USDA United States Department of Agriculture

Natural Resources Conservation Service

Montana Water Supply Outlook Report

May 1, 2025

As the valleys begin to turn green and snow lines retreat for the mountains, access to snow courses can become difficult. Low elevation sites are melting quickly, while many high elevation sites are just now reaching their peak snowpack. Here, a snow surveyor for Custer-Gallatin National Forest contemplates the joy of late season surveys on the way to measure New World Gulch Snow Course. Spring weather has an outsized impact on runoff and how our water supply evolves. Data collected this time of year helps us understand both the total amount of water stored in the mountains and how fast the snowpack is melting. New World Gulch measured 10.9 inches of snow water equivalent or 101% of normal. Spring weather will determine how and when that water is released. (Photo: Vince Pacific – April 30th, 2025)

Table of Contents

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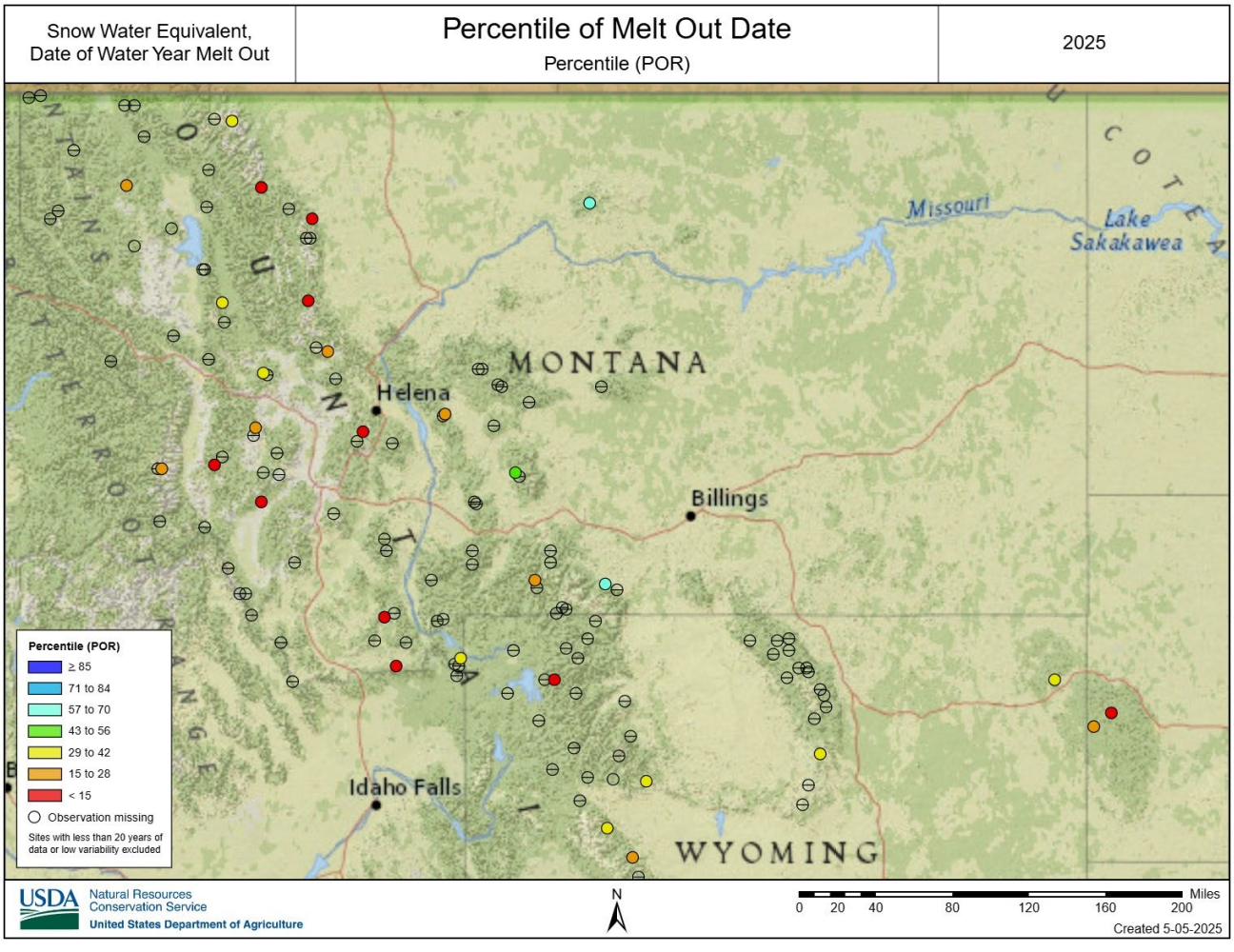
Statewide Overview

Summary

April ushered in spring conditions in Montana. Variable temperatures and weather effected snowpack across the state. Many sites experienced a halt to snow accumulation during this time. Scattered winter storms caused accumulation to momentarily restart at certain sites. Accumulation continued at higher elevations throughout the month. Widespread melt occurred at lower and mid elevation stations. With some stations melting out completely. Higher elevations experienced some snowmelt with SWE beginning to decrease near the end of the month.

Shown below is a map of SNOTELs that have melted out and the percentile rankings of their melt out dates. Of the SNOTELs that have melted out, the average departure from the median melt out date was -10 days. It has been an early melt out for the lower and mid elevation SNOTELs thus far. However, this isn't a result of a low snowpack year for all of these stations. Some stations recorded near normal percentages of median water year peak SWE such as Frohner Meadow SNOTEL. It reached 90% of median peak SWE but still melted out 17 days before the median melt out date. Several stations melted out near or after the median melt out date such as Burnt Mountain, Porcupine, and Rocky Boy SNOTELs. The remaining SNOTEL sites with snowpack have potential to melt out past the median melt out date.

Although early melt out has occurred at some stations, it doesn't mean that will be the case for all sites. Spring precipitation and temperatures will determine the melt rates of the remaining snow in the mountains. There is still a lot of water stored within the higher elevation snowpacks. Weather in the following weeks will shape water supply as we head towards summer.



Statewide Overview

Precipitation

The Beartooth and Bighorn mountains won big in the April precipitation game. SNOTEL sites like Burnt Mountain near Red Lodge received 6.9" or double the normal April precipitation. A large, late April storm dropped over an inch of liquid water in these regions, most of it as snow. Below average precipitation in the Wind River Range offset the gains from the Bighorn Range, resulting in 93% of median precipitation across the Bighorn basin.

The late April storm missed the rest of Montana, where despite consistent small storms, precipitation remained largely below average. Calvert Creek SNOTEL in the Jefferson Basin received a mere 15% of normal precipitation. Nearby Basin Creek SNOTEL received 59% of its normal 2.7" of water in April. The Flathead and Kootenai basins differed from this trend due to an early April storm. Hand Creek SNOTEL, on the border of the two basins received 3.4" of precipitation, 148% of normal. The basins received 96% and 101% of normal precipitation respectively despite some below average recordings at low elevation SNOTEL sites near Flathead Lake.

Precipitation totals do not always correlate with snowpack. The Powder and Tongue basins in the Bighorns respectively saw 91% and 99% of median precipitation since October 1. However, the Powder sits at 75% of median snow water equivalent (SWE) for this time of year while its northern neighbor towers at 111% of SWE.

Aside from slightly below average water year totals in northwest Montana, precipitation remains near median since October 1. Water year medians are largely un-changed from March in much of Wyoming and Montana. However, the Smith-Judith-Musselshell did decrease, and the Powder basin made notable improvements. Sun-Teton-Marias basin remains the lowest at 73% of median precipitation since the start of the water year.

April - Highest Total Accumulated Precipitation - SNOTEL/SNOLITE

Station	Precipitation (Inches)	Median (Inches)	Elevation	Basin
Noisy Basin	7.5	5.6	6070	Flathead
Burnt Mtn	6.9	3.3	5920	Upper Yellowstone
Little Goose	6.2	3.8	8560	Tongue
Sacajawea	6.1	4.6	6610	Upper Yellowstone, Gallatin
Brackett Creek	6.0	5.0	7370	Upper Yellowstone, Gallatin

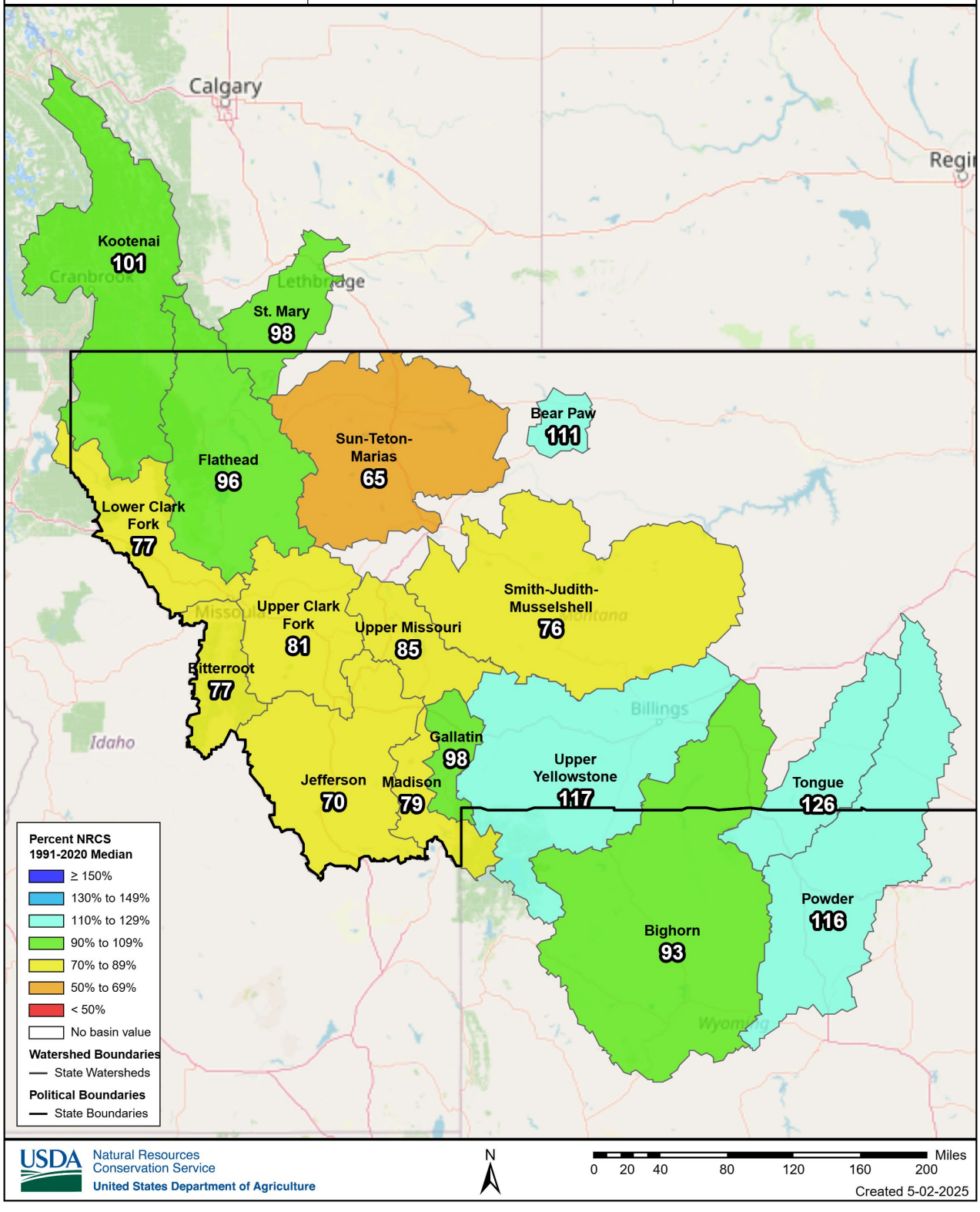
April - Lowest Total Accumulated Precipitation- SNOTEL/SNOLITE

Station	Precipitation (Inches)	Median (Inches)	Elevation	Basin
Calvert Creek	0.2	1.3	6410	Jefferson
Copper Bottom	0.6	1.8	5200	Upper Clark Fork
Ashley Divide	1.0	-	4820	Flathead
Daly Creek	1.1	2.0	5780	Bitterroot
Blacktail Mtn	1.2	2.3	5660	Flathead

Statewide Overview

Precipitation (Continued)

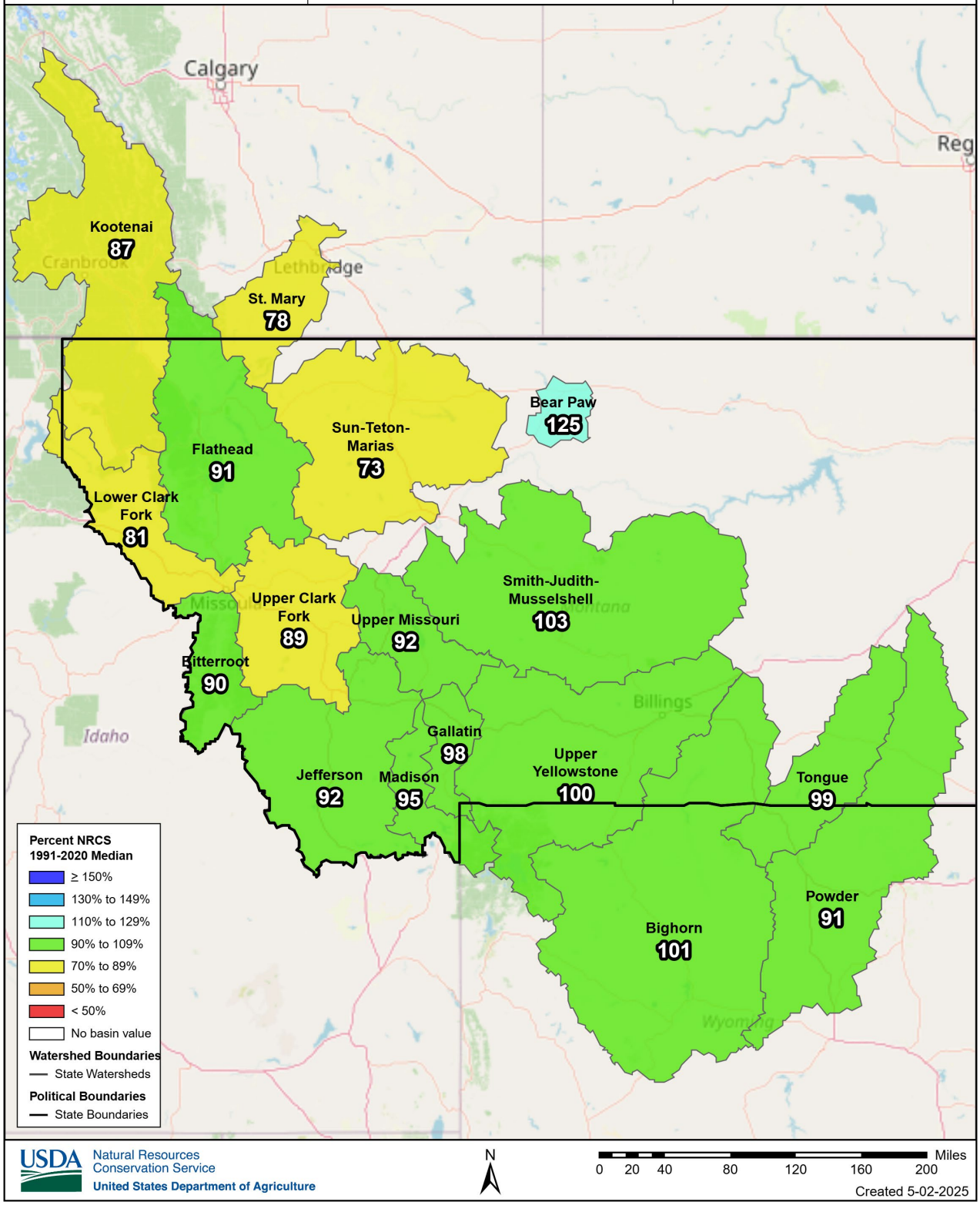
1 month Precipitation	Percent NRCS 1991-2020 Median	April 1, 2025 - April 30, 2025



Statewide Overview

Precipitation (Continued)

Water Year to Date Precipitation	Percent NRCS 1991-2020 Median	October 1, 2024 - April 30, 2025



Statewide Overview

Snowpack

In southwest and central Montana May 1 snowpack remains near to slightly above normal, around 95% to 110% of median. April storms favored the Bighorn Mountains, increasing the snowpack percentage in the Tongue River basin, but failing to improve snowpack conditions in the Powder River basin. May 1 snowpack decreased from April 1 values across much of western Montana, with snowpack ranging between 75% and 90% of median. The Sun-Teton-Marias basin snowpack remains well below normal at 60% of median. One exception is the St. Mary basin, showing a marked improvement in snowpack since April 1. A factor in St. Mary's snowpack increase is the inclusion of snow courses measured only on May 1 that have near normal snowpack values. Users may notice a difference in first of month snowpack based on "Daily" frequency (that includes automated SNOTEL sites only) or "Monthly" frequency (that includes automated SNOTEL sites and manually measured snow courses). The "Monthly" frequency is used in this report.

Most SNOTEL sites have passed peak SWE accumulation for the season. Overall, SNOTEL sites reached near to below normal peak SWE. Some sites recorded surpluses of up to 7" above median peak SWE or deficits of up to 8" below median peak SWE. Generally, the southwest to central part of the state had closer to normal SWE, similar to 2013 or 2002. The western part of the state tended to have larger deficits in peak SWE, similar to 2013 or 2007. The Sun-Teton-Marias and St. Mary basins have larger deficits similar to 2004 levels. Across the state the timing of peak snowpack accumulation was near normal to 10-20 days early.

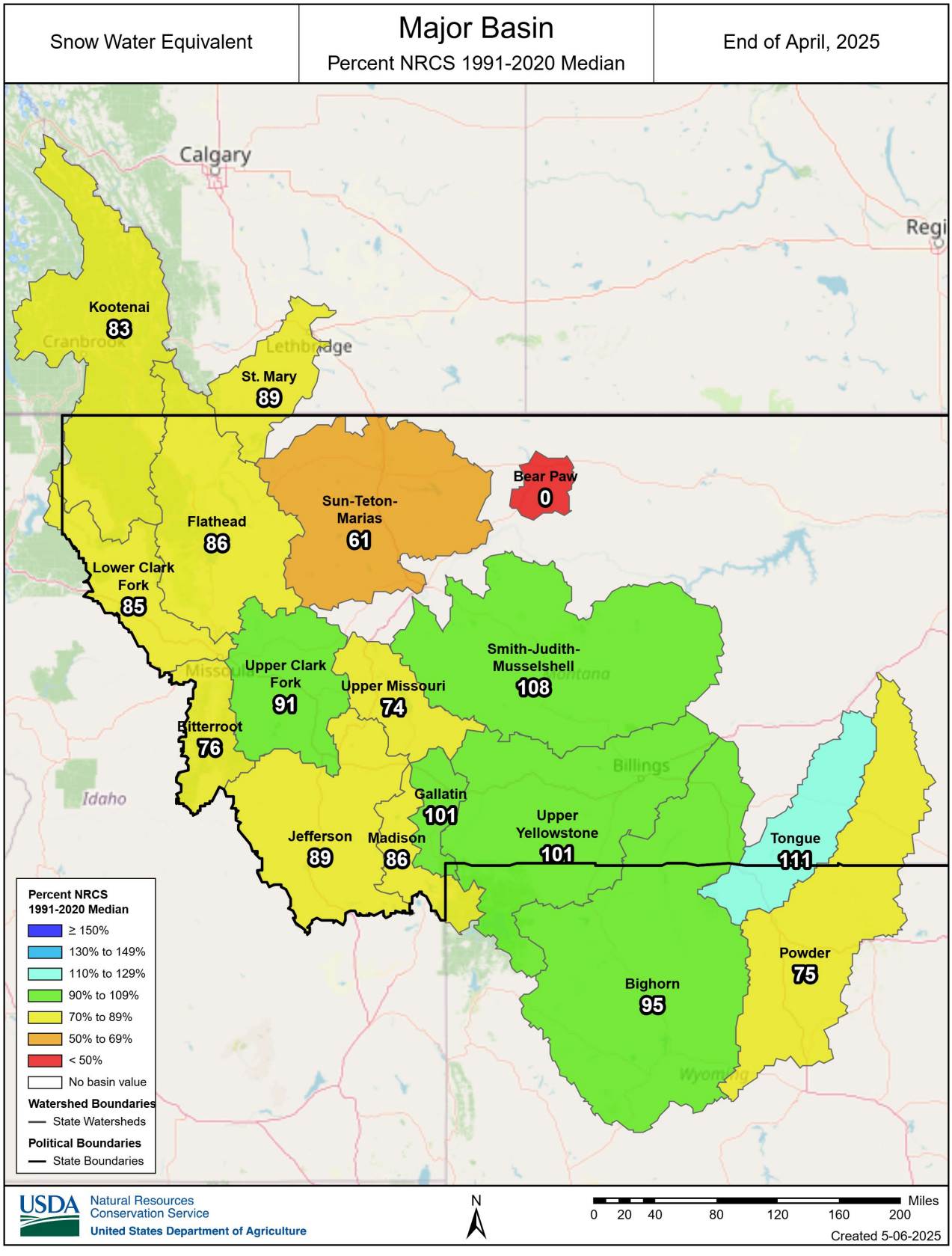
The snowpack accumulation season has passed peak SWE, and significant snowpack gains are unlikely. Statewide snowpack densities are increasing, indicating a snowpack ripe for runoff. Many SNOTEL sites are beginning to melt with some lower elevation sites completely melted out. How the existing snowpack melts will influence summer streamflow; more spring moisture combined with cooler temperatures will encourage gradual runoff and improve summer streamflow conditions. A hot, dry spring spurring rapid runoff will diminish summer streamflow outlooks.

Water Year 2025 - Major Basin - Snowpack Percent of Normal ('91-'20)

Basin	Nov 1	Dec 1	Jan 1	Feb 1	Mar 1	Apr 1	May 1	Jun 1
Kootenai	56	127	117	80	82	90	83	-
Flathead	51	124	105	79	84	87	86	-
Upper Clark Fork	38	83	72	78	93	86	91	-
Bitterroot	74	99	91	80	97	95	76	-
Lower Clark Fork	55	134	112	80	85	91	85	-
Jefferson	44	82	75	82	95	93	89	-
Madison	56	87	84	80	94	96	86	-
Gallatin	53	85	93	92	110	104	101	-
Upper Missouri	-	67	67	77	93	90	74	-
Smith-Judith-Musselshell	2	86	91	131	118	115	108	-
Sun-Teton-Marias	25	81	70	56	71	70	61	-
St. Mary	50	106	94	67	72	77	89	-
Upper Yellowstone	42	62	73	78	98	99	101	-
Bighorn	54	65	69	81	99	103	95	-
Powder	54	65	60	81	74	78	75	-
Tongue	80	81	65	95	94	100	111	-
Bear Paw	-	222	136	228	158	107	-	-

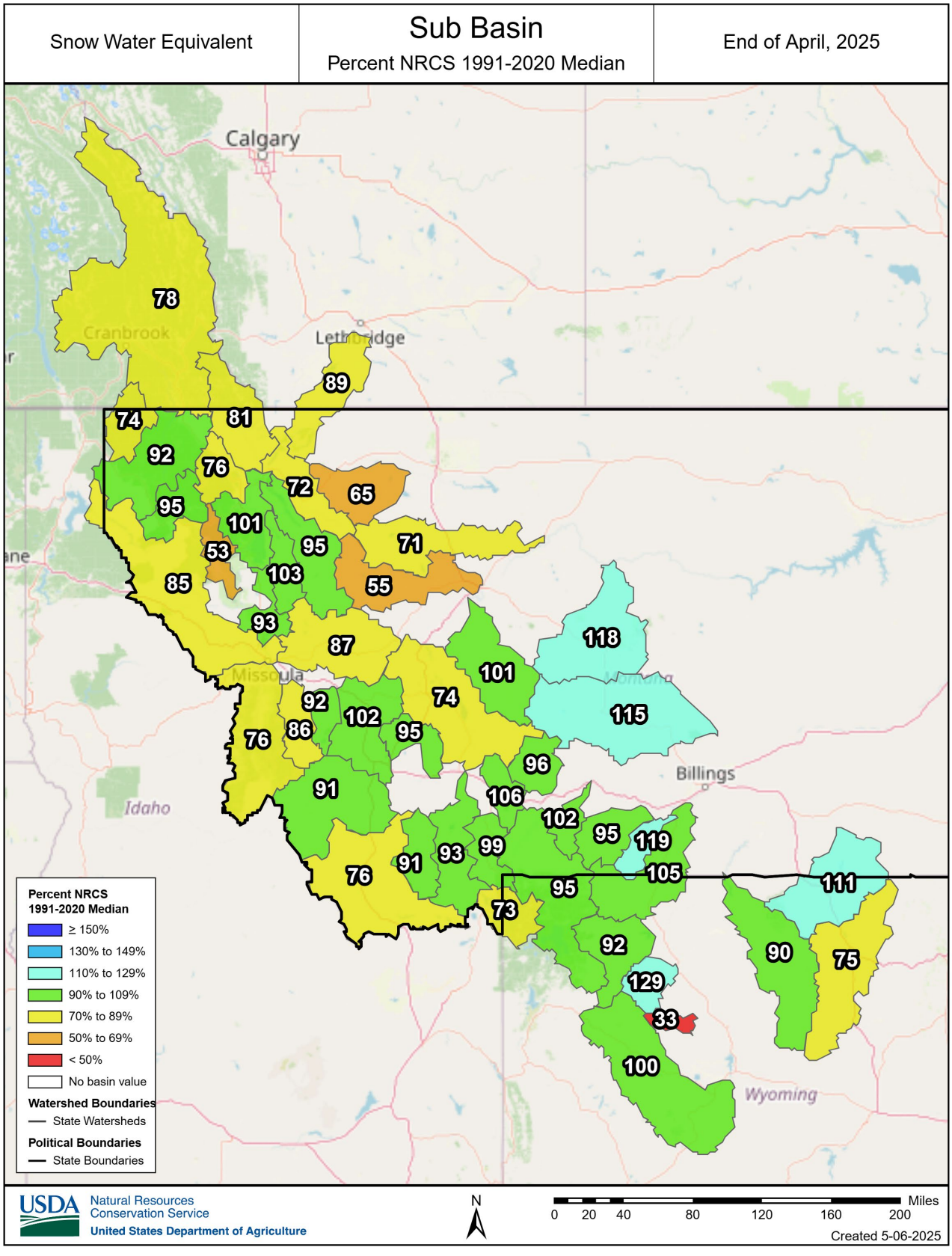
Statewide Overview

Snowpack (Continued)



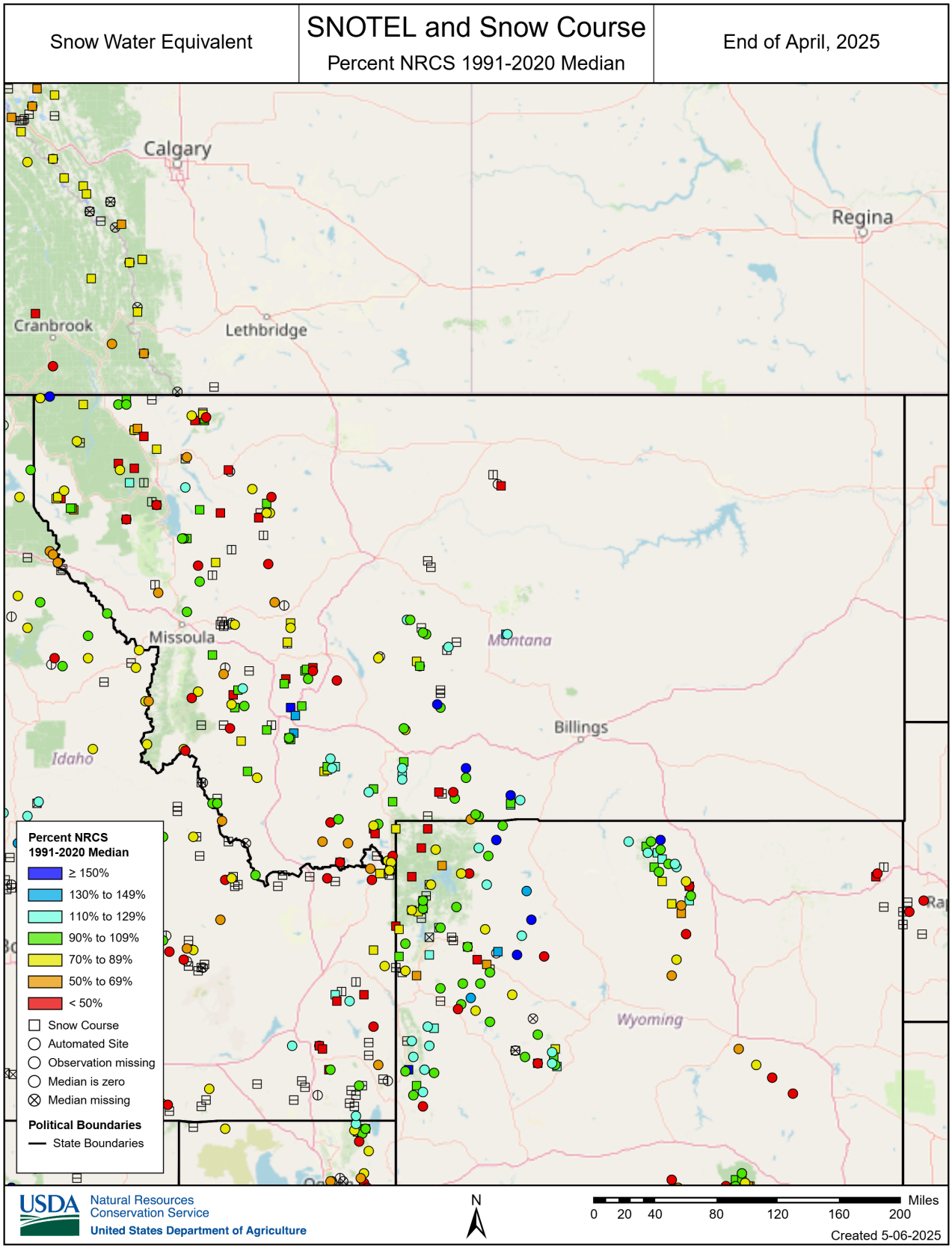
Statewide Overview

Snowpack (Continued)



Statewide Overview

Snowpack (Continued)

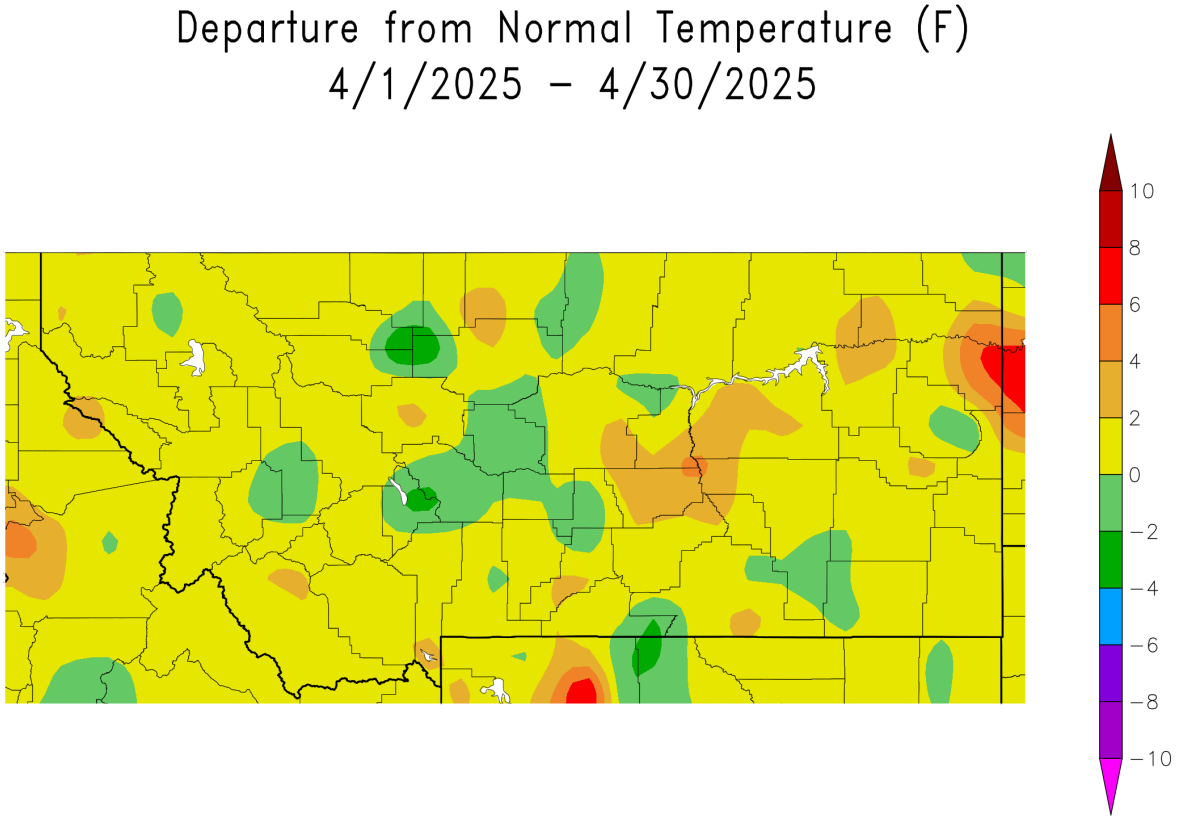


Statewide Overview

Temperature

Temperatures across most of Montana averaged near to slightly above normal in the Month of April, with a few scattered pockets warmer and colder than the rest of the state. The entirety of Montana followed very similar weather patterns where changes in temperature were felt equally across the state. The exception being northwest Montana with well above average temperatures the last week of April.

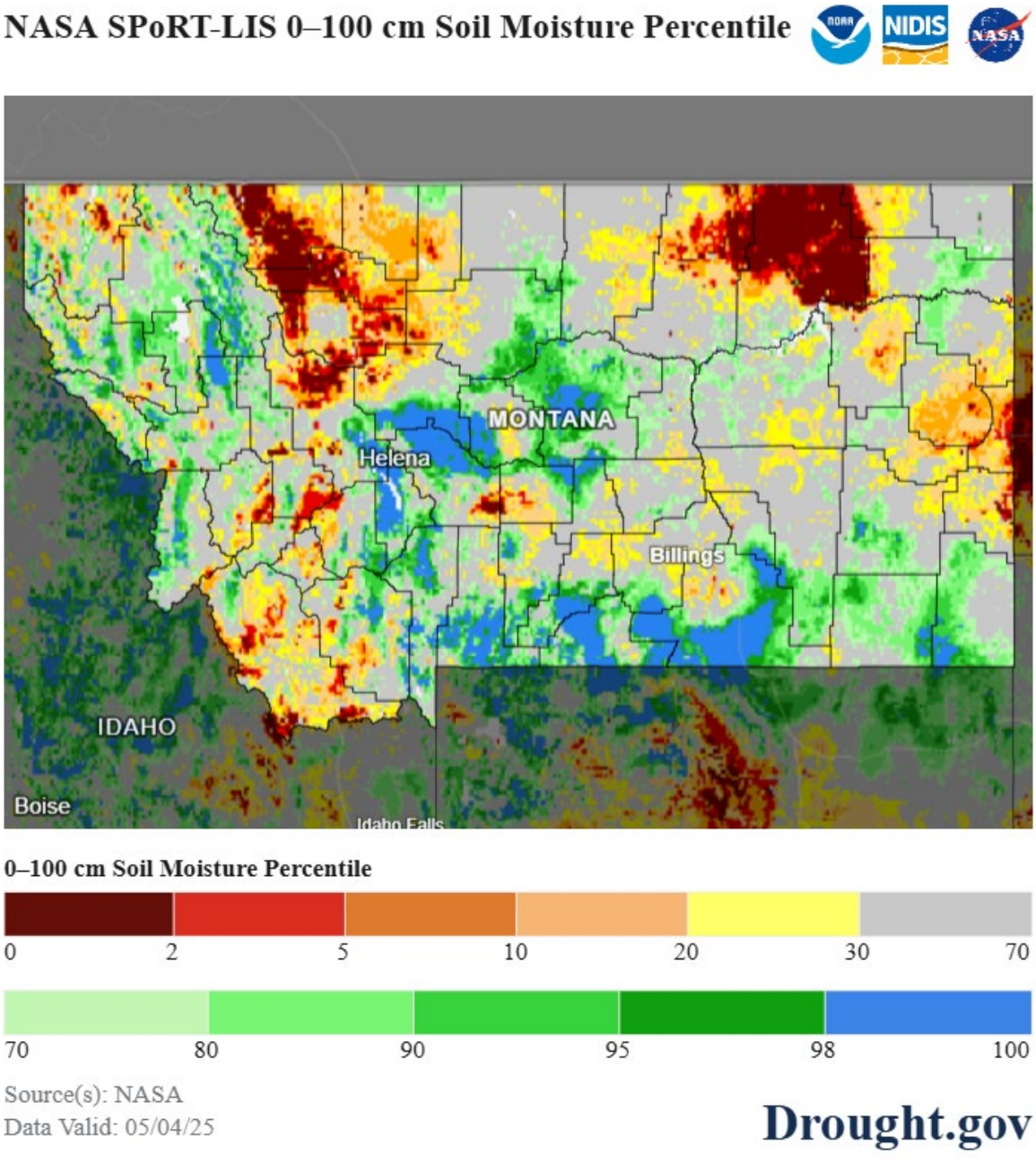
Below average temperatures persisted into early April before three waves of warmth crossed the region. The first two waves averaged 9 °F above normal. On April 11 during the second wave, SNOTEL sites in the Bighorn Basin reached 17 °F above normal. Most mid-elevation SNOTEL sites reached 60 °F, with Castle Creek SNOTEL nearly breaking 70 °F. Southwest Montana's turn to break records came with the third wave of warmth on April 15. The combined average of SNOTEL sites in the Jefferson basin exceeded records by around 4 °F with highs near 60 °F in a basin that averages around 28 °F. In the following days temperatures across the state tipped well below normal with statewide SNOTEL averages around in the mid twenties, then stabilized near normal the following week. Temps climbed 5 °F above average for the last week of April, and even higher in the Bighorn and Flathead regions. Despite the procession of warm waves, most of the state only registered slightly above normal temperatures across the whole month of April.



Statewide Overview

Soil Moisture

Soil moisture in the top 100 cm is largely unchanged from March, and values continue to vary across the state. The area north of Fort Peck Reservoir and the Rocky Mountain Front have the lowest soil moisture, with large areas in the 0-2 percentile. The central and south-central portions of the state have large areas with the highest soil moisture. The northwest part of the state has varying soil moisture with some areas well above normal. The southwest part of the state has isolated areas of well below normal soil moisture. Spring precipitation will be crucial for maintaining and improving soil moisture.



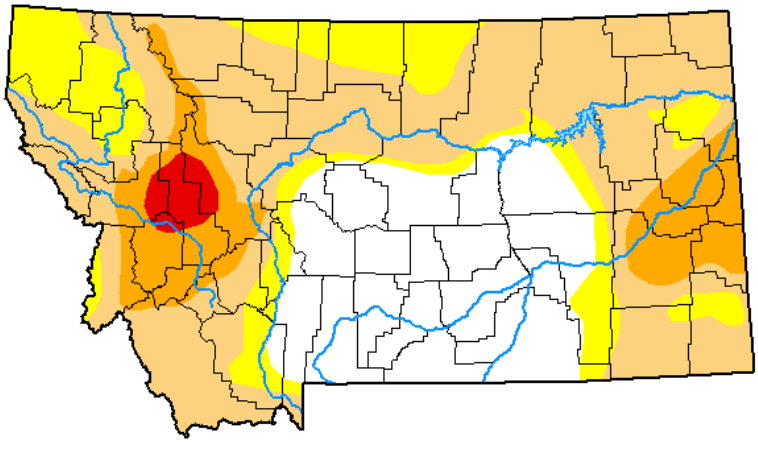
Statewide Overview

Drought Monitor

Drought conditions increased since last month in Montana. A greater portion of the state is now under drought conditions. The percentage of the state with no drought decreased from 36.81% to 26.38% since last month. This can be attributed to the north-central portion of the state, which changed from no drought conditions to abnormally dry and moderate drought. Portions of the Upper Clark Fork and Blackfoot basins are still classified as severe to extreme drought. This is the only area of the state with extreme drought classification. For drought conditions to improve, increased spring precipitation will be critical.

U.S. Drought Monitor

Montana



April 29, 2025

(Released Thursday, May. 1, 2025)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
Current	26.38	16.82	43.55	11.53	1.72	0.00
Last Week 04-22-2025	25.10	24.68	36.20	12.30	1.72	0.00
3 Months Ago 01-28-2025	3.51	43.22	29.33	19.37	4.58	0.00
Start of Calendar Year 01-07-2025	6.70	39.08	26.98	13.46	13.79	0.00
Start of Water Year 10-01-2024	15.18	42.58	21.19	11.61	8.54	0.90
One Year Ago 04-30-2024	14.10	42.53	30.68	11.22	1.47	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

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CPC/NOAA/NWS/NCEP

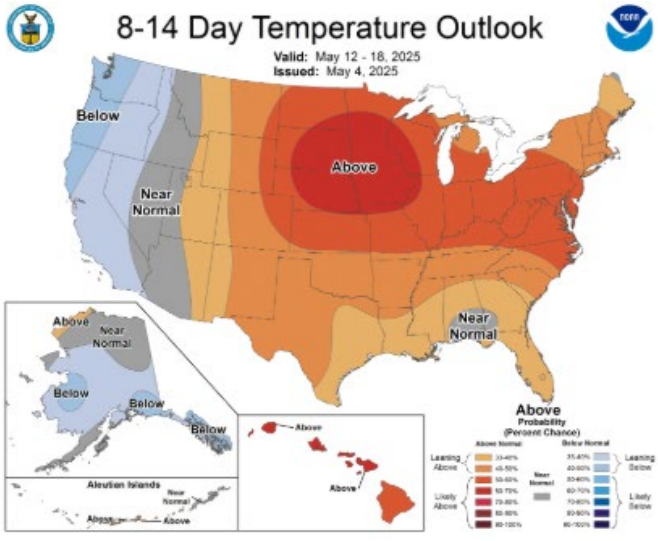
droughtmonitor.unl.edu

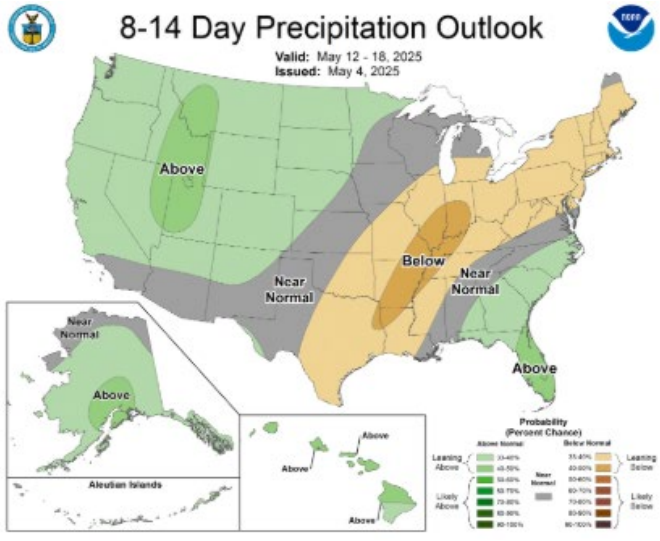
Statewide Overview

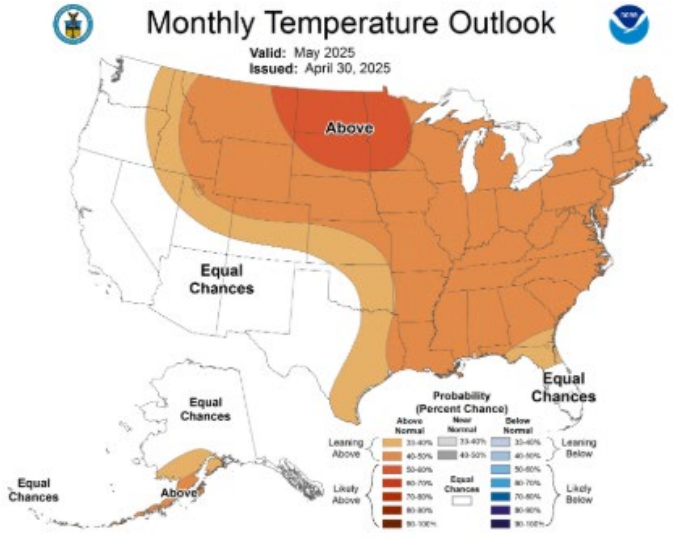
Weather Outlook

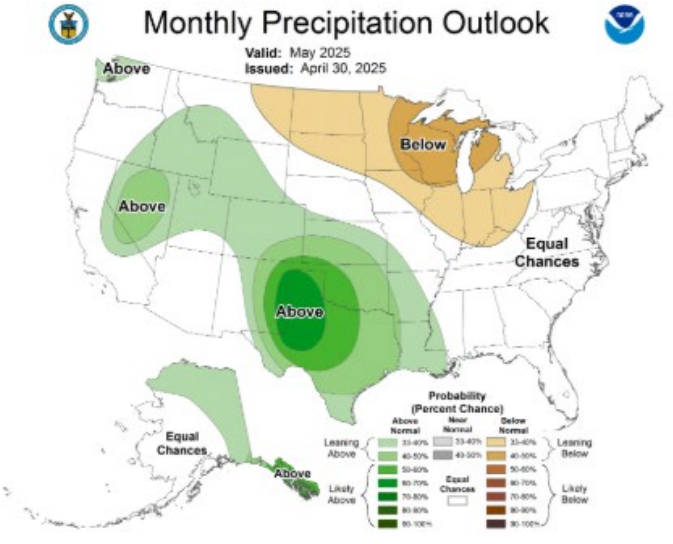
According to the NOAA Climate Prediction Center, the western third of the state will have near normal temperatures over the next 8-14 days while the eastern two-thirds of the state leans toward above normal temperatures - except for the far southeastern corner of the state which will likely have above normal temperatures. The whole state leans toward above normal precipitation in the next 8-14 days, with the southwestern portion of the state having slightly higher chances.

The monthly outlook predicts the whole state to lean toward above normal temperatures, with the northwestern corner of the state having slightly lower chances and the northeastern portion of the state having slightly higher chances. The northeastern corner of the state leans toward below normal precipitation while the southwest corner is leaning toward above normal. The rest of the state has equal chances of above or below normal precipitation.





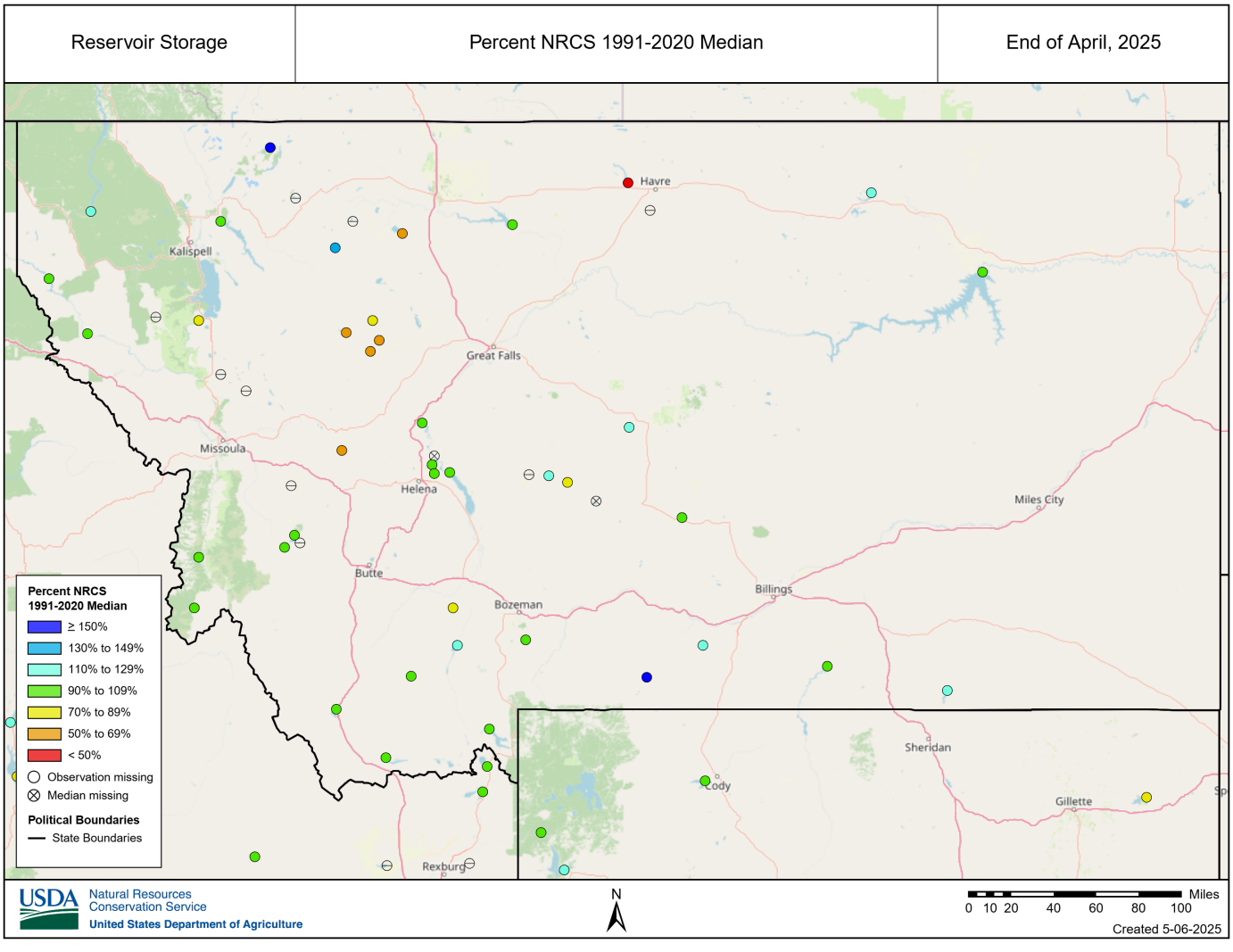




Statewide Overview

Reservoirs

Montana reservoirs at the end of April were a mixed bag of near, above, and below normal levels. Around half of the reservoirs included in this report had near normal levels for the end of April. Around a quarter of the reservoirs had above normal end of April levels. Ackley Lake, Cooney, Ennis Lake, Lake Koocanusa, Nelson, Smith River, Swift, and Tongue River Reservoirs had end of April levels between 110% and 130% of median. Lake Sherburne and Mystic Lake reported well above normal end of April reservoir fill levels. The remaining quarter of reservoirs across the state reported below normal end of April fill levels between 50% and 90% of median, this includes Bair, Gibson, Flathead Lake, Fresno, Lake Frances, Nevada Creek, Nilan, Pishkun, Willow Creek – Augusta, and Willow Creek – Harrison Reservoirs.



Statewide Overview

Reservoirs (Continued)

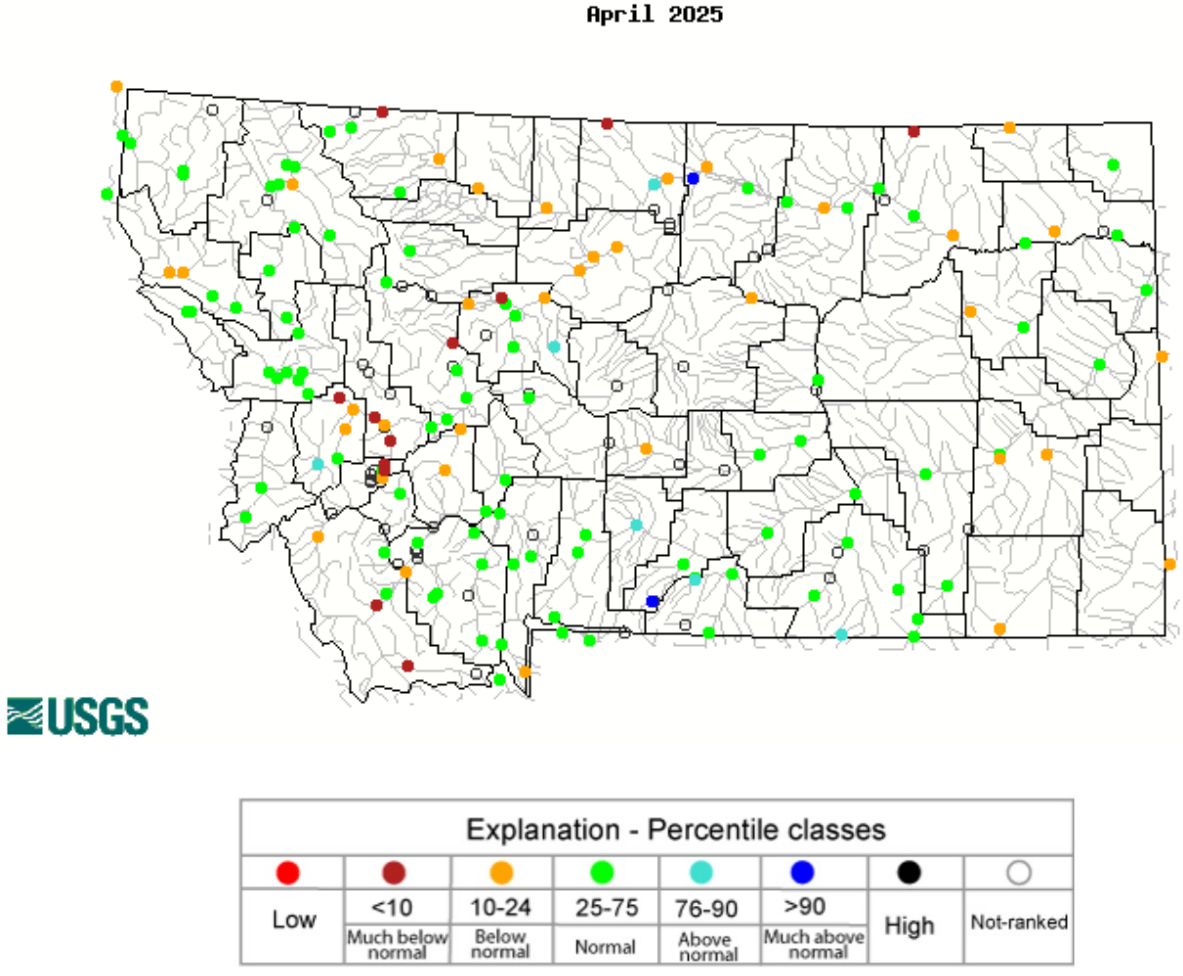
End of April - Reservoir Storage Percent of Capacity

Reservoir	Basin	Current % Capacity	Last Year % Capacity	Median % Capacity
Smith River Res	Smith-Judith-Musselshell	98	108	80
Deadman's Basin Res	Smith-Judith-Musselshell	97	99	89
Bair Res	Smith-Judith-Musselshell	52	79	70
Swift Res	Sun-Teton-Marias	80	71	61
Lake Frances	Sun-Teton-Marias	36	46	66
Lake Elwell (Tiber)	Sun-Teton-Marias	50	53	55
Gibson Res	Sun-Teton-Marias	34	43	62
Mystic Lake	Upper Yellowstone	3	2	1
Cooney Res	Upper Yellowstone	104	100	83
Ruby River Reservoir	Jefferson	94	97	97
Lima Reservoir	Jefferson	78	91	74
Clark Canyon Res	Jefferson	58	68	54
Painted Rocks Lake	Bitterroot	64	88	68
Lake Como	Bitterroot	64	71	62
Bull Lake	Bighorn	26	51	55
Buffalo Bill	Bighorn	59	72	61
Boysen	Bighorn	63	69	67
Bighorn Lake	Bighorn	59	58	57
Lake Helena	Upper Missouri	86	87	87
Holter Lake	Upper Missouri	99	100	99
Helena Valley Reservoir	Upper Missouri	90	95	95
Canyon Ferry Lake	Upper Missouri	73	80	72
Lake Koocanusa	Kootenai	65	71	52
Hungry Horse Lake	Flathead	77	87	72
Flathead Lake	Flathead	49	60	57
Nelson Res	Milk	85	89	75
Fresno Res	Milk	34	35	68
Noxon Rapids Reservoir	Lower Clark Fork	89	96	95
Fort Peck Lake	Lower Missouri	72	77	74
Nevada Creek Res	Upper Clark Fork	46	71	84
Georgetown Lake	Upper Clark Fork	95	95	92
Tongue River Res	Tongue	80	87	70
Lake Sherburne	St. Mary	77	54	32
Hebgen Lake	Madison	80	88	75
Ennis Lake	Madison	89	88	80
Middle Creek Res	Gallatin	65	68	66

Statewide Overview

Streamflow

Streamflow was near normal at most stations in the month of April. The south-central portion of the state experienced near to above normal streamflow. This includes the Madison, Gallatin, and Yellowstone basins. The Upper Clark Fork sustained below to much below normal streamflow. This same area is currently in extreme to severe drought conditions. Snowmelt at low and mid elevations contributed to streamflow increases in some locations. Spring precipitation and snowmelt rates will affect streamflow in the following weeks.



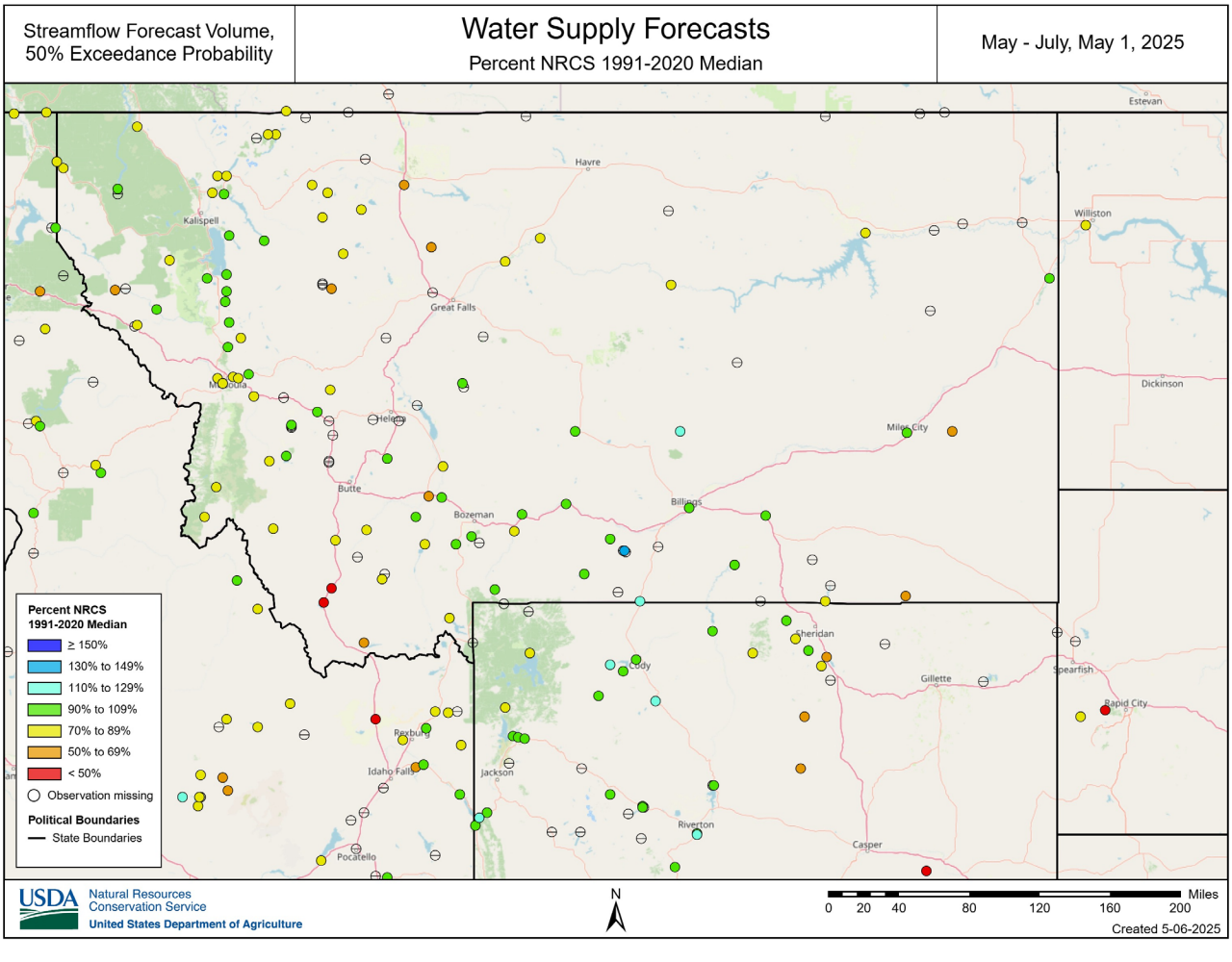
Statewide Overview

Water Supply Forecasts

The May 1 water supply forecasts are similar to the April 1 forecasts, with most of the state forecasted to be near or below normal at 70 – 110% of the median. April storms in the Big Horns helped improve the forecast for the Tongue River Basin with forecast points improving by about 10% to 85 – 100% of normal. To the south, the Powder River Basin did not see these improvements, where forecasts remain about 60 – 70% of normal.

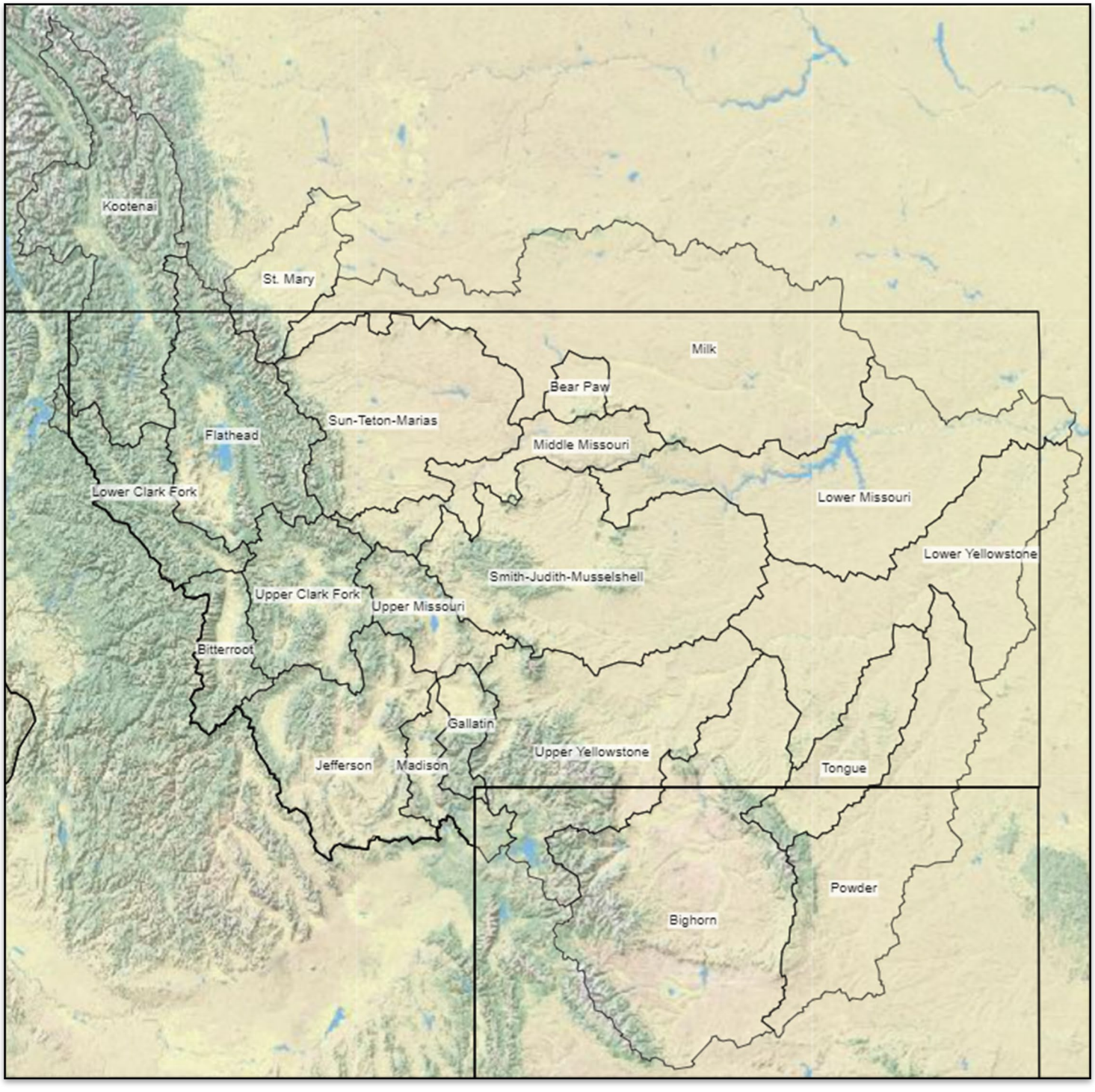
The Upper Yellowstone and Big Horn Basins are still on track to experience normal streamflow, with SNOTEL sites in the Absaroka-Beartooth Wilderness averaging near normal snow water equivalent. For example, the forecast point on the Stillwater River near Absarokee has stayed near 100% of normal since the March 1 forecast, with the uncertainty in the forecast decreasing. The Missouri Headwaters and Flathead Valley areas are both forecasted to be near or slightly below normal stream volume with 80 – 100% of median. The larger deficit in the Sun-Teton-Marias basin persisted and forecasted water volume slightly decreased to 60 – 75% of median. The Beaverhead River Basin is forecasted for 35 – 50% of normal streamflow. The Beaverhead River at Barretts forecast point dwindled from a 50% chance of exceeding 80,000 Acre-Feet in the April 1 forecast to 60,000 Acre-Feet in the May 1 forecast. Percentagewise, this is one of the biggest drops in forecasted streamflow from last month's forecast.

Forecasts are subject to uncertainty due to the unpredictable nature of spring weather, and these forecasts provide a range of possible runoff values. It is important to consider all exceedance probabilities to fully understand the water supply outlook and possible associated error. Note that forecasts for April-July are comparable to May-July forecasts because the May-July forecast includes observed April stream flow volume.



Basin Overview

Montana River Basin Definitions

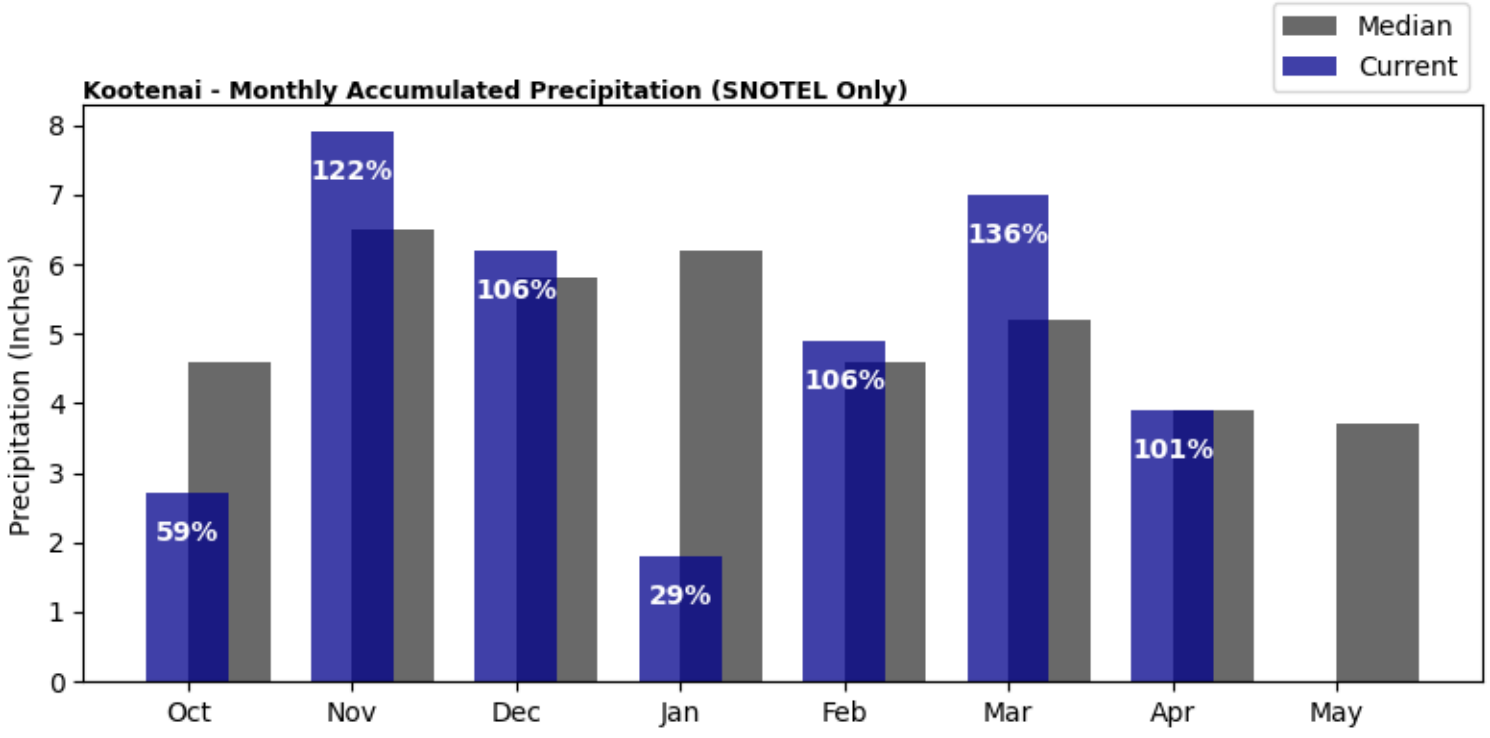


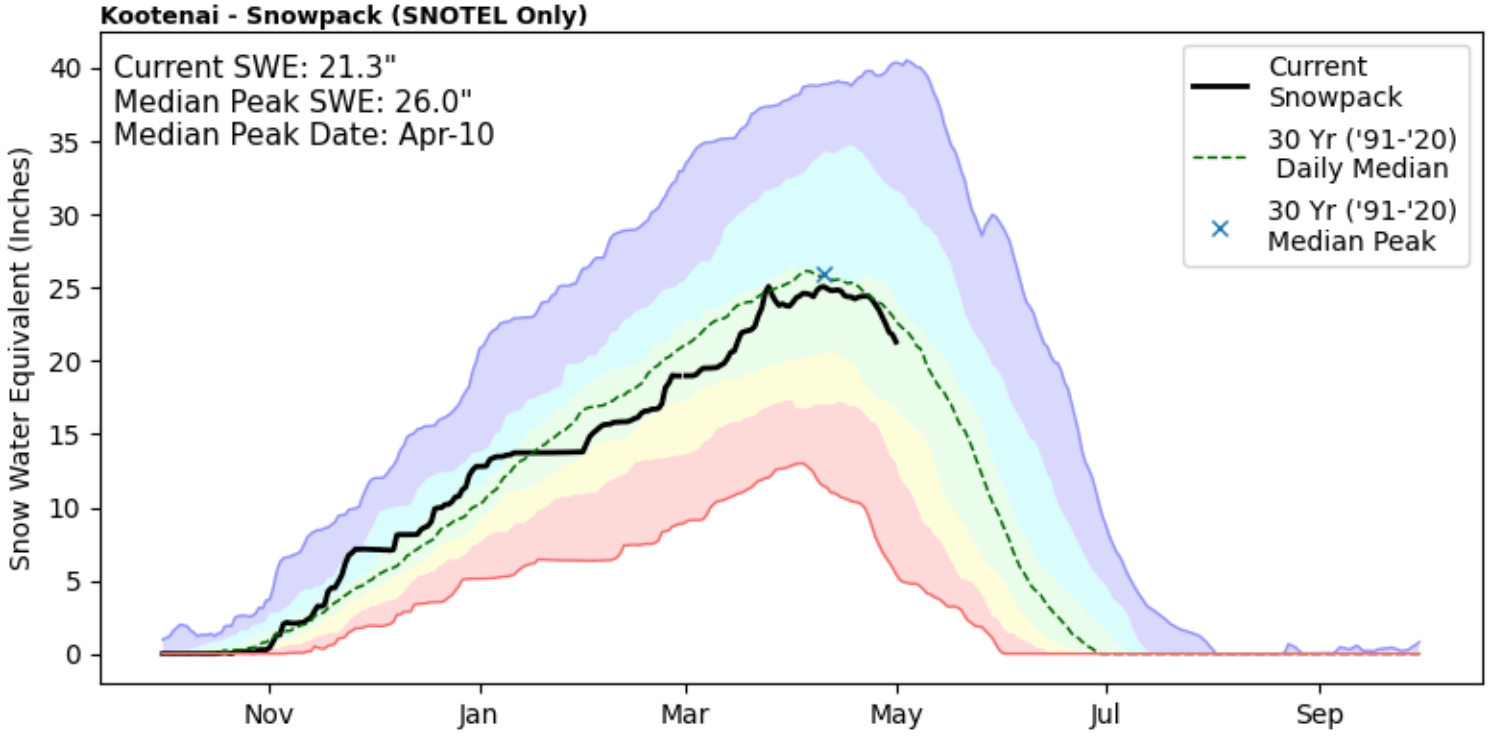
The following basin overview sections only include basins that have SNOTEL sites. For example, there is no basin overview for the Lower Yellowstone, because there are no SNOTEL sites associated with that basin. Water supply information for basins not included in the following sections can be found at https://nwcc-apps.sc.egov.usda.gov/

Basin Overview

Kootenai

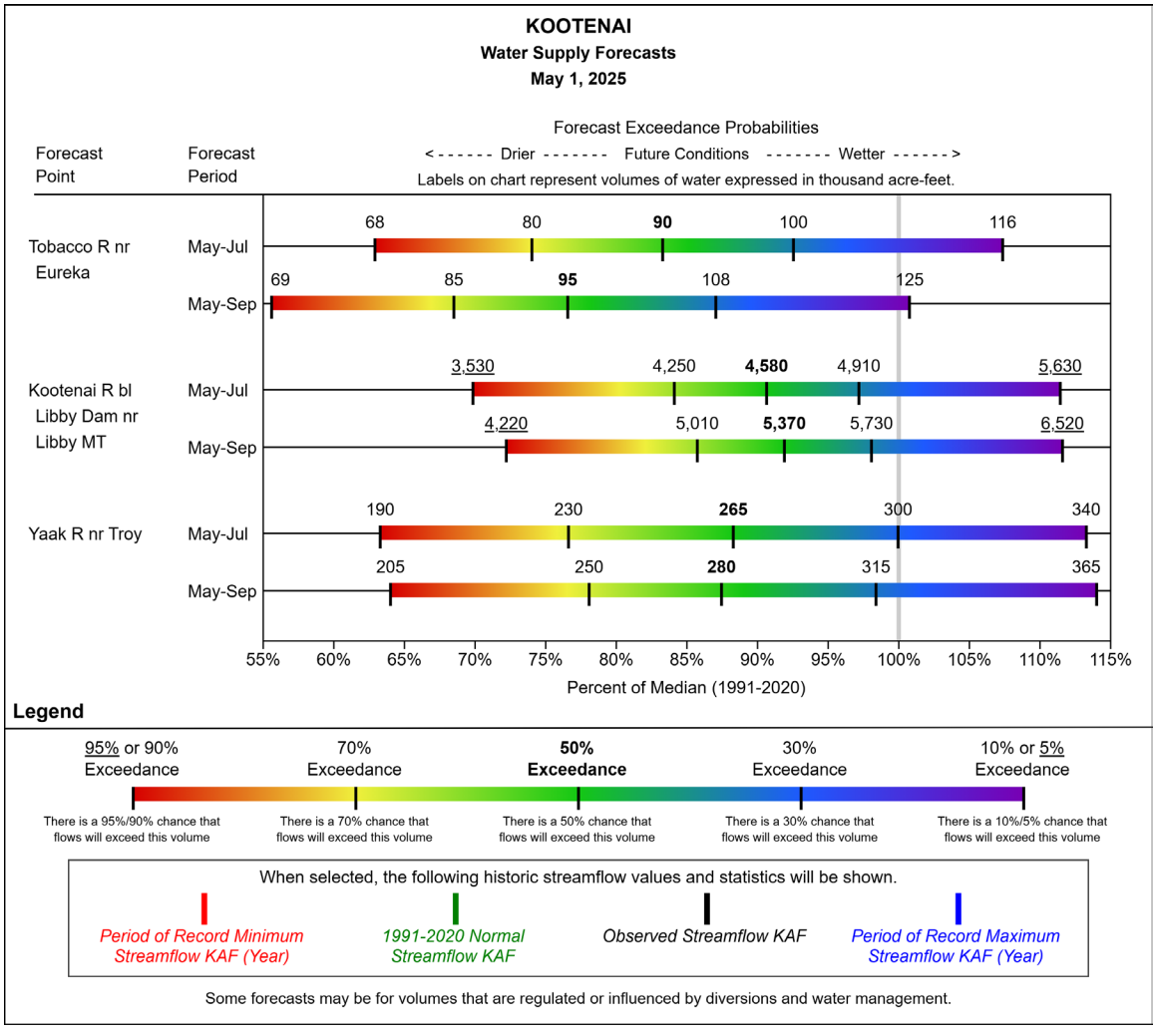
Precipitation in April was near normal at 101%, which brings the seasonal accumulation (October-April) to 87% of median. The snowpack in the Kootenai is below normal at 83% of median, compared to 77% at this time last year.





Basin Overview

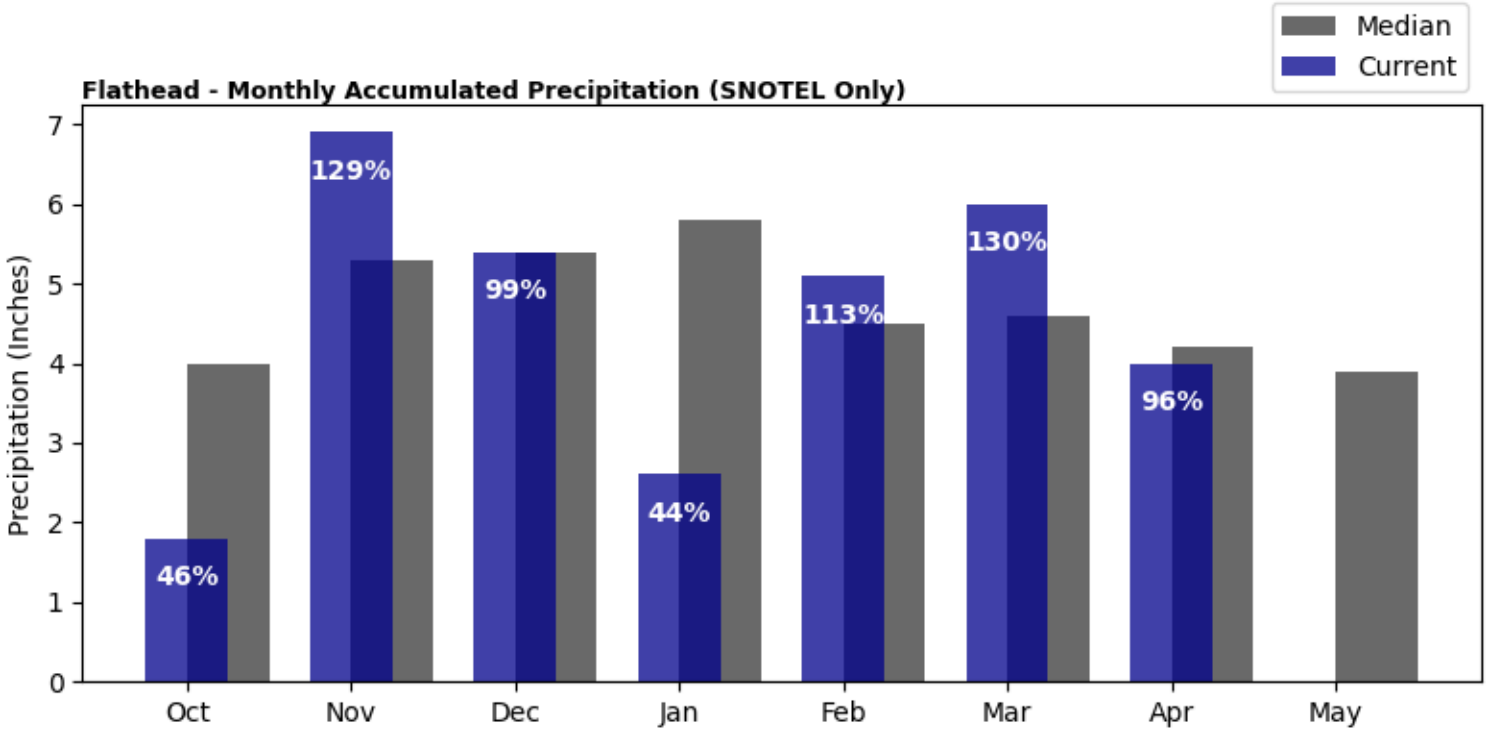
Kootenai (Continued)

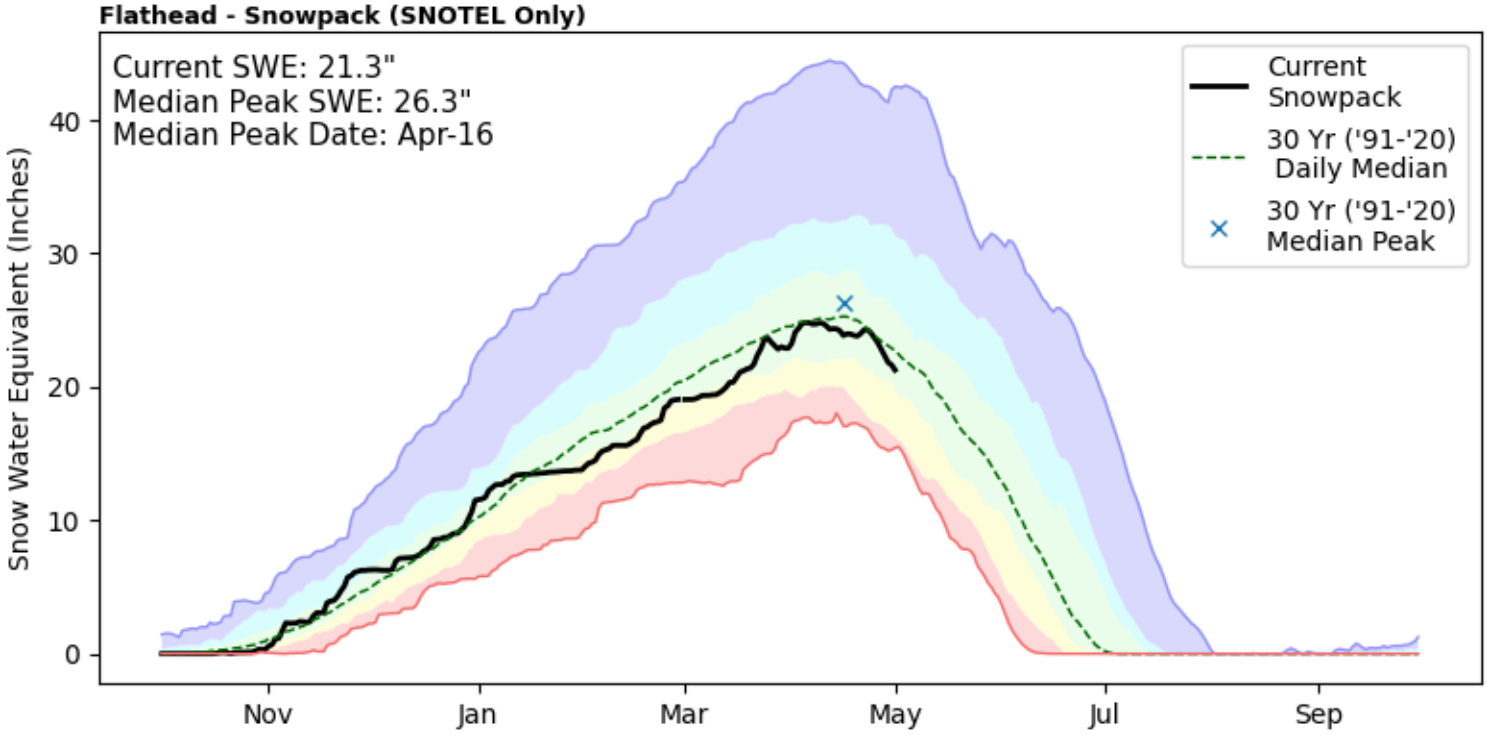


Basin Overview

Flathead

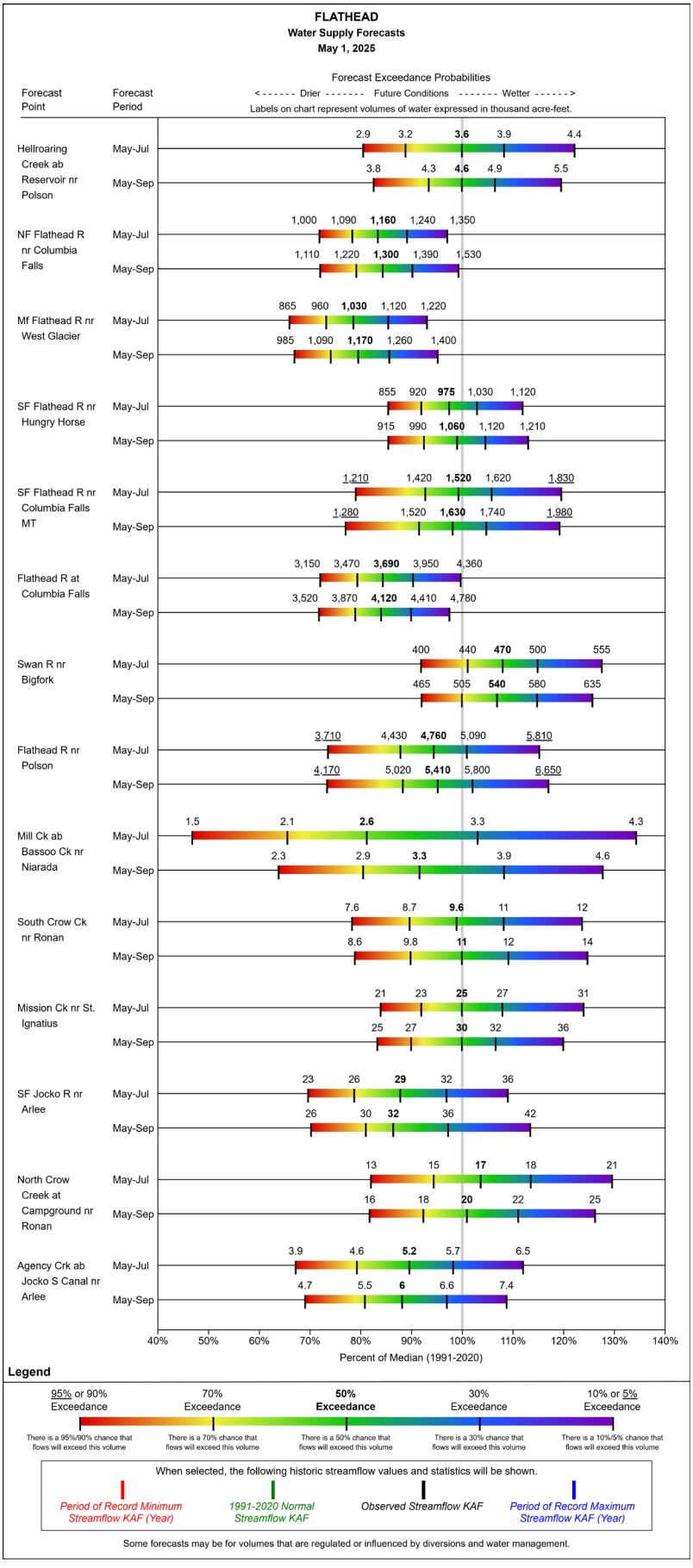
Precipitation in April was near normal at 96%, which brings the seasonal accumulation (October-April) to 91% of median. The snowpack in the Flathead is below normal at 86% of median, compared to 68% at this time last year.





Basin Overview

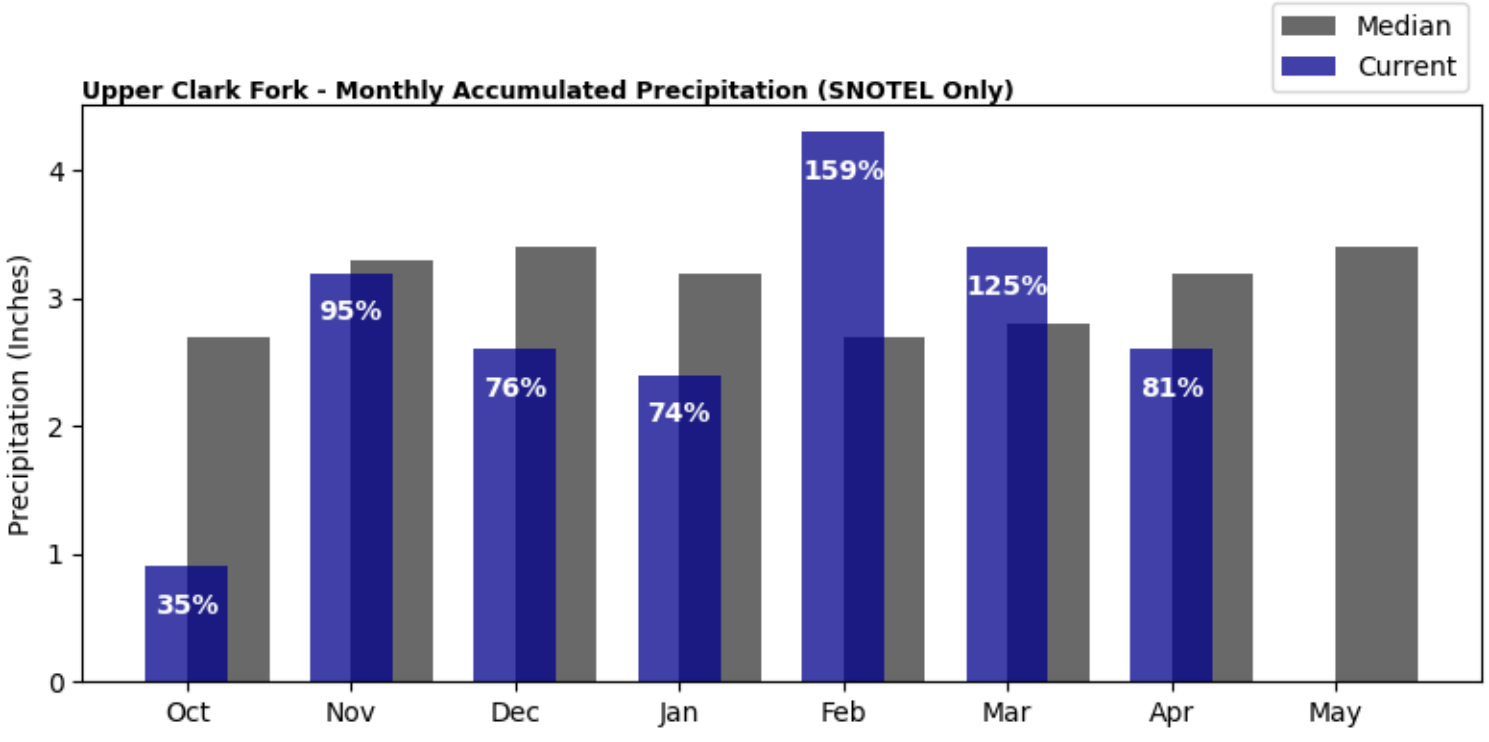
Flathead (Continued)

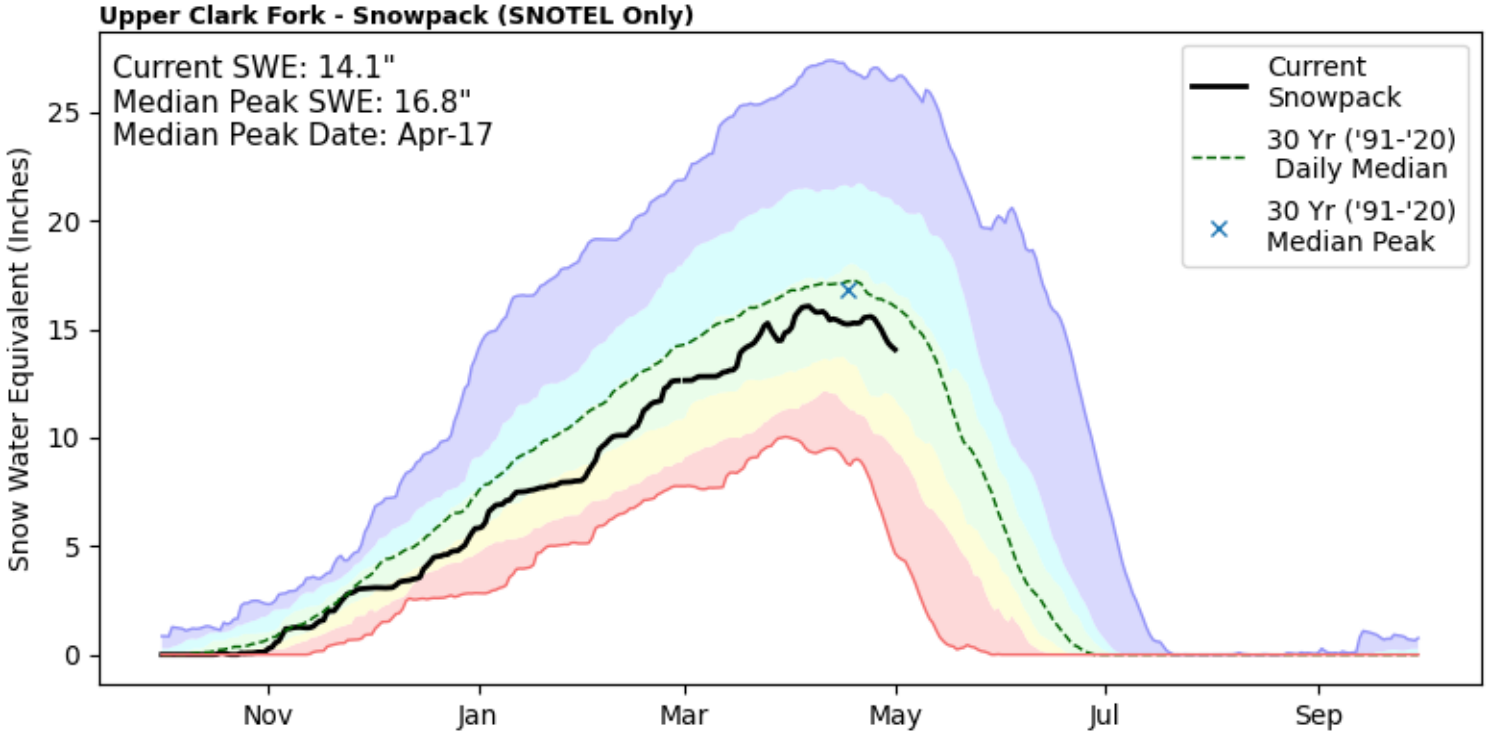


Basin Overview

Upper Clark Fork

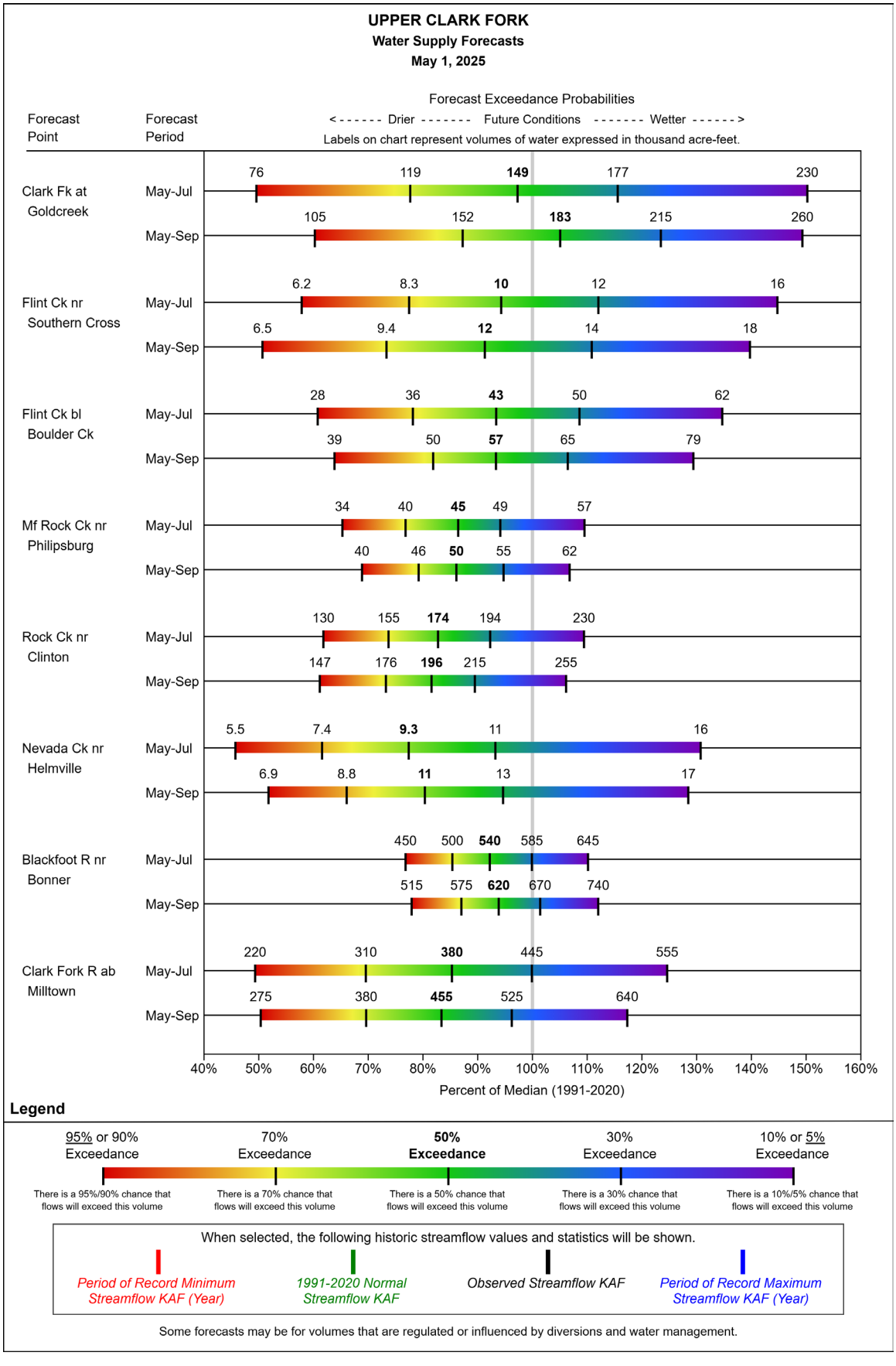
Precipitation in April was below normal at 81%, which brings the seasonal accumulation (October-April) to 89% of median. The snowpack in the Upper Clark Fork is below normal at 91% of median, compared to 56% at this time last year.





Basin Overview

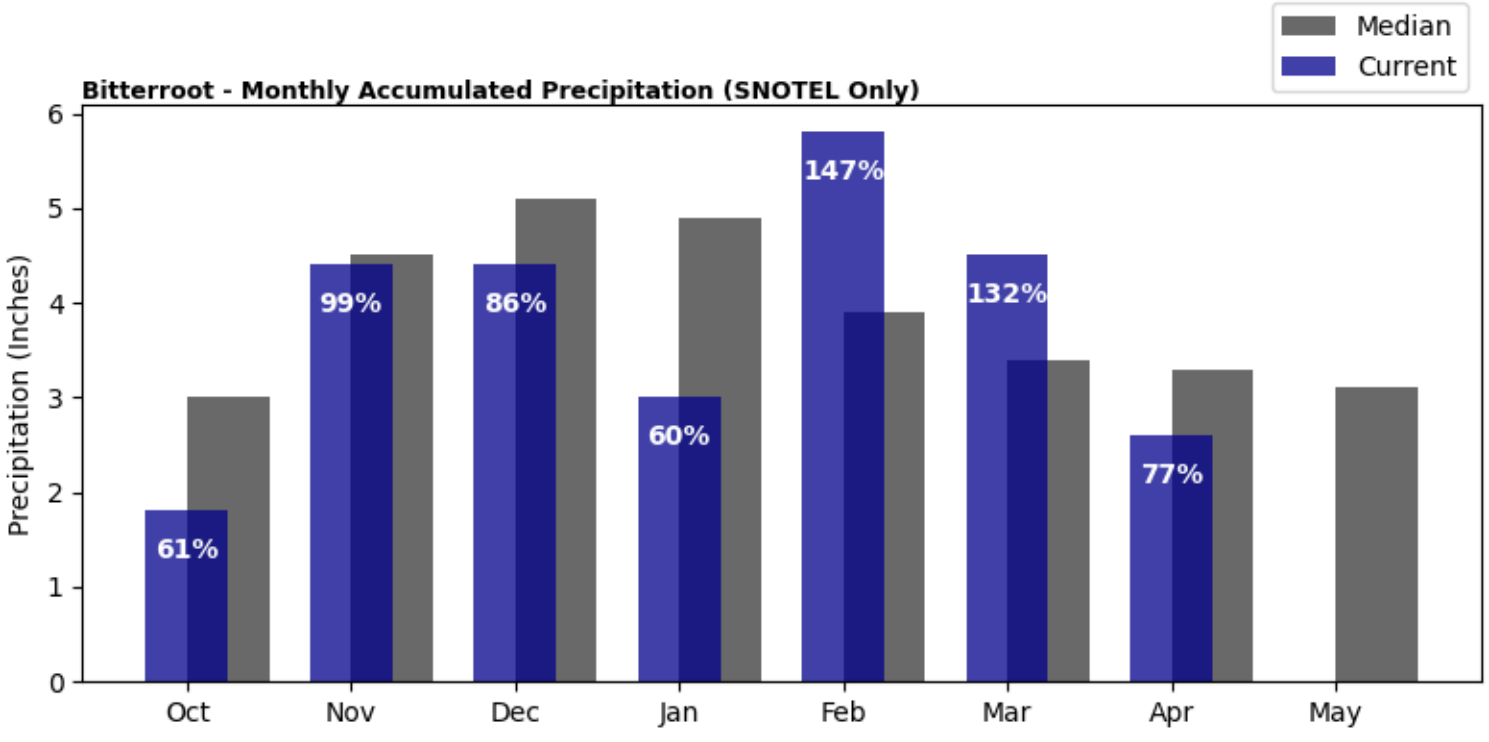
Upper Clark Fork (Continued)

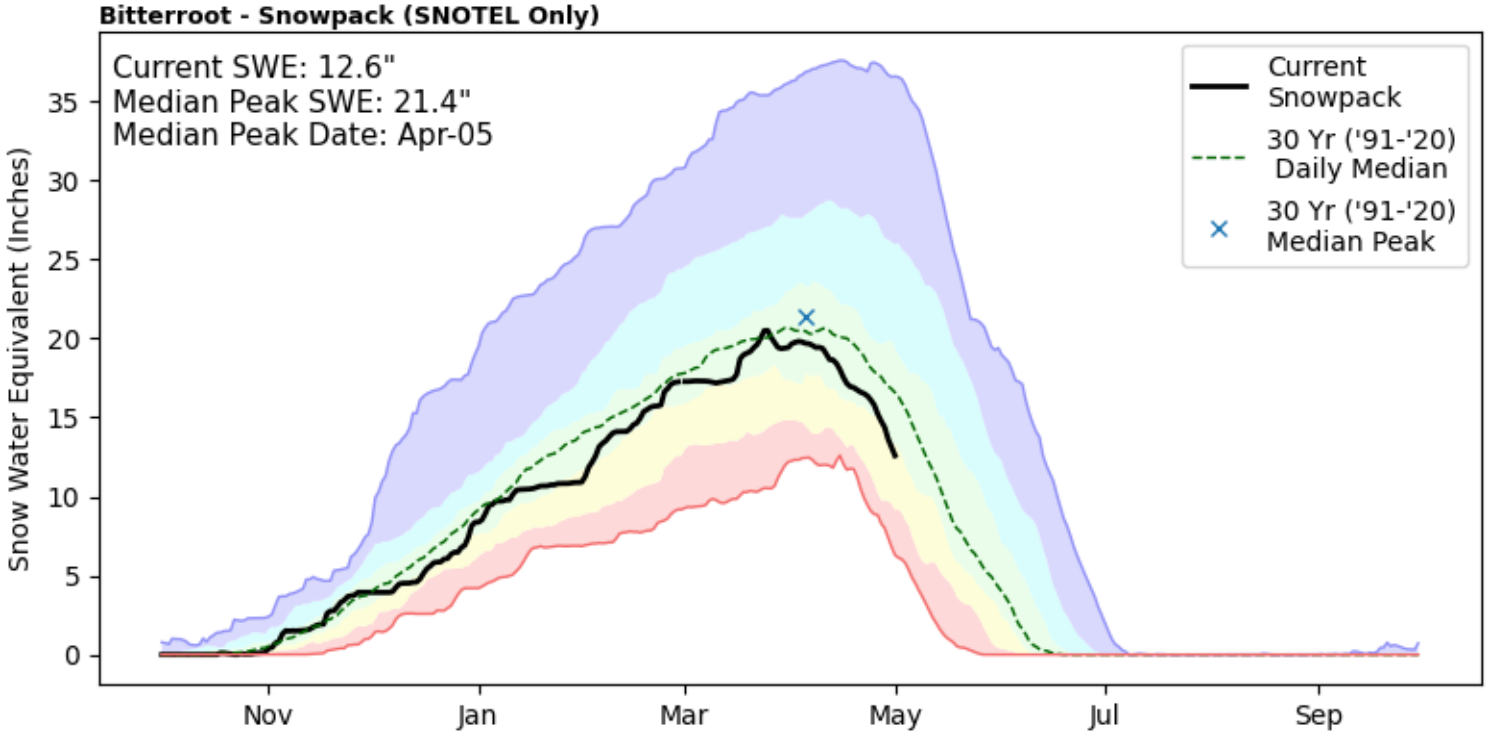


Basin Overview

Bitterroot

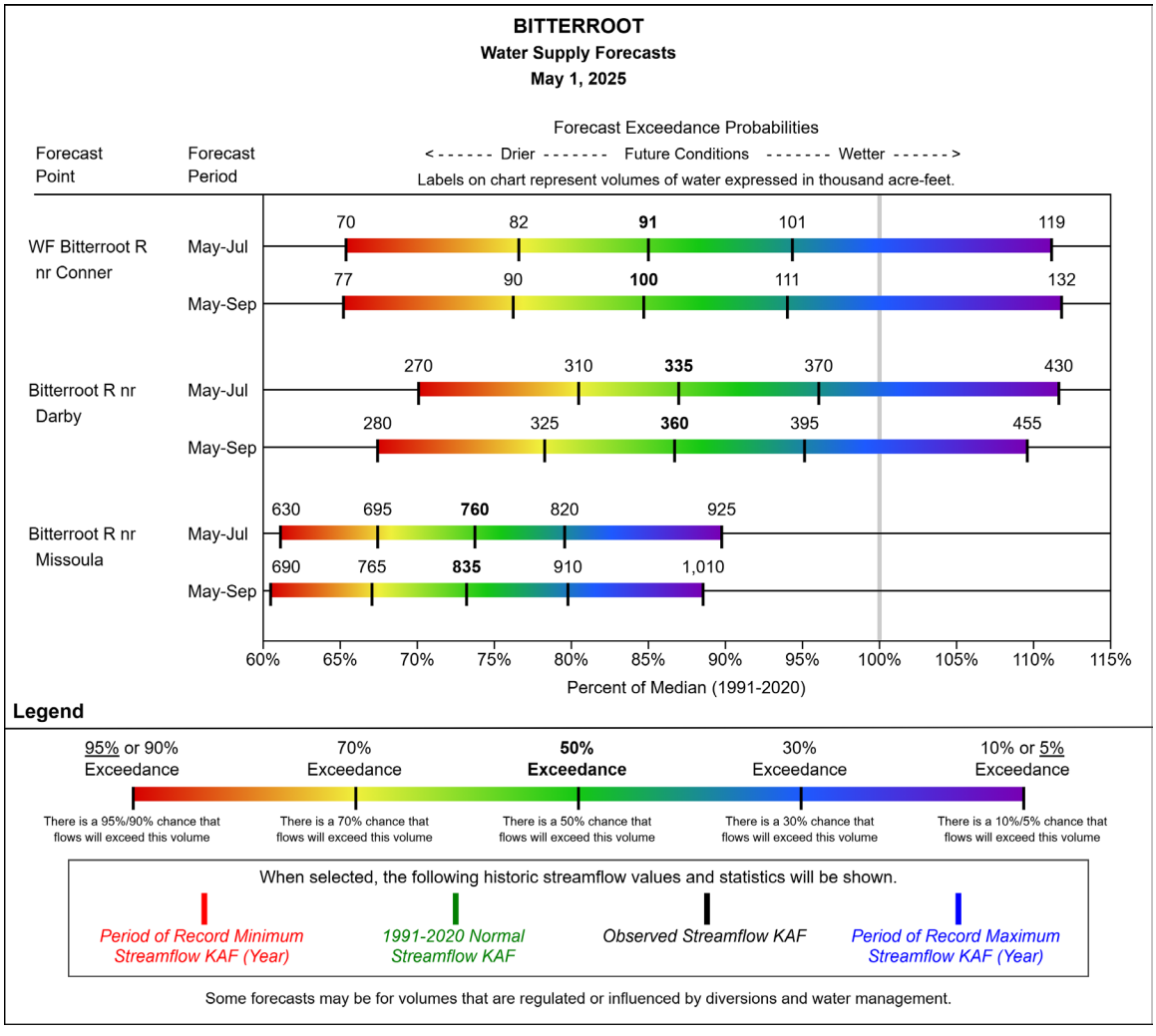
Precipitation in April was well below normal at 77%, which brings the seasonal accumulation (October-April) to 90% of median. The snowpack in the Bitterroot is well below normal at 76% of median, compared to 54% at this time last year.





Basin Overview

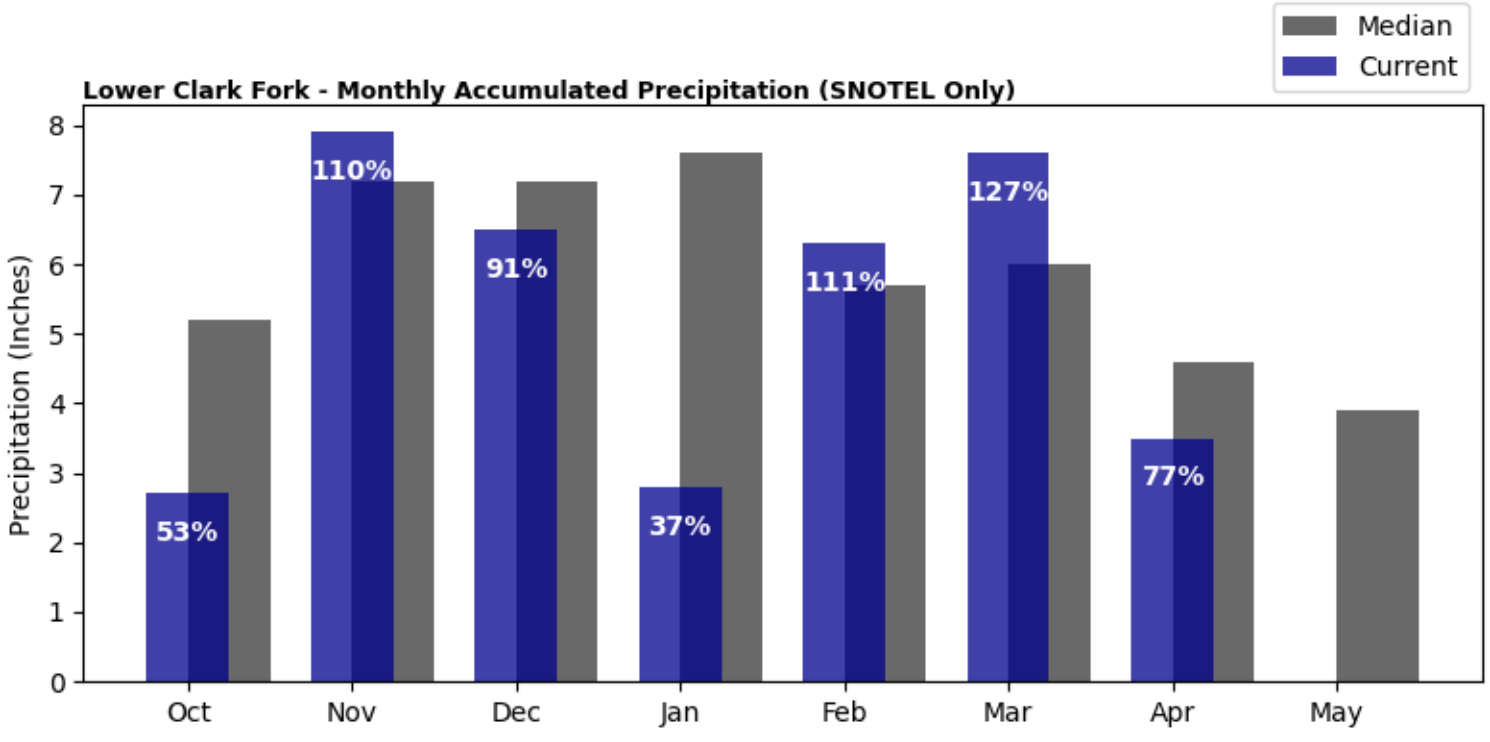
Bitterroot (Continued)

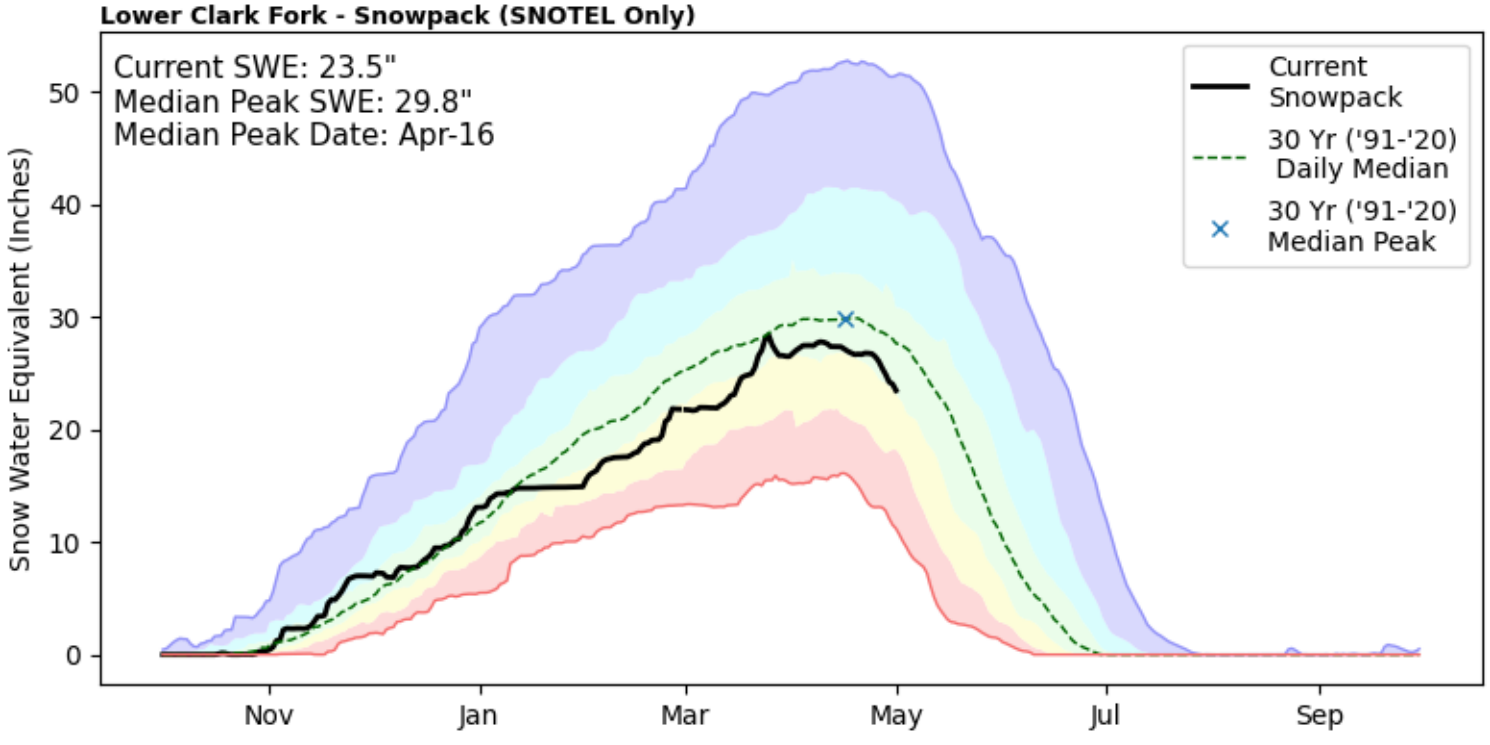


Basin Overview

Lower Clark Fork

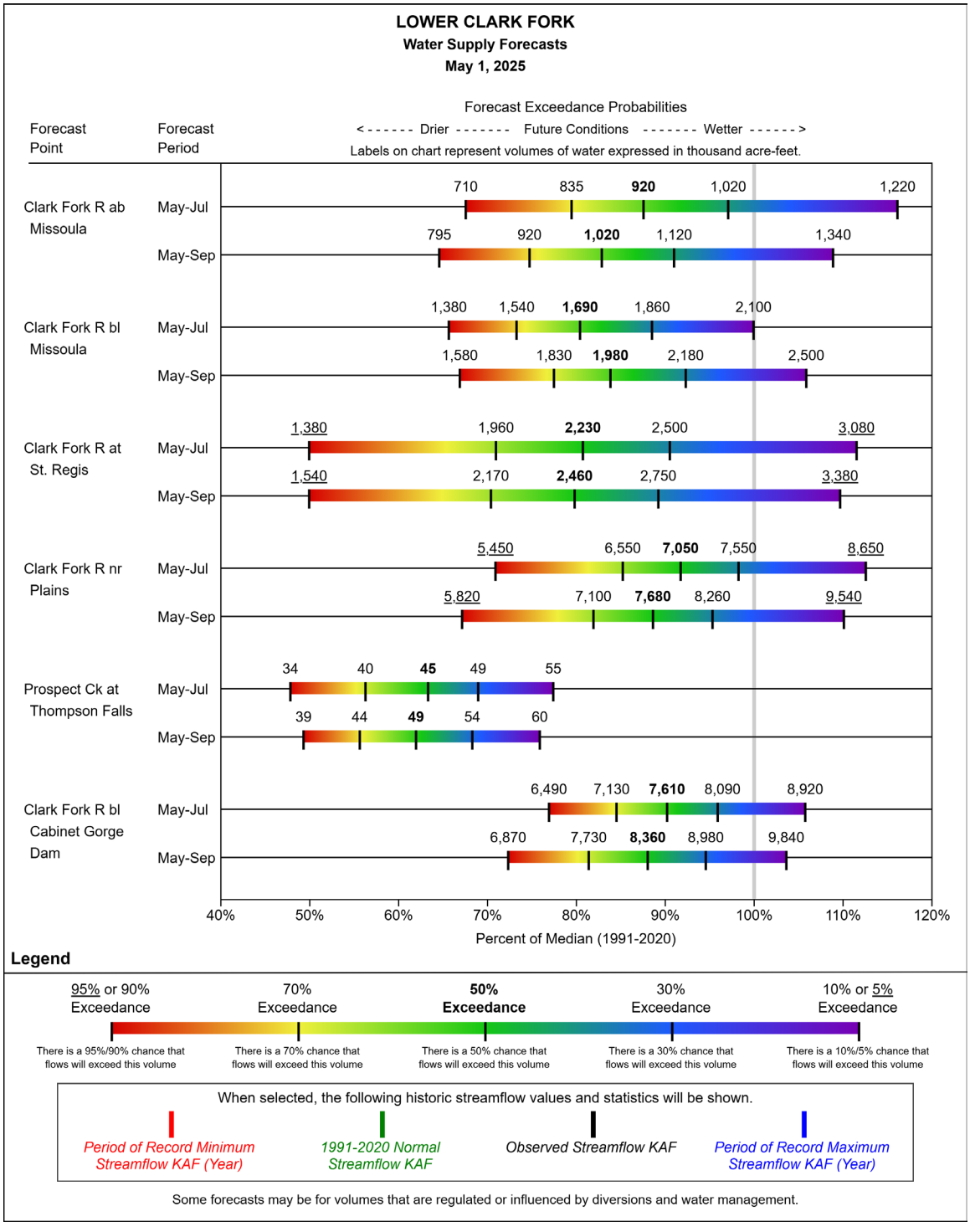
Precipitation in April was well below normal at 77%, which brings the seasonal accumulation (October-April) to 81% of median. The snowpack in the Lower Clark Fork is below normal at 85% of median, compared to 68% at this time last year.





Basin Overview

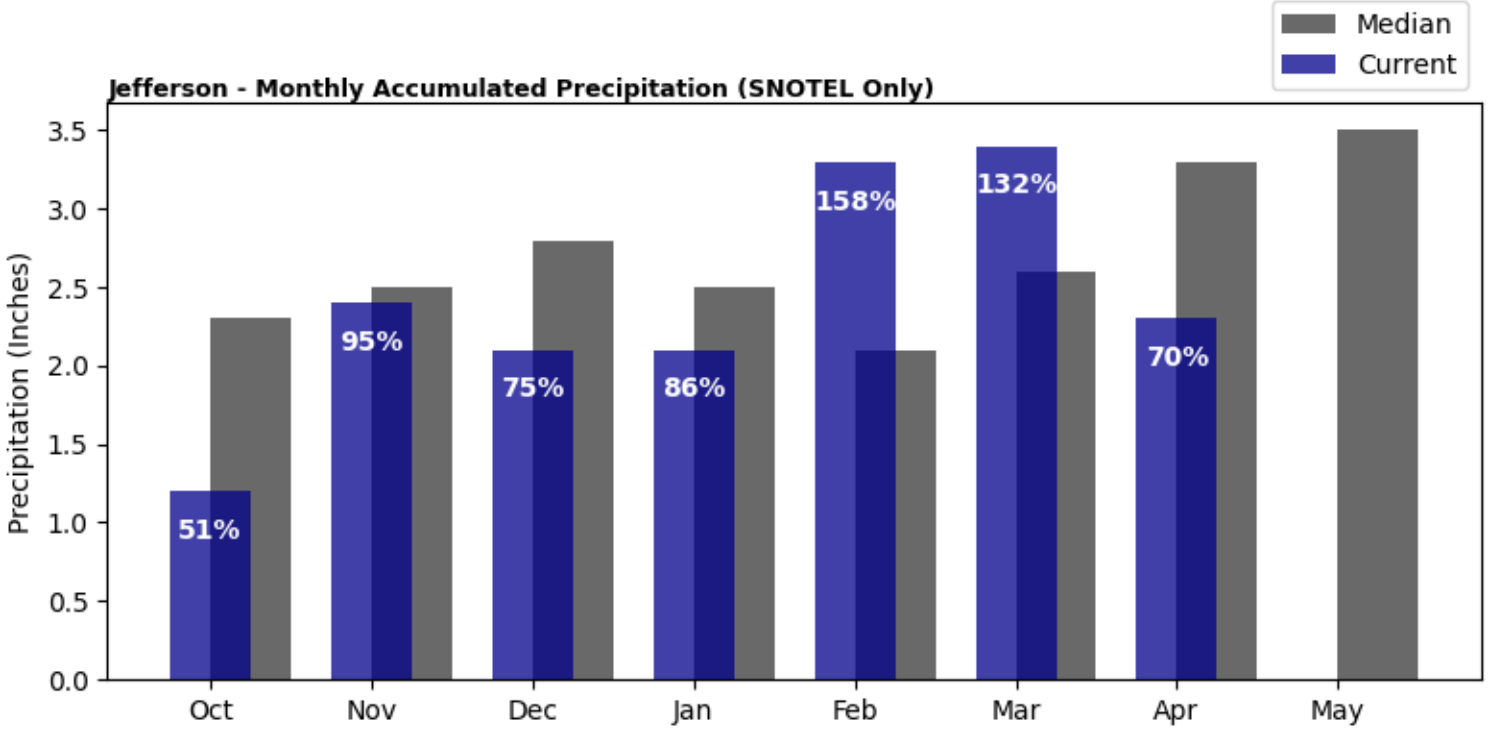
Lower Clark Fork (Continued)

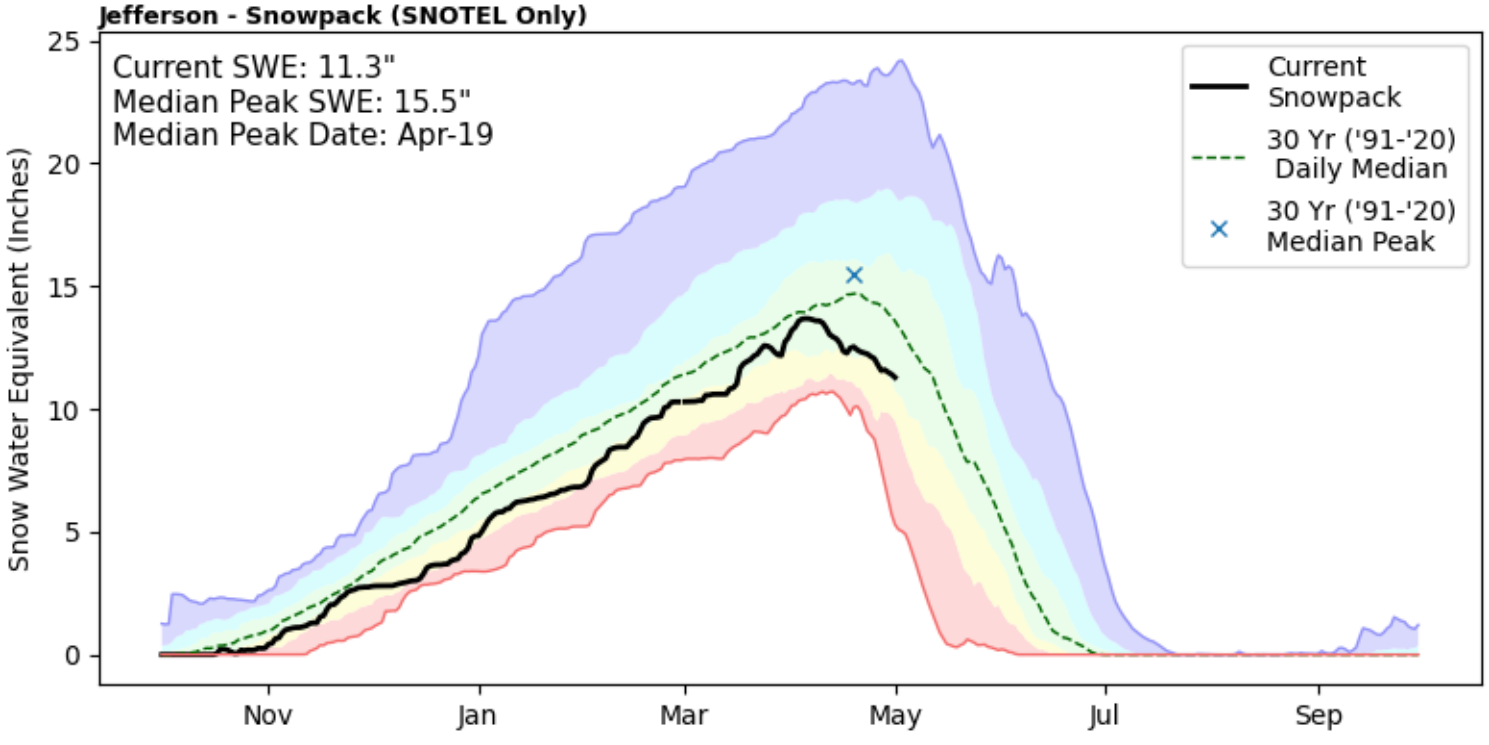


Basin Overview

Jefferson

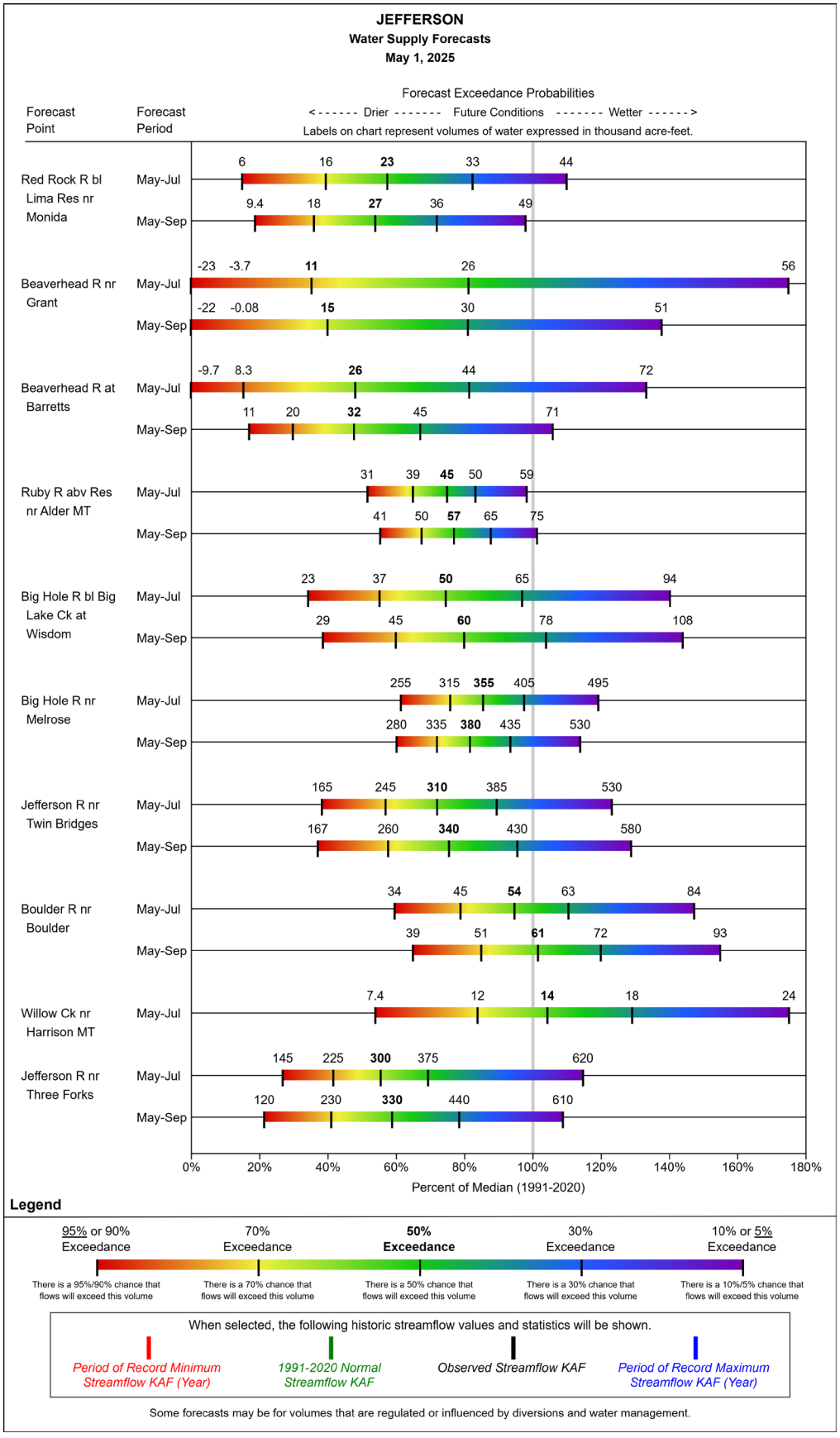
Precipitation in April was well below normal at 70%, which brings the seasonal accumulation (October-April) to 92% of median. The snowpack in the Jefferson is below normal at 89% of median, compared to 69% at this time last year.





Basin Overview

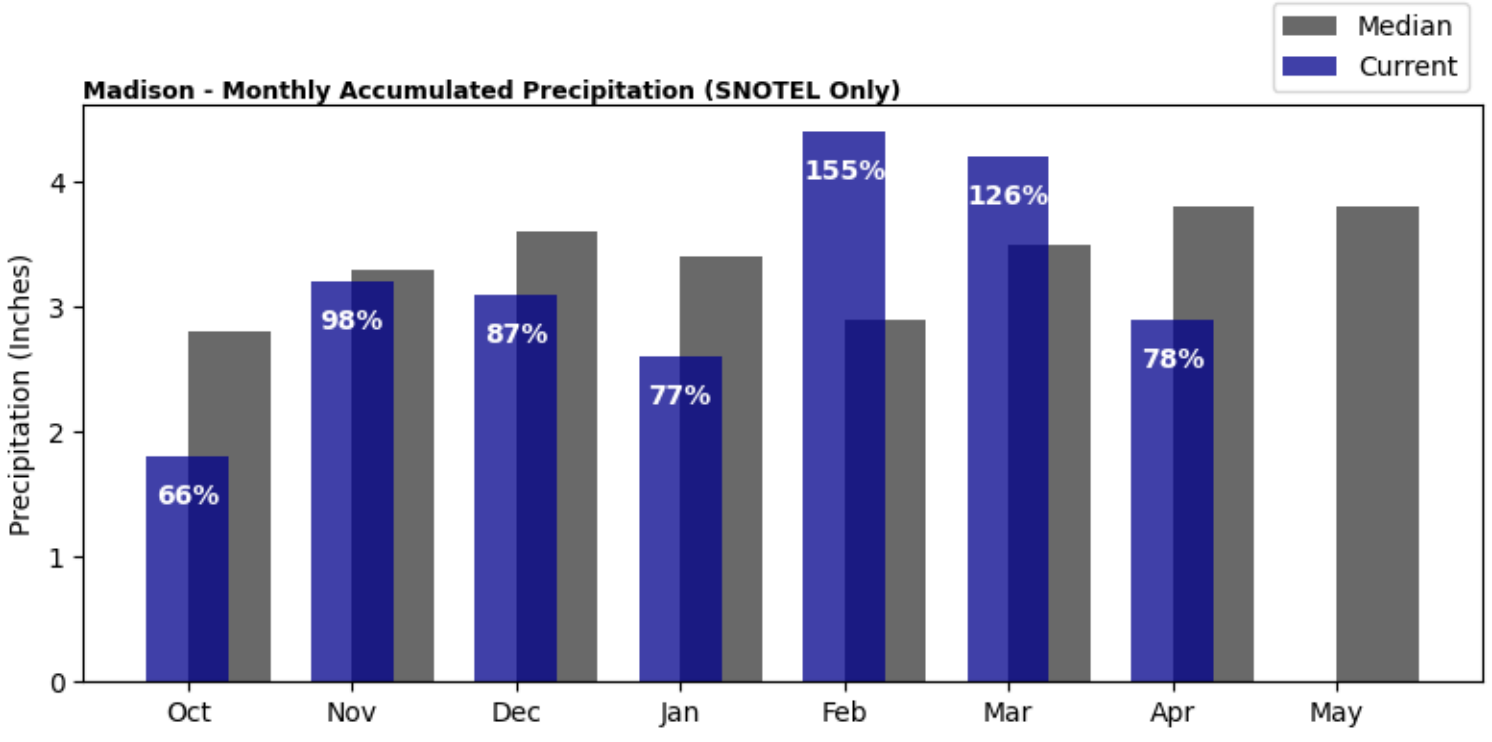
Jefferson (Continued)

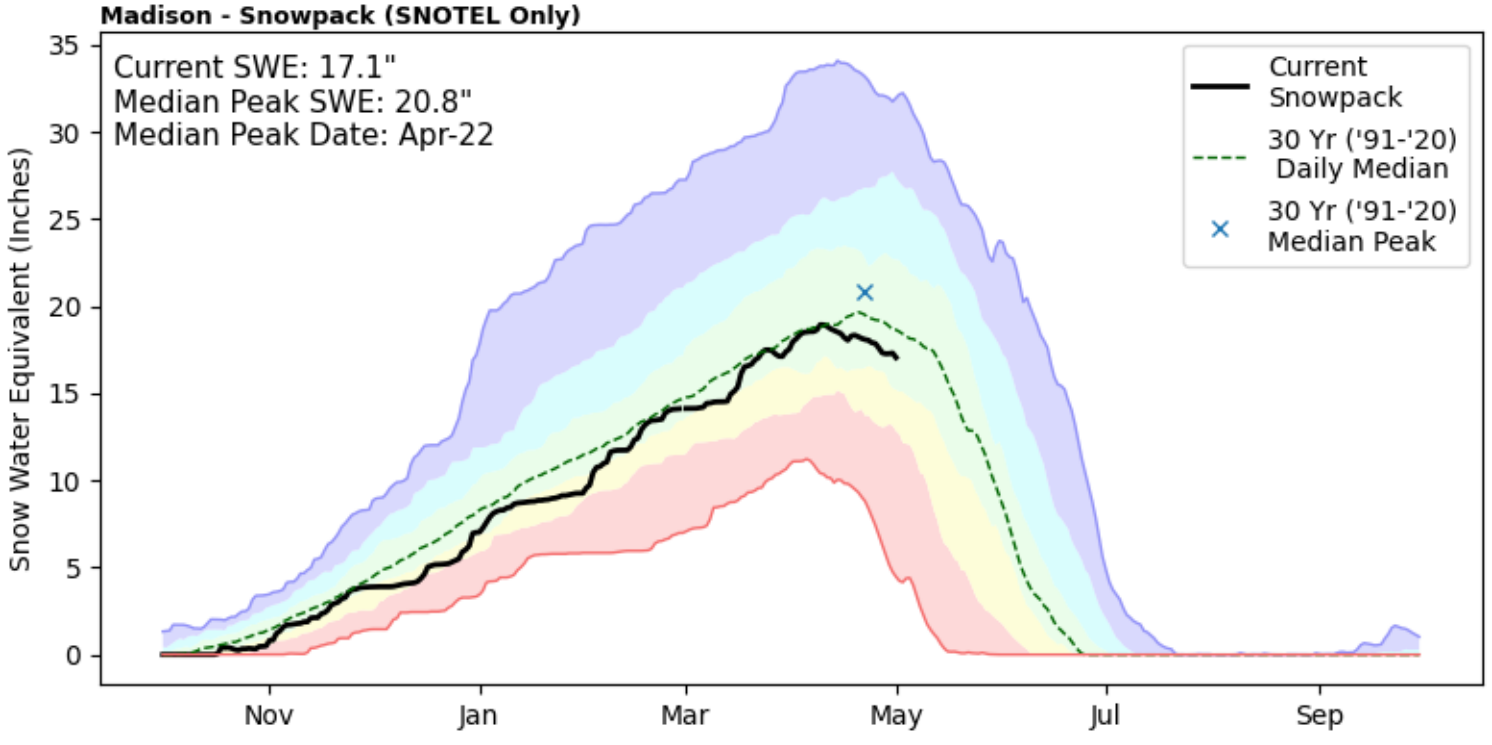


Basin Overview

Madison

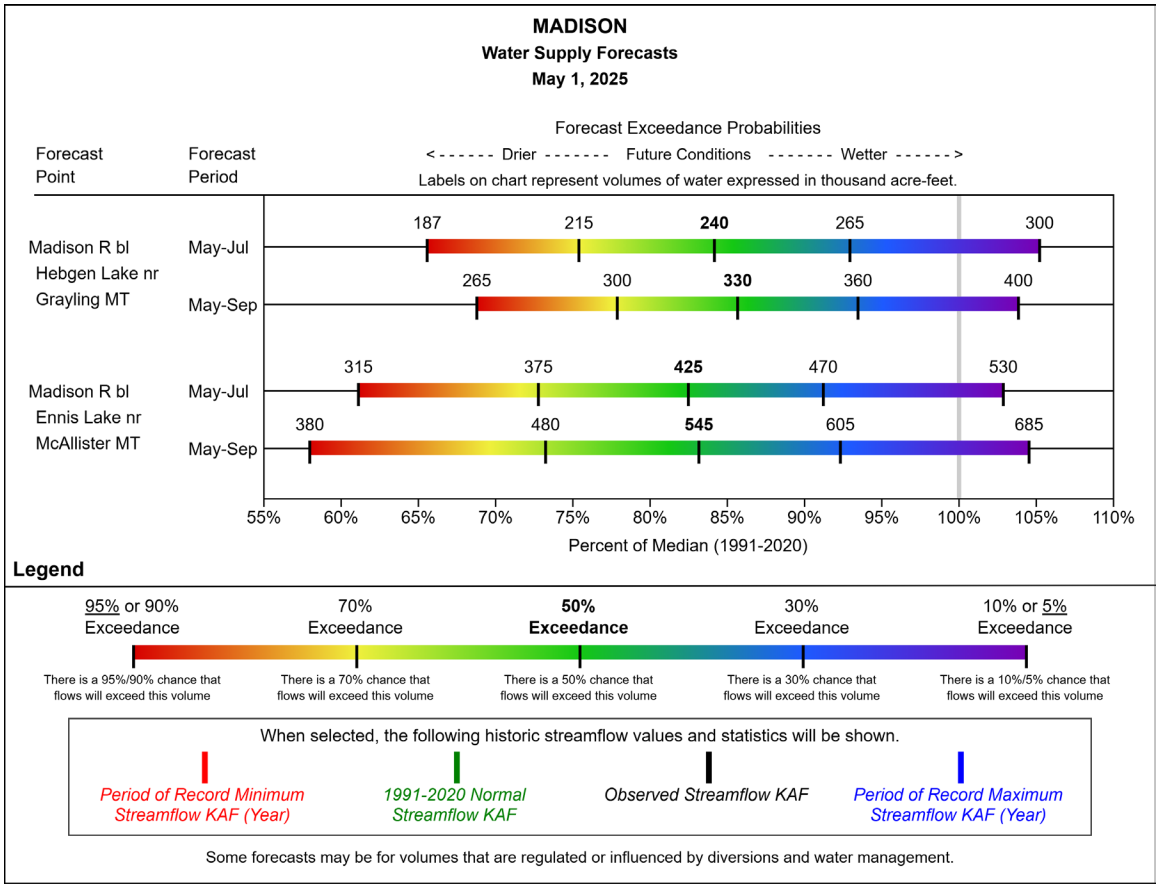
Precipitation in April was well below normal at 78%, which brings the seasonal accumulation (October-April) to 95% of median. The snowpack in the Madison is below normal at 86% of median, compared to 74% at this time last year.





Basin Overview

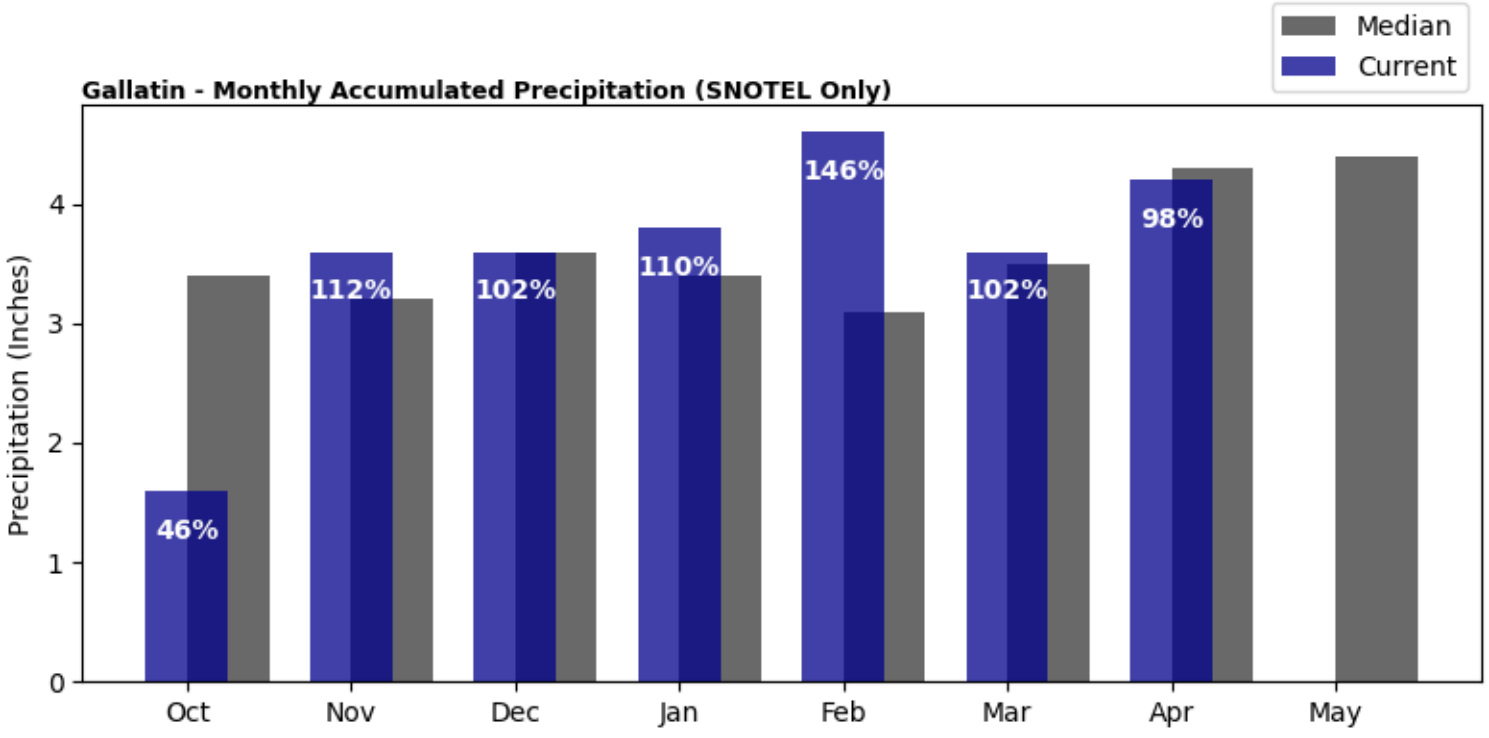
Madison (Continued)

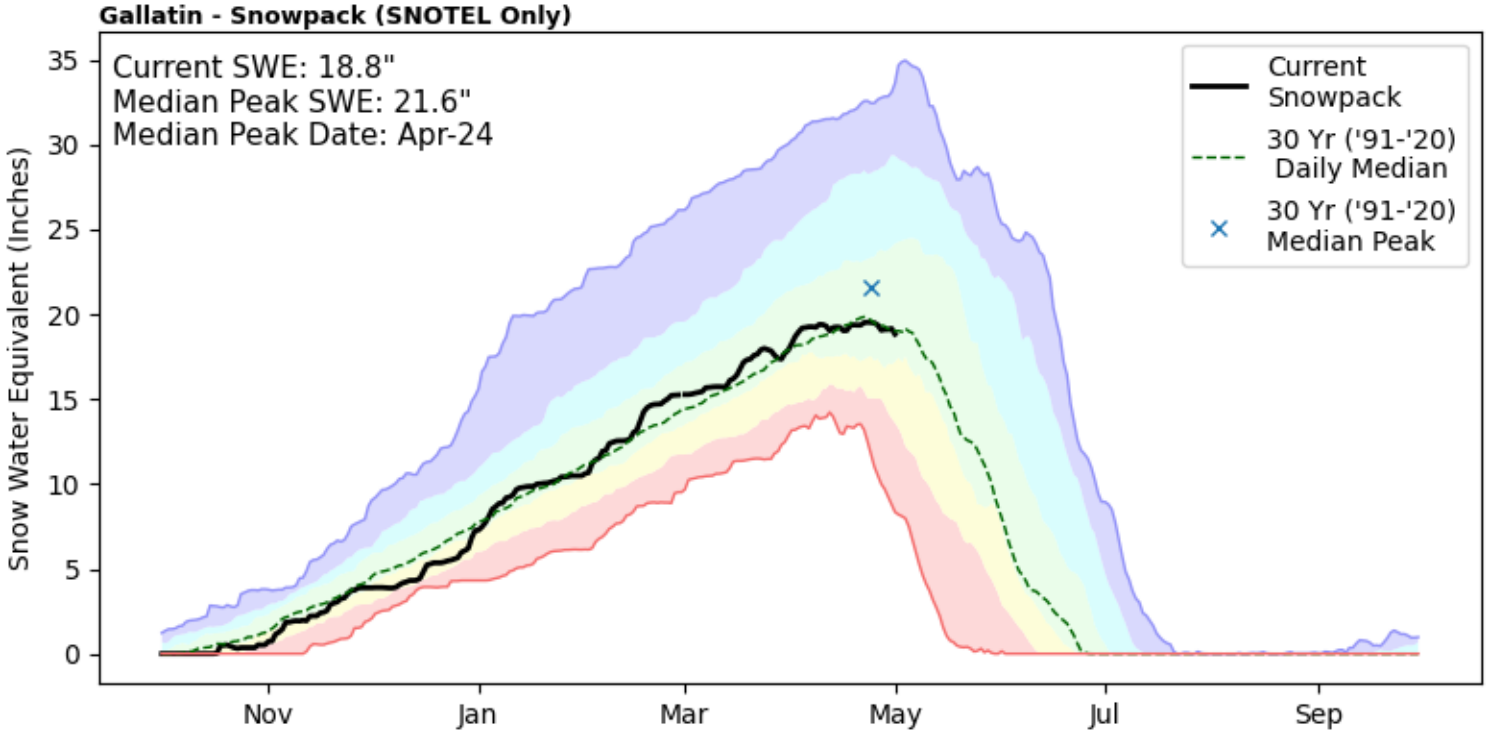


Basin Overview

Gallatin

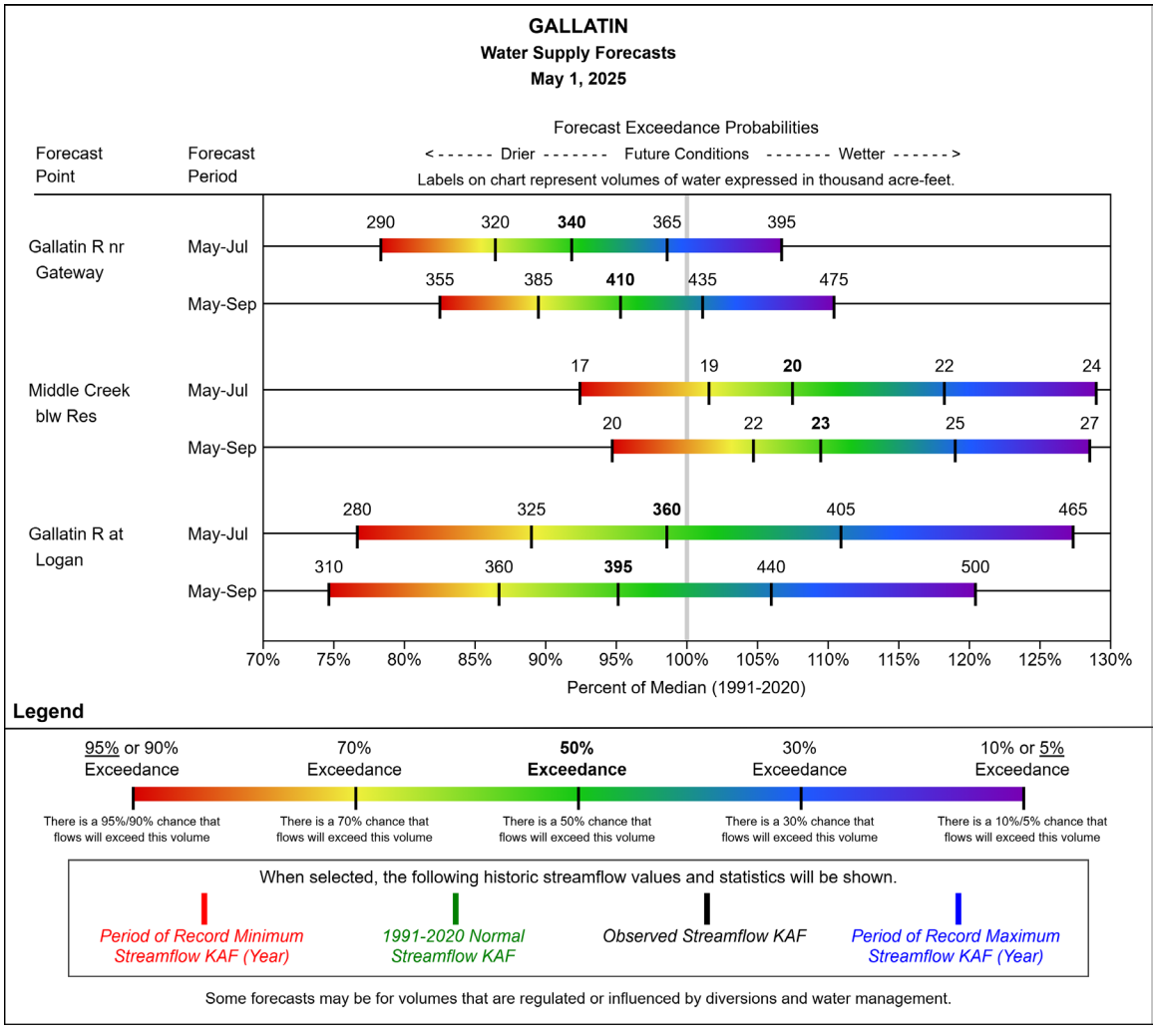
Precipitation in April was near normal at 98%, which brings the seasonal accumulation (October-April) to 98% of median. The snowpack in the Gallatin is near normal at 101% of median, compared to 66% at this time last year.





Basin Overview

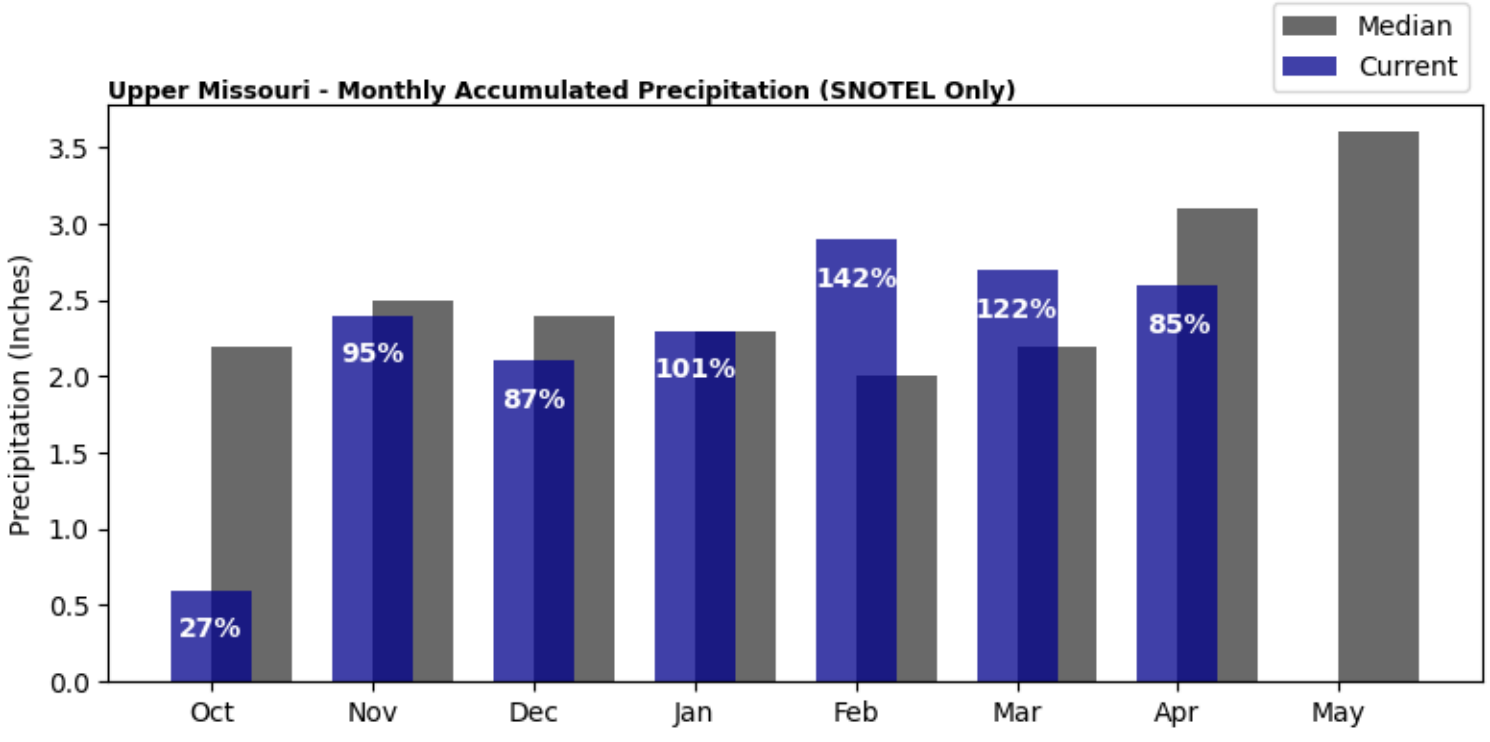
Gallatin (Continued)

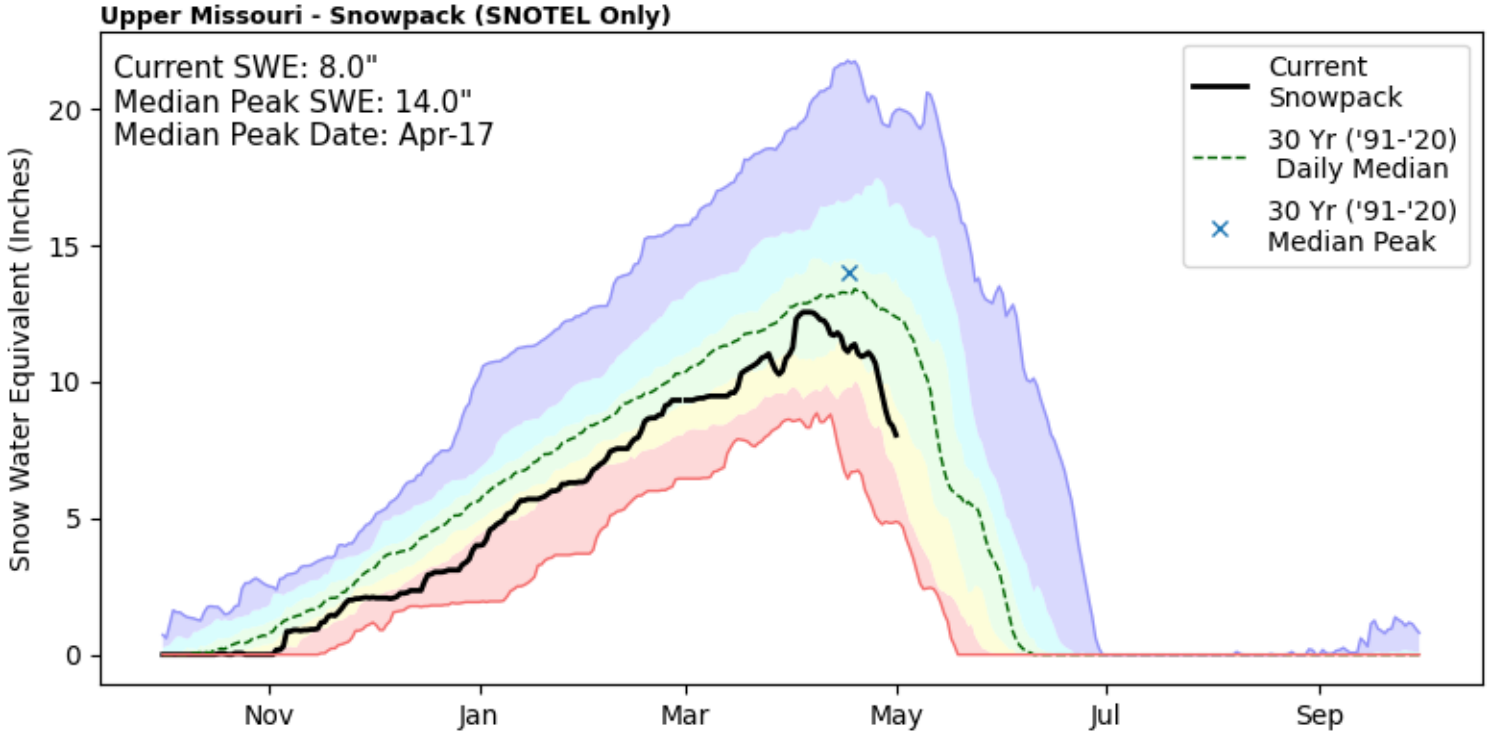


Basin Overview

Upper Missouri

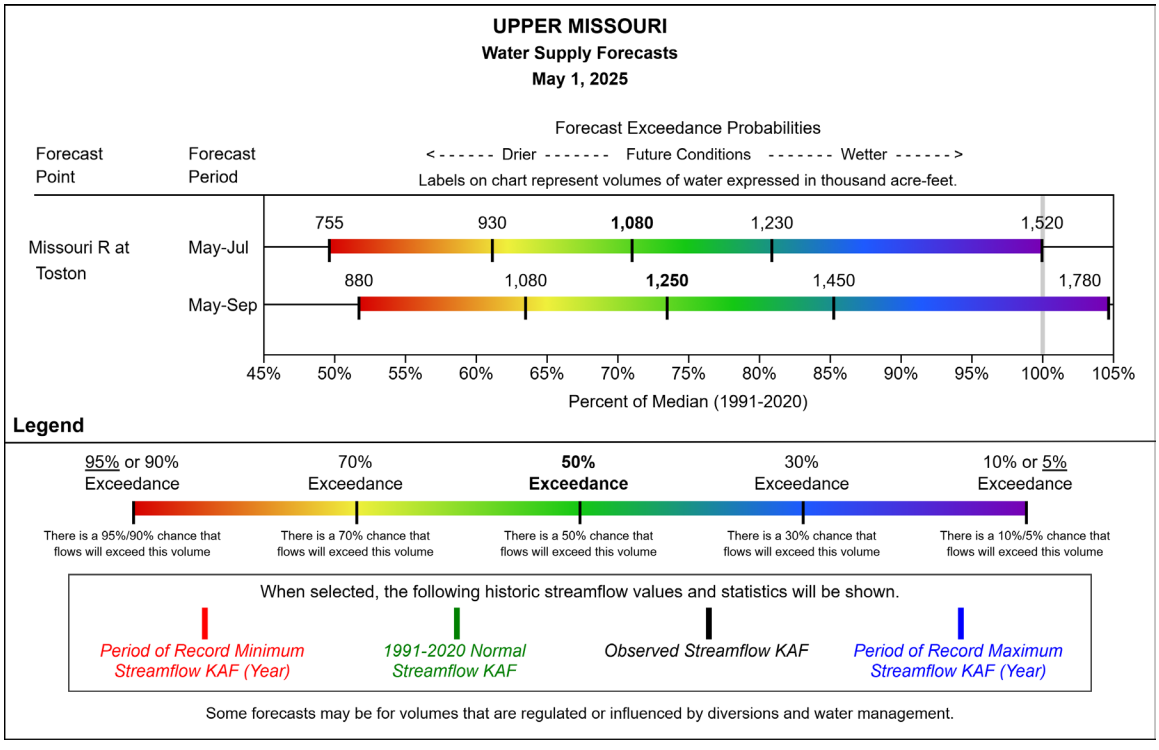
Precipitation in April was below normal at 85%, which brings the seasonal accumulation (October-April) to 92% of median. The snowpack in the Upper Missouri is well below normal at 74% of median, compared to 42% at this time last year.





Basin Overview

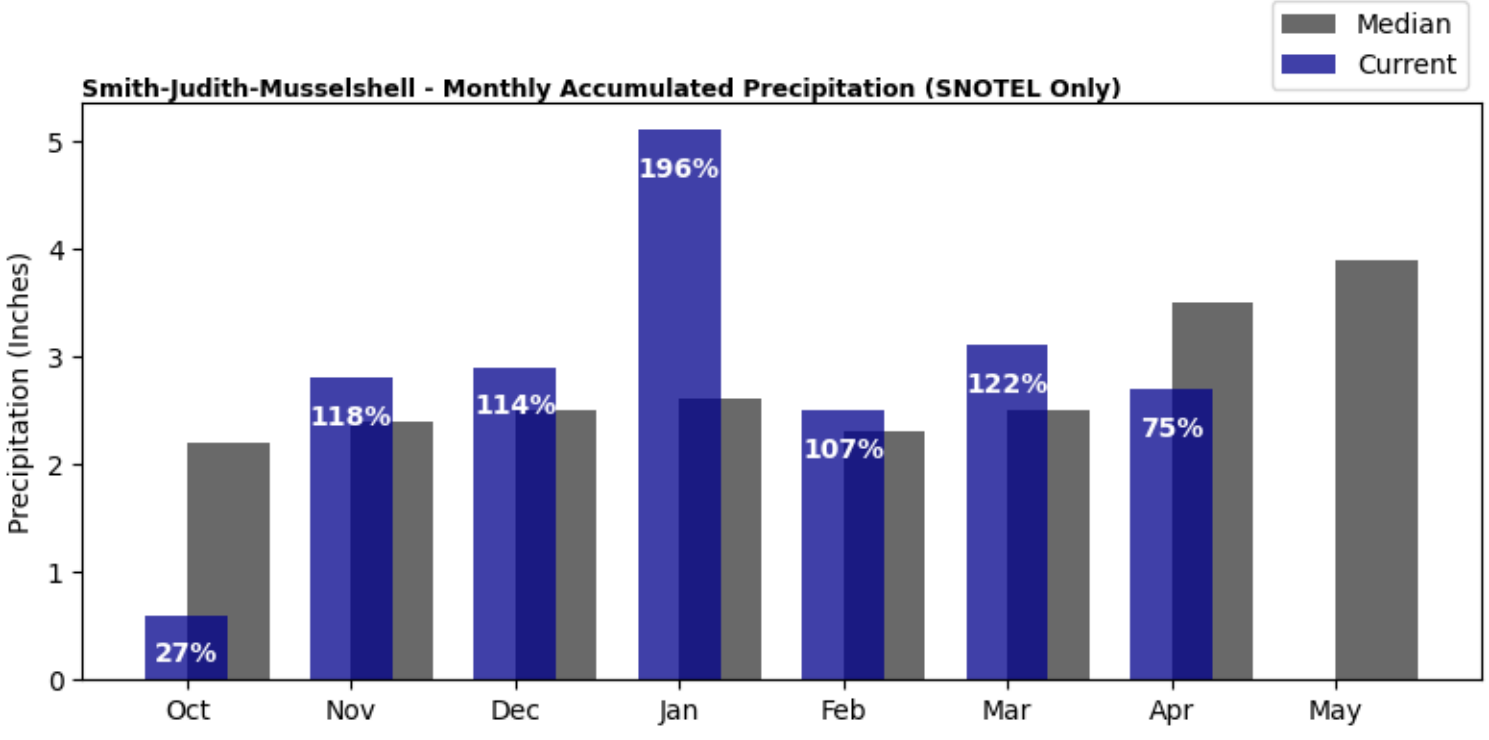
Upper Missouri (Continued)

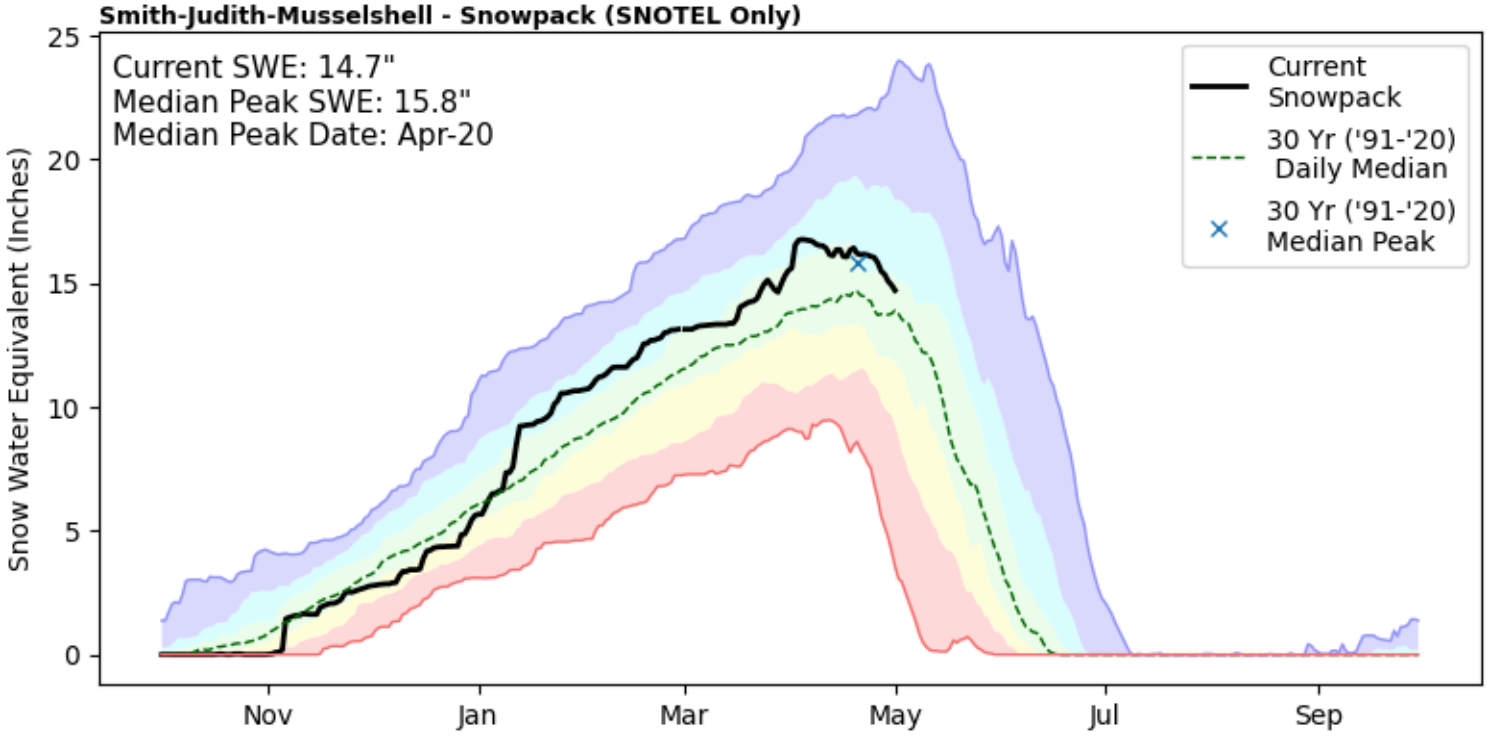


Basin Overview

Smith-Judith-Musselshell

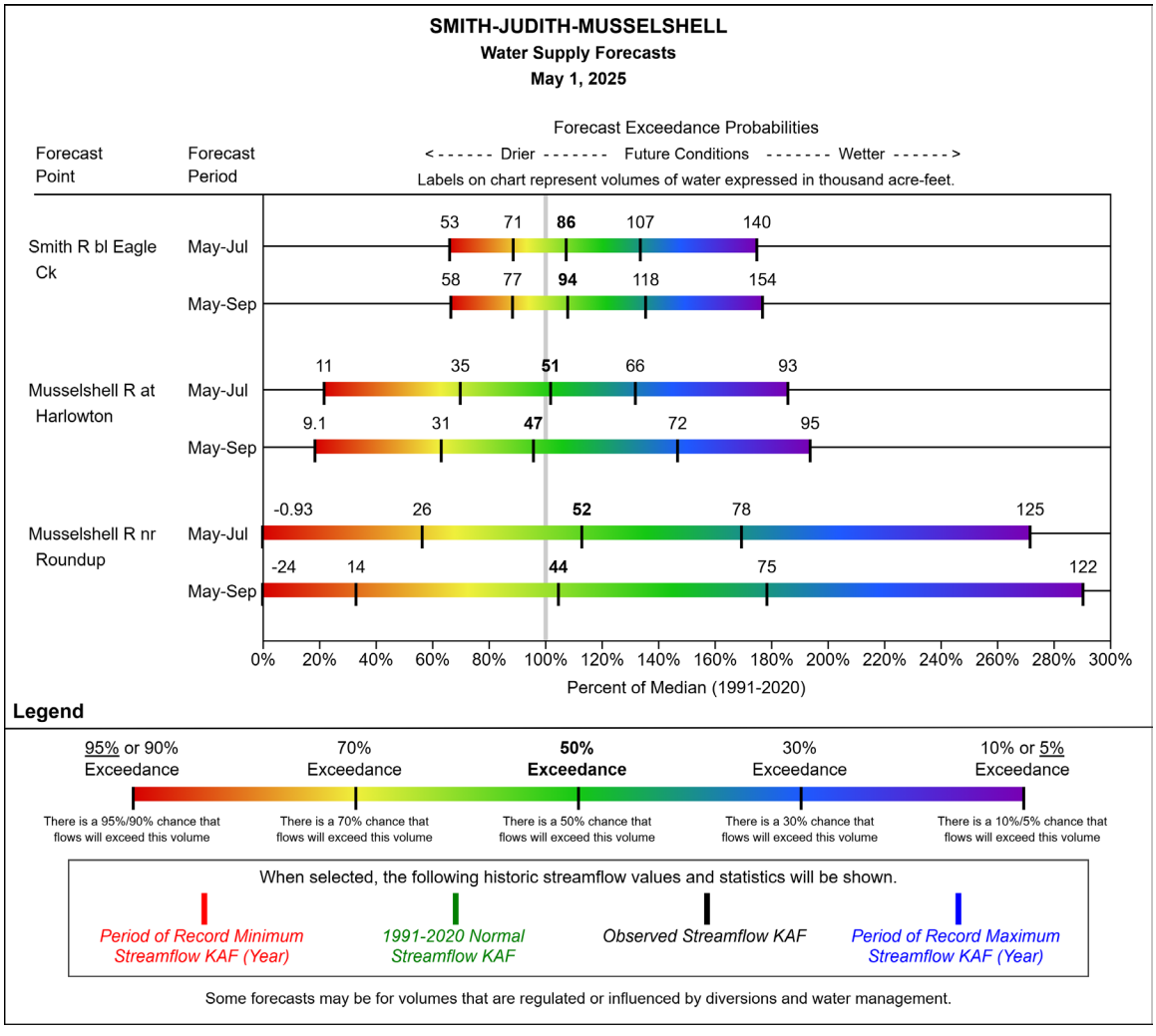
Precipitation in April was well below normal at 75%, which brings the seasonal accumulation (October-April) to 103% of median. The snowpack in the Smith-Judith-Musselshell is above normal at 108% of median, compared to 55% at this time last year.





Basin Overview

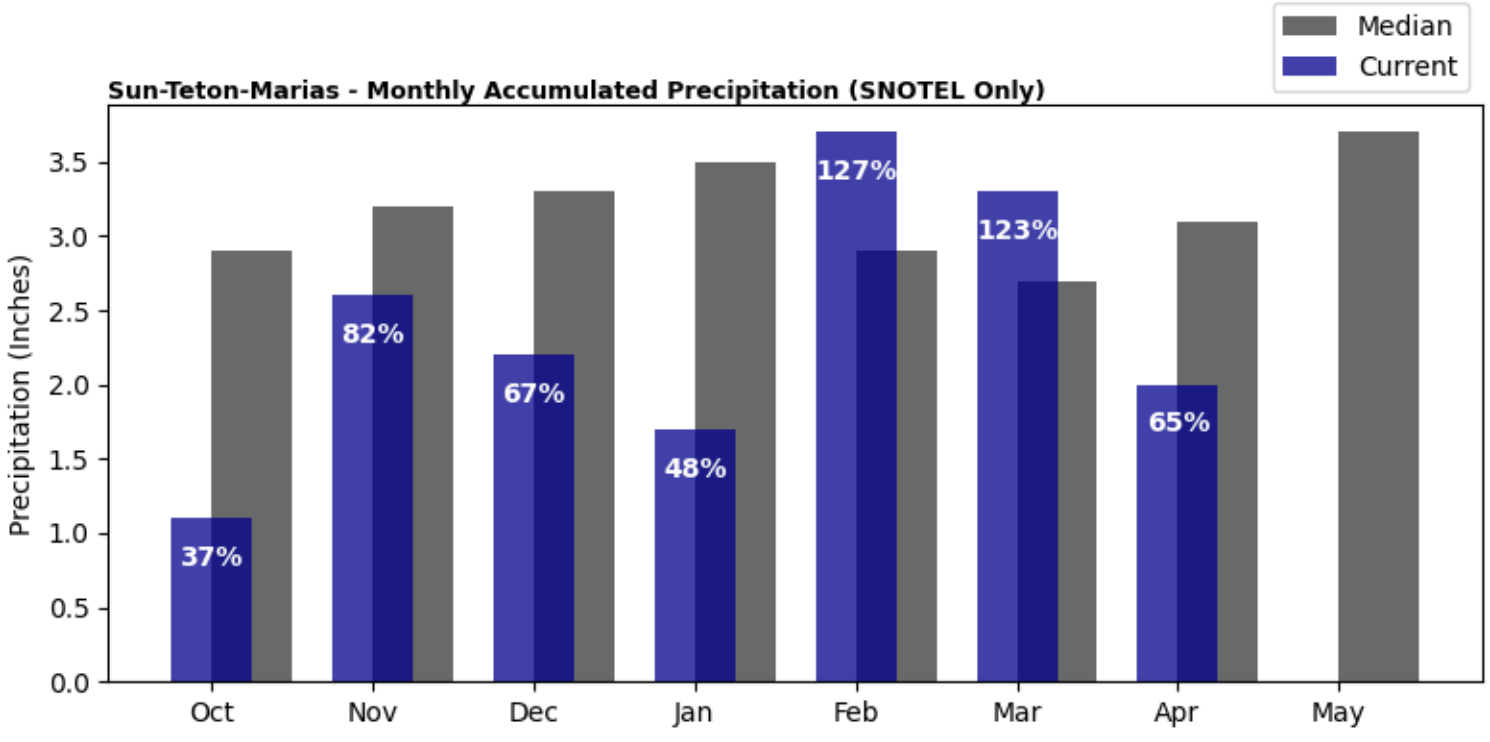
Smith-Judith-Musselshell (Continued)

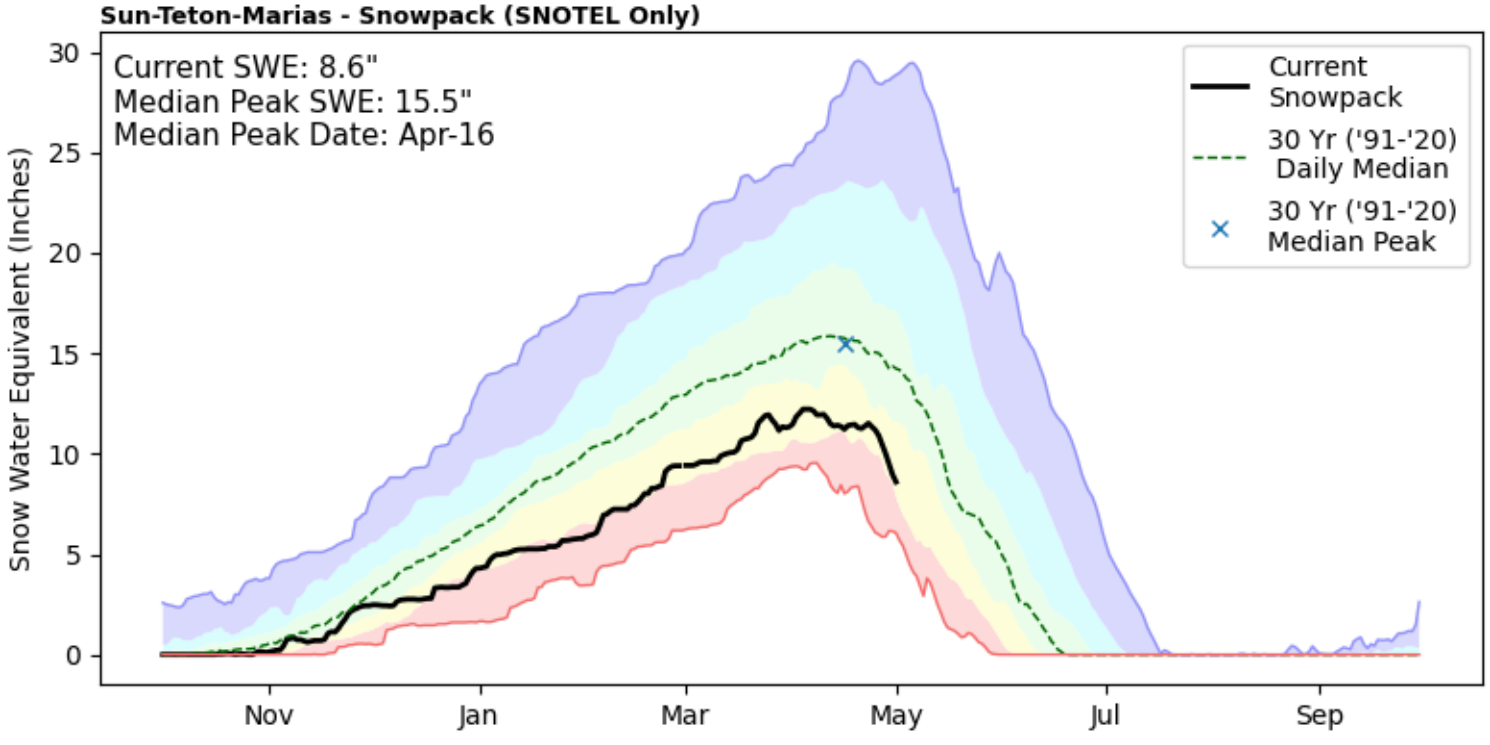


Basin Overview

Sun-Teton-Marias

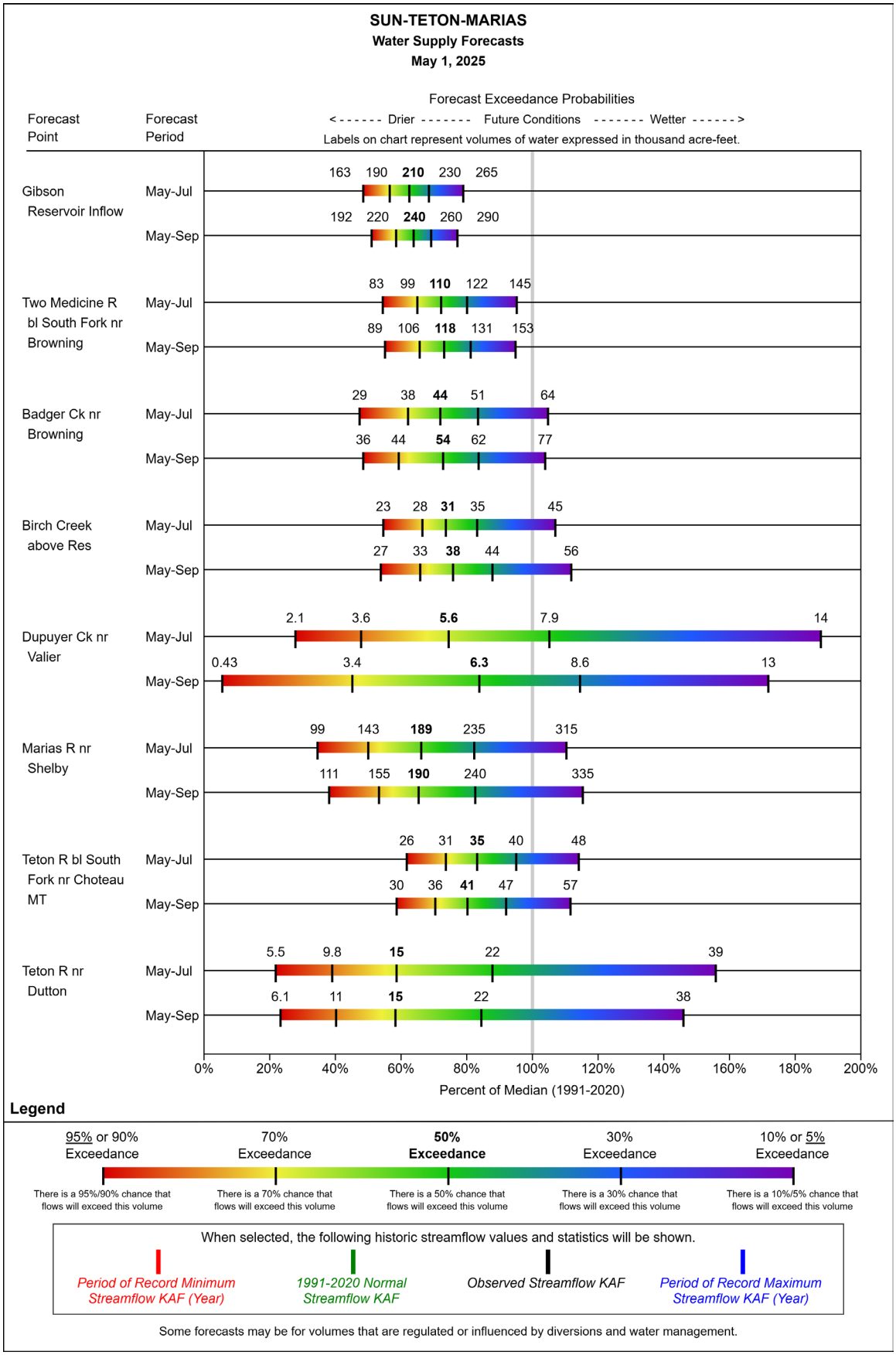
Precipitation in April was well below normal at 65%, which brings the seasonal accumulation (October-April) to 73% of median. The snowpack in the Sun-Teton-Marias is well below normal at 61% of median, compared to 41% at this time last year.





Basin Overview

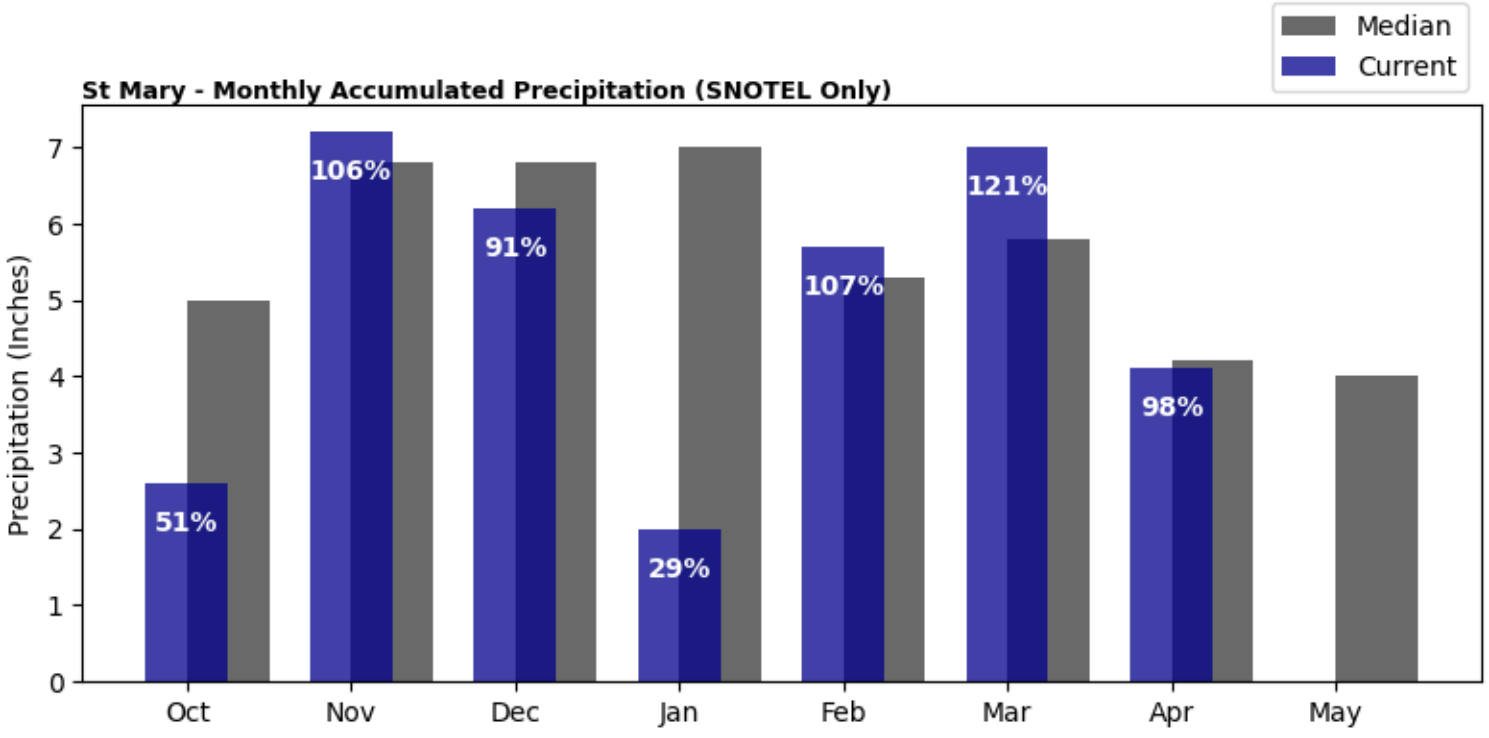
Sun-Teton-Marias (Continued)

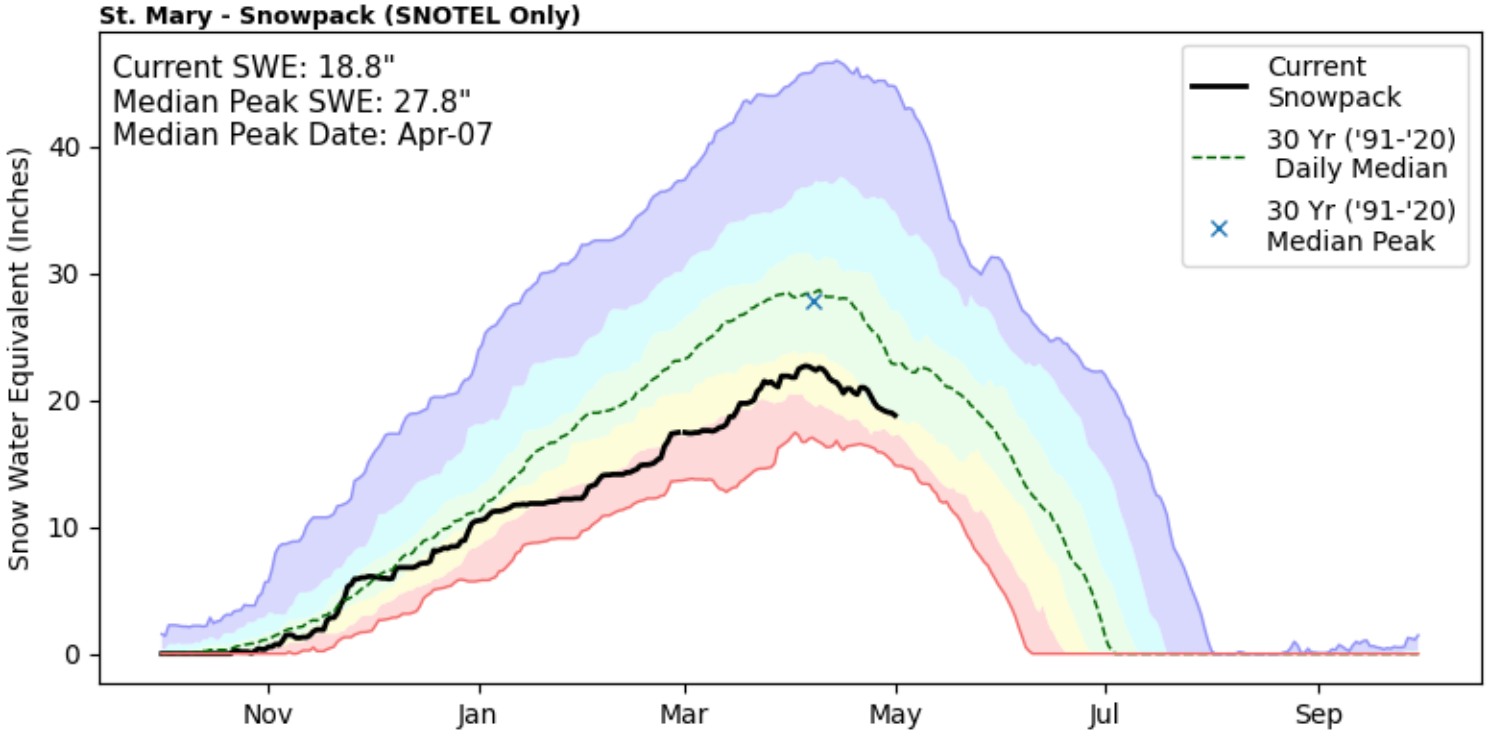


Basin Overview

St. Mary

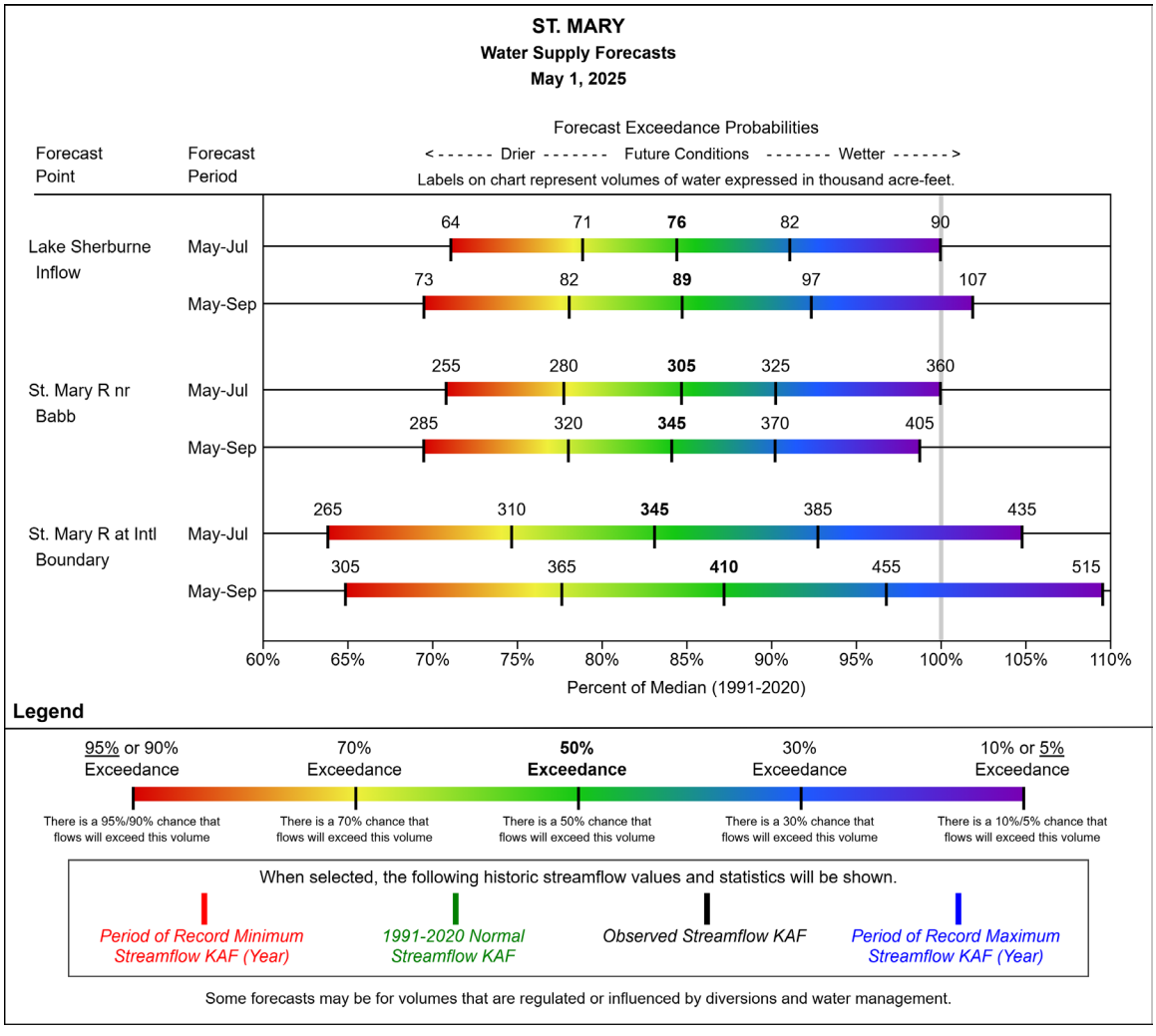
Precipitation in April was near normal at 98%, which brings the seasonal accumulation (October-April) to 78% of median. The snowpack in the St. Mary is below normal at 89% of median, compared to 77% at this time last year.





Basin Overview

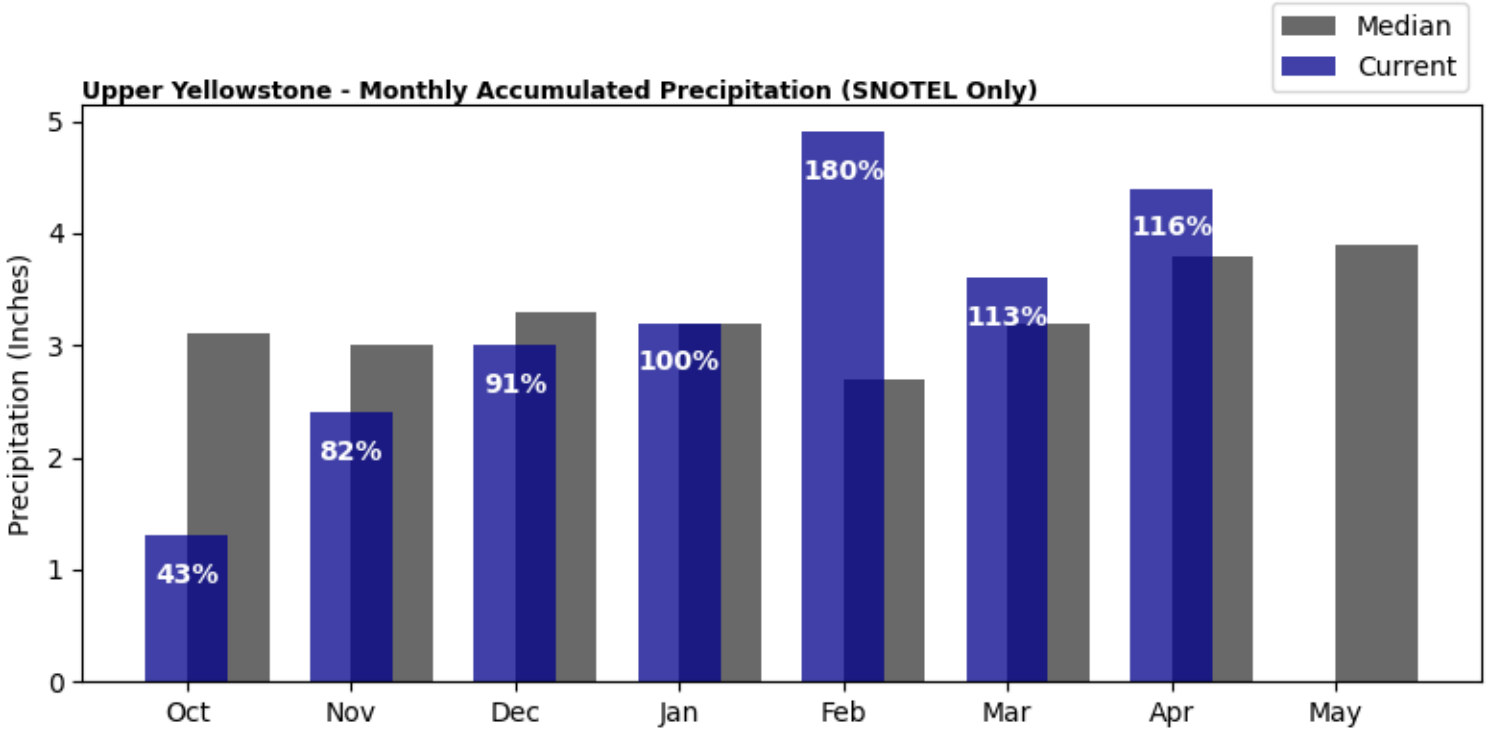
St. Mary (Continued)

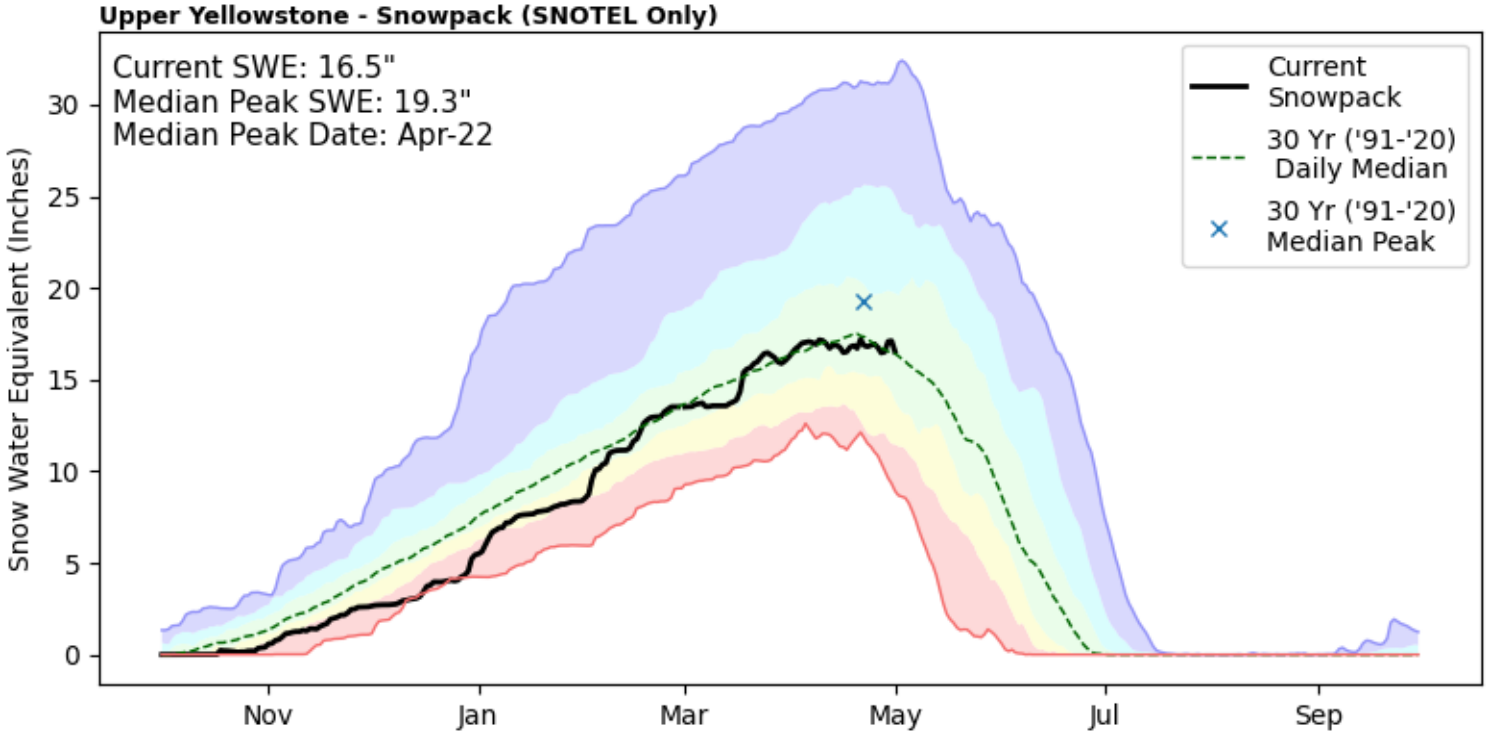


Basin Overview

Upper Yellowstone

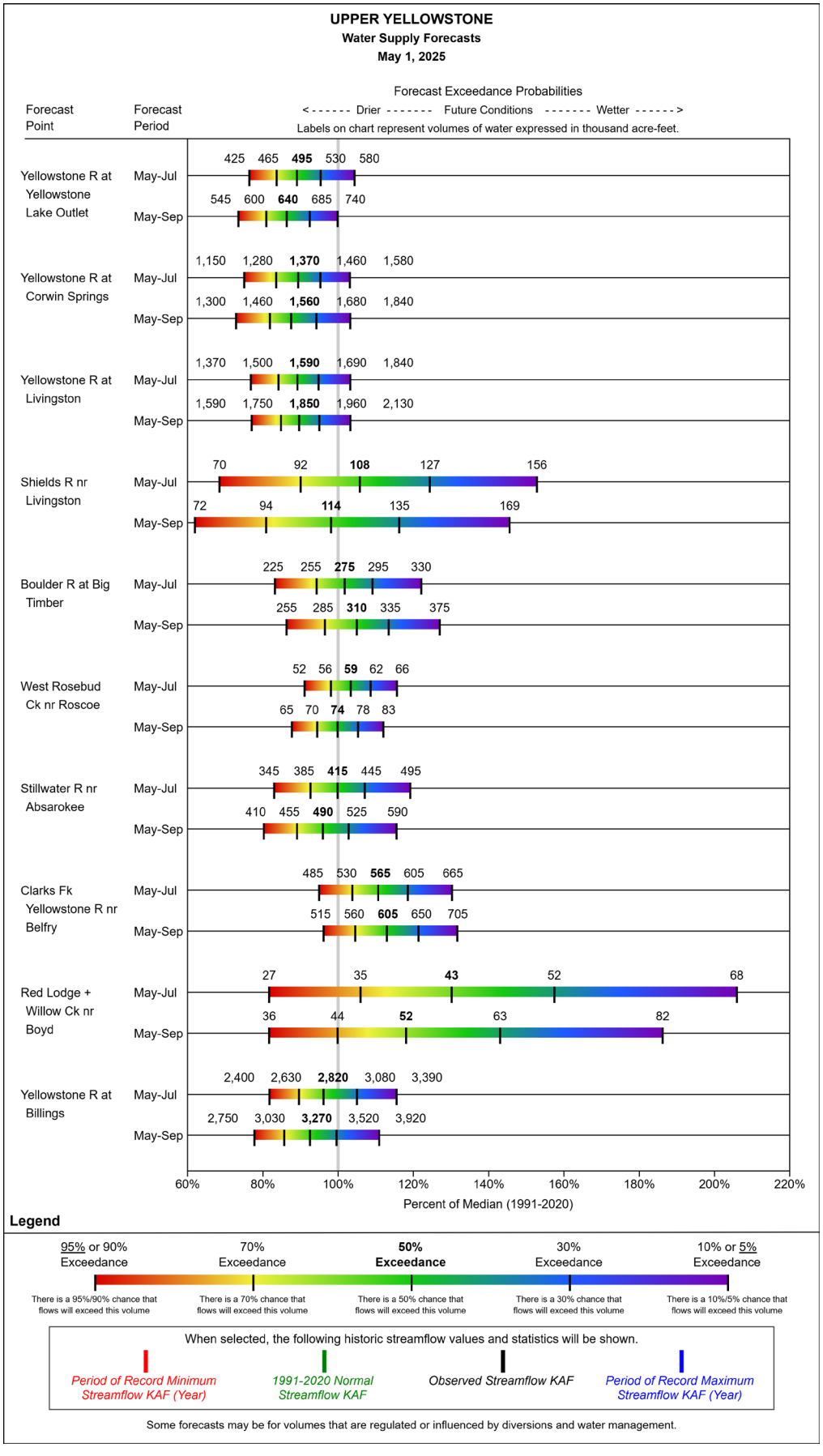
Precipitation in April was above normal at 116%, which brings the seasonal accumulation (October-April) to 100% of median. The snowpack in the Upper Yellowstone is near normal at 101% of median, compared to 67% at this time last year.





Basin Overview

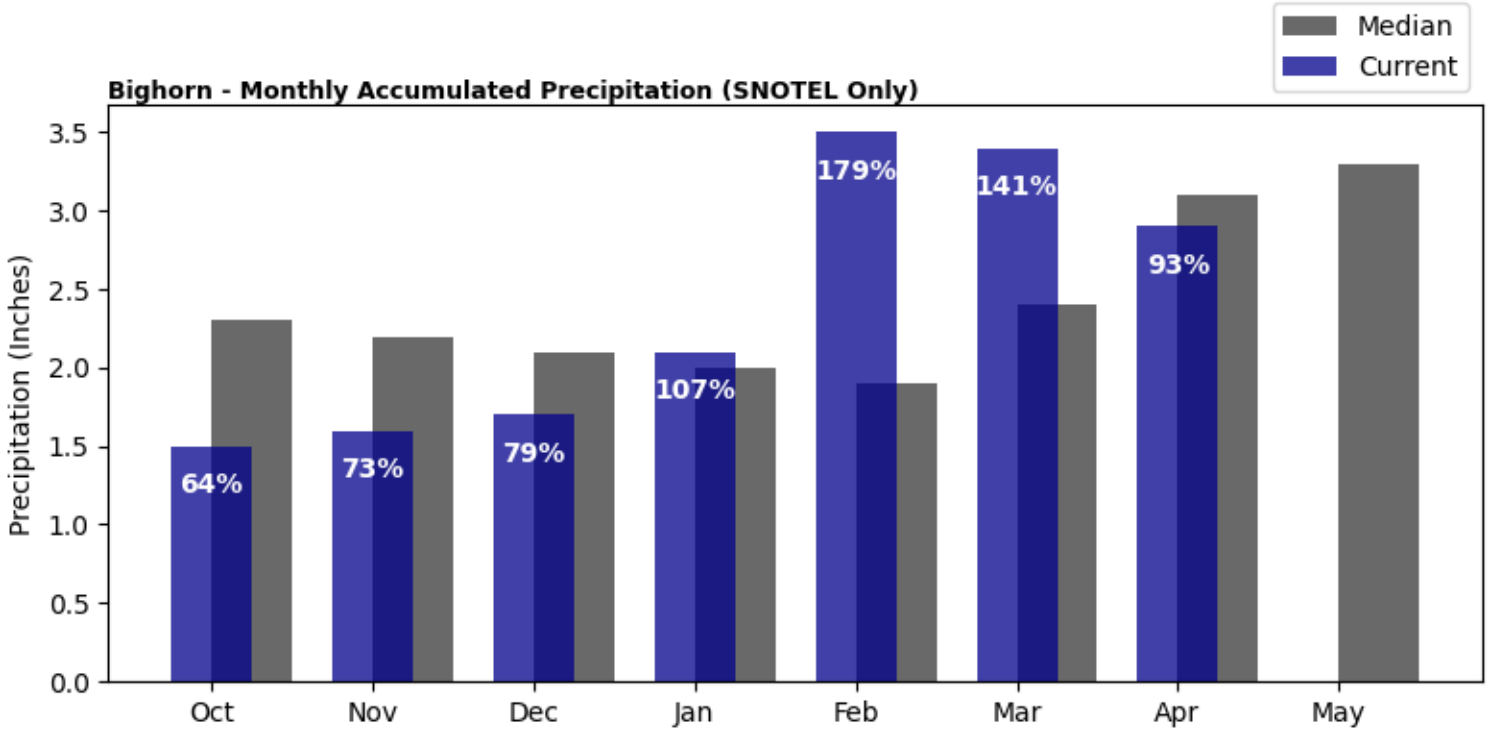
Upper Yellowstone (Continued)

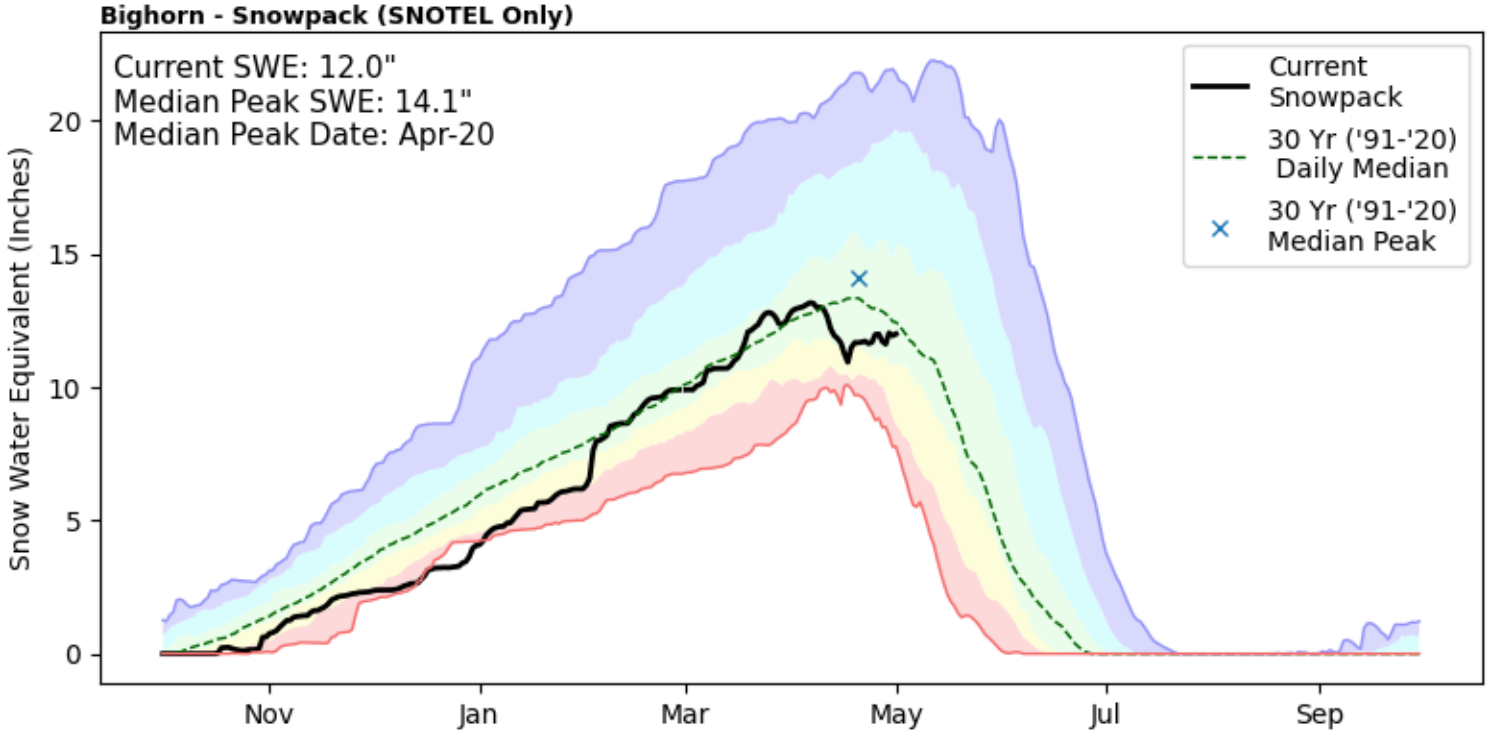


Basin Overview

Bighorn

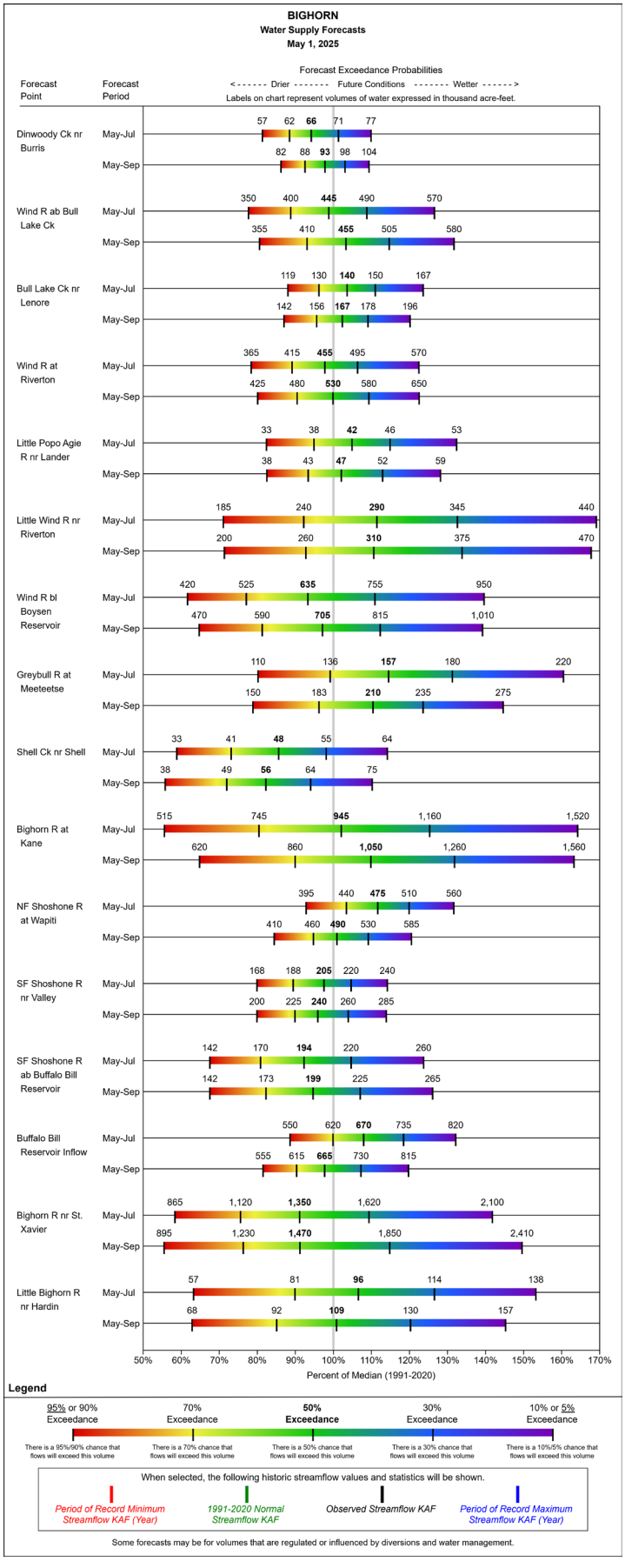
Precipitation in April was below normal at 93%, which brings the seasonal accumulation (October-April) to 101% of median. The snowpack in the Bighorn is near normal at 95% of median, compared to 86% at this time last year.





Basin Overview

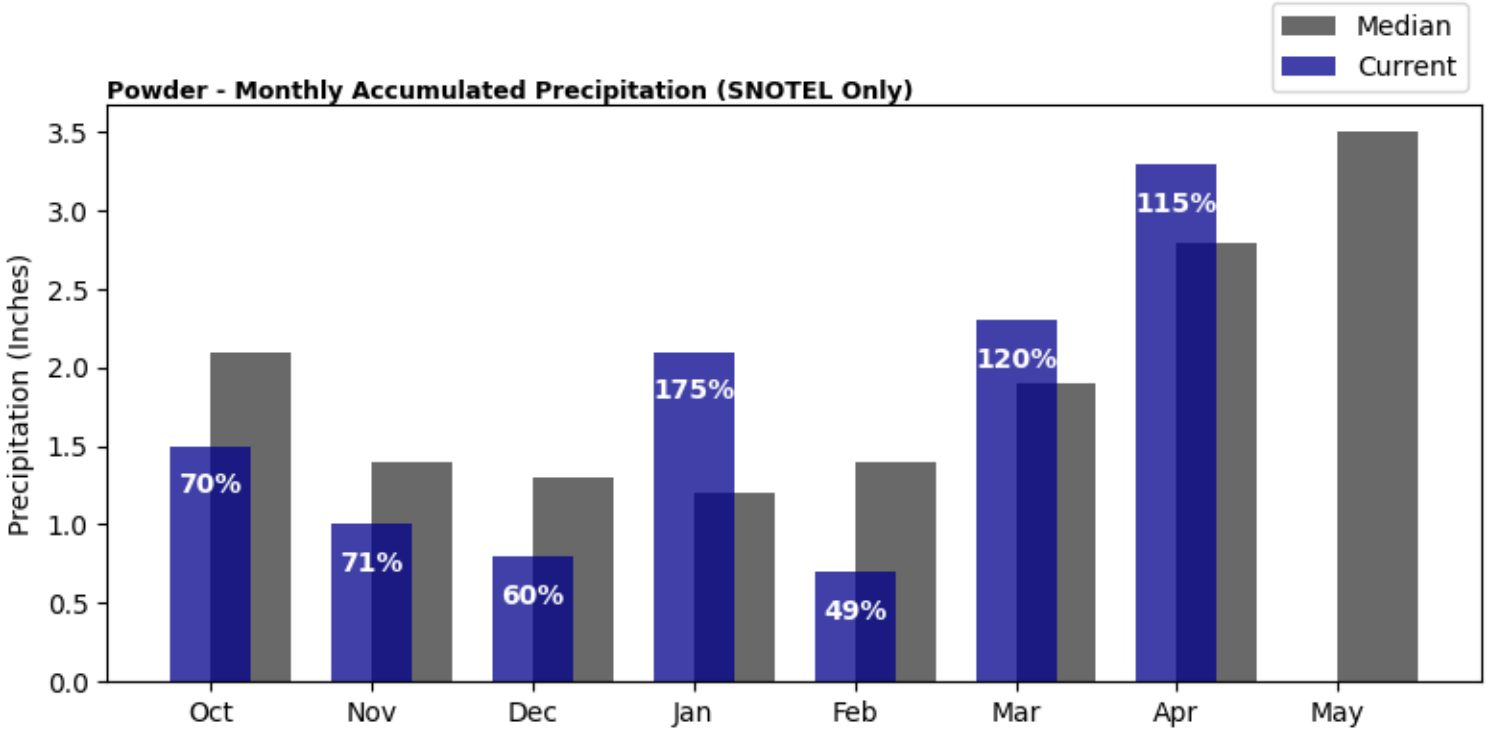
Bighorn (Continued)

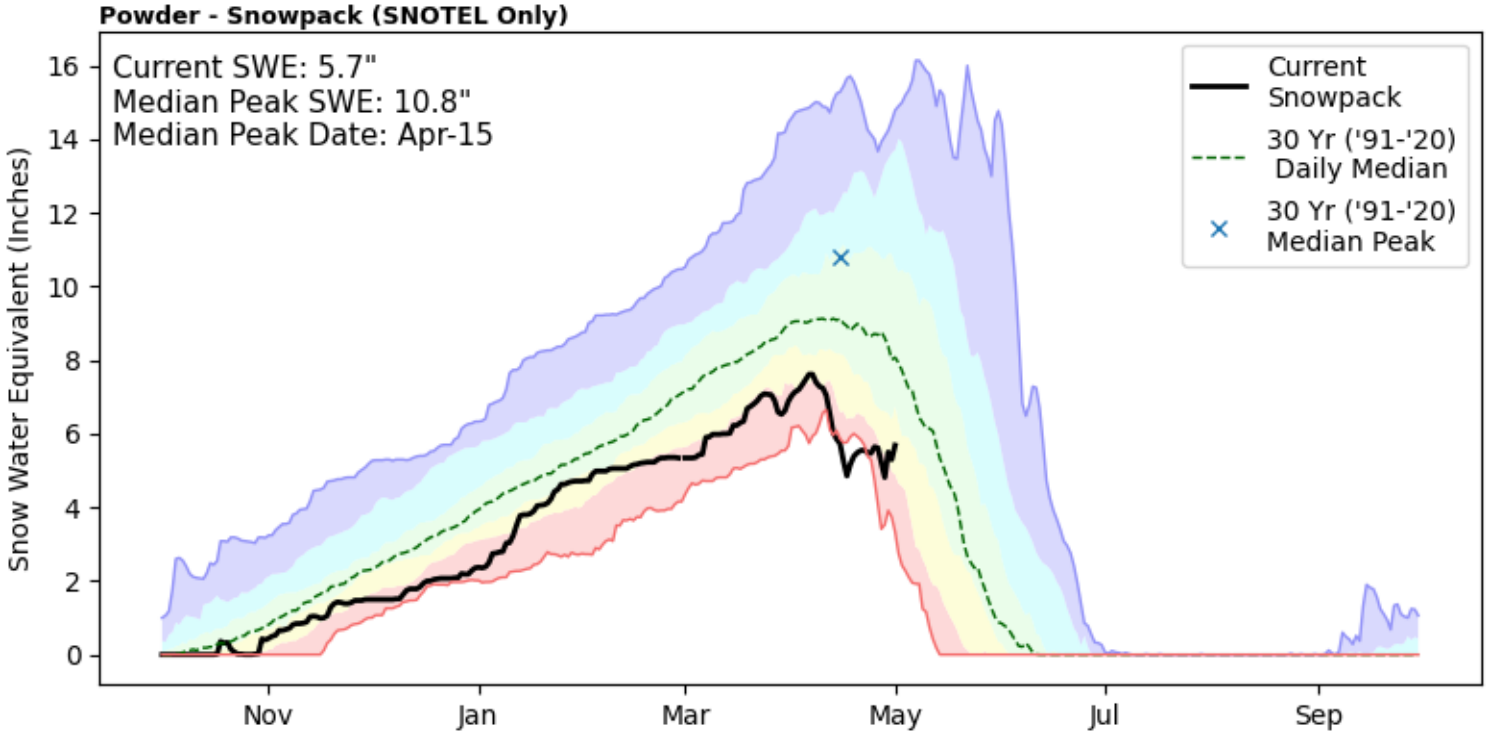


Basin Overview

Powder

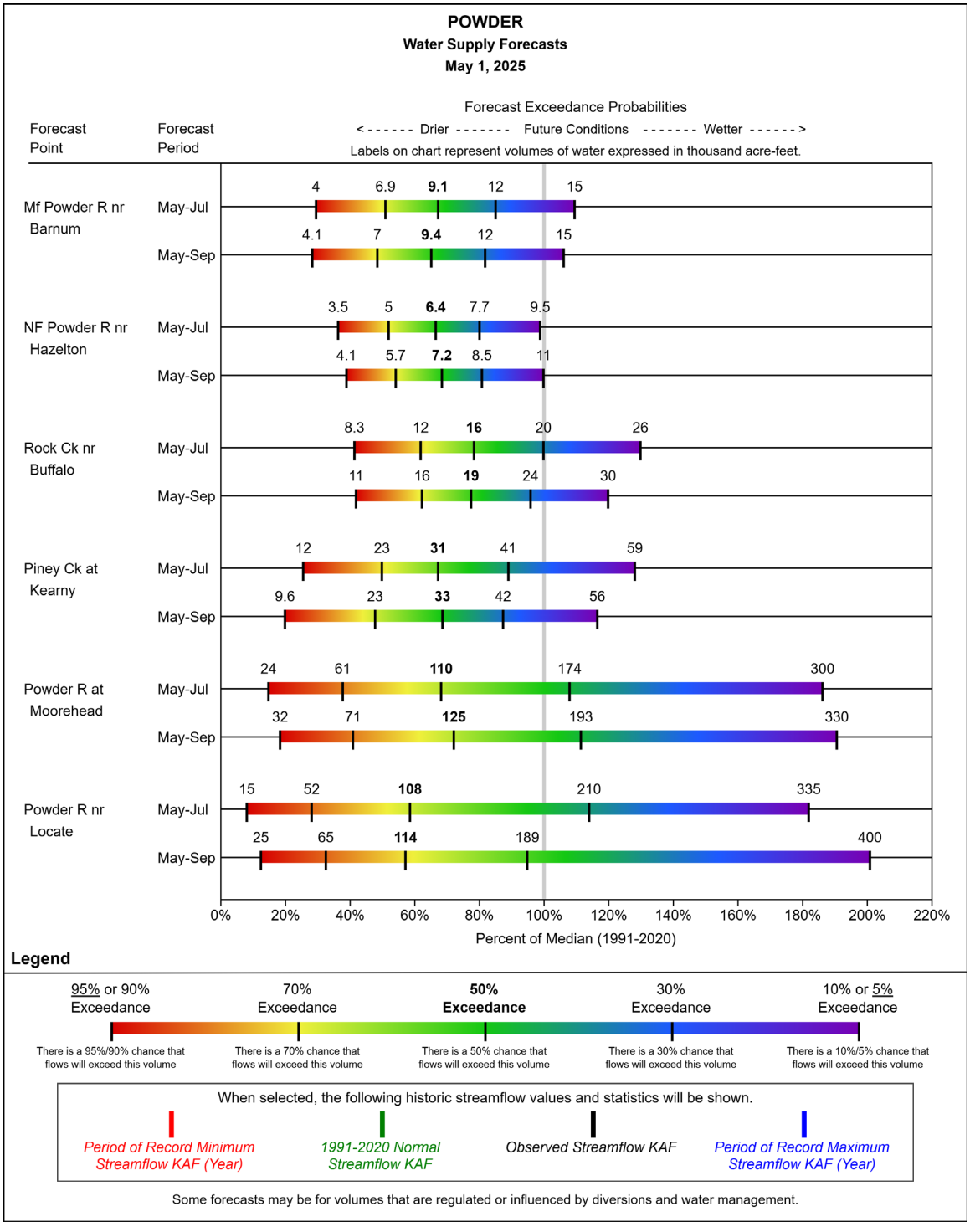
Precipitation in April was above normal at 115%, which brings the seasonal accumulation (October-April) to 91% of median. The snowpack in the Powder is well below normal at 75% of median, compared to 70% at this time last year.





Basin Overview

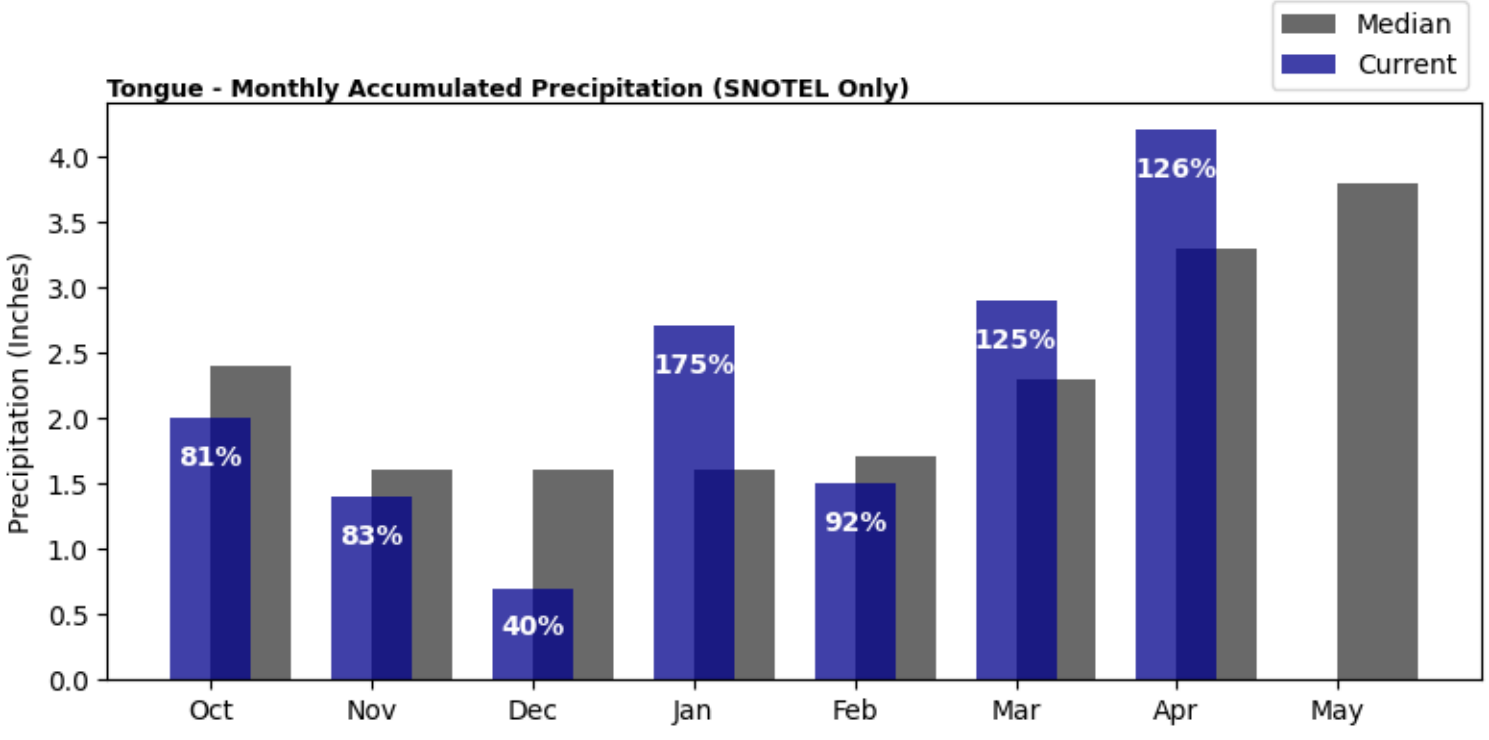
Powder (Continued)

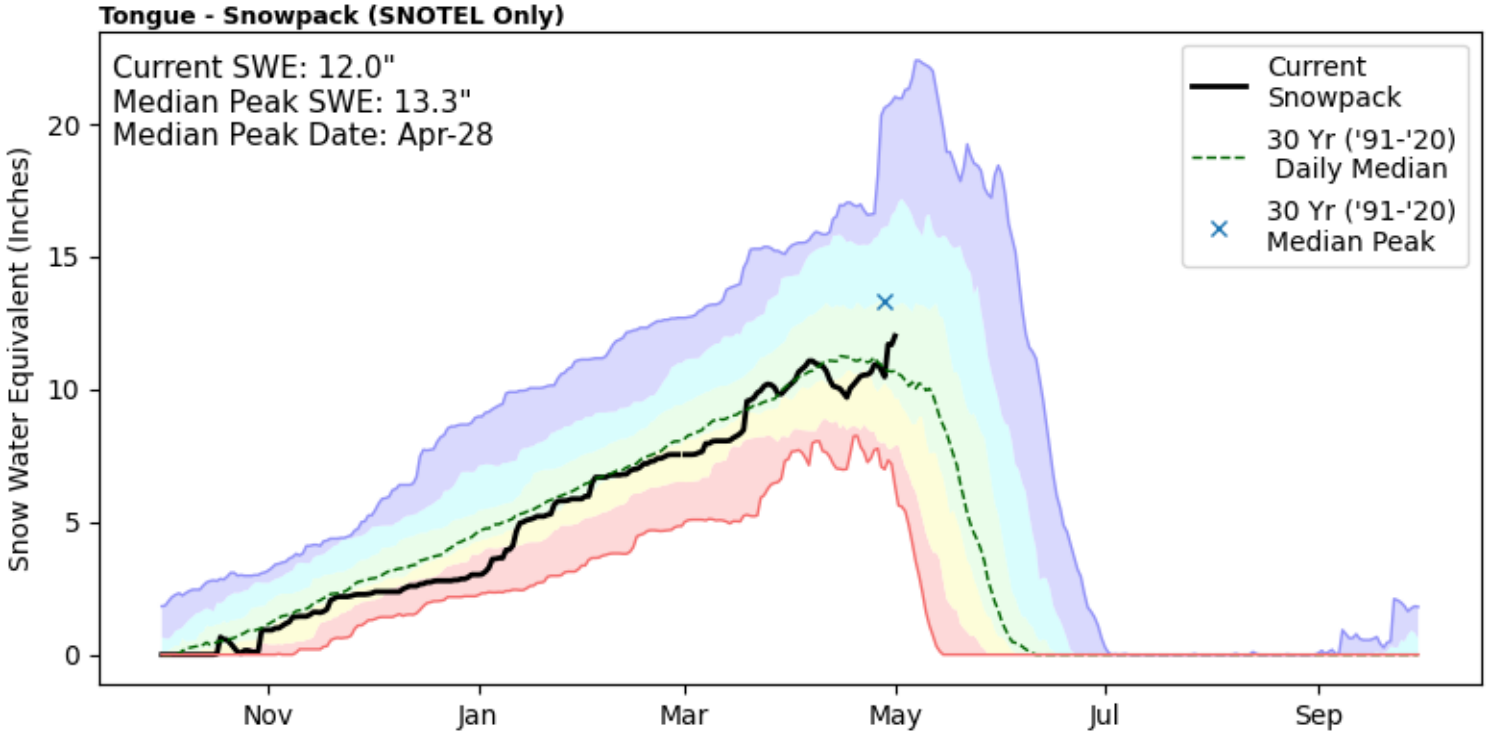


Basin Overview

Tongue

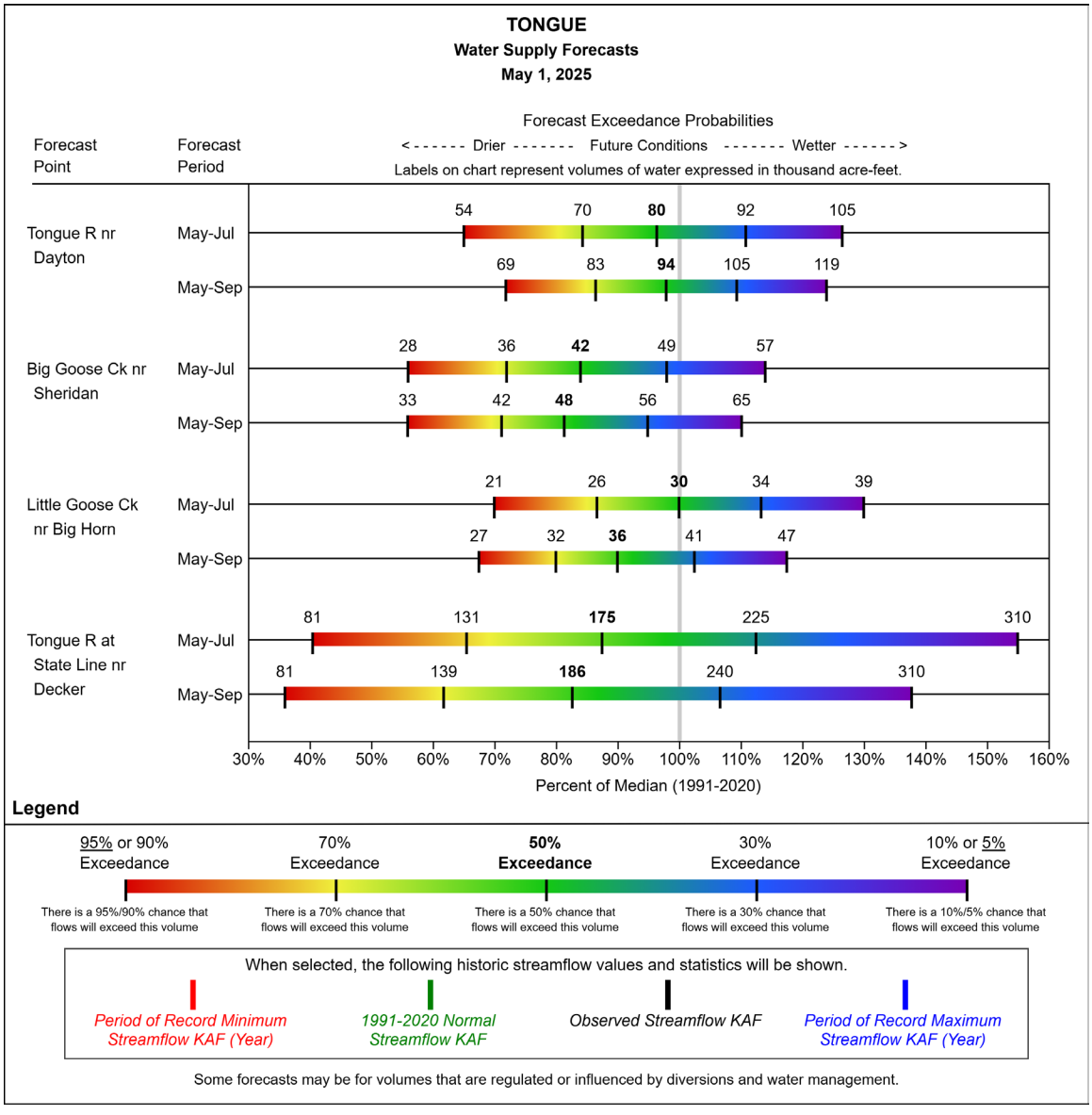
Precipitation in April was well above normal at 126%, which brings the seasonal accumulation (October-April) to 99% of median. The snowpack in the Tongue is above normal at 111% of median, compared to 79% at this time last year.





Basin Overview

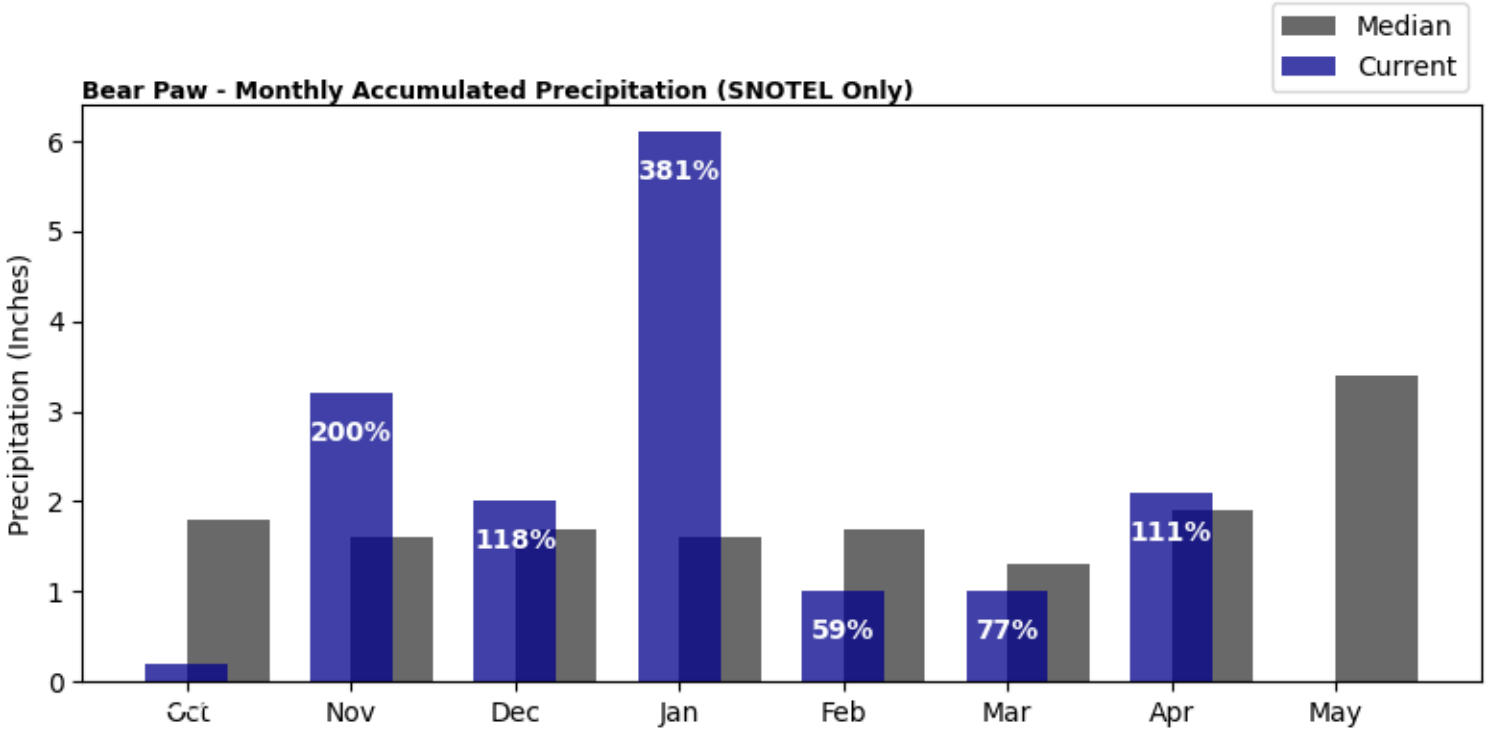
Tongue (Continued)

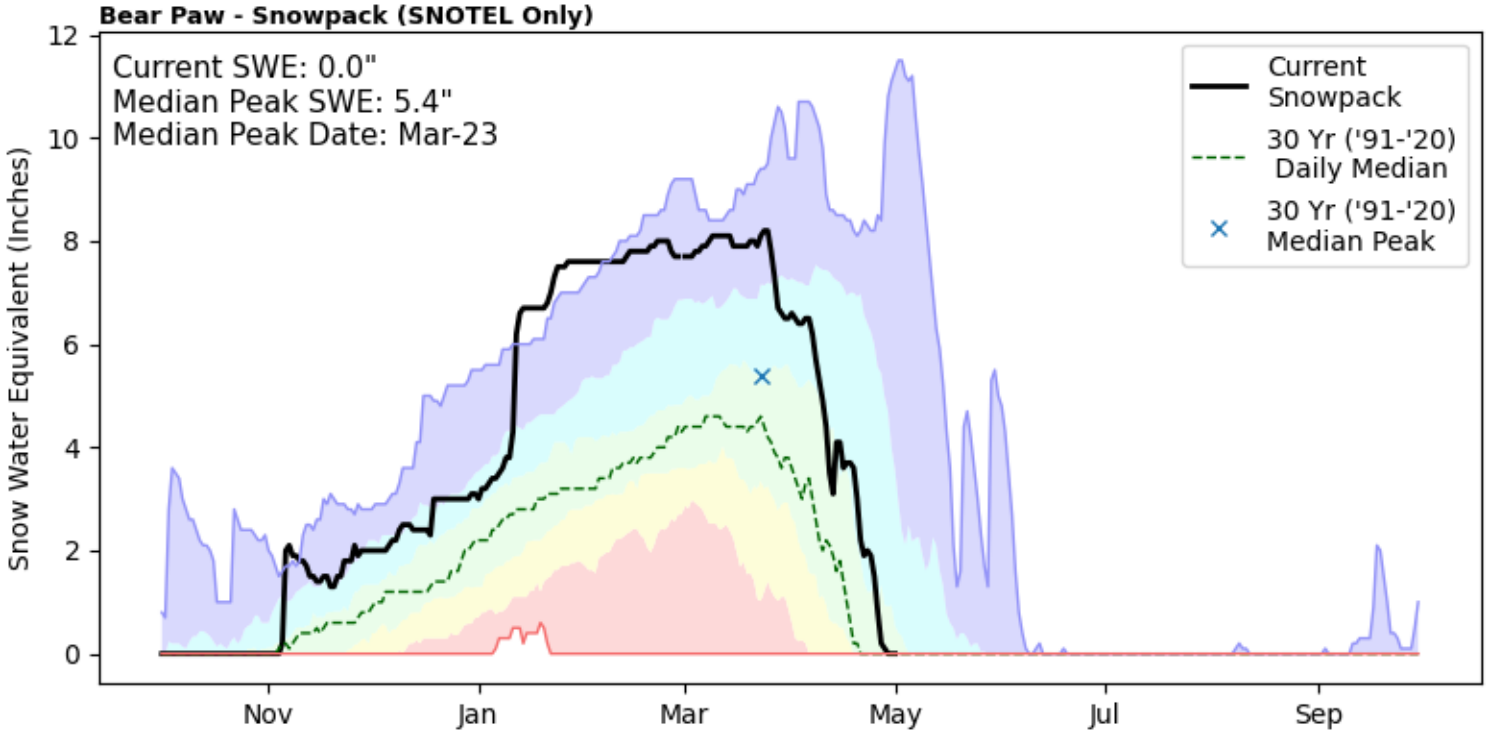


Basin Overview

Bear Paw

Precipitation in April was above normal at 111%, which brings the seasonal accumulation (October-April) to 125% of median. The snowpack in the Bear Paw is None at None% of median, compared to None% at this time last year.





Appendix

Water Supply Forecast Information

Most of the annual streamflow in the Western United States originates as snowfall that has accumulated high in the mountains during winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Predictions are based on careful measurements of snow water equivalent at selected index points. Precipitation, temperature, soil moisture and antecedent streamflow data are combined with snowpack data to prepare runoff forecasts.

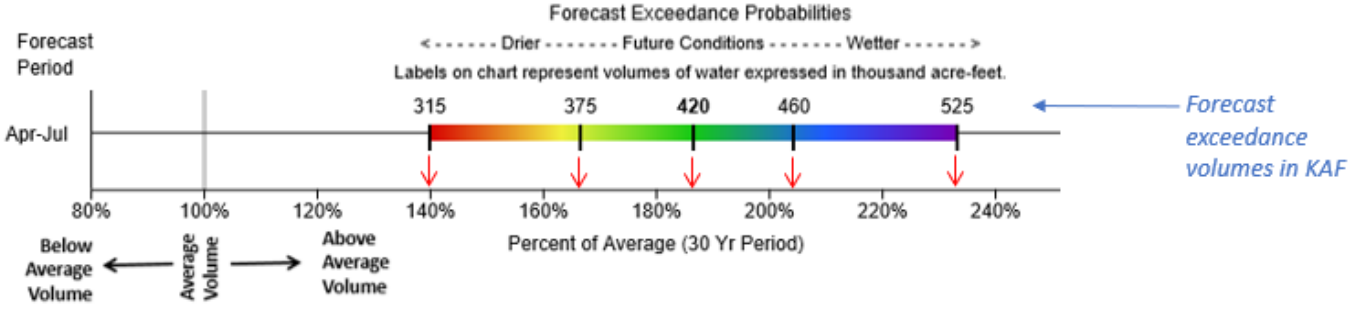
Forecast uncertainty originates from two sources: (1) uncertainty of future hydrologic and climatic conditions, and (2) error in the forecasting procedure. To express the uncertainty in the most probable forecast, four additional forecasts are provided. The actual streamflow can be expected to exceed the most probable forecast 50% of the time. Similarly, the actual streamflow volume can be expected to exceed the 90% forecast volume 90% of the time. The same is true for the 70%, 30%, and 10% forecasts. Generally, the 90% and 70% forecasts reflect drier than normal hydrologic and climatic conditions in the coming months; the 30% and 10% forecasts reflect wetter than normal conditions. As the forecast season progresses, a greater portion of the future hydrologic and climatic uncertainty will become known, and the additional forecasts will move closer to the most probable forecasts.

Interpreting Water Supply Forecast Charts

Typically, the Natural Resources Conservation Service (NRCS) has presented streamflow forecasts as a table format showing the five exceedance probabilities compared to the 30-year average as follows:

	Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast						
Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
APR-JUL	315	375	420	187%	460	525	225

The Forecast Chart provides a visual alternative to the table. The forecast range is represented by a colored bar. Vertical lines on the bar signify the five forecast exceedances. Below is an example. The numbers above the forecast bar are the five exceedance probability volumes in thousand acre-feet (KAF). Each exceedance forecasts percent of median can be estimated by looking at the horizontal axis. The gray line centered above 100% on the horizontal axis represents the 1991-2020 historical median streamflow for the forecast period.



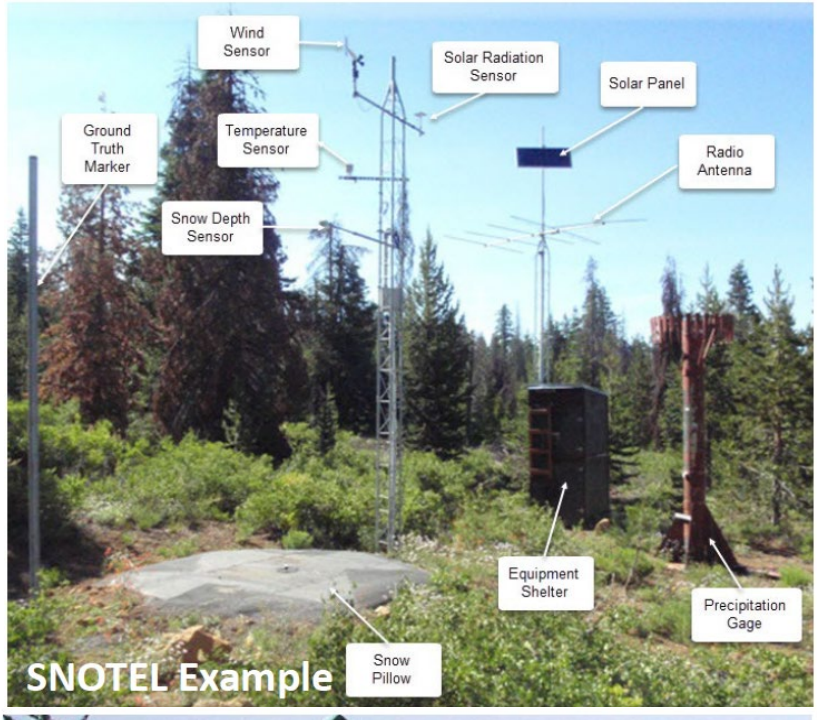
In the example, the entire forecast bar is shifted right of the gray line indicating a forecast for above normal streamflow. The 50% exceedance is represented by the black line in the green portion of the colored bar. This represents a forecast volume of 420KAF which is ~185% of average. If drier than normal future conditions occur the 70% exceedance forecast may be more likely (375KAF or ~165% of average). If future conditions turn wetter than normal, the 30% exceedance forecast may be more likely (460KAF or ~205% of average). Water users are encouraged to consider the range of forecast exceedances instead of relying solely only on the 50% forecast.

Appendix

Monitoring Station Overview

SNOTEL

The NRCS operates an extensive, automated data collection network called SNOTEL (short for Snow Telemetry). SNOTEL sites are designed to operate unattended in remote mountain locations. Data are collected and transmitted hourly and available on the internet. Daily data (midnight values) are quality checked by NRCS hydrologists on at least a weekly basis. SNOTEL sites provide snowpack water content data via a pressure-sensing snow pillow. Other data include snow depth, water year precipitation accumulation, air temperature with daily maximums, minimums, and averages. The earliest NRCS SNOTEL sites have data back to the mid-1970s.



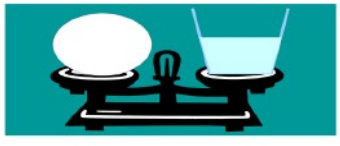
Snow Course

Snow courses are measurement transects where snow tubes are used by snow surveyors during the winter season to determine the depth and water content of the snowpack. Hollow snow tubes are used to vertically core the snowpack. The tubes are then weighed to determine the water content of the snow. Generally, snow courses are situated in meadows or forest openings protected from the wind. A snow course measurement is the average of a number of sample points, typically 5 or 10. Snow courses are measured on a monthly basis typically between January 1 and June 1. Snow courses provide a longer record than SNOTEL. The earliest snow courses in the Montana have data back to the 1920s.

Snow Water Equivalent (SWE)

Sometimes also called snow water content, this is the amount of water contained within the snowpack. It can be thought of as the depth of water (in inches) that would result if you melted the snowpack. For example, if a snowpack containing 12 inches of SWE melted instantaneously, there would be a puddle of water 12 inches deep on the ground.

SWE measurements made by snow pillows or snow tubes rely on the fact that water weighs the same whether it is liquid or frozen.



Weight of frozen water = Weight of liquid water

Snow core inside snow tubes

Appendix

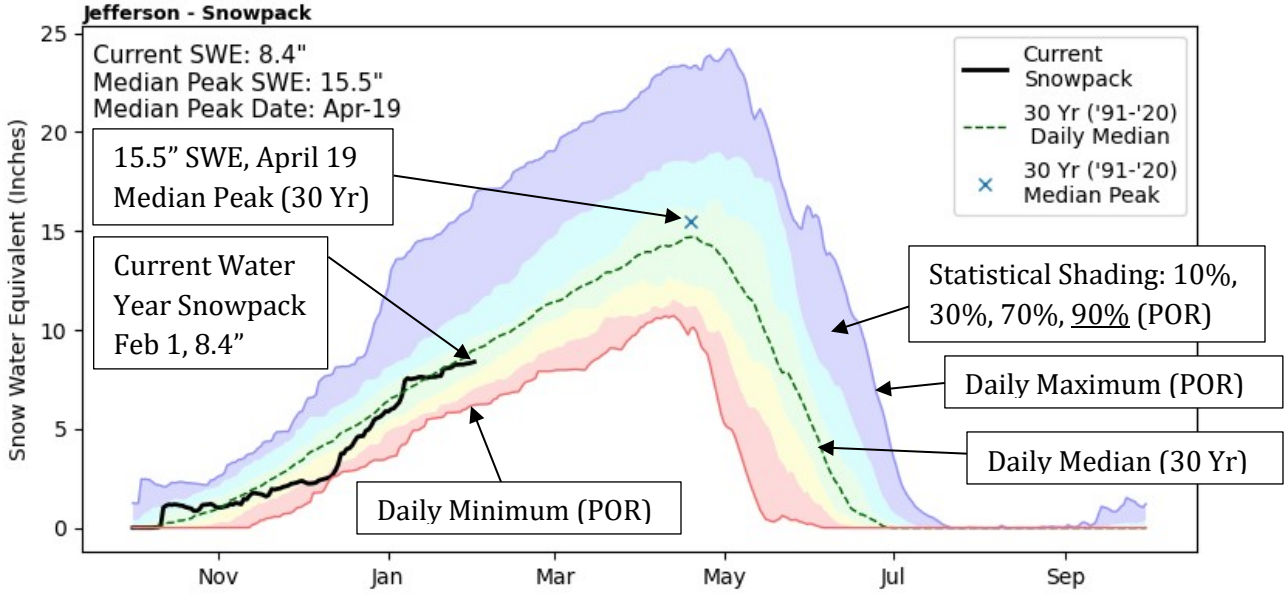
Additional Information

Climatic and Hydrologic Normals

The Snow Survey and Water Supply Forecasting (SSWSF) normals are site-specific measures of central tendency (either the median or average) for a data type, such as snow water equivalent (SWE). The statistics are calculated over a 30-year period and updated each decade, in agreement with World Meteorological Organization (WMO) standards. This 30-year reference period was chosen to characterize the current hydroclimatology at each station. The most recent medians and averages have been updated to include data for the water years 1991-2020. The National Water and Climate Center (NWCC) also provides medians and averages for the 1981-2010 and 1971-2000 reference periods for stations with sufficient data. The normals available from the NWCC include the median and average for SWE, snow depth (snow courses only), precipitation, volumetric streamflow, and reservoir storage. Values are calculated from data collected by NRCS-managed stations and external agencies such as the U.S. Geological Survey (USGS), National Weather Service (NWS), state agencies, and private organizations. Normal is calculated for various durations including daily, month-to-date, semi-monthly, monthly, seasonal, and annual based on the data type. More information is available here: https://www.nrcs.usda.gov/resources/data-and-reports/climatic-and-hydrologic-normals

Interpreting Snowpack Charts

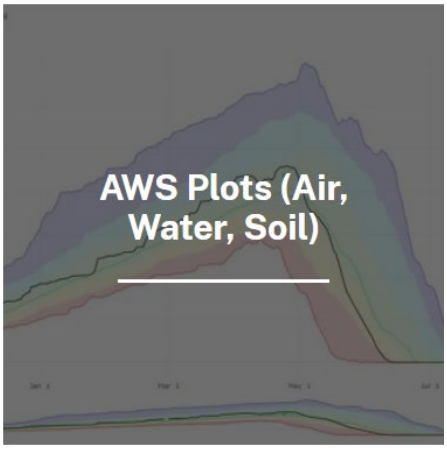
Snowpack charts displayed in this report are created using daily (midnight) snow water equivalent (SWE) values at SNOTEL sites determined to represent the basin. Snow Course data is not included. Plotted lines are the average of each SNOTEL's individual values. For example, the "Current Snowpack" on January 1st is the average all SNOTEL SWE values in that basin for that day. The "30 Yr. ('91-'20) Daily Median" is the average of each SNOTEL's median SWE value for a given day. The upper and lower extent (blue/red lines) show the maximum/minimum daily SWE values, which is determined using the "Current Snowpack" SWE value for all days in the period of record (POR). Snowpack peak SWE dates differ from season to season, as a result the high point on the "30 Yr. ('91-'20) Daily Median" line is not the true median peak SWE. The point "X" is plotted by calculating the median peak date and median peak value independently. Similar charts with other basin definitions are available here: https://nwcc-apps.sc.egov.usda.gov/basin-plots/#mt

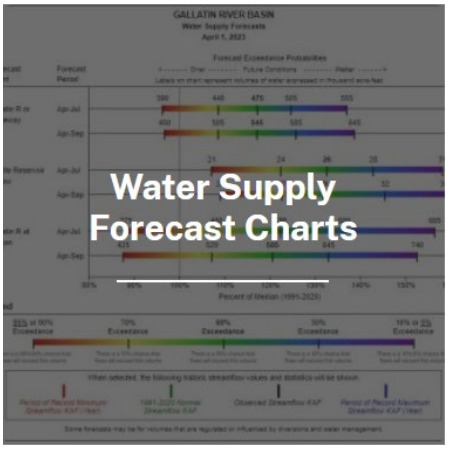


Appendix

Links and Resources

Products and Reports (click image)





Interactive Map Predefined Links

Snow

- Snow Water Equivalent > Daily > Percent of 1991-2020 Median > **Stations** | **Basins**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percent of 1991-2020 Median > **Stations** | **Basins**
- Snow Depth > Daily > **Stations**
- Snow Density > End of Previous Month (SNOTEL and Snow Course) > **Stations**

Precipitation

- Month-to-Date > Daily > **Stations**
- Water Year-to-Date > Daily > Percent of 1991-2020 Median > **Stations** | **Basins**
- Previous Month > Percent of 1991-2020 Median > **Stations** | **Basins**
- Previous 3 Months > Percent of 1991-2020 Average > **Stations** | **Basins**

Streamflow

- Observed (Adjusted Volume) > Previous Month > Percent of 1991-2020 Median > **Stations** | **Basins**
- Forecast (Adjusted Volume) > Most Recent (Available March 1 through June 1) > Percent of 1991-2020 Median > **Stations** | **Basins**

Reservoir Storage

- End of Previous Month > Percent of 1991-2020 Median > **Stations**

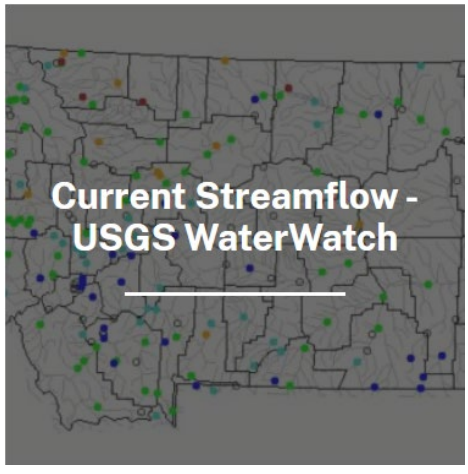
Other

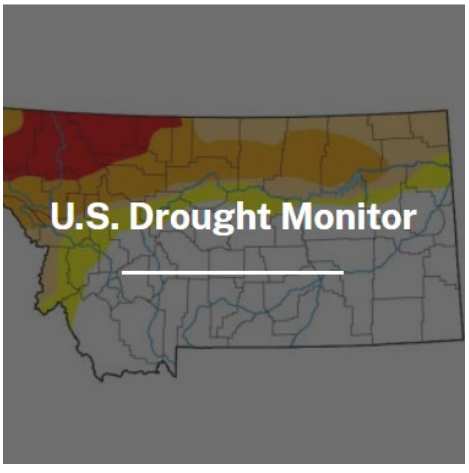
- Snow Water Equivalent > Daily > Compared to POR > **Stations**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percentile > **Stations**
- Water Year-to-Date Precipitation > Daily > Compared to POR > **Stations**

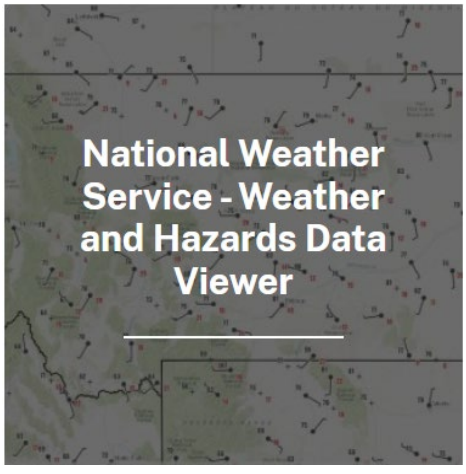
Appendix

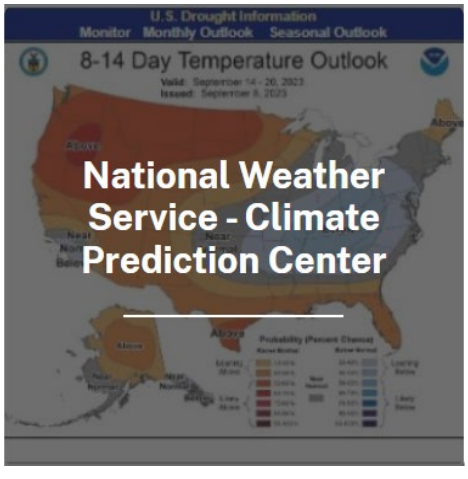
Links and Resources (Continued)

External Agencies (click image)









Additional Drought Information

- U.S. Drought Monitor
- National Integrated Drought System (Drought.gov)
- USDA Drought Portal (News and Resources)
- Farm Services Agency Montana (Information on Programs and Deadlines)
- Farm Services Agency Disaster Assistance Programs
- Montana Department of Natural Resources and Conservation Drought Management

Snow Survey Program FAQ

Frequently Asked Snow Survey Questions - Montana | Natural Resources Conservation Service (usda.gov)

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https://www.nrcs.usda.gov/montana/snow-survey

Montana Water Supply Outlook Report

Natural Resources Conservation Service