Attachment A

CITY OF BELLEVUE

Comprehensive Plan 2044

Climate Vulnerability Assessment

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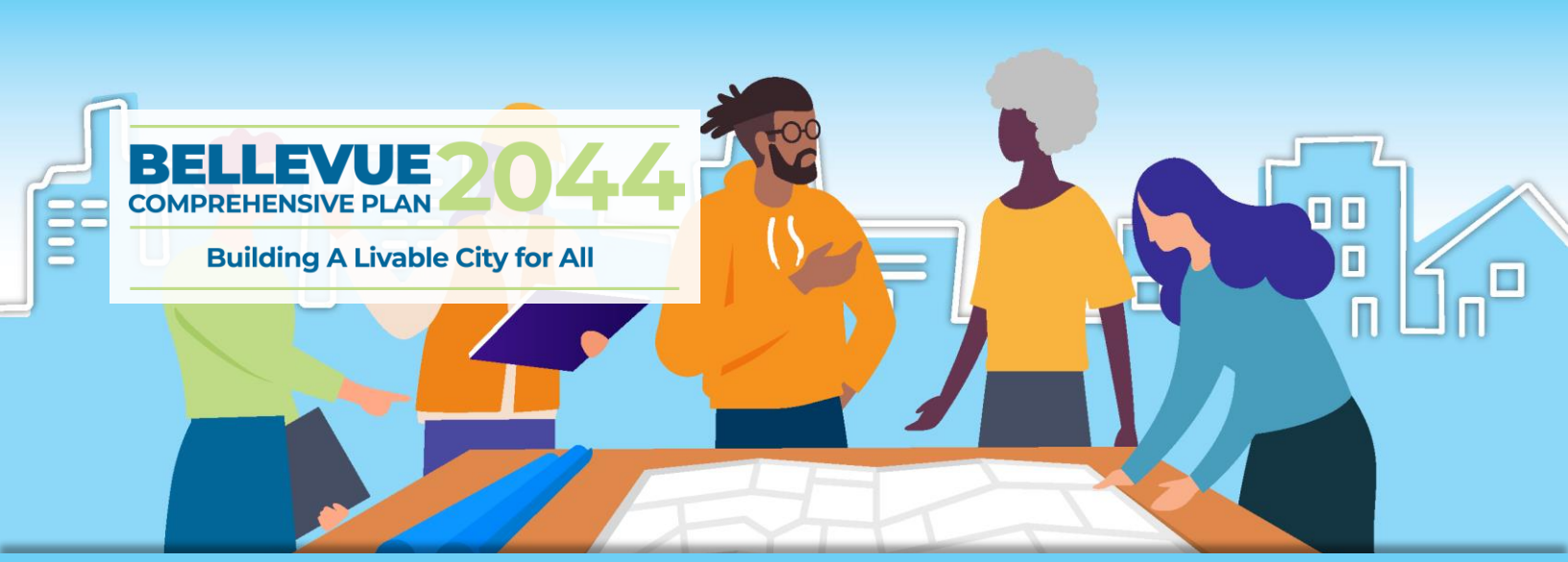


SECTION 1 Summary and Introduction

The City of Bellevue conducted a Climate Vulnerability Assessment to identify potential impacts associated with climate change, vulnerabilities, and adaptive capacities for Bellevue's people, built environment, and natural systems. Conducting this assessment was an action in the Sustainable Bellevue Environmental Stewardship Plan, and will help inform the Comprehensive Plan Periodic Update, other planning processes, and future capital projects. With this information, the City of Bellevue can consider adapting its policies and strategies to be more prepared and more resilient to climate impacts. Bellevue will likely experience the following changes over the next 50 years (University of Washington Climate Impacts Group [UW CIG] 2009; Roop et al. 2020), which will have impacts on human health and the built and natural environment:

- Increasing average annual air temperatures leading to:
  - More frequent and extreme heat events
  - More prolonged periods of drought, particularly during summers, in soil moisture and streambeds
  - Increasing stream temperatures
- Increasing extreme precipitation events, particularly during the winter, leading to:
  - Increased risk of runoff, erosion, and landslides or mudslides
  - Increased frequency and extent of flood events
- Increasing frequency, severity, and extent of regional wildfires leading to:
  - Increasing frequency and severity of poor air quality (local risk of wildfires is low, but wildfire smoke will be an issue as fires increase across the Pacific Northwest)

What is climate resilience?

The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption (US Climate Resilience Toolkit 2021).

The vulnerability of a community or particular resource (e.g. sector, neighborhood) to climate change is determined by evaluating its exposure, sensitivity, and adaptive capacity. **Exposure** refers to the degree of climate change impacts that occur, while **sensitivity** is the degree to which a community or resource is

affected by some amount of exposure. Exposure and sensitivity combined provide an understanding of the potential impacts posed by climate change to a resource. **Adaptive capacity** refers to the degree to which a community or resource is able to cope with those potential impacts. When combined, these three factors—exposure, sensitivity, and adaptive capacity—create an overall picture of vulnerability (Figure 1). To reduce vulnerability, communities like Bellevue can engage in resilience planning. A plethora of resilience strategies are available for the City of Bellevue to explore integrating into its Comprehensive Plan and other projects and planning efforts. Although many of these strategies are already being implemented—such as tree planting, which helps to reduce urban heat islands while also improving air quality, providing stormwater management, and enhancing overall livability—many such programs will need to be expanded to address the climate vulnerabilities described in this report.

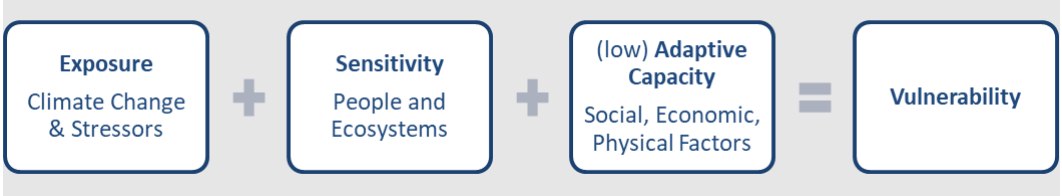


FIGURE 1 **Elements of Climate Vulnerability**

Climate impacts, vulnerabilities, and adaptive capacity are analyzed and organized by the following sectors:

- Buildings and Energy
- Cultural Resources
- Economic Development
- Ecosystems
- Emergency Management
- Human Health
- Land Use and Development
- Transportation
- Utilities (Solid Waste, Wastewater, and Stormwater)
- Water Resources

The purpose of this report is to summarize the vulnerabilities posed to people and resources in the city by climate change and identify potential resilience strategies for the City of Bellevue to consider in planning and projects. The report includes regional climate trend data and a climate vulnerability index, which is a spatial map incorporating data from 30 different indicators considering local information about exposure, sensitivity, and adaptive capacity in Bellevue. Environmental and land use planners, biologists, engineers, and other professionals on the project team considered climate science, social and economic conditions, land cover, infrastructure systems, programs and plans, and more to develop vulnerability summaries of community assets, hazards, risks, and opportunities for each sector described above.

Resilience strategies were derived from a review of the Washington State Department of Commerce's Model Climate Resilience Element and Menu of Measures,[1] the King County–Cities Climate Collaboration (K4C), and other municipal adaptation plans. The summary of resilience strategies begins with an audit of current policies, and identification of gaps or opportunities to strengthen or add policies. These questions guided the audit of existing policies:

- What goals and policies (measures) explicitly or implicitly build climate resilience?
- How can the measure be amended or supplemented by a new goal or policy to better address Bellevue's climate-related hazards and impact(s)?

1.1 People Vulnerable to Climate Change

Communities that tend to be more vulnerable to climate stressors are those that are already at greater social and economic risk, including older people, children, low-income families, immigrant communities, and Black, Indigenous, and people of color (BIPOC) individuals. For example, people who are elderly may have more limited mobility or preexisting health conditions, and children under five years old may have a harder time regulating temperature and may have underdeveloped immune systems. Low-income households may be more susceptible to illnesses and have limited resources to adapt or respond to climate change. Communities of color may have cumulative exposures to pollution and health and social disparities. Persons that speak English less than very well may have more difficulties during evacuation and difficulties accessing post-disaster funding.

Although Bellevue is considered a largely affluent community, 25% of households are low-income (households with incomes less than 80% of the Area Median Income). Other demographic risk factors include a high share of BIPOC residents, including those who are foreign born and speak English less than very well, older adults, and those living alone (Table 1). A lack of quality affordable housing is also a risk.

TABLE 1 **City of Bellevue Demographic Risk Factors Associated with Neighborhoods**

Bellevue Demographic Indicators	Citywide Statistics: 2021	Neighborhoods with Greater Share
Children, <5 years old	4.4%	BelRed, Crossroads, Eastgate, Newport, West Bellevue, West Lake Sammamish
Older Adults, > 65 years old	15.0%	Crossroads, Northeast Bellevue
Communities of Color (non-White, including Hispanic)	56.5%	BelRed, Bridle Trails, Cougar Mountain, Crossroads, Lake Hills, Somerset, West Bellevue
Low-Income Communities (80% below AMI, 2022 figure)	25%	BelRed, Crossroads, Lake Hills, Factoria, Newport
Living Alone	14.6%	BelRed, Downtown
Immigrants (including limited English)		

[1] Menu of Measures: https://app.smartsheet.com/b/publish?EQBCT=ac5e7c0a46e54f779f35588b1fa2a9c7

Bellevue Demographic Indicators	Citywide Statistics: 2021	Neighborhoods with Greater Share
Foreign Born	42.0%	
Speak English less than "very well"	16.5%	Linguistic Isolation: Downtown
Disabled	9.5%	Unmapped
Unemployment	3.8%	Crossroads, Newport, Northeast Bellevue, Northwest Bellevue, Woodridge
Outdoor workers	4.1%	Eastgate, Newport, Northeast Bellevue, West Lake Sammamish, Woodridge
Persons with pre-existing or chronic medical conditions, Fair or poor health	8.5%	Crossroads, Eastgate, Factoria, Lake Hills, Newport, Somerset, West Lake Sammamish
Education – less than high school degree	10%	Northwest Bellevue

SOURCE: 2021 ACS 5-Year Estimates (ACS 2020); Seattle-King County Health Department n.d.

Potential impacts to vulnerable populations include:

- An increase in heat-related deaths and illnesses, particularly among the elderly, poor, those living alone, and persons with certain existing disabilities or medical conditions. A study in King County showed an increase in basic life services (BLS) and advanced life services (ALS) with extreme heat events (DeVine et al. 2017).
- Rising temperatures, wildfires, and decreasing summer precipitation will lead to increases in ozone and particulate matter, elevating the risk of cardiovascular and respiratory illnesses and death (Yu 2021). This vulnerability may be more acute for those with existing cardiovascular or respiratory medical conditions, as well as for those who live within an Air Pollution Exposure Zone (APEZ; 500 feet of a major roadway such as I-405). Roughly 13% of Bellevue's land area is within an APEZ, of which about 18% is zoned for multifamily or mixed-use residential.

In discussing demographic risk factors, it is worth noting that while the planning horizon for the Comprehensive Plan update is 20 years and the climate change impacts are modeled to 2050 or 2080 (see 2.1 Regional Climate Trends), the demographic conditions that increase vulnerability are current. They do not necessarily represent the neighborhood distribution of vulnerable populations or characteristics in the future. It is unknown whether the same neighborhoods will have the same disproportionate distribution of persons with vulnerable demographic characteristics 20, 30, or 40 years from now. This is also not to imply that demographic characteristics such as limited English proficiency, low income, or less education are immutable or hereditary.

1.2 Places Vulnerable to Climate Change

The Bellevue Climate Vulnerability Index (CVI) was developed as part of the vulnerability assessment and is explained in detail in Section 2. The CVI includes 30+ indicators and combines them to form an index that

supports a planning-level view of climate vulnerability in Bellevue to help identify areas of the city that may be more or less vulnerable to the impacts of climate change. The indicators include metrics for climate stressors, demographics, community health, critical areas, and others relevant to the spatial variability of climate vulnerability. The CVI combines the results of the three subindices for exposure, sensitivity, and adaptive capacity. Figures 2 and 3 show the index results, geographically illustrating climate vulnerabilities with and without population density.

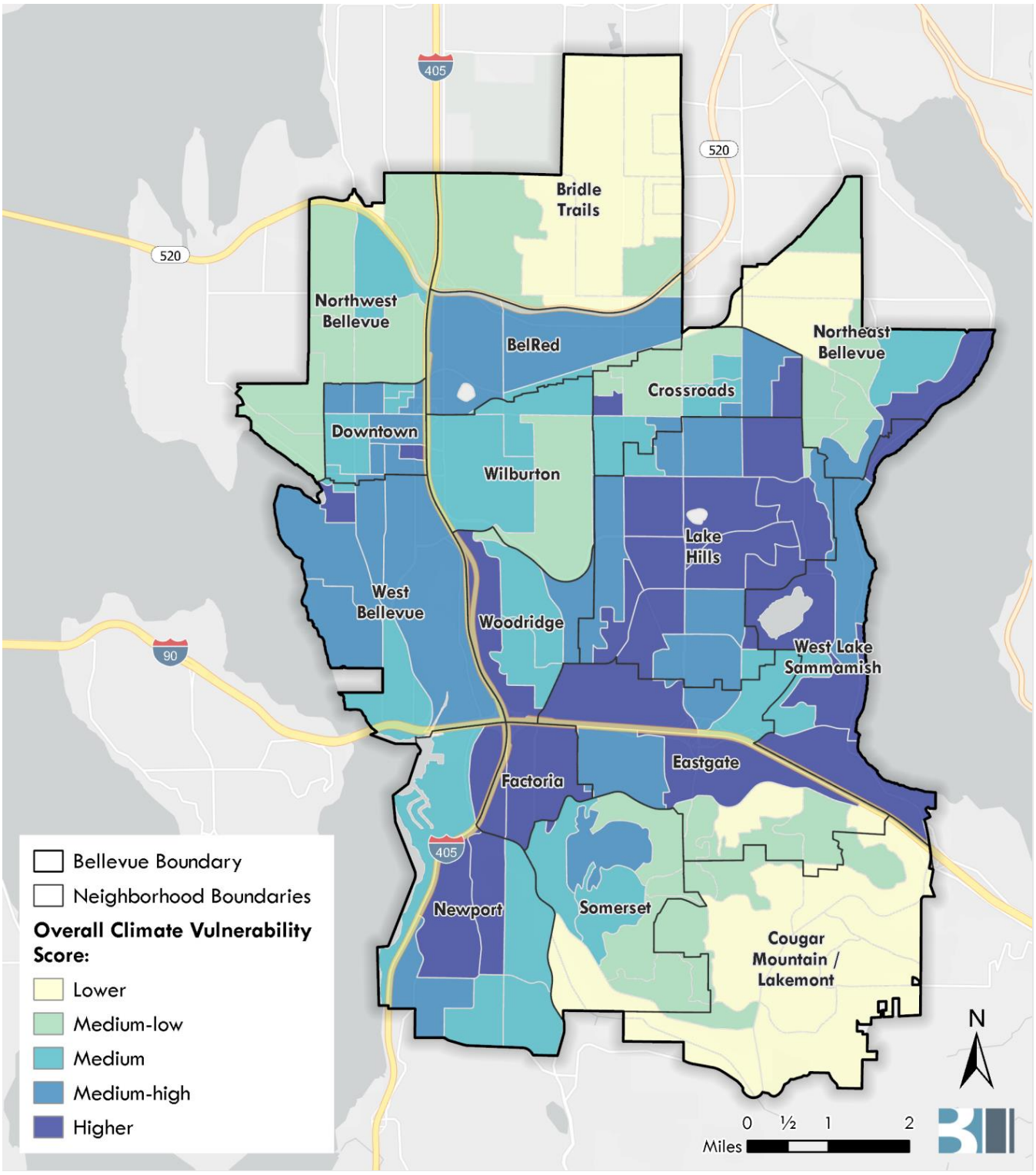
Figure 2 shows climate vulnerability on a single axis: higher or lower (more or less vulnerable). Figure 3 shows two axes: both vulnerability and population. It is useful to look at climate vulnerability both with and without population density because it illuminates areas where higher or lower concentrations of people either increase vulnerability or, in some cases, increase adaptive capacity. It can therefore also illuminate where anticipated changes to population could place more people in vulnerable areas, which can in turn help guide the City in enhancing the adaptive capacity and climate resilience of those areas through mitigation from development impacts.

For example, BelRed has a medium-high index score on Figure 2 without population density accounted for. With population accounted for in Figure 3, BelRed is noted as an area with higher vulnerability and lower population density. As BelRed grows, the City of Bellevue can consider the factors that identify this area as higher vulnerability (e.g. extreme heat exposure, urban heat island, and lower tree canopy) and employ strategies to reduce vulnerability (e.g. green infrastructure, passive cooling, tree planting etc.). Another example is Downtown, which Figure 2 (without population density) shows as medium to medium-high vulnerability due to extreme heat exposure and air quality exposure, and a higher share of older adults and foreign-born persons who may be more vulnerable. However, Figure 3 (combined with population density) indicates a higher level of vulnerability due to the number of people potentially impacted.

Urban Heat Island Effect

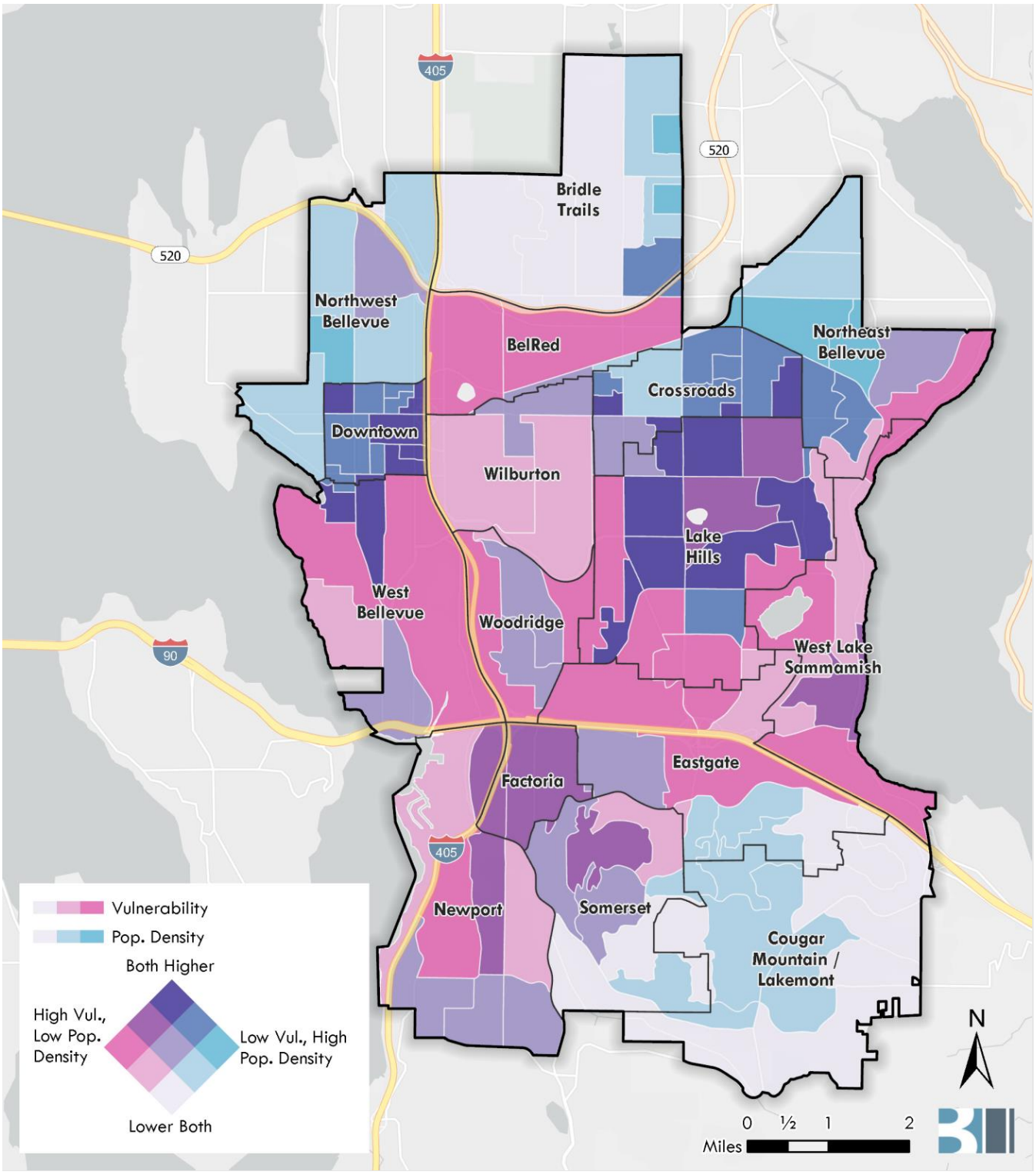
Certain elements of urban development, especially pavement and dark-colored building materials, absorb and re-emit the sun's heat more than natural landscapes or light-colored materials. Urban areas where these elements are highly concentrated and greenery is limited can become "islands" of higher temperatures, compared to outlying areas. This is referred to as the "urban heat island effect."

A review of research studies and data found that in the US, the heat island effect results in daytime temperatures in urban areas about 1–7°F higher than temperatures in outlying areas, and nighttime temperatures about 2–5°F higher. Humid regions (primarily in the eastern United States) and cities with larger and denser populations experience the greatest temperature differences. Research predicts that the heat island effect will strengthen in the future as the structure, spatial extent, and population density of urban areas change and grow (US EPA).



SOURCE: BERK 2023

FIGURE 2 **Climate Vulnerability Index without Population Density**



SOURCE: BERK 2023

FIGURE 3 **Climate Vulnerability Index with Current Population Density**

1.3 Overall Climate Vulnerability Summary

VULNERABILITY SUMMARY

For each sector, the project team evaluated: assets (e.g. people, places, infrastructure, and resources); climate-related hazards; risks and vulnerabilities; and gaps and opportunities for increasing adaptive capacity. At a high level, the potential impacts and risks to sectors of importance in the city include:

- Increased public health risks due to heat and wildfire smoke
- Degradation and loss of habitat and trees (e.g. erosion, water quality, canopy loss)
- Increased flooding and stormwater runoff
- Damage to infrastructure due to flooding or extreme precipitation
- Increased cooling demand in summer and potential for more frequent power loss
- Loss of or damage to cultural/historic sites and culturally significant foods
- Disruption to business continuity
- Shifts in business and recreation opportunities
- Increased demand for emergency services
- Preparing infrastructure for climate impacts
- Recovering from climate impacts and natural disasters, including infrastructure damage
- Damage to housing and risk of displacement

For many of these impacts, the City of Bellevue has existing policies or programs to expand resilience, such as energy conservation and tree canopy plans and protections, which have co-benefits for climate mitigation and adaptation. High-level qualitative climate vulnerability scores for each sector included in this assessment (Table 2) were developed using the following rubrics:

- **Potential Impacts** (assumes assets are exposed to climate change)
  - High: Likely to experience major damage or disruption
  - Moderate: Likely to experience minor damage or disruption
  - Low: Unlikely to experience significant damage or disruption
- **Adaptive Capacity** (based on ability to cope or recover from impacts)
  - High: Able to rebound quickly
  - Moderate: Able to rebound somewhat quickly
  - Low: Unable to rebound quickly

		Potential Impact		
		Low	Moderate	High
Adaptive Capacity	Low	Low	High	Highest
	Moderate	Low	Moderate	High
	High	Lowest	Moderate	Moderate

A more detailed description of sector-specific impacts, vulnerabilities, and adaptive capacities is provided at the end of each sector in Section 3. Those descriptions are based on rigorous analysis but are expressed using the same basic rubric of High/Moderate/Low for each climate impact category (extreme heat, extreme precipitation events, stream temperature, drought, and wildfire/smoke). Table 2 is an aggregate representation of the high-level qualitative scores from each sector, which is why Moderate-High impacts + Moderate capacity may be shown as Moderate-High vulnerability for some sectors but Moderate or High for others. These discrepancies reveal nuances found within those more detailed end-of-sector tables.

TABLE 2 **Vulnerability Summary by Sector**

Sector	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)
Buildings & Energy	Moderate-High	Moderate	Moderate-High
Cultural Resources & Practices	Moderate-High	Moderate	Moderate-High
Economic Development	Moderate-High	Low-Moderate	Moderate-High
Ecosystems	Moderate-High	Low-Moderate	Moderate-High
Emergency Management	Moderate-High	Moderate	Moderate
Human Health	Moderate-High	Moderate	High
Land Use & Development	High	Moderate	Moderate-High
Transportation	Moderate	Low-Moderate	Moderate
Utilities (Solid Waste, Wastewater, Stormwater)	Moderate	Low-Moderate	Moderate-High
Water Resources	Moderate	Moderate-High	Moderate

SOURCE: ESA & BERK 2023

SUMMARY OF RESILIENCE STRATEGIES

Cities play an important role in reducing greenhouse gas emissions and combatting climate change (Nunn et al. 2019). While the focus of this report is on identifying climate-related vulnerabilities posed to sectors of concern in Bellevue, the consultant team also identified some potential resilience measures that can be considered in departmental programs and projects. Section 4 lists suggested resilience strategies organized by associated sectors (i.e. those with similar vulnerabilities and needed responses). The consultant team also recommended several new Comprehensive Plan policies, or amendments to existing policies, that are responsive to climate change. The list of initial Comprehensive Plan policy recommendations is provided in Appendix 1. Many of these strategies and policies are listed as high-performing measures in the Washington State Department of Commerce Model Climate Element Menu of Measures (April 2023).

Figure 4 illustrates categories of high-performing strategies.

Buildings Energy Economic Development Land Use Development

Strategies related to these sectors include: energy efficiency, electrification, and renewable power generation for City-owned facilities as well as residential and commercial buildings; strategies to reduce or mitigate the urban heat island effect; and support for local businesses and the green economy.

Cultural Resources Practices Ecosystems

Strategies related to these sectors include: protect important historic and cultural sites; provide the public with resources on how to anticipate climate-related impacts and build their resilience; enhance the urban tree canopy, especially in areas prone to extreme heat and other impacts, and manage local forest health and resilience; protect and enhance the resilience of critical habitats and ecosystems, such as by minimizing stormwater runoff into waterbodies.

Water Resources Utilities , Solid Waste Wastewater and Stormwater

Strategies related to these sectors include: increase the capacity of the stormwater system, where possible by expanding natural stormwater management; utilize existing public communications systems for providing up-to-date information to inform and educate communities about climate issues impacting both flooding and water supply; and account for projected climate impacts and ensure redundancy in critical water systems.

Emergency Management Human Health

Strategies related to these sectors include: ensure that emergency response plans incorporate projected climate impacts – especially extreme weather events; build redundancy into emergency management alert and other response systems; support the creation of Resilience Hubs to foster community connection and provide support during extreme weather events; and identify and implement ways to support community health during chronic climate-related events such as wildfire smoke.

Transportation

Strategies related to this sector include: targeted infrastructure modifications to anticipate risks of flooding or erosion; paving strategies to reduce heat absorption and extend useful life; collaborate with other departments (such as Emergency Services) and external agencies to ensure access to places of respite from extreme weather events; and improve non-automobile access to basic goods and services.

What is a Resilience Hub?

Resilience Hubs are community-serving facilities augmented to support residents, coordinate communication, distribute resources, and reduce carbon pollution while enhancing quality of life. Hubs provide an opportunity to effectively work at the nexus of community resilience, emergency management, climate change mitigation, and social equity while providing opportunities for communities to become more self-determining, socially connected, and successful before, during, and after disruptions (resilience-hub.org).

SOURCES: Commerce Menu of Measures, K4C Climate Toolkit 2021, Urban Land Institute (ULI) Resilient Retrofits 2022

FIGURE 4 **High Performing Adaptation Measures**

1.4 Next Steps

Section 4.2 of this report provides a detailed list of proposed next steps. In general terms, Bellevue can address the findings of the Climate Vulnerability Assessment in its Comprehensive Plan growth strategy and policies. As part of the public engagement process associated with the Comprehensive Plan Periodic Update, and ongoing engagement with overburdened communities, the broader community, and organizational stakeholders, it can help prioritize efforts both citywide and by neighborhood.

SECTION 2 Climate Change in Bellevue

2.1 Regional Climate Trends

Climate is the average weather for a region expected at different times of the year. Climate is usually reported over a span of 30 years. Climate change means a difference in the historical average conditions in a region such as temperature and rainfall.[2] As noted in Section 1, Bellevue and King County will likely experience a wide range of climate-driven changes:

- Rising air temperatures, extreme heat events, drought, and low soil moisture
- Low streamflow and increasing water temperatures
- Wildfire smoke from fires in the Pacific Northwest
- Increased storm intensity and extreme precipitation events

For this assessment, climate projections were evaluated for the 2050s (2040–2069) or the 2080s (2070–2099), as compared to the historical period of 1981–2010. The 2050s projections align well with the City's 2044 Comprehensive Plan update. The 2080s projections are recommended for longer-range climate planning and are useful in anticipating longer-term trends of climate impacts.

The climate projections are all based on Representative Concentration Pathway (RCP) 8.5, a global emissions scenario developed for the Intergovernmental Panel on Climate Change (IPCC), in which global emissions continue unabated throughout this century. The use of RCP 8.5 is generally considered best practice for climate vulnerability assessments.

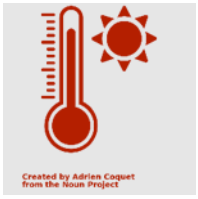
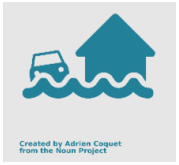
2021 Heat Dome, Seattle Region

"...health officials urged people to reschedule outdoor activities and to stay hydrated. Over the next two days, officials said 223 people visited emergency rooms with heat-related illnesses and at least 13 people in King County had died from heat exposure. Restaurants and some grocery stores closed early or altogether on June 28, and hotels saw a flood of people wanting air-conditioned rooms. At 4:14 p.m., the Bellevue Fire Department announced a burn ban, including all recreational fires. Amazon sent workers home from a Kent warehouse, while some office workers at Amazon's Doppler building in downtown Seattle said it felt like the most crowded day since before the pandemic, as workers flocked to air-conditioned offices." (McNerthney 2021)

Information about climate change considers hazards based on climate and hydrologic models. The direction of climate trends in the county plus local information about conditions in Bellevue can be useful for general planning and assessment, such as climate vulnerability assessments, climate resilience plans, climate action plans, or climate resilience elements in comprehensive plans. Table 3 shares climate change trends expected in 2050 for King County and communities within, including Bellevue. It is generally based on county-level information provided in the Climate Mapping for a Resilient Washington tool (UW CIG 2022). Local stream information is included as well for Kelsey Creek.

[2] NASA Climate Kids: https://climatekids.nasa.gov/climate-change-meaning/#.

TABLE 3 **King County Median Changes by 2050**

	Description of Likely Changes	Indicators
 **Extreme Heat**	An increase in average summer temperatures is expected. This can affect people, landscaping, agriculture, and natural areas like wetlands, wildlife habitats, and other ecosystems. More days above 90°F humidex (humidity and heat) are expected, which can affect public health. An increase in the number of cooling degree days is an indicator of greater potential for more cooling demand for buildings in the summer. Hotter days can increase ground-level ozone, a greenhouse gas (GHG).	+ 6.3°F change in average summer (June - August) maximum temperature + 20.1 days above 90°F humidex + 287°F-days change in cooling degree days (base 65°F)
 **Wildfire & Smoke**	There are likely to be more fire-danger days that could affect homes and businesses at the wildland-urban interface (WUI). More wildfire smoke can result in particulates that worsen certain health conditions (e.g. heart and lung disease, pregnancy, etc.).	+ 10 days change in high fire danger days
 **Extreme Precipitation & Drought**	More frequent and intense storms are expected. This can increase flooding, erosion, and runoff and impact stormwater systems, transportation, and emergency responses. Summer precipitation below 75% of normal is an indicator of drought. The legal definition of drought in Washington State includes less than 75% of normal water supply.	+ 13% change in the magnitude of 25-Year Storm + 9% change in the magnitude of 2-Year Storm 25% chance that a year in the 2040-2069 period will have summer precipitation at or below 75% of normal.
 **Flooding**	The county is expected to experience increases in peak streamflow, which would lead to more areas experiencing flooding. This could impact more homes, businesses, farms, and infrastructure.	82% of stream lengths in King County are expected to see 10-50% more streamflow on the day of the year with the highest streamflow. Values mapped in Bellevue: Kelsey Creek +12%
 **Changes in Streamflow, Stream Temperature, and Reduced Snowpack**	In winter, there may be less stored water in snow, and less water available for streams, soil, and reservoirs. This would affect aquatic species, trees, vegetation, and water supply. Changes in average August stream temperature: Stream temperatures generally warm as air temperatures rise. Warming stream temperatures are an indicator of salmonid health; salmon experience physiological stress at ~17°C and mortality at 20°C and higher.	-76% change in April 1 snowpack Most stream lengths would see -10 to -100% change from historic low streamflow in summer (June-September). Values mapped in Bellevue: -6% In King County, only 6% of stream lengths have a historical baseline of >16°C in August. By the mid-century, over 18% of streams in the county are projected to warm above 16°C.

SOURCES: CIG 2022; U.S. Environmental Protection Agency (EPA) 2022

2.2 Bellevue Climate Vulnerability Index

PURPOSE & APPROACH

The Bellevue Climate Vulnerability Index (CVI) was developed as part of the Bellevue Climate Vulnerability Assessment. The CVI is a more fine-grained and quantitative approach to identifying vulnerabilities and capacities. While the overall vulnerability of an area or sector is *expressed* in this report as being High, Moderate or Low (or gradations in-between), the CVI is the analytic framework on which those assessments of vulnerability are based.

Climate vulnerability in the context of the CVI is defined as (1) exposure to a changing climate based on regional trends for extreme heat and precipitation, and (2) an overall vulnerability index made up of three subindices:

- A sub-index reflecting local environmental conditions including flooding, air quality, and heat data
- A sub-index reflecting the inherent sensitivity of people (e.g. health or age) or environments (e.g. geologic hazards, water quality) to a changing climate
- A sub-index regarding the capacity of the community and place to cope or adapt to the impacts of a changing climate

The conceptual formula is:

Climate Vulnerability =
Regional Climate Change Exposures + CVI (Local Environmental Exposures Sub-index + Sensitivity Sub-index + Adaptive Capacity Sub-index)

The CVI combines 30+ indicators (Table 4) to form an index that supports a planning-level view of climate vulnerability in Bellevue, to help identify areas of the city that may be more or less vulnerable to the impacts of climate change. The indicators include metrics for climate stressors, demographics, community health, critical areas, and others relevant to the spatial variability of climate vulnerability.[3]

For example, some areas are more vulnerable due to extreme heat, such as urban heat islands with more pavement and fewer trees, or areas with a higher concentration of older residents. Some areas, such as floodplains and landslide hazard areas, are vulnerable to extreme precipitation events, as are individuals who live alone or have less access to a vehicle. The CVI provides information useful for Bellevue to develop strategies to enhance the city's resilience over the medium and long term. The strategies can be included in plans, budgets, partnerships, and more.

The remainder of this section (2.2) explains the individual elements of that conceptual formula in greater detail, beginning with regional climate change exposures.

[3] The CVI sums over 30 indicators of climate vulnerability at the parcel level and displayed at larger and/or generalized geographies (e.g., census block groups, heat maps, etc.), which help to identify where Bellevue is more or less vulnerable to climate change. The indicators are drawn from literature and studies regarding social vulnerability, health, environment, and climate change.

REGIONAL CLIMATE CHANGE EXPOSURES

There are a number of regional climate change impacts that people, ecosystems, and infrastructure can be exposed to. This report focuses on two of the most significant: extreme heat and extreme precipitation events. (Exposures to other regional climate impacts such as wildfire smoke are addressed in the Climate Vulnerability Assessment qualitatively.) As described in the conceptual formula above, the regional exposure indicators (extreme heat and extreme precipitation events) are distinct from the Climate Vulnerability Index (CVI), but are considered in relation to local environmental exposures, sensitivity conditions, and adaptive capacity conditions (i.e. the three CVI sub-indices).[4] So while regional exposures are not part of the CVI, they are part of the overall assessment of climate vulnerability in Bellevue.

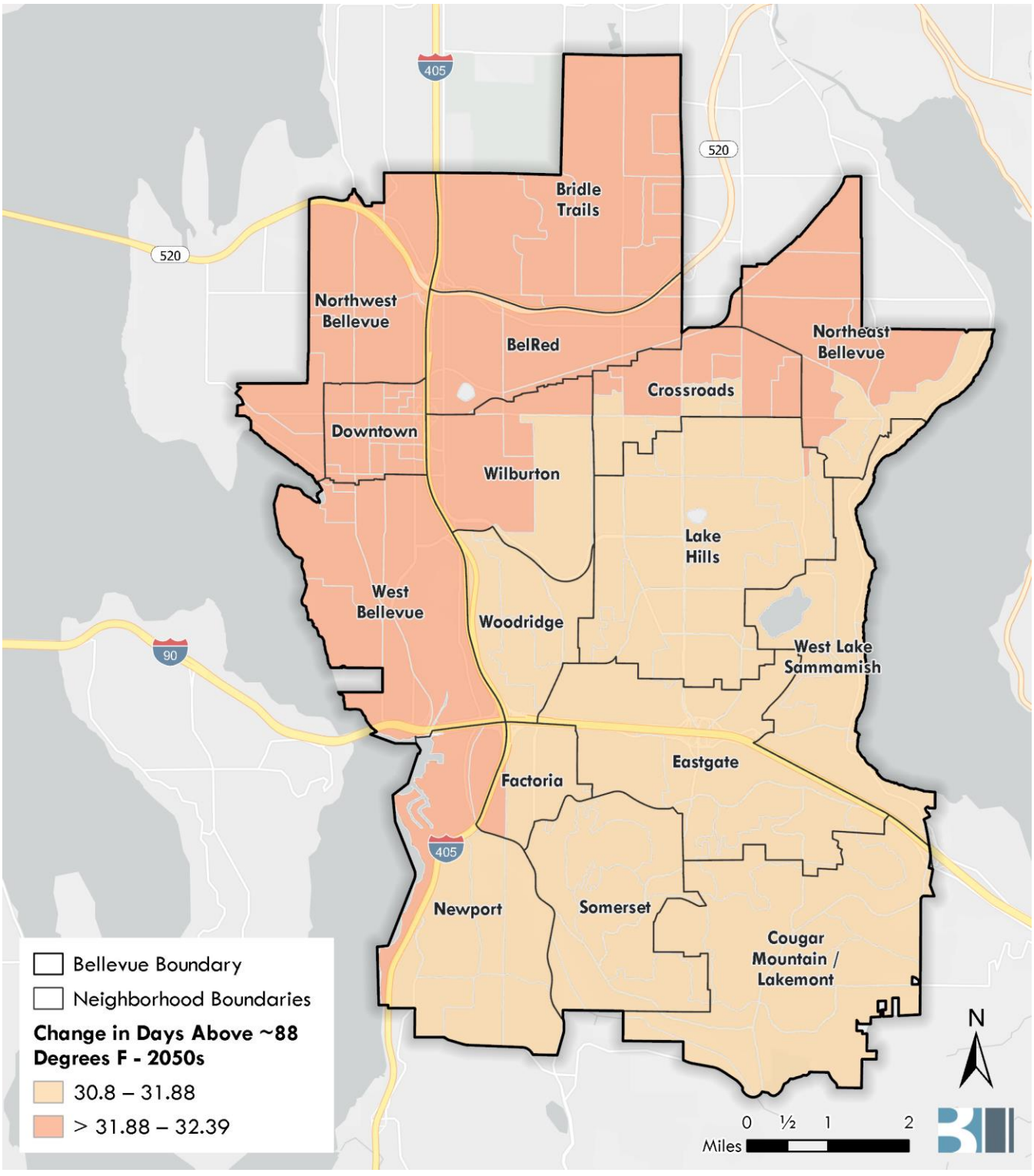
The regional extreme heat and precipitation exposure data are shown in Figure 5 and Figure 6, respectively.

Extreme Heat

Extreme high temperatures are anticipated to increase over historic conditions. In Bellevue by 2050 the change in the number of days above 88 degrees Fahrenheit (°F) humidex (heat and humidity) is projected to increase by 30.8 to 32.4 days . The modeled historical average for King County as a whole is 5 days. Although the projected increase in number of extreme heat days is significant to Bellevue as a whole, the data do not indicate strong geographic variability—less than 1-2°F across the city. The specific geographic distribution shown in Figure 5 is likely a result of downscaling regional model data to Bellevue; mapping urban heat islands (which are included in the CVI) is a more accurate means of identifying highly local areas where vulnerability to extreme heat is expected to be higher. Figure 5 clearly shows how much extreme heat days are projected to increase throughout Bellevue.

The change in the number of 88°F humidex days is an indicator of stress on public health. Local exposure data regarding heat islands can provide local geographic information where extreme heat would be more or less felt. Combined with impervious area, lack of tree canopy, and populations with age or health conditions, some areas of Bellevue could be more vulnerable.

[4] Regional exposure is not included in the CVI because the indicators that make up the CVI are local and specific to Bellevue, while regional exposure to extreme heat and precipitation does not appear significantly different across a city the geographic size of Bellevue.



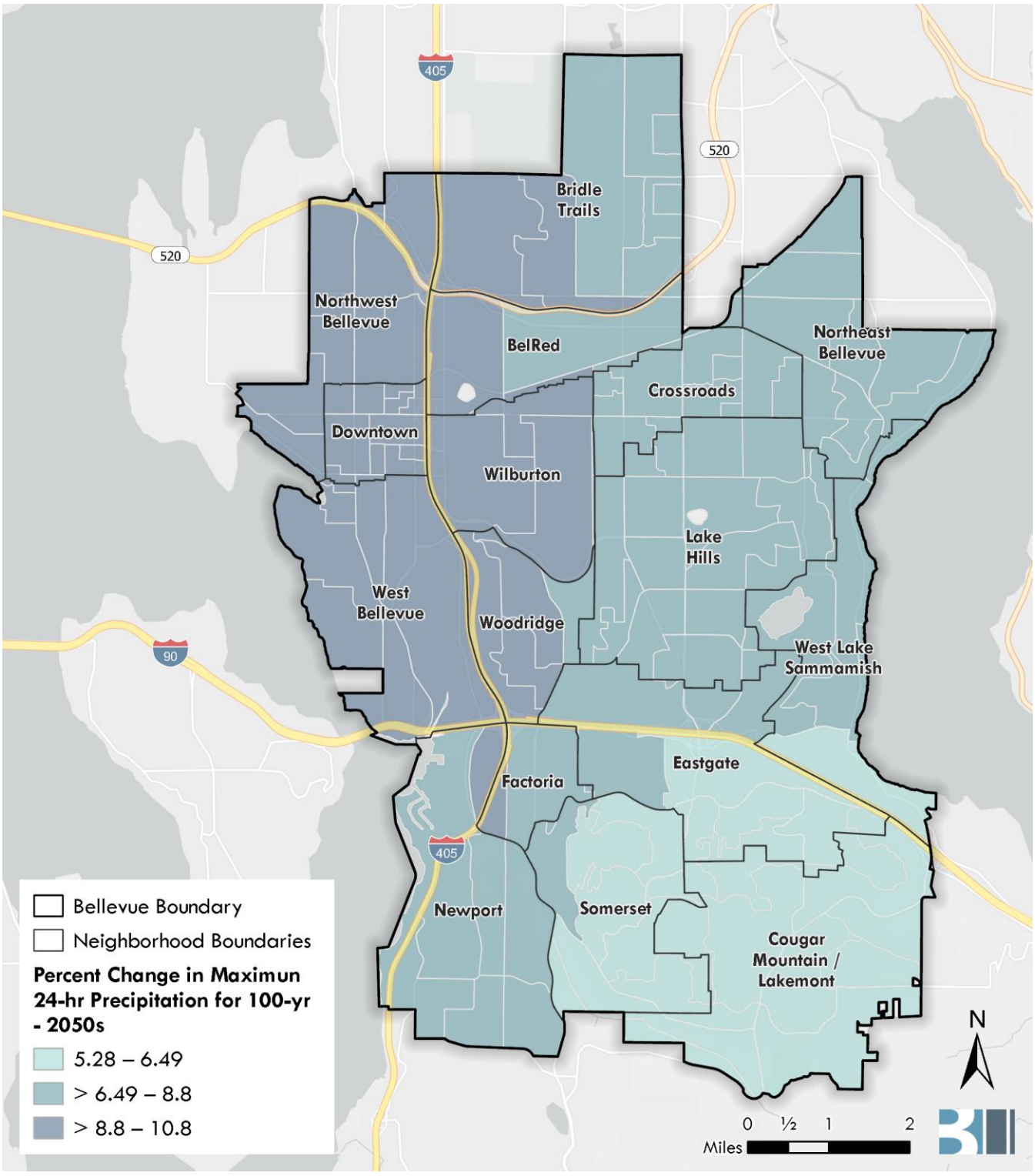
SOURCE: BERK 2023; DeVine et al. 2017

FIGURE 5 **Extreme Heat Change in Days above 88 Degrees F Humidex – 2050s**

Extreme Precipitation Events

The intensity of rainstorms is anticipated to increase at greater likelihood intervals (2-year or 25-year) and at lesser likelihood storms (100-year), stressing stormwater systems and increasing flood risk. Figure 6 illustrates the projected percentage change in Maximum 24-Hour Precipitation for the 100-Year Storm by the 2050s. The percent change could differ by 5.3% to 10.8% from south to central to west Bellevue. This significant difference in rainfall within the city can likely be attributed to downscaling regional model data to Bellevue (as with extreme heat, the precipitation models are scaled to regional, rather than local, impacts). The greater geographic variability in projected rainfall across the city may also be a result of greater uncertainty in how climate change will affect local precipitation patterns and volumes. Figure 6 does clearly show that projected increases in high intensity rainfall events could be significant.

This indicator can be used to consider how climate change could affect stormwater system capacity, floodplain conditions and localized flood risk, and erosion and landslide potential.



SOURCE: UW CIG 2022; BERK 2023

FIGURE 6 **Extreme Precipitation Exposure**

CVI INDICATORS

An index is a calculation used to summarize multiple datasets into one measure and normalizes or standardizes dissimilar data. This index uses the *standard score*[5] where for each indicator dataset, values are standardized by calculating the corresponding score for each value, creating an "apples-to-apples" measure by which dissimilar datapoints can be compared.

To visually present the CVI, final index values are classified based on quintile categorization, which distributes the values into five groups of an equal number of values based on the total range of scores. The final group results in **low**, **medium-low**, **medium**, **medium-high**, and **high** vulnerability classifications, emphasizing the relative nature of the calculation.

Table 4 shows the exposure, sensitivity, and adaptive capacity indicators selected for the index. Note that a (+) indicates greater vulnerability (higher exposure, higher sensitivity, and *lower* adaptive capacity).

- **Local Exposure Sub-index:** This sub-index contributes to the CVI and is comprised of equal parts flooding, air quality, and heat, considering local conditions. (Although they are not part of the CVI itself, regional climate exposures interact with these local sub-indices. For example, extreme precipitation could exacerbate the depth and extent of flooding; extreme heat can exacerbate the health conditions of persons also exposed to air pollution or be magnified by local environmental conditions such as fewer trees and more pavement.)
- **Sensitivity Sub-index:** Sensitivity is the component of the CVI addressing attributes inherent to the population or place that predispose them to increased impacts from climate exposure. The indicators for sensitivity are categorized into sub-categories of age, environment, and health conditions, as described below.
- **Adaptive Capacity Sub-index:** Adaptive capacity is the component of the CVI addressing attributes related to a population or environment's capacity to adapt to increased exposure and/or sensitivity to climate change impacts. The indicators for adaptive capacity are categorized into sub-categories of socioeconomic, transportation, housing/built environment, employment, health, and environmental/ecological, as described below.

These components—exposure, sensitivity, and adaptive capacity—taken together create the CVI.

[5] Also called a 'z-score' – this is a statistical measure that describes how many standard deviations away from the mean a given value is. Scores greater than the mean have a positive value, and scores less than the mean have a negative value. For each component of climate vulnerability (exposure, sensitivity, and adaptive capacity), the indicators are standardized and then averaged to create an average z-score for each component. These three component z-scores are then averaged together to create the final CVI value.

TABLE 4 **Indicators for Bellevue CVI**

Sub-Category		Indicator
LOCAL EXPOSURE		
Extreme Heat	(+)	Urban heat island
Air Quality	(+)	Air Quality (PM2.5)
Extreme Precipitation	(+)	100-yr Floodplains (potentially include 500-yr Floodplains)
	(+)	Historically Flood-Prone Areas
SENSITIVITY		
Age	(+)	Under 5 years old
	(+)	Over 65 years old
Environment	(+)	Geologically Hazardous Areas (steep slopes/ liquefaction/ landslide hazards)
	(+)	Poor Stream/Waterbody Health – 303d list for bacteria, dissolved oxygen, and temperature
Health Conditions	(+)	Diabetes – crude rate in population >= age 18
	(+)	Asthma – crude rate in population >= age 18
	(+)	Respiratory Disease - COPD – crude rate in population >= age 18
	(+)	Coronary Heart Disease – crude rate in population >= age 18
	(+)	Poor Physical Health – crude rate in population >= age 18
	(+)	Poor Mental Health – crude rate in population >= age 18
ADAPTIVE CAPACITY		
Socioeconomic	(+)	People of Color
	(+)	Population Experiencing Poverty
	(+)	Low Educational Attainment – less than high school degree
	(+)	Linguistic Isolation – households with limited English speaking at home
	(+)	Living Alone – households comprised of householder living alone
	(+)	Housing Cost Burden – renter households spending >30% of income on housing
	(+)	Access to Vehicle – households without access to a vehicle
Transportation	(-)	Access to Frequent Transit
Housing/Built Environment	(+)	Housing Condition – houses built before 1960
	(+)	Affordable Housing Inventory
	(+)	Impervious Surfaces
	(-)	Proximity to City-Owned Facilities that increase adaptive capacity (libraries, community centers, fire stations)
Employment	(+)	Unemployment
	(+)	Outdoor Professions – jobs likely to be performed outside (NAICS codes 11, 21, and 23)
Health	(+)	Adult Population Without Health Insurance
Environment/ Ecologic	(-)	Tree Canopy Coverage
	(-)	Access to Parks/Open Space

NOTES: A (+) means that a higher indicator value contributes to a *higher* index value, while a (-) means that a higher indicator value contributes to a *lower* index value.
COPD = chronic obstructive pulmonary disease.
NAICS = North American Industry Classification System

CLIMATE VULNERABILITY INDEX MAPS

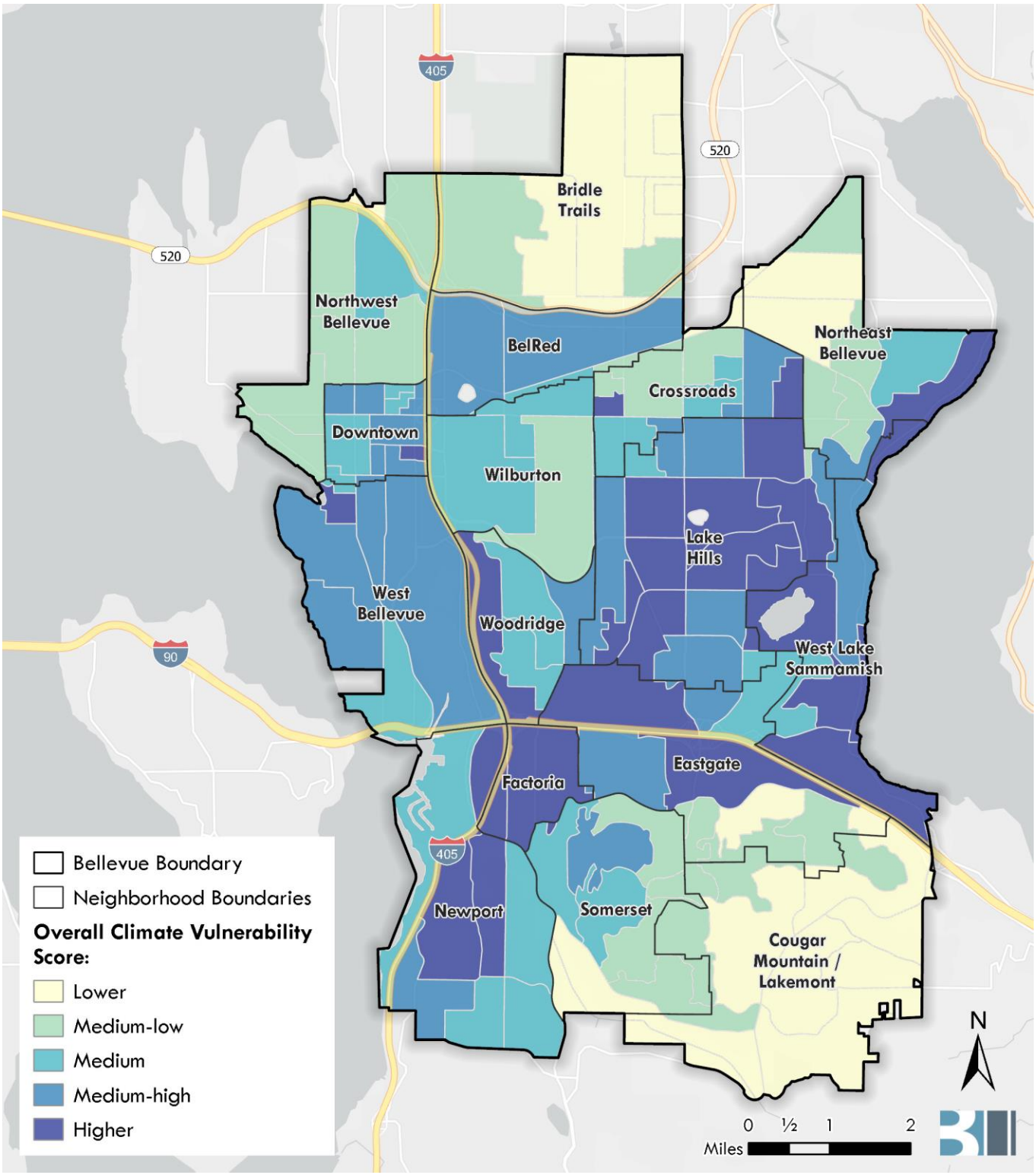
The indicators in Table 4 were used to calculate index values and a map of the overall CVI (all indicators) is shared below without population density (Figure 7) and with population density (Figure 8). It is useful to look at climate vulnerability both with and without population density because it illuminates areas where higher or lower concentrations of people either increase vulnerability or, in some cases, increase adaptive capacity. It can therefore also illuminate where anticipated changes to population could place more people in vulnerable areas, which can in turn help guide the city in enhancing the adaptive capacity and climate resilience of those areas through mitigation from development impacts.

When looking at these maps, it is important to keep in mind that they express broad categories of vulnerability based on 30+ indicators. They are intended to provide a high-level view of comparative vulnerability across the city; they are not intended to provide detailed information about what makes specific areas more or less vulnerable. Many of the sector-specific assessments in Section 3 include this more detailed geographic breakdown of vulnerability.

That said, some of the factors that increase or decrease the vulnerability of a given area may be known, at least in general terms. For example, BelRed has a medium-high index score on Figure 7 without accounting for population density. With population accounted for in Figure 8, the vulnerability index score for BelRed goes up (higher vulnerability), because it is an area that combines exposure indicators (e.g. extreme heat exposure, urban heat island) with low population density which may correlate with low adaptive capacity (e.g. less transit access, fewer parks, less tree canopy). That combination indicates higher vulnerability that is only apparent once population density is accounted for.

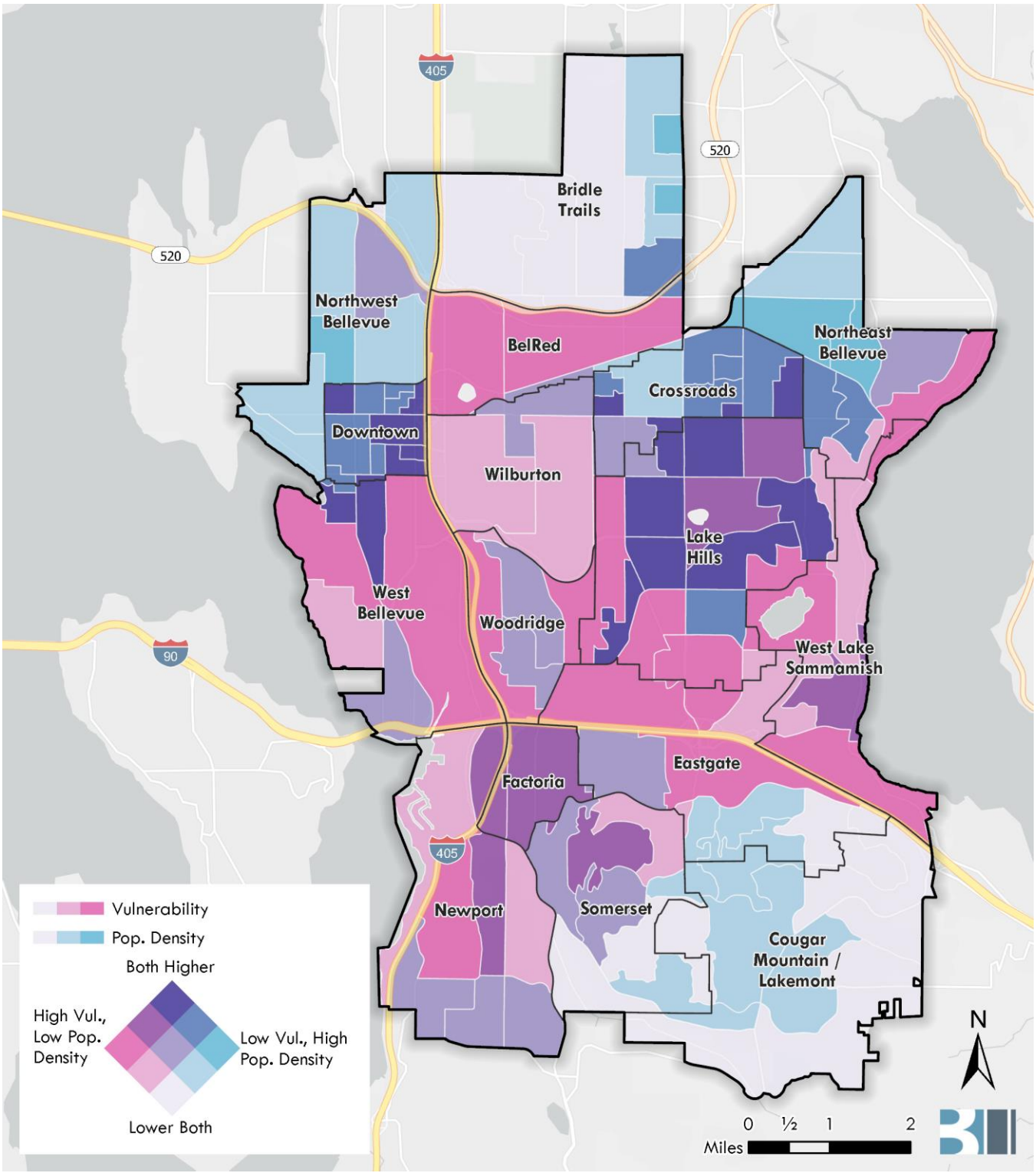
These indices will likely change over time as underlying conditions change and/or the data improves. Looking again at the BelRed example, as the area continues to grow and develop, the City can consider and employ strategies to reduce vulnerability. Such strategies also benefit from a combinatorial effect, where actions to reduce exposure (e.g. increased tree canopy and other green infrastructure, passive cooling) interact with actions to increase adaptive capacity (e.g. the arrival of mass transit, greater walkability and non-motorized transportation options, more parks) to reduce vulnerability for more people as population density increases.

This climate vulnerability information is meant to support the planning level review of Comprehensive Plan growth alternatives. The City of Bellevue will consider multiple factors in its selection and refinement of a preferred alternative.



SOURCE: BERK 2023

FIGURE 7 **Climate Vulnerability Index without Population Density**



SOURCE: BERK 2023

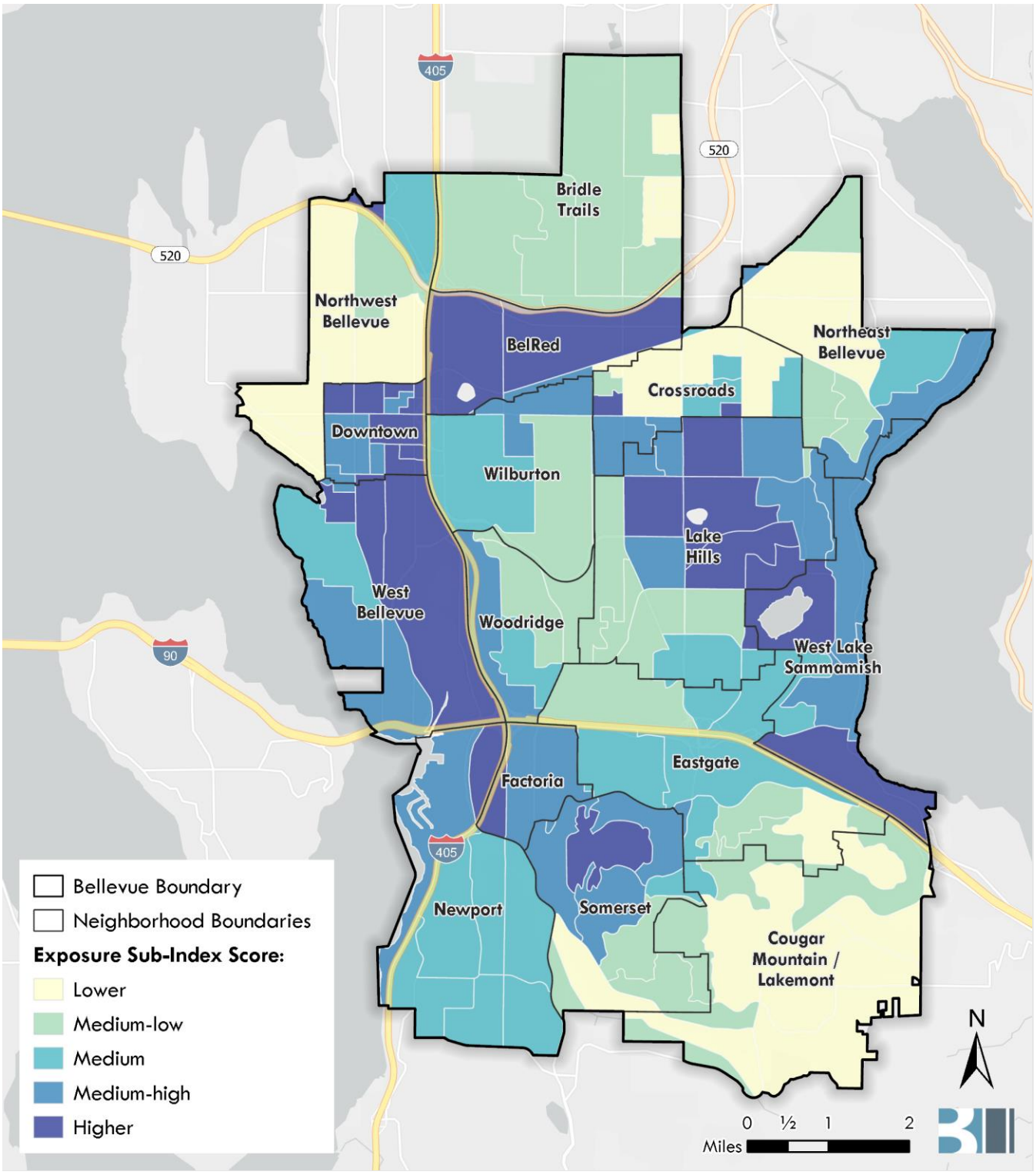
FIGURE 8 **Climate Vulnerability Index with Current Population Density**

LOCAL EXPOSURE SUB-INDEX MAP

This map shows aggregate local environmental exposure, based on the following data points included in the Local Exposure sub-index:

- **Flooding:** Floodplains and Historical flooding hot spots
- **Air Quality:** CLINE modeled PM2.5 concentrations. This represents Average Modeled Concentration of Particulate Matter 2.5 (e.g. air particles that are 2.5 microns or less in width that pose a high risk to human health)
- **Heat:** King County evening heat index. Generally, there are heat islands in west, central, and east Bellevue.

These three categories (flooding, air quality, and heat) are equally weighted. The results of the sub-index show relatively higher exposure to local environmental conditions in BelRed, Lake Hills, West Lake Sammamish, Somerset, Factoria, West Bellevue, and Downtown, in clockwise order (Figure 9). In Downtown and BelRed, there is greater local exposure to air pollution and heat islands. In Lake Hills and West Lake Sammamish, there is local exposure to heat islands and flooding (based on land area within floodplains). In West Bellevue and Factoria, there is exposure to flooding hot spots, air pollution, and heat islands.

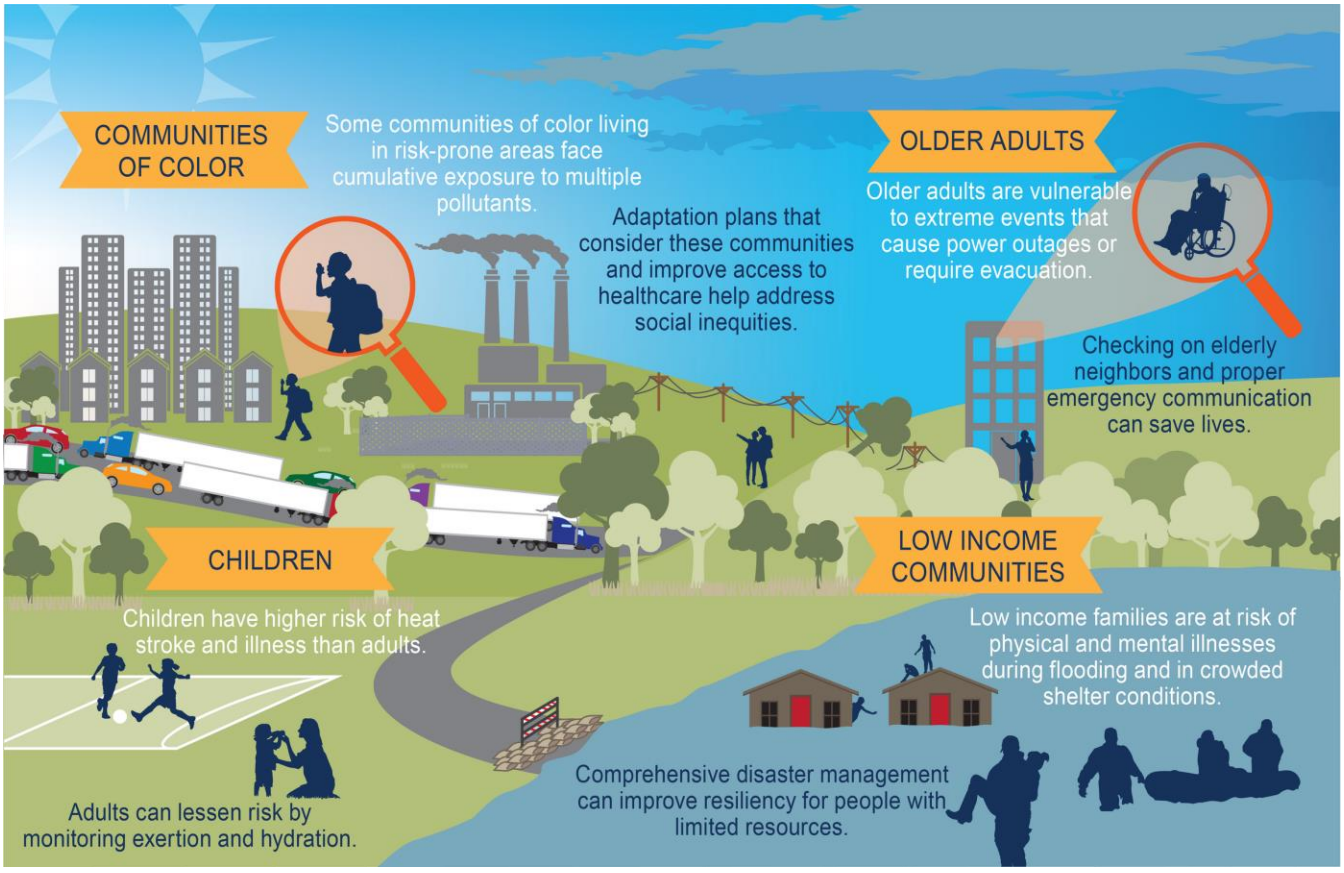


SOURCE: BERK 2023

FIGURE 9 **Local Environmental Exposure Sub-Index**

SOCIAL VULNERABILITY & SENSITIVITY AND ADAPTIVE CAPACITY SUB-INDICES MAPS

Based on social vulnerability and climate change research, communities that tend to be more sensitive to climate stressors include older people, children, low-income families, and people of color and immigrant communities (Figure 10). People who are elderly may have more limited mobility or preexisting health conditions, and children under five years old may have a harder time regulating temperature and/or underdeveloped immune systems. Low-income households may be more susceptible to illnesses and have limited resources to adapt or respond to climate change. Communities of color may have cumulative exposures to pollution and health and social inequities. People who speak English less than very well may have more difficulties during evacuation and difficulties accessing post-disaster funding and other resources.



SOURCE: EPA 2018

NOTES: Examples of populations at higher risk of exposure to adverse climate-related health threats are shown, along with adaptation measures that can help address disproportionate impacts. When considering the full range of threats from climate change as well as other environmental exposures, these groups are among the most exposed, most sensitive, and have the least individual and community resources to prepare for and respond to health threats. White text indicates the risks faced by those communities, while dark text indicates actions that can be taken to reduce those risks.

FIGURE 10 **Vulnerable Populations**

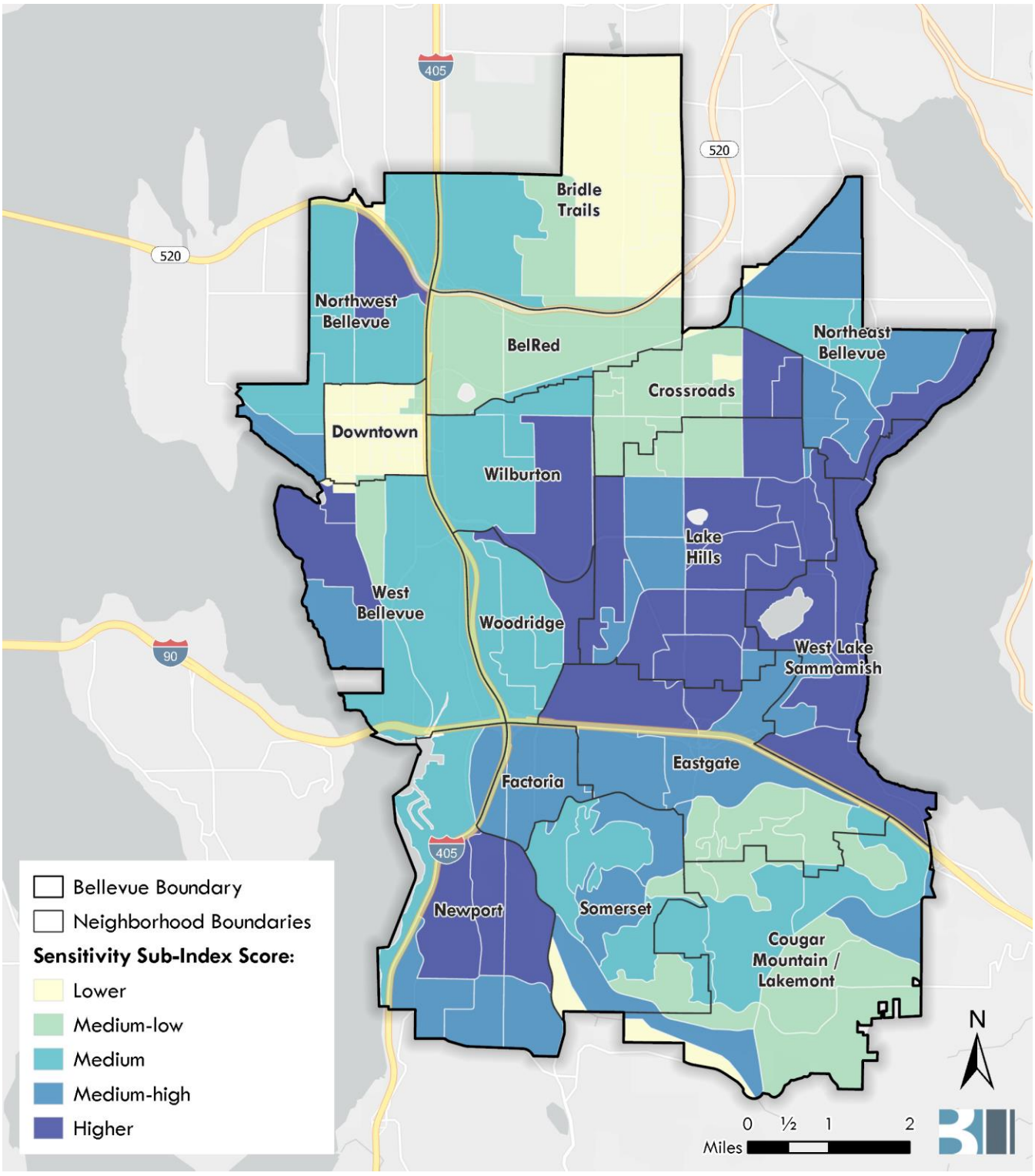
Understanding the location and number of populations that are more sensitive or less adaptable to climate change events can help communities develop strategies to increase resilience.

Examples of sensitivity indicators (e.g. under 5 years old, over 65 years old, air quality) and adaptive capacity indicators (e.g. heat island, linguistic isolation) in Bellevue are shared below in the sub-indices for sensitivity and adaptive capacity.

Sensitivity Sub-Index

The sensitivity sub-index addresses a variety of health or environmental conditions that represent conditions unchangeable at the time of the climate stressor (Figure 11).

- **Age:** Under 5 years old and Over 65 years old (as a percentage of population):
  - *Population Age 65 Years or Older:* Generally higher shares in north and east Bellevue
  - *Age under 5 Years:* Generally higher in central and west Bellevue
- **Environment:** Geologic Hazard Areas (liquefaction, steep slopes, erosion) and Poor Stream/Waterbody Health – 303d list for bacteria, dissolved oxygen, and temperature:
  - *Seismic/liquefaction hazards* are mostly along West Lake Sammamish and West Bellevue, but can also found in certain locations throughout the city where historic wetlands and streams have been covered with fill.
  - *Steep slopes* are found in most neighborhoods with greater concentrations in east, south, and west areas of Bellevue.
  - *Erosion* is more prevalent in the northern half of Bellevue and along both lakes, as well as in the Coal Creek basin.
  - *Poor waterbody health* is found in Wilburton, West Bellevue, and the south end.
- **Health Conditions:** Diabetes, Asthma, Respiratory Disease – COPD, Coronary Heart Disease (Adults), Poor Physical Health (Adults), Poor Mental Health (Adults):
  - *Poor Physical Health:* Generally central and south Bellevue



SOURCE: BERK 2023

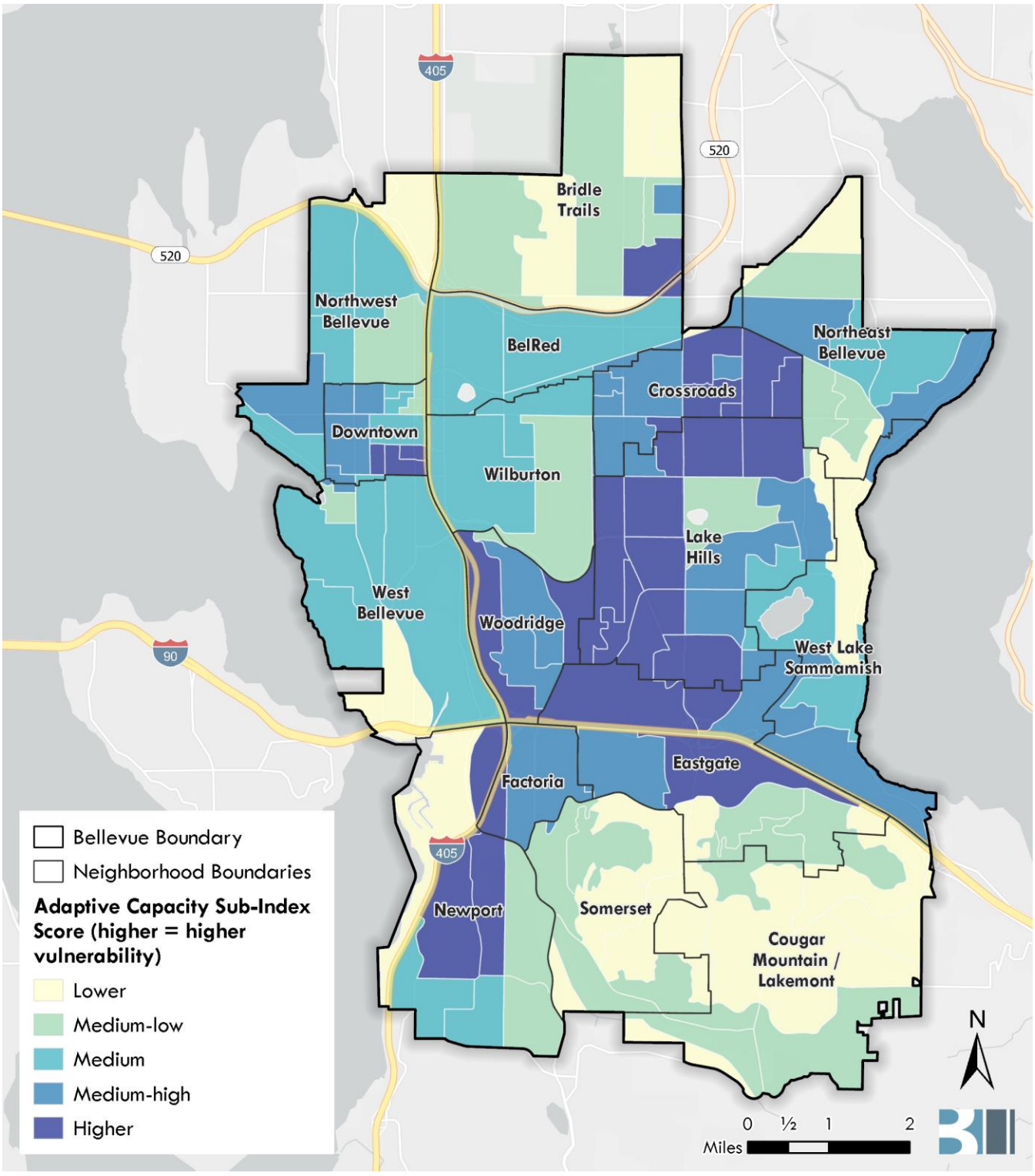
FIGURE 11 **Sensitivity Sub-Index**

Adaptive Capacity Sub-Index

A wide variety of indicators are part of the adaptive capacity sub-index including:

- **Socioeconomic:** Race, poverty, lesser education, linguistic isolation, lack of vehicle, other
- **Transportation:** Access to Frequent Transit (current)
- **Housing/Built Environment:** Housing condition (built before 1960), affordable housing inventory, impervious surfaces, proximity to libraries, community centers, fire stations
- **Employment:** Unemployment, Outdoor Professions
- **Health:** Adult Population Without Health Insurance
- **Environmental/Ecological:** Tree Canopy Coverage, Access to Parks

The areas with more vulnerable populations and lower-quality built environment conditions (e.g. less tree canopy, more impervious surface) are shown in Figure 12. There are more areas with higher vulnerability, (e.g. a higher score on the Adaptive Capacity Index below) in Crossroads, Lake Hills, Eastgate, Newport, Factoria, Woodridge, and Downtown.



SOURCE: BERK 2023

FIGURE 12 **Adaptive Capacity Sub-Index**

2.3 Planning for Climate Change in Bellevue

The City of Bellevue has developed several plans and programs addressing climate change mitigation and adaptation. Highlights of these plans and efforts are listed below.

BELLEVUE COMPREHENSIVE PLAN

The current Comprehensive Plan sets forth a growth strategy for the year 2035 (see below for the 2044 update underway), with a future land use plan and many elements describing goals, policies, and implementation strategies. Bellevue's Comprehensive Plan policies are used to guide decisions on capital investments, development permits, and more. Bellevue has addressed climate change in its Comprehensive Plan Environment Element with some key policies, such as:

- EN-6. Establish an achievable citywide target and take corrective actions to reduce greenhouse gas emissions such as reducing energy consumption and vehicle emissions, and enhancing land use patterns to reduce vehicle dependency.
- EN-7. Develop and implement climate change adaptation strategies that create a more resilient community by addressing the impacts of climate change to public health and safety, the economy, public and private infrastructure, water resources, and habitat.

ENVIRONMENTAL STEWARDSHIP PLAN

Bellevue adopted the *Sustainable Bellevue: Environmental Stewardship Plan* in December 2020 with 78 actions meant to be a strategic roadmap to achieving the following targets over the 2020-2050 period (City of Bellevue Community Development 2020a):

- Reduce GHG emissions by 80% by 2050 and prepare for a changing climate
- Use 30% less energy and the energy used will be 100% renewable
- 100% of households will live within a third of a mile of a park, open space, or trail; increase tree canopy by 600+ acres
- 100% of vehicles will be electric; drive alone less than 45% of the time to work
- Strive toward zero waste and recycle 90% or more of all waste
- The city will lead by example

The plan includes action C.1.1 Climate vulnerability assessment: Perform a climate vulnerability assessment to understand long-term risks and vulnerabilities associated with climate change and identify next steps in terms of enhancing resiliency.

REGIONAL PLANNING, KING COUNTY CITIES CLIMATE COLLABORATION (K4C)

Bellevue is a key member of the King County–Cities Climate Collaboration or K4C. In addition to King County, 24 cities participate, representing 85% of the county population. The collaborative offers

workshops, resources, and other information for staff and legislative representatives. A recent tool helpful to long-range planning includes a Climate Action Toolkit looking at the effectiveness of different climate strategies (K4C 2021).

The revised K4C Joint Commitments, signed by the Bellevue City Council in 2020, include commitment X. Climate Preparedness Pathway: Increase community resilience by planning and preparing for the impacts of climate change on K4C communities and the King County region.

STEWARDSHIP PLAN PROGRAMS

Bellevue has set up programs or initiatives to help fulfill its Stewardship Plan outlined below. These programs not only help to reduce GHG emissions and enhance sustainability, but also support climate resiliency. These efforts include:

- **Buildings and Energy:** Bellevue has a Clean Buildings Incentive Program with a team of experts to help benchmark building energy use and strategies to save energy. Bellevue has partnered with Issaquah, Kirkland, Mercer Island, and Redmond to develop the Energy Smart Eastside program, which offers incentives, education, and support for residents to install energy efficient heat pumps. Program incentives are targeted towards low and moderate income households, to support the most vulnerable in decreasing their energy burden and increasing their resilience during high heat and smoke events, through the air conditioning provided by heat pumps.
- **Climate Change and Air Quality:** Bellevue has developed a Greenhouse Gas Emissions Inventory to track communitywide emissions. The City of Bellevue has also committed to reducing emissions associated with its government operations.
- **Green Business:** Bellevue offers a Refresh Recycling program with consultation to understand services for businesses. Bellevue offers a Commute Trip Reduction program that fulfills state requirements and helps manage transportation demand. Bellevue also participates in EnviroStars, a free one-stop hub to get information, resources, and recognition for businesses.
- **Transportation and Electric Vehicles:** Bellevue plans for active transportation through a Pedestrian and Bicycle Transportation Plan. The City of Bellevue owns and operates 15 electric vehicle charging stations available for public use at City facilities. Bellevue is also working on facilitating permitting for installing charging stations on private properties.
- **Trees:** Bellevue assesses its tree canopy every several years and has a 39% tree canopy as of 2019. The City of Bellevue is also reviewing and updating its Tree Code to improve tree preservation, protection, and replacement to support the long-term health and growth of Bellevue's tree canopy.
- **Bellevue Climate Challenge:** The Bellevue Climate Challenge is a program of the Eastside Climate Challenge, along with Redmond, Issaquah, and Mercer Island. It includes a voluntary online tool to allow households to develop an energy profile and identify how to reduce impacts.
- **Stormwater Management Program:** Through the City's National Pollution Discharge Elimination System Program, Bellevue has a comprehensive suite of best management practices in place to prevent and address pollution.

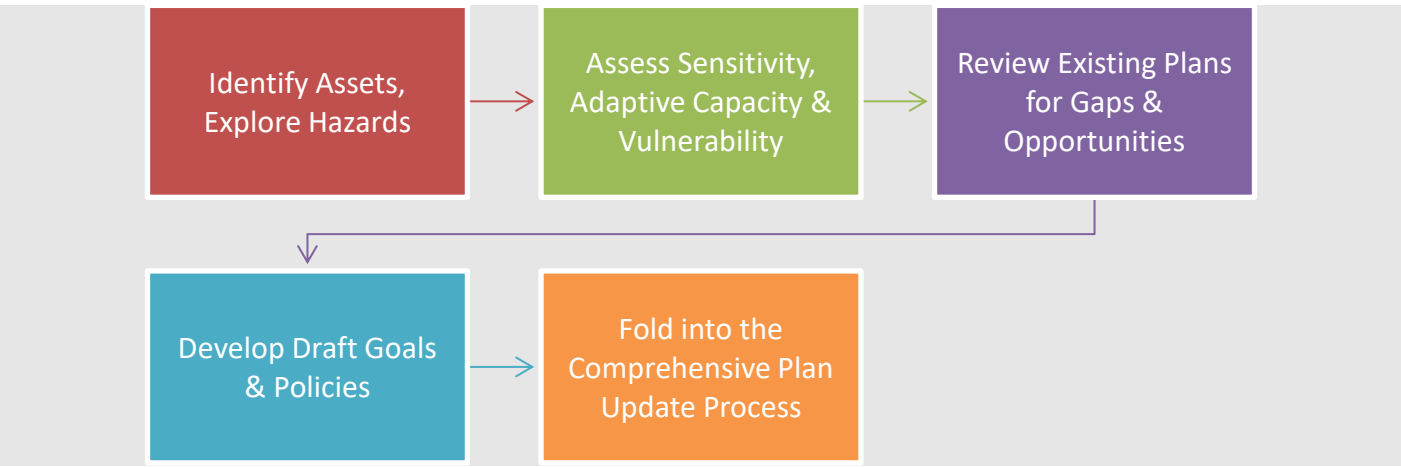
Many of these initiatives have multiple co-benefits that support climate resiliency. The Energy Smart Eastside program is focused on reducing energy use and greenhouse gas emissions associated with heating, but it also increases community resilience by focusing on low-income households and those most vulnerable to extreme heat, since heat pumps provide air conditioning. Preserving and growing Bellevue's tree canopy has multiple benefits including preserving ecological functions, improving air quality, managing stormwater, reducing urban heat island effect, enhancing neighborhood livability, and preserving community character.

BELLEVUE 2044 AND COMMERCE MODEL CLIMATE ELEMENT

Bellevue is working on its Comprehensive Plan Periodic Update (CPPU), called Bellevue 2044. The plan is scheduled for adoption in 2024, covering a 20-year period and setting a new plan for growth and sustainability through 2044. Bellevue received a grant to prepare this Climate Vulnerability Assessment from the Washington State Department of Commerce as part of the CPPU. This assessment will help the City of Bellevue respond to new legislation (HB 1181), which amended the Growth Management Act, chapter 36.70A RCW (GMA), to require a climate change and resiliency element as part of a comprehensive plan. If funds are appropriated, then the GMA would require Bellevue to include this climate change and resiliency element as part of its first implementation progress report in 2029. To address the requirements of the legislation, the climate change and resiliency element can be a new element or incorporated into the existing Environment element, and must address both greenhouse gas emissions reductions (mitigation) and climate resilience (adaptation).

Through an interagency effort,[6] Commerce developed a Draft Model Climate Element with resilience planning guidance to illustrate how counties and cities can develop and implement plans, goals, and policies that build communitywide climate resilience (Washington State Department of Commerce 2023). The Draft Model Climate Element recommendations have been considered in this document, including identifying, for each sector, potential climate change-related hazards and vulnerabilities in Bellevue. Based on a review of gaps and opportunities, the City of Bellevue can develop draft goals and policies and fold them into the comprehensive plan update (Figure 13).

[6] Washington State Department of Commerce, Washington State Department of Transportation, Department of Ecology, Department of Health, Department of Fish & Wildlife, Department of Natural Resources, and Military — Emergency Management Division. The core team also includes members from the UW Climate Impacts Group, Municipal Research & Services Center, and Association of Washington Cities.



SOURCE: Washington State Department of Commerce 2023

FIGURE 13 **Draft Model Climate Element Resilience Sub-Element Development Process**

SECTION 3 Climate Vulnerability Assessment

3.1 Buildings & Energy

3.1.1 Sector Overview

This section identifies assets, potential impacts associated with climate change, and vulnerabilities for buildings and energy infrastructure. Land use patterns and development regulations are addressed in **3.7 Land Use & Development**. The City of Bellevue regulates buildings and construction and applies energy codes. It also incentivizes green buildings. The City of Bellevue is setting ambitious goals to promote renewable energy and reduce greenhouse gas emissions with a large focus on Buildings & Energy to improve energy efficiency and decarbonization. Many green building strategies can also increase resilience.

One reason to consider the vulnerabilities and adaptive capacities of buildings and energy at the same time is that Bellevue is growing fast and expects to add a significant number of new buildings to the city at a time when the local and regional economy is rapidly electrifying, as buildings transition from natural gas to electricity, local renewable energy production increases, and cars transition from gas to electric. System Planners at Puget Sound Energy expect that even accounting for greater energy efficiency, meeting the combined increase in electricity demand will require significant new infrastructure and/or system improvements (PSE 2023).

Local resources reviewed for this section include the following:

- Bellevue Buildings and Energy programs
- Bellevue Environmental Performance Dashboard
- Energize Eastside Need and Solution

ASSETS – BUILDINGS

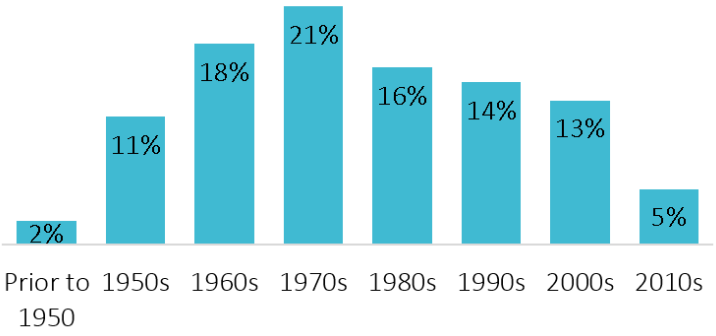
Bellevue is growing. Over the past several decades, the city has accommodated new residents and employees primarily in mixed-use centers such as Downtown and more recently BelRed. Table 5 shows the breakdown of commercial square feet and housing units within each neighborhood area in 2019. Since much of this growth occurred within the last 30 years, many of these buildings were constructed after Washington state incorporated energy codes in the state building code in 1986. Office square footage is predicted to grow. The city incentivizes LEED and BuiltGreen certification. Today, Bellevue has over 100 certified green buildings, including high rises in Downtown as well as schools and municipal facilities across the city (Table 6). Future investment in energy-efficient and green building construction will help Bellevue reach its climate goal of using 15% less energy, and 80% renewable per the Sustainable Bellevue: Environmental Stewardship Plan. Some energy conservation strategies can help building resilience such as designing for passive cooling in the case of power outages and extreme heat. During building weatherization, attention to indoor air quality as well as energy conservation is a best practice.

The greatest amount of recent residential growth has occurred within Downtown in mixed-use and high-rise residential construction, which has also been subject to more recent energy codes. Housing in single-family areas built prior to 1980 was more likely constructed under older standards (State Energy Code adopted in 1985). Over 50% of Bellevue's housing stock was built prior to 1980 (American Community Survey [ACS] 2020), and a share of the homes likely need energy efficiency updates. Housing built prior to 1960 is expected to have lower adaptive capacity due to lack of modern elements that reduce climate exposure, such as air conditioning and modern ventilation. Neighborhoods with more homes built prior to 1960 are Lake Hills, Eastgate, and Newport. The City of Bellevue is working towards incentivizing property owners to update their homes to make them more energy efficient and resilient, through the installation of energy efficient heat pumps that include air conditioning.

TABLE 5 **Commercial Square Feet and Housing Units by Neighborhood (2019)**

Neighborhoods	Commercial Square Feet	Housing Units
BelRed	8,501,986	1,835
Bridle Trails	1,715,871	4,944
Cougar Mountain / Lakemont	232,106	4,184
Crossroads	1,786,601	6,651
Downtown	17,267,637	9,963
Eastgate	6,389,929	2,722
Factoria	2,901,091	1,405
Lake Hills	2,648,172	6,911
Newport	299,179	3,811
Northeast Bellevue	1,096,979	4,053
Northwest Bellevue	2,143,997	4,414
Somerset	306,066	2,906
West Bellevue	2,693,040	3,962
West Lake Sammamish	204,964	2,424
Wilburton	2,259,333	1,948
Woodridge	279,292	2,239
Total	***50,726,243***	***64,372***

SOURCE: City of Bellevue, BERK 2023



SOURCE: U.S. Census Bureau, 2015 American Community Survey

FIGURE 14 **Housing Stock Age - Year of Construction (as of 2015)**

TABLE 6 **Buildings: Space by Sector**

Sector	2019 Base Year Square Feet
Education	4,727,218
Food	2,206,951
Government	1,260,267
Industrial	3,896,804
Medical	2,985,105
Office	18,981,286
Other	1,144,448
Retail	5,595,326
Service	9,928,837
Total	***50,726,243***

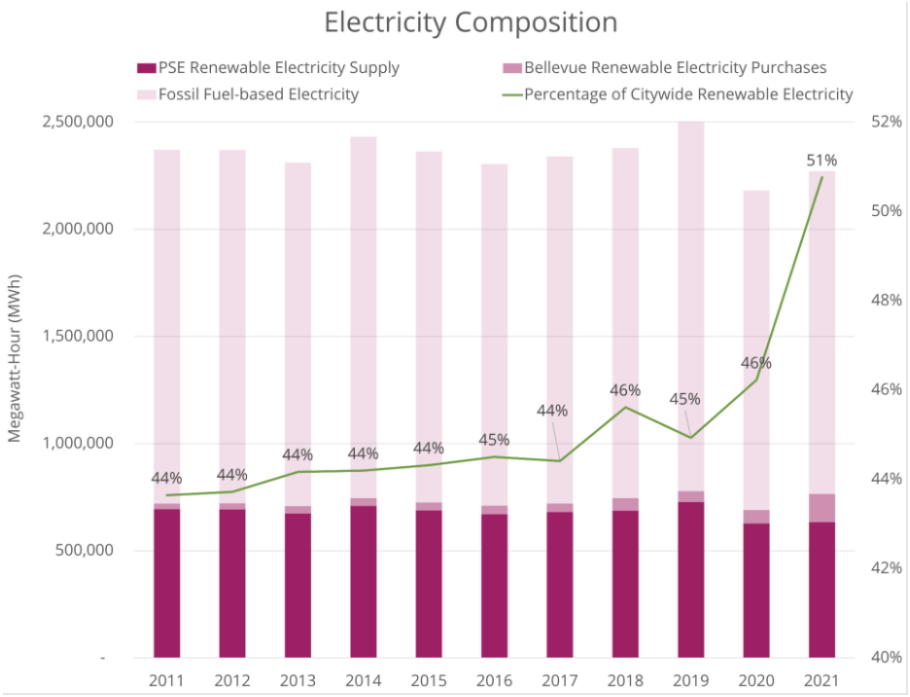
SOURCE: City of Bellevue, BERK 2023

ASSETS – ENERGY

Energy sources for Bellevue are hydroelectric, coal, natural gas, and renewable energy from wind and solar. The city is served by an investor-owned utility company, Puget Sound Energy (PSE), for both electricity and natural gas. The Sustainable Bellevue Plan has set a goal to transition to 100% renewable energy by 2050 (Environmental Performance Dashboard). To support this transition, the City of Bellevue participated in PSE's Green Direct program, which built the first wind farm in Western Washington and the largest solar array in Washington State capable of supplying 350,000 MWh annually (PSE Green Direct 2019). The

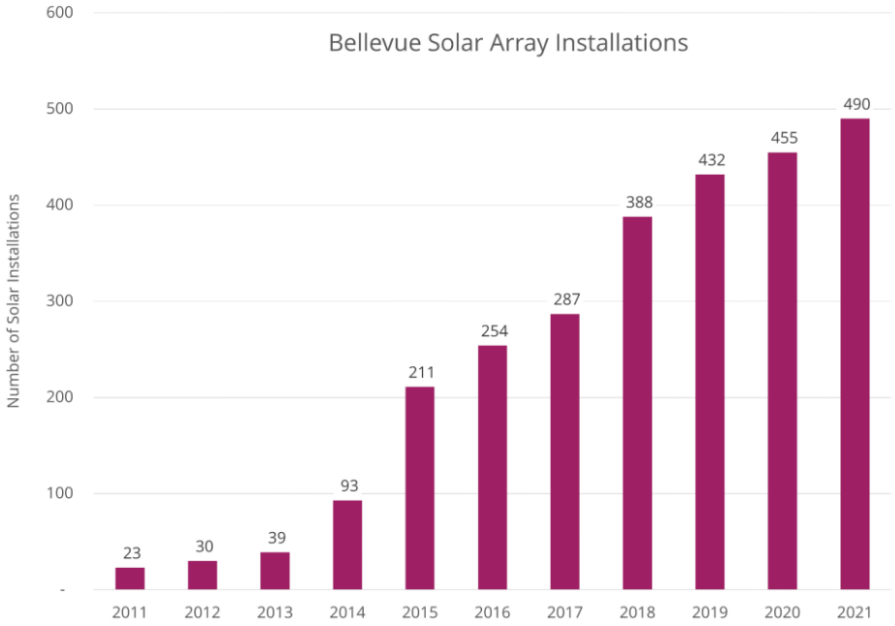
Washington State Clean Energy Transportation Act, passed in 2019, requires utilities to transition to 100% renewable energy by 2045. In response, PSE has established a Pathway to Beyond Net Zero, which includes a commitment to being coal-free by 2025.

Figure 15 shows how the commercial and residential sectors have committed to purchasing renewable energy through PSE programs over the past 10 years to help accelerate the transition, with a large increase in 2021 when the PSE Green Direct Skookumchuck windfarm went live. The city has also launched Solarize Campaigns to support residential installations of rooftop solar panels to generate local, clean energy. Figure 16 shows the increase in solar array installations since 2011. The City of Bellevue continues to pursue State and Federal grants to incentivize and grow the city's clean energy capacity. Local generation and diversification of renewable energy resources, between wind and solar, continues to be a priority as the city works towards the 100% renewable energy goal.



SOURCE: PSE 2020

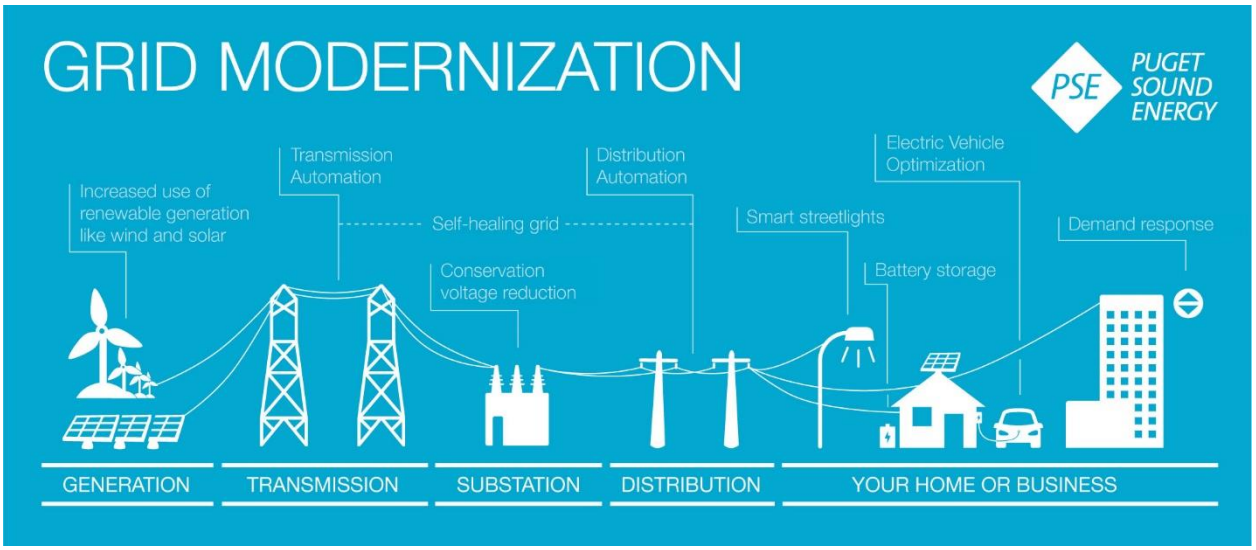
FIGURE 15 **PSE and Bellevue Fossil Fuel and Renewable Electricity Purchases**



SOURCE: Puget Sound Energy, Renewable Energy Product Management, 2021.

FIGURE 16 **Bellevue Solar Array Installations**

PSE has a holistic program to develop a resilient power grid involving activities such as renewable power, smart streetlights and electric vehicles, as well as actions that homeowners and business owners can take to build resilience (Figure 17). PSE is also implementing a number of strategies to increase the reliability of the grid and to plan for future growth in Bellevue and on the Eastside, through Energize Eastside and other projects. PSE reports on electric service reliability annually for their entire system, and specifically for the City of Bellevue (Bellevue Electric Service Reliability Report for 2022).



SOURCE: PSE 2020. https://www.pse.com/en/pages/grid-modernization

FIGURE 17 **PSE and Resilient Power Grid**

ASSETS – BUILDINGS, FLOODPLAINS, AND STORMWATER SYSTEMS

Approximately 2% of land in Bellevue is in a floodplain. This area includes numerous streams across the city but is concentrated on the eastern side of the city in the Lake Hills neighborhood (FEMA 2020; BERK 2023). Other areas in the city such as West Bellevue, Factoria, Somerset, Eastgate, and West Lake Sammamish are prone to flooding due to poor drainage. The drainage system is comprised of natural and engineered solutions. Bellevue provides real-time tracking of water levels in high flood areas. The City of Bellevue regulates development in flood hazard areas, requires stormwater management in all new development, and operates its stormwater system to enable storage, infiltration and safe conveyance of stormwater to reduce flooding and provide solutions for those who are impacted by it. Retaining and enhancing stream and floodplain functions including wetland and riparian protections are also addressed in critical area regulations to support surface and groundwater quality and wildlife habitat.

3.1.2 Potential Impacts

Climate change impacts could have far-reaching consequences on buildings and energy systems in Bellevue. Increased wildfires and smoke, droughts, heatwaves, and extreme storm events will exacerbate existing vulnerabilities and introduce new challenges. Bellevue could face the following climate-related risks to buildings and the energy system:

- Extreme temperatures and prolonged heatwaves can strain the electric grid, resulting in power failures like blackouts or brownouts. Extreme heat can damage critical grid infrastructure, such as transformers and electric lines, due to overheating which can cause wires to expand, sag, or even puncture their insulation. This increases the risk of short circuits and intensifies the threat of power failures. Greater

frequency and duration of power failures limits building operations, communication, health and safety, and security, which can lower economic productivity.

- Increased precipitation intensity and higher volumes of stormwater runoff from impervious surfaces can overwhelm drainage systems, leading to localized flooding in lower levels, basements, and parking garages of buildings. Flooding can damage property, critical infrastructure, disrupt daily operations, and pose safety risks to occupants, such as mold growth and structural deterioration in buildings.
- Increased intensity and frequency of extreme winter storm events, potentially including hailstorms and snowstorms, that can cause physical damage to buildings and energy infrastructure, potentially leading to extended power outages.
- Droughts sufficient to reduce water availability for hydropower generation which supplies 53% of electricity statewide (WA State Fuel Mix Disclosure 2021). Prolonged periods of drought combined with increased cooling demand can shift power supply to expensive fossil fuel-based generation, increasing electricity costs and resulting in higher greenhouse gas emissions.
- Drought impacts water reservoirs that supply potable water to populated areas, including water resources required to operate building cooling systems, especially during prolonged heatwaves. Reduced water supply could require accessing more distant alternative water reservoirs, which could lead to higher costs and increased energy.
- Wildfires may indirectly impact Bellevue's buildings or energy systems if the grid is damaged, but local risk is mostly confined to areas defined as Wildland-Urban Interface (WUI). Wildfire smoke and ash can reduce solar panel generation capacity both by making sunlight more diffuse and by physically obscuring the panels. This impact is expected to become more significant as the electric grid transitions to renewable energy sources and wildfires continue to increase in frequency and severity. Particulate matter from wildfires can also increase maintenance needed for building filtration systems; more frequent and prolonged wildfire seasons may require more advanced building filtration systems to protect indoor air quality for occupants.

Reducing the heat island effect and ensuring effective cooling measures during escalating summer temperatures is particularly important in neighborhoods such as Crossroads, Lake Hills, and Downtown, which were identified by the Climate Vulnerability Index as exhibiting heightened vulnerability due to higher concentration of vulnerable populations and lack of heat-reducing elements in the built environment. Effective cooling relies on structural insulation, the presence and capacity of mechanical and/or natural cooling systems, and other thermal properties that determine a building's ability to reflect or shed heat. The neighborhoods of Eastgate, Lake Hills, and Newport are also more vulnerable to extreme heat due to their higher concentrations of homes built prior to 1960.

Projected increases in extreme rainfall events may lead to more frequent and severe flooding that can cause property and structural damage. Extreme precipitation could enlarge floodplains, intensify stormwater runoff, and accelerate erosion. Elevated flooding risks and rising water tables could trigger below-grade flooding in basements, where housing furnaces and equipment is commonly located, and/or in parking garages, especially in the downtown area. Property in floodplains or areas with poor drainage would be more severely or frequently impacted, and new structures may be subject to damage that were not previously in defined flood hazard areas. Neighborhoods at higher risk of these impacts include the central area of Bellevue, West Bellevue, Woodridge, Lake Hills, and West Lake Sammamish.

3.1.3 Adaptive Capacity

Adaptive capacity in this sector is the ability of buildings and energy infrastructure to respond and adjust to changing conditions and requirements in a manner that is environmentally responsible and economically beneficial. It includes all characteristics that enable the building or energy system to maintain its functionality even as climate change impacts increase in frequency, severity, or both. The city's adaptive capacity may differ between and even within neighborhoods, depending on factors such as the natural environment or age of buildings and infrastructure.

The City of Bellevue can increase adaptive capacity by planning for more resilient development and by increasing the resilience of existing buildings and infrastructure. For future development, the City can start by reviewing its building and land use codes for opportunities to increase resilience. This is particularly important as the city continues its projected growth through the next decades in the face of worsening climate impacts. The City has several existing programs that bolster the adaptive capacity of the buildings and energy sector, which can be expanded to further increase climate resilience. These programs include:

- The City of Bellevue's permit under the National Pollutant Discharge Elimination System (NPDES), which requires that low-impact development be considered as the preferred method of stormwater management. Low-impact development includes features such as downspouts that flow into bioretention swales, planters, ponds, or raingardens that help slow the speed of runoff to promote groundwater infiltration (Buranen 2017).
- Building codes for stormwater management, which could be reviewed for alignment with projected increases in climate-related precipitation patterns and potential flooding impacts.
- Clean Buildings Incentive Program: Assists commercial buildings over 50,000 ft^2 to comply with the Washington Clean Building Performance Standard. Brings together developers, property owners, and city government to implement energy efficiency measures that support climate resilience in the built environment.
- Bellevue 2030 District: A public-private partnership that works with commercial building owners, businesses / tenants, and the city to support energy and water efficiency, transportation emissions reduction, and waste and stormwater.
- Energy Smart Eastside Heat Pump Campaign: Bellevue has partnered with Issaquah, Kirkland, Mercer Island, and Redmond to expand awareness of and access to heat pumps for residents of all five Eastside cities. This supports resilience by replacing fossil fuels with electricity in home energy systems, while also reducing overall energy use and providing air conditioning, which is becoming increasingly necessary during high heat days and smoke events.
- Green Building Incentives: The City of Bellevue offers incentives for certified green buildings such as LEED, Built Green, Living Building, and Passive House in designated neighborhoods, including Downtown, BelRed, and East Main subareas. Green Building incentives can increase adaptive capacity both by making buildings more resilient to climate change impacts and by reducing energy demand.

3.1.4 Vulnerability Summary

Buildings and energy systems are directly and indirectly vulnerable to climate change impacts in Bellevue. Wildfires can damage energy infrastructure, which could disrupt service and cause power outages. Excessive smoke and ash can degrade building filtration systems and reduce indoor air quality. Prolonged drought could strain water resources for hydropower generation and impact building cooling systems and daily operations. Frequent or prolonged heatwaves can strain cooling systems and grid capacity by further increasing energy demand during peak demand periods. More frequent or intense storm events can physically damage buildings and power infrastructure.

Impacts to buildings and energy systems are expected to be unevenly distributed throughout the city. Certain neighborhoods may be less resilient to heatwaves because they have a higher percentage of older buildings, or older infrastructure (Eastgate, Lake Hills, and Newport), or due to more severe urban heat island effect (Crossroads, Lake Hills, and Downtown) and/or larger vulnerable populations. Wildfire danger is considered low throughout Bellevue, except where it is moderately low (parts of Bridle Trails, Newport Hills, Somerset/Hilltop, and Cougar Mountain/Lakemont) due to a higher concentration of homes in the Wildland-Urban Interface.

Table 7 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Buildings & Energy sector in Bellevue.

TABLE 7 **Buildings & Energy: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	High (Energy) Moderate (Buildings)	Moderate	Moderate-High (Energy) Moderate (Buildings)	Energy supply may be impacted during extreme heat events, and certain neighborhoods in the city are projected to experience heightened impact of extreme heat. Buildings and energy infrastructure may be damaged or destroyed by extreme weather events.
Extreme Precipitation/ Flooding	Moderate	Low-Moderate	Moderate	Energy systems and buildings are at risk of physical impacts due to extreme precipitation events. Properties and energy infrastructure located in floodplains are more at risk.
Stream Temperature	N/A	N/A	N/A	No significant impacts projected.

Drought	Moderate	Moderate	Moderate	Hydroelectric energy systems will be impacted by low streamflow during drought. Installation of solar panels and other energy diversification programs can increase the adaptive capacity of buildings and energy systems during drought events.
Wildfire and Wildfire Smoke	Low	Moderate	Low	Particulate from smoke can reduce solar energy generation, which could be of increasing concern as the grid shifts to renewable energy sources. Smoke impacts may also increase need for costly air filtration systems. Direct damage from wildfire may temporarily reduce electricity generation capacity. Some areas of Bellevue have elevated wildfire risk, particularly where homes are built in or near the WUI.

SOURCE: BERK 2023

3.2 Cultural Resources & Practices

3.2.1 Sector Overview

This section examines the projected impacts of climate change on Bellevue's cultural and historic resources and practices. These include cultural landscapes and heritage sites, culturally significant natural resources and species, significant structures such as historic buildings and public art, and community cultural events and gathering spaces. Properties and spaces falling within this sector include both public and private parks and outdoor venues, libraries and educational facilities, and cultural and arts centers. Projected climate change impacts of concern include increased stream temperatures, increased extreme precipitation and associated flooding events, and increases in extreme heat events.

Local resources reviewed for this section include the following:

- Bellevue Map Viewer of heritage sites, historic buildings, and environmental layers (e.g. floodplains, steep slopes)

3.2.2 Potential Impacts

SIGNIFICANT STRUCTURES

- Exposure to extreme heat, extreme precipitation, and increased storm intensity may accelerate the degradation of historic structures (Sesana et al. 2021).

- Extreme precipitation events may lead to increased risk of landslides (Handwerger et al. 2022), which could damage historically significant structures located in areas susceptible to landslides, including the Burrows Cabin and the Calvert House.
- Heat, flooding, and landslides, among other impacts, may damage public art installations, though sensitivity will vary by installation.

CULTURAL LANDSCAPES AND NATURAL RESOURCES

- Mercer Slough and Larsen Lake Farm are managed by the City of Bellevue as berry farms to preserve the area's agricultural heritage. Potential climate change impacts to the operations of these farms include flooding, crop damage due to extreme heat, increased irrigation requirements during periods of drought (Schreiber 2016), and increased hazard to u-pick visitors and operating staff due to increased incidence of extreme heat and poor air quality from wildfires in the greater region (Kearl and Vogel 2023; UW CIG et al. 2018).
- Bellevue Botanical Garden is managed by the City of Bellevue and faces exposure to climate change impacts such as drought and extreme heat, which will have operational implications for the gardens such as increased plant mortality, increased competition from invasive species and pests, and increased need for irrigation. Additionally, the Botanical Garden contains areas that may be susceptible to landslides during extreme precipitation events, creating a hazard for users and an operational challenge for resource managers.
- Ecosystem health is intractably connected to human and cultural health in Native American worldviews (UW CIG et al. 2018). Further damage or degradation of natural areas that exist within Bellevue threatens this already diminished aspect of cultural well-being for Indigenous individuals residing in and originating from the area. This includes rising stress on Chinook, coho, and sockeye salmon due to increased water temperatures, more severe winter streamflow, increased pollutant concentration in waterways, decreased water levels in summer and fall, and other ecological shifts (WDFW 2022).
- Community garden spaces and the P-Patch program are likely to experience a variety of climate change impacts. The primary impact will be increased heat with those working in gardens more exposed to higher temperatures and crops experiencing increased stress due to increasing air temperatures (Bisbis et al. 2018; UW CIG et al. 2018).
- Assets such as urban parks and the urban tree canopy support Bellevue's cultural identity as embodied in their motto: "A City in a Park." Increases in extreme heat events, drought, and rising temperatures will all negatively impact these assets through increasing tree mortality (COB and UW 2019) and susceptibility to infestation (Raymond et al. 2014).

CULTURAL AND COMMUNITY CENTERS AND EVENTS

- Several cultural and/or community centers in Bellevue may be exposed to climate change risks owing to their proximity to the wildland-urban interface (WUI), steep slopes, or floodplain hazards. The sensitivity of individual structures is determined by site characteristics and the elements of each structure exposed and thus varies accordingly.

- Bellevue is host to many multicultural celebrations and events. Depending on circumstances, these events may be vulnerable to climate change impacts. Events held outside or in venues with exposure to climate change impacts may be affected by poor air quality, extreme heat events, floods, or landslides.
- Climate change impacts to the transportation system may cause difficulties in accessing resources for individuals who live long distances from these centers or who rely on transit and active transportation or those who require mobility devices.

3.2.3 Adaptive Capacity

- Adapting cultural resources to climate change impacts can be challenging because many are unique, irreplaceable, and location based.
- Due to their historic nature and the associated limitations on structural adaptation, some historic structures have very constrained adaptative capacity. Non-historic significant structures may be possible to move or armor against impacts without compromising their cultural function.
- Bellevue has invested in creating culturally responsive governance structures: e.g. creation of the Diversity Advantage Team (staff within City Manager's Office), Bellevue's Diversity Advisory Network (community members appointed by City Manager), Neighborhood Liaisons within the Community Development Department, and its Communities of Color Coordinating Team.
- Community owned and operated cultural resources may experience difficulties in adapting to climate change due to factors including a lack of knowledge about effectiveresilience strategies and/or insufficient resources.
- Adaptive capacity of certain natural resources such as the Botanical Gardens and farms operated by the City of Bellevue may be limited by conflicts between resource needs and climate resilience policies surrounding water use during periods of drought. Future-focused planning and management of agricultural areas or botanical gardens can focus on species, management approaches, and technologies that support continued operations even in changing conditions.
- Salmon populations in the Salish Sea are already threatened by human disturbances to the environment. Compounding exposures from climate change complicate salmon recovery efforts, although many organizations and governments are aligned in their efforts to support and restore these populations.

3.2.4 Vulnerability Summary

While the vulnerability of cultural resources and practices to climate change varies by resource, overall vulnerability is moderate to high. This is due to the large role natural systems and resources play in the cultural environment, history, and identity of Bellevue. Salmon populations in particular present a substantial challenge. Similar levels of vulnerability can be seen in certain historic resources such as the Burrows Cabin and the Larsen Lake Farm. Conversely, many modern cultural resources have low to moderate vulnerability to climate change impacts due to low exposure and sensitivity as well as higher adaptive capacity, given updated building codes and regulations, compared to their historical counterparts.

Table 8 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Cultural Resources & Practices sector in Bellevue.

TABLE 8 **Cultural Resources & Practices: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	Moderate-High	Moderate-High	Moderate	Degradation of structures; drought or heat damage to natural landscapes and species of cultural and/or historic significance.
Extreme Precipitation/ Flooding	Moderate-High	Moderate	Moderate-High	Flooding, erosion, and landslides could damage structures, public art or cultural venues, and natural landscapes and species of cultural and/or historic significance.
Stream Temperature	High	Moderate	High	Increased pressure on culturally important stream and near-shore species, including but not limited to salmon.
Drought	Low-Moderate	Moderate	Low-Moderate	Water stress on culturally important plant species, as well as places of natural historic or cultural meaning such as Mercer Slough or the Botanical Gardens.
Wildfire Smoke	Moderate-High	Moderate-High	Moderate	Potential to reduce the viability of outdoor gathering or event spaces and cultural events that take place during summer; increased stress on animal and plant species.

SOURCE: ESA 2023

3.3 Economic Development

3.3.1 Sector Overview

This section identifies assets, potential impacts associated with climate change, and vulnerabilities for Economic Development in Bellevue. Bellevue is the second largest job center in Washington with an emphasis on information technology (City of Bellevue Community Development 2020b). It has a low unemployment rate, and a large proportion of its residents are highly educated. Recently, jobs in the information, tourism, health and fitness, construction, retail, and services sectors have grown in Bellevue, while jobs in manufacturing have declined, following a long-term trend given redevelopment of industrial areas to office and mixed uses (e.g. in BelRed).

Climate impacts, including extreme heat, extreme precipitation, wildfire smoke, and other events, can affect Bellevue's economy by disrupting business continuity by increasing insurance costs, disrupting supply chains, altering the timing and rate of construction, increasing infrastructure costs, and disrupting other aspects of the economy. Responding to climate change can also present economic opportunities through increased demand for environmentally responsible products and services, greater investment in green and low carbon technologies, improved local production and supply, and increased investment in and valuation of areas with lower climate risks.

Local resources reviewed for this section include the following:

- Bellevue Community Profiles 2016-2020 ACS (Puget Sound Regional Council [PSRC] 2022)
- Bellevue Economic Development Plan (City of Bellevue Community Development 2020b)
- Bellevue Environmental Stewardship Plan (City of Bellevue Community Development 2020a)

ASSETS – ECONOMIC DEVELOPMENT

Bellevue is a major job center for the region and state, with over 11% of all jobs in King County and almost 5% of all jobs statewide.7 According to City of Bellevue data, the city had a total of 50.1 million square feet of employment space and a total of about 137,700 jobs in 2019 (Table 9).

[7] According to US Census data, Bellevue had 157,810 jobs in 2019, which is 11.4% of jobs in King County and 4.8% of jobs in Washington State. Exact jobs estimates vary by source – see Table 9 for City of Bellevue estimates based on Neighborhood Employment Space.

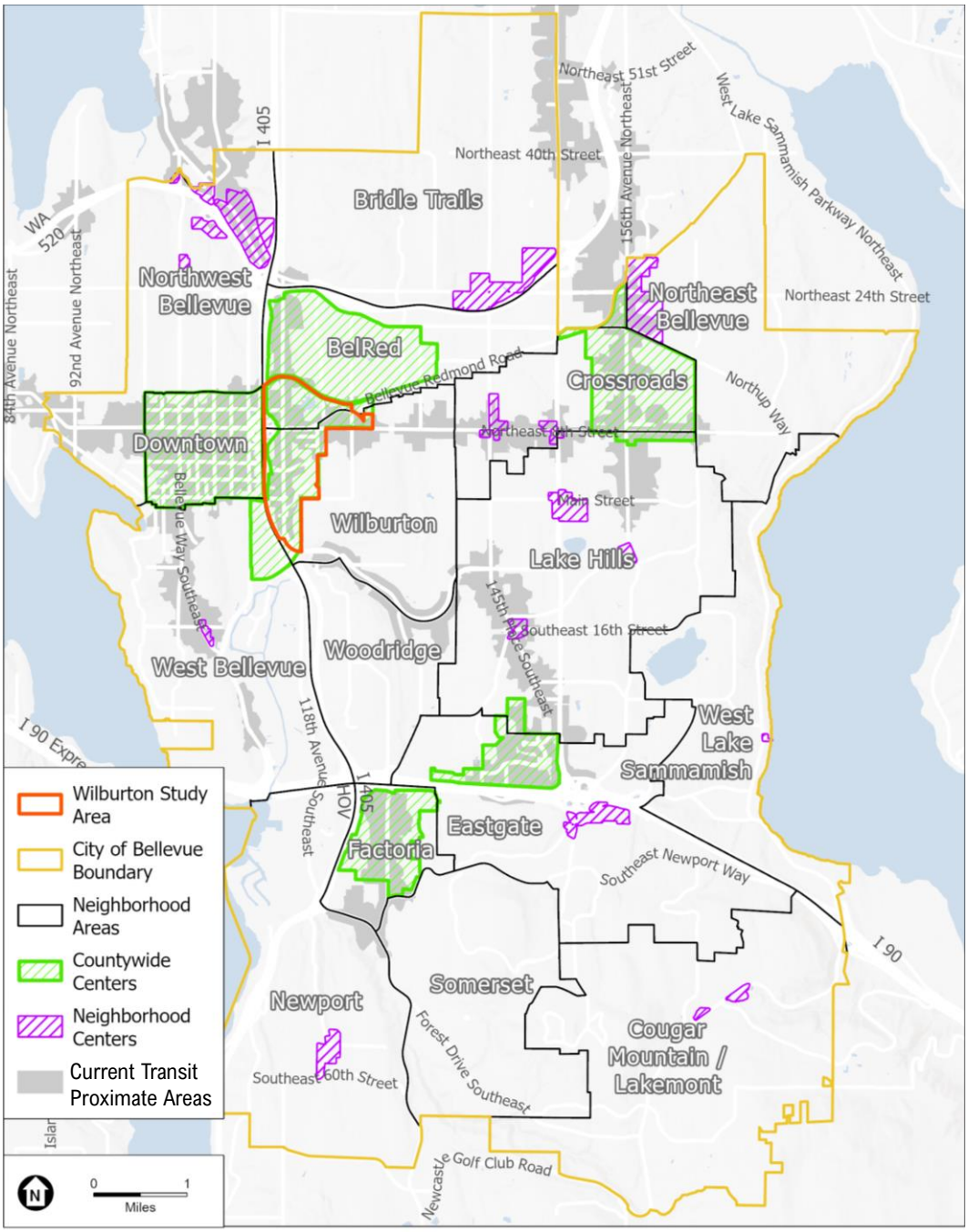
TABLE 9 **Employment Space by Neighborhood**

Neighborhoods	Square Feet	Jobs
Downtown	17,267,637	59,865
BelRed	8,501,986	18,796
Eastgate	6,389,929	17,054
Factoria	2,901,091	8,879
Wilburton	2,259,333	6,455
West Bellevue	2,693,040	5,112
Lake Hills	2,648,172	4,961
Northwest Bellevue	2,143,997	4,942
Crossroads	1,786,601	3,859
Bridle Trails	1,715,871	3,772
Northeast Bellevue	1,096,979	2,146
Newport	299,179	583
Cougar Mountain / Lakemont	232,106	432
Woodridge	279,292	332
Somerset	306,066	310
West Lake Sammamish	204,964	222
Total	***50,726,243***	***137,722***

SOURCE: City of Bellevue 2023

About 4.1% of those jobs potentially require working outdoors (e.g. construction, maintenance, emergency response), which is associated with higher sensitivity to climate change impacts, especially extreme heat events. Bellevue has a comparatively high share of residents with office jobs, and fewer production and construction jobs (Figure 19).

Currently, most jobs and office buildings are in Downtown, BelRed, and Eastgate neighborhoods. Within these neighborhoods, the City of Bellevue has identified neighborhood centers in its Comprehensive Plan; these centers are areas of focus for jobs, housing, and shopping (Figure 18). Economic development efforts are expected to be concentrated in these two areas (existing centers and neighborhood growth areas identified in the Comp Plan), and therefore actions to reduce vulnerability and increase adaptive capacity are likely to also be concentrated in these areas.



SOURCE: City of Bellevue, BERK 2023

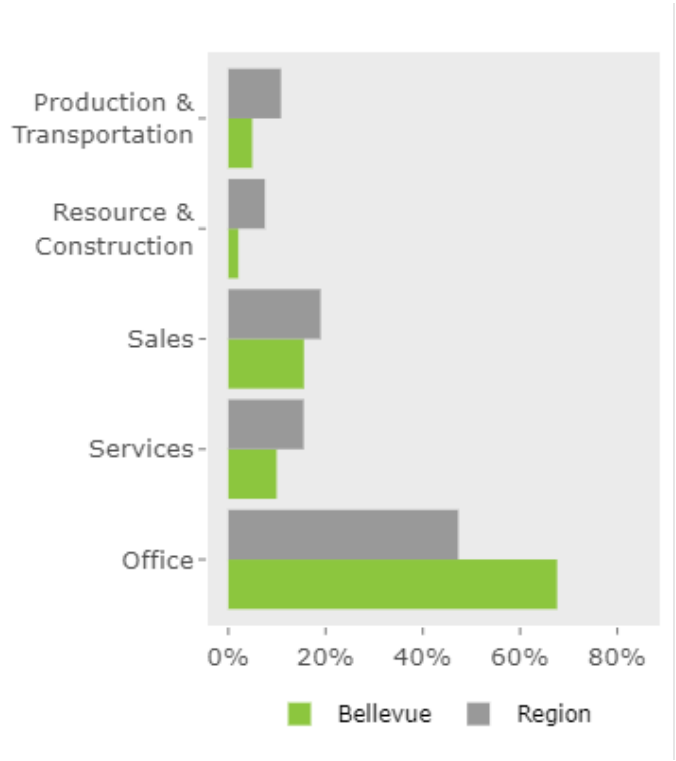
FIGURE 18 **Neighborhood Centers**

TABLE 10 **Employment Space by Sector**

Sector	Square Feet
Office	18,981,286

Sector	Square Feet
Service	9,928,837
Retail	5,595,326
Education	4,727,218
Industrial	3,896,804
Medical	2,985,105
Food	2,206,951
Government	1,260,267
Other	1,144,448
Total	***50,726,242***

SOURCE: City of Bellevue 2023



SOURCE: PSRC 2022

FIGURE 19 **Occupation of Bellevue Residents (2020)**

3.3.2 Potential Impacts

Economic development is expected to experience the greatest vulnerability to disruptions and direct damage caused by increases in extreme heat and extreme precipitation events. Smoke from wildfires is also an impact of potential concern for outdoor summer activities and tourism.

- Climate-related extreme weather events may lead to business disruptions and closures due to their impacts to customers and/or employees. Extreme heat, extreme precipitation and flooding, and wildfire smoke all have the potential to disrupt economic activity for the duration of the event, particularly for business that operate outdoors and/or have a large contingent of outdoor workers. For example, during the extreme 2021 Heat Dome event, the region saw retail and restaurant business closures, and restrictions on recreation and outdoor work, as well as an abrupt increase in demand for indoor spaces with air conditioning, such as hotel rooms. (McNerthney 2021). During extreme weather events, office workers may elect to work from home, impacting local retail businesses and activity; however, many older homes in this region do not have air conditioning, so workers may also elect to work from air-conditioned offices or local shops.

- Insurance premiums and coverage rates, and mortgage interest rates could increase for properties at greater risk of exposure to climate hazards. Conversely, rates may be lowered in areas with lower risk or that are actively acting to reduce risk. Washington State's Office of the Insurance Commissioner has coordinated with other national efforts to address future risks (Office of the Insurance Commissioner n.d.).

- Extreme precipitation events are anticipated to increase citywide, with the potential to damage infrastructure that businesses depend on through flooding and erosion. Neighborhood areas with smaller employment, such as West Bellevue and Lake Hills, have higher percentages of properties in the floodplain or in flooding hotspots. The intensity and frequency of storms could affect roads, stormwater systems, and result in greater costs to businesses.

- Increased polarization in storm systems may exacerbate current conditions related to groundwater infiltration. If rain falls primarily in large storms that exceed absorption rates of existing wetlands and other infiltration sites, a greater proportion of annual precipitation will be lost as runoff. This may result in declining streamflow, as described above, but also has an important secondary impact of decreasing aquifer reserves, which can negatively affect recreation opportunities.

- Shifts in tourism dollars from jurisdictions losing recreational opportunities to jurisdictions gaining opportunities. Tourism is a sector of focus in the Economic Development Plan, and the City of Bellevue desires to increase the number of conventions, performances, and special events as well as increase dining and bars, lodging, and arts/culture/recreation (City of Bellevue Community Development 2020b). Outdoor recreation could be limited during climate events such as extreme heat, extreme precipitation, or wildfire smoke, but recreation could be increased indoors where temperatures are controlled, such as at the Meydenbauer Center, which hosts indoor events. In addition, it is possible that Bellevue could experience an influx of tourists seeking to avoid more severe weather conditions in other regions (or countries), especially in the summer.

Based on the combination of exposure, sensitivity, and adaptive capacity, employment centers with greater vulnerability and population density include Crossroads, Downtown, and Factoria. Other employment centers, such as BelRed, Eastgate, and Wilburton, have high or medium high exposure, but currently have low population densities; however, these are locations where the City of Bellevue is anticipated to add more mixed-use growth (Table 11). In both existing and new centers, implementation of climate adaptation strategies would increase resilience.

TABLE 11 **Top 5 Neighborhoods with Employment and Climate Vulnerability**

Center	Exposure*	Sensitivity*	Adaptive Capacity*	Vulnerability Index: Center Areas	Vulnerability Index with Population: Center Areas
BelRed	Heat island, Air Quality, Floodplain (Moderate)	Age (Under 5, percentage of total)	Public Facility Access, Parks Access, Tree Canopy, Impervious, Single Householders, Poverty, BIPOC	Moderate-High	Higher Vulnerability / Lower Pop. Density
Crossroads	Heat Island, Air Quality	Age (65+, Under 5, percentage of total), Health	Health Insurance, Unemployment, Tree Canopy, Impervious, Affordable Housing, Cost Burden, Poverty, BIPOC	Higher (east) Moderate-Low (central) Moderate-High (west)	Higher Vulnerability / Higher Pop. Density (east and west) Low/Moderate Vulnerability/Higher Vulnerability (central)
Downtown	Urban Heat Island, Air Quality	Age (over 65) (Moderate)	Impervious, Tree Canopy, Impervious, Cost Burden, Single Householders, Linguistic Isolation	Moderate-High/High (northwest, southeast) Medium (north and southwest) Medium Low (southwest)	Partial: Higher Vulnerability / Higher Pop. Density Partial: Moderate Vulnerability / Higher Pop. Density
Eastgate	Air Quality	Age (Under 5), Health	Public Facility Access, Affordable Housing, Housing Quality (Year)	Lower	Higher Vulnerability / Lower Pop. Density
Factoria	Heat (Moderate), Air Quality, Flooding hotspots (Moderate)	Health	Parks Access, Low Educational Attainment	Higher	Higher Vulnerability / Moderate Pop. Density
Wilburton	Flooding (Moderate), Heat (Moderate),	Water Quality (Moderate), Health (Moderate)	Transit, Poverty, BIPOC	Moderate- High (north and southwest)	Partial: Higher Vulnerability / Lower Pop. Density

Center	Exposure*	Sensitivity*	Adaptive Capacity*	Vulnerability Index: Center Areas	Vulnerability Index with Population: Center Areas
	Air Quality (Moderate)			Moderate (center)	Partial: Lower Vulnerability / Lower Pop. Density

*Higher unless stated

3.3.3 Adaptive Capacity

Adaptive capacity for Economic Development is the ability of the city's economy and workforce to withstand and recover from climate impacts in ways that are equitable and support workers. To increase the resiliency and adaptive capacity of its economy, the Environment Stewardship Initiative plan includes the following performance indicators related to economic development:

- Sustainable Bellevue Key Performance Indicator: Jobs located within 1/4 mile of a frequent transit stop (percent of jobs): 75% short term and 85% long term.
- Sustainable Bellevue Strategy E.2.1: Commercial energy efficiency. Provide technical assistance for commercial energy benchmarking and retrofits for large buildings to support compliance with the statewide program and leverage early adoption incentives.

The city can further increase the adaptive capacity of its economy by implementing policies that assist businesses and workers in recovering from climate disasters, as well as by implementing measures that minimize the impacts of climate events to economic development.

Building efficiency retrofits and resiliency measures described in section 3.1.3 of this report can increase adaptive capacity by improving the ability of infrastructure to withstand extreme heat and precipitation events, thereby decreasing the negative economic impact of those events.

The city can also identify and support shifts in business opportunities driven by demand for goods and services that promote sustainability and climate resilience. Business opportunities in renewable energy and low carbon technologies are expected to grow with increased action in response to climate change. While the Economic Development Plan does not reference green technology directly, it calls for facilitating and encouraging desirable business investment and small businesses. Supporting green technology could help accomplish this. The Environmental Stewardship Plan notes:

All three of these elements—economic competitiveness, social vibrancy, and environmental stewardship—are needed to protect human health and quality of life, support well-paying green jobs, sustain a healthy environment, and generate long-term cost savings and resilience to economic and environmental challenges. (City of Bellevue Community Development 2020a)

The City of Bellevue has also set an equity priority for city programs, practices, and decision making, including its sustainability program: "*Does the proposed action support communities of color and low-income*

populations through workforce development, contracting opportunities, or the increased diversity of city staff?" As low-income and BIPOC workers experience a lower baseline adaptive capacity to climate impacts, the city can increase the adaptive capacity of its economic sector by implementing programs that center justice and equity.

3.3.4 Vulnerability Summary

Disruptions to business continuity and economic activities in Bellevue are likely in a changing climate. These impacts may be felt more acutely in specific neighborhoods and employment centers, which affects both residents and commuters to the city. In addition, economic vitality associated with tourism and cultural events that are held outdoors could be impacted by extreme heat, wildfire smoke, and sites could be damaged by drought and extreme precipitation; indoor recreation and cultural venues could alternatively see more demand as a result. The ability of this sector to prepare for and adapt to climate change depends on impacts to and adaptation measures enacted for other sectors, such as transportation, ecosystems, and land use and development.

Table 12 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for economic development in Bellevue.

TABLE 12 **Economic Development: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	High	Moderate	High	Impacts to infrastructure critical to business operations; direct impacts to outdoor workers during summer/fall; potential impacts to viability of outdoor-dependent businesses.
Extreme Precipitation/ Flooding	Moderate	Low-Moderate	Moderate	Impacts to infrastructure critical to business operations; potential impacts to viability of outdoor-dependent businesses.
Stream Temperature	N/A	N/A	N/A	No significant impacts anticipated.
Drought	Moderate	Moderate	Moderate	Sites could be damaged by drought, potentially impacting economic vitality associated with tourism and cultural events that are held outdoors
Wildfire Smoke	High	Moderate	High	Disruption of economic activity for the duration of smoke events, especially outdoor work and tourism.

SOURCE: BERK 2023

3.4 Ecosystems

3.4.1 Sector Overview

This section examines the projected impacts of climate change on Bellevue's ecosystems and natural features, which include urban forests, parks, open spaces, biodiversity, and ecosystem services. The city has almost 2,000 acres of parks and public Native Growth Protection Area (NGPA), which encompasses stream corridors, wetlands, forests, and habitat for a variety of terrestrial and aquatic species. Bellevue is known as a "City in a Park" and has strong community values around the natural environment, access to open space, and beautiful natural areas.

Ecosystem features and resources within Bellevue are varied, including 79 miles of streams within the city limits, approximately thirteen miles of large-lake shoreline, three small lakes, 650 acres of open space and gardens, and an urban tree canopy that covers 39% of land area (2019 Tree Canopy Assessment). These natural resources provide habitat for wildlife, and support critical ecosystem services, including water management and erosion control, and benefits to human health and wellbeing. Impacts on habitats and species affect the quality and supply of ecosystem services.

Bellevue's Parks and Community Services Department manages the city's street trees and arterial landscapes in designated areas. The department works to protect and enhance wildlife habitat, water quality, and forest conditions, and manages 92 miles of multi-use trails.

Projected climate change impacts of concern for ecosystems include increases to annual average air temperatures, increased average stream temperatures, increases in heavy rainfall and extreme precipitation events, increased frequency and extent of flood events, more prolonged and intense periods of drought, and an increased risk of wildfires and wildfire smoke.

Local resources reviewed for this section include the following:

- City of Bellevue Comprehensive Plan —Environment and Parks, Recreation, and Open Space Chapters (City of Bellevue Community Development 2015)
- Bellevue Parks & Open Space System Plan (City of Bellevue Parks & Community Services 2022)
- 2019 Urban Tree Canopy Assessment (Plan-It Geo LLC 2021)

3.4.2 Potential Impacts

Bellevue's ecosystems are projected to be highly vulnerable to extreme heat and higher stream temperatures, and more moderately vulnerable to extreme precipitation events and flooding. Wildfires are expected to have a significant direct impact in wildland areas outside the city, but not within the city.

- Increasing air temperature, combined with decreasing summer precipitation, is projected to decrease the species range for native birds such as the bald eagle, black oystercatcher, western grebe, trumpeter swan, and others (Mauger et al. 2015).

- Changes to temperature patterns over the course of a year are likely to impact the onset of spring conditions. These shifts will impact food availability for species, creating mismatches with established migratory and reproductive timings diminishing survival rates and reproductive success.
- Some native species (such as Douglas fir) require sufficiently low winter temperatures to be reached before they begin spring growth cycles. Higher winter temperatures could threaten the health or survival of such species (Mauger et al. 2015).
- Higher temperatures and increased incidence of extreme heat are likely to increase resident demand for access to shaded natural areas and recreational facilities with water access. This will likely contribute to increased use of parks and open spaces, which will both place additional burden on ecological systems and habitats, and potentially expose residents to hazards such as algal blooms (Mauger et al. 2015).
- Increased air temperature and extreme heat events may cause stress for species of local importance such as the Oregon Spotted Frog and other amphibians. These species are also expected to be impacted by changes in precipitation patterns and projected decline in wetland habitat (Mauger et al. 2015; WDFW 2015).
- Higher temperatures and increased incidence of extreme heat are likely to increase resident demand for access to shaded natural areas and recreational facilities with water access. This will likely contribute to increased use of parks and open spaces, which will both place additional burden on ecological systems and habitats, and potentially expose residents to hazards such as algal blooms (Mauger et al. 2015).
- Increased air temperature and extreme heat events may cause stress for species of local importance such as the Oregon Spotted Frog and other amphibians. These species are also expected to be impacted by changes in precipitation patterns and projected decline in wetland habitat (Mauger et al. 2015; WDFW 2015).
- Some invasive species and pests benefit from changing climatic conditions. Changing environmental conditions and increasing stress to host species and natives will give a competitive edge to nonnative and invasive species that may experience expansion in their ranges or be more adaptable to changes (e.g. extreme heat events may result in excessive tree mortality and increased spread and impacts of invasive species such as bark beetles).
- Extreme precipitation events, changes to precipitation patterns, and increased intensity of storms are likely to alter streamflow patterns and increase the volume of flows in streams and rivers, particularly those receiving stormwater runoff, during rainfall events. These heightened flows may increase erosion of stream banks and scouring around developed areas. Riparian corridors that have been degraded by urbanization and development are more susceptible to erosion and instability (May et al. 1998). Erosion of banks can also be exacerbated by degradation of vegetation, which is likely due to forecasted increases in drought conditions (Mauger et al. 2015).
- As precipitation events are forecast to become more polarized in nature (bigger storms are more intense, smaller storms are lessened), runoff that originates in developed and impervious areas is likely to increase. This can mean an increase in pollutant transport into waterways and decreased groundwater infiltration (Lake Sammamish Watershed Assessment).

- More intense precipitation events may lead to higher incidence of landslide events. Many parks and open spaces, including Weowna Park and Woodridge Open Space, contain steep slopes vulnerable to landslides. Should landslides occur in these areas, there may be damage to trail networks, which would reduce access for residents and increase maintenance demand.
- Many Bellevue parks and open space areas are susceptible to flooding, including the Lake Hills Greenbelt, Richards Creek Open Space, and Kelsey Creek Park. While some open spaces may be designed to accommodate flooding and may even play a role in mitigating the impacts of high streamflow, others may experience damage to trail networks and other recreational facilities because of increased flood exposure. This can damage habitat for wildlife and increase maintenance burdens, potentially reducing access to these spaces by residents.
- Urban flooding impacts resulting from intense precipitation events will likely occur more often in drainage basins with higher percentages of their land covered with impervious surfaces. This runoff negatively impacts water quality, habitat, and aquatic/amphibious species.
- Increased polarization in storm systems may exacerbate current conditions related to groundwater infiltration. If rain falls primarily in large storms that exceed absorption rates of existing wetlands and other infiltration sites, a greater proportion of annual precipitation will be lost as runoff. This may result in declining streamflow, as described above, but also has an important secondary impact of decreasing aquifer reserves, which can negatively affect wildlife.
- Increased occurrence of events such as landslides, flooding, or especially intense storms may create a need for additional resources for cleanup and/or restoration projects.
- More intense streamflow events due to increased precipitation, increased runoff, and decreased groundwater infiltration may increase erosion and sediment transport while decreasing dissolved oxygen levels having the overall effect of lowering water quality for aquatic species (CIG 2009).
- Warming of lakes may alter the timing of critical biological events such as the spring plankton bloom, which is tied to the onset of thermal stratification. This may alter predator-prey interactions or cause the decline of certain species such as *Daphnia pulicaria*, a keystone herbivore whose peak abundance has not shifted to match phytoplankton availability (Mauger et al. 2015).
- Warming lake temperatures will likely stress native kokanee fish in Lake Sammamish as waters become more stratified. These coldwater fish thrive within a narrow band of suitable temperature and dissolved oxygen conditions. During summers, these waters become too warm and dissolved oxygen levels drop, creating physiological stress on kokanee and other species. As lake temperatures rise with climate change, the suitable temperature-dissolved oxygen band will be severely limited or eliminated (King County 2013).
- Warm stream temperatures (influenced by ambient temperatures and streamflow rates) can affect adult salmon spawning and migration, by lowering availability of dissolved oxygen and increasing heat stress and competition from less heat-sensitive species. Warmer stream temperatures may be harmful to native vegetation in riparian areas, as well as aquatic vegetation, which could enable growth of invasive species that are harmful for riparian and aquatic habitat. These conditions may become more common as annual average air temperatures increase and precipitation patterns become more polarized.

- Soil moisture is expected to decrease during summer months and extended periods of drought. Decreased soil moisture means lower vegetation moisture, which increases stress on trees and plants, as well as diminishing the cooling effects of vegetation on the surrounding environment.
- Drought could deplete water availability in tributaries, especially in basins with high amounts of impervious surface and streams that are piped for long extents. Dry streambeds reduce the availability of fish spawning habitat.
- Drought and extreme heat-related declines in the groundwater stores that replenish streams in Bellevue will diminish streamflow, degrading habitat conditions through stagnation and warming. This can potentially lead to ecosystem failure if historically annual streams become seasonal as a result of depleted groundwater.
- Declines in groundwater availability may also drive increased demand for irrigation, particularly in settings that are less drought tolerant such as sports fields and agricultural uses. This can result in conflicts over water use between ecosystem needs and other uses when demand exceeds supply (typically in summer and early fall).
- Lower water availability and increased demand during periods of drought may diminish water levels in Bellevue's lakes. Declining water levels will diminish recreational value and contribute to warmer water temperatures, which may cause increases in hazardous algal blooms and harm cool-water aquatic species.
- Drier conditions due to drought, increased temperatures, and extreme heat events may increase the risk of wildfires occurring in large open spaces and urban forests. These fires may originate in these areas as a result of human activity (e.g. grills, cigarette butts, fireworks, electricity transmission infrastructure, etc.) or result from the spread of fire that originated in adjacent developed areas.
- Increased frequency of high fire danger days, drier fuels, and other climate variables are expected to increase fire risk in urban forests and in the wildland-urban interface. Increased wildfire is expected to cause disturbance to, and in the case of severe fires, alter regional ecosystems (CIG 2009).
- All of these impacts and stressors on wildlife and habitat may reduce the availability or efficacy of critical ecosystem services, including water management and erosion control, pollination, soil nutrient transport, and direct benefits to human health and wellbeing.

3.4.3 Adaptive Capacity

Adaptive capacity for ecosystems is the ability of Bellevue's ecosystems and natural features to withstand projected changes in the climate system and recover from climate shocks. To some extent, the adaptive capacity of ecosystems is determined by the qualities and features of the ecosystem itself—including the evolutionarily-determined attributes that may make a species more resilient or susceptible to climate extremes, and the capacity of an ecosystem as a whole to recover from species extinction. Many of the major limits to the adaptive capacity of ecosystems exist at regional, evolutionary, and planetary scales, and cannot be influenced by local policies alone; however, the City of Bellevue can continue to implement programs that support the resiliency of ecosystems and increase adaptive capacity of the ecosystem sector.

- Bellevue's Shoreline Master Program (SMP) establishes goals of maintaining shoreline ecological function, facilitating improvement of degraded conditions, and ensuring no net loss of ecosystem

function. By incorporating projected climate changes and climate shocks into SMP updates, the city can support the adaptive capacity of its riparian and aquatic ecosystems.

- Some native plant and tree species are projected to respond well or have higher adaptive capacity to specific climate shocks or changing climatic conditions. The city can support native habitat and ecosystem resilience by using these species in future landscaping and restoration projects.
- Many plans in Bellevue identify and prioritize restoration and conservation of habitat. These plans can increase adaptive capacity by incorporating projected climate change impacts and designing restoration and conservation projects with the goal of assisting ecosystems in adapting to those impacts.
- Expansion of low-impact development practices can help mitigate runoff pollution and decrease incidence of urban flooding, promoting ecosystem health.
- Some adaptive capacity initiatives, such as the reduction of non-point pollution sources into waterways, require the public to make modifications to their own properties. The City can support these efforts through educational and incentive programs.
- Regulated wetland habitats within Bellevue are protected from development through the city's critical areas regulations. The city also manages wetlands on city property and seeks to restore ecosystem function. Wetlands can provide environmental benefits and ecosystem services, such as helping to mitigate flooding severity by capturing, storing, and filtering stormwater. There may be opportunities for the city to partner with private landowners, non-profit organizations, or others to expand wetland restoration efforts.
- Certain significant local species, including salmon and Douglas fir, are expected to be highly sensitive to climate change impacts. Habitat degradation and ecosystem fragmentation can further stress these native species and directly damage population by blocking naturally occurring species migration in response to climate change. The city can support the adaptive capacity of these and other culturally significant species, and the ecosystems of which they are a part, by implementing and supporting policies that protect and restore quality habitat and habitat connectivity.
- Bellevue has completed a series of Urban Tree Canopy Assessments, the most recent for 2019. These assessments serve to guide the city as they aim to protect and expand the urban canopy from 39% of the city's land area towards a goal of 40%. Restoring tree canopy can provide increased habitat for biodiversity, as well as secondary benefits such as mitigation of the urban heat island effect and shading of waterways and streams. These aims are aided in part by strategies included in the 2021-2025 Environmental Stewardship Plan:
    - 8% of the urban tree canopy overhangs impervious surfaces
    - Bellevue gained 2 percentage points of tree canopy between 2011 and 2019
    - 22% of the city has been identified as possible planting area while 39% has been identified as unsuitable
    - Tree canopy varies between neighborhoods. For example: Downtown, BelRed, and Factoria all have 20% or less coverage while Bridle Trails and Cougar Mountain/Lakemont exceed 50% coverage

- The 2021-2025 Environmental Stewardship Plan includes strategies to improve stormwater systems through the expansion of green infrastructure and system retrofits. Strategies to reduce municipal water usage by 10% are also included.
- The 2022 Parks & Open Space System Plan lays out a framework for the acquisition and development of new and existing parks and open spaces, including waterfront access, with a goal for all of Bellevue residents to live within a 1/3 mile of a park, open space, or trail head.
- Bellevue anticipates substantial population growth. Policies in the Environmental Stewardship Plan consider climate change impacts in land use planning. Implementation of these policies will be essential to minimize encroachment on undeveloped or rehabilitated ecosystems.
- Changes to the level of tree canopy and green space have secondary impacts on a number of ecosystem-related factors, including stormwater retention and ambient air quality. The benefits of increasing green space and tree canopy are reflected throughout the Bellevue Comprehensive Plan and the 2021-2025 Environmental Stewardship Plan.
- An updated Watershed Management Plan is currently being developed by the City of Bellevue, which will address projects to improve runoff pollution, habitat protection, and stream restoration.

3.4.4 Vulnerability Summary

The vulnerability of ecosystems in Bellevue to climate change impacts is moderate to moderate-high. Non-climate stressors including development pressure, adjacent land use, and historic land uses all magnify the level of sensitivity of many ecosystems experience in Bellevue. High levels of exposure and sensitivity are partially offset by moderate to high adaptive capacity in the form of substantial planning for the future of resources such as the Urban Tree Canopy and each of the city's watersheds.

Table 13 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Ecosystems sector in Bellevue.

TABLE 13 **Ecosystems: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	High	Low	High	Many ecosystems will be highly impacted by extreme heat, and adaptive capacity is limited. The city can increase adaptive capacity through programs that promote overall ecosystem health.
Extreme Precipitation/ Flooding	High	High	Moderate	Extreme precipitation is expected to cause flooding, erosion, and habitat destruction. The city can increase adaptive capacity through Low-Impact

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
				Development and other water management programs.
Stream Temperature	High	Low	High	Many aquatic species are very vulnerable to changes in stream temperature, and opportunity for significant increases in adaptive capacity is limited.
Drought	Moderate	Moderate	Moderate	More frequent and more intense drought will stress species, decrease soil moisture, and impact streamflow and groundwater reserves.
Wildfire	Low	Low	Low	Periods of extreme heat, combined with more frequent drought, will increase potential for wildfire in large open spaces and urban forests. Some potential for wildfire smoke to impact animal species.

SOURCE: ESA 2023

3.5 Emergency Management

3.5.1 Sector Overview

This section identifies assets, potential impacts associated with climate change, and vulnerabilities for Emergency Management in Bellevue. The City of Bellevue performs emergency management through four phases: mitigation, preparedness, response, and recovery. All departments contribute to mitigation of potential hazards and emergencies through planning, regulation, and capital improvements. Emergency preparedness involves education, establishing procedures for continuity of operations, maintaining assets, and coordination with partners. While day-to-day emergency response is primarily handled by the Fire, Police, and other operational departments (Transportation, Utilities, Parks, etc.), larger emergencies can require disseminating information, coordinating resources, and an activation of the interdepartmental Emergency Operations Center (EOC). Recovery involves damage assessment, conducting repairs, and providing assistance to impacted people and organizations.

Emergency management is a complex system of efforts to ensure that protocol and resources are in place to minimize negative impacts from emergencies. Climate change presents a challenge to the emergency management system, which will have to respond with increasing frequency to increasingly severe extreme weather events and natural disasters. These changes could strain capacity and challenge current

approaches to mitigation, preparedness, response, and recovery. Climate change may or may not substantially alter Bellevue's emergency management protocol, but managing greater and more frequent climate extremes will require adapting equipment, facilities, and services.

Local resources reviewed for this section include the following:

- 2018-2023 Bellevue Comprehensive Emergency Management Plan (City of Bellevue Office of Emergency Management 2018)
- 2018-2023 Hazard Inventory and Risk Assessment (City of Bellevue 2018)

ASSETS – EMERGENCY MANAGEMENT SERVICES

Fire Department Emergency Response Resources: The Bellevue Fire Department has 179 Firefighter-EMTs and 34 Firefighter-Paramedics. Nine fire stations (plus a paramedic unit stationed at Overlake Hospital) are located throughout the city to minimize response times. There are three aid cars equipped with basic life support and four parametric units with advanced life support equipment. In addition to the city, the Bellevue Fire Department provides services to the communities of Newcastle, Medina, Clyde Hill, Hunts Point, Yarrow Point and Village of Beaux Arts. In 2021, there were 22,545 incidents provided a response, and most are emergency medical related. Of 15,951 emergency medical incidents most required basic life services (two thirds) (Table 14).

TABLE 14 **Bellevue Fire Department Emergency Medical Incidents**

Service	2017	2018	2019	2020	2021
BLS	9,337	10,555	10,405	9,115	10,693
ALS	5,982	5,121	5,217	4,676	5,258
Total	***15,319***	***15,346***	***15,622***	***13,791***	***15,951***

Legend: BLS: basic life support ALS: advanced life support

SOURCE: Bellevue Fire Department 2022a

3.5.2 Potential Impacts

Potential impacts of note for Bellevue's emergency management sector are extreme heat, extreme precipitation and flooding, and wildfires/wildfire smoke. Drought is not expected to be a major concern.

- Extreme weather events may strain resources of the departments of the City of Bellevue that provide emergency support functions, due to increased demand for emergency response and challenges to response. Increased frequency of precipitation and flood events could result in compounding impacts or prolonged emergency situations, which could overwhelm emergency management services and disrupt the continuity of operations. If emergency management personnel or systems are under-resourced for future climate conditions, they may struggle to maintain standard operating procedures for lower priority short-term response activities, such as documentation of efforts, status reports, or other administrative processes.

- Increased temperatures will result in more heat-related illness, especially among older residents, young children, and people with existing health issues. This will result in more emergency calls, which could strain emergency response capacity. Increases in the frequency of heat-related illness calls could demand that emergency response apparatus carry more fluids or ice than they currently have capacity for. There may be increased demand for emergency medical services for communities outside of the Bellevue Fire District, as Bellevue provides advanced life support services to numerous communities that have only basic life support training (e.g. Issaquah). Basic life support training does not allow for intravenous medical procedures, such as providing intravenous (IV) fluids, which is a standard procedure for people suffering from heat-related illness.
- Bellevue Fire CARES outreach efforts to vulnerable populations for welfare checks and to offer assistance will be required with greater frequency in a changing climate. Secondary resources to which CARES refers residents may become overwhelmed, which could direct the need for response back to police and fire departments.
- There will be increased demand for cooling centers and capacity of existing cooling centers may be exceeded. Information about cooling centers is not clearly publicized in a consistent manner. Having inconsistent hours and locations may increase the public's exposure to extreme heat if they travel to locations that are not serving as cooling centers. Seniors, low-income populations, people who are not fluent in English, and other vulnerable populations may not as easily access information online and could rely on established procedures when seeking respite or assistance. In addition, individuals without reliable transportation means may not easily access these sites.
- Greater numbers of people will seek out opportunities for swimming during extreme heat events, which could lead to a higher number of calls for water search and rescue operations. Lifeguards monitor beaches for part of the day at Meydenbauer Bay, Enatai Beach, Newcastle Beach, Clyde Beach, Chism Beach, and Chesterfield Beach. While there are a small number of other public waterfront access points, a majority of water access likely occurs on private land that cannot be monitored. As such, there can be additional challenges to quickly and safely accessing the location of water-based emergencies. Increasing occurrences or risks of drowning may increase demand for water rescue training and education around water safety.
- Extreme heat events increase the risk of power outages, due to overwhelmed energy infrastructure and increased energy demand. Power outages can disrupt emergency management activities, including communications, office operations, and response procedures, depending on the availability of battery-powered equipment. While personnel may be equipped with portable radios, centralized communication equipment and other technology at emergency management facilities are more likely to rely on the power grid.
- Response personnel may be more likely to experience heat-related illness due to exposure to the elements and exertion in extreme heat conditions, which could be exacerbated by wearing heavy uniforms. Increased exposure to extreme heat may necessitate additional education or training to remind emergency management personnel to take precautions to avoid heat-related illness.
- Power outages at water facilities can result in loss of pressure in hydrants, which can harm fire response. Power outages may result in failure of other utilities and safety systems at private buildings that could increase calls for emergency response.

- Extreme precipitation events will strain stormwater systems, especially in urban areas, which could necessitate closures, inspections, and evacuations of affected areas by emergency personnel. A concentrated response to urbanized areas of Bellevue could delay response to more remote areas of the city.
- Intense precipitation and storm events may result in power outages, which could impact emergency operations for facilities without backup power. Communications and utility systems may especially be vulnerable to storm events. Loss of communications would inhibit critical information-sharing procedures established by the Comprehensive Emergency Management Plan.
- Extreme precipitation events may affect the ability of emergency management personnel to respond to calls or require additional precautions. Heavy rain may require slower, cautious response from emergency vehicles. Roads inundated from stormwater may also require slower driving or alternative routes to destinations. Extreme precipitation in winter may result in ice that creates unsafe conditions in vehicles and on foot.
- Floodwaters may incapacitate certain emergency response vehicles and demand for amphibious vehicles or boats may increase.
- Increased demand for technical rescues in various disciplines, including structural collapse, may occur due to increased potential for landslides.
- Erosion or landslides resulting from extreme precipitation can damage roads, which would require emergency management coordination for road closure and redirecting traffic.
- Demand for technical rescue from floodwaters and inundated vehicles may increase due to increased frequency and severity of flood events.
- Drought conditions will heighten wildfire risk, which would likely result in more calls about brush fires and yard fires. The Fire Department may have to dedicate greater resources to communicating and enforcing burn bans and managing brush or yard fires.
- Drought conditions may strain the availability of water for emergency services, including firefighting and medical services. Demand for medical services and firefighting is likely to be somewhat elevated during a drought, especially in an emergency that has disrupted the availability of water. Firefighters can draw water from surface water sources, but medical services would require disinfected water sources that would be less readily available during a water supply emergency.
- If drought conditions strain drinking water resources, there may be a need for water distribution or assistance from emergency management personnel. Long-term disruptions to water service could entail additional planning for emergency assistance.
- Extended drought conditions may require stricter and more active enforcement of water bans.
- Wildfire smoke from outside of the city would present health risks, especially to elderly populations and those with existing health issues, which could increase emergency calls. Poor air quality from wildfire smoke is not easily mitigated. Public safety alerts would need to be communicated widely to the public to convey best practices for preventing exposure. CARES or other human services workers may have strained capacity doing outreach to vulnerable populations and could be exposed to unhealthy air quality conditions.

- Cumulative impacts from multiple emergencies, such as an earthquake during an extreme heat event, could strain existing emergency response systems and facilities.

3.5.3 Adaptive Capacity

Adaptive capacity for Emergency Management is the ability of Bellevue's Emergency Management systems to adequately respond to climate emergencies and minimize the impact of climate events on the community, without putting emergency management personnel at risk or straining resources.

- The City of Bellevue maintains a Comprehensive Emergency Management Plan, an all-hazards plan that provides a framework for how the city would respond to and recover from an emergency. As such, there are established methods of emergency management that can be implemented under any of the projected extreme weather events. The city could increase adaptive capacity by ensuring that its Comprehensive Emergency Management Plan accounts for projected increases in extreme weather and climate events.
- The City of Bellevue has an Emergency Water Supply Master Plan to address severe and long-lasting community water supply impacts anticipated from natural disasters in Bellevue's service area. The Plan is not itself intended to address emergency response, but summarizes vulnerabilities to the water supply and recommends mitigations that may ease the burden of emergency response in the event of natural disaster impacting water supply. The City can increase the adaptive capacity of Emergency Management by further incorporating climate impacts into the Emergency Water Supply Master Plan (City of Bellevue Utilities 2023).
- The longer-term impacts of climate change will allow for Emergency Management to plan for and adapt to projected future conditions. The sector can increase its adaptive capacity by proactively implementing programs that prepare it for intensifying climate change. This could include personnel training, updating risk assessment protocols, and communicating risks to the public.
- Climate change in the present could have short-term effects on the continuity of operations and delivery of services in Bellevue, which will provide opportunities to observe specific impacts and prepare for them before these impacts become more frequent or severe.
- Both the Fire and Police Departments have personnel who write proposals for and administer grants to support additional training, equipment, or resources for emergency management departments. The City of Bellevue has historically participated in emergency management grant programs to support training and equipment for emergency preparedness. The Bellevue Police Foundation also provides annual grants to the Bellevue Police Department, most of which are for equipment and training. Continuing to pursue these grants may provide future opportunities for improving the resilience of Bellevue's emergency management operations to climate change.
- The City of Bellevue is in the early stages of building electric vehicle charging capacity for its electric emergency vehicles. This includes adding Level 2 electric vehicle charging stations and establishing fast chargers on backup generators in case of emergency events.
- Recurring updates to plans for hazard mitigation, emergency management, growth management, and other affected areas of city operations will allow for opportunities to reassess historical impacts and projected changes, which can inform future adaptation.

- The City of Bellevue maintains development regulations that aim to prevent the creation of new risks to people and property by restricting impactful land use activities in hazard areas. Outcomes of the implementation of these regulations can be assessed to determine their effectiveness. Modifications to regulations can be made to account for climate change and related increases in risk to public health and safety, such as accounting for future flood extents.
- To increase the adaptive capacity of Emergency Management, departments can plan for and mitigate the impacts of projected climate changes on their personnel. Response personnel may need additional education or training to remind them to take precautions to avoid heat-related illness.
- The City of Bellevue has numerous active channels for communicating with the public, including King County & Bellevue Alerts, Bellevue Television, the city website, and social media. These communications channels are used to send out emergency information. There are also resources through King County's Office of Emergency Management (e.g. King County Alert, Reverse 9-1-1) that can be used to issue alerts directly to members of the public. These media could be used to increase education around risks, directing the public to emergency assistance and resources, and conveying further information about ongoing emergencies, which will be especially useful as emergency weather events become more severe in their impacts.
- The city has upsized culverts in the past to reduce the risk of flooding and has identified many capital projects to enhance the resilience of the drinking water supply during emergencies. Improvements could similarly be made to transportation infrastructure, such as evacuation routes or those to the hospital, or utilities at critical facilities.
- The city can plan for extreme weather events by setting up programs for cooling centers and evacuation locations for residents temporarily displaced by flooding and landslides. The city can increase adaptive capacity by creating a proactive, ongoing, and flexible protocol for opening and operating these emergency centers, rather than acting in response to an extreme weather event as it occurs.

3.5.4 Vulnerability Summary

Most of the major climate change-driven vulnerabilities to emergency management are related to capacity, facilities, and equipment. Emergency management personnel in Bellevue already respond to extreme weather events that are comparable to future conditions. More severe weather events will strain existing resources, but in many cases would not require different resources for emergency response. The potential for adaptive capacity in this sector is high. Minor impacts to emergency management primarily relate to mitigation and preparedness. Training and resources that support personnel enable success in their job performance; many such trainings and resources are already provided but may be insufficient for future needs. Emergency management personnel are often charged with responding to public behaviors, such as mental health crises, that create risk or worsen during emergencies. Under a more extreme climate, these behaviors may present greater vulnerabilities. Building adaptive capacity and preparedness to respond to them will be a critical component of reducing vulnerability.

Table 15 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Emergency Management sector in Bellevue.

TABLE 15 **Emergency Management: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	High	Moderate	High	Emergency Management departments will need to respond to increasing heat-related illnesses and search and rescue calls caused by extreme heat events. This could strain resources and place emergency responders at risk of heat illness.
Extreme Precipitation/ Flooding	High	Moderate	High	Extreme precipitation may cause power outages, which could impact fire response. Flooding and landslide emergencies will impact Emergency Management infrastructure and strain resources and capacity.
Stream Temperature	N/A	N/A	N/A	No significant impacts projected.
Drought	Low	Low-Moderate	Low	Drought may impact water supply for fire and medical emergencies and require water distribution during drinking water emergencies. This may limit the ability of Emergency Management to respond effectively to emergencies and strain resources/capacity.
Wildfire and Wildfire Smoke	Moderate-High	Low-Moderate	High	Wildfire risk, requiring emergency responders, is projected to increase, particularly during extreme heat and drought events. Wildfire smoke will increase emergency calls and require more robust emergency communication systems.

SOURCE: ESA 2023

3.6 Human Health

3.6.1 Sector Overview

This section identifies assets, potential impacts associated with climate change, and vulnerabilities for Human Health in Bellevue. Human health is influenced by countless environmental, social, and economic

factors. The City of Bellevue supports healthy living and communities through regulation of the environment, provision of community resources and facilities, management of utilities and services, and engagement with the population. Climate change can impact people and the systems currently in place to maintain public health through harmful weather conditions, disruption of services, increasing the potential for exposure to hazardous materials, and increasing the exposure of vulnerable populations.

Climate change events can exacerbate pre-existing health conditions. Additionally, persons with less economic resources and BIPOC populations or those who speak English less than very well can have difficulty preparing for and recovering from climate change events. The City of Bellevue supports human health through its human services programs, parks and recreation, and emergency medical services, and this section identifies potential hazards and strategies to promote community health and well-being including building on Bellevue's current programs and policies.

Local resources reviewed for this section include the following:

- Bellevue Comprehensive Plan – Human Services Element (City of Bellevue Community Development 2015)
- Bellevue Parks & Open Space System Plan (City of Bellevue Parks & Community Services 2022)
- Sustainable Bellevue: Environmental Stewardship Plan (City of Bellevue Community Development 2020a)
- Blueprint for Addressing Climate Change and Health (Seattle-King County Public Health Department n.d.)

ASSETS – HUMAN HEALTH

- Residential Population: The Washington Office of Financial Management estimates Bellevue's 2022 population at 153,900 people, making it the second-largest city in King County.
- Human Services Resources: The City of Bellevue convenes human service providers and manages a human services fund meant to meet basic human needs for: survival, finding and retaining gainful employment, support in times of personal and family crisis, assistance in overcoming family or individual problems, and help in gaining access to available, appropriate services.
- Recreation Facilities: City park assets include over 2,700 acres of land, 98 miles of multi-use trails, 30 sport fields, 63 sport courts, 47 playgrounds, 13 picnic shelters, four community centers, three community farms, and 100 community garden plots.
- King County operates four libraries in Bellevue, which have air conditioning and have operated as cooling centers.
- Neighborhoods: Bellevue has fourteen designated neighborhoods and roughly 50 neighborhood associations, which help to build connections within local communities.
- Mini City Hall: Bellevue's Mini City Hall is a neighborhood service center at the Crossroads mall, which provides referrals to human services providers and other resources for Bellevue residents.

- Overlake Hospital is the primary hospital in Bellevue, and Seattle Children's Hospital operates a clinic, surgery center, and urgent care in Bellevue. Kaiser Permanente Medical Center offers urgent care and other services.

3.6.2 Potential Impacts

Potential impacts of concern for human health are high temperatures/extreme heat events and wildfires, especially wildfire smoke. Extreme precipitation events and flooding, and higher water temperatures in streams and lakes also present potential vulnerabilities for human health.

- Increased temperatures will worsen the urban heat island effect, where built environments absorb and retain heat. Urban heat island effects are worse in areas with limited tree canopy or natural ground cover, which provide shade and cool the air. The average urban tree canopy coverage in Bellevue neighborhoods is 39%, but the following neighborhoods have notably lower urban tree canopy: BelRed (14%), Downtown (9%), Crossroads (31%), and Factoria (20%). King County's heat island mapping study demonstrates that many of these areas, as well as Lake Hills, retain high levels of heat into the evening, while much of the city cools. Seniors and people with disabilities are especially vulnerable to heat-related illness. BelRed and Northeast Bellevue both have relatively high numbers of senior residents, while Lake Hills and Northeast Bellevue have relatively high numbers of people with disabilities. People in these neighborhoods could have more significant health impacts during extreme heat.
- Extreme heat and prolonged periods of high temperatures can strain the electric grid, with power outages presenting a significant risk to human health, due to the need for electricity to provide critical services and maintain safe conditions at home.
- Increases in average annual temperature and frequency of extreme heat events have increased the demand for air conditioning. Higher levels of air conditioning usage result in significant increases in energy demand during warm months, in addition to the demand increases from fans, refrigerators, and people spending more time inside. High energy demand threatens power outages, putting the public at increased risk of extreme heat exposure. In 2013, 16% of households in the Seattle-Tacoma-Bellevue Metropolitan Statistical Area had air conditioning, which had increased to 53% of households by 2021. In 2013, 9% of households up to 150% of the poverty line had air conditioners, which increased to 11% by 2021, while the overall proportion of households in poverty increased. As such, low-income populations are at a high-risk of exposure to extreme heat, with limited adaptive capacity at home. Households without air conditioning would already have elevated temperatures at the start of a power outage, creating increased sensitivity to the power outage for these households, which would also experience exposure to extreme heat indoors sooner than a house that was running air conditioning at the start of an outage. Buildings with greater mass tend to retain heat more effectively, increasing the risks to low-income and other vulnerable populations, who are more likely to live in multifamily or congregate housing situations. Seniors and people with disabilities would have heightened sensitivities to these conditions, especially if they are low-income or living in multifamily or congregate housing.
- Increased stormwater flooding and extreme weather conditions in general can increase risks of systems failures and illicit discharges of hazardous waste at sites that handle or store hazardous materials. Release of hazardous materials can have negative health consequences or necessitate evacuation of the area. The EPA's Environmental Justice Index places the BelRed neighborhood above the 90th percentile in the state for hazardous waste proximity. The Environmental Justice Index weights metrics

based on the vulnerability of the population in the area. While hazardous waste proximity in the neighborhood ranges from the 72nd to the 81st percentile in the state, the socioeconomic demographics of the population in BelRed reflect a higher sensitivity to hazards.

- Increases in extreme precipitation events and flood extents will produce waterlogged soil, which can be unstable and hinder drainage into the soil. Waterlogged soil or flooded areas can lead to sewer backups from septic systems. Most of Bellevue is connected to the King County wastewater system, but a few neighborhoods have high concentrations of septic systems, including the Bridle Trails neighborhood and a section of the Newport neighborhood between 118th Avenue SE and I-405. The Newport area may be especially impacted by waterlogged soil, as much of the area between 118th Ave SE and the Lake Washington waterfront is in the 1% annual chance floodplain. Inundation of these lower areas could slow drainage out of the neighborhood and backup septic systems.
- Extreme precipitation and flooding can create unsafe living conditions through damage to structures and introduction of harmful materials in floodwaters. Buildings exposed to wet conditions through inundation, roof leaks, or damage to utilities risk growing mold, if not dried or cleaned sufficiently. Mold exposure can create serious health conditions and worsen existing conditions, especially respiratory diseases. The risk of exposure to mold or harmful materials is higher for those living in older houses, which are more likely to have been built prior to floodplain development regulations. Older homes may also be in worse states of deterioration and may be more likely to utilize organic materials such as wood that mold grow on. Low-income residents may lack adaptive capacity to professionally repair or clean flood damage, while senior and disabled residents are less likely to be able to perform needed cleaning or repairs after their homes are damaged.
- Heavy rains can produce dangerous travel conditions that result in higher numbers of accidents. Large numbers of injuries in a concentrated time period may overwhelm the Overlake Medical Center, especially if other regional hospitals are experiencing similar service demand or road conditions make other hospitals inaccessible. Flooded roadways are a serious hazard, with a majority of flood-related drownings occurring when vehicles are driven into floodwaters. However, the few locations where roads are at risk of flooding in Bellevue indicate that a more common hazard would be injuries from slippery road conditions. Rain events in general can create hazardous travel conditions, but high-volume winter freezing-rain events have produced icy conditions in recent history that resulted in significant increases in injury.
- Ice from large precipitation events is harder to remove from streets and sidewalks and is present for longer periods of time, exposing more people to the hazard. During a December 2022 ice storm, the Seattle Fire Department had its highest call volume on record, which included over 300 calls for falls on the ice, approximately one-third of which required hospitalization. During the same storm, Washington State Patrol responded to hundreds of vehicle collisions in King County. People who cannot work from home, especially those in service industries, would be most exposed to risks of fall and collisions.
- Increased temperatures in Lake Washington will improve growing conditions for cyanobacteria (blue-green algae), which can cause irritation from skin contact and severe illness if ingested. Pets may experience organ damage or death if consuming water with cyanobacteria. Limited English speaking and low-income populations may be most vulnerable to cyanobacteria exposure, as they may be more likely to rely on public facilities for recreation, may not have appropriate technology access to receive

alerts, and warning signage at beaches may not be translated. However, private waterfront exposure could be much more significant, as water quality would not be monitored at private properties.

- Increased wildfire risks will worsen air quality, as wildfire smoke contains carcinogenic particulate matter that can irritate the lungs. Exposure to wildfire smoke would have negative health impacts for anyone, but it would be particularly harmful for people with respiratory diseases, such as asthma, seniors, and young children. Bellevue has a fairly average asthma rate for King County, with little variation across Census Tracts. The highest asthma rates are in Lake Hills, but they are not particularly elevated. People living or working near the highways in Bellevue have heightened levels of exposure to a variety of harmful pollutants, which can impair lung development, reduce lung function, and increase risks of lung disease, in addition to non-respiratory impacts. Extended periods of poor air quality due to wildfire smoke, coupled with degraded air quality where people live or work, could increase development of respiratory disease and drive increased hospitalizations. The large senior population in BelRed and somewhat high percentage of children living in Eastgate may be more vulnerable to wildfire smoke impacts because they both belong to groups associated with higher sensitivity, combined with increased exposure from proximity to highway pollution if they are within the APEZ.
- Wildfire smoke may indirectly impact mental health. The Washington Department of Health has warned of psychological stress as a symptom of exposure to smoke. The presence of wildfire smoke has been described in research as causing "solastalgia," which is place-based distress related to environmental change. The direct impacts of wildfire smoke on mental health have not been extensively studied (Eisenman et al. 2021). However, spending extended periods of time inside, which is frequently encouraged to avoid poor air quality, has been studied extensively and been found to cause heightened stress levels and depression. As such, people who follow best practices and avoid wildfire smoke are still at risk of health impacts.
- Although Bellevue is a more affluent community, some demographic risk factors include a high share of BIPOC residents including those that are foreign born and speak English less than very well, and older adults and those living alone. A lack of affordable housing is also a risk. The link between demographic factors and climate stressors is described in more detail in Table 16. Generally, age, health, income, race, immigration/language, and other factors can increase vulnerability to extreme heat, flooding, and wildfire smoke.

TABLE 16 **Demographics and Link to Climate Stressors**

Demographics	Vulnerability	Heat	Flood	Smoke
Children, <5 years old	Breathe more air and drink more water per body weight than adults Developing organs and low immunity Dependent on adults More time spent outdoors	X	X	X
Older Adults, > 64 years old	Low immunity Pre-existing conditions Limited mobility	X	X	X

Demographics	Vulnerability	Heat	Flood	Smoke
Communities of Color	Structural racism Inadequate infrastructure Health disparities Lack of social capital	X	X	X
Low-Income Communities	Less resources and means to evacuate Inadequate infrastructure	X	X	
Living Alone	May be less connected to information or community.	X	X	
Immigrants (inc. limited English)	Lesser English language abilities and cultural differences during evacuation Access to post-disaster funding		X	
Disabled	Limited access to knowledge, resources, and services to effectively respond to environmental change Compromised health makes people with disabilities more vulnerable to extreme climate events or infectious diseases More likely to have difficulties during required evacuations	X	X	X
Unemployment	The potential loss of employment following a disaster exacerbates the number of unemployed workers in a community, contributing to a slower recovery from the disaster.	X	X	
Outdoor workers	Exposure to high temperatures, air pollution, extreme weather and natural disasters, and biological hazards	X		X
Persons with pre-existing or chronic medical conditions	Climate stressors can increase respiratory and cardiovascular disease, injuries and premature deaths related to extreme weather events, increased exposure to food- and water-borne illnesses and other infectious diseases, and threats to mental health	X	X	X
Pregnancy	Exposure to high temperatures or air pollution could increase the potential for babies to be premature, underweight or stillborn.	X		
Education—less than high school degree	Lower education constrains the ability to understand warning information and access to recovery information.	X	X	X

Note: * The CVI addresses outdoor workers in the heat index based on a review of literature and example climate index models.

SOURCES: APHA 2021; Cutter, 2003; EPA 2021; Lundgren and Jonsson 2012; Reid et al. 2009; Yu et al. 2021

Table 17 shows that these risk factors are not evenly distributed throughout the city; some neighborhoods are more vulnerable to climate impacts than others due to their demographic makeup. Bellevue has a high share of BIPOC population and persons speaking English less than very well. Older adults and adults living alone are also notable at above 10%.

TABLE 17 Geographic Distribution of Demographic Risks from Climate Impacts

Demographics	Citywide Statistics	Neighborhoods with Greater Share
Children, <5 years old	4.4%	BelRed, Crossroads, Eastgate, Newport, West Bellevue, West Lake Sammamish
Older Adults, > 65 years old	15.0%	Crossroads, Northeast Bellevue
Communities of Color (non-White including Hispanic)	56.5%	BelRed, Bridle Trails, Cougar Mountain, Crossroads, Lake Hills, Somerset, West Bellevue
Low-Income Communities (Poverty Rate)	7.4%	BelRed, Crossroads, Lake Hills, Factoria, Newport
Living Alone	14.6%	BelRed, Downtown
Immigrants (inc. limited English) - Foreign Born - Speak English less than "very well"	 42.0% 16.5%	 Linguistic Isolation: Downtown
Disabled	9.5%	Unmapped
Unemployment	3.8%	Crossroads, Newport, Northeast Bellevue, Northwest Bellevue, Woodridge
Outdoor workers	4.1%	Eastgate, Newport, Northeast Bellevue, West Lake Sammamish, Woodridge
Persons with pre-existing or chronic medical conditions - Fair or poor health%	 8.5%	Crossroads, Eastgate, Factoria, Lake Hills, Newport, Somerset, West Lake Sammamish
Education – less than high school degree	10%	Northwest Bellevue

SOURCES: ACS 2022; Seattle-King County Public Health Department n.d

3.6.3 Adaptive Capacity

Adaptive capacity for Human Health is the city's ability to minimize the health risks of climate impacts to its community while addressing demographic-related disparities in climate health risks to the city's population.

- The City of Bellevue incorporates public health considerations into strategic planning efforts, such as its Tree Giveaway program, which targets neighborhoods with low tree canopy and low tree equity scores. Consistently assessing public health risks and how to alleviate them in planning efforts will help to build capacity and competencies for managing health impacts of climate extremes.
- The city, via the Utilities Department and in coordination with the Seattle-King County Health Department, regulates septic systems that pose a threat to public health. Septic systems are at risk of failing under flood and extreme precipitation conditions, which will make maintaining these systems more difficult for property owners as climate change worsens. State and County regulations establish when there is a need for a property with a septic system to connect to a public sewer, but the city has

the capacity for outreach to septic owners and to financially support property owners in connecting to public sewer systems.

- The City of Bellevue provides supplemental public transportation options and works with partners to improve existing public transportation resources. Most community centers, libraries, and major medical centers are accessible through multiple public transportation options, some are underserved, such as the Highland Community Center in BelRed, which can be directly accessed through only one bus route. Providing public transit information when utilizing public facilities for emergency services can improve access. Additionally, the City of Bellevue could implement expanded paratransit services during emergencies or work with King County Metro to expand access to these services that are crucial for senior and disabled populations.
- The City of Bellevue has established community centers and libraries as cooling centers during heat waves in recent years. Excessive heat warnings and cooling center announcements on the city's website have historically identified four community centers as cooling centers (e.g. Crossroads, Highland, North Bellevue, and South Bellevue), which are all located on the east side of the city. King County operates four libraries in Bellevue, all of which are air conditioned and most of which have operated as cooling centers during heat waves. See section 3.5.3 for further discussion.
- King County Metro Transit also provides service to cooling and heating centers during extreme temperature events. During previous extreme heat events, King County Metro Transit did not collect fares for individuals travelling to cooling centers.
- The adaptive capacity of low-income households to extreme heat and wildfire smoke can be supported by the city through connecting households with existing energy assistance and weatherization programs. The federally-funded Low-Income Home Energy Assistance Program can provide low-income households with assistance on utility bills, as well as pay for air conditioners and air purifiers. PSE's Home Energy Lifeline Program also provides assistance with bill payment for low-income households. Home Weatherization Assistance provided through state and federal funding funds improvements for low-income households, such as air sealing, energy conservation, and improving indoor air quality, which reduces the financial burden of maintaining cool and healthy indoor spaces. Energy Smart Eastside provides incentives for low and moderate income Bellevue households to install energy efficient heat pumps, which can be run in reverse to air condition a home.
- BelRed and the Downtown district have the two lowest percentages for possible planting area for new trees and the two lowest percentages of existing tree canopy. The City of Bellevue has limited capacity to directly plant new trees in these areas to adapt to climate change, except on public property. The ability to increase tree canopy in these areas would mainly be through development requirements or partnership with private property owners in these areas. This could be performed through land use standards in the Bellevue Land Use Code, such as 20.20.900 Tree Retention and Replacement or 20.25A.120 Green and Sustainability Factor.
- Low-income populations may have limited adaptive capacity that could increase their vulnerability, such as needing to physically go to work during a climate emergency, being unable to afford air conditioning, or lacking the funds to make repairs after a flood. People in the eastern part of the Crossroads neighborhood and the northeast corner of Lake Hills may especially lack adaptive capacity, as the two Census Tracts in this area currently have high concentrations of low-income populations and have the highest ratios of housing cost to income in Bellevue.

- Limited English-speaking populations may have reduced adaptive capacity due to reduced accessibility of information and reduced ability to communicate needs. The area bounded by 64th Ave SE and NE 8th Street that consists of the Landmark Apartments, Bellepark East Apartments, and Woodside East Apartments is currently above the 90th percentile in Washington for limited English speaking and low-income. The City of Bellevue has the capacity to translate weather emergency information and perform outreach to vulnerable populations during weather emergencies to ensure they are aware of available resources.
- The city can perform similar public health information outreach to limited English-speaking populations for other climate-related impacts such as swimming closures due to algal blooms or wildfire smoke / poor air quality.

3.6.4 Vulnerability Summary

Human health vulnerabilities to climate change in Bellevue are largely an outcome of increased exposure to climate hazards of people with existing sensitivities (e.g. respiratory diseases, aging, outdated buildings or infrastructure). Human health impacts are not expected to be evenly distributed throughout Bellevue's population—certain groups are more vulnerable than others due to demographic factors. Inclusive planning efforts that work to reach vulnerable populations will help the City of Bellevue identify sensitivities and plan for appropriate adaptations. Vulnerabilities based in infrastructure are already regulated by the City of Bellevue or King County. Monitoring outcomes of existing policies and identifying opportunities to improve those policies to meet the needs of the future will allow Bellevue to effectively respond to impacts to human health in the built environment.

Many of the populations currently most vulnerable to climate change are concentrated in specific neighborhoods, particularly Downtown, BelRed, Crossroads, and Newport. The city can address disparities in vulnerability by focusing outreach, needs assessment, and community-based adaptive capacity programs on highly vulnerable neighborhoods, as identified by current data.

Table 18 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Human Health sector in Bellevue.

TABLE 18 **Human Health: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	High	Moderate	High	Extreme heat is expected to cause increases in heat-related illness, particularly among elderly populations and those with disabilities and/or pre-existing health conditions. Cooling centers, urban tree canopy, and home energy programs for low-income

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
				residents can increase adaptive capacity.
Extreme Precipitation/ Flooding	Moderate-High	Moderate	Moderate-High	Extreme precipitation is projected to cause increased accidents, physical injuries, and damage to housing with negative human health impacts. Extreme weather alerts and post-disaster repair assistance for residents can increase adaptive capacity.
Stream / Lake Temperature	Low-Moderate	Moderate	Low-Moderate	Higher water temperatures can cause toxic algal blooms. Low-income residents may be at highest risk of health impacts due to greater exposure. Better public information dissemination channels and closures of public swimming areas during blooms can increase adaptive capacity.
Drought	Low	Moderate	Low	Because of the region's high reliance on hydropower, drought can strain the electrical grid. Drought-related power outages during extreme heat events can cause heat-related illness. Programs that improve energy efficiency and efficient use of water resources can improve adaptive capacity.
Wildfire Smoke	High	Low-Moderate	High	Wildfire smoke is expected to cause respiratory injury and illness as well as mental health impacts. Programs that support installation of air purification for low-income residents can increase adaptive capacity.

SOURCE: ESA 2023

3.7 Land Use & Development

3.7.1 Sector Overview

This section addresses how climate change may affect current land use patterns and planned growth in Bellevue. Bellevue is a metropolitan city with a wide range of economic and retail centers, residential neighborhoods, parks and trails, and civic facilities, governed by the Comprehensive Plan and Land Use

Code. The city also has a network of high rank order wetlands and bogs, streams, and Geologic Hazard Areas protected by critical areas regulations. Bellevue fronts on two major lakes, Lake Washington and Lake Sammamish, and implements a Shoreline Master Program. The city is growing rapidly and has one of the highest target growth rates in the region. The city is planning for new jobs and housing growth with additional transit-oriented development and other policies. The city is currently in the process of updating its Comprehensive Plan, which will direct growth and development through 2044.

Local resources reviewed for this section include the following:

- City of Bellevue Land Use Code
- Environmental Stewardship Plan (City of Bellevue Community Development 2020a)
- Vision 2050 (Puget Sound Regional Council – PSRC, 2023)

ASSETS – LAND USE & DEVELOPMENT

- Over the last several decades, Bellevue has grown significantly and has become a major employment center. This growth in population and jobs is projected to continue rapidly, with totals for both expected to exceed 220,000 by 2044 (PSRC, LUV-it model; PSRC 2023).
- The majority of the land in Bellevue is currently zoned for single-family development (a designation that includes most of the city's parks and schools), though recent growth has occurred in mixed-use Countywide centers and corridors (Figure 20). The City of Bellevue is in the process of updating its Comprehensive Plan and Land Use Code, which will direct growth within the city through 2044 and will continue to focus development near transit and increase mobility options and the essential components of livability for people who live and work in Bellevue.
- One of the requirements of the Comprehensive Plan Periodic Update is for cities to plan for "a range of housing types and choices to meet the housing needs of all income levels and demographic groups within the region." Bellevue recognizes the need to plan for and encourage what is often referred to as 'missing' middle housing; this is housing that fills the gap between single-family development and smaller apartment or condo units in large buildings that constitute most of the housing units built in the past two decades. Currently, Bellevue permits Attached Accessory Dwelling Units (ADUs) in single-family zones, provided they meet certain criteria defined in the Land Use Code. In 2023, the state legislature passed House Bill 1110 (Middle Housing) and HB 1337 (Accessory Dwelling Units). HB 1110 requires cities over a certain size (including Bellevue) to permit four units per lot (with up to 6 units, depending on the proximity to transit and if affordable units are provided) in single-family zones, with certain exceptions and contingent on meeting criteria defined in the bill. HB 1337 requires cities to allow up to two accessory dwelling units (either attached or detached to the primary residence) per residential lot based on criteria in the bill. The impacts of HB 1110 and HB 1337 are being analyzed as part of the environmental review of the Comprehensive Plan Periodic Update. Bellevue's implementation of these bills is expected to expand housing options to more types of households.
- Sound Transit's East Link light rail line will extend fourteen miles from downtown Seattle to the Overlake area in Redmond, with six stations in Bellevue as well as stations in Mercer Island and Redmond. Passenger service between Bellevue and Redmond (through a "Starter Line") is expected to

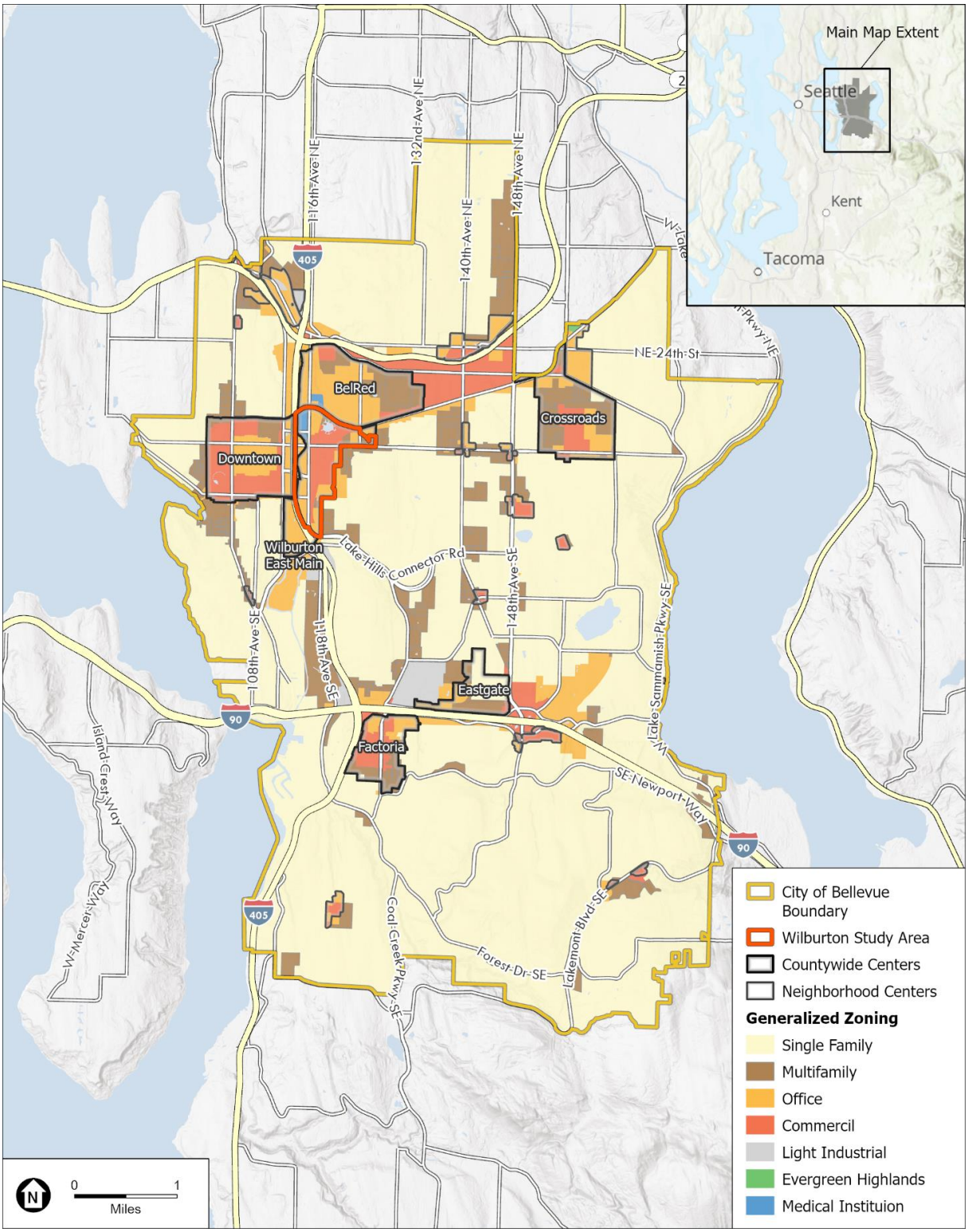
begin in 2024, with full service to Mercer Island and Seattle expected in 2025. Once service begins, East Link will be known as the "2 Line".

- In April of 2022, the Bellevue City Council directed staff to implement the vision for the west edge of the Wilburton neighborhood area (aka Wilburton study area). The vision was developed by a Citizen Advisory Committee (CAC) in 2018. Council directed staff to update the vision to consider citywide growth targets, housing, sustainability, and multimodal transportation. This initiative will amend the city's policies and codes to facilitate changes that can help best achieve this vision.
- Built on a former railroad, the Eastrail trail will eventually connect Eastside cities from Renton all the way to Woodinville and Snohomish County. In 2018 the Wilburton Commercial Area Citizen Advisory Committee presented recommendations to the Bellevue City Council that envision Eastrail as a signature public space with art, nature, retail, and community events all along the route. To help realize this vision, the City of Bellevue is partnering with King County Parks and Sound Transit to develop a vision for the portion of the Eastrail trail that runs from SE 5th Street to NE 12th Street in Wilburton.

TABLE 19 **Current Zoning**

Generalized Zoning	Acres
Single-family	16,309
Multi-family	2,020
Office	1,826
Commercial	1,157
Light Industrial	215
Evergreen Highlands	7
Medical Institution	29
Total	***21,562***

SOURCE: City of Bellevue, BERK 2023



SOURCES: City of Bellevue, BERK 2023

FIGURE 20 **Bellevue Generalized Zoning**

3.7.2 Potential Impacts

Bellevue's current land use patterns and future development may be vulnerable to the following potential impacts of climate change:

- Urban heat island effects at parking lots and other areas of extensive asphalt or other dark materials could increase risks to people's health and comfort, particularly during extreme heat events. This risk has the potential to be exacerbated by expected increases in development in the city's urban core and some neighborhood centers, although it should be noted that regulations for planting trees and providing landscaping during redevelopment may increase green space and tree canopy in certain areas even as they urbanize.

- Extreme precipitation events and unpredictable precipitation patterns are expected to increase localized flooding and erosion, possibly leading to landslides. Current infrastructure was not designed for the degree of precipitation projected, and current zoning does not take into account climate-driven changes in frequency and severity of erosion or landslides.

- In addition to flooding impacts to buildings and adjacent infrastructure (described in 3.1 Buildings & Energy), extreme precipitation could affect geologic hazard areas. Neighborhoods with more risk of erosion include Bridle Trails, Northeast Bellevue, West Lake Sammamish, West Bellevue, and Northwest Bellevue, particularly lands along shorelines. Steep slopes, which are more at risk of erosion and landslides, are more extensive throughout West Bellevue and particularly in West Lake Sammamish and Cougar Mountain.

- Infrastructure is at risk of damage during extreme weather events. Bridges and roads, stormwater facilities, and water and wastewater systems, among other infrastructure, could be affected by extreme weather or new chronic conditions such as flooding or heat.

- Extreme weather events, including precipitation events and flooding, are expected to increase climate-induced displacement and changes in housing stock availability. Displacement could also occur as a result of extreme heat and wildfire smoke, as certain households lack resources to secure cooling and clean air. Displacement of households with existing housing security challenges could be exacerbated by climate stressors (see additional information below).

- Drought is likely to damage urban landscaping, including parks and other public greenspaces. Drought may also impact the city's tree canopy, which is critical to minimizing the urban heat island effect.

- Wildfire smoke is expected to impact public health and could increase displacement as a result. However, because wildfire smoke impacts are expected to be more evenly distributed throughout the city and larger region, wildfire smoke is not likely to impact the land use or development pattern of the city as a whole. The risk of wildfire itself is low for Bellevue, however the city should continue to monitor the evolving climate science around wildfire risks in western Washington and King County, especially for the wildland urban interface. If wildfire risk does increase in King County, it could negatively impact tree canopy as people seek to create defensible space around homes and other structures.

Displacement Risk for Housing

Households across Bellevue are already at risk of displacement due to high housing costs and potential for redevelopment (see Table 20). As described above, climate change stressors have the potential to exacerbate the risk of displacement further. Households with limited resources are at greater risk for displacement, due to potentially compounding costs such as physical damage to structures from flooding, increased energy use for cooling, and healthcare costs to treat illness from extreme heat or smoke. Due to market pressures along with the presence of floodplains, low tree canopy coverage, and relatively higher proportions of people with adverse health and/or lower incomes, the neighborhood areas of West Bellevue, Wilburton, Lake Hills, and West Lake Sammamish have relatively higher proportions of households at risk of experiencing displacement than other parts of the city.

TABLE 20 **Housing Unit Displacement Risk, Bellevue Neighborhoods**

	Lower		Moderate		Higher	
Neighborhoods	**SF**	**MF**	**SF**	**MF**	**SF**	**MF**
BelRed	36	1,702	61	36	-	-
Bridle Trails	957	31	1,001	2,955	-	-
Cougar Mountain / Lakemont	3,744	440	-	-	-	-
Crossroads	-	-	840	3,878	392	1,541
Downtown	-	-	79	9,884	-	-
Eastgate	1,145	48	1,404	125	-	-
Factoria	-	-	396	1,009	-	-
Lake Hills	196	-	4,359	1,935	330	91
Newport	2,347	171	1,086	207	-	-
Northeast Bellevue	3,890	163	-	-	-	-
Northwest Bellevue	220	474	2,231	1,489	-	-
Somerset	2,896	-	10	-	-	-
West Bellevue	1,536	859	650	917	-	-
West Lake Sammamish	1,683	322	419	-	-	-
Wilburton	-	-	900	1,048	-	-
Woodridge	1,176	395	97	571	-	-
Total	***19,826***	***4,605***	***13,533***	***24,054***	***722***	***1,632***

SF = Single Family, MF = Multifamily

SOURCE: PSRC 2023

3.7.3 Adaptive Capacity

Adaptive capacity for Land Use and Development is the ability of the city to plan for and minimize the projected impacts of climate change to its growth and development through codes and land use planning.

Bellevue plans for its long-term growth in its Comprehensive Plan. The periodic update due in 2024 is an opportunity to integrate climate change resilience more fully into policies related to land use and development. Climate resilience is a key consideration during this update process. To increase the adaptive capacity of both current land uses and future development, the City has opportunities to further integrate climate resilience into its policies and then utilize those policies to guide the adoption of development standards throughout the city.

When planning for future development, Bellevue can foster redundancy in the provision of essential goods and services by distributing commercial uses in neighborhood centers throughout the city. This will create access to essential goods and services in multiple places, reducing the impact of a climate shock to any one area that might otherwise isolate residents from essential goods and services. Currently, Downtown and BelRed are the city's largest mixed-use centers. The Comprehensive Plan update and associated Land Use Code changes give the city opportunities to create more centers focused around housing, retail, jobs, bike and pedestrian infrastructure, and new transit.

By implementing climate-smart development standards, the city can increase the adaptive capacity of the development sector and mitigate the impact of climate stress on new development. These can include standards that increase the capacity of infrastructure to withstand the impacts of extreme heat and precipitation, as well as resiliency and efficiency standards.

The city has some existing programs that bolster the adaptive capacity of the development sector, including the Clean Buildings Incentive Program, which assists commercial buildings of over 50,000 square feet to comply with the Washington Clean Building Performance Standard, and the Bellevue 2030 District—a recently launched public-private partnership that works to reduce energy use, water use, and GHG emissions from transportation in new and existing buildings. Both programs bring together developers, property owners, and city government to implement climate resiliency in the development sector. Bellevue can expand these programs and create others like them to increase the resiliency of new development. The Energy Smart Eastside Program supports the retrofitting of existing residential buildings to energy efficient heat pumps, helping to expand access to air conditioning for vulnerable residents and reducing energy costs.

At a smaller scale, Bellevue can use site design to build adaptive capacity for stormwater infiltration by creating design standards and guidelines that require soil enhancement and landscaping on building sites and streetscapes.

The City uses best available science (BAS) when updating its critical area regulations, as required by state law. In some circumstances BAS may include evaluating or incorporating the projected impacts of climate change—such as extreme precipitation, low streamflow, and decreased soil moisture—to protect wetlands, streams, aquifers, floodplains, and geologic hazard areas. The city could also increase adaptive capacity of land use and development by considering climate risks when designating areas of high development, including the adoption of codes, standards and regulations that are informed by potential climate impacts and apply to new development in areas expected to be at increased risk of climate-exacerbated impacts.

The City of Bellevue has several development regulations in the City's critical areas code, Part 20.25H LUC, intended to minimize the risk of landslides in connection with development. The land-use code and critical areas regulations limit construction and the clearing of vegetation in geological hazard areas identified throughout the city. The City of Bellevue also regulates development in areas of steep slopes and in areas with identified drainage routes that are susceptible to erosion. Other efforts may include maintaining vegetation on sloped areas to stabilize soil and connecting all storm drains to channel runoff to approved areas outside of slopes and hillsides. Adaptive capacity can be further increased by considering projected future precipitation patterns and volumes into these codes and regulations as they are updated, based on best available science.

A climate-exacerbated risk of high concern to land use and development is the potential for housing stock damage and loss, and resulting displacement of households, especially those with preexisting health conditions and limited resources. A key area of focus for the Comprehensive Plan update is the Housing Element, which must be amended to meet recent State requirements to supply housing for all income levels, and to remove racially disparate impacts that impede access to housing, including ownership housing. As the city plans for and accommodates increased housing supply and improved housing quality across all income levels, the City could also increase adaptive capacity by incorporating climate resilience into this planning initiative. Expanding the city's Energy Smart Eastside Campaign, which includes the Boost Program that covers the cost of a heat pump for low-income residents, could also help decrease displacement in low-income neighborhoods.

3.7.4 Vulnerability Summary

Current land use patterns and future development are vulnerable to several of the evaluated climate impacts: increased air temperature/extreme heat, extreme precipitation and flooding, drought, and wildfire smoke. Potentially significant impacts include infrastructure damage as a result of extreme heat and intense rainfall events, as well as damage to the urban landscape from drought. Of particular concern is the risk of displacement as a result of climate shocks, particularly in communities with pre-existing health conditions and/or lower incomes.

- Although all neighborhoods in Bellevue are expected to experience similar exposure to the evaluated climate impacts, historic and current zoning and development patterns leave certain areas more vulnerable to impacts than the city as a whole. West Bellevue, Wilburton, Lake Hills, and West Lake Sammamish are at higher risk of displacement. Bridle Trails, Northeast Bellevue, West Lake Sammamish, West Bellevue, Northwest Bellevue, and Cougar Mountain are more at risk of erosion, flooding, and landslides. In addition to other risks, these kinds of geologic hazards can damage roadways, making them temporarily dangerous or impassable. This is an additional point of vulnerability for households in these neighborhoods that are auto dependent (those that are beyond reasonable walking distance to goods and services or transit).
- Broader geographic distribution of neighborhood centers and businesses that provide goods and services, as well as increased proximity to multi-modal and mass transit options, can increase the climate resilience of those areas.
- Bellevue can increase the adaptive capacity of its land use and development sector through its Comprehensive Plan, Shoreline Master Program, critical areas regulations, and other initiatives.

Table 21 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Zoning & Development sector in Bellevue.

TABLE 21 **Land Use and Development: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	High	Moderate	High	Extreme heat will impact infrastructure and increase demand for cooling. It could also lead to displacement, particularly in neighborhoods with low tree canopy and high urban heat island effect.
Extreme Precipitation/ Flooding	Moderate-High	Moderate	Moderate-High	Extreme precipitation can cause flooding, erosion, and landslides, which is expected to damage infrastructure and housing, particularly in areas located on steep topography or close to shorelines. Highly auto-dependent neighborhoods may experience greater impacts if transportation infrastructure is damaged during extreme weather events.
Stream Temperature	N/A	N/A	N/A	No significant impacts projected.
Drought	Low	Moderate-High	Low	Green infrastructure and urban landscaping, including the city's tree canopy, are expected to be impacted by drought.
Wildfire Smoke	Low-Moderate	Moderate	Low-Moderate	Smoke is projected to impact the entire city and could lead to displacement in communities with low resources and pre-existing health conditions.

SOURCE: BERK 2023

3.8 Transportation

3.8.1 Sector Overview

This section identifies assets, potential impacts associated with climate change, and vulnerabilities for the Transportation sector in Bellevue. Bellevue relies on a robust transportation system comprised of

infrastructure that supports walking, bicycling, transit, and driving. Transportation investments and services in Bellevue are guided by the Transportation Element of the Comprehensive Plan, the goal of which is "to improve all mobility options so that everyone in Bellevue has a safe, comfortable, and efficient experience on their preferred mode while encouraging and transitioning to more environmentally and fiscally sustainable modes."

ASSETS – TRANSPORTATION

Bellevue is connected to the region by Interstate-90, Interstate-405, and State Route-520 highway systems, which are all operated by the Washington State Department of Transportation. Additionally, the city is also served by regional trails including the I-90 Trail along the Mountains to Sound Greenway, and the SR-520 Trail, which are within Washington State Department of Transportation right-of-way and are maintained by the city of Bellevue. Eastrail is a new north-south multipurpose trail through Bellevue that is being developed in stages by King County and Sound Transit. King County Metro and Sound Transit jointly operate 42 bus routes that include at least one stop in Bellevue, which connect the city to Seattle, other cities on the Eastside, and all parts of King County. Sound Transit will provide light rail service in 2024/2025 with six stations in Bellevue with connections to Redmond and Seattle.

Local resources reviewed for this section include the following:

- City of Bellevue Comprehensive Plan – Transportation Element (City of Bellevue Community Development 2022)
- 2022–2033 Transportation Facilities Plan (City of Bellevue Transportation Department 2022)
- Eastgate Transportation Study (City of Bellevue Transportation Department 2019)
- Downtown Transportation Plan (City of Bellevue Transportation Department 2013)
- City of Bellevue Bike Map (Choose Your Way Bellevue 2020)
- Environmental Stewardship Plan (City of Bellevue Community Development 2020a)

3.8.2 Potential Impacts

Of the projected climate change impacts facing the city, the transportation sector is expected to be most vulnerable to increasing air temperature variability and extreme temperature events, increasing heavy rainfall and extreme precipitation, and increased flood events.

- A recently completed King County project to map heat impacts across the county revealed that downtown Bellevue experiences high heat impacts due to limited vegetation and high density of buildings and infrastructure. The Bellevue Transit Center is located in downtown Bellevue; during extreme heat events, transit users may be susceptible to higher temperatures in this area (King County 2022).
- Extreme heat events, such as the heatwave of June 2021, can impact transportation services in Bellevue. While passengers riding in air-conditioned personal vehicles and transit busses and trains may be minimally impacted, individuals who rely on active transportation modes such as walking or bicycling (including those short walk/bike trips to/from transit) are disadvantaged during such events when the

heat poses risks to health and safety. Additionally, extreme heat in 2021 led Sound Transit to slow its trains to maintain safe operating conditions as the heat caused rails to expand and overhead power lines to lose tension. Elsewhere in the region the extreme heat caused sections of roadways to buckle, resulting in road closures and delays (Crowe 2021).

- Overall, the challenges presented by increasing air temperature variability and extreme temperature events present moderate challenges to the transportation sector in Bellevue. While snow, ice, and extreme heat threaten public safety and may cause transportation delays, the impact of these events is typically short-lived. However, as extreme heat events become more common in the future, they will pose more frequent challenges to the city.
- Increased rainfall and extreme precipitation events will present challenges to transportation infrastructure throughout Bellevue. One such impact may be an increase in sinkholes causing road damage, road closures, or the disruption of transit service. In September 2022, segments of Interstate-405 were closed to repair the freeway's drainage system after a 15-foot-deep sinkhole was discovered adjacent to the freeway. This repair required the closure of the freeway for 23 hours in both directions, resulting in significant delays and disruptions for those traveling through Bellevue. The impacts of sinkholes caused by heavy rainfall are significant, and depending on their location, have the potential to alter transportation options for a large number of individuals (Sullivan 2022).
- Increased rainfall and precipitation may also lead to increased mudslide events throughout the city, particularly in areas with steep slopes. Certain geologically hazardous areas of Bellevue may be susceptible to landslide events given the significant amount of rainfall the city receives and its hilly terrain. During prolonged periods of precipitation, areas prone to erosion or landslide due to soils and geological conditions may become unstable and result in landslides, which can damage properties, and may also block roads and other transportation corridors. In 2012, heavy rainfall resulted in a landslide that closed a section of West Lake Sammamish Parkway for nearly nine weeks (Levy 2012).
- Increased precipitation and heavy rainfall events also lead to localized urban flooding, which can result in significant impacts to roads and other transportation corridors. In December 2019, extreme rainfall flooded many roadways in Bellevue including Southeast Seventh Place, which was inundated with four feet of standing water. Apart from closures and alternate routes, flooding and standing water also pose safety concerns for transportation as cars become susceptible to hydroplaning. Roadway flooding, especially on a large scale, can limit the movement of emergency services and first responders, hindering their ability to respond to accidents and other emergencies (MyNorthwest 2019).
- Overall, flood events pose a moderate risk to the transportation sector in Bellevue. Similar to extreme temperature events, the impacts associated with floods are typically isolated and short-lived. However, like the impacts associated with increased precipitation and landslides, the location of flood events is important in evaluating their impacts on transportation resources. Additionally, existing resources such as FEMA Flood Maps and other geospatial analyses have provided managers with information about areas most susceptible to flooding, which can be used to help guide planning efforts.
- Some climate-driven challenges to the transportation sector may be viewed in the context of existing vulnerability to extreme winter weather and cold temperatures. In February 2019, a winter storm resulted in 2-3 inches of snow in lower elevations of the city and between 6-8 inches in areas of higher elevation. This snow, combined with below-freezing temperatures, made travel throughout the city difficult. Snow clearing was prioritized for major arterial streets leaving travel on public streets within

low-volume residential areas, less traveled routes served by public streets, sidewalks, and bicycle lanes more difficult. Additionally, transit services were reduced and operated on designated snow routes, which substantially reduced the number of stops serviced (City of Bellevue 2019a).

- In December 2022, freezing rain led to substantial disruptions to transportation corridors throughout Bellevue. Untreated public roadway surfaces, sidewalks and bike lanes became nearly impassable, particularly in areas with steep terrain. Additionally, all transit services were cancelled for several hours due to roadway conditions (Westside Seattle 2022). High winds associated with winter storm events have impacted roads throughout the city. In 2019, several arterial streets were temporarily closed due to downed trees, power lines, and other debris (City of Bellevue 2019b).
- As the transportation sector electrifies, it may become increasingly vulnerable to potential climate impacts on energy infrastructure, described in Section 3.1.2. Reduced electricity generation capacity due to extreme heat and drought, as well as direct physical damage from extreme heat, more intense winter storms, and wildfire, could impact the charging infrastructure network that electric vehicles depend on.

3.8.3 Adaptive Capacity

Adaptive capacity for the transportation sector is its ability to withstand climate shocks and recover rapidly from climate impacts. There are several policies, programs, and other measures currently in place to help Bellevue adapt to the challenges presented by climate change to the transportation sector. Broadly speaking, the short-term response capacity of most transportation infrastructure is limited, given the need for large capital investments, which require funding, design, stakeholder engagement, and construction over long periods of time. This makes planning for future climate scenarios more viable for transportation infrastructure, but possibly makes responding to and recovering from severe short-term climate-related events and damages more challenging.

- In 2022, the City of Bellevue began development of a web-based mapping tool for residents and those who work in the city to see which streets have been plowed and the location of snowplows in near real time during winter weather events (https://bellevuewa.gov/winter-response-map). This map can be used by individuals to help identify recently treated roads before they travel through the city. Currently, the map displays data for primary and secondary arterial streets but will be developed to include all routes serviced during winter weather events. This type of public information tool could also be used to inform residents of impacts to transportation infrastructure from weather-related events such as extreme heat, windstorms, and flooding, and also damage from earthquakes.
- In 2022, several King County departments began working together to develop an Extreme Heat Mitigation Strategy to help coordinate a response by the county to extreme heat events. As part of the development of this strategy, King County Metro Transit is using information from heat mapping exercises to inform the design of bus stop structures and amenities to provide relief for transit users during extreme heat events, particularly at stops serving disadvantaged communities. Similarly, the county launched a 3 Million Trees initiative to grow the urban tree canopy, which will provide relief to transit users, bicyclists, and pedestrians during heat events (King County 2022).
- Adaptive capacity can be increased by incorporating best available science as it relates to projected future precipitation patterns and volumes into codes and regulations concerning geologic hazard areas

when they are updated; specifically, slopes susceptible to erosion or landslide above or adjacent to transportation infrastructure.

- In its 2022-2033 Transportation Facilities Plan, the City of Bellevue has outlined several road projects intended to help manage stormwater, drainage, and flow diversion to minimize impacts from urban flooding. Additionally, the City of Bellevue has taken steps to plant greenspaces and gardens in areas of the city to help mitigate the impacts from increased stormwater during heavy precipitation events. This type of natural flood protection can also provide habitat while increasing green space, enhancing adaptive capacity in multiple sectors.

3.8.4 Vulnerability Summary

Changes to transportation systems that increase adaptive capacity by meaningfully shifting travel patterns and behaviors typically require large capital investments and long planning, design, and construction timelines. The investment and time required limits the adaptive capacity of the transportation sector in Bellevue in the short term, making it highly vulnerable to climate change. The primary impacts that present the greatest risks to transportation include increasing air temperature variability and extreme temperature events, increasing heavy rainfall and extreme precipitation, and increased flood events. The consequences of these impacts will depend on duration (e.g. extreme heat impacts can be highly disruptive but are typically short lived) and space (e.g. disruption or damage to freeways and arterial routes are more impactful to the transportation needs of city residents and commuters).

Certain areas of Bellevue, such as downtown, Wilburton, and BelRed, currently experience some degree of urban heat island effect and have comparatively lower tree canopy. Users of transit infrastructure that is located in these areas may therefore be more exposed to extreme heat events. Due to short wait times, access to nearby buildings with air conditioning, and integral shading of waiting areas, this is expected to be a relatively minor aspect of overall vulnerability.

Low-lying roadways and other transportation infrastructure, as well as those built on or near steep slopes, are susceptible to flooding and erosion from extreme precipitation events. Similar to most of the region, Bellevue's transportation sector is vulnerable to winter storms. High wind speeds can damage trees and block infrastructure, while snow and ice can lead to road closures and transit service shutdowns.

Through regular maintenance and targeted new transportation infrastructure investments, the city of Bellevue can increase the adaptive capacity of its transportation sector and lower its vulnerability to climate impacts.

Table 22 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Transportation sector in Bellevue.

TABLE 22 **Transportation: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	Moderate-High	Low-Moderate	High	Extreme heat may damage transportation infrastructure; although these impacts are generally short-lived, they may occur with increasing frequency. Adaptive capacity may be limited by the expense and long time horizon of infrastructure updates.
Extreme Precipitation/ Flooding	High	Moderate	High	Extreme precipitation is expected to increase risk of landslides, flooding, and sinkholes that could disrupt transit services, close roads, and damage infrastructure. Adaptive capacity can be increased by incorporating climate projections into regulation and code updates, and through use of real-time system information tools.
Stream Temperature	N/A	N/A	N/A	No significant impacts projected.
Drought	Low	Moderate	Low	No significant direct impacts projected. See Ch. 3.1 for discussion of impacts to energy infrastructure that may impact transportation as the sector electrifies.
Wildfire and Wildfire Smoke	Low	Low	Low	No significant direct impacts projected. See Ch. 3.1 for discussion of impacts to energy infrastructure that may impact transportation as the sector electrifies.

SOURCE: ESA 2023

3.9 Utilities (Solid Waste, Wastewater, and Stormwater)

3.9.1 Sector Overview

This section identifies assets, potential impacts associated with climate change, and vulnerabilities for utilities in Bellevue, including waste, wastewater, and stormwater in Bellevue. As Bellevue has grown over the past decades, it relies on a complex utilities infrastructure system and services to provide residents and businesses with materials recycling and disposal as well as wastewater and stormwater management:

- The City of Bellevue contracts with Republic Services for garbage, recycling, and compost services. The Utilities Department administers programs and other initiatives to educate residents and business owners about environmentally friendly waste management practices.
- The Utilities Department manages a stormwater system that consists of streams, lakes, wetlands, pipes, catch basins, and flood control sites all of which drain into either Lake Washington or Lake Sammamish. The Utilities Department leads initiatives and projects that provide flood control, protect water quality, and enhance and protect natural habitats.
- Wastewater is managed by the Wastewater Division, which oversees the city's wastewater collection system that connects to the King County regional sewage system where it is treated according to state and federal water quality standards. The City of Bellevue's wastewater service area covers over 37 square miles and includes maintenance holes, mainline pipes, and pump and flush stations.

This section provides an overview of potential impacts expected as a result of climate change and their connection to waste management infrastructure in Bellevue.

Local resources reviewed for this section include the following:

- Wastewater System Plan (Bellevue Utilities 2015)
- Storm and Surface Water System Plan (Bellevue Utilities 2016)
- Business Profile (Bellevue Utilities 2021)
- Sustainable Bellevue Environmental Stewardship Plan (Bellevue Community Development 2020a)

3.9.2 Potential Impacts

Bellevue's Utilities sector is projected to be most vulnerable to increasing heavy rainfall events and increased flooding. Higher air temperatures and extreme weather events are also impacts of concern for this sector; wetter winter weather conditions, extreme heat, and wildfire smoke have the potential to temporarily disrupt service provision when conditions outdoors are unsafe for workers.

- Some climate-driven challenges to this sector may be viewed in the context of existing vulnerability to cold temperatures and winter weather conditions, which can impede garbage, recycling, and compost collection, resulting in cancellation or delay of services. During the freezing rain event of December 2022, service was suspended for two days (KOMO News 2022). Areas accessed by roadways with steep slopes are most at risk of service disruption. Overall, impacts from such events present a minimal risk to waste management operations since they are usually short-lived.
- Uncertainty surrounding the specifics of changes to future rainfall amounts is a primary obstacle for future planning. Potential changes in the intensity and timing of rain events will have dramatic implications for stormwater management as well as potential changes to the biology and chemistry of receiving waterways.
- Increasing extreme precipitation events will present many challenges to flood control initiatives led by the Utilities Department. Most of the precipitation in Bellevue occurs during the winter months. While water can be absorbed by soils, there is less plant uptake during winter.

- With increasing winter precipitation, and with that precipitation falling in fewer, more concentrated events, the capacity for soil absorption will be limited, resulting in more stormwater and increased flood risk, requiring the Utilities Department to increase its capacity for stormwater management. Heightened flood risk may limit the ability of existing stormwater management features to abate flood risk and increase the capacity demands put on aging infrastructure.
- Aging and/or undersized infrastructure also poses significant challenges to stormwater management in the face of climate change. The average age of drainage assets in Bellevue is 45 years and with increased rainfall, this infrastructure may be unable to adequately handle increased flows. This system was built to handle typical light rainfall expected in Western Washington; however, as more intense rainstorms occur, the stormwater system in Bellevue may become overwhelmed (Buranen 2017).
- Specific areas of Bellevue are more at risk from flood events than others. For example, a portion of stormwater flows into Lake Washington at Lower Coal Creek; however, the creek is restricted to a narrow channel that flows through a residential neighborhood. Flows associated with 100-year storms or increased precipitation during winter months as a result of climate change could impact the creek's levees and place adjacent homes at risk of flooding.
- Between 1986 and 2006, Bellevue lost 20% of its tree canopy cover, due to development of previously undeveloped areas in the city and annexation of new areas. Since then, the city's tree canopy has grown from 36% in 2007 to 39% in 2019. Despite the overall growth in canopy in recent years, certain neighborhoods have experienced losses in overall canopy. The loss of mature trees presents obstacles to flood management as less mature forests and trees absorb less water during and before flood events.
- Increased flooding will present risks to homeowners and demand larger and more comprehensive flood management systems. Fortunately, extensive flood mapping data exists for the city, which will help resource managers identify and prioritize areas in need of infrastructure upgrades and other initiatives.
- Septic systems in Bellevue are at risk of failure or reduced capacity from flood events. Floodwater can damage septic systems and fully saturate soils in the system's drain field.
- The Wilburton Pump Station, part of the King County Wastewater Treatment System, is located within the Regulatory Floodway as identified by the Federal Emergency Management Agency. Pump station infrastructure could become damaged during flood events. Flood events also pose risks for sanitary sewer overflows, which occur when sewage from city-owned assets reaches storm drains or waterways and poses public health and environmental threats. The City of Bellevue has an established goal of 4 or fewer overflows per 100 miles of pipe each year.

3.9.3 Adaptive Capacity

Adaptive capacity for the Utilities sector is the ability of the city's complex utilities systems to continue to function through climate events and recover quickly from climate-related disruptions.

- In 2022, the City of Bellevue began the development of a web-based mapping tool for residents and those who work in the city to see which streets have been plowed and the location of snowplows in near real-time during winter weather events. This tool could be used by waste management collectors to help prioritize areas in which to collect garbage, recycling, and compost during winter weather

events. This type of public information tool could also be used to inform residents of impacts to waste management from extreme heat and flooding.

- The City of Bellevue is piloting Salmon Safe Certification for the construction of Fire Station 10, and have approved other development projects that were certified under Salmon Safe. This includes the design of landscape features that capture excess stormwater to mitigate flood risk and remove pollutants from stormwater. Bellevue could increase the adaptive capacity of its stormwater management by replicating this project at sites throughout the city.
- In 2016, the City of Bellevue amended its Land Use Code to address the NPDES Phase II stormwater permit, and adopted standards for hard surfaces and pervious surfaces. These updates prioritize strategies for stormwater runoff reduction during and after heavy rainfall events. These changes bolster the adaptive capacity of the Utilities sector during extreme rainfall events.
- The Bellevue stormwater system includes regional detention ponds that can hold water during periods of heavy rainfall and slowly release it. These systems are designed to hold a week's worth of water under normal precipitation intensities, which can provide a buffer to the system during heavy rainfall events (Buranen 2017).
- The City of Bellevue's permit under the National Pollutant Discharge Elimination System requires low-impact development be considered as the preferred method of stormwater management. Low-impact development includes features such as downspouts that flow into planters, or raingardens and swales that help slow the speed of runoff to promote detention and groundwater infiltration (Buranen 2017).
- In the Environmental Stewardship Plan, the City of Bellevue set a target to increase tree canopy to 40% of the city's total area. This would equate to roughly 670 acres of additional tree canopy, or approximately 75,000 new trees compared to the tree canopy in 2017. The tree canopy in 2019 was 39%. Increasing the city's tree canopy will increase the amount of water uptake by plants. During extreme precipitation events, this can provide a buffer to excess stormwater volume and help to limit flood risk.
- The City of Bellevue has a goal of open space preservation throughout the city. In addition to maintaining access to parks and open spaces for residents, open space areas can help to alleviate the damages associated with flood events, particularly when situated in floodplains and low-lying areas. These initiatives are further detailed in the Watershed Management Plan and the Parks and Open Space System Plan.
- The City of Bellevue is enrolled in FEMA's Community Rating System, which means Bellevue residents receive a 25% discount on National Flood Insurance Program policies. This provides added financial capacity for Bellevue residents to respond to and recover from flood events.
- The 2016 Storm and Surface Water System Plan reports few incidences of structural flooding between 1996 and 2011 and identifies 11 street locations that are commonly at risk of flooding during large storms. Flooding due to debris is a recognized concern at 64 city-owned drainage facilities. As extreme precipitation occurs more frequently than it has historically, structural flooding will increase. The City of Bellevue has established a goal of no more than five occurrences of structural flooding in the public stormwater system after heavy rainfall events per year. From 2015 through 2020, Bellevue recorded only 12 such events, all of which took place in 2019. (Utilities Performance | City of Bellevue (Metric 4))

- The City of Bellevue has recently completed stream health assessments of all major open streams, to inform the development of the Watershed Management Plan. The Watershed Management Plan will guide City efforts to improve stream health by prioritizing investments in high-impact areas that will lead to measurable benefits over short time horizons. The City has advanced several stream restoration projects underway, including the acquisition of eight acres in BelRed for future restoration efforts. Restored streams can mitigate the impacts of extreme precipitation events by providing stormwater management and flood control.
- The City of Bellevue has also identified several green stormwater infrastructure projects in its Capital Improvement Plan to expand pervious surfaces, facilitate rainwater catchment, and reduce the flow of stormwater runoff to limit water pollution. Reducing impervious surfaces and increasing tree canopy and infiltration sites for runoff could also reduce temperatures in some areas.
- The Storm and Surface Water System Plan and Wastewater System Plan outline the approach to stormwater and wastewater management through a series of stated policies. These plans also include adaptive management to identify how environmental and operations monitoring data can be used to adjust and reframe policies of the programs.
- The City of Bellevue regulates runoff that can load nutrients and pollutants into water bodies but is limited in its ability to regulate runoff from developments that pre-date current stormwater regulations.

3.9.4 Vulnerability Summary

Overall, climate change poses moderate risk to Bellevue's Utilities sector. Many of the direct services provided by the City of Bellevue (e.g. garbage, recycling, and compost collection) will be minimally impacted by climate change. However, large-scale elements of the Utilities sector such as stormwater management and flood control may be impacted by climate change to a greater degree. The effects of climate change will be felt throughout the city, and building capacity will be critical to help managers identify and prioritize adaptation efforts. Of the evaluated impacts, Bellevue's Utilities sector is most vulnerable to extreme temperature variability, intense rainfall events, increased winter precipitation, and flooding. It is expected to be less impacted by, but still vulnerable to, drought events, particularly when drought occurs in combination with extreme heat.

Vulnerability to extreme heat and drought is expected to be evenly distributed throughout the city. However, some areas in Bellevue are more vulnerable to flooding than others, particularly the residential area around Lower Coal Creek, which is restricted to a narrow channel in this area. Flows associated with 100-year storms or increased precipitation during winter months as a result of climate change could impact the creek's levees and place adjacent homes at risk of flooding.

Table 23 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Utilities sector in Bellevue.

TABLE 23 **Utilities: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	Moderate-High	Moderate	Moderate-High	Extreme temperature variability / extreme heat has the potential to temporarily disrupt service provision when conditions outdoors are unsafe for workers.
Extreme Precipitation/ Flooding	High	Moderate	High	Increased winter precipitation and extreme precipitation events year-round are expected to cause damage and service disruption. Adaptive capacity can be increased by changes to stormwater management and other programs.
Stream Temperature	N/A	N/A	N/A	No significant impacts projected.
Drought	Low	Low-Moderate	Low	Prolonged drought can stress vegetation, potentially causing loss of trees and other vegetation. This can in turn impact flood management, as less mature forests and trees absorb less water during and before flood events.
Wildfire Smoke	Low	Moderate	Low	Wildfire smoke has the potential to temporarily disrupt service provision when conditions outdoors are unsafe for workers.

SOURCE: ESA 2023

3.10 Water Resources

3.10.1 Sector Overview

Water resources play a vital and diverse role in Bellevue: as drinking water, recreational resources, habitat, and a critical utility for emergency functions such as medicine and firefighting. The city, as well as other incorporated and unincorporated areas in the Bellevue Water District, receives water through the Cascade Water Alliance, which contracts with Seattle Public Utilities. Bellevue receives its water via two supply lines: one from a reservoir on the South Fork Tolt River and one from a reservoir on the Cedar River. The city operates and maintains the water distribution system, including its pipes, reservoirs, pump stations, and hydrants. Climate change may have direct impacts on water resources and/or cause changes to the environment that drive impacts to water resources, all of which can affect water quality, quantity, natural

drainage systems, and aquatic resources. Climate change may also impact the functionality of drinking water system infrastructure, potentially affecting utility service.

Local resources reviewed for this section include the following:

- City of Bellevue Habitat and Watershed Assessment Reports (e.g. Vasa Creek, Kelsey Creek, Lake Sammamish) (City of Bellevue Utilities 2018-2020)
- Water Shortage Contingency Plan (Seattle Public Utilities 2018)

3.10.2 Potential Impacts

Climate change impacts of concern for water resources include increased air temperatures and extreme heat, extreme precipitation events, increased water temperatures in lakes and streams, and drought.

- Elevated energy demand, particularly during extreme heat events, may result in power outages that impact the water distribution system. Most pump stations either have a backup generator onsite or inputs for portable generators, which have enabled uninterrupted service throughout the longest power outages in Bellevue. However, many historical power outages have occurred during winter storms when demand is lower. Heightened water demand during heat waves could strain the backup power system for pump stations or require more frequent maintenance to keep it running.
- Extreme precipitation can increase the risk of landslides. Landslides can deposit sediment and debris into water bodies, which may disrupt habitat or other critical areas. The Factoria, Forest Hills, and Parksite Reservoirs could be vulnerable to structural damage or impacts to water quality due to their locations in relation to landslide hazard areas. Landslides may also damage supply lines from drinking water resources, but these areas are outside of Bellevue's jurisdiction and are the responsibility of Seattle Public Utilities.
- Increased precipitation will result in more polluted runoff entering water bodies. In addition to degrading water quality, heavy metals and other pollutants in runoff can kill aquatic species. Stormwater runoff provides a more frequent and consistent input of pollutants into water bodies, but flood events can inundate areas with hazardous materials or debris that would otherwise be kept out of water bodies, which can severely impact aquatic and riparian habitat.
- Extreme precipitation events, especially back-to-back events can overwhelm the capacity of water resource infrastructure, such as culverts, which can lead to overtopping of roads or inundating adjacent properties.
- Runoff from roadways can increase stream temperatures in tributaries and lakes to the east and west of the city. Increased water temperatures and eutrophication are expected to cause more frequent and bigger algae blooms. Algae blooms can kill aquatic life by severely reducing dissolved oxygen in water. Waterborne pathogens, such as *Legionella and E. coli*, also pose a threat to water quality and human health, as these pathogens may thrive in warmer water temperatures or due to high levels of nutrients from runoff. Bellevue's water is sourced from protected forested watersheds on the Tolt and Cedar River, which limits the potential for severe impacts to the water from algae blooms, though some impact is still likely. Algae blooms have occurred in the Cedar River water supply, which is unfiltered, but can be treated. The protected watershed prevents significant nutrient loading that drives algae blooms; as such, historic occurrences of algae blooms in the water supply have had limited impacts.

- Water shortages can occur from climate change through decreased snowpack that feeds Bellevue's primary drinking water supply and extended periods of hot temperatures and dry weather. Preliminary scenario assessments by Seattle Public Utilities found that climate change impacts to water supply could vary significantly, with projections for 2050 ranging from a zero to 50% reduction in supply. Water levels in the drinking water supply reservoirs are kept low in the winter for flood storage, but dry springs and summers will result in higher water levels not being restored. A multi-year drought is unlikely, but early stages of the Seattle Public Utilities Water Shortage Plan have been implemented during single-year droughts, the worst being in 2015.
- Droughts, as well as changing precipitation patterns, could reduce Bellevue's emergency groundwater supplies from wells. Pumping from the wells during water supply emergencies impacts surface water availability. If emergency water supplies were needed for 100 days, the surface water in Kelsey Creek could be depleted, which would impact salmon and aquatic species and habitat. Restoration of streamflow would be especially hindered during a drought.
- In general, Bellevue's municipal water supply is somewhat drought-resilient given that it comes from Seattle Public Utilities reservoirs, which are less impacted by drought events and declarations. However, as summers continue to warm and periods of drought are more frequent, the city will face challenges related to regular maintenance and other activities that require the use of water.
- Increases in wildfires increase the risk of ash and dissolved organic matter entering drinking water, which increases treatment costs. Dissolved organic matter produced from fire has different chemical characteristics than dissolved organic matter under natural conditions and can require different approaches to water treatment. Burned dissolved organic matter can be flushed into water supplies in large quantity from post-fire rain events. This increases turbidity of water and total suspended solids, which can reduce dissolved oxygen and kill aquatic resources that help to maintain clean water. The most likely impact would be increased costs to Bellevue for water treatment.

3.10.3 Adaptive Capacity

Adaptive capacity for Water Resources is the ability of the city to continue to supply sufficient, uncontaminated water to residents throughout climate impact events, and without significantly impacting the watershed and aquatic ecosystems.

- The City of Bellevue assesses water resource conditions on a recurring basis to monitor the effects of implementing various watershed management, habitat improvement, and stormwater management initiatives. The city has done this with basin-specific habitat assessments, the Storm and Surface Water System Plan, and Stormwater Management Plan, in addition to annual reports on water quality, municipal stormwater permit compliance, and performance from relevant departments.
- The City of Bellevue protects and restores water resources, riparian areas, and surrounding natural resource buffers, in order to preserve water quality, habitat, and ecological functions.
- While the City of Bellevue can directly enforce critical area ordinances and regulate activities that are impacting the environment, it has limited ability to monitor critical areas on private land or direct property owners on how to manage their land beyond regulated activities.

- The City of Bellevue has built hazard-resilient drinking water facilities, such as the Horizon View 2 Reservoir and Pike Peak Reservoir Replacement, which can reduce risks of exposure to landslides.
- The City of Bellevue has added backup power equipment at pump stations and other utility facilities to ensure service through power outages. Improvements that included adding backup power have been pursued at multiple Horizon View and Cougar Mountain pump stations.
- The Bellevue Parks and Community Services Department has developed best management practices and design standards to guide the conservation of natural resources. This includes information related to native tree and vegetation plantings in city rights-of-way to limit the need for water during periods of drought. Additionally, the document includes information about upgrading irrigation systems to more efficient models.
- The City of Bellevue Utilities Department developed the Emergency Water Supply Master Plan, which anticipates the impact of natural disaster on the city's water supply and recommends mitigations. The City can increase the adaptive capacity of its water resources by incorporating climate impacts into the Emergency Water Supply Master Plan and developing mitigation actions and investment levels to improve the climate resilience of its water systems (City of Bellevue Utilities 2023).
- Bellevue Utilities is also upgrading water meters to improve leak detection and updating building standards to specify water-efficient plumbing fixtures to optimize indoor and outdoor consumptive use. Increased water availability improves adaptive capacity in water management.
- In late summer 2015, Bellevue and the greater Puget Sound Region experienced drought due to historically low precipitation and high temperatures. The cities of Seattle, Everett, and Tacoma created a regional agreement with a goal of reducing water use by 10%. As part of this effort, Bellevue Utilities limited routine maintenance activities that require the use of water, instead postponing them until October and November of that year. This included flushing of water mains and other work. Additionally, Bellevue Fire limited their training drills that required water. Regional water management agreements of this kind may become more necessary as summer drought conditions become more common and more extreme.

Flood Risk in Lake Washington

Recent modeling[1] suggests that the Washington coast could see as much as four to six inches of sea level rise by 2050, and potentially nearly three feet by the end of the century. Extreme precipitation events are expected to increase, delivering a greater volume of water into streams and rivers that feed into Lake Washington. What would these impacts mean for flooding risk on the lake?

Not much, it turns out, at least for this century. According to the U.S. Army Corps of Engineers[2], who operate the Ballard Locks, Puget Sound would have to be at least 6.6 feet higher for properties on Lake Washington to potentially flood – more than twice the 2100 projection from NOAA.

The locks help to maintain a constant water level in Lake Washington by releasing water into the Sound. The lake level is maintained at roughly 20 feet above the Puget Sound mean low tide. This means that even after extreme precipitation events, when high streamflow carries greater-than-usual volumes of water into the lake, flood risk is mitigated by releasing that extra volume through the locks.

1. 2022 Sea Level Rise Technical Report, NOAA.
2. Letter to the Seattle Times, 2017.

3.10.4 Vulnerability Summary

Bellevue's Water Resources sector is expected to be vulnerable to all the evaluated impacts. Many of the water resources that could potentially be impacted by climate change are outside of or only partially within the City's jurisdiction, which limits its ability to minimize some of these impacts on its own. Coordinating with other municipalities and entities will play a large role in increasing the adaptive capacity of this sector, especially to drinking water supply sources, Lake Washington, and Lake Sammamish. However, local impacts from stormwater runoff and degraded natural resources can be addressed by the City of Bellevue.

Although the impacts of extreme heat, increased stream temperature, drought, and wildfire smoke are expected to be evenly distributed throughout the city, water quality impacts from extreme precipitation events and the risk of potential landslides are greater for the Factoria, Forest Hills, and Parksite Reservoirs.

Table 24 presents potential impacts, adaptive capacity, and overall vulnerability scores for the main climate-driven factors of concern for the Water Resources sector in Bellevue.

TABLE 24 **Water Resources: Potential Impacts, Adaptive Capacity, and Vulnerability Scores**

Impact Category	Potential Impacts (Low, Moderate, High)	Adaptive Capacity (Low, Moderate, High)	Vulnerability (Low, Moderate, High)	Summary of Vulnerability
Air Temperature/ Extreme Heat	Moderate	Low-Moderate	Moderate	Extreme heat events may strain the electrical grid, leading to power outages that impact water distribution systems and strain backup power for pump stations.
Extreme Precipitation/ Flooding	Moderate-High	Low-Moderate	Moderate-High	Extreme precipitation and resultant landslides can impact water quality and damage water distribution infrastructure, as well as sensitive critical areas. Resultant flooding and runoff can introduce pollutants to Bellevue's water resources.
Stream Temperature	Moderate	Low-Moderate	Moderate	Increased stream temperature can cause harmful algae blooms and increase the presence of pathogens in water sources.
Drought	Moderate	Low-Moderate	Moderate	Drought is expected to impact water availability, including Bellevue's emergency groundwater supply.
Wildfire	Moderate	Low	Moderate	Dissolved solids and other pollutants from wildfires and smoke can pollute water sources, increasing water treatment costs.

SOURCE: ESA 2023

SECTION 4 Strategies & Next Steps

4.1 Climate Resilience Strategies

While the focus of this report is on identifying climate-related vulnerabilities posed to sectors of concern in Bellevue, the consultant team also identified some potential resilience measures for consideration, including a suite of recommended strategies for consideration in departmental programs and projects. This section describes those strategies organized by associated sectors (i.e. those with similar vulnerabilities and needed responses). Many of these are listed as high-performing measures in the Washington State Department of Commerce Model Climate Element Menu of Measures (April 2023). Strategies were also sourced from the K4C Climate Action Toolkit and from other regional climate change plans.

Buildings & Energy, Economic Development, Land Use & Development

- Minimize power outages from the local electric utility during extreme weather events by identifying and protecting critical energy facilities.
- Encourage facility owners to develop decentralized power generation and fuel flexibility capabilities.
- Increase energy efficiency across all sectors through education, efficiency retrofits, and building management systems, and increase access to air conditioning through the provision of heat pumps in new construction and retrofits.
- Increase solar readiness for new residential and commercial buildings.
- Ensure backup power generation for critical facilities and identified key infrastructure during power outages.
- Support retrofits to public facilities for energy efficiency, on-site renewable energy generation, and electrification of building energy systems.
- Encourage use of reflective surfaces (“cool paving” or “cool roofs”) in public and private projects (e.g., parking lots, streets, sidewalks, etc.).
- Install energy-efficient equipment and water-saving fixtures during renovations in city-owned buildings.

- Encourage best practices and/or sustainability certifications to optimize sustainability of public building and infrastructure projects, to increase resilience (e.g. LEED, Envision Rating System – Institute for Sustainable Infrastructure, Passive House, etc.).
- Promote green jobs and invest in a resilient economy as directed by Bellevue's Economic Development Plan and Sustainable Bellevue: Environmental Stewardship Plan (e.g., support contractor training for energy efficient equipment installation).
- Support local businesses' efforts to generate and store renewable electricity on-site, which can provide back-up power during emergencies and help ensure continuity of operations.

Cultural Resources & Practices, Ecosystems

- Engage local/regional Tribes and community groups to identify and protect historic and cultural sites and heritage that may be acutely sensitive to climate hazards such as flooding (e.g. raising, retrofitting, relocating structures; protecting native species).
- Create and implement culturally contextualized outreach and education initiatives and materials that will inform the community about near-term and longer-term climate change threats and ways that the community can prepare and build resilience to these changes.
- Enhance urban tree canopy initiatives and use shade trees (e.g. canopy-forming trees) in all city projects, and require the use of shade trees in connection with private development projects where feasible.
- Develop a comprehensive list of plant and tree species known to have a broad range of environmental tolerances (e.g. heat, drought, pests, and disease), and adopt standards to require their use.
- Manage local forest health to reduce susceptibility to drought stress, pests, and diseases and plant trees that are compatible with future climate conditions.
- Preserve and enhance natural ecological functions and values provided by critical areas to help mitigate the long-term impacts of climate change. Consider the projected impacts of climate change on those critical area functions and values when creating plans or strategies to protect and/or restore them.
- Work with private property owners to build resilience of critical areas to the impacts of climate change.
- Install water-saving equipment and monitoring technology to reduce water use in parks and streetscapes to conserve water during droughts (e.g. smart irrigation systems and sensors).

Water Resources, Utilities

- Increase capacity of stormwater systems to manage increases in precipitation and higher peak flows.
- Update/revise flood maps to ensure the City's floodplains are accurately mapped (i.e. actual water bodies and topography) and that flood elevations are consistent.
- Educate residents and businesses about the benefits and appropriate uses of local water supplies (including recycled water and onsite water reuse systems) and further integrate recycled water (if available) and onsite water reuse systems into new development and redevelopment plans.
- Encourage projects that capture and reuse stormwater onsite.

- Encourage use of permeable pavement in non-critical areas such as low-use roadways, sidewalks, parking lots and alleys where soils, topography, light penetration, and other factors permit proper drainage.
- Ensure all water and wastewater pumping stations have off-grid, onsite energy sources and/or reliable backup power sources by increasing the number of backups and pulling electricity from different grids.
- Minimize pollutant loads and improve quality of stormwater runoff to help keep streams, lakes and other waterbodies clean.

Emergency Management, Human Health

- Increase local access to and production of healthy and affordable foods to reduce stress and capacity constraints during extreme events.
- Ensure that emergency response plans incorporate climate impacts, to better protect staff, infrastructure, and facilities during emergencies and extreme weather events.
- Improve indoor air quality through advanced monitoring and filtration systems in public facilities, commercial buildings, multifamily housing, and single-family homes.
- Evaluate, improve, and build redundancy into all public and inter-agency warning and communication systems.
- Conduct planning to identify evacuation routes and modes for effective transport during emergency situations.
- Build and foster community connections and resilience through neighborhood programming and outreach, and incorporate climate resilience into neighborhood oriented communication and programming.
- Explore the creation and implementation of community-based Resilience Hubs to provide support during and after extreme events.
- Support vulnerable populations during wildfire smoke events and high heat events.
- Develop strategies to support the homeless population during extreme weather events.

Transportation

- Prioritize infrastructure upgrades for streets at risk of flooding.
- Raise streets in flood-prone areas, while ensuring no rise of the base flood elevation or impacts to fish and wildlife habitat areas.
- Implement a repaving strategy that reduces heat-related damage to asphalt and incorporates maintenance and operations that extend the life of the road surface.
- Employ deicing strategies and materials that are effective in extreme cold temperatures and prolonged freeze events to stabilize roadway and bridge surfaces, while ensuring no impacts to fish or other aquatic species or habitat.
- Collaborate with transit service providers to ensure vulnerable populations are served by transit during extreme weather events or emergencies.

- Increase access to cooling centers, parks, and shorelines through transit and pedestrian/bicycle infrastructure.
- Provide complete and connected infrastructure for walking and biking.
- Ensure backup power for electric vehicle charging for fleets, critical facilities, and publicly accessible charging stations.

4.2 Next Steps

The City of Bellevue has identified a number of possible next steps for leveraging the Climate Vulnerability Assessment findings and recommendations to continue integrating climate change and resilience into city policies, programs, and projects. Many of these next steps will produce additional action items, but those already identified include:

- Review suggested strategies and identify priority actions for implementation, based on vulnerabilities and capacities identified in this report.
- Identify opportunities to integrate report findings into upcoming plan updates, including:
  - Sustainable Bellevue Environmental Stewardship Plan update (2025)
  - Comprehensive Emergency Management Plan update, including the Hazard and Inventory Risk Assessment (2025)
- Inform the Comprehensive Plan Periodic Update, mainly through policy recommendations intended to further integrate climate change and resilience into the CPPU (see Appendix 1),
- Evaluate creating an interdepartmental / interagency Climate Preparedness Team, in close collaboration with King County and other regional partners.
- Conduct a Climate Risk and Resilience Assessment for City-owned buildings and facilities.
- Partner with Emergency Services staff and stakeholders to conduct a Resilience Hub Gap Analysis (use the Resilience Hub model to identify opportunities within existing Emergency Services centers and programming, including in support for / partnership with community centers and organizations)
- Provide training to city staff in implementing climate-resilient best practices for capital project design and construction through the Institute of Sustainable Infrastructure (ISI) Envision framework.
- Identify opportunities and models for community engagement programs specific to vulnerable groups identified in this report, including partnership opportunities through existing programs
- Inventory, prioritize, and model capital investment costs and cost-savings to increase climate readiness, including present cost of non-investment. Integrate analysis into capital improvement planning and budget discussions.

SECTION 5 Appendices

5.1 Appendix 1: Climate Mitigation & Resilience Policy Recommendations

In addition to the climate resilience strategies described in Section 4, the Climate Vulnerability Assessment consultant team also identified a number of opportunities to further incorporate climate mitigation and resilience into the Comprehensive Plan Periodic Update (CPPU). While the focus of this report is on evaluating climate-related vulnerabilities posed to sectors of concern in the city, the consultant team also identified potential resilience measures. These recommendations include existing Comprehensive Plan policies that are responsive to climate change, suggested modifications to those policies to better address climate change, and suggestions for entirely new policies.

This appendix presents these policy recommendations organized by the same associated sectors used in Section 4:

- Buildings & Energy, Economic Development, Land Use & Development
- Cultural Resources & Practices, Ecosystems
- Water Resources, Utilities
- Emergency Management, Human Health
- Transportation

The policy recommendations presented in this report—whether addition, modification, or deletion—are not final and may be further modified by city staff for clarity, consistency, and relevance. These policy recommendations are subject to the same Comprehensive Plan policy review and vetting process applied to all policies and policy modifications under consideration for the CPPU, including input from stakeholders, subject matter experts, and city boards and commissions. Any policy revisions resulting from this study will be reviewed and finalized through that process.

5.1.1 Buildings & Energy, Economic Development, Land Use & Development

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Existing Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- UD-37. Use site design, water efficient landscaping and stormwater management practices to reduce the environmental impact of impervious surfaces.
    - No change.
- ED-11. Provide city leadership and direction to maximize the business retention and recruitment efforts of Bellevue's economic development partners.
    - Add: Implement Bellevue's Economic Development Plan and Sustainable Bellevue: Environmental Stewardship Plan to invest in a resilient economy and promote green jobs.
- ED-22. Support efforts that promote tourism, hotel, retail and arts businesses.
    - Add: Encourage provision of indoor and outdoor spaces that are adapted to climate stressors such as extreme heat (e.g. awnings, tree canopy, green infrastructure) and promote energy conservation measures (e.g. passive cooling design, energy conservation retrofits, etc.).
- ED-24. Cultivate development of diverse, distinctive, well-defined places that invite community activity and gathering. Specifically facilitate the redevelopment and re-invigoration of older neighborhood shopping centers. Work with stakeholders to transform such centers into high quality and dynamic retail/mixed-use commercial areas that also provide a gathering place and sense of community for the neighborhood. Allow for flexibility to repurpose and re-use a variety of building types to accommodate new uses.
    - Add: When redeveloping, encourage shopping centers to become more resilient to climate stressors such as extreme heat and extreme precipitation through installations of green infrastructure, tree canopy, and solar.
    - Add: Develop or modify design standards to integrate exterior building features (e.g. awnings, cool roofs, solar panels) that reduce the impacts of climate change including extreme heat.
- ED-25. Where commercial areas are in decline, work with businesses and other stakeholders to identify corrective actions, which may include:
    - Targeting investments in public infrastructure that may help catalyze new private sector investment, including investments that would increase resilience to climate change.

- ED-30. Facilitate efforts of businesses and institutions to train workers for today's and tomorrow's jobs, including green jobs, and support continuing education in the community.
    - Add: Invest in workforce training that promotes green jobs.
- HS-17. Encourage services that support Bellevue's workforce in maintaining or advancing their employment opportunities.
    - Add: Support job opportunities and workforce education that create a more climate-resilient Bellevue economy.
- LU-20. Support Downtown's development as a regional growth center, with the density, mix of uses and amenities, and infrastructure that maintain it as the financial, retail, transportation, and business hub of the Eastside.
    - Add: Adapt Downtown's streets and buildings to be resilient to climate stressors and reduce vulnerability of Downtown residents, such as with tree canopy, green infrastructure, and building designs promoting renewable energy and energy efficiency.
- LU-21. Support development of compact, livable and walkable mixed-use centers in BelRed, Eastgate, Factoria, Wilburton and Crossroads.
    - Add: Adapt Center streets, parking areas, and buildings to reduce vulnerability to extreme heat and extreme precipitation such as with tree canopy, green infrastructure, and building and site designs promoting alternative heat and cooling for energy efficiency and resilience.
- LU-28.4. Consider a land use incentive system that offers additional floor area in exchange for infrastructure and amenities that contribute to the public good.
    - No change.
- UT-70. Facilitate the conversion to cost-effective and environmentally sensitive alternative technologies and energy sources.
    - Add: Support local businesses' efforts to generate and store renewable electricity on-site, which can provide back-up power during emergencies and help ensure continuity of operations.
- LU-6. Encourage new residential development to achieve a substantial portion of the maximum density allowed on the net buildable acreage.
    - Add: Prioritize middle housing and infill development in residential communities to offer new housing choices and supply and add mixed-use development in high-capacity transit areas.
- LU-20. Support Downtown's development as a regional growth center, with the density, mix of uses and amenities, and infrastructure that maintain it as the financial, retail, transportation, and business hub of the Eastside.

- Add: Increase urban tree canopy and green infrastructure and landscape and building design that reduce heat islands throughout all mix use centers.

- LU-33. Preserve open space and key natural features through a variety of techniques, such as sensitive site planning, conservation easements, existing critical area buffers, green infrastructure practices, transferring density, land use incentives and open space taxation.

- EN-4. Promote and invest in energy efficiency and renewable energy resources as an alternative to non-renewable resources.

    - Add: Work with PSE to improve the safety and reliability of power infrastructure vulnerable to climate change.

    - Add: Support distributed renewable energy generation, and design of buildings for passive survivability. Encourage electric heat pumps and discourage natural gas in new commercial and residential construction.

- EN-5. Protect air, water, land, and energy resources and build climate resilience consistent with Bellevue's role in the regional growth strategy.

- EN-6. Establish an achievable citywide target and take corrective actions to reduce greenhouse gas emissions such as reducing energy consumption and vehicle emissions and enhancing land use patterns to reduce vehicle dependency.

    - Add: Increase tree canopy and green infrastructure to improve resilience to climate change.

- EN-7. Develop and implement climate change adaptation strategies that create a more resilient community by addressing the impacts of climate change to public health and safety, the economy, public and private infrastructure, water resources, and habitat.

    - No change.

- EN-24. Reduce runoff from streets, parking lots and other impervious surfaces and improve surface water quality by utilizing low impact development techniques in new development.

    - Add: Consider modifying stormwater design standards to address extreme precipitation and changes in summer soil moisture including sizing of facilities and types of plantings including those that are native and drought resilient.

- EN-41. Provide information to the public about potential geologic hazards, increased risk from climate change, including site development and building techniques and disaster preparedness.

- EN-45. Implement the citywide use of low impact development techniques and green building practices to protect and improve water and air quality and energy resilience.

- EN-47. Construct and operate new city facilities to exceed required development standards to conserve energy, water, and environmental resources.

- Add: Incentivize new private development for commercial and residential to exceed minimum standards and optimally conserve these resources.

- EN-48. Support the use of emerging best practices in green building and site design including climate resilience measures through the use of pilot programs and model ordinances.

- EN-49. Provide education and incentives to support the implementation of low impact and green development practices (LEED Standards, etc.), integrated site planning, and green building, with a focus on early consideration of these in the site development process.

- EN-62. Preserve and maintain the 100-year floodplain in a natural and undeveloped state, and restore conditions that have become degraded.

    - Add: Update floodplain regulations applicability and standards, consistent with federal and state requirements, to address increasing frequency and extent of flooding and resilience measures in new development.

- EN-86. Facilitate the transfer of development potential away from critical areas ~~and the~~ with ways such as clustering of development on the least sensitive portion of a site.

    - Add: Encourage restoring and maintaining critical areas and open space areas to maximize the climate resilience benefits they provide consistent with best available science.

- NEW: Use a climate vulnerability lens in considering adoption of new policies, zoning, and development standards (e.g. reducing impervious surface, reducing asphalt and other heat absorbing materials, and increasing landscaping and/or tree canopy).

5.1.2 Cultural Resources & Practices, Ecosystems

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- UD-37. Use site design, water efficient landscaping and stormwater management practices to reduce the environmental impact of impervious surfaces.

    - No change.

- UD-84. Designate historic landmark sites and structures and review proposed changes to ensure that these sites and structures will continue to be a part of the community and explore incentives for rehabilitation.

    - Add: Identify and protect historic and cultural sites that may be acutely sensitive to climate hazards such as flooding (e.g. raising, retrofitting, relocating structures).

- PA-8. Develop partnerships with other public agencies and the private sector to provide parks, open space, and cultural and recreation facilities in the city.
    - No change.
- PA-32. Provide environmental stewardship and nature education programs to increase the community's awareness, understanding, and appreciation of Bellevue's natural environment.
    - Add: Create and implement culturally contextualized outreach and education initiatives and materials that will inform the community about near-term and longer-term climate change threats and ways that the community can prepare and build resilience to these changes.
- PA-21. Use parks to celebrate, promote and preserve Bellevue's history, cultural arts and local heritage when consistent with the park's design and programming.
    - No change.
- EN-7. Develop and implement climate change adaptation strategies that create a more resilient community by addressing the impacts of climate change to public health and safety, the economy, public and private infrastructure, water resources, and habitat.
    - No change.
- EN-12. Work toward a citywide tree canopy target of at least 40% canopy coverage that reflects our "City in a Park" character and maintain an action plan for meeting the target across multiple land use types including right-of- way, public lands, and residential and commercial uses.
    - Add: Increase tree canopy cover to boost carbon sequestration, reduce heat islands, and improve air quality, prioritizing overburdened communities.
    - Add: Ensure that tree species selection and planting guidance are updated to be resilient to climate change.
    - Add: Choose native drought- and pest-resistant trees, shrubs, and grasses in restoration efforts to support climate resilience.
- EN-62. Preserve and maintain the 100-year floodplain in a natural and undeveloped state, and restore conditions that have become degraded.
    - Add: Restore floodplains and connectivity to improve the resilience of streams and rivers and reduce flood risk.
    - Add: Protect and restore riparian vegetation to reduce erosion, provide shade, and support other functions that improve the resilience of streams to climate change.
- EN-75. Protect wildlife corridors to minimize habitat fragmentation, especially along existing linkages and in patches of native habitat.
    - Add: Identify opportunities to expand habitat protection and improve habitat quality and connectivity to foster climate resilience using conservation area designations, vegetated buffers, and open space corridors.

- EN-76. Develop programs and regulations acknowledging that designated critical areas such as wetlands, shorelines, riparian corridors, floodplains, and steep slopes provide multiple functions including fish and wildlife habitat.
    - Add: Ensure no net loss of ecosystem composition, structure, and functions, especially in Priority Habitats and Critical Areas, and strive for net ecological gain to enhance climate resilience.

5.1.3 Water Resources, Utilities

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- UT-20. Coordinate emergency preparedness and response with local and regional utility partners.
    - No change.
- UT-34. Provide a storm and surface water system that controls damage from storms, protects surface water quality, provides for the safety and enjoyment of citizens, supports fish and wildlife habitat, and protects the environment.
    - Add: Require the use of green infrastructure and low-impact development where such approaches are feasible, to address increased storm intensities and stormwater runoff.
- UT-38. Encourage the use of low impact development and stormwater best management practices to manage stormwater runoff, which may result in smaller facilities constructed on- and off-site for flow control, conveyance, and water quality.
    - Add: Develop a fund to build green infrastructure projects that help capture, filter, store, and reuse stormwater runoff.
- UT-39. Provide a reliable, cost-effective supply of safe, secure, high quality drinking water that meets the community's water needs in an environmentally responsible manner.
    - No change.
- UT-41. Provide reliable water service for domestic use, fire flow protection, and emergencies.
    - Add: Construct new water storage systems (e.g. large cisterns, water towers, and reservoirs) to provide back-up water supplies during droughts and emergencies.
- UT-42. Promote conservation and the wise and efficient use of the public water supply and discourage the waste of this valuable resource.
    - Add: Manage water resources sustainably in the face of climate change through smart irrigation, stormwater management, preventative maintenance, water conservation and wastewater reuse, plant selection, and landscape management.

- SH-48. Work with public health agencies to require repair or replacement of failing onsite septic systems within the shoreline area or require direct connection to the city's sewer system in accordance with the city's wastewater development regulations.
    - No change.
- SH-49. Encourage, natural drainage practices and associated low impact development techniques, where technically feasible, to minimize impervious surfaces, reduce surface water runoff, and prevent water quality degradation.
    - Add: Require the use of green infrastructure and low-impact development to address increased storm intensities and stormwater runoff.

5.1.4 Emergency Management, Human Health

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- N-3. Equip residents, businesses, and community service providers through education and training to be active participants in public safety (including, but not limited to, emergency preparedness, crime prevention, first aid and fire prevention, and climate-related hazards).
    - Add: Connect residents with outreach materials to help them plan and practice actions that make evacuation quicker and safer.
- N-4. Plan and prepare for the response, recovery, and mitigation of potential disasters and hazards.
    - Add: Develop and maintain local government staff members' technical expertise and skills related to climate change, as it relates to emergency management, so as to improve communitywide policy implementation and resilience.
    - Add: Factor climate impacts into the planning of operations and coordination of preparedness, response, and recovery activities among first responders and partners, including public health, law enforcement, fire, school, and emergency medical services (EMS) personnel.
    - Add: Identify needs of at-risk community members and identify strategies that mitigate wildfire smoke, including incentivizing infrastructure updates that protect against wildfire smoke (e.g. HVAC updates and MERV 13 filters for air intake) for facilities that serve high-risk populations.
- HO-41. Collaborate with other jurisdictions and social service organizations to assure availability of emergency shelters and day centers that address homelessness.
    - Add: Collaborate with other jurisdictions and social service organizations to develop resilience hubs — community-serving facilities augmented to support residents and coordinate resource distribution and services before, during, and after a hazard event (Urban Sustainability Directors Network [USDN] 2023).

- EN-51. Work with the private sector to reduce ~~growth in~~ vehicle trips as a key strategy for reducing automobile-related air pollution.
    - Add: Design new development, and work with the private sector to retrofit existing development, to reduce resident exposure to air pollution, to increase access to clean indoor air during smoke events.
    - Add: Consider air quality and environmental health impacts, as well as mitigation strategies, when increasing development capacity for sensitive uses (e.g. day care, elder care) within 500 feet of a freeway where concentrations of air pollutants are already high.
- HS-8. Make Bellevue a welcoming, safe, and just community marked by fairness and equity provided to those disproportionately affected by poverty, discrimination, ~~and~~ victimization, and vulnerable to climate stressors.
- HS-15. Support a network of service points that are easily accessible by Bellevue residents and workers, geographically distributed within the city and proximate to public transit.
    - Add: Develop resilience hubs — community-serving facilities augmented to support residents and coordinate resource distribution and services before, during, and after a hazard event.
- PA-18. Provide a variety of services and programs accessible to all throughout the city with special emphasis on serving those with limited opportunities including low-income households, youth, individuals with disabilities, ~~and~~ older adults, and those vulnerable to climate stressors.

5.1.5 Transportation

COMPREHENSIVE PLAN POLICIES AND POTENTIAL MODIFICATIONS

Comprehensive Plan policies are listed below with suggested additions or modifications in ~~strikeout~~ or underline to better address climate change. Suggested additions could be appended to current policies or written as new standalone policies.

- EN-52. Implement transportation projects that provide significant air quality improvements to areas with existing air quality problems, even where the project does not bring all locations up to adopted standards, provided that the project is the best feasible solution and it significantly improves the air quality at each substandard location.
    - No change.
- TR-2. To aggressively plan, manage, and expand transportation investments to reduce congestion and expand opportunities in a multimodal and comprehensive manner and improve the quality of the travel experience for all users.
    - Add: Consider system redundancy in planning for a climate-resilient transportation system.
    - Add: Promote government telework options wherever practicable to reduce exposure to extreme events. Transition any staff professional development and training programs to online to reduce need for travel.

- TR-35. Design, maintain, and protect the transportation system—including infrastructure, routes, and travel modes—to be resilient to disaster and climate change impacts.
    - Add: Promote diverse transportation options (e.g. car, bus, bike, sidewalk). Integrate climate change into asset design, maintenance, and management.

5.2 Appendix 2: References

American Community Survey (ACS). 2020. 5-year Estimates. U.S. Census. URL: https://www.census.gov/programs-surveys/acs/

American Public Health Association (APHA). 2021. Climate Changes Health: Vulnerable Populations. URL: https://www.apha.org/topics-and-issues/climate-change/vulnerable-populations.

Association of Washington Cities. 2021. Climate Resilience Handbook: Preparing for a changing environment. URL: www.cfqc.org/wp-content/2021/06/ClimateHandbook.pdf

Bellevue Arts Commission and City of Bellevue. 2004. Cultural Compass: A Strategic Vision for the Arts and Culture. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/Cultural%20Compass%20-%20A%20Strategic%20Vision%20for%20the%20Arts.pdf

Bellevue Fire Department. 2022a. Bellevue Fire Department 2021 Annual Report. URL: https://bellevuefirefoundation.org/wp-content/uploads/2022/06/BFD_2021_Annual_Report.pdf

Bellevue Fire Department. 2022b. Somerset Landslide. URL: https://bellevuewa.gov/city-government/departments/fire/emergency-management/prepare-known-hazards/landslides/somerset-slide

Bellevue Police Department. 2022. Bellevue Police Department 2021 Report to the Community. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2022/BPD-22-7131-2021%20Police%20Annual%20Report-WEB.pdf

Bellevue Utilities. 2015. Wastewater System Plan. URL: https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/utilities-plans-and-reports/wastewater-system-plan

Bellevue Utilities. 2016. Storm and Surface Water System Plan. URL: https://bellevuewa.gov/city-government/departments/utilities/utilities-projects-plans-standards/utilities-plans-and-reports/storm-and-surface-water-system-plan

Bellevue Utilities. 2021. 2021 Utilities Business Profile. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2021/2021%20Bellevue%20Utilities%20Business%20Profile_FINAL2.pdf

Bisbis, M.B., N. Gruda, and M. Blanke. 2018. Potential impacts of climate change on vegetable production and product quality – A review. Journal of Cleaner Production 170: 1602-1620.

Buranen, M. 2017. Stormwater Management in Western Washington State. Stormwater Solutions, August 4, 2017. URL: https://www.stormwater.com/home/article/13030902/stormwater-management-in-western-washington-state

Casola, J.H., J.E. Kay, A.K. Snover, R.A. Norheim, L.C. Whitely Binder, and the Climate Impacts Group. 2005. Climate Impacts on Washington's Hydropower, Water Supply, Forests, Fish, and Agriculture. A report prepared for King County (Washington) by the Climate Impacts Group (Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle).

Cayabyab, C. 2018. Shaping Our Inclusive Future: Cross-Cultural Programming Public Outreach Study. City of Bellevue. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/Cross-Cultural%20Programming%20Public%20Outreach%20Study%20Oct.%202018.pdf

Centers for Disease Control and Prevention (CDC). n.d. PLACES: Local Data for Better Health. URL: https://www.cdc.gov/places/index.html

City of Bellevue. 2019a. Snow (and ice!) hits Bellevue. City News, February 4, 2019. URL: https://bellevuewa.gov/city-news/snow-and-ice-hits-bellevue

City of Bellevue. 2019b. Windstorm strikes region. City News, January 7, 2019. URL: https://bellevuewa.gov/city-news/windstorm-strikes-region

City of Bellevue and University of Washington. 2019. Climate Change Vulnerability Assessment for Bellevue. URL: https://lcy.be.uw.edu/wp-content/uploads/sites/35/2019/09/LCY_ClimateChange-1.pdf

City of Bellevue Community Development. 2015. 2015 Comprehensive Plan Update. URL: https://bellevuewa.gov/city-government/departments/community-development/planning-initiatives/comprehensive-plan

City of Bellevue Community Development. 2020a. Sustainable Bellevue: Environmental Stewardship Plan. URL: https://bellevuewa.gov/city-government/departments/community-development/environmental-stewardship

City of Bellevue Community Development. 2020b. Economic Development Plan. URL: https://bellevuewa.gov/city-government/departments/community-development/economic-development/economic-development-plan

City of Bellevue Office of Emergency Management. 2019. 2018-2023 Bellevue Comprehensive Emergency Management Plan. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2019/CEMP%20Plan%20-%20with%20WA%20EMD%20approval.pdf

City of Bellevue Parks & Community Services. 2022. Bellevue Parks & Open Space System Plan. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2022/ParksPlan_2022-07-11_Adopted.pdf

City of Bellevue Transportation Department. 2013. City of Bellevue Downtown Transportation Plan. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/DTPFINAL2015.pdf

City of Bellevue Transportation Department. 2019. City of Bellevue Eastgate Transportation Study. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2019/Eastgate%20TR%20Study-FINAL%20Appendices.pdf

City of Bellevue Transportation Department. 2022. City of Bellevue 2022 – 2023 Transportation Facilities Plan. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2022/City%20of%20Bellevue%202022-2033%20Transportation%20Facilities%20Plan_0.pdf

City of Bellevue Utilities. 2023. Emergency Water Supply Master Plan. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2023/EWSMP_March2023.pdf

City of Bellevue. n.d. State of Our Neighborhoods. URL: https://storymaps.arcgis.com/stories/7772aee4d4e345b3962aac153740004d

City of Bellevue. 2017. Diversity Advantage Plan Progress Report. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/mc2685A%20Diversity%20Advantage%20PlanWEB%20progress%20report.pdf.

City of Bellevue. 2019. 2018-2023 Hazard Inventory and Risk Assessment. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/2019/HIRA%20Combined.pdf

Clean Energy Transition Institute. 2022. Operation 2030: Scaling Building Decarbonization in Washington State. URL: https://www.cleanenergytransition.org/projects/building-decarbonization/operation-2030

Climate Adaptation Planning and Analytics Strategies/National Integrated Heat Health Information System (CAPA/NIHHIS). 2021. Heat Watch Seattle & King County. URL: https://your.kingcounty.gov/dnrp/climate/documents/2021-summary-report-heat-watch-seattle-king-county.pdf

Crowe, M. 2021. Extreme heat's impact on Northwest infrastructure gives a taste of climate change. King 5 News, June 28, 2021. URL: https://www.king5.com/article/tech/science/environment/extreme-heat-northwest-infrastructure-climate-change/281-3f66ada0-412f-488e-8890-10ba9670986b

Cutter, S.L., B.J. Boruff, and W.L. Shirley. 2003. Social Vulnerability to Environmental Hazards. Social Science Quarterly 84(2): 242-261.

DeVine, A., P.T. Vu, M.G. Yost, E.Y.W. Seto, and T.M. Busch Isaksen. 2017. A geographical analysis of emergency medical service calls and extreme heat in King County, WA, USA (2007–2012). International Journal of Environmental Research and Public Health 14(8):937.

Eisenman, D.P., M.M.T. Kyaw, and K. Eclarino. 2021. Review of the Mental Health Effects of Wildfire Smoke, Solastalgia, and Non-Traditional Firefighters. UCLA Center for Healthy Climate Solutions, David Geffen School of Medicine at UCLA, & Climate Resolve. Los Angeles, CA.

Environmental Protection Agency (EPA). n.d. EJScreen. URL: https://ejscreen.epa.gov/mapper/

EPA. 2018. Vulnerable Populations. *In* Ebi, K.L., J.M. Balbus, G. Luber, A. Bole, A. Crimmins, G. Glass, S. Saha, M.M. Shimamoto, J. Trtanj, and J.L. White-Newsome, 2018: Human Health. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 539–571. doi: 10.7930/NCA4.2018.CH14

EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. Social Vulnerability Report. URL: https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf.

EPA. 2022. Smart Growth and Climate Change. URL: www.epa.gov/smartgrowth/smart-growth-and-climate-change

Federal Emergency Management Agency (FEMA). 2020. Flood Maps. URL: https://www.fema.gov/flood-maps

Georgetown Climate Center. 2020. Equitable Adaptation Toolkit. URL: https://www.georgetownclimate.org/adaptation/toolkits/equitable-adaptation-toolkit/

Handwerger, A. L., E.J. Fielding, S.S. Sangha, and D.P.S. Bekaert. 2022. Landslide sensitivity and response to precipitation changes in wet and dry climates. Geophysical Research Letters 49: e2022GL099499.

Haokip, S.W., K. Shankar, and J. Lalrinngheta. 2020. Climate change and its impact on fruit crops. Journal of Pharmacognosy Phytochemistry 9(1): 435-438.

International Economic Development Council. 2021. Economic Development in a Changing Climate: Minimizing Risks and Maximizing Opportunities. URL: https://app.hubspot.com/documents/19924342/view/477812481?accessId=605f5f

Kearl, Z. and J. Vogel. 2023. Urban extreme heat, climate change, and saving lives: Lessons from Washington state. Urban Climate 47: 101392.

King County. n.d. Communities Count: Health Indicators. URL: https://www.communitiescount.org/topics/#health

King County. 2013. Predicting climate change effects on kokanee habitat suitability in Lake Sammamish, Washington. Prepared for U.S. Fish and Wildlife Service, Lacey, Washington. Prepared by C. DeGasperi, Water and Land Resources Division, Seattle, Washington.

King County. 2022. King County to develop its first-ever Extreme Heat Mitigation Strategy to prepare the region for more intense, prolonged heat waves caused by climate change. King County Natural Resources and Parks News Release, June 24, 2022. URL: https://kingcounty.gov/depts/dnrp/newsroom/newsreleases/2022/June/24-extreme-heat-mitigation-strategy.aspx

King County–Cities Climate Collaboration (K4C). 2021. Climate Action Toolkit. URL: https://kingcounty.gov/services/environment/climate/actions-strategies/initiatives-programs/climate-action-toolkit.aspx

KOMO News. 2022. Winter weather, road conditions impacting trash pickup in King County. KOMO News, December 22, 2022. URL: https://komonews.com/news/local/seattle-trash-pickup-seattle-public-utilities-king-county-republic-services-garbage-delays-winter-weather-road-conditions

Levy, N. 2012. Portion of West Lake Sammamish Parkway will remain closed for another six to nine weeks. Bellevue Reporter, February 3, 2012. URL: https://www.bellevuereporter.com/news/portion-of-west-lake-sammamish-parkway-will-remain-closed-for-another-six-to-nine-weeks/

Lundgren, L., and A. Jonsson. 2012. Assessment of social vulnerability: a literature review of vulnerability related to climate change and natural hazards. CSPR Briefing No 9.

McNerthney, C. 2021. Heat wave broils Western Washington, shattering Seattle and regional temperature records on June 28, 2021. URL: https://www.historylink.org/File/21266

MyNorthwest. 2019. Driver has to swim from submerged car in Bellevue during rain. MyNorthwest, December 20, 2019. URL: https://mynorthwest.com/1650337/bellevue-rain-flood-car-swim/

Nunn, R., J. O'Donnell, J. Shambaugh, L.H. Goulder, C.D. Kolstad, and X. Long. 2019. Ten facts about the economics of climate change and climate policy. A joint report from The Hamilton Project and the Stanford Institute for Economic Policy Research. URL: https://www.brookings.edu/research/ten-facts-about-the-economics-of-climate-change-and-climate-policy/

Office of the Insurance Commissioner. n.d. The insurance commissioner's work on climate risk and insurance. URL: https://www.insurance.wa.gov/insurance-commissioners-work-climate-risk-and-insurance

Plan-It Geo LLC. 2018. Urban Tree Canopy Assessment. Prepared for the City of Bellevue, Washington. URL: https://bellevuewa.gov/sites/default/files/media/pdf_document/Bellevue%20WA%20-%20Full%20Tree%20Canopy%20Assessment%20Report%20-%202018_FINAL-compressed%20-%20Copy.pdf

Puget Sound Energy (PSE). 2020. Electricity Supply. URL: https://www.pse.com/en/pages/energysupply/electric-supply.

PSE. 2021. Energize Eastside. Eastside Need and Solution. URL: https://energizeeastside.com/need

Puget Sound Regional Council (PSRC). n.d. Puget Sound Regional Council Interactive Regional Hazards Map. URL: https://psregcncl.maps.arcgis.com/apps/MapSeries/index.html?appid=0775a678df3741788b4ad2fd4d97c09d.

PSRC. 2022. Bellevue Community Profiles, 2016-2020 ACS. URL: https://psrcwa.shinyapps.io/community-profiles/.

PSRC. 2023. Vision 2050. URL: https://www.psrc.org/planning-2050/vision-2050.

Raymond, C.L., D.L. Peterson, and R.M. Rochefort, eds. 2014. Climate change vulnerability and adaptation in the North Cascades region, Washington. Gen. Tech. Rep. PNW-GTR-892. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 279 p.

Reid, C.E., M.S. O'Neill, C.J. Gronlund, S.J. Brines, D.G. Brown, A.V Diez-Roux, and J. Schwartz. 2009. Mapping Community Determinants of Heat Vulnerability. Environmental Health Perspectives 117(11).

Roop, H.A., G.S. Mauger, H. Morgan, A.K. Snover, and M. Krosby. 2020. Shifting Snowlines and Shorelines: The Intergovernmental Panel on Climate Change's Special Report on the Ocean and Cryosphere and Implications for Washington State. Briefing paper prepared by the Climate Impacts Group, University of Washington, Seattle. DOI: doi.org/10.6069/KTVN-WY66.

Schreiber, A. 2016. State of the Washington blueberry industry. URL: http://whatcom.wsu.edu/ag/edu/sfc/documents/sfc2015/SchreiberBlueComm_SFC2015.pdf

Seattle-King County Public Health Department. n.d. Blueprint for Addressing Climate Change and Health. URL: https://kingcounty.gov/~/media/depts/health/environmental-health/documents/publications/blueprint-climate-change-and-health.ashx?la=en

Seattle Public Utilities. 2018. Water Shortage Contingency Plan. URL: https://www.seattle.gov/documents/Departments/SPU/Documents/Plans/SPU%20Water%20Shortage%20Contingency%20Plan%202019%20WSP.pdf

Sesana, E., A.S. Gagnon, C. Ciantelli, J.A. Cassar, and J.J. Hughes. 2021. Climate change impacts on cultural heritage: A literature review. WIREs Climate Change 12:e710.

Sullivan, C. 2022. WSDOT closes portion of I-405 this weekend to repair '15-foot-deep sinkhole.' KIRO News, September 13, 2022. URL: https://www.kiro7.com/news/local/wsdot-closes-portion-i-405-this-weekend-repair-15-foot-deep-sinkhole/5VZ7SS77CBAS5M5UFEJ3DIHVW4/

The Constructor. n.d. Designing Resilient Buildings for Extreme Weather Conditions. URL: https://theconstructor.org/architecture/designing-resilient-buildings-for-extreme-weather-conditions/571350/

U.S. Census Bureau. 2019. *On the Map.* URL: https://onthemap.ces.census.gov/.

University of Washington Climate Impacts Group (UW CIG). 2009. The Washington Climate Change Impacts Assessment. M. McGuire Elsner, J. Littell, and L. Whitely Binder (eds). Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington, Seattle, Washington.

UW CIG, UW Department of Environmental and Occupational Health Sciences, Front and Centered and Urban@UW. 2018. An Unfair Share: Exploring the disproportionate risks from climate change facing Washington state communities. A report prepared for Seattle Foundation. University of Washington, Seattle, WA. URL: https://cig.uw.edu/wp-content/uploads/sites/2/2018/08/AnUnfairShare_WashingtonState_August2018.pdf.

UW CIG. 2022. Climate Mapping for a Resilient Washington. URL: https://data.cig.uw.edu/climatemapping/

Urban Land Institute (ULI). 2022. Resilient Retrofits. URL: https://knowledge.uli.org/en/Reports/Research%20Reports/2022/Resilient%20Retrofits

Urban Sustainability Directors Network (USDN). 2023. *Resilience Hubs.* URL: http://resilience-hub.org/.

Washington Department of Fish and Wildlife (WDFW). 2015. Washington's State Wildlife Action Plan: 2015 Update. URL: https://wdfw.wa.gov/sites/default/files/publications/01742/wdfw01742.pdf

WDFW. 2022. Bellevue Salmon Spawner Surveys 2021: Coal Creek, Kelsey Creek, West Tributary, and Richards Creek. URL: https://bellevuewa.gov/sites/default/files/media/document/dept-utilities/utilities/BellevueStreams_SalmonMonitoringReport_2021_final.pdf.

Washington State Department of Commerce. 2022. Early Adopter Incentive Program. URL: https://www.commerce.wa.gov/growing-the-economy/energy/buildings/early-adopter-incentive-program

Washington State Department of Commerce. 2023a. Climate Element Planning Guidance. URL: https://www.commerce.wa.gov/serving-communities/growth-management/growth-management-topics/climate-change/

Washington State Department of Health. n.d. Health Disparities Map. URL: https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/washington-environmental-health-disparities-map

Water Supply Forum. 2016. Climate Change Resiliency Assessment Technical Memorandum: Snohomish, King, and Pierce Counties, Washington. URL: https://www.watersupplyforum.org/docs/102/cd8d53786c6d6fa0d0367520126295576b92515f/WSFregionalwatersupplyresiliencyprojectclimatechangeApril2016FINAL.pdf

Westside Seattle. 2022. Ice and snow shut down Metro. December 23, 2022. URL: https://www.westsideseattle.com/robinson-papers/2022/12/23/update-ice-and-snow-shut-down-metro-it-will-resume-4pm

Yager, J. 2015. Planning for Resilience: The Challenge of Floodproofing Multifamily Housing. URL: https://furmancenter.org/research/publication/planning-for-resilience-the-challenge-of-floodproofing-multifamilyhousing

Yu, J., K. Castellani, K. Forysinski, P. Gustafson, J. Lu, E. Peterson, M. Tran, A. Yao, J. Zhao, and M. Brauer. 2021. Geospatial indicators of exposure, sensitivity, and adaptive capacity to assess neighbourhood variation in vulnerability to climate change-related health hazards. Environmental Health 20(31).

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