DRAFT

2025 CITY OF BELLEVUE HAZARD MITIGATION PLAN

Public Review Draft
April 17, 2025

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Executive Summary

Hazard Mitigation Overview

Hazard mitigation is the use of long-term and short-term policies, programs, projects and other activities to alleviate the death, injury and property damage that can result from a disaster. The City of Bellevue and a partnership of local governments, community-based organizations and other stakeholders within the city have developed a hazard mitigation plan to reduce risks from natural disasters anywhere within the city. The plan complies with federal and state hazard mitigation planning requirements to establish eligibility for funding under Federal Emergency Management Agency (FEMA) grant programs for all planning partners.

Plan Development Approach

Organization

A core planning team consisting of contract consultants and city staff was assembled to facilitate this plan update. A 21 member steering committee was assembled to oversee the plan update, consisting of both city representatives and non-city stakeholders within the planning area. In addition to the 21 primary members, there were 18 alternates. Coordination with other regional, state and federal agencies involved in hazard mitigation occurred throughout the plan update process. Organization efforts included a review of the 2019 King County Hazard Mitigation Plan, the Washington State Hazard Mitigation Plan, Bellevue Climate Vulnerability Assessment and existing programs that may support hazard mitigation actions.

Public Outreach

The planning team implemented a multi-media public involvement strategy utilizing the outreach capabilities of the city. The strategy included public events, a hazard mitigation survey, a project website, city newsletters, the use of social media and multiple media releases.

Plan Document Development

The planning team and steering committee assembled a document to meet federal hazard mitigation planning requirements.

Adoption

Once pre-adoption approval has been granted by the Washington Emergency Management Division and FEMA Region X, the plan will be adopted.

Risk Assessment

Assessing risk is the process of measuring the potential loss of life resulting from natural hazards, as well as personal injury, economic injury and property damage, in order to determine the vulnerability of people, buildings and infrastructure to natural hazards. For this update, risk assessment models were developed with the newest data and technologies. The steering committee used the risk assessment to rank risk and to gauge the potential impacts of each hazard of concern in the county. The risk assessment included the following:

- Hazard identification and profiling
- Assessment of the impact of hazards on physical, social and economic assets
- Identification of particular areas of vulnerability
- Estimates of the cost of potential damage.

Based on the risk assessment, hazards were ranked for the risk they pose to the overall planning area, as shown in Table ES-1.

Table ES-1. Hazard risk ranking

Hazard Risk Ranking	Hazard	Risk Score	Risk Classification
1	Severe Weather	48	High
2	Earthquake (Cascadia)	32	Medium
3	Earthquake (Seattle)	18	Medium
4	Landslide	18	Medium
5	Volcano	17	Medium
6	Drought	14	Low
7	Wildfire	12	Low
8	Flood	10	Low
9	Dam Failure	6	Low

Mitigation Vision and Goals

Mitigation goals represent broad statements that are consistent with the hazards identified in the Plan and achieved through the implementation of specific mitigation actions. The vision statement and goals and actions in this plan all support each other. Goals were selected to support the guiding principle. Actions were prioritized based on their ability to meet multiple objectives.

Plan Vision Statement

To establish and promote a comprehensive mitigation strategy that will equitably reduce risk from current and future natural hazards and increase the resiliency of our community, economy and environment.

Goals

- Protect life, property and the environment.
- Increase the whole community's awareness of their risk to natural hazards through ongoing education, outreach and partnerships.
- Develop, prioritize and implement resilient, long-term, cost-effective, equitable and environmentally friendly hazard mitigation measures.
- Increase the whole community's capability and capacity to prepare for, respond to and recover from the impacts of natural hazards.
- Increase the resilience of critical infrastructure and community lifelines by reducing vulnerability to current and future natural hazards.
- Prepare for and reduce the impacts of climate change by increasing the city's adaptive capacity.

Mitigation Action Plan

The city stakeholders identified mitigation actions to help achieve the plan, vision and goals. Mitigation actions are activities designed to reduce or eliminate losses resulting from natural hazards. The planning process resulted in the identification of 25 mitigation actions for implementation by the city.

1. Introduction to Hazard Mitigation Planning

1.1 About Hazard Mitigation

1.1.1 What is it?

As the cost of disasters continues to rise, communities must find ways to reduce hazard risks. The term “hazard mitigation” refers to actions that reduce or eliminate long-term risks caused by hazards such as earthquakes, floods, storms and wildfires. It involves strategies such as planning, policy changes, programs, projects and other activities that can mitigate the impacts of hazards. Without an investment in hazard mitigation, repeated disasters result in repeated damage and rebuilding. This recurrent reconstruction becomes more expensive as the years go by. Hazard mitigation breaks this costly cycle of damage and reconstruction by taking a long-term view of rebuilding and recovering from disasters.

1.1.2 When does it apply?

The federal Disaster Mitigation Act (DMA) of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. The DMA emphasizes planning for disasters before they occur. However, hazard mitigation is also essential to post-disaster recovery. After disasters, repairs and reconstruction often just restore damaged property to pre-disaster conditions. The implementation of additional hazard mitigation actions leads to building smarter, safer and more resilient communities that are better able to reduce future injuries and damage.

1.1.3 Who is responsible?

The responsibility for hazard mitigation lies with private property owners; business and industry; and local, state and federal governments. The Federal Emergency Management Agency (FEMA) encourages multi-jurisdictional planning under its guidance for the DMA, urging state and local authorities to work together on pre-disaster planning. The enhanced planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

1.1.4 How is it developed and implemented?

The DMA promotes sustainability for disaster resistance. "Sustainable hazard mitigation" includes the sound management of natural resources and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. Efforts to reduce risks should be compatible with other community goals, which may be related to economic development, sustainability, public and environmental health, or other issues. As communities plan for new development and improvements to existing infrastructure, mitigation should be an important consideration.

1.2 2025 Hazard Mitigation Plan

The plan identifies strategies and actions that will reduce risk for those who live in, work in, and visit the city. It provides a viable planning framework for all foreseeable natural hazards that may impact the city. Participation in the development of the plan by key stakeholders in the city, including agencies that represent socially vulnerable populations, was key to the plan's success. This single-jurisdictional hazard mitigation plan identifies Bellevue as the sole jurisdiction seeking FEMA plan approval. The City of Bellevue participation included stakeholder engagement, interdepartmental collaboration, and public involvement activities.

1.3 2025 Community Wildfire Protection Plan

[To be completed]

1.4 Who will Benefit from this Plan?

Effective hazard mitigation can provide the following benefits:

- Reduce the loss of life, property, essential services, critical facilities, and economic hardship
- Reduce short-term and long-term recovery and reconstruction costs
- Increase cooperation and communication within the community through the planning process
- Increase potential for state and federal funding for pre- and post-disaster projects.

All community members and businesses of the City of Bellevue are the ultimate beneficiaries of this hazard mitigation plan. The plan identifies strategies and actions that will reduce risk for those who live in, work in, and visit the city. It provides a viable planning framework for all foreseeable natural hazards that may impact the city. Participation in the development of the plan by key stakeholders in the city, including agencies that represent socially vulnerable populations, helped ensure that outcomes will be mutually beneficial. The resources and background information in the plan are applicable citywide and the plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

2. Planning Process

2.1 Formation of the Core Planning Team

The City of Bellevue hired Perteet, Inc and Black & Veatch to assist with development and implementation of the Hazard Mitigation Plan and the enhancement of the wildfire risk assessment chapter to qualify as a Community Wildfire Protection Plan and to provide subject-matter expertise to the overall planning process. A core planning team formed to lead the planning effort, which included the following Bellevue and consultant staff:

- Kristi Oosterveen, Bellevue Transportation Department, Co-Project Manager
- Ellen Montañana, Bellevue Emergency Management, Co-Project Manager
- Linda DeBolt, Bellevue Utilities Department
- Gillian Hagstrom, Bellevue Communications Department
- Christina Wollman, Perteet, Project Manager, Lead Planner
- Samantha Criner, Perteet, Planner
- Rob Flaner, Black and Veatch, Risk Assessment Lead
- Megan Brotherton, Black and Veatch, Planner

The core planning team coordinated regularly throughout the course of the planning process to track plan development milestones and to develop the content for steering committee meetings. This team was principally responsible for the writing and formatting of this 2025 plan.

2.2 Defining Stakeholders

At the beginning of the planning process, the core planning team identified a list of stakeholders to engage during the creation of the HMP. For this planning process, “stakeholder” was defined as any person or public or private entity that owns or operates facilities that would benefit from the mitigation actions of this plan and/or has an authority or capability to support mitigation actions identified by this plan.

2.3 Defining the Planning Area

The planning area was defined to consist of the City of Bellevue. A map showing the geographic boundary of the defined planning area for this plan update is provided in Chapter 3, along with a description of planning area characteristics.

2.4 The Steering Committee

2.4.1 Hazard Mitigation Plan Steering Committee

Hazard mitigation planning enhances collaboration among diverse parties who can be affected by hazard losses. A key element of the public engagement strategy for this plan was the formation of a steering committee to oversee all phases of the creation of the City of Bellevue Hazard Mitigation Plan. Besides departmental representatives, the core planning team prioritized the involvement of non-city agencies who provide service to the city and representation of the diverse and vulnerable populations within the city. The planning team assembled a list of candidates representing interests within the planning area that could have recommendations for the plan or be impacted by its recommendations. The city's co-project managers extended invites to all identified participants. A steering committee of 21 primary members was confirmed at the first meeting on July 10, 2024, with 18 alternates.

Participating City of Bellevue departments included:

- Emergency Management
- Transportation
- Utilities
- Community Development
- Communications
- Fire
- Police
- Development Services
- Finance and Asset Management
- Information Technology
- City Managers Office

Stakeholders representing non-profits and diverse, vulnerable and underserved community members included:

- Diversity Advisory Network
- Diversity Advantage Team
- Bellevue Communities of Color

Non-city stakeholders on the steering committee included:

- Bellevue School District
- Cascade Water Alliance
- King County OEM
- Sound Transit

Table 2-1 lists the steering committee members and their designated alternates.

Table 2-1. Primary HMP steering committee members.

Name	Role	Department/Agency
City Departmental Representatives		
Nathan McCommon	Primary	City Manager's Office
Gillian Hagstrom	Primary	Communications
Michaelene Fowler	*Alternate*	*Communications*
Mike McCormick-Huntelman	Primary	Community Development
Patrick Babbitt	*Alternate*	*Community Development*
Jennifer Ewing	*Alternate*	*Community Development*
Bryce Williams-Tuggle	*Alternate*	*Community Development*
Justus Stewart	*Alternate*	*Community Development*
Gregg Schrader	Primary	Development Services
Ryan Mumma	*Alternate*	*Development Services*
Nate Tilson	*Alternate*	*Development Services*
Jake Hesselgesser	*Alternate*	*Development Services*
Lauren Eck	*Alternate*	*Development Services*
Demitri Bergeron	Primary	FAM
Megan Ryan	*Alternate*	*FAM*
Ryan Armstrong	Primary	Fire
Heather Wong	*Alternate*	*Fire*
Matthew Dubose	Primary	IT
Carl Lunak	Primary	OEM
Ellen Montañana	*Alternate*	*OEM*
Rick Bailey	Primary	Parks
Tom Purcell	*Alternate*	*Parks*
Sgt. Tony Romero	Primary	Police
Drew Andrews	*Alternate*	*Police*
Pete Bourgeault	Primary	Risk Management
Kristi Oosterveen	Primary	Transportation
Hillary Stibbard	Primary	Transportation
Brian Breeden	*Alternate*	*Transportation*
Linda De Boldt	Primary	Utilities

Don McQuillams	*Alternate*	*Utilities*
Diverse and Vulnerable Populations Representatives		
Marcus Johnson	Primary	Diversity Advantage Team
Yvonne Adagala	Primary	Diversity Advisory Network
Ricardo Perezchica	Primary	Bellevue Communities of Color
Non-City Representatives		
Andrew Matthews	Primary	KCOEM
Kali Clark	Primary	Sound Transit
Tim Braniff	*Alternate*	*Sound Transit*
Melina Thung	Primary	Cascade Water Alliance
Ginger Bonnell	Primary	Bellevue School District
Jason Moore	*Alternate*	*Bellevue School District*

2.4.2 Community Wildfire Protection Plan Sub-Committee

The CWPP development was supported by a sub-committee including members of the consultant team, core planning team, Bellevue Fire Department, Bellevue Parks and the Department of Natural Resources. The CWPP planning process also sought involvement from neighboring landowners and fire protection agencies, including Washington State Parks (Bridle Trails State Park) and King County (Cougar Mountain).

2.5 Review of Existing Programs

Chapter 5 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation actions. In addition, the following programs can affect mitigation within the planning area and were reviewed and incorporated where appropriate:

- 2023 Washington State Hazard Mitigation Plan
- 2024 Comprehensive Plan
- Capital improvement programs
- Emergency operations plans
- Local zoning ordinance

Many of these relevant plans, studies and regulations are cited in the capability assessments.

Many technical documents, reports, studies and other resources were incorporated into this plan and supported the risk assessment update. For example, resources such as Drought.gov, DNR Geology Portal, FEMA flood insurance studies and research studies were used to update the plan. When used, these sources are referenced in the text. A complete list of references is provided at the end of the document.

2.6 Public Involvement

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The strategy for involving the public in this plan update emphasized the following elements:

- Open steering committee meetings to the public.
- Attempt to reach as many community members as possible using multiple media, including social media.
- Identify and involve planning area stakeholders including community-based organizations (CBOs) and groups that serve the whole community.

All public outreach materials are provided in Appendix A.

2.6.1 Stakeholder coordination

Stakeholders are the individuals, agencies and jurisdictions that have a vested interest in the recommendations of the hazard mitigation plan.

The effort to include stakeholders in this process included stakeholder participation on the steering committee, notification of public involvement opportunities and direct contact. The goal was to ensure broad representation of the community and an opportunity to be involved and participate in the process. Table 2-2 describes the types of stakeholders provided an opportunity to be involved in the process. All stakeholders, except for Providence Hospital, were able to participate in the planning process.

Table 2-2. Stakeholders offered an opportunity to be involved in the process

Stakeholders	
Local and regional agencies involved in hazard mitigation activities	
Bellevue Office of Emergency Management	Bellevue Fire Department
Bellevue Transportation Department	Bellevue Utilities Department
Bellevue Police Department	Bellevue Information Technology
Bellevue Parks Department	Bellevue Finance and Asset Management
City Manager's Office	Bellevue Communications
Cascade Water Alliance	Bellevue School District
WA Department of Natural Resources	King County Emergency Management
Sound Transit	Bellevue School District
Agencies that have the authority to regulate development	
Bellevue Development Services	Bellevue Community Development
Bellevue Transportation Department	Bellevue Utilities Department
Neighboring communities	
King County Emergency Management	Sound Transit
Cascade Water Alliance	
Representatives of businesses, academia, and other private organizations	
Cascade Water Alliance	Bellevue School District
Providence Hospital	
Representatives of nonprofit organizations, including community-based organizations	
Diversity Advantage Team	Bellevue Communities of Color
Diversity Advisory Network	

2.6.2 Hazard Mitigation Plan website

The City of Bellevue's developed a hazard mitigation plan webpage to keep the public informed on plan development milestones. The page included information on how to get involved, meeting summaries and current status. The webpage can be found at: https://bellevuewa.gov/city-government/departments/fire/emergency-management/hazard-mitigation-plan.

2.6.3 Online engagement

Engaging Bellevue is a website where the community can learn information about city projects and participate in interactive engagement activities. The core planning team developed an online open house using the Engaging Bellevue website which both provided information to and gathered information from the community. The page featured a survey asking questions about the community member's

experience and concern with natural hazards, a mapping exercise with a feature to place a pin on and describe areas of concern and a place to ask questions. The webpage can be found at: https://www.engagingbellevue.com/hmp.

2.6.4 In-person involvement opportunities

The core planning team identified several opportunities to engage the community through in-person events.

- **August 14, 2024** – The core planning team handed out an informational postcard at a community event.
- **September 23, 2024** – The city's Office of Emergency Management hosted an emergency preparedness workshop. The core planning team presented information about the plan to the workshop attendees and set up a table with maps so that one-on-one discussions could happen during the workshop breaks.
- **April 17, 2025** – During the two week draft plan public comment period, the core planning team hosted an open house at the Crossroads Community Center. The open house included a short presentation about the draft plan, printed maps and an opportunity for questions and answers and one-on-one discussion.
- **April 19, 2025** – The core planning team attended the city's Earth Day celebration with maps and information about the draft plan.

2.6.5 Public comment period

On April 17, 2025, the core planning team released the draft plan for public review. The plan was posted on the City's website and the Engaging Bellevue page. A second survey was developed to help guide the community's review and provide comments.

2.6.6 Notification methods

The city's communications team used several methods to reach the community and inform them about the planning process and draft plan. These methods included press releases, Neighborhood News articles and social media, including the post on X shown in Figure 2-1. The city developed a postcard that was handed out at community events, shown in Figure 2-2.

Figure 2-1. Social media post

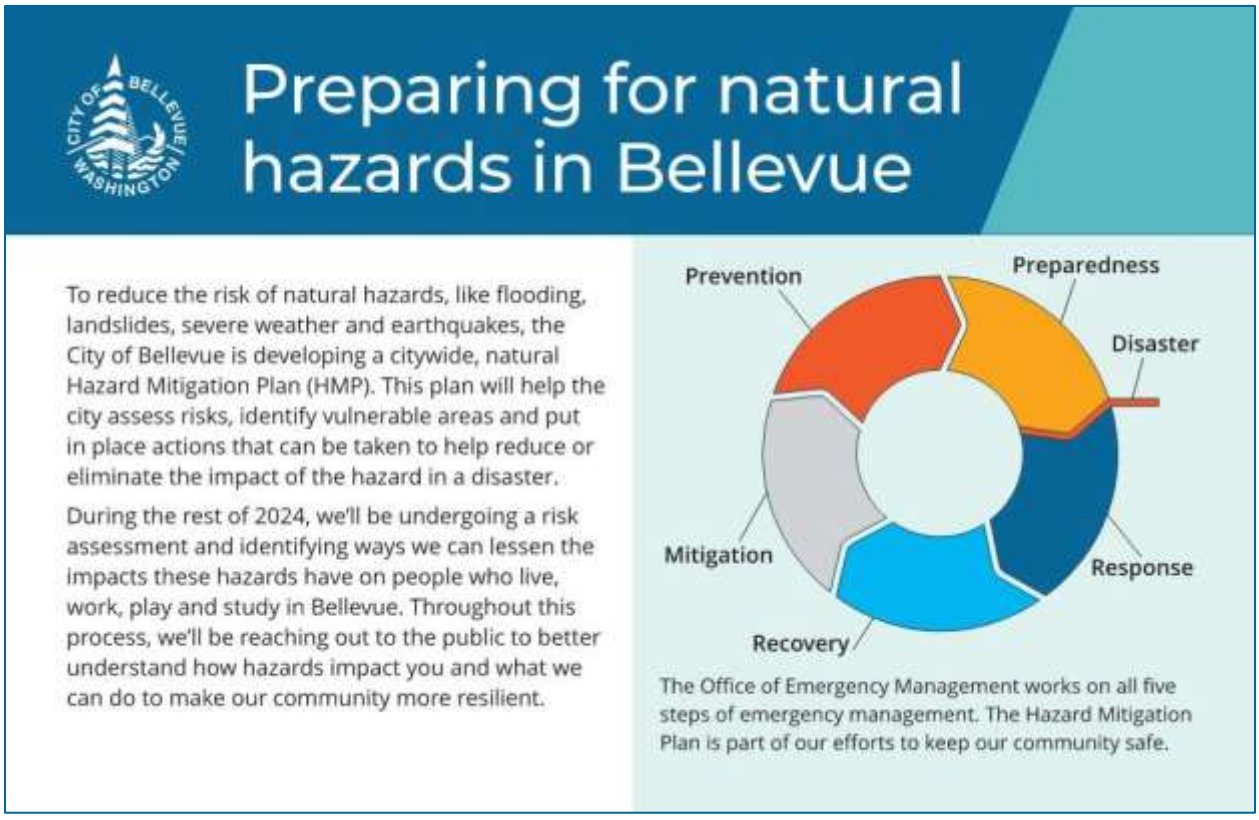

Figure 2-2. Postcard at project commencement

2.6.7 Public outreach results

[To be completed after public comment period ends]

2.7 Plan Development Chronology/Milestones

The plan was developed over a one year timeframe. Events and milestones are described in Table 2-3.

Table 2-3. Plan development timeline

Date	Event	Description	Attendance
2023			
	City awarded Hazard Mitigation Grant Program funds	▪ Funding ID #DR-4584-WA / 4584-01-P	
9/14	Request for proposal advertised		
11/17	Consultant selected		
2024			
4/17	Contract executed	▪ The city signed contract with consultant	
6/5	Project Kick-off Meeting	▪ Reviewed planning process, including DMA provisions and timelines ▪ Reviewed responsibilities/ expectations of steering committee ▪ Reviewed State HMP and King County HMP and identified hazards that may impact the City.	24
7/10	Steering Committee Meeting #1	▪ Confirmed hazards of concern ▪ Adopted vision statement and goals ▪ Defined critical facilities	21
8/7	Steering Committee Meeting #2	▪ Reviewed capability assessment ▪ Reviewed plan maintenance strategy	21
8/14	Community event	▪ Handed out an informational postcard with link to the project website	
9/4	Steering Committee Meeting #3	▪ Began SWOO (Strengths, Weaknesses, Opportunities and Obstacles) activity	21

9/23	Online Open House Opens, Emergency Preparedness Workshop	▪ Notified public of online open house through press release, Neighborhood News and social media ▪ Presented project information during the Emergency Preparedness Workshop	
10/2	Steering Committee Meeting #4	▪ Completed SWOO activity ▪ Presented risk assessment results for residential properties	14
11/6	Steering Committee Meeting #5	▪ Reviewed risk assessment results ▪ Introduced mitigation action planning	18
12/4	Steering Committee Meeting #6	▪ Mitigation action planning workshop	20
2025			
2/5	Department Action Workshops	▪ Begin meeting with each department to discuss mitigation actions	
3/5	Steering Committee Meeting #7	▪ Present rough draft plan to steering committee	
4/17	Begin public comment period		
4/17	Open House	▪ Open house held at the Crossroads Community Center	
4/19	Earth Day event	▪ Set up table at Earth Day event	
5/1	End public comment period	▪	
	Submit draft plan to WA Emergency Management Division	▪	
	Approval Pending Adoption	▪ Receive approval pending adoption from FEMA	
	Plan adoption	▪ City Council adopts plan	
	Plan approval	▪ FEMA approves plan	
2030			
	Plan expiration	▪	

3. Vision Statement, Goals, Objectives

Mitigation goals represent broad statements that are consistent with the hazards identified in the Plan and achieved through the implementation of specific mitigation actions. The vision statement and goals, objectives and actions in this plan all support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Actions were prioritized based on their ability to meet multiple objectives.

3.1 Plan Vision Statement

A plan's vision statement focuses the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome and it is broader than a hazard-specific objective. The vision statement for this hazard mitigation plan is as follows:

> To establish and promote a comprehensive mitigation strategy that will equitably reduce risk from current and future natural hazards and increase the resilience of our community, economy and environment.

3.2 Goals

The following are the mitigation goals for this plan:

1. Protect life, property and the environment.
2. Increase the whole community's awareness of their risk to natural hazards through ongoing education, outreach and partnerships.
3. Develop, prioritize and implement resilient, long-term, cost-effective, equitable and environmentally friendly hazard mitigation measures.
4. Increase the whole community's capability and capacity to prepare for, respond to and recover from the impacts of natural hazards.
5. Increase the resilience of critical infrastructure and community lifelines by reducing vulnerability to current and future natural hazards.
6. Prepare for and reduce the impacts of climate change by increasing the city's adaptive capacity.

4. City of Bellevue Profile

4.1 Historical Overview

Coast Salish tribes including the Duwamish and Snoqualmie lived, hunted and fished in the Puget Sound. In 1867, coal was discovered in the Coal Creek area, leading to mining, logging and the arrival of white settlers. Bellevue ("Beautiful View" in French) was officially named in the 1880s, possibly referring to its scenic views or settlers' origins from a town in Indiana.

By the early 1900s, the area's forests were cleared and it became a prosperous farming community. Community members sold their produce by ferrying across Lake Washington to Seattle. They then began transporting even farther on the Northern Pacific rail line, which came through in 1904. Japanese immigrants played a key role, producing much of the local crops including strawberries and vegetables. The opening of a bridge over Lake Washington in 1940 brought new community members and Bellevue Square, one of the country's first suburban shopping centers, opened in 1946.

Bellevue became an incorporated city in 1953 and has since grown into a high-tech hub and thriving urban center (City of Bellevue).

4.2 Location

Bellevue is located on the east side of Lake Washington. Major transportation routes through Bellevue include I-90, I-405 and SR 520. The city is north of Newcastle and south of Redmond and Kirkland. See Figure 4-1 for a map of the planning area.

4.3 Major Past Hazard Events

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Review of presidential disaster declarations helps establish the probability of reoccurrence for

each hazard and identify targets for risk reduction. See Table 4-1 for a list of presidential disaster declarations within King County.

Figure 4-1. Planning area map

Table 4-1. Historical King County presidential disaster declarations

Event	State or Federal Disaster #	Date
Severe Winter Storms, Straight-line Winds, Flooding, Landslides, Mudslides	DR-4775-WA	1/5-1/29/2024
Washington Bolt Creek Fire	FM-5455-WA	9/10-10/24/2022
Severe Storms, Flooding, Landslides, Mudslides	DR-4539-WA	1/20-2/10/2020
Severe Winter Storms, Flooding, Landslides, Mudslides	DR-4039-WA	1/30-2/22/2017
Severe Winter Storms, Flooding, Landslides, Mudslides	DR-4056	1/14-1/23/2012
Severe Winter Storms, Flooding, Landslides, Mudslides	DR-1963-WA	1/11-1/21/2011
Severe Winter Storm and Record and Near Record Snow	DR-1925-WA	12/12/2008-1/5/2009
Severe Winter Storm, Landslides, Mudslides and Flooding	DR-1817-WA	1/6-1/16/2009
Severe Storms, Flooding, Landslides, Mudslides	DR-1734-WA	12/1-12/17/2007
Severe Winter Storm, Landslides and Mudslides	DR-1682-WA	12/14-12/15/2006
Severe Winter Storm, Landslides and Mudslides	DR-1671-WA	11/2-11/11/2006
Washington Hurricane Katrina Evacuation	EM-3227-WA	8/29-10/1/2005
Severe Storms and Flooding	DR-1499-WA	10/15-10/23/2003
Washington Earthquake	DR-1361-WA	2/28-3/16/2001
Severe Winter Storm, Landslides and Mudslides	DR-1172-WA	3/18-3/28/1997
Severe Winter Storm, Flooding	DR-1159-WA	12/26-2/10/1997
Severe Winter Storm, Flooding	DR-1100-WA	1/26-2/23/1996
Storms, High Winds, Floods	DR-1079-WA	11/7-12/18/1995
High Tides, Severe Storm	DR-896-WA	12/20-12/31/1990
Flooding, Severe Storm	DR-883-WA	11/9-12/20-1990
Flooding, Severe Storm	DR-852-WA	1/6-1/16/1990
Flooding, Severe Storm	DR-784-WA	11/22-11/29/1986
Flooding, Severe Storm	DR-757-WA	1/16-1/19/1986
Volcanic Eruption, Mt. St. Helens	DR-623-WA	5/21/1980

Storms, High Tides, Mudslides, Flooding	DR-612-WA	12/31/1979
Severe Storms, Mudslides, Flooding	DR-545-WA	12/10/1977
Severe Storms, Flooding	DR-492-WA	12/13/1975
Heavy Rains, Flooding	DR-328-WA	4/24/1972
Earthquake	DR-196-WA	5/11/1965
Heavy Rains, Flooding	DR-185-WA	12/29/1964

(FEMA, 2025)

4.4 Physical Setting

4.4.1 Geology

Bellevue, Washington, is located between the Puget Lowland and North Cascade geologic provinces, shaped by millions of years of tectonic activity and volcanic processes. Around 55 to 20 million years ago, the Insular Superterrane, a group of ancient island chains, was accreted onto the North American continent. Volcanic eruptions and magma intrusions during this time helped form the region's bedrock as the subduction zone shifted westward. These processes laid the foundation for Bellevue's geology, with layers of solidified lava and intrusive rock beneath the surface.

During the Pleistocene Ice Age, massive glaciers advanced over the region, carving the landscape and depositing thick layers of sand, silt and gravel. Ice dams created large reservoirs, which occasionally burst, causing catastrophic floods that further shaped the terrain. As the glaciers melted and retreated, they left behind Lake Washington and Lake Sammamish, which now border Bellevue to the west and east. Today, the city's rolling hills, lakes and sediment-rich soils reflect the powerful forces of its geologic past. (Washington State Geology, 2013) (DNR, 2025)

Typical geology under Bellevue displays an array representing examples from the Puget Lowland and North Cascade geologic provinces, including sedimentary, metamorphic and volcanic rocks. The ice age glaciation created the diverse topography in western Washington, Puget Sound and Bellevue. Bellevue's soil is primarily glacial till, left behind from the ice age. Bellevue sits approximately 85 feet above sea level, with areas over 400 feet in the east portion of the city.

4.4.2 Watersheds

Bellevue contains 25 drainage basins. Each basin in Bellevue eventually drains into Lake Sammamish or Lake Washington. Bellevue lies within the larger Lake Washington/Cedar/Sammamish watershed that drains to the Puget Sound. See Figure 4-2 for a map of drainage basins.

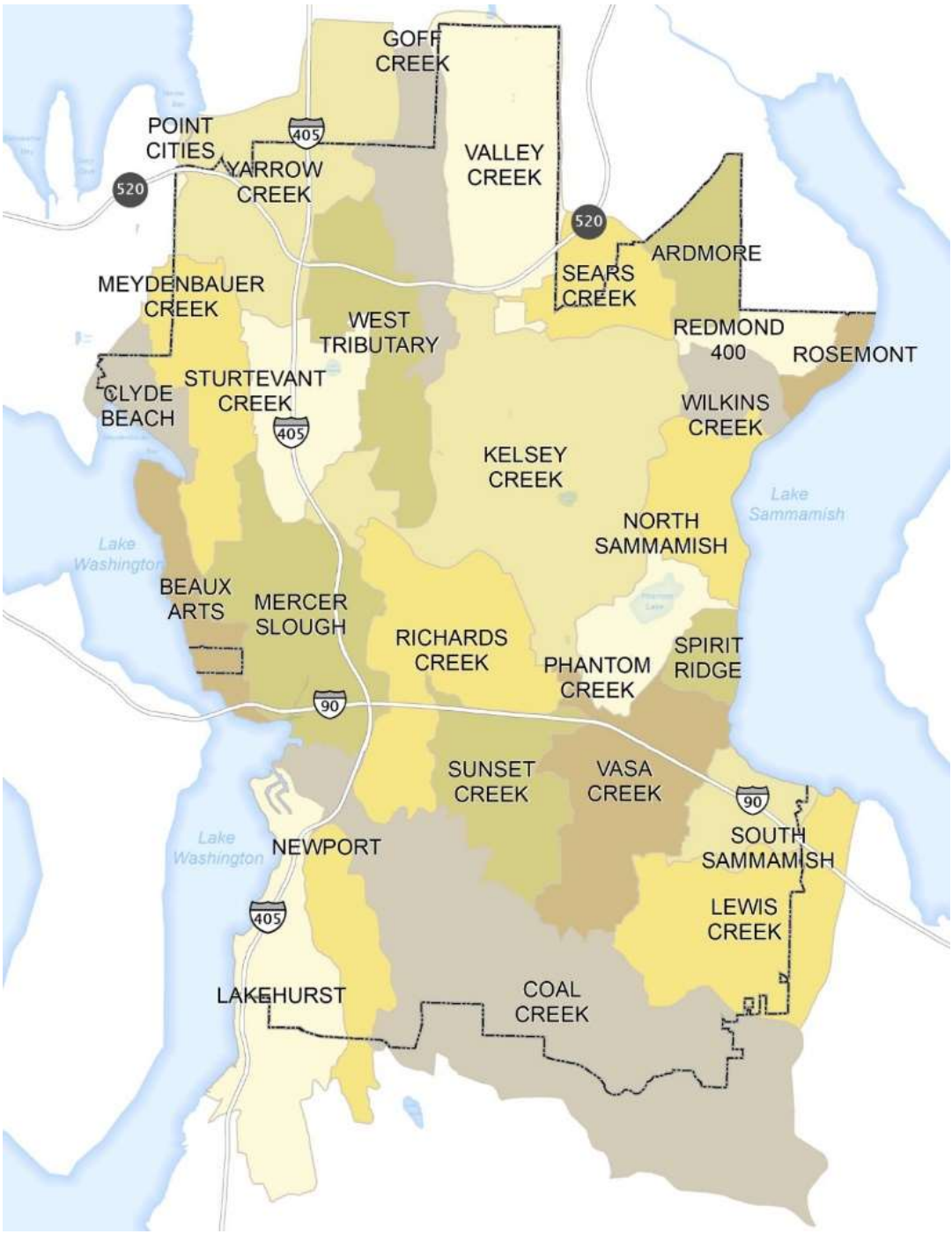

Figure 4-2. Drainage basins

4.4.3 Climate

The City of Bellevue features a typical climate of the Pacific Northwest, with a maritime climate and significant rainfall. The city averages 37 inches of annual rainfall and seldom experiences heavy snowfall. Bellevue summers are characterized by average daytime temperatures between 72-79°F degrees with low humidity. Most precipitation occurs in the fall-winter timeframe. Average winter temperatures range from 46-50°F (Weather Spark, 2025).

Table 4-2. Average weather in Bellevue

Average	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Temperatures (°F)												
High	47	50	55	60	66	71	77	77	71	61	51	46
Temp	42	43	47	51	57	62	66	67	62	53	46	41
Low	38	39	41	45	50	55	58	58	54	48	42	37
Precipitation												
Snowfall	1.5"	0.4"	0.0"	0.0"	0.0"	0.0"	0.0"	0.0"	0.0"	0.0"	0.2"	1.4"
Rainfall	6.6"	5.6"	4.9"	3.5"	2.4"	1.8"	0.8"	0.9"	2.0"	4.8"	8.2"	7.1"
Days	15.5	13.5	15.4	12.3	9.8	7.6	3.9	3.7	6.6	12.4	17.2	16.4
Wind (mph)												
Wind	5.0	4.8	4.5	4.0	3.4	3.1	2.8	2.8	3.2	4.0	5.0	5.1
Cloud cover (% coverage)												
Clouds	73%	70%	68%	63%	56%	49%	31%	31%	39%	57%	71%	73%
Clear Sky	27%	30%	32%	37%	44%	51%	69%	69%	61%	43%	29%	27%

Source: (Weather Spark, 2025)

4.5 Development Profile

4.5.1 Land use

Bellevue, a major regional job center, has more people working in the city than living in it. Bellevue has transitioned from annexation-driven growth to attracting community members, especially from abroad. Surrounded by natural features like Lake Washington and urban forests, the city is focusing growth in Downtown and BelRed, leveraging transportation access and environmental enhancements. Despite limited land for expansion, Bellevue plans to add 35,000 housing units and 70,000 jobs by 2044, aligning with regional growth targets while maintaining its park-like character (City of Bellevue, 2024).

4.5.2 Critical facilities and infrastructure

A critical facility is any structure, facility, or other improvement that, because of its function, service area, or uniqueness, provides service that enables the continuous operation of critical business and government functions and is critical to human health and safety or economic security. For the purposes of this hazard mitigation plan, all FEMA Community Lifelines are defined as critical facilities:

- **Safety and Security**—Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Facilities, Schools, Community Safety
- **Food, Hydration, Shelter**—Food, Hydration, Shelter, Agriculture, Irrigation Systems
- **Health and Medical**—Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
- **Energy**—Power Grid, Generation Systems, Dams, Fuel, Pipelines
- **Communications**—Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
- **Transportation**—Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
- **Hazardous Materials**—Facilities, HAZMAT, Pollutants and Contaminants
- **Water Systems**– Potable Water Infrastructure, Wastewater Management Infrastructure

The number of critical facilities within or managed by the City of Bellevue are listed in Table 4-3 and Table 4-4 and shown in Figure 4-3 and Figure 4-4.

Table 4-3. Critical facilities – services and hazmat

Area	Safety and Security	Food, Hydration, Shelter	Health and Medical	Hazardous Materials	Total
BelRed	8	0	16	6	30
Bridle Trails	8	0	0	0	8
Cougar Mountain / Lakemont	5	0	0	0	5
Crossroads	14	0	8	0	22
Downtown	4	0	7	0	11
Eastgate	8	0	5	1	14
Factoria	5	0	7	0	12

Lake Hills	17	1	5	0	23
Newport	4	0	0	0	4
Northeast Bellevue	5	0	2	0	7
Northwest Bellevue	10	0	4	0	14
Somerset	4	0	0	0	4
West Bellevue	6	1	1	0	8
West Lake Sammamish	3	0	0	0	3
Wilburton	8	1	3	0	12
Woodridge	1	0	0	0	1
City of Clyde Hill	1	0	0	0	1
Total	**111**	**3**	**58**	**7**	**179**

Table 4-4. Critical facilities – infrastructure

Area	Energy	Communi-cations	Transpor-tation	Water Systems	Total
BelRed	0	10	34	4	48
Bridle Trails	0	2	8	14	24
Cougar Mountain /Lakemont	0	18	8	10	36
Crossroads	0	9	0	6	15
Downtown	0	51	11	0	62
Eastgate	0	17	10	7	34
Factoria	0	16	3	2	21
Lake Hills	0	14	0	12	26
Newport	0	7	13	9	29
Northeast Bellevue	0	1	0	3	4
Northwest Bellevue	0	0	15	3	18
Somerset	0	2	1	15	18
West Bellevue	0	8	13	14	35
West Lake Sammamish	0	2	0	9	11
Wilburton	0	4	3	1	8
Woodridge	0	6	10	5	21
City of Clyde Hill	0	0	0	0	0
Total	**0**	**167**	**129**	**114**	**410**

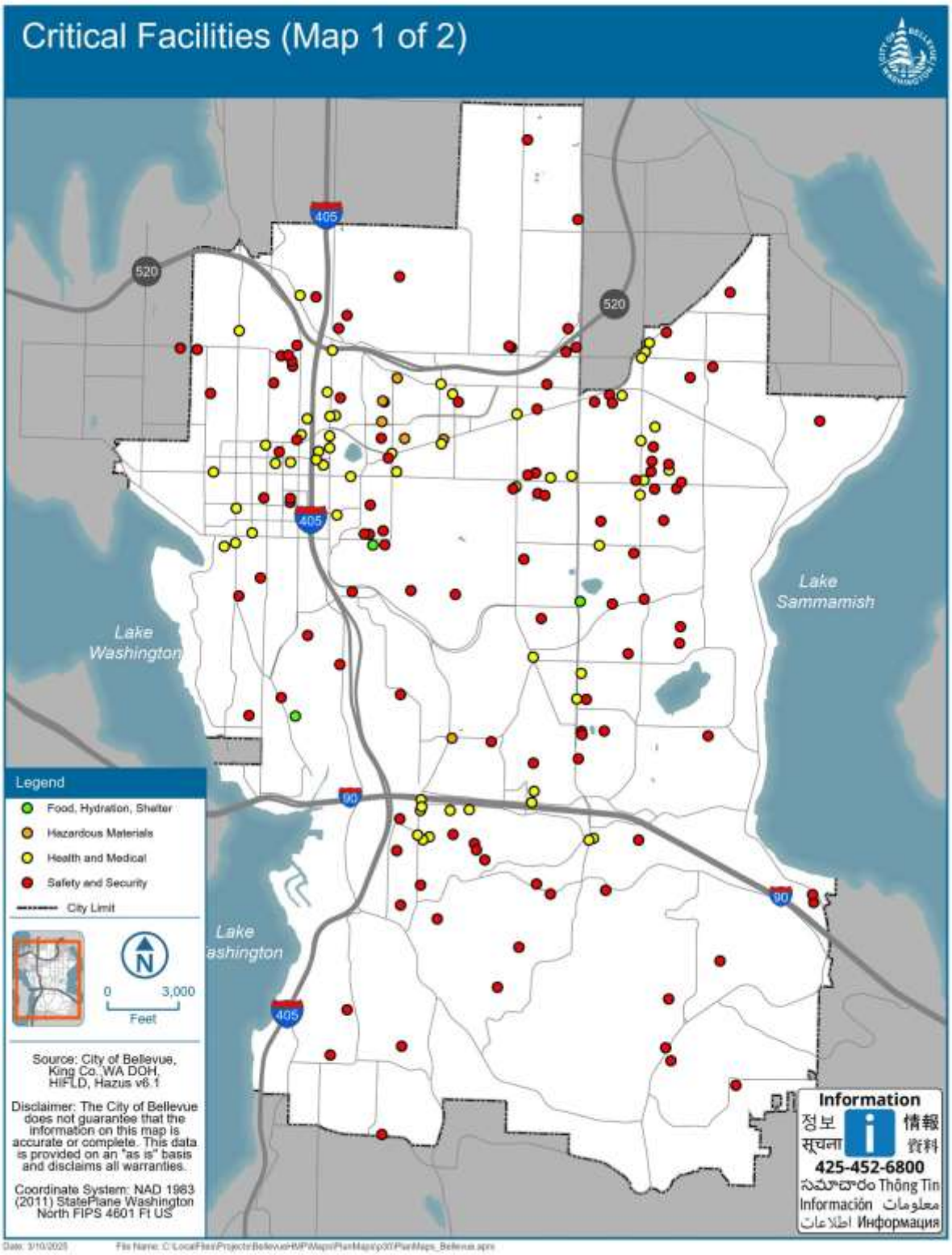

Figure 4-3. Critical facilities (Map 1)

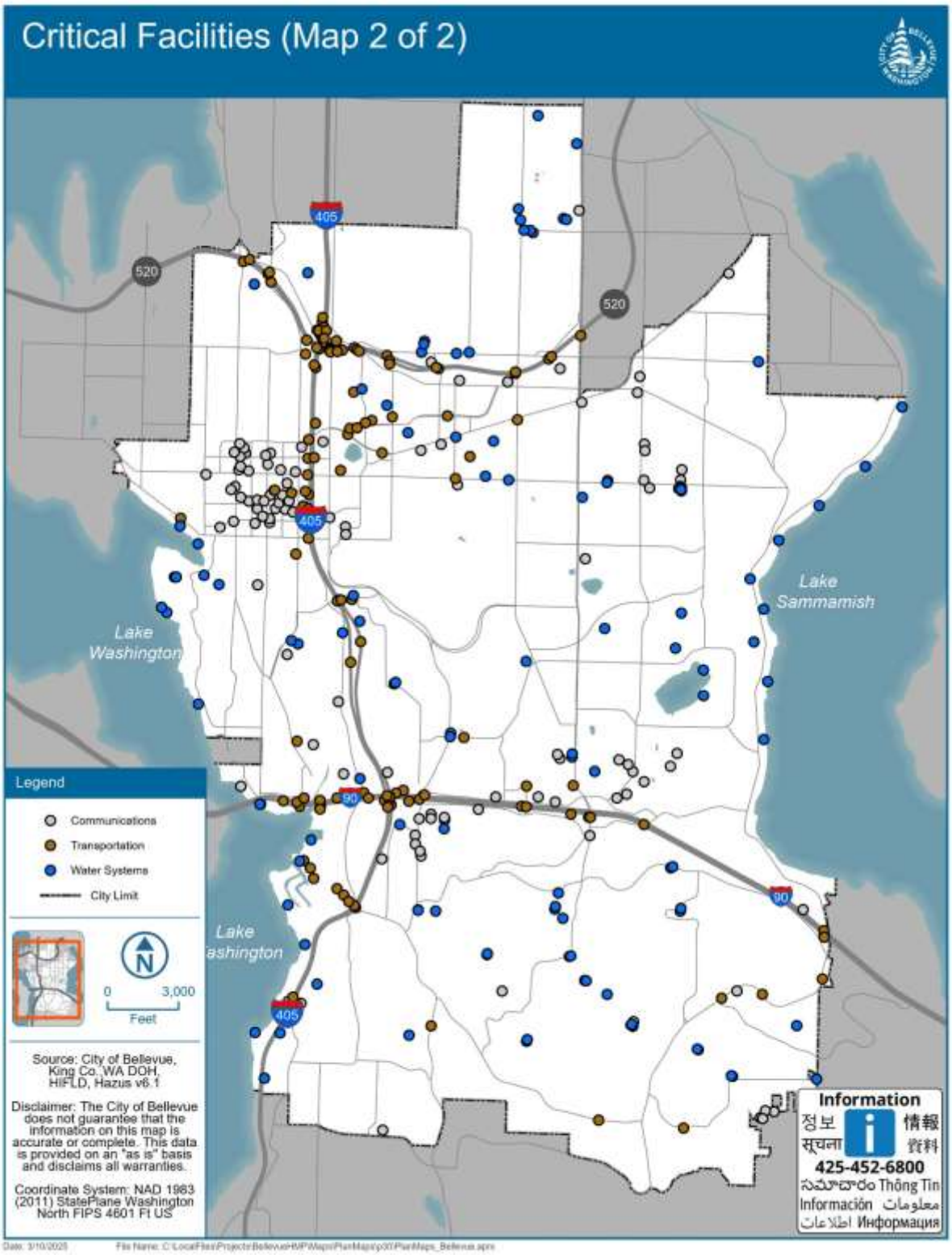

Figure 4-4. Critical facilities (Map 2)

4.5.3 Future trends in development

For the 2024 Comprehensive Plan periodic update, Bellevue needed to plan for an additional 35,000 housing units and 70,000 jobs by 2044 to align with regional growth targets. With limited land for expansion, Bellevue studied three growth alternatives and selected a preferred alternative. The preferred alternative focuses growth into mixed use centers, neighborhood centers and the Wilburton study area, where a new light rail station was recently constructed. In the residential areas, increased density mandated by state legislation will create additional housing capacity. See Figure 4-5 for a map of Bellevue's growth areas.

4.6 Demographics

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly (especially older single men), the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population (Rufat, Tate, Burton, & Maroof, 2015). These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, minority, race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would help to extend focused public outreach and education to these most vulnerable community members.

The source of all data is the US Census 2023 American Community Survey, unless otherwise noted.

4.6.1 Population characteristics

Knowledge of the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services and transportation. Bellevue has an estimated population of

155,000, making it the 5th largest city in Washington State (Office of Financial Management, 2024).

Source: (City of Bellevue, 2023)

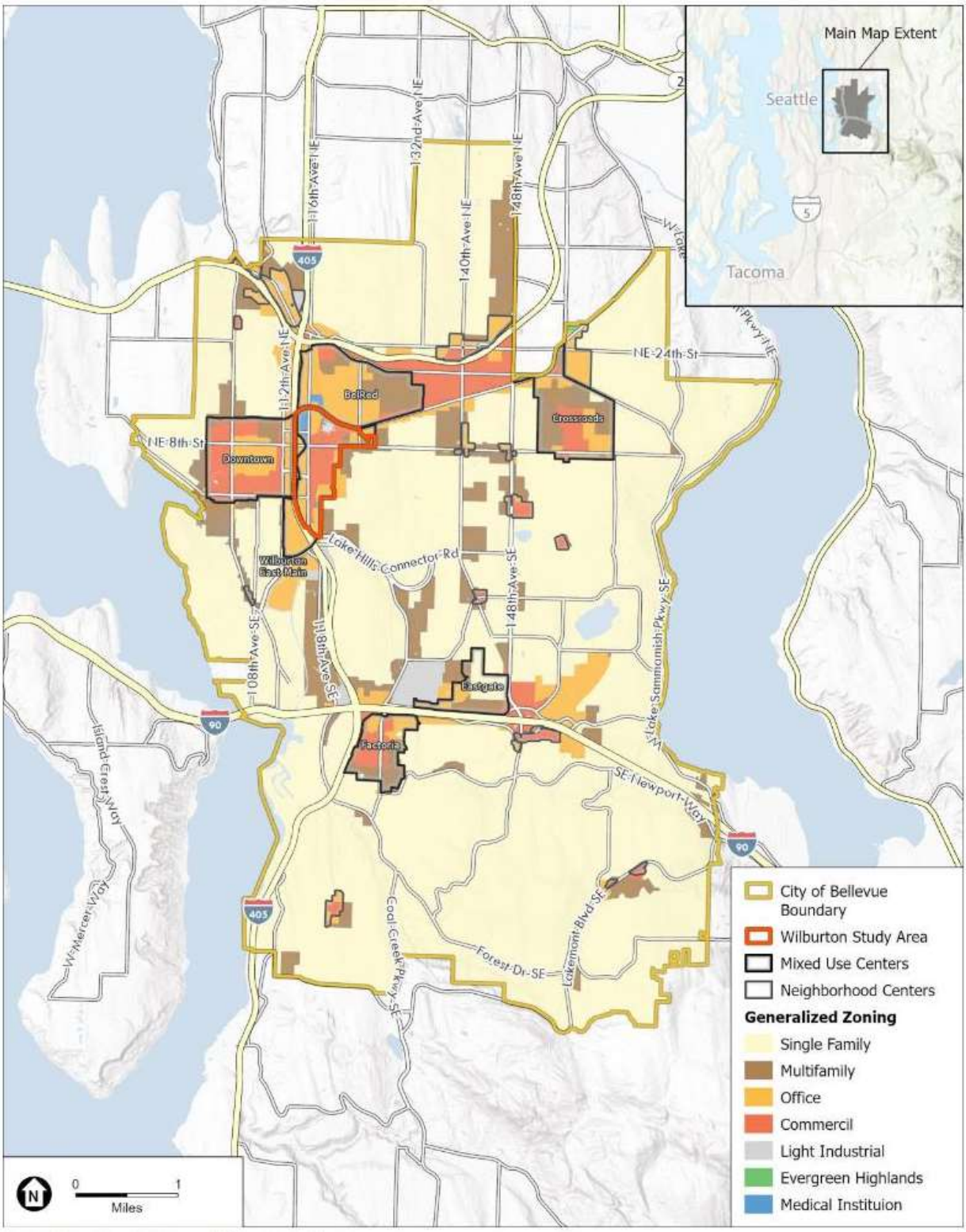

Figure 4-5. Bellevue growth centers

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. Figure 4-6 shows Bellevue population change from 1968 to 2024 (Office of Financial Management, 2024).

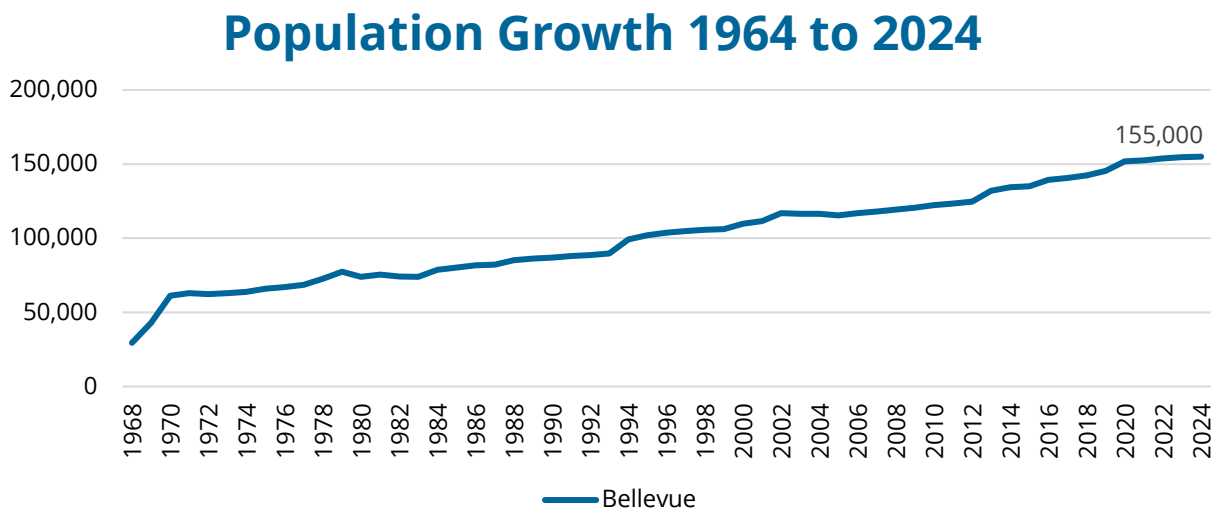

Figure 4-6. Population growth from 1964 to 2024

4.6.2 Racial and ethnic minority status

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. In Bellevue, 46.8% of the population speaks a language other than English at home. The planning area has a 42% foreign-born population, with 71% of those community members identifying as Asian. See Table 4-5.

Table 4-5. Race and ethnicity

Race and Ethnicity	Percent
Not Hispanic or Latino	94.1%
Hispanic or Latino	5.9%
White	41%
Black of African American	0.9%
American Indian and Alaska Native	0.1%
Asian	45.8%
Native Hawaiian or other pacific islander	0.1%
Two or more races	5.7%

Source: (U.S. Census Bureau, 2023)

4.6.3 Socioeconomic status

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are disadvantaged when confronting and recovering hazards such as flooding, wildfires and severe storms. An estimated 8.3% of the population in Bellevue are in poverty (US Census Bureau, 2023). White and Asian households are more likely to be in higher income brackets than Black and Hispanic households. Black and Hispanic households are the most cost burdened at 38% and 34%. Of those who experience the most cost burden, 74% fall in the very low income and 74% in the extremely low-income categories (City of Bellevue, 2023).

Community members below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. Based on the most recent 2023 American Community Survey, the median household income in Bellevue is $158,253 compared to King County's $122,148. An estimated 3.2% of community members do not have health insurance, which is half of the state average. This means that community members below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses.

Table 4-6. Income characteristics

Characteristics			
Income and percent of total population			
Less than $10,000	2.8%	$50,000 to $74,999	6.3%
$10,000 to $14,999	2.3%	$75,000 to $99,999	7.6%
$15,000 to $24,999	3.4%	$100,000 to $149,999	14.6%
$25,000 to $34,999	4.5%	$150,000 to $199,999	12%
$35,000 to $49,999	4.7%	$200,000 or more	41.7%
Income levels			
Median income (Bellevue)		$158,253	
Median income (King County)		$120,824	
Median income (Washington State)		$94,605	
Poverty levels and percent of total population			
Earning below 100% poverty level		8.3%	
Earning 100-149% of poverty level		3.1%	
Earning above 150% of poverty level		88.7%	
Earning less than 80% of median income		38% (approximate)	

Source: (City of Bellevue, 2023)

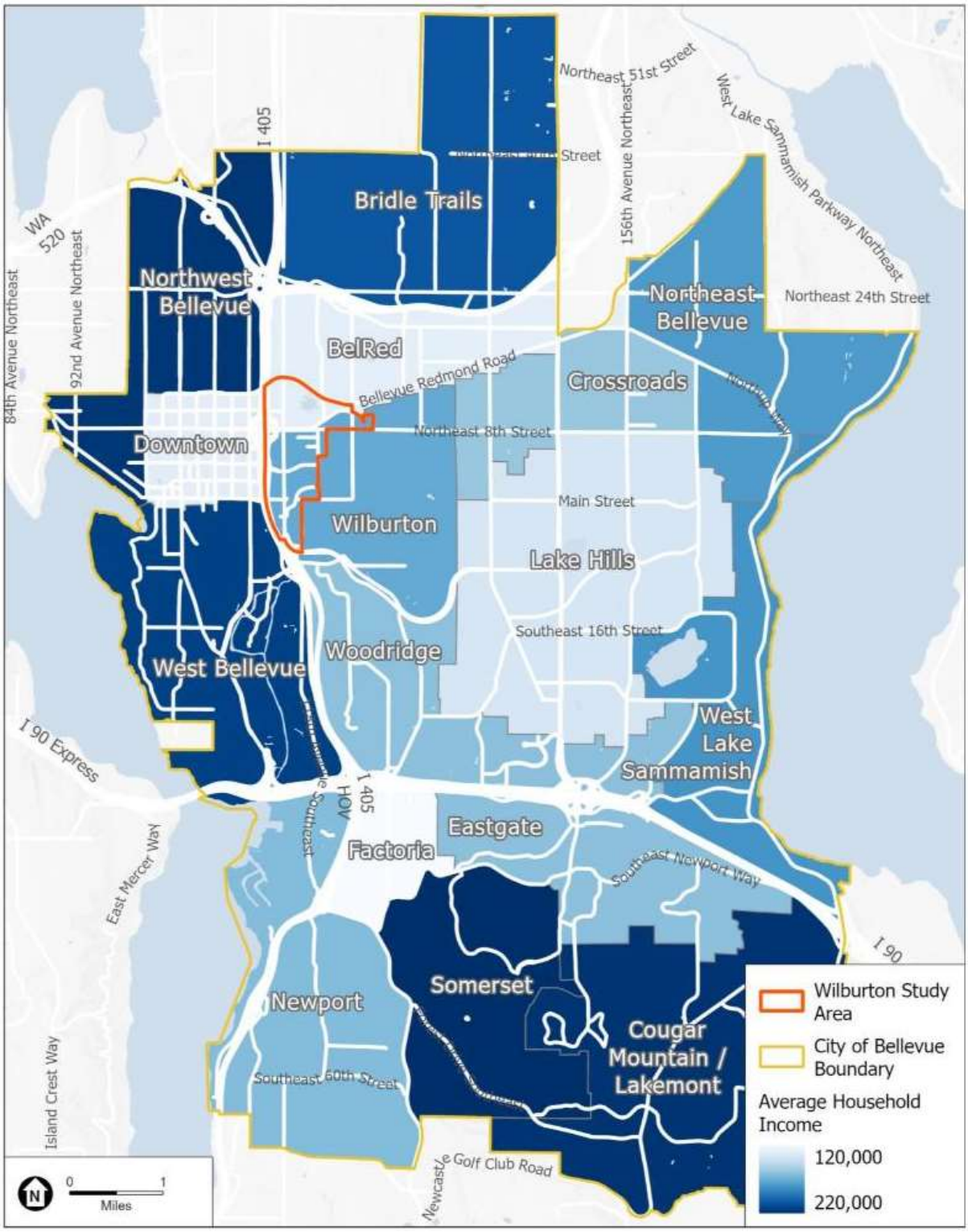

Figure 4-7. Average household income

4.6.4 Household characteristics

As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as “critical facilities” by emergency managers because they require extra notice to implement evacuation. Elderly community members living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population. The US Census Bureau identifies that 14.6% of the population in the city of Bellevue is age 65 or older, compared to the state average of 17.1%.

Children under 17 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from the hazard. An estimated 20% of the city’s population is under the age of 18, with 5% being under the age of 5 (US Census Bureau, 2023).

Furthermore, people with disabilities are more likely to have difficulty responding to a hazard event than the general population. Local government is the first level of response to assist these individuals and coordination of efforts to meet their access and functional needs is paramount to life safety efforts. It is important for emergency managers to distinguish between functional and medical needs in order to plan for incidents that require evacuation and sheltering. Knowing the percentage of population with a disability will allow emergency management personnel and first responders to have personnel available who can provide services needed by those with access and functional needs. The US Census Bureau estimated that 5.3% of the population under age 65 have a disability (US Census Bureau, 2023).

4.6.5 Housing type and transportation

According to the 2023 American Community Survey, 54.9% of community members own their homes and 45.1% rent. 10% of households do not have a vehicle.

This represents a decline in the proportion of owner household units since 1990, when 58% of Bellevue households were homeowners and 42% were renters. The breakdown of households between renters and owners and by size has changed over the past couple of decades. Bellevue is gaining renter households at a much faster rate than owner households. Between 2000 and 2020, the city experienced a net gain of more than 5,600 small households (1 or 2 members), the overwhelming majority of which (5,500 households) were renter households.

The increase in renter households in Bellevue is closely related to the current rate of multi-family housing development in the city. The city has almost exclusively produced multi-family housing in the past two decades and therefore, mostly rental housing. Between 2000 and 2020, Bellevue produced very few single-family residential units and more than 12,000 multi-family units. More than 80% of multi-family occupied housing units are renter-occupied, versus 19% of single-family occupied housing units (City of Bellevue, 2023).

4.7 Economy

4.7.1 Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are disadvantaged when confronting hazards such as flooding. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in floods than other types of housing. Furthermore, community members below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. Community members living below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. The events following Hurricane Katrina in 2005 illustrated that personal household economics significantly impact people's decisions on evacuation. In addition, individuals who cannot afford gas for their cars will likely decide not to evacuate.

Based on the 2023 American Community Survey, median household income in Bellevue is $158,253 compared to $120,824 in King County. Over 41% of households earn more than $200,000 per year, compared to 28.6% of households in King County.

The Census Bureau estimates that 8.3% of the population in the planning area lives below the poverty level.

4.7.2 Industry, businesses and institutions

Information technology has been Bellevue's fastest growing industry. As of 2023, six of the city's top 10 employers are in the tech industry. See Table 4-7.

Table 4-7. Bellevue's top employers

Employer	Number of Employees
Amazon	11,000
T-Mobile USA	5,200
Meta/Facebook	3,600
Overlake Hospital	3,600
Bellevue School District	2,800
City of Bellevue	1,700
Salesforce	1,500
Smartsheet	1,100
Bellevue College	1,000
Bungie	1,000

Source: (City of Bellevue, 2023)

According to the 2023 American Community Survey, 68.9% of the planning area's population 16 years old or older is in the labor force. Table 4-8 lists the percentage (rounded) of jobs per industry (U.S. Census Bureau, 2023).

Table 4-8. Percentage of jobs by industry

Industry	Percentage of Total Jobs
Agriculture, forestry, fishing and hunting and mining	0%
Construction	2%
Manufacturing	6%
Wholesale Trade	2%
Retail Trade	13%
Transportation and warehousing and utilities	5%
Information	9%
Finance and insurance, and real estate and rental leasing	7%
Professional, scientific and management, and administrative and waste management services	31%
Educational services, and health care and social assistance	15%
Arts, entertainment, and recreation and accommodation and food services	7%
Other services, except public administration	3%
Public administration	1%

Source: 2023 ACS DP03

5. Regulations and Programs

Existing regulations, agencies and programs at the federal, state and local level can support or impact hazard mitigation actions identified in this plan. Information presented in this section can be used to review local capabilities to implement the action plan this hazard mitigation plan presents.

5.1 Relevant Federal and State Agencies, Programs and Regulations

State and federal regulations and programs that need to be considered in hazard mitigation are constantly evolving. For this plan, a review was performed to determine which regulations and programs are currently most relevant to hazard mitigation planning. The findings are summarized in Table 5-1 and Table 5-2. Short descriptions of each program are provided in Appendix B.

Table 5-1. Summary of relevant federal agencies, programs and regulations

Agency, Program, or Regulation	Hazard Mitigation Area Affected	Relevance
Americans with Disabilities Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Civil Rights Act of 1964	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Clean Water Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Community Development Block Grant Disaster Resilience Program	Action Plan Funding	This is a potential alternative source of funding for actions identified in this plan.
Community Rating System	Flood Hazard	This voluntary program encourages floodplain management activities that exceed the minimum National Flood Insurance Program requirements.

Disaster Mitigation Act	Hazard Mitigation Planning	This is the current federal legislation addressing hazard mitigation planning.
Emergency Relief for Federally Owned Roads Program	Action Plan Funding	This is a possible funding source for actions identified in this plan.
Emergency Watershed Program	Action Plan Funding	This is a possible funding source for actions identified in this plan.
Endangered Species Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
Federal Energy Regulatory Commission Dam Safety Program	Dam Failure Hazard	This program cooperates with a large number of federal and state agencies to ensure and promote dam safety.
Federal Wildfire Management Policy and Healthy Forests Restoration Act	Wildfire Hazard	These documents mandate community-based collaboration to reduce risks from wildfire.
National Dam Safety Act	Dam Failure Hazard	This act requires a periodic engineering analysis of most dams in the country
National Environmental Policy Act	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable federal acts.
National Flood Insurance Program	Flood Hazard	This program makes federally backed flood insurance available to homeowners, renters and business owners in exchange for communities enacting floodplain regulations
National Incident Management System	Action Plan Development	Adoption of this system for government, nongovernmental organizations and the private sector to work together to manage incidents involving hazards is a prerequisite for federal preparedness grants and awards

Presidential Executive Order 11988 (Floodplain Management)	Flood Hazard	This order requires federal agencies to avoid long and short-term adverse impacts associated with modification of floodplains
Presidential Executive Order 11990 (Protection of Wetlands)	Action Plan Implementation	FEMA hazard mitigation project grant applications require full compliance with applicable presidential executive orders.
U.S. Army Corps of Engineers Dam Safety Program	Dam Failure Hazard	This program is responsible for safety inspections of dams that meet size and storage limitations specified in the National Dam Safety Act.
U.S. Army Corps of Engineers Flood Hazard Management	Flood Hazard, Action Plan Implementation, Action Plan Funding	The Corps of Engineers offers multiple funding and technical assistance programs available for flood hazard mitigation actions
U.S. Fire Administration	Wildfire Hazard	This agency provides leadership, advocacy, coordination, and support for fire agencies and organizations.

Table 5-2. Summary of relevant state agencies, programs and regulations

Agency, Program, or Regulation	Hazard Mitigation Area Affected	Relevance
Building Code	Action Plan Implementation	The adoption and enforcement of appropriate building codes is a significant component for hazard mitigation loss avoidance. Using the most up to date and relevant codes reduces risk and increases capability.
Comprehensive Emergency Management Planning	Hazard Mitigation Planning	Emergency management functions of the state and its political subdivisions must be coordinated with comparable functions of the federal government, agencies of other states and localities and private agencies.
Dam Safety Program	Dam Failure	This program requires regular inspection of state-regulated dams.

Department of Ecology Grants	Action Plan Implementation; Flood Hazard	Flood Control Maintenance Program provides grant funding to local governments for flood hazard management planning and implementation
Enhanced State Hazard Mitigation Plan	Hazard Mitigation Planning	Local hazard mitigation plans must be consistent with their state's hazard mitigation plan. The Bellevue plan must, at a minimum, address those hazards identified in the state plan as impacting King County.
State Environmental Policy Act	Action Plan Implementation	This act establishes a protocol of analysis and public disclosure of the potential environmental impacts of development projects. Any project action identified in this plan will seek full State Environmental Policy Act compliance upon implementation.
Floodplain Management Law	Flood Hazard	Identifies prevention of flood damage as a matter of statewide public concern and authorizes county governments to levy taxes, condemn properties and undertake flood control activities
Growth Management Act	Hazard Mitigation Planning	Regulates development in critical areas and therefore has the potential to affect hazard vulnerability and exposure at the local level
Hydraulic Code	Action Plan Implementation	Will require state permit for mitigation projects that will use, divert, obstruct, or change the natural flow or bed of any salt or freshwaters of the state.
Land and Water Conservation Fund	Action Plan Implementation	May provide funding for mitigation projects that include land acquisition and development or renovation, such as natural areas and open space.
Salmon Recovery Fund	Action Plan Implementation	May provide funding for mitigation projects that protect existing, high quality habitat for salmon or that restore degraded habitat to increase overall habitat health and biological productivity

Shoreline Management Act	Hazard Mitigation Planning	Shoreline management programs are local capabilities relevant to mitigation activities.
Silver Jackets	Flood Hazard	The team's projects address state needs and improve flood risk management throughout the full flood life cycle.
Washington Administrative Code 118-30-060(1)	Hazard Mitigation Planning	Requires each political subdivision to base its comprehensive emergency management plan on a hazard analysis and provides a standardized definition of "hazard."
Watershed Management Act	Hazard Mitigation Planning	Encourages local communities to develop plans for protecting local water resources and habitat.

5.2 Local Capability Assessment

The City of Bellevue has performed an inventory and analysis of existing capabilities, plans, programs and policies that enhance its ability to implement mitigation strategies. The assessment identifies potential gaps in core capabilities. Those gaps or identified needs for improvement or expansion of capabilities may be filled by developing mitigation actions in the plan. The introduction at the beginning of this plan describes the components included in the capability assessment and their significance for hazard mitigation planning.

5.2.1 Planning and regulatory capability

Jurisdictions have the ability to develop policies and programs and to implement rules and regulations to protect and serve community members. Local policies are typically identified in a variety of community plans, implemented via a local Ordinance and enforced through a governmental body. An assessment of planning and regulatory capabilities is presented in Table 5-3.

Table 5-3. Planning and regulatory capability

Plan	Local Authority	Other Jurisdiction Authority	State Mandated?	Integration Opportunity?
Codes, Ordinances & Requirements				
Building Code	Yes	Yes	Yes	Yes
Comment:	Chapter 23 BCC "Construction Codes", Ordinance No. 6781, May 2024			

Zoning Code	Yes	Yes	Yes	Yes
Comment:	Chapter 20.10 Land Use Districts (ORD 6670, 2022)			
Subdivisions	Yes	Yes	Yes	Yes
Comment:	Chapter 20.45A Platting and Subdivisions (ORD 6670, 2022); 20.45B Short Plats and Short Subdivisions (ORD 6568, 2021)			
Stormwater Management	Yes	Yes	Yes	Yes
Comment:	Chapter 24.06 Storm and Surface Water Utility Code (Ord. 5905 § 1, 2009)			
Post-Disaster Recovery	No	No	No	No
Comment:				
Real Estate Disclosure	Yes	Yes	Yes	No
Comment:	RCW 64.06.020 and 64.06.015. WA has a residential property disclosure requirement for improved or unimproved residential real property. Sellers must disclose whether a property is in a special flood hazard area (form Section 7), and whether it has suffered from flood damages in the past (flooded basement, specifically).			
Growth Management	Yes	Yes	Yes	Yes
Comment:	BCC Title 21 - Comprehensive Plan February 26, 2024, BCC is current through Ordinance 6778.			
Site Plan Review	Yes	Yes	Yes	Yes
Comment:	Chapter 23.76 Clearing and Grading; Chapter 20.30V Master Development Plan			
Environmental Protection	Yes	Yes	Yes	Yes
Comment:	Chapter 22.02 Bellevue Environmental Procedures Code (Ord. 3305 § 1, 1983; Ord. 2340 § 2, 1976); Part 20.25H Critical Areas Overlay District			
Flood Damage Prevention	Yes	No	Yes	Yes
Comment:	BCC Part 20.25H.175 Article IX (Ord. 6521, 2020)			
Emergency Management	Yes	No	Yes	Yes
Comment:	Chapter 13.98.060 Office of emergency management (Ord. 6255 § 3, 2015)			
Climate Change	No	No	No	No
Comment:				
Planning Documents				
Comprehensive Plan	Yes	No	Yes	Yes
Comment:	Bellevue Comprehensive Plan 2044, October 22, 2024			
Capital Improvement Plan	Yes	No	Yes	Yes

How often is the plan updated?	Every 2 years			
Comment:	2023-2029 Capital Investment Program Plan (add 2024 date of update)			
Floodplain or Watershed Plan	Yes	No	Yes	Yes
Comment:	Bellevue Watershed Management Plan (add completion date)			
Stormwater Plan	Yes	Yes	Yes	Yes
Comment:	2025 Stormwater Management Program Plan (draft to be completed in March) 2015 Storm and Surface Water System Plan (currently being updated)			
Urban Water Management Plan	No	No	No	No
Comment:				
Habitat Conservation Plan	No	No	No	No
Comment:				
Economic Development Plan	Yes	No	No	Yes
Comment:	City of Bellevue Economic Development Plan, November 2, 2020			
Shoreline Management Plan	Yes	Yes	Yes	Yes
Comment:	Shoreline Master Program, City of Bellevue Comprehensive Plan, 2018			
Community Wildfire Protection Plan	Yes	No	No	Yes
Comment:	The wildfire Chapter of this mitigation plan is being developed to qualify as a CWPP.			
Forest Management Plan	No	No	No	No
Comment:				
Comprehensive Emergency Management Plan	Yes	No	Yes	Yes
Comment:	Comprehensive Emergency Management Plan (CEMP), December 2018			
Threat & Hazard Identification & Risk Assessment	Yes	No	No	Yes

Comment:	Hazard Inventory and Risk Assessment (HIRA), December 2018 2023 Climate Vulnerability Assessment			
Disaster Debris Management Plan	Yes	No	No	Yes
Comment:	City has a Disaster Debris Management Plan that was adopted by promulgation letter in 2023.			
Continuity of Operations Plan	Yes	No	Yes	Yes
Comment:	Continuity of Operations Plan (COOP) 2018-2023 (update due December 2025).			
Climate Change Plan	Yes	No	No	Yes
Comment:	2023 Climate Vulnerability Assessment and 2020-2025 Sustainable Bellevue Environmental Stewardship Plan			
Water System Plan	Yes	Yes	No	Yes
Comment:	The plan was adopted by the City Council in June 2016 and approved by the state Department of Health in January 2017			
Wastewater System Plan	Yes	Yes	No	Yes
Comment:	The City Council adopted the 2013 Wastewater System Plan via Resolution 8771 in July 2014. The King County Council adopted the plan via Ordinance 17968 in February 2015. The plan was approved by the Washington State Department of Ecology in May 2015.			

5.2.2 Development and permitting capability

Jurisdictions regulate land use through the adoption and enforcement of zoning, subdivision and land development ordinances, building codes, building permit ordinances, floodplain and stormwater management ordinances. When effectively prepared and administered, these regulations can lead to hazard mitigation. Development and permitting capabilities are presented in Table 5-4.

Table 5-4. Development and permitting capability

Criterion	Response
Does the city issue development permits?	Yes
Which department?	Development Services Department
Does the city track permits by hazard area?	Yes
Does the city have a buildable lands inventory?	Yes

5.2.3 Fiscal capability

Assessing a jurisdiction's fiscal capability provides an understanding of the ability to fulfill the financial needs associated with hazard mitigation projects. This assessment identifies both outside resources, such as grant-funding eligibility and local jurisdictional authority to generate internal financial capability, such as through impact fees. An assessment of fiscal capabilities is presented in Table 5-5.

Table 5-5. Fiscal capability

Financial Resource	Accessible or Eligible to Use?
Community Development Block Grants	Yes
Capital Improvements Project Funding	Yes
Authority to Levy Taxes for Specific Purposes	Yes
User Fees for Water, Sewer, Gas or Electric Service	Yes
Incur Debt through General Obligation Bonds	Yes
Incur Debt through Special Tax Bonds	Yes
Incur Debt through Private Activity Bonds	No
Withhold Public Expenditures in Hazard-Prone Areas	Yes
State-Sponsored Grant Programs	Yes
Development Impact Fees for Homebuyers or Developers	Yes

5.2.4 Administrative and technical capability

Planning, regulatory and fiscal capabilities provide the backbone for successfully developing a mitigation strategy; however, without appropriate personnel, the strategy may not be implemented. Administrative and technical capabilities focus on the availability of personnel resources responsible for implementing all the facets of hazard mitigation. These resources include technical experts, such as engineers and scientists, as well as personnel with capabilities that may be found in multiple departments, such as grant writers. An assessment of administrative and technical capabilities is presented in Table 5-4.

Table 5-6. Administrative and technical capability

Staff/Personnel Resource	Available?	Department & (Number of Staff)
Planners or engineers with knowledge of land development and land management practices	Yes	DSD (24), Fire (2), Transportation (15), Utilities

Engineers or professionals trained in building or infrastructure construction practices	Yes	DSD (52), Fire (3), Transportation (27), Utilities (8+), Parks (4+), FAM (8+), CD (8+)
Planners or engineers with an understanding of natural hazards	Yes	DSD (14), CD (11), Utilities (6+), Fire (2), Transportation (5)
Staff with training in benefit/cost analysis	Yes	Transportation (8)
Surveyors	Yes	FAM (9)
Personnel skilled or trained in GIS applications	Yes	Information Technology (8), Citywide (99), Utilities (3), Fire (1); Transportation (7)
Scientists familiar with natural hazards in local area	No	
Emergency Manager	Yes	Emergency Manager – Fire
Grant writers	Yes	Grant Coordinator – Fire Dept. Grant Coordinator – Utilities Grant Coordinator – Parks Grants Manager (1); Grants Coordinator (1) – Transportation Grant writers/managers - Community Development
Other professionals familiar with natural hazards	Yes	Transportation (11)
Planners & Engineers trained & familiar with the Transportation system	Yes	Transportation (40)

5.2.5 Education and outreach capability

Regular engagement with the community on issues regarding hazard mitigation provides an opportunity to directly interface with community members. Assessing this outreach and education capability illustrates the connection between the government and community members, which opens a two-way dialogue that can result in a more resilient community based on education and public engagement. An assessment of education and outreach capabilities is presented in Table 5-7.

Table 5-7. Education and outreach capability

Criterion	Response
Public Information Officer or Communications Office?	Yes
Personnel skilled or trained in website development?	Yes

Hazard mitigation information available on your website?	Yes
If yes, please briefly describe: Site created for HMP update; information on a variety of hazards such as winter weather and earthquakes available in Bellevue's top 8 languages.	
Social media for hazard mitigation education and outreach?	Yes
If yes, please briefly describe: Provide information to the public on hazards and how they can prepare; will be used to share information about the HMP work and how people can be involved.	
Citizen boards or commissions that address issues related to hazard mitigation?	No
Other programs already in place that could be used to communicate hazard-related information?	Yes
If yes, please briefly describe: Monthly Neighborhood News e-newsletter, three times per year print newspaper that is sent to every household in the city; community member engagement program called Bellevue Essentials	
Established warning systems for hazard events? If yes, please briefly describe: NWS/NOAA & King County	Yes

5.2.6 Participation in other programs

Other programs, such as the Community Rating System and Storm Ready, can enhance a jurisdiction's ability to mitigate, prepare for and respond to natural hazards. These programs indicate a jurisdiction's desire to go beyond minimum regulatory requirements in order to create a more resilient community. These programs focus on communication, mitigation and community preparedness to minimize the impact of natural hazards on a community. Classifications under various community mitigation programs are presented in Table 5-8.

Table 5-8. Community classifications

	Participating?	Classification / Number	Date Classified
Federal Information Processing Standards (FIPS) Code	Yes	033	N/A
Unique Identity ID (UEI)	Yes	DQ3JYJ78JMD5	N/A
Community Rating System (CRS)	Yes	5	05/01/2006
Building Code Effectiveness Grading Schedule (BCEGS)	Yes	2/2	2022
Public Protection (WSRB)	Yes	2	2021
Storm Ready	Yes	N/A	2022
Firewise USA	No	N/A	N/A

5.2.7 Adaptive capacity

An adaptive capacity assessment evaluates a jurisdiction's ability to anticipate impacts from future conditions. By looking at public support, technical adaptive capacity and other factors, jurisdictions identify their core capability for resilience against issues such as extreme heat. The adaptive capacity assessment provides jurisdictions with an opportunity to identify areas for improvement by ranking their capacity high, medium, or low. The community's adaptive capacity for the impacts of climate change is presented in Table 5-9.

Table 5-9. Adaptive capacity for climate change

Criterion		Jurisdiction Rating [a]
Technical Capacity		
City understanding of potential climate change impacts		High
Comment:	City has multiple staff with climate science, policy and programming experience as well as strategic plans and assessments, including 2020-2025 Sustainable Bellevue Environmental Stewardship Plan and 2023 Climate Vulnerability Assessment.	
City monitoring of climate change impacts		Medium
Comment:	Formalization of climate change impacts monitoring, including quality and depth of monitoring and analysis, varies to some extent by impact. Stormwater and flood management efforts are relatively advanced.	
Technical resources to assess proposed strategies for feasibility and externalities		Medium
Comment:	City developed 2023 Climate Vulnerability Assessment to understand geographic and socio-economic vulnerabilities to specific climate impacts, with consideration for adaptive capacity. City is developing a GIS tool to support planning and implementation decisions that are informed by climate impacts. 34 staff are credentialed as Envision Sustainability Professionals, demonstrating their readiness to leverage the professional association-developed and –endorsed Envision Framework to implementing sustainable, resilient and equitable infrastructure.	
City capacity for development of greenhouse gas emissions inventory		High
Comment:	City has updated its GHG inventory annually since 2011 with consultant support and in coordination with various institutions on best practices and data inputs.	
Capital planning and land use decisions informed by potential climate impacts		Medium

Comment:	2044 Comprehensive Plan policies integrate climate impacts considerations into City policy and work. Technical tools and staff resources supplement planning and land use decisions.
Participation in regional groups addressing climate risks	High
Comment:	City participates in multiple regional climate action collaboratives, including the King County Cities for Climate Collaboration, Puget Sound Climate Preparedness Collaborative, Eastside Climate Partnership and other working groups organized in formal or ad hoc manners at varying levels, from region to county to sub-county.
Implementation Capacity	
Clear authority/mandate to consider climate change impacts during public decision-making processes	Medium
Comment:	2044 Comprehensive Plan policies integrate climate impacts considerations into City policy and work. Funding, staff resources, process improvements and navigating tradeoffs in decisions and work remain as limitations.
Identified strategies for greenhouse gas mitigation efforts	Medium
Comment:	City has identified practical strategies, actions and investments to address greenhouse gas reductions related to major emitting sectors, including buildings and transportation. Additional work will improve strategies in these sectors and add strategies for emissions related to local consumption of goods and services – a major emissions sector.
Identified strategies for adaptation to impacts	Low
Comment:	City developed the 2023 Climate Vulnerability Assessment to identify priorities and potential strategies or actions related to climate impacts. Future work will clarify practical implementation strategies, actions and investments to adapt to climate impacts.
Champions for climate action in local government departments	Low
Comment:	Integrating climate action priorities, including making investments in services and infrastructure to mitigate and adapt to climate change, remains an area for improvement across departments and their many work areas and processes.
Political support for implementing climate change adaptation strategies	Low
Comment:	Integrating climate change adaptation strategies consistently into City work, through funding, staff resources and process improvements, remains an area for additional political support.
Financial resources devoted to climate change adaptation	Low
Comment:	City needs additional funding, staff resources and technical resources (such as assessments) to implement services and infrastructure to enhance community preparedness and adaptation to climate impacts.

Local authority over sectors likely to be negative impacted	Medium
Comment:	City implements public infrastructure, sets code to guide land and building development and provides services and incentives to influence behavior. Together with partnerships, these work areas and strategies can enhance the resilience of buildings, transportation, infrastructure, other sectors and systems to climate impacts.
Public Capacity	
Local community members' knowledge of and understanding of climate risk	Low
Comment:	Community members will benefit from additional practical education to prepare for and adapt to climate risks where they live, work and play.
Local community members' support of adaptation efforts	Medium
Comment:	Community members are generally supportive of City action and investments for climate change mitigation and adaptation.
Local community members' capacity to adapt to climate impacts	Medium
Comment:	Community members" relatively high education and income provides strong social determinants to adapt to climate impacts.
Local economy current capacity to adapt to climate impacts	Medium
Comment:	Local economy is relative adaptable to climate impacts, with a highly educated workforce, newer building stock and infrastructure and a strong private sector supported by robust public sector capacity and resources.
Local ecosystems capacity to adapt to climate impacts	Medium
Comment:	Bellevue is relatively safe from sea level rise and flooding due to elevation and a local floodplain and also benefits from a moderate climate with high seasonal precipitation. Summertime drought, high stream temperatures, impacts to salmon, extreme heat and wildfire smoke remain risks to Bellevue's environmental health and ecosystems.

[a.] High = Capacity exists and is in use; Medium = Capacity may exist, but is not used or could use some improvement; Low = Capacity does not exist or could use substantial improvement; Unsure = Not enough information is known to assign a rating

5.3 Opportunity to Expand Capabilities

The city uses extensive existing capabilities for education and outreach. However, the city's commitment to continued education and outreach is noted in action_____.

The capability assessment in the table above indicates that the city has in-house capability for all core capabilities identified. The city does not need to have a

scientist familiar with natural hazards on staff. The city has identified an action to expand existing administrative and technical capabilities by action_____.

One of the objectives in developing this hazard mitigation plan is to establish eligibility to pursue FEMA HMA grant funding opportunities. HMA funding streams typically require a 25% local match. The city has identified local funding sources in the table above that can provide the local match for projects in the mitigation action plan that list HMA grants as a potential primary funding source. Therefore, the city sees no need to identify specific mitigation actions for the expansion of fiscal capabilities beyond the implementation of this plan.

The City has a robust catalog of established planning and regulatory capabilities and is committed to plan integration where feasible as cited in the mitigation action plan (insert action number and description for plan integration). List any other actions that expand this capability.

6. Hazards of Concern for Risk Assessment

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury and property damage resulting from natural hazards. The Disaster Mitigation Act requires hazard mitigation planning to include risk assessment (44 CFR, Section 201.6(c)(2)). The risk assessment for the City of Bellevue Hazard Mitigation Plan evaluates all natural hazards that are prevalent in the defined planning area. The first step in the process was to identify which hazards to include in the assessment. This chapter describes the process of identifying these hazards of concern.

6.1 Focus on Natural Hazards

Natural hazards are naturally occurring severe events that have the potential to result in the loss of life and property. Technological or human-caused hazards also have the potential to result in the loss of life and property but originate from human activities. Federal hazard mitigation planning guidelines require risk assessment for all natural hazards of concern; risk assessment of non-natural hazards (technological and/or human-caused) is optional. The steering committee decided that this plan will focus on natural hazards of concern due to limitations in the funding source.

6.2 Identified Hazards of Concern

The steering committee considered the full range of natural hazards that could impact the planning area and selected those that present the greatest concern for evaluation in this hazard mitigation plan. The process incorporated review of state and county hazard planning documents, the National Risk Index maps, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. The following eight hazards for concern were identified:

- Dam Failure
- Drought
- Earthquake
- Flood
- Landslide
- Severe Weather
- Volcano
- Wildfire and Wildfire Smoke

7. Risk Assessment Methodology

7.1 Overall Risk Assessment Approach

The risk assessments in Chapter 8 though Chapter 15 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, and the planning area's vulnerability and impact . The planning team reviewed existing studies, reports and technical information to determine the best available data to utilize in the risk assessment. Information from these sources was incorporated into the hazard profiles and forms the basis of the exposure and vulnerability assessment. The following steps were used to define the risk of each hazard:

- **Profile each hazard**—The following information is given for each hazard:
  - Summary of past events
  - Geographic area most affected by the hazard
  - Event frequency estimates
  - Severity estimates
  - Warning time likely to be available for response
  - Secondary hazards associated with or resulting from the hazard of concern
  - Future trends that may impact risk, including future development and climate trends
  - Worst-case event scenario
  - Key issues related to mitigation of the hazard in the planning area.
- **Determine vulnerability of assets to each hazard**—Vulnerability was determined by overlaying hazard maps with demographic information and an inventory of structures, facilities and systems to determine which of them would be vulnerable to each hazard. For each hazard of concern, the best available existing data was used to delineate the hazard area, based on scale, age and source. Data available in a GIS-compatible format with coverage of the full extent of the planning area was preferred when available.
- **Assess the impact of vulnerable assets**—Impact of vulnerable structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are vulnerable to each hazard. FEMA's hazard-modeling program, Hazus was used to perform this assessment for some hazards; GIS-based spatial analysis or qualitative assessments were used for others.

7.2 National Risk Index

FEMA's National Risk Index (NRI) was included as an additional layer of data to assess potential hazard-related losses. The NRI assigns numerical risk scores (based on percentiles) and descriptive risk ratings (very low to very high) at the Census tract and county levels. These scores and ratings are based on estimates of annual losses due to 18 types of hazard events, with adjustments to account for social vulnerability (which increases risk) and community resilience (which decreases risk).

The NRI multiplies the expected annual loss and the community risk factor derived from the social vulnerability and community resilience scores. Each county or census tract's resulting risk value is compared to all census tracts nationwide to assign its percentile-based score from zero (lowest risk value) to 100 (highest risk value). Although census tract-level results are available, they are not aggregated by city, only county. The annual losses estimated in the NRI represent economic losses to buildings and agriculture and human fatalities and injuries. Building values and populations are derived from the Hazus model default inventory.

In this plan, each NRI hazard that aligns with this plan is described in the risk assessment chapter. Hazards included in the NRI analysis that align with this plan are:

- Drought
- Earthquake
- Flood
- Landslide
- Volcanic Activity
- Wildfire
- Severe Weather
  - Winter weather
  - Strong Wind
  - Tornado
  - Lightning
  - Ice Storm
  - Heat Wave
  - Cold Wave
  - Hail
  - Extreme Temperatures
  - Thunderstorms

NRI only provides results at a county and census tract level. For this city plan, the NRI data was downloaded in an excel spreadsheet and Bellevue census tracts were pulled from the data to conduct an approximate city-level analysis.

City results are provided in Table 7-1 and in each relevant risk assessment chapter.

Table 7-1. City-wide NRI results

Expected Annual Loss	Expected Annual Loss Rating	Community Resilience Rating	Social Vulnerability Rating	Risk Index Score	Risk Index Rating
$73,389,721	Relatively Moderate	Relatively Moderate	Relatively Low	77	Relatively Moderate

7.3 Mapping

National, state and county databases were reviewed to locate spatially based data relevant to this planning effort. Maps were produced using GIS software to show the spatial extent and location of identified hazards when such data was available. These maps are included in the hazard profile chapters of this document.

7.4 Earthquake and Flood

7.4.1 Overview of FEMA's Hazus software

FEMA developed the Hazards U.S., or Hazus, model in 1997 to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology with new models for estimating potential losses from hurricanes and floods. The use of Hazus for hazard mitigation planning offers numerous advantages:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.

- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, community lifelines, transportation, utility lifeline and multiple models to estimate potential losses from natural disasters. The program can be used to map hazard data and the results of damage and economic loss estimates for buildings and infrastructure.

7.4.2 Levels of detail for evaluation

Hazus provides default data for inventory, vulnerability and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

7.4.3 Application for this plan

The Hazus model was used as follows for the hazards evaluated in this plan:
The following hazards were evaluated using Hazus:

- **Flood**—A Level 2 user-defined analysis was performed for general building stock in flood zones and for critical facilities and infrastructure. The effective flood

mapping for the planning area was used to delineate flood hazard areas and estimate potential losses from the 1%-annual-chance and 0.2%-annual-chance flood events. To estimate damage that would result from a flood, Hazus uses pre-defined relationships between flood depth at a structure and resulting damage, with damage given as a percent of total replacement value. Curves defining these relationships have been developed for damage to structures and for damage to typical contents within a structure. By inputting flood depth data and known property replacement cost values, dollar-value estimates of damage were generated.

- **Earthquake**—A Level 2 analysis was performed to assess earthquake exposure and vulnerability for three scenario events:
  - A Magnitude-7.23 event on the Seattle Fault zone with an epicenter approximately 13 miles southwest of the City of Bellevue.
  - A Magnitude-9.34 event on the Cascadia Fault with an epicenter approximately 206 miles south-southwest of the City of Bellevue.
  - The 750-year probabilistic scenario.

7.5 Drought

The risk assessment methodologies used for this plan focus on damage to structures. Because drought does not impact structures to the same degree as other hazards, the risk assessment for drought was more limited and qualitative than the assessment for the other hazards of concern.

7.6 Sources of Data Used in Risk Assessment

7.6.1 Building count and replacement cost value

Parcel and building information from the King County Assessor were used to compile a detailed, citywide structure inventory including replacement costs. When available, an updated inventory was used in place of the Hazus defaults for critical facilities and infrastructure.

Replacement cost is the cost to replace the entire structure with one of equal quality and utility. Replacement cost is based on industry-standard cost-estimation models published in RS Means Square Foot Costs (RS Means, 2024). It is calculated using the RS Means square foot cost for a structure, which is based on the Hazus occupancy class (i.e., multi-family residential or commercial retail trade), multiplied by the square footage of the structure from the tax assessor data. The construction

class and number of stories for single-family residential structures also factor into determining the square foot costs.

7.6.2 Hazus data inputs

The following hazard datasets were used for the Hazus Level 2 analyses conducted for the risk assessment:

- **Flood**—Flood depth grids were generated using the FEMA effective floodplain mapping and digital terrain model (DTM) data for King County downloaded from the Washington LiDAR Portal.
- **Earthquake**—Earthquake ShakeMaps data prepared by the U.S. Geological Survey (USGS) were used for the analysis of this hazard. National Earthquake Hazard Reduction Program (NEHRP) soils and liquefaction susceptibility information from the Washington State Department of Natural Resources (WA DNR) were utilized in the Hazus model.

7.6.3 Other local hazard data

Locally relevant information on hazards was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. Data sources for specific hazards were as follows:

- **Dam or Levee Failure**—An inundation map provided by the City of Bellevue was used to evaluate downstream risk.
- **Landslide**—The landslide hazard was represented by the intersection of areas of 15% or greater slope with areas of NEHRP D and E soils. The slope data was generated from the digital terrain model (DTM) data.
- **Seiche**—No GIS format seiche area datasets were identified for the City of Bellevue.
- **Severe Weather**—No GIS format severe weather area datasets were identified for the City of Bellevue.
- **Wildfire**—A combination of the Interface and Intermix zones in the Wildland-Urban Interface data from WA DNR and risk data from Wildfirerisk.org was used for this hazard.

7.6.4 Data used for spatial analysis

Table 7-2 describes the data used for spatially-based exposure and vulnerability assessments. If no database was available, it was noted as a gap.

Table 7-2. Data and sources

Data	Source	Date	Format
City Limits	City of Bellevue	Provided 2024	Digital (GIS) format
Neighborhood Areas	City of Bellevue	Provided 2024	Digital (GIS) format
Parcels	City of Bellevue	2024	Digital (GIS) format
Assessments Data (including residential and commercial buildings, apartment complexes and condos)	King County	2024	Digital (tabular) format
Buildings (footprints)	City of Bellevue	Provided 2024	Digital (GIS) format
Building replacement cost	RS Means	2024	Paper format. Updated RS Means values
FEMA Effective DFIRM for King County (dated 8/19/2020 with latest LOMR 7/17/2023)	FEMA	2023	Digital (GIS) format
1.5-foot LiDAR DEM for King County	Washington LiDAR Portal	Downloaded 2024	Digital (GIS) format
Cascadia Megathrust M9.34 ShakeMap	USGS Earthquake Hazards Program website	2017	Digital (GIS) format
Seattle Fault zone - northern M7.23 ShakeMap	USGS Earthquake Hazards Program website	2017	Digital (GIS) format
Seismic Ground Response – Liquefaction Susceptibility (Open File Report 2004-20)	WA DNR	2010	Digital (GIS) format
Seismic Ground Response – Seismic Site Class (Open File Report 2004-20)	WA DNR	2010	Digital (GIS) format
Washington State Landslide Inventory Database - Digital Data Series 29 (DS-29)	WA DNR	2023	Digital (GIS) format
Wildland Urban Interface (WUI)	WA DNR	2024	Digital (GIS) format
Critical Facilities and Assets			
Police Stations	City of Bellevue	Provided 2024	Digital (GIS) format
Fire Stations	City of Bellevue	Provided 2024	Digital (GIS) format

Community Facilities	City of Bellevue	Provided 2024	Digital (GIS) format
School Sites	City of Bellevue	Provided 2024	Digital (GIS) format
Medical Facilities including Hospitals	King County	Downloaded 2024	Digital (GIS) format
Kidney Dialysis Centers	WA DOH	Downloaded 2024	Digital (GIS) format
Pharmacies	WA DOH	Downloaded 2024	Digital (GIS) format
Nursing Homes	HIFLD	2024	Digital (GIS) format
Communications Facilities	Hazus v6.1	Various	Digital (GIS) format
Cellular Towers	HIFLD	2024	Digital (GIS) format
Land Mobile Broadcast Towers	HIFLD	2024	Digital (GIS) format
Microwave Service Towers	HIFLD	2024	Digital (GIS) format
Paging Transmission Towers	HIFLD	2024	Digital (GIS) format
FDIC Insured Banks	HIFLD	2024	Digital (GIS) format
Transit Center	City of Bellevue	Provided 2024	Digital (GIS) format
East Link Station	City of Bellevue	Provided 2024	Digital (GIS) format
OMSF (rail yard)	City of Bellevue	Provided 2024	Digital (GIS) format
Highway Tunnels	Hazus v6.1	Various	Digital (GIS) format
Highway Bridges	Hazus v6.1	Various	Digital (GIS) format
Railway Bridges	Hazus v6.1	Various	Digital (GIS) format
EPA Toxic Release Inventory (TRI) Facilities	HIFLD	2024	Digital (GIS) format
Water Network Structures	City of Bellevue	Provided 2024	Digital (GIS) format
Sewer Network Structures	City of Bellevue	Provided 2024	Digital (GIS) format

7.7 Limitations

7.7.1 General limitations

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. However, results are subject to uncertainties associated with the following factors:

- Incomplete scientific knowledge about natural hazards and their effects on the built environment
- Approximations and simplifications necessary to conduct a study

- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice community members have to prepare for a specific hazard event

Hazus currently represents the industry best management practice for assessing risk in support of hazard mitigation planning. However, Hazus and other models used for this risk assessment are limited by the availability of data to support their working components. Such models must use assumptions where firm data are not available. Assumptions are used, for example, to estimate ground deformation caused by liquefaction. These model limitations can lead to an understatement or overstatement of risk.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk. Over the long term, the City of Bellevue will collect additional data to assist in estimating potential losses associated with other hazards.

7.7.2 Specific limitations noted during the planning process

The following are limitations specific to the datasets used in this planning process:

- King County assessor data lacked detailed information on foundation type, with the exception of identifying single-family residential structures with basements. The assessor data also lacked detailed information on building type (e.g. masonry construction) for residential buildings. Default information was used, which impacts the accuracy of vulnerability estimates because building and foundation type play a major role in how structures will behave during hazard events.
- Model data input requirements necessitate the representation of buildings as single point features. Building locations are represented by single points located at the centroid of the largest building footprint in each parcel, or in the centroid of the parcel.

8. Dam Failure

8.1 General Background

Dam failures can be caused by natural events, such as flooding or an earthquake, but they are predominantly caused by human error such as poor construction, operation, maintenance or repair. The effects of a dam failure are highly variable, depending on the dam, the amount of water stored behind the dam, the current stream flow and the size and proximity of the downstream population. There are many effects of a major dam failure: loss of life, destruction of homes and property, damage to roads, bridges, power lines and other infrastructure, loss of power generation and flood control capabilities, disruption of fish stock and spawning beds and the erosion of stream and riverbanks.

8.2 Hazard Profile

8.2.1 Location

Washington State's Downstream Hazard Classification system for dams assigns a hazard rating of "Low," "Significant" or "High" for areas at risk of economic loss and environmental damage should a dam fail. According to the Washington Department of Ecology's Dam Safety Office's inventory of dams, there are eight dams in or adjacent to Bellevue. All eight dams are owned by the Bellevue Utilities Department and are for stormwater management, debris control, or recreation. Of the eight state inventoried dams within Bellevue, only one is rated high hazard (See Table 8-1).

High hazard dams are subclassified into 1A with more than 300 lives at risk within the inundation area, 1B have more than 31 to 300 lives at risk, and 1C have 7-30 lives at risk. Significant hazard dams are rated as 2D and have 1-6 lives at risk. Failure of any of these dams could inundate major transportation routes and industries, cause damage to downstream structures, and have long-term effects on water quality and wildlife.

The DSO provided a detailed summary of the dams for this planning process. The city provided an inundation area map for the high hazard dam.

Table 8-1. Dam inventory

Name	Water Course	Purpose[1]	Year Built	Crest Length (feet)
	Height (feet)	Max Storage (acre-feet)	Drainage Area (sq. mi.)	High Hazard Class
Bellevue Detention Pond 149	Kelsey Creek	C, D, R	1983	860
	6	92	0.8	3
Bellevue Detention Pond 133	Kelsey Creek	C, D	1983	-
	12	90	1.9	3
Bellevue Detention Pond 197	Valley Creek	C, D, R	1983	250
	12	50	2.37	3
Bellevue Detention Pond 165	West Tributary Kelsey Creek	C, D	1983	80
	16	73	.68	3
Bellevue Detention Pond 179 North	Sears Creek	C	1977	50
	26	17	0	3
Bellevue Detention Pond 104	Richards Creek	C, D	1983	-
	22	25	0.45	3
I-405 Coal Creek Stormwater Detention Dam	Coal Creek	C	1987	-
	31	40	0	3
Lakemont Stormwater Pond	Lewis Creek	C	1992	930
	13	25	0.469	1B

1. C = stormwater, D = debris control, R = recreation
Source: (Department of Ecology, 2025)

8.2.2 Extent

In 1996, a task group finalized a universal standardized dam safety hazard classification system. This classification ensures dams throughout the United States are classified using a consistent methodology and rating system. The classification descriptions are shown in Figure 8-1.

The DSO classifies regulated dams in Washington by hazard class, based on the at-risk population living in the area that could be inundated if the dam fails. The number of lives at risk are determined by counting residential structures and assuming three people per household (Department of Ecology, 2019). The hazard class definitions and number of Bellevue dams in each class are as follows (Washington Department of Ecology, 2023).

Source: (ASCE, 2021)

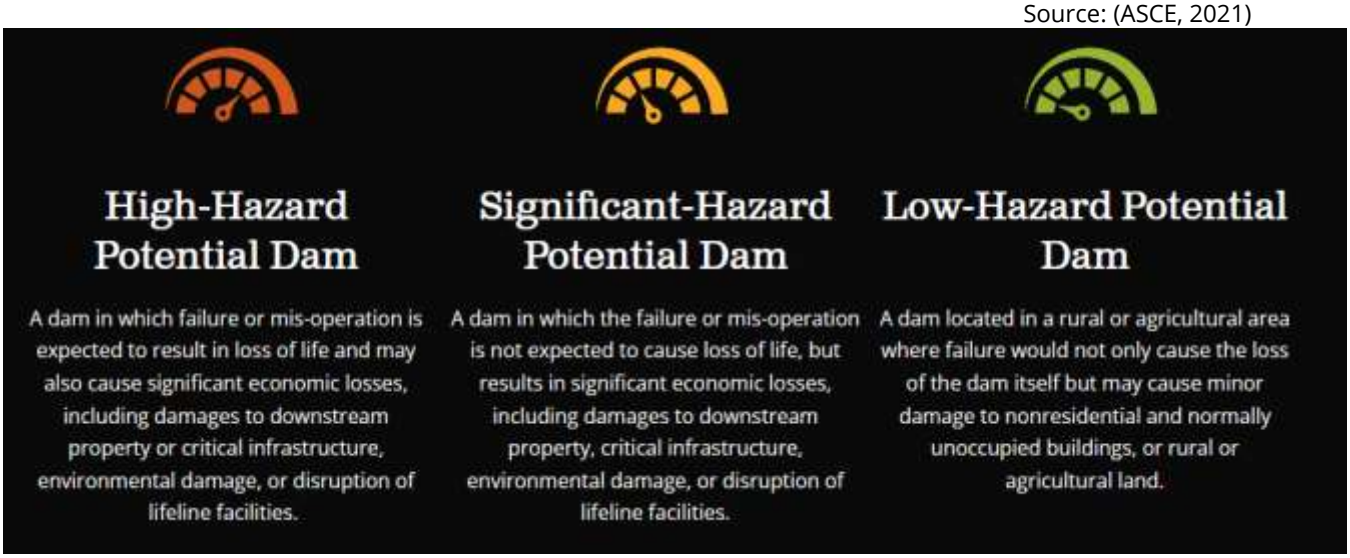

Figure 8-1. Dam hazard potential classifications

- 0 Hazard Class 1A (High—a downstream at-risk population of more than 300)
- 1 Hazard Class 1B (High—a downstream at-risk population of 31 to 300)
- 0 Hazard Class 1C (High—a downstream at-risk population of 7 to 30)
- 0 Hazard Class 2D (Significant—a downstream at-risk population of 1 to 6)
- 0 Hazard Class 2E (Significant economic or environmental risk, no lives at risk)
- 6 Hazard Class 3 (Low—no downstream at-risk population).

The hazard classification is not an indicator of the condition of the dam, only the number of people at risk downstream. A dam in good condition can still be considered a high hazard dam.

8.2.3 Previous occurrences

No known dam failures have occurred in Bellevue.

8.2.4 Overall probability

Dam failure events are low probability, high consequence events and often coincide with other hazard events that cause them, such as earthquakes, landslides and excessive rainfall and snowmelt. There is a “residual risk” associated with dams. Residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam failure is low in today’s dam safety oversight environment. Based on historic frequency and future

conditions, the probability of future dam or levee failures is less than one event every 100 years.

8.2.5 Warning time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted, or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours.

8.2.6 Climate change impacts

Climate change intensifies risks related to dam failure in Bellevue through its impact on extreme weather patterns and water management systems. Projected increases in extreme precipitation events lead to higher quantities of stormwater that must be retained and higher peak stream flows which put additional strain on dam infrastructure. This creates elevated risks of overtopping or structural failure during heavy rainstorms. Additionally, more frequent droughts can weaken dam reservoirs by reducing water levels, increasing stress on structural materials.

8.2.7 Future trends in development

New development upstream of the dam can create more impervious surfaces which may increase runoff into the stormwater pond. New development downstream of the dam may place more people and structures in the inundation area. With careful planning and application of stormwater regulations, adverse effects of future development can be avoided.

8.3 Secondary Hazards

Dam failure may result in the release of impounded waters at a high velocity. Water flowing at a high velocity can cause downstream flooding, erosion and loss of habitat.

8.4 Vulnerability and Impacts

8.4.1 People

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area before floodwaters arrive. This population includes the elderly and young who may be unable to evacuate the inundation area. The vulnerable population also includes those who would not have adequate warning from NORCOM's Code Red Process and would need to rely on door to door notifications. Based on the estimated number of buildings in the inundation area, over 650 people may be vulnerable.

People could be impacted by closed transportation routes affecting their mobility or damage to their structures. Both of these impacts may cause financial losses to people who are vulnerable to the hazard.

8.4.2 Structures

Vulnerable structures, including critical facilities, are those within the dam inundation zone. While the Lakemont Stormwater Pond is located in Bellevue, it discharges through Lewis Creek to Lake Sammamish, which passes through Issaquah. There are no structures in Bellevue that would be impacted; however, there are over 250 homes and apartment complexes in Issaquah within the inundation area.

These structures would experience the largest surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Structures would be impacted by flooding and velocity flows, which may cause damage or erosion around the structure. Structures in the dam inundation zone that are built to National Flood Insurance Program (NFIP) minimum construction standards may have some level of protection against dam inundation, depending on the velocity and elevation of the inundation waters. These structures are also more likely to have flood insurance.

Critical facilities within the dam inundation area could receive significant damage from an event. This could result in significant down-time of identified critical facilities and infrastructure, such as power infrastructure. Damage to roads and bridges could isolate populations.

8.4.3 Systems

Transportation and utility systems are vulnerable to dam inundation and have the potential to be impacted. If the Lakemont Stormwater Pond were to fail, SE Newport Way and both directions of I-90 would be overtopped and there may be temporary or longer-term transportation impacts. Utilities such as overhead power lines, cable and phone lines in the inundation zone could also be vulnerable. Buried utility systems are less vulnerable but may be impacted if erosion occurs. In addition, emergency response would be hindered due to the loss of transportation routes. Critical systems may need to be repaired after the dam break.

8.4.4 Natural, historic and cultural resources

All natural, historic and cultural resources in the dam inundation zone are at risk from the dam failure hazard. The rapid release of water may erode or degrade downstream habitat. Historic and cultural resources may be destroyed, eroded, or washed away by inundation waters.

8.4.5 Activities that have value to the community

The Lakemont Stormwater Pond is located at Lakemont Community Park. The park includes multi-use pathways that surround the lake, a portion of which is on the dam embankment. The park also has trails that lead to Lewis Creek and through the open spaces. If the dam were to have a catastrophic failure, walking paths and creek could be damaged and closed to the public.

8.5 Mitigating the Hazard

Table 8-2 presents a range of potential opportunities for mitigating the dam failure hazard.

Table 8-2. Dam failure mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ None
Corporate	▪ Remove dams ▪ Harden dams
Government	▪ Remove dams ▪ Harden dams
Reduce Exposure	
Personal	▪ Relocate out of dam failure inundation areas

Corporate	▪ Replace earthen dams with hardened structures
Government	▪ Replace earthen dams with hardened structures ▪ Relocate critical facilities out of dam failure inundation areas ▪ Consider open space land use in designated dam failure inundation areas
Reduce Vulnerability	
Personal	▪ Elevate home to appropriate levels
Corporate	▪ Flood-proof facilities within dam failure inundation areas
Government	▪ Adopt higher regulatory floodplain standards in mapped dam failure inundation areas ▪ Retrofit critical facilities within dam failure inundation areas.
Increase Preparation or Response Capability	
Personal	▪ None
Corporate	▪ Educate employees on the probable impacts of a dam failure ▪ Develop a Continuity of Operations Plan
Government	▪ Map dam failure inundation areas ▪ Enhance emergency operations plan to include a dam failure component ▪ Institute monthly communications checks with dam operators. ▪ Inform the public on risk reduction techniques ▪ Adopt real estate disclosure requirements for the resale of property located within dam failure inundation areas ▪ Consider the probable impacts of climate in assessing the risk associated with the dam failure hazard ▪ Establish early warning capability downstream of listed high hazard dams ▪ Consider the residual risk associated with protection provided by dams in future land use decisions

9. Drought

9.1 General Background

Drought is a normal phase in the climatic cycle of most geographical regions. Drought originates from a deficiency of precipitation over an extended period of time, usually a season or more, and results in a water shortage for some activity, group or environmental sector. Unlike most disasters, droughts normally occur slowly but last a long time.

According to the Washington State Department of Agriculture, drought in Washington usually results from low mountain snow accumulation (from low precipitation or warm winter temperatures that causes winter precipitation to fall as rain rather than snow) or early melt of the snowpack due to warm weather in late winter or early spring (Washington State Department of Agriculture, 2019).

Defining when drought begins is a function of the impacts of drought on water users and includes consideration of the supplies available to local water users as well as the stored water that may be available in surface reservoirs or groundwater basins. Different local water agencies have different criteria for defining drought conditions in their jurisdictions. Some agencies issue drought watch or drought warning announcements to their customers. Determinations of regional or statewide drought conditions are usually based on a combination of hydrologic and water supply factors. Washington has a statutory definition of drought (RCW 43.83B.400), defining being in a drought condition when the water supply for the area is below 75% of normal and water uses and users in the area are likely to incur undue hardships because of the water shortage.

9.1.1 Types

There are five generally accepted operational definitions of drought:

- Meteorological drought is when dry weather patterns dominate an area.
- Agricultural drought occurs when crops become affected by drought.
- Hydrological drought is when low water supply becomes evident in the water system.
- Socioeconomic drought occurs when the supply and demand of various commodities is affected by drought.
- Ecological drought is when natural ecosystems are affected by drought.

9.1.2 Monitoring and categorizing drought

Drought is characterized by its severity, area affected and timing. Monitoring involves observation indicators like precipitation, temperature and soil moisture and using indices, which are numerical representations of drought severity derived from climatic data. These indices provide essential quantitative measurements for tracking, predicting and planning for drought impacts. The National Integrated Drought Information System (NIDIS), a multi-agency partnership that coordinates drought monitoring, forecasting, planning and information at national, state and local levels across the country, has determined three main methods for monitoring drought to guide early warning assessment. These methods include:

- Using a single indicator or index
- Using multiple indicator or indices
- Using composite or hybrid indicators

The U.S. Drought Monitor, a map released weekly, is a multi-indicator drought index and shows where droughts are occurring and their intensity. Impact type indicates whether a drought in a given area is short-term or long-term. Short-term is generally less than six months and impacts are expected on agriculture and grasslands. Long-term drought is typically longer than 6 months and impacts are seen on hydrology and ecology in the area impacted. The intensity of a drought is categorized on a scale of D0 to D4, where D0 is abnormally dry and D4 is exceptional drought (U.S. Drought Monitor, 2024). Standard indices used to measure short- and long-term drought include:

- The **Palmer Z Index** measures short-term drought on a monthly scale.
- The **Palmer Drought Severity Index** measures the duration and intensity of long-term weather patterns. The intensity of drought in a given month is dependent on current weather plus the cumulative patterns of previous months. Weather patterns can change quickly and the Palmer Drought Severity Index can respond fairly rapidly. See Figure 9-1.
- The **Standardized Precipitation Index** is a probability index that considers only precipitation. It is computed for several timescales ranging from 1 to 72 months to capture the various scales of both short-term and long-term drought.
- The **Crop Moisture Index** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season (National Integrated Drought Information System, 2024).

Source: (National Integrated Drought Information System, 2024)

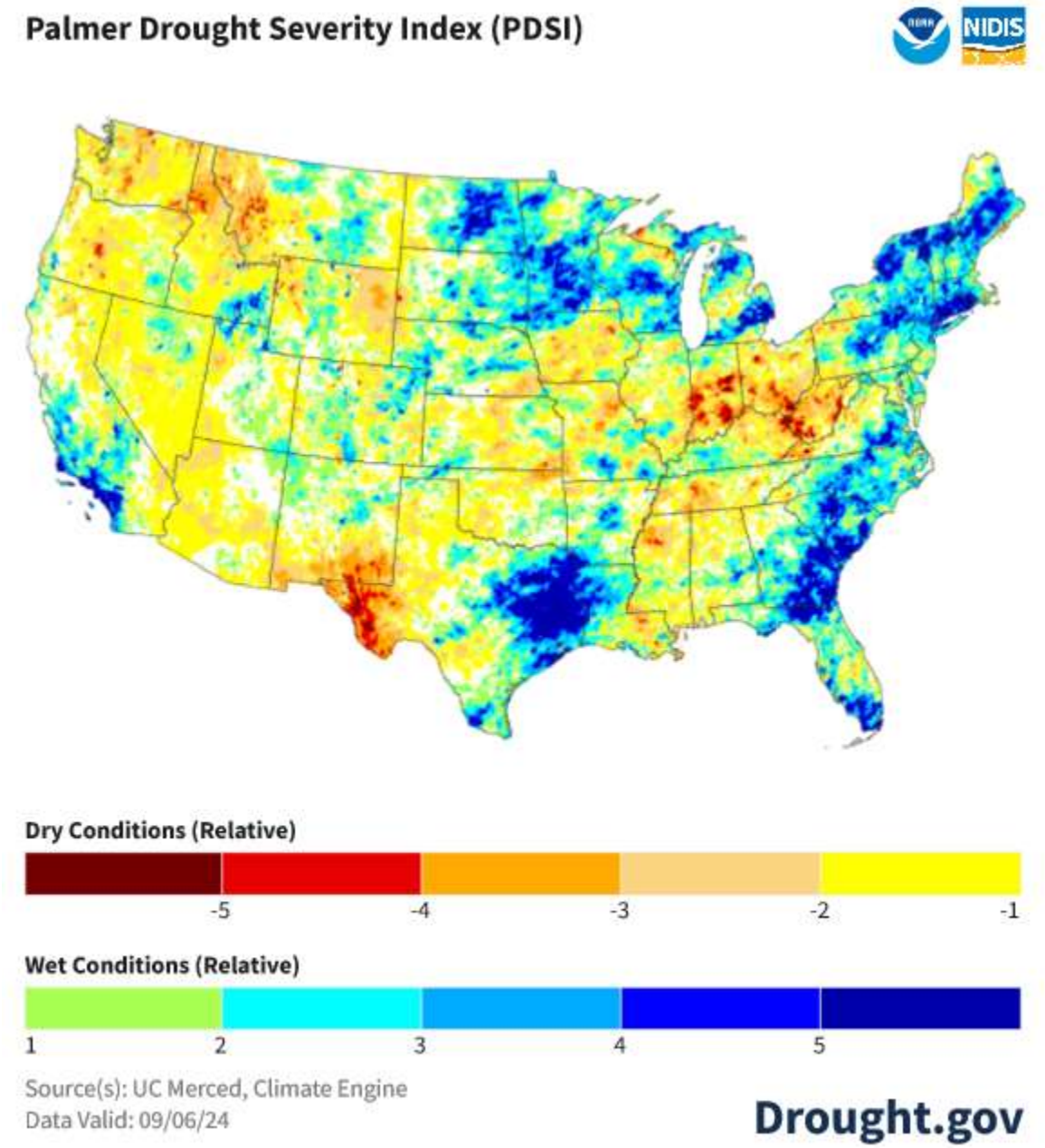

Figure 9-1. Palmer Drought Severity Index

9.2 Hazard Profile

9.2.1 Location

Drought is a regional phenomenon that has the potential to impact the entire planning area. Washington State experiences drought conditions frequently, though generally occurring east of the Cascade Mountain Range.

During the 2020 update of the King County Hazard Mitigation Plan, drought was not identified as a hazard of concern countywide. However, the City of Bellevue chose to include this hazard due to how the city may be impacted through water resources and changing climate conditions. Drought has the potential to directly or indirectly impact every person in the planning area.

9.2.2 Extent

US Drought Monitor

There are several quantitative methods for measuring drought in the United States. How these indices measure drought depends on the drought classification and the region being considered. To update the U.S. Drought Monitor, agencies assess multiple numeric measures of drought to depict the drought conditions and locations across the United States. The U.S. Drought Monitor uses five drought intensity categories, D0 through D4, to identify areas of drought. These categories are shown in Figure 9-2. The map is shown in Figure 9-3.

Source: (Northeast Regional Climate Center, n.d.)

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: • short-term dryness slowing planting, growth of crops or pastures Coming out of drought: • some lingering water deficits • pastures or crops not fully recovered
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water-use restrictions requested
D2	Severe Drought	• Crop or pasture losses likely • Water shortages common • Water restrictions imposed
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies

Figure 9-2. U.S. Drought Monitor Categories

Source: (NOAA, 2024)

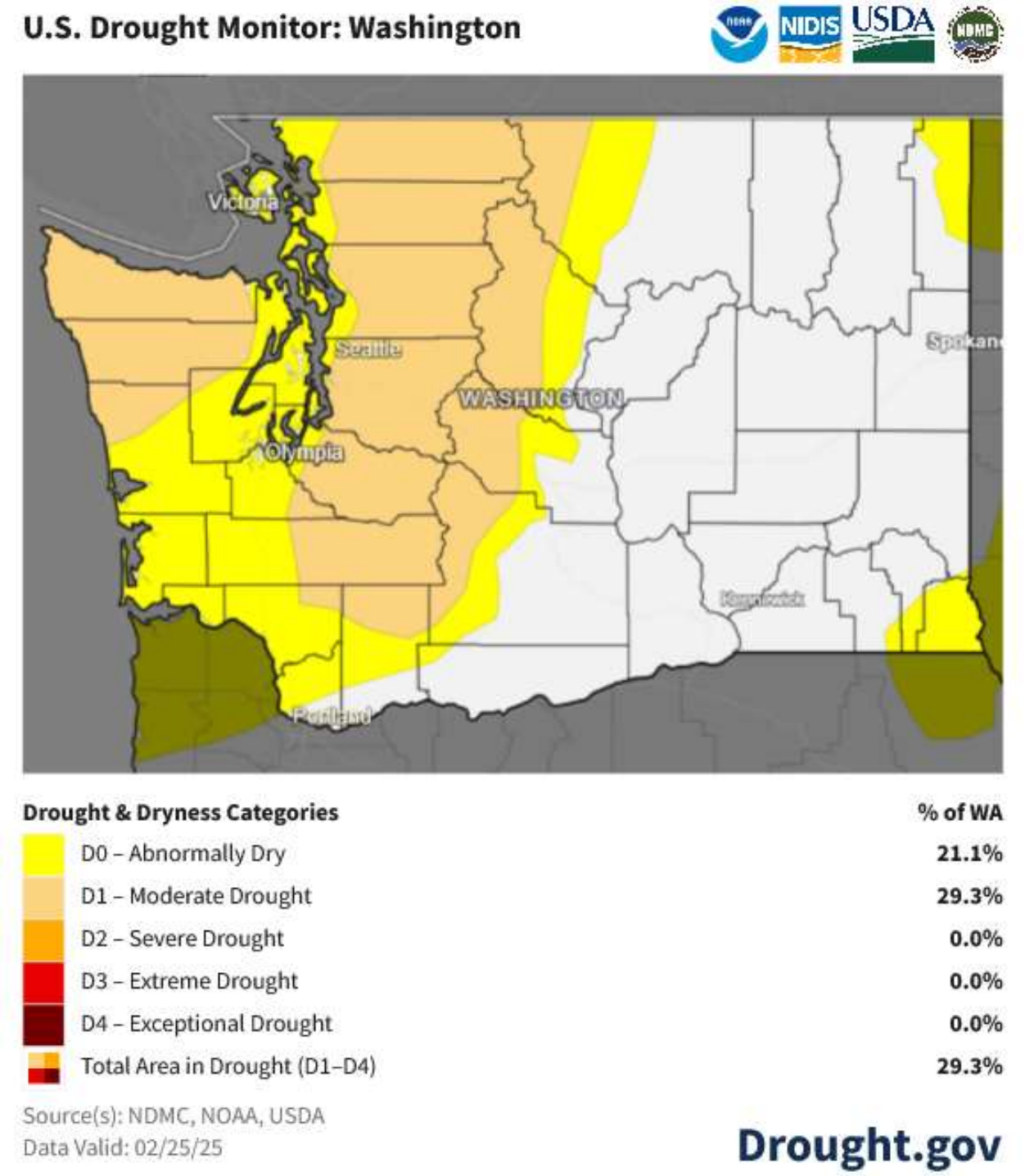

Figure 9-3. US Drought Monitor map for Washington State

Drought Impact Reporter

The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States (National Drought Mitigation Center, 2025). Information comes from a variety of sources: online, drought-related news stories and scientific publications, members of the public who visit the website and submit a drought-related impact for their region, members of the media and staff of government agencies. The database is being populated beginning with the most recent impacts and working backward in time. The Drought Impact Reporter indicates that King County has the following impacts from drought in recent years:

- Burn bans
- Higher electrical rates
- Requests to conserve water
- Increased wildfire risk
- Declining tree health
- Higher prices for agricultural commodities, such as beef and Christmas Trees

9.2.3 Previous occurrences

In the State of Washington there have been 11 official drought declarations between 1980 and 2024. These dry spells have typically lasted for a period of one to two months to a period of two years. In 2021, the Department of Ecology declared a drought emergency covering most of Washington State. That year, the precipitation March through June tied with 1926 as the second driest period since 1895. In addition, in late June, a heat dome brought triple digit temperatures, breaking heat records all throughout the state and exacerbating drought conditions (Washington State Department of Ecology, 2021).

In 2023 drought conditions were declared in 12 counties (Washington State Department of Ecology, 2023). As a result of this drought, Cascade Water Alliance asked community members and businesses in the City of Bellevue to voluntarily conserve water until mountain reservoirs could be replenished by rainfall (King 5 News, 2023).

On April 16, 2024, a statewide drought was declared with exceptions for Seattle, Everett and Tacoma metro areas. The state's low snowpack and forecasts for a warm and dry spring/summer caused Ecology to declare a drought emergency for most of Washington State. There was $4.5 million available in drought response grants to respond to impacts from the current drought conditions (Washington State Department of Ecology, 2024).

Between 2016 and 2024, Washington has been included in 373 USDA drought declarations. King County has been included in nine declarations occurring in June 2019, April 2020, April 2021, March 2021, April 2022 (part of two declarations), August 2023, June 2024 and July 2024 (USDA, 2024).

In 2025, the state experienced its fifth driest January on record. Early predictions are indicating that a third year of drought may plague the state (Department of Ecology, 2025).

Drought records have been kept for King County since 1895. The historical drought conditions over time are shown in Figure 9-4.

Source: (NIDIS, 2025)

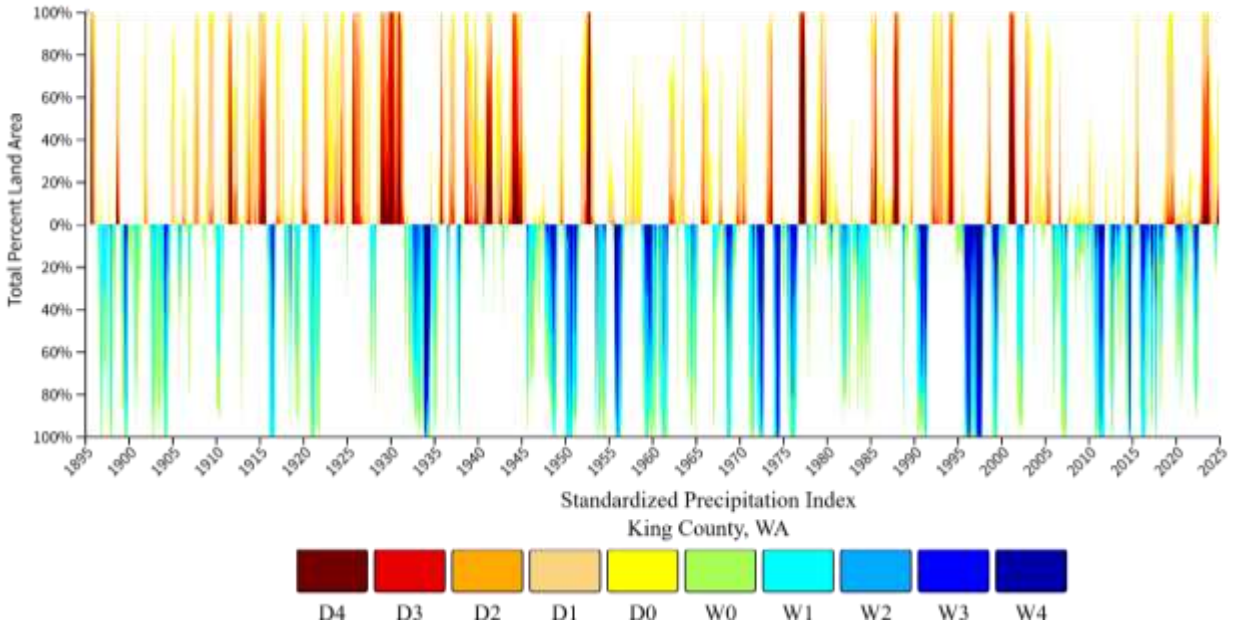

Figure 9-4. Historical drought conditions

9.2.4 Overall probability

According to the National Drought Mitigation Center, the Pacific Northwest region (Columbia, Willamette, Snake River basins of Idaho, Oregon, Washington and portions of Montana and Wyoming) experiences drought more frequently than most other regions of the nation. From 1895 to 1995, much of the state was in severe or extreme drought at least 5% of the time. The east slopes of the Cascades and much of Western Washington were in severe or extreme drought from 5% to 10% of the time. Based upon the drought history, King County can expect to experience a severe drought every 15-30 years.

9.2.5 Warning time

Droughts are climatic patterns that occur over long periods of time. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long droughts last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

Because drought conditions in Washington State are often related to deficiencies in snowpack accumulation, some warning is available through monitoring snowpack accumulation through the winter. The U.S. Natural Resources Conservation Service's snow survey and water supply forecasting program conducts snow surveys to develop accurate and reliable water supply forecasts (United States Department of Agriculture, 2024). The system, called SNOTEL (short for Snow Telemetry), provides information for local governments, water consumers and providers and the general public on snowpack conditions that may impact water resources in future months. When snowpack levels are below average, communities may make changes to their water management programs and practices to reduce impacts from a possible future drought.

NOAA's National Integrated Drought Information System launched a Drought Early Warning System for the Pacific Northwest in February 2016. The early warning system draws upon new and existing federal, tribal, state, local and academic partner networks to make climate and drought science readily available, easily understandable and usable for decision makers. The system improves stakeholders' abilities to monitor, forecast, plan for and cope with the impacts of drought (The National Integrated Drought Information System, 2024).

9.2.6 Climate change impacts

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overuse
- Aging urban water infrastructure
- Increased competition for available water

With a warmer climate, droughts could become more frequent, more severe and longer lasting. According to the USGS, since 2000, the western United States has experienced some of the driest conditions on record. Droughts impact a variety of sources including surface water (wetlands, lakes, rivers and creeks) and ground water (aquifers) (USGS).

The City of Bellevue's Climate Resilience Plan identifies reduced snowpack in the Cascades as a key contributor to diminished summer water availability, affecting the city's water supply and increasing stress on ecosystems dependent on consistent stream flows (City of Bellevue, 2023). Bellevue's Climate Vulnerability Assessment also indicates prolonged periods of drought combined with increased cooling demand can shift power supply to expensive fossil fuel-based generation, increasing electricity costs and resulting in higher greenhouse gas emissions. As mentioned, drought impacts water supply, including water reservoirs that supply potable water to populated areas, including water resources required to operate building cooling systems. (City of Bellevue, 2023)

According to the Climate Mapping for a Resilient Washington (CMRW) the likelihood of a year with summer precipitation below 75% of the historical normal is 22% in Bellevue in the early century (2020-2049) and increases to 28% by mid-century (2050-2079) and 37% in the late century (2070-2099). Lower precipitation will reduce the amount of water available and increase the need for emergency services to plan, prepare and respond to water shortages. In addition, an increase in drought may lead to an increase in voluntary or mandatory conservation requirements and water use restrictions. (University of Washington, 2024).

9.2.7 Future trends in development

Historically, Bellevue water purveyors receive their water either from mountain watersheds or local aquifers. Short-term droughts in the past have caused limited disruptions, however, as populations grow, the demand for water also increases. The increased demand for domestic, commercial, agricultural and industrial purposes can exacerbate water scarcity during drought periods and may put further stress on water resources, leading to more significant water rationing measures.

9.3 Secondary Hazards

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. In addition, lack of sufficient water resources can stress trees and other vegetation, making trees more vulnerable to infestation from pests, which in turn can make them more vulnerable to ignition.

9.4 Vulnerability and Impacts

9.4.1 People

The entire population of Bellevue is vulnerable to drought events and may be impacted. Drought can affect people's health and safety, including health problems related to low water flows, poor water quality or dust. Droughts can also lead to loss of human life (National Drought Mitigation Center). Other possible impacts include:

- Recreational impacts
- Effects on air quality
- Diminished living conditions related to energy, air quality and hygiene
- Compromised food and nutrition
- Increased incidence of illness and disease. (Centers for Disease Control and Prevention, 2020).

9.4.2 Structures

Although all structures in the planning area may be vulnerable to drought, no structures are likely to be directly impacted by drought conditions. Some structures may become more vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscaping, which could cause a financial burden on property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

Community lifelines as defined for this plan will continue to be operational during a drought. The risk to community lifelines will be largely aesthetic, such as drought's effect on landscaping. Structures are at most risk from the secondary hazards exacerbated by drought, such as wildfire.

9.4.3 Systems

Systems in Bellevue such as water systems are vulnerable and may be impacted by drought. Water supply shortages affect the ability of local government to effectively fight fires or provide sufficient water and sewage services. However, local water providers have plans in place including alternate water sources and memorandums of agreement to ensure operations continue during severe drought conditions.

Drought generally does not affect groundwater sources as quickly as surface water supplies, but groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when stream flows are lowest.

The economic impact of drought is largely associated with industries that use water or depend on water for their business. For example, landscaping businesses are affected as the demand for their service significantly declines because landscaping is not being watered. Drought can lead to a reduction in power-generating capacity in hydroelectric-dominated systems, such as those found in Washington. Reductions in capacity can lead to interruptions in the power supply that may have economic impacts in the region.

9.4.4 Natural, historic and cultural resources

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes and vegetation. In addition, the reduction of streamflows during drought may raise water temperatures of important creeks such as Kelsey and Coal Creek, adversely impacting salmon populations. However, many species will eventually recover from this temporary aberration. The degradation of landscape

quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Changes in water levels from drought may expose previously submerged archaeological sites or artifacts. This may increase risk of erosion and damage to cultural artifacts.

9.4.5 Activities that have value to the community

Locally, droughts can leave significant impacts on individuals and the broader Bellevue community, affecting urban life, ecosystems and regional industries. Bellevue depends heavily on regional water resources, including snowpack from the Cascade Mountains, which supports municipal water supply, hydroelectric power and recreation. A lack of snowpack or prolonged dry periods could severely affect the region's ability to meet water demands and maintain natural ecosystems. Recreation-based businesses, particularly those tied to outdoor activities like hiking or water sports, may experience economic hardships during drought conditions.

One of the most pressing secondary impacts of drought is the heightened danger of wildfires. Prolonged dry conditions increase fire hazards in nearby forested areas and urban green spaces, posing risks to public safety and infrastructure. Bellevue's parks, neighborhoods and greenbelts, which are vital to the city's character, may face restrictions or damage due to fire risks.

9.5 National Risk Index

The National Risk Index does not provide a risk rating for the drought hazard in Bellevue because drought risk is only based on agricultural losses.

9.6 Mitigating the Hazard

Table 9-1 presents a range of potential opportunities for mitigating the drought hazard.

Table 9-1. Drought mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ None

Corporate	▪ None
Government	▪ Groundwater recharge through stormwater management
Reduce Exposure	
Personal	▪ Consider stored water/captured water techniques during dry seasons
Corporate	▪ Consider stored water/captured water techniques during dry seasons
Government	▪ Identify and create groundwater backup sources
Reduce Vulnerability	
Personal	▪ Drought-resistant landscapes ▪ Reduce water system losses ▪ Install water efficient fixtures
Corporate	▪ Drought- resistant landscapes ▪ Reduce private water system losses
Government	▪ Water use conflict regulations ▪ Reduce water system losses ▪ Distribute water saving kits ▪ Identify sites ideally suited for ground water recharge
Increase Preparation or Response Capability	
Personal	▪ Practice active water conservation
Corporate	▪ Practice active water conservation ▪ Develop a water conservation plan
Government	▪ Public education on drought resistance ▪ Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers ▪ Develop a drought contingency plan ▪ Develop criteria “triggers” for drought-related actions ▪ Improve accuracy of water supply forecasts ▪ Modify rate structure to influence active water conservation techniques ▪ Consider providing incentives to property owners that utilize drought resistant landscapes in the design of their homes

10. Earthquake

10.1 General Background

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive earthquakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

This Hazard Mitigation Plan analyzed vulnerability and impacts from three earthquake scenarios that are most likely to impact the planning area including: Seattle Fault Zone North M 7.23, Cascadia Subduction Zone M 9.34 and the 750-year probabilistic earthquake.

10.1.1 Types of earthquakes

The Pacific Northwest experiences three types of earthquakes:

- **Subduction Zone Earthquakes (Megathrust)** – The Earth's crust is divided into eight major plates and many minor plates. In Washington, the primary plates of interest are the Juan De Fuca and North American plates. The Juan De Fuca plate moves northeastward with respect to the North America plate at a rate of about 3 to 4 centimeters per year. The boundary where these two plates converge, the Cascadia Subduction Zone, lies approximately 50 miles offshore and extends from the middle of Vancouver Island in British Columbia to northern California. As it collides with North America, the Juan De Fuca plate slides beneath the continent and sinks into the earth's mantle. Subduction Zone earthquakes occur at the interface between tectonic plates. A subduction zone earthquake would be centered off the coast of Washington or Oregon. The potential exists for large earthquakes measuring 9 or more on the Richter scale. Such an earthquake would last several minutes and produce catastrophic damage in the region.

- **Benioff Zone (Deep) Earthquakes** – Benioff Zone earthquakes occur within the Juan De Fuca plate as it sinks into the Earth's mantle. They are the most frequent type of large earthquake affecting Bellevue. These are deep earthquakes, usually 15 to 60 miles deep. Due to their depth, aftershocks are typically not felt in association with these earthquakes. These earthquakes are caused by mineral changes as the plate moves deeper into the mantle. Minerals that make up the plates are altered to denser, more stable forms as temperature and pressure increase. This results in a decrease in the size of the plate and stresses build up that pull the plate apart (Washington State Department of Natural Resources, 2014). Deep earthquakes generally last 20 to 30 seconds and have the potential of reaching 7.5 on the Richter scale.
- **Shallow Crustal Earthquakes** – Shallow crustal earthquakes occur within the North America plate at depths of 30 kilometers or less. Shallow earthquakes within the North America plate occur frequently. Most are relatively small, but the potential exists for major shallow earthquakes as well. Generally, these earthquakes are expected to have magnitudes less than 8 and last from 20 to 60 seconds. Of the three types of earthquake, crustal events are the least understood.

10.1.2 Faults

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface within the last 11,000 years. Potentially active faults are those that displaced layers of rock within the last 1,800,000 years. Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Additionally, earthquakes may occur on faults that have not been mapped and identified.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater displacements and are aligned so that movement can relieve tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion. Small, local faults may produce lower-magnitude quakes but strong ground shaking with significant damage to nearby surface areas. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area (Stone, 2020) (Musa, 2022).

10.1.3 Earthquake classification

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as magnitude; or by the impact on people and structures, measured as intensity. Magnitude describes the size at the focus of an earthquake and intensity describes the overall felt severity of shaking during the event.

Magnitude

An earthquake's magnitude is a measure of the energy released at the source of the earthquake. It is expressed by ratings on the Richter scale or the moment magnitude scale. Currently, the most commonly used magnitude scale is the moment magnitude (M_w) scale, with the following classifications of magnitude:

- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes.

Intensity

The intensity of an earthquake is based on the observed effects of ground shaking on people, buildings and natural features. Intensity of a given earthquake varies with location. The Modified Mercalli (MMI) scale expresses intensity of an earthquake and describes how strong a shock was felt at a particular location. Table 10-1 summarizes earthquake intensity as expressed by the Modified Mercalli scale.

Table 10-1. Mercalli Scale and peak ground acceleration comparison

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17% – 1.4%
IV	Light	None	None	1.4% – 3.9%
V	Moderate	Very Light	Light	3.9% – 9.2%
VI	Strong	Light	Moderate	9.2% – 18%
VII	Very Strong	Moderate	Moderate/Heavy	18% – 34%
VIII	Severe	Moderate/Heavy	Heavy	34% – 65%
IX	Violent	Heavy	Very Heavy	65% – 124%
X – XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA measured in percent of g, where g is the acceleration of gravity
Sources: (USGS, n.d.)

10.1.4 Ground shaking

The ground experiences acceleration as it shakes during an earthquake. The peak ground acceleration is the largest acceleration recorded by a monitoring station during an earthquake. PGA is a measure of how hard the earth shakes in a given geographic area. It is expressed as a percentage of the acceleration due to gravity (%g). PGA varies with soil or rock type. Earthquake risk assessment estimates the annual probability that a certain ground accelerations will be exceeded, and then summing the annual probabilities over a time period of interest.

National maps of earthquake shaking hazards provide information for creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (USGS 2001). The USGS updated the National Seismic Hazard Maps in 2023. New seismic, geologic, geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps (USGS, 2024). The 2023 map, shown in Figure 10-1, also includes updated ground motion models for the subduction zone faults.

Source: (USGS, 2024)

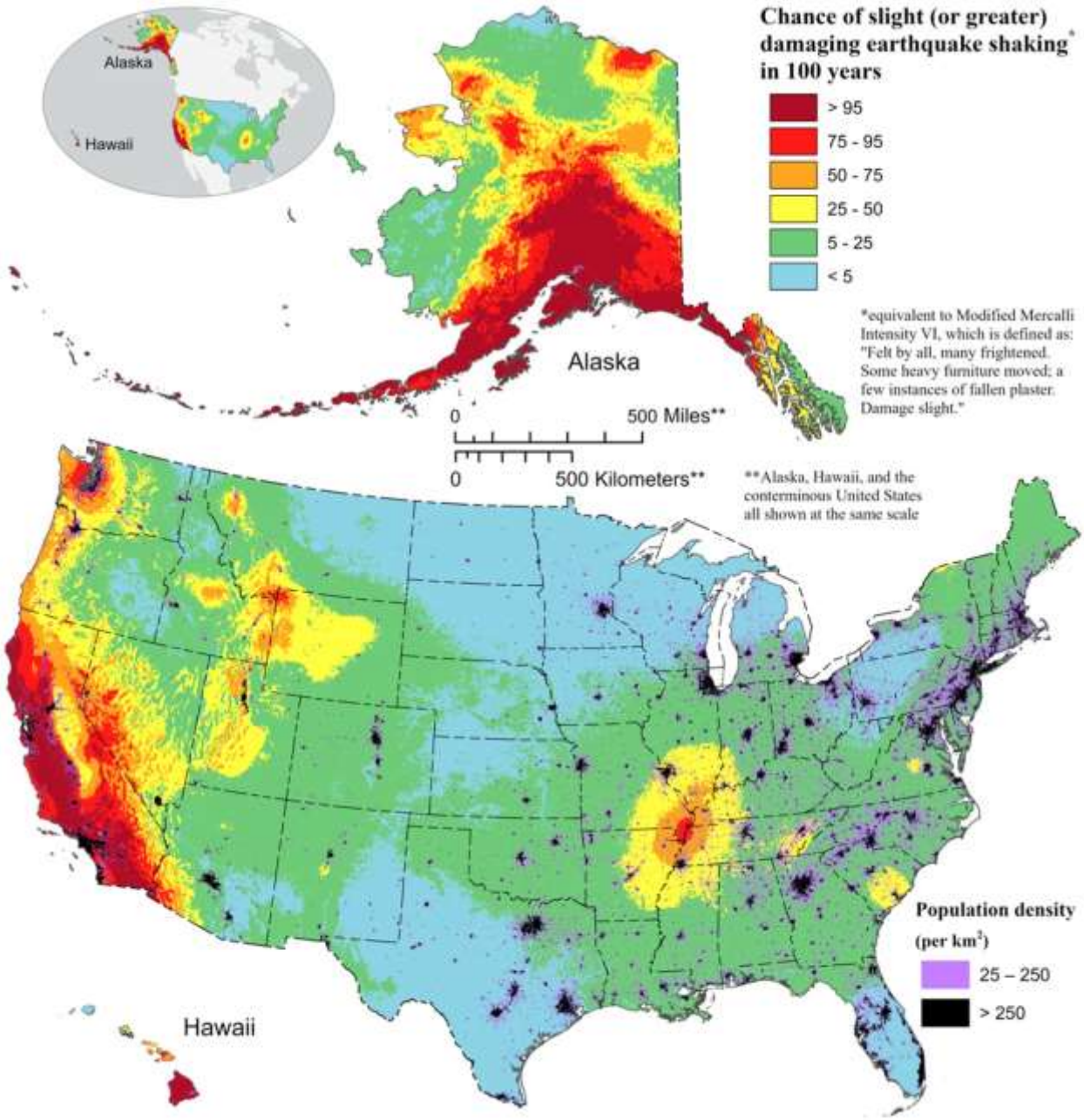

Figure 10-1. National Seismic Hazard Model (2023)

Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. The determination of how great a force a structure should be able to withstand is based on probabilistic seismic mapping of the area. Such mapping identifies the probability of a given magnitude of ground shaking occurring over a specified time period. A common probabilistic rating used for building design is the

level of ground shaking that has a 10% probability of being equaled or exceeded in a 50-year period.

Buildings, bridges, highways and utilities built to meet modern seismic standards typically can withstand earthquakes with less damage and disruption. PGA values are directly related to lateral forces that can damage "short period structures" (e.g. single-family dwellings). Longer-period components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges).

10.1.5 Liquefaction and soil types

Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. A program called the National Earthquake Hazard Reduction Program creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 10-2 NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

Table 10-2. NEHRP soil classifications

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	N/A

10.2 Hazard Profile

10.2.1 Location

Earthquakes can occur anywhere, at any time and without warning. Because a majority of earthquakes are not associated with known faults, they are also very unpredictable. Past geological studies indicate areas prone to earthquakes may experience long periods of inactivity. These areas may be building tension which can lead to a major earthquake. Due to the unpredictability of earthquakes, forecasting when or where the next one will occur in Bellevue is impossible.

Historical Epicenter Locations

Although earthquakes are unpredictable and can occur anywhere at any time, historical and scientific data document that there is a high risk potential for future seismic activity in Bellevue. Since 1900, 18 earthquakes have occurred within 50 miles of Bellevue with a magnitude of 4.5 or greater.

Fault Locations

The City of Bellevue may be impacted by several seismic faults within the Puget Sound Region including the Seattle Fault Zone, Cascadia Subduction Zone, South Whidbey Island Faults and the Tacoma Fault. The plan assessed the impacts of the Seattle Fault Zone and Cascadia Subduction Zone.

- The **Seattle Fault Zone** is a significant east-west thrust fault zone running south of Bellevue. New research suggests that the fault was formed when a string of oceanic islands was pulled into the subduction zone. The northern most islands were pushed down below the crust (subducted) and southern islands were push up over the crust (obducted). The Seattle faults are in the area in between where the islands were being subducted and obducted, where intense pressure would have caused tearing and fragmentation (DNR, 2024). This fault zone, shown in Figure 10-2, lies close to dense urban areas and has been responsible for major past earthquakes, including a magnitude 7.0-7.5 event around 1,100 years ago (Blakely, Wells, Weaver, & Johnson, 2002). This fault would produce shallow crustal earthquakes with high intensity and many aftershocks, and poses significant risks to Bellevue, including potential surface ruptures. Features like Cougar Mountain and Somerset reflect the fault's "hanging wall," where elevated terrain lies above the fault plane (City of Bellevue, 2018).
- The **Cascadia Subduction Zone** extends from Vancouver Island to northern California. Ground shaking from these events can last up to four minutes and

produce low-frequency waves that particularly threaten tall structures. Local sedimentary basins may amplify the ground motion, increasing damage potential in the region (City of Bellevue, 2018).

Source: WGS

Figure 10-2. Seattle Fault Zone

10.2.2 Extent

Shake Maps

A ShakeMap is a representation of ground shaking produced by an earthquake. ShakeMaps are produced based on scenarios and for actual earthquake events. The scenarios are predictive and have an assumed magnitude and epicenter location. They are based on realistic assumptions and provide a "what-if" scenario to use for planning.

ShakeMap scenarios show the predicted intensity and range of an earthquake. The ShakeMaps used to evaluate Bellevue's earthquake risk indicate that all of Bellevue is at risk from an earthquake. However, some areas have a higher risk because they are in liquefaction zones or built upon unstable soils. Table 10-3 describes how earthquake intensities may be felt based on the Modified Mercalli Scale.

Figure 10-3 and Figure 10-4 show the ShakeMap scenario intensities for the Seattle Fault M7.3 scenario and the Cascadia M9.34 scenario.

Table 10-3. Earthquake intensity based on Modified Mercalli Scale

Intensity	Shaking	Description/Damage
I	Not Felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not regard it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, may frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundation.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Source: (USGS, n.d.)

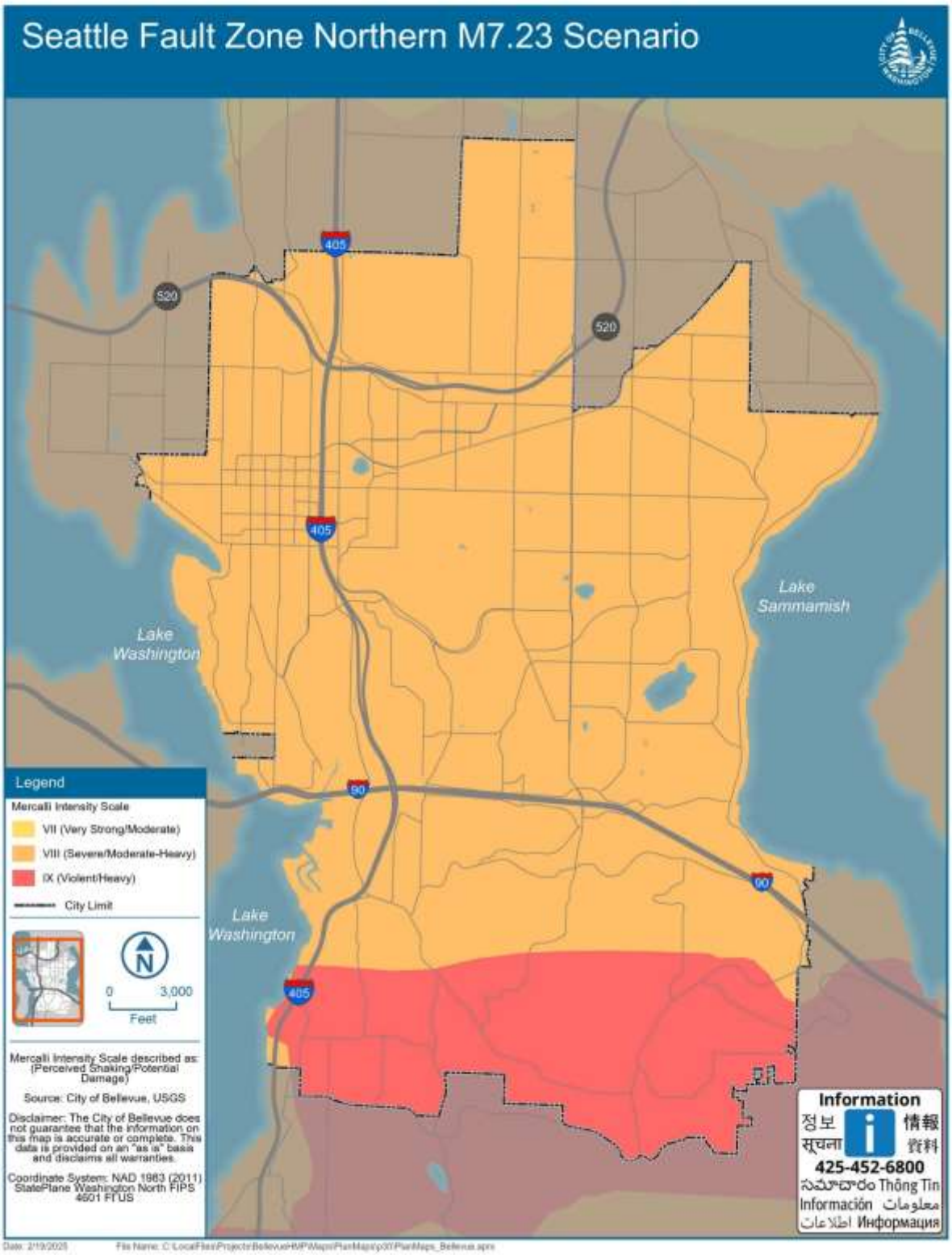

Figure 10-3. Seattle fault M7.23 scenario

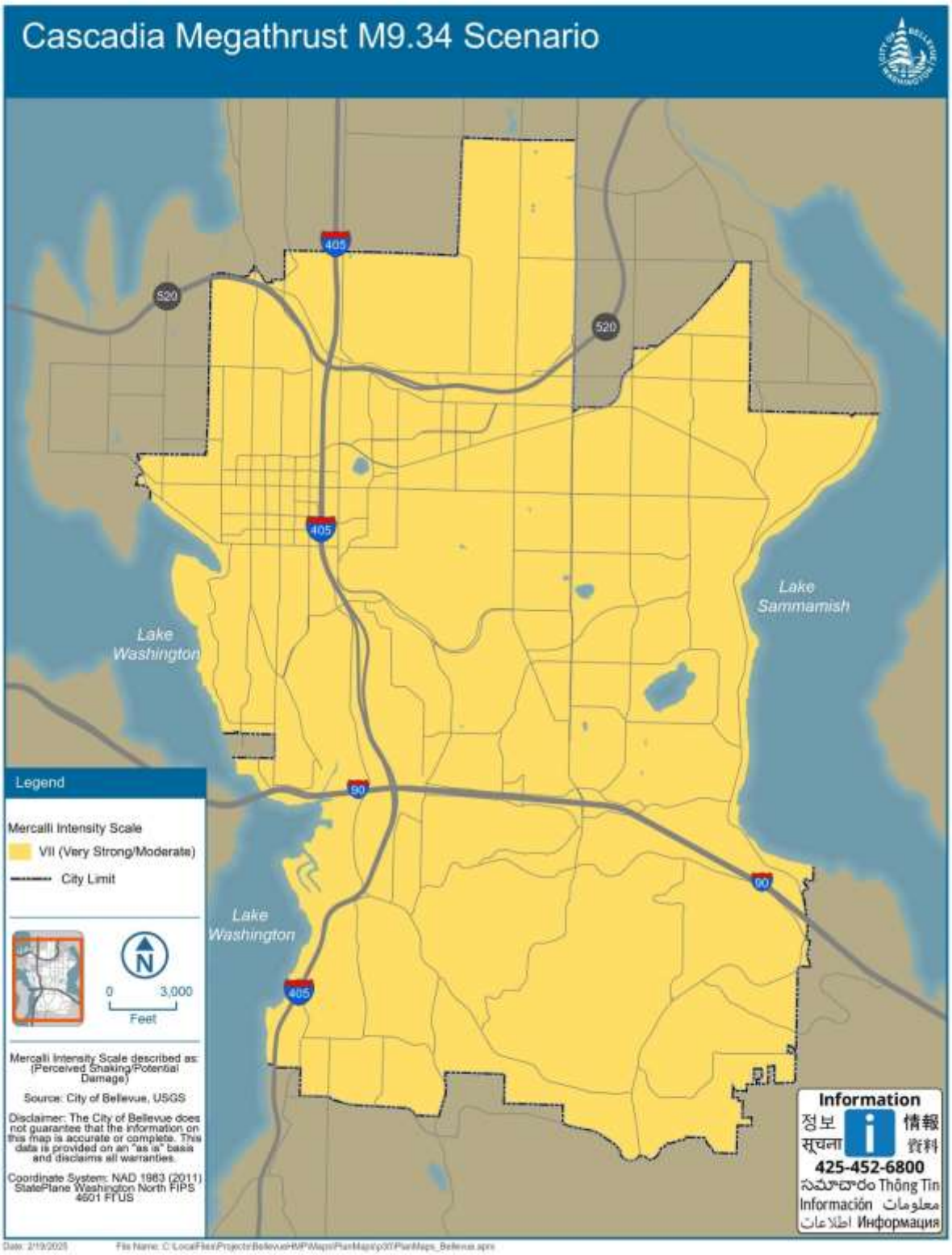

Figure 10-4. Cascadia M9.34 scenario

10.2.3 Previous occurrences

From the early 1900s to the present, the epicenter of 18 earthquakes with a magnitude of 4.5 or greater have been recorded within approximately 50 miles from the City of Bellevue.

Table 10-4. Regional earthquake history

Date	Location	Magnitude
July 12, 2019	2 km S of Roosevelt, Washington	4.5
January 30, 2009	6 km ESE of Lofall, Washington	4.6
February 28, 2001	7 km SSE of Longbranch, Washington (Nisqually)	6.8
June 23, 1997	2 km NE of Enetai, Washington	4.9
May 3, 1996	8 km NNE of Lake Marcel-Stillwater, Washington	5.4
January 29, 1995	3 km WSW of Des Moines, Washington	5.0
March 11, 1978	5 km W of Burley, Washington	4.8
September 8,1976	2 km NNE of Union, Washington	4.5
April 29, 1965	3 km ESE of Browns Point, Washington	6.7
January 24, 1963	2 km N of West Lake Sammamish, Washington	4.5
December 31, 1962	3 km E of Wilkeson, Washington	4.7
September 10, 1960	2 km SSE of Bangor Trident Base, Washington	4.6
May 15, 1954	4 km ENE of Machias, Washington	5.0
November 13, 1939	Puget Sound region, Washington	6.1
July 18, 1932	9 km NE of Lake Marcel-Stillwater, Washington	5.2
December 31, 1931	Olympic Peninsula, Washington	4.8
March 17, 1904	Eastern Olympic Peninsula, Washington	5.3
March 14, 1903	Near Kirkland, Washington	4.9

Source: (USGS, 2025)

10.2.4 Overall probability

Earthquakes along the Cascadia Subduction Zone occur on average every 500 to 600 years, although the frequency appears to be irregular. The intervals between earthquakes in this subduction zone have ranged from 200 years to more than 1,000 years. The probability of a magnitude 6.5 or higher earthquake occurring along the subduction zone in the Puget Sound Region is estimated to be about 84% in the next 50 years (Cascadia Region Earthquake Workgroup (CREW) n.d.).

The Seattle Fault is less active. Scientists believe that a magnitude 7.0 earthquake may occur every thousand to several thousand years. The chance of a large (M6.5+)

earthquake on the Seattle Fault is about 5% in the next 50 years. However, smaller earthquakes could occur more frequently and could still cause damage.

10.2.5 Warning time

There is no current reliable way to predict the day or month that an earthquake will occur at any given location, but immediate warning can be given when the earthquake occurs. The USGS has developed an earthquake early warning system for Washington, California and Oregon. The system detects earthquakes immediately as they begin and takes only a few seconds for the warning to be sent out, providing warning before the ground movement occurs. The warning time is very short (10s of seconds, depending on the type of earthquake), but it could allow time for someone to get under a desk, step away from a hazardous material they are working with or shut down a computer system. The data could also be used to take automatic actions, such as stopping elevators at the nearest floor, closing water reservoir valves to prevent loss of potable water or activating backup generators.

In Washington, the early warning alerts are sent to all cell phones using the Wireless Emergency Alert System or the MyShake smartphone app. Cell phones on the Android system will receive the messages automatically (PNSN 2024).

10.2.6 Climate change impacts

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms or heavy precipitation could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. These effects on soil conditions and infrastructure can increase Bellevue's overall vulnerability to seismic events.

Other impacts would be the cumulative impacts from multiple emergencies. For example, an earthquake during an extreme heat event could strain existing emergency response systems. (City of Bellevue, 2023)

10.2.7 Future trends in development

Land use in the planning area will be directed by the city's comprehensive plan adopted under Washington's Growth Management Act. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. The geologic hazard portions of the planning area are regulated under the city's critical areas ordinance. The most recently adopted building codes take liquefaction and soil mapping into account in their standards.

Areas targeted for future growth and development have been identified across the city. It is anticipated that the human exposure and vulnerability to earthquake impacts in newly developed areas will be similar to those that currently exist within the city. According to the 2024-2044 Comprehensive Plan, the city aims to accommodate 35,000 new housing units and 70,000 jobs by 2044 (City of Bellevue, 2024). New development in areas with softer NEHRP soil classes, liquefaction and landslide-susceptible areas may be more vulnerable to the earthquake hazard.

10.3 Secondary Hazards

10.3.1 Seiche

A seiche is a standing wave that occurs in enclosed or semi-enclosed waterbodies, such as lakes or bays, typically triggered by earthquakes, landslides or strong winds. Seiches arise when resonances in a disturbed body of water generate vertical oscillations without horizontal wave motion. These oscillations occur as an impulse travels across the basin, reflects back and creates standing waves with nodes, or points of no motion. The frequency of a seiche is determined by the basin's size, depth, shape and water temperature. The biggest seiches develop when the period of the ground shaking matches the frequency of oscillation of the water body.

Seiches are often imperceptible due to their long wavelengths and typically occur far from an earthquake's epicenter, as low-frequency seismic waves are more effective at inducing oscillations. In Bellevue, Lake Washington is particularly vulnerable to seiches because of its size and proximity to the Seattle Fault Zone. A

significant earthquake could generate a seiche, leading to potential flooding in low-lying areas like Mercer Slough and the Bellevue waterfront. Such events could disrupt infrastructure, such as the I-90 and SR 520 bridges and natural ecosystems. Few recorded seiches have occurred in Lake Washington. An earthquake on the Seattle Fault in AD900-950 triggered a landslide into Lake Washington that may have caused a seiche. In 1891, an earthquake near Port Angeles caused an eight-foot seiche on Lake Washington. A small seiche occurred after the 1949 and 1964 earthquakes.

10.4 Vulnerability and Impacts

Earthquake impact data was generated using a Hazus analysis. Three event scenarios were modeled:

- A Magnitude 7.23 earthquake on the North Seattle Fault
- A Magnitude 9.34 earthquake on the Cascadia Fault
- A 750-year probabilistic earthquake

10.4.1 People

The entire planning area population of 148,489 is potentially vulnerable to some degree to direct or indirect impacts such as death, injury, business interruption, road closures and loss of utilities.

Community Members in High-Risk Areas

The degree of impact is dependent on many factors, including where people are located when the earthquake happens, their ability to quickly move to a safe location, the age and construction type of the structures people are in, the soil type their homes are constructed on, their proximity to fault location, etc. People can be injured or killed from falling bookshelves in their homes, facades or debris falling onto city streets, building collapses, or vehicle collisions due to fissures forming in roads. After an earthquake, people may experience health concerns caused by lack of clean water, poor sanitation or hospitals operating at lower capacities. Many people may be impacted financially – most homeowners insurance does not cover earthquake damage. A separate earthquake policy is required. A 2017 study by the Washington State Office of the Insurance Commissioner found that only 15.71% of residential policy holders in King County have earthquake coverage (Kreidler, 2018).

Susceptible Population Groups

Two groups are particularly vulnerable to impacts from earthquake hazards:

- Population Below Poverty Level—Households below the poverty level may lack the financial resources to improve their homes to prevent or mitigate earthquake damage or repair their homes after the earthquake. Economically disadvantaged community members are also less likely to have insurance to compensate for losses incurred during earthquakes.
- Population Over 65 Years Old—Population group over 65 years old are vulnerable because they are more likely to need special medical attention, which may not be available due to isolation caused by earthquakes. Elderly community members also have more difficulty leaving their homes during earthquake events and could be stranded in dangerous situations.

Estimated Impacts on Persons and Households

Hazus estimated impacts on persons and households in the planning area for the three selected earthquake scenarios as summarized in Table 10-6.

Table 10-5. Estimated earthquake impact on persons

Scenario	Number of Displaced Households	People Requiring Short-Term Shelter
Seattle North M7.2	1,507	559
Cascadia M9.34	76	21
750-Year Probabilistic	1,660	597

10.4.2 Structures

There are estimated to be 33,229 buildings in the planning area, with a total value of $74.5 billion. All buildings are vulnerable to the earthquake hazard, including all critical facilities. Table 10-6 list the number and values of structures within Bellevue's neighborhoods.

Table 10-6. Structures vulnerable to earthquake hazards

Area	Number of Buildings	Total Building and Contents Value	% of Total Value Exposed
BelRed	523	$8,518,500,025	100%
Bridle Trails	1,804	$3,716,266,051	100%
Cougar Mountain/ Lakemont	3,435	$4,031,189,714	100%
Crossroads	959	$3,468,244,940	100%

Downtown	272	$20,768,217,226	100%
Eastgate	2,473	$5,794,939,585	100%
Factoria	313	$2,614,440,584	100%
Lake Hills	4,715	$4,152,650,030	100%
Newport	3,336	$2,527,794,754	100%
Northeast Bellevue	3,916	$2,829,683,325	100%
Northwest Bellevue	2,331	$4,417,359,258	100%
Somerset	2,936	$2,204,544,173	100%
West Bellevue	2,211	$4,324,839,513	100%
West Lake Sammamish	2,039	$1,659,986,590	100%
Wilburton	899	$2,235,446,710	100%
Woodridge	1,137	$1,180,056,243	100%
Total	**33,299**	**$74,444,158,721**	**100%**

The City of Bellevue is a relatively new community, with most of its development occurring since 1950. Table 10-7 lists the city's structures by the time period in which they were built, based on age-of-structure data from the King County Assessor's database. The number of structures does not reflect the number of total housing units, as many multi-family units and attached housing units are reported as one structure.

Table 10-7. Age of structures in the City of Bellevue

Time Period	Number of Structures	Significance of Time Period
Pre-1972	14,223	Adoption of building codes was at the discretion of individual cities and counties. There were no state minimums regarding residential construction, although newly constructed schools, hospitals and places of assembly were required to withstand a lateral force of 5% of the building weight.
1972-1993	10,454	Houses built after 1972 are in compliance with the 1970 Uniform Building Code, which required that all structures be constructed to Zone 2 seismic standards.
1994-2003	3,797	Zone 3 standards of the Uniform Building Code went into effect in western Washington in 1994, requiring all new construction to be capable of withstanding the effects of 0.3 times the force of gravity.
2004-2006	797	Adoption of new codes that became effective in July of 2004 brought Washington State's building codes to the highest level nationwide addressing the state's seismic hazard.

2007-present	4,028	Amendments to the International Building Code that took effect in July of 2007 included provisions for structural design for earthquake loads and flood hazards. The code applies to all building permits in the state of Washington. The codes are driven in part by soil and liquefaction maps prepared.

A Hazus analysis was conducted on structures for the three scenarios. Hazus uses several inputs to estimate the damage that will occur to each structure. The Seattle North M7.23 earthquake is anticipated to have the largest impact on structures, damaging 10.9% of the total value. The highest impact is anticipated in Northeast Bellevue, where 46.8% of the total value of structures will be damaged.

Table 10-8. Impacts of Seattle North M7.23

Area	Value of Structure Damaged	Value of Content Damaged	Total Value Damaged	% of Total Value Damaged
BelRed	$292,176,187	$147,653,094	$439,829,281	5.2%
Bridle Trails	$187,023,747	$79,910,859	$266,934,606	7.2%
Cougar Mountain/ Lakemont	$324,227,603	$124,121,033	$448,348,636	11.1%
Crossroads	$158,101,751	$67,330,057	$225,431,808	6.5%
Downtown	$859,777,924	$165,763,744	$1,025,541,668	4.9%
Eastgate	$436,421,376	$164,053,626	$600,475,002	10.4%
Factoria	$181,686,686	$75,826,826	$257,513,513	9.8%
Lake Hills	$420,060,941	$145,213,070	$565,274,011	13.6%
Newport	$390,431,227	$100,311,262	$490,742,489	19.4%
Northeast Bellevue	$973,255,162	$350,265,961	$1,323,521,124	46.8%
Northwest Bellevue	$361,506,902	$156,329,909	$517,836,811	11.7%
Somerset	$248,078,681	$72,315,019	$320,393,700	14.5%
West Bellevue	$605,388,178	$208,273,015	$813,661,194	18.8%
West Lake Sammamish	$341,690,766	$108,940,768	$450,631,534	27.1%
Wilburton	$152,132,330	$68,109,438	$220,241,767	9.9%
Woodridge	$121,731,056	$38,219,934	$159,950,990	13.6%
Total	**$6,053,690,518**	**$2,072,637,616**	**8,126,328,134**	**10.9%**

Table 10-9. Impacts of Cascadia M9.34

Area	Value of Structure Damaged	Value of Content Damaged	Total Value Damaged	% of Total Value Damaged
BelRed	$74,923,612	$39,000,739	$113,924,350	1.3%
Bridle Trails	$39,987,132	$19,574,260	$59,561,392	1.6%
Cougar Mountain/ Lakemont	$28,400,983	$15,338,735	$43,739,717	1.1%
Crossroads	$27,754,949	$14,116,984	$41,871,933	1.2%
Downtown	$283,675,811	$43,890,641	$327,566,452	1.6%
Eastgate	$52,275,808	$26,164,240	$78,440,048	1.4%
Factoria	$31,702,720	$14,113,408	$45,816,128	1.8%
Lake Hills	$62,796,171	$27,944,030	$90,740,201	2.2%
Newport	$57,396,783	$18,592,946	$75,989,729	3.0%
Northeast Bellevue	$254,291,395	$84,407,347	$338,698,742	12.0%
Northwest Bellevue	$85,243,362	$37,774,394	$123,017,756	2.8%
Somerset	$16,642,829	$8,945,026	$25,587,855	1.2%
West Bellevue	$149,486,836	$48,745,128	$198,231,963	4.6%
West Lake Sammamish	$74,075,833	$23,904,287	$97,980,120	5.9%
Wilburton	$29,391,223	$14,768,252	$44,159,475	2.0%
Woodridge	$11,961,964	$6,013,295	$17,975,259	1.5%
Total	**$1,280,007,411**	**$443,293,710**	**$1,723,301,122**	**2.3%**

Table 10-10. 750-Year Probabilistic Impacts

Area	Value of Structure Damaged	Value of Content Damaged	Total Value Damaged	% of Total Value Damaged
BelRed	$271,617,123	$140,922,427	$412,539,550	4.8%
Bridle Trails	$175,425,768	$79,652,712	$255,078,479	6.9%
Cougar Mountain/ Lakemont	$137,144,423	$68,527,356	$205,671,779	5.1%
Crossroads	$116,741,400	$56,553,880	$173,295,280	5.0%
Downtown	$701,376,102	$144,257,488	$845,633,589	4.1%
Eastgate	$185,613,824	$92,127,784	$277,741,608	4.8%

Factoria	$96,498,151	$46,941,521	$143,439,672	5.5%
Lake Hills	$241,668,903	$105,336,125	$347,005,028	8.4%
Newport	$149,072,487	$53,352,840	$202,425,327	8.0%
Northeast Bellevue	$716,199,978	$277,142,902	$993,342,880	35.1%
Northwest Bellevue	$287,027,083	$136,765,271	$423,792,354	9.6%
Somerset	$82,197,784	$37,046,596	$119,244,380	5.4%
West Bellevue	$453,118,774	$170,380,361	$623,499,134	14.4%
West Lake Sammamish	$209,812,658	$76,237,548	$286,050,206	17.2%
Wilburton	$109,089,850	$55,544,442	$164,634,292	7.4%
Woodridge	$55,282,946	$23,783,473	$79,066,418	6.7%
Total	**$3,987,887,252**	**$1,564,572,723**	**5,552,459,975**	**7.5%**

10.4.3 Systems

All systems, networks and capabilities within Bellevue are vulnerable to earthquakes.

The transportation system is especially vulnerable to impacts, including the I-90 floating bridge that crosses in Lake Washington. Bridges may collapse, fissures may open in roads, or a seiche may damage the floating bridge. With damaged roads, emergency response personnel may not be able to travel and supplies may not be able to be delivered.

During an earthquake event, networks and capabilities that are essential for emergency services (including first responders and public works) and economic stability can be severely impacted. Emergency services and public works may face challenges adequately responding to the event due to collapsed buildings, blocked roads and reduced capacity. In addition, planning and permitting departments may face challenges during the recovery phase following an earthquake event due to the scale of damage and the number of inspections and permits that will be required.

The transportation system is especially vulnerable to impacts, including the I-90 floating bridge that crosses in Lake Washington. Bridges may collapse, fissures may open in roads, or a seiche may damage the floating bridge. With damaged roads, emergency response personnel may not be able to travel and supplies may not be able to be delivered.

After a large-scale earthquake event, the economy may suffer business closures, disrupted supply chains and higher unemployment. Many homeowners do not have earthquake coverage as part of the homeowners insurance and may be liable for all costs to repair damaged structures.

Hazus analysis indicates thousands of tons of debris may need to be removed from roads and property after an earthquake. When falling, this debris may block roads or damage utilities, further impacting systems. Table 10-11 provides city-wide debris estimates for each earthquake scenario.

Table 10-11. City-wide debris estimates

Scenario	Structure Debris (x 1,000 Tons)
Seattle North M7.2	745.86
Cascadia M9.34	109.68
750-Year Probabilistic	640.99

Table 10-12. Debris estimate for Seattle North M7.23 earthquake

Area	Structure Debris (x 1,000 Tons)	Area	Structure Debris (x 1,000 Tons)
Downtown	292.83	Cougar Mountain/ Lakemont	23.54
Eastgate	84.28	West Lake Sammamish	18.64
BelRed	50.89	Northeast Bellevue	16.60
Lake Hills	45.34	Wilburton	16.42
Newport	44.76	Northwest Bellevue	13.57
West Bellevue	41.63	Woodridge	13.21
Factoria	33.09	Crossroads	13.08
Somerset	27.98	Bridle Trails	10.00
Total			**745.86**

Table 10-13. Debris estimates for Cascadia M9.34 earthquake

Area	Structure Debris (x 1,000 Tons)	Area	Structure Debris (x 1,000 Tons)
Downtown	71.24	Factoria	1.51
BelRed	9.34	Bridle Trails	1.26
Eastgate	6.92	West Lake Sammamish	1.21
West Bellevue	4.96	Northeast Bellevue	1.20
Lake Hills	3.91	Crossroads	1.16
Northwest Bellevue	1.76	Cougar Mountain/ Lakemont	0.86
Newport	1.63	Somerset	0.72
Wilburton	1.53	Woodridge	0.49
Total			**109.68**

Table 10-14. Debris estimates for 750-year probabilistic earthquake

Area	Structure Debris (x 1,000 Tons)	Area	Structure Debris (x 1,000 Tons)
Downtown	310.93	Newport	15.23
BelRed	66.26	Crossroads	14.32
Eastgate	42.99	Cougar Mountain/ Lakemont	12.81
West Bellevue	34.91	Northeast Bellevue	12.56
Lake Hills	27.85	Somerset	12.23
Northwest Bellevue	22.44	West Lake Sammamish	9.62
Bridle Trails	19.72	Woodridge	8.14
Wilburton	15.56		
Total			**640.99**

A Hazus analysis was performed on critical facilities to determine probability of damage and time to restore the facility to fully functional use. Each facility was categorized based on the type of facility, for example fire station, sewer lift station, dialysis center and bridge. Each facility type will experience different damage and loss of functionality. Individual results for each facility were determined and summarized in the tables and charts below.

Table 10-15 summarizes the probability of a structure exceeding slight, moderate and extensive damage. The results indicate that transportation facilities are the

least vulnerable to earthquake damage. The Seattle North scenario has potential to cause the most damage, with many facilities likely to sustain moderate or greater damages.

Table 10-15. Average damage of critical facilities

	Exceed Slight	Exceed Moderate	Exceed Extensive
Safety and Security			
Seattle North M7.23	99%	96%	71%
Cascadia M9.34	86%	67%	19%
750-yr probabilistic	89%	78%	49%
Food, Hydration, Shelter			
Seattle North M7.23	98%	76%	34%
Cascadia M9.34	63%	43%	16%
750-yr probabilistic	84%	59%	31%
Health and Medical			
Seattle North M7.23	98%	81%	26%
Cascadia M9.34	77%	34%	1%
750-yr probabilistic	89%	64%	22%
Communications			
Seattle North M7.23	100%	98%	78%
Cascadia M9.34	97%	79%	38%
750-yr probabilistic	96%	87%	58%
Transportation			
Seattle North M7.23	40%	32%	20%
Cascadia M9.34	13%	7%	3%
750-yr probabilistic	29%	22%	13%
Hazardous Materials			
Seattle North M7.23	100%	98%	76%
Cascadia M9.34	96%	84%	33%
750-yr probabilistic	95%	87%	61%
Water Systems			
Seattle North M7.23	100%	99%	88%
Cascadia M9.34	96%	84%	36%
750-yr probabilistic	94%	85%	59%

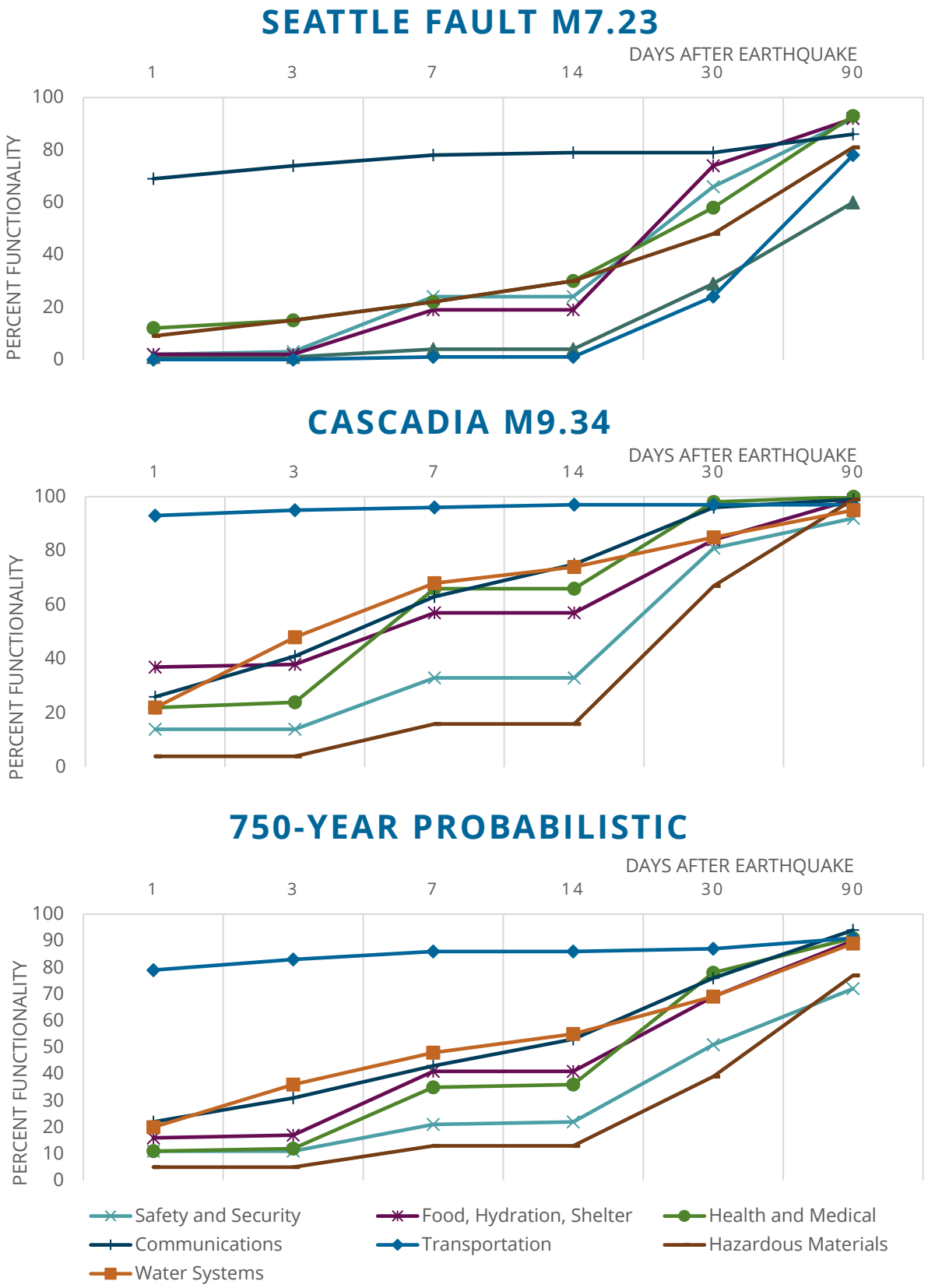

Figure 10-5. Average days to return to full functionality

10.4.4 Natural, historic and cultural resources

The entire planning area is vulnerable to the earthquake hazard, including natural resources, habitat, wildlife and historic and cultural resources.

Impacts to the environment as a result of an earthquake can be numerous. Secondary hazards will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly damage surrounding habitat. It is also possible for streams to be rerouted after an earthquake. Rerouting can change the water quality, possibly damaging habitat and feeding areas. Streams fed by groundwater wells can dry up because of changes in underlying geology.

Structures on historic registers were constructed to less stringent or even no earthquake building standards. Historic structures may be destroyed or severely damaged by an earthquake if they have not been retrofitted.

10.4.5 Activities that have value to the community

All activities that have value to the community are vulnerable to the earthquake hazard.

Earthquakes can greatly impact on activities that have value to the community, depending on the location and severity of the event. Residential life, business operations and recreational pursuits may be disrupted by an earthquake. Schools may become unsafe, disrupting student learning and after school activities such as sports, clubs and other community events. Other activities that have value to the community such as local parks, sports facilities and trails may suffer damage and be closed to public use until repaired due to safety.

10.5 National Risk Index

Table 10-16. NRI results

Expected Annual Loss	Expected Annual Loss Rating	Community Resilience	Social Vulnerability	Risk Index Score	Risk Index Rating
$64,176,454	Relatively High	Relatively Moderate	Relatively Low	92	Relatively High

10.6 Mitigating the hazard

Table 10-17 presents a range of potential opportunities for mitigating the earthquake hazard.

Table 10-17. Earthquake mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ None
Corporate	▪ None
Government	▪ None
Reduce Exposure	
Personal	▪ Locate outside of hazard area (off soft soils)
Corporate	▪ Locate or relocate mission-critical functions outside hazard area where possible
Government	▪ Locate critical facilities or functions outside hazard area where possible
Reduce Vulnerability	
Personal	▪ Retrofit structure (anchor house structure to foundation) ▪ Secure household items that can cause injury or damage (such as water heaters, bookcases and other appliances) ▪ Build to higher design
Corporate	▪ Build redundancy for critical functions and facilities ▪ Retrofit critical buildings and areas housing mission-critical functions
Government	▪ Harden infrastructure ▪ Provide redundancy for critical functions ▪ Adopt higher regulatory standards
Increase Preparation or Response Capability	
Personal	▪ Practice “drop, cover and hold” ▪ Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, ▪ 72-hour self-sufficiency during an event ▪ Keep cash reserves for reconstruction ▪ Become informed on the hazard and risk reduction alternatives available. ▪ Develop a post-disaster action plan for your household
Corporate	▪ Adopt higher standard for new construction; consider “performance-based design” when building new structures ▪ Keep cash reserves for reconstruction ▪ Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. ▪ Develop a Continuity of Operations Plan

Government	▪ Provide better hazard maps ▪ Provide technical information and guidance ▪ Enact tools to help manage development in hazard areas (e.g., tax incentives, information) ▪ Include retrofitting and replacement of critical system elements in capital improvement plan ▪ Develop strategy to take advantage of post- disaster opportunities ▪ Warehouse critical infrastructure components such as pipe, power line and road repair materials ▪ Develop and adopt a Continuity of Operations Plan ▪ Initiate triggers guiding improvements (such as <50% substantial damage or improvements) ▪ Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunity ▪ Develop a post-disaster action plan that includes grant funding and debris removal components

11. Flood

11.1 General Background

Flooding is defined as a significant rise in water level due to increased surface water run-off or groundwater saturation that results in an increase in surface water levels beyond what is typically expected and that can cause damage to man-made structures.

A floodplain is the area adjacent to a flood source such as a river, creek, alluvial fan or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be altered or significantly reduced.

11.1.1 Measuring floods and floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled or exceeded in any given year. These measurements reflect statistical averages only; it is possible for two or more floods

with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1% annual chance of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

11.1.2 Floodplain ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

11.1.3 Effects of human activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for several reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions

11.1.4 Types of floodplains in the planning area

The main types of floodplains in the planning area include:

- **Urban Stream Flooding** which occurs when prolonged, moderate- to high-intensity rainfall overwhelms natural and manmade drainage systems. This is often exacerbated during rain-on-snow events, where warm storms rapidly melt accumulated snow, causing sharp rises in stream flow and potential flooding. Floodwaters can impact streets, ditches, culverts and storm drains, especially if debris reduces system capacity. These floods generally develop gradually, allowing preparation time, but some areas may experience rapid flooding. Regular maintenance of stormwater systems can help mitigate these risks (City of Bellevue, 2018).
- **Groundwater Floodplains** occur after prolonged periods of heavy rainfall, often weeks after the last significant storm. This type of flooding can persist for weeks or months and shift locations as groundwater levels fluctuate across the region. Groundwater flooding typically impacts low lying areas with shallow water tables, creating long-term challenges for affected communities (City of Bellevue, 2018).

11.2 Hazard Profile

11.2.1 Watersheds

Bellevue's watersheds feature diverse hydrological systems impacted by urban development, historical activities and varying environmental conditions. These watersheds play a vital role in the city's ecology and flood management while facing challenges from impervious surfaces, stream modifications and sedimentation (City of Bellevue, 2024).

Coal Creek Watershed

The Coal Creek Watershed spans approximately 4,550 acres in southern Bellevue, with the creek originating in Cougar Mountain's steep terrain. Historically altered by extensive coal mining and urban development, the watershed has experienced increased flooding, sedimentation and erosion. Efforts such as sediment retention ponds have helped mitigate some of these issues, but challenges remain with suspended fine sediments impacting aquatic habitats. The basin includes significant parklands, maintaining some natural riparian areas.

Newport Creek

Newport Creek, a tributary of Coal Creek, features steep gradients and moderate channel alterations. Although some areas are culverted, the watershed retains relatively undisturbed riparian corridors, especially within parklands, supporting critical habitat areas.

Kelsey Creek Watershed

Spanning over 10,870 acres, Kelsey Creek Watershed is heavily urbanized, comprising multiple streams like Mercer Slough and Sturtevant Creek. Urban development has led to significant channel modifications, including culverts and impervious surfaces, contributing to flooding risks. Mercer Slough remains a vital ecological area with less impervious surfaces, while other basins face challenges with habitat fragmentation and altered stream flows. Sturtevant Creek has the highest level of stream alteration, with nearly 45% contained in culverts.

Lakehurst Basin

This basin includes four streams flowing into Lake Washington, with Newcastle Beach Creek being the least modified. Other streams face moderate to high levels of alteration, including culverting. Seasonal flows and gradients influence hydrological behavior, posing varying flood and habitat challenges.

West Lake Sammamish Basin

Phantom Creek and Vasa Creek dominate this basin. Phantom Creek features high-gradient segments and moderate channel modifications, while Vasa Creek exhibits diverse conditions from steep headwaters to low-gradient downstream areas. Urbanization and culverting impact hydrological connectivity, with habitat limitations in smaller tributaries like Ardmore and Wilkins Creek.

Mercer Creek

Mercer Creek is one of the most extensively studied creeks in the U.S., providing critical insights into urbanization's effects on hydrology. Increasing impervious surfaces have significantly amplified flood risks, with peak flows more than doubling over two decades. This serves as a key indicator of the ongoing impacts of urban growth on Bellevue's waterways.

11.2.2 Location

Bellevue is divided into two primary drainage basins: Lake Washington and Lake Sammamish, which encompass a total of 26 watersheds. A watershed refers to the land area that channels water to a specific body of water, such as a stream or lake. These watersheds vary in size, with the smallest being the Wilkins Creek watershed at 900 acres and the largest, the Coal Creek watershed, covering approximately 4,000 acres (City of Bellevue, 2018).

In Bellevue, frequently flooded areas include:

- Areas designated as FEMA floodplains (see Figure 11-1)
- The 148th Avenue SE road corridor has been closed many times due to flooding within the roadway. This area is the subject of an ongoing mitigation project in coordination with King County.
- The Lake Hills Boulevard and Kelsey Creek area experiences drainage and flooding issues. The city has been working on a solution to mitigate the flood problem for the past several years, with plans for construction in summer 2025. The project is in coordination with King County.
- Homes along the Lake Sammamish waterfront experience seasonal flooding.
- SE Seventh Place near Lake Hills Connector (see Figure 11-2)
- Other frequently flooded areas include 148th Avenue SE and SE 8th Street; SE 21st Street, east of 140th Avenue NE; 156th Avenue SE, north of SE 16th Street; and SE 30th Street, east of Richards Rd.

Table 11-1. Bellevue's major basins, storm drainage basins and stream names

Regional Stream Inventory Basin	City of Bellevue Storm Drainage Basin	Primary Streams	Total Length Streams	% Piped	Total Impervious Area
East Lake Washington	Yarrow Creek	Yarrow Creek	24,026	22%	28.8%
	Meydenbauer Creek	Meydenbauer Creek	2,408	29%	52.9%

	Lake Hurst Area	Lakehurst Creek, Newcastle Beach Creek, 60th Street Creek, 64th Street Creek	11,411	29%	36.3%
Kelsey Creek	Mercer Slough	Mercer Slough	23,419	15%	35.3%
	Kelsey Creek	Kelsey Creek	55,169	12%	41.8%
	West Tributary	West Tributary	17,791	15%	44.2%
	Goff Creek	Goff Creek	9,684	23%	30.3%
	Valley Creek	Valley Creek	15,566	15%	32.3%
	Sears Creek	Sears Creek	3,326	43%	64.2%
	Richards Creek	Richards Creek	12,180	12%	45.0%
	East Creek	East Creek	12,739	15%	48.4%
	Sturtevant Creek	Sturtevant Creek	23,419	15%	35.3%
	Sunset Creek	Sunset Creek	12,193	21%	44.1%
Coal Creek	Coal Creek	Coal Creek	77,187	5%	24.7%
	Newport Area	Newport Creek	4,715	3%	38.1%
West Lake Sammamish	North Sammamish Area	Idlywood Creek, Sunich Creek, Unnamed Creek, Unnamed Creek, Weona Park Creek	6,778	18%	33.2%
	Phantom Creek	Phantom Creek	4,046	7%	38.3%
	Vasa Creek	Vasa Creek	18,614	19%	40.3%
	South Sammamish Area	Reservoir Creek, Unnamed Creek, Sunrise Creek	17,884	20%	30.9%
Lewis Creek	Lewis Creek	Lewis Creek	48,520	10%	28.2%

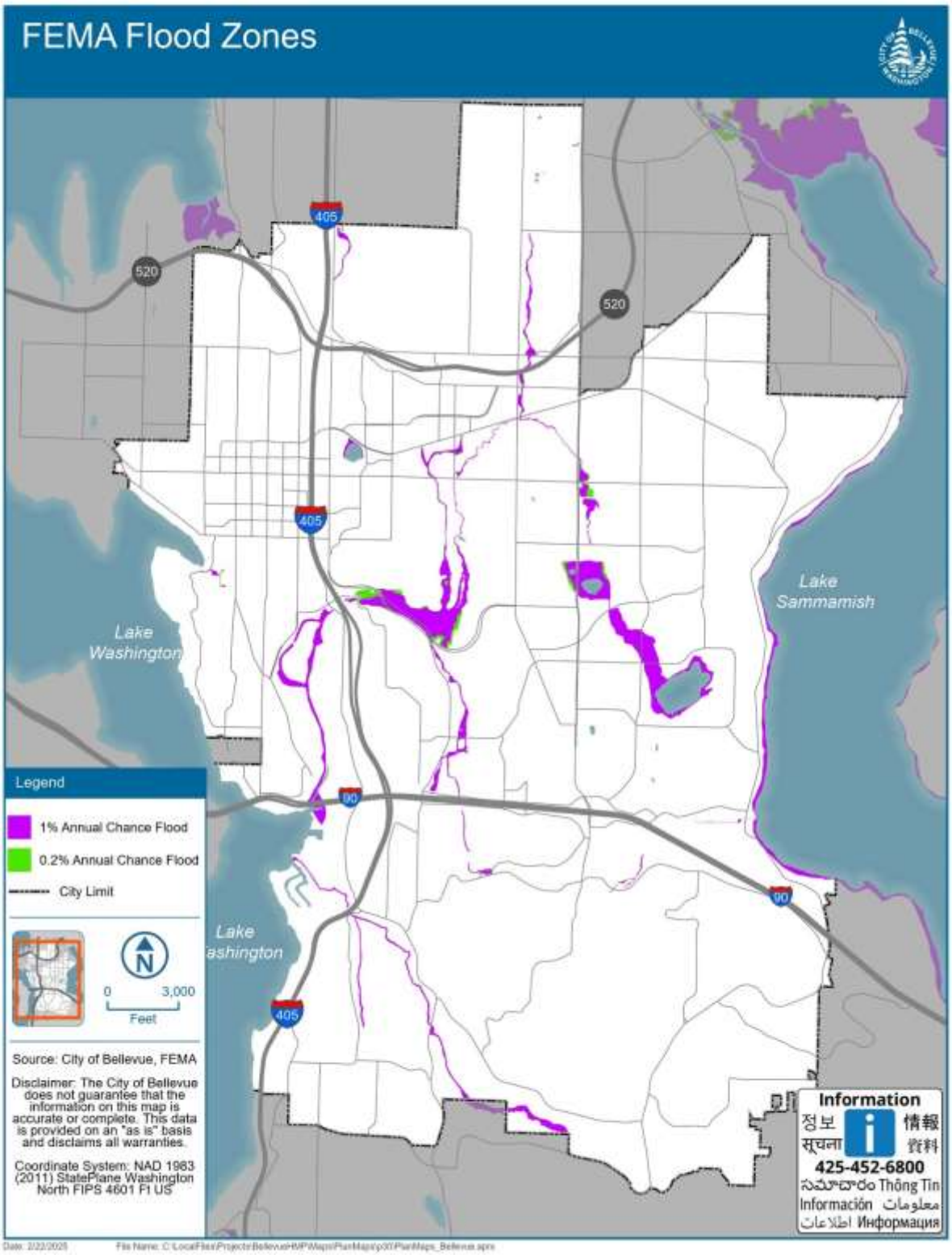

Figure 11-1. FEMA floodplains

Table 11-2. Bellevue floodplains

Stream Name	Stream Basin	City Storm Drainage Basin
East Creek	Mercer Slough/Kelsey Creek	East Creek Basin
262 (East Creek)	Mercer Slough/Kelsey Creek	East Creek Basin
East Creek Tributary 1	Mercer Slough/Kelsey Creek	East Creek Basin
East Creek Tributary 2	Mercer Slough/Kelsey Creek	East Creek Basin
0263A Tributary 2	Mercer Slough/Kelsey Creek	East Creek Basin
0263A Tributary 3	Mercer Slough/Kelsey Creek	East Creek Basin
Kelsey Creek Tributary 9 (0265N)	Mercer Slough/Kelsey Creek	Kelsey Creek Basin
New Castle Beach Creek	New Castle Beach Creek	Lakehurst Area
New Castle Beach Creek Tributary	New Castle Beach Creek	Lakehurst Area
Kelsey Creek	Mercer Slough/ Kelsey Creek	Mercer Slough Basin
Meydenbauer Creek	Meydenbauer Creek	Meydenbauer Creek Basin
West Tributary	Mercer Slough/ Kelsey Creek	West Tributary Basin
0264A	Mercer Slough/ Kelsey Creek	West Tributary Basin
Yarrow Creek	Yarrow Creek	Yarrow Creek Basin

Source: City of Bellevue

Figure 11-2. Flooding on SE Seventh Place near Lake Hills Connector

11.2.3 Extent

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. The discharges rates for floodplains with detailed studies are shown in Table 11-3.

Table 11-3. Summary of discharges

Flood Source	Drainage Area (Sq Mi)	Peak Discharges (cfs) 10% annual chance	2% annual chance	1% annual chance	0.2% annual chance
Coal Creek					
Mouth	7.31	228	306	340	420
At I-405	6.76	213	287	320	396
Kelsey Creek					
At mouth	10.10	434	604	690	925
At 140th Ave NE	6.69	279	390	447	601
At Lake Hills Blvd	2.25	63	83	92	114
West Tributary Kelsey Creek					
At mouth	1.75	146	225	268	395
At upstream confluence of East Branch	.34	16	25	29	41

Source: (FEMA, 2020)

11.2.4 Previous occurrences

The City of Bellevue has experienced a wide array of flooding events in the past and has areas that frequently flood after heavy rain events. Past flooding events include:

- In January 1996 an intense rainstorm caused state-wide flooding that led to $113 million in public losses.
- In winter 1997, ice storms, flooding and snow wreaked havoc on the region, causing $83 million in public loses.
- In December 2007, flooding occurred throughout western Washington. Bellevue sustained over $521,000 in public losses.

- In January 2009, Bellevue sustained over $500,000 in flood damage.
- In June 2013, heavy rains caused flooding in downtown Bellevue. Flood waters entered Bellevue Square Mall and flooded stores including the Apple Store and Tiffany & Co (Suman, 2013).
- In August 2014 a heavy rainstorm brought 2.65 inches of rain within 6 hours and caused flooding in Factoria. The flooding damaged eight condos and one commercial building. The rainfall was considered a 1,000 year event.
- In December 2023, intense rains caused flooding of several streets, including Southeast 7th Place, Southeast 26th Street, Northeast 21st Street and 148th Avenue Southeast when nearly three inches of rain overwhelmed local drainage systems. City crews worked to clear blocked storm drains and reopen roads after the waters receded (City of Bellevue, 2023).

11.2.5 Overall probability

The areas of floodplain evaluated in this plan have either a 1% chance of flooding each year (100-yr flood) or a 0.2% chance of flooding each year (500-yr flood).

11.2.6 Warning time

The City of Bellevue experiences varying warning times for flooding depending on the type and contributing factors. Urban stream flooding, which occurs when runoff exceeds the capacity of natural and man-made drainage systems during prolonged or intense rainfall, generally develops gradually, providing property owners time to prepare. However, high-intensity storms can cause rapid-onset flooding in some areas with little warning.

Groundwater flooding, driven by cumulative rainfall over multiple storms or seasons, develops more slowly, with high water levels persisting for weeks or months. Stormwater system failures, caused by blocked or overwhelmed drainage infrastructure, can lead to localized flooding with little to no warning.

The use of real-time stream gauge data, weather forecasts, atmospheric river tracking and regular maintenance of stormwater systems to issue timely warnings can enhance preparedness.

11.2.7 Climate change impacts

Climate change is expected to increase the frequency and intensity of flooding in the region due to rising rainfall volumes and more severe storm events. By 2050, Kelsey Creek in Bellevue is predicted to increase its peak streamflow by 12%.

The 2023 City of Bellevue Climate Vulnerability Assessment projects that climate change will heighten stormwater system stress, leading to increased localized flooding, erosion and sedimentation, especially during peak rain events. There is an anticipated 13% change in the magnitude of the 25-year storm and a 9% change in the 2-year storm. In addition, 82% of streams in King County are anticipated to see 10-50% more streamflow on the day of the year with the highest streamflow. These changes may lead to more areas in the City of Bellevue experiencing flooding and could disrupt transportation, ability to commute to work, and harm vital infrastructure (City of Bellevue, 2023).

Flooding, among other impacts, has the potential to damage public art, historic elements, infrastructure, as well as ecosystems and access to city services. An increase in flood events could also increase insurance premiums, coverage rates and mortgage interest rates could increase for properties at greater risk. Urban flooding runoff will negatively impact water quality, habitat and aquatic species. (City of Bellevue, 2023)

11.2.8 Future trends in development

A growing population may increase the number of people and infrastructure exposed to flood risks, leading to potential health hazards, displacement and in rare cases, loss of life. Changes in land use may harm ecosystems that help regulate flooding, such as wetlands. As areas in Bellevue continue to develop, there is an increase in impervious surfaces such as roads, buildings and pavement which reduce natural infiltration and increase runoff, leading to a higher flood risk during heavy rainfall events. In addition, development in the floodplain may also reduce natural water storage areas and impact ecosystems that play a vital role in absorbing and storing excess water during heavy rainfall. However, through effective planning, resilient infrastructure and updated floodplain management, the adverse impacts of flooding can be minimized.

11.3 Secondary Hazards

Secondary hazards associated with flooding include landslides triggered by saturated soils on the city's steep slopes, erosion that undermines infrastructure such as roads and bridges, and the potential for stormwater systems to overflow, causing urban flooding. Flooding can also lead to water contamination, posing risks to public health, disrupt utilities, transportation and emergency services.

11.4 National Flood Insurance Program

11.4.1 NFIP compliance

Flooding is the costliest natural hazard in the United States. Community participation in the National Flood Insurance Program opens opportunities for additional grant funding associated specifically with flooding issues. Assessment of the city's current NFIP status and compliance provides planners with a greater understanding of the local flood management program, opportunities for improvement and available grant funding opportunities. Information on NFIP participation is presented in Table 11-4, NFIP policies information is in Table 11-5 and information NFIP compliance is presented in Table 11-6.

Table 11-4. NFIP participation

ID	Initial Flood Hazard Boundary Map	Initial Flood Insurance Rate Map	Current Effective Map Date	Program Entry Date
530074B	08/02/1974	12/01/1978	08/19/2020	4/15/1981

Source: (NFIP, 2025)

Table 11-5. NFIP policies

Number of Policies	Insurance in Force	Total Annual Premium	Number of Claims	Value of Claims
396	$110,822,000	$179,311	66	$970,382[a]

[a.] Losses have not been adjusted for inflation

Table 11-6. NFIP compliance

Information	Response
Department responsible for floodplain management	Utilities Department and Development Services Department
Floodplain administrator	The Director of the Development Services Department, or designee

Number of Certified Floodplain Managers on staff	0
Date that the flood damage prevention ordinance was last amended	July 2020; Ord 6521
Minimum requirements exceeded	1-foot freeboard; floodplain includes lands subject to flooding not shown on FIRM, compensatory storage required
Date of most recent CAV or CAC?	2023
Outstanding NFIP compliance violations	0
Current RiskMAP projects	None
Adequate flood hazard maps	Yes
Does your floodplain management staff need any assistance or training to support its floodplain management program?	No

11.4.2 Community Rating System

The City of Bellevue has participated in the Community Rating System since October 1, 1992. The city is currently a Class 5, providing NFIP policy holders up to a 25% discount on their flood insurance premium. The Community Rating System Coordinator resides in the Utilities Department. The last reverification visit occurred in 2022.

11.4.3 Repetitive loss properties

A repetitive loss property is defined by FEMA as an NFIP-insured property that has experienced 2 paid losses in excess of $1,000 within any rolling 10-year period.

Repetitive loss properties within the City of Bellevue are listed in Table 11-7.

Table 11-7. Repetitive and multiple loss properties

Property Type	Mitigated	Number of Losses	Most Recent Loss	Area	Insured
Repetitive Loss Properties					
Single family	No	2	2014	Eastgate	No
Condo or Apartment Unit	Yes	2	2009	Downtown	Yes
Single family	No	2	1990	Newport	No
2-4 unit residential	Yes	2	2017	Eastgate	No
2-4 unit residential	Yes	2	2017	Eastgate	No

Multiple Loss Properties					
Single family	Yes	3	1991	Newport	No
Non-residential	Yes	2	1997	Crossroads	No

11.5 Vulnerability

11.5.1 People

There are 1,020 people living in the 100-year floodplain, representing .7% of the total population. Only 3 additional people live in the 500-year floodplain. The highest percentage of vulnerable population is in West Lake Sammamish, where 9.6% of the population live in the floodplain.

11.5.2 Structures

There are 323 structures within the 1% annual chance floodplain and an additional 4 structures in the 0.2% annual chance floodplain. There is an estimated 1.2% ($862 million) of the total replacement value of structures located in the 100-year floodplain. Most of the structures are located in the West Lake Sammamish neighborhood and are along the lakefront.

Table 11-8. Value of structures and content located in 1% annual chance floodplain

Area	Value of Structure Exposed	Value of Content Exposed	Total Value Exposed	% of Total Value Exposed
BelRed	$72,327,000	$62,225,685	$134,552,685	16.0%
Bridle Trails	$5,386,611	$2,693,305	$8,079,916	0.2%
Cougar Mountain/ Lakemont	$0	$0	$0	0%
Crossroads	$0	$0	$0	0%
Downtown	$0	$0	$0	0%
Eastgate	$56,192,905	$56,999,682	$113,192,587	2.0%
Factoria	$0	$0	$0	0%
Lake Hills	$22,805,058	$21,839,709	$44,644,767	1.1%
Newport	$14,727,428	$7,363,714	$22,091,142	0.9%
Northeast Bellevue	$18,742,937	$9,371,469	$28,114,406	1.0%
Northwest Bellevue	$0	$0	$0	0%

Somerset	$0	$0	$0	0%
West Bellevue	$149,554,641	$141,574,988	$291,129,629	6.7%
West Lake Sammamish	$134,944,029	$67,631,158	$202,575,187	12.2%
Wilburton	$4,522,755	$2,261,378	$6,784,133	0.3%
Woodridge	$5,509,419	$5,509,419	$11,018,837	0.9%
Total	**$484,712,782**	**$377,470,506**	**$862,183,289**	**1.2%**

The four additional structures in the 0.2% annual chance floodplain add an $4 million dollars in structure and contents value.

The type of structures in the 1% annual chance floodplain are shown in Table 11-9.

Table 11-9. Number of structures in the 1% annual chance floodplain

Jurisdiction	Res.	Comm.	Ind.	Rel.	Gov.	Edu.	Total
BelRed	1	16	0	0	0	0	17
Bridle Trails	7	0	0	0	0	0	7
Cougar Mountain/ Lakemont	0	0	0	0	0	0	0
Crossroads	0	0	0	0	0	0	0
Downtown	0	0	0	0	0	0	0
Eastgate	2	6	3	0	0	0	11
Factoria	0	0	0	0	0	0	0
Lake Hills	6	4	0	0	0	0	10
Newport	23	0	0	0	0	0	23
Northeast Bellevue	36	0	0	0	0	0	36
Northwest Bellevue	0	0	0	0	0	0	0
Somerset	0	0	0	0	0	0	0
West Bellevue	2	13	0	0	0	0	15
West Lake Sammamish	192	1	0	1	0	0	194
Wilburton	9	0	0	0	0	0	9
Woodridge	0	1	0	0	0	0	1
Total	**278**	**41**	**3**	**1**	**0**	**0**	**323**

In the 0.2% chance annual floodplain, there is 1 additional commercial structure in BelRed, 2 additional commercial structures in Lake Hills and 1 additional residential structure in West Lake Sammamish.

11.5.3 Systems

Essential systems, networks and capabilities such as emergency response systems, economic stability and planning capabilities are vulnerable to the flooding hazards. Roads or railroads that are blocked or damaged can isolate community members and can prevent access throughout the planning area. Preserving access is particularly important for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Underground utilities can be damaged.

Flooding events can also significantly impact bridges and transportation routes. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

11.5.4 Natural, historic and cultural resources

Natural, historic and cultural resources that are in areas with flood risk are vulnerable to flooding. Many species of mammals, birds, reptiles, amphibians and fish live in Bellevue in floodplain ecosystems. Watercourses and water bodies in Bellevue have historic and cultural significance. Streams such as Kelsey Creek and Coal Creek historically supported indigenous communities such as the Snoqualmie.

11.5.5 Activities that have value to the community

Much of Bellevue's recreation and economy is intertwined with its urban parks, green spaces and proximity to waterbodies such as Lake Washington and local streams. All water-based recreation within the city is vulnerable to flooding.

11.6 Impacts

11.6.1 People

The Hazus analysis determined that 154 people will be displaced and 11 people will require short-term shelter after the 1% annual chance flood occurs. The 0.2% annual chance flood will displace one additional person.

However, people may be impacted by flooding due to reduced mobility when streets are flooded. People may not be able to travel to work or appointments, and delivery services may be delayed.

11.6.2 Structures

Even though there are 323 structures in the 1% annual chance floodplain, only 17 structures are expected to be impacted. These structures were likely constructed prior to when floodplain construction regulations were in place. Newer structures are built to avoid flood damages.

Table 11-10. Damage value

Area	Number of Structures	Value of Structure Damages	Value of Contents Damages	Total Value Damaged	% of Total Value Damaged
BelRed	10	$2,351,130	$4,556,170	$6,907,300	0.1%
Eastgate	1	$198	$198	$397	0.0%
Lake Hills	3	$18,204	$236,650	$254,854	0.0%
West Lake Sammamish	3	$64,235	$1,000	$65,235	0.0%
Total	**17**	**$2,433,768**	**$4,794,018**	**$7,227,786**	**0.0%**

11.6.3 Systems

Systems, networks, and capabilities can be impacted by flooding in Bellevue in a variety of ways. An extreme flood event may stress emergency response, public works and other government services with high demands for response and recovery. Floods block access routes and delay rescue or medical aide access to impacted areas. Flood damage can impact the local economy through closure of businesses, which will directly impact employment in the community.

Significant financial resources are often needed to recover from flood events. Applying for, receiving, and managing the necessary public assistance and grant

funding to effectively recover will require a greater capacity from local government, including the Public Works Department and Utilities Department.

11.6.4 Natural, historic and cultural resources

Flooding is a natural event and floodplains provide natural and beneficial functions. Still, flooding can impact the natural environment in negative ways, especially when compounded with impacts from human development. Migrating fish can wash into roads or into flooded fields. Pollution from roads, such as oil and hazardous materials can wash into rivers and streams. During floods these pollutants can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

11.6.5 Activities that have value to the community

Flooding in Bellevue can significantly impact water-based recreation and associated infrastructure. Flooding can reduce water quality, damage riparian areas and wash out trails. Additionally, floodwaters can harm waterfront infrastructure such as boat launches, docks, trails and waterfront parks.

11.7 National Risk Index

Table 11-11 provide NRI results for flooding.

Table 11-11. NRI results

Expected Annual Loss	Expected Annual Loss Rating	Community Resilience	Social Vulnerability	Risk Index Score	Risk Index Rating
$28,932	Very Low	Relatively Moderate	Relatively Low	19	Very Low

11.8 Mitigating the Hazard

Table 11-12 presents a range of potential opportunities for mitigating the flood hazard.

Table 11-12. Flood mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ Clear stormwater drains and culverts ▪ Institute low-impact development techniques on property
Corporate	▪ Clear stormwater drains and culverts ▪ Institute low-impact development techniques on property
Government	▪ Maintain drainage system ▪ Require low-impact development techniques ▪ Dredging, levee construction, and providing regional retention areas ▪ Structural flood control, levees, channelization, or revetments. ▪ Stormwater management regulations and master planning ▪ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Exposure	
Personal	▪ Locate outside of hazard area ▪ Elevate utilities above base flood elevation
Corporate	▪ Locate business critical facilities or functions outside hazard area
Government	▪ Locate or relocate critical facilities outside of hazard area ▪ Acquire or relocate identified repetitive loss properties ▪ Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. ▪ Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Vulnerability	
Personal	▪ Elevate structures and items within homes above base flood elevation ▪ Flood-proof existing structures
Corporate	▪ Build redundancy for critical functions or retrofit critical buildings ▪ Provide floodproofing measures when new critical infrastructure must be located in floodplains
Government	▪ Harden infrastructure ▪ Provide redundancy for critical functions and infrastructure ▪ Adopt appropriate regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions ▪ Stormwater management regulations and master planning ▪ Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities
Increase Preparation or Response Capability	
Personal	▪ Buy flood insurance

	▪ Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72-hour self-sufficiency during and after an event ▪ Find out if you live in an area with flood risk ▪ Educate yourself on risk and vulnerability to the flood hazard as well as emergency warning procedures and protocols.
Corporate	▪ Keep cash reserves for reconstruction ▪ Support and implement hazard disclosure for the sale/resale of property in identified risk zones ▪ Solicit cost-sharing through partnerships with other stakeholders on projects with multiple benefits. ▪ Develop a continuity of operations plan (COOP)
Government	▪ Produce better hazard maps ▪ Provide technical information and guidance ▪ Enact tools to help manage development in hazard areas (stronger controls, tax incentives and information) ▪ Incorporate retrofitting or replacement of critical system elements in capital improvement plan ▪ Develop strategy to take advantage of post-disaster opportunities ▪ Develop and adopt a Continuity of Operations Plan ▪ Maintain existing data and gather new data needed to define risks and vulnerability ▪ Train emergency responders ▪ Create a building and elevation inventory of structures in the floodplain ▪ Develop and implement a public information strategy ▪ Integrate floodplain management policies into other planning mechanisms within the planning area. ▪ Consider the probable impacts of climate change on the risk associated with the flood hazard ▪ Consider the residual risk associated with structural flood control in future land use decisions

12. Landslide

12.1 General Background

12.1.1 Landslide types

Landslides are commonly categorized by the type of initial ground failure. Common types of slides are shown on Figure 12-1 through Figure 12-4. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, which are less common than other types.

Source: Washington Department of Ecology, 2014

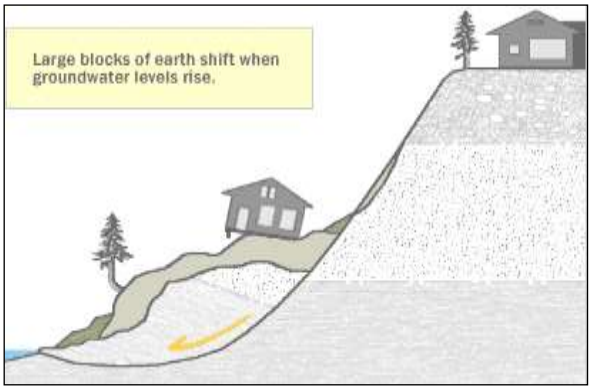

Figure 12-1. Deep seated slide

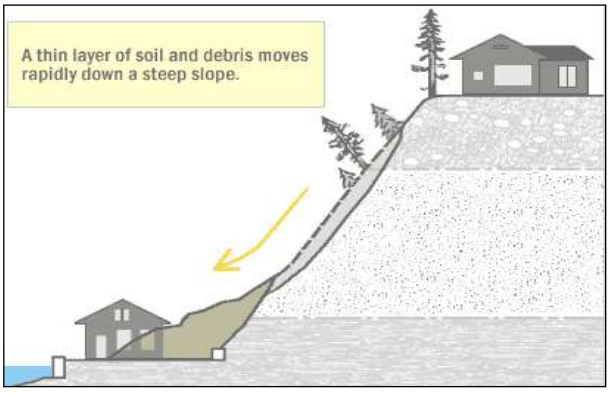

Figure 12-2. Shallow colluvial slide

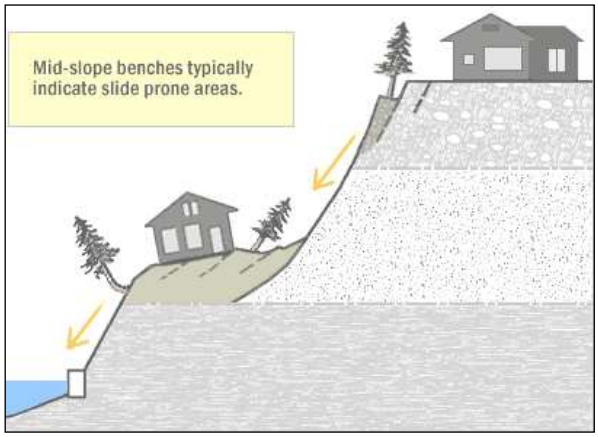

Figure 12-3. Bench slide

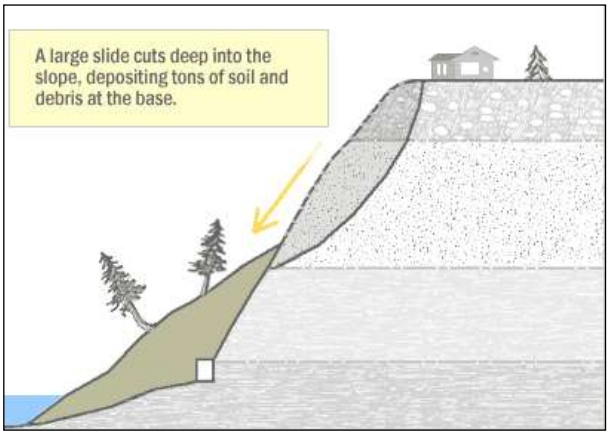

Figure 12-4. Large slide

Other landslide types also include the following:

- **Block slides**—Blocks of rock that slide along a slip plane as a unit down a slope.

- **Creep**—A slow-moving landslide often only noticed through crooked trees and disturbed structures.
- **Debris avalanche**—A debris flow that travels faster than about 10 miles per hour (mph). Speeds in excess of 20 mph are not uncommon and speeds in excess of 100 mph, although rare, can occur. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars and anything else in its path.
- **Earth flows**—Fine-grained sediments that flow downhill and typically form a fan structure.
- **Mudslides or Debris Flows**—Rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt.
- **Rock falls**—Blocks of rock that fall away from a bedrock unit without a rotational component.
- **Rock topples**—Blocks of rock that fall away from a bedrock unit with a rotational component.
- **Rotational slumps**—Blocks of fine-grained sediment that rotate and move down slope.
- **Transitional slides**—Sediments that move along a flat surface without a rotational component.

12.1.2 Landslide causes

Landslides are caused by a combination of geological and climate conditions, as well as encroaching urbanization. Vulnerable areas are affected by residential, agricultural, commercial and industrial development and the infrastructure that supports it. The following human activities have particular influence on the landslide hazard:

- **Construction Earthwork**—Excavation, grading and fill during construction of buildings or roads on sloping terrain can steepen the terrain and increase weight loads on slopes, potentially increasing the landslide hazard.
- **Drainage and Groundwater Alterations**—Activities that increase the amount of water flowing into landslide-prone slopes can increase the landslide hazard. This can include broken or leaking water or sewer lines, water retention facilities that direct water onto slopes, lawn irrigation, minor alterations to small streams and ineffective stormwater management measures. Development that increases

impervious surface may redirect surface water to other areas. Road and driveway drains, gutters, downspouts and other constructed drainage facilities can concentrate and accelerate flow.

- **Changes in Vegetation**—Removal of vegetation from very steep slopes, by wildfire or land clearing, can increase landslide hazards. In addition, woody debris in stream channels (both natural and man-made) may cause the impacts from debris flows to be more severe.

Other factors that can contribute to landslide include the following:

- Change in slope of the terrain
- Increased load on the land, shocks and vibrations
- Change in water content
- Groundwater movement
- Frost action
- Weathering of rocks
- Removing or changing the type of vegetation covering slopes.
- Erosion by rivers, glaciers or ocean waves that create over-steepened slopes

12.1.3 Landslide management

Landslides are primarily natural phenomena triggered by heavy precipitation or seismic events, although human activity can exacerbate smaller landslides. Large landslides typically occur in areas with a history of movement, impacting roadways, infrastructure, private property, and can cause flooding and erosion. While they pose significant risks to public safety, landslides also contribute to stream ecosystems by supplying sediment and large wood, which are essential for aquatic and riparian habitats. Effective management includes identifying high-risk areas, regulating development near unstable zones, preparing for emergency response and exploring stabilization or relocation options for critical infrastructure.

Local regulations, including the City of Bellevue's Critical Area Ordinance, guided by the Washington State Growth Management Act, aim to minimize the impacts of landslides and other geohazards on development.

12.2 Hazard Profile

12.2.1 Location

Portions of Bellevue may be directly and indirectly impacted by landslides. Seismic/liquefaction hazards are mostly along West Lake Sammamish and West Bellevue, but can also be found in certain locations throughout the city where historic wetlands and streams have been covered with fill. Steep slopes that are more susceptible to landslides are found in most neighborhoods with greater concentrations in east, south and west areas of Bellevue. The city has classified landslide hazard areas as those areas that have slopes greater than 15% with more than 10-feet of rise that have certain characteristics, such as areas of historic failures, areas with seeps, or areas affected by erosion.

12.2.2 Extent

In Bellevue, landslides occur in areas with steep slopes and often after heavy rainfall, which can destabilize the soil. The city is especially susceptible due to its hilly terrain and high precipitation, making it prone to both small and large landslides. See Figure 12-5 for a map of known landslide hazard areas.

Landslides can be classified as either shallow landslides or deep-seated landslides. Shallow landslides are generally less intense and affect a smaller area. Shallow landslides include debris flows, rock falls and rock topples. Deep seated landslides are rooted in bedrock are generally much more intense than shallow landslides. They cover larger areas and are more destructive to infrastructure and structures. Deep seated landslides include translational slides, rotational slides and large block slides (DNR, 2017).

Landslides of all intensities destroy property and infrastructure and can take the lives of people. Even small landslides have the potential of destabilizing the foundation of structures, which may result in monetary loss for community members. Landslides are estimated to cost billions of dollars in damage annually and result in multiple deaths (USGS) Landslides can pose a serious hazard to properties on or below hillsides. They can cause block access to roads, which can isolate community members and businesses and delay commercial, public and private transportation. This can result in economic losses for businesses. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

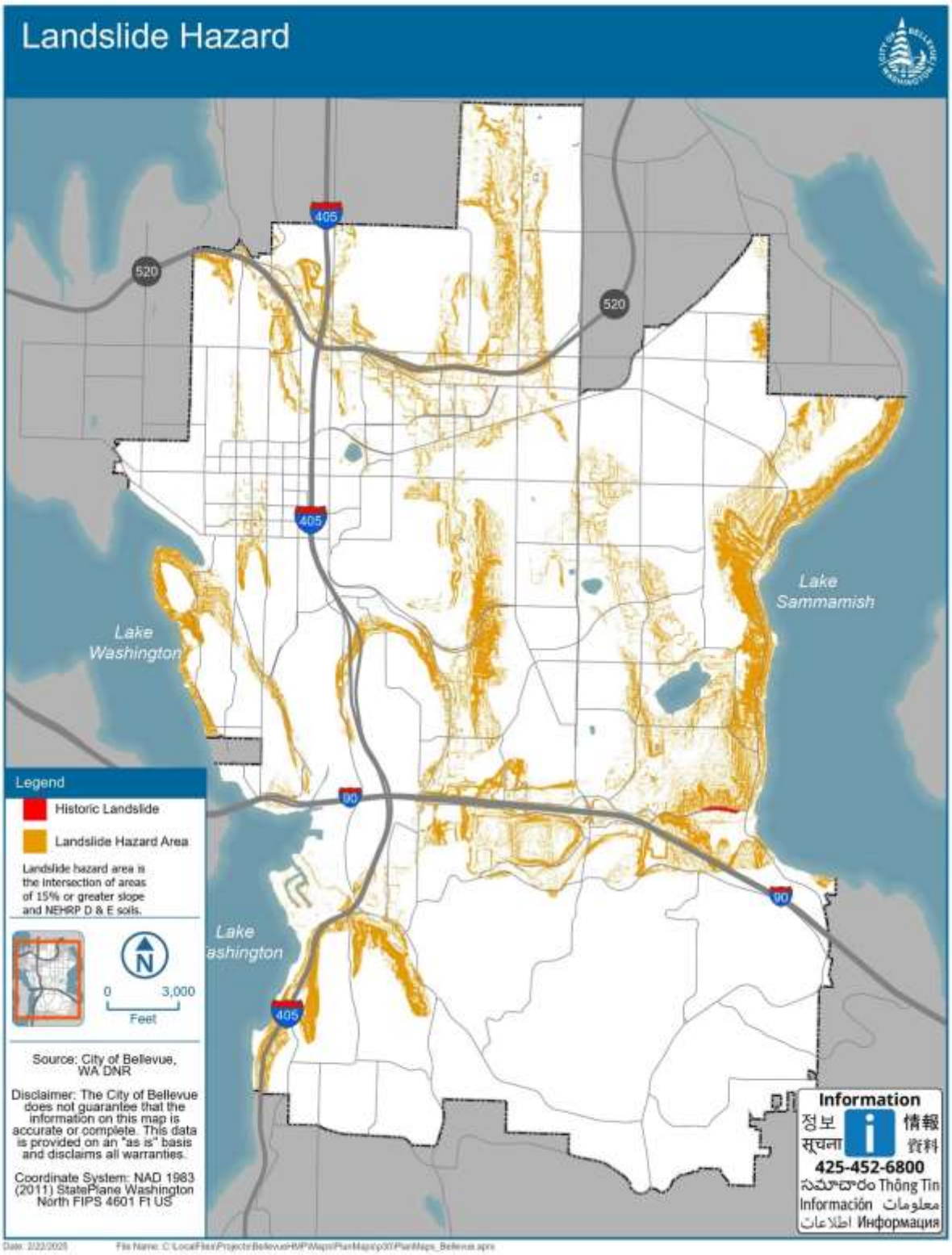

Figure 12-5. Landslide hazard areas

12.2.3 Previous occurrences

The City of Bellevue has experienced several notable landslides. These landslides often are the result of a variety of factors including slope, unstable soils and heavy rainfall.

- Most recently, in January of 2022, a landslide caused by a broken water main in Bellevue's Somerset neighborhood pushed a house off its foundation and caused seven other houses to be deemed unsafe (City of Bellevue, 2024).
- In 2012 a section of West Lake Sammamish Parkway Southeast was closed for nine weeks due a January landslide. The landslide was caused by a water main break and required the evacuation of four homes.
- In 2001, after the Nisqually Earthquake, city had to perform emergency bank stabilization after a landslide threatened the Olympic Pipeline. In 2003, the city had to repair the roadway due to the ground continuing the shift (City of Bellevue, 2018).
- In 2001, a January storm caused a slide on West Lake Sammamish Parkway that caused power outages to over 1,500 customers, toppled trees onto the road and forced the evacuation of several homes (USGS, 2013).
- In 2001, a November storm caused a shallow debris flow that undermined a portion of the West Lake Sammamish Parkway. Caused by a plugged culvert, the material slid down a steep hill and affected at least three homes. One home had up to one foot of mud throughout the first floor of the house (USGS, 2013).
- In 1997, a storm caused a culvert crossing West Lake Sammamish Parkway Southeast to clog, causing a slide that blocked the road. A slide on Southeast Shoreline Drive forced three homes to be evacuated (Diane Brooks, 1997).

12.2.4 Overall probability

Landslides are difficult to predict. In some years, like 2001, multiple landslides occurred due to heavy rain, storms and the Nisqually earthquake. Landslides have occurred from water main breaks. Overall, since 1997, at least 6 damaging landslides have occurred. Based on historic frequency and future conditions, the probability of future landslide occurrences is high, with a chance of at least one landslide occurring every four years.

12.2.5 Warning time

Mass movements can occur suddenly or slowly. The velocity of movement may range from inches per year to many feet per second, depending on slope angle,

material and water content. Generally accepted warning signs for landslide activity include the following:

- Springs, seeps or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)
- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows and visible open spaces indicating frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. Assessing the geology, vegetation and amount of predicted precipitation for an area can help in predictions of what areas are generally at risk. Currently, there is no practical warning system for individual landslides. The standard operating procedure is to monitor situations on a case-by-case basis and respond after an event has occurred.

12.2.6 Climate change impacts

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. More intense rainfall, caused by climate change, may saturate the soil and trigger landslides. The Bellevue Climate Resilience Plan identifies landslides as a critical hazard for the city, given its steep

slopes and areas of unstable soil. Increase in global temperature is likely to affect the snowpack and its ability to hold and store water.

In a warming climate, precipitation that previously would have fallen as snow, is now rain. Rain falling on an existing snowpack may cause rapid melting and increased runoff. This may lead to a greater risk of landslides (USGS 2019). Urban development and deforestation on hillsides further exacerbate these risks by reducing natural vegetation that stabilizes slopes. The extreme precipitation could also increase landslide risk which could deposit into the water bodies or damage drinking water supply lines managed by Seattle Public Utilities. There is also a greater risk to the disruption of transportation and recreation in areas adjacent to areas of steep slope (City of Bellevue, 2023).

12.2.7 Future trends in development

Future development in Bellevue, particularly urban expansion into slope-prone areas, could increase landslide hazards due to vegetation removal, soil disturbance and amplified stormwater runoff. However, the State of Washington has adopted the International Building Code by reference in its Washington Building Standards Code. The International Building Code includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions ensure that new construction is built to standards that reduce vulnerability to the landslide risk. In addition, the city of Bellevue's comprehensive plan defines landslide hazard areas as critical areas and have adopted critical areas ordinances that regulate development in landslide-prone areas. This will facilitate wise land use decisions as future growth impacts landslide hazard areas. It is anticipated that some new development will be exposed to landslide risk, as runout models do not yet exist and it is likely that not all landslide hazard areas have been identified.

12.3 Secondary Hazards

Secondary hazards such as flooding from blocked streams or drainage systems and debris flows may impact homes and infrastructure. In addition, erosion can increase sediment in waterways. These events can disrupt utilities, damage transportation networks and harm aquatic habitats. Additionally, landslides may release pollutants into water and soil, compounding environmental and recovery challenges.

12.4 Vulnerability and Impacts

12.4.1 People

Landslides can directly endanger lives, particularly in hillside neighborhoods or areas with steep slopes. Community members living near landslide-prone zones face risks of injury, evacuation and displacement, especially following heavy rainfall or seismic events. In Bellevue, there are almost 13,000 people living in areas with landslide risk.

12.4.2 Structures

Homes, buildings and infrastructure on or near steep slopes are vulnerable to landslide damage. The impacts include structural collapse, foundation instability and utility line disruptions, leading to costly repairs and reduced property values. In Bellevue, there are 3,214 buildings vulnerable to the landslide hazard, with structure and contents valued at $4.67 million. The vulnerability per neighborhood is shown in Table 12-1.

Table 12-1. Number and value of vulnerable structures

Area	Number of Vulnerable Buildings	Total Building and Contents Value	% of Total Value
BelRed	40	$336,093,328	3.9%
Bridle Trails	143	$183,490,508	4.9%
Cougar Mountain/ Lakemont	0	$0	0.0%
Crossroads	39	$30,515,594	0.9%
Downtown	10	$765,806,846	3.7%
Eastgate	293	$479,111,602	8.3%
Factoria	14	$512,206,701	19.6%
Lake Hills	558	$260,775,952	6.3%
Newport	121	$92,024,892	3.6%
Northeast Bellevue	642	$371,870,309	13.1%
Northwest Bellevue	96	$342,792,963	7.8%
Somerset	9	$21,523,294	1.0%
West Bellevue	353	$453,769,215	10.5%
West Lake Sammamish	762	$635,510,641	38.3%
Wilburton	68	$45,339,635	2.0%
Woodridge	66	$143,865,936	12.2%
Total	**3,214**	**$4,674,697,417**	**6.3%**

12.4.3 Systems

Critical systems such as roads, power lines and water infrastructure can be severely affected by landslides. Blocked transportation routes and damaged utility systems can delay emergency responses and disrupt daily life in affected areas.

12.4.4 Natural, historic and cultural resources

Landslides can degrade natural habitats, particularly forested areas and streams, by uprooting vegetation and increasing sedimentation. Historic sites and cultural landmarks situated on slopes or near waterways are also at risk of damage or loss.

12.4.5 Activities that have value to the community

Outdoor recreation, including hiking and trail use, can be disrupted by landslides, which may destroy trails and access points. Community events or tourism tied to natural areas could also face interruptions, impacting the city's economy.

12.5 National Risk Index

Table 12-2. NRI results

Expected Annual Loss	Expected Annual Loss Rating	Community Resilience	Social Vulnerability	Risk Index Score	Risk Index Rating
$31,826	Relatively Low	Relatively Moderate	Relatively Low	54	Relatively Low

12.6 Mitigating the Hazard

Table 12-3 presents a range of potential opportunities for mitigating the landslide hazard.

Table 12-3. Landslide mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ Stabilize slopes (dewater, armor toe) ▪ Reduce weight on top of slope ▪ Minimize vegetation removal and the addition of impervious surfaces
Corporate	▪ Stabilize slope (dewater, armor toe) ▪ Reduce weight on top of slope
Government	▪ Stabilize slope (dewater, armor toe, construction retention walls)

	▪ Reduce weight on top of slope ▪ Improve stormwater and drainage on steep slopes
Reduce Exposure	
Personal	▪ Locate structures outside of hazard area (off unstable land and away from slide-run out area)
Corporate	▪ Locate structures outside of hazard area (off unstable land and away from slide-run out area)
Government	▪ Acquire properties in high-risk landslide areas. ▪ Adopt land use policies that prohibit the placement of habitable structures in high-risk landslide areas ▪ Relocate utilities and critical facilities from hazard areas
Reduce Vulnerability	
Personal	▪ Retrofit home
Corporate	▪ Retrofit at-risk facilities
Government	▪ Adopt higher regulatory standards for new development within unstable slope areas ▪ Armor/retrofit critical infrastructure against the impact of landslides
Increase Preparation or Response Capability	
Personal	▪ Develop household evacuation plan ▪ Keep cash reserves for reconstruction ▪ Educate yourself on risk reduction techniques for landslide hazards ▪ Ensure homeowners insurance provides landslide coverage
Corporate	▪ Institute warning system and develop evacuation plan ▪ Keep cash reserves for reconstruction ▪ Develop a Continuity of Operations Plan ▪ Educate employees on the potential exposure to landslide hazards and emergency response protocol
Government	▪ Gather LiDAR data ▪ Produce better hazard maps ▪ Provide technical information and guidance ▪ Enact tools to help manage development in hazard areas: better land controls, tax incentives, information ▪ Develop strategy to take advantage of post-disaster opportunities ▪ Develop and adopt a Continuity of Operations Plan ▪ Educate the public on the landslide hazard and appropriate risk reduction alternatives

13. Severe Weather

13.1 General Background

Severe weather refers to any dangerous meteorological event with the potential to cause damage, serious social disruption or loss of human life. The most common severe weather events to impact the planning area are winter storms (hail, ice storms, snowstorms), severe thunderstorms, high winds and extreme temperatures. For this risk assessment, any use of the term "severe weather" refers to these four event types in aggregate. They are assessed as a single hazard for the following reasons:

- Records indicate that each of these weather event types has impacted the planning area to some degree, and all have similar frequencies of occurrence.
- These weather event types have no clearly defined extent or location. Therefore, no quantitative, geospatial analysis is available to support exposure or vulnerability analysis; the analyses for this hazard are qualitative.

13.1.1 Winter storms

A winter storm is defined for this plan as a storm with snow, ice and/or freezing rain. In Bellevue, heavy snowfall is 4-inches or more in a 12-hour period, or 6-inches or more in a 24-hour period. Severe winter storms occur when there is significant precipitation and the temperature is low enough that the precipitation completely or partially freezes.

Figure 13-1 shows the general circumstances that result in different winter precipitation events.

13.1.2 Thunderstorms

NOAA classifies a thunderstorm as a storm with lightning and thunder, usually with gusty winds, heavy rain and sometimes hail. Thunderstorms are usually short (seldom more than two hours). In the summer, dry thunderstorms occur, with lightning strikes but no rain (dry lightning). A severe thunderstorm is defined for this plan as a thunderstorm with heavy precipitation, dry lightning, or large hail. Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Super-cooled water may accumulate on frozen particles near the back-side of a storm as they are pushed

forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground. Fortunately, storms with large damaging hail are infrequent.

Lightning associated with thunderstorms is an electrical discharge that results from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt." This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000°F. The rapid heating and cooling of air near the lightning causes thunder. Dry thunderstorms are a major cause of wildfire during the summer.

Source: National Weather Service, n.d.)

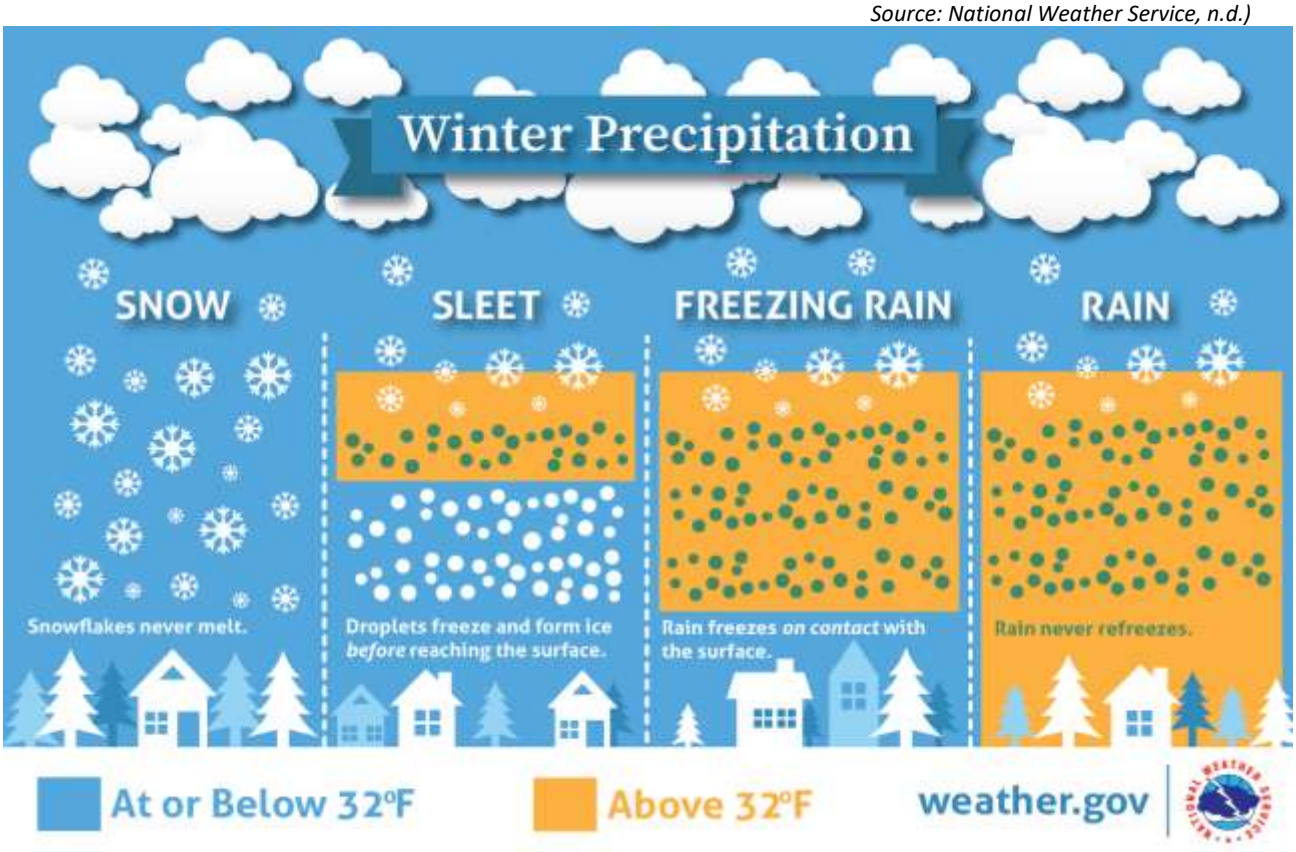

Figure 13-1. Effects of air temperature on winter precipitation events

13.1.3 High winds

High winds are defined for this plan as sustained winds of 40 mph or gusts of 58 mph or greater, not caused by thunderstorms, that are expected to last for an hour or more. The National Weather Service classifies wind from 38 to 55 mph as gale force winds; 56 to 74 mph as storm force winds and any winds over 75 mph as

hurricane force winds. Destructive winds normally occur in the planning area between October and March.

High winds also include tornados. Although rare, tornadoes have occurred in the area and several funnel clouds have been spotted.

A bomb cyclone brings powerful winds and heavy precipitation. A bomb cyclone occurs when a midlatitude cyclone rapidly intensifies and undergoes bombogenesis, a rapid decrease in pressure at the center of the cyclone. The decrease in pressure causes the winds to intensify and the warmer air to rise forming into a precipitation. See Figure 13-2 for a satellite photo of the bomb cyclone that formed in November 2024.

Figure 13-2. Satellite photo of November 2024 bomb cyclone (NASA)

13.1.4 Extreme temperatures

FEMA defines extreme weather as prolonged periods of excessively hot or cold weather, with temperatures above the average high (extreme heat) or below the average low (extreme cold). In Bellevue, extreme cold means approximately

temperatures below freezing and extreme heat means temperatures above 90 degrees Fahrenheit. These types of extreme temperatures will pose significant risk to human health and infrastructure. Extreme heat often results in the highest annual number of deaths among all weather-related disasters (FEMA 2024). Extreme cold can cause frostbite, hypothermia and may even become life-threatening (National Oceanic and Atmospheric Administration (Combos, 2021)

Extreme cold occurs when temperatures are in dangerous ranges that may cause frostbite or hypothermia to people who are exposed. Very cold temperatures are often a result of an unstable polar vortex which brings cold air to the south.

Source: NOAA

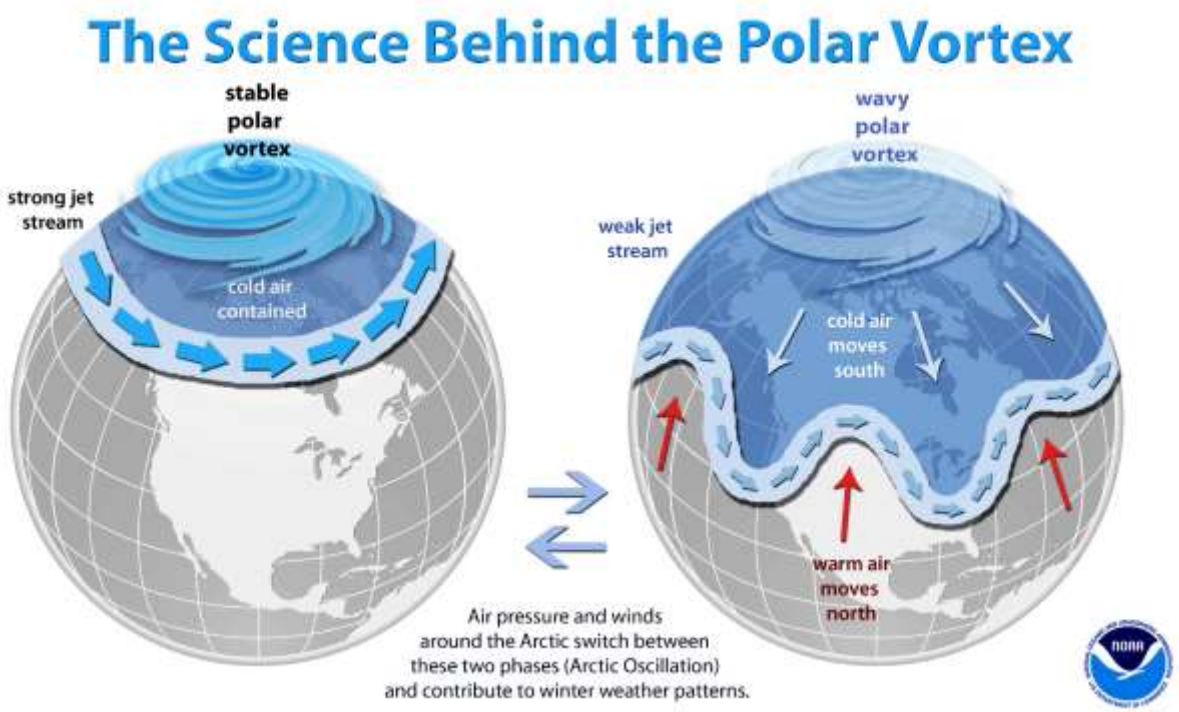

Figure 13-3. The science behind the polar vortex

13.2 Hazard Profile

13.2.1 Location

All areas of Bellevue are vulnerable to the threat of severe weather.

13.2.2 Extent

Severe weather events in Bellevue, including winter storms, severe thunderstorms, high winds and extreme temperatures, vary in their intensity and frequency. Winter

storms can bring snow, ice and sleet, resulting in hazardous road conditions and power outages. Severe thunderstorms often come with lightning, hail and heavy rains, which can lead to flash floods and property damage. High winds can lead to downed trees, damaged power lines and structural impacts. Extreme temperatures, both high and low, may stress infrastructure and affect public health.

13.2.3 Previous occurrences

Historically, Bellevue has experienced notable high-wind events, extreme precipitation and occasional heat waves. The city's severe weather history is described in Table 13-1.

Most recently in November 2024, a "bomb cyclone" brought powerful winds that uprooted trees, damaged infrastructure, and left community members trapped by debris in neighborhoods like Bridle Trails (Drew Andre, 2024).

Table 13-1. Severe weather history

Event Date and Type	Description
January 1880 Wind Storm / Snow Storm	A series of storms known as "The Big Snow" and the "Storm King" in January 1880 led to 4-6 feet of snow on the ground in Seattle after it settled.
February 1916 Snow Storm	On Groundhog Day 1916, Seattle received 21.5 inches of snow.
October 1934 Wind Storm	An intense wind storm brought 70 mph wind gusts to Seattle and caused widespread power outages, buildings to collapse and numerous fires.
January 1943 Winter Storm	In January 1973 and snow storm and cold snap brought Puget Sound to a stop. Temperatures dropped to 6 degrees, natural gas supplies ran low, snow and ice broke power lines, and 11 children were injured in sledding accidents.
January 1950 Winter Storm	During the last two weeks of January, storms rolled through the region, bringing wind, snow and freezing temperatures. The last week of the month brought single digit temperatures and eight of the coldest days still on record. Lake Washington and Lake Sammamish partially froze.
January 1958 Wind Storm	The storm brought 63 mph winds to Seattle, toppling power lines and trees.
November 1958 Wind Storm	During "The Intense Cyclone," wind gusts up to 59 mph were recorded at Sea-Tac Airport.

October 1962 Wind Storm	The "Columbus Day windstorm" began as Typhoon Freda and is still the most powerful storm to affect the region. Wind gusts of 100 mph were recorded in Renton. On the Washington coast, wind speeds were equivalent to a category 3 hurricane. Entire stands of trees were blown down, totaling more than the average annual tree harvest.
February 1979 Wind Storm	The Hood Canal Storm brought winds exceeding over 100 mph to the Hood Canal area. Associated wind gusts to 60 mph damaged the Evergreen Point Floating Bridge.
November 1981 Wind Storm	Two storms within 48-hours caused deaths and power outages throughout Western Washington, and 70-80 mph wind gusts damaged shut down the Evergreen Point Floating Bridge.
November 1983 Wind Storm	A storm on Thanksgiving Day knocked out power to 270,000 homes around Puget Sound.
January 1993 Wind Storm	The Inauguration Day Storm brought gusts of wind up to 88 mph, closed the Evergreen Point Floating Bridge and the I-90 floating bridge, destroyed buildings, and caused long power outages for over 600,000 people. A cold snap after the storm exacerbated the situation due to the widespread power outages. This is one of the first well-predicted wind storm, but coverage of the presidential inauguration was seen as the priority by local news coverage.
December 1995 Wind Storm Disaster #DR-1079	High winds caused power outages and down trees throughout Bellevue.
September 1996 Flood	Thunderstorms moved through the region knocking out power and flooding roads and crawlspaces. In some areas, rain fell at a rate of half an inch in 20 minutes.
November 1996 Lightning	Lightning knocked out power in several areas of Bellevue.
December 1996 Wind Storm / Heavy Rain Disaster # DR-1159	The Hanukkah Eve storm brought heavy rain caused over $315 million in damages, widespread power outages and landslides. In Seattle, over 8 inches of rain fell in 8 days. Over 700,000 people were without power. After the storm, temperatures dropped past freezing creating a new emergency. Many people, overwhelmingly immigrants, moved grills and generators into homes to stay warm. Hundreds of people were treated at emergency rooms for carbon monoxide poisoning and eight people died.
June 1997 Funnel Cloud	A funnel cloud was spotted over Redmond.

September 2003 Heavy Rain	Heavy showers fell on eastern King and Snohomish counties after a month of dry weather.
August 2004 Heavy Rain	Heavy rain flooded a Qwest copper cable, disrupting phone service to 1,500 customers. Damage to 26 homes in Seattle's Madison Valley occurred due to a backed up stormwater overflow tank.
January 2006 Heavy Rain Disaster # DR-xxxx	Ten days of intermittent heavy rain caused over $7 million dollars in damage, to transportation infrastructure in western Washington. It also contributed to mudslides and water covered roads in western Washington. Many homes experienced flooded basements and crawlspaces.
October 2006 Funnel Cloud	A funnel cloud was spotted over Kirkland.
December 2006 Heavy Rain Flash Flood	A strong overnight rain followed by damaging winds brought one to two inches of heavy rainfall to western Washington. This resulted in areas of urban and small stream flooding and overwhelming drainage systems. High winds caused downed trees, damaged transmission lines and power poles, damage to other utility infrastructure, and power outages to close to 1.5 million western Washington customers.
June 2008 Funnel Cloud	Two funnel clouds were spotted and wind gusts to 45 mph. Nearly 35,000 customers lost power.
August 2008 Funnel Cloud	Funnel clouds spotted over Lake Washington, on the northwest side of Mercer Island and near Black Diamond.
October 2014 High Wind	High winds in Puget Sound area caused power outage to approximately 75,000 customers and forced temporary closure of the SR 520 Bridge, multiple reported casualties.
November 2014 Strong Wind	High winds in Puget Sound area caused outages to approximately 14,000 PSE customers.
December 2014 Strong Wind High Wind	Strong windstorm caused wind damage in Tacoma and northward. The storm impacted nearly 246,000 power customers and caused an estimated $500,000 in damage. SR 520 bridge recorded 40-44 mph sustained winds.
January 2015 High Wind	High winds in Seattle area knocked down trees and left thousands without power.
August 2015 Strong Wind	Widespread power outages affecting about 450,000 people and widespread tree damage and road closures.
September 2015 Strong Wind	Strong winds resulted in one injury and one fatality on Lake Washington near Bellevue.
March 2016 High Wind	High winds resulted in the closure of SR 520 bridge which sustained minor wind damage. Hood Canal Bridge and sections of I-405 closed for several hours. Power outage for nearly 250,000 people.

April 2016 Heat	Unseasonably warm weather in Puget Sound area with temperatures near 90 degrees.
February 2017 Heavy Snow	Snowfall in western Cascades and western Washington lowlands from 4 to 11 inches. Caused snowy and icy roads, widespread power outages, and closure of schools and businesses.
April 2017 High Wind	High wind on Washington coast and north interior.
June 2017 Heat	Temperatures rose to record setting levels throughout Puget Sound. Bellevue's high temperature reached 96F.
November 2017 High Wind	Gusts up to 70 mph in regions of western Washington, Bellevue reporting 35 mph. Spot near Renton recorded 40mph sustained and verified warning system in Bellevue. Power outage to roughly 200,000 residents, delayed or cancelled ferry service, and some heavy rain resulted in local urban flooding. Late afternoon wind event adversely impacted evening commute. Power restoration cost just over $7 million.
December 2018 High Wind	Seattle area reported high wind and numerous power outages. I-90 and SR 520 floating bridges over Lake Washington recorded 40-51mph sustained wind.
December 2018 High Wind	Low pressure system with high winds extending to Seattle region. 30,000 Seattle City Light customers lost power. Was the strongest storm in northwest interior with widespread power outages, some lasting nearly a week.
January 2019 High Wind	Brief high wind event in Seattle and Tacoma area, SR 520 bridge reporting 49 mph sustained wind and I-90 floating bridge reporting 48 mph sustained wind.
February 2019 Heavy Snow	Reports of 4-8 inches of snowfall in Bellevue and some areas of heavy snowfall in western Washinton.
February 2019 Heavy Snow	Snowfall in western Washington lowlands, some areas of heavy snow, numerous reports of 6-10 inches.
February 2019 Heavy Snow	Major snowstorm covered western Washington with heavy snow. Observers reported 4-6 inches.
January 2020 Winter Storm	Cold air trapped under upper level system resulted in lowland snow, with measurements ranging from trace to 2 inches.
September 2020 Strong Wind	East winds caused widespread power outages in Seattle metro area from down power lines. Wind event also increased wildfire/fire spread threat and generated multiple fires.
September 2020 Dense Smoke	Following early wind event and Pacific Northwest wildfires, weather pattern shifted, with low level moisture and fog combined with dense smoke, which spread smoke across most of Washington. Some

	airlines cancelled flights out of SeaTac and postponement of Mariners game.
January 2021 High Wind	Short period of strong winds caused over 550,000 power outages across Olympic Peninsula. Bellevue reported wind gusts of 52 mph. Multiple road closures from downed power lines.
February 2021 Winter Storm	Winter storm hit Bellevue area, with 5-9 inches of snow in a 12 hour period.
June 2021 Heat	Record breaking "heat dome" converged over the pacific northwest with multiple days over 100F. Bellevue temperatures soared to 109F. The extended heat caused pavement buckles, requiring road closures and repair and led to the deaths of 157 people in Washington. 34 of those deaths occurring in King County. The heat led to the highest energy usage in Seattle public utility's history during summer months. Many PSE customers experienced power outages due to heat related equipment failure.
August 2021 Heat	Above normal temps in Seattle area ranging from mid 80's to low 90's, with daily record high of 93 degrees.
October 2021 Strong Wind	Wind and precipitation caused multiple reported downed trees in Redmond and Bellevue area, causing road detours, closures and downed power lines.
December 2021 Heavy Snow Cold/Wind Chill	Significant lowland moisture and mountain snow fell followed by record breaking low temperatures. SeaTac reporting 20F.
January 2022 Heavy Rain	Atmospheric river followed several storms, resulting in heavy rain, major and minor flooding and landslides.
July 2022 Excessive Heat	Extended period of abnormally warm temperatures in Seattle area, impacting those without adequate cooling and/or hydration access.
July 2022 Excessive Heat	Extended period of abnormally warm temperatures in Seattle area, impacting those without adequate cooling and/or hydration access. SeaTac reported 95F, breaking previous record of 94F for that day.
August 2022 Heat	Very warm weather over western Washington, setting some new record max daytime temperatures and warmer overnight lows. This posed moderate risk for heat related impacts.
August 2022 Heat	Continued very warm weather over western Washington, setting some new record max daytime temperatures and warmer overnight lows. This posed moderate risk for heat related impacts.
September 2022 Heat	Region wide warmer temperatures with SeaTac recording new daily max temp of 92F.

October 2022 Heat	Warm, dry conditions over an extended period of time with record high temperatures. SeaTac daily max of 88F, breaking previous record of 72F.
November 2022 Strong Wind	Heavy rains and gusty winds caused numerous damage reports.
November 2022 Heavy Snow	Early season lowland snow, and heavy snow to areas of Bellevue; 3-4 inches of snow reported around Kirkland and Woodinville, 2 inches reported south of Bellevue towards Renton.
December 2022 Winter Weather	Winter weather over a period of several days, widespread heavy snow in the lowlands, with lighter snow in the Bellevue area, averaging 1 to 4 inches over the duration of the storm.
December 2022 Winter Weather	Arctic front brought snow and colder weather, resulting in 1 inch of snow in Bellevue, 1 – 4 inches in areas around Seattle.
December 2022 Ice Storm	Freezing rain led to measurable ice accumulation with hazardous impacts to roadways and travel. Major impacts in Bellevue, Sammamish and Woodinville reporting .10-.15 inches of ice accumulation. Kirkland and Issaquah reported .25 inches and .30 inches of ice. SeaTac reported .20 inches of freezing rain. .20 inches in Renton, .13 inches in Mountlake Terrace and .25 inches in Kenmore.
May 2023 Heat	High temperatures in the upper 80's to low 90's, WADOT temperature sensors recorded above normal temperatures through most of mid-may east of Lake Washington. SeaTac recorded a series of record breaking temperatures from May 12 to May 16, ranging from 82F to 88F.
January 2024 Cold/Wind Chill	Record low temperatures, followed by heavy snow in areas and freezing rain/drizzle impacting travel in Puget Sound area. Record low temperature of 16F was reported in NWS Seattle.
January 2024 Ice Storm	Wintry precipitation across interior portions of Whatcom County southward into King County.
July 2024 Heat	A long period of hot temperatures in western Washington occurred breaking multiple records. SeaTac reported a high of 93F, breaking the previous record of 90F.
November 2024 Wind	An atmospheric river and bomb cyclone brought wind up to 77 mph and blizzard conditions across the pacific northwest. The winds down trees and powerlines, causing days long power outages for over 650,000 people. Tree fell across roads and on homes and vehicles, killing two people. Weather forecasters described the event as a 10-year windstorm.

Sources: (Wilma, 2006) (Banel, 2024) (NOAA , 2024) (Washington State Department of Health, 2021) (My Northwest News, 2024)

13.2.4 Overall probability

Severe weather events occur frequently in Bellevue. Based on historical records, the probability of a severe weather event occurring is at least once every five years.

13.2.5 Warning time

Meteorologists can often predict the likelihood of a severe weather event, such as extreme temperatures, windstorms, winter weather or thunderstorms. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of a storm. Some storms may come on quickly, with only a few hours of warning time. The Seattle and Spokane Offices of the National Weather Service (NWS) monitor weather stations and issue watches and warnings when appropriate. Watches and warnings are broadcast over NOAA weather radio, through cell phone apps and are forwarded to local media for re-transmission using the Emergency Alert System.

13.2.6 Climate change impacts

Climate change presents a challenge for risk management associated with severe weather. The science for linking the severity of specific severe weather events to climate change is still evolving; however, a number of trends provide some indication of how climate change may be impacting these events. The Intergovernmental Panel on Climate Change reports that heatwaves have become more frequent and severe over the past few decades. Global temperatures are anticipated to continue rising for decades, due to greenhouse gas emissions (IPCC, 2021). Extreme heat days in the planning area are likely to increase; according to the CMRW, Bellevue can expect one more day over 100 degrees Fahrenheit in the mid-century (2050-2079), an average summertime temperature that increases by 3.7 degrees, and an average increase of 17.4 additional 90 degree humidex days (Climate Mapping for a Resilient Washington, 2024) (City of Bellevue, 2023).

In addition, rising temperatures lead to more water vapor being evaporated in atmosphere. This, in turn, leads to more fuel for severe storms (USGS). With a warmer atmosphere, there is potential to hold more moisture, which may lead to more severe winter storms in areas where temperatures are cold enough for snow (National Geographic, 2020).

Climate change impacts on other severe weather events such as thunderstorms and high winds are still not well understood.

Severe weather events have contributed to business interruptions and closures, transportation disruptions, and infrastructure damage including sinkholes and road buckling caused by extreme heat. Extreme temperatures and prolonged heatwaves can could also strain and damage the electrical grid, causing power failures like blackouts and brownouts. Increased intensity and frequency of winter storms, potentially hailstorms and snowstorms, can cause physical damage to buildings, infrastructure, also leading to possible power failures, which could also interrupt the water distribution system (City of Bellevue, 2023)

13.2.7 Future trends in development

Increased urban density and expansion could strain stormwater systems and exacerbate runoff intensifying the impacts of extreme weather events. Additionally, larger impermeable surfaces such as roads and parking lots may further reduce the city's natural capacity to absorb rainwater, increasing flood risks.

Bellevue's commitment to climate resilience planning includes updates to stormwater management systems and incorporation of climate-adaptive designs, this will likely counteract some of the risks posed by more intense storms anticipated.

13.3 Secondary Hazards

Depending upon the time of year, additional hazards resulting from a severe storm or extreme temperatures can include wildfires, flash floods or landslides. Secondary effects can include severe wind erosion of dry soils, overtaxing of electric utilities during severe weather conditions, power loss, roof damage from hail and temporary shortages of necessities in a storm-impacted area.

13.4 Vulnerability and Impacts

13.4.1 People

The entire Bellevue population is vulnerable to severe weather and may be impacted. The most common problems associated with severe weather events are immobility and loss of utilities. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black

out, while populations in low-lying areas are at risk for possible flooding. In general, populations who lack adequate shelter during severe weather events, those who are reliant on sustained sources of power in order to survive, and those who live in isolated areas with limited ingress and egress options are the most impacted. The most common impacts of specific weather event types on people are as follows:

- **Winter Storms**—Deaths and injuries from severe winter storms are generally the result of vehicle collisions, heart attacks from shoveling snow and frostbite or hypothermia from prolonged exposure to the cold. Death and injury may also result from flooding from severe winter storms. About 70% of snow and ice-related injuries occur in automobiles, and 25% result from exposure. Of those killed or injured, 50% are people over the age of 60; more than 75% are male; and 20% occur in the home (National Severe Storms Laboratory). Vulnerable populations, such as those with poor quality housing, the homeless or those without access to a vehicle may be the most impacted. They may experience high heating bills, inability to travel to work or even death due to lack of shelter.
- **Severe Thunderstorms**—Flash flooding caused from thunderstorms kills more people each year than hurricanes, tornadoes or lightning (National Severe Storms Laboratory). Those that are low-income may struggle to recover from flood damage, and those that are disabled, elderly, or young may be unable to evacuate on their own.
- **High Winds**—Damaging winds can cause injuries and fatalities in several ways. Downed trees may fall on homes or cars, killing or injuring those inside. Objects that are not secured can be picked up in wind events and become projectiles. Structures that collapse or blow over during damaging wind events, especially tornadoes, may kill or injure those seeking shelter inside. Vulnerable populations may be unable to recover from damage to their homes caused by high wind, which may require roof or structural repairs.
- **Extreme Temperatures**—During periods of extreme heat, Bellevue's community members can suffer from heat-related illnesses such as heat exhaustion or heat stroke. Cold waves may lead to an increased risk of hypothermia and frostbite. The individuals most vulnerable to extreme temperatures are the elderly, children and those with pre-existing health conditions. Extreme heat can be deadly for people who do not have air conditioning, shelter, or who do not stay hydrated. Extreme heat can also lead to more wildfire starts and poor air quality from dust and smoke. Extreme cold can cause very high power bills and places a burden on the low-income population who do not live in energy efficient and well insulated homes.

Severe weather often causes power outages. During winter storms and extreme temperatures, power outages can be deadly. During extreme heat, air conditioners and refrigerators stop working, which especially impacts the elderly and those with poor health or those that require refrigerated medicines, such as insulin. Power outages also limit communication capabilities, as most communication now occurs over the internet or cell service, which require electricity to operate.

13.4.2 Structures

All structures are vulnerable to severe weather and can potentially be impacted during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. Critical facilities are vulnerable during severe weather events, especially those that lack backup power generation capabilities. The most common impacts of specific weather event types on structures are as follows:

- **Winter Storms**—Damage from severe winter storms in the planning area is most likely to be related to secondary hazards, such as major or localized flooding or landslides. Damage could also be caused by tree fall, roof collapse, or other incidents caused by heavy snowfall. The transportation system is especially impacted by winter storms and road closures, especially on mountain passes, is a frequent event in the winter.
- **Severe Thunderstorms**—Damage from thunderstorms in the planning area is most likely to be related to secondary hazards accompanying the event, such as flooding, wildfire, or damaging winds. If lightning directly strikes a building, it may cause substantial damage and may even set the structure on fire.
- **High Winds**—Mobile homes can be seriously damaged by wind gusts over 80 mph, even if they are anchored (National Severe Storms Laboratory n.d.). Properties at higher elevations or on ridges may be more prone to wind damage. Falling trees can result in significant damage to structures. High wind can damage roofs by ripping of shingles. Roads and other transportation infrastructure could be blocked by downed trees or other debris.
- **Extreme Temperatures**— Extreme cold events may lead to pipes freezing, resulting in property damage. Extreme heat without air conditioning may cause a building to be uninhabitable due to temperatures.

Figure 13-4. West Lake Sammamish Parkway, November 21, 2024

13.4.3 Systems

Emergency response capabilities, economic systems and government capabilities are vulnerable and may be impacted by severe weather. During severe weather events such as high winds and winter storms, power may be out, communication networks may be down and critical transportation routes may be impassible. Therefore, first responders may face difficulty responding effectively and coordinating efforts. Severe storms often overwhelm agencies that are responsible for road maintenance. See for a photo of trees down on West Lake Sammamish Parkway after the November 21, 2024 bomb cyclone.

Severe weather, including extreme heat and cold, may lead to business closures and economic losses. When transportation routes are closed or employees are unable to travel to work, businesses suffer.

All severe weather can cause impacts to communication and power facilities. If facilities supplying power to the planning area were disrupted due to severe weather, significant issues would arise with communication in the planning area. In addition, some facilities are particularly vulnerable to specific types of severe weather events.

Power outages occur frequently in Bellevue due to severe weather events. The power system is vulnerable to falling trees. In wind storms, outages are widespread. See Figure 13-5 for a map of the power outages after the 2024 bomb cyclone. After a widespread outage, it may take several days to a week to restore power to everyone.

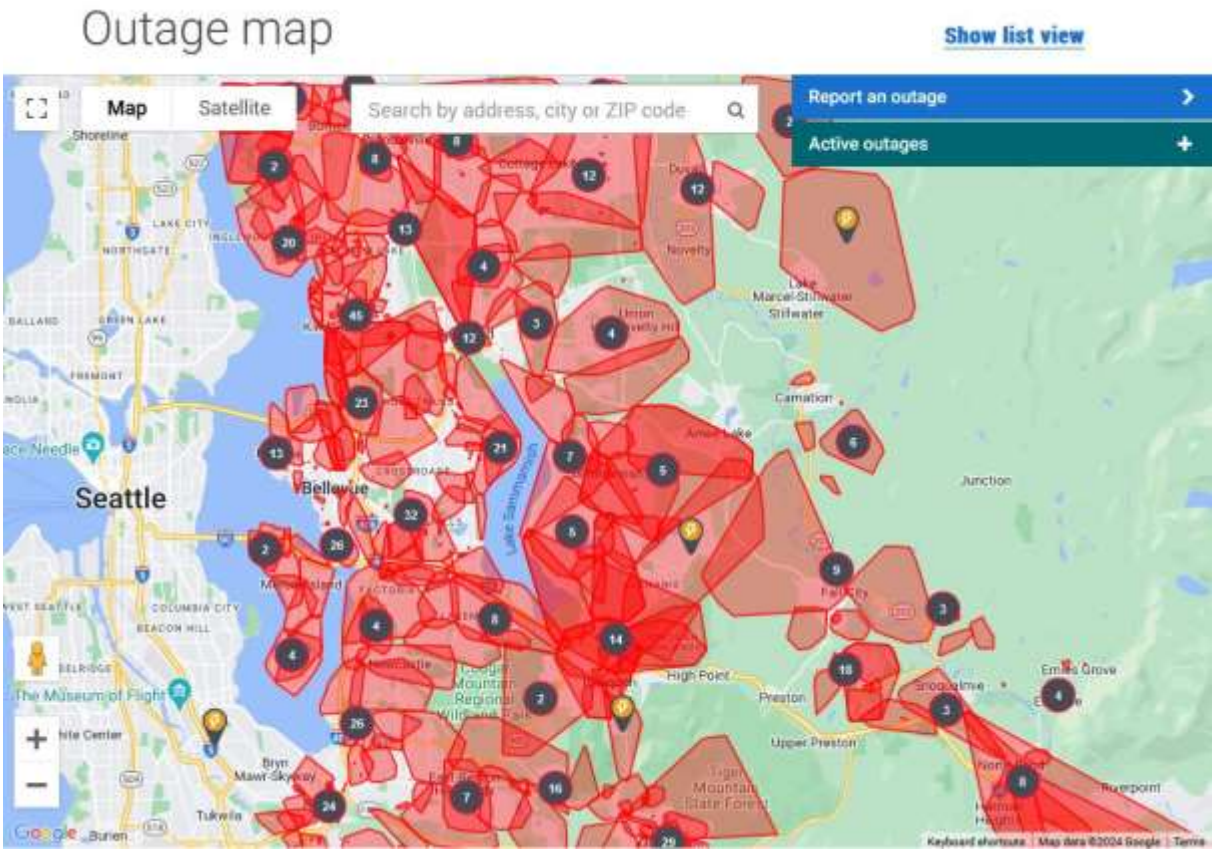

Figure 13-5. PSE outage map after November 2024 bomb cyclone

13.4.4 Natural, historic and cultural resources

Natural resources are highly vulnerable to severe weather events. Natural habitats such as streams and trees are vulnerable to the elements during severe weather risk major damage and destruction. Prolonged rains can saturate soil and lead to slope failure. Flood events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Climate change is a major driver impacting weather patterns and, in turn, the natural environment.

Historic and cultural resources may be damaged by severe weather. In addition, extreme temperatures may affect events and the ability for people to gather.

13.4.5 Activities that have value to the community

Activities that have value to the community are vulnerable to all severe weather events. Severe weather such as high winds, winter storms, severe thunderstorms and extreme temperatures may lead to cancellation of events, temporary closure of businesses and disruptions in services. The community may need to stay home due to poor road conditions.

Figure 13-6. Roads after a snowstorm

13.5 National Risk Index

Table 13-2 provide NRI results for the severe weather hazard.

Table 13-2. NRI Results

Event	Expected Annual Loss	Expected Annual Loss Rating	Community Resilience	Social Vulnerability	Risk Index Score	Risk Index Rating
Hail	$138	Very Low	Relatively Moderate	Relatively Low	0.9	Very Low
Heat Wave	$33,327	Relatively Low	Relatively Moderate	Relatively Low	21	Relatively Low
Ice Storm	$9,170	Very Low	Relatively Moderate	Relatively Low	9	Very Low
Lightning	$27,563	Very Low	Relatively Moderate	Relatively Low	13	Very Low
Strong Wind	$2,131	Very Low	Relatively Moderate	Relatively Low	3	Very Low
Tornado	$206,046	Very Low	Relatively Moderate	Relatively Low	13	Very Low
Winter Weather	$924	Very Low	Relatively Moderate	Relatively Low	17	Very Low

13.6 Mitigating the Hazard

Table 13-3 presents a range of potential opportunities for mitigating the severe weather hazard.

Table 13-3. Extreme weather mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ None
Corporate	▪ None
Government	▪ None
Reduce Exposure	
Personal	▪ None
Corporate	▪ None
Government	▪ None

Reduce Vulnerability	
Personal	▪ Insulate house ▪ Provide redundant heat and power ▪ Insulate structure ▪ Plant appropriate trees near home and power lines
Corporate	▪ Relocate critical infrastructure (such as power lines) underground ▪ Reinforce or relocate critical infrastructure such as power lines to meet performance expectations
Government	▪ Harden infrastructure such as locating utilities underground ▪ Trim trees back from power lines ▪ Designate snow routes and strengthen critical road sections and bridges ▪ Adopt higher regulatory standards that include provisions for wind loads and shear forces
Increase Preparation or Response Capability	
Personal	▪ Trim or remove trees that could affect power lines ▪ Promote 72-hour self-sufficiency ▪ Obtain a NOAA weather radio ▪ Obtain an emergency generator
Corporate	▪ Trim or remove trees that could affect power lines ▪ Create redundancy ▪ Equip facilities with a NOAA weather radio ▪ Equip vital facilities with emergency power sources
Government	▪ Support programs such as “Tree Watch” that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. ▪ Increase communication alternatives ▪ Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors ▪ Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable and phone lines ▪ Provide NOAA weather radios to the public ▪ Pursue Storm Ready designation

14. Volcano

14.1 General Background

Hazards related to volcanic eruptions are distinguished by the different ways in which volcanic materials and other debris are emitted from the volcano. The molten rock that erupts from a volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles. Ash and fragmented rock material can become airborne and travel far from the erupting volcano to affect distant areas.

14.2 Hazard Profile

14.2.1 Location

Figure 14-1 shows the location of the Cascade Range volcanoes, most of which have the potential to produce a significant eruption. The Cascade Range extends more than 1,000 miles from southern British Columbia into northern California and includes 13 potentially active volcanic peaks in the US.

14.2.2 Extent

Although Bellevue is not directly within lahar hazard zones, the city's economy and infrastructure could be indirectly affected by such an event. Lahars from Mt. Rainier, identified as being in an active eruptive phase by USGS volcanologists and Washington DNR geologists, pose a catastrophic risk to densely populated river valleys in Pierce and South King Counties. These areas are home to over 150,000 people and contain significant transportation routes, industrial centers and economic hubs like the Port of Tacoma. See Figure 14-2 for a map of lahar zones.

A major lahar could disrupt transportation, result in economic losses and trigger population redistribution, all of which would have regional impacts affecting Bellevue. While Bellevue is not physically at risk, the interconnected nature of the region’s infrastructure and economy make the city vulnerable to secondary effects of such hazards.

Although Bellevue will not experience direct lahar impacts, the city has the potential to experience ashfall from an eruption of Mt. Rainier or other volcanoes in the Cascade chain (City of Bellevue, 2018). Most ash is deposited within 100 kilometers

of the eruption site; however, the extent of the ash fall depends on the ash particle size (finer particles travel farther), height of the eruption column, rate and duration of the eruption and prevailing wind conditions (USGS, 2015).

Source: (Bobbie Myers, Carolyn Driedger, 2008)

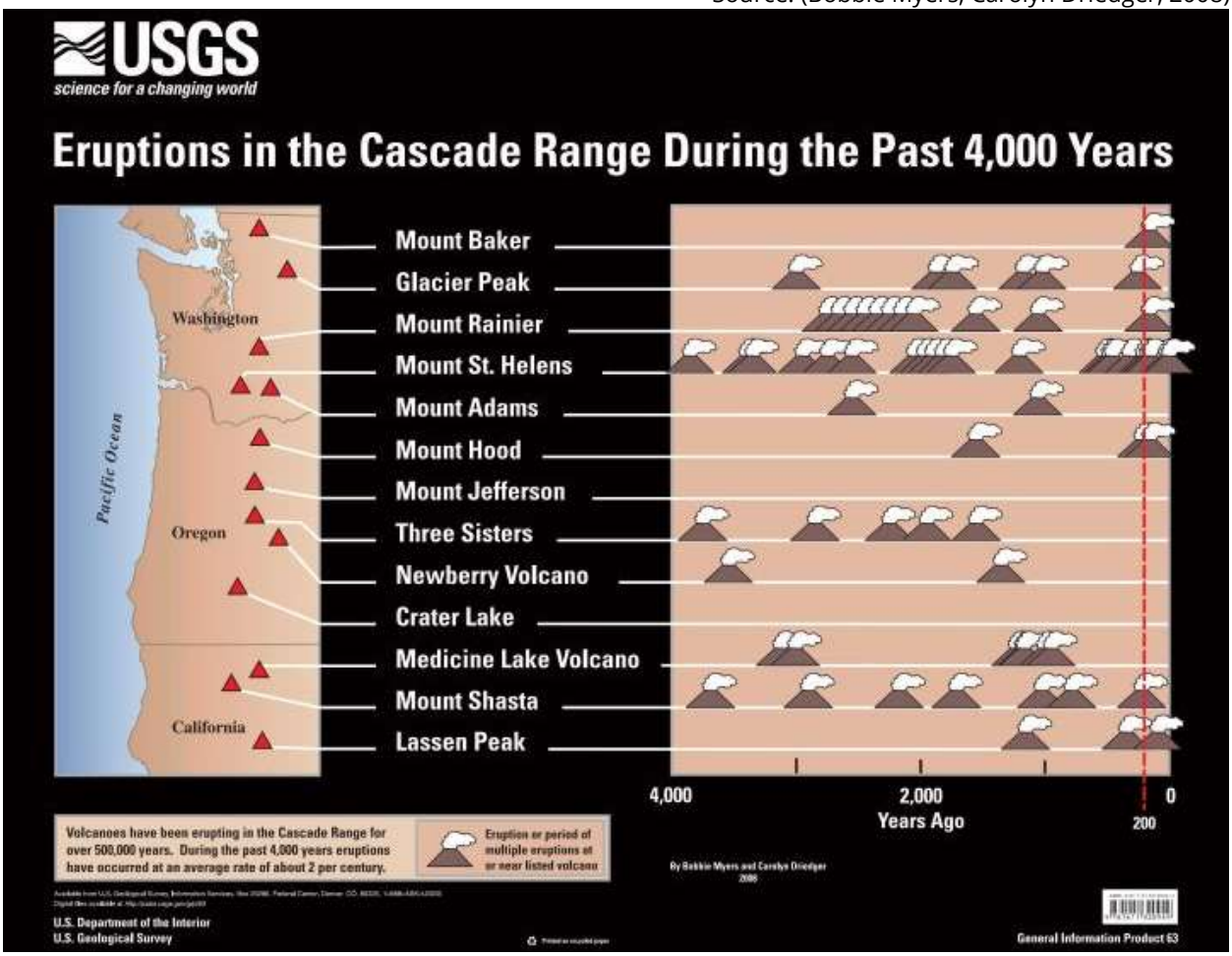

Figure 14-1. Location and past eruptions in the cascade range

14.2.3 Previous occurrences

Many Cascade volcanoes have erupted in the recent past and will be active again in the foreseeable future. Given an average rate of one or two eruptions per century during the past 12,000 years, these disasters are not part of everyday experience in the Pacific Northwest; however, in the past hundred years, California's Lassen Peak and Washington's Mt. St. Helens have erupted with terrifying results. The US Geological Survey classifies Glacier Peak, Mt. Adams, Mt. Baker, Mt. Hood, Mt. St. Helens and Mt. Rainier as potentially active volcanoes in Washington State. Mt. St. Helens is by far the most active volcano in the Cascades, with four major explosive eruptions in the last 515 years, the most recent occurring on May 18, 1980.

Source: (Driedger, 2008)

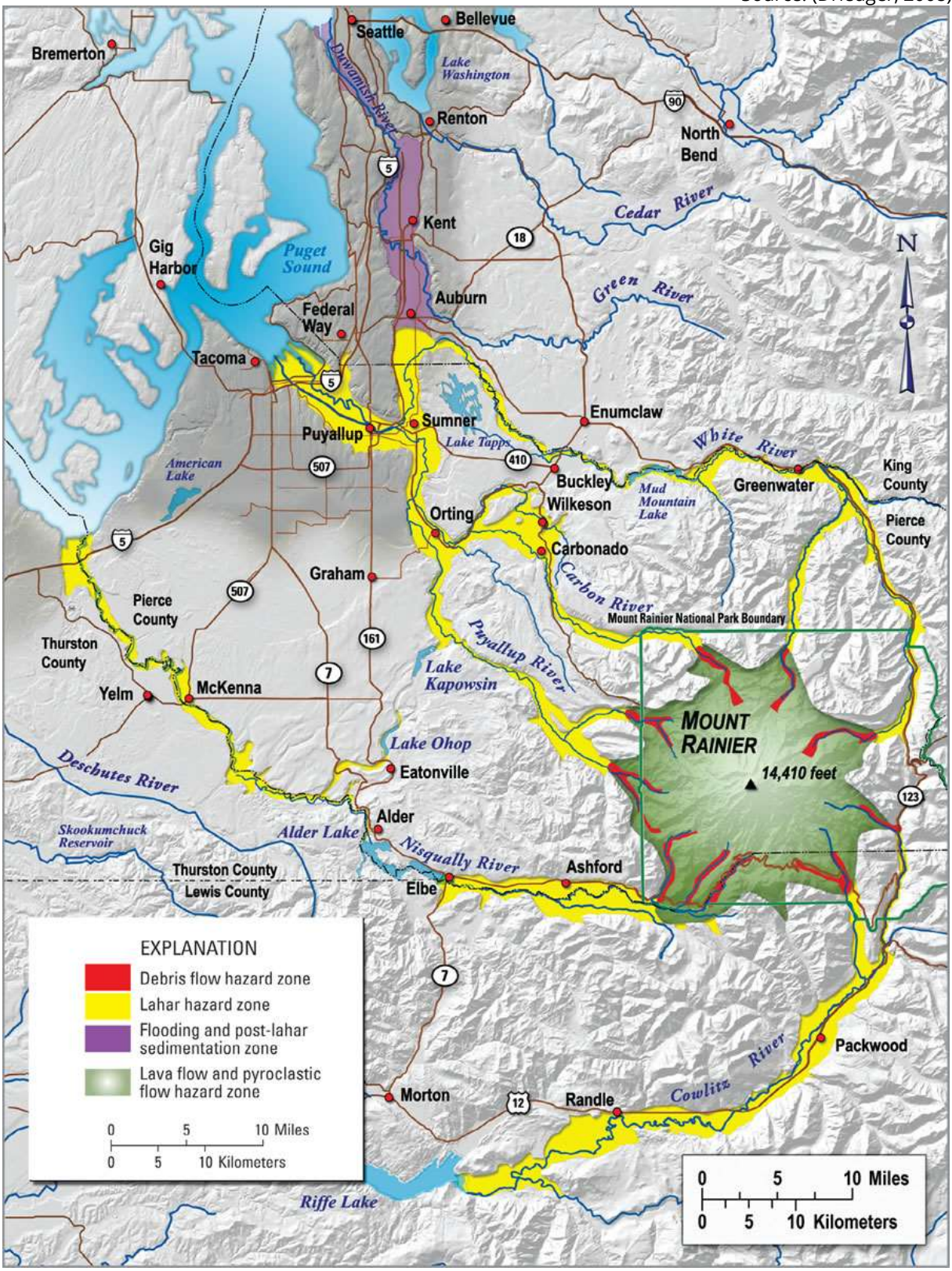

Figure 14-2. Mt. Rainier lahar zones

14.2.4 Overall probability

Over the past 12,000 years, the Cascade volcanoes have experienced one or two eruptions every century. With a recurrence interval of once every 500 to 1000 years, the probability of an eruption is low. Additionally, even if a volcano does erupt in the near future, it may or may not affect the Bellevue area. Prevailing winds generally blow from the northwest and in most cases the winds will blow ash away from the city towards Eastern Washington.

Figure 14-3 shows the annual probability of a tephra, or ash, accumulation of 10 centimeters or more (about 4 inches) from Mt. St. Helens. The distribution considers wind direction and likelihood. The map shows that Bellevue has a 0.01% to 0.02% annual chance of receiving more than 10 centimeters of ash.

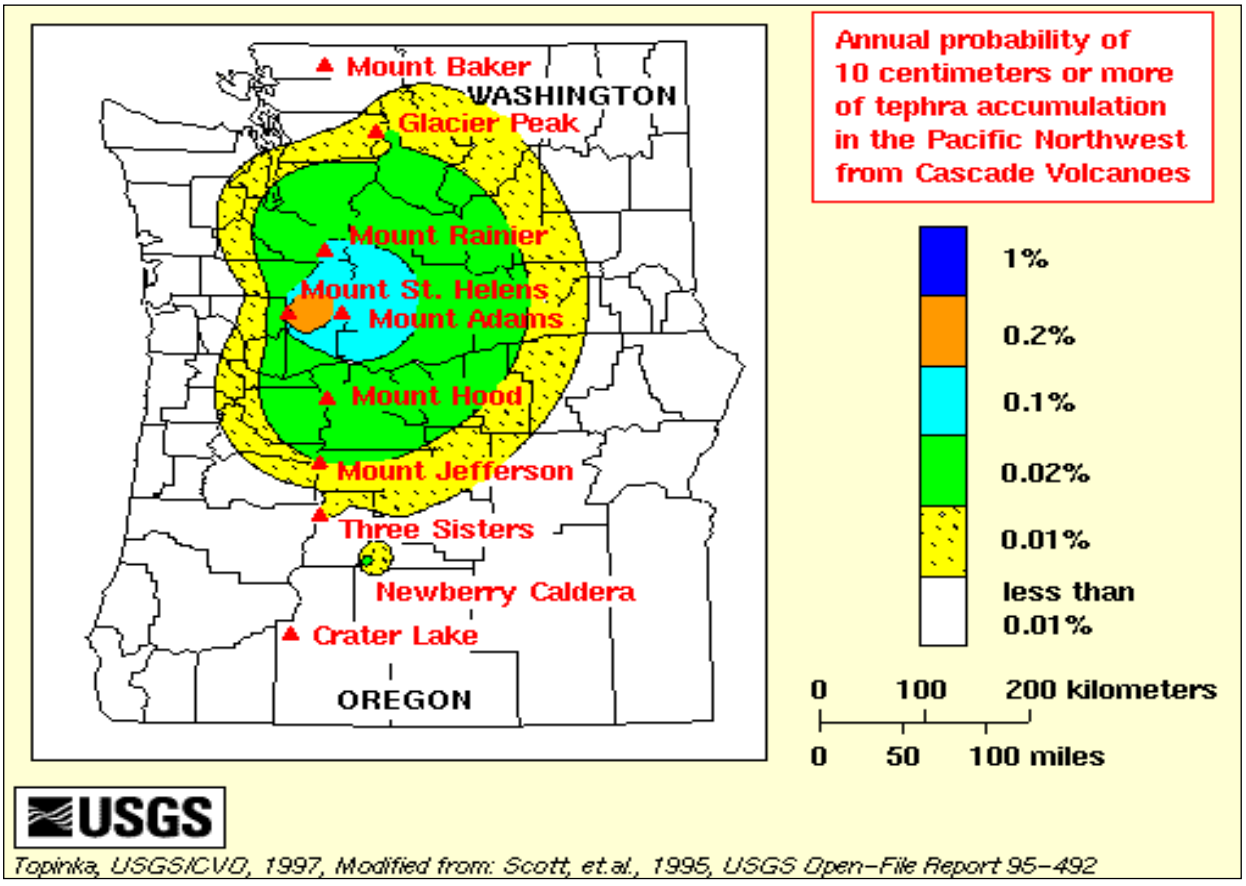

Figure 14-3. Probability of tephra accumulation in pacific northwest

14.2.5 Warning time

Constant monitoring of all active volcanoes means that there will be more than adequate time for evacuation before an event. Since 1980, Mt. St. Helens has

settled into a pattern of intermittent, moderate and generally non-explosive activity, the severity of tephra, explosions and lava flows have diminished. All episodes, except for one very small event in 1984, have been successfully predicted several days to three weeks in advance. However, scientists remain uncertain as to whether the volcano's current cycle of explosivity ended with the 1980 explosion. The possibility of further large-scale events continues for the foreseeable future.

An eruption of Mount Rainier is likely to be preceded by days or months of small earthquakes, allowing ample time for visitors, community members and businesses to prepare for an eruption. Mount Rainier is monitored by the USGS Cascades Volcano Observatory and the Pacific Northwest Seismic Network. These organizations operate a network of over 40 real-time monitoring stations, including seismometers, acoustic flow monitors (AFMs) and infrasound sensors on Mt. Rainer. The Rainier Lahar Detection System, operational since 1998, has been upgraded to improve detection and warning capabilities, providing real-time alerts for communities downstream in lahar-prone areas, such as the Puyallup and Nisqually River valleys. Alerts are disseminated through sirens, emergency alert systems and evacuation plans (USGS, 2023) (USGS, 2023).

14.2.6 Climate change impacts

Volcanic eruptions are not known to be affected by climate change. However, large-scale volcanic eruptions can reduce the amount of solar radiation reaching the Earth's surface, lowering temperatures in the lower atmosphere and changing atmospheric circulation patterns. The massive outpouring of gases and ash can influence climate patterns for years.

14.2.7 Future trends in development

All future development has the potential of being impacted by ash fall generated from volcanic events. The weight of the ash should be taken into consideration when new construction occurs to ensure reduced impact from damaging events by strengthening the load values of roofs.

14.3 Secondary Hazards

The secondary hazards associated with volcanic eruptions are customarily mud flows and landslides, as well as traffic disruptions and increased issues with dust storms recirculating the ash.

14.4 Vulnerability and Impacts

Volcanic ash is made of tiny pieces of rock fragments and glass shards. It is very abrasive and can easily damage surfaces when wiped or brushed. Finer particles of ash can remain suspended in the air for some time and are easily remobilized when disturbed. When ash becomes wet, it absorbs water to create a slippery, mud-like mixture that acts like cement and dries in a hard mass. Ash is corrosive and can damage metal surfaces.

14.4.1 People

The whole population of Bellevue is vulnerable and may be impacted by the effects of tephra fall. Those especially vulnerable to the effects of a tephra fall are the elderly, the very young and those already experiencing ear, nose and throat problems and respiratory diseases such as asthma. Homeless people, who may lack adequate shelter, are also more susceptible to the effects of a tephra fall. In 2019, the Bellevue School District reported that 295 students were experiencing homelessness, making this an especially vulnerable group (City of Bellevue, 2019).

When exposed to ash, people may experience irritation of eyes and airways. Ash can scratch corneas and cause eyes to be painful and itchy. Breathing in ash can cause bronchitis-like symptoms, including coughing, wheezing and shortness of breath. Ash that contains high amounts of silica may cause silicosis, a chronic lung disease.

14.4.2 Structures

All structures in Bellevue are vulnerable to the volcanic hazard. Structure may experience major to minor impacts from ash fall. Major impacts, such as structural damage may occur if roofs were not built to withstand the weight of ash, especially when mixed with rain or snow, which would increase its weight. Other major impacts could include damage to HVAC systems, clogging of gutters which may cause flooding and corrosion of metal components.

Ash can also cause minor, cosmetic damage. The abrasiveness of ash can scratch glass surfaces and floors.

14.4.3 Systems

Systems including regional transportation networks, highways and interstates are highly vulnerable to ashfall. Ash can impact visibility, reduce traction, or even cause

a road to be impassable due to thick ash fall. Power outages due to ash would affect street lights and traffic signals.

Government services would be impacted by ash fall, especially those required for emergency response and recovery. Vehicles are very vulnerable to ash and can be damaged if ash enters into the engine compartment or air intake. This vulnerability will reduce the efficiency of emergency services to respond and public works to begin ash removal.

Ash can impact water, sewer and stormwater systems. Water filtration systems may not be able to manage the increased turbidity, stormwater systems may become clogged by ash that dries into a cement-like mass and waste water facilities may experience mechanical damage or blockages.

This could disrupt public transit and the distribution of goods, greatly impacting the local economy. In addition, ashfall can damage power lines, impact water supply systems, delay emergency response and increase need for emergency services.

14.4.4 Natural, historic and cultural resources

All natural, historic and cultural resources in Bellevue are vulnerable and may be impacted by ashfall. Waterways, such as Lake Washington, may experience contamination for ash deposits. In addition, cultural resources and historic resources may be impacted by accumulation of ash.

14.4.5 Activities that have value to the community

Volcanic ashfall may disrupt transportation, regional utilities and supply chains, affecting commuting, local businesses and public services. Recreation and tourism in nearby areas could be limited by ash hazards or closures, while public health could be impacted by respiratory issues from ash inhalation.

14.5 National Risk Index

Table 14-1 provides NRI results for the volcano hazard.

Table 14-1. NRI results

Expected Annual Loss	Expected Annual Loss Rating	Community Resilience	Social Vulnerability	Risk Index Score	Risk Index Rating
$8,860,079	Relatively High	Relatively Moderate	Relatively Low	87	Relatively High

14.6 Mitigating the Hazard

Table 14-2 presents a range of potential opportunities for mitigating the volcano hazard.

Table 14-2. Volcano mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ None
Corporate	▪ None
Government	▪ None
Reduce Exposure	
Personal	▪ None
Corporate	▪ None
Government	▪ None
Reduce Vulnerability	
Personal	▪ Monitor situation and begin preparations early
Corporate	▪ Monitor situation and begin preparations early
Government	▪ Monitor situation and begin preparations early
Increase Preparation or Response Capability	
Personal	▪ Purchase PPE and filtration materials to protect self, HVAC systems, generators, vehicles and other systems ▪ When ashfall is imminent, prepare homes to protect exterior, interior and utilities ▪ Be prepared to stay at home for days to weeks as ash is removed from surfaces
Corporate	▪ Purchase PPE and filtration materials to protect employees, HVAC systems, generators, vehicles, machinery and other systems ▪ When ashfall is imminent, prepare structures to protect exterior, interior and utilities ▪ Be prepared for business closures, transportation interruptions
Government	▪ Prepare or provide outreach materials that describe actions to take when ash fall is imminent and during recovery ▪ Prepare an ashfall response plan

15. Wildland Fire and Wildfire Smoke

15.1 General Background

A wildland fire is any uncontrolled fire on developed or undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, fire pits, equipment use and arson or can be caused when materials like mulch spontaneously combust.

Fire hazards present a considerable risk to vegetation, wildlife habitats and the built environment. Short-term loss caused by a wildfire can include the destruction of rangelands, crops, wildlife habitat, scenic vistas and watersheds. Long-term effects include reduced vegetation for wildlife, reduced access to affected recreational areas and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding after a fire increases due to the destruction of soils and vegetation. The potential for significant damage to life and property exists in areas designated as “wildland urban interface” (WUI) areas.

15.1.1 Factors affecting wildfire risk

Topography

Fires burn differently under varying topographic conditions. Topography alters heat transfer and localized weather conditions, which in turn influences vegetative growth and resulting fuels. Changes in slope and aspect can have significant influences on how fires burn. Generally speaking, north slopes tend to be cooler, wetter, more productive sites. This can lead to heavy fuel accumulations, with high fuel moistures, later curing of fuels and lower rates of spread. In contrast, south and west slopes tend to receive more direct sun and thus, have the highest temperatures, lowest soil and fuel moistures and lightest fuels. The combination of light fuels and dry sites leads to fires that typically display the highest rates of spread. Thus, these slopes tend to be “available to burn” a greater portion of the year.

Slope also plays a significant role in fire spread, by allowing preheating of fuels upslope of the burning fire. As slope increases, rate of spread and flame lengths tend to increase. Therefore, we can expect the fastest rates of spread on steep, warm south and west slopes with fuels that are exposed to the wind.

Fuels

Fuel is any material that can ignite and burn. This includes organic material, dead or alive, in the fire environment—Grasses, brush, mulch, branches, down woody material, leaves, conifer needles, fences and buildings. The physical properties of fuels govern how fires burn. Fuel loading, size and shape, moisture content and continuity and arrangement all have an effect on fire behavior. Generally speaking, the smaller and finer the fuels, the faster the potential rate of fire spread. Small fuels such as grass, needle litter and other fuels less than a quarter inch in diameter are most responsible for fire spread. This is apparent to anyone who has ever witnessed the speed at which grass fires burn.

As fuel size increases, the rate of spread tends to decrease due to a decrease in the surface to volume ratio. Fires in large fuels generally burn at a slower rate but release much more energy and burn with much greater intensity. This increased energy release, or intensity, makes these fires more difficult to control. Thus, it is much easier to control a fire burning in grass than to control a fire burning in timber.

Weather

Of all the factors influencing wildfire behavior, weather is the most variable. Extreme weather leads to extreme events and it is often a moderation of the weather that marks the end of a wildfire's growth and the beginning of successful containment. High temperatures, low humidity and wind can produce vigorous fire activity. The cooling and higher humidity brought by sunset can dramatically quiet fire behavior.

15.1.2 Wildfire types

Fire types can be generally characterized by their fuels as follows:

- **Ground fires** are fed by roots and other buried organic matter. Ground fires typically burn by smoldering and can burn slowly for days to months.
- **Crawling or surface fires** are fueled by low-lying vegetation such as mulch and bark, tree litter, grass and low shrubbery.
- **Ladder fires** consume material between low-level vegetation and tree canopies, such as small trees, downed logs and vines. Invasive plants that scale trees may encourage ladder fires.
- **Crown, canopy, or aerial fires** burn suspended material at the canopy level, such as tall trees, vines and mosses. The ignition of a crown fire depends on the

density of the suspended material, canopy height, canopy continuity and the presence of surface and ladder fires to reach the tree crowns.

15.1.3 Factors affecting wildfire smoke

As wildfires have increased in intensity and numbers each summer, wildfire smoke has become a greater concern due to the health impacts. Wildfire smoke is a mixture of gasses released by burning vegetation that include carbon monoxide, carbon dioxide, hydrocarbons and particulate matter. The composition of wildfire smoke depends on many factors, including vegetation burned, fuel loads, fuel moisture and fire intensity. The dispersion of wildfire smoke depends on the weather. When smoke plumes rise into the atmosphere, they are caught by winds and transported to different regions. Western Washington is frequently impacted by smoke from wildfires in California, Oregon, Idaho and Canada.

15.2 Hazard Profile

15.2.1 Location

Wildfire

Bellevue, located in western Washington, has had far less risk to wildfires than most of the state. However, the “city in a park” is heavily vegetated. The city has more than 2,700 acres of parks and open spaces and 8,499 acres of tree canopy. These natural areas, along with the vast landscaping throughout the city, increase the city’s vulnerability to wildfires.

According to Wildfirerisk.org, 6% of buildings in the city have direct exposure to wildfire. These homes are at the greatest risk of wildfire as they may be ignited by adjacent vegetation, flying embers and nearby structures. 17% of structures have indirect exposure to wildfire and may be at risk from embers or home-to-home ignition. The remaining structures have less exposure and are not likely to be directly affected by wildfires.

The different exposure areas within the city are shown in Figure 15-1.

Every year, Bellevue Fire Department responds to dozens of calls for brush and bark fires (see following sections). These fires are quickly extinguished and cause little damage. In 2023, the city responded to 247 incidents, significantly higher than previous years. After analysis of the fire starts, the city found that most fire starts occurred along roadsides and in greenbelt areas and were concentrated in the

BelRed, Downtown, Wilburton, Factoria, Eastgate, Crossroads and Lake Hills neighborhoods.

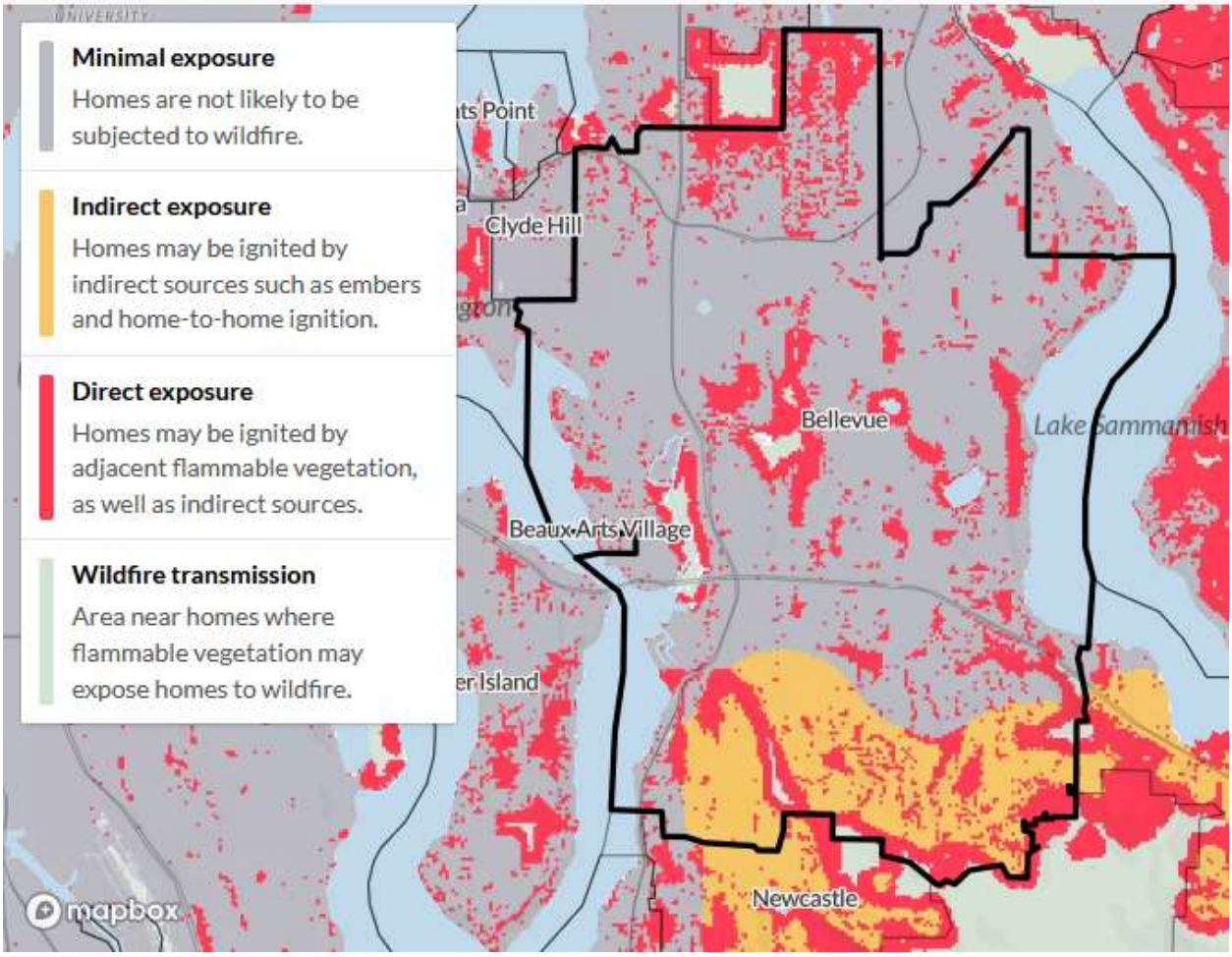

Figure 15-1. Wildfire exposure

Wildfire Smoke

All areas of Bellevue are subject to wildfire smoke. Smoke from a distant wildfire event will affect all areas of the city equally. Smoke from a local event may affect areas of the city differently, depending on their proximity to the fire or wind direction.

Locally Determine Risk Locations

After reviewing the WIldfirerisk.org assessment, the wildfire subcommittee determined that there are additional risk areas within the fire response area. The subcommittee conducted a local risk assessment using factors such as topography, fuel and weather, suppression capability of local and regional resources, where and

what types of structures are in the Wildland Urban Interface and what types of pre-fire mitigation activities have been completed.

The WUI is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. A WUI designation is not an indicator or risk. To determine risk to structures in the WUI, other factors must be considered, such as climate, vegetation type, likelihood, and intensity.

WUI areas within Bellevue are shown in Figure 15-2.

The main types of wildland-urban interface areas are:

- **Intermix**: Areas where structures intermingle with wildlands. To be considered intermix, a development or structure must be surrounded on two or more sides by wildlands. Intermix is often found between the interface and the wildlands.
- **Interface**: Often found along the outskirts of an urban area. The wildland-urban interface is defined as areas where human developments meets areas that are covered with more than 50% wildlands. To be considered interface, development/structures must be bordered by wildlands on at least one side. (WA DNR, 2022)

The locally determined risk areas include:

- Areas where homes and vegetation intermingle, due to their potential for wildfire in the right conditions (generally shown as direct and indirect exposure in Figure 15-1, or as intermix or interface on Figure 15-2)
- Road corridors
- Greenbelts and drainages where community members may be using fire to cook or keep warm
- Neighborhoods where structures have flammable wood shake roofs that are more vulnerable to ember cast

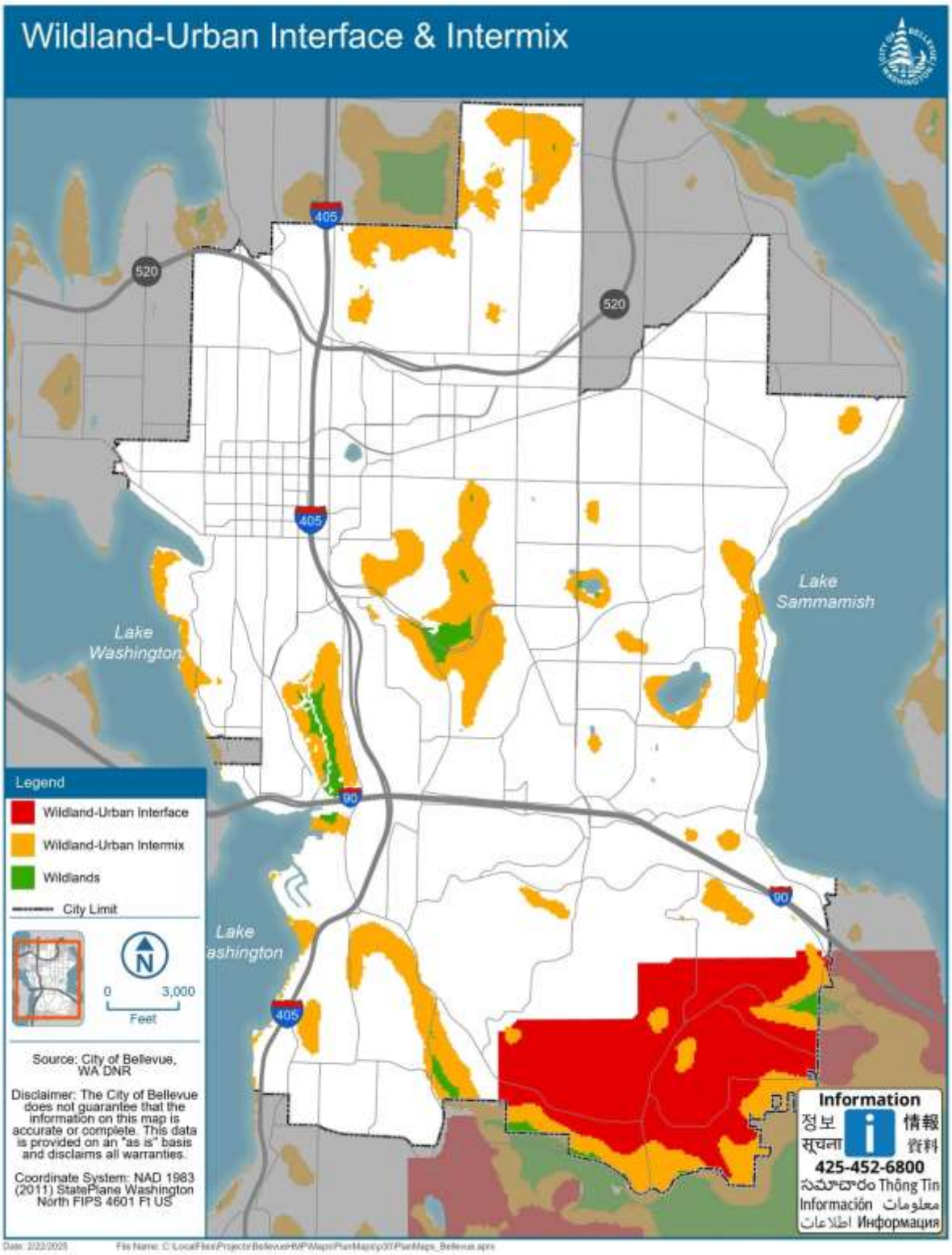

Figure 15-2. WUI areas

15.2.2 Extent

Wildfires in Bellevue have been smaller in scale compared to larger incidents seen across the state. This is a function of response time, weather and vegetation type. However, due to dense vegetation and the proximity of homes and neighborhoods to vegetated areas, even moderate fires can pose significant risks. Smoke and poor air quality from regional wildfires also contribute to the extent of the hazard.

Significant effects of wildfire can include loss of lives, personal injury, damage to private and public property and economic impact. Fires cause economic impact on local businesses. This impacts not only business, but also community members and government due to loss of tax revenue.

15.2.3 Previous occurrences

Bellevue has not experienced large-scale damaging wildfires, but the city faces several small brush and bark fires each year, often caused by human activity or dry weather conditions. Additionally, Bellevue community members are frequently impacted by smoke and air quality issues from larger wildfires occurring elsewhere in the state or across the Pacific Northwest, California and Canada.

Each year, the Bellevue Fire Department responds to dozens of calls for low-moderate risk brush and bark fires within their fire response area. The Fire Department has been able to extinguish the low-moderate risk fires quickly before they can grow into a larger fire.

In the summer of 2023, the Fire Department experienced two incidents within the city that included significant fire growth and spread from ember casts onto neighboring rooftops and vegetation. The Fire Department was able to extinguish the ember fires without further growth.

Table 15-1 provides the number of brush and bark fires per year since 2019. Figure 15-2 shows the location of 2023 brush and bark fires and hotspots. Figure 15-4 provides the number of brush or bark call per month for the past several years.

Table 15-1. Calls for brush and bark fires

Year	Brush Fires	Bark Fires	Total
2019	25	102	127
2020	37	57	94
2021	50	144	194
2022	61	139	200
2023	77	170	247

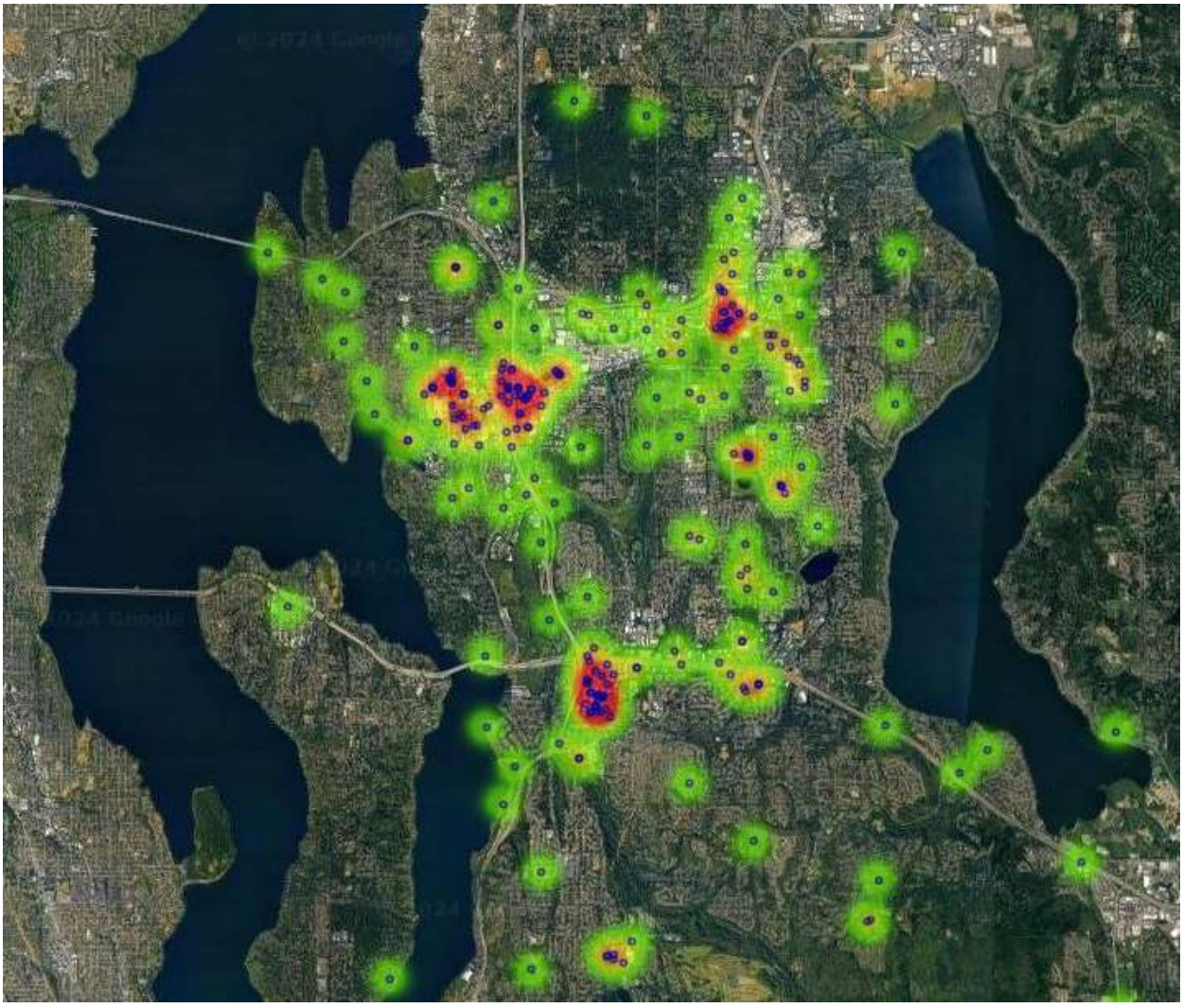

Figure 15-3. 2023 brush and bark fire starts and hotspots

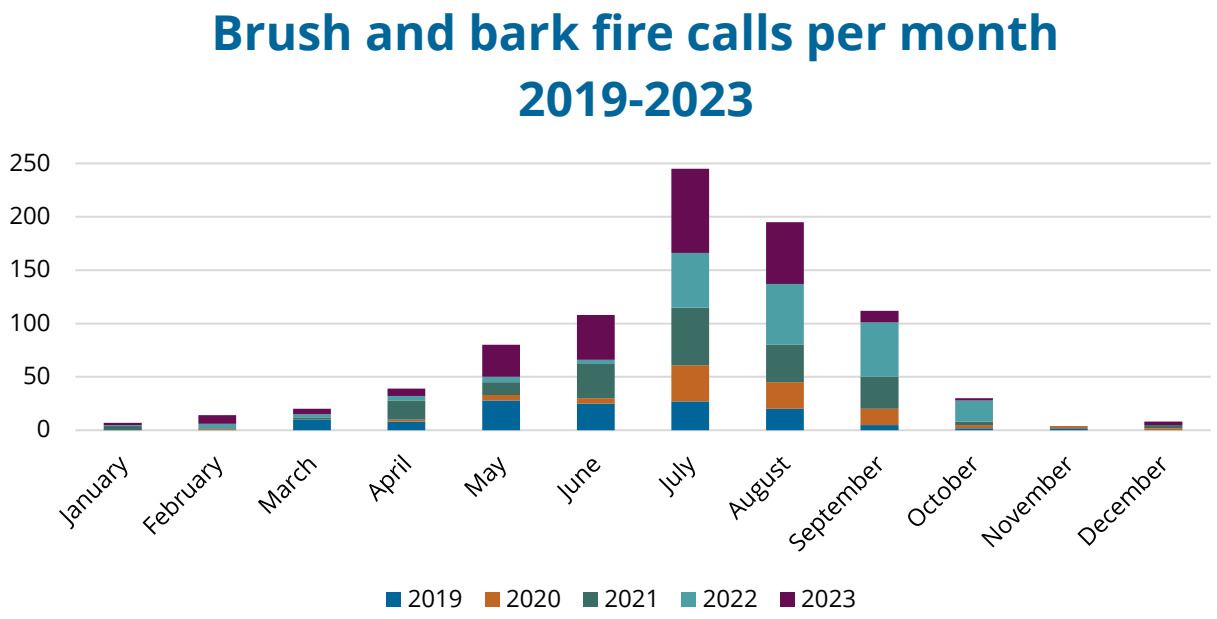

Figure 15-4. Brush and bark fire calls per month 2019-2023

15.2.4 Overall probability

Based on Wildfirerisk.org analysis using current weather, topography and ignitions, the likelihood of a damaging wildfire occurring each year is low. Areas in the southernmost portion of the city, adjacent to the Cougar Mountain Regional Wildland Park, experience a low-moderate likelihood of a wildfire occurring each year. See Figure 15-5 for a map of wildfire likelihood within the city. More frequent drought conditions and warmer summertime weather is expected to increase the probability of a damaging wildland fire.

15.2.5 Warning time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when a human-caused wildfire might break out. Dry seasons, extreme heat and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. On most cases, severe weather can be predicted in advance, so special attention can be paid during weather events that may include lightning or hot and dry winds. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

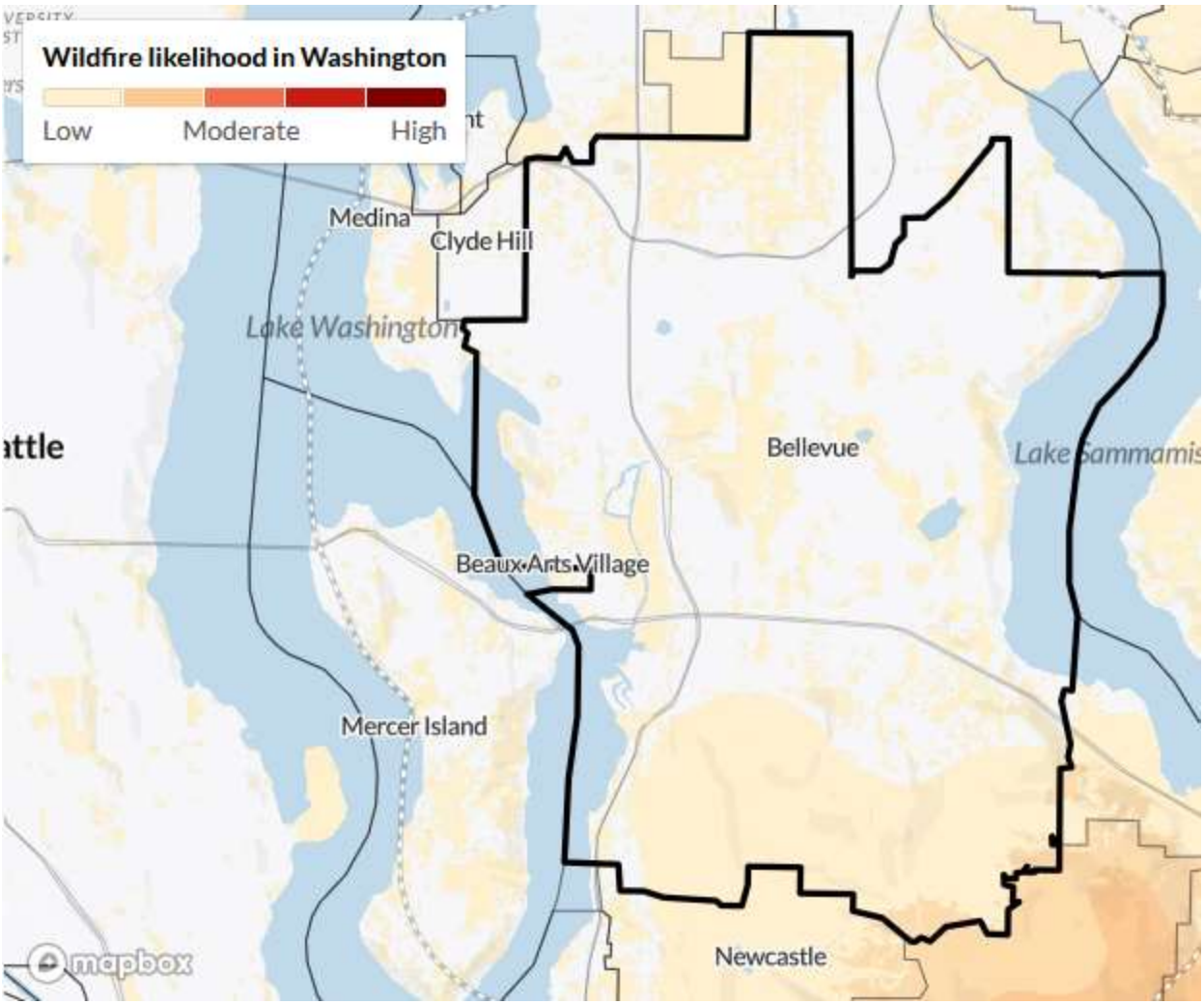

Figure 15-5. Wildfire likelihood

15.2.6 Climate change impacts

Fire in western Washington ecosystems is determined by climate variability, local topography and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management and vegetation fuels. Historically, summer weather in Bellevue is mild, without the extreme heat and dry winds that can create high risk conditions. In the future, increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain and thus, are more likely to expand into residential neighborhoods.

The Climate Vulnerability Assessment for Bellevue indicates that climate change is increasing wildfire risks due to hotter, drier conditions and prolonged drought periods. The assessment indicates that by 2050 there will be 10 more fire danger days each year, increasing the risk of wildfire.

Although Bellevue's urban setting limits most direct wildfire threats, the city faces increased secondary risks, such as poor air quality from wildfire smoke and disruptions to regional infrastructure and utilities. Ash also poses a risk of dissolved organic matter entering the drinking water which requires treatment and potentially increasing water treatment costs.

15.2.7 Future trends in development

As the city's population grows and development becomes more dense, fire suppression calls have become more frequent. There has been an increases trend in the number of fire suppression calls that started as cooking and heating fires in greenbelt and drainage areas. With more growth anticipated, there will be more opportunities for human caused fires and the demand for firefighting capabilities will increase. Fire starts have been increasing over the years and the fire season has extended from May to October, longer than the traditional August-September fire season. These trends indicate a need for additional prevention and awareness outreach to the community and training for firefighters.

15.3 Secondary Hazards

The most significant secondary hazard of wildfire impacting the city is poor air quality due to smoke, which can exacerbate respiratory conditions in vulnerable populations. Bellevue may experience the impacts of smoke from fires all throughout the Pacific Northwest. Wildfires can contaminate reservoirs, destroy power, transmission lines and contribute to flooding.

Landslides are a significant secondary hazard of wildfires. Wildfires strip slopes of vegetation and cause soil to repel moisture, exposing slopes to greater amounts of rain and run-off. This in turn can weaken soils and cause erosion, debris flows, and slope failures. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

15.4 Wildland Fire Response Capabilities

The Bellevue Fire Department was established in 1965 and exists as a separate department within the city governance. The Fire Department is led by a fire chief who reports to City Council. The Fire Department provides several services including fire suppression, emergency medical services, hazardous materials response, rescue, emergency management, fire prevention services and community engagement.

The Fire Department provides services within the City of Bellevue and six contracted adjacent communities: Newcastle, Clyde Hill, Medina, Yarrow Point, Hunts Point and Beaux Arts Village. The Fire Department has automatic/mutual aid agreements with all fire response agencies within King County Zone One, including Bothell, Eastside Fire and Rescue, King County Fire District 27, Kirkland, Redmond, Shoreline, Snoqualmie, and Snoqualmie Pass.

Source: Bellevue Fire Foundation

Figure 15-6. Brush truck

The Fire Department provides annual wildland firefighting training and offers mobilization of equipment and personnel to support large scale wildfire incidents around the Pacific Northwest. Through training and experience, several fire personnel have obtained their “red card,” a certification that qualifies a person as a wildland firefighter. Red card holders are assigned throughout the city at all stations and in all platoons.

The Fire Department has 10 fire stations throughout the city that are staffed 24 hours a day, seven days a week. See Figure 15-7. The Fire Department maintains a brush truck (Figure 15-6) and wildland firefighting gear so a wildlands crew can be quickly assembled.

15.5 Vulnerability and Impacts

15.5.1 People

All community members in Bellevue are vulnerable to the wildfire hazard. Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive community members, including children, the elderly and those with respiratory and cardiovascular diseases. In addition, wildfire may threaten the health and safety of those fighting the fires. First responders are exposed to dangers from the initial incident and after-effects from smoke inhalation and heat stroke. Community members with access and functional needs, the elderly and very young may be especially vulnerable to wildfire if there is not adequate warning time before evacuation is needed. Low income community members may not be able to recover financially if they suffer property damage.

The greatest and most frequent impact from wildfires will be smoke. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides) and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. The Department of Ecology monitors smoke impacts from active wildfires and issues wildfire smoke air quality notifications ranging from “good” to “hazardous.”

Source: (Bellevue Fire Department)

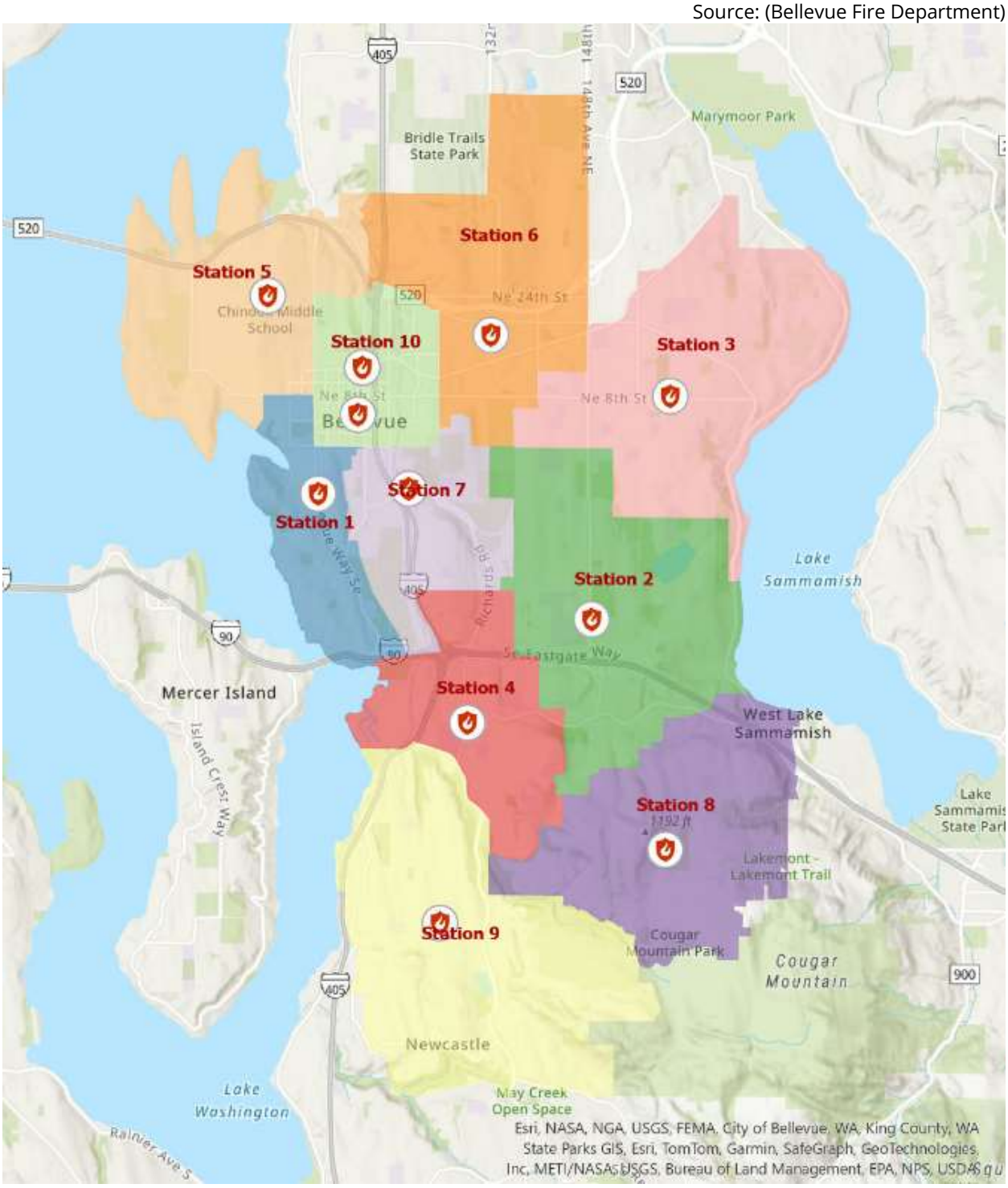

Figure 15-7. Fire station locations

There are approximately 14,000 community members within WUI areas, where risk exists during the right conditions, that may be impacted by a wildfire, representing 9.6% of Bellevue's population. The neighborhood with the most community members living in the WUI is Cougar Mountain/Lakemont.

15.5.2 Structures

Wildfires can damage or destroy structures. Wildfire smoke, in heavy concentrations, can damage the contents and belongings within structures, even if those structures were not damaged by fire. Those structures in areas identified as direct exposure or indirect exposure are the most vulnerable if a wildfire were to occur in Bellevue. See Table 15-2 for the value of structures that are vulnerable if the conditions were right for a large wildfire in Bellevue.

Table 15-2. Structures vulnerable to the wildfire hazard

Area	Number of Buildings	Total Building and Contents Value	% of Total Value Exposed
BelRed	0	$0	0%
Bridle Trails	188	$217,244,869	6%
Cougar Mountain/ Lakemont	2,520	$3,350,646,507	83%
Crossroads	3	$3,860,606	0%
Downtown	0	$0	0%
Eastgate	75	$69,409,536	1%
Factoria	0	$0	0%
Lake Hills	46	$35,248,541	1%
Newport	160	$118,604,827	5%
Northeast Bellevue	6	$3,994,242	0%
Northwest Bellevue	0	$0	0%
Somerset	656	$490,051,418	22%
West Bellevue	127	$157,566,921	4%
West Lake Sammamish	131	$119,326,688	7%
Wilburton	30	$30,015,236	1%
Woodridge	34	$111,196,654	9%
Total	**3,976**	**$4,707,166,046**	**6%**

However, the likelihood of a vulnerable structure being impacted is low, according to Wildfirerisk.org Risk to Homes map. This map, shown in Figure 15-8**Error! Reference source not found.**, measures the consequences of wildfire to residential structures by integrating data about wildfire likelihood and intensity and

susceptibility of homes. Because the likelihood and intensity of a wildfire is low, the risk to homes within Bellevue is also low.

The homes most likely to be impacted are those that are adjacent or nearby to a brush or bark fire. The fire may run up to a home directly exposing it to the fire, or an ember may fall onto the roof of a nearby home or start a second fire. Homes within areas where brush and bark fires frequently occur are the most likely to be impacted.

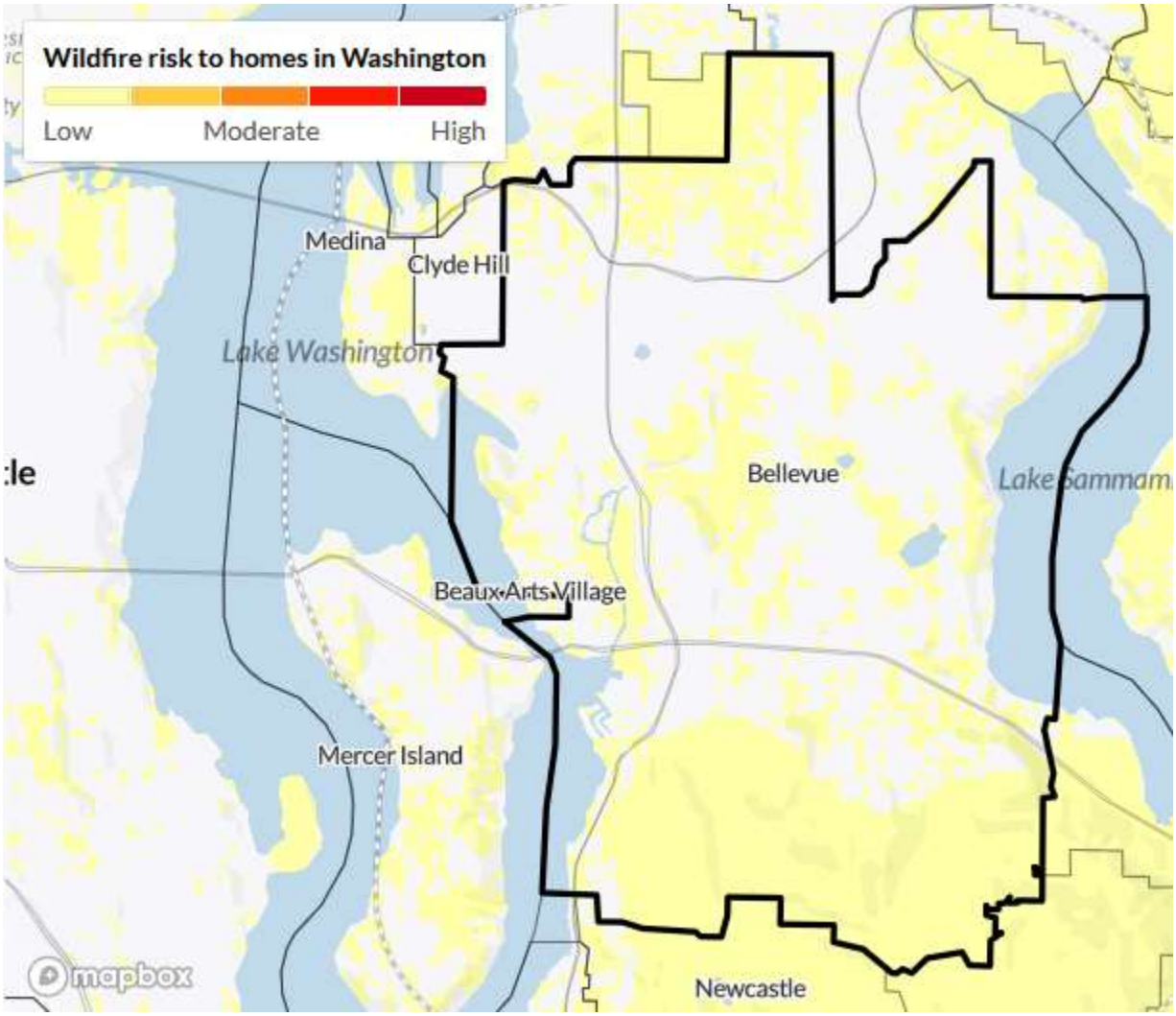

Figure 15-8. Risk to homes

15.5.3 Systems

All systems are vulnerable to wildfire and smoke hazard, such as systems not built to fire protection standards, wooden utility poles and lines, and facilities containing hazardous materials.

Most road and railroads would be without damage except in the worst scenarios, although roads and bridges can be blocked by debris or other wildfire-related conditions and become impassable.

Potable water reservoirs and surface water supplies are vulnerable to ash and other organic materials and may require additional filtering and treatment before water can be distributed.

Based upon the likelihood of a wildfire occurring in Bellevue, systems within Bellevue are not likely to be directly impacted. Most impacts will be indirect, such as power outages or interruptions to the water supply which is sourced from mountainous areas with higher wildfire likelihood.

Similar to structures, systems that are adjacent to or nearby a brush or bark fire have a greater change of being impacted. They may experience fire damage, loss of business, or loss of function.

The Fire Department may experience the greatest impact due to the increasing frequency of brush and bark fire calls.

15.5.4 Natural, historic and cultural resources

All natural, historic and cultural resources are vulnerable to the wildfire hazard.

Although fire is a natural and critical ecosystem process in most terrestrial ecosystems, it can also cause severe environmental impacts:

- **Damaged habitat**—Fish and wildlife can suffer from destroyed habitat, increased water temperatures, sedimentation, and changes in water quality.
- **Soil Erosion**—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.
- **Spread of Invasive Plant Species**—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the landscape and become difficult and costly to control.
- **Soil Sterilization**—Some fires burn so hot that they can sterilize the soil. Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost.

- **Damaged Cultural Resources**—Access to recreational areas can be reduced and cultural sites and resources may be destroyed or damaged.
- **Damaged Historic Structures**—Historic structures made of wood may be destroyed or damaged.

15.5.5 Activities that have value to the community

Activities that have value to the community are vulnerable to wildfire and wildfire smoke. These activities are most likely to be impacted by smoke. Outdoor activities, such as visiting parks, using trails, or playing on the lake may not be possible on days with very low air quality due to smoke. The smoke may lead to cancellation of events, temporary closure of businesses and disruptions in services.

15.6 National Risk Index

Table 15-3 provides NRI results for the wildfire hazard.

Table 15-3. NRI results

Expected Annual Loss	Expected Annual Loss Rating	Community Resilience	Social Vulnerability	Risk Index Score	Risk Index Rating
$13,128	Very Low	Relatively Moderate	Relatively Low	40	Very Low

15.7 Mitigating the Hazard

Table 15-4 presents a range of potential opportunities for mitigating the wildfire hazard.

Table 15-4. Wildfire mitigation alternatives

Scale	Alternatives
Manipulate Hazard	
Personal	▪ Clear potential fuels such as dry underbrush and diseased trees
Corporate	▪ Clear potential fuels such as dry underbrush and diseased trees
Government	▪ Clear potential fuels such as dry underbrush and diseased trees ▪ Implement best management practices on public lands
Reduce Exposure	
Personal	▪ Create and maintain defensible space around structures ▪ Locate outside of hazard area

	▪ Mow regularly
Corporate	▪ Create and maintain defensible space around structures and infrastructure ▪ Locate outside of hazard area
Government	▪ Create and maintain defensible space around structures and infrastructure ▪ Locate outside of hazard area ▪ Enhance building code to include use of fire-resistant materials in high hazard area
Reduce Vulnerability	
Personal	▪ Create and maintain defensible space around structures and provide water on site ▪ Use fire-resistant building materials and landscaping
Corporate	▪ Create and maintain defensible space around structures and infrastructure and provide water on site ▪ Provide air filtration resources for employees ▪ Use fire-resistant building materials and landscaping
Government	▪ Create and maintain defensible space around structures and infrastructure ▪ Use fire-resistant building materials ▪ Use fire-resistant plantings in buffer areas of high wildfire threat ▪ Establish biomass reclamation initiatives ▪ Designate clean air facilities with air filtration systems ▪ Implement WUI Code and higher regulatory standards
Increase Preparation or Response Capability	
Personal	▪ Employ techniques from the National Fire Protection Association's Firewise USA program to safeguard home ▪ Identify alternative water supplies for fire fighting ▪ Install/replace roofing material with non- combustible roofing materials
Corporate	▪ Support Firewise USA community initiatives ▪ Create /establish stored water supplies to be utilized for firefighting
Government	▪ More public outreach and education efforts, including active fuel reduction and home hardening programs ▪ Identify fire response and alternative evacuation routes ▪ Seek alternative water supplies ▪ Become a Firewise USA community ▪ Establish/maintain mutual aid agreements between fire service agencies. ▪ Create/implement fire plans ▪ Consider probable impacts of climate change on risk associated with wildfire hazards in future land use decisions

16. Risk Ranking

16.1 About Risk

FEMA requires all hazard mitigation planning partners to have jurisdiction-specific mitigation actions based on local risk, vulnerability and community priorities (FEMA, 2022). This plan included a risk ranking protocol in which "risk" was calculated by multiplying probability by impacts. The risk estimates were generated using methodologies promoted by FEMA. The risk ranking assesses factors such as:

- **Probability**—The likelihood of each hazard's occurrence
- **Impact on Property**—The likely impact on structures, including residential, commercial and critical facilities (community lifelines)
- **Impact on People**—The population vulnerable to the hazard
- **Impacts on the Economy**—The likely interruption of services, businesses and jobs

This risk rating was conducted using a combination of quantitative and qualitative data on each hazard for these selected metrics. Metrics are the quantifiable measures that are used to compare and assess the identified risk of each hazard. The risks of each hazard were rated as high, medium, or low. These impacts are then multiplied by the probability factor to generate the hazard risk rating for each hazard. The quantitative analysis aspect of this exercise was limited to hazards with a clearly defined extent and location. For other hazards, such as drought, a more qualitative approach was applied.

Numerical ratings of probability and impact were based on the hazard profiles and exposure and vulnerability evaluations presented in Chapters 8 through 15. When available, estimates of risk were generated with data from Hazus or GIS. For hazards of concern with less specific data available, qualitative assessments were used. As appropriate, results were adjusted based on local knowledge and other information not captured in the quantitative assessments.

Risk ranking results are used to help establish mitigation priorities. The city was directed to identify mitigation actions, at a minimum, to address each hazard with a "high" or "medium" risk ranking. Actions that address hazards with a low hazard ranking are optional.

16.2 Probability of Occurrence

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- **High**—Hazard event is likely to occur within 25 years (Probability Factor = 3)
- **Medium**—Hazard event is likely to occur within 100 years (Probability Factor =2)
- **Low**—Hazard event is not likely to occur within 100 years (Probability Factor =1)
- **No vulnerability**—There is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is based on past hazard events in the area and the potential for changes in the frequency of these events resulting from climate change. Table 16-1 summarizes the probability assessment for each natural hazard of concern for this plan.

Table 16-1. Probability of hazards

Hazard	Probability	Probability Factor
Dam Failure	Low	1
Drought	Medium	2
Earthquake (Seattle)	Low	1
Earthquake (Cascadia)	Medium	2
Flooding	Medium	2
Landslide	High	3
Severe Weather	High	3
Volcano	Low	1
Wildfire	Medium	2

16.3 Impact

Hazard impacts were assessed in three categories: impacts on property, impacts on people and impacts on the local economy.

Each hazard category was assigned a weighting factor to reflect its significance. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3, impact on property was given a weighting factor of 2 and impact on the economy was given a weighting factor of 1. Table 16-2, Table 16-3 and Table 16-4 summarize the impacts for each hazard.

16.3.1 Property

Values were assigned based on the percentage of the **total property value exposed** to the hazard event:

- High—25% or more of the total assessed property value and community lifelines exposed to a hazard (Impact Factor = 3)
- Medium—10% to 25% of the total assessed property value and community lifelines exposed to a hazard (Impact Factor = 2)
- Low—10% or less of the total assessed property value and community lifelines exposed to the hazard (Impact Factor = 1)
- No impact—None of the total assessed property value or community lifelines exposed to a hazard (Impact Factor = 0)

Table 16-2. Impact on property

Hazard	Impact	Impact Factor	X	Weighting Factor	=	Total
Dam Failure	Low	1		2		2
Drought	Low	1		2		2
Earthquake (Seattle)	High	3		2		6
Earthquake (Cascadia)	High	3		2		6
Flooding	Low	1		2		2
Landslide	Low	1		2		2
Severe Weather	High	3		2		6
Volcano	High	3		2		6
Wildfire	Low	1		2		2

16.3.2 People

Values were assigned based on the percentage of the **total population exposed** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows for the total population:

- High—25% or more of the population is exposed to a hazard (Impact Factor = 3)
- Medium—10% to 24% of the population is exposed to a hazard (Impact Factor = 2)
- Low—9% or less of the population is exposed to the hazard (Impact Factor = 1)
- No impact—None of the population is exposed to a hazard (Impact Factor = 0)

Table 16-3. Impact on people

Hazard	Impact	Impact Factor	X	Weighting Factor	=	Total
Dam Failure	Low	1		3		3
Drought	Low	1		3		3
Earthquake (Seattle)	High	3		3		9
Earthquake (Cascadia)	High	3		3		9
Flooding	Low	1		3		3
Landslide	Low	1		3		3
Severe Weather	High	3		3		9
Volcano	High	3		3		9
Wildfire	Low	1		3		3

16.3.3 Economy

Values were assigned based on the percentage of the **total property value vulnerable** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total replacement value of the property exposed to the hazard. Loss estimates separate from the exposure estimates were generated for the earthquake and flooding hazards using Hazus. For other hazards, such as dam failure, landslide and wildfire, vulnerability was estimated as a percentage of exposure due to the lack of loss estimation tools specific to those hazards.

- High—Estimated loss from the hazard is 10% or more of the total exposed property value (Impact Factor = 3)
- Medium—Estimated loss from the hazard is 5% to 10% of the total exposed property value (Impact Factor = 2)
- Low—Estimated loss from the hazard is 5% or less of the total exposed property value (Impact Factor = 1)
- No impact—No loss is estimated from the hazard (Impact Factor = 0)

Table 16-4. Impact on economy

Hazard	Impact	Impact Factor	X	Weighting Factor	=	Total
Dam Failure	Low	1		1		1
Drought	Medium	2		1		2
Earthquake (Seattle)	High	3		1		3
Earthquake (Cascadia)	Low	1		1		1
Flooding	None	0		1		0
Landslide	Low	1		1		1
Severe Weather	Low	1		1		1
Volcano	Medium	2		1		2
Wildfire	Low	1		1		1

16.4 Risk rating and ranking

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors, as summarized in Table 16-5. Based on these ratings, a priority of high, medium, or low was assigned to each hazard. Table 16-5 shows the hazard risk ranking for the planning area. The ranking was assigned based upon the total score as follows:

- Low—0 to 15
- Medium—16 to 32
- High—33 to 54

Table 16-5. Hazard risk ranking

Hazard	Probability Factor	X	Sum of Weighted Impact Factors	=	Total	Risk Ranking
Dam Failure	1		6		6	Low
Drought	2		7		14	Low
Earthquake (Seattle)	1		18		18	Medium
Earthquake (Cascadia)	2		16		32	Medium
Flooding	2		5		10	Low
Landslide	3		6		18	Medium
Severe Weather	3		16		48	High
Volcano	1		17		17	Medium
Wildfire	2		6		12	Low

17. Mitigation Action Plan

17.1 Mitigation Action Planning Process

17.1.1 Mitigation alternatives analysis

As part of the planning process, the steering committee participated in a SWOO exercise (strengths, weaknesses, opportunities and obstacles). During the SWOO, each hazard of concern was discussed. Participants discussed where the city already has strengths and opportunities and where there are weaknesses and obstacles.

The participants discussed weaknesses and obstacles in more detail, considering different mitigation alternatives to address each. The project team provided participants a catalog of mitigation actions, the FEMA BRIC Mitigation Action Portfolio, Nature Based Solutions Guide and Mitigation Ideas documents, the BRIC FY 2023 support materials that described project scoping and building code activities and the 2024 HMA Guidance to identify a wide range of potential mitigation actions. The catalog of mitigation actions is provided at the end of each risk assessment chapter.

The SWOO resulted in dozens of potential mitigation actions. The project team and steering committee condensed, refined and combined SWOO mitigation actions into 21 actions that were determined to be the best alternative, feasible and a city priority. Potential mitigation actions that were not included in the action plan were not selected for one or more of the following reasons:

- The action is not feasible.
- The action is already being implemented.
- The city does not have the capability to implement the action.
- There is an apparently more cost-effective alternative.
- The action does not have public or political support.

17.1.2 Mitigation action plan

Table 17-1 lists the recommended hazard mitigation actions that make up the action plan. Each action is described in more detail in the mitigation worksheets in Appendix C. For this table, timeline and estimated cost are defined as follows:

- Timeline to completion
  - Short-term: less than 5 years
  - Long-term: more than 5 years
  - On-going: a multi-year phased project
- Cost
  - Low: $0 to $50,000
  - Medium: $50,000 to $250,000
  - High: $250,000 to $1 million
  - Very high: more than $1 million

Table 17-1. Mitigation action plan summary

Benefits New or Existing	Goals Met	Lead Department	Support Department / Agency	Cost	Potential Funding Sources	Timeline
Action 1:	Adopt and enforce a WUI code with defensible space and fire-resistant building material standards for high-risk wildfire areas.					
Hazards Mitigated:	Wildfire					
New and Existing	1,2,3,4	Development Services	Bellevue Fire Department	Low	FEMA BRIC, HMGP, General Funds	Short-term
Action 2:	Update landslide hazard maps and integrate the data into building codes and critical area ordinances, restricting development in high-risk areas and improving existing geotechnical data.					
Hazards Mitigated:	Landslide					
New and Existing	1,2,3	Development Services	Transportation, Utilities, Information Technology	Med	FEMA BRIC, HMGP, General Funds	Short-term
Action 3:	Perform seismic vulnerability assessments for city facilities and infrastructure, including but not limited to the city's water, wastewater and stormwater system, bridges, buildings and designated shelters, to identify risks and prioritize retrofitting efforts.					
Hazards Mitigated:	Earthquake					
New and Existing	1,3,4,5	Utilities	Finance and Asset Management, Transportation	Very High	FEMA BRIC, HMGP, Staff time, Department/Utility funds	Ongoing
Action 4:	Prioritize retrofitting older buildings and critical facilities, including but not limited to school administration buildings, unreinforced masonry and soft-story structures and emergency shelters, to meet current seismic standards.					
Hazards Mitigated:	Earthquake					
Existing	1,3,4,5	Development Services	Finance and Asset Management, Fire, Parks	Very High	FEMA BRIC, HMGP, General fund, Department/Utility	Long-term

Benefits New or Existing	Goals Met	Lead Department	Support Department / Agency	Cost	Potential Funding Sources	Timeline
					funds, Special purpose funds, Other grant funds	
Action 5:	Evaluate the vulnerability of the Bellevue Service Center (BSC) to natural hazards and mitigate or relocate as recommended.					
Hazards Mitigated:	All hazards					
Existing	1,3,4,5,6	Finance and Asset Management	City Manager's Office, Transportation, Utilities, Information Technology	Very High	FEMA BRIC, HMGP, Staff time, General fund, Department/Utility funds	Short-term
Action 6:	Implement recommended actions from the wastewater I/I study.					
Hazards Mitigated:	Earthquake, Flood, Landslide, Severe Weather					
New and Existing	1,2,3,4	Utilities	Finance and Asset Management, Transportation,	Very High	FEMA BRIC, HMGP, Department/ Utility funds,	Long-term
Action 7:	Implement a city-wide education campaign to increase community resilience and awareness about all natural hazard events, with targeted outreach to high-risk wildfire, flood and dam inundation areas.					
Hazards Mitigated:	All hazards					
New and Existing	2	Emergency Management	Community Development	High	FEMA HMGP, BRIC, general funds	Ongoing
Action 8:	Update the city's fleet plan to protect vehicles and equipment from ashfall and develop a plan to protect city infrastructure and facilities that are sensitive to ash, such as HVAC systems.					
Hazards Mitigated:	Volcano					
New and Existing	1,3,5,6	Finance and Asset Management	City Manager's Office, Parks, Transportation, Utilities	Mod	Staff time, General funds, Other grand funding	Short-term
Action 9:	Expand the use of drought-tolerant landscaping designs across parks, transportation projects and public spaces and encourage the use of drought-tolerant landscaping for private development.					
Hazards Mitigated:	Drought					

Benefits New or Existing	Goals Met	Lead Department	Support Department / Agency	Cost	Potential Funding Sources	Timeline
New and Existing	1,3,6	Parks	Community Development, Development Services, Transportation, Fire, Utilities	Very High	FEMA BRIC, HMGP, Staff time, Department/Utility funds, General funds, CIP funding	Long-term
Action 10:	Collaborate with emergency management and regional transportation agencies to improve evacuation plans for all types of hazard events. The plans should account for potential transportation system failures, micro-islands and high daytime population density, include specific procedures for transit-dependent residents and workers and provide clear routes and shelter locations. The plan updates should be developed in coordination with neighboring municipalities to increase regional capabilities.					
Hazards Mitigated:	All Hazards					
New and Existing	1,2,3	Emergency Management	Transportation, Police, WSDOT	High	Staff time, General funds, Emergency Mgnt planning grants	Long-term
Action 11:	Expand use and build staff capabilities and capacities for existing communication methods, such as satellite phones or emergency radio systems, to maintain communication after a natural hazard, especially in the event of cell tower or internet failures.					
Hazards Mitigated:	All Hazards					
New and Existing	1,2,4	Emergency Management	Finance and Asset Management, Fire, IT, Transportation, Utilities	High	Staff time, General funds	Short-term
Action 12:	Expand roadside mowing to reduce summertime vegetation, balancing fuel reduction and tree canopy protection.					
Hazards Mitigated:	Wildfire					
New and Existing	1,3,5	Transportation	Parks, Utilities	Mod	Staff time, General funds, Other grant funding	Short-term
Action 13:	Support upgrades to HVAC systems in public and private facilities throughout the city, especially in critical facilities and housing that supports vulnerable populations, to ensure they have adequate heating, cooling and air filtration systems for current and future conditions.					
Hazards Mitigated:	Severe Weather, Wildfire					

Benefits New or Existing	Goals Met	Lead Department	Support Department / Agency	Cost	Potential Funding Sources	Timeline
New and Existing	1,3,4	Finance and Asset Management	Community Development, Development Services, Parks	Mod	Staff time, Department/ Utility funds, Special purpose funds	Long-term
Action 14:	Establish a network of city- and partner-managed resiliency hubs throughout the city to provide safe spaces for community members and vulnerable populations during extreme heat and cold events, during times of low air quality and in other times of need. Ensure all locations have adequate heating, cooling and air filtration systems, backup power supply and communication systems and other resilient features to support the community in all types of situations including future conditions.					
Hazards Mitigated:	Severe Weather, Wildfire					
New and Existing	1,2,3,4	Emergency Management	Community Development, Parks	Very High	Staff time, General funds, FEMA HMPG, BRIC	Long-term
Action 15:	Improve stormwater management systems by developing more green infrastructure and increasing capacity to reduce urban flooding events. Prioritize nature-based green stormwater infrastructure solutions, such as wetland enhancements, to reduce flooding risk. Ensure new and retrofitted stormwater systems include sufficient capacity to manage more intense rainfall events occurring now and into the future.					
Hazards Mitigated:	Dam Failure, Flood, Severe Weather					
New and Existing	1,2,3,5,6	Utilities	City Manager's Office, Information Technology, Finance and Asset Management, Parks, Transportation, Department of Ecology	Very High	FEMA BRIC, HMGP, Department/ Utility funds, Clean Water Act /Department of Ecology	Ongoing
Action 16:	Collaborate with Cascade Water Alliance (CWA) to expedite efforts in diversifying Bellevue's water supply and accelerate the implementation of the Emergency Water Supply Master Plan. Collaborate with water suppliers managing the Tolt and Cedar dams to develop contingency plans ensuring a continued water supply in case of dam failure. Investigate and implement alternative water sources, including the use of groundwater, surface water and water recycling, to reduce reliance on a single supplier, reduce impacts of drought and					

Benefits New or Existing	Goals Met	Lead Department	Support Department / Agency	Cost	Potential Funding Sources	Timeline
	provide water for emergency situations such as firefighting. Increase water conservation efforts.					
Hazards Mitigated:	All Hazards					
New and Existing	1,2,3	Utilities	Finance and Asset Management, Transportation, CWA	Mod	FEMA BRIC, HMGP, Department/ Utility funds, CWA	Long-term
Action 17:	Update and maintain inventory of rockeries and other retaining walls that may be susceptible to seismic or landslide failures. Prioritize, plan and fund mitigation, repair or replacement projects.					
Hazards Mitigated:	Earthquake, Landslide, Severe Weather					
Existing	1,3,5	Transportation		High	FEMA BRIC, HMGP, staff time, general fund, Department/ Utility funds	Short-term
Action 18:	Provide cross-training for Parks and Community Services employees to support wildfire response and suppression on city parks.					
Hazards Mitigated:	Wildfire					
New and Existing	1	Fire, Parks and Community Services	Community Development, King County, WA State DNR	High	FEMA fire fighting grants, General funds	Long-term
Action 19:	Partner with the power utility to enhance grid resilience, promote backup power systems and reduce wildfire and service disruption risks.					
Hazards Mitigated:	All Hazards					
New and Existing	1,4,5,6	Community Development, City Manager's Office	Emergency Management, Puget Sound Energy	High	FEMA BRIC, HMGP, Staff time, General funds, Other grant funding	Long-term
Action 20:	Expand earthquake drills and training to include remote and hybrid staff. Develop virtual training resources and conduct online drills to ensure all staff, regardless of location, are prepared to respond effectively during an earthquake.					
Hazards Mitigated:	Earthquake					

Benefits New or Existing	Goals Met	Lead Department	Support Department / Agency	Cost	Potential Funding Sources	Timeline
New and Existing	2,4	Emergency Management	Human Resources, Community Development	Low	Staff time, General funds	Ongoing
Action 21: Seek opportunities to increase existing collaboration with the Bellevue School District and support planning, mitigation and mitigation grant application.						
Hazards Mitigated: All Hazards						
New and Existing	1,2,3,4	Emergency Management	Bellevue School District	Very High	FEMA BRIC, HMGP, Staff time, General funds, BSD funds	Ongoing
Action 22: Evaluate NHS, emergency and other critical routes for flooding risks and plan/program/fund mitigation projects.						
Hazards Mitigated: Flood						
Existing	5,6	Transportation, Utilities	King County Flood Control District	High	FEMA BRIC, HMGP, Staff time, General fund, Department/ Utility funds, King County FCD	Short-term
Action 23: Acquire, maintain and analyze data, such as LiDAR, to identify and mitigate hazard risk areas.						
Hazards Mitigated: All hazards						
New and Existing	1,2,3,4,5,6	IT, Development Services	Transportation, Utilities, King County Flood Control District	Mod	FEMA BRIC, HMGP, General fund, Department/ utility funds	Short-term
Action 24 Develop new data and maps to identify where the most vulnerable populations are located.						
Hazards Mitigated: All Hazards						
New and Existing	2,4	Emergency Management	Community Development, IT, Transportation	Mod	Staff time, General funds, Other	Ongoing

17.2 Mitigation Action Prioritization and Classification

17.2.1 Prioritization

Table 17-2 shows the prioritization of each action. Actions were prioritized based on a numerical system in the mitigation action worksheets that examined 15 different criteria. The criteria include life safety, property protection, cost-effectiveness, feasibility, legal authority, funding availability, grant eligibility, incorporation of nature-based solutions, examining climate change, benefitting socially vulnerable communities, administrative capability, multi-hazard risk reduction, timeline, policy and objective support and community support. Each criteria was given a score based on the following answers, and added together to determine prioritization:

- Yes = 3 points
- Maybe = 1 points
- No = 0 point

- High = 40-57
- Medium = 20-39
- Low = 0-19

17.2.2 Classification

Each recommended action was classified based on the hazard it addresses and the type of mitigation it involves. Table 17-3 shows these classifications. Mitigation types used for this categorization are as follows:

- **Prevention**—Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. Includes planning and zoning, floodplain laws, capital improvement programs, open space preservation and stormwater management regulations.
- **Property Protection**—Modification of buildings or structures to protect them from a hazard or removal of structures from a hazard area. Includes acquisition, elevation, relocation, structural retrofit, storm shutters and shatter-resistant glass.
- **Public Education and Awareness**—Actions to inform residents and elected officials about hazards and ways to mitigate them. Includes outreach projects, real estate disclosure, hazard information centers and school-age and adult education.
- **Natural Resource Protection**—Actions that minimize hazard loss and preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and

vegetation management, wetland restoration and preservation and green infrastructure.

- **Emergency Services**—Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services and the protection of essential facilities.
- **Structural Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Includes dams, setback levees, floodwalls, retaining walls and safe rooms.
- **Climate Resiliency**—Actions that incorporate methods to mitigate and/or adapt to the impacts of climate change. Includes aquifer storage and recovery activities, incorporating future conditions projections in project design or planning, or actions that specifically address jurisdiction-specific climate change risks.
- **Community Capacity Building**—Actions that increase or enhance local capabilities to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Includes staff training, memorandums of understanding, development of plans and studies and monitoring programs.

Table 17-2. Mitigation action prioritization

Action	Life Safety	Property Protection	Cost-Effective	Economic Benefit	Public Support	City Leadership Support	Community Partner Support	Implementation Authority	Funding under Existing	Grant funding eligible	Nature based solutions	Vulnerable populations	City capacity to execute	Multi-hazard	Climate change	Start within 5 years	Completed within 5 years	Community Lifelines	Multi-objective	Total Score	Priority
1																					
2																					
3	Y	Y	M	M	Y	Y	Y	Y	M	Y	N	M	M	Y	N	M	N	Y	Y	36	Medium
4	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	N	M	Y	N	N	M	M	Y	Y	40	High
5	Y	Y	Y	Y	Y	Y	M	Y	N	Y	N	M	M	Y	Y	Y	Y	Y	Y	45	High
6	Y	Y	M	M	Y	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	M	Y	Y	49	High
7	Y	N	M	M	Y	Y	Y	Y	M	M	N	Y	M	Y	M	Y	M	Y	Y	37	Medium
8	Y	N	M	Y	M	Y	M	Y	Y	M	N	M	Y	N	N	Y	Y	M	Y	33	Medium
9	N	M	Y	M	Y	Y	Y	Y	M	M	Y	M	M	Y	Y	Y	N	Y	Y	39	Medium
10	Y	M	M	Y	Y	Y	Y	Y	M	M	N	Y	M	Y	M	M	N	Y	Y	37	Medium
11	Y	M	Y	Y	Y	Y	Y	Y	M	M	N	M	M	Y	Y	Y	Y	Y	Y	44	High
12	Y	Y	Y	Y	Y	M	Y	Y	N	M	Y	Y	Y	N	Y	Y	Y	Y	Y	47	High
13	Y	N	M	N	M	M	Y	Y	M	Y	N	Y	M	Y	Y	Y	M	Y	Y	36	Medium
14	Y	N	M	Y	Y	Y	Y	Y	N	Y	N	Y	M	Y	Y	M	N	Y	Y	39	Medium
15	M	Y	M	M	Y	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	N	Y	Y	46	High
16	Y	Y	M	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	M	Y	Y	51	High
17	Y	Y	Y	M	M	M	M	Y	M	Y	M	M	M	M	Y	Y	Y	Y	Y	39	Medium
18	Y	Y	M	M	M	M	M	Y	M	M	Y	M	M	M	Y	Y	M	Y	Y	35	Medium
19	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	N	Y	M	Y	Y	Y	N	Y	Y	47	High
20	Y	N	Y	Y	Y	Y	Y	Y	Y	M	N	M	Y	N	N	Y	Y	Y	Y	41	High
21	Y	Y	M	Y	Y	Y	Y	Y	M	M	M	M	M	Y	M	Y	N	Y	Y	40	High
22	Y	Y	Y	Y	M	M	M	Y	M	Y	M	M	M	N	Y	Y	Y	Y	Y	40	High
23	Y	Y	Y	M	Y	Y	Y	Y	M	M	N	M	Y	Y	Y	Y	Y	Y	Y	46	High
24	M	N	Y	M	Y	Y	Y	Y	M	M	N	Y	Y	Y	Y	Y	Y	Y	Y	43	High

Table 17-3. Mitigation action classification and hazards

Action	Prevention	Property Protection	Public Education and Awareness	Natural Resource Protection	Emergency Services	Structural Projects	Climate Resilience	Community Capacity Building	Hazard Risk Ranking: High — Severe Weather	Medium — Earthquake	Medium — Landslide	Medium — Volcano	Low — Drought	Low — Flooding	Low — Dam Failure	Low — Wildfire
1	■	■	■	■	■											■
2															■	
3		■		■		■			■							
4	■	■			■			■	■							
5		■			■	■	■	■	■	■	■	■	■	■	■	■
6				■				■	■		■			■	■	
7			■						■	■	■	■	■	■	■	■
8	■	■			■		■			■						
9				■			■						■			
10					■			■	■	■	■	■	■	■	■	■
11					■			■	■	■	■	■	■	■	■	■
12		■		■			■									■
13							■				■					■
14			■		■			■			■					■
15	■	■		■			■				■	■		■		
16	■		■	■	■		■		■	■	■	■	■	■	■	■
17	■	■		■	■	■	■		■		■				■	
18	■	■		■	■											■
19	■						■	■	■	■	■	■	■	■	■	■
20		■						■	■							
21		■	■		■	■	■	■	■	■	■	■	■	■	■	■
22	■				■	■	■							■		
23	■		■	■	■		■	■	■	■	■	■	■	■	■	■
24	■			■			■						■			■
25	■		■		■				■	■	■	■	■	■	■	■

17.3 Action Plan Implementation

The city's action plan presents a range of action items for reducing loss from natural hazard events. The planning partners have prioritized actions and can begin to implement the highest-priority actions over the next five years. The effectiveness of the hazard mitigation plan depends on its effective implementation and incorporation of the outlined action items into all partners' existing plans, policies and programs. Some action items do not need to be implemented through regulation but can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation.

The Office of the Emergency Management will assume lead responsibility for coordinating hazard mitigation plan implementation. Plan implementation will be a shared responsibility among all departments.

17.4 Incorporation into Other Planning Mechanisms

Integrating relevant information from this hazard mitigation plan into other plans and programs where opportunities arise will be the ongoing responsibility of the departments responsible for the other plans. The hazard mitigation planning process provides the city with an opportunity to review and expand on policies contained within these documents, based on the best science and technology available at the time this plan was prepared. The city should use their plans and the hazard mitigation plan as complementary documents to achieve the ultimate goal of reducing risk exposure to community members. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

All departments have committed to creating a future linkage between the hazard mitigation plan and the plans identified in the core capability assessment.

Other planning processes and programs that can be integrated with the hazard mitigation plan by include the following:

- Capital improvement programs
- Climate action/adaptation plans
- Community design guidelines

- Critical areas regulations
- Debris management plans
- Emergency response plans
- Bellevue City Code
- Post-disaster action/recovery plans
- Stormwater management plans
- Water/utility system vulnerability assessments
- Water-efficient landscape design guidelines

18. Plan Adoption and Maintenance

18.1 Plan Adoption

This plan will be submitted to Washington State Emergency Management Division and FEMA for a pre-adoption review. Once pre-adoption approval has been provided, the city will formally adopt the plan. A copy of the adopting resolution and FEMA plan approval can be found in Appendix B of this plan.

18.2 Plan Maintenance Strategy

Plan maintenance is the formal process for achieving the following:

- Incorporating the mitigation strategies outlined in this plan into existing planning mechanisms and programs, such as any relevant comprehensive land-use planning process, capital improvement planning process and building code enforcement and implementation.
- Ensuring that the hazard mitigation plan and community wildfire protection plan remains an active and relevant document and that the city maintains its eligibility for applicable funding sources.
- Monitoring and evaluating the plan annually and producing an updated plan every five years.
- Integrating public participation throughout the plan maintenance and implementation process.

To achieve these ends, a hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.6(c)(4)):

- A method and schedule for monitoring, evaluating and updating the mitigation plan.
- A process for incorporating the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.
- A strategy for continuing public participation through the plan maintenance process.

This section details the formal process that will ensure that the hazard mitigation plan and community wildfire protection plan remains an active and relevant document and that the City of Bellevue maintains its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This section also describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

18.3 Plan Monitoring and Evaluation

The city's Office of Emergency Management, Transportation Department, Fire Department and Utilities Department will monitor the plan by tracking the status of all recommended mitigation actions in the action plan. The plan will be evaluated by how successfully the implementation of identified actions has helped to achieve the plan goals and objectives. This will be assessed by a review of the changes in risk that occur over the performance period and by the degree to which mitigation goals and objectives are incorporated into existing plans, policies and programs.

18.4 Steering Committee

The steering committee is a volunteer body that contributed greatly to development of this hazard mitigation plan. The committee oversaw development of this plan and made recommendations on key elements of it, including this maintenance strategy.

A steering committee, as determined by the city's Office of Emergency Management, Transportation Department and Utilities Department, will remain involved in the proposed maintenance strategy. The steering committee will include members of the CWPP sub-committee and will perform annual reviews of the plan and its implementation. The make-up of this steering committee will strive for representation from community members, community groups and stakeholders within the planning area. Previous and existing members will be given the option to remain involved.

18.5 Annual Progress Report

The city's Office of Emergency Management, Transportation Department and Utilities Department will prepare a formal annual report on the progress of the current plan. This team will assemble city staff members with connection to hazard mitigation efforts. This group will meet at least annually to review the various action items and assess their continued relevance and importance, add any new action items, delete ones that are no longer relevant and include any new or applicable mitigation data and information to the plan. These meetings will occur throughout the life of the plan.

An annual progress report, submitted by September 1 of each year, will provide a streamlined approach for fulfilling update requirements delineated in 44 CFR 201.6(d)(3) during the next plan update initiative. The objective of the progress report will be to evaluate the progress of individual actions and their effectiveness in achieving the goals of the plan. The review will include the following:

- Summary of any hazard events that occurred during the prior year and their impact on the planning area.
- Identification of new hazards that have emerged.
- Review of community vulnerability and any notable shifts.
- Review of successful mitigation actions identified in the 2025 plan.
- Brief discussion about why targeted strategies were not completed.
- Re-evaluation of mitigation strategies to determine if the actions are still appropriate for the community's circumstances.
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term project because of funding availability).
- Recommendations for new projects.
- Changes in or potential for new funding options (grant opportunities).
- Impacts of any other planning programs or actions in the city that involve hazard mitigation.

This report will be used as follows:

- Posted on the city website on the page dedicated to the hazard mitigation plan.
- Announced on multiple social media platforms.

- Provided to the local media through a press release.
- Presented to the Bellevue City Council.
- Provided as part of the Community Rating System annual re-certification package.

The CRS program requires an annual recertification to be submitted by October 1 of every calendar year for which the community has not received a formal audit. To meet this recertification timeline, the city will strive to complete the progress report process between June and September every year.

18.6 Plan Update

FEMA requires the hazard mitigation plan to be revised and resubmitted for review and approval by Washington EMD and FEMA prior to the five-year anniversary date of the plan's adoption to remain eligible for benefits under the DMA (44 CFR, Section 201.6(d)(3)). The City of Bellevue intends to update its hazard mitigation plan on a 5-year cycle. This cycle may be accelerated to less than 5 years based on the following triggers:

- A presidential disaster declaration that impacts the City of Bellevue
- A hazard event that causes loss of life
- A periodic update of the city's comprehensive plan

It will not be the intent of this update process to start from scratch and develop a completely new hazard mitigation plan. Based on needs identified by the planning team, this update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and updated using best available information and technologies.
- The action plan will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new city policies identified under other planning mechanisms, as appropriate (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.

- The public will be given an opportunity to comment on the update prior to adoption.
- The Bellevue City Council will adopt the updated plan

18.7 Continuing Public Involvement

The public will continue to be apprised of hazard mitigation actions through the city website and by providing copies of the annual progress reports to the media. Upon initiation of the update process, a new public involvement strategy will be initiated based on the needs and capabilities of the city at the time of the update.

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