Memorandum

To	**Mark Hofman, Community Development Director** City of Lake Forest Park
From	**Sebastian Espinosa, Maddie Seibert, Katherine Allison, Mike Chang, Alexandra Doty** Cascadia Consulting Group, Inc.
Date	**May 2025**
Subj	**City of Lake Forest Park Climate Impacts Summary Memorandum**

Introduction

This summary reviews historical climate trends and future projections to highlight the impacts of climate change to the City of Lake Forest Park. Without significant reductions in greenhouse gas (GHG) emissions regionally and globally, the City is likely to face the following challenges:

- **Extreme Heat**: Annual maximum temperature is projected to rise by 8.3°F by 2100, compared to the 1980–2009 average. Average summer temperatures are expected to increase from 64.2°F (1950–2005 baseline) to 70.4°F by 2100 (Hegewisch & Abatzoglou, n.d.).
- **Precipitation**: Annual precipitation is projected to increase by 7% by 2100, with winter precipitation rising by 7% and summer precipitation decreasing by 21%, relative to the 1950–2005 baseline (Hegewisch & Abatzoglou, n.d.).
- **Streamflow and Inland Flooding**: By 2080, streamflows are projected to increase by 15.2%, and 100-year flood magnitudes may rise by 2.3% (Washington Department of Fish and Wildlife, 2023).
- **Drought**: April 1st snowpack, representing peak accumulation of snow, is expected to decline by 83% by 2100, compared to the 1980–2009 average, exacerbating water resource challenges (Chegwidden et al., 2017).
- **Wildfire and Smoke**: Wildfire-conducive conditions in King County are projected to increase 11% by 2100 when compared to the 1980 to 2009 average heightening wildfire risk (Sheehan et al., 2015).

This climate impacts summary will inform the City's forthcoming climate vulnerability assessment by documenting the historical and projected climate trends to build understanding of future changes in climate hazards and risks in Lake Forest Park.

FUNDED BY WASHINGTON'S CLIMATE COMMITMENT ACT

The City of Lake Forest Park Climate Element is supported with funding from Washington's Climate Commitment Act. The CCA supports Washington's climate action efforts by putting cap-and-invest dollars to work reducing climate pollution, creating jobs, and improving public health. Information about the CCA is available at www.climate.wa.gov.

Background

WA House Bill (HB) 1181

As part of the 2023 amendments to the Washington Growth Management Act (GMA), Washington House Bill (HB) 1181 requires cities and counties to integrate climate policies into their comprehensive plan updates. The City of Lake Forest Park must adopt policy changes that mitigate climate change impacts and enhance resiliency across multiple sectors. These policies must align with the Department of Commerce's Climate Planning Guidance (Growth Management Services, 2023).

Climate Planning Guidance in WA

To align with the Department of Commerce's (Commerce) Resilience Guidance framework, the initial step in developing a Climate Element involves identifying the climate impacts most relevant to the community. This framework integrates the U.S. Climate Resilience Toolkit and best practices from organizations like the Association of Washington Cities (AWC), the Municipal Research and Services Center of Washington (MRSC), and the American Planning Association (APA). It provides a flexible approach for incorporating the latest climate science, assessing local impacts, and considering resilience policy options. This summary aligns with Step 3, Task 1.1–1.3 of Commerce's "Climate Element Workbook" to examine how projected climate changes may intensify natural hazards and affect critical assets and sectors.

Methodology

Cascadia Consulting Group ("Cascadia") conducted this climate impacts assessment for the City of Lake Forest Park by utilizing a variety of established and peer-reviewed resources such as the University of Washington Climate Impacts Group's Climate Mapping for a Resilient Washington and other key sources noted in Table 1. When city-scale data was not available, Cascadia relied on King County-scale climate impact data, as noted throughout the document.

Resource	Publisher	Scale	Year
Climate Toolbox	National Centers for Environmental Information	Lake Forest Park	2013
AirNow Data	U.S. Environmental Protection Agency	Greater Seattle Area	2024
Climate at a Glance Tool	National Oceanic and Atmospheric Administration	King County	2024
Culverts and Climate Change Tool	Washington State Department of Fish and Wildlife	Lake Forest Park	2023

Table 1: Key sources used in this summary.

Climate Drivers and Variability

Climate change refers to the long-term shifts in weather patterns and environmental conditions due to human activities such as the emission of Greenhouse gases (GHGs) from fossil fuel use. Elevated atmospheric GHG levels have driven rising land and ocean temperatures since the

Industrial Revolution, leading to intensified heatwaves, wildfires, storms, droughts, melting glaciers, sea-level rise, and ocean acidification. While natural phenomena like the El Niño-Southern Oscillation and Pacific Decadal Oscillation contribute to periodic climate variability, human-induced climate change is occurring at an unprecedented rate, vastly outpacing these natural processes (Perlwitz et al., 2017).

Climate Scenarios and Projection Models

The Representative Concentration Pathways (RCPs), developed by the Intergovernmental Panel on Climate Change (IPCC), are scenarios designed to model potential climate outcomes based on different greenhouse gas (GHG) concentration levels. Each pathway outlines a distinct trajectory for carbon dioxide and other emissions, reflecting various potential human actions and climate responses. These scenarios serve as tools for researchers, policymakers, and communities to evaluate risks and develop strategies for adaptation (IPCC, 2022).

This summary focuses on RCP8.5, often called the "business-as-usual" scenario, as it most closely aligns with current emission trends. For flooding projections, however, the more moderate A1B scenario is used, which assumes emissions continue on their current path until midcentury, followed by significant mitigation efforts.

Alignment with City Planning Documents

To ensure alignment with other City planning documents, hazards identified in Lake Forest Park's Hazard Mitigation Plan (HMP) and Climate Action Plan (CAP) were cross-referenced with the Climate Impacts Summary (CIS). The CAP and HMP cover the following climate hazards described in this CIS (Table 2). The CIS and CAP strongly align in terms of the key climate impacts summarized; the CAP does not include any climate hazards beyond those described in this CIS. Due to its wider scope, the HMP includes some hazards that are not climate-related.

Hazard (CIS)	Climate Action Plan	Hazard Mitigation Plan
Extreme Temperature	Yes	
Precipitation	Yes	Yes
Flooding	Yes	Yes
Stream Temperatures	Yes	
Landslides	Yes	Yes
Drought	Yes	
Wildfire and Smoke	Yes	Yes

Table 2: Identified climate hazards in the Lake Forest Park CAP or HMP.

This crosswalk helps integrate climate considerations into hazard mitigation and resilience planning efforts across City policies.

Summary of Climate Impacts

The following sections provide an overview of key climate change impacts – extreme heat, more intense precipitation, altered streamflows and inland flooding, increased drought, and more frequent wildfire and smoke – and how they are expected to affect sectors within Lake Forest Park. The climate impacts included in this document are supported by local and regional data; weather events that climate projections do not show as becoming more likely or severe, such as wind and extreme cold, were excluded. This assessment aims to build a baseline awareness of climate impacts to guide the City's resilience and GHG emissions reduction planning within the Climate Element.

Extreme Heat

Average temperature in the Northwest and Washington state has warmed over the last century and is expected to warm at a faster rate through the next century and beyond. The Northwest's average yearly temperature has increased by 2°F since the early 20th century (Chang et al., 2023). From 1950 to 2024, King County's average annual temperature has increased by 1.7°F (

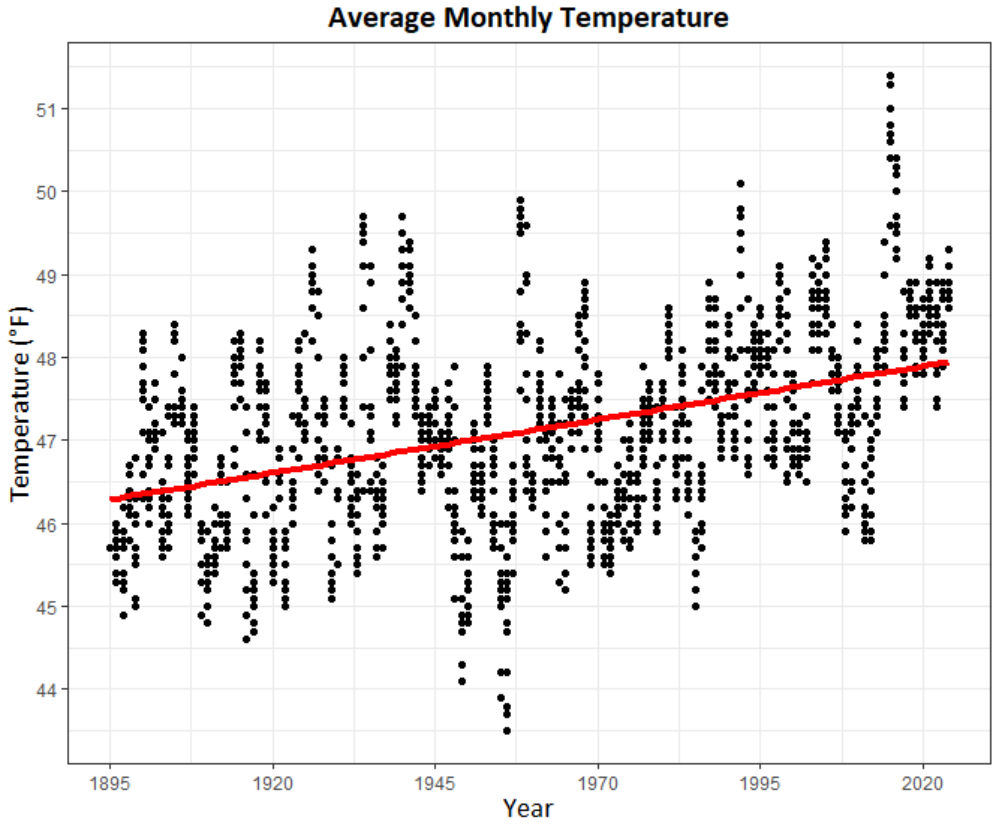

Figure 1) (NOAA, 2024).

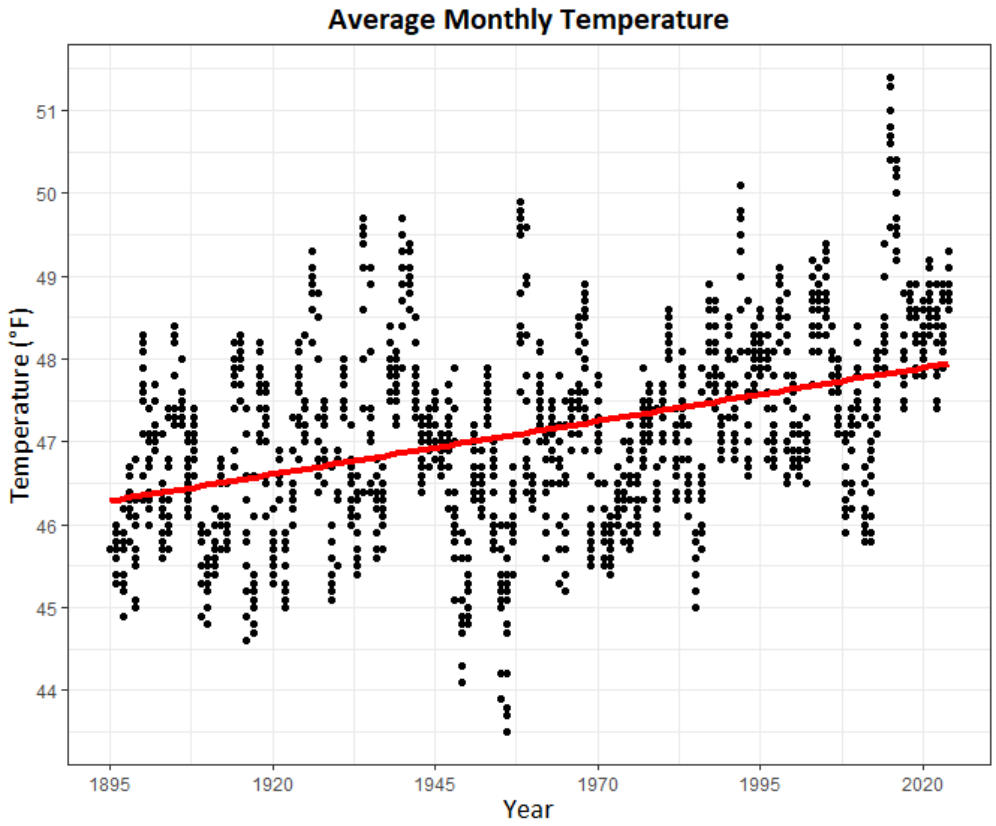

Figure 1: Average monthly temperature between 1895 and 2024 in King County, WA.

Data from NOAA's National Centers for Environmental Information. Accessed 11 November 2024. Graph created by Cascadia Consulting Group.

Year-to-year temperature fluctuations are influenced by natural climate patterns, such as the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). Despite these variations, there is a clear and consistent warming trend. In addition, historic summer heat stress has also increased, as from 1979 to 2024, summertime temperatures (Jun–Aug) in Lake Forest Park have risen by 2.6°F (Hegewisch & Abatzoglou, n.d.).

Compared to the 1951–2005 historic baseline, Lake Forest Park's annual maximum temperature is projected to rise by 8.3°F under the RCP8.5 scenario by the end of the century. During the same period and scenario, maximum summertime temperatures (Jun–Aug) are projected to increase from 74.5°F to 84.8°F (Figure 2) (Hegewisch & Abatzoglou, n.d.).

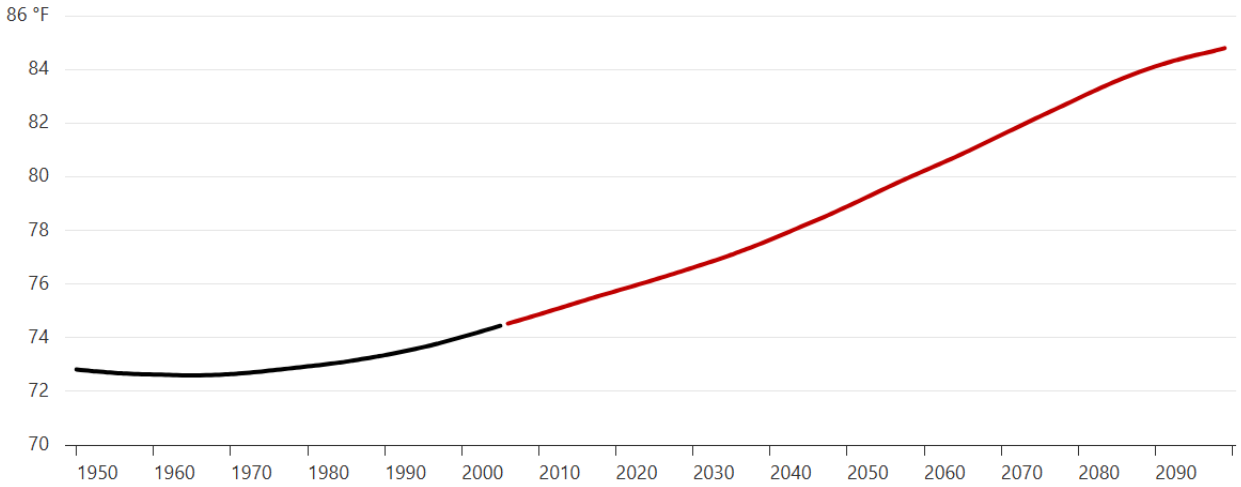

Figure 2: Historic average (black) and projected increase in average summertime (Jun-Aug) temperature under the RCP8.5 scenario (red), in Lake Forest Park, Washington.

Figure from Climate Toolbox. Accessed 11 November 2024.

By the end of the century, projected temperature increases in King County are expected to result in over 40 additional days per year with maximum humidex values (a heat index combining temperature and humidity) exceeding 90°F. This marks a significant increase in heat-related public health stress compared to the 1980–2009 average, under the RCP8.5 scenario (Table 3) (Abatzoglou & Brown, 2012).

Timeframe	Projected Additional 90 °F Humidex Days in King County
2040–2069	20.1 additional days
2050–2079	27.8 additional days
2070–2099	40.9 additional days

Table 3: Projected additional 90 °F humidex days in King County compared to the 1980-2009 baseline under an RCP 8.5 scenario.

Data from Climate Impacts Group. Accessed 11 November 2024.

In Lake Forest Park, a similar rise in extreme heat events is expected. Under the RCP8.5 scenario and by the end of the century, projections indicate around 9 days per year with heat index values (how hot the temperature feels) above 105°F (Table 4) (Hegewisch & Abatzoglou, n.d.).

Timeframe	Days with Heat Index above 90°F	Days with Heat Index above 100°F	Days with Heat Index above 105°F
2040-2069	38.8 days	7.4 days	1.5 days
2070-2099	61.4 days	20.6 days	9.0 days

Table 4: Projected number of hot days per year in Lake Forest Park under the RCP8.5 scenario.

Data from Climate Toolbox. Accessed 11 November 2024.

AFFECTED SECTORS

Extreme heat is anticipated to pose significant challenges across various sectors within Lake Forest Park, impacting infrastructure, ecosystems, and human health (Rogers & Mauger, 2021).

Sector	Impacts/Exposure
Building and Energy	• Greater potential energy demand for cooling buildings in summer. • Urban heat island effect.
Ecosystems	• Reduced tree growth and forest productivity. • Increase prevalence of invasive species such as mountain pine beetle. • Habitat fragmentation.
Emergency Management	• Strain on emergency services due to extreme heat incidents.
Health and Well-being	• Increased concentrations of air pollutants such as ozone. • Impacts on the elderly, the very young, and those with health conditions. • Night-time heat stress.
Transportation	• Potential damage to roads and bridges. • Greater maintenance and repair costs.

Table 5: Extreme heat sector impacts.

Precipitation

In the Pacific Northwest, projected precipitation changes are expected to vary seasonally. Under the RCP8.5 scenario, areas west of the Cascades are likely to see increased rainfall in fall, spring, and winter, while summer precipitation is projected to decrease by nearly 15% by 2080, relative to the 1950–1999 baseline (Figure 3) (Rogers & Mauger, 2021).

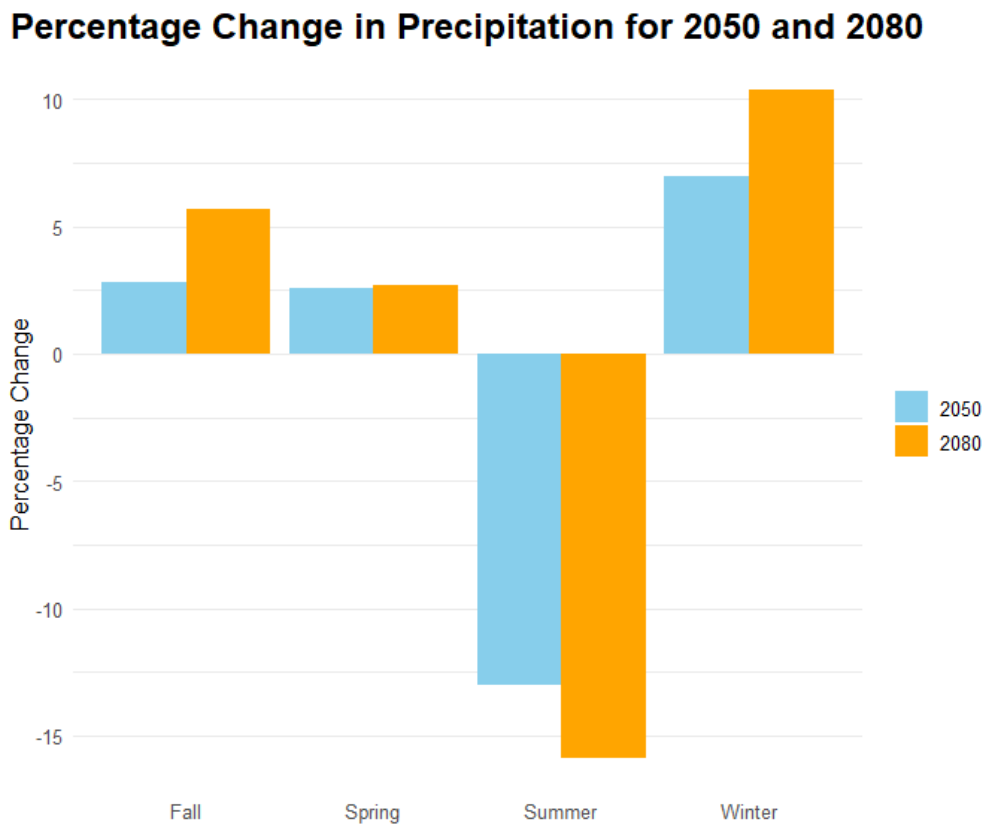

Figure 3: Projected change in total summer precipitation, West of the Cascades in the 2080s relative to 1950-1999.

Data from Climate Impacts Group. Accessed 11 November 2024. Graph created by Cascadia Consulting Group.

Annual precipitation in Lake Forest Park is expected to increase 7% by the end of the century under the RCP8.5 scenario, compared to the 1950–2006 baseline (Figure 4). Seasonal shifts are also expected; winter precipitation (Dec–Feb) is projected to rise by 7%, while summer precipitation (Jun–Aug) is anticipated to decrease by 21% over the same timeframe and scenario (Hegewisch & Abatzoglou, n.d.).

In addition to total rainfall, intensification of precipitation events is also expected. Compared to the 1980–2009 baseline, the magnitude of the 25-year precipitation event in King County is projected to increase by 12% by the end of the century under the RCP8.5 scenario (Salathé et al., 2010). This increase in both frequency and intensity of heavy rain events is linked to higher soil water content potentially increasing the likelihood of future landslide risks (Mauger et al., 2015).

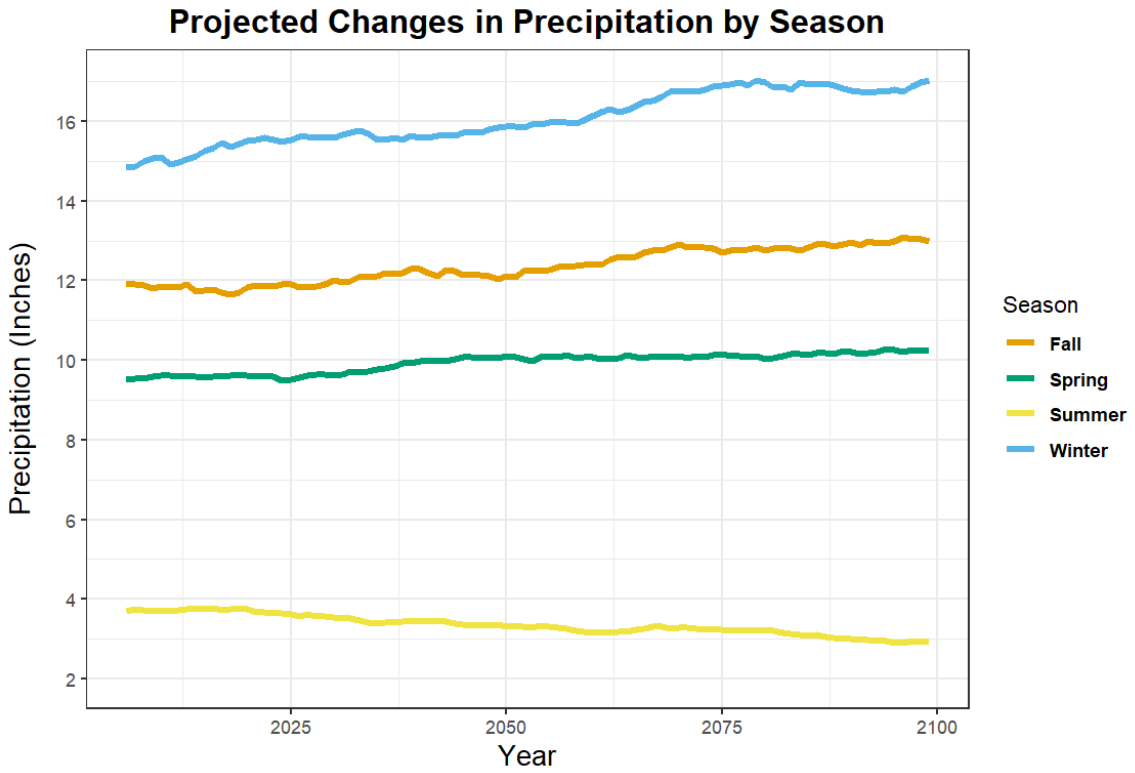

Figure 4: Projected seasonal shifts in precipitation in Lake Forest Park under the RCP8.5 scenario, compared to the 1951–2005 baseline.

Data from Climate Toolbox. Accessed 10 November 2024. Figure created by Cascadia Consulting Group.

AFFECTED SECTORS

More intense precipitation is expected to significantly impact ecosystems, emergency management, and transportation infrastructure (Rogers & Mauger, 2021).

Sector	Impacts/Exposure
Economic Development	• More days with heavy precipitation are expected to increase rainfall-induced erosion and landslides. This can affect businesses through property damage.
Ecosystems	• Middle and high-elevation streams that currently receive a large fraction of winter precipitation will be more susceptible to high streamflows. • Impacts on aquatic species such as salmon.
Emergency Management	• Increase in demand for flooding-related emergency services.
Transportation	• Transportation routes located in river valleys and in or near current and historical flood zones will be most exposed

Table 6: Precipitation sector impacts.

Streamflow and Inland Flooding

The City of Lake Forest Park includes several creeks, some of which have historically been prone to flooding. The 100-year FEMA flood zone represents areas with a 1% chance of flooding in any given year and the 500-year flood zone indicates regions with a 0.2% chance of flooding annually (Figure 5) (King County, 2020). Due to higher winter rainfall and more intense precipitation events, streamflow and flooding are expected to increase.

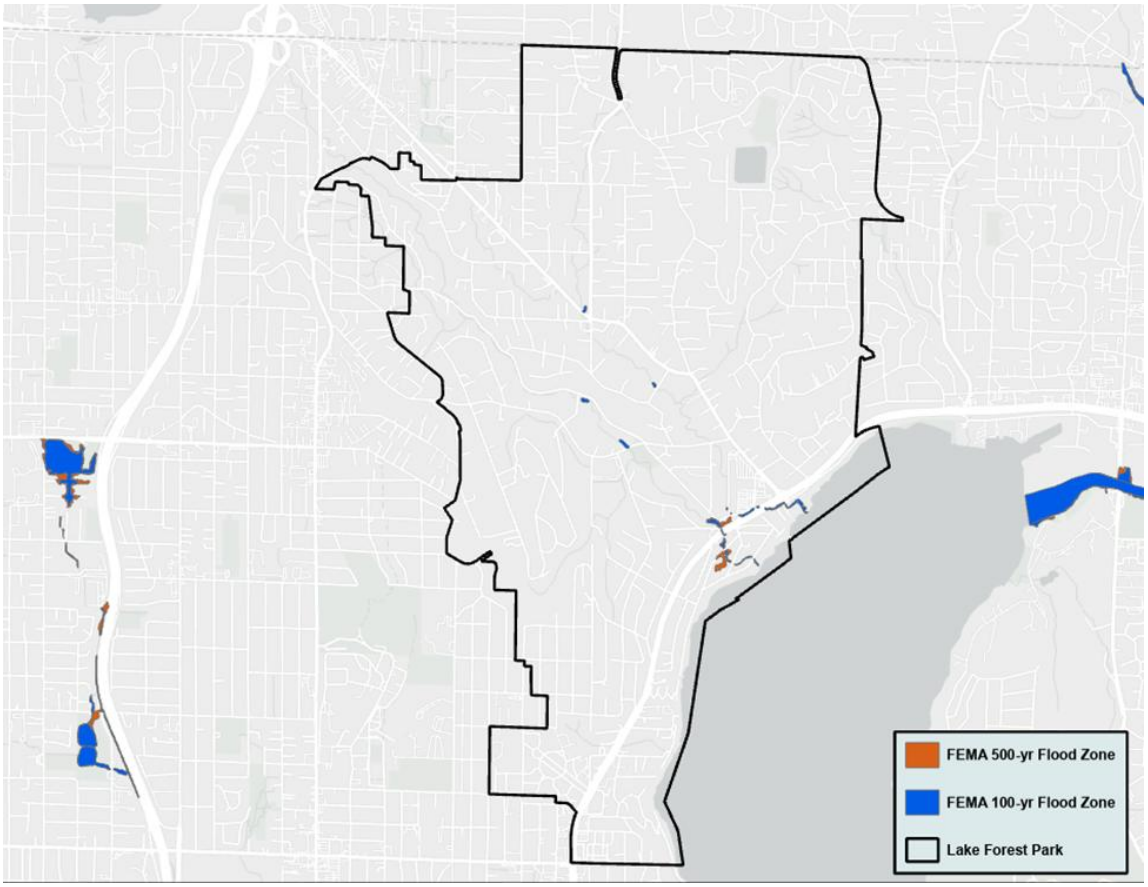

Figure 5: 100-year and 500-year flood zones within the City of Lake Forest Park.

Data from King County GIS Open Data. Assessed 11 November 2024. Figure created by Cascadia Consulting Group.

The A1B scenario indicates that streamflows and channel widths are projected to rise, along with an increase in the magnitude of the 100-year flood within the Lake Forest Park area (Table 7) (Washington Department of Fish and Wildlife, 2023).

Timeframe	Projected mean percent change in stream bankfull flow	Projected mean percent change in stream bankfull width	Projected mean percent change in 100-year flood
2040	12%	5.7%	0.3%

Timeframe	Projected mean percent change in stream bankfull flow	Projected mean percent change in stream bankfull width	Projected mean percent change in 100-year flood
2080	15.2%	7.1%	2.3%

Table 7: Percent change in average future bankfull flow and width, and future 100-year flood projections.

Data from Culverts and Climate Change Tool. Assessed 18 November 2024.

Although overall streamflow is projected to increase, summer low flows are expected to become more frequent across the region. By 2100, under the RCP8.5 scenario, 43% of King County's stream lengths are projected to experience at least 10 additional days per year with streamflows below the 1980–2009 summer low-flow threshold (Chegwidden et al., 2017).

Lower streamflows, combined with warmer air temperatures, are expected to significantly impact stream temperatures. In Lake Forest Park, Both McLeer and Lyon creek have already seen significant increase in stream temperature since 1979 (Figure 6) (Saunders, 2022).

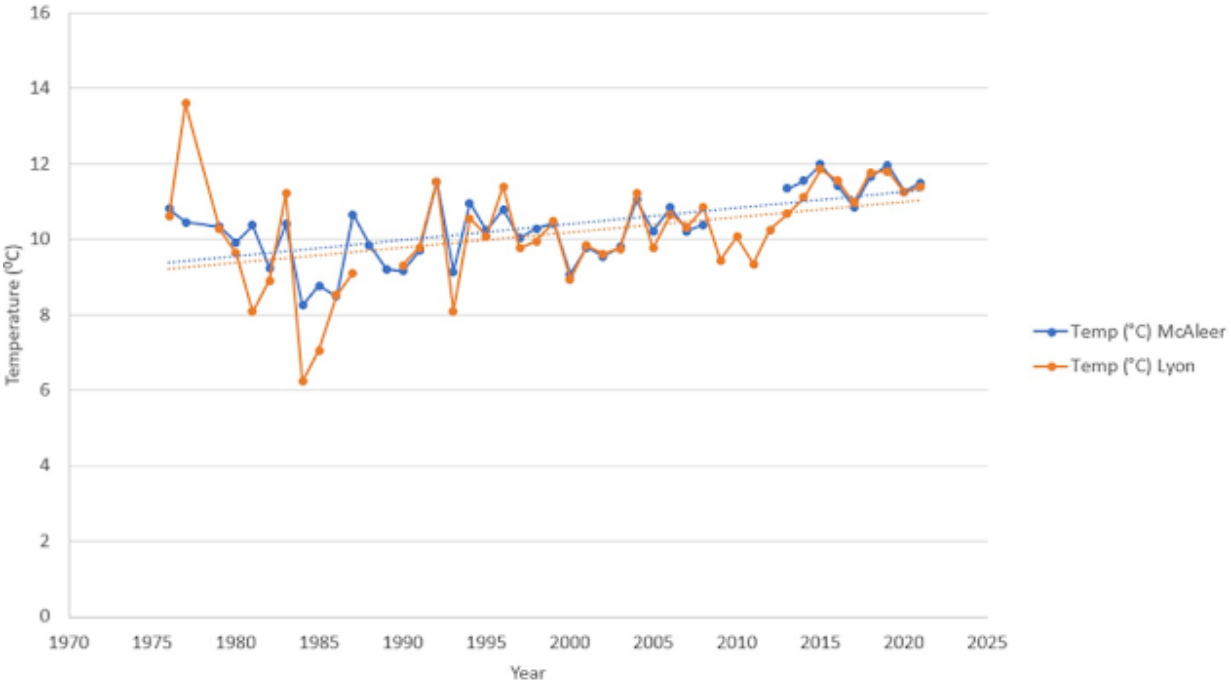

Figure 6: Average temperature (C°) of McAleer and Lyon Creek over time.

Figure from Shoreline Area News. Assessed 31 January 2024.

By 2080, under the RCP8.5 scenario, 16% more stream locations in western Washington are projected to experience weekly summer stream temperatures exceeding 67°F, a threshold that if exceeded, can stress salmon populations and increase mortality (Mantua et al., 2010).

AFFECTED SECTORS

Increased flooding is projected to affect a wide range of sectors, with significant implications for buildings, ecosystems, emergency management, public health, and transportation infrastructure (Rogers & Mauger, 2021).

Sector	Impacts/Exposure
Building and Energy	• Buildings located in low-lying areas or flood zones will be exposed to more frequent high streamflows.
Ecosystems	• Higher peak streamflows may affect the habitat of salmon and other riverine species, particularly in streams already vulnerable to high flow conditions.
Emergency Management	• High streamflows can lead to more flooding which could result in an increased need for emergency services.
Health and Well-being	• Inland flooding can lead to disruption of crops and agricultural practices.
Transportation	• Transportation routes located in river floodplains and low-lying areas will be exposed to more frequent and intense flooding.

Table 8. Flooding sector impacts.

Drought

Across the Pacific Northwest, summer precipitation is expected to decline, increasing the prevalence and duration of drought conditions (Chang et al., 2023). This trend is already evident—in April 2024, low snowpack and a warm, dry spring led the Department of Ecology to declare a drought emergency across much of Washington State (Department of Ecology, 2024). By the end of the century, under the RCP8.5 scenario, King County watersheds, including Lyon and McAleer Creeks in Lake Forest Park, are projected to experience a 12% reduction in late summer precipitation (Jul-Sept). Snowpack reduction is also anticipated to become a significant concern, with April 1st snowpack projected to decline by 83% under the RCP8.5 scenario, further exacerbating water resource challenge (Figure 77) (Chegwidden et al., 2017).

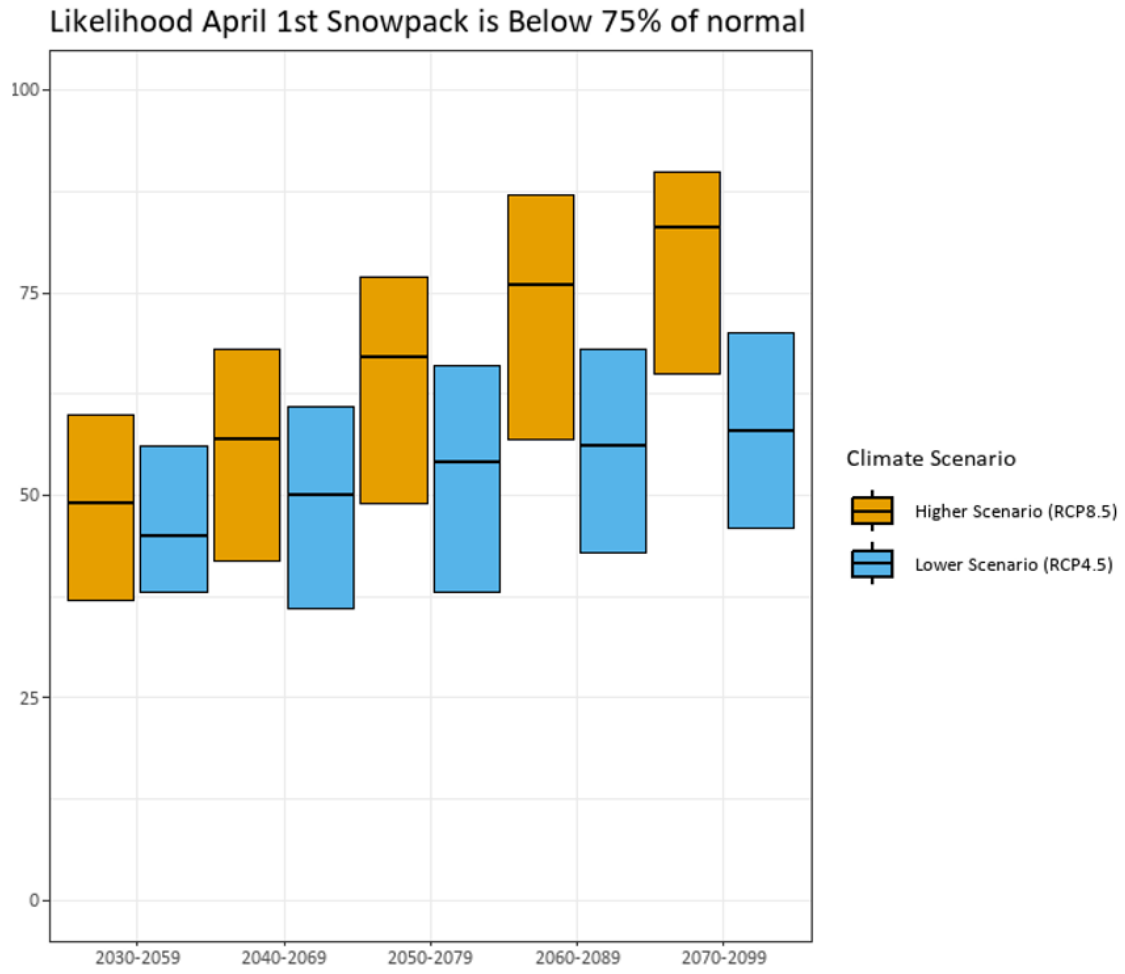

Figure 7: Likelihood of snowpack is below 75% of 1980 – 2009 average in King County (RCP8.5)

Data from Climate Impacts Group. Assessed 18 November 2024. Figure created by Cascadia Consulting Group.

AFFECTED SECTORS

More prevalent drought conditions are expected to impact ecosystems, water resources, and energy systems, posing challenges for agriculture, hydropower, and groundwater availability (Rogers & Mauger, 2021).

Sector	Impacts/Exposure
Ecosystems	• Non-irrigated agriculture • Decreased fuel moisture during the height of fire season.
Buildings & Energy	• Reduced hydropower potential.
Ecosystems	• Stressed vegetation, forests, and worsened habitat quality • Greater wildfire risk due to stressed ecosystems and increased fuel loads
Water Resources	• Groundwater sources are sensitive to changes in annual precipitation. • Increases in water demand • Lower/decreased water quality due to less pollutant dilution

Table 9. Drought sector impacts.

Wildfire and Smoke

The City of Lake Forest Park has on average greater wildfire likelihood than 18% of communities in King County, and has a low wildfire risk (Figure 8) (USDA Forest Service, 2024,). Wildfire risk across the Northwest is expected to increase due to a variety of factors, including warming conditions and drought (Chang et al., 2023). By 2100 under the RCP8.5 scenario, King County is expected to experience an 11% increase in the likelihood of climate and fuel conditions conducive to wildfires when compared to the 1980 to 2009 average (Sheehan et al., 2015).

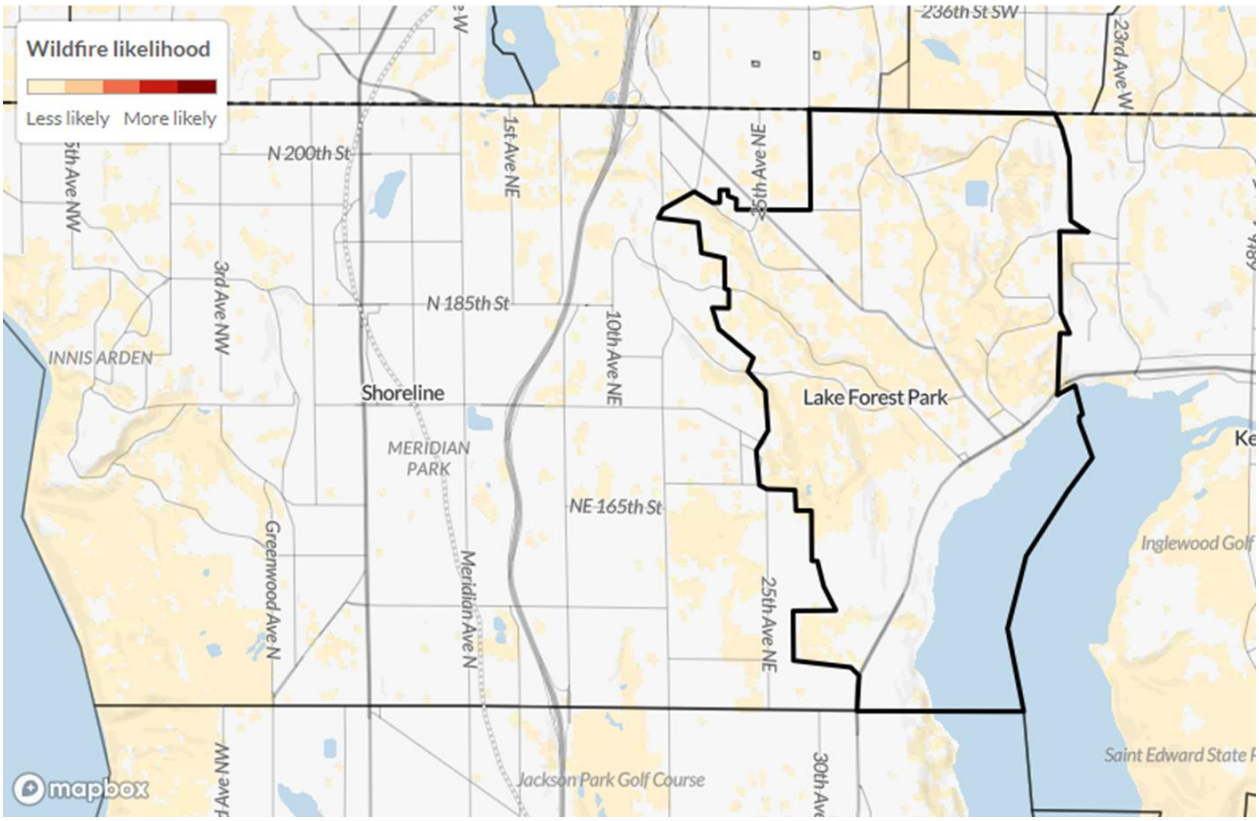

Figure 8: Wildfire risk in Lake Forest Park.

Figure from Wildfire Risk.org. Assessed 21 November 2024

In addition to direct wildfire exposure, wildfire smoke is the largest source of particle pollution in Washington and can pose a significant health risk (State of Washington Department of Ecology, 2024). Exposure to wildfire smoke is associated with increased hospital admissions and exacerbations of respiratory and cardiac conditions (Wilgus & Merchant, 2024). As climate change drives more frequent wildfires across the region, associated health impacts of wildfire smoke exposure, such as cardiovascular and respiratory issues, are expected to rise (Clarke et al., 2023).

Although no clear long-term trend is evident, the City of Lake Forest Park and greater Seattle metropolitan area remain vulnerable to episodes of high pollution levels, including PM2.5, in any given year (Figure 9). Particulate matter is challenging to predict, but recent years have shown significant spikes, exposing residents to unhealthy pollution levels (EPA, 2024).

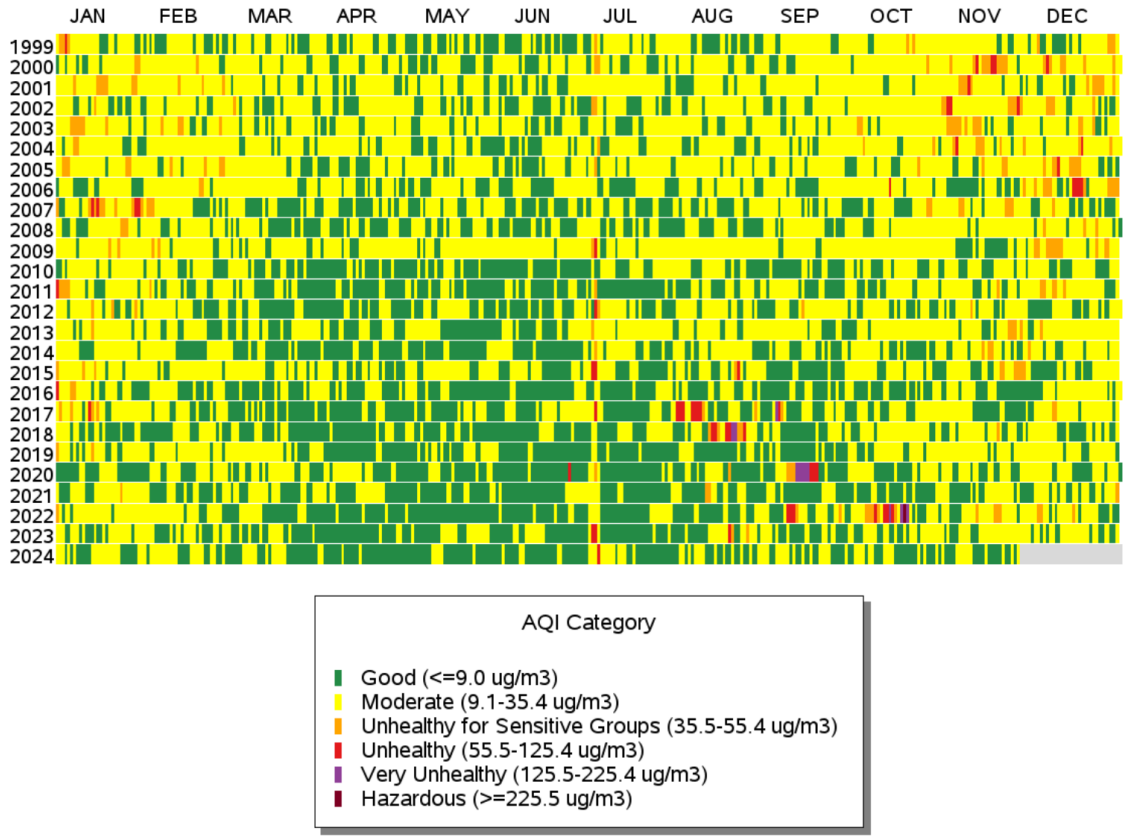

Figure 9: $PM_{2.5}$ AQI index from 1999 to 2024 in the greater Seattle area. The yellow, orange, red, and maroon bands represent days between 1999 and 2024 when air quality was considered moderate, unhealthy, or hazardous. The increasing frequency of these bands in summer months coincide with more frequent smoky days.

Figure from AirData, Environmental Protection Agency. Accessed 27 November 2024.

AFFECTED SECTORS

Increased frequency and intensity of wildfires as well as wildfire smoke, are anticipated to affect various sectors, with impacts ranging from ecosystem degradation and water quality issues to increased emergency management needs and health risks (Rogers & Mauger, 2021).

Sector	Impacts/Exposure
Ecosystems	• Potential reduction in forested areas within the City; Reduction of carbon storage, and wildlife habitat. • Increase the prevalence of invasive species.
Emergency Management	• Increase in the need for fire bans, enforcement, and capacity to respond to wildfires.
Health and Well-being	• Poor air quality could lead to adverse respiratory health effects. • Could lead to a variety of mental and physical health impacts that come from wildfire smoke and loss of homes.

Sector	Impacts/Exposure
Transportation	• Disruption of travel could increase road closures and delays.
Water Resources	• Increase runoff and sediment storage in streams reducing water quality. • Damage to water distribution systems and infrastructure.

Next steps

The climate impacts summary identifies historical and projected climate impacts, with the goal of supporting the climate policy audit and identifying gaps and opportunities within Lake Forest Park's Comprehensive Plan. This work will inform the City's Climate Vulnerability Assessment (CVA), which will ultimately guide the development of the Climate Element for the Comprehensive Plan.

Moving forward, Cascadia will seek review and feedback from the Climate Policy Advisory Team (CPAT) and City staff to ensure that the climate impacts summary accurately reflects local climate impacts. Cascadia will use this Impacts Summary as the foundation for the Climate Vulnerability Assessment, which will explore how climate impacts affect different sectors and communities across the City. This input will be crucial for informing the upcoming policy development, ensuring that the policies identified are robust and responsive to the climate challenges identified.

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