Spokane County

Climate Impacts Summary

May 14, 2025

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Overview

This climate impacts summary provides a foundational understanding of historical trends and how future changes in the climate and associated hazards will affect Spokane County. Spokane County is expected to experience the following impacts:

- **Temperature**: Higher annual temperatures with an expected 9.5 ˚F increase by 2100, and especially high temperature increases during the summer months
- **Wildfire and Wildfire Smoke**: Increased wildfire activity and risk due to extreme heat and heightened drought, resulting in increased wildfire smoke and a higher concentration of pollutants, decreasing air quality.
- **Precipitation, Snowpack, and Drought**: Changes to precipitation patterns, with increased winter precipitation as rain rather than snow and reduced summer precipitation increasing the risk of drought.
- **Stream Temperatures, Streamflow, and Inland Flooding:** Changes to precipitation patterns will alter streamflows, increasing winter streamflow by 84% and decreasing summer streamflow by 60%. Stream temperatures are anticipated to increase which may threaten ecosystems.

The climate impacts summary intends to outline the expected changes in environmental conditions related to climate change. The summary notes some potential impacts these changes may have on the County, with a more detailed review to be addressed in the climate vulnerability assessment (CVA). This summary will support the climate gaps and opportunities assessment of Spokane County's Comprehensive Plan and inform the CVA. These components will ultimately inform the Climate Element and Resilience Sub-Element in the Comprehensive Plan.

Legislative Background

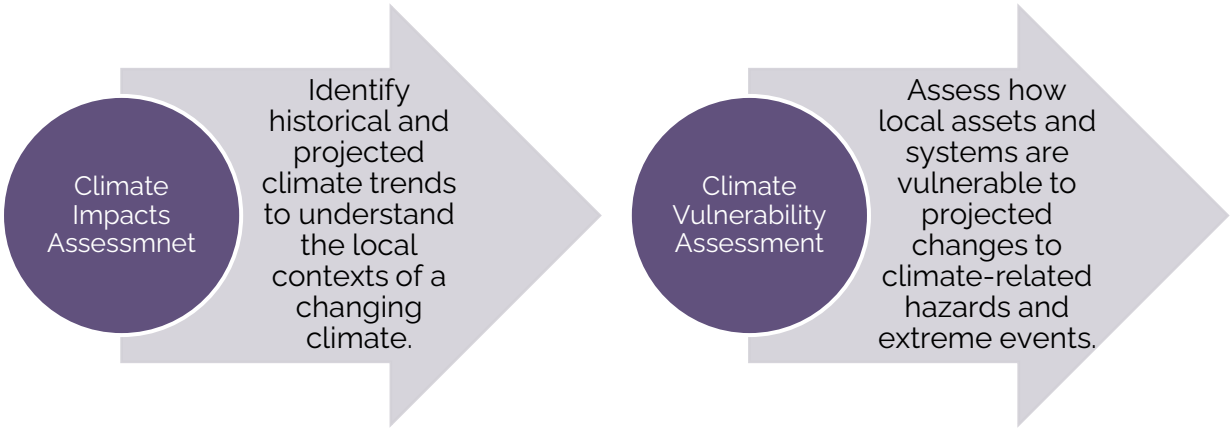
The Washington Growth Management Act (GMA) was amended in 2023 under Washington House Bill (HB) 1181, requiring cities and counties to integrate climate policies into comprehensive plan updates. For Spokane County, these required policy changes must address climate impacts and increase resilience across local sectors. Jurisdictions must adopt climate policies through a framework consistent with the Department of Commerce's ("Commerce") Climate Planning Guidance (Washington Department of Commerce, 2023).

To comply with State guidance, the first step in developing a Climate Element is exploring climate impacts within a community (Washington Department of Commerce, 2023). This guidance integrates the U.S. Climate Resilience Toolkit's framework and best

practices from various organizations such as the Association of Washington Cities (AWC), Municipal Research and Services Center of Washington (MRSC), and the American Planning Association (APA). This climate impacts summary mirrors Commerce's "Climate Element Workbook" Step 3 Task 1.1, 1.2, and 1.3, with the goal of exploring how expected changes in the climate could exacerbate natural hazards (e.g., droughts, floods, etc.) and impact critical assets and sectors (e.g., ecosystems, infrastructure, public health, etc.).

Approach

Cascadia Consulting Group ("Cascadia") used a variety of established and peer-reviewed resources—including the University of Washington's Climate Impacts Group's Climate Mapping for a Resilient Washington, NOAA National Centers for Environmental Information WA State Climate Summary, the 5th National Climate Assessment's Northwest Chapter, and other relevant studies and datasets—to identify observed and projected climate trends relevant for the County. This climate impacts assessment will inform the next phase of climate risk and vulnerability and risk analysis.



Climate Drivers and Variability

Climate change refers to the long-term shifting of environmental conditions and weather patterns. Climate change is primarily caused by human activity, particularly the emission of GHGs from burning fossil fuels. Higher levels of atmospheric GHGs, notably carbon emissions, have driven the increase in land and ocean temperatures since the Industrial Revolution, leading to various biophysical impacts such as more frequent and intense heatwaves, wildfires, storms, droughts, melting glaciers, sea-level rise, and ocean acidification (Marvel, et al., 2023).

In the Pacific Northwest, natural feedback processes like the El Niño-Southern Oscillation and the Pacific Decadal Oscillation contribute to variations in air temperature, extreme weather events, precipitation, and ocean conditions over interannual and

interdecadal periods. However, the rate of climate change caused by human activities far exceeds any natural variability from these processes (Perlwitz et al., 2017).

Climate Scenarios and Projection Models

The rise in GHG emissions in the atmosphere has already caused the climate to change significantly. Models projecting future climate conditions and impacts, including how climate hazards will increase and intensify over the next century, use a variety of climate scenarios. These scenarios are based on factors such as global GHG emission levels, future land use, population growth, and technological innovation.

The Representative Concentration Pathways (RCPs) are scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) to model potential climate futures based on different levels of greenhouse gas concentrations. Each RCP represents a different "pathway" or possible level of carbon dioxide and other emissions in the atmosphere, depending on a range of possible human behaviors and climate processes (IPCC, 2022).

This climate impacts summary will primarily use RCP 8.5, referred to as the high emissions scenario, which represents a "business-as-usual" approach in which emissions continue at their current trajectory. The high emissions scenario projects a global temperature warming of about 4.3˚C (approximately 7.7˚F) by 2100 relative to pre-industrial temperatures (IPCC, 2022). This summary also uses the moderate, A1B scenario which projects a rise of about 2.3°C by the end of the century (Bralower & Bice, n.d.).[1]

Summary of Climate Change Impacts

The following section aims to describe the county-scale climate-related environmental changes Spokane is currently facing or may face in the future. When reviewing this section, it's important to consider that many climate conditions are interconnected. For example, warmer air temperatures can worsen drought conditions and increase the likelihood of wildfire.

Additionally, the climate impacts summary will inform the CVA, and presents a general overview of conditions and a snapshot of potential impacts that these climate change

[1] The moderate A1B model is only used in the Stream Temperatures section of the Climate Impacts Summary, as the UW Climate Mapping for a Resilient Washington tool did not include RCP 8.5 high emissions scenario data.

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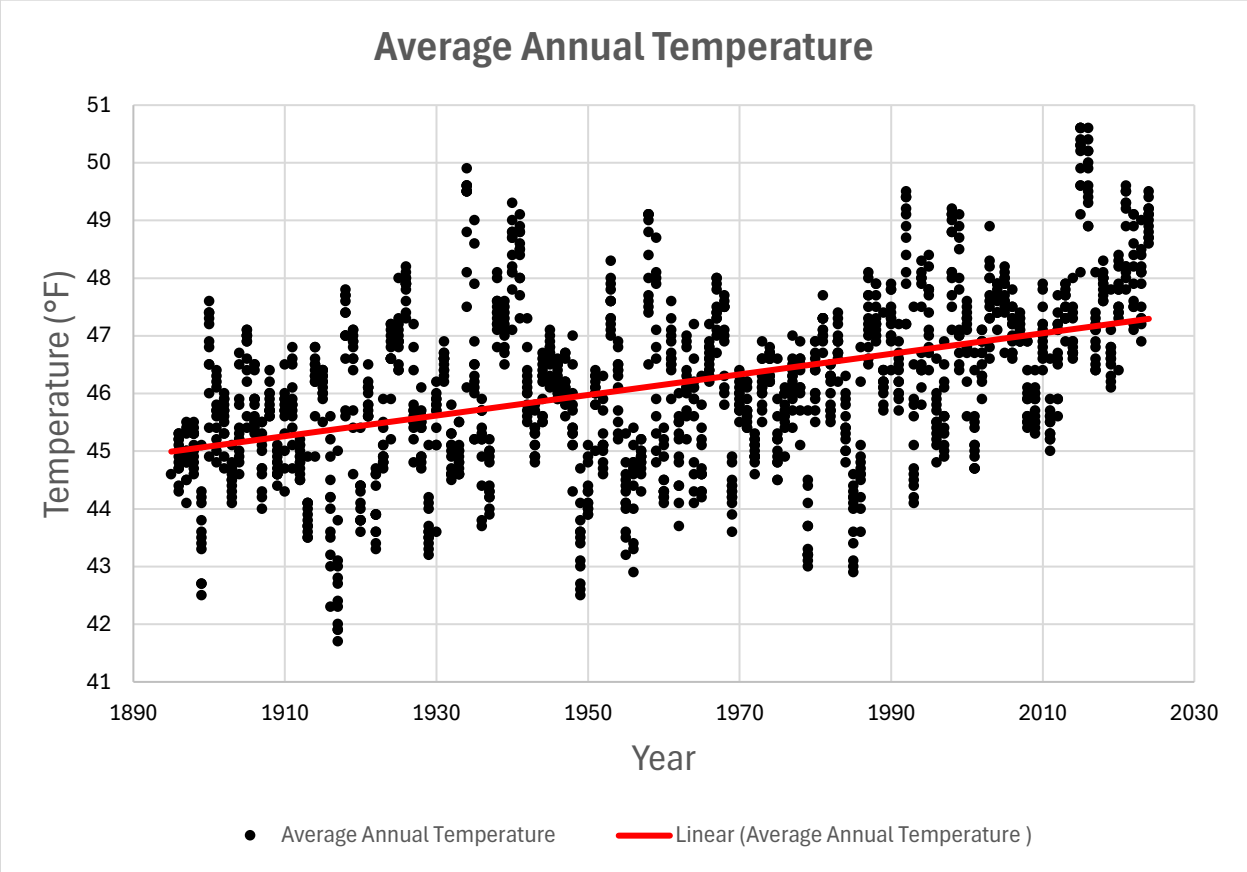
projections may pose to the County. The CVA will consider these projected changes and dive deeper into the potential impacts they have for Spokane County, beyond the broad analysis completed here.

Temperature

From 1895 to 2024, average annual temperatures in Spokane County increased by 2.3˚F (Figure 1) (NOAA National Centers for Environmental Information, 2024).

Figure 1. Average annual temperature for Spokane County, Washington 1895-2024.

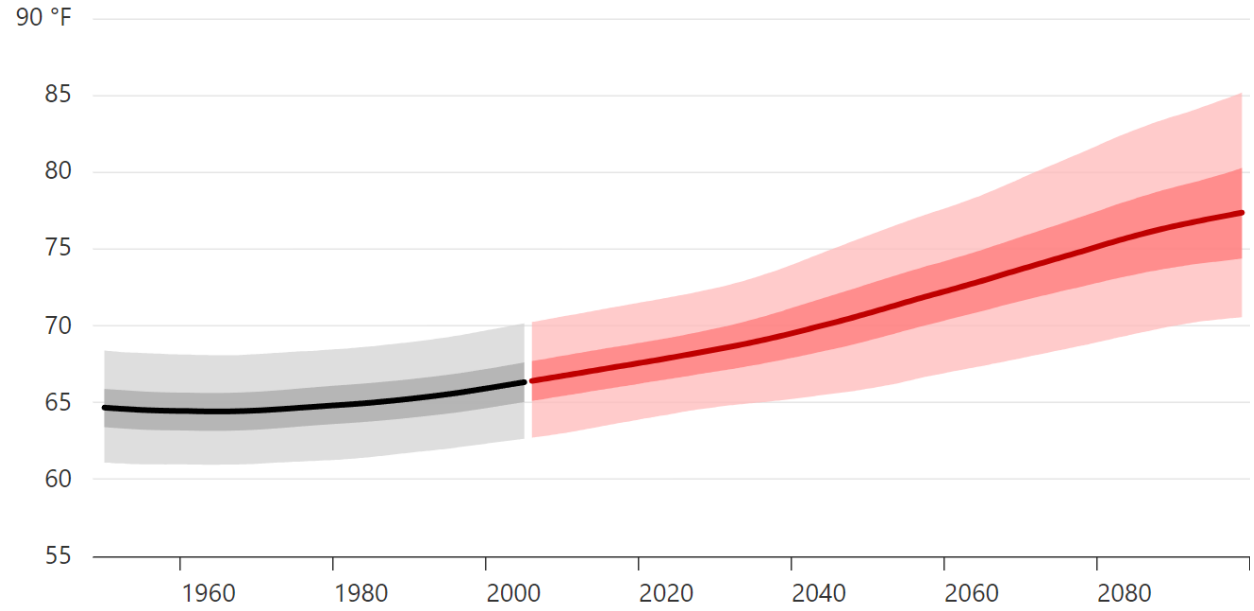


Source: NOAA's National Centers for Environmental Information. Accessed 28 January 2025. Graph created by Cascadia Consulting Group.

Relative to the 1971- 2000 historic average, the annual maximum temperature in Spokane County is projected to rise from 58.3˚F to 67.8˚F under the high emission scenario, by 2100. Under the same scenario and timeframe, average summer temperatures (Jun-Aug) are projected to increase by 11.3˚F (

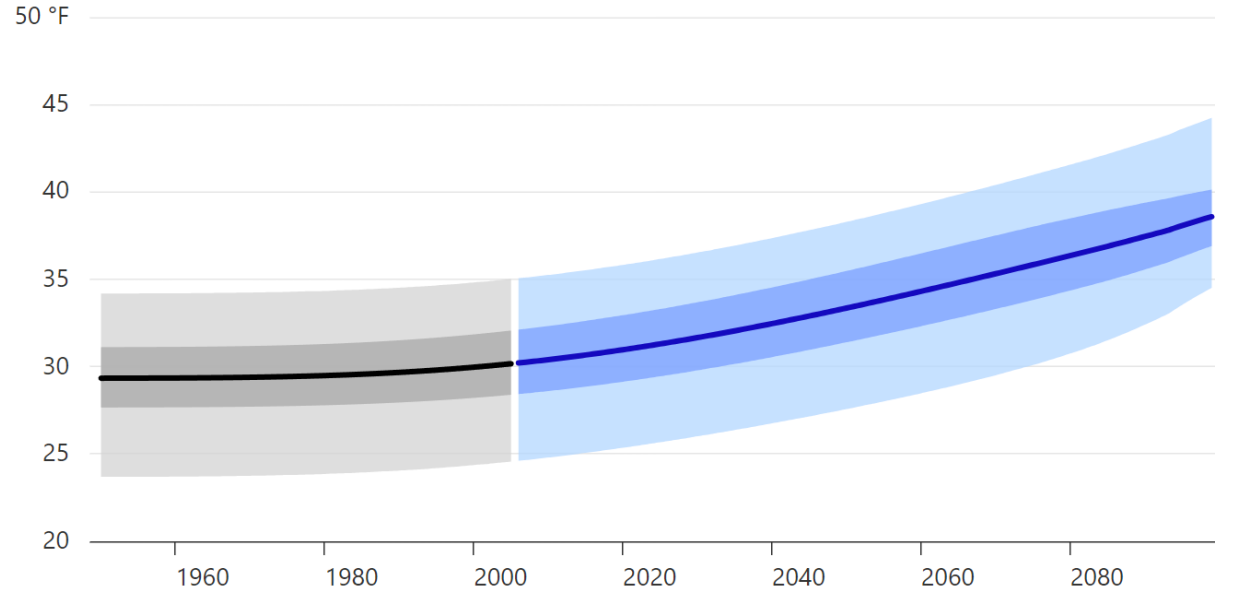
Figure 2), and wintertime temperatures (Dec-Feb) are projected to increase by 9.5˚F (Figure 3).

Figure 2. Projected increase in average summertime (Jun-Aug) temperature under the high emission scenario, in Spokane County Washington.



Source: Climate Toolbox. Accessed 9 January 2025.

Figure 3. Projected increase in average wintertime (Dec-Feb) temperature under the high emission scenario in Spokane County Washington.

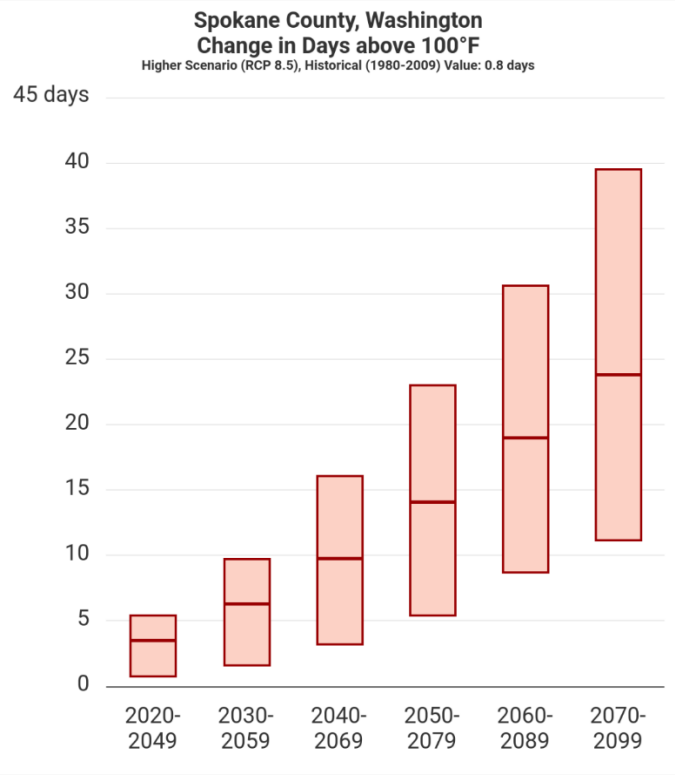


Source: Climate Toolbox. Accessed 9 January 2025.

Relative to the historical 1980-2009 baseline, the number of days above 100°F is expected to increase from .8 days to 23.8 days by the end of the century (Abatzoglou & Brown, 2012). See Figure 4. An increase in the number of hot days, or days above 100°F,

will have adverse impacts on County infrastructure and the health of vulnerable populations such as outdoor workers.

Figure 4. Projected increase in the number of days over 100 ℉ in Spokane County Washington by the end of the century compared to 1980-2009 baseline.



Source: UW Climate Impacts Group. Accessed 9 January 2025.

Wildfire, Wildfire Smoke, and Air Quality

Spokane County has a historically higher risk of wildfires due to surrounding forests and its dry, drought prone climate. Wildfire risk is expected to increase in the region due to a variety of factors, including increase drought severity and length and land use changes into the wildland-urban interface (Chang, et al., 2023). Under RCP 8.5, Spokane is projected to experience an additional 53.7 "very high" fire danger days (calendar days that fall into the 10th percentile of fuel dryness as defined by the 100-hour fuel moisture index; days when fuels are dry) and 18.9 "extreme" fire danger days (calendar days that fall into the lowest 3rd percentile of fuel dryness as defined by the 100-hour fuel moisture index; days when fuels are very dry) by mid-century (Hegewisch & Abatzoglou, n.d.). Moreover, under the same high emissions scenario, Spokane County is projected to see an increase in wildfire probability. By the end of the century, the likelihood of climate and fuel conditions within Spokane County being favorable for wildfire in any given year is expected to be 87%, as shown in Figure 5 (Sheehan et al., 2015).

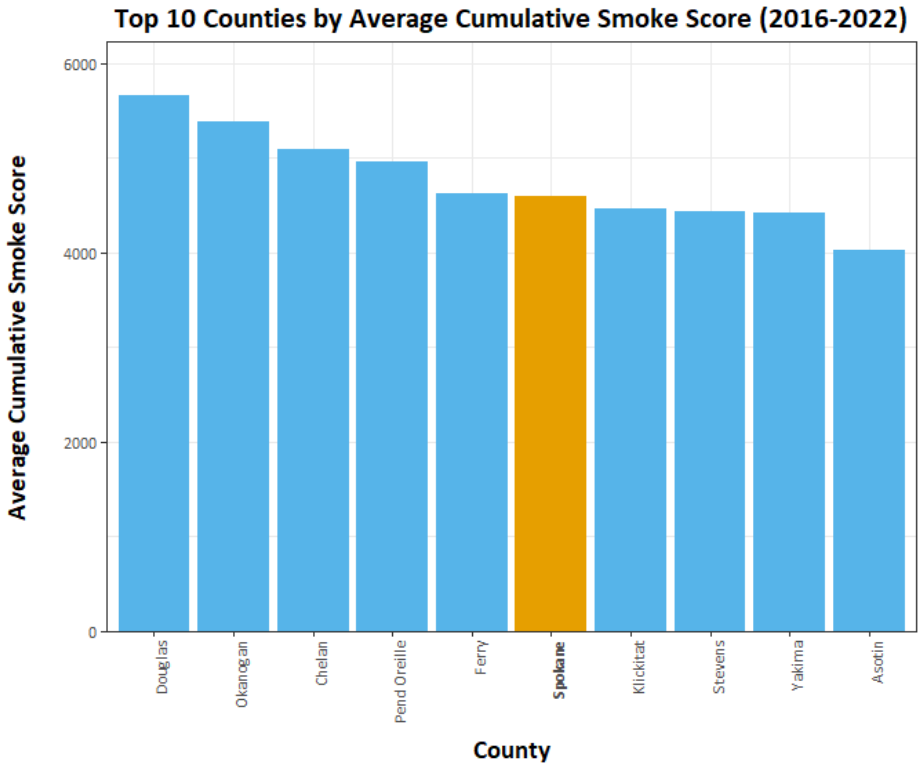
Figure 5. Likelihood of climate and fuel conditions being favorable for wildfire in any given year in Spokane County.

Source: Raymond & Rogers 2022. Accessed 21 January 2025.

Spokane County has one of the highest wildfire smoke scores in Washington state (

Figure 6).

Figure 6. Washington state counties ranked by average cumulative smoke score (2016-2022).

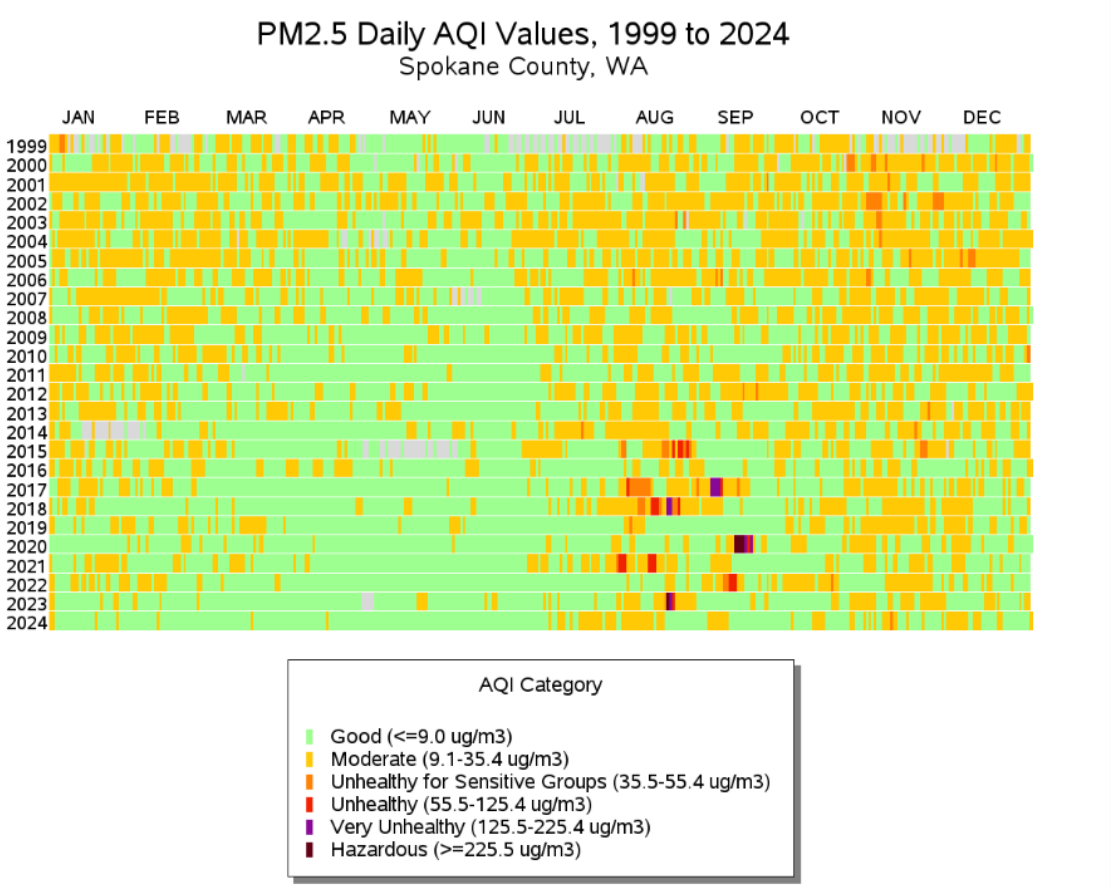


Source: Data from Washington Tracking Network, Washington State Department of Health. Figure created by Cascadia Consulting Group. Accessed 28 January 2025.

These scores reflect elevated particulate matter concentrations on days affected by wildfire smoke (Washington Tracking Network & Washington State Department of Health, 2023). In addition to the extensive physical damage caused by wildfires, the regional smoke produced degrades air quality and leads to significant health and economic issues for the County. Wildfire smoke is strongly associated with increased hospital admissions and the worsening of respiratory and cardiac conditions (Wilgus & Merchant, 2024).

While there is no discernible long-term trend, the Spokane-Spokane Valley area is susceptible to experiencing high levels of pollution, such as PM2.5, in any given year (Washington Tracking Network & Washington State Department of Health, 2023). See Figure 7. While particulate matter is difficult to project, recent years have seen notable spikes that correlate with wildfire season (EPA, n.d.).

Figure 7. $PM_{2.5}$ AQI Index from 1999 to 2024 in Spokane County. Note: gray indicates no data/missing data.



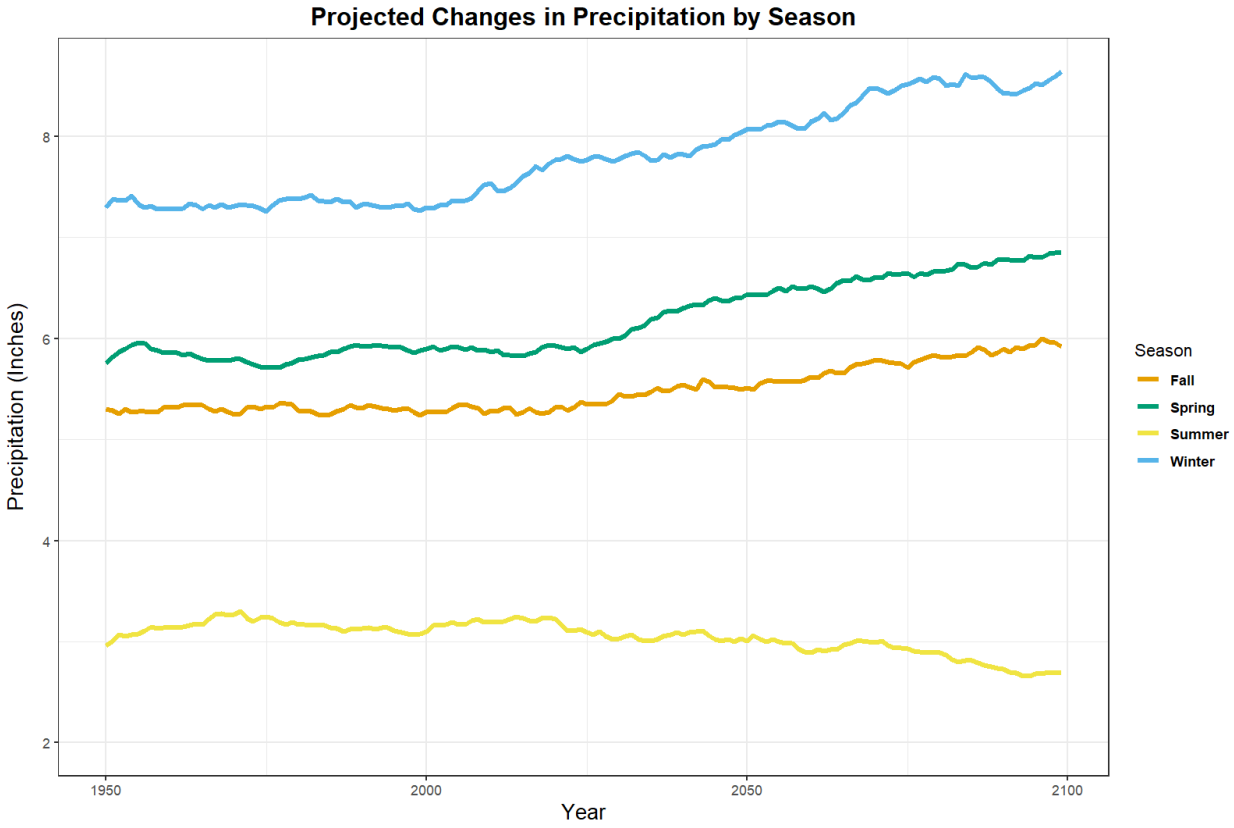
Source: Figure from AirData, Environmental Protection Agency. Accessed 22 January 2025.

Precipitation, Snowpack, and Drought

Precipitation

From 1979 to 2024, Spokane County received an average of 21.4 inches of rain annually (Hegewisch & Abatzoglou, n.d.). In recent years, there has been a slight increase in annual precipitation, a slight increase in precipitation during the fall, winter, and spring months, and a decrease in summer precipitation (Figure 8) (Breems & Booth, 2020).

Figure 8. Projected change in precipitation by season.



Source: Data from Climate Toolbox (Hegewisch & Abatzoglou, n.d.). Figured created by Cascadia Consulting 28 January 2025.

Compared to the baseline period of 1951-2005, annual precipitation is projected to increase by 11.6% by 2099 under RCP 8.5. However, summertime precipitation is expected to decrease by 14.6% during the same period (Hegewisch & Abatzoglou, n.d.).

Snowpack

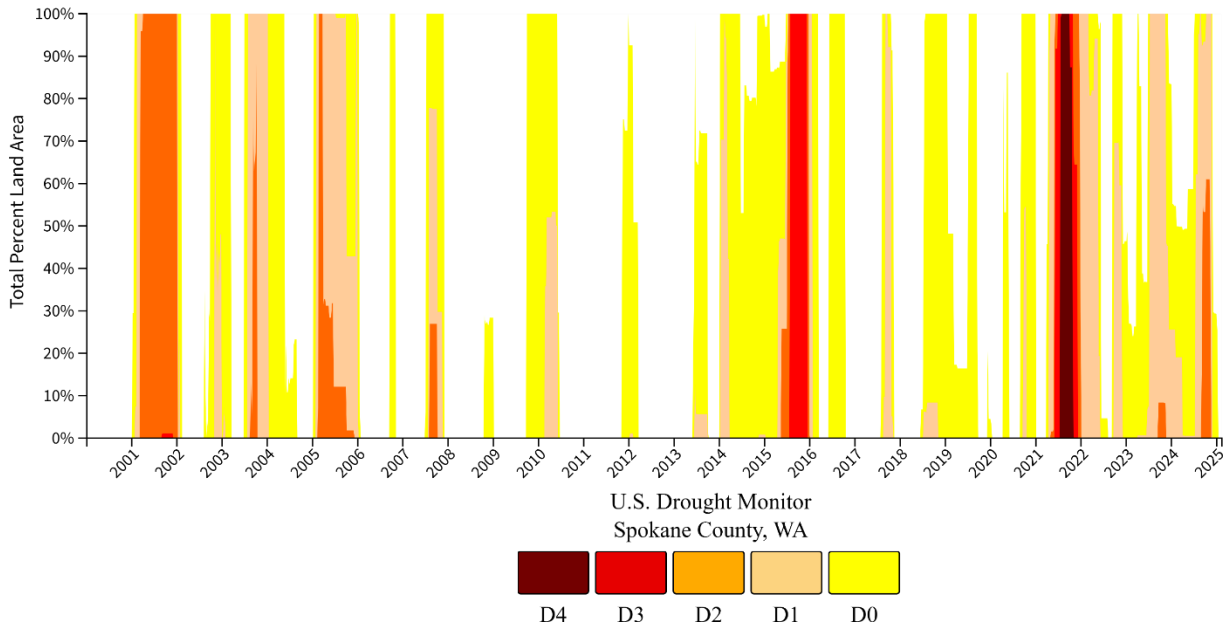
Warming temperatures are expected to cause a shift from snow to rain across many western mountain ranges. In the Spokane region, snow stations in the Cascades and Northern Rockies are projected to experience low-snowfall years – or years when the snow water equivalent falls below the 25th percentile – almost every year by midcentury, compared to the baseline average of every four years (Lute, Abatzoglou, & Hegewisch, 2015).

Under the high emissions scenario, the likelihood of the April 1st snowpack in the Spokane county area being below 75% of the 1980-2009 average is nearly 100% by the end of the century. A decrease in April 1st snowpack indicates that less stored water will be available to supply streams, soil, and reservoirs during the melt season (Chegwidden et al., 2017).

Drought

The US Drought Monitor uses five categories to measure drought in the US. D0 is abnormally dry, and the four stages of drought are D1-D4 and represent varying levels of drought severity, ranking from early signs of dryness to extreme drought conditions. Figure 9 shows the area and intensity of drought in Spokane County from 2000 to 2024. The figure shows that in recent years, there have been more instances of abnormal dryness and instances of drought at D1 and higher.

Figure 9. Drought severity for Spokane County, 2000-2024.



Source: U.S. Drought Monitor. Accessed January 28, 2025.

Although slight increases in precipitation are projected, the benefits may be offset by decreased snowpack, potentially leading to less aquifer recharge at some sites (Meixner, et al., 2016). Spokane County is projected to see an increase in evapotranspiration (combined processes which move water from Earth's surface into the atmosphere) of 8.2 inches by the end of the century under the high emissions scenario (Hegewisch & Abatzoglou, n.d.).

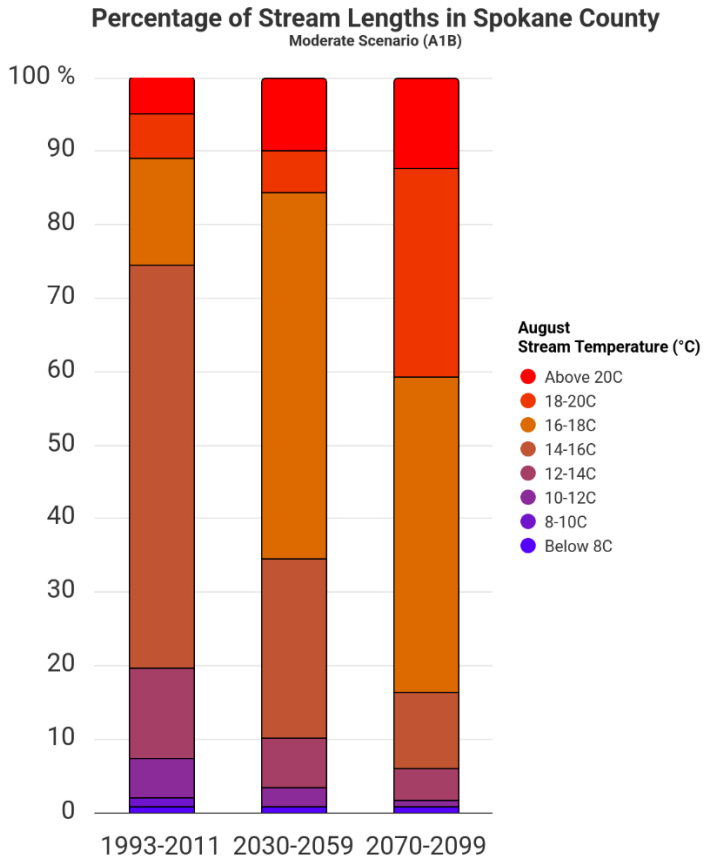
Stream Temperatures, Streamflow, and Inland Flooding

Stream Temperatures

August stream temperatures are expected to increase under moderate scenarios (A1B) (Isaak, et al. , 2017). Ideal stream temperatures for aquatic life are considered between

12.5 and 17 °C, however conditions above 20°C are considered fair, but may threaten juvenile salmonid species (WA State Department of Ecology, 2024). The percentage of stream lengths in Spokane County at 14-16°C is expected to decrease from the historical baseline of 54.8% to 10.3% by the end of the century, while stream lengths between 16-18°C are expected to increase from 14.5% to 42.9% for the same period. The percentage of stream lengths above 20°C is expected to increase from 5.1% to 12.4%, which may indicate an increased risk to stream ecosystems. See Figure 10

Figure 10. Projected increase of August stream temperatures and increase in the percentage of stream lengths above 16C.



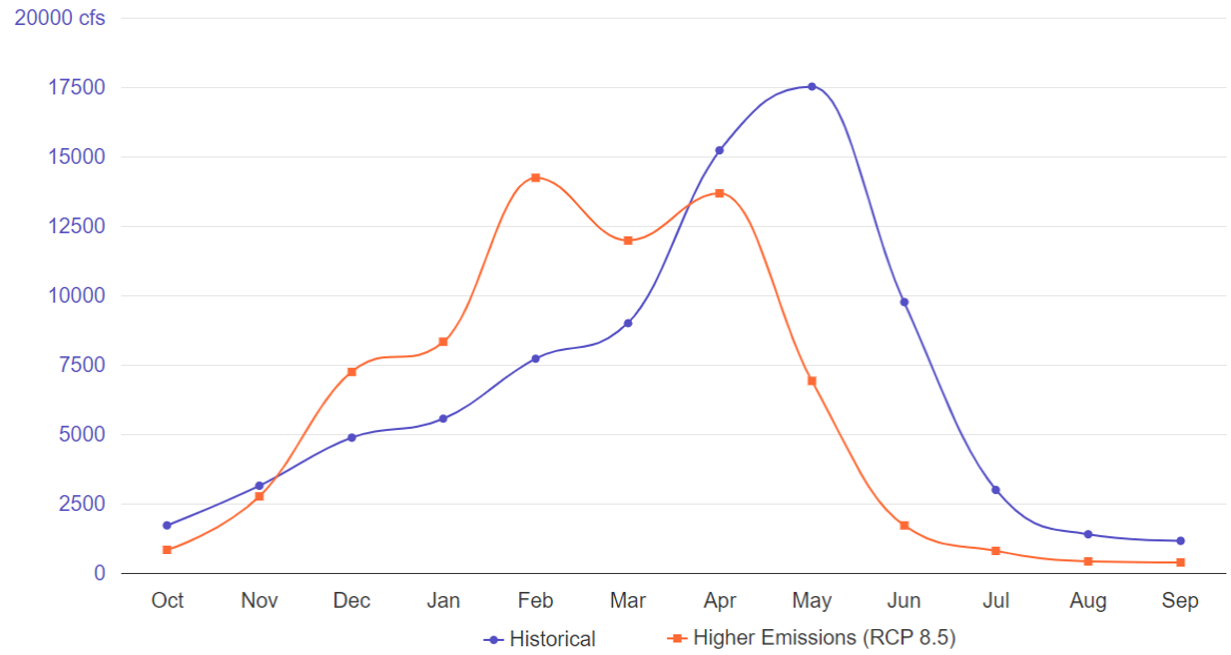
Source: UW Climate Impacts Group. Accessed 9 January 2025.

Streamflow

Streamflows are expected to increase in winter and decrease in late spring and summer. By the end of the century, February streamflow at the Monroe Street gauge along the Spokane River is projected to be 84% higher than the historical average (Figure 11) (Hegewisch, Abatzoglou, & Chegwidden, n.d.). However, it will be less than the historical May peak.

In contrast to the increasing winter streamflow, later spring and summertime streamflow is expected to decrease significantly in volume and begin earlier in the year. Under the high emissions scenario, by the end of the century, May streamflow is projected to decrease by 10,598 cubic feet per second—a 60% reduction compared to the historical average (Figure 11 (Hegewisch, Abatzoglou, & Chegwidden, n.d.).

Figure 11. Projected and historic non-regulated streamflow in the Spokane River at Monroe Street.



Source: Figure from Climate Toolbox. Accessed 28 January 2025.

Changes in streamflow are expected throughout Spokane County, which will affect the County's outdoor recreation economy, leading to a shorter season and reduced water flow for activities like rafting and other river-based tourism (Rains et al., 2020). There may be differences in streamflow changes in flashy, non-controlled watersheds like Hangman/Latah and Little Spokane, compared to the Spokane River.

Inland Flooding

Inland flooding is expected to intensify and become more frequent as winter streamflow and winter precipitation shift and increase. Under the high emissions scenario, annual peak streamflows are expected to increase overall, indicating larger areas of inundation overall. See Table 1. Note this table addresses annual maximum streamflow, so is not a direct indicator of specific events.

Table 1. Percentage of stream lengths in Spokane County and percent change in annual maximum streamflow high emissions scenario. More peak streamflow Is an indicator of flood potential and larger areas inundated every year at high flows.

		Percent change in annual maximum streamflow in Spokane County			
		-10 to 10%	**10 to 30%**	**30 to 50%**	**50 to 70%**
Time period	**Historical baseline (1980-2009)**	100	0	0	0
	Midcentury (2030-2059)	.8	35.3	64	0
	End of century (2070-2099)	0	21.8	55.4	22.8

Overall, Spokane County faces high flooding risk, with approximately 9.1% of properties at risk for flooding in the 100-year flood zone this year, and 9.7% of properties in 30 years (First Street, 2025). This will be explored further in the CVA.

Next Steps

The climate impacts summary identifies historical and projected climate impacts. This work will inform the County's Climate Vulnerability Assessment (CVA), which will ultimately guide the development of the Climate Resilience Sub-Element for the Comprehensive Plan.

Cascadia will use this Impacts Summary as a base for the Climate Vulnerability Assessment, which will explore how climate impacts affect different sectors and communities across the County. 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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