Climate Vulnerability and Risk Assessment
Technical Report

City of Enumclaw

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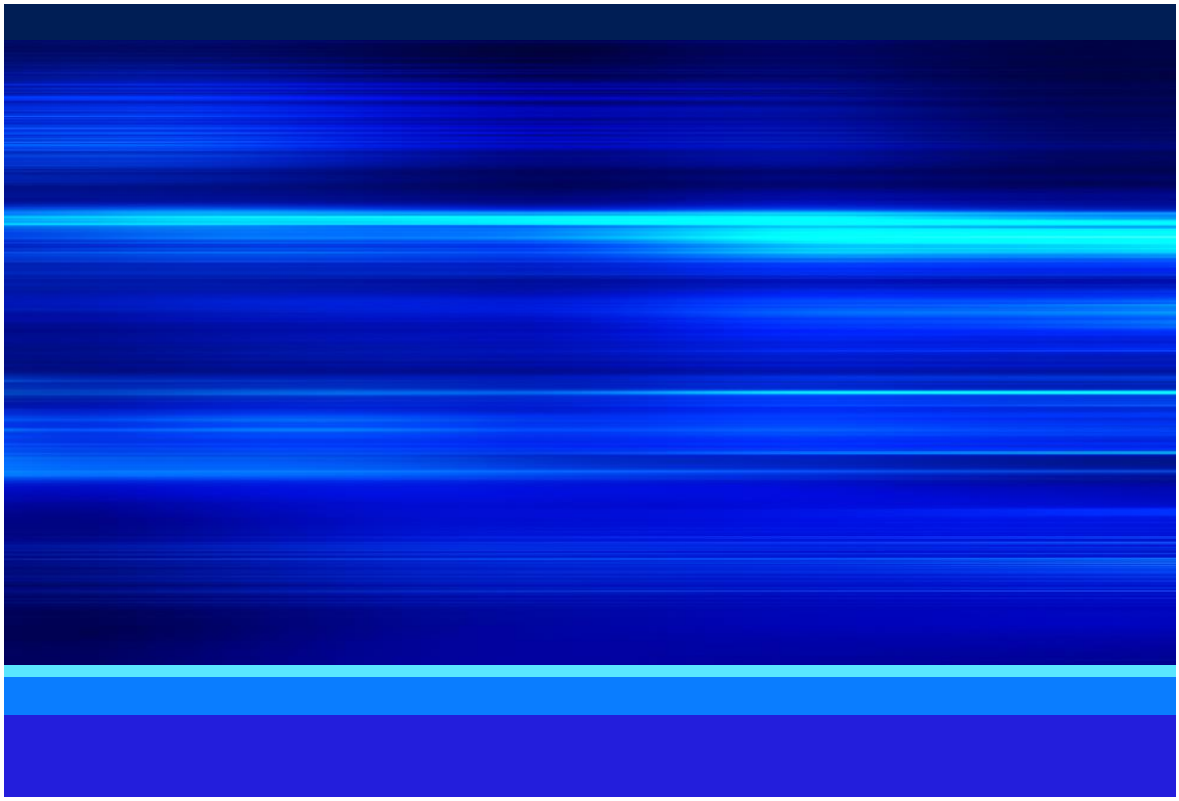
June 4, 2023



Climate Vulnerability and Risk Assessment

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Jacobs Engineering Inc.

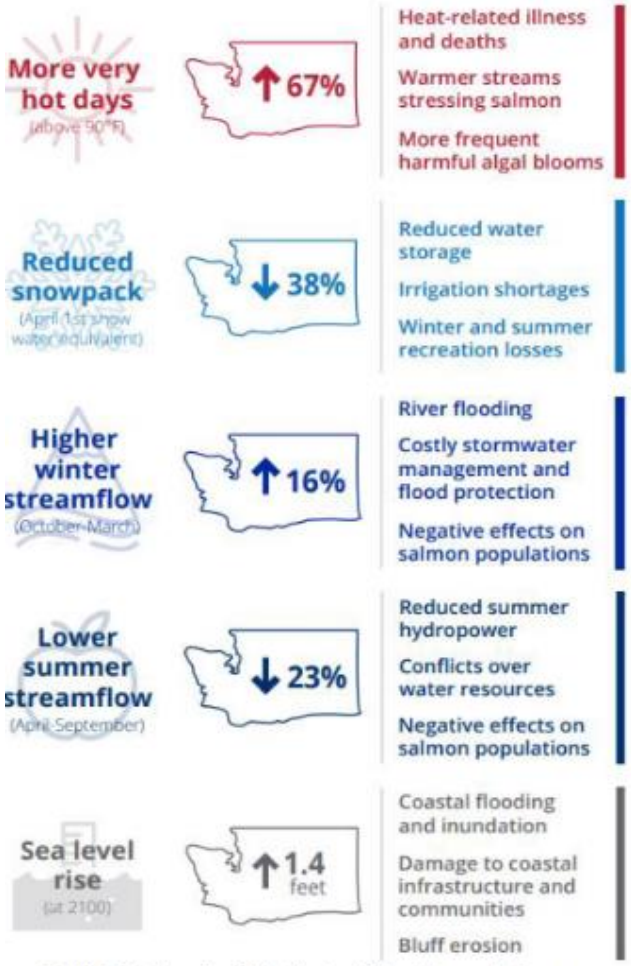
2600 Michelson Drive
Suite 500
Irvine, CA 92612
United States

T +1.949.224.7500
F +1.949.224.7501
www.jacobs.com

Executive Summary

Global climate is expected to continue to change in unprecedented ways and alter the risks and opportunities facing our communities. Enumclaw's social, built, and natural environment systems will likely be exposed to serious climate hazards in the years to come. To maintain ecosystem integrity, infrastructure reliability and community well-being, policy decisions must consider the interaction between such climate risks and existing comprehensive planning efforts.

At the local scale, the consequences of a changing climate look different depending on a community's values and sensitivities. Different communities value different assets. The likelihood and magnitude of different hazard exposures will affect a community's priorities. The Puget Sound region is projected to experience more intense and more frequent heatwaves, an ongoing decrease in snowpack, a continued shift from snow to rain, increasing stream temperatures, a continued shift to earlier peak streamflows, an increase in the frequency and extent of flooding, and declining summer flows. These changes may be most pronounced in areas like Enumclaw, mid-elevation basins that have historically received a mix of rain and snow during winter. Further, there is growing concern over large wildfires in Eastern Washington and California, smoke events in Western Washington, and growing evidence that changes in the climate are increasing the likelihood of wildfire in the Pacific Northwest (PNW).



SOURCE: University of Washington Climate Impacts Group

Enumclaw's comprehensive plan is a decision-making tool based on long-term goals for the future, some of which may take years to achieve. The City of Enumclaw (City) initiated this planning effort to voluntarily integrate a climate element and/or resilience sub-element into their comprehensive plan. The purpose of this document is to provide recommended policy measures ranging from capital improvement programming and budgeting to land use, transportation, and housing policies.

Guidance was recently released on developing a resilience sub-element. A vulnerability assessment is recommended in the guidance to assess climate-exacerbated hazards and identify community-level opportunities to adapt. Accordingly, this assessment explores climate hazards and impacts, assesses assets' vulnerability and risk, identifies policy gaps and barriers, and recommends a dynamic mix of measures aimed to increase the City's resilience.

To characterize asset vulnerability to climate-exacerbated hazards, exposure risk, sensitivity, and adaptive capacity were qualitatively assessed according to the following steps adapted from both the U.S. Resiliency Toolkit and Commerce guidance:

- **IDENTIFY** potentially sensitive community assets.
- **EXPLORE** priority hazards and exposure consequences.
- **CHARACTERIZE** vulnerability and risk.

This guidance will provide Enumclaw decision-makers with relevant, specific information that will allow them to account for climate change when addressing and preparing for climate impacts across a range of sectors. The information can be used to catalyze and support the integration of a resilience sub-element into Enumclaw's Comprehensive Plan.

Objectives of this planning effort are as follows:

- Incorporate the best available science, updated climate modeling, and communities' evolving needs and priorities into long-range plans.
- Inform climate change risk discussions related to long-range planning in Enumclaw.
- Identify Enumclaw's highest relative climate risks and develop more locally tailored climate resilience policies and measures.

The main body of this document outlines the methods and summarizes of literature review. It summarizes how likely changes in the climate are expected to exacerbate hazards in the Puget Sound region and Enumclaw. Results are summarized by asset sector and by climate hazard. Potential policy measures and actions to address vulnerabilities are found in Section 5.

The following supporting documents are included as attachments:

- **Attachment** 1: Potentially Sensitive Asset Inventory
- **Attachment 2**: Risk and Vulnerability Assessment Results (spreadsheet)

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Acronyms and Abbreviations

°F	degree(s) Fahrenheit
µg/m^3	microgram(s) per cubic meter
AQI	Air Quality Index
City	City of Enumclaw
Commerce	Washington Department of Commerce
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GMA	Growth Management Act
NAAQS	National Ambient Air Quality Standards
NPDES	National Pollutant Discharge Elimination System Permit
PDO	Pacific Decadal Oscillation
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PNW	Pacific Northwest
SR	State Route
TMDL	total maximum daily load
UGA	urban growth area
UW CIG	University of Washington Climate Impacts Group
WSDOT	Washington State Department of Transportation
WUI	wildland-urban interface
WWTP	wastewater treatment plant

Definitions

Adaptation: The process of adjusting to new (climate) conditions to reduce risks to valued assets.

Adaptive capacity: The ability of a person, asset, or system to adjust to a hazard, take advantage of new opportunities, or cope with change.

Assets: People, resources, ecosystems, infrastructure, and the services they provide. Assets are tangible and intangible things people or communities value.

Critical Infrastructure: Systems and assets, whether physical or virtual, so vital that the incapacity or destruction of such may have a debilitating impact on the security, economy, public health or safety, environment, or any combination of these matters

Climate stressor: A condition, event, or trend related to climate variability and change that can exacerbate hazards.

Climate vulnerability assessment: An assessment of community assets to evaluate potential impacts that may occur as a result of climate change and the timeframe within which impacts are expected.

Consequence: A subsequent result (usually negative) that follows from damage to or loss of an asset. Quantifying potential consequences is an important part of determining risk.

Ecosystem services: Benefits that humans receive from nature. These benefits underpin almost every aspect of human well-being, including our food and water, security, health, and economy.

E**xposure:** The presence of people, assets, and ecosystems in places where they could be adversely affected by hazards.

Extreme heat events: Multiple consecutive days of recorded temperatures greater than 90 degrees Fahrenheit (°F).

Floodplains: 100- and 500-year floodplains designated by the Federal Emergency Management Agency (FEMA).

Greenhouse gas: Greenhouse gases, such as carbon dioxide, methane, nitrous oxide, and certain synthetic chemicals, trap some of the Earth's outgoing energy, thus retaining heat in the atmosphere.

Hazard: An event or condition that may cause injury, illness, or death to people or damage to assets.

Impacts: The effect on natural and human systems that result from hazards.

Indicator: A sign that shows what something is like or how a system is changing.

Magnitude: The measure of consequences for an asset that is impacted by a climate-exacerbated hazard.

Non-climate stressor: A change or trend unrelated to climate that can exacerbate hazards.

Probability: The likelihood of hazard events occurring. Probabilities have traditionally been determined from the historic frequency of events. With changing climate and the introduction of non-climate stressors, the probability of hazard events also changes.

Projections: Potential future climate conditions calculated by computer-based models of the Earth system. Projections are based on sets of assumptions about the future (scenarios) that may or may not be realized.

Resilience: The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption.

Risk: The potential for negative consequences where something of value is at stake. In the context of the assessment of climate impacts, the term risk is often used to refer to the potential for adverse consequences of a climate-related hazard. Risk can be assessed by multiplying the probability of a hazard by the magnitude of the negative consequence or loss.

Sensitivity: The degree to which a system, population, or resource is or might be affected by hazards.

Snowpack: A mass of snow on the ground (commonly in mountainous areas) that is compressed and hardened by its own weight.

Uncertainty: A state of incomplete knowledge. Uncertainty about future climate arises from the complexity of the climate system and the ability of models to represent it, as well as the inability to predict the decisions that society will make.

Vulnerability: The propensity or predisposition of community assets to be adversely affected by hazards. Vulnerability encompasses exposure, sensitivity, potential impacts, and adaptive capacity.

Weather: The changes observed events (such as rain, snow, wind) from day to day

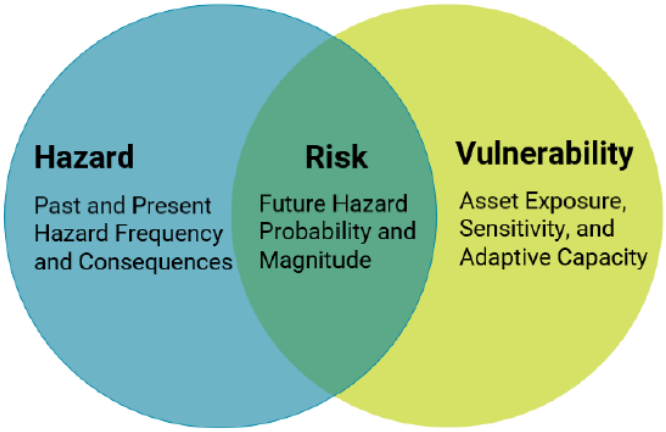
1. Introduction

Changes in precipitation and temperature are making it increasingly critical for local comprehensive planning to prioritize climate resilience policies and measures that increase the capacity to adapt to climate-exacerbated hazards. By characterizing the predisposition of Enumclaw's assets to be adversely affected, this assessment recommends policies and measures to reduce their vulnerability to such hazards by increasing the capacity to adapt. Assets in the built, natural, and social environment were assessed, and highly vulnerable assets are discussed in terms of their adaptive capacity.

The City of Enumclaw (City) initiated this planning effort to voluntarily integrate a climate element and/or resilience sub-element into their comprehensive plan. The purpose of this vulnerability assessment is to better understand who and what are impacted by climate change, when, where, how, and why. This report will provide Enumclaw decision-makers with relevant policies and measures that will allow them to account for climate change when addressing and preparing for potential consequences across a range of sectors from capital improvement programming and budgeting to land use, transportation, and housing policies.

The vulnerability assessment methods are adapted from the U.S. Resiliency Toolkit and Commerce guidance to qualitatively describe the exposure risk, sensitivity, and adaptive capacity by identifying community assets, exploring priority hazards and exposure consequences, and characterizing vulnerability and risk. Assumptions regarding the levels of asset exposure risk and sensitivity are based on available literature and data, along with local knowledge. Recommendations in this report have been made based on the degree of vulnerability assessed for Enumclaw's assets in the built, natural, and social environments.

Figure 1-1. Relationship between Hazard, Risk and Vulnerability
Source: *Washington Department of Commerce Guidance (Draft 2023)*



1.1 Planning Context

A comprehensive plan is a decision-making tool required by the Growth Management Act (GMA) (RCW 36.70A) based on long-term goals that is updated on a regular schedule. The comprehensive plan covers a 20-year planning horizon, and mandatory elements include land use, housing, capital facilities, utilities, rural, transportation, and economic development. The City's current Comprehensive Plan was adopted in 2016 and covers the time period from 2015 to 2035.

Currently, a climate element is a voluntary element of comprehensive plans under the GMA. Enumclaw's comprehensive plan (City of Enumclaw 2016) does not include a climate element. The City was awarded a competitive grant for climate planning by the Washington Department of Commerce (Commerce) to help local governments incorporate climate change into comprehensive plans. This assessment represents the first step in the development of a resilience policies and measures for Enumclaw's climate element.

Table 1-1. Crosswalk of Asset Sectors and Comprehensive Plan Elements

Asset Sectors	Nexus with Enumclaw Comprehensive Plan Chapters
Agricultural and Food Systems	Natural Environment
Buildings and Energy	Capital Facilities; Community Development and Design;; Land Use Economic Development
Cultural Resources and Practices	Natural Environment
Economic Development	Economic Development
Ecosystems	Land Use; Park & Recreation; Capital Facilities; Community Development and Design; Natural Environment
Emergency Management	Capital Facilities; Economic Development; Human Services
Health and Well-being	Human Services, Natural Environment
Waste Management	Capital Facilities
Water Resources	Land Use; Capital Facilities; Natural Environment
Zoning and Development	Housing; Land Use; Capital Facilities; Community Development and Design; Park & Recreation; Economic Development; Natural Environment

Source: *Washington Department of Commerce Guidance (Draft 2023)*

Commerce recently released Climate Element Planning Guidance (Draft 2023) which provided for counties and cities a common planning framework to build adaptive capacity within their comprehensive plans. It includes model goals and policies as measures to be incorporated as part of periodic updates. This vulnerability assessment is aligned with the approach outlined in the Commerce guidance. The results are used to make recommendations for policy and measures the City can implement to increase resilience. The Commerce guidance adapts the U.S. Climate Resilience Toolkit's "Steps to Resilience" planning framework and integrates best practices recommended by the Association of Washington Cities, Municipal Research and Services Center of Washington, American Planning Association, and other organizations.

1.2 Geographic Study Area

Enumclaw is in the Puget Sound region, a coastal area of the PNW including Puget Sound, the Puget Sound lowlands, and the surrounding region roughly west of the Cascade Range and east of the Olympic Mountains (**Figure 1-2**). Specifically, Enumclaw is located in the eastern-most extent of the Puget Lowlands at an elevation of about 800 feet against the Cascade foothills in the western shadow of Mt. Rainier. The Puget Lowland region is a wide low-lying area between the Cascade Range to the east and the Olympic Mountains to the west. The region extends from the San Juan Islands in the north to past the southern end of the Puget Sound.

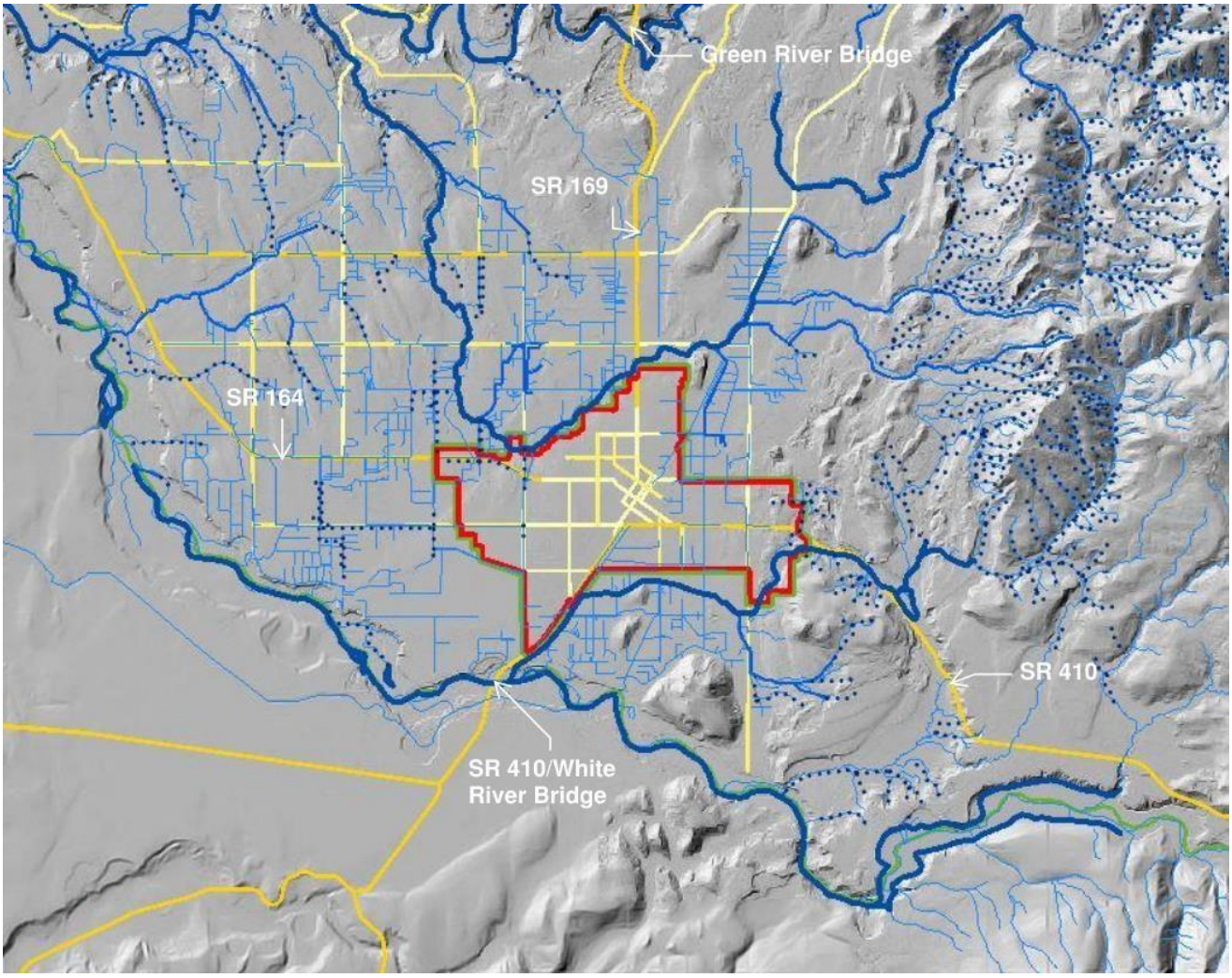
Figure 1-2. Puget Sound Lowland Region
Source: *State of Knowledge, Mauger et al. 2015*

The planning study area for the majority of the City's critical systems are defined by the City's urban growth area (UGA) limits established in its Comprehensive Plan (**Figure 1-3**). Because critical components of the City's transportation and water systems extend beyond the UGA, the evaluation includes assets such as the water system spring sources and the two bridges serving emergency evacuation routes that are outside of the primary study area (**Figure 1-3**).

Enumclaw is situated on a relatively flat fertile plateau between the White and Green Rivers in the western shadows of Mt. Rainier. The Enumclaw Plateau is composed of agricultural and forest land draining into the Newaukum Creek, Boise Creek, and White River watersheds. Enumclaw sits on the Enumclaw Plateau, which is composed of agricultural and forest land draining to Newaukum Creek to the north and Boise Creek to the South. Much of the plateau in the Enumclaw area was formed by the Osceola Mudflow, a lahar originating from Mount Rainier. Soils formed in mudflow deposits are poorly drained.

Critical areas, including wetlands, floodplains, and erosion hazards are primarily associated with the riparian corridors of Newaukum and Boise Creeks Newaukum Creek is one of the largest tributaries of the Green River and is located in the Middle Green Sub-watershed. Both creeks are located in upper middle of their respective basins and are relatively low gradient as they cross the plateau. Both support anadromous and non-anadromous salmonids, including threatened Chinook salmon. The Green River flows to Lake Washington and Puget Sound. Soils in the Newaukum subbasin are highly erodible. Boise Creek is a tributary of the White River which flows to the Puyallup River and Puget Sound. Boise Creek and the White River are located in the White River subbasin. Boise Creek flows through the Enumclaw Golf Course, exits the City, and flows through agricultural lands to the south (EPA 2023a, 2023b; WRIA 10 1999).

Figure 1-3. Geographic Study Area Vicinity
Source: *King County iMap*



1.3 Population and Demographics

Enumclaw is located in King County, Washington, with a 2021 population of approximately 12,543 (Jacobs 2022). Enumclaw has a higher proportion of those over the age of 65, slightly lower median income, and slightly higher poverty rates than King County. In Enumclaw, households with ethnic and racial minorities, disabilities, and those over the age of 65 generally have lower incomes and fewer financial resources than average households. (Jacobs 2022). Vulnerable people include, but are not limited to, those with disabilities, racial or ethnic minorities, low-income populations, and people over the age of 65 who live alone. The most vulnerable populations are summarized as follows:

- **Minorities –** Approximately 2,430 residents are racial or ethnic minorities. With 21.1% of the population identifying as a race other than white, the City is less racially diverse than King County, with 41.8% of its population identifying as a race other than white. The City has a higher proportion of Hispanic and Latino population than King County. Both the City and King County are becoming more diverse.

- **Poverty –** Approximately 2,670 low-income households are within the City. Poverty rates in the City are higher for people of color than they are for the white community. According to American Community Surveys, the poverty rate for the white community is 7.8%, whereas the poverty status of Hispanic and Latino populations is 12.9%, Asian populations is 10.8%, and Black or African American population is 20.5%.
- **Disability –** Approximately 14% of the population (1,743 residents) live with a disability. Disabilities include vision, hearing, ambulatory, cognitive, self-care, and independent living. People living with disabilities have very low incomes. The median income for disabled people is who earn income is $29,151 (USCB n.d.).
- **Age –** The median age is 39.3 compared with King County's median age of 37. However, between 2010 and 2020, the City's population became younger with a reduction in median age from 41.2 to 39.3. The City has a higher proportion of school-age children (under 17 years), residents 55 to 64 years, and elderly residents (over 65 years) than does King County (USCB n.d.).

2. Enumclaw's Changing Climate

Enumclaw is influenced by Puget Sound's moderate maritime climate. The annual mean temperature ranges from 54.9°F to 60°F at the Weather Report Stations north, east, and south of Enumclaw. High summertime temperatures reach the mid-70s (°F), and low temperatures average just below freezing in January. At the foot of the Cascades, the area sees more precipitation than the western region of Puget Sound, although the annual snow depth averages only 0 to 2 inches. Average annual precipitation is approximately 50 inches per year, about 10 inches more than lower elevations closer to Puget Sound. Historically, Enumclaw's climate has been characterized as wet and temperate, with little in weather extremes, either high or low (City of Enumclaw 2016).

Natural climate variability has an important influence on PNW climate, and some models project that it could continue to have a larger influence on temperatures than warming related to greenhouse gas emissions for roughly the next 20 to 30 years. Large-scale fluctuations in weather patterns and ocean conditions drive natural variability in Puget Sound's climate. Seasonal, year-to-year, and decade-to-decade variations influence local climate observations and long-term trends caused by rising greenhouse gas emissions. Two of the dominant patterns are the El Niño – Southern Oscillation and the Pacific Decadal Oscillation (PDO). These climate patterns are associated with variations in ocean temperatures, local surface winds, air temperatures, and precipitation. Other small fluctuations can cause short-term warming or cooling trends.

The Puget Sound region is currently in a cool phase PDO that could persist for another decade or longer (Mauger et al. 2015). This does not mean that warming related to greenhouse gas emissions is not having an impact on the PNW. Rather, that the year-to-year and decade-to-decade variations have recently diminished the influence of greenhouse warming on regional temperatures. Understanding the likely local effects of climate variability and change is the first step toward characterizing, and ultimately reducing, the risks associated with climate hazards. The following sections summarize the trends and projections for two key climate drivers: temperature and precipitation.

2.1 Data Tools and Resources

Climate change will continue to affect the Puget Sound region into the future by altering key drivers of change that are important planning considerations for Enumclaw: temperature and precipitation. Information on temperature and precipitation from statewide and regional reports was reviewed and key takeaways were identified for Enumclaw. Current trends and future projections are summarized. Observed and likely future changes in these factors for the region are detailed in this report from the State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015) The term "Puget Sound region" describes the entire watershed, including all land areas that ultimately drain into the waters of Puget Sound.

One of the challenges to projecting future changes in temperature and precipitation is that it is unknown at what rate global reductions in greenhouse gases will occur. Complex models are used to understand how greenhouse gases will affect global changes in climate. **Figure 2-1** and **Figure 2-2** illustrate both observed trends and future projections in temperature and precipitation. Future projections for two possible scenarios are shown: one in which global emissions of greenhouse gases are drastically reduced (RCP 4.5) and another where emissions continue to rise through the end of the twenty-first century (RCP 8.5). The International Panel on Climate Change has developed these scenarios to show what might happen in the future based on different scenarios under which greenhouse gas emissions increase to different degrees. It is not certain which scenario is likely to occur.

Another challenge is that climate models generate projections at broad geographic scales that are not representative of local weather patterns. While climate models have proven effective at describing past and future conditions, they are not equipped to describe changes for small areas. Even though the data here is downscaled, it is best suited for community and county-scale analysis. Projections must be downscaled to a local level for decision-making. Downscaled projections from the University of Washington Climate Impacts Group (UW CIG) for the Puget Sound region were obtained from the webtool *Climate Mapping for a Resilient Washington* (Raymond and Rogers 2022) to explore the expected affects to Enumclaw's various asset sectors in coming decades. The data in this tool is not a prediction of future conditions, rather a depiction of multiple possible futures. The data in this tool was analyzed at the county or community scale. Additional graphic representations of past, present and future temperature, precipitation and variability were also obtained from the U.S. Climate Resilience Toolkit Climate Explorer.

2.2 Observed Changes in Temperature and Precipitation

In the following sections, key takeaways from regional climate reports are summarized and the potential impacts identified in the Commerce guidance. Observed trends are focused on the regional level because measurement biases have a much smaller effect on regional trends than on locally observed trends.

2.2.1 Regional Temperature Trends

The Puget Sound region has experienced long-term warming, a lengthening of the frost-free season, and more frequent nighttime heat waves as follows:

- Air temperatures are increasing in the Puget Sound.
- Nighttime air temperatures are rising faster than daytime air temperatures.
- The frost-free season has lengthened.
- Warm nights have become more frequent, but daytime heat waves have not changed.
- Short-term trends can differ substantially from the long-term trend.
- Long-term air temperature trends are affected by natural variability.

Table 2-1. Observed Temperature Trends in Puget Sound and Enumclaw

Temperature Change in Puget Sound (1895 to 2014)	
Annual	Warming: +1.3°F Range: +0.7°F to +1.9°F
Fall	Warming: +0.12°F/decade Range: +0.07 to +0.17
Winter	Warming: +0.13°F/decade Range: +0.02 to +0.24
Spring	No significant change
Summer	Warming: +0.13°F/decade Range: +0.07 to +0.19
Extremes	Statistically significant increase in nighttime heat events west of the Cascade Mountains in Oregon and Washington (1901 to 2009). No significant trends in daytime heat events.
Frost-Free Season	Lengthening: +30 days +3 days/decade for 1920 to 2014

Source: *State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015)*

2.2.2 Regional Precipitation Trends

There has been no discernible long-term trend in precipitation for the Puget Sound region as follows:

- Year-to-year variability in total precipitation is large compared to long-term trends.
- Spring precipitation is increasing, but no other trends are statistically significant.
- Modest increases in heavy rainfall have been documented in Western Washington.

Table 2-2. Observed Precipitation Trends in Puget Sound and Enumclaw

Precipitation Change in Puget Sound (1895 to 2014)	
Annual	No significant change
Fall	No significant change
Winter	No significant change
Spring	Increasing +2.3%/decade
Summer	No significant change
Extremes	Most studies find increases in the frequency and intensity of heavy precipitation events but few are statistically significant. Results depend on the dates and methods of the trend analysis.

Source: *State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015)*

Figure 2-1. Temperature Past, Present, and Future

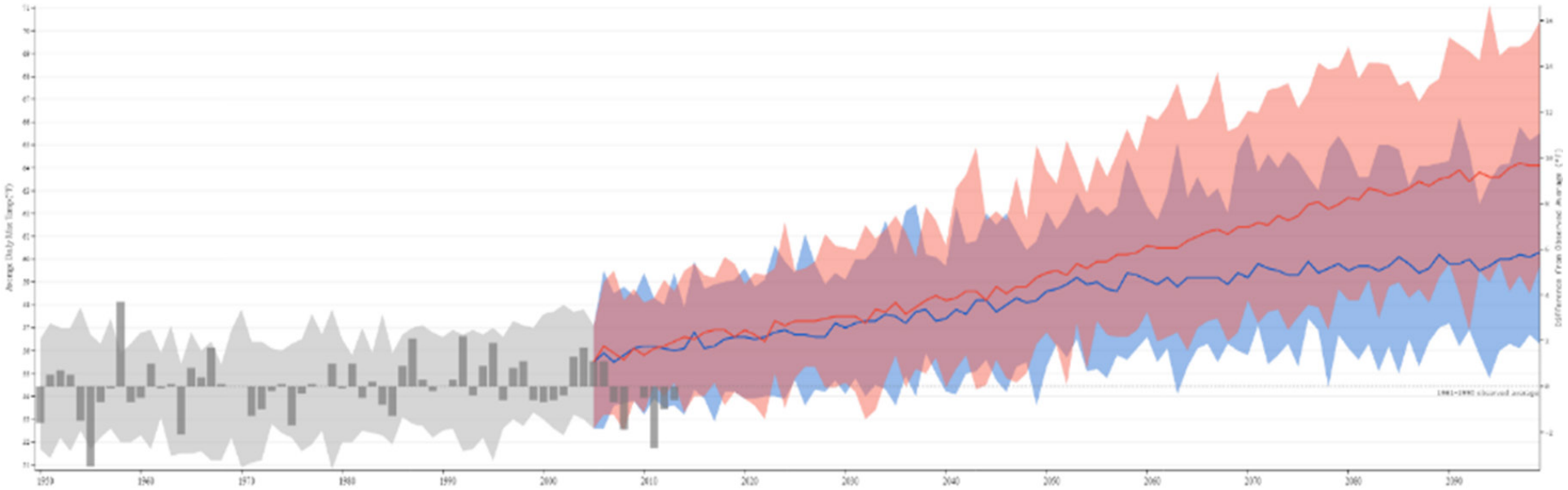
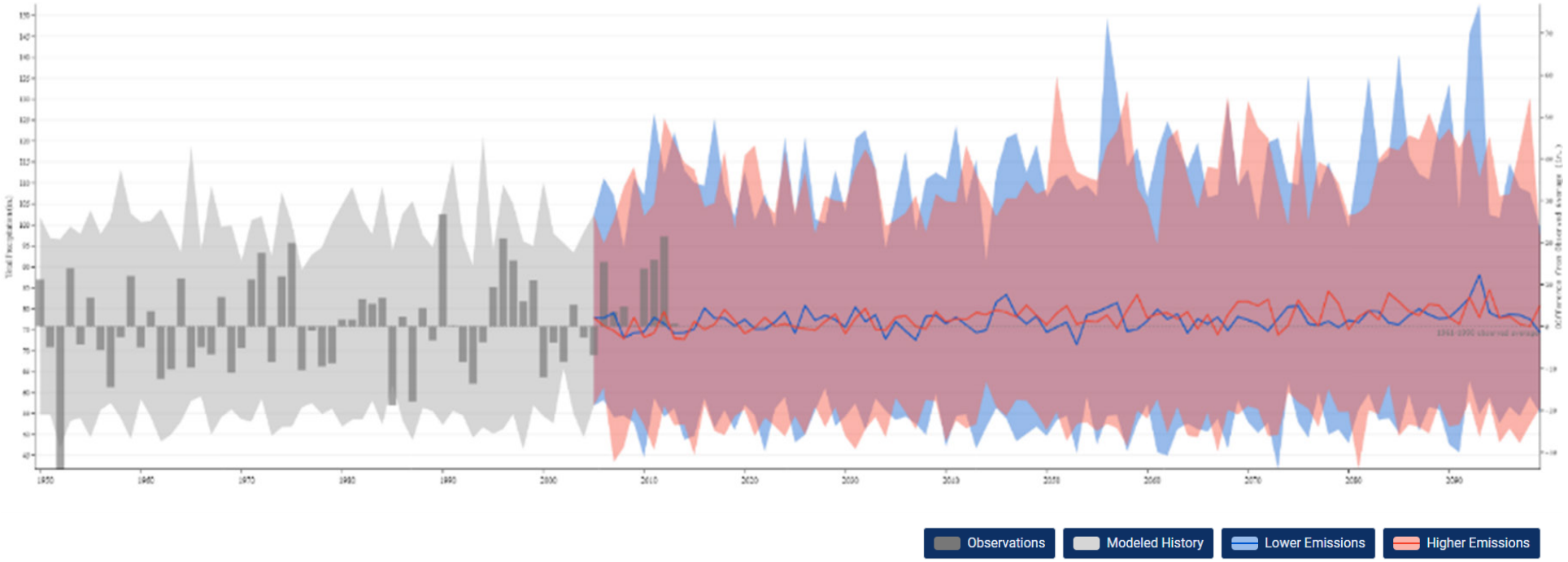


Figure 2-2. Precipitation Past, Present, and Future



2.3 Future Changes in Temperature and Precipitation

Projections presented are statistically downscaled based on 10 global models and two greenhouse gas scenarios (RCP 4.5 and 8.5).

2.3.1 Projected Regional Temperature Changes

The Puget Sound region is projected to warm rapidly during the twenty-first century as follows:

- All scenarios project warming.
- Warming is projected for all seasons.
- More extreme heat is likely, although the increase may be moderated by changes in weather patterns.
- Ongoing variability will continue to play a role in regional climate
- The projected warming for the Puget Sound region is large compared to year-to-year variability.
- Heat waves are projected to intensify, while cold snaps are projected to become less severe.

Table 2-3. Projected Temperature Change for Puget Sound

	Projection Year	Emission Scenarios: RCP 4.5/RCP 8.5	Temperature Change	Range of Uncertainty
Annual	2050	Low	+4.2°F	+2.9°F to +5.4°F
		High	+5.5°F	+4.3°F to +7.1°F
	2080	Low	+5.5°F	+4.1°F to +7.3°F
		High	+9.1°F	+7.4°F to +12°F
Fall	2050	Low	+4.1°F	+2.6°F to +5.6°F
		High	+5.6°F	+3.9°F to +7.2°F
	2080	Low	+5.2°F	+3.7°F to +7.1°F
		High	+9.0°F	+6.5°F to +11°F
Winter	2050	Low	+3.9°F	+2.8°F to +5.0°F
		High	+4.9°F	+3.2°F to +6.5°F
	2080	Low	+5.0°F	+4.3°F to +6.3°F
		High	+8.3°F	+6.0°F to +10°F
Spring	2050	Low	+3.9°F	+2.4°F to +5.3°F
		High	+4.8°F	+3.0°F to +7.6°F
	2080	Low	+5.3°F	+3.8°F to +8.2°F
		High	+7.9°F	+5.2°F to +11°F
Summer	2050	Low	+5.1°F	+3.3°F to +7.5°F
		High	+6.8°F	+4.8°F to +9.7°F
	2080	Low	+6.4°F	+4.4°F to +9.1°F
		High	+11°F	+8.8°F to +15°F

Source: *State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015)*

Cooling and heating degree days are measurements used to estimate energy use demand. One heating degree day is counted for each degree that average daily temperature falls below 65°F. A cooling degree day is counted for each degree the average temperature for a day moves above the base temperature of 75°F. Similarly, a growing degree day uses a base temperature of 50°F.

Table 2-4. Projected Changes in Temperature Extremes for Puget Sound

Temperature Extremes	Change Projected for 2050 (Range of Uncertainty)	Change Projected for 2080 (Range of Uncertainty)
Temperature of hottest days	+6.5°F (+4.0 to +10.2°F)	+9.8°F (+5.3 to +15.3°F)
Temperature of coolest nights	+5.4°F (+1.3 to +10.4°F)	+8.3°F (+3.7 to +14.6°F)
Heating degree days	-1600 deg-days (−2300 to −1000 deg-days)	-2306 deg-days (−3493 to −1387 deg-days)
Cooling degree days	+17 deg-days (+5 to +56 deg-days)	+52 deg-days (+6 to +200 deg-days)
Growing degree days	+800 deg-days (+500 to +1300 deg-days)	+1280 deg-days (+591 to +2295 deg-days)

Source: *State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015)*

2.3.2 Projected Regional Precipitation Changes

Changes in annual and fall, winter, and spring precipitation will continue to be primarily driven by year-to-year variations rather than long-term trends. All models project a decline in summer precipitation for the Puget Sound region as follows:

- Small changes in annual precipitation are projected.
- Summer precipitation is projected to decline.
- Projected changes in fall, winter, and spring precipitation are mixed.
- Winter precipitation extremes are projected to increase.
- Research is lacking regarding the effect of climate change on thunderstorms and lightning in the Puget Sound region.
- Projected shifts in the storm track are small.
- Although the projected change in annual and seasonal precipitation is smaller than historic variability, the change in heavy precipitation is not.
- Heavy precipitation events are projected to become more intense and more frequent.

Table 2-5. Projected Precipitation Change for Puget Sound

	Projection Year	Emission Scenarios: RCP 4.5/RCP 8.5	Precipitation Change	Range of Uncertainty
Annual	2050	Low	+4.2%	+0.6 to +12%
		High	+5.0%	−1.9 to +13%
	2080	Low	+6.4%	−0.2 to +10%
		High	+6.9%	+1.0 to +9.4%
Fall	2050	Low	+5.5%	−5.7 to +13%
		High	+6.3%	−2.4 to +19%
	2080	Low	+12%	+1.6 to −21%
		High	+10%	+1.9 to +15%
Winter	2050	Low	+9.9%	−1.6 to +21%
		High	+11%	+1.8 to +19%
	2080	Low	+11%	+1.3 to +16%
		High	+15%	+6.2 to +23%
Spring	2050	Low	+2.4%	−9.4 to +13%
		High	+3.8%	−7.7 to +13%
	2080	Low	+1.6%	−3.2 to +9.3%
		High	+2.5%	−6.7 to +11%
Summer	2050	Low	−22%	−45 to −6.1%
		High	−22%	−50 to −1.6%
	2080	Low	−20%	−37 to −10%
		High	−27%	−53 to +10%

Source: *State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015)*

Table 2-6. Projected Change in Extreme Precipitation Events for Western Washington

24-hour Precipitation	Change in Extreme Precipitation	Frequency of Exceedances
Annual Extremes 99th percentile	+22% (Range: +5 to +34%)	Historical: 2 days per year
		Future: 7 days per year (Range: 4 to 9 days per year)

Source: *State of Knowledge: Climate Change in Puget Sound (Mauger et al. 2015)*

Note: Changes in precipitation are expected to be different from place to place, but it is not known how patterns will shift with warming.

3. Assessment Methods

A comprehensive inventory of Enumclaw's assets was conducted to identify potentially sensitive assets. In this context, the term "asset" refers broadly to community groups, places, natural resources, infrastructure, and services. Refer to **Attachment A**, Inventory of Potentially Sensitive Assets in Enumclaw. The following questions were designed to qualitatively assess the exposure risk and vulnerability of Enumclaw's assets in the built, natural, and social environments:

- What are the priority hazards for Enumclaw's assets?
- To what extent are Enumclaw's assets at risk due to climate hazard exposure?
- To what extent are Enumclaw assets sensitive to priority hazards?
- How vulnerable are Enumclaw's assets to priority hazards?

3.1 What are the priority hazards for Enumclaw's assets?

Following the review of available data base tools and literature on climate change in the PNW and the Puget Sound region (discussed in Section 2), the findings were used to determine priority hazards for Enumclaw. Priority hazards were determined based on potential magnitude and likelihood of occurrence and were characterized based on indicators that the associated risk will be exacerbated by a changing climate. Assumptions were made according to past frequency and historical impacts to Enumclaw. Indicators of change were used to identify thresholds for exposure for the purpose of the qualitative evaluation. The role of non-climate stressors that can exacerbate the consequences of climate impacts were also considered.

3.2 To what extent are Enumclaw assets sensitive to priority hazards?

Sensitivity was characterized based on considerations of whether or not an asset could sustain a negative impact from a hazard. If the potential impact from a hazard is minimal, the asset is not sensitive. Indicators used to assess the potential sensitivity of community assets to climate hazard exposures are based on the asset type, hazard, and publicly available information from existing plans and reports, including the City's comprehensive land use, water, sewer, stormwater and park plans, King County assessor data, and King and Pierce county infrastructure reports. Depending on the asset type, questions such as those in **Table 3-1** were answered.

Table 3-1. Sensitivity Considerations for Various Asset Types`

Asset Types	Sensitivity Considerations
Built Environment	▪ What is the age of the asset relative to its design life? ▪ What is the condition of the asset? ▪ Is the asset located proximal to a floodplain or potential landslide hazard areas?
Natural Environment	▪ Would water quality changes affect cold-water species? ▪ Does the asset support fish and wildlife habitat for sensitive species? ▪ Does the asset contribute to riparian habitat corridor continuity? ▪ Does the asset provide critical ecosystem services?
Social Environment	▪ How many days was the air quality rated "unhealthy for sensitive groups"? ▪ To what extent is the service critical to supporting vulnerable populations? ▪ To what extent would a hazard impact the provision of critical services?

3.3 To what extent are Enumclaw's assets at risk due to climate hazard exposure?

Next, the risk associated with climate-exacerbated hazards was considered. The magnitude of the potential climate impact and the likelihood of the exposure were used to determine the risk of exposure relative to the types of assets in Enumclaw. Local hazard mitigation plans were referenced for timeframes, probability, and risk information (such as past wildfire smoke events, landslides, and floods).

The **RISK** associated with climate impacts was evaluated by asking the following questions:

- What is the **PROBABILITY** of the asset being exposed to a hazard?
  - What is the chance of sustaining a substantial loss?
  - How frequently has the hazard occurred in the past? (High = <5 years; Moderate = 5 to 20 years; Low = >20 years)
  - Is the asset located in areas at increased risk of impacts by climate-exacerbated hazards? (for example, potential landslide areas, areas adjacent 100-year flood plain)
- What would the **MAGNITUDE** of the impact be for the community following the damage to or loss of an asset due to a hazard exposure?
  - How redundant is the asset? Is there an alternative (for example, route)?
  - What is the replacement cost (for example, assessor's parcel value)?
  - What is the criticality? Does the asset meet FEMA's critical facility definition?

3.4 How vulnerable are Enumclaw's assets to priority hazards?

The next step was to characterize with a qualitative rating (low, medium, or high) each asset's vulnerability to the priority hazards it is potentially sensitive. Assets with high sensitivity and low adaptive capacity have high vulnerability. The sensitivity and adaptive capacity information was then used to characterize the asset's vulnerability. To characterize the sensitivity, core questions such as the ones in **Table 3-1** were explored using select indicators and other available information (such as hazard plans and local knowledge).

The UW CIG webtool was used to describe factors that affect a given asset sector's susceptibility to change. Expected changes in the climate and related hazards were visualized as maps, graphs, and tables at the state- and county-level for the 2040 and 2080 time periods and for the RCP4.5 and RCP8.5 climate scenarios. The UW CIG webtool was used to explore county-level information about expected changes in the climate. This provided important contextual information on the factors likely to affect exposure and susceptibility at the local scale. Adaptive capacity is the ability to adjust to a hazard, take advantage of new opportunities, or cope with change. This is a high-level characterization of the assets' ability to adjust to the hazard, take advantage of new opportunities, or cope with change.

4. Assessment Results

4.1 Asset Exposure Risk by Sector

Following the inventory of the potentially sensitive assets (**Attachment A)**, local planners and technical experts conducted an interdisciplinary assessment of the hazards identified at the regional level and their implications at the local level in Enumclaw. Priority hazards were identified by asset sector based on the risk of exposure to climate consequences. The resulting hazard priorities are coupled with sensitive assets sector in **Table 4-1**. In the future, both climate and non-climate stressor conditions are expected to make hazards more frequent or severe. Non-climate stressors include changes in land cover, construction projects that disrupt natural water drainage or common traffic patterns, and population growth.

Priority hazards were determined based on potential magnitude of the impacts and likelihood of occurrence. For instance, a low-impact hazard event expected to be comparatively less costly and disruptive would be a lesser priority and are therefore not indicated in the matrix. Priority hazards are defined as follows:

- **Drought** – An imbalance between water supply and water demand characterized by more than one consecutive season of below average rainfall.
- **Extreme heat**– More prolonged periods of hot days greater than 100°F and extreme heat events.
- **Extreme precipitation events** – Above average short-duration rainfall of greater than 2 inches in a day, which is an indicator for increased flooding potential.
- **Flooding** – Major flood events are influenced by changes in peak streamflow and snowpack, along with extreme precipitation.
- **Wildfire smoke event** – More than 2 consecutive days with Air Quality Index (AQI) >100 related to elevated levels of particulate matter from wildfire.
- **Wildfire** – More than 0.25 acre (Class B) fire involving grassland, shrub, or forested areas.

Local knowledge was used to identify potentially sensitive asset types (**Table 4-1**). The relative sensitivity considerations were identified in the literature review, preliminary sensitivity data collection, and from local knowledge sources (such as planning commission and staff, public survey).

Table 4-1. Enumclaw's Priority Hazards and Potentially Sensitive Asset Sectors

Climate Hazards	Potentially Sensitive Assets										
	Agricultural and Food Systems	Buildings and Energy	Cultural Resources and Practices	Economic Development	Ecosystems	Emergency Management	Health and Well-being	Transportation	Waste Management	Water Resources	Zoning and Development
Drought	X		X	X	X		X			X	
Extreme heat	X	X	X		X	X	X	X			
Extreme precipitation	X	X	X	X	X	X		X	X	X	X
Flooding	X	X	X	X	X	X	X	X	X	X	X
Reduced snowpack	X			X	X					X	
Wildfire smoke		X		X		X	X				
Wildfire	X	X	X	X	X	X		X		X	X

4.1.1 Agriculture and Food System Sector

Agriculture is potentially sensitive to climate change as it relies heavily on precipitation, temperature, and frost timing. The effects depend on the rate and severity of change, as well as the capacity for agricultural practices to adapt.

The City is surrounded by flat farmlands and dairy farms, with farm preservation designated on three sides of its boundaries and protected forestland to the east. Local farm-to-table offerings are featured at restaurants around Enumclaw, and farmstands offer local produce for purchase on the roadsides.

Table 4-2. Sensitivity Considerations for Agricultural Assets

Asset Sector	Sensitivity Considerations[1]	Potentially Sensitive Assets in Enumclaw
Agriculture and Food Systems ▪ Natural environment ▪ Built environment ▪ Social environment	▪ Use of integrated pest management ▪ Lack of crop rotation practices ▪ Reduced photosynthesis/growth rate ▪ Worker heat exposure ▪ Nutrient-laden run off	▪ Community gardens ▪ Protected agricultural lands ▪ Roadside stands ▪ Employment

Drought is the primary risk factor affecting agriculture and food system assets in Enumclaw; however, the probability and magnitude of the impacts makes this a low risk to the community overall. Further, the lands that support agriculture in the vicinity are outside the jurisdictional boundaries of the Comprehensive Plan.

Table 4-3. Impact Risks to Agricultural and Food System Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ More frost-free days	Seasonal shifts	▪ Timing of biological events ▪ Crop rotation and timing	▪ Reliance on traditional crops and rotations
▪ Decreasing summer precipitation (25% less than 75% of normal) and streamflow (10–37% less/slower). ▪ Increasing winter-spring streamflow ratio (by 1.3–2 times; higher winter streamflow reverse lower in the spring)	Drought, particularly in summer months	▪ Frequent and severe droughts from drier summers reduce available water for agriculture and animal husbandry ▪ Increasing the dependence on stored water and groundwater ▪ The shift in streamflow timing may not align with some crops' growing season	▪ Local farm economy

[1] U.S. Environmental Protection Agency. 2022. "Climate Change Impacts on Agriculture and Food Supply." https://www.epa.gov/climateimpacts/climate-change-impacts-agriculture-and-food-supply.

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Increasing extreme and heavy precipitation events (10%) ▪ Increasing 1-inch precipitation days (by 0.9 day annually)	Extreme precipitation events	▪ Intensify flooding and inundate agricultural lands, cause spring planting delays, affect crop quality and quantity ▪ Increase erosion and runoff (and contaminants) ▪ Increase susceptibility to root diseases ▪ Increased risk of food scarcity	▪ Local farm economy ▪ Agricultural soils
▪ Increase in summer maximum temperature (by 3.6°F)	Extreme heat	▪ Longer, warmer growing seasons will increase irrigation water demand ▪ Cause heat stress on crops and livestock and decrease crop yields	▪ Agricultural pests, drought stress, and invasive introduction that cause competition and disease for native plants
▪ Increasing wildfire likelihood (3%)	Wildfire and/or Wildfire smoke events	▪ Frequent wildfires may cause damage to crops, livestock, and agriculture infrastructure and disrupt operations ▪ Wildfire smoke may reduce crop quality and adversely affect outdoor workers	▪ Protected farmland at wildland interface

4.1.2 Buildings and Energy Sector

Enumclaw has been incorporated for over 100 years, and the age of buildings spans the same length of time. Many of the buildings in the downtown core date from approximately 1925, and many of the residential buildings were constructed before 1990. The City owns, operates, and maintains municipal buildings that house the services provided by the City, including City Hall, Senior Center, Public Works shops, water reservoirs and booster pump station buildings, the Enumclaw Expo Center, the Enumclaw Pool and the wastewater treatment plant (WWTP). The Enumclaw School District owns, operates, and maintains Enumclaw High School, two middle schools, and three elementary schools within the City.

Enumclaw owns and operates a natural gas system consisting of a high-pressure system that delivers natural gas from the larger regional delivery system to a local district regulator system and an intermediate distribution system. The high-pressure system is located in or adjacent to State Route (SR) 164 (City of Enumclaw 2016). Enumclaw is subject to the Climate Commitment Act "cap-and-invest" program and is required to mitigate for carbon emissions by purchasing carbon offsets (Enumclaw Courier Herald 2022).

Table 4-4. Sensitivity Considerations for Buildings and Energy Assets

Asset Sector	Sensitivity Considerations[2]	Potentially Sensitive Assets in Enumclaw
Buildings and Energy ▪ Built environment	▪ Structural condition/age ▪ Structural Proximity to WUI ▪ Structural Proximity to Hazard Areas (Floodplain, Landslide, Erosion) ▪ Energy supply chain diversity ▪ Cooling and HVAC system availability and sufficiency ▪ Lack of redundancy/Power disruptions ▪ Power storage capacity/Peak demand	▪ Electric and gas utility supply lines ▪ Electrical substations ▪ Schools ▪ City buildings ▪ Public housing

The highest risk to buildings and energy assets is warming air temperatures and extreme heat events. Increasing cooling degree days will result in higher demand on energy.

Table 4-5. Impact Risks to Buildings and Energy Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Reduction in heating degree days (by 7.4% on average; 807 days in the next 30 years) ▪ Increasing in cooling degree days (by 1.6% on average; 175 days in the next 30 years)	Warming air temperatures / Extreme heat events	▪ An increase in electricity demand for air conditioning and industrial cooling systems over a wider geographical region and a prolonged period ▪ Regional hydropower supply due to the summer drought exacerbating the electricity demand ▪ Warmer, non-summer seasons decreases heating demand and eases the household's energy burden ▪ Reduced non-summer demand also reduces revenue supporting utility companies' operations	▪ Energy supply/demand ▪ Vulnerable residents
▪ Increasing wildfire likelihood (3%)	Wildfire and/or Wildfire smoke events	▪ Frequent wildfires can cause damage to infrastructure and property, as well as lead to power outages for residents and businesses	▪ Structures at wildland interface ▪ HVAC sufficiency ▪ Tourism and other business continuity

[2] U.S. Climate Resilience Toolkit. 2019. Building Resilience in the Energy Sector. https://toolkit.climate.gov/topics/energy-supply-and-use/building-resilience-energy-supply-and use#:~:text=Possible%20actions%20involving%20existing%20or%20new%20equipment%201,have%20a%20more%20sustainable%20water%20supply%20More%20items.

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
		▪ Wildfire smoke events can increase the usage of building air filtration systems ▪ Increased business disruptions	
▪ More intense, heavy precipitation in spring and winter	Extreme precipitation and related hazards	▪ Increase in extreme storms, erosion, and landslides that lead to infrastructure damage and frequent power loss ▪ Increase risk of power disruptions due to trees	▪ Landslides and erosion ▪ Tree hazards ▪ Power outages in cold season
▪ Increase in magnitude and frequency of peak stream flows (8-20%)	Larger and more frequent floods	▪ More frequent and larger flood events can damage buildings and infrastructure	▪ Structures and infrastructure in floodplains

4.1.3 Cultural Resources and Practices Sector

The area has many historic and culturally significant sites and buildings. The City is over 100 years old and has structures that are listed or eligible for listing on a state or national register of historic places. In addition to the buildings and sites constructed by the early settlers, the Enumclaw Plateau includes sites used by indigenous communities prior to the arrival of settlers.

Cultural resources in the Enumclaw vicinity include Pacific salmon runs in streams and rivers, archaeological and cultural sites important to indigenous communities, structures and sites that are culturally important to the community such as Pete's Pool and Evergreen Memorial Cemetery, and buildings that are listed or eligible for listing on the state or national registers of historic places.

Pacific salmon are culturally and ecologically important to indigenous communities in the PNW. Salmon are integral to cultural identity, cultural wealth and the health of indigenous communities. The salmon is a key component of family structures and community cohesion and provides food security, among many other benefits. Indigenous treaty rights to salmon are sensitive to changes in salmon abundance due to habitat availability and functionality.

Table 4-6. Sensitivity Considerations for Cultural Resources and Practices Assets

Asset Sector	Sensitivity Considerations[3]	Potentially Sensitive Assets in Enumclaw
Cultural Resources and Practices ▪ Social Environment	▪ Proximity to hazard areas (FEMA floodplain, landslide, erosion) ▪ Damage from wind and wind-driven rain	▪ Arts commission ▪ Archaeological sites ▪ Cemetery and monuments

[3] Sesana, E., Gagnon, A.S., Ciantelli, C., Cassar, J.A., Hughes, J.J. 2021. "Climate change impacts on cultural heritage: A literature review." *WIREs Climate Change*. https://doi.org/10.1002/wcc.710.

▪ Built Environment	▪ Thermoclastic deterioration	▪ Tribal treaty rights ▪ Historic buildings ▪ Paper collections ▪ Museums and galleries

Although cultural assets exposed to the outside environment are at risk of climate impacts, so are those in the interiors of historical buildings (i.e., collections). Events such as extreme precipitation, floods are the highest risks to cultural resources such as historic structures and archaeological sites, as well as salmon abundance and salmon habitat. There are no known historic structures within floodplains or landslide hazard areas. The location of archaeological sites are confidential, however there is evidence of habitation by indigenous communities throughout the plateau so it is assumed that archaeological sites are sensitive to flooding and extreme precipitation events. Salmon and salmon habitat are likely to be impacted as habitat are already experiencing degradation and several species of Puget Sound salmon present in the basin are listed as threatened (NOAA 2023).

Table 4-7. Impact Risks to Cultural Resource Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Increase in precipitation during 2-year storm (10% increase)	Extreme precipitation	▪ Erosion of archaeological sites	▪ Cultural preservation
▪ Increasing peak streamflow (by 8-20%)	Flooding	▪ Directly impact the population of culturally important species for Northwest Tribes, such as salmonids, through altering their habitat ▪ Damage to cultural and historic sites and structures	▪ Salmonid habitat in Newaukum and Boise Creeks ▪ Cultural and historic sites and structures in floodplains
▪ Warmer August stream temperature (57-63°F)	Extreme heat	▪ Diminished habitat quality for culturally important species that live in cold water ▪ Increase in salmonid mortality	▪ Salmon survival and return rate
▪ Reduce in flow during low streamflow season (by 1-15% annually)	Drought	▪ Reduced the quality and quantity of Northwest Tribes' culturally important species' habitat	▪ Salmon survival and return rate
▪ Increasing wildfire likelihood (3%)	Wildfire	▪ Raising the risk of damaging cultural and historic structures, sites, and resources and limiting the Northwest Tribes' access	▪ Historic and culturally important sites and structures

4.1.4 Economic Development Sector

Enumclaw has a relatively diverse economy with many locally owned businesses, including grocery stores, car dealerships, manufacturing facilities and a historic downtown with retail shops and restaurants.

Tourism is an important part of the economy in Enumclaw, which is the gateway to Mount Rainier National Park and the Crystal Mountain ski area. SR 410 is the scenic byway that provides seasonal access from Enumclaw to the Yakima Valley and Eastern Washington. Enumclaw has four state parks in close proximity: Nolte, Flaming Geyser, Kanaskat Palmer, and Federation Forest. The Enumclaw Expo Center annually hosts many events, including the King County Fair, the PNW Scottish Highland Games, and the Olympic Kennel Club dog show.

Table 4-8. Sensitivity Considerations for Economic Development Assets

Asset Sector	Sensitivity Considerations[4]	Potentially Sensitive Assets in Enumclaw
Economic Development ▪ Social Environment ▪ Built Environment	▪ Degree of economic dependency ▪ Population growth ▪ Access limitations ▪ Lack of renewable energy ▪ Climate-adapted technology availability ▪ Sustainable development goals/policies ▪ Supply chain crises ▪ Carbon finance ▪ Insurance-linked securities	▪ Insurance rates Employment Availability ▪ Retail and Service industry ▪ Shipping and distribution of goods ▪ Tourism and seasonal recreation ▪ Manufacturing ▪ City-owned parking lots ▪ Enumclaw golf course

Economic development is considered sensitive if it relies heavily on shipping and distribution of goods and tourism that could be interrupted by impacts of extreme precipitation events or wildfire on transportation infrastructure.

The golf course is sensitive to extreme precipitation in the early spring as it located in a low-lying area bisected by Boise Creek, sits on poorly drained soil and lacks sufficient drainage facilities.

Table 4-9. Impact Risks to Economic Development Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets[5]	Risk to…
▪ Reducing April 1st snowpack by 61% annually	Drought	▪ Decrease opportunities for winter outdoor recreation. ▪ Increase in warm-season outdoor recreation options leads to tourism	▪ Recreation and seasonal tourism ▪ Community farm crop yields

[4] Dietz, S. 2011. High impact, low probability? An empirical analysis of risk in the economics of climate change. Climatic change. pp. 519-541.https://www.cccep.ac.uk/wp-content/uploads/2015/10/WorkingPaper9.pdf.

[5] Pavement Interactive. n.d. Climate Change Impacts on Pavements and Resilience. https://pavementinteractive.org/climate-change-impacts-on-pavements-and-resilience/.

Climate Change Indicator	Climate Hazard	Consequences for Assets[5]	Risk to…
▪ Increasing in winter-spring streamflow ratio (by 1.3-2 times) ▪ Reduction in spring water availability		revenue shift among different sectors. ▪ Shorten its duration, adversely impacting the local economy and characteristics. ▪ The shift in hydropower generation timing may cause price volatility in energy and raw product markets and affect residents and businesses.	▪ Renewable energy production ▪ Groundwater levels ▪ Reservoirs
▪ Increase in extreme and heavy precipitation events (10%) and 1-inch precipitation days (by 0.9 days)	Extreme precipitation events	▪ Cause frequent flooding and heavy rainfall that induce erosion and landslides. ▪ Harm local businesses with property damage and transportation and logistics disruption. ▪ Increase flooding in low-lying areas. ▪ Increase demand for stormwater drainage infrastructure.	▪ Life and property ▪ Landslide hazards areas ▪ Erosion and scouring ▪ Water quality and turbidity ▪ Pavement resilience
▪ Shortening 25-year peak streamflow interval (to 9-11 years)	Flood events	▪ Increased disruptions to business operations (from travel and logistics interruptions and property and infrastructure damage.) ▪ Increased insurance premiums cause certain properties to be uninsurable.	▪ Life and property ▪ Infrastructure and structures in floodplain areas
▪ Increase in Summer Maximum Temperature (by 3.6°F)	Extreme heat events	▪ Shifting tourism revenue focus from winter to warm-season outdoor recreation. ▪ High summer temperatures may relocate warm-season recreation activities.	▪ Tourism dependent economies ▪ Future investments in snow-related recreation
▪ Increasing wildfire likelihood (3%) and wildfire danger days (by 6 days annually)	Wildfires and Wildfire smoke events	▪ Frequent wildfires can cause periodic closures of recreational site, restrictions on outdoor activities during wildfire season, and disruptions to timber operations and impact these industries. ▪ Frequent and intensified smoke events can increase operation disturbances for tourists and other businesses.	▪ Recreation and seasonal tourism ▪ Insurance rates

Climate Change Indicator	Climate Hazard	Consequences for Assets[5]	Risk to…
		▪ Wildfires can cause an increase in insurance premiums or difficulty to be uninsurable.	

4.1.5 Ecosystems Sector

The ecosystems sector includes the natural systems that sustain fish and wildlife habitat and ecosystem services such as clean air and water, attenuation of flood waters and providing shade and respite from heat. It includes riparian habitat, wetlands, cold-water species and surface waters. Riparian corridors provide cool moist habitat relative to surrounding areas that can help mitigate extreme heat making them valued assets that spans temperature gradients. They can serve as dispersal corridors for species range shifts and provide species refuge from warming (Krosby et al. 2018).

Newaukum and Boise Creeks include wetlands, fish and wildlife habitat, and cold-water salmonids, including Chinook salmon which are listed as threatened under the Endangered Species Act. Newaukum Creek consists of low–velocity habitats, including side channels and floodplain wetlands that provide important spawning, rearing and refuge habitat for cold-water species including juvenile Chinook salmon. Elevated instream temperatures and interrupted natural transport of large wood and sediment are the habitat impairments impacting salmonid species in the Middle Green River Sub-watershed. Chinook return to spawn in the Green River between July and October. Newaukum creek is listed as impaired by the Environmental Protection Agency (EPA) due to bacteria and other microbes, degraded aquatic life and temperature (EPA 2023b). Boise Creek contains important spawning habitat for salmonids. Lack of off-channel habitat and large wood, excessive sediment fines and temperature are the habitat impairments for salmonids in Boise Creek. Chinook are present between late February and June. (EPA 2023a; WRIA 10 1999). Boise creek is listed as impaired by the EPA due bacteria and other microbes. (EPA 2023a).

City parks (excluding the Enumclaw Golf Course and City Ballfields) and street trees are also included in this sector. Open spaces can help avoid habitat fragmentation, facilitate species movement and provide refuge from the heat. They also contribute to the quality of life for the community. Street trees help moderate heat in urban settings. Heat events and warm temperatures may impact trees and vegetation which are sensitive to higher temperatures.

Table 4-10. Sensitivity Considerations for Ecosystem Assets

Asset Sector	Sensitivity Considerations	Potentially Sensitive Assets in Enumclaw
Ecosystems ▪ Natural Environment ▪ Social Environment	▪ Habitat fragmentation potential ▪ Ephemeral streams and wetlands ▪ Drought-tolerant plantings ▪ Disturbed areas (invasive plant colonization) ▪ Critical habitat and sensitive species listings	▪ Riparian habitat connectivity ▪ Cold-water species (such as salmonids) ▪ Street trees ▪ Streams and rivers ▪ Native Vegetation

The highest risks to ecosystems are the volume and timing of peak flows related to snowpack declines and extreme precipitation events. Higher peak flows could both generate more sediment through bank erosion and increase the rate of transport downstream. Enumclaw's ecosystem assets are potentially sensitive to expected increases in the rate of erosion and sediment transport in winter and spring, primarily as a result of continued declines in snowpack and projected increases in the frequency and intensity of heavy rain events. Enhanced sedimentation can affect habitat quality for aquatic species. Less water stored as snow and lower streamflows during fish-critical also presents a risk to habitat availability. Extreme precipitation events reduces slow-water habitat availability, which during fish critical times can be a risk to survival rates. Further, high streamflow events have the potential to crush salmon eggs, causing mortality. Flushed juvenile salmonids downstream prematurely, reducing their returns rate.

Water temperatures also present a risk to ecosystem assets. Puget Sound rivers are projected to increasingly experience average August stream temperatures stressful to salmon (in excess of 64°F) and char (in excess of 54°F) (Mauger et al. 2015).

Table 4-11. Impact Risks to Ecosystem Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Reduction in late summer precipitation (by 11.3% annually) ▪ Increase in duration of low streamflow (by 0-16 days annually) ▪ Decreased in low streamflow (by 6-21% annually) ▪ Increasing winter-spring streamflow ratio (by 1.3-2 times; reduction in spring water availability)	Warming air temperature and/or Drought	▪ Decline in water quality and warmer water temperatures for freshwater ecosystems ▪ High stream temperatures can create stress and thermal barriers for cold-water aquatic species ▪ Habitat degradation, limited migration, resource competition, disease and predation susceptibility ▪ Loss of ephemeral wetlands and streams ▪ Early spring snowmelt can affect streamflow timing and modify the migration and survival rates of salmonids ▪ Earlier spring snowmelt can vary streamflow timing and change salmonids' migration timing and survival rates ▪ Reducing the growth and productivity of terrestrial ecosystems vegetation ▪ Increased risk of forest wildfire	▪ Habitat quality and connectivity ▪ Sensitive species disease resistance ▪ Cold-water species (such as salmonids) ▪ Wildfire regimes ▪ Street trees
▪ Increase in Summer Maximum Temperature (by	Warming air temperatures	▪ Some plants and animals may undergo physiological stress due	▪ Forest health and fire regime ▪ Cold-water species

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
3.6°F) and August stream temperature (57-63°F)	and Extreme heat events	to decreased summer soil moisture. ▪ Reduced presence of ephemeral wetlands ▪ Area of tree growth and forest productivity shifting to mild climates ▪ Increase probability of outbreaks of pests in forests ▪ Increased stress on cold-water species in rivers due to stream temperature increases for longer durations for more river miles	▪ Stream temperature ▪ Ephemeral wetlands ▪ Street trees
▪ Increasing peak streamflow (by 5-18%) ▪ Shortening 25-year peak streamflow interval (to 9-11 years)	Flooding and/or Extreme precipitation events	▪ High streamflow reduces slow-water habitat availability, crush salmon eggs, and cause mortality ▪ Enhance sedimentation, affecting habitat quality ▪ Flushed juvenile salmonids downstream prematurely, reducing their returns rate ▪ Interfering steelhead's incubation and migration phases	▪ Aquatic habitat quality ▪ Salmonid survival/return rates ▪ ▪
▪ Increasing wildfire likelihood (3%)	Wildfire	▪ Reduction of forest habitat ▪ Expanded opportunity for invasive species establishment ▪ May increase runoff and sediment in streams, affect aquatic habitats	▪ Native vegetation ▪ Sensitive species and water quality ▪ Slope destabilization

4.1.6 Emergency Management Sector

Emergency management consists of a framework of mitigation, preparedness, response, and recovery. Preparedness measures can include exercising plans for response, acquiring supplies, training, and purchasing additional personal protective equipment for responders. Mitigation also occurs prior to a disaster and involves working to lessen the effects of a hazardous event before it happens (FEMA n.d.). The City has identified funding to facilitate improved emergency preparedness, and existing plans are periodically reassessed and updated, but city resources in a major disaster would be limited (City of Enumclaw n.d.). Funding options are being identified to potentially support emergency preparedness efforts in Enumclaw. Due to a changing climate, there will be more frequent and intense hazard events will affect more residents throughout the year. This will result in increased costs and demands for emergency preparedness, response, and recovery activities.

Table 4-12. Sensitivity Considerations for Emergency Management Assets

Asset Sector	Sensitivity Considerations[6]	Potentially Sensitive Assets in Enumclaw
Emergency Management ▪ Social Environment ▪ Built Environment	▪ Disaster response capacity ▪ Support infrastructure for emergency response ▪ Updated climate hazard plans ▪ Hospital capacity ▪ Technical assistance resource availability	▪ Disaster Preparedness Plans (such as pandemic, wildfire) ▪ First responders (fire, police, EMS) ▪ Snow removal services ▪ Public works hazard response services ▪ Emergency shelter (schools) ▪ Fire Stations ▪ Hospital

The highest risks to emergency management are related to response capacity for wildfire and extreme precipitation events. Emergency response providers may need to plan for overtime to address wildfire and extreme precipitation events, both snow and rain. Additionally, service providers may need equipment and supplies to facilitate a response (e.g., sand bags, salt/ice-melt, plow trucks, pumps).

Table 4-13. Impact Risks to Emergency Management Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ 10% increase in precipitation on 2 -a year storm	Extreme precipitation	▪ Increasing demand for public works hazard response service due to riverine flooding.	▪ Human health and safety ▪ Service response times
▪ Increasing peak streamflow (by 8-20%) ▪ Shortening 25-year peak streamflow interval (to 9-11 years)	Flooding	▪ Increasing demand for first responders ▪ Increasing demand for public works hazard response services	▪ Human health and safety ▪ Service response times
▪ Increasing 65 degrees and 90 degrees Min Humidex Days annually (4.8 days and 12.5 days, respectively)	Extreme heat	▪ Growing demand for emergency services due to heat-related health impacts	▪ Human health and safety ▪ Service response times
▪ Increasing wildfire likelihood (3%) and	Wildfire	▪ Increasing emergency service demand for	▪ Human health and safety ▪ Service response times

[6] U.S. Environmental Protection Agency. 2022. Office of Land and Emergency Management 2022-2023 Climate Adaptation Implementation Plan. EPA 231-B-22-001. October. https://www.epa.gov/system/files/documents/2022-10/bh508-OLEM%20CAIP_August%202022_POST_OGCreview_9.12.2022.pdf.

high wildfire danger days (4 days) annually		wildfire response including personnel for enforcing fire bans and reacting to emergencies.	

4.1.7 Health and Well-being Sector

Increasing exposure to compounding natural hazards can cause a range of negative health effects impacting community and social services that are particularly critical to vulnerable populations. Approximately 44% of the City's population has two or more risk factors that increase vulnerability, likely related to availability of financial resources and age. However, according to the U.S. Census Bureau Community Resiliency, Enumclaw's population is moderately resilient based on estimates for the census tracts that make up the majority of the City. Factors that contribute to vulnerability of people and communities include access to financial resources, race and ethnicity, social cohesion, linguistic isolation and age and health status. Financial resources determine the ability to respond to hazard events. Those with fewer resources are more vulnerable because they have limited ability rebuild or recover. Racial and ethnic minorities may be more vulnerable due to historic socioeconomic and health inequities. Social cohesion can help a community be more resilient as neighbors and the community support each other. Displacement pressure from rising prices increases vulnerability as community members are forced to relocate. Communities that are linguistically isolated, lacking English proficiency, are more vulnerable to hazard events as they may have limited understanding of warning of extreme weather or poor air quality if translated information is not available.

Table 4-14. Sensitivity Considerations for Health and Well-being Assets

Asset Sector	Sensitivity Considerations	Potentially Sensitive Assets in Enumclaw
Health and Well-being ▪ Social Environment ▪ Built Environment	▪ Growth in population, particularly vulnerable populations ▪ Climate-induced mental health stressors (such as resource scarcity, air pollution) ▪ Elevated anxiety, depression and post-traumatic stress disorders (i.e., "eco-anxiety") ▪ More frequent hazard exposures	▪ Aging and disability resources ▪ Health care clinics and hospitals ▪ Community Mental health ▪ ADA para transit services ▪ Vulnerable residents

The highest risks to health and well-being are related to the provision of services to vulnerable populations and overall community mental health. Enumclaw provides community and social services in the form of the Enumclaw Senior Center and, the Enumclaw Pool. The Enumclaw Senior Center provides activities, meals and assistance to senior residents of the City and surrounding plateau. St. Elizabeth Hospital provides emergency and critical care services to the residents of the City and larger surrounding area. There are several skilled nursing facilities and retirement facilities in the City that provide aging support and disability care.

Distress about climate change is often relative to how directly the surrounding environment is threatened or vulnerable, the existential threat of climate change is increasingly noted by mental health professionals as having an indirect impact on levels of despair and guilt (Ingle and Mikulewicz 2020; Coyle and Van Susteren 2011).

Table 4-15. Impact Risks to Health and Well-being Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Rising summer maximum temperatures (by 3.6 deg F) ▪ Increasing 65 deg min humidex (nighttime) days and 95 deg min humidex (daytime) days by 14.8 to 5.9 represent	Extreme heat events	▪ Increase in heat-related deaths, illnesses, and hospitalization, particularly the elderly and poor. ▪ Concentrations of air pollution (ozone) and vector-borne illnesses (West Nile virus). ▪ Increase in water temperatures and the risk of exposure to waterborne disease. ▪ Longer and more severe pollen seasons and changing pollen composition. ▪ More severe seasonal allergies and increase in respiratory and cardiovascular admissions.	▪ Vulnerable populations ▪ Groups with greater sensitivity to air quality changes ▪ Public health ▪ Allergies and infectious diseases
▪ Increasing wildfire likelihood (3%)	Wildfires and/or Wildfire smoke event	▪ Wildfire smoke increases ozone and particulate matter and raise the risk of cardiovascular and respiratory illnesses and death. ▪ Cause loss of life, injury, and mental health issues associated with displacement.	▪ Groups sensitive to air pollutants (such as lung disease, diabetes, older adults, children)

4.1.8 Transportation Sector

The City's transportation system consists of state routes jointly managed by the City and the Washington State Department of Transportation (WSDOT) and arterials and local collector roads owned and maintained by the City. SR 410, 164 and 169 connect Enumclaw to the surrounding region and the primarily evacuation routes in the event of an emergency. The City is served by King County metro transit via SR 164 from Auburn. Two of the primary routes, SR 410 and SR 169, are connected by bridges. SR 410 crosses the White River 1 mile southwest of the City via the White River Bridge, and SR 169 crosses the Green River approximate 5.3 miles north via the Green River Dan Evans Bridge. There are several smaller bridge crossings of Newaukum and Boise Creeks by arterials or collector roads that serve the City and surrounding area.

Table 4-16. Sensitivity Considerations for Transportation Assets

Asset Sector	Sensitivity Considerations	Potentially Sensitive Assets in Enumclaw
Transportation ▪ Built Environment	▪ Capacity of culverts and ditches ▪ Pavement condition and surface type ▪ Armoring ▪ Age and condition of structures ▪ Bridge ratings	▪ Bridges ▪ State routes ▪ City streets ▪ Transit facilities

The highest risks to transportation assets are related to extreme precipitation and flooding. The infrastructure is considered sensitive to erosion and landslides due to proximity of potential or known hazards. These hazards have consequences for the bridges that connect highways routes into Enumclaw from neighboring communities. These routes are critical transportation routes serving the City.

Table 4-17. Impact Risks to Transportation Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Increase in heavy precipitation events (10%) annually in spring and winter and 1 inch precipitation days (by 0.9 days)	Extreme precipitation	▪ Flooding or Rainfall-induced erosion and landslides damage infrastructure ▪ Increasing repair costs, service interruption, and public safety hazards	▪ Bridges and other infrastructure in landslide and erosion hazard areas
▪ Increasing peak streamflow (by 8-20%) ▪ Shortening 25-year peak streamflow interval (to 9-11 years)	Flood events	▪ Increasing riverine flooding causes damage to roads, bridges, and railways ▪ Overwhelming the drainage structure and causing higher operational costs and service disruption (cancellations and reroutes)	▪ Bridges and other infrastructure in floodplains
▪ Increase 0.1 days annually within a maximum temperature greater than 100°F	Extreme heat	▪ Increased road and bridge surface damage leading to higher operational costs and frequent service disruptions	▪ Heat damage to bridges, state routes and City streets
▪ Increasing wildfire likelihood (3%)	Wildfire	▪ Increase in travel disruption, road closure, and construction delay due to wildfire smoke	▪ Road closures

4.1.9 Waste Management Sector

Enumclaw collects solid waste, recyclables and yard waste from commercial and residential customers within the City. Solid waste and recyclables are transported to the King County Transfer Station located at 1650 Battersby Ave East, Enumclaw. Solid waste is transported by King County to the Cedar Hills Regional Landfill. Yard waste is transported to the Cedar Grove Composting Facility near Maple Valley.

Table 4-18. Sensitivity Considerations for Waste Management Assets

Asset Sector	Sensitivity Considerations	Sensitive Assets in Enumclaw
Waste Management ▪ Social Environment ▪ Built Environment	▪ Optimization of waste streams to minimize disruptions ▪ Capacity to handle and dispose of disaster debris ▪ Frequency or severity of chemical spills ▪ Location of contaminated sites ▪ Contaminant behavior disposal sites	▪ Recycling and transfer station ▪ Waste hauling and management ▪ Household and commercial hazardous waste management

Solid waste management infrastructure might be vulnerable to climate-related disruptions that could affect the disposal or management of waste and recyclable materials. Major disasters can result in additional need for debris, which oftentimes runs the risk of contamination. Overall, the risk of spills or releases of pollutants is increased due to extreme precipitation. Additionally, the frequency and severity of accidental chemical releases and oil spills could increase due to climate hazards (EPA 2022).

Table 4-19. Impact Risks to Waste Management Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ 10% increase in precipitation on 2 -a year storm	Extreme precipitation	▪ Increased debris disposal like tree limbs	▪ Municipal waste management system capacity
▪ Shortening 25-year peak streamflow interval (to 9-11 years)	Flood events	▪ Increase in solid waste (downed tree limbs, building rubble) due to damage caused by floods ▪ Floods in waste facilities can release contaminants and impact the environment and public safety	▪ Municipal waste management system capacity ▪ Facilities in floodplains
▪ Increasing wildfire likelihood (3%)	Wildfire	▪ More solid waste is generated from wildfire-related damage ▪ Increase the burden on waste management capacity	▪ Municipal waste management system capacity ▪ Facilities in wildland/urban interface

4.1.10 Water Resources Sector

The water resources sector consists of assets related to water quality and quantity, stormwater and sewer system, and the drinking water supply, which are described in this section.

Water Quality and Quantity. Water quality, such as temperature and concentration of contaminants, can also be impacted by climate change. Newaukum and Boise Creeks have been impacted by agricultural activities, including ditching/straightening and removal of riparian vegetation, and both have impaired water quality. The Stormwater Comprehensive Plan states that Newaukum Creek has a total maximum daily load (TMDL) for temperature and includes proposed mitigation measures including revegetation of Newaukum stream banks and use of low-impact development techniques where feasible. Boise Creek has a TMDL for fecal coliform that is likely a result of agricultural land uses and failing septic systems.

Stormwater and Sewer System. The City's stormwater system consists of stormwater retention/detention ponds, culverts and ditches which drain rainfall to Newaukum and Boise Creeks. A large portion of the city drains to drainage ditches maintained by King County Drainage Districts 5, 5A, and 6 before flowing into the creeks. The trunk and laterals of the system were designed to transport runoff from a 10-year and 5-year frequency storm. The Stormwater Comprehensive Plan states that a 5- or 10- year conveyance capacity may not be an adequate level of protection to minimize flooding risk.

The City's sewer system service area is the City's UGA. The system consists of a system of gravity and pressure mains, lift stations and the Enumclaw WWTP. The WWTP is located in at the south side of the City, just north of the intersection of Semanski Street South and SR 410. Treated wastewater is discharged to the White River via a 30 inch diameter outfall located on the north bank of the White River, just west of the White River Bridge. During extremely high flow conditions raw effluent by-passes the WWTP and is discharged at this location. The City has a National Pollutant Discharge Elimination System Permit (NPDES) for the outfall issued May 1, 2003. The most recent update to the NPDES permit indicates that the outfall location is influenced by the river's very active channel morphology and mixing of the effluent is delayed during late-summer low flows. The City's sewer system is older and experiences infiltration from groundwater and inflow from stormwater increasing flows to the WWTP. The sewer system experiences higher levels of rain-induced infiltration-inflow than other systems in the region.

Drinking Water Supply. The City's water system serves the City and surrounding unincorporated areas via a system of spring sources, wellfields, storage tanks/reservoirs and pump stations. Many of these facilities are located in the rural area outside of the City Urban Growth Boundary. The City's water system source is groundwater that resides in porous layer of glacial drift and ice contact sediments underlying the Osceola Mudflow. Groundwater is recharged directly by infiltration of precipitation in the Enumclaw area and through deeper, more extensive groundwater flow paths that transmit infiltrated precipitation falling on the foothills to the east of the City (City of Enumclaw Water System Plan 2013).

Water supply is provided by two spring sources, a groundwater wellfield and an emergency intertie with the City of Tacoma. The City's two spring sources and wellfield are fed by groundwater that resides in porous layer of stratified glacial drift and ice contact sediments underlying the Osceola Mudflow. Groundwater is recharged directly by infiltration of precipitation in the Enumclaw area and groundwater flow paths that transmit infiltrated precipitation falling on the foothills to the east of the east of the City. The source of water for the City of Tacoma is a combination river water from the Green River (TPU n.d.) and groundwater wells in the Green River Watershed.

Table 4-20. Sensitivity Considerations for Water Resource Assets

Asset Sector	Sensitivity Considerations	Sensitive Assets in Enumclaw
Water Resources ▪ Natural Environment ▪ Built Environment	▪ Excessive water withdrawals/growing demand ▪ Conflicts among water users ▪ Water quality degradation (temperature increases) ▪ More frequent and intense droughts and floods ▪ Increased risk of contaminant spills and leaching ▪ Access to potable water ▪ Untreated discharge into waterbodies	▪ Wells and storage tanks ▪ Groundwater supplies ▪ Wellhead protection areas ▪ Treatment and conveyance facilities and outfalls (stormwater, wastewater) ▪ Drinking water conveyance system ▪ Culverts (design and capacity)

Decreasing snowpack, a continued shift from snow to rain, increasing stream temperatures, earlier streamflow timing, increased flooding, and declining summer minimum flows all have the potential to impact water resources. This affects where, when and how much water is available to users. The highest risks to water resource assets are consequences related to changing sediment dynamics, increased risk of contamination and overall system capacity for conveyance and treatment.

Table 4-21. Impact Risks to Water Resource Assets from Climate Hazard Exposure

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Heavy precipitation (10% increase in precipitation during 2- year storm)	Extreme Precipitation	▪ Increased magnitude of peak stormwater flows ▪ More frequent peak stormwater events	▪ Wastewater collection system capacity ▪ Wastewater treatment facility capacity ▪ Stormwater conveyance and detention capacity
▪ Decrease in spring and summer precipitation and snowpack (25% summer precipitation less than 75% of normal and snowpack reduced by 61%). ▪ Less streamflow in the warm season (by 4-17% annually). ▪ Increase in total annual precipitation (by 4% annually) may boost	Drought	▪ Declining precipitation and snowpack during peak seasons (late spring and summer) lead to less water for commercial, residential, and agricultural use, and hydropower ▪ Requiring more water conservation through voluntary or mandatory regulations and restrictions ▪ Increasing dependence on stored water	▪ Water storage and supplies ▪ Energy supplies

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
groundwater recharge and offset some impacts.		▪ Decrease in hydropower generation can cause an energy shortage for summer cooling	
▪ Increasing wildfire likelihood (3%)	Wildfire	▪ Wildfires can damage water infrastructure and decrease reservoir water quality through increased runoff, erosion, and turbidity	▪ Water infrastructure located in the wildland/urban interface ▪ Water quality treatment facilities

4.1.11 Zoning and Development Sector

The majority of the City is zoned for residential uses, with commercial and industrial uses concentrated in the downtown and along the state routes.

Table 4-22. Sensitivity Considerations for Zoning and Development Assets

Asset Sector	Sensitivity Considerations[7]	Potentially Sensitive Assets in Enumclaw
Zoning and Development ▪ Natural Environment ▪ Built Environment	▪ Siting development/proximity to hazards ▪ Lack of climate driven design ▪ Walkability ▪ Lack of mixed use development	▪ Mixed, Multi-Family and Manufactured Home zones ▪ Commercial and Downtown zones ▪ Residential zones ▪ Industrial and manufacturing zones ▪ Parks and Open space

It is worth noting the risk to manufactured home parks due to their proximity to either floodplains or the wildland-urban interface. These types of land use and development are particularly sensitive to the consequences of hazard exposure because they typically house vulnerable populations with limited capacity to recover from hazard events.

Table 4-24. Enumclaw Changes in Climate and Zoning and Development Sector Impacts

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Increase in precipitation on 2 - a year storm (by 10%) and 1 inch precipitation days (by 0.9 days).	Extreme precipitation	▪ Flooding and rainfall-induced erosion and landslides can damage structures. ▪ Runoff from impervious surfaces can overwhelm systems and damage structures.	▪ Residential and non-residential areas with insufficient drainage infrastructure

[7] U.S. Environmental Protection Agency. 2021. Essential Smart Growth Fixes for Communities. https://www.epa.gov/smartgrowth/essential-smart-growth-fixescommunities#Rural_Planning_Zoning_and_Development_Codes.

Climate Change Indicator	Climate Hazard	Consequences for Assets	Risk to…
▪ Increasing peak streamflow (by 8-20%); shortening 25-year peak streamflow interval (to 9-11 years)	Flooding	▪ Increasing damage of assets in floodplain and adjacent area. ▪ Need for new or upgraded flood-control and, erosion-control structures. ▪ Increasing cost for assets relocation and stormwater infrastructure.	▪ Residential areas in floodplains ▪ Parks in floodplains ▪ Industrial and manufacturing areas in floodplains
▪ Increasing wildfire likelihood (3%)	Wildfire	▪ Increasing damage to assets and property and the displacement of residents.	▪ Residential and non-residential areas in the wildland/urban interface

4.2 Asset Vulnerability by Hazard Event

Priority hazards of concern for Enumclaw were found to include extreme precipitation events, flood events, wildfire, wildfire smoke events, and extreme heat events. Changes in streamflow are discussed in terms of the increase in peak flows (resulting in larger and more frequent floods), decrease in low flows (resulting in lower minimum flows in late summer), and earlier streamflow timing (resulting in lower flows and a more prolonged low flow season).

Assessed were 111 site-specific and community-wide assets in 11 asset sectors (**Attachment A**). Of these, 28% of assets were found to be moderately vulnerable and 20% were found to be highly vulnerable. Assets found to be highly vulnerable include those that are highly sensitive to hazard exposure and have limited capacity to adapt. The following are low-priority hazards for Enumclaw, as they are either unlikely to occur or have low-magnitude of impacts:

Sea level rise and ocean acidification. Enumclaw is not on or near saltwater shorelines, and none of its critical facilities rely on access to saltwater shorelines, so sea level rise was not included in the analysis. While not directly applicable, neither sea level rise nor ocean acidification will directly impact Enumclaw.

Drought. The City's assets were considered to have low vulnerability to drought because multiple-season drought in Western Washington is a fairly rare occurrence, with a probability of occurrence of once in 10 to 30 years (King County Hazard Report 2020). Based on this low probability, City assets were considered to have low vulnerability. (NIDIS 2023)

4.2.1 Extreme Precipitation

Extreme precipitation events (i.e.,, "Atmospheric River" events) are projected to become more severe and more frequent due to climate change. Whereas changes in annual and seasonal precipitation are not consistent among models: some project increases while others project decreases. Extreme precipitation events are expected to exceed the range of variability shortly after mid-century, as shown in Section 2. For instance, by 2049, the magnitude of both the 2-year storm and 25-year storm may increase by up to 10%. Global models project that the heaviest 24-hour rain events in Western Washington will intensify by +22%, on average, by the end of the century, relative to 1970 to 1999. An increase in 2-inch precipitation days indicates increased flooding potential due to heavy rain (**Figure 4-1**).

Winter precipitation extremes are projected to increase and the type of precipitation show a clear shift to less snow and more rain. By the end of the twenty-first century, the dominant form of precipitation in most Puget Sound watersheds will be rainfall, with less influence of snowfall in winter. In Enumclaw, extreme precipitation events may cause localized flooding as culverts and stormwater facilities are temporarily overwhelmed. Recent extreme precipitation events in November 2021 had significant impacts to the northwestern portion of the Puget Sound region. Extreme precipitation was attributed to three large atmospheric rivers that delivered unprecedented rainfall, a record 6 inches in 3 days in Whatcom County. Although, Enumclaw's proximity to the storm's landfall and subsequent path resulted in less extreme precipitation than other parts of the Puget Sound region, the potential for atmospheric rivers to bring heavy amounts of rainfall to a localized area could present a future risk for Enumclaw.

Extreme precipitation events also have the potential to alter sediment dynamics. Higher peak flows generate more sediment through bank erosion and increase the rate of transport downstream. Sediment dynamics are expected to become less affected during the summer months due to diminishing streamflow and drier soils.

The Puget Sound region is expected to experience increases in the frequency of landslides, the rate of erosion, and sediment transport in winter and spring, primarily as a result of continued declines in snowpack and projected increases in the frequency and intensity of heavy rain events. Few studies have identified trends in landslides and even fewer have related these changes to climate.

For Enumclaw, potential landslide hazard areas are limited to the areas adjacent to the Green and White Rivers, north and sound of town, respectively. The headwaters of Boise Creek also are mapped for landslide hazard. Historic landslides are mapped along SR 410 near the White River and along SR 164 near the Green River bridge.

Figure 4-1. Increase in flooding due to heavy rain as indicated by increasing number of 2-inch precipitation days (RCP 8.5)

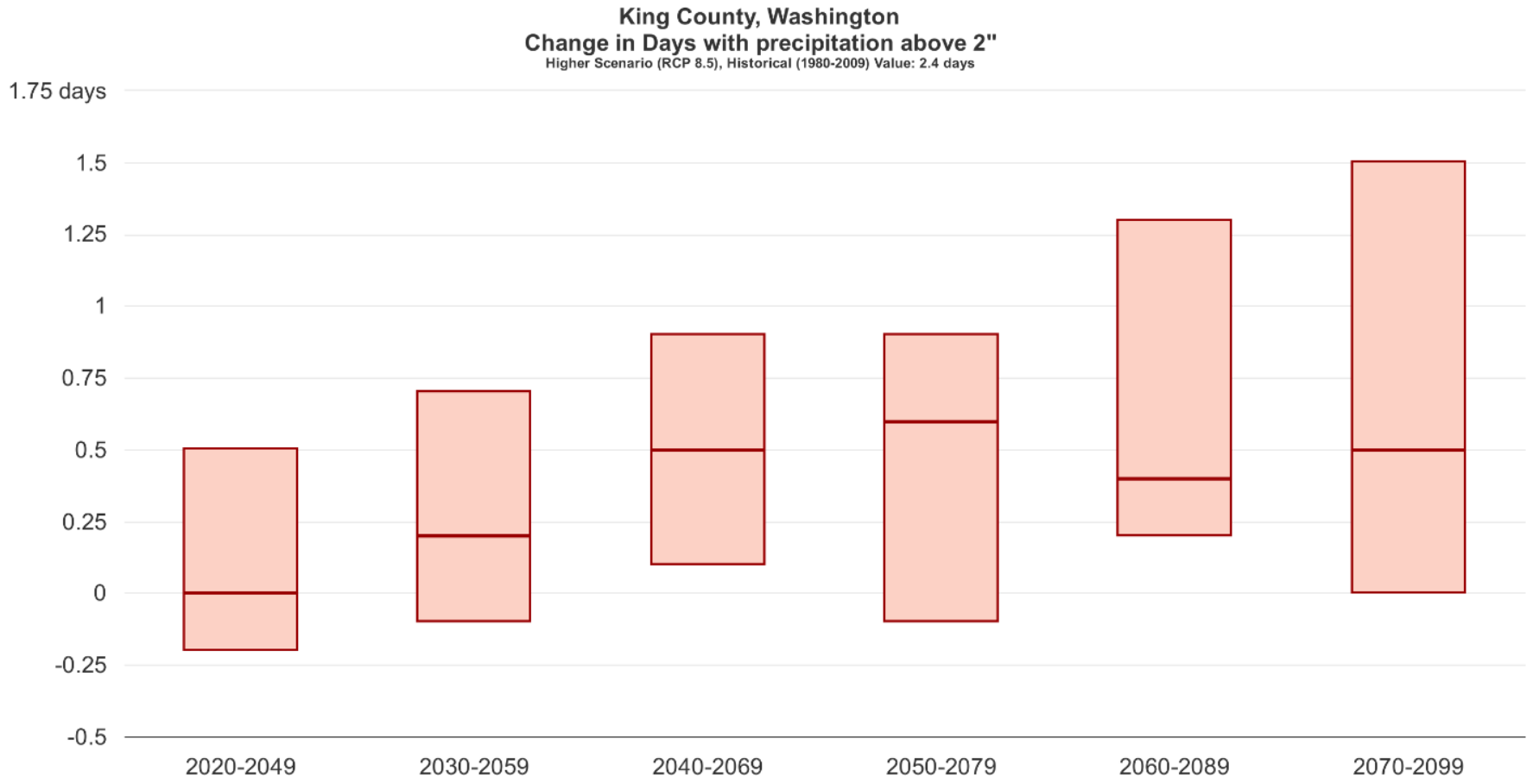


Figure 4-2. Sediment Dynamics and Potential Geologic Hazards in the Enumclaw Vicinity

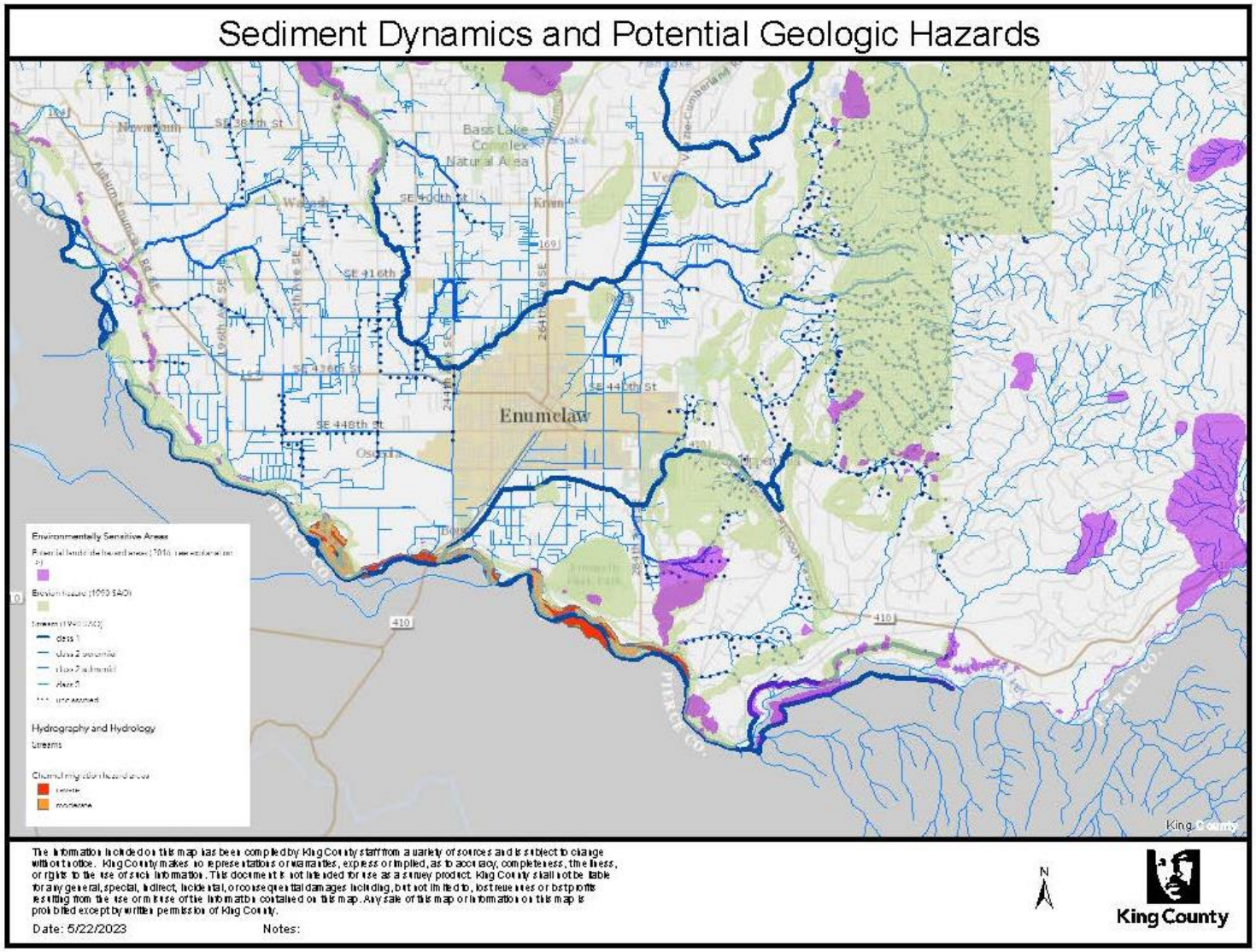


Table 4-24. Assets with Moderate or High Vulnerability to Extreme Precipitation Events

Environment	Moderate Vulnerability	High Vulnerability
Built	▪ SR 164 ▪ Crossings of Newaukum Creek ▪ Crossings of Boise Creek	▪ City street network ▪ WWTP and collection system ▪ Stormwater ponds, culverts, ditches ▪ SR 410 (east of Enumclaw) ▪ Porter Street/SR 169/ Green River Bridge
Natural	▪ Boise Creek ▪ Newaukum Creek	▪ Habitat for salmonids and other sensitive aquatic species
Social	▪ Public Works drainage response ▪ Archaeological sites ▪ Emergency Preparedness Plans	▪ City-owned ballfields ▪ Enumclaw golf course

4.2.1.1 High Vulnerability Assets and Potential Adaptation Strategies

- **City Street Network** – City streets drain to the stormwater conveyance and detention facilities, which may become overwhelmed during extreme precipitation events and temporarily back up onto city streets. Adaptation may involve identification and retrofit of existing undersized facilities.
- **WWTP and Collection System** – The City's wastewater collection system is vulnerable to extreme precipitation events due to groundwater infiltration and stormwater cross connections that may cause capacity issues at the WWTP. Adaptation may involve replacement of elements of the collection system or capacity upgrades.
- **Stormwater System** – The City's stormwater conveyance and detention facilities are vulnerable to extreme precipitation events as current regulations require design based on historic precipitation patterns which may be insufficient for future events. Adaptation may involve identification and retrofit of existing undersized facilities as well as updates to stormwater plans and regulations.
- **Porter Street/SR 169/Green River Bridge** – Green River Bridge was determined to be vulnerable to extreme precipitation due to its proximity to potential landslide hazard and site of a historic landslide. It was also found to be highly vulnerable by the Climate Impacts Vulnerability Assessment conducted by WSDOT (WSDOT 2011). Adaptation may involve updating emergency preparedness plans to include contingency plans and/or coordination with WSDOT.
- **Habitat for salmonids and other sensitive aquatic species** – Spawning habitat for aquatic species, especially salmonids, is vulnerable to altered sediment dynamics such as erosion resulting from more water and higher velocity flows during extreme precipitation events. The increase in water and velocity scours stream banks and beds impacting spawning habitat and riparian vegetation. Adaptation may include protecting riparian wetlands and evaluating the detention capacity of the stormwater system.
- **City Ballfields** – Ballfields at Boise Creek and McFarland Park are vulnerable to extreme precipitation in the early spring as soils in the area are poorly drained and the parks lack sufficient drainage facilities. Adaptation may involve upgrading ballfield drainage or shortening the season of use.
- **Enumclaw Golf Course** – The golf course is sensitive to extreme precipitation in the early spring as it located in a low-lying area bisected by Boise Creek, sits on poorly drained soil and lacks sufficient drainage facilities. Adaptation may involve upgrading drainage or shortening season of use.

4.2.2 Flooding

Flooding can be influenced by changes in snowpack and streamflow, which are driven by changes in temperature, heavy rainfall, and seasonal precipitation. Models predict return intervals of events that inundate beyond 100-year flood areas to areas of minimal flood hazard or 500-year flood. The 100-year flood area includes FEMA special flood hazard areas are those with 1 percent-annual-chance flood. The 500-year flood area is between the FEMA-identified limits of the base flood and the 0.2-percent-annual-chance flood (**Figure 4-3**). Streamflow is projected to change substantially in response to warming, melting snow, drier summers, and more intense heavy rain events. An increase in the magnitude of peak streamflow is an indicator of flood potential and larger areas inundated every year at high flows (**Figure 4-4** and **Figure 4-5**).

Snowpack declines can lead to increased flooding by increasing the portion of the watershed that receives water during a winter storm events as precipitation that normally accumulates as snow ends up in rivers and streams (Mauger et al. 2021). Anticipated changes in the timing and magnitude of peak streamflow are largely influenced by increases in the proportion of rainfall relative to snowfall and the volume of water supplied to streams and rivers. By 2080, rivers and streams in King County are predicted to have higher and more prolonged monthly winter flows and lower spring and summer flows (Mauger et al. 2020).

Globally, stronger and longer lasting atmospheric rivers are projected with warming temperatures (Espinoza et al. 2018; Payne et al. 2020). Research suggests that there will be a shift in the number of atmospheric river events that are “mostly or primarily beneficial” to “mostly or primarily hazardous” to water resources (Rhoades et al. 2020). According to a recent study examining 40 years of data on flood insurance claims, atmospheric rivers are a significant driver of flood damages in the western United States (Corringham et al. 2019).

A recent series of atmospheric rivers caused wide-spread damage in the PNW in November 2021. Floodwaters across Western Washington state impacted homes, destroyed roads and highways, and cut off railroads. Although Enumclaw sustained limited impacts, atmospheric rivers will continue to pose a flood damage risk as the storms increase in severity.

Assets found to be highly vulnerable to flooding are those located within floodplains that have limited capacity to adapt. Bridges that are entirely within the floodplain were considered a higher risk than those that span the floodplain but do not have footings in the floodplain. Bridges sited entirely within the floodplain were considered to be more vulnerable than bridges that span the floodplain.

Figure 4-3. 100-year and 500-year floodplains in the Enumclaw vicinity

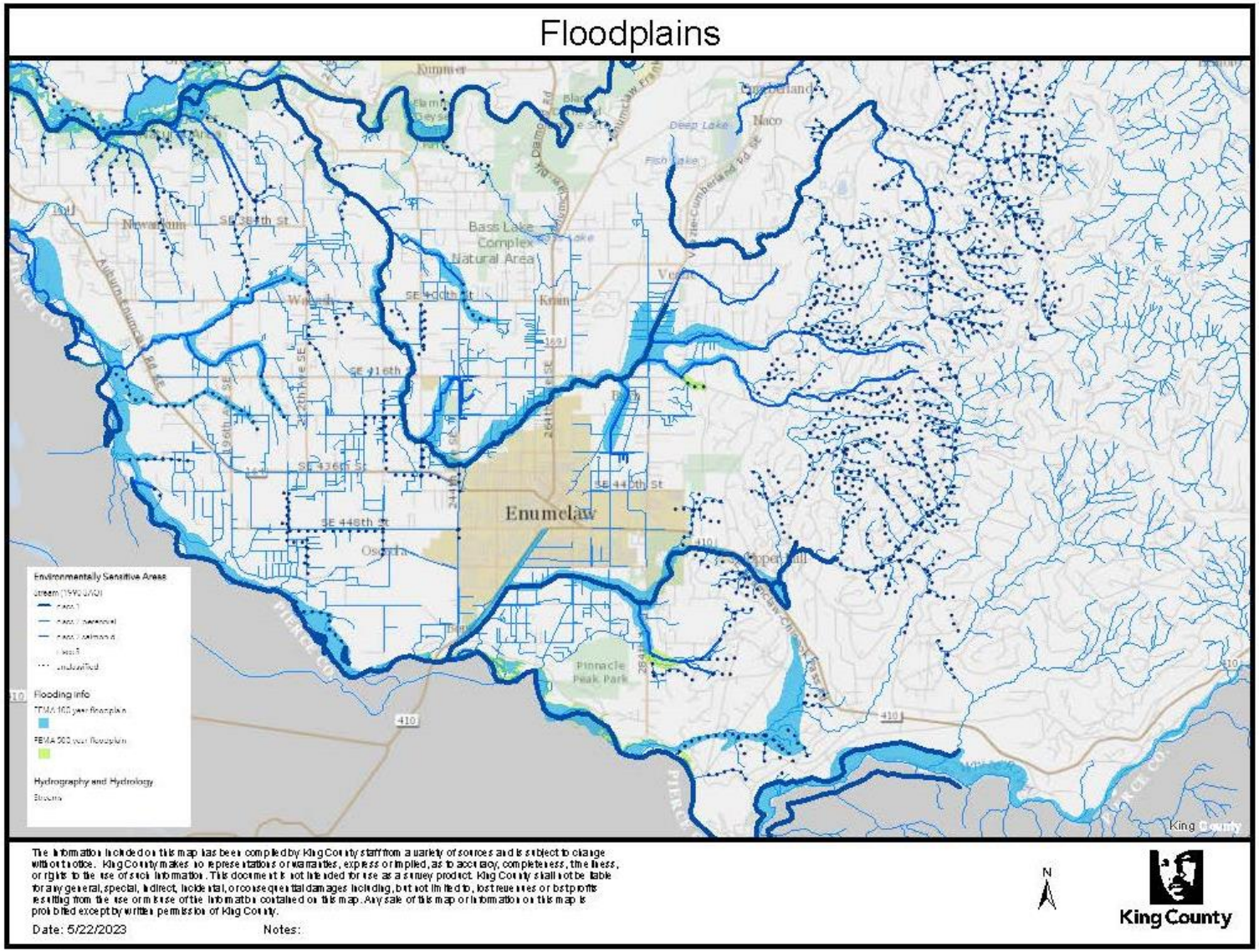


Figure 4-4. Percent of stream length with maximum streamflow change in King County compared to 1980-2009 peak streamflow levels (RCP 4.5)

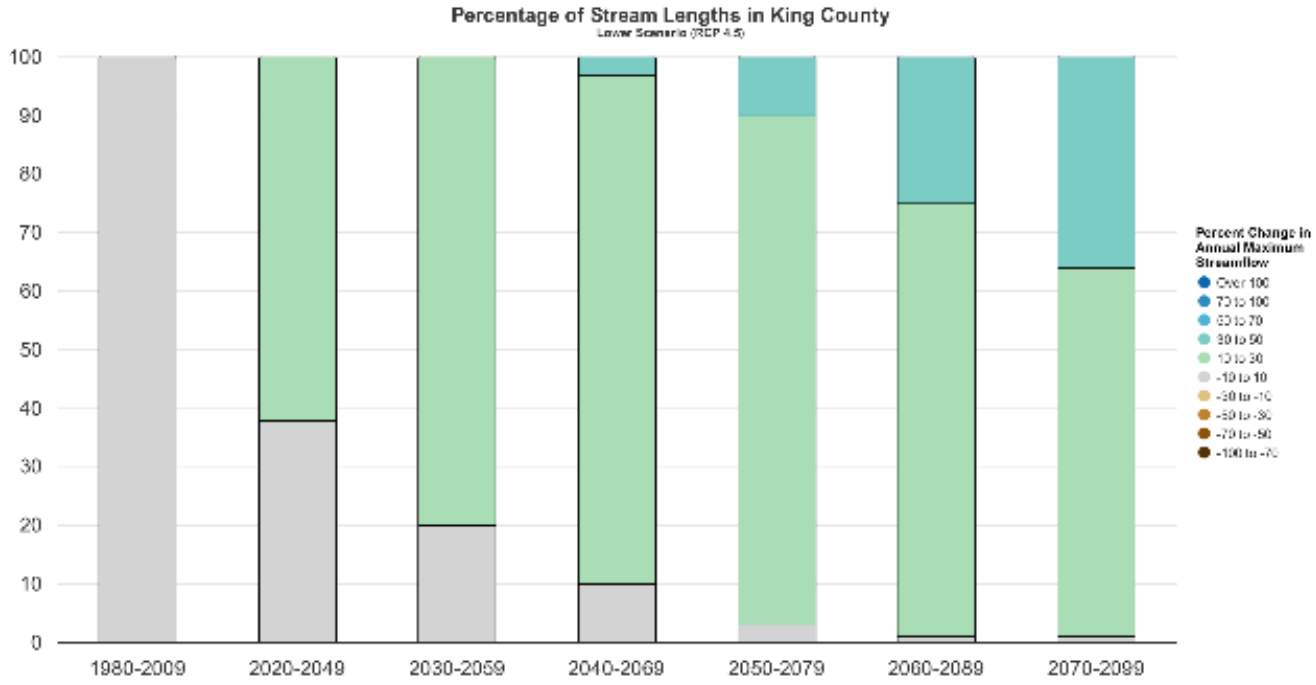


Figure 4-5. Percent of stream length with maximum streamflow change in King County compared to 1980-2009 peak streamflow levels (RCP 8.5)

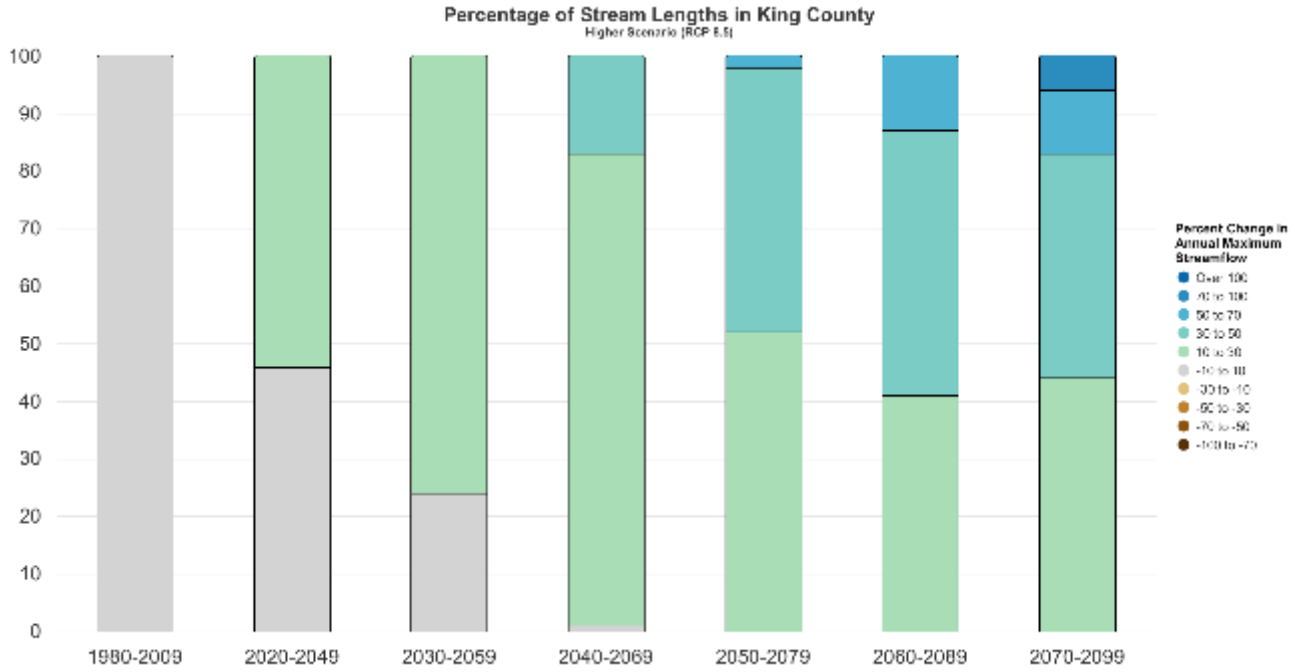


Table 4-25. Assets with Moderate or High Vulnerability to Increasing Flood Events

Environment	Moderate Vulnerability	High Vulnerability
Built	▪ Evergreen Memorial Cemetery ▪ Roosevelt/SR 410 and White River Bridge ▪ Warner Crossing of Boise Ditch	▪ WWTP Outfall ▪ Crossings of Newaukum Creek ▪ Crossings of Boise Creek
Natural	▪ Riparian habitat quality ▪ Native vegetation ▪ Invasive plant establishment	
Social	▪ Archaeological Sites ▪ Emergency Management/First Responders ▪ Emergency Preparedness Planning	▪ Enumclaw Golf Course ▪ Manufactured Home Park Zoning

4.2.2.1 High Vulnerability Assets and Potential Adaptation Strategies

- **WWTP Outfall** – The City's WWTP outfall is located roughly within the White River 100-year floodplain. It is possible that larger and more frequent flood events could result in increased scouring that may impact outfall stability. Adaptation may involve evaluating the need for flood protection measures.
- **Crossings of Boise Creek** –Several bridges within the Boise Creek 100-year floodplain and provides access to components of the City water system. It is not owned by the City, so adaptation may include ensuring that water system contingency plans address this vulnerability.
- **Crossings of Newaukum Creek** - Bridges located within the Newaukum Creek floodplain. Typically not owned by the City, so adaptation may include ensuring that emergency preparedness plans address this vulnerability.
- **Enumclaw Golf Course** – The golf course is located in the Boise Creek 100-year floodplain and is damaged during flood events. A project to relocate the stream channel is under construction and will remove flood risk for the golf course.
- **Manufactured Home Park Zoning** -The edge of the Residential Manufactured Home Park zone is located within the 100-year floodplain of Boise Creek. Adaptation may include goals and policies that encourage placement of Residential Manufactured Home Park zoning outside of floodplains.

4.2.3 Extreme Heat

Extreme heat is predicted to occur more often and last longer due to our changing climate. Extreme heat is defined as above-average number of hot days per year with a maximum temperature greater than 90°F. Extreme heat events are record-setting heat waves consisting of a period with temperatures above 100°F for 3 or more days (Department of Homeland Security).

Figure 4-6. Change in annual hot days in King County for future 30-year periods compared to the 1980 to 2009 average (RCP 4.5)

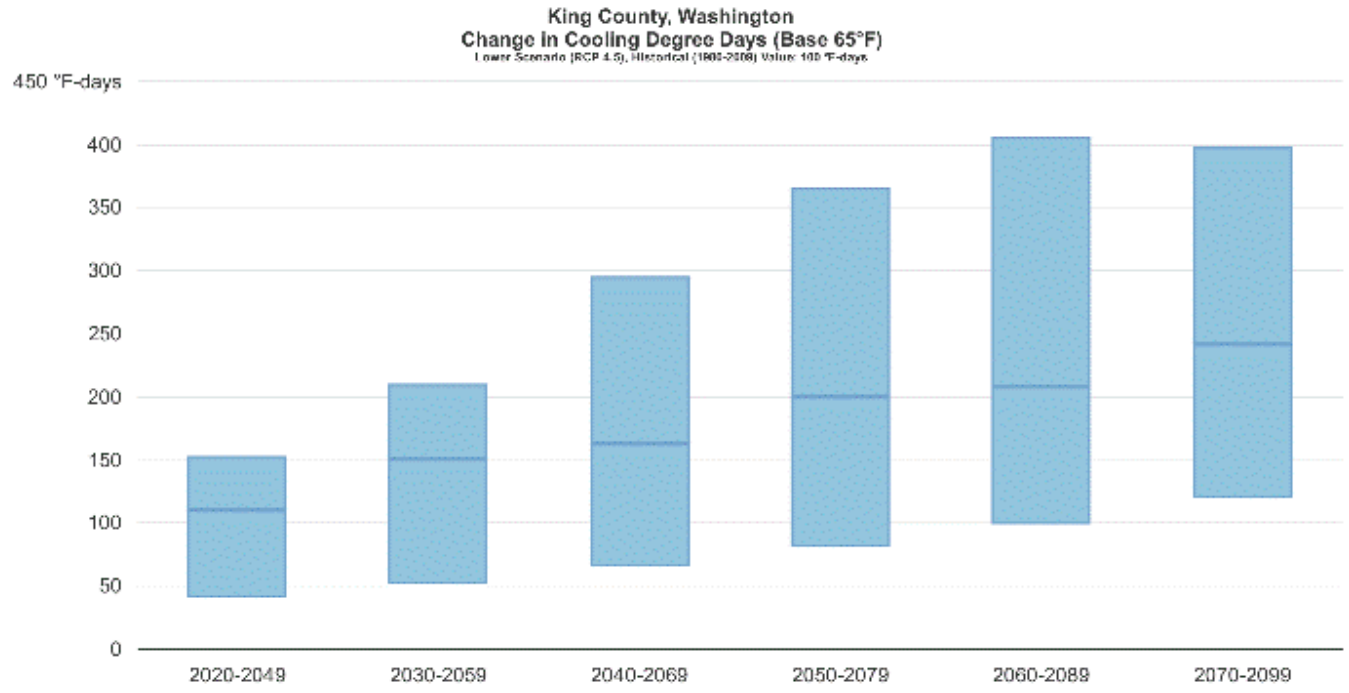
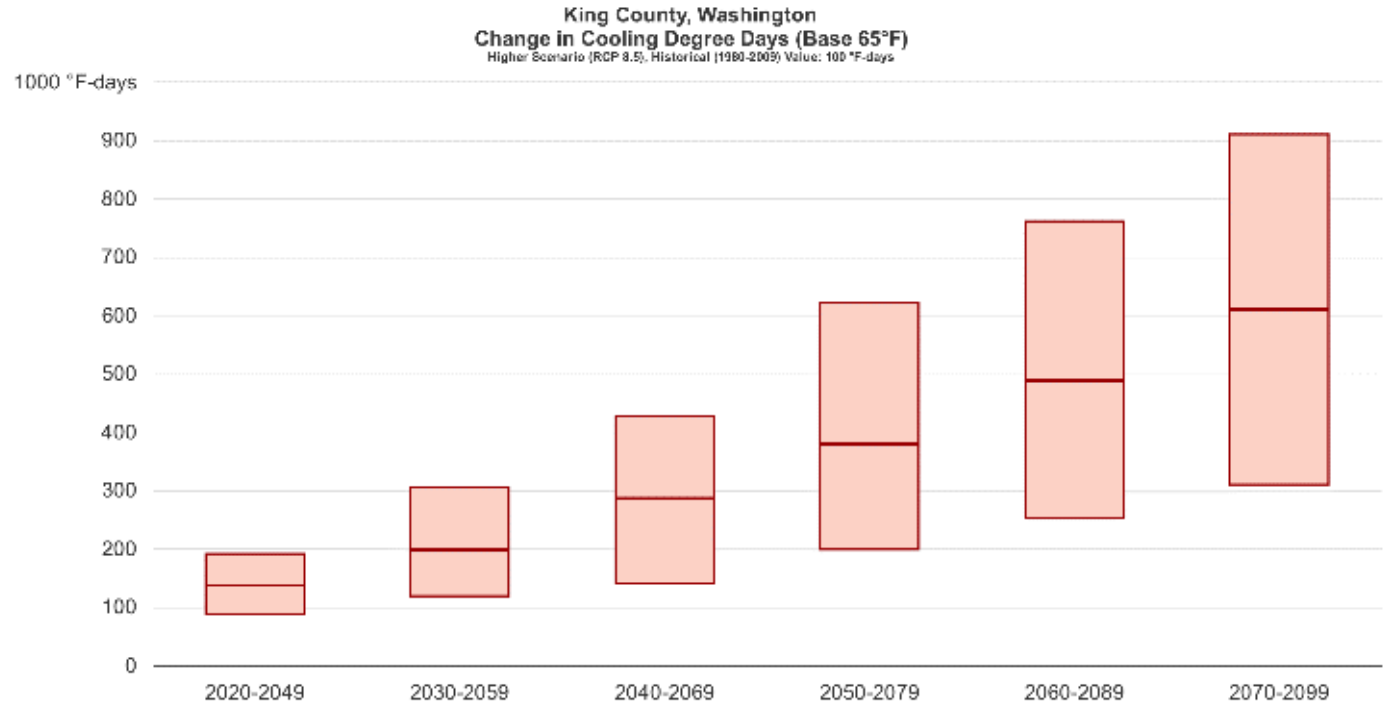


Figure 4-7. Change in annual hot days in King County for future 30-year periods compared to the 1980 to 2009 average (RCP 8.5)



An increase in the number of days above 100°F is an indication of more stress infrastructure and vulnerable populations. Energy demand is also a concern due to increasing number of days where energy is required for cooling. The increase in annual number of degree-days above the average daily temperature of 65°F is an indicator of greater potential for more cooling demand for buildings in the summer (i.e., cooling degree days).

People who are over 65, children and individuals with pre-existing health condition tend to be more vulnerable to extreme heat (UW Climate Impacts Group 2018). The National Weather Service in Seattle reported heat wave event throughout the PNW occurred in late June 2021. This unprecedented week-long extreme heat event resulted in significant increase in risk of heat-related illness for populations that are heat sensitive without effective cooling or adequate hydration. The most affected groups were males and people aged 75 and older (DOH 2021). The Centers for Disease Control and Prevention reported more than 100 heat-related deaths. The mean daily number of heat-related illness emergency department visits during this period was 69 times higher than that during the same days in 2019.

Figure 4-8.

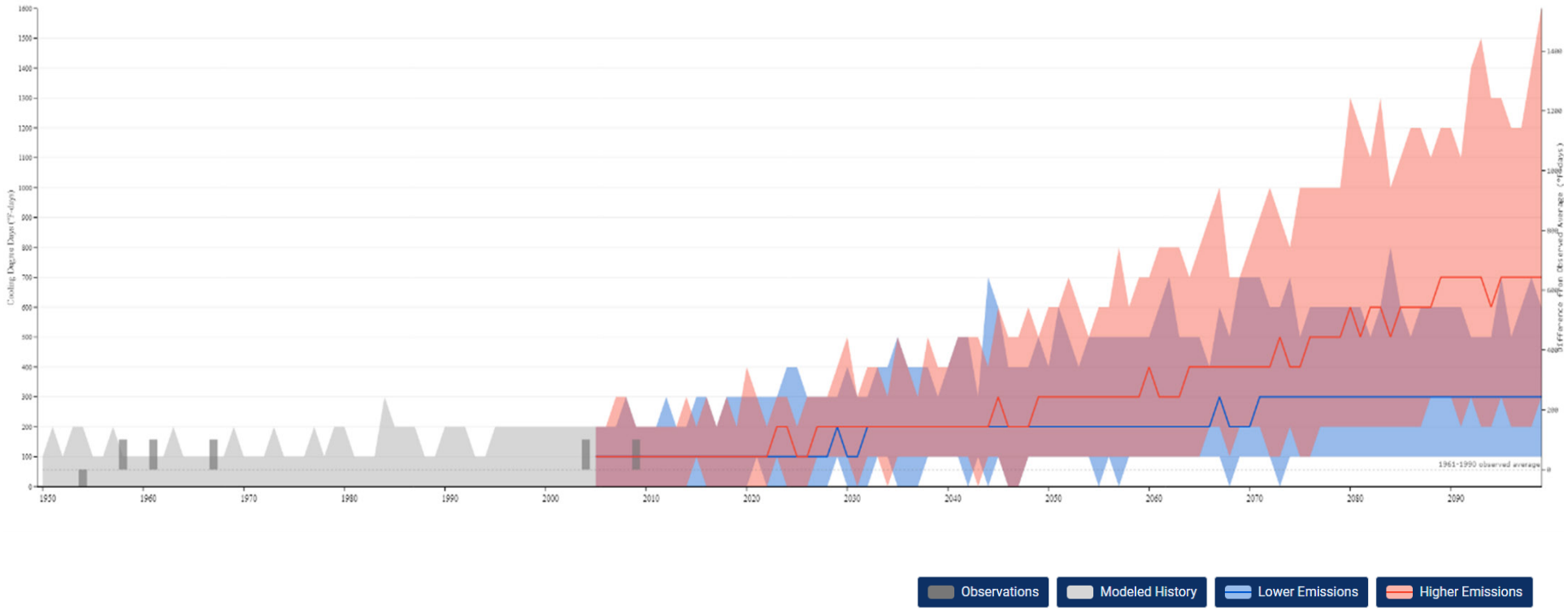

Observations
Modeled History
Lower Emissions
Higher Emissions

Figure 4-9. Ecosystems in the Enumclaw vicinity

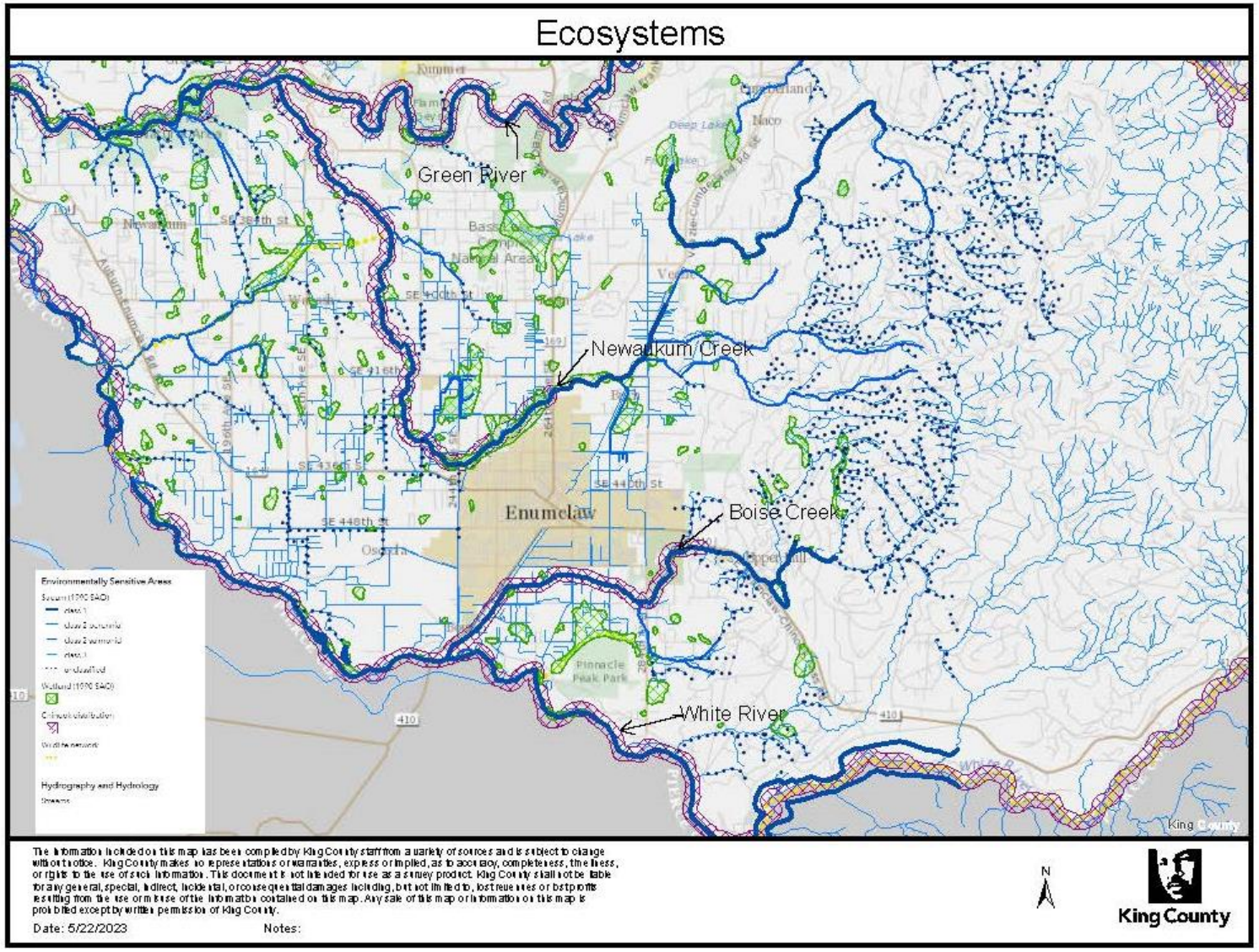


Table 4-26. Assets with Moderate or High Vulnerability to Extreme Heat Events

Environment	Moderate Vulnerability	High Vulnerability
Built	▪ Senior Center	▪ St. Elizabeth Hospital ▪ Emergency Shelters
Natural	▪ Low drought tolerance street trees	▪ Cold-water species ▪ Riparian habitat connectivity
Social	▪ Aging Support Services	▪ EMS and First Responders ▪ Emergency Preparedness Plans

4.2.3.1 High Vulnerability Assets and Potential Adaptation Strategies

- **St Elizabeth Hospital, Emergency Medical Response and Preparedness Plans –** Services will be impacted by additional demand during extreme heat events. Adaptation may include coordination between emergency service providers, ensuring that emergency preparedness plans address extreme heat events, and developing public information and notification systems.
- **Emergency shelters – T**here may be greater demand for shelters with cooling capabilities during extreme heat events. Adaptation may include identifying buildings capable of being used as shelter extreme heat events and coordinating with various shelter owners (such as schools) for use during events.
- **Riparian habitat connectivity –** Wetlands and streams are susceptible to extreme heat events because they can dry up. To adapt, it will be important to better identify high-value riparian climate corridors within the relatively flat, degraded areas and protect areas more at risk of drying up during heat waves (Krosby et al. 2018).
- **Cold-water species** – Extreme heat events impact cold-water species by warming the water temperature in surface water bodies that they depend on beyond their ability to adapt, resulting in deadly events. Adaptation measures may include protection and restoration of shade trees in riparian corridors and adjacent to upstream surface water features such as ditches to help cool water temperatures (Sharma et al. 2021).

Figure 4-10. RCP4.5 scenario change in days >100 degrees F for King County for future 30-year periods compared to the 1980 to 2009 average

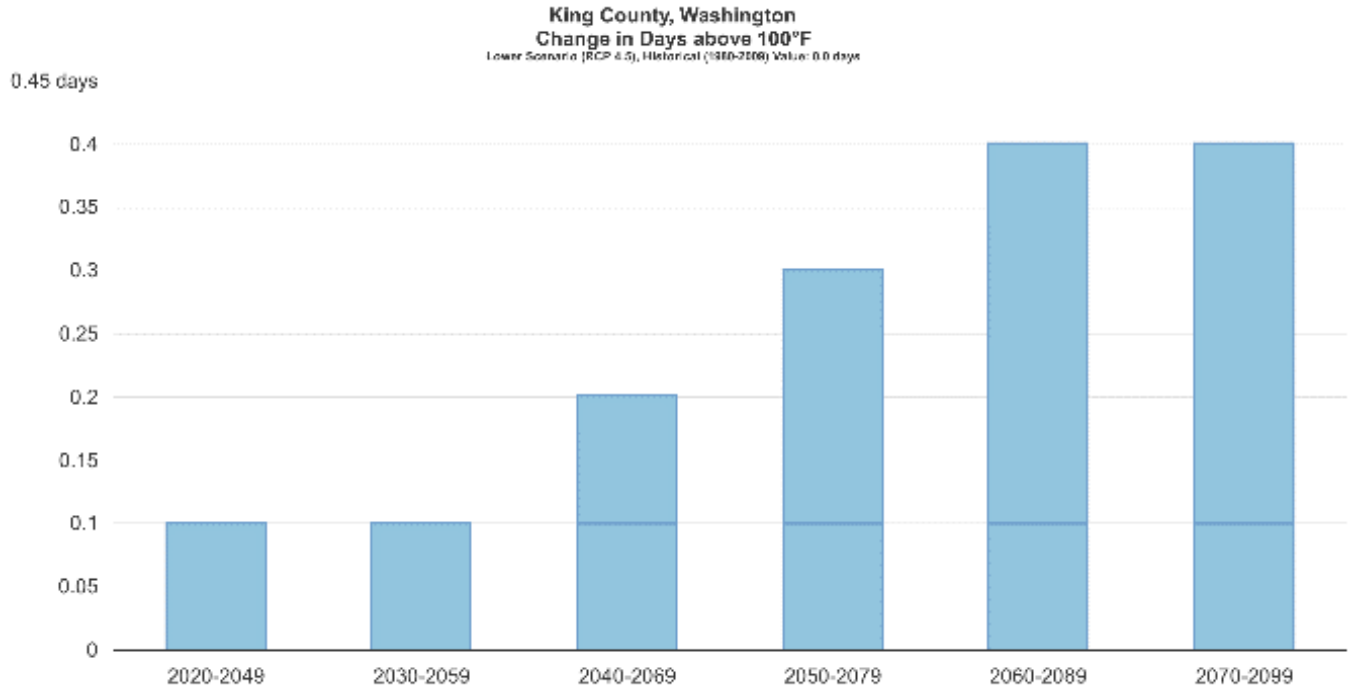
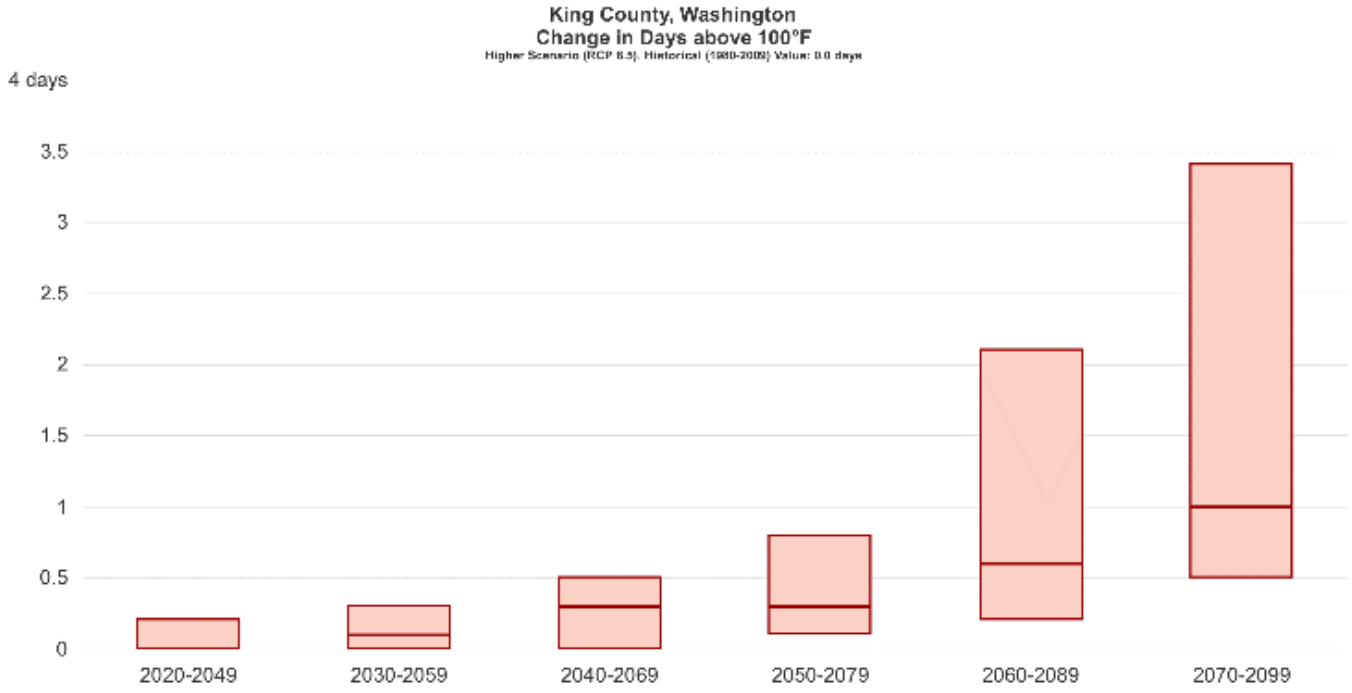


Figure 4-11. RCP8.5 scenario change in days >100 degrees F for King County for future 30-year periods compared to the 1980 to 2009 average



4.2.4 Wildfire

Wildfires include fires in grasses, shrubs, and forestlands. Communities can be directly exposed to wildfire from adjacent wildland vegetation, or indirectly exposed to wildfire from embers and home-to-home ignition, particularly at the WUI. The WUI is the area where houses and wildland vegetation coincide (**Figure 4-12**). The WUI map (Stewart et al. n.d.) does not indicate the risk of fire; it shows only where houses and wildland vegetation coincide. Some of the areas identified as WUI are prone to fire, and some are not.

In the Puget Sound lowland, including Enumclaw, there is low, but increasing, probability of direct exposure to wildfires. The wildfire probability and the number fire danger days are both predicted to increase with rising temperatures. While the potential exposure to direct impacts of wildfires is low, exposure to indirect impacts of wildfire such as embers is high (Wildfire Risk to Communities 2023). Wildfire is included as a priority hazard due to the proximity of the City to forested areas in the Cascade foothills, which have higher risk of wildfire than the Puget Sound lowlands.

Table 4-27. Assets with Moderate or High Vulnerability to Increased Wildlife Likelihood

Environment	Moderate Vulnerability	High Vulnerability
Built	▪ Structures at wildland interface	
Natural	▪ Protected Habitat and Species	▪ Springs and reservoirs (i.e., wildland interface)
Social	▪ Insurance rates ▪ Manufactured home park zoning ▪ Outdoor recreation and tourism economy	

An increasing likelihood of wildfire indicates a greater potential for wildfire to damage infrastructure, interrupt businesses, or affect public health and well-being. In 2020 and 2021, wildfires resulted in evacuation and structure damage in the Summer-Bonney Lake area approximately 15 miles southwest of Enumclaw (King 5 News 2021). The largest fire, the Sumner Grade Fire, occurred in 2020 as a result of an electrical transmitter that exploded during high winds (Mikkleson 2020). While these fires were not in Enumclaw, access to Enumclaw via SR 410 was impacted, and Enumclaw experiences the same wind and heat events that led to the Sumner Grade Fire.

Figure 4-13 and **Figure 4-14** show the likelihood of climate and fuel conditions favorable for wildfire in the county for future 30-year periods. The likelihood of wildfire is simulated using a fire process model.

Figure 4-12. Enumclaw proximity to the wildland urban interface as an indicator of wildfire risk

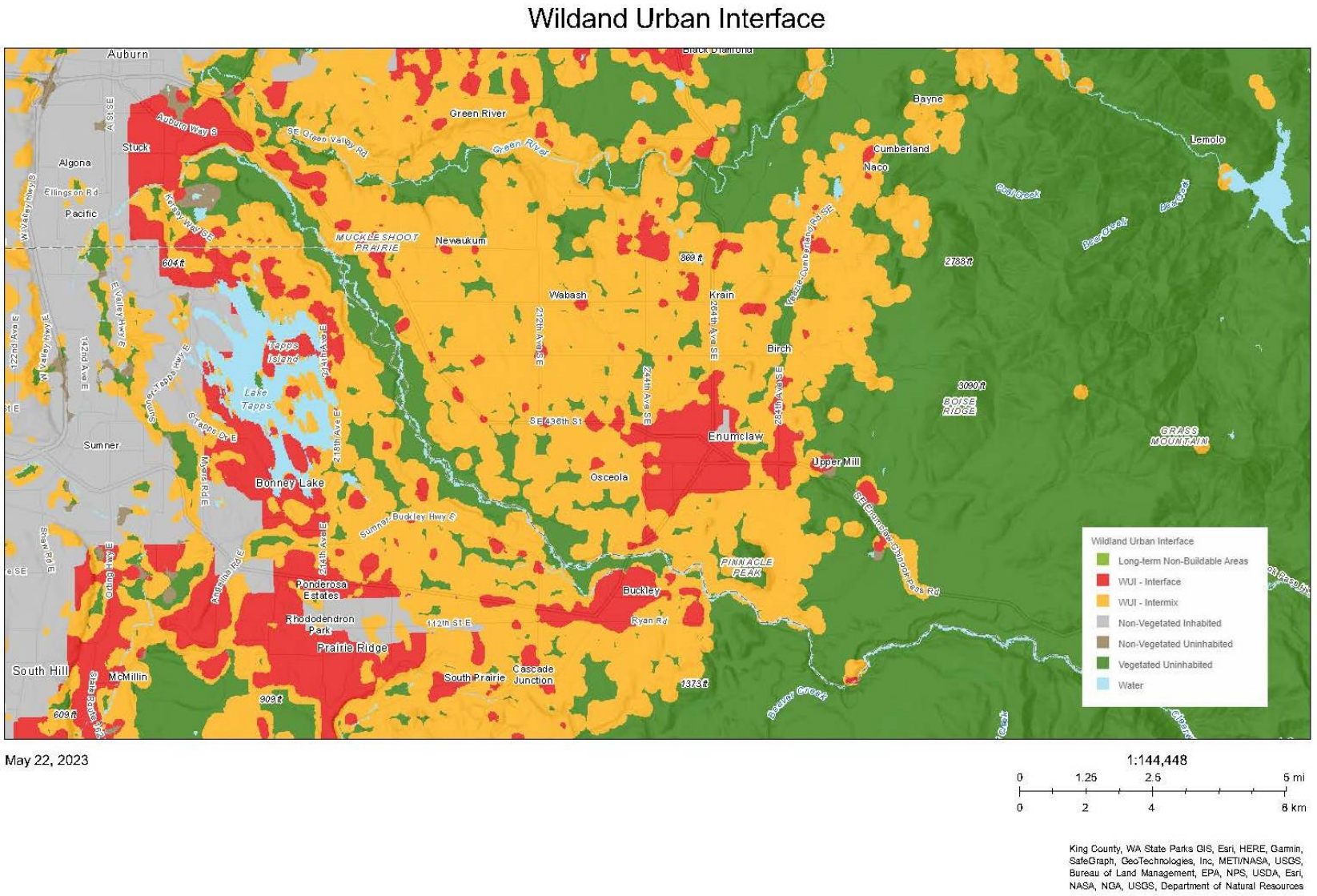


Figure 4-13. Likelihood of climate and fuel conditions favorable for wildfire in King County for future 30-year periods (RCP4.5) compared to the 1980 to 2009 average

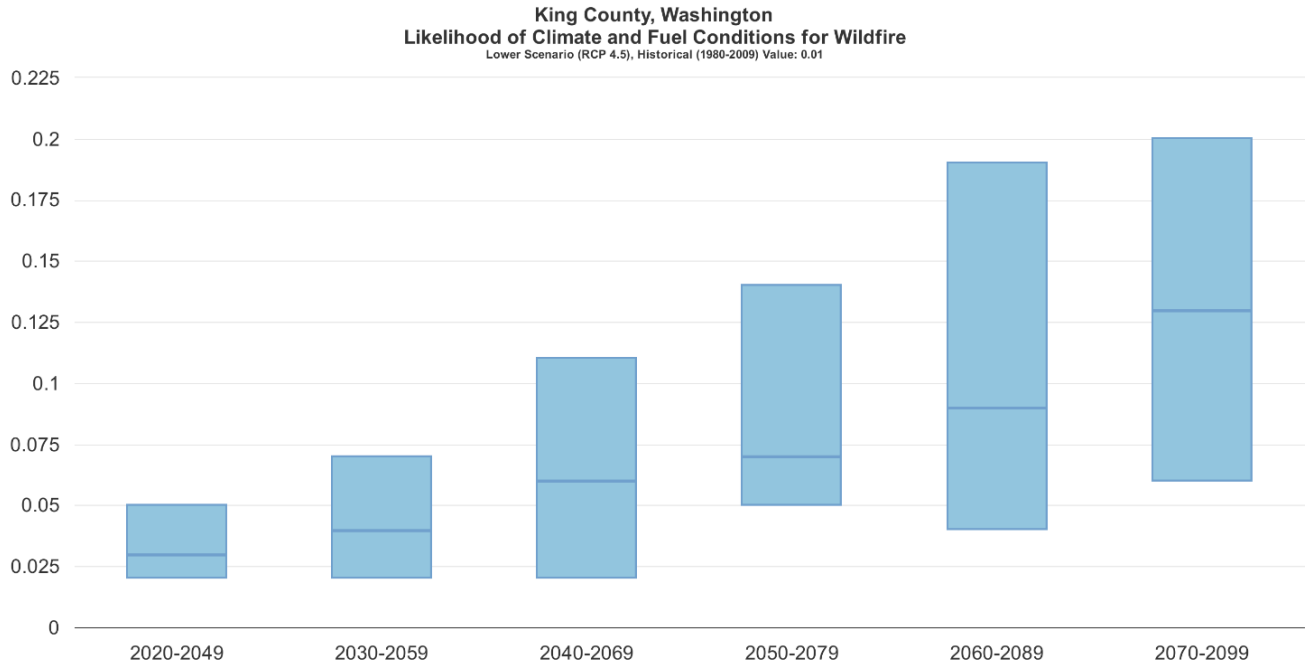
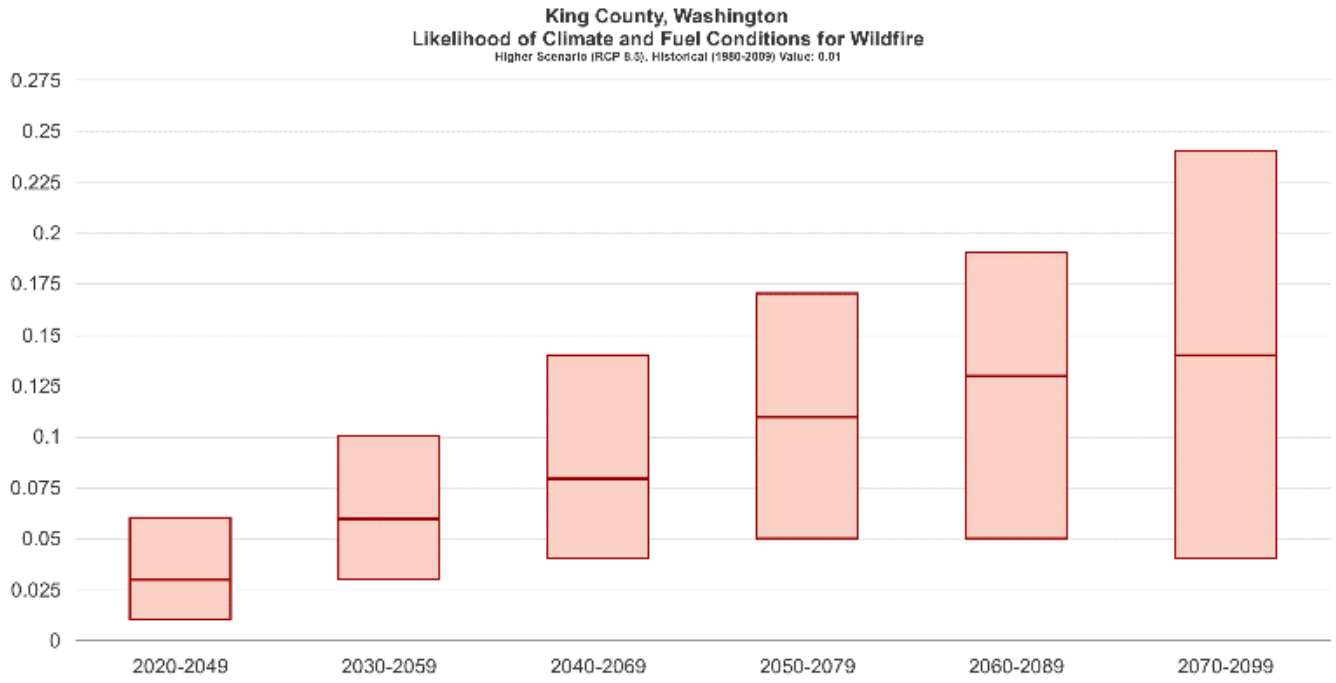


Figure 4-14. Likelihood of climate and fuel conditions favorable for wildfire in King County for future 30-year periods (RCP8.5) compared to the 1980 to 2009 average



4.2.4.1 High Vulnerability Assets and Potential Adaptation Strategies

- **Springs and Reservoirs** – Several components of the City's water system are located on the edge of the urban wildland interface in heavily forested areas and may be vulnerable to wildfire. Adaptation may include policies and measures encouraging the use of fire-resistive materials and vegetation management.

4.2.5 Wildfire Smoke

Wildfire smoke events are an indirect effect of wildfires that can occur hundreds or thousands of miles away from the source of the wildfire. Wildfire smoke is a mix of gases and fine particles that raise the level of particle pollution to unhealthy concentrations. The frequency of smoke events are expected to increase as regional wildfire risk grows and temperatures rise. However, the unpredictable behavior of wildfires and factors such as wind, weather, and terrain make smoke events difficult to predict.

Wildfire smoke events are comprised of days when air quality reaches levels considered unhealthy for sensitive groups (AQI >100). The U.S. AQI is EPA's index for reporting air quality (**Table 4-28**). For each pollutant, an AQI value of 100 corresponds to the National Ambient Air Quality Standards (NAAQS) threshold for protection of public health. When AQI values are above 100, air quality is unhealthy for everyone, but sensitive groups (such as lung or heart disease, diabetes, older adults, infants and children) may experience health effects. As AQI values increase, the general public is more likely to be affected. A recent study reported a 7.2% increase in risk of respiratory-related admissions during wildfire smoke event days with high wildfire-specific particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) greater than 37 micrograms per meter (Liu et al. 2017).

Table 4-28. Unhealthy Air Quality Index Days per Year

Days per Year	Moderate (51–100)	Unhealthy for Sensitive[a] (101–150)	Unhealthy (151–200)	Very Unhealthy (201–300)	Max AQI	TOTAL DAYS >35 µg/m³ $PM_{2.5}$
2017	82	10	7	1	202	18
2018	84	5	6	0	192	11
2019	85	0	0	0	90	0
2020	57	4	4	5	275	13
2021	49	3	2	0	177	5
2022	31	6	0	0	143	6

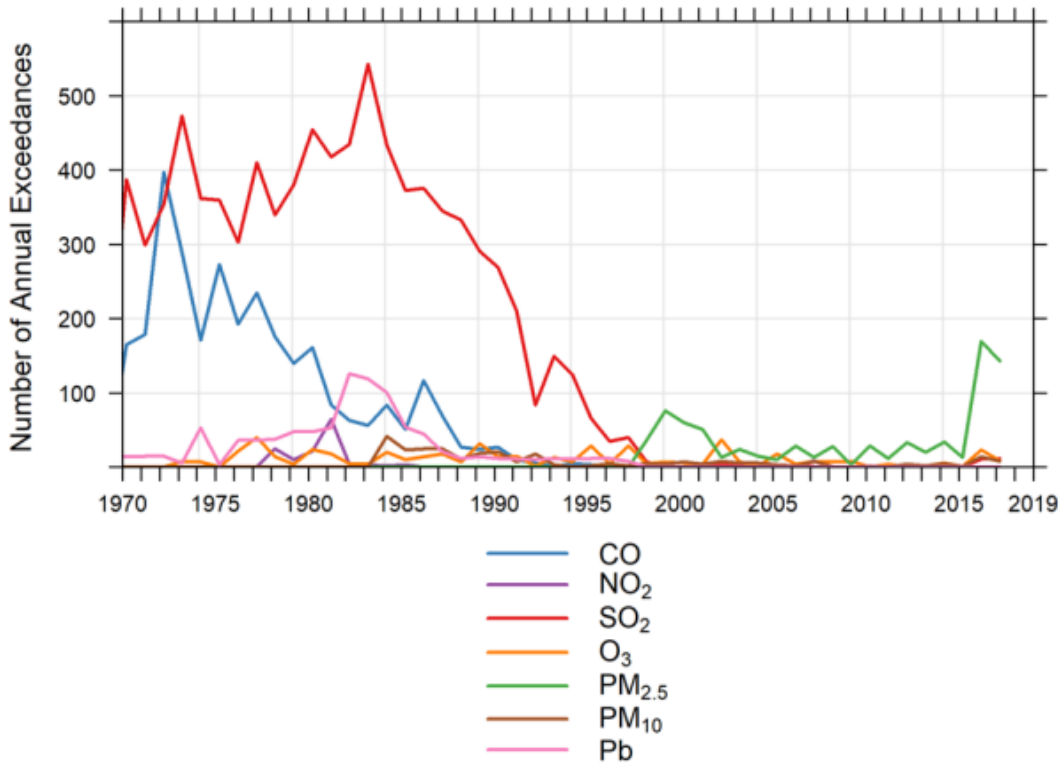
[a] AQI = 100 is equivalent to a $PM_{2.5}$ NAAQS exceedance (35 µg/m³)

µg/m³ = microgram(s) per cubic meter

The air quality pollutants shown in (**Figure 4-15**) shows trends in common pollutants. $PM_{2.5}$ increases are commonly associated with wildfire smoke events. The increase in $PM_{2.5}$ exceedances ($PM_{2.5}$ = 35 µg/m³), particularly notable in 2017 and 2018, are largely be attributed to extreme wildfire smoke conditions in the late summers of those years.

Figure 4-15. Air Quality Exceedances by Year 1970 to 2018 for Individual Pollutants

Source: *Ecology 2020*



Wildfire smoke is known to contribute to increased ozone levels in urbanized areas (SITNBoston 2022). Another existing source of concern for atmospheric pollution is the ozone concentrations, which are often worsened due to wildfires (Puget Sound Clean Air Agency 2020). Ozone is a harmful air pollutant made up of three oxygen atoms and is linked to respiratory illness. The Enumclaw Mud Mountain monitor has the highest regional ozone concentrations. Ozone exceedances are considered to be 75 parts per billion. An increased frequency of wildfire events could increase these existing urban air pollution impacts for Enumclaw.

Table 4-29. Assets with Moderate or High Vulnerability to Wildfire Smoke Events

Environment	Moderate Vulnerability	High Vulnerability
Built	▪ City Hall ▪ Public Housing ▪ Emergency Shelters	▪ Enumclaw Senior Center ▪ Schools ▪ St. Elizabeth Hospital
Natural	▪ Migratory birds	
Social	▪ Outdoor recreation and related tourism economy (for example, Enumclaw Golf Course) ▪ Emergency Preparedness Plans	▪ Emergency Management and First Responders ▪ Aging Support Services

4.2.5.1 High Vulnerability Assets and Potential Adaptation Strategies

- **Enumclaw Senior Center and Other Aging Support Services –** The building is highly vulnerable to wildfire smoke events because it serves a vulnerable population. Services for aging adults may become overwhelmed or inaccessible. Adaptation may include upgrading HVAC equipment or including policies and measures encouraging municipal buildings to be designed to mitigate wildfire smoke events.
- **Schools –** Schools are highly vulnerable because they serve vulnerable populations. Schools are not owned by the City. Adaptation may include evaluating the need for upgraded HVAC equipment or service closures during events.
- **St. Elizabeth Hospital and Other Emergency Management Facilities and Services –** Services will be impacted by additional demand during wildfire smoke events. Adaptation may include coordination between emergency service providers, ensuring that emergency preparedness plans address extreme smoke events and developing public information and notification systems.

5. Climate Resilience Planning in Enumclaw

5.1 Asset Vulnerability Implications for Comprehensive Planning

Most of the City's assets are located outside of high-hazard locations such as floodplains, landslide hazard areas, and shoreline areas that are less likely to be disproportionately impacted by extreme precipitation events and sea level rise.

Overall, many of Enumclaw's asset sectors appear to have adaptive capacity to anticipated climate impacts. Table 5-1 provides a summary of priority hazards, high vulnerability assets, and the relevant chapters of the Comprehensive Plan. Specific components and assets are summarized by asset sector and below. Use of the term "component" versus "system" indicates that only discrete portions of a system are vulnerable. Specific assets are identified in **Attachment A**.

Table 5-1. Crosswalk of Priority Hazards

Priority Hazard	Vulnerable Assets	Comprehensive Plan Chapters
Extreme precipitation	▪ Ecosystem integrity ▪ Parks and recreation ▪ Stormwater system ▪ Transportation infrastructure ▪ Wastewater system	▪ *Transportation* ▪ *Capital Facilities* ▪ *Natural Environment* ▪ *Parks and Recreation*
Flooding	▪ Residential zoning ▪ Transportation infrastructure ▪ Wastewater system components ▪ Water system components	▪ *Land Use* ▪ *Transportation* ▪ *Capital Facilities* ▪ *Natural Environment*
Extreme heat	▪ Ecosystems ▪ Emergency Response System ▪ Emergency shelters	▪ *Land use* ▪ *Natural Environment* ▪ *Human Services*
Wildfire	▪ Water system components	▪ *Capital Facilities*
Wildfire smoke	▪ Emergency Management System ▪ Enumclaw Senior Center ▪ Schools ▪ Aging support services	▪ *Human Services*

5.2 Recommended Resilience Policies and Measures

The menu of potential comprehensive plan polices and measures (**Table 5-2**) is a list of actions that could be taken to incorporate climate resilience into the City's Comprehensive Plan and address the vulnerabilities identified in this report. These measures are selected or adapted from those recommended in the Commerce guidance.

Table 5-2. Menu of Comprehensive Plan Policies and Measures

Priority Hazard	Comprehensive Plan Chapter	Potential Polices and Measures
All hazards	*Capital Facilities*	Consider future climate conditions during the siting and design of capital facilities, including changes to temperature and rainfall to help ensure they function as intended over their planned life cycle.
All hazards	*Land Use*	Encourage efforts to generate and store renewable electricity onsite, which can provide backup power during emergencies and help ensure continuity of operations.
All hazards	*Human Services*	Promote development of a community-wide emergency management plan that addresses climate hazards to support a sustainable economic recovery after a disaster.
All hazards	*Transportation*	Ensure that the transportation system—including infrastructure, routes, and travel modes—is able to withstand and recover quickly from the impacts of extreme weather events and other hazards exacerbated by climate change.
Extreme heat	*Land Use*	Promote exterior building features such as awnings and cool roofs that reduce the impacts of climate change and increase resilience.
Extreme heat	*Land Use*	Maximize tree coverage in surface parking lots.
Extreme heat	*Land Use*	Ensure that tree species selection and planting guidance are updated to be resilient to climate change.
Extreme heat	*Natural Environment*	Promote preservation and increase of tree canopy cover to increase summer cooling and improve air quality.
Extreme heat	*Natural Environment*	Promote the use of native drought and pest-resistant trees, shrubs, and grasses in landscape areas, parks, and riparian areas.
Extreme heat, wildfire	*Parks and Recreation*	Manage tree canopy in streets and parks to reduce risks from severe wildfires, protect residents, and improve ecosystem health and habitat.
Extreme heat, wildfire smoke	*Human Services*	Develop resilience hubs: community-serving facilities augmented to support residents and coordinate resource distribution and services before, during, and after a hazard event.
Extreme precipitation, Extreme heat	*Capital Facilities*	Evaluate the long-term adequacy of water delivery infrastructure to ensure that changes in hydrological patterns can be anticipated.

Priority Hazard	Comprehensive Plan Chapter	Potential Polices and Measures
Extreme precipitation, Flooding	*Capital Facilities*	Incorporate hydrologic effects of climate impacts into the design of water-crossing structures (i.e., culverts and bridges) to increase resiliency of transportation system and ecosystems.
Extreme precipitation, Flooding	*Capital Facilities*	Develop and implement a strategy to expedite debris management work (such as down tree limbs and buildings blocking roads and streams).
Extreme precipitation, Flooding	*Transportation*	Map transportation infrastructure that is vulnerable to repeated floods, landslides, and other natural hazards, and designate alternative travel routes for critical transportation corridors when roads must be closed.
Extreme precipitation, Flooding, Extreme heat	*Natural Environment*	Protect and restore riparian vegetation to reduce erosion, provide shade, and support other functions that improve the resilience of streams and wetlands to climate change.
Extreme precipitation, Flooding, Extreme heat,	*Natural Environment*	Prevent the spread and establishment of invasive plant species, and enhance the climate resilience of native plant communities.
Flooding	*Capital facilities*	Plan for buildings, facilities, utilities, and infrastructure to avoid or withstand flooding from changing floodplains.
Flooding	*Land Use*	Direct new development into areas outside of floodplains.
Flooding	*Natural Environment*	Restore floodplains and connectivity to improve the resilience of ecosystems and to reduce flood risk.
Wildfire	*Capital Facilities*	Evaluate municipal water system for adequate pressure during a major wildfire event (for example, multiple structures burning).
Wildfire	*Natural Environment*	Promote fire prevention practices such as use of fire-resistive building materials and controlling flammable brush and debris.
Wildfire smoke events	*Human Services*	Develop and implement notification alerts within the community to reduce risk of exposure to wildfire smoke and particulate matter.
Wildfire smoke events	*Human Services*	Prioritize at-risk community members for actions that mitigate wildfire smoke, including providing PPE (personal protective equipment) and filter fans or incentivizing infrastructure updates for facilities that serve high-risk populations.

5.3 Next Steps to Build Resilience to Climate Hazards

5.3.1 Develop Public Engagement Strategies

The purpose of this assessment is to provide a starting point for community discussion and education about climate vulnerability and resilience. Educating these participants will be an important part of gaining support for implementing resilience actions. The vulnerabilities identified in this assessment are an preliminary high-level evaluation that will change based the priorities of members of the community, agency, and service partners. Survey data from these participants can be used to refine this engagement strategy as well as the results of this vulnerability assessment.

5.3.2 Implement Comprehensive Plan Policies and Measures

To promote climate resilience, the recommended actions are for integration as a climate element during the current comprehensive plan update. This assessment identifies only a limited subset of possible actions that could be taken to increase community resilience to climate impacts based on the assets that are the most vulnerable. There is a wide range of possible actions the community can take to become more resilient to climate impacts.

5.3.3 Conduct Focused Hazard Assessments

This assessment is a high-level review of City assets and sectors and identifies systems and assets that may benefit from additional focused review. To understand and address the vulnerability, the City could conduct a focused evaluation on a single hazard or sector. For example, the City's stormwater system has been identified as vulnerable to future extreme precipitation events. A focused hazard assessment of the stormwater system would be useful to inform an update to the Stormwater Comprehensive Plan to address future climate conditions.

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