Climate Vulnerability and Risk Assessment

City of Lacey Resilience Sub-Element

January 31, 2025
Prepared by Raimi + Associates

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List of Acronyms

ACS: American Community Survey

CDC/ATSDR: Centers for Disease Control Agency for Toxic Substances and Disease Registry

Commerce: Washington Department of Commerce

DNR: Washington Department of Natural Resources

ENSO: El Niño Southern Oscillation

FEMA: Federal Emergency Management Agency

HMP: Hazard Mitigation Plan

HVAC: Heating, Ventilation, and Air Conditioning

IPCC: Intergovernmental Panel on Climate Change

JBLM: Joint Base Lewis-McChord

Lacey HMP Annex: Lacey Annex to the Hazard Mitigation Plan for the Thurston Region

NOAA: National Oceanic and Atmospheric Administration

NRI: National Risk Index

PSE: Puget Sound Energy

PSPS: Public Safety Power Shutoff

RCP: Representative Concentration Pathway

Regional HMP: Hazard Mitigation Plan for the Thurston Region

SVI: Social Vulnerability Index

TRPC: Thurston Regional Planning Council

UGA: Urban Growth Area

UW: University of Washington

WUI: Wildland-Urban Interface

1. Executive Summary

The Lacey Climate Vulnerability and Risk Assessment (Assessment) is a high-level evaluation of the climate-related hazards that affect the city. The Assessment is the technical analysis supporting the development of the Lacey Resilience Sub-Element of the Comprehensive Plan, as required by state law HB 1181. Specifically, the Assessment identifies potential climate hazard impacts that will affect Lacey and determines the impact of these hazards on key assets and populations within the city and its urban growth area (UGA). This analysis helps identify areas where additional adaptation strategies are needed to mitigate the negative impacts of climate change and guides the development of goals and policies for the Resilience Sub-Element.

1.1 Key Findings

1.1.1 Priority Climate-Related Hazards

Overall, Lacey has a low level of vulnerability and risk associated with climate change hazards. Only a small portion of the buildings, infrastructure, and other assets in the city and urban growth area (UGA) are projected to be impacted by climate change. Even so, events like heat waves, microburst storms, and wildfires that have not historically been part of Washington's climate are projected to be more frequent and extreme by mid- and end-of-century.

Severe weather, especially extreme winds, is a priority hazard based on historical events and the breadth of the impacts to people and assets. Severe weather events including extreme storms, winds, and cold and can cause significant impacts that can be particularly dangerous for vulnerable populations.

Extreme heat is a priority hazard and should be considered separately from the other types of severe weather when crafting policy. Vulnerabilities to extreme heat are significantly different from those associated with other severe weather (extreme storms, wind, and cold). Specifically, extreme heat can be fatal within the span of a few-day event, and it requires preventative mitigation as much as it does rapid response like other weather-related hazards (e.g., getting power back on, clearing roads of trees, helping people whose homes have been damaged).

Wildfire smoke causes few impacts to assets but many serious impacts to people, particularly vulnerable populations. Wildfire smoke will become an even more serious hazard in Lacey in the future even if no wildfires occur within the city's boundaries. The same factors that make people vulnerable to the impacts of heat apply to the impacts of wildfire. The City should consider policies that address both hazards, especially since it is possible that extreme heat and wildfire smoke occur simultaneously.

Reassess wildfire risk when better mapping is available. Wildfire is rated as a low-risk hazard based on currently available mapping and data, However, the City recognizes the importance of wildfire and will reassess its risk level when new DNR wildfire risk assessment maps are available.

1.1.2 Population Vulnerabilities

Household characteristics are a leading factor in the climate vulnerability of Lacey residents. Specifically, age and health status are associated with some of the most severe consequences from extreme heat and wildfire, including smoke, due to physiological factors and less ability to evacuate.

Housing and transportation characteristics are the second greatest source of climate vulnerability of Lacey residents. Characteristics of housing quality, especially those related to insulation and cooling/ventilation, are associated with negative health impacts from extreme heat and wildfire smoke. People living in homes without air conditioning may be more likely to become ill or pass away during extreme heat events. Lack of air filtration systems to filter indoor air during smoky conditions can increase residents' likelihood of negative cardiovascular and/or pulmonary symptoms. Lack of transportation impacts residents' ability to travel to safer location when a climate hazard event is occurring.

People experiencing homelessness are extremely vulnerable to climate change impacts. Unsheltered residents are particularly vulnerable to climate-related hazards by virtue of being exposed to the elements. People experiencing homelessness may also have compounding risk factors such as age and health status.

1.1.3 Sector Vulnerabilities

The electrical grid is a significant infrastructural vulnerability. Electrical grid outage is a potential vulnerability for buildings, critical and community-serving facilities, infrastructure and utilities, and economic development. Multiple climate-related hazards can cause electrical grid outages, and their impacts can be far-reaching. Severe storms and wind can cause outages when downed trees and wind damage transmission lines; when combined with blocked roadways and debris associated with these events, residents can go multiple days without power. Extreme temperatures also stress the electrical grid by increasing demand from the use of heating and air conditioning. Though heating during winter has historically been a large demand for Puget Sound Energy (PSE), higher temperatures, heat waves, and the increase of buildings with air conditioning will cause greater stress on the grid in summer as well.

Existing buildings are vulnerable to heat and wildfire smoke. Existing buildings without central air conditioning can reach dangerous temperatures indoors for residents, workers, and visitors during extreme heat events. Relying on opening windows for cooling may be insufficient to combat high indoor temperatures, even at nighttime. Insufficient ventilation can also lead to unhealthy indoor air quality when there is wildfire smoke.

2. Introduction

2.1 Purpose

The Lacey Climate Vulnerability and Risk Assessment (Assessment) is a high-level evaluation of the climate-related hazards that affect the city.

The Assessment is the technical analysis supporting the development of the Lacey Resilience Sub-Element, a new Comprehensive Plan Element required by state law HB 1181. The Assessment fulfills two steps recommended by the WA Department of Commerce (Commerce) to comply with HB 1181:[1] (1) identify potential climate hazard impacts that will affect Lacey and (2) determine the impact of these hazards on key assets and populations within the city and UGA.

Paired with the findings of the Plan and Policy Audit, this analysis helps identify areas where additional adaptation strategies are needed and guides the development of goals and policies to mitigate the negative impacts of climate change. These goals and policies will be the foundation for the Resilience Sub-Element of the Comprehensive Plan.

2.2 Assessment Overview

The Assessment includes three substantive sections that correspond with Commerce's guidelines for climate vulnerability assessments:

- **Section 3, Climate-Related Hazards in Lacey.** Summarizes the projected trends of climate-related hazards that are likely to impact Lacey and the Urban Growth Area (UGA).
- **Section 4, Population and Public Health Vulnerabilities and Risks.** Analyzes the ways that populations can be impacted by climate-related hazards, with a focus on more vulnerable populations.
- **Section 5, Sector Vulnerabilities and Risks**. Analyzes the ways that community assets can be impacted by climate-related hazards. The assets are organized by sector: Buildings and Zoning, Critical and Community-Serving Facilities, Infrastructure and Utilities, Habitats and Ecosystems, Economic Development, and Agriculture and Food Systems.

2.3 Methods

The Assessment is compliant with the Commerce Planning Element Guidance for exploring climate impacts and assessing vulnerability and risk.[2]

Lacey has a FEMA-compliant Hazard Mitigation Plan (HMP), adopted in March 2024, which identifies the risks to the city and its UGA from hazards, including those that are not impacted by or related to climate change. This Assessment builds on the Lacey HMP Annex and the Regional HMP and supplements them with additional mapping of hazards and assets and an assessment of impacts to vulnerable segments of the community.

[1] *WA Department of Commerce. (2024). Intermediate Planning Guidance.* https://deptofcommerce.app.box.com/s/fpg3h0lbwln2ctqjg7jg802h54ie19jx
[2] *WA Department of Commerce. (2024).*

The time horizons of the HMP and the Comprehensive Plan are well-aligned. The HMP makes long-term projections of climate-related hazards. Likewise, the Comprehensive Plan is a long-range plan that should take into account trends through the end of the century.

2.3.1 Data Sources

The Assessment relies on the best available data from the University of Washington (UW) Climate Impacts Group for climate hazard projections. The UW data is sourced directly from the "Climate Mapping for a Resilient Washington" mapping application, or as referenced in the Regional HMP. The Climate hazard risk ratings are from the FEMA National Risk Index (NRI) as cited in the Regional HMP. Data for the social vulnerability assessment is from the Center for Disease Control and Prevention and Agency for Toxic Substances and Disease Registry Social Vulnerability Index (CDC/ATSDR SVI), which uses data from the American Community Survey 2018-2022 5-year estimates.

The data used to assess wildfire risk is subject to change. The wildland-urban interface (WUI) mapping used to assess wildfire risk in the Regional HMP, the Lacey HMP Annex, and this Assessment is subject to change in the near future. The Regional HMP and Lacey Annex used the WUI maps prepared by the Department of Natural Resources (DNR) in 2019 to identify areas prone to wildfire. The WUI identifies communities adjacent to wildlands that could be impacted by wildland fire hazards (because a fire may originate in the wildland area and spread to structures and dwellings and vice versa), but it does not reflect wildfire risk. In 2024, SB 6120 was adopted and directs DNR to establish a new statewide wildfire hazard map and base-level wildfire risk maps for each county.[3] DNR is expected to provide the wildfire risk maps tool and analysis by June 2026.

2.3.2 Key Terms

The following key terms related to climate-related hazards and their impacts are used in this Assessment.

2.3.2.1 Resilience

Throughout the Assessment, the term **resilience** is shorthand for **climate resilience**. State law defines climate resilience as:

> *The ongoing process of anticipating, preparing for, and adapting to changes in climate and minimizing negative impacts to our natural systems, infrastructure, and communities. For natural systems, increasing climate resilience involves restoring and increasing the health, function, and integrity of our ecosystems and improving their ability to absorb and recover from climate-affected disturbances. For communities, increasing climate resilience means enhancing their ability to understand, prevent, adapt, and recover from climate impacts to people and infrastructure.*[4]

2.3.2.2 Hazards

Hazards are defined by FEMA as "something that is potentially dangerous or harmful, often the root cause of an unwanted outcome is potentially dangerous or harmful."[5] This is an umbrella term covering man-made hazards (like dam failure), natural hazards, and technological hazards. The

[3] *Washington State Fire Marshalls. (2025). WUI Updates – DNR Wildfire Risk Maps, New HB 1254. https://wsafm.com/news/13451798*
[4] *Greenhouse Gas Emissions-Cap and Invest Program. Definitions. RCW 70A.65.010.*
[5] *FEMA. (n.d.) Analyzing Hazards. https://training.fema.gov/programs/emischool/el361toolkit/analyzinghazards.htm. Accessed 12/20/24.*

subject of the Assessment is only the subset of natural hazards related to climate (see climate-related hazards definition).

Climate-related hazards are natural hazards that are exacerbated by global climate change, such as extreme heat events, flooding, sea level rise, and wildfire. These can be long-term, chronic changes (sometimes referred to as stressors) or acute events (sometimes referred to as shocks).

Climate hazard events are acute events (sometimes referred to as shocks) of a climate-related hazard. Examples are an extreme storm or a weeklong heat dome event.

2.3.2.3 Vulnerability

Vulnerability in this Assessment is shorthand for **climate vulnerability,** meaning "susceptibility of a system to harm from climate change." Vulnerability is a function of exposure, sensitivity, impact, and adaptive capacity.[6] (see Figure 1)

Exposure is the "presence of people, infrastructure, natural systems, and economic, cultural, and social resources in areas that are subject to harm."[7]

Sensitivity is "the degree to which a built, natural, or human system is directly or indirectly affected by changes in climate conditions (e.g., temperature and precipitation) or specific climate change impacts (e.g., sea level rise, increased water temperature)."[8]

Impacts are "specific negative result[s] of a climate change effect, generally on a particular population or asset."[9] They are a function of exposure and sensitivity. For example, if a person is exposed to extreme heat and they have more sensitivity due to having asthma, a potential impact to that person is heat illness.

Adaptive capacity is "the ability to adjust to potential damage, to take advantage of opportunities, or to respond to consequences."[10] In the FEMA NRI, this concept of adaptive capacity is called **community resilience.**[11]

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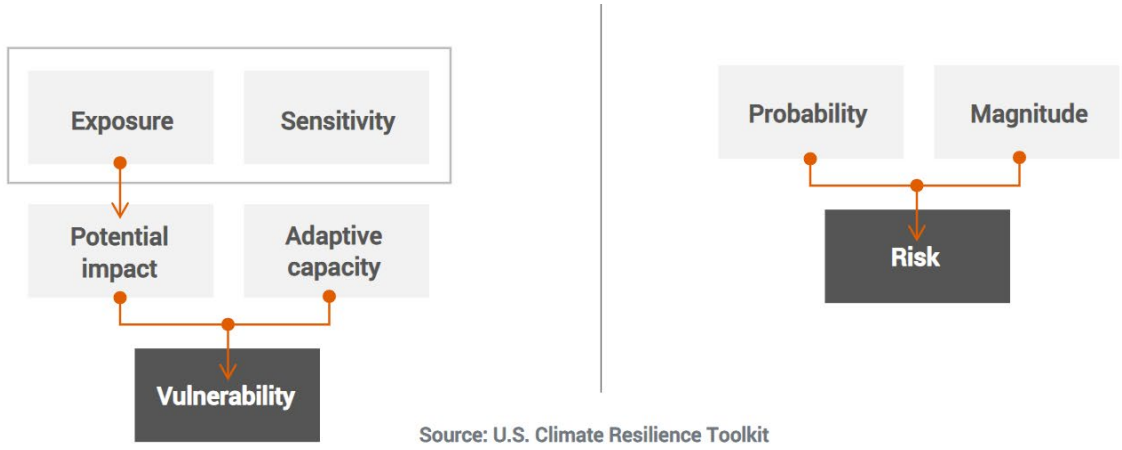
[6] *UW. (2007). Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments. https://cig.uw.edu/wp-content/uploads/sites/2/2020/12/snoveretalgb574keyterms.pdf. P. 6.*
[7] *CalOES. (2020). California Adaptation Planning Guide. https://www.caloes.ca.gov/wp-content/uploads/Hazard-Mitigation/Documents/CA-Adaptation-Planning-Guide-FINAL-June-2020-Accessible.pdf#search=adaptation%20planning%20guide*
[8] *UW. (2007). P. 5.*
[9] *CalOES. (2020).*
[10] *Ibid.*
[11] *FEMA. (2023). National Risk Index Technical Documentation. https://www.fema.gov/sites/default/files/documents/fema_national-risk-index_technical-documentation.pdf*

Figure 1. Components of Vulnerability and Risk



Source: US Climate Resilience Toolkit, as cited in Commerce Intermediate Planning Guidance

Social vulnerability in this Assessment is "the susceptibility of social groups to the adverse impacts" of climate-related hazards, "including disproportionate death, injury, loss, or disruption of livelihood. Social Vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards."[12]

Risk is the probability and magnitude of impacts from a climate-related hazard (see Figure 1, right side). The Assessment uses the risk ratings from the Regional HMP, which are from the FEMA NRI.

[12] *FEMA. (2023).*

3. Climate-Related Hazards in Lacey

Chapter 4: Risk Assessment of the Regional HMP assesses the location, extent/severity, impacts, previous occurrences, future probability, and projected changes due to climate change of natural hazards that are likely to occur in Thurston County in the future. The Regional HMP uses the University of Washington Climate Impacts Group Climate data, which presents climate data at the county scale. These county-level projections are applicable to Lacey because the city is subject to the same regional climatic patterns and changes. The Lacey HMP Annex provides additional Lacey-specific details, such as past hazard events in the city. This Assessment uses and builds on the HMP and the Lacey Annex and supplements them with additional analysis.

3.1 Climate-Related Hazards

The Regional HMP assesses the hazards that have a connection to climate change and that Commerce requires to be assessed to develop the Resilience Sub-Element:

- Flood (Chapter 4.3): Riverine, groundwater, tidal, and urban flooding
- Landslide (Chapter 4.4)
- Sea level rise (Chapter 4.5)
- Severe weather (Chapter 4.6): Hazardous temperatures (heat and cold), precipitation, and wind
- Wildfire (Chapter 4.9).

In the analyses of climate projections, two trends (or scenarios) are presented. They are the result of different modeled global climate scenarios, called Representative Concentration Pathways (RCPs), assessed by the Intergovernmental Panel on Climate Change (IPCC).

- RCP 4.5 is a low-intermediate GHG emissions scenario where carbon dioxide (CO_2) emissions peak around 2040, then decrease and stabilize around end-of-century. In this scenario, global warming could be limited to 3°C (5.4°F).
- RCP 8.5 is a very high GHG emissions scenario where CO_2 emissions continue in a business-as-usual trend, resulting in roughly double the emissions from current levels by 2050. In this scenario, global warming could exceed 4°C (7.2°F) by 2100.

Available climate hazard projections for the county are summarized in Table 1. Strong winds are assessed qualitatively and have a risk index rating in the Regional HMP as part of the analysis of severe weather, but there are no climate change projections specifically for strong winds in the UW data. Unlike the other climate-related hazards, flooding does not have projections for the two RCPs because it is assessed using historical data. Extreme cold/cold waves are assessed qualitatively but did not receive a risk index rating in the Regional HMP.

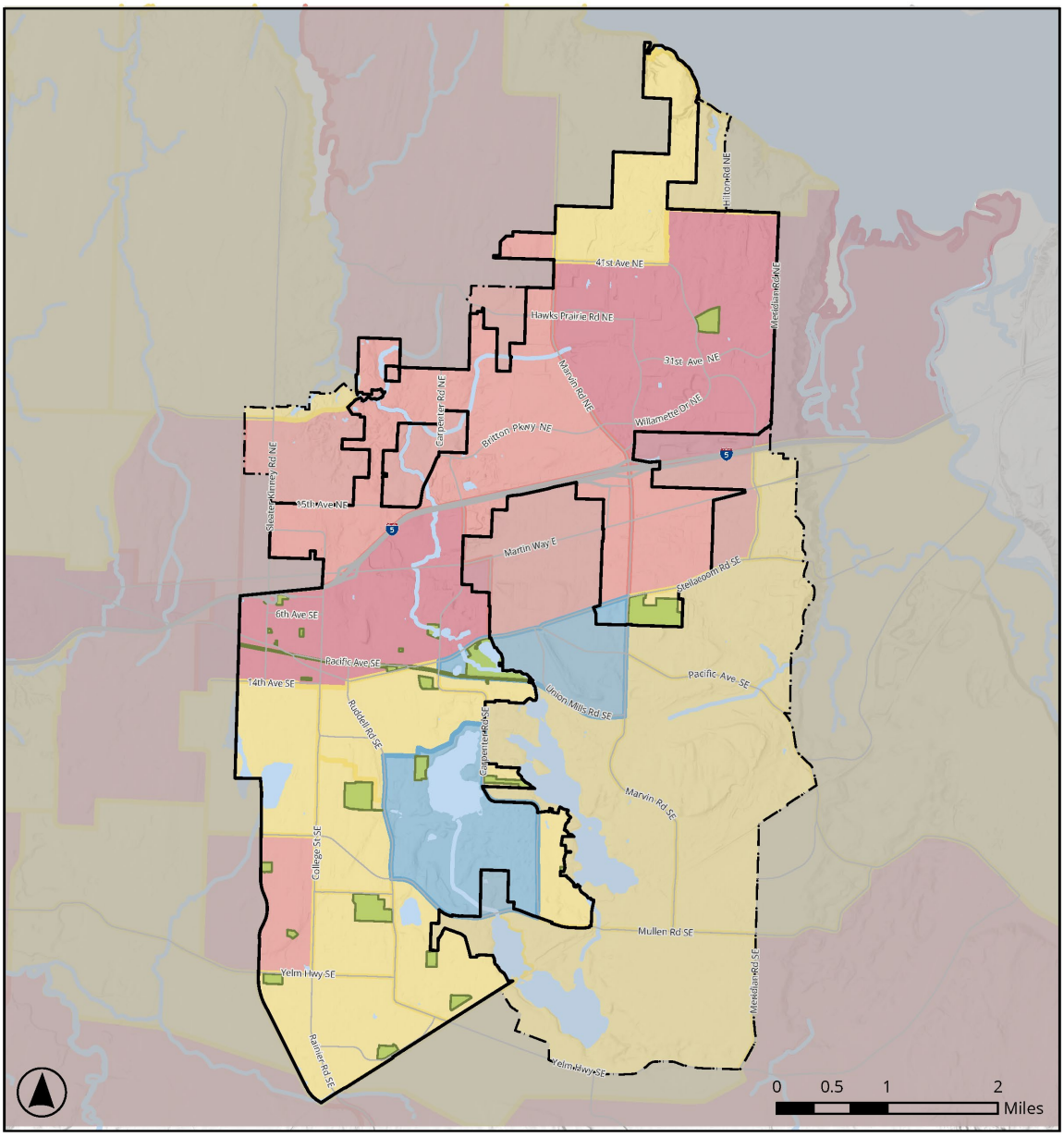
Table 1. Summary of Climate Hazard Projections for Thurston County

Climate Hazard	Trend	RCP	Mid-Century Projection* (2040-2069)	End-of-Century Projection* (2070-2099)
Extreme Heat	Increasing temperatures and number of hot days	RCP 4.5	~4°F increase in average summer maximum temperature ~22 more days per year with maximum humidex >90°F	~5°F increase in average summer maximum temperature 29.5 more days per year with maximum humidex > 90°F
		RCP 8.5	~6°F increase in average summer max. temperature ~34.5 more days per year with max. humidex >90°F	~10°F increase in average summer max. temperature 62 more days per year with max. humidex >90°F
Wildfire	More days with wildfire conditions, increasing chance of smoke and poor air quality	RCP 4.5	+3% change in wildfire likelihood 7 more high fire days per year	+13% change in wildfire likelihood High fire days not assessed
		RCP 8.5	+5% change in wildfire likelihood 9 more high fire days	+12% change in wildfire likelihood High fire days not assessed
Precipitation, Storms, and Wind	More intense storms, greater seasonal precipitation variation (but no change in total annual precipitation)	RCP 8.5	Heavy (2-year) storms will have 14% more precipitation Extreme storms (25-year) will have 17% more precipitation No projections for wind	Heavy (2-year) storms will have 15% more precipitation Extreme storms (25-year) will have 31% more precipitation No projections for wind
Flooding	See rightmost column	N/A	Higher probability of localized urban and groundwater flooding due to more intense storms. Nisqually River is prone to atmospheric river flooding.	
Changes in Streamflow	More flow in winter, less in spring	RCP 4.5	In both emissions scenarios, streams in the county will have more flow in winter and less in spring. The trend becomes more pronounced between mid- to end-of-century and with the high emissions scenario. In both emissions scenarios and both timeframes, there is a 100% chance of snowpack drought.	
		RCP 8.5		
Sea Level Rise	Higher sea levels, higher tidal/storm surge	RCP 4.5	0.8 feet (likely scenario) 1.4 feet (high scenario)	1.8 feet (likely scenario) 4.4 feet (high scenario)
		RCP 8.5	0.8 feet (likely scenario) 1.5 feet (high scenario)	2.3 feet (likely scenario) 5.1 feet (high scenario)
Drought	Drier summers	N/A	Regional projections indicate that longer, warmer, and drier summers will become the norm by mid-century	

Source: University of Washington Climate Impacts Group, Hazards Mitigation Plan for the Thurston Region (2023)
** Median projection. Rounded to the nearest 0.5 day*

FEMA's National Risk Index (NRI) indicates that the census tracts directly north and south of the I-5 are the most at risk for natural hazards based on a composite score of expected annual loss, social vulnerability, and community resilience (Figure 2). The tract along the southwestern edge of the city (bordered by Herman Rd SE, College St SE, and Yelm Hwy SE) also has a high score. However, NRI is based on measurements for 18 natural hazards, many of which are not relevant to climate change (such as volcanic activity and earthquake). NRI scores for climate-related hazards only are in Table 2.

Figure 2. National Risk Index Scores (Census Tracts)



Legend

City Limits
Urban Growth Area
Parks

National Risk Index

Very High
Relatively High
Relatively Moderate
Relatively Low

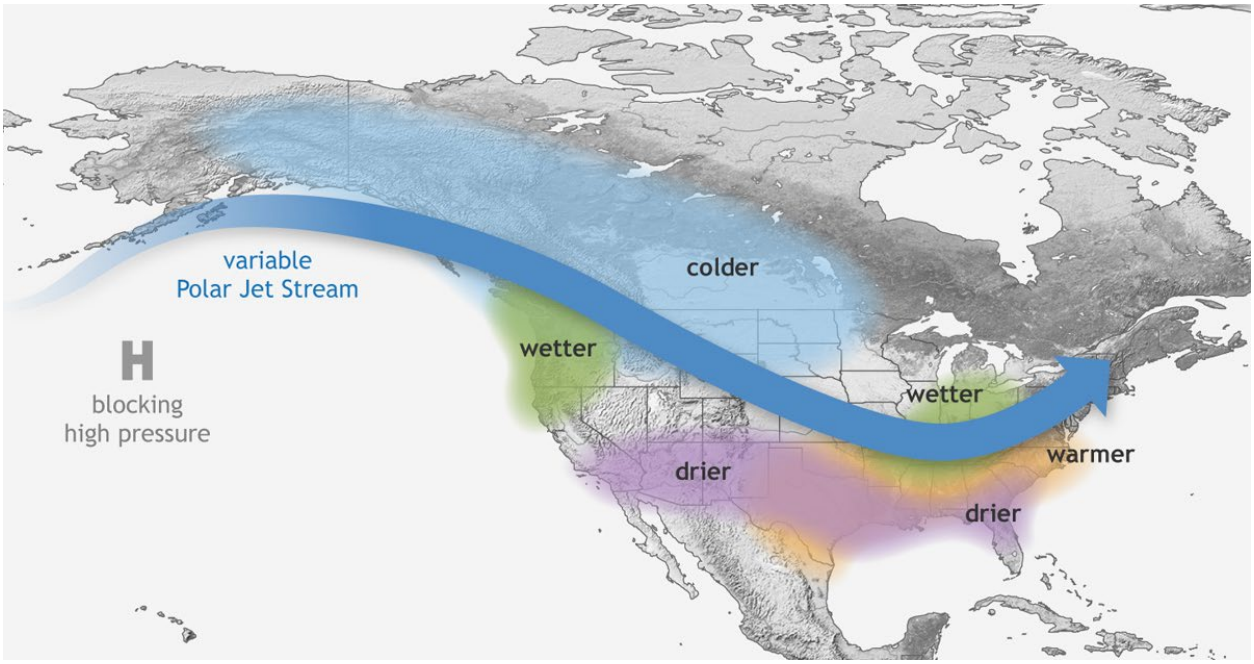
Sources: City of Lacey (2024), FEMA (2023).

3.1.1 Impacts of ENSO

Though the Regional HMP provides a comprehensive description of climate hazard projections, there is another element of potential climate change impacts that it does not address related to severe cold and storms.

There is some uncertainty around the future severity of extreme cold and storms because of the El Niño Southern Oscillation (ENSO), which is the cycle of El Niño and La Niña. In the Pacific Northwest and Canada, La Niña generally leads to heavy rains and flooding and can cause cooler than normal winter temperatures[13] (Figure 3). La Niña's effects in the Pacific Northwest are caused by trade winds that bring cold waters to the surface of the Pacific Ocean, pushing the Polar Jet Stream (blue arrow in Figure 3) northward.[14]

Figure 3. Typical La Niña Pattern



Source: NOAA

Warmer global air and ocean temperatures could alter the severity and frequency of La Niña events in the future. Researchers have found that there is a high likelihood that the rise of greenhouse gas concentrations in the atmosphere since 1960 have caused larger swings (10% change) in ENSO.[15] With this, "ENSO variations are likely to become even stronger (by 15-20% under high emission scenarios) later this century if atmospheric greenhouse gas concentrations continue to rise."[16]

[13] *NOAA. (n.d.). What are El Niño and La Niña? https://oceanservice.noaa.gov/facts/ninonina.html#:~:text=La%20Ni%C3%B1a%20has%20the%20opposite,rich%20water%20to%20the%20surface. Accessed 12/12/24.*
[14] *Ibid.*
[15] *McPhaden, M. (2023). Has climate change already affected ENSO? https://www.climate.gov/news-features/blogs/enso/has-climate-change-already-affected-enso*
[16] *Ibid.*

3.2 Priority Climate-Related Hazards

The Regional HMP rates the hazard risk for each hazard in Lacey, summarized in Table 2. It uses the hazard-specific ratings from the FEMA National Risk Index which considers expected annual loss, social vulnerability, and community resilience. It identifies heat and severe weather events and landslide as the highest risk hazards for Lacey.

Discussions with City staff and community stakeholders confirmed that all three components of severe weather (heat, precipitation/storms, and winds) are a major concern in Lacey. Staff and stakeholders underscored the dangerous impacts of previous incidents (especially the deadly 2021 heat dome) and the likelihood that they will continue to occur in the future. For this reason, extreme heat is assessed separately from the other types of severe weather because of its medium-high impact on people.

Wildfire smoke from wildfires burning outside the Puget Sound is another hazard that City staff and community stakeholders have identified as a priority to address. HB 1181 also requires the Resilience Sub-Element to consider wildfire smoke a climate hazard. Actual wildfire events occurring within Lacey's boundaries are less of a priority compared to smoke, as they have a low risk rating within the city boundary and UGA.

Based on City and community input, priority hazards for the Resilience Sub-Element to address should be expanded to:

- Extreme heat
- Severe weather (storms and wind) and landslide[17]
- Wildfire smoke
- Wildfire[18]

Table 2. Summary of Lacey Climate Hazard Risk Ratings (Regional HMP)

Climate Hazard	Hazard Risk Rating; Justification
Extreme Heat	**Medium**; high probability of occurrence, but low impact on people and buildings
Wildfire	**Low**; low probability of occurrence
Severe Weather Events (precipitation, storms, wind)	**Medium**; high probability of occurrence, but low impact on people and buildings
Landslide	**Medium**; high probability of occurrence
Flooding (50-, 100-, and 500-year flood, groundwater)	**Low**; medium-high probability of occurrence, but low impact on people property, and economy
Changes in Streamflow	Not rated but is discussed in flooding
Sea Level Rise	**Low**; low probability of occurrence
Drought	Not rated but relates to precipitation, streamflow and heat

Source: Lacey Annex to the Hazards Mitigation Plan for the Thurston Region (2024) and Hazards Mitigation Plan for the Thurston Region (2023)
Note: Risk assessment was not performed for drought in the Regional HMP or Lacey Annex. Drought may be profiled in a future Regional HMP update if the Hazard Mitigation Planning Workgroup decides it is an emerging threat or if new evidence warrants its inclusion.

[17] *Per Commerce guidance, landslide should be discussed in the context of extreme precipitation, as landslide risks are expected to change in the future because of heavy rain events that can make slopes unstable.*
[18] *Wildfire is rated as a low-risk hazard. However, the City recognizes the importance of wildfire and will reassess its risk level when new DNR wildfire risk assessment maps are available.*

As noted above, the assessment of wildfire risk is subject to change. The wildland-urban interface (WUI) mapping used to assess wildfire risk in the Regional HMP, the Lacey HMP Annex, and this Assessment is subject to change in the near future. The Regional HMP and Lacey Annex used the WUI maps prepared by the Department of Natural Resources (DNR) in 2019 to identify areas prone to wildfire. The WUI identifies communities adjacent to wildlands that could be impacted by wildland fire hazards (because a fire may originate in the wildland area and spread to structures and dwellings and vice versa), but it does not reflect wildfire risk. In 2024, SB 6120 was adopted and directs DNR to establish a new statewide wildfire hazard map and base-level wildfire risk maps for each county.[19] DNR is expected to provide the wildfire risk maps tool and analysis by June 2026.

[19] *Washington State Fire Marshalls. (2025). WUI Updates – DNR Wildfire Risk Maps, New HB 1254.* https://wsafm.com/news/13451798

4. Population and Public Health Vulnerabilities and Risks

The section of the Assessment focuses on the impact of climate-related hazards on the general population of Lacey, with added emphasis on the effects on sub-populations that are more vulnerable.

Social vulnerabilities and physiological sensitivities of a population can affect exposure to climate-related hazards and their sensitivity to impacts. Climate stressors and shocks can both expose people to a wide range of stress-inducing and hazardous situations (e.g., emergency evacuations, more illnesses due to increased air pollution and aeroallergen concentration, increased energy costs during extreme heat events), which can result in greater negative health outcomes. Older adults, young children, and people with chronic diseases and disabilities are generally more sensitive to impacts from the effects of climate-related hazards, such as droughts, extreme heat, and poor air quality. In addition, low-income populations, including homeless populations and communities of color, are generally more likely to be exposed to climate-related hazards, are more sensitive to these hazards, and have the fewest resources to cope or adapt.

4.1 Key Findings

Household characteristics are a leading factor in the climate vulnerability of Lacey residents. Specifically, age and health status are associated with some of the most severe consequences from extreme heat and wildfire, including smoke, due to physiological factors and less ability to evacuate.

Housing type and transportation characteristics are the second greatest source of climate vulnerability of Lacey residents.
Characteristics of housing quality, especially those related to insulation and cooling/ventilation, are associated with negative health impacts from extreme heat and wildfire smoke. People living in homes without air conditioning may be more likely to become ill or pass away during extreme heat events. Lack of air filtration systems to filter indoor air during smoky conditions can increase residents' likelihood of negative cardiovascular and/or pulmonary symptoms. Lack of transportation impacts residents' ability to travel to a safer location when a climate hazard event is occurring.

People experiencing homelessness are extremely vulnerable to climate change impacts. Unsheltered residents are particularly vulnerable to climate-related hazards by virtue of being exposed to the elements. People experiencing homelessness may also have compounding risk factors such as age and health status.

4.2 Social Vulnerability in Lacey

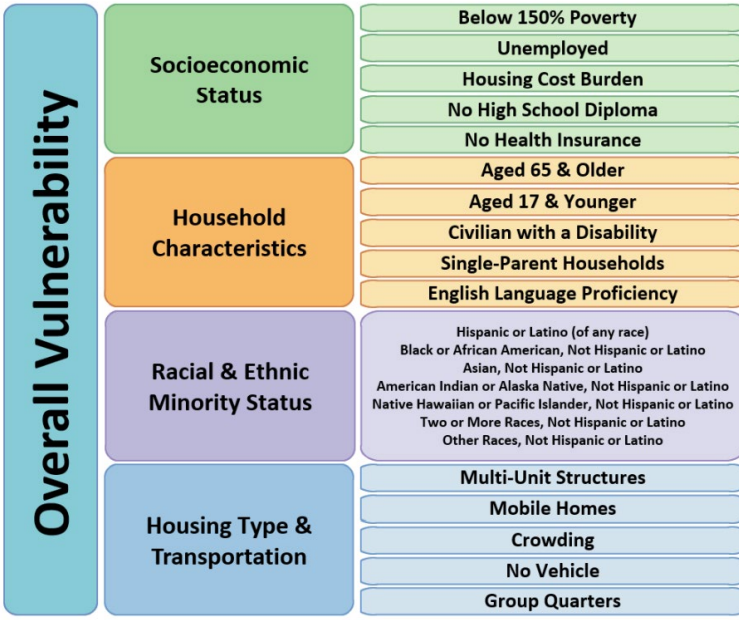
The NRI methodology used to determine risk in the Regional HMP utilizes the Centers for Disease Control's Social Vulnerability Index (CDC/ATSDR SVI) to understand the level of residents' social vulnerability in each census tract. The CDC/ATSDR SVI score is based on four categories of data available from the American Community Survey 2018-2022 5-Year Estimates: Socioeconomic Status, Household Characteristics, Racial & Ethnic Minority Status, and Housing Type & Transportation (Figure 4).

The overall CDC/ATSDR SVI vulnerability score identifies the following census tracts with the highest overall vulnerability in the City and UGA:

- Tract 112
- Tract 113
- Tract 115
- Tract 116.25
- Tract 116.26
- Tract 123.30.

As shown in Figure 5, census tracts with the most socially vulnerable residents are concentrated along the southern side of the Interstate 5 and the southwestern edge of the city.

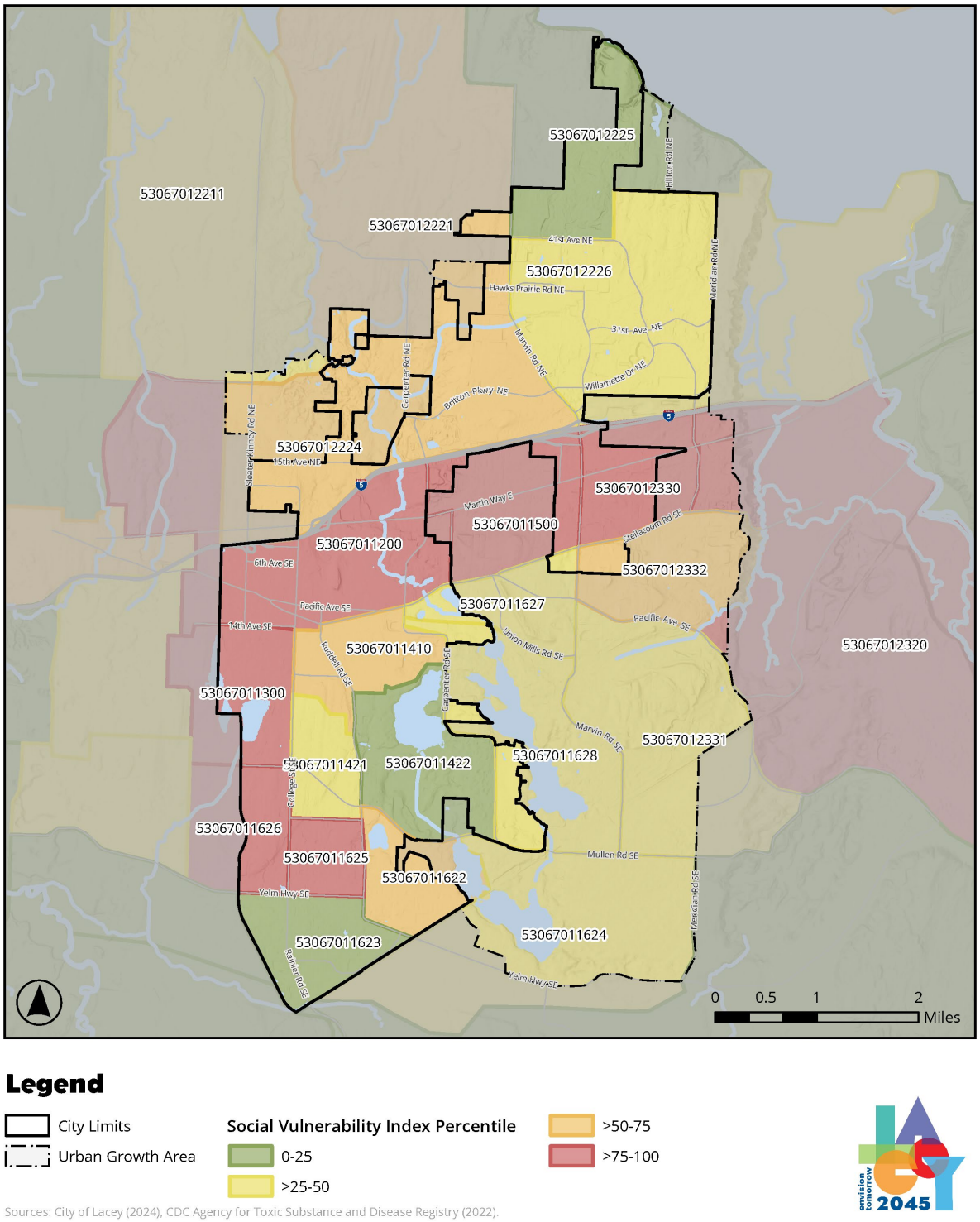
Figure 4. CDC/ATSDR SVI Components



Source: CDC/ATSDR

Maps of each of the four component scores are in Appendix A. Of the four components, Household Characteristics and Housing Type & Transportation are larger drivers of social vulnerability in Lacey than Socioeconomic Status and Race & Ethnic Minority Status. However, it is notable that tract 116.25 (North of Yelm Hwy SE and East of College St SE) is the only one with a high Race & Ethnic Minority Status percentile score in the city and UGA.

Figure 5. Lacey Social Vulnerability Scores (Census Tracts)



Legend

City Limits
Urban Growth Area

Social Vulnerability Index Percentile

0-25
>25-50
>50-75
>75-100

Sources: City of Lacey (2024), CDC Agency for Toxic Substance and Disease Registry (2022).

Source: National Risk Index, with data from CDC/ATSDR.

4.3 Climate Hazard Population Exposures and Consequences

The following sections describe the ways that Lacey residents, particularly those who have high social vulnerability, can be impacted by climate-related hazards.

Chapter 4 of the Regional HMP describes the impacts of each hazard to people. This Assessment uses and builds on the HMP and the Lacey Annex and supplements them with additional analysis.

Each of the four priority climate-related hazards identified above – extreme heat, severe weather and landslides, wildfire smoke, and wildfire – are discussed in sections 4.3.1 through 4.3.4 below. Each section analyzes the factors that increase people's vulnerability to the climate hazard and then identifies the census tracts where those social vulnerabilities are highest, if available. When the factors are part of one of the four components of the CDC/ATSDR SVI (Figure 4), the census tracts with high vulnerability (a score in the 75th percentile or above) are listed. Maps of the four vulnerability score components are in Appendix A.

4.3.1 Extreme Heat Population Exposures and Consequences

All Lacey residents are vulnerable to higher temperatures and extreme heat events because they occur on a regional scale. Any person can experience acute debilitating or life-threatening heat-related illnesses regardless of age, sex, or health status if they are exposed to extreme heat (especially if participating in physical activities) and cannot cool down their body. Additionally, because houses in the region have not historically needed air conditioning, most residents regardless of income are likely to live in a home that can be dangerous during an extreme heat event.

All Lacey residents can experience other health impacts related to extreme heat. There may be a link between heat and poor mental health, specifically increased incidence of aggressive behavior, violence, and suicide.[20] People may experience more or worsening pollen allergies as rising temperatures extend the length and timing of pollen season.[21]

Residents who have higher social vulnerability have an increased susceptibility to heat illness, cardiac strain, pulmonary strain, and/or death associated with extreme heat based on the following factors:

4.3.1.1 Age and Health Status (older adults, children, and people with underlying health conditions)

- Older adults, children, people with some underlying health conditions, and people who take certain medications have a reduced ability to regulate their body temperature. This increases their risk of heat illness and heat-related mortality.[22]
- Older adults have higher rates of underlying health conditions, like high blood pressure, diabetes, and kidney disease, that can increase likelihood of heat illness and heat-related mortality.

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[20] *Dodgen, D., D. Donato, N. Kelly, A. La Greca, J. Morganstein, J. Reser, J. Ruzek, S. Schweitzer, M.M. Shimamoto,K. Thigpen Tart, and R. Ursano, 2016: Ch. 8: Mental Health and Well-Being. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 217–246. http://dx.doi.org/10.7930/J0TX3C9H*

[21] *Washington State Department of Health. (n.d). Pollen and Climate Change. https://doh.wa.gov/community-and-environment/climate-and-health/pollen. Accessed 1/31/25.*

[22] *Dodgen et. al. (2016)*

- Heat accelerates the process that produce ground-level ozone, an air pollutant that can exacerbate symptoms for people who have asthma or other respiratory conditions.23
- Older adults and people with underlying health conditions are more likely to use medical devices or refrigerators for medication, which can be shut off in the event of a blackout or brownout during an extreme heat event.
- Individuals with mental health or psychiatric conditions have an increased incidence of hospital admissions and risk of death due to heat wave exposure.[24]

The CDC/ATSDR Household Characteristics score includes age and disability status and can serve as a proxy for where the populations noted above live in Lacey. Census tracts with high vulnerability due to Household Characteristics include: 113, 114.10, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.1.2 Low Income

- Heat waves and warm nights cause households to consume more energy if they are running fans and/or air conditioning for long periods of time. Even though there are programs to assist low-income households with energy costs, low-income households may face higher energy costs which are difficult for them to absorb.
- Low-income individuals are likely to have less access to healthcare.[25] This is associated with higher rates of underlying health conditions (like high blood pressure, diabetes, asthma), which in turn increase the likelihood of heat illness.

The CDC/ATSDR Socioeconomic Status score includes multiple factors associated with low-income status, including having an income below 150% poverty status, unemployment, and housing burden. The Socioeconomic Status score can serve as a proxy for where low-income populations live in Lacey. Census Tracts with high vulnerability due to Socioeconomic Status include: 112, 113, 116.22, 116.25, 123.20, and 123.30

4.3.1.3 Homelessness

- Unsheltered individuals have inadequate shelter from extreme heat.
- Unsheltered individuals do not have regular access to water and power. They may have limited access to drinking water, making it more difficult to stay hydrated and reduce their risk of heat illness.
- 43% of people experiencing homelessness countywide reported experiencing a disability, meaning the vulnerabilities related to age and health status on page 14 apply as well.

Countywide, over half of the people experiencing homelessness are unsheltered (living in a micro shelter, tent or encampment, vehicle, RV without water or power, or on the street).[26]

4.3.1.4 Working Outdoors

- People who work outdoors, such as landscapers, construction workers, and agricultural workers, conduct strenuous physical activity for extended periods of time in the heat. Without preventative measures like frequent breaks to cool down, this can lead to heat illness and death.

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[23] *US EPA. (2024). Ground-Level Ozone Basics.* https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics
[24] *Dodgen, D. et. al. (2016).*
[25] *WA Department of Health. (2018). State Health Assessment.* https://doh.wa.gov/sites/default/files/legacy/Documents/1000/SHA-HealthcareAccess.pdf
[26] *Thurston County. (2024). 2024 Thurston County Point in Time Count Preliminary Data Report.* https://s3.us-west-2.amazonaws.com/thurstoncountywa.gov.if-us-west-2/s3fs-public/2024-03/2024%20PIT%20Prelim%20Report_03-28-2024.pdf

4.3.1.5 Linguistic Isolation

- Individuals or households that are linguistically isolated may not have access to emergency notifications or information about what to do/where to go during an extreme heat event.

The CDC/ATSDR Household Characteristics score includes English proficiency and can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Household Characteristics include: 113, 114.10, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.1.6 Renters

- Renters are reliant on their landlord to implement heat resilience upgrades to their homes. For example, they cannot install air conditioning on their own.

34.3% of the housing in the city and the UGA are occupied by renters.[27]

4.3.1.7 Housing without Air Conditioning or with Poorer Insulation

- Unless they were built or remodeled recently, most homes in Lacey are unlikely to have air conditioning.
- Many mobile homes, especially older models, were built with thin walls, single-pane windows, and insufficient insulation in walls, floors, and ceilings. This results in higher heat gain in the summer as compared to conventional homes. Older mobile homes may have gaps or poorly sealed windows, doors, and seams, which makes it harder to maintain cool indoor temperatures.

The CDC/ATSDR Housing Type & Transportation score includes factors that indicate poorer-quality housing, including mobile homes and crowding. The Housing & Transportation score can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Housing Type & Transportation include: 112, 113, 115, 116.25, 116.26, 116.27, 122.24, and 123.30.

4.3.2 Severe Weather and Landslide Population Exposure and Consequences

There is not a defined geospatial area in Lacey where severe weather events are likely to occur, so all residents in Lacey are potentially vulnerable to the impacts of an extreme storm/wet microburst, hazardous wind event, and landslide triggered by severe weather. Any resident, regardless of income and housing type, could experience extended power outages when wind leads to fallen trees that down power lines. Affected people can also experience mental health impacts including stress, post-traumatic stress disorder, depression, and general anxiety.[28]

Residents who have higher social vulnerability can experience greater impacts from severe weather and landslide due to the following factors:

4.3.2.1 Age and Health Status (older adults, children, and people with underlying health conditions)

- Older adults and people with underlying health conditions are more likely to use medical devices or refrigerators for medication, which can be shut off during an intermittent or extended power outage.
- Older adults, children, and people with underlying health conditions are more likely to rely on others to evacuate if a landslide is imminent, increasing the risk of injury and mortality.

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[27] *Shepherd, H. (2024, December 11). Comp Plan Outreach Results [PowerPoint presentation].*
[28] *Dodgen, D., et al. (2016).*

The CDC/ATSDR Household Characteristics score includes age and disability status and can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Household Characteristics include: 113, 114.10, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.2.2 Low Income

- Low-income households who experience food insecurity may not have the funds to purchase a stockpile of food and supplies (such as a portable generator) necessary to survive an extended power outage.
- Low-income households will be more cost-burdened by home repairs after severe weather events.

The CDC/ATSDR Socioeconomic Status score includes multiple factors associated with low-income status, including having an income below 150% poverty status, unemployment, and housing burden. The Socioeconomic Status score can serve as a proxy for where low-income populations live in Lacey. Census Tracts with high vulnerability due to Socioeconomic Status include: 112, 113, 116.22, 116.25, 123.20, and 123.30

4.3.2.3 Homelessness

- Unsheltered individuals have inadequate shelter from rain, pooled water, and winds.
- 43% of people experiencing homelessness countywide reported experiencing a disability, meaning the vulnerabilities related to age and health status on page 16 apply as well.
- Countywide, over half of the people experiencing homelessness are unsheltered (living in a micro shelter, tent or encampment, vehicle, RV without water or power, or on the street).[29]

4.3.2.4 Linguistic Isolation

- Individuals or households that are linguistically isolated may not have access to emergency notifications or information about what to do/where to go during severe weather events and landslides.

The CDC/ATSDR Household Characteristics score includes English proficiency and can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Household Characteristics include: 113, 114.10, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.2.5 No Vehicle

- Households without a vehicle will not be able to evacuate by car if a landslide is imminent.

The CDC/ATSDR Housing Type & Transportation score includes households that do not have access to a vehicle and can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Housing Type & Transportation include: 112, 113, 115, 116.25, 116.26, 116.27, and 122.24.

4.3.3 Wildfire Smoke Population Exposure and Consequences

All Lacey residents are vulnerable to the impacts of wildfire smoke because it can affect the entire region. Any person can experience pulmonary and/or cardiac stress from smoke, as studies have linked wildfire smoke exposure to an increased risk of sudden cardiac arrest, heart attacks, and

[29] *Thurston County. (2024). 2024 Thurston County Point in Time Count Preliminary Data Report.* https://s3.us-west-2.amazonaws.com/thurstoncountywa.gov.if-us-west-2/s3fs-public/2024-03/2024%20PIT%20Prelim%20Report_03-28-2024.pdf

coronary artery disease.[30] The increase is most notable for older adults (65 and older) but can affect all people exposed. Another impact that is not life-threatening but does impact quality of life is decreased time spent outdoors. When conditions are smoky, people are advised to avoid physical activity outside. Residents are likely to spend less time outdoors for recreation or physical activity.

Residents who have higher social vulnerability are more susceptible to heat illness, cardiac strain, pulmonary strain, and/or death associated with wildfire smoke based on the following factors:

4.3.3.1 Age and Health Status (older adults, children, and people with underlying health conditions)

- Older adults, children, and people with some underlying health conditions are more susceptible to cardiac and respiratory strain due to smoke exposure. Smoke in the air exacerbates symptoms for people who have asthma or other respiratory conditions.

The CDC/ATSDR Household Characteristics score includes age and disability status and can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Household Characteristics include: 113, 114.10, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.3.2 No Health Insurance

- Households without health insurance may have higher incidences of chronic diseases such as asthma, heart disease, and obesity which are risk factors for experiencing negative health impacts from wildfire smoke.

The CDC/ATSDR Socioeconomic Status score includes no health insurance and can serve as a proxy for where this population lives in Lacey. Census Tracts with high vulnerability due to Socioeconomic Status include: 112, 113, 116.22, 116.25, 123.20, and 123.30

4.3.3.3 Homelessness

- Unsheltered individuals are more exposed to wildfire smoke because they cannot close themselves off from the outside air in an insulated shelter.

Countywide, over half of the people experiencing homelessness are unsheltered (living in a micro shelter, tent or encampment, vehicle, RV without water or power, or on the street).[31]

4.3.3.4 Working Outdoors

- People who work outdoors, such as landscapers, construction workers, and agricultural workers, conduct strenuous physical activity for extended periods of time in smoky conditions. Even with preventative measures like using a respirator or face mask, they likely have higher amounts of smoke inhalation than people working indoors.

4.3.3.5 Linguistic Isolation

- Individuals or households that are linguistically isolated may not have access to emergency notifications or information about what to do/where to go during smoky conditions.

The CDC/ATSDR Household Characteristics score includes English proficiency and can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to

[30] *American Heart Association. (2023). Wildfires may fuel heart health hazards: smoke exposure increases cardiovascular risks.* https://newsroom.heart.org/news/wildfires-may-fuel-heart-health-hazards-smoke-exposure-increases-cardiovascular-risks

[31] *Thurston County. (2024). 2024 Thurston County Point in Time Count Preliminary Data Report.* https://s3.us-west-2.amazonaws.com/thurstoncountywa.gov.if-us-west-2/s3fs-public/2024-03/2024%20PIT%20Prelim%20Report_03-28-2024.pdf

Household Characteristics (which includes English proficiency) include: 113, 114.10, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.3.6 Housing without Air Filtration or with Poorer Insulation

- Unless they were built or remodeled recently, most homes in Lacey are unlikely to have an HVAC system that can filter the outside air.
- Mobile homes may have outdated or less effective air filtration systems. Older mobile homes may have air leaks around doors and windows that allow for the infiltration of smoke into the living area.

The CDC/ATSDR Housing Type & Transportation score includes factors that indicate poorer-quality housing, including mobile homes and crowding. It can serve as a proxy for where these populations live in Lacey. Census tracts with high vulnerability due to Housing Type & Transportation include: 112, 113, 115, 116.25, 116.26, 116.27, 122.24, and 123.30.

4.3.4 Wildfire Population Exposure and Consequences

The risk of wildfire within Lacey's city boundaries and the UGA is low based on existing analysis in the Regional HMP. This risk rating may change in the future, since DNR is tasked with creating new wildfire risk maps. These new maps will be more accurate than DNR's WUI maps from 2019, which is the data that the Regional HMP relies on.

Despite the low risk rating, wildfire is a hazard that the City should continue to monitor. If a wildfire event occurs in Lacey, all residents in the affected area would be at risk for severe life and safety impacts. Affected people can also experience mental health impacts including stress, post-traumatic stress disorder, depression, and general anxiety.[32]

Residents with high social vulnerability are even more susceptible and may have more difficulty recovering based on the following factors:

4.3.4.1 Age and Health Status (older adults, children, and people with underlying health conditions)

- Older adults, children, and people with underlying health conditions are more likely to rely on others to evacuate from their homes during a wildfire. Without assistance they may be more susceptible to injury or death.
- Older adults and people with underlying health conditions are more likely to use medical devices or refrigerators for medication which can be shut off in the event of a blackout, brownout, or intentional power shutoff by the power company during high wildfire conditions or an active wildfire.

The CDC/ATSDR Household Characteristics score includes age and disability status and can serve as a proxy for where these populations live in Lacey. Census tracts that are in the WUI and have high vulnerability based on Household Characteristics include: 113, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.4.2 Low Income

- Low-income households will be more cost-burdened by home repairs if a wildfire affects their home or property.

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[33] *WA Department of Commerce. (2024). Intermediate Planning Guidance. https://deptofcommerce.app.box.com/s/fpg3h0lbwln2ctqjg7jg802h54ie19jx*

The CDC/ATSDR Socioeconomic Status score includes multiple factors associated with low-income status, including having an income below 150% poverty status, unemployment, and housing burden. The Socioeconomic Status score can serve as a proxy for where low-income populations live in Lacey. All census tracts with high vulnerability based on Socioeconomic Status are in the WUI: 112, 113, 116.22, 116.25, 123.20, and 123.30.

4.3.4.3 Linguistic Isolation

- Individuals or households that are linguistically isolated may not have access to information about what to do during or after a wildfire. This includes emergency notifications, evacuation directions, and information/support that may be available to help victims recover from impacts to their home, mental health, etc.

The CDC/ATSDR Household Characteristics score includes English proficiency and can serve as a proxy for where these populations live in Lacey. Census tracts that are in the WUI and have high vulnerability due to Household Characteristics include: 113, 114.21, 116.22, 122.26, 123.20, and 123.32.

4.3.4.4 No Vehicle

- Households without a vehicle will not be able to evacuate by car in the event of a wildfire. This is particularly critical for life and safety because homes in the WUI, where wildfires are more likely to occur, are more isolated and may be on less accessible roads.

The CDC/ATSDR Housing Type & Transportation score includes households that do not have access to a vehicle and can serve a proxy for where these populations live in Lacey. Census tracts that are in the WUI and have high vulnerability due to Housing Type & Transportation include: 112, 113, 115, 116.25, 116.26, 116.27, and 122.24.

5. Sector Vulnerabilities and Risks

Chapter 4 of the Regional HMP describes the impacts each hazard has on structures and systems; natural, cultural and historic resources; and activities. This Assessment uses and builds on the Regional HMP and the Lacey Annex and supplements them with additional analysis.

Assets are organized into the sectors required in Commerce guidance (Table 3).[33] Some of the sectors combined or nested; for example, solid waste infrastructure and electricity transmission included as Infrastructure and Utilities.

Maps illustrating the overlay between hazards and each sector's assets are included in Appendix B. There are no maps for Buildings and Zoning in Appendix B since the analysis was already conducted by the Regional HMP.

Table 3. Assets by Sector

Sectors	Assets
Buildings and Zoning	• Privately owned residential and commercial buildings and properties
Critical and Community-Serving Facilities	• City service buildings (civic, Fire, Police, Libraries, etc.). Includes provision of emergency services. • Schools • Parks (Developed and Trails) • Historic resources
Infrastructure and Utilities	• Transportation (roads and highways, transit) • Water and wastewater systems • Stormwater systems • Solid waste infrastructure • Electricity transmission • Natural gas transmission • Telecommunications
Habitats and Ecosystems	• Urban forest • Parks (Undeveloped and Natural) • Ecosystems (wetlands, streams, lakes) • McAllister Geologically Sensitive Area
Economic Development	• Local businesses • Connectivity to regional job centers
Agriculture and Food Systems	• Minimal agricultural production in Lacey and UGA

[33] *WA Department of Commerce. (2024). Intermediate Planning Guidance. https://deptofcommerce.app.box.com/s/fpg3h0lbwln2ctqjg7jg802h54ie19jx*

5.1 Key Findings

Overall, Lacey has a low level of vulnerability and risk associated with climate change hazards. Only a small portion of the buildings, infrastructure, and other assets in the city and Urban Growth Area (UGA) are projected to be impacted by climate change.

The electrical grid is a significant infrastructural vulnerability. Electrical grid outage is a potential vulnerability for buildings, critical and community serving facilities, infrastructure and utilities, and economic development. Multiple climate-related hazards can cause electrical grid outages, and their impacts can be far-reaching. Severe storms and wind can cause outages when downed trees and wind damage transmission lines; when combined with blocked roadways and debris associated with these events, residents can go multiple days without power. Extreme temperatures also stress the electrical grid by increasing demand from the use of heating and air conditioning. Though heating during winter has historically been a large demand for Puget Sound Energy (PSE), higher temperatures, heat waves, and the increase of buildings with air conditioning will cause greater stress on the grid in summer as well.

Existing buildings are vulnerable to heat and wildfire smoke. Existing buildings without central air conditioning can reach dangerous temperatures indoors for residents, workers, and visitors during extreme heat events. Relying on opening windows for cooling may be insufficient to combat high indoor temperatures, even at nighttime. Insufficient ventilation can also lead to unhealthy indoor air quality when there is wildfire smoke.

5.2 Buildings and Zoning

This sector includes privately owned residential and commercial buildings and properties. This Assessment identifies the way that the structure, building energy use, and property may be affected by applicable climate-related hazards.

5.2.1 Asset Overview

The Regional HMP analysis of building hazard exposure assumes there are 18,985 total buildings in Lacey, 17,637 of which (approximately 93%) are residential. Wildfire is the most prevalent hazard to impact buildings in Lacey, with 6,349 (approximately 33%) of the city's buildings located in either the Wildland-Urban Interface or Intermix. All buildings are also impacted by hazards that lack a defined geospatial footprint, including extreme heat, wildfire smoke, and severe weather events. Building exposure to flooding and sea level rise is negligible. Table 4 below summarizes the population and number of buildings exposed to each climate hazard.

Table 4. Buildings Exposed to Climate-Related Hazards

Climate Hazard (subcategory)	Pop. Exposed (%)	# Buildings Exposed
Extreme Heat	All	All; high temperatures may be worse in areas with lower tree canopy and high amounts of paving, but an extreme heat event will generally occur citywide
Severe Weather Events	All	All; no defined geospatial footprint where severe weather events may occur in the city*
Landslide	66 (0.1%)	20 residential
Wildfire**	19,420 (33%)	6,349 total: 5,887 residential, 385 commercial, 77 other
Wildfire Smoke	All	All; smoke may be worse in certain areas depending on where a wildfire is and wind conditions, but the impacts would generally occur citywide
Flooding (50-, 100-, and 500-year)	0%	Two residential
Flooding (High Groundwater)	201 (0.3%)	61 residential
Sea Level Rise[34]	0	Zero buildings, but properties at the water's edge at Hawks Prairie Estate and Beachcrest are exposed to passive flooding and tidal flooding.

Source: Hazards Mitigation Plan for the Thurston Region (2023). Buildings and population exposed to extreme heat, wildfire smoke, and severe weather were not quantitatively assessed in the Regional HMP.
**Note: The Regional HMP applied a 5% population exposure in the Hazus model for severe weather in all jurisdictions.*
***Note: Subject to change. The Regional HMP assessed population and building exposure using the DNR WUI maps (2019). DNR has been directed to develop a new wildfire risk map that will more accurately assess the hazard.*

[34] *See maps in Appendix B.*

5.2.2 Climate Change Vulnerabilities by Climate Hazard

Extreme heat does not cause structural damage to buildings, but it can increase building energy consumption from running fans and air conditioning. Increased building energy use can stress the electrical grid, leading to brownouts and blackouts. Puget Sound Energy (PSE) may ask customers to conserve energy during extreme heat events to avert these, which can be disruptive for people's daily life.

Severe weather can cause structural damage to buildings and properties (detailed on pages 34-37 of the Lacey HMP Annex). Electrical transmission can be cut off to buildings, potentially for extended periods of time, if trees fall onto the lines during extreme storms and wind events. **Landslides** triggered by severe weather events can make the land unstable (causing buildings to shift) and damage utility lines. In the worst cases, homes can be damaged or completely destroyed by mudflows.

Wildfire can cause structural damage to buildings and properties. Buildings are more vulnerable if they have vinyl siding, do not follow defensible space principles,[35] if they have vents and other gaps where embers can enter the buildings, and if they have combustible accessory structures (sheds, patios, fences).[36] Trees and landscaping on properties can be particularly vulnerable if they are dried out due to warming temperatures and/or are weakened by pests. Electricity may be disrupted to buildings if PSE initiates a Public Safety Power Shutoff (PSPS), or transmission systems are directly damaged from wildfire. Lastly, permitting of solar and lithium-ion batteries is an issue City staff will continue to manage so they do not cause fires or other fire-related challenges.

Wildfire smoke does not cause structural damage to buildings, but it can infiltrate into buildings and cause poor indoor air quality. Smoke can require people to change out their air filters (if they have an HVAC system) or use more electricity to run portable air filters. If wildfires occur in close proximity to Lacey, ash could accumulate on buildings and properties that requires safe cleanup.

Urban flooding and **groundwater flooding** mean the water table is high, which could cause sewage systems to back up into the home if properties have septic systems).

Sea level rise is not projected to affect any buildings, but passive flooding could occur on the properties bordering the Puget Sound (Hawks Prairie Estate and Beachcrest). Under the most extreme sea level rise scenario, by end-of-century the shoals of two small harbors could be flooded (Figure B - 2). The tidal "nuisance" flooding is also already occurring along the water's edge in these areas (Figure B - 3).

[35] *WA Department of Natural Resources. (n.d.). 12 Steps to Defend Your Home from Wildfire.* https://www.dnr.wa.gov/publications/rp_fire_defend_home_from_wildfire.pdf
[36] *CalFire. (2024). Home Hardening.* https://www.fire.ca.gov/home-hardening

5.3 Critical and Community-Serving Facilities

This sector includes City service buildings (civic, Fire, Police, Libraries, etc.), schools, parks (developed and trails), and historic buildings.[37] This Assessment identifies the way that the structure, property, building energy use, and services provided may be affected by applicable climate-related hazards.

5.3.1 Asset Overview

Overall, Lacey's critical and community-service facilities have low exposure and vulnerability to climate-related hazards. Important City facilities such as the Operation and Maintenance Facility, the Community Center, and the Senior Center are located outside of the areas at risk of wildfire or flooding. Most of the Fire Department facilities are also out of hazardous areas, so emergency services should not be greatly impacted. Only one historic building, the Taylor House, is exposed to any climate-related hazards. Unfortunately, schools do face some risk of wildfire impacts, as close to half of the schools in the city and UGA are in the WUI. Exposed facilities are listed in Table 5 below, and maps showing them overlaid with flood layers are included in Appendix B.

The assessment of wildfire exposure in Table 5 below is subject to change because DNR's 2019 WUI map is expected to be replaced when the agency develops a new, more accurate wildfire risk map. The facilities exposed to the WUI are included in Table 5 as it is consistent with the Regional HMP and is based on the best available data at this time; however, maps of facilities located in the WUI (2019) are not included in Appendix B.

Table 5. Critical and Community-Serving Facilities Exposed to Hazards

Climate Hazard (subcategory)	Critical and Community-Serving Facilities Exposed
Extreme Heat	All; high temperatures may be worse in areas with lower tree canopy and high amounts of paving, but an extreme heat event will generally occur citywide
Severe Weather Events	All; no defined geospatial footprint where they may occur in the city
Wildfire*	• City service buildings: City Hall, Library, one Police Department substation, two Fire Department facilities • Schools: 13 out of the 29 schools in the city and UGA. Includes five elementary schools (Seven Oaks, Evergreen Forest, Pleasant Glade, Olympic View, Meadows), one K-12 school (NW Christian Academy), two middle schools (Chinook, Salish), three high schools (North Thurston, River Ridge, South Sound), two universities (SPSCC Hawks Prairie College, Brandman University) • Developed Parks: portions of 11 parks. Includes Civic Plaza, I-5 Park, Karen Fraser Woodland Trail, Lake Lois Park, Woodland Creek Community Park, Regional Athletic Complex, Avonlea Park, Wonderwood Park, Meridian Neighborhood Park, Long Lake Park, and Wanschers Park.
Wildfire Smoke	All; smoke may be worse in certain areas depending on where a wildfire is and wind conditions, but the impacts would generally occur citywide

[37] *Undeveloped and natural open spaces are included in the Habitats and Ecosystems section.*

Flooding (50-, 100-, and 500-year)	• City service buildings: None exposed • Schools: None exposed • Developed parks: portions of five parks. Includes Karen Fraser Woodland Trail, Lake Lois Park, Woodland Creek Community Park, Long Lake Park, and Wanschers Park • Historic buildings: Taylor House near Wanschers Park/Hicks Lake

Source: Raimi + Associates. Note: No assets are exposed to sea level rise.
**Note: Subject to change. The Regional HMP assessed wildfire exposure using the DNR WUI maps (2019). DNR has been directed to develop a new wildfire risk map that will more accurately assess the hazard.*

5.3.2 Climate Change Vulnerabilities by Climate Hazard

Extreme heat does not cause structural damage to City facilities, schools, and park facilities, but it can increase building energy consumption from running fans and air conditioning. Regional increases in energy consumption during an extreme heat event could lead to power outages, disrupting the provision of City services, emergency response, and school instruction. Facilities would need to use their backup power sources if they have them. Residents are less likely to go outdoors and use parks during extreme heat.

Severe weather can cause structural damage and cause power outages at City facilities, schools, and park facilities (as described in the Buildings and Zoning section). **Landslides** triggered by severe weather events could hinder emergency response from Fire and Police by blocking roads.

Wildfire can cause structural damage to City facilities, schools, and park facilities as described in the Buildings and Zoning section. Electricity may be disrupted if PSE initiates a PSPS or transmission systems are directly damaged from wildfire. This can disrupt the provision of City services, emergency response, and school instruction. Facilities would need to use their backup power sources if they have them.

Wildfire smoke does not cause structural damage to City facilities, schools, and park facilities. Schools may need to change their activities to reduce the amount of time students spend outside. The number of visitors to parks will decrease since people will be advised to stay indoors.

Flooding from a 100-year flood touches the five park facilities listed in Table 5. The affected parks border or fully encompass creeks and lakes (Figure B - 6). Any trails, park buildings, or other equipment located within the footprint of the 100-year floodplain could experience flooding during times of high streamflow and/or an extreme storm. One historic building adjacent to Wanschers Park on Hicks Lake is exposed to the 100-year floodplain, so it could be at risk of inundation from floodwaters.

5.4 Infrastructure and Utilities

This sector includes transportation (roads and highways, transit), water and wastewater systems, stormwater systems, solid waste infrastructure, electrical grid and transmission, natural gas transmission, and telecommunications. This Assessment identifies the way that structures, systems, and resources may be affected by applicable climate-related hazards.

5.4.1 Asset Overview

Overall, Lacey's infrastructure has low exposure and vulnerability to climate-related hazards. Exposed assets are listed below in Table 6, and maps showing them overlaid with flood layers are included in Appendix B.

The assessment of wildfire exposure in Table 6 below is subject to change because DNR's 2019 WUI map is expected to be replaced when the agency develops a new, more accurate wildfire risk map. The facilities exposed to the WUI are included in Table 6 as it is consistent with the Regional HMP and is based on the best available data at this time; however, maps of the infrastructure and utilities located in the WUI (2019) are not included in Appendix B.

Table 6. Infrastructure and Utility Assets Exposed to Hazards

Climate Hazard (subcategory)	Infrastructure and Utilities Exposed
Extreme Heat	• Roads: all • Water: water supply, wells, reservoirs and sewer lift stations • Electrical grid
Severe Weather Events	• Roads and highways: all • Transit: all • Water: wells, reservoirs and sewer lift stations • Stormwater: drains, stormponds • Electrical grid
Wildfire*	• Roads and highways in the WUI • Transit: two park and ride lots, transit stops • Water: wells, reservoirs and sewer lift stations in the WUI • Wastewater: LOTT wastewater treatment facility • Solid Waste: County waste transfer station and Hazo House/recycling • Electrical grid
Wildfire Smoke	All assets are exposed but do not experience impacts
Flooding (50-, 100-, and 500-year, high groundwater)	• Roads and highways: Nisqually River Bridge I-5 • Water: Nisqually wells 19.A/S24 and 19.C/S25 that are part of the City's water system but outside of the City and UGA boundary (Figure B - 6)

	• Stormwater: One stormwater facility is in a high groundwater flood area.[38] Stormwater pond south of Hicks Lake is exposed (Figure B - 10)

Source: Raimi + Associates. Note: No assets are exposed to sea level rise.
**Note: Subject to change. The Regional HMP assessed wildfire exposure using the DNR WUI maps (2019). DNR has been directed to develop a new wildfire risk map which will more accurately assess the hazard.*

5.4.2 Climate Change Vulnerabilities by Climate Hazard

Extreme heat can cause the pavement on roads and highways to soften, crack, form potholes, and distort. One study has shown that extreme heat events in cooler climates (such as Lacey's) can cause more of these problems than in warmer climates due to the sharp variations in air temperature.[39]

Severe weather can cause debris to block storm drains and contaminate stormponds. Even with the fully maintained and operational City stormwater system, large amounts of runoff created during an extreme storm event carry pollutants from roads, homes and properties, and open spaces into the region's water bodies. This negatively impacts drinking water, habitats, aquatic-based industries, and recreation.

Extreme storms and winds can down trees, causing power outages, telecom outages, road blockages, and transit route disruptions. **Landslides** triggered by these events can also cause road blockages, disrupt transit routes, and damage underground gas and electrical infrastructure. Extreme cold and extreme storms can cause roads to crack and form potholes. All of these impacts can affect regular vehicle traffic and local bus routes.

Wildfire can cause electrical blackouts and brownouts if PSE infrastructure is damaged by wildfire. PSE can also shut off power as a preventative measure in certain areas during dangerous fire weather. Roads and transit stops may be within wildfire risk areas (pending new DNR maps), but roads are not necessarily a vulnerability as they are critical for evacuation and often serve as firebreaks.

Two County-operated solid waste facilities are located in the WUI. Solid waste collection at the transfer station and Hazo House could be temporarily disrupted during a wildfire. If a wildfire burns on the property and hazardous waste is present, dangerous toxins and substances like asbestos could be released into the smoke. There is also one wastewater facility located in the WUI.

Wildfire smoke is unlikely to cause any physical or operational impacts to infrastructure and utilities. Visibility on roads and highways could be reduced in extremely smoky conditions, but roads themselves would not be impacted.

Flooding of the Nisqually River under the I-5 could cause temporary flooding and even structural damage to the highway. The 620 – Olympia/Lakewood bus route that runs on the I-5 would be impacted in addition to regular vehicles. Even though that vulnerability is technically outside of Lacey and the UGA, if I-5 is cut off (even temporarily) many Lacey residents work at the military base and are dependent on this route.

Nisqually Wells 19.A and 19.C are located outside of the City and UGA boundary but contribute to Lacey's active groundwater sources. Flooding can occur in the lower Nisqually Valley when the river

[38] *TRPC. (2023). Hazards Mitigation Plan for the Thurston Region.*
[39] *Sushobhan, S., Li, H., and Khazanovich, L. (2016). Effect of climate change and urban heat islands on the deterioration of concrete roads. https://doi.org/10.1016/j.rineng.2022.100736*

discharge is exceptionally high,[40] which can impact water quality. Two stormwater facilities are in the 100-year floodplain, but that does not necessarily mean they are vulnerable. In the case of the stormpond south of Hicks Lake, its purpose is to collect water and allow it to percolate slowly. It buffers other properties from flooding, unless the floodwaters exceed the pond's capacity.

Urban flooding and **groundwater flooding** will likely have minimal impact on the City's sewer distribution system according to City staff, but flooding can impact the electrical system of pumps.

Changes in streamflow (more streamflow in winter, less in spring) can impact wells in the upper water aquifer (Sources 1, 4, 16, 24, 25, and 33). Typically there is a time delayed impact on these wells' water levels.

5.5 Habitats and Ecosystems

This sector includes the urban forest, parks (undeveloped and natural), ecosystems (wetlands, streams, lakes), and the McAllister Geologically Sensitive Area.[41]

5.5.1 Asset Overview

Lacey's ecosystems have low to medium vulnerability to climate change, mostly due to the threat posed by extreme heat (and wildfire to a lesser extent). Exposed assets are listed below in Table 7, and maps showing them overlaid with flood layers are included in Appendix B.

The assessment of wildfire exposure in Table 7 below is subject to change because DNR's 2019 WUI map is expected to be replaced when the agency develops a new, more accurate wildfire risk map. The facilities exposed to the WUI are included in Table 7 as it is consistent with the Regional HMP and is based on the best available data at this time; however, maps of the Habitats and Ecosystems located in the WUI (2019) are not included in Appendix B.

Table 7. Habitats and Ecosystems Exposed to Hazards

Climate Hazard (subcategory)	Infrastructure and Utilities Exposed
Extreme Heat	All; high temperatures may be worse in areas with lower tree canopy and high amounts of paving, but an extreme heat event will generally occur citywide
Severe Weather Events	All; no defined geospatial footprint where they may occur in the city
Wildfire*	• Urban forest: trees in the WUI • Parks (undeveloped and natural) Pleasant Glade Park, Lake Lois Habitat Reserve, Mullen Road Habitat Reserve, Southwick Lake Natural Area, Long Lake Natural Area, McAllister Grove Community Park
Wildfire Smoke	• Ecosystems: all (potentially)

[40] *City of Lacey. (2022). Lacey Water System Plan.* https://cityoflacey.org/wp-content/uploads/sites/3/2022/04/Lacey-Water-System-Plan-April-2022rev1.pdf

[41] *The McAllister Geologically Sensitive Area is technically a water-related asset because it protects McAllister Springs and the associated aquifer system. It is included in this section because limits on development in the area have made it so there are larger areas of open space and forested land than in other parts of the city.*

Flooding (50-, 100-, and 500-year)	• Ecosystems: southern portion of the city and UGA
Sea Level Rise	• Butterball Cove, Hawks Prairie Community private beach, and Beachcrest private beach

Source: Raimi + Associates
**Note: Subject to change. The Regional HMP assessed wildfire exposure using the DNR WUI maps (2019). DNR has been directed to develop a new wildfire risk map that will more accurately assess the hazard.*

5.5.2 Climate Change Vulnerabilities by Climate Hazard

Extreme heat events and increasing average temperatures stress and damage plants. Direct heat damage can scorch the leaves of trees and other plants in Lacey's urban forest and undeveloped and natural parks. While trees can survive these events, they may eventually cause the plant's death or make it susceptible to pests such as bark beetles.[42]

Severe weather events including extreme storms and wind can cause trees to fall down and break off their branches. In the latter case the trees can survive, provided the tree is otherwise healthy and the break did not cause too much structural damage to other parts of the tree. Extreme storms and wind may also cause downed trees or washed out trails in natural and undeveloped parks. This would require increased city maintenance to make them safe for visitors. High volumes of stormwater runoff from extreme storms can affect the delicate balance of ecosystems by carrying pollution and sediment into streams, estuaries and lakes.

Wildfire could damage the trees, plants, and animals in the habitat reserves throughout the city and UGA. As listed in Table 7 and mapped in Figure B - 11, multiple undeveloped and natural areas are within the Wildland-Urban Intermix. Wildfire can also damage trees throughout the urban forest, but particularly in the WUI.

Wildfire smoke may affect the natural processes that occur in freshwater ecosystems (oxygen production through photosynthesis, and the breaking down of organic matter).[43] The main mechanism identified by researchers is the fact that smoke reduces the amount of light reaching the ecosystem.[44]

Flooding in a 100-year flood event will occur around creeks and lakes, mostly in the southern portion of the city and UGA. The habitat areas and wetlands around these bodies of water (Figure B - 12) are not necessarily vulnerable to flooding, since they actually buffer surrounding areas from the floodwaters. However, if the volume of floodwaters is too high it can cause erosion and sediment deposits in estuary ecosystems.

Sea level rise causes the loss of sandy beach area and higher high tide flooding. The more extreme SLR scenario is projected to cause passive flooding at the private beaches along the Puget Sound (slight amount by 2050, more by 2100; see figures B – 1 and - 2). High tide "nuisance" flooding (current levels shown in Figure B - 3) will likely run up even further into the coves/marinas and beaches.

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[42] *Breda, I. (February 13, 2023). How extreme heat scorched Pacific Northwest's evergreen trees. The Seattle times. https://www.seattletimes.com/seattle-news/environment/how-extreme-heat-scorched-pacific-northwests-evergreen-trees/*
[43] *Note: this is an emerging area of research based on one study conducted with data from lakes in California. More research is needed to fully understand implications in the Pacific Northwest.*
[44] *Smits, A.P., Scordo, F., Tang, M. et al. (2024). Wildfire smoke reduces lake ecosystem metabolic rates unequally across a trophic gradient. Commun Earth Environ **5**, 265 (2024). https://doi.org/10.1038/s43247-024-01404-9*

5.6 Economic Development

This sector includes local businesses and connectivity to regional job centers.

5.6.1 Asset Overview

Lacey's economy faces low impacts from climate-related hazards. The Regional HMP's ratings for each climate hazard's impact to the economy were either "low" or "none."[45] However, because a majority of Lacey residents work outside of the city limits, the economy is very tied to the rest of the region. In Thurston County, all climate-related hazards have a low impact on the economy other except for wildfire, which has a medium impact.[46]

The assessment of wildfire exposure in Table 8 below is subject to change because DNR's 2019 WUI map is expected to be replaced when the agency develops a new, more accurate wildfire risk map. The facilities exposed to the WUI are included in Table 8 as it is consistent with the Regional HMP and is based on the best available data at this time; however, maps of the economic assets located in the WUI (2019) are not included in Appendix B.

Table 8. Economic Assets Exposed to Hazards

Climate Hazard (subcategory)	Economic Assets Exposed
Extreme Heat	All; high temperatures may be worse in areas with lower tree canopy and high amounts of paving, but an extreme heat event will generally occur citywide
Severe Weather Events	All; no defined geospatial footprint where severe weather events may occur in the city
Wildfire*	• 385 commercial buildings exposed to either Interface or Intermix • 20 industrial buildings either Interface or Intermix
Wildfire Smoke	All; smoke may be worse in certain areas depending on where a wildfire is and wind conditions, but the impacts would generally occur citywide
Flooding (50-, 100-, and 500-year)	• Zero commercial or industrial buildings exposed • I-5 over Nisqually River (outside of city and UGA)

Source: Raimi + Associates. Note: No assets are exposed to sea level rise.
**Note: Subject to change. The Regional HMP assessed wildfire exposure using the DNR WUI maps (2019). DNR has been directed to develop a new wildfire risk map that will more accurately assess the hazard.*

5.6.2 Climate Change Vulnerabilities by Climate Hazard

Extreme heat does not cause structural damage to buildings, but it can increase costs and lead to lost business/work time. Businesses may experience higher electricity bills due to energy consumption from running fans and air conditioning. Increased building energy use can stress the electrical grid, leading to brownouts and blackouts that can disrupt business operations.

[45] *TRPC. (2023). Hazards Mitigation Plan for the Thurston Region.*
[46] *Ibid.*

Additionally, businesses may need to close temporarily if the indoor temperatures become unbearable for employees and customers.

Severe weather can cause trees to fall on power lines and roads. This can cause power outages that disrupt business operations. Downed trees can block roads, making it hard for people to get to work. Of course, commercial and industrial buildings could also experience structural or water damage from severe weather, increasing maintenance costs and potentially disrupting business operations.

Wildfire can cause structural damage to commercial buildings, power outages, and road closures that can make it hard for people to get to work.

Wildfire smoke can create unhealthy working conditions for all employees working both indoors and outdoors, potentially disrupting business operations. Businesses may incur costs from purchasing and running air filters, and purchasing face masks.

Flooding of the Nisqually River under the I-5 could disrupt commutes to the Joint Base Lewis–McChord (JBLM), which is one of the main employers for Lacey residents. Even though that vulnerability is technically outside of Lacey and the UGA, if I-5 is cut off (even temporarily) all economic activity could be impacted by supply issues.

5.7 Agriculture and Food Systems

Climate change poses minimal risk to agriculture because it is not a significant industry in Lacey. In small-scale urban farms or agricultural operations, residents could experience impacts of extreme heat and warmer temperatures. These include having to use more water for irrigation and having difficulty growing crops that are suitable for the cooler historical climate of the region.

The food system is closely tied to regional systems rather than local production. As described in the Economic Development section, Lacey's supply chain could be interrupted if flooding on the Nisqually River cuts off the I-5. Regional aquaculture, which includes shellfish farming in the Puget Sound, is vulnerable to impacts from ocean acidification.[47, 48]

[47] *Ocean acidification refers to changes in the chemistry of the ocean due to increased carbon dioxide in the atmosphere (from human emissions).*
[48] *WA Department of Ecology. (n.d.). Acidification in Puget Sound. https://ecology.wa.gov/water-shorelines/puget-sound/issues-problems/acidification. Accessed 12/15/24.*

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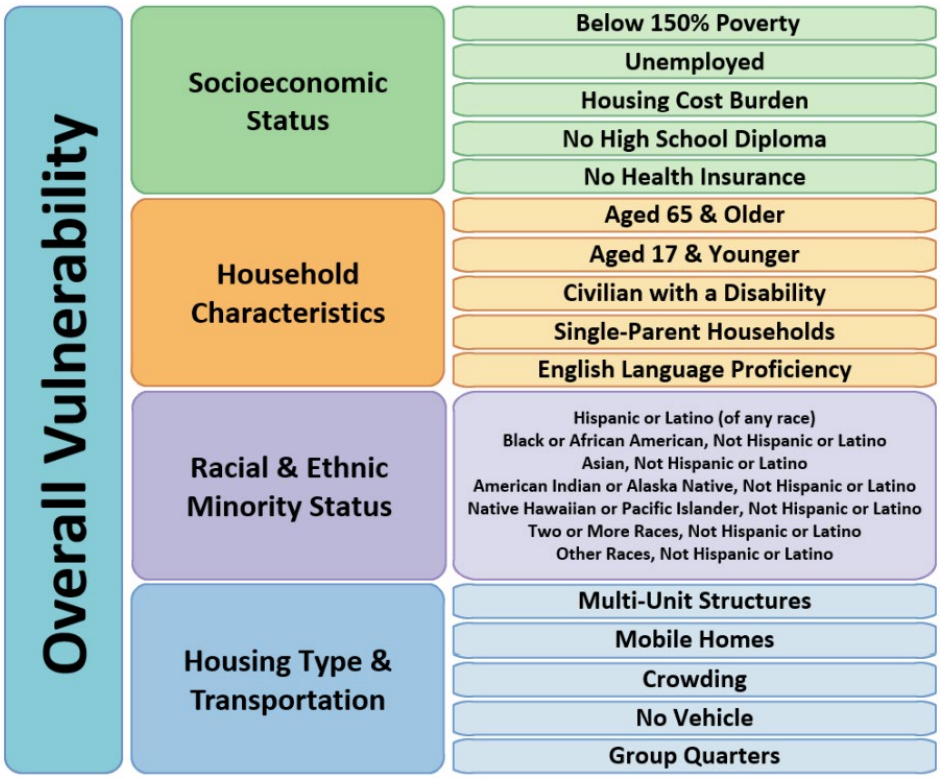
7. Appendix A: Social Vulnerability Mapping

Appendix A contains maps of the four components of the Centers for Disease Control's Social Vulnerability Index (CDC/ATSDR SVI) for Lacey and the UGA. The CDC/ATSDR SVI score is based on four categories of data available from the American Community Survey 2018-2022 5-Year Estimates: Socioeconomic Status, Household Characteristics, Racial & Ethnic Minority Status, and Housing Type & Transportation (**Error! Not a valid bookmark self-reference.**). This index comprises the social vulnerability aspect of the National Risk Index (NRI) that is used to assign levels of risk to hazards in

Figure A - 1. CDC/ATSDR SVI Components



Source: CDC/ATSDR

the Regional HMP and Lacey Annex.

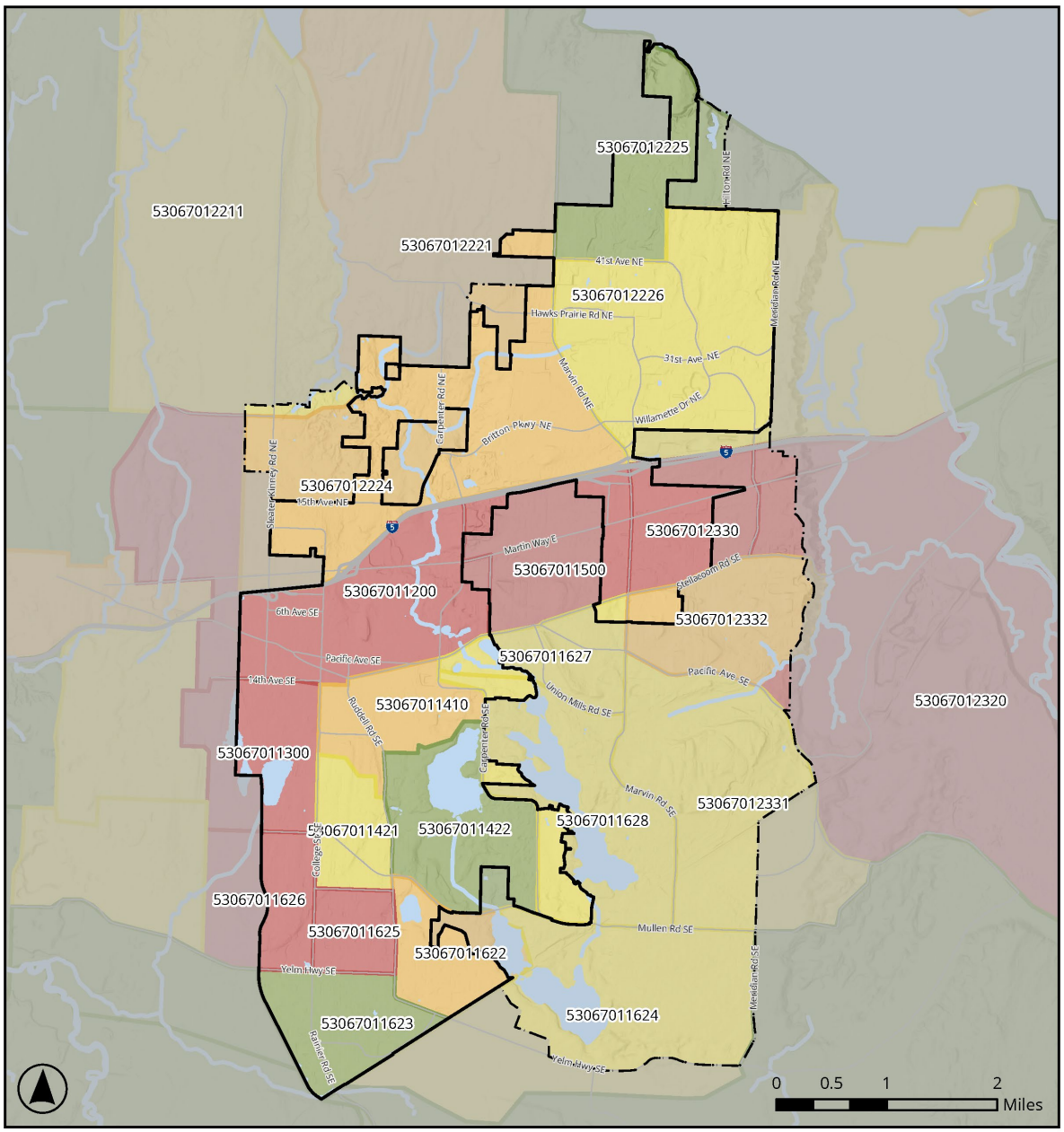
Table A - 1 summarizes the information that is visualized in the maps (Figures A-2 thru 5). The scores are based on percentiles, meaning a tract with a score of 0.9 (90th percentile) is more vulnerable for that indicator than 90% of other census tracts.

Table A - 1. Summary of CDC/ATSDR Rankings

FIPS Code	Census Tract	CDC ASTDR SVI	CDC SVI: Socioeconomic Status	CDC SVI: Household Characteristics	CDC SVI: Racial & Ethnic Minority Status	CDC SVI: Housing Type & Transportation
53067011200	Census Tract 112	0.96	0.94	0.68	0.71	0.99
53067011300	Census Tract 113	0.89	0.79	0.84	0.53	0.94
53067011410	Census Tract 114.10	0.72	0.59	0.88	0.61	0.55
53067011421	Census Tract 114.21	0.50	0.63	0.82	0.60	0.08
53067011422	Census Tract 114.22	0.20	0.27	0.47	0.20	0.13
53067011500	Census Tract 115	0.80	0.69	0.69	0.65	0.84
53067011622	Census Tract 116.22	0.73	0.81	0.78	0.72	0.35
53067011623	Census Tract 116.23	0.25	0.12	0.74	0.68	0.12
53067011624	Census Tract 116.24	0.44	0.35	0.70	0.56	0.33
53067011625	Census Tract 116.25	0.89	0.83	0.70	0.83	0.91
53067011626	Census Tract 116.26	0.80	0.70	0.67	0.63	0.85
53067011627	Census Tract 116.27	0.45	0.14	0.46	0.57	0.82
53067011628	Census Tract 116.28	0.28	0.15	0.59	0.45	0.31
53067012211	Census Tract 122.11	0.39	0.43	0.67	0.31	0.19
53067012221	Census Tract 122.21	0.59	0.48	0.74	0.59	0.49
53067012224	Census Tract 122.24	0.57	0.36	0.63	0.46	0.76
53067012225	Census Tract 122.25	0.07	0.13	0.63	0.36	0.00
53067012226	Census Tract 122.26	0.42	0.32	0.81	0.64	0.20
53067012320	Census Tract 123.20	0.79	0.85	0.81	0.61	0.50
53067012330	Census Tract 123.30	0.84	0.85	0.45	0.73	0.89
53067012331	Census Tract 123.31	0.45	0.20	0.60	0.71	0.60
53067012332	Census Tract 123.32	0.57	0.42	0.93	0.73	0.23

Source: CDC/ATSDR, Raimi + Associates

Figure A - 2. Composite CDC SVI Score



Legend

City Limits

Urban Growth Area

Social Vulnerability Index Percentile

0-25

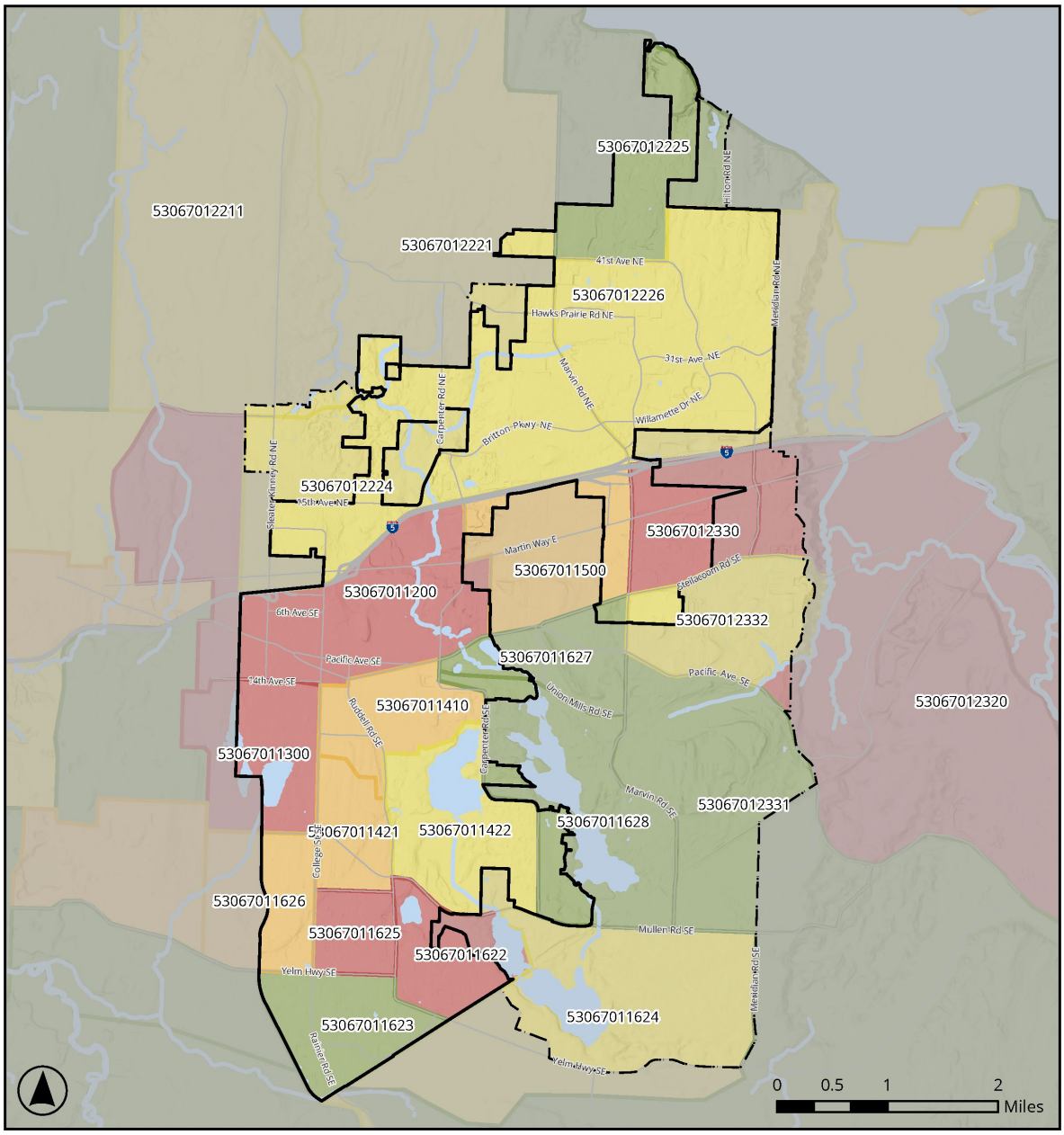
>25-50

>50-75

>75-100

Sources: City of Lacey (2024), CDC Agency for Toxic Substance and Disease Registry (2022).

Figure A - 3. Socioeconomic Status



Legend

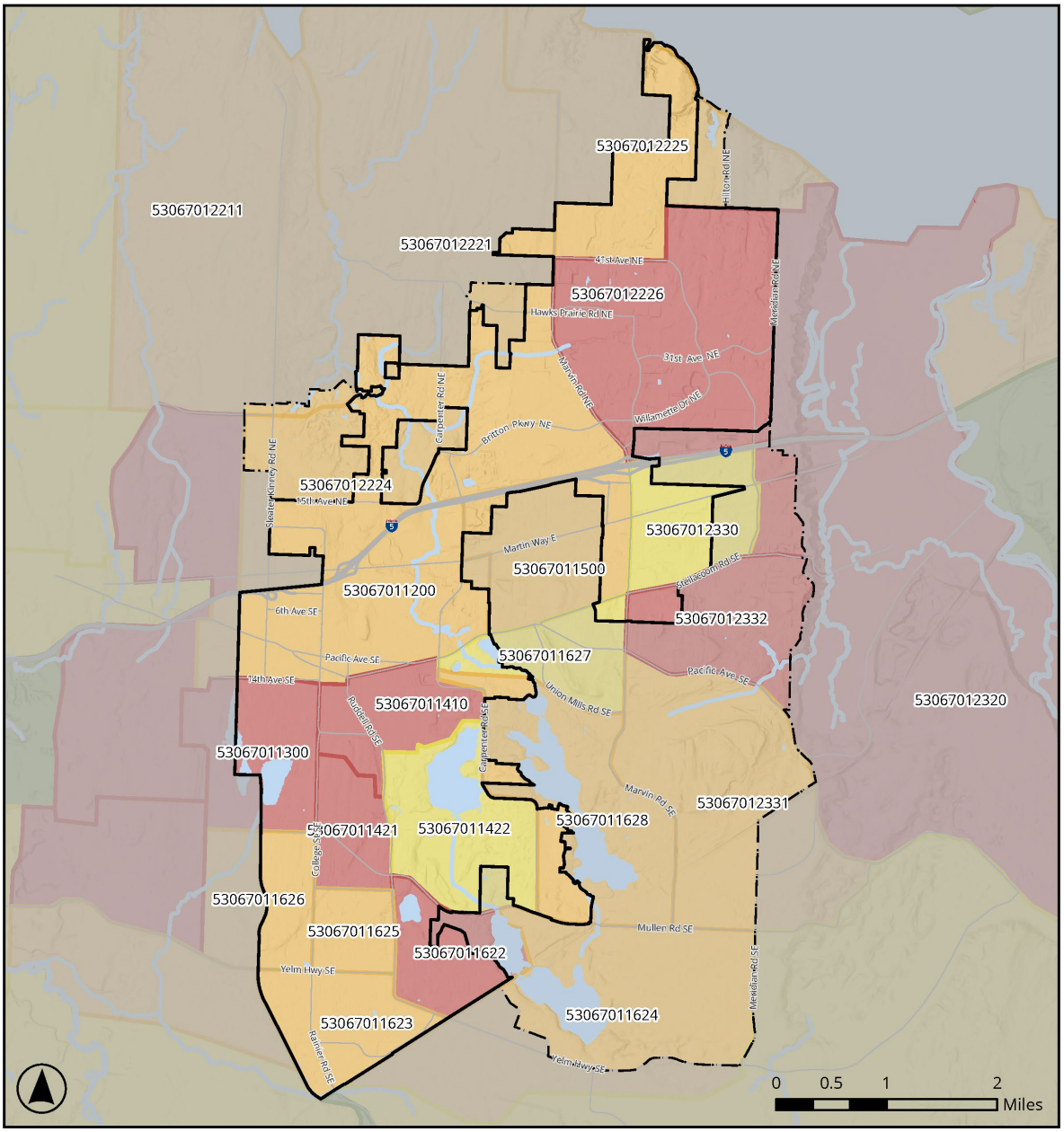
City Limits
Urban Growth Area

Socioeconomic Status Percentile

0-25
>25-50
>50-75
>75-100

Sources: City of Lacey (2024), CDC Agency for Toxic Substance and Disease Registry (2022).

Figure A - 4. Household Characteristics



Legend

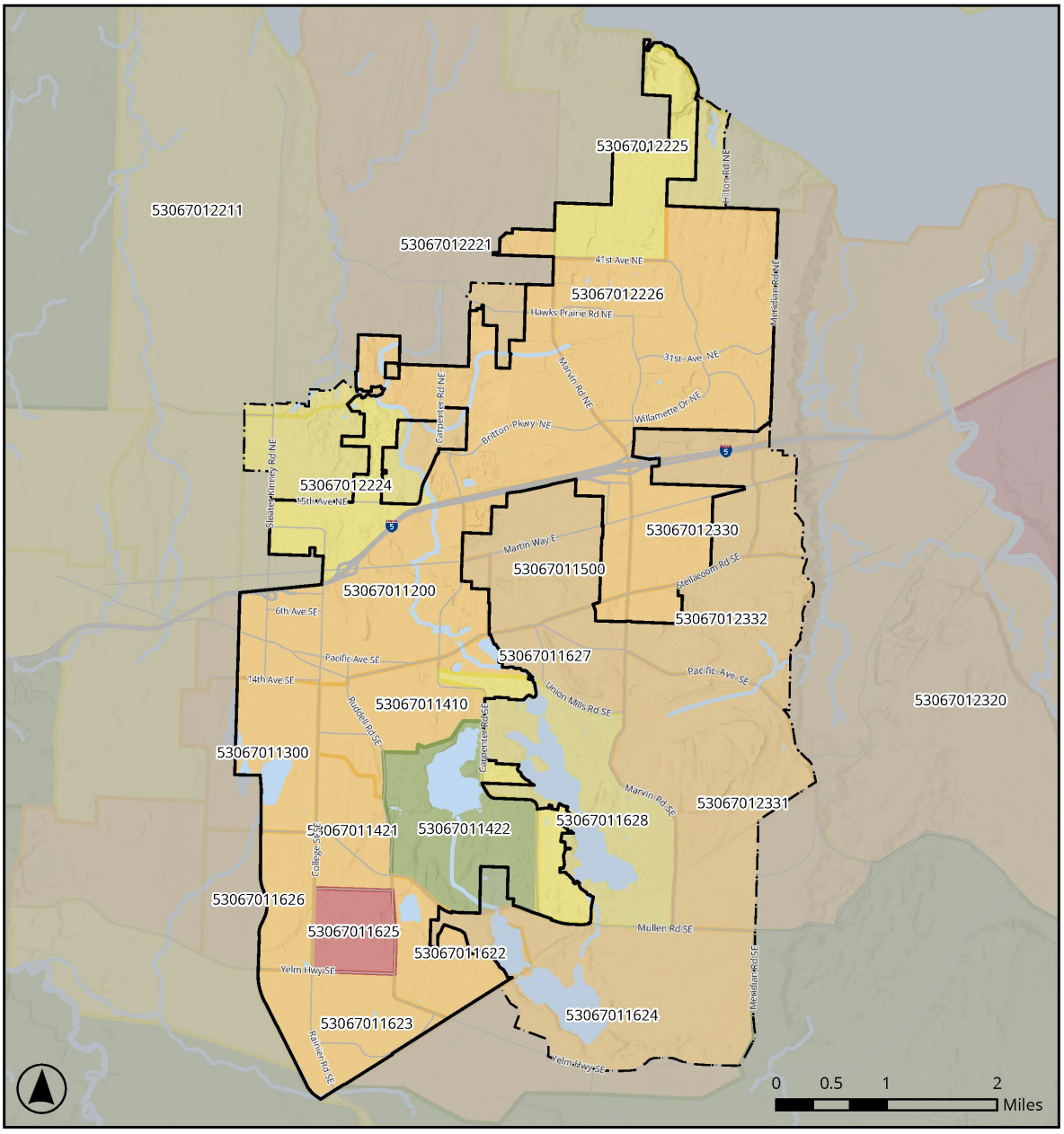
City Limits
Urban Growth Area

Household Characteristics Percentile

0-25
>25-50
>50-75
>75-100

Sources: City of Lacey (2024), CDC Agency for Toxic Substance and Disease Registry (2022).

Figure A - 5. Race and Ethnic Minority Status



Legend

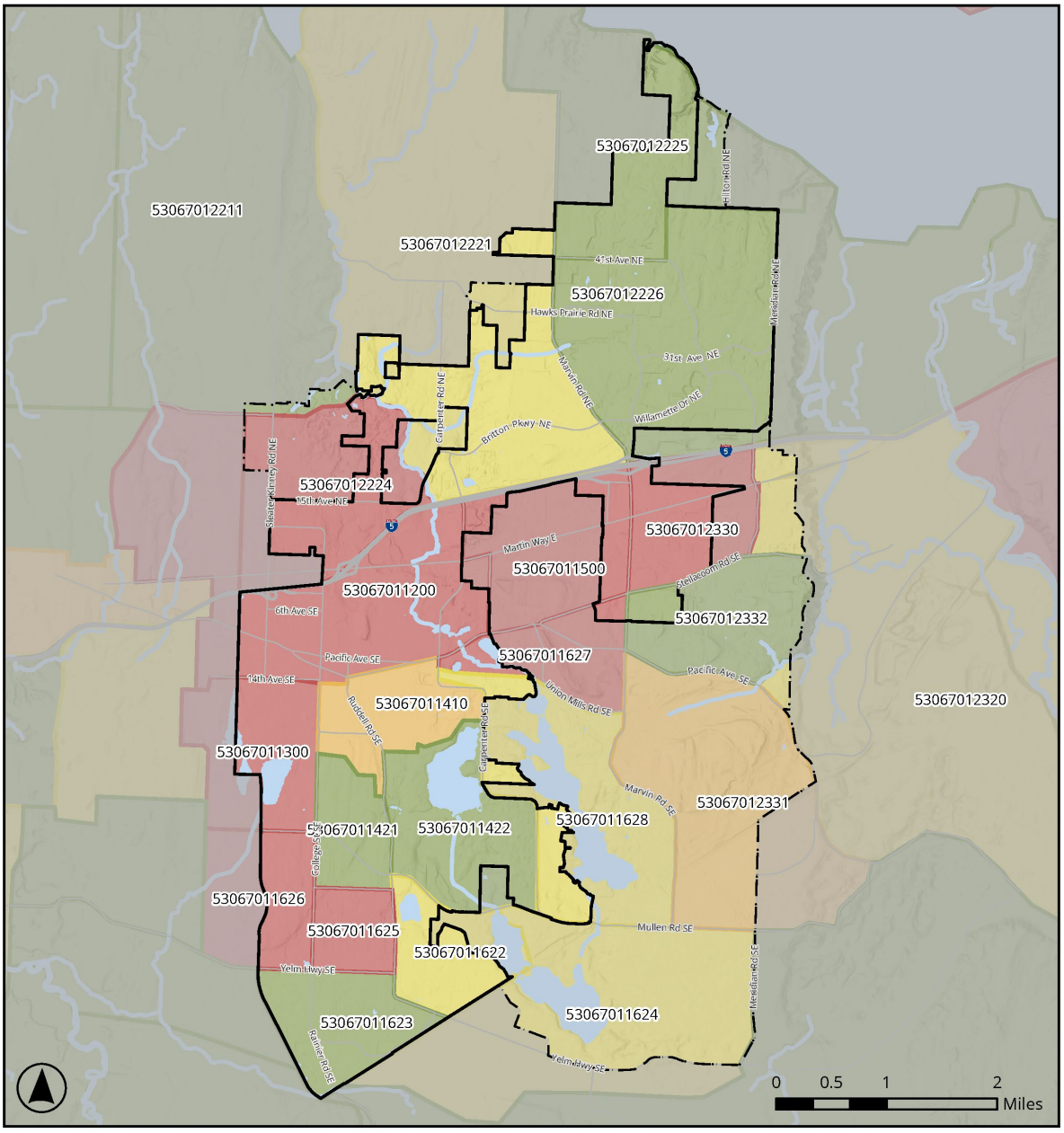
City Limits
Urban Growth Area

Racial & Ethnic Minority Status Percentile

0-25
>25-50
>50-75
>75-100

Sources: City of Lacey (2024), CDC Agency for Toxic Substance and Disease Registry (2022).

Figure A - 6. Housing Type and Transportation



Legend

City Limits
Urban Growth Area

Housing Type & Transportation Percentile

0-25
>25-50
>50-75
>75-100

Sources: City of Lacey (2024), CDC Agency for Toxic Substance and Disease Registry (2022).

8. Appendix B: Asset Mapping

This Appendix contains maps of the assets overlaid with hazards which are described in the Sector Vulnerability and Risk Assessments. Wildfire maps are not included because of issues with the DNR WUI (2019) mapping, which are set to be replaced by more accurate wildfire risk maps to be developed by DNR by June 2026.

8.1 Hazard and Asset Maps

Figure B - 1. SLR Passive Flooding (2050, 1% chance scenario)

Source: NOAA SLR Viewer
Note: The 1% chance SLR scenario is the more extreme scenario. For Lacey, the projected amount of SLR for 2050 in this scenario is 1.5 feet, but the map shows 2 feet of SLR because the viewer only uses whole numbers.

Figure B - 2. SLR Passive Flooding (2100, 1% chance scenario)

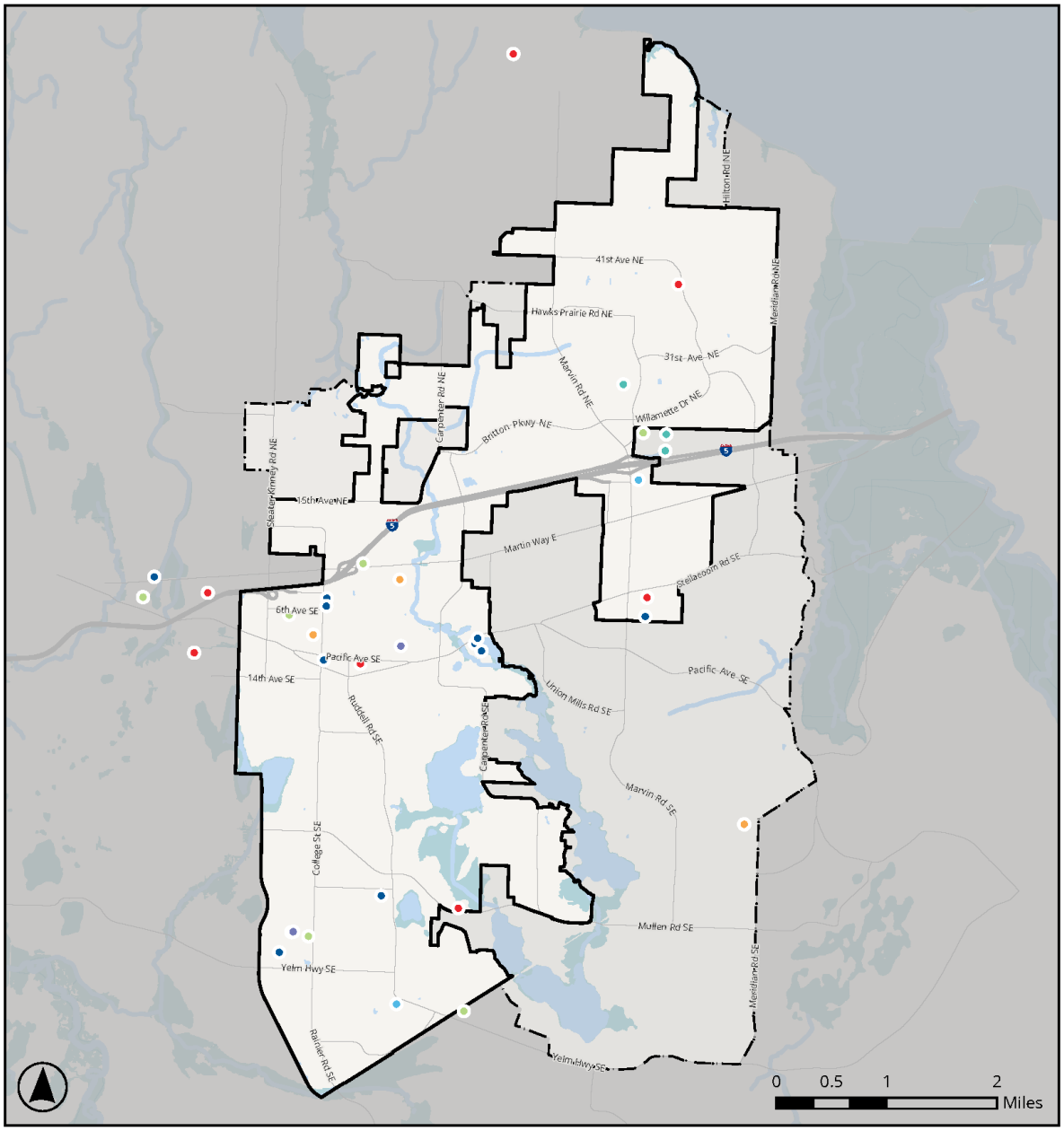
Source: NOAA SLR Viewer
Note: The 1% chance SLR scenario is the more extreme scenario. For Lacey, the projected amount of SLR for 2100 in this scenario is 4.5-5 feet. The map shows 5 feet, the high end of the projected SLR. Compared to 2050 (Figure B - 1), the small strips of land at the mouth of the two small harbors will experience passive flooding.

Figure B - 3. High Tide Flooding (Current)

Source: NOAA SLR Viewer
Note: The red layer represents areas currently subject to tidal flooding, often called "recurrent or nuisance flooding."

8.2 Critical and Community-Serving Facilities Maps

Figure B - 4. City Services in 100-Year Flood Zone

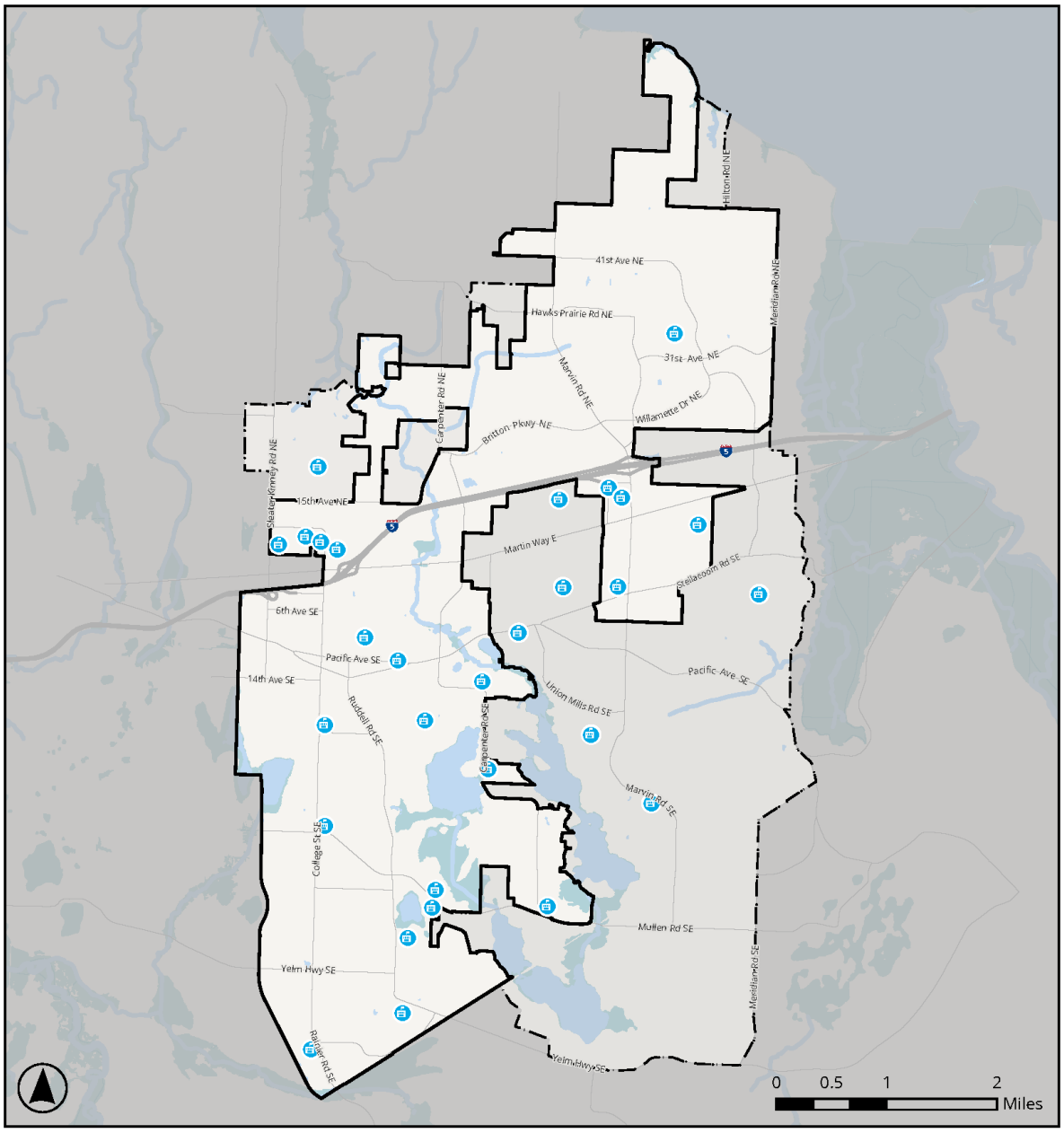


Legend

City Limits
Urban Growth Area
Assets
City of Lacey
Thurston County
Washington State
Fire
History
Police
Transit
100-Year Flood

Sources: City of Lacey (2024), FEMA (2019).

Figure B - 5. Schools in 100-Year Flood Zone

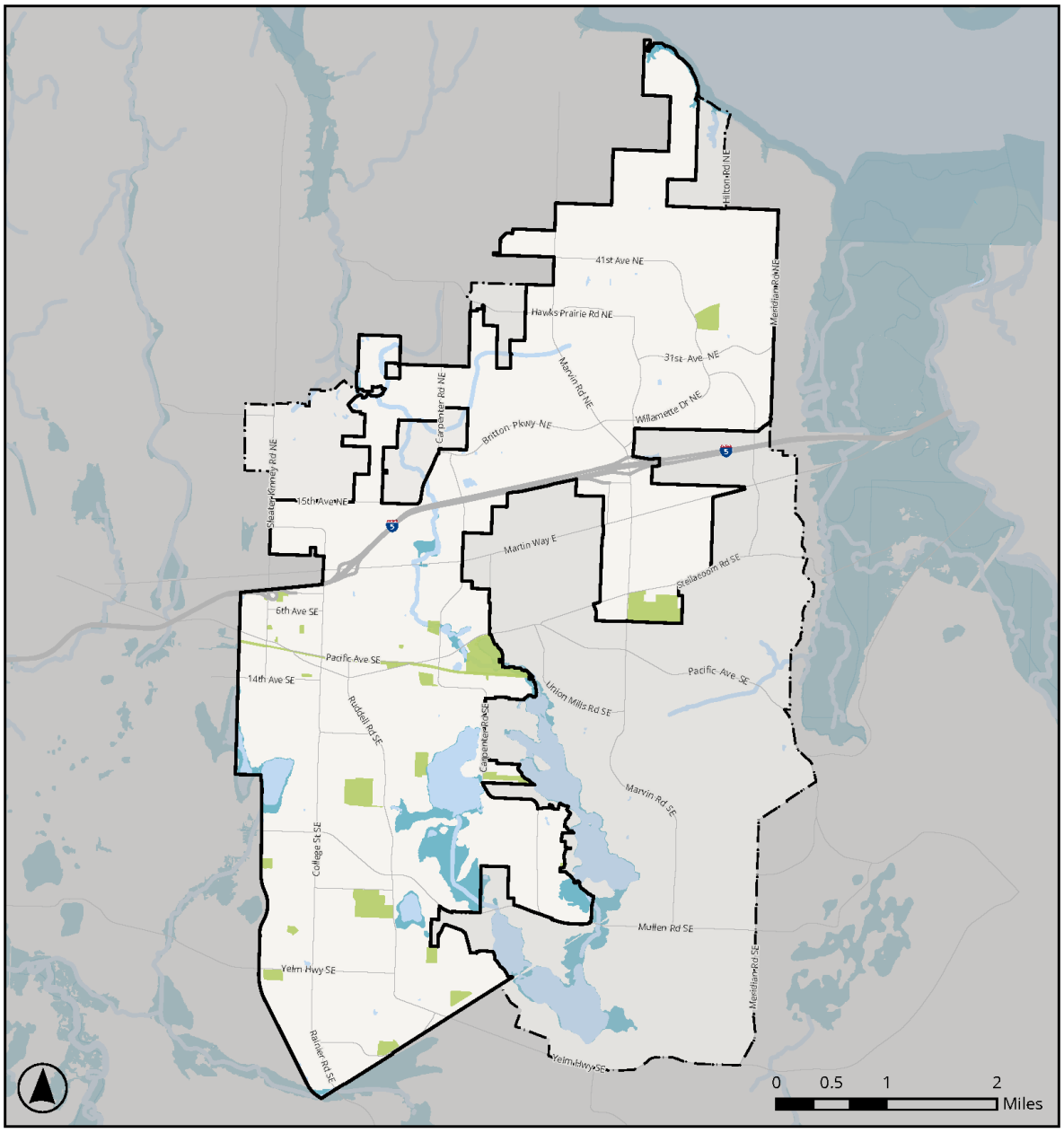


Legend

City Limits
Urban Growth Area
Schools
100-Year Flood

Sources: City of Lacey (2024), FEMA (2019).

Figure B - 6. Developed Parks in 100-Year Flood Zone



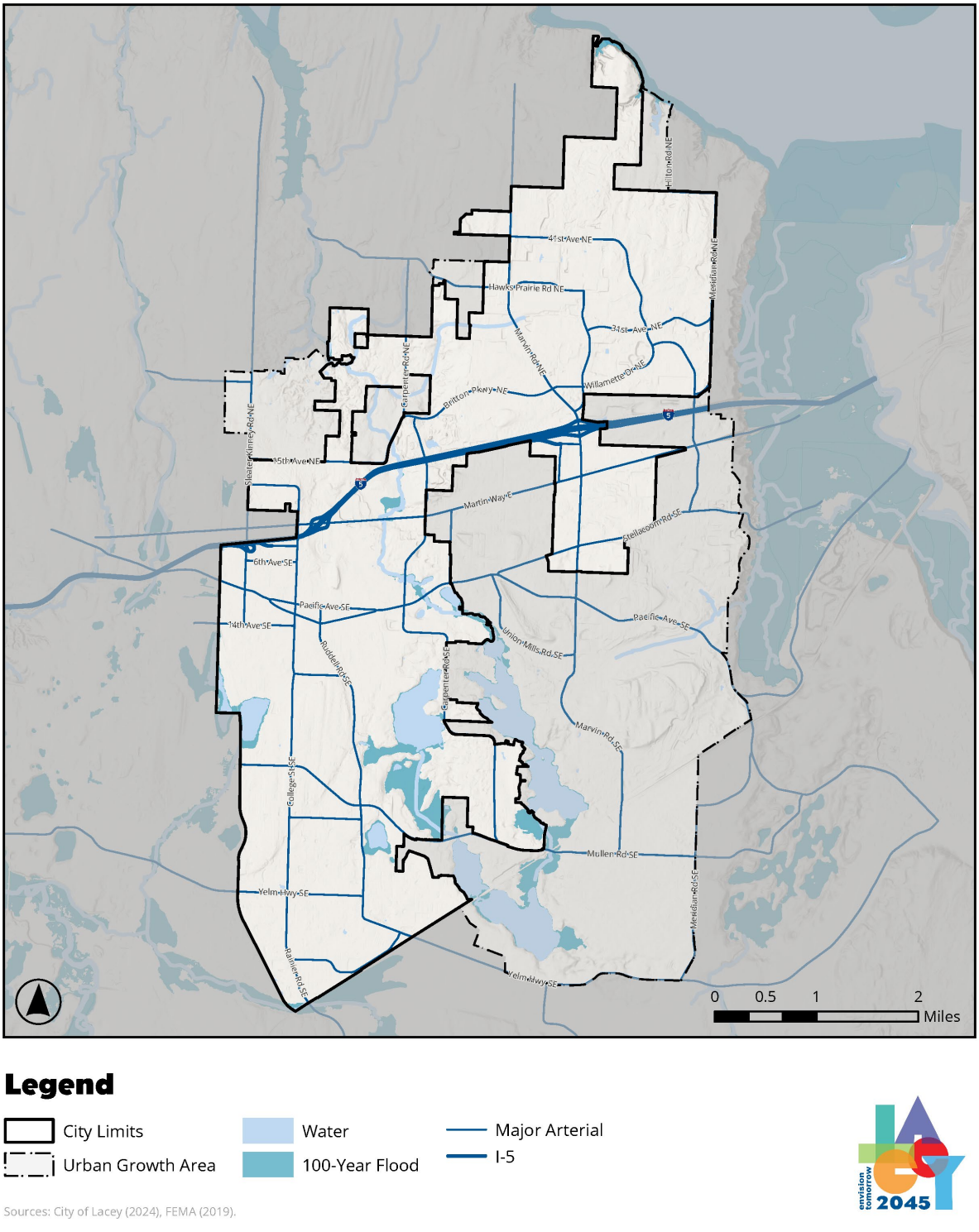
Legend

City Limits
Urban Growth Area
Parks
100-Year Flood

Sources: City of Lacey (2024), FEMA (2019).

8.3 Infrastructure and Utilities Maps

Figure B - 7. Major Roads in 100-Year Flood Zone

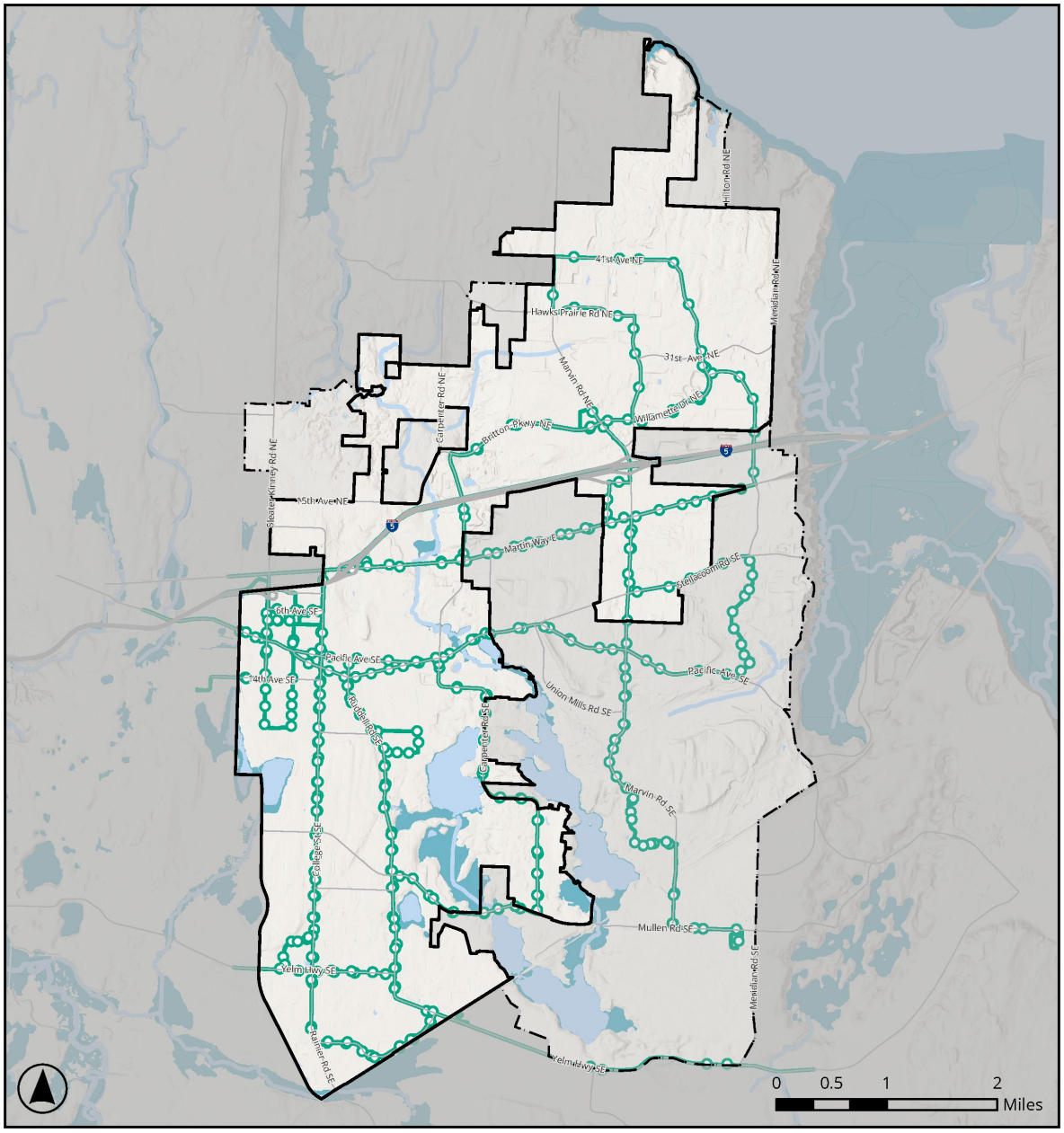


Legend

City Limits
Urban Growth Area
Water
100-Year Flood
Major Arterial
I-5

Sources: City of Lacey (2024), FEMA (2019).

Figure B - 8. Transit Routes and Stops in 100-Year Flood Zone

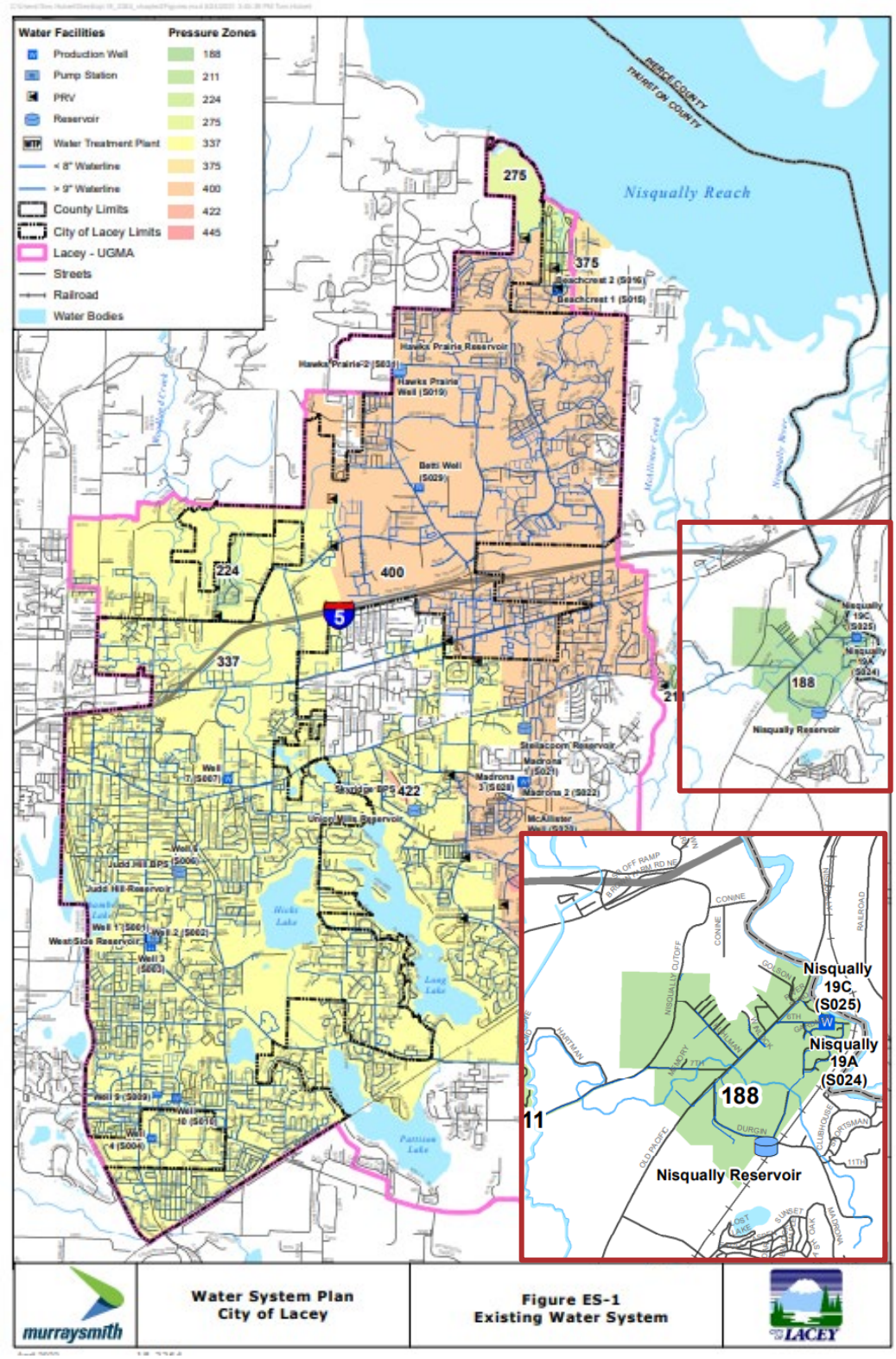


Legend

City Limits
Urban Growth Area
Transit Stops
Transit Routes
100-Year Flood

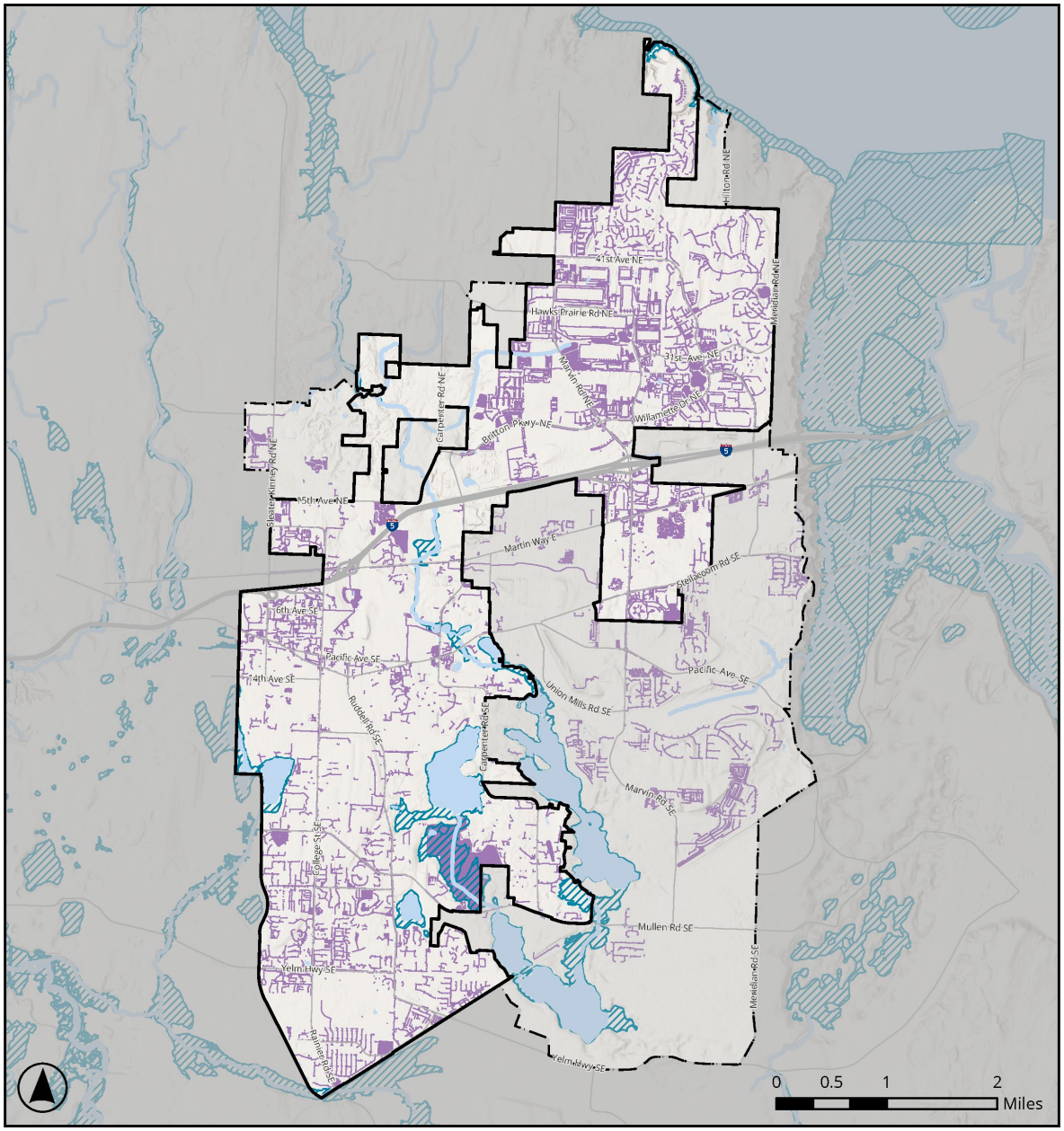
Sources: City of Lacey (2024), FEMA (2019).

Figure B - 9. Lacey Water System



Source: Lacey Water System Plan (2022)

Figure B - 10. Stormwater Infrastructure in 100-Year Flood Zone



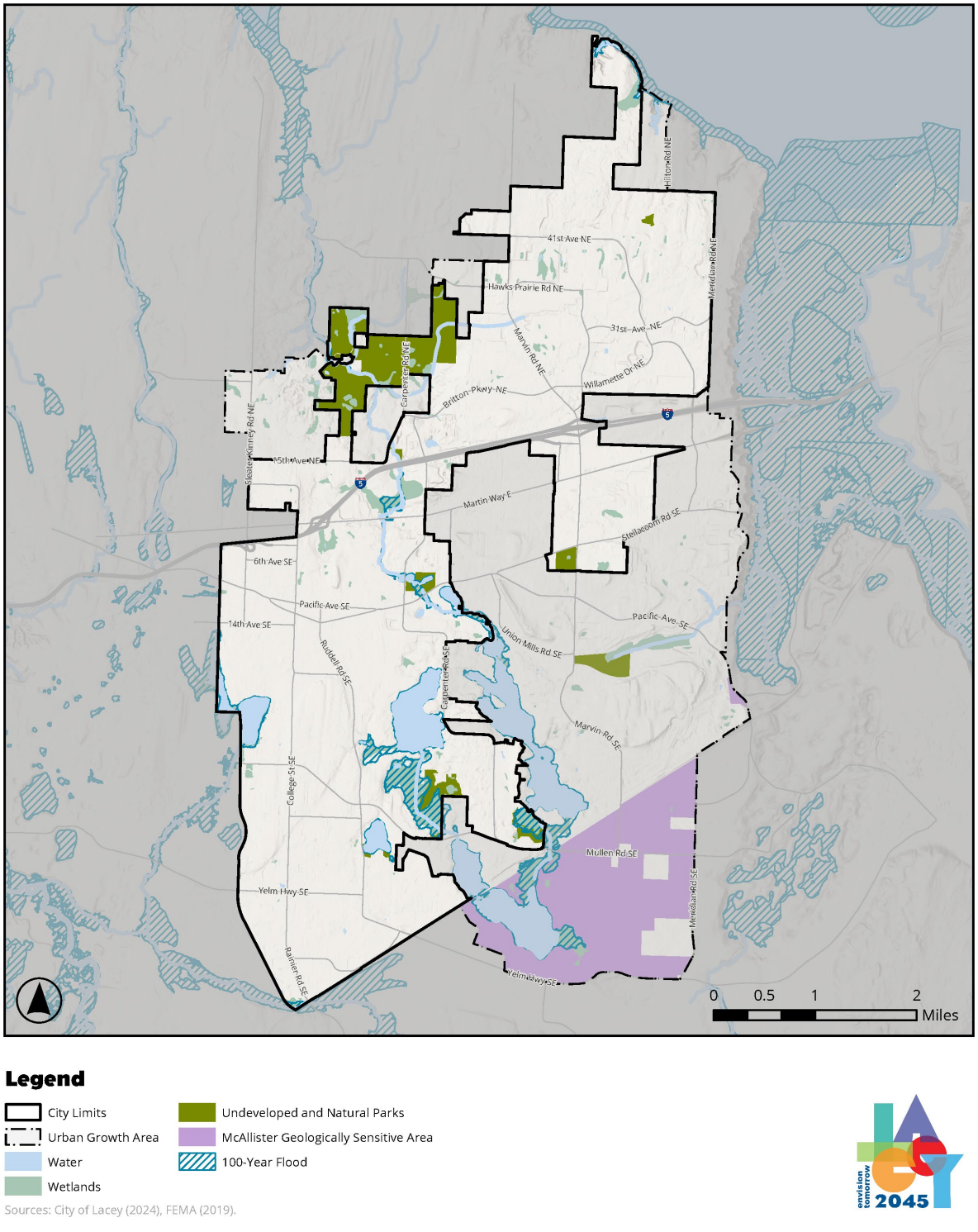
Legend

- City Limits
- Urban Growth Area
- 100-Year Flood
- Stormlines
- Stormpond

Sources: City of Lacey (2024), FEMA (2019).

8.4 Habitats and Ecosystems Maps

Figure B - 11. Habitats and Ecosystems in 100-Year Flood Zone



Legend

- City Limits
- Urban Growth Area
- Water
- Wetlands
- Undeveloped and Natural Parks
- McAllister Geologically Sensitive Area
- 100-Year Flood

Sources: City of Lacey (2024), FEMA (2019).