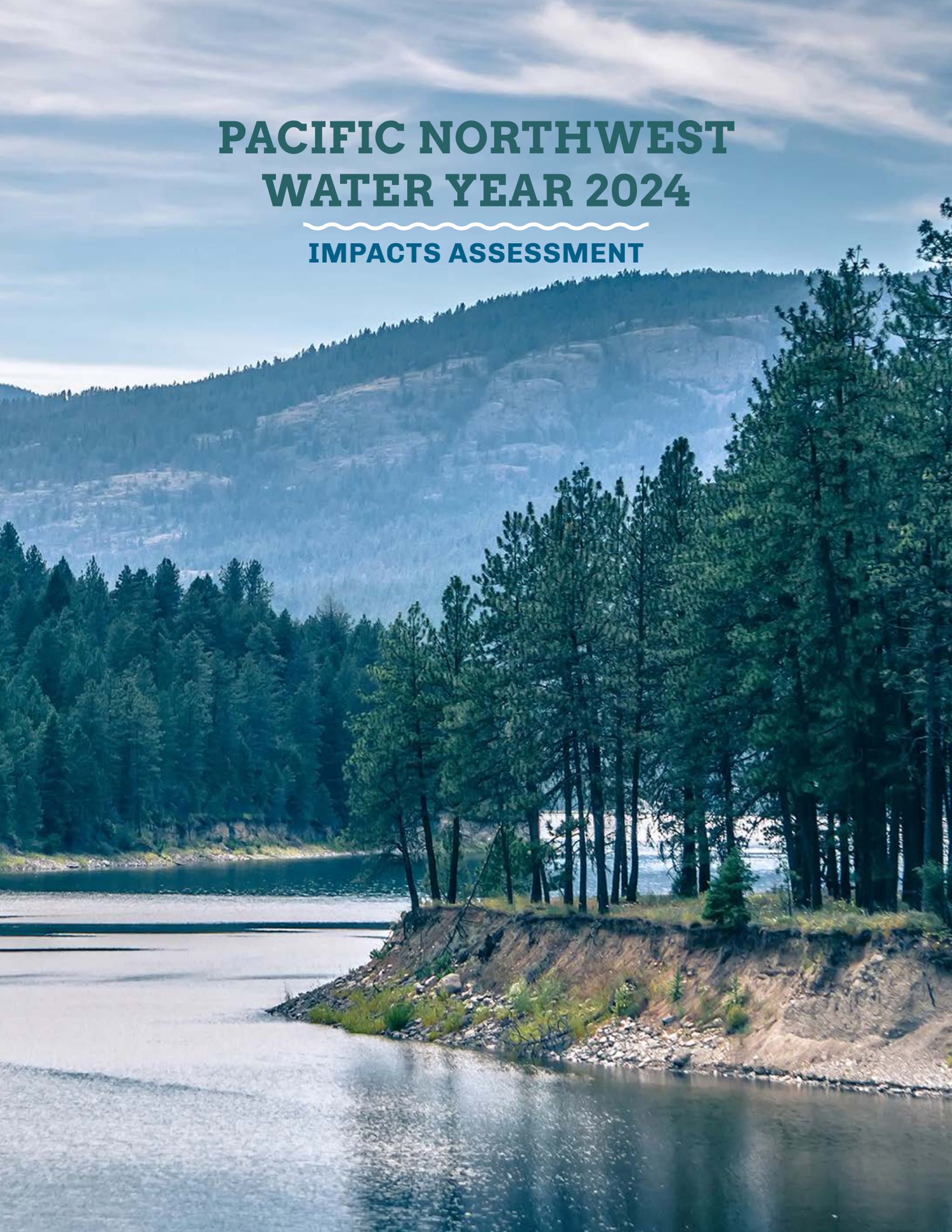
PACIFIC NORTHWEST WATER YEAR 2024

IMPACTS ASSESSMENT



Pacific Northwest Water Year 2024 Impacts Assessment

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Design

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Table of Contents

Executive Summary

Regional Water Year Conditions

- Across Washington, Oregon, and Idaho, the 2024 water year (October 1, 2023-September 30, 2024) average temperature was tied for the 4th warmest (+1.4°F above the 1991-2020 normal) in the 129-year record. Total precipitation was near-normal in Oregon and slightly below normal in Idaho and Washington.

- Over the 2024 water year, the severity of drought decreased across Washington, Oregon, and Idaho (the Pacific Northwest; PNW), but the area experiencing drought expanded slightly. In general, drought improved across western Washington and western Oregon and worsened in the inland PNW.

- A warm and dry start to the water year, combined with an exceptionally warm December that ranked as the 6th warmest on record across the PNW, caused regional snowpack to be much below normal by January 1.

- Across Washington and Oregon, a series of warm atmospheric rivers at the end of January melted much of the existing mountain snowpack. At the end of the snow accumulation season, average snowpack rebounded to near to above median across most of Oregon, above median on the southern side of the Snake River Plain in Idaho, and below median along the north and east side of the plain. Snowpack remained below median in Washington, northern Idaho, and northeastern Oregon (Figure ES1).

- Cooler than normal May temperatures and mountain snow in the beginning of the month slowed the rates of melt of the existing snowpack and prolonged the persistence of the PNW snowpack.

- Across the PNW, July 2024 ranked as the 2nd warmest July since records began in 1895. The warmer and drier than normal July conditions exacerbated significant drought impacts such as a record breaking fire season in Oregon.

- A period of cooler and wetter than normal weather in mid- to late-August provided unexpected relief from drought impacts and aided migration of salmon by increasing streamflows and reducing river temperatures, particularly in Washington.

April 1, 2024 Snowpack

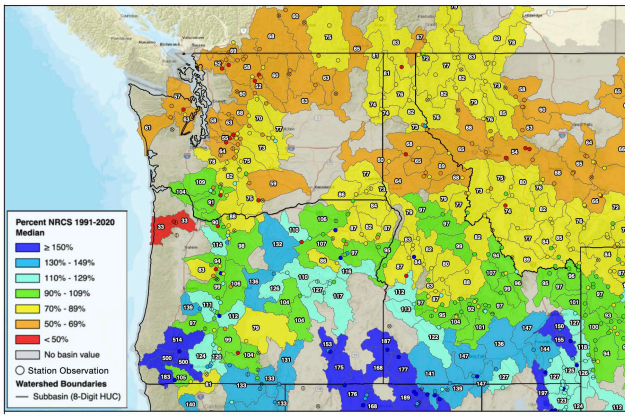


Figure ES1: April 1, 2024 snow water equivalent (SWE) percentage of 1991-2020 median. Source: **NRCS**.

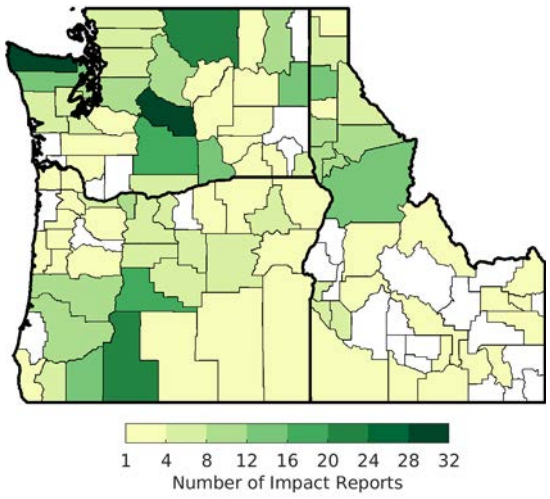


Figure ES2: Number of dry or wet impacts reported by Annual Pacific Northwest Water Year Impacts Survey respondents in counties in Washington, Oregon, and Idaho. Survey respondents were also able to select "statewide" for a specific impact reported; those responses were not included in this map. White indicates that no reports were submitted for that county.

Impacts

- Impacts from dry conditions were reported much more often than those from wet conditions over the course of the water year. The Annual Pacific Northwest Water Year Impacts Survey received 319 reports of impacts from dry conditions and 58 reports of impacts from wet conditions. Similarly, the National Drought Mitigation Center Condition Monitoring Reports (CMOR) on Drought received 35 reports related to dry conditions and 10 related to wet conditions over the course of the water year.

- The 2023 drought impacts persisted at the start of water year 2024, particularly in western Washington, where drought reports noted lower flows from natural springs and water-stressed trees.

- More impacts from both dry and wet conditions were reported in Washington than Oregon or Idaho, which is likely a result of both greater survey dissemination and response across the state and the fact that drought was more pronounced in Washington during the 2024 water year (Figure ES2).

- Among seven sectors, the agricultural sector reported the highest number of impacts from dry conditions, most of which related to limited water availability and reduced crop yields. Many respondents also noted negative consequences for livestock. Reports indicated that hay and pasture were both the most negatively impacted by dry conditions and the most positively impacted by wet conditions across the PNW, demonstrating the variability in local conditions.

- Drinking water had a high number of dry impacts related to the need for voluntary conservation, low groundwater, increased pumping costs, and the use of alternative water sources. Limited summer water supply in the Idaho panhandle was mentioned explicitly in survey responses.

- Examples of frequently reported impacts from dry conditions on other sectors included recreational closures due to heat, fire, and smoke; tree mortality; increased insect activity; reduced streamflows; warmer temperatures; and increased salmon mortality.

Responses

- A drought emergency was extended across nearly all of Washington in April 2024 with the exception of the areas served by the utilities of Everett, Seattle, and Tacoma. Drought declarations were issued from June 2024 through November 2024 for four Oregon counties and two Idaho counties.

- At least 60% of respondents to the Annual Pacific Northwest Water Year Impacts Survey reported that they changed their seasonal operations in response to abnormally dry conditions.

- The recreation, agriculture, and drinking water sectors appeared to have the highest operational resilience to abnormally dry conditions. These sectors responded by closing fisheries, limiting recreational access, implementing burn bans, harvesting crops earlier, switching to alternate sources of water, fallowing fields, shortening livestock rotations, and raising awareness of abnormally dry conditions to promote conservation.

1 Purpose

The purpose of the fifth Pacific Northwest (PNW) Impacts Assessment is to connect the water year[1] conditions to sector-specific impacts to inform planning, response actions, and technical and scientific information needs. Ultimately, the assessment can be used as a resource for future management of drought and other climate extremes.

We gathered the information presented in this assessment in three main ways. First, we held two separate but similar annual Water Year Recap and Outlook meetings, one focused on Washington and Oregon and one on Idaho. The meeting objectives were to summarize the climate during the previous water year and to review climate and weather-related impacts of drought and other climate extremes on various sectors. Second, the University of Washington Climate Impacts Group and Washington State Climate Office distributed the Annual Pacific Northwest Water Year Impacts Survey. Third, we collected Condition Monitoring Reports from Community Collaborative Rain, Hail, and Snow Network volunteers and Condition Monitoring Observer Reports (CMOR) submitted to the National Drought Mitigation Center (NDMC) during the 2024 water year.

The assessment primarily reflects the information from the meeting discussions, surveys, and the authors' expertise. We focus on the occurrence and impacts of an extremely warm December, a heavy precipitation event at the end of January that melted mountain snowpack, below normal May temperatures, the extremely warm and dry July, and August precipitation.

1. A water year is defined as the 12 months beginning on October 1 and ending on September 30 of the following year (e.g., water year 2024 began on October 1, 2023 and ended on September 30, 2024).

2 Lessons Learned

LESSON 1:
Drought impacts would have been worse if not for several episodes of cooler and wetter conditions.

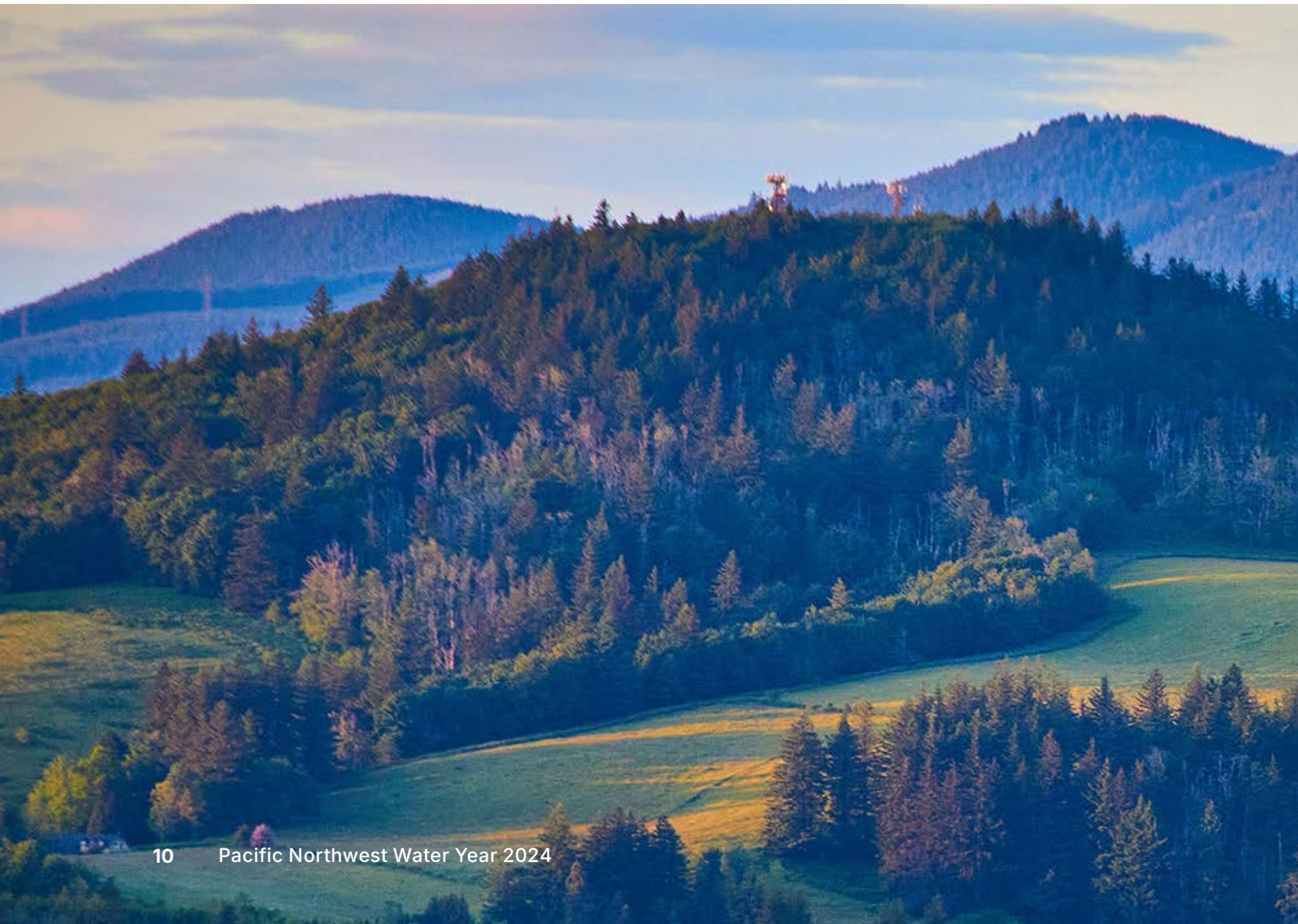
Cooler than normal May temperatures and the accumulation of mountain snow in early May slowed the rates of melt of the existing snowpack and prolonged the persistence of the snowpack across the PNW. A period of cooler and wetter than normal weather in mid- to late-August provided unexpected relief from drought impacts and aided migration of salmon by increasing streamflows and reducing river temperatures, particularly in Washington. Neither of these fairly short-duration anomalies were predicted well in monthly outlooks, demonstrating the continued need for improvements to subseasonal and seasonal forecasts. For example, the Climate Prediction Center issued a May temperature outlook in mid-April that called for increased chances of above normal temperatures for nearly all of the PNW, but the least likely outcome (below normal temperatures) occurred.

LESSON 2:
Monthly temperature anomalies were just as important as precipitation anomalies on water supply at several points during the water year.

The Annual Pacific Northwest Impacts Survey focuses on impacts from abnormally dry and abnormally wet conditions, and this assessment emphasizes the impacts of precipitation anomalies. The importance of temperatures, however, cannot be overstated. During the 2024 water year, the extremely warm December and July and cool May shaped overall water supply and related impacts. That said, it is difficult to separate the individual contributions of temperature and precipitation to specific impacts. The impacts reported here—such as the lack of snowpack in December, the slower snowmelt in May, and the rapid onset of the wildfire season in July—are influenced by variations in both temperature and precipitation.

LESSON 3:
People responded proactively to drought risks.

Preemptive actions were taken at the state and local level to reduce the impacts of abnormally dry and abnormally wet conditions. The Washington State Department of Ecology, for example, issued a drought emergency with the Governor's approval in mid-April in response to the low snowpack and forecasts of warmer and drier than normal spring and summer conditions. The timing of the declaration allowed for advanced warning and more time to take action compared to other recent declarations (e.g., July 2021, mid-May 2022, and July 2023). Over 65% of our survey respondents affiliated with the drinking water, agriculture, and recreation sectors reported changing their operations due to abnormally dry conditions. Collaboration among the Jamestown S'Klallam Tribe, Washington state agencies, irrigators, and non-profit organizations to facilitate salmon migration in the Dungeness Basin in Washington illustrates how drought response can be honed to achieve success.



LESSON 4:

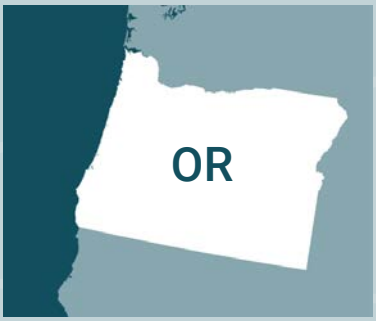
Even in the absence of drought, impacts from previous droughts persisted.

Survey respondents reported impacts from abnormally dry conditions even in places that did not experience drought conditions this year. These impacts likely reflect multiple years of drought across the PNW. The Deschutes Basin in Oregon is an example: although snowpack was near-median for 2024 and reservoir storage improved, the region experienced drought during water years 2020-2023. Water year 2024 was a step towards drought recovery in the Deschutes Basin, though impacts from long-term drought still lingered.

3

Water Year Evolution

Water Year Summary



OREGON

5th warmest
+1.4°F

59th wettest
+0.05" (100% of normal)

WASHINGTON

9th warmest
+1.2°F (tied with 2003)

39th driest
-4.60" (89% of normal)

IDAHO

4th warmest
+1.6°F

29th driest
-2.62" (89% of normal)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

The PNW 2024 water year temperatures were above normal and total precipitation was near-normal.[2] Averaged across the PNW, the 2024 water year tied 1940 as the 4th warmest (+1.4°F). Precipitation was 94% of normal, ranking 45th driest of 129 years.[3] The 2024 water year was warmer than six of the last eight water years; 2016 (+1.3°F) and 2021 (+1.3°F) had similar warm anomalies. Precipitation was about the same as in the 2023 water year (92% of normal), lower than in the 2022 water year (102% of normal), and higher than the 2020 (83% of normal) and 2021 (86% of normal) water years.

Temperatures were warmer than normal, generally by 1-2°F, throughout the region (Figure 1). There were some pockets of near-normal temperatures in each state, particularly in western Washington. The individual state water year temperature rankings reflect this, with lower temperature anomalies in Washington (1.2°F) compared to Oregon (1.4°F) and Idaho (1.6°F). Across the majority of the region, water year precipitation was below normal (70-90% of normal) or near-normal (90-110% of normal). Coastal Oregon, southeastern Oregon, parts of southern Idaho including much of the Snake River Plain, and some isolated locations in southwestern Washington received above normal water year precipitation (110-150% of normal). Washington and Idaho were drier than Oregon relative to their normals, with 89% of normal precipitation.

2. Unless otherwise noted, this assessment uses 1991-2020 as the baseline and ranks each water year relative to the full historical record, beginning with 1896.
3. NOAA National Centers for Environmental Information (NCEI), Climate-at-a-Glance: Statewide Time Series. Published December 2024. Retrieved in December 2024 from https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/. All monthly and seasonal rankings in this assessment are from this source.

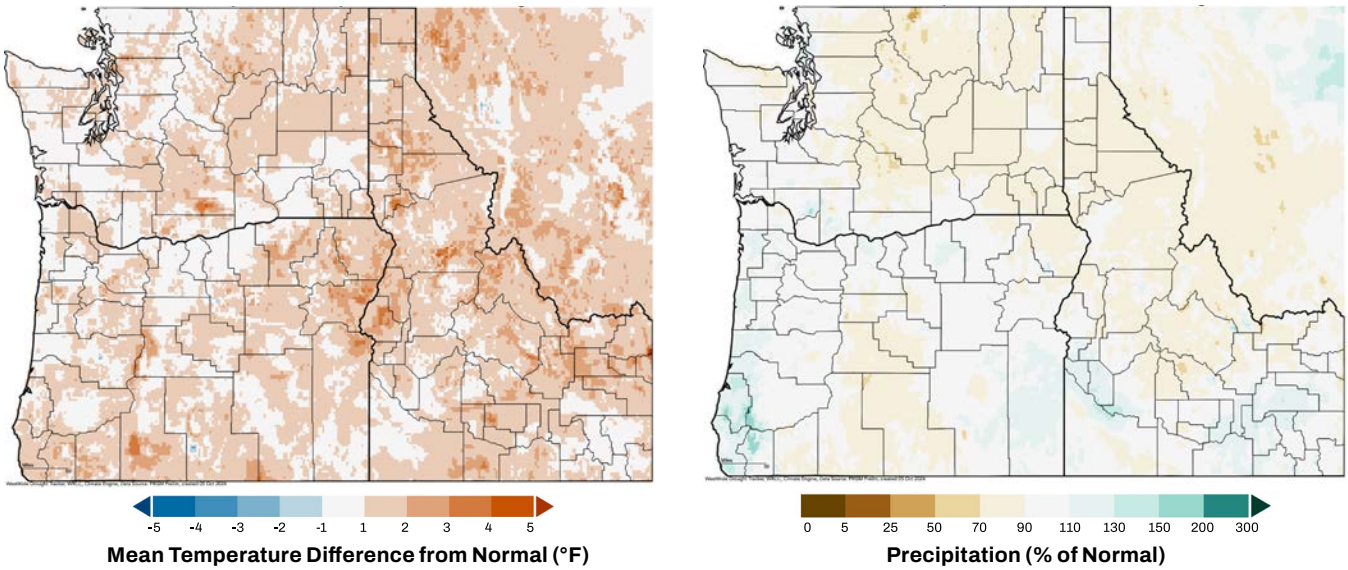


Figure 1: October 2023-September 2024 average temperature departures and precipitation totals as percentages of normal. The normal period is 1991-2020. Source: Preliminary PRISM data through the **WestWide Drought Tracker**.

According to the U.S. Drought Monitor, drought improved across western Washington and western Oregon and worsened in the inland PNW over the course of the water year (Figure 2). At the start of the water year, 43% of Washington and 25% of Oregon were in severe to extreme drought. Those percentages were 10% and 1%, respectively, by the end of the water year. Nevertheless, drought worsened in parts of Washington and Oregon. Moderate drought, for example, covered essentially the same percentage of Washington at the start (32%) and end (30%) of the water year, although different areas were affected at different times of the year. Drought developed over the water year in central Washington, southeastern Oregon, and southern Idaho. Drought severity decreased in some parts of the Idaho panhandle but otherwise remained.

The following section details the progression of weather conditions that led to drought improvement in some areas and drought development in others.

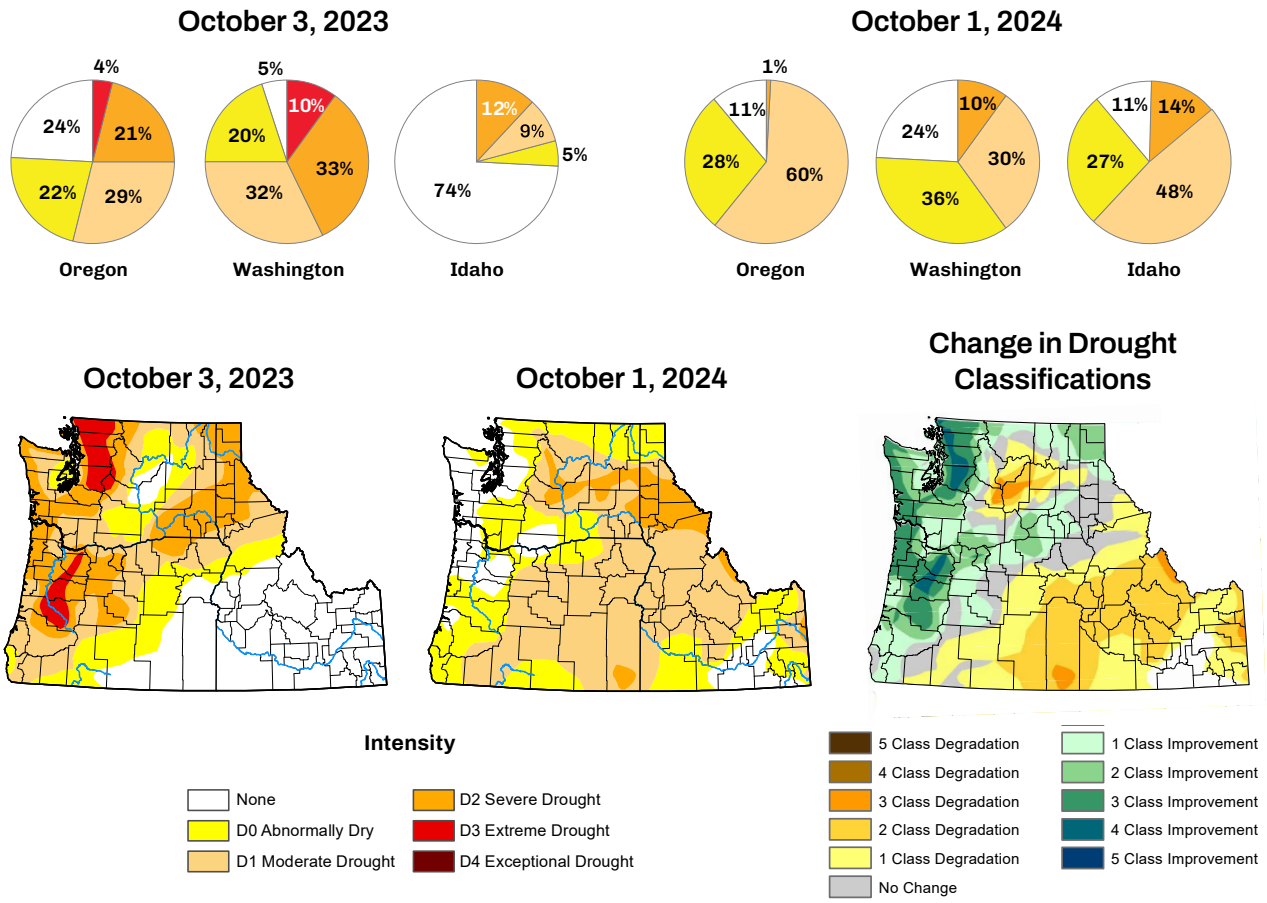


Figure 2: Drought conditions as characterized by the U.S. Drought Monitor on October 3, 2023 (left) and October 1, 2024 (center), the beginning and end of the 2024 water year, respectively. The changes in the **U.S. Drought Monitor** classifications from the start to the end of the water year are also shown (right).

Seasonal Progression

Although total water year precipitation was near-normal for the PNW as a whole, only Oregon's water year precipitation was near-normal. In Washington and Idaho, water year precipitation ranked as abnormally dry compared to the historical record (Figure 3). The seasonal progression of temperature and precipitation, as summarized in this and the following sections, characterizes the water year better than water year averages and totals.

Further geographic differences in precipitation across the PNW are apparent from the monthly rankings (Figure 3). In each state, only one month was ranked among the wet percentiles, and that month differed by state. January ranked as severely wet in Oregon, February as abnormally wet in Idaho, and August as abnormally wet in Washington. The other eleven months were classified as neutral or dry. Precipitation during March and May (neutral) and July (abnormally dry to moderately dry) also was similar among the three states. The number of months classified as dry was greatest in Oregon, with five months (November, April, June, July, and September) classified as abnormally dry to moderately dry. In Washington, four months were abnormally or moderately dry (October, April, July, and September), and in Idaho, two months (June and July) were abnormally dry. Even though Idaho only had two months rank in the abnormally dry category, several months with climatologically high precipitation totals were below normal (e.g., November, December, May), causing the water year total to be classified as abnormally dry. In contrast, five months in Oregon were in the dry categories but water year precipitation was balanced out by several months being wetter than normal (January, March, May, August).

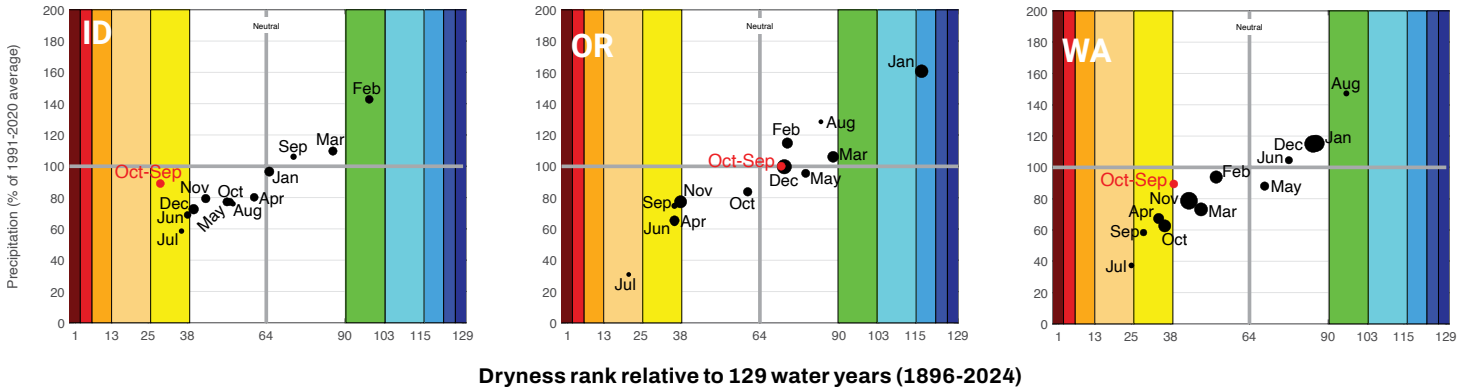


Figure 3: Monthly percentage of normal precipitation (compared to 1991-2020 baseline) as a function of statewide precipitation rank relative to the last 129 water years for Idaho (top), Oregon (middle), and Washington (bottom). The red point illustrates the water year 2024 total. The colors corresponding to dry conditions are consistent with the U.S. Drought Monitor scale, and those corresponding to wet conditions with the **Climate Toolbox U.S. Water Watcher tool**. The sizes of the circles are scaled according to each month's relative average contribution to the total water year precipitation, from dry (small) to wet (large). Provisional NCEI nClimDiv data accessed on January 10, 2025.

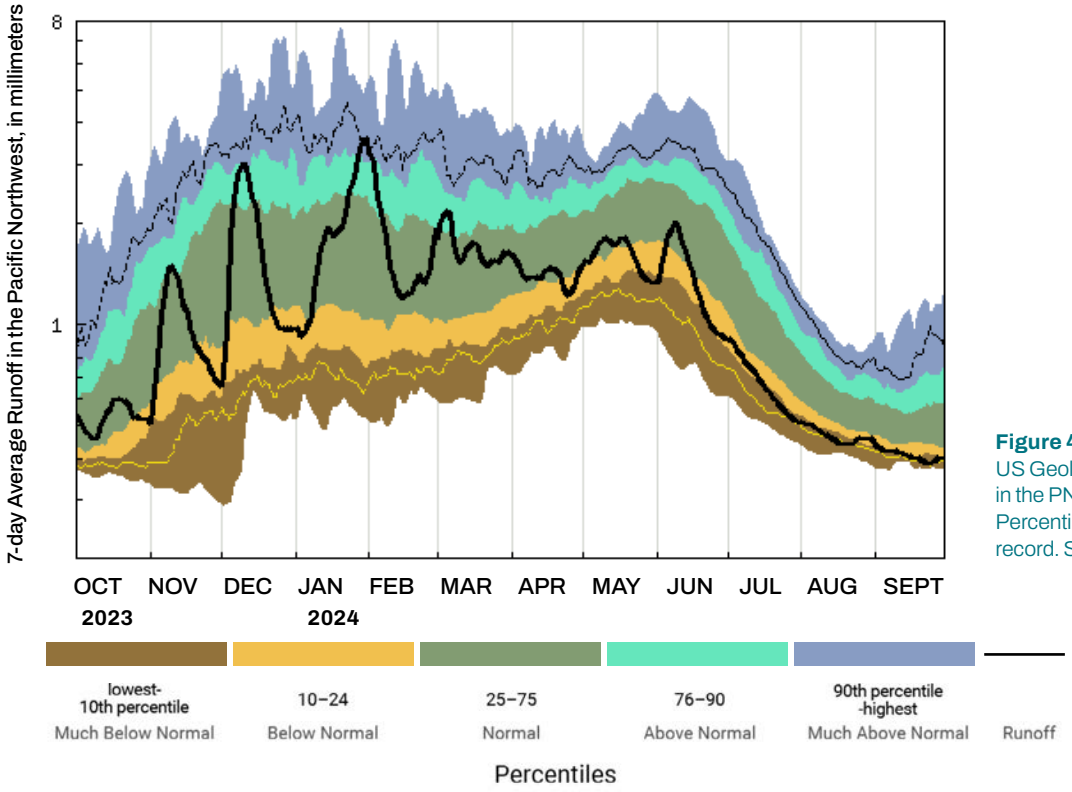


Figure 4: Seven-day average runoff at all US Geological Survey monitoring stations in the PNW during water year 2024. Percentiles are relative to the historical record. Source: **USGS**.

Despite the geographic differences, few months had extreme precipitation anomalies. In **2020**, **2021**, and **2022**, many more months were classified as severely to exceptionally dry or wet. Nevertheless, the water year's runoff averaged across the PNW (Figure 4) features substantial temporal variability due to fluctuations in temperature as well as precipitation relative to their norms. For example, average runoff in December 2023 was above normal across the PNW in response to the warm temperatures causing most precipitation to fall as rain that drained into the region's rivers rather than accumulate as snowpack. Streamflows were also much above normal at the end of January following a heavy precipitation event accompanied by snowmelt in Washington and Oregon. Much below normal runoff in May reflected abnormally cool temperatures that temporarily halted snowmelt. The small increase in regionally averaged flows in late August was driven by unseasonably wet conditions in Washington.

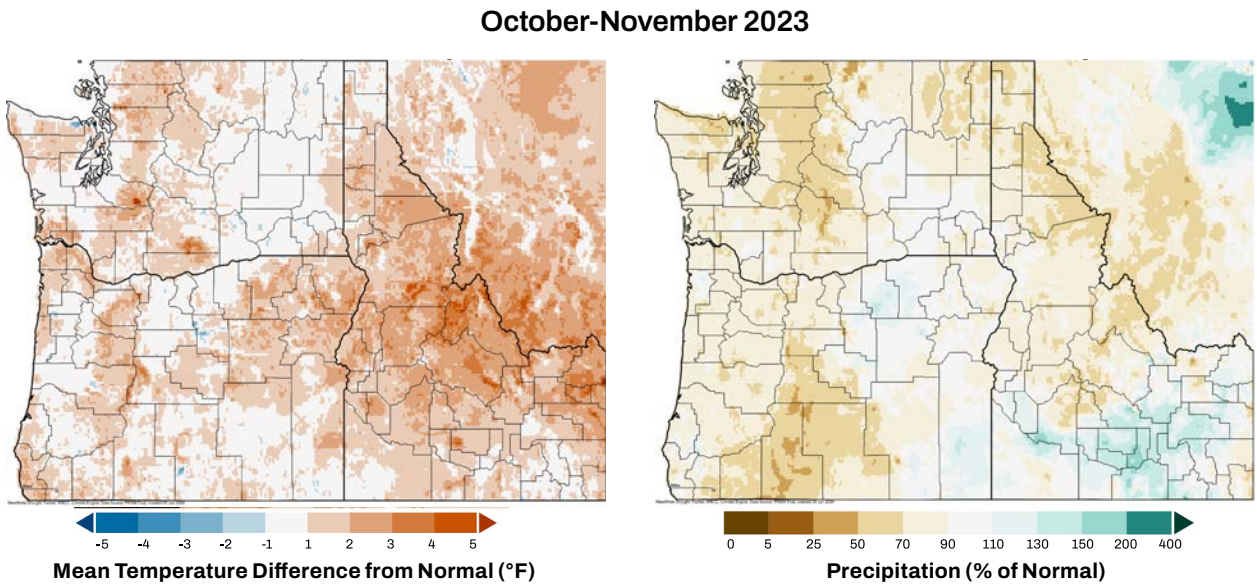
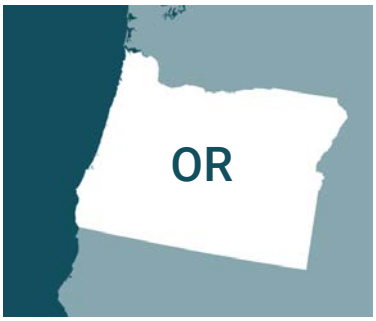


Figure 5: October-November 2023 average temperature departures and precipitation totals as percentages of normal. The normal period is 1991-2020. Source: Final PRISM data through the **WestWide Drought Tracker**.

October-November 2023
Average Temperature and Precipitation Statistics



OREGON

15th warmest

+1.4°F (tied with 1926)

36th driest

-1.37" (80% of normal)

WASHINGTON

27th warmest

+1.0°F (tied with 1923, 1989, 1998, 2004, 2021)

31st driest

-2.78" (74% of normal)

IDAHO

21st warmest

+1.9°F (tied with 1950 and 2015)

29th driest

-0.92" (79% of normal, tied with 1986)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

October-November 2023

TEMPERATURE

October through November 2023 temperatures were near to above normal across the PNW (Figure 5). Each state's average temperatures were in the warmest third of the historical record, with Idaho ranking the warmest (21st) relative to its normal. Although overall temperatures were warmer than normal in each state, there were some areas, mostly in Washington and Oregon, where temperatures were near-normal.

PRECIPITATION

October through November 2023 precipitation was below normal across most of the PNW. The western slopes of the northern and central Washington Cascades and the eastern slopes of the central and southern Oregon Cascades were particularly dry, receiving between 50 and 70% of normal precipitation. Considering that the wet season typically begins in earnest across the PNW during November, the water year began with substantial precipitation deficits. On the other hand, some parts of eastern Washington, eastern Oregon, and southern Idaho had near to above normal precipitation.

SNOWPACK

Snowpack accumulation began slowly given the above normal temperatures and below normal precipitation. By December 1, 2023, only parts of the west slopes of the central and southern Oregon Cascade Range and southern Idaho had near-median snowpack[4] (not shown). Median basin average snowpack elsewhere in the PNW ranged from about 35 to 80% of median.

December 2023

TEMPERATURE

December 2023 was much warmer than normal across the PNW (Figure 6), with particularly warm periods occurring during the first and last week of the month. Average statewide temperature anomalies were near 5.0°F above normal in each of the three states, and December ranked among the top 6 warmest Decembers in each state relative to its historical records.

PRECIPITATION

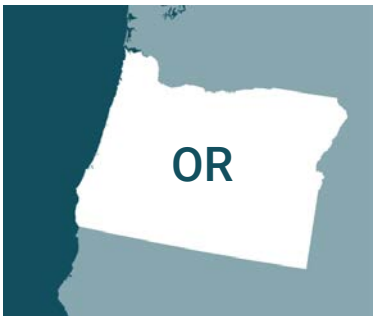
December precipitation varied across the PNW, with near-normal to above normal precipitation in most of Washington, western Oregon, and southeastern Oregon (Figure 6). Central Oregon and most of Idaho had below normal precipitation. Averaged statewide, Idaho's precipitation was below normal (73% of normal), Oregon's was near-normal (100% of normal), and Washington's was above normal (115% of normal).

SNOWPACK

Even in areas that received above normal precipitation, the warm December temperatures were detrimental to snowpack growth. Snowpack by January 1 was below median in nearly every basin in the PNW, and large portions of Washington, Oregon, and northern Idaho had less than 50% of median snowpack (Figure 7). For most of the PNW, the warm temperatures did not melt the existing snowpack, but rather caused more precipitation to fall as rain and less as snow. Areas that were both warmer and drier than normal had particularly low snow accumulation. Combined with the limited snowpack growth at the start of the water year, snowpack by January 1 was below normal across the PNW and much below normal (less than 50% of median) in large areas of Washington, Oregon, and the Idaho panhandle.

4. Throughout this assessment, "snowpack" refers to the snow water equivalent or SWE.

December 2023 Average Temperature Statistics



OREGON

6th warmest

+4.9°F

WASHINGTON

3rd warmest

+5.1°F

IDAHO

5th warmest

+5.3°F (tied with 1929 and 1950)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

December 2023

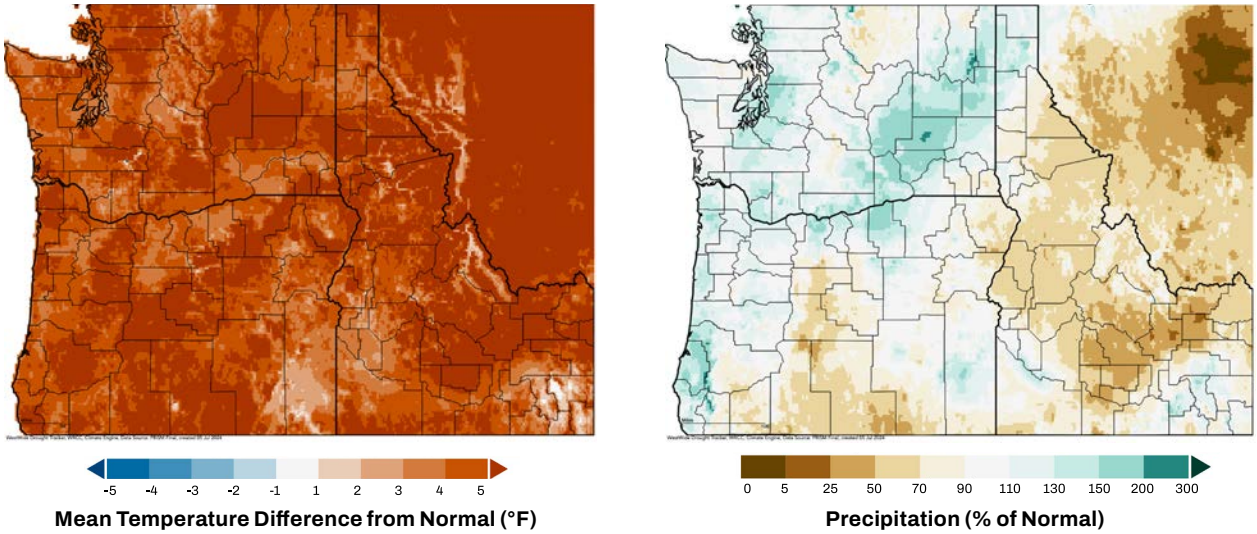


Figure 6: December 2023 average temperature departures and precipitation totals as percentages of normal. The normal period is 1991-2020. Source: Final PRISM data through the **WestWide Drought Tracker**.

January 1, 2024 Snowpack

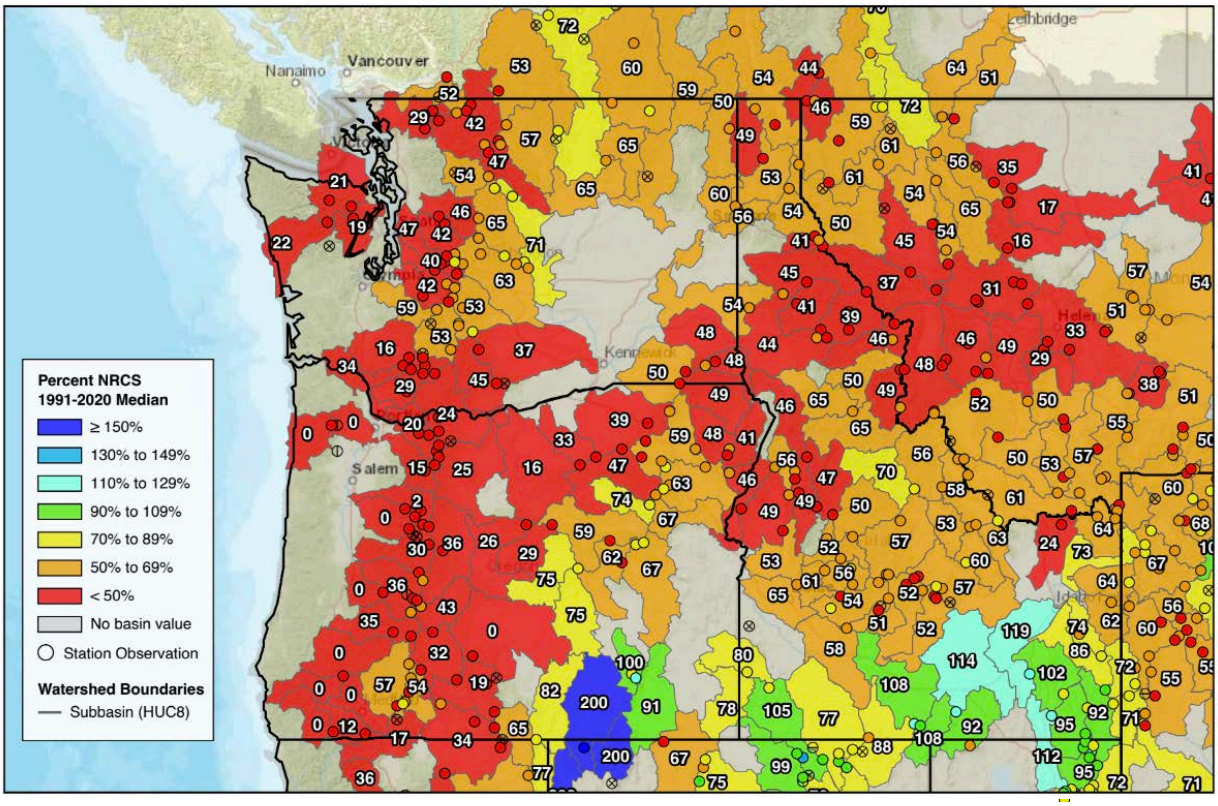
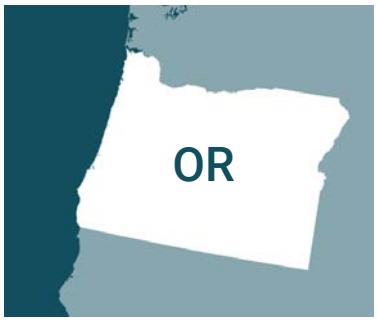


Figure 7: January 1, 2024 snow water equivalent (SWE) percentage of 1991-2020 median. Station values may differ from the sub-basin averages. Source: **NRCS**.

Snow Water Equivalent January 1, 2024



OREGON

37% of median

WASHINGTON

46% of median

IDAHO NORTH OF THE SALMON RIVER

48% of median

IDAHO SOUTH OF THE SALMON RIVER

64% of median

(source: **Natural Resources Conservation Service**)

January 2024

TEMPERATURE

January temperatures were below normal in the northern portions of the PNW and near-normal to above normal in the southern portions (Figure 8). Averaged statewide, the temperature anomalies were near-normal in Oregon and Idaho, but below normal in Washington. A 5-day cold snap across the entire PNW occurred in mid-January. The impacts varied across the PNW, but some low elevation regions received snow and other areas in the inland Northwest experienced bitterly cold temperatures of well below 0°F. In contrast, temperatures across the PNW at the end of the month were extremely mild. Portland, Oregon, for example, recorded a high temperature of 58°F on January 29, a 43 degree difference from the minimum temperature of 15°F recorded on January 13.

PRECIPITATION AND SNOWPACK

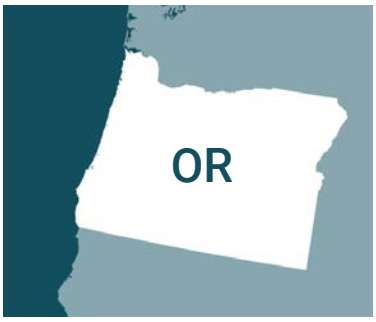
January precipitation was above normal in Oregon, southern Washington, and parts of southern Idaho (Figure 8). Averaged statewide, Oregon and Washington received above normal precipitation, and Oregon's January precipitation ranked as the 12th wettest on record. Idaho's precipitation was near-normal averaged statewide, with the less than normal totals in parts of the panhandle offset by greater than normal totals in the southern parts of the state.

A series of three atmospheric rivers, accompanied as usual by mild temperatures, heavy rain, and high freezing levels, impacted western Washington and western Oregon on January 26, 28, and 30. Not only did the mild temperatures cause a majority of the precipitation in the mountains to fall as rain rather than snow, but they caused much of the existing snow to melt. Figure 9 shows the snowpack traces from two example SNOTEL[5] stations where there was a significant loss of snowpack. Many of these locations took two to four weeks to recover to snowpack levels seen prior to these events.

Overall, the PNW snowpack grew significantly over the course of January. On February 1 (not shown), the percentages of median snowpack in most basins were higher than on January 1 (Figure 7), although still below median. The exceptions were in parts of southern Idaho and central eastern and southeastern Oregon, where snowpack ranged from 92 to 147% of median. Even with the improvements in snowpack from earlier in January, the end-of-January atmospheric rivers were a major setback, particularly in western Washington and western Oregon, and were a critical factor leading to sub-par streamflows in some watersheds later in the water year.

5. SNOTEL stations are the weather and snow monitoring stations installed in mountain locations by the Natural Resources Conservation Service that measure temperature, total precipitation, and snow water equivalent. The stations are represented by circles in Figures 7 and 11.

January 2024 Average Temperature and Precipitation Statistics



OREGON

29th warmest

+0.7°F (tied with 1990 and 2009)

12th wettest

+2.74”

(161% of normal, tied with 1996)

WASHINGTON

66th coldest

-1.9°F (tied with 1921)

45th wettest

+0.90”

(114% of normal)

IDAHO

31st warmest

+0.9°F (tied with 1992)

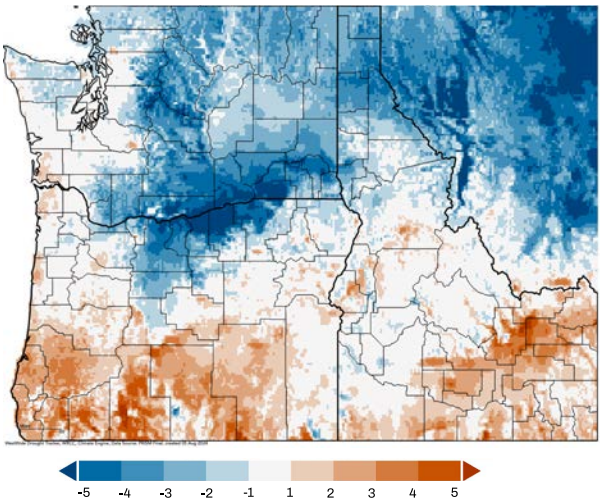
64th driest

-0.11”

(96% of normal, tied with 2009)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

January 2024



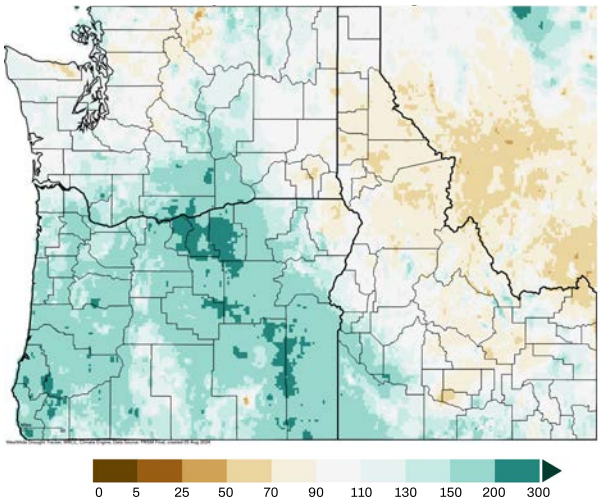


Figure 8: January 2024 average temperature departures and precipitation percentage of normal. The normal period is 1991-2020. Source: Final PRISM data through the **WestWide Drought Tracker**.

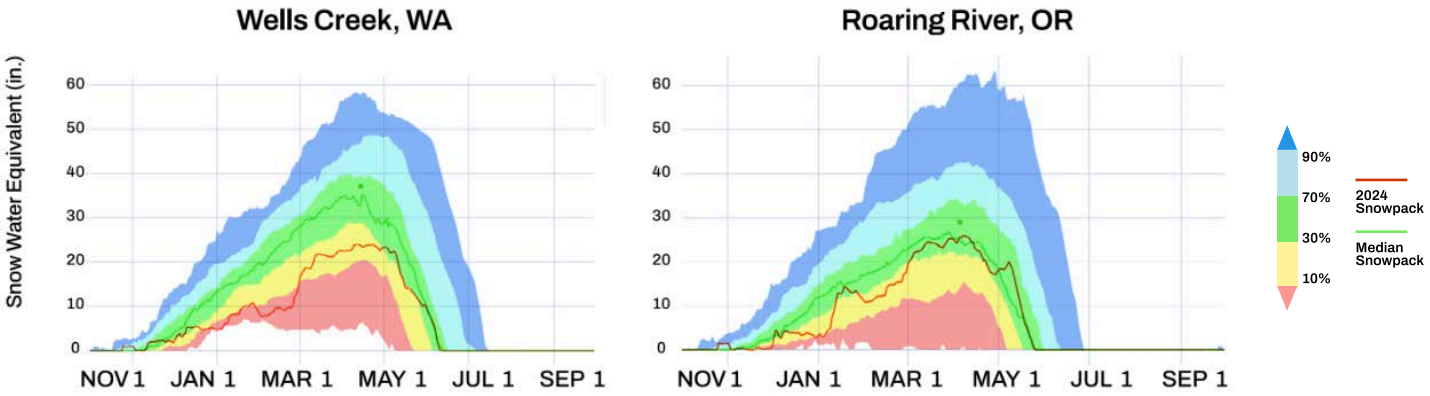
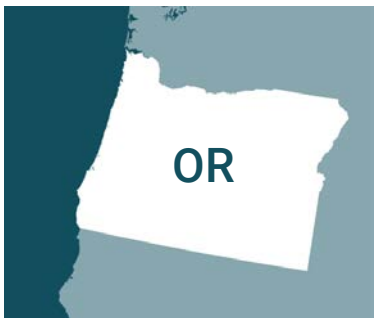


Figure 9: Water year 2024 snow water equivalent (red line) compared with historical percentiles (shading) and the 30-year median (green line) for Wells Creek, Washington, on the west slopes of the northern Cascade Range (top; 4,030 feet) and Roaring River, Oregon, in the central Cascade Range (bottom; 4,950 feet), two SNOTEL stations that experienced substantial losses in snow water equivalent from the January atmospheric rivers. Source: **NRCS**.

Snow Water Equivalent February 1, 2024



OREGON

81% of median

WASHINGTON

61% of median

IDAHO NORTH OF THE SALMON RIVER

58% of median

IDAHO SOUTH OF THE SALMON RIVER

80% of median

(Source: **Natural Resources Conservation Service**)

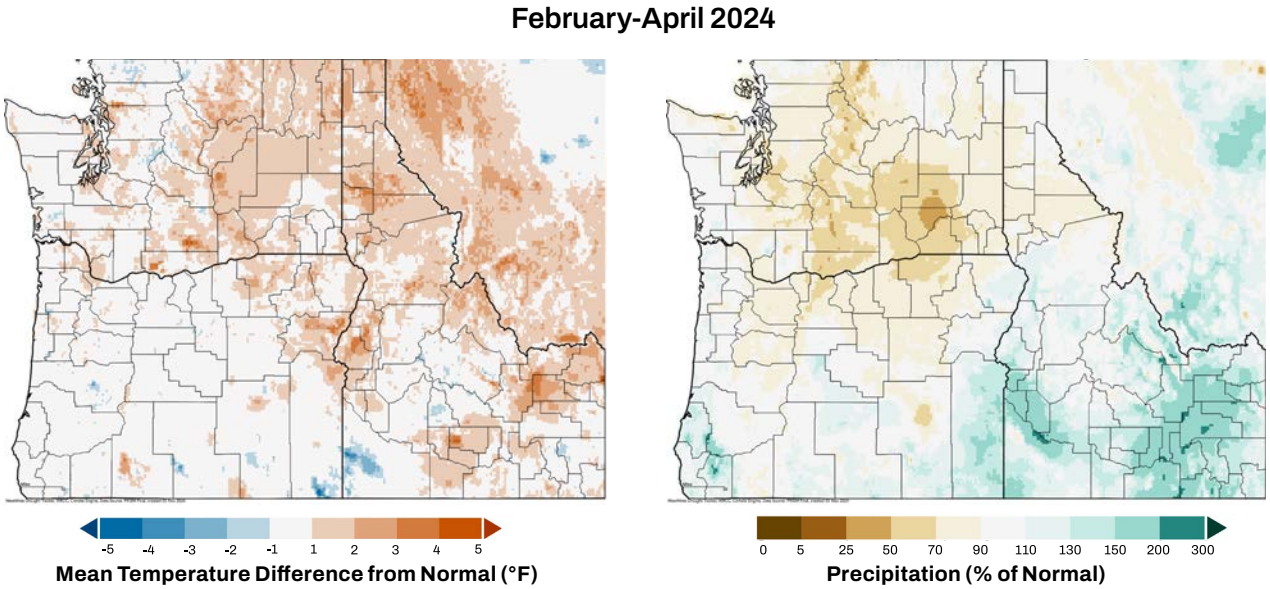


Figure 10: February-April 2024 average temperature departures and precipitation percentage of normal. The normal period is 1991-2020. Source: Final PRISM data through the **WestWide Drought Tracker**.

February-April 2024

TEMPERATURE

February through April temperatures were near-normal to above normal across the PNW (Figure 10). Washington and Idaho were the warmest relative to their normals (+1.0°F), ranking as the 20th and 21st warmest on record, respectively. Temperatures were near-normal across almost all of Oregon.

PRECIPITATION

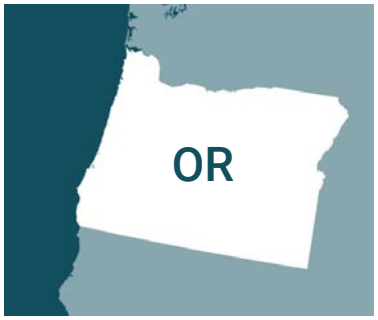
February through April precipitation was below normal across most of Washington, the Idaho panhandle, and northern Oregon. Washington was the driest relative to its normal, with 79% of normal precipitation averaged statewide. A portion of southern Oregon received above normal precipitation, resulting in near-normal statewide average precipitation. Parts of southern Idaho received 150 to 300% of normal precipitation, and the statewide average precipitation was above normal (111% of normal).

SNOWPACK

April 1 snowpack varied substantially across the PNW. Snowpack generally was below median across Washington and the Idaho panhandle and above median across Oregon and southern Idaho (Figure 11). Consistent with the drier than normal February-April conditions in Washington, Washington's snowpack was the worst of the three states, averaging 69% of median on April 1. Similarly, the Idaho panhandle's April 1 snowpack was 74% of median, in part due to late winter in the panhandle being warmer and drier than normal. Washington and the Idaho panhandle also had lower than median snowpack at the start of this period (February 1) as well, reflecting slower than usual growth earlier in the accumulation season. Snowpack across most of Oregon and southern Idaho averaged near-median, with some exceptions for individual basins as shown in Figure 11.

The date of peak snowpack was near-median at all of the SNOTEL stations in Idaho and a majority in Oregon. In Washington, the date of peak snowpack was near-median or earlier (14 to 30 days earlier than median). A handful of low elevation stations on the west slopes of the central and southern Cascades peaked 40 to 59 days earlier than the median. The date of peak snowpack also was 14 to 49 days earlier than the median in parts of the Blue Mountains in northeastern Oregon. The date of peak snowpack during the 2024 water year was between mid-March and mid-April at a majority of SNOTEL stations across the PNW.

February-April 2024 Average Temperature and Precipitation Statistics



OREGON

32nd warmest

+0.2°F (tied with 1977 and 2013)

74th driest

-0.27” (97% of normal)

WASHINGTON

20th warmest

+1.0°F (tied with 1988 and 1991)

38th driest

-2.53” (79% of normal)

IDAHO

21st warmest

+1.0°F
(tied with 1900, 1907, and 1963)

38th wettest

+0.74”
(111% of normal, tied with 1961)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

April 1, 2024 Snowpack

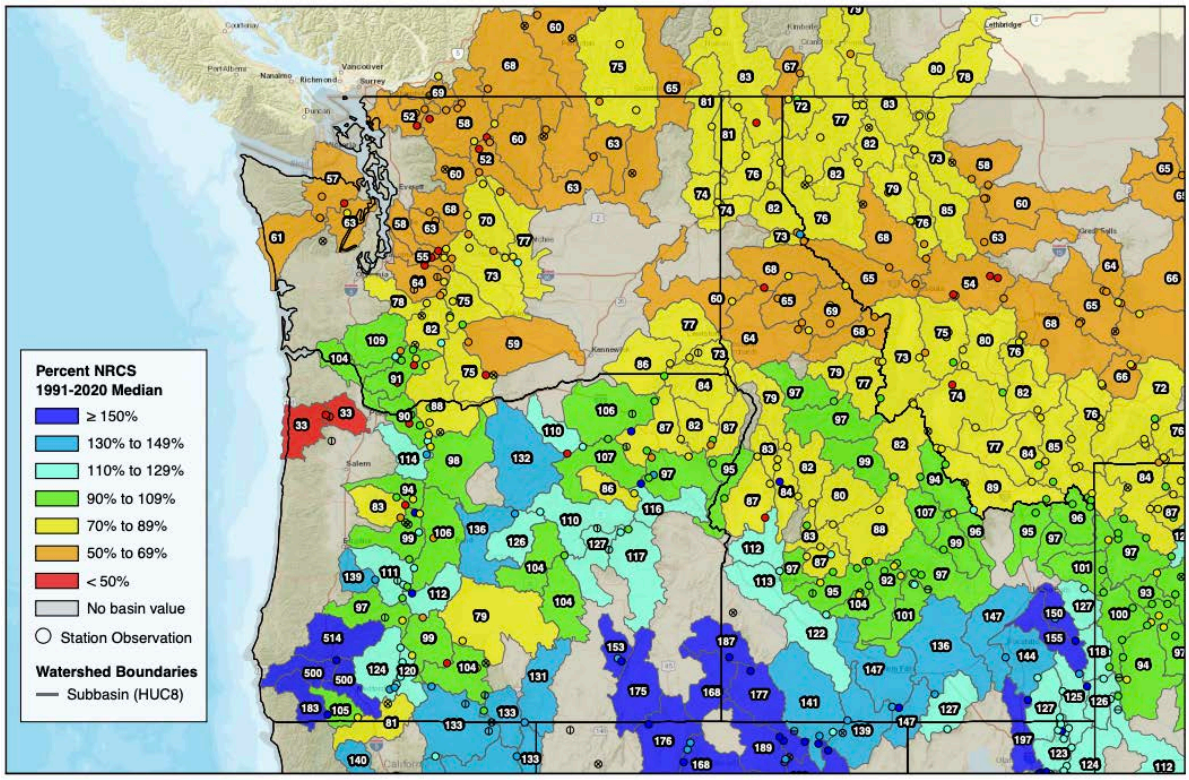
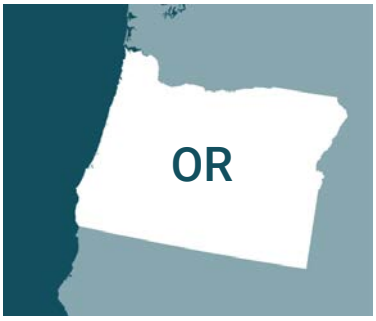


Figure 11: April 1, 2024 snow water equivalent (SWE) percentage of 1991-2020 median. Source: **NRCS**.

Snow Water Equivalent April 1, 2024



OREGON

104% of median

WASHINGTON

69% of median

IDAHO NORTH OF THE SALMON RIVER

74% of median

IDAHO SOUTH OF THE SALMON RIVER

102% of median

(source: **Natural Resources Conservation Service**)

May-June 2024

TEMPERATURE

May through June temperatures were near-normal to below normal across the PNW (Figure 12). May temperatures were more consistently below normal, with temperature anomalies 1-5°F below normal across the region. The statewide temperature rankings for just May show that the statewide averages were 1.7-2.7°F below normal for the individual states.

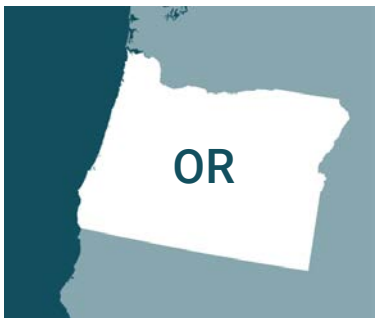
PRECIPITATION

May through June precipitation was below normal across a majority of the PNW, particularly the Lower Columbia Basin of Washington, south-central Oregon, and parts of southern Idaho, where totals were 25 to 50% of normal (Figure 12). Precipitation was generally below normal elsewhere east of the Cascade Range and further inland, although not as extreme. Western Washington and most of western Oregon had near to above normal precipitation.

SNOWPACK

The below normal May through June temperatures slowed the rate of snowmelt, especially compared to the rapid spring snowmelt in recent water years (e.g., 2021, 2023). Several storms in early May led to increases in snow water equivalent. For example, the rate of melt in the Yakima, Washington; Deschutes, Oregon; and Salmon, Idaho Basins slowed in mid-May as a result of the colder than normal temperatures (Figure 13). The slowed rate of melt allowed the snowpack to linger in the Yakima and Deschutes Basins, leading to near-normal seasonal melt out dates. The Salmon Basin melted out about a week earlier than normal. Across the PNW, the effect of an extended snowmelt season was more pronounced in Oregon and Idaho, as the date of snowpack meltout was near-median for most SNOTEL stations. In Washington, there was more variation: about half of the stations had normal meltout dates and the other half melted 2 to 4 weeks earlier than normal. A handful of low elevation stations on the western slopes of the central and eastern Cascade Range melted 5-9 weeks earlier than usual.

May 2024 Average Temperature Statistics



OREGON

54th coldest

-1.8°F (tied with 1988)

WASHINGTON

50th coldest

-1.7°F

IDAHO

34th coldest

-2.7°F (tied with 1915)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

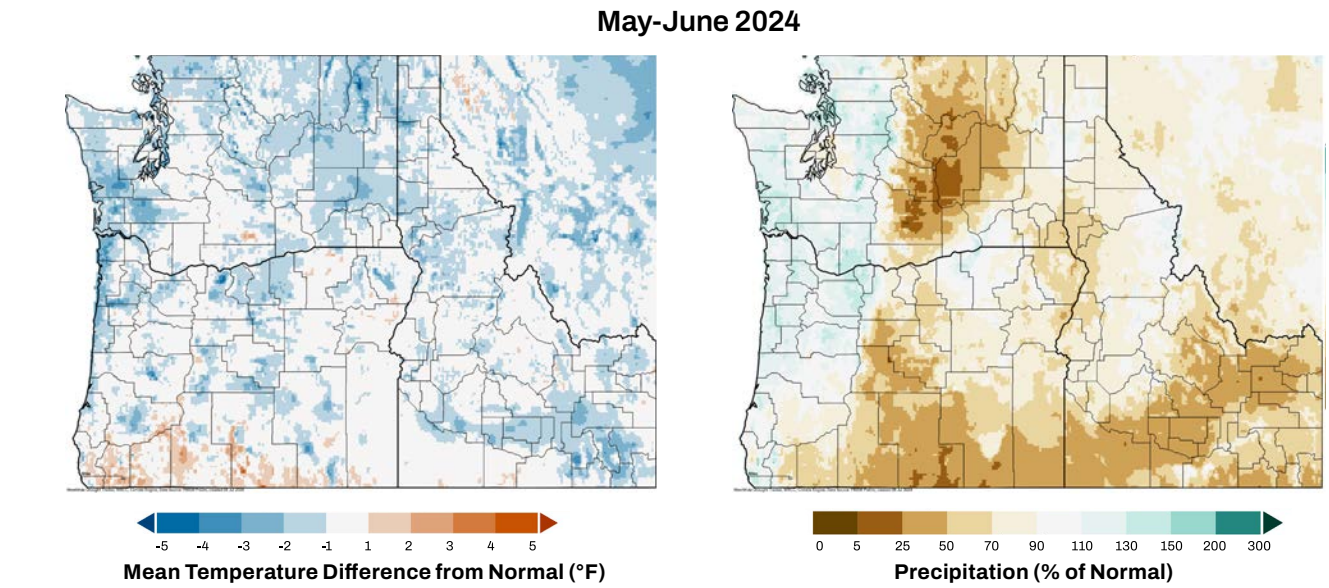


Figure 12: May-June 2024 average temperature departures and precipitation percentage of normal. The normal period is 1991-2020. Source: Preliminary PRISM data through the **WestWide Drought Tracker**.

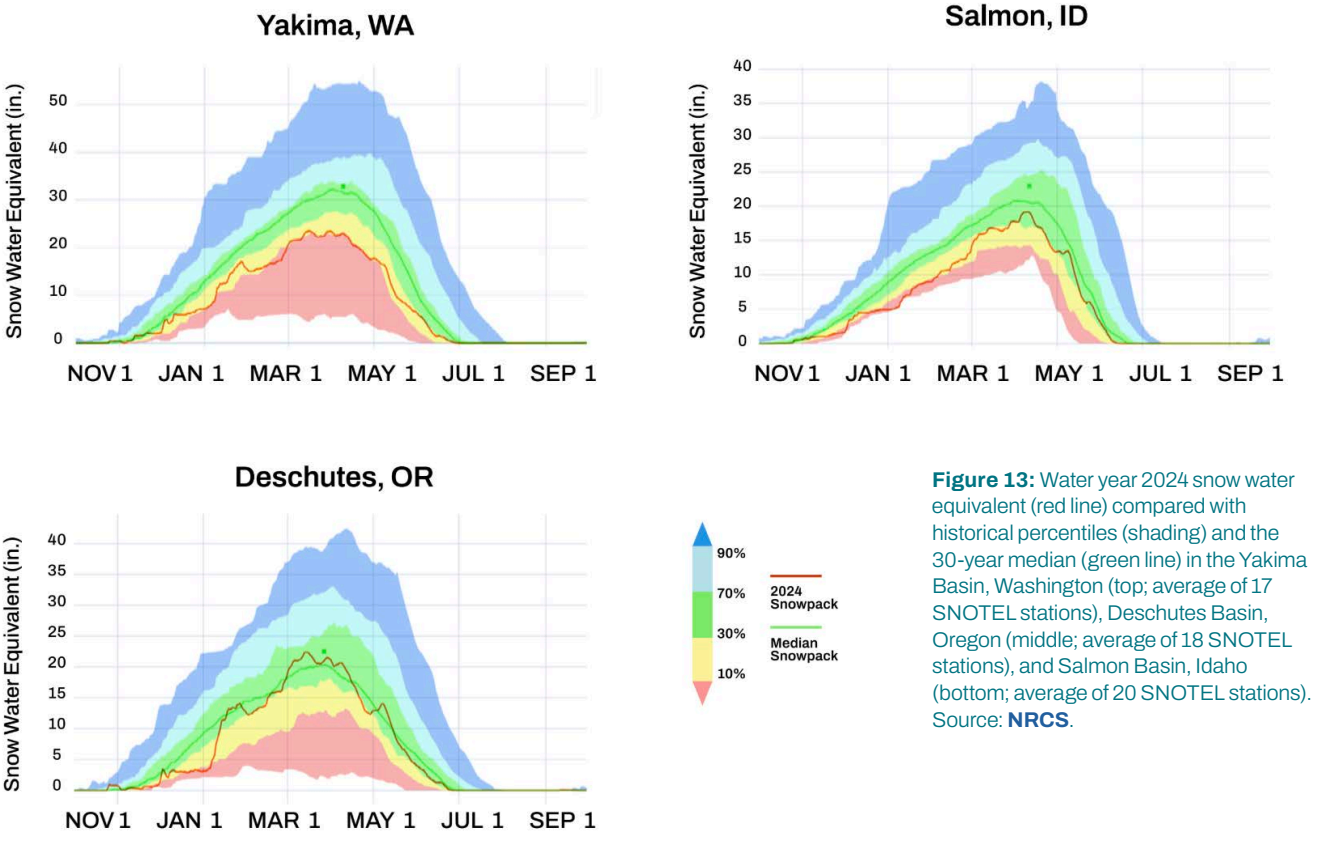


Figure 13: Water year 2024 snow water equivalent (red line) compared with historical percentiles (shading) and the 30-year median (green line) in the Yakima Basin, Washington (top; average of 17 SNOTEL stations), Deschutes Basin, Oregon (middle; average of 18 SNOTEL stations), and Salmon Basin, Idaho (bottom; average of 20 SNOTEL stations). Source: **NRCS**.

July 2024

TEMPERATURE

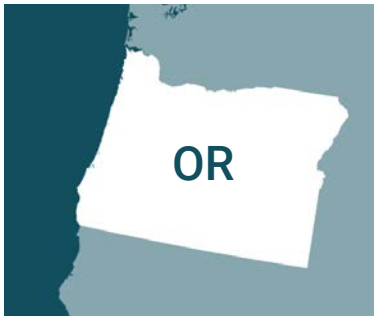
July temperatures were much warmer than normal across the PNW, with most areas exceeding anomalies of at least 2°F (Figure 14). It was the second warmest July on record, after 2021, in both Washington and Oregon. July temperature in Idaho ranked as the 7th warmest; temperatures were closer to normal across much of southeastern Idaho.

PRECIPITATION

July precipitation was less than 25% of normal across eastern Washington, north central and southwestern Oregon, and in a few areas along the southern borders of Oregon and Idaho (Figure 14). Oregon and Washington were drier relative to their monthly normals than Idaho, where precipitation in southern parts of the state was near-normal to slightly above normal.

The warmer and drier than normal July contributed to an active wildfire season, particularly in Oregon, where the number of acres burned in the 2024 calendar year exceeded that in any other year since **National Interagency Fire Center** records began in 2007.

July 2024 Average Temperature and Precipitation Statistics



OREGON

2nd warmest

+4.6°F

21st driest

-0.31" (31% of normal)

WASHINGTON

2nd warmest

+4.0°F (tied with 1906)

25th driest

-0.50" (38% of normal)

IDAHO

7th warmest

+3.0°F (tied with 2022)

35th driest

-0.29"

(59% of normal, tied with 1910)

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

July 2024

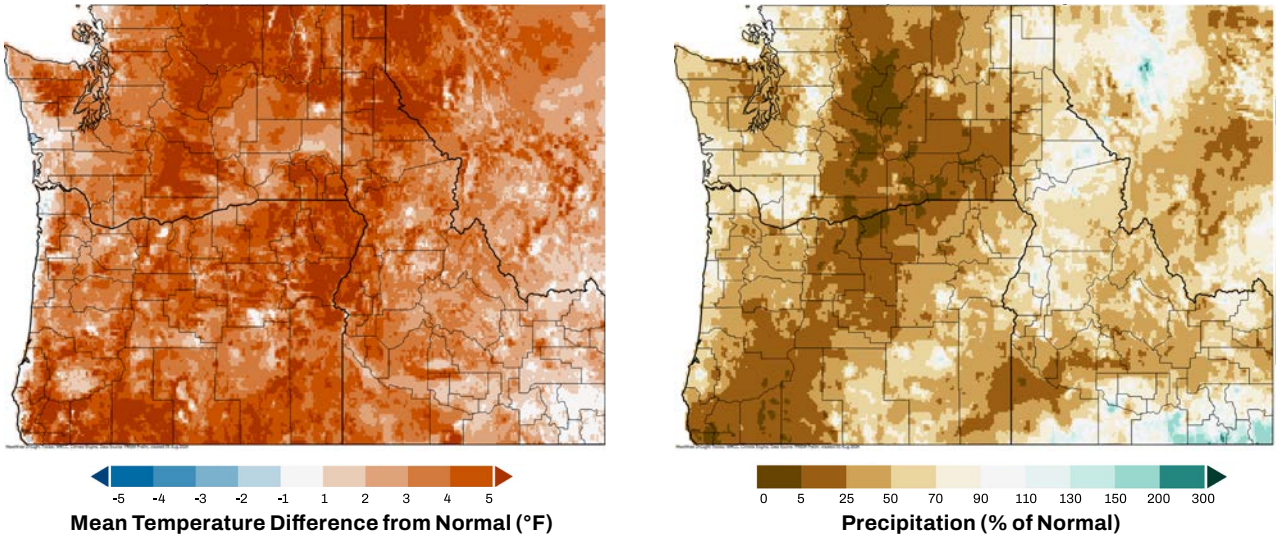


Figure 14: July 2024 average temperature departures and precipitation percentage of normal. The normal period is 1991-2020. Source: Preliminary PRISM data through the **WestWide Drought Tracker**.

August-September 2024

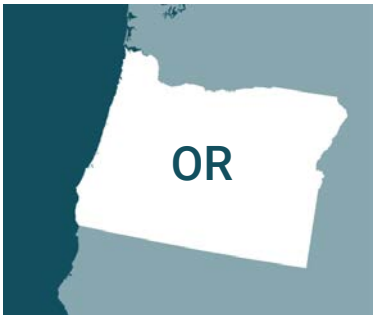
TEMPERATURE

August through September average temperatures were above normal across much of the PNW, but anomalies were not as extreme as in July (Figure 15). August-September temperatures were 1-2°F above normal across most of eastern Washington, northeastern Oregon, and Idaho, and near-normal in western Washington and the majority of Oregon. Nevertheless, August-September temperatures ranked among the 13 warmest of the 130-year record for each state. There was some variability within the two month period: August temperatures were near-normal across the PNW and even below normal in parts of Oregon, and September temperatures were above normal.

PRECIPITATION AND STREAMFLOW

August-September precipitation was near normal to above normal across most of the PNW (Figure 15). Totals in the wettest areas in southern Oregon, the central and northern Puget Sound region, and north central Washington were more than 150% of normal. The normal to above normal late summer precipitation provided some relief from drought impacts, especially wildfires and high river temperatures and low flows, which in turn assisted migrating salmon (more details on **page 45**). Runoff averaged across the PNW in late August improved to below normal (10th to 24th percentile) from much below normal (less than 10th percentile) (Figure 4). This transition had notable benefits for coldwater aquatic species, agriculture, and other sectors throughout the region. In contrast, parts of southern Idaho, eastern Washington, and northwestern Oregon had below normal precipitation during August.

August-September 2024 Average Temperature Statistics



OREGON

13th warmest

+0.9°F

WASHINGTON

6th warmest

+1.7°F (tied with 2014)

IDAHO

10th warmest

+1.8°F

(Anomalies relative to the 1991-2020 normal; rankings based on full record beginning in 1895. Source: NOAA NCEI 2024.)

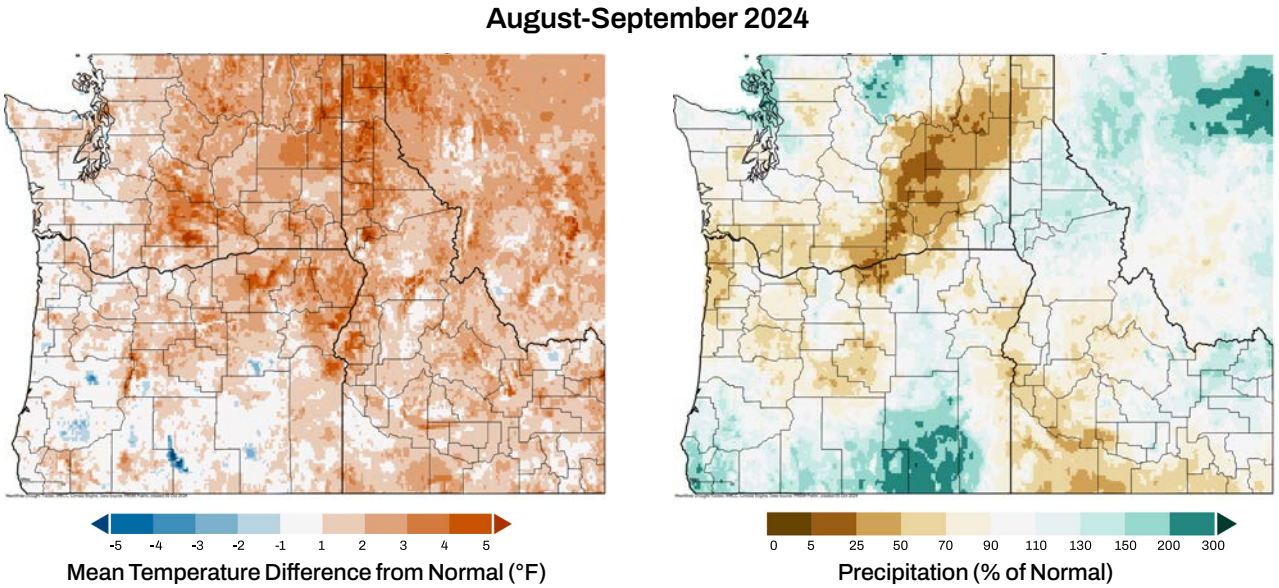


Figure 15: August-September 2024 average temperature departures and precipitation percentage of normal. The normal period is 1991-2020. Source: Preliminary PRISM data through the **WestWide Drought Tracker**.

4

Water Year Impacts

The fundamental purpose of a water year assessment is to understand the effects of seasonal and annual conditions on people and ecosystems. Our examination of the water year impacts on multiple sectors in Idaho, Oregon, and Washington is based on four sources:

1. The national **Condition Monitoring Observer Reports on Drought (CMOR)** which allows members of the public to submit location-specific drought impact reports at any time of year.

2. National **Condition Monitoring Reports** from Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) Network volunteers who rate the local conditions based on the landscape and impacts on a 7-point scale from dry to wet.

3. The Annual Pacific Northwest Water Year Impacts Survey, which is distributed at the end of the water year to natural resource managers, agency staff, and all registrants for the water year meetings

4. Presentations at the 2024 water year meetings, which highlight particularly compelling stories of climate impacts and responses within the region.

None of these sources nor the impacts presented in this assessment are exhaustive. Instead, this summary provides a general overview of the kinds of impacts that were experienced across the Pacific Northwest.

2024 Condition Monitoring Observer Reports

The Condition Monitoring Observer Reports on Drought (CMOR) provided by the National Drought Mitigation Center (NDMC), collects local observations of drought impacts to aid in drought monitoring and research. Observations inform the U.S. Drought Monitor and agencies that make drought-related decisions. During the 2024 water year, observers submitted 1 report from Idaho, 28 reports from Oregon, and 20 reports from Washington (Figure 16).

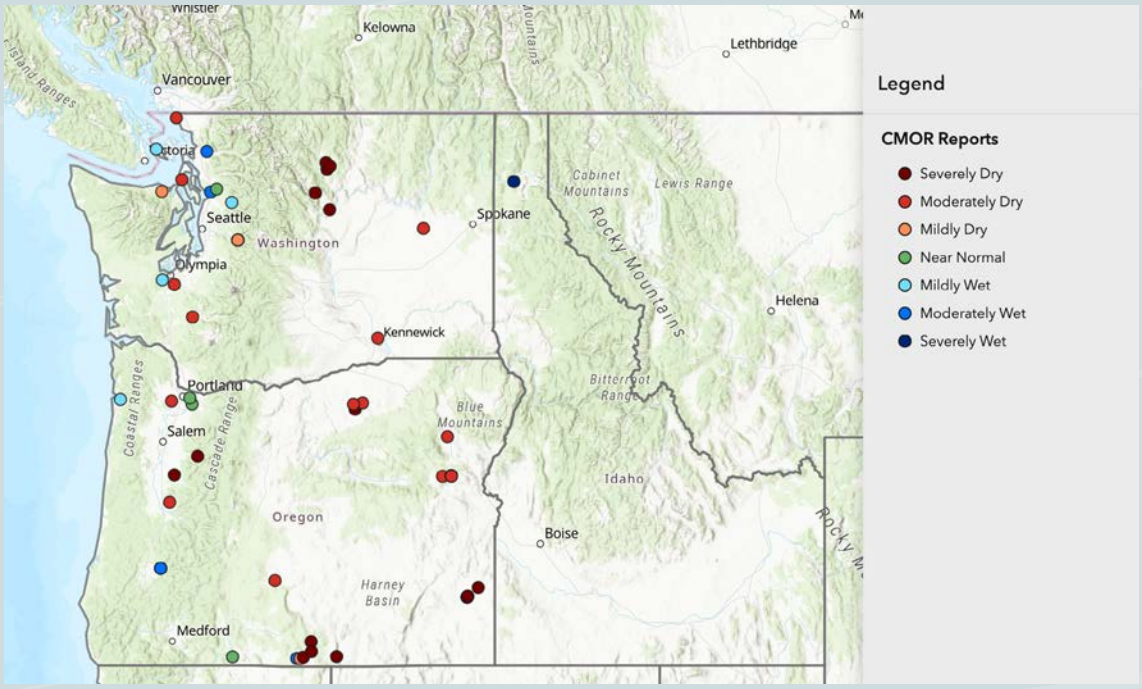


Figure 16: Condition Monitoring Observer Reports (CMOR) submitted across the PNW during the 2024 water year. Source: **NDMC CMOR Reports**.

DROUGHT CONDITIONS ACROSS MUCH OF OREGON AND WASHINGTON

Drought conditions were observed across Oregon and Washington, and respondents noted particularly acute impacts in northeastern Oregon (Morrow, Baker, and Malheur Counties) and on the eastern slopes of the Cascade Range in Washington (Chelan and Okanogan Counties). Reports describe low spring snowpack followed by high temperatures and low precipitation in summer. For example, one observer in Thurston County estimated that May-July precipitation was just under 20% of normal. Reports on the severity of the drought differed. Of the 35 respondents who reported dry conditions, about half classified the dry conditions as severe, while most of the remaining respondents classified the conditions as moderate. Respondents also highlighted the impacts associated with these dry conditions, including low groundwater levels, lack of water for livestock, dry or stressed vegetation, and wildfires.

There were 10 reports of wet conditions. These reports all came from northern Idaho, western Washington, and southwestern Oregon—areas that received above normal precipitation at the time of the CMOR submissions.

LIVESTOCK AND WILDFIRE IMPACTS IN OREGON

Observations from Oregon focused on two impacts: the consequences of dry conditions for livestock and the unprecedented nature of some wildfires. For example, illustrating the persistent effects of drought during the 2023 water year, a respondent from Linn County noted early in the water year that a pond on their property was nearly dry, despite being full in spring 2023. Toward the end of the water year, another respondent reported similar conditions in Baker County, noting lower flows from springs, dry vegetation, and dust. Both of these respondents noted the impacts on livestock.

Another prominent theme in the Oregon observations was wildfire. Respondents highlighted stressed and dying trees in the southern Willamette Valley and wildfires across Morrow, Malheur, and Lake Counties in eastern Oregon. In Lake County, on the southeastern slopes of the Cascade Range, a respondent attributed wildfire to below average snow and precipitation, whereas respondents in other locations pointed to low summer precipitation and persistently high temperatures.

Observers also noted the spatial variability in conditions. For example, a respondent from southeastern Oregon noted that the Drought Monitor did not accurately reflect drought conditions at their location, likely because small valleys and other topographic features are not captured in large-scale drought reporting. This particular observer described the drought conditions they were experiencing as unprecedented.

PERSISTENCE OF 2023 DROUGHT IMPACTS IN WASHINGTON; EXCEPTIONALLY DRY JULY

Many of the observations from the beginning of the 2024 water year reported impacts persisting from the 2023 drought. Many of these were from western Washington (Whatcom, Island, King, Thurston, and Lewis Counties). Several observers noted lower water tables and reduced flows from natural springs, attributing these occurrences to a lack of precipitation to recharge aquifers. Other observers noted impacts on trees, from low survival of new plantings to stressed and dying trees in established stands. In north central Washington, an observer noted the same persistence of 2023 impacts, including low fish populations and a lack of water for livestock.

Most of the observations of severely dry conditions in Washington were submitted in July from Okanogan and Chelan Counties on the east slopes of the Cascade Range. These reports highlighted the effects of the combination of extremely high temperatures and low rainfall totals on nearby wildfires and adverse health of cattle. Although not mentioned in the reports, the dry conditions in July may have been exacerbated by an early end to the snowmelt season, given these counties are on the eastern slopes of the Cascades. A few observers noted that moderately dry conditions continued into September. Although these conditions were largely mitigated by the late August rainfall, respondents commented that drought conditions were generally most severe on the Columbia Plateau and less severe further east.

CoCoRaHS Condition Monitoring Reports

The volunteer members of the Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) Network take daily measurements of precipitation in their backyards, schools, or similar locations and enter their measurements in a national database. CoCoRaHS observers are also encouraged to submit regular Condition Monitoring Reports in which they rate their local conditions as mildly, moderately, or severely dry, near normal, or mildly, moderately, or severely wet. A condition monitoring guide provides examples of conditions associated with each of these categories to assist the observer's determination.

During the 2024 water year, observers in Washington, Oregon, and Idaho submitted a total of 1,032 Condition Monitoring Reports (Figure 17). These local reports closely align with the water year evolution (section 3) and impacts presented in this assessment (section 4). During the first several months of the water year, conditions observed in Washington and Idaho oscillated among wet, neutral, and dry, consistent with the variable conditions. In contrast, a higher percentage of reports from Oregon, nearly 50% of those submitted each week from November through March, noted wet conditions. Observers in Washington reported dry conditions from March through May more frequently than observers in Oregon and Idaho, but reports from all three states mainly noted dry conditions during July. About 50% of the reports from Washington and Oregon in August and September classified conditions as dry. The shift to reporting more neutral conditions during these months is consistent with the wetter than normal and near-normal August temperatures in some parts of these states.

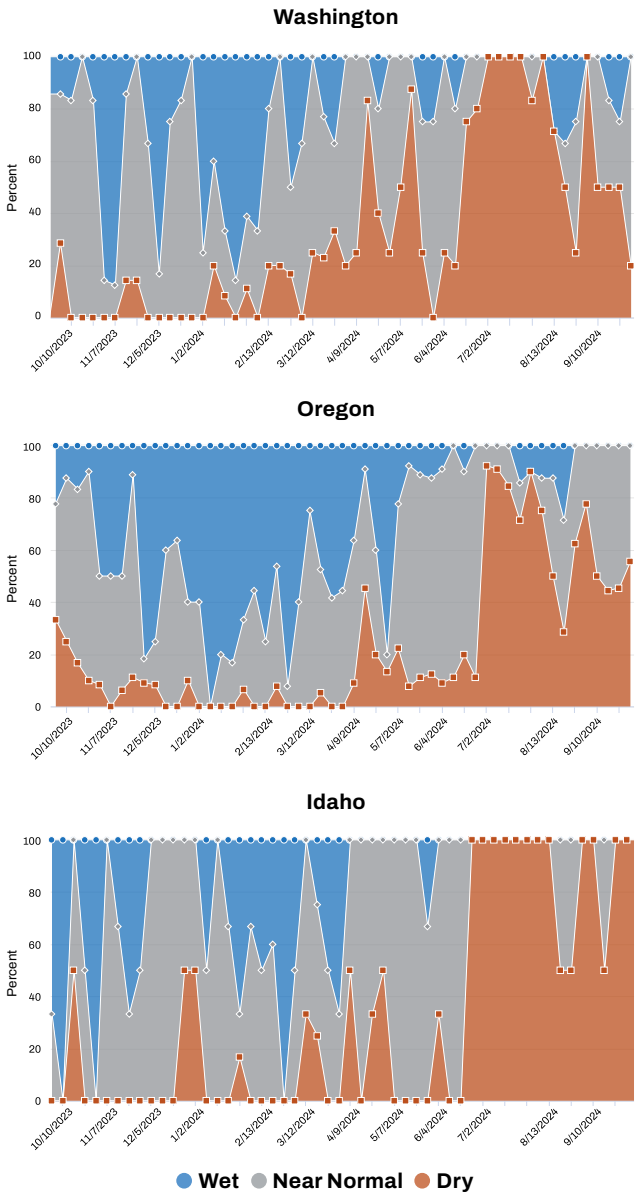


Figure 17: The percentage of weekly CoCoRaHS Condition Monitoring Reports from Washington (top), Oregon (middle), and Idaho (bottom) that classified local conditions as wet, near-normal, or dry over the 2024 water year. Because the number of reports varies weekly, the reports are more appropriate for tracking general conditions over several weeks to a season rather than from week to week (**CoCoRaHS**).

Annual Pacific Northwest Water Year Impacts Survey

The PNW Water Year Impacts Survey collects information on impacts of abnormally dry or wet conditions on the drinking water, agriculture, forestry, fisheries, hydropower, recreation, and stormwater sectors. The survey is distributed at the end of the water year. Survey respondents indicate whether they experienced abnormally dry and/or abnormally wet conditions during the water year. They may either select impacts from a list or report other impacts that they experienced given these conditions.

We distributed the 2024 water year survey in October 2024 via listservs of NIDIS, Washington State Climate Office (WASCO), Climate Impacts Group, and PNW Tribal Climate Change Network. Furthermore, we sent the survey to all registrants of the Oregon/Washington Water Year Meeting and Idaho Fall Water Supply Meeting, and featured the survey in the WASCO and USDA Northwest Climate Hub monthly newsletters and on the website of the Idaho Department of Water Resources. The PNW Water Year Impacts Survey is in its fifth year and distribution has grown each year. We continued to distribute the survey through state agency partners as we have in past years, and added outreach efforts in collaboration with the Oregon Department of Forestry and several Idaho agricultural associations. We also included information about the survey in presentations throughout autumn. For example, we promoted the survey in presentations to Washington's Water Supply Availability Committee, Washington State University Extension Climate Group, and the PNW Tribal Climate Change Network.

Three hundred and fifty-eight (358) people responded to at least one section of the survey. This is a substantial increase from the 68 responses that we received in 2022 and the 145 responses that we received in 2023. Nearly 30% of respondents identified their affiliation as local, state, or federal government, 21% as agricultural producers, 15% as non-profit or private sector, and 7% as Tribal agency or government. Respondents associated with different sectors may have different perspectives on the same impacts (Figure 18).

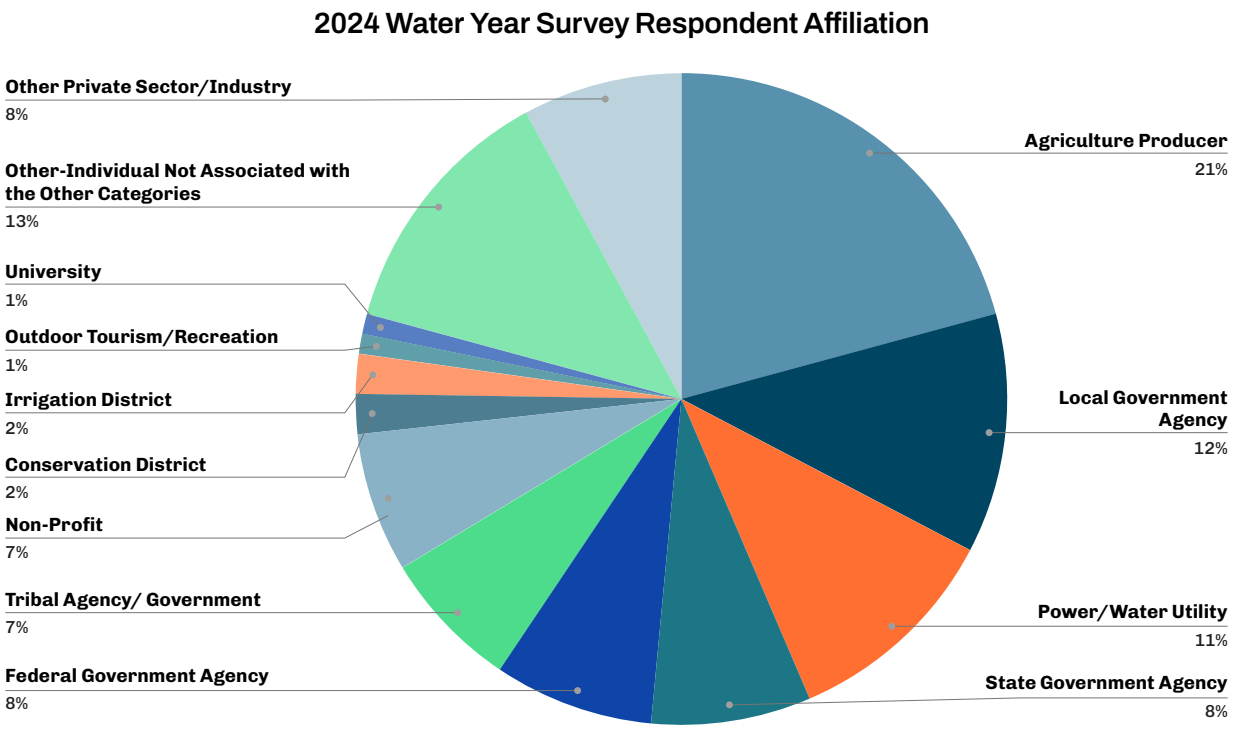


Figure 18: Self-identified affiliations of the 358 respondents to the 2024 Water Year Impacts Survey.

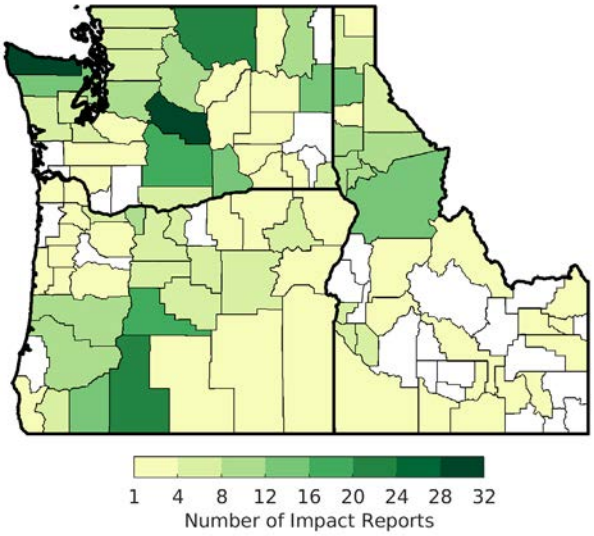


Figure 19: Number of dry or wet impacts reported by Annual Pacific Northwest Water Year Impacts Survey respondents in counties in Washington, Oregon, and Idaho. Survey respondents were also able to select "statewide" for a specific impact reported; those responses are not included in the map. White indicates that no reports were submitted for that county.

This year's respondents represented a broader range of sectors than did respondents in past years. Respondents in 2023 were primarily affiliated with local, state, and federal governments or utilities. In 2024, a greater proportion of respondents were affiliated with agriculture and tribes. The increase in diversity of responses may be a result of sending announcements through the Oregon Department of Forestry listservs and the Idaho agricultural associations mentioned above. In the sections below, we reference an impact if it was reported by at least three people. For example, we do not reference impacts of abnormally wet conditions on hydropower because only two respondents reported such impacts.

We also refined the location information that we gathered through the survey this year. More impacts were reported from Washington, which is likely a result of increased outreach across the state and the severity of drought during the 2024 water year (Figure 19). The greatest number of reports were submitted by observers in Clallam and Kittitas Counties, but because multiple reports may describe similar impacts, these counties were not necessarily the most strongly impacted. Almost all counties were affected by seasonal climate conditions during this water year. We suspect that the relative lack of reports from southern Idaho reflects that the survey did not reach people in those areas as effectively as it reached people across Washington and Oregon and also that spring snowpack was greater in southern Idaho than elsewhere across the PNW (median to above median). Another potentially important factor is that most southern Idaho reservoirs had above average carryover at the start of the 2024 water year due to the remnants of Tropical Storm Hilary in August 2023 bringing heavy and unseasonable precipitation.

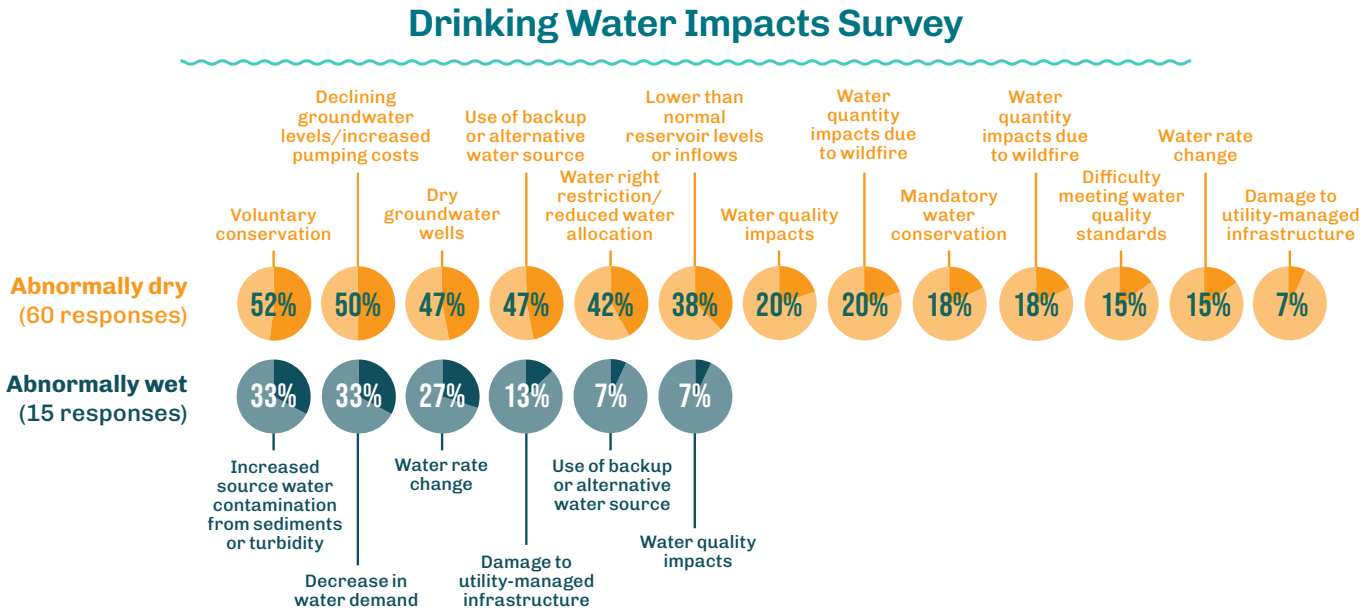
The PNW Water Year Impacts Assessments are available shortly after the end of the water year and describe preliminary reports of impacts across multiple sectors. Later in 2025, other government agencies release detailed sector-specific reports of conditions and impacts from the 2024 calendar year. We link to several of these annual reports as another and sometimes more-detailed source of information on sector-specific impacts.

Sector-Specific Water Year Impacts

DRINKING WATER

Of the 75 respondents who reported impacts to the drinking water sector, 60 (80%) reported impacts due to abnormally dry conditions and 15 (20%) reported impacts due to abnormally wet conditions. Most reports were specific to a particular location or water system.

The most common impacts were voluntary conservation in response to limited water availability, low groundwater levels or increased pumping costs, dry groundwater wells, and the need to use alternative water sources. Although there were far fewer reports of impacts due to wet conditions, those responses highlighted water quality concerns, changes in demand, or changes in the rates charged by water utilities.



> *"I have to use less water on a daily basis and will most likely run dry in the next few years d/t [due to] 8 new wells drilled in my neighborhood"*
>
> — Okanogan County, Washington

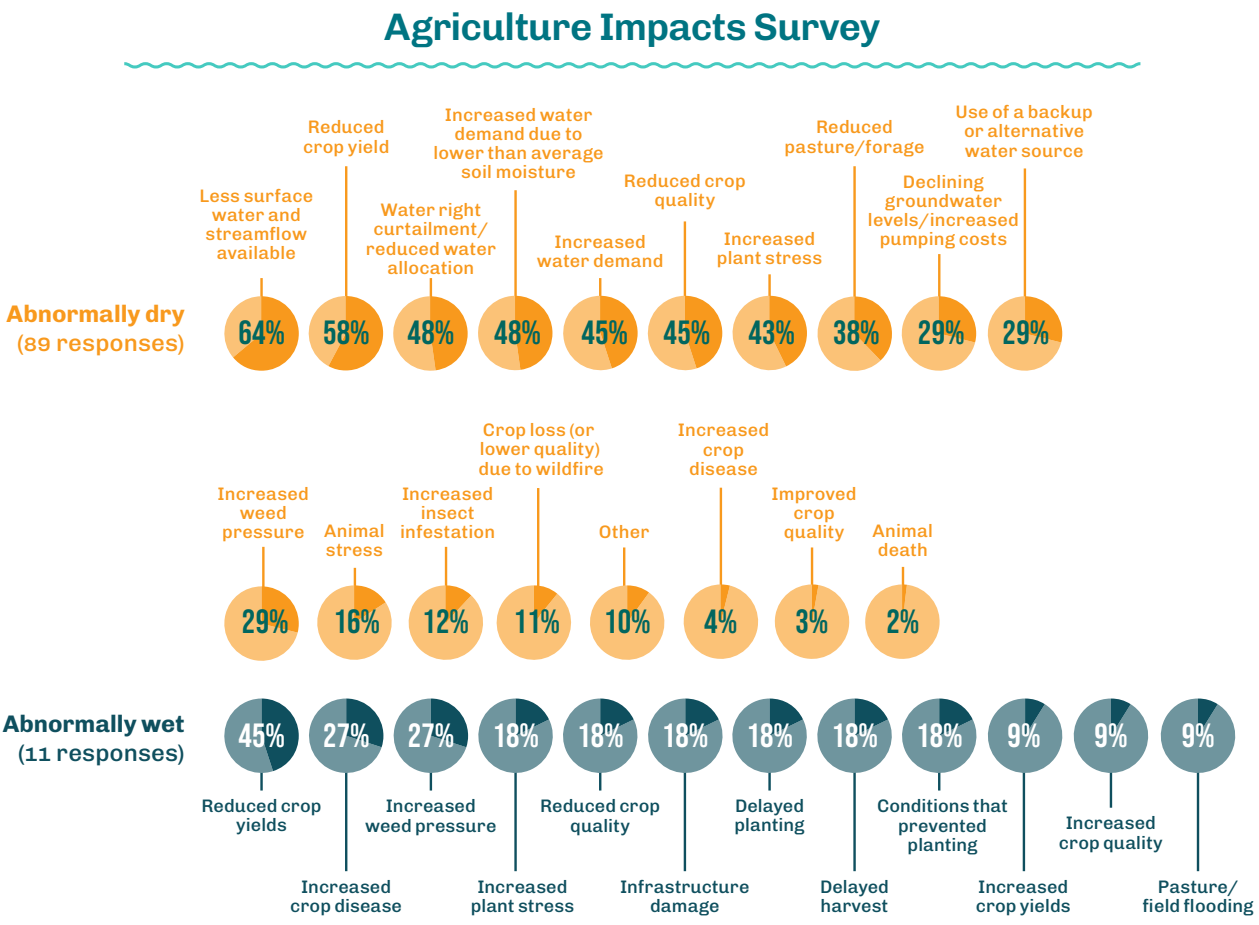
> *"North Idaho rivers not meeting minimum flows, without the ability to make withdraws for drinking or other water use. Purveyors [of] the SVRP [the Spokane Valley Rathdrum Prairie aquifer] barely able to meet summer demand."*
>
> — Multiple Counties, Idaho

AGRICULTURE

Of the 100 respondents who reported impacts to agriculture, 89 (89%) reported impacts of abnormally dry conditions and 11 (11%) reported impacts of abnormally wet conditions. Most of the former reported limited water availability and reduced crop yields. Many also cited increased curtailments, increased demand, and reduced crop quality. For example, the Yakima River Basin in eastern Washington, which supports a $4.5 billion agriculture industry, had significant water shortages and impacts. There, the U.S. Bureau of Reclamation reduced the total water supply available for prorationed water users (those without senior water rights) to around 50% of usual from May through September.

Eleven respondents reported impacts on agriculture from abnormally wet conditions. Respondents cited delays in planting or harvest, limited pollination due to unfavorable conditions for pollinators, increased weed pressure on new crops, increased diseases of greenhouse crops, and delays in chemical applications that cannot be done when rain is forecasted. Responses were submitted across Washington, Oregon, and Idaho, suggesting that impacts were largely due to isolated precipitation events as opposed to seasonal anomalies.

The 2024 survey included additional questions for agricultural producers about the supply of water for irrigation and crops that were affected by abnormally dry conditions. Of the 100 respondents, 66 indicated that they changed the timing of irrigation or stopped irrigating earlier than usual.



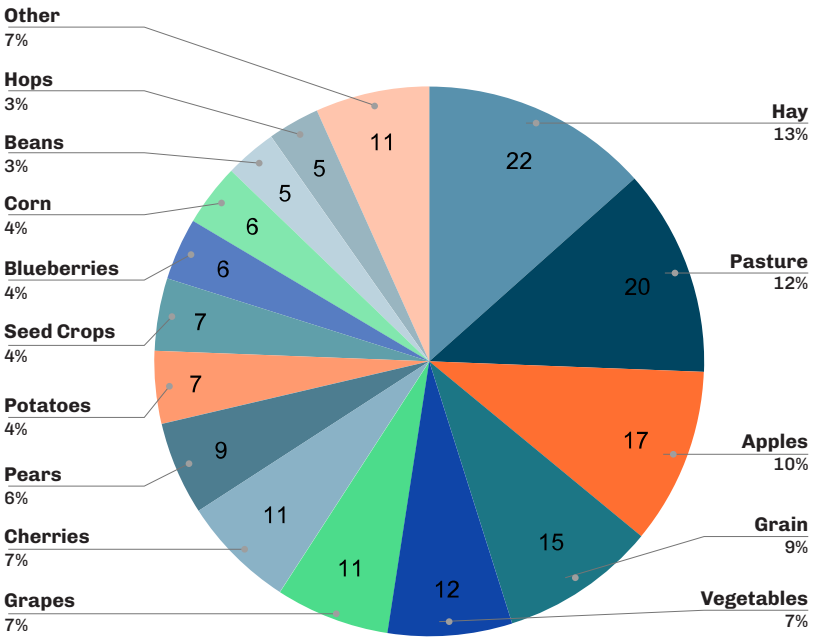
Negative impacts on a variety of crops were reported (Figure 20). Hay, pasture, and apples were most often reported to have suffered from dry conditions. Hay and pasture were most often reported to have been negatively impacted by wet conditions.

Few respondents reported that crops benefited from either dry or wet conditions. In a few cases, respondents noted positive effects of wet conditions for hay, pasture, apples, blueberries, and grapes in their respective locations or seasons.

For more detail on crop yields and other agricultural impacts, the U.S. Department of Agriculture's **National Agricultural Statistics Service** compiles annual state-level statistics on crop yields and other agricultural impacts.

> *"Began irrigating earlier than normal because not as much spring rainfall. Had to shut some lines off later in season to provide water to newly seeded fields we needed to irrigate. Cut the hay earlier than normal so there would be enough water to get back over the field with water. "*
>
> — Wallowa County, Oregon

Crops That Experienced Negative Impacts Due To Abnormally Dry Conditions



Crops That Experienced Negative Impacts Due To Abnormally Wet Conditions

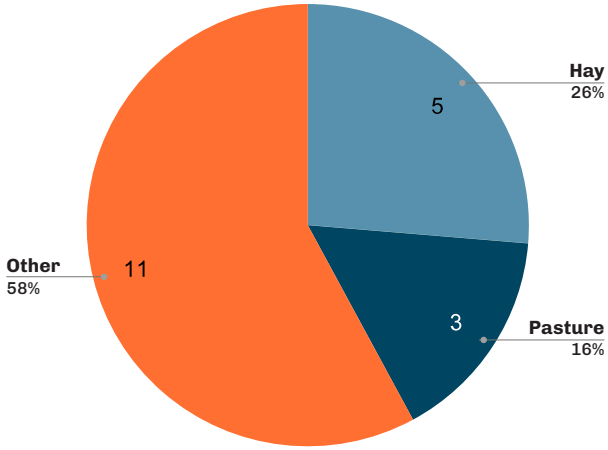


Figure 20: The percentage and number of responses for crops that were negatively impacted by dry and wet conditions. Eighty-eight respondents reported negative impacts due to abnormally dry conditions on a total of 164 crops. Crops were categorized as "Other" if they collected less than three responses. The crops in the "Other" category for dry conditions are plums, garden vegetables, peaches, watermelon, hazelnuts, alfalfa, cranberries, caneberries, and sugar beets.

Twelve respondents reported negative impacts due to abnormally wet conditions on a total of 19 crops. The crops in the "Other" category for the wet conditions are apples, blueberries, grapes, hops, vegetables, cherries, grain, and beans.

The view of C. Ben Ross Reservoir near Hillsdale, Adams County, Idaho

Idaho Fall Water Supply Meeting

Parts of the Idaho Fall Water Supply Meeting highlighted the drought impacts from water year 2024. Drought impacts on agriculture were most severe in northern Idaho where irrigation is limited and most agriculture is rain-fed. Winter wheat conditions were more favorable than that of spring wheat, due to the advanced development of roots deep enough to reach moisture during the dry spring. Other spring planted crops did not develop the root depth needed to access adequate moisture. Yields in the southern and central part of the Idaho panhandle were a third of normal in some cases. Yields of legumes and oilseeds were also impacted by drought.

In the irrigated portions of southern Idaho, above normal precipitation in the Snake River Plain helped mitigate some of the impacts of warmer than normal temperatures. As discussed in the **2023 Water Year Impacts Assessment**, most of Idaho's reservoirs had excess carryover storage from the 2023 water year. That excess carryover was mostly used up during the irrigation season as demand was higher than normal. By the end of the irrigation season, most reservoirs had returned to normal storage levels with the exception of the Magic Reservoir and Salmon Falls Creek Reservoir located in south-central Idaho, which fell below normal levels. Most irrigators in southern Idaho had adequate water supply in water year 2024.

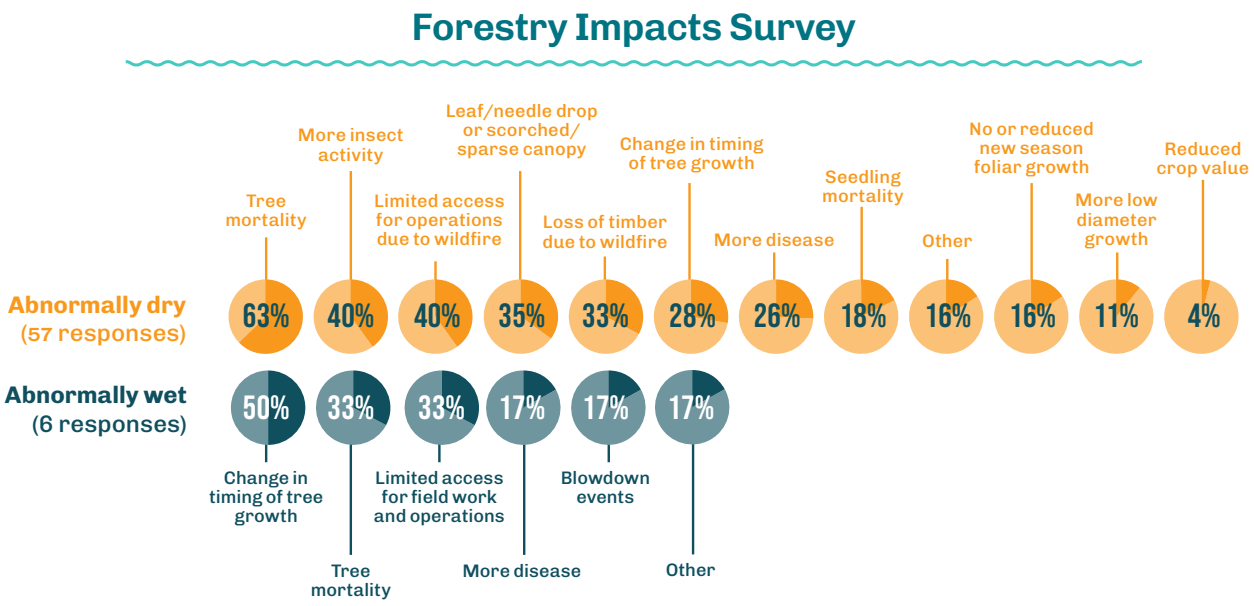
In general, the April 1st forecast across Idaho over-estimated water supply, due to drier than normal spring conditions. While a cool and dry May helped preserve snowpack longer in the mountains, the dry conditions increased water losses to evaporation and transpiration. However, despite the over-forecast of runoff, most reservoir systems did require some limited flood control operations. The Idaho Water Resource Board (IWRB) was able to take advantage of the flood control operations on the Snake River by diverting some of the flood water in the Snake River system to aquifer recharge. They contributed over 372,000 ac-ft into the eastern Snake Plain Aquifer from the Milner Pool and over 91,000 ac-ft above American Falls Reservoir.

In May 2024, Idaho **issued a curtailment call** on groundwater pumpers who did not meet mitigation requirements based on an agreement established in 2015 between groundwater pumpers with junior water rights and surface water users with senior rights. The groundwater pumpers, after intense negotiations with surface water pumpers, were able to prevent groundwater pumps from being turned off. A new agreement was reached between groundwater pumpers and surface water users to expand the aquifer recharge program and continue voluntary groundwater pumping cutbacks. Because of an imbalance in groundwater extraction versus recharge, the natural flow of the Snake River below American Falls has declined by about 500 cfs since 2000. Together groundwater pumping cutbacks and the aquifer recharge program are estimated to have increased storage in the eastern Snake Plain by around 2,000,000 ac-ft over what would have occurred under historical management conditions. The aquifer recharge program and voluntary groundwater pumping cutbacks have so far prevented the aquifer from continuing its decline below 2015 levels.

FORESTRY

Of the 63 survey respondents that reported impacts on forestry, 57 (90%) reported impacts due to abnormally dry conditions and six (10%) reported impacts due to abnormally wet conditions. Impacts were reported across Washington, eastern Oregon, and northern Idaho. The most commonly reported impacts of abnormally dry conditions were tree mortality, increased insect activity, and limited access for operations due to wildfire danger. Most responses about impacts of abnormally wet conditions highlighted changes in the timing of tree growth.

More information on impacts to forest conditions and wildfire in 2024 will be available in the coming months in agency reports such as the Washington Department of Natural Resources' **Annual Forest Health Highlights Repor**t, Oregon Department of Forestry's Forest **Health Highlights**, Idaho Department of Lands' **Forest Health Highlights**, and the **Northwest Interagency Coordination Center Northwest Annual Fire Report**.

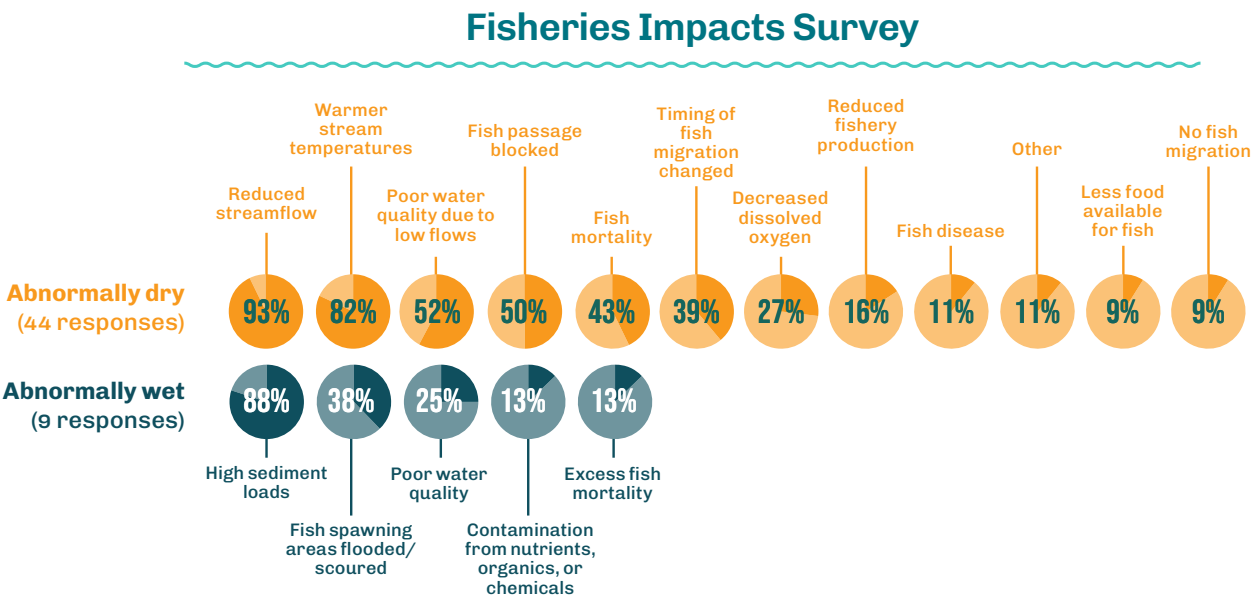


> *"Spring growth season for new leaves/needles shortened by early warm and dry conditions, observed several wildfires in Ponderosa and Lodgepole stands that started early and are continuing into October [2024] due to warm and dry conditions."*
>
> — Deschutes and Klamath Counties, Oregon

FISHERIES

Forty-four survey respondents (83%) reported impacts on fisheries due to abnormally dry conditions, and nine (17%) reported impacts due to abnormally wet conditions.

The most commonly reported impacts of abnormally dry conditions were reduced streamflows, warmer stream temperatures, and obstacles to fish passage. Water quality was often mentioned, as were lower dissolved oxygen, shifts in migration timing, reduced productivity, and fish mortality. In Clallam County, Washington, some fisheries were closed due to low water levels. The majority of reported impacts were in Washington, where drought was more pronounced, but about one-third of the observations applied to either Oregon or Idaho. This underscores that drought may exacerbate fisheries impacts, but other factors limit water quantity and quality even in the absence of drought.



Eight of the nine responses highlighting the impacts of wet conditions came from western Washington and Oregon. Most of these respondents highlighted high sediment loads, flooding or scouring of spawning locations, or both. A few respondents also highlighted water quality impacts.

More information on water year impacts on the fisheries sector is in the **Ecosystem Status Report** released each March by the California Current Ecosystem Integrated Ecosystem Assessment. The report focuses on the marine ecosystem with the goal of informing fisheries management. The annual **Puget Sound Marine Waters Report** summarizes the oceanic, atmospheric, and terrestrial influences on the Puget Sound during the calendar year.

> *"Increased mortality to juvenile smolts during outmigration, adult sockeye mortality near mouth of Yakima River, limited access to tributary spawning grounds for bull trout, Rimrock Reservoir extremely low and well below the 30KAF target for fisheries maintenance."*
>
> — Benton, Franklin, Yakima, and Kittitas Counties, Washington

Record Return of Sockeye Salmon in North Central Washington

As of January 2025, the Washington Department of Fish and Wildlife estimates that over 750,000 sockeye salmon (Oncorhynchus nerka) returned to the Columbia River Basin during summer and autumn 2024, the largest run since dams were built in the mainstem Columbia River (10-year average return is ~330,000). Of those 750,000 fish, record runs of approximately 500,000 were bound for the Okanogan River and 190,000 were bound for the Wenatchee River. These numbers are still preliminary, and were initially presented at the Oregon/Washington Water Year Meeting by Washington Department of Fish and Wildlife staff. The record runs also supported excellent fishing opportunities in the Upper Columbia River.

Many factors contributed to the record return in north central Washington, such as long term collaborative management plans among Tribes, dam operators, and natural resource managers in the United States and Canada. Furthermore, during the past three to four years, conditions for juveniles in the rivers and adults in the ocean were relatively positive. Additionally, several periods of favorable weather during water year 2024 increased flows and reduced water temperatures to levels that increase habitat quality for salmon.

To illustrate, streamflow at a site on the Okanogan River began dropping in mid-May, coinciding with stream temperatures that were increasing, but still below the lethal migration temperature threshold (Figure 21). Salmon migrated freely after they arrived in the area in June. Although a thermal block developed on the Okanogan River during the anomalously hot July, a cool and wet period in mid- to late-August decreased stream temperatures and sockeye continued to move toward Canada. Stream temperatures remained below the lethal migration temperature for the remainder of late summer and early autumn with the exception of a brief period in early September.

Sockeye runs on the Yakima and Snake Rivers were not as successful, with thermal barriers and fish kills. Additional fisheries impacts reported at the Water Year Meeting included closures on the coast of Washington due to low streamflows and stranding of fishes in isolated pools. Regardless, the Washington Department of Fish and Wildlife reported that the number of strandings was relatively low given the relatively cool and wet conditions in mid- to late-August.

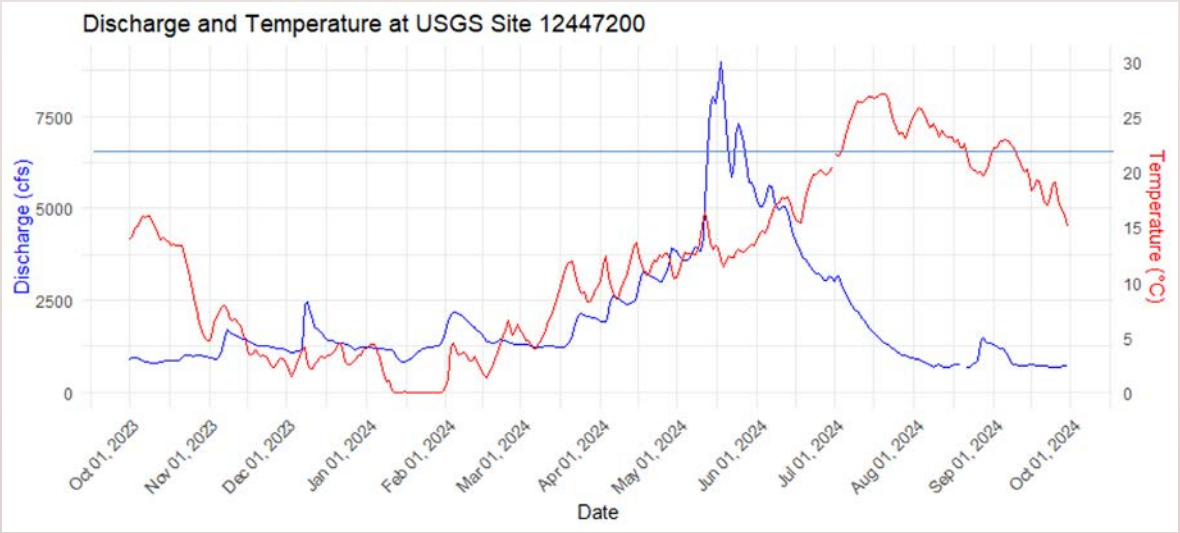


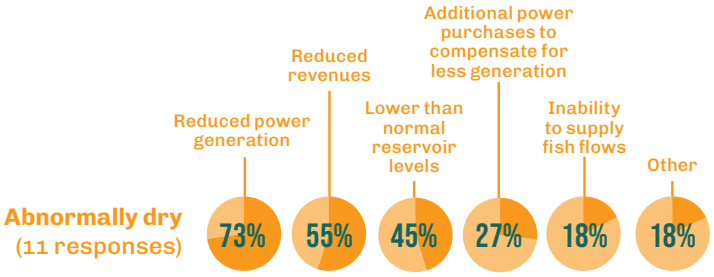
Figure 21: Water year 2024 streamflow (cubic feet per second; cfs) and stream temperature (°C) at the Okanogan River at Malott, Washington (USGS site #: 12447200). The blue line (at 21°C) represents the lethal migration temperature for sockeye salmon (credit: Jeremy Cram, Washington State Department of Fish and Wildlife).

HYDROPOWER

Eleven respondents (84%) reported impacts associated with abnormally dry conditions and two (15%) reported impacts of abnormally wet conditions. Respondents cited impacts across the three states, including comments about low hydropower production throughout the region and at facilities on the Skagit, Yakima, Spokane, and Klamath Rivers. Many cited reduced power generation due to lower than normal water levels, and accompanying increases in costs (due to additional power purchases) and a limited ability to supply flows for fishes.

For more detail on water year impacts on hydropower, the U.S. Energy Information Administration maintains several online sources of information on hydropower production. The **Electricity Data Browser** provides monthly statistics by state, and the **Electric Grid Monitor** provides a regional view of production. Both include online data viewers and options to download data. The U.S. Army Corps of Engineers' **Dataquery 2.0** enables searches and downloading of power generation data at selected dams, such as Grand Coulee (choose file names that begin with "Power.Total").

Hydropower Impacts Survey



> *"Due to the less peaky [more steady] and extended spring runoff pattern, the City of Spokane's hydroelectric facility was able to capitalize on favorable hydraulic head conditions and generate more power than usual."*
>
> — Spokane County, Washington

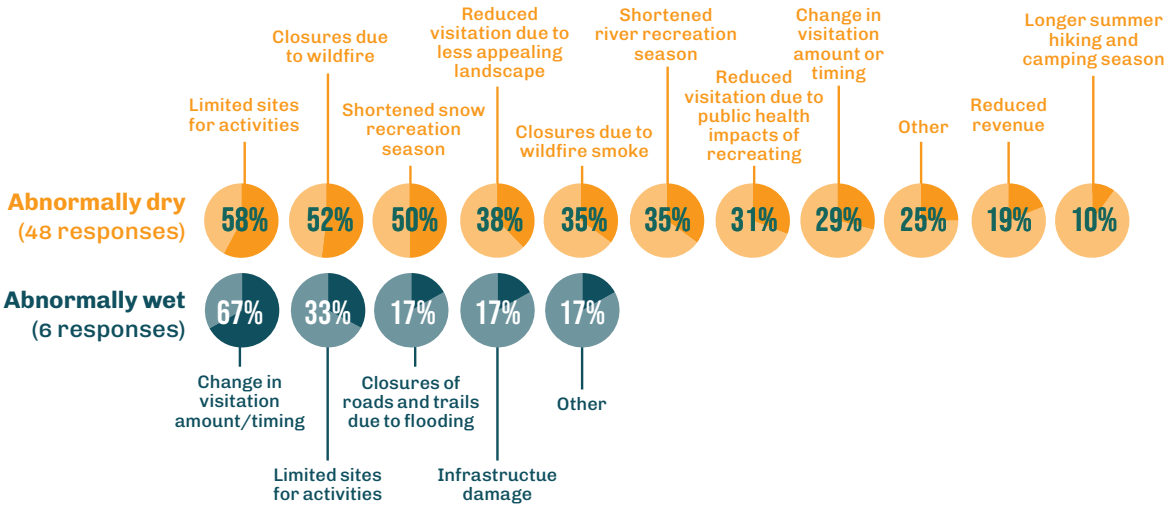
RECREATION

Forty-eight respondents (88%) reported impacts associated with abnormally dry conditions and six (11%) reported impacts of abnormally wet conditions. Impacts of abnormally dry conditions included closures due to heat, fire, and smoke, fisheries and wildlife impacts, poor water quality due to cyano-bacteria blooms, a shorter ski season, and water levels that were too low for boating.

> *"Pools and other outdoor scheduled events were closed or reduced hours due to the heat [hot] temperatures over 100 degrees."*
>
> — Multnomah County, Oregon

Most reports of impacts of abnormally wet conditions cited changes in the amount and timing of visitors, although one respondent cited closures due to flooding and another cited infrastructure damage. No reports cited benefits from either dry or wet conditions.

Recreation Impacts Survey



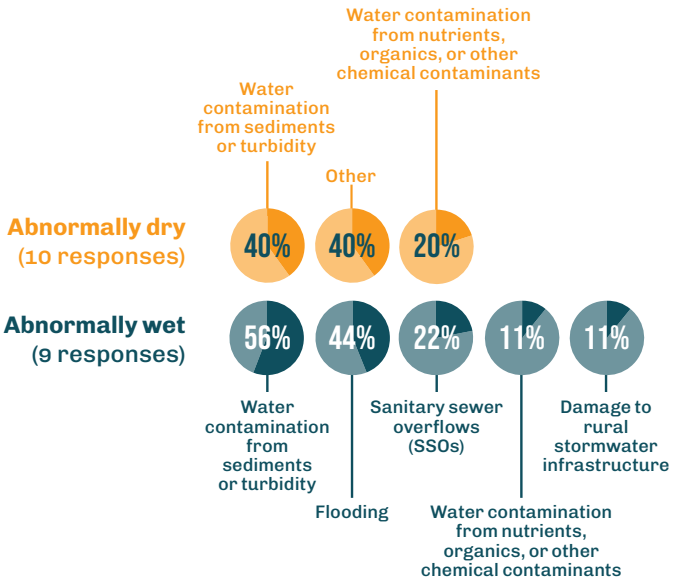
> *"Most of the N. Cascades Hwy and areas of Lake Chelan where I recreate were close[d] this past summer. There wasn't enough snow to ski most of the winter."*
>
> — Okanogan County, Washington

STORMWATER

Ten respondents (53%) reported impacts associated with abnormally dry conditions and nine (47%) reported impacts of abnormally wet conditions. Respondents reporting impacts from dry conditions cited reduced water quality from increases in the concentration of pollutants and low groundwater levels. For abnormally wet conditions, respondents cited sanitary sewer overflows, water contamination, and flooding.

> *"High stormwater flows have impacted local septic systems with washout and soil loading rates."*
>
> — Klickitat County, Washington

Stormwater Impacts Survey



> *"WA State shut down logging operations on some state lands due to repeated point source pollution of sediment off of hauling roads during winter 2023-2024."*
>
> — Clallam and Jefferson Counties, Washington

5

State Level and Sector-Specific Responses

State Responses

State drought declarations are typically used to facilitate the temporary transfer of water rights and offer short-term solutions to water supply challenges. For example, Washington drought declarations expedite processing of temporary transfers of water rights and open up funding for the state to support public entities to address drought impacts. Drought declarations (Figure 22) were issued throughout the water year in **Washington**, **Oregon**, and **Idaho**.

In Washington, a drought emergency was already in place for parts of the state at the start of the water year. That drought emergency was issued for parts of 12 counties in July 2023, encompassing sections of the northern Puget Sound, northern Olympic Peninsula, and Lower Columbia Basin. The original expiration date of the 2023 drought emergency, June 30, 2024, anticipated that a developing El Niño during winter of 2023-2024 might extend drought conditions. On April 16, 2024, the drought emergency was extended across nearly all of Washington. The areas served by the utilities of Everett, Seattle, and Tacoma were excluded from the emergency because they had adequate water and did not meet the hardship criteria for declaring drought in Washington's statute. Those municipalities were able to adjust operations during water year 2024 to store more water than they otherwise would have because they prepared earlier for the potential impacts of a snowpack drought.

The Washington Department of Ecology received 25 applications for the Washington Drought Response Grant program as of January 2025, and applications to address water supply issues related to the 2024 drought are still being accepted. While not all of the 25 applications were funded (many were not eligible due to the issue not being caused by the current drought), there were several projects funded that helped reduce drought impacts. For example, the Roza Irrigation District in the Yakima Basin received funding to lease water from other water right holders and for improved efficiency projects. The Benton Conservation District received funding to remove stargrass to better facilitate fish passage during low streamflows. Finally, the Cascade Irrigation District received funding to install a new and backup transformer for the pumping plant to deliver water to irrigation customers after it failed from increased demand, above normal temperatures, and less return flow, halting water delivery for 10 days in June 2024.

In Oregon, a drought emergency was issued for Morrow County on November 6, 2023, in response to 2023 water year conditions. Oregon drought declarations expire at the

Drought Declarations or Advisories During Water Year 2024

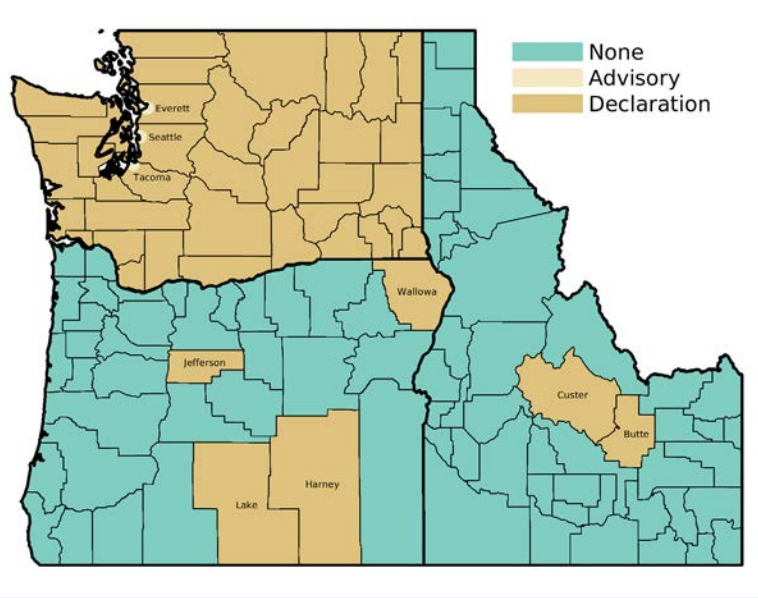


Figure 22: PNW counties for which drought declarations or advisories were issued during the 2024 water year. Wallowa and Harney Counties in Oregon received declarations during the 2025 water year (October 24 and November 22, 2024, respectively), but we included them here because the 2024 water year conditions led to the declarations. The utilities of Seattle, Everett and Tacoma, labeled with light tan circles, were not included in the Washington drought declaration due to healthy reservoir storage and active management for drought conditions early in 2024. Geographic areas in Snohomish, King, and Pierce Counties were included in the Emergency Drought Declaration if they did not receive direct service for potable water through contract with the cities of Seattle, Everett, or Tacoma. The Puget Sound metro areas that do receive potable water from the utilities of Seattle, Everett or Tacoma were kept in drought advisory status.

end of the calendar year, so the latter declaration expired on December 31, 2023. Jefferson and Lake Counties received drought declarations on June 25, and September 9, 2024, respectively. Wallowa and Harney counties received drought declarations on October 24 and November 22, 2024, respectively (technically during the 2025 water year).

In Idaho, a drought emergency was issued for Butte and Custer counties (in the Big Lost, Little Lost, and Salmon River Basins) on July 23, 2024. The declaration expired on December 31, 2024. A drought emergency in Idaho allows for the emergency transfer of water rights. As such, counties with extensive surface water diversions frequently request a drought emergency and those without many water rights rarely request a drought emergency. Butte and Custer county have an unusually high number of water rights. Idaho did not receive any drought declarations during the 2023 water year, so the declaration for Butte and Custer counties was the first in the state since April 2022.

In addition to drought declarations, emergency proclamations were made in Oregon and Washington in response to the weather and climate conditions (Table 1). Emergency proclamations follow a different process compared to each state's drought declaration approach. The number of emergency conflagration proclamations issued in Oregon is notable and illustrates the risks wildfires posed to life and property during the water year.

DATES	PROCLAMATION	STATE	COUNTIES	REASON FOR EMERGENCY
December 1-12, 2023	State of Emergency	OR	Coos, Curry, Douglas, Jackson, Tillamook	Heavy rain, flooding, landslides, and erosion impacting road transportation
January 12-26, 2024	State of Emergency	OR	Statewide	Severe winter storm including snow, freezing rain, ice, high winds, and cold temperatures
January 24, 2024	State of Emergency	WA	Clallam, Grays Harbor, Mason, Skagit, Snohomish, Whatcom	December 3 atmospheric river causing heavy rain, flooding, and infrastructure damage
March 15, 2024	State of Emergency	WA	Chelan, Clallam, Clark, Cowlitz, Douglas, Ferry, Grays Harbor, King, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Skamania, Wahkiakum	January winter storms producing winds, ice, extreme cold temperatures, heavy rain, coastal flooding, and landslides
June 25, 2024	Emergency Conflagration	OR	Deschutes	Darlene 3 Fire
July 5-9, 2024	State of Emergency	OR	Statewide	Extreme heat
July 9, 2024	Emergency Conflagration	OR	Wasco	Larch Creek Fire
July 12, 2024	Emergency Conflagration	OR	Malheur	Cow Valley Fire
July 12, 2024	Emergency Conflagration	OR	Statewide	Imminent threat of wildfire
July 14, 2024	Emergency Conflagration	OR	Harney	Falls Fire
July 15, 2024	Emergency Conflagration	OR	Gilliam, Morrow, Wheeler, Grant	Lone Rock Fire Boneyard Fire
July 17, 2024	Emergency Conflagration	OR	Umatilla, Morrow, Gilliam	A series of fires
July 20, 2024	Emergency Conflagration	OR	Baker, Malheur	Durkee Fire
July 21, 2024	Emergency Conflagration	OR	Grant, Umatilla	Battle Mountain Complex Fire
August 1, 2024	Emergency Conflagration	OR	Harney	Telephone Fire
August 2, 2024	State of Emergency	WA	Statewide	Dry conditions and fires; fuel delivery waiver
August 5, 2024	Emergency Conflagration	OR	Jefferson	Elk Lane Fire
August 6, 2024	Emergency Conflagration	OR	Baker	Town Gulch Fire
August 10, 2024	Emergency Conflagration	OR	Douglas	Dixon Fire
August 16, 2024	State of Emergency	WA	Ferry, Klickitat, Skagit, Yakima	Wildfires and high wildfire potential
September 1, 2024	Emergency Conflagration	OR	Klamath	Copperfield Fire
September 6, 2024	Emergency Conflagration	OR	Crook, Grant	Rail Ridge Fire
September 6, 2024	Emergency Conflagration	OR	Wheeler	Shoe Fly Fire
September 9, 2024	Emergency Conflagration	OR	Wheeler	Service Fire

Table 1: Emergency proclamations made in Washington (WA) and Oregon (OR) during the 2024 water year. The dates, type of proclamation, the state and counties it relates to, and a brief reason for each proclamation are listed.

Sector-Specific Changes in Operations

The Annual Pacific Northwest Water Year Impacts Survey asked respondents if they modified operations in response to abnormally dry or wet conditions during the water year. Of respondents who reported impacts due to abnormally dry conditions, over 60% indicated that they changed operations in response to those conditions (Figure 23). Changes due to abnormally wet conditions were much less common, but reported impacts of these conditions were also less common. Because there were so few responses, we do not summarize the actions taken in response to abnormally wet conditions.

DRINKING WATER

The drinking water sector demonstrated operational flexibility in response to dry conditions, with 70% of respondents indicating that they changed operations in response to abnormally dry conditions. Response actions included requesting reductions from commercial customers, switching to alternative sources (typically groundwater), rotating among wells to minimize drawdown, and engagement to raise awareness and promote conservation. One respondent noted that they started refilling their reservoir in February, which was earlier than usual for their system.

AGRICULTURE

The agriculture sector also reported high operational flexibility in response to abnormally dry conditions, with 64% of respondents indicating that they changed operations. Reported changes included harvesting crops earlier, switching to alternate sources of water, leaving some fields fallow, increasing irrigation (due to heat), reducing irrigation (due limited supply), and shortening livestock rotations. Two respondents upgraded to more efficient irrigation systems, and one participated in a water bank.

FORESTRY

Among the forestry sector, 47% of respondents described responding to dry conditions. Much of the effort in this sector was devoted to firefighting. Other actions included planting a greater variety of seedlings to increase the chances of success, clearing debris and dead trees, and irrigating when possible.

FISHERIES

Over half (58%) of respondents affiliated with the fisheries sector reported changing operations. Although most did not specify the actions they took, many cited increased engagement to raise awareness. Others mentioned closure of treaty fisheries, other fishery restrictions, increases in the volume of water released from

reservoirs, increased hatchery production, and irrigation curtailments. On the Dungeness River, irrigators and the Jamestown S'Klallam Tribe collaborated to alter irrigation schedules to facilitate salmon migration (highlighted on **page 55**).

HYDROPOWER

Sixty-seven percent of respondents affiliated with the hydropower sector indicated that they changed operations in response to abnormally dry conditions. All respondents that specified a response listed reduced generation.

RECREATION

With 77% of respondents reporting a change in operations, the recreation sector exhibited the highest operational flexibility. Responses included fisheries closures, limiting access (e.g., due to fire and smoke), and implementing burn bans.

STORMWATER

Of the stormwater sector responses, 45% reported changing operations in response to abnormally dry conditions. Although there were few responses overall, one respondent installed a rainwater harvesting system and another installed sediment filters.

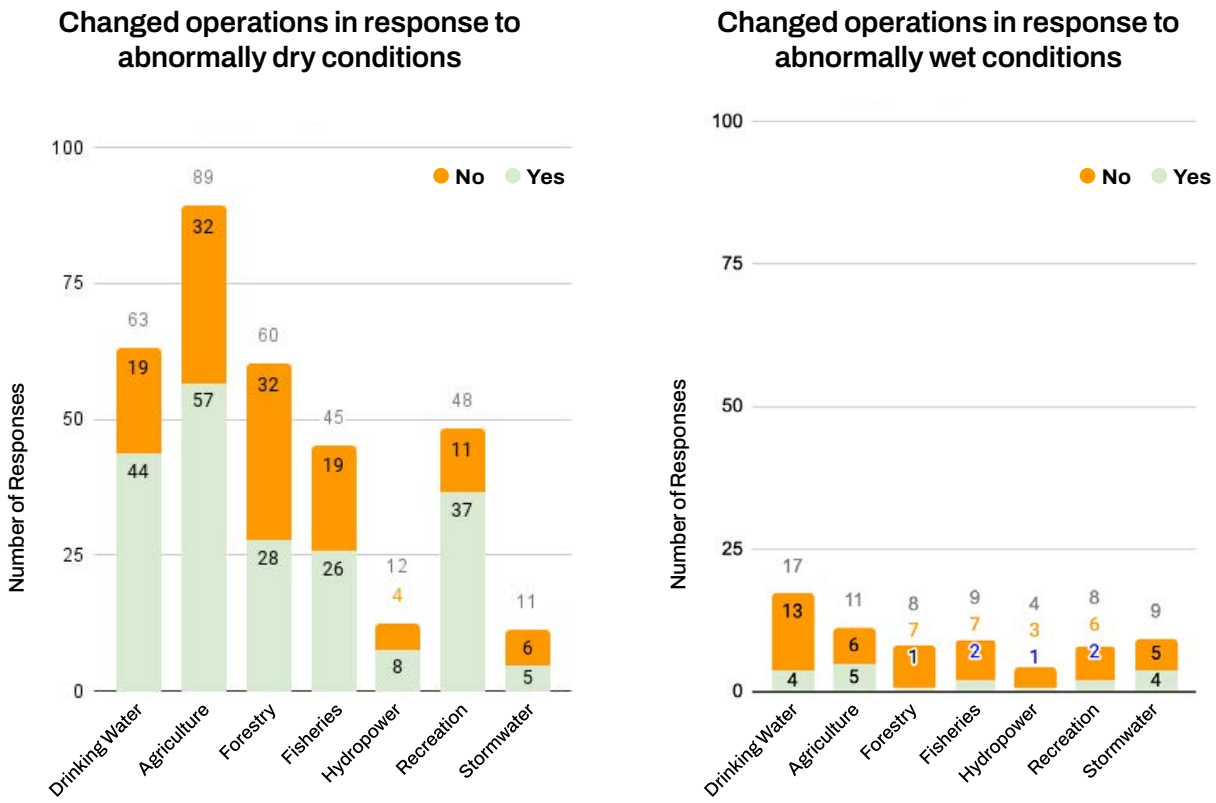


Figure 23: Annual PNW Water Year Impacts Survey responses to whether operations in multiple sectors were changed in response to abnormally (a) dry or (b) wet conditions.

Figure 24: Crews modify a low flow barrier riffle on the Dungeness River to assist fish passage during drought (credit: Chandra Johnson, Jamestown S'Klallam Tribe).

Dungeness River, Washington, Drought Response

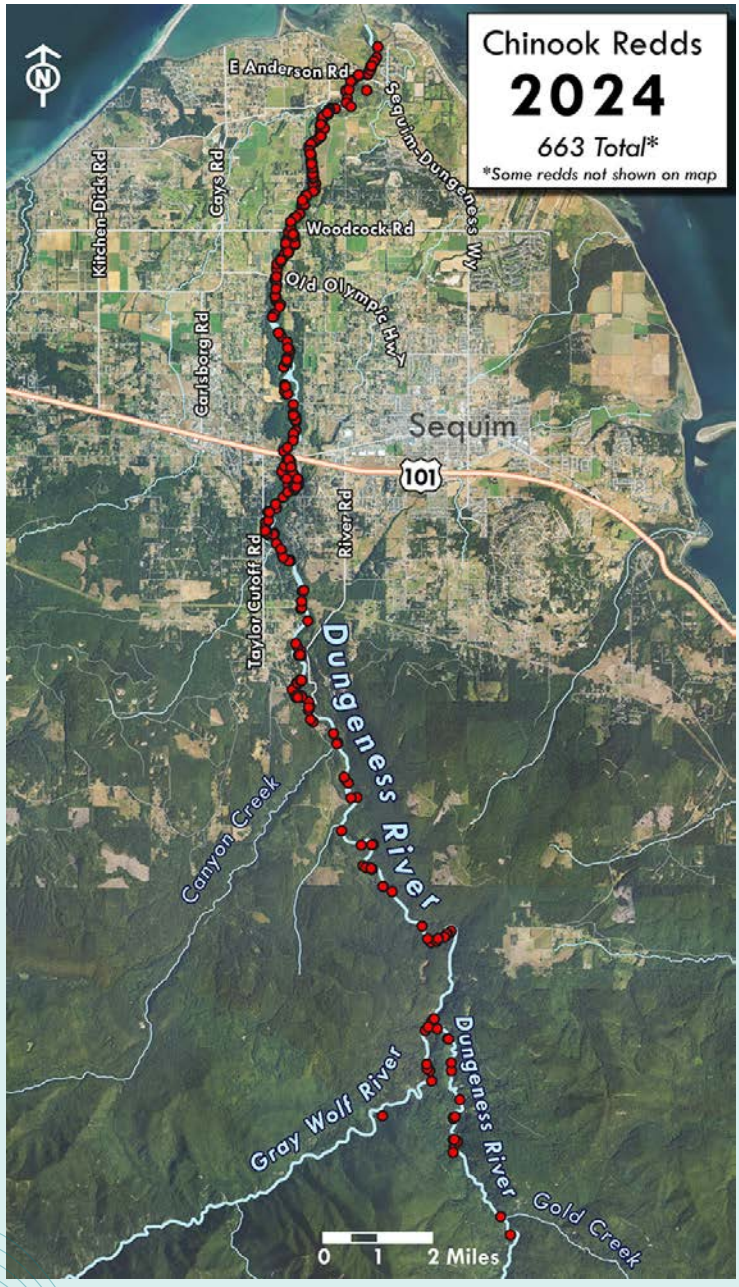
The Dungeness River on the Olympic Peninsula in Washington is inhabited by multiple salmon species and has experienced frequent droughts in recent years. The 2024 water year was no exception, as reported by Shawn Hines of the Jamestown S'Klallam Tribe at the Oregon/Washington Water Year Meeting. Snowpack at the Dungeness SNOTEL (4,100 ft) completely melted by mid-April 2024. In a non-drought year, the snowpack would typically last through early June, albeit snowpack has melted before May 1 at that particular location in seven of the last 11 years. The Dungeness Basin water has historically been overallocated, but in recent years multiple partners have collaborated to ensure that there is enough water for salmon species.

There are still challenges for salmon survival and reproduction during drought years. Shawn described four collaborative efforts that the Jamestown S'Klallam Tribe led or participated in to reduce drought impacts to fishes during the 2024 water year. The first was led by the Tribe with participation by the Washington Conservation Corps and the Washington Department of Fish and Wildlife. These partners modified 15 sites along the Dungeness River to create deeper channels for fish passage. For example, strategically placed rock dams modify river flow and can help ease passage (Figure 24).

The second effort, dry year leasing, aims to reduce the amount of water used for irrigation to keep more water in the river during the time when salmon are spawning. This voluntary program was managed by the Washington Water Trust, funded by the Washington Department of Ecology and private donors, and planned with the help of the Tribe, Water Users Association, and Department of Fish and Wildlife. During two critical periods for fish (August 1-September 1 and September 2-15), farmers that opted in were paid to not use their water right for irrigation. The 15 agreements in the program returned about 9 cubic feet per second (cfs) to the Dungeness River in 2024.

The third effort also included the Washington Water Trust, the Jamestown S'Klallam Tribe, Washington Department of Fish and Wildlife, and irrigators, and was funded by the Washington Department of Ecology and private donors. During four 13-hour overnight periods in August, irrigators who opted in were paid to turn off their diversions to create a larger pulse of flow in the river. These pulses were intended to simulate a rain event to enable fish to move over barriers in the river. The four events increased flow by an average of about 20 cfs. This program was piloted in 2023 but its success was not measured. In 2024, monitoring was conducted to track results. The Tribe led tagging of Chinook salmon (Oncorhynchus tshawytscha) to track their movements throughout the basin. Preliminary results indicated that despite the early snowmelt, Chinook redds were well distributed throughout the Dungeness, with 20% of the fish reaching the upper watershed (Figure 25).

Fourth, a coordinated drought messaging effort by Washington State University Extension, with funding from Ecology and the Tribe, raised awareness about drought conditions and the benefits of water conservation and promoted gold (as opposed to green) lawns across the region. The messages were disseminated through news articles, webpages, and event booths. Initial feedback suggested that the program increased regional awareness.



These efforts illustrate how collaboration can limit drought impacts on fishes and other valued interests. As work in the Dungeness continues, we hope to learn more about the longer-term effects of these efforts on fishes and farms in the basin.

Figure 25: 2024 Chinook redd distribution in the Dungeness River. Targeted drought response, cool temperatures, and rain events enabled Chinook salmon to reach spawning grounds in the upper river (credit: data from Washington Fish and Wildlife, Jamestown S'Klallam Tribe, and Clallam County; WaTech (2023) imagery. Map created by Chandra Johnson, Jamestown S'Klallam Tribe, October 2024).

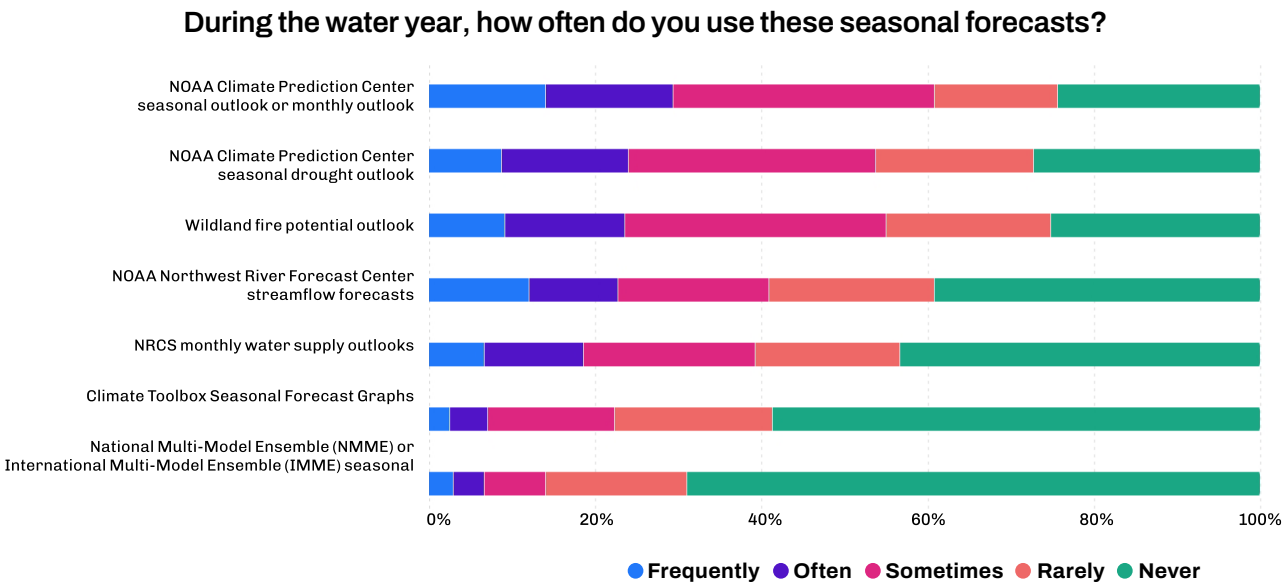


Figure 26: Annual PNW Water Year Impacts Survey responses to the question, "During the water year, how often do you use these seasonal forecasts and outlooks?"

Changes in Operations Based on Forecasts and Outlooks

The NOAA Climate Prediction Center's seasonal and monthly outlooks and National Interagency Fire Center's wildland fire potential outlook are the forecast tools most commonly used by survey respondents (Figure 26). The next most commonly used forecast tools are the NOAA Climate Prediction Center's drought outlook and the Northwest River Forecast Center's streamflow forecasts. Respondents cited a variety of tools and sources of data on current status and forecasts of weather, river flow, snowpack, wildfire risk, and other conditions. Many also cited trusted sources, such as experts, who play a role as intermediaries, providing interpretation of available information and forecasts. Overall, the proportion of respondents who reported using these tools was much higher in 2024 than in 2023, and a much smaller proportion than in the 2022 survey. It is unclear why the results are so variable.

Survey respondents described some ways in which they responded to information in the seasonal forecasts and outlooks, such as short-term adjustment of operations, greater interagency coordination, and communications.

OPERATIONAL CHANGES

- Altered operations (e.g., timing of prescribed burns, reservoir storage)
- Increased monitoring to understand water use, water availability, and impacts
- Changed timing of planting or harvest
- Changed crop or variety
- Increased or decreased irrigation
- Used alternate water sources (e.g., well, tank) or obtained permits for emergency wells
- Implemented water conservation measures.
- Updated emergency, maintenance, and capital plans
- Increased wildfire and smoke preparedness
- Closed or restricted fisheries
- Planned for obstacles to fish passage

COMMUNICATION CHANGES

- Increased the frequency of communications
- Incorporated new information in communications (e.g., more details on forecasts)
- Water conservation outreach and education
- Severe heat outreach and education
- Issued heat warnings

6 Forecast Verification

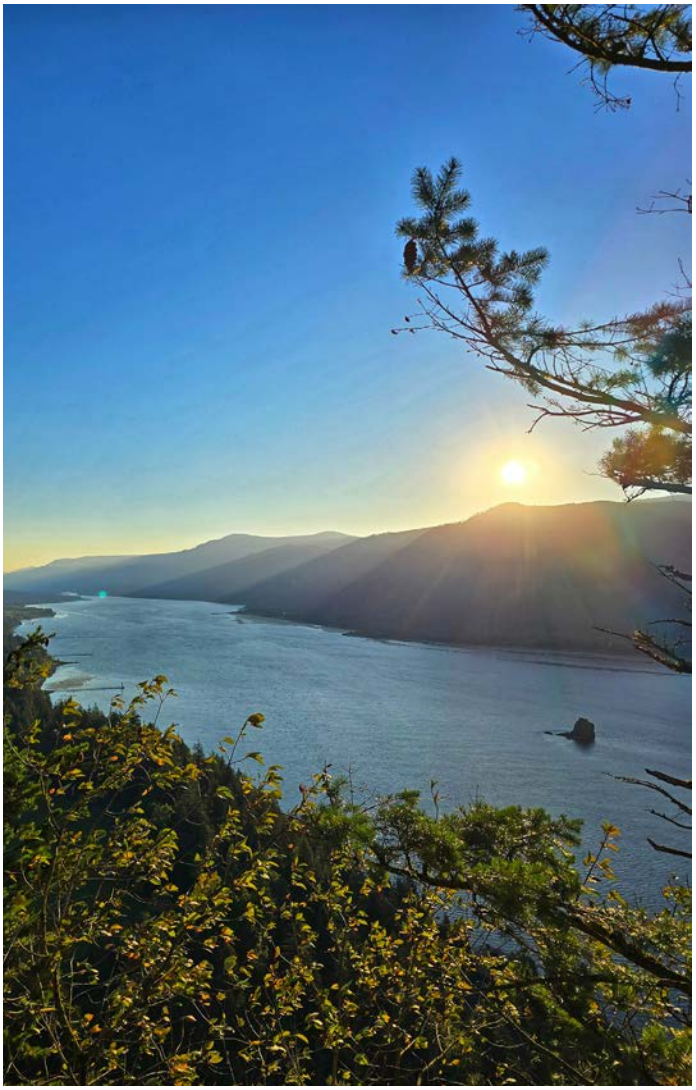
A strong El Niño was present for a majority of the water year. The El Niño developed in spring 2023 and persisted through spring 2024 before transitioning to neutral conditions for the remainder of the water year. The El Niño timelines were well-predicted. Typically, El Niño events are associated with warmer and drier than normal winters in the PNW, with below normal snowpack by April, however there is some variability in the strength of that relationship throughout the PNW. NOAA's Climate Prediction Center (CPC) and other centers that issue long-term forecasts produce their seasonal weather predictions on the basis of relationships observed during past ENSO (El Niño-Southern Oscillation) events, along with other observed properties of the global climate system that provide predictability, and projections from global atmosphere-ocean climate models.

Because the CPC seasonal outlooks were among the forecast tools most commonly used by our survey respondents, we qualitatively evaluated the accuracy of two monthly forecasts during the 2024 water year. We chose December and May as our examples because the extremely warm December limited snow accumulation while May 2024 was cooler than what we've seen in recent water years.

December 2023 Forecast and Verification

The CPC temperature forecast for December, issued in mid-November 2023 (Figure 27), included equal probability (33.3% chance of each outcome) of below, near-normal, or above normal December temperatures across all of Washington, Oregon, and Idaho. Those equal probabilities were inconsistent with the above normal December temperatures that were observed across the PNW. The updated December 2023 forecast (not shown), issued on November 30, included a higher probability of above normal temperatures across the PNW. In other words, two additional weeks of information improved the monthly outlook substantially.

The CPC precipitation forecast for December, issued in mid-November 2023, indicated equal probability of below, near-median, or above median December precipitation across all of Washington, Oregon, and Idaho. Observed December precipitation was above median across western Washington, parts of northwestern Oregon, and northeastern Washington. Below median December precipitation was observed throughout nearly all of Idaho and parts of south central Oregon. Precipitation elsewhere in the PNW was near-median. The December precipitation forecast did not capture the observed distribution across the region, but was reasonably accurate in that it did not tilt the odds toward an outcome in which the opposite occurred.



December 2023 Outlook

The monthly outlook did not capture the observed above normal December temperatures across the PNW.

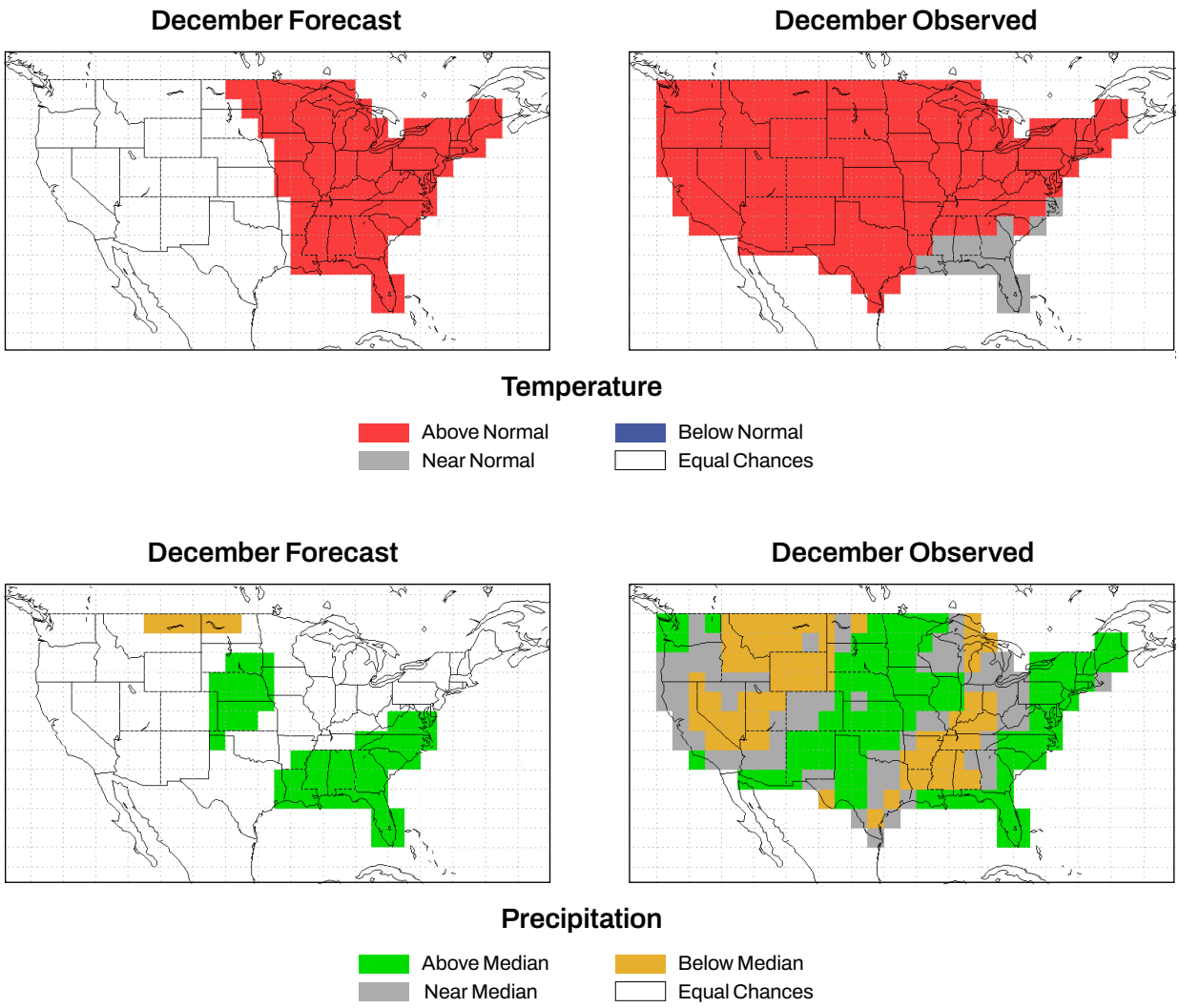


Figure 27: Categorical temperature and precipitation forecasts for December 2023, issued in November 2023, compared to observations for the month. Source: **Climate Prediction Center**.

May 2024 Forecast and Verification

The CPC temperature forecast for May 2024, issued in mid-April (Figure 28), favored above-normal temperatures across all of Washington and Oregon and parts of the Idaho panhandle. Forecasted probabilities of below, near-normal, or above normal May temperatures in southern Idaho were equal.

Observed temperatures throughout the PNW were below normal for the majority of Washington and Idaho and in some Oregon locations, contrary to the forecast. Although the CPC forecast of above normal temperatures across most of the PNW did not provide much advance warning of the observed below normal May temperatures, the updated May 2024 forecast, issued on April 30 (not shown), was downgraded to equal chances (33% each) of below normal, normal, or above normal temperatures.

The CPC precipitation forecast for May, issued in mid-April 2024, indicated below-median precipitation across northern Washington and Idaho (Figure 25). Similar to the temperature forecast, the CPC attributed equal probability of below, equal to, or above median precipitation elsewhere in the PNW.

The below median precipitation forecast for northern Washington and Idaho matched some of the observed conditions in the northern part of the area, but the forecast did not indicate below median precipitation across the majority of Idaho. Precipitation in coastal Oregon, which also was above median, contrasted with the May precipitation forecast of equal chances of above, near, or below normal.

Users of monthly and seasonal projections from NOAA/CPC and other climate centers should keep in mind that these products represent deviations from expected norms over broad spatial scales and extended time scales of a month and longer. Because of the intrinsic variability of the climate in the mid-latitudes, there are real limits on predictability, with temperature generally being more skillfully forecast than precipitation. The climate community is actively investigating potential new sources of predictability, and techniques such as machine learning to supplement existing methods, and hopefully this work will have significant payoffs. It is clear that the users of the PNW Water Year Impacts Assessments would benefit from improved long-term forecasts.

May 2024 Outlook

The May temperature outlook tilted the odds toward higher than normal temperatures across the PNW, but the observed temperatures were near-normal to below normal.

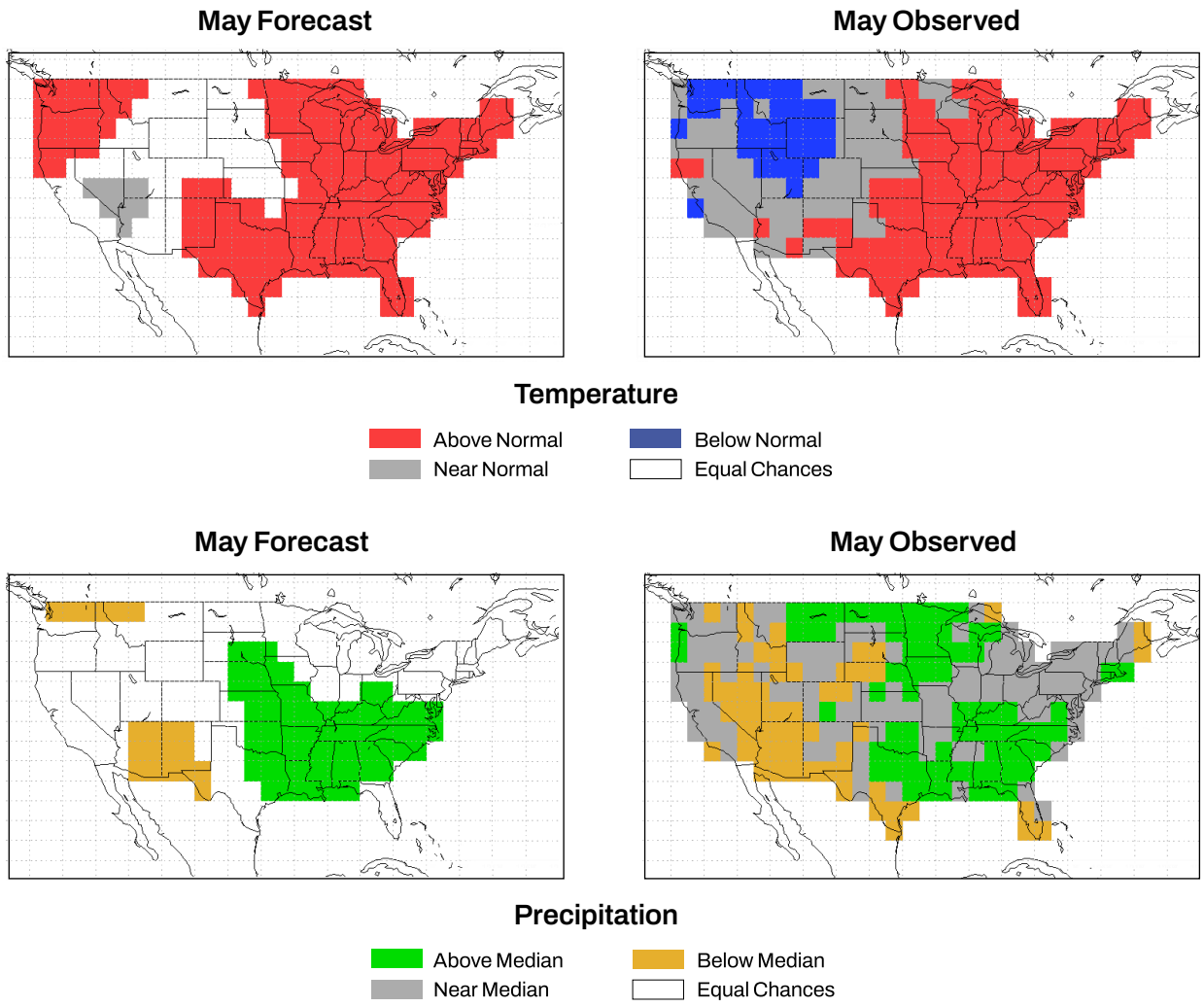


Figure 28: Categorical temperature and precipitation forecasts for May 2024, issued in April 2024, compared to observations for those months. Source: **Climate Prediction Center**.