among riverine, tidal, and coastal influences on flooding, including potential impacts and roles and responsibilities for preparedness and response.	Public information	King County Water and Land Resources	King County Surface Water Management Various federal, state, and local grants King County FCD		
Use projections of changes in future river flows **to study potential changes in river or basin-scale risks from climate change** to inform appropriate risk reduction and resilience actions.	Prevention	King County	Grants King County FCD		
Relocation Planning — Identify high-risk properties or neighborhoods where managed retreat may be preferred or necessary, including retreat from severe channel migration zones and coastal, landslide, and alluvial fan hazard areas.	Property protection	King County Water and Land Resources	King County Surface Water Management Various federal, state, and local grants King County FCD		
Support property owners with resources for **on-site flood response action plans and other short-term response tools**.	Emergency services	King County Water and Land Resources King County Office of Emergency Management	Grants King County FCD		 (or undetermined)
Improve Road Safety in Flood-Prone Areas — Assess opportunities to improve flood-safe road access, map current and possible evacuation routes, and explore feasibility of priority resilient evacuation road projects.	Structural	King County Roads	Grants		 (or undetermined)

Capital Project Recommendations

South Fork Skykomish/Snoqualmie River Watershed

South Fork Skykomish River

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Lower Miller River Floodplain Restoration Project — Restore up to 140 acres and several miles of Miller River mainstem and tributary and side-channel habitat to improve salmonid habitat in the South Fork Skykomish watershed.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management Various state and local grants		

Upper Snoqualmie River

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
SE Reinig Road Drainage Improvement Culvert — The existing culvert on SE Reinig Road near North Fork Road SE is inadequately sized, which restricts water flow and causes annual flooding on nearby roadways and private properties. This project will replace the 40-inch-diameter corrugated metal pipe to increase water flow and provide fish passage.	Natural resource protection; structural	King County Roads	Real Estate Excise Tax Local grants		
North Fork Bridge #1221 Replacement (Roads CIP #1143969) — Bridge replacement project to reduce the frequency of road flooding and subsequent neighborhood isolation by raising the height of 428th Avenue SE and increasing the hydraulic opening of the bridge.	Structural projects	King County Roads	Real Estate Excise Tax Federal, state, or local grants		

Lower Snoqualmie River

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Mouth of Tuck Creek Fish Passage Project (FPS-1671) — Fish passage project to replace one barrier culvert, floodgate, and fishway with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources	King County Surface Water Management Various federal, state, and local grants		
Langlois Creek Fish Passage Project at NE 24th Street (FPS-2130) — Fish passage project to replace one barrier culvert at a road intersection with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Local grants		
Tributary to Horseshoe Lake at Snoqualmie Valley Trail just North of NE Carnation Farm Road (FPS-2373) — Replace existing concrete culvert to improve fish passage and conveyance.	Natural resource protection; structural	King County Parks	Real Estate Excise Tax 2 Local grants		
Ames Creek Fish Passage Projects at NE 100th (FPS-1757) and NE 80th (FPS-565) — Fish passage projects to replace two existing barrier culverts with a fish-passable structure at both locations.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, local grants		
Mouths of Unnamed Tributaries to the Snoqualmie River at W Snoqualmie River Road (FPS-2528 & -2529) — Fish passage projects to replace three barrier culverts/flood gates with fish-passable structures.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management State and local grants		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Harris Creek Fish Passage Projects on NE Stossel Creek Way (FPS-2176, -157, -638, -5670) — Fish passage projects to replace four existing barrier culverts with fish-passable structures.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		
Snoqualmie River Farm Floodplain Reconnection — Explore ways to reconnect Snoqualmie River floodplain to improve salmon habitat while also protecting farmland and farm structures at the Snoqualmie River Farm (formerly Beyers property) with a feasibility study and project design.	Natural resource protection	King County Water and Land Resources	Various federal, state, and local grants		 (or undetermined)

Lake Washington/Cedar/Sammamish River Watershed

Cedar River Basin

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Cedar River Lower Rutledge-Johnson Floodplain Restoration — Multi-benefit floodplain restoration project adjacent to State Route 169 and Cedar River Trail.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management State and local grants		
Molasses Creek Barrier Removal Project — A fish passage project that will remove a fish passage barrier at the mouth of Molasses Creek.	Natural resource protection	King County Water and Land Resources King County Roads	King County Surface Water Management		
Molasses Creek Culvert Replacement Project at SE Petrovitsky and 134th SE (FPS-1602, -650) — Replace two failing culverts with two fish-passable structures.	Natural resource protection; structural	King County Roads	Real Estate Excise Tax Federal, state, and local grants		
WPA Levee Setback – Remove and set back the WPA Levee along the Cedar River. This project would reconnect floodplain habitat and could reduce erosion and potential levee failure risk to the downstream Belmondo Levee.	Natural resource protection; structural	King County Water and Land Resources	King County Surface Water Management State and local grants		 (or undetermined)
SE Petrovitsky Road at 151st Avenue SE – The culvert under SE Petrovitsky Road and 151st Avenue SE is failing, and the road is at risk of collapsing. Due to the failed pipe, the outlet often plugs and water overtops SE Petrovitsky Road. This project will replace the culvert and add a new inlet structure with a debris cage to prevent the system from plugging. This will also improve outfall from the nearby detention facility.	Structural projects	King County Roads	King County Surface Water Management King County Roads Capital Budget		 (or undetermined)

Sammamish River/Lake Sammamish Basin

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Peters Creek at WSRT north of NE 90th Street (FPS-941, CLO-132509) — Replace 72-inch-diameter deteriorating metal pipe with fish-passable structure. Improved conveyance.	Natural resource protection; structural	King County Parks	Real Estate Excise Tax 2		
Trib to Sammamish River at Marymoor Dog Park (FPS-1257, CLO-114463 & FPS-1258, CLO-147289) — Replace two deteriorating culverts with fish-passable structures. Improved conveyance.	Natural resource protection; structural	King County Parks	Real Estate Excise Tax 2		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Trib to Sammamish River at SRT near NE 143rd Street (FPS-2076, CLO-130643) — Replace existing 24-inch-diameter corroded bottom barrel of culvert with fish-passable structure. Improved conveyance.	Natural resource protection; structural	King County Parks	Real Estate Excise Tax 2		
Bear Creek Integrated Restoration and Stormwater Projects — Integrated planning and implementation of habitat restoration and stormwater retrofit projects.	Natural resource protection; structural	King County Water and Land Resources	King County Surface Water Management State and local grants		
Daniels Creek Fish Passage Projects at NE 185th (FPS-408) and NE Woodinville-Duvall Road (FPS-170) — Fish passage projects to replace two existing barrier culverts with fish-passable structures at both locations.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		
Cottage Lake Creek Fish Passage Projects at Avondale Road NE (FPS-2098), NE 128th Way (FPS-165), NE 165th (FPS-2296), and NE Avondale & NE 144th (FPS-2099) — Fish passage projects to replace four barrier culverts with fish-passable structures.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		
George Davis Creek at ELST (FPS-2142) — Fish passage culvert replacement is part of ELST South Sammamish Phase 2 project.	Natural resource protection; structural	King County Parks	King County Parks Levy		 (or undetermined)

Issaquah Creek Basin

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Carey/Holder/Issaquah Creek Confluence Restoration — New project start on former Bonomi farm. Feasibility completed in 2023. Coordinated planning effort between King County's Agriculture, Forestry, and Incentives; Ecological Restoration and Engineering Services; Basin Steward; and Parks kicks off in 2024. Cost assumes 45 acres of restoration and 4,500 linear feet of channel work.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management State and local grants		
Carey Creek Fish Passage Project at 276th SE — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		
East Fork Issaquah Creek Fish Passage Project at NE High Point Way (FPS-2897) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		
East Fork Issaquah Creek Floodplain Restoration Strategy —System-wide study of the benefits of restoring a 3-mile section of the creek in unincorporated King County from West Tiger Mountain at SE 88th, downstream to the High Point Way interchange off I-90.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management Federal, state, and local grants		
Fifteen Mile Creek Bridge #493C Replacement — The current bridge carries SE May Valley Road, a major arterial over Fifteen Mile Creek. The original bridge was built in 1932 and is structurally deficient with substandard rails, narrow width, and a poor hydraulic opening. This bridge replacement project will remove the existing bridge, associated fill, and stream bank armoring that is constricting the creek's flow and creating flooding, scour, and potential water-quality issues.	Structural projects	King County Roads	King County Roads Capital Budget Federal grants		
208th Avenue SE @ SE 135th Culvert — The existing culvert at 208th Avenue SE and SE 135th Street is in an area where alluvial soils and sediment build up and reduce its capacity to carry flows. This causes frequent flooding on a sole-access road. This project will replace the culvert to increase water flow and provide fish passage.	Natural resource protection; structural	King County Roads	Real Estate Excise Tax		

Lake Washington Basin

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Margaret's Way Trailhead Driveway Culvert (FPS-2737) — Replace culvert with fish passage structure. Existing culvert is corroded and undersized, which causes piping around the inlet to form sinkholes. Improved conveyance.	Natural resource protection; structural	King County Parks	Real Estate Excise Tax 2 Local grants		

Green/Duwamish River Watershed

Green/Duwamish River Basin

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Cecil Moses Tire Revetment — Cecil Moses Park features a failing tire revetment, a tidally influenced backchannel, and a fish-impassable tributary culvert just upstream of the park. This project will pursue removal of the tire revetment, turning the backchannel into a side channel and making the culvert fish-passable.	Natural resource protection	King County Water and Land Resources	State and local grants		
NE Auburn Creek Restoration — Enhance tributary confluence with Green River and create a new side channel, provide stream enhancement on public lands, replace a fish passage barrier, flood benefits, and improve access to non-natal stream for rearing and flood refuge by juvenile Chinook.	Natural resource protection	King County Water and Land Resources	King County Surface Water Management State and local grants		
Lower Green-Duwamish Levee Vegetation Guidelines — Update lower Green-Duwamish vegetation management guidelines for maintenance and capital projects developed as part of the lower Green River SWIF. The purpose of the update is to reflect current levee safety risk management and vegetation management best-practice recommendations from the Corps, experienced with vegetation on levees in California and through Engineering with Nature. The update will also achieve greater alignment with initiatives, such as Clean Water Healthy Habitat and WRIA 9 salmon recovery goals.	Natural resource Protection	King County	Federal, state, and local grants		
Little Soos Creek Fish Passage Project at SE 240th Street (FPS-1997) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, and local grants		
Watercress Creek Fish Passage Project at SE 432nd (FPS-2123) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, and local grants		
Unnamed Tributary to Big Soos Creek Fish Passage Project at 156th SE & SE 240th (FPS-101, -2604, -1771) — Fish passage project to replace three barrier culverts with two fish-passable structures.	Natural resource protection; structural	King County Water and Land Resources King County Roads	Real Estate Excise Tax Federal, state, and local grants		
Unnamed Tributary to Covington Creek Culvert Replacement at Thomas Road SE (FPS-2129) — Replace a failing culvert with a fish-passable structure.	Natural resource protection; structural	King County Roads	Real Estate Excise Tax		
North Fork Newaukum Creek near 284th Avenue SE (FPS-2089) — Remove fish barrier culvert and restore stream to natural process and improve conveyance.	Natural resource protection; structural	King County Parks	Real Estate Excise Tax		
S Langston at 125th Drainage Improvement and Flood Risk Reduction — The existing drainage system along S Langston Road and 61st Place S is poorly functioning and results in chronic flooding on public roads and private property, which damages property. This project will upgrade or replace the stormwater conveyance pipes to improve drainage issues and alleviate flooding impacts.	Structural projects	King County Roads	Local grants		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
North Green River Park Floodplain Reconnection — Remove fish passage barrier at an existing flapgate and reconnect floodplain to increase off-channel rearing habitat for juvenile salmon.	Natural resource protection; structural	King County Water and Land Resources	King County Surface Water Management State and local grants		
Cristy Creek Fish Passage Project at 249th Avenue SE (FPS-3136) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, and local grants		
Jenkins Creek Fish Passage Project at Kent-Black Diamond Road SE (FPS-2110) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, and local grants		
Newaukum Creek Fish Passage Project at SE 400th (FPS-1995) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, and local grants		
Unnamed Tributaries to Newaukum Creek Fish Passage Projects at SE 424th (FPS-365), 228th SE (FPS-374), and 216th SE (FPS-912) — Fish passage projects to replace three barrier culverts with fish-passable structures.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Various federal, state, and local grants		
Berrydale Overcrossing Bridge #3086OX Replacement and Corridor Improvements – This project replaces a fish barrier culvert at Jenkins Creek within the project corridor. This will improve the performance of the culvert and reduce the risks of neighborhood flooding.	Natural resource protection; structural	King County Roads	King County Roads Capital Budget Grants		 (or undetermined)

Vashon-Maury Island and Puget Sound Nearshore

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Dockton Seawall Periodic Repair — The Dockton Road timber seawall on Vashon Island was originally built in 1916, and much of the seawall has failed. Storm surges often damage the low-elevation seawall, and breaches to the wall cause shoulder and roadway erosion. There have been 15 repairs over the last 20 years, primarily to repair sinkholes but larger repair projects are also needed to rebuild the road base and seawall itself.	Structural projects	King County Roads	King County Roads Operating or Capital Budget determined by the type and estimated costs of the repair		

White River Watershed

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Unnamed Tributary to Hylebos Creek Culvert Replacement at 370th SE (FPS-2124) — Replace a failing culvert with a fish-passable structure.	Natural resource protection; structural	King County Roads	Real Estate Excise Tax Federal, state, and local grants		
Unnamed Tributaries to the White River Fish Passage Projects at SE 472nd (FPS-106), 196th SE (FPS-762), and SE Mud Mtn. Dam Road (FPS-2644) — Fish passage projects to replace three barrier culverts with fish-passable structures.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management State and local grants Real Estate Excise Tax		

Activity Name and Description	Mitigation Category	Potential Lead Agency	Potential Funding Source(s)	Types of Flooding Addressed	Timeline
Pussyfoot Creek Fish Passage Projects at 180th SE (FPS-1754), 196th SE (FPS-2499), & 212th SE (FPS-158) — Fish passage projects to replace three existing barrier culverts with a fish-passable structure at each location.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		
Seconds Creek Fish Passage Project at 196th Avenue SE (FPS-2286) — Fish passage project to replace one barrier culvert with a fish-passable structure.	Natural resource protection; structural	King County Water and Land Resources King County Roads	King County Surface Water Management Federal, state, and local grants		

CHAPTER 5
Plan Implementation

This 2024 King County Flood Management Plan identifies many activities to enhance the resilience of King County communities to various flood-related risks, but the Flood Plan is only useful insofar as it is implemented and maintained. Step 10 of the 10-step Community Rating System (CRS) planning process calls for implementing plans and changing course as conditions change or new information becomes available. This chapter describes how King County will implement the Flood Plan and keep the plan current through annual evaluation and describes the expectations for future updates to the plan. The chapter also discusses how to incorporate the Flood Plan into existing planning mechanisms and continue public involvement.

5.1 Plan Implementation

This Flood Plan and its recommendations are based on the premise that flooding in King County is a regional and cross-jurisdictional issue and, as such, flood risk reduction and building flood-resilient communities require extensive collaboration and strong partnerships. King County will continue to coordinate and partner with local jurisdictions, special districts, state and federal agencies, tribal governments, and others to collaboratively advance the goals of this Flood Plan. King County will continue to implement activities that reduce flood risk and improve resilience countywide using a variety of funding sources and partnerships.

King County's Role in Implementation

Chapter 4 describes a comprehensive strategy for reducing flood and flood-related risks for multiple floodplain management partners throughout the county. King County's role in implementing these strategies is multifaceted. First, King County functions as a convener to work collaboratively with partners to identify salmon recovery, open space, agriculture, and stormwater projects and programs that often intersect with flood risk reduction (such as through groups like Snoqualmie Fish Farm Flood and the WRIA salmon recovery forums). Second, King County develops, adopts, and implements zoning and land use regulations and manages stormwater and habitat restoration projects and programs within the unincorporated areas of the county. Third, King County develops and adopts the Regional Hazard Mitigation Plan and provides regional parks, wastewater, and road services.

King County is also the primary contracted service provider to the King County Flood Control District (FCD; see next section below for description) for delivering a wide range of programs and projects to reduce flood risk. As explained elsewhere in this Flood Plan, the FCD is a separate government from King County, with its own revenue stream and decision-making structure. Many of the activities funded by the FCD are implemented by King County acting as service provider to the FCD.

The Flood Plan is a functional plan of King County's Comprehensive Plan. Once adopted by the County Council, the Flood Plan establishes policy guiding flood risk reduction and floodplain management, including setting the foundation for the County's codes and regulations addressing flood hazard areas. King County will consider any needed code revisions to align with the Flood Plan's recommendations, as well as its goals, objectives, and guiding principles.

The Comprehensive Plan specifies that King County shall coordinate with cities, special purpose districts, and other local service providers when providing local, countywide, and regional services, including when services are delivered within cities. This type of coordination is especially important when dealing with flooding since water does not adhere to jurisdictional boundaries. In addition to King County's interest in coordination and collaboration, the pursuit of integrated floodplain management and the successful delivery of multiple benefits—both foundational to this plan—are predicated on early and proactive engagement and coordination (see Section 5.2 for more detail).

As explained in Chapter 4, the activities King County proposes to implement are called out in the King County Action Plan, which is driven by need, feasibility, and funding availability or the commitment to seek funding. King County's Water and Land Resources Division (WLRD) in the Department of Natural Resources and Parks is the County's lead agency in implementing many of the County's flood risk reduction services. Other King County divisions and departments lead activities in the realm of emergency operations, maintenance of roads and bridges, implementation and enforcement of land use and building regulations, and park and open space management. WLRD will continue to provide leadership and collaborate with these other departments and divisions to pursue cooperative, interdisciplinary implementation of this Flood Plan and will continue its work to leverage a variety of funding sources to achieve this plan's goals.

Partnerships and Existing Authorities Supporting Implementation

This Flood Plan articulates the different types of flooding and flood-related risks that are present in King County, which extend from marine shorelines to the upstream extent of developed landscapes in the Cascades foothills. Flooding takes many forms and occurs in a variety of different landscapes and affects multiple jurisdictions. A variety of existing institutional structures are in place to address specific aspects of flood-related issues. These include the following:

- **Surface water/stormwater management** – Local governments in King County—including the County and most cities—are required to address stormwater and surface water runoff through the National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit. All cities and counties that implement activities under their municipal stormwater permit collect surface water management fees. Stormwater management programs generally address outreach, maintenance, and capital projects to reduce the impacts of stormwater runoff and flooding. The nature of these programs is that they are perpetual, with variable funding and staffing capacity as determined by locally established surface water management fees. In addition to local governments developing and implementing their own stormwater management programs, regional efforts are underway in Central Puget Sound intended to achieve the best overall outcomes at the watershed scale.
- **Floodplain management** – Many local governments maintain floodplain management programs of some kind to ensure compliance with National Flood Insurance Program (NFIP) standards. This

includes maintaining and enforcing land use regulations to prevent the creation of new risks, communicating about flood preparedness, and providing emergency response services. These roles and authorities are successful for achieving flood risk reduction and building resilient communities yet are often underfunded.

- **King County Flood Control District (FCD)** – The King County FCD was established in 2007 as a special-purpose district following a recommendation from the 2006 King County Flood Hazard Management Plan, with the purpose of addressing a growing list of flood risk reduction and infrastructure maintenance needs. A levy to fund the FCD's priorities became effective in 2008. The FCD has become the most prolific sponsor of flood risk reduction projects and programs across King County, with a focus on mainstem rivers and major tributaries, as well as on maintaining the County's flood protection infrastructure (levees and revetments). King County serves as the primary service provider to implement the FCD's work program. The King County FCD is a separate governmental entity from King County, with its own governance, funding source, and budgetary process. This Flood Plan was developed in consultation with the FCD and includes activities funded in its current publicly available 6-year Capital Improvement Plan (CIP) and programmatic budgets. The region contributes to and benefits from the FCD levy, and it is hoped that the FCD will find the concepts outlined in this Flood Plan in alignment with FCD work program and budget priorities.
- **Tribal governments** – King County is the homeland of indigenous people who have continuously inhabited this landscape since time immemorial. These lands are the ancestral territories of the Coast Salish people, who today are affiliated with the Duwamish, Muckleshoot, Puyallup, Snoqualmie, Suquamish, and Tulalip tribes. Ongoing consultation and coordination between King County and the tribes will be integral to implementing the activities outlined in this Flood Plan to ensure tribal interests and treaty rights are upheld. King County has and will continue to directly invite tribes to be represented on planning committees, comment on environmental reviews and plans, and contribute as partners in planning processes.
- **Federal and state agencies** – Ongoing state and federal coordination is important to the implementation of this Flood Plan, including setting policy and minimum standards, providing funding to leverage local budgets, and collaborating to resolve sometimes competing standards in the implementation of multi-objective efforts. This includes permitting of project activities, compliance with the ESA, adherence to the NFIP Biological Opinion, coordination on dam operations and emergency response activities, and funding for flood protection facility repairs (see *Funding* section later in this chapter for more detail).
- **WRIA salmon recovery groups** – In Washington state, cities, counties, and a range of other interests organized at the scale of major river watersheds (Water Resource Inventory Area, or WRIA) to provide direction to implement watershed-based salmon recovery plans. King County includes two entire WRIAs and portions of two others. Many of the activities identified in watershed-based salmon recovery plans align spatially with areas that experience flood risk. Furthermore, many WRIA priorities for habitat restoration may modify historic flood protection facilities, and projects have the potential to enhance natural floodplain functions in ways that benefit flood risk reduction. Coordination with WRIAs will ensure that mutually beneficial flood risk reduction and habitat restoration opportunities are realized.
- **Other partnerships and collaboration** – Beyond the specific strategies and organizations mentioned previously, King County's flood risk reduction goals demand a broad spectrum of partnerships and collaborative initiatives. Aligned with the principles outlined in both the King County Comprehensive Plan and the King County Countywide Planning Policies, such

collaborative efforts are essential for providing efficient, high-quality public services. These alliances bolster climate change resilience efforts, optimize limited resources, and support the provision of multiple benefits. It follows that effective flood risk mitigation and the enhancement of countywide flood resilience hinge on cooperation with a diverse array of organizations. This includes cities, adjacent counties, tribes, and special purpose districts (like those managing drainage, stormwater, fire services, etc.), as well as interest groups, non-governmental organizations, and more.

Volunteer floodplain restorative planting event with Snoqualmie Tribe in Fall City, February 2020

Ongoing Community Engagement

In addition to continuing to implement current activities and partnering with other governments to advance flood risk reduction, King County recognizes the need to expand its work in local communities, to build relationships and trust, and to move toward co-creation of flood resilience by working with community groups and representatives. By bringing community into the decision-making process and engaging them in defining problems, designing solutions, and implementing programs where feasible, better outcomes will be achieved.

King County developed and implemented an extensive community engagement strategy as part of this planning effort to have a more diverse representation of voices heard when defining needs (**Appendix C**). Based on lessons learned during community engagement activities to date, the County is interested in expanding its work, particularly in flood-vulnerable communities, to ensure that their

needs and interests are understood. This understanding will, in turn, help King County innovate floodplain management programs that better support and meet the needs of community members.

5.2 Advancing Integrated and Multi-Benefit Floodplain Management

Swimmers at Tolt-MacDonald Park at Lower Tolt River Floodplain Restoration project site, July 2016

As described in the introduction to this Flood Plan and elaborated upon in the goals, objectives, and guiding principles (see Chapter 1), King County has developed this Flood Plan to align with integrated floodplain management principles. A goal of integrated floodplain management is to improve the resilience of floodplains and flood hazard areas to protect communities and the health of ecosystems while honoring tribal sovereign rights (including treaty-reserved fishing, hunting, and gathering rights), supporting values important to the region and local communities, and being efficient with limited financial resources (Ecology 2021).

A core component of integrated floodplain management is to improve the resilience of floodplains for community needs and the health of the environment by embracing comprehensive solutions and collaborative decision-making. As an approach, integrated floodplain management takes a holistic perspective and evaluates considerations and opportunities at a reach or watershed scale while seeking to achieve outcomes that provide multiple benefits. In practical terms, this means finding ways to develop solutions that reduce flood risk and restore and support natural floodplain functions while achieving objectives for salmon recovery, the economy, recreation, water quality, viable

agriculture, environmental justice, and transportation. Policy 11 in Chapter 1 of this Flood Plan identifies several potential multi-benefit outcomes:

- Climate-resilient public infrastructure, ecosystems, and communities.
- Protected and restored fish and wildlife habitat, including that which supports threatened and endangered salmonids.
- Productive, viable agriculture.
- Safe and sustainable development.
- Opportunities for jobs and economic development.
- Clean water.
- Expanded conservation of open space.
- Enhanced opportunities for recreation and connecting people with nature.

As noted in this plan's policies, flood-prone areas encompass different land uses that are valued by King County and communities within and beyond the county, including developed landscapes that support regional economic activity. Also described in Chapter 1, several state and federal laws and programs intersect with and influence activities in flood-prone areas, including the Clean Water Act, Endangered Species Act, National Flood Insurance Program, and Shoreline Management Act, among others. Effective flood risk reduction reduces flood damage and increases the resilience of communities, and coordinated planning and implementation of activities in flood-prone areas can ensure that trade-offs are adequately considered and that solutions align with integrated floodplain management principles.

Alternatives for flood risk reduction should be informed not just by physical risk, but by the range of other factors described in this plan's goals, objectives, guiding principles, and policies. King County's Comprehensive Plan and Clean Water Healthy Habitat Strategic Plan recommend seeking opportunities to advance multi-benefit outcomes that reflect community priorities and interests as part of broader planning efforts and doing so early in capital project development as part of the initial scoping of alternatives in partnership with local communities.

King County has implemented flood risk reduction capital projects that provide multiple benefits, yet, in many instances, the opportunities to address additional benefits beyond flood risk reduction are identified on a case-by-case basis as part of the design process for individual projects. Adopting an integrated floodplain management approach means moving beyond project-level decision-making to more holistic, reach-based, or watershed-scale implementation.

Over the years, King County and partners have developed an array of plans that outline priorities for flood risk reduction, stormwater, open space protection, transportation, salmon recovery, watershed health, agriculture, and other objectives. The various priorities to achieve a range of objectives are largely known. To achieve the systematic multi-benefit outcomes envisioned by this Flood Plan, King County needs to develop a structure for watershed-based portfolio planning that draws on the range of available information about the priorities referenced in this plan, addresses capital and programmatic needs, and drives implementation of these intentional, watershed-based strategies.

The bulleted list above identifies possible outcomes to pursue along with flood risk reduction activities, but it is not exhaustive. The actual benefits provided by different projects should be determined based on local context and community-identified needs. Proactive outreach with local communities during portfolio planning and through the project development phase is required to ensure that the appropriate range of interests are being considered and accounted for as alternatives are developed and as activities are implemented. Early assessment of opportunities to achieve multiple benefits will result in activities that better meet community needs and will more effectively and responsibly steward public funds and the landscape in which the work takes place.

The following elements are essential for successfully implementing multi-benefit projects. While this framework is focused on project development, this is a foundation from which systematic portfolio planning can occur. Developing these tools and practices will allow King County to formalize collaborative project development and institutionalize approaches focused on multi-benefit outcomes, and these elements can be applied to developing watershed-based prioritization and sequencing strategies as a future body of work. This will ultimately support the type of higher-level, coordinated implementation envisioned by integrated floodplain management.

Including the following steps in the *Water and Land Resources Division Project Management Manual* will support formalizing this approach to multi-benefit project development.

- **Coordination Across County Programs**
  - **Process Improvement** – King County should develop systems and accompanying expectations that foster collaboration across agencies and work programs. Opportunities to work proactively toward multiple objectives should be identified at the earliest phases of portfolio and project planning, ideally before projects are chartered but at a minimum during the chartering phase. A paradigm shift is needed to move away from individual program or funding stream priorities toward actively seeking opportunities to advance multiple public benefits. Such internal coordination can also identify potential external public outreach and engagement needs and opportunities early in project planning and development.
  - **Planning Tools** – King County has multiple plans and policies that intersect with flood risk reduction. The County can improve its systems to identify internal connection points between plans, programs, and policies. Existing county plans and initiatives that connect to flood risk reduction include:
    - King County Comprehensive Plan[41]
    - King County Strategic Climate Action Plan[42]
    - King County Clean Water Healthy Habitat Strategic Plan[43]

41 https://kingcounty.gov/en/dept/council/governance-leadership/county-council/topics-of-interest/comprehensive-plan/2024.

42 https://kingcounty.gov/en/legacy/services/environment/climate/actions-strategies/strategic-climate-action-plan.

43 https://kingcounty.gov/en/dept/dnrp/about-king-county/about-dnrp/sustainability-commitments/clean-water-healthy-habitat.

- King County Regional Hazard Mitigation Plan[44]
- King County Parks Open Space Plan[45]
- King County Parks Leafline Trail Network[46]
- King County Land Conservation Initiative[47]
- King County Local Food Initiative[48]
- King County 30-Year Forest Plan[49]
- WRIA salmon recovery plans (WRIAs 7, 8, 9, and 10)
- King County Stormwater Investment Strategy
- King County Strategic Plan for Road Services[50]
- King County Repetitive Loss Area Analysis (2023 Annual Progress Report included as **Appendix F** of this Flood Plan)
- King County Equity and Social Justice Strategic Plan[51]

Project planning and development should consider the needs identified by the above plans and initiatives, to be facilitated by:

- A geospatial decision support tool that includes data layers from each of these functional areas to support capital planning and project teams in performing an assessment of intersecting priorities during capital portfolio planning.
- Institutionalized, proactive coordination and collaboration where overlapping interests exist to assess the potential for mutually beneficial outcomes or conflicts and to collaboratively establish goals and relative priorities, with reach-scale interests considered at a minimum.

- **External Coordination and Consultation**

44 https://kingcounty.gov/en/legacy/depts/emergency-management/emergency-management-professionals/regional-hazard-mitigation-plan.

45 https://kingcounty.gov/en/dept/dnrp/nature-recreation/parks-recreation/king-county-parks/parks/open-space-plan.

46 https://kingcounty.gov/en/legacy/services/parks-recreation/parks/trails/regional-trails.

47 https://kingcounty.gov/en/legacy/services/environment/water-and-land/land-conservation.

48 https://kingcounty.gov/en/legacy/elected/executive/constantine/initiatives/local-food-initiative.

49 https://kingcounty.gov/en/legacy/services/environment/water-and-land/forestry/forest-policy/30-year-forest-plan.aspx.

50 https://kingcounty.gov/en/dept/local-services/transit-transportation-roads/roads-and-bridges/plans-reports/strategic-plan.

51 https://kingcounty.gov/en/legacy/elected/executive/equity-social-justice/strategic-plan.

  - **Tribal Consultation and Coordination** – Government-to-government consultation with tribal partners, as well as outreach at the staff level with tribal natural and cultural resources departments, is needed to ensure projects are developed with an understanding of factors that are most important to tribes and honors their sovereign rights, including treaty-reserved fishing, hunting, and gathering rights.
  - **Engage Partners** – Collaboration with external groups—such as cities, WRIAs, the FCD, Snoqualmie Fish/Farm/Flood, WSDOT, adjacent counties, emergency responders, and others—is needed during planning efforts and, for specific projects, as early in the design process as possible (i.e., at project charter) to develop mutual understanding of interests and identify partnerships upon which integrated floodplain management is based.
  - **Identify Community Needs** – Understanding the needs of local communities is an imperative component of developing equitable flood risk reduction solutions. Engagement with community members and groups about their local interests, concerns, and priorities should inform project goals, including information about flood vulnerability; environmental justice factors; short-, medium-, or long-term adverse impacts of project construction or implementation; and potential adverse and beneficial outcomes on low-income, minority, or other vulnerable communities.

- **Capital Project Planning and Development**
  - **Establish a Shared Vision** – In coordination with county programs and external partners and communities, establish a shared vision that incorporates reach-based considerations and opportunities and reflects multiple interests and benefits.
  - **Develop Alternatives** – Following from the shared vision and the understanding of internal and external interests and priorities, develop project alternatives that reflect the ways these priorities can or cannot be achieved through the design process. External groups, partners, and communities should be included in the alternatives analysis process. Build mutual support for selected alternatives and consider opportunities to develop a portfolio of projects that achieve a shared vision at the reach scale. For example, developing a package of related flood risk reduction, water quality, and habitat restoration projects in a reach could garner broader community and grant funding support and help meet multiple goals.
  - **Evaluate Effectiveness and Communicate** – Track progress in achieving multiple objectives or providing multiple benefits. Communicate successes and challenges with partners and adjust strategies and actions over time based on results.

5.3 Flood Plan Maintenance

Flood Plan maintenance implies an ongoing effort to monitor and evaluate plan implementation and to update the plan as progress, roadblocks, or changing circumstances are recognized. King County WLRD is responsible for initiating Flood Plan reviews. To monitor progress and update the mitigation activities identified in the Action Plan, the County will review implementation of this Flood Plan annually. The County will also submit a 5-year written update to FEMA consistent with CRS requirements. With this Flood Plan expected to be fully approved and adopted in 2024, the next Flood Plan update will conclude and be adopted in 2029.

Annual Flood Plan Review Process

WLRD will lead annual evaluations of Flood Plan implementation and create a report per CRS planning Step 10.

The division will convene the Partner Planning Committee or similar committee to review the progress toward implementation of the Flood Plan's Action Plan. This review will evaluate any changed conditions or progress made on implementation of mitigation activities listed in Chapter 4. During the review process, the following activities will take place:

- King County will engage the public, community organizations, Flood Plan partners, and past participants to inform them of the annual review process and invite their participation on the committee. One-half of the committee must be comprised of members of the public and partners, so that King County can receive full CRS credit for this activity. The committee will convene at least once per year but could meet more frequently to evaluate plan implementation.
- Meetings of the committee shall be published in accordance with local rules regarding public notice.
- The public will also be notified via an advertisement on the County's website specifying the date and time for the review and inviting public participation.
- Prior to the review, county representatives and others identified as implementors of the various activities will be queried about progress on each action.
- Minutes of the meetings and status reports will be prepared by WLRD.
- The results of each meeting will be made available on the County's website and to the County Council for informational purposes, as well as released to local news media.
- WLRD will maintain copies of minutes and status reports to provide to FEMA as part of the community's annual recertification to the CRS program.
- WLRD will provide the annual Flood Plan evaluation report to the King County governing body each year and will make the report available to the media and the public on the King County website.

King County's annual reviews will do the following:

- Report the implementation status of the flood risk mitigation activities in the Action Plan. Completed projects will be noted and project status will otherwise be described.
- Report changes in federal, state, and local policies to determine whether the policy changes will affect Flood Plan implementation or should be incorporated into the plan.
- Report flood or flood-related events that caused damage or closure of businesses, schools, or public services, including:
  - Dates and descriptions of the events.
  - Documentation of damages due to the event.
  - Closures of places of employment or schools and the number of days closed.
  - Road or bridge closures and the length of time closed.

  - Assessment of the number of private and public buildings damaged and whether the damage was minor, substantial, major, or resulted in total destruction. The assessment will include residences, mobile homes, commercial structures, industrial structures, and public buildings, such as schools and public safety buildings.
- Identify improvements to public infrastructure at risk of flooding or the County's flood protection infrastructure.
- Document any new information related to climate change and flood risk that could influence flood risk-reduction decision-making.
- Report new policies or guidance related to equity in flood hazard management.
- Develop and track new equity and social justice evaluation metrics to measure progress toward pro-equity outcomes over time.

5-Year Flood Plan Update

King County's Class 2 rating in the CRS program requires that the County submit an update to this Flood Plan every 5 years to maintain the benefits of that rating. The Flood Plan update will assess any changes in flood-related hazards and reevaluate associated risk. It will also report on the implementation of the last Flood Plan and provide a new strategy for reducing flood risk. This process will include outreach to those who participated in this planning process and others to solicit parties interested in participating in updating and revising the Flood Plan.

A committee of partners and community members, like the Partner Planning Committee, will be convened, and King County will also develop an engagement strategy to involve the diverse voices that reflect county communities, including disseminating information through a variety of media channels detailing the Flood Plan update process. As part of this effort, public comments will be solicited on the Flood Plan update draft. The public outreach process for the Flood Plan update will be coordinated with the program for public information established pursuant to CRS guidelines. King County estimates this planning effort takes up to 3 years. Presuming the King County Council adopts this Flood Plan in 2024, the next planning cycle would begin in 2026, with the commensurate Flood Plan update adopted in 2029.

5.4 Adaptive Management

Adaptive management is a cornerstone of this Flood Plan's implementation strategy. As new technical information associated with King County's flood hazard areas evolves, Flood Plan implementation priorities will be re-evaluated and reported in annual reviews. Shifting Flood Plan implementation priorities over time will reflect King County's more detailed understanding of the level of risk posed by flooding and channel migration to human safety and the regional economy, the degree to which flood risk reduction strategies are working, and the effectiveness of approaches in meeting the needs of King County communities.

Adaptive management requires a commitment to information management. Emerging data, maps, studies, innovative project designs, and monitoring information will be maintained in an accessible

and organized format. Informed decision-making will ensure that limited financial resources will be directed to highest risk portions of the floodplain environment.

Adaptive management of major rivers for flood risk reduction requires high-quality, well-organized, and accessible technical information.

5.5 Funding

King County faces challenges to address the variety of flood risks that currently exist and that could emerge due to climate change. Existing funding sources to implement the activities identified in King County's Action Plan include the County's Surface Water Management (SWM) fee, grants, general fund, and other program-specific funding sources authorized in the county budget. However, these sources have statutory limitations that make them unable to meet the funding need on their own. Even with King County's strong partnership with the FCD and the County's long track record of successfully receiving millions of dollars in grant funding to address elements of this Flood Plan, the scope of this plan is ambitious. As implementation progress is assessed each year, King County may be required to adjust course based on funding realities.

King County Surface Water Management (SWM) Fee

King County's discharges of surface water must comply with state law and the federal Clean Water Act through its National Pollutant Discharge Elimination System (NPDES) permit. SWM fees are a core source of funding for addressing surface water impacts on water quality and flooding that result from runoff from roads, rooftops, and other impervious surfaces. RCW 36.89.080[52] and 35.67.020[53] authorize the collection of SWM fees by cities and counties. Most cities in King County have their own SWM programs, and they assess fees based on contributions to stormwater runoff and benefits from projects and programs, as authorized by RCW 35.67.020. SWM fee rates, revenues, and programs vary by jurisdiction. In the case of King County's SWM program, a fee is applied to parcel owners in unincorporated areas as set forth in K.C.C. Title 9.08,[54] and the revenues help fund a range of services that address flood risk, such as regulations, technical assistance for landowners, drainage improvements, stormwater infrastructure repair and replacement, and restoration projects.

King County's SWM fee is currently assessed based on the amount of impervious surface on a property. For residential parcels or very lightly developed non-residential parcels, a flat fee of $323 per parcel is applied annually. For non-residential parcels that are lightly to very heavily developed, a per acre fee is applied. The per acre fee varies progressively based on the parcel's percent of impervious surface coverage (i.e., correlating to impact), ranging from $898 to $4,916 per acre, annually. For the 2023 – 2024 biennium, projected total revenue from King County unincorporated

52 https://apps.leg.wa.gov/rcw/default.aspx?cite=36.89.080.

53 https://app.leg.wa.gov/RCW/default.aspx?cite=35.67.020.

54 https://kingcounty.gov/en/legacy/council/legislation/kc_code/12_title_9.

rate payers is estimated at $88 million, which supports surface water management projects and programs, many of them mandated by federal and state regulations.

King County Road Fund and General Fund

Other King County funding sources contributing to the activities described in this Flood Plan include the County's Road Fund and the General Fund. The Road Fund contributes to road and bridge maintenance activities described in the King County Action Plan (see Chapter 4), including culvert replacements that improve drainage and conveyance and restore fish passage. The General Fund supports the Office of Emergency Management's hazard preparedness and response activities.

It is important to note that both the Road Fund and General Fund are experiencing long-standing structural funding issues. By voter initiative in 2001, subsequently passed into law by the Washington State Legislature, the amount of property taxes levied by counties is limited to an increase of 1 percent per year, plus revenue from new construction. As a result, revenues counties receive grow at a much lower rate than the cost of maintaining services to residents. The General Fund faces a $35 million deficit in 2025. This follows approximately $13 million of reductions to the adopted 2023–2024 budget in the fall of 2023.

Flood Control Zone Districts

Counties are authorized by Chapter 86.15 RCW[55] to create flood control zone districts for the purpose of undertaking, operating, or maintaining flood control projects, stormwater control projects, or groups of projects that are of special benefit to specified areas of the county. In addition to these purposes, RCW 86.15.035[56] authorizes flood control zone districts to participate in and expend revenue on cooperative watershed management arrangements and actions for purposes of water supply, water quality, and water resource and habitat protection and management.

King County's 2006 Flood Plan reviewed several potential funding sources for flood risk reduction, but – due to the current limitations imposed on those funding sources by state law – none had the potential to generate the level of revenue possible as with a flood control zone district. Consequently, the King County Council established a countywide flood control zone district in April 2007, later named the King County Flood Control District (FCD). The FCD is a separate government from King County. The FCD has made significant and meaningful investments for many flood risk reduction activities in King County, including programmatic activities (such as flood warning and flood hazard mapping) and a wide range of capital activities focused on maintaining and improving the County's flood protection infrastructure, both in incorporated and unincorporated areas.

The FCD levies an annual property tax countywide and has since 2008. From 2008 – 2022, the FCD levy raised $723 million for flood risk reduction activities in King County. For 2024, the FCD's adopted budget authorizes collection of $59 million in revenue. Under state law, the FCD may levy up to $0.50 per $1,000 of assessed valuation, although certain technical factors may limit revenue

55 https://app.leg.wa.gov/rcw/default.aspx?cite=86.15.

56 https://app.leg.wa.gov/rcw/default.aspx?cite=86.15.035.

collections above a levy rate of $0.25 per $1,000 of assessed valuation. The levy rate for 2024 is $0.08 per $1,000 of assessed valuation.

Establishment and adoption of the FCD's annual work program and capital budget, as well as establishment of the levy rate, is at the sole discretion of the FCD Board of Supervisors. King County is the primary contracted service provider to the FCD under an Interlocal Agreement and performs many of the programs and projects funded by the FCD.

River Improvement Fund

Prior to the creation of the FCD in 2007, the majority of regional flood risk reduction services in King County were funded by the River Improvement Fund. This fund was created in the 1950s for the purpose of providing revenue to construct and repair flood protection facilities along King County's major rivers.

The River Improvement Fund is authorized under RCW 86.12.010[57] and is a countywide property tax levy. State law allows the River Improvement Fund levy to be assessed up to a rate of $0.25 per $1,000 of assessed valuation, although various technical factors resulted in King County's actual applied rate being much lower. From the 1980s through the early 2000s, the levy rate averaged less than $0.02 per $1,000 of assessed value. In 2005, the levy rate was $0.01039 per $1,000 of assessed valuation, which generated $2.58 million in revenue.

King County stopped collecting the River Improvement Fund tax after the creation of the FCD and its taxing authority. State law does not preclude King County from collecting the River Improvement Fund alongside the FCD's collection of its tax levy. However, limits on the overall taxing capacity of local governments set by state law result in practical limitations on the rate that could be collected under the River Improvement Fund.

Grants

The SWM fees and FCD tax revenue are the primary local and countywide funding sources, respectively, for flood risk reduction. Given the scope of projects and project need, and the increasingly multi-benefit nature of projects, it is imperative to leverage local and regional funding with federal and state grants and other funding sources to make meaningful progress on the mitigation activities identified in this Flood Plan. A wide range of grant programs are currently in existence that either directly or indirectly support flood risk reduction activities. Examples of these programs—many of which are actively used by King County and partners—are listed in **Table 5-1**.

TABLE 5-1
GRANT PROGRAMS

Funder	Program	Focus
FEMA	Hazard Mitigation Grant Program	Flood disaster recovery, hazard mitigation planning, and community and infrastructure resilience projects

57 https://app.leg.wa.gov/RCW/default.aspx?cite=86.12.010.

Funder	Program	Focus
FEMA	Pre-Disaster Mitigation Program	Hazard mitigation planning and community and infrastructure resilience projects
FEMA	Building Resilient Communities and Infrastructure	Capability- and capacity-building, and community and infrastructure resilience projects
Ecology	Floodplains by Design	Integrated floodplain management and multi-benefit floodplain capital project
Ecology	Flood Control Assistance Account Program	Flood hazard management planning and studies
Ecology	Stormwater Financial Assistance	Stormwater management projects
Ecology	Streamflow Restoration Program	Natural resource protection and enhancement, watershed management capital projects, and environmental monitoring
Washington Recreation and Conservation Office	Salmon Recovery Funding Board	Natural resource protection and enhancement, integrated floodplain management, and multi-benefit floodplain capital projects
Washington Recreation and Conservation Office	Puget Sound Acquisition and Restoration	Natural resource protection and enhancement, integrated floodplain management, and multi-benefit floodplain capital projects
Washington Recreation and Conservation Office	Estuary and Salmon Restoration Program	Natural resource protection and enhancement, integrated floodplain management, and multi-benefit floodplain capital projects
Washington Recreation and Conservation Office	Washington Wildlife and Recreation Program	Natural resource protection and enhancement, integrated floodplain management, and multi-benefit floodplain capital projects
King County	Conservation Futures Tax	Natural resource protection and enhancement, integrated floodplain management, and stormwater management projects
King County	Parks Levy	Natural resource protection and enhancement
King County	Open Space and River Corridors	Natural resource protection and enhancement, integrated floodplain management, and multi-benefit floodplain capital projects
King County Flood Control District	Flood Reduction Grant Program	Small to medium flood reduction projects, including for stormwater control, urban streams, coastal flooding and erosion, and culvert replacement/fish passage
King County Flood Control District	WRIA Salmon Recovery Grants	Natural resource protection and enhancement, integrated floodplain management, and multi-benefit floodplain capital projects
King County Flood Control District	Subregional Opportunity Fund	Structural flood control projects, stormwater management, and multi-benefit floodplain capital projects

Federal Partnerships

In addition to grants, federal assistance programs can provide significant funding for repairs to flood and erosion protection facilities. FEMA's Public Assistance Program is available following a federal disaster declaration, and federal funding is no less than 75 percent of the cost of the repair, with the remaining 25 percent being split between the state and local sponsor. Certain disasters, such as the February 2020 floods in King County, have been eligible for a federal cost share of 90 percent, leaving a 5 percent local match requirement for King County.

Another federal program available to repair levees damaged by flooding is provided by the U.S. Army Corps of Engineers through the Public Law 84-99 (PL 84-99) Levee Rehabilitation and Inspection Program. King County partnered with the Corps on several repairs through this program on the Green River between 2008 and 2016, and several repairs are planned for 2024 and 2025. Only levees that meet certain criteria are eligible for funding assistance, and the minimum federal contribution is 80 percent of the cost of the project. Importantly, repairs can only be made to the pre-damaged condition; improvements or enhancements are not authorized.

5.6 Conclusion

King County and partners throughout the county have made significant progress toward building resilience to flood risks, and this Flood Plan reveals that the magnitude of risk that exists along the county's rivers, streams, lakeshores, and marine shorelines remains significant and will likely increase in the years to come due to climate change. The King County Action Plan describes many activities that county agencies will take to reduce flood risk, protect public safety, increase preparedness, and provide a host of other benefits to the county's communities. Further, the Comprehensive Risk Mitigation Strategy outlines an extensive body of work that will greatly enhance flood resilience countywide and for which partner support will be essential. Where the recommendations in this Flood Plan align with the goals of cities, the FCD, WRIAs, tribes, and others, it is envisioned that these entities will play a key role in sponsoring flood risk reduction activities throughout the county. The work of a diverse group of implementers will be critically important in reaching this plan's goals.

Much more work is needed to improve the resilience of all communities regardless of location or the type of flood risks they face, and more effort is needed to align King County's flood risk reduction activities with the County's equity and social justice, climate change, and clean water and healthy habitat goals. This Flood Plan proposes policies and actions that attempt to move flood risk reduction in King County toward integrated, holistic solutions that will deliver multiple benefits. However, this Flood Plan ultimately represents a point in time, and it is incumbent upon King County agencies and partners to build on the foundation outlined in the plan, which itself is built on the foundation of work that preceded this plan and informed its development.

CHAPTER 6
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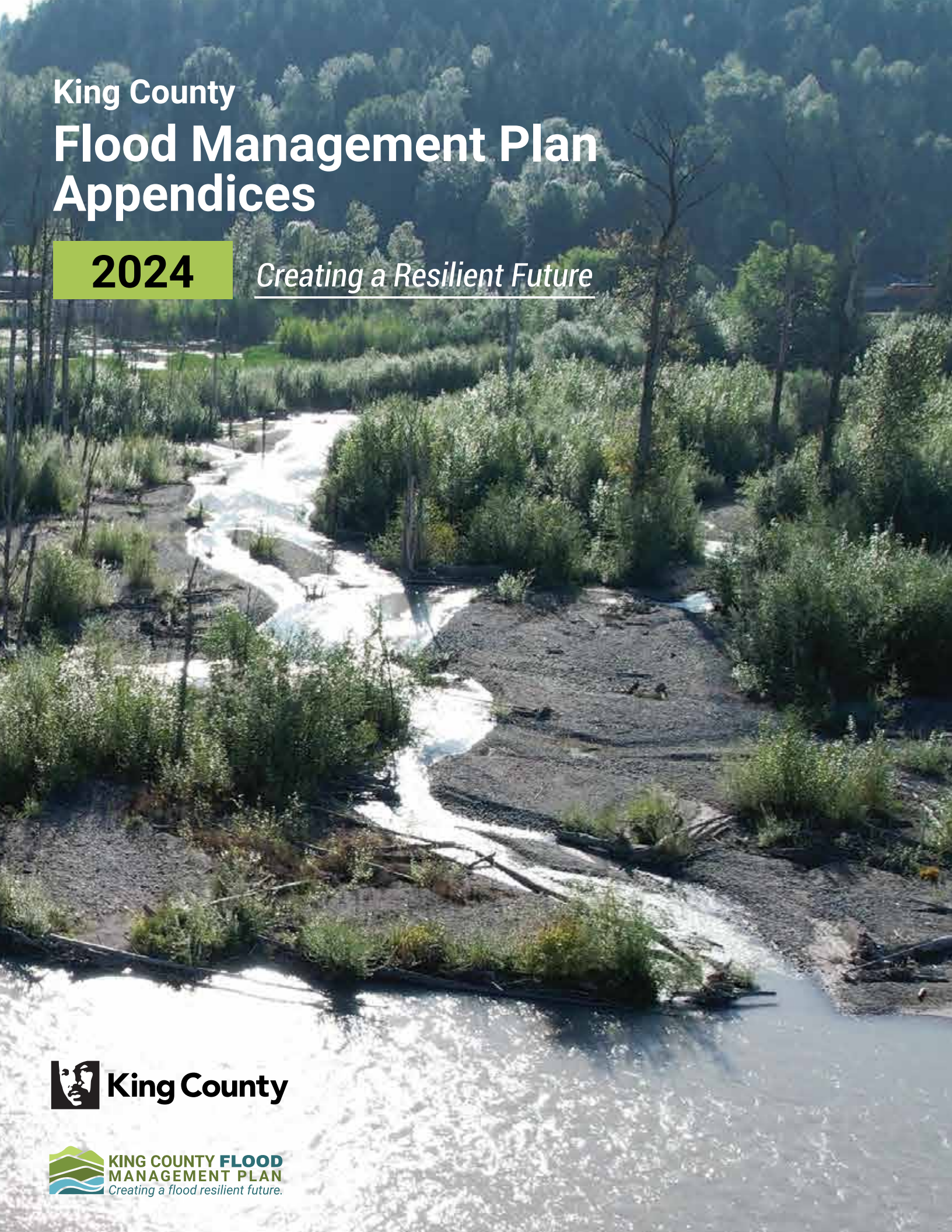

King County

Flood Management Plan Appendices

2024

Creating a Resilient Future

King County

KING COUNTY FLOOD MANAGEMENT PLAN
Creating a flood resilient future.

2024 KING COUNTY FLOOD MANAGEMENT PLAN APPENDICES

King County Water and Land Resources Division
201 S Jackson St # 600
Seattle, WA

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2024 King County Flood Management Plan Appendices

Appendix A
Planning Committees

APPENDIX A
Planning Committees

TABLE A-1
FLOOD PLAN INTERNAL STAFF PLANNING COMMITTEE ROSTER

Name	Role
Eric Beach	Water and Land Resources Division – Agriculture Program
Sarah Brandt	Department of Natural Resources and Parks – Parks Division Open Space Program
John Brosnan	Water and Land Resources Division – Stormwater Services Section
Denise Di Santo	Water and Land Resources Division – Basin Stewardship and Natural Resources Conservation and Restoration
Edan Edmonson	Office of Emergency Management – Dam Safety Program
Ruth Harvey	Road Services Division
Kollin Higgins	Water and Land Resources Division - Watershed and Ecological Assessment Team
Abigail Hook	Department of Natural Resources and Parks – Clean Water and Healthy Habitat Initiative [former]
Janne Kaje	Water and Land Resources Division – Regional Partnerships and Salmon Recovery
Nicole Johnson	Office of Emergency Management – Risk Reduction and Operations
Richard Martin	Water and Land Resources Division – Agriculture, Forestry, and Incentives Program
Michael Murphy	Water and Land Resources Division – Land Conservation Program
Brian Murray	Water and Land Resources Division – River and Floodplain Management Section [former]
Jared Schneider	Office of Emergency Management – Hazard Mitigation Program [former]
Megan Smith	Department of Natural Resources and Parks – Clean Water and Healthy Habitat Initiative
Scott Smith	Department of Local Services – Permitting Division
Katy Vanderpool	Water and Land Resources Division – River and Floodplain Management Section
Lara Whitely Binder	Executive Climate Office - Climate Preparedness Program

TABLE A-2
KING COUNTY FLOOD PLAN PARTNER PLANNING COMMITTEE ROSTER

Name	Affiliation
King County Staff	
Steve Bleifuhs	King County Water and Land Resources – County Floodplain Administrator
Edan Edmonson	King County Office of Emergency Management – Emergency Preparedness and Response, Dam Safety Program
Laura Hendrix	King County Water and Land Resources – Land Use Planning and Zoning and Floodplain Development Certification and Permitting
Nicole Johnson	King County Office of Emergency Management – Emergency Preparedness and Response, Risk Reduction and Operations
Matt Knox	King County Water and Land Resources – Environmental Science and Natural Resource Protection
Judi Radloff	King County Water and Land Resources – Geology and Geomorphology, Flood Hazard Studies and Mapping
Lorin Reinelt	King County Water and Land Resources – Engineering and Structural Flood Control Projects
Jared Schneider	King County Office of Emergency Management – Emergency Preparedness and Response, Hazard Mitigation Program
Jason Wilkinson	King County Water and Land Resources – Flood Plan Project Manager
Ken Zweig	King County Water and Land Resources – Property Protection and Flood Warning
Community and Partner Committee Members	
Matt Baerwalde	Snoqualmie Indian Tribe
Tom Dean	Vashon-Maury Island Land Trust
Angela Donaldson	Fall City resident
Sherry Edquid	City of Tukwila
Kayla Eicholtz	Washington Department of Ecology
Erin Ericson	Snoqualmie Valley Watershed Improvement District
Miranda Fix	Seattle resident
Adrienne Hampton	Duwamish River Community Coalition
Patrick Haluptzok	Lake Sammamish resident
Jamie Hearn	Duwamish River Community Coalition
Molly Lawrence	Van Ness Feldman, representing Port of Seattle
Laurie Lyford	Washington Sensible Shorelines Association
Mike Mactutis	City of Kent
Martha Neuman	City of Seattle
Diane Pasta	Des Moines resident
Stewart Reinbold	Washington Department of Fish and Wildlife
Kate Ryan	People to Preserve the Tualco Valley
Robert Seana	Snoqualmie valley resident
Lauren Silver	Snoqualmie Valley Preservation Alliance
Jackie Underberg	Bellevue resident

TABLE A-3
KING COUNTY FLOOD PLAN PARTNER PLANNING MEETINGS AND TOPICS

Meeting Number and Date	Meeting Topic
#1 – October 26, 2022 11:00 a.m. – 1:00 p.m.	• Introduction to the Flood Plan: Purpose, Process, Scope, and Schedule • Discussion of flooding issues of most concern to committee members • Introduction to Flood Plan goals, objectives, and guiding principles
#2 – December 20, 2022 10:30 a.m. – 12:30 p.m.	• Updates on Flood Plan process and SEPA review • Review and discuss Flood Plan goals, objectives, and guiding principles
#3 – February 21, 2023 10:30 a.m. – 12:30 p.m.	• Review and develop Flood Plan goals, objectives, and guiding principles • Review and discuss river flood hazards and risks
#4 – March 21, 2023 10:30 a.m. – 12:30 p.m.	• Review and discuss hazards and risks from coastal, tributary, and urban flooding workshops • Continued review and discussion of river flood hazards and risks
#5 – April 18, 2023 10:30 a.m. – 12:30 p.m.	• Introduction to and discussion of Flood Plan policies • Introduction to activity evaluation criteria
#6 – May 16, 2023 10:30 a.m. – 12:30 p.m.	• Introduction to flood risk reduction strategies and actions • Review and discuss activities to address identified flood problems
#7 – July 18, 2023 10:30 a.m. – 12:30 p.m.	• Review and discuss draft Flood Plan policies • Review and discuss potential activities to be considered for including in the Flood Plan • Review and discuss draft evaluation criteria
#8 – September 19, 2023 10:30 a.m. – 12:30 p.m.	• Review and discuss committee input provided throughout the planning process and how it is being incorporated in the draft plan • Review and discuss potential flood risk mitigation activities and the process to identify activities to include in the plan
#9 – October 17, 2023 10:30 a.m. – 12:30 p.m.	• Review and discuss strategies and actions included in the past King County flood plan and hazard mitigation plan • Review and discuss activities that should be included in this plan • Summary of the remainder of the planning effort
NOTE: All committee meetings were open to the public and notice posted on King County's website.[1]	

[1] https://kingcounty.gov/en/dept/dnrp/nature-recreation/environment-ecology-conservation/flood-services/flood-management-plan/partner-planning-committee

King County Flood Management Plan

Partner Planning Committee – Meeting #1 Agenda
October 26, 2022| 11:00 – 1:00 p.m.

Meeting Objectives:

- To introduce committee members to the flood plan process, scope, and schedule
- To solicit input on which issues are most important to committee members
- To introduce and begin to discuss flood plan goals, objectives, and guiding principles

11:00 – 11:15 **Welcome and Introductions**

11:15 – 11:40 **Flood Plan Purpose, Process, Scope, and Schedule**

11:40 – 12:20 **Identifying Important Issues**

- Breakout room discussions
- Which are the most important topics/issues for you in the flood plan update?
- What flood issues have you observed or are you most concerned about?

12:20 – 12:40 **Introduction to Goals, Objectives, and Guiding Principles**

12:40 – 12:50 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

12:50 – 1:00 **Wrap Up**

Partner Planning Committee Communication Expectations

- Respect each other's input
- Allow others to complete their statements before contributing yours
- Offer constructive comments in disagreement, but be respectful
- Allow space for others to contribute to the conversation
- State concerns and interests clearly, listen carefully to and assume the best in others, ask questions rather than make assumptions
- Acknowledge that all partners bring legitimate purposes, goals, concerns, and interests, whether or not there is agreement
- Acknowledge that different organizations or agencies have different business models, decision-making requirements, and obligations

King County Flood Management Plan

Partner Planning Committee – Meeting #1 Meeting Notes
October 26, 2022 | 11:00 a.m. – 1:00 p.m.

List of committee members/alternates present:

- Alex Lincoln (King County)
- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jackie Underberg (Bellevue resident)
- Jamie Hearn (Duwamish River Community Coalition)
- Jared Schneider (King County Office of Emergency Management)
- Jason Wilkinson (King County)
- Judi Radloff (King County)
- Kate Ryan (People to Preserve the Tualco Valley)
- Ken Zweig (King County)
- Laura Hendrix (King County)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Lexanne Bumm (Des Moines resident)
- Lisa Nelson (Washington Department of Ecology)
- Lorin Reinelt (King County)
- Martha Neuman (Seattle Public Utilities)
- Matt Baerwalde (Snoqualmie Indian Tribe)
- Patrick Haluptzok (Lake Sammamish resident)
- Robert Seana (Snoqualmie Valley resident and farmer)
- Sherry Edquid (City of Tukwila)
- Shawn Gilbertson (City of Kent)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Thomas Wilkenson (Upper Preston resident)
- Tom Dean (Vashon-Maury Island Land Trust)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Eric Beach (King County), Frederick Chavre (Maple Valley resident), Helen Gitahl (Green River farming interest), Kjristine Lund (interested citizen), Lucy Gitahl (Green River farming interest)

Flood Plan Purpose, Process, Scope, and Schedule

Steve Bleifuhs presented on flood risk in King County and the roles of King County and the Flood Control District in identifying flood hazards and mitigating flood risks. Jason Wilkinson presented on the reasons for pursuing a new flood plan, including changing conditions and the importance of

considering equity, and detailed the scope of the plan, which will identify flood hazards, describe impacts, and outline strategies and actions to mitigate flooding.

Jason Wilkinson described the purpose of the Partner Planning Committee is to share information and ideas, provide input on goals, objectives, and guiding principles, and to develop a shared vision for flood hazard management across jurisdictions and interest areas.

Multiple questions were asked by Partner Planning Committee members about the role of the Flood Control District, what they fund, and what government entities adopt or implement the Flood Plan. Jason Wilkinson explained that King County submits the Flood Plan to the County Council for consideration and the Flood Control District determines how they want to consider the plan through their own process. Steve Bleifuhs explained that the Flood Control District funds staff in the King County River and Floodplain Management Section and that the Flood Control District is funded through a county tax, having significant legal obligations in how they spend that money, but no regulatory authority to manage the floodplain or legal obligation to implement the Flood Plan.

Spencer Easton summarized initial input from one-on-one interviews with committee members, which included a desire for the Flood plan to address equity, climate change, agriculture, a balanced approach to multi-benefits, as well numerous more specific issues. A need for further discussion on the role between King County, the King County Flood District, and the cities of King County was identified.

Breakout Room Discussion of Important Issues

The Partner Planning Committee was divided into four breakout rooms with Spencer Easton, Jason Wilkinson, Steve Bleifuhs, and Dan Beckley as hosts.

Issues frequently identified as important to attendees included:

- Agriculture (drainage issues, economic losses, regulations, soil impacts, viability)
- Climate change (adaptation, increased flood frequency, sea level rise, climate projections)
- Equity (communication, education, environmental justice)
- Development in the floodplains (property acquisition, managed retreat, regulations, resources)
- Interagency coordination (implementation roles, FEMA programs)
- Related disasters and impacts (burn scars, erosion, forest fires, logging, landslides)
- Stormwater management (drainage infrastructure, upper watershed runoff, urban flooding)

Areas of concern and locations where attendees have observed impacts included:

- Coastal areas
- Cedar River
- City of Kent
- Lake Sammamish
- Raging River
- Rural streams
- Urban areas
- Upper watershed areas

Introduction to Goals, Objectives, and Guiding Principles

The draft goals were presented to the Partner Planning Committee. Multiple people expressed a desire to see agriculture represented in the goals, as well a show of consideration for other land uses and geographic areas. There was discussion about whether goals should emphasize reducing flood risk or reducing flooding, which led to identifying a need to further clarify and define flood risk, among other terms.

Public Comment

The only public comment inquired about the potential for engaging with the Army Corps of Engineers on reducing flooding in Lake Sammamish, similar to the way that Lake Washington's water levels are lowered in winter to reduce flooding.

Next Steps

The next meeting will focus on goals, objectives, and guiding principles. A recording of this meeting will be made available online.

King County Flood Management Plan

Partner Planning Committee – Meeting #2 Agenda
December 20, 2022| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To follow up on the conversation at the first meeting (October 26, 2022)
- To solicit input on flood plan goals, objectives, and guiding principles

Pre-meeting interactive slides:
https://docs.google.com/presentation/d/1jSXb1meRna_L8DdRf8NtIOJU2afuzYlc/edit?usp=sharing&ouid=117101940176352132038&rtpof=true&sd=true

Agenda

10:30 – 10:40 **Welcome and Introductions**

10:40 – 10:50 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:50 – 11:00 **Flood Plan Updates and Follow-up from Meeting #1**

- Refresher on role of Partner Planning Committee
- Updates on Flood Plan Process
  - Upcoming topic-specific workshops
  - SEPA Scoping Period
- Summary of feedback received at first Partner Planning Committee Meeting
- Follow-up on questions received at and since first meeting

11:00 – 11:10 **Communication Agreements**

11:10 – 11:20 **Presentation: Goals, Objectives, and Guiding Principles**

- Context and purpose of Goals, Objectives, and Guiding Principles
- Presentation of working draft Goals, Objectives, and Guiding Principles
- Summary of input received from committee members prior to the meeting

11:20 – 11:50 **Breakout Rooms: Goals, Objectives, and Guiding Principles**

11:50 – 12:20 **Report Out and Discussion**

12:20 – 12:30 **Wrap Up**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #2 Meeting Notes
December 20, 2022 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Edan Edmonson (King County)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jackie Underberg (Bellevue resident)
- Jamie Hearn (Duwamish River Community Coalition)
- Jason Wilkinson (King County)
- Kayla Eicholtz (Department of Ecology)
- Kazia Mermel (Sound Cities Association)
- Kelsey Payne (Snoqualmie Indian Tribe, substituting for Matt Baerwalde)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Lexanne Bumm (Des Moines resident)
- Lorin Reinelt (King County)
- Martha Neuman (Seattle Public Utilities)
- Matt Knox (King County)
- Mike Mactutis (City of Kent)
- Miranda Fix (Seattle resident)
- Patrick Haluptzok (Lake Sammamish resident)
- Sherry Edquid (City of Tukwila)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Tom Dean (Vashon-Maury Island Land Trust)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Eric Beach (King County), Helen Gitahi (Green River farming interest), Kjristine Lund (interested citizen), Laura Casey (Carnation farmer), Laura Wolfe (Port of Seattle), Lucy Gitahi (Green River farming interest), Molly Lawrence (Van Ness Feldman), Regina Fletcher (Snoqualmie Valley Preservation Alliance)

Public Comment

An opportunity to provide public comment was provided at the beginning of the meeting. Kjristine Lund commented on her appreciation for the video about the Flood Plan and commended the sharing of the video as an opportunity to inform the public about the Flood Plan process.

Flood Plan Updates and October 26, 2022 Meeting Follow-up

Jason Wilkinson provided a review of the role of the Partner Planning Committee and provided an update on current actions and upcoming steps in the Flood Plan Process, including detailing the scoping process for the Flood Plan under the State Environmental Policy Act. He also provided a summary of feedback received at the first Partner Planning Committee Meeting in October 2022.

Communication Agreements

Spencer Easton shared the Communication Agreements that Partner Planning Committee members are asked to commit to. Further revisions were not made to the Communications Agreements. Committee members signaled their commitment to the Communication Agreements through Zoom reactions.

Goals, Objectives, and Guiding Principles

Spencer Easton presented a summary of the feedback on goals, objectives, and guiding principles, provided by Partner Planning Committee members prior to the meeting. Comments on goals generally reflected a need to define or clarify words and phrases ("equitable" and "all flooding" in Goal 1; application of "cost-effectiveness" in Goal 3) or to change wording to be more address a broader set of issues (changing "tribal treaty rights" to "tribal rights" in Goal 2). Comments on objectives mostly suggested adding further specific process or outcome details, such as expanding upon Objective 11's recommendation to seek funding sources for flood risk reduction to include collaboration and partnership opportunities. Comments on guiding principles largely suggested minor wording changes or sought clarification on the meaning or intent of the guiding principles.

Participants in the meeting were given the opportunity to provide further feedback on goals, objectives, and guiding principles in breakout rooms. Feedback from these separate discussions included:

Goals:

- Define "flood risk reduction" or further clarify intents (Goal 3)
- Highlight importance of coordination between various government agencies and intersection of various strategic plans
- Incorporate explicit language about consideration of different types of King County communities, such as vulnerable communities, and different types of land uses, including rural and urban development

Objectives:

- Requesting clarification on the relationship between the Flood Plan and other planning efforts, including Vision 2050, salmon recovery plans, and the 2020 Regional Hazard Mitigation Plan
- Suggest explicit consideration of renters as impacted stakeholders, not just property owners
- Suggest inclusion of an objective to increase water storage capacity in the upper watershed
- Address impacts to working waterfronts and existing development

Guiding Principles

- Numerous comments suggesting that guiding principles could be better organized, more clearly distinguished from facts and assumptions, or reduced in number
- Include guiding principles related to equity and social justice

Jason Wilkinson addressed comments about coordinating the Flood Plan with other planning efforts and government agencies, noting that King County is also updating its comprehensive plan and is coordinating with that effort. Jason Wilkinson stated that the Flood Plan will include an assessment of potential climate change impacts in coordination with the University of Washington's Climate Impacts Group, in response to comments about using the latest climate science in the Flood Plan.

Spencer Easton noted committee comments that the objectives and guiding principles often focused on natural environments and were less applicable to urban development, in response to comments about the lacking recognition of working waterfronts. Regarding the numerous comments about the need to define terms that are used in the plan, a glossary or definitions section in the Flood Plan would be helpful.

King County staff will email a copy of the draft goals, objectives, and guiding principles along with a deadline to submit further input. King County staff will revise the goals, objectives, and guiding principles based on the committee feedback and will report back to the committee about the edits at the February meeting.

Next steps

Participants in the meeting expressed general support for the breakout room approach to engagement that was used in the meeting. All participants were invited to participate in upcoming topic-specific workshops, starting in January. Anyone interested in the workshops can contact Spencer Easton at seaston@esassoc.com for more information.

King County Flood Plan

Working Draft Goals, Objectives, and Guiding Principles
Comments from December 20, 2022, Partner Planning Committee

General Comments/Questions

- How does this fit in with Vision 2050? That relates to salmon, etc.
- Would be helpful to include something adaptive. We aren't able to update these plans frequently, but we need to be able to more adaptive as new information comes to light, new plans are adopted, etc.
- Should there be an objective related to a risk assessment? 2006 plan had a risk assessment as an appendix.
- How will this plan relate to the 2020 Regional Hazard Mitigation Plan?
- Can we identify local problems and places to get neighborhoods/communities involved in things they can do to help with and prevent flooding? Things like checking storm drains, etc.
- Consider connections with roads, fish passage barrier removal.

Goals – describe the long-term outcomes the flood plan is trying to reach

1. To reduce risks from all sources of flooding and channel migration through comprehensive, equitable, climate-resilient solutions
    - Does "all sources" really include urban/suburban stormwater contributions?
    - Does "all" mean even minor flooding caused by water line breaks, possibly others not thought of?
    - What does "equitable" mean in this sense? Does this include compensation for historic/systematic inequities?
    - Matt B brings up excellent point…what is defining equitable and how is it promulgated?
    - Do "solutions" include those for which there likely is no funding?
2. To promote flood risk reduction solutions that preserve, restore, and enhance the natural functions of flood hazard areas, honor Tribal rights, and support interests important to King County communities through actions that achieve multiple benefits
    - Would it be too long to add "preserve" and/or "restore" natural functions? (Preservation/protections typically most cost effective)
    - I agree with Matt, I'd like to see "preserve" or "restore" added to the goal.

- Suggest removing "treaty" and keeping more inclusive "Tribal rights" or "sovereign Tribal rights."
- In my mind this statement is completely contradictory. Enhancing natural functions is in direct conflict with supporting interest important to KC communities.
- Wondering whether we can add "promote flood risk reduction solutions by preserving, restoring and enhancing…"
- Re: interests to KC communities; often communities most impacted don't have as many resources. BIPOC communities impacted by flooding.
- Should start with "To promote flood risk reduction solutions that enhance…"
- On its own this one doesn't make sense unless it refers to flood risk reduction actions.
- Suggest this goal should be: Promote flood risk reduction solutions that enhance the natural functions of flood hazard areas, honor Tribal treaty rights, and support interests important to King County communities through actions that achieve multiple benefits

3. To promote flood risk reduction solutions focused on long-term cost effectiveness
    - Add language that indicates a desire for more coordination and cooperation from other agencies (state, federal); coordination with other plans out there; coordination between groups and different jurisdictions. Agricultural plans, WRIA plans, city flood plans, etc. (all of the above). With the FCD ability, they can choose what to adopt from this. Concerns about what implementation will look like. Concern that the FCD is not obligated to adopt this. RFMS paid for by FCD.
    - Why is the only value listed that of cost-effectiveness? If we spend a million and it does very little vs 10 million and it helps a great deal, this statement would rate the effective solution lower.
    - There is a mention of multi benefit. Is it the number of benefits, or the amount of the benefits? How do we quantify or address them in strategy?

General comments on goals:

- Seems like there's something missing about how different actions will be prioritized.
- Have a definition in the plan about what we mean by reduce risk; minimize and prevent the impacts of flooding. Or are we trying to reduce peak flows and amount of water? Spencer noted that flood risk also includes prevention of flooding.
- A couple of notes: we did cover flood risk vs. flooding. Important that we are not trying to reduce flooding because it is a natural function. We should focus more on public safety. Add definition section. The term equity is questioned a lot. Are we referring to legal definition of equity or the ESJ of the KC plan. How does this coordinate with other KC plans? Definition of net ecological gain is not state law (yet?). Are we going off of the proviso from WDFW or the

prior language? Provide context around "NEG" There are some RCWs that address this. I like the comment about preserving and restoring, but I would still like to see the word enhance. Use all three words - want to see net gain.

- Comment on reduced risk - flooding is natural. For example, is there an opportunity to provide more overall storage in the upper watershed (this is what goal #1 means)? Can we consider removing the word cost and focus on long-term effectiveness? Cost is a detail.
- I think the goals are pretty good as written.
- Can we weave in something about areas where we need to address flooding that are not very natural? E.g., areas in the Duwamish that are very altered. Need to capture both rural and urban needs well. I like "all sources of flooding."
- Is there a goal or objective recognizing existing development and infrastructure? So much of this seems focused on nature, managed retreat, etc. The goals might be different for working waterfronts, for example.

Objectives – more specific statements describing how we will achieve the outcomes in the goals

1. Use the best available science to identify and assess flood and channel migration risks and identify how future changes may affect future risks.
    - Can we look at how things beyond climate change may affect future risk? e.g., land use trends/plans; large projects
    - Best available science covers many other subjects beyond climate change.
2. Promote public awareness of identified and potential flood hazards and resilience strategies in ways that are accessible and easy to understand.
    - Reference to promoting public awareness, will the plan contain an outreach strategy?
3. Identify and prioritize actions to reduce risks to life, property, and public infrastructure that advance multi-benefit outcomes and reflect the perspectives of affected communities.
4. For existing flood protection facilities, pursue the most appropriate long-term solutions—maintain, repair, retrofit, set back, or remove—that are compatible with current and future goals for the area, are set in a watershed-based context, and that take climate change into account.
    - Should something about the watershed-based context be an objective by itself to recognize that floodplain management shouldn't just treat symptoms? Work toward this as an objective.
5. Adopt forward-looking land use management policies to prevent creation of new flood and channel migration risks, while preserving or enhancing natural floodplain functions and preventing further habitat degradation of imperiled species.

- Is there any thought or intent to expand the land covered by flood regulations beyond what FEMA has mapped?
- Consider watershed scale.

6. Maintain a regionally coordinated flood warning and emergency response program and improve public awareness of emergency response programs
7. Coordinate across King County departments and with other jurisdictions to provide consistency in flood hazard management and disaster response and recovery activities.
    - Who are we talking about with the reference to other jurisdictions--cities, tribes, other govt's?
    - Add FCD as a specific jurisdiction?
    - What does flood hazard management encompass? Does this include regulations?
    - This objective should include water concurrency between the jurisdictions and the county.
8. Proactively acquire properties (developed or undeveloped) to reduce flood and channel migration risks, support the implementation of multi-benefit projects, and provide ecological benefits.
    - This is a high priority objective for the Snoqualmie Tribe.
    - Add idea of managed retreat? Way to break cycle of repeated damage, esp. in coastal areas.
    - How does acquiring property reduce flooding or risk?
    - What is the definition of a multi-benefit project, and how will benefits be prioritized?
9. Co-design solutions with impacted communities throughout King County that reflect local priorities, actively seek opportunities and partnerships to meet multiple benefits, and leverage grant funding and partner investments.
    - At what stage does co-design happen? Is this co-design during the planning, during implementation, both?
    - What does co-design mean? This goes back to the scope of the plan.
    - Who are impacted communities, and where are they? Does this mean cities or neighborhoods in unincorporated areas?
    - Also provide support to partners to achieve multiple benefits/mutual goals.
10. Improve access to programs that help residents recover from flooding beyond traditional flood insurance (such as federal crop insurance programs).
    - How do we improve access to programs? Are we promoting/educating about these? Are we actually dealing with access? How do we put ppl in state of prevention and preparedness rather than reacting?

11. Identify funding sources for implementing recommended flood risk reduction activities, including multi-objective activities, and identify opportunities, strategies, and partnerships to leverage grant funding.
    - Is there a specific person with this role of identifying funding sources? Needs to be considered in an ongoing way rather than being reactive (like a grant writer).
    - Including collaborating with/supporting partners.
    - What is the purpose of the King County Flood Control District taxing authority?
12. Use adaptive management to adjust actions based on scientific and technological advances, including climate projections, the best available information on floodplain management practices, principles, and risk assessment, and equity considerations.
    - Also, emerging equity issues.

General comments on objectives:

- Does the county anticipate updating their floodplain regulations as a part of the plan update?
- Don't focus only on property owners, consider renters as well.
- Consider water storage in upper watersheds as a way to facilitate climate resilience and address flooding. Can this be included somewhere (#5)? Consider controlled and natural storage project the WID has done a lot of work on this, reports are available.
- Lots of objectives—can we refine/consolidate?
- With outreach efforts, try to reach younger people. They have opinions that should be considered. Be creative and try different methods of communication.

Guiding Principles – the facts and technical understanding that direct flood hazard management in King County

Natural Environment

1. Flooding and erosion are natural processes that sustain biological productivity and diversity.
    - Support for this principle.
    - With climate change and in urban areas, flooding and erosion don't always sustain biological productivity and diversity.
    - I think this statement is overly broad and may not reflect a developed environment.
    - Suggest it should be: "Promote flood risk reduction solutions that sustain biological productivity and diversity."
    - Flooding is a natural process we are trying to prevent in a manner that maintains as much prod
    - Sounds biased against fixing flooding issues.
2. Protecting and working with natural processes can provide environmental benefits, increase climate change resilience, and reduce flood risks to people and property in a less costly manner than structural flood control approaches.

- Again, in an urban area, working with natural processes isn't always less costly.
- Natural processes require space, and that results in purchasing expensive property.
- Sounds biased against fixing flooding issues.
- Promote flood risk reduction solutions that protect and work with natural processes and provide environmental benefits, increase climate change resilience, and can be done in a less costly manner.
- And we may be willing to pay more (in some instances) for natural process solutions.

3. Rivers and streams and their floodplains, coastal areas, and riparian areas provide habitat for salmon, including several that are listed as threatened under the Endangered Species Act. Salmon are intricately connected to Native American culture and tribal rights.
    - Needed?
4. Riparian vegetation improves levee/bank stability and provides a host of other ecological functions and benefits.
    - Riparian vegetation also provides a whole host of other critical, irreplaceable functions.
    - It was a huge feat to get to the point where we have this understanding and can include it as a guiding principle.
    - Needed?
5. Habitat protection and restoration and salmon recovery are dependent on rivers and areas adjacent to them, as well as marine nearshore areas.
    - Preserving, restoring, and enhancing are three distinct items, and they are the trifecta we want to go after.
    - These things are also dependent on marine areas.
    - "Restoring" may not be needed here.
    - This one could use some wordsmithing.
    - Needed?

<u>Risk Management</u>

6. Many areas behind levees or outside of the mapped floodplain have a residual risk of flooding (for example, from potential levee failure).
    - Could be helpful to contextualize this residual risk with other types of risk, and what that means in terms of priority.
    - Not just people behind levees, also risks from decertified levees.
    - Needed?

7. Flooding is influenced by land use and land management decisions, stormwater, and climate change.
    - What about land "management" decisions? "Land use" implies regulatory framework but management includes actions.
    - Aren't 7 and 11 mostly duplicative? Combine them?
8. Structural flood control methods can reduce flood damage in the near-term, yet those methods require maintenance, do not eliminate all risk, and may not be adaptable to changing conditions.
    - All flood control methods, structural or natural, fall into those categories.
    - These statements apply to all flood control methods, not just structural. None eliminate all risk. All of the things we do may not be adaptable to changing conditions. This seems unbalanced. Doesn't reflect urban flood management needs/conditions.
    - How are we defining what structural flood control methods are? We understand that no one method can eliminate all risk. Why are structural methods called out? Would prefer to see structural flood control measures considered?
    - This sounds biased against fixing flooding issues.

<u>Best Practices</u>

9. Actions to address flood risk to existing development must consider the existing land use context, other land uses and interests (such as fish and wildlife habitat, open space, agriculture, recreation, and transportation), and climate change and other future changes.
    - Does not address urban and urban use.
10. Flood damage creates public and private financial costs, and effective flood risk reduction reduces long-term flood damage costs while minimizing new impacts to other values.
    - What does "new impacts to other values" mean?
11. Flooding is a watershed-scale issue; actions and environmental conditions in upland portions of watersheds can impact flooding and channel migration downstream.
    - Floodplain management throughout history has been about flood control, dealing with symptoms and not cause. Would like to see the watershed-scale lens throughout the document. The new state guidance on floodplain management is integrated but I don't see us talking about integration in the goals and objectives. This is the first statement that talks about addressing the causes and not the symptoms. Angela is super passionate about this topic. We need to look at the whole picture. Want to put exclamation marks on this item.
12. Engagement with and involvement of tribes, residents, stakeholders, flood-vulnerable communities, and public and private landowners is vital in developing a responsible, effective flood management plan.

13. Private property rights should be respected when providing flood protection.
    - Unclear what this is trying to say.
14. Cooperation among local, regional, state, and federal agencies is essential for the success of long-term comprehensive flood hazard management.
15. Constructing new flood protection facilities where none currently exist should be an option of last resort.
    - Is this a guiding principle? It may be a statement of preference. This may be something we have to do related to sea level rise. Could be stated in the positive instead - natural solutions are preferred where possible.
    - What is considered as a flood protection facility?
    - What science is telling us that new facilities should be the last resort? Is this an opinion or should we be supporting further evaluation to see what's most effective?
    - Assume this does not apply to setbacks? Clarification needed?
    - Importance of protecting life and property. Not balanced. If building a new one is cost effective, we should. If not, we shouldn't. Suggestion to delete this one.
    - This could be specifically in critical areas. Flooding in older developed areas may not have other options.
    - Why would this be here? Shouldn't the cost/benefit analysis just apply to new and existing flood reductions equally, why this?
16. Identifying flood risks and determinations of flood risk reduction solutions is most effective in the long-term when informed by the best available science, best practices in floodplain management, and multi-objective and multi-benefit considerations.
    - "Best available science" may be a bit jargony and needs definition.
17. Solutions to address flood and channel migration risks should consider historic, ongoing, and continuous negative ecological impacts of flood risk reduction facilities and offset these impacts through implementing the standard of Net Ecological Gain for each project.
    - Nebulous standard (gain in whose opinion?); Is there and can we use a better term or phrase?
    - Solutions could make forward progress in addressing environmental justice.
    - Why is Net Ecological Gain capitalized? Is this a specific concept being referred to? This may be redundant with other Guiding Principles.
    - Net Ecological Gain - this is not a state law at this point. How are we going to reach a standard that is not legally set yet? Needs to be addressed in next leg session.
    - Concerned about the standard we are saying we will commit to without clarity on what the standard is.
    - In an urban environment that reduces flooding, we would not do it if it has loss of ecological function.

18. Equity and social justice factors must be considered in developing flood risk reduction solutions.

General comments on Guiding Principles:

- These are a lot of principles to keep track of, and there are a lot of redundancies in the list. It would be helpful to have something simpler.
- The guiding principles are very nature based and sound a bit biased. They don't address flooding in urban areas.
- The guiding principles don't address underserved communities.
- #14 is a good principle. Many of the others seems solution-oriented and not principles. There is a lot of mixing of different things in the guiding principles.
- Some of these are underlying assumptions and some are principles/guidelines. It's a mix, and guiding principles may not be the clearest title for them.
- Could be helpful to have a handful of guiding principles and a separate set of underlying assumptions/facts.
- Add a guiding principle that we want actions that are forward looking for a changing future.
- Add a guiding principle related to race and social justice issues.
- What are the facts and technical understanding that was the background for the development of these guiding principles? It would be helpful to know what these align with. There is a lot stated in here—assumptions about structural projects, for example—and these statements would be more helpful if they were aligned with technical references.
- The term "principles" is being used here in a different way than people expect. Principles should give direction to the plan—be forward thinking to a changing future, use current science, address impacts to people and business.
- Important to talk about lessons learned, adaptive management. After we complete a project, there are lessons learned that need to be captured so we can continue to adapt as we learn more.
- Where did the list of guiding principles categories come from? It seems limited.
- Guiding Principles looks like a list of reasons to not do any flood risk reduction.
- Suggest deleting 1-6, just statement of facts.

King County Flood Management Plan

Partner Planning Committee – Meeting #3 Agenda
February 21, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To share how committee input on the flood plan goals, objectives, and guiding principles was incorporated
- To introduce and discuss river flooding problems, focusing on the Snoqualmie River, Cedar River, and Green River (other river systems will be discussed at the March Partner Planning Committee meeting)

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 11:10 **Flood Plan Goals, Objectives, and Guiding Principles Follow-up**

- Reminders about purpose of Goals, Objectives, and Guiding Principles
- Summary of Partner Planning Committee input
- Updates to drafts in response to partner feedback
- Discussion and next steps

11:10 – 11:40 **Introduction to River Flooding Hazards and Risks** – *King County staff share current understanding of primary problems and implementation progress*

- Snoqualmie River (including Raging and Tolt rivers)
- Cedar River
- Green River

Note: other King County river systems will be discussed at the March Partner Planning Committee meeting.

11:40 – 12:10 **Breakout Rooms: Basin-Focused Discussions** – *committee identifies additional problems and begins to share ideas for solutions*

12:10 – 12:20 **Report Out and Discussion**

12:20 – 12:30 **Wrap Up**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #3 Meeting Notes
February 21, 2022 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Adrienne Hampton (Duwamish River Community Coalition)
- Alicia Kellogg (King County)
- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jackie Underberg (Bellevue resident)
- Jared Schneider (King County)
- Jason Wilkinson (King County)
- Jay Smith (King County)
- Jon Sloan (Port of Seattle)
- Judi Radloff (King County)
- Kazia Mermel (Sound Cities Association)
- Laura Hendrix (King County)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Lexanne Bumm (Des Moines resident)
- Lorin Reinelt (King County)
- Ken Zweig (King County)
- Martha Neuman (Seattle Public Utilities)
- Mary Strazer (King County)
- Matt Knox (King County)
- Mike Mactutis (City of Kent)
- Miranda Fix (Seattle resident)
- Monica Walker (King County)
- Nancy Sandford (King County)
- Sherry Edquid (City of Tukwila)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Teresa Lewis (King County)
- Tom Dean (Vashon-Maury Island Land Trust)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Laura Casey (Carnation farmer), Laura Wolfe (Port of Seattle), Lucy Gitahl (Green River farming interest), Molly Lawrence (Van Ness Feldman), Regina Fletcher (Snoqualmie Valley Preservation Alliance)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer reviewed the purpose and planning process for the Partner Planning Committee

Public Comment

An opportunity to provide public comment was provided at the beginning of the meeting. No public comments were made.

Flood Plan Goals, Objectives, and Guiding Principles Follow-up

Spencer Easton provided an overview of the development of the goals, objectives, and guiding principles, which the Partner Planning Committee provided input on in December. The Committee would review and discuss revisions based on prior input in this meeting.

Goals were updated to:

- Acknowledge existing development and infrastructure
- Distinguish urban vs. rural needs
- Consider long-term costs rather than cost effectiveness

Objectives were updated to:

- Consider future changes beyond climate, including land use changes
- Address engagement with affected communities
- Address the watershed context for flooding
- Clarify the role of acquisition in flood risk reduction
- Clarify the application of multi-benefit activities

Guiding principles were updated to:

- Reflect urban contexts
- Give direction to the plan
- Remove language that was suggestive of bias in favor of nature-based solutions or against structural solutions

Comments about prioritizing actions and potential solutions were not addressed because these will be incorporated in other elements of the flood plan. Additional comments were provided about clarifying the intent or better defining terms in the goals, objectives, and guiding principles, but none of the comments were in opposition to the concepts presented.

Introduction to River Flooding Hazards and Risks

Spencer Easton reviewed ongoing engagement efforts to identify flood issues, described basin-specific flood risk discussions that would occur in this meeting, and noted that the remaining river basins in King County would be discussed at the next Partner Planning Committee meeting. Spencer introduced Jay Smith, Nancy Sandford, and Monica Walker, who are members of the King County River and Floodplain Management Section's basin teams for the Snoqualmie River Basin, Cedar River Basin, and Green-Duwamish River Basin, respectively.

Jay Smith described flooding and flood hazard management in the Snoqualmie River Basin:

- Flooding characteristics: overbank floods, deep and fast flows, levee failures, high variability in flood pattern
- Impacts: roads overtopped, channel migration, flooding of urban areas and agricultural landscapes

- Initiatives: incorporating climate projections into capital projects, land acquisitions on Tolt River, flood gages, floodplain reconnection, reduce channel migration, road and infrastructure resilience

Nancy Sandford described flooding and flood hazard management in the Cedar River Basin:

- Flooding characteristics: overtopping banks, deep flows through neighborhoods, large wood deflects flows into banks, avulsion, sediment aggradation limits levee capacity
- Impacts: extensive residential property impacts, roads overtop including SR-169, landslides, erosion, vulnerable broadband infrastructure
- Initiatives: buyouts of vulnerable neighborhoods, levee maintenance, dredging at mouth of river, levee setbacks and floodplain reconnection, bank stabilization and repairing revetments along roadways

Monica Walker described flooding and flood hazard management in the Green-Duwamish River Basin:

- Flooding characteristics: overbank flows, flooding in areas without levees, channel migration risks
- Impacts: erosion, levee and revetment instability, urban flooding
- Initiatives: system-wide levee improvement framework, urban stormwater management, floodplain and habitat restoration

Breakout Rooms: Basin-Focused Discussions

Spencer Easton introduced an exercise where participants could provide input in a basin-specific breakout room on experiences with flood problems and solutions.

Discussion of the Snoqualmie River Basin included:

Flood issues

- Lower valley flooding being caused by upper watershed impacts
- Erosion on farmland and regulatory barriers to armoring shorelines
- Recurring and prolonged impacts to productive farmland
- Landslides near Spring Glen, Mud Creek, Tokul Creek, Snoqualmie Falls Hill, Raging River, and San Souci

Potential solutions

- Upper watershed storage, including retrofitting existing development and stormwater/floodwater retention to stagger high volume flows
- Changing King County Code to enable private flood control and drainage measures
- Changing management of Ames Lake weir to address flooding
- Assess flood management potential in FERC relicensing of Tolt Dam
- Streamlining solutions to drainage needs, such as prioritizing drainage response without necessarily needing to meet the variety of environmental requirements or incorporate multi-benefits

Discussion of the Cedar River Basin included:

Flood issues

- Sediment aggradation in lower river worsens flooding, requires ongoing maintenance
- Jones Road reach is constrained, lacks capacity
- Tributary flooding has localized impacts

Potential solutions

- Multi-benefit analysis of project identification and prioritization
- Levee setbacks and additional floodwater storage
- Continue coordination with City of Seattle on floodplain restoration efforts downstream of Landsburg Dam

Discussion of the Green-Duwamish River Basin included:

Flood issues

- Sea level rise and tidal influence impacts flooding upriver to Kent
- USGS change in the rating curve at their Auburn stream gage on the Green-Duwamish River will affect how Howard Hanson Dam is operated and may result in high volume releases from the dam that could raise the Green-Duwamish River stage an additional one foot in Kent
- Storm surge issues in Duwamish River area

Potential solutions

- Stricter regulation and monitoring of potential contaminants and pollution sources, especially in urban areas that flood
- Study compound impacts of sea level rise, storm surges, and riverine flooding to understand viability of different flood risk reduction solutions
- Adaptive management approach to monitoring outcomes of current and upcoming projects
- Seek additional funding sources for flood hazard management in South Park

Next Steps

Spencer Easton noted that the next Partner Planning Committee meeting would be on March 21st, at 10:30 a.m. The next meeting will provide an opportunity for participants to identify flood hazards and risks on the South Fork Skykomish River, Sammamish River, and White River, as well as to continue conversations initiated at this meeting about flooding in the Snoqualmie basin, on the Cedar River, and on the Green River.

King County Flood Management Plan

Partner Planning Committee – Meeting #4 Agenda
March 21, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To share outcomes from the coastal, tributary, and urban flooding workshops
- To continue discussing river flooding problems, focusing on the South Fork Skykomish River, Sammamish River, and White River
- To have a full committee discussion of the primary flooding hazards and problems that should be the focus of the flood plan

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 11:10 **Outcomes from Workshops on Coastal, Tributary, and Urban Flooding**

- Overview of workshops and approach
- Summary of each topic and input received on flood hazards, problems, and potential solutions
- Questions

11:10 – 11:40 **River Flood Hazards and Risks** – *King County staff share current understanding of primary hazards, risks, and implementation progress*

- South Fork Skykomish River
- Sammamish River
- White River

Note: Presentations about the flooding on the Cedar River, Green River, and Snoqualmie River were shared during February's Partner Planning Committee meeting.

11:40 – 12:20 **Committee Discussion** – *group discussion of the sources and causes of flooding in King County and their impacts to local communities, and identification of additional flooding problems and potential gaps in our understanding (consider all flooding sources)*

12:20 – 12:30 **Wrap Up and Next Steps**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #4 Meeting Notes
March 21, 2022 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Adrienne Hampton (Duwamish River Community Coalition)
- Alex Lincoln (King County)
- Angela Donaldson (Fall City resident)
- Chase Barton (King County)
- Diane Pasta (Des Moines resident)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jackie Underberg (Bellevue resident)
- Jared Schneider (King County)
- Jason Wilkinson (King County)
- Kate Akyuz (King County)
- Kate Ryan (People to Preserve the Tualco Valley)
- Kayla Eicholtz (Department of Ecology)
- Ken Zweig (King County)
- Laura Hendrix (King County)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Lorin Reinelt (King County)
- Martha Neuman (Seattle Public Utilities)
- Mary Strazer (King County)
- Matt Baerwalde (Snoqualmie Tribe)
- Mike Mactutis (City of Kent)
- Miranda Fix (Seattle resident)
- Monica Walker (King County)
- Nancy Sandford (King County)
- Natalie Seitz (King County)
- Patricia Robinson (King County)
- Patrick Haluptzok (Sammamish resident)
- Regina Fletcher (Snoqualmie Valley Preservation Alliance)
- Sherry Edquid (City of Tukwila)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Teresa Lewis (King County)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Danielle Butsick (Port of Seattle), Laura Casey (Carnation farmer), Molly Lawrence (Van Ness Feldman), Regina Fletcher (Snoqualmie Valley Preservation Alliance)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer noted the objectives of the meeting included reviewing outcomes of recent topic-specific workshops, discussion of river flooding problems, and discussion of primary flood hazards and problems that should be the focus of the Flood Plan.

Public Comment

An opportunity to provide public comment was provided at the beginning of the meeting. No public comments were made.

Outcomes from Workshops on Coastal, Tributary, and Urban Flooding

Jason Wilkinson presented background information on the topics for tributary, coastal, and urban flooding, for which there were two workshops per topic. Participants, who included city officials, tribes, non-governmental organizations, and residents had the opportunity to provide input on problem areas, impacts, and solutions.

Key takeaways from the workshops included:

- Improved stormwater management at existing and new development was discussed as a possible solution for all types of flooding.
- Better emergency management coordination across jurisdictions is needed, including more clarity around King County's role.
- Property acquisition is a key tool for reducing flood risk, but has complications and challenges, such as equity and housing impacts.
- Urban flooding issues are difficult and expensive to solve. Actions that provide multiple benefits open up more funding possibilities.
- Multiple factors combine to exacerbate coastal impacts, and addressing these impacts can be complicated by challenges with regulations, spatial limitations, and other natural hazards.
- Modeling for future flood conditions and pluvial flooding is needed to better understand risks.
- Sediment deposition and management are primary concerns in areas where sediment accumulation is impacting infrastructure and affecting flood conditions.
- Education and access to culturally appropriate tools are needed to better convey flood risk and related issues.

Following the overview of the workshops, Partner Planning Committee members who had attended the workshops emphasized the importance of future climate conditions, thoughtfully coordinated emergency response, and understanding the differences in approaches to flooding in rural and urban areas. Equity, mental health, waterfront access for certain land uses, and food production issues were discussed as some of the concerns that were identified in relation to managed retreat and floodplain property acquisition.

River Flood Hazards and Risks

Staff from King County's River and Floodplain Management Section presented on the South Fork Skykomish River, Sammamish River, and White River, continuing discussions of basin-specific flood issues and characteristics from the previous meeting.

Chase Barton described flooding and flood hazard management in the South Fork Skykomish River Basin:

- Flooding: overbank flows, channel migration, avulsion
- Impacts: landslides, Miller River avulsion destroyed portion of Old Cascade Highway, levee and revetment damage
- Initiatives: stream monitoring, inspection of facilities, levee repair, property acquisition

Kate Akyuz described flooding and flood hazard management in the Sammamish River Basin:

- Flooding: flooding largely contained by banks, channel capacity restricted, surface water ponding due to stormwater drainage issues, backwater effects can increase lake levels
- Impacts: erosion, sediment aggradation, inundation of agricultural land, wave action on Lake Sammamish and damage to boat docks and lakefront properties
- Initiatives: Sammamish River Capital Investment Strategy, Issaquah Creek flood mapping, channel migration mapping, Willowmoor Flood Risk Reduction Project

Mary Strazer described flooding and flood hazard management in the White River Basin:

- Flooding: sediment accumulation limits conveyance capacity, overbank flooding in urban areas, channel migration
- Impacts: erosion of levees, extensive residential flooding, increased flood extents from reduced channel capacity
- Initiatives: floodplain reconnection, setback levees, revetment repair, HESCO installation near development and infrastructure, channel migration studies, property acquisition

Committee Discussion

The meeting transitioned to an open discussion about sources and causes of flooding in King County and their impacts. The Committee's initial focus on discussion of transportation impacts included challenges with transporting children to school in rural areas due to flooding inhibiting access, costs of delay to employees and employers, flooding of roads, impacts to inundated vehicles, limited vehicle access for low-income families, and challenges with receiving support to resolve transportation issues. In response to a comment about a City of Portland emergency transportation route plan, staff from the King County Office of Emergency Management noted that routes for snow emergencies are default routes for other emergencies, but that a coordinated effort with cities and stakeholders to develop an emergency transportation route plan has not been undertaken.

Discussion of the importance of early flood warning noted the Snoqualmie Valley Floodzilla system, King County's alert system, and Seattle's alert system. Participants noted that flood warning systems could help to activate pre-positioned resources and prepare people in exposed areas outside of the mapped floodplain. Issues of obtaining funding for retrofits and repairs related to flooding outside of the FEMA mapped floodplain were discussed. Jason Wilkinson noted that King County has worked with the University of Washington Climate Impacts Group to model future flood impacts, which will not affect how FEMA maps the floodplain, but it can help inform King County about future flood risks outside of the mapped floodplain.

Historical floodplain management activities were discussed as causing harm and pushing flood impacts to other locations, which have resulted in impacts to agricultural, natural resources, and ancestral lands. Flooding impacts to safe drinking water and food supplies were also noted as potential issues—flooded produce cannot be sold, and flood impacts to agricultural areas may limit access between farmers and sellers. Discussion of flood impacts to underserved populations highlighted that the lower cost of living in floodplains draws people to at-risk locations, and important considerations include the provision of sufficient resources to impacted communities, impacts to

disabled and senior populations, and the possibility that basing funding for flood risk reduction projects on certain demographics could unintentionally result in a loss of funding.

Next Steps

Spencer Easton noted that the Partner Planning Committee will talk about a framework for identifying appropriate strategies and more Flood Plan development topics in the next meeting, following up on participant comments about the importance of the Flood Plan reflecting the discussions in these meetings. Jason Wilkinson stated that in upcoming meetings there would be opportunities to provide input on strategies and policies, including consideration of where changes in the policy approaches from the 2006 Flood Plan may be needed.

King County Flood Management Plan

Partner Planning Committee – Meeting #5 Agenda
April 18, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To solicit initial input from the Committee on the Flood Plan's approach to policies and on specific policy recommendations
- To introduce evaluation criteria that can be used to assess actions proposed for inclusion in the Flood Plan

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 11:15 **Presentation: Flood Plan Policies**

- Presentation on the purpose, use, and planned approach for policies in the Flood Plan
- Questions

11:15 – 11:40 **Breakout Rooms: Discussion of Policies**

11:40 – 12:10 **Full Group Discussion: Flood Plan Policies**

12:10 – 12:20 **Presentation: Introduction to Evaluation Criteria**

12:20 – 12:30 **Wrap Up and Next Steps**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #5 Meeting Notes
April 18, 2023 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Eric Beach (King County)
- Jamie Hearn (Duwamish River Community Coalition)
- Jared Schneider (King County)
- Jason Wilkinson (King County)
- Judi Radloff (King County)
- Kate Ryan (People to Preserve the Tualco Valley)
- Kayla Eicholtz (Department of Ecology)
- Ken Zweig (King County)
- Laura Hendrix (King County)
- Laura Wolfe (Port of Seattle)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Lorin Reinelt (King County)
- Martha Neuman (Seattle Public Utilities)
- Matt Knox (King County)
- Mike Mactutis (City of Kent)
- Miranda Fix (Seattle resident)
- Sherry Edquid (City of Tukwila)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Laura Casey (Carnation farmer), Molly Lawrence (Van Ness Feldman), Regina Fletcher (Snoqualmie Valley Preservation Alliance)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer noted the objectives of the meeting included soliciting input from the Partner Planning Committee about the Flood Plan's approach to policies and specific policy topics, as well as introducing the Committee to approaches to evaluating actions proposed in the Flood Plan.

Public Comment

An opportunity to provide public comment was provided at the beginning of the meeting. No public comments were made.

Flood Plan Policies Presentation

Jason Wilkinson provided background on the policies from the 1993 and 2006 Flood Plans, which were not updated during the 2013 Flood Plan Update. There were 47 policies, which range from broad policy statements to detailed operational standards. Steve Bleifuhs described the use of Flood Plan policies for framing priority actions, guiding flood risk reduction efforts, informing decision-making, and being the basis for code development or updates. Jason discussed the potential for approaching policies differently in the 2024 Flood Plan, such as using broad policy statements with more detailed guidance reserved for other parts of the Flood Plan. Jason summarized input relevant to policy updates from past topic-specific workshops, Partner Planning Committee meetings, and Internal Planning Committee meetings.

Participants raised questions about requirements for cities within King County to adopt King County's Flood Plan and its policies. Steve Bleifuhs reported that while state law indicates a county's flood plan is to be considered binding on cities within that county, this requirement has not been enforced nor has the state indicated it is likely to enforce this provision going forward. Participants expressed some concerns about King County's Flood Plan establishing policies that set higher standards than basic compliance with National Flood Insurance Program standards, such as incorporating multiple benefit requirements, and what this would entail for cities in King County. A participant suggested that any new or maintained King County policies proposed for the 2024 Flood Plan should be compared to King County Flood Control District policies, in order to identify and explain reasoning for the differences.

Steve Bleifuhs, when asked about challenges to implementing the existing policies, stated that detailed operational policies can present challenges to implementing projects across different contexts, suggesting that high level policies provide more flexible frameworks. Jason Wilkinson stated that he would provide the Partner Planning Committee with more information in the future regarding the process and timeline for code updates related to Flood Plan policy changes.

Flood Plan Policies Breakout Rooms and Discussion

Participants were divided into three breakout room groups to discuss policy topics for the 2024 Flood Plan, including scope, new policies, and which existing policies to keep. Summaries of responses to breakout room questions are included below. Existing policies can be found in Chapter 2 of the 2006 King County Flood Plan.

Do you agree with an approach that reduces the number of policies and focuses on high-level direction?

- Policies should be clear about their intent, commitments, and measures of success
- Policies should be simplified, with a flexible overarching vision
- Policies should avoid details about specific operations and programs
- County policies should be coordinated with cities, get buy-in from other jurisdictions

Which topics and which categories of activities should be covered by policies?

- Cover all types of flooding in geographic scope, including tributary, urban, and coastal
- Consider whether policies covered in other regulatory documents are redundant or reinforcing

- Clarification of roles and responsibilities, coordination across jurisdictions
- Broad, flexible policies that can be applied to different contexts
- Cover climate change, equity, and environmental justice

What are the top policies that should be retained from the 2006 Flood Plan?

- Property acquisition, elevation, and relocation policies, with some revisions
- Integrated floodplain management, multiple benefits, and protection of ecological functions
- Inter-governmental and intra-governmental coordination policies

What are new policies that should be considered for the 2024 Flood Plan?

- Further clarification of inter-governmental and intra-governmental coordination, roles and responsibilities, requirements for cities
- More detailed policies on the inclusion of climate change in flood planning
- Integrated floodplain management, with more explicit consideration of agriculture, tribal treaty rights, and endangered species
- Policies that address different approaches to flood hazard management and needs for rural and urban areas

What policies from the 2006 Flood Plan should not be carried forward or need revision?

- Economic impact assessment requirements, which could have environmental justice implications from deprioritizing small projects and protection of low-income areas
- Gravel management, sandbags, and other detailed operational practices
- Stronger language around funding, revise funding requirements related to King County standards

Participants continued an open discussion of the breakout room questions after reconvening as a whole group. Numerous participants reported out the points they had made in the breakout rooms, summarized above.

Participants had concerns about conflicts between policies and conflicts with how policies are implemented in different contexts. One participant suggested that it would be challenging to resolve all conflicts between policies and that there should be different policies for different times and places. Another participant stated that the Flood Plan should not aim to establish consistency and resolve conflicts between all policies, as those are more detailed, technical issues that should be addressed elsewhere either in the Flood Plan or in other plans. Discussion continued about whether or not cities should have to adopt King County standards; participants with knowledge of state requirements reiterated that cities only need to meet National Flood Insurance Program standards. There was disagreement about whether the Flood Plan should have different policies for urban and rural areas or if the policies should be flexible and cover all areas.

Participants generally agreed about inclusion of climate change policies and a geographic scope that covers all types of flooding and flooded areas. One participant suggested that stormwater management needs to be more explicitly considered in the policies as a flood issue on a watershed scale. One participant recommended carrying forward all policies related to funding but revising them to be more considerate of environmental justice and adding planning elements that would serve as precedent for funding requests. Agriculture and fish habitat were discussed as topics that should be detailed further in integrated floodplain management policies.

Evaluation of Actions

Spencer Easton presented an overview of how actions are evaluated for inclusion in flood plans, including state guidance on evaluation considerations and principles of comprehensive flood hazard management. Participants suggested that evaluating actions on the cost of implementation could present issues due to differing costs in urban and rural areas. One participant noted that an adaptive management component of the plan could provide a pathway for consideration of projects in the future that do not currently make sense to include in the plan.

King County Flood Management Plan

Partner Planning Committee – Meeting #6 Agenda
May 16, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To introduce the flood plan's risk reduction strategies and actions.
- To solicit committee feedback on flood risk reduction activities that could be included in the flood plan.

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 11:15 **Presentation: Introduction to Flood Risk Reduction Strategies and Actions**

- Presentation on the purpose, use, and planned approach for the Action Plan component of the Flood Plan, including the types of flood risk reduction activities that could be included in the plan
- Questions

11:15 – 12:20 **Group Discussion: Input on Activities to Address Flood Problems**

12:20 – 12:30 **Wrap Up and Next Steps**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #6 Meeting Notes
May 16, 2023 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jackie Underberg (Bellevue resident)
- Jason Wilkinson (King County)
- Judi Radloff (King County)
- Kayla Eicholtz (Department of Ecology)
- Ken Zweig (King County)
- Laura Hendrix (King County)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Martha Neuman (Seattle Public Utilities)
- Matt Baerwalde (Snoqualmie Tribe)
- Mike Mactutis (City of Kent)
- Miranda Fix (Seattle resident)
- Patrick Haluptzok (Sammamish resident)
- Robert Seana (Snoqualmie Valley resident)
- Sherry Edquid (City of Tukwila)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Tom Dean (Vashon-Maury Island Land Trust)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Molly Lawrence (Van Ness Feldman), Regina Fletcher (Snoqualmie Valley Preservation Alliance), Kjristine Lund (interested citizen)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer noted the objectives of the meeting included providing information on state and federal guidance for planning and selecting actions, providing information on the action plan component of the King County Flood Plan, and collecting input on types of actions to consider for inclusion in the Flood Plan.

Public Comment

An opportunity to provide public comment was provided at the beginning of the meeting. No public comments were made.

Presentation: Introduction to the Action Plan and Activities

Spencer Easton outlined flood issues that were identified during previous Partner Planning Committee meetings and in the topic-specific workshops that were held in early 2023. Spencer outlined the types of actions that were included in the 2006 and 2013 King County Flood Plans. Steps to identify and select actions were detailed from the Washington Department of Ecology's Comprehensive Flood Hazard Management Plan Guidebook and the Federal Emergency Management Agency's Community Rating System Coordinator's Manual.

The Community Rating System is an incentive program that provides flood insurance premium discounts to property owners in communities that participate in the program and implement floodplain management activities that exceed federal minimum standards. A participant asked if properties in incorporated cities are eligible for discounts. King County staff clarified that incorporated areas are eligible for discounts based on whether the local jurisdiction participates in the program, and the flood hazard management activities performed by those local governments dictate the discount (all participating cities in King County currently receive smaller discounts than unincorporated King County).

Spencer explained that the proposal for the action plan component of the Flood Plan was to include priority programs and projects for unincorporated areas of King County. Actions that may be implemented by other entities or in incorporated areas were proposed to be included in an appendix that would detail programs and projects led by others that align with the goals, objectives, and policies of King County's Flood Plan.

Multiple participants were confused that the action plan would not include projects in incorporated areas, with some concerned about projects that may be implemented by other entities only appearing in the appendix. Jason Wilkinson responded that the Flood Plan—while intending to characterize flooding countywide—can only recommend activities under the authority of King County. King County desires to reflect the activities of others but wants to avoid dictating the actions other government entities should perform. In response to questions about the expenditures of the King County Flood Control District (FCD), Jason reiterated that the FCD is an entity independent of King County government. Jason explained that, while actions would be distinguished by jurisdiction or implementing entity, flood hazards and risks identified in the Flood Plan would be countywide and span jurisdictional boundaries.

Participants continued to raise questions and concerns about the organization of the action plan and King County not implementing actions in incorporated areas, including:

- Will the Sammamish River be included in the Flood Plan?
    - Jason explained that the Sammamish River and all other rivers in King County will be included in the Flood Plan, with the identification of risks and needs, but that like other rivers, King County can only commit to actions in unincorporated areas.
- As King County's Water and Land Resources Division has historically performed some activities for the FCD, how will King County actions be differentiated from FCD actions?
    - Jason stated that King County implements numerous flood risk reduction activities that are not on behalf of or funded by the FCD, which would be distinguished in the action plan as the activities carried out by King County. These activities include flood risk reduction efforts carried out by Surface Water Management, the Office of Emergency Management, Roads, and Stormwater Services, among others. Activities

that are carried out by King County on behalf of or funded by other jurisdictions would be noted as such.

- For tasks that King County's Water and Land Resources Division performs on behalf of or funded by the FCD, will the King County Flood Plan policies be guiding that work?
    - Steve Bleifuhs responded that the Flood Plan policies will inform King County's work for the FCD, and King County will communicate risks and information to the FCD to help prioritize projects. King County's hope is that the FCD will adopt the Flood Plan.
- It was suggested that priority needs and actions that may be performed by entities besides King County should not be in the appendix but should be called out as priorities in the main text of the Flood Plan, with language to indicate that those actions are optional for entities besides King County.
- The flood plan team clarified that this was an initial conversation with the committee to get their input, and they will consider how to adjust the approach to the action plan in light of the feedback provided.

Spencer continued the presentation to review the following action types, based on the categorizations detailed in the Community Rating System Coordinator's Manual:

- Preventive – activities that keep flood problems from getting worse, such as regulations
- Property protection – activities that reduce impacts of hazards to properties as a parcel or neighborhood scale
- Natural resource protection – activities that preserve or restore natural areas or natural functions
- Emergency services – activities taken during an emergency to minimize impacts
- Structural projects – activities that keep flood waters away from an area
- Public information – activities that inform people on ways to protect themselves and their property from hazards

Discussion: Input on Activities

Spencer initiated a discussion on activities that should be considered for inclusion in the Flood Plan, based on the activity types from the Community Rating System Coordinator's Manual.

Suggested preventive activities included:

- Vegetation management in the Sammamish River and Sammamish Lake
- Drainage basin assessments and planning
- Incentivizing development outside of flood zones
- Sediment management to increase channel capacity
- Sea level rise studies
- Increasing freeboard requirements on structures in the floodplain

Suggested property protection actions included:

- Relocating structures to locations outside of the floodplain
- Incentives for mitigation for repetitive loss properties
- Deed upon death approach, where property is acquired when owner passes
- Reimbursement coverage for flood prevention actions by homeowners, such as sandbagging
- Framework for determining when it is acceptable to condemn properties

- Property acquisition, retrofits, and managed retreat
- Financial assistance for low-income households to purchase flood insurance

Suggested public information activities included:

- Communicating risks of levee breech and dam inundation areas, including potential overlapping flood risks with seismic events and landslides
- Require disclosure to tenants or property owners if a property is in a floodplain
- More outreach, including distributing information through schools, through community groups, and at community events
- Coordinate with Washington Department of Labor and Industries and Office of Insurance Commissioner to promote flood insurance
- Coordination of messaging and outreach between King County and other jurisdictions withing the county
- Post-disaster outreach and education

Other suggested actions included:

- Providing people with emergency kits for their home or informing people about creating their own emergency kits
- Protecting headwaters wetlands and disallow filling of headwater wetlands with purchasing of mitigating credits from downstream projects
- Aligning activities with flood risk reduction policies in the Comprehensive Plan
- Flood modeling to identify changes from improving flood control structures
- Repurposing structures in the floodplain to flood-compatible uses
- Address flood risks in areas where other entities, such as the King County Flood Control District, are not planning to take action

Next Steps

The next Partner Planning Committee meeting will be on Tuesday July 18th. The meeting will cover draft policies and will continue with a discussion of potential actions to consider in the Flood Plan.

King County Flood Management Plan

Partner Planning Committee – Meeting #7 Agenda
July 18, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To solicit committee feedback on the draft Flood Plan policies.
- To provide an update on the approach to flood risk reduction activities in the Flood Plan and solicit committee feedback on draft evaluation criteria.

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 11:15 **Discussion: Policies**

- Recap prior discussion of Flood Plan policies
- Discuss Draft Flood Plan policies (distributed in advance)

11:15 – 11:35 **Presentation and Discussion: Action Plan and Activities**

- Update on the planned approach to how projects and other activities will be referenced in the Flood Plan
- Questions and discussion

11:35 – 12:20 **Presentation and Discussion: Evaluation Criteria**

- Presentation on draft criteria for evaluating actions in the Flood Plan (10 minutes)
- Breakout room discussions (15 minutes)
- Full group discussion and questions (20 minutes)

12:20 – 12:30 **Wrap Up and Next Steps**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #7 Meeting Notes
July 18, 2023 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Edan Edmonson (King County)
- Eric Beach (King County)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jackie Underberg (Bellevue resident)
- Jamie Hearn (Duwamish River Community Coalition)
- Jason Wilkinson (King County)
- Judi Radloff (King County)
- Kayla Eicholtz (Department of Ecology)
- Ken Zweig (King County)
- Laura Haren (City of Kent)
- Laura Hendrix (King County)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laure Wolfe (Port of Seattle)
- Martha Neuman (Seattle Public Utilities)
- Nicole Johnson (King County)
- Sherry Edquid (City of Tukwila)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Tom Dean (Vashon-Maury Island Land Trust)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Laura Casey (Carnation farmer), Molly Lawrence (Van Ness Feldman), Regina Fletcher (Snoqualmie Valley Preservation Alliance)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer noted the objectives of the meeting included soliciting input from the Partner Planning Committee on the draft Flood Plan policies, providing an update on the approach to Flood Plan actions and the Action Plan, and collecting input on potential evaluation criteria for Flood Plan actions.

Public Comment

An opportunity to provide public comment was provided at the beginning of the meeting. No public comments were made.

Discussion: Flood Plan Policies

Jason Wilkinson provided an overview of the revisions to the Flood Plan policies since they were last shared with the Partner Planning Committee. New policies were added to address capacity building with community organizations, limiting sediment removal activities, the importance of large wood in rivers and streams, identifying multi-benefit floodplain projects, and accounting for uncertainty in future flooding conditions due to climate change. Some of the previous draft policies were revised to expand on the application of best available science and streamline the policies that address land use.

Spencer Easton facilitated a discussion on the newest updates to the draft Flood Plan policies.

- In reference to draft policy #16, a participant asked what it meant for King County to exceed minimum standards of the National Flood Insurance Program.
    - Jason noted that by participating in the Community Rating System, King County already exceeds the National Flood Insurance Program minimum requirements. Laura Hendrix also noted that King County's land use regulations exceed National Flood Insurance Program minimums and that Washington's state floodplain management standards exceed the minimums.
- A participant suggested that policy #18, which urges street improvements for safe egress, should also encourage improvements for safe ingress.
- A participant described a gap in the policies in addressing existing development and land uses in the floodplain, noting that prioritizing restoration is not appropriate for all environments.
    - The participant described goals and objectives from the 2006 Flood Plan as having more acknowledgement of protecting existing development.
    - Other participants noted there are locations where intensive infrastructure exists and may have a need for flood control, also noting that if existing land use is not acknowledged, the draft policies could be interpreted as suggesting floodplain development should be removed.
    - Jason clarified that the absence of acknowledging particular land uses or infrastructure is not intended to suggest that they be eliminated or disregarded, but that the policies use a broad approach, in order to not disregard potential opportunities for restoration or floodplain reconnection based on existing land uses, while recognizing that full floodplain restoration is not possible everywhere.
    - Participants reiterated the need for clarification and acknowledgement around existing land uses, stating that existing land uses like working waterfronts and flood control infrastructure provide benefits.
    - One participant expressed a concern that committee feedback has not been incorporated into the draft documents developed for the Flood Plan.
- A participant suggested that more policies identify a need for adding floodwater storage, as well as the potential for releasing stored water during low-flow seasons, especially in response to climate impacts.
- A participant noted that many of the policies address planning before a flood, but there is a lack of policies to direct flood emergency response and post-flood recovery.
    - Jason stated that the King County Office of Emergency Management supported detailing specific flood response and recovery practices elsewhere in the Flood Plan.

Comments will continue to be accepted on the Flood Plan policies. King County will send out the policies and goals to the committee and would like comments back by August 18. The policies will not be finalized until the final draft of the Flood Plan in 2024.

Presentation and Discussion: Action Plan and Activities

Jason provided an update on revisions to the proposed approach to the Action Plan section of the Flood Plan. The previous proposed approach would have the Flood Plan list actions that King County would commit to in the body of the Flood Plan, while actions that King County supports other jurisdictions pursuing would be included in an appendix. The revised proposed approach would be called the Comprehensive Mitigation Strategy, which would include an Action Plan (actions that King County is committed to pursue) and a separate list of flood risk reduction actions that other jurisdictions may pursue. Participants indicated that this approach to the Action Plan addressed previous concerns about actions led by jurisdictions other than King County being reflected separate from King County's actions.

Presentation and Discussion: Evaluation Criteria

Spencer Easton provided an overview of how evaluation criteria would be applied to determine which actions to include from King County and other jurisdictions in the Comprehensive Mitigation Strategy.

Draft evaluation criteria for the discussion included:

- Compatibility with Flood Plan goals and objectives
- Compatibility with other King County plans and commitments
- Environmental impact
- Impact on people
- Benefits
- Effectiveness/suitability
- Resilience/adaptive capacity

The following comments were made in discussion of the draft evaluation criteria:

- There should be transparency on how projects are ranked against each other.
- Using the evaluation criteria, projects that are included in the Flood Plan should be organized in tiers based on priority.
- Definitions of evaluation criteria should be clarified to avoid subjective interpretations and improve transparency.
- Adding a quantitative component to the application of evaluation criteria could clear up confusion.
- There were mixed opinions on whether or not actions that would be pursued by jurisdictions other than King County should be based on existing, adopted capital improvement programs, although multiple people raised concerns about wanting flexibility for projects that may not be in adopted capital improvement programs.
- The resilience/adaptive capacity criteria could be more explicitly linked to climate change.
- The evaluation criteria should include consideration of projects being in accordance with King County regulations.

Wrap-up

Jason will resend the policies and distribute a copy of the revised goals, objectives, and guiding principles to the Partner Planning Committee, with comments on Flood Plan policies due to Jason and Spencer by August 18, 2024.

King County Flood Management Plan

Partner Planning Committee – Meeting #8 Agenda
September 19, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To discuss how committee feedback has thus far informed the Flood Plan.
- To discuss the request for mitigation activities and specific activities that should be considered in the plan's Comprehensive Mitigation Strategy.

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 11:05 **Presentation and Discussion: Flood Plan Input to Date**

- Summary of Partner Planning Committee and community input received to date and how it is being incorporated into components of the Flood Plan
- Questions and discussion

11:05 – 11:35 **Presentation and Discussion: Activity Submittal Form/Process**

- Overview of the request for mitigation activities
- Questions and discussion

11:35 – 12:20 **Breakout Rooms: Mitigation Activity Brainstorming**

- Opportunity to brainstorm potential mitigation activities in small groups and to submit activities for consideration through the conversation

12:20 – 12:30 **Wrap Up and Next Steps**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #8 Meeting Notes
September 19, 2023 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Edan Edmonson (King County)
- Eric Beach (King County)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jamie Hearn (Duwamish River Community Coalition)
- Jason Wilkinson (King County)
- Ken Zweig (King County)
- Laura Wolfe (Port of Seattle)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Martha Neuman (Seattle Public Utilities)
- Matt Baerwalde (Snoqualmie Tribe)
- Matt Knox (King County)
- Mike Mactutis (City of Kent)
- Patrick Haluptzok (Sammamish resident)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

Emily Arteche (City of Snoqualmie), Jamie Brakken (Bellevue real estate agent), Laura Casey (Carnation farmer), Michael Pruett (Real estate project manager), Molly Lawrence (Van Ness Feldman) Peter Lamanna (Washington Sensible Shorelines Association), Regina Fletcher (Snoqualmie Valley Preservation Alliance)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer noted the objectives of the meeting included to review input provided by this committee so far, to share input received in other forums, to provide an overview of the process to submit activities to be considered for the Flood Plan, and to brainstorm ideas that could be considered to include in the Flood Plan.

Public Comment

An opportunity to provide formal public comment was provided at the beginning of the meeting. No public comments were made.

Presentation and Discussion: Flood Plan Input to Date

Spencer provided an overview of input received on numerous topics, including flood hazards, goals and objectives, policies, risk reduction activities, structure of the Flood Plan, and evaluation criteria for

activities included in the Flood Plan. A detailed overview of this input and how it informed the Flood Plan development process can be found in the presentation and video from this meeting.

Following the overview of input and how it has been used, Spencer asked if there was any input that wasn't included in the overview that committee members would like to highlight. Diane Pasta noted that she had previously discussed concerns about access to drinking water during floods and potential impacts to drinking water sources from flooding and was requesting more information on this topic. King County committed to providing additional information and resources on this topic at the next meeting, as there were not County staff with expertise in this area present at the meeting.

Presentation and Discussion: Action Submittal Form/Process

Jason Wilkinson introduced the approach to developing the Comprehensive Mitigation Strategy and Action Plan components of the Flood Plan. King County shared forms with cities, tribes, and other entities which would allow them to propose flood risk reduction activities that will be reviewed for inclusion in the Flood Plan's Comprehensive Mitigation Strategy. All proposals will be reviewed against evaluation criteria. For activities to be included in the Action Plan, King County must be the lead agency, King County must be able to commit to funding or seeking funding for the activity, and the activity must be completed or advanced within five years of adopting the Flood Plan. All other proposed activities that meet the evaluation criteria would be included in the broader Comprehensive Mitigation Strategy.

Jason and Spencer responded to questions about the form and the process.

- What types of activities should be submitted with the form? Is it oriented towards projects with established plans and secured funding or can activities be included that are not well defined and require further scoping or planning?
    - Jason responded that the Flood Plan has a five-year timeline, although that schedule is primarily a commitment that King County is making. There will be consideration of projects that are not fully developed or require further planning if elements of the project can be studied or advanced in some manner within the five-year timeline.
    - Spencer added that activities do not need to be proposed as individual components, if they are all part of a larger program or project.
- Could you clarify what Comprehensive Mitigation Strategy means and entails?
    - Jason explained that the Comprehensive Mitigation Strategy is inclusive of all activities being recommended in the Flood Plan, both activities that meet the requirements of the Action Plan and those that do not. The name Comprehensive Mitigation Strategy reflects that the list of proposed flood hazard mitigation activities is inclusive of those that King County is not committing to completing within five years. The Action Plan, which is a component of the Comprehensive Mitigation Strategy, only includes actions that King County can commit to completing and reporting on to FEMA, as required by the Community Rating System process that King County is undertaking. Committee members suggested that the name Comprehensive Mitigation Strategy is confusing and that it might be helpful to select a different name.
- One of the evaluation criteria is that activities must not conflict with legal obligations of King County. How intensive will the legal review of activities be?
    - The review will be a high-level assessment of the proposed activity to determine if there is an obvious legal conflict. It will not be an intensive review.

- Will planned projects by the King County Flood Control District be included in the Flood Plan?
    - Spencer stated that actions in the King County Flood Control District's current capital improvement program would be included in the Comprehensive Mitigation Strategy.
    - In response to a specific follow-up question about the Lower Green River Corridor Plan, Jason added that the work that the Flood Control District has been discussing for the Lower Green River has not been developed into a project list at this point and will not be included, but the planning work they are undertaking will likely be referenced in some way.
- Is King County planning to conduct an analysis of repetitive loss properties?
    - King County completed an analysis of repetitive loss properties in 2022, which can be accessed here.
- How will the Comprehensive Mitigation Strategy be used, if King County is not committing to implementing or funding activities put forward by other entities?
    - Jason explained that the Comprehensive Mitigation Strategy demonstrates a need for flood risk reduction activities throughout King County (not just in unincorporated areas) and demonstrating this need can support efforts to seek funding for implementation. Outlining proposals by a wide array of entities in King County in one place may also help support collaboration across jurisdictions and coordinated implementation.

By request King County committed to making activity form submissions available to other Partner Planning Committee members via a shared electronic file.

Breakout Rooms: Action Brainstorming

Partner Planning Committee members were divided into breakout rooms to brainstorm and discuss projects to be submitted for potential inclusion in the Comprehensive Mitigation Strategy. The Partner Planning Committee will discuss some of the activities that were submitted at their October 17th, 2023, meeting.

King County Flood Management Plan

Partner Planning Committee – Meeting #9 Agenda
October 17, 2023| 10:30 a.m. to 12:30 p.m.

Meeting Objectives:

- To review past risk reduction strategies, recap earlier committee feedback, share an update on proposed Flood Plan activities, and solicit committee feedback on activities.
- To discuss the Flood Plan process moving forward.

Agenda

10:30 – 10:35 **Welcome and Introductions**

10:35 – 10:45 **Public Comment**

- Opportunity to provide official public comment (up to 2 minutes per commenter)

10:45 – 12:10 **Presentation and Discussion: Flood Plan Strategies and Activities**

- Presentation and discussion of strategies and actions in King County's most recent flood plan and hazard mitigation plan and recap of committee input on priority strategies for this Flood Plan.
- Summary of the activities submitted and being considered for the Flood Plan.
- Committee discussion and input on drafting Flood Plan actions.

12:10 – 12:20 **Flood Plan Process**

- Summary of the process for the Flood Plan moving forward, with opportunity for questions and answers.

12:20 – 12:30 **Wrap Up and Next Steps**

King County Flood Hazard Management Plan Update

Partner Planning Committee – Meeting #9 Meeting Notes
October 17, 2023 | 10:30 a.m. – 12:30 p.m.

List of attendees:

- Angela Donaldson (Fall City resident)
- Diane Pasta (Des Moines resident)
- Eric Beach (King County)
- Erin Ericson (Snoqualmie Valley Watershed Improvement District)
- Jason Wilkinson (King County)
- Judi Radloff (King County)
- Laura Hendrix (King County)
- Laura Wolfe (Port of Seattle)
- Lauren Silver (Snoqualmie Valley Preservation Alliance)
- Laurie Lyford (Washington Sensible Shorelines Association)
- Lisa Nelson (Department of Ecology)
- Martha Neuman (Seattle Public Utilities)
- Matt Baerwalde (Snoqualmie Tribe)
- Mike Mactutis (City of Kent)
- Nicole Johnson (King County)
- Patrick Haluptzok (Sammamish resident)
- Sherry Edquid (City of Tukwila)
- Steve Bleifuhs (King County)
- Stewart Reinbold (Washington Department of Fish and Wildlife)
- Spencer Easton (Consultant team – ESA)
- Dan Beckley (Consultant team – ESA)

Interested parties present:

- Emily Arteche (City of Snoqualmie), Laura Casey (Carnation farmer), Regina Fletcher (Snoqualmie Valley Preservation Alliance), Molly Lawrence (Van Ness Feldman)

Introductions

Spencer Easton provided an overview of the agenda for the meeting. Spencer noted the objectives of the meeting included reviewing flood risk reduction activities from past King County plans, summarizing activities that were submitted for the 2024 Flood Plan, discussing gaps and opportunities for expanding upon the activities submitted, and discuss next steps in the Flood Plan process.

Public Comment

An opportunity to provide formal public comment was provided at the beginning of the meeting. No public comments were made.

Presentation and Discussion: Flood Plan Activities

Spencer provided an overview of flood risk reduction activities recommended in the 2020 King County Regional Hazard Mitigation Plan, including whether these activities were complete, ongoing, or not yet started. Participants were prompted to discuss if these activities were relevant to the 2024 Flood Plan, should be included in the 2024 Flood Plan, or if they should be modified.

- Numerous members expressed their support for including flood-related activities from the 2020 King County Regional Hazard Mitigation Plan in the 2024 Flood Plan.
- Martha Neuman asked for clarification on the activity that recommends "Rehabilitation or removal of high hazard dams," expressing concern that this may apply to the dams that support storage of Seattle's drinking water supply.
    - Nicole Johnson stated that the technical definition of a high hazard dam is one whose failure would result in any loss of human life, which applies to many of the dams in the region.
    - Erin Ericson suggested this strategy could be expanded upon to include outreach about dam risks and support for better dam monitoring technologies.
    - Martha expressed general support for dam improvements, but that the activity would need to be reworded, so as not to construe the potential for removal or major changes to critical infrastructure.
    - Lauren Silver suggested possible improvements around dam failure warnings and studying evacuation routes and protocol.

Spencer provided an overview of flood risk reduction activities recommended in the 2013 King County Flood Plan, including the progress on completing activities in each major river basin. Participants were prompted to discuss if these activities were relevant to the 2024 Flood Plan, should be included in the 2024 Flood Plan, or if they should be modified.

- There was general support for the types of activities in the 2013 Flood Plan, but nobody expressed support for pulling activities from the 2013 Flood Plan for direct inclusion in the 2024 Flood Plan.
- Lauren Silver expressed concerns about approaches to land acquisition, which could impact agricultural production, and suggested this be approached differently in the 2024 Flood Plan through other property protection methods.

Spencer detailed the process for evaluating activities submitted for possible inclusion in the Flood Plan and summarized information about the activities submitted, including their basin, activity types, benefits, and types of flooding addressed.

- Over 100 activities were submitted by King County and nearly 200 were submitted by other cities, governments, and organizations operating in King County or were otherwise pulled from publicly available information.
- 101 activities (or 33%) were natural resource protection projects, such as floodplain restoration, habitat improvements, and levee setbacks.
- 89 activities (or 29%) were structural projects, such as levees, revetments, floodwalls, or drainage improvements.
- 56 activities (or 18%) were preventive activities, such as land use regulations, flood hazard mapping, planning, and stormwater management.
- 37 activities (or 12%) were property protection, such as acquisition or elevation of homes.

- 14 activities (or 5%) were public information activities, such as technical assistance, education, and outreach.
- 9 activities (or 3%) were emergency services, such as flood warnings and emergency response.

For more detailed information on the activities submitted, review the presentation or video recording of the October 17th, 2023 Partner Planning Committee meeting here.

The Partner Planning Committee discussed potential gaps in the activities submitted or additions that could be made.

- Erin Ericson suggested improvements to existing flood warning systems and dam failure warning systems.
- Lauren Silver suggested emergency planning technical assistance for communities and private landowners, including working with private landowners to document risks on properties that could improve emergency response.
- Laura Casey noted that many earlier discussions emphasized the importance of public information activities, which were not widely represented in the activities submitted.
    - Jason Wilkinson acknowledged the substantial input about the need for public outreach and education about flood risk, indicating that King County is considering ways to improve public information activities and will work to identify additional activities that will address the input that has been heard.
- Sherry Edquid suggested that the Comprehensive Risk Mitigation Strategy could include technical assistance provided by King County to communities conducting substantial damage assessments after flood disasters.
- Martha Neuman inquired about adaptive management of the Flood Plan and how implementation of the Comprehensive Risk Mitigation Strategy could change over the life of the Flood Plan.
    - Jason stated that the Flood Plan would be updated every five years, in addition to annual evaluations and progress reporting. These update and monitoring activities will allow for reconsideration of priorities and adapting to potential changes that could necessitate changes to how the Flood Plan is implemented. These activities would involve coordination with partners and would not be an action performed independently by King County.
- Molly Lawrence and Laura Wolfe suggested including an activity that would involve a planning effort on best practices and resilience in addressing sea level rise, with coordination between King County, the Port of Seattle, and other governments.
- Sherry suggested distinguishing property protection activities that apply to residential properties from those that apply to commercial properties.

Spencer detailed the proposed process for prioritizing activities submitted for inclusion in the Flood Plan's Comprehensive Risk Mitigation Strategy. Based on the evaluation criteria and consideration of other Flood Plan themes, such as equity and climate change resilience, a short list of activities would be selected for distinction as high priority activities. This would be different from alternatives that would rank all or some activities in multiple tiers.

- Laura Hendrix suggested prioritizing activities that reduce risk to repetitive loss properties.

- There was discussion of prioritizing a range of activities that would be appropriate for different environments, such as rural and urban areas, as well as a variety of activities that are appropriate for different types of flood impacts.

Flood Plan Process

Jason provided information on next steps in developing the Flood Plan and opportunities for review. An initial draft of the Flood Plan has been developed. Internal review and revision processes will be occurring through the end of 2023. A draft Flood Plan is expected to be available in January or February 2024, with a 45-day comment period.

No other Partner Planning Committees are scheduled. A proposed Partner Planning Committee meeting would occur in February 2024, which would allow for Committee members to discuss the draft Flood Plan and provide feedback.

Appendix B

Implementation Status of 2013 Action Plan: 2013 – 2023

APPENDIX B
Implementation Status of 2013 Action Plan: 2013 – 2023

Step 7 of the FEMA Community Rating System planning framework requires that each activity recommended by a previously credited plan must be discussed, along with implementation status. This Flood Plan updates the *2013 King County Flood Hazard Management Plan Update and Progress Report*, which identified the 2013 – 2018 King County Flood Control District 6-Year Capital Improvement Project list as the Action Plan. The following tables, organized by major river watershed, list the name, description, and status of each item listed on the 2013 Action Plan.

Basin/River	Name	Description	Status
WRIA 7 – South Fork Skykomish/Snoqualmie Watershed			
Skykomish	Maloney Creek Confluence Improvements	Investigate ways to improve infrastructure at the mouth of Maloney Creek and on the SF Skykomish River to reduce the frequency of flooding of homes and property within the Town of Skykomish.	Completed in 2013.
Skykomish	Miller River Road Protection	Repair of 290 feet of rock revetment within its existing footprint to provide protection to Miller River Road.	Completed in 2014.
Skykomish	Miller River Home Buyouts	Purchase monastery compound threatened by flooding and erosion.	Completed in 2014.
Skykomish	South Fork Skykomish Repetitive Loss Mitigation	Elevate or buyout individual structures in the South Fork Skykomish Basin to eliminate the risk of flooding or erosion damage during future flood events.	Since 2017, 20 parcels purchased, covering 7.89 acres. Two more acquisitions are in process. No home elevations have occurred in the SF Skykomish Basin.
Skykomish	Skykomish Home Buyouts	Purchase homes and property subject to flooding risk in the Town of Skykomish.	Incorporated into South Fork Skykomish Repetitive Loss Mitigation.
Skykomish	Timberlane Erosion Buyouts	Acquire and remove homes along a stretch of the South Fork Skykomish River that are endangered by erosive forces, channel migration, and inundation.	Since inception, eight parcels purchased, totaling 2 acres.

Basin/River	Name	Description	Status
Upper Snoqualmie	City of Snoqualmie Natural Area Acquisition	Acquire and demolish individual residential structures to eliminate the associated risk of flood damage to homes.	This project was incorporated into the Upper Snoqualmie Residential Flood Mitigation project in 2013.
Upper Snoqualmie	Meadowbrook 2011 Repair	Repair damage from 2011 flood event.	Completed in 2017.
Upper Snoqualmie	Middle Fork Levee System Improvements	Upgrade the Middle Fork Snoqualmie levees to meet the US Army Corps of Engineers PL84-99 certification standards.	One Middle Fork Snoqualmie levee upgraded to meet PL 84-99 certification standards in 2020.
Upper Snoqualmie	Mason-Thorsen Extension 2011 Repair	Repair damage resulting from flood events.	Completed in 2011.
Upper Snoqualmie	North Bend Residential Flood Mitigation	Relocate or elevate individual residential structures to eliminate the associated risk of flood damage to homes.	This project was incorporated into the Upper Snoqualmie Residential Flood Mitigation project in 2017.
Upper Snoqualmie	South Fork Levee System Improvements	Design and reconstruct the impaired segment of levee in place to resolve six known levee deficiencies.	Necessary repairs completed in 2018.
Upper Snoqualmie	SR 202 Bridge Lengthening	Expand bridge SR202 opening over South Fork Snoqualmie and Ribary Creek to improve conveyance and reduce upstream flood impacts.	The Bendigo Bridge Replacement project was identified as a Proposed Long Term Action in the South Fork Snoqualmie River Capital Investment Strategy that was completed in 2017.
Upper Snoqualmie	Upper Snoqualmie Residential Flood Mitigation (includes North Bend Residential Flood Mitigation and City of Snoqualmie Natural Area Acquisition)	Acquire flood-prone properties or elevate individual structures in the Upper Snoqualmie basin to eliminate the risk of flood damage when Snoqualmie River flows overtop the existing levees.	Since 2008, 48 home elevations have been completed and two are currently underway. Since 2008, 25 parcels have been acquired, totaling 24.1 acres, with one more in process.
Upper Snoqualmie	Record Office Repair	The Record Office revetment is located along the Snoqualmie River in the City of Snoqualmie. Flooding in 2015 and 2016 damaged the revetment, causing loss of riprap armoring and steepening the bank along approximately 200 feet. The revetment protects a city street and various utilities form river erosion hazards.	The repair and adjacent riparian enhancements were completed in 2022, with the City of Snoqualmie incorporating in other park and stormwater-related improvements in the area.
Lower Snoqualmie	Aldair Buyout	Remove homes and agricultural structures from behind the Aldair levee, to eliminate risk of a potential levee failure.	No further progress on the purchase of the three agricultural properties abutting the Aldair levee since 2010.

Basin/River	Name	Description	Status
Lower Snoqualmie	Farm Flood Task Force Implementation	Provide technical and cost-sharing assistance to agricultural landowners in floodplains to help them better maintain their operations during and after flood events. Specific project actions include farm pads, elevations of barns and agricultural accessory dwellings, etc.	Three Barns have been elevated since 2009, as well as one golf course club house. Twenty-six farm pads were permitted and constructed in the Lower Snoqualmie Valley as part of the farm pad program.
Lower Snoqualmie	Lower Snoqualmie Repetitive Loss Mitigation	Elevate or purchase individual structures in the Lower Snoqualmie basin to eliminate the risk of damage during Snoqualmie River floods.	This project was merged with the Lower Snoqualmie Residential Flood Mitigation in 2019.
Lower Snoqualmie	Lower Snoqualmie Residential Flood Mitigation	Provide technical and cost-sharing assistance to residential and agricultural landowners in the Lower Snoqualmie floodplain to help them better withstand the impacts of flooding. Specific project actions include farm pads, elevations of homes, and elevation or flood proofing of agricultural structures.	Since 2008, 17 home elevations have been completed in the Lower Snoqualmie Basin, with three more in progress. 15 parcels have been acquired, totaling 33.9 acres. One more is in process. Three barn elevations were completed as part of Farm Flood Task Force Implementation project. Twenty-six farm pads were permitted and constructed in the Lower Snoqualmie Valley as part of the farm pad program.
Lower Snoqualmie	McElhoe/Person Levee	Repair damage from 2006 flood event.	Completed in 2012.
Lower Snoqualmie	Sinnema Qualle Repair	Project included reconstruction of 750 feet of bank revetment to protect the Snoqualmie Valley Trail and State Route 203 from ongoing bank erosion and slope instability.	Completed in 2016.
Lower Snoqualmie	Tolt Pipeline Protection	Project reconstructed 1,200 feet of bank revetment, which was threatening the Tolt River Pipeline. The pipeline provides about 1/3 of the water to more than a million people in Seattle and surrounding cities.	Completed in 2018.
Tolt	Lower Tolt River Acquisition	Purchase Swiftwater property to allow for future setback of Upper Frew levee (right bank)	This acquisition was completed in 2013. Additional high priority acquisitions in the Lower Tolt are ongoing.
Tolt	San Souci Neighborhood Buyout	Multi-year project included removing nearly 20 at-risk homes from willing sellers. Following the full neighborhood acquisition, the river was reconnected to 33 acres of its historic floodplain.	All but the three northern-most parcels from one landowner were acquired by 2018, and the floodplain reconnection was completed in 2019.
Tolt	SR 203 to Trail Bridge Floodplain Reconnection	Setback Frew levee (right bank) to improve conveyance and allow habitat enhancement.	Project in preliminary design, construction currently scheduled for 2027.

Basin/River	Name	Description	Status
Tolt	Tolt River Mile 1.1 Levee Setback	Purchase flood and erosion prone properties on both sides of the Tolt River between SR203 and the Snoqualmie Valley Trail Bridge. These acquisitions will allow for future setback of the Tolt 1.1 (Hwy to RR Bridge) levee in order to reduce flood and channel migration hazards, increase sediment storage and flood conveyance capacity, restore natural riverine processes, and reduce future maintenance costs.	Acquired 16 parcels, totaling 11.27 acres.
Tolt	Tolt River Natural Area Acquisitions	Acquire up to 12 properties in the channel migration zone of the Tolt River in the vicinity of the Tolt Natural Area.	Acquired 16 additional parcels since 2008, totaling 29.52 acres. Ongoing.
Tolt	Tolt Supplemental Study	Update technical information on flood and erosion risks and habitat restoration to recommend priority actions.	Tolt Capital Investment Strategy was completed in 2017.
Raging	Abandoned Bridge Abutment and Waring Revetment Removal		The project has not been implemented.
Raging	Alpine Manor Mobile Home Park Acquisition	Acquire and remove most, if not all, of the homes in the Alpine Manor Mobile Home Park, as well as several single family homes in the area in order to permanently remove these structures from areas at high risk for channel migration, avulsion and flooding.	All but one at-risk parcel acquired as of 2023. Raging River Channel Migration Zone Study and Map was completed in 2019 and improved the understanding of properties at risk from channel migration and avulsion.
Raging	Preston Fall City Upper Repair		Repair was completed in 2012.
WRIA 8 – Lake Washington/Cedar/Sammamish Watershed			
Sammamish	Willowmoor Floodplain Restoration	Reconfigure the Sammamish River "transition zone" to provide necessary lake level control for Lake Sammamish, enhance habitat conditions in the river, adjacent wetlands, and tributaries for Endangered Species Act (ESA) listed Chinook salmon and other fish, and reduce the costs of ongoing maintenance of the transition zone.	Completed stakeholder outreach in 2015 and selected a preferred alternative design in 2016. Project design paused in 2019 to allow time to prepare additional technical analyses directed by the Flood District.
Lake Washington tributaries	Lower Coal Creek Phase I	Increase the storage capacity of the regional detention pond while maintaining fish passage and increasing conveyance capacity at five box culvert crossings.	Group 1 – Upper Skagit Key Culvert Replacement construction completed fall 2017, currently in Post-Construction Monitoring. Group 2 – Cascade Key and Newport Key Culvert Replacements, construction completed in 2018, currently in post-construction monitoring and storm repairs completed in fall 2020.

Basin/River	Name	Description	Status
			Group 3 – Glacier Key and Lower Skagit Key Culvert Replacements construction completed in fall 2020, currently in post-construction monitoring and storm repairs completed in summer 2020. Group 4 – Newport Yacht Club and Grand Canal Outfalls and Storm Drains – design and land acquisitions activities ceased, unable to acquire easements, project will not proceed.
Lake Washington tributaries	Issaquah Creek Repetitive Loss Mitigation	Mitigate repetitive loss properties on Issaquah Creek, and investigate other potential at-risk homes in repetitive loss areas.	Progress identified in basin profile
Lake Washington tributaries	McAleer/Lyon Channel Improvements	Re-establish a more natural floodplain for Lyon Creek and upgrade undersized culverts in the project area.	Completed in 2015.
Cedar	Belmondo Repair	Mitigation for emergency bank stabilization during 2009 flood.	First phase of mitigation for emergency repair completed in 2010 (rip rap removal, installation of one flow deflection structure, vegetated geogrids, native plantings). Second phase of mitigation completed 2012 (riprap removal, install rock toe and geogrids). Third phase of mitigation completed 2013 (install 2 flow deflection structures, roughness trees, vegetated geogrids).
Cedar	Cedar Pre-Construction Strategic Acquisitions	Acquire real estate properties that several large Flood District capital projects depend on, namely the levee setback projects at the Herzman, Jan Road, Rutledge-Johnson, Rhode, Getchman, Lower Jones Rd, and Elliot Bridge levee segments. Priorities for acquisition will be directed by the Flood District.	Acquired numerous properties from willing sellers to support capital projects.
Cedar	Cedar Levee Setback Feasibility	Determine bridge and levee modifications to increase level of flood protection along the lower 1.2 miles of the Cedar River through the City of Renton.	Feasibility study initiated in 2021.
Cedar	Cedar River Repetitive Loss Mitigation	Develop and implement mitigation measures for flood prone properties in repetitive loss areas. Acquisitions are from willing sellers.	Acquired numerous at-risk properties in flood-prone and repetitive loss areas.
Cedar	Cedar Rapids 2011 Repair	Perform emergency bank stabilization along setback levee alignment during January 2011 flood event.	Completed in 2011.
Cedar	Cedar River Gravel Removal	Remove gravel along the lower 1.25 miles of the Lower Cedar River in order to maintain 100-year level of flood protection for the City of Renton.	Completed in 2016.

Basin/River	Name	Description	Status
Cedar	Dorre Don Meanders Phase I	Conduct feasibility study of existing levees to identify modifications and property acquisitions to reduce flood risks.	The project has not been completed. Three projects in this reach have been identified in the Cedar River Capital Investment Strategy.
Cedar	Elliott Bridge Levee Setback	Acquire flood-prone homes in a repetitive loss area spanning both sides of the Cedar River. Levees on both banks will then be setback or removed. The project will eliminate potential for future flood damage to these homes.	Completed in 2016.
Cedar	Herzman Levee Setback	Remove and setback a portion of or the entire Herzman Levee along the right bank of the Cedar River between river mile 6.55 and river mile 6.70 to reduce upstream water surface elevations during flood events, reduce future maintenance needs on the downstream Cedar Trail 2 (CRT2) revetment, reduce future maintenance needs on the Herzman Levee, and provide improved riparian and aquatic habitat.	Planned for 2024.
Cedar	Jan Road-Rutledge Johnson Levee Setbacks	Reconnect floodplain by removing levees, constructing a setback levee and side channels, and installing large wood structures and native vegetation. Jan Road project reduced risk to CRT 7 during high flows and provided safe egress to residents during flooding, provided mitigation for 2017 large wood relocation, and improved habitat conditions.	Jan Road completed 2022. Rutledge Johnson planned for 2025.
Cedar	Maplewood Acquisition and Setback	Complete a detailed landslide risk assessment and feasibility study for existing levee to reduce flood risk.	Landslide risk assessment completed in 2021. Schedule for feasibility study to be determined by prioritization in Cedar River Capital Investment Strategy.
Cedar	Rainbow Bend Levee Setback	Remove the Rainbow Bend levee to allow river flows to spread across the open space created by the completed acquisition of over 50 flood-prone homes. This slows flood velocities and reduces flood elevations in this area of the river, protecting the adjacent state highway and regional trail.	Completed in 2013.
Cedar	Rhode Levee Setback and Home Buyouts	Purchase homes along path of fastest, deepest flood flow, and set back the levee to lower localized velocities and depths.	Properties acquired from wiling sellers. Project schedule determined by prioritization in Cedar River Capital Investment Strategy.

Basin/River	Name	Description	Status
Cedar	Cedar Rapids Repair	Repair 2020 damage to engineered log jam caused by erosion and scour resulting in loss of upper ballast, dislodging of key logs, shearing of piles, and damage to hardware connections.	Completed in 2021.
Cedar	Youngs Revetment Repair	Reposition logs that jammed up against the revetment during the January 2011 flood event, threatening the integrity of the flood protection structure.	Completed 2012.
Cedar	Riverbend Mobile Home Park Acquisition and Levee Setback		Completed in 2023.
Green/Duwamish River Watershed			
Green/Duwamish	Black River Pump Station Repairs	Establishment of secondary containment for all fuel tanks and lines completed. Rehabilitation and improvements to the pump station to meet current standards, construction of high use engines and fish passage improvements continue.	Original scope completed in 2019. Other improvements on-going.
Green/Duwamish	Boeing Levee Addition – Kent	A new earthen levee and flood wall combination was constructed behind 1.000 feet of the existing Boeing Levee.	Completed in 2014.
Green/Duwamish	Boeing Levee USACE ERP	Planned Ecosystem Restoration Project (ERP) in partnership with Kent and the Corps of Engineers riverward of the setback levee and floodwall.	The project was not implemented, however the City of Kent applied for King County Parks levy grant in 2023 for feasibility studies for habitat and recreation improvements between the river and the setback facility.
Green/Duwamish	Briscoe Levee Setback	The City of Kent constructed four floodwall segments to support NFIP levee accreditation. Floodwall segments/reaches locations include RM 14.5-14.6 (Reach 1), 15.45-15.6 (Reach 2), 16.0-16.4 (Reach 3) and 16.9-17 (Reach 4).	Completed between 2014 and 2017.
Green/Duwamish	Briscoe Reach Design	This project was for design of a levee setback at Rivers Edge, located south of 190th and west of 62nd Ave S. at RM 16.1 to 16.2. Three parcels were purchased to support the setback.	This project was not implemented. The three parcels that were purchased were sold to private owners. Floodwall Reach 4 was instead constructed.
Green/Duwamish	Green River Flood Emergency Prep	Local efforts to prepare for flooding after USACE advised that Howard A. Hanson Dam was compromised. Preparation efforts included building miles of sandbag and HESCO barriers on the levee crest.	Completed in 2012.

Basin/River	Name	Description	Status
Green/Duwamish	Green River PL 84-99 Mitigation	Between 2008 and 2009, 461 trees were cut from the Lower Green River levees to maintain eligibility for the PL 84-99 levee program. Permitting for this work required mitigation including placement of large wood and planting of riparian trees in three locations include Foster Golf, the Green River Natural Resource Area and Teufel.	Completed in 2018
Green/Duwamish	Hawley Road Levee – Kent	Earthen levees were installed behind the existing Hawley Road Levee	Completed in 2014.
Green/Duwamish	Horseshoe Bend Acquisition and Reconstruction	Reconstruct the Horseshoe Bend Levee at the Breda facility (RM 24.46-24.72) and McCoy (RM 24.26-24.45) to a more stable configuration in order to reduce flood risk to the surrounding areas. The projects will also increase the design containment elevation to the 500-year (0.2% annual chance) flood.	Two acquisitions completed in 2018, the City of Kent constructed a secondary containment facility in 2012/2013, landward of the McCoy segment of the Horseshoe Bend Levee. A repair of the McCoy facility is planned for 2024, and repair of the Breda facility is planned for 2027.
Green/Duwamish	Holiday Kennel Acquisition and Berm	Property acquired in 2017. Initial project subsumed under Lower Russell Road Levee Setback Project which was completed in 2023. Project replace an old levee and revetment that did not meet current engineering design standards.	Completed in 2023.
Green/Duwamish	Reddington Reach Setback and Extension	Project replaced a sub-standard levee with a new levee that protects nearly 600 properties valued at $680M. Created wider corridor for flood flows which greatly reduced flood risks to residents, business and infrastructure within the City of Auburn and the Green River Valley and provided wider riparian corridor with enhanced ecological benefits, improved natural river functions.	Completed in 2014.
Green/Duwamish	Russell Road Upper	Installation of a 1,190 foot secondary levee behind the existing Russell Road Upper Levee at two locations, RM 19.5-19.8 and RM 20.1 to 20.4.	Completed in 2013.
Green/Duwamish	Sandbag Removal	Removal of 26 miles of temporary flood-protection sandbags on the Green River.	Completed in 2012.
Green/Duwamish	USACE SWIF	The Lower Green River System Wide Improvement Framework (SWIF) was submitted to the Corps of Engineers on March 26, 2019. The SWIF outlines a prioritized strategy to address levee deficiencies to optimize flood risk reduction, address system-wide issues, and maintain eligibility for the 17 miles of	Ongoing

Basin/River	Name	Description	Status
		levees currently enrolled in the USACE Levee rehabilitation and Inspection Program under PL 84-99. USACE officially accepted the Interim Green River The Final SWIF was accepted by USACE in September 2019 and implementation will continue through 2028.	
White River Watershed			
White	Countyline to A Street Levee Setback	Address loss in channel capacity due to ongoing sedimentation by removing 4,500 linear feet of existing levee and reconnecting the river with 121 acres of off-channel aquatic habitat on the river's left bank. Involved construction of a new setback levee, 6,000 feet in length, protected by a 5,780-foot wood bio-revetment and several engineered log jams. The project is expected to provide significant flood risk reduction for more than 200 residential properties near the river.	Completed in 2017.
White	Red Creek Acquisitions	Acquire homes near the confluence of Red Creek and the White River as willing sellers become available.	The project has not been implemented.
White	Right Bank Levee Setback	Acquire at-risk, flood prone residential properties along the right bank of the White River within the City of Pacific to allow for the construction of a new levee setback flood protection structure. Acquired residential structures will be removed, temporary sand-filled flood protection barriers will be removed, artificial fill will be excavated, existing wetland areas will be enhanced, and an earthen setback levee will be constructed.	In planning/design phases.
White	Greenwater Acquisition	Acquire flood prone residences along the White River near the Greenwater River, several of which experience inundation and are very exposed to channel migration hazards.	One property has been donated in 2020.
Annual Programs and Local Jurisdiction Contracts			
Monitoring/Maintenance	Flood CIP Monitoring and Maintenance	Monitor projects using performance measures and adaptive management to track the effectiveness of completed projects and inform the design and implementation of future projects.	Ongoing, annual.

Basin/River	Name	Description	Status
Opportunity Fund	Subregional Opportunity Fund	Provide funding equal to each jurisdiction in King County to allow the jurisdiction to carry our local flood reduction improvements, local storm water control improvements, and watershed management activities.	Ongoing, annual.
Seattle	Alaskan Way Seawall Construction	Rebuild the Alaskan Way Seawall along Elliot Bay to protect the downtown waterfront, meet current seismic standards, and improve nearshore habitat.	Completed in 2017.
Seattle	South Park Duwamish Backwater	Construct a pump station to alleviate flooding in Seattle's Duwamish industrial area that occurs during high tides when storm water runoff is unable to drain to the Duwamish River.	Completed in 2023.
Countywide	Central Charges	Administrative project used for incurring expenditures for central costs assigned by the Budget Office.	Ongoing, annual.
Countywide	Flood Emergency	Provides funding for minor emergency repairs during a flood event.	Ongoing, as needed.
Countywide	WRIA grants	Provide grant funding for salmon recovery and riverine habitat restoration.	Ongoing, annual.

Appendix C

Flood Plan Community Engagement Overview and Synthesis

APPENDIX C
Flood Plan Community Engagement Overview and Synthesis

Introduction

King County performs a wide range of services intended to reduce risks from flooding and erosion, protect people and property, support preparedness, and build resilience. Even with these measures, flooding is a natural occurrence on the landscape. Natural disasters, such as flooding, affect all who are touched by them, yet not all people are equally able to cope with or recover from the hardship of natural disasters. As King County acknowledges in its Equity and Social Justice Strategic Plan, deeply entrenched social, economic, and environmental inequities worsen and threaten our collective prosperity. King County also acknowledges the public involvement opportunities that accompanied past King County flood hazard management plans did not do enough to remove barriers to participation. With these factors in mind, this flood planning effort set out to hear from those who may be among the most vulnerable to flooding and who may not have been intentionally offered opportunities to share their perspectives in the past.

As the flood plan scope was being developed, King County secured a grant from the Washington Department of Ecology to support development of a community engagement plan[1] and to implement much of the outreach described in this summary. Engagement goals were twofold: gather public feedback to inform future flood risk reduction and flood resilience strategies, and increase awareness of flooding issues, local risks, and resources to build community and personal resilience. The approach involved three distinct phases, which began in early 2022:

- Research: King County and its consultants researched best engagement practices to reach diverse audiences. Research included a literature review and interviews with community leaders and agency representatives. An online survey was deployed to understand the best engagement methods and tactics to reach community members who had not been engaged in King County's past flood planning efforts and who are at risk and potentially among the most vulnerable to flooding. Local demographic information and other King County engagement efforts were analyzed. An equity-focused consulting firm performed an equity review of the 2006 and 2013 King County Flood Hazard Management Plans and identified multiple ways to improve accessibility through this plan.

[1] https://publicinput.com/Customer/File/Full/68d106bf-46c1-4b3f-972e-dc157c8e6316

- Planning: Drawing on the research, the project team developed a multi-layered outreach plan focused on the two engagement goals. To guide engagement efforts, King County identified "priority communities." These are communities who are among the most vulnerable to flooding—low-income, Black, Indigenous and People of Color (BIPOC), renters, those under 5 and over 65 years old, foreign-born individuals, those with disabilities, those who speak a language other than English at home, or those have limited access to information.
- Implementation: Implementation of the community engagement plan began in October 2022 and continued through fall 2023.

This appendix provides a summary of the outreach conducted, the input received, and the lessons learned in creating a pro-equity, community-based approach to the development of the King County Flood Management Plan.

Overview of Community Engagement Approach

As referenced in the introduction, King County developed a plan to guide engagement efforts, titled the Flood Plan Community Engagement Implementation Plan. A fundamental premise of the engagement approach was to offer multiple avenues for input. The plan identified six strategies to bring more voices and different perspectives into the planning process. King County implemented five of the strategies, and one additional strategy was added midstream in response to changing circumstances. Five of the six implemented engagement strategies are described in this section. Planning committee representation is described in Chapter 1 of the plan in the Partner Planning Committee section.

Community partnerships: Drawing on the connections and knowledge of local, community-based organizations, community partnerships were intended to extend the reach of other engagement strategies. King County invited community groups to enter a contracted partnership in which the County and the partner would co-create an engagement strategy best suited to reaching the partner's network. The County offered funding to partners to implement the work (provided primarily through the Ecology grant). The groups contacted were BIPOC-focused, small organizations working in King County.

The engagement plan originally envisioned approximately 10 community partners. County staff held conversations with 13 different organizations and local government agencies to identify potential partners, and one organization agreed to a contractual partnership. The organization—the Washington State Coalition of African Community Leaders (WSCACL)—has relationships with over 100,000 native Africans or people descended from Africans living within King County.

Organizations that opted to not participate cited limited capacity during the project timeframe and a perspective that flooding was not a high priority topic for them. An additional identified barrier was the lack of familiarity with King County's Water and Land Resources Division and project team staff.

Through this partnership and in collaboration with King County, WSCACL translated and produced an educational video in multiple languages, distributed the video via multiple channels, and transcreated and distributed King County's two-part flood plan online survey (described later in this section).[2]

Despite the limited number of formal community partnerships, several local governments and other organizations helped broadcast county-produced information to their networks or invited King County staff to attend events or meetings.

Community visits: The most visible of all engagement tools used during the development of the Flood Plan, community visits involved county staff attending events or meetings hosted and led by other groups or organizations. County staff attended 25 such events ranging from ethnic festivals to unincorporated area council meetings. Through personal conversations and presentations at these events, connections were made with over 1,350 people. These visits provided opportunities for King County to engage with individuals and organizations who may not have had prior knowledge of flood risk, flood risk reduction, or King County's work to address flood risks.

Community visits had the dual goals of increasing awareness of flooding and gathering public input to inform the development of the Flood Plan. The project team developed key messages, talking points, and outreach materials to provide consistent, accessible messaging for all visits, and a "live poll" was developed to align with the online survey and to gather in-person comments. The poll and an email sign-up list provided pathways for community members to share their concerns, ideas, and priorities in the moment, as well as to stay informed throughout the planning process. At least 625 people shared their input in the live polls, tracked by the number of home zip codes shared in the polls.

Water and Land Resources Division representatives staffed these in-person events, which helped to build relationships with community members and increase the County's understanding of the issues that that are front and center for the community. Events were selected to achieve geographic coverage and to connect with priority communities. Staff attended three ethnic festivals in Seattle to reach predominantly BIPOC communities. While 48% of the live poll participants at these events were from Seattle, they represented very diverse communities, including many people with disabilities, people over 65, and BIPOC community members. Across all events, over 84% of those who engaged in the live polls at the community visits and provided their home zip codes were from King County.

2 Video available at: https://www.youtube.com/watch?v=mZWqfHtjWaE

TABLE C-1
COMMUNITY VISIT CALENDAR AND NUMBERS REACHED

Venue	Date	Target Community / Location	Type	Estimated Contacts
Washington State Coalition of African Community Leaders Fifth Annual Summit	2/25/2023	African Immigrant and African American / Eastern King County	Event	30
Kimball Creek Earth Day / Snoqualmie Tribe Event	4/22/2023	Native American and Youth / Snoqualmie	Event	60
Asian Pacific Islander Heritage Celebration	5/6/2023	Asian American / Countywide	Event	125
Indigenous People Festival	6/10/2023	Native American / Countywide	Event	150
King County Fair	7/14/2023	South King County	Event	60
Pacific Days	7/15/2023	BIPOC / South King County	Event	63
Renton River Days	7/21/2023	BIPOC / Renton	Event	174
Duwamish River Festival	8/5/2023	BIPOC / South Seattle	Event	116
Fiesta Patrias Celebration	9/17/2023	Latino / Countywide	Event	146
Marymoor at the Movies	8/9/2023	East King County	Event	59
Skykomish Open Air Market	8/19/2023	Skykomish area	Event	44
Maple Valley Emergency Preparedness Fair	9/30/2023	Maple Valley	Event	86
Issaquah Alps Trails Club Hike in Upper Issaquah Basin	8/26/2023	Issaquah Basin	Field event	6
Snoqualmie Basin Immigrant Farm Visits	2/9/2023	Hmong Farmers / Snoqualmie	Interpreted field visit	10
Green River Valley Immigrant Farm Visits	3/23/2023	Hmong Farmers / Green River	Interpreted field visit	2
Sammamish Valley Immigrant Farm Visits	2/15/2023	Hmong Farmers / Sammamish Valley	Interpreted field Visit	3
King County Frontline Resilient Task Force	11/2/2022	BIPOC / Countywide	Presentation	15
Greater Unincorporated Maple Valley Community	3/6/2023	Maple Valley	Presentation	14
City of Issaquah Park and Environmental Advisory Boards	3/16/2023	Issaquah	Presentation	18
Snoqualmie Valley Recreation Coalition	3/21/2023	Recreation Interests / Snoqualmie	Presentation	18
Fall City Community Association	4/4/2023	Fall City	Presentation	50
Vashon Maury Island Community Council	4/20/2023	Vashon – Maury Island	Presentation	70
Snoqualmie Valley Mobility Coalition	6/9/2023	Mobility-limited / Snoqualmie	Presentation	25
Green River Coalition	6/12/2023	Maple Valley	Presentation	6
Regional Alliance for Resilient and Equitable Transportation Coalition	5/24/2023	Mobility – limited / Countywide	Discussion	34
Total Contacted				**1384**

Online Engagement: In addition to the survey used to inform the creation of the engagement plan described in the introduction, King County developed and promoted an online platform to share information about flooding and to solicit input via two phases of an online survey that would inform the development of the Flood Plan.[3] All survey content was translated into ten languages. Each phase stayed open for at least two months, and 247 survey responses were submitted across the two phases. In addition, the WSCACL transcreated the survey and distributed it to their network, and across both phases WSCACL gathered 626 survey entries (see Table C-2).

TABLE C-2
ONLINE SURVEY ENGAGEMENT

	King County Survey Responses	WSCACL Survey Responses	Total Survey Responses
Phase One	139	315	**454**
Phase Two	108	311	**419**
Total	**247**	**626**	**873**

The first phase focused on identifying respondents' level of concern about flooding, whether and how flooding had impacted them, the level of awareness of King County's flood risk reduction services, preferred strategies to increase flood preparedness and reduce risk, and other benefits most important to the respondents (for example, clean water, accessible and safe roadways, supporting local farms).

The second phase focused exclusively on strategies and actions King County could take to reduce flood risk and build flood resilience, with questions focused on six categories of action (prevention, protection, structural activities, natural resource protection activities, emergency services, and public information). This phase also provided an opportunity for respondents to list specific projects, actions, or locations they felt should be included in the plan.

Both survey phases requested demographic information. This was an optional question that included a "I prefer not to answer" response. In addition, both phases requested home zip code information to track geographic representation.

King County-sponsored meetings: King County organized two public meeting series, each with two potential meeting times. The first two meetings kicked off the formal planning effort in October 2022, and the second two meetings in June 2023 involved sharing feedback provided up to that point and gathering additional input on potential plan elements. Both sets of meetings shared information about flood risks and resources for preparedness and invited input using group discussions, small group breakout sessions, and live polls. All meetings were led by an outside facilitator.

Three of the four meetings were offered virtually (two in the evening and one during the day), and interpretation and closed caption services were offered. One meeting was offered in

3 Surveys were shared at https://publicinput.com/FloodPlan.English#0

person at the Tukwila Community Center. This meeting was ultimately cancelled due to low registration. In total, 91 individuals attended the three county-sponsored meetings. Zip code and demographic information were not collected at these meetings.

In addition to these public meetings, King County hosted a series of workshops to gather perspectives on tributary, coastal, and urban flooding. Two workshops were held for each for these three flood topics. The workshops were organized to hear from participants about flood hazards, specific problem areas, impacts associated with those problems, and potential solutions to consider in the Flood Plan. Attendance for the six workshops totaled 152.

Targeted advertising: Targeted advertising was not identified as a strategy in the engagement plan, but this activity was added as part of adaptively managing the engagement effort due to the availability of grant resources. Retaining the goals of geographic diversity and reaching members of priority communities, county staff implemented two targeted advertising outreach methods.

- Transit Ads: Using King County Metro's transit ad system, English and Spanish posters and signs were placed in three transit stations (Bellevue, Issaquah, and Renton), on buses in the East and South County areas, and on the light rail line that runs from North Seattle to SeaTac. The ads ran from early September to early October 2023. The purpose was to drive people to online flood preparedness information and the online survey.
- Ethnic News: Ethnic media companies typically have an exceptional understanding of specific communities, the issues important to them, and the messages that will resonate with them. King County approached two ethnic media companies—one focused on African American communities and one on Latino communities—to increase outreach to these groups. Through paid advertising or reporting campaigns, the ethnic media companies were asked to transcreate King County's messages for the communities they serve and promote those messages. Runta News, an ethnic media company focusing on African American and immigrant populations, participated and ran an ad campaign using social media and online content from June to August 2023. The campaign was intended to increase awareness about flooding and preparedness resources while also encouraging participation in the June 2023 county-sponsored public meetings. The Latino-focused media company chose not to participate.

Community Engagement Summary

During this planning effort, providing multiple avenues for engagement offered the opportunity for more people to share input with King County and allowed County staff to begin to develop new relationships, including with individuals and organizations who may not have previously been aware of floodplain management activities.

The strategies that resulted in the greatest numbers of people sharing input were community partnerships and community visits. While many people visited the King County-administered online information site, less than 10% completed the survey. The partnership with WSCACL was a more effective method to gather survey responses than the promotion King County did on its own, and WSCACL was also very successful in reaching majority BIPOC, immigrant

community members. Across all forms of input, over 88% of those who shared their home zip codes were from King County.

TABLE C-3
ENGAGEMENT APPROACHES AND NUMBERS REACHED

Engagement Approach	Description	Number Reached	Number Providing Input
Community partnerships[1]	Co-created, customized outreach plan with community partners as well as an onboarding session	626	626
Community visits	Presentations, field events, festivals, roundtable discussions	1,384	626
Online polling / feedback[1, 2]	Online survey, email notices, social media	3,720	247
King County-sponsored meetings	Virtual meetings	243	243
Targeted advertising[3]			
Metro Transit Ads	Bus and light rail four-week campaign	35,635	Undetermined
Runta News Ads	Somali / African media two-month campaign	1,650	Undetermined
Total Reached **Direct Contacts** (partnerships, visits, online polls, and county meetings) **Indirect Contacts** (via targeted advertising)		 **5,973** **37,285**	
Total Providing Input			**1,742**

Notes:
1. The community partner and King County distributed two different online surveys, which resulted in 1,252 responses. It is unknown how many respondents completed both surveys, so the actual number reached may be smaller.
2. Online survey site viewership numbers reduced by 25% to adjust for King County staff views of the site.
3. Targeted advertising contact numbers estimated by multiplying 5% with total viewership or estimated impressions.

Synthesis of Community Input

This section presents a review of the information shared by at least 1,740 community members as part of this planning effort between October 2022 and October 2023. It is divided into the following sections:

- representativeness of those who shared their input;
- information shared about the level of concern for and experiences with flooding;
- the issues that community members identified as most important; and
- input provided about the actions local governments should take to reduce flood risk and increase flood resilience.

As described in the previous section, the WSCACL distributed a transcreated version of King County's online survey to their networks, and the responses to the two surveys were able to be separated for analysis. Where the WSCACL survey and King County survey provided notably different results, those are called out in the following sections.

Representativeness

Across all forms of input and based on those who provided home zip codes, input was shared from those residing in urban, suburban, and rural areas. The area with the greatest number of respondents was Seattle—102 respondents from south Seattle, 181 from north Seattle, and 90 from central Seattle. Other communities with high levels of participation were Renton (103), Kent (95), Bellevue (78), Maple Valley (63), and Federal Way (49). King County did not request zip code or demographic information at the County-sponsored meetings.

For the online surveys, 675 individuals chose to provide demographic information. Those responses demonstrate representation from priority communities as follows:

- 59% identified as Black, Indigenous or People of Color
- 47% were born in another country
- 44% identified as female
- 34% reported speaking a language other than English at home
- 32% rent their homes
- 15% were 65 years old or older
- 12% reported not having flood insurance and knowing they live in a flood prone area
- 10% were caregivers of those under 5 years old or those 65 years or older
- 9% do not have health insurance
- 8% reported their highest level of education was high school or less
- 8% reported having a disability
- 8% stated they were eligible for food or income assistance

Demographic data was not collected during live polls at in-person events. However, events were selected based on an assumption that priority communities reflecting many of the above demographic characteristics would be in attendance. Participants responding to the WSCACL survey represented priority community demographics more than any other source of input.

Concern about and Experiences with Flooding

The survey asked respondents to share their level of concern about flooding using a scale of 1 to 5, where 1 indicated not at all concerned and 5 indicated very concerned. Those responding to the WSCACL survey reported the greatest level of concern about flooding (47% responding 4 or 5). Those who responded to the King County-administered survey indicated their level of concern was, on average, in the middle of the range. The live polls conducted at events with a large percentage of indigenous or youth attendees revealed an above average level of concern, while event attendees with a large percentage of Asian attendees revealed a below average level of concern.

Experiences of flooding varied widely across all respondents to the online survey and live polls. Nearly 40% indicated no direct experience with flooding, 33% reported experiencing flooded roads in their communities, and 31% have either known someone or personally been physically at risk from flooding. The majority of those who reported physical risk were from the WSCACL survey, and WSCACL members shared personal stories of floods in other nations. The highly variable concerns about flooding may be due to personal proximity to hazards.

The survey asked respondents to select two sources of flooding that are of greatest concern to them. Respondents to the WSCACL survey selected Puget Sound coastal flooding as the top concern (45%), and respondents to the King County survey selected large river flooding as the greatest concern (54%). Both groups selected stormwater runoff as their second-highest flooding concern.

Community visits to Hmong farmers in the Green, Snoqualmie, and Sammamish valleys revealed the perspective that farm fields seem to be wet for longer periods each year, and all but one of the immigrant farmers met during these field visits reported some level of flood damage to their farm-related business.

Perspectives on the Issues that Matter in Local Communities

Community members were asked their opinion about the range of benefits and outcomes that could be achieved as part of flood risk reduction activities. A pre-defined list of benefits was shared, and those that were commonly selected as very important, at two times the rate of other options, were:

- Keep roads and railways safe and accessible;
- Reduce flood risks and increase flood resilience;
- Protect and restore natural habitat; and
- Improve water quality.

In addition, benefits that were considered very important for those who replied to the WSCACL survey were:

- Create and support local jobs;
- Preserve natural lands and green spaces; and,
- Distribute resources equitably across King County.

Live poll responses were collected with the open-ended statement “What matters most to you? We can achieve other community goals while reducing flood risks. Write in your own responses.” Responses were categorized into broad categories. The following word cloud includes only those phrases mentioned or liked by two or more people. The size of the words reflects the frequency of the mention. For context, housing affordability was mentioned or “liked” 54 times, and the smallest text words were mentioned by only two people.

The role of flood risk reduction in addressing some of these concerns is unclear, such as housing affordability. However, some community concerns could be incorporated more actively into flood risk reduction projects, such as road safety, addressing climate change, education, outreach, and park access.

Community Perspectives on Local Government Actions to Reduce Risk and Increase Resilience

Before King County began implementing public outreach, the new flood plan was envisioned to be different than past plans in several ways. Differences included a greater focus on climate change and multi-benefit and equitable outcomes, and an increased geographic scope to include coastal areas, tributaries, and urban flooding considerations. Overall, these represent significant changes from the 2006 and 2013 King County Flood Hazard Management Plans.

Online survey and live poll responses and other submitted public comments indicate the public supports the increased attention given to these specific topics. Written comments affirmed an interest in expanding services beyond large river systems to include coastal areas, lakes, small tributaries, and urban flooding. Landowners who experience flooding from sources other than large river systems expressed a feeling that they have been omitted from the benefits of previous flood plan implementation. Likewise, community members and government staff who attended the coastal, tributary, and urban flooding workshops expressed strong interest in seeing the Flood Plan address risks related to these flood hazards.

Comments also revealed support for multi-benefit projects, climate change planning, and a request to share resources and agency benefits equitably throughout King County, with several mentions of improved service for areas along the Duwamish River. In some cases,

community members asked King County to expand or scale up the actions currently implemented, and many comments requested collaboration among all levels of government to better achieve the desired outcomes. The remainder of this section summarizes some of the key themes that were shared.

General Approaches for Reducing Flood Risk and Improving Flood Resilience

Survey and live poll participants were asked to select three of the most important actions King County could take in its flood planning, from a list of five options. From the online survey, the option to "reduce the risk of flooding or build community capacity for flood resilience and preparedness" was the most frequently selected (28%). Other choices that survey respondents selected at a high rate included listening to community input on local flood risk reduction strategies and approaches, providing other benefits for recreation, open space, habitat for fish and wildlife, water quality or local jobs, and providing benefits to historically underserved communities.

The live polls provided different results, with event attendee responses being split fairly evenly among the four actions listed above. Attendees consistently selected consideration of the cost of the project or action as the least important factor for flood planning (8%).

Event attendees were also asked to weigh the relative importance of the six categories of flood risk reduction activities described in Chapter 3 of this plan (prevention, property protection, natural resource protection, emergency services, structural projects, and public information). They could select any number of the six categories they felt were important. In addition, all public comments received from community members in public meetings, presentations, emails, telephone calls, and write-in comments submitted with live polls and surveys were assigned to the six flood risk reduction categories.

Two categories of action rose to the top of both the live polls and in the public comments:

- *Public information* received the second highest number of selections in the live polls, and it received the most write-in comments by a wide margin. All the comments requested more public information provided in a variety of ways, affirming the value of this type of action.
- *Natural resource protection* was most frequently selected in the live polls as an important focus for local government action. This category received many favorable public comments, but some comments expressed reservations or alternate views about some of the specific strategies in this category.

Specific Strategies for Reducing Flood Risk and Improving Flood Resilience

Phase two of the online survey, deployed in the summer of 2023, presented specific strategies for each of the six categories of flood risk reduction activities, drawing from

suggestions that had been provided up to that point in the planning process. Survey participants were asked to select up to three activities within each category that that they felt were the most important. A write-in option was also available, and community members provided many additional suggestions. This section summarizes the results of the online survey responses and the themes that emerged from public comments. The general categories are presented in order of the communities' weighting of importance.

Public information Priorities and Key Takeaways

- Expand public information sharing to reach youth, small businesses, local governments, and residents of King County, especially those new to the area.
- Maintain the educational efforts used during this planning effort to make sure all communities understand flood risks and the resources available to increase preparedness and flood resilience, regardless of their race, income, or access to power. Share more information about how climate change will affect flooding, the importance of wetlands, soft shorelines, and naturally flowing rivers, and ways to prevent public and environmental health impacts during and soon after floods.
- Share information clearly in multiple languages and through multiple avenues (in person, online, and in writing) to make information more accessible.
- Fund and build the capacity of community organizations and leaders to train others on how to prepare for, be safe during, and respond to flood events.
- Provide more frequent, ongoing communications linking people to information on preparedness and resources.

Nature Resource Protection Priorities and Key Takeaways:

- Over three-quarters of survey respondents identified protecting upper watershed areas and preserving wetlands so water distributes slower downstream as priorities.
- Over half of respondents selected reconnecting rivers to their floodplains and implementing low-impact development and green infrastructure (like rain gardens) as important activities.
- 41% of respondents identified working with communities and businesses in floodplains to protect or restore the environment and finding ways to incorporate natural elements into projects even in the most developed areas.
- Most written comments support actions like levee setbacks, restoration or revegetation of natural areas, planning for climate change, and fish and wildlife habitat improvements, but several comments also expressed a desire for more dredging or the perspective that beavers are an impediment to flood reduction efforts.
- Several community members shared concern about water supply in the future and asked King County to consider how to use floodwater to recharge aquifers or increase water supply.

Prevention Priorities and Key Takeaways:

Respondents to the WSCACL survey more frequently selected incentives or technical assistance to support development in low-risk areas (58%) than those responding to the King County survey (33%). Three field visits to meet with mostly Hmong farmers indicated a strong desire for technical assistance and incentives to allow them to maintain their farming businesses in the face of flooding.

- Public comments across all engagement methods expressed that new development should be managed carefully to prevent making flooding worse for others, and many comments were submitted asking for greater restrictions or limitations on development in both incorporated and unincorporated areas. A small number of comments requested less regulation to allow landowners more flexibility in what they can do on their property.
- High value is placed on accurate mapping and modeling that convey where flooding may occur.
- Many comments noted that farms can co-exist with flooding better than other types of development, although there were calls for ensuring that regulations support the continued viability of farms in flood prone areas.
- Recommendations for adjusting building codes were shared, from encouraging more second story living in flood prone areas to incentivizing more high-density development in urban areas.

Structural Project Priorities and Key Takeaways:

- Improving the flood resilience of roads and bridges throughout King County was identified as a priority, with specific mentions of roads on Vashon – Maury Island, Covington, and May Valley. NE 124th Street (Duvall) and Tolt Hill Road (Carnation) both received multiple requests for action.
- Community members requested more information about dam failures and dam failure planning and called out dam maintenance and upgrades as important where needed.
- Other priorities identified include:
  - Maintaining or retrofitting stormwater systems, drains, and ditches to increase drainage and reduce flooding in urban, suburban, and rural communities.
  - Maintaining aging or damaged river protection facilities and consideration of adding new ones, including reservoirs to store flood waters and new flood barriers.
  - Converting the Lake Sammamish weir to something that will allow for increased floodwater storage in certain months, such as the structures used for Lake Washington.

As mentioned in the introduction to this section, survey respondents were presented pre-defined lists of actions under each of the six activity categories and were asked to select the three actions they felt were most important. The survey responses submitted by WSCACL participants were quite different than those who responded to the King County-administered survey, as shown in the following table.

TABLE C-4
STRUCTURAL PROJECT ACTIONS IMPORTANCE RANKING

Structural Project Action	WSCACL Survey	King County Survey
Explore ways to improve existing drainage pumps and floodgates	67%, #1 rank	56%, #2 rank
Explore locations without any structural projects to identify if new structures may reduce flood risk	63%, #2 rank	29%, #5 rank
Improve flood resilience of major transportation routes	60%, #3 rank	67%, #1 rank
Increase the ability of culverts to pass more water	57%, #4 rank	52%, #3 rank
Explore opportunities for more floodwater storage	33%, #5 rank	49%, #4 rank

Emergency Services Priorities and Key Takeaways:

A main theme that emerged from public comments is that communicating flood evacuation routes and road closure information in real time is among the most important emergency services actions King County can take. Road closures came up repeatedly in all engagement arenas, and most of the direct flood experience shared was related to flooded roads. Some community members shared their personal stories of being affected by flooded roads and conveyed a sense that the County had abandoned them by allowing those roads to flood.

Public comments also indicated that most people don't know where to obtain information about emergency supplies, emergency plans, evacuation routes, road closures, locations of shelters, and early alert warning systems, suggesting current outreach efforts have been inadequate to inform the community about the existence of these already available resources.

The WSCACL survey respondents frequently highlighted the need for more communications with community members and capacity building for community organizations. This may be due to their greater reliance and trust in their community networks rather than government agencies, and it could also reflect the lack of flood-related outreach that has reached these groups.

Several additional suggestions were offered worth noting:

- Establish a reverse 911 system to communicate impending flooding;
- Improve coordination between FEMA and local governments to better support community members during disaster recovery;
- Provide targeted free resources and enhanced planning for those with limited income, limited mobility, or experiencing homelessness; and
- Organize evacuation drills and improve barriers for closed roads.

Property Protection Priorities and Key Takeaways:

The specific strategy selected by most survey respondents as the most important was providing technical support to property owners in at-risk areas to transition to land uses that

better accommodate flooding. 60% of WSCACL survey respondents selected education to property owners and renters on the benefits of flood insurance as an important activity, whereas only 14% of the respondents to the King County survey selected this option. This could be due to many WSCACL members being unfamiliar with the resources available to reduce flood risk prior to engaging in this effort. Other highly ranked options include technical assistance for elevation projects and incentives to help property owners with mitigation for repetitively flooded buildings.

Acquisition from willing sellers and home elevations were called out as important property protection strategies, but comments also acknowledged the need to consider the negative equity impacts of acquisition practices and policies. Additionally, small-scale implementation of green stormwater infrastructure projects, especially rain gardens and permeable pavement, were identified by community members as important to reduce the impacts of stormwater runoff.

Outcomes

As described in the previous sections, extensive input was provided through multiple channels throughout the planning process. In some instances, the input provided by community members aligned with the direction established by King County for this plan. In other cases, community members shared new ideas and perspectives that informed the development of the plan. This section summarizes how community input influenced the plan's recommendations.

Since the scope of services King County provides that address elements of flood risk is broad, completely new concepts were not necessarily revealed. However, new perspectives on existing services were shared that suggest room for improvement and which identify ways to amplify or expand services to meet the needs identified. Examples include:

- **Ongoing Expanded Public Outreach** – Based on the input received and the value provided by the public engagement process for this Flood Plan, King County is committing to expanded public outreach about flooding moving forward. The Flood Plan includes a programmatic recommendation to develop a Program for Public Information to collaboratively create and implement with floodplain managers, community members, and partners more targeted outreach to change behavior building more resilient communities. It also includes a programmatic recommendation to improve access to flood preparedness materials by collaboratively engaging diverse community organizations to co-create effective flood preparedness outreach.
- **Communication and Coordination** – King County and other local governments provide flood awareness outreach and communication, and emergency services are structured to provide resources in times of need. Even so, the most cited need by community members was improved communication from local governments and improved coordination among governments during times of emergency. In the coastal flooding workshops, the December 2022 king tide and coastal flooding event was highlighted as an example of local governments not fully understanding the needs of the local

communities affected, and the multiple jurisdictional authorities involved in the response created confusion for community members.

This plan includes recommendations for improving existing services and considers ways to address the increasing risk in areas subject to high tides, storm surge, and coastal flooding, including in the Duwamish River. The recommendations also address improving coordination among local governments so that services are delivered efficiently and equitably.

- **Regulations** – Most community members provided feedback in multiple venues that existing regulations are not strong enough to prevent at-risk development in flood prone areas. In addition, community members also shared that regulations are too stringent to allow for taking the desired actions to reduce risk.

  These ideas are addressed in multiple ways in this plan. First is a recommendation for collaboration across jurisdictions to identify differences in municipal flood hazard area regulations and provide technical assistance to jurisdictions to strengthen regulations if doing so would be beneficial. Additionally, the plan contains recommendations to expand hazard identification and to improve existing regulations or develop new regulations to manage development in at-risk areas.

  For regulations that pose barriers to action, the plan contains recommendations to identify regulatory flexibility for flood resilience upgrades to structures and to pursue updates to King County's flood hazard code that would allow for more efficient restoration of natural floodplain functions and culvert upgrades.

- **Technical Assistance and Capacity Building** – Input identified that both property owners and renters currently need more technical assistance to improve their resilience to flooding. Beyond government action, providing support to local community organizations was cited as a powerful way to build resilience.

  Technical assistance recommendations in the plan include helping homeowners understand the feasibility and funding options for home elevations and providing aid to low-income property owners in securing the funding needed to implement an elevation project. Assistance-focused recommendations also include providing more accessible flood hazard permitting information and customer support and providing resources to help community members develop flood response action plans.

  To build capacity with community organizations, the plan calls for creation of a comprehensive flood resilience improvement program, whereby community organizations are engaged in raising awareness of flooding, identifying their flood resilience goals, and increasing preparedness and resilience among their networks.

- **Encouraging Flood Insurance** – As noted above, over 60% of WSCACL survey respondents selected education to property owners and renters on the benefits of flood insurance as an important activity. A programmatic recommendation to encourage the purchase of flood insurance and collaboratively work with partners to design a social marketing campaign or other similar effort with a goal of increasing flood insurance policies held in King County is included in the Action Plan.

- **Road Access** – A topic identified by community members as a priority throughout the engagement effort is ensuring safe ingress and egress options during times of flooding. Public comments centered on evaluating and identifying ways to improve flood-safe

road access, mapping current and possible evacuation routes, and exploring the feasibility of projects to improve the resilience of transportation routes affected by flooding. The plan includes several warning and response activities related to roadway flooding, as well as many capital projects intended to improve the resilience of the county's road and bridge infrastructure.

- **Confirmation of Other Recommendations** – Many other activities recommended in the Flood Plan, which arose from King County departments, partners (such as cities and nonprofits), and conversations with the Partner Planning Committee, are consistent with the input received from the community through the engagement activities described in this overview. Public confirmation of the value of many of the activities being considered for the plan increased confidence in including these activities in the Flood Plan.

Appendix D
Levee Failure

APPENDIX D
Levee Failure

Levee Failure Defined

The following definitions apply in the discussion of levee failure hazards:

- ***Levee*** — A human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to reduce the risk from temporary flooding.
- ***Levee Failure*** — A breach or overtopping of contained water from a river or stream causing the water to flood the land behind the levee.

General Background

Levees are constructed parallel to a watercourse, such as a river or stream, to reduce the risk of flooding to the land, infrastructure, or building areas behind the levee. Levees serve to protect areas from flooding, but they only offer protection to a certain flood level. Flooding can exceed a levee system's capacity, or flaws in the levee structure can cause it to overtop or fail, and both may result in rapid inundation behind the levee. Water may also seep through cracks or animal burrows within levees and cause weaknesses that lead to collapse.

Levee systems may consist of levees, floodwalls, and associated structures, such as opening/closing drainage devices, which are engineered, constructed, and operated by individuals or government agencies. Levees sometimes have complex "interior drainage" systems that function to move water from the landward side of the levee to the water side. This type of levee drainage system may include features such as culverts, canals, ditches, storm sewers, or pumps.

Levees may be constructed from earthen materials, such as sand and compacted soil, or artificial materials, such as concrete or steel. To protect soft earthen levees against erosion and scouring, levees may be covered with native vegetation, grasses, gravel, or harder surfaces like stone, asphalt, or concrete.

While levees provide some level of flood protection, they are not guaranteed to be entirely floodproof. Earthen levee systems are prone to liquefaction during an earthquake, which can cause major failure of the levee structures. If floodwaters are being held back at the time of an earthquake, the damaged levee can fail, and flooding could occur very quickly. Levees designed to protect against a specific flood level, such as the 1 percent annual chance flood,

could be overtopped during severe weather events when floodwaters exceed design levels. Levees reduce—but do not eliminate—the risk to people, property, and infrastructure behind them. A levee system failure or overtopping can create catastrophic and immediate flooding with high-water velocities to the adjoining land. It is important to recognize that levees only provide protection from the flood events for which they were designed. They are human-made earthen structures, and proper operation and continuous maintenance are necessary to reduce the probability of failure.

Past Events/Previous Occurrences

In King County, levees have a long history of damage and sediment problems resulting in costly repairs. Notable levee damage that has occurred since 2013 includes:

- Two flood events in November 2015 and December 2015 caused widespread impacts in King County, especially along the South Fork Skykomish River, Snoqualmie River, Tolt River, and Green River. These events resulted in the following levee damage:
  - **South Fork Skykomish River** – Levee armor eroded from Town of Skykomish Left Bank Levee.
  - **North Fork Snoqualmie River** – A total breach of the Shake Mill Left Bank Levee occurred, but no private property or infrastructure was damaged.
  - **Middle Fork Snoqualmie River** – Damage to the levee face of the Mason Thorson Extension Levee.
  - **South Fork Snoqualmie River** – Damage to the face of the Reif Road Levee.
  - **Tolt River** – Face rock was displaced from the Girl Scout Camp and Frew levees.
  - **Green River** – Scour and slumping along the Tukwila 205 Levee.
- A significant flood event in January – February 2020 damaged numerous flood protection facilities along the Cedar River, Green River, and Issaquah Creek, including:
  - **Cedar River** – Damage to the Belmondo Levee (which protects a regional fiber optic line, a regional trail, and a state highway) and erosion and scour at the Orchard Grove, Royal Arch, McDonald, Jan Road, and Getchman levees.
  - **Green River** – Erosion at the Fort Dent Levee, seepage and ponding at the Desimone and Briscoe School levees, and cracking in the crest of the McCoy Levee.
  - **Issaquah Creek** – Erosion at the State Route 18 Upstream and Downstream levees.

Location and Severity

King County has 139 levees along the Snoqualmie River, South Fork Snoqualmie River, North Fork Snoqualmie River, Middle Fork Snoqualmie River, South Fork Skykomish River, Green River, Cedar River, Raging River, White River, Tolt River, Miller River, and Holder Creek. Levees are highly susceptible to flood damages from seepage, sloughing, erosion, and channel migration, and they may also be impacted by landslides and earthquakes. Acts of terrorism or

sabotage could provide a serious threat to the integrity of the levees (King County 2020). Regardless of the source, levee damage puts people, property, and infrastructure at risk.

Risk always exists that a levee may be overwhelmed during an extreme flood event, even if it is accredited by Federal Emergency Management Agency (FEMA) for floodplain mapping purposes. Very few of the levees in King County were designed to withstand the 1 percent annual chance flood, and flood flows contained by the County's levees may range from a 10 percent annual chance to 1 percent annual chance flood protection level (King County 2013).

Table D-1 provides an inventory of the levees within King County, including the bank location and river mile (RM). **Figure D-1** shows the locations of the levees in King County, and **Figure D-2** shows the potential inundation areas for these levees should they fail.

Potential Impacts

Damages and impacts associated with levee failure were assessed in the King County Levee Breach Analysis for King County Rivers in May 2019 (Watershed Science and Engineering 2019). The King County Flood Control District initiated this levee breach analysis to review currently available information and characterize the potential for levee breaches and the resultant risk to people and infrastructure.

The 2019 analysis summarizes what is known about the physical character of containment levee systems and adjacent existing land uses, and identifies potential risks and consequences should a breach occur. The analysis also identifies data gaps and provides recommendations for obtaining additional information and conducting additional investigations to increase understanding of the potential for levee breaches. Planning-level cost estimates were developed for use in considering the level of effort that may be needed to obtain site data and conduct technical analyses necessary to further the understanding of the potential for breaches along certain lengths of containment levee systems within King County. This study only looked at publicly owned or operated flood protection facilities and does not include an assessment of potential flood hazards in reaches with natural riverbanks or those protected by privately installed flood protection armoring.

Six containment levee systems were evaluated in the 2019 analysis:

- Lower Tolt River from RM 2.2 (Holberg Levee) to the confluence with the Snoqualmie River.
- Lower Raging River from RM 1.5 (328th Way SE) to the confluence with the Snoqualmie River.
- South Fork Snoqualmie River from RM 5.4 (McConky and Holstein Extension levees) to RM 2.1 (Snoqualmie Valley Trail crossing).
- Lower Cedar River from RM 1.3 to Lake Washington.

- Lower Green River from RM 30.9 (Lone's Addition Levee) to RM 11.0 (Black River Pump Station).
- Town of Skykomish Left Bank Levee from RM 15.85 to RM 16.42.

The estimated costs for the recommended additional data collection and studies to better understand the levee breach risks ranged from $3 million to $4.4 million, and a new levee breach study is currently underway for all of the six levee containment systems except the Green River. The potential impacts and loss estimations for the buildings, critical facilities, and infrastructure protected by levees in King County are not fully known and would require additional analysis to determine.

Levee Inventory

TABLE D-1
INVENTORY OF KING COUNTY LEVEES

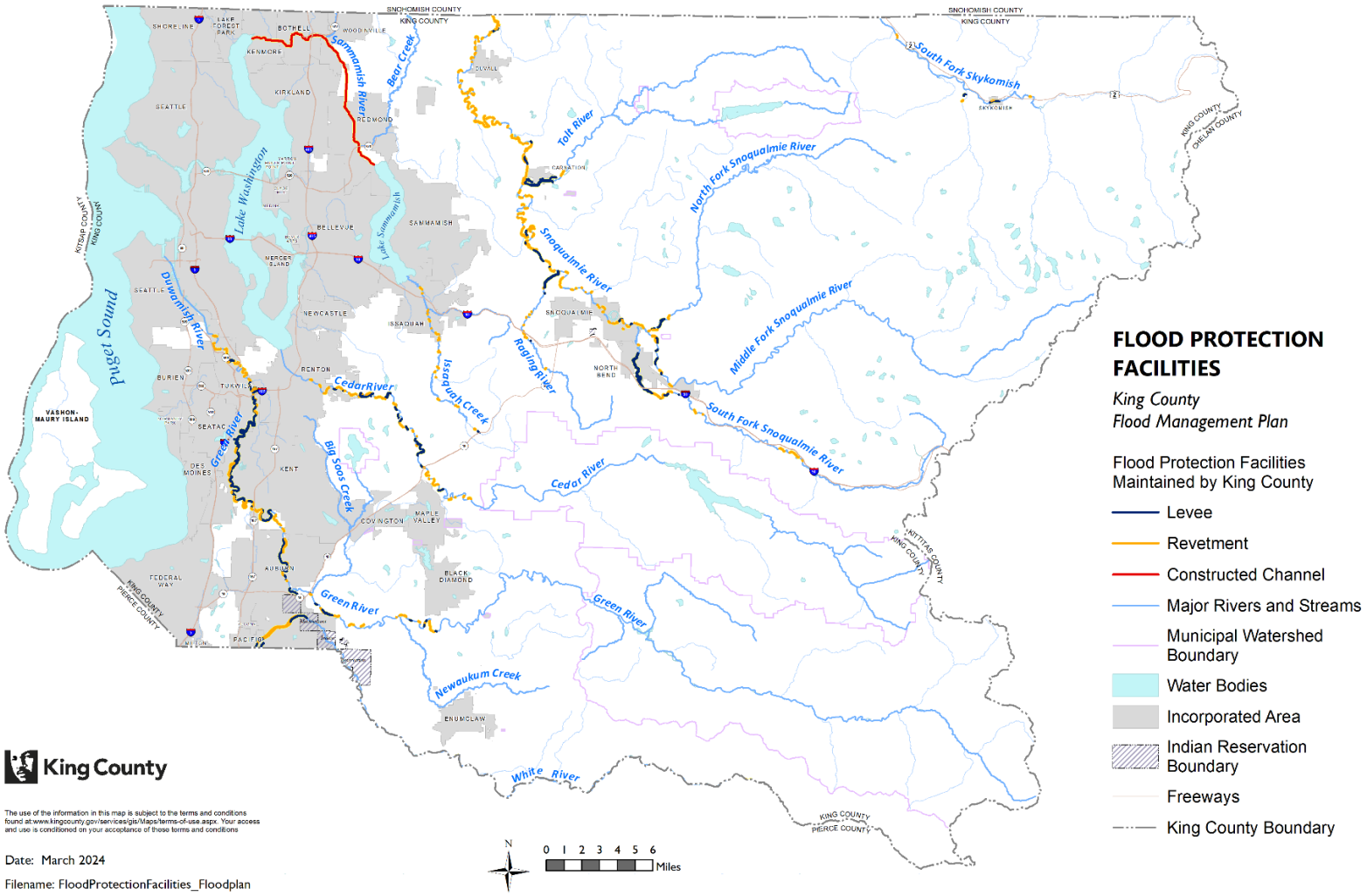
Levee Name	River Name	River Bank	River Mile Downstream	River Mile Upstream
Byer's Curve	Cedar River	Left River Bank	12.71	12.81
Elliot Brg	Cedar River	Left River Bank	5.39	5.45
Herzman	Cedar River	Right River Bank	6.57	6.7
Royal Arch	Cedar River	Left River Bank	14.03	14.25
Scott-Indian Grove	Cedar River	Right River Bank	8.22	8.78
WPA	Cedar River	Left River Bank	10.72	10.96
McDonald	Cedar River	Left River Bank	11.47	11.66
Getchman	Cedar River	Right River Bank	13.69	14.01
Lower Bain Road	Cedar River	Left River Bank	14.87	15
Orchard Grove	Cedar River	Right River Bank	17.27	17.63
Upper Elliot Park	Cedar River	Left River Bank	4.78	4.91
Cedar Trl 5B	Cedar River	Left River Bank	9.78	9.94
Cedar Rapids R	Cedar River	Right River Bank	7.36	7.37
Rhode Cedar	Cedar River	Left River Bank	13.74	14.01
Belmondo	Cedar River	Left River Bank	10.34	10.39
Riverbend Lower Ext.	Cedar River	Left River Bank	6.58	6.83
Jan Road Setback	Cedar River	Right River Bank	12.6	13.3
Riverbend Setback	Cedar River	Left River Bank	6.51	7.4
Rutledge Johnson	Cedar River	Left River Bank	13.42	13.56
Progressive Investment	Cedar River	Left River Bank	8.38	8.5
Old RM 33.8 Right	Green River	Right River Bank	33.26	33.29
Old RM 41.8 Left	Green River	Left River Bank	41.14	41.19
Old RM 41.9 Left	Green River	Left River Bank	41.22	41.29
Barnett	Green River	Left River Bank	31.19	31.21

Levee Name	River Name	River Bank	River Mile Downstream	River Mile Upstream
Boeing	Green River	Right River Bank	17.5	17.84
Briscoe	Green River	Right River Bank	16.17	16.24
Briscoe Meander	Green River	Right River Bank	15.45	16.17
Briscoe School	Green River	Right River Bank	16.24	17
Christian Brothers	Green River	Right River Bank	16.99	17.19
Corps 68th AV S	Green River	Left River Bank	23.5	23.59
County Road #8	Green River	Right River Bank	22.99	23.17
Desimone	Green River	Right River Bank	14.48	15.45
DS Flaming Geyser Bridge	Green River	Left River Bank	42.44	42.53
Dykstra	Green River	Left River Bank	29.68	30.8
Family Fun Center	Green River	Right River Bank	12.03	12.23
Ft. Dent	Green River	Right River Bank	11.02	11.84
Galli's Section	Green River	Left River Bank	29.49	29.68
Gateway Lower	Green River	Left River Bank	7.96	8.27
Horath	Green River	Right River Bank	34.86	35.22
Kaech	Green River	Right River Bank	34.54	34.84
Mccoy	Green River	Right River Bank	24.26	24.44
Myers Golf	Green River	Right River Bank	21.28	21.83
Nursing Home Extension	Green River	Right River Bank	26.03	26.13
Okimoto	Green River	Right River Bank	21.91	22.04
Old Flaming Geyser Bridge	Green River	Left River Bank	42.67	42.83
Park DS	Green River	Left River Bank	43.97	43.99
Park US	Green River	Left River Bank	44	44.03
Pig Farm	Green River	Right River Bank	30.41	30.58
Pipeline	Green River	Right River Bank	21.83	21.91
Plemmons	Green River	Right River Bank	25.14	25.32
Porter Bridge	Green River	Right River Bank	30.96	31.08
Pre-1959	Green River	Left River Bank	34.82	35.05
Russell Rd Lower	Green River	Right River Bank	18.66	19.23
Russell Rd Upper	Green River	Right River Bank	19.69	20.4
Tukwila Community Center	Green River	Right River Bank	8.03	8.16
Fenster	Green River	Left River Bank	31.77	32
Pautzke	Green River	Left River Bank	32.02	32.43
White Swan Left	Green River	Left River Bank	12.25	12.27
Tukwila 205-Lily Pointe	Green River	Left River Bank	14.31	14.56
Boeing Setback	Green River	Right River Bank	17.05	17.83
Russell Rd Lowest	Green River	Right River Bank	17.85	18.25

Levee Name	River Name	River Bank	River Mile Downstream	River Mile Upstream
Somes Dolan 1,2&3	Green River	Right River Bank	19.23	19.69
Narita 1&2	Green River	Right River Bank	20.4	21.27
Breda	Green River	Right River Bank	24.44	25.14
Nursing Home	Green River	Right River Bank	25.32	26.03
Tukwila 205-Christensen Rd	Green River	Left River Bank	13.04	14.31
Tukwila 205-Van Warden	Green River	Left River Bank	12.45	13.04
Tukwila 205-Segale	Green River	Left River Bank	14.89	15.75
Tukwila 205-GACO Western	Green River	Left River Bank	15.73	15.88
Tukwila 205-Gunter	Green River	Left River Bank	15.88	16.71
Tukwila 205-Cutoff	Green River	Left River Bank	16.71	16.77
Tukwila 205-Ratola	Green River	Left River Bank	14.56	14.89
Reddington	Green River	Left River Bank	28.6	29.49
Boeing Floodwall	Green River	Right River Bank	17.05	17.83
Porter	Green River	Left River Bank	33.85	34.08
Tukwila South	Green River	Left River Bank	16.7	17.28
SR 18 DS	Holder Creek	Right River Bank	1.08	1.12
SR 18 US	Holder Creek	Right River Bank	1.15	1.21
Mason Thorson Ext	Middle Fork Snoqualmie River	Left River Bank	1.36	1.49
Norman Upper	Middle Fork Snoqualmie River	Right River Bank	0.65	0.93
Mason Thorson Ells	Middle Fork Snoqualmie River	Left River Bank	1.89	2.29
Mt. Si Rd Protection	Middle Fork Snoqualmie River	Left River Bank	2.89	2.96
Miller River Curve	Miller River	Left River Bank	0.36	0.41
North Park	North Fork Snoqualmie River	Right River Bank	1.11	1.34
Shake Mill RB	North Fork Snoqualmie River	Right River Bank	0.29	0.41
Burhans	North Fork Snoqualmie River	Left River Bank	0.68	0.86
Valcauda	North Fork Snoqualmie River	Left River Bank	0.86	1.22
Bridge to Bridge LB	Raging River	Left River Bank	0.5	1.46
Bridge to Bridge RB	Raging River	Right River Bank	0.51	1.46
Bryce's Bump	Raging River	Left River Bank	1.82	1.85
Georgeff	Raging River	Right River Bank	5.69	5.7
Mouth to Bridge LB	Raging River	Left River Bank	0.02	0.49
Mouth to Bridge RB	Raging River	Right River Bank	0.05	0.52
Sammamish River	Sammamish River	Left and Right River Bank	0	13.85

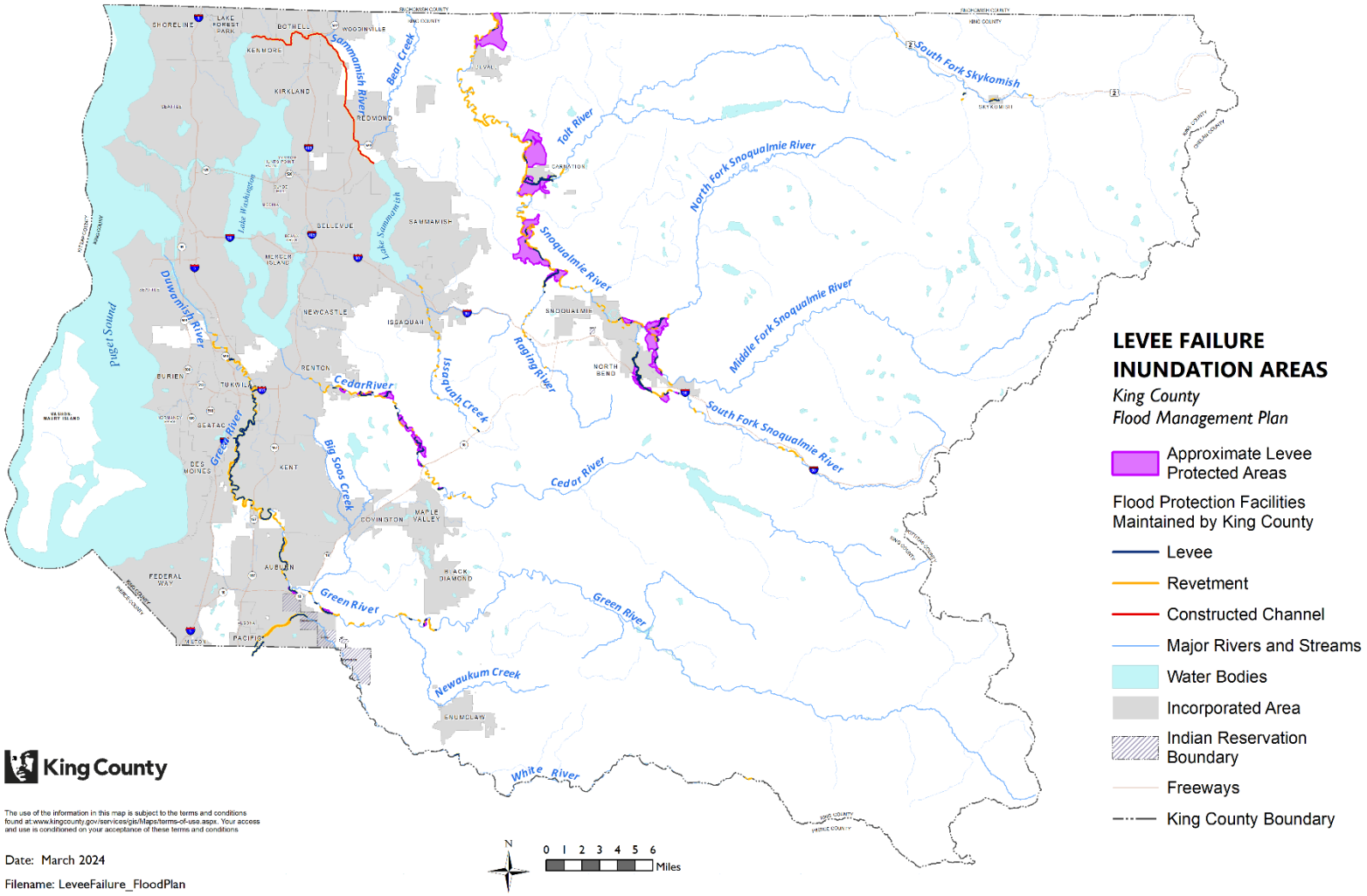
Levee Name	River Name	River Bank	River Mile Downstream	River Mile Upstream
Hanson	Snoqualmie River	Left River Bank	31.57	31.62
Pleasant Hill Farm	Snoqualmie River	Right River Bank	29.48	29.85
Groin	Snoqualmie River	Right River Bank	41.3	41.38
Railroad Brg	Snoqualmie River	Right River Bank	40.43	40.67
Aldair	Snoqualmie River	Left River Bank	32.28	33.14
McElhoe Pearson Upper	Snoqualmie River	Right River Bank	22.3	22.71
McElhoe Pearson Lower	Snoqualmie River	Right River Bank	22.21	22.3
Game Farm	Snoqualmie River	Right River Bank	20.93	21.29
Barfuse	Snoqualmie River	Left River Bank	33.42	33.81
Town of Skykomish LB	South Fork Skykomish River	Left River Bank	15.85	16.42
McConky	South Fork Snoqualmie River	Left River Bank	4.88	5.21
Prairie Acres RB	South Fork Snoqualmie River	Right River Bank	2.09	2.28
Riverbend	South Fork Snoqualmie River	Left River Bank	6.3	6.51
Reif Rd	South Fork Snoqualmie River	Left River Bank	2.89	4.77
Bendigo Upper LB	South Fork Snoqualmie River	Left River Bank	2.55	2.89
Bendigo Lower LB	South Fork Snoqualmie River	Left River Bank	2.28	2.55
Prairie Acres LB	South Fork Snoqualmie River	Left River Bank	2.08	2.28
Bendigo Lower RB	South Fork Snoqualmie River	Right River Bank	2.28	2.54
Bendigo Upper RB	South Fork Snoqualmie River	Right River Bank	2.49	2.88
Si View Park	South Fork Snoqualmie River	Right River Bank	2.88	3.28
Si View Levee	South Fork Snoqualmie River	Right River Bank	3.28	4.8
Holstine Ext	South Fork Snoqualmie River	Right River Bank	4.92	5.39
Brissack Brg Sidestream	South Fork Snoqualmie River	Left River Bank	5.96	5.97
O'Bert	South Fork Snoqualmie River	Left River Bank	7.22	7.23
Frew Upper	Tolt River	Left River Bank	1.14	1.66
Pond Berm	Tolt River	Left River Bank	0.63	0.68
Remlinger	Tolt River	Left River Bank	1.13	1.43
Swiftwater Berm	Tolt River	Left River Bank	1.2	1.33

Levee Name	River Name	River Bank	River Mile Downstream	River Mile Upstream
Frew	Tolt River	Left River Bank	0.57	1.13
Tolt River Levee LB	Tolt River	Left River Bank	0.08	0.56
Hwy to RR Bridge	Tolt River	Left River Bank	0.57	1.12
Tolt River Levee RB	Tolt River	Right River Bank	0.46	0.57
Tolt Campground	Tolt River	Left River Bank	0	0
Lower Tolt River RB	Tolt River	Right River Bank	0	0.6
Holberg	Tolt River	Left River Bank	1.66	2.2
Girl Scout Camp	Tolt River	Left River Bank	1.43	1.99
Game Farm Wilderness Park	White River	Left River Bank	8.22	8.65
Pacific City Park Levee	White River	Right River Bank	5.57	5.86
Union Pacific	White River	Left River Bank	6.23	6.38
Trans-Canada	White River	Left River Bank	8.65	9.37
Countyline	White River	Left River Bank	5	6.2
Countyline Upper	White River	Left River Bank	6.1	6.38



King County Flood Management Plan

Figure D-1
Flood Protection Facilities in King County



King County Flood Management Plan

Figure D-2
Levee Failure Inundation Areas in King County

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Appendix E
Dam Failure

APPENDIX E
Dam Failure

Dam Failure Defined

The following definitions apply in the discussion of dam failure hazards:

- ***Dam*** — Any artificial barrier or controlling mechanism that can impound 10 acre-feet or more of water.
- ***Dam Failure*** — An uncontrolled release of impounded water due to structural deficiencies in the dam.
- ***High-Hazard Dam*** — A dam whose failure would cause a loss of human life.
- ***Significant Hazard Dam*** — A dam whose failure would cause a loss of human life and/or environmental or economic impact.

General Background

The impact of dam failure varies according to factors such as impoundment size, steepness, land use downstream of the dam, and speed of failure. For larger dams, failure is characterized by a flood wave with high velocities. Smaller dams may only raise water levels slightly and slowly. A dam failure can result in the loss of life, property and infrastructure damage, public health impacts, impacts on safe drinking water, and environmental degradation within the inundation zone. Dam failure may also lead to secondary effects on populations outside of the flooded area.

Under the National Dam Inspection Act (Public Law 92-367), the U.S. Army Corps of Engineers (Corps) is responsible for safety inspections of dams in the United States that meet the size and storage limitations specified in the act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices, and regulations regarding the design, construction, operation, and maintenance of dams; developed guidelines for the inspection and evaluation of dam safety; and formulated recommendations for a comprehensive national program (Corps 2018).

The National Dam Safety Program requires a periodic, thorough engineering analysis of every major dam in the United State. The goal of this Federal Emergency Management Agency (FEMA) monitored effort is to identify and mitigate the risk of dam failure to protect the lives and property of the public. The Washington State Department of Ecology (Ecology) Dam Safety Office (DSO) is the regulating body over non-federal dams that impound at least 10

acre-feet of water in the State of Washington. The DSO permits all new dam construction, inspects all high and significant hazard dams every 5 years, and requires that all deficiencies be remedied.

Dam failures typically occur due to:

- Overtopping of the primary dam structure because of inadequate spillway design, settlement of the dam crest, blockage of spillways, and by other means.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage.
- Internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Conduit and valve problems, typically caused by the piping of embankment material into conduits through joints or cracks.
- Geologic or atmospheric events, equipment/structural issues, damage, or sabotage.

Many dam failures in the United States have been secondary results of other disasters, such as earthquakes, landslides or debris flows, wildfires, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, or sabotage. The most likely disaster-related causes of dam failure in King County are earthquakes, overtopping caused by excessive rainfall, and landslides. Poor construction, aging infrastructure, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for, and these threats are under continuous review by public safety agencies.

King County has high-hazard dams on the Green, White, Cedar, and South Fork Tolt rivers. Additionally, Culmback Dam in Snohomish County would flood parts of the lower Snoqualmie Valley if it failed. The Green/Duwamish, White, and lower Snoqualmie valleys are the areas of greatest concern for dam failure in King County. Smaller dams, privately owned or owned by small governments, are also a concern, as they may not have access to the same funding streams available to larger municipal governments.

Past Events/Previous Occurrences

Four dam failure incidents have occurred in King County, and they account for all lives lost due to dam failure in Washington State (Ecology 2019):

- December 1918 – Masonry Dam near North Bend had excessive seepage, which caused a mudflow, destroyed a railroad line, and damaged the village of Eastwick. No lives were lost.
- February 1932 – A slide caused railroad fill at Eastwick to back up and fail, which destroyed a railroad line and damaged the village of Eastwick. Seven lives were lost.

- July 1976 – Increased discharge from Mud Mountain Dam caused a surge in flow, killing two children playing in the White River near Auburn.
- January 1997 – The North Boeing Creek Dam in Shoreline failed during a large storm event due to excessive seepage, poor hydraulics, and no emergency spillway. No lives were lost.

Other notable dam incidents in King County:

- In January 2009, two depressions were discovered in the right abutment of the Corps' Howard Hanson Dam. While repairs were being conducted, there was a 1 in 3 chance of a 25,000 cubic foot per second (cfs) release down the Green/Duwamish River, which would have caused significant flooding. The Corps was able to fully repair the dam by 2011 and before a substantial flood ensued.
- In January 2009, Mud Mountain Dam, owned and operated by the Corps, released a higher-than-usual flow down the White River during a heavy rain event. As a result, 100 homes were flooded. Subsequently, the King County Flood Control District, Washington State, and Pierce County jointly funded a levee setback to reduce the risk of flooding and restore aquatic habitat.

Location and Severity

Located throughout King County, dams serve a variety of purposes including agriculture, hydroelectric power, flood control, and recreation. There are 147 dams within or adjacent to King County that could impact the county if they were to fail. Of those dams, 94 threaten human life and 10 dams[1] are classified as having a high hazard potential (defined as a population of more than 300 at risk within the dam failure inundation area). **Figure E-1** presents a map showing the location and potential dam failure inundation areas for these facilities.

Potential Impacts

Table E-1 presents dam failure impacts. Dam failure impacts are estimated from the potential high release scenario at Howard Hanson Dam in 2009 (Tetra Tech 2017).

[1] One of the 10 dams included in this tally is the Hiram M. Chittenden (Ballard) Locks, which is classified as a dam but has a unique function and location.

TABLE E-1
DAM FAILURE IMPACTS

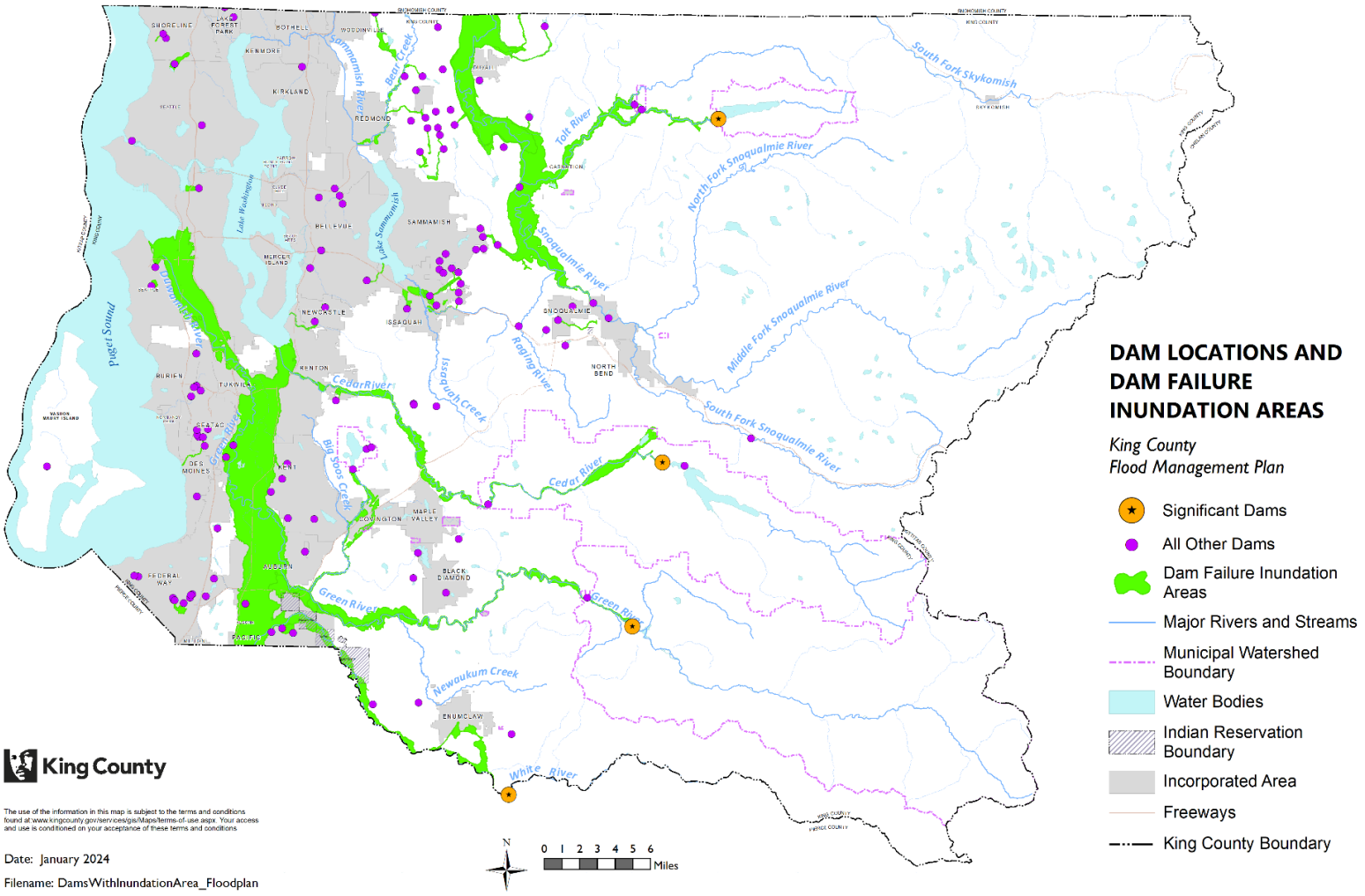
Dam Name	Estimated Impacted King County Population (Full Pool Failure)	Estimated Impacted King County Population (Sunny Day Failure)*
Mud Mountain (White River Watershed)	24,480	2,031
Howard Hanson (Green/Duwamish River Watershed)	20,845	6,235
South Fork Tolt (Snoqualmie River Watershed)	2,291	N/A
Lake Youngs (Green/Duwamish River Watershed)	2,744	2,139
Culmback (Snoqualmie River Watershed)	145	N/A
Other dams combined (estimate)**	5,295	N/A

* Sunny day failure assumes a regular pool.
** Hazard class median reach of range.

Dam hazard class definitions are presented in **Table E-2**. The complete list of dams that impact King County can be found in **Table E-3**; the "hazard class" column in Table E-3 refers to the definitions presented in Table E-2 (Ecology 2021).

TABLE E-2
DAM HAZARD CLASS DEFINITIONS

Downstream Hazard Potential	Downstream Hazard Classification	Population at Risk
Low	3	0
Significant	2	1 to 6
High	1C	7 to 30
High	1B	31 to 300
High	1A	More than 300



King County Flood Management Plan

Figure E-1
Dam Locations and Dam Failure Inundation Areas

TABLE E-3
INVENTORY OF DAMS THAT IMPACT KING COUNTY

Dam Name	Owner Name	River	Hazard Class
Des Moines Creek Stormwater Detention	Port of Seattle	Des Moines Creek	2
204th Street Stormwater Detention Basin	City of SeaTac	Patterson Creek - Offstream	2
Newcastle Railroad Embankment Dam	Seattle City Light	Tr - May Creek	2
Quadrant East Campus Parcel 1 Dam	King County Parks	North Lake	2
Snoqualmie Falls Diversion Dam	Puget Sound Energy Inc.	Snoqualmie River	2
Tolt River Regulated Basin West Dam	Seattle Public Utilities Water Engineer	South Fork Tolt-Offstream	2
Youngs Lake Cascades Dam	City of Seattle	Tr-Cedar River	2
Lake Kittyprince Dam	Dept Of Natural Resources	Icy Creek	2
Tolt River Regulating Basin South Dam	City of Seattle	North & South Fork Tolt River	2
Tapps Lake Dike No. 8	Cascade Water Alliance	Diversion From White River	2
Tapps Lake Dike No. 9	Cascade Water Alliance	Diversion From White River	2
Tapps Lake Dike No. 2b	Cascade Water Alliance	Diversion From White River	2
Tapps Lake Dike No.10	Cascade Water Alliance	Diversion From White River	2
Tapps Lake Dike No. 2a	Cascade Water Alliance	Diversion From White River	2
Tapps Lake Dike No.13	Cascade Water Alliance	Diversion From White River	2
Tapps Lake Dike No. 12	Cascade Water Alliance	Diversion From White River	2
Lakeland South Pond No.1	Auburn City	Offstream - White R.	2
Issaquah Highlands WSDOT Detention Pond	City of Issaquah	E. Fork Issaquah Crk-Offstream	1A
Madsen Creek West Basin Dam	King County Nat Resources	-	1A
Green Lake Reservoir	Seattle Public Utilities	Tr-Puget Sound-Offstream	1A
Howard A Hanson Dam	CENWS	Green	1A
Masonry Dam	City of Seattle	Cedar River	1A
Youngs Lake Outlet Dam	City of Seattle	Little Soos Creek	1A
Mud Mountain Dam	CENWS	White River	1A
Tolt River - South Fork Tolt Dam	City Of Seattle	South Fork Tolt River	1A
Tapps Lake Dike No. 1	Cascade Water Alliance	Diversion From White River	1A
Culmback Dam	PUD #1 Of Snohomish County	Sultan River, Skykomish River	1A
Panther Lake Ballfield Dam	Federal Way Nat' Lit League	Offstream	1B
Lakemont Stormwater Pond	Bellevue City Public Works	Lewis Creek	1B
Issaquah Highlands Reid Pond Dam	Berger, Jim	NF Issaquah Creek - Offstream	1B
Panther Lake Detention Dam	Federal Way Nat' Lit League	Offstream	1B
Panther Lk. First Ave. Detention Pond	Federal Way Nat' Lit League	Hylebos Creek - Offstream	1B
Volunteer Park Reservoir	Seattle Public Utilities	Tr-Lake Union-Offstream	1B
High Point Redevelopment Stormwater Dam	Seattle Housing Authority	Longfellow Creek - Offstream	1B

Dam Name	Owner Name	River	Hazard Class
Lake Forest Park Reservoir	Seattle Public Utilities	Tr-Lyon Creek-Offstream	1B
Hiram M. Chittenden Locks & Dam	CENWS	Cedar River, Sammamish River	1B
Bitter Lake Reservoir	Seattle Public Utilities	Tr-Puget Sound-Offstream	1B
Radar Lake (Obrian) Dam	Radar Lake Holding Trust	Tr-Bear Creek	1B
Johnson Pond Dam	Greg & Sandy Johnson	Rutherford Creek - Offstream	1B
Crystal Lake Dam	Crystal Lake Inc	Daniels Creek	1B
Tapps Lake Dike No. 6	Cascade Water Alliance	Diversion from White River	1B
Tapps Lake Dike No. 5	Cascade Water Alliance	Diversion from White River	1B
Tapps Lake Dike No. 4	Cascade Water Alliance	Diversion from White River	1B
Newcastle Vista Development Pond 3	Newcastle Public Works	-	1B
Cedar Way Stormwater Detention Dam	Mountlake Terrace City	Lyons Creek	1B
Redmond Ridge East Pond SRN 2 No.1	Redmond Ridge East LLC	Evans Creek - Offstream	1C
Issaquah Highlands South Pond Dam	City of Issaquah	E. Fk Issaquah Crk - Offstream	1C
Springwood Stormwater Detention Dam	Swan Lake Estates Assoc	Soos Creek, Wetland 87	1C
Talus P5 Stormwater Detention Dam	Kim, Thomas	Offstream - Tibbets Cr.	1C
Snoq. Ridge Douglas Ave. Pond D1 Dam	City of Snoqualmie	Unnamed Tr. - Snoqualmie River	1C
South 336th Street Stormwater Dam No. 1	Progressive Casualty Insurance	Hylebos Creek	1C
Peterson Stormwater Detention Dam	Swan Lake Estates Assoc	Evans Creek	1C
Reba Lake Stormwater Detention Dam	Port of Seattle	Miller Creek	1C
Mill Pond Stormwater Detention Dam	City of Auburn	Offstream	1C
Yellow Lake Outlet Dike	Swan Lake Estates Assoc	North Fork Issaquah Creek	1C
South Ridge Stormwater Detention Dam	Issaquah South Ridge Owners Assoc	NF Issaquah Creek - Offstream	1C
Trossachs Detention Pond PC-3	City of Sammamish	Offstream	1C
Trossachs Detention Pond PC-2	City of Sammamish	Patterson Creek - Offstream	1C
Garrison Creek - 98th Avenue Detention Dam	Kent City Public Works Dept	Garrison Creek	1C
Mill Creek Canyon Stormwater Detention Dam	Kent City Public Works Dept	Mill Creek	1C
Upper Mill Creek Stormwater Detention Dam	City of Kent	Mill Creek	1C
South 336th Street Stormwater Dam No. 2	Kitts Corner LLC	Hylebos Creek	1C
Weyerhaeuser-Enumclaw Flood Control Dam	Weyerhaeuser Company	Boise Creek	1C
Issaquah Highlands NPE Pond	City of Issaquah	NF Issaquah Creek - Offstream	1C
Redmond Ridge Cedar Dam	City of Redmond	Offstream-Tributary to Bear Cr	1C
Redmond Ridge Drive EC 4N Roadway Dam	King County	Offstream-Trib. to Evans Cr	1C
Port Of Seattle - Lagoon #3 Expansion	Port of Seattle	Des Moines Creek - Offstream	1C

Dam Name	Owner Name	River	Hazard Class
Issaquah Highlands Np2 Pond Dam	City of Issaquah	NF Issaquah Creek - Offstream	1C
Icon Materials Auburn Sediment Pond	Ma Segale Inc.	White River - Offstream	1C
Boeing Creek Stormwater Detention Dam	Shoreline Community College	Boeing Creek	1C
Snoqualmie Mill Pond Dam	Weyerhaeuser	Tr-Snoqualmie River	1C
Welcome Lake Dam	Lake of The Woods HOA	Colin Creek	1C
Tuck Lake Dam	Tuck Lake Home Owners Assoc	Tuck Creek	1C
Youngs Lake New Inlet Dam	City of Seattle	Tr-Cedar River	1C
Marcel Lake Dam	Lake Marcel Community Club	Essency Creek	1C
Loreene Lake Dam	Twin Lakes Golf & Country Club	Joes Creek	1C
Margaret Lake Dam	Bunker, Stan	Margaret Creek	1C
Des Moines Creek Regulatory Detention Facility West Berm	Port of Seattle	Off Stream	1C
Des Moines Creek Regulatory Detention Facility East Berm	Port of Seattle	Off Stream	1C
Icon Materials Sediment Pond 6	Icon Materials	White River - Offstream	1C
Southwest Genesee Street Detention Dam	City of Seattle Parks Dept	Longfellow Creek	1C
Tapps Lake Dike No. 11	Cascade Water Alliance	Diversion from White River	1C
Tapps Lake Dike No. 3	Cascade Water Alliance	Diversion from White River	1C
Kayak Lake Dam	Mtn View Park Comm Club	Tr-Cherry Creek	1C
Redmond Ridge East Pond SRS 1 No. 1	Redmond Ridge East LLC		1C
SeaTac Airport Pond M	Port of Seattle	Miller Creek to Puget Sound	1C
Silver Firs Detention Pond No. 3	Silver Firs II HOA	Little Bear Creek	1C
Boeing Creek M1 Detention Dam	City of Shoreline	NF Boeing Creek - Offstream	2D
Muth Stormwater Pond	Kent City Public Works Dept	Green River - Offstream	2D
Klahanie Stormwater Detention Dam No. 2	City of Sammamish	Tr-Laughing Jacobs Lake Outlet	2D
Klahanie Stormwater Detention Dam No. 13	City of Sammamish	Tr-Issaquah Creek	2D
Klahanie Stormwater Detention Dam No. 1	City of Sammamish	Tr-Laughing Jacobs Lake Outlet	2D
Garrison Creek Stormwater Detention Dam	Kent City Public Works Dept	Garrison Creek	2D
Conner Jarvis East Pond	City of Sammamish	Offstream	2D

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Appendix F

King County 2023 Repetitive Loss Area Analysis Progress Report

King County

Appendix F

REPETITIVE LOSS AREA ANALYSIS

2023 Annual Report

PERTEET

King County, Washington

REPETITIVE LOSS AREA ANALYSIS

2023 Annual Report

October 16, 2023

King County Department of Natural Resources and Parks
Water and Land Resources Division

River and Floodplain Management Section
King Street Center, KSC-NR-0600
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
206-477-4812
TYY Relay: 711

Alternate Formats Available
206-477-4812 TYY Relay: 711

1.0 BACKGROUND

In 2022, King County, Washington, completed a Repetitive Loss Area Analysis (RLAA). The RLAA identified and evaluated repetitive loss properties throughout the County. The RLAA identified 41 repetitive loss areas in King County located within 7 drainage basins, including the Cedar River Basin, Sammamish River Basin, Skykomish River Basin, Snoqualmie River Basin, Vashon Island, and Green River Basin. The RLAA was adopted by the County on September 6, 2022, by Motion 16199.

Within the 41 repetitive loss areas, there were 88 unmitigated repetitive loss properties and an additional 523 properties that have the same or similar flood conditions but have either been mitigated, constructed to higher standards, or do not have repetitive claims paid against the NFIP. The RLAA suggests methods to mitigate or reduce flood loss for each specific property, including elevate/replace/relocate, acquire/demolish, modify building utilities, capital projects, or drainage maintenance. Each property may have several possible mitigation options. Table 1 summarizes the possible mitigation actions in each repetitive loss area. The RLAA also identifies the capital projects proposed for the drainage basins which may reduce the risk of flooding for repetitive loss areas. Section 2 of this progress report describes the mitigation actions that have occurred in each repetitive loss area over the past year.

This RLAA was prepared as part of King County's participation in the FEMA Community Rating System (CRS) Program. Through participating in the CRS program, property owners within the County are provided flood insurance premium discounts on NFIP backed flood insurance policies. To retain CRS credit for the RLAA, the County must prepare an annual progress report on the various activities the County is performing as referenced in the RLAA. This report shall serve as King County's annual progress report for the period of October 1, 2022, through October 1, 2023. The report was prepared by Perteet and King County staff in collaboration with planning partners. King County staff reviewed permit applications and checked with program leads for updates related to the mitigation and capital projects identified within the RLAA. The annual report will be shared with the governing body in a public meeting, released to the media, and shared with the public by posting the report online.

The County performs annual outreach to repetitive loss area property owners. In December 2022, the County sent a repetitive loss letter to all 611 property owners and residents within the repetitive loss areas. The letter included information on flood risks, how to prepare property for flooding, types of mitigation actions, and available assistance. The 2023 repetitive loss letter is scheduled to be sent in November and will include a link to review the RLAA and annual report.

The RLAA can be accessed at: https://your.kingcounty.gov/dnrp/library/water-and-land/flooding/final-repetitive-loss-area-analysis-external-7-26-22.pdf

The annual progress report can be accessed at: https://kingcounty.gov/en/dept/dnrp/nature-recreation/environment-ecology-conservation/flood-services/flood-programs/community-rating-system

Table 1. Summary of Mitigation Actions Proposed in each Repetitive Loss Area.

Area	Possible Mitigation Options					
	Elevate/ Replace/ Relocate	Acquire/ Demolish	Modify (HVAC, etc.)	Capital Projects	Drainage Maint.	Other
Cedar 1	X	X		X		
Cedar 2		X		X		
Cedar 3						
Cedar 4	X	X				
Cedar 5		X		X		
Sammamish 1	X	X		X		
Sammamish 2			X	X		
Sammamish 3	X				X	
Skykomish 1	X			X	X	
Skykomish 2	X		X		X	
Skykomish 3	X		X		X	
Skykomish 4			X		X	
Snoqualmie 1-2	X		X	X	X	
Snoqualmie 3	X		X		X	
Snoqualmie 4	X	X	X		X	
Snoqualmie 5	X	X	X	X		
Snoqualmie 6	X	X				
Snoqualmie 7	X	X	X			
Snoqualmie 8	X	X	X			
Snoqualmie 9	X	X	X			
Snoqualmie 10	X	X	X			
Snoqualmie 11	X	X		X		
Snoqualmie 12	X	X				
Snoqualmie 13	X	X		X		
Snoqualmie 14-16	X	X	X	X		
Snoqualmie 17	X	X				
Snoqualmie 18	X		X			
Snoqualmie 19	X					
Snoqualmie 20	X					
Snoqualmie 21	X					
Snoqualmie 22	X	X				
Vashon Island 1	X		X			
Vashon Island 2	X		X			
Green River 1	X		X			
Green River 2	X	X				
Green River 3	X					
Green River 4			X		X	
Green River 5	X	X	X		X	

2.0 MITIGATION ACTION PROGRESS

2.1 Elevate/Replace/Relocate

2.1.1 Description

When the floor of a home is below the 100-year flood elevation, physically elevating the structure, relocating the structure, or demolishing and building a new structure is one of the most effective means to prevent flood damage. Financial assistance may be available for elevations or relocations. Since 2008, King County Flood Control District has provided financial assistance to 66 homeowners to elevate or relocate their homes. The County also requires all substantially damaged or improved structures to come into compliance with current regulations, which often includes elevation. A substantial improvement is any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the "start of construction" of the improvement.

2.1.2 Where Mitigation is Proposed

Table 2 provides the number of properties in each basin identified for elevation, replacement, or relocation mitigation.

Table 2. Number of Properties Proposed for Elevate/Replace/Relocate Mitigation.

Snoqualmie River Basin	Sammamish River Basin	Cedar River Basin	Green River Basin	Skykomish River Basin	Vashon Island
258	1	5	5	18	12

2.1.3 Where Mitigation Occurred

In the Snoqualmie River Basin, two properties have received funding from the King County Flood Control District to elevate their structures. The structures are a home built in 1936 on a crawlspace foundation and a home built in 1916 also on a crawlspace foundation. The homeowners are in the process of obtaining permits for the work. King County's efforts to support homeowners through the process of elevating, replacing, or relocating properties are ongoing.

2.2 Acquire/Demolish

2.1.1 Description

The most effective approach to preventing further flood damage to a building is acquisition of the land and demolition of the structure. The property would then serve as open space or recreation area in perpetuity. Property owners retain the right to select this as a mitigation method and acquisitions are voluntary when possible. They may sell their property to King County or an agency dedicated to the preservation and management of local open space. Acquisition is a relatively expensive mitigation measure, but it provides the greatest benefit in that lives and property are protected from flood damage.

King County's program for land acquisition has been very successful, with the purchase of 215 flood-prone or repetitive loss properties since 2008 and several more in progress.

2.2.2 Where Mitigation is Proposed

Table 3 provides the number of properties in each basin identified for acquisition and demolition mitigation.

Table 3. Number of Properties Proposed for Acquire/Demolish Mitigation.

Snoqualmie River Basin	Sammamish River Basin	Cedar River Basin	Green River Basin	Skykomish River Basin	Vashon Island
149	1	48	2	0	0

2.2.3 Where Mitigation Occurred

Since October 2021, King County has acquired and demolished 11 buildings in the regulatory floodplain and 1 building outside of the regulatory floodplain. None of the demolished buildings, which included single family homes, mobile homes, and small business structures, were located in repetitive loss areas. In October 2022, the King County Flood Control District acquired a repetitive loss structure located in the FEMA Floodway within the Snoqualmie River Basin. Demolition permits have not yet been acquired. Upon demolition, this acquisition will provide multiple benefits, including permanent flood hazard risk reduction, open space, and recreational access opportunities for the community. King County continues to identify properties for voluntary acquisition to permanently reduce flood risk.

2.3 Modify (HVAC and Other Utilities)

2.3.1 Description

Modifying building utilities in a floodplain is essential to reduce the risk of damage during flood events and ensure the safety and functionality of these essential systems. Modification of heating, ventilation, and air conditioning (HVAC) systems and other utilities may include elevating equipment, waterproofing and sealing, installing sump pumps, providing backup power (such as generators), and installing flood sensors and alarms to provide early warning. Modifying HVAC and other utilities can be an affordable way for homeowners to protect their investment. Through these preventative measures, damage can be minimized and the utilities will remain functional.

2.3.2 Where Mitigation is Proposed

Table 4 provides the number of properties in each basin identified for modification mitigation. These properties had building utilities that were visible to the inspectors from the road or were identified in other plans or during landowner interviews. Because building utilities are often hidden from view, more properties than identified would likely benefit from this mitigation action.

Table 4. Number of Properties Proposed for Modify (HVAC and Other Utilities, etc) Mitigation.

Snoqualmie River Basin	Sammamish River Basin	Cedar River Basin	Green River Basin	Skykomish River Basin	Vashon Island
54	1	1	12	14	29

2.2.3 Where Mitigation Occurred

No known modifications occurred during the reporting period. Many of the modifications that protect building utilities from flooding can be implemented without a permit and are difficult for staff to track. The efforts to help repetitive loss area properties mitigate potential flood losses to building utilities are ongoing.

2.4 Capital Projects

2.4.1 Description

Capital projects can keep floodwaters away from an area through structural modification of the river system, such as with new levees, setback levees, reservoirs, or other flood control measures. They may increase safety by elevating roads or modifying critical facilities. Capital projects may also include implementing flood warning systems, updating floodplain mapping, and conducting public outreach to increase awareness of flood risk. King County Flood Control District generally leads capital projects within the floodplain. These projects are planned for and identified within each basin's Capital Investment Strategy and other planning documents. They include levee repairs and setbacks, elevating roads, and other capital projects. Capital projects aim to reduce the impact of flooding events, protect lives and property, and enhance the resiliency in the communities located within the floodplain.

2.4.2 Where Mitigation Activity is Proposed

Table 5 provides the number of properties in each basin that will benefit from capital projects.

Table 5. Number of Properties Proposed for Capital Projects Mitigation.

Snoqualmie River Basin	Sammamish River Basin	Cedar River Basin	Green River Basin	Skykomish River Basin	Vashon Island
12	2	42	12	7	0

2.4.3 Where Mitigation Occurred

Table 6 provides status updates of capital projects identified within the RLAA. Capital projects to reduce the flood losses within or adjacent to repetitive loss areas are ongoing and King County Flood Control District continues to identify potential new capital projects.

Table 6. Capital Project Status.

Location	Name of Project	Summary	Status
Cedar River Basin	Herzman to Camp Freeman Project	Flood and erosion risk reduction will be provided along the Cedar River, four miles east of Renton	Final design/permits, 2023 Construction contracting, 2024
	Jan Road Levee Setback Project	Jan Road will be raised to improve access, portions of the Jan Road Levee will be set back or removed, and at-risk homes will be acquired	Completed in 2022
	Maplewood Landslide and Flood Reduction Feasibility Study	Analyzes flood and landslide hazards in Maplewood neighborhood, which includes an analysis of existing levees	Development of potential risk mitigation solutions, pending funding, ongoing
Sammamish River Basin	Sammamish River Capital Investment Strategy	A capital investment strategy will be developed for the entire length of the Sammamish River from Lake Sammamish to Lake Washington	Plan development phase, 2022-2024
	Willowmoor Floodplain Restoration Project	The reconfiguration of the outlet from Lake Sammamish to the Sammamish River will maintain or reduce downstream flooding and flooding impacts and improve conditions for fish listed in the ESA	Preliminary design, stakeholder/community engagements, 2023
South Fork Skykomish River Basin	South Fork Skykomish Repetitive Loss Mitigation	This project funds elevation or buyout of structures in the basin, to eliminate flood risk or erosion damage during future flood events	Project is ongoing
	Timberlane Village Revetment Repair	The repair of the revetment will protect lives, the rivers, and aquatic species	Project completed
Snoqualmie River Basin	Residential Flood Mitigation-Property Acquisition	This project considers acquisition of properties that are at risk of severe channel migration hazards	Project is ongoing
	Circle River Ranch (South Fork Snoqualmie)	Evaluates actions to reduce long-term risks from channel migration in the Circle River Ranch neighborhood	Design and permitting, 2022-2024 Construction, 2024
	Reinig Road Revetment Repair	Short-term risk reduction measures and permanent repairs of damages to three sections of Reinig Road Revetment	Completed in 2022
	SR 203 Bridge Improvement Feasibility Study	Evaluates the opportunities, costs, and benefits of providing increased water flow through SR 203 Bridge and road.	Project report finalized, 2022, improvements to be part of Lower Frew Levee Setback project
	Tolt River Level of Service Analysis	Provides a technical analysis to determine levels of protection from new levee systems to maximize public protection and investigates project sequencing and the resulting flood effects	Alternative evaluations study, 2022 – briefing Flood Control District, 2023

Location	Name of Project	Summary	Status
	Tolt River Sediment Management Feasibility Study	Determines if sediment removal is a feasible and effective flood risk reduction tool for the lower two miles of the Tolt River. In addition, this study reviews and updates previous analysis of the sediment production in the upper Tolt River basin and sediment rates in the lower two miles of the Tolt River	Study completed, 2022 – briefing Flood Control District, 2023
Green River	Black River Pump Station Improvements	Includes a number of improvements to the pump station to ensure flood risk reduction benefits	Mechanical system repairs, 2021-2023, replace control building alternatives analysis, 2023, ongoing
	Galli's-Dykstra Levee Repair Project	Completes Phase 1 repair	Project completed
	Green River System-Wide Improvement Framework	Outlines prioritized strategy to address levee deficiencies. This framework optimizes flood risk reduction and addresses system-wide issues to maintain eligibility for the 17 miles of levee currently enrolled	SWIF implementation, ongoing
	Lower Russell Levee Setback Project	Removes and replaces existing flood containment system of levee and revetments to construct new flood prevention system	Completed in 2022

2.5 Drainage Maintenance

2.5.1 Description

Drainage maintenance for homes in a floodplain is critical to ensure effective functioning of drainage systems, reduce flood risk, and protect homes from water damage. In some cases, there are activities that the property owner can do on-site such as directing shallow floodwater away from flood-prone structures or cleaning on-site ditches. Shallow flooding can often be kept away from a structure if some simple improvements are made to the yard. For example, regularly removing debris such as leaves, branches, and trash from culverts and storm drains can prevent blockages that impede water flow. In addition, regularly inspecting the drainage infrastructure and managing vegetation in and around drainage channels can greatly reduce flood risk.

2.5.2 Where Mitigation is Proposed

Table 7 provides the number of properties in each basin identified for acquisition and demolition mitigation.

Table 7. Number of Properties Proposed for Drainage Maintenance Mitigation.

Snoqualmie River Basin	Sammamish River Basin	Cedar River Basin	Green River Basin	Skykomish River Basin	Vashon Island
34	1	0	6	13	0

2.5.3 Where Mitigation Occurred

King County Roads Services Division performs regular ditch maintenance within county road rights of way. Any ditch maintenance performed by the County within or nearby repetitive loss areas supports this mitigation action. No other drainage maintenance projects occurred during the reporting period within repetitive loss areas. The County will continue efforts to implement drainage maintenance projects within repetitive loss areas.

3.0 PROPOSED MODIFICATIONS TO MITIGATION ACTIONS OR RECOMMENDATIONS

No modifications to the mitigation actions are proposed at this time. The County continues to implement the identified mitigation projects on schedule.

During upcoming Hazard Mitigation Plan and Flood Management Plan update processes, the County should integrate the RLAA actions and strategies into the updated plans.

Appendix G
Public Information Activities

APPENDIX G

Documentation of King County Flood Plan Public Information Activities

This appendix details various public information activities conducted to support the development of the King County Flood Management Plan and is aligned with Step 2.d. of the 10-step CRS planning process. Included are the following elements:

- Flood Plan public kickoff meeting information
- King County Flood Management Plan website
- King County Flood Management Plan engagement hub
- King County Flood Management Plan online survey questions
- Advertisements used on King County metro buses and Sound Transit light rail
- List of events attended where King County hosted a Flood Plan booth/table
- List of community groups/associations to which King County presented about flooding and the Flood Plan
- Email announcements to subscriber list

News Release for Flood Plan Public Kickoff Meetings (CRS Step 2.b.)

Newsroom[1]

Natural Resources and Parks
Public Affairs

Help King County prepare communities for more frequent, severe floods that are occurring due to climate change

September 26, 2022

As climate change increases the potential for more frequent and more severe flooding across the region, King County is seeking community expertise and advice on managing flood risks to people, homes, businesses, and roads. Two online meeting options – Tuesday, Oct. 4, from 10 a.m. to noon or Thursday, Oct. 6 from 6:30 to 8:30 p.m. – will kick off the plan update. This is the first opportunity for public input on this countywide plan.

King County will host two public meetings in October as it prepares to update its flood plan for the first time in nearly a decade, accounting for the increasing risk of more frequent and intense flooding due to climate change.

Both meetings – on Tuesday, Oct. 4 from 10 a.m. to noon and on Thursday, Oct. 6 from 6:30 to 8:30 p.m. – will be hosted online. Participants will have the opportunity to learn about current flood risks, share how flooding impacts their community, and help shape the plan that will guide how the county manages flood hazards for people, homes, businesses, and roads in unincorporated areas.

Visit kingcounty.gov/FloodPlan to learn more about King County's most common natural disaster, sign up for updates, and register to attend one of the kickoff meetings.

[1]Posted online at:
https://kingcounty.gov/en/legacy/depts/dnrp/newsroom/newsreleases/2022/September/26-Flood-Plan-Kickoff.aspx

"We want hear from people who live and work in areas that are at risk of flood so that we can address what they see as the opportunities and challenges related to flooding," said Christie True, Director of King County's Department of Natural Resources and Parks. "These meetings will be one of many times the public can shape the flood plan update."

Annual flood seasons have changed how local rivers function since King County last updated the flood plan in 2013. The updated flood plan will include new strategies to reduce flood hazards while also achieving other benefits such as recovering salmon runs, supporting working farms, protecting water quality, and protecting open space. King County wants to hear from and partner with communities most impacted by flooding to shape solutions.

"The flood plan presents a tremendous opportunity for King County to help reduce flood risks while delivering significant community benefits like clean water, healthy habitat, improved recreation and open space, sustainable agriculture, and supporting livelihoods and local jobs," said Josh Baldi, Director of King County's Water and Land Resources Division.

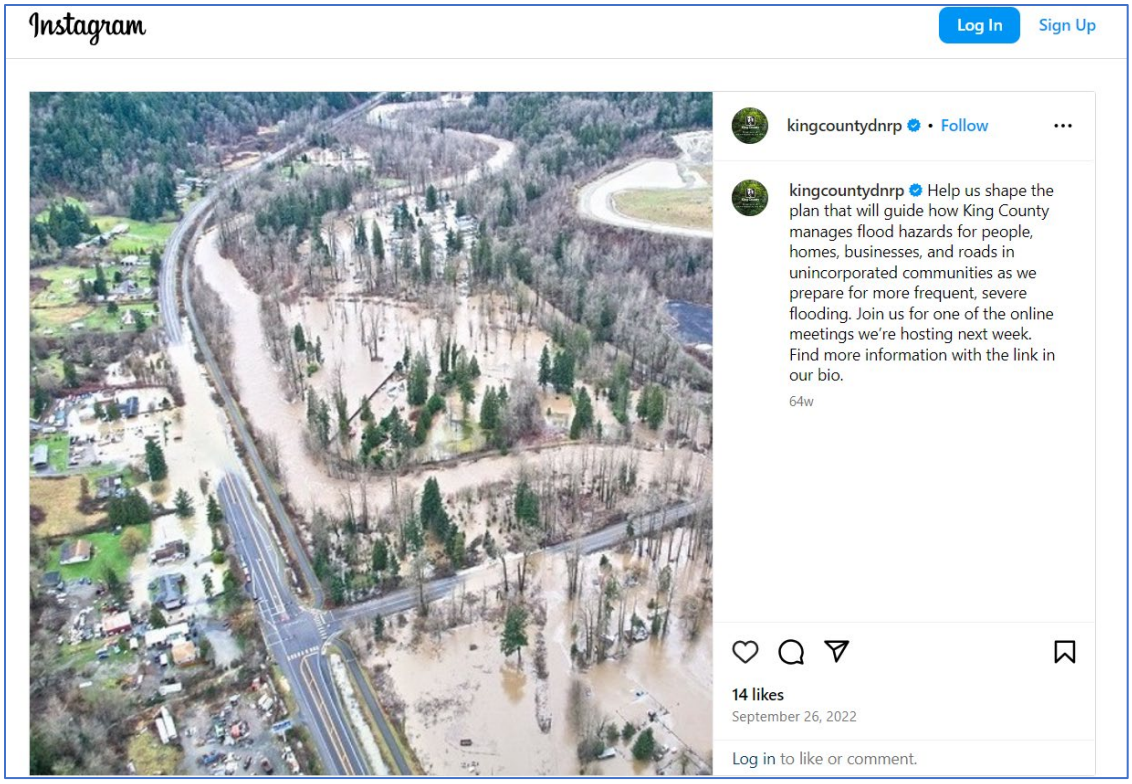
The planning, led by the King County Department of Natural Resources and Parks, will continue through 2023. Additional ways to get involved will be shared later this fall. The plan will be submitted to the King County Council for approval in 2024.

For more information about the flood plan, contact Jason Wilkinson, project manager, via email or call 206-477-4786.

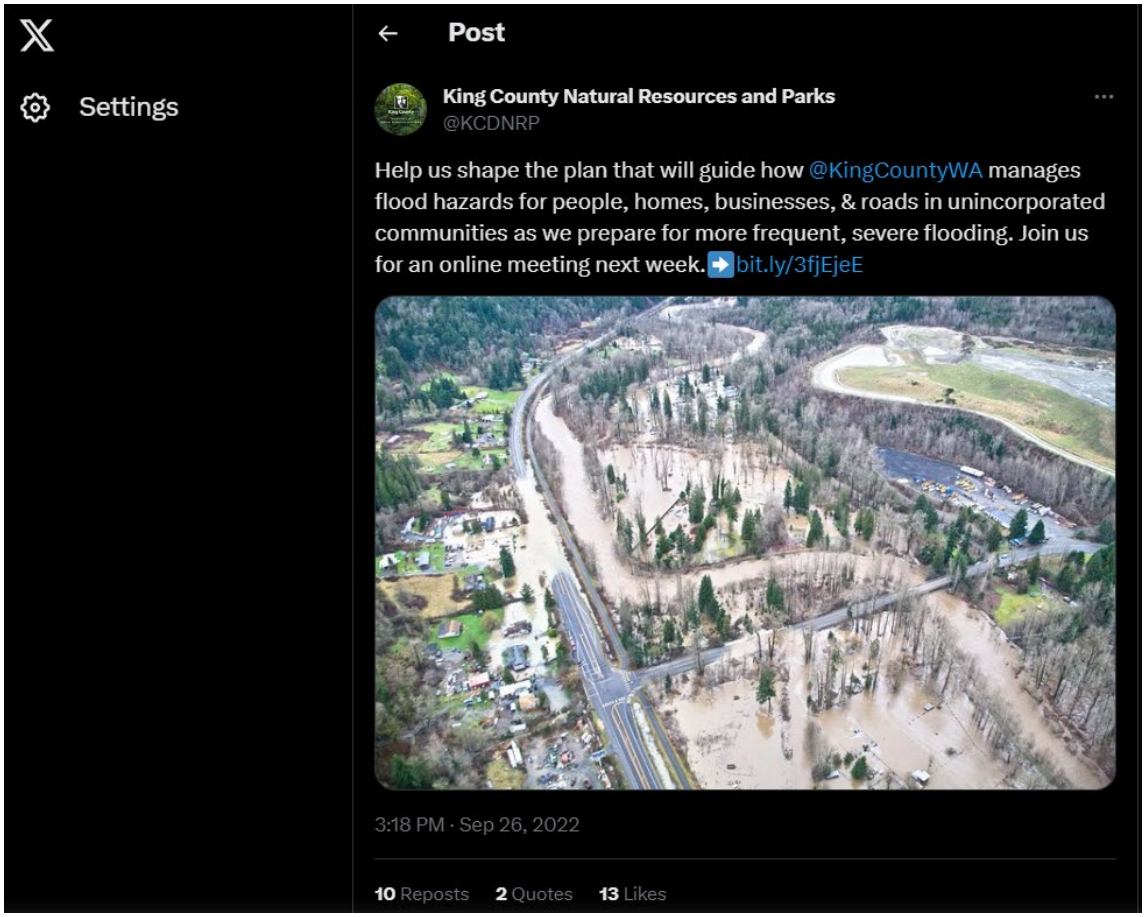
Can't join the online meeting?

We understand not everyone can attend these meetings. We are still interested in hearing from you. King County staff members can come to community groups for conversations about flooding to inform our planning. We welcome suggestions on community events or meetings to attend. Contact Chrys Bertolotto via email or call 206-263-2677 to discuss options.

Instagram Post for Flood Plan Public Kickoff Meetings (CRS Step 2.b.)



Twitter/X Post for Flood Plan Public Kickoff Meetings (CRS Step 2.b.)



Meeting Agenda for Flood Plan Public Kickoff Meetings (CRS Step 2.b.)

10/6 Meeting Agenda (6:30 – 8:30 pm)

Topic	Time	Speaker	Affiliation
Pre-meeting Attendee Technology Check	6:20 p.m.		
Welcome	6:30 p.m.	Running Grass	Three Circles Center (facilitator)
Flooding and the Flood Plan	6:45 p.m.	Steve Bleifuhs	King County River and Floodplain Management (Section Manager)
Integrated Floodplain Management Works Best When People Engage	7 p.m.	Brandon Parsons	American Rivers (Director of River Restoration, NW Floodplain Lead)
Perspectives on Flooding (recordings)	7:15 p.m.	Sung Baek and Delores Lee	Community Residents
Hearing from You - Discussion	7:30 p.m.	All	Facilitated by Running Grass
The Flood Plan Update Process	8 p.m.	Jason Wilkinson	King County Water and Land Resources Division (Flood Plan Update Manager)
Next Steps	8:20 p.m.	Running Grass	

Attendance Log for Flood Plan Public Kickoff Meeting – Oct. 4, 2022 (CRS Step 2.b.)

Name	Do you represent an agency, jurisdiction or community-based organization? If so, please tell us the name of your group.:
Lorin Reinelt	King County - RFMS
STEVEN HIESTER	WA
Megan Smith	King County Water and Land Resources Division
Iris Kemp	WRIA 9
David Haakenson	
Edie	
Tom Hardy	City of Redmond
don huling	SCAR
Emily Flanagan	City of Redmond
Laura Hendrix	King County - RFMS
Martha Neuman	Seattle Public Utilities
Sevin Bilir	King County
Claudia Donnelly	
sarah steen	
Laurie Lyford	WSSA
Lindsey Amtmann	
Elissa Ostergaard	Snoqualmie Watershed Forum
Harshitha Sai Viswanathan	Northwest Seaport Alliance
Dawn Judkins	Mountain View Fire and Rescue
Mark Ruebel	King County River and Floodplain Management Section
Alisha Pena	NW Seaport Alliance
Molly Lawrence	
Virginia Russell	
Karen Wilson	
linn gould	Just Health Action
Mike Mactutis	City of Kent
Jenny Gaus	City of Kirkland
John Cornelison	Vashon EOC
Mary Strazer	King County - RFMS
Pat and Mike Krebs	
Erin Ericson	Snoqualmie Valley Watershed Improvement District
Yi Tyan Tsai	WA
Lindsay Dillon	
Judy Haggard	
Kim Urquhart	No
Laura Cooper	WA State Department of Natural Resources
Savanna Steele	Congresswoman DelBene's Office
Brian and Frances Collinwood	
Lucy G	The Firm Outreach
Heather Young	
Alex Lincoln	King County - RFMS
Thomas Bloxton	King County - RFMS
Angela Angove	Pierce County Planning and Public Works - Surface Water Management
Kris Buitrago	King County - RFMS
Brynne Walker	Pierce County Surface Water Management
Jim Schlomer	Department of Fish and Wildlife
Anjali Fisher	King County DNRP

Attendance Log for Flood Plan Public Kickoff Meeting – Oct. 4, 2022, continued (CRS Step 2.b.)

Name	Do you represent an agency, jurisdiction or community-based organization? If so, please tell us the name of your group.:
Mary Harenda	WA
MJ Jorgensen	City of Renton
Arlene RITZHAUPT	
Ingrid Lundin	
Anna Ritzhaupt	
Susan Saffery	Seattle Public Utilities, City of Seattle
Cheryl Paston	City of Bellevue Utilities
Henry Sladek	Town of Skykomish
Mike Perfetti	City of Tukwila
Miles Mayhew	seattle public utilities
Melanie Jordan	
Frederick Chavre	TaHoMa River Survivors
SHERRY EDQUID	City of Tukwila
Donald Finney	King County Water and Land Resources Division
Joel Roalkvam	
Sabrina Warren	Riverview SD
Diane Pasta	
Katrina Johnston	King County - RFMS
Staff/Meeting Support	
Running Grass	facilitator
Steve Bleifuhs	speaker
Jason Wilkinson	speaker
Carol Macilroy	speaker - Carol Macilroy Consulting Corporation
Anny Chang	support staff
Lily Barrett	support staff
Chrys Bertolotto	support staff

Attendance Log for Flood Plan Public Kickoff Meeting – Oct. 6, 2022 (CRS Step 2.b.)

Staff / Meeting Support	
Brandon Parsons	Speaker
Steve Bleifuhs	Speaker
Jason Wilkinson	Speaker
Running Grass	Facilitator
Maria Fiallos	Interpreter
Christopher Michael Fallas Urena	Interpreter
Anny Chang	support staff
Lily Barrett	support staff
Chrys Bertolotto	support staff

Name	**Do you represent an agency, jurisdiction or community-based organization? If so, please tell us the name of your group.:**
Terry Clark	
Henry Sladek	Mayor of the Town of Skykomish
Rosemary Neff	
Maria Gerace	No
Donald K Vardy	
Scott Sheffield	WSSA
Heather young	
Darcey Peterson	King County Water District No. 90
Christopher Ensor	Feet First
Katy Vanderpool	King County staff - RFMS
LarKen Buchanan	no
Lisa Figueroa	City of Redmond
Harshitha Sai Viswanathan	Northwest Seaport Alliance
Reid Brockway	Sammamish Home Owners
Kjristine Lund	Lund Consulting, Inc.
Linda Grez	
Lara Thomas	City of Duvall
Lauren Silver	Snoqualmie Valley Preservation Alliance
Miranda Fix	
Laura Tautz	
R Bowe	
Mary Harenda	Washington
Kate Ryan	People for the Preservation of the Tualco Valley
Rachel Minnery	
Angela Donaldson	Fall City Community Association
Melinda Wilde	Valley Communications Center
Don Huling	Soos Creek Area Response Group
Zebiba Al-Tahir	
Steven Heister	

King County Flood Management Plan Website (CRS Step 2.d.)

King County Flood Management Plan

Over the next two years King County will update its Flood Management Plan. The plan is our guide for managing flood risks along our rivers, creeks, and coastlines.

This page has been translated into other languages

View this page in the following languages:

Español
한국어
русский
soomali
繁體中文首頁
Tiếng Việt

CONTACT

Contact person: Jason Wilkinson

Email: jason.wilkinson@kingcounty.gov

Phone: 206-477-4786

Stay informed

Sign up for monthly news and announcements about the King County Flood Management Plan

To create the next plan, King County is learning about the interests and goals of our communities most vulnerable to flooding. How does reducing flood risks impact rivers that support wildlife and farming? Ensure safe roads and reliable infrastructure? How do we address the likelihood of bigger floods with the resources available? What matters most to you?

What we learn will help us equitably shape our programs, policies, and infrastructure for years to come.

About the flood plan update

As our most common natural disaster, flooding is part of life in King County. The plan will set floodplain management policy for unincorporated King County and could inform flood management actions by cities, the King County Flood Control District, and other floodplain partners.

Our core values in developing the flood plan are:

- To stay community-centered.
- Embrace transparency and openness.
- Work with local partners.
- Strive for full accessibility.
- Have communities that are often left out of flood risk reduction conversations at the table.

People work to assess damage to State Route 202 caused by the flooding of the Snoqualmie River in 2009.

Why is King County updating the flood plan?

Rivers and streams are alive—they change over time. King County last updated the flood plan in 2013. Since then, nearly 10 seasons of flooding have changed

how our rivers look and function. Our population has grown, and we've added more homes and businesses to the landscape. How we develop land, manage waste, accommodate traffic, grow food, and recreate affects our rivers and coastal areas.

How will this flood plan be different?

To create a flood resilient future, the plan must represent the diverse perspectives of our community. Due to unjust historical practices, some communities are more at risk of flooding. Some people are less able to prepare or recover from flood disasters. Understanding what all communities need and their proposed solutions is King County's priority.

Past plans have focused on flooding along King County's major rivers. This plan will capture a broader range of flood hazards that affect people. It will include coastal flood hazards and sea level rise, small stream flooding, and urban flooding.

The updated plan will look for ways that we can reduce flood risks while delivering other community benefits. How can our projects and programs support farming or create new jobs? Improve salmon habitat and provide recreational areas? What's most important to you and what does your community need?

King County will work directly with communities on the flood plan in 2022 and 2023. Engagement opportunities will include community partnerships, advisory groups, and online surveys. King County will also hold open houses and virtual meetings. Staff are available to join community-hosted meetings and share information. See below for information on these opportunities.

Coastal flooding on Vashon Island in 2021.

Get involved

Sign up to receive flood plan updates and learn about ways to be involved in creating a flood resilient future. You can unsubscribe at any time.

Let's plan ahead for flooding, together. We're looking for your input to help everyone in our community be more resilient to flooding. Visit the 2024 King County Flood Management Plan engagement hub. You can share what flooding problems concern you in an online survey, open through October 15. You can also check out an upcoming events calendar or suggest events for King County to come to in your community.

Partner Planning Committee

The Partner Planning Committee is one avenue for gathering public input on the flood plan. Learn more about the purpose of the committee and upcoming committee meetings on the Partner Planning Committee webpage.

State Environmental Policy Act process - environmental impact statement

An important part of our process to update the Flood Management Plan is to prepare an environmental impact statement (EIS). An EIS is a document that describes proposed actions and how they would affect the environment and

people. Through the EIS process, King County will identify and analyze potential impacts of the plan on threatened or endangered species, water quality, historical and cultural resources, transportation, and more.

King County will explore the impacts of two scenarios, called “alternatives,” in the EIS. As a standard part of the EIS process, a “no action alternative” is considered. The analysis will consider the impacts of not adopting the new flood plan (the no action alternative) and continuing to use the 2006 and 2013 flood plans to guide floodplain management policy and activities and will also evaluate the impacts associated with adopting the new flood plan.

The County’s current flood plan focuses on flooding and erosion hazards on major rivers and streams like the Snoqualmie and Cedar rivers and Issaquah Creek. The updated flood plan proposes to address flooding more broadly on smaller streams and tributaries, lakes, and in urbans and coastal areas. Public comments from the EIS scoping period confirmed this broader scope has the potential to result in better outcomes for King County communities.

Learn more about the EIS process by reading our scoping fact sheet (1.11 MB, PDF)

Scoping period (completed in 2022)

The scoping period is a formal opportunity for public input. We invited the public, tribal governments, and local, state, and federal agencies to comment on the range of alternatives, areas of impact, and possible mitigation measures that should be evaluated within the EIS.

A 30-day comment period was held from Monday, Nov. 7 to Friday, Dec. 9, 2022. The submitted comments provided valuable information about topics to consider in evaluating potential environmental impacts. Many of these topics will be considered as the EIS is drafted. We also received comments that are not applicable to the EIS analysis but are relevant to the flood plan itself, and those comments will be considered as part of plan development.

Review the King County Flood Plan Environmental Impact Statement (EIS) Scoping Summary (May 2023), (PDF, 190 KB)

More opportunities to comment on the EIS

King County will offer another formal opportunity for public input during the draft EIS review period. This is when comments are requested on the merits of the alternatives and the adequacy of environmental analysis. Tentative timing is fall 2023.

Past flood plans

The most recent flood plan was completed in 2006 and adopted by King County Council in January 2007. The flood plan was last updated in 2013 and adopted by King County Council with the passage of Ordinance No. 2013-0419.

Download the 2006 flood plan and 2013 flood plan update. These reports are provided in Adobe Acrobat .pdf format.

2006 King County Flood Hazard Management Plan (16.6 MB)

2013 King County Flood Hazard Management Plan Update and Progress Report (4 MB)

Printed copies of the 2006 flood plan and 2013 flood plan update are available at the following King County libraries:

- Auburn Library
- Bellevue Regional Library
- Bothell Regional Library
- Carnation Library
- Duvall Library
- Fairwood Library
- Fall City Library
- Issaquah Library
- Kent Library
- Maple Valley Library
- Muckleshoot Library
- North Bend Library
- Redmond Regional Library
- Skykomish Library
- Snoqualmie Library
- Tukwila Library

King County Flood Management Plan Online Engagement Hub (CRS Step 2.d.)

2024 King County Flood Management Plan

Flooding happens in King County. Flood risks are managed through the King County Flood Management Plan. Lets plan for the future together. **Complete a survey to share your ideas on how to build a flood resilient future.** You can also use this site to learn about flooding in King County and resources available to reduce flood risks.

Interpretation and translation services are available to you at no cost. If you need them, please contact us at 206-263-2677.

English | Español | Tiếng Việt | Soomaali | 한국어 | Русский язык | 繁體中文 | Kiswahili | Français | Mandi'nka kango | ខ្មែរ

Community flood planning survey

You don't need to be an expert in flooding to provide valuable input. Your responses to the following questions will help shape the priorities in the next flood plan. This survey will...

View Results

Let's plan for flood resilience together

Flooding is our region's most common natural disaster and is a part of life in King County. Flooding can be devastating to neighborhoods. Floods damage homes, destroy personal property and put lives at risk. Floods also affect access to jobs, stores and schools and can damage community open spaces. Flooding is likely to get more frequent and severe with climate change.

Natural disasters affect people differently, with some having a harder time recovering, or perhaps not recovering at all. Building flood resilience means that we are increasing the ability for people and communities to recover quickly from whatever impacts flooding brings to our doorsteps. Flooding will never disappear in King County, but being prepared can reduce the risks for communities, families, and individuals.

The flood plan guides how we manage flood risks and how the benefits of our efforts are distributed across the county. Information on this site is organized into five sections:

- Flooding and building flood resilience - background information and resources
- Planning for flood resilience - introduction to the plan, the process for updating the plan, and why the plan matters
- Share your thoughts - survey questions to inform the scope and actions identified in the plan
- Meetings and events - venues to learn about flooding and share your local insights
- What we've heard from you - a report on the feedback we've recieved so far

Sign up to receive email updates about the flood plan!

Snoqualmie River flooding near Duvall in December 2015.

Contacts

For general information or assistance with questions about flooding, please contact:

King County River and Floodplain Management Section

206-477-4812

For questions about the flood plan update, please contact:

Jason Wilkinson

Project Manager

206-477-4786

Jason.Wilkinson@kingcounty.gov

For questions about flood plan community engagement opportunities or how to submit comments, please contact:

Chrys Bertolotto

Flood Plan Community Engagement Coordinator

206-263-2677

cbertolotto@kingcounty.gov

King County Flood Management Plan Online Survey – Phase 1[2] (CRS Step 2.d.)

You don't need to be an expert in flooding to provide valuable input about how King County should manage flood risks. Your responses to the following questions will help inform the next flood plan. What needs does your community have when it floods? What types of services would be most useful to reduce flood risks? How should King County plan for future climate impacts? We value your responses and encourage you to bring forward new ideas!

Thank you for taking the time to complete this 10 - 15 minute survey! Responses for all but the last question are visible to the public.

1. How has flooding impacted you? (Select all that apply):
   A. Flooding has damaged my home or homes in my community.
   B. Flooding has damaged my business or businesses in my community.
   C. My community has experienced flooded roads that has made it challenging or impossible to get to needed destinations.
   D. Flooding forced me to temporarily move from my home.
   E. Flooding forced me to permanently leave my home.
   F. I or people I know in my community have experienced physical danger due to flooding.
   G. Flooding has not impacted me.
   H. Other (please describe):

2. What is your current level of concern about flooding? (pick one – not all concerned, moderately concerned, very concerned)

3. Select the two sources of flooding that are of greatest concern to you:
   A. I am not concerned about flooding.
   B. Large rivers (Cedar, Duwamish, Green, Sammamish, Snoqualmie, South Fork Skykomish, White)
   C. Rivers, creeks, and streams not mentioned above
   D. Puget Sound coastlines (high tides and sea level rise)
   E. Stormwater (surface water) runoff
   F. Lakes
   G. Other (please describe):

4. There are many ways King County currently works to reduce flood risk. Please select the ways you are aware of:
   A. Provide information to help residents prepare and protect themselves from flooding.
   B. Communicate flooding conditions through flood alerts, flood apps and the Flood Warning Center.
   C. Buy properties that are at high flood risk from willing and eligible landowners.

[2] These survey questions were posted on the online engagement hub (https://publicinput.com/s2727) from March – June 2023.

   D. Offer technical assistance or incentives for understanding flood risks, relocation, home elevation or other flood proofing actions.
   E. Track flood conditions and map changing flood and channel migration hazards.
   F. Maintain or repair levees and stabilize riverbanks to reduce flood risk.
   G. Limit new development in at-risk areas through land use regulations and permitting.
   H. Protect public infrastructure like roads, water treatment plants and underground utilities.

5. Please rank each item based on their level of importance in helping you prepare for, respond to and recover after a flood or reduce flood risks.
   A. Provide information to help residents prepare and protect themselves from flooding.
   B. Communicate flooding conditions through flood alerts, flood apps and the Flood Warning Center.
   C. Buy properties that are at high flood risk from willing and eligible landowners.
   D. Offer technical assistance or incentives for understanding flood risks, relocation, home elevation or other flood proofing.
   E. Track flood conditions and map changing flood and channel migration hazards.
   F. Maintain or repair levees and stabilize riverbanks to reduce flood risk.
   G. Limit new development in at-risk areas through land use regulations and permitting.
   H. Protect public infrastructure like roads, water treatment plants and underground utilities.

6. Please tell us what other activities or services would help you prepare for, respond to or recover from flooding or reduce flooding risks.

7. King County can improve flood resilience and deliver other community benefits. How would you rate the importance of the following community benefits?
   A. Distribute resources equitably across King County
   B. Protect and restore natural habitat
   C. Recover salmon and orca populations
   D. Support local farms
   E. Reduce flood risks and increase flood resilience
   F. Create and support local jobs
   G. Preserve natural lands and green spaces
   H. Improve water quality
   I. Provide access for recreation on or near water
   J. Keep roads and railways safe and accessible
   K. Provide opportunities to learn about the landscape and history of the area

8. What do you think are most important elements for a flood resilient future in King County?
   A. Plan for future impacts of climate change
   B. Reduce flood risks while delivering other community benefits (like the examples in question #7)
   C. Ensure equitable outcomes of flood risk reduction efforts across King County
   D. Consider flooding from all potential sources including rivers, streams, coastlines, stormwater, and lakes
   E. Identify measures to enhance natural ecosystem functions that also will reduce flooding

F. Identify ways for local governments to work together to help communities better prepare for, respond to, and recovery flood flooding
G. Get involved with community networks or planning with neighbors
H. Identify cost-effective, long-term solutions
I. Other (please describe): (Text box opens)

9. We want to make sure we are hearing from people through King County. Please provide your zip code to help us do that.

10. We want to make sure all people in King County are resilient in the face of natural disasters. To help us understand our communities better, please select all statements that apply to you. (*multiple choice optional question, make optional)*.
    a. I prefer not to answer.
    b. I identify as Black, Indigenous or Person of Color.
    c. I have a disability.
    d. I rent my place of residence.
    e. I am a caregiver of children under 5 or seniors 65 or over.
    f. I am 65 years or older.
    g. I speak a language other than English at home.
    h. I use SNAP food stamps or other income assistance programs.
    i. I do not have flood insurance and I know I live in a flood prone area.
    j. I was born in another country.
    k. I do not have health insurance.
    l. My highest level of education is high school or less.
    m. I identify as a female.

Thank you for taking the time to complete this survey! If you would like to sign up to receive email notifications related to the flood plan, please sign up here.

King County Flood Management Plan Online Survey – Phase 1[3] (CRS Step 2.d.)

You don't need to be an expert in flooding to provide valuable input. Your responses to the following questions will help shape the priorities in the next flood plan.
This survey will take **approximately 10 minutes** to complete and will be available until **October 1**. Survey results are anonymous and will be visible to the public. On write-in questions, you can opt to make your response private. Click "confirm" to save your response to each question.

Q1)
What factors are most important to you when considering the actions King County includes in its flood planning? **Select up to three (3)** options.

A. Reducing the risk of flooding or building community capacity for flood resilience and preparedness.
B. Cost of the project or action.
C. Provides benefits to historically underserved communities.
D. Provides other benefits for recreation, open space, habitat for fish and wildlife, water quality, or local jobs.
E. Community input on local flood risk reduction strategies and approaches.
F. Other (Please Specify)

Q2)

The following questions will help identify specific approaches to reduce flood risks or improve flood preparedness. The ideas presented do not include everything we've heard so far. They provide a sample of the types of suggestions we're hearing from communities.

Prevention helps keep flood problems from getting worse. Prevention measures include developing and enforcing land use regulations that prevent risky development. It can also include buying land and returning it to a natural state. This allows nature to help lessen the impacts of flooding.

Community members have shared the following ideas about prevention. **Select up to three (3)** ideas that are most important to you.

A. Adopt and enforce regulations to limit development in areas at risk of flooding.
B. Adopt regulations to disallow filling of wetlands in upper watershed areas.
C. Provide regulatory incentives to develop in areas at low risk of flooding or flood damage.
D. Identify and provide more ways for stormwater or overland runoff to soak into the ground.
E. Increase building elevation requirements in flood hazard areas.
F. I have another suggestion to prevent flood problems from getting worse. (Please Specify)

[3] These survey questions were posted on the online engagement hub (https://publicinput.com/s2727) from August - October 2023.

Q3)

Protecting property from flooding can include many activities to promote flood resilience. These are typically taken by property owners, renters, or local governments.

Community members have shared the following ideas about protecting property from flooding. **Select up to three (3)** ideas that are most important to you.

A. Offer technical assistance or reduce regulatory barriers to retrofit or elevate buildings.
B. Help property owners sell or move structures that are at risk of flooding.
C. Provide technical support to repurpose structures in at-risk areas to new uses that accommodate flooding.
D. Provide education to property owners and renters on the benefits of flood insurance.
E. Offer incentives to help property owners make changes to properties that have flooded many times.
F. I have another suggestion help protect properties from flooding. (Please Specify)

Q4)
Protecting natural resources and the environment allows floodplains and watersheds to store floodwater, improve water quality, and provide habitat for fish and wildlife.

Community members have shared the following ideas about protecting natural resources and the environment. **Select up to three (3)** ideas that are most important to you.

A. Work with communities and businesses in floodplains to protect or restore the environment.
B. Reconnect floodplains to help store and move floodwater and create habitat for fish.
C. Promote low-impact development and green infrastructure (like rain gardens). This slows runoff and helps protect aquatic habitat.
D. Protect upper watershed areas and preserve wetlands so water distributes slower downstream.
E. Find ways to incorporate natural elements into projects even in the most developed areas.
F. I have another suggestion related to protecting natural resources and the environment. (Please Specify)

Q5)

Emergency services support communities and limit impacts during urgent or life-threatening flooding.

Community members have shared the following ideas about emergency services. **Select up to three (3)** ideas that are most important to you.

A. Improve coordination between governments agencies during times of flooding.
B. Build capacity and support coordination between community organizations to respond to local emergencies.
C. Plan for sea level rise and emergency response in coastal areas.
D. Communicate flood evacuation routes and road closure information in real time.
E. Provide support to communities on short-term emergency response tools, like building preparedness kits.
F. I have another suggestion related to emergency services for flood events. (Please Specify)

Q6)

Structural projects are designed to contain, control, or divert the flow of water. They can prevent temporary flooding of certain areas of land.
Community members have shared the following ideas about structural projects. **Select up to three (3)** ideas that are most important to you.

A. Explore opportunities for more floodwater storage at existing dams.
B. Increase of the ability of culverts to pass more water.
C. Explore locations without any structural projects to identify if new structures may reduce flood risks.
D. Improve the flood resilience of major transportation routes.
E. Explore ways to improve existing drainage pumps and floodgates.
F. I have another suggestion related to structural projects to prevent temporary flooding. (Please Specify)

Q7)

Public information helps people learn how to protect people and property from flooding. It can also help people learn about the beneficial functions of floodplains.

Community members have shared the following ideas about public information. **Select up to three (3)** ideas that are most important to you.

A. Promote flooding and flood risk information to property owners, renters, and visitors.
B. Work with community and non-governmental organizations to share preparedness and emergency response messages and resources.
C. Develop materials and support services that are culturally and locally relevant and in more languages.
D. Disclose flood risks and ways to reduce those risks to people buying or renting property in flood-prone areas.
E. I have another suggestion related to public information. (Please Specify)

Q8)
Do you have specific projects, actions or locations that you feel should be included in the flood plan, not reflected above? If so, please describe them as completely as you can below.

Thank you for taking the time to complete this survey!

Sign up to receive email updates about the flood plan and find out about other ways to share your opinions.

King County Flood Management Plan Bus and Light Rail Advertisement (CRS Step 2.d.)

King County Flood Management Plan Bus and Light Rail Advertisement (CRS Step 2.d.)

King County Flood Management Plan Presentations to Community Groups and Associations (CRS Step 2.d.)

Venue	Date	Target Community / Location	Estimated Contacts
King County Frontline Resilient Task Force	11/2/2022	BIPOC / Countywide	15
Greater Unincorporated Maple Valley Community	3/6/2023	Maple Valley	14
City of Issaquah Park and Environmental Advisory Boards	3/16/2023	Issaquah	18
Snoqualmie Valley Recreation Coalition	3/21/2023	Recreation Interests / Snoqualmie	18
Fall City Community Association	4/4/2023	Fall City	50
Vashon Maury Island Community Council	4/20/2023	Vashon – Maury Island	70
Snoqualmie Valley Mobility Coalition	6/9/2023	Mobility-limited / Snoqualmie	25
Green River Coalition	6/12/2023	Maple Valley	6
Regional Alliance for Resilient and Equitable Transportation Coalition	5/24/2023	Mobility – limited / Countywide	34
Total Contacted			**250**

King County Flood Management Plan – Events for Tabling and Booths (CRS Step 2.d.)

Venue	Date	Target Community / Location	Estimated Contacts
Washington State Coalition of African Community Leaders Fifth Annual Summit	2/25/2023	African Immigrant and African American / Eastern King County	30
Kimball Creek Earth Day / Snoqualmie Tribe Event	4/22/2023	Native American and Youth / Snoqualmie	60
Asian Pacific Islander Heritage Celebration	5/6/2023	Asian American / Countywide	125
Indigenous People Festival	6/10/2023	Native American / Countywide	150
King County Fair	7/14/2023	South King County	60
Pacific Days	7/15/2023	BIPOC / South King County	63
Renton River Days	7/21/2023	BIPOC / Renton	174
Duwamish River Festival	8/5/2023	BIPOC / South Seattle	116
Fiesta Patrias Celebration	9/17/2023	Latino / Countywide	146
Marymoor at the Movies	8/9/2023	East King County	59
Skykomish Open Air Market	8/19/2023	Skykomish area	44
Maple Valley Emergency Preparedness Fair	9/30/2023	Maple Valley	86
Total Contacted			**1,113**

King County Flood Management Plan – News Release for Public Workshops (CRS Step 2.d.)

Newsroom

Natural Resources and Parks
Public Affairs

Help King County identify potential solutions for future flooding as the region prepares for climate impacts

February 6, 2023

With climate change increasing the potential for more frequent and severe flooding in the Pacific Northwest, King County seeks community input on solutions for coastal, tributary, and urban flooding problems. Input collected during online meetings this month will help identify strategies for the update to King County's Flood Management Plan.

King County will host three public meetings in February to inform its work to update its flood plan for the first time in a decade. Past flood plans focused on mainstem river flooding, and while rivers will continue to be a focus of the updated plan, the new plan will also explore urban, coastal, and tributary flooding. These flooding types are expected to occur more frequently due to climate change.

Similar workshops were held in January, and conversations will continue in February with three, topic-specific online meetings

- Tributary flooding on Wednesday, Feb. 8 from 10 a.m. to noon
- Coastal flooding on Wednesday, Feb. 15 from 10 a.m. to noon
- Urban flooding on Monday, Feb. 27 from 1 to 3 p.m.

King County's Water and Land Resources Division wants to hear from everyone who lives and works in areas – both urban and rural – who are at risk of flooding or have experienced impacts from flooding. In addition to reducing flood risk, the flood plan will help promote clean water, healthy habitat, improved recreation and open space, and sustainable agriculture, demonstrating the co-benefit approach of Clean Water Healthy Habitat.

These meetings are one of many ways the public can help shape the way King County will manage flooding in the future. Planning will continue throughout the year and will be submitted to the King County Council for its consideration in 2024.

Visit kingcounty.gov/FloodPlan for meeting details, and watch this video to learn more about King County's plan to create a flood-resilient future. For more information about the flood plan, contact Jason Wilkinson, project manager, via email at jason.wilkinson@kingcounty.gov or call 206-477-4786.

King County Flood Management Plan – Public Workshops, Meeting Agendas and Meeting Summaries (CRS Step 2.d.)

King County Flood Management Plan
Coastal Flooding Workshop #1 – Agenda
January 18, 2023| 2:00 – 4:00 p.m.

2:00 – 2:10 **Welcome and Introductions**

2:10 – 2:20 **Purpose and Context**

- Flood Management Plan process, scope, schedule
- Purpose and approach to workshops

2:20 – 2:50 **Coastal Flooding Problem Areas Mapping Exercise**

2:50 – 3:35 **Coastal Flooding Problem Identification Discussion**

- What is your/your organization's experience with these flooding problems?
- What are the impacts?
- What concerns do you have about this type of flooding in the future?
- Where are we most exposed to coastal flooding problems?
- What is the need for actions to address coastal flooding?

3:35 – 3:55 **Initial Brainstorm: Potential Solutions**

3:55 – 4:00 **Wrap-Up and Next Steps/Adjourn**

King County Flood Hazard Management Plan Update
Coastal Flooding Workshop #1 – Meeting Notes
January 18, 2023 | 2:00 p.m. – 4:00 p.m.

List of attendees:

Adam Bettcher (City of Seattle), Adrienne Hampton (Duwamish River Community Coalition), Ann Grodnik-Nagle (Seattle Public Utilities), Chris Ensor (resident), Dan Beckley (ESA), Dan Brubaker (King County), David Goldberg (City of Seattle), Grant Gutierrez (City of Seattle), Jason Wilkinson (King County), Joel Lehn (City of Seattle), Kayla Eicholtz (Washington Department of Ecology), Ken Zweig (King County), Kollin Higgins (King County), Laura Casey (resident), Laura Hendrix (King County), Laura Wolfe (Port of Seattle), Martha Neuman (Seattle Public Utilities), Matt Goehring (WRIA 9), Mike Tipton (City of Carnation), Mimi Reed (King County), Nancy Sackman (Duwamish Tribe), Spencer Easton (ESA), Steven Souriyadeth (City of Seattle), Stewart Reinbold

(Washington Department of Fish and Wildlife), T.J. McDonald (City of Seattle), Tom Dean (Vashon-Maury Island Land Trust)

Introductions

Spencer Easton began the workshop with an introduction to the Flood Plan update process and provided background on the purpose of the workshops. Spencer gave a brief tutorial on using the Mural software that would be used for engagement during the workshop. The Mural is available at: https://app.mural.co/t/esassoc5274/m/esassoc5274/1673824857021/01c7df23a9ed31af2e0fa6be11e4e1538a40e241?sender=u03b40326661c27e60b4b3436

Purpose and Context

Jason Wilkinson gave a presentation on the risks that flooding presents in King County, including impacts to property, infrastructure, and the economy. Jason described the ongoing process to update the 2006 and 2013 King County Flood Plans, which largely focused on flooding of major rivers. This update to the Flood Plan will expand upon the scopes of past Flood Plans to consider equity, climate change, and all sources of flooding, including tributary, coastal, and urban flooding. In response to questions about the opportunity to review the draft flood plan, Jason Wilkinson indicated that public comment will be a part of the draft flood plan and Draft Environmental Impact Statement, which are both intended to be made publicly available toward the end of 2023.

Map Exercise

Spencer Easton introduced an exercise in Mural, which provided an opportunity for participants to indicate on a map of King County where they had observed flooding and where they were concerned about future flooding. (See the end of this document for images from the map exercise and Mural input.) Participants provided descriptions of the areas they had marked on the map and descriptions of the flooding in those locations. Many of the flood occurrences identified on the map were in areas surrounding the Duwamish River, the east side of Vashon Island, and the along shoreline from West Seattle to Des Moines.

Commonly observed flood issues included:

- Flooding during king tide and high tide events, especially near tidally-influenced areas of rivers and streams
- Overtopping of roads that access beach properties, with occasional flood impacts to the waterfront properties/structures
- Overwhelmed sewer and stormwater systems in urbanized areas of the lower Duwamish, especially South Park and Georgetown

Concerns about future flood issues included:

- Impacts to coastal railroad infrastructure from sea level rise
- Flood impacts in the SODO neighborhood
- Worsening flood impacts to the built environment along the lower Duwamish River

- Compound flooding and related hazards are not well understood and can be difficult to assess. For example, sea level rise's impact on coastal erosion, which could trigger landslides, is not considered when identifying landslide risk areas

Problem Identification

Spencer Easton encouraged participants to further discuss the flood issues that they had identified on the map of King County.

There was substantial discussion of flood issues on the Duwamish River, including details of recent flood impacts to the South Park neighborhood during a king tide event. Coastal flooding in South Park was described as a recurring issue over the years, with sewer backup issues and contaminated floodwaters from the combined sewer overflow system being highlighted as notable flood impacts to public health and homes in the neighborhood. It was reported that flood response personnel lacked informational materials in languages commonly spoken in the South Park neighborhood, other than English.

Questions were raised about King County's ability to address compound flood impacts, such as when a king tide under sea level rise conditions affects a neighborhood with a combined sewer overflow. Jason Wilkinson indicated that the models currently used for projecting flood impacts on the west coast are not capable of assessing compound issues. Other King County staff indicated that models that are intended to be developed in the future should be able to assess compound flooding issues.

Flood impacts to Vashon Island were discussed as a difficult issue to fully grasp. Models exist that show the flooded areas, but it was noted that much of the flooded area on the island is private property—the extent of impacts cannot be observed by King County or other agency personnel, and property owners don't always report flooding. Landslides were noted as a major issue that often occurs around flood events on Vashon Island, being exacerbated by extreme precipitation. For Vashon Island, landslides were described as a more significant hazard than flooding due to the potential for significant damage, while flooding has historically caused minor impacts, such as overtopping roads. The steep terrain on Vashon and landslide risks were identified as an obstacle to adapting waterfront properties to climate change, as setting homes further back from shorelines could put them at greater risk from landslides. Roads becoming impassable due to overtopping was also noted. Some residents on Vashon Island have armored the shoreline, which reduces erosion, but does not prevent flooding. The issue of flood impacts worsening to waterfront homes was also highlighted as an issue in Des Moines, Federal Way, Normandy Park, and West Seattle.

The Port of Seattle described their facilities as being mostly resilient to current flooding, with most of their facilities being set above base flood elevation. A small number of facilities have been indicated as vulnerable based on projected future base flood elevations, and work is being pursued to address long-term solutions at those properties.

Other flood impacts in vulnerable areas, mostly near the Duwamish River, that were described included:

- Mental health impacts of displacement, property loss, and relocation

- Challenges to renters getting support, compared with homeowners
- Deficiencies in coordinated flood response from public agencies and a lack of state and federal resources for public agencies to support responses in localized emergencies
- Impacts to the economy from flooding in industrial areas
- Public health impacts from exposure to contaminated floodwater and wastewater

Jason Wilkinson indicated that there is a role for the plan to address the issues discussed, identify needs for preparation, response, and recovery planning, and articulate how best to address these issues in the future.

Solutions

Spencer Easton prompted the participants to review what others had written in Mural about problems and solutions to guide further discussion.

Some of the solutions that were mentioned or added to the Mural included:

- Code amendments that account for sea level rise and address issues at waterfront properties, such as allowing for homes that cannot be moved or elevated to be rebuilt with flood resilient materials and utilities elevated above base flood elevation, which allows structures to be inundated without being damaged (also referred to as wet floodproofing)
- Nature-based solutions for mitigating flooding and improving habitat
- Upgrading sewer and stormwater infrastructure to be flood resilient
- Funding to support home buyouts, elevations, and relocations in coastal areas
- Increasing equity and social justice focus in flood response, such as providing translated support materials, culturally appropriate relief services, and coordination with community partners
- Managed retreat and home buyout mechanisms that support affordable relocation and renters

Follow-up discussion on recent flooding focused on the responsibilities of the government to the people impacted by flood events. Having pre-positioned resources in place to support vulnerable communities with recurring flood issues was noted as one solution. There was broader discussion about a need for systemic change in the way counties and cities respond, such as increasing flexibility to accommodate the specific needs of impacted communities.

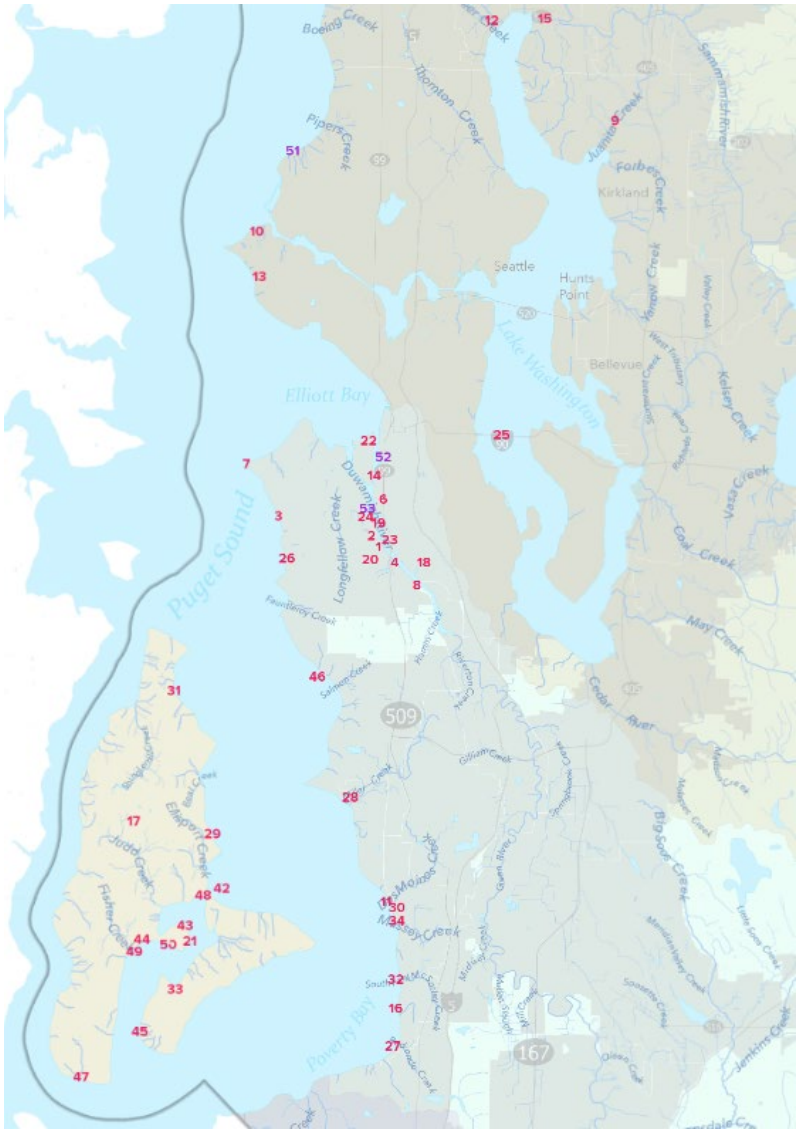
In reviewing solutions that were added to the Mural, some concerns were expressed about raising homes in flood hazard areas and adding new shoreline armoring infrastructure.

Next Steps

Spencer Easton noted that there is an urban flooding workshop scheduled for February 1st, 2023, as well as follow-up workshops for tributaries and coastal flooding that will focus more on solutions.

Mural Map Exercise and Solutions Brainstorm

Mapping exercise: Red numbers reflect observed flood issues and purple number reflect potential future flood issues.



King County Flood Management Plan
Coastal Flooding Workshop #2 – Agenda
February 15, 2023| 10:00 a.m. – 12:00 p.m.

10:00 – 10:10 **Welcome and Introductions**

10:10 – 10:20 **Purpose and Context**

- Flood Management Plan process, scope, schedule
- Purpose and approach to workshops
- Brief summary of Workshop #1

10:20 – 10:30 **Problem Areas**

- Opportunity to revisit/add to discussion of problem areas from Workshop #1

10:30 – 11:30 **Potential Solutions**

- Discuss pros and cons and considerations of various solutions brainstormed at Workshop #1
- Identify additional potential solutions

11:30 – 11:50 **Solutions Mapping Exercise**

11:50 – 12:00 **Wrap-up and Next Steps/Adjourn**

King County Flood Hazard Management Plan Update
Coastal Flooding Workshop #2 – Meeting Notes
February 15, 2023 | 10:00 a.m. – 12:00 p.m.

List of attendees:

Adam Bettcher (City of Seattle), Angela Donaldson (resident), Ann (resident), Ann Grodnik-Nagle (Seattle Public Utilities), Carolyn Carnahan (resident), Chris Ensor (resident), Dan Beckley (ESA), Dan Brubaker (King County), David Goldberg (City of Seattle), Diane Hoyer (resident), Jackie Underberg (resident), Jason Wilkinson (King County), Joel Lehn (City of Seattle), John Klochak (King County), Jon Sloan (Port of Seattle), Kayla Eicholtz (Washington Department of Ecology), Ken Zweig (King County), Kollin Higgins (King County), Laura Casey (resident), Laura Hendrix (King County), Laura Wolfe (Port of Seattle), Lorin Reinelt (King County), Martha Neuman (Seattle Public Utilities), Mike S (resident), Molly Lawrence (resident), Spencer Easton (ESA), Steven Souriyadeth (City of Seattle), T.J. McDonald (City of Seattle), Tom Dean (Vashon-Maury Island Land Trust), Tyler Beekley (City of Des Moines)

Introductions

Spencer Easton began the workshop with an overview of the agenda. Spencer gave a brief tutorial on using the Mural software that would be used for engagement during the workshop. The Mural is available at: https://app.mural.co/t/esassoc5274/m/esassoc5274/1673824857021/01c7df23a9ed31af2e0fa6be11e4e1538a40e241?sender=u03b40326661c27e60b4b3436

Purpose and Context

Jason Wilkinson provided an overview of the role of the flood plan and the schedule for updating the flood plan. Participants asked how the flood plan will be used and what implementation of the plan would entail. Jason explained that the flood plan provides a policy framework for King County flood hazard management and it contains an action plan that spans capital and non-capital initiatives. The Flood Control District is a separate entity from King County and the updated flood plan will not direct their work, but the Flood Control District could consider adopting this plan or use it to inform their work.

Problem Areas

Spencer Easton provided a summary of Coastal Flooding Workshop #1 and identified the flood topics that were discussed in the workshop, which included:

- Impacts of flood events that occurred in December 2022
- Flooding during king tide and high tide events
- Overtopping of roads that access beach properties
- Overwhelmed sewer and stormwater systems in urbanized areas
- Flood impacts to public health
- Concerns about future flood issues for coastal railroad infrastructure and effects of compound flooding

Based on input about potential solutions brainstormed by participants in the first workshop, Spencer outlined eight types of solutions, as well as examples of each solution category. The categories were:

- Managed retreat
- Floodproofing and elevations
- Equity-centered actions
- Multi-benefit projects and restoration
- Flood risk reduction infrastructure
- Stormwater management
- Programmatic actions
- Education and outreach

Participants discussed the need for better communication and transparency regarding flood risks to properties amongst mortgage lenders, realtors, insurance agents, and prospective property owners. There was discussion of the importance of communicating flood risk to

properties as a spectrum, as properties outside of a Special Flood Hazard Area can still be impacted.

Potential Solutions

Spencer Easton prompted participants to input their ideas for potential solutions under the appropriate categories in Mural, as well as to share input on considerations, pros, and cons for those solutions.

Discussion of managed retreat solutions included:

- Efficacy of single home buyouts vs. entire streets or neighborhoods
- Identifying high-risk neighborhoods where managed retreat may be preferred or necessary
- King County's limited ability to pay more than appraised value for property
- King County and other entities' ability to pay relocation assistance in addition to buyouts
- Developing a list of acceptable mitigation options with affected communities
- Studying best practices from other states or coastal flood areas
- Recognition of the higher complexity of relocating businesses affected by coastal flooding, including water-dependent uses

Discussion of floodproofing and elevations included:

- Challenges of moving or retrofitting septic systems for elevated buildings
- Continued risk of landslides or earthquake risk for elevated buildings, especially on Vashon Island
- Challenges of floodproofing, elevating homes, and retrofits due to shoreline codes or flood hazard area designations
- Limitations of FEMA-approved floodproofing options
- Limitations of wet floodproofing for residential properties; benefits of wet floodproofing for commercial properties
- Need for flood resilience solutions to be in alignment with the Shoreline Master Plan and to be coordinated with the Department of Local Services

Discussion of programmatic action solutions included:

- Incorporating language in the flood plan to increase competitiveness for grants, including new Community Disaster Resilience Zone funding from FEMA
- Challenges to home elevations or relocations from increasing regulatory standards
- Relief from regulatory standards for flood resilience improvements
- Landslide risk assessment mapping

One participant asked about the timeline for sea level rise impacts to coastal properties and whether there will be large areas flooded that were previously unaffected or if the severity of flooding would mostly increase in areas that are already at risk. Multiple King County staff spoke to the County's efforts to model for sea level rise and coastal flooding impacts using the USGS's Coastal Storm Modeling System (CoSMoS). The CoSMoS modelling is not projected to be

completed until after the flood plan, so the flood plan will need to draw references to new information such as this as best available science for guiding implementation.

Discussion of flood risk reduction infrastructure solutions included:

- Building a levee or berm in the South Park neighborhood
- Challenges to building a new levee and alternatives for extending or adapting existing levees
- Need to align infrastructure programs with WRIA priorities

Discussion of equity-centered action solutions included:

- Prioritizing outreach to communities that have faced harm in the past
- Engaging communities most vulnerable to future risks
- Providing culturally-appropriate resources to communities

Other topics that were discussed included:

- Coordination between ecological restoration and flood protection efforts
- Retrofitting stormwater management infrastructure at existing developments
- Encouraging the purchase of flood insurance
- Education of mortgage lenders, realtors, and insurance agents about flood risks

Solutions Mapping Exercise

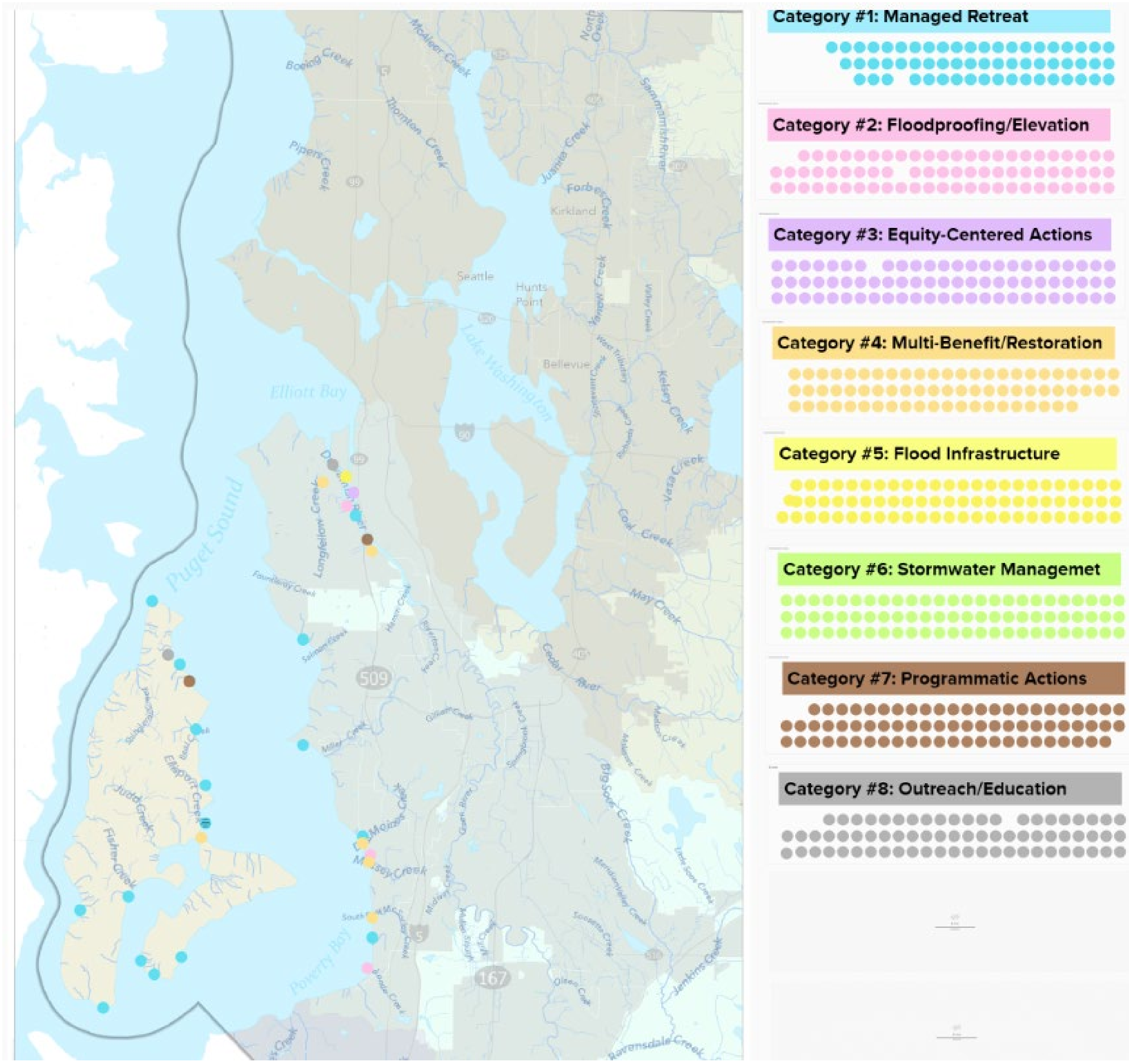
Spencer Easton prompted participants to mark locations on a King County map in Mural, showing where they think different types of solutions may help to address flood issues. An image of the map is below.

Next steps

Spencer Easton detailed upcoming participation opportunities and that the public will have an opportunity to comment on the draft flood plan in late 2023.

Mural Input

Participants marked locations on this map of King County with dots corresponding to the color of the solution type they suggested.


Category #1: Managed Retreat
Category #2: Floodproofing/Elevation
Category #3: Equity-Centered Actions
Category #4: Multi-Benefit/Restoration
Category #5: Flood Infrastructure
Category #6: Stormwater Managemet
Category #7: Programmatic Actions
Category #8: Outreach/Education
Puget Sound
Elliott Bay
Seattle
Bellevue
Kirkland
Hunts Point

King County Flood Management Plan
Tributary Flooding Workshop #1 – Agenda
January 12, 2023| 2:00 – 4:00 p.m.

2:00 – 2:10 **Welcome and Introductions**

2:10 – 2:20 **Purpose and Context**

- Flood Management Plan process, scope, schedule
- Purpose and approach to workshops

2:20 – 2:50 **Tributary Flooding Problem Areas Mapping Exercise**

2:50 – 3:35 **Tributary Flooding Problem Identification Discussion**

- What is your/your organization's experience with these flooding problems?
- What are the impacts?
- What concerns do you have about this type of flooding in the future?
- Where are we most exposed to tributary flooding problems?
- What is the need for actions to address tributary flooding?

3:35 – 3:55 **Initial Brainstorm: Potential Solutions**

3:55 – 4:00 **Wrap-Up and Next Steps/Adjourn**

King County Flood Hazard Management Plan Update
Tributary Flooding Workshop #1 – Meeting Notes
January 12, 2023 | 2:00 p.m. – 4:00 p.m.

List of attendees:

Adam Bettcher (City of Seattle), Brandon Pitts (resident), Eric Palmer (City of Enumclaw), Ginny Marsh (resident), Chris Hilton (Seattle Public Utilities), Jackie Underberg (resident), Janet Geer (City of Bothell), Joe Farah (City of Renton), Joel Lehn (City of Seattle), Eric Beach (King County), Erin Ericson (Snoqualmie Valley Watershed Improvement District), John Edgerly (Seattle Public Utilities), Kate Ryan (People to Preserve the Tualco Valley), Kayla Eicholtz (Washington Department of Ecology), Laura Casey (resident), Lauren Silver (Snoqualmie Valley Preservation Alliance), Lisa Nelson (Washington Department of Ecology), Lou Beck (King County), Martha Neuman (Seattle Public Utilities), Matt Baerwalde (Snoqualmie Indian Tribe), Mike Tipton (City of Carnation), Peter Lamanna (Washington Sensible Shorelines Association), Regina Fletcher (Snoqualmie Valley Preservation Alliance), Sherry Edquid (City of Tukwila), Shawn Gilbertson (City of Kent), Steven Souriyadeth (City of Seattle), Stewart Reinbold (Washington Department of Fish and Wildlife), Tyler Beekley (City of Des Moines), Karl Burton (Seattle Public Utilities), Iris Kemp (King County), Jamie Brakken (Washington Sensible Shorelines Association), Helen

Westphal (Seattle Public Utilities), David Goldberg (City of Seattle), Stephanie Sullivan (City of Sammamish), Virginia Russell (resident), Jason Wilkinson (King County), Spencer Easton (ESA), Dan Beckley (ESA)

Introductions

Spencer Easton began the workshop with an introduction to the Flood Plan update process and provided background on the purpose of the workshops. Spencer gave a brief tutorial on using the Mural software that would be used for engagement during the workshop. The Mural is available at: https://app.mural.co/t/esassoc5274/m/esassoc5274/1672179394520/cbf44fcb28191693620548412a90ed187d736f47?sender=u03b40326661c27e60b4b3436

Purpose and Context

Jason Wilkinson gave a presentation on the risks that flooding presents in King County, including impacts to property, infrastructure, and the economy. Jason described the ongoing process to update the 2006 and 2013 King County Flood Plans, which had largely focused on flooding of major rivers. This update to the Flood Plan would expand upon the scopes of past Flood Plans to consider equity, climate change, and all sources of flooding, including tributary, coastal, and urban flooding.

Map Exercise

Spencer Easton introduced an exercise in Mural, which provided an opportunity for participants to indicate on a map of King County where they had observed flooding and provide descriptions of the observed flooding. (See the end of this document for images of the map and input from Mural.) Many of the identified flood areas were in areas surrounding Lake Sammamish, lower sections of the Snoqualmie River Basin, and in the Duwamish River Basin near the City of Kent.

Commonly observed flood issues included:

- Sediment transport and aggradation, including resulting environmental impacts.
    - Alluvial fans were identified as an issue in tributaries flowing into Lake Sammamish and in the Snoqualmie River Basin, being described as contributing to flooding that impacts private property and an issue that is challenging to respond to, especially in priority fish habitat areas. Stormwater management officials noted there are challenges to returning tributaries to original channels when they avulse due to sediment buildup.
- Inundation of roads, especially in the Snoqualmie River Basin.
- Flooding on private properties or obstacles to implementing solutions, as well as challenges identifying the appropriate King County agencies/resources for property owner support.
    - King County Stormwater Services responds to drainage concerns with inspections and makes efforts to reroute the issue to the proper authority, but if there is not a King County program for an issue on private property, the County may not be able to address the problem directly.

- Inadequacy of flood and stormwater management infrastructure to handle flood volumes.
- Beaver activity was identified as a topic that should be discussed because beavers can create long-term changes to flooding patterns, although beaver activity is not always an issue.

Potential future flood problems that were identified included:

- Avulsion issues on tributaries of Snoqualmie River.
- Fish passage issues on Skunk Creek and the need to daylight streams on a tributary off Kimball Creek near the Snoqualmie Reservation were noted, also referencing flood impacts from the small capacity of pipes and culverts.
- General concerns about balancing fish habitat needs with flood and sediment management issues into the future were referenced throughout the discussion.
- Inadequacy of floodwater storage in wetlands and tributaries.
- General concerns about Lake Sammamish as a receiving water body for a large drainage area.

Problem Identification

After participants marked observed and potential future flood risks on the King County map, further discussion and analysis of these flood risks was opened to the participants.

Discussion of flood problems included:

- Multiple people expressed an interest in performing more dredging or making sediment removal an easier process to permit, indicating that the obstacles to permitting sediment removal can exacerbate flooding, and sediment buildup can overwhelm drainage infrastructure.
    - Tributaries in Renton, near Lake Sammamish, and in the Snoqualmie River Basin were discussed as areas with sediment aggradation issues where there is an interest in pursuing dredging or other resolutions.
    - Jason Wilkinson indicated that dredging and sediment management is a topic that will be discussed further as the Flood Plan moves forward.
- Piped streams and other infrastructure for managing water resources were identified as being outdated or having insufficient capacity for flooding.
- The relicensing process at Tolt Dam was suggested as a potential opportunity for aligning the Flood Plan with planning activities at dams, with the intent to increase floodwater storage in upper watersheds.
- Private property flooding and sediment aggradation, suggested to be the result of alluvial fans, were identified as issues at Lake Sammamish. There was additional discussion about issues of drainage and runoff into Lake Sammamish.

Solutions

Participants were given the opportunity to have an unstructured conversation on solutions that could be considered for the identified flood problems. The discussion of solutions included:

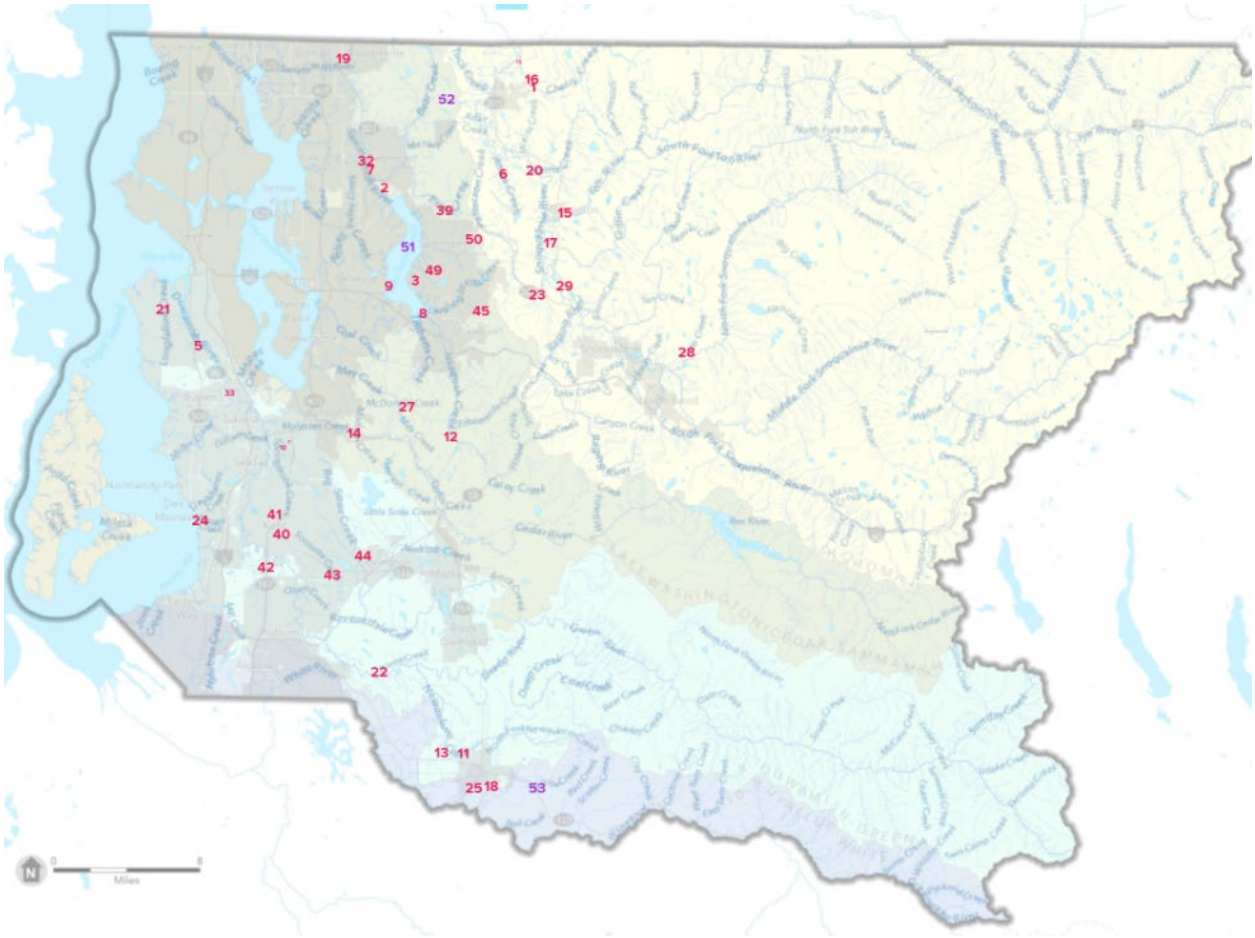
- In a follow-up on the topic of alluvial fans and dredging, it was noted that dredging permits are granted each year by the Washington Department of Fish and Wildlife, including for alluvial fan areas, but part of the understanding of providing dredging permits is that they are part of a larger improvement project that would not require dredging as an ongoing maintenance activity. Otherwise, fish stocks are negatively impacted. Past discussions between King County and the Department of Fish and Wildlife about current dredging projects have involved looking for solutions to avoid future dredging and support fish resources.
    - In response, there was a suggestion to establish a mechanism for responding to flooding and sedimentation issues in a time frame that is shorter than what is typical for permitting dredging in order to address emerging issues. Restoration projects combined with dredging projects require a longer timeline for implementation. Increased funding for stormwater services was also suggested.
- Updating or retrofitting stormwater and flood infrastructure to accommodate increased volumes during flood was identified as a solution by multiple people.
- A participant asked if the full scale of flood issues is understood by King County and if a risk assessment had been performed.
    - Jason Wilkinson noted that the flood plan will involve an updated understanding of risk, including a vulnerability assessment using a common Federal Emergency Management Agency tool that quantifies potential impacts. That tool only covers areas that have been identified as special flood hazard areas, which do not cover all areas that are exposed to flooding.
- In response to concerns about increased runoff into Lake Sammamish, officials with knowledge of stormwater management issues noted that, while permitted developments need to mitigate runoff to meet local or state standards, older developments may not meet current standards and jurisdictions across the region do not coordinate on total allowable runoff into the lake.
    - Increasing capacity of stormwater storage in upper watershed areas through low impact development and improved stormwater infrastructure, especially at new developments, was suggested as a solution for the Lake Sammamish area.
    - Coordination across jurisdictions within basins to manage total runoff into a receiving water body was also discussed.
- Increasing regulations around development in flood hazard areas and regulating activities around alluvial fans was discussed.
- Acquisition of properties in the floodplain, including repetitive loss properties, and implementing flood management projects was suggested.

Wrap-up and Next Steps

Jason Wilkinson stated that all comments are being considered for the Flood Plan and, while participants may not receive individual responses, the intent is to explain how comments are being addressed. Spencer Easton noted that there are coastal and urban flooding workshops scheduled for the near future.

Mural Input: Map Exercise and Solutions Brainstorm

Mapping exercise: Red numbers reflect observed flood issues and purple number reflect potential future flood issues.



King County Flood Management Plan
Tributary Flooding Workshop #2 – Agenda
February 8, 2023| 10:00 a.m. – 12:00 p.m.

10:00 – 10:10 **Welcome and Introductions**

10:10 – 10:20 **Purpose and Context**

- Flood Management Plan process, scope, schedule
- Purpose and approach to workshops
- Brief summary of Workshop #1

10:20 – 10:30 **Problem Areas**

- Opportunity to revisit/add to discussion of problem areas from Workshop #1

10:30 – 11:30 **Potential Solutions**

- Discuss pros and cons and considerations of various solutions brainstormed at Workshop #1
- Identify additional potential solutions

11:30 – 11:50 **Solutions Mapping Exercise**

11:50 – 12:00 **Wrap-up and Next Steps/Adjourn**

King County Flood Hazard Management Plan Update
Tributary Flooding Workshop #2 – Meeting Notes
February 8, 2023 | 10:00 a.m. – 12:00 p.m.

List of Attendees:

Angela Donaldson (resident), Conner Board (King 5), Diane Hoyer (resident), Diane Pasta (resident), Eric Palmer (City of Enumclaw), Erin Ericson (Snoqualmie Valley Watershed Improvement District), Helen Westphal (Seattle Public Utilities), Iris Kemp (WRIA 9), Jackie Underberg (resident), John Edgerly (Seattle Public Utilities), Kayla Eicholtz (Washington Department of Ecology), Laura Casey (resident), Lauren Silver (Snoqualmie Valley Preservation Alliance), Laurie Lyford (Washington Sensible Shorelines Association), Liz Stockton (King Conservation District), Lou Beck (King County), Martha Neuman (Seattle Public Utilities), Mike Mactutis (City of Kent), Nancy Sackman (Duwamish Tribe), Patrick Haluptzok (resident), Peter Lamanna (Washington Sensible Shorelines Association), Regina Fletcher (Snoqualmie Valley Preservation Alliance), Reid Brockway (Sammamish Homeowners), Saffa Bardaro (King County), Sherry Edquid (City of Tukwila), Jason Wilkinson (King County), Spencer Easton (ESA), Dan Beckley (ESA)

Introductions

Spencer Easton introduced the Mural software, which would be used to collect input and map flood risk reduction solutions during the workshop. The Mural is available at: https://app.mural.co/t/esassoc5274/m/esassoc5274/1672179394520/cbf44fcb2819169362054 8412a90ed187d736f47?sender=u03b40326661c27e60b4b3436

Purpose and Context

Jason Wilkinson provided an overview of the Flood Plan update process, discussed the project timeline, and outlined how workshop input is used to develop the Flood Plan. A participant asked what guides the work of the King County Flood Control District if they do not adopt the updated Flood Plan. Jason indicated that the Flood Control District has looked to the 2006 King County Flood Plan for guidance and follows annual budgeting processes and capital investment strategies to determine what projects are implemented. Spencer Easton provided an overview of the Tributary Flooding Workshop #1, which included discussion of commonly observed flood

issues including sediment transport and aggradation, inundation of roads, flooding on private property, inadequate flood and stormwater management infrastructure, and beaver activity.

Problem Areas

Based on ideas about potential solutions brainstormed by participants in the first workshop, Spencer outlined eight types of solutions, as well as examples of each solution category. The categories were:

- Stormwater management
- Staying out of/moving out of hazard areas
- Channel conveyance
- Floodplain reconnection and restoration
- Infrastructure upgrades/management
- Education
- Studies and planning
- Programmatic actions

Multiple participants supported including a solution category for emergency management, with some discussion around the possibility of future engagement opportunities related to flood emergency management. Emergency management was included in the Mural as an independent category for solutions.

Other issue areas that were discussed included resources for unhoused populations in flood emergencies, damage that unhoused populations may cause to critical areas and restored floodplains by residing in them, potential vulnerability of infrastructure to vandalism, water quality issues related to flooding, and equity in areas with tributary flooding.

Potential Solutions

Spencer Easton prompted participants to input their ideas for potential solutions under the appropriate categories in Mural, as well as input on considerations, pros, and cons for solutions.

Discussion of stormwater management solutions included:

- Retrofitting existing development
- Low impact development techniques
- Increased capacity of stormwater infrastructure and King County Stormwater Services

Discussion of emergency management solutions included:

- Better defining King County's role in emergency response and raising public awareness of the County's role
- Support property owners with resources for on-site flood response action plans and other short-term response tools for property owners
- Increased training for emergency responders related to flooding and providing resources to impacted populations

Discussion of education solutions included:

- Coordination between urban and rural areas to learn more about how communities with different types of flood issues and environments address flooding
- Improve understanding of what role King County plays and what communities can do to seek short and long-term solutions to flooding
- Providing translated educational materials and emergency information

Discussion of solutions for staying out of/moving out of hazard areas included:

- Balancing equity considerations, cultural needs, and best uses of resource lands when considering relocation of floodplain inhabitants or acquisition of floodplain properties
- Acknowledgement of floodplain compatible land uses, including agriculture and golf courses
- Acquisition of properties, moving structures out of the floodplain, and elevating structures
- Increasing restrictions on development in the floodplain

Discussion of channel conveyance solutions included:

- Beaver management and potential landowner tools
- Impacts of private flood control infrastructure and changes in private flood control practices
- Volunteers and outreach to work with private property owners that manage drainage infrastructure
- Daylighting streams, improving fish passage, and expanding culvert capacity

Discussion of floodplain reconnection and restoration solutions included:

- Working with farmers to implement riparian buffers, native plantings, and flood resilience measures on agricultural land in the floodplains
- Implementing more setback levees
- Water quality monitoring
- Habitat restoration, wetland restoration and protection, and floodplain reconnection projects

There was limited discussion of other solutions topics, but Mural input included:

- Infrastructure (dam and upper watershed storage, road drainage, home elevations)
- Studies and planning (improved flood modelling, climate change projections in regulations, floodplain mapping and assessments)
- Programmatic actions (flexibility for urgent projects, technical assistance for sediment issues, increasing departmental resources, addressing criminal behavior that damages infrastructure)

Solutions Mapping Exercise

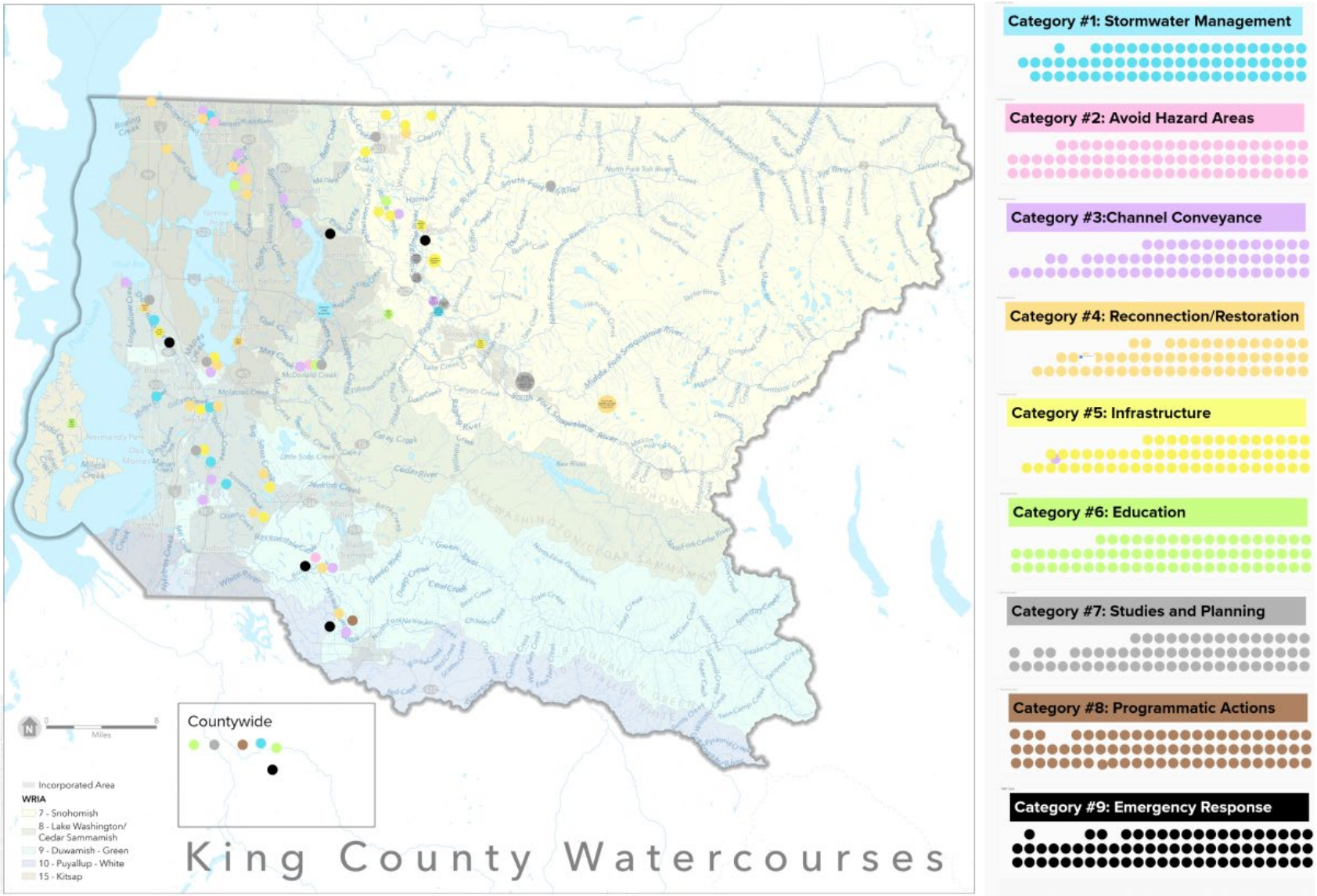
Spencer Easton prompted participants to mark locations on a King County map in Mural, showing where they think types of solutions may help to address flood issues. An image of the map is below.

Next steps

A participant asked if there would be other opportunities to provide input. Jason Wilkinson detailed that King County was developing a web-based engagement platform with a survey component that would be made public soon. King County also intends to host in-person public meetings and attend meetings hosted by community organizations for outreach. The public also can comment on the draft Flood Plan and Draft Environmental Impact Statement near the end of 2023.

Mural Input

Participants marked locations on this map of King County with dots corresponding to the color of the solution type they suggested.



King County Flood Management Plan
Urban Flooding Workshop #1 – Agenda
February 1, 2023| 10:00 a.m. – 12:00 p.m.

10:00 – 10:10 **Welcome and Introductions**

10:10 – 10:20 **Purpose and Context**

- Flood Management Plan process, scope, schedule
- Purpose and approach to workshops

10:20 – 10:50 **Urban Flooding Problem Areas Mapping Exercise**

10:50 – 11:35 **Urban Flooding Problem Identification Discussion**

- What is your/your organization's experience with these flooding problems?
- What are the impacts?
- What concerns do you have about this type of flooding in the future?
- Where are we most exposed to urban flooding problems?
- What is the need for actions to address urban flooding?

11:35 – 11:55 **Initial Brainstorm: Potential Solutions**

11:55 – 12:00 **Wrap-Up and Next Steps/Adjourn**

King County Flood Hazard Management Plan Update
Urban Flooding Workshop #1 – Meeting Notes
February 1, 2023 | 10:00 a.m. – 12:00 p.m.

List of attendees:

Adam Bettcher (City of Seattle), Chapin Pier (Seattle Public Utilities), Cheryl Paston (City of Bellevue), Diane Pasta (resident), Eric Palmer (City of Enumclaw), Grant Gutierrez (City of Seattle), Jamie Hearn (Duwamish River Community Coalition), Janet Geer (City of Bothell), Jenny Gaus (City of Kirkland), Joel Lehn (City of Seattle), Krista Camenzind (King County), Laura Wolfe (Port of Seattle), Laurie Lyford (Washington Sensible Shorelines Association), Leslie Webster (Seattle Public Utilities), Maggie Glowacki (City of Seattle), Martha Neuman (Seattle Public Utilities), Matt Baerwalde (Snoqualmie Tribe), Mike Mactutis (City of Kent), Mimi Reed (King County), Miranda Fix (resident), Molly Lawrence (resident), Nancy Sackman (Duwamish Tribe), Patrick Haluptzok (resident), Reid Brockway (Sammamish Homeowners), Russ Avery (City of Algona), Sherry Edquid (City of Tukwila), Stewart Reinbold (Washington Department of Fish and Wildlife), T.J. McDonald (King County), Troy Linnell (City of Algona), Lex Bumm (resident), Scott Sheffield (resident), Dan Beckley (ESA), Spencer Easton (ESA), Jason Wilkinson (King County)

Introductions

Spencer Easton began the workshop with an introduction to the Flood Plan update process and provided background on the purpose of the workshops. Spencer gave a brief tutorial on using the Mural software that would be used for engagement during the workshop. The Mural is available at:
https://app.mural.co/t/esassoc5274/m/esassoc5274/1674845179680/48aafa97c1c5e4608a4a4f6d60f6f18179a9850a?sender=u03b40326661c27e60b4b3436

Purpose and Context

Jason Wilkinson gave a brief presentation on the risks that flooding presents in King County, including impacts to property, infrastructure, and the economy. Jason described the ongoing process to update the 2006 and 2013 King County Flood Plans, which had largely focused on flooding of major rivers. This update to the Flood Plan will expand upon the scopes of past Flood Plans to consider equity, climate change, and all sources of flooding, including tributary, coastal, and urban flooding. This workshop is focused on urban flooding, such as shallow flooding with no defined channel, stormwater runoff, and flooding resulting from overwhelmed urban stormwater infrastructure.

Urban Flooding Problem Areas Map Exercise

Spencer Easton introduced an exercise in Mural, which provided an opportunity for participants to indicate on a map of King County where they had observed flooding and where they were concerned about future flooding. See the end of this document for images from the map exercise and Mural input.

Participants provided descriptions of the areas they had marked on the map and descriptions of the flooding in those locations. Many of the flood occurrences identified on the map were in areas surrounding the Duwamish River, Lake Sammamish, Kirkland, Bothell, and Snoqualmie, though many other issue areas were identified.

Commonly observed flood issues included:

- Tributaries in urban areas overtopping their banks, especially due to high volumes of stormwater runoff
- Large sediment loads overwhelming small streams and stormwater infrastructure
- Flooding and backups due to inadequate capacity of stormwater infrastructure, combined sewer overflows, and culverts
- Lack of natural drainage or floodwater storage capacity in urban areas
- Inundation of roads and related transportation impacts

Potential future flood problems that were identified included:

- Flooding in areas that have historically not flooded, including highly developed inland areas with significant impervious surface
- Worsening flood impacts to private property and related economic impacts

- Reduced effectiveness of pumping systems and increased inundation of low-lying areas due to sea level rise

Urban Flooding Problem Identification Discussion

Spencer Easton encouraged participants to further discuss the flood issues that they had identified on the map of King County.

There was discussion of flooding in urban tributaries and lakes near Kirkland and Bothell. Juanita Creek and other urban streams have experienced regularly occurring erosion and high streamflow events, driven by intense rain events and runoff. Structural impacts were noted as minimal, but development in areas near urban streams was described as driving these high runoff and high streamflow events. This discussion brought questions of how to address flood risks in areas that are not in a FEMA special flood hazard area.

Issues in the Snoqualmie Valley that were identified related to small stream flooding caused by backups from high streamflow in the South Fork Snoqualmie River. Opportunities to setback levees and reconnect floodplains were discussed as ways to increased floodplain capacity.

Stormwater infrastructure and runoff were discussed as issues in numerous cities, including Kent, Kirkland, and Enumclaw. Increasing culvert capacity to improve fish passage was discussed as potentially increasing downstream flooding through higher conveyance volumes. The need for additional funding and capacity to implement stormwater retrofits was discussed. Runoff from upper watershed areas was also discussed as being impactful to lower watershed stormwater infrastructure and tributaries. Runoff from higher elevations in Kent was described as overwhelming stormwater infrastructure in the valley with sediment, which is already strained due to high groundwater.

Flood impacts from beavers was identified as an issue in Algona, Kirkland, Bothell, Kent, Seattle, and Enumclaw.

Urban flooding was discussed as inundating roads and affecting private property areas in Seattle, Kent, Bothell, Duvall, Carnation, Sammamish, and Des Moines. In Seattle, portions of the stormwater system are private, such as some culvert mainlines, which prevents the city from retrofitting inadequate systems. Flooding was noted as especially impactful in extensive flat areas, which cannot be easily altered with capital projects. Pollution impacts from urban flooding were described as a concern, especially in the South Park neighborhood. Property damage and sewer overflows from flooding were described on Lake Sammamish.

In response to questions about the role of the King County Flood Control District, Jason Wilkinson clarified that the Flood Control District does use the 2006 Flood Plan for guidance and King County is coordinating with them to develop the updated Flood Plan, but that it is a County-led effort and the Flood Control District will not necessarily adopt the updated Flood Plan. Other participants noted that they would hope the Flood Control District would adopt the updated Flood Plan, but also recognized that coordinating projects across incorporated areas presents challenges.

Initial Brainstorm: Potential Solutions

Spencer Easton encouraged participants to share initial ideas about solutions to the flood issues they had identified. The solutions discussed included:

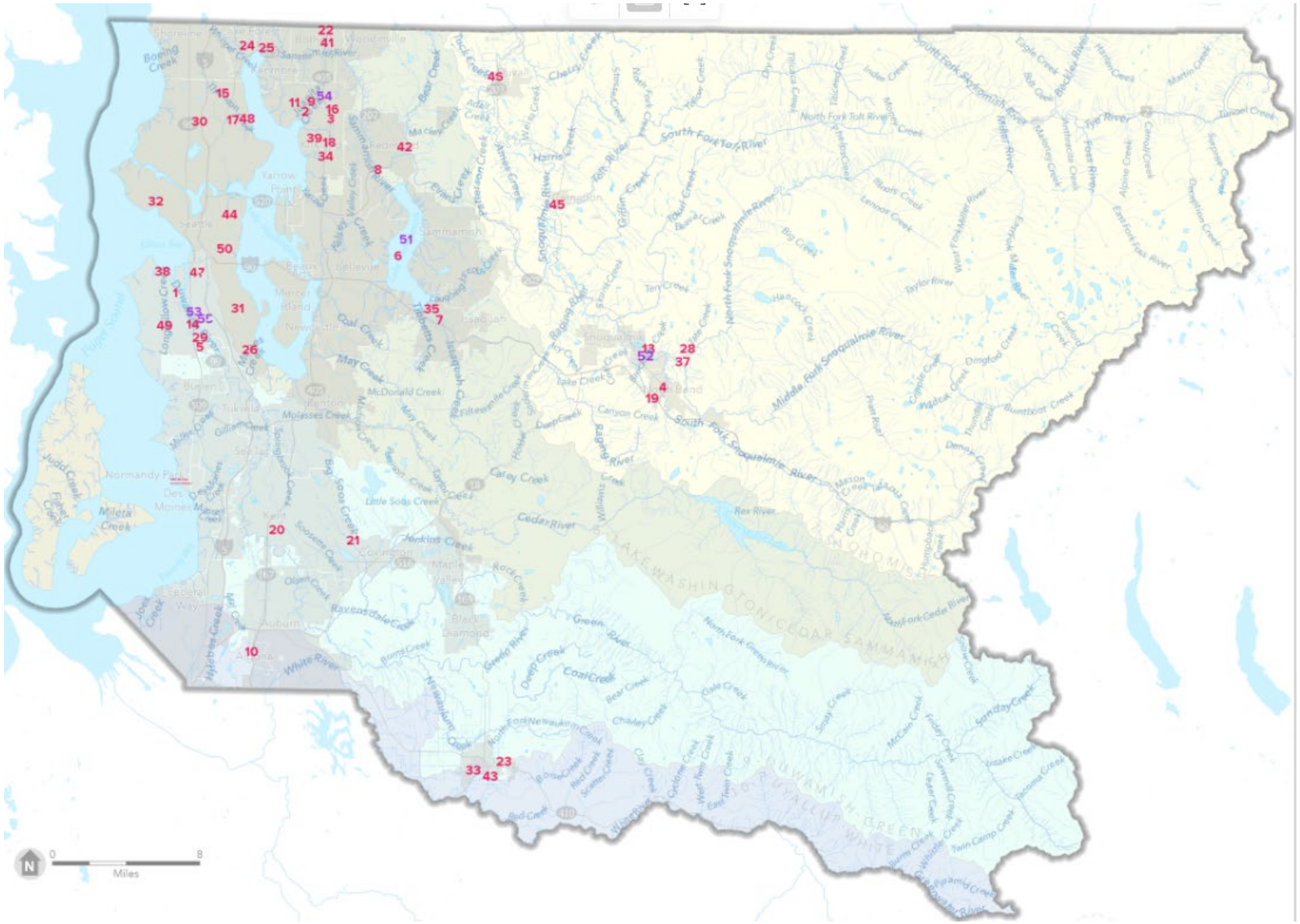
- Education, resources for homeowners, and improved outreach to the public to connect them with appropriate government services related to flood issues
- Nature-based solutions to increase resilience and floodwater storage capacity, such as swales along streets and incentives for low impact development
- Coordination across jurisdictions for improved basin-scale management, such as multiple cities adopting model stormwater management guidelines or planning cumulative allowable runoff into a drainage area
- Increased coordination between governments and community organizations to help community organizations pursue grants and implement small projects
- Improved beaver management strategies, such as temporary relocation for project implementation

Next Steps

Spencer Easton noted that there are upcoming workshops to discuss solutions for tributary, coastal, and urban flooding.

Mural Map Exercise and Solutions Brainstorm

Mapping exercise: Red numbers reflect observed flood issues and purple number reflect potential future flood issues.



King County Flood Management Plan
Urban Flooding Workshop #2 – Agenda
February 27, 2023| 1:00 – 3:00 p.m.

1:00 – 1:10 **Welcome and Introductions**

1:10 – 1:20 **Purpose and Context**

- Flood Management Plan process, scope, schedule
- Purpose and approach to workshops
- Brief summary of Workshop #1

1:20 – 1:30 **Problem Areas**

- Opportunity to revisit/add to discussion of problem areas from Workshop #1

1:30 – 2:30 **Potential Solutions**

- Discuss pros and cons and considerations of various solutions brainstormed at Workshop #1
- Identify additional potential solutions

2:30 – 2:50 **Solutions Mapping Exercise**

2:50 – 3:00 **Wrap-up and Next Steps/Adjourn**

King County Flood Hazard Management Plan Update
Urban Flooding Workshop #2 – Meeting Notes
February 27, 2023 | 1:00 p.m. – 3:00 p.m.

List of attendees:

Adam Bettcher (City of Seattle), Angela Donaldson (resident), Danielle Butsick (Port of Seattle), Janet Geer (City of Bothell), Jenny Gaus (City of Kirkland), Laurie Lyford (Washington Sensible Shorelines Association), Leslie Webster (Seattle Public Utilities), Martha Neuman (Seattle Public Utilities), Mike Mactutis (City of Kent), Nicole Smith (King County), Patrick Haluptzok (resident), Russ Avery (City of Algona), Sherry Edquid (City of Tukwila), T.J. McDonald (City of Seattle), Toby Coenen (City of Sammamish), Troy Linnell (City of Algona), Dan Beckley (ESA), Spencer Easton (ESA), Jason Wilkinson (King County)

Introductions

Spencer Easton began the workshop with an overview of the agenda. Spencer gave a brief tutorial on using the Mural software that would be used for engagement during the workshop. The Mural is available at: https://app.mural.co/t/esassoc5274/m/esassoc5274/1674845179680/48aafa97c1c5e4608a4a4f6d60f6f18179a9850a?sender=u03b40326661c27e60b4b3436

Purpose and Context

Jason Wilkinson provided an overview of the role of the flood plan and the schedule for updating the flood plan. Jason noted that engagement efforts would continue through 2023 and the public would have an opportunity to comment on the draft flood plan and draft Environmental Impact Statement in late 2023.

Problem Areas

Spencer Easton provided a summary of Urban Flooding Workshop #1, identifying flood topics that were discussed in the workshop, which included:

- Urban tributaries overtopping their banks, especially due to high levels of stormwater runoff
- Large sediment loads overwhelming small streams and stormwater infrastructure
- Inadequate capacity of stormwater infrastructure, combined sewer overflows, and culverts
- Flooding from beaver activity
- Lack of natural drainage or floodwater storage capacity in urban areas
- Inundation of roads and related transportation impacts
- Concerns about worsening impacts from higher volume precipitation and flooding in the future

Based on input on potential solutions brainstormed by participants in the first workshop, Spencer outlined seven categories of solutions, with example solutions. The categories were:

- Infrastructure and stormwater management
- Restoration, reconnection, and multiple benefit projects
- Beaver management
- Acquisition
- Regulations and incentives
- Maps, modeling, and planning
- Programmatic actions

Participants suggested separating multiple benefit projects into their own category. The framing of solutions in the Mural was updated to reflect this.

Spencer Easton prompted participants to review flood issues in the Mural that were identified in the first urban flooding workshop, asking if there were any other flood issues that had not been listed. Participants discussed a disconnect between FEMA flood programs and urban flooding issues, with urban flood areas often outside of FEMA-mapped floodplains and difficulties getting mitigation or recovery funding for urban floods. There was also discussion of sheet flow flooding in the Snoqualmie Valley, including in commercial areas upstream of the confluence of the South Fork and Middle Fork Snoqualmie and residential neighborhoods near downtown North Bend.

Potential Solutions

Spencer Easton prompted participants to input their ideas for potential solutions under the appropriate categories in Mural, as well as input on considerations, pros, and cons for solutions.

Discussion of infrastructure and stormwater management solutions included:

- Modelling to show increased frequency of flash flooding and sheet flow in urban areas
- Providing technical assistance and funding for updating infrastructure
- Encourage WSDOT to make more stormwater management improvements in urban areas
- Using a dynamic weir to actively manage Lake Sammamish water levels
- Concerns about permitting complexity, meeting regulatory requirements, cost, and upkeep requirements of expanded stormwater infrastructure
- Issues with the lack of flow control on stormwater infrastructure

Discussion of regulation and incentive solutions included:

- Information for homeowners about permitting requirements related to home resilience upgrades, and funding and technical assistance to support such work
- Relaxing regulatory standards for flood resilience upgrades to structures
- A program like CPACER that funds home improvements, where payment obligations follow the property, which would require state legislative or regulatory action
- Challenges to making retrofits in highly developed urban areas, such as Seattle

Discussion of acquisition solutions included:

- Preferences for seeing stormwater retrofits and resilience improvements over buyouts in areas that are not ecologically significant
- Cost challenges to buyouts in urban areas and other locations with expensive real estate
- Financial challenges and equity issues related to relocation after buyouts of low-income homes
- Concern about the use of condemnation of flood-prone properties and having standards in place to determine when condemnation of properties is acceptable

Discussion of restoration solutions included:

- Loss of space for restoration in urban areas due to increasing density in urban growth areas
- Benefits of using green infrastructure and corridor approaches to reduce flooding and risks
- Issues with restoration of urban areas requiring use of limited, expensive real estate
- Lack of funding for urban restoration and its high upfront costs, even though there are long-term benefits

Discussion of programmatic action solutions included:

- Outreach to lower watershed areas during permitting of development upstream

- Regional and cross-agency coordination for local emergency response
- Emergency response training and educational materials
- Engage communities about their needs with culturally-appropriate outreach

Other solution considerations and discussion topics included:

- Success with using a variety of funding sources for restoration and multiple benefit projects
- Need for better modelling of pluvial flooding
- Encourage beaver management in headwater areas
- Utilize Army Corps of Engineers design guidelines for multiple benefit projects

Solutions Mapping Exercise

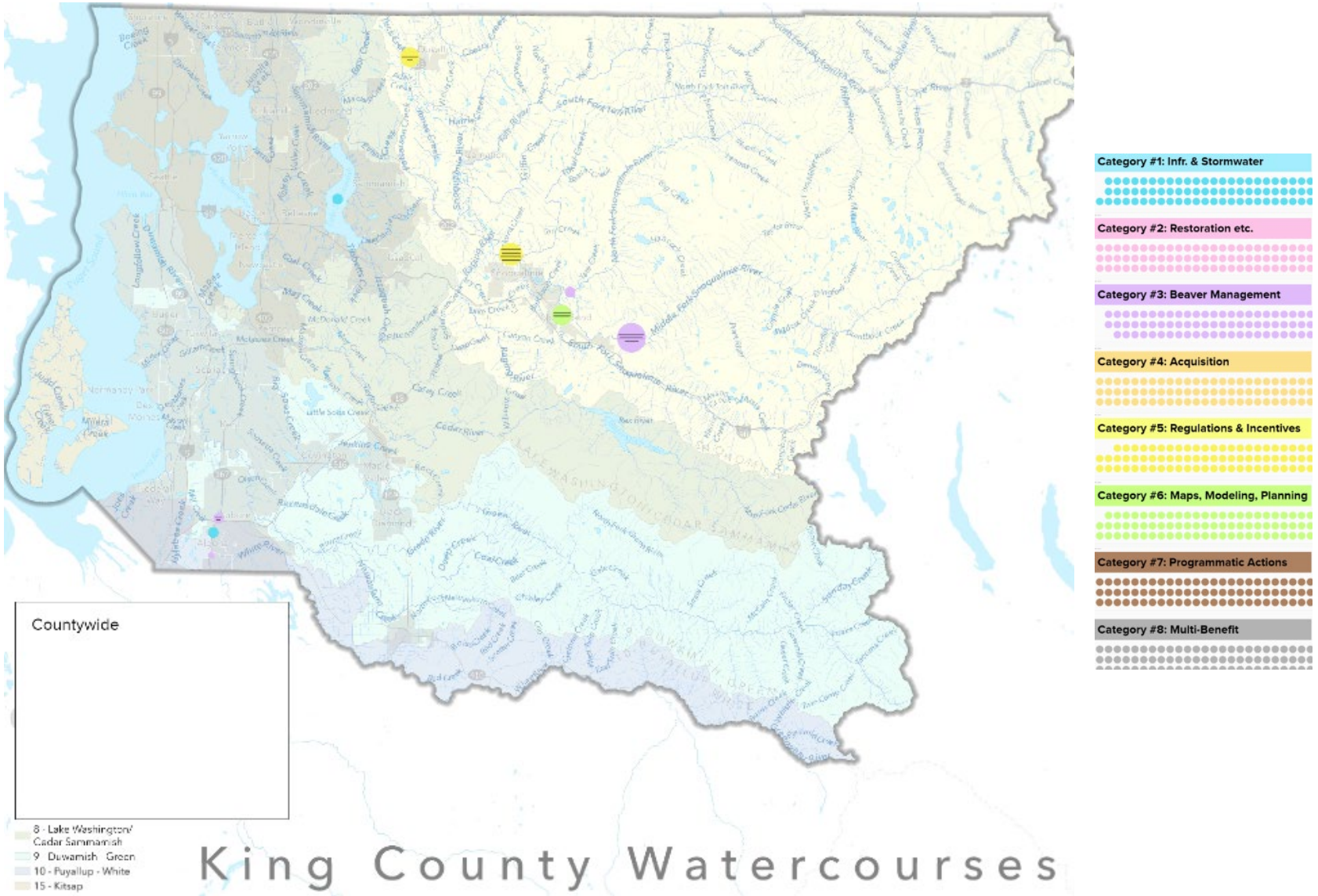
Spencer Easton prompted participants to mark locations on a King County map in Mural, showing where they think different types of solutions may help to address flood issues. An image of the map is below.

Next steps

Spencer Easton detailed how input from the topic-specific workshops would inform the description of flood impacts and the development of recommendations in the flood plan. The draft flood plan will be available for review and public comment in late 2023.

Mural Input

Participants marked locations on this map of King County with dots corresponding to the color of the solution type they suggested.



King County Flood Management Plan – Email Distributions to Flood Plan Distribution List (CRS Step 2.d.)

Kick-off meeting reflections + welcoming our Partner Planning Committee

King County, Washington sent this bulletin at 10/24/2022 05:50 PM PDT

Kick-off meeting recap

If you joined us earlier this month to kick-off the flood plan, thank you! We held two online meetings on October 4 and 6. With the help of guest speakers we shared information about flooding in King County and about the development of the next flood plan. More than 80 people participated across the two meetings. Meeting attendees shared how flooding affects them and ideas to help prepare for flooding or reduce flood risks. We gathered a lot of valuable feedback to shape the focus of the flood plan. Our staff is following up with folks who shared specific questions or comments in the meeting chat. Here is some of the collective feedback we heard:

- Interest in planning for climate change.
- Interest in Integrated Floodplain Management (IFM). Carol Macilroy, Carol Macilroy Consulting, and Brandon Parsons, American Rivers, introduced IFM in their presentations. IFM is a collaborative model designed to deliver more funding, more partners, more support, better results, and be a more efficient way to reduce flood risks.
- Need for solutions to stormwater, small stream, lakeshore, and coastal flooding.

- Interest in having flood risk reduction projects do more! Such as protecting and restoring habitat for fish and wildlife, supporting local agriculture, and improving water quality in streams, lakes, and Puget Sound.

Recordings from both meetings are available on the King County Flood Management Plan webpage. We invite you to watch and if you have feedback, please share it with Jason Wilkinson at Jason.Wilkinson@kingcounty.gov.

Couldn't make it to the kick-off meetings? King County is interested in coming to you. We welcome your suggestions for community events that we can attend to hear from you about flooding. Please contact Chrys Bertolotto at 206-263-2677 or cbertolotto@kingcounty.gov to discuss options.

Partner Planning Committee

We shared a broad invitation in September and October for people to join the Partner Planning Committee. This Committee is one important avenue for gathering public input on the flood plan, and will help inform the recommendations in the plan. We're grateful for our partners' time and interest in participating on it.

King County will hold the first Committee meeting this week on Wednesday, Oct. 26, 2022, from 11 a.m. to 1 p.m. Committee meetings are open to the public. If you are interested in attending, please contact Spencer Easton at seaston@esassoc.com for the virtual meeting information. The agenda is posted on the Partner Planning Committee webpage. Future Committee meeting dates will be posted when they are scheduled.

2023 events, workshops + our roadmap for community engagement

King County, Washington sent this bulletin at 11/28/2022 01:05 PM PST

Got events? Please tell us! What community events should we attend in 2023?

We're interested in coming to your community to raise awareness about flooding and listen to your ideas on what's important to include in the flood plan. Do you have suggestions on community events or meetings that we should attend? Do you have ideas for potential groups that we could partner with?

Your suggestions will make a difference. Please contact Chrys Bertolotto, Flood Plan Community Engagement Coordinator, at cbertolotto@kingcounty.gov or 206-263-2677 with your ideas.

Our roadmap for community engagement

Before kicking off the flood plan this fall, we conducted research, launched an online survey, and worked with a consultant to lead community interviews to learn how we can improve our approach to gathering public input. Thanks to the valuable insights people shared, we've created a Community Engagement Implementation Plan. This will be our roadmap for providing better community engagement opportunities as we develop the flood plan together. The implementation plan is available on the flood plan webpage.

Flood hazard workshops in 2023

King County's past flood plans focused on addressing mainstem river flooding. Our updated plan will also explore urban, coastal, and tributary flooding. We welcome your attendance at workshops covering these topics in early 2023. We'll have two virtual workshops on each topic. At the workshops we'll discuss the hazards and associated problems and identify potential risk reduction

approaches. King County staff and our consultant team will lead the workshops. Learn more details and how to register on the flood plan webpage.

Reminder: Comment period on scope of EIS closes Dec. 9

An important part of our process to update the Flood Management Plan is to prepare an environmental impact statement (EIS). An EIS is a document that describes proposed actions and how they would affect the environment and people. Through the EIS process, King County will identify and analyze potential impacts of the flood plan on threatened or endangered species, water quality, historical and cultural resources, transportation, and more.

We're holding a 30-day comment period to collect input on the scope of the EIS. The comment period began Monday, Nov. 7 and ends Friday, Dec. 9, at 5 p.m. The draft EIS scope may be revised based on input received during the comment period.

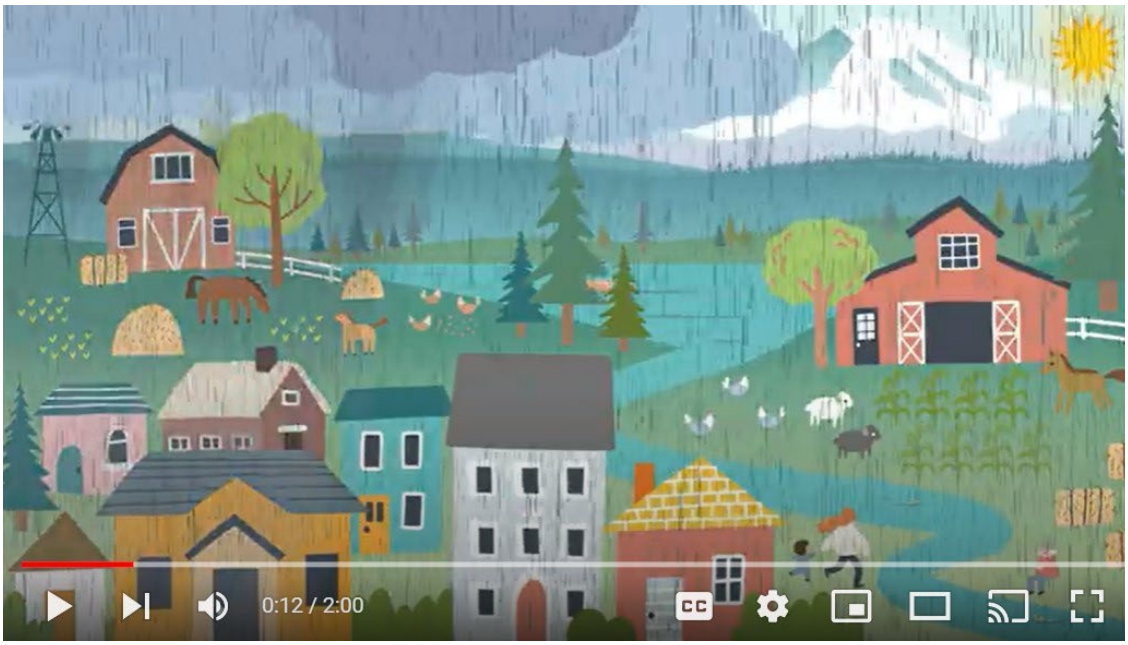
To learn more about the flood plan's EIS scope and how to submit comments, please visit the flood plan webpage. You can also learn more about the EIS in our news release.

New flood plan video, workshop reminders, and a thank you!

King County, Washington sent this bulletin at 12/16/2022 10:35 AM PST

Watch and share our video about the flood plan!

To get more people involved in creating the flood plan, we developed a video to explain what the King County Flood Management Plan is and why it matters. Please watch and share the video with your friends and networks. We'll share versions of this video in additional languages in 2023.



Reminder: Join us for workshops on flood hazards in early 2023

King County's past flood plans focused on addressing mainstem river flooding. Our updated plan will also explore urban, coastal, and tributary flooding. We welcome your attendance at workshops on these topics in January and February. At the workshops we'll discuss the hazards and associated problems and identify potential solutions.

Check out the workshop dates and times and how to register on the flood plan webpage.

Learn about the Partner Planning Committee

The flood plan's Partner Planning Committee includes the Snoqualmie Indian Tribe, King County residents, and representatives from state and local governments and community-based organizations. Partners provide critical input on:

- The plan's goals and objectives.
- The problems caused by flooding in King County.
- Key topics such as equity and climate change.
- Ways to achieve other community benefits while addressing flood hazards.

Committee meetings are held approximately monthly and are open to anyone who would like to attend! You can see the meeting schedule and what's on the agenda on the Partner Planning Committee webpage. If you'd like to join a committee meeting, please contact Spencer Easton at seaston@esassoc.com for the virtual meeting information.

Comment period on EIS scope is now closed

If you submitted comments on the scope of the flood plan environmental impact statement (EIS), thank you! The comment period began Monday, Nov. 7 and ended Friday, Dec. 9, at 5 p.m.

An EIS is a document that describes proposed actions and how they would affect the environment and people. Through the EIS process, King County will identify and analyze potential impacts of the flood plan on threatened or endangered species, water quality, historical and cultural resources, transportation, and more.

We appreciate commenters' time and input on the EIS scope. We will review all comments received. Once the scope of the EIS is determined, we will begin developing the Draft EIS. We will post a scoping summary on the webpage when available.

To learn more about the flood plan EIS, please visit the flood plan webpage.

Flood plan engagement hub launch, workshop updates & an upcoming event

King County, Washington sent this bulletin at 02/21/2023 10:10 AM PST

New, easy way to get involved with the flood plan

This month we launched the 2024 King County Flood Management Plan engagement hub. This resource shares information about:

- Flooding in King County and actions people can take to get prepared.
- Background and milestones for the flood plan and our roadmap for community engagement.
- Feedback we've heard from community members so far.
- Events and meetings where we'll be gathering input to inform the flood plan.

The hub also includes a survey where we ask about experiences with flooding, community priorities, and what is needed to build flood resilience. **Please visit the survey and share your ideas!**

The survey will be open until June 30, 2023. Another survey will be available after that date to gather input on specific strategies and priorities that have emerged.

The site and survey are available in nine languages (Spanish, Traditional Chinese, Korean, Russian, Somali, Vietnamese, Mandinka, French, and Swahili). Check out the engagement hub and share it with your friends and networks: publicinput.com/FloodPlan.English.

If you have feedback on the engagement hub, contact Jason Wilkinson, Project Manager, at 206-477-4786 or Jason.Wilkinson@kingcounty.gov.

Update on coastal, tributary, and urban flood hazard workshops

In January and February King County hosted public meetings to explore sources of flooding beyond mainstem river flooding. Participants shared their knowledge of problem areas and ideas for potential solutions that will be considered in the flood plan. Some of the problem areas included:

- Compound flooding where high tides and storm surge combine with freshwater to cause flooding. This is what South Park and Vashon Island community members experienced in late December.
- The significant impact flooding has on communities, including on people's mental health and challenges to public health.
- An acknowledgment that flooding conditions are changing, resulting in more flood impacts or flooding in unexpected areas.

Workshop participants contributed many ideas for potential solutions, such as:

- Retrofit stormwater systems to manage larger volumes of water and consider opportunities for infiltration.
- When considering property acquisition and home elevation as tools to reduce risk, ensure the programs promote equity and

social justice goals and reflect the needs of renters. Expand access to these tools to areas affected by coastal flooding.
- Build capacity within communities. Provide technical help so that residents can better prepare and recover from flooding.
- Develop approaches that support ecological functions, fish habitat, and agricultural land uses, while reducing flood risks.

Thanks to everyone that participated in these meetings. There's one workshop left in the series! The last meeting on urban flooding will take place Monday, Feb. 27 from 1-3 p.m. If you're interested in attending, please contact Spencer Easton at seaston@esaassoc.com for the virtual meeting information. More information about the flood hazard workshops is available on the flood plan webpage.

Catch us at the Washington State Coalition for African Community Leaders' Summit

We're thrilled to have a table where we'll share information about flooding and gather input on priorities for the flood plan at the Washington State Coalition for African Community Leaders (WSCACL) 5th Annual Leadership Summit on Saturday, Feb. 25 from 11 a.m. – 3 p.m. at the Bellevue Botanical Garden.

This year's Summit will cover topics related to leadership development, marketing to gain influence and attract funders, the power of unity, how to win and manage grants, recruit and retain volunteer talent, and youth issues. Visit the WSCACL website for more information and to register.

Flood plan team members, what we've heard, and more

King County, Washington sent this bulletin at 03/30/2023 04:45 PM PDT

Meet Samara and Dahira – interns working on the flood plan!

We are fortunate to have Dahira Abukar (she/her/hers) and Samara Pendley (she/her/hers) on our team to support a wide variety of flood plan community engagement activities. Over the next several months, they will join our team showing up in communities, sharing information about flooding in King County, and gathering input to inform the development of the flood plan. Get to know Dahira and Samara and why they are excited to work on building the next flood plan:

Hi! My name is Dahira Abukar. I'm from West Seattle, Washington and I'm currently in my second year at University of Washington studying Informatics with a focus in human interaction and information management. I enjoy cooking during my free time and trying out new recipes. Being a Seattle native, I always felt a strong desire to make an impact in my community, and I am looking forward to meeting everyone and making a difference together!

Hello, my name is Samara Pendley. I'm so glad to get started because I have a huge passion for the environment and environmental sciences. I am currently a dual enrollment student at South Seattle College majoring in Environmental Science, and I'll be majoring in the same subject next year at the University of Washington. Most of my time is spent doing environmental work such as restoration, outdoor education, studying for Envirothon (an environmental science competition) and being a Youth Ocean Advocate at the Seattle Aquarium. Other than that, I also love to thrift and listen to music in my free time. My favorite thrift store is red light vintage which is in the U District of Seattle and my favorite genre of music to listen to is Rock! Thanks for having me :)

Keep an eye out for Dahira and Samara at future community events and meetings! If you have suggestions for events for us to attend, contact Chrys Bertolotto, Flood Plan Community Engagement Coordinator, at 206-263-2677 or cbertolotto@kingcounty.gov.

What we learned at the Washington State Coalition for African Community Leaders' Summit

Last month we joined approximately 40 African community leaders and members for their fifth annual summit. We shared information about flooding

and the flood plan while also conducting a live poll. Check out what we learned from attendees at the event.

As we attend community events, we'll continue to share the feedback we've received by posting to the what we've heard from you section of the Engagement Hub.

Flood plan video now available in Spanish

We're excited to share the flood plan video in Spanish! We created this video to explain what the King County Flood Management Plan is and why it matters. The video is available on YouTube.

Reminder: 2024 King County Flood Management Plan engagement hub has launched

In February we shared the 2024 King County Flood Management Plan engagement hub. This online resource includes information about:

- Flooding in King County and actions people can take to get prepared.
- Background and milestones for the flood plan and our roadmap for community engagement.
- Feedback we've heard from community members so far.
- Events and meetings where we'll be gathering input to inform the flood plan.

The hub also includes a survey that asks about experiences with flooding, community priorities, and what is needed to build flood resilience. The survey will be open until June 30, 2023. Another survey will be available after that date to gather input on specific strategies and priorities. Please visit the

engagement hub and share it with your friends and networks: publicinput.com/FloodPlan.English.

If you have feedback on the engagement hub, contact Jason Wilkinson, Project Manager, at 206-477-4786 or **Jason.Wilkinson@kingcounty.gov**.

More flood plan events, our first community partner, and an EIS update

King County, Washington sent this bulletin at 05/23/2023 04:50 PM PDT

Thank you to our Partner Planning Committee

Public input is critical to shaping the next King County Flood Management Plan. Our Partner Planning Committee is a dedicated group of people who have worked to help shape flood plan goals and objectives and guiding principles. The committee includes community members; floodplain residents; staff from tribal governments, local jurisdictions, and state agencies; non-profit organizations and interest groups; and King County staff. The committee has been meeting since October 2022. Members have also helped identify flood hazards and risks that the flood plan should address, as well as potential policies and strategies that the plan should consider. To those who have been participating in committee meetings, thank you! Your participation is crucial to this effort.

All Partner Planning Committee meetings are open to the public and held virtually. To learn more about the committee and how to attend an upcoming meeting, visit the Partner Planning Committee webpage.

Save the date: June flood plan workshops!

King County will host two workshops next month to share progress on the flood plan. We look forward to talking with community members and hearing what is important to you as the plan moves forward. We'll share information on how to register soon. In the meantime, please save these dates and join us next month!

- Wednesday, June 14, 6:30-8 p.m. at the Tukwila Community Center
- Tuesday, June 27, 6:30-8 p.m. will be a virtual meeting

More upcoming events

We're attending community events to talk with people about flood risks and the King County Flood Management Plan. Check out our meetings and events page to see all upcoming events we'll be attending.

- Saturday, June 10 – Indigenous People Festival
- Monday, June 12 – Green River Coalition meeting

If you have suggestions for events for us to attend, contact Chrys Bertolotto, Flood Plan Community Engagement Coordinator, at 206-263-2677 or cbertolotto@kingcounty.gov.

Community partner highlight: Washington State Coalition of African Community Leaders

The African diaspora is the worldwide collection of communities descended from native Africans or people from Africa, predominantly in the Americas. Washington State Coalition of African Community Leaders (WSCACL) is the only African diaspora-led nonprofit in Washington state, serving 140 community leaders from nonprofits and businesses. They serve 100,000 native Africans or people descended from Africans living within Washington.

As a community partner on the flood plan, WSCACL leaders are working with their networks to raise awareness about flooding. Leaders are sharing videos in multiple languages about flood risks and flood preparedness resources. They are also using surveys to capture their communities' ideas that will shape the next flood plan. We are grateful for the opportunity to

learn from and co-create with WSCACL on this project. Learn more about Washington State Coalition of African Community Leaders at wscacl.org.

Image caption: WSCACL leaders attend a workshop with King County staff on the flood plan and local flood hazards.

Environmental Impact Statement Scoping Summary now available

As part of the process to update the flood plan, King County will prepare an environmental impact statement (EIS). An EIS is a document that describes how proposed actions could affect the environment and people. Through the EIS process, King County will identify and analyze potential impacts of the flood plan on threatened or endangered species, water quality, historical and cultural resources, transportation, and more.

In November and December 2022, we held a public comment period to gather feedback on the scope of the EIS. We greatly appreciate all the comments that were provided, and those comments will be used to inform the evaluation in the draft EIS, which is expected to be released for public comment later this year. A final scoping summary that describes the types of comments received during the scoping period has been posted on the project webpage.

If you have questions about the EIS, contact Jason Wilkinson, Project Manager, at 206-477-4786 or Jason.wilkinson@kingcounty.gov.

The Greenwater River is pictured where it joins the White River.

Join us this month for a Flood Planning Community Workshop

King County, Washington sent this bulletin at 06/02/2023 11:35 AM PDT

We're hosting two workshops for community members to join the conversation on flooding and help shape how King County manages future flood risks. Register today and join us on either:

- Wednesday, June 14 from 6:30 to 8 p.m. at the Tukwila Community Center, 12424 42nd Ave. S. Tukwila, or
- Tuesday, June 27 from 6:30 to 8 p.m. for an online meeting

At both interactive workshops you'll have the opportunity to learn about local flood risks and free or low-cost resources for family and community preparedness. You'll be able to share ideas to shape how the county manages flood risks for people, homes, and businesses in unincorporated areas. King County will also provide an update on progress being made to develop the next King County Flood Management Plan.

Both workshops will offer interpretation in Spanish and Somali. Additional interpretation and translation services are available at no cost to you. To request other language interpretation or accommodations for people with disabilities, select those options when you register or call Chrys Bertolotto at 206-263-2677, (TTY) Relay: 711, at least five days before the meeting you want to attend.

More ways to shape the next flood plan

Can't join us in June? We are still interested in hearing from you. Share your flooding concerns and ideas for what services would help community members be more resilient to flooding in our online survey, or join us at an upcoming community event near you.

If you have questions about the flood plan or how to get involved, contact Chrys Bertolotto, Flood Plan Engagement Coordinator, at cbertolotto@kingcounty.gov or 206-263-2677.

A Flood Planning Workshop and working together for regional solutions

King County, Washington sent this bulletin at 06/21/2023 03:20 PM PDT

Reminder: You're invited to a Flood Planning Virtual Community Workshop!

Join us to learn about local flood risks and free or low-cost resources for flood preparedness. You'll also be able to share your ideas to shape how the county manages flood risks. We look forward to talking with community members and hearing what is important to you as the flood plan moves forward.

Learn more and register to attend on Tuesday, June 27 from 6:30 to 8 p.m. for an online meeting.

The workshop will offer interpretation in Spanish and Somali. Interpretation and translation services are available at no cost to you. To request additional language interpretation or accommodations for people with disabilities, select those options when you register or call Chrys Bertolotto at 206-263-2677, (TTY) Relay: 711, by June 22.

Visit us at these upcoming community events

Summer is here and we're attending community events to talk with people about flood risks and the King County Flood Management Plan. Check out our meetings and events page to see all the upcoming events we'll be attending.

- Friday, July 14 - King County Fair in Enumclaw
- Saturday, July 15 - Pacific Days in Pacific
- Saturday, Aug. 5 - Duwamish River Festival in Seattle
- Saturday, Sept. 23 – Maple Valley Health and Safety Fair in Maple Valley

If you have suggestions for events for us to attend, contact Chrys Bertolotto, Flood Plan Community Engagement Coordinator, at 206-263-2677 or cbertolotto@kingcounty.gov.

Watch a video on regional solutions to reduce stormwater pollution

Stormwater pollution is a big problem caused by runoff that pushes toxics like motor oil, metals, pesticides, fertilizer, and pet waste into rivers, lakes, and Puget Sound. Our stormwater infrastructure – and our floodplains – play an important role in helping manage runoff and capturing and filtering rainwater. Watch a video to learn more about stormwater solutions.

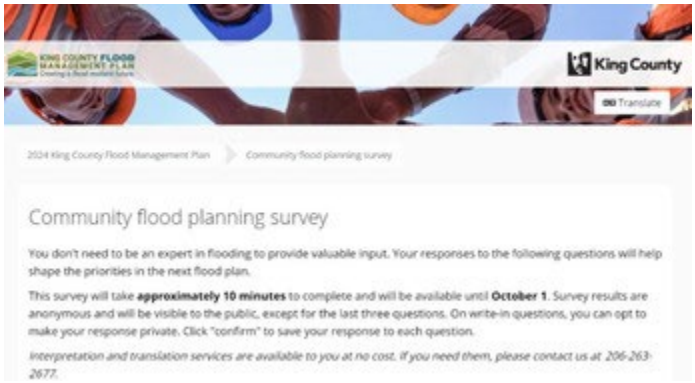
Floodplain restoration projects can help improve water quality and habitat for fish and wildlife. Through the flood plan we can also identify and provide more

opportunities for stormwater to be able to soak into the ground. Together, we can create solutions that will benefit people, fish, and orca.

What are your top priorities for the next flood plan?

King County, Washington sent this bulletin at 08/25/2023 03:20 PM PDT

Take a new Community Flood Planning Survey today



To shape the next flood plan, we asked community members this spring and summer about their flooding problems and what services would help them. Now, we're seeking input on top priorities for the next flood plan.

Your voice makes a difference –take a **new survey** today. Share what actions you would focus on to help your community reduce flood risks or improve flood preparedness. You can also submit photos of locations where you think specific actions should take place.

The survey should only take 10 minutes to complete and will be available until Oct. 1, 2023. Feel free to share the survey and encourage your friends, family, and neighbors to take it. If you have questions about the survey or flood plan, contact Jason Wilkinson, Project Manager, by email or 206-477-4786.

Look for the flood plan at a Metro station, bus or light rail car near you

To help people learn about the latest flood plan survey, we're teaming up with King County Metro. Look for advertisements promoting the survey in the Renton, Bellevue and Issaquah bus stations, and inside buses in south and east King County or on light rail cars.

Why are we working with Metro? Bus advertising allows us to bring the flood plan survey to areas of King County with priority communities for flooding. Our goal is to capture riders' attention while they wait or travel to their destination and increase online survey responses. The advertisements will appear in English and Spanish and run through September.

Join us at these last few community events!

It's been a busy summer attending community events talking with people about flood risks and the flood plan. Join us at these last events of the season as we gather community input with live polls. Check our meetings and events page for more information.

- Saturday, Aug. 26 – Holder Creek Interpretative Hike – Taylor Mountain
- Sunday, Sept. 17 – Sea Mar Fiestas Patrias at Seattle Center
- Saturday, Sept. 30 – Maple Valley Health and Safety Fair

If you have questions about upcoming events or how to share your comments, contact Chrys Bertolotto, Flood Plan Community Engagement Coordinator, by email or 206-263-2677.

Flood plan updates and community event photos

King County, Washington sent this bulletin at 09/15/2023 11:50 AM PDT

Flood plan community engagement update

As we transition to fall, we're appreciative of all the community events that we've been able to attend so far this year. We had one-on-one conversations with over 900 people at festivals, field trips, and events. We also connected with another 250 people at community meetings. Through these opportunities we gathered valuable input on flooding concerns and how to reduce local flood risks and help residents prepare for flooding.

Thank you to all the organizations and community leaders who hosted us at these events! Take a look at some of the events we attended.

Pacific Days, July 2023

Skykomish Open Air Market, August 2023

King County Fair, July 2023

There are two events left on our calendar! Check our meetings and events page for details on how to join us.

- Sunday, Sept. 17 – Sea Mar Fiestas Patrias at Seattle Center
- Saturday, Sept. 30 – Maple Valley Health and Safety Fair at the Maple Valley Farmers Market

If you have questions about upcoming events or how to share your comments, contact Chrys Bertolotto, Flood Plan Community Engagement Coordinator, by email or 206-263-2677.

Thank you to our flood plan interns, Dahira and Samara!

It takes a team to develop the next King County Flood Management Plan, and we're grateful to Dahira Abukar and Samara Pendley, who recently completed internships with our team. Both contributed to community outreach efforts. With their involvement, we were able to expand the ways we connect with people about the flood plan. A few of their accomplishments that we'd like to acknowledge:

- Samara explored opportunities to connect with youth and Black, Indigenous, and People of Color communities. Her work led to the flood plan being shared in Runta News (check out the article!), which serves the Somali community in King County, as well as displays on Metro buses, light rail cars, and stations.
- Dahira helped plan our June 2023 Community Flood Planning workshop. She also analyzed survey results and started a pictorial representation of community feedback. This visualization will help incorporate community input into the draft flood plan.

Dahira and Samara also shared information about the flood plan with hundreds of people at community events during their internships. We extend a big thanks for all their contributions! If you're interested in interning with King County, look for opportunities on the Careers webpage or on King County Department of Natural Resources and Parks LinkedIn.

Reminder: Take our Community Flood Planning Survey

Your voice makes a difference! We're seeking input on top priorities for the next flood plan. **Take the survey today.** Share what actions would help reduce flood risks or improve flood preparedness in your community.

The survey should only take 10 minutes to complete and will be available until Oct. 15, 2023. If you have questions about the survey or flood plan, contact Jason Wilkinson, Project Manager, by email or 206-477-4786.

King County Flood Management Plan – Planning Process and Online Survey in the News[4] (CRS Step 2.d.)

County flood plan update looks at flood challenges facing the Valley

King County is making the first update to its flood management plan in a decade

By Conor Wilson • April 28, 2023 11:30 am

Crews assess the damage to State Route 202 during the 2009 Snoqualmie River flood. Photo courtesy of King County Department of Natural Resources.

Anyone living in the Snoqualmie Valley in 2009 surely has a flood story.

Flows from the Snoqualmie River that January reached 60,000 cubic feet per second — 22,000 cubic feet over what's required for a phase 4 flood

[4] Story ran in *Snoqualmie Valley Record* on April 28, 2023: https://www.valleyrecord.com/news/county-flood-plan-update-looks-at-flood-challenges-facing-the-valley/

alert. Evacuation orders were issued, roads were closed or destroyed, and some residents were airlifted to safety by helicopter.

River system floods, like the 2009 event, have historically been a focus of King County's Flood Management Plan, a document that outlines how the county addresses and mitigates flood risks.

But as county officials prepare to update the flood plan for the first time in a decade, they are hoping to take a more holistic approach. This time around, they are putting a greater emphasis on climate change and less severe but increasingly frequent flood events.

King County's Flood Management Plan is a strategic vision that identifies where flooding happens and narrows in on policies or projects that can address the risks they cause, said Jason Wilkinson, a project manager with King County's Department of Natural Resources, who is leading the plan.

"It's a super important document because it's essentially how we plan to address flooding over the next ten years," Wilkinson said.

The flood plan is receiving its first update since 2013, and its first comprehensive update since 2006, Wilkinson said. County officials will create the plan, taking feedback from stakeholders and residents of at-risk communities. A draft plan is expected to come near the end of the year.

The new plan will make several key changes. Notably, it is the first flood plan to explicitly address the impacts of climate change on flooding. The county has partnered with groups like the University of Washington's Climate Impact Group to better understand what changes can be anticipated.

"We're gaining a much better understanding of the potential implications of climate change," Wilkinson said. "We have a real good opportunity before us to be able to take that updated information and apply it to the strategies that we use to address flooding."

Additionally, the plan will target flooding beyond river-caused events, something that had also been neglected in prior plans. Urban, coastal and small tributary flooding, known for being low in severity but high in frequency, are all expected to become more common in the future.

"What we have seen is an increase in the frequency of lower severity floods that affect our day-to-day lives," said Angela Donaldson, a flood insurance agent in Fall City and member of a committee working on the flood plan. "It's not enough to warrant property damage, but it is enough to impact the crops for the farmers to close roads and have [State Route] 203 topping over."

Donaldson said the most significant flood-related change for the Valley over the last decade has been an increased risk of landslides. With warm, dry summers and wildfires becoming more common, there is increased soil erosion, making it easier for flood waters to cause landslides or pull down trees.

"Because we've had such long dry summers, our trees and our plants are less resilient when we do get flooding," Donaldson said.

Farms and their crops have been hit particularly hard by climate change, said Lauren Silver, executive director of the Snoqualmie Valley Preservation Alliance and another committee member.

Silver said the flood plan's focus on climate change is "very relevant to us in the Valley," due to drier summers coupled with more frequent flooding events, making it more difficult for farmers to produce crops.

While farmers anticipate flooding, she said, they have more frequently faced floods late into the season, sometimes into the early summer. Last year, there was a predicted flood event in early June, Silver said.

"Farming in a floodplain, you're going to have floods during the flood season. And actually it really produces a great environment for agricultural production," she said. "But over time, in the last couple of decades, we've been seeing more frequent and much more severe flooding events."

Silver said the Snoqualmie Valley Preservation Alliance would like to see the new flood plan better focus on strategies specific to mitigate tributary flooding in the Valley as well as differentiate management strategies for rural areas vs. urban ones, making it easier for farmers to implement small mitigation projects. She also hopes the county will evaluate water storage strategies as the demand for water increases.

"It's nice to be at every one of these meetings and bringing issues and challenges to decision makers," she said. "Hopefully it will lead to the

prioritization and allocation of funding and support to implement actions that will alleviate these issues in the future."

Check it out:

Through June, King County is running an online survey for residents to share their ideas on flood resiliency. The survey is one step in the development of the Flood Management Plan. Take the survey at bit.ly/3LvzDQC.

Appendix H

Status of Flood Hazard Mapping Studies

APPENDIX H
Status of Flood Hazard Mapping Studies

TABLE H-1
FLOOD STUDIES COMPLETED SINCE 2013 FHMP UPDATE OR IN-PROGRESS

River	Study Reach (Length in river miles)	Hydrologic Period of Record	Date of Physical Base Data	Date Submitted to FEMA	Date of Effective FIRM
Cedar River	Elliot Bridge to Landsburg (17 miles)	Two gages: 1946 - 1999; 1920 - 1999	1999 aerials and 1999-2000 topographic maps and channel surveys	December 2002, technically approved in 2003	August 19, 2020
Lower Snoqualmie River	Snohomish County line to Snoqualmie Falls (34 miles)	1930 - 2004	2004 aerials, topographic maps and channel survey	May 2006	August 19, 2020
Patterson Creek	Mouth to upstream crossing of SR 202 (9 miles)	Three gages: 1991-2005; 1991-2005; 1991-2005	2004 aerials and topographic maps and 2005 channel survey	July 2006	August 19, 2020
Lower Green River	16th Avenue Bridge to SR 18	1962-2007	2006 aerials, topographic maps and channel survey	March 2010	August 19, 2020
Middle Green River	SR 18 to Flaming Geyser State Park	1962-2007	2006 aerials, topographic maps and channel survey	March 2010	August 19, 2020
White River (Zone 4)	SR 410 near Enumclaw to Mud Mountain Dam	1946-2007	2007 aerials and topographic maps and 2007 channel survey	September 2009, technically approved in January 2012	August 19, 2020
Sammamish River	Mouth at Lake Washington to Lake Sammamish	1948-2008	2009 aerials and topographic mapping and 2009 channel survey	July 2012, technically approved in January 2012	August 19, 2020
Vashon Maury Island	Entire marine shoreline	1948 to 2010 wind data and most recent tidal epoch	2009 aerials and topographic maps	August 2011, technically approved in January 2012	August 19, 2020
Incorporated Marine Shoreline	Marine shoreline Snohomish county line to Pierce county line, and Duwamish Waterway	1948 to 2010 wind data and most recent tidal epoch	2010 aerials and topographic maps	December 2011, technically approved in January 2012	August 19, 2020
South Fork Skykomish River	Confluence of Tye and Foss Rivers to King-Snohomish county line (13 miles)	Several gages; 1903-1982; 1930-1970; 1999-2016; 2016-2020	2020 aerial imagery and topographic LiDAR and 2020 channel survey	August 2022	In review

River	Study Reach (Length in river miles)	Hydrologic Period of Record	Date of Physical Base Data	Date Submitted to FEMA	Date of Effective FIRM
Newaukum Creek	Boise Ridge to confluence with the Green River (16 miles)	HSPF hydrologic model calibrated to gage data; 1949-2021	2020 aerial imagery and topographic Lidar and 2020-2022 channel survey	Anticipated submittal in 2024	Dependent on review timeline
Seidel Creek	Redmond Watershed Preserve to confluence with Bear Creel (1.4 miles)	HSPF hydrologic model calibrated to King County gage data; 2016-2024	2020 aerial imagery and topographic Lidar and 2021 channel survey	Anticipated submittal in 2024	Dependent on review timeline
Covington Creek	328th Place to confluence with Big Soos Creek (3.6 miles)	HSPF hydrologic model and King County gage data; 1988-2021	2020 aerial imagery and topographic Lidar and 2022 channel survey	Anticipated submittal in 2024	Dependent on review timeline
Jenkins Creek	SE 272nd Street to confluence with Big Soos Creek (2.4 miles)	King County gage data; 1988-2022	2020 aerial imagery and topographic Lidar and 2022 channel survey	Anticipated submittal in 2024	Dependent on review timeline
Little Soos Creek	Upstream limit near Lake Youngs to confluence with Big Soos Creek	King County gage data; 1995-2022	2020 aerial imagery and topographic Lidar and 2021 channel survey	Anticipated submittal in 2024	Dependent on review timeline
Issaquah Creek and tributaries	SR18 to mouth at Lake Sammamish (13.3 miles) and portions of the North Fork (1.2 miles), East Fork (6.6 miles), McDonald Creek (2.7 miles), Tributary 0217 (1.4 miles), Carey Creek (1.5 miles), and Holder Creek (1.2 miles)	HSPF hydrologic model and gage data; 1986-2023	2021 aerial imagery and topobathymetric Lidar and 2022-2023 bridge and supplemental survey	Anticipated submittal in 2025	Dependent on review timeline

Appendix I

Review of Categories of Floodplain Management Activities

APPENDIX I
Review of Categories of Floodplain Management Activities

This appendix supplements the information in Chapter 3 (Risk Reduction Tools and Approaches) of the 2024 King County Flood Management Plan. **Tables I-1** through **I-6** document the results of review of the six categories of floodplain management activities outlined in Step 7 of activity 512.a (Floodplain management planning) in the Community Rating System Coordinator's Manual.[1]

TABLE I-1
REVIEW OF PREVENTIVE ACTIVITIES

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Prevention Activities Considered and Not Recommended			
None			
Prevention Activities Recommended for Implementation			
Floodplain and flood hazard areas mapping	Provides best available information to communicate risk, which informs regulatory updates, project-level decisions, and public awareness and preparedness.	Insofar as mapping provides useful information, this activity is meeting expectations. However, the pace of completing new and updated mapping and the lag time between data collection and map adoption can hinder the effectiveness of these programs and their use for land use regulation (although King County regulates to the best available information). Also, data show that climate change is expected to increase rainfall intensity in King County, which would increase flood frequency and flood depths but not necessarily change the locations of flood hazards. Changes to mapping that incorporate climate data or future conditions hydrology into flood models will make this information more useful in the future.	FCD, various grants

1 https://www.fema.gov/sites/default/files/documents/fema_community-rating-system_coordinators-manual_2017.pdf.

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Regulations (zoning, land use, building codes, subdivisions, stormwater management)	One of the most effective ways to prevent development in risk-prone areas and ensure that redevelopment or improvements are done in ways that reduce existing risk.	King County's flood hazard and critical area regulations are aimed at preventing new at-risk development from occurring for most hazards. Current regulations present challenges to the County's ability to efficiently restore floodplain habitat and natural floodplain functions, improve culvert capacity, and construct stormwater management infrastructure; new regulations are needed for alluvial fans, which are not adequately addressed by the existing regulatory framework.	Operating Budget, Surface Water Management Fee, FEMA BRIC
Open space conservation	Can protect natural floodplain functions and allow other natural processes to occur without risk to people or property when development rights are permanently removed from the land. Can also protect watershed hydrologic functions and reduce runoff.	King County has a very active open space conservation program. The primary limitation to King County's ability to protect open space is the availability of funding. The County would likely be able to protect more open space if more funding were available.	Various state and federal grants, local Conservation Futures and Parks Levy, Surface Water Management fee, FCD

TABLE I-2
REVIEW OF PROPERTY PROTECTION ACTIVITIES

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Property Protection Activities Considered and Not Recommended			
None			
Property Protection Activities Recommended for Implementation			
Elevations	Elevating structures in areas of slow-moving floodwaters has proven an effective mitigation activity in King County.	Implemented projects are performing well, but there are opportunities to expand the geography of the program, increase the pace of implementation, and improve the equity of service delivery.	Grants, FCD
Acquisitions	Acquisition and demolition of structures and permanently removing development rights from properties that have flooded or that are at high risk of flooding or channel migration completely remove the flood risk and eliminate vulnerability while supporting natural floodplain functions and providing opportunities for environmental enhancement.	Acquisitions achieve the desired outcomes in riverine environments in terms of removing risk for those who are aware of the program. Acquisitions in the coastal environment are currently driven by environmental objectives, so the use of this tool could be expanded to include coastal areas that are at risk from coastal flooding or sea level rise.	Grants (including Conservation Futures, Parks Levy, and state grants, such as Floodplains by Design, Salmon Recovery Funding Board, Puget Sound Acquisition and Restoration), FCD, King County Surface Water Management
Relocation	Relocation provides risk mitigation while protecting housing stock and providing housing outside of at-risk areas. Many at-risk properties can be more effectively mitigated through elevation (where floodwaters are slow-moving) or acquisition (where flooding is fast or erosion is possible).	Relocation has limited application in King County, and elevations and acquisitions are used more often than relocation. An option for expanding the use of relocation as a tool to reduce risk could be relocating structures from the severe channel migration hazard area to a location on the same property that does not face this risk.	Grants
Promoting Flood Insurance	Encouraging the purchase of flood insurance can raise general awareness of flood preparedness and can help to protect people in the event they incur flood damage. This includes property owners and renters. It includes property owners and renters both in the regulatory floodplain and in areas outside of the regulatory floodplain but with residual flood risk (such as in areas shown on flood maps as being protected by levees).	King County could do more to promote the purchase of flood insurance by way of promoting general awareness about flood risk and flood preparedness, especially to renters and socially vulnerable communities.	FCD, Grants, King County Surface Water Management
Floodproofing	As a retrofitting method, floodproofing can help to reduce flood losses when implemented in appropriate settings.	Elevations and acquisitions have typically been used more often than floodproofing in King County.	Grants

TABLE I-3
REVIEW OF NATURAL RESOURCE PROTECTION ACTIVITIES

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Natural Resource Protection Activities Considered and Not Recommended			
Headwaters protection for major rivers	Major river headwaters in King County are already protected/in public ownership.		
Natural Resource Protection Activities Recommended for Implementation			
Floodplain reconnection/ restoration	Effective tool to reduce flood and flood-related risks, improve natural floodplain functions, and enhance habitat for ESA-listed species.	Implemented projects have resulted in documented flood risk reduction benefits and improved habitat quantity/quality. Complete restoration of process is often limited by land use/development, which limits space available for river process; land ownership; and flow regulation, which can impact transport of sediment and wood, as well as habitat formation.	Various federal, state, and local grants; King County Surface Water Management; FCD
Large wood management	King County's approach to managing naturally occurring large wood needs review and clarification about intent, the types of actions that will be taken and when, and the roles of different agencies.	While not a flood risk mitigation activity per se, large wood is often managed in association with risk to people and public safety in waterways. King County is cognizant of this risk, yet current practices are not achieving all desired objectives.	King County Surface Water Management
Headwaters protection for tributaries	Provides opportunities for infiltration and limits flashy flows that are expected to get worse with climate change.	Acquisition of tributary headwaters areas is limited by the availability of funding and by willing sellers. As opportunities become available and resources are secured, lands can be acquired.	Various federal, state, and local grants
Wetlands protection/ restoration	Provides natural flood risk reduction benefits and protects/improves habitat for aquatic species.	Local regulations allow for some amount of wetland development and conversion with mitigation yet providing mitigation off-site results in a loss of function at the area of impact.	Various federal, state, and local grants; King County Surface Water Management
Beaver restoration and management	Provides natural flood risk reduction benefits and protects/improves habitat for aquatic species. Relocation or management of beaver activity in problem areas can reduce flood risk.	King County has developed extensive guidance on living with beavers and managing beaver activity. As beaver populations increase, the tools made available will need to be revisited to ensure they continue to be useful.	King County Surface Water Management
Green stormwater infrastructure (GSI)	Effective tool to slow runoff and limit its effects.	Meeting expectations at small, site-specific scales. Implementing GSI solutions at larger scales could have more meaningful benefit.	Various federal, state, and local grants; King County Surface Water Management

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Marine shoreline restoration	Provides long-term improvement of ecological conditions and reduces the effects of coastal erosion and impacts on critical habitat features, like eelgrass meadows, kelp forests, marshes, beaches, and riparian zones.	Individual projects are successful in reducing erosion and improving environmental conditions, but shoreline restoration is limited in effectiveness as a flood risk reduction measure unless combined with other property protection measures. This is an area for future program development.	Various federal, state, and local grants; King County Surface Water Management

TABLE I-4
REVIEW OF EMERGENCY SERVICES ACTIVITIES

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Emergency Services Activities Considered and Not Recommended			
None			
Emergency Services Activities Recommended for Implementation			
Provide regional flood warning services to residents and partners throughout King County	Serves as an essential service to help individuals, businesses, and other local governments prepare for impending flooding and assemble resources needed to provide response and support.	The program is a valuable service, yet there are opportunities for King County to work with partners to evaluate expanding the flood warning system to include Lake Sammamish and the Sammamish River, small tributaries, and coastal flooding and high-tide events. Additionally, the flood phases should be periodically revisited to ensure the flow thresholds correspond to the extent of flooding that results at those flows.	Grants, FCD
Emergency response	Provides essential services to the public and other partners during times of emergency.	King County and other agencies and jurisdictions within the county have robust emergency response programs. However, during development of the Flood Plan, community members and partners expressed a desire for greater coordination between agencies.	King County (Emergency Management budget), FCD
Community capacity building for emergency response	Can provide additional (and in some cases perhaps more effective) means to reach vulnerable communities and improve their flood resilience.	Not currently implemented—new service.	Grants
Technical assistance	Provides opportunity to improve resilience in new ways.	Not currently implemented—new service.	Grants, King County (Emergency Management budget), FCD

TABLE I-5
REVIEW OF STRUCTURAL ACTIVITIES

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Structural Activities Considered and Not Recommended			
None			
Structural Activities Recommended for Implementation			
Levees and floodwalls	Maintenance of existing structures is needed to ensure they continue to provide the intended protection. Higher levels of flow containment than currently provided are planned for the Green River, Tolt River, Cedar River, and other river systems, as needed and recommended by capital investment strategies. Looking forward, maintenance should follow the provisions outlined in this Flood Plan for identifying multiple benefit opportunities and supporting resilience to climate change.	King County routinely inspects flood protection infrastructure to ensure it is performing as designed and, in cases where it is not, determines the appropriate measures to improve performance, including reconstruction to current engineering standards.	FCD, USACE PL 84-99 rehabilitation program, grants
Revetments	Maintenance of existing structures is needed to ensure they continue to provide the intended protection. Looking forward, maintenance should follow the provisions outlined in this Flood Plan for identifying multiple benefit opportunities and supporting resilience to climate change.	King County routinely inspects flood protection infrastructure to ensure it is performing as designed and, in cases where it is not, determines the appropriate measures to improve performance.	FCD, FEMA and other grants
Pump stations	Maintenance of existing pump stations is necessary to ensure their continued performance. Rehabilitation of the Black River Pump Station is ongoing to upgrade systems, pumps, engines, seismic improvements and significantly improve fish passage.	Given the negative impacts of flapgates on juvenile fish passage into tributary streams, opportunities should be explored to replace flapgates with fish passable structures.	FCD, grants
Culverts	Replacing existing undersized or damaged culverts can improve conveyance and fish passage. Box culverts or bridges may be needed in some applications.	King County has many existing culverts that are not capable of passing high flows and which block passage for ESA-listed salmonids. Efforts to replace these culverts are under way.	Grants, King County Surface Water Management
Instream flow deflection structures	Can reduce erosion risk while also providing instream habitat function.	Typically installed as a component of a project with other elements, these structures effectively divert flow away from undesired locations.	FCD
Dredging and gravel removal	Dredging and gravel removal as a stand-alone flood risk reduction action does not support the goals and objectives of this Flood Plan. However, in limited circumstances, it can be considered, such as when a small part of a larger, long-term solution is undertaken as part of Congressionally authorized flood control projects.	Provides limited and temporary flood risk reduction, has highly restrictive permit requirements, and is detrimental to aquatic ecosystems and salmon habitat.	FCD, King County Surface Water Management
Sedimentation basins	Maintenance of existing sedimentation basins is necessary to ensure their continued performance.	Current maintenance must be regularly performed.	King County Surface Water Management

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Stormwater management projects	Especially important given increased development pressure in unincorporated King County and impacts that will result from climate change.	Current services provided by King County have gaps, and those could be addressed by making proposed program modifications.	King County Surface Water Management, grants
Flood storage projects	More stormwater flow control facilities are needed to manage the volumes of stormwater that are anticipated to result from future development and from climate change. Innovative, regional solutions such as stormwater parks are being developed to manage large volumes of stormwater and provide other amenities.	Older flow control facilities are often not able to handle the runoff volumes associated with severe storms.	King County Surface Water Management, grants

TABLE I-6
REVIEW OF PUBLIC INFORMATION ACTIVITIES

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Prevention Activities Considered and Not Recommended			
None			
Prevention Activities Recommended for Implementation			
Flood hazard and flood preparedness education	Ongoing outreach and education are necessary to engage and inform community members to become disaster-resilient. Messaging will focus on opportunities for households, businesses, and employers to minimize losses from flood hazards that threaten the county.	Improvements can be made to better reach priority communities. Developing and implementing a PPI will support this work. Additionally, there are a vast number of communication strategies from digital to in-person engagement that King County should continue to refine and improve. In-person outreach is limited in the current approach.	FCD, grants, community partnerships
Technical assistance for property owners and builders	Building, remodeling, and repairing flood damages in flood risk areas requires the navigation of complex safety regulations. Limited access to easily understandable requirements and processes hinders the County's success at preventing new risk from being created and unnecessarily lengthens the permitting process. Improved technical services is an investment that would provide more readily available information so property owners and renters could understand flood hazard-related regulations, more successfully evaluate building flood-safe structures, and help the County avoid costly mitigation for illegal, at-risk development.	New proposal	Permit fees
Map information improvements	The Cedar River Flood Level Viewer is an interactive web-based mapping application that shows inundation areas and flood depths at various modeled high-flow conditions. It allows the public to understand potential flood risk and take action to become more resilient and less vulnerable to flooding. During the February 2020 flood, this tool proved to be effective in communicating risk to the public, particularly since it had been more than 11 years since the Cedar River had a higher peak flow. The displayed inundation areas and depths on the Cedar River Flood Level Viewer resembled conditions that occurred during the February 2020 flood. The analysis would determine the feasibility of producing similar Flood Level Viewers on other major rivers using existing information and models already available to the public, such as those used for FEMA's Flood Insurance Rate Map studies and reports.	The existing service is available only on the Cedar River and has been successful at demonstrating potential risks associated with different extents of flooding. This proposal is to assess the feasibility and develop a scope and cost estimates to extend Flood Level Viewers to other flood-prone areas of the county.	Grants, FCD, King County Surface Water Management

Mitigation Activity	Reason for Recommending or Not Recommending	Meeting Expectations, Achieving Desired Outcomes?	Funding Options, including all potential funding sources
Program for Public Information (PPI)	Research shows that when public information efforts are planned, coordinated, and implemented considering the unique needs of different communities related to different hazards, people will take steps to protect themselves. Development and implementation of a PPI will connect a varied collection of floodplain managers and partners to collaboratively create and implement more targeted outreach to change behavior, build more resilient communities, and raise awareness about flooding. In addition to being a method of achieving more effective outcomes, a PPI is a highly credited CRS activity, which helps ensure that property owners in King County maintain access to discounted FEMA flood insurance. A PPI can expand the effectiveness of other public information resources King County already provides.	Not a current activity.	Grants, King County, FCD