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Natural Resources Conservation Service

Montana

Water Supply Outlook Report

May 1, 2023

Photo: Park County Public Works Department

Warm temperatures during the week of April 10th resulted in significant melt of snowpack below mid-mountain elevations across Montana. The photo above shows the Shields River near Livingston exceeding its banks on April 12th when it reached an estimated peak streamflow of nearly 5000 cfs, which was the second highest peak on record, only behind 1979. The snowpack across all of Montana appears to have peaked for the season. Low elevation mountain snowpack has seen significant melt and many snow survey stations below 6000 ft have melted out. The high elevation mountain snowpack has only begun to melt. While it's starting to feel like summer, it's not uncommon to get rain and snow in May in Montana and snowpack conditions could still change. May 1st USDA-NRCS seasonal water supply forecasts are now available in the following report.

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https://www.nrcs.usda.gov/wps/portal/wcc/home/quicklinks/states/montana/

Operational News

Improving Temperature Data in the SNOTEL Network

When SNOTEL stations were originally installed in the 1960s and 1970s, they only collected snow water equivalent data, and in subsequent years, precipitation and snow depth sensors were added. Some stations in the Western US collected air temperature data, not initially as a climate record, but for the practical purpose of helping data editors determine whether precipitation was rain or snow. In addition, the installed sensors were not constructed to handle the extreme temperature swings that occur in mountainous regions, and there was not a standardized method for these installations. Beginning in the late 1990s, the SNOTEL network began installing an improved air temperature sensor, the YSI Extended Range sensor, which could handle a wider range of temperatures. While this sensor did a better job than its predecessor, the Snow Survey and Water Supply Forecasting program opted to use a linear least-squares regression algorithm to convert voltage to temperature, and in recent years this equation has been shown to be slightly biased.

In Montana, YSI Extended Range sensors were added to SNOTEL stations beginning in 1996, and it took until 2001 to outfit all existing stations with the extended range air temperature sensors. YSI Extended Range sensors have been collecting temperature data at Montana's SNOTEL and SNOLITE stations ever since. Beginning in 2023, we will be taking two actions to improve temperature data in the SNOTEL and SNOLITE network.

To begin, we will be replacing all YSI Extended Range sensors with a more accurate platinum resistant thermometer (PRT), the Apogee ST-300. This sensor was selected after four years of testing different sensors at SNOTEL stations across the west-wide Snow Survey network. The sensor will be installed inside of a new radiation shield, the MetSpec RAD06. This shield performed best during testing at reducing temperature bias resulting from shortwave and longwave radiation. Montana Snow Survey staff will begin installing the new sensors and shields in summer 2023, with all SNOTELs and SNOLITEs in the Montana Snow Survey network completed by 2027. We will continue to collect data from the YSI Extended Range sensors for 2-5 years and provide both datasets to the public.

The second part of improving air temperature data will entail back-correcting the historical YSI Extended Range temperature data with an improved equation. More information and references regarding the equation and methods are available on the National Water and Climate Center website. The bias correcting of YSI Extended Range air temperature data will take place after the new sensor and shield are installed at each station; therefore, it will take up to five years for all of Montana's SNOTEL and SNOLITE stations to be corrected. The bias correction process does not correct for any environmental factors, such as type of radiation shield (Montana's air temperature sensors have been housed in silver aluminum shields since their installation), placement within the SNOTEL site, shading, or radiative heating considerations; it only corrects the former biased linear equation and will only change the temperature data very slightly.

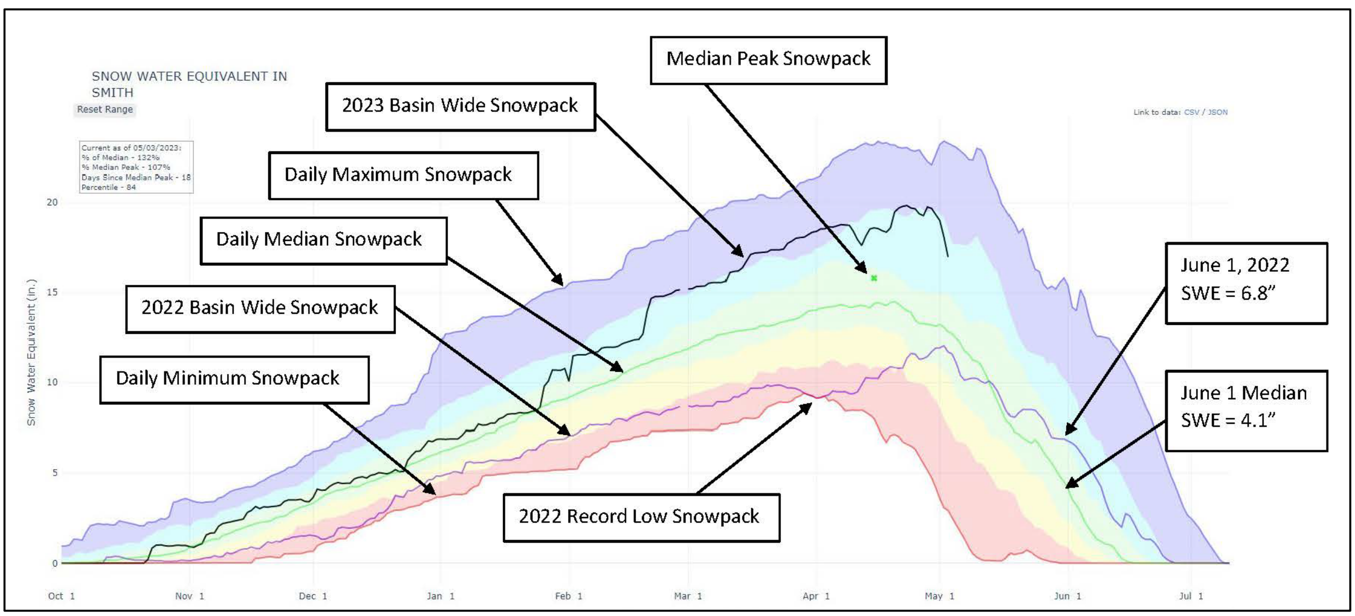
We are continually working to improve our data quality, data availability, and transparency regarding all the factors that go into maintaining a network of weather stations. As one of the largest and longest-running mountain weather networks in the world, we are committed to providing high quality data to our customers who rely on it for a variety of essential objectives. The air temperature upgrade is the latest in a series of major electronic and sensor upgrades to SNOTEL and SNOLITE stations in Montana in recent years.

Photo: Fisher Creek SNOTEL currently has a YSI Extended Range air temperature sensor in an aluminum shield, shown in the red circle. This station is slated to receive a new ST-300 air temperature sensor and RAD06 shield this summer.

Late Season Snowpack Percent of Normal Information

When assessing the snowpack after peak snow water equivalent has occurred (April/May/June) and the snow is almost fully melted, it is important to look at the season in its entirety. For example, the basin wide snowpack in the Smith River basin during water year 2022 was near record low all winter. On April 1, 2022, about normal timing of peak snow water equivalent, the Smith River basin wide snowpack was record low. The snowpack made a slight recovery in May, however it still peaked about 4 inches below the median peak of 15.8 inches. The daily median snowpack curve decreases after mid-April (peak snowpack) and delayed melt in a basin can cause large snowpack percentages that might appear like the basin made a significant recovery, while it actually didn’t. Because of the delayed melt, the Smith River basin wide snowpack on June 1, 2022, was 6.8 inches, while the median was 4.1 inches (166% of normal). When assessing the snowpack its import to consider other factors such as how it compared to normal over the entire season and how the season’s peak snow water equivalent compared to normal.

Smith River Basin Snow Water Equivalent Chart



Precipitation

After a couple months of above normal precipitation across most of Montana, active weather slowed down in April. Precipitation last month was overall below normal across the region. West of the Continental Divide basin wide precipitation ranged from about 70-90% of normal. Several SNOTEL stations between Flathead Lake and Libby received less that one inch of precipitation during the April, which is less than 50% of normal. East of the divide basin wide precipitation was closer to normal and a couple locations did receive above normal April precipitation including the mountains surrounding Helena, Smith-Judith-Musselshell River basin, Bears Paw Mountains, and the Wind River basin. Elsewhere east of the divide precipitation was about 70-90% of normal except in the Tongue River basin, which only received about 50% of normal monthly precipitation.

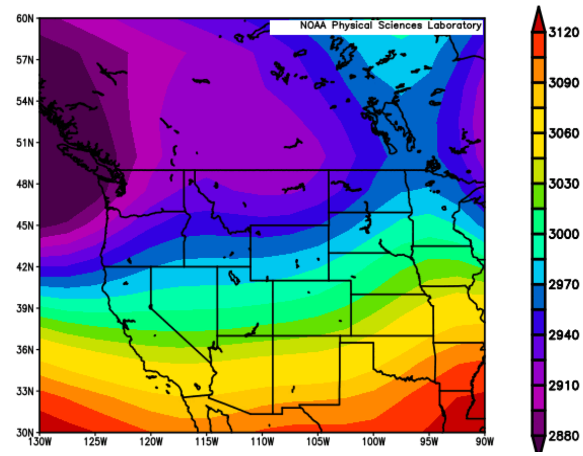


Figure: 700mb atmospheric pressure during the April 18-22 storm that brought significant precipitation to the region. Daily Climate Composites: NOAA Physical Sciences

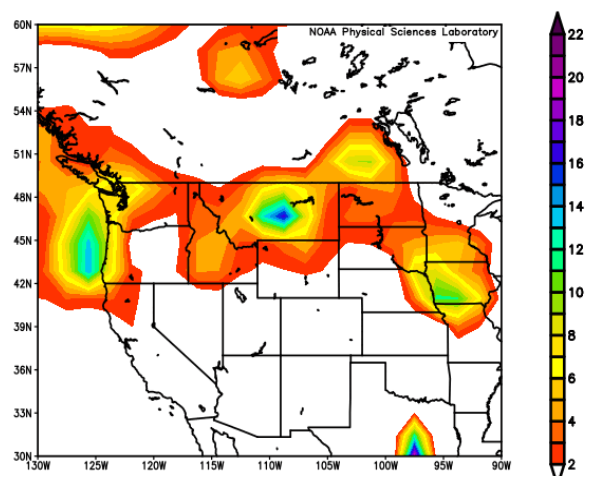


Figure: Surface precipitation rate during the April 18-22 storm Daily Climate Composites: NOAA Physical Sciences

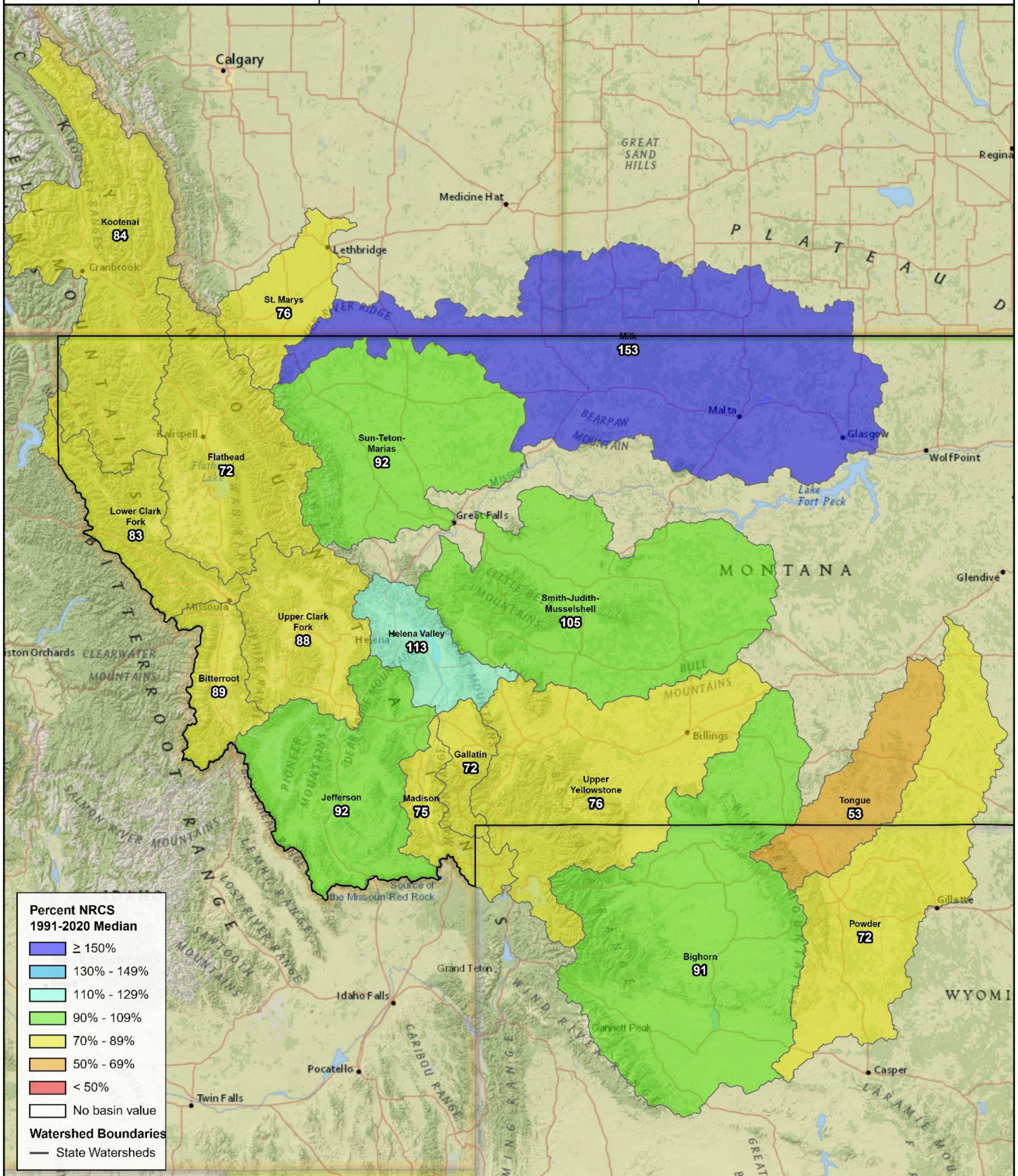
April weather consisted of both sunny days, winter weather, and rain. Last month's largest precipitation events were relatively localized and not as widespread as some storms earlier this year. The most widespread storm last month occurred around April 18-22 and delivered two to three inches of precipitation (snow) to the northern Swan Mountain Range, Rocky Mountain Front and central Montana. Crystal Lake SNOTEL in the Big Snowy Mountains received 4.5 inches of snow water equivalent accumulation during this storm and upper mountain elevations across all of southwest Montana received one to two inches of snow water equivalent. Other notable storms occurred during the first and the last week of April when one to two inches of precipitation fell in the southern Wind River Mountains. Additionally, another mid-month storm (April 12-14), brought about one to two inches of precipitation to central Montana.

Overall, water year precipitation has been near to above normal east of the divide, except in the Rocky Mountain Front, which similar to basins west of the divide has been below normal (75-90%). In northwest Montana precipitation since October 1 ranks near lowest in 30 years (1991-2020) where current water year precipitation as a percentile ranges from about the 5th-30th across the Flathead, Kootenai, Lower Clark Fork and Bitterroot River basins. In contrast, this year's water year precipitation in central Montana, southwest Montana, and the southern Wind River Mountains ranks in the 70th-80th percentile at many SNOTEL stations. Elsewhere, west of the divide, water year precipitation is closer to normal. May 1 marks the halfway point through the water year and as we near the drier summer months a significant change in weather will be required to make significant gains in northwest Montana where it is needed most.

Photo: Road conditions on Bozeman Pass (I-90) on April 19, 2023, during the mid-month snowstorm when 2-3+ inches on snow water equivalent accumulated in the region.

Photo: Road conditions heading to Grasshopper snow course on April 26, 2023, for May 1 surveys when the weather was warm and sunny. (Skier: L. Austin, Photo: M. Hultstrand)

1 month Precipitation	Monthly SNOTEL Precipitation Percent NRCS 1991-2020 Median	April 1, 2023 - April 30, 2023



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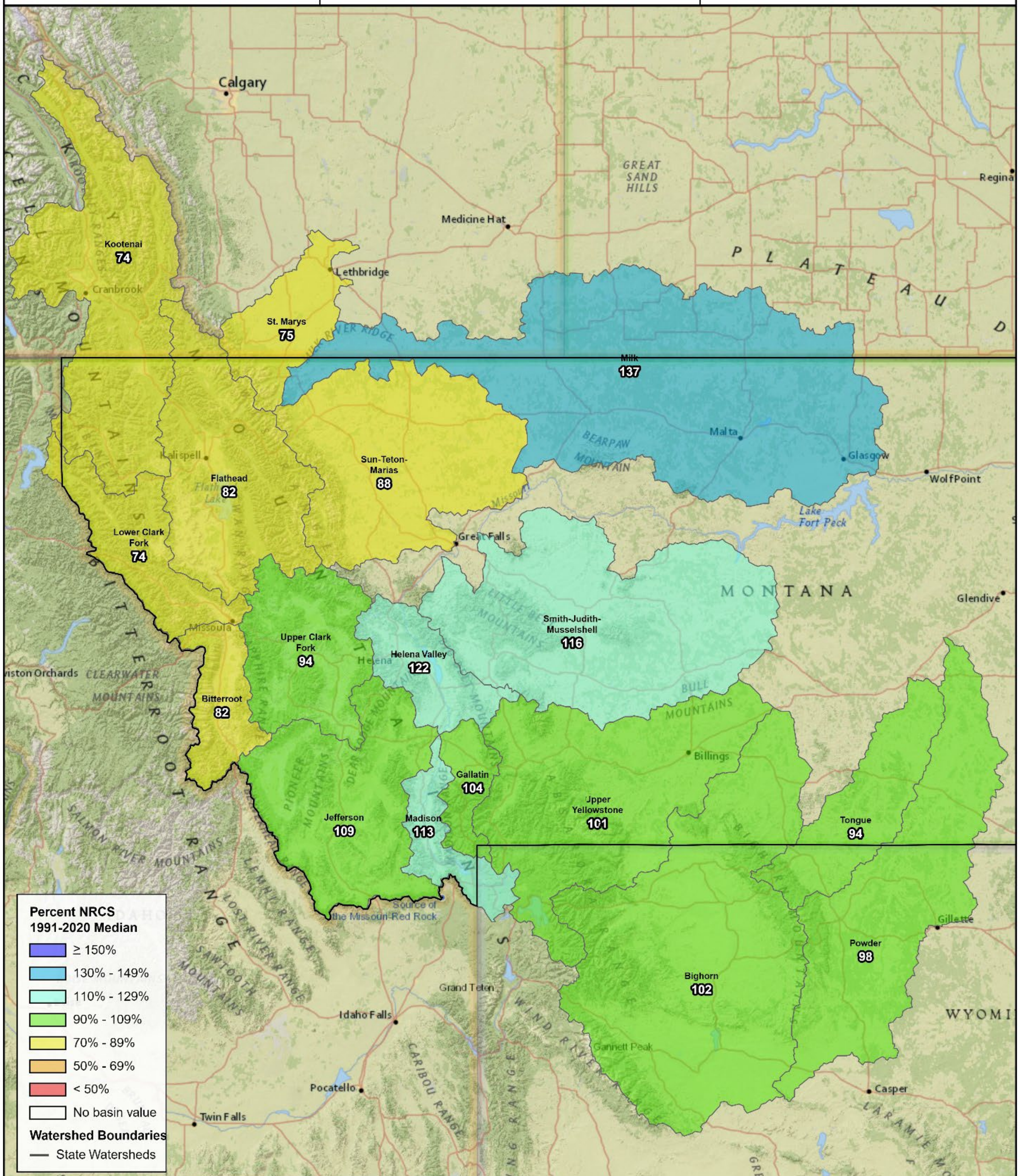
Water Year to Date Precipitation	Water Year SNOTEL Precipitation Percent NRCS 1991-2020 Median	October 1, 2022 - April 30, 2023



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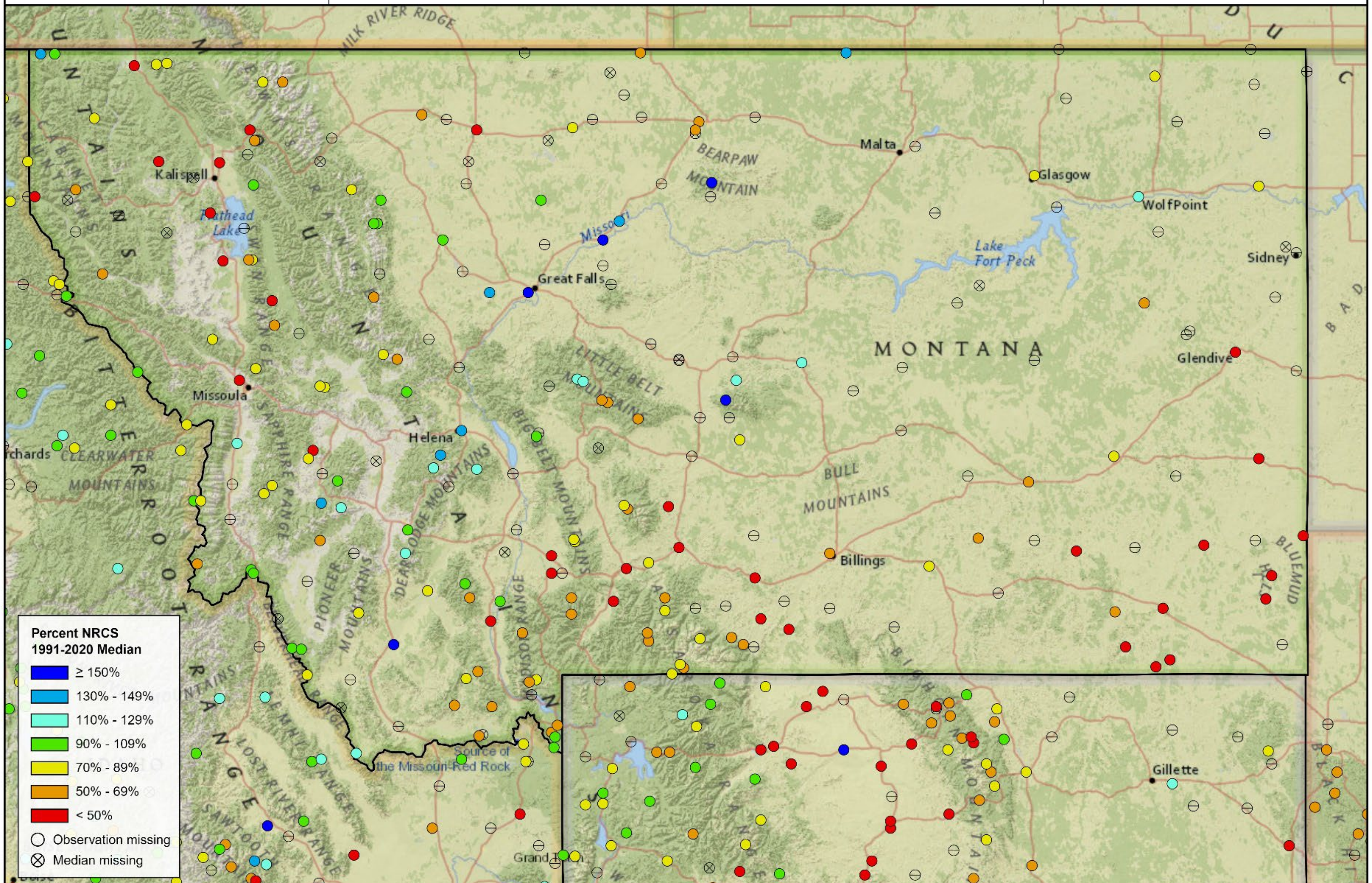

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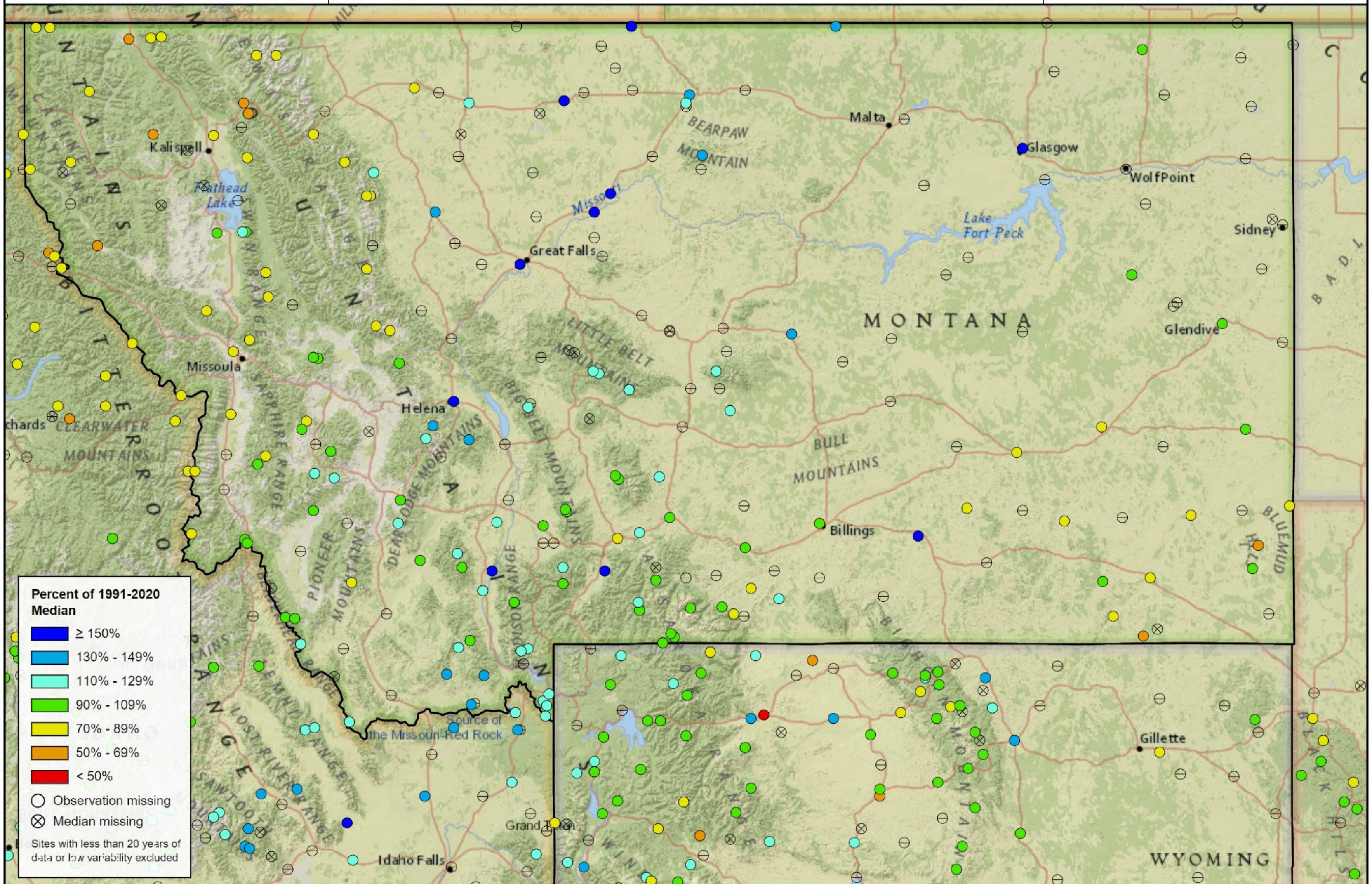
Water Year to Date Precipitation	Water Year Precipitation Percent of 1991-2020 Median	October 1, 2022 - April 30, 2023



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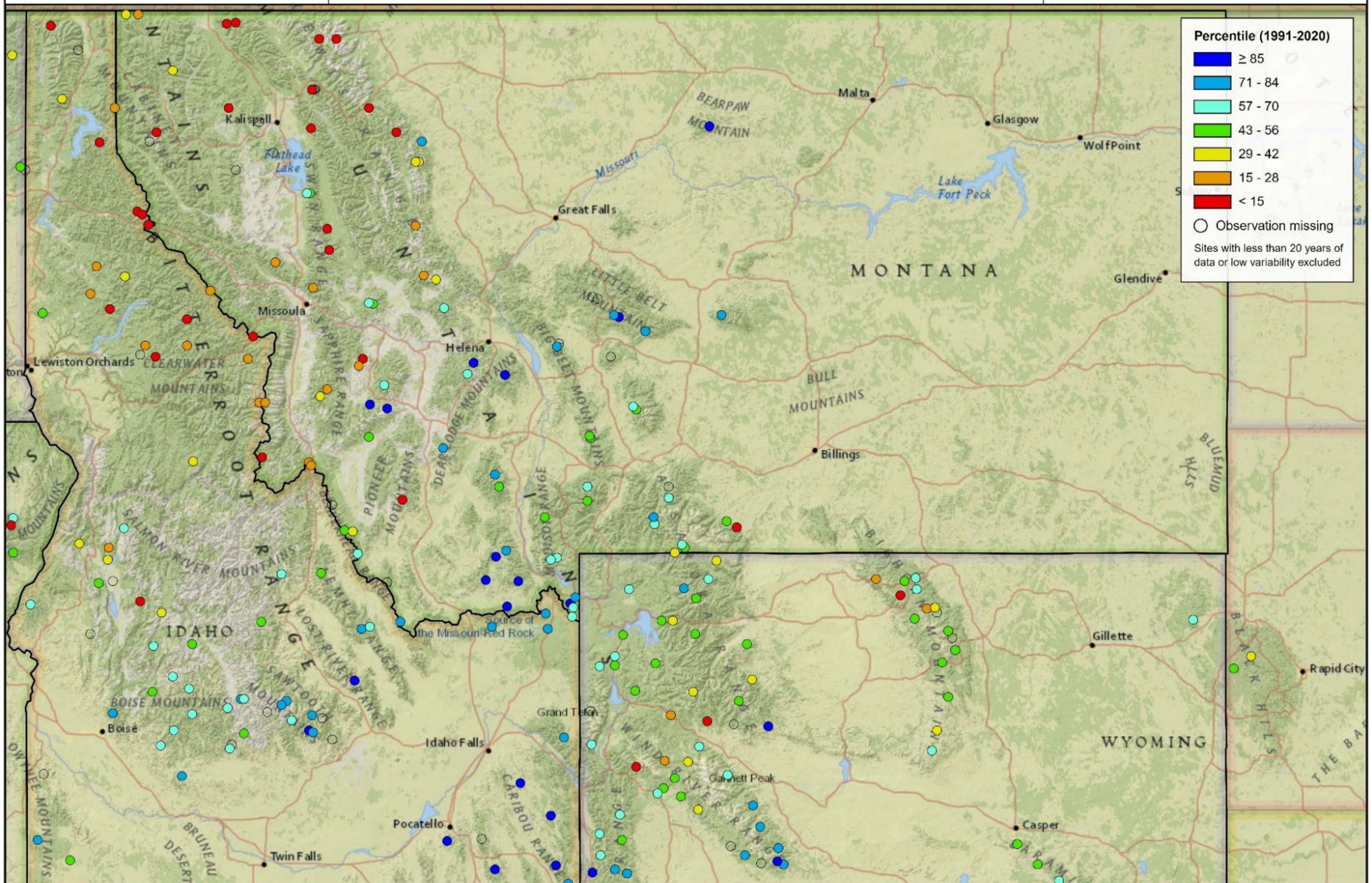
Water Year to Date Precipitation	Water Year SNOTEL Precipitation Percentile (1991-2020)	October 1, 2022 - April 30, 2023



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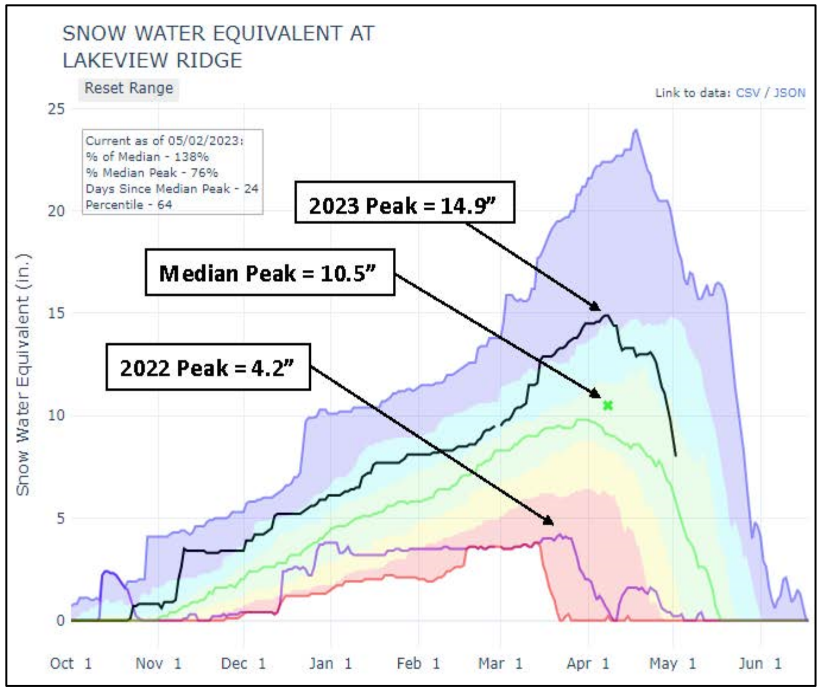
Snowpack

East of the Continental Divide

River basins east of the divide, except the Rocky Mountain Front, have received near to well above normal precipitation this water year and that is evident in the current snowpack. Central Montana and part of southwest Montana currently have a near record high snowpack and percentages are over 130% of normal for May 1. Basin wide the Jefferson, Gallatin, Upper Yellowstone, Bighorn, Powder, and Tongue River basins have received closer to normal precipitation and the snowpack currently ranges from about 105-130% of normal. The Rocky Mountain Front snowpack is currently about 75-90% of normal. April precipitation was overall below normal in south central and northern Wyoming and snowpack percentages decreased slightly since April 1.



Snow water equivalent plot showing this year's snowpack at Lakeview Ridge SNOTEL compared to last year.

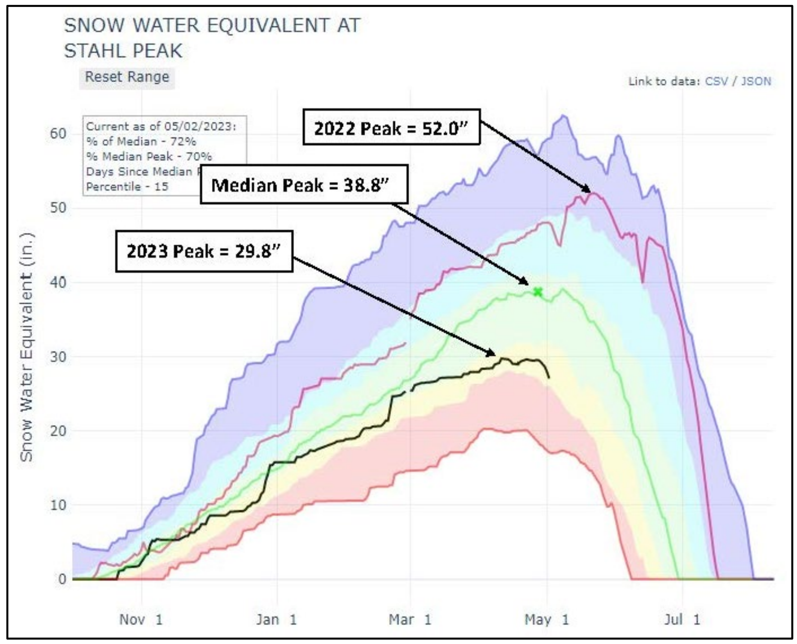
The mountain snowpack has peaked at lower elevations, and it appears to have peaked at upper elevations but minor accumulation in early May could cause a later peak. Snow water equivalent peaks generally occur around May 1 at upper elevations. If we don't receive a higher snowpack peak in May, then peak SWE occurred within about a week of normal this year for a majority of SNOTEL stations on the east side. However peak snow water equivalent values compared to normal varied. SNOTEL stations at all elevations in the southern Madison, southern Jefferson, and central Montana exceeded normal peaks by roughly three to seven inches of snow water equivalent. That is significantly different than last year when many SNOTEL stations peaked well below normal by a similar amount. One of the more drastic examples is Lakeview Ridge SNOTEL in the Centennial Mountains, which this year peaked at 14.9 inches, 4.4 inches more than normal, while last year's peak was only a total of 4.2 inches of snow water equivalent. Elsewhere east of the divide, peaks were generally within one to two inches of normal except at lower elevations where Tie Creek SNOTEL, Short Creek SNOTEL, and Cole Canyon SNOTEL set record high peaks this year.

Spring snowmelt has started at all SNOTEL elevations. The lowest stations east of the divide started melting in mid-to-early April and have since released a significant amount of water. The snowpack at upper elevation SNOTEL stations is primed as indicated with current densities (snow water equivalent ÷ snow depth) at about 35-45%. As of May 1 the snowpack at most high elevation SNOTEL stations has released less than 0.5 inches of snow water equivalent in the last 7 days. Some of the high elevation SNOTEL stations have 35+ inches of water remaining in the snowpack.

West of the Continental Divide

Water year precipitation has not been as abundant in most locations west of the divide, which is also evident in the current snowpack. Ideally April would have brought above normal snowfall to the west side of the divide, but that did not occur. Current snowpack percentages are generally worse in the far northwest part of Montana and better to the south on the west side. The snowpack in the Kootenai and northern Flathead River basins is only about 80% of normal, while the Swan River basin and other southern Flathead basins are near normal. The Bitterroot River basin made significant gains over the last several months and currently has a near normal snowpack. The Upper Clark Fork River basin snowpack is currently more similar to the east side. While overall the Upper Clark Fork River basin snowpack is about 120% of normal, the snowpack above Flint creek is about 155% of normal.

The snowpack at all SNOTEL stations appears to have peaked for season, however future weather could potentially change that at upper elevations. The low elevation mountain snowpack peaked in early April within a week or two of normal. Further north on the west side low elevation snowpack peaks were within one to two weeks of normal. Upper elevation snowpack peaks in the Kootenai and northern Flathead region are currently the lowest compared to normal in Montana. Assuming the peaks have already occurred, then they were 9-15 inches less than normal. That is significantly different than last year at this time. For example, Stahl Peak SNOTEL appears to have peaked at 29.8 inches this year. The median peak is 38.8 inches and last year it peaked higher than normal at 52.0 inches of snow water equivalent. Lower Clark Fork River basin snowpack peaks were about four to six inches below normal this year. Further south on the west side of the divide the snowpack appears to have peaked closer to normal, except in the Upper Clark Fork River basin near Butte and Anaconda where peaks were much higher than normal.



Snow water equivalent plot showing this year's snowpack at Stahl Peak SNOTEL compared to last year.

Spring snowmelt is also in full swing west of the divide. The snowpack at lower elevation SNOTEL stations started melting in early April and has since significantly melted. Several SNOTEL stations have melted out. The high elevation snowpack on the west side has released more water than the high elevation snowpack on the east side, which is not uncommon as the snowpack on the east side generally peaks slightly earlier. The following table includes snow survey stations that had no snow remaining on May 1 (SNOTEL melt out statistics):

SNOTEL – Melted Out

Name	County	Side of Divide	Elevation (ft)	Normal Melt Out
Bassoo Peak	Sanders	West	5150	na
Calvert Creek	Deer Lodge	East	6430	2-May
Combination	Granite	West	5600	23-Apr
Copper Bottom	Lewis And Clark	West	5200	27-Apr
Hand Creek	Flathead	West	5035	9-May
Lubrecht Flume	Missoula	West	4680	8-Apr
Pike Creek	Pondera	East/West	5930	na

Snow Course – Melted Out

Name	County	Side of Divide	Elevation (ft)
Colley Creek	Park	East	6300
Coyote Hill	Missoula	West	4200
Holbrook	Powell	West	4530
Revais	Sanders	West	4800
Taylor Road	Hill	East	4080
Truman Creek	Flathead	West	4060
Bear Lodge Divide	Crook	East	4680

Major Basin Snow Water Equivalent (SWE) Percentage and Peak SWE Information

Basin	Last Year SWE % Normal 5/1/2022	Last Month SWE % Normal 4/1/2023	Current SWE % Normal 5/1/2023	Normal Peak Date -	Normal Peak SWE (inches)	Current 2023 Peak Date -	Current 2023 Peak SWE (inches)	2023 Peak SWE Departure from Normal (inches)
St. Marys	130%	91%	94%	April 6	29.2	April 7	24.3	-4.9
Kootenai	114%	85%	81%	April 8	25.6	April 5	20.9	-4.7
Flathead	111%	92%	88%	April 14	26.1	April 6	22.8	-3.3
Sun-Teton-Marias	120%	95%	105%	April 16	17.1	April 23	14.1	-3.0
Lower Clark Fork	106%	90%	93%	April 14	31.2	April 24	28.2	-3.0
Bitterroot	110%	96%	103%	April 6	21.4	April 7	20.7	-0.7
Tongue	121%	117%	105%	April 29	13.5	April 7*	12.8	-0.7
Upper Yellowstone	97%	116%	113%	April 23	19.1	April 22	19.6	0.5
Powder	113%	118%	113%	April 14	10.8	April 7	11.6	0.8
Bighorn	100%	114%	113%	April 20	13.9	April 7	15.0	1.1
Gallatin	92%	123%	118%	April 24	21.9	April 25	23.0	1.1
Upper Clark Fork	98%	114%	123%	April 13	15.9	April 6	17.7	1.8
Helena Valley	99%	137%	155%	April 16	13.6	April 25	16.3	2.7
Jefferson	93%	117%	127%	April 18	14.9	April 26	17.6	2.7
Madison	90%	129%	135%	April 22	21.9	April 25	25.3	3.4
Smith-Judith-Musselshell	93%	135%	135%	April 16	15.4	April 28	18.9	3.5
Milk	0%	252%	1180%	March 26	5.4	April 3	10.7	5.3

**Note: The Tongue River Basin had a second peak of 12.1 inches on April 28, 2023*

NOAA NOHRSC - Modeled Snow Water Equivalent for May 1, 2023

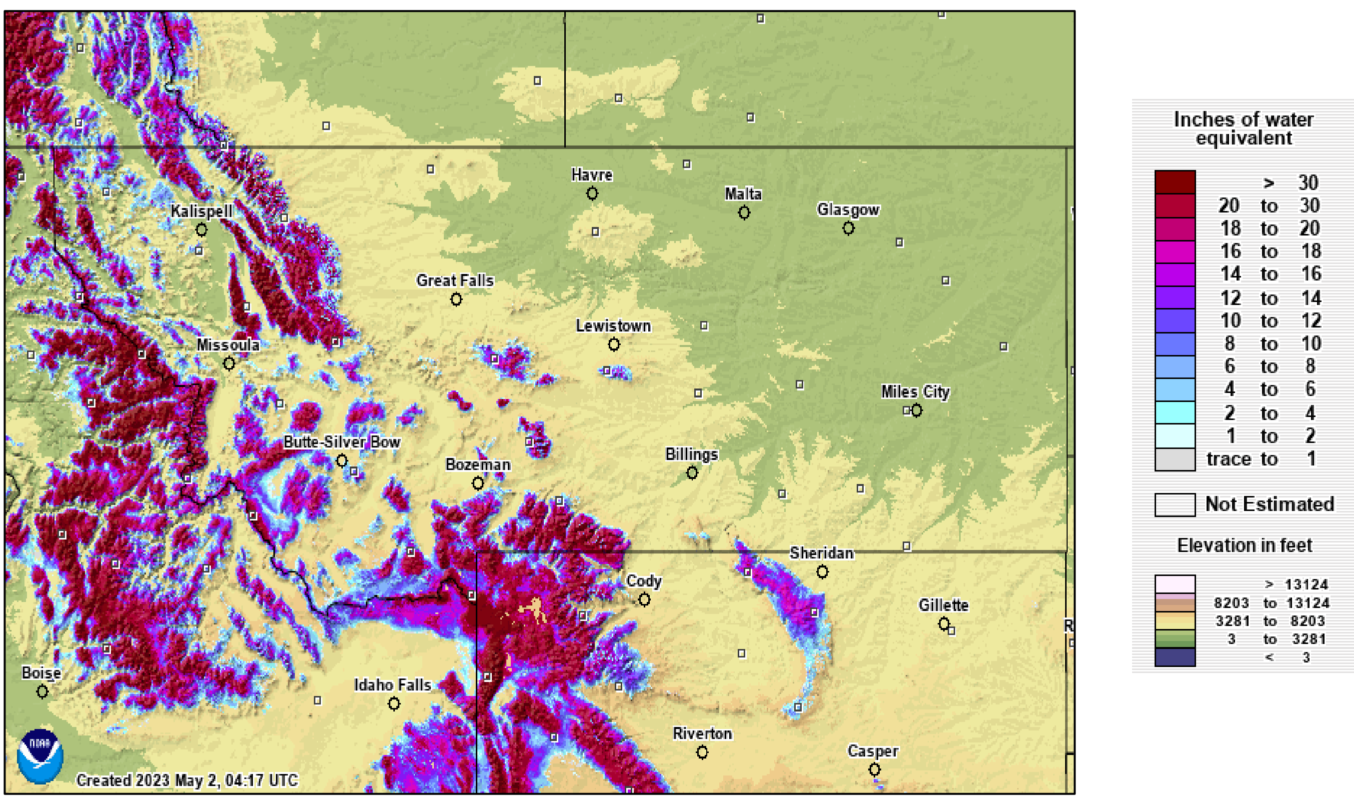
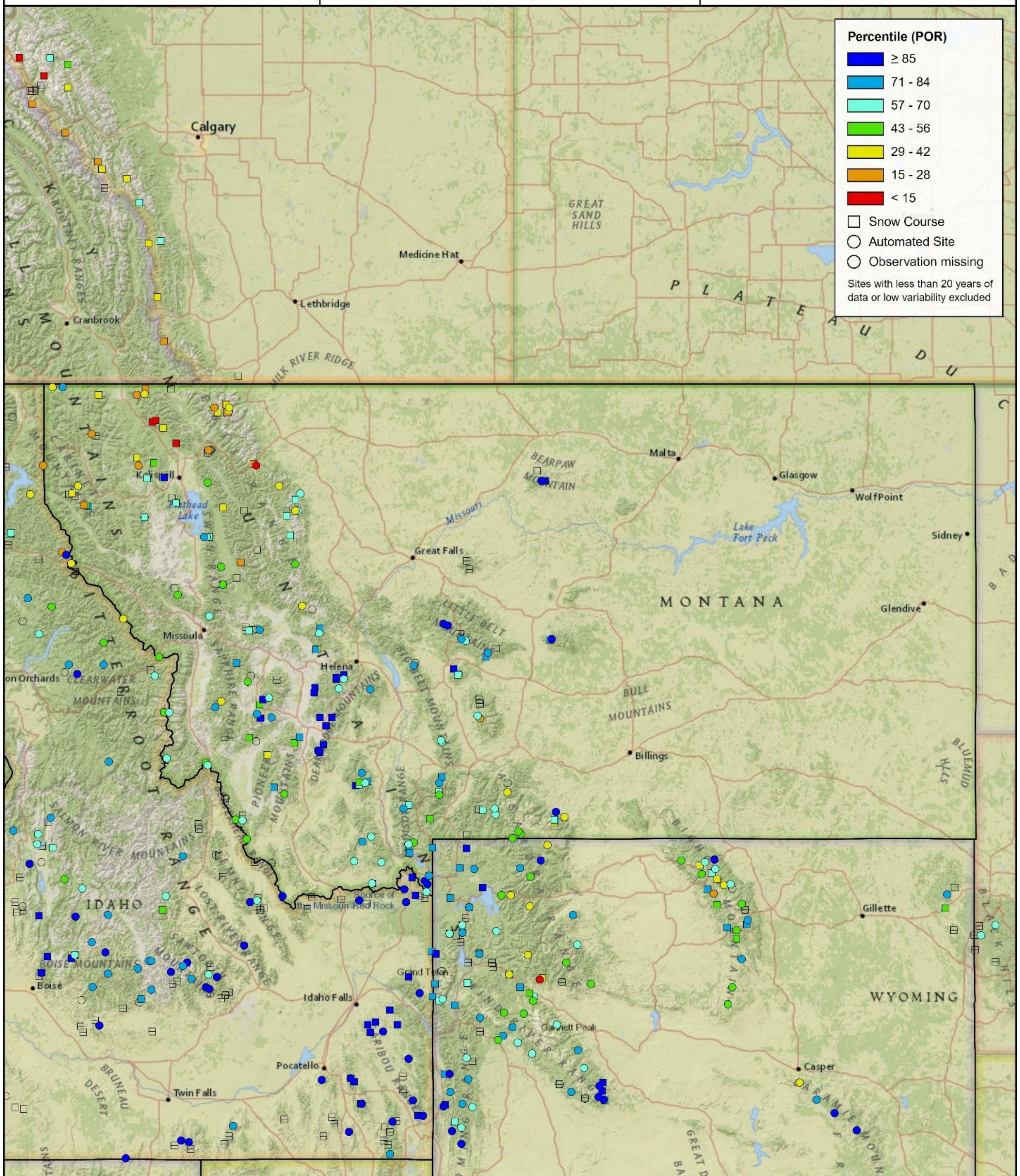


Figure: Modeled snow water equivalent map showing valley snow has melted. Link

Sub-Basin Snow Water Equivalent – Current Compared to Last Month

River Basin Name	April 1, 2023 SWE % Normal	May 1, 2023 SWE % Normal	SWE % Difference
Bear Paw	252%	1180%	
Beaverhead	120%	123%	+3%
Big Hole	107%	116%	+9%
Big Horn	109%	104%	-5%
Bitterroot	96%	103%	+7%
Blackfoot	105%	101%	-4%
Boulder (Jefferson)	127%	157%	+30%
Boulder (Yellowstone)	122%	116%	-6%
Clarks Fork Yellowstone	106%	106%	+0%
Fisher	97%	96%	-1%
Flathead Lake	104%	107%	+3%
Flint	112%	126%	+14%
Gallatin ab Gateway	122%	116%	-6%
Greybull-Wood	117%	110%	-7%
Helena Valley	137%	155%	+18%
Judith	126%	133%	+7%
Kootenai in Canada	84%	78%	-6%
Kootenai in Montana	81%	77%	-4%
Little Bitterroot	109%	164%	+55%
Lower Clark Fork	90%	93%	+3%
Madison ab Hebgen	132%	149%	+17%
Madison bw Hebgen	125%	126%	+1%
Marias	95%	100%	+5%
Middle Fork Flathead	83%	82%	-1%
Musselshell	130%	131%	+1%
North Fork Flathead	80%	73%	-7%
Northern Gallatin	120%	117%	-3%
Owl	138%	167%	+29%
Powder	118%	113%	-5%
Rock (Clark Fork)	115%	118%	+3%
Rock (Yellowstone)	119%	112%	-7%
Ruby	114%	118%	+4%
Shields	114%	98%	-16%
Shoshone	106%	95%	-11%
Smith	129%	133%	+4%
South Fork Flathead	90%	88%	-2%
Southern Flathead	102%	98%	-4%
St. Marys	91%	94%	+3%
Stillwater (Flathead)	81%	68%	-13%
Stillwater (Yellowstone)	116%	110%	-6%
Sun	94%	112%	+18%
Swan	102%	98%	-4%
Teton	101%	114%	+13%
Tongue	117%	105%	-12%
Upper Clark	126%	157%	+31%
Wind	121%	132%	+11%
Yaak	86%	87%	+1%
Yellowstone ab Livingston	116%	115%	-1%

Snow Water Equivalent	Snow Water Equivalent (SNOTEL and Snow Course) Percentile (POR)	May 1st, 2023



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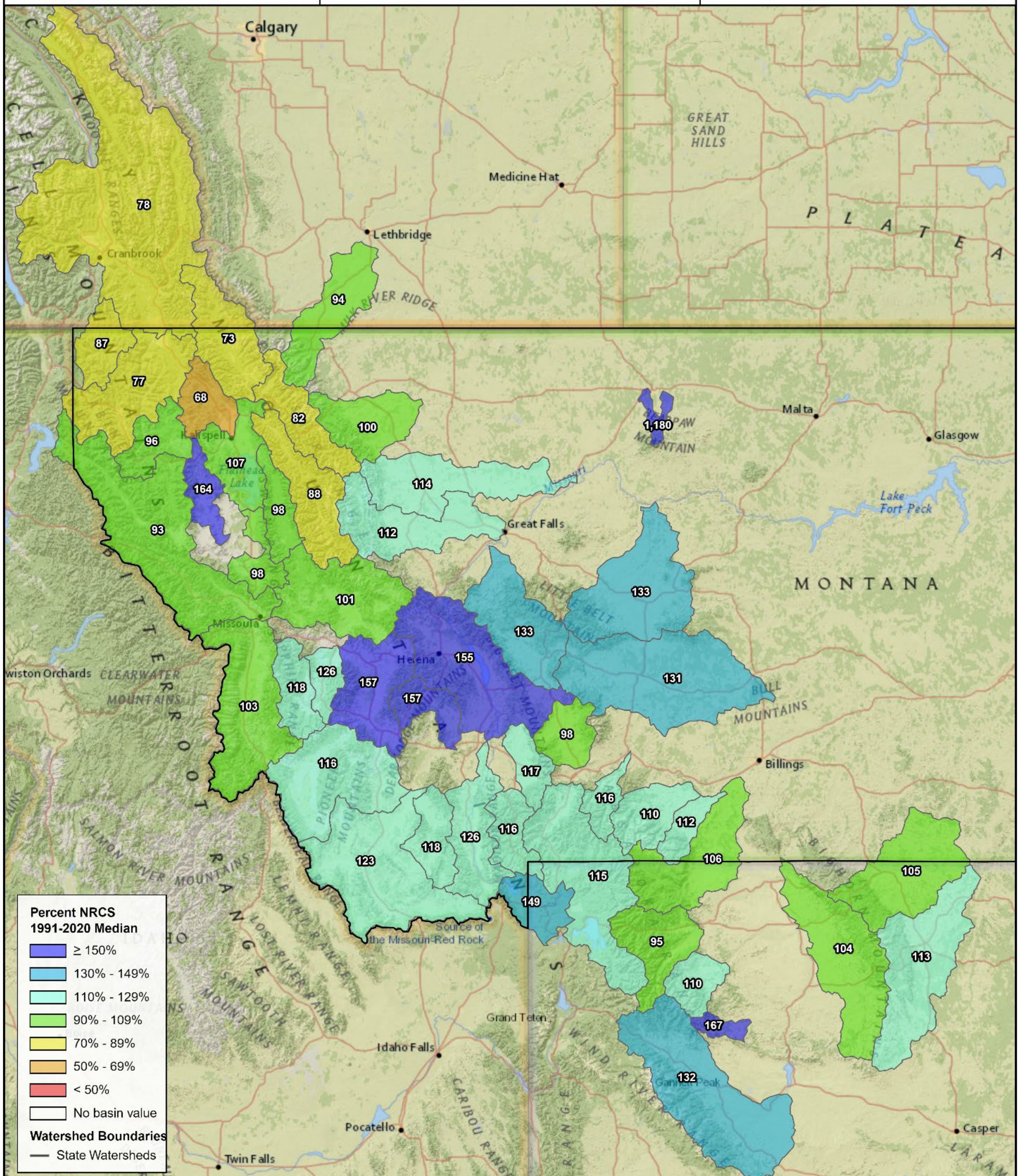
Snow Water Equivalent	Sub-Basin Snow Water Equivalent Percent NRCS 1991-2020 Median	May 1st, 2023



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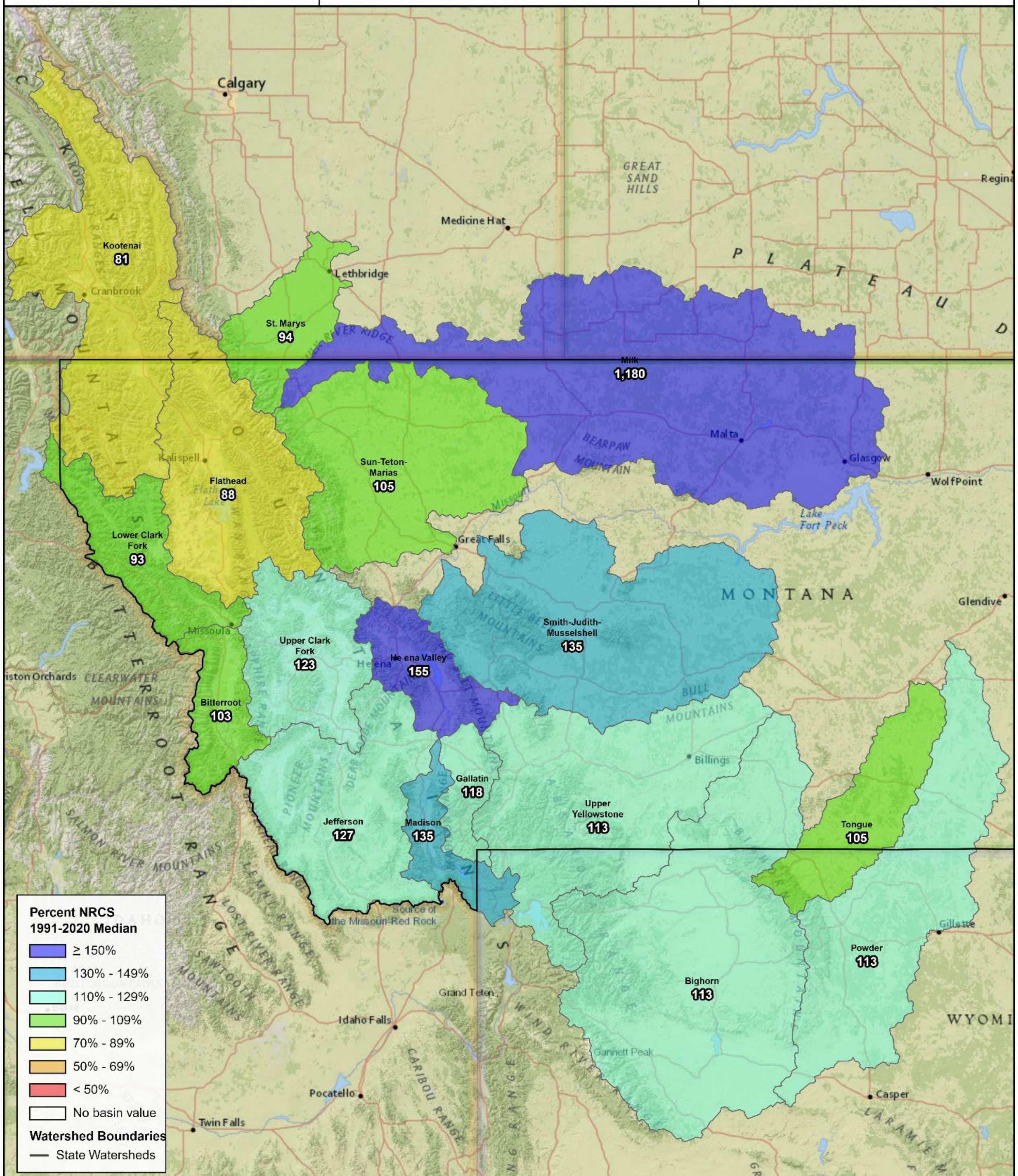
Snow Water Equivalent	Major Basin Snow Water Equivalent Percent NRCS 1991-2020 Median	May 1st, 2023



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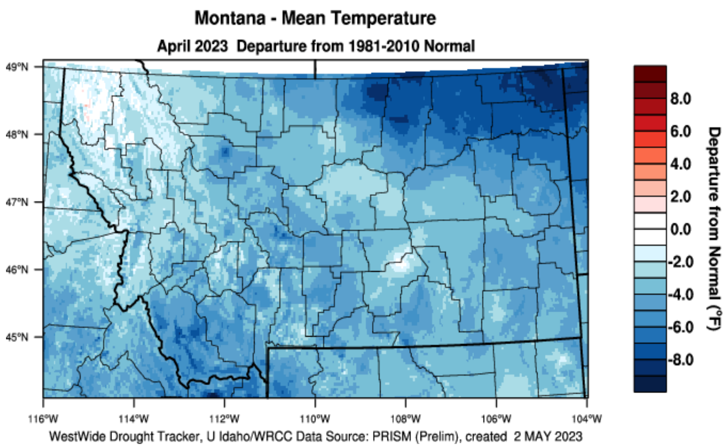
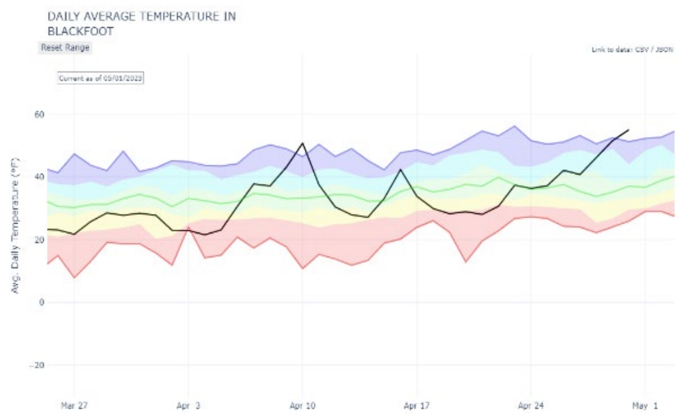
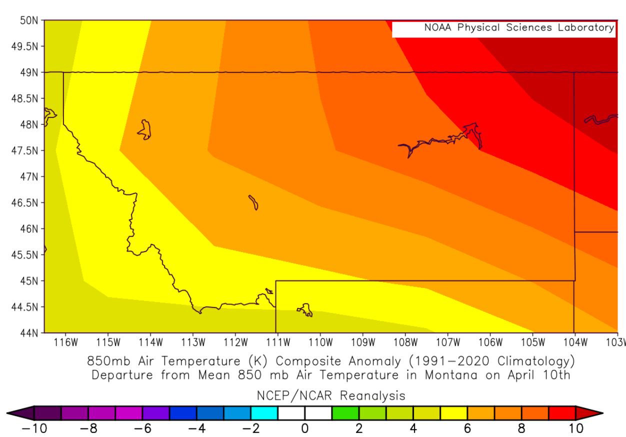
Temperature

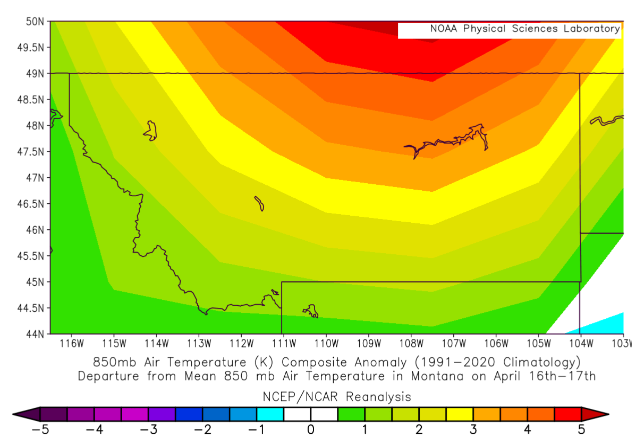
Average temperatures throughout Montana were predominantly below normal during April. The upper northwest portion of the state had air temperatures at or slightly above normal. The rest of the state had below normal temperatures overall, with the northeast being the coldest compared to normal. The map below on the left shows statewide temperature in relation to the monthly mean. The graph below on the right shows the April daily average temperatures at seven SNOTEL stations located within the Blackfoot River basin. As seen in the temperature graph below, a warming trend produced above average temperatures towards the end of April and into the start of May. This same pattern was also observed across other basins in Montana.





Although monthly temperatures were mostly below normal, there were several days where above normal temperatures were observed statewide. The most notable of those days were April 10 and April 16-17. The maps below show the above normal temperatures with April 10 on the left and April 16-17 on the right. The graph above on the right also shows the corresponding peaks in average temperatures on those days. In the Blackfoot River basin, the average temperature on April 10 was 17.5° F above the median. On April 16 the average temperature was 7° F above the median.





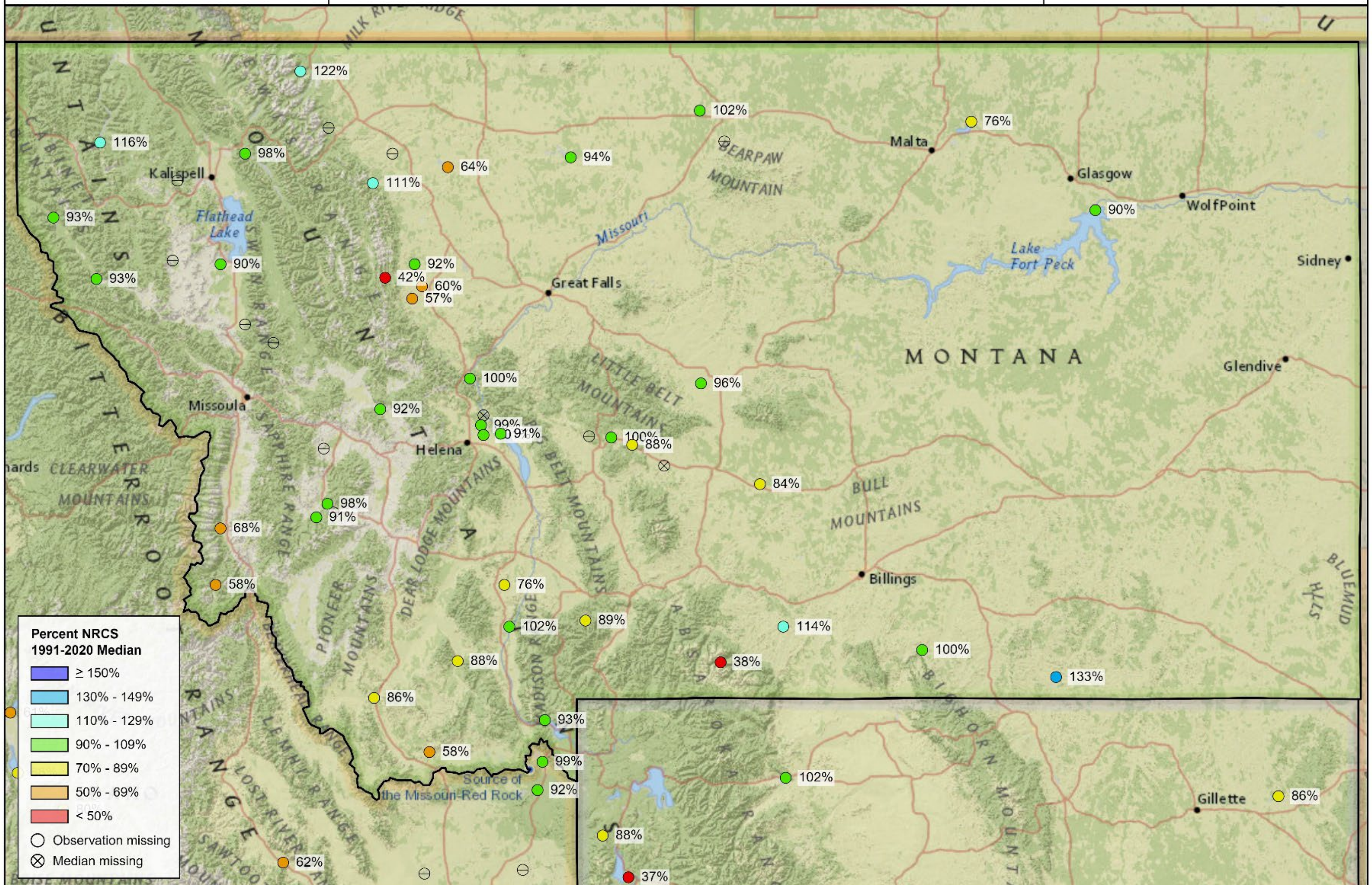
Reservoirs

There are multiple reservoirs in Montanan that deviate from normal storage levels leading into May. Reservoirs such as Gibson, Lake Como, Lake Frances, Lima, Mystic Lake, Nilan, Painted Rocks Lake and Willow Creek (Augusta) were all well below normal for the beginning of May. Cooney, Lake Koocanusa, Lake Sherburne, Swift and Tongue River Reservoir were significantly higher compared to normal. The remaining reservoirs were near normal for this time of the year.

Reservoir Storage – Current Compared to Last Month and Last Year

	% of Median (1991-2020)		
Reservoir	May 1, 2023	April 1, 2023	May 1, 2022
Ackley Lake	96%	99%	76%
Bair Res	88%	43%	58%
Bighorn Lake	100%	96%	100%
Canyon Ferry Lake	91%	93%	88%
Clark Canyon Res	86%	82%	71%
Cooney Res	114%	99%	118%
Deadman's Basin Res	84%	75%	65%
East Fork Rock Creek Res	91%	94%	94%
Ennis Lake	102%	104%	94%
Flathead Lake	90%	103%	80%
Fort Peck Lake	90%	88%	91%
Fresno Res	102%	58%	68%
Georgetown Lake	98%	99%	101%
Gibson Res	42%	28%	56%
Hebgen Lake	93%	102%	96%
Helena Valley Reservoir	101%	125%	96%
Holter Lake	100%	100%	100%
Hungry Horse Lake	98%	101%	109%
Lake Como	68%	63%	118%
Lake Elwell (Tiber)	94%	94%	98%
Lake Frances	64%	70%	89%
Lake Helena	99%	91%	97%
Lake Koocanusa	116%	110%	82%
Lake Sherburne	122%	68%	62%
Lima Reservoir	58%	57%	62%
Middle Creek Res	89%	91%	NA
Mystic Lake	38%	226%	193%
Nelson Res	76%	58%	60%
Nevada Creek Res	92%	59%	78%
Nilan Reservoir	57%	NA	63%
Noxon Rapids Reservoir	93%	98%	91%
Painted Rocks Lake	58%	73%	77%
Pishkun Res	92%	100%	89%
Ruby River Reservoir	88%	111%	88%
Smith River Res	100%	NA	66%
Swift Res	111%	99%	109%
Thompson Falls Res	93%	103%	96%
Tongue River Res	133%	108%	116%
Willow Creek Res (Harrison)	76%	77%	77%
Willow Creek Res - Augusta	60%	62%	92%

Reservoir Storage	Reservoir Storage Percent NRCS 1991-2020 Median	May 1st, 2023



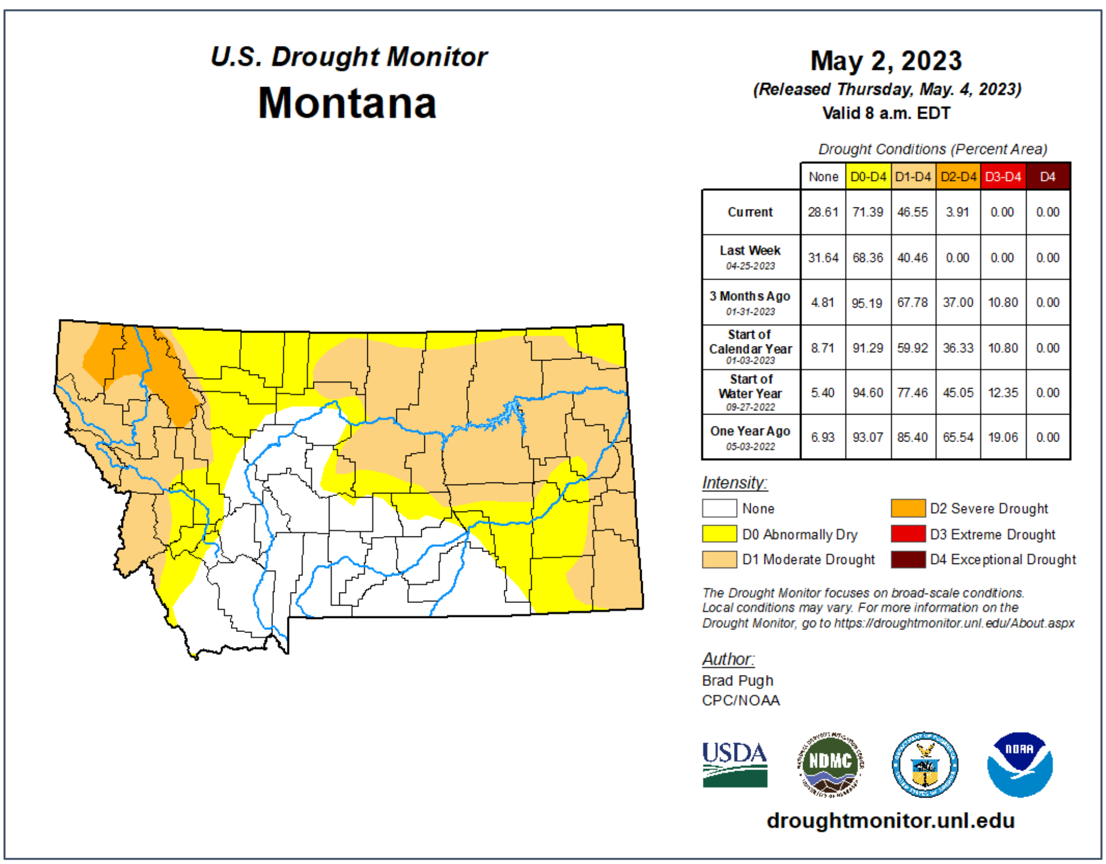
Drought Status

The most recent U.S. Drought Monitor map, released on May 4, 2023, classifies 71% of Montana as D0 (abnormally dry conditions), D1 (moderate drought), or D2 (severe drought). There are currently no counties or regions in Montana that are classified in the D3 (extreme drought) category or above. This is a significant improvement to conditions at the start of this winter when 42% of the state fell into the D2 and D3 categories.

Above normal snowpack and precipitation east of the continental divide this season have allowed soil moisture to begin to recharge and drought designations to improve. In contrast, lack of precipitation this water year and a below normal snowpack have caused drought conditions to degrade in northwest Montana by 1 to 2 class designations over the last year. Portions of Lincoln and Flathead counties were degraded to D2 in the most recent version of the drought monitor; this is the only area in the state in the severe drought category.

Drought Links:

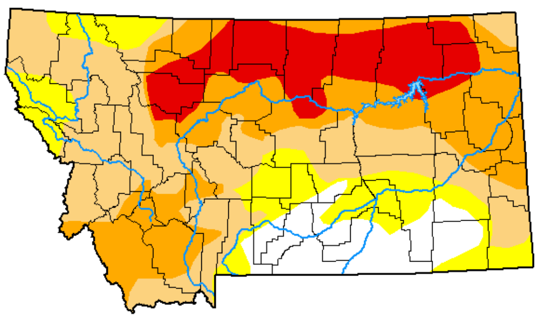
- U.S. Drought Monitor
- National Integrated Drought Information System
- USDA Drought Portal (News and Resources)
- Farm Services Agency Montana News Releases (Information on Programs and Deadlines)
- Farm Services Agency Disaster Assistance Programs
- Montana Department of Natural Resources and Conservation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



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	28.61	71.39	46.55	3.91	0.00	0.00
Last Week 04-25-2023	31.64	68.36	40.46	0.00	0.00	0.00
3 Months Ago 01-31-2023	4.81	95.19	67.78	37.00	10.80	0.00
Start of Calendar Year 01-03-2023	8.71	91.29	59.92	36.33	10.80	0.00
Start of Water Year 09-27-2022	5.40	94.60	77.46	45.05	12.35	0.00
One Year Ago 05-03-2022	6.93	93.07	85.40	65.54	19.06	0.00

U.S. Drought Monitor
Montana

November 1, 2022
(Released Thursday, Nov. 3, 2022)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	10.43	89.57	74.32	41.97	15.61	0.00
Last Week *10-25-2022*	10.43	89.57	74.32	41.97	15.61	0.00
3 Months Ago *08-02-2022*	60.80	39.20	21.17	15.35	3.51	0.00
Start of Calendar Year *01-04-2022*	7.36	92.64	89.33	86.35	53.93	13.87
Start of Water Year *09-27-2022*	5.40	94.60	77.46	45.05	12.35	0.00
One Year Ago *11-02-2021*	0.00	100.00	100.00	100.00	69.68	22.59

Intensity:

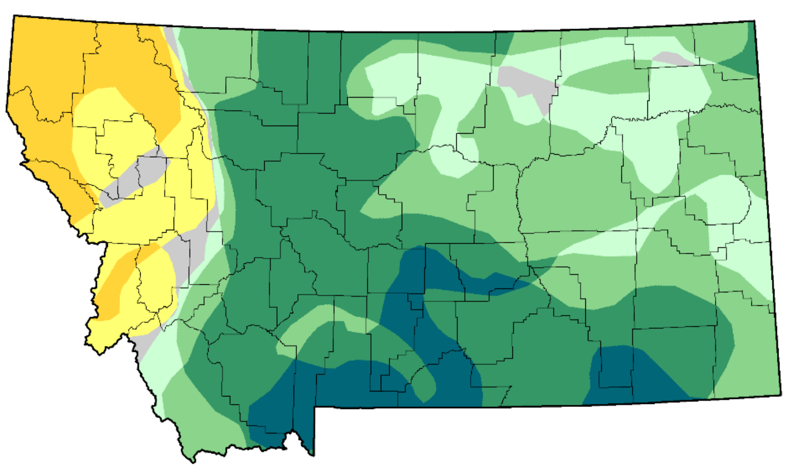
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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

Author:
Brian Fuchs
National Drought Mitigation Center

droughtmonitor.unl.edu

U.S. Drought Monitor Class Change - Montana
52 Week



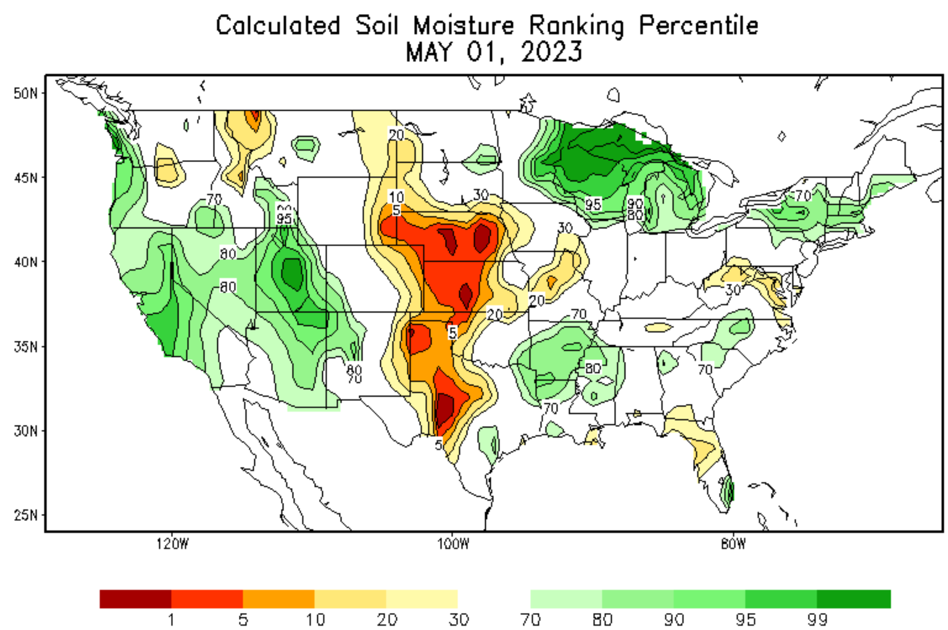
- 5 Class Degradation
- 4 Class Degradation
- 3 Class Degradation
- 2 Class Degradation
- 1 Class Degradation
- No Change
- 1 Class Improvement
- 2 Class Improvement
- 3 Class Improvement
- 4 Class Improvement
- 5 Class Improvement

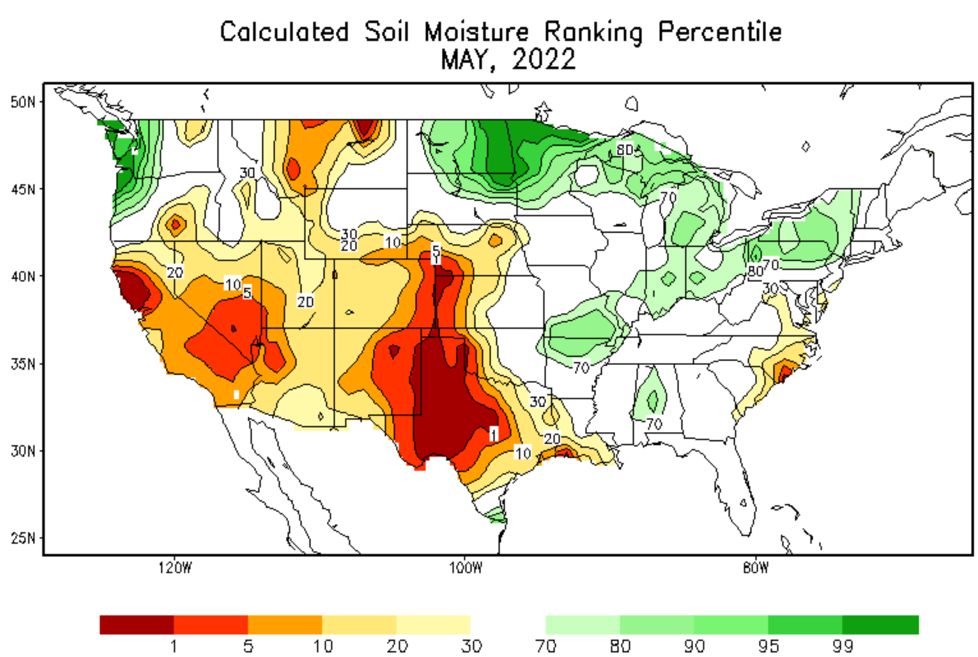
April 4, 2023
compared to
April 5, 2022

droughtmonitor.unl.edu

Soil Moisture

Modeled soil moisture for May 1, 2023, is in the 50th percentile (normal) across most of Montana. Soil moisture percentiles are lowest in Northwest Montana where soil moisture is less than the 25th percentile. Overall Montana will enter this growing season with much better soil moisture conditions than the previous year when much of the state was ranked in the 20th percentile or lower.





Current Streamflows

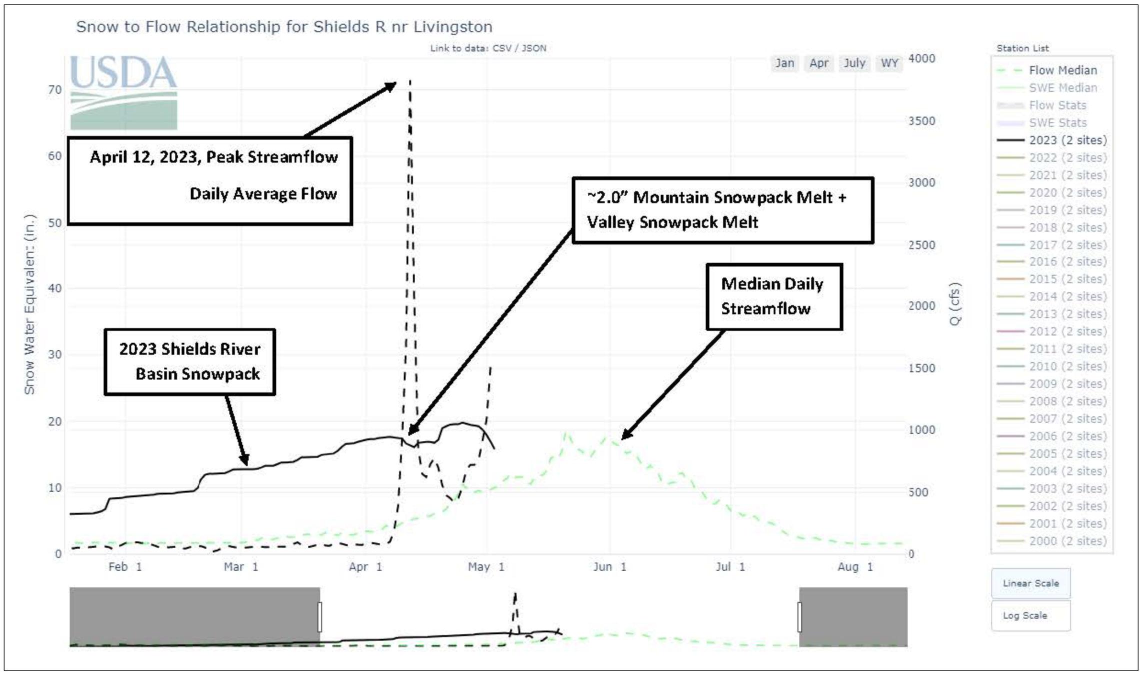
April temperatures were mostly below normal, but several days of above normal temperatures were observed statewide. This warm weather was enough to drive valley and low mountain elevation snowmelt into full swing. The snowpack at those elevations was substantial in some locations this year and that was highlighted when many of Montana's smaller rivers on the east side of the divide exceeded flood stage, several of those included the Shields River, Smith River, and Milk River. Total volumetric streamflows last month were overall below normal in far western Montana, well above normal in the Milk River and northeast Montana, and mostly near to above normal across the rest of Montana. As of May 1, larger rivers are starting to rise, which is now the result of the high elevation snowmelt that has just begun. Peak river levels over the next couple months will be driven primarily by the weather. Extended above normal temperatures and or significant rain would certainly cause rivers to reach high levels. Ideally May will bring a mixture of warm and cool days, which would likely release water from the snowpack in phases. While parts of central Montana and the southern Madison and Jefferson River basins have an exceptional snowpack, most of Montana is closer to normal. 2018 was a notable year in which the May 1 statewide snowpack was very high, but spring weather provided a relatively slow snowmelt, and overall peak flows weren't as high as anticipated in many rivers. Let's hope for similar runoff timing in those basins that currently have an exceptional snowpack.

Annual Peak Streamflow Statistics for Select USGS Stream Gages

	Stream Gage	Years of Data	Minimum Peak (cfs)	Date of Minimum Peak	Maximum Peak (cfs)	Date of Maximum Peak	Median Peak (cfs)	Median Peak Day-Month
East of Divide	Bighorn River at Bighorn MT	37	5020	10/1/1965	59200	5/20/1978	13000	17-Jun
	Gallatin River near Gallatin Gateway, MT	94	1740	5/8/1934	9160	6/2/1997	5225	7-Jun
	Jefferson River near Silver Star MT	25	2090	5/8/1937	20300	6/15/1927	8070	11-Jun
	Judith River nr mouth, nr Winifred MT	22	530	7/10/2022	15900	3/24/2019	2605	28-May
	Madison River bl Ennis Lake nr McAllister MT	83	2000	9/19/1961	9550	6/12/1970	4670	10-Jun
	Marias River near Loma MT	34	613	7/13/2001	12300	4/18/2018	2805	15-Jun
	Missouri River at Toston MT	90	6580	5/28/1987	34000	6/12/1997	18600	8-Jun
	Musselshell River near Roundup MT	76	241	5/10/1988	15000	5/26/2011	1615	10-Jun
	Powder River near Locate MT	85	697	6/2/1961	31000	2/19/1943	5800	24-May
	Shields River nr Livingston MT	44	723	5/17/2000	5600	6/20/1979	1760	25-May
	Smith River bl Eagle Cr nr Fort Logan MT	26	472	4/29/2001	4030	6/9/2011	1410	3-Jun
	St. Mary River near Babb MT	87	1700	5/2/1992	16500	6/9/1964	3590	8-Jun
	Sun River at Simms MT	41	294	5/11/1977	50000	6/9/1964	4310	6-Jun
	Teton River at Loma MT	25	81	5/27/2016	6520	5/30/2019	477	30-May
	Tongue River at Miles City, MT	81	335	6/25/2002	15300	5/21/2011	3330	11-Jun
	Yellowstone River near Livingston, MT	98	7450	6/8/1987	55200	6/13/2022	20950	7-Jun
West of Divide	Blackfoot River near Bonner MT	89	1940	6/2/1941	19200	6/10/1964	9040	26-May
	Bitterroot River near Missoula MT	38	6370	5/1/1992	38300	6/20/1889	16050	30-May
	Clark Fork at St. Regis MT	107	11300	6/8/1977	68900	5/24/1948	36400	28-May
	Clark Fork at Turah Bridge nr Bonner MT	36	1380	5/1/1992	13300	6/11/2011	5515	28-May
	Flathead River at Perma MT	39	14300	6/30/2001	55400	6/25/2022	37900	11-Jun
	Kootenai River at Libby MT	81	21400	11/26/1976	121000	6/21/1916	57100	6-Jun
	Middle Fork Flathead River at West Glacier MT	23	7250	5/2/1915	45000	6/21/1916	18000	23-May

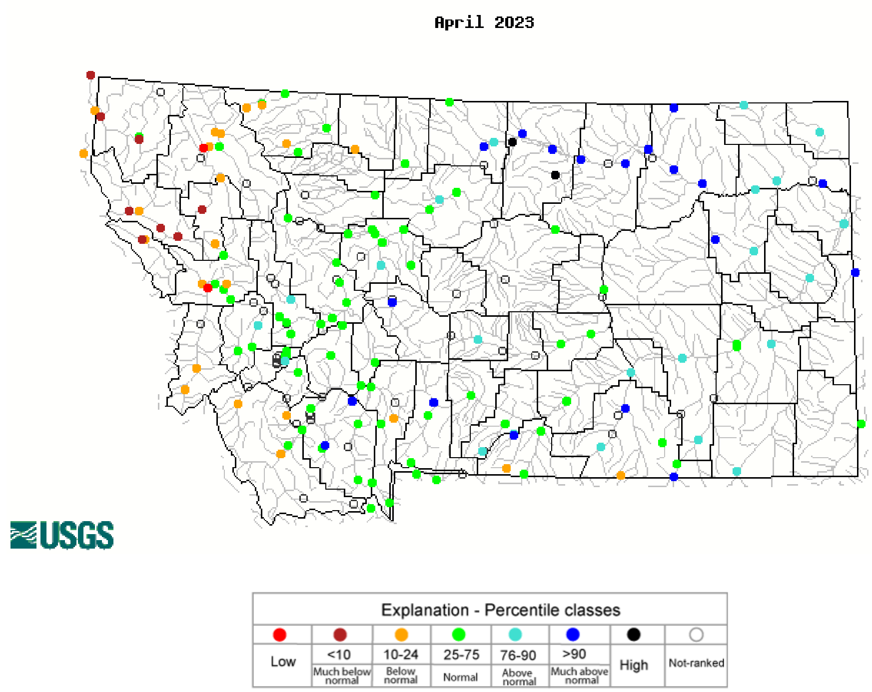
Example Source Data (Shields River nr Livingston): https://nwis.waterdata.usgs.gov/usa/nwis/peak/?site_no=06195600

USDA-NRCS Snow to Flow Chart for the Shields River nr Livingston



Source: https://www.wcc.nrcs.usda.gov/ftpref/support/stf/

Monthly Average Streamflow Compared to Normal in Montana



Source: https://waterwatch.usgs.gov/index.php?m=mv01d&r=mt&w=map

Shields River on April 12, 2023. (Photo: Park County Planning Department)

The Smith River exceeding its banks from valley and low elevation mountain snowmelt on April 10, 2023. On that date it was flowing at approximately 1200 cfs. Two days later it exceeded over 2000 cfs. Prior to 2023 the Smith River Near Ft Logan MT had only exceeded 2000 cfs three times since 1978. Those years include 2011 (2270 cfs), 1996 (2700 cfs), 1981 (4600 cfs). Peak flow data (Photo: Maggie Buckingham)

Weather and Climate Outlook

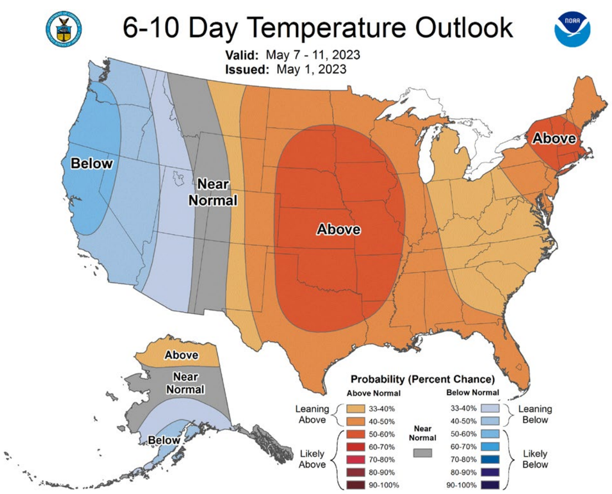
NOAA's Climate Prediction Center (CPC) indicates that Montana has a slight chance of above average precipitation within the next 6-10 days. Eastern and central Montana are anticipated to have a slight chance of elevated temperatures. Western Montana is expected to experience near normal temperatures.

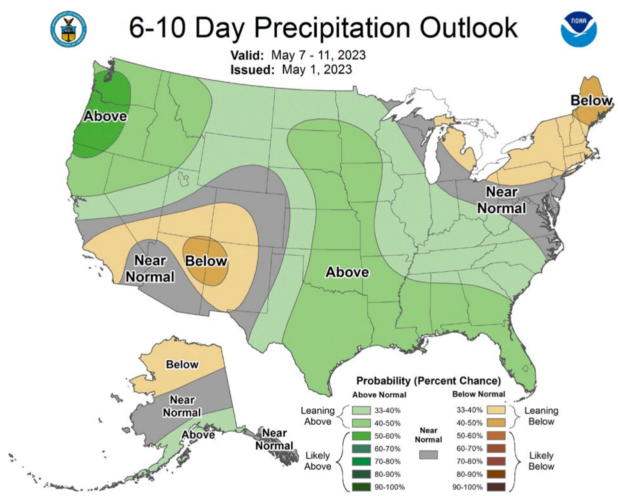
In the next 8-14 days, the CPC's outlook forecasts an ongoing possibility of heightened precipitation. Eastern Montana is predicted to sustain a slight chance of continued warmth. Western and central Montana is forecasted to fall within a seasonable temperature range.

Over the next month, the outlook indicates the chance of above average temperatures in western and central Montana, while eastern Montana has the possibility of encountering either above or below average temperatures. Montana as a whole has an equal likelihood of above or below average precipitation.

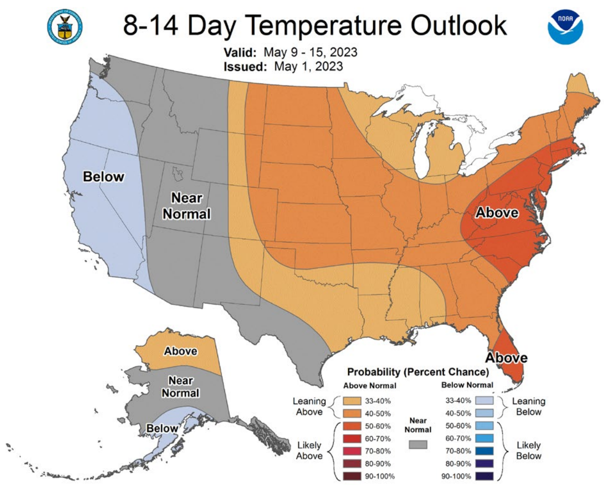
NOAA's outlook anticipates a slight chance of above average temperatures in northwest Montana for the next three months. The northwestern portion of the state is predicted to see a slight probability of below average precipitation, while the other half has equal chances of above or below average precipitation.

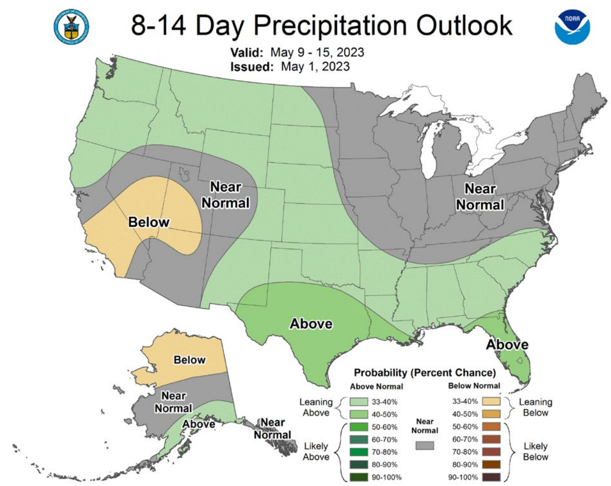
6-10 Day Outlook:



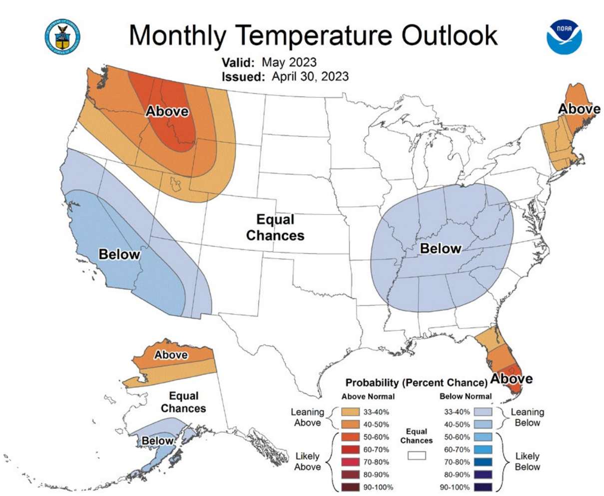


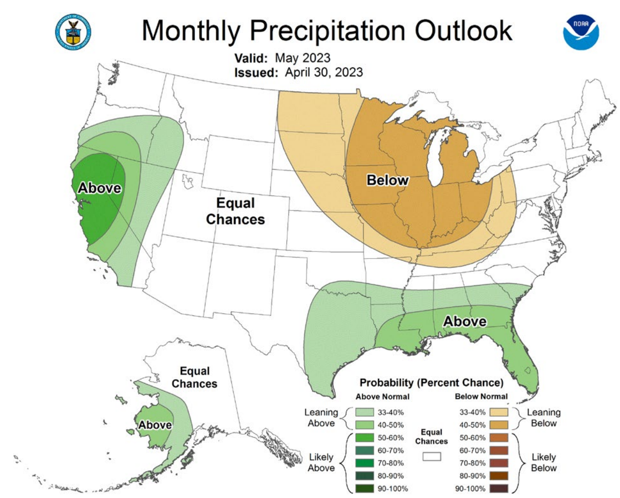
8-14 Day Outlook:



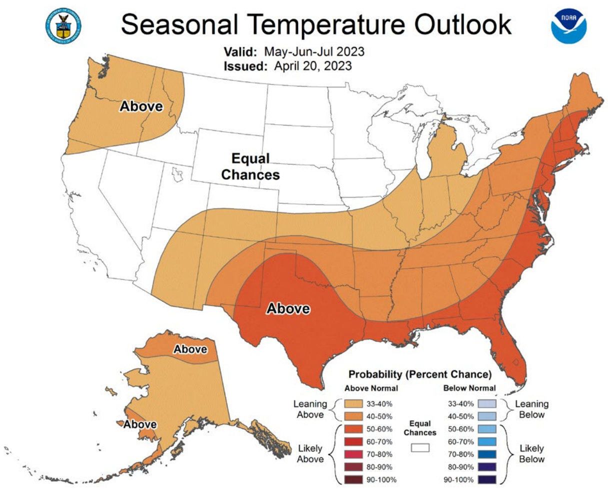


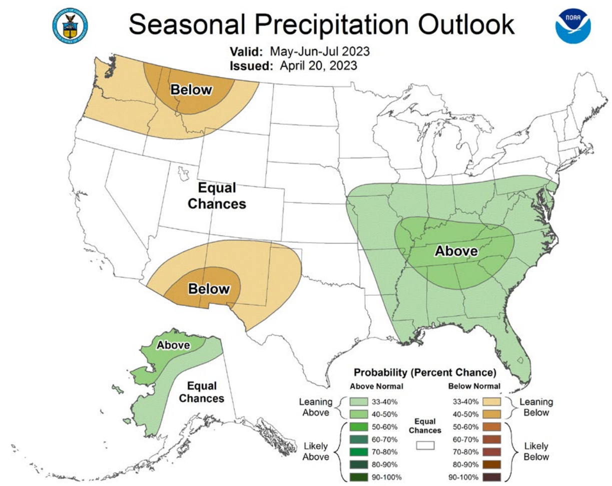
1 Month Outlook:





3 Month Outlook:





Official Water Supply Forecasts

How Forecasts Are Made

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.

Snowpack measurements are obtained by using a combination of manual and automated SNOTEL measurement methods. Manual readings of snow depth and water equivalent are taken at locations called snow courses on a monthly or semi-monthly schedule during the winter. At automated stations, snow depth and snow water equivalent as well as precipitation and temperature are monitored on a daily basis. Both monthly and daily data are used to project snowmelt runoff.

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.

Summary – May 1, 2023

May-July water supply forecasts currently trend with water year precipitation and snowpack conditions, and therefore significantly vary across Montana. In northwest Montana 50% exceedance streamflow forecasts range from 60-80% of normal in the Kootenai River basin and tributaries of Lower Clark Fork River. The Lower Clark River itself is forecasted to be slightly higher because of the substantial snowpack in the Upper Clark Fork River basin. Water supply forecasts in the Flathead River basin range from about 80-90% of normal in the northern region to near normal in the tributaries surrounding the Mission Mountains. On the eastside most May-July forecasts are near to above normal, except for the St. Mary River and its tributaries, which are closer to 85% of normal. 50% exceedance forecasts in northern Wyoming are generally within 10% of normal.

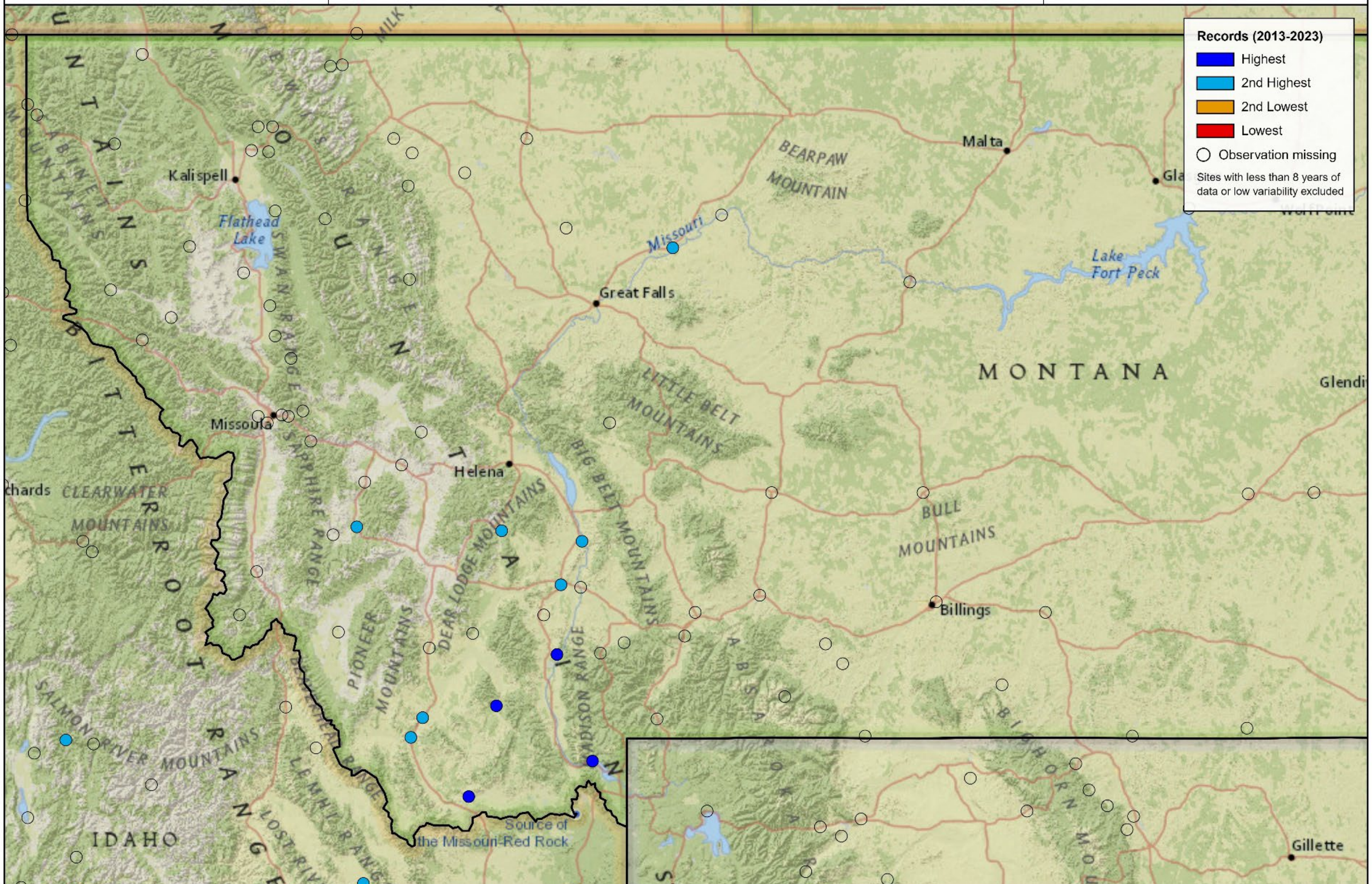
Water supply forecasts in the Jefferson River basin are notable this year where 50% exceedance forecasts are well above normal. In the southern end of the Jefferson forecasts are over 170% of normal, while further north forecasts range from about 120-140% of normal. May-July forecasts in that region are the highest or second highest in the last 10 years, with 2018 and 2014 having similar conditions.

Forecast Volume,
50% Exceedance Probability

May 1, 2023 Forecasts Compared to the Last 10 Years

Records (2013-2023)

May - July, May 1, 2023



USDA Natural Resources Conservation Service
United States Department of Agriculture

N

0 10 20 40 60 80 100 Miles

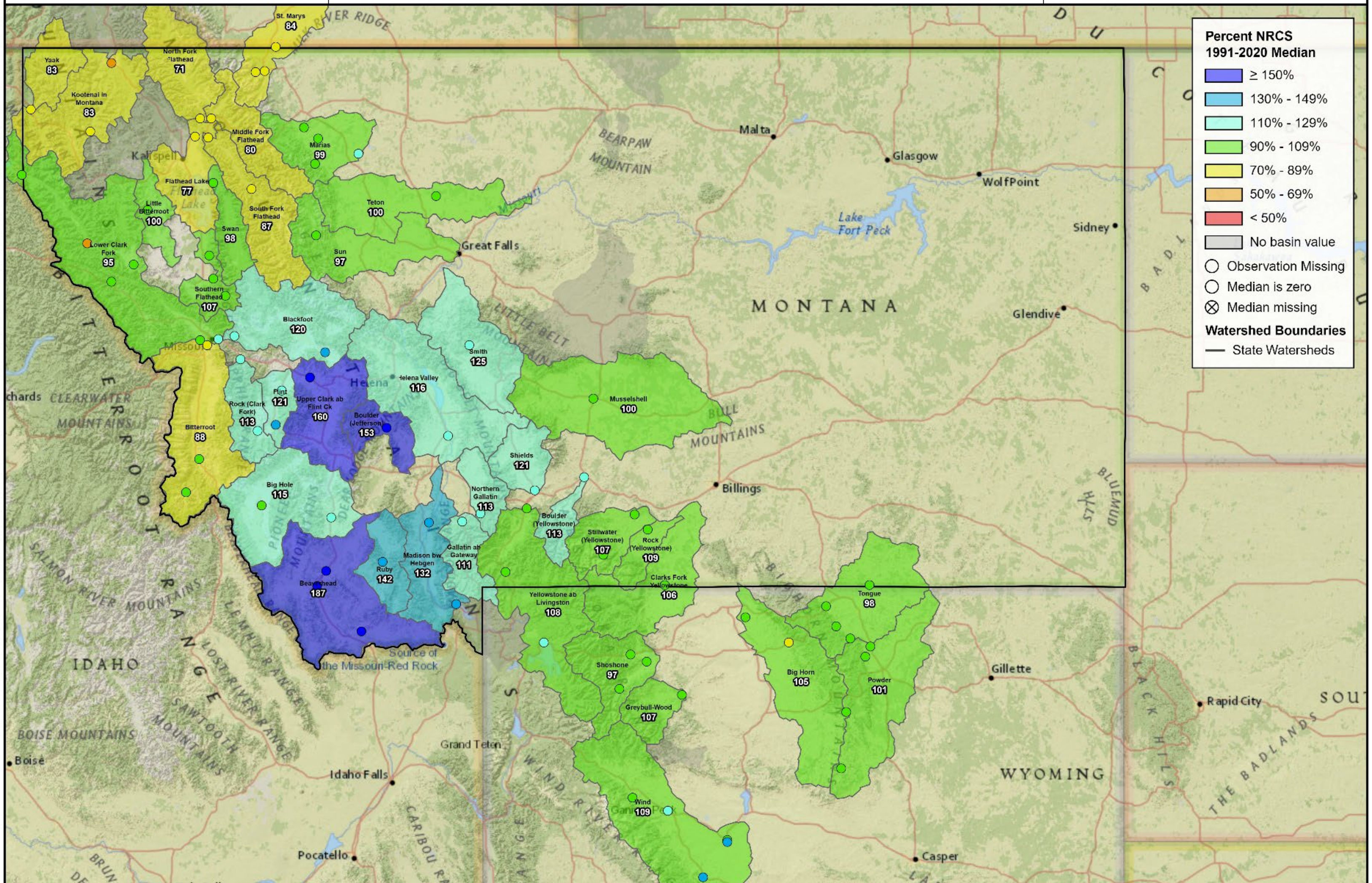
Created 5-04-2023

Forecast Volume,
50% Exceedance Probability

May 1 Streamflow Forecasts

Percent NRCS 1991-2020 Median

May - July, May 1, 2023



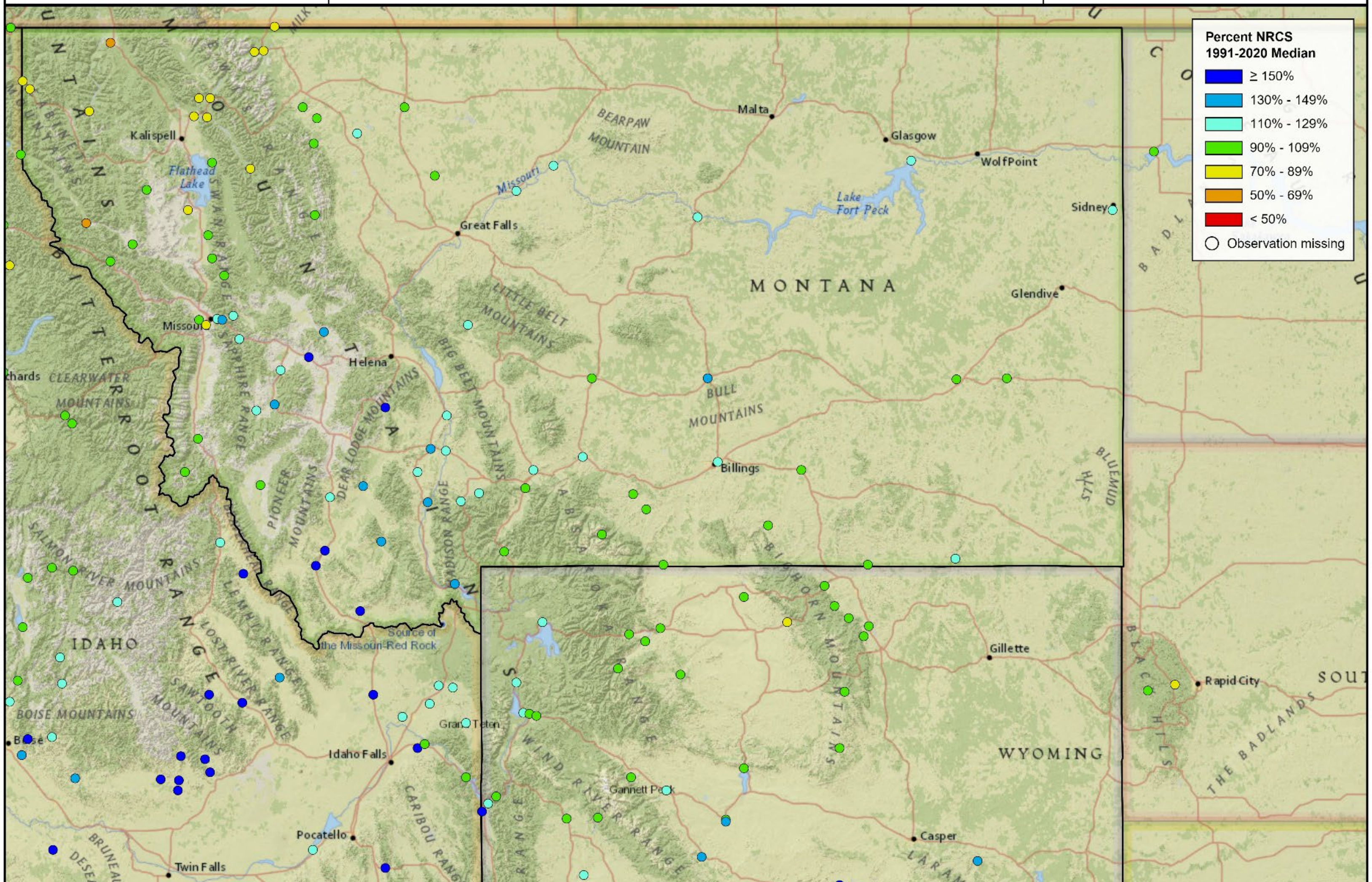
USDA Natural Resources Conservation Service
United States Department of Agriculture

N

0 20 40 80 120 160 200 Miles

Created 5-04-2023

Forecast Volume, 50% Exceedance Probability	May 1 Streamflow Forecasts Percent NRCS 1991-2020 Median	May - July, May 1, 2023



USDA Natural Resources Conservation Service
United States Department of Agriculture

N

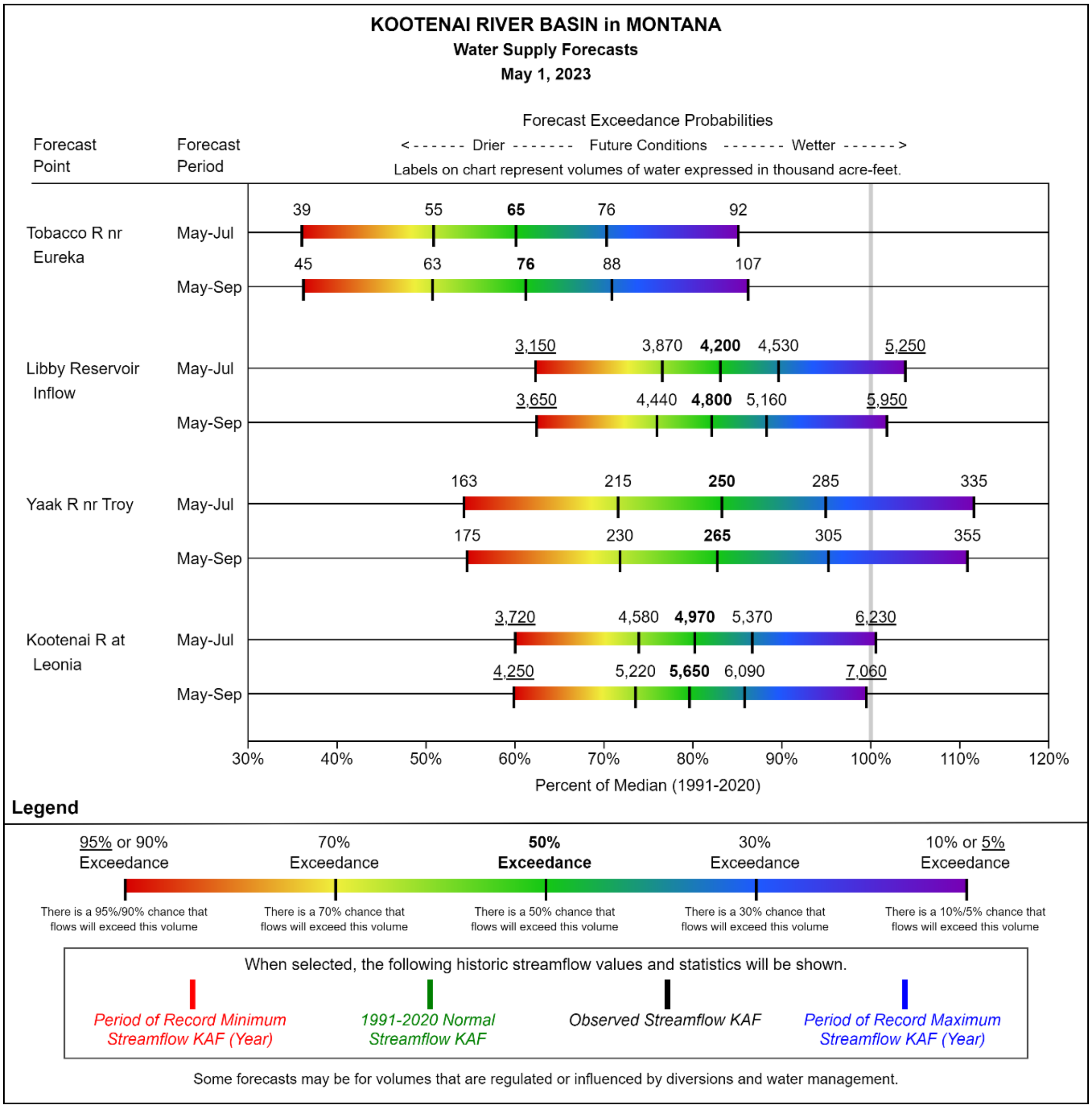
0 20 40 80 120 160 200 Miles

Created 5-04-2023

Water Supply Forecast Charts

Interpreting Water Supply Forecast Charts - Link

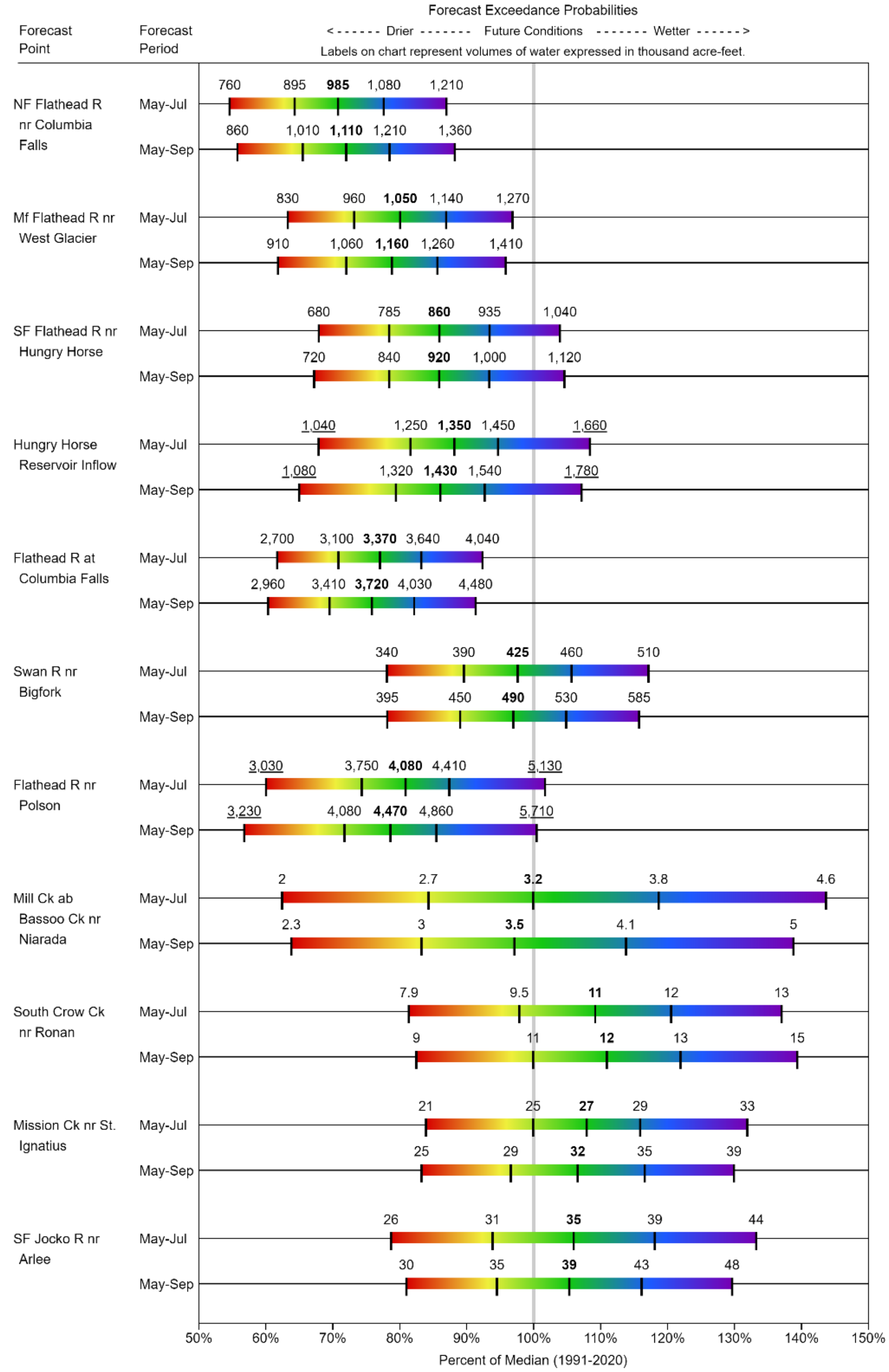
Water Supply Forecast Charts - Link



FLATHEAD RIVER BASIN

Water Supply Forecasts

May 1, 2023



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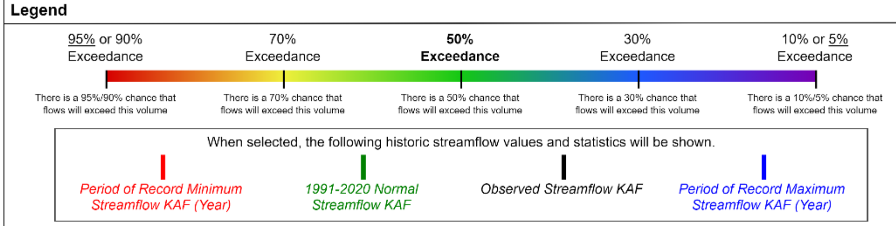
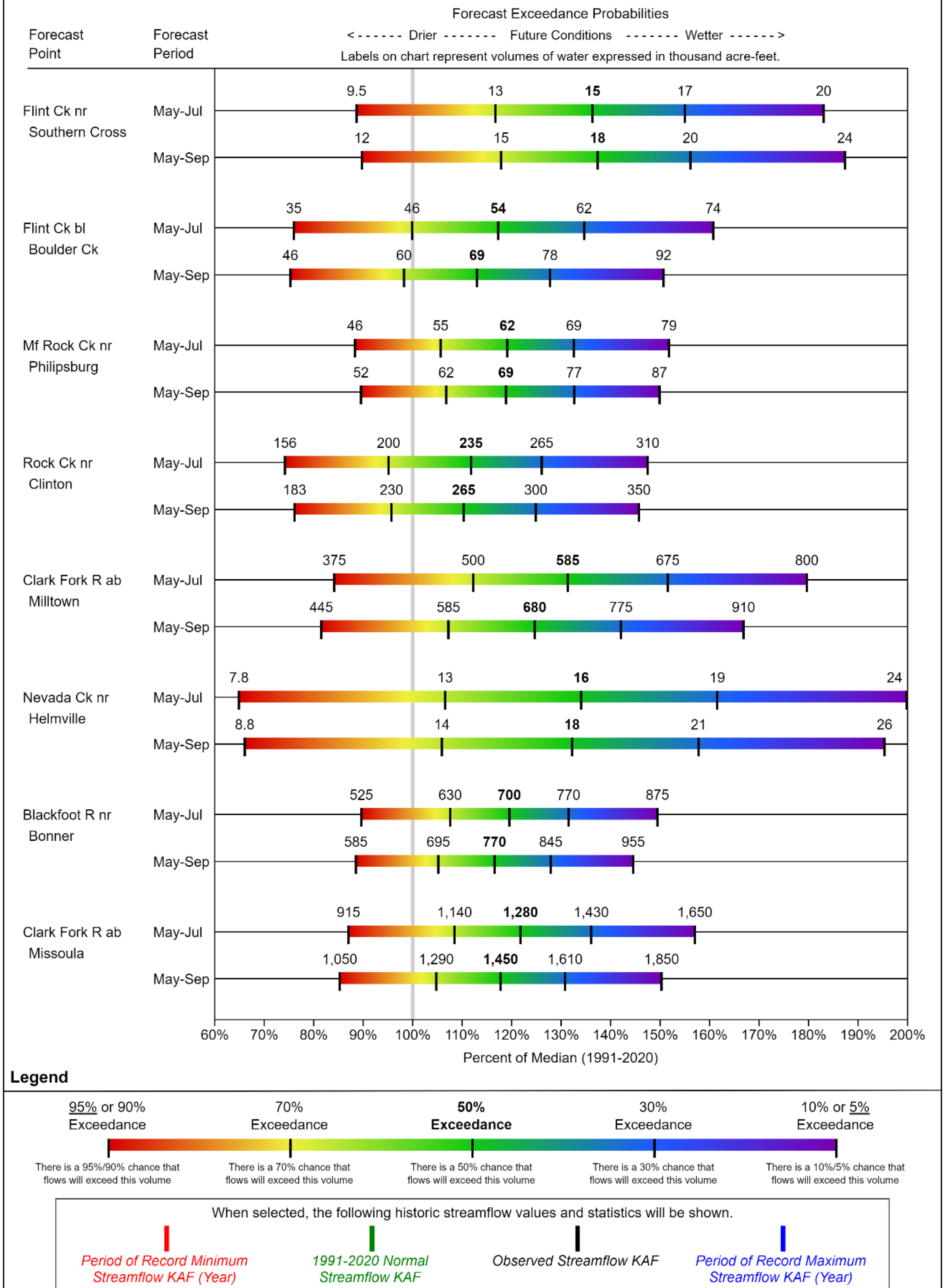


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

UPPER CLARK FORK RIVER BASIN

Water Supply Forecasts

May 1, 2023

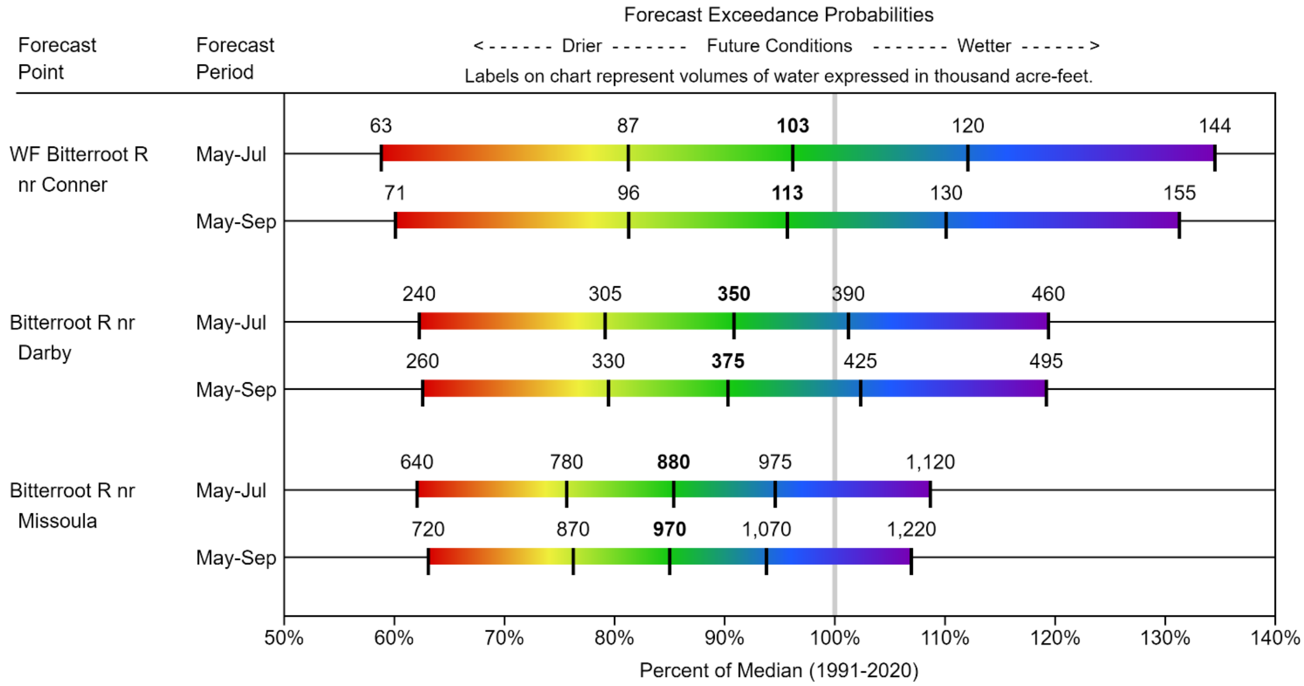


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

BITTERROOT RIVER BASIN

Water Supply Forecasts

May 1, 2023



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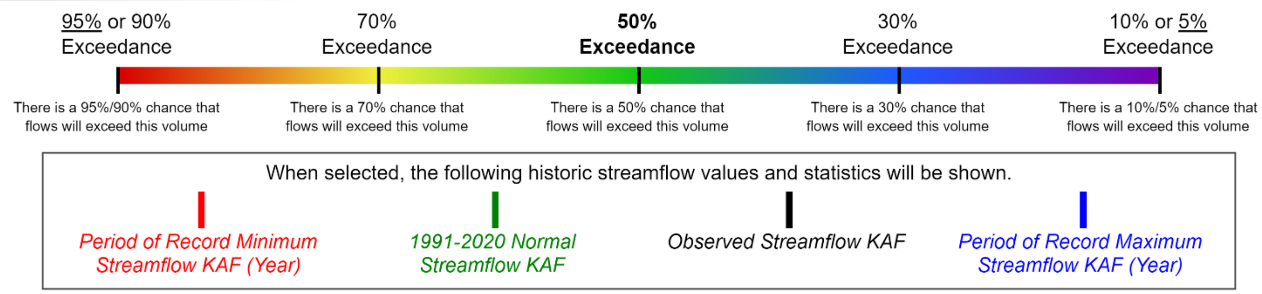
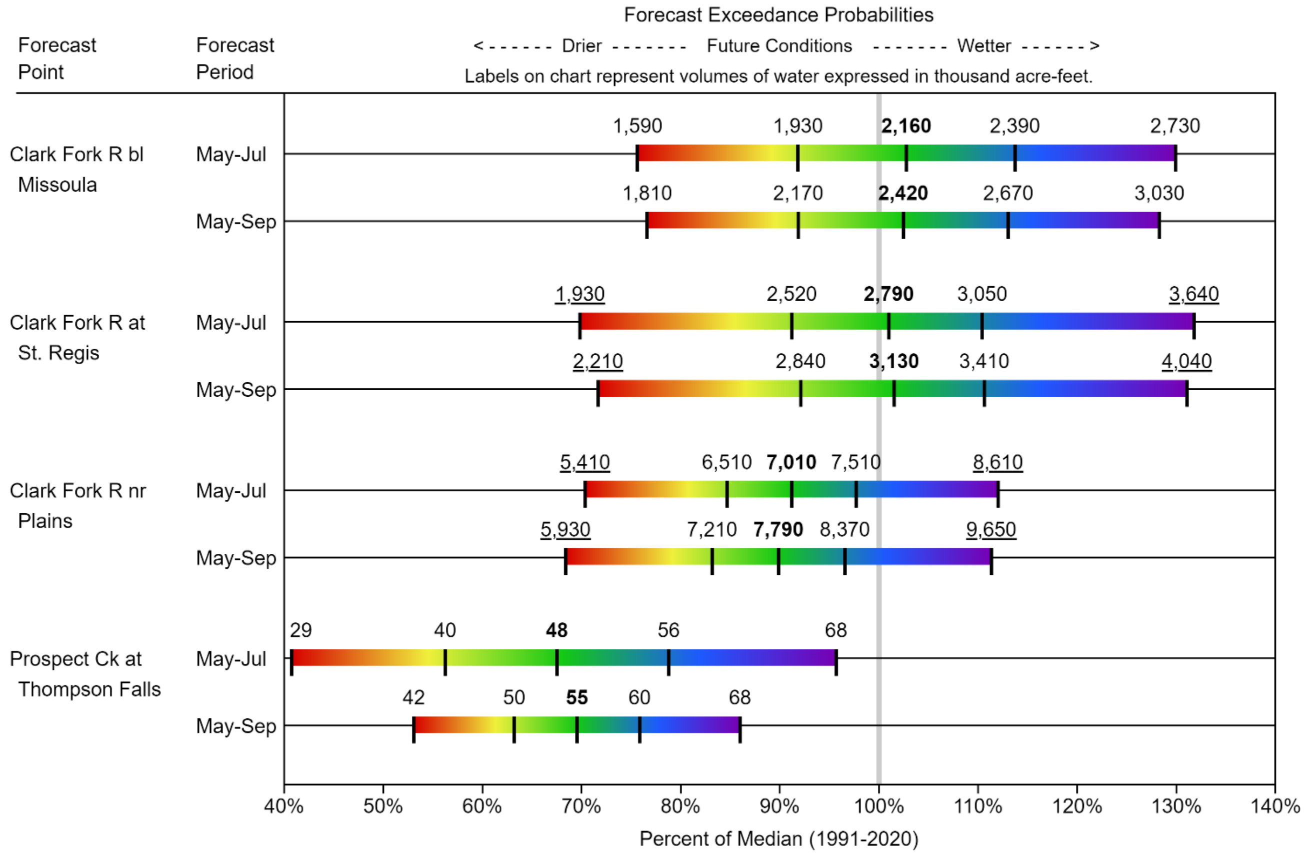


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

LOWER CLARK FORK RIVER BASIN

Water Supply Forecasts

May 1, 2023



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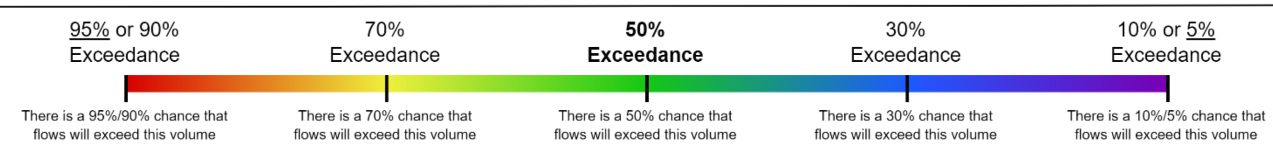


When selected, the following historic streamflow values and statistics will be shown.

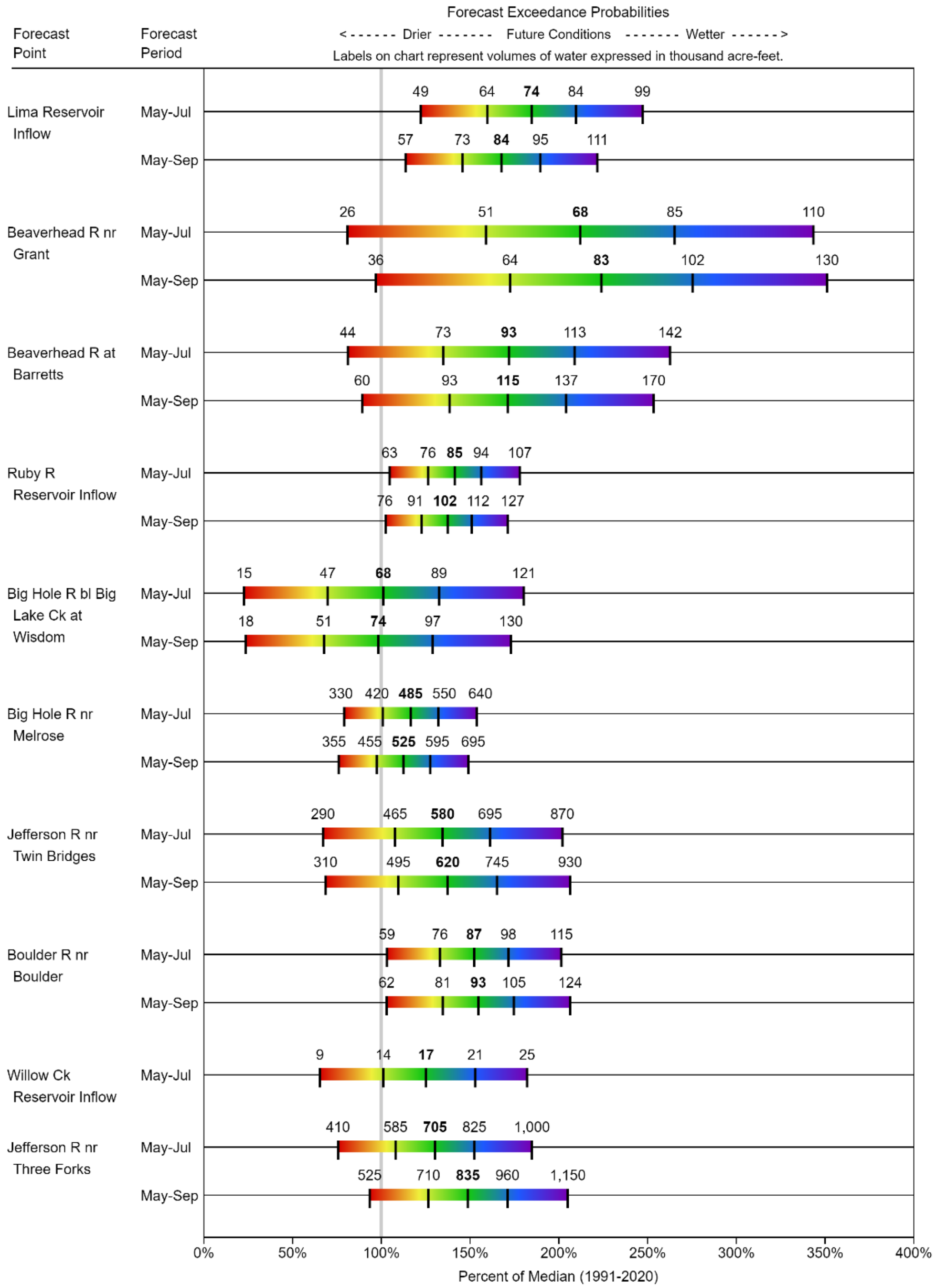
Period of Record Minimum Streamflow KAF (Year) | *1991-2020 Normal Streamflow KAF* | *Observed Streamflow KAF* | *Period of Record Maximum Streamflow KAF (Year)*

Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

JEFFERSON RIVER BASIN

Water Supply Forecasts

May 1, 2023



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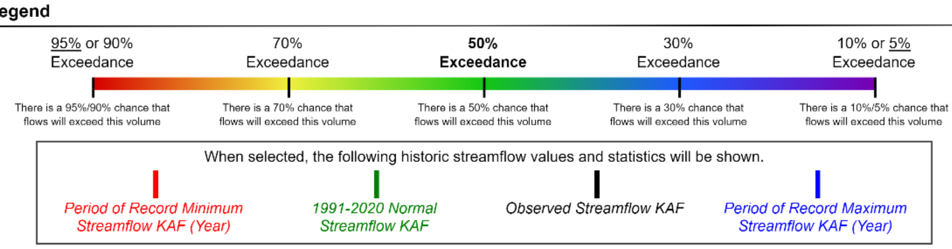
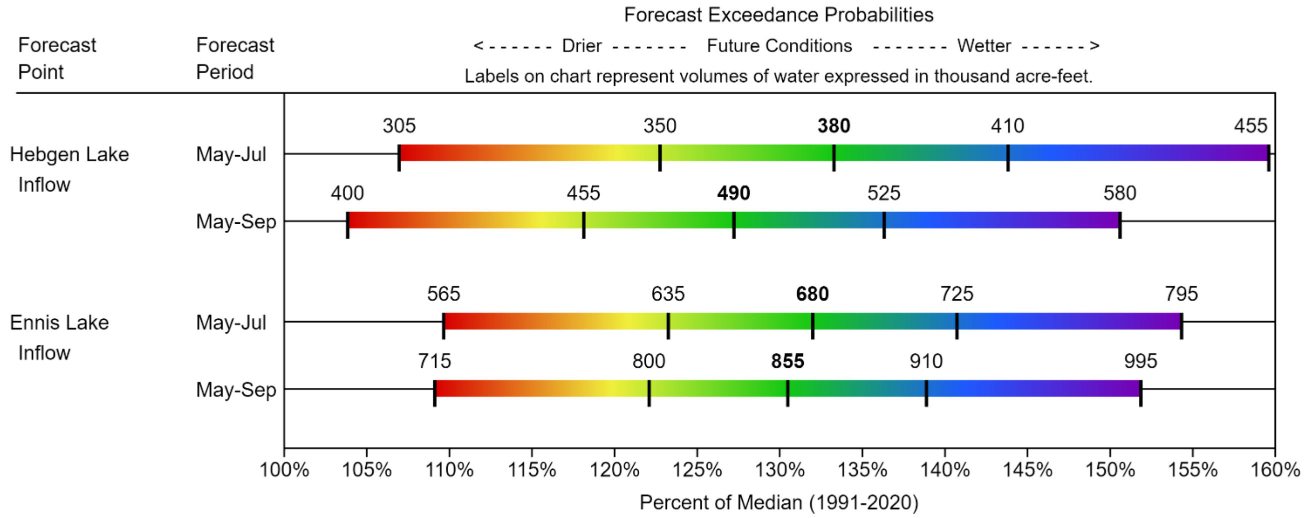


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

MADISON RIVER BASIN

Water Supply Forecasts

May 1, 2023



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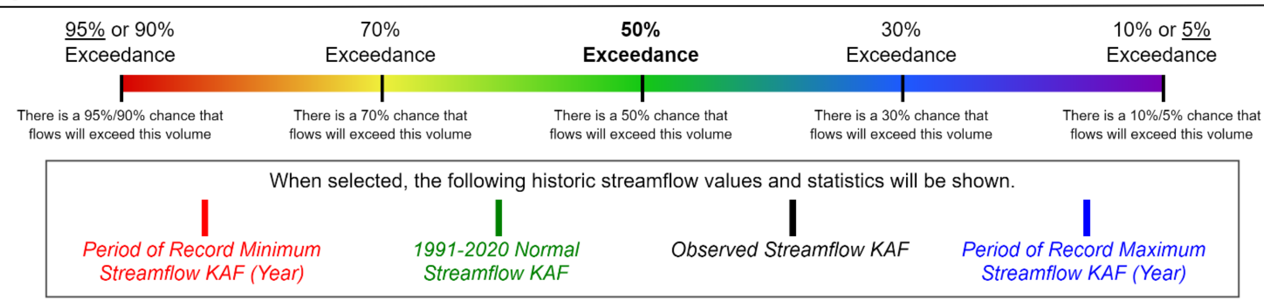
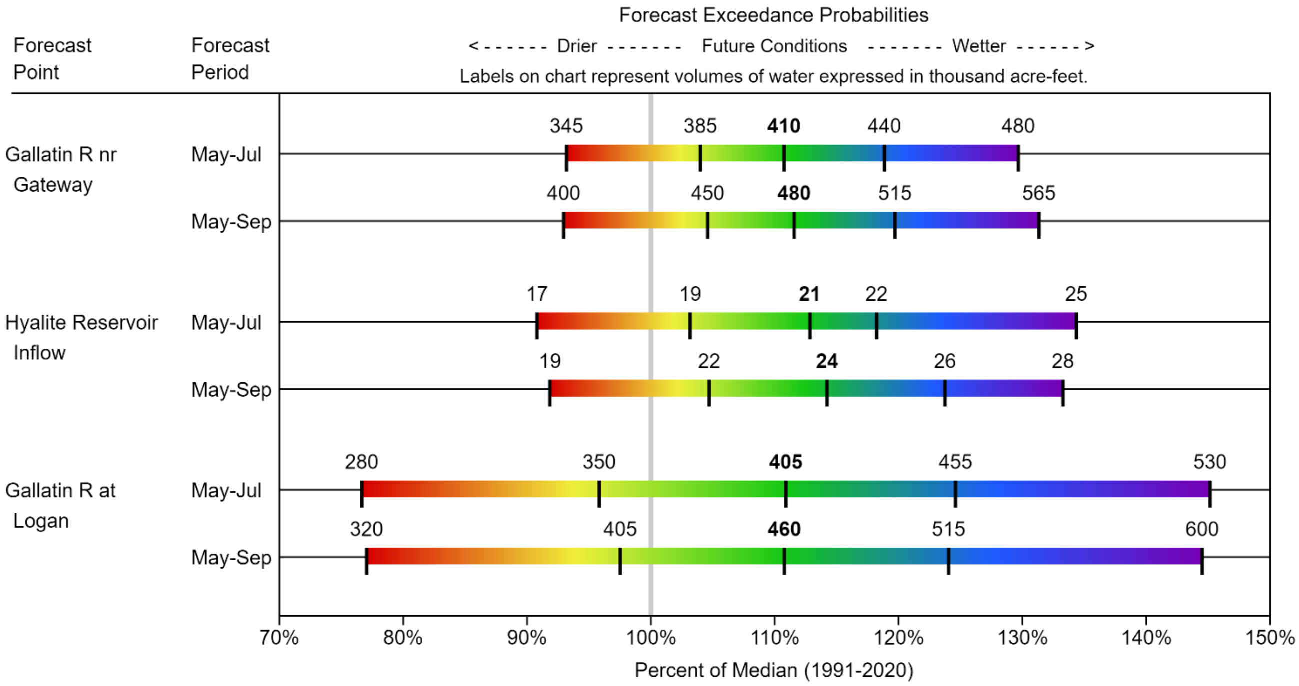


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

GALLATIN RIVER BASIN

Water Supply Forecasts

May 1, 2023



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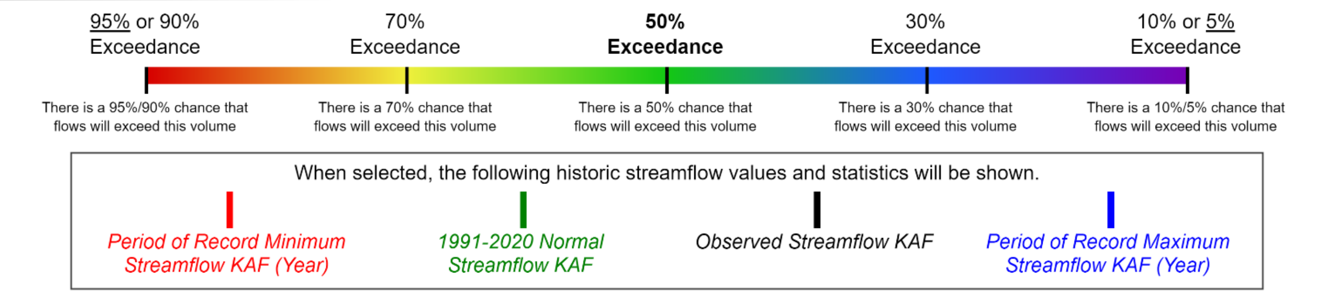
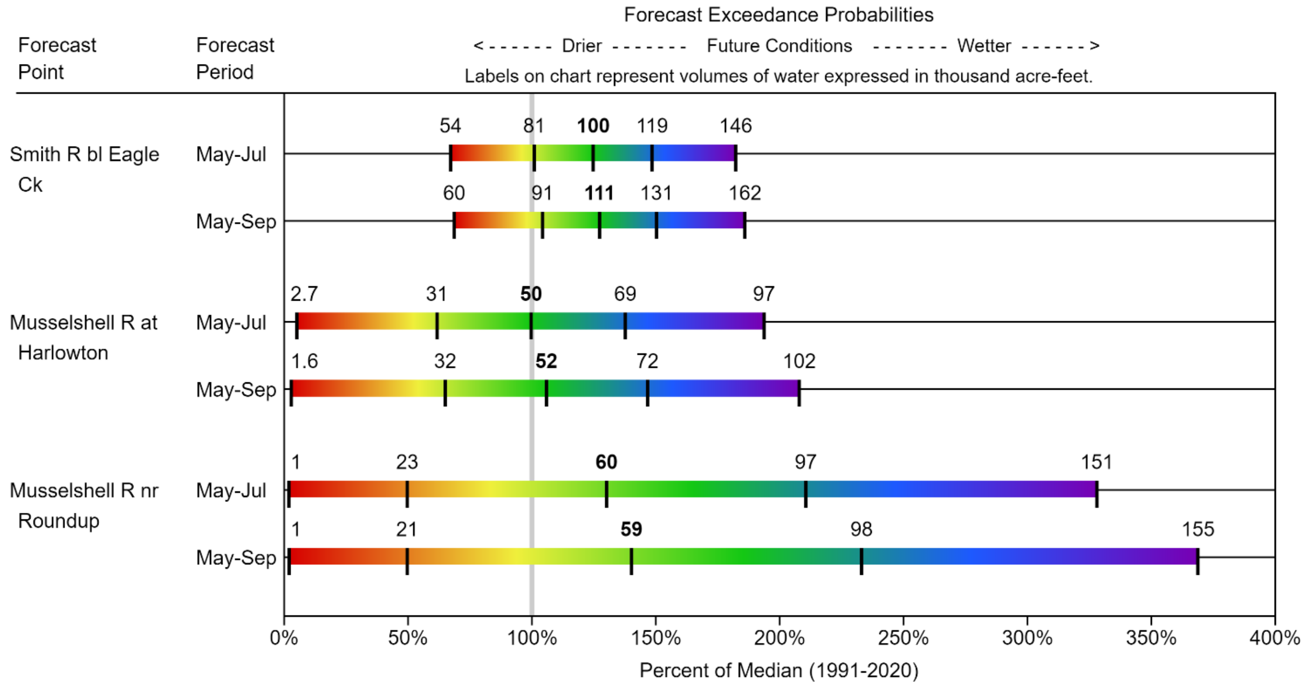


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

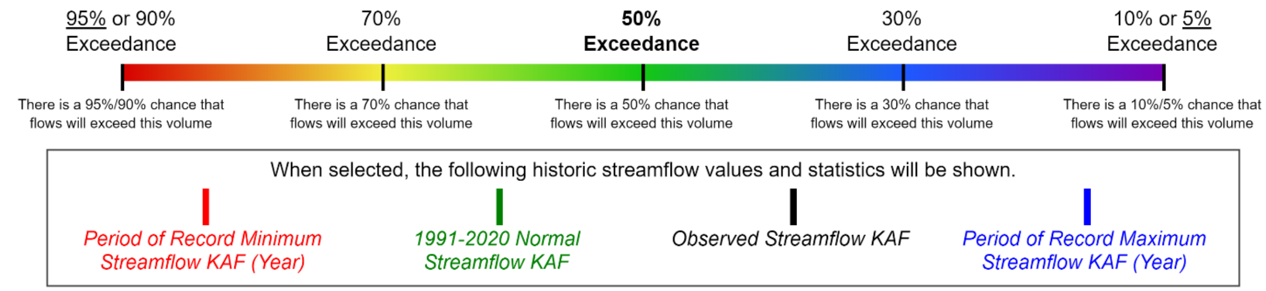
SMITH-JUDITH-MUSSELSHELL

Water Supply Forecasts

May 1, 2023



Legend

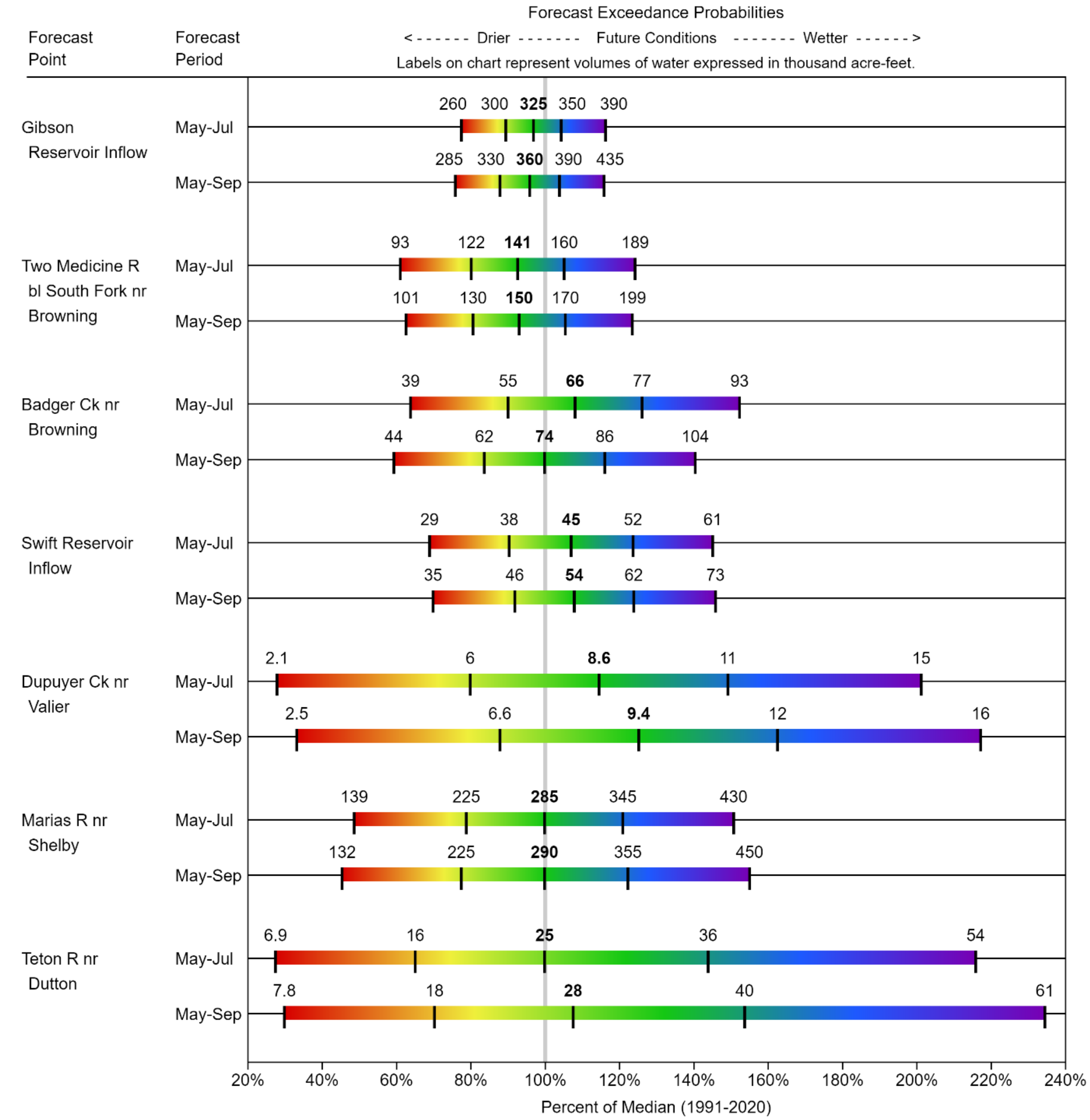


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

SUN-TETON-MARIAS

Water Supply Forecasts

May 1, 2023



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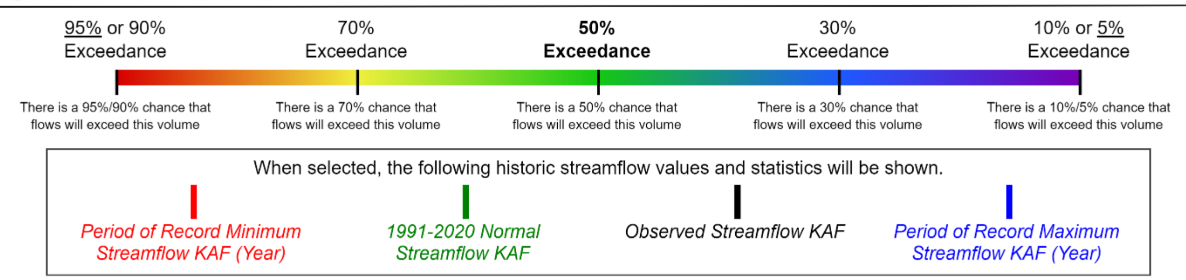
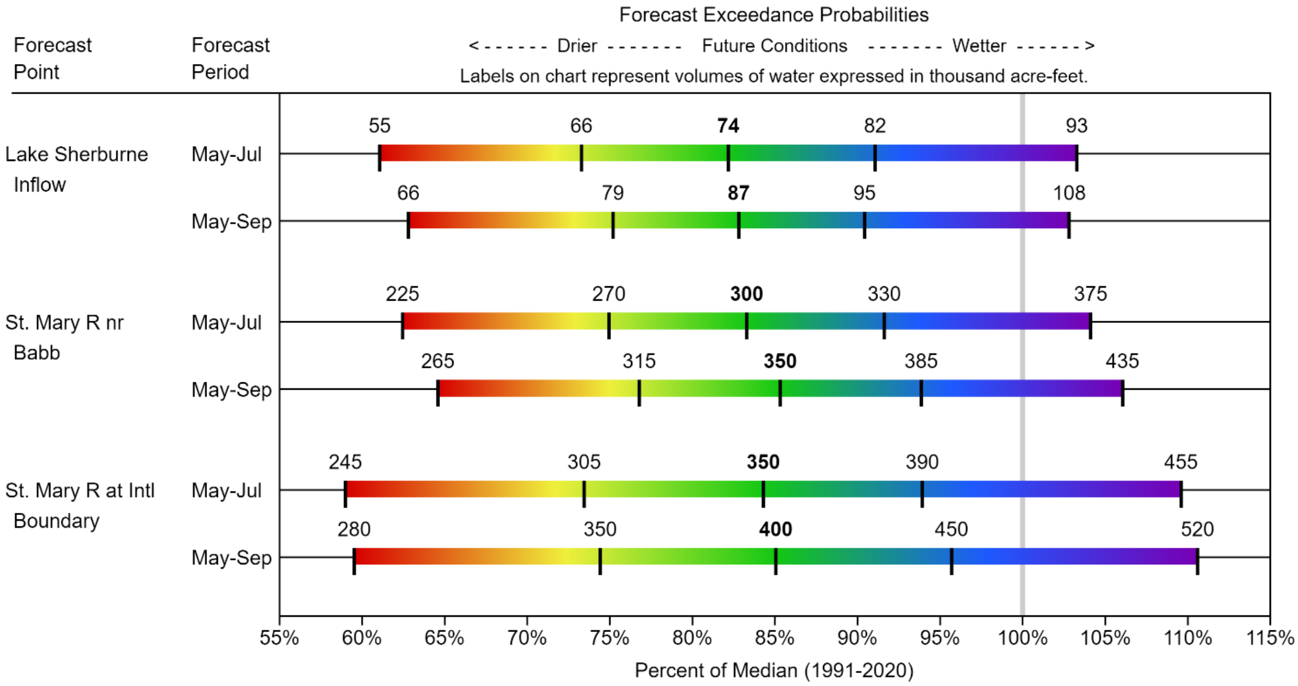


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

ST. MARY & MILK BASINS

Water Supply Forecasts

May 1, 2023



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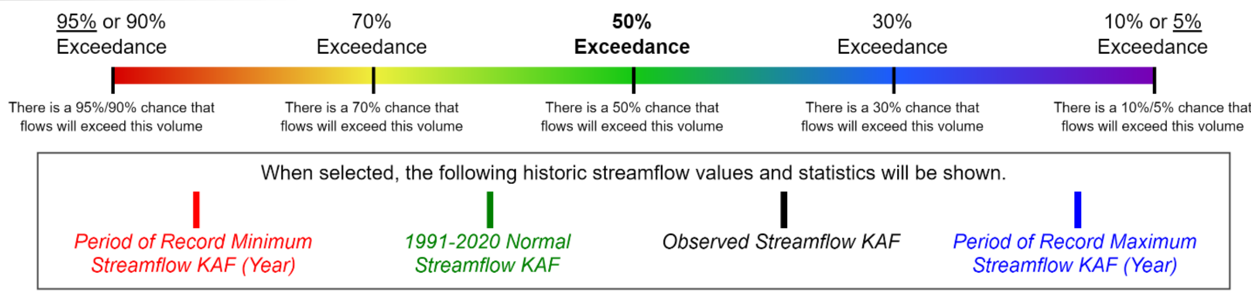
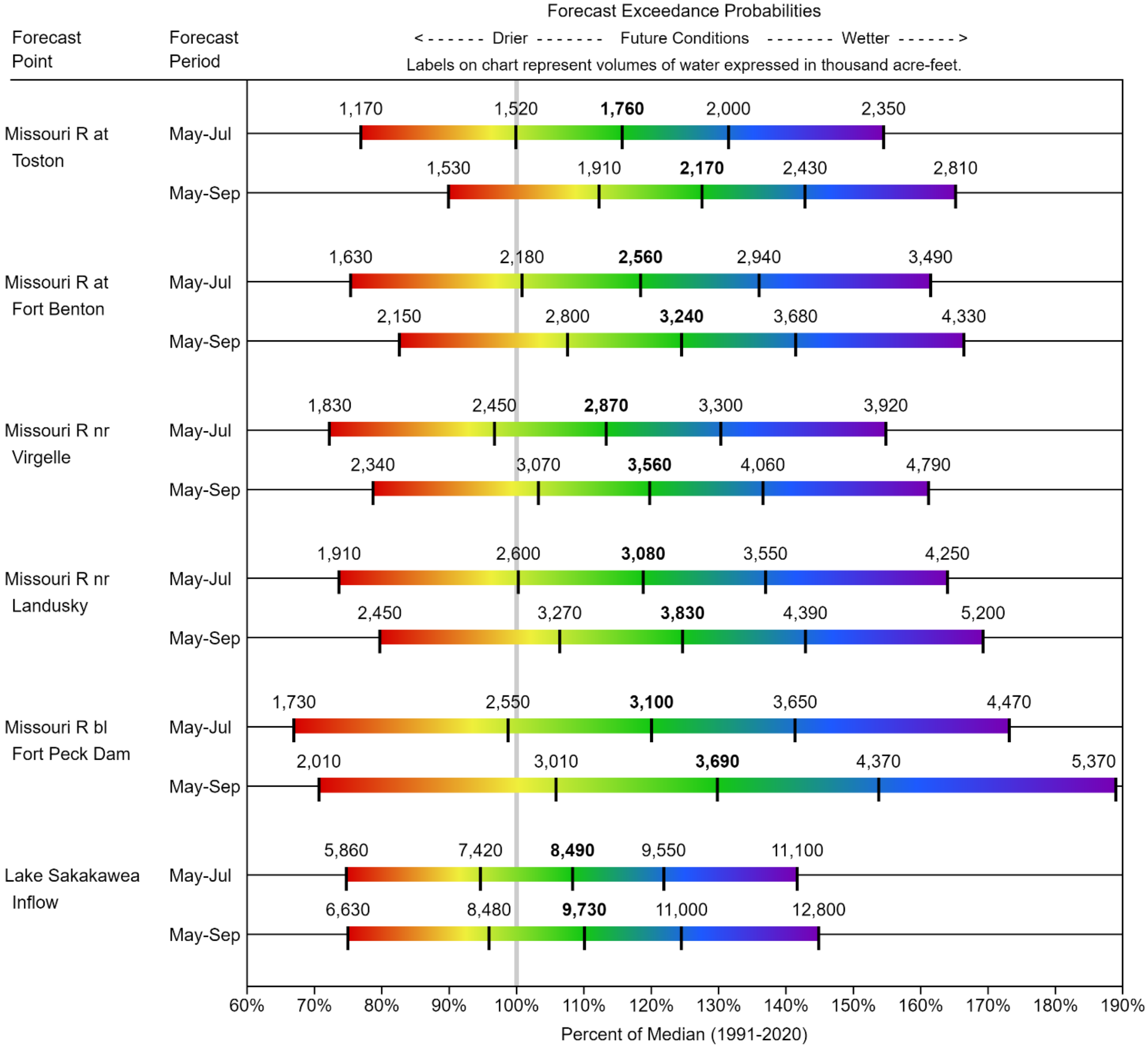
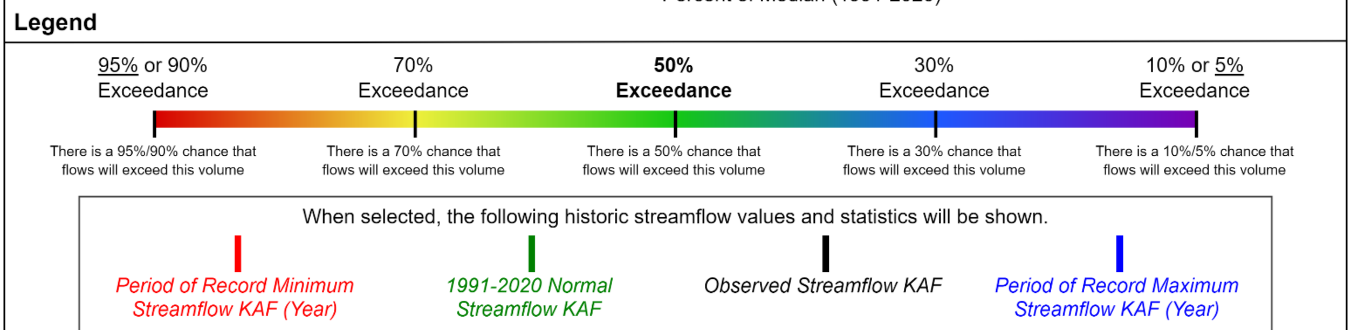


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

MISSOURI MAINSTEM BASIN
Water Supply Forecasts
May 1, 2023



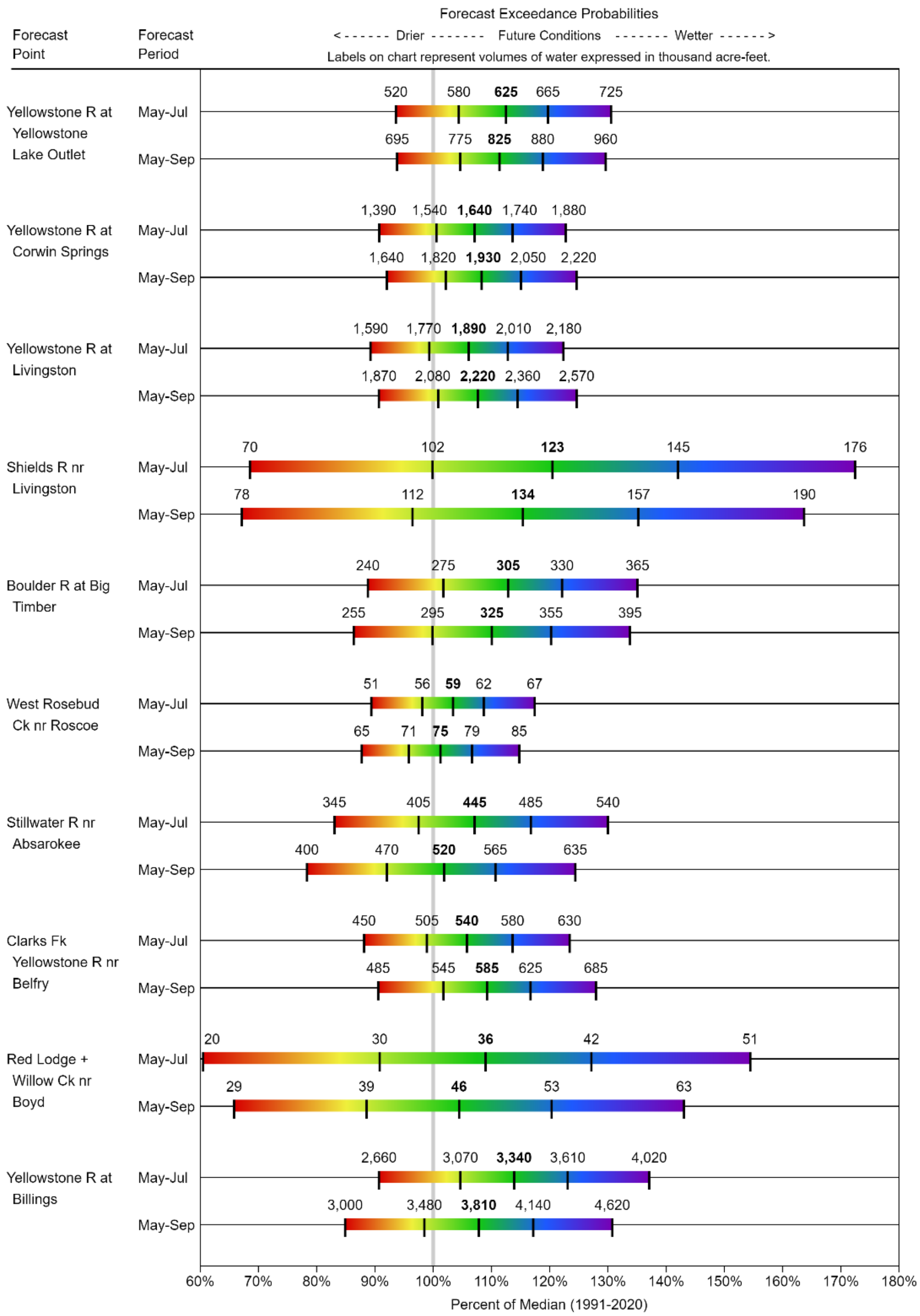


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

UPPER YELLOWSTONE RIVER BASIN

Water Supply Forecasts

May 1, 2023



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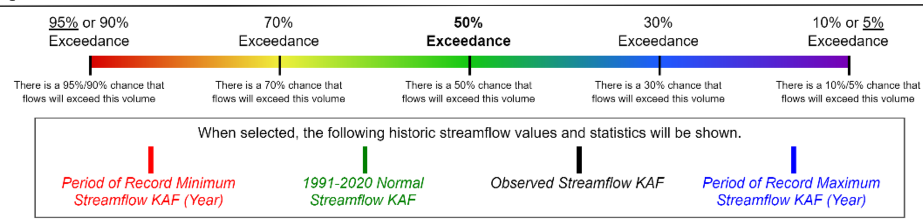
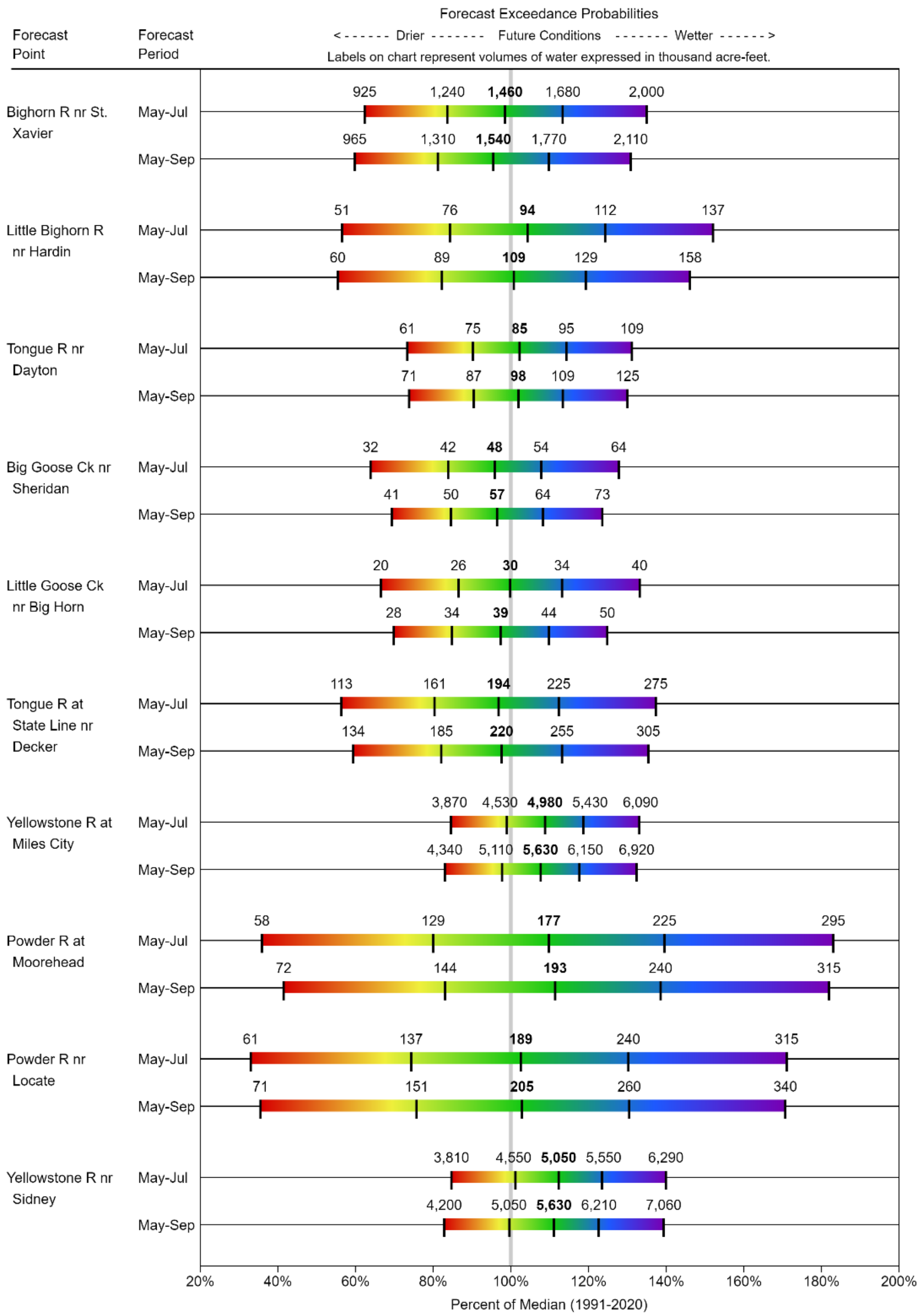


Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

LOWER YELLOWSTONE RIVER BASIN (Wyoming)

Water Supply Forecasts

May 1, 2023



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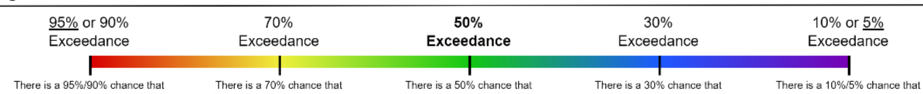

When selected, the following historic streamflow values and statistics will be shown.

Period of Record Minimum Streamflow KAF (Year) | *1991-2020 Normal Streamflow KAF* | *Observed Streamflow KAF* | *Period of Record Maximum Streamflow KAF (Year)*

Some forecasts may be for volumes that are regulated or influenced by diversions and water management.

Water Supply Outlook Report - Webpage Access

The following links will take you to Snow Survey webpages dedicated to Montana's major river basins and a statewide overview. Various water supply related maps are available using the drop-down menus. Hover over and click on points or basins of interest to view data and charts.

Monthly Data - Interactive Web Pages		
Monthly Data - Statewide Overview		
Monthly Statewide Overview		
Monthly Data - River Basin Summaries		
Columbia River Basin	Missouri River Basin	Yellowstone River Basin
Kootenai	Jefferson	Upper Yellowstone
Flathead	Madison	Bighorn-Powder-Tongue
Upper Clark	Gallatin	
Bitterroot	Helena Valley	
Lower Clark	Smith-Judith-Musselshell	
	Sun-Teton	
	St. Mary	
	Milk	

Links and Resources

The following links will take you to the external (non-NRCS) resources used in this report:

Precipitation

- PRISM Climate Group – Oregon State University
- West Wide Drought Tracker
- Montana Climate Office – University of Montana
    - Drought Indicator Dashboard

Temperature

- West Wide Drought Tracker
- NOAA NWS – Climate Offices

Drought Information

- Montana | U.S. Drought Monitor (unl.edu)
- Outlooks | U.S. Drought Monitor (unl.edu)
- Montana | Drought.gov

Soil Moisture

- USDA – National Agricultural Statistics Service – National Crop Progress
- NOAA NWS Climate Prediction Center - Calculated Soil Moisture Ranking Percentiles

Current Streamflow

- USGS WaterWatch -- Streamflow conditions

Weather and Climate Predications

- Climate Prediction Center (noaa.gov)

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U.S. DEPARTMENT of AGRICULTURE

CONSERVATION OF WATER BEGINS WITH THE SNOW SURVEY

Montana Water Supply Outlook Report

Natural Resources Conservation Service