2025 - 2030

King County Regional Hazard Mitigation Plan

King County
Emergency Management

Acknowledgements

The King County Office of Emergency Management extends its sincere gratitude to our local, state, and national partners, non-governmental organizations, community members, and dedicated staff whose expertise, experience, and support were instrumental in the development of this plan. All contributions, big and small, are greatly appreciated.

Program Leads

Mercedes Stroeve, King County Hazard Mitigation Planner
Andrew Matthews, King County Emergency Management Coordinator

County Agency

Brendan McCluskey, Director OEM
Nicole Johnson, Risk Reductions Manager OEM
Celia Taylor, Planning & Finance Manager OEM
Sheri Badger, Public Information Officer OEM
Alli Ferreri, Wildfire Planning Coordinator OEM
Andrew Dixon, Dam Safety Coordinator OEM
Edan Edmonson, Prevention Coordinator OEM
Lexi Swanson, Homeland Security Coordinator OEM
Nathan Emory, Extreme Weather Coordinator OEM
Tom Sharp, LEPC Manager OEM
Sunita Hall, Zone-1 Liaison OEM
Sally Calengor, Zone-3 Liaison OEM
Audrey Hoen, Cyber Security Fellow OEM
Alexis Mee, Preparedness Fellow OEM
Keara Ryan, Preparedness Specialist OEM
Ken Zweig, Program Manager, DNRP
Laura Hendrix, Floodplain Management Program Manager DNRP
Katy Vanderpool Program Manager, DNRP
Mike Lasecki, Rural Forest Health Coordinator KCD
Stephan Carr, Assistant CISO KCIT
Jamie Emert, Emergency Preparedness Planning and Partnerships Manager PHSKC
Lara Whitely-Binder, Climate Preparedness Specialist EOC
Cecelia Hayes, Equity and Social Justice Program Manager DES
Sean Catanese, Risk Management
Addison Houston, Climate Adaptation Strategist PHSKC

State Agency

Doug Larm, WSFC
Maximilian Dixon, Earthquake Program Manager EMD
Kate Mickelson, Landslide Hazards Program Manager DNR
Megan Anderson, Earthquake Geologist and Geophysicist DNR
Josh Halofsky, Natural Resource Scientist DNR

National Agency

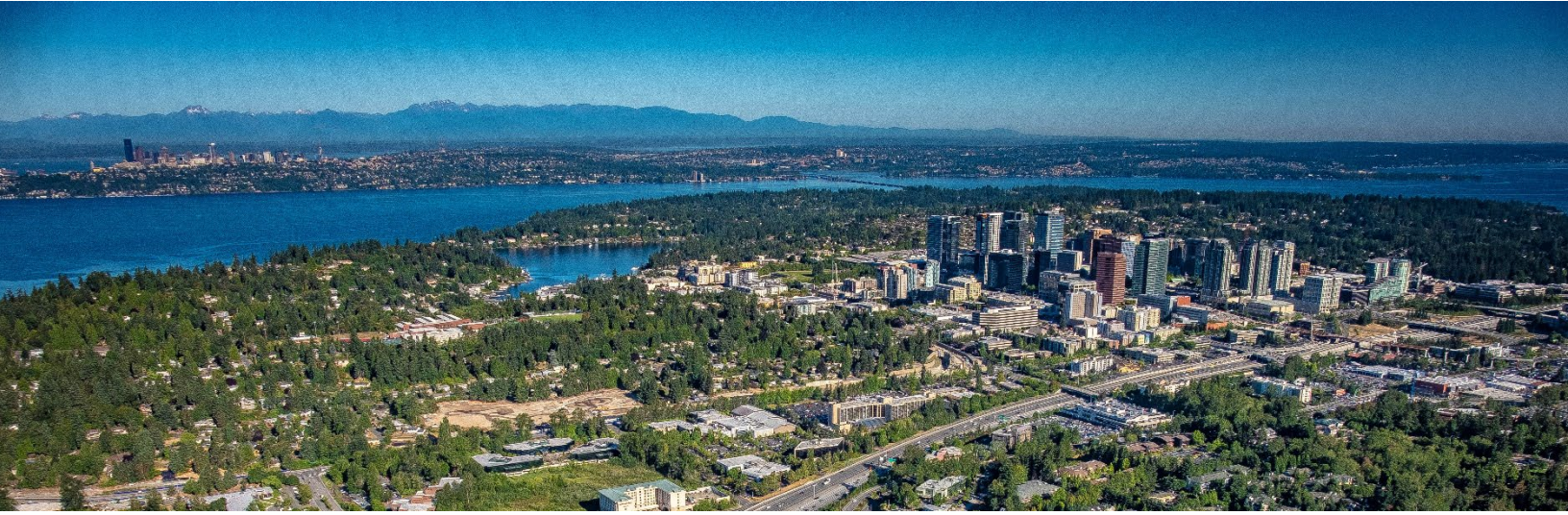
Dennis D'Amico, Forecast Director NWAC
Reid Wolcott, Meteorologist NWS
Brent Bower, Senior Service Hydrologist NWS

Jurisdictions & Special Districts

Cat Robinson, Emergency Coordinator EFR
Diane Pottinger, District Manager NCWD
Jared Schneider, Issaquah Emergency Manager
Deborah Needham, Renton Emergency Manager
Will Lugo, SeaTac Emergency Manager
Colby Cavanaugh, Bothell Emergency Manager
Lisa Figueroa, Redmond Emergency Manager
Ryan Zavala, Shoreline Emergency Manager

Non-Government Organization

Matt Rogers, Research Scientist UW CIG
Dave Cook, Principal Geologist Aspect Consulting



Executive Summary

The King County Regional Hazard Mitigation Plan (RHMP) 2025-2030 serves as a strategic blueprint to safeguard the community and its assets from potential nature and human-induced hazards. In compliance with the Federal Emergency Management Agency (FEMA) and the Washington State Emergency Management Division (EMD) regulations, the plan ensures King County remains eligible for critical hazard mitigation funding and other resources.

The plan's overarching goal is to create a framework that reduces the impact and susceptibility of the identified hazards on people, property, and the environment, prioritizing historically underserved communities. To achieve this goal, the Core Planning Team worked to foster collaboration across local, state, and federal agencies, community organizations, and private sector partners. Collaboration is at the heart of this plan, working in partnership to identify and assess potential hazards and their impacts, determine high-risk areas and populations, integrate hazard mitigation into land use planning, and develop strategies to minimize risk.

Equity is a cornerstone of the King County Regional Hazard Mitigation Plan, ensuring that mitigation efforts prioritize those most vulnerable to the impacts of hazards. This includes focusing on communities that are historically underserved, such as low-income households, elderly residents, and individuals with disabilities. By recognizing the unique challenges faced by these populations, the plan strives to reduce disparities in risk exposure and access to resources.

Through comprehensive research, analysis, and collaboration, a set of targeted mitigation strategies has been developed, incorporating both structural and non-structural measures. Structural actions, such as retrofitting buildings and infrastructure, are complemented by non-structural approaches like land use planning and community engagement. Key mitigation actions identified include the development and implementation of floodplain management plans, improvements to emergency response capabilities, and the promotion of green infrastructure solutions to manage stormwater and reduce flood risks.

The significance of the 2025-2030 King County RHMP cannot be overstated. By identifying and addressing the region's most pressing hazards, the plan aims to protect lives and property, reduce the risk of injury, loss of life, and property damage, and enhance community resilience. This includes strengthening infrastructure, strengthening emergency response capabilities, and fostering social cohesion, ensuring that communities can better withstand, prepare, and recover from disasters.

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Chapter 1: Introduction

Mitigation planning is a vital strategic tool for reducing risk and enhancing community resilience to hazard events. It provides a platform for local partners to collaborate, assess potential risks, and build integrated mitigation strategies for risk reduction. The 2025 King County Regional Hazard Mitigation Plan explores the intersection of mitigation with prevention, protection, response, and recovery.

Hazard mitigation, a core mission within emergency management, goes beyond life safety by emphasizing that disaster impacts are not inevitable. While incidents will occur, their consequences are not predetermined. Through targeted investments in critical areas, we can strengthen the most vulnerable aspects of our community, enhancing resilience, and reducing the severity of future disasters.

The 2025 King County Regional Hazard Mitigation Plan complies with FEMA's local mitigation planning requirements outlined in Title 44, Part 201 of the Code of Federal Regulations (44 CFR 201) incorporating the latest policy updates that took effect in April 2025. The plan reassesses the risks and vulnerabilities associated with eight natural hazards and seven human-caused hazards, developing actionable strategies to mitigate these risks.

Serving as a base plan for all of King County, the plan also includes annexes from 50 jurisdictions, schools, and special districts, each contributing their specific analyses and mitigation actions tailored to their needs.

1.1 Mitigation Goal and Priorities

The goal of the 2025 King County Regional Hazard Mitigation Plan is to create a framework that reduces the impact and susceptibility of the identified hazards on people, property, and the environment, prioritizing historically underserved communities. This framework takes into account King County's 15 Determinants of Equity and Social Justice. These population-level indicators help

planners to better understand disparities and opportunities to make a difference across the communities we serve.

1.2 Revisions from 2020 Edition

When updating the 2020 RHMP, several key revisions and improvements have been made to enhance the plan's effectiveness and alignment with contemporary needs and requirements. The 2020 plan was fully rewritten and reformatted to comply with FEMA's 2022 updated local mitigation planning requirements. This includes the incorporation of new subsections addressing climate change considerations, and ensuring the plan accounts for the evolving impacts of climate change on hazards and vulnerability.

The risk assessments have been refocused to better support emergency managers, who are the primary audience of the plan. This shift ensures that the risk assessments are more directly relevant to the people responsible for preparedness and operations related to the hazards in King County. With advancements in science and technology since the development of the original plan, the 2025 edition benefits from newly available data and tools. These improvements enable a more detailed and accurate risk assessment, providing better insight into the County's hazard exposure and vulnerabilities. The methodology for ranking hazards has been refined to incorporate criteria from the Emergency Management Accreditation Program (EMAP). This enhanced scoring approach offers a more robust evaluation of hazards, better reflecting the County's risk landscape.

The 2025 plan places a stronger emphasis on equity and social justice, integrating these considerations into the understanding of risk and vulnerability. The County worked with various departments to identify vulnerable populations and include relevant data in a way that is operationally meaningful, ensuring that mitigation strategies address and reduce risks to these populations. Additionally, a community profile was introduced to this update, offering a deeper understanding of King County's demographics. This addition allows the plan to better identify and understand vulnerable populations in the region, ensuring that mitigation strategies can be tailored to meet the needs of these groups.

In anticipation of a significant increase in federal grants for natural hazard mitigation through the Disaster Recovery Reform Act, the plan includes a strategy to identify projects and project champions. This revision emphasizes capacity-building among planning partners and County agencies to better identify vulnerabilities, craft mitigation strategies, communicate the benefits of projects, and pursue funding opportunities effectively.

These revisions ensure that the 2025 Regional Hazard Mitigation Plan is more comprehensive, up-to-date, and aligned with local, regional, and federal priorities, while addressing the unique needs of vulnerable populations and the evolving risks posed by climate change.

1.3 Plan Guide

The base plan satisfies all requirements for King County plus many of the planning requirements for local planning partners. The plan is organized as follows.

Chapter 2 Planning Process

- The planning process section corresponds to Element A in the FEMA Mitigation Plan Review Guide and includes information on the planning process such as public outreach, meetings, and the planning timeline.

Chapter 3 Community Profile

- The community profile provides a detailed overview of King County's demographics, including population data, economic conditions, and historical context. It also highlights development trends, helping to identify potential vulnerabilities.

Chapter 4-18 Risk Assessments

- The risk assessment chapters include profiles of each profiled natural and human-caused hazard. These profiles are brief and are designed to provide an overview to emergency managers and other users of this plan. This section meets the requirements of Element B in the FEMA Mitigation Plan Review Guide.

Chapter 19 Capabilities Assessment

- The capabilities chapter meets requirements associated with coordinating the hazard mitigation program with other entities as well as information on available funding.

Chapter 20 Mitigation Strategies

- Hazard mitigation strategies are the key deliverable of this plan and include information on how strategies are identified, developed, and prioritized. This section meets the requirements in Element C of the FEMA Mitigation Plan Review Guide.

Chapter 21 Plan Maintenance

- The plan maintenance chapter outlines a framework for monitoring, evaluating, and updating the plan at regular intervals to ensure its relevance and accuracy throughout the 5-year period. Additionally, it provides a structured approach for tracking the progress and effectiveness of mitigation strategies.

Chapter 22 Plan Adoption

- The plan adoption chapter outlines the formal approval of the hazard mitigation plan by the King County Council, affirming the King County's and annex jurisdiction's commitment to the outlined goals and actions.

1.4 EMAP Standards

The Emergency Management Accreditation Program (EMAP) is a national, standards-based assessment and accreditation process for emergency management programs. In the context of hazard mitigation, EMAP ensures the RHMP takes into account all the phases of emergency and disaster management: mitigation, protection, prevention, response, and recovery. These phases are addressed in the impact (or consequence) and vulnerability assessments, which are essential for evaluating hazards risk to various community components.

Each identified hazard includes a detailed quantitative summary of its overall impact, vulnerability, and risk on the respective chapter cover page, along with a qualitative summary provided at the end of the chapter. The RHMP narrative is tailored to local emergency managers, the primary audience, and emphasizes collaboration by involving them in the planning, implementation, and ongoing maintenance of the plan.

EMAP Section	2022 Standard	Location in Plan
4.1	**Hazard Identification, Risk Assessment, and Consequence Analysis**	
4.1.1	The Emergency Management Program identifies the natural and human-caused hazards that potentially impact the jurisdiction using multiple sources. The Emergency Management Program assesses the risk and vulnerability of the following:	
	(1) people;	Located in each hazard profile Chapters 5 through 18 both on the chapter cover page and under the section title *Vulnerability Assessment*. Definitions are found in Chapter 4, Section 2.
	(2) property;	
	(3) the environment; and	
	(4) its own operations from these hazards.	
4.1.2	The Emergency Management Program conducts a consequence analysis for the hazards identified in Standard 4.1.1 to consider the impact on the following:	
	(1) public;	Located in each hazard profile Chapters 5 through 18 both on the chapter cover page and under the section title
	(2) responders;	
	(3) continuity of operations, including continued delivery of services;	

	(4) property, facilities, and infrastructure;	*Impact Assessment*. Definitions are found in Chapter 4, Section 2.
	(5) environment;	
	(6) the economic condition of the jurisdiction; and	
	(7) public confidence in the jurisdiction's governance.	
4.1.3	The Emergency Management Program has a maintenance process for its Hazard Identification, and Risk Assessment (HIRA) identified in Standard 4.1.1, and the Consequence Analysis (CA) identified in Standard 4.1.2, including a method and schedule for evaluation and revision.	
	Maintenance Process (HIRA)	Maintenance process for HIRA and CA, including evaluation and revision, are located in Chapter 21, Section 1.
	Maintenance Process (CA)	
	Method and schedule evaluation	
	Method and schedule for revision	
4.2	**Hazard Mitigation**	
4.2.1	The Emergency Management Program has a plan to implement mitigation projects and sets priorities based upon loss reduction. The plan:	
	(1) is based on the natural and human-caused hazards identified in Standard 4.1.1 and the risk and consequences of those hazards;	Located in Chapter 4, Section 1.
	(2) is developed through formal planning processes involving Emergency Management	Located in Chapter 2, Sections 1 and 2.
4.2.2	The Emergency Management Program documents project ranking based upon the greatest opportunity for loss reduction and documents how specific mitigation actions contribute to overall risk reduction.	
	Priority Process	Located in Chapter 20, Section 4.
	Mitigation Actions	Located in Chapter 20, Section 7.

4.2.3	The Emergency Management Program utilizes a process to monitor the overall progress of the mitigation activities and documents completed initiatives and their resulting reduction or limitation of hazard impact on the jurisdiction.	
		Emergency Management Program monitoring is addressed in Chapter 21, Section 1.
4.2.4	The Emergency Management Program, consistent with the scope of the mitigation program, does the following:	
	(1) identifies ongoing mitigation opportunities and tracks repetitive loss;	Mitigation program tracking and technical assistance is addressed in Chapter 21, Section 1.
	(2) provides technical assistance in implementing mitigation codes and ordinances; and	
	(3) participates in jurisdictional and multi-jurisdictional mitigation efforts.	Multi-jurisdictional mitigation is addressed in Chapter 21, Section 2.
4.2.5	The Emergency Management Program has a maintenance process for the plan identified in Standard 4.2.1, including a method and schedule for evaluation and revision.	
		Maintenance process for the plan, including evaluation and revision, are located in Chapter 21, Section 1.

Chapter 2: Planning Process

The King County 2025 Regional Hazard Mitigation Plan (RHMP) follows the established planning guidelines of the Office of Emergency Management (OEM). This approach adheres to the standards of the Emergency Management Accreditation Program (EMAP) and FEMA's Comprehensive Preparedness Guide (CPG). The planning process embraced a whole-community approach, collaborating with a multiagency multijurisdictional steering committee. Consulting with subject matter experts through targeted focus groups, and actively engaged vulnerable communities through listening sessions to ensure comprehensive and inclusive input. Cities, tribes, special purpose districts, and school districts were invited to participate in this plan update. These jurisdictions and entities are critical to effective implementation of multi-jurisdictional mitigation projects.

2.1 Partner Engagement and Collaboration

Core Planning Team

The Core Planning Team, composed of key members from the King County Office of Emergency Management, played a pivotal role in guiding both the internal county process and supporting the planning efforts of individual cities. Their responsibilities included coordinating outreach activities, developing and reviewing plan drafts, contributing to the risk assessment, formulating mitigation goals and strategies, and overseeing the submission of the plan for local adoption.

Steering Committee

The Steering Committee, overseen by the Core Planning Team, is made up of different King County departments and representatives from participating jurisdictions and special districts including community planners, emergency managers, and subject matter experts. The committee supervised the writing of the plan and was consulted for final decisions made by the Core Planning Team. Individual departments developed their own strategies internally and then socialized the strategies with the other county participants.

Table 2-1 Planning Team Members

Name	Organization	Title
Core Planning Team		
Andrew Matthews	King County Emergency Management	Hazard Mitigation Program Coordinator

Nicole Johnson	King County Emergency Management	Senior Program Manager
Mercedes Stroeve	King County Emergency Management	Hazard Mitigation Planner
Steering Committee Members		
Addison Houston	KC Public Health	Climate Adaptation Strategist
Cat Robinson	Eastside Fire and Rescue	Emergency Coordinator
Cecelia Hayes	King County Department of Executive Services	Equity and Social Justice Program Manager
Colby Cavanaugh	City of Bothell	Emergency Manager
Deborah Neeham	City of Renton	Emergency Manager
Diane Pottinger	North City Water District	District Manager
Edan Edmunson	King County Emergency Management	Dam Safety Coordinator
Jared Schneider	City of Issaquah	Emergency Manager
Lara Whitely-Binder	King County Department of Natural Resources and Parks	Climate Preparedness Specialist
Laura Hendrix	King County Department of Natural Resources and Parks	Floodplain Management Program Manager
Lisa Figueroa	City of Redmond	Emergency Manager
Meisha Roberton	Riverview School District	Assistant Superintendent Business Program Manager

Sally Calengor	King County Emergency Management	Zone 3
Nathan Emory	King County Emergency Management	Extreme Weather Coordinator
Ryan Zavala	City of Shoreline	Emergency Manager
Sean Catanese	King County Risk Management	Risk Management
Sheri Badger	King County Emergency Management	Recovery Program Manager
Sunita Hall	King County Emergency Management	Zone 1
Will Lugo	City of SeaTac	Emergency Manager

The steering committee convened monthly to assess the progress of the core planning team and provide strategic guidance on critical decisions regarding the direction of the planning efforts. These meetings were held in-person at the King County Office of Emergency Management, with a virtual option also available to ensure broad participation.

Table 2-2 Steering Committee Meetings

DATE	SUMMARY
Feb 2024	**Introductions** Create outline for 2024/2025 update process; Review the new FEMA guidance and how it will affect the plan; Discuss other County wide plans we can incorporate; Begin creation of annex template.
Mar 2024	**Public outreach strategy** Strategize public outreach approach; Identify subject matter experts for risk assessment; Review Annex template; Examine example HMPs (i.e. Thurston County RHMP).
Apr 2024	**Equity and social justice (part 1)** Address how the RHMP will factor in equity in the planning and implantation; Review the Equity in Response Planning Tool; Update the Equity Matrix for scoring strategies; identify potential new partners and/or opportunities for collaboration.
May 2024	**Equity and social justice (part 2)**

	Continue to discuss how the RHMP will factor in equity in the planning and implantation; Continue to update the Equity Matrix for scoring strategies; Finalize outreach event schedule and locations.
June 2024	**Plan goals, priorities, and strategy (part 1)** Establish plan goals, priorities, and strategy prioritization method; Provide update on current risk profiles; Review public outreach survey flyer and questions.
July 2024	**Plan goals, priorities, and strategy (part 2)** Confirm RHMP goal, priorities, and strategy prioritization method.
Aug 2024	**Risk assessment** Review risk assessment matrix; organize risk assessment workshop identifying speakers; Create invite list of subject matter experts.
Oct 2024	**Impact and vulnerability assessment** Recap the risk assessment workshop; Identify plans and studies to incorporate into the risk assessments; Identify impacts and vulnerabilities.
Nov 2024	**Mitigation strategies** Review King County capabilities for mitigation efforts (i.e. policies, programs, staff, collaborations); Review previous mitigation strategies; Brainstorm new mitigation action opportunities.
Jan 2025	**Review draft base plan**

'Subject Matter Experts' Engagement

This region has benefitted significantly over the years from the partnerships and collaboration to address all the phases in emergency management (prevention, mitigation, preparedness, response, and recovery). The following discipline partners were sources of subject matter experts and/or the channels to share information and engage in emergency management planning efforts.

- King County Fire Chiefs Association
- King County Police Chiefs Association
- King County Office of Emergency Management
- Zone 1, 3 & 5 Emergency Managers
- Washington Association of Water & Sewer Districts
- Puget Sound Educational Service District
- King County Emergency Management Advisory Committee & Subcommittees
- King County partner agencies (Department of Natural Resources and Parks (DNRP), Public Health (PHSKC), Facilities Management Division (FMD), Executive Climate Office (ECO))
- Washington State departments (Emergency Management Division, Department of Natural Resources, Washington Geological Survey, Fusion Center, Department of Transportation)
- Federal agencies (National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), Northwest Avalanche Center (NWAC))

All subject matter experts, partners, and participating jurisdictions and special districts were directly invited to partake in the steering committee and be involved in the planning process.

2.2 Planning Steps

The hazard mitigation planning process is a systematic approach to identifying, assessing, and reducing the risks posed by natural and human-made hazards to a community. It is an essential part of building resilience, ensuring that future disaster impacts are minimized through strategic planning and collaboration. This process is divided into four distinct phases, each of which contributes to the development of a comprehensive mitigation plan.

Plan Coordination

The planning process begins with initial coordination and the establishment of a structured framework for development. This phase involves gathering key stakeholders and creating a foundation for the plan's development.

- **Initial Coordination:** Organizing the Core Planning Team and Steering Committee to help establish goals and planning process. The core planning team outlines the steps, timelines, and resources necessary to complete the mitigation plan. The steering committee, consisting of representatives from key agencies and local officials, oversees and guides the planning process.
- **Partner Development:** Identify and engage partners who will contribute to the process. These partners include local government agencies, non-governmental organizations (NGOs), community groups, and other entities with a vested interest in hazard mitigation.
- **Develop Outreach Strategy:** An outreach strategy is developed to engage the public and stakeholders through various channels. This may include meetings, social media, newsletters, and more. This includes a public survey to gather feedback from residents about their perceptions of hazards, mitigation needs, and priorities.

Assess Risk

Once the coordination phase is complete, the next step is to assess the hazards and risks that the community faces. This phase focuses on identifying and analyzing potential threats and their impacts.

- **Risk Assessment Methodology:** Identifies the natural and human-made hazards that may affect King County. This includes developing criteria for evaluating the severity, likelihood, and potential impacts of each hazard. This process helps ensure that all risks are adequately considered and prioritized. This is done by evaluating a comprehensive list of local, state, and federal data (see Chapter 4: Risk Assessment Overview).

- **Capability Assessment:** Evaluates the community's current capacity to respond to and manage the identified risks. This includes reviewing existing mitigation measures, resources, and expertise (see Chapter 19: Capabilities).

Mitigation Strategy

This phase focuses on developing strategies to reduce the identified risks. It is about determining actions that align with our goals, and establishing how the plan will be maintained.

- **Mitigation Strategy:** Craft detailed mitigation strategies in that align with the goal to reduce the impact and susceptibility of the identified hazards on people, property, and the environment, prioritizing historically underserved communities.

- **Identify Plan Maintenance:** Outline how the plan will be maintained and updated over time. This includes establishing a process for monitoring progress, updating risk data, and revising the plan as necessary.

Review & Adoption

The final phase of the hazard mitigation planning process involves reviewing and formalizing the plan, ensuring it meets regulatory requirements, and gaining official approval.

- **State Review:** The draft plan is submitted to the Washington Emergency Management Department (EMD) for review. The state ensures that the plan meets all applicable state regulations and is consistent with state hazard mitigation goals.

- **FEMA Review:** After state approval, the Federal Emergency Management Agency (FEMA) reviews the plan to ensure it meets federal standards and requirements for hazard mitigation planning.

- **Public Comment Period:** Following FEMA approval, the plan is made available to the public for 30-days to review and provide further input or concerns before the final plan is approved.

- **Council Approval:** The plan is submitted to King County Council for final approval. Once the governing body approve, the plan is officially adopted and becomes a living document that guides ongoing hazard mitigation efforts.

2.3 Jurisdiction Annex Process

KCOEM invited incorporated municipalities, Tribes, school districts, special districts, and other stakeholders to participate in the RHMP planning process. There are 29 participating jurisdictions and 21 special districts.

Jurisdictions	North Bend	King County Water District #125 (KCWD 125)
Beaux Arts Village	Redmond	Midway Sewer District
Bothell	Renton	North City Water District
Burien	Sammamish	Northeast Sammamish Sewer and Water District
Carnation	SeaTac	Renton School District
Clyde Hill	Shoreline	Riverview School District
Covington	Skykomish	Sammamish Plateau Water District
Des Moines	Snoqualmie	South King County Fire and Rescue
Duvall	Tukwila	Shoreline School District
Federal Way	Woodinville	Seattle Housing Authority
Hunts Point	**Special Districts**	Skyway Water and Sewer District
Issaquah	Cedar River Water & Sewer District	Soos Creek Water and Sewer District
Kenmore	Coal Creak Utility District	Valley Regional Fire Authority
Kent	Covington Water District	Vashon Island Fire and Rescue
Kirkland	King County Water District #19 (KCWD 19)	Woodinville Water District
Lake Forest Park	King County Water District #20 (KCWD 20)	
Maple Valley	King County Water District #90 (KCWD 90)	
Mercer Island		
Newcastle		

Individual jurisdictions and special districts participating in a multi-jurisdictional plan must meet the mitigation planning requirements, adopt the plan and provide documentation to FEMA through Washington State Emergency Management Department (EMD). Once the agency receives the jurisdiction's adoption, FEMA will issue an approval letter for the jurisdiction.

Each jurisdiction that chose to participate in the planning process and development of the plan was required to meet plan participation requirements defined at the first planning meeting. Those that were not able to participate in KCOEM's planning meetings had organized their own planning processes and have noted those meetings in their annex. The Core Planning Team hosted meetings for different phases of the planning process and presented at emergency management meetings in order to meet participants "where they're at" to provide updates on the planning process and gather input. Opportunities for participation include:

- **Kickoff Meeting:** First meeting to discuss the update of the RHMP and learn about FEMA's updated planning policy guide.
- **Steering Committee Meetings:** 9 total meetings providing committee members opportunity to contribute to the shaping of the planning process.
- **Annex Workshops:** 6 total workshops for participating jurisdictions and special districts to go through FEMA requirements for their RHMP annex.
- **Risk Assessment Workshops:** Review data on each of the identified hazards presented by subject matter experts and offering input on impacts and vulnerabilities.
- **Quarterly Emergency Management (EM) Meeting:** Review findings from the Risk Assessment Workshop and offering additional input on impacts and vulnerabilities.
- **Zone Meeting Presentation:** Discuss local, county, and state tools that help mitigate hazard risks and identify gaps in capabilities.
- **Co-Host Tabling Events:** Help to organize a community outreach event to discuss local and regional hazard risks.

Table 2-3 Jurisdictions and special districts participation in RHMP planning process

Jurisdiction	Kickoff Meeting	Steering Committee	Annex Workshops	Risk Assessment Workshop	Quarterly EM Meeting	Zone Meeting Presentation	Co-Host Tabling Events	Total
Beaux Arts Village								**0**
Bothell	1	1	1	1				**4**
Burien	1		1					**2**
Carnation			1				1	**2**
Clyde Hill	1							**1**
Covington	1		1		1	1		**4**
Des Moines	1		1		1		1	**4**
Duvall	1		1		1			**3**
Federal Way	1		2	1	1	1		**6**
Hunts Point								**0**
Issaquah		8	1					**9**
Kenmore	1							**1**

Jurisdiction	Kickoff Meeting	Steering Committee	Annex Workshops	Risk Assessment Workshop	Quarterly EM Meeting	Zone Meeting Presentation	Co-Host Tabling Events	Total
Kent					1			**1**
Kirkland	1		2		1	1		**3**
Lake Forest Park								**0**
Maple Valley			1			1		**2**
Mercer Island	1		2		1			**4**
Newcastle	1		2					**3**
North Bend								**0**
Redmond	1	4	1					**6**
Renton		8	2	1		1		**12**
Sammamish								**0**
SeaTac	1	**5**	1	1	1	1		**10**
Shoreline	1	**7**	3	1				**12**
Skykomish								**0**
Snoqualmie								**0**
Tukwila	1		1			1		**3**
Woodinville			1					**1**
Cedar River Water & Sewer District	1		4					**5**
Coal Creak Utility District	1		1					**2**
Covington Water District	1			1				**2**
King County Water District #19 (Vashon)								**0**
King County Water District #20 (Burien)								**0**
King County Water District #90 (East Renton)			2					**2**
King County Water District #125 (Tukwila)	1		1					**2**
Midway Sewer District			3					**3**
North City Water District		5	2	1				**8**
Northeast Sammamish Sewer and Water District		1	1					**2**
Renton School District								**0**
Riverview School District	1	1						**2**
Sammamish Plateau Water District	1		2					**3**
Shoreline School District								**0**
Seattle Housing Authority			1					**1**
Skyway Water and Sewer District	1	2	5	1				**9**
Soos Creek Water and Sewer District	1		4					**5**
South King County Fire and Rescue								**0**

Jurisdiction	Kickoff Meeting	Steering Committee	Annex Workshops	Risk Assessment Workshop	Quarterly EM Meeting	Zone Meeting Presentation	Co-Host Tabling Events	Total
Valley Regional Fire Authority								**0**
Vashon Island Fire and Rescue								**0**
Woodinville Water District	1		2					**3**
Grand Total	**23**	**42**	**53**	**8**	**7**	**7**	**2**	

Individual jurisdiction annexes were developed in partnership with King County, but with separate internal steering committees. The members of each jurisdiction's steering committee are documented in each annex.

Jurisdictions may join the regional hazard mitigation plan at any time by submitting a letter of intent to King County Emergency Management and completing the planning process and plan template. Each plan can be unique, and jurisdictions may do more than what is required in the template; however, this template is designed to help walk communities through the planning process in an accessible way. King County staff will provide technical assistance to planning partners, whenever possible.

The Core Planning Team hosted regular workshops for participating jurisdictions and special districts to go through FEMA requirements for their RHMP annex. These workshops were held on June 7th, June 14th, June 20th, July 11th, July 19th, and July 25th. There were over 50 attendees for the combined six workshops. Further support was offered to those seeking to apply for grant funding for their mitigation strategies.

Following the submission of the base plan in October 2025, King County will begin a second stage of outreach targeting those jurisdictions who missed the original submission deadline and those who were not previously involved. Among the second group, school districts will be proactively engaged and offered assistance in developing annexes to the hazard mitigation plan.

2.4 Timeline

The following timeline outlines key events and milestones for King County in the Regional Hazard Mitigation Plan Update. The planning process officially began in December 2023 and workshop, open to all planning partners. Following the kickoff, the Core Planning Team successfully facilitated 9 steering committee meetings, 6 planning workshops for jurisdictions annexing onto the plan, and engaged with over 60 subject matter experts to ensure a comprehensive and collaborative approach to the plan's development.

Table 2-4 Plan update timeline

Planning Activity	Date	Summary	Attendees
Plan Kickoff	Dec 2023	Conduct a kickoff meeting for the planning process, including discussions of expectations and the project timeline.	Designated county, city, and special district staff who are leading local plan updates
Steering Committee Meeting Kickoff	Feb 2024	Outline proposed planning process and timeline and approve plan and plan annex templates.	Steering committee
Outreach Strategy Meeting	Feb 2024	Meet with staff to identify outreach strategy	KCOEM staff
Steering Committee Meeting	Mar 2024	Identify public outreach sites and strategy	Steering committee
Steering Committee Meeting	Apr 2024	Integrating equity and social justice into the mitigation plan.	Steering committee
Steering Committee Meeting	May 2024	Integrating equity and social justice into the mitigation plan.	Steering committee
Annex Workshop	June 2024	Hosted 3 workshops the month of June to review the planning process and help local partners on mitigation planning questions	local jurisdiction partners
EMCC Meeting	June 2024	Mitigation strategy meeting discussions and identify points of contact in each agency	County departments
Steering Committee Meeting	June 2024	Establish plan goals, priorities, and strategy prioritization method	Steering committee
Annex Workshop	July 2024	Hosted 3 workshops the month of July to review the planning	local jurisdiction partners

		process and help local partners on mitigation planning questions	
Steering Committee Meeting	July 2024	Establish plan goals, priorities, and strategy prioritization method	Steering committee
Wildfire Strategy and Community Preparedness Discussion	July 2024	Discuss planning process, community outreach, funding opportunities, and mitigation strategies	Residents of North Bend, KC community members, local partners
Hazard Mitigation Workshop	July 2024	Work through the entire strategy development process from risk identification to mitigation projects.	County and local partners
Steering Committee Meeting	Aug 2024	Review mitigation capabilities	Steering committee
Mitigation Funding Workshop	Aug 2024	Work through process of developing a successful hazard mitigation grant application	County and local partners
Risk Assessment Workshop	Sept 2024	Review risk and vulnerability assessments	Subject matter experts
Steering Committee Meeting	Oct 2024	Review base plan and King County mitigation strategies	Steering committee
County Departments Strategy Coordination	Nov 2024	Meet with King County departments to go over all the mitigation strategies, eliminate gaps, and ensure consistent priorities.	County departments, including OEM, FMD, DNRP, PHSKC, KCIT, DES.
Steering Committee Meeting	Nov 2024	Review draft base plan	Steering committee
Mitigation Strategy Meetings	Dec 2024	Meet with internal planning partners (county departments)	DNRP, PHSKC, ECO, FMD

		to develop mitigation strategies.	
Steering Committee Meeting	Jan 2025	Review draft base plan	Steering committee
Submit to WA EMD and FEMA	Feb 2024	Submit full mitigation plan to FEMA for review	Planning Team
Plan Adoption	Sept 2025	King County Council vote to approve plan	King County Council
Plan Approval	Oct 2025	FEMA plan approval	FEMA Region 10

2.5 Outreach and Engagement

King County Office of Emergency Management (KCOEM) led an extensive public outreach campaign to gain public input for the RHMP. KCOEM uses public input to help prioritize which strategies listed in this plan should be implemented. The campaign included partnering with jurisdictions and community-based organizations to engage the public both through an online public survey and in-person tabling events.

2.5.1 Public Survey

The online survey was run from June 2024 to November 2024. It conducted on the platform "PublicInput" and saw a total 135 participants from all over the county. The top hazards listed were earthquake, extreme weather, and wildfire (including smoke impacts). To maximize outreach, the survey was promoted through the King County Emergency Blog and Department of Executive Services newsletters, advertised on the KCOEM Instagram page, and featured on the King County website banner. Additionally, printed copies of the survey were distributed at tabling events, community meetings, and shared with partners, jurisdictions, and entities involved in the planning process.

Survey questions include:

1. Where do you live?
2. What top three hazards are you most concerned about?
3. If your city had $1,000,000 to make your community safer from disasters, what would you spend it on?
4. If your city had $10,000 to make your community safer from disasters, what would you spend it on?

Figure 2-1 King County hazard survey flyer

Regional Hazard Mitigation Plan

We want to know what you think.

King County Regional Hazard Mitigation Plan

We're updating our hazard mitigation plan and seeking input. The plan looks at ways to reduce risks from natural and human-caused hazards in the region. If you live anywhere in King County, we'd like to hear your ideas.

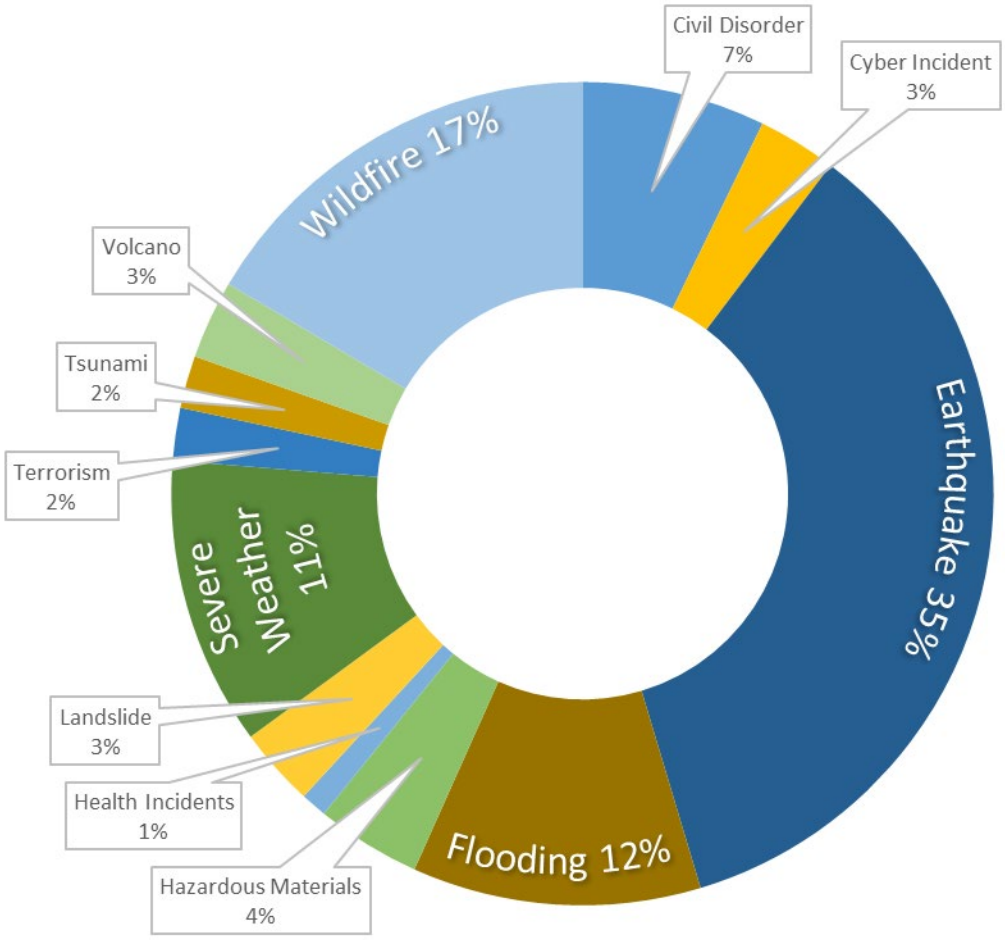
- What are the hazards you are most concerned about?
- What would you do to make your community safer?

Take the survey

publicinput.com/v1147

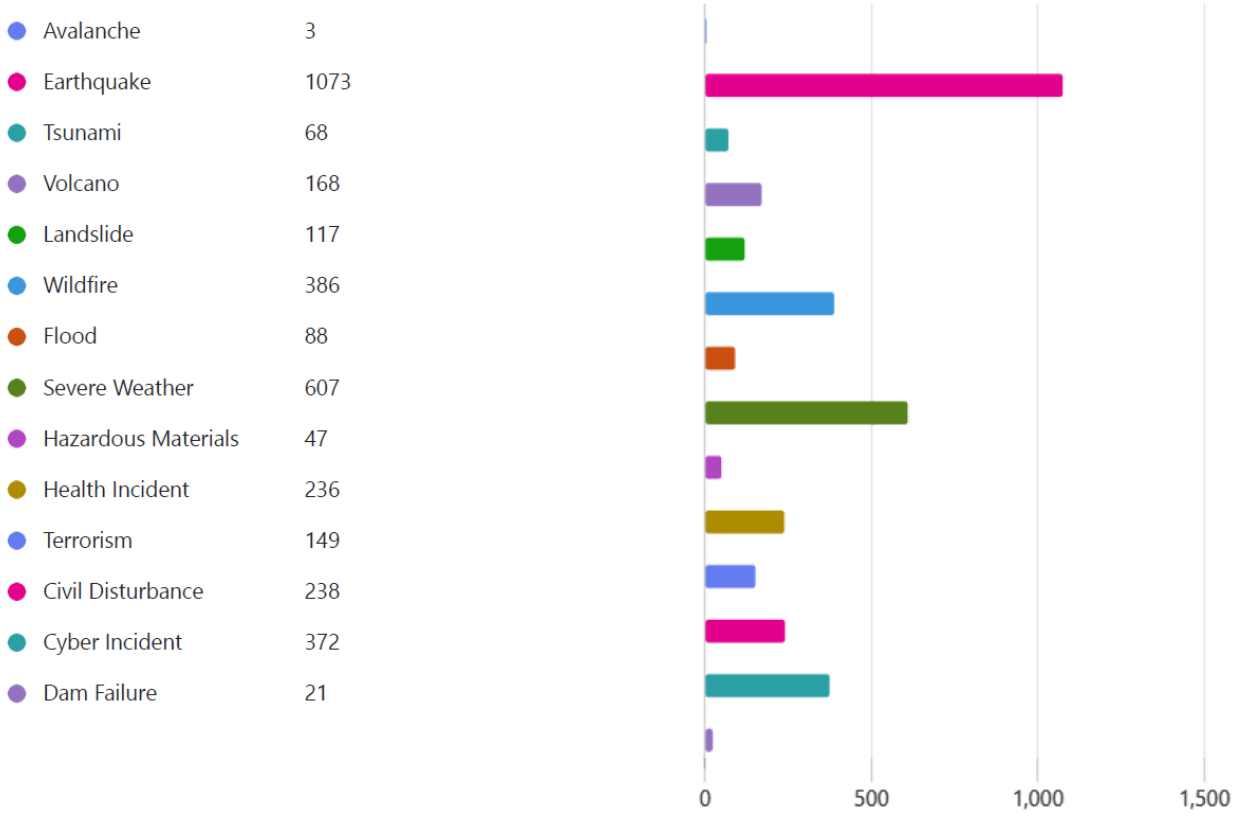
King County
Emergency Management

Figure 2-2 King County public survey results on top hazard concerns



In addition, on September 19, 2024, KCEOM conducted its semiannual Alert King County test and survey to opt in members of the Alert King County System. One of the survey questions asked participants, “What are the top three King County Hazards you are most concerned about?” The survey saw 1194 responses and the top three hazards were: 1. Earthquake 2. Extreme Weather and 3. Cyber Incident.

Figure 2-3 Alert King County survey results on hazard concerns



2.5.2 Tabling events

Figure 2-4 Public outreach tabling event in Kent, WA

KCOEM attended 34 community events across the county with approximately 3000 attendees (see Table 2-4).

At the events, we presented the survey using an interactive poster (see Figure 2-5). Attendees were invited to place dotted stickers on the locations where they live and on the hazards they were most concerned about. We also provided sticky notes for participants to write down actions they'd

like to see taken to mitigate these hazards. For children, we offered a spinning wheel featuring trivia questions on hazards and emergency preparedness to engage them in a fun and educational way.

These tabling events received input from over 700 community members in total, requesting information on which hazards they are most concerned about in their communities. Wildfire emerged as a top hazard in the more rural areas of North Bend and Black Diamond, whereas earthquake was the top hazard in the more urban areas of Seattle, Tukwila, and Des Moines. Community members in Redmond cited cyber incident as their top concern.

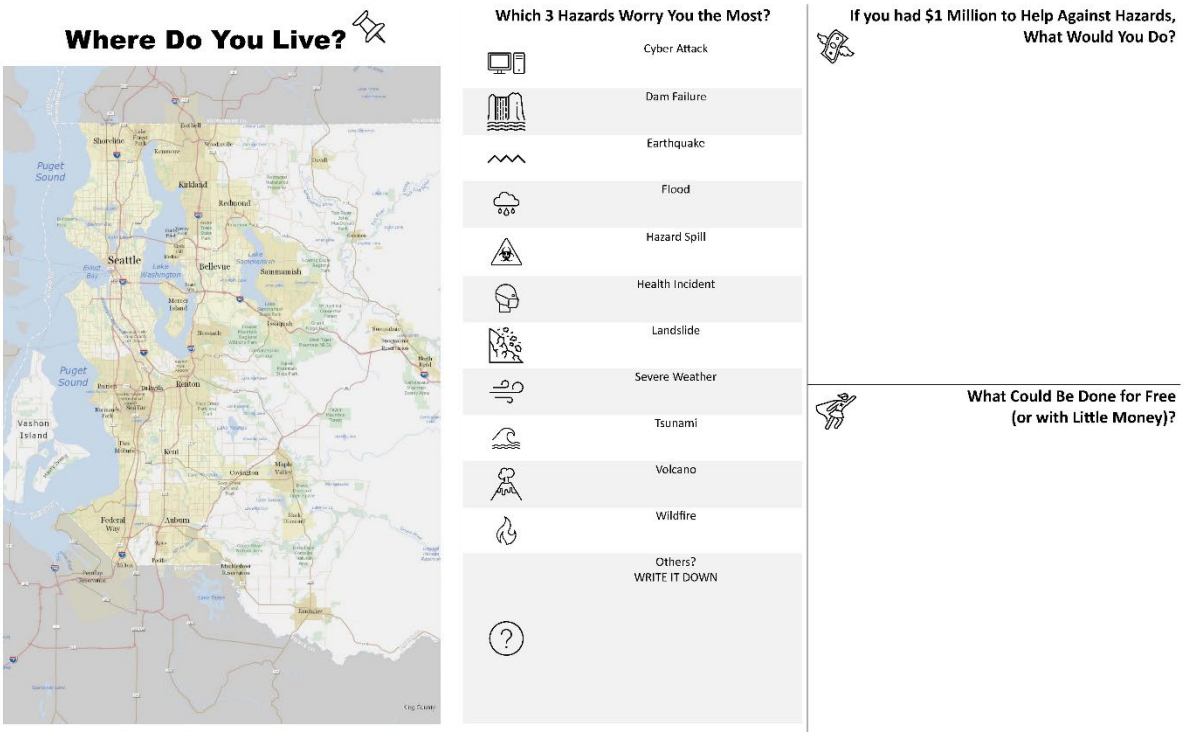
Many residents also shared personal stories of past events that left them vulnerable. For example, during snow and ice storms, Skyway residents often find themselves unable to travel due to the area's hilly terrain. This isolation is compounded by limited resources including the community only having one grocery store on the hilltop and one bus line that runs through the area. This makes access to food and services challenging, particularly during severe weather events.

Table 2-5 Public outreach tabling events, May 2024 – November 2024

Date	Event	Jurisdiction	Attendees
May 4, 2024	Pacific Islander Cultural Festival	Seattle	80-100
May 8, 2024	Skyway Public Library Resource Fair	Skyway	20
May 10, 2024	Auburn Valley Cities Resource Fair Tabling	Auburn	35
May 20, 2024	Chinese Cultural Festival	Seattle	150-200
May 29, 2024	Wildland Fire and Touch a Truck	Black Diamond	200
June 6, 2024	White Center Heights STEAM Carnival	White Center	80-100
June 15, 2024	Skykomish Tunnel Days	Skykomish	25
July 27, 2024	Community Resource Fair	Kent	60
July 30, 2024	Legislative Branch Picnic	Redmond	60
July 30, 2024	Des Moines Block Party	Des Moines	30
July 31, 2024	Marymoor - Movies in the Park/Go Green Night	Redmond	50
August 6, 2024	National Night Out	Carnation	55
August 6, 2024	National Night Out	Milton	100
August 14, 2024	Akin Children's Resource and Back to School	Kent	250
August 17, 2024	Skyway Health and Safety Fair	Skyway	40
August 17, 2024	Redmond Ridge Summer Festival	Redmond	150
August 26, 2024	Covington Wildfire Town Hall	Covington	70
September 12, 2024	Uwajimaya Seattle	Seattle	60
September 13, 2024	Uwajimaya Renton	Renton	100
September 14, 2024	Sammamish Emergency Preparedness Fair	Sammamish	70

September 14, 2024	NEMCo Preparedness Fair	Lake Forest Park	70
September 14, 2024	Maple Valley fire open house	Maple Valley	115
September 21, 2024	Love Train Community Block Party	Skyway	40
September 21, 2024	China Town Night Market	Seattle	100
September 26, 2024	Uwajimaya Bellevue	Bellevue	150
September 28, 2024	Carnation Be Dam Ready Evacuation Drill	Carnation	15
September 28, 2014	Maple Valley Emergency Preparedness Fair	Maple Valley	150
October 9, 2024	Highline College Resource Fair	Des Moines	200
October 11, 2024	Mother Africa Health and Wellness Fair	Kent	100
October 27, 2024	Skyway Farmers Market	Skyway	35
November 4, 2024	Muckleshoot Casino Resort Safety and Benefits Fair	Muckleshoot	200
November 13, 2024	Liberty Square Community Resource Fair	Renton	20
November 21, 2024	City of Carnation Open House	Carnation	10

Figure 2-5 Tabling event poster for public engagement



2.5.3 Continued Outreach

King County and its partner cities already maintains substantial public outreach capabilities, focusing on personal preparedness and education. Information on ongoing progress in implementing the hazard mitigation plan will be integrated into public outreach efforts. In the vertical integration of risk-reduction activities from personal to local to state and federal, it is important that the public understand how its activities support, and are supported by, larger-scale efforts.

The Core Planning Team will also continue to work with media and other agency partners to publicize mitigation success stories and help explain how we are safeguarding communities from the risk of hazard events. When possible, public tours of successfully completed mitigation projects will be organized to allow community members to see successful mitigation in action.

2.6 Plan Integration

When plans and planning processes are more integrated, it is possible to achieve greater impact through clearer definition, smarter investment, partnerships, and innovation. Successful integration requires coordination between planning efforts and, especially, cross-participation in planning processes. The goals of plan integration are to:

- Ensure consistency with jurisdiction priorities across all planning processes
- Leverage opportunities to further multi-benefit initiatives that are supported by multiple planning processes
- Achieve common measures of success for outcomes

The hazard mitigation plan can benefit from integration with planning processes that:

- Prioritize and invest in infrastructure
- Regulate development
- Set strategic direction for programs

To other planning processes, the hazard mitigation plan brings risk and vulnerability information to help prioritize projects and set development standards or regulations. The mitigation plan also comes with potential funding for investments in cost-effective risk-reduction projects. On the other hand, the mitigation plan depends on other plans and processes to implement many strategies. Since the mitigation plan is not itself a regulatory or budgetary document, strategies identified in the mitigation plan are often best implemented through those processes or programs.

The Core Planning Team leveraged a number of existing and ongoing planning processes and other documents, integrating data and strategies from state, regional, and county plans. This approach ensures alignment of priorities, synchronization of actions, and reduction of silos across jurisdictions. By coordinating hazard mitigation efforts at the regional and county levels, it is possible to address widespread hazards more effectively. Furthermore, by identifying common goals, there can be joint funding initiatives, sharing of resources, and coordinated efforts in implementing mitigation strategies. More information can be found in the Program Capabilities chapter of this plan.

- 2024 King County Comprehensive Plan
- 2024 King County Flood Management Plan
- Public Health - Seattle & King County 2024-2029 Strategic Plan
- 2023 Washington State Enhanced Hazard Mitigation Plan
- 2023 Hazardous Materials Response Plan
- Puget Sound Regional Council’s Vision 2050
- 2022 KC Wildfire Risk Reduction Strategy
- 2022 Washington Geological Survey:
- 2022 Washington Geological Survey: Tsunami Inundation, Current Speeds, and Arrival Times Simulated from a Large Seattle Fault Earthquake Scenario
- 2020 King County Strategic Climate Action Plan (SCAP)
- 2020-2025 KC Clean Water Healthy Habitat Strategic Plan
- 2019 King County Dam Inventory from the Washington State Department of Ecology
- 2017 Dam Safety Gap Analysis Report
- King County Equity and Social Justice Strategic Plan, 2016-2022

- 2016 Mapping of Potential Landslide Hazards along the River Corridors of King County, Washington

Furthermore, the RHMP will help inform plans and strategies put together by KCOEM including Prevention Protection Plan, Response Plan, Recovery Plan, and the Comprehensive Emergency Management Plan (CEMP).

Chapter 3: Community Profile

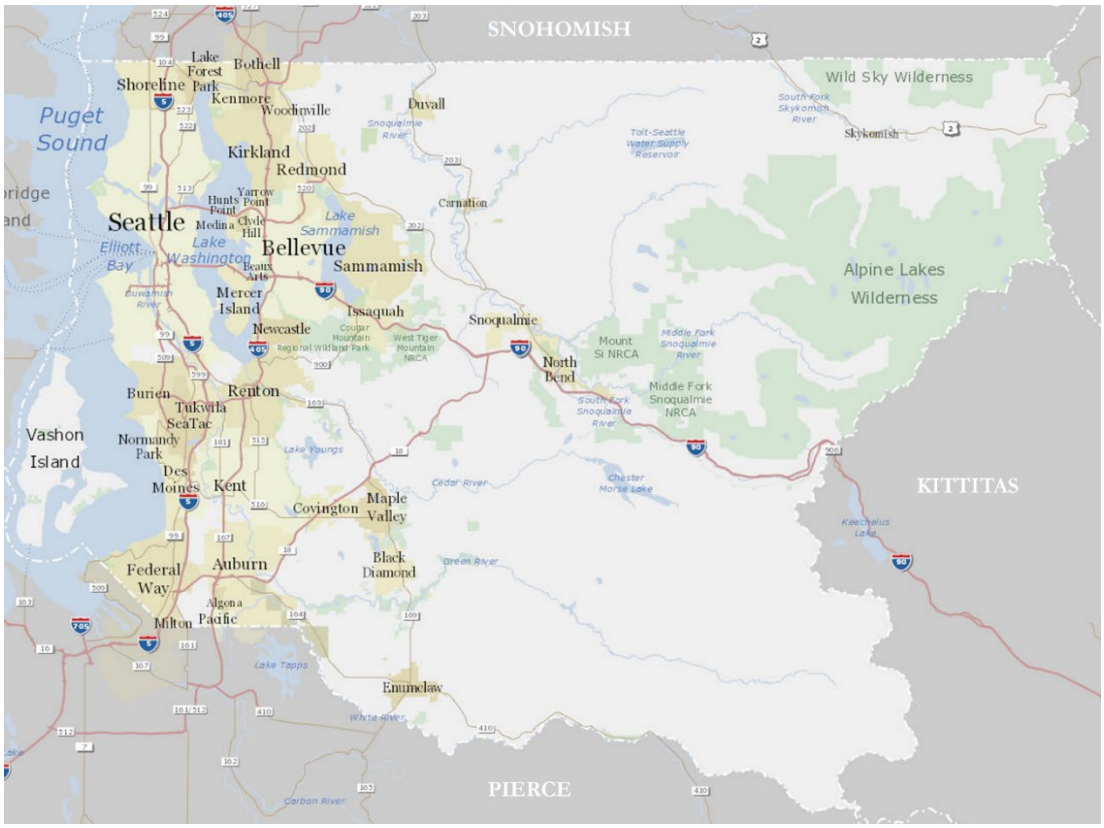
3.1 Geography

King County is located in western Washington, bordered by Snohomish County to the north, Pierce County to the south, and Kittitas County to the east. Its topography is incredibly varied, ranging from sea level along the Puget Sound in the west to mountain peaks approaching 8,000 feet in the Cascade Range to the east.

The county's human geography reflects this natural diversity, with densely populated urban areas along Puget Sound, suburban neighborhoods east of Lake Washington, rural communities to the southeast, and remote towns nestled in the Cascade foothills. King County is home to 39 cities and towns, and two tribal nations Muckleshoot and Snoqualmie Tribe.

Seattle, the county seat, is Washington state's largest city and serves as the cultural and economic hub of the region. King County is both the most populous county in the state and the most densely populated, ranking 12th largest in the nation.

Figure 3-1 King County geography



3.2 Climate

The Puget Sound and Cascade Range plays a key role in shaping its climate. The region is heavily influenced by maritime atmospheric conditions, with the mountains acting as natural barriers trapping in moisture. As moist air is forced upward by the Cascades, it cools and condenses, leading to heavy precipitation on the windward side of the mountains. In addition to its natural climate influences, the region is home to numerous urban centers and transportation networks that feature impermeable surfaces, which contribute to the urban heat island effect.

3.3 History

King County is a part of a larger area that has been the traditional aboriginal territory of the Coast Salish peoples, who continue to live around the Salish Sea in what is now Washington State and the Canadian province of British Columbia. These sovereign tribal nations enrich the region through environmental stewardship, cultural heritage, and economic development.[1]

Before European-American settlers arrived, the region's economy and culture were sustained by the Coast Salish peoples through practices like hunting, freshwater and saltwater fishing, and gathering plants for food and medicine. Waterways served as the primary means of transportation, fostering interconnectedness and commerce.

European-American settlement of the area now known as King County began in the 1840s. Natural resources – especially timber – played a major role in King County's early history. Maritime trade spurred the development and growth of Seattle, which was established in 1869. Seattle became an important stopping point for those hoping to prospect for gold in Alaska and the Yukon Territory at the close of the 19th century.[2]

In the 20th century, communities in King County were profoundly shaped by discriminatory practices, particularly in housing and employment. All minority groups in Seattle faced various forms of discrimination, including geographic segregation, inequitable access to jobs, and housing discrimination. Seattle's redlining practices, in particular, exacerbated racial and economic

[1] Metropolitan King County Council, "King County Comprehensive Plan" (December 2024): https://kingcounty.gov/en/dept/council/governance-leadership/county-council/useful-links/comprehensive-plan/2024

[2] Anneliese Vance-Sherman, Ph.D., "King County profile" *Washington Employment Security Department* (May 2022): p 1, https://esd.wa.gov/media/pdf/952/king20county20profile202022pdf/download?inline#:~:text=The%20county's%20median%20household%20income,the%20state%20at%209.8%20percent.

segregation, leaving neighborhoods like the Central District to suffer long-term disinvestment, declining property values, and substandard housing quality.[3]

The legacy of redlining continues to shape the built environment and ongoing inequalities in the region. Communities of color still face limited access to critical resources like education, healthcare, and job opportunities. Additionally, these neighborhoods often experience heightened exposure to environmental hazards, such as flooding, pollution, and the impacts of earthquakes.

3.4 Population

Table 3-1 2023 King County Demographics[4]

King County	King County Estimate
Total population	2,271,380
Under 5 years	5.0%
Median age (years)	37.7
Under 18 years	19.1%
65 years and over	14.5%
Male	50.6%
Female	49.4%
Owner-occupied	55.6%
Renter-occupied	44.4%
Gross Rent Median (dollars)	$ 2,043
Average household size	2.35
Median household income (dollars)	$120,824
Per capita income (dollars)	$72,488
High school graduate or higher	94.1%
Bachelor's degree or higher	58.3%
Employed	67.8%
Unemployment	3.0%

King County's population has increased by approximately 17 percent from 2010 to 2023. Since 2020, the population has grown by an average of 1,675 people annually, or 0.1%, a significant slowdown compared to the 1.1% average annual increase from 2017 to 2020. The slowdown in population growth is primarily due to fewer people are being born in King County than before, and more people have been leaving the area than moving in.

Most of King County's residents are of working age, with the largest share of residents (17 percent) being 30 to 39 years old. Approximately 20 percent (449,242) of King County's population is 17 years old or younger. Unincorporated King County residents are older on average than King County residents.

The per capita income in King County exceeds $72,000, while the median household income is over $120,000. Income distribution is varied, with 20% of the population earning less than $50,000, 22% earning between $50,000 and $100,000, 29% earning between $100,000 and $200,000, and 29% earning over $200,000. While the data shows King County to be overall affluence, a significant portion of low-income households

[3] City of Seattle, "Redlining in Seattle" *Seattle Municipal Archives* (n.d.): https://www.seattle.gov/cityarchives/exhibits-and-education/online-exhibits/redlining-in-seattle
[4] US Census Bureau, "DP02: Selected Social Characteristics", "DP03: Selected Economic Characteristics", DP04: Selected Housing Characteristics", "DP05: ACS Demographic and Housing Estimates" *American Community Survey* (2023)

face substantial housing challenges. In 2023, 70% of low-income households in King County spent more than 30% of their income on housing.[5] This financial strain makes it difficult for these households to afford other essential needs, such as food, healthcare, and transportation.

Figure 3-2 2020 US Decennial Census, King County Race and ethnicity Data

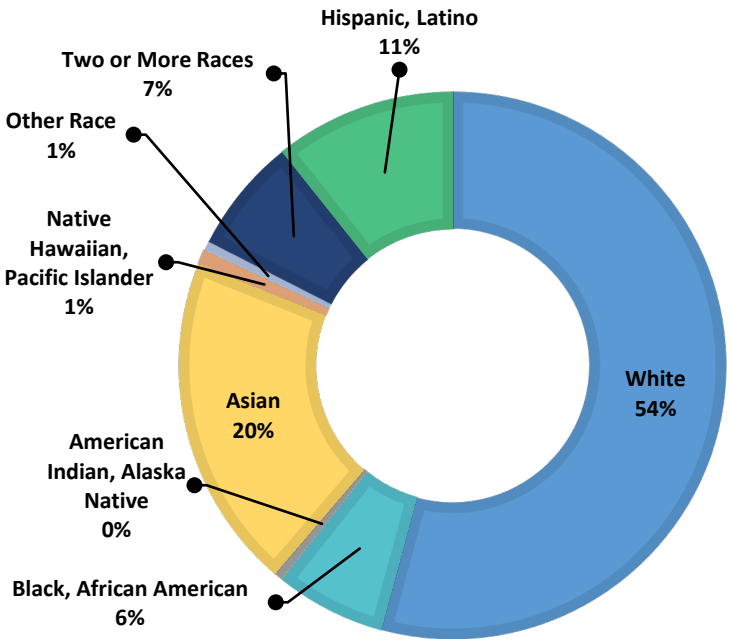


Figure 3-2 shows King County's 2020 Decennial Census data on race and ethnicity. Between 2010 and 2020, King County saw significant increases in racial diversity, particularly large growth in the Asian (60 percent) and Hispanic/Latino community (41 percent). Communities that saw a decline in population include White (1.6 percent) and American Indian/Alaskan Native population (8.7 percent). It's important to note that U.S. Census has historically faced challenges when it comes to accurately capturing Native American populations, especially those living on reservations.

Vulnerable Populations and Population-Based Vulnerability

Population vulnerability (or social vulnerability) measures factors that theoretically increase the likelihood of a population to suffer more losses during disasters or recover more slowly after being impacted. There is a growing body of work on this kind of vulnerability; however, how the data is reported can obscure the root causes of vulnerability when converted into an index or score. Knowing the root causes of vulnerability and how those vulnerabilities contribute to losses during disasters is critical for hazard mitigation professionals since each cause may require a unique strategy to address. For example, if the vulnerability results from language differences, then this can be addressed with robust translation and outreach services.

Communities that consider population-based vulnerability and social justice, often do it as an overlay – examining the impacts of a proposed project on vulnerable populations, for example, after the project has already been prioritized or mapping the location of vulnerable populations in accordance with some composite score and institutionally-defined definition of vulnerability. It is

[5] King County, "Regional Affordable Housing Dashboard" (November 2024): https://kingcounty.gov/en/dept/dchs/human-social-services/housing-homeless-services/affordable-housing-committee/regional-affordable-housing-dashboard

unclear if mapping alone, if awareness alone, has had much impact on where the bulk of resources are directed.

For this analysis, we examine the best available data of factors that have been found to lead to increased losses or recovery times following hazard events. This is to establish areas with different kinds of heightened vulnerability. We then overlay data on race, ethnicity, and income. This is to establish where equity may be a concern, where causes of vulnerability overlap with historically underrepresented minority populations.

Determinants of Population Vulnerability

Factors that were identified through research and by the planning team as critical determinants of vulnerability. However, Good data at the appropriate scale was not available for all the below factors. Maps of a selection of these factors, along with priority hazard areas, follow the list of variables.

Population factors

(population-based measures)

- Home Ownership Status
- Age
- Unemployment, Income
- Wealth, Access and Functional Needs/Disability
- Dependence on public transportation
- Language other than English spoken at home
- No health insurance
- Hazard insurance coverage
- Minimum wage employment/service sector employment,
- Families with dependents
- Living in poverty
- Crime rate
- Years of schooling completed

Accessibility & capital factors

(access/infrastructure meaures/ social capital)

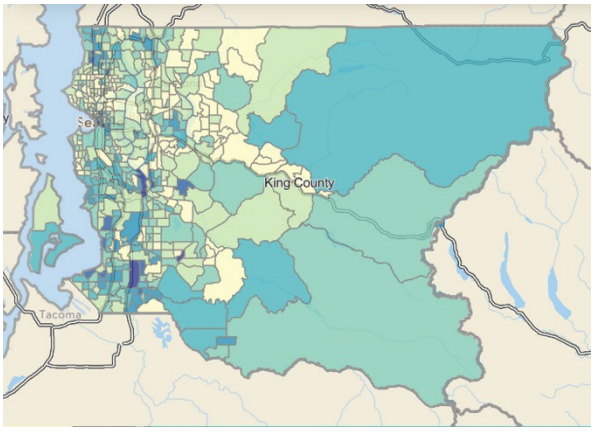
- Access to services
- Quality of public facilities
- Access to phone + internet
- Average age of housing
- Average commute time/distance to work
- Per capita government spending
- Neighborhood engagement

Meta-factors

(Determinants of equity)

- Race, ethnicity
- Age
- Income
- Immigrant, refugee status

The following maps are gathered from FEMA's Resilience Analysis and Planning Tool (RAPT) with quantitative insight from the 2023 US Census American Community Survey 1-Year estimates. They illustrate several of the above variables associated with greater hazard risk along with high hazard areas and non-white populations. This is just a selection of potential variables and illustrates how high-hazard areas, factors associated with hazard risk, and communities of color or with higher rates of disability may overlap. The highest population-risk areas in King County tend to be areas south of Seattle in the Green River Valley. These areas also are areas with the highest hazard risk. Investments that target critical public infrastructure and support structures in these communities would likely have the best cost-benefit ratio. Investments in these areas would have the added benefit of also promoting more equitable access to high-quality infrastructure and services for populations historically underserved by public investment.

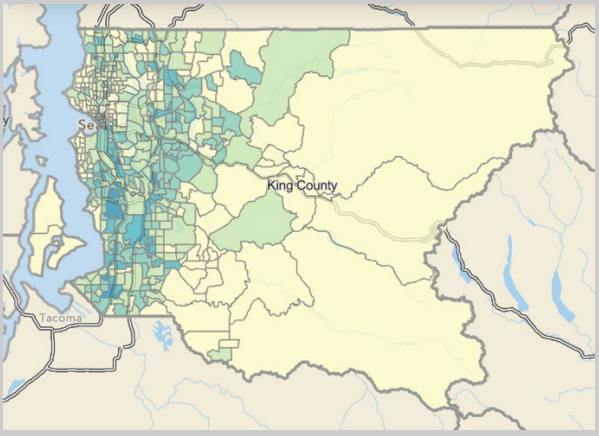


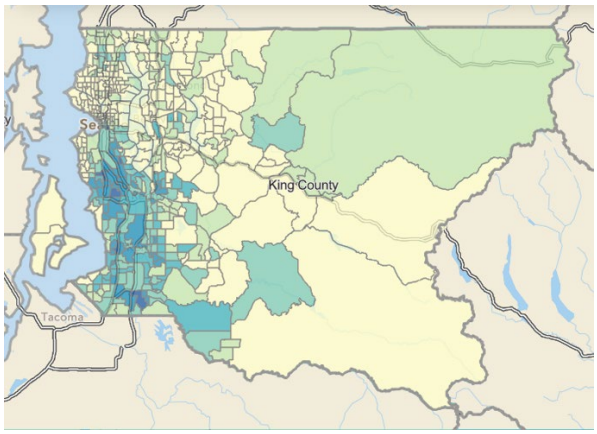
People with access and functional needs/disabilities 10.5%

Concentrated populations in Kent, Algona, Pacific, Renton, Shoreline, and Kenmore. These individuals may require additional support in areas such as mobility, communication, or daily living activities.

Limited English 11%

Residing primarily in Bellevue, Newcastle, Renton, Federal Way, Burien, and Seattle. Limited English proficiency can affect individuals' ability to access essential services such as healthcare, education, and employment opportunities. This population includes immigrants, refugees, and non-native English speakers who may face language barriers in navigating day-to-day life, emphasizing the need for culturally competent services and language assistance programs in these areas.



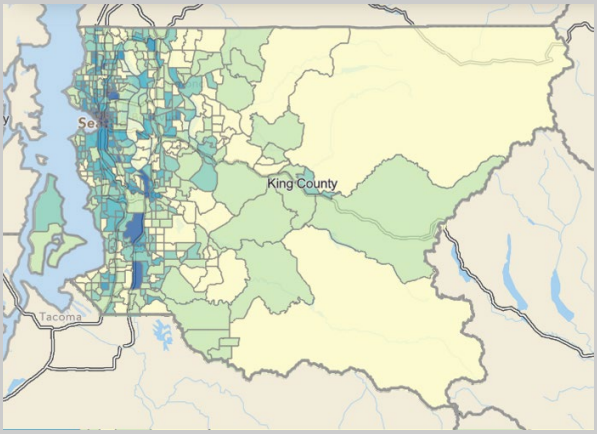


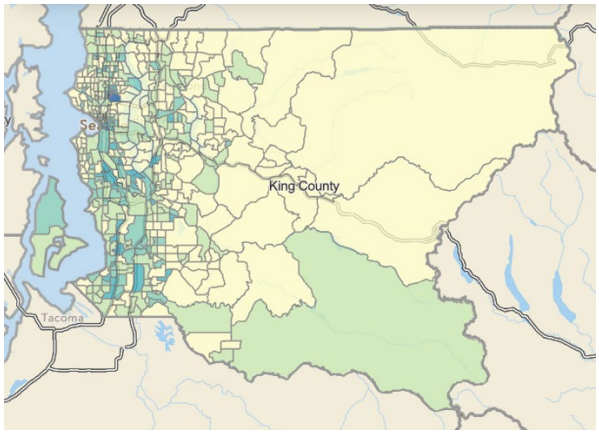
No high school diploma

Trend is shown in south Seattle, Tukwila, SeaTac, Des Moines, Algona, and Auburn. This demographic often faces greater barriers to employment and economic mobility. Lack of a high school diploma can limit access to better-paying jobs and higher education opportunities, contributing to socioeconomic disparities in these communities.

Don't own a vehicle 11.9%

Higher concentration in Seattle, Renton, Kent, and Auburn. While the city of Seattle has a robust transit network, cities such as Renton, Kent, and Auburn are more limited and would require connections to the Sound Transit Light Rail, or train stations (connecting to Sound transit buses or the Sounder commuter rail) to better connect to the region. Lack of vehicle ownership can limit access to job opportunities, healthcare, education, and essential services, particularly in areas with limited public transportation options.



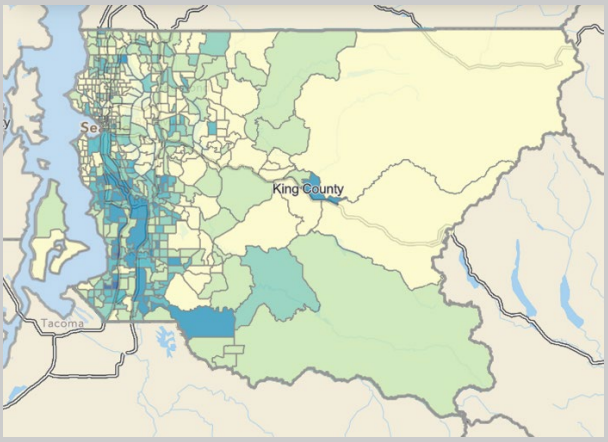


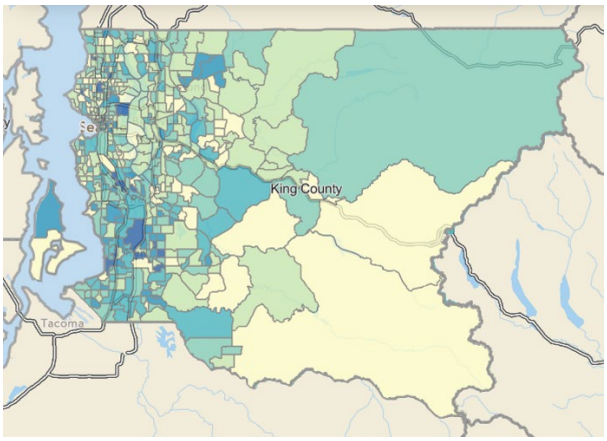
Below the poverty line

8.8% of individuals, 10.8% of children under 18 years old, 5.1% of families are living below the poverty line. Those facing these economic challenges experience a higher cost burden which can limit their access to education, healthcare, housing and food security.

No health insurance coverage 4.9%

Primarily reported with people who reside in South King County, lack of health insurance can result in individuals delaying or avoiding necessary medical care, which may lead to worsened health outcomes and higher costs in the long term.





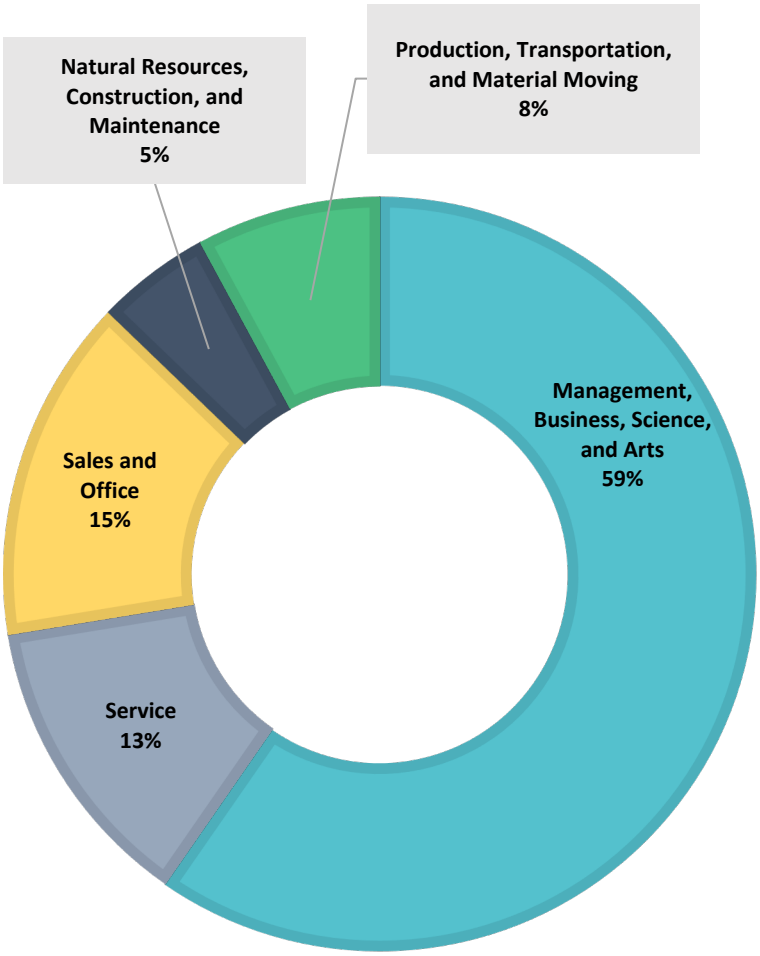
Unemployment 3%

Seen in communities such as Vashon, Skykomish, and Redmond. This can be the result of a lack of diverse work opportunities. Unemployment can pose several risks to individuals, families, and communities. These risks extend beyond financial instability and can have long-term effects on health, mental well-being, and overall societal outcomes.

The results from this analysis will be used to promote more effective, equitable disaster mitigation, response, and recovery by identifying key vulnerabilities and areas that may require additional investment. This analysis will also help identify areas where public infrastructure is older or less resilient, or where hazard risk is greater, so that additional investments can be targeted in those areas.

3.5 Economy

Figure 3-3 2023 US Census data, King County Industries



Throughout the 1990s, the county underwent extraordinary gains in employment, population and wages. Despite the county's increasing cost of living, especially in housing, the high-tech job boom lured well-educated newcomers to the area; a pattern that has continued to the present day. King County continues to hold a strong national reputation as a hub for information technology development.[6]

King County is culturally diverse and aims to be a place where people from a variety of backgrounds can feel at home. The geographic orientation of King County on the Pacific Rim and the presence of an active natural deep-water port reinforce strong economic ties to East Asian markets. In 2008, King County nonfarm employment reached a peak in excess of 1.2 million jobs before joining the rest of the nation in recession. Job growth was strong and stable from 2010 to 2019. Total nonfarm employment in King County climbed to nearly 1.47 million over the long economic expansion. The pandemic-induced recession of 2020 interrupted the long arc of local employment growth. From February to April 2020, total nonfarm employment plummeted by about 166,600 jobs – more than 11.0 percent. Total employment since April 2020 has shown remarkable recovery, with a great deal of variation by industry. Total employment continues to expand. As of March 2022 (preliminary), businesses located in King County collectively supplied nearly 1.46 million jobs – about 10,000 shy of pre-pandemic levels. King County is characterized by a diverse economy. Major industry sectors in King County supplying

[6] Anneliese Vance-Sherman, Ph.D., "King County profile" *Washington Employment Security Department* (May 2022): p 2, https://esd.wa.gov/media/pdf/952/king20county20profile202022pdf/download?inline#:~:text=The%20county's%20median%20household%20income,the%20state%20at%209.8%20percent.

more than 100,000 estimated jobs in 2021 include professional and business services, education and health services, retail trade, government, information, and leisure and hospitality.

Prior to the pandemic-induced recession of 2020, King County was well-situated, with long-term growth observed in all major industry sectors. The COVID-19 pandemic disrupted all industries at a local level, with employment patterns varying substantially from one industry to the next. Leisure and hospitality lost the largest number of jobs of any sector (65,100 jobs from February to May, not seasonally adjusted). As of March 2022, this set of industries was still down 44,000 jobs or about 30 percent. At the other end of the continuum, industries such as information and professional and business services, maintained or even expanded employment levels, even early on, insulated by the ability to establish telecommuting arrangements for their workforces. King County's information sector added 700 jobs during the initial months of the pandemic. As of March 2022, employment in the information sector was 15,500 above the level observed in March 2020. Comparing March 2022 against March 2020, the following industries have fully recovered or expanded total employment: professional and business services (up 15,600 jobs), information (up 15,500 jobs) retail trade (up 9,000 jobs), financial activities (up 4,000 jobs), and construction (up 1,400 jobs).

Referencing the same time frame, the following industries have yet to recover the number of jobs lost in the pandemic recession: leisure and hospitality (down 19,400 jobs), manufacturing (down 9,900 jobs), government (down 9,200 jobs), other services (down 8,600), wholesale trade (down 3,700 jobs), transportation, education and health services (down 2,800 jobs), and warehousing and utilities (down 1,400 jobs).

3.6 Development Trends

Over the past decade, King County saw steady population growth, particularly in Seattle and its surrounding cities including Bothell, Kent, Renton, Shoreline, Lynnwood, Redmond, SeaTac. The demand for housing close to transit hubs, job centers, and amenities spurred the construction of high-rise apartments and condominiums in downtown Seattle and other urban areas. The Washington State Office of Financial Management projects that King County's population will grow by 24.6%, reaching 2,887,137 people by 2044. In contrast, the population of unincorporated King County is expected to grow more slowly, increasing by 7.3% to 266,301 people by 2044.

As demand for housing increased, King County also faced challenges with affordability. Housing prices surged, especially in Seattle, due to high demand, limited supply, and low interest rates. Many residents moved further out from the city center, due to rising costs in Seattle, leading to increased development in suburban areas like Bothell, Renton, Shoreline, and Kent. There was a notable shift toward suburban apartments, townhomes, and single-family homes that catered to those seeking more affordable living options. To accommodate the housing needs of both current and future residents, King County is required by the Growth Management Act and the Countywide Planning Policies to plan for housing that serves a range of income levels, from moderate to

extremely low-income households. This includes provisions for emergency housing, shelters, and permanent supportive housing. By 2044, urban unincorporated King County will need an additional 5,412 housing units, along with 1,034 new emergency housing beds to meet short-term housing needs.[7]

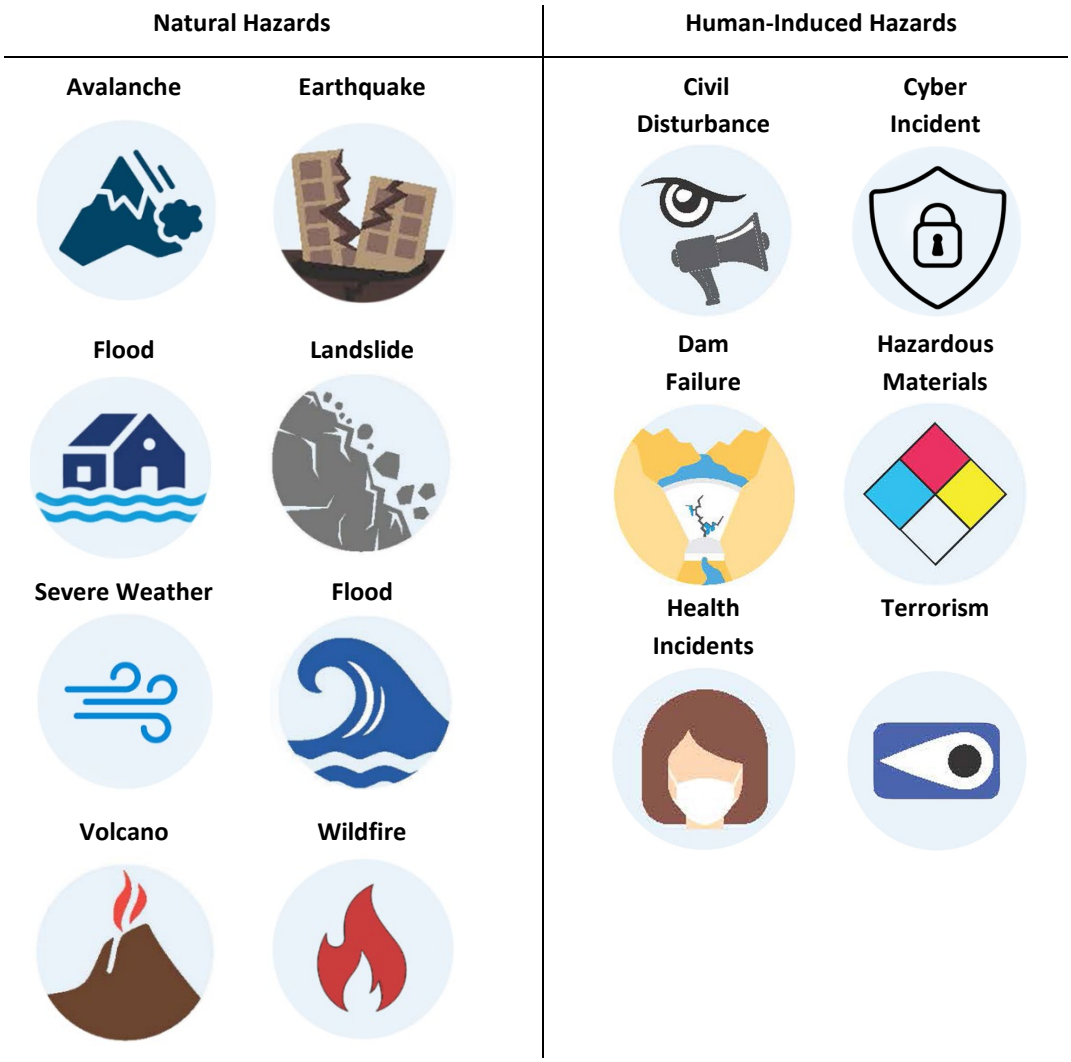
The 2024 King County Comprehensive Plan Maintaining the urban growth boundaries and developing within this area. The plan focuses on maintaining urban growth boundaries and encouraging development within these areas. Zoning updates will expand middle housing options, such as duplexes and triplexes, and offer increased incentives for affordable housing. It will also address temporary farmworker housing needs. Environmental protections are part of the plan, with policies aimed at promoting green energy, climate action, and improving infrastructure resilience against flooding and wildfires.

[7] Metropolitan King County Council, "King County Comprehensive Plan" (December 2024): https://kingcounty.gov/en/dept/council/governance-leadership/county-council/useful-links/comprehensive-plan/2024

Chapter 4: Risk Assessment Overview

4.1 Overview

The King County Regional Hazard Mitigation Plan identifies 14 hazards, including 8 natural hazards and 6 human-induced threats. The list of hazards was developed through an examination of the previous RHMP, local hazard mitigation plans, and hazard events in the last five years. The list was cross referenced with FEMA's National Risk Index (NRI), a tool that assesses natural hazards and community risk factors. Based on insights from these sources and recent trends in hazard events, we retained the same list of hazards from the 2020 plan.



A risk assessment was conducted with subject matter experts for each hazard. Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards.

Risk profile structure

- **Description:** This section provides clear, concise definitions of the specific hazard being assessed. It includes scientific and technical terms related to the hazard and its characteristics, ensuring a shared understanding for all stakeholders involved.

- **Location:** This section identifies and outlines geographical regions that are particularly vulnerable to the hazard. It highlights areas that are more likely to experience higher levels of risk based on historical data, topography, weather patterns, and other relevant factors.

- **Magnitude:** This defines the scale of the hazard's potential effects. For example, in the case of an earthquake, magnitude might be measured by the Richter scale, or in a flood, it could be measured by the depth of inundation or the amount of rainfall. This provides a basis for understanding how severe the hazard could be in terms of its physical, economic, and social impact.

- **Previous Occurrences:** This section provides a historical record of previous occurrences of the hazard in the area. It includes dates, locations, and the severity of past events, offering valuable insights into the frequency and extent of the hazard, as well as the impacts on people, property, and infrastructure.

- **Probability of Future Occurrences:** This section forecasts the likelihood of the hazard occurring in the future. It may include statistical probabilities based on historical data, trends, and modeling.

- **Climate Change Considerations:** This section examines how climate change might influence the frequency, intensity, or characteristics of the hazard.

- **Impact Assessment:** This section evaluates the specific consequences of the hazard on various sectors, using a structured table format.

- **Vulnerability Assessment:** This section outlines the vulnerabilities in different sectors. It identifies which groups or resources are most at risk and why. Stats and Specifics on What Is at Risk: Specific data, such as population demographics, infrastructure condition, or environmental features, are included here.

4.2 Methodology

Table 4-1 Hazard risk assessment methodology

HAZARD RISK ASSESSMENT *Risk = Hazard (Severity) x Impact (Exposure) x Vulnerability (Susceptibility)*		
	Location	Hazard
	Probability	
	Extent/Magnitude	
	Public	Impact
	Responders	
	Continuity of Operations (COO)	
	Property, Facilities, and Infrastructure (PFI)	
	Environment	
	Economy	
	Public Confidence in Governance (PCG)	
	Vulnerable Population	Vulnerability
	Property	
	Environment	
	Operations	
	People	Risk
	Property	
	Environment	
	Operations	
	Overall Risk	

Measurement	
1	Low
2	Moderate
3	High
4	Very High

The Core Planning Team developed a risk matrix to assess hazards, their impacts on county assets, and the vulnerabilities of these assets across various dimensions (see Table 4-1). The purpose of this risk assessment is to identify which hazards pose the greatest risk and which areas and assets are most vulnerable. The matrix incorporates Emergency Management Accreditation Program (EMAP) standards to quantify the hazard impacts on county assets and assess their vulnerability. It provides a snapshot of each hazard's impact and is complemented with qualitative insight to guide mitigation action. It contains key details to enable emergency managers to plan for and responding to disasters effectively. The matrix is broken up into three categories that equate to total risk. Risk depends on all three factors: the *hazard* that can cause damage, *exposure* to the hazard and the *vulnerability* of the exposed population. Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. It refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage.

4.2.1 Hazard Assessment

A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. Hazards exist with or without the presence of people and land development. Earthquakes, hurricanes, tornadoes, and other geological and meteorological events have been occurring for a very long time, and the natural environment adapted to their impacts. Hazard identification is the process of identifying hazards that threaten a given area. The likelihood and severity of the 14 hazards were measured in the following ways.

- **Location** – The percentage of the people and property within the planning area impacted by the event, and the degree to which they are impacted.

LOCATION			
1 - Negligible	2 - Limited	3 – Critical	4 - Catastrophic
Less than 10% - Few if any injuries or illness. Minor quality of life lost with little or no property damage. Brief interruption of essential facilities and services for less than four hours.	10-24% - minor injuries and illness. Minor, short term property damage that does not threaten structural stability. Shutdown of essential facilities and services for 4 to 24 hours.	25-49% - Serious injury and illness. Major or long-term property damage, that threatens structural stability. Shutdown of essential facilities and services for 24 to 72 hours.	More than 50% - Multiple deaths. Property destroyed or damaged beyond repair. Complete shutdown of essential facilities and services for 3 days or more.

- **Probability** – Probability of a hazard event occurring in the future was assessed based on the number of times the hazard event occurred divided by the period of record. If the hazard lacked a definitive historical record, the probability was assessed qualitatively based on regional history and other contributing factors.

PROBABILITY			
1 - Unlikely	2 - Possible	3 – Likely	4 - Highly Likely
Less than 1% probability in the next 100 years.	Between 1% and 10% probability in the next year, or at least one chance in the next 100 years.	between 10% and 100% probability in the next year, or at least one chance in the next 10 years.	Greater than 1 event per year (frequency greater than 1).

- **Extent/Magnitude** – Magnitude measures the strength of a hazard event. It was calculated for each hazard using available property damage data using the following equation: Property Damage / Number of Incidents) / $ of Building Stock Exposure = Magnitude. In some cases, the HAZUS model provided specific people/dollar impact data. For other hazards, a GIS exposure analysis was conducted.

EXTENT/MAGNITUDE			
1 - Negligible	2 - Limited	3 – Critical	4 - Catastrophic
Less than 5% - Very minor impact to people, property, economy, and continuity of government at 90%.	6-24% - Injuries or illnesses minor in nature, with only slight property damage and minimal loss associated with economic impact; continuity of government only slightly impacted, with 80% functionality.	25-49% - Injuries result in some permanent disability; 25-49% of the population impacted; moderate property damage; moderate impact to economy, with loss of revenue and facility impact; government at 50% operational capacity with service disruption more than one week, but less than a month.	More than 50% - Injuries and illness resulting in permanent disability and death to more than 50% of the population; severe property damage greater than 50%; economy significantly impacted as a result of loss of buildings, content, inventory; government significantly impacted; limited services provided, with disruption anticipated to last beyond one month.

4.2.2 Impact Assessment

The impact assessment examines seven key types of county assets located with a hazard area, incorporating both asset exposure and event magnitude to determine the overall impact. These assets are identified by the Emergency Management Accreditation Program (EMAP) consequence analysis for the hazards specified in Standard 4.1.1.

- **Public:** The impact on public health and safety is gauged by the number of people exposed and the magnitude of the hazard. A low-impact scenario involves minimal health and safety concerns, leading to minor inconveniences or temporary disruptions. In contrast, a very high-impact event can cause extensive health issues, significant fatalities, and severe public safety disruptions, potentially overwhelming healthcare systems and necessitating extensive emergency responses.
- **Responders:** The impact on emergency services - including fire, police, and EMS – is determined by the number of emergency requests and the magnitude of the event, which influences response times and resource allocation. A low impact would involve minor delays or disruptions with manageable resource demands. In a very high impact scenario,

responders face severe delays, overwhelming resource demands, and may struggle to provide adequate emergency services.

- **Continuity of Operations (COO):** This includes the operational stability of King County government functions, assessing disruptions and their effects on essential services and processes. A low impact involves minor disruptions with manageable effects on essential services and processes. A very high impact entails severe and widespread disruptions, potentially leading to a complete breakdown in essential services and prolonged recovery periods.
- **Property, Facilities, and Infrastructure (PFI):** The impact on private property includes damage to housing, critical infrastructure, roadways, and utilities. Low impact means minimal damage or inconvenience to property with little long-term effect. Very high impact results in severe and widespread damage to properties and infrastructure, causing significant financial losses and prolonged recovery.
- **Environment:** Hazards can affect natural resources, including wildlife, vegetation, and ecosystems, leading to changes in landscapes, waterways, and environmental systems. A low impact involves minor environmental changes with negligible effects on wildlife and natural systems. A very high impact indicates severe and widespread environmental destruction with long-term effects on natural resources, wildlife, and ecosystems, requiring substantial recovery and restoration efforts.
- **Economy:** Economic impacts encompass disruptions to business operations and economic assets, affecting overall financial stability. A low impact entails minimal disruption to business operations and economic assets with minor financial effects. Very high impact signifies severe and widespread economic disruption with major financial losses, potentially leading to long-term economic instability and extended recovery periods.
- **Public Confidence in Governance (PCG):** The perception of government effectiveness during and after a hazard event can influence public trust and confidence in emergency preparedness and response efforts. A low impact involves minor concerns about government response with little effect on overall public trust. A very high impact entails a severe loss of public confidence and trust in government, potentially leading to widespread criticism and long-term reputational damage.

4.2.3 Vulnerability Assessment

Vulnerability is susceptibility to physical injury, harm, damage, or economic loss. It depends on an asset's construction, contents, and economic value of its functions. Vulnerability assessment provides the extent of injury and damages that may result from a hazard event of a given intensity in a given area.

The Emergency Management Program identifies the natural and human-caused hazards that potentially impact the jurisdiction using multiple sources. The Emergency Management Program assesses the risk and vulnerability of the following:

- **Vulnerable Populations:** Communities limit to preparing and preventing impact to a hazard event.
- **Property:** Properties limit to withstanding and maintaining integrity to a hazard event.
- **Environment:** Environments limitation to preventing degradation during and following a disaster.
- **Operations:** lifelines that have limited capacity and resources to properly respond to a hazard event.

4.2.4 Risk Calculation

When calculating risk, we're looking at most likely scenario accounting for currently capabilities and regulations (reference chapter 19 for capabilities).

People

To assess the total risk to people, we consider hazard assessments, potential impacts on individuals, responders, and the economy, as well as the concentration of vulnerable populations who have limited ability to prepare for or respond to a hazard event.

Property

In evaluating the total risk to property, we consider hazard assessments, the potential impacts on buildings, facilities, infrastructure, the environment, and the economy. Additionally, we assess the ability of properties to withstand and maintain structural integrity during and after a hazard event.

Environment

When assessing the risk to the environment, we account for hazard assessments, potential environmental impacts, and economic consequences. We also evaluate the environment's capacity to prevent degradation during and after a disaster.

Operations

To determine the total risk to operations, we consider hazard assessments, the impact on the continuity of government functions, the economy, and public confidence in the government. We also assess the vulnerability of critical operations, such as lifeline services, which may have limited capacity and resources to respond effectively to a hazard event.

Overall Risk

The overall risk is determined by combining the risks to people, property, environment, and operations.

4.3 Risk Assessment Results

Table 4-2 King County risk assessment results

		Avalanche	Civil Disorder	Cyber Incident	Dam Failure	Earthquake	Flood	Hazardous Materials	Health Incident	Landslide	Severe Weather	Terrorism	Tsunami	Volcano	Wildfire
Hazard	Location	1	1	3	2	4	3	3	4	2	4	1	2	1	2
	Probability	2	3	4	2	3	4	3	3	3	4	2	2	2	3
	Extent/ Magnitude	2	2	3	3	4	2	3	3	2	3	3	3	3	3
Impact	Public	1	2	1	2	3	2	2	3	1	3	2	2	2	3
	Responders	1	3	2	2	3	2	3	3	1	3	2	2	2	3
	Continuity of Government	1	2	3	2	4	3	2	3	1	3	2	1	1	1
	Property, Facilities, and Infrastructure	1	2	2	3	4	3	2	1	2	3	2	1	1	3
	Environment	1	1	1	3	3	2	3	1	3	3	2	2	2	2
	Economy	1	2	3	3	4	3	1	3	2	2	2	1	2	3
	Public Confidence in Governance	1	3	4	3	4	3	2	3	2	2	2	1	2	3
Vulnerability	People	1	2	2	2	4	2	3	4	1	3	2	2	3	2
	Property	1	3	2	2	4	3	2	1	2	3	2	1	1	2
	Environment	1	1	2	2	3	2	3	1	2	2	2	2	2	2
	Operations	1	3	3	2	4	3	2	2	1	2	2	1	2	1
Risk	People	1	2	3	2	4	3	3	3	2	3	2	2	2	3
	Property	1	2	3	3	4	3	2	2	2	3	2	2	2	3
	Environment	1	2	3	3	4	3	3	3	2	3	2	2	2	3
	Operations	1	2	3	2	4	3	2	3	2	3	2	2	2	2
Overall Risk		Low	Moderate	High	High	Extremely High	High	High	High	Moderate	Extremely High	Moderate	Moderate	Moderate	Moderate

4.4 GIS Data

Geographic Information System (GIS) data was taken from a variety of King County, Washington State, and federal sources. The data was sourced via King County GIS, including layers owned by both GIS and by other entities. Some of the GIS data analyzed in completing this risk assessment include:

Title	Description	Source
Active Faults	Known active faults in the Puget Sound region	WA State Department of Natural Resources (DNR)
Wastewater Systems	King County wastewater treatment and conveyance systems	King County Department of Natural Resources and Parks Water Treatment Division (DNRP)
Water Supply Facilities	Seattle water supply facilities and conveyance systems. These are used to supply Seattle as well as many cities.	City of Seattle Public Utilities
Bridges	King County-maintained bridges	King County Roads
Rail Routes	All rail routes, including BNSF and Sound Transit	King County GIS
Transit Routes	Metro transit routes	King County Metro
Arterials	Arterial streets	King County Roads
Levees and Revetments	County-maintained flood protection structures.	DNRP, King County Flood Control District
BPA Transmission Lines	Bonneville Power Administration power transmission systems	Bonneville Power Administration
Historic Buildings	Designated historic buildings	King County GIS
Schools	School facilities	King County GIS
Government Buildings	King County government buildings	King County GIS, Facilities Management Division

Hospitals and Medic Units	Hospitals and medic unit locations	King County GIS
Pharmacies	Pharmacy locations	King County GIS
First Responder Facilities	Locations of fire, police, and EMS	King County GIS
City Boundaries	City jurisdictional boundaries	King County GIS
Rivers and Lakes	Waterbodies	King County GIS
Building Address Points	Building address points and age	King County Assessor
Building Age	Building address points and age	King County Assessor
Volcanic Hazard Areas	Lahar, lava flow, and lahar sediment areas	WA DNR, U.S. Geological Survey
Landslide Hazard Areas	Lidar-based landslide inventory mapping	WA DNR
Preliminary 100-year Floodplain	1% annual chance, special flood hazard area as mapped by FEMA. Will take effect as the regulatory floodplain in 2020.	FEMA, King County Flood Control District
Floodways	The regulatory areas including the channel and adjacent land areas that must be preserved in order to discharge the base flood without increasing the water surface elevation by more than a designated height.	FEMA, King County Flood Control District
Liquefaction Potential	Areas of NEHRP soil classes D, E, and F.	WA DNR
Landslide Buffer Areas	Buffers of 50 feet around known landslide areas.	King County GIS
Statewide Roads	State and federal highways	King County GIS

Health Insurance Coverage	Individuals with health insurance, by Census Tract	US Census, American Community Survey (ACS)
Travel Time to Work	Travel time to work on average by Census Tract	US Census, ACS
Means of Transportation to Work	Means of transportation to work, by percent, by Census Tract	US Census, ACS
Race	Self-identified race	US Census, ACS
Ethnicity	Self-identified ethnicity	US Census, ACS
Income	Income (range)	US Census, ACS
Languages	Languages other than English spoken at home	US Census, ACS
Disability Status	Counts of disabled persons	King County GIS
Education	Educational attainment by years, by Census Tract	US Census, ACS
Tenure	Housing tenure (ownership) status	King County GIS
HAZUS for earthquake (Seattle Fault, Cascadia Subduction Zone)	HAZUS runs for Seattle Fault 7.1 and Cascadia Subduction Zone 9.0 scenarios	FEMA RiskMAP

This and any additional data can be viewed on the ArcGIS online hazard map called the King County Equity in Response and Planning Tool.

4.5 Jurisdiction-Specific Risk Assessments

In addition to this countywide risk assessment, each participating jurisdiction completed a risk assessment focusing on the priority hazards, vulnerabilities, and consequences. These assessments are contained in each planning partner annex. These assessments will have much more detail about

individual jurisdiction risks and should supplement the wider lens of the risk profiles contained in the base plan.

To complete their assessments, jurisdictions were provided with GIS data and an ArcGIS online map containing relevant data on hazards and impacts. The data is the same as that used in the base plan risk assessments, but jurisdictions were asked to focus on impacts specific to their assets and boundaries. Jurisdictions assessed risk in two ways.

- First, jurisdictions looked at hazards that could impact them, how susceptible/vulnerable they are to those hazards, and the consequences/impacts of a hazard event. The task was to develop “risk elevator pitches” that summarize the key elements of hazard risk in a way accessible to elected officials and the public.
- Second, jurisdictions were asked to consider an asset-based approach, looking at their priority assets, the hazards that threaten those assets, and the consequences of losing the asset. All jurisdictions were encouraged to complete this process, but only special purpose districts were required to complete it. The goal of this approach was to identify assets that needed mitigation.

In developing their risk assessments, jurisdictions held internal meetings to select the list of hazards that would be included and to assess the relative risk of each hazard. Most used a high-medium-low approach for impact, where high impact is a debilitating event, and moderate impacts are serious events that disrupt operations for multiple days. For those that also considered probability separately from the base plan, a high probability event is likely to occur on an annual basis. These jurisdiction-specific risk assessments are not designed to be exhaustive but should give a much clearer picture of risk and vulnerability than is normally available from countywide assessments.

Chapter 5

Avalanche

Risk Assessment Scoring		
1	Location	Hazard
2	Probability	
2	Magnitude	
1	Public	Impact
1	Responders	
1	COP	
1	PFI	
1	Environment	
1	Economy	
1	PCG	
1	People	Vulnerability
1	Property	
1	Environment	
1	Operations	
1	People	Risk
1	Property	
1	Environment	
1	Operations	
Low	**Overall Risk**	

PC: WADOT

Chapter 5 Avalanche

5.1 Hazard Description

Avalanche hazards in the Pacific Northwest are most common during the winter and spring in the Cascade and Olympic Mountain Ranges. They occur when a mass of snow slides, flows, or tumbles down a slope. The slopes range between 30 to 45 degrees and have enough snow depth to cover anchors such as rocks and small trees. Avalanches may also release on slopes steeper than 45 degrees, where snow may accumulate, and occasionally on low-angle slopes under ideal wet snow conditions. Avalanche forecasters use nine categories to describe the current avalanche problem. These include two primary types of avalanches:

- **Loose snow avalanche:** an avalanche that releases from a single point and entrains cohesionless snow as it fans downhill.
- **Slab avalanche:** a cohesive layer of snow that avalanches. Slab avalanches account for the large majority of avalanche accidents because their failures propagate across the slope and around the victim, making them harder to escape than a point-release avalanche. Slabs form as snow settles and becomes denser or winds load or add cohesion to snow.
- **Roof avalanche:** an avalanche that falls from the roof of a man-made structure. Roof avalanches commonly slide on the roof's surface, thus involving the entire existing snowpack. Roof avalanches most commonly occur during warming periods after substantial snow has accumulated. Accidents involve unsuspecting residents, or snow removal and maintenance workers.

Additional categories include qualification to the age and depth of the snowpack's weak layer, the formation type, and a few specific types, such as cornices.

Common factors that contribute to avalanche danger include old snow depth, old snow surface, new snow depth, new snow type, snow density, snow fall intensity, precipitation intensity, settlement, wind direction and wind speed, temperature, subsurface snow crystal structure, and tidal effect.[1] Research done at Snoqualmie Pass indicates that most natural avalanches occur within one hour after the onset of rain over a weakened snow pack. Large amounts of new snow accumulation also increases avalanche risk, especially when coupled with wide temperature swings. These events, whether natural or human-triggered, pose risks to recreationalists, ski area operations, and travelers on highways.

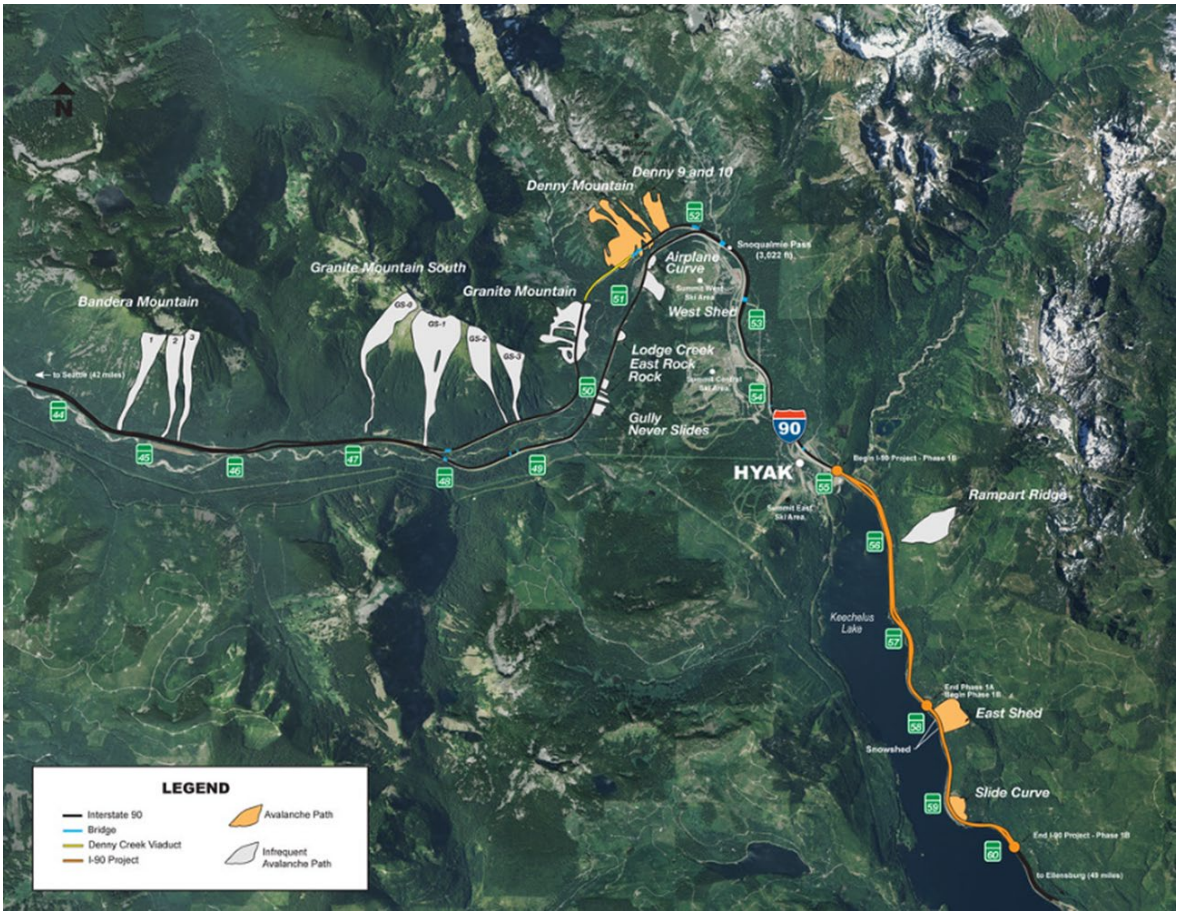
[1] Scott M Kruse, "Avalanche Evaluation Check List" *Avalanche Review* vol. 8, No 4 (February 1990)

5.2 Location

Avalanche events occur at two mountainous locations in King County: Stevens Pass in the northeast along US Highway 2 and Snoqualmie Pass on the county's central-eastern boarder along Interstate 90. Snoqualmie and Stevens Pass are significant transportation routes, particularly for commercial traffic connecting the Ports of Tacoma and Seattle to Eastern Washington and the northern tier of the US. They are also the closest ski areas and snow parks to the greater Seattle area.

Snoqualmie Pass spans 3,022 feet of the I-90 roadway and receives an average annual snowfall of 294 inches. The typical daily traffic volume on I-90 is around 28,000 vehicles, with approximately 5,600 of those being freight.[2] In the event of an avalanche, significant disruptions to east-west travel are anticipated. Figure 5-1 shows in orange common avalanche paths, and in grey infrequent avalanche paths. It also highlights projects, bridges, and viaducts that could be disrupted.

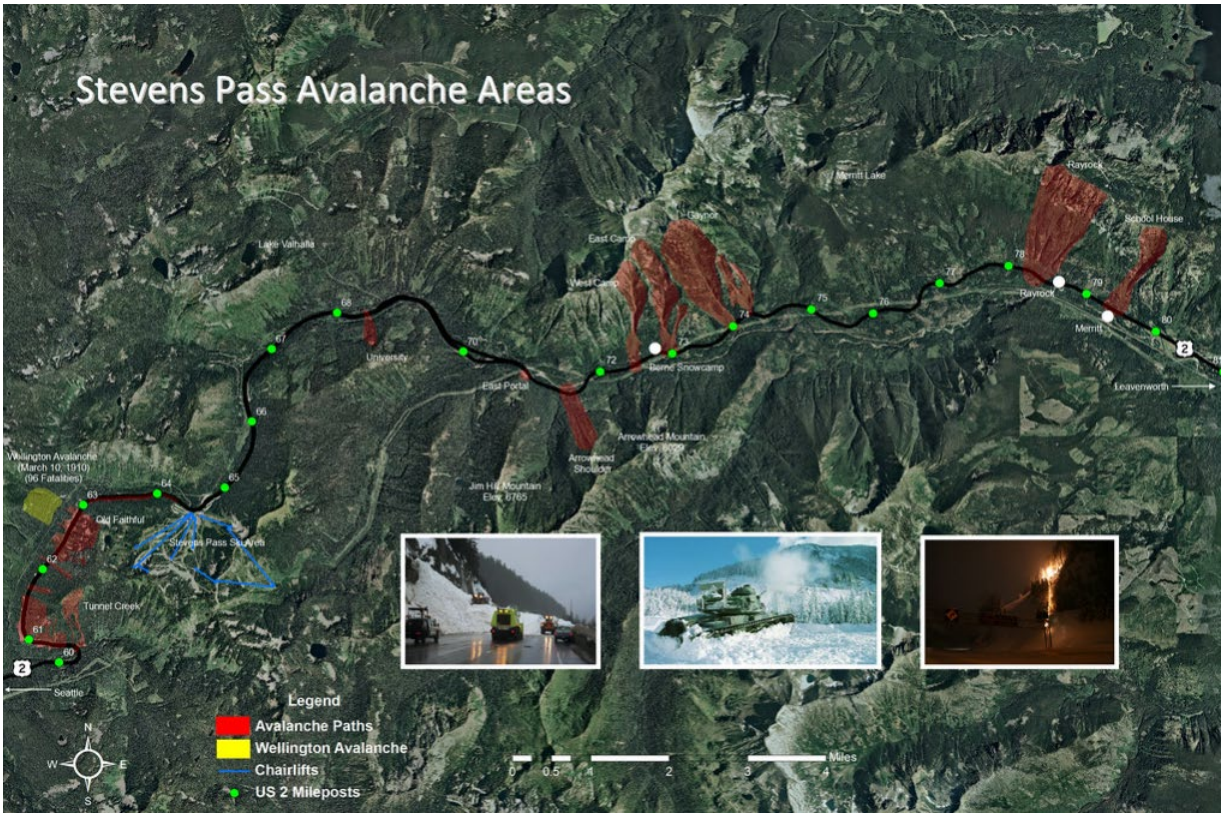
Figure 5-1 Snoqualmie Pass



[2] WSDOT, "Avalanche control" WSDOT Operations & Services (n.a.): https://wsdot.wa.gov/travel/operations-services/avalanche-control

Stevens Pass spans 4,061 feet of the highway and receives an average annual snowfall of 338 inches. The typical daily traffic volume over Stevens Pass is approximately 4,500 vehicles, with about 450 of those being freight. Figure 5-2 highlights the avalanche paths in red, with the Wellington Avalanche, marked in yellow, which remains the deadliest avalanche in U.S. history. This tragic event occurred in 1910, claiming the lives of 96 people.

Figure 5-2 Stevens Pass



Both maps indicate that most avalanches occur in remote areas away from the ski resorts. The primary risks are posed to backcountry recreationalists and travelers along the transportation corridors.

The popular backcountry areas around Stevens and Snoqualmie passes involve complex terrain where avalanche fatalities occur with relative frequency. These areas draw in snowshoeing, alpine and cross-country skiing, snowmobiles, and winter hikers and campers. While many people who engaged in snow sports in these areas are highly experienced enthusiasts; even with safety equipment, they may trigger or fall victim to avalanches. The Snoqualmie Pass backcountry area has more complex terrain with more elevation difference between top and bottom of surrounding mountains than Stevens Pass. Based on the terrain, Snoqualmie Pass backcountry has larger avalanche paths capable of producing larger and more destructive avalanches than Stevens Pass.

Several stretches of Interstate 90 and Highway 2 in King County are vulnerable to avalanches between October and April each year, depending on snowpacks and weather conditions. In the event that these transportation corridors are closed down due to an avalanche, I-84 in Oregon or air travel are the only practical ways to travel between Spokane and Seattle. These closures can have a significant economic impact, particularly due to delays in freight transportation. To address these risks, the Washington State Department of Transportation (WSDOT) has established specialized avalanche crews that play a vital role in monitoring and mitigating avalanche hazards, ensuring the safety and efficiency of travel.

5.3 Magnitude

Each year, avalanches in Washington State cause an average of one to three fatalities. Thousands of avalanches occur in the Cascades during the winter season, though most are triggered naturally and have no human impact. In King County, the primary avalanche risk arises from severe winter storms between October and May, when Pacific storms frequently affect the region.

Figure 5-3 North American Public Avalanche Danger Scale

North American Public Avalanche Danger Scale

Avalanche danger is determined by the likelihood, size, and distribution of avalanches.
Safe backcountry travel requires training and experience. You control your risk by choosing when, where, and how you travel.

Danger Level	Travel Advice	Likelihood	Size and Distribution
5 - Extreme	**Extraordinarily dangerous avalanche conditions.** Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Very large avalanches in many areas.
4 - High	**Very dangerous avalanche conditions.** Travel in avalanche terrain not recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 - Considerable	**Dangerous avalanche conditions.** Careful snowpack evaluation, cautious route-finding, and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 - Moderate	**Heightened avalanche conditions on specific terrain features.** Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 - Low	**Generally safe avalanche conditions.** Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Avalanches are measured using the North American Public Avalanche Danger Scale, which measures the likelihood of both natural and human-triggered avalanches, as well as their size and distribution. Figure 5-3 shows the scale ranges from 1 (low danger) to 5 (extreme danger).

Both Stevens and Snoqualmie Pass areas experience all levels of avalanche danger as well as human-triggered and natural avalanches in their surrounding backcountry terrain. However, Snoqualmie Pass has more highway and parking capacity than Stevens Pass. There is no definitive source on backcountry use, however, known parking capacity, proximity to population centers, and the number of avalanche observations publicly submitted to Northwest Avalanche Center per zone suggest more backcountry users visit the Snoqualmie Pass corridor over the course of the season.

The most frequent impact from avalanches is from pass closures, especially along Snoqualmie Pass on I-90. In particularly severe events, Snoqualmie, Stevens, and White Passes may close for days, cutting the state in half. The other routes that cross the cascades, such as US 20, SR 410, and SR 14, are closed throughout the winter and are not suitable for large traffic volumes or commercial traffic. Impacts on transportation through mountain passes result in travel delays with local to regional economic effects. Avalanche risk reduction occurs on these corridors throughout the spring as WSDOT clears the road for summer operations.

In addition to the roadway risk, two of the state's three cross-state railways pass through the Cascades. These railroads travel along a route similar to the major highways and are similarly susceptible to avalanche danger. Significant snowfall and avalanche danger can disrupt rail freight traffic across the state, with substantial economic impacts.

5.4 Previous Occurrences

The Northwest Avalanche Center has reported on avalanche incidents that presented a risk of human injury or fatality, excluding those avalanches that occurred without resulting in significant impact. There was a total of 14 injuries and 13 fatalities across the region. Specifically, Stevens Pass experienced 3 injuries and 2 fatalities, while Snoqualmie reported 11 injuries and 11 fatalities. Regarding the reported danger levels for each event, 68% were classified as moderate risk, and 26% were classified as considerable. The number of reported avalanche incidents have also show to decline over this period.

While there is more frequent reporting of avalanche activity in Snoqualmie Pass, the avalanche terrain around Stevens Pass is more than capable of producing avalanches large enough to bury, injure or kill a person, and has over the years. In fact, the most significant avalanche event in Washington State, and the deadliest in US history, occurred in 1910 near Stevens Pass. Two trains carrying passengers were hit by an avalanche killing 96 people.

Table 5-1 Significant Avalanches in King County, 2001-2024[3]

Date	Pass	Size	Fatalities and Injuries
1910 (Historic Maximum)	Stevens Pass (railway)	n/a	96 Fatalities
April 9, 2010	Snoqualmie Pass	D2 - Moderate	2 Injuries
April 10, 2010	Snoqualmie Pass	D3 - Considerable	1 Injury
February 1, 2011	Snoqualmie Pass	D2 - Moderate	1 Fatality
March 23, 2011	Snoqualmie Pass	D1 - Low	None
March 27, 2011	Stevens Pass	n/a	1 Fatality
April 3, 2011	Stevens Pass	n/a	1 Injury
April 6, 2011	Snoqualmie Pass	D2 - Moderate	3 Injuries
January 1, 2012	Snoqualmie Pass	n/a	None
January 21, 2012	Snoqualmie Pass	n/a	None
February 19,2012	Snoqualmie Pass	D2 - Moderate	1 Fatality
February 19, 2012	Stevens Pass	n/a	1 Fatality
January 15, 2013	Snoqualmie Pass	n/a	1 Injury
April 13, 2013	Snoqualmie Pass (two locations)	n/a	2 Fatalities
April 13, 2013	Stevens Pass	n/a	None
January 4, 2014	Snoqualmie Pass	n/a	None
February 11, 2014	Stevens Pass	D3 - Considerable	2 Injuries
February 22, 2014	Snoqualmie Pass	n/a	None
March 22, 2014	Snoqualmie Pass	D3 - Considerable	1 Fatality

[3] NWAC "Northwest Avalanche Accident Summaries" *Northwest Avalanche Center* (December 2024) https://www.nwac.us/accidents/accident-reports/

April 27, 2014	Snoqualmie Pass	D2 - Moderate	1 Injury
December 6, 2015	Stevens Pass	D2 - Moderate	None
December 17, 2015	Snoqualmie Pass	D3 - Considerable	1 Injury
December 19, 2015	Snoqualmie Pass	D3 - Considerable	1 Fatality
December 31, 2015	Snoqualmie Pass	D1/D2 – Low/Moderate	1 Fatality
March 4, 2017	Snoqualmie Pass	D2 - Moderate	1 Injury
March 5, 2017	Stevens Pass	n/a	None
April 11, 2017	Snoqualmie Pass	D2 - Moderate	1 Fatality
February 18, 2018	Snoqualmie Pass	D2 - Moderate	None
February 25, 2018	Snoqualmie Pass (two locations)	D2 - Moderate	3 Fatalities
February 16, 2019	Stevens Pass	n/a	None
February 16, 2020	Stevens Pass	n/a	None
January 31, 2021	Snoqualmie Pass	D2 – Moderate	1 Injury
February 7, 2021	Stevens Pass	n/a	None
February 12, 2023	Stevens Pass	n/a	None
March 5 2024	Stevens Pass	D2 - Moderate	None

5.5 Probability of Future Occurrences

The overall frequency of avalanche events is likely to decrease due to the changing climate. As snow cover diminishes at lower elevations, the potential areas for avalanches to occur are reduced. However, at higher elevations where snowfall remains abundant, avalanche events may increase in intensity. Many factors contribute to avalanche formation and release, though the most significant involves the bond between snow layers and loading from new snow or rain. The Pacific Northwest has a maritime snow climate, and most avalanche activity is directly related to precipitation events,

either snow or rain. Rapid changes in temperature, especially at or near the freezing point, further contribute to avalanche release.

5.6 Climate Change Considerations

Research pertaining to climate change impact on avalanche activity in this region is currectly limited. However, climate change is expected to lead to a significant decrease in snowpack in Washington, with projections indicating a reduction of up to 70% by 2080 compared to 2006 levels.[4]

Avalanche frequency and type relative to elevation and location will likely change over time due to the impacts of climate change. Initial research on the impacts of climate change and avalanches suggest we may see fewer lower elevation avalanches due to reduced snowpack. Depending on how the climate warms in our region, we may see fewer avalanches associated with colder weather (persistent slabs) and more wet snow avalanches.

5.7 Impact Assessment

Public	Avalanche conditions can cause closure of ski areas like: Alpental, Hyak (Summit East), Ski Acres (Summit Central), and Stevens Pass. The recreational skiers and the people who are seasonally employed can be impacted when these conditions close ski areas. People who ski "out of bounds" take exceptional risks in locations where avalanche control does not maintain safe conditions and search and rescue operations may be hampered. Pass closures may inconvenience people by causing them to either take commercial flights between eastern and western Washington or cause them to take wide routes around the mountain area through the Columbia Gorge between Washington and Oregon. There are no major populations in King County that are exposed to avalanche terrain. The King County community closest to avalanche country is Skykomish. It has not experienced an avalanche in recent memory.

[4] Washington Emergency Management Division (EMD), "Avalanche" *Washington State Enhanced Hazard Mitigation Plan* (2023): p. 28, https://mil.wa.gov/asset/651ec296d76a9/2023_WA_SEHMP_final_20231004.pdf

Responders	When avalanches bury or injure skiers and backcountry hikers, the King County Sheriff's Office Search and Rescue team(s) may be deployed along with trained volunteers and specially trained volunteer K-9 units like BARK (Backcountry Avalanche Rescue K-9). Most search missions occur in or around the off-trail perimeter of ski areas like Snoqualmie Acres, Hyak, Alpental, and Steven's Pass. Buried skiers are often severely injured or may be killed from their injuries or suffocation under large amounts of snow in areas difficult to reach.
Continuity of Operations	Avalanche areas are remote to most King County operations. Where avalanches may occur, King County Sheriff's Office Search and Rescue, Ski patrols, and volunteers may be involved. This may include BARK, a group that provides K-9 search capability for avalanche victims. Support may also be required from the aviation unit of the King County Sheriff's Office and from Emergency Medical Service units. Support personnel for avalanche control are provided by Washington State Department of Transportation.
Property, Facilities, and Infrastructure	**Property** Property exposed to avalanches include seasonal vacation homes and ski resort operations. **Facilities** There are no known healthcare facilities or systems exposed to avalanches. **Infrastructure** Critical infrastructure that may be impacted includes the BNSF railway (also used by Amtrak) and the east west highways, US 2 (Stevens Pass) and I-90 (Snoqualmie Pass). Chinook Pass usually closes from October through May.
Environment	Avalanches are natural events, but they can have significant environmental impacts, including the destruction of wildlife, trees, and the alteration of the landscape. These events can reshape terrain and disrupt ecosystems. To mitigate the effects of avalanches on both infrastructure and the environment, several upcoming infrastructure projects along I-90 in Snoqualmie Pass are being proposed including the installation of avalanche chutes. These chutes are designed to redirect

	snowfall away from the I-90 animal crossing overpass, which serves as a vital north-south habitat connector for wildlife.
Economy	Closure of ski areas from avalanche danger usually lasts only a short time. While revenue to one or more ski areas may be reduced, no long-term economic impacts can be expected from avalanche issues. Heavy snows and avalanche danger may close Stevens and/or Snoqualmie Pass for extended periods. These pass closures can impede transportation of goods between eastern/western Washington, impact the Port of Seattle and port/countries around the/Pacific Rim. Avalanche closure of King County passes may cause motorists and truckers to reroute through Interstate 84 in Portland. In 2024, WSDOT completed an "Estimated Road User Cost of Snoqualmie Pass Closure", using the volumes of traffic in the winter months to determine an average total hourly cost of delays based on weekday/weekend calculations. For weekdays, the average hourly cost of a delay is $52,743, while for a weekend, the average hourly cost of a delay is $67,576.[5]
Public Confidence in Governance	The public at risk has a good understanding of the risks from avalanche. Warnings are regularly posted and announced to skiers and back country hikers during the winter months.

5.8 Vulnerability Assessment

Vulnerable populations	Snowmobilers, hikers, and skiers in back-country and off-trail environments are at the highest risk from avalanche. Search and Rescue regularly travel on search missions for missing recreationists, putting them at risk from avalanche as well.
Property	Several homes in the Alpental Valley have been directly affected by avalanches. Snow fences installed in 1999 mitigate the hazard. Avalanche professionals' ongoing monitoring and evaluation contribute to the risk evaluation.

[5] WSDOT, *Snoqualmie Winter Operations Study* (December 2024): p. 6, https://wsdot.wa.gov/sites/default/files/2024-12/Snoqualmie-Winter-Operations-Study-December2024.pdf

Environment	Avalanches are a natural disturbance that can both harm and benefit ecosystems. Next to Snoqualmie Pass is the wildlife crossing overpass that provide a critical north-south connection for elk, deer, coyotes, and cougars.
Operations	I-90 and US-2 are the most vulnerable routes to avalanche. Disruptions to both are common during the winter, though most are for a short duration. A long-duration disruption could have significant economic consequences.

Chapter 6

Civil Disorder

Risk Assessment Scoring		
1	Location	Hazard
3	Probability	
2	Magnitude	
2	Public	Impact
3	Responders	
2	COP	
2	PFI	
1	Environment	
2	Economy	
3	PCG	
2	People	Vulnerability
3	Property	
1	Environment	
3	Operations	
2	People	Risk
2	Property	
2	Environment	
2	Operations	
Moderate	**Overall Risk**	

PC: Dean Rutz

Chapter 6: Civil Disorder

6.1 Hazard Description

The United State Constitution, in accordance with the stipulations of ratification from the Colonies, adopted the first 10 amendments collectively known as the Bill of Rights, laying out the initial protected rights under the Constitution guaranteed to all citizens of the United States. The First being the protected right to peacefully assemble. This right has been entrenched in the very fabric of the United States even before the country as we know it existed. However, as we evolved as a nation, complex social, political, and economic problems began to arise. Almost in tandem, the effectiveness of this right began to come into question with many movements, leveraging changing tactics and technology, finding other forms of assembly more effective at affecting change either for or against the status quo. With the evolution of the protest many social and political scientist began to identify the different forms of protests, collectively known as Civil Unrest, and laws were written to both protect public order and further define the right to protest under the 1st Amendment.

Table 6-1 Hierarchy of civil unrest

Name	Description
Peaceful Protests	Under the 1st Amendment, the right to "protest" is defined as "the right of the people peaceably to assemble." However, laws have evolved that govern this right clarifying that assemblies which are not peaceful are generally not protected under the law. The laws that deal with disruptive conduct are generally grouped into offenses that disturb the public peace. They range from misdemeanors, such as blocking sidewalks or challenging another to fight, to felonies, such as looting and rioting. [1]
Civil Disobedience	Promoted by nationalist movements in Africa and India, the Civil Rights movement in the U.S., and labor and anti-war movements in many countries, Civil Disobedience is typically equated with protests or non-violent resistance. Civil Disobedience, in contrast, is a "public, nonviolent, conscientious yet political act contrary to law, usually aimed at bringing about a change of the law or government policy; limited to instances of substantial and clear injustice and must occur only after the legal means of redress have proved futile."[2]

[1] Revised Code of Washington Title 9A.
[2] US Department of Justice, "Theory of Civil Disobedience" *NCJRS Virtual Library* (1989): https://www.ojp.gov/ncjrs/virtual-library/abstracts/theory-civil-disobedience-civil-disobedience-p-125-149-1989-paul

Civil Disorder	Defined under Title 18 of the United States Code § 232 (1) Civil Disorder is "any public disturbance involving acts of violence by assemblages of three or more persons, which causes an immediate danger of or results in damage or injury to the property or person of any other individual." 18 U.S. Code § 231 outlines what is considered "disorder," including the use, application or making of any firearm, or explosive or incendiary device, or technique capable of causing injury or death to persons; transports or manufactures for transportation in commerce any firearm, or explosive or incendiary device, knowing or having reason to know or intending that the same will be used unlawfully in furtherance of a civil disorder; commit any act to obstruct, impede, or interfere with any fireman or law enforcement officer lawfully engaged in the lawful performance of official duties incident to and during the commission of a civil disorder. In this context, any disobedience in which participants turn violent and antagonistic toward public safety and civil authority is illegal.[3] Similarly, Washington state law defines civil disorder as "any public disturbance involving acts of violence that is intended to cause an immediate danger of, or to result in, significant injury to property or the person of any other individual." Further, under the Revised Code of Washington 9A.48.120, a person is guilty of civil disorder training if "he or she teaches or demonstrates to any other person the use, application, or making of any device or technique capable of causing significant bodily injury or death to persons, knowing, or having reason to know or intending that same will be unlawfully employed for use in, or in furtherance of, a civil disorder."

Causation

Civil disorder can arise from a variety of circumstances and encompasses a wide range of civil actions, from peaceful demonstrations to more disruptive or violent forms of unrest. The intensity of these disturbances often correlates with the level of public dissatisfaction or protest.

Examples of civil disorder include, but are not limited to, violent protests, roadblocks, riots, acts of sabotage, and various forms of criminal behavior. Such disturbances can pose serious risks, becoming increasingly chaotic and difficult to control.

[3] Office of the Law Revision Council. "Ch. 12: Civil Disorders" *18 USC* (1968): https://uscode.house.gov/view.xhtml?path=/prelim@title18/part1/chapter12&edition=prelim.

One group often associated with civil disorder is the "Black Bloc." This tactic, employed by certain anarchist factions, involves a group of individuals dressing uniformly in black clothing to create the illusion of a cohesive and unified force, which is meant to promote solidarity for a particular cause. This strategy is especially challenging for law enforcement, as it makes it nearly impossible to distinguish one participant from another, providing anonymity while facilitating coordinated criminal acts.

Additionally, the presence of law enforcement often escalates tensions during these events. Rather than deterring violence, their intervention can sometimes heighten aggression and provoke further unrest.

The political climate surrounding civil disorder is constantly shifting, with changes in leadership, policies, and public sentiment contributing to the volatile nature of these disturbances.

6.2 Location

While demonstrations and protests can occur throughout King County, civil disorder is more likely to occur in specific areas, particularly in Seattle, which serves as the county's political and cultural hub. These civil actions often involve free speech rights in public places and do not evolve into chaos and violence. Civil disorder is often seen at government buildings, military bases, schools, universities, city council meetings, as they represent centers of power and decision-making. Additionally, areas like state and city parks, as well as the downtown core, are prime locations for civil unrest due to their visibility and accessibility to large groups.

Sites that are attractive for political rallies should be viewed as potential locations for the epicenter of civil disorder events. Disruption of critical infrastructure may occur during very severe civil disorder events. Public services such as water, power, communication, and transportation may be temporarily unavailable.

6.3 Magnitude

In King County, civil disorder can emerge from a series of escalating events, each building upon the next. It often begins as peaceful protest or civil disobedience, where individuals express their grievances within the bounds of the law. However, when external factors—such as the presence of anarchists, police violence, or broader social unrest—intervene, these peaceful demonstrations can transform into civil disturbances and, in extreme cases, civil disorder. The impact of such events can be far-reaching, affecting not only the immediate community but also the larger social and political landscape. Understanding the escalation of civil disturbances into full-scale civil disorder requires a look at the different phases and levels of conflict—from peaceful protesting to violence and property damage.

Phases of Protest and Escalation

Protests typically start as peaceful demonstrations, where individuals or groups gather to voice their concerns on a particular issue. In King County, these types of events are often seen as essential elements of civic expression. People may gather in public spaces to peacefully advocate for causes such as racial justice, environmental protection, or workers' rights. The aim is to engage in civil disobedience, challenging laws or actions perceived as unjust, without resorting to violence or property destruction.

However, not all protests remain peaceful. As tensions rise, peaceful demonstrations can escalate into civil disturbances. Civil disturbances often involve acts of resistance that push the boundaries of legal protest. This might include blocking roads, disrupting business operations, or engaging in minor property damage. While these actions may be disruptive, they are usually aimed at drawing attention to the issue at hand without the intent to incite widespread violence. In this phase, there may still be some level of public support or sympathy, as the demonstration is seen as a legitimate expression of discontent, albeit one that has exceeded acceptable behavior.

In the worst-case scenario, civil disturbances can escalate into civil disorder. Civil disorder represents the highest level of escalation, where protests turn violent and cause significant disruption to public order. This stage can be triggered by a variety of factors, including the actions of provocateurs or groups seeking to exploit the unrest for their own agendas[4]. The presence of anarchists, especially those utilizing tactics like the "Black Bloc," can turn an otherwise peaceful protest into a violent event. The Black Bloc strategy involves groups of anarchists dressing in all black, often with masks, to conceal their identities and present a unified front. This anonymity allows them to engage in criminal activities, such as vandalism, arson, or violent confrontations with law enforcement, without immediate identification or accountability.

The 1999 World Trade Organization (WTO) protests in Seattle serve as a clear example of civil disorder. Initially organized as a peaceful demonstration against the WTO's policies, the protests quickly escalated into violent confrontations. Anarchists, employing Black Bloc tactics, vandalized businesses, looted stores, and engaged in violent clashes with police. The event led to over 600 arrests, widespread property damage, and millions of dollars in losses for local businesses.[5] The city's cost of managing the situation ballooned, with emergency services, repairs, and security efforts costing far more than anticipated. This event marked a significant turning point in the way law enforcement responded to large-scale protests, with authorities becoming more adept at identifying the potential for escalation and monitoring certain groups for signs of trouble.

[4] Kory Flowers, "Understanding the Black Block" *Police: The Law Enforcement Magazine.* (January 30, 2015): https://www.policemag.com/341767/understanding-the-black-bloc.
[5] Sean Rossman, "G-20 summit protests: What is a Black Bloc?" *USA Today.* (February 2, 2017): https://www.usatoday.com/story/news/nation-now/2017/02/02/what-black-bloc/97393870/.

Triggers and Tensions

Civil disorder can be triggered by a variety of factors, often stemming from a combination of social, political, and economic issues. Police violence is a common catalyst for such events. For example, the 2009 police shooting of Oscar Grant in Oakland, California, led to widespread unrest, which echoed in cities across the country, including Seattle.[6] Similarly, in King County, the 2008 video of a King County deputy assaulting a teenage girl in a holding cell became a flashpoint for public outrage. In 2010, activists in Seattle organized a "March Against Police Brutality," drawing attention to systemic violence and misconduct. Protests like these can lead to cycles of unrest, where each new demonstration builds upon the emotional intensity of previous events.[7]

Protests often create a feedback loop, where the actions and outcomes of one protest can inspire and fuel subsequent protests. This cycle occurs because protests are not just reactions to immediate events but are deeply rooted in emotional and social responses to perceived injustice or systemic problems. When one protest takes place, it sets off a chain reaction that can influence the actions and emotional environment of future demonstrations.

When protests escalate into civil disorder, the presence of anarchist groups like Black Bloc often plays a pivotal role. These groups operate as accelerants, transforming protests into more violent confrontations. Law enforcement now carefully monitors these groups during peaceful protests, noting any signs of aggression or unlawful behavior. As soon as such elements appear, the situation can rapidly deteriorate, creating a volatile environment where clashes are inevitable. These heightened police presence can, in turn, provoke further unrest, exacerbating tensions and leading to a dangerous feedback loop.

The ultimate severity of any civil disorder event will depend on the magnitude of the event and its location. The more widespread an event is, the greater the likelihood of excessive injury, loss of life and property damage. Additional factors, such as the ability of law enforcement to contain the event, are also critical in minimizing damages.

[6] Associated Press, "Ex-BART Officer Johannes Mehserle Released From Jail" *KPIX CBS SF Bay Area.* (June 13, 2011) https://sanfrancisco.cbslocal.com/2011/06/13/ex-bart-officer-johannes-mehserle-released-from-prison/.
[7] J Seattle, "Protest against police brutality starts at Seattle Central" *Capitol Hill Seattle Blog.* (April 9, 2010) https://www.capitolhillseattle.com/2010/04/protest-against-police-brutality-starts-at-seattle-central/.

6.4 Previous Occurrences

Date	Location	Cause	Description
Nov 1999	Seattle, WA – World Trade Organization	Anti-globalization	An example of a worst-case scenario was the 1999 Seattle World Trade Organization rioting which significantly impacted the City and led to numerous injuries and arrests. The rioting raised Seattle's cost of handling the conference to $9 million from an earlier estimated city cost of $6 million surpassing worst-case projections. In addition, downtown Seattle businesses lost an estimated $20 million in property damage and lost sales during the WTO conference.[8]
Feb 27, 2001	Seattle, WA – Pioneer Square	Unknown	During a Mardi Gras celebrations, there were numerous random attacks including reports of widespread brawling, vandalism, and weapons being brandished. Damage to local businesses exceeded $100,000. About 70 people were reported injured. Several women were sexually assaulted. One man, Kris Kime, died of injuries sustained during an attempt to assist a woman being brutalized.[9]
May 2013	Seattle, WA	May Day	A 2013 May Day protest in downtown Seattle turned violent with police responding to demonstrators throwing rocks, bottles, metal pipes, fireworks -- and even a skateboard. The clashes left eight officers with injuries, and police reporting the arrests of 17 people on various offenses including property destruction and assault. During the clashes, police deployed flash-bang grenades and tackled unruly protesters to the ground.[10]
May 2016	Seattle, WA	May Day	In 2016 May Day protest in Seattle a peaceful march turned violent when protesters lit

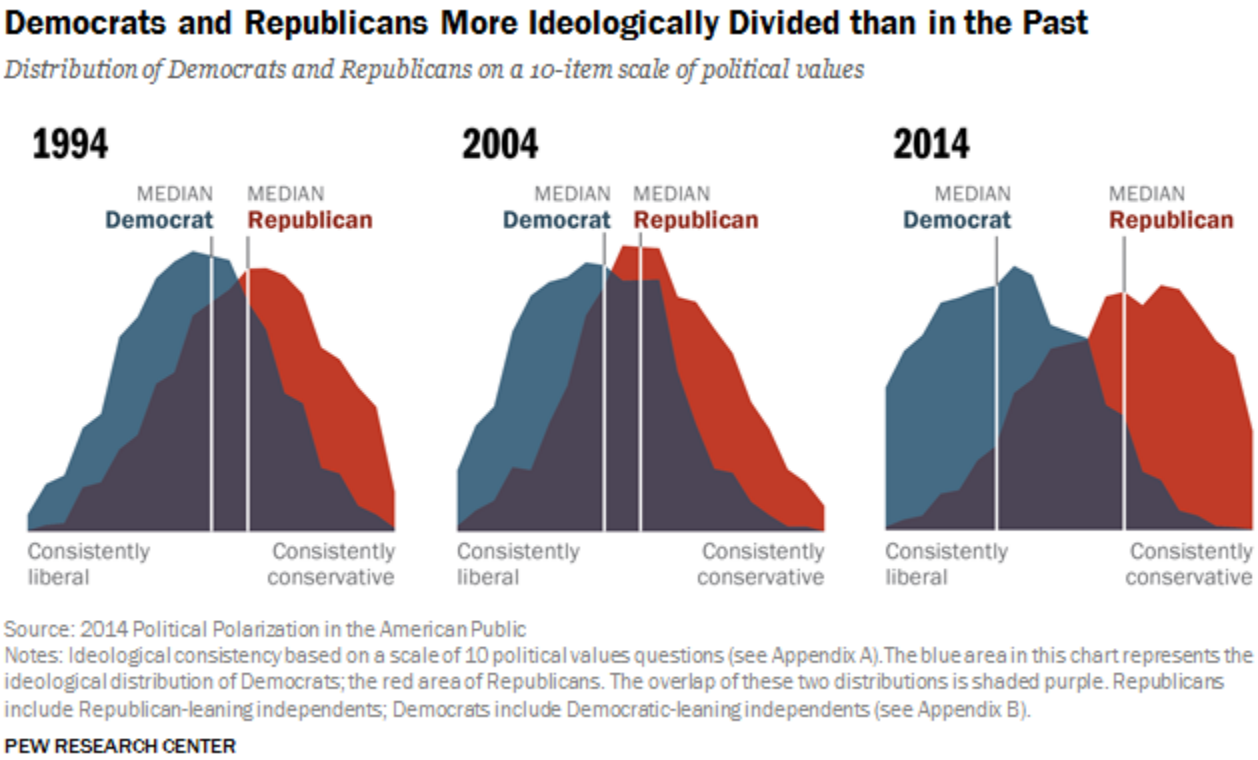
[8] CBC News," WTO protests hit Seattle in the pocketbook" (January 6, 2000): https://www.cbc.ca/news/world/wto-protests-hit-seattle-in-the-pocketbook-1.245428.
[9] Lynsi Burton, "Looking back: Mardi Gras riots of 2001" *The Seattle Times.* (February 16, 2015): https://www.seattlepi.com/seattlenews/article/Looking-back-Mardi-Gras-riots-of-2001-6084162.php.
[10] Amanda Watts, Lindy Royce-Bartlett. "17 arrested as Seattle May Day protests turn violent" *CNN.* (May 2, 2013) https://www.cnn.com/2013/05/01/us/seattle-may-day-protests/index.html.

			fireworks and threw rocks and Molotov cocktails at police. Nine people were arrested and five officers were injured in the clashes.
January 2017	Seattle, WA – University of Washington	Politics	In January 2017 at University of Washington, demonstrators and counter-demonstrators gathered as a politically conservative commentator was scheduled to speak. Violent protests took place on campus and a person was shot.
June 2020	Chaz/Chop Seattle Zone	Police Brutality	In the wake of George Floyd protests, some demonstrators took over a portion of the Capitol Hill neighborhood, establishing the CHOP/CHAZ (Capitol Hill Organized Protest/Capitol Hill Autonomous Zone). This area became a flashpoint for further clashes, with occasional violence, shootings, and confrontations between police and activists.

6.5 Probability of Future Occurrences

There is a significant likelihood of future civil disorder in King County. Like many urban centers across the U.S., King County is grappling with growing political discontent driven by ideological divides over social policies, economic priorities, and individual rights. These divisions are further intensified by a political realignment that has funneled differing viewpoints into two increasingly polarized parties. This polarization is compounded by longstanding tensions between certain communities, particularly communities of color, and local law enforcement, which continue to fuel distrust and demands for reform.

Figure 6-1 Political Polarization in the American Public[11]



Moreover, the rapid spread of information and organization via social media platforms, especially TikTok, amplifies these tensions. Social media enables quick mobilization and the viral dissemination of events, making it easier to organize protests and quickly escalate unrest. As these factors converge, the risk of civil disorder in King County is likely to increase.

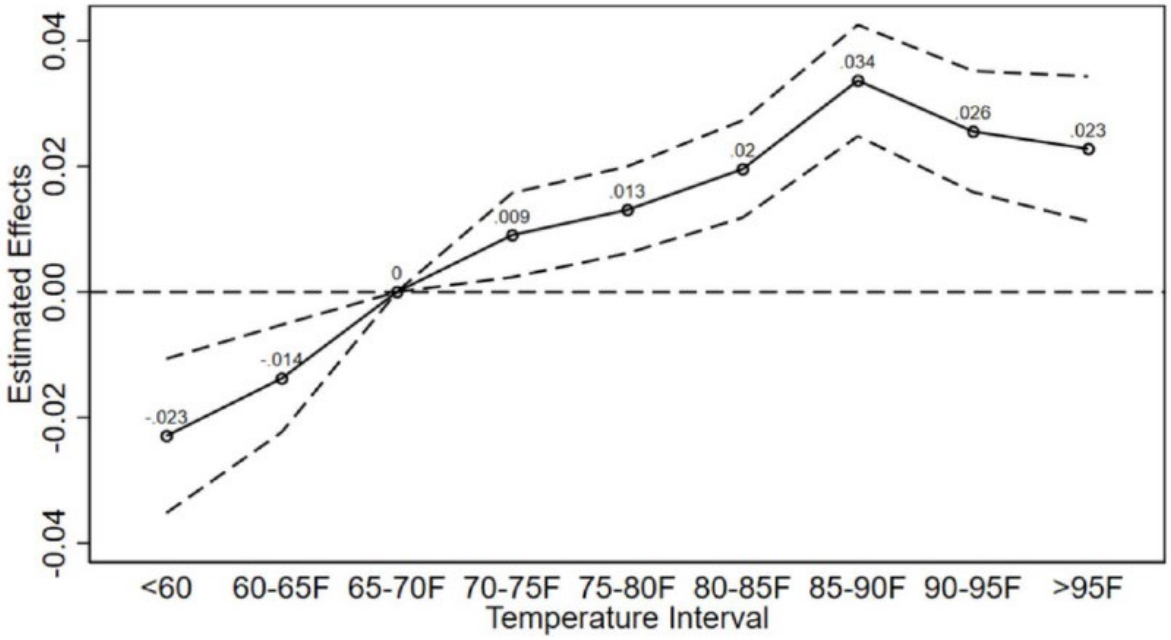
6.6 Climate Change Considerations

The effects of climate change have shown to amplify civil unrest by exacerbating existing economic, social, and political instabilities. Urban areas, particularly those with limited greenspaces that are susceptible to climate-related phenomena like the urban heat island effect, are more prone to increased communal frustration and conflicts. The intensifying effects of climate change, such as extreme weather events, resource scarcity, and rising costs of living, intersect with social inequalities, creating a volatile environment where vulnerable communities are disproportionately affected. This intersectionality between social issues and climate change heightens tensions, fueling civil unrest as people confront both environmental and systemic challenges simultaneously. Figure

[11] Michael Dimock, Carroll Doherty, Jocelyn Kiley, Russ Oates, "Political Polarization in the American Public" *Pew Research Center* (June 2014): p. 6, https://www.pewresearch.org/wp-content/uploads/sites/4/2014/06/6-12-2014-Political-Polarization-Release.pdf

6-2 takes the city of Los Angeles as a case study and plots the point estimates for the temperature-crime relationship. The assessment concluded that heat acts as a driver crime, namely that occurs within the same day.

Figure 6-2 Impact of Daily Temperature on Crime Rates in Los Angeles[12]



6.7 Impact Assessment

Public	All King County residents can be impacted, though those who live or work in downtown areas tend to be more exposed and impacted by civil disorder incidents.
Responders	Responders are often on the front line of events. Responders can be targeted, causing injury to personnel, damage to facilities, and the loss of equipment. Responders are often injured during major incidents and, even when events are brought under control, may be seen as an enemy of the community causing long-term trust issues.
Continuity of Operations	Major incidents can bring government services to a standstill. In King County, with both City of Seattle and King County offices are in the same area, along with

[12] Kilian Heilmann, Matthew Kahn, Cheng Keat Tang, "The urban crime and heat gradient in high and low poverty areas" *Journal of Public Economics* (May 2021): p. 17

	court facilities. A major incident in this area would prevent employees from getting to work or home. Furthermore, government buildings are often targeted and can be damaged or destroyed.
Property, Facilities, Infrastructure	**Property** Much of the impact from civil disorder is to property, secondary only to economic impacts. During the World Trade Organization protests in 2000, over $20 million in damage was recorded by businesses and $9 million in costs to the city. **Facilities** Health systems can be overwhelmed by civil disorder incidents, such as when large numbers of demonstrators are brought to the hospital due to exposure to tear gas or due to clashes with counter-demonstrators or with police. **Infrastructure** • Energy: Pipelines carrying oil are a potential target for demonstrators. Oil trains have been targeted frequently in Washington; however, these protests do not tend to turn violent. • Water/Wastewater: Water systems are rarely the primary target of a demonstration and may only be peripherally impacted. • Transportation: One of the largest impacts from a major incident is disruption to transportation. Transit facilities and assets like busses may be destroyed. Roads can be closed for hours or days. • Communications: Communication systems are redundant and are unlikely to be severely impacted by a civil disorder incident.
Environment	Civil Disorder will have a minimum impact on the environment; unless, hazard material facilities such as petroleum, chemical, and recycling are targeted in arson fires or vandalism. The impact on the environment in such cases could be significant.
Economy	Economic impacts caused by loss of business, destruction of businesses, and business interruption can exceed the property damage dollar figures by a factor of two or more. Lost sales and uninsured losses can permanently destroy many businesses. Areas can also become perceived as unsafe or unwelcoming for business, further hurting the economy.

Public Confidence in Governance	Major incidents can cause long-term damage to public confidence in the jurisdiction or, especially, public safety elements of jurisdiction governance. This can cause either alienation or, when response is proactive, help rebuild confidence and trust. To best preserve and grow confidence, a jurisdiction must respond quickly and effectively but without excessive force. The general public expects a quick restoration of order and protection of property while activists may demand accountability from officials and safety for peaceful demonstrators.

6.8 Vulnerability Assessment

Vulnerable populations	Certain population groups are more vulnerable during civil disorder event either because they are the target of civil discord, or because of social, economic, or physical circumstances. **Communities of color** People of color, particularly Black, Indigenous, and Latino communities, are historically targeted by civil disorder events. While rare in our region, the United States has a long history of racially-motivated riots that burn and destroy minority-owned businesses and homes. **Immigrant communities** Immigrant and refugee populations are often already marginalized and may face heightened vulnerability during civil disorder due to language barriers, lack of familiarity with local legal systems, or fear of interaction with law enforcement due to potential immigration status concerns. **People experiencing homelessness** In times of civil unrest, people experiencing homelessness are more likely to be exposed to violence, police crackdowns, or displacement from encampments, making it even harder to access basic necessities like food, shelter, or healthcare. Moreover, homeless individuals may have nowhere to go when public services, shelters, or transportation networks are disrupted.

	Woman and gender minorities Women may face increased risks of sexual violence, exploitation, or harassment in chaotic or unsafe environments, while gender minorities may face added discrimination, marginalization, or violence. **Essential workers** Workers in essential services, such as healthcare, public transportation, utilities, and law enforcement, are particularly vulnerable during civil disorder events due to their proximity to the unrest. These workers may face risks of violence or aggression, especially if they are seen as part of the system that protesters are targeting.
Property	Businesses in high traffic areas of Seattle would be vulnerable to property damage from civil disorder. Property that would be targeted in this situation includes banks, financial institutions, government buildings, retail chains, and monuments.
Environment	During civil disorder events, acts of arson and the destruction of properties—such as vehicles, buildings, and businesses—can result in the release of harmful pollutants into the air. Fires release smoke, soot, and toxic chemicals like carbon monoxide, particulate matter, and volatile organic compounds (VOCs) that can severely impact air quality and public health. In urban areas, these pollutants may be concentrated, exacerbating pollution levels in already affected regions.
Operations	**Government Facilities** Civil disorder incidents often target government organizations or visible images of the government such as police vehicles, city halls, or court facilities. **Businesses** Businesses such as banks, businesses in downtown areas or along transportation routes, and other commercial establishments are often targeted during looting or may be targeted for political or racist reasons such as ownership by an immigrant group in the case of anti-immigration riots or because they are associated with an industry being targeted by the manifestation (banks, abortion clinics, oil company offices, etc.).

Chapter 7

Cyber Incidents

Risk Assessment Scoring		
3	Location	Hazard
4	Probability	
3	Magnitude	
1	Public	Impact
2	Responders	
3	COP	
2	PFI	
1	Environment	
3	Economy	
4	PCG	
2	People	Vulnerability
2	Property	
2	Environment	
3	Operations	
3	People	Risk
3	Property	
3	Environment	
3	Operations	
High	**Overall Risk**	

Chapter 7: Cyber Incidents

7.1 Hazard Description

Information technology has become deeply integrated into how we conduct everyday life. In the context of government, technology plays a crucial role in delivering essential public services, such as healthcare, public transportation, law enforcement, citizen engagement, public utilities, and managing tax and ratepayer systems. A cyber incident can have a profound and disruptive effect on these technologies, jeopardizing local governments' ability to provide critical services and maintain daily operations.

A **cyber incident** is defined by the Department of Homeland Security (DHS) in the 2024 National Cyber Incident Response Plan as "an event occurring on or conducted through a computer network that actually or imminently jeopardizes the confidentiality, integrity or availability of computers, information on communication systems or networks, physical or virtual infrastructure controlled by computers or information systems, or information resident thereon. A cyber incident may include a vulnerability in an information system, system security procedures, internal controls, or implementation that could be exploited by a threat source."[1] This definition is further elaborated in U.S. Code, Title 44, Section 3542.

Figure 7-1 CIA triad model[2]

Confidentiality: preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information.
Integrity: guarding against improper information modification or destruction and ensuring information non-repudiation and authenticity.

- **Data Integrity (DI)**: The property that data has not been altered in an unauthorized manner. DI covers data in storage, during processing, and while in transit.
- **System Integrity (SI)**: The quality that a system has when it performs its intended function in an unimpaired manner, free from unauthorized manipulation of the system, whether intentional or accidental.

Availability: Ensuring timely and reliable access to and use of information.

[1] Department of Homeland Security, *National Cyber Incident Response Plan Draft*, (December 2024): p. 5, https://www.cisa.gov/sites/default/files/2024-12/NCIRP%20Update%20Public%20Comment%20Draft%20508c.pdf
[2] Debbie Walkowski, "What is the CIA Triad?" *F5 Labs* (2019): https://www.f5.com/labs/learning-center/what-is-the-cia-triad

Cyber incidents can be categorized as (1) malicious attacks, (2) human errors and system glitches, or (3) environmental hazards.

Malicious attacks

Cyber incidents based on actors with malicious intent can be driven by criminal motives for profit, extortion, and theft or to damage, destroy or interfere with infrastructure systems. Organizations worldwide experience malicious attacks on a daily basis. Most of the attacks are unstructured with little to no organization behind them such as a phishing attack or malware hidden in a downloaded file. Attacks are carried out with tools aiming to take advantage of well-known flaws and are often detected by security tools such as antivirus programs before they cause harm. However, an undetected attack can cause significant harm to an organization before it's detected and fully contained. More sophisticated attacks with a specific target are less common, harder to detect and take longer to contain. These attacks are more likely to have a catastrophic impact on an organization causing disruptions over some or all of the network. Over the last few years attackers have been targeting organizations using sophisticated ransomware, which encrypts the organizations' data and demands a ransom to decrypt it. Other attacks include cyber terrorism(aiming to cause sufficient destruction or disruption) to generate fear or undermine entities such as an organization, a region, a sector or a country.

Human error and system glitches

Cyber incidents due to human errors and system glitches can occur because of negligence, lack of implemented policies and/or process, unclear roles and responsibilities, insufficient training, misconfigurations etc. Such incidents are often identified and contained faster than disruptions caused by malicious actors. Human errors and system glitches can expose confidential data, decrease availability and put data integrity at risk.

Environmental hazards

Data centers, physical IT infrastructure and hardware are vulnerable to other hazards such as earthquakes, flooding, fires, and extreme weather that result in long lasting power outages. In the event of such hazards it is likely that the disruption to information technology will slow down the recovery time of critical communication systems, essential services and hardware. This can cause a variety of cyber incidents including loss of data and system availability and communications.

Unshielded electronic and electrical equipment is sensitive to electromagnetic pulses (EMP) and geomagnetic disturbances (GMD). An EMP is an intense burst of electromagnetic energy resulting nuclear explosion in the atmosphere whereas a GMD is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock or cloud of magnetic field that interacts with Earth's

magnetic field.[3] Whether caused by man or nature, EMP and GMD events can temporarily affect or permanently damage electronic equipment. Solar storms that affect electronic equipment are rare but have occurred in the past, impacting GPS satellite systems and signals sent to ground-based receivers.

7.2 Location

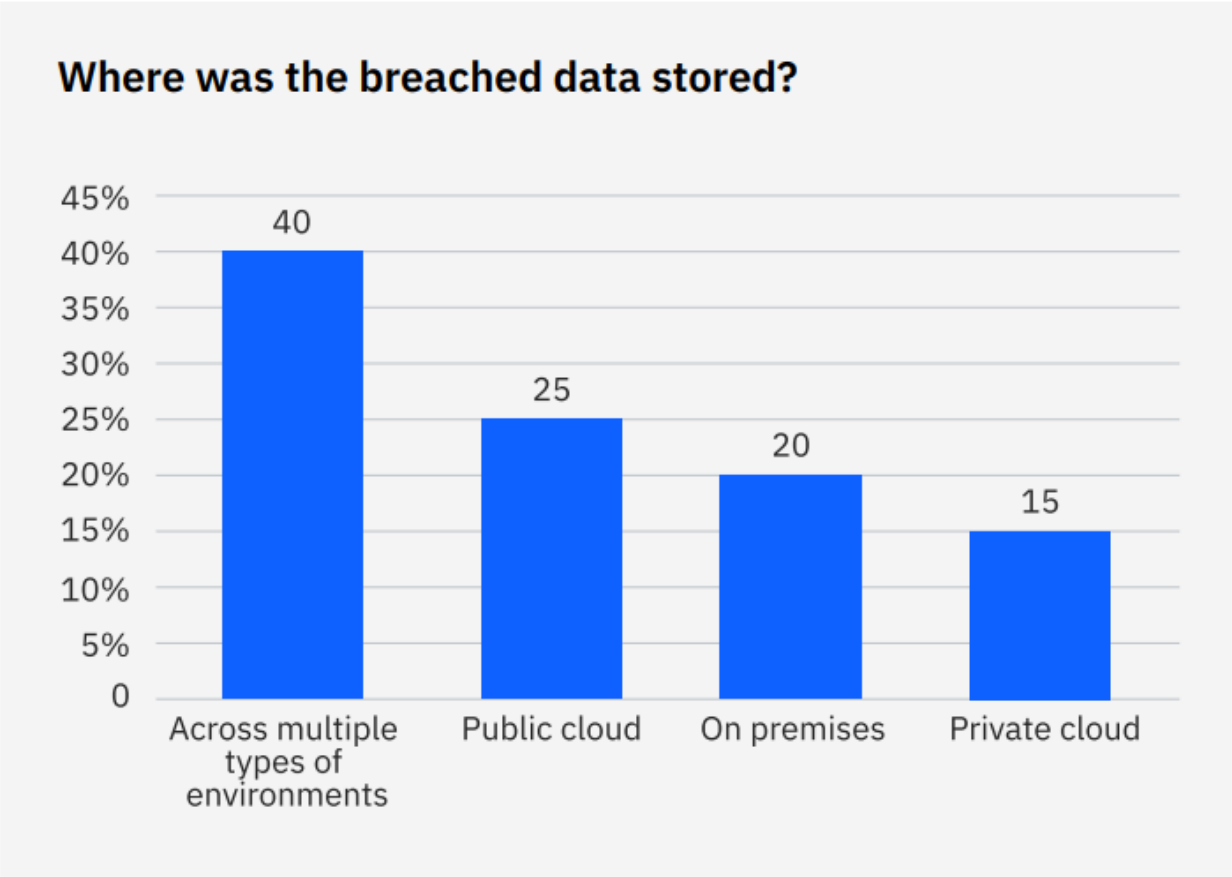
The cyber threat "landscape" is constantly evolving due to advances in technology, the growing motivation of attackers, and the expansion of attack "surfaces" across digital ecosystems. Wherever information technologies exist and are used, cyber incidents can occur. The nature of a cyber-incident differs from other types of hazards because it is inherently driven by online actions and targets digital systems, but it can also result in significant physical impacts. For instance, cyberattacks can disrupt critical infrastructure, manufacturing processes, or even cause breaches in physical security. As the digital landscape expands and technology becomes more integrated into daily operations, cyber incidents increasingly have the potential to affect both virtual and physical environments. The primary avenues of attack, or virtual locations of threat, include cloud-based, phishing, third party breaches, ransomware, and insider threats.

Cloud-Based

Regardless of where data is stored, it is always susceptible to breaches. However, some storage environments are more vulnerable and costly to breach than others. A significant number of breaches involve data that is distributed across multiple environments, including public clouds, private clouds, and on-premises systems. As organizations continuously evolve their data management strategies, they often fail to account for shadow data —data that's unmanaged and likely invisible to the IT department. This shadow data typically arises when employees use unauthorized applications or upload files to unsanctioned cloud storage locations without the organization's knowledge. In fact, approximately 40% of all data breaches are linked to data spread across multiple environments, highlighting the complexity of managing data security in hybrid and multi-cloud architectures.

[3] Department of Homeland Security, *Electromagnetic Pulse (EMP)/Geomagnetic Disturbance (GMD)* (December 2023): https://www.dhs.gov/science-and-technology/electromagnetic-pulse-empgeomagnetic-disturbance

Figure 7-2 IBM data storage type for reported data breaches, 2024



Phishing

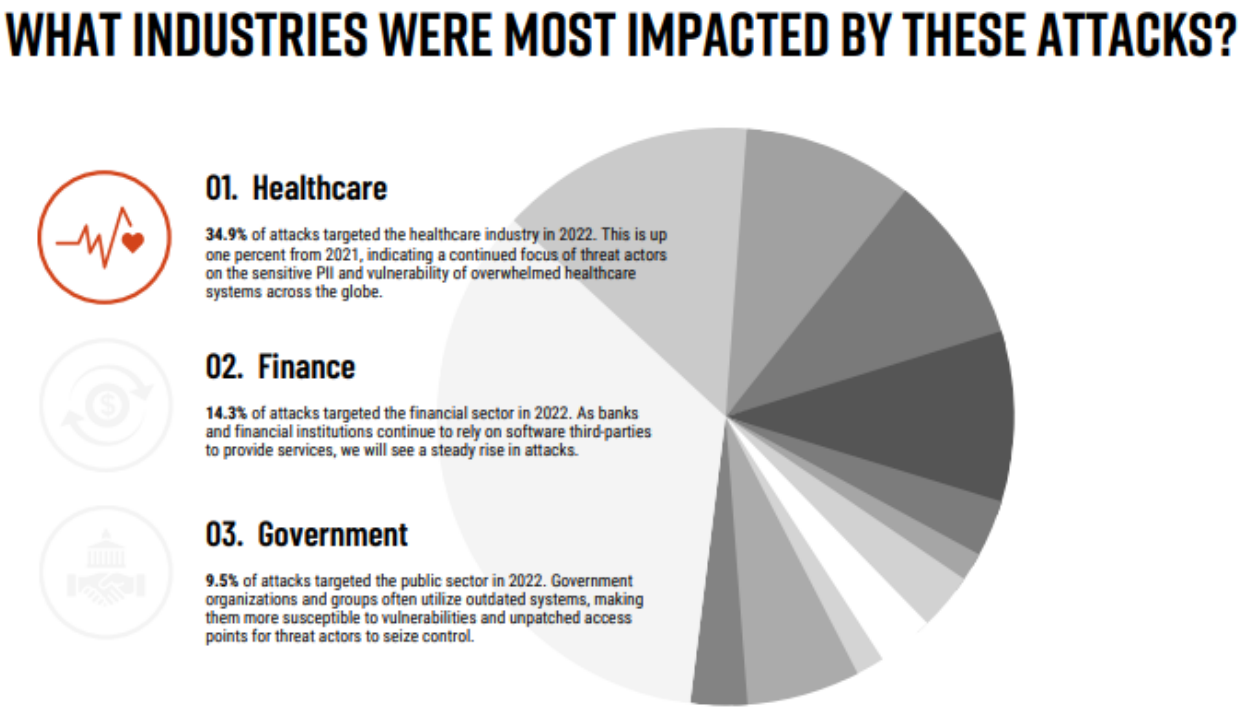
Phishing is a social engineering tactic that is used to persuade individuals to provide sensitive information and/or take action through seemingly trustworthy communications, such as through impersonations of financial institutions, IT departments, or government agencies. Phishing attacks are usually untargeted and come in the form of an email. According to the IBM, employee training continues to be an essential element in cyber defense strategies, specifically for detecting and stopping phishing attacks.[4]

Third Party Breaches

Technology vendors that provide technical, software, and healthcare services are particularly vulnerable to third-party breaches.[5] Hackers frequently exploit weaknesses in software or

[4] IBM, *Cost of a Data Breach Report* (2024): p. 23
[5] Black Kite, *Third Party Breach Report* (2023): p. 7, https://blackkite.com/wp-content/uploads/2023/01/third-party-breach-report-2023.pdf

manipulate code to gain unauthorized access. However, many organizations place undue trust in the security of the software and services they rely on, often neglecting to conduct thorough checks for vulnerabilities within their digital supply chain. In 2022, industries such as healthcare, finance, and government, which are heavily reliant on technology vendors, were particularly impacted by these kinds of attacks.



This type of breach occurred in 2020 for the Washington State Employment Service Department (ESD). The breach was traced back to Accellion, a technology provider that facilitated file transfers. At the time, many individuals were applying for unemployment benefits due to the COVID-19 pandemic, increasing the volume of sensitive data being processed. As a result, personal information of approximately 1.6 million individuals was compromised, and the ESD faced a staggering loss of $600 million due to fraudulent unemployment claims.[6]

Ransomware

Ransomware is a type of malicious software (malware) designed to deny access to a computer system or data until the victim pays a ransom. Ransomware attacks saw a significant resurgence in early 2023, with high-profile incidents affecting organizations worldwide. The United States was the most targeted country, accounting for 43% of all attacks, followed by the UK (5.7%) and Germany

[6] Kurt Schlosser, "Data breach exposes 1.6 million Washington state residents who filed unemployment claims in 2020" *Geekwire* February 2021): https://www.geekwire.com/2021/data-breach-exposes-1-6-million-washington-state-residents-filed-unemployment-claims-2020/

(4.4%). Among industries, manufacturing (19.5%), professional, scientific, and technical services (15.3%), and educational services (6.1%) were the most frequently targeted.

Manufacturing and professional service companies are often prime targets due to the valuable intellectual property and sensitive data they store, making them attractive to cybercriminals looking for high-value ransoms. Educational institutions, on the other hand, tend to hold large volumes of personal data, including information on students, staff, and research, which makes them lucrative targets for ransomware groups.

Insider Threats

While external threats often dominate discussions, insider threats, whether malicious or inadvertent, pose significant risks. Insiders could include employees, contractors, or partners/collaborators who have access to critical systems. While malicious insider attacks make up only 7% of breaches, they are often the highest cost for response and recovery averaging 4.99 million dollars.

Others

While cloud-based attacks, phishing, third-party vulnerabilities, ransomware, and insider threats are some of the most common avenues for cyberattacks, they are not the only vectors that entities should consider when planning their defenses. Table 7-1 offers a comprehensive list of various cyber threat vectors and their subtypes, including different types of malware, network and database interception, password and access control breaches, social engineering tactics, and physical/infrastructure-related threats.

Table 7-1 Cyber threat vectors used for malicious attacks

Cyber Threat Vector	Definition
Malware Types	
Advanced Persistent Threat (APT)	An attack in which the attacker gains access to a network and remains undetected. APT attacks are designed to steal data instead of cause damage.
Backdoor	An undocumented way of gaining access to a computer system. This is a security risk.
Drive-by Downloads	Malware is downloaded unknowingly by the victims when they visit an infected site.
Malware	Software or firmware intended to perform an unauthorized process that will have an adverse impact on the confidentiality, integrity, or availability of an information system. Examples include:

	• **Adware:** A form of software that displays advertising content in a manner that is potentially unexpected and unwanted by users, which may also include various user-tracking functions (similar to spyware). • **Malvertising:** Malware downloaded when the victim clicks on an affected ad. • **Ransomware:** Malware that locks a person's keyboard or computer to prevent them from accessing data until a ransom is paid, usually in Bitcoin. A popular variation of this is ransom crypto ware, which corrupts files using a private key that only the attacker possesses. • **Spyware:** Software that allows others to gain private information about a user, without that person's knowledge or consent, such as passwords, credit card numbers, social security numbers, or account information. • **Trojan horses:** A computer program that appears to have a useful function, but also has a hidden and potentially malicious function that evades security mechanisms. • **Virus:** A program or code that attaches itself to a legitimate, executable program, and then reproduces itself when that program is run. • **Worms:** A self-contained program (or set of programs) that is able to spread copies of itself to other computer systems, usually through network connections of email attachments.
Structured Query Language injection (SQLi)	Attackers use malicious SQL code for backend database manipulation to access information that was not intended to be displayed.
Zero-day exploit	An attack which occurs the same day a vulnerability is discovered in the software. The vulnerability is exploited by the attacker before it can be fixed by a patch or a permanent solution.
Network and Data Interception	
Denial-of-Service Attack (DoS)	Attacks that focus on disrupting service to a network in which attackers send high volumes of data until the network becomes overloaded and can no longer function.
Man-in-the-Middle (MITM)	MITM attacks mirror victims and endpoints for online information exchange. In this type of attack, the MITM communicates with the victim who believes they are interacting with the legitimate endpoint website. The MITM is also communicating with the actual endpoint website by impersonating the victim. As the process goes through, the MITM obtains entered and received information from both the victim and endpoint
Pharming	Arranging for a website's traffic to be redirected to a different, fraudulent site, either through a vulnerability in an agency's server

	software or through the use of malware on a user's computer system.
Password and Access Control	
Password Attacks	Third party attempts to crack a user's password and subsequently gain access to a system. Password attacks do not typically require malware, but rather stem from software applications on the attacker's system. These applications may use a variety of methods to gain access, including generating large numbers of generated guesses, or dictionary attacks, in which passwords are systematically tested against all of the words in a dictionary. Due to users reusing the same password for different systems a password attack targeting an unrelated system can give the attacker access to a more sought-after system.
Spoofing	Attempting to gain access to a system by posing as an authorized user, synonymous with impersonating, masquerading, or mimicking. Attempting to fool a network user into believing that a particular site was reached, when actually the user has been led to a false site that has been designed to appear authentic, usually for the purpose of gaining valuable information, tricking the user into downloading harmful software, or providing funds to the threat actors.
Social Engineering	
Social Engineering	In the context of cyber-security, this refers to an effort to psychologically manipulate a person, especially through misrepresentation or deception, to gain access to information. Methods of social engineering include: • **Phishing:** Malicious email messages that ask users to click a link or download a program. Phishing attacks may appear as legitimate emails from trusted third parties. • **Spear Phishing:** A form of phishing that targets a specific individual, company, or agency, usually relying on an accumulation of information to make subsequent ruses more effective when further probing the target, until a successful security breach finally becomes possible.
Physical and Infrastructure	
Physical damage	Intentional or unintentional damage to physical infrastructure such as data centers, hardware, or power grids.

7.3 Magnitude

Cyber incidents put both financial resources and sensitive information at risk. The financial impact includes costs related to downtime, remediation efforts to repair damaged systems, expert consultations, and potential ransom payments. Data loss or compromise also poses a significant threat, particularly for entities handling sensitive information such as Personally Identifiable Information (PII) or Personal Health Information (PHI). The County, for example, manages a wide range of public, sensitive, and confidential data, some of which is regulated by federal law, the Revised Code of Washington, and global compliance standards. Unauthorized, unintentional, or unanticipated disclosure of confidential data could lead to identity theft, financial loss for individuals, operational disruptions for businesses, legal action, and reputational damage for the County.

The magnitude of a cyber incident is further influenced by the duration of the event and the ability to detect and respond to it in a timely manner. Having the ability to preempt the incident and activate a well-known and effective incident response plan is also critical in reducing the duration of the event. It could take weeks, months, or even years to fully recover from a cyberattack. According to IBM's 2024 Cost of a Data Breach Report, the average time it takes a business to identify a data breach is 194 days. The average time it takes to fully contain a breach, after it has been identified, is 64 days.[7]

Scenarios

Smaller cyber incidents may have minimal impact, such as a minor configuration error discovered early, or a stolen encrypted laptop without sensitive data. These types of incidents, while disruptive, are often recoverable without significant consequences for the County's operations. On the other hand, a large-scale cyber incident, such as a ransomware attack that encrypts all or most of the County's data, can have catastrophic effects. This could lead to the loss of critical operational capabilities, economic damage, reputational harm, and even health and safety risks for the individuals living, working, or visiting the region. The County's essential services, which are crucial for public health, safety, and legal compliance, can be severely disrupted if they are unavailable for 0-72 hours after the initial attack.

A prolonged disruption to these essential services can have devastating consequences for the region. The County's essential functions, which are critical to supporting life, health, and safety, include services that must meet specific legal requirements. The loss of critical system availability, functionality, and operational effectiveness can hinder productivity and impact the performance of individuals supporting County operations. In cases where hardware, networks, servers, or backup systems are damaged by other hazards or malicious actions, recovery delays can be further

[7] IBM, *Cost of a Data Breach Report* (2024): p. 10

compounded. Moreover, if unauthorized changes are made to IT systems or data—either intentionally or accidentally—system and data integrity may be compromised. If such integrity issues are not addressed, continued use of contaminated systems or corrupted data can lead to inaccurate decisions, fraud, or further operational risks.

Vendors

The County also relies on SCADA (Supervisory Control and Data Acquisition) systems, which are used to control infrastructure and facility processes, including wastewater treatment and airport operations. Cyber incidents targeting these critical systems could have severe consequences, including environmental, health, safety, and financial risks for the region.

Not all IT systems utilized by the County are managed internally; the County also relies on third-party vendors and partners who may be exposed to cyber threats. Disruptions within these external organizations can also affect the County's operations, underscoring the importance of securing the entire ecosystem of stakeholders to minimize cyber risk.

Cyber Resiliency

As cyber threats evolve, entities must continually update their security posture. Due to the complexity of the cyber threat landscape, a comprehensive, multi-layered approach to defense is essential. Cyber defense can be broken down into five phases: (1) identification, (2) protection, (3) detection, (4) response, and (5) recovery strategies. To mitigate the risk of cyber incidents, it is crucial to manage threats and vulnerabilities by investing in network protection and malware detection, developing incident response plans and exercises, providing employee training, and establishing backup systems.

The Cybersecurity and Infrastructure Security Agency (CISA) is the Nation's risk advisor, partnering with industry and government to understand and manage risk to our Nation's critical infrastructure. They coordinate security and resilience efforts using trusted partnerships across the private and public sections and deliver technical assistance and assessments to federal stakeholder as well as to infrastructure owners and operators nationwide. Their CISA Resource Hub offers a range of cybersecurity assessments that evaluate operational resilience, cyber security practices, organizational management of external dependencies, and other key elements of a robust and resilient cyber framework.

7.4 Previous Occurrences

Cyber incidents occur daily across the globe. The quantity of information being stolen by malicious attackers, destroyed or exposed as a result of a human error, or made unavailable due to a system glitch is growing each year. King County is the recipient of a constant variety of attacks ranging from scans for weaknesses in our defenses, malware, phishing, and internet-based attacks, as well as

insider threats. In recent years, we have seen a rise ransomware. Table 7-2 comprises local, state, national, and international events and exemplifies consequences of cyber-incidents.

Table 7-2 Notable cyber-attack events, 2014 – 2024

Year	Location/Affiliation	Vector	Description
2014	Washington State	Human error	Washington State experienced a six hour long 911 system outage due to human error.
2014	United States	Malicious insider threat	280,000 AT&T accounts were breached by insiders who accessed user information with malicious intent.
2015	United States	Third-party breach	The Office of Personnel Management (OPM) experienced a malicious attack resulting in over 20 million compromised personnel records.
2016	United States	Third-party breach	The US Special Counsel Robert S. Mueller, III investigated Russia's interference in the 2016 presidential election. Known as the Mueller Report, the investigation states Russians hacked into the Democratic National Committee and released documentation through the media organization WikiLeaks.[8]
2017	Global	Hazard	A geomagnetic storm affected power grids and radios.
2017	University of Washington	Human error	The University of Washington suffered a HIPAA data breach exposing the information of nearly 1 million patients due to human error.
2019	Washington State	Ransomware	The City of Sammamish was targeted by a ransomware attack that shut down many of the city's online services, requiring the city manager to declare an emergency and request support from law enforcement and King County IT, as well as hire a tech company to help resolve the crisis.

[8] Special Council Robert S. Muller III, *Report On The Investigation Into Russian Interference In The 2016 Presidential Election,* v. I of II (March 2019): p. 1, https://www.justice.gov/archives/sco/file/1373816/dl?inline=

2020	WA Employment Security Department (ESD)	Third-party breach	Personal information of more than 1.6 million people who filed for unemployment claims through ESD was compromised in 2020. The Office of the Washington State Auditor attributed the breach on a third-party software provider named Accellion, whose services are used to transmit computer files. The state Employment Security Department (ESD) lost $600 million to fraudulent unemployment claims.[9]
2023	Pierce College District	Human error	Personal data belonging to more than 155,000 former Pierce College students and staff was leaked on the dark web after a cyber attack. It was the third-largest data breach in Washington state that year.[10]
2024	City of Newcastle, WA	Ransomware	The City of Newcastle had fallen victim to a ransomware attack orchestrated by the cybercriminal group RansomHub. The attackers have claimed possession of the city's confidential data and threatened to publish or sell the stolen data if the city did not respond to their demands.[11]
2024	Port of Seattle	Ransomware	The Port of Seattle isolated its critical systems after the port identified system outages consistent with a cyberattack. The investigation determined that the unauthorized actor was able to gain access to certain parts of its computer systems and was able to encrypt access to some data. As the port refused to pay the ransom, it is feared that the attacker may post allegedly stolen data on the dark web.[12]

[9] Kurt Schlosser, "Data breach exposes 1.6 million Washington state residents who filed unemployment claims in 2020" *Geekwire* February 2021): https://www.geekwire.com/2021/data-breach-exposes-1-6-million-washington-state-residents-filed-unemployment-claims-2020/

[10] Shea Johnson, "Pierce College cyberattack exposed 155,000 people's data. Is the district at fault?" *The News Tribune* (November 2023): https://www.thenewstribune.com/news/local/article281698368.html

[11] Halcyon, *RansomHub Ransomware Attack Threatens City of Newcastle, Washington's Data Security* (July 2024) https://www.halcyon.ai/attacks/ransomhub-ransomware-attack-threatens-city-of-newcastle-washingtons-data-security

[12] Syed Rakin Rahman, "Port of Seattle shares details of a cyberattack" *Port Technology International* (September 2024): https://www.porttechnology.org/news/port-of-seattle-shares-details-of-a-cyberattack/

2024	Seattle Public Library	Ransomware	The Seattle Public Library's experienced a ransomware attack that took down their systems, internet, public computers, and library catalog at all 27 locations throughout the city.[13]
2024	Highline School District	Ransomware	School district within Seattle, WA identified a form of ransomware on their network which shutdown their systems. A third-party cybersecurity forensic specialist and launched an investigation which is ongoing.[14]

7.5 Probability of Future Occurrences

Unlike natural hazards, cyber threats cannot be predicted at regular intervals. However, as our digital reliance increases so will vulnerabilities that can be exploited by threat actors. In mitigating these vulnerabilities, organizations are faced with choices regarding response to ransomware threats. Best practices dictate not paying ransomware attackers the sums of money they request. This is thought to decrease the risk of future occurrences by potentially removing financial gain as a viable option for the target.

With increased digital reliance comes increased and evolving technological advancements. Artificial Intelligence makes its way into daily operations for many organizations. While AI can decrease the gap of necessary skilled professionals in cybersecurity and increase efficiency in the detection and response process, it can also decrease the barrier to entry for attackers. Language models make producing phishing messages simple for threat actors.[15] Inputting sensitive data into AI models can also pose a risk to organizations as how this data is used and reused by AI models is not well accounted for. Due diligence is needed to ensure companies providing AI services have adequate protection for the data inputted into their models. This may contribute to frequency of cyber threat occurrences in the future.

[13] Keely Quinlan, "Seattle Public Library ransomware attack to cost $1M, officials say" *Statescoop* (September 2024): https://statescoop.com/ransomware-attack-seattle-public-library-2024/
[14] Highline Public Schools, "Incident FAQS" *Departments/Communications* (2024): https://www.highlineschools.org/departments/communications/incident-faqs
[15] IBM, *Cost of a Data Breach Report* (2024): p. 6

7.6 Climate Change Considerations

Artificial Intelligence impacts to carbon emissions and water usage make it a contributor to climate change. As natural disasters, storms, and hazards increase in frequency, vulnerabilities in critical infrastructure impacted by these hazards also increase.

7.7 Impact Assessment

Public	Anyone who is present in King County during a cyber-incident can be impacted. Impact on residents may include: delayed services such as transportation, impaired or cancelled healthcare services, decreased or no availability of public services, information, and financial loss and exposed or lost information.
Responders	Emergency responders may not be able to access their mission critical system, and therefore experience delays or performance issues. If data confidentiality is lost the public may lose their trust in the response organization and system. If data integrity is lost it may put patients and first responders at risk. King County may experience a prolonged incident response if the disruption is long lasting, complex and exhausting internal resources.
Continuity of Operations	Minor cyber incidents which are identified early and are recoverable may have some impact on daily operations before being fully contained but won't lead to significant loss of operations. A significant incident impacting one or more functions and businesses can severely affect the County's capability to perform critical operations. However, not all daily operations are critical. The County has defined its essential services, which need to become operational within 0-72 hours after disruption to ensure the organizations capability to maintain critical healthcare, safety, legal and regulatory needs. **In the event of a cyber-incident which render a non-critical service unavailable the County may lose revenue, experience loss of productivity and risks losing data over time.**
Property, Facilities, and Infrastructure	**Property** Cyber incidents can cause physical damage if property such as facilities, devices, infrastructure, or end consumers are affected by the disruption. An incident including utilities, life support devices, transportation or telecommunications may lead to extensive property damages.

Facilities

Last years' cyber incidents including ransomware attacks, distributed denial of service attacks, system glitches and human error in healthcare systems all demonstrate that cyber incidents are capable of triggering emergencies that impact patient care and public health. If an agency cannot access its own EHR, patient care could be delayed or hindered. Furthermore, if other critical healthcare related systems and devices can't be accessed or data integrity can't be guaranteed, patient safety will be at risk.

Infrastructure

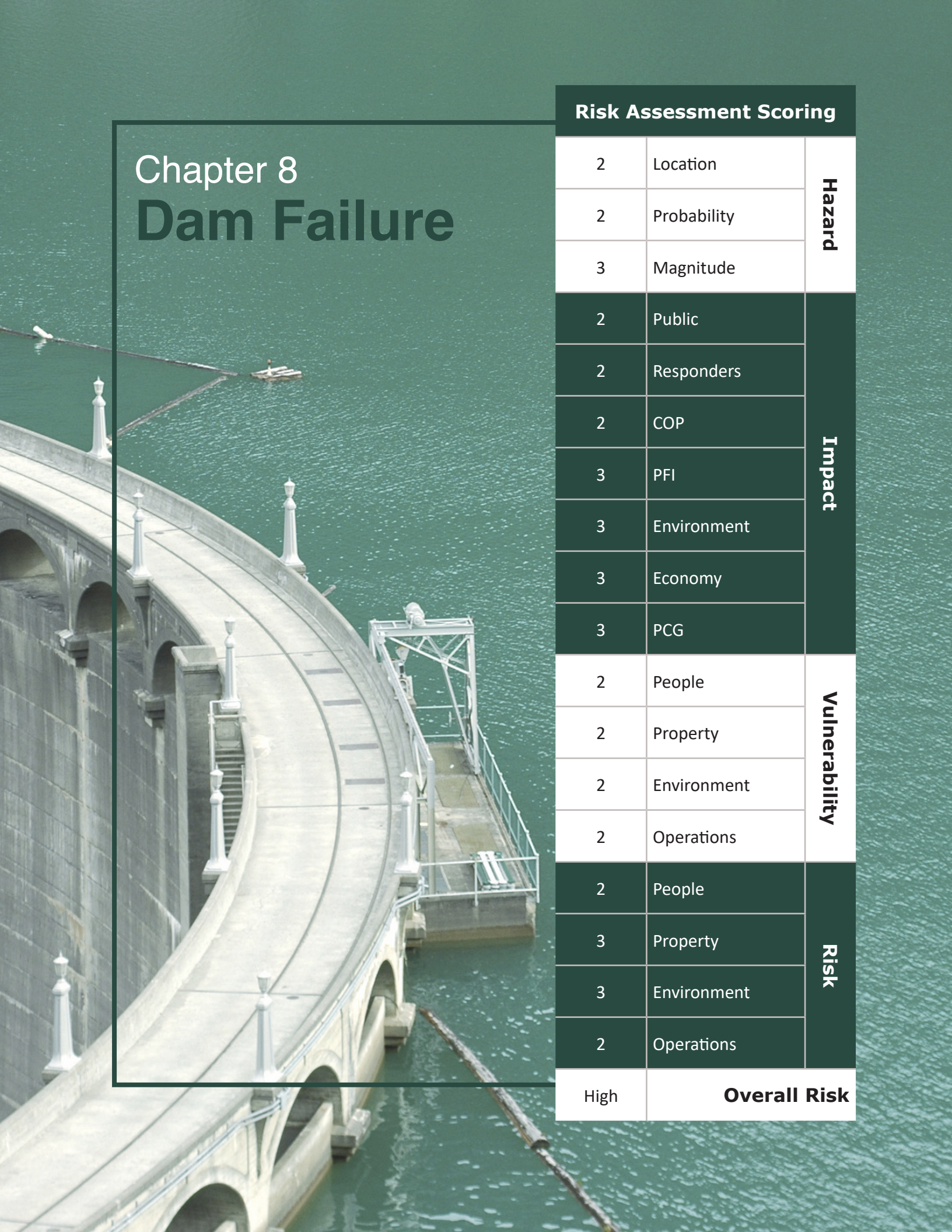
- Energy – Information technology has a direct dependency to energy. A hazard impacting the power system can therefore have a secondary effect on the County and lead to a cyber-incident due to loss of power to devices rendering systems and data unavailable, loss of power to cooling systems which can cause overheating and fires in server rooms and data centers. Critical infrastructure has backup generators. Ensuring fuel delivery during long lasting power outages for the generators is critical.
  A cyber incident impacting King County and no other organization should not have an effect on the energy system.
- Water/Wastewater – Both water and wastewater facilities and infrastructure are vulnerable to cyber incidents on their SCADA systems, which can result in the release of hazardous material and system malfunctions. Such scenarios can result in environmental impact and create health and safety risks in the region.
- Transportation – Transportation systems are vulnerable to attacks on their SCADA systems, which may result in trains and vehicles not operating as planned, airport functionality issues, delays, and cancellations which can result in a secondary economic impact in the region due to loss of productive if people can't access public transportation to and from work.
- Communications – The County relies on different types of technology-based communications methods such as its website, VOIP and email to conduct its daily operations. A cyber incident impacting the VOIP or email system would quickly result in a loss of productivity, a negative consumer experience and could potentially halter or delay some of the County's operations.

Environment	The loss of control or availability of the County's SCADA systems could potentially impact the environment in the region if, for example, it causes the release of hazardous materials or improper disposal of wastewater.

Economy	The financial impact of a cyber-incident ranges from little or minimal to significant depending upon duration, scale, affected systems, devices and users. A significant, extended cyber incident affecting most or all of the County's operations would likely impact the local and possibly regional economy for some time. An incident of that magnitude would likely create significant, potentially long-term or ongoing challenges to the County's ability to fund essential services and activities related to Executive priorities. Organizations who experience cyber incidents which leads to data breaches of sensitive or confidential information can be subjects to legal fines and financial penalties if, for example, Personal Healthcare Information (PHI) is lost or exposed or personal identifiable information including social security numbers, credit card information or driver's license information is breached. Organizations who fail to meet regulatory and contractual obligations due to a cyber-incident may have significant cost for legal fees, settlements, and fines.
Public Confidence in Governance	Recent cyber-incidents involving government agencies such as the ransomware attack on the City of Atlanta shows that such large-scale disruption generate National media interest; third party actions; jeopardizes perceptions of effective operations, Executive priorities, and public confidence.

7.8 Vulnerability Assessment

Vulnerable Populations	Individuals who have a direct dependency on King County for health and safety reasons are vulnerable to cyber incidents impacting their needed services. Other vulnerable populations include individuals and organizations who depend on an income from the County if payments can't be processed, who are dependent on critical public services or County provided transportation.
Property	**Critical SCADA Systems** Industrial control systems which are used to control infrastructure and facility-based processes such as wastewater treatment and airports.
Environment	If SCADA systems were to become compromised, ecosystems could become vulnerable to the release of hazardous material. This impacts waterways, soil, and vegetation.
Operations	Facilities such as data centers and incident response facilities. The County has identified a number of essential services which are critical to support life, health, safety and legal requirements in the region. Although separate communication systems can be utilized in the event of a severe incident the County still relies on its communications systems for daily operations.



Chapter 8
Dam Failure

Risk Assessment Scoring		
2	Location	Hazard
2	Probability	
3	Magnitude	
2	Public	Impact
2	Responders	
2	COP	
3	PFI	
3	Environment	
3	Economy	
3	PCG	
2	People	Vulnerability
2	Property	
2	Environment	
2	Operations	
2	People	Risk
3	Property	
3	Environment	
2	Operations	
High	**Overall Risk**	

Chapter 8: Dam Failure

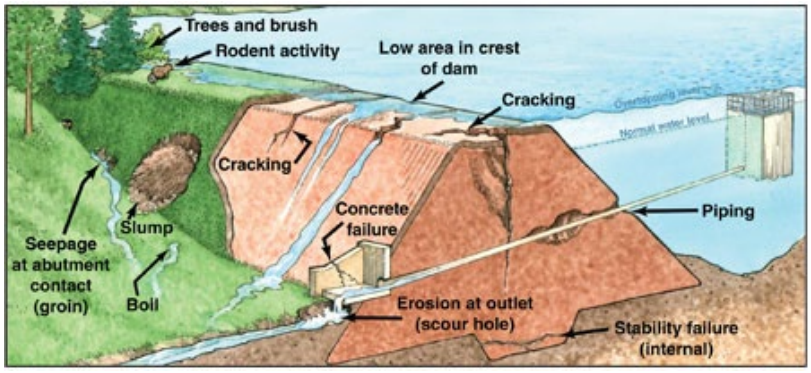
8.1 Hazard Description

Dam failure is an uncontrolled, often times, rapid release of water from an impoundment.[1] The impact of failure varies on 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. The result of a dam failure can result in loss of life, property, infrastructure damage, public health impacts, safe drinking water, and environmental degradation within the inundation zone, but may have secondary effects on populations outside of the flooded area.

King County has 127 dams that serve in a variety of ways, agriculture, hydroelectric power generation, flood control, and recreation. All but eleven of these dams are embankment-type dams. Contrary to the popular images of dams like the Hoover dam, these dams are smaller and are typically made of a mixture of compacted materials such as soil, clay, and rock. A semi-pervious outer covering with a dense impervious core gives embankment dams their ability to resist seepage and water pressure. The other dams are made of concrete.

Dams fail for a variety of reasons, but the four most common are:[2]

- **Overtopping,** 34% - caused by the reservoir reaching capacity and water spilling over the top of a dam.
- **Foundation defects,** 30% - caused by settlement and slope instability.
- **Piping and seepage**, 20% - when water travels through the dam and causes internal erosion.
- **Conduits and valves,** 10% - Piping of embankment material into the conduit through joints or cracks.



[3]

[1] Tetra Tech. 2017. King County Dam Safety Emergency Planning Gap Analysis Report. Page 10.
[2] Washington State Department of Ecology – Water Resource Program – Dam Safety Office. Accessed 8/28/2019. https://ecology.wa.gov/Water-Shorelines/Water-supply/Dams/Emergency-planning-response/Incidents-failures.
[3] Washington State Department of Ecology – Water Resource Program – Dam Safety Office. 2018. Status of High and Significant Hazard Dams. Page 6.

Causation

Dam failure events are infrequent and may coincide with other events, such as earthquakes, landslides, excessive rainfall, wildfires, lahars and snowmelt. The average age of dams in King County is 47. As infrastructure ages, increased spending is needed to maintain its integrity. Following is a selection of events that may cause a dam to fail.

Table 8-1 Causation of dam failure by hazard events

Causation	Description
Earthquake[4]	Earthquakes can result in damage or failure of a dam. Earthquake effects on dams mainly depend on dam types. For example, the 2011 Tohoku Earthquake damaged 48 dams, causing one embankment type dam to fail[5]. Safety concerns for embankment dams subjected to earthquakes involve either the loss of stability due to a loss of strength of the embankment and foundation materials or deformations such as slumping, settlement, cracking and planer or rotational slope failures. Dams are engineered to withstand the Maximum Considered Earthquake, but older dams may have been engineered before we fully understood the earthquake risk in the region.
Climate Change[6]	While dam failure probabilities are low. The chance of flooding associated with changes of dam operation in response to weather patterns is higher. Dam designs and operations are developed in part from hydrographs and historical records. If weather patterns experience significant changes over time due to the impacts of climate change, the dam design and operations may no longer be valid for the changed condition. Release rates and impound thresholds may have to be changed. This would result in increased discharges downstream, thus increasing the probability and severity of flooding.
Landslides[7]	The integrity of a dam or reservoir can be affected by a landslide if they fail or move. Landslides can be triggered by heavy rainfall, snowmelt, reservoir drawdown, or earthquakes. Landslides can occur upstream in the reservoir, in a canyon downstream of a dam, or within the abutment of a dam. A landslide into the reservoir can generate a wave large enough to overtop a dam. Sloshing back and forth in the reservoir can

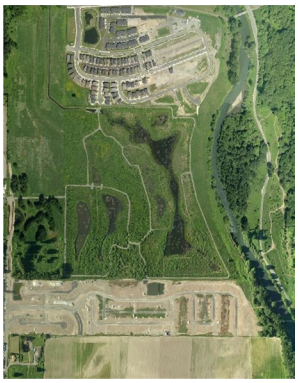
[4] KUOW. Seattle's Faults: Maps that Highlight Our Shaky Ground. Accessed 8/29/19. http://archive.kuow.org/post/seattles-faults-maps-highlight-our-shaky-ground
[5] International Commission on Large Dams. 2013. The 2011 Tohoku Earthquake and Dams. Page 9.
[6] Climate Impacts Group - University of Washington. 2018. New Projections of Changing Heavy Precipitation in King County. Page 40.
[7] Washington State Department of Natural Resources. Geological Portal Information. Accessed 8/28/2019. https://geologyportal.dnr.wa.gov/#natural_hazards

	result in multiple waves overtopping the dam. If the waves are large enough, there could be downstream consequences just from a wave overtopping the dam even if it doesn't fail. If enough large waves overtop an embankment dam or a concrete dam with erodible abutments, a failure could potentially result[8]. Some dams in the County have been built abutting a landslide. Often, these are ancient landslides that have stopped moving or are moving very slowly. However, if a landslide moves far enough, it can crack the core of an embankment dam, resulting in pathways for internal erosion to initiate, or disrupting the abutment support of a dam, resulting in failure.[9]
Wildfires[10]	Many of the County's highest hazard dams lie within wildfire-prone areas. Wildfires can damage dams, such as Eightmile dam near Leavenworth, directly by burning the surface of the dam or spillway and damaging other facilities at the dam. But the main threat from wildfires is how the surrounding watershed behaves. Heavy rains in a burned area can create: • More and faster runoff from rainfall events, especially high-intensity storms. • Large amounts of sediment, which may reduce storage capacity in a reservoir. • Debris flows (mudslides) or downed timber, which may obstruct access to the dam. • Debris flows from hill slopes near spillways, which may obstruct spillways. • More floating debris (dead trees, branches, sticks) in a reservoir, which may obstruct spillways[11]

[8] U.S Department of the Interior: Bureau of Reclamation. 2015. Risk Management: H-2 Landslide Risks. Page 1.
[9] Quartz. 2015. The World's Biggest Hydro Power Project May Be Causing Giant Landslides in China. https://qz.com/436880/the-worlds-biggest-hydropower-project-may-be-causing-giant-landslides-in-china/
[10] NW News Network. 2019. Eightmile Dam Near Leavenworth Has New Spillway, Is Being Monitored. https://www.nwnewsnetwork.org/post/eightmile-dam-near-leavenworth-has-new-spillway-being-monitored
[11] Washington State Department of Ecology - Water Resources Program - Dam Safety Office. 2015. Focus on Dams and Wildfires. Page 1.

Additionally, new development, outside of the 100-year flood plain, continues in dam inundation zones, meaning the population-at-risk from dam failure will continue to rise. Below shows development outside of the floodplain, but within a dam failure inundation area.

Green River 2009



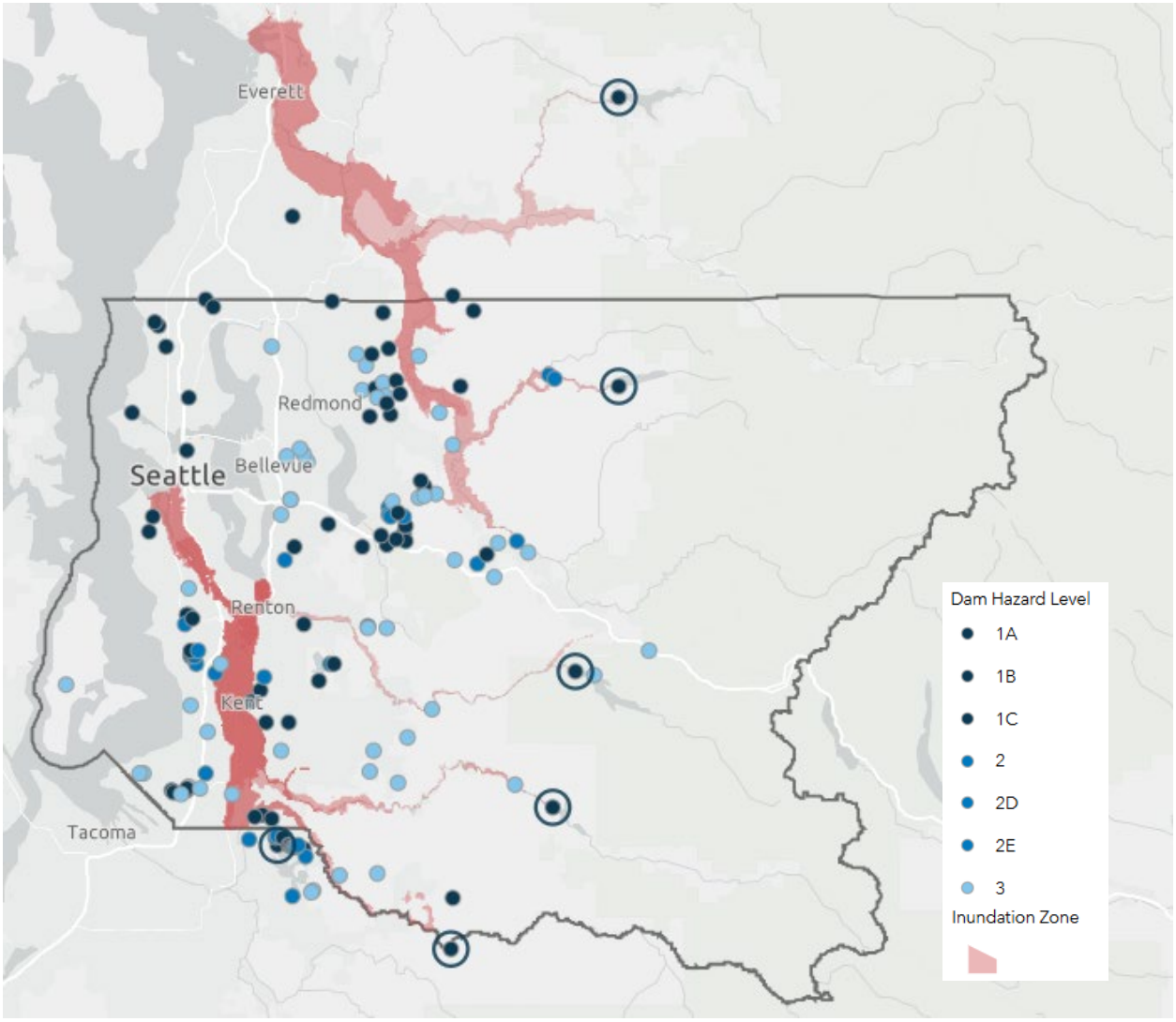
Green River 2012

100-Year Floodplain

8.2 Location

There are a total of 127 dams located within King County, with an additional 20 dams situated outside, though their inundation zones extend into the county. Figure 1-1 illustrates all identified dams in the county, color-coded from dark blue to light blue. The darker blue shades represent higher hazard classifications, while the lighter blue indicates lower hazard classifications. The six dams marked with circles are classified as "Significant Dams" due to their potential impact, if they were to fail.

Figure 8-2 Dams in King County



Howard A Hanson

Howard Hanson, constructed in 1961, is a federally owned and operated dam by the United States Army Corps of Engineers. Its primary purpose is to provide flood control in the winter and fish enhancement in the summer. It dramatically reduced the amount of flooding that the Green River Valley experienced before its construction.

The right abutment of the dam is the toe of a large landslide. Seepage problems can occur for dams built into landslides. As mentioned previously, landslide activity can pose a serious risk to dams. Many mitigation actions have been taken to reduce risk at the dam, such as a gravel blanket and additional vertical and horizontal drains in the drainage tunnel have all drastically improved the safety of the dam. If preventative actions are not taken, internal erosion could fail the dam.

South Fork Tolt Dam

The South Fork Tolt Dam is owned and operated by the City of Seattle. It is a hydroelectric dam that also provides drinking water for 30% of 1.3 million people across the greater Seattle area. South Fork Tolt Dam is a large embankment type dam, equipped with a morning glory spillway.

The Tolt dam has known landslide hazards below the dam, and above the reservoir. If a slide were to occur below the dam, the slide may create a dam of its own. Engineers would need to evaluate what action should be taken. The Tolt Dam would have to lower the amount of flow downstream why the risk is being assessed. Additionally, if a slide were to occur in the reservoir, an overtopping wave may be generated that could cause the dam to fail or send a flood wave downstream.

Mud Mountain Dam

Mud Mountain Dam is a United States Army Corps of Engineer owned and operated dam on the White River. Its primary purpose is to provide flood control for nearly 400,000 residents in King and Pierce Counties. Typically, there isn't a reservoir being impounded by the dam. During heavy rains or times of snowmelt, engineers will impound the water and slowly release it downstream to avoid flooding residents.

The White River is a glacial river fed by Mt. Rainier. This leaves the possibility that a lahar, triggered by an earthquake, volcanic activity, or heavy rains could cause a debris flow that would block the intake structure on the dam. Such an event would decrease the storage capacity of the reservoir and cause flows to travel over the spillway. The loss in flood control capabilities on the White River would leave the Green, White, and Puyallup River Valleys susceptible to flooding.

Culmback Dam

Situated in Snohomish County, but inundating a portion of the King County's Lower Snoqualmie Valley, the Culmback Dam is owned and operated by Snohomish Public Utility District One. Culmback offers hydroelectric power generation, flood control, drinking water, and recreational benefits to the region.

Culmback Dam's morning glory spillway is designed to maintain adequate levels of freeboard in maximum probable flood events. Changes in hydrology affect the amount of water a dam would need to convey downstream to keep it from failing. Culmback Dam's watershed lies within a densely forested area that slows the speed in which water enters the reservoir, prevents sediment from entering the reservoir, and prevents debris flows. A wildfire around the dam would increase the hydrologic strain on the dam. An increased flow could be compensated with larger releases from the dam but would result in flooding of the Town of Sultan. If not, enough water could be discharged, an overtopping scenario at the dam would prove very dangerous.

Lake Tapps

Lake Tapps is a reservoir that sits in Pierce County made up of a system of dikes. If particular dikes were to fail, they would inundate Auburn and portions of the Green and White River Valley. Lake Tapps was built by Puget Sound Energy in 1911 and ran a hydroelectric program until 2004. Lake Tapps was purchased by Cascade Water Alliance in 2009 who currently owns and operates the reservoir. Its primary function is to provide drinking water to a group of contracting King County cities and water districts.

In addition to providing drinking water, Lake Tapps is also a residential community, many of whom use the Lake for recreational purposes. While residents are instructed to stay off the dikes, there is no physical security to keep individuals from accessing the structure. Many dikes have publicly accessible roads. Acts of terrorism or sabotage could pose a serious threat to the integrity of the levees.

Madsen Creek Flow and Water Control Pond

Madsen Creek Pond is a King County-owned dam. Constructed in 2008, its primary purpose is to provide flood control in extreme rainfall events. There is oftentimes no impoundment behind the dam in Summer months when there isn't consistent rainfall.

Madsen Creek Pond is designed to store runoff from a 100-year 24-hour storm and still maintain freeboard necessary to prevent flooding downstream. While the dam is comparatively very young as climate patterns become more unpredictable, Madsen Creek Pond and other dams may need to be retrofitted to accommodate the change in probable maximum precipitation. If actions were not taken to adjust to the new hydrology, chances of failure from an overtopping situation or an uncontrolled release would become higher.

Cedar Falls Project Masonry Dam

While there have been fewer failures of concrete dams than earthen dams in general[12], this doesn't mean that failure is unrealistic. The Masonry dam sits near the Rattlesnake Mountain Fault. While concrete dams have escaped failure in earthquake scenarios, minor damage has been observed. The Masonry Dam would need to be assessed for damage after an earthquake for cracking or other deficiencies in the structure or supporting structures. If deficiencies are noted, action must be taken to ensure that the dam doesn't fail. Earthquakes can also trigger landslides around the dam. Finally, large earthquakes can devastate communities, created a resource-scarce environment, potentially making it more difficult to find resources.

[12] Association of State Dam Safety Officials. 1989. Failure of Concrete Dams. Page 4.

8.3 Magnitude

The impact of a dam failure depends on factors such as the size of the impoundment, the steepness of the terrain, downstream land use, and the speed of failure. For larger dams, failure typically results in a fast-moving flood wave with high velocities. In contrast, smaller dams may only cause a gradual rise in water levels. The consequences of a dam failure can include loss of life, property damage, destruction of infrastructure, public health risks, contamination of drinking water, and environmental harm within the inundation zone. Additionally, there may be secondary effects on communities and ecosystems outside the flooded area.

While there are 127 dams in King County, there are 21 other dams situated in neighboring counties that impact the County if they were to fail. Out of the 147 total dams, 94 threaten human life.

Table 8-2 Dam hazard classification

Hazard Class	Number
1A = High – Greater than 300 lives at risk	10
1B = High – 31 to 300 lives at risk	18
1C = High – 7 to 30 lives at risk	42
2* = Significant – 1 to 6 lives at risk	17
2D = Significant – 1 to 6 lives at risk	7
2E = Significant – Environmental or economic impact	3
3 = Low – No lives at risk	50

* Legacy classification, parsing all 2's into 2D's and 2E's [13]

the KCOEM Dam Safety program consists of creating response plans for high hazard dams in the community, educating at-risk populations of the threat of dam failure, and connecting poor condition dams to resources that are available for repair or removal of the dam. The King County Emergency Management Dam Safety Officer works closely with Washington State Department of Ecology's Dam and Wells Manager to share information and create a regional effort to heighten dam safety in the County. The information on dams in the hazard profile are from the State Department of Ecology's Inventory of Dams. The Washington State Department of 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.

8.4 Previous Occurrences

King County has high hazard 1A dams that sit on the Green, White, Cedar, and Tolt Rivers. Additionally, Culmback dam in Snohomish County would flood parts of the Lower Snoqualmie

[13] Washington State Department of Ecology - Water Resources Program - Dam Safety Office. 2019. Inventory of Dams Report.

Valley. The Green, White and Lower Snoqualmie Valleys are the areas of greatest concern for dam failure. Smaller privately owned and government dams are also a concern, as they may not have access to funding streams that other larger municipal governments do.

Four dam failure incidents have occurred in King County; they account for all lives lost due to dam failure in Washington State:[14]

Table 8-3 Previous dam failure events

Date	Dam Name	Description
December 1918	Masonry Dam	Located near North Bend, Masonry Dam had excessive seepage, which caused a mudflow, destroyed a railroad line and damaged the village of Eastwick; no lives lost. Now referred to as the "Boxley Burst".
February 1932	Eastwick RR Fill	The failure was caused by a blockage in the culvert. Resulting in the destruction of the town of Eastwick and the loss of 7 lives.
January 1997	N. Boeing Creek Dam	Failure from damage caused by seepage resulted in water running into an intersection and detention pond.
January 2009	Howard Hanson Dam	Two depressions were discovered in the right abutment of the United States Army Corps of Engineers' Howard Hanson Dam. While repairs were being conducted, there was a 1 in 3 chance of a 25,000 cfs release down the Green River which would have caused significant flooding. The USACE was able to fully fix the dam by 2011 before a substantial flood ensued. King County and local jurisdictions spent $30 million on flood protection that wasn't reimbursed by FEMA.[15]
January 2009	Mud Mountain Dam	Mud Mountain Dam, owned and operated by the USACE, released a higher than usual flow down the White River during a heavy rain event. As a result, 100 homes were flooded. Since then, King County Flood Control District, Washington State, and Pierce County jointly funded a levee setback to reduce the risk of flooding and increase habitat restoration[16].

[14] Washington State Department of Ecology - Water Resources Program - Dam Safety Office. 2019. Washington State Notable Dam Failures and Incidents.
[15] Seattle Times. 2011. FEMA won't pick up $30 million tab to prepare for flooding. https://www.seattletimes.com/seattle-news/fema-wont-pick-up-30-million-tab-to-prepare-for-flooding/
[16] King County Department of Natural Resources and Parks – Water and Land Resource Division. 2018. Lower White River Countyline Levee Setback Project. https://www.kingcounty.gov/depts/dnrp/wlr/sections-programs/river-floodplain-section/capital-projects/lower-white-river-countyline-a-street.aspx

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.

8.5 Probability of Future Occurrences

The likelihood of a dam failure in King County is very low. While the county's location near the Juan de Fuca Plate and Puget Sound Faults does lead to more frequent earthquakes than other parts of the U.S., the risk of dam failure from seismic activity is still minimal. Many of the dams in King County are relatively new, which reduces the chance of structural damage. Additionally, all large, high-hazard dams in the area are closely regulated by the Federal Energy Regulatory Commission (FERC) and other agencies. These organizations ensure that dams are properly maintained and that operators are prepared for potential emergencies, such as flooding.

8.6 Climate Change Considerations

Climate change introduces several factors that can increase the risk of dam failure. Wildfires, for example, can heighten the likelihood of landslides and sloughing, creating cascading hazards. Additionally, debris runoff from fires can lead to post-fire sedimentation and siltation in downstream dams. Warmer water temperatures, a direct result of climate change, can contribute

to soil saturation, increasing the risk of dam seepage. The earlier spring thaw and changing snowmelt patterns may also cause higher flow rates, placing additional stress on dams.

Heavy rainfall events can lead to erosion and scouring near dams, exacerbating runoff and increasing water pressure, while rising temperatures lead to faster evaporation, which may weaken dam structures over time. Both extreme heat and cold can further damage the structural integrity of dams. Finally, the increasing frequency and intensity of precipitation events elevate the risk of dam overtopping and complicate freeboard management, making it harder to ensure the dam's safety in extreme weather conditions.

8.7 Impact Assessment

With all the dams in the county, only a small amount of information can be shared here due to "For Official Use Only Designation". Another reason is that there is a lack of in-depth study done on dam failure impacts to King County. The best and most available estimates for dam failure damages/impacts are from the potential high release scenario at Howard Hanson Dam in 2009. Examples provided here relate to those studies.

Public	As the Green River Valley experience drastic differences in day time/night time population being an economic hub. The number of people that would need to be evacuated could drastically differ from the numbers identified in the hazard classification. An estimate in 2009 put a 25,000 cfs release from Howard Hanson triggering an evacuation on the scale of 200,000 to 300,000 people.[17]
Responders	Kent, Pacific, Seattle, Renton Regional Fire Authority, Valley Regional Fire Authority, and Eastside Fire and Rescue all have fires stations within dam inundation areas. Auburn, Algona, Pacific, Kent, Seattle, State Patrol Crime Lab, and King County Sherriff all have stations in dam failure inundations.
Continuity of Operations	Auburn, Kent, Tukwila, Carnation, Pacific, and Algona all have city halls within inundation areas. Courts, the County Elections office, King County Regional Justice Center in Kent where Superior Courts, Adult Detention, and other county agencies are located within dam failure inundation areas as well.

[17] Seattlepi. 2019. 300,000 might have to evacuate if Green River Floods. https://www.seattlepi.com/seattlenews/article/300-000-might-have-to-evacuate-if-Green-River-889468.php

Property, Facilities, Infrastructure

Dam Name	Residential Buildings Impacted in King County (Full Pool Failure)	Estimated Impacted in King County (Sunny Day Failure)*
Mud Mountain	9,992	829
Howard Hanson	8,508	2,545
South Fork Tolt	935	N/A
Lake Youngs	1,120	873
Culmback	59	N/A
Other Dams Combined (Estimate)	N/A	N/A

[18]

*Sunny day failure assumes a regular pool

2009 modelling of a high release from Howard Hanson.

Structures impacted	Lower Green	In 17,000 cfs impact area	In 25,000 cfs impact area
Residential	3,486	1,743	1,937
Commercial	16,798	12,245	13,667
Industrial	7,839	6,549	6,644

[19]

Facilities

[18] Tetra Tech. 2017. King County Dam Safety Emergency Planning Gap Analysis Report. Page 168.
[19] FEMA Region X. 2009. HAZUS Analysis for the Green River Valley. Page 166.

MultiCare Auburn Medical Center lies within a dam failure inundation area, but further study is needed to fully understand the impacts on health systems from dam failure.

Infrastructure

Infrastructure impacts vary dramatically based on the individual dam and type of failure.

- Energy- While there are dams that generate power in the County, they provide a relatively small amount of power. The Cedar, Snoqualmie, Twin Falls and, Tolt projects account for only 126 max MW output[20]. Power outages may be long term in areas where there has been a failure.
- Water/Wastewater – Drinking water availability would be drastically impacted by a failure of the Masonry, Lake Tapps, Lake Youngs, and Howard Hanson Dams. A failure of one of the many of the reservoirs around the County would also challenge water systems. The King County South Treatment Plant also lies within a dam failure inundation area.
- Transportation- Rail lines (commercial and commuter), LINK Light Rail, bus routes, numerous state highways, and numerous bridges can be impacted by dam failure.

Environment	The primary environmental impact from dam failure is natural and manmade debris from the inundation. Silt, wood, rocks and gravel, hazardous materials, construction debris, vehicles, dead animals may be carried by inundation waters to locations that may be spawning areas for local fish, wetlands for birds and reptiles, or inhabited areas that the County has invested in heavily. While recovery and impact will vary with each inundation area.
Economy	The Green River Valley is an economic powerhouse in the region. Flood damage prevented in the valley by Howard Hanson Dam since the January 2009 flood is estimated at $6 billion alone[21]. The economic impact of a failure would devastate the region. With large employers, such as Boeing, and economic centers like the South Center Mall, in the Valley, a dam failure would leave the local economy crippled. Commutes, roadways, and rail lines would all be impacted by a high release from Howard Hanson. Unemployment may follow in areas that experience a dam failure.

[20] Bonneville Power Administration. 2018 Transmission Plan. 2018. Page 77.
[21] USACE. Howard A. Hanson Dam. Accessed 8/28/2019. https://www.nws.usace.army.mil/Missions/Civil-Works/Locks-and-Dams/Howard-Hanson-Dam/

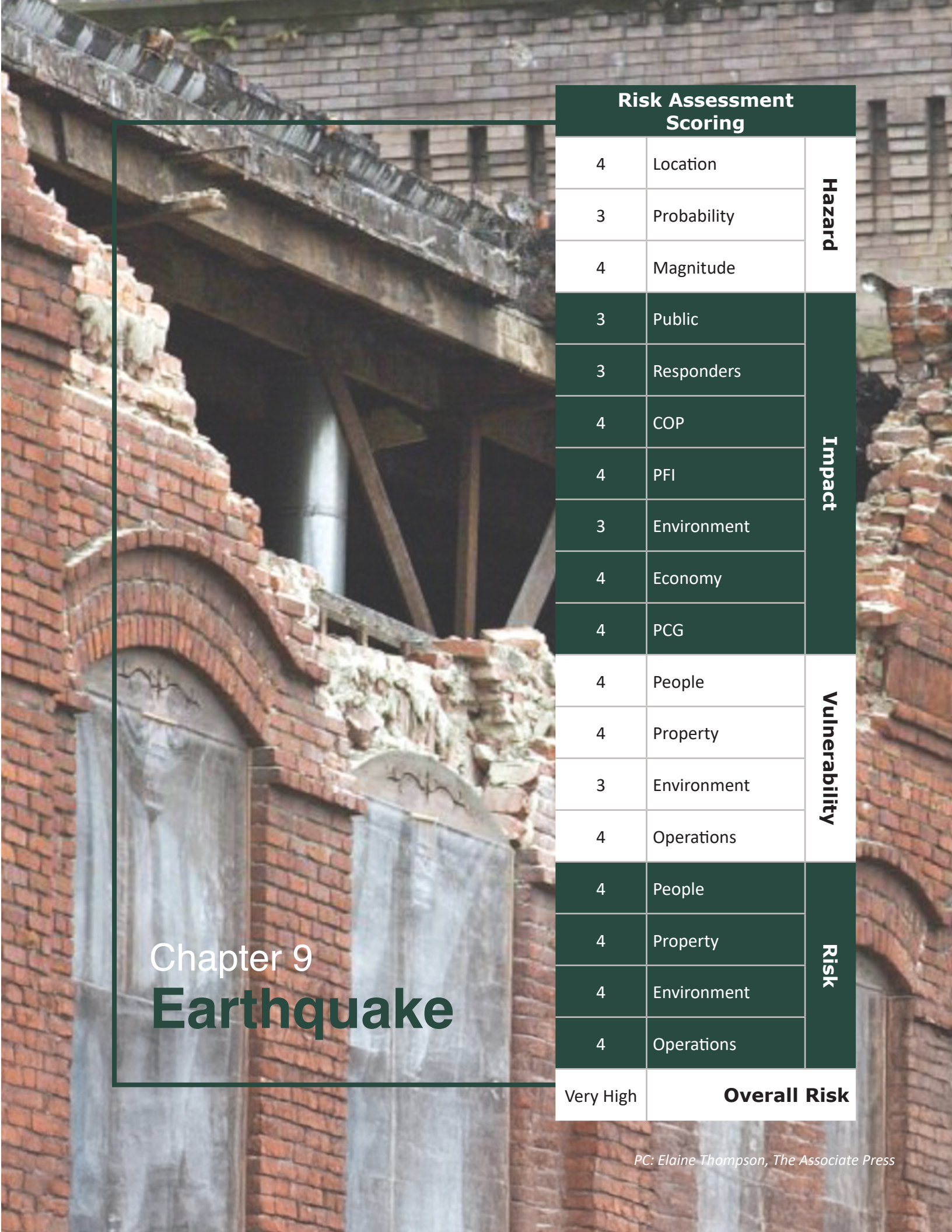
Public Confidence in Governance	A dam failure may cause the public to lose confidence in dam owners, both public and private, to manage local dams. Depending on the success of the response, the public may also lose confidence in first responders.

8.8 Vulnerability Assessment

Vulnerable Populations	Dam inundation areas consist of some of the highest Limited English Proficiency populations in the County. Spanish, Vietnamese, African Languages, and Mandarin are all spoken in high percentages in dam inundation areas. Auburn, Kent, and Riverview School District, as well as private schools, have locations that are vulnerable to dam failure. Riverview school district practices an evacuation of Carnation Elementary School and Tolt Middle School every September in the City of Carnation. Both schools would need to be evacuated if the South Fork Tolt Dam failed. Preliminary studies indicate that there are at least 15 assisted living facilities within dam inundation areas.[22] Evacuation will take longer for this population than most. A 2019 report indicates that there 11,199 individuals experiencing homelessness in the County.[23] Alert and warning can be especially challenging for this population as they may not be tied to a geo-coded database. **Lack of public knowledge** Most dams use a "For Official Use Only" designation on their inundation maps. This means that inundation maps only be shared on a need-to-know basis. A lack of public knowledge about dams, their presence in the community, and their failure potential creates an added challenge in creating a resilient community.
Property	Dam events, such as seepage, overtopping, or failure, can cause significant damage or destruction to homes, businesses, and other property in downstream flood areas. For this reason, it is recommended that people in these areas secure insurance or review their current coverage to ensure they're protected. The extent of downstream impacts can vary depending on the size of the dam and

[22] FEMA Region X. 2009. HAZUS Analysis for the Green River Valley. Page 168.
[23] All Home. 2019. Seattle/King County Point-In-Time County of Persons Experiencing Homelessness.

	the specific event, but generally, low-lying areas in floodplains with dense infrastructure are most at risk for physical damage and economic disruption.
Environment	Dam incidents, particularly dam failures, can have significant negative impacts on both downstream and upstream environments. A sudden failure often leads to severe erosion and a rapid increase in sediment in local water sources. Additionally, ecosystems in the area are affected by the sudden release of water and debris. In some cases, smaller dams may contain contaminated water, which can pose chemical or biological risks to the local environment. While these instances are rare and typically involve small dams with limited water storage, they still present a potential hazard. Moreover, such events can disrupt migrating fish populations, which in turn may affect local communities that rely on fishing as an economic resource.
Operations	**Small Local Government and Privately Owned Dams** These dams may not have access to funding, or have employees dedicated to dam safety. This means that there is a higher chance that maintenance and deficiencies go unmediated. Thus, leading to a higher chance of dam failure. **Emergency Action Plan** High and significant dams are required to have Emergency Action Plans in Washington State. Missing EAPs and out of date EAPs pose a risk if owners are unequipped to deal with an emergency at their dam. **Dam Standard** Any dam that is designated as “poor” or “unsatisfactory” by the Washington State Dam Safety Office should be brought to a higher standard.



Chapter 9

Earthquake

Risk Assessment Scoring		
4	Location	Hazard
3	Probability	
4	Magnitude	
3	Public	Impact
3	Responders	
4	COP	
4	PFI	
3	Environment	
4	Economy	
4	PCG	
4	People	Vulnerability
4	Property	
3	Environment	
4	Operations	
4	People	Risk
4	Property	
4	Environment	
4	Operations	
Very High	**Overall Risk**	

PC: Elaine Thompson, The Associate Press

Chapter 9: Earthquake

9.1 Hazard Description

Washington has the second-highest earthquake risk in the United States, after California. This risk largely originates from the Cascadia subduction zone (CSZ) off the coast of Washington where Juan de Fuca Plate collides and descends beneath the North American Plate. This tectonic activity generates significant stress in the earth, making the region prone to powerful earthquakes.

Earthquakes present the greatest regional threat in terms of potential damage, casualties, economic disruption, and social impacts. Disruptions to essential services, including communications, power, gas, water, and transportation infrastructure, are also inevitable. The severity of an earthquake's impact is driven by ground shaking and secondary impacts include liquefaction, landslides, tsunamis, and even post-earthquake fires.

Table 9-1 Earthquake secondary hazards

Secondary Hazard	Description
Ground shaking	The most immediate and widespread consequence of an earthquake. Ground shaking can also happen from foreshocks or aftershocks that can persist for days to even decades, worsening damage and injuries. While the shaking itself rarely causes fatalities, the resulting destruction—such as collapsing buildings and falling debris—is a major contributor to casualties.
Liquefaction	Occurs when soft, water-saturated soils lose their strength during an earthquake and behave like a liquid. This phenomenon can severely damage buildings and infrastructure that rely on solid ground for support, particularly in areas with loose sedimentary soils.
Landslides	Soil, rock or debris that detach and fall downslope – can be triggered by ground shaking. Depending on where the landslide occurs, this event can lead to additional cascading effects. For instance, in 1949 an earthquake landslide that occurred on the Tacoma Narrows generated a tsunami.
Tsunamis	A destructive movement of the ocean involving at least one 'wave', and strong currents. Even a relatively 'small' tsunami could be devastating to

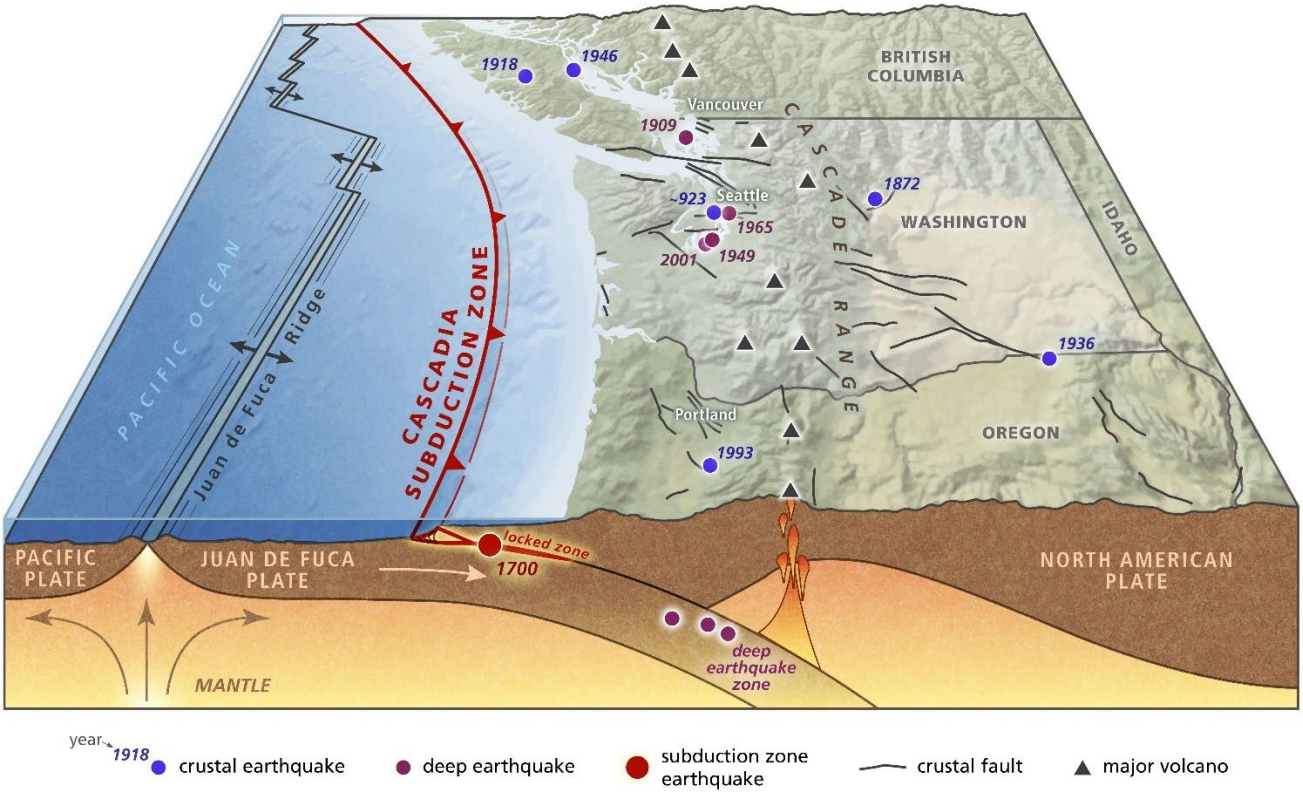
	port and maritime infrastructure within Puget Sound.[1] There is evidence that an earthquake on the Seattle fault that occurred around 923-24 CE produced a 16-foot tsunami.
Dam failure	Earthquakes can cause significant shaking that may compromise the structural integrity of dams. If a dam is already weakened by age, poor maintenance, or underlying geological issues, the seismic forces can cause cracks, ruptures, or even complete failure of the dam structure. This would result in the flooding of inundation zones.
Volcanic eruptions/ Lahar	The shaking from the earthquake can impact volcanic systems. Particularly if a volcano is already experiencing unrest, an earthquake could induce a landslide, the collapse of a volcanic vent, or disrupt the pressure balance inside a volcano, leading to an eruption. An example of this is the 1980 eruption of Mount St. Helens where an earthquake triggered a landslide. This led the volcano, which had already been at an elevated level of activity, to violently erupt out of the north face where the landslide had occurred.
Hazardous material release	Earthquakes can trigger hazmat releases from a pipelines rupture, underground fuel storage tanks fail, oil train derailment, or damage to port facilities.

9.2 Location

The Juan de Fuca plate is moving northeastward with respect to the North American plate at a rate of 3 to 4 centimeters per year. The boundary where these two plates converge, the Cascadia subduction zone, lies approximately 50 miles offshore from Washington and extends nearly 700 miles from northern Vancouver Island in British Columbia to northern California. The collision of these two tectonic plates produces three types of earthquakes: crustal (shallow) earthquakes, deep earthquakes, and subduction zone earthquakes. The relative frequency of these events varies across the region; for example, deep earthquakes have historically occurred more frequently in parts of western Washington, however, it dependents on the tectonic environment and in lots of places, shallow crustal earthquakes are more common than deep earthquakes. Subduction zone earthquakes are rarest events in the region but pose the most significant risk.

[1] Seattle Office of Emergency Management, "Tsunamis and Seiches" *Seattle.gov* (n.d.) https://www.seattle.gov/emergency-management/hazards/tsunamis-and-seiches.

Figure 9-1 Earthquake sources and past events



Subduction zone earthquakes originate from the Cascadia Subduction Zone (CSZ), located off the coast of Washington and Oregon. These earthquakes are the largest, because they happen on such a long fault. While they occur offshore and are distant from many communities, they still pose a major threat. A subduction zone earthquake has the potential to reach a magnitude of 9.0 or greater. If this occurs, it will trigger a tsunami along the entire fault line, from British Columbia to Mendocino, California. However, even if a megathrust earthquake along the CSZ doesn't reach a magnitude of 9.0, a tsunami could still be generated. The ground shaking from such an event would last several minutes, causing catastrophic regional damage from the earthquake itself and widespread destruction from the resulting tsunami. Additionally, these earthquakes are typically followed by numerous large aftershocks.

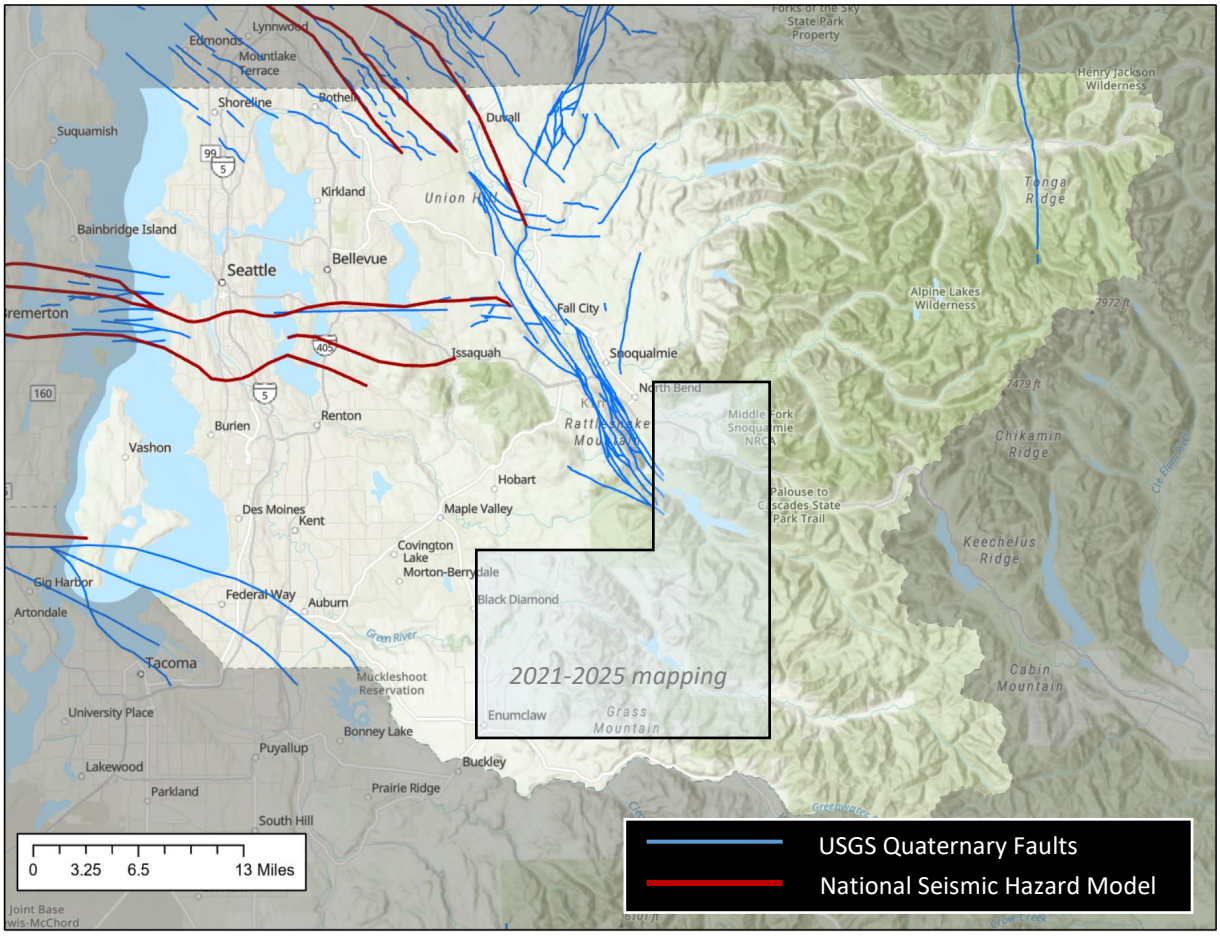
Deep earthquakes are the most frequent earthquakes in the Puget Sound area. They occur within the Juan de Fuca plate as it subducts beneath the North American Plate, at depths ranging from 16 to 60 miles. Due to their depth, aftershocks are typically not felt. Deep earthquakes usually last between 20 to 30 seconds and can reach magnitudes of 7 to 7.5 on the moment magnitude scale. The most recent major deep earthquake in the Puget Sound region was the 6.8 magnitude Nisqually Earthquake on February 28, 2001.

Crustal earthquakes occur within the North American plate at depths of 18 miles or less. Typically, they have magnitudes under 8 and last between 20 to 60 seconds. Local examples include:

- **Seattle Fault,** running east to west through downtown Seattle.
- **Rattlesnake Mountain Fault Zone,** running northwest to southeast through Fall City, Snoqualmie, and North Bend.

Of the three types of earthquakes, the timelines and recurrence intervals for crustal events are the least understood. In 2020, the USGS refreshed their documentation of crustal faults in Washington, and the WGS is currently engaged in mapping faults from North Bend to the southeast edge of King County.

Figure 9-2 2020 USGS Crustal Faults in King County, Crustal Faults



9.3 Magnitude

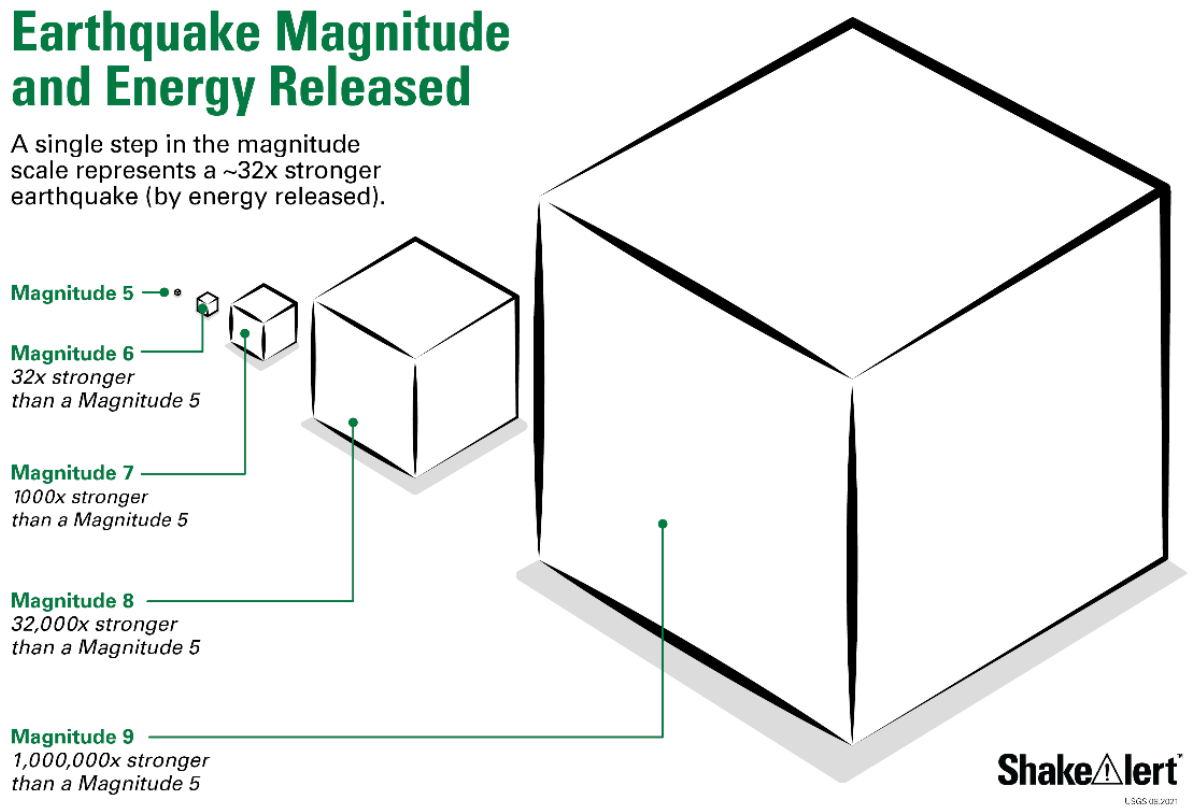
In earthquake science, there are two kinds of magnitude; the **Moment Magnitude Scale** (M_W) that measures amount of energy released when an earthquake happens, and the **Earthquake Intensity**

Scale (or Modified Mercalli Intensity MMI) that is based on impacts to people, property, and operations.

Moment Magnitude Scale

Washington Department of Natural Resources (WADNR) no longer uses the Richter scale, but the Moment Magnitude Scale. It's logarithmic, meaning for every single digit increase the moment magnitude, you have a 32 times stronger earthquake, which translates to 32 times the amount of energy released at the source. A magnitude 2 earthquake with be equivalent to 56 kilograms of explosive whereas a magnitude 10 earthquake would release over 60 trillion kilograms of explosive.

Figure 9-3 Moment Magnitude Scale



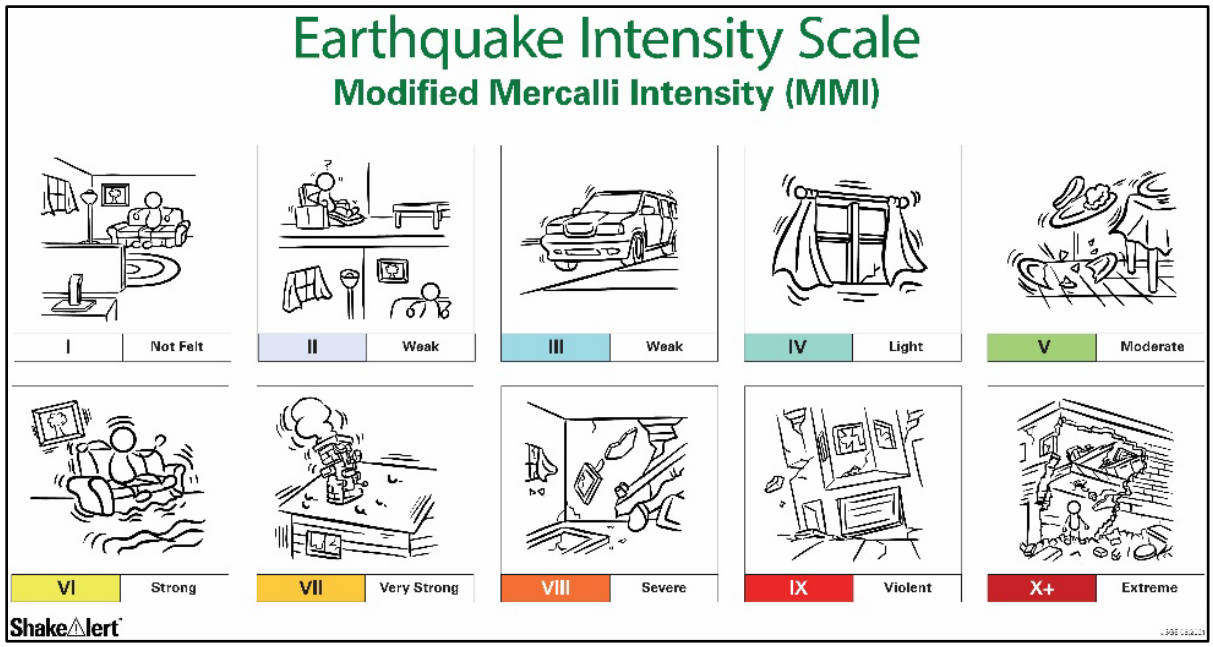
Earthquake Intensity Scale

Earthquake intensity, or ground shaking, is measured by the Modified Mercalli Scale. Its intensity depends on the original moment magnitude and the distance of where the earthquake started to where the impacts are being assessed, and the soil type and material near the surface at the area being shaken.

A shallowly-sourced earthquake that has relatively small magnitude, but nearer to populated areas is potentially more damaging than a much larger magnitude earthquake that is farther away from

populated areas. Even when an earthquake source is distant, unconsolidated soils, such as uncompacted sands, or gravels, found in many floodplains or river valleys, amplify shaking, leading to more potential damage.

Figure 9-4 Earthquake Intensity Scale



Liquefaction

The National Earthquake Hazard Reduction Program (NEHRP) supports map creation based on soil characteristics to help identify locations subject to ground shaking amplification and liquefaction during earthquakes. Areas with NEHRP soil classes D, E and F are prone to shaking amplification, and structures in these areas experience greater damage during shaking. These soils also tend to be more susceptible to liquefaction.

Table 9-2 NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity in Meters per Second
A	Hard Rock	1500
B	Firm to Hard Rock	760-1500
C	Dense Soil / Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clay	<180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays > 36 meters thick)	

Figure 9-5 shows the level of susceptibility areas in King County area to liquefaction. Liquefaction maps in Washington State have not been updated for some time. However, there is currently an academic government collaborative, CRESCENT, that is working with the Washington Department of Natural Resources to update state maps relating to ground shaking and liquefaction.

Figure 9-5 Liquefaction susceptibility in King County

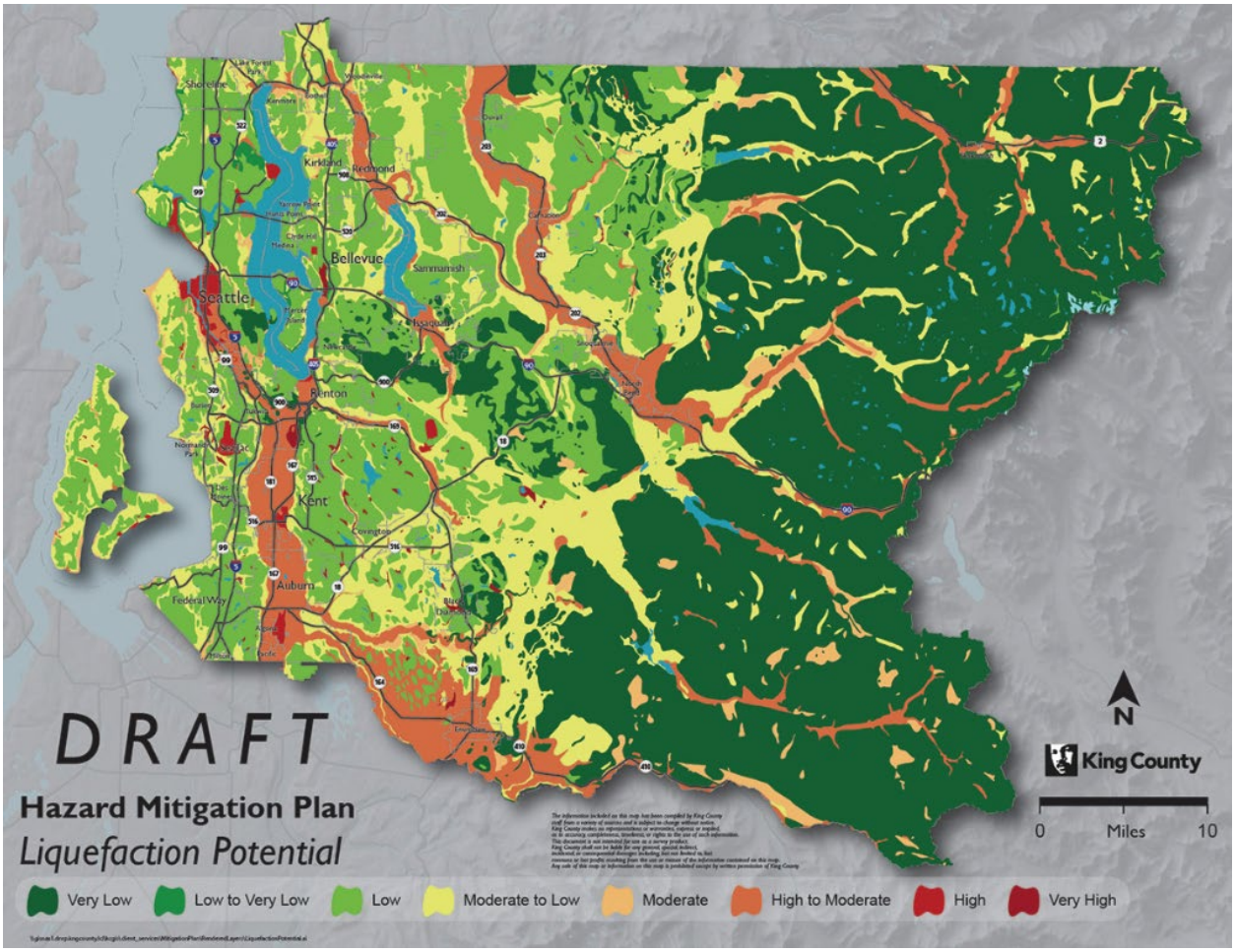
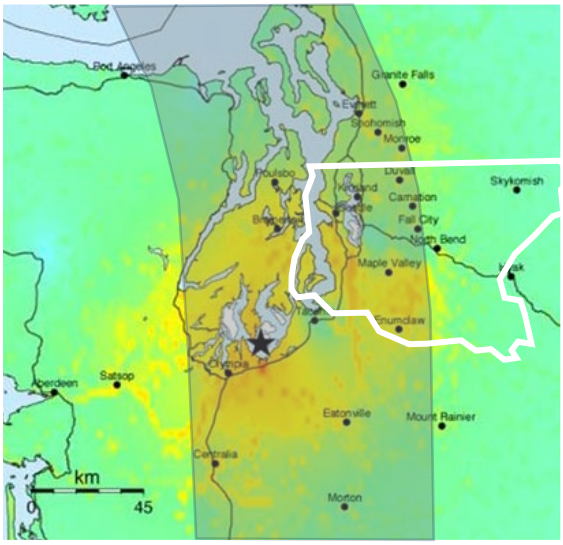


Figure 9-6 Nisqually Earthquake 2001, Impact Map

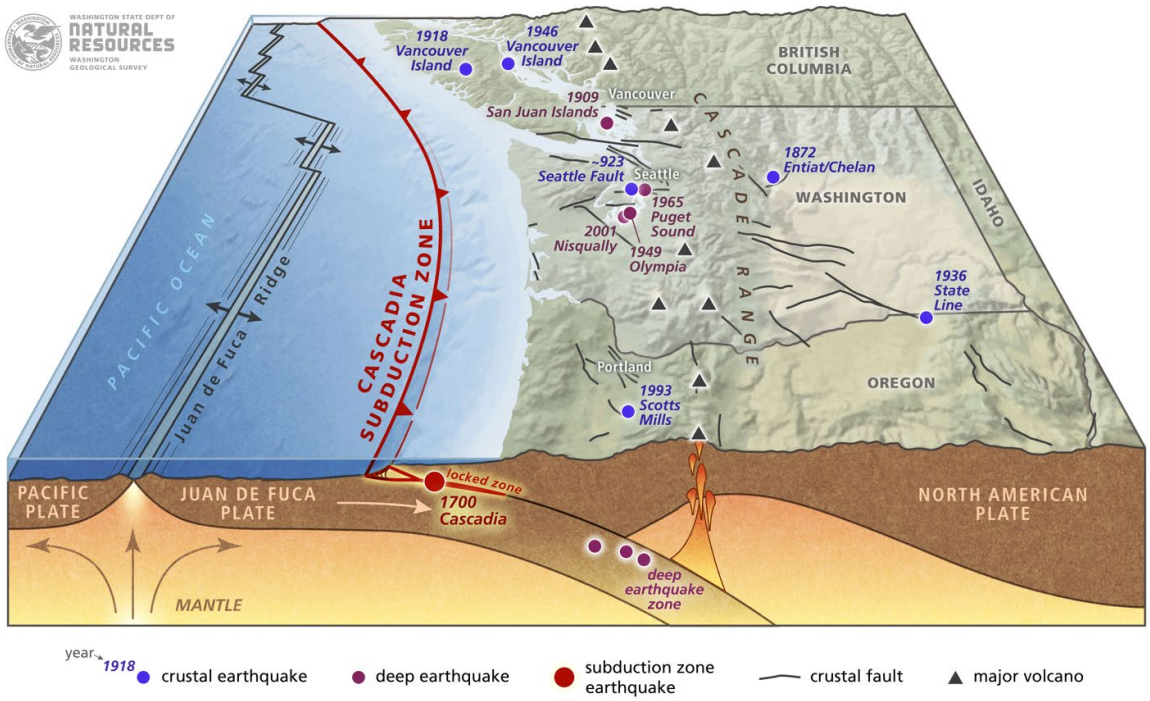


An example of an Intensity Scale map from the Nisqually earthquake of 2001. Colors match the scale in Figure 9-4.

This was a deep earthquake, which are the most frequently occurring types in Washington. The map shows only a few areas experiencing up to very strong to severe shaking. However, the shaking happened over a broad area. King County, highlighted in white, saw high impacts along the Duwamish River where there is soft surface material. The grey band shows the area in Washington prone to such deep-seated earthquakes.

9.4 Previous Occurrences

Figure 9-7 Past Earthquakes in Washington



Name	Source	Date	Size
Nisqually Earthquake	Deep – Juan de Fuca	February 28, 2001	M 6.8

This earthquake, with an epicenter 10 miles northeast of Olympia in Thurston County (over 40 miles from Seattle), resulted in statewide losses exceeding $2 billion and injured 700 people, many in King County.[2] A landslide in King County generated from the 2001 Nisqually Earthquake partially blocked the Cedar River – flooding several homes.

The 6.8 magnitude Nisqually earthquake was centered under Anderson Island in south Puget Sound. The most extensive damage occurred along the Interstate-5 corridor, where river sediments led to shaking amplification and liquefaction impacts. Damage was experienced in 300,000 households, many from settling foundations. Buildings built prior to 1950 located in the south downtown area and Pioneer Square in Seattle were the most impacted; structural damage to chimneys, walls, foundations, and nonstructural elements accounted for two-thirds of all damage reported.[3] Insured losses were recorded as $305M with $2B in losses overall. Of those persons impacted, 21% had earthquake insurance but did not meet the deductible. 75% of retail businesses in Seattle that were impacted closed for a period for cleanup or repairs. The average closure was 4.8 days in Pioneer Square. Of those businesses impacted, 50% were financially threatened with closure. Harbor Island saw 69 businesses impacted for an average of $30,900. The Nisqually Earthquake led to a new emphasis in Washington, and King County especially, on the importance of retrofitting historic, unreinforced masonry buildings (URMs). The loss of historic buildings is not only costly in financial terms but can alter the social fabric of a community and fundamentally change its feel and sense of place.

Puget Sound Earthquake	Deep – Juan de Fuca	April 1965	M 6.5

At magnitude 6.5, the earthquake killed seven people and caused $12.5 Million in damage (1965 dollars). Severe shaking was felt in Seattle and as far as Issaquah and beyond. Most damage was in the Pioneer Square area and waterfront. Older masonry buildings were most impacted. Damage patterns experienced in 1949 were repeated. Eight schools were closed for inspections and repairs; two were severely damaged. Areas along the Duwamish River experienced severe settling. Three water mains failed in Seattle.

Olympia Earthquake	Deep – Juan de Fuca	April 1949	M 7.1

The 7.1 magnitude earthquake was centered along the southern edge of Puget Sound. Eight people were killed and property damage in Olympia-Tacoma-Seattle amounted to about $25 Million in 1949 dollars. In Seattle, a sixty-inch water main ruptured, a radio tower collapsed, power lines and gas lines were broken in over 100 places. Three damaged schools needed to be demolished and one rebuilt. Three days after the event, a landslide entering the water along the

[2] EQE International, "Seattle Nisqually Washington Earthquake" (Feb 2001): http://www.propertyrisk.com/refcentr/seattleeq.pdf

[3] "Hazard Mitigation Survey Team Report, Nisqually Earthquake" *Federal Emergency Management Agency and Washington Military Department, Emergency Management Division* (February 2001)

steep bluff of the Tacoma Narrows said to have been correlated with the earthquake generated a tsunami.

Cascadia Earthquake	Subduction zone	1700	M 9.0

This earthquake, one of the largest in the history of North America, was found by combining First Nations and Native American oral histories with tree-ring dating and other geological evidence in North America and an "orphan tsunami" in Japan. From oral history of the Huu-ay-aht First Nation, people were just going to sleep in the longhouses at Anacla, on Pachena Bay, [present-day Vancouver Island] when the earthquake hit. It shook for more than half a minute, and many of the longhouses sank into the sand [a description of liquefaction]. The tsunami that followed had an estimated wave height of more than 50 ft (15 m) and flooded Anacla and other coastal villages. Only 1 out of more than 600 people in Anacla survived, and in all, seven Huu-ay-aht villages were destroyed. Only the village of Malthsit survived, since it was on high ground about 75 feet (23 m) above Pachena Bay. Several oral accounts describe a great flood on what is known today as the Olympic Peninsula of Washington.[4]

Seattle Fault	Crustal fault	in 923-924 CE	M 7.0 and 7.5

The Seattle fault runs east-west and cuts across Puget Sound, through downtown Seattle, and across Lake Washington. Geologic evidence indicates that it ruptured in a major earthquake (estimated magnitude 7.3) around in 923-924 CE, causing a maximum of 7 meters (~21 feet) of offset at the surface, generating a tsunami in Puget Sound, and large block landslides into Lake Washington. Native oral traditions from Puget Sound associate landsliding, earth-shaking, and rushes of turbid water with a monstrous serpent called A'yahos.[5]

9.5 Probability of Future Occurrences

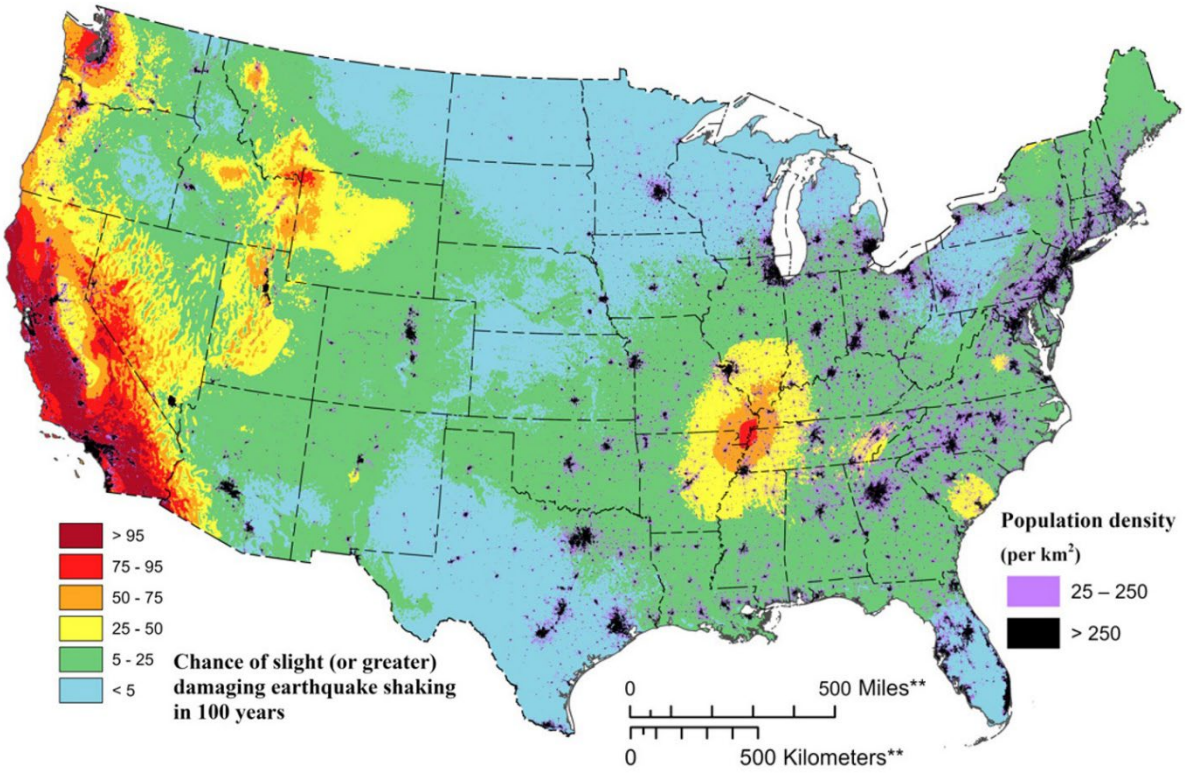
The likelihood of future earthquakes in King County is inevitable, with a 100% certainty that one will occur eventually. However, predicting the magnitude and exact location is not possible. Earthquakes occur at unpredictable intervals, and there are few scientifically verified early warning signs to indicate when one might strike. Estimating the probability of a future earthquake in Washington is challenging due to their rarity and the insufficient length of historical data needed to establish reliable recurrence patterns. Consequently, we rely on analyzing available data to detect potential trends that could inform planning and decision-making. However, pattern detection must be approached with caution, as it is prone to biases (e.g., pattern recognition bias), which could lead to misleading conclusions. Despite advanced analytical methods, earthquakes continue to defy reliable prediction.

In 2023, the US National Seismic Hazard Model (NSHM) updated seismic hazard estimates for all 50 states based on available seismicity, fault rupture, and ground motion data. Zooming in on this

[4] David Wiwchar, "Prepare for next tsunami, says chief" *Raven's Eye* vl 8 Issue 9(2005): p.3, https://www.ammsa.com/publications/ravens-eye/prepare-next-tsunami-says-chief
[5] R. S. Ludwin, et al., "Serpent Spirit-power Stories along the Seattle Fault" Seismological Research Letters, V. 76, No. 4, 426-431(July 2005)

map, you see the King County region has from 75% to greater than 95% chance of damaging shaking in the next hundred years.

Figure 9-8 2023 US National Seismic Hazard Model, Chance of Damaging Earthquake Shaking[6]



9.6 Impact Assessment

The severity of an earthquake is different depending on the conditions under which it occurs. Also, different sectors of the population, economy, or government will have different levels of exposure and vulnerability that impact their susceptibility to an earthquake. This risk assessment looks at impacts of five earthquake scenarios to a series of critical sectors. The impact data for physical structures is generated using the Hazus-MH tool for three different Seattle Fault M7.0 scenarios, a Tacoma Fault M 7.1 scenario, and a Cascadia M9.0 scenario. These scenarios are chosen based on their probability and potential impact. This earthquake model also includes information on liquefaction potential of soils and the age of buildings (as an instrument for building code levels).

This assessment considers impacts to physical and human elements of each of 11 impact areas. For example, for health systems, the locations of key facilities identified by Public Health Seattle – King

[6] Mark D. Petersen, et al., "The 2023 US 50-State National Seismic Hazard Model: Overview and implications" *USGS* (December 2023): https://www.usgs.gov/publications/2023-us-50-state-national-seismic-hazard-model-overview-and-implications#:~:text=The%20US%20National%20Seismic%20Hazard,than%20%E2%88%BC475%20or%20less

County will be assessed against data on high hazard areas. The impacts to the health system overall, including employees and existing patients, will also be examined.

The HAZUS scenarios used in this section were generated by the FEMA RiskMAP team for the 2018 King County Risk Report.[7]

Public	The entire population of King County is potentially exposed to the direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of residence, the soil type homes are constructed on, the proximity to the fault, etc. Impacts to the population are not restricted to displacement and sheltering. People may be injured, lose their jobs, schools may be closed from their own damages, government services may be interrupted, health facilities and care may also be interrupted or be completely unavailable. Family members may be separated, including children, elderly in care facilities, may be moved to alternate facilities – and unaccounted for. Deaths of homeless and unidentified people may require burial before family can claim their remains.
Responders	First responders experience personal and professional impacts from an earthquake. Since responders are also local residents, they will be personally impacted by the disaster. Professionally, emergency services will be called upon to help with life safety operations while also seeking to restore day-to-day services.
Continuity of Operations	Any damaging earthquake has the potential to impact delivery of essential government services in the days, weeks, months, and even years following the earthquake. The damages to infrastructure and residential or business locations may curtail or even prevent government employees from reaching their work locations or may prevent services from reaching populations in need scattered around the county. Even after initial short-term repairs have been made, the impact on the taxable value of properties in the county may cause a revenue shortfall that reduces available services from budgetary impacts. Collection of available tax revenue, the revaluation process (including documentation), and appeals process might produce a further burden on already stretched government obligations. Earthquakes can damage anything at which services are provided. This may include adult and juvenile detention facilities, wastewater treatment facilities, solid waste disposal systems and facilities, the court system, health

[7] Federal Emergency Management Agency, "King County Risk Report" (2018) https://fortress.wa.gov/ecy/gispublic/AppResources/SEA/RiskMAP/King/KingCounty_RiskReport.pdf

	and medical institutions and clinics, fire and police stations or equipment, public transportation, schools, and libraries.
Property, Facilities, Infrastructure	**Property** Unreinforced masonry buildings are particularly vulnerable during an earthquake. The Nisqually Earthquake of 2001 caused extensive damage to such structures, as well as to those built prior to the 1949 earthquake. A similar pattern of damage was observed in roads and bridges. In contrast, buildings constructed after the 1949 and 1965 earthquakes, which influenced the development and improvement of seismic building standards, showed little to no significant damage, underscoring the effectiveness of modern seismic building standards. In October 2018, the Washington State Department of Archaeology and Historic Preservation (DAHP) developed a statewide inventory of identified and suspected unreinforced masonry (URM) buildings, excluding single-family homes. This data was integrated into an interactive online map, revealing 1,145 identified URM buildings within Seattle. Outside the city, King County has over 120 suspected URM buildings, with the highest concentrations in Bothell, Kirkland, and Redmond. Across the county, nearly 50% of buildings were constructed to pre- or low-code standards, leaving them susceptible to moderate to high-magnitude earthquakes. These are preliminary numbers and could go up after further assessment.

Figure 9-10 Identified Unreinforced masonry (URM) buildings in King County[8]

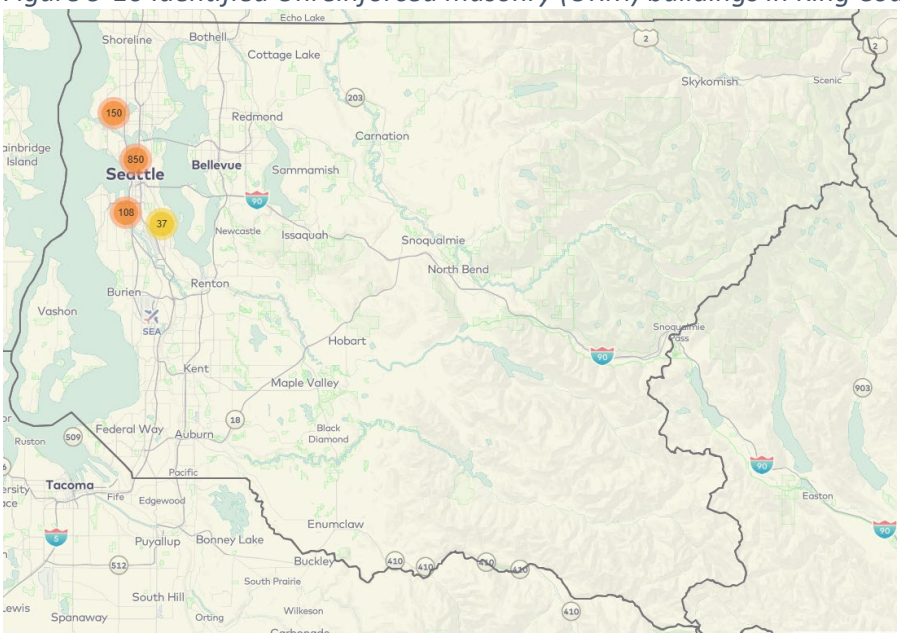
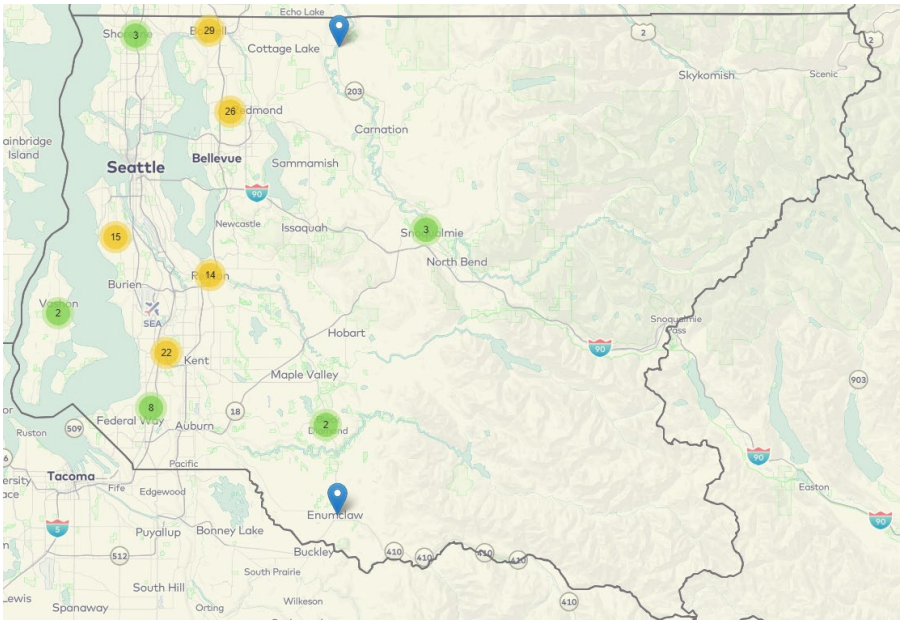


Figure 9-11 Suspected Unreinforced masonry (URM) buildings in King County



Facilities

Health system impacts from a major disaster include disruptions to emergency services, community health clinics, pharmacies, and hospitals.

[8] Department of Archaeology and Historic Preservation (DAHP), "Washington URM Dashboard" (2018): https://fortress.wa.gov/com/urmasonary/urmasonary/#11/47.6469/-122.3026/775

While new hospitals are required to meet criteria for seismic resilience and may engage in supply-chain and patient evacuation planning, much of the rest of the network is likely to be shut down after a disaster. This is an especially high threat to populations needing regular medical services, such as kidney dialysis and insulin injections (which require refrigeration). In Hurricane Maria in 2017, Puerto Rico was left without power for months and the majority of fatalities recorded due to the storm were from the elevated death rate among medically-fragile populations.

To function, hospitals require significant infrastructure inputs, including power and water that are likely to be disrupted after an earthquake. Backup services are available; however, may be insufficient to meet the need if infrastructure recovery takes too long.

Health system impacts therefore include large-scale disruptions to supply chains, disruptions to ongoing care regimens for certain medically-vulnerable populations, disruption of community care networks of pharmacies and local clinics, loss of trained staff, and potential damage to hospitals or loss of hospital functionality due to infrastructure damage.

Infrastructure

Energy: Dams are the primary source of electricity generation for the region and may be impacted by a major earthquake, even if failure is relatively unlikely. Furthermore, most generators have a maximum run time before needing to be serviced (~500 hours for natural gas generators). Pipelines cross the region carrying fuel and are susceptible to earthquakes. In the event of a catastrophic earthquake, the energy infrastructure could be impacted for months surpassing the generators capacity. Since Washington is home to the Pacific Northwest's only refineries, damage to this conveyance system will have far reaching, regional consequences. A major concern for maintaining power in facilities while the power grid is down after an earthquake is fuel distribution. With transportation networks seriously impacted, it will be difficult to ensure a supply of fuel is distributed to hospitals, public facilities, and communications centers. Without this fuel, systems are likely to fail after a few days of operation.

Water/Wastewater: Water and wastewater systems are among the most vulnerable to an earthquake of all lifeline infrastructure. Pipelines, especially those over NEHRP class D, E, and F soils, are vulnerable to rupture. King County maintains a wastewater treatment system that is connected to dozens of smaller systems and operates multiple water treatment plants. There are also many separate water systems that operate their own conveyance systems and reservoirs. All of these systems will be impacted.

Transportation: Transportation lifelines are both state and local responsibilities. According to a Regional Resiliency Assessment Program (RRAP) report published by DHS, WSDOT has operated a seismic retrofit program since 1991 and has been steadily retrofitting bridges through a three-stage process of stabilizing the bridge superstructure, strengthening single-column bridge supports, and reinforcing multi-column piers. As of January 2025, King County has 25 out of 229 bridges in the program. At least every two years, those bridges are inspected and recommendations are made for their repair or replacement.

Bridges, however, are only part of the transportation puzzle. Bridge approaches, and pavement crossing on unstable soils can be impacted. The WSDOT Seismic Lifeline route discussed above is only considering bridges, not pavement or approaches.

Railways are another highly-vulnerable piece of transportation infrastructure. Tracks can become misaligned and require repair before train travel is possible. Even in the relatively moderate 2001 Nisqually Earthquake, rail travel was disrupted for several days.

Port facilities are seriously threatened by a major earthquake due to liquefaction potential of port areas and tsunami threats. It is likely a major earthquake would completely destroy port facilities, requiring years of investment to completely recover. As with the 1995 Kobe, Japan earthquake, port operations may never again reach pre-disaster levels.

Airports are also vulnerable to earthquakes. In the 2001 Nisqually Earthquake, the air traffic control tower at Seattle-Tacoma International Airport was damaged, drastically reducing takeoff and landing capacity. Runway damage is also common as the ground shifts and would require repair before large jets could land. While the region has a number of airports, many of them will also be critical facilities for disaster response, medical patient evacuation, and food and fuel deliveries.

Communications: While the public sector maintains critical radio communications networks, the networks on which most residents depend is privately owned. While cell towers are equipped with backup generators, these generators may only have enough fuel for a few days of continuous operation.

Environment	Impacts to the environment from an earthquake include the creation and disposal of large quantities of debris, releases of hazardous materials, the disruption of environmental conservation programs, and the relaxing of environmental program rules during the cleanup and recovery. Moving

	debris out of the area, given the disruptions to transportation infrastructure, will be difficult. The greatest potential for environmental damage is from hazardous materials releases as fuel and waste pipelines rupture, underground fuel storage tanks fail, trains, including oil trains, may derail, port facilities are damaged by any tsunami or seiche, and other chemicals, including household items, are spilled. The multi-source nature of materials releases, the scale of potential releases, and the lack of resources for cleanup all complicate the scenario.[9] An example is the Northridge and Loma Prieta earthquakes, where hundreds of gas line ruptures and pipeline breaks, and releases of ammonia, chlorine, and sulfuric acid.[10]
Economy	The economic risks posed by a major earthquake are wide-ranging and multifaceted. The immediate impacts include the destruction of facilities and inventory, as well as the loss of employees and customers. In King County, which accounts for approximately 55% of Washington's gross domestic product, these disruptions could be particularly severe. Although the county's economy is diverse and has proven resilient to various types of disruptions, it is heavily dependent on global interconnectedness. A total loss of critical lifeline infrastructure—such as port facilities, communication hubs, and major highway corridors—could be devastating, particularly if these links are not swiftly restored. While some major companies in western Washington, like Amazon and Microsoft, may experience less disruption due to the global reach of their operations and the redundancy in their systems, others, like Boeing, would face significant setbacks. The loss of essential transportation routes, such as rail and highways crucial for material shipment, would severely impact their production. Additionally, a large earthquake could halt or reverse King County's population growth, as displaced residents might lose their jobs, struggle with uninsured housing recovery costs, and move to safer areas in the aftermath of the disaster.
Public Confidence in Governance	Disasters of the magnitude we can expect from a damaging earthquake have the potential to shake public confidence in government's ability to maintain law and order, provide essential services, repair or replace needed infrastructure for employment, process building permits and inspections, clear debris, and other needs. Restoration efforts may take longer than the public is willing to accept. Amendments to zoning and building standards may not be embraced by those seeking to rebuild. If rapid restoration is not possible, the area may lose employers and the population may relocate to

[9] Sengul et al., "Analysis of Hazardous Materials Releases Due to Natural Hazards in the United States" (2012)
[10] Stacy Young, Lina Balluz, and Josephine Malilay, "Natural and Technologic Hazardous Material Releases During and After Natural Disasters: A Review" *Public Health Resources* (2004)

other areas of the country in search of employment, as well as housing, schools, and services.

Earthquake hazards specifically have been the subject of significant reporting in recent years. Articles in the Seattle Times, the New Yorker, and on local television have argued that the Pacific Northwest is unprepared for the level of destruction expected following a Cascadia Subduction Zone 9.0 event.[11] These articles have led to both stepped-up state and local action on earthquake preparedness and to more public awareness.

9.7 Vulnerability Assessment

Vulnerable Populations	Vulnerable populations are more likely to suffer losses during an earthquake and are likely to take longer to recover after. Factors influencing likelihood of damage include living in higher hazard areas, living in older buildings, being less likely to have emergency supplies, and having a higher rate of persons with disabilities. Slower recovery is exacerbated by poorer populations likelihood of not having access to institutions leading recovery, not having insurance, not having a stable job, wealth, or savings, being more likely to be renters who are ineligible for many federal recovery programs, and having a lower-level of education on average, making it more difficult to find a new job and to navigate the complex post-disaster system. In many catastrophic disasters, most notably Hurricane Katrina, poor communities may never recover. **Populations without the means to care for themselves over multiple weeks, especially those with Access and Functional Needs** The response and initial recovery following a catastrophic earthquake will take weeks. Homebound populations, those requiring medications, the chronically ill, or others with access and functional needs may need to sustain themselves for an estimated two weeks in some places. **Populations without insurance, especially those without renters' insurance or homeowner insurance earthquake riders.** According to the Office of the Insurance Commissioner, which conducted a major earthquake insurance study in 2017, residential earthquake coverage in western Washington is 13.8%. Commercial coverage rates are much higher than residential, with 43.2% of

[11] Kathryn Schulz, "The Really Big One," *The New Yorker* (July 20, 2015)

	insurance policies having some earthquake coverage. A key finding is that, for both residential and commercial customers, insured properties have a much higher assessed value than uninsured properties, indicating that it is higher-income people that are, in general, purchasing earthquake insurance coverage. Earthquake insurance coverage rates are a good measure of resilience because insurance is the primary source of disaster recovery funding after an earthquake. Low levels of insurance coverage have stymied recovery efforts in major disasters, such as hurricanes, where hazard coverage is not automatically included in homeowner's policies. Populations communicating in languages other than English Information from responders, notifications, and other information will likely be communicated predominately in English. Special care will need to be taken to ensure that non-English speakers have access to relief supplies from established points of distribution.
Property	**Unreinforced masonry buildings, especially those built during pre or low-code eras (pre-1973)** Unreinforced masonry buildings (URMs) that characterize areas like Pioneer Square in Seattle are extremely susceptible to even minor earthquakes. Unreinforced masonry buildings are likely to collapse or partially collapse during a major earthquake and be a leading source of fatalities due to falling debris. **Structures, including roads and bridges, structures, built on vulnerable soils.** Structures on less stable soils are more likely to buckle or collapse. High risk areas cover the region and are especially common in historic river valleys where sediment has been deposited very recently. **Public facilities built to "life safety" codes that will be unusable after a major earthquake** Public facilities, such as city halls, schools, etc. are not required to be built to "immediate occupancy" standards. A major earthquake would render many of these facilities inoperable, leading to difficulties in organizing the recovery in affected jurisdictions. **Structures and populations on or near steep slopes** Steep slopes greater than 40% grade are likely to fail in an earthquake, unless properly stabilized by geological engineering techniques. This likelihood increases when the ground is saturated. Buildings on or

	below these slopes will be damaged or destroyed if these slopes were to fail.
Environment	**Hazmat** Hazardous materials, or Hazmat, sites dot the region and FEMA has recognized hazardous materials as a community lifeline due to experiences dealing with recovery after recent disasters. Hazmat releases are likely to occur at industrial facilities, on pipelines, and elsewhere around the region. The chemical cocktail of potential contaminants is likely to threaten the public, responders, and the environment, and to delay recovery in parts of the region for years.
Operations	**Dams, especially older, less regulated dams** Major dams in the region that provide electricity, such as the Tolt Dam and Howard Hanson Dam, play a vital role in future recovery. It is unlikely a total failure would occur at these dams because they are highly regulated. However, damage to these dams from an earthquake could require a shutdown to perform repairs before they can resume electricity generation. There are also many lower-priority dams that meet high-hazard throughout King County that are not recognized by their jurisdiction. A failure of some of these dams has the potential to cause numerous fatalities and the inundation of property and infrastructure. **Levees, dikes, and other flood control structures** Flood control structures are usually earthen and built on highly unstable soils. An earthquake during the winter months when these systems are running close to capacity could cause major failures and widespread flooding. **Rail systems** Rail systems require tracks to be perfectly aligned and will fail during an earthquake as the ground shifts and buckles. Landslides may deposit material on the tracks. Trains traveling at high speeds during an earthquake have a significantly greater chance of de-railing, potentially injuring passengers, or spilling cargo, which may cause additional hazardous material incidents. **Port facilities** Ports are almost always built on fill and other extremely unstable soils. Major earthquakes will damage and potentially destroy port facilities. Any seiche or tsunami will also have a greater impact on port facilities than inland facilities.

Water and sewer transmission lines

Water and sewer transmission lines, especially those built of cast iron, concrete, or wood, are vulnerable to fracturing or breaking in the event of an earthquake. Many of these lines are being replaced with ductile iron throughout the region. Nevertheless, most special purpose districts undertaking this work are decades from completing it. Water systems will likely fail throughout the region and will be difficult to restore due to limitations in transportation capacity. Even systems able to complete conversion to ductile iron will experience failures, especially in areas of unstable soils.

Chapter 10

Flood

Risk Assessment Scoring		
3	Location	Hazard
4	Probability	
2	Magnitude	
2	Public	Impact
2	Responders	
3	COP	
3	PFI	
2	Environment	
3	Economy	
3	PCG	
2	People	Vulnerability
3	Property	
2	Environment	
3	Operations	
3	People	Risk
3	Property	
3	Environment	
3	Operations	
High	**Overall Risk**	

PC: King County

Chapter 10: Flood

10.1 Hazard Description

Flooding is King County's most persistent and recurrent natural hazard, impacting tens of thousands of families and property owners across the region. These events have far-reaching impacts on life safety, economic stability, and the overall functioning of the county system.

Flooding along the Snoqualmie River in 2015

Flooding occurs when normally dry areas are inundated by overflowing rivers, coastal surges, or other accumulations of surface water. King County's diverse geography—from the Cascade Mountains to Puget Sound—leads to various forms of flooding, each with distinct causes. The most common types of flooding observed in King County include:

- **Riverine flooding:** a river or stream overflows its banks and spills into nearby low-lying areas due to excess water flow.
- **Tributary flooding:** a smaller stream or river overflows its banks and spills into nearby low-lying areas due to excess water flow. 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.[1]
- **Coastal flooding:** when high tides and storm surges inundate or cause damaging erosion to normally dry areas along the marine shoreline.[2] 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. Additionally, compound flooding—resulting from saturated soils and significant freshwater inflow—exacerbates these conditions.

[1] King County. 2024. *King County Flood Management Plan*. kingcounty.gov/en/dept/dnrp/nature-recreation/environment-ecology-conservation/flood-services/flood-management-plan/about-plan source
[2] FEMA. 2023. *FEMA National Risk Index website, Coastal Flooding webpage.* hazards.fema.gov/nri/coastal-flooding.

- **Urban flooding:** Caused by stormwater runoff or overwhelmed urban storm sewer systems, leading to localized flooding in developed areas.

Several conditions can cause flooding from too much rainfall in a river's watershed to sustained offshore wind driving a high tide inland, but flooding can also be caused by events such as liquefaction of levees during an earthquake that release water the levees hold back. Causes of flooding are listed in Table 10-1.

Table 10-1 King County Flood Causation Types

Causation Type	Description
Heavy Rain	Intense rainfall, typically seen in the fall and winter months, can overwhelm rivers' ability to carry flows in their banks and cause inundation of the adjacent floodplains. These factors not only drive riverine flooding, but also urban flooding issues that can overwhelm local stormwater infrastructure.
Atmospheric Rivers	Atmospheric rivers are narrow bands of concentrated moisture in the atmosphere that transport water from the tropics to be dropped as heavy precipitation.
Storm Surge and King Tides	Strong winter storms combined with king tides can lead to significant coastal flooding, damaging properties and infrastructure, as seen during the 1982 king tide event in King County.
Sea level rise	Rising sea levels in Puget Sound elevates the base sea level, increasing the likelihood of inundation along King County coastlines during storm surge events.
Channel Migration	Rivers that significantly shift during high flow events or gradually through erosion of streambanks. This is a prevalent feature in northwest river systems including Green, Cedar, Tolt, Raging, and Snoqualmie River.[3]
Dam/Levee Failure	Dam and levee failure is the uncontrolled release of impounded water resulting in downstream flooding, affecting both life and property.
Overtopping	Overtopping, often a precursor of dam failure, is water spilling over the top of a dam. This can be the due heavy rain causing excess water or inadequate spillway design. For instance, water can seep through levees and cause weaknesses that lead to collapse.

[3] Seattle and King Hazard Ready, n.d. *Channel Migration Zones.* hazardready.org/seattle/static/img/data/flood_cmz.pdf

Landslide	Landslides can block rivers or add material, leading to mudflows and rapid property damage, notably on the Cedar River.
Earthquake	Earthen levee systems are prone to liquefaction in an earthquake. If water is being held back, this could lead to swift flooding.
Volcanic Eruption	In the event that Mt. Rainier erupts, lahars can fill river valleys and drastically change the course of rivers, streams, and shorelines.
Tsunami	Tsunamis, caused by underwater earthquakes or collapses, can generate significant wave action and damage coastal properties in King County.
Humanmade watershed changes	Development of impervious surfaces speeds up floodwater flow to streams, increasing flood severity.
Climate Change	Climate change is projected to intensify flooding risks through increased rainfall, sea level rise, and other altered weather patterns affecting King County.

The King County Flood Control District was established in 2007 to regionally manage flood hazards and reduce risk, in partnership with the Department of Natural Resources and Parks' River and Floodplain Management Section. The newly updated 2024 King County Flood Management Plan drives much of the work that both the District and King County do to reduce flood risk and manage flood-related hazards.

10.2 Location

King County is broken up into four watersheds: Snohomish, Cedar-Sammamish, Duwamish-Green, and Puyallup-White (shown in Figure 10-1). Within these watersheds are eight sub-basins, shown in Figure 10-2, that host six major river systems flow through King County (South Fork Skykomish, Snoqualmie, Sammamish, Cedar, Green and White Rivers) along with their significant tributaries (Tolt, Raging, Miller and Greenwater rivers). Additionally, the county has other smaller tributaries and streams, including but not limited to those with existing flood risk reduction facilities (Tokul, Kimball, Coal (Snoqualmie), Issaquah, Fifteen Mile, and Holder creeks).[4]

[4]King County Flood Control, "About Us," accessed October 23, 2024, kingcountyfloodcontrol.org/about-us/

Figure 10-1 King County Watersheds

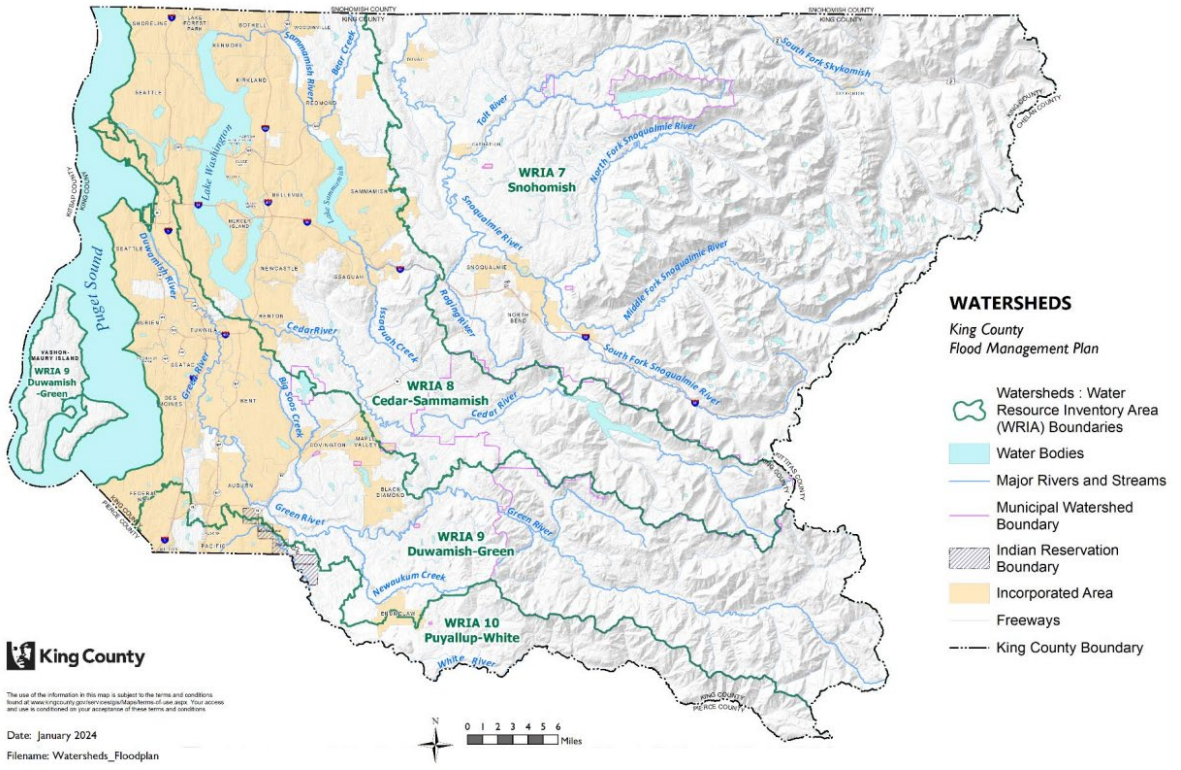
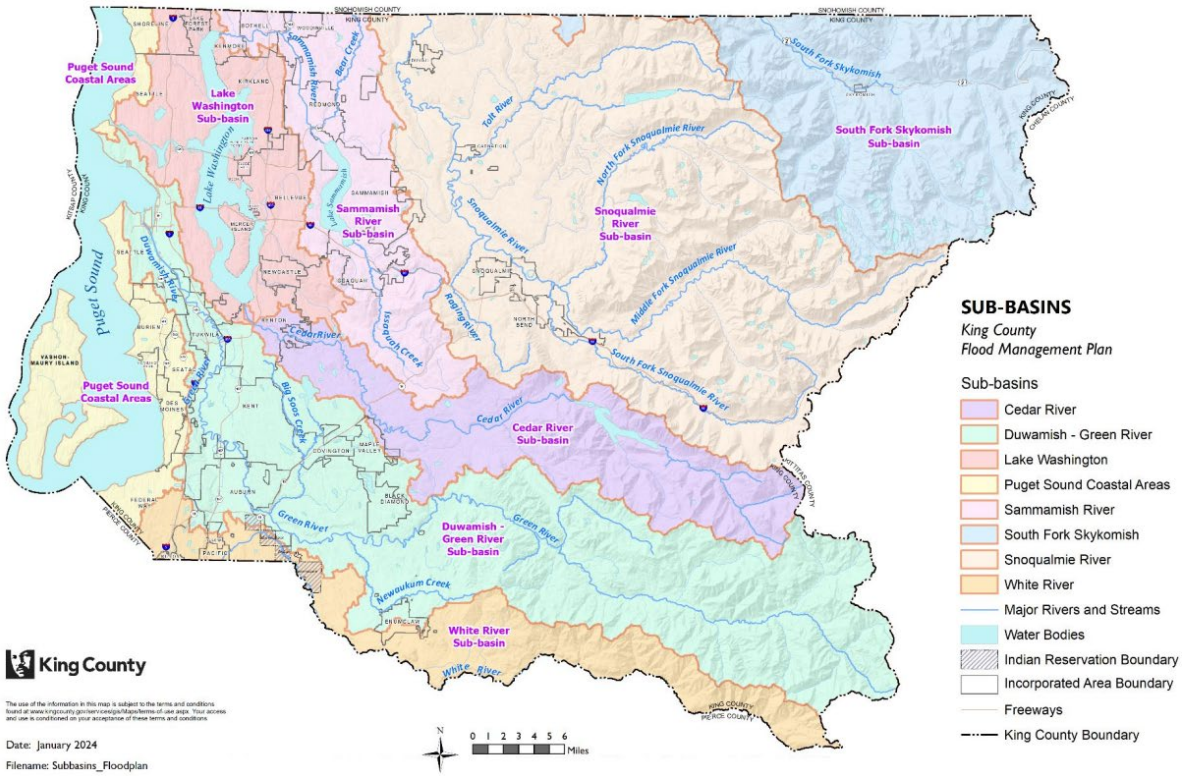


Figure 10-2 King County Sub-Basins



A variety of factors affect how flooding occurs and its severity. One main factor for riverine flooding is the "hydrology," which includes how much precipitation falls, how fast it falls, how fast it reaches the stream, and the amount of water already in the stream. The second main factor for riverine flooding is the "hydraulics" of the watershed, which includes characteristics like the topography, stream channel dynamics, and the overall slope of areas of the watershed.

The combination of hydrology and hydraulics plays a critical role in shaping the behavior of rivers in King County and directly contributes to the significant flood risks the region faces. Several rivers in King County face significant flood risks, each presenting unique challenges. The most flood-prone areas include:

- **Snoqualmie River Valley,** located within the Snohomish Watershed and Snoqualmie River sub-basin, is the most flood-prone area of King County. Flooding typically results in inundation by deep, slow-moving floodwaters, with some areas of deep and fast flows, especially along certain tributaries. The Upper Snoqualmie River and some of the major tributaries are characterized by steep gradient headwater systems and some lower gradient floodplains near the incorporated communities of North Bend and Snoqualmie. The cities of Carnation and Duvall and the unincorporated community of Fall City all lie within the broad Lower Snoqualmie Valley that features wide floodplains along the low gradient channel.[5]
- **South Fork Skykomish River** generates deep, fast-moving flood flows capable of severe bank erosion. This sub-basin drains 234 square miles of mountainous terrain within King County and includes major tributaries such as the Foss, Tye, Miller, and Beckler Rivers. The cities of Skykomish, Baring, and Gold Bar as well as many unincorporated area neighborhoods are located near or on the banks of the rivers and frequently experience impacts from flooding. The basin features steep slopes in the upper portion, thus significant runoff can result in fast major flooding. The rivers in the basin are also very prone to channel migration.
- **Cedar River** that connects to the south end of Lake Washington experiences fast, erosive flows. The basin has been heavily altered from its natural condition, with major projects constructed including Masonry Dam and the Landsburg Diversion, both to serve as water supply infrastructure. Along the Cedar River are many unincorporated community neighborhoods as well as cities like Maple Valley and Renton. Naturally-occurring large wood is a prevalent hazard in the basin.
- **Issaquah Creek**, located in Sammamish River Basin, can experience "flashy" flows that can rise quickly during storms with minimal infiltration.
- **Green River** which becomes the Duwamish River at the Black River confluence in the city of Tukwila, can experience fast flowing flooding in some areas and slow-moving overbank inundation in others. The Howard Hanson Dam in the upper reaches of the Green River,

[5] King County. 2024. *2024 King County Flood Management Plan*. Seattle: King County Department of Natural Resources and Parks, Water and Land Resources Division.

built and managed by the U.S. Army Corps of Engineers, provides flood control to the highly developed downstream areas of the river corridor.

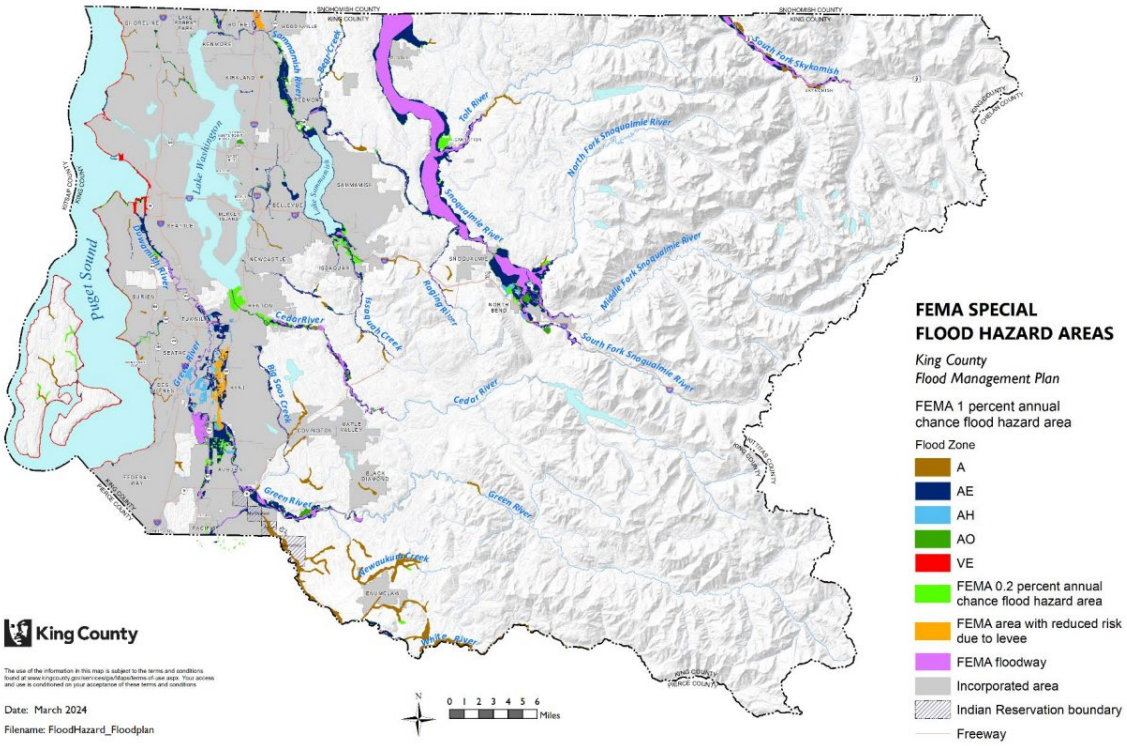
- **Duwamish River** is characterized primarily by slow-moving inundation primarily driven by precipitation as well as tidal influence from the Puget Sound.
- **White River** is lightly populated flowing through the Muckleshoot Indian Tribe reservation before reaching more developed areas in the most 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. However, the Mud Mountain Dam has a significant effect on reducing flooding in the basin. Additionally, water is diverted from the river to Lake Tapps.

Coastal flood hazard areas also pose potential risks to King County. There is approximately 100 miles of shoreline, about half of which is on Vashon Island in unincorporated King County and the other half is the incorporated shoreline through the cities of Shoreline, Seattle, Burien, Des Moines, and Federal Way. Storm surge and wave action are significant flood hazards facing development along shorelines. Coastal erosion also is a prevalent hazard, including along the steep bluff areas around the shoreline in King County. Many miles of shoreline are variably armored by bulkheads and other structures. Coastal flooding will be exacerbated by sea level rise and other impacts of climate change.

10.3 Magnitude

FEMA Special Flood Hazard Areas (SFHAs) in King County were first mapped in 1975 and last updated in 2020. SFHAs encompass regions at risk for flooding, mudflow, or flood-related erosion. These areas are classified based on their annual probability of occurrence, with larger flood events generally associated with a lower likelihood of occurrence. These classifications are illustrated in Figure 10-3.

Figure 10-3 King County Special Flood Hazard Areas



King County's SFHAs are broken up into the following flood zones:

- **100-Year Floodplain:** areas with a 1% annual chance of flooding. FEMA floodplain regulations and federal flood insurance are based on this flood event forms the basis for community regulations for participating communities in the National Flood Insurance Program. Flood zones A, AE, AH, AO, and VE are all Special Flood Hazard Areas (SFHAs) in King County, Washington, which are areas that have a 1% chance of flooding in any given year.
- **500-Year Floodplain:** area with a 0.2% (or 1 in 500 chance) annual chance of flooding.
- **Floodway:** Channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Figure 10-3 shows the 100-year floodplain areas and floodways. Note that Lake Washington does not have an identified floodplain because its water levels are controlled by the US Army Corps of Engineers operated at Chittenden Locks in Seattle.

King County experiences a wide range of annual precipitation amounts depending on location. Western areas including Seattle receive approximately 37 inches per year while areas along the cascade foothills to the east can exceed 100 inches annually.

10.4 Previous Occurrences

King County has faced 29 presidentially declared flooding disasters since 1956, resulting in millions of dollars in property damage. Historical data indicates that minor flooding occurs every winter, while significant flooding events happen every two to five years.

The most recent county-wide flood event occurred in between January to February 2020, when an atmospheric river arrived in the region bringing heavy and sustained rain. The Tolt River reached the highest flow in over 10 years and other rivers overflowed their banks causing widespread road closures. 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 most recent high impact coastal flooding event occurred in December 2022. King tides and strong winds resulted in major coastal flooding with the Puget Sound water level peaking at 3.76 feet above the normal mean higher high water (MHHW) mark. 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. This lead to the evacuation of 15 to 18 homes and damage to several businesses.

The following table summarizes flood events throughout King County dating back to 1990. Data was collected from the National Center for Environmental Information (NCEI) Storm Events Database.[6]

Table 10-2 NCEI Flood Related Events in King County, 1990 - 2023

Date	Type of Flood	Location	Deaths/ Injuries	Property Damage	Narrative
9/3/1996	Flood	Seattle, Bellevue	0	Unknown	Urban flooding
3/1/1999	Heavy Rain	County-Wide	0	$5,500,000	The heavy rain, which in turn caused flooding and mudslides, over the winter season.
11/17/1999	Heavy Rain	Issaquah	0	$85,000	Heavy rains led to a road being washed out by Issaquah Creek.

[6] National Oceanic and Atmospheric Administration, "Storm Events Database," accessed October 23, 2024, www.ncdc.noaa.gov/stormevents/

2/28/2001	Heavy Rain	County-Wide	0	$200,000	An earthquake triggered a mudslide that damaged a home. The slide also blocked the Cedar River, which then backed up and flooded a road, forcing its closure.
11/13/2001	Heavy Rain	County-Wide	-	Unknown	Urban flooding and mudslides
9/8/2003	Heavy Rain	Kirkland	0	$5,000	Urban flooding
8/22/2004	Heavy Rain	Bellevue	0	$50,000	Urban flooding
01/05/2006	Heavy Rain	County-Wide	0	$800,000	The Governor declared a state of emergency after 10-day long rainstorm, causing over 7 million in damage, mainly to transportation infrastructure throughout western Washington. In King County, there were 19 road closures from water over the roadway. Many homes had flooded basements or crawlspaces.
11/4/2006	Flood	Snoqualmie Falls	0	$11,100,000	Major flooding on the Tolt, Snohomish, Skokomish, Skagit, and White rivers.
12/14/2006	Flash Flood	Seattle	1	$750,000	The strongest reported rain and windstorm struck producing areas of urban and small stream flooding and overwhelming drainage systems. In the Madison Valley area of Seattle, heavy rainfall produced excessive street runoff, flooding 25 basements and drowning one woman trapped in her basement by rapidly rising water.
12/3/2007	Heavy Rain	Bothell		$12,000,000	Flooding occurred on the Snohomish, Skykomish, Snoqualmie, and Issaquah Creek. Impact was felt in Snohomish, King, Lewis, Thurston, Mason, and Kitsap counties.
11/12/2008	Flood	Snoqualmie	0	$100,000	Major flooding caused by heavy rain on the Snoqualmie River.
1/7/2009	Flood	Snoqualmie, Carnation,	0	$14,000,000	The cities of Snoqualmie, Carnation, Duvall and Fall City flooded, some residents had to be rescued, many

		Duvall, Fall City, Pacific			homes were flooded. The Issaquah Creek flooded some residences and businesses. It also eroded part of the riverbank, which caused a guest house to fall into the creek. About 40 King County roads were closed. In Pacific, about 1000 people evacuated their homes due to flooding from releases from the Mud Mountain dam, 100 of those homes were damaged, some with 3 feet of water in them.
12/12/2010	Flood	Covington, North Bend, Vashon Island	0	$3,000,000	There was major flooding along the Snoqualmie River. Westside Hwy on Vashon Island was closed due to a portion of the road sinking. Some basements flooded as China Creek in Newcastle, overflowed. Several roads around North Bend and Carnation were closed due to flooding.
1/16/2011	Flood	Snoqualmie Falls, Fall City, Carnation	1	$20,000	The Snoqualmie Falls golf course in Fall City and parts of Highway 202 were flooded after the Snoqualmie river near Carnation reached major flood stage. A 66 year old state DOT worker was killed when a tree fell on Highway 203 south of Carnation, hitting him and his truck. Several mudslides blocked roads.
9/5/2013	Heavy Rain	Burien	0	$10,000	Rain caused flash floods and mudslides in several locations and closed a 24-mile section of the North Cascades Highway for several days. Also heavy rain caused a sinkhole which damaged a road in Burien.
11/17/2015	Heavy Rain	Skykomish	0	$200,000	Heavy rain swelled a creek that undermined the foundation of a US Hwy 2 bridge outside of Skykomish, closing a 15-mile stretch of the highway for about a week.
2/9/2017	Heavy Rain	Seattle	0	$33,000,000	Heavy rainfall in the Puget Sound area lead to high storm runoff. damaged the West Point sewage treatment plant in Seattle. King county dumped an estimated 235 million gallons of untreated wastewater - including 30 million gallons of raw sewage - into

					Puget Sound because of damage to the plant.
1/12/2021	Flood	Duvall	0	$474,000	The Snoqualmie and White Rivers exceeded flood stage. Urban and small stream flooding occurred as well. Heavy rain caused some landslides.
1/7/2022	Heavy Rain	Seattle, Renton	1	$1,520,000	Two atmospheric river events from Jan 5 - 7 and Jan 11- 13 that resulted in heavy rain, minor to major flooding, and landslides. 2 flood fatalities occurred, and possibly a third from a landslide.
12/27/2022	Coastal Flood	Seattle	0	Unknown	Duwamish river and tidal flooding leading to evacuation of 15-18 homes and damage to several businesses. It was reported that 18 homes did sustain damage.
12/05/2023	Heavy Rain	Seattle	0	Unknown	An atmospheric river event brought flooding, record breaking rainfall, and record high temperatures to Western Washington.

10.5 Probability of Future Occurrences

House destroyed due to channel migration along the Raging River.

King County is inherently vulnerable to flooding due to its distinctive geography and heavy precipitation patterns. As a result, flooding is an annual reality for the region. King County sees at least minor flooding ever year in the fall and winter and big events are often driven by atmospheric river narrow bands of concentrated moisture in the atmosphere transport water from the tropics to be dropped as heavy precipitation in western Washington. On average, major floods occur every two to five years, and projections indicate that both the frequency and severity of these events will likely increase due to the broader impacts of climate change.

According to King County's Flood Frequency Analysis conducted in 2016, certain areas exhibit particularly high probabilities of severe flooding. For instance, the upper Snoqualmie River Valley has a 22% annual probability of severe flooding, with an expected return period of approximately 4.5 years. The Tolt River faces an even higher annual probability of 38%, translating to a return period of about 2.8 years.[7]

10.6 Climate Change Considerations

According to the 2023 Fifth National Climate Assessment, the northwest region in the United States is projected to see an increase in frequency and intensity of extreme precipitation events.[8] 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.

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. This expected increase may also exacerbate compound flooding in coastal drainages, which could impact public health, life, and safety.

10.7 Impact Assessment

Flooding, no matter the source, causes widespread and long-lasting damage. The force of moving floodwaters can tear homes from their foundations, sweep cars off the road, and destroy public infrastructure. Houses and businesses damaged by flooding can take many months to repair and are often unsuitable to live in during the repairs. 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, contaminated food and drinking water, and mental health stresses from the traumatic experience.

Public	Flooding can impact anyone who lives, works, or travels in or near floodplains. There are over 50,000 people residing in designated flood hazard zones. For those situated within the 100-year floodplain, there is a 26% likelihood of experiencing flooding over a 30-year period, the length of a typical mortgage. Not only can it impact people's safety, but flooding can also have significant financial costs. It's estimated that one foot of water in an average size home can

[7] King County. 2016. *Flood Frequency Analysis of King County Rivers with an Emphasis on the January 2009 Floods*. Prepared by Curtis DeGasperi, Water and Land Resources Division. Seattle, Washington.
[8] U.S. Global Change Research Program. "2023 National Climate Assessment." Accessed October 23, 2024. nca2023.globalchange.gov/.

	cause over $50,000 in damage. Without flood insurance, this level of damage can overwhelm a family's finances. Flooding also affects those who work in flood-prone areas or commute through them. In a flood event, most deaths occur from people driving through floodwaters and being swept away in their cars. Many farmworkers are employed in the Snoqualmie, Sammamish, and Green River valleys that are susceptible to river or tributary flooding.
Responders	Police, firefighters, and paramedics play key roles in the response to flooding. Police officers often help shut roads down to prevent people from driving through floodwaters; firefighters often rescue people trapped by flooding; and paramedics transport people hurt by flooding, often from hypothermia or other causes. If any of these first responders' buildings are in the 0.2% annual chance floodplain, their ability to respond is seriously threatened. Additionally, neighborhoods with roads that are inaccessible during flooding pose challenges to first responders. They may not be able to drive to homes and may require helicopters or boats to access.
Continuity of Operations	There are few government facilities located within flood prone areas in King County. Thus, flooding does not pose a substantial risk to the continuity of government operations. Those within flood areas include city buildings located in Snoqualmie, North Bend, and Carnation. Although the facilities themselves are relatively safe, government employees may still need to traverse flood-prone regions to reach their workplaces. This may necessitate the development of alternative work sites to ensure continuity of operations during flood events.
Property, Facilities, and Infrastructure	**Properties** Flooding often results in many millions of dollars in property damage. For families, damage to homes may mean difficult financial decisions, displacement for weeks, and lost belongings. For business owners, flood damage may mean lost economic output from shutdowns, destroyed inventory, and inability to pay employees. The National Flood Insurance Program is the primary way building owners financially protect their property in flood prone areas. As of June 2019, flood insurance policies cover over $2 billion worth of property throughout King County. Many larger commercial or industrial facilities are insured through private contracts, the value of which is not available to government agencies. Below is the cost estimate for Repetitive Loss (RL) properties across the county, along with a breakdown of the number of structures and their types by jurisdiction. Jurisdictions not listed do not have any RL properties. These

properties are defined as insurable buildings for which the National Flood Insurance Program (NFIP) has paid two or more claims exceeding $1,000 each within any 10-year rolling period.

Table 10-3 County-wide Damages of Repetitive Loss Properties

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

Table 10-4 NIFP Repetitive Loss Properties by Jurisdiction

Jurisdiction	2-4 Family	Business – nonresidential	Other – Residential	Other – Nonresidential	Single Family	Total
Auburn					1	1
Bellevue			1			1
Burien					1	1
Carnation				1	17	18
Duvall				1	4	5
Fall City				1	1	2
Issaquah	1		1		9	11
Kent	1				1	2
Maple Valley					3	3
Normandy Park					1	1
North Bend					18	18
Sammamish					1	1
Seattle			1		1	2
Skykomish					3	3
Snoqualmie	4	1	1	2	127	135
Vashon					1	1
Grand Total	6	1	4	5	189	205

Critical Facilities

There are 498 critical facilities county-wide that could be exposed to the 1% annual chance riverine flood event, and 26 critical facilities for a coastal flood event. Potential damages could exceed $114 million for a 1% annual chance riverine flood event and approach $500,000 for a 1% annual chance coastal flood event.[9]

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

There is concern that residents in sole-access neighborhoods, such as the lower Snoqualmie Valley, could become isolated in a flood event and won't be able evacuate for medical reasons.

Infrastructure

Transportation: Flooding regularly causes impacts to our roadways and bridges, which can cause very extensive and expensive repairs. Roads through the lower Snoqualmie Valley are particularly susceptible to flooding and close regularly during high water events. During these events, Valley residents can become isolated making evacuation and access for emergency responders challenging. Repeated roadway inundation also accelerates infrastructure deterioration and increases lifecycle costs.

Energy systems: Most overhead powerlines are not susceptible to impacts from flooding unless the power poles are not resistant to flooding. Buried cables typically aren't affected by flooding very often.

Water/Wastewater: Flooding, particularly from king tides and coastal storm systems can damage wastewater infrastructure such as the County's West Point Treatment Plant. Some city wastewater treatment plants are also located in flood prone riverine areas. Where these linear systems cross rivers, flooding can pose issues. The Tolt Pipeline, a water supply line for Seattle, was at risk from the Snoqualmie River migrating further toward its alignment. In 2019, a project was completed to provide some protection from that risk.

Communications: 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.
Environment	Flooding is a natural process and supports unique ecosystems and habitats. Many riparian and aquatic ecosystems depend upon some amount of regular flooding or high-water events. Various salmonid species use high water events to seek refuge as juveniles or access more favorable habitats, which makes flooding an important part of recovery for the endangered salmon species in Puget Sound. Natural floodplain functions typically result in slower-moving floodwaters with less intense flood height peaks. When upland forest areas are logged or burned, rain and snowmelt reach streams faster, which can cause flooding to be more intense and push water through the floodplain more quickly. King County often incorporates natural functions into the design of projects, which helps reduce flood risk as well as protect and restore ecosystems. Reconnecting rivers and coastlines to their historic floodplains through levee setbacks, creating side channels, and removing obstructions help restore natural functions and bring flood risk reduction benefits as well. The large Countyline project near Auburn restored 121 acres of floodplain along the White River and reduce flood risk for over 200 residential properties.
Economy	Flooding can significantly impact industries that rely on floodplain locations such as agriculture, aerospace, manufacturing, and distribution. In the lower Snoqualmie valley, there are nearly 200 farms that produce a wide range of products from dairy to herbs and row crop vegetables. The Sammamish River valley supports a number of wineries and other small farms. And the Green River valley hosts many large fields of row crops as well as a large County-owned farm leased out by a diverse group of farmers. Flooding can negatively impact these operations, particularly if it occurs before harvest or late into the spring planting season. Farmers cannot sell food products from flood-damaged fields. Flooding, however, also provides nutrients to the soil that supports productive agriculture. While some agricultural sectors are dependent on natural floodplain functions, other economic sectors have located in the floodplain over decades for other reasons. Large warehouses in the Green River valley, many in the floodplain, make the region one of the largest logistics hubs in the nation. But, the square footage of warehouse and aerospace facilities means that billions of dollars are at risk of flooding every year as well as thousands of jobs.

[9] King County. 2024. *King County Flood Management Plan*. kingcounty.gov/en/dept/dnrp/nature-recreation/environment-ecology-conservation/flood-services/flood-management-plan/about-plan source

	In 2007, an economic study was conducted to understanding the economic impact of flooding. The study found that 6% of the county's jobs are located in floodplains and nearly 7% of the county's wages and salaries are generated in the floodplain ($3.7 billion). Approximately 20% of the county's manufacturing employment and 30% of the county's aerospace employment are found in floodplains. 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.
Public Confidence in Governance	Flooding occurs frequently enough in King County that residents often turn to the King County River & Floodplain Management Section for help and information during flooding events. Confidence is high in the government's ability to respond to flooding events. The multiple iterations of the Flood Management Plan have featured robust stakeholder involvement processes, which has inspired confidence in King County's ability to manage floodplains with higher regulatory standards and other programs to keep people and property safe from flooding.

10.8 Vulnerability Assessment

Vulnerable Population	Vulnerable populations that are particularly susceptible to the long-term impacts of flooding include low-income individuals, renters, and people with limited English proficiency, and communities of color. **Low-Income** Low-income individuals and families are among the most affected by flooding. The financial burden of flood damage can be overwhelming, making recovery difficult. Without flood insurance, families may have to deplete their savings to cover repair costs. Even with insurance, flood-damaged homes can remain uninhabitable for months, prolonging the disruption to their lives. **Renters** Renters are far less likely to have a flood insurance policy and may not even be aware of their flood risk. Generally, renters are not required to obtain such coverage, and it can often be unaffordable, especially in

	flood prone areas. Renters may also have less wealth or savings to draw from to pay for uninsured losses. **Limited English** Those who do not speak English do not have easy access to government resources. Most flood warning systems are in English and much of the flood insurance, floodplain regulations, and any mitigation programs are made up of materials in English. Flooding is a complicated hazard to understand and accessing flood warning, flood insurance, and other information often requires command of English, understanding of government bureaucracy, and access to financial resources. **BIPOC** In King County, approximately 41% of the 57,737 residents living in mapped flood hazard areas 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%) than white residents (41%) reside in mapped flood hazard areas. Other watersheds exhibiting a high percentage of BIPOC community members residing in flood hazard areas include the Sammamish (43%), Cedar (36%), and White River watersheds (38%).[10]
Property	The exposure analysis determined that approximately $11.9 billion of structural value for the general building stock is at risk to the 1% annual chance riverine flood event, and approximately $15.3 billion to the 0.2% annual chance flood event. 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. 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.
Environment	Along the Snoqualmie Valley River, the three forks (North Fork, South Fork, Middle Fork) are vulnerable to sediment accumulation that reduces channel capacity. This is the result of intense flooding causing bank erosion and landslides. This can degrade salmonid habitats and their ability to migrate.

[10] King County. 2024. *2024 King County Flood Management Plan*. Seattle: King County Department of Natural Resources and Parks, Water and Land Resources Division.

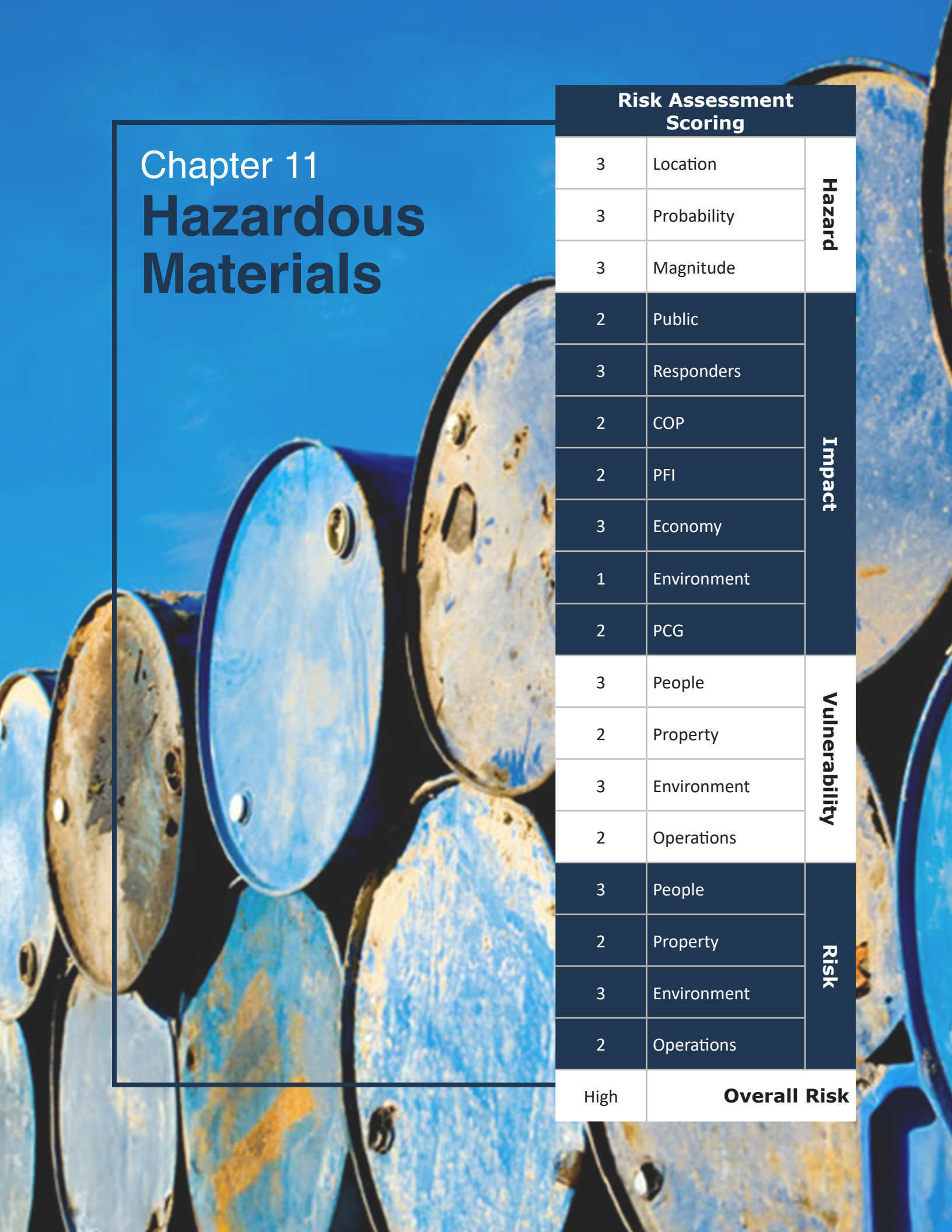
Operations

A handful of government operations are located within the flood areas of King County. For first responders we have, 3 out of 64 police stations in the 0.2% annual chance floodplain (located in Skykomish, Redmond, and Issaquah), 6 out of 161 fire stations (located in Skykomish, Seattle, North Bend, Renton, Issaquah, and near Enumclaw), and 3 city buildings (located in Snoqualmie, North Bend, and Carnation).

For critical facilities, there are 498 county-wide that could be exposed to the 1% annual chance riverine flood event, and 26 for a coastal flood event.

Chapter 11

Hazardous Materials



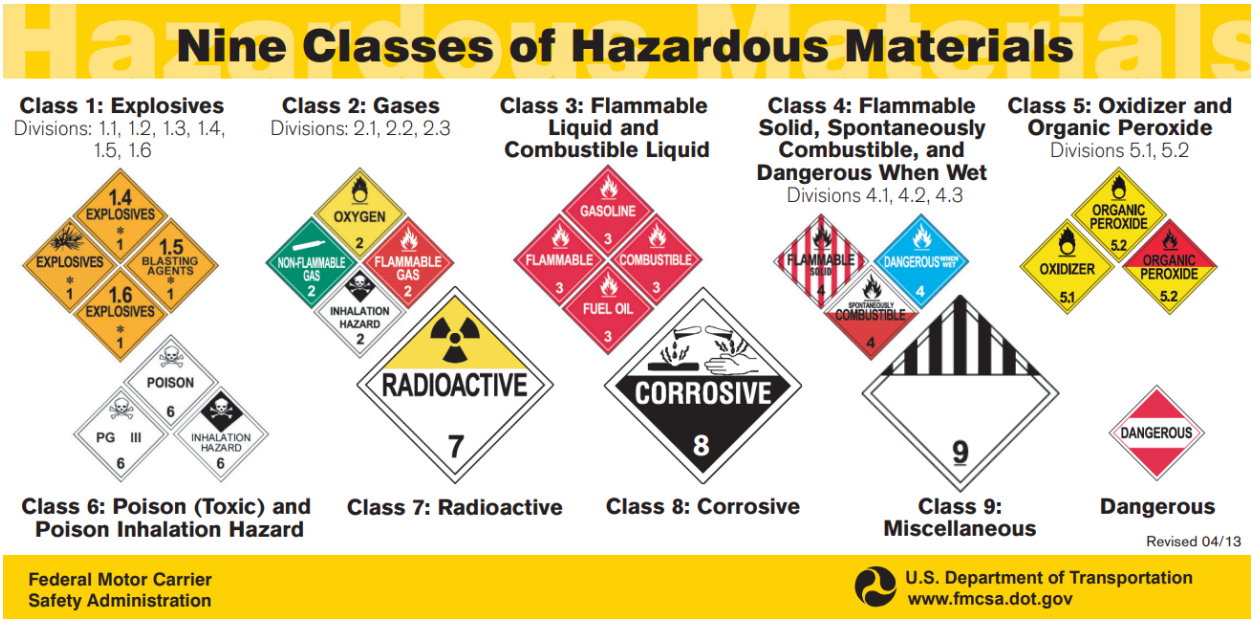
Risk Assessment Scoring		
3	Location	Hazard
3	Probability	
3	Magnitude	
2	Public	Impact
3	Responders	
2	COP	
2	PFI	
3	Economy	
1	Environment	
2	PCG	
3	People	Vulnerability
2	Property	
3	Environment	
2	Operations	
3	People	Risk
2	Property	
3	Environment	
2	Operations	
High	**Overall Risk**	

Chapter 11: Hazardous Materials

11.1 Hazard Description

Hazardous materials (hazmat) releases are among the most common types of incidents. These "releases" can occur through spills, leaks, toxic vapor emissions, or any other process that allows a material to escape its container, enter the environment, and create a potential hazard.[1] Hazmat is classified into nine different categories based on its characteristics:

Figure 11-1 Classifications of Hazardous Materials[2]



Common hazardous materials include substances like anhydrous ammonia (used as a refrigerant), gasoline and diesel (used as fuels), paints and dyes (used in residential and commercial applications), and various corrosives (used in industries such as aircraft manufacturing). Pipelines and rail lines transport crude oil to refineries and finished fuels to homes (like natural gas) and retail fueling stations.

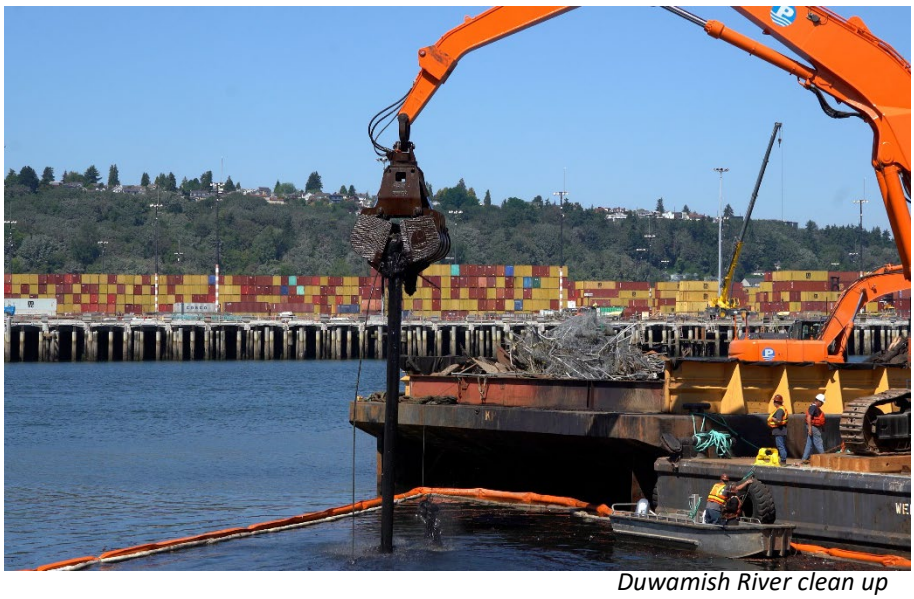
Hazardous material releases can occur through a variety of causes, ranging from accidents and mismanagement to natural disasters and malicious attacks.

[1] US DOT Pipeline and Hazardous Materials Safety Administration, "List of Hazardous Substances and Reportable Quantities" *49 CFR 172.101 Appendix A* (n.d.)
[2] FMCSA, "Nine Classes of Hazardous Materials (Yellow Visor Card)" *Regulations* (April 2013)

- **Accidents and Mismanagement:** Hazmat releases can occur from leaking containers or pipelines due to corrosion or punctures. Accidental overflows during the transfer of hazardous materials, loading dock and warehouse accidents, careless handling, and even illegal activities such as drug labs can also lead to dangerous spills. For example, when someone dumps paint down a sewer, they are releasing hazardous material into the environment. Similarly, illegal drug labs not only use hazardous substances but also create hazardous waste, while car accidents that result in fuel, oil, or antifreeze spills also create hazardous cleanup situations. Another growing concern is the dumping of electronic waste, which releases toxic chemicals like lead, zinc, nickel, flame retardants, barium, and chromium into the environment.
- **Natural Hazards:** Hazmat releases can also result from natural events like earthquakes, volcanic activity, severe flooding, and wildfires, which can cause containers or pipelines to rupture or overflow.
- **Malicious Attacks:** The risk of a CBRNE event (chemical, biological, radiological, or nerve agent attack) is low, but its potential impacts would be severe. Despite the minimal daily risk, it remains a top priority for counterterrorism planners due to the catastrophic consequences. In Washington, over 20 billion gallons of oil and hazardous chemicals are transported annually by various means.

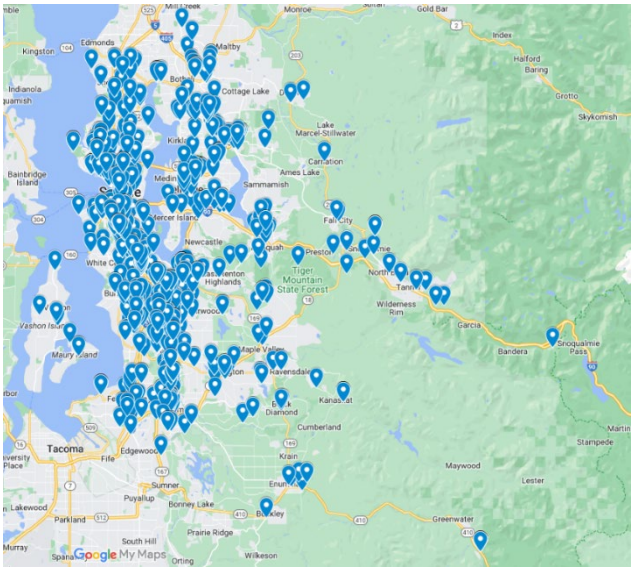
11.2 Location

Hazardous materials can be present in a variety of locations, ranging from residential homes and workplaces to medical facilities and industrial sites. These materials can include cleaning products, engine fuels, chemicals, and everything in between. Certain areas are more prone to hosting or interacting with hazardous substances, such as distribution centers, ports, industrial zones, Tier II facilities, and transportation networks (including highways, rail lines, and pipelines). Additionally, there are identified contaminations sites such as Superfund and brownfield sites that face both short- and long-term exposure to hazardous materials. Below is a detailed overview of the most concerning areas.



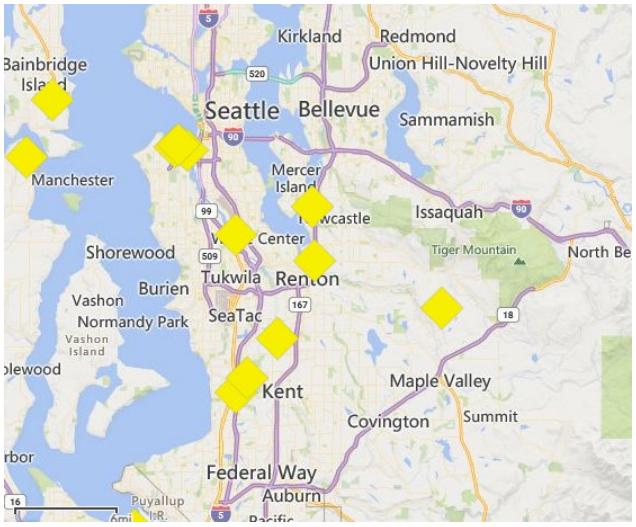
Duwamish River clean up

Figure 11-2 Tier II Facilities[3]



There are 3,164 facilities that submitted Tier II reports in 2023. In the City of Seattle alone there are thousands of facilities with hazardous materials regulated under the fire code. Other areas with high concentrations of hazardous materials usage include Auburn, Redmond and the Kent Valley. Business types that commonly use hazardous materials include: hospitals, schools and universities, metal plating and finishing, the aircraft industry, public utilities, cold storage companies, the fuel industries, the communication industry, chemical distributors, research, and high technology firms. Each of these facilities is required to maintain plans for warning, notification, evacuation and site security under various regulations. Primary hazardous materials stored are motor oil, sulfuric acid, and lead acid batteries. A facility failure, including an explosion or release of chemicals, could endanger or kill many people. In Waco, Texas in 2013, an ammonium nitrate explosion occurred at a distribution facility, leveling a neighborhood and killing 15 people. A train derailment in 2013 in Lac Megantic in Quebec, Canada killed 60 people and destroyed much of the town.

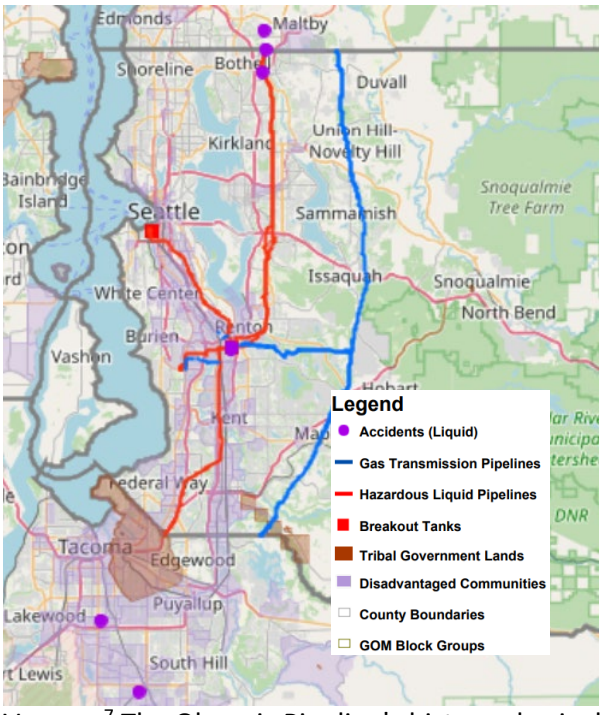
Figure 11-3 Superfund National Priorities List (NPL) Sites[4]



There are currently 10 active superfund sites and 8 brownfield sites in King County. Superfund is a US EPA program that cleans up severely contaminated sites that have significant risk to the environment and public health. On the other hand, a brownfield site is a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.[5]

[3] WA Department of Ecology, 2023
[4] US Environmental Protection Agency, "Superfund National Priorities List (NPL) Where You Live Map" *Learn About Superfund* (September 2024): https://www.epa.gov/superfund/search-superfund-sites-where-you-live#advanced
[5] US Environmental Protection Agency, "Brownfield Overview and Definition" (n.d.): https://19january2017snapshot.epa.gov/brownfields/brownfield-overview-and-definition_.html

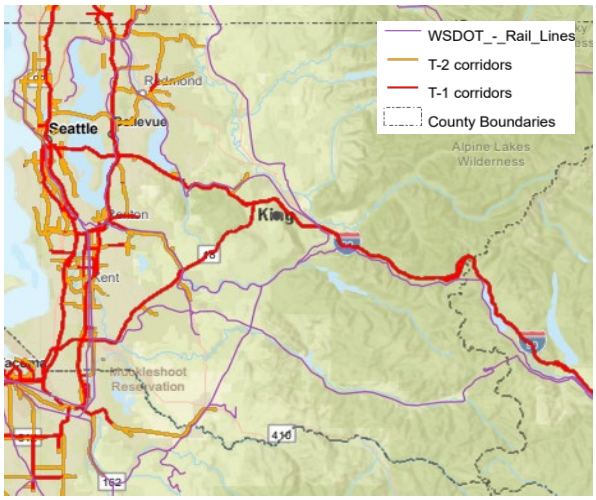
Figure 11-4 Pipelines in King County[6]



King County is home to several major pipelines, including those operated by Phillips 66, TransMontaigne, Williams Pipeline, Northwest Pipeline, Olympic Pipeline Company, Puget Sound Energy, and Swissport Fueling. These pipelines transport essential fuels and chemicals across the region, but mismanagement and poor maintenance can lead to failures or shutdowns, which may cause contamination in nearby communities and significant economic impacts, including fuel shortages and price increases.

One notable incident occurred in 2023 when a valve failure on the Olympic Pipeline in the Skagit Valley, just north of King County, caused a spill of approximately 30,660 gallons of gasoline. This spill impacted nearby creeks not far from Mount Vernon.[7] The Olympic Pipeline's history also includes a tragic explosion in 1999, which killed three people and caused over $58 million in property damage. Other past incidents include a 2005 spill in Renton (40 gallons) and one in Bothell (30 gallons), as well as a 2020 spill in Bothell of 11.7 gallons.

Figure 11-5 Transport restrictions for hazardous materials



King County hosts a variety of unique transportation and geographic conditions, including one of the largest deep-water seaports on the west coast, an International Airport in SeaTac that handles cargo from all over the world, as well as fuel pipelines running south from Whatcom County through King County and down into Portland carrying jet fuels, diesel, gasoline, etc. Additionally, local highways like Interstate-5, Interstate-90, Interstate 405, US Highway 2, State Route (SR) 18, SR 516, SR 167, US Highway 99 and others transport hazardous materials throughout the region. Restricted HM routes include I-90 through Mercer Island, I-5 in

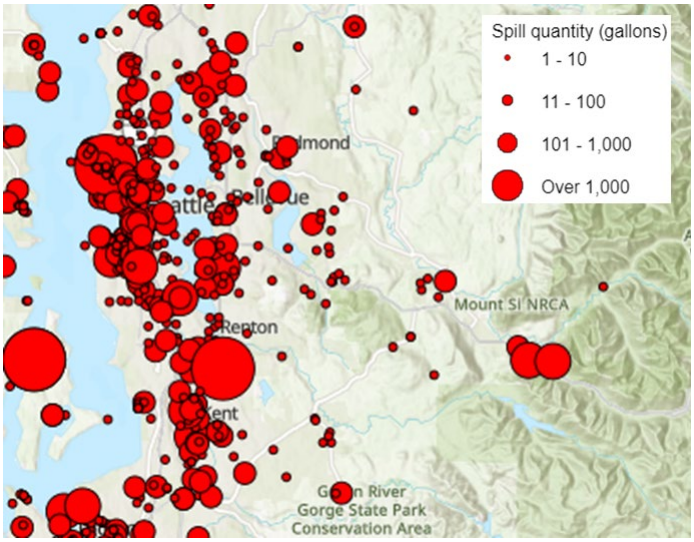
[6] US DOT, "National Pipeline Mapping System (NPMS)" (n.d.): https://pvnpms.phmsa.dot.gov/PublicViewer/
[7] Lauren Girgis, "Olympic Pipeline leak released 25,000 gallons of gasoline" *The Seattle Times* (December 2023): https://www.seattletimes.com/seattle-news/environment/olympic-pipeline-leak-released-25000-gallons-of-gasoline/

Seattle under the Convention Center, SR-99 Seattle Tunnel, and 188th S in Sea Tac. An oil spill in 2016 in Mosier, Oregon along the Columbia River very nearly caused the destruction of the entire town and an ecological catastrophe in the river. The community was saved by luck of the weather and because most of the oil that spilled flowed into a water treatment plant, where it was safely contained.

11.3 Magnitude

Several systems are used to evaluate the either release of hazardous materials or areas that formerly acted as hazmat storage. These factors are based on contamination levels, risk to human health, environmental damage (for soil and water), and local impact. Although the likelihood of large numbers of fatalities from a single materials release is low, the effects can be devastating to impacted communities, the economy and the environment. A major oil spill in Puget Sound would destroy the fishery, including $4.5 billion in commercial fishing, plus tourism, and sport fishing. The Puget Sound is also a culturally sacred and environmentally critical resource that cannot be replaced or valued in dollars. In this way, the hazardous materials incident hazard is one of the most complex. It includes frequent spills and releases from day-to-day human activities, the threat of a major release from a massive spill or accident, and the threat of an intentional release from an attack. The impacts from hazardous materials are also complex, including slow-acting releases that kill people and the environment over years and catastrophes that kill thousands.

Figure 11-6 Reported spills to waterways in King County, 2019 – 2023[8]



Spill Quantity	No. Incidents
1 to 10	3056
11 to 100	812
101 to 1000	145
over 1000	32

[8] WA Department of Ecology, *Spill Map* (December 2024): https://gis.ecology.wa.gov/portal/apps/experiencebuilder/experience/?id=591270509d254f189fb63d4c2d0af340&page=Page&views=Reported-Incidents

Between 2019 and 2023, Washington State Department of Ecology received 4,045 reports of oil spills of one gallon or more reaching a water source, including both running into storm drains and running directly into a waterway. This only includes reported spills and only includes oil spills. This does not include the uncountable quantity of micro-spills that occur and are later washed into waterways by rain. For example, the rough spot of pavement in a parking lot that is the result of fluids dripping onto the pavement from parked vehicles is an oil spill.[9] In Washington, the state Department of Ecology is the lead agency for hazardous materials. Local response is led by fire services.

11.4 Previous Occurrences

Though they occur every day, many spills are not reported or go undetected. Some industrial spills from the 1970's and 1980's are still being cleaned up in the Kent Valley, Harbor Island, Duwamish corridor, and Seattle/South Park as federal Superfund cleanup sites. There are currently 10 active superfund cleanup sites in King County and eight brownfield sites.[10] Currently active sites include:

Table 11-1 Superfund and Brownfield sites within King County

Site Name	City	Site Type	Description
Superfund Sites			
Harbor Island (lead)	Seattle	Recycling	Batteries/scrap metals/secondary smelting/precious metal recovery groundwater contains benzene, ethyl benzene, xylene, mercury, cadmium, lead and zinc with poly chlorinated bi-phenols (PCB) sediments.
Lockheed West Seattle	Seattle	Manufacturing, Processing, Maintenance	Trucks/ships/trains/aircraft and related components heavy metal contaminants: arsenic, chromium, copper, lead, silver, and zinc with butyl tins and PCBs.
Lower Duwamish Waterway	Seattle	Other	Contaminated sediment site with no identifiable source. River sediments are contaminated with mercury, arsenic, PCBs, dioxins, furans, and phthalates.
Midway Landfill	Kent	Waste Management	Co-disposal landfill (municipal and industrial). Ground water contaminated with heavy metals and volatile organics.

[9] Washington State Department of Ecology. Coastal Atlas. Accessed online on 7/2/19 from https://fortress.wa.gov/ecy/coastalatlas/storymaps/spills/spills_sm.html.
[10] U.S. Environmental Protection Agency. Superfund Sites Where You Live. Accessed online on 6/25/19 from https://www.epa.gov/superfund/search-superfund-sites-where-you-live

Site Name	City	Site Type	Description
Pacific Car & Foundry Co.	Renton	Manufacturing, Processing, Maintenance	Trucks/ships/trains/aircraft and related components. Soil is contaminated with heavy metals, PCBs and solvents. Approximately 37,000 obtain drinking water from wells within three miles.
Pacific Sound Resources	Seattle	Manufacturing, Processing, Maintenance	Lumber and wood products/wood preserving/treatment. Soil and ground water contaminated by PCBs and heavy metals from former wood treatment operations.
Queen City Farms	Maple Valley	Waste Management	Industrial waste facility (non-generator). the site is a former landfill. Ground water, surface water, and sludge contaminated by volatile organic compounds. Soil contaminated with PCBs and metals.
Quendall Terminals	Renton	Manufacturing, Processing, Maintenance	Chemicals and allied products. Soil and ground water contaminated with benzene and creosote from former manufacturing plant. Contaminants release to Lake Washington.
Seattle Municipal Landfill (Kent Highlands)	Kent	Waste Management	Landfill contains volatile organic compounds like toluene, xylene, vinyl chloride, and others – plus heavy metals.
Western Processing Co. Inc.	Kent	Recycling	Chemicals/chemical waste (e.g., solvent recovery). former industrial processing facility ground water and sediment contains volatile organic compounds, PCBs, phenols, and heavy metals.
Brownfield Sites			
Boathouse Inc Renton Skyway	Seattle	Dry cleaning facility	The 0.48-acre site was formerly home toa dry cleaning facility. The facility's operations led to hazardous chemical releases into the soil and groundwater. Located 5,700 feet from the Duwamish River and the Skyway Water District and City of Renton are within 2 miles.
Rainier Court	Seattle	Housing	7-acre Rainier Court Property Phase IV Development, built on land with contaminated fill, has seen past uses such as vehicle storage, welding, and small residences with heating oil tanks.

Site Name	City	Site Type	Description
Goodwill Corp Dearborn Campus	Seattle	Retail, Storage, Learning Facility	Goodwill site located in Seattle's Central District. Contaminants in the soil and groundwater are linked to past activities, including a dry cleaner, hazardous materials storage, petroleum USTs, metal plating, and contaminated fill.
Grand Street Commons	Seattle	Housing	Located in Judkins Park neighborhood has hosted manufacturing, dry cleaning, and vehicle repair businesses, leading to hazardous substance releases into the soil and groundwater. Cleanup includes excavation and disposal of PCE- and petroleum-contaminated soil. Additionally, groundwater treatment began in June 2021.
Chubby & Tubby	Seattle	Gas Station	Half acre commercial space formerly used as a gas station that had petroleum contaminated soil.
Boeing Auburn	Auburn	Manufacturing	Auburn Plant has caused groundwater contamination with volatile organic compounds (VOCs), chemicals that emit vapors. Contaminated groundwater flows north and northwest from the site, affecting areas in Algona and Auburn.
Betty Brite Cleaners	SeaTac	Dry cleaning facility	This site has confirmed contamination of halogenated solvents that could potentially harm people and the environment. Currently awaiting cleanup.
Mt Baker Properties	Seattle	Housing	Since 2016, the Mt. Baker Housing Association (MBHA) has been cleaning up the contaminated site. Former business activities impacted the soil and groundwater, including contamination from a former gas station and Mount Baker Cleaners.

While the majority of incidents tend to involve petroleum products, a significant number involve extremely hazardous materials. Extremely hazardous materials include chemicals like chlorine, ammonia, sulfuric acid, nitric acid, some pesticides (EHS is a technical designation, so not pesticides-although the chemistries used as pesticides might be on the EHS list), and other chemicals that can cause immediate death or injury when inhaled, ingested, or come in contact with skin.

An example of the cleanup costs for a Superfund site is illustrated by the Harbor Island Cleanup. The former owner, RSR Corporation agreed to pay $8.5 million in fines toward the cleanup that will cost (when completed) over $32 million.[11] The cost to cleanup an illegal drug lab (in a home) can cost between $5,000 and $100,000 depending on the size of the home. Often the occupants vacate or abandon the sites – leaving a bank or credit union holding the mortgage and cleanup costs.[12]

11.5 Probability of Future Occurrences

Given the widespread use and distribution of hazardous materials across the county, including in residential homes, medical facilities, and industrial sites, the risk of a hazmat release within the next year is inevitable. Certain areas are more vulnerable to these incidents, such as the 3,164 reported Tier II facilities, transportation networks like the Olympic Pipeline, and Superfund sites. Historical data shows that most spills are relatively small, with over 75% involving 1 to 10 gallons oil and 20% falling within the 11 to 100-gallon range. However, approximately 5% of spills exceed 101 gallons, underscoring the potential for more substantial environmental damage.

11.6 Climate Change Considerations

Climate change increases the risk and impact of hazardous material (hazmat) releases due to more extreme weather events like floods, storms, and wildfires, rising sea levels, and higher temperatures. These factors can damage infrastructure, such as chemical storage tanks and pipelines, causing spills and leaks. Changes in precipitation patterns, including droughts and heavy rainfall, can overwhelm containment systems and lead to toxic runoff. Additionally, aging infrastructure may be more vulnerable to climate stresses, and extreme weather can disrupt emergency response efforts, making it harder to manage hazmat incidents. Climate change also affects ecosystems, making them more susceptible to contamination from spills.

11.7 Impact Assessment

Public	Potential Impacts to the public from a hazardous materials spill can vary widely. Temporary or even permanent displacement through evacuation from an unsafe area can result in relocation/displacement of populations. Employment disruption, school closure, impacts to private and community wellheads and other impacts can change whole communities. Long term exposure to toxic

[11] U.S. Department of Justice. 2006. Former Harbor Island Smelter Operator to Pay $8.5 Million in Superfund Cleanup Costs. Accessed online on 6/25/19 from https://www.justice.gov/archive/opa/pr/2006/January/06_enrd_047.html.
[12] Dewan, Shaila and Robbie Brown. July 25, 2009. When an ex-meth lab is home. *The Seattle Times.* Accessed online on 6/25/19 from https://www.seattletimes.com/business/real-estate/when-an-ex-meth-lab-is-a-home/.

	chemicals can cause birth defects and temporary or permanent health problems – especially for the young, old and infirm.[13]
Responders	Hazardous materials make response and recovery activities in all disasters a threat to the health and safety of responders. During local events, such as house fires, stores of chemicals can catch fire and explode, injuring responders. During larger events such as earthquakes, large-scale releases can surprise and overwhelm responders without proper equipment. It can also be extremely difficult to determine the chemical or chemicals that have been released from a given spill, adding to first responder danger.
Continuity of Operations	King County is the operator of several facilities that are vulnerable to hazardous materials spills. The county has three waste water operations (South Plant, West Point Treatment Plant, and Brightwater). These expensive facilities are vulnerable to the introduction of chemicals (when in large volumes) to the sanitary sewer system. The county also has solid waste (garbage) transfer stations and a major landfill operation at Cedar Hills. While contaminants are avoided, some material may make its way into the landfill and the ground water table. Drinking water facilities including private and community well heads and reservoirs may also be vulnerable to introduction of chemical or biological contaminants. Any chemical spill that impacts a major roadway or rail line may impact public transit routes in the county.
Property, Facilities, and Infrastructure	**Property** Spills of hazardous materials to soil or buildings can result in extensive and costly cleanup efforts. Cleanup standards are established by federal (U.S. EPA), state (Washington State Department of Ecology), and local standards (fire agencies and environmental agencies). Until a site is cleaned up to those standards, residential or business occupancy can be denied under the Health Code. The responsible party (property owner) may be required to pay for the cleanup. Often this can lead to bankruptcy and clean up by state or federal agencies and contractors. Contaminated property can drastically reduce the value of the property and the King County subsequent property taxes available to local and state government. Similar impacts can be expected for transportation accidents with hazardous material spills. **Facilities** Hospitals can be overwhelmed by major releases of hazardous materials as populations, both those exposed and those who feel they may have been, check in at emergency rooms. Hospitals and pharmacies are also sources of hazardous materials, including some radioactive materials such as those associated with cancer treatment.

[13] U.S. Centers for Disease Control. Health Effects of Chemical Exposure. Accessed online on 6/25/19 from https://www.atsdr.cdc.gov/emes/public/docs/Health%20Effects%20of%20Chemical%20Exposure%20FS.pdf.

	Infrastructure With hazardous materials being everywhere in our modern community, it is possible to impact almost any critical facility in the county. Any roadway or rail line is vulnerable to the many chemicals transported over them daily. Spills to soils and surface water sources can impact drinking water and the environment. Materials dumped into sanitary sewers can contaminate wastewater treatment plants. Airborne chemicals can cause the evacuation of the area downwind of the spill, including critical facilities. Damage to road surfaces from chemical spills may require the removal and replacement of the entire road surface and foundational roadbed. Transformers used in power transmission contain chemicals called PCB (Poly chlorinated bi-phenols) that can be released during wind storms or lightning strikes and traffic accidents. The impacts to business from interrupted commute/road or railroads closures can last for hours, days, weeks, or longer. White powder incidents have closed postal facilities and government buildings until the substance was identified and removed
Environment	Any chemical spill on or along rails, roads, pipelines, fixed industrial facilities or illegal drug labs/dumping may impact the natural environment. Wetlands, streams and rivers, lakes, and reservoirs may all be damaged from chemical spills. In some cases these damages may injure the plant and animal life irreparably. Birds, reptiles, amphibians, fish, and mammals may all be impacted. Air pollutants may impact human inhabitants as well as the natural environment. Recreational areas can be closed until a suitable solution can be found to recover the natural environment.
Economy	Small spills can close businesses and have a rather large impact on employment and land use including the properties of neighbors not responsible for the chemical release. Superfund sites can impact a community for decades until they are cleaned up. The large salmon and fishing fleet that calls King County home may be impacted when some of a year's fish stock – or even the entire run is impacted.
Public Confidence in Governance	The Community Right to Know Act, and other related legislation, resulted from serious breaches in public confidence following massive releases, explosions, or other failures in hazardous materials systems. Any major incident in and of itself seems to offer proof to the public of a regulatory failure. Maintaining Local Emergency Planning Committees and a regular structure to report and analyze hazardous materials releases is critical to maintaining public confidence.

11.8 Vulnerability Assessment

Vulnerable populations	Vulnerable populations often live in closer proximity to facilities with the risk of hazardous materials release. In King County, this includes residences near the Duwamish industrial area, in Kent, Renton, and south Seattle. These are also the locations of the superfund sites in the region. In cases of major releases or system failures, the most impacted populations are frequently lower-income, often ethnic minority communities that live nearby. Populations with respiratory issues are also at a heightened risk of impacts due to an airborne release of chemicals. **Low-income communities in or around industrial facilities** Low-income communities are more likely to be impacted from major releases due to the proximity of affordable housing to industrial areas and historic environmental injustices. **Individuals with respiratory issues** Individuals with respiratory issues are more likely to succumb quickly to an airborne release of a chemical.
Property	Properties vulnerable to hazardous material (hazmat) release typically include former industrial sites, dry cleaning facilities, gas stations with underground storage tanks, landfills, and vehicle maintenance or repair shops. These properties often suffer from contamination due to the improper disposal or leakage of chemicals, solvents, petroleum products, heavy metals, and other toxic substances. Sites with contaminated fill or former military and chemical storage areas are also at risk, as they may harbor pollutants that persist in the soil and groundwater.
Environment	Oil tankers are expected to traverse Puget Sound in growing numbers due to Canada's approval of a major pipeline and terminal in Vancouver, BC. When this occurs, it will significantly raise the risk of a spill that could destroy much of the aquatic life in Puget Sound.
Operations	**Transportation** Major transportation facilities store huge amounts of chemicals and fuel in depots. A failure or fire at one of these facilities could damage or destroy these assets. Interstate highways are a major artery carrying chemicals. Accidents happen every day and major chemical spills can shut down a roadway

for an extended period of time. Additionally, oil slicks contribute to traffic injuries and fatalities when it rains.

Rail facilities transport chemicals and fuels, including highly combustible crude oil. There have been multiple derailments and spills. In Mosier, Oregon in 2016, a train derailed causing a fire that nearly destroyed the town, and the fuel avoided leaking in large quantities into the Columbia River by luck.

Chapter 12

Health Incidents

Risk Assessment Scoring		
4	Location	Hazard
3	Probability	
3	Magnitude	
3	Public	Impact
3	Responders	
3	COP	
1	PFI	
1	Environment	
3	Economy	
3	PCG	
4	People	Vulnerability
1	Property	
1	Environment	
2	Operations	
3	People	Risk
2	Property	
3	Environment	
3	Operations	
High	**Overall Risk**	

PC: Ken Lambert

Chapter 12: Health Incidents

12.1 Hazard Description

For the purpose of this risk assessment, health incidents are referred to as infectious disease outbreaks affecting the population, agriculture, and/or wildlife. While there have been great advancements in public health and medicine to address and even eradicate dangerous infectious diseases, the emergence of evolving and novel pathogens, as well as increased mistrust in government and health institutions, present new challenges for the coming years. This risk is a growing concern for the county in the wake of the COVID-19 pandemic, which led to a substantial morbidity (illness) and mortality (death) as well as strained healthcare systems and economic losses. Proactive planning by federal, state, and local agencies is essential for mitigating the future spread of illnesses and their impacts. The county's primary concerns include communicable and agricultural diseases.

Communicable diseases are vector-borne illnesses that people spread to one another through contact with contaminated surfaces, bodily fluids, blood products, insect bites, or through the air. Examples include influenza, norovirus, and hepatitis A.

Agricultural diseases encompass a variety of animal and crop diseases, pest infestation, and food safety outbreaks. Examples include highly pathogenic avian influenza (HPAI), Chronic Wasting Disease and *e coli*.

An outbreak can be characterized by the extent of spread of the disease:

- **Endemic**, seen in more common diseases, are at baseline levels within a community. Animal and crop diseases are endemic in many parts of the world.
- E**pidemic** refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
- **Pandemic** refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

Outbreaks of any scale can have significant impacts on public health and healthcare resources. New or emerging diseases can also quickly become an epidemic or pandemic if there is little or no immunity in the population.

12.2 Location

All King County jurisdictions are susceptible to infectious disease outbreaks. However, several factors can increase the likelihood of a disease spreading, including population density, the amount of international travel and trade in an area, likelihood of exposure to animals, the availability of accessible healthcare services, and the pre-existing health conditions of those exposed or infected.

Population Density

King County is the largest county in Washington State, home to over 2.2 million residents with a population density of approximately 985 people per square mile. Comparatively, urban centers in the county such as Seattle has a population density of about 9,000 people per square mile across its 83.83 square miles. Similarly, the City of Bellevue has around 4,612 people per square mile within its 33.5 square miles. High population density in these cities create environments conducive to the rapid spread of infectious diseases, as close human contact is a primary driver of transmission.

Port and Travel

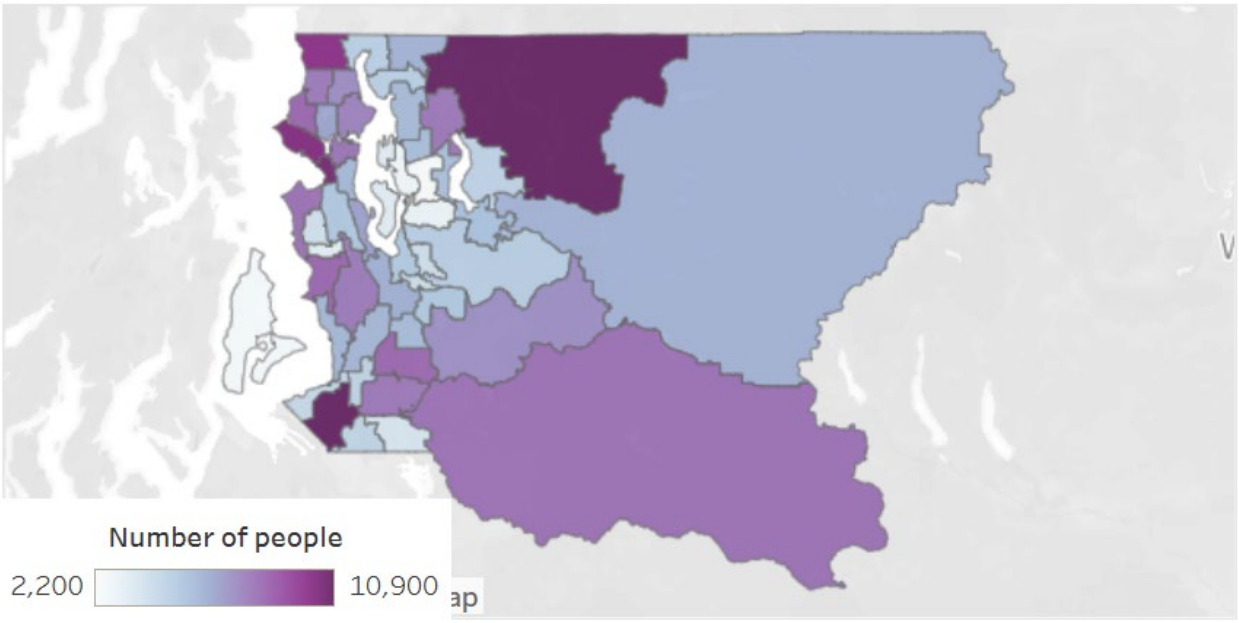
Seattle is home to the eighth largest port and the eleventh busiest airport in the United States, and the Seattle Tacoma airport is one of the first points of entry for international travelers across the Pacific. The presence of major international air and sea ports, along with a thriving cruise ship industry creates a steady flow of visitors to our area, raising the risk of importing (and exporting) infectious diseases. Diseases that are not endemic to Washington have the potential for introduction and spread among our residents. Vaccine preventable diseases (e.g., acute viral hepatitis, measles, and influenza) are significant contributors to morbidity and potential mortality in international travelers and can cause local outbreaks among susceptible persons. Furthermore, unvaccinated individuals travelling abroad risk acquiring and spreading diseases that are not common in the United States.[1]

Health Risk Populations

Those who are often hit the hardest by disease outbreaks include young children, the elderly, the poor, and those with underlying health conditions. There is extensive healthcare infrastructure within King County that provides care for the wider region, including one of the area's only pediatric hospitals and the only Level 1 Trauma center for Washington, Idaho, Montana, and Alaska. Similarly, Airlift Northwest is the only life-flight agency serving the same four-state region. The areas with the highest number of adults with high-risk health conditions, shown in Figure 12-1, include Carnation, Duvall, Federal Way, Downtown Seattle, Queen Anne, Magnolia, Shoreline, Ballard, Burien, and Kent.

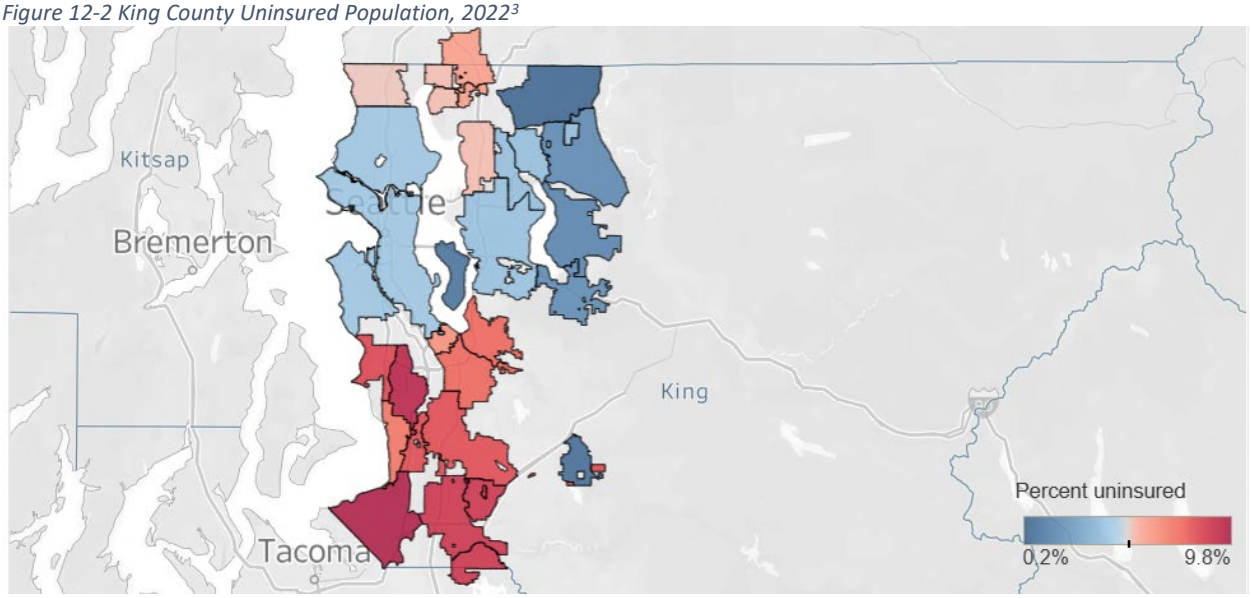
[1] CDC, "Routine Vaccines" *CDC Travelers' Health* (September 2024): https://wwwnc.cdc.gov/travel/page/routine-vaccines

Figure 12-1 King County Map of Adults with High-Risk Health Conditions[2]



The communities Shoreline, Burien, Federal Way, and Kent are also shown to have high percentages of uninsured community members. People who experience homelessness often have limited access to medical care and may not be fully represented in this data set.

Figure 12-2 King County Uninsured Population, 2022[3]

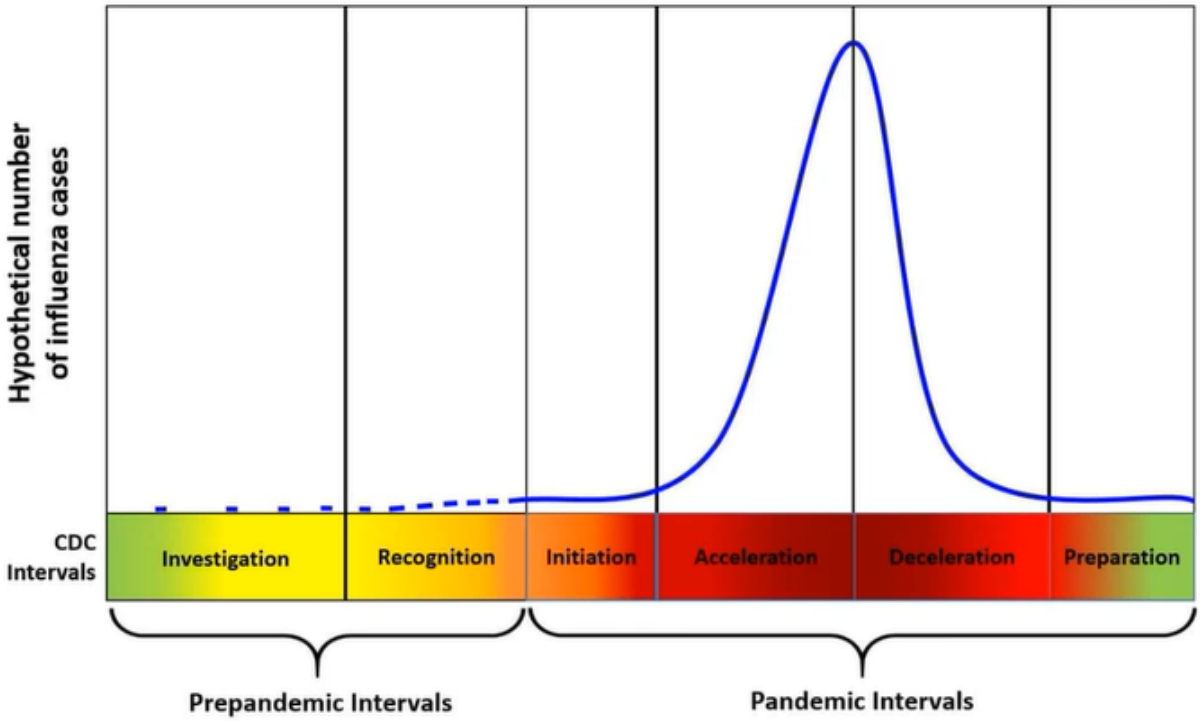


[2] "COVID-19 Vulnerable Communities Data Tool" *Communities Count* (n.d.): communitiescount.org/covid19vulnerable
[3] "Health Insurance" *Communities Count* (2023): communitiescount.org/health-insurance

12.3 Magnitude

When monitoring communicable diseases, the King County Department of Public Health employs the Centers for Disease Control and Prevention (CDC) Pandemic Intervals Framework (PIF), which delineates the progression of an influenza pandemic through six distinct intervals. This widely recognized framework not only visualizes fluctuations in disease activity but also provides a standardized method for describing pandemic phases, thereby guiding public health responses effectively.

Figure 12-3 CDC Pandemic Intervals Framework (PIF)[4]



The CDC PIF is also cross referenced with the World Health Organization (WHO) phases along with federal, state, and local indicators which notes when one interval moves into another. The impact of a disease can be tracked and characterized using several different indicators. These indicators can help Public Health – Seattle & King County (PHSKC) assess and respond to potential disease outbreaks.

[4] "Pandemic Intervals Framework (PIF)" *CDC Pandemic Flu* (n.d.): https://www.cdc.gov/pandemic-flu/php/national-strategy/intervals-framework.html

Table 12-1 WHO Phases, CDC Intervals, Indicators[5]

World Health Organization phases	CDC intervals	Federal indicators for CDC intervals	State/Local indicators for CDC intervals
Interpandemic phase: Period between influenza pandemics **Alert phase:** Influenza caused by a new subtype has been identified in humans	**Investigation:** Investigation of novel influenza A infection in humans or animals	Identification of novel influenza A infection in humans or animals anywhere in the world with potential implications for human health	Identification of novel influenza A infection in humans or animals in the United States with potential implications for human health
	Recognition: Recognition of increased potential for ongoing transmission of a novel influenza A virus	Increasing number of human cases or clusters of novel influenza A infection anywhere in the world with virus characteristics, indicating increased potential for ongoing human-to-human transmission	Increasing number of human cases or clusters of novel influenza A infection in the United States with virus characteristics indicating increased potential for ongoing human-to-human transmission
Pandemic phase: Global spread of human influenza caused by a new subtype	**Initiation:** Initiation of a pandemic wave	Confirmation of human cases of a pandemic influenza virus anywhere in the world with demonstrated efficient and sustained human-to-human transmission	Confirmation of human cases of a pandemic influenza virus in the United States with demonstrated efficient and sustained human-to-human transmission
	Acceleration: Acceleration of a pandemic wave	Consistently increasing rate of pandemic influenza cases identified in the United States, indicating established transmission	Consistently increasing rate of pandemic influenza cases identified in the state, indicating established transmission
	Deceleration: Deceleration of a pandemic wave	Consistently decreasing rate of pandemic influenza cases in the United States	Consistently decreasing rate of pandemic influenza cases in the state

[5] Sonja A. Rasmussen MD, et al., "Updated Preparedness and Response Framework for Influenza Pandemics" *CDC Morbidity and Mortality Weekly Report (MMWR)* (September 2014): https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6306a1.htm#Tab

Transition phase: Reduction in global risk, reduction in response activities, or progression toward recovery actions	**Preparation:** Preparation for future pandemic waves	Low pandemic influenza activity but continued outbreaks possible in some jurisdictions	Low pandemic influenza activity but continued outbreaks possible in the state

12.4 Previous Occurrences

Since 2000, there have been several large-scale health incidents around the world which have had a devastating impact on lives and livelihoods, including the 2003 SARS outbreak, 2009 H1N1 influenza pandemic, 2014 Ebola outbreak, 2015 Zika epidemic, COVID-19 pandemic, and the 2022-2023 mpox outbreak.[6] While the impacts, risk factors, and causes vary, infectious disease outbreaks are an ongoing threat that requires preparedness and vigilance.

Table 12-2 Previous infection disease outbreaks in King County

Disease	Time	Description
E. coli.	1993	E. coli-contaminated hamburger meat from a local Jack in the Box caused illness in 400 people and led to the death of two people within one month in the Washington area. Cases were seen in California, Idaho, and Nevada as well.
Pertussis	2002-2005	Between 2002 and 2003 Public Health reported an 82% increase in the number of Pertussis infections in infants, and a three-fold increase in the number of cases in children <6 months. The occurrence of Pertussis in adolescents and adults has been on the rise since 1990, culminating in a national epidemic in 2005 when 25,616 reported cases nation-wide. Outbreaks within healthcare facilities can occur quickly because the bacterial infection is highly contagious.
Influenza	2009	The H1N1 outbreak of 2009 affected the young and healthy populations as well as those with chronic diseases. This increase in morbidity caused strain on the local healthcare system. Although the H1N1 virus was not as virulent and there were not

[6] Public Health – Seattle & King County (PHSKC), "Biological Incident Response Annex" (June 2024): https://kingcounty.legistar.com/LegislationDetail.aspx?ID=6458573&GUID=7E04B4F2-35E5-47B8-BA78-6FD7C85966AB

		nearly as many fatalities as previous pandemics, the outbreak caused a larger than usual amount of disease in the community than seasonal influenza virus does.
Hepatitis A	2017, 2019	In 2017, several state and local health departments responded to hepatitis A outbreaks, spread through person-to-person contact, that occurred primarily among persons who use injection and non-injection drugs, and/or person who experienced homelessness and their close contacts. Multistate outbreaks of hepatitis A infections have also been linked to food products (i.e. strawberries in 2016 and pomegranate seeds in 2013). A large outbreak centered in Seattle would cause a strain on the public health system and potentially have strong impacts on local businesses, especially any that the public perceives as responsible for the outbreak.[7]
COVID-19	2020-Present	Severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2), the virus that causes coronavirus disease 2019 (COVID-19), was first identified in Wuhan, China in December 2019. On January 20, 2020, the first case of COVID-19 in the United States was identified in Washington state. Since February 2020 there have been almost 600,000 reported cases, close to 18,000 hospitalizations, and more than 3,600 deaths from COVID-19 in King County.
Mpox	2022	In May 2022, an outbreak of mpox (formerly known as monkeypox virus disease) suddenly and rapidly spread across Europe, the Americas, and all six WHO regions, with 110 countries reporting a combined approximate 87,000 cases and 112 deaths. Cases of mpox were reported from countries where the disease was not endemic and cases were increased in several endemic countries, i.e., most confirmed cases with travel history reported travel to countries in Europe and North America, rather than West or Central Africa where the mpox virus is endemic. The global outbreak affected primarily (but not only) gay, bisexual, and other men who have sex with men and spread person-to-person through touching, kissing, sex, or contact with contaminated sheets, clothes, or needles.
Avian Influenza	2022 – Present	A strain of H5N1 highly pathogenic avian influenzas (HPAI) circulated in wild birds and poultry was first identified in Washington state in May 2022. The first human cases of H5 avian

[7] "Hepatitis A Outbreak Linked to Person-to-Person Contact" *CDC Viral Hepatitis* (April 2024): https://www.cdc.gov/hepatitis/outbreaks/ongoing-hepatitis-a/index.html

		influenza were reported in Washington state in October 2024. There are now 9 cases of human with H5. CDC currently the risk to the general public's health to be low.[8]
Varicella (chicken pox)	2023	In May 2023, at least 3 confirmed cases of varicella among asylum seekers at an encampment located in Tukwila.[9]
Measles	2024	In 2024, several confirmed cases of measles were reported in King County, all linked to international travel. In April, a group of international travelers in King County came into close contact with a confirmed measles case in Georgia. Several of these individuals lacked documented immunity to the virus. On May 10th and 11th, an adult with a confirmed case of measles passed through Seattle-Tacoma International Airport. The individual is believed to have contracted the virus while traveling in Europe or while en route to the region. On June 10th, a child at Franciscan Urgent Care in West Seattle was diagnosed with measles. The child, who had not been vaccinated, likely contracted the virus during international travel.

12.5 Probability of Future Occurrences

While it is impossible to predict the timing or nature of the next outbreak, history demonstrates that they are not uncommon and can have devastating effects on communities. Although advancements in medicine over the past century have enhanced our ability to combat diseases, several factors—such as rapid population growth in our city centers, increasing number of individuals without adequate healthcare, the evolution of antibiotic-resistant bacteria, globalization, and societal upheaval —contribute to the rapid spread and increased severity of outbreaks.

Emerging variants of COVID-19, novel strains of influenza, and severe acute respiratory syndrome (SARS) all pose risks with the potential to trigger outbreaks. These diseases and variants can also have limited or no medical countermeasure (therapeutic treatment or vaccine), posing as a high risk/low frequency event that have the potential to broadly impact health and medical capacity as well as disrupt critical resources and support infrastructure.

[8] "Avian Influenza" *Washington State Department of Health (DOH)* (n.d.): doh.wa.gov/you-and-your-family/illness-and-disease-z/avian-influenza

[9] Public Health – Seattle & King County (PHSKC), "Varicella cluster in Tukwila, King County" *King County* (December 2023): https://kingcounty.gov/en/dept/dph/health-safety/disease-illness/health-advisories/2023/13-december

12.6 Climate Change Considerations

Climate change and globalization have significantly heightened the reach of invasive species, pathogens, and diseases affecting people, agriculture, and the environment. With extensive global travel networks and increasing urbanization, novel pathogens can quickly spread far beyond their origins. This rapid transmission poses a particular threat to individuals on the front lines of exposure, especially those with fewer resources, as well as vulnerable populations.

Key ecological concerns include the introduction of diseases and parasites to wild species, competition between wild and farm-raised species, threats from invasive species, and the negative effects of pollution and fish farming on shellfish beds, among others. These climate-driven changes in ecosystems further exacerbate the risk of emerging infectious diseases by altering the interactions between humans, pathogens, and animals.[10]

Rising temperatures have also allowed the spread of diseases and vectors that previously were not of concern to King County. For example, Coccidioides fungus that causes Valley Fever detected in south-central Washington State and spreads through dust or disturbed soil.[11] Warmer average temperatures have resulted in expanding mosquito distribution. Warmer temperatures also speed up the life-cycle of mosquitoes, allowing adult mosquitoes to mature faster, increasing people's risk of exposure to diseases such as West Nile virus (WNV).[12] Between 2003 and 2023, more than 1 million cases of vector-borne diseases were reported in the United States. Rising temperatures and changing rainfall patterns can boost mosquito and tick populations and make it easier for them to spread harmful pathogens to people.

12.7 Impact Assessment

Epidemics directly affect the health of people who live, work, and visit a community. They have the potential to be one of the deadliest hazards a community can face. As demonstrated during the COVID-19 pandemic, they can have cascading impacts to the economy and society at large.

[10] KC Ernest, et al., "Focus on Covid-19 and Climate Change" *Fifth National Climate Assessment* (2023): https://doi.org/10.7930/NCA5.2023.F3
[11] "Valley Fever (Coccidioidomycosis)" *Washington State Department of Health (DOH)* (n.d.): https://doh.wa.gov/you-and-your-family/illness-and-disease-z/valley-fever-coccidioidomycosis#:~:text=Valley%20Fever%2C%20also%20called%20coccidioidomycosis,severe%20forms%20of%20the%20disease
[12] "Infectious Diseases and Climate Change" *Washington State Department of Health (DOH)* (n.d.): https://doh.wa.gov/community-and-environment/climate-and-health/infectious-diseases#:~:text=Environmental%20Fungal%20Diseases,will%20change%20with%20changing%20environments

Public	Infectious diseases can have a profound impact on human health, leading to a range of negative consequences, including increased healthcare costs, lost income due to time away from work, and, in the most severe cases, loss of life.
Responders	Emergency services would be severely impacted during a serious outbreak because they are likely to be exposed early due to public contact. As responders become sick, response times and capabilities would be severely limited. Public Health teams widely reported that they were overwhelmed with workload during many phases of the COVID-19 pandemic. Response demands often outpaced Public Health resources.[13]
Continuity of Operations	Many government operations may cease to function on a normal basis during the most severe outbreaks. Agencies may have to adopt work from home policies and take other steps to protect employees. Due to employee illness, many non-essential functions may have to be curtailed.
Property, Facilities, and Infrastructure	**Facilities** King County has a large concentration of healthcare resources, but in an epidemic or pandemic these resources can be stretched or overwhelmed by the outbreak situation. As facilities become unable to take additional patients, it may be possible to treat people in outpatient facilities. **Infrastructure** • Energy: There are no direct impacts, outside of employee absenteeism, to the energy sector. • Water/Wastewater: King County has many open reservoirs that provide water to the city. These reservoirs could become contaminated and be a source of infection for area residents. This system is a potential target of bioterrorist activities. • Transportation: A disease would not cause any direct damage to the transportation system, but high absenteeism would affect it. Public transit, shipping, and other services may only function at 50% during especially severe outbreaks. • Communications: There are no direct impacts, outside of employee absenteeism, to the communications sector.

[13] Public Health – Seattle & King County (PHSKC), "Biological Incident Response Annex" (June 2024): https://kingcounty.legistar.com/LegislationDetail.aspx?ID=6458573&GUID=7E04B4F2-35E5-47B8-BA78-6FD7C85966AB

Environment	In the case of a pandemic that requires quarantine, the reduced amount of travel can have positive effects on the local air quality, as decreased vehicular and industrial activity reduces emissions of harmful pollutants and greenhouse gases. Regarding agricultural diseases, there is large negative impact on natural resources including landscape, livestock, and forests. In the event of a outbreak of livestock such as avian flu, farmers are required to put down their flock in order to prevent further spread of the virus.
Economic	The economy may come to a virtual standstill for weeks on end during severe outbreaks as people avoid public places. Many small businesses may lose too much revenue and be forced to close. On March 15, 2020, of non-essential businesses closed down in order to limit the spread of COVID-19. This resulted in a dramatic increase in the number of people laid off or furloughed in King County. Workers residing in King County filed an average of more than 30,000 initial claims per week between March 1 and May 2, 2020. During an outbreak of infectious disease in livestock, large-scale depopulation of livestock may be necessary to curb further spread of the pathogen and prevent associated welfare problems arising. This puts large financial constraints on farmers.
Public Confidence in Governance	The public understands that an outbreak is a severe natural event; however, restrictions on public gatherings are not popular and create frustration. Some people may believe they are not getting enough attention from the medical community. Others may begin to doubt the efficacy of treatment options if the disease worsens. In the most extreme cases, confidence in the medical system can be shaken.

12.8 Vulnerability Assessment

Vulnerable Populations	Data shows the burdens of infectious diseases are not evenly borne across the population. Viruses have had disproportionate impacts on the elderly, people with weakened immune systems, those with several pre-existing chronic medical conditions and disabilities, and communities of color. During a serious epidemic, older adults, individuals with compromised immune systems, children, people without health insurance, people who speak a language other than

English, and people who are recent immigrants to the country are likely to be the most at-risk and suffer the worst impacts.

Young and Old People

People who are either old or young have weaker immune systems and are usually more likely to succumb during an outbreak. In 2017-2018 flu season, there were nearly 1,000,000 hospitalizations and 79,400 deaths. The most at-risk group is adults over 65 years of age (70% of hospitalizations).[14] Older adults account for nearly 90% of deaths.

People with Disabilities and Compromised Immune Systems

People with disabilities experienced gaps regarding translation and interpretation services, gaps in testing and vaccine site accessibility in early phases of the pandemic, inadequate disability representation on public health data dashboards, and limited transportation options to obtain resources. Those with compromised immune systems are also most likely to become infected and succumb from a serious disease.

BIPOC

In King County, American Indian/Alaskan Native, Black, Hispanic, and Native Hawaiian/Pacific Islander residents experienced higher rates of COVID-19 cases, hospitalizations, and deaths than Asian and White residents. Through June 12, 2022, King County has had 2,850 deaths (0.6% of positive reported cases). Age-adjusted death rates of confirmed cases are highest among residents who are Native Hawaiian/Pacific Islander (749 per 100,000), American Indian/Alaska Native (452 per 100,000), Hispanic/Latinx (260 per 100,000), and Black (219 per 100,000). Case rates for most communities of color are higher than among White residents (106 per 100,000).

Immigrants and Refugees

Immigrants and refugees make up more than 24% of King County population. There are also over 100 languages spoken in King County.[15] This can lead to communication barriers on important

[14] Centers for Disease Control, "Estimated Influenza Illnesses, Medical visits, Hospitalizations, and Deaths in the United States — 2017–2018 influenza season" (November 2019) https://www.cdc.gov/flu/about/burden/2017-2018.htm
[15] Public Health – Seattle & King County (PHSKC), "Equity Response Annex" (June 2024)

	health protocol. It also makes navigating the American health system challenging. **People without health insurance** People without health insurance are more likely to delay getting care, allowing the disease to spread farther before it is identified. **Healthcare Staff** Healthcare staff are on the front line of any infectious disease outbreak. They come into regular contact with sick patients and are likely to be exposed both before the illness is identified and during treatment.
Property	No property is vulnerable in the event of an infectious disease outbreak.
Environment	Certain environments can be a conduit for infectious diseases. They can create conditions that support the spread of toxic fungi or the increased population of virus transmitters such as mosquitoes. However, the spread of communicable diseases in humans does not have known impacts on the environment.
Operations	The health system is likely to be overwhelmed in any serious epidemic. In especially serious outbreaks, it may be inadvisable for patients to even come to the hospital and treatment may have to occur outside of hospital facilities. For example, many Public Health employees during the early COVID response worked 80–100-hour work weeks, often going months without a day off.[16]

[16] Public Health – Seattle & King County (PHSKC), "Biological Incident Response Annex" (June 2024): https://kingcounty.legistar.com/LegislationDetail.aspx?ID=6458573&GUID=7E04B4F2-35E5-47B8-BA78-6FD7C85966AB

Chapter 13

Landslide

Risk Assessment Scoring		
2	Location	Hazard
3	Probability	
2	Magnitude	
1	Public	Impact
1	Responders	
1	COP	
2	PFI	
3	Environment	
2	Economy	
2	PCG	
1	People	Vulnerability
2	Property	
2	Environment	
1	Operations	
2	People	Risk
2	Property	
2	Environment	
2	Operations	
Moderate	**Overall Risk**	

PC: WADNR

Chapter 13: Landslide

13.1 Hazard Description

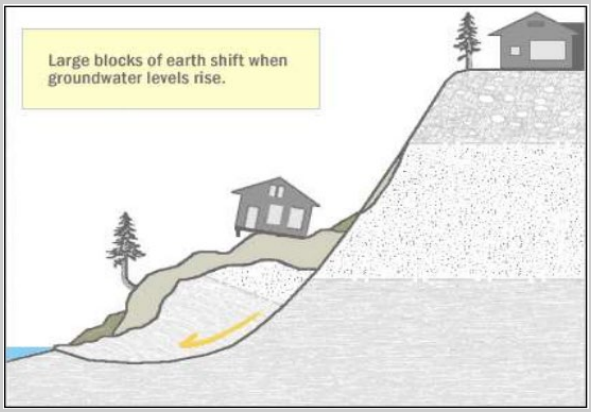
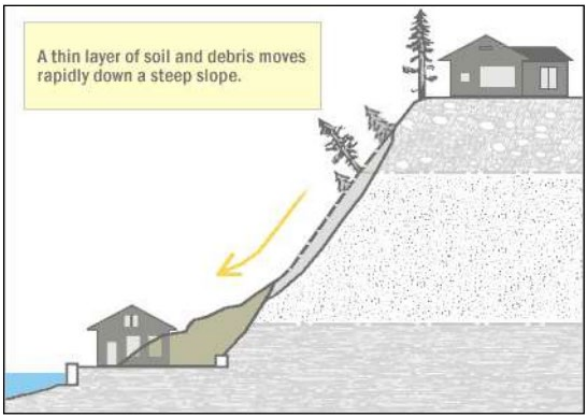
The term “landslide” encompasses a variety of geomorphic processes in which masses of soil, rock, and debris (a mixture of soil and rock) become detached and move downslope. Typically, this mass is wet, saturated, or suspended in water. Landslide movement can occur rapidly or slowly, and the displaced material may remain solid or behave like a liquid. The size of landslides can vary significantly, ranging from a few cubic yards to millions of cubic yards. The specific nature of this movement is referred to as the "landslide style," which depends on the local geology, topography, and hydrology at the site of the failure.

1996 Perkins Lane landslide in Seattle’s neighborhood Magnolia

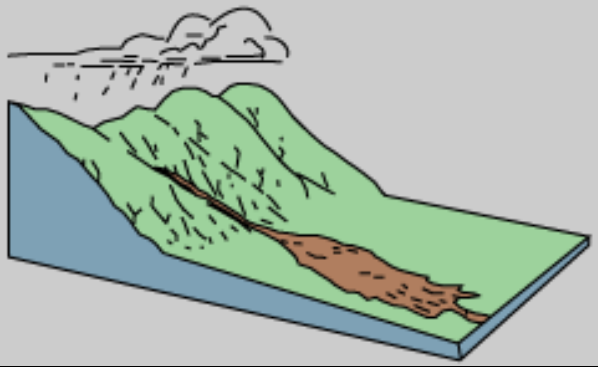
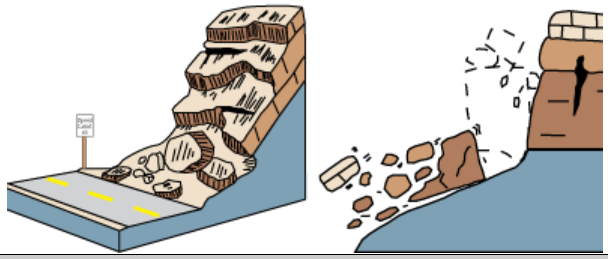
Causation

Landslides are generally considered secondary hazards, triggered by precipitation, earthquakes, wildfires, and human activities. Smaller, shallower landslides often occur in response to short-term storm events lasting hours or days, while larger, deep-seated slides may be initiated by prolonged wet conditions persisting for months. Historical records and geological evidence indicate that significant earthquakes, though infrequent, can also serve as powerful landslide triggers. Areas affected by wildfires are particularly susceptible, as burn scars can lead to debris flows. Human activities such as improper clearing, grading, or stormwater discharge can also contribute to landslide occurrences. Additionally, landslides tend to occur in areas where there is a history of previous occurrences. Five general styles of landslide phenomenon have been identified in King County:

Table 13-1 Landslide styles that occur in King County[1]

Name	Description
Deep-seated landslides 	Deep-seated landslides are those that fail below the rooting depth of trees and vegetation. They are often slow moving but can also move rapidly. Deep-seated landslides can cover large areas and devastate infrastructure and housing developments. These landslides usually occur as translational slides, rotational slides, or large block slides. Deep-seated landslides are typically much larger than shallow landslides, in terms of both surface area and volume. A deep-seated landslide may appear stable for years, decades, or even centuries. These long-lived features can be partially or entirely reactivated for a variety of reasons.
Shallow debris slides 	Shallow debris slides (also known as shallow landslides, infinite slope failures, and colluvial slides) are a common style of slope - movement both in the Puget Lowland and Cascade Mountains. Shallow landslides are rooted in the soil layer and often form slumps along roadways or fast-moving debris flows down valleys. These types of landslides are often called 'mudslides' by the news media. Shallow landslides also occur as flows, slides, or rockfalls and topples. Shallow landslides typically occur during the winter months in western Washington.

[1] King County DNRP, "Mapping of Potential Landslide Hazards along the River Corridors of King County, Washington" *River and Floodplain Management Section, Water and Land Resources Division, Department of Natural Resources and Parks* (2016): https://your.kingcounty.gov/dnrp/library/2016/kcr2783.pdf

Debris flows 	Debris flows and debris floods usually occur in steep gullies, move very rapidly, and can travel for many miles. Debris flows and floods deposit material on alluvial or depositional fans. They may contain more coarse material than a mudflow when channelized. Slopes where vegetation has been removed by fire or humans are at greater risk for debris flows and many other types of landslides.
Rock fall[2] 	Falls and topples are usually rapid, downward movement of large pieces of rock or debris. Sometimes this is enough rock to cover a road or block a stream or river. Rockfalls and topples are common in Washington's mountain highways.
Rock avalanches	Rock avalanche is a style of landslide characterized by the simultaneous failure of an entire bedrock hillslope and with the dislodged mass cascading to the valley below. Extremely rapid, massive, flow-like motion of fragmented rock from a large rockslide or rock fall. Although no rock avalanches have occurred in King County in historical times, fields of angular boulders at the base of steep mountainsides are clear evidence of prehistoric failures.

[2] Washington Department of Natural Resources (DNR), "Falls and Topples" *Landslides* (n.d.): https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/landslides#types-of-landslides.9

13.2 Location

King County is shaped by multiple glacial advances over the past two million years, the most recent occurring around 14,000 years ago. Landslides are most prevalent in areas where post-glacial erosion has created steep slopes in glacial deposits, particularly along beach bluffs, ravine slopes, and river valley walls. Interestingly, some areas with lower slopes may actually be remnants of old, deep-seated landslides that could be at risk of reactivation.

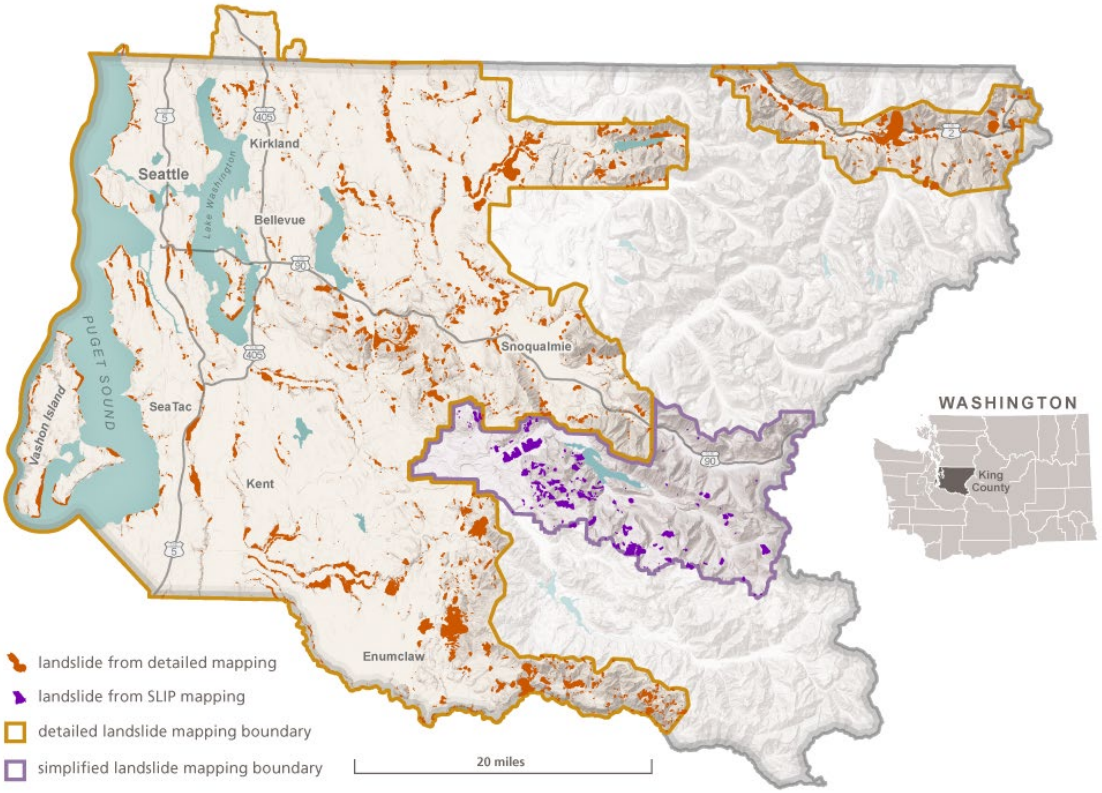
Key characteristics of landslide hazard areas include:[3] [4]

- A slope greater than 40 percent
- Landslide activity or movement in the last 10,000 years
- Stream or wave action with erosion or bank undercutting
- The presence of a depositional fan that may indicate a history of debris flows, debris floods, or rockfall
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel

In 2019, The Washington Geological Survey (WGS) published a landslide inventory for Washington State. The Landslide Hazards Program is actively creating inventories for densely populated areas, successfully mapping 60% of King County where people and infrastructure are present. Utilizing LiDAR derivatives, landslide geologists have identified and mapped 2,838 landslides and 1,251 alluvial fans. High landslide density was noted along Puget Sound bluffs, river corridors, and in the upland areas of the Cascade Range.

[3] Federal Emergency Management Agency (FEMA), "King County Risk Report: Landslide Exposure Assessment" (2018): p 52.
[4]

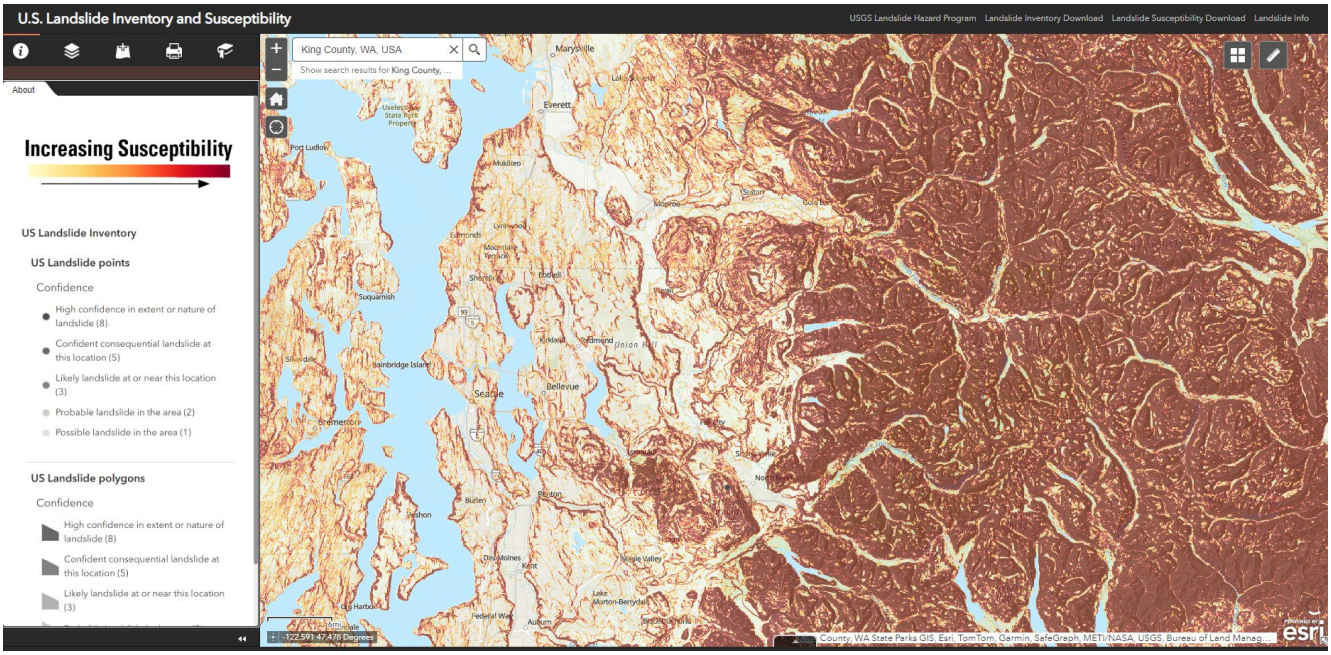
Figure 13-1 King County Landslide Inventory[5]



While landslide polygons indicate areas where landslides have already occurred, landslide susceptibility attempts to highlight areas that could experience a landslide in the future. WA DNR have not done landslide susceptibility for the county. But the USGS just published a national scale landslide susceptibility map.

[5] Washington Department of Natural Resources (DNR), "WSG Landslide Inventory" (2019): https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/landslides#find-mapped-landslidesl

Figure 13-2 Landslide inventory and susceptibility[6]



13.3 Magnitude

Landslides in King County, Washington, are most commonly of small magnitude, but they have the potential to become large and highly destructive, especially when triggered by significant weather events, human activities, or disturbances like major wildfires. For planning purposes, King County focuses on three types of landslides, which are particularly deadly and often occur after extreme weather events or other disruptions.

Warning time

Landslides are dangerous and unpredictable. Some landslides may show indications of impending or incipient movement; others may happen suddenly without any warning signs. Warning signs of a potential or impending landslide include:

- Rapidly growing cracks in the ground; downslope movement of rock, soil, or vegetation.
- Sudden changes in creek water levels, sometimes with increased sediment, especially during or right after large or protracted storm events
- Sounds of cracking wood, knocking boulders, groaning of the ground, or other unusual sounds, especially if the sound increases

[6] United States Geological Survey (USGS),"US Landslide Inventory and Inventory." (2024): https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=ae120962f459434b8c904b456c82669d

- A hillside that has increased spring and (or) seep activity, or newly saturated ground, especially if it was previously dry
- Formation of cracks or tilting of trees on a hillside
- New or developing cracks, mounds, or bulges in the ground
- Sagging or taut utility lines; leaning telephone poles, deformed fences, or bent trees
- Sticking windows or doors; new and (or) growing cracks in walls, ceilings, or foundations
- Broken or leaking utilities, such as water, septic, or sewer lines
- Separation of structures from their foundation; movement of soil away from foundations
- Changes in water well levels or water wells that suddenly run dry

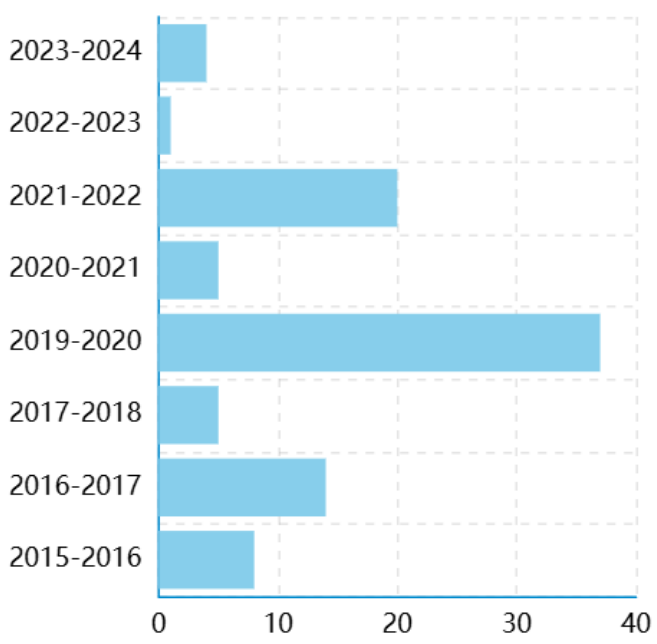
Susceptible areas

King County's geography makes certain areas particularly susceptible to landslides. The most vulnerable areas include:

- **Puget Sound Shoreline:** The region's stratigraphy, consisting of permeable sand and gravel deposits over less permeable silts and clays, creates ideal conditions for landslides. When sand and water accumulate on top of the clay layer, it can increase pore water pressure, destabilizing the slope and causing it to fail.
- **Steep Bluffs Along Incised Rivers:** The steep, unstable bluffs along rivers in King County are particularly vulnerable to landslides due to erosion and the shifting of materials over time.
- **Eastern Cascade Foothills:** In the eastern portion of the county, particularly in the Cascade Range, weakly consolidated and tectonically deformed sediments make the area highly susceptible to landslides. These areas often experience landslides after heavy rainfall or during seismic activity.
- **Fire Burn Scars:** Areas that have been affected by wildfires are more prone to landslides due to the loss of vegetation and soil stability. Without the root systems to anchor the soil, heavy rains can quickly trigger landslides in these fire-impacted zones.
- **Previous Landslide Zones:** Areas that have experienced landslides in the past are more likely to experience them again. Landslides often reoccur along the same paths, with new movement triggered by a variety of factors, including stormwater, changes in vegetation, or human development.

13.4 Previous Occurrences

Figure 13-3 Reported landslides in King County by water year



Since 2006, there have been 10 disaster declarations impacting the county, including DR-4168 for the SR 530 (Oso) landslide in Snohomish County. Landslides occur during virtually every major storm event and earthquake. Landslides are especially likely in areas where they have been recorded before. A good method of assessing likelihood of a future landslide is to know if the area has had a history of landslides.

WGS has complied and mapped reports of landslides from a variety of media sources as well as city, county, and state agencies. Since 2016, there has been 98 landslides. The bulk are occurring during December, January, and February making about 80% occur during rainy winter months.

The most significant landslide event in King County occurred in March 1997 in the Magnolia neighborhood of Seattle, Washington, known as the Perkins Lane Landslide. The primary trigger for the landslide was prolonged heavy rainfall in the days leading up to the incident. As the soil became saturated from the continuous rainfall, its stability was compromised, and the added weight of the water caused the deep-seated slide to reactivate. The landslide resulted in the collapse of five homes situated at the top of the slope, causing significant property damage and displacement.

Figure 13-4 King County's Recent Landslides 2016-2023[7]

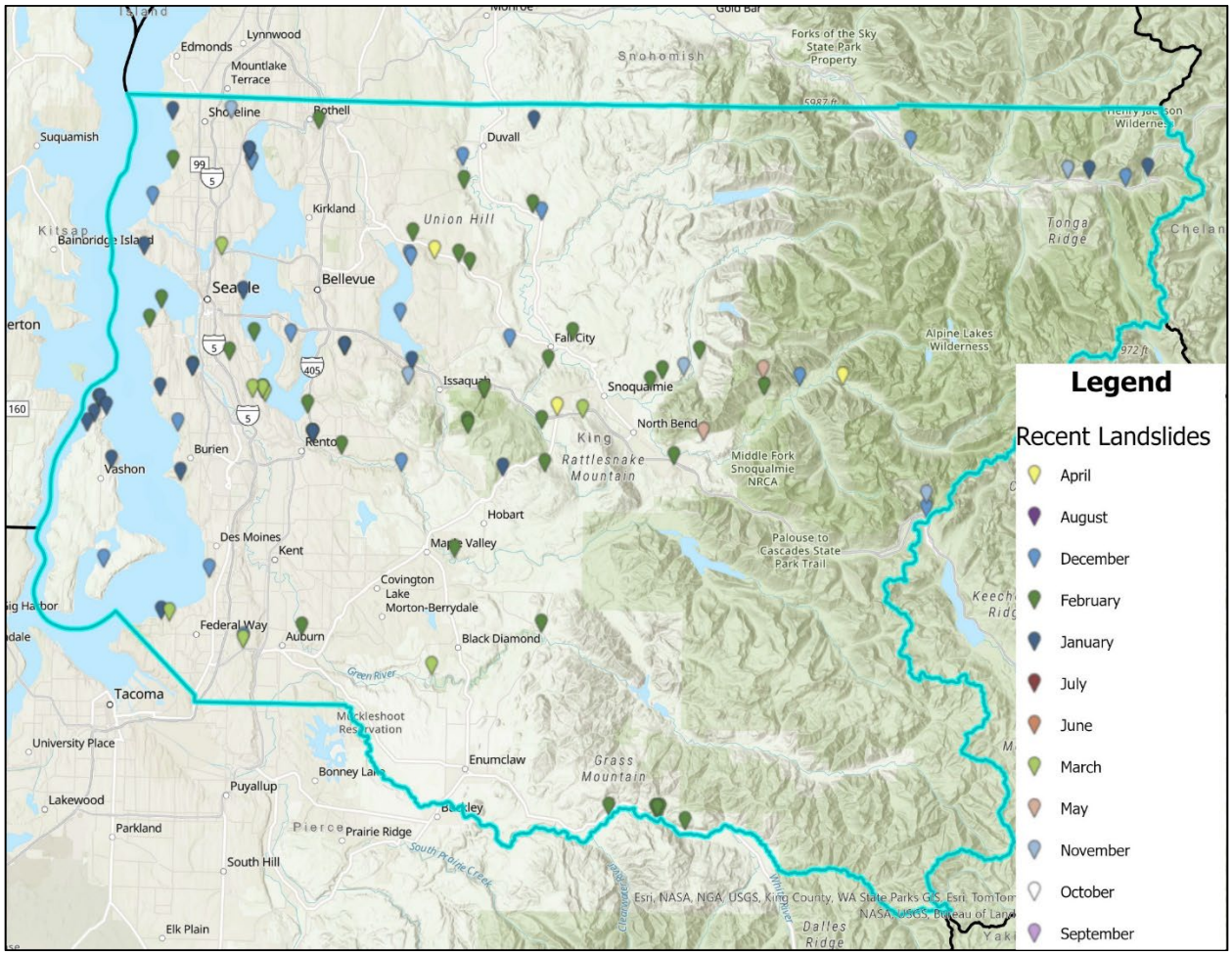


Table 13-2 Past landslide disaster declarations in King County

Date	Declaration #	Description
2001	DR 1361	Nisqually Earthquake triggers landslides around the state. $66.7M in Public Assistance was authorized.
2006	DR 1737	Severe storms trigger flooding and landslides. $29.5M in Public Assistance (statewide) was authorized along with $5.4M in Individual Assistance.
2007	DR 1734	Severe winter storms trigger landslides. $61.3M in Public Assistance was authorized along with $21.2M in Individual Assistance.
2009	DR 1817	Sever winter storms trigger flooding and landslide.

[7] Washington Department of Natural Resources (DNR), "WSG Recent Landslides" (2024): https://wadnr.maps.arcgis.com/apps/webappviewer/index.html?id=ef7ea514f7e54dde8cf1e8eefd2037b4

2011	DR 1963	Severe winter storms trigger flooding and landslides.
2012	DR 4056	Severe winter storms trigger flooding and landslides. $30.1M in Public Assistance was authorized.
2014	DR 4168	A slope along SR 530 in Snohomish County fails, bringing with it an entire neighborhood and killing 43 people. This is one of the deadliest disasters in Washington State History. There is a long history of landslides in this area and the tragedy leads the state to invest in a new landslide mapping program.
2017	DR 4309	Severe winter storms trigger flooding and landslides. $12.5M in Public Assistance was authorized.
2019	DR 4418	December 10 to December 24, 2018 - resulting from severe winter storms, straight-line winds, flooding, landslides, mudslides, and a tornado
2020	DR 4539	January 20 to February 10, 2020 - resulting from severe storms, flooding, landslides, and mudslides
2024	DR 4775	January 5 to January 29, 2024 - resulting from severe winter storms, straight-line winds, flooding, landslides, and mudslides

13.5 Probability of Future Occurrences

Due to the region's topography and geological conditions, the probability of landslides in King County will continue to be moderate to high in specific areas, especially following heavy rainfall, snowmelt, or other destabilizing events. As the climate warms, the frequency of heavy rainfall events and extreme weather may increase, leading to more frequent landslides, particularly in fire-impacted and urbanized areas.

13.6 Climate Change Considerations

Climate change is poised to significantly elevate the risk of landslides in King County, particularly in unincorporated areas, due to a combination of wetter winters, drier summers, and increased severe weather events. Projections indicate that more intense and frequent rainstorms will saturate soils, making them more susceptible to movement, especially along coastal bluffs and river corridors. As winter rains intensify, the saturation of soil increases the likelihood of landslides, particularly in steep, unstable slopes common in the region.[8]

Rising summer temperatures and drought conditions contribute to an increase in wildfires, which further destabilize the landscape. After wildfires, areas with exposed land—especially those with glacial soils—become highly vulnerable to erosion. The loss of vegetation results in denuded ground, depleting topsoil and exacerbating the risk of post-fire debris flows.

[8] King County DNRP, "Mapping of Potential Landslide Hazards along the River Corridors of King County, Washington" *River and Floodplain Management Section, Water and Land Resources Division, Department of Natural Resources and Parks* (2016): https://your.kingcounty.gov/dnrp/library/2016/kcr2783.pdf

Moreover, larger and more frequent storm events are expected to lead to increased flooding in Pacific Northwest rivers, which may cause significant channel migration and bank erosion. These changes can further destabilize steep slopes in river valleys, heightening the risk of landslides. While sea level rise is less of a concern in the river corridors of unincorporated King County, it can still accelerate erosion at the base of coastal bluffs, especially during high tides and storm surges, compromising the stability of these marginally stable landforms.

13.7 Impact Assessment

People	While the total number of people exposed to landslides is relatively small, and the risk of a rapid slope failure has tended to be low, many homeowners do not carry insurance to cover losses from landslide hazards. The total number of people exposed to the landslide hazard is unknown since landslide hazards are spatially limited and do not align with population information in Census data.
Responders	Most commonly, homes are isolated and ready access to communities by first responders is impeded by slide activity. Access to schools, businesses, and public services may be impeded by road blockages from slide activity. While no recent deaths or injuries have been reported in King County from land movement, the incident in Snohomish County referred to as the SR 530 Slide or the Oso Slide, 43 people were killed (2014).
Continuity of Operations	Most impacts to King County delivery of essential services are indirect. Roadways closed may impede the county work force from reaching work locations. Transfer stations for solid waste management and sewer lines and lift stations feeding the Metro South Plan, West Point Treatment facility or Brightwater facility may be impacted by slide activity. Only a small number of bus routes use roadways with the potential for impacts by slide activity. Slide activity has resulted in first responder access issues and diverted road and infrastructure maintenance resources. Resulting detours have also impacted the commute of essential workers to their normal work locations. Some slide activity has caused temporary access issues for solid waste transfer stations and to the Cedar Hills Landfill locations.
Property, Facilities, and Infrastructure	**Property** In total, 2.6 percent of structures in King County are identified as being within a landslide hazard area, resulting in an estimated $9.8 billion in exposed value. The City of Lake Forest Park has the highest percentage of structures exposed in a landslide hazard area at 16.4 percent. The cities of Bellevue and Seattle and unincorporated King County are estimated to each have over $1 billion of estimated exposed value within landslide hazard areas. The slopes of Magnolia, West Seattle, Burien, Des Moines, Vashon Island, Newcastle, Federal Way and many areas of Bellevue have long been developed for their magnificent views of Mount Rainier, the Cascade and Olympic Mountains, and Puget Sound. Homes with vistas of the Olympic Mountains provide sunsets that are breathe taking – and expose a risk of land movement damages to property build on poor soils.

Homes built above, on, or below bluffs or slopes. Homes built on bluffs or other slopes apply addition weight to a slope and increase the likelihood of slope failure. Homes built below bluffs have also been destroyed by slope failure. Transportation corridors, including on I-90 and Seattle-Everett BNSF rail line. Transportation routes are often cut through steep areas or travel through valleys with a history of landslides.

Facilities
No special impacts to health systems are expected from this hazard.

Infrastructure

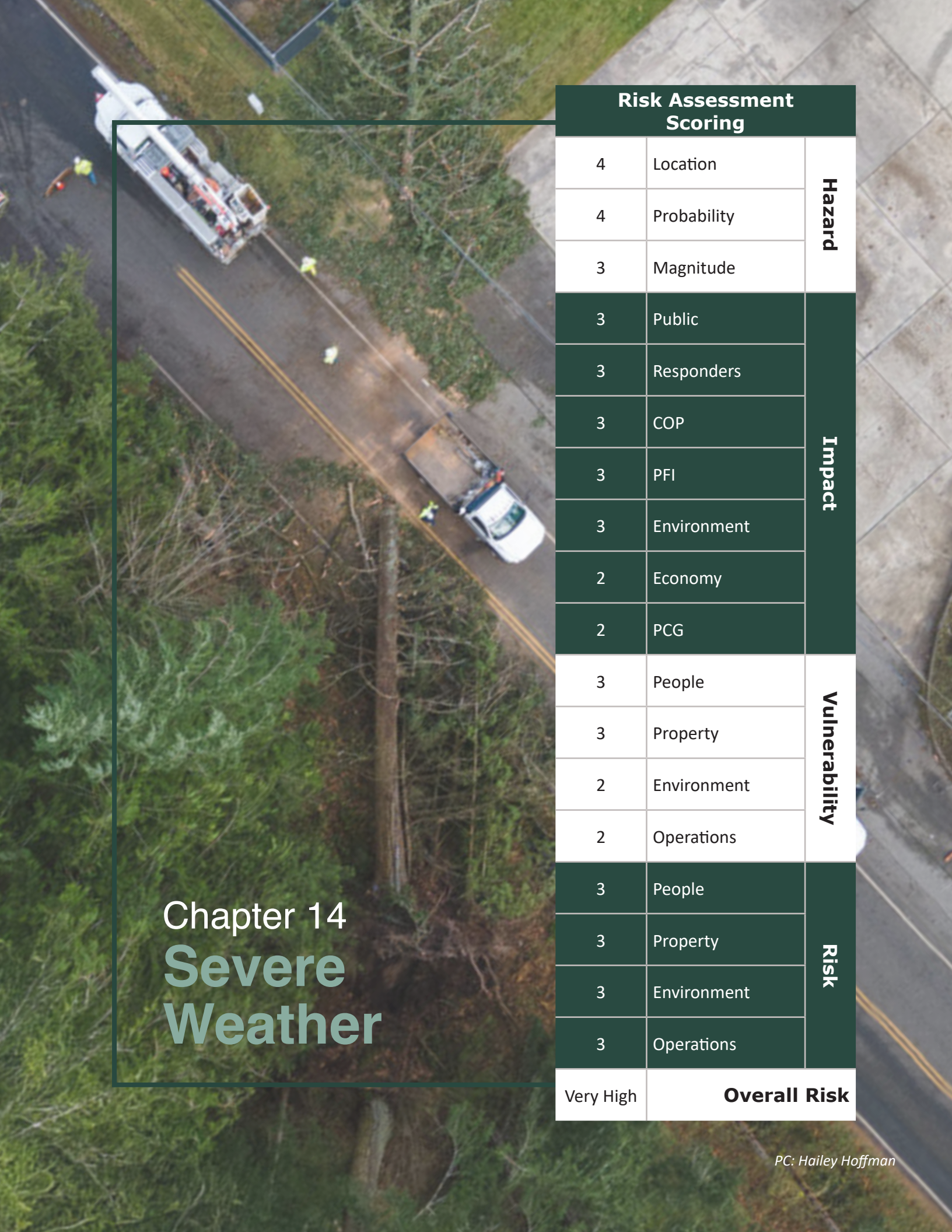
- Power: Landslides pose some risk to transmission lines that cross unstable slopes. Otherwise, landslides are not a primary concern for this sector.
- Water/Wastewater: Landslides or debris flows in and around reservoirs or waterbodies that support water systems can cause disruptions in water services and the loss of infrastructure. Water supply pipelines may cross unstable areas and be damaged by slope movement. Even if not directly impacted by earth movement, systems that pull water directly from impacted waterbodies will have to deal with increased turbidity or a loss of supply if the water is temporarily cut off by earth damming or rerouting a river. Finally, failures in water system transmission mains can actually saturate a slope and trigger landslides.
- Transportation: Transportation routes can be closed for long periods by landslides and rockslides. The following are some documented incidents. In November 2008, State Road 410 was closed as the result of a debris flow east of Enumclaw. A landslide caused damage to the Green River Bridge on State Route 169 that resulted in the bridge being closed for repairs for eight months. These incidents resulted in SBA loans to impacted businesses. In May 2005, 11 homes were isolated after a small slide on Mercer Island. That September, two lanes of I-90 west of Snoqualmie Pass were closed after a rockslide. A January 15, 1997 slide at Woodward in southern Snohomish County derailed five cars of a freight train. Passenger and cargo rail traffic was interrupted for nine days. Cargo traffic resumed first. Amtrak remained concerned for passenger safety and did not travel on this section of track for several weeks. This type incident can happen almost annually and sometime more than once each year.
- Communications: There is limited risk to communications systems as a whole from landslides. Given the redundancy in systems and proliferation of cell towers, which tend to be less vulnerable, landslides are not a primary concern.

Environment	Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods of time due to landslides. However, landslides also provide integral resources for many ecosystems. They contribute needed gravel and sediment or wood for building complex in-stream habitats, estuarine marshes, and beaches that are important for fisheries, wildlife and recreation. The Cedar River was partially dammed by slide debris from the Nisqually Earthquake in 2001. Similarly, in March of 2004, a landslide near Renton partially dammed the Cedar River again. All major rivers in King County support salmon and/or steelhead spawning populations. **Vegetation removal** Vegetation removal due to logging, land development, view clearing, or wildfire reduces the root strength that often anchors and reinforces shallow soils. Shallow landslides often increases following vegetation removal and if debris from such a slide enters a hillside swale it may transition into a debris flow that can have devastating impacts far below and distant from the initial failure. **Coseismal landsliding** This Risk Profile addresses primarily landsliding for which our region has significant collective experience. This includes of landslides triggered by weather events and human disturbance. Geologic evidence is clear that this region is subject to earthquakes from several sources larger than those that have been well documented in the historical record. Widespread landsliding is likely to be a secondary but significant and potentially catastrophic consequence of a future occurrence of such a large earthquake.
Economic	There have been direct and indirect impacts to the greater King County community from landslide activity. Residential housing in the greater Puget Sound area that have been built to enjoy the spectacular mountain of the Olympics and Cascade ranges and water views of Lake Washington, Lake Sammamish, and Puget Sound are vulnerable to land movement. Loss of transportation can also have economic impacts. In November 2008, State Road 410 was closed as the result of a debris flow east of Enumclaw. A landslide caused damage to the Green River Bridge on State Route 169 that resulted in the bridge being closed for repairs for eight months. These incidents resulted in SBA loans to impacted businesses. The SR 530 Oso landslide caused a complete reroute of the main highway between Everett and Darrington, devastating the local economy and forcing residents to commute several hours longer to work each day.
Public Confidence in Governance	The 2014 SR 530 Oso landslide demonstrated some of the major weaknesses in emergency management capabilities. It also demonstrated a lack of regulation and foresight on the part of government in the permitting of development in the area, which was a known slide area. Local critical areas ordinances do require mitigation for construction in slide hazard areas, but in the Oso slide,

	this proved to be inadequate. A failure by developers, the government, and residents to properly account for slide risk and protect people from it led to multiple lawsuits and a general lowering of public confidence in government's ability to properly regulate land development.

13.8 Vulnerability Assessment

Vulnerable Populations	People who live or travel through landslide-prone areas are at significant risk, especially those who engage in outdoor recreation. The vulnerability of recreational areas depends on the history of the trail, its maintenance, and recent weather events that could trigger instability. In King County, low-income communities, such as those near Renton along the Maple Valley Highway, are particularly at risk from larger landslides. These areas, which may lack the resources to properly mitigate landslide threats, could face substantial damage.
Property	Properties located on or below bluffs or steep slopes are particularly vulnerable to landslides. Homes built on these elevated areas contribute additional weight to the slope, which can destabilize the soil and increase the likelihood of slope failure. The added pressure from the structure, combined with factors such as heavy rainfall or seismic activity, can trigger a landslide that may lead to significant damage. Properties built below bluffs are also at risk, as the downward movement of the slope can result in devastating consequences, including the destruction of homes and infrastructure.
Environment	Landslides create lasting damage to both terrestrial and aquatic habitats. The loss of vegetation and the influx of debris into streams can disrupt ecosystems, displacing wildlife and degrading water quality. The recovery process is slow, often taking years for vegetation to return and stream habitats to stabilize. In the meantime, affected species face significant challenges, and the overall health of the ecosystem may be compromised for an extended period.
Operations	Roads, bridges, and transit systems are highly susceptible to landslides. Major transportation routes, including I90, and Seattle-Everett BNSF rail line go through steep valleys with historic landslides can be blocked or damaged during a landslide, disrupting the daily flow of traffic and emergency services.



Chapter 14
Severe Weather

Risk Assessment Scoring		
4	Location	Hazard
4	Probability	
3	Magnitude	
3	Public	Impact
3	Responders	
3	COP	
3	PFI	
3	Environment	
2	Economy	
2	PCG	
3	People	Vulnerability
3	Property	
2	Environment	
2	Operations	
3	People	Risk
3	Property	
3	Environment	
3	Operations	
Very High	**Overall Risk**	

PC: Hailey Hoffman

Chapter 14: Severe Weather

14.1 Hazard Description

King County experiences a large variation of severe weather events that has the potential to impact the entire region. Severe weather can include extreme heat events, winter storms, heavy rainfall, and strong winds. These weather events are categorized as follows:

- **Extreme heat,** including heatwaves, are periods of high heat and humidity with temperatures above 90 degrees Fahrenheit for at least two to three days.
- **Drought** is defined by Washington state statute as below 75% of normal water supply for a given area.
- **Extreme cold**, also classified as a winter storm, is a storm having significant snowfall, ice, and/or freezing rain; the quantity of precipitation varies by elevation.
- **Heavy precipitation** refers to instances during which the amount of rain or snow experienced in a location substantially exceeds what is normal.
- **High wind** is a storm sustaining wind speeds greater than 39 miles per hour. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds.
- **Tornados** are violently rotating columns of air touching the ground, usually attached to the base of a thunderstorm. Wind speeds start at 65 miles per hour and can reach 300 miles per hour. It is not unusual to have funnel clouds spotted during the winter season.

Severe weather events can lead to secondary hazards and cascading impacts. For instance, heavy precipitation can cause flooding and landslides, resulting in road closures and property damage. In rural or suburban areas, high winds can knock down trees and powerlines, leading to extended power outages and road blockages. In urban areas, extreme heat or cold may disproportionately affect the unsheltered population and families with limited resources, particularly those without access to heating or cooling systems.

As the climate continues to change, many but not all of these events are expected to become more frequent, intense, and prolonged, increasing the risk of widespread impacts across the county.

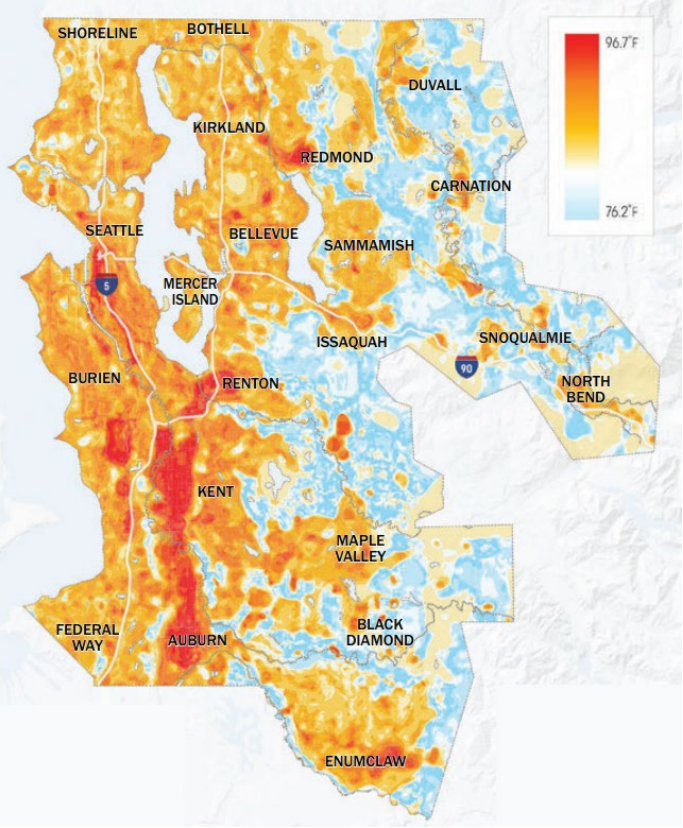
14.2 Location

King County's geographic location, bordered by Puget Sound and the Pacific Ocean to the west and the Cascade Range to the east, plays a key role in shaping its climate. The region is heavily

influenced by maritime atmospheric conditions, with the mountains acting as natural barriers that trap-in in moisture. As moist air is forced upward by the Cascades, it cools and condenses, leading to heavy precipitation on the windward side of the mountains. In addition to its natural climate influences, the region is home to numerous urban centers and transportation networks that feature impermeable surfaces, which contribute to the urban heat island effect.

Extreme Heat

Figure 14-1 King County Heat Island Map[1]



Hotter summer temperatures affect everyone in King County. However, the impacts of that heat are not felt equally. Figure 14-1 shows the county's surface temperatures with red and orange indicating hot areas and blue indicating cool. These elevated surface temperatures are a result of the "urban heat island" effect, where there is a concentration of pavement and heat retaining material that result in higher surface temperatures compared to their surrounding areas.

Drought

Washington State approaches drought emergencies from the perspective of water supply, which can affect the entire county. This includes residents and businesses who depend on local water resources and well as farmers and landowners who use water resources for irrigation. A key factor contributing to drought in this region is reduced snowpack in the Cascades. The snowpack acts as a critical source of runoff that feeds our watersheds and replenishes reservoirs. While there is a slight projected increase in winter precipitation, the main driver of declining snowpack is that more of this precipitation is falling as rain rather than snow due

[1] King County Executive Climate Office (ECO), "King County Extreme Heat Mitigation Strategy" (July 2024): p. 6, https://cdn.kingcounty.gov/-/media/king-county/depts/executive/climate-office/documents/c2-240802_13570m_kc-extreme-heat-strategy_prnt.pdf?rev=2cceaee431a14df29323d98bd817cfe5&hash=2C0B0D0227F7100C58DF612DB2351820

to rising temperatures. This shift, combined with hotter, drier summers, reduces the amount of snowmelt available in spring and summer, ultimately exacerbating drought risk.

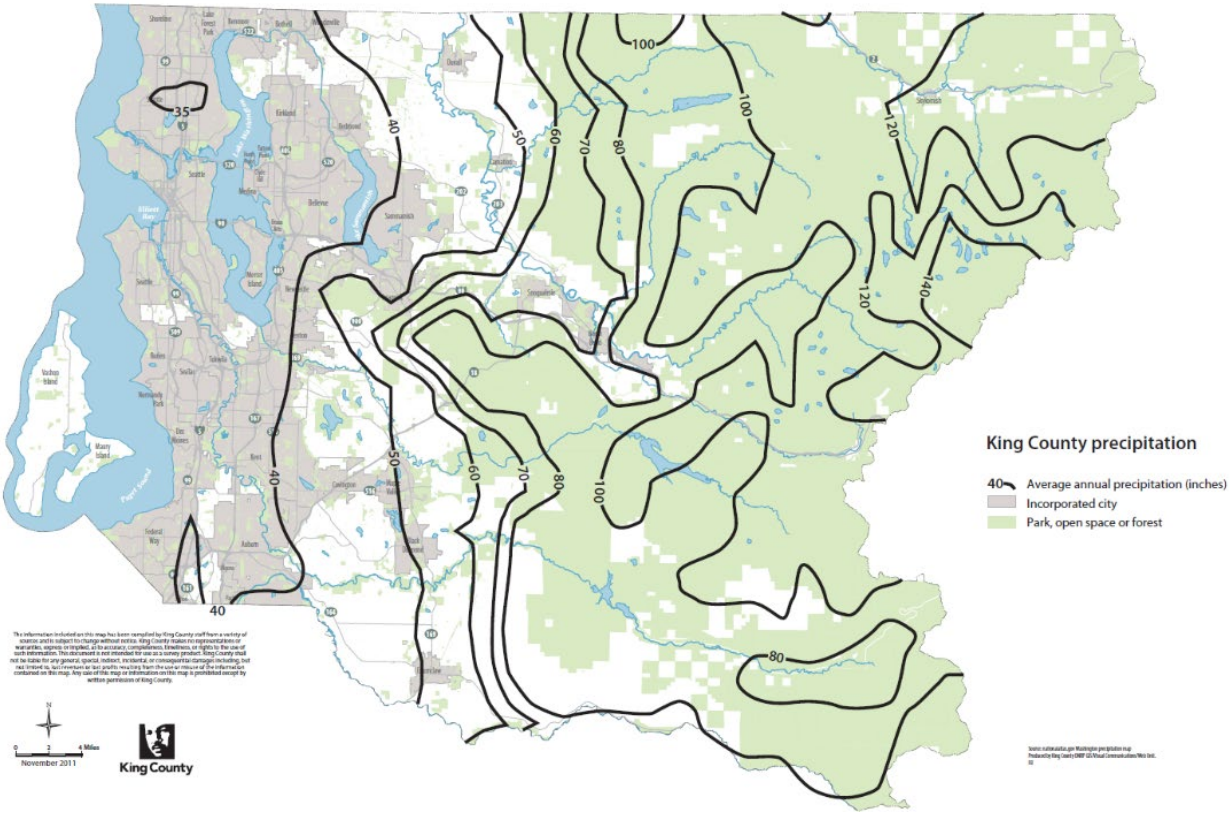
Winter Weather

King County's marine climate, that maintains relatively mild temperatures, results in very few extreme cold weather events. Snow accumulation at elevations below 2,000 feet is considered rare, and when snowstorms do occur, they usually last less than two days. However, since 1990, King County has experienced an increasing frequency of prolonged cold spells. These events, which generally last 10 to 14 consecutive days, typically occur in January or February each winter. The heavy snowfalls and accompanying cold conditions often lead to power outages, disruptions to transportation systems, school closures, and significant economic impacts on the region.

Heavy Precipitation

Though known for being wet, the Seattle metro area has around the same average annual precipitation as Dallas, Texas, and much less than New York City, Houston, Atlanta, or New Orleans. Higher amounts of rainfall occur as you move closer to the Cascades. King County owes its mild climate to the influence of Puget Sound and the Pacific Ocean, which moderate the climate, and to the protective barrier of the Cascade Mountain range, which blocks cold air from the interior.

Figure 14-2 King County Precipitation Map



Rainfall in King County varies widely from city to city and area to area. The City of Seattle has an average of 37 inches annually, while Enumclaw has an annual average of 57.9 inches and Snoqualmie/North Bend has 61+ inches of precipitation. The majority of this precipitation occurs as rain in the lowlands between October and early May with substantial snowpack in the Cascades during the same time frames. Precipitation on Snoqualmie Pass in the unincorporated community of Hyak (2800 feet) average 410 inches of snowfall from October to May.

High Wind and Tornados

High wind events are common in King County, especially during winter, with gusts frequently reaching 40-45 mph and severe winds surpassing 90 mph. Certain areas of the county are more prone to these events due to their geography and location relative to wind patterns.

The north Puget Sound region, particularly areas along the Strait of Juan de Fuca, regularly experiences high winds during the winter. In certain conditions, the Strait acts as a wind funnel, accelerating winds as they move eastward toward the interior of the region. Areas closer to the water, such as Edmonds, Mukilteo, and Everett, are often more affected by these powerful gusts.

The build-up of high pressure east of the Cascades can trigger strong windstorms that surge through lower passes in the Cascades, including Stampede Pass. These winds often impact communities located to the east of the mountains, such as Enumclaw, which routinely experiences strong winds due to its proximity to these wind corridors. The Enumclaw area, with its elevated position on the foothills of the Cascades, is especially susceptible to wind gusts that can reach up to 70-80 mph.

Other parts of King County, such as the higher-elevation areas in Snoqualmie Pass and parts of the foothills surrounding the Cascades, can also experience gusty winds, particularly when a low-pressure system interacts with the mountainous terrain. During these systems, southerly winds are often funneled between the Olympic and Cascade Mountains, creating a wind tunnel effect that can intensify gusts in the lowlands. Additionally, south of Seattle, areas like Federal Way and Fife can experience localized wind events as gusts push through the lower valleys.

14.3 Magnitude

Severe weather events in King County have the potential to cause significant disruptions, posing both immediate and long-term risks to infrastructure, the economy, and public safety. High winds, which can exceed 100 mph during certain storms, are a frequent cause of power outages, road closures, and structural damage. The region also experiences intense heat, with temperatures occasionally surpassing 110°F, and extreme cold, with lows dipping below -40°F, although these cold extremes are rarer.

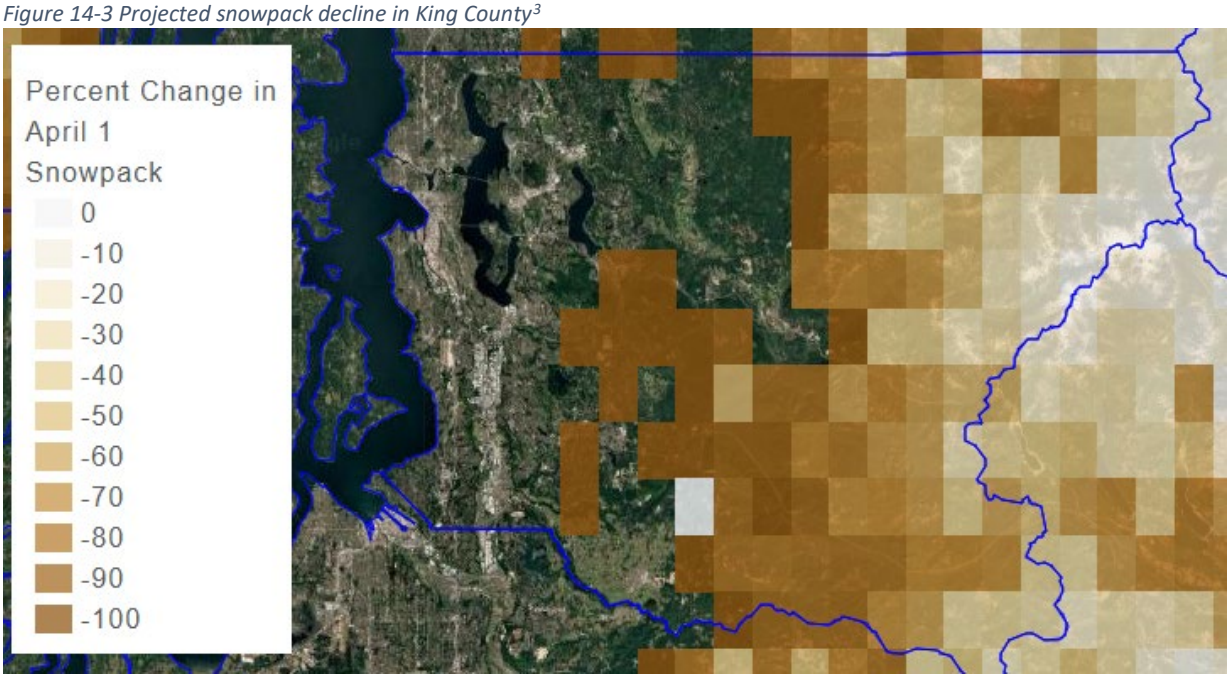
Extreme Heat

Extreme heat is the number one cause of weather-related fatalities nationally. Current annual losses in Washington State due to heat-related illness and heat-associated traumatic injury, death, and productivity losses are calculated to be between $111 to $153 million annually. By 2030, heat-related losses in labor productivity alone are projected to reach around $100 billion annually nationally. A major factor that contributes to heat-related impacts is the fact that many residents lack efficient cooling systems in their homes or businesses. A 2015 American Housing Survey data shows that only 33.7% of Seattle area homes have air conditioning. For those aged 65 and older, the percentage only jumps slightly, to 37%.[2]

Drought

Figure 14-3 shows the model median for projected percent change in April 1st snowpack over a 30-year period compared to the 1980-2009 average. April 1st snowpack is an important indicator of water stored in snow that will be available during the melt season. The brown areas on the map indicate where snowpack is expected to decrease, with the most significant decline projected for lower elevations in the Cascade Mountains.

Figure 14-3 Projected snowpack decline in King County[3]



[2] Seattle Office of Emergency Management (OEM), "Excessive Heat Events" City of Seattle CEMP – SHIVA (n.d.): p 9-6, https://www.seattle.gov/documents/Departments/Emergency/PlansOEM/SHIVA/SHIVAv7.0-Heat.pdf
[3] UW Climate Impacts Group (CIG), "Climate Mapping for a Resilient Washington" *University of Washington* (n.d.): https://data.cig.uw.edu/climatemapping/

In the event of drought, the combined effect of reduced snowpack and warmer temperatures can lead to severe water shortages, impacting agriculture, communities, and wildlife, including fish and salmon. King County's dependence on hydroelectric dams further complicates this issue, as drought could affect the availability and cost of electricity, potentially leading to planned power outages (brownouts) during severe conditions. These changes can have serious consequences, including higher mortality rates for salmon and steelhead due to elevated water temperatures and low river flows, negative impacts on local crops and livestock, and increased health risks, such as heat stress-related emergency room visits. As drought becomes more common in the Northwest, driven by variable rainfall patterns and rising temperatures, the risk of wildfires also increases, further exacerbating the challenges for King County.

Winter Weather

King County is also vulnerable to extreme winter conditions, with heavy snowfalls and ice storms disrupting transportation, power, and emergency services. While the region typically receives moderate snow, events like the 2008 winter storm can paralyze the area for extended periods, particularly in hilly communities such as Skyway, where limited resources exacerbate the effects of severe weather. Given the rarity of extreme snow events, King County maintains a relatively low budget for snow removal services. When major incidents do occur, vehicles and drivers can be stranded almost anywhere in the county. Transportation impacts to buses, trains, roads, bridges include snow routes, shelter needs, and power outages. The December 26, 1996 storm lasted 11 days. Multiple consecutive freezing days can threaten the lives of unsheltered and lower-income individuals, requiring the opening of additional shelter beds or more heating assistance funding.

Heavy Precipitation

Intense precipitation is the primary cause of both river and urban flooding in King County. Areas such as Snoqualmie, Auburn, and White River are particularly vulnerable to frequent flooding following rain events. The larger, more destructive floods are often driven by **atmospheric rivers**—narrow bands of concentrated water vapor in the atmosphere that can bring significant rainfall and snow. The Pineapple Express, a type of atmospheric river, is a common source of severe weather, where moisture picked up from warm areas of the Pacific Ocean near Hawaii is carried by the jet stream and releases as intense precipitation when it rises over the Olympic and Cascade Mountains. These atmospheric river events are major contributors to river flooding in King County.

Heavy rainstorms also lead to urban flooding, stressing the stormwater infrastructure and affecting ground-floor structures and basements. This can cause widespread damage and pose a risk to public safety, particularly in areas ill-equipped to manage such intense rainfall.

High Wind

High wind events are common in King County, especially during winter, with gusts often reaching 40-45 mph and severe winds surpassing 90 mph. From the north Puget Sound region during the winter season, the Strait of Juan de Fuca can also act as a wind funnel in the right conditions. High pressure build-up in east of the Cascades can also cause strong windstorms that surge through areas like Stampede Pass and the area immediately below it, Enumclaw.

These intense wind events often lead to widespread power outages, road and bridge closures, tree damage, airport disruptions, and risks such as carbon monoxide poisoning and injuries to utility workers, first responders, and the public. Notable examples of such events include the Inaugural Day Windstorm on January 19, 1993, which saw winds exceed 90 mph in downtown Seattle, and the Hanukkah Eve Windstorm on December 15, 2006, which caused significant damage to the Seattle area power grid, leaving hundreds of thousands without power for weeks.

November 20, 2024 bomb cyclone aftermath

A particularly severe event occurred on November 19, 2024, when Washington's Puget Sound region was struck by an unprecedented severe windstorm, colloquially referred to as a "Bomb Cyclone." This event was the result of rapidly intensified storm that experienced a dramatic drop in atmospheric pressure by 64 millibars in just 24 hours. This storm generated powerful east to southeast winds, with wind gusts in the Seattle Metropolitan Area reaching 50–60 mph, while mountain areas saw gusts surpassing 70 mph. This intense storm caused widespread destruction across King County, uprooting trees, downing powerlines, and leaving approximately 520,000 customers without power. King County was the most severely affected jurisdiction, with preliminary damage assessments estimating total losses at $17 million. The storm also prompted a tornado warning and led to the sighting of a waterspout along the southwest coast of Washington.

Tornado activity is relatively rare in the Pacific Northwest, but it has been recorded in the region, including an EF1 tornado in Enumclaw in September 2009. Despite wind speeds reaching up to 110 mph, the most significant damage was caused by uprooted trees and roof damage, largely due to

the preceding storm. Tornadoes are uncommon in the Puget Lowlands, though several have been recorded. The Enhanced Fujita (EF) scale, which rates tornadoes from EF0 to EF5 based on wind speed and damage, has noted tornadoes as strong as EF3 in the Puget Sound area.

14.4 Previous Occurrences

The majority of disaster declarations in King County are from severe weather events. Disasters are usually declared for a combination of winter storms, mudslides, heavy rains, and straight-line winds. The primary impacts and costs triggering these declarations include emergency protective measures for, and damage to, utilities, roads, and bridges, and for costs associated with debris removal. A recent example is the June 2021 Pacific Northwest Heat Dome, an event made 150 times more likely because of climate change. The 2021 Heat Dome currently stands as the single most deadly climate disaster event in Washington State with more than 125 reported heat related deaths statewide, including 34 deaths in King County.

Table 14-1 Major Weather Disaster Declarations including King County

Date	Hazard	Description
November 2006	Rain Storm	This event saw unusually intense rainfall in a short period, leading to rapid runoff and increased flooding risks across King County. The heavy rains overwhelmed the region's stormwater systems, causing localized flooding in urban areas and exacerbating existing river flood conditions.
December 2006	Windstorm	Hannukah Eve - Unusually intense levels of rainfall in a very short period of time were immediately followed by very heavy winds up to 69 miles per hour that felled power poles and large, mature, healthy trees. The storm overwhelmed Seattle City Light when 49% of its customers lost power. 95% of customers were restored within two days, but full restoration took a week
July 2009	Excessive Heat	On July 29, 2009, the temperature reached 103åt SeaTac airport, an all-time record. Two people in Western Washington died. The most brutal temperatures lasted three days.[4]
August 2015	Windstorm	The strongest August windstorm on record hit Western Washington, with winds of 50-60 mph (46 mph at

[4] Seattle Office of Emergency Management (OEM), "Excessive Heat Events" *City of Seattle CEMP – SHIVA* (n.d.): p 9-4, https://www.seattle.gov/documents/Departments/Emergency/PlansOEM/SHIVA/SHIVAv7.0-Heat.pdf

		SeaTac). Almost half a million people lost power, two people died from falling trees, two people died from carbon monoxide poisoning, and four people were injured.
August 2015	Excessive Heat	Seattle's hottest summer on record. The average high temperature was 80.2 degrees Fahrenheit. July had 10 days with high temperatures in the 90s.
January 2019	Winter Storm	The hefty snowfall (a daily record) bumped the city's monthly snowfall total to 20.2 inches, making February 2019 Seattle's snowiest month in a half-century.
June 2021	Excessive Heat	Between June 26 and July 2, 2021, an extreme heat event caused by a "heat dome" descended upon the Pacific Northwest, setting 128 all-time high temperature records across Washington state and killing 126 Washingtonians due to heat-related causes according to official estimates.[5] This includes 34 deaths in King County.[6]
December 2023	Rain Storm	An atmospheric river event brought intense rainfall to King County, significantly impacting local rivers, streams, and urban drainage systems. This atmospheric river caused widespread flooding and river overflow, leading to property damage, transportation disruptions, and power outages.
November 2024	Windstorm	A bomb cyclone struck King County in November 2024, causing widespread damage. This intense storm system rapidly intensified, resulting in high winds, heavy rainfall, and flooding. It caused power outages for over 520,000 customers and left an estimated $17 million in damages.

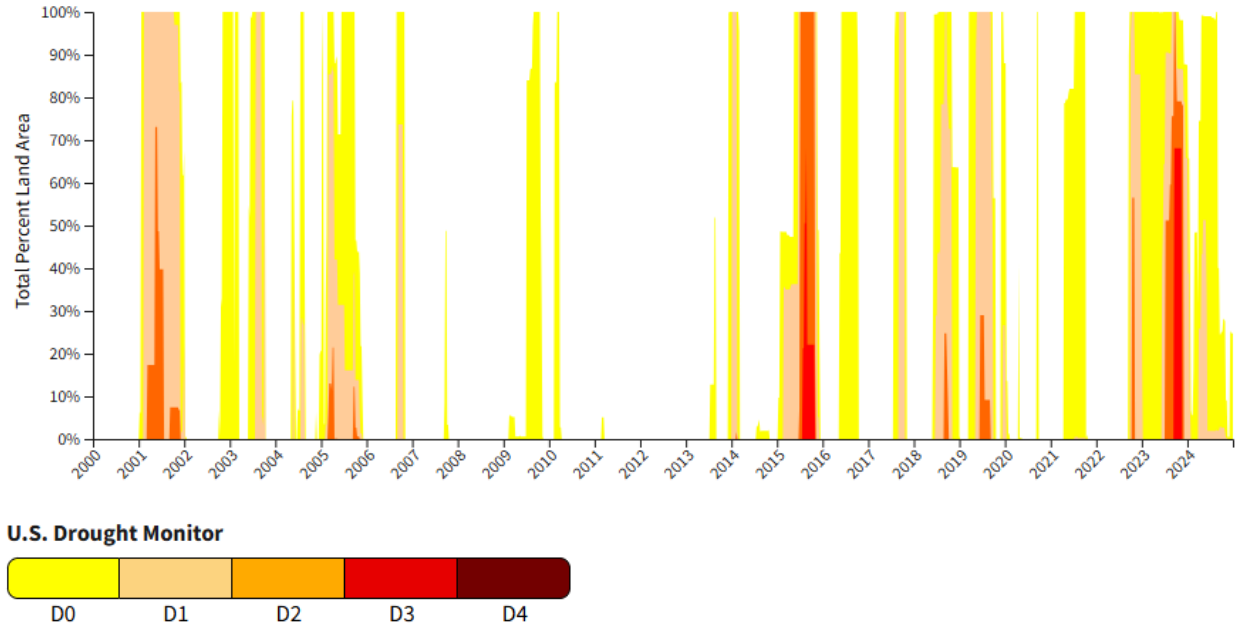
According to the US Drought Monitor, King County has experienced an increasing frequency of moderate to extreme drought conditions over the past two decades. These conditions have become

[5] UW Climate Impact Group (CIG), "In the Hot Seat: Saving Lives from Extreme Heat in Washington State" *University of Washington* (2023): p. 1, https://cig.uw.edu/wp-content/uploads/sites/2/2023/06/CIG-Report-Heat-202-pages.pdf

[6] King County Executive Climate Office (ECO), "King County Extreme Heat Mitigation Strategy" (July 2024): p. 5, https://cdn.kingcounty.gov/-/media/king-county/depts/executive/climate-office/documents/c2-240802_13570m_kc-extreme-heat-strategy_prnt.pdf?rev=2cceaee431a14df29323d98bd817cfe5&hash=2C0B0D0227F7100C58DF612DB2351820

more pronounced in recent years, with significant spikes in extreme drought levels observed in 2015, 2019, and 2023. These periods of drought have been driven by a combination of low snowpack, reduced rainfall, and higher-than-average temperatures, which have led to decreased water availability in streams, rivers, and reservoirs.

Figure 14-4 Historic drought conditions for King County[7]

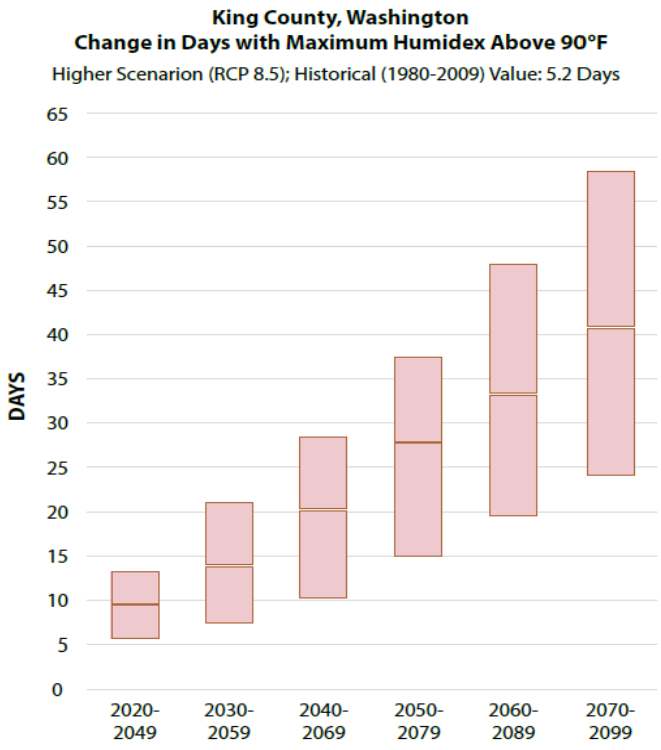


14.5 Probability of Future Occurrences

King County is projected to experience significant changes in weather patterns due to climate change, particularly with regard to extreme heat and precipitation. All climate scenarios predict hotter summers in the region. By the 2080s, the average maximum summer temperature is expected to increase by 10.5°F (with a range of 7.4°F to 13.0°F). The number of days above 90°F will also rise substantially, with projections indicating a median of 41 days per summer by the 2080s. Additionally, nighttime temperatures are expected to increase, which is concerning from a public health perspective. Nights with a humidex above 65°F are projected to occur 45 more nights (with a range of 18-71 days), which can exacerbate heat-related health risks.

[7] NIDIS, NOAA, "Drought Conditions for King County" *The U.S. Drought Monitor* (2024): https://www.drought.gov/states/washington/county/King

Figure 14-5 Projected change in frequency of extreme heat events in King County[8]



In addition to extreme heat, King County is likely to experience a decrease in summer precipitation, intensifying drought conditions. While projections for rainfall are more uncertain due to the natural variability of weather patterns in the Northwest, the projections points to wetter winters and drier summers in the future. This shift in seasonal precipitation could increase the risk of landslides, as more rain in the winter may lead to greater soil saturation. Furthermore, heavy precipitation events are expected to become more intense, with a projected 14% increase in intensity by the 2050s and up to 30% by the 2080s. This is driven by warmer air, which can hold more moisture, resulting in the potential for more intense rainfall events. These changes in temperature and precipitation highlight the need for adaptive strategies to address the increased risks of extreme weather events in the coming decades.

14.6 Climate Change Considerations

Climate change is a significant concern for King County, as it is expected to alter the frequency, intensity, and severity of extreme weather events in the region. These changes are projected to result in hotter, drier summers and an increase in heavy rainfall events, which could lead to a range of hazardous consequences, including floods, landslides, avalanches, droughts, and wildfires. The economic impacts of these events could be severe, as communities are often unprepared for such extreme weather.

In addition to the economic consequences, extreme weather events also pose a threat to public health. For example, if global temperatures rise by 5.4 degrees Fahrenheit over pre-industrial levels, some climate scenarios suggest that extreme heat events could result in hundreds of deaths in the

[8] UW Climate Impacts Group (CIG), "Climate Mapping for a Resilient Washington" *University of Washington* (n.d.): https://data.cig.uw.edu/climatemapping/

Seattle area alone.[9] Public health sensitivity to heat events is especially high in the Puget Sound region due to the lack of widespread air conditioning. In response, Public Health Seattle-King County has plans to activate cooling centers and issue public messaging during multiple days of heat in the mid-80s. While global trends show a decrease in the number of cold events since 1950, some areas in the Northern Hemisphere, including parts of the U.S., have experienced an increase in extreme cold since 1990, potentially linked to changes in the polar vortex.

14.7 Impact Assessment

Below offers an overview on the impacts from severe weather events. Additional details on impacts for each type of severe weather event are provided under 14.3 Magnitude.

Public	Anyone present in King County at the time of a weather incident is subject to the potential impacts of severe weather incidents. While the likelihood of a winter weather incident is high, the likely of direct and significant impacts is Moderate. Impacts to residents may include personal property damages, interruption of sports and recreation, extension of the daily business commute, impacts to daycare and school closures, injuries, and sheltering needs from power outages. Avalanche control may be needed to reduce the impact to alpine and cross-country skiing enterprises. Injuries and deaths do occur from avalanche impacts to recreational skiers. Impacts from drought take time to materialize as water shortage cause restrictions to water usage and issue of burn bans to reduce the threat of wildfires, especially in suburban areas. Only the most severe weather incidents have an impact on local employment.
Responders	Portions of the population may be stranded or isolated from the results of severe weather, like roads blocked by trees and power lines, snow- and ice-covered roads, water or slides over roadways. Closure of the mountain passes for heavy snow conditions or avalanche control is a fairly common occurrence.

[9] Evan Bush, "Seattle unprepared for deadly heat waves made worse by global warming, researchers say" *The Seattle Times.* (June 14, 2019): https://www.seattletimes.com/seattle-news/environment/heat-waves-could-kill-hundreds-more-in-seattle-as-globe-warms-researchers-say/.

	Excessive heat that extends over days or weeks or cold conditions for similar timeframes may result in the need for cooling or warming shelters. These especially impact the poor, elderly, young, and infirmed. First responders will be impacted by limited road access, impacts of heat and cold on operations. Conditions will require monitoring efforts during incident response.
Continuity of Operations	During the February 2019 snowstorm, King County took the unprecedented step of closing many government offices to protect employee safety. After two days, due to the growing amount of snow and the need to resume services, offices were reopened. Even with the reopening, many employees chose to telework due to safety concerns. An earlier activation of the EOC for the 1996 snow/ice storm saw activations for 11 days – 2 shifts per day when 16 inches of snow came and stayed for weeks. During that time frame, buses were on snow routes, up to 40% of the employees for King County government were either unable to get to work or arrived very late. A major improvement from 1996 to 2019 is that it is now much easier to telework, meaning that non-public-facing positions can work remotely for days. Hospitals, courts, detention facilities, businesses, law enforcement, fire and emergency medical services were all severely impacted. Search and Rescue volunteers transported medical personnel, emergency management staff, and other essential employees to work and between hospitals for the duration of the incident. During the February 2019 snowstorm, busses were on the most restrictive service routes ever seen. These routes were established in response to previous snow events. Similar impacts were observed for the January 2011 snow storm that impaired King County government operations for 8 days. Some damages were experienced at crucial facilities around the county. See FEMA Disasters 1079 and 1817 above. The recent February 2019 snowstorm did not receive a disaster declaration. During that time frame, most regional public services were impacted by absenteeism, access restrictions to critical facilities, and damage to vehicles like buses, police cruisers, and aid units. Busses and other vehicles that use tire chains are especially vulnerable to breaking down, which can delay a return to full service, even once the snow has melted.
Property, Facilities, and Infrastructure	**Property** All structures in the county are subject to the direct impacts of severe weather incidents. These same structures are subject to flood impacts

where they may be in the flood plain. Structures along the coastline (seawalls) may be eroded. Local urban flooding also occurs from storm debris clogged sewers.

High winds that accompany winter weather fronts often cause infrastructure damages, power outages, and communications interruptions. Rain saturated soils may cause mudslides that close roadways, damage bridges, and buried rail service interruptions

Private property damages to homes and vehicles from floods, trees downed from wind and saturated soils are regular occurrences. Private property experiencing repeated flood damages may require elevation of the structure or offers of buy outs (mitigation efforts).

High winds, snow, and icy conditions can close airports or cause flight delays and rerouting. Mountain pass conditions may be so severe that they are closed to all traffic for days at a time. The floating bridges over Lake Washington (I-90 and SR 520) experience closures for sustained winds over 45 miles per hour. These closures extend the business commute with increased traffic on surface streets and routes around Lake Washington.

Impacts to emergency medical services from impacts to the roadways of the county can delay response times, restrict emergency room staff and supplies, and result in under staffing EMS and hospitals during severe weather emergencies.

Facilities

Severe weather disrupts the regular schedule of patient visits and regularly-scheduled appointments for chronic care. Severe weather also can cause more demand on the health system as people are injured or are unable to leave the hospital to return home. Any disruptions to electricity and water supply also can be a threat, though hospitals generally maintain backup generators.

During severe cold or warm spells, public health may be required to provide additional patient transport services and to canvass for homeless populations that may be in need of shelter. During the February 2019 snowstorm, hospitals suffered major staffing shortages as doctors and nurses were unable to get to work. Staff had to work longer than normal hours and potentially stay temporarily at or near the hospital.

Although both requiring the expansion of sheltering services, heat and cold differ because older and less health populations are especially at risk to hot temperatures. One of the most famous examples is the 1995 Chicago heat wave, during with 739 people lost their lives, with the city unprepared to provide support to residents who may be home bound or offer sufficient cooling centers to support residents. In Seattle, where few residents have air conditioners, deaths from heat events are a growing threat.

Infrastructure

- Power: Downed trees caused by high winds and rain saturated soils can damage transmission lines and cause power outages in local areas for hours to days when multiple occurrences are experienced. Utility crews from Puget Sound Energy, Bonneville Power and Seattle City Light work around the clock to restore services. The Inaugural Day Windstorm left 750,000 customers without power. The Hanukkah Eve Windstorm winds and subsequent heavy rains cut electricity to more than 1.8 million customers, hundreds of thousand remained without power for days. Downed power lines pose an electrocution hazard to motorists, pedestrians and any unsuspecting by-standers. During extremely hot temperatures, demands on the power system can increase, especially as more residents install air conditioning. As a winter-peaking system, however, this power demand will still likely be lower than current winter demand.
- Water/Wastewater: Water and wastewater systems are vulnerable to a multi-day loss of power as well as to serious flooding. In February 2017, as a result of heavy rains, high tides, and other severe weather, an equipment failure at King County's West Point Wastewater Treatment Plan led to the dumping of over 235 million gallons of untreated wastewater into Puget Sound. Drought can also impact water systems as water levels in reservoirs and groundwater wells drop.
- Transportation: Events that impact transportation can include severe snow, ice, wind, and rain. Storms may cause downed trees and snow or ice that temporarily blocks roadways or can cause large floods that can wash out or undermine roads and bridges. For many parts of the state and county, such as around the town of Skykomish, the loss of a single route due flooding can completely cut the community off from the rest of the county. This is especially a problem in the eastern parts of the

	county that are more rural and have fewer transportation route options. • Communications: Systems can be knocked out by high winds or loss of power transmission. While the move to cell phones has reduced the vulnerability of telephone lines to outage caused by trees, a multi-day loss of power can still shut down a cell transmission site. Furthermore, high winds can damage or destroy critical equipment on cell towers. Most equipment is built to withstand inclement weather; however, especially severe conditions could still lead to outages.
Environment	Severe weather can have impacts to the environment through flooding and floodplain damages to salmon and steelhead habitat, wetland impacts to amphibians and reptiles, and bird sanctuaries. This can occur from both too much water (flooding or dam failure) or too little snowpack and resulting drought conditions. Hillside destabilization can occur where soil geology and saturation of soils occur. The moisture content of vegetation drops throughout the summer. Dry conditions can result in an increase in the threat of wildfires from lightning strikes, unattended campfires, fireworks, sparks from automobiles, cigarettes thrown from cars on roadways and other heat sources. One dilemma of drought conditions is the balance between human water needs and the protection of the environment including plants, wildlife, and fish that require minimum stream flows to support their annual spawning migrations. Dry conditions also contribute to higher water temperatures, which causes increased salmon mortality.
Economy	There are several local ski areas important to King County: Crystal Mountain (Chinook Pass); Alpental, Hyak, and Ski Acres (Snoqualmie Pass); and Steven's Pass (Steven's Pass). Ski area closures can occur from both large snowfalls and where snow is too light or melts off. This can impact seasonal employment at the ski areas. Also associated with the passes, as outlined in the avalanche chapter, a WSDOT study claimed that a four-day closure at Snoqualmie Pass in the winter of 2007/2008 cost the state $27.9M in economic output, 170 jobs, and $1.42M in state revenue (2008 dollars). Businesses can be severely impacted when weather events impede mobility during high seasons, such as around the holidays. Since a large percentage of annual personal spending is spent during the November-

	December season, negative weather limits access to stores and can cause stores to close. Drought conditions can impact the regional agricultural output of fruits, vegetables, and flowers grown in all the major river basin areas of King County. Regional drought conditions can impact generation of hydroelectric power and drive up electric rates as well as increase usage during hot summers. The most serious and longest-lasting impacts may be to low-income individuals and families who may lose jobs or days of wages due to snow closures. Debt traps caused by missed bills due to lost wages can damage a family for months or years.
Public Confidence in Governance	The 2008 and 2011 snowstorms highlighted the shortage of snowplows and the management of the general response to the snow incident in the City of Seattle. The February 2019 event can be regarded by many as much more successful on the public perception front. Successful coordination of a regional call center in the Emergency Operations Center (EOC) to support other county departments and take snow plowing requests helped ensure the public always had someone to call. The county also maintained substantial engagement with media outlets. The County Executive was fully involved as well, helping to boost awareness and public perception that county government was engaged in the storm recovery effort.

14.8 Vulnerability Assessment

Below offers an overview on vulnerability from severe weather events. Additional details on vulnerability for each type of severe weather event is provided under 14.3 Magnitude.

Vulnerable Populations	Severe weather events, while usually concentrating impacts on infrastructure and agriculture, can seriously threaten the lives of vulnerable people. Cold and hot weather events can lead to an increase in fatalities among the elderly and homeless populations. Immigrant and low-income populations also have been known to succumb by carbon monoxide poisoning that can occur when generators or grills are lit indoors and without proper ventilation. Snow can trap people

indoors for days, something especially threatening for people with food insecurity or chronic health conditions that require access to medical services. Any disruption to the economy is also especially threatening to those who are low-income or who work in hourly work or in the service sector. When those jobs are not open, they frequently do not pay wages, which can threaten the entire livelihood of a low-income family.

Unsheltered populations

Populations needing shelter are especially exposed during heat and cold events. Since King County has a moderate climate, many of these populations are unprepared. Cold events may require opening additional shelter spaces and canvassing areas to offer shelter services.

Immigrant populations and those with limited English proficiency

Populations with limited English proficiency or who are inexperienced with Northwestern climate are more likely to take risky actions, like operating a generator or grill indoors for heat. These populations are also less likely to receive information and warnings about weather systems and to know where to go for help.

Low-income and minimum-wage populations

Populations working in low-wage professions such as extractive industries and service industries can be severely impacted from multi-day weather events that impact transportation systems. These events can trigger a long-term decline in living standards or even homelessness in these populations.

People dependent on public transportation

Public transit moved to the most restrictive routes ever recorded during the February 2019 snowstorm. These cutbacks had apparent disproportionate impacts on underserved areas, including some areas with populations dependent on transit. When transit services are cut, it can be impossible for these populations to get to work or appointments.

People with chronic medical conditions

People requiring regular care from doctors are negatively impacted by severe weather events. During heatwaves, people with chronic

	illnesses, especially heart and respiratory conditions, are also disproportionately impacted. **Residents down private roads** Private roads are not eligible to be cleared by public snow removal services. Many homeowner's associations contract with the same set of snow removal companies. These companies may become overwhelmed during long-running events. **Service industry during peak periods** Many service businesses, especially retail, are heavily dependent on income earned during certain months of the year. A major event around the Christmas holidays, for example, can threaten the viability of many businesses. **All residents during multi-day events** Although it is recommend having two weeks of food and supplies available during these severe weather events, few residents follow this guidance, regardless of income. After more than a few days, many residents will run out of food for themselves and any pets.
Property	**Buildings on slopes of greater than 40% grade** Landslides are a major secondary hazard of severe precipitation events. Buildings on or near slopes of greater than 40% grade are most at-risk.
Environment	Severe weather events can have significant impacts on ecosystems, disrupting habitats and threatening biodiversity in various ways. For example, strong winds can lead to tree falls, habitat destruction, and loss of vegetation, while heavy precipitation can cause soil erosion and degradation, disrupting both wildlife and aquatic habitats. This damage to soil and vegetation can also increase the risk of landslides, further destabilizing the environment. During extreme heat events, prolonged heat stress can reduce plant productivity, heighten susceptibility to diseases, and lead to higher mortality rates for trees and other vegetation. Drought conditions further exacerbate these issues by reducing stream and river flows, which negatively impacts aquatic species, particularly those that rely on specific water flow and temperature conditions, like salmon. As vegetation dies off or becomes desiccated, ecosystems become more vulnerable to wildfires, compounding the environmental disruption.

Operations

Power

Power transmission systems, especially power lines, are frequently damaged during storms with high winds by falling trees. During major wind events, it is not uncommon to have hundreds of thousands of residents without power.

Water/Wastewater

Damage to water and wastewater facilities can occur due to a secondary hazard, flooding and tidal surge. These facilities are often built in low-lying areas. The severe damage and release of untreated water that occurred at King County's West Point Treatment Plan occurred during a severe weather event.

Waste Management

Garbage pickup can be delayed for weeks. This causes significant public frustration.

Transportation

Rural transportation routes are lower priority and may not even be cleared at all during a snow event.

Airports and Travelers

Airport facilities are frequently impacted by severe weather events, but often have plans and procedures to contain disruption. During multi-day events, however, passengers can be stranded and there can be a shortage of hotel rooms since many airlines contract with the same hotels.

Chapter 15
Terrorism

Risk Assessment Scoring		
1	Location	Hazard
2	Probability	
3	Magnitude	
2	Public	Impact
2	Responders	
2	COP	
2	PFI	
2	Economy	
2	Environment	
2	PCG	
2	People	Vulnerability
2	Property	
2	Environment	
2	Operations	
2	People	Risk
2	Property	
2	Environment	
2	Operations	
Moderate	**Overall Risk**	

PC: King County Sheriff's Office

Chapter 15: Terrorism

15.1 Hazard Description

Terrorism, as defined under Title 18 of the United States Code, is categorized into two primary types: international terrorism and domestic terrorism. Both forms involve acts of violence or danger to human life that violate U.S. criminal laws but differ in their geographic focus and intent.

International terrorism: means activities that—violent acts or acts dangerous to human life that are a violation of the criminal laws of the United States or of any State, or that would be a criminal violation if committed within the jurisdiction of the United States or of any State; appear to be intended—(i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping. [These acts] occur primarily outside the territorial jurisdiction of the United States […].

Domestic terrorism: means activities that—involve acts dangerous to human life that are a violation of the criminal laws of the United States or of any State; appear to be intended—(i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping. [This] occur primarily within the territorial jurisdiction of the United States.[1]

The Federal Bureau of Investigation (FBI) designates terrorism as its top investigative priority, further defines these two primary types as:

- **International terrorism:** Perpetrated by individuals and/or groups inspired by or associated with designated foreign terrorist organizations or nations (state-sponsored).
- **Domestic terrorism:** Perpetrated by individuals and/or groups inspired by or associated with primarily U.S.-based movements that espouse extremist ideologies of a political, religious, social, racial, or environmental nature.

Domestic terrorism represents a complex and multifaceted threat to communities across the United States. The motivations behind domestic terrorist activities are diverse, and the consequences—both direct and indirect—are far-reaching. Understanding the nature of domestic terrorism and its potential impacts is essential for crafting effective mitigation strategies, enhancing preparedness, and ensuring a coordinated response to protect public safety and critical infrastructure.

[1] Definitions. 2015. 18 USC §2331. https://uscode.house.gov/view.xhtml?path=/prelim@title18/part1/chapter113B&edition=prelim.

Domestic terrorism in the United States can be driven by various extremist ideologies, all of which fall under the definition of **Domestically Violent Extremists (DVE)**. DVEs Listed in Table 15-1, these groups and individuals often have distinct motivations and methods of operation:

Table 15-1 US Domestically Violent Extremists (DVE) defined by FBI and DHS[2]

Group Name	Description
Animal Rights/Environmental Violent Extremists (AREVEs)	Groups or individuals who facilitate or engage in the unlawful use or threat of force or violence or intent to intimidate or coerce, in furtherance of political and/or social agendas by those seeking to end or mitigate perceived cruelty, harm, or exploitation of animals or perceived exploitation or destruction of natural resources and the environment.
Anti-Government or Anti-Authority Violent Extremism	The potentially unlawful use or threat of force or violence in furtherance of ideological agendas, derived from anti-government or anti-authority sentiment, including opposition to perceived economic, social, or racial hierarchies, or perceived government overreach, negligence, or illegitimacy.
Homegrown Violent Extremists (HVEs)	A person of any citizenship who has lived and/or operated primarily in the United States or its territories who advocates, is engaged in, or is preparing to engage in ideologically motivated terrorist activities (including providing support to terrorism) in furtherance of political or social objectives promoted by a foreign terrorist organization but is acting independently of direction by a foreign terrorist organization.
Racially (or Ethically) Motivated Violent Extremists (RMVE)	Groups or individuals who facilitate or engage in the potentially unlawful use or threat of force or violence with intent to intimidate or coerce, in furtherance of political and/or social agendas, which are deemed to derive from bias, often related to race or ethnicity, held by the actor against others, including a given population or group.

In addition to organized groups, domestic terrorism can also involve lone actors—individuals who commit violent acts independently, often motivated by personal grievances or a desire to retaliate against perceived injustices. These individuals, sometimes referred to as "lone wolves," may have no formal affiliation with extremist groups but are driven by personal ideologies or emotional distress. A common example of this type of terrorism is school shootings, where individuals, often with a history of social isolation or personal trauma, resort to violence to express their anger,

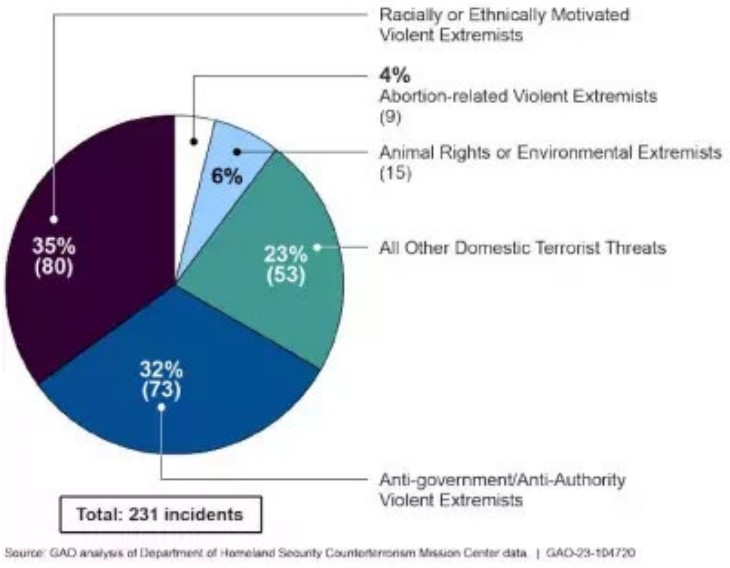
[2] https://www.fbi.gov/file-repository/fbi-dhs-domestic-terrorism-definitions-terminology-methodology.pdf/view

frustration, or desire for retribution. Another to consider is violent attacks against LGBTQ gathering spaces and other protected classes of people.

15.2 Location

King County plays a prominent role as a major economic, governmental, and transportation hub in Washington State. It is the state's largest county, with a population exceeding 2.2 million residents. It is geographically diverse, featuring a mix of high-density urban areas along the shores of Puget Sound, suburban communities to the east, and rural areas to the southeast. Seattle, the county's largest city, is home to the eighth-largest port and the eleventh-busiest airport in the United States, with Seattle-Tacoma International Airport serving as a primary entry point for international travelers, particularly from the Pacific. King County also boasts the state's largest labor market, with a range of key economic sectors. These include government operations centered in Seattle, technology hubs in Bellevue and Redmond, manufacturing in South King County, research facilities associated with institutions like the University of Washington, and agricultural activities in the Snoqualmie Valley. All which could be at risk of being targeted by various extremist groups, each seeking to disrupt specific sectors or make a political statement through acts of violence or intimidation.

Figure 15-1 Domestic Terrorism-Related Incidents by Category, from 2010 through 2021[3]



Each domestic terrorist group has distinct goals and motivations, and the locations they target for attacks reflect their ideological intentions and desired impact.

- Animal Rights/Environmental Violent Extremists (AREVEs), who are concerned with the well-being of animals or environmental degradation, often target research laboratories conducting animal testing, agricultural facilities such as farms or slaughterhouses, and environmental impact areas like logging or mining sites. They may also focus on corporate headquarters with large environmental footprints or government buildings involved in the regulation of environmental issues. Washington is the 4th highest state in the U.S. for individuals radicalized with AREVE.

[3] https://www.gao.gov/blog/rising-threat-domestic-terrorism-u.s.-and-federal-efforts-combat-it

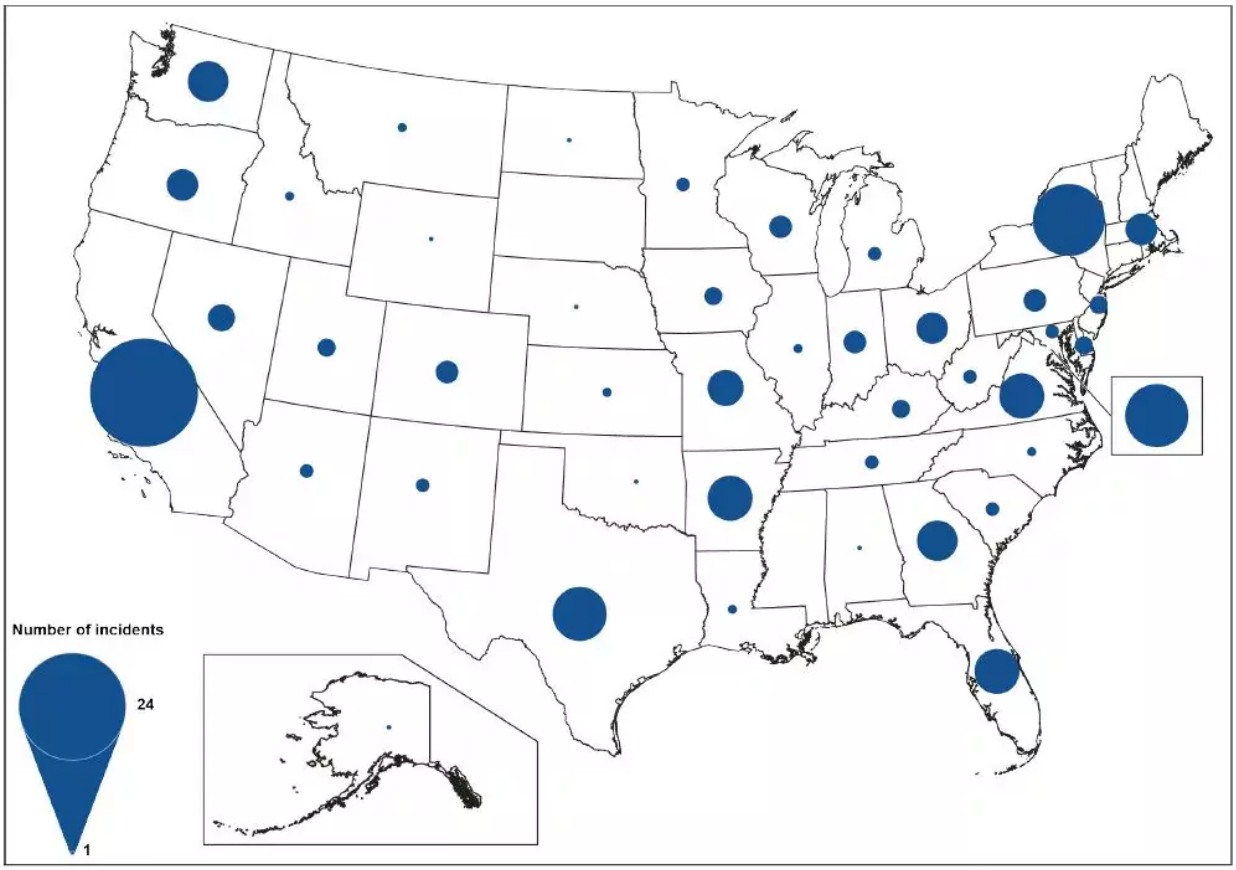
- Anti-Government or Anti-Authority Violent Extremists primarily target government institutions and operations, including law enforcement and military facilities. Their focus also extends to critical infrastructure—such as power grids or water systems—political institutions like capitol buildings, and public areas of symbolic significance, such as monuments or government offices, to disrupt the legitimacy of state authority.
- Homegrown Violent Extremists (HVEs), inspired by foreign terrorist ideologies but acting independently, are inclined to target U.S. government buildings, military and law enforcement facilities, transportation hubs like airports and bus terminals, and public venues or events, where their attacks can gain maximum visibility and cause widespread disruption.
- Racially (or Ethnically) Motivated Violent Extremists (RMVEs) often focus on areas that serve minority communities. These may include minority neighborhoods, schools with diverse student bodies, religious institutions such as churches, synagogues, or mosques, and civic organizations advocating for racial equity and social justice. In the Washington State 2022, Domestic Terrorism Study, participants from the Jewish, Muslim, immigrant, and Asian American and Pacific Islander communities expressed significant level of fear over potential use of violence against their community.[4]
- Lone Wolves, individuals who are motivated by personal grievances or emotional distress, typically target schools, workplaces, places of worship, night clubs, and public spaces with high visibility, aiming for maximum casualties or media attention. They may also target government buildings or institutions they believe have wronged them in some way, acting without the support or coordination of larger extremist groups.

15.3 Magnitude

Terrorism is designed to instill fear in its intended audience, disrupting daily life and making ordinary activities feel dangerous. It creates an environment where people are afraid to attend events, send their children to school, or even gather in places of worship. The scope of domestic terrorism has expanded significantly in recent years. The number of FBI investigations into domestic terrorism has more than doubled since 2020, with open investigations skyrocketing from 1,981 in Fiscal Year 2013 to 9,049 in FY 2021. Over the past decade, investigations into domestic terrorism have surged by 357%. This increase is most pronounced in states with major metropolitan areas, such as Seattle, Washington.

[4] https://agportal-s3bucket.s3.amazonaws.com/2022%20Domestic%20Terrorism%20Study.pdf

Figure 15-2 Domestic Terrorism Incidents by State, 2010 through 2021[5]



Source: GAO analysis of Department of Homeland Security Counterterrorism Mission Center data. | GAO-23-104720

Domestic terrorism threats continue to evolve rapidly, and combating them requires close coordination between the FBI, the Department of Homeland Security (DHS), and other federal, state, and local agencies. In Washington State, the Washington State Fusion Center serves as the coordination hub for federal, local, and private sector partners involved in preventing, responding to, and recovering from emergencies, including terrorist threats. The Fusion Center also tracks over 800 large gatherings annually in King County, encompassing events like parades, festivals, and sporting events that draw large crowds.

Mass gatherings, particularly open-access events, remain a primary target for domestic terrorists. These events, such as marathons, parades, protests, rallies, and festivals, are attractive to extremists due to their public accessibility, the availability of detailed schedules, and the generally unrestricted entry. Terrorists may also target gatherings near high-security events, such as tailgates adjacent to major sporting events. Based on previous attacks, extremists are likely to continue targeting civilian locations at such gatherings, exploiting perceived security vulnerabilities.

[5] https://www.gao.gov/blog/rising-threat-domestic-terrorism-u.s.-and-federal-efforts-combat-it

Terrorist attacks differ significantly from other types of man-made hazards, and their unique characteristics often result in both immediate and long-term impacts on communities. For example, incidents involving hazardous materials like chemical, biological, or radioactive agents are particularly challenging because the presence of the threat may not be immediately identifiable, complicating response efforts and posing serious risks to public health and safety. In addition to physical dangers, terrorist attacks cause substantial emotional and psychological distress, evoking intense reactions such as fear, anxiety, and anger, which can hinder recovery and affect first responders. Furthermore, the economic toll of terrorism is often much greater than the direct cost of the attack. Even failed terrorist attempts can result in significant financial losses, particularly in sectors like critical infrastructure and government operations, as the long-term costs of heightened security measures and the recovery process can far exceed the cost of the attack itself.

15.4 Previous Occurrences

Prior to the attacks on September 11, 2001, there were less than a dozen major terrorist events in Washington State. Since then, violent extremism has become commonplace, on a global and national scale, and the number of local terrorism and violent extremism cases continue to rise.[6] Some of the most notorious terror cases in Washington State include the arrest of Ahmed Ressam, the "Millennium Bomber," in December 1999, the Earth Liberation Front (ELF) firebombing of University of Washington's (UW) horticulture center in May 2001, and the foiled Seattle Military Entrance Processing Station attack plot in 2011.

Table 15-2 Past terrorist occurrences in Washington state and King County

Date	Description
January 17, 2011	Kevin Harpham, an admitted white supremacist, placed a remote-controlled backpack improvised explosive device (IED), with rat-poison coated shrapnel, at a park bench near the marching route on the morning of the Martin Luther King Jr. Day Parade in Spokane, WA. Prosecutors said the device was "constructed with a clear, lethal purpose," and Harpham said it was intended to protest social concepts, such as unity and multiculturalism.[7]
May 11, 2011	Joseph Brice of Clarkston WA was arrested for assembling, practicing, and detonating explosive devices after an incident that occurred on April 18,

[6] United Nations Development Programme. 2016. Prevent Violent Extremism Through Promoting Inclusive Development, Tolerance and Respect for Diversity. Accessed online on 8/26/19 from https://www.undp.org/content/dam/norway/undp-ogc/documents/Discussion%20Paper%20-%20Preventing%20Violent%20Extremism%20by%20Promoting%20Inclusive%20%20Development.pdf.

[7] Clouse, Thomas. December 20, 2011. MLK bomb maker gets 32 years in prison. *The Spokane Spokesman-Review.* Accessed online on 8/26/19 from https://www.spokesman.com/stories/2011/dec/20/mlk-parade-bomber-seeks-guilty-plea-withdrawal/.

	2010, when an explosive device he made prematurely ignited, causing him significant injuries. He had a YouTube channel called "Strength of Allah," where he posted the videos in an attempt to support terrorism.[8]
June 22, 2011	Abu Khalid Abdul-Latif and Walli Mujahidh were arrested for planning to attack the Military Entrance Processing Station (MEPS) in Seattle with machine guns and grenades after previously planning, but discounting, an attack at Joint Base Lewis McChord (JBLM). According to FBI investigators, "Abdul-Latif said that 'jihad' in America should be a 'physical jihad,' and not just 'media jihad'."[9]
September 8, 2011	Michael McCright was arrested and charged with second-degree assault for a July 2011 incident where he intentionally swerved his vehicle at a government-plated vehicle occupied by two U.S. Marines in Seattle. Known on the Internet as "Mikhail Jihad," McCright had ties to Abu Khalid Abdul-Latif, a man convicted of plotting to kill federal employees and military recruits in Seattle, WA.[10]
October 27, 2012	Abdisalan Hussein Ali, a 22-year old born in Somalia but raised in Seattle and Minnesota, was the third American killed as an al-Shabaab suicide bomber in Mogadishu. Ali was reportedly one of two bombers in an attack that killed "scores of African Union peacekeepers." He arrived in Seattle in 2000 and moved to Minneapolis before being recruited into al-Shabaab and travelling to Somalia in 2008.[11]
July 18, 2014	Ali Muhammad Brown was arrested after killing four people in WA and a college student in NJ, as part of a personal vengeance against the U.S. government for its actions in the Middle East. In 2004, he was arrested and prosecuted for his role in a bank fraud scheme to finance fighters traveling abroad, and had known links to a disrupted terror cell in Seattle, WA and Bly, OR in 1999.[12]

[8] Pignolet, Jennifer. Wednesday, June 12, 2013. Clarkston man convicted of trying to aid terrorists *The Spokane Spokesman-Review.* Accessed online on 8/26/19 from https://www.spokesman.com/stories/2013/jun/12/bomb-maker-sentenced/.

[9] The Associated Press. June 5, 2012. Seattle terror suspect wants evidence tossed. *Fox News.* Accessed online on 8/26/19 from https://www.foxnews.com/us/seattle-terror-suspect-wants-evidence-tossed#ixzz28jz1MkOE.

[10] Carter, Mike. May 29, 2012. Felon admits he tried to run Marines off I-5. *The Seattle Times.* Accessed online on 8/26/19 from https://www.seattletimes.com/seattle-news/felon-admits-he-tried-to-run-marines-off-i-5/.

[11] Kron, Josh. October 30, 2011. American Identified as Bomber in Attack on African Union in Somalia. *The New York Times.* Accessed online on 8/26/19 from https://www.nytimes.com/2011/10/31/world/africa/shabab-identify-american-as-bomber-in-somalia-attack.html?_r=0.

[12] Collins, Laura. September 18, 2014. Revealed, one man's terrifying 'jihad' on U.S. soil: Extremist 'executed four in revenge for American attacks in the Middle East and carried out bank fraud for the Cause'. *Daily Mail Online.* Accessed online on 8/26/19 from https://www.dailymail.co.uk/news/article-2759901/Revealed-terrifying-one-man-jihad-U-S-soil-Extremist-executed-four-revenge-American-attacks-Middle-East-carried-bank-fraud-Cause.html.

January 1, 2014	Musab Masmari attempted to set fire to a gay nightclub on Capitol Hill in Seattle, WA by spilling gasoline down a set of stairs and lighting it, while 750 people packed the club's New Year's Eve event. According to investigative documents, Masmari told a friend that "homosexuals should be exterminated." In July 2014, he was sentenced to ten years in federal prison for arson.[13]
August 25, 2017	Melvin Neifert from Selah was arrested and charged with receiving incendiary explosive device materials—specifically, potassium nitrate and other materials to make a potassium nitrate-sugar bomb—that were to be used in connection with the 2016 May Day events. Federal authorities seized evidence and questioned Neifert on May 1, the same day anti-capitalist demonstrations took place in Seattle.[14]
March 31, 2017	Muna Osman Jama of Reston VA and Hinda Osman Dhirane of Kent WA were sentenced to 12 years and 11 years respectively, after being found guilty of conspiracy to provide material support to al-Shabaab. The two reportedly organized an all-female fundraising group, called the "Group of Fifteen," who provided monthly payments to al-Shabaab; facilitating and tracking money sent through conduits in Kenya and Somalia.[15]
March 26, 2018	Thanh Cong Phan from Everett was arrested after mailing at least 11 suspicious packages to multiple military and government facilities in the Washington, D.C. metropolitan area, which contained potential destructive devices. He was charged with shipping of explosive materials, after the packages were found to contain small amounts of black explosive powder.[16]

[13] Carter, Mike. July 31, 2014. Man who set fire in Capitol Hill nightclub sentenced to 10 years. *The Seattle Times.* Accessed online on 8/26/19 from https://www.seattletimes.com/seattle-news/man-who-set-fire-in-capitol-hill-nightclub-sentenced-to-10-years/.

[14] Meyers, Donald W. August 31, 2016. Bail decision delayed in Selah explosives case. *The Seattle Times*. Accessed online on 8/26/19 from https://www.seattletimes.com/seattle-news/crime/bail-decision-delayed-in-selah-explosives-case/.

[15] Department of Justice. Friday, March 31, 2017. Two Women Sentenced for Providing Material Support to Terrorists. Accessed online on 8/26/19 from https://www.justice.gov/opa/pr/two-women-sentenced-providing-material-support-terrorists.

[16] Shayanian, Sara. March 28, 2018. Man charged with sending explosives to D.C. military sites. *United Press Internationa.* Accessed online on 8/26/19 from https://www.upi.com/Top_News/US/2018/03/28/Man-charged-with-sending-explosives-to-DC-military-sites/5591522255789/.

15.5 Probability of Future Occurrences

The probability of domestic terrorist risks in King County, Washington, is a complex and evolving concern, influenced by a range of factors including current security measures, historical incidents, and future events such as the 2026 World Cup, which will be hosted in Seattle. Domestic terrorist attacks are inherently difficult to predict and prevent due to their unpredictable nature and the tendency of perpetrators to blend into society undetected by law enforcement. These attacks are often carried out without warning, complicating efforts to identify potential threats in advance.

King County, being a major urban center and home to Seattle—one of the host cities for the 2026 World Cup—faces an increased risk of domestic terrorism, particularly in the lead-up to this international event. Large-scale events like the World Cup attract global attention and a significant influx of visitors, making them prime targets for domestic and international terrorists aiming to cause disruption or gain media attention.

15.6 Impact Assessment

Public	Certain groups within King County are more vulnerable to targeted attacks by Domestic Violent Extremists (DVEs), but the broader population is susceptible to the impacts of terrorism as a whole. The county's population as a whole remains vulnerable to the broader consequences of terrorism. Public gatherings such as marathons, protests, or festivals, as well as everyday locations like schools and workplaces, are potential sites of attack, exposing civilians across the county to direct harm. Additionally, the emotional and psychological toll of terrorist attacks—fear, anxiety, and anger—will affect not only those directly targeted but also the wider community, potentially altering everyday behaviors and impacting mental health. The economic consequences of such attacks, including disruptions to business and public services, further affect the county's residents at large.
Responders	First responders—including law enforcement, firefighters, emergency medical services (EMS), and disaster recovery teams—face immediate risks when responding to terrorism-related incidents, especially when dealing with hazardous materials, active shooter situations, or explosive devices. The physical danger posed by these incidents places responders at risk of injury or death.
Continuity of Operations	Government facilities and employees are a common target for anti-government extremists, and attacks on these facilities can severely disrupt daily operations for extended periods. These disruptions can range from temporary shutdowns to long-term closures, requiring significant recovery efforts. Essential services such as public health, social services, and law enforcement could be delayed or interrupted, affecting the county's ability to serve its residents effectively.

Property, Facilities, and Infrastructure	**Property** Property, including commercial buildings, venues, vehicles, places of worship, or other areas are often damaged or destroyed during terror incidents. Trauma from the incident can prevent the rebuilding of the facility in the same place. **Facilities** When facilities are targeted, the immediate impact is often physical destruction or damage to the structure, systems, and equipment within. Employees and existing patients could become injured or killed. Even in the event they are not targeted, facilities could still become overwhelmed with patients in the aftermath of attacks. **Infrastructure** • Energy: Energy facilities, including fuel pipelines, are common targets for terrorists and saboteurs around the world. Many power facilities, such as neighborhood substations, are relatively unguarded and, if lost, can have immediate impacts on people and property in an area. Cyber-attacks are one area where a large-scale attack on the energy system could cause widespread disruption. • Water/Wastewater: Water systems are considered a high-impact potential target. A chemical attack on a water system, if not immediately detected, could harm or kill thousands, depending on the size of the water-system targeted. • Transportation: transportation systems, especially public transit, have been targets around the world, such as in the Madrid Train Bombings or the London Subway Bombings. Attacks on busses are also common. These incidents can cause a loss in public confidence in the transit system. Furthermore, an attack on a tunnel, such as the I-90 tunnel across Lake Washington, can impede mobility in our region over the long-term. • Communications: Communications infrastructure, such as cell towers, are relatively redundant and so somewhat less vulnerable to terrorist attacks. There is a huge vulnerability, however, to cyber-terrorism, which can take multiple facilities offline quickly.
Environment	A major attack can pollute the environment and poison water and food sources. This can have far-reaching, long-term consequences and damage animal and plant life as well as people.
Economy	In addition to the economic costs of stepped-up security, attacks can have a huge impact on a region's economy. Places seen as less safe are less attractive to investors or visitors. Often, terrorist attacks attempt to destroy part of the economy by killing tourists or destroying an important piece of infrastructure.

Public Confidence in Governance	A failure to protect the public from a terrorist attack, even one that is thwarted at the last moment, can cause a total failure in public confidence in government. As seen after 9/11/2001 or after attacks by white supremacists against African-American or Jewish congregations, groups begin to feel isolated, threatened, and isolated from the community. This is especially true in cases where government fails to quickly reassure impacted communities and support them morally and with security resources.

15.7 Vulnerability Assessment

Vulnerable Populations	Certain groups, particularly those from protected classes, are particularly vulnerable to attacks by domestic terrorists. These individuals or communities may be specifically targeted due to their race, religion, ethnicity, gender identity, sexual orientation, or other protected characteristics. Vulnerability arises because these groups are often seen as symbols of the values or causes that extremists oppose, making them more likely to be victims of violence, discrimination, or intimidation. Terrorist attacks and attempted attacks in the northwest have been motivated by white supremacy (targeting non-white populations), xenophobia (targeting immigrants), homophobia/transphobia (targeting gathering places of gay, lesbian, and transgendered people), and anti-religious attacks against Muslims, Jews, Christians, or other religious groups. Individuals in positions of power—such as government officials and those involved in corporations perceived as targets of domestic extremist groups—are also particularly vulnerable to attacks by domestic terrorists. Terrorists have increasingly targeted mass-gatherings in densely populated or high profile areas. Consequently, any major urban area in Washington State could be considered at-risk as well as any crowded or high profile critical infrastructure. The specific motivations of terrorists will largely dictate target selection.
Property	Infrastructure systems such as dams, water systems, bridges, and public buildings are high-value targets to terrorists that both stand for government order and, when lost, can cause significant regional harm to people, property, and the economy.

Environment	Extremist can often exploit a range of environmental vulnerabilities through attacks such as contaminating the city's water supply, using hazardous chemicals that could seep into the various ecosystems .
Operations	A new challenge that is emerging is the increasing use of terror tactics by non-terrorists. A number of evolved weapons, tactics, and targets have emerged through the sheer volume of attacks within the last decade. This normalization of violence has been further exacerbated by extensive media coverage and the ease by which detailed instruction manuals, 'how-to' videos, and online forums dedicated to weapons, explosives, and tactics. It is "essentially shared community content, easily accessible for extremists of all stripes to consume and put into action" including those with no affiliation to foreign or domestic extremism ideologies.[17] Lessons learned from past attempts continue to shape the means by which attackers develop plots—the push for using small arms, edged-weapons and vehicle ramming against soft targets—instead of the often-failed large-scale attacks.

[17] Johnson, Bridget. March 21, 2018. The Austin bomber and our new age of open-source terrorism: How Mark Anthony Conditt likely benefited from Al Qaeda tutorials. *The New York Daily News.* Accessed online on 8/26/19 from http://www.nydailynews.com/opinion/austin-bomber-new-age-open-source-terrorism-article-1.3888244.

Chapter 16
Tsunami

Risk Assessment Scoring		
2	Location	Hazard
2	Probability	
3	Magnitude	
2	Public	Impact
2	Responders	
1	COP	
1	PFI	
2	Economy	
1	Environment	
1	PCG	
2	People	Vulnerability
1	Property	
2	Environment	
1	Operations	
2	People	Risk
2	Property	
2	Environment	
2	Operations	
Moderate	**Overall Risk**	

PC: Duwamish River Community Coalition

Chapter 16: Tsunami

16.1 Hazard Description

A **tsunami** is a series of fast, powerful, and highly destructive waves that radiate outward in all directions from their point of origin. Tsunamis are typically triggered by the displacement of the ocean floor, often due to an earthquake, or by the collapse of an underwater or aerial landmass. Once generated, a tsunami can travel across entire oceans in less than a day, impacting coastal areas far from its source.

In contrast, a **seiches** is a type of wave that forms in enclosed or semi-enclosed bodies of water—such as lakes, bays, and rivers—due to wind, atmospheric pressure changes, or seismic activity. Seiche waves can also affect harbors, canals, and other water systems with limited flow.

Causation

In King County, there are four main triggers for tsunami; distant earthquakes, localized earthquakes, Cascadia subduction zone, and landslides. The most significant tsunami threat comes from seismic activity along the Seattle Fault or other geological events within the Puget Sound Lowlands, such as large underwater landslides or local fault movements. Additionally, smaller tsunamis can pose maritime risks along the western coastlines of the United States.

- **Distant earthquakes:** Tsunamis generated by distant earthquakes or underwater landslides can travel across vast stretches of ocean.[1] Powerful tsunamis originating in the Pacific Ocean can reach the Puget Sound, where they may cause damage to boats, docks, piers, and navigation aids such as lighthouses and channel markers. Vessels, both moored and underway, could also be impacted. A notable example of this is the Alaskan-Aleutian subduction zone earthquake.
- **Localized earthquakes:** Local seismic events, particularly those along the Seattle Fault, can trigger tsunamis in nearby large bodies of water. These localized tsunamis could cause significant damage to port infrastructure and navigational terminals, especially in areas like the Seattle waterfront.
- **Cascadia subduction zone:** A massive earthquake (magnitude 8-9) off the coast of Washington, Oregon, or British Columbia could generate a catastrophic tsunami.
- **Landslides**: Underwater or coastal landslides—such as the one that occurred at Tacoma Narrows—can displace enough water to create dangerous tsunami waves.

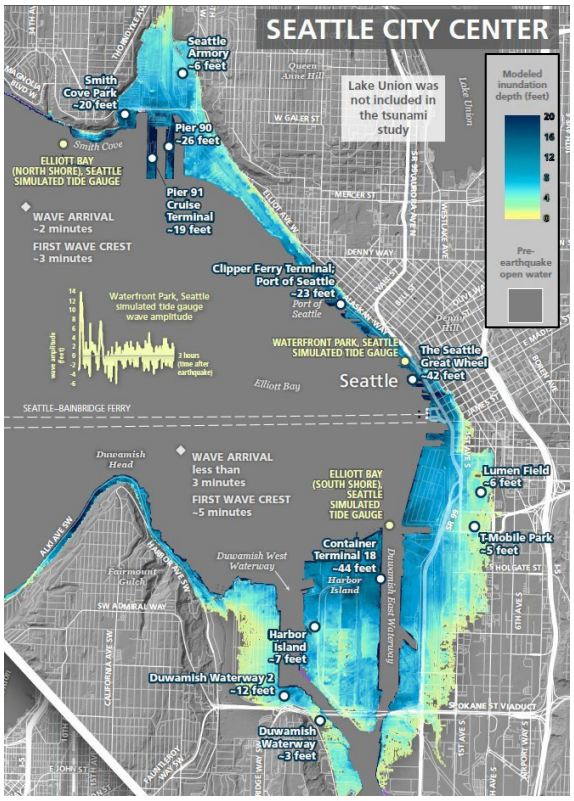
[1] Washington State Department of Natural Resources (DNR), "Tsunamis" (n.d.): https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/Tsunamis#understanding-tsunamis.1

16.2 Location

King County is home to the deep-water Port of Seattle and several cities along the Puget Sound, including Shoreline, Seattle, Burien, Des Moines, and Federal Way. Together with Vashon Island, unincorporated King County includes a great deal of industry, import/export activity, and commercial and residential real estate that border bodies of water. These waterfront areas are particularly vulnerable to the impacts of tsunamis or seiches, which can be triggered by earthquakes occurring hundreds, if not thousands, of miles away from King County. There are four likely triggers for a tsunami in King County. These include an earthquake on the Seattle Fault, Cascadia Subduction Zone, and Alaska-Aleutian Subduction Zone, as well as a tsunami caused by a major landslide into Puget Sound or another major body of water.

Seattle Fault Tsunami

Figure 16-1 Seattle fault scenario detailed tsunami inundation



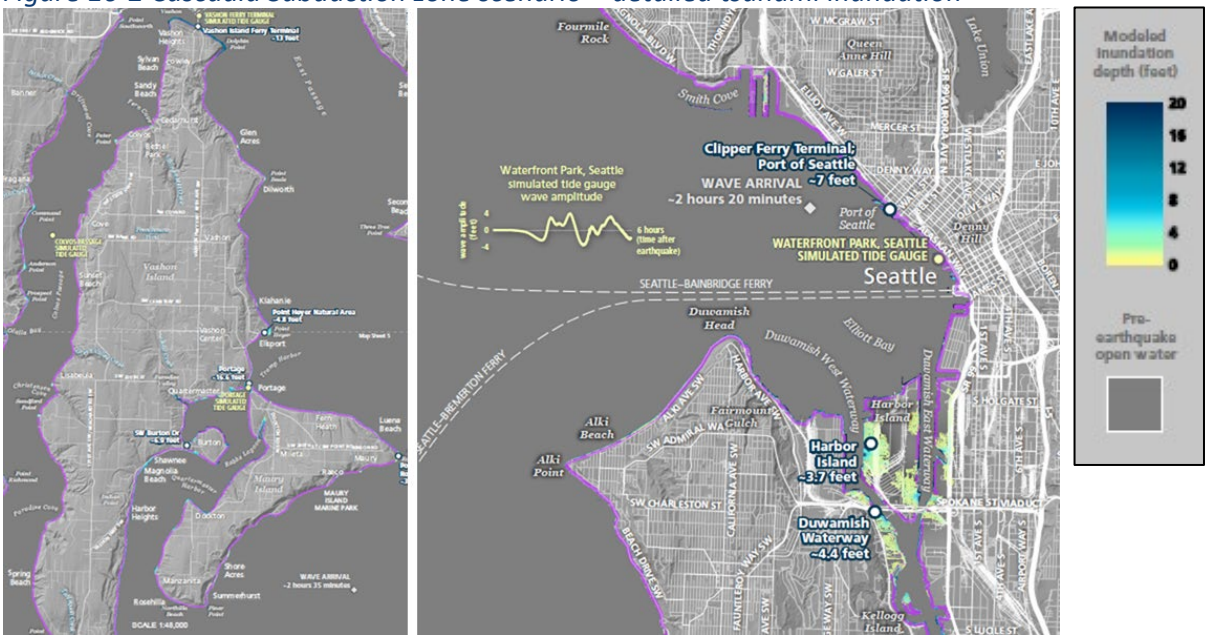
The first wave of a tsunami caused by an earthquake along the Seattle Fault would arrive to King County shores within minutes. The worst flooding is expected around Seattle, but especially the port and industrial facilities around the Port of Seattle and Magnolia. Harbor Island is expected to be completely flooded because they are at sea level, with inundation averaging 9–13 feet (3–4 meters). Areas near Elliott Bay, like SoDo and Smith Cove, could see flooding more than 20 feet (6 meters) deep. Other places, like Magnolia Bluff and Alki Beach, could see flooding up to 20 feet (6 meters) deep, but it wouldn't spread far because of steep cliffs. The tsunami would also cause flooding along rivers, including the Duwamish River. The first wave of the tsunami will hit the northern shore of Elliott Bay within minutes of the earthquake. The waves will continue to affect the shorelines for at least 3 hours, and strong currents could last much longer. The earthquake could also change the land's height, either lowering some areas or raising others.[2]

[2] Dolcimascolo, Alexander; Eungard, D. W.; Allen, Corina; LeVeque, R. J.; Adams, L. M.; Arcas, Diego; Titov, V. V.; González, F. I.; Moore, Christopher, 2022, Tsunami inundation, current speeds, and arrival times simulated from a

Cascadia Subduction Zone Tsunami

A Cascadia Subduction Zone tsunami in a Cascadia event, the first wave will arrive in approximately 2 hours and 20 minutes. It would devastate the outer coast and seriously impact low-lying areas around Everett and the San Juan Islands. The islands and the strait of Juan de Fuca protect King County from the worst flooding impacts. Modeling suggests that little inundation would occur along the coastline of south King County, though some flooding may be expected in areas of Seattle SODO and Port. For example, Harbor Island in Seattle could see up to 3.7 feet of flooding, with water speeds also between 0-3 knots (very low speed). at the Vashon Island Ferry Terminal, the modeled flooding could reach up to 13 feet, with water moving at speeds of 0-3 knots. The Duwamish Waterway would be among the most impacted areas with waves reaching 4 feet (1.2 meters) above Mean High Water. The worst flooding is expected to occur at Portage Bay with estimated wave amplitudes up to 13 feet (4 meters) above Mean High Water. Strong currents are also estimated at Portage Bay near spits of land and in the narrows, which can be hazardous to the maritime community. The first wave is expected to reach Seattle at approximately 2 hours and 20 minutes.[3]

Figure 16-2 Cascadia Subduction zone scenario – detailed tsunami inundation



large Seattle Fault earthquake scenario for Puget Sound and other parts of the Salish Sea: Washington Geological Survey Map Series 2022-03, 16 sheets, scale 1:48,000, 51 p. text. [https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2022-03_tsunami_hazard_seattle_fault.zip]

[3] Dolcimascolo, Alexander; Eungard, D. W.; Allen, Corina; LeVeque, R. J.; Adams, L. M.; Arcas, Diego; Titov, V. V.; González, F. I.; Moore, Christopher; Garrison-Laney, C. E.; Walsh, T. J., 2021, Tsunami hazard maps of the Puget Sound and adjacent waters—Model results from an extended L1 Mw 9.0 Cascadia subduction zone megathrust earthquake scenario: Washington Geological Survey Map Series 2021-01, originally published 2021, 16 sheets, scale 1:48,000, 49 p. text. [https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2021-01_tsunami_hazard_puget_sound.zip]

Alaska-Aleutian Distant Source Tsunami

An earthquake along the Alaskan-Aleutian subduction zone could reach up to magnitude 9.2, similar to the one that occurred in 1964. A tsunami generated by such an earthquake would be a distant-sourced tsunami for Washington state. Preliminary modeling for a worst-case scenario of a magnitude 9.2 earthquake in Alaska suggests that the resulting tsunami in King County would be somewhat comparable to the Cascadia Subduction Zone event, but with roughly half the strength. The highest wave amplitudes are estimated to reach up to 7 feet (2 meters), primarily affecting Portage Bay, though they are not expected to overtop the northern spit. Unsafe currents may also pose a risk to maritime operations, especially in Portage Bay. The first wave is predicted to reach Seattle's coastline approximately 6 hours after the earthquake.

Landslide Tsunami

In the last 200 years, landslides, not earthquakes, have caused all historical tsunamis in the Puget Sound/Salish Sea. Since the 1800s, no seismic activity along the Seattle Fault has been recorded. These locally generated tsunamis include 1820s Hat Island, 1894 Commencement Bay, and 1949 Tacoma Narrows. The 1949 Tacoma Narrows landslide, for example, was triggered by an earthquake, but the tsunami was caused by the landslide itself. However, historical and oral accounts, including those of the Salish peoples, describe numerous tsunamis, including a significant Seattle Fault earthquake around 1,100 years ago (~900–930 CE). This study models that event for planning purposes, aiding tsunami hazard preparedness in Puget Sound and the Salish Sea. Verbal accounts among the Snohomish Tribe describe a great landslide-induced wave caused by the collapse of Camano Head at the south end of Camano Island around the 1820s. The slide itself is said to have buried a small village, and the resulting tsunami drowned people who were clamming on Hat (Gedney) Island, 2 miles to the south. Bathymetry between Camano Head and Hat Island could have contributed to the size and destructive power of the wave.[4] In 1894 a large submarine landslide occurred on the Puyallup River delta in Commencement Bay, resulting in two deaths and the destruction of the Northern Pacific freight docks and other port facilities. It also destroyed 300 feet of the North Pacific docks and created at least a ten-foot wave in the Old Town section of Tacoma. It washed over homes on the tide flats and resulted in one fatality.[5] While no landslide generated tsunamis are known to have impacted King County there is potential that a subaerial or subaqueous slide may do so in the future.

[4] Koshimura, Shunichi and Harold O. Mofjeld. 2001. Inundation modeling of local tsunamis in Puget Sound, Washington due to potential earthquakes. ITS 2001 Proceedings, Session 7, Number 7-18. Accessed online on 6/11/19 from https://www.pmel.noaa.gov/pubs/docs/ITS2001/7-18_Koshimura.pdf.
[5] Pierce County Natural Hazard Mitigation Plan, 2004-2009 Edition, Tacoma, Washington, Sub-Section 4.6, Pierce County Tsunami Hazard, http://www.co.pierce.wa.us/xml/abtus/ourorg/dem/EMDiv/MP/PC%20Tsunami.pdf

16.3 Magnitude

Tsunamis that could impact King County vary significantly in strength depending on their origin and the type of event triggering them. The speed of a tsunami depends on the depth of the water it's traveling through. The deeper the water, the faster the tsunami. In the deep ocean, tsunamis are barely noticeable, but they can move as fast as a jet plane, more than 500 mph. As they enter shallow water near land, they slow to approximately 20 or 30 mph, which is still faster than a person can run.[6]

Distant earthquakes, like those along the Pacific Rim, can create tsunamis that take hours to reach the region. Despite traveling across vast distances, these tsunamis often lose much of their destructive power by the time they reach the shallow waters of Puget Sound. For example, the 2011 magnitude 9.0 earthquake in Japan and the 1964 magnitude 9.2 earthquake in Alaska generated tsunamis that reached King County, but the highest recorded wave heights were only around 0.04 meters (~2 inches) and 0.12 meters (~5 inches), respectively. While these distant tsunamis pose little immediate threat, studies show that tsunami inundation from large distant earthquakes can still affect inland waters.[7]

In contrast, tsunamis generated by localized earthquakes, such as those occurring along the Seattle Fault, would reach King County within minutes, causing more immediate danger. The Cascadia subduction zone, a major fault off the Pacific Northwest coast, is capable of producing significant tsunamis, with waves potentially reaching the region in tens of minutes. A tsunami generated by such an earthquake would bring faster and more intense wave energy, making it a higher-risk scenario. Similarly, landslides occurring within or near the Puget Sound region could also generate tsunamis, with these events typically causing waves to strike within minutes, depending on the location of the slide. The value and density of property along the waterfront suggests a potential for moderate impacts from such an event.

16.4 Previous Occurrences

This paleo-seismic evidence and tree ring dating of landslides around the region suggests the last tsunami occurred in King County was 923-924 AD when the local Seattle fault raised some landmasses around the Puget Sound shoreline by as much as 26 feet.[8] A scientific study focused on seismic activity on the Seattle fault within the last 7,500 years found evidence for 6 additional

[6] Washington State Department of Natural Resources (DNR), "Tsunamis" (n.d.): https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/Tsunamis#understanding-tsunamis.1
[7] Washington State Military Department, Emergency Management Division, "Tsunami Maritime Response and Mitigation Strategy - Port of Bellingham" (April 2021): https://mil.wa.gov/asset/60ad926bdefd6
[8] B.A. Black, et al., "A multifault earthquake threat for the Seattle metropolitan region revealed by mass tree mortality" *Science Advances*, v. 9, no. 39 (2023) p. 9 [https://doi.org/10.1126/sciadv.adh4973]

earthquakes, however none of these are known to be tsunamigenic.[9] This suggests a low probability of a large earthquake to occur on the Seattle fault as the recurrence interval could be thousands of years. Since 923 AD, tsunami waves in King County have been less than 18 inches in height and caused little damage to boats and shoreline property.[10] Multiple seiches have been generated in King County from various local and distant seismic events.

Table 16-1 Past tsunami and seiche occurrences in the Puget Sound region

Date	Type	Location	Trigger	Description
923 - 924	Tsunami	Seattle, WA	Earthquake	Caused by the Seattle Fault raising land by 26 feet.
1820s	Tsunami	Hat Island	Landslide	Large landslide at Camano Head triggered a tsunami that flooded an entire village. Additional verbal accounts among the Snohomish Tribe reported by Colin Tweddell in 1953 described a great landslide-induced wave caused by the collapse of Camano Head at the south end of Camano Island around the 1820s.[11]
1891	Seiche	Lake Washington	Earthquake	Two earthquakes near Port Angeles caused water in the Puget Sound to surge onto beaches two feet above the high-water mark and an eight-foot seiche in Lake Washington.
1894	Tsunami	Commence Bay	Landslide	Submarine landslide-triggered tsunami, which cased 2 fatalities.
1906	Seiche	Lake Washington	Earthquake	Mw 7.9 San Francisco earthquake caused agitated wave activity on the west shore of Lake Washington "so violently that house boats, floats and bathhouses were

[9] T.L. Pratt, et al., "Kinematics of shallow backthrusts in the Seattle Fault zone" *Washington State: Geosphere,* v. 11, no. 6 (2015): p. 1948–1974, https://doi.org/10.1130/GES01179.1
[10] NOAA, "Global Historical Tsunami Database. *National Geophysical Data Center / World Data Service (NGDC/WDS)* (n.d.) doi:10.7289/V5PN93H7
[11] Shunichi Koshimura, Harold O. Mofjeld, "Inundation modeling of local tsunamis in Puget Sound, Washington due to potential earthquakes." *ITS 2001 Proceedings*, Session 7, Number 7-18. (2001): https://www.pmel.noaa.gov/pubs/docs/ITS2001/7-18_Koshimura.pdf.

				jammed and tossed about like leaves on the water," reported by the Seattle Post-Intelligencer (4/19/1906).
1949	Seiche	Lake Union, Lake Washington	Earthquake	A magnitude-7.1 deep earthquake occurred in Olympia that caused seiches within Lake Union and Lake Washington, but no damages were reported.
April 16, 1949	Tsunami	Tacoma Narrows	Landslide	A 6-8 foot tall tsunami cased by a landslide at after the Mw 6.8 Olympic Earthquake
1964	Seiche	Lake Union	Earthquake	The magnitude 9.2 Great Alaska earthquake of 1964 created global seiches, including in Lake Union that damaged houseboats, buckled moorings, and broke water and sewer lines.
1965	Seiche	Green Lake	Earthquake	Magnitude 6.5 deep earthquake occurred in the Puget Sound which caused a seiche where water "sloshing back and forth like soup in a shallow bowl" was observed at Green Lake, North Seattle (reported by the Seattle Times, 4/30/1965).
2002	Seiche	Lake Union	Earthquake	Magnitude 7.9 Denali earthquake caused seiches in Lake Union that damaged houseboats, buckled moorings, and broke water and sewer lines.

16.5 Probability of Future Occurrences

As stated in the earthquake risk assessment, there is a high probability that a high magnitude earthquake will occur in King County which will likely be accompanied by a tsunami. However, when that event will happen is still uncertain. The increasing population and development in tsunami-prone areas mean that more people and critical assets are now exposed to these hazards. As population growth continues, especially in areas around the Puget Sound and Pacific Coast regions, the vulnerability to tsunamis increases.

By 2050, an estimated 268,000 people will reside in coastal tsunami inundation zones in Washington, representing a 3% increase from 2020. The development of coastal areas, coupled with higher exposure to tsunami hazards, will further elevate the challenges in mitigating the impacts of future events. As the state grows, this increased vulnerability highlights the need for continued resilience efforts.

While inland landslide-driven tsunamis, often associated with human-made reservoirs, have decreased in frequency since the 1950s, the threat of tsunamis generated by large subduction zone earthquakes remains a serious concern. Despite the low probability of such catastrophic events, the growing population and infrastructure in tsunami zones necessitate ongoing preparedness and mitigation measures to reduce future risks.

16.6 Impact Assessment

Public	While it would take a rather sizable tsunami along the shoreline of King County, precautionary evacuations from houseboats, live aboard pleasure craft, cruise ships, and property immediately adjacent to waterfronts of Puget Sound and lakes Washington, Sammamish, and lake Union may be recommended.
Responders	Along the shoreline of King County, precautionary evacuations from houseboats, live aboard pleasure crafts, cruise ships, and property immediately adjacent to waterfronts of Puget Sound and lakes Washington, Sammamish, and Lake Union would cause impacts to the public. The volume of search and rescue efforts along waterfronts affected from the tsunami may pose potential issues to first responders (police, fire, EMS). There are only small number of scenarios where this is a likely issue.
Continuity of Operations	It is possible that Sounder traffic between Everett and Seattle or Tacoma and Seattle could be impacted by any large tsunami in Puget Sound. Otherwise, it is unlikely that King County governmental operations would be directly impacted by a tsunami or seiche.
Property, Facilities, and Infrastructure	**Property** Tsunami and seiche threats were not defined until recently. Most of the early 19th and 20th century structures located near the water were probably not engineered to withstand impacts from a tsunami, seiche, or earthquake. The properties along the entire Seattle Waterfront and those in Shoreline, Des Moines, Federal Way, and Vashon Island are at risk from tsunami activity. **Facilities** There are no major health centers located in the mapped tsunami inundation areas. **Infrastructure** • Power: Little to no impact directly from tsunami is expected.

- Water/Wastewater: Tsunami may impact the West Point treatment plant. The damage would depend on the height of the tsunami and a significant event would be required. If such an event were to occur, the plant would be rendered inoperable.
- Transportation: damage to port facilities are the primary threat to infrastructure from a tsunami. Even relatively small tsunami surges, such as the aforementioned example from Crescent City, have caused tens of millions of dollars. Damage to low-lying rail and roads is also likely, but less of a concern since it would not impact primary transportation routes. Notably, Washington State Ferries have been conducting infrastructure enhancements to the terminals to make them tsunami resilient, that should be noted here.
- Communications: There is limited risk to communications systems as a whole from tsunami.

Environment	It is possible for a tsunami or seiche to have an impact on the natural environment immediately adjacent to Puget Sound through the release of fuels and hazardous materials or their storage facilities around the waterfront. This may include fish habitat or natural and farmed shellfish beds, wetlands, estuaries, and marsh areas.
Economy	A tsunami or seiche that impacts port facilities, such as one triggered by the Seattle Fault would have any sizable impact on the economy of the region. Damage would run potentially in the billions and have far-reaching consequences for Washington's export-based economy.
Public Confidence in Governance	Coverage from major news outlets, including the Seattle Times and the New Yorker magazine, have argued that Washington is highly underprepared for a major seismic event large enough to generate a tsunami. Both media coverage and reports from state emergency management has led Washington's governor to convene a Resilient Washington Subcommittee to look into mitigation actions out of concern for the apparent low-level of public confidence in state and local ability to manage major disasters. Data is available from Japan and New Zealand that clearly demonstrate that policy level decisions and direct communication to the public will greatly influence the public confidence in King County government.

16.7 Vulnerability Assessment

Vulnerable populations	There are no additional anticipated direct impacts from tsunami to vulnerable populations. As always, any disruption to services, the economy, and infrastructure would cause more harm to lower-income and marginalized communities.
Property	**Low lying homes** Homes and businesses along the many waterfronts would be damaged or destroyed by a mid-sized tsunami and devastated by a local crustal earthquake and tsunami. **Port/harbor facilities** Tsunamis are expected to devastate near-shore port infrastructure, boats, and piers. This is the largest economic consequence of a tsunami.
Environment	Several areas in Central and South Seattle current hold and or are impacted by the release of hazardous materials such as the Duwamish River, Harbor Island and the SODO district. They also lie within the tsunami inundation zone. The quantity and speed of a tsunami would quickly spread these contaminants into adjacent aquatic ecosystems and soil.
Operations	**Wastewater treatment facilities** West Point treatment plan is in the inundation zone for a Seattle Fault tsunami. Historical records also suggest tsunamis have impacted this area before.

Chapter 17
Volcano

Risk Assessment Scoring		
1	Location	Hazard
2	Probability	
3	Magnitude	
2	Public	Impact
2	Responders	
1	COP	
1	PFI	
2	Environment	
2	Economy	
2	PCG	
3	People	Vulnerability
1	Property	
2	Environment	
2	Operations	
2	People	Risk
2	Property	
2	Environment	
2	Operations	
Moderate	**Overall Risk**	

PC: Richard Bowen

Chapter 17: Volcano

17.1 Hazard Description

May 18, 1980 Mount St. Helens eruption taken by Richard Lasher

Volcanic eruptions are the result of geological activity beneath the earth's surface, often resulting in the release of lava, rock fragments, gases, and ash from a vent on the surface. Deposits of rock, lava, and ash create the structures we call volcanoes. Washington State has five active volcanoes, each posing varying levels of risk to King County. Mt Adams is classified by U.S. Geological Survey as a "high" threat, while the remaining four—Mount Baker, Glacier Peak, Mount Rainier, and Mount St. Helens—are classified as "very high" threat due to their proximity to developed areas.[1] The regions primary hazards associated with volcanoes include lahars and volcanic ashfall.

Lahars, also called volcanic mudflows or debris flows, can have the consistency of wet cement and are historically one of the most damaging elements of an eruption. When enough water mixes with loose volcanic ash and rock on the side of a volcano, the mixture flows downhill and forms a lahar. These mudflows can travel more than 50 miles from the volcano, and commonly at speeds of 40 miles per hour.[2] These flows pick up debris like trees and boulders, and if sufficiently large and powerful, also houses, cars and anything else in their paths. They slow down once they reach flatter gradients typical of distant river channels but are still an unstoppable mass

[1] Washington Emergency Management Division (EMD), "Volcano" *Washington State Enhanced Hazard Mitigation Plan* (2023): p. 71, https://mil.wa.gov/asset/651ec296d76a9/2023_WA_SEHMP_final_20231004.pdf
[2] Washington Geological Survey, "Vocanic Hazards in Washington State" (n.d.): p. 4, https://www.dnr.wa.gov/publications/ger_volcano_hazards_brochure.pdf

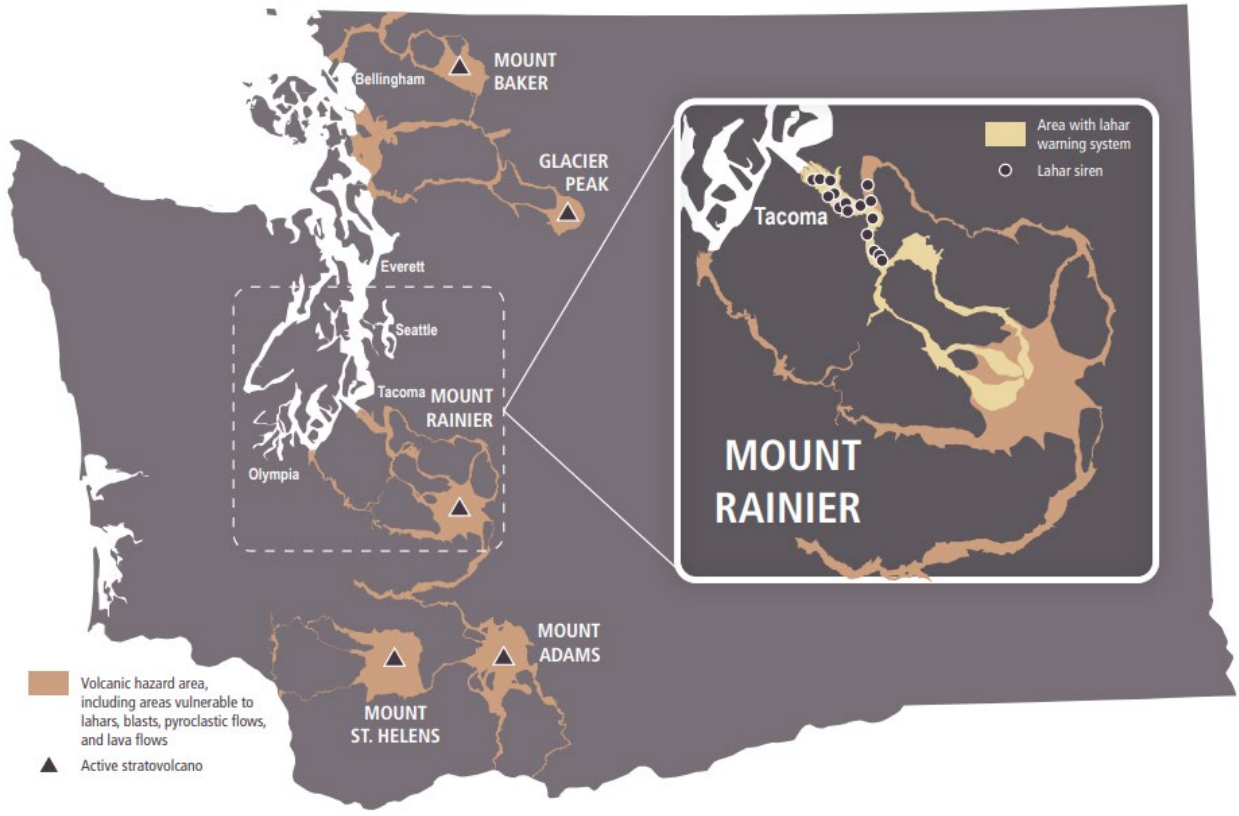
of mud and debris, often pushing a flow of water ahead of them. The only personal protective action available to avoid a lahar is evacuation to higher ground.

Ashfall is made up of tiny particles of broken rock, glass, and minerals. The fine particles may travel hundreds of miles or more downwind. Even in tiny quantities, volcanic ash can be very disruptive, as it lowers air quality, poses potential health hazards if ingested, especially to those with pulmonary conditions, makes roads slippery to drive on, is abrasive, poses risks to aircraft, motor vehicles and electronics, and is extremely difficult to clean up.

17.2 Location

Washington's five volanoes are scattered along the Cascade Range. Mount Baker and Glacier Peak are located in the north, Mount St Helens and Mount Adams are located in the south, and Mount Rainier is central.

Figure 17-1 Washington State Volanoes[3]



[3] Washington Geological Survey, "Vocanic Hazards in Washington State" (n.d.): p. 2, https://www.dnr.wa.gov/publications/ger_volcano_hazards_brochure.pdf

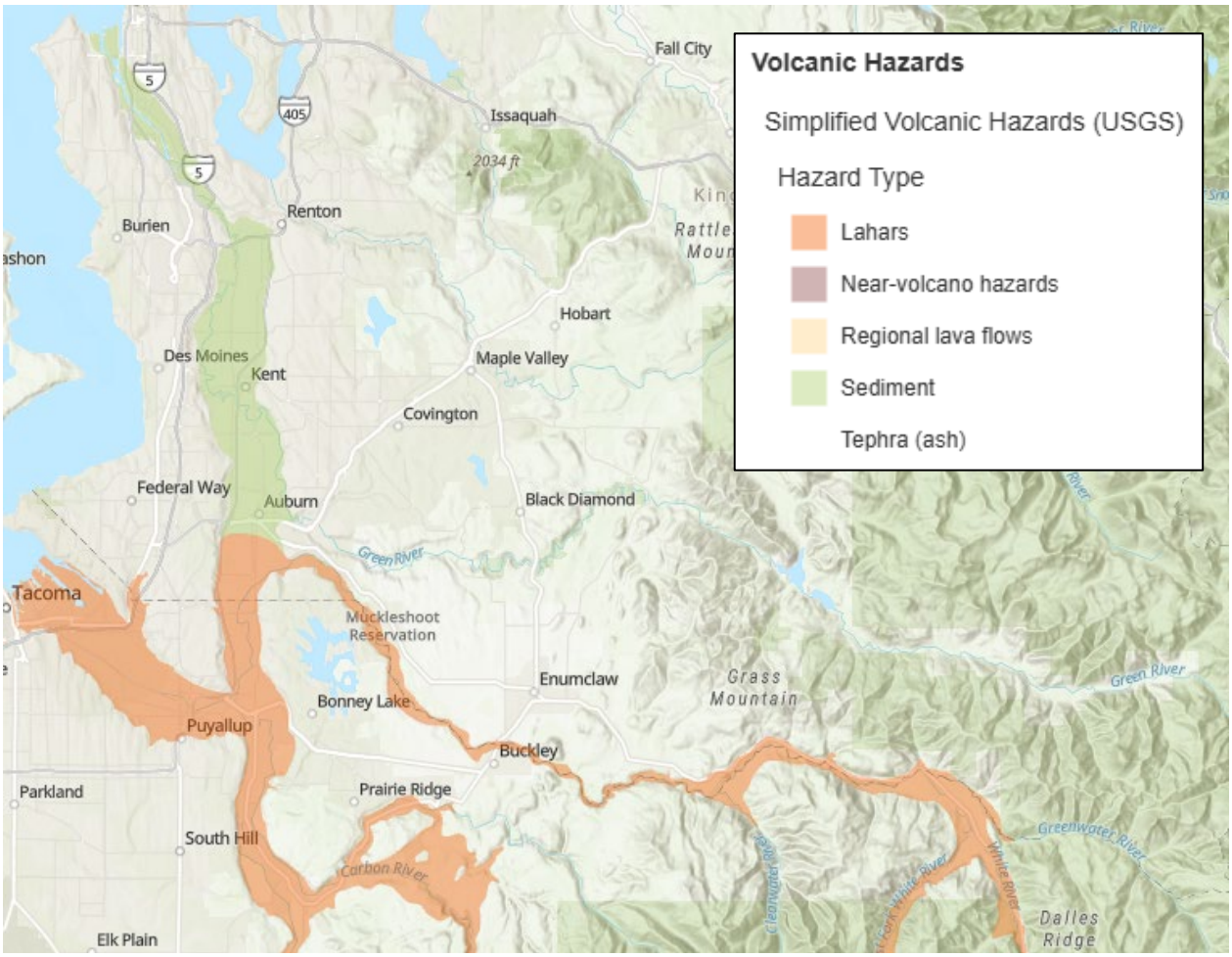
Hazards from eruptions are typically divided into near-volcano hazards, those which impact areas immediately on the slopes of the volcano, and distant hazards, which can put areas miles away from the volcano at risk. Near-volcano hazards include pyroclastic flows (hot avalanches of gas, ash, and rock fragments), lava flows, rock (tephra), debris flows, and landslides. Distant hazards, include lahars, and volcanic ash. Lahars may travel tens of miles down river valleys, picking up debris and inundating floodplains, and leave a cement-like deposit of sediment where they stop. For King County, all Washington Volcano's are distant hazards.

Mount St. Helens and Glacier Peak are the more highly explosive volcanoes in the Cascade Range. If they were to erupt, prevailing winds could carry the ashfall into King County. Such ashfall could prompt airport closure, disrupt communications system, and wreak general havoc.

Mount Rainer is also a distant hazard but with the additional threat of lahar. Figure 17-2 highlights the communities at risk from a potential eruption and subsequent lahar, including Algona, Pacific, Auburn, and the Muckleshoot Tribal Nation. Lahars along the White River would carry a mixture of mud, ash, rocks, and debris, leaving behind thick layers of sediment, potentially tens of feet deep. These flows could travel downstream into the Puget Sound via the Green and Duwamish Rivers.

The aftermath would likely result in widespread regional impacts. Excess sediment erosion and transport down river valleys could disrupt transportation networks, including major highways like I-5, and damage critical infrastructure such as the Port of Tacoma. The map also highlights areas at risk of "post-lahar sedimentation" (shown in green), where sediment would fill riverbeds, create new floodplains, and exacerbate local flooding. This sediment would continue to accumulate in river systems for years, due to the unstable mountainous terrain. While Mount Rainier is not as explosively active as volcanoes like Mount St. Helens or Glacier Peak, the threat of ashfall in King County is relatively low. However, the potential for lahars and the long-term impacts of sediment deposition are serious concerns for the region.

Figure 17-2 Mount Rainier



17.3 Magnitude

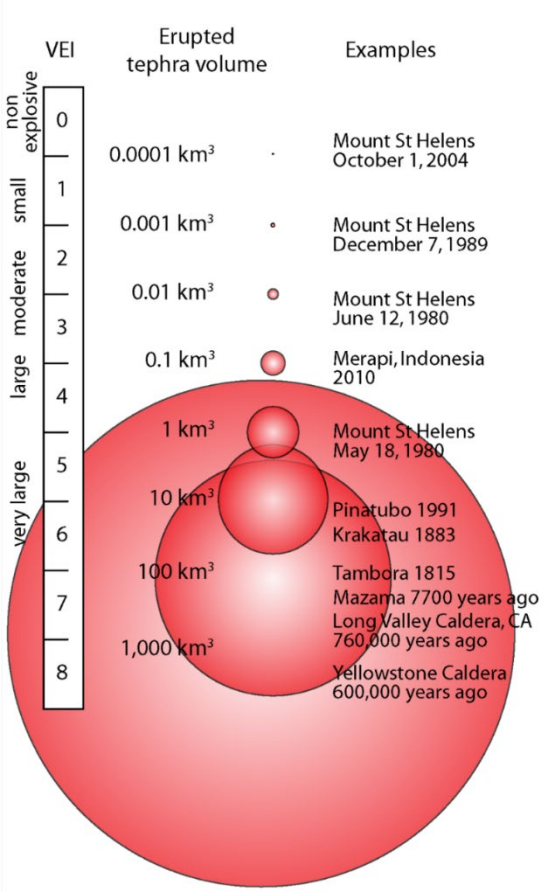
The Volcanic Explosivity Index (VEI), shown in Figure 17-3, is a scale used to measure the size of explosive volcanic eruptions. Ranging from 0 to 8, the VEI is a logarithmic scale, comparable to the to the way magnitude of earthquakes is measured. For instance, the 1980 Mt St Helens eruption followed a 5.1 magnitude earthquake and the amount of ash (1 Cubic Kilometer of dense rock equivalent) scored a 5 on VEI.[4]

Each increment on the VEI represents a ten-fold increase in eruption size. The scale considers factors such as the volume of magma erupted and the height of the eruption column. The 1980 eruption of Mount St. Helens, for instance, produced an eruption column that reached approximately 15 miles in height. For Mount Rainier, the VEI of a major explosive eruption that

[4] USGS, "1980 Cataclysmic Eruption" *Mount St. Helens* (November 2023): https://www.usgs.gov/volcanoes/mount-st.-helens/science/1980-cataclysmic-eruption

occurred between 30,000 and 100,000 years ago is tentatively estimated to be between 4 and 5. This suggests that Mount Rainier is capable of eruptions ranging from moderate to very large in scale.[5]

Figure 17-3 Volcanic Explosivity Index[6]



Given it has been approximately 200 years since Mount Rainier has last erupted, the measurement of magnitude and extent has been based of the evaluation of soil. For instance, the Osceola Mud Flow 5,600 years ago went 31 miles downstream and the deposit of lahar was 26 feet thick.

Unlike Mount St. Helens, Mount Rainier is only a moderate producer of ash (tephra) fall. Even so, tephra fallout in populated areas is a health hazard, will damage property, and may require Temporary Flight Restrictions (TFRs) of airways over affected areas. Further, Lahars can flow many tens of miles from Mount Rainier and represent the greatest volcanic threat to populated areas. They are capable of burying and destroying anything in their path.

A lahar should not be seen as a singular event, but rather as a mass movement of sediment requiring significant time to recover from. Deposition of feet to tens of feet of sediment along a river valley and its floodplain creates long-term changes to the river environment. Lahars from the 1980 eruption of Mt. St. Helens themselves destroyed 27 bridges, and over 200 homes, and over 185 miles of roads. In addition to this damage, it caused ongoing sediment deposition for years, that caused the need for dredging the Columbia River multiple times, and for the Army Corps of Engineers to spend over a million dollars building a sediment retention structure to mitigate this added hazard of lahars.[7]

After a lahar, mitigation measures may be necessary to prevent hazards from continued sedimentation over the decades following the eruption. One such mitigation measure at Mount St.

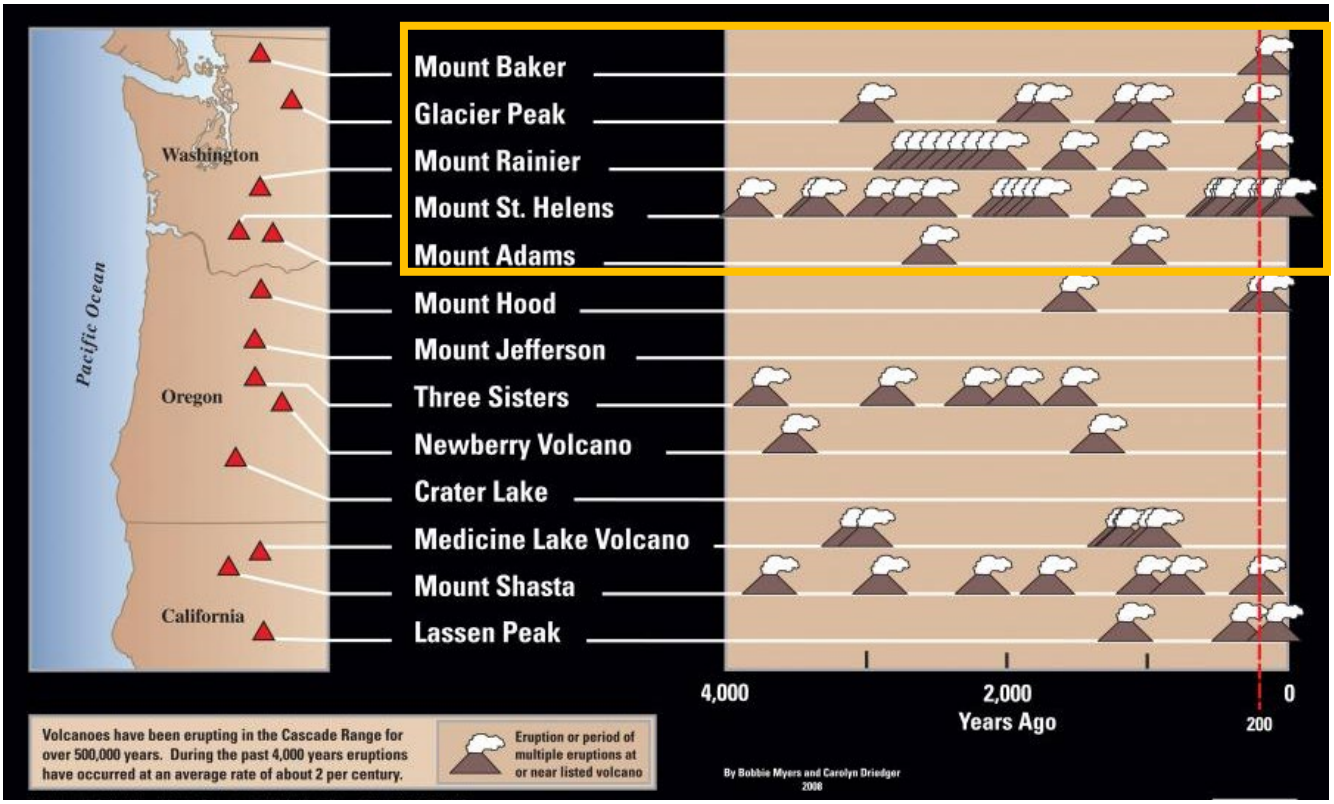
[5] National Research Council, "Mount Rainier: Active Cascade Volcano" The National Academies Press. (1994): https://doi.org/10.17226/4546
[6] National Park Service, "Volcanic Explosivity Index (VEI)" *Volcanoes, Craters & Lava Flows* (August 2022): https://www.nps.gov/subjects/volcanoes/volcanic-explosivity-index.htm
[7] USGS, "Lahar Hazards at Mount St. Helens" *Mount St. Helens*, (November 2023): https://www.usgs.gov/volcanoes/mount-st.-helens/science/lahar-hazards-mount-st-helens

Helens, a sediment retention structure built on the North Fork Toutle River, is intended to prevent too much sand from reaching distant channel reaches and exacerbating flood potential. Dredging is an option to remove sediment deposited in distant channel reaches, but it is expensive, must be repeated, and requires substantial areas to deposit dredge spoil. Deposition of a large amount of sediment on a floodplain may change floodplain character and can entomb structures built on the floodplain.

17.4 Previous Occurrences

The Cascade Range has a long history of volcanic activity, evidenced both by geological deposits that shape the landscape and in the oral histories of the Salish and Coast Salish tribes, passed down through generations. Although the volcanoes in the Cascades remain active, their eruptions are generally infrequent, with geological records indicating an eruption roughly a few times per century. Figure 17-3 illustrates the number of eruptions along the Cascade Range over the past 4,000 years. Some volcanoes, such as Mount Baker and Mount Adams, experience relatively rare eruptions, while others, including Glacier Peak, Mount Rainier, and Mount St. Helens, have shown patterns of clustered eruptions.

Figure 17-4 USGS, Eruptions in Cascade Range in the Past 4,000 Years



In recent years, Mount St. Helens has been intermittent activity from 1980 to 1986 and continuous activity from late 2004 to early 2008.

- **May 1980** eruption of Mount St Helens is the best examples of potential local damages from volcanic activity. This eruption produced significant ash-fall over eastern Washington, Oregon, Idaho, and Montana, with trace amounts falling over the Dakotas, Wyoming, Nebraska, Colorado, Oklahoma, and Minnesota as well as Canadian provinces. Lahars associated with the eruption damaged or destroyed over 200 homes, ruined 27 bridges, and buried 185 miles of roadway. Community water supplies and sewer systems were disabled and reservoirs partly filled with debris.

Mount Rainier began erupting 500,000 years ago and has had numerous eruptions and shed numerous lahars since then. It is estimated that Mount Rainier has generated about 60 of these lahars in the last 10,000 years, with about 10 large enough to reach the Puget Sound. Many communities, including Orting, Puyallup, and Auburn, between Mount Rainier and the Puget Sound are built on top of these deposits.

- **5,600 years ago (approx.)**, an eruption created a massive debris avalanche that transformed into a very large lahar, called the Osceola Mudflow. That lahar traveled down the White River valley and into the Puget Sound. It filled valleys of the White River system to depths of more than 350 feet and moved at speeds of 40 to 50 miles an hour. Following the Osceola Mudflow, many other eruptions and lahars occurred.
- **500 years ago (approx.),** a large landslide-generated lahar originated on the west flank of the volcano called the Electron Mudflow. That lahar traveled down the Puyallup River valley through Orting and into Sumner and Puyallup. However, there is no evidence that this event was triggered by a volcanic eruption.

17.5 Probability of Future Occurrences

According to the Washington State Enhanced Hazard Mitigation Plan, there is a 2.5% chance each year that a volcanic disaster could lead to a formal disaster declaration.[8] While this statistic highlights the potential risk, it's important to note that volcanic eruptions, particularly in the Cascades, can be unpredictable. Volcanoes like Mount Rainier and others in the region can lie dormant for hundreds or even thousands of years between eruptions, making it difficult to foresee exactly when an eruption might occur. Despite this uncertainty, scientists do know that future eruptions are likely.

Furthermore, the population of the Pacific Northwest continues to grow, the risk associated with volcanic events is also increasing. Since the 1980 eruption of Mount St. Helens, there has been a significant rise in both the number of people living in at-risk areas and the infrastructure exposed to volcanic hazards. Advance warning of unrest and potential implications of unrest are critical to

[8] Washington Emergency Management Division (EMD), "Volcano" *Washington State Enhanced Hazard Mitigation Plan* (2023): p. 71, https://mil.wa.gov/asset/651ec296d76a9/2023_WA_SEHMP_final_20231004.pdf

communities downstream from the volcanoes, because even a relatively small eruption could scour and melt snow and glacier ice and produce lahars that could reach heavily populated areas.

17.6 Climate Change Considerations

Volcanic eruptions can influence climate, primarily through the release of gases, aerosols, and ash into the atmosphere. While volcanic ash, which is injected into the stratosphere during major explosive eruptions, typically falls back to Earth within days or weeks and has little lasting impact on climate, the gases released can have significant effects.

For instance, sulfur dioxide (SO_2) can form aerosols that reflect sunlight, leading to temporary global cooling. In contrast, carbon dioxide (CO_2), a greenhouse gas, can contribute to global warming by trapping heat in the atmosphere. However, despite the release of CO_2 during contemporary volcanic eruptions, it has not been shown to cause detectable global warming on a large scale.[9]

17.7 Impact Assessment

Public	The estimated King County population that might be impacted from Mount Rainier by a Case 1 lahar is 17,920, Case 2 is 3,527 and 49,486 in a post-lahar sedimentation zone. The distance from Mount Rainier makes direct impact of eruption from a pyroclastic event unlikely. Prevailing winds make ash fall in the county a relatively low probability event. Lava flows and landslide activity would impact the National Park and possibly part of Pierce County but are unlikely to reach any portion of inhabited King County. Indirect impacts from a major eruption might include a cooling climate from atmospheric suspended ash clouds but this too is unlikely. Fine ash may cause regional health impacts – especially respiratory for the duration of ash fall or during any ash resuspension by strong winds. Impacts to vehicles and air handling systems in homes and workplaces may have an employment impact to the King County population. However, it is also worth noting many Pierce County residents commute to jobs in King County, so disruptions in Pierce could have economic ripple effects throughout the region.
Responders	Responder vehicles need regular air filter changes during ashfall. Air filters in the quantity required are likely not available. Responders will also be taxed by high numbers of calls and dangerous roads caused by slick ash.
Continuity of Operations	Potential impacts to county delivery of services from a Mount Rainier eruption would be the result of damages to infrastructure, equipment including machinery and vehicles, inaccessibility to service areas, impedance

[9] USGS, "Volcanoes Can Affect Climate" *Volcano Hazards Program* (n.d.): https://www.usgs.gov/programs/VHP/volcanoes-can-affect-climate

	to transportation routes used by the county workforce, and health impacts to residents and the workforce. County services that might be interrupted might include: Medic One response, King County Sheriff's Office services like 9-1-1 dispatch, search and rescue and marine or aviation unit response, adult detention, solid waste and waste water services. Services provided by other government agencies and basic service providers might include interruption of: power, phone and cell phone service, emergency medical service, fire and law enforcement, water systems, and health/medical facilities.
Property, Facilities, and Infrastructure	**Property** The cities of Algona and Pacific are the most at risk from a Mount Rainier lahar event, with over 90 percent of their structures exposed to the lahar. While the percentage of structures is not as high, the City of Auburn has the highest potential dollar-value losses. Other damages would include the loss of HVAC and air filtration systems, and electrical systems shorting out. Furthermore, following rains, ash hardens to a concrete-like consistency, which can clog gutters and drains and cause them to fail or collapse. Businesses that operate electronic systems will require decontamination rooms to prevent ash from getting inside and damaging electrical equipment. **Facilities** Health systems would be impacted by an expected dramatic rise in demand for services as ash causes people to seek care for respiratory distress and lahars can cause serious injuries. Health systems would also be hindered by transportation system impacts. First responder vehicles should have air filters changed a frequent as every 30 minutes during volcanic ash events and there are not enough air filters on hand to meet this requirement. **Infrastructure** • Power: Ash can short out electrical systems and cause widespread power failure. Ash accumulation may also cause issues with power generation dams. Generation facilities may be shut down to prevent damage to sensitive components. • Water/Wastewater: Water systems, including reservoirs, could quickly clog with ash, potentially polluting water supply. • Transportation: volcanic ash is very slick and roadways would become treacherous. Vehicles would need regular air filter replacements and there are not sufficient air filters in the region to offset the need. Airports in the region may require Temporary Flight Restrictions (TFRs) of airways over affected areas. Any lahar could potentially destroy major transportation routes, including I-5.

- Communications: Electrical and communication impact can be severely impacted during ashfall. Ash getting into electrical systems can cause systems to short out.

Environment	Any significant volcanic activity at Mount Rainier would have an impact to the environment. Tephra (ash) fall, pyroclastic flows, large landslides, and lahar activity would directly impact birds, fish, mammals, reptiles, amphibians, trees, and vegetation. Sediment deposition would impact rivers that support salmon and steelhead spawning. Large landslides and lahars may change the course of rivers entirely. Lahars may cause hazardous material releases that harm birds, fish and other wildlife. Recreational use of ski areas and hiking trails would also be impacted. After four decades, timber and wildlife at Mount St. Helens have not yet fully returned to pre-1980 levels.
Economy	Many of the impacts to humans and the environment from a Mount Rainier eruption would also impact the economy of King County. Aviation interruption would likely occur from airborne ash. A lahar event would impact rail and port service from direct damages to infrastructure like bridges, rails, and roadways, or from inaccessibility to ports. Post-eruption excess sedimentation would affect areas father downstream and exacerbate flooding. Ash would cause interruption of all internal combustion engines or vehicles that require filters would impact the workforce and movement of food and supplies as well as repair crews. Abrasion from fine ash on all mechanical parts would cause longer term damages to industrial operations and the ports. Health and respiratory issues would make both indoor and outdoor professions difficult. Medical facilities and the patients that rely on them would have difficulty operating. The cost of debris removal following a lahar or substantial ash fall would be enormous, even similar to efforts from a major earthquake. Volcanic ash can also have major impacts on agriculture if feed and water sources are not taken care of properly. Farm animals can inadvertently grind down their teeth while grazing on grasses that include volcanic ash over time, and may suffer from stomach or intestinal injuries from drinking ashy water.[10]

[10] USGS, "Agriculture – Plants & Animals" *Volcanic Ashfall Impacts Working Group*, (December 2015): https://volcanoes.usgs.gov/volcanic_ash/agriculture.html

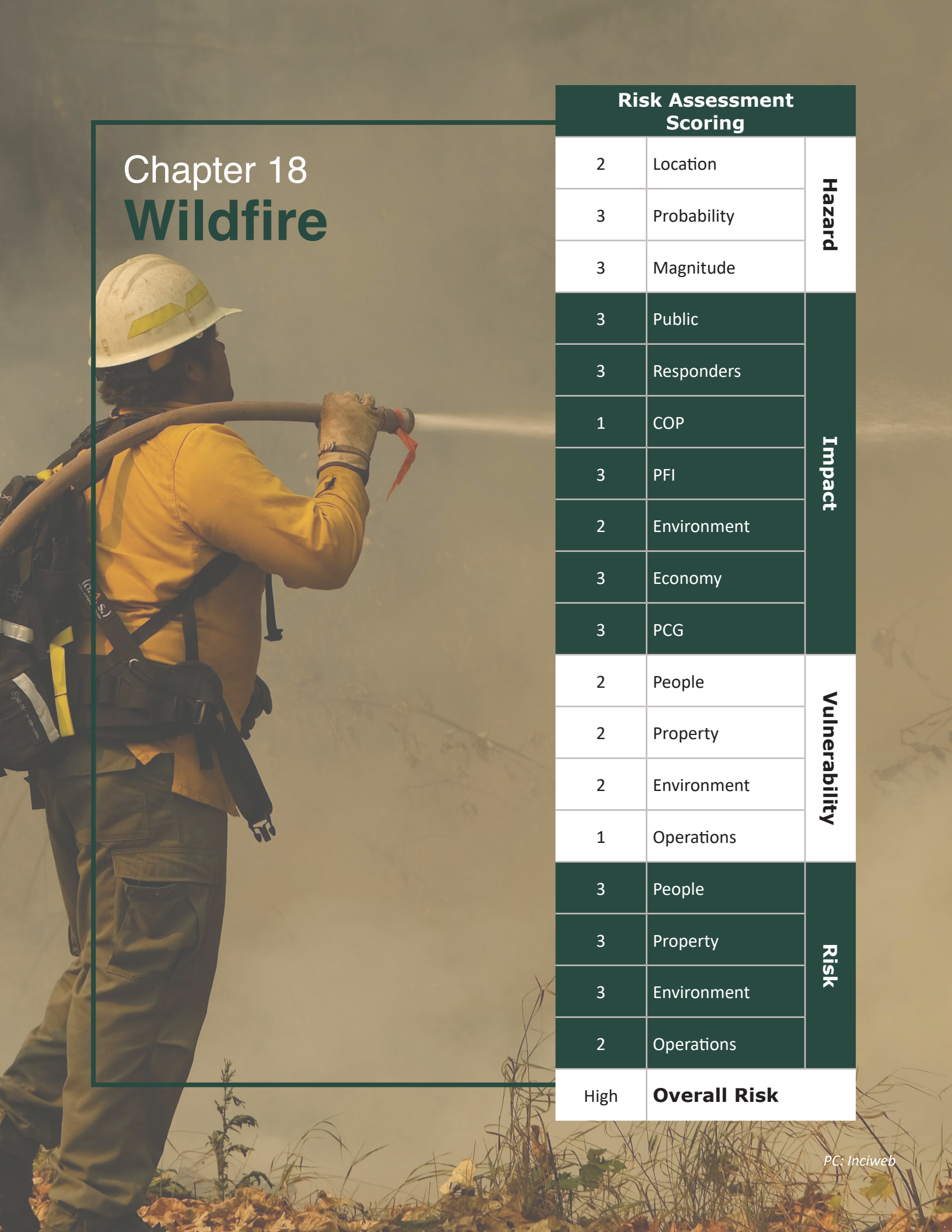
Public Confidence in Governance	The public's knowledge on volcanic eruption and evacuation protocols are limited due to the infrequent eruptions in this region of the Cascades. The last large eruption was Mount St. Helens in 1980. At the time, US scientists had no direct experience with monitoring and forecasting eruptions of explosive volcanoes, thus Mount St. Helens eruption didn't come with early warning. There was even confusion on the possibility that the volcano could erupt sideways. This could give the impression that government isn't well prepared for another eruption. However, since that time, investments in research, volcano monitoring, and public outreach have increased the ability of the USGS to detect early signs of unrest and with local emergency management to communicate factual, reliable, and actionable information to government authorities and the public.

17.8 Vulnerability Assessment

Vulnerable Populations	Impacts to individuals with access and functional needs will be extremely serious. Transportation will be impacted, resulting in difficulty accessing appointments. Individuals with chronic respiratory vulnerabilities will be most negatively impacted by ash. While there are limited numbers of King County residents in the path of the lahar, the communities that are most impacted have higher rates of disability and poverty than the statewide average. Communities downstream of the direct lahar impact area will likely experience post-lahar excess river sedimentation which can exacerbate flooding. Communities in the path of lahar hazards Communities in the vicinity of Mount Rainier, including the King County communities of Algona, Pacific, and Auburn, are most vulnerable to a large lahar generated by an eruption of Mount Rainier. Communities further down valley are vulnerable to excessive river sedimentation in the aftermath of an eruption and lahar. Populations vulnerable to respiratory distress brought on by ash Ash from any volcanic eruption can lead to disruption of daily life and is a major threat to people with medical vulnerabilities. Populations in the immediate vicinity of a volcano Populations that use Mount Rainier National Park or work in the area around the mountain are most susceptible to multiple near-volcano hazards that can affect the immediate surroundings within minutes.

	Although advanced notice of a potential eruption is likely, it will be impossible to predict the exact moment of eruption. Residents from the town of Orting have approximately 45-minutes to evacuate following onset of a large lahar in the Puyallup valley.
Property	Property damage from lahars can include complete inundation and destruction of any property in the lahar's path. Furthermore, property damage that can occur from ash fall include obstructed filters in HVAC systems, clogged drainage systems in gutters, and corrosion on metal roofs.
Environment	Lahars along the White River, with post sedimentation in the Green and Duwamish River can drastically alter the riverbed and changing water flow dynamics. The added sediment can increase erosion downstream and significantly impact aquatic life, leading to long-term ecological disruption. Changes to floodplains can also create new areas of vulnerability, potentially exposing hazardous materials and increasing erosion risks during future flood events.
Operations	**Energy** Electrical systems may short out due to ashfall and power generation can be curtailed as generation systems are shut off to protect sensitive components. **Communication** Communications equipment has the same vulnerability as general electrical systems and is subject to failure due to ash damage. **Air Travel** Airports may be closed for the duration of major ash dispersal including ash remobilization due to wind. **Roads** Traffic signals may short out during ashfall. Ash can create a very slippery driving surface. Ash can damage vehicle engines and scratch windshields when wipers are being used. Driving is not recommended during heavy ashfall.

Chapter 18
Wildfire



Risk Assessment Scoring		
2	Location	Hazard
3	Probability	
3	Magnitude	
3	Public	Impact
3	Responders	
1	COP	
3	PFI	
2	Environment	
3	Economy	
3	PCG	
2	People	Vulnerability
2	Property	
2	Environment	
1	Operations	
3	People	Risk
3	Property	
3	Environment	
2	Operations	
High	**Overall Risk**	

PC: Inciweb

Chapter 18: Wildfire

18.1 Hazard Description

2022 Bolt Creek Fire

A wildfire is an unplanned, unwanted fire burning in a natural area such as a forest, grassland, or prairie**.** Wildfire is a historically natural phenomenon that has played a role in reshaping and regenerating our ecosystems since time immemorial. However, the dangers wildfires can pose to the public and first responders are significant. Wildfires can damage natural resources, destroy homes and structures, and threaten the safety of the public and first responders. While King County and Western Washington have historically been viewed as having a relatively low fire risk, the dense vegetation in our forests can serve as an ample source of wildfire fuel if conditions are right for them to burn. In the last decade, the region has been experiencing drier summers and longer fire seasons, with approximately 30-40% of wildfire starts in Washington occurring on the west side of the Cascade Crest.[1] Meanwhile, more and more people are moving into the wooded areas of King County with a higher likelihood of exposure to fire. Of particular concern is a wildfire that spreads from the wildlands to the urban environment.

While wildfires do start naturally through lightning strikes, 85% of wildfires in Washington are started by human activity.[2] Human-caused ignitions include arson but starts are more often the result of a range of unintentional and avoidable causes such as sparks from vehicles dragging

[1] Courtney Flatt, "Washington's 2022 fire season has been the mildest in a decade" *OPB* (October 2022): https://www.opb.org/article/2022/10/09/washington-wildfire-season-bolt-creek-fire-goat-rocks-fire-oregon-wildfires/
[2] Washington Department of Natural Resources (DNR), "Wildfire Resources" *Wildland Fire Management Division* (n.d.): https://www.dnr.wa.gov/programs-and-services/wildfire-resources

materials, fallen utility lines, negligent backyard debris burning, or pyrotechnics and recreational fires that get out of control. Wildfires can spread rapidly when fueled by dense, dry, uninterrupted vegetation, especially in areas with steep slopes, ridges, and during windy conditions with high temperatures and low humidity.

To compound the situation, an area burned by an intense wildfire is more likely to experience additional hazards such as flooding and landslides. Wildfire smoke is also a significant threat to public health, and smoke annually impacts King County even when the source fires are well outside of county boundaries. Wildfire smoke is made up of fine particulate matter (PM2.5) which can cause a range of negative health impacts, especially for vulnerable populations including people with chronic health conditions, children, pregnant women, and first responders who are exposed to large amounts of PM2.5 through their work.

The wildland fire season in Washington generally starts in May and continues through October.[3] Conditions such as drought, low snowpack, and local weather conditions can impact the length of the fire season. In King County, the window of vulnerability to wildfire is from late August to October. The most recent significant fire in King County, the 2022 Bolt Creek Fire, ignited in September and burned through the end of October. The National Weather Service issues Red Flag Warnings when warm temperatures, very low humidities, and stronger winds are expected to combine to produce an increased risk of fire danger; August and September were the months when the most Red Flag Warnings were issued from 2006-2022.[4]

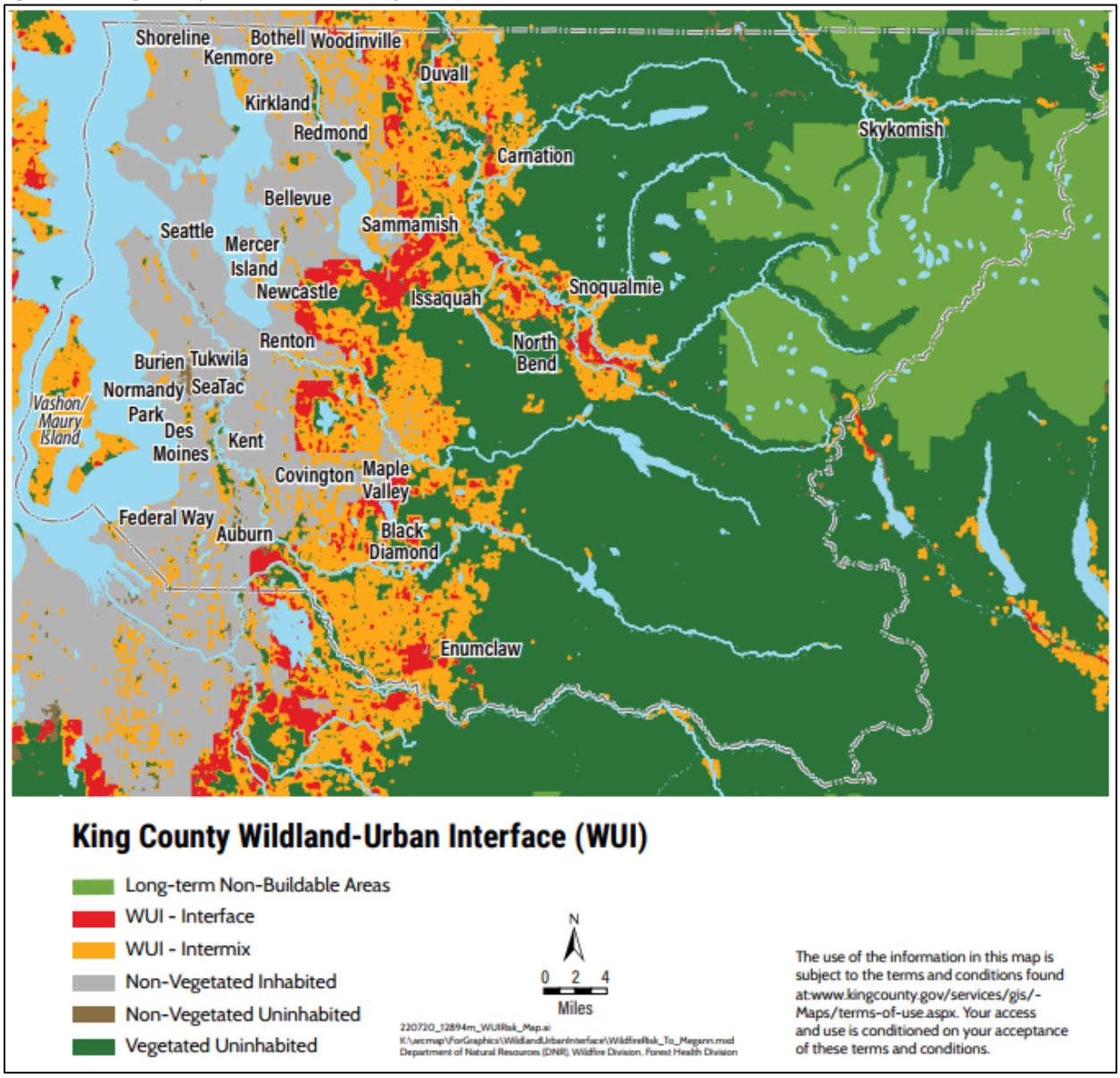
To address concerns related to wildfire, King County will be publishing a countywide Community Wildfire Protection Plan (CWPP) in 2025 that expands upon items listed in this chapter and describes concerns, risk factors, and effective wildfire mitigation actions. Actions or mitigation plans listed in the King County CWPP will be considered a part of the King County Regional Hazard Mitigation Plan, regardless of the adoption date, and will be incorporated into this plan at the next scheduled update.

[3] Western Fire Chiefs Associate, "Washington Fire Season: In-Depth Guide" (April 2024): https://wfca.com/wildfire-articles/washington-fire-season-in-depth-guide/

[4] National Oceanic and Atmospheric Administration (NOAA), "Red Flag Warning" *National Weather Service (NWS)* (n.d.): https://www.weather.gov/mqt/redflagtips#:~:text=A%20Red%20Flag%20Warning%20means,increased%20risk%20of%20fire%20danger.

18.2 Location

Figure 18-1 King County Wildland Urban Interface (WUI)[5]



Wildland-Urban Interface

The **wildland-urban interface (WUI),** or the zone of transition between structures and human development and undeveloped land or vegetative fuels, is of particular importance for wildfire mitigation. Figure 18-2 displays the current King County WUI map.

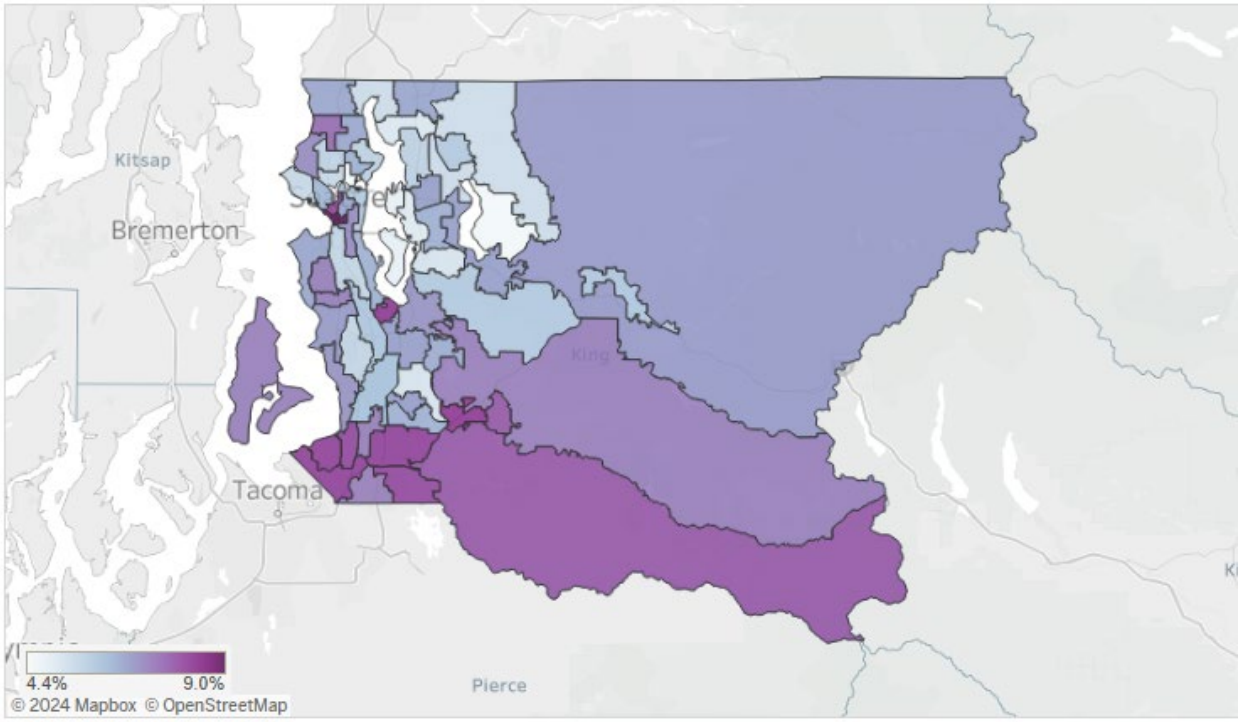
[5] King County, "Wildfire Risk Reduction Strategy" *Office of Emergency Management* (July 2022): https://your.kingcounty.gov/dnrp/climate/documents/king-county-wildfire-strategy-report.pdf

- **Interface** areas are those in which development and structures are bordered by wildlands on at least one side.
- **Intermix** areas are defined as a development or structure that is surrounded on two or more sides by wildlands.

The WUI map above is not a wildfire risk map and simply demarcates where the wildlands and urban areas meet and overlap; however, communities in the WUI have a higher likelihood of exposure to wildland fires so it is an important area to consider for wildfire mitigation work.

Wildfire Smoke

Figure 18-2 Asthma Diagnosis Medicaid Members (All Ages), King County 2023[6]



Wildfires in neighboring regions, including Eastern Washington, Oregon, and British Columbia, frequently bring wildfire smoke into King County, leading to hazardous air quality conditions. Recent studies on wildfire smoke exposure in Washington have revealed a significant link between exposure to PM2.5 from wildfire smoke and increased visits to emergency rooms and outpatient clinics.[7] Vulnerable groups, particularly children with asthma and those experiencing childhood respiratory or chest symptoms, are disproportionately affected. Chronic Obstructive Pulmonary

[6] King County, "Asthma data dashboards - Asthma diagnosis among Medicaid members" *Public Health – Seattle & King County (PHSKC)* (October 2024): https://kingcounty.gov/en/dept/dph/about-king-county/about-public-health/data-reports/climate/asthma
[7] https://deohs.washington.edu/hsm-blog/wildfire-smoke-tied-increased-risk-er-visits

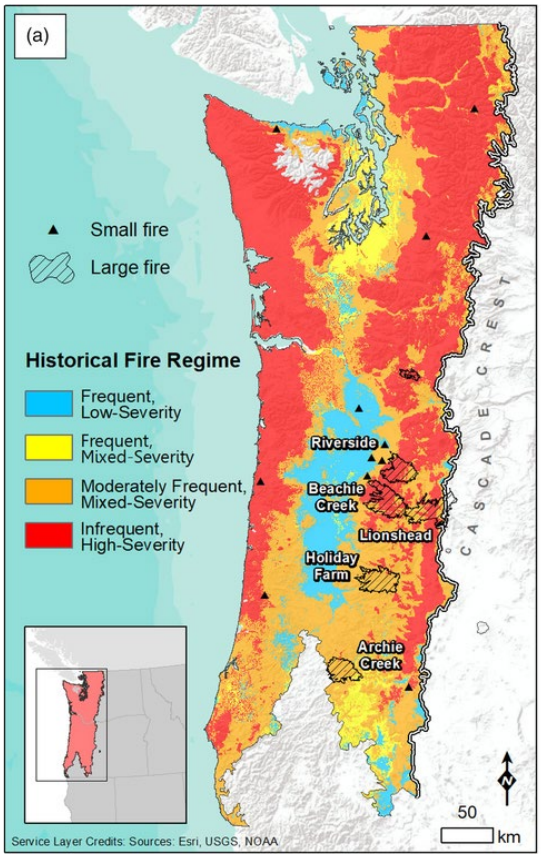
Disease (COPD) patients across all age groups also face heightened risks, as do individuals with other respiratory conditions.

In 2021, The Puget Sound Clean Air Agency reported that the region's unprecedented wildfire smoke events resulted in the highest amounts of particulate matter in the air since air quality monitoring for PM2.5 began in 1980.[8] As climate change increases the likelihood of larger and more severe wildfires, the number of days with poor air quality from smoke increases as well.

18.3 Magnitude

Wildfire Regime

Figure 18-3 Western Cascadia wildfire regime[9]



To understand the magnitude and frequency of wildfires, it is essential to understand the norms and patterns of wildfires in our area over time, which is known as the **wildfire regime**.[10] King County has two predominant wildfire regimes, demonstrated in Figure 18-3. Parts of King County experience frequent to moderately frequent and lower- to moderate-severity wildfires. These fires are often relatively small (<50,000 acres) and are more easily limited by external factors such as weather, available fuel, topography, and standard firefighting techniques.

The other type of fire in our wildfire regime is **infrequent and high-severity wildfire**. The most likely scenario for a such a fire to occur is during a major east-wind event when vegetative fuels are dry and primed for burning; such fires can be massive (100,000 to >1,00,000 acres), are incredibly difficult to contain, and often burn at a severity that kills entire sections of forest (what is known as a "stand-

[8] Puget Sound Clean Air Agency, "2021 Data Summary" (2022): https://www.pscleanair.gov/673/2021-Data-Summary
[9] Matthew J. Reilly, et. al, "Cascadia Burning: The historic, but not historically unprecedented, 2020 wildfires in the Pacific Northwest, USA" *ESA* (June 2022): https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecs2.4070
[10] Emily Fales, Daniel Donato, "Key Insights for Wildfire Management in Western Washington: Fire Regime and Forest Structure" *Forest Stewardship Notes* (February 2024): https://foreststewardshipnotes.wordpress.com/2024/02/06/key-insights-for-wildfire-management-in-western-washington-fire-regime-and-forest-structure/

replacing" fire). Because the majority of the wildlands in King County are east of the populous areas of the county, strong wind from the east could push a wildfire directly into the urban areas of King County, a situation which would be dangerous and even deadly.

The challenge of the low-frequency, high-severity fire regime is that many of the major stand-replacing wildfires that have impacted the region are out of living memory. The average return interval between such wildfires is anywhere from 100-500 years. Because major westside fires rarely occur, people in areas of higher risk may not realize just how vulnerable they are to a major wildfire. Lack of awareness can lead to lack of preparedness, low interest in mitigation, and inadequate precaution with potential ignition sources. Maps of fire risk in the United States – such as the FEMA Risk Index map – show King County as "relatively low" risk, but this is because these maps are calculated using annualized frequency fires.[11] Such calculations convey the low frequency of our wildfire regime but does not accurately capture the danger of a major fire if conditions are right. Furthermore, the impacts of climate change are rapidly increasing the risk factors for wildfire. We must not only plan for our historic fire regime but consider the likely worsening wildfire scenarios of the future.

Severity of Wildfire

While a fire is actively burning, its impact can be measured several ways. The size of a fire is often typically communicated to the public by the number of acres burned. Within the first responder community, wildfires are categorized by the complexity of a response using Incident Command System (ICS) typing. Table 18-2 describes the factors of a wildfire response that delineate incident type, with Type 1 is the most resource-intensive.

Table 18-1 Incident Command System (ICS) for wildfire response

Type 5:	Type 4:	Type 3:	Type 2:	Type 1:
Very small wildland fire only Short duration Few resources assigned (generally less than 6 people) Little complexity	Initial attack or first response to an incident Few resources are used (several individuals or a single strike team) Normally limited to one operational period	Extended initial attack on wildland fires Resources may vary from several single resources to several task forces or strike teams May extend into another operational period (12 hours), and require an IAP	Large number of resources utilized Incident extends into multiple operational periods Significant logistical support is required	Multi-agency and national resources Large number of personnel and equipment are assigned to the incident It is a large, complex incident

[11] FEMA, "Wildfire" *National Risk Index* (n.d.): https://hazards.fema.gov/nri/wildfire

Wildfire intensity is the amount of energy or heat given off by a forest fire at a specific point in time.

- **Low Intensity:** Flames are low, staying close to the ground making the fire spread slowly. Not much heat is produced which makes it more manageable.
- **Moderate Intensity:** Flames are a bit higher but only by a few inches so the fire spreads at moderate speed with moderate heat produced.
- **High Intensity:** Flames are high and can be tough to control. The fire moves considerably faster and can be a challenge. The heat coming from the fire has noticeably increased in temperature.
- **Extreme Intensity:** Flames are extremely high, towering above everything. The fire spreads extremely fast and is hard to predict. The substantial heat generated poses a significant threat to people and nature.

The intensity of a wildfire is a key indicator of the fire's severity, or the measure of a fire's impact on the area burned. A low intensity fire may burn low-level vegetation but leave trees intact, so forests can quickly rebound. Conversely, a high or extreme intensity fire can destroy the flora of an entire area, leaving a lengthy road to recovery.

AQI for PM2.5 – Smoke

According to the Washington Department of Ecology, wildfire smoke is the largest source of particle pollution in Washington.[12] The effects of smoke exposure range from eye and respiratory tract irritation to more serious health problems including reduced lung function, bronchitis, asthma exacerbation, heart failure, and premature death. People with existing heart and lung diseases, older adults, children and pregnant women are especially at risk of smoke-related health problems. The Puget Sound Clean Air Agency monitors air quality and communicates the level of unhealthiness with the Air Quality Index, which tracks concentrations of several pollutants including PM2.5.[13] In 2017, and especially 2018, smoke from wildfires inundated Seattle, causing unhealthy air quality. This was due to wind patterns that blew smoke from fires in British Columbia, Oregon,

[12] WA Department of Ecology, "Wildfire smoke information" (n.d.): https://ecology.wa.gov/air-climate/air-quality/smoke-fire/wildfire-smoke
[13] US Environmental Protection Agency (EPA),"Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (AQI)" (May 2024): https://document.airnow.gov/technical-assistance-document-for-the-reporting-of-daily-air-quailty.pdf

and Eastern Washington into the region. Warmer summers will increase the number of fires and with more fires, more smoky days are likely.[14]

Table 18-2 Sensitive Groups and the Air Quality Index

Sensitive Groups and the Air Quality Index

Index Value	Level of Health Concern	What it Means
301 - 500	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.
201 - 300	Very Unhealthy	Health alert: everyone may experience more serious health effects.
151 - 200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
101 - 150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
51 - 100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.

According to the Washington Department of Ecology, wildfire smoke is the largest source of particle pollution in Washington.[15] The effects of smoke exposure range from eye and respiratory tract irritation to more serious health problems including reduced lung function, bronchitis, asthma exacerbation, heart failure, and premature death. People with existing heart and lung diseases, older adults, children and pregnant women are especially at risk of smoke-related health problems. The Puget Sound Clean Air Agency monitors air quality and communicates the level of unhealthiness with the Air Quality Index, which tracks concentrations of several pollutants including PM2.5.[16] In 2022, smoke from the Bolt Creek Fire and other area fires reduced air quality in the region to the worst in the world for multiple days.[17] According to a health impact assessment by University of Washington researchers, a similar smoke episode in 2020 contributed to an estimated 92 excess deaths, several of which could have been prevented with reduced exposure to $PM_{2.5}$.[18] Wildfire smoke is particularly dangerous when a wildfire burns through the WUI, because the smoke contains fine particular matter along with toxins released

[14] Greg Gilbert, "Smoky Seattle summers: expect more of them, scientists say" *The Seattle Times* (August 2018): https://www.seattletimes.com/seattle-news/smoky-seattle-summers-expect-more-of-them-scientists-say/.
[15] WA Department of Ecology, "Wildfire smoke information" (n.d.): https://ecology.wa.gov/air-climate/air-quality/smoke-fire/wildfire-smoke
[16] US Environmental Protection Agency (EPA),"Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (AQI)" (May 2024): https://document.airnow.gov/technical-assistance-document-for-the-reporting-of-daily-air-quailty.pdf
[17] Michelle Baruchman, "Seattle air quality among worst in world" *Seattle Times* (October 2022): https://www.seattletimes.com/seattle-news/environment/seattle-air-quality-among-worst-in-world/
[18] A. Doubleday, A, et. al., "Mortality associated with wildfire smoke exposure in Washington state, 2006-2017: A case-crossover study" *Environmental Health*, 19(1) (2022): https://pmc.ncbi.nlm.nih.gov/articles/PMC8101535/#gh2228-bib-0012

from burning household hazardous materials, vehicles, and structures.[19] Warmer summers will increase the number of fires and with more fires, more smoky days are likely.[20]

Cascading Impacts

Post-wildfire flooding, landslides, and mudslides are deadly cascading impacts that result from extreme wildfires in areas with steep slopes and are a serious threat to King County. 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. This can lead to large debris flows and mudslides when heavy rains occur that damage infrastructure and communities downstream for several years after a fire. A fire in one of the foothills communities could cause major mudflows and devastating flooding in communities in the watershed impacted by the fire and through which rivers and creeks pass. Communities with existing flood risk, such as along the Snoqualmie River, are especially vulnerable. Following a wildfire, experts from the US Geological Survey and/or Washington DNR can conduct assessments on burned areas to determine the likelihood of major debris flows from a burned area.[21]

18.4 Previous Occurrences

Modern recordkeeping on wildfires did not begin until the 20th century, so occurrences of major fires before then in King County are not well documented. However, several high-intensity fires similar to those anticipated here have been recorded on the west side of the Cascades. Table 18-4 notes past wildfires in King County that have burned at least 100 acres of timber.

Table 18-3 Previous large wildfire events in King County, 1893 - 2024

Date	Event Name	Description
September 1, 1893	n/a	Several large, human-caused wildfires sparked during windy conditions and burned from Snoqualmie Pass to Skykomish. No acreage burned recorded.[22]

[19] https://phys.org/news/2023-06-toxic-emissions-wildland-urban-interface.html
[20] Gilbert, Greg. "Smoky Seattle summers: expect more of them, scientists say" *The Seattle Times* (August 2018): https://www.seattletimes.com/seattle-news/smoky-seattle-summers-expect-more-of-them-scientists-say/.
[21] US Geological Survey (USGS), "Miriam Fire Preliminary Hazard Assessment" (2018): https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=224.
[22] Living Snoqualmie, Honoring Our Valley History: Past Fires of the Snoqualmie Valley" *Snoqualmie Valley Info* (October 2022): https://prod.livingsnoqualmie.com/honoring-our-valley-history-past-fires-of-the-snoqualmie-valley/

May 31, 1922	n/a	A human-caused wildfire started during a windy day in eastern King County and destroyed half the town of Cedar Falls. No acreage burned recorded.[23]
September 1, 2009	Lemah Fire	A fire sparked in the Alpine Lakes Wilderness and burned approximately 600 acres.[24]
August 11, 2017	Quarry Fire	A wildfire started 30 miles northwest of North Bend and burned 243 acres.[25] The response cost $1,089,194.
September 4, 2017	Sawmill Creek Fire	A fire started in the Green River Watershed burned 1,061 acres.[26] The response cost $4,500,000.
***September 7, 2020**	Labor Day Fires	This series of fires was preceded by dry conditions and a synoptic east-wind event, and the fires that sparked burned approximately 840,160 acres in two weeks.[27] The fires prompted evacuation orders to 90,000 people and resulted in millions of dollars in damage.[28]
September 8, 2020	Fish Fire	A fire southeast of Enumclaw burned approximately 150 acres during the Norse Creek Fire.
August 18, 2022	Murphy Lake Fire	A fire sparked by a lightning strike on August 18th grew to 170 acres, temporarily closing a section of the Pacific Crest Trail.[29]

[23] Washington Forest Protection Association (WFPA), "A Chronology of the First 100 Years of the Washington Forest Protection Association 1908-2008" *History Link* (n.d.): https://www.wfpa.org/wp-content/uploads/2022/11/100-Year-Chronology-small-file.pdf
[24] The Associated Press, "Fire closes part of Pacific Crest Trail in central Cascades" *Seattle Times* (September 2009): https://www.seattletimes.com/life/outdoors/fire-closes-part-of-pacific-crest-trail-in-central-cascades/
[25] Northwest Interagency Coordinator Center (NWCC), "Northwest Annual Fire Report" (2017): https://gacc.nifc.gov/nwcc/content/pdfs/archives/2017_NWCC_Annual_Fire_Report_FINAL.pdf
[26] USDA, "Sawmill Creek Fire Update" *USFS* (September 2017): https://www.fs.usda.gov/detail/mbs/news-events/?cid=FSEPRD558196
[27] Matthew J. Reilly, et al., "Cascadia Burning: The historic, but not historically unprecedented, 2020 wildfires in the Pacific Northwest, USA" *Ecosphere* (2022): https://www.fs.usda.gov/pnw/pubs/journals/pnw_2022_reilly001.pdf
[28] Emily Fales, Daniel Donato, "Key Insights for Wildfire Management in Western Washington: Fire Regime and Forest Structure" *Forest Stewardship Notes* (February 2024): https://foreststewardshipnotes.wordpress.com/2024/02/06/key-insights-for-wildfire-management-in-western-washington-fire-regime-and-forest-structure/
[29] Northwest Interagency Coordinator Center (NWCC), "Northwest Annual Fire Report" (2017): https://gacc.nifc.gov/nwcc/content/pdfs/archives/2017_NWCC_Annual_Fire_Report_FINAL.pdf

September 9, 2022	Bolt Creek Fire	September 9, the fire started 1.5 miles north of Skykomish, prompted evacuations, and burned approximately 14,766 acres in the Mt. Baker-Snoqualmie National Forest.[30]
October 16, 2022	Loch Katrine Fire	A wildfire spread during a Red Flag Warning 35 miles east of Seattle and burned 2,000 acres.[31]

18.5 Probability of Future Occurrences

As the climate changes, there is a greater likelihood that high temperature and dry conditions will be present along with the already-existing topographic, wind, and fuel conditions necessary to support a large fire. Development is also expected to densify in the wildland-urban interface. The building patterns in these areas are not in accordance with Fire Wise principles and many communities have limited ingress and egress routes.

18.6 Climate Change Considerations

As the climate changes, it is expected to lengthen the fire season and increase the likelihood of more wildfire in Western Washington.[32] Prolonged summer heat, combined with high density forests and areas of poor forest health, is increasing fire risk. Hotter and drier conditions are two of the three factors that influence fire behavior and make a wildfire significantly more likely to occur in King County. If emissions continue at their current rate, the annual average amount of acres burned in the Pacific Northwest is expected to more than triple by the 2040s.[33]

18.7 Impact Assessment

Public	Approximately 6% of King County's total population (~352,000 people) who live in the Wildland Urban Interface (WUI) are more likely to be directly exposed to wildfire than the rest of the county.

[30] InciWeb, "10/2/2022 Bolt Creek Fire Update" (October 2022): https://inciweb.wildfire.gov/incident-publication/wanws-bolt-creek-fire/1022022-bolt-creek-fire-update
[31] Chris Bentley, "Loch Katrine Fire Swells to over 2,000 Acres Overnight Due to Severe Fire Weather" *USDA, USFS* (October 2022): https://www.fs.usda.gov/detail/mbs/news-events/?cid=FSEPRD1067163
[32] Alex W. Dye, et. al., " Simulated Future Shifts in Wildfire Regimes in Moist Forests of Pacific Northwest, USA" *AGU* (February 2024): https://doi.org/10.1029/2023JG007722
[33] H.A. Morgan, et. al, "Managing Western Washington Wildfire Risk in a Changing Climate" *UW Climate Impacts Group, Northwest Climate Adaptation Science Center* (2019): https://nwcasc.uw.edu/wp-content/uploads/sites/23/2019/04/Managing-Western-Washington-Wildfire-Risk-in-a-Changing-Climate-1.pdf

	This risk is growing due to climate change and new development in the WUI. It's also important to note that evacuations cannot be enforced, thus in the event of wildfire outbreak, those who remain in their homes located in or near the WUI are at higher risk. The most frequent impact of wildfires King County residents will experience is exposure to smoke. Wildfire smoke can cause respiratory issues, prevent people from taking part in outdoor activities, and increase emergency department visits.
Responders	Growing numbers of wildfires will increase risk to firefighters. With an increase in WUI fires, firefighting becomes more complex and dangerous. Also, communities without proper ingress/egress routes further increase risk to firefighters who may be called upon to attempt evacuations in such communities. As climate change exacerbates wildfires across the United States, increasing frequency and severity of fires and extending wildfire season, it increases the strain on firefighting resources. King County's window of vulnerability to wildfire is near the end of the current wildfire season when resources are waning. If federal or state land management agencies are targeted for staff reductions or significant budget cuts, it will decrease the number of trained responders assigned to protect large portions of land in King County, putting increased pressure on mutual aid.
Continuity of operations	Most King County government operations and facilities are in the more urban areas of the county and unlikely to be directly impacted by wildfires. However, a major wildfire might occupy most of the region's first responder capabilities, pulling resources from other sectors and parts of the county through mutual aid. Smoke, which is the most frequent impact of wildfires experienced by King County, can cause an increase in employee absenteeism, put a strain on the health systems, and prompt cancellations of various outdoor activities and events.
Property, facilities, and infrastructure	**Property** King County is working on a countywide wildfire risk assessment that will be published in our Community Wildfire Protection Plan (CWPP) in 2025. Likely impacts to property include smoke damage to total loss of facilities. Communities built with many homes close together and constructed of flammable materials can be completely burned in a short time, as seen in Paradise, CA, Superior, CO, and Lahaina, HI.

Facilities

Exposure to PM 2.5 is a significant health concern, because the small size of the particle allows people to inhale it deep in the lungs where the particles can directly enter the blood stream. The effects of smoke exposure range from eye and respiratory tract irritation to more serious health problems including reduced lung function, bronchitis, exacerbation of asthma and heart failure, and premature death. During extreme smoke pollution events, public health systems are likely to be burdened by populations suffering respiratory distress.

Infrastructure

- Energy: Many major transmission lines run through wildland areas. While utilities have their own wildfire mitigation plans and typically keep brush surrounding transmission lines clear, wildfires in King County could damage or destroy these systems. Rural and other interface power lines would be burned in any fire, as has been seen in numerous communities in Eastern Washington. Many utility providers in the West, including Puget Sound Energy, have implemented plans for Public Safety Power Shut-offs (PSPS) to reduce the likelihood that energized lines will start a fire during “red flag” fire conditions, affecting energy customers, especially those reliant on electricity.
- Water/Wastewater: Many of King County’s watersheds and primary water reservoirs are in forested areas and could be impacted by wildfire that could burn power supplies to pump stations or the pump stations themselves. Furthermore, post-fire runoff and flooding could damage or pollute reservoirs.
- Transportation: Fire can prompt road closures due to visibility concerns, direct contact with fires, and to keep the public away from an evacuated area. Another major risk is post-fire flooding and debris flows that can damage or destroy roads and bridges downstream or downslope from a burned area after a rain. Additionally, SeaTac Airport has had to cancel flights due to poor visibility during wildfire smoke events.
- Communications: Cellular communications sites can lose power or be damaged by wildfire. During these events, it may be necessary to deploy cellular on wheels capabilities.

The environment	While wildfires can be beneficial to the landscape, a major wildfire can be damaging in the near term. Fires can pollute water systems and destroy old growth habitat. They can burn over springs and increase evaporation. Following extreme fires, hydrophobic soils make it difficult for plants to regrow in and the runoff over these soils increases the turbidity of local streams, endangering fish and other water animal populations.
The economy	Wildfire suppression alone is incredibly expensive, with Washington spending an estimated $145.3 million for wildfire suppression in FY 2023.[34] A high-severity wildfire impacting structures could cause significant economic impact to an affected community for years. Disaster recovery is a lengthy process and a wildfire would likely result in displacement of residents and impact local housing stock and prices. Economic costs may be felt by a wildfire that does not impact structures as well. Besides suppression costs, the impacts of wildfire smoke inundation is likely to be limited and temporary. For a wildfire he largest impacts on the economy are likely to be indirect, including losses in work days because of poor air quality, interrupted access to various services, and losses in tourist income.
Public confidence in governance	Wildfire hazards have gained renewed importance in recent years. WUI wildfires are particularly destructive and deadly, and several recent such fires resulted in mistrust of responding institutions, conspiracy theories about fires' sources, and anger and blame at parties in or near the fire. Government will need to be proactive in managing this hazard, communicating clearly throughout a response, and commit to recovery in order to maintain public confidence, which is difficult to earn and easy to lose.

[34] Washington State Legislature, "Emergency Fire Suppression Report for Fiscal Year 2023, Executive Summary for November 2022" *Department of Natural* Resources (2023): https://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=Copy%20of%20MONTHLY%20FIRE%20SUPPRESSION%20REPORT%20FY23_FM17_November_FINAL_1.19.23_3f03aaee-f2de-4a60-ac08-c0d89ef7d331.pdf

18.8 Vulnerability Assessment

Vulnerable populations	Populations suffering from respiratory ailments are at the greatest risk from wildfire since smoke from fire. People with existing heart and lung diseases, older adults, children and pregnant women are especially at risk of smoke-related health problems. **Foothills/interface** Communities in or around areas at a higher risk of fire, such as those in the foothills of the Cascades, are more susceptible to fire. **Fire Footprints** Major wildfires leave behind an environment that is more vulnerable to flooding. When rains come, large quantities of water and debris and rush down hillsides and destroy homes and infrastructure while causing flooding in downstream communities.
Property	There are several factors that put a structure at higher risk of damage from a wildfire. Buildings in the WUI that do not have sufficient defensible space surrounding them are likely to be damaged if directly exposed to wildfire. This includes homes with flammable roofs, proximity to dense brush or timber, or tightly packed neighborhoods with space between buildings. Structures built in interface or intermix areas are more likely to be exposed to fires, including from spotting and embers ahead of a fire. Fires tend to burn up slopes and ridges, endangering structures in those areas. Buildings less than 30 feet from a slope of greater than 30% grade are at risk. Buildings more than five miles away from fire services and with limited pressurized fire hydrant access are more vulnerable.

Environment	A wildfire that burns homes can significantly damage the environment due to numerous quantities of household hazardous materials that burn and release toxins into the air, ash, and soil. Wildfires can harm riparian environments and other critical habitats, and ashfall can decrease water quality. Wildfires are also major carbon emitters. For example, 2023 wildfires in North America released 640 million metric tons of carbon, an amount comparable to annual emissions of a large, industrialized nation.[35] Those areas eventually recover the ability to capture and store carbon as they recover. This can take years, however, because mature forests have the greatest carbon storage potential.[36]
Operations	**Ingress/Egress** Communities with a single route in or out of the area are much more difficult to evacuate. Roads that are less than 24 feet wide, especially those less than 20 feet wide, and those driveways without a turnaround are highest risk.

[35] NASA, "New NASA Study Tallies Carbon Emissions from Massive Canadian Fires" (August 2024): https://www.jpl.nasa.gov/news/new-nasa-study-tallies-carbon-emissions-from-massive-canadian-fires/
[36] NSF, "After the Fire: Studying Forest Recovery and Carbon Storage Potential" (February 2021): https://www.neonscience.org/impact/observatory-blog/after-fire-studying-forest-recovery-and-carbon-storage-potential

Chapter 19: Capabilities

King County includes 39 cities, over 129 special purpose districts, and large unincorporated areas. While each city and special purpose district is responsible for its own hazard mitigation efforts, King County supports these jurisdictions through region-wide services and planning coordination, including efforts associated with land use, emergency management, and floodplain management. County departments involved in hazard mitigation efforts include Executive Services (facilities management, emergency management), Local Services (permitting, roads), Natural Resources and Parks (wastewater, landslides, floodplain management, climate change), and the Office of the Executive (planning).

As the lead agency for hazard mitigation, the King County Office of Emergency Management (KCOEM) collaborates with a wide range of partners to advance and support mitigation efforts through its hazard mitigation program. KCOEM actively promotes Hazard Mitigation Assistance grant opportunities, offering technical support to help develop competitive applications. KCOEM also serves on interagency workgroups such as comprehensive planning, climate adaptation, and transportation as a way of promoting consistency in risk assessment and reduction priorities.

Hazard Mitigation Program

Hazard mitigation is most effective when approached through a systematic program that sets clear priorities and recognizes that building resilience requires widespread, coordinated investments. A cohesive, comprehensive strategy founded on strong partnerships is essential to the success of this program.

To support this approach, King County Emergency Management facilitates multi-agency committees, provides technical assistance for federal mitigation grants, aids partners in planning and executing mitigation projects, and continually updates the King County Regional Hazard Mitigation Plan to ensure it reflects the evolving needs and priorities of the region.

The focus of the KCOEM's hazard mitigation program is integration across plans, programs, and departments and jurisdictions. Plan integration ensures that all partners utilize the best available data and align their efforts to support a resilient future. Program integration connects partners with funding sources and resources beyond their individual departments or programs. Departmental and jurisdictional integration builds on the county's role through the Emergency Operations Center (EOC), mobilizing resources to prioritize and implement the most effective hazard mitigation strategies.

A crucial component of this integration is the capabilities assessment, which evaluates the community's capacity to reduce or mitigate the impacts of disasters. By conducting this assessment, KCOEM creates a comprehensive toolbox of plans, policies, ordinances, programs, and departmental resources that address identified hazards. This ensures that all partners have a clear understanding of their current capabilities and are equipped to effectively contribute to hazard mitigation efforts. The assessment also serves as a roadmap for refining and enhancing existing plans and ordinances, ensuring they are aligned with the broader hazard mitigation strategy and responsive to evolving risks and needs.

19.1 Plan, Policies, & Ordinances

In King County, numerous plans, policies, and ordinances already exist that directly address or influence the impact of hazard risks. These frameworks serve as a foundation for guiding mitigation efforts, integrating risk reduction into everyday decisions, and ensuring that communities can effectively reduce hazard vulnerabilities.

Gaps in policies for King County is National 2021 Wildlife Urban Interface (WUI) Code. Washington state parts of the 2021 code in March 2024, however, jurisdictions are waiting to adopt the code until new WUI mapping and amendments can be developed.

Table 19-1 Plans, policies, and ordinances capabilities

Plans, Policies, & Ordinances	Description	Lead Agency
30-Year Forest Plan	2021 King County 30-Year Forest Plan provide a shared county-wide vision for rural and urban forest cover and forest health.	DNRP
Building and Development Codes	Building and development codes are adopted and modified from the 2021 IBC by Washington State Building Code Council and King County. These codes help ensure that new construction and substantial improvements meet international standards, accounting for our hazard risk.	Department of Local Services (DLS) – Permitting Division
Build Code Effectiveness Grading Schedule (BCEGS)	In November 2023, the Washington Surveying and Rating Bureau (WSRB) gave King County the BCEGS rating of Class 4 for commercial properties and Class 4 for one- and two-family dwellings.	DSL

Clean Water and Health Habitat Strategic Plan	The 2020-2025 CWHH Strategic Plan seeks to establish a strategic alignment across all plans that impact clean water and healthy habitat in order to achieve "greater impact through clearer definition, smarter investment, partnerships, and innovation." This process is just starting, and it includes over 20 separate plans and programs.	Department of Natural Resources and Parks
Community Wildfire Protection Plan	The Office of Emergency Management is currently building upon the 2022 King County Wildfire Risk Reduction Strategy to develop the King County's first Wildfire Protection Plan.	KCOEM
Comprehensive Emergency Management Plan (CEMP)	The CEMP is for use by elected and appointed County officials, and King County government department directors, managers and staff in mitigating, preparing for, responding to, and recovering from disasters. (2020)	KCOEM
Comprehensive Plan	The 2024 King County Comprehensive Plan is the long-range guiding policy document for all land use and development regulations in unincorporated King County, and for regional services throughout the County including transit, sewers, parks, trails and open space. • Encourage updates to the critical areas ordinance • Provide feedback and comments on the plan	Executive's Office
Continuity of Government (COG) Plan	The King County Continuity of Government (COG) Plan addresses the continuation, resumption, and recovery of King County Government, and focuses on critical areas pertaining to government continuity: Succession of leadership Emergency authority Command and control	All KC agencies

	The COG Plan identifies how the responsibilities of King County Government, as defined by the Washington State Constitution and the King County Charter, will be preserved, maintained, or reconstructed in the event of a disaster or other event. Much of the content of the COG Plan is derived from or a direct excerpt of provisions in the King County Charter and King County Code.	
Continuity of Operations Plan (COOP)	The purpose of King County's Continuity of Operations (COOP) Plans are to provide the framework for the restoration of essential functions/processes in the event of an emergency or incident that affects operations. COOP plans identify and prioritize essential functions and processes that must continue, and include activation procedures, establishing clear lines of succession, defining who has the authority to make decisions, identifying alternate locations, and managing vital records. COOP plans help us remain resilient and capable of maintaining critical operations, even under challenging circumstances.	All KC agencies
Critical Area Ordinance	The critical areas ordinance requires the identification of geologically-hazardous and frequently-flooded areas. These areas must either be protected from development or any development in these areas must be designed to account for hazard risk. Supplemental changes to the ordinance are being incorporated into the updated 2024 King County Comprehensive Plan.	DLS
Critical Facilities Plan (Mitigation/Response/Recovery)	Capital facilities plans identify and prioritize large-scale projects. Entities involved in this include the King County Facilities Management Division and the King County Flood Control District.	Various

	• Integrate mitigation strategies from capital plans • Encourage the use of hazard information to prioritize capital improvements • Support county departments with funding gaps in accessing Hazard Mitigation Assistance to complete or expand projects that are identified as important but are unfunded or partially funded.	
Debris Removal Plan	The 2024 KC Debris Management Framework is intended to aid all of King County and its departments, including individual jurisdictions, special purpose districts, and tribes within the county. This framework will be used to support debris management activities in unincorporated King County and when individual jurisdictions, special purpose districts, and tribes within King County become overwhelmed or when there is need to coordinate resources among the various entities requesting assistance. It is intended to facilitate rapid response and recovery efforts during and after a disaster.	DNRP
Equity and Social Justice Ordinance	King County has deep and persistent inequities – especially by race and place–that in many cases are getting worse and threaten our collective prosperity. Launched by King County Executive Ron Sims in 2008 and formalized by Executive Dow Constantine and the Metropolitan King County Council via ordinance in 2010, Equity and Social Justice (ESJ) is an integrated part of the County's work and is supported by the Office of Equity and Social Justice since it was established in early 2015.	King County Executive's Office, Office of Equity and Social Justice

Equity and Social Justice Plan	The 2016-2022 Equity and Social Justice Strategic Plan is a blueprint for action and change that will guide the county's pro-equity policy direction, decision-making, planning, operations and services, and workplace practices in order to advance equity and social justice within County government and in partnership with communities. • Follow guidance in the ESJ plan for the prioritization of strategies • Develop information on populations vulnerable to hazards and share with ESJ planning teams	Executive's Office
Extreme Heat Mitigation Strategy	The 2024 Extreme Heat Mitigation Strategy focuses on reducing risks associated with extreme heat events, particularly for vulnerable populations in urban heat islands.	ECO
Flood Management Plan	The 2024 King County Flood Management Plan is a functional annex of the comprehensive plan. It outlines the County's approach to comprehensive floodplain management including land use planning, flood mitigation efforts, and flood protection facilities management. • Work with department responsible for floodplain management to write the flood risk assessment. • Work with local CRS coordinators to ensure the mitigation plan is worth the maximum number of points.	DNRP
Floodplain Ordinance	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. King County's flood hazard reduction policies, as they relate to land use and regulatory compliance, are as follows: Consistent with prerequisites for FEMA's CRS program, King County shall regulate development	DNRP

	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, . King County should look for opportunities to improve, modify, or relocate existing county roads to ensure safe ingress and egress during flood events.	
Growth Management Ordinance	incorporated into the King County Comprehensive Plan. The state of Washington also has the Growth Management Act.	Executive's Office
National Pollutant Discharge Elimination System (NPDES)	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.	DNRP
Post-Disaster Recovery Plan	The Office of Emergency Management is currently using the 2016 King County Recovery Framework to develop the King County Disaster Recovery Plan.	KCOEM

Public Health Plans	Public Health – Seattle & King County's 2024-2029 strategic plan describes how we will meet the most persistent and urgent health challenges facing King County, embed Racism is a Public Health Crisis into our everyday work, and strengthen our core functions to protect and promote health.	PHSKC
Sea Level Rise Risk Area Regulation	King County created a new sea level rise risk area for Vashon-Maury Island. The risk area extends inland from the edge of the existing 100-year floodplain. Under these new regulations, new homes built in the risk area must be built three feet above the 100-year base flood elevation and comply with other floodplain regulations.	DNRP
Stormwater Management Program Plan (SWMP)	The King County Stormwater Program 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.	DNRP
Strategic Climate Action Plan	The 2020 King County's Strategic Climate Action Plan (SCAP) is a five-year blueprint for County action to confront climate change, integrating climate change into all areas of County operations and its work in the community. The SCAP is King County's blueprint for climate action and provides a "one-stop-shop" for county decision-makers, employees, and the general public to learn about the	Executive Office

	County's climate change goals, priorities and commitments. • Inter-workgroup participation • Integrated mitigation strategies • Consistent risk assessments	
Strategic Plan for Road Services	The 2014 Road Services Strategic Plan lays out system needs and anticipated service levels and an asset management approach to road maintenance and improvement. • Integrate mitigation strategies	DLS
Surface Water Design Manual	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.	DNRP
Sustainable & Resilient Frontline Communities (SRFC) Framework	Sustainable & Resilient Frontline Communities (SRFC) Framework ensures that climate preparedness efforts address the disproportionate impacts of climate change on frontline communities.	ECO
Threats and Hazard Identification and Risk Assessment (THIRA)	The Threats and Hazard Identification and Risk Assessment (THIRA) is a three-year process which helps a region determine what threats and hazards the are likely to experience, provides context on those threats and hazards for planning purposes, identifies potential impacts to the region, and identifies current and desired capabilities for	KCOEM

	responding to and recovering from those threats and hazards. The THIRA uses a combination of experience and Subject Matter Expertise as well as documented capabilities and gaps, such as in After-Action Reports, to articulate the regions readiness. The gaps listed in the THIRA are often used as areas to seek additional funding to build capacity and close gaps.	

19.2 Programs

The hazard mitigation planning process has engaged participants from across these programs in order to establish a common assessment of hazards, identify potential mitigation strategies, partnerships for future projects, and to assess county capabilities to implement mitigation projects. The list below identifies King County programs that support and implement hazard mitigation and assesses the effectiveness of each.

Table 19-2 Program and special district capabilities

Programs & Special Districts	Description	Lead Agency
ALERT King County	ALERT King County is a regional emergency public information and mass notification service that uses voice, text, and email. Alerts can be sent to the public to inform them about potential hazards and threats in the area. The system is administered through CodeRed.	KCOEM
Flood Buyout Program	Any structure located in a flood-prone area of unincorporated King County may be eligible for this program. Buyouts are appropriate in areas where there is deep, fast-moving water, serious bank erosion, and significant risk of channel migration. Priority applicants for the Buyout Program are: structures located in the floodway, structures located in the channel migration zone, and FEMA Repetitive Loss Properties.	DNRP
Hazard Awareness Program	King County's Public Education & Outreach program supports emergency preparedness by integrating an all-hazards approach across	KCOEM

	prevention, response, recovery, and mitigation. It provides strategic outreach and education support to KCOEM's emergency planning and operations while engaging both government stakeholders and community members. Through initiatives such as public input processes, open houses, and the creation of educational materials, the program empowers residents to understand and manage risks.	
Hazard Mitigation	The hazard mitigation program works with partners across county departments and local jurisdictions to coordinate and promote hazard mitigation projects. The program also coordinates applications to federal Hazard Mitigation Assistance grant programs and conducts hazard mitigation planning for the county in partnership with local jurisdictions and special-purpose districts.	KCOEM
King County Conservation District	The King County Conservation District is an independent special purpose district with separately-elected commissioners. It promotes water, land, soil, and forest conservation and preservation and conducts wildfire risk reduction activities.	King County Conservation District
King County Flood Control District	In 2007, the King County Flood Control District was established to provide a proactive, regional approach to flooding as well as funding to improve the county's nearly 500 aging and inadequate flood protection facilities. Funding for the Flood Control District comes from a county-wide property levy of 12.9 cents per $1,000 assessed value. This amounts to $54 per year on a $416,000 home. The levy raises roughly $54.5 million a year. This funding dramatically increases the number of projects that can be completed each year. The additional local funding also enhances the District's ability to receive federal and state matching funds. The King County Flood Control District is a separate special purpose district.	King County Flood Control District

Land Use Planning and Zoning	Land use planning and zoning establishes growth and land use patterns that are consistent with long-range plans and supported by infrastructure.	King County Executive's Office
Landslide Hazards	The Landslide Hazards program conducts mapping and outreach associated with landslide risk.	DNRP Water and Land Resources Division
Mutual Aid Agreement	King County's mutual aid strategy was originally outlined in the Regional Coordination Framework and included an omnibus document that later became known as "the Agreement." While the broader strategy is now being incorporated into the county's Comprehensive Emergency Management Plan (CEMP), the Agreement remains a separate, binding document. The Agreement outlines the obligations and basic procedures for resource sharing between entities that have signed on. This framework ensures that during emergencies, all parties understand their roles and responsibilities in facilitating mutual aid. By maintaining the Agreement alongside the evolving CEMP, King County reinforces a structured and coordinated approach to emergency response. Ultimately, this dual approach strengthens the county's overall emergency management capabilities.	KCOEM
National Flood Insurance Program (NFIP)	Communities that participate in the National Flood Insurance Program adopt a floodplain management code in exchange for FEMA making flood insurance available to residents and businesses.	DNRP, DLS – Permitting Division
NFIP Community Rating System (CRS)	The CRS program rewards communities that have established exceptional floodplain management programs and undertaken certain activities to reduce flood risk. King County is one of the highest rated communities in the country. The program provides NFIP policyholders in floodplains with a discount of up to 40% on their insurance.	DNRP DLS KCEM

Puget Sound Climate Preparedness Collaborative	King County advances climate resilience through collaborative initiatives such as the Puget Sound Climate Preparedness Collaborative. This initiative strengthens the regional partnerships to advance climate preparedness and foster cross-jurisdictional coordination across the Puget Sound basin.	ECO
RainWise Rebate Program	RainWise helps private property owners install rain gardens and cisterns to help manage the rain that falls on their roofs. These installations can also add attractive landscaping, provide water for summer irrigation, and may reduce flooding. RainWise rebates cover most or all of the cost of installing cisterns and rain gardens on private properties in eligible combined sewer overflow basins. The average rebate is approximately $4,740.	DNRP
Regional Code Collaboration (RCC)	Jurisdictions across the Puget Sound Region work together to share resources and expertise to develop codes, policies, and tools supporting sustainable building practices that can be adopted/utilized locally.	DNRP
ShakeAlert	The USGS ShakeAlert Earthquake Early Warning system sends a warning to mobile phone users that shaking is about to occur. The system uses ground-motion sensors to detect earthquakes that have already started and estimates their size, location, and impact. When it detects a significant magnitude, the system issues a ShakeAlert® Message, providing a warning a few seconds before shaking begins.	USGS, PNSN

Shoreline Master Program	King County has nearly 2,000 miles of shoreline along major lakes and rivers and Vashon-Maury Island. These shorelines provide habitat for fish and wildlife, places for public enjoyment and space for wide-ranging waterfront land uses. The Shoreline Master Program helps preserve King County's nearly 2,000 miles of shoreline, thereby reducing risk to hazards including sea-level rise.	DLS – Permitting Division
StormReady	StormReady is an NWS planning tool to become better prepared for hazardous weather events. To become StormReady, the county had to meet specific criteria, such as having a 24-hour emergency operations center, providing severe weather notifications to residents, conducting public awareness programs, and maintaining a trained team of weather spotters. The goal is to enhance the county's readiness to respond to severe weather events, ensuring public safety and effective communication during storms.	National Weather Service (NWS)
The Integrated Public Alert & Warning System (IPAWS)	IPAWS is FEMA's national system for local alerting that provides authenticated emergency and life-saving information to the public through mobile phones using Wireless Emergency Alerts (WEA), to radio and television via the Emergency Alert System (EAS), and on the National Oceanic and Atmospheric Administration's Weather Radio.	KCOEM

19.2.1 NFIP Participation

The National Flood Insurance Program (NFIP) provides federally backed flood insurance in exchange for communities enacting floodplain regulations. Participation and good standing under NFIP are prerequisites to grant funding eligibility under the Robert T. Stafford Act. The County and most of the partner cities for this plan participate in the NFIP and have adopted regulations that meet the NFIP requirements.

Many cities in King County have mapped flood hazard areas, and 37 of the 39 incorporated municipalities participate in the NFIP; all are currently in good standing with the provisions of the

NFIP. The five jurisdictions that do not currently participate in NFIP are Beaux Arts Village, Hunts Point, Maple Valley, Newcastle and Yarrow Point. Except for Newcastle, these communities have no special flood hazard areas.

Participants in the NFIP must, at a minimum, regulate development in floodplain areas in accordance with NFIP criteria. Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent. The Washington State Building Code Act requires new construction to be elevated to 1 foot above the base flood elevation or to the design flood elevation, whichever is higher. Some communities in King County have adopted more stringent standards. For example, a 3-foot freeboard (height above the 100-year flood elevation) is standard for most structures in unincorporated King County.

Additionally, in the Puget Sound watershed, communities are required to regulate development in floodplains in a way that doesn't cause habitat loss or negative impacts to Chinook, coho, and steelhead salmon species. This is part of the FEMA/NOAA Biological Opinion related to communities' participation in the National Flood Insurance Program.

In Washington State, the Department of Ecology is the coordinating agency for floodplain management. Ecology works with FEMA and local governments by providing grants and technical assistance, evaluating community floodplain management programs, reviewing local floodplain ordinances, and participating in statewide flood hazard mitigation planning. Compliance is monitored by FEMA regional staff and by Ecology. Maintaining compliance under the NFIP is an important component of flood risk reduction. All planning partners that participate in the NFIP have identified initiatives to maintain their compliance and good standing. Planning partners who do not currently participate have identified initiatives to consider enrollment in the program.

Table 19-3 King County NFIP Participants

Community Name	NFIP Participation	Curr Eff Map Date	Reg-Emer Date
Algona	No	(NSFHA)	5/25/1978
Auburn	Yes	8/19/2020	6/1/1981
Beaux Arts Village	No	(NSFHA)	2/4/2000
Bellevue	Yes	8/19/2020	12/1/1978
Black Diamond	Yes	8/19/2020	10/30/1979
Bothell	Yes	8/19/2020	6/1/1982
Burien	Yes	8/19/2020	9/30/1994

Carnation	Yes	8/19/2020	3/4/1980
Clyde Hill	No	(NSFHA)	11/3/2008
Covington	Yes	8/19/2020	4/19/2001
Des Moines	Yes	8/19/2020	5/15/1980
Duvall	Yes	8/19/2020	6/4/1980
Enumclaw	Yes	8/19/2020	8/19/2020
Federal Way	Yes	8/19/2020	6/21/1996
Hunts Point	No	(NSFHA)	1/11/2022
Issaquah	Yes	8/19/2020	5/1/1980
Kenmore	Yes	8/19/2020	11/13/1998
Kent	Yes	8/19/2020	4/1/1981
King County	Yes	8/19/2020	9/29/1978
Kirkland	Yes	8/19/2020	6/15/1981
Lake Forest Park	Yes	8/19/2020	2/15/1980
Maple Valley	No		
Medina	No	(NSFHA)	3/16/1979
Mercer Island	Yes	(NSFHA)	6/30/1997
Milton	No	(NSFHA)	
Muckleshoot Indian Tribe	No		
Newcastle	Yes	8/19/2020	9/15/2021
Normandy Park	Yes	8/19/2020	11/2/1977
North Bend	Yes	8/19/2020	8/1/1984
Pacific	Yes	8/19/2020	12/2/1980

Redmond	Yes	8/19/2020	2/1/1979
Renton	Yes	8/19/2020	5/5/1981
Sammamish	Yes	8/19/2020	5/25/2000
SeaTac	Yes	8/19/2020	9/30/1994
Seattle	Yes	8/19/2020	
Shoreline	Yes	8/19/2020	3/4/1997
Skykomish	Yes	8/19/2020	7/2/1981
Snoqualmie Indian Tribe	Yes	8/19/2020	5/11/2007
Snoqualmie	Yes	8/19/2020	7/5/1984
Tukwila	Yes	8/19/2020	8/3/1981
Woodinville	Yes	8/19/2020	10/10/1997
Yarrow Point	No		

19.2.2 CRS Participation

The Community Rating System is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements and rewards discounts to ratepayers in participating communities. King County is a Class 2 community. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions meeting the following three goals of the CRS:

- Reduce flood losses.
- Facilitate accurate insurance rating.
- Promote awareness of flood insurance.

For participating communities, flood insurance premium rates are discounted in increments of 5 percent. For example, a Class 1 community receives a 45-percent premium discount, and a Class 9 community receives a 5-percent discount. (Class 10 communities are those that do not participate in the CRS; they receive no discount.) The CRS classes are based on 18 creditable activities in the following categories:

- Public information

- Mapping and regulations
- Flood damage reduction
- Flood preparedness

As of this writing, there are 10 CRS-rated communities in King County.

Table 19-4 King County CRS Participation

Community Name	Class	% Discount in SFHA	% Discount in non-SFHA
Auburn	5	25%	10%
Bellevue	5	25%	10%
Issaquah	5	25%	10%
Kent	5	25%	10%
North Bend	5	25%	10%
Renton	5	25%	10%
Snoqualmie	5	25%	10%
Carnation	6	20%	5%
Redmond	5	25%	10%
King County	2	40%	10%

19.2.3 Flood Warning Program

The King County Flood Control District was established in 2007 to regionally manage flood hazards and reduce risk, in partnership with the Department of Natural Resources and Parks' River and Floodplain Management Section. The newly updated 2024 King County Flood Management Plan drives much of the work that both the District and King County do to reduce flood risk and manage flood-related hazards.

King County has a long-established Flood Warning Program that has been monitoring river systems for over 50 years. The King County Department of Natural Resources and Parks' River and Floodplain Management Section operates a Flood Warning Center that opens 24 hours a day when flooding occurs on any of the river systems with gages. For the Flood Warning Program, the rivers are measured by a "flood phase" system based on real-time flow information. When a river reaches flood phase 2, the Center opens, coordinates with local, state, and federal agencies, and accepts calls from the public requesting information about flooding. When a river reaches flood phase 3, patrol teams are sent out to monitor flood protection facilities and any potential flooding impacts. When a river reaches flood phase 4, additional staff are brought into the Flood Warning Center, sent on flood patrols, and begin to collect damage information in case of a disaster declaration.

Table 19-5 Flood Warning Phase Thresholds

Phase	South Fork Skykomish River	Tolt River	Snoqualmie	Issaquah Creek	Cedar River	Green River	White River
1	6,000 cfs	2,500 cfs	6,000 cfs	6.5 ft	1,800 cfs	5,000 cfs	4,000 cfs
2	10,000 cfs	3,500 cfs	12,000 cfs	7.5 ft	2,800 cfs	7,000 cfs	5,000 cfs
3	18,000 cfs	5,000 cfs	20,000 cfs	8.5 ft	4,200 cfs	9,000 cfs	7,000 cfs
4	27,000 cfs	8,500 cfs	38,000 cfs	9.0 ft	5,000 cfs	12,000 cfs	9,000 cfs

19.3 Staffing & Departments

With over 15,000 employees and dozens of departments and offices, King County has a tremendous capability to implement mitigation projects. Mitigation efforts are underway throughout the county, including such organizations as the Rivers and Floodplain Management Section of DNRP and the Wastewater Treatment Division of DNRP.

Staff & Departments	Description	Lead Agency
Building and Development Code Enforcement	The Department of Local Services, Permitting Division is the agency that provides land use, building and fire regulatory and operating permits, code enforcement and a limited number of business licenses for unincorporated areas of King County. Other local jurisdictions provide similar services within incorporated areas. The Code Enforcement Section investigates complaints regarding violations of King County Codes (KCC) related to zoning, building, property maintenance, shorelines and critical areas in unincorporated King County.	DLS– Permitting Division

Emergency Operations Center	The King County Emergency Operations Center (EOC) serves as the central hub for coordinating emergency response and managing resources during crisis situations. It is operated by KCOEM staff who double as Emergency Management Coordinators.	KCOEM
Facilities Management Division	The Facilities Management Division (FMD) oversees and maintains King County's real estate assets. The Major Projects and Capital Planning section is tasked with efficiently and effectively delivering large-scale projects in alignment with the policy directives of King County government, the facility needs of employees and the public, and for overall service to the community. Part of this includes the development of hazard-resilient facilities.	Department of Executive Services, FMD
Information Technology	KCIT leads the county's response to, and preparedness for, cyber incidents. KCIT has helped local cities recover from ransomware and other attacks.	KCIT
Local Emergency Planning Committee (LEPC)	The Local Emergency Planning Committee (LEPC) covers all of King County, excluding areas with other emergency plans, such as the City of Seattle, the City of Kent, and regions overseen by a Tribal Emergency Response Committee. Its primary mission is to enhance chemical safety and protect public health and the environment. The LEPC is responsible for developing a community Hazardous Materials Response Plan, conducting annual reviews of this plan, and collecting and maintaining chemical inventory forms and release reports. It also provides chemical inventory information to the public upon request.	KCOEM
Mapping Specialist (GIS)	King County GIS provides analysis support, mapping, and other data to all King County departments. This data is valuable for hazard mitigation planning activities.	KCIT

NFIP Floodplain Administrator	The NFIP (National Flood Insurance Program) Floodplain Administrator oversees and managing floodplain management activities including enforcing floodplain regulations and educating the public about flood management.	DNRP
Office of Risk Management Services	Risk Management investigates and resolves claims against King County in a fair and expeditious manner, and also provides internal services to King County agencies, including: • Insurance: King County administers a self-insurance program and purchases a variety of other insurance policies and related services consistent with good risk management practices and the needs of the County. • Contracts: Risk Management advises King County agencies on insurance requirements, indemnification, release, and hold harmless provisions in all types of contracts. Risk Management actively negotiates these provisions and, together with the Prosecuting Attorney's Office, assists agencies in pursuing and tendering claims arising out of contractual relations. • Recovery Services: The recovery section of Risk Management is charged with seeking compensation for damages caused to King County property or injury to King County employees by negligent third parties. • Loss Control Program: The Loss Control Manager works with King County agencies to identify areas of potential loss and recommend strategies to reduce exposure to liability. The Loss Control Program also administers continuing workplace training and education for King County employees. Part of this work includes the development and maintenance of a risk register of events and information on how those events can impact King County.	Department of Executive Services
Road Services Division	Road services builds and maintains over 2000 miles of road and 200 bridges. They are responsible for many mitigation activities,	Department of Local Services

	including those related to culvert replacement, pavement preservation, and bridge retrofits.	
Wastewater Treatment Division	Invest in upgrades to pipe and water treatment facilities to make them more resilient to earthquakes, severe weather, flooding, and climate-change.	DNRP

19.3.1 Departments and Jurisdiction Coordination

Beyond departmental collaboration, King County works with local jurisdictions, special purpose districts, and Tribes to support effective risk reduction. King County coordinates activities related to emergency management and hazard mitigation through two bodies, the Emergency Management Coordinating Committee (EMCC) and the Emergency Management Advisory Committee (EMAC), which are each described in greater detail in the table below.

Table 19-6 King County Stakeholder Integration Capabilities

Committees	Description	Membership
Emergency Management Coordinating Committee (EMCC)	EMCC is charged by the King County Council with coordinating interdepartmental emergency preparedness matters. EMCC works to support departments in developing continuity of operations plans (COOP), preparedness plans, and hazard mitigation plans. It also contributes to after action reports. EMCC has played an important role in the mitigation plan update process for the county by identifying and dedicating key staff to participate in planning and by reviewing and providing feedback on planning team activities.	EMCC is made up of internal King County agencies/departments. All county departments are included in the EMCC. The following are those who attend meetings more regularly: • Assessor • Community and Human Services • District Court • Elections • Executive Services • Human Resources • Judicial Administration • Information Technology • King County Council • King County Executive • Local Services • Metro Transit • Natural Resources and Parks • Prosecuting Attorney • Public Health • Public Defender • Sheriff

		• Superior Court
Emergency Management Advisory Committee (EMAC)	EMAC advises, assists, reviews, and comments on emergency management and homeland security issues, regional planning, and policies. They measure and prioritize core capabilities and recommend homeland security allocations and work products to sustain and enhance preparedness and operational levels. Members, as set forth in code, provide regional and multi-disciplinary perspective, and represent cities, fire service, law enforcement, hospitals, the Port of Seattle, government, special purpose districts, tribes, utilities, non-profit agencies, and the private sector.	EMAC is made up of both internal and external partners. The committee is composed of members who represent the following emergency management interests: • Central region EMS and Trauma Care Council • City of Bellevue • City of Kent • City of Renton • City of Seattle • 1 Utility • 1 Faith-Based Organization • 1 Financial Community Organization • American Red Cross • KC DNRP • KC Metro • KC Roads • KC Executive Office • King County Fire Chief's Association • King County Fire Commissioner's Association • King County Police Chief's Association • King County Sheriff's Office • KC Local Emergency Management Planning Committee • Muckleshoot Tribal Nation • Northwest Healthcare Response Network • Port of Seattle • 1 Private Industry Representative • Public Health Seattle and King County • Puget Sound Educational Services District • Snoqualmie Tribal Nation • Sound Cities Association • Washington Association of Building Officials

EMAC, in particular, serves as the advisory body designated by the funding requirements to provide input from a stakeholder group. However, the committee's role has evolved over time, influenced by how the federal and state guidelines for distributing funds—specifically the State Homeland Security Grant Program (SHSP)—are structured. Members are tasked with forming a task force to prioritize projects by discipline for submission to the state for competitive funding consideration. EMAC's involvement primarily focuses on the SHSP, though they are informed about other HSGP awards (excluding UASI, which follows a separate process) for transparency and awareness.

19.4 Potential Funding Sources

Hazard mitigation projects are most often completed with funding from capital budgets as part of the normal building and maintenance processes that occur in any jurisdiction. There is also source and use-specific funding, such as that provided by the King County Flood Control District that is part of regular program funding and is highlighted in the program section above. Beyond regular capital funding, there are dedicated mitigation programs operated by state, county, and federal agencies.

Table 19-7 Potential sources of hazard mitigation funding

Program	Lead Agency	Description	Project Types
Federal Programs			
BUILD Grants	Department of Transportation (DOT)	Grants support investments in surface transportation infrastructure and are to be awarded on a competitive basis for projects that will have a significant local/regional impact.	Transportation and related infrastructure retrofits, including stormwater projects
Building Blocks for Sustainable Communities	Environmental Protection Agency (EPA)	This EPA program provides targeted, technical assistance to communities to develop resilience plans, development plans, sustainability strategies, etc.	Planning and feasibility studies
Climate Resilience Regional Challenge grant	National Oceanic and Atmospheric Administration (NOAA)	A competitive grant program is focused on collaborative projects that increase the resilience of coastal communities to extreme weather and other climate change impacts, including sea level rise and drought.	Coastal flooding, sea level rise, restoration, nature-based improvements

Community Development Block Grants (CDBG)	Department of Housing and Urban Development (HUD)	CDBG funds comprehensive plans, limited infrastructure planning/construction, feasibility studies, community action plans. Income and population restrictions apply.	Housing and infrastructure retrofits, feasibility studies, planning
Cooperating Technical Partnership Program	Federal Emergency Management Agency (FEMA)	The program creates partnerships between FEMA and qualified local and state partners to create, maintain, and publicize up-to-date flood and other hazard maps and data.	Planning, outreach, feasibility studies
Emergency Watershed Protection Program	Natural Resource Conservation Service (NRCS)	Emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards created by a natural disaster.	Infrastructure retrofits, slope stabilization, source-water protection, flood risk reduction, erosion prevention
Flood Mitigation Assistance (FMA) Grant Program	Federal Emergency Management Agency (FEMA)	FMA provides funding to local jurisdictions and states for projects and planning that reduces or eliminates long-term risk of flood damage to structures insured under the NFIP.	Flood risk reduction projects that benefit the NFIP, including acquisitions, elevations, and some structural mitigation such as local risk reduction structures and dry floodproofing.
Hazard Mitigation Grant Program	Federal Emergency Management Agency (FEMA)	HMGP is authorized statewide after a disaster declaration and is the most flexible of FEMA's three mitigation programs. Jurisdictions must have an approved hazard mitigation plan and projects must be cost effective.	Most long-term risk-reduction projects that protect against fire, flood, earthquake, and other natural hazards.
Post-Fire Hazard Mitigation Grant Program	Environmental Protection Agency (EPA)	Program authorized following a Fire Management Assistance Grant (FMAG) declaration. Program focuses on wildfire risk and post-fire	Fire-related mitigation, including defensible space, generators, and post-

		risk mitigation, including fuels reduction and post-fire flood control projects. Program prioritizes the county receiving the FMAG declaration.	fire flood risk reduction, planning, feasibility studies
State Homeland Security Program (SHSP)	Federal Emergency Management Agency (FEMA)	SHSP is divided up into two sections, the National Priority Area projects are competitive at the state level and voted on by the Homeland Security Coordinators for each region. The remaining funds are allocated direct to each region for them to cover other projects not approved through the National Priority Area projects. All projects must be primarily for counter-terrorism projects.	Planning, staffing, counter-terrorism, equipment, training, exercises
State & Local Cybersecurity Grant Program (SLCGP)	Federal Emergency Management Agency (FEMA)	SLCGP is a federal program that helps state, local, and tribal governments improve cybersecurity and protect their systems from threats.	Firewalls, system testing, cybersecurity monitoring, identity management (multi-factor authentication), training, and policy development.
Urban Area Security Initiative (UASI)	Federal Emergency Management Agency (FEMA)	The UASI functions through targeted subcommittees that provide grant projects to Urban Area Working Group Voting Members for review and finally to the Core Group for approval. Each of the 5 jurisdictions have one representative at each of these levels. All projects must be primarily for counter-terrorism projects.	Planning, staffing, counter-terrorism, equipment, training, exercises
Urban and Community Forest Program	Department of Agriculture (USDA)	Program provides technical, financial, research and educational services to local jurisdictions and organizations for the preservation, protection, and restoration of forestlands.	Natural resource protection, public information, planning

State Programs			
Community Economic Revitalization Board	WA Department of Commerce	CERB provides loan funding to local jurisdictions for public infrastructure to support private business growth and expansion.	Infrastructure retrofits, public-private partnerships
Combined Water Quality Funding Program	WA Department of Ecology	Fund sources for projects associated with publicly-owned wastewater and stormwater facilities. The integrated program also funds nonpoint source pollution control activities.	Drinking-water system improvements, feasibility studies, source-water protection, infrastructure retrofits
Drinking Water State Revolving Fund	WA Department of Health	The Drinking Water State Revolving Fund (DWSRF) provides loans to drinking water systems to pay for infrastructure improvements. In some cases, partial loan forgiveness is offered.	Infrastructure retrofits, source-water protection, planning, drinking-water system improvements
Estuary and Salmon Restoration Program	WA Department of Fish and Wildlife (DFW)	ESRP provides funding restoration and protection efforts in Puget Sound, including projects such as flood storage, erosion control, and climate resilience measures.	Acquisitions, slope stabilization, flood risk reduction projects, ecosystem restoration
FireWise Fuel Mitigation Grant Program	WA Department of Natural Resources	The Fuel Mitigation Grant provides a cost share for communities engaged in defensible space and fuels reduction projects.	Wildfire fuels reduction, defensible space
Flood Control Assistance Account Program (FCAAP)	WA Department of Ecology	FCAAP provides two types of grants to communities; (1) planning grant, which supports integrated flood hazard management planning by communities. this planning has to be related to a new or existing comprehensive flood hazard management plan or CFHMP; and (2) emergency grant that supports local emergency response activities.	Planning, mapping, permitting, engagement, response, recovery, federal match

Floodplains by Design	WA Department of Ecology	Floodplains by Design is the primary grant program for projects that reduce flood hazards while restoring the natural functions that Washington rivers and floodplains provide.	Slope stabilization, ecosystem recovery, flood-risk recovery
Public Works Board	WA Department of Commerce	Low-interest loans for pre-construction or new construction for replacement/repair of infrastructure for stormwater, solid waste, road, or bridge projects. Emergency loans are available for public projects made necessary by a disaster or imminent threat to public health and safety.	Utility and infrastructure retrofits
Source Water Protection Grant Program	WA Department of Health	Projects and studies to identify solutions to source water protection problems, implement protection plans, or update data that directly benefits source water protection.	Source-water protection, drinking water system improvements, other retrofits, feasibility studies
Transportation Improvement Board	WA Transportation Improvement Board	TIB makes and manages street construction and maintenance grants to 320 cities and urban counties.	Infrastructure retrofits, flood risk reduction
Local Programs			
Community Climate Resilience Grant Program	King County	The CCR Grant Program funds community-based climate justice projects in communities disproportionally impacted by climate change.	Community capacity development, public health, emergency preparedness, heat mitigation
Flood Control District Flood Reduction Grants	King County Flood Control District	The Flood Reduction Grants target medium and small local flood reduction projects including projects where the control of stormwater will have a direct benefit in reducing flooding. Eligible applicants include	Projects can address either existing or potential flooding and proposals should show that the flooding has current

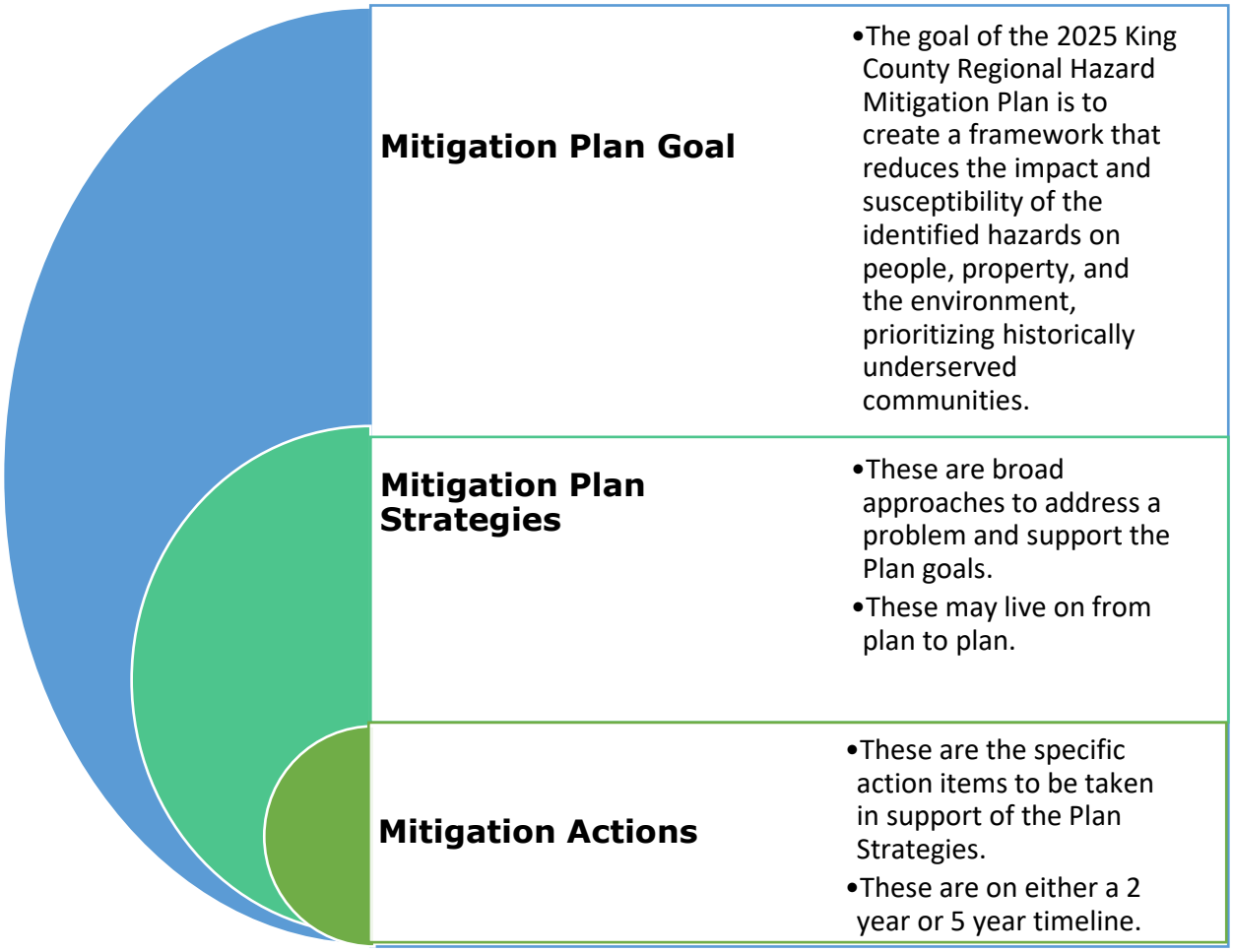
		homeowners, special districts, tribes, cities, and county agencies.	or potential economic impacts.
General Budget	King County	The two-year King County budget for 2019-2020 was approximately $11.6 billion dollars. Approximately 15% of this money makes up the general fund. Major Expenditures are: Metro Transit (21%), Wastewater (14%), Health & Human Services (13%), and Law, Safety, & Justice (12%). There are ~15,000 full-time-equivalent (FTE) county employees with most employed in Transit (35%), Criminal Justice (25%), and Public Health (9%).	Various
Loss Control Fund	King County Office of Risk Management	The Loss Control Fund is for internal county projects and is limited to emergent risks where advance planning and budgeting were unavailable. $2M has been appropriated for the 2019-2020 biennium.	Emergent risks, to include likely infrastructure failure
Conservation Futures Tax levy	King County DNRP	Conservation Futures is an open space acquisition grant program. Our grants help buy parks and open spaces such as natural lands, urban greenspaces, forests, community gardens, farms, and trails.	Land acquisitions
Parks Levy	King County	Revenue generated by the parks levy goes to fund open space protection, new parks, trails, and other assets. This funding could theoretically be used for the acquisition of threatened properties for preservation as open space.	Acquisition of high-hazard properties for preservation as open space
Non-Government Organization (NGO) Programs			
American Cities Grant	Kresge Foundation	Kresge Foundation seek efforts that will result in expanded opportunity for city residents, engage the community in a meaningful way,	Varies

		have potential for long-term sustainability or community impact, and have potential for scalability or translation to other communities. We use an array of funding and investment tools to foster change, including project grants, operating support, planning grants and program-related investments.	
Cooling Program	ClimateWorks Foundation	The ClimateWorks Cooling Program leads the clean Cooling Collaborative, an initiative advancing efficient, climate-friendly cooling for all. Clean Cooling Collaborative focuses on solutions that cool people and the planet, including super-efficient appliances, climate-friendly refrigerants, and passive cooling.	Extreme heat
Environment Program Grants	Hwelett Foundation	The Environment Program makes grants to address climate change globally and to conserve the U.S. West. The Foundation make a wide range of grants to protect the extraordinary natural resources of the Western United States, and back efforts to build broad public support and empower citizens who care about the conservation of land, water and air in the West.	Conservation
National Climate Solutions RFP	Paul G. Allen Family Foundation	This Paul G. Allen Family Foundation initiative, with an RFP announced in 2024, will fund 3-5 rigorous, place-based Natural Climate Solutions efforts in the Pacific Northwest. The foundation is looking to fund programs that accelerate climate change mitigation, while also providing biodiversity and human wellbeing co-benefits.	Resiliency, nature-based solutions

Resilient Community Impact Fund	Resilient Cities Network (RCN)	RCN has established the Resilient Community Impact Fund, providing critical funding to cities and organizations to initiate local resilience projects. This fund supports initiatives designed to help communities withstand the impacts of extreme weather events, including heatwaves and flooding.	Resiliency, extreme heat, fooding
Rural Community Assistance Corporation	Rural Community Assistance Corporation	Water, wastewater, stormwater, and solid waste planning; environmental work; to assist in developing an application for infrastructure improvements for small, rural communities.	Planning, feasibility studies
Rural Water Revolving Loan Fund	National Rural Water Association	The RWLF provides low-cost loans for short-term repair costs, small capital projects, or pre-development costs associated with larger projects to small, rural communities.	Source-water protection, drinking water system improvements, other retrofits
Wildfire Resilience Initiative	Moore Foundation	The Wildfire Resilience Initiative aims to support a transformation in the role that fire plays and is perceived to play in Western North America, from an unwanted, destructive threat to a vitalizing element in our landscapes.	Wildfire

Chapter 20: Mitigation Strategies

The primary focus of this plan update was the creation of new comprehensive, operationally viable hazard mitigation strategies and promote their implementation. Plan strategies were developed using the following structure:



Hazard mitigation strategies were developed by KCOEM and various KC agencies as described in the planning partner engagement section of the introduction.

The KCOEM Hazard Mitigation Team coordinated with each KC agency and assisted with each developing and submitting a list of potential hazard mitigation strategies and projects.

20.1 Mitigation Plan Goal

The goal of the 2025 King County Regional Hazard Mitigation Plan is to create a framework that reduces the impact and susceptibility of the identified hazards on people, property, and the environment, prioritizing historically underserved communities.

20.2 Mitigation Plan Strategies

Mitigation Plan Strategies will be developed based on threats to essential assets and capabilities from hazards within cities and unincorporated areas of King County. In the past these have included strategies for risks such as land movement and flood impacts and projects such as bridge seismic retrofits and generators for critical facilities. For this plan, hazard mitigation strategies are sets of coordinated actions that, taken together, address a risk or vulnerability. They are comprehensive, long-term, and designed to be regularly updated as actions are completed.

The updated strategy format will be used going forward in order to better support long-term tracking of mitigation actions and strategies. The updated strategy template is displayed below.

Table 20-1 Mitigation strategy template

<table>
<tr><td>Lead Points of Contact (Title)</td><td>Partner Points of Contact (Title)

Who else outside your jurisdiction benefits from the strategy or will help implement the strategy?</td><td>Hazards Mitigated</td><td>Funding Sources and Estimated Costs</td></tr>
<tr><td colspan="4">Strategy Vision/Objective

Long-term objective and vision for the strategy</td></tr>
<tr><td colspan="4">Mitigation Strategy

Describe the program/proposed program</td></tr>
<tr><td colspan="2">2-Year Objectives</td><td>5-Year Objectives</td><td>Long-Term Objectives</td></tr>
</table>

Implementation Plan/Actions *This can provide a timeline, indicate partners, discuss implementation stages, etc. Use this to discuss how the strategy/program will be implemented over the long term.*
Performance Measures

With the support of King County Risk Management, this template will be built into a database where strategies can be entered, updated, and projects can be tracked consistently and effectively. The goal is for strategies to remain in place through future updates, while implementation plan actions are changed.

20.3 Mitigation Plan Actions

Mitigation Plan Actions represent the specific work to be done to mitigate a risk or hazard. Candidate actions will be developed and considered for and by each participating jurisdiction. These actions will be taken into consideration when scoring the overall strategies for prioritization.

20.4 Prioritizing Mitigation Strategies

Emergency management is centered around communities and people – those who understand their communities' unique demographic, economic, and physical characteristics best and know the most appropriate actions necessary to promote resilience and facilitate recovery from disaster. While several studies show the disproportionate impacts of disasters, they also show that federal response programs intended to support communities before and after disasters are also inequitable and inaccessible for those most vulnerable. Likewise, the methods used to quantify disaster impacts and justify risk reduction measures and mitigation projects do not account for the disparate impacts of these hazards. This incomplete measure of the total effects lends itself to prioritizing projects that can ignore measures that reduce the long-term consequences of disasters in these populations. Moreover, the siloing of these impact considerations fails to acknowledge the compounding effects these disasters can have on our built environments, nor do they offer tailored solutions designed to meet the unique needs of these communities.

It's no secret that humanity continues to have an adverse effect on weather, and human-induced climate change has led to an increase in the frequency of catastrophic devastation caused by severe weather. Historically marginalized populations, due to historic housing discrimination and housing

segregation, continue to suffer more damage from these disasters and take the longest to recover (for a summary, see the Brookings memo "Hurricanes Hit the Poor the Hardest"). These communities are most likely to exist in disaster-prone areas, lack sufficient financial resources for emergencies, and generally are less resilient to climate change, natural disasters, and their increasing devastation. Further, lower-income and minority communities are much more likely to experience public forms of vulnerability, epitomized by substandard infrastructure and less public infrastructure investment overall, and are in close proximity to hazardous materials with less public protection. Previous research shows that the primary determinants of post-disaster recovery include socioeconomic and demographic conditions, pre-existing vulnerability, and access to and receipt of aid, of which the most marginalized and vulnerable communities struggle.

Too often, disaster risk reduction strategies and mitigation projects are assessed with an equity and social justice lens too late in the process to be effective. However, with the right changes, we can turn this around. In 2019, King County set out to apply an approach to prioritization of mitigation projects designed to benefit those most vulnerable to disaster. With the adoption of the previous iteration of our hazard mitigation plan, we became among the first counties in the nation that applied an equity approach both in our base plan and subsequent annexes, as well as our project prioritization. We recognize the continuing inequities present in our society and in our pre-disaster preparedness and response, and, again, call for a reconsideration of all projects regardless of those targeted. Our industry has only recently begun incorporating equity into our work, and the prioritization methods used so far have not been effective. Likewise, research shows that emergency managers have a long road ahead. By prioritizing disaster risk reduction and mitigation projects that account for this institutional failure, we can make a significant and positive impact over time, increasingly putting more resources in areas and communities where they are needed most.

Methods

Before revising the previous method for ranking mitigation projects based on equity, the core planning team reviewed the last version of the document and found several deficiencies:

1. Localities did not have rigid guidelines against which to rank their projects.
2. The language following the factors was either vague or supposedly inherent in the mission of hazard mitigation.
3. Localities were given the 14 determinants of equity and informed on their importance but needed to be given practical strategies to analyze these determinants and factors in their projects.
4. Because the matrix lacked structure and guidelines, projects could be ranked in a manner determined by an individual contributor that was inconsistent with other rankings elsewhere in the county using the same matrix.

This methodology solves several of these issues by providing localities annexing onto the hazard mitigation plan guidelines on how to rank their projects, straightforward language and scoring methods allowing for consistency in project rankings across the county. These methods were discussed again with the larger hazard mitigation planning team and reviewed by internal Office of Emergency Management Equity and Social Justice Change Team members, the Department of Executive Services Intradepartmental Teams, and the Office of Equity, Racial, and Social Justice. FEMA determined these methods to meet the Justice40 Initiative requirements for localities seeking future federal funding for hazard mitigation projects.

King County developed a prioritization process based on criteria taken from national best practices and priorities identified by the King County Executive. These criteria are used to prioritize projects within strategies. Strategies are also prioritized in this way to identify those areas of emphasis for KCOEM and the mitigation steering committee, though this may not impact which strategies are implemented since many depend on exclusive funding sources. The below criteria will be used to establish priorities. These priorities will be applied to projects annually for submission to FEMA Hazard Mitigation Grants.

The updated scoring matrix broken into categories, like previous iterations. These categories are **Economics and Equity; Multi-Jurisdictional; Multi-Beneficial; Community Resilience and Long-Term Vulnerability Reduction; Climate, Environment and Sustainability; Effectiveness; Urgency; and Shovel-Ready.** Each category is given a score between 0 and 4, with 0 being the lowest score a project can receive in a certain category and 4 being the highest. Due to the close collaboration between urban and land-use planners, public works and emergency management professionals, environmental regulators, government officials, and community members needed to analyze these projects we removed negative scoring as a component of this version. It's important to note that communities should prioritize projects that have high marks in all categories, with a particular emphasis on the first four, when funding becomes available. We do, however, recognize these projects typically require significant financial investments well beyond the capacity of localities and grant funding over several years and lower-ranked projects may be more feasible with limited funding and time. Below you will find the factors for consideration and the process by which to analyze and score potential mitigation projects.

- 0 Unsatisfactory for this factor
- 1 Minimal level of standards for this factor
- 2 Satisfactory level of standards for this factor
- 3 High level of standards for this factor
- 4 Outstanding or beyond expectations for this factor.

Table 20-2 Mitigation strategy priority scoring matrix

2025 Hazard Mitigation Strategy:	
Factors for Consideration	**2025 Hazard Mitigation Strategy Score**
• Economics and Equity (project is designed to benefit, account for, and include vulnerable populations, especially those in the community most likely to suffer harm from a disaster and those likely to take longest to recover after a disaster)	
• Multi-Jurisdictional (project is supported by multiple jurisdictions or agencies)	
• Multi-Beneficial (project has benefits beyond hazard risk reduction, including environmental, social, or economic benefits)	
• Community Resilience and Long-Term Vulnerability Reduction (project is designed to increase community resilience and focus on the long term impacts to vulnerable areas)	
• Climate, Environment, and Sustainability (project helps people, property, and the environment become more resilient to the effects of climate change, regional growth, and development)	
• Effectiveness (project is designed to attain the best-possible benefit-cost ratio)	
• Urgent (project is urgently needed to reduce risk to lives and property)	

• Shovel-Ready (project is largely ready to go, with few remaining roadblocks that could derail it)	
Total Scores	

Process Note: Once a jurisdiction has prioritized projects within that jurisdiction, those projects will be advanced to the regional plan. If ever there is competition between projects advanced from different jurisdictions, the RHMP Steering Committee, consisting of representatives from county departments and jurisdiction partners, will establish the order of priorities based on the values identified above. The Steering Committee will also organize priority projects with corresponding strategies. It should be noted that while prioritized projects will be included in the plan, they may not all receive funding. The Steering Committee may also seek to promote a diversity of projects so that all plan goals receive some benefits. In the case of a tie between projects during scoring, the higher prioritization may go to the less-represented mitigation strategy.

20.5 Crosswalk with the Strategic Climate Action Plan

Several strategies appear in some form in both the 2025 SCAP and this plan. This was done to ensure multiple avenues of implementation and monitoring and to help relevant actions gain a higher profile with other departments. Below are strategies that appear in some form in both plans. It is important to note that strategies can be added to this list throughout the lifecycle of both plans.

Table 20-3 Mitigation strategies developed with the 2025 Strategic Climate Action Plan (SCAP)

Regional Hazard Mitigation Plan Strategy	Strategic Climate Action Plan Action
Integrate Hazard Mitigation into County Plans	OEM Hazard Mitigation Training
2024 Floodplain Management Enactment	2024 Floodplain Management Enactment
Resilience Hubs	Resilience Hubs
Community Wildfire Protection Plan	Community Wildfire Protection Plan
Extreme Heat Communications	Implementation of Extreme Heat Strategy
Climate Change and Health Adaption	PHSKC Climate Impacts

20.6 Mitigation Strategy 2020 Status Updates

The format for hazard mitigation strategies has been completely changed in the 2020 plan update. All actions previously identified have been removed and/or incorporated into new mitigation strategies. The updated strategy format will better support tracking and implementation of mitigation strategies and their constituent actions. Strategies that are preparedness focused have been removed, as well as those that are ongoing in nature and do not have specific targets or responsible entities.

The following tables are taken from the 2023 annual progress report for the 2020 King County Regional Hazard Mitigation Plan. This list only includes strategies submitted by King County departments and countywide strategies. Individual jurisdiction action progress reports are included in each annex. The new statuses for strategies include:

- Removed – Strategy is not carried forward into the new plan
- Complete – Strategy is complete and not carried forward into the new plan
- Updated – Strategy is updated and carried forward into the new mitigation plan.

CURRENT PROGRESS ON 2020 ACTION PLAN INITIATIVES				
Progress (Yes/No)	Timeline	Update Status	Comment (Describe progress or changed priority)	2025 Status
DLS – Roads: Reduce Flood Impacts to Unincorporated King County Road System				
Yes	Long Term	Removed	This study looks at different ways to reduce or eliminate traffic problems caused by flooding in the Snoqualmie Valley. It focuses on keeping at least one of four existing roads and bridges that cross the Snoqualmie River open during floods rather than solving the flooding itself. The county and our partners began the Cross Valley study in December 2022. The first phase was completed in October of 2024.	Ongoing
DLS – Roads: Increase Seismic Resilience of Bridges in Unincorporated King County				
Yes	Long Term	Removed	The study "Impacts of Cascadia Subduction Zone M9 Earthquakes on Bridges in Washington State" was published in June 2022. Work on retrofitting bridges in King County continues.	Ongoing
DNRP – WLRD: Stormwater Outfall Erosion Hazard Inventory				
Yes	Long Term	Removed	The King County Stormwater Management Action Plan was completed December 21, 2022. Seeking funding for action items in the plan continues.	Ongoing
DNRP – WTD: Resilience in Design and Build of Critical Water Treatment and Conveyance Facilities				
Yes	Long Term	Removed	West Point is undergoing upgrades to make the facility more resilient in the event of an earthquake. King County is improving large, enclosed sedimentation tanks that play a key role in the wastewater treatment process. This project began in 2021.	Ongoing
DNRP – WLRD: Landslide, Erosion, and Sedimentation Event Mapping				
Yes	Long Term	Removed	King County routinely updates its iMap layers including landslide and erosion. This work is expanded upon in the 2025 strategies.	Ongoing
DNRP – WLRD: Stormwater and Surface Water Infrastructure Risk Reduction				

Yes	Long Term	Removed	Action items for this strategy can be located in the Stormwater Management Action Plan of 2022.	Ongoing
DNRP – WTD: Sea Level Rise Resilience in Wastewater Facilities				
Yes	Long Term	Removed	Work continues in addressing the impacts of Climate Change on WTD facilities.	Ongoing
DNRP - WTD: Control System Security and Performance				
Yes	Long Term	Updated	Cyber-attacks continue to be an ongoing threat for DNRP and other King County agencies. The work on this strategy is expanded upon in the 2025 strategies.	Ongoing
DNRP – WTD: GIS Emergency Response Mapping and Real-Time Flow Data				
Yes	Long-term	Updated	In 2022 King County created the Equity in Response Planning tool that addresses a majority of mapping layers identified in this strategy. The work for improving and updating those layers is an ongoing project for King County.	Ongoing
KCIT- Emergency Communications Enhancements				
Yes	Short Term	Removed	All King County agencies have received new 800MHz Radios and routinely complete bimonthly radio checks. KCOEM offers trainings to agencies on how to use these radios.	Complete
DNRP – WTD: Emergency Event Management System				
Yes	Long-term	Removed	DNRP staff and other KC staff routinely test and train on how to use WebEOC.	Ongoing
DNRP – Flood Services: Flood Warning System				
Yes	Long Term	Updated	The purpose of the King County Flood Warning System is to warn KC residents about rising floodwaters on major rivers so they can prepare before serious flooding occurs. In most places, the warning system provides at least 2 hours lead time before floodwaters reach damaging levels. Since flooding is a common occurring hazard in the	Ongoing

			County, the work that the Flood Warning System does is expanded upon in the 2025 strategies.	
DNRP/KCOEM: Post-Flood Recovery Efforts				
Yes	Long Term	Updated	KCOEM continues to work with partners to create a comprehensive Recovery Plan including recovering from floods. KCOEM staff are routinely trained on how to complete damage assessments in addition to understanding how FEMA's IA and PA programs are implemented.	Ongoing
DNRP – Flood Services: Home Elevations				
Yes	Long-term	Removed	Homeowners located in a flood-prone area of King County may be eligible for help from the Flood Elevation Program. Currently funding is only available for home elevation projects in the Snoqualmie River Basin. The first floor of the home must be below the Base Flood Elevation as documented on a FEMA Elevation Certificate produce by a licensed surveyor. There is usually more property owners interested in this program than funds available. King County maintains a list of property owners who want to participate in the program and will reach out to them as funds become available. The elevation program is only for properties where the owner has agreed to take part in the program.	Ongoing
DNRP – Flood Services: Home Acquisitions and Relocations				
Yes	Long-term	Removed	The King County Flood Buyout Program purchases homes at risk of damage from flooding. Buyouts are voluntary. Flood-prone properties and structures are sold to King County and all structures are removed. Flood buyouts eliminate future flood damages and health and safety risks for owners and rescuers. This helps reduce the cost of emergency response actions such as evacuations, emergency shelters, temporary housing, debris	Ongoing

			removal and repairs to damaged structures. After all structures are removed, the property is restored to permanent open space. This allows more room for flood water storage and flow, and creates natural space for fish, wildlife, and passive recreation. Any structure located in a flood-prone area of unincorporated King County may be eligible for this program. Buyouts are appropriate in areas where there is deep, fast-moving water, serious bank erosion, and significant risk of channel migration.	
DNRP – WLRD: Protect and Restore Natural Floodplain Functions				
Yes	Long-term	Removed	The 2024 King County Flood Management Plan outlines a vision for reducing flood and flood-related risks countywide. It describes the actions King County will take to manage risks associated with flooding along our rivers, creeks, and shorelines, including opportunities for the County to work with cities, partners, and community members to build flood resilience. These action items include many that restore natural floodplain functions.	Ongoing
DNRP – WLRD: Flood Risk Mapping				
Yes	Long-term	Updated	Flood maps are one tool that communities can use to know which areas have the highest risk of flooding. The maps help people make decisions about where to live, what to build, and how to reduce flood risks. Property owners, insurance agents, and lenders can use flood maps to determine flood insurance requirements and policy costs. King County conducts flood studies using the latest data and technology to produce more accurate flood maps. These maps are submitted to the Federal Emergency Management Agency (FEMA) for adoption. King County routinely updates	Ongoing

			its Flooding Layers in iMap with the most recent data. This is expanded upon in the 2025 strategies.	
DNRP/KCOEM: Public Information Flood Activities				
Yes	Long-term	Removed	Both DNRP and KCOEM update their public websites including www.kcemergency.com which provides residents on the latest information on signification events happening in King County, including flooding.	Ongoing
DNRP – Flood Services: Flood Insurance Promotion				
Yes	Long-term	Removed	King County has a Class 2 CRS rating. A Class 2 rating provides a 40 percent discount on flood insurance premiums for all insurable properties located within unincorporated King County. King County was the first county in the nation to achieve this rating in 2007 and remains one of only three counties in the region with a Class 2 rating. In 2022, flood insurance policyholders in unincorporated King County saved $806,292, an average of $523 per annual policy. This work is located in the updated Floodplain Management Plan.	Ongoing
DLS/DNRP: Enforce Higher Floodplain Management Regulations				
Yes	Long-term	Removed	This strategy is addressed in the 2024 King County Floodplain Management Plan.	Ongoing
DNRP – Flood Services: Manage Flood Protection Facilities				
Yes	Long-term	Removed	This strategy is addressed in the 2024 King County Floodplain Management Plan.	Ongoing
FMD: Seismic Evaluation of King County Courthouse and Maleng Regional Justice Center				
No	Long-term	Removed	King County was not awarded a PDM grant for this project in 2020.	No Progress

FMD: Kent Valley Flood Facility Mitigation				
Yes	Long-term	Removed	Work identified for this strategy can be located in the 2024 King County Floodplain Management Plan.	Ongoing
KCOEM: Integrate ESJ into Mitigation, Response, and Recovery Activities				
Yes	Long-term	Removed	KCOEM continues to integrate ESJ into all aspects of their work.	Ongoing
KCOEM/ECO: Mitigate Weather Impacts to Vulnerable Communities				
Yes	Long-term	Removed	The Extreme Heat Mitigation Strategy was completed in 2024 and includes 20 actions. The actions take a comprehensive approach to equitably preparing people and places in King County for the impacts of hotter summers and more extreme heat events. The King County Extreme Heat Mitigation Strategy was co-developed in collaboration with state and local governments, service providers, community-based organizations, frontline communities, and other partners to provide strategic direction for local and countywide work on heat mitigation.	Ongoing
KCOEM: Seismic Lifeline Route Resilience				
Yes	Long-term	Removed	WSDOT updates its Online Map Center with Seismic Lifeline layers. The last update was in June 2024.	Ongoing
KCOEM: Integrate Hazard Mitigation and Comprehensive Planning				
Yes	Long-term	Removed	KCOEM addresses hazard mitigation in the updated county comprehensive plan.	Ongoing
KCOEM: Engage Community Organizations in Emergency Management				
Yes	Long-term	Removed	KCOEM has a robust public outreach program that focuses on engaging underserved communities in emergency management, reducing risk, and disaster preparedness. This work is expanded upon in the 2025 strategies.	Ongoing

KCOEM: Climate Integration Training				
Yes	Long-term	Removed	All programs in KCOEM consider climate and climate induced hazard impacts in their planning where applicable.	Ongoing
KCOEM: Disaster Skills Risk Reduction Training				
Yes	Long-term	Updated	King County Emergency Management continues to deliver the county's disaster education, and provides year round free training and education to county employees, residents, and organizations/businesses via several programs and activities aimed at promoting personal and community risk reduction.	Ongoing
KCOEM: Dam Failure Risk and Impact Reduction				
Yes	Long-term	Updated	KCOEM continues to fund the role of Dam Safety coordinator with the overall goal of lowering the risk and impacts of dam failure in King County.	Ongoing
KCOEM: Wildfire Preparedness and Risk Reduction				
Yes	Short-term	Removed	In 2022 King County completed the Wildfire Risk Reduction Strategy. This work is being expanded upon by KCOEM in creating a Community Wildfire Protection Plan (CWPP).	Complete
KCOEM: Hazard Mitigation Assistance Grant Support				
Yes	Long-term	Updated	KCOEM continues to assist local governments and county departments with Hazard Mitigation Assistance (HMA) grant applications, providing guidance and support throughout the application process. This includes trainings, webinars, and guidance on how to properly create competitive HMA grants for King County Agencies and eligible partners.	Ongoing
KCOEM: Public Assistance Grant Support				
Yes	Long-term	Removed	KCOEM continues to assist eligible King County applicants in FEMA's PA program.	Ongoing

KCOEM: Language Accessible Video Emergency Messaging				
Yes	Long-term	Updated	KCOEM is continuing to expand its efforts to make emergency messaging more accessible to county residents.	Ongoing
PHSKC: King County Facilities Indoor Air Quality Monitoring Network				
No	Long-term	Removed	The county has yet to procure and deploy 280 Dylos DC1100 (indoor aire quality monitors). PHSKC will continue to find methods of funding for this strategy.	No Progress
PHSKC: Medical Gas Seismic Detection & Emergency Shut Off				
Yes	Long-term	Removed	Work on retrofitting Harborview Medical Center is ongoing.	Ongoing
Parks: Park and trail Facility Landslide Protection				
No	Long-term	Removed	KC Parks was not awarded a 2021 BRIC grant for this project.	No Progress
Parks: Seismic Evaluation and Retrofits of King County Parks Facilities				
No	Long-term	Removed	KC Parks was not awarded a 2021 BRIC grant for this project.	No Progress

20.7 Mitigation Strategies 2025

King County identified the following strategies through meetings among county departments. They are a mix of current projects the County is working on as well as projects identified by the County that require outside funds to complete. These strategies were scored by KCOEM's Hazard Mitigation Program using the prioritization criteria outlined earlier in this section. The strategies are listed in no particular order. It is important to note that these strategies are evolving. King County agencies are welcomed and encouraged to add strategies to this plan throughout the lifecycle of the plan. As more strategies are created, both WA EMD and FEMA will be made aware of the existence of new strategies. Below is the current list of King County Hazard Mitigation Strategies:

Table 20-4 Mitigation Strategies 2025

STRATEGY	PRIORITY (SCORE)	LEAD AGENCY	VISION
Expand King County Jumpstart Program	23	Executive Climate Office (ECO)	To create a diverse, skilled workforce capable of building greener infrastructure and advancing King County's clean energy goals.
Identify and Create County-Wide Resilience Hubs	19	KCOEM/ECO	As King County grows, and awareness of climate change-driven wildfire risk grows, King County has a coordinated strategy to support individuals and local jurisdictions in identifying and managing wildfire risk, including risk to property and public health.
Unreinforced Masonry Mapping for King County	16	KCIT/GIS	To enhance community safety and resilience by accurately mapping unreinforced masonry (URM) buildings in King County, enabling targeted mitigation strategies that reduce the risk of severe damage during seismic events and other natural hazards.
Expand Dam Failure Emergency Action Plans	14	KCOEM	By 2030, all dams within King County will have fully updated Emergency Action Plans (EAPs) and Emergency Operations Plans (EOPs) to ensure coordinated and timely responses to any potential emergencies, enhancing public safety and minimizing the impact of dam-related disasters.
Expanding Public Awareness of "Make It Through" Website	20	KCOEM	To ensure every resident in King County has the knowledge and resources to prepare for and respond to emergencies by expanding the reach and impact

			of www.makeitthrough.com, providing timely, accessible, and practical preparedness information.
Climate Change and Health Adaptation Strategy	23	PHSKC	To create the necessary conditions to prepare for, adapt to, and mitigate the health impacts of climate change in King County, particularly in communities that are most vulnerable and disproportionately impacted by climate hazards.
Expand King County Energize! Program	21	ECO	To improve energy efficiency and reduce environmental impacts in King County homes by providing affordable access to clean, energy-efficient technology, such as heat pumps, weatherization, and electric appliances.
Risk Reduction Through Equitable Language Access	22	KCOEM	To enhance community resilience by improving public translation, cultural communications, and community partnerships, ensuring consistent and accurate information delivery to all residents in King County during emergencies.
Extreme Heat Event Communications	21	KCOEM	To ensure all King County residents, especially those with limited English proficiency, have access to culturally relevant, multilingual heat safety and preparedness information to increase community resilience to extreme heat events.
Enhanced Cooling Centers	21	KCOEM	To increase awareness, accessibility, and utilization of public cooling centers in King County, ensuring all residents, especially those in heat-impacted

			neighborhoods, have safe, reliable access to cooling during extreme heat events.
Shake Alert Sign Up Campaign	18	KCOEM	To ensure that all King County residents are registered for ShakeAlert to receive timely earthquake early warnings, enabling them to take immediate protective actions to reduce injury and property damage during seismic events.
Increase Alert King County Registrations	24	KCOEM	To increase the number of residents signed up for Alert King County by fostering community awareness, engagement, and trust, ensuring that all residents receive timely emergency alerts to protect life and property.
King County Community Wildfire Protection Plan	25	KCOEM	To develop a county-scale Community Wildfire Protection Plan (CWPP) for King County that enhances resilience against wildfire risks through proactive planning, stakeholder collaboration, and public involvement. This CWPP will ensure the county's preparedness, response, and recovery capabilities are robust, inclusive, and community-driven.
Integration of Hazard Mitigation into County Plans	19	KCOEM	To ensure that hazard mitigation strategies are seamlessly integrated into all current King County plans, strengthening the community's resilience to disasters and reducing long-term risk to lives, property, and infrastructure.
King County Flood Warning Center	21	DNRP - Flood	To ensure timely and effective flood warnings and response

			actions for King County residents, minimizing loss of life, property damage, and public health risks during flood events.
Update Liquefaction Mapping King County	21	DNRP	Enhance community resilience in King County by updating and improving liquefaction hazard mapping, leading to better-informed land use planning, infrastructure development, and disaster preparedness in areas vulnerable to liquefaction during seismic events.
Expanding Roadway Access to Isolated Communities in Unincorporated King County	18	DLS- Roads	To ensure that isolated communities in unincorporated King County have reliable and safe access routes for evacuation and emergency response, particularly during wildfire events and power outages. This strategy aims to enhance community resilience and improve public safety by reducing the risk of isolation during extreme events.
HVAC Upgrades for Extreme Weather	18	FMD	To enhance the resilience of King County facilities to extreme weather events by upgrading HVAC systems to ensure reliable temperature control, air quality, and energy efficiency, safeguarding public health and infrastructure, while reducing long-term operational costs.
King County OEM Zone Program	22	KCOEM	Overall, the role of the Zone Liaison is to promote, support, and facilitate regional coordination, communication, and collaboration, in an effort to unify and/or connect region-wide

			emergency management practices, with the aim of maximizing benefits from individual efforts and reducing redundancies.
Actively Manage King County Devices	20	KCIT	To establish a secure, streamlined, and adaptive IT environment within King County by actively managing network devices and software. Starting with a controlled, known baseline, King County will minimize attack surfaces and enhance its ability to adapt to dynamic cybersecurity threats.
Multi-Factor Authorization for King County Devices	19	KCIT	To strengthen King County's cybersecurity posture by prioritizing the protection of accounts with elevated privileges, remote access, and high-value assets through the adoption of multi-factor authentication (MFA) and the reduction of reliance on single-factor authentication systems.
Timely Software Updates for King County Devices	19	KCIT	To ensure King County's IT systems remain secure and resilient by applying all available software updates immediately, automating the update process wherever possible, and maintaining a high level of vigilance against threats, reducing the risk of exploitations and ensuring the integrity of county systems
Creation of County-Wide Recovery Plan	20	KCOEM	To create a comprehensive, resilient, and flexible county-wide recovery plan that effectively addresses the unique needs of all

			communities in King County, ensuring a swift and equitable recovery process after disasters. This plan will integrate community needs, enhance preparedness, and optimize resource allocation, providing clear guidance for a seamless recovery effort.
Wastewater Treatment Division Workforce Development Program	21	DNRP	To create a sustainable and diverse workforce for the clean water sector by providing comprehensive recruitment, mentorship, training, and career growth opportunities to entry-level candidates. The program ensures that individuals are equipped with the skills and knowledge necessary to thrive in the wastewater treatment industry while contributing to a more equitable and inclusive workforce
King Conservation District Wildfire Mitigation Program	22	KCD	To reduce the risk of wildfire damage to homes and communities in King County, especially in the Wildland Urban Interface (WUI), through proactive risk assessments, strategic wildfire mitigation projects, and collaborative efforts aimed at enhancing community resilience.
Improving Emergency Management Public Outreach	21	KCOEM	To ensure that all residents of King County are well-informed and prepared to effectively respond to and mitigate the impacts of hazards, through comprehensive and targeted public outreach strategies. By enhancing public awareness and

			providing accessible resources, we aim to reduce vulnerability and improve community resilience.
Maintain LEPC in King County	20	KCOEM	To ensure the continued protection of King County residents, workers, and the environment by maintaining a robust and effective Local Emergency Planning Committee (LEPC) focused on hazardous materials. The LEPC will provide proactive mitigation strategies, streamline emergency response coordination, and promote the safe management of hazardous materials throughout the county.
Strengthening and Maintaining Partnerships for Emergency Response and Coordination	20	KCSO	To create a coordinated, resilient emergency response system by maintaining strong and effective partnerships between the King County Sheriff's Office, the King County Office of Emergency Management, and the Fusion Center, ensuring a rapid, unified, and data-driven approach to mitigating and responding to a wide range of hazards.
Implementation of 2024 King County Floodplain Management Plan	22	DNRP	To reduce the vulnerability of communities, infrastructure, and ecosystems to flooding by implementing the King County Floodplain Management Plan, fostering resilience through sustainable land use, strategic mitigation, and enhanced floodplain management practices.

Mount Si Road Undergrounding Project	18	Tanner Electric/Roads	To enhance energy resilience and mitigate wildfire and storm-related risks for the North Bend community by undergrounding critical electrical infrastructure along Mount Si Road, ensuring consistent, safe, and uninterrupted power supply to residents, businesses, and essential services.
Plan for Post-Wildfire Community Recovery	23	OEM	Ensure King County is prepared to support equitable, coordinated, and efficient recovery from wildfires—particularly those that impact homes, public facilities, and infrastructure—through a dedicated planning framework that guides action, accountability, and access to recovery resources.
Standardize and Promote Best Management Practices for Wildfire Mitigation	19	DNRP	Reduce wildfire risk to homes, infrastructure, and evacuation routes in King County through coordinated and standardized best management practices that can be easily adopted and implemented by fire departments, agencies, and communities.
Expand Access to Cooling Locations for Communities	20	ECO	Ensure equitable access to safe, welcoming, and community-trusted cooling locations throughout King County to protect high-risk populations during extreme heat events.

Expand the Use of Residential Flood Risk Mitigation Tools Countywide to Benefit Those Who Are Most Vulnerable to Flooding	23	DNRP	Expand access to effective, equitable residential flood risk mitigation tools across King County—such as buyouts and home elevations—to reduce the impacts of flooding for the most vulnerable and financially burdened property owners while also aligning with community priorities and environmental values.
Identify and Seek Funding to Reduce Sea Level Rise and Flood Risks to On-Site Wastewater Infrastructure in unincorporated King County	19	PHSKC	Protect public health and environmental quality by proactively addressing the risks that sea level rise and flooding pose to on-site wastewater infrastructure in vulnerable unincorporated areas of King County, with a focus on equitable outcomes.
WSDOT Avalanche Forecasting and Control Program	15	WSDOT	Maintain the safety and reliability of Washington's mountain highway corridors by proactively forecasting and controlling avalanches to reduce hazards for motorists, freight traffic, and recreational users.

20.7.1 Expand King County JumpStart Program

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
King County Executive Climate Office (ECO)	County Agencies	Extreme Weather Hazardous Materials Cyber Incident Earthquake	County Budget

Vision

To create a diverse, skilled workforce capable of building greener infrastructure and advancing King County's clean energy goals.

Description

JumpStart is a workforce development program designed to help young adults (ages 18-24) from underrepresented communities pursue careers in clean energy and skilled trades. The program focuses on pathways in electrical, HVAC, solar energy, and project management. Participants receive training in these fields and are then matched with local contractors for 240 hours of paid work-based learning. This initiative provides opportunities to work on sustainable, living-wage career paths, helping young people contribute to a cleaner, healthier King County.

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Recruit young adults (ages 18-24) for participation in skilled training programs • Partner with at least 10 local contractors to join the JumpStart Network • Train 150+ young adults in clean energy-related career pathways • Provide paid internships to 100+ program participants • Build a strong, diverse workforce ready to take on jobs in clean energy and trades	• Expand partnerships with additional pre-apprenticeship and training organizations • Increase the number of clean energy infrastructure projects within King County • Develop a long-term pipeline for workers in fields such as HVAC, electrical, solar, and project management • Ensure sustainable employment for at least 80% of participants in the program's work-based learning phase • Help contractors successfully integrate young, diverse talent into their workforce	• Contribute to King County's clean energy goals by significantly increasing the number of skilled workers in the sector • Ensure a lasting and diverse workforce capable of building and maintaining green infrastructure across the region • Foster an inclusive and equitable clean energy transition with job opportunities for historically underrepresented communities • Enable sustained career success for program participants, helping to close gaps in access to well-paying jobs in green sectors

Implementation Plan/Actions

- Recruit young adults for training in electrical, HVAC, solar, and project management pathways
- Partner with training program providers to deliver hands-on learning opportunities
- Match participants with JumpStart Network contractors for work-based learning opportunities
- Promote the JumpStart program to local businesses and contractors to grow the network and increase job opportunities
- Work with local contractors to train the next generation of skilled workers
- Provide resources and guidance to contractors on contracting opportunities with King County and clean energy incentives

Performance Measure

- Number of young adults recruited into training programs
- Number of local contractors participating in the JumpStart Network
- Number of paid internships completed by participants
- Number of participants employed in clean energy and skilled trades positions post-program
- Feedback from contractors regarding the readiness and performance of program participants
- Retention rates of participants in the clean energy and trades sectors after completing the program

20.7.2 Identify and Create County-Wide Resilience Hubs

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM and ECO	DNRP, WLRD, DNRP, Parks, DLS, Permitting KC Fire Districts, WA DNR, King Conservation District, Tribes, USFS, KC Climate Preparedness Public Health Seattle-KC	Wildfire Extreme Weather Flood	Existing Resources

Vision

As King County grows, and awareness of climate change-driven wildfire risk and extreme weather grows, King County has a coordinated strategy to support individuals and local jurisdictions in identifying and managing risk, including risk to property and public health.

Description

Partner with King County communities, fire districts, and other organizations to develop an integrated King County strategy for wildfire. The strategy will review current efforts to address wildfire risk in King County and develop recommendations for addressing identified gaps and opportunities. These recommendations will be carried out through a coordinated Firewise technical assistance program, likely led by DNRP. This effort will be coordinated with a SCAP action seeking a similar outcome. This strategy will be based in part on the results of WA DNR effort to map the Wildland Urban Interface in King County.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Convene a multiagency committee to develop a strategy • Request funding for outreach	• Implement the strategy through coordinated technical assistance between the county and local communities	• Maintain consistent outreach to potentially-impacted communities.

Implementation Plan/Actions

- KC EM will work with DNRP, WLRD and the Climate Preparedness team to identify partners.
- Continue to partner with WA DNR and DLS to map WUI areas – ultimately use this map to target strategy priorities.
- Socialize results of WUI mapping efforts with comprehensive plan staff and look into planning policies that could limit density or development in fire-prone areas.
- Convene multiagency committee once WA DNR WUI maps are closer to being finalized
- Identify existing preparedness actions and gaps, including areas that are/are not receiving Firewise outreach and support.
- Develop wildfire preparedness and mitigation coordination strategy and socialize it.
- DNRP to request $150k funding for an additional FTE to support Firewise efforts.
- Look into model codes, ordinances, or other strategies to promote in addition to Firewise.
- Host an annual tabletop at the wildfire workshop held each year by KCEM.

Performance Measure

- KC EM was successful/not successful in convening *all* the necessary partners to establish a unified strategy for community wildfire preparedness and risk reduction.

20.7.3 URM Mapping Specific to King County

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
DNRP GIS	KCOEM	Earthquake Extreme Weather	County Budget HMGP

Vision

To enhance community safety and resilience by accurately mapping unreinforced masonry (URM) buildings in King County, enabling targeted mitigation strategies that reduce the risk of severe damage during seismic events and other natural hazards.

Description

Unreinforced masonry buildings (URMs) pose a significant risk during earthquakes due to their structural vulnerabilities. In King County, the exact number and distribution of these buildings are not fully mapped or documented. This strategy aims to conduct a comprehensive update of the URM building mapping within King County. The updated data will guide mitigation measures such as retrofitting, building code updates, and prioritizing resources for emergency response.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete a comprehensive update of URM building data within King County using available building permits, structural reports, and GIS mapping tools. • Conduct outreach to property owners, developers, and local jurisdictions to improve building data accuracy. • Establish a baseline risk assessment for all identified URM structures in high-risk seismic zones. • Initiate educational campaigns for property owners on the importance of retrofitting and strengthening URM buildings.	• Complete the full retrofitting or replacement of a significant number of high-risk URM buildings in King County through targeted funding and grants. • Implement local ordinances requiring retrofitting for URMs in high-risk zones. • Develop a collaborative funding program with local municipalities to subsidize retrofitting for private building owners. • Improve local zoning codes to encourage safer construction in areas with high concentrations of URM buildings.	• Achieve a substantial reduction in URM-related fatalities and injuries in the event of a major earthquake in King County. • Establish a system for regularly updating URM building data and conducting periodic re-assessments of seismic vulnerabilities. • Foster long-term community resilience by ensuring all vulnerable buildings are retrofitted or replaced with more seismically resilient structures.

Implementation Plan/Actions

- **Action 1:** Collaborate with local governments to compile existing data on URM buildings.
- **Action 2:** Utilize GIS tools and risk assessment software to update building vulnerability data across King County.
- **Action 3:** Launch public outreach programs to inform property owners about the importance of retrofitting URMs and available funding programs.
- **Action 4:** Establish partnerships with structural engineering firms to evaluate and propose retrofitting solutions for the most at-risk URM buildings.
- **Action 5:** Secure funding from federal and state sources for high-priority retrofitting projects.
- **Action 6:** Integrate updated URM mapping into King County's broader hazard mitigation and emergency response planning frameworks.
- **Action 7:** Provide ongoing training for local emergency responders on identifying URMs and the associated risks in disaster scenarios.

Performance Measure

• Completion of updated URM building mapping within King County (measured as a percentage of total URM buildings mapped).
• Number of URM buildings assessed for retrofit or replacement within the first 2 years.
• Percentage of URM buildings identified as high-risk that undergo retrofitting within the 5-year timeframe.
• Increase in the number of URM building owners participating in voluntary retrofitting programs.
• Reduction in the estimated number of injuries and fatalities in future seismic events due to URM vulnerabilities.

20.7.4 Dam Failure EAPs

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	SPU Washington State Department of Ecology	Dam Failure Flooding Terrorism	County Budget FEMA Grants

Vision

By 2030, all dams within King County will have fully updated Emergency Action Plans (EAPs) and Emergency Operations Plans (EOPs) to ensure coordinated and timely responses to any potential emergencies, enhancing public safety and minimizing the impact of dam-related disasters.

Description

King County is home to a variety of dams that serve critical functions for flood control, water supply, and recreational purposes. However, as some of these dams are aging, it is crucial that up-to-date Emergency Action Plans and Emergency Operations Plans are in place for each. This strategy focuses on ensuring that every dam within the county has comprehensive, actionable, and regularly updated plans by 2030. These plans will be aligned with state and federal standards and will involve coordination with key emergency response agencies to ensure a swift and efficient response in the event of a potential dam failure or other emergency scenarios.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete an initial review and assessment of all dams within King County to evaluate the status of their current Emergency Action Plans and Emergency Operations Plans. • Identify gaps or outdated components within existing plans and develop a prioritized action plan to address them. • Establish a working group with key partners (Emergency Management, DNRP, state agencies) to guide the process of updating plans. • Begin the process of updating EAPs and EOPs for the highest-priority dams (based on risk and condition).	• Update Emergency Action Plans and Emergency Operations Plans for at least 50% of the dams in King County. • Conduct at least two county-wide emergency response exercises involving dam failures, ensuring the participation of local, state, and federal agencies. • Create a public awareness campaign to inform the community about dam safety and emergency preparedness in the region. • Establish a long-term plan for maintaining and regularly updating EAPs and EOPs, ensuring they are revisited every 2-3 years.	• Ensure that 100% of dams in King County have updated EAPs and EOPs by 2030. • Improve public and agency preparedness and response times in case of dam failure events. • Continuously enhance coordination and communication protocols between local, state, and federal agencies in managing dam emergencies. • Secure long-term funding mechanisms to maintain up-to-date plans and facilitate regular drills.

Implementation Plan/Actions

• Conduct a comprehensive inventory of all dams in King County, identifying those with outdated or missing Emergency Action Plans and Emergency Operations Plans.
• Collaborate with local, state, and federal agencies to develop a unified approach to updating the EAPs and EOPs.
• Hire consultants or experts to assist with plan updates and ensure compliance with state and federal regulations.
• Provide training for all relevant stakeholders, including local emergency responders and community leaders, to ensure they understand the updated plans.
• Schedule regular drills and simulations to test the effectiveness of the updated plans and refine response protocols.
• Establish a system for regular plan reviews and updates, with an emphasis on technological advancements and emerging threats such as climate change.

Performance Measure

- Percentage of dams with up-to-date EAPs and EOPs by 2025 and 2030.
- Number of drills and exercises conducted each year to test the response capabilities related to dam emergencies.
- Feedback from local agencies and responders on the clarity and effectiveness of the updated plans.
- Reduction in response times during dam-related emergency events.
- Number of gaps identified and corrected during regular assessments.

20.7.5 Expanding Public Awareness of "Make It Through" Website

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	PHSKC ECO DNRP KCIT	Avalanche Terrorism Volcano Earthquake Health Incident Extreme Weather Wildfire Cyber Incident Hazardous Materials	General Fund

Vision

To ensure every resident in King County has the knowledge and resources to prepare for and respond to emergencies by expanding the reach and impact of www.makeitthrough.com, providing timely, accessible, and practical preparedness information.

Description

This strategy aims to increase awareness of and engagement with www.makeitthrough.com, a critical online resource designed to help King County residents prepare for various hazards, including earthquakes, flooding, wildfires, and other public health emergencies. Through targeted outreach, educational campaigns, and strategic partnerships, the goal is to ensure that residents have the necessary tools, knowledge, and motivation to prepare themselves and their communities for a range of disaster scenarios.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Increase website traffic by 50% through targeted campaigns and outreach. • Reach at least 20% of King County residents through media campaigns (TV, radio, social media). • Partner with 15 local organizations to promote the website and offer preparedness workshops. • Develop and distribute preparedness materials in 5 languages widely spoken in King County.	• Achieve a 100% increase in website traffic, with ongoing sustained engagement. • Establish long-term partnerships with 50+ local organizations to ensure continuous promotion and education. • Ensure 75% of King County residents report being aware of the website in post-campaign surveys. • Introduce and promote regional preparedness events featuring www.makeitthrough.com resources.	• Make www.makeitthrough.com a widely recognized tool for emergency preparedness across King County. • Ensure King County residents are among the best-prepared populations in the nation for emergencies. • Maintain a long-term, continuous education program to keep preparedness information relevant and up-to-date.

Implementation Plan/Actions

- **Website Enhancements**: Improve user experience and mobile access on www.makeitthrough.com.
- **Media Campaigns**: Launch multi-channel campaigns (social media, print, radio, TV) to drive awareness of the website.
- **Partnership Development**: Establish partnerships with schools, local businesses, nonprofit organizations, and community groups to share the website.
- **Community Outreach Events**: Host preparedness fairs, workshops, and town halls featuring the website's resources.
- **Material Distribution**: Create bilingual, culturally relevant preparedness pamphlets and digital resources to distribute to local organizations.

• **Public Service Announcements**: Collaborate with local media outlets to air public service announcements about www.makeitthrough.com. • **Surveys and Feedback**: Conduct regular surveys and community feedback sessions to assess awareness levels and adjust strategies as needed.
Performance Measure • Website traffic analytics (visits, unique users, page views) from the website's analytics platform. • Survey results measuring awareness of www.makeitthrough.com among King County residents. • Number of media impressions (TV, radio, social media reach). • Number of partnerships established and the number of preparedness events conducted. • Feedback from community organizations and participants on the effectiveness of outreach materials and events. • Number of preparedness materials distributed in targeted languages and communities.

20.7.6 Climate Change and Health Adaptation Strategy

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
PHSKC	ECO	Avalanche Flood Health Incident Landslide Extreme Weather Wildfire	County Budget

Vision

To create the necessary conditions to prepare for, adapt to, and mitigate the health impacts of climate change in King County, particularly in communities that are most vulnerable and disproportionately impacted by climate hazards.

Description

The Climate Change and Health Adaptation Strategy focuses on improving community resilience to climate-related health risks, including extreme heat, wildfire smoke, and floods. Through co-created risk communication campaigns, community capacity building, evidence-based solutions, and integration of climate data, the strategy aims to mitigate adverse health impacts while promoting equitable climate change programs and policies. This multi-year initiative includes outreach efforts, technical assistance, the development of climate-related health data systems, and collaboration with healthcare and community organizations to reduce inequities caused by climate change.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Co-create and deliver risk communication campaigns with communities impacted by extreme heat, wildfire smoke, and floods • Increase awareness in disproportionately impacted communities about how to mitigate and adapt to climate change • Support community programs addressing the health impacts of heat and wildfire smoke with technical assistance and evidence-based solutions • Begin data collection and improvement for key climate, health, and resilience indicators • Establish collaborative partnerships for integrating climate change into Public Health programs aligned with the Strategic Climate Action Plan	• Expand technical assistance to support communities in adapting to the health impacts of heat and wildfire smoke • Enhance the use of climate data dashboards for tracking health impacts and support policy changes based on qualitative and quantitative data • Ensure health services providers and partners across the region prioritize climate resilience through quarterly healthcare collaborative meetings • Strengthen partnerships with BIPOC communities to co-develop programs and policies that address climate-related health impacts • Increase community capacity to mitigate and adapt to climate hazards by scaling successful programs and strategies	• Influence regional and statewide leadership on climate policies focused on decarbonization, data use, and climate change resilience • Ensure health equity through the integration of climate data into public health decision-making and policy • Establish King County as a national leader in addressing the health impacts of climate change through community programming, research, and collaborations • Build long-term sustainability in community resilience through ongoing education, partnerships, and adaptation strategies

Implementation Plan/Actions
• Collaborate with community partners to develop and disseminate educational resources in multiple languages • Implement strategies and solutions co-created with BIPOC communities to reduce health impacts from climate hazards • Establish and continuously improve a robust data system to monitor climate, health, and resilience indicators • Provide technical assistance to partners and support community-based programs addressing climate health impacts • Integrate climate change considerations into public health programs, ensuring alignment with King County's Strategic Climate Action Plan • Convene quarterly healthcare collaboratives to drive regional climate and health leadership • Collect and analyze data to support public health action and address health inequities
Performance Measure
• Number of community-specific communications campaigns and strategies developed • Number of technical-assistance consultations provided and community partners engaged • Number of data requests, visits to the climate data dashboard, and feedback on data usage • Number of healthcare partners engaged annually in climate and health initiatives • Number of evidence-based programs successfully implemented to reduce health impacts of climate hazards

20.7.7 Expand King County Energize! Program

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
ECO	North Highline and Skyway-West Hill communities	Extreme Weather	CCA FEMA

Vision

To improve energy efficiency and reduce environmental impacts in King County homes by providing affordable access to clean, energy-efficient technology, such as heat pumps, weatherization, and electric appliances.

Description

The Energize! Heat Pump Program focuses on installing heat pumps and other clean technologies in homes in the North Highline and Skyway-West Hill unincorporated areas of King County. The program targets income-qualified residents who may be eligible for 100% cost-coverage, while other residents may receive discounts. Heat pumps, which provide efficient heating and cooling, are part of King County's effort to reduce energy use and help residents lower their energy bills. In 2025, the program will expand through funding from the Climate Commitment Act (CCA) to include electric appliances, plumbing improvements, home energy audits, and weatherization services for single-family homes and small businesses across King County.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Install heat pumps and other clean technology in homes in North Highline and Skyway-West Hill • Provide energy audits and weatherization services • Expand program eligibility to include small businesses in targeted areas • Increase awareness of the program to encourage broader participation from residents in the designated regions	• Install heat pumps and energy-efficient upgrades in across King County • Reduce energy consumption and lower energy bills for participating households • Expand the program to additional communities in King County • Support the installation of energy-efficient technologies for small businesses in King County	• Contribute to King County's clean energy goals by reducing reliance on fossil fuels for home heating and cooling • Improve air quality and lower carbon emissions in the region • Achieve widespread adoption of energy-efficient technology in homes and small businesses across King County • Ensure that lower-income and historically underserved communities have equitable access to clean energy solutions

Implementation Plan/Actions

- Continue installing heat pumps and energy-efficient technology in North Highline and Skyway-West Hill
- Increase outreach to income-qualified residents for 100% cost-coverage opportunities
- Partner with local contractors and service providers to ensure high-quality installations and services
- Expand program offerings to include electric appliances, plumbing improvements, home energy audits, and weatherization in 2025
- Use CCA funding to support program expansion and increase coverage for additional residents and businesses
- Track and evaluate energy savings and customer satisfaction for program improvements

Performance Measure

- Number of homes and small businesses participating in the program
- Total energy savings achieved through heat pump installations and other energy-efficient upgrades
- Reduction in energy bills for participating households
- Number of income-qualified residents who receive 100% cost coverage or discounts
- Customer satisfaction and feedback on program services and installation quality
- Successful implementation of the expanded program in 2025, with a measurable increase in participation and coverage

20.7.8 Risk Reduction Through Equitable Language Access

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
KCOEM	PHSKC Trusted Partner Network	Cyber Incident Dam Failure Earthquake Flood Hazardous Materials Health Incident Landslide Extreme Weather Terrorism Tsunami Volcano Wildfire	County Budget Preparedness Grants

Vision

To enhance community resilience by improving public translation, cultural communications, and community partnerships, ensuring consistent and accurate information delivery to all residents in King County during emergencies.

Description

COVID-19 demonstrated the vital role of timely, accurate, and culturally relevant communication in protecting public health and the economy. King County engaged with community leaders and trusted partners to tailor messages for specific ethnic and language groups, focusing on vulnerable and marginalized populations. This initiative relied on various outreach methods such as webinars, social media, and direct communications to disseminate essential information during the pandemic. Building on this experience, the goal is to refine and expand these efforts to improve public hazard resilience, enhance language access, and sustain these partnerships for future emergency responses.

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Refine and build on the lessons learned from COVID-19 to strengthen community partnerships and cultural communication networks. • Invest in language access resources, including translation, interpretation, and media outreach, to ensure consistent services for all residents. • Formalize the network of Community Navigators to enhance the development and dissemination of in-language communications for emergency preparedness.	• Expand the use of digital and virtual outreach platforms (social media, online platforms) for broader communication access. • Broaden the role of Community Navigators in post-disaster recovery, providing continuous community engagement. • Foster community partnerships to ensure that the public health communication system can quickly adapt to new types of hazards.	• Establish a sustainable framework for language and cultural communications in all future emergency preparedness and mitigation efforts. • Ensure that King County is well-equipped to provide rapid, appropriate, and accurate information to diverse populations in future emergencies. • Integrate community partnerships into long-term resilience planning for environmental, biological, and physical hazards.

Implementation Plan/Actions

- Expand language access resources, such as translation and interpretation services, to provide clear messaging for all King County residents.
- Strengthen and formalize the Community Navigator network to ensure culturally appropriate information dissemination.
- Increase community outreach efforts through social media and digital platforms to maintain flexibility and consistency in communication during emergencies.
- Engage in continuous training and collaboration with local ethnic and media outlets to ensure that all communication is clear, timely, and accessible.

Performance Measure

- Increase in the number of residents receiving emergency communications in their preferred language.
- Number of community events and outreach initiatives conducted with diverse ethnic groups.
- Effectiveness of public health messaging, as measured by surveys or feedback from target communities.
- Tracking the engagement levels in virtual and social media outreach platforms.
- Evaluation of the Community Navigator network's impact on reaching vulnerable populations.

20.7.9 Extreme Heat Event Communications

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	PHSKC ECO Community based organizations	Extreme Weather Wildfire	County Budget

Vision

To ensure all King County residents, especially those with limited English proficiency, have access to culturally relevant, multilingual heat safety and preparedness information to increase community resilience to extreme heat events.

Description

Language and cultural barriers can limit the effectiveness of heat preparedness and mitigation efforts. This action focuses on the development and distribution of multilingual, culturally relevant materials about heat safety to better serve communities in King County, particularly those in the hottest areas. These areas have a high proportion of limited English-speaking residents who are more vulnerable to heat-related health impacts. Through collaboration with community organizations, local governments, and multilingual media, the aim is to increase the reach and impact of heat safety messages before, during, and after heat waves.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Develop and distribute multilingual and culturally relevant heat safety and preparedness materials. • Partner with community organizations to evaluate heat messaging needs and priorities. • Increase the use of community networks and media to distribute heat safety messages, especially in communities with limited English proficiency. • Ensure the inclusion of heat safety content in various formats, such as print, digital, and multimedia. • Ensure preparedness messaging is provided well before heat waves to encourage early actions like purchasing cooling items.	• Co-create comprehensive, community-specific heat safety materials with a diverse set of local partners. • Build sustainable distribution channels for multilingual heat safety information, integrating them into community networks and media. • Provide consistent access to multilingual heat safety content in areas with high heat vulnerability. • Enhance outreach to include information on supporting at-risk populations, including low-income seniors and people with disabilities.	• Ensure equitable access to heat preparedness information for all residents, particularly those in the hottest areas of King County. • Make multilingual heat safety resources a consistent part of community resilience and public health efforts. • Foster long-term partnerships between King County, local governments, and community organizations for heat safety outreach and preparedness.

Implementation Plan/Actions

• **Co-create culturally relevant content**: Partner with community-based organizations, service providers, and residents to develop heat safety materials that reflect community needs and priorities.
• **Expand distribution networks**: Work with local, multilingual media and community-trusted organizations to adapt and distribute heat safety information in multiple languages through various formats (e.g., printed materials, digital media, video).
• **Integrate heat safety into pre-summer messaging**: Begin heat safety messaging early in the year, especially to encourage the purchase of cooling devices during the off-season.
• **Focus on high-risk communities**: Prioritize outreach to areas with the highest temperatures and most limited English-speaking populations.
• **Collaborate on cross-strategy multilingual materials**: Develop multilingual resources related to heat safety, in-

home support for vulnerable populations, urban tree canopy management, and energy efficiency. • **Facilitate access via an online clearinghouse**: Add multilingual heat safety materials to the extreme heat online clearinghouse (Action 19: Partnerships for Implementation) for easier access.
Performance Measure • Increased distribution of multilingual heat safety materials, measured by the number of materials distributed and the reach of messaging. • Increased engagement with community-based organizations and media partners to co-create and distribute content. • Higher levels of community awareness and preparedness for heat events, as measured through surveys and feedback. • Reduced language and cultural barriers to heat safety information, as indicated by the number of communities with limited English proficiency receiving the materials.

20.7.10 Enhanced Cooling Centers

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	Local Community Organizers ECO	Extreme Weather	County budget, grants, public-private partnerships (cost estimation to be determined)

Vision

To increase awareness, accessibility, and utilization of public cooling centers in King County, ensuring all residents, especially those in heat-impacted neighborhoods, have safe, reliable access to cooling during extreme heat events.

Description

In response to community feedback and surveys by King County's Office of Emergency Management, there is a need for increased awareness, access, and services at existing public cooling centers. This action focuses on increasing the utilization of these centers through staffing improvements, enhanced amenities, and better transportation options, particularly targeting communities with elevated heat risks. Although cooling centers are available, utilization has been low, primarily due to a lack of awareness, family-friendly programming, and transportation barriers. This action calls for collaborative efforts to address these challenges and increase accessibility.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Increase public awareness of cooling center locations and services. • Improve transportation options to cooling centers, particularly in heat-impacted neighborhoods. • Enhance amenities at cooling centers, such as snacks, water, Wi-Fi, and device charging capabilities. • Increase staff capacity and operational budgets to ensure extended hours of access.	• Achieve a significant increase in the utilization rates of public cooling centers, especially in identified heat islands and underserved communities. • Establish a comprehensive, multilingual communications strategy for cooling center outreach and updates during heat events. • Ensure long-term sustainability of funding for cooling center operations and staffing.	• Ensure year-round, reliable cooling center access for King County residents during extreme heat events. • Create a model of community engagement and center utilization that can be replicated in other regions facing similar challenges. • Establish consistent funding and infrastructure to support cooling centers as essential community resources.

Implementation Plan/Actions

• **Collaborate with local governments and agencies** to identify gaps in cooling center services and transportation access, particularly in heat-impacted neighborhoods.
• **Promote transit options** to and from cooling centers, ensuring accessibility for all community members.
• **Provide incentives** at cooling centers, including snacks, bottled water, Wi-Fi access, and charging stations.
• **Increase communications and outreach** about cooling center availability, focusing on heat events, multilingual messaging, and disability accessibility.
• **Budget for additional staff** and operational resources to support extended hours and improved services at cooling centers.

Performance Measure

• Increased utilization of cooling centers, measured by attendance data and community feedback.
• Greater awareness as indicated by surveys and outreach tracking.
• Improved accessibility, measured by transportation utilization rates and increased family participation in programs.

• Satisfaction levels of residents accessing cooling centers, as measured through surveys and community engagement.

20.7.11 Shake Alert Sign Up Campaign

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	WAEMD USGS Local Jurisdictions	Earthquake	General Fund FEMA Preparedness Grants

Vision

To ensure that all King County residents are registered for ShakeAlert to receive timely earthquake early warnings, enabling them to take immediate protective actions to reduce injury and property damage during seismic events.

Description

ShakeAlert provides critical early warnings seconds before an earthquake strikes, allowing residents to take protective actions such as "Drop, Cover, and Hold On." Despite its importance, many King County residents remain unaware of ShakeAlert or are not registered to receive notifications. This strategy will focus on increasing awareness of the system, educating residents on how to sign up, and expanding accessibility to ensure that ShakeAlert reaches all King County residents, especially those in vulnerable communities.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Conduct at least 10 public outreach events in community centers, schools, and libraries to promote ShakeAlert • Distribute ShakeAlert promotional materials to 100,000 households in King County • Launch a targeted social media and digital advertising campaign to educate residents about ShakeAlert • Implement ShakeAlert registration in at least 50 local schools and businesses	• Achieve a 50% increase in ShakeAlert registrations across all demographics in King County • Establish permanent partnerships with schools, libraries, and community organizations to continue ShakeAlert education and registration • Integrate ShakeAlert information into existing emergency preparedness initiatives across King County • Expand ShakeAlert accessibility to populations with limited access to smartphones or the internet	• Ensure that 90% of King County residents are registered for ShakeAlert • Establish King County as a national model for earthquake early warning systems, with widespread participation • Foster a resilient community where earthquake preparedness is ingrained in daily life

Implementation Plan/Actions

• **Community Outreach and Engagement**: Conduct in-person outreach at local community centers, schools, and libraries to demonstrate ShakeAlert registration and educate residents about the system's importance.
• **Partnership with Schools and Businesses**: Collaborate with local schools and businesses to encourage staff and students to register for ShakeAlert, ensuring that these groups are well-informed and can spread the message to families.
• **Public Awareness Campaign**: Use digital and traditional media (TV, radio, social media) to spread the word about ShakeAlert. Develop eye-catching ads that explain how to register and the benefits of receiving early earthquake warnings.
• **Multilingual Outreach**: Provide materials in multiple languages spoken in King County, such as Spanish, Chinese, and Somali, to ensure wide accessibility.
• **Incentivize Registration**: Host contests or offer small prizes for residents who sign up and engage in ShakeAlert awareness campaigns.
• **Mobile App Partnerships**: Work with mobile phone carriers to include ShakeAlert sign-up prompts or integration directly within their apps to make the process seamless for users.
• **Targeted Education for Vulnerable Populations**: Focus on outreach efforts to populations that may be harder to reach, including seniors, low-income households, and people with disabilities, providing them with information on how to register for ShakeAlert via different methods (e.g., text messages, landline phones, apps).

Performance Measure

• **Registration Metrics**: Track the number of new ShakeAlert sign-ups in King County over time and measure the percentage increase in registrations.
• **Outreach Effectiveness**: Monitor participation in community events, workshops, and other outreach efforts, measuring attendance and engagement through sign-up rates.
• **Social Media Engagement**: Evaluate the effectiveness of digital campaigns through social media analytics, such as likes, shares, comments, and click-through rates on ShakeAlert registration links.
• **Demographic Data**: Assess the demographic breakdown of ShakeAlert registrants (e.g., age, language, location) to ensure equitable access and participation across all communities in King County.
• **Community Feedback**: Collect feedback from community organizations, schools, and local leaders to evaluate the impact of outreach efforts and identify areas for improvement.

20.7.12 Increase Alert King County Registrations

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	Local Jurisdictions	Avalanche Civil Disorder Cyber Incident Dam Failure Earthquake Flood Hazardous Materials Health Incident Landslide Extreme Weather Terrorism Tsunami Volcano Wildfire	General Budget

Vision

To increase the number of residents signed up for Alert King County by fostering community awareness, engagement, and trust, ensuring that all residents receive timely emergency alerts to protect life and property.

Description

Alert King County is a critical system for delivering emergency notifications to King County residents. However, a large portion of the population remains unregistered, especially among underserved communities, people with disabilities, and those with limited access to technology. This strategy will focus on outreach, education, and incentives to increase sign-ups, with particular emphasis on those vulnerable populations. By engaging residents and community organizations, we aim to raise awareness about the importance of timely alerts for disaster preparedness.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Increase Alert King County registrations by 20% • Expand outreach to at least 50 community organizations and institutions • Host at least 10 community events focused on Alert King County registration • Collaborate with local schools and libraries to reach families and seniors • Develop multilingual promotional materials and outreach methods	• Achieve a 50% increase in Alert King County sign-ups across all demographic groups • Establish sustainable, ongoing partnerships with local organizations to ensure consistent outreach • Integrate Alert King County registration into emergency preparedness training and public health campaigns • Improve access to Alert King County for residents with disabilities or those without smartphones or internet access	• Ensure 90% of King County residents are signed up for Alert King County • Create a robust public engagement model that can be adopted by other regions in Washington State • Foster an emergency preparedness culture that includes all communities, particularly vulnerable populations

Implementation Plan/Actions • **Develop a Comprehensive Communication Campaign**: Launch targeted digital, print, and in-person outreach efforts. Use local radio, social media, and direct mail to inform residents about the benefits of registering. • **Host Community Registration Events**: Work with local libraries, community centers, schools, and places of worship to set up registration booths and provide live demonstrations. • **Incentivize Registration**: Offer rewards or incentives, such as raffle entries for prizes, to encourage people to sign up. • **Collaborate with Local Media**: Engage local news outlets to broadcast reminders and alerts about Alert King County registration. • **Multilingual Outreach**: Provide materials and registration assistance in Spanish, Russian, Somali, Mandarin, and other languages spoken in King County. • **Train Community Leaders**: Educate community leaders on the importance of emergency alerts, so they can share the information with their networks and encourage sign-ups. • **Address Accessibility Needs**: Partner with organizations that serve people with disabilities to ensure that Alert King County registration is accessible to all.
Performance Measure • **Registration Metrics**: Track the number of new registrants over time and compare it to baseline data to gauge the increase in sign-ups. • **Engagement Analytics**: Measure the effectiveness of outreach campaigns through website analytics (e.g., clicks on registration links), social media interactions, and event attendance. • **Community Feedback**: Gather feedback from community organizations and participants to assess the impact of outreach efforts. • **Demographic Breakdown**: Track the demographic breakdown of registrants (e.g., age, race, language, location) to ensure equitable outreach efforts.

20.7.13 King County Community Wildfire Protection Plan

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	KCSO DNRP KCD KCECO	Wildfire	HMGP/FEMA/State Grants

Vision

To develop a county-scale Community Wildfire Protection Plan (CWPP) for King County that enhances resilience against wildfire risks through proactive planning, stakeholder collaboration, and public involvement. This CWPP will ensure the county's preparedness, response, and recovery capabilities are robust, inclusive, and community-driven.

Description

The King County Office of Emergency Management (KCOEM) is spearheading the development of King County's first county-scale Community Wildfire Protection Plan (CWPP). Over the next 18 months, KCOEM will hire a Temporary Limited Term planner to lead the planning process, working alongside key local agencies and jurisdictions. The CWPP will be developed through stakeholder collaboration, involving public, private, and Tribal entities to enhance wildfire preparedness, response, and recovery across King County. The plan will include a county-wide risk assessment, capabilities assessment, public outreach, and prioritization of mitigation actions.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Hire and onboard a Temporary Limited Term planner to lead the CWPP development. • Develop a comprehensive risk assessment using GIS tools to identify wildfire risks and vulnerable populations in King County. • Complete the first draft of the CWPP and begin public outreach and community engagement. • Facilitate workshops with stakeholders and local communities to ensure a broad, inclusive planning process.	• Finalize and submit the King County CWPP for Federal and State review. • Create annexes for individual communities to provide detailed, localized wildfire mitigation plans. • Develop prioritized mitigation actions based on the risk assessment, forest health, and community input. • Implement priority wildfire risk reduction actions, including fuels reduction and structural hardening projects.	• Achieve increased resilience of King County forests and infrastructure to wildfire risks. • Enhance the wildfire preparedness, response, and recovery systems for all communities within the county. • Ensure ongoing public engagement and updates to the CWPP to reflect evolving wildfire risks and mitigation strategies.

Implementation Plan/Actions

• Convene a core planning team from relevant county departments, agencies, and external partners.
• Conduct risk assessments, including overlaying critical infrastructure, vulnerable populations, and historical wildfire data in a unified GIS tool.
• Perform community outreach, surveys, and meetings to gather local knowledge and input.
• Develop and prioritize mitigation actions, focusing on fuels reduction, defensible space, and structural hardening across the county.
• Facilitate the creation of annexes for individual communities, offering tailored wildfire mitigation strategies.
• Ensure the CWPP aligns with broader state and national wildfire strategies, including the National Cohesive Wildland Fire Management Strategy.

Performance Measure

• Completion of the CWPP within 18 months, with ongoing updates to the annexes.
• Engagement of key stakeholders, local communities, and the public throughout the planning process.
• Number of mitigation actions prioritized and completed, as well as funding secured for implementation.
• Feedback and participation levels from affected communities, particularly vulnerable populations in the WUI.

20.7.14 Integration of Hazard Mitigation into County Plans

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	All County Agencies	Avalanche Civil Disorder Cyber Incident Dam Failure Earthquake Flood Hazardous Materials Health Incident Landslide Extreme Weather Terrorism Tsunami Volcano Wildfire	County Budget

Vision

To ensure that hazard mitigation strategies are seamlessly integrated into all current King County plans, strengthening the community's resilience to disasters and reducing long-term risk to lives, property, and infrastructure.

Description

The King County Office of Emergency Management (KCOEM) will lead efforts to integrate hazard mitigation strategies into existing countywide planning processes. This will involve updating current plans—such as the Comprehensive Emergency Management Plan (CEMP), land use planning, transportation, and infrastructure development—so that mitigation actions are explicitly included and prioritized. By embedding hazard mitigation into these planning documents, KCOEM will enhance long-term resilience, reduce future disaster impacts, and ensure that mitigation strategies are a consistent part of local government and community actions. The integration process will engage stakeholders, incorporate data-driven risk assessments, and ensure that mitigation actions are incorporated into all planning phases, from preparedness to recovery.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Conduct an inventory of all existing King County plans and identify opportunities for hazard mitigation integration. • Develop a framework for embedding hazard mitigation strategies into key county planning documents. • Work with local jurisdictions to align hazard mitigation with existing regional plans, including the Regional Hazard Mitigation Plan. • Integrate risk reduction measures into at least two major planning documents (e.g., transportation or land use plans). • Provide training and resources for	• Ensure hazard mitigation strategies are fully integrated into at least 75% of all major King County planning documents. • Establish a regular review process for incorporating updated hazard mitigation information into planning documents and procedures. • Collaborate with local governments and regional partners to incorporate mitigation into hazard-specific plans (e.g., floodplain management, wildfire prevention, heat preparedness). • Build capacity for communities to implement hazard mitigation actions	• Achieve widespread adoption of hazard mitigation strategies across all King County plans, ensuring a holistic approach to disaster resilience. • Create a long-term, sustainable framework for ongoing integration of hazard mitigation into new plans and projects. • Foster a culture of resilience where hazard mitigation is a standard consideration for all county planning and development activities.

county departments and local governments on incorporating hazard mitigation into their operations and planning.	through grants, funding programs, and technical support.	

Implementation Plan/Actions

• **Conduct an assessment of current plans**: Review King County's existing plans and identify gaps where hazard mitigation strategies can be integrated (e.g., CEMP, Comprehensive Plan, transportation plans, capital improvement plans).
• **Develop a hazard mitigation integration framework**: Create a standard framework for including hazard mitigation actions and policies in all relevant county plans, with clear guidelines and objectives for each department and jurisdiction.
• **Engage stakeholders**: Collaborate with local governments, community organizations, and other stakeholders to ensure that hazard mitigation strategies are reflective of community needs and priorities.
• **Update plans**: Integrate specific hazard mitigation actions and strategies into at least two major planning documents, and ensure that new planning processes include mitigation considerations.
• **Provide training and support**: Offer training and resources to King County departments and local governments on how to include hazard mitigation strategies in their planning processes, including best practices and available funding sources.
• **Track and review**: Implement a process for ongoing tracking, monitoring, and updating of hazard mitigation integration efforts to ensure continued alignment with county goals and evolving hazard risks.

Performance Measure

• Number of King County plans that integrate hazard mitigation strategies, tracked by specific document reviews and updates.
• Percentage of departments and jurisdictions that have adopted the hazard mitigation integration framework into their planning processes.
• Feedback from stakeholders, including community organizations and local governments, on the effectiveness and relevance of integrated mitigation strategies.
• Number of hazard mitigation actions implemented from countywide plans.
• Progress on reducing risk and enhancing resilience in specific hazard areas, measured through post-event analysis and risk assessments.

20.7.15 King County Flood Warning Center

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
DNRP	NWS PHSKC KCOEM	Flood	County Budget

Vision

To ensure timely and effective flood warnings and response actions for King County residents, minimizing loss of life, property damage, and public health risks during flood events.

Description

The King County Flood Warning Center (FWC) provides critical flood monitoring, alerts, and decision support during flood events in King County. The FWC utilizes a combination of real-time flood monitoring tools, hydrologic modeling, and collaboration with local agencies and the National Weather Service to provide flood forecasts and warnings. It works closely with local jurisdictions and public health agencies to ensure communities have the necessary information to protect lives, property, and the environment. The center also supports public outreach, ensuring flood information is accessible, especially for vulnerable populations.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Improve real-time flood monitoring and forecasting capabilities to enhance flood warnings. • Expand community outreach and flood awareness programs, ensuring residents understand flood risks and warnings. • Develop and distribute multilingual flood preparedness materials. • Strengthen coordination with local jurisdictions and agencies to ensure efficient flood response. • Continue improving flood mapping and risk assessment tools.	• Increase community trust and engagement with flood warning systems through outreach and educational programs. • Enhance the capacity of the FWC to issue timely, accurate flood warnings across all flood-prone areas. • Develop an integrated flood response plan that involves all local, regional, and state partners. • Provide equitable flood warning and preparedness materials for all King County communities, with a focus on underserved populations.	• Establish a fully integrated and automated flood warning system that can predict and respond to flood events across King County in real-time. • Build long-term resilience in communities, reducing vulnerability to flooding through education, infrastructure improvements, and emergency preparedness. • Expand floodplain management strategies to reduce future flood risks and enhance sustainable flood mitigation efforts.

Implementation Plan/Actions

• **Enhance flood monitoring capabilities**: Continue to upgrade and integrate flood monitoring tools, hydrologic models, and real-time data from streams and rivers.
• **Increase public awareness**: Provide ongoing public education on flood preparedness through workshops, outreach programs, and multilingual resources.
• **Collaborate with local and regional partners**: Coordinate flood monitoring and warning efforts with local governments, public health agencies, and the National Weather Service to provide timely, accurate information to communities.
• **Improve accessibility**: Develop and distribute flood warning alerts and preparedness materials in multiple languages to ensure accessibility for all residents.
• **Refine flood forecasting**: Invest in tools and resources to improve the accuracy of flood forecasting, integrating new technologies and data sources.

Performance Measure • Timeliness and accuracy of flood warnings issued by the FWC, measured by the lead time provided before flood events. • Increased public awareness and understanding of flood risks, as assessed through surveys and community engagement. • Number of communities reached through multilingual flood preparedness messaging. • Reduced flood-related impacts in communities, such as property damage or loss of life, as measured through post-event assessments and data analysis. • Enhanced coordination and response times among local, regional, and state partners during flood events.

20.7.16 Update Liquefaction Mapping in King County

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
DNRP GIS	EMD USGS KCOEM	Earthquake	KC General Fund HMGP

Vision

Enhance community resilience in King County by updating and improving liquefaction hazard mapping, leading to better-informed land use planning, infrastructure development, and disaster preparedness in areas vulnerable to liquefaction during seismic events.

Description

Liquefaction, a process where saturated soil temporarily loses strength during an earthquake, poses a significant risk to buildings, infrastructure, and people in King County, particularly in low-lying areas. While previous mapping efforts have identified many areas at risk, updated and more accurate mapping, including new geotechnical data, advancements in seismic research, and changing land-use patterns, is needed to better understand the spatial distribution and intensity of liquefaction hazards.

The updated liquefaction hazard maps will inform land-use policies, zoning, building codes, emergency preparedness plans, and mitigation strategies, ultimately reducing the risk of property damage, loss of life, and economic disruption in the event of a significant seismic event.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Conduct a comprehensive review of existing liquefaction hazard maps and identify areas requiring new data or more refined analysis. • Secure funding and develop partnerships with state, local, and federal agencies. • Complete geotechnical field studies in key areas of King County to update soil and seismic data. • Develop a draft of the updated liquefaction hazard maps for peer review.	• Finalize and publish the updated liquefaction hazard maps for King County. • Integrate updated maps into local land-use planning and development guidelines. • Conduct a series of outreach programs and workshops to educate local governments, developers, and the public about the updated maps and their implications. • Implement mitigation strategies based on the updated maps, including targeted infrastructure improvements and building code updates.	• Monitor the effectiveness of the updated liquefaction maps and mitigation measures in reducing risk to people, property, and infrastructure. • Expand the scope of the liquefaction mapping to cover areas outside of King County with potential future seismic risks. • Continue ongoing data collection and modeling to refine maps as seismic research advances. • Ensure continuous integration of updated maps into emergency management systems and protocols.

Implementation Plan/Actions

Year 1-2

- Coordinate with the Washington State EMD, USGS, and local jurisdictions to establish the scope of the project and secure funding.
- Identify critical areas of King County lacking detailed liquefaction data and prioritize them for field studies.
- Conduct geotechnical surveys and collect new data in high-priority areas (e.g., downtown Seattle, Bellevue, and South King County).
- Revise and update the preliminary liquefaction hazard maps.
- Review existing policies and zoning codes to incorporate updated hazard mapping requirements.

Year 3-5

- Conduct peer reviews of the updated maps with seismic experts and stakeholders to ensure accuracy and applicability.
- Finalize the updated liquefaction hazard maps and publish them online and in public forums.
- Integrate the updated maps into King County's GIS system and collaborate with local municipalities to update their land-use and building codes.
- Develop and implement an outreach strategy to inform developers, planners, and residents about the new data and its implications for construction and safety measures.
- Explore funding for infrastructure improvements in identified high-risk areas.

Ongoing

- Monitor seismic events and update maps as necessary based on new data and research.
- Periodically assess and refine mitigation measures to enhance community resilience.
- Maintain and update collaboration with state, local, and federal agencies to ensure continuous improvement in hazard mitigation efforts.

Performance Measure

• Completion of updated liquefaction hazard maps by the end of Year 2.
• Integration of updated maps into at least 80% of local jurisdictions' land-use policies and building codes by Year 5.
• Engagement with at least 500 stakeholders (e.g., community members, developers, emergency responders) through workshops, webinars, and outreach materials.
• 75% of identified high-risk infrastructure sites implement mitigation measures (e.g., retrofitting, land-use restrictions) within five years of map publication.

20.7.17 Expanding Roadway Access to Isolated Communities in Unincorporated King County

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
DLS -Roads Fire Districts	KCOEM Eastside Fire and Rescue	Wildfire Extreme Weather	Existing Budget/BRIC/HMA Grants

Vision

To ensure that isolated communities in unincorporated King County have reliable and safe access routes for evacuation and emergency response, particularly during wildfire events and power outages. This strategy aims to enhance community resilience and improve public safety by reducing the risk of isolation during extreme events.

Description

Many isolated communities in unincorporated King County are vulnerable to wildfires and power outages due to limited or poorly maintained access roads. These roadways are crucial not only for evacuation but also for the delivery of essential services and the ability of emergency responders to reach affected areas. This strategy focuses on improving and expanding roadway access to these communities, ensuring that critical infrastructure can withstand and respond effectively to the challenges posed by wildfires, storms, and other natural disasters.

Key actions include road upgrades, clearing vegetation to create defensible spaces, and building alternative routes to avoid blocked roads during emergencies. The project will focus on both short-term improvements (such as road widening, emergency turnouts, and vegetation management) and long-term efforts (such as permanent road upgrades and redundancy in evacuation routes).

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Conduct a comprehensive assessment of road access to all isolated communities in unincorporated King County, identifying the most critical and vulnerable areas. • Prioritize roadways in high-risk wildfire zones and areas with limited access to power grid infrastructure. • Initiate vegetation management and clearance along key roads to improve accessibility during wildfire events and storms. • Establish agreements with fire districts, emergency medical services, and utility companies to facilitate coordinated response efforts during emergencies.	• Complete roadway upgrades (e.g., widening, resurfacing) for the highest-priority access routes to isolated communities, focusing on fire-prone and remote areas. • Develop alternative evacuation routes in at least 50% of identified communities to reduce the risk of blockage from wildfire or flooding. • Improve road resilience by reinforcing infrastructure (e.g., reinforcing bridges, culverts, and other critical structures) to withstand extreme weather events and wildfire risks. • Complete community engagement efforts to inform residents about emergency preparedness, evacuation plans, and available access routes.	• Achieve 100% access to all identified isolated communities with multiple, resilient, and well-maintained evacuation routes that are safe during wildfire, storms, and power outages. • Ensure that all access routes are equipped with necessary emergency signage, lighting, and traffic management systems for easy navigation during crises. • Fully integrate the road access improvements with the King County Emergency Response Plan to ensure coordination between first responders, residents, and emergency services.

		• Secure long-term funding and partnerships to maintain roadways, manage vegetation, and ensure consistent access for emergency response and recovery efforts.

Implementation Plan/Actions

Initial Roadway Assessment & Community Engagement:

- Complete a detailed analysis of current road conditions, identifying high-risk areas for wildfire or power outages.
- Consult with community members to understand local challenges and needs regarding road access and emergency response.
- Establish a prioritization framework for addressing the most urgent areas based on risk, accessibility, and population density.

Roadway Improvements:

- Begin widening key roads, particularly those serving remote areas, to allow for easier access for emergency vehicles, evacuation traffic, and utility crews.
- Install emergency turnouts, pull-offs, and strategic points for firefighting vehicles to ensure better response times and safety.
- Implement firebreaks and vegetation management along critical access roads to reduce the risk of road blockage due to wildfires or fallen trees.
- Improve road signage, emergency markers, and reflective materials to aid nighttime navigation during power outages or smoke-filled conditions.

Develop Alternative Routes:

- Identify and design secondary or backup evacuation routes that could be used if primary roads are compromised by wildfires, flooding, or other events.
- Construct or upgrade bridges, culverts, and other critical infrastructure to improve the durability of these alternative routes.
- Work with landowners and local stakeholders to secure rights-of-way and easements for new roads or alternate routes.

Coordination with Emergency Services:

- Work with local fire districts, emergency medical services (EMS), and law enforcement to create coordinated evacuation plans and response protocols.
- Train community members and emergency responders on the new road access options and the routes for evacuations.
- Establish communication protocols for when roads become impassable or when alternative routes are needed during a crisis.

Maintenance and Long-Term Sustainability:

- Develop a long-term plan for maintaining and upgrading roadways, including regular vegetation management, pothole repairs, and culvert maintenance.
- Seek federal, state, and local funding sources to sustain roadway improvements and ensure continued access for both regular use and during emergencies.
- Monitor changes in climate and infrastructure to adapt the roadway network to future challenges, such as more frequent wildfires or heavier storm events.

Performance Measure

- **Improvement in Access and Evacuation Times:** Measure the reduction in evacuation times and the ability of emergency responders to reach isolated communities compared to baseline data.
- **Road Condition Assessment:** Track improvements in the physical condition of roads, including road width, surface quality, and clearance levels for wildfire defense and emergency access.
- **Community Feedback and Engagement:** Monitor community satisfaction through surveys to assess the effectiveness of the improvements and how well residents understand and use the new access routes.
- **Emergency Response Metrics:** Measure the response times of fire, medical, and utility services to the upgraded areas, comparing pre- and post-upgrade metrics.
- **Frequency of Road Closures and Access Denials:** Track the reduction in instances of blocked or impassable roads during wildfire and storm events.

20.7.18 HVAC Upgrades for Extreme Weather

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
FMD PHSKC	KCOEM	Extreme Weather	BRIC/FEMA/WAEMD

Vision

To enhance the resilience of King County facilities to extreme weather events by upgrading HVAC systems to ensure reliable temperature control, air quality, and energy efficiency, safeguarding public health and infrastructure, while reducing long-term operational costs.

Description

The purpose of this hazard mitigation strategy is to ensure that King County's facilities are equipped with HVAC systems that can effectively handle extreme weather conditions. These upgrades will address the increasing frequency of heatwaves, cold snaps, wildfires, and other weather-related events that can disrupt normal operations and threaten the safety and comfort of occupants.

These improvements include the installation of climate-resilient systems capable of maintaining optimal indoor conditions, even during power outages or extreme environmental conditions. The strategy will involve the integration of smart HVAC technologies, renewable energy sources (solar, battery storage), and emergency air filtration systems to protect public health in the event of poor outdoor air quality.

2-Year Objectives

- Conduct a comprehensive audit of all King County facilities' HVAC systems to assess current vulnerabilities to extreme weather conditions.
- Prioritize facilities based on usage, vulnerability to climate risks, and the population served, focusing on high-risk areas first.
- Implement immediate upgrades to HVAC systems in high-priority facilities (e.g., public health centers, emergency shelters, senior housing).
- Establish a task force to evaluate HVAC system designs, incorporating energy efficiency, sustainability, and climate adaptability.

5-Year Objectives

- Complete HVAC system upgrades for at least 75% of all county facilities in high-risk areas, including smart thermostats, emergency power backup, and air filtration systems.
- Install renewable energy-powered HVAC units or integrate battery storage systems in at least 30% of King County facilities.
- Improve air quality monitoring systems and ensure that HVAC systems can filter out smoke and pollutants from wildfire events in all key facilities.
- Develop a county-wide emergency HVAC operations plan for use during extreme weather events or power outages.

Long-Term Objectives

- Achieve 100% HVAC system resilience in all King County facilities, with real-time monitoring and automatic adjustments for extreme weather.
- Reduce the county's carbon footprint from HVAC operations by 40% through sustainable energy solutions, such as solar and geothermal systems.
- Establish King County as a regional model for climate-resilient public infrastructure, with HVAC systems that are adaptable, energy-efficient, and environmentally sustainable.
- Integrate HVAC resilience into broader climate adaptation strategies for King County.

Implementation Plan/Actions

1. **HVAC System Audit:**
   - Conduct detailed assessments of all existing HVAC systems in King County facilities to determine areas of improvement.
   - Identify facilities at highest risk based on location, function, and building age.
   - Establish a baseline for energy use, HVAC system age, and vulnerabilities.
2. **System Design & Selection:**
   - Research and select HVAC technologies that provide optimal resilience for extreme temperatures, air quality, and energy efficiency.
   - Focus on systems that are capable of utilizing renewable energy sources, especially solar or wind power, where feasible.
   - Develop a comprehensive retrofit plan for each facility based on audit findings.
3. **Upgrade Implementation:**
   - Begin upgrades in facilities with the greatest immediate need, such as hospitals, shelters, senior centers, and community hubs.
   - Install smart thermostats, backup power solutions (battery storage), and high-efficiency filters.
   - Include systems that can adjust to extreme weather patterns (e.g., high heat or low temperatures).
4. **Staff Training & Emergency Planning:**
   - Train maintenance staff and facility managers in HVAC system operation and emergency protocols.
   - Develop standard operating procedures (SOPs) for HVAC systems during power outages or extreme weather.
   - Integrate HVAC operations into King County's broader emergency response plans.
5. **Public Engagement & Communication:**
   - Provide community outreach regarding HVAC improvements, focusing on vulnerable populations that may be affected by extreme weather events (e.g., seniors, low-income residents).
   - Ensure all facility occupants are informed of HVAC system changes, particularly in terms of air quality and temperature regulation during emergencies.

Performance Measure

- **HVAC system performance during extreme weather events:** Measure the ability of upgraded systems to maintain comfortable and safe indoor environments during heatwaves, cold spells, or power outages.
- **Energy savings and sustainability metrics:** Track reductions in energy consumption and carbon footprint in facilities with upgraded HVAC systems.
- **Public health outcomes:** Monitor the incidence of heat-related illnesses, respiratory issues due to poor air quality, and other health impacts before and after HVAC upgrades.
- **Completion rates for HVAC system upgrades:** Measure the percentage of King County facilities with upgraded HVAC systems over the 2-year, 5-year, and long-term objectives.

20.7.19 KC Zone Program

Lead	Partners	Hazards Mitigated:	Funding Sources and Estimated Costs
KCOEM	Zone 1 & 3 Partner jurisdiction and special purpose districts and unincorporated county.	Avalanche Civil Disorder Cyber Incident Dam Failure Earthquake Flood Hazardous Materials Health Incident Landslide Extreme Weather Terrorism Tsunami Volcano Wildfire	~$220k

Vision

Overall, the role of the Zone Liaison is to promote, support, and facilitate regional coordination, communication, and collaboration, in an effort to unify and/or connect region-wide emergency management practices, with the aim of maximizing benefits from individual efforts and reducing redundancies.

Description

The focus of these regional efforts will be developed in partnership with King County Emergency Management and the zone partners, with input and advice from the Regional Emergency Managers group (the designated emergency manager for each city) and the Emergency Management Advisory Committee (EMAC).

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• By the end of two years, the Zone Liaison will have achieved 75% participation in monthly meetings with all zone agencies, facilitated the completion of at least 24 zone-wide meetings, and supported six regional training or exercise initiatives. The Zone Liaison will also ensure timely situational updates and emergency activation responses, improving regional coordination and preparedness outcomes.	• Within five years, the Zone Liaison will have established a robust network of engaged zone partners, evidenced by 85% compliance with meeting and training objectives, and increased participation in preparedness initiatives across all partner agencies. This effort will enhance regional emergency management capabilities and ensure seamless collaboration during emergencies and planned events.	• The Zone Liaison will serve as a cornerstone for sustainable regional emergency management practices, fostering enduring partnerships and achieving measurable improvements in preparedness and operational readiness across all mission areas. Through consistent leadership and innovation, the Zone Liaison will help create a unified, resilient region capable of addressing evolving threats and challenges

Implementation Plan/Actions

- Facilitate Regional Coordination: Represent zone partners' interests at regional and state emergency management events, ensuring their needs and concerns are addressed in work plans and capability assessments.
- Maintain Situational Awareness: Regularly collect and distribute updates on training, exercises, planning efforts, and operational issues to King County Emergency Management and regional partners.
- Strengthen Relationships: Meet individually with each zone agency and organization monthly to foster collaboration, mentorship, and stakeholder engagement in preparedness efforts.
- Lead Preparedness Initiatives: Organize and facilitate monthly zone-wide meetings, lead training and exercise programs, and assist in the development of plans, policies, and tools to enhance regional capabilities.
- Support Emergency Operations: Act as a liaison during emergencies, ensuring effective communication and coordination between the zone, King County Emergency Management, and other partners.

Performance Measure

Facilitate Regional Coordination:

- Measure: Attend at least 90% of regional and state emergency management events and meetings annually.
- Measure: Submit quarterly reports demonstrating how zone partner needs and concerns are incorporated into regional work plans and capability assessments.

Maintain Situational Awareness:

- Measure: Provide at least biweekly situational awareness updates to King County Emergency Management, including information on training, exercises, and operational issues.
- Measure: Ensure situational updates are shared with all zone partners within 48 hours of receiving new information relevant to the region.

Strengthen Relationships:

- Measure: Conduct one-on-one meetings with at least 95% of zone agencies and organizations each month.
- Measure: Provide feedback from zone partners during quarterly reviews to demonstrate active engagement and relationship-building.

Lead Preparedness Initiatives:

- Measure: Organize and facilitate 12 monthly zone-wide meetings annually, with attendance from at least 80% of zone partners at each meeting.
- Measure: Lead or support at least three training sessions, exercises, or plan development initiatives per quarter, with participation from multiple zone partners.

Support Emergency Operations:

- Measure: Respond to emergency activation requests within one hour, with a 100% response rate during activated events.
- Measure: Provide a post-event report for each incident or event within 72 hours of its conclusion, highlighting actions taken and outcomes achieved.

20.7.20 Actively Manage Network Devices and Software

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCIT	King County Risk Management	Cyber Incident	General Fund

Vision

To establish a secure, streamlined, and adaptive IT environment within King County by actively managing network devices and software. Starting with a controlled, known baseline, King County will minimize attack surfaces and enhance its ability to adapt to dynamic cybersecurity threats.

Description

This strategy involves conducting a thorough inventory of all network devices and software within King County's IT infrastructure. By identifying and removing unwanted, unneeded, or unexpected hardware and software, King County will significantly reduce its network's attack surface. Starting from a clean, known baseline allows for better control over the operational environment, making it easier to identify and mitigate security threats.

Once the inventory is complete, ongoing active management will be key. This includes managing devices, applications, operating systems, and security configurations to ensure systems are secure, scalable, and adaptable. Active enterprise management enables King County to respond effectively to emerging threats while streamlining administrative tasks and optimizing resource allocation.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete a comprehensive inventory of all devices and software across King County's IT environment. • Remove at least 90% of unwanted, unneeded, or unexpected devices and software from the network. • Establish a baseline configuration for devices, applications, and security settings. • Implement a centralized management system to actively monitor and manage network devices and software. • Conduct regular audits to ensure compliance with the inventory and management processes.	• Achieve 100% accuracy in the inventory of devices and software across King County. • Fully integrate centralized management tools across all departments to streamline operations and improve response times. • Establish continuous monitoring systems for identifying and responding to changes or additions to the network that may introduce risks. • Reduce the number of security incidents related to unpatched software and unauthorized devices by at least 75%.	• Create a dynamic, scalable IT environment where all devices and software are continuously tracked, and the system automatically adapts to new threats. • Foster a culture of security awareness across all King County departments, where all personnel actively contribute to maintaining secure and controlled IT operations. • Achieve and maintain cybersecurity compliance with local, state, and federal regulations, particularly in areas related to system configuration and device management.

Implementation Plan/Actions

Conduct an Inventory of Network Devices and Software

- Utilize automated inventory management tools to catalog all devices, applications, and software currently in use across King County's network.
- Work with department heads to ensure all devices and software are accounted for and included in the inventory.

Remove Unwanted or Unnecessary Devices and Software

- Identify and eliminate any unauthorized or redundant devices and software that do not contribute to operational needs or security.
- Develop a decommissioning process for safely removing these devices from the network.

Establish a Known Baseline for Security Configurations

- Define and document a standard baseline for security configurations across devices, operating systems, and applications.
- Apply these configurations uniformly across all departments to ensure consistency.

Implement Centralized Management and Monitoring Systems

- Deploy centralized tools for managing and monitoring the security configurations of devices and software.
- Integrate these tools with existing cybersecurity measures for enhanced visibility and control.

Ongoing Active Management and Adaptation

- Continuously monitor and manage network devices, applications, and security configurations to ensure they remain secure and up-to-date.
- Adapt the management practices to address emerging threats and scale with changing needs.

Regular Audits and Compliance Checks

- Conduct periodic audits to ensure compliance with the inventory and active management protocols.
- Address any discrepancies or gaps identified during audits to maintain a secure environment.

Performance Measure

- **Inventory Accuracy**: Percentage of devices and software accurately inventoried and tracked within the system.
- **Reduction in Unauthorized Devices/Software**: Percentage reduction in unapproved or unnecessary devices and software on the network.
- **Compliance with Baseline Configurations**: Percentage of devices and systems configured according to the defined security baseline.
- **Incident Reduction**: Reduction in the number of security incidents linked to unauthorized devices, software vulnerabilities, or misconfigurations.
- **Audit Compliance**: Results of regular audits showing adherence to inventory and management policies.
- **Management Tool Integration**: Percentage of departments using centralized management and monitoring tools for device and software management.

20.7.21 Multi-Factor Authorization for King County Devices

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCIT	King County Risk Management	Cyber Incident	General Fund

Vision

To strengthen King County's cybersecurity posture by prioritizing the protection of accounts with elevated privileges, remote access, and high-value assets through the adoption of multi-factor authentication (MFA) and the reduction of reliance on single-factor authentication systems.

Description

This strategy focuses on enhancing authentication security across King County's IT systems, particularly for high-risk accounts, including those with elevated privileges, remote access, and access to critical or sensitive assets. Single-factor authentication (SFA), such as password-based authentication, is vulnerable to a variety of threats, including credential theft, phishing attacks, and password reuse across systems.

To mitigate these risks, King County will implement multi-factor authentication (MFA) with a focus on using physical token-based systems (e.g., smart cards, hardware tokens) to supplement knowledge-based factors such as passwords and PINs. This will significantly reduce the chances of unauthorized access, ensuring that even if a password is compromised, access to sensitive systems and data remains secure.

The migration away from single-factor authentication to MFA will prioritize accounts that pose the highest risks, including administrative accounts, remote access accounts, and those tied to high-value assets.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Implement multi-factor authentication (MFA) for all accounts with elevated privileges or remote access within the first year. • Complete a risk assessment to identify high-value assets and systems requiring immediate implementation of MFA. • Provide training for all IT staff and administrators on the secure use of MFA systems.	• Achieve 100% deployment of MFA across all user accounts with elevated privileges, remote access, and high-value assets. • Phase out the use of single-factor authentication across all non-administrative accounts. • Achieve a reduction in unauthorized access attempts and cyber incidents linked to credential theft by at least 75%. • Ensure compliance with federal and state cybersecurity standards and regulations for authentication systems.	• Establish King County as a leader in cybersecurity best practices, with MFA fully integrated across all IT systems and user access points. • Continuously evaluate and update authentication methods as new technologies and best practices emerge, maintaining the highest level of security. • Foster a cybersecurity-aware culture across King County where secure authentication practices are the norm.

Implementation Plan/Actions

1. **Identify High-Risk Accounts and Systems**
    - Conduct a comprehensive audit of King County IT systems to identify accounts with elevated privileges, remote access, and access to high-value assets.
    - Prioritize MFA implementation for these accounts based on their associated risks.
2. **Deploy Multi-Factor Authentication (MFA)**

- Select and implement physical token-based MFA systems (e.g., hardware tokens, smart cards, biometric systems) for high-risk accounts.
- Integrate MFA with existing authentication systems across King County's IT infrastructure.

3. **Migrate Away from Single-Factor Authentication (SFA)**
   - Gradually phase out single-factor authentication for non-administrative accounts, replacing them with MFA systems.
   - Provide clear timelines and training for all staff members transitioning to MFA.
4. **Training and Awareness**
   - Provide training sessions for all relevant King County staff on the importance of MFA and how to use the new systems effectively.
   - Increase awareness of common authentication risks, such as phishing and password reuse, and educate staff on avoiding them.
5. **Ongoing Monitoring and Evaluation**
   - Continuously monitor the effectiveness of MFA deployment, tracking system usage and incidents related to authentication breaches.
   - Regularly evaluate and update MFA protocols to keep pace with emerging threats and new technologies.

Performance Measure

- **MFA Deployment**: Percentage of high-risk accounts protected by MFA.
- **Reduction in Breaches**: Reduction in the number of unauthorized access incidents due to credential theft or misuse.
- **Staff Training**: Percentage of relevant IT staff and users who have completed MFA training and are actively using MFA.
- **Compliance Rate**: Percentage of King County systems compliant with the updated MFA policies.
- **Incident Monitoring**: Number of cybersecurity incidents linked to authentication vulnerabilities after MFA implementation.

20.7.22 Timely Software Updates from KCIT

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCIT	King County Risk Management	Cyber Incident	KCIT Budget

Vision

To ensure King County's IT systems remain secure and resilient by applying all available software updates immediately, automating the update process wherever possible, and maintaining a high level of vigilance against threats, reducing the risk of exploitations and ensuring the integrity of county systems

Description

This strategy aims to implement a robust software update and patch management process to protect King County's IT systems from vulnerabilities. Cybersecurity threats, especially those related to unpatched software, are a significant risk to public safety and data security. Threat actors often take advantage of delays in patching, using exploits shortly after a patch is released—referred to as N-day exploits. The strategy emphasizes the importance of rapid, thorough software updates, using automation tools to ensure timely application of patches, and relying on authenticated vendor updates delivered through secure channels.

By automating the patching process and ensuring updates are applied promptly, King County will reduce the time available for threat actors to exploit vulnerabilities, thereby minimizing the risk of breaches or system failures.

2-Year Objectives

- Implement an automated patch management system across all critical King County IT systems.
- Apply 100% of available software updates within 24 hours of release, reducing patch application times significantly.
- Establish an authentication verification process for all vendor-provided software updates to ensure integrity.
- Conduct quarterly internal audits to assess the effectiveness of patch management.

5-Year Objectives

- Ensure that 100% of all county-wide systems are covered by the automated patch management system.
- Achieve a reduction in cyber incidents related to unpatched software vulnerabilities by 75%.
- Partner with vendors to streamline update delivery processes and integrate further security measures into patching protocols.
- Regularly update training for IT staff on the latest patch management tools and security trends.

Long-Term Objectives

- Establish King County as a leader in cybersecurity resilience within local government by ensuring all software systems are continuously updated and secure.
- Create a dynamic cybersecurity culture across King County departments, where proactive patching and security measures are ingrained in daily operations.
- Achieve zero successful exploitation of known vulnerabilities in County systems within 12 months of patch release.

Implementation Plan/Actions

Automate Software Updates

- Deploy patch management automation tools to ensure all critical systems automatically receive and apply updates.
- Work with key departments to ensure integration of automated patching into day-to-day IT operations.

Vendor Coordination and Authentication

- Set up a system to only accept vendor updates that are signed and transmitted over secure channels, ensuring the integrity of all patches.
- Work with vendors to streamline update delivery and verify authenticity of updates.

Patch Cycle Management

- Create and enforce a policy that software patches are applied within 24 hours of release for critical vulnerabilities.
- Develop a detailed patching calendar that aligns with known release cycles of major software vendors.

Monitoring and Reporting

- Monitor the status of updates across all systems and ensure compliance with patching timelines.
- Implement dashboards and alerts for IT staff to track update status in real-time.

Training and Awareness

- Provide continuous training for IT staff on best practices for patch management and cybersecurity.
- Raise awareness across departments about the importance of timely software updates.

Performance Measure

- **Patch Application Speed**: Percentage of software patches applied within 24 hours of release.
- **Automation Coverage**: Percentage of IT systems covered by the automated patch management system.
- **Incident Reduction**: Reduction in the number of cybersecurity incidents related to known unpatched vulnerabilities.
- **Audit Results**: Results of quarterly patch management audits, measuring compliance and effectiveness.
- **Staff Training**: Number of IT staff trained on patch management best practices and tools.

20.7.23 Creation of County Wide Recovery Plan

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	DNRP PHSKC ECO FEMA	Avalanche Civil Disorder Cyber Incident Dam Failure Earthquake Flood Hazardous Materials Health Incident Landslide Extreme Weather Terrorism Tsunami Volcano Wildfire	General Fund

Vision

To create a comprehensive, resilient, and flexible county-wide recovery plan that effectively addresses the unique needs of all communities in King County, ensuring a swift and equitable recovery process after disasters. This plan will integrate community needs, enhance preparedness, and optimize resource allocation, providing clear guidance for a seamless recovery effort.

Description

The goal of this strategy is to update and enhance King County's County-Wide Recovery Plan, ensuring that it reflects current risks, best practices, and lessons learned from past disasters. The plan will improve the coordination between local municipalities, agencies, and partners, integrating the entire county into the recovery process. It will focus on an equitable, community-driven recovery approach, with particular attention given to vulnerable and underserved populations.

The updated plan will address key areas of recovery, such as housing, public health, infrastructure, utilities, and economic recovery, providing specific action items, timelines, and responsibilities. Additionally, the plan will be flexible to accommodate different types and scales of disasters, ensuring that King County can respond effectively to both common and rare events.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete a comprehensive review of the current recovery plan and identify gaps or outdated sections. • Engage with at least 15 community organizations to incorporate their perspectives into the updated plan. • Conduct a series of public workshops and stakeholder meetings to gather input and feedback from King County residents and local leaders.	• Fully integrate recovery planning with King County's hazard mitigation strategies. • Establish a coordinated recovery task force composed of key agencies, local governments, and community representatives. • Develop a county-wide recovery resource network, including logistics, supplies, and personnel, that can be quickly activated during an emergency.	• Achieve a recovery plan that is adaptable, scalable, and inclusive, with a focus on the most vulnerable populations and critical infrastructure. • Ensure that King County's recovery processes are fully integrated with state and federal systems, enabling swift resource

• Develop and implement an updated recovery framework with clear action steps for each recovery phase (immediate, short-term, long-term). • Update the recovery plan to reflect new hazards, such as climate change-related events, and new recovery needs, such as mental health and economic recovery.	• Implement a training program for recovery personnel across King County, ensuring readiness for all disaster recovery phases. • Conduct a large-scale recovery exercise with local municipalities to test the updated plan's effectiveness.	allocation and coordination. • Foster a culture of continuous improvement through annual updates, community engagement, and post-disaster reviews. • Create a recovery plan that is recognized as a model for other counties across the state or region, with lessons learned shared widely.

Implementation Plan/Actions

Comprehensive Review and Assessment

- Conduct a detailed review of the current county-wide recovery plan.
- Identify areas where the plan is outdated, insufficient, or needs to be enhanced based on emerging threats (e.g., climate change).
- Engage emergency management experts, local municipalities, and community stakeholders to evaluate the plan's effectiveness.

Community and Stakeholder Engagement

- Host public workshops and focus groups to solicit feedback on the recovery plan from residents, local businesses, and community organizations.
- Collaborate with vulnerable communities to ensure the plan reflects their specific needs and concerns during recovery.
- Build partnerships with local utilities, transportation authorities, and non-profit groups to understand their recovery roles and challenges.

Plan Update and Enhancement

- Revise and update the recovery plan with current data, guidelines, and best practices for disaster recovery.
- Create clear, actionable steps for recovery in critical areas such as housing, public health, economic recovery, and infrastructure restoration.
- Integrate recovery strategies into King County's overall emergency management framework, linking recovery efforts to mitigation and preparedness activities.

Training and Capacity Building

- Develop training materials and exercises for county staff, recovery personnel, and partners, focusing on roles and responsibilities during recovery.
- Conduct workshops and simulations to test the effectiveness of the new recovery plan.
- Build a recovery team within KCOEM and local municipalities that will be ready to implement the plan in the aftermath of a disaster.

Testing and Drills

- Conduct multi-agency recovery exercises to simulate a real disaster recovery scenario.
- Identify any weaknesses or challenges in the recovery process and refine the plan accordingly.
- Ensure all recovery partners are well-versed in the plan's procedures and their individual responsibilities.

Performance Measure

- **Plan Completion**: Percentage of recovery plan sections updated and reviewed (e.g., housing, infrastructure, health).
- **Stakeholder Engagement**: Number of community members, organizations, and agencies engaged in the planning process.
- **Training Participation**: Number of recovery personnel trained on the new recovery framework.
- **Recovery Exercises**: Successful completion of recovery drills and exercises, with identified improvements incorporated into the plan.
- **Plan Activation Time**: Time taken to activate and implement the recovery plan after a disaster.
- **Post-Disaster Evaluation**: Feedback from the community and stakeholders on the recovery process, assessing satisfaction and areas for improvement

20.7.24 Wastewater Treatment Division Workforce Development Program

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
DNRP – WTD	Local partners	Extreme Weather	King County Budget

Vision

To create a sustainable and diverse workforce for the clean water sector by providing comprehensive recruitment, mentorship, training, and career growth opportunities to entry-level candidates. The program ensures that individuals are equipped with the skills and knowledge necessary to thrive in the wastewater treatment industry while contributing to a more equitable and inclusive workforce

Description

WTD's Workforce Development Program focuses on recruiting, training, mentoring, and placing entry-level candidates into long-term careers in the clean water sector. The program supports individuals who are either building their skills or are new to the field by providing them with hands-on experience, site visits, and challenging assignments across different WTD work groups. Cohort members are hired in small groups and exposed to various areas within WTD, such as planning, engineering, project management, and construction management. The program's goal is to help individuals discover their passion and secure permanent positions within the organization. After completing the program, cohort members are encouraged to apply for open positions within WTD and will have an advantage due to their familiarity with the agency's operations and culture. Graduates typically transition smoothly into roles across different units, such as planning, engineering, and project management, and contribute to WTD's diverse workforce.

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Recruit and onboard 4 to 8 new cohorts of entry-level candidates each year. • Place 70% of cohort members into permanent positions within WTD by the end of their program. • Increase the diversity of the applicant pool by 20%. • Develop and implement mentorship programs for cohort members to support career growth.	• Expand the program to include additional work groups within WTD, such as operations and maintenance. • Achieve a 90% placement rate of cohort members into permanent positions within WTD. • Ensure that 40% of cohort graduates come from underrepresented communities in the clean water sector. • Develop partnerships with community colleges to offer accredited certifications in wastewater treatment for cohort members.	• Establish WTD's Workforce Development Program as a national model for clean water sector career training and inclusion. • Fully integrate workforce development initiatives into WTD's long-term staffing and succession planning strategies. • Ensure that all cohorts reflect the demographic diversity of King County and are prepared to meet the future workforce needs of the clean water industry.

Implementation Plan/Actions

Recruitment and Onboarding

- Launch targeted recruitment campaigns to attract entry-level candidates, especially from diverse and underserved communities.
- Provide extensive onboarding that includes tours of WTD facilities, introductions to various teams, and detailed orientation sessions.
- Organize site visits and team rotations for cohorts to gain exposure to different work groups within WTD.

Mentorship and Career Support

- Assign mentors to cohort members to guide them through their training and career development within WTD.
- Offer regular check-ins and professional development workshops to help individuals progress in their careers.
- Facilitate peer networking and collaboration opportunities within the cohort and across different WTD teams.

Training and Skill Development

- Provide cohort members with challenging, hands-on assignments that build relevant skills in areas such as engineering, project management, and construction.
- Offer continuous learning opportunities such as online courses, certification programs, and technical training to enhance career readiness.

Placement and Retention

- Actively track the progress of cohort members toward securing permanent roles within WTD.
- Create a streamlined internal application process for cohort members to apply for open positions within the agency.
- Maintain a strong relationship with graduates and provide ongoing support to ensure retention in the clean water sector

Performance Measure

- **Cohort Success Rate**: Percentage of cohort members successfully placed in permanent roles within WTD.
- **Diversity Metrics**: Increase in the diversity of cohort participants, including gender, race, and background.
- **Program Retention**: Retention rates of cohort members within WTD, measured over a 2- and 5-year period.
- **Graduation Rates**: Percentage of cohort members completing the program and transitioning into desired roles. **Employee Satisfaction**: Cohort members' satisfaction with mentorship, training, and career growth opportunities (survey results).

20.7.25 King Conservation District Wildfire Mitigation Program

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
King Conservation District (KCD)	Eastside Fire and Rescue DNRP	Wildfire	KCD Budget

Vision

To reduce the risk of wildfire damage to homes and communities in King County, especially in the Wildland Urban Interface (WUI), through proactive risk assessments, strategic wildfire mitigation projects, and collaborative efforts aimed at enhancing community resilience.

Description

The King Conservation District's (KCD) Wildfire Mitigation Program provides wildfire risk assessments and mitigation planning to increase community resilience against wildfires. KCD partners with local fire districts, the Washington State Department of Natural Resources, and other organizations to assist homeowners and communities in the Wildland Urban Interface (WUI). By assessing properties, providing mitigation recommendations, and offering cost-share funding for implementation, KCD helps reduce wildfire risk and prepare areas vulnerable to wildfire events. KCD conducts individual and community-wide risk assessments, focusing on practical steps such as vegetation removal, roof maintenance, and forest health improvement. Through funding and planning assistance, KCD supports homeowners and communities to take preventative actions, including thinning, fuel management, and creating defensible spaces.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete 200 wildfire risk assessments in King County, focusing on homes and communities within the WUI. • Begin 50 wildfire mitigation projects, providing cost-share funding for eligible homeowners and communities. • Engage at least 10 community organizations to help expand wildfire mitigation outreach.	• Complete 500+ wildfire risk assessments across King County's high-risk wildfire zones. • Successfully implement wildfire mitigation projects on 200 properties and community-owned forests. • Achieve a 25% reduction in wildfire risk within assessed areas as measured by post-project assessments.	• Establish wildfire mitigation as a key part of all residential and community planning in King County. • Ensure that all homes and communities in the WUI have access to wildfire risk assessments and mitigation resources. • Strengthen public-private partnerships to enhance wildfire resilience through expanded cost-share and technical assistance programs.

Implementation Plan/Actions

Wildfire Risk Assessments

- Conduct individual and community-wide assessments within the WUI.
- Focus on the 100-foot defensible space around each home and forest health assessments for community-owned forests.
- Provide homeowners and community associations with a list of mitigation recommendations based on the assessments.

Wildfire Mitigation Project Planning and Cost-Share

- Offer project planning assistance to homeowners and community associations.

- Provide cost-share funding, reimbursing 75% of eligible project costs for activities such as vegetation removal, gutter/roof maintenance, and fire break creation.
- Prioritize funding for projects that reduce wildfire risk to homes and improve community resilience.

Outreach and Community Engagement

- Develop and distribute informational materials to educate residents about wildfire risks and mitigation actions.
- Collaborate with local fire districts, the Red Cross, and other partners to reach underserved and at-risk populations.
- Host workshops and training sessions on wildfire preparedness and mitigation strategies.

Forest Health and Fuel Management Projects

- In community-owned forests, assess forest health and implement projects such as thinning, brush management, and fuel breaks.
- Work with local agencies and fire districts to coordinate larger-scale mitigation projects that benefit multiple properties and forested areas.

Performance Measure

- **Risk Assessment Completion**: Number of wildfire risk assessments completed annually.
- **Mitigation Projects**: Number of mitigation projects funded and successfully implemented.
- **Community Engagement**: Level of participation in outreach efforts (workshops, surveys, etc.).
- **Impact on Wildfire Risk**: Percentage reduction in wildfire risk within the targeted areas as measured through post-implementation evaluations.
- **Cost-Share Utilization**: Amount of cost-share funding distributed, and the number of households/communities receiving support.

20.7.26 Improving Emergency Management Public Outreach

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	Local jurisdictions within the county	Avalanche Civil Disorder Cyber Incident Dam Failure Earthquake Flood Hazardous Materials Health Incident Landslide Extreme Weather Terrorism Tsunami Volcano Wildfire	King County Budget

Vision

To ensure that all residents of King County are well-informed and prepared to effectively respond to and mitigate the impacts of hazards, through comprehensive and targeted public outreach strategies. By enhancing public awareness and providing accessible resources, we aim to reduce vulnerability and improve community resilience.

Description

The King County Office of Emergency Management seeks to improve its public outreach efforts to raise awareness about local hazards, promote preparedness actions, and encourage mitigation strategies. By using a combination of media, community partnerships, educational initiatives, and social engagement, the strategy will ensure that residents of all backgrounds understand the risks they face and how to reduce them. This outreach initiative will focus on diverse communities, ensuring inclusivity and accessibility to the county's mitigation programs.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Increase public engagement through digital campaigns and social media platforms. • Develop partnerships with 10 new community organizations to amplify hazard mitigation messaging. • Conduct 5 community preparedness workshops targeting underserved populations.	• Establish a countywide public education program integrated with schools, community centers, and local businesses. • Increase public awareness about hazard mitigation by 30% as measured through surveys. • Implement a mobile application for hazard alerts and mitigation resources. • Achieve a 15% increase in the adoption of preparedness plans among residents and businesses in King County.	• Create a culture of resilience where all King County residents are knowledgeable about hazards and preparedness. • Ensure that all at-risk neighborhoods have access to tailored hazard mitigation and preparedness information. • Make hazard mitigation a priority in every public and private sector planning effort.

Implementation Plan/Actions

Community Engagement Campaigns

- Launch digital media and social media campaigns to inform the public about mitigation practices.
- Use targeted outreach strategies for at-risk communities, utilizing culturally relevant content.
- Conduct public service announcements through local media.

Educational Outreach

- Create and distribute educational materials (flyers, posters, websites, brochures) to key stakeholders such as schools, libraries, and community centers.
- Develop and promote interactive tools (e.g., hazard scenario simulations) to educate residents on risks and mitigation actions.
- Host workshops and town halls focusing on hazard preparedness and mitigation.

Collaboration and Partnerships

- Partner with local businesses, schools, and non-profit organizations to expand outreach and engage more residents.
- Coordinate with local emergency services and public health officials to integrate hazard mitigation into public health campaigns.
- Engage influencers and local celebrities to help spread key messages on social media and at community events.

Data and Research

- Gather data through surveys and focus groups to assess the effectiveness of outreach efforts and areas needing improvement.
- Develop and share annual reports on the public's understanding of hazard risks and mitigation actions.

Performance Measure

- **Engagement Metrics**: Social media interaction rates, attendance at public outreach events, and engagement with online resources.
- **Survey Results**: Improvement in public understanding of hazard risks and mitigation actions through pre- and post-campaign surveys.
- **Participation Rates**: The number of residents who complete mitigation action steps, such as signing up for emergency alerts or attending preparedness workshops.
- **Outreach Reach**: Number of educational materials distributed, community organizations involved, and media coverage achieved.

20.7.27 Maintain LEPC in King County

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
KCOEM	Local Fire Departments KCSO PHSKC	Hazardous Materials	KCOEM Budget

Vision

To ensure the continued protection of King County residents, workers, and the environment by maintaining a robust and effective Local Emergency Planning Committee (LEPC) focused on hazardous materials. The LEPC will provide proactive mitigation strategies, streamline emergency response coordination, and promote the safe management of hazardous materials throughout the county.

Description

The King County LEPC is dedicated to reducing the risks associated with hazardous materials in the community. This strategy seeks to maintain and enhance the effectiveness of the LEPC in response to hazardous materials incidents. The committee works collaboratively with government agencies, local businesses, fire and emergency responders, and the public to prepare for and mitigate the risks of hazardous materials.

Key activities of the LEPC will include:

- Developing and maintaining emergency response plans for hazardous materials incidents
- Organizing regular training for first responders and community stakeholders
- Maintaining an up-to-date inventory of hazardous materials in King County
- Ensuring public awareness and education about hazardous materials
- Conducting hazard assessments and implementing mitigation actions to reduce risk exposure

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Maintain a fully operational LEPC with diverse membership across sectors (government, private industry, first responders). • Complete a comprehensive hazardous materials inventory across King County. • Conduct a county-wide hazardous materials risk assessment and prioritize mitigation actions. • Increase public education campaigns focused on hazardous materials safety and emergency preparedness. • Provide at least two full-scale hazardous materials emergency response exercises for local responders.	• Establish a regional hazardous materials response network to ensure seamless collaboration across jurisdictions. • Develop and implement new hazard mitigation actions based on evolving hazardous materials risks (e.g., transportation routes, facility operations). • Achieve a 25% reduction in hazardous materials-related incidents through risk mitigation efforts. • Secure long-term funding mechanisms to sustain LEPC activities beyond initial federal and state grants.	• Incorporate new technologies (e.g., real-time data collection, advanced response equipment) into LEPC operations. • Expand the LEPC's scope to include emerging environmental threats, such as climate change impacts on hazardous material risks. • Develop a county-wide certification program for businesses and industries involved in hazardous materials handling.

Implementation Plan/Actions

- **Action 1: Maintain LEPC Membership and Leadership**
  - Ensure diverse participation from all relevant stakeholders, including local government, fire departments, health agencies, and industry partners.
  - Schedule quarterly LEPC meetings to review progress, address concerns, and discuss evolving hazards.
- **Action 2: Hazardous Materials Inventory and Risk Assessment**
  - Survey and document all facilities in King County that store or handle hazardous materials.
  - Conduct a risk assessment to evaluate the potential for chemical spills, accidents, and other hazardous materials incidents.
  - Prioritize the most critical locations for mitigation efforts.
- **Action 3: Emergency Response Plan Updates and Drills**
  - Update the King County hazardous materials emergency response plan annually.
  - Conduct regular training for first responders on the use of hazardous materials response equipment.
  - Organize annual full-scale exercises that simulate hazardous materials incidents for training purposes.
- **Action 4: Public Outreach and Education**
  - Develop educational materials for residents and businesses regarding hazardous materials risks and emergency procedures.
  - Launch a public awareness campaign on hazardous materials safety, especially in high-risk areas.
- **Action 5: Funding and Resource Development**
  - Identify new federal, state, and private funding opportunities to sustain the LEPC's efforts.
  - Explore partnerships with local industries to secure in-kind donations and resources for training and mitigation activities.

Performance Measure

- Successful execution of at least one full-scale hazardous materials emergency exercise per year.
- Completion of a hazardous materials inventory for 100% of King County facilities within 2 years.
- Achieving sustainability through securing long-term funding sources for LEPC activities by Year 5.

20.7.28 Strengthening and Maintaining Partnerships for Emergency Response and Coordination

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
KCSO	KCOEM Fusion Center	Terrorism Civil Disorder	General Fund

Vision

To create a coordinated, resilient emergency response system by maintaining strong and effective partnerships between the King County Sheriff's Office, the King County Office of Emergency Management, and the Fusion Center, ensuring a rapid, unified, and data-driven approach to mitigating and responding to a wide range of hazards.

Description

The partnership between the King County Sheriff's Office, King County Office of Emergency Management, and the Fusion Center is vital for providing effective emergency response and mitigation strategies. This strategy aims to sustain and strengthen this collaboration by improving communication, sharing resources, and enhancing training and preparedness. The goal is to ensure a seamless response to emergencies, optimize resource allocation, and enhance public safety by addressing a wide array of threats, from natural disasters to public safety concerns.

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Formalize and enhance communication protocols between KCSO, KCOEM, and the Fusion Center for real-time data and situational awareness • Establish regular joint training exercises and tabletop scenarios involving all partners • Update and review emergency response plans and protocols for cross-agency collaboration • Strengthen information-sharing networks and systems between the agencies • Secure initial funding for technology improvements that enable faster, more secure data sharing	• Develop an integrated emergency response plan that incorporates all relevant agencies and ensures efficient resource deployment • Expand the Fusion Center's role in coordinating intelligence and public safety data across jurisdictions • Increase the frequency of joint exercises and develop more advanced scenarios • Achieve regional coordination agreements with neighboring counties and agencies for large-scale emergencies • Enhance cross-training programs to build mutual understanding of each agency's capabilities and limitations	• Fully integrate emergency response systems across King County with real-time data sharing and multi-agency collaboration • Establish a robust regional and statewide network of fusion centers for better intelligence and situational awareness • Ensure all staff at KCSO, KCOEM, and the Fusion Center are trained on advanced emergency response protocols and technologies • Strengthen public trust and cooperation through transparent emergency management efforts and clear public communication strategies • Increase efficiency in resource deployment during large-scale emergencies, reducing response times by 20%

Implementation Plan/Actions • Develop a comprehensive communication and data-sharing framework that outlines roles, responsibilities, and protocols during an emergency • Conduct bi-annual joint exercises and simulation drills between KCSO, KCOEM, and the Fusion Center, focusing on realistic scenarios, including natural and man-made disasters • Integrate data management systems between the KCSO, KCOEM, and Fusion Center to allow seamless flow of real-time information during emergencies • Regularly review and update emergency response plans to ensure they reflect changes in technology, population growth, and evolving threats • Advocate for and apply for state and federal funding to enhance technology and infrastructure for inter-agency coordination • Establish clear points of contact and dedicated personnel responsible for ensuring the continuity of communication and collaboration during emergencies • Create a public education campaign that outlines the roles of each agency in emergency response, fostering community awareness
Performance Measure • Number of joint training exercises conducted and the level of participation from all partners • Speed and accuracy of information exchange during emergencies, measured by response time and situational awareness • Increased integration of data systems, tracked by the implementation of new technology and successful data-sharing tests • Satisfaction surveys from participating agencies evaluating the effectiveness of coordination and response efforts • Secured funding for technology enhancements and collaborative infrastructure • Improved response times during actual emergencies, measured through after-action reports and evaluations

20.7.29 Implementation of 2024 King County Floodplain Management Plan

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
DNRP	Flood Control District	Flooding Extreme Weather	

Vision

To reduce the vulnerability of communities, infrastructure, and ecosystems to flooding by implementing the King County Floodplain Management Plan, fostering resilience through sustainable land use, strategic mitigation, and enhanced floodplain management practices.

Description

The 2024 King County Floodplain Management Plan outlines a comprehensive strategy for flood risk reduction, environmental restoration, and improved community resilience. This mitigation strategy focuses on managing floodplains as dynamic ecosystems while enhancing the capacity to manage flood risks through collaboration and smart growth planning. The goal is to protect vulnerable communities and the environment from flood hazards, improve floodplain health, and provide a resilient, sustainable foundation for future generations.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete a comprehensive floodplain risk assessment and mapping update for priority areas • Develop and implement a public education campaign about flood risk and preparedness • Initiate floodplain restoration projects in high-priority areas • Secure FEMA funding for flood mitigation infrastructure improvements • Collaborate with municipalities to align local planning policies with floodplain management goals	• Expand floodplain restoration efforts across King County's flood-prone regions • Complete the construction of at least three major flood mitigation infrastructure projects • Achieve a 15% reduction in flood risk exposure for critical infrastructure in high-priority zones • Integrate floodplain resilience measures into regional development and land use policies • Build community partnerships for ongoing public engagement in floodplain management	• Reduce flood risk for 50% of the county's flood-vulnerable communities • Ensure the restoration of 500 acres of floodplain habitat • Fully integrate floodplain management and resilience into regional land use and development planning • Achieve a 25% reduction in the economic impact of flooding to the local economy • Increase public awareness and preparedness for flood events by 30%

Implementation Plan/Actions

• Update flood risk maps and floodplain zoning regulations to reflect the latest data
• Identify and prioritize floodplain restoration sites, focusing on high-risk areas for both communities and ecosystems
• Develop and implement hazard reduction measures (levees, flood barriers, natural flood control systems) in high-priority flood zones
• Provide ongoing training for local governments and first responders on floodplain risk management and emergency preparedness
• Create a dedicated funding pool to support local governments' flood mitigation projects
• Facilitate community-based planning processes, ensuring that vulnerable populations have a voice in floodplain management decisions
• Expand the role of technology and data in flood monitoring and prediction

Performance Measure

- Reduction in flood risk to critical infrastructure (measured through floodplain risk assessments)
- Acres of floodplain restored and improved
- Number of local municipalities that have updated their floodplain policies and zoning laws
- Percentage increase in community awareness and preparedness as measured by surveys and public engagement metrics
- Amount of funding secured from federal and state sources for flood mitigation projects
- Number of completed flood mitigation and infrastructure projects in high-priority areas

20.7.30 Mount Si Road Undergrounding Project

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
Tanner Electric Cooperative	OEM DLS - Roads	Wildfire Severe Weather	$3.5 Million

Vision

To enhance energy resilience and mitigate wildfire and storm-related risks for the North Bend community by undergrounding critical electrical infrastructure along Mount Si Road, ensuring consistent, safe, and uninterrupted power supply to residents, businesses, and essential services.

Description

The Mount Si Road Undergrounding Project proposes the installation of approximately 1.63 miles of underground three-phase electrical distribution lines using Schedule 40 PVC conduit in North Bend, Washington. Initiated by Tanner Electric Cooperative, the project seeks funding to significantly improve the resilience of energy infrastructure historically vulnerable to wildfires, winter storms, and high winds.

The existing overhead distribution lines—exposed for over five to six decades—are a known source of power outages and fire ignition risks. Undergrounding will eliminate these overhead vulnerabilities, ensure consistent energy supply to 486 meters (approximately 1,290 residents), and support critical infrastructure such as local water tanks, communications booster stations, and private wells. The affected section currently relies on a radially fed circuit with limited access, which complicates repair and restoration during outages.

Underground infrastructure will provide virtually maintenance-free power delivery, increased longevity, and significantly reduced risk of outages. It will also prevent power shutoffs during red flag wildfire events when Tanner currently implements one-shot policies and delays re-energizing lines until full inspection by daylight.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Complete project design and permitting • Secure construction contracts • Begin trenching and conduit installation	• Complete full underground conversion of the 1.63-mile section • Transition affected customers to the underground system • Decommission overhead lines and poles in project area	• Achieve near-elimination of weather-related outages in project zone • Reduce wildfire ignition risk from power lines • Ensure reliable service for critical utilities and community resilience during extreme events

Implementation Plan/Actions

- Finalize engineering design and secure environmental approvals
- Engage local stakeholders and residents for public input and support
- Coordinate with North Bend and utility partners for water and communications systems
- Procure and install underground conduits and cables
- Transition electrical loads to underground service and remove old infrastructure

Performance Measure

- Reduction in outage frequency and duration in the Mount Si Road area
- Elimination of power shutoff events during red flag warnings
- Decreased wildfire risk tied to electrical infrastructure
- Improved reliability metrics and maintenance savings over 10+ years

20.7.31 Plan for Post-Wildfire Community Recovery

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
OEM	ECO DLS – Roads DNRP PHSKC	Wildfire	County Budget

Vision

Ensure King County is prepared to support equitable, coordinated, and efficient recovery from wildfires—particularly those that impact homes, public facilities, and infrastructure—through a dedicated planning framework that guides action, accountability, and access to recovery resources.

Description

Post-wildfire recovery is a complex and multi-faceted challenge. To improve outcomes for affected communities, King County will develop a **wildfire-specific annex** to the King County Disaster Recovery Plan. This annex will:

- Define agency roles and responsibilities during post-wildfire recovery
- Outline key actions for short- and long-term recovery
- Include protocols for accessing FEMA Public and Individual Assistance, SBA loans, and HUD-supported housing recovery programs
- Be reviewed and updated every five years or after major wildfire disasters

The annex will guide recovery following disasters that damage homes, infrastructure, and public facilities and will ensure that recovery efforts are inclusive, timely, and aligned with other county and regional resilience efforts.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Convene key partners and begin development of the wildfire-specific annex • Identify recovery needs and equity gaps through stakeholder input • Draft and publish initial version of the annex as part of the broader Disaster Recovery Plan	• Operationalize the annex through partner training and plan exercises • Establish coordination protocols for post-wildfire funding and housing support • Update annex with new best practices and lessons learned from any wildfire events	• Institutionalize wildfire recovery planning as a core element of King County's emergency management • Improve recovery outcomes and speed for wildfire-impacted communities • Reduce long-term disparities in disaster recovery support and outcomes

Implementation Plan/Actions

- Collaborate with local, state, and federal partners to define post-wildfire recovery pathways
- Integrate the annex into the King County Disaster Recovery Plan
- Identify recovery funding mechanisms and align with existing support programs
- Build capacity among local jurisdictions and departments to support implementation
- Include equity-centered planning and community engagement throughout

Performance Measure

- Completion and adoption of the wildfire-specific annex
- Number of trainings or exercises conducted using the annex
- Time to initiate and coordinate recovery actions post-wildfire
- Amount of federal and state recovery funding accessed through the plan
- Stakeholder and community satisfaction with post-wildfire recovery support

20.7.32 Standardize and Promote Best Management Practices for Wildfire Mitigation

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
DNRP -WLRD	ECO DLS Parks	Wildfire	County Budget

Vision

Reduce wildfire risk to homes, infrastructure, and evacuation routes in King County through coordinated and standardized best management practices that can be easily adopted and implemented by fire departments, agencies, and communities.

Description

Wildfires pose increasing threats to King County, particularly in Wildland-Urban Interface (WUI) areas. Evidence shows that mitigation is cost-effective—every dollar spent yields $4 in avoided future losses. To address this growing risk, King County will lead the development and promotion of standardized wildfire mitigation Best Management Practices (BMPs). These practices will be:

- Focused on home hardening, infrastructure protection, and evacuation planning
- Designed for integration into services provided by fire departments, local governments, and technical assistance providers
- Distributed to relevant partners and programs for implementation across the County

This effort will ensure consistent, effective wildfire preparedness and risk reduction countywide.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Develop and finalize a countywide set of wildfire mitigation BMPs • Distribute BMPs to local agencies, fire departments, and partners • Begin incorporating BMPs into technical assistance services and programs	• Train partner organizations and service providers to implement BMPs • Integrate BMPs into relevant County plans and community wildfire education efforts • Monitor uptake and use across jurisdictions and agencies	• Establish BMPs as the standard wildfire mitigation approach in King County • Demonstrate reduced wildfire losses in areas where BMPs have been implemented • Strengthen community and agency capacity for long-term wildfire resilience

Implementation Plan/Actions

- Convene partners to co-develop wildfire mitigation BMPs
- Coordinate with existing wildfire programs and risk reduction strategies
- Create user-friendly materials and distribute BMP guidance
- Support training and technical integration through county departments and partners
- Monitor and evaluate adoption of BMPs over time

Performance Measure

- Completion and distribution of BMP guidance materials
- Number of agencies and partners adopting BMPs
- Number of properties or facilities implementing BMP-aligned practices
- Feedback from partners on BMP usability and effectiveness
- Reduction in property loss or evacuation disruptions in BMP-implemented areas

20.7.33 Expand Access to Cooling Locations for Communities

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
ECO	DCHS OEM PHSKC	Severe Weather	TBD

Vision

Ensure equitable access to safe, welcoming, and community-trusted cooling locations throughout King County to protect high-risk populations during extreme heat events.

Description

Extreme heat poses serious health risks, especially for vulnerable populations. Community-based organizations (CBOs) are uniquely positioned to host culturally relevant and accessible cooling spaces. King County will work with CBOs and local jurisdictions to identify, equip, and support these facilities.

Support will include:

- Identifying and vetting potential cooling sites
- Assisting with upgrades and cooling-related resources
- Training staff from CBOs to operate cooling sites
- Connecting interested partners to the Resilience Hub model and resources

This approach builds long-term community capacity while addressing short-term extreme heat response needs.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Identify and engage with CBOs and jurisdictions to develop a list of potential cooling sites • Provide technical assistance and small-scale resources for site readiness • Launch pilot cooling locations in priority neighborhoods	• Expand number of operational cooling sites across the county • Create a resource network linking cooling sites and Resilience Hubs • Develop long-term partnerships and shared protocols for heat events	• Establish a sustainable, community-led network of cooling locations countywide • Reduce heat-related health disparities in vulnerable communities • Integrate cooling location planning into broader climate resilience strategies

Implementation Plan/Actions

- Convene CBOs and jurisdictional partners for collaborative planning
- Map areas of greatest need based on heat vulnerability and population risk
- Support training and operational readiness of facility staff
- Leverage county and grant funds to support capital and operational upgrades
- Align with the Energize Program and Resilience Hub development efforts

Performance Measure

- Number of operational community cooling sites established
- Geographic coverage of cooling access in high-risk areas
- Number of individuals served during extreme heat events
- Community feedback and satisfaction with site accessibility and cultural relevance
- Reduction in heat-related health incidents in served areas

20.7.34 Expand the Use of Residential Flood Risk Mitigation Tools Countywide to Benefit Those Who Are Most Vulnerable to Flooding

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
DNRP -WLRD	OEM FEMA FCD	Flooding	TBD

Vision

Expand access to effective, equitable residential flood risk mitigation tools across King County—such as buyouts and home elevations—to reduce the impacts of flooding for the most vulnerable and financially burdened property owners while also aligning with community priorities and environmental values.

Description

Flood mitigation tools like voluntary buyouts and home elevations are underutilized in King County due to barriers including geographic limitations, funding challenges, upfront homeowner costs, and variable interest. These constraints often leave the most vulnerable communities unprotected.

This strategy focuses on expanding voluntary residential flood mitigation programs countywide to better support at-risk property owners—especially those with financial need. King County will:

- Identify residential properties at highest risk from current and future flooding
- Prioritize assistance based on vulnerability and documented harm
- Expand mitigation efforts to additional river basins (beyond the Snoqualmie)
- Target repetitive loss areas including Sammamish, Skykomish, Green, Cedar, and Snoqualmie River Basins, and Vashon Island
- Seek federal and local funding to broaden the program's reach
- Align mitigation actions with farmland protection when applicable

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Identify high-risk flood areas and assess residential property vulnerabilities • Develop equity-based criteria for prioritizing mitigation support • Apply for federal and local grants to support program expansion	• Increase the number of homes participating in voluntary mitigation programs • Expand geographic coverage of home elevation efforts • Build partnerships with community-based organizations to improve outreach and access	• Reduce the number of repetitive loss properties in King County • Ensure that flood mitigation benefits are equitably distributed countywide • Establish a sustainable, well-funded, and flexible residential flood mitigation program

Implementation Plan/Actions

- Map and prioritize residential flood risk based on current and future projections
- Secure funding from the Flood Control District, FEMA, and other sources
- Expand community engagement, especially in historically impacted neighborhoods
- Coordinate with farmland protection efforts to avoid conflicts
- Implement mitigation actions through voluntary buyouts, elevations, or repairs

Performance Measure

- Number of homes mitigated through buyouts, elevations, or repairs
- Funding secured and leveraged for mitigation
- Reduction in repetitive flood loss claims
- Increased participation from vulnerable or low-income homeowners
- Equity outcomes tracked and reported

20.7.35 Identify and Seek Funding to Reduce Sea Level Rise and Flood Risks to On-Site Wastewater Infrastructure in Unincorporated King County

Lead	**Partners**	**Hazards Mitigated**	**Funding Sources and Estimated Costs**
PHSKC	DNRP SPU	Flooding Severe Weather	TBD

Vision

Protect public health and environmental quality by proactively addressing the risks that sea level rise and flooding pose to on-site wastewater infrastructure in vulnerable unincorporated areas of King County, with a focus on equitable outcomes.

Description

Sea level rise and increased precipitation-driven flooding present growing risks to on-site wastewater systems in unincorporated King County. Building on 2025 sea level rise assessments for Vashon and Maury Island, the County will identify areas most at risk—specifically on Vashon-Maury Island and in the lower Duwamish Valley adjoining South Park. Emphasis will be placed on identifying where equity-related needs are greatest, then working with partners to secure funding and implement infrastructure improvements.

2-Year Objectives	**5-Year Objectives**	**Long-Term Objectives**
• Conduct targeted assessments to identify high-risk locations • Engage community-based organizations and other partners for localized insights • Seek initial grant funding opportunities	• Secure funding and initiate design and implementation in priority areas • Begin infrastructure improvements in areas with highest vulnerability and equity needs	• Complete infrastructure resilience upgrades in all identified high-risk areas • Integrate long-term flood resilience and equity priorities into countywide wastewater infrastructure planning

Implementation Plan/Actions

- Identify priority locations using environmental data and community input
- Collaborate with partners to align on equity and infrastructure needs
- Apply for and secure external funding (grants)
- Implement infrastructure improvements through phased project delivery

Performance Measure

- Number of high-risk locations identified and assessed
- Amount of funding secured
- Number of wastewater systems improved or relocated
- Community satisfaction and participation levels in planning and implementation

20.7.36 WSDOT Avalanche Forecasting and Control Program

Lead	Partners	Hazards Mitigated	Funding Sources and Estimated Costs
WSDOT	NWS OEM WSP	Avalanche	State Budget

Vision

Maintain the safety and reliability of Washington's mountain highway corridors by proactively forecasting and controlling avalanches to reduce hazards for motorists, freight traffic, and recreational users.

Description

The WSDOT Avalanche Forecasting and Control Program includes two regional teams of full-time and seasonal avalanche professionals. These teams monitor mountain weather, forecast avalanche risks, and execute control operations using explosives, trams, and artillery. They work fall through spring to protect critical corridors like I-90 Snoqualmie Pass and US 2 Stevens Pass. The program combines active control (e.g., detonations) and passive infrastructure (e.g., berms, catchment basins) to manage avalanche hazards. Seasonal closures occur where safety cannot be maintained. Public education and enforcement help mitigate risks associated with recreational backcountry use. New technologies, such as drones and Remote Avalanche Control Systems (RACS), are currently under evaluation.

2-Year Objectives	5-Year Objectives	Long-Term Objectives
• Continue testing and evaluation of remote avalanche monitoring technologies like drones • Expand educational outreach to backcountry users • Improve mapping and public accessibility of Avalanche Atlas tools	• Integrate RACS technology in high-risk areas to reduce reliance on military surplus artillery • Reduce average road closure times by 10% through operational efficiency • Enhance collaboration with ski areas and law enforcement to reduce recreational intrusions into avalanche zones	• Achieve near-complete transition from manual to remote-controlled avalanche control in accessible zones • Eliminate injuries/fatalities due to recreational intrusion in avalanche zones • Maintain full accessibility on key corridors throughout winter, barring severe weather extremes

Implementation Plan/Actions

- Continue use and maintenance of cable trams, explosives, and artillery
- Expand deployment of passive infrastructure (e.g., diversion dams, catchment basins)
- Close roads temporarily during high-risk periods and perform control operations at night when possible
- Post avalanche zone warnings and enforce hitchhiking bans
- Collaborate with law enforcement and ski areas to manage backcountry user behavior
- Pilot and assess effectiveness of drones and RACS
- Update and maintain the Avalanche Atlas map interface for public use

Performance Measure

- Reduction in number and duration of road closures
- Number of avalanches successfully mitigated without incident
- Decrease in unauthorized recreational entry into avalanche zones
- Number of successful remote-control operations conducted
- Improvement in response time and forecasting accuracy

Chapter 21: Plan Maintenance

21.1 Monitoring and Updating

The King County Office of Emergency Management (KCOEM) hazard mitigation team will internally track mitigation strategies submitted by the county and participating annexes. All participating jurisdictions will convene on a biannual basis to provide progress updates on their respective strategies. These updates are solicited by the county for inclusion in the countywide annual report. As part of the 2025 update to the Regional Hazard Mitigation Plan, each participating jurisdiction agrees to convene its internal planning team at least once annually to assess progress and maintain accountability.

Tracking will be organized using a standardized format, as illustrated below:

ID	Jurisdiction	**Strategy**	**Vision**	**Lead Agency**	**Priority *(High, Medium, Low)***	Hazard(s)	Potential Funding Source(s)	Estimated Cost	Timeline (Ongoing, Short-Term, Long-Term)	Status (Not Started, In Progress, Complete)

In addition to biannual check-ins, working groups will be formed by identifying shared characteristics among strategies. These groupings may be based on approach (e.g., code updates, public education programs, ecological restoration), hazard type, or funding sources. These working groups will foster collaboration by enabling participants to share resources, exchange best practices, learn from one another's experiences, and better understand the capabilities and assets available across jurisdictions.

To enhance implementation, key partners and county departments will be invited to clarify processes and next steps. Additionally, KCOEM will work to build public-private partnerships by engaging nonprofits and corporations with aligned missions to help secure future mitigation funding.

As part of its leadership role in the countywide planning effort, KCOEM will also distribute federal Notices of Funding Opportunity (NOFOs). Proposals submitted by partners will be assessed according to the prioritization process identified in this plan and the county will, where possible,

support those partners submitting grant proposals. This will be a key strategy to implement the plan.

King County Office of Emergency Management (KCOEM) will schedule annual check-ins to evaluate and revise the identified hazards risk analysis along with each hazards impact and vulnerability analysis.

The next plan update is expected to be due in September 2030. All jurisdictions will submit letters of intent by 2028, at least two years prior to plan expiration. The county will lead the next regional planning effort, beginning at least 18 months before the expiration of the 2025 plan.

In addition to the updates for mitigation strategies, the expected publication of data from several programs may trigger an update.

- Publication of the Department of Homeland Security Regional Resiliency Assessment Program report
- Publication of the countywide landslide susceptibility map from Washington Department of Natural Resources
- Publication of the Wildland Urban Interface wildfire risk map from Washington Department of Natural Resources
- Publication of tsunami inundation data from Washington Department of Natural Resources

21.2 Integrating into Existing Planning Mechanisms

To ensure a comprehensive and cohesive approach to hazard mitigation, the data and insights from the RHMP will be seamlessly integrated into existing county, regional, and local plans and frameworks. These include comprehensive plans, emergency operations plans, regional strategies, and sustainability initiatives, all of which contribute to a holistic approach to risk reduction. This integration effort is already underway with the incorporation of hazard risk and vulnerability data into the 2025 update of the countywide planning processes.

Many of these plans have been updated simultaneously, allowing for the development of data and mitigation strategies to made in partnership other departments. As a result, several strategies are now reflected in multiple county plans, such as the Flood Management Plan and the Strategic Climate Action Plan. This approach ensures that mitigation actions are implemented and monitored across multiple channels, increasing their visibility and support across departments. By embedding these strategies in various plans, we help elevate their profile and facilitate more comprehensive execution.

It’s important to note that additional strategies may be added to this list throughout the lifecycle of both plans, as new opportunities for collaboration and integration arise. This continuous process ensures that the RHMP remains dynamic and aligned with evolving county goals and priorities.

21.3 Continued Public Involvement

To foster transparency, continuous improvement, and community collaboration, King County is committed to maintaining an effective communication strategy throughout the ongoing maintenance of the RHMP. Following biannual meetings dedicated to RHMP updates, KCOEM will leverage its official Emergency Blog and social media platforms as primary communication channels to keep the public informed. These platforms will provide timely updates on the status of mitigation actions, key developments, and upcoming initiatives.

Regular updates will not only highlight the progress of specific mitigation actions but also offer concise summaries of completed and ongoing efforts. In addition, whenever updates or addendums are introduced to the RHMP, King County will actively open channels for public input. This ensures that the community remains a vital and engaged participant in the planning process. Residents, local stakeholders, and other interested parties will be encouraged to provide comments, voice concerns, and offer valuable feedback on proposed changes to the plan.

Chapter 22: Plan Adoption

The King County Regional Hazard Mitigation Plan is submitted first to Washington State Emergency Management for review and then to FEMA for final review and preliminary approval. Each jurisdiction, along with the base plan, must meet all FEMA requirements outlined in the FEMA Local Hazard Mitigation Plan Review Guide. If requirements are found to not be met, the jurisdiction involved must revise the plan and resubmit. Once preliminary approval is secured, FEMA will send a notice of Approval – Pending Adoption.

The RHMP is adopted by each participating jurisdiction, primarily through a resolution passed by the council or commission responsible. The King County Council is expected to adopt this plan before the expiration date of 9/30/2025, following notice of approval, pending adoption from FEMA and Washington State Emergency Management. This plan will be effective on 10/1/2025 FEMA and will expire 5 years to the day, 9/30/2030.