# Upper Missouri River Basin
# January 2024 Calendar Year Runoff Forecast
# January 2, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

The 2023 calendar year runoff summation for the Missouri Basin above Sioux City, IA was 30.4 MAF, 118% of average.

December 2023 runoff was 1.3 MAF, 172% of average. Runoff was above average due to above-normal precipitation over the central part of the Basin and above-normal temperatures over the whole Basin.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **20.1 MAF, 78% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **17.7 MAF, 76% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 12 months, expected inflow could range from the 13.3 MAF lower basic forecast to the 27.9 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that 12 months are being forecast for this January 1 forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is very large, and is attributed to all six reaches for the entire year. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for January 2 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 46% of the Basin, with 1.6% of that being Extreme or Exceptional Drought. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of March, indicates drought conditions are likely to persist wherever they exist.

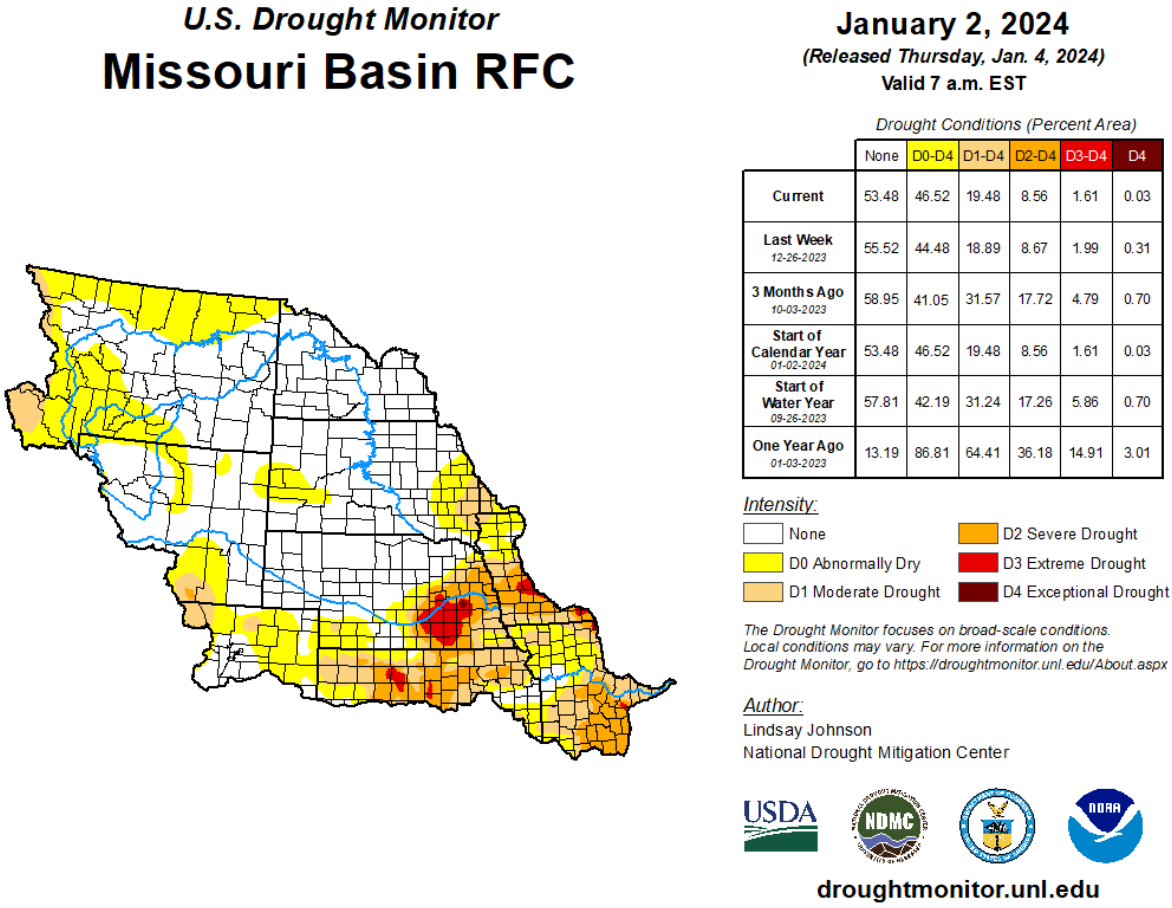


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

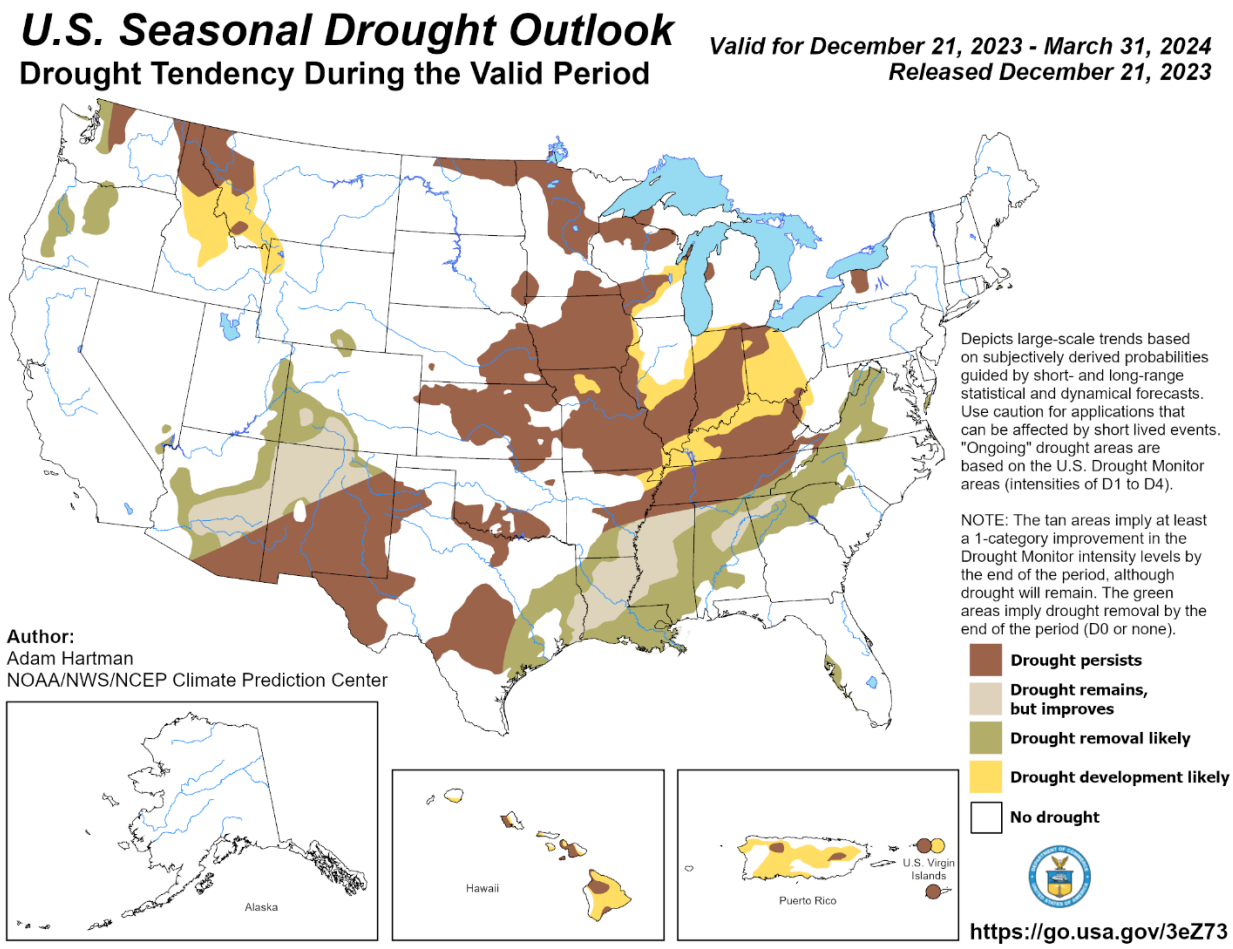


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

## Precipitation

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The December precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was below normal in Montana and north-central North Dakota, and above normal in the rest of the Basin.

Precipitation as a percent of normal for the October-November-December period (**Figure 4**) was more mixed. Large pockets of above-normal precipitation were observed in northwest North Dakota, southern and eastern South Dakota, north-central Nebraska, and eastern Kansas. Precipitation was drier in the other areas of the Basin.

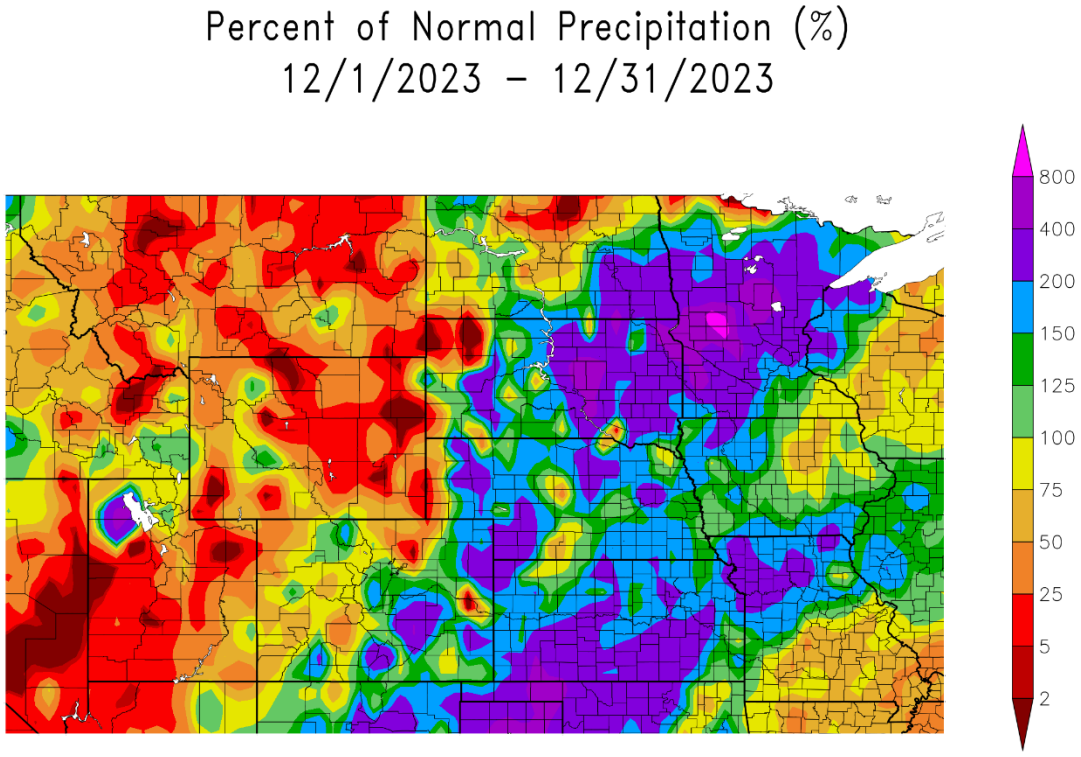


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

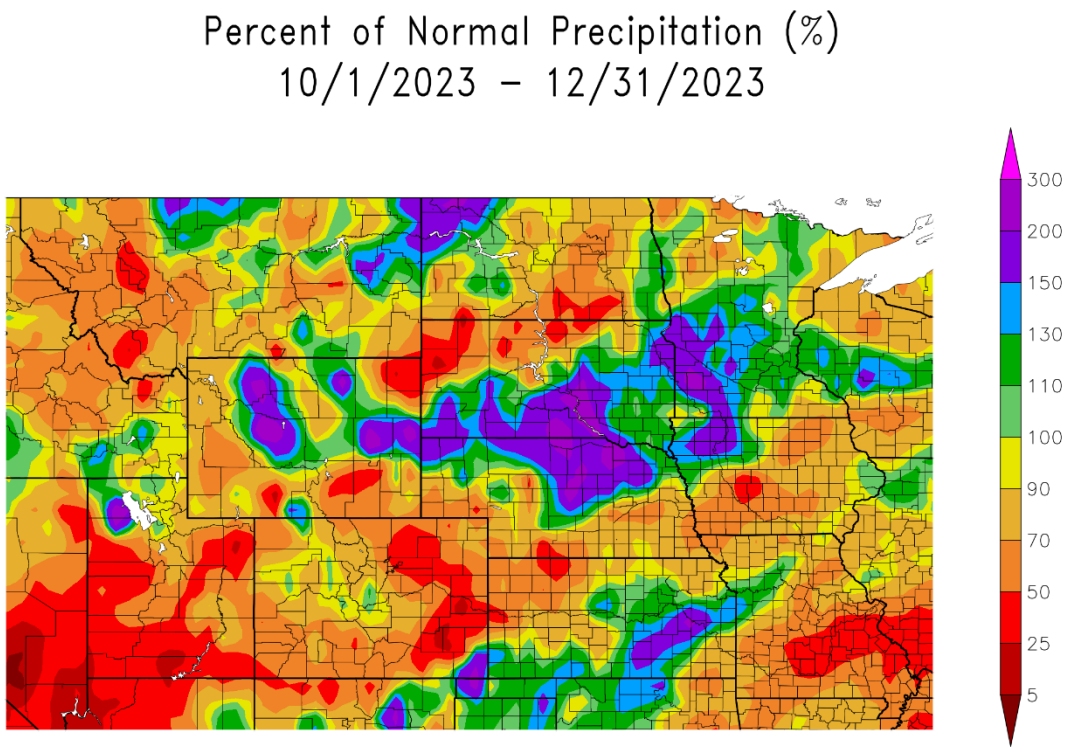


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

December temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures across the Basin. In the northern parts of the Basin, temperatures were 9-15 degrees above average. October-November-December temperature departures are shown in **Figure 6**. The three-month average temperature departures were also above normal across the Basin.

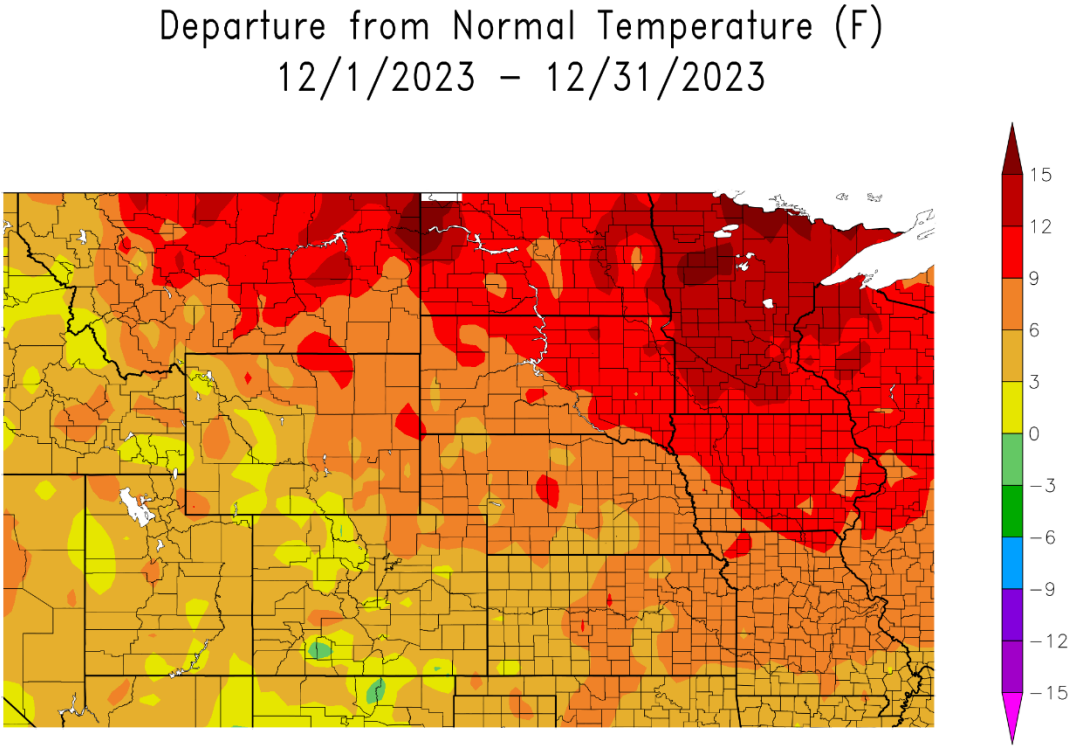


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

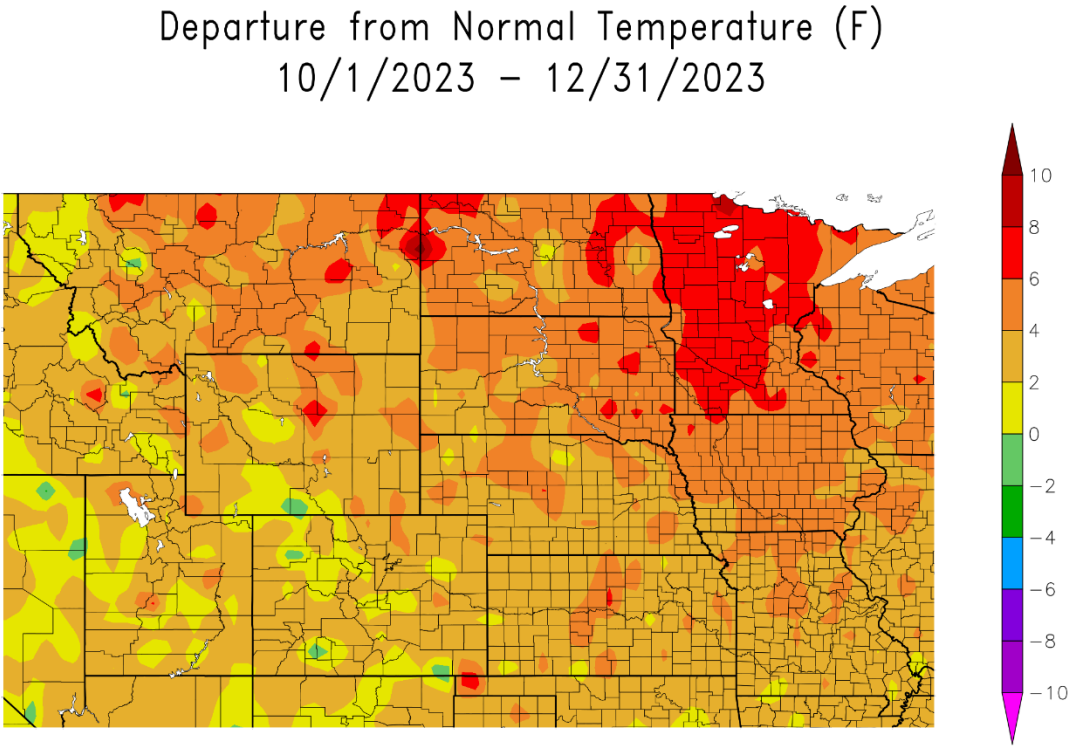


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff. As the calendar year approaches winter, the soil moisture conditions will provide some insight into late winter and early spring runoff potential.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture at the end of December 2023 is shown in **Figure 7**, along with a comparison of soil moisture last year at this time. Soil moisture is drier than normal across the northern edge of the Basin and in the lower Basin, and is wetter than normal in South Dakota and part of Wyoming.

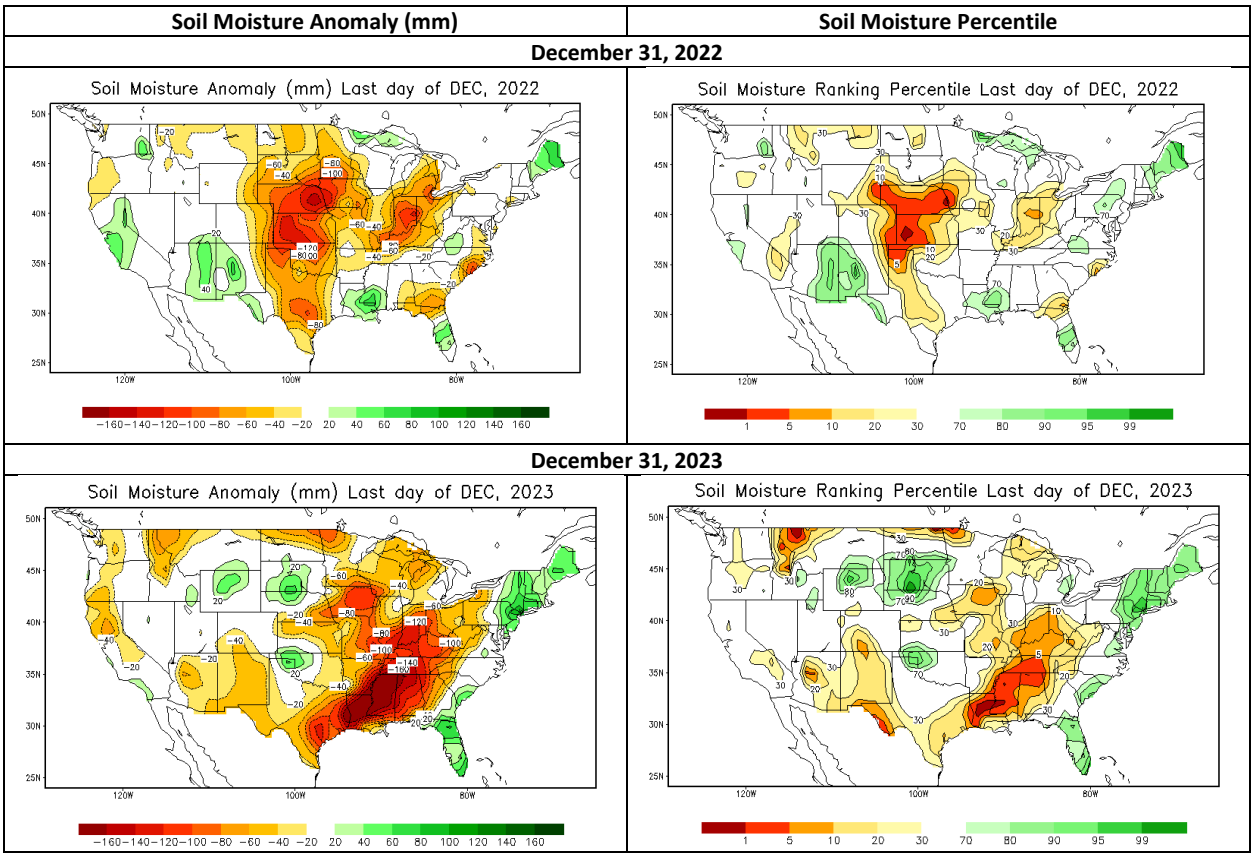


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

## Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts. At this time of year, plains snowpack provides some indication of March-April runoff; however, as the snowpack reaches its ultimate peak accumulation, better forecasts of future runoff can be made.

The National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) modeled snow assessment (available here) from January 1, 2024, shown in **Figure 8**, shows below-normal accumulated plains snowpack for this time of year. While last year at this time showed wide extents to the plains snowpack many areas in the plains have no snowpack as of the beginning of the year. Trace to 1" of snow water equivalent (SWE) is modeled across much of South Dakota and Nebraska, except for a small portion of south-central South Dakota which has 1-2" of SWE. Sporadic areas of SWE are modeled in parts of North Dakota. The amount of runoff received in March and April will depend greatly on precipitation and temperatures over the next few months.

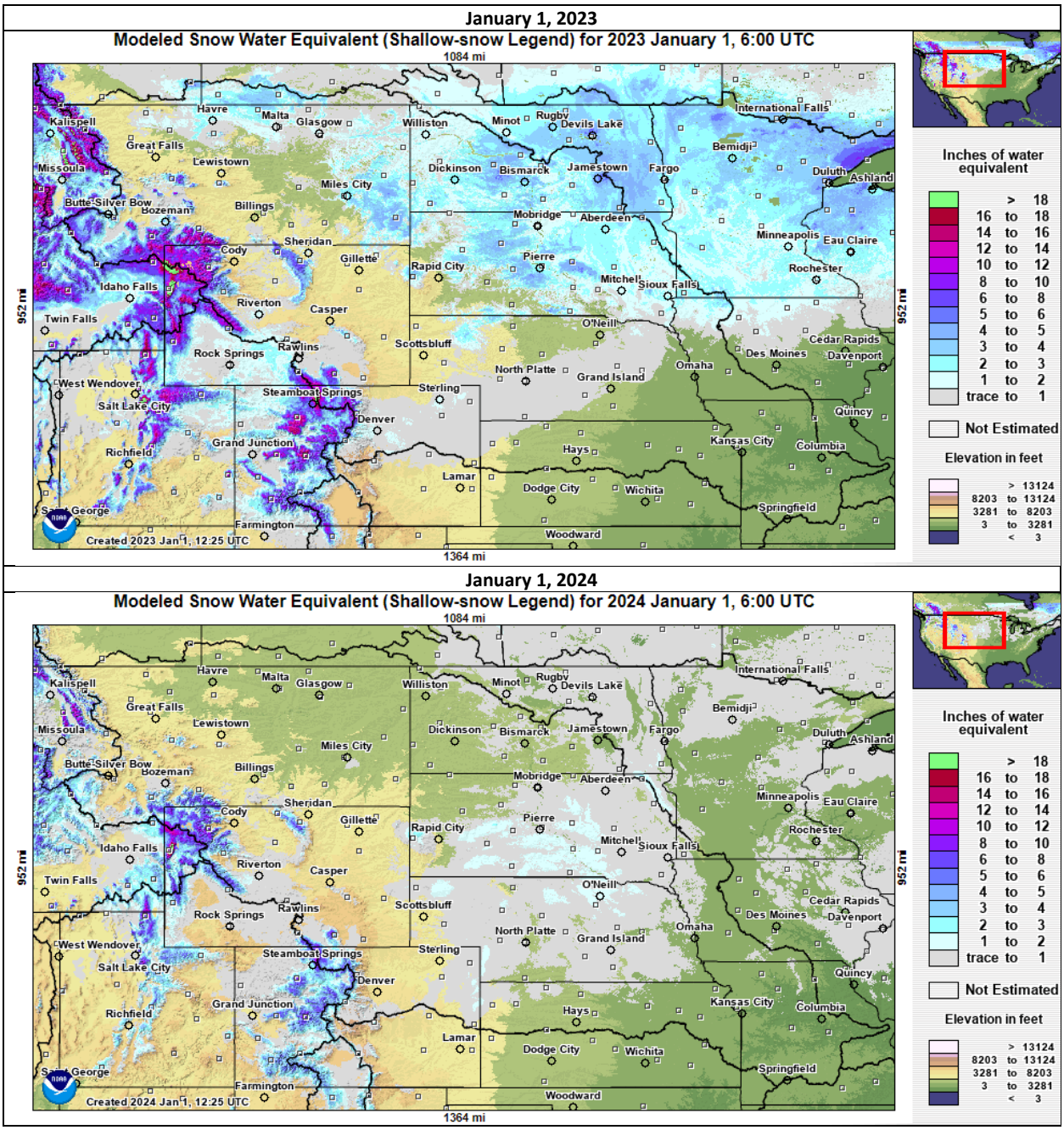


**Figure 8. NOHRSC Modeled Snow Water Equivalent**

### Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has very little correlation to the January 1 snowpack, because less than half of the mountain snowpack has accumulated by January 1. Mountain snowpack typically peaks in mid-April; therefore, later measurements of mountain snowpack are better runoff indicators.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 9** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural

Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE year between 1991-2020 (green line) and the historic high SWE year between 1991-2020 (dark blue line).

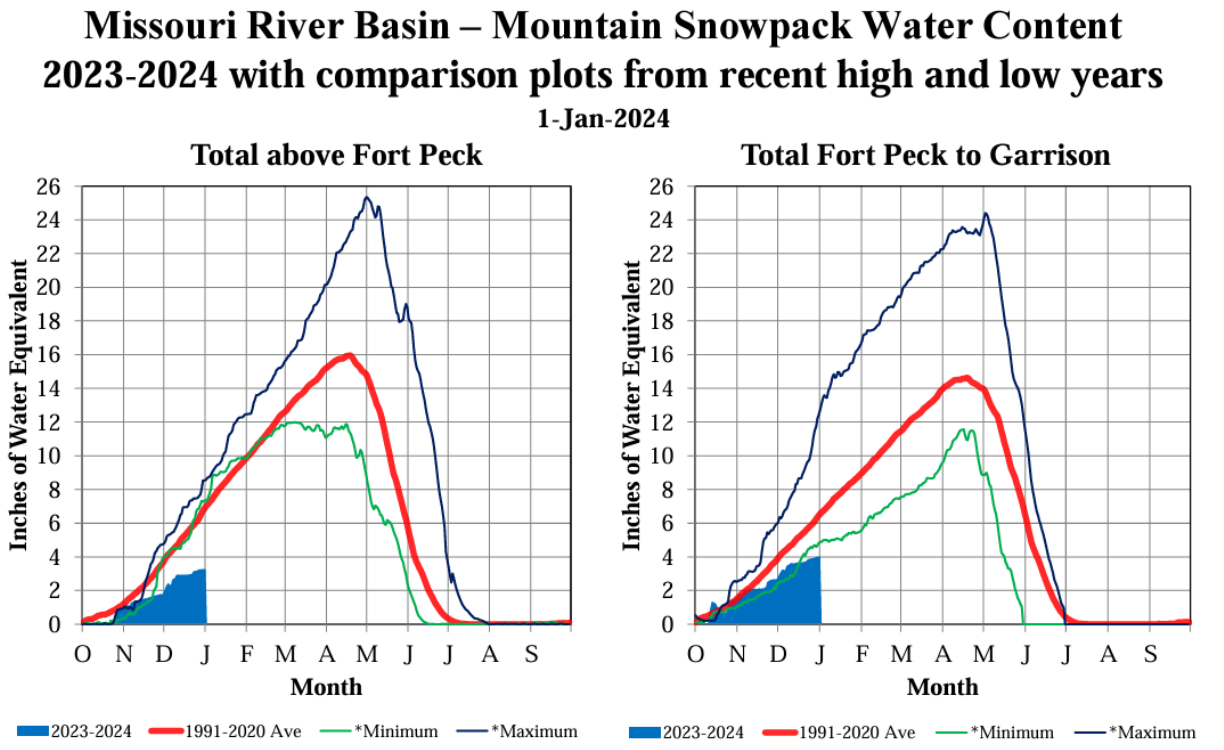


**Figure 9. Mountain Snowpack Water Content**

As of January 1, the average mountain SWE in the Fort Peck reservoir reach was 3.3”, 47% of average. In the reservoir reach between Fort Peck and Garrison dams, the average mountain SWE was 4.1”, 62% of average. Typically, 44% of the total mountain SWE accumulation has occurred by January 1, and snowpack generally peaks near April 17.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

**El Niño Southern Oscillation (ENSO)**

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

El Niño conditions are currently observed and are expected to continue through winter, with a 60% chance of transitioning to ENSO-neutral conditions during April-June.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for January (**Figure 10**) indicates increased chances for below-normal temperatures across most of the Basin. The January precipitation outlook (**Figure 10**) shows equal chances for below-normal, normal, or above-normal precipitation in the upper Basin, and increased chances for above-normal precipitation in the lower Basin.

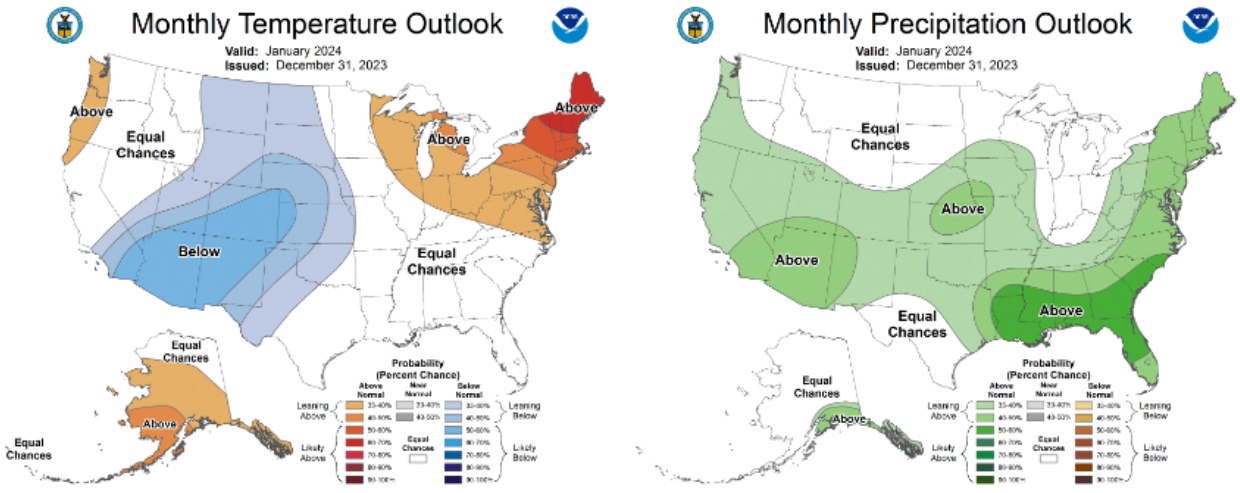


**Figure 10. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the four 3-month periods in 2024 are shown in **Figure 11**. The January-February-March temperature outlook indicates increased chances for above-normal temperatures across the upper Basin and equal chances for below-normal, normal, or above-normal temperatures in the lower Basin. The precipitation outlook for the same period indicates increased chances for below-normal precipitation across Montana and northern North Dakota. Increased chances for above-normal precipitation is possible in Nebraska and Kansas, and equal chances for below-normal, normal, or above-normal precipitation across the rest of the Basin.

The April-May-June temperature and precipitation outlooks have no strong indicators either way, with equal chances for below-normal, normal, or above-normal temperature and precipitation across the Basin.

The July-August-September temperature outlook shows increased chances for above-normal temperatures across the entire Basin. The precipitation outlook shows increased chances for below-normal precipitation in Montana and equal chances for the rest of the Basin.

The October-November-December temperature outlook shows equal chances for below-normal, normal, or above-normal temperatures in the upper Basin, and increased chances for above-normal temperatures in the lower Basin. The precipitation outlook for the same time period shows equal chances across most of the Basin, except for increased chances of above-normal precipitation in Iowa and increased chances for below-normal precipitation in Wyoming and Colorado.

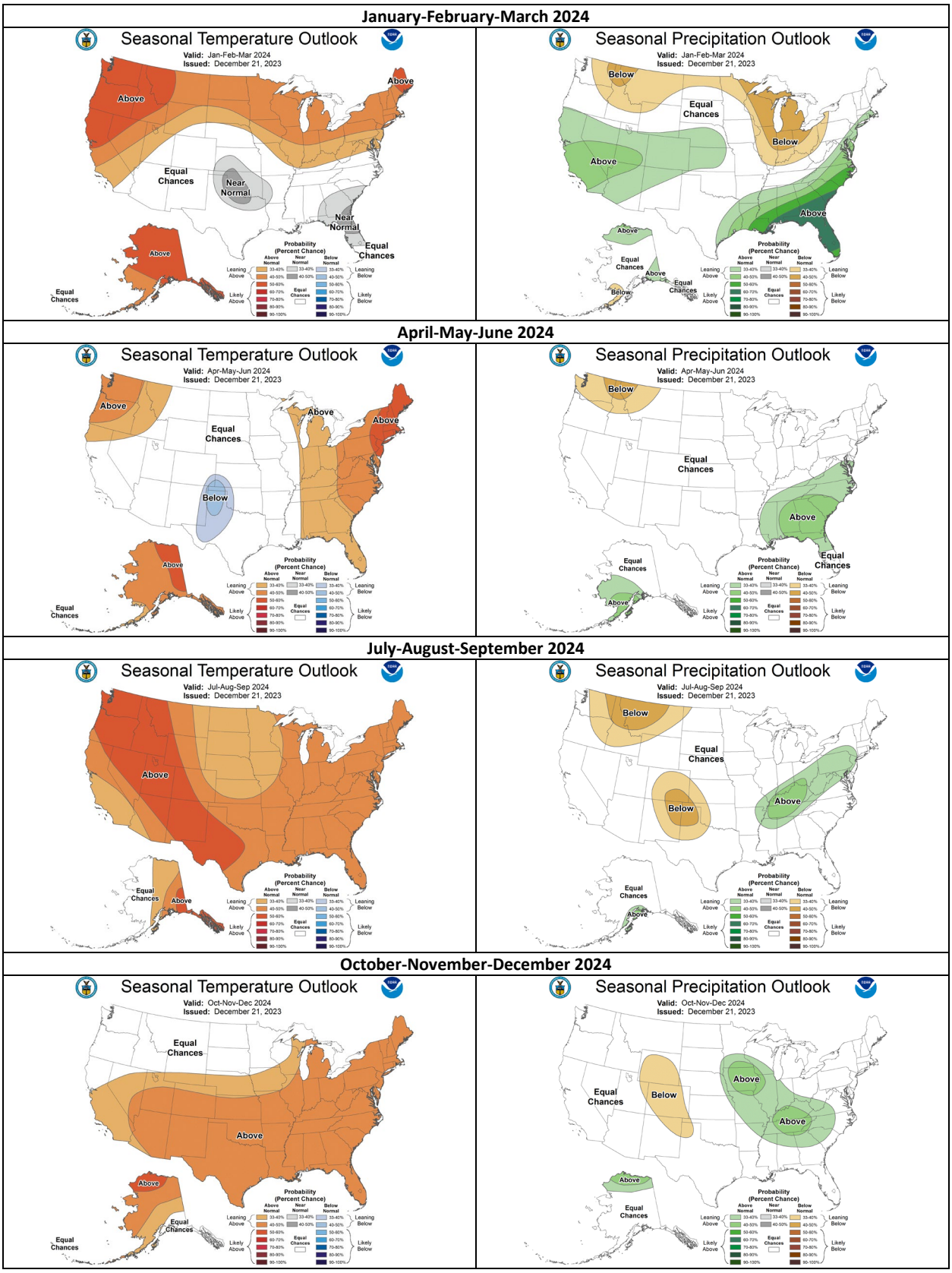


**Figure 11. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

Given current streamflow and the potential for cooler weather in January, we expect total runoff above Sioux City, IA in January and February to be near normal. March and April runoff potential is slightly below normal in most reaches due to the below-normal plains snowpack and soil moisture conditions but will depend greatly on the accumulation of additional plains snowpack and temperatures over the next 2 to 3 months. During May, June, and July, Fort Peck and Garrison runoff is forecast to be below average due to the below-normal mountain snowpack.

In summary, the 2024 calendar year runoff forecast is **20.1 MAF, 78% of average**.

## NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
* - DATA CURRENT AS OF: January 08, 2024 09:51:09 AM
- Based on January 01, 2024 forecast values

PRELIMINARY MISSOURI RIVER BASIN FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | max (KAF) | 30% (KAF) | 70% (KAF) | min (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Hebgen Lake Inflow (2) | APR-JUL | 310 | 89 | 430 | 360 | 260 | 192 | 350 |
| | APR-SEP | 380 | 84 | 520 | 435 | 325 | 240 | 455 |

PRELIMINARY YELLOWSTONE RIVER BASIN FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | max (KAF) | 30% (KAF) | 70% (KAF) | min (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Mystic Lake Inflow (2) | APR-JUL | 52 | 90 | 64 | 57 | 47 | 40 | 58 |
| | APR-SEP | 63 | 84 | 78 | 69 | 57 | 48 | 75 |
| Wind R Ab Bull Lake Ck (2) | APR-JUL | 430 | 90 | 625 | 510 | 350 | 235 | 480 |
| | APR-SEP | 455 | 97 | 670 | 540 | 370 | 240 | 470 |
| Bull Lake Ck nr Lenore (2) | APR-JUL | 138 | 98 | 185 | 157 | 119 | 91 | 141 |
| | APR-SEP | 158 | 94 | 210 | 180 | 136 | 104 | 168 |
| Boysen Reservoir Inflow (2) | APR-JUL | 675 | 92 | 1100 | 850 | 500 | 245 | 730 |
| | APR-SEP | 710 | 90 | 1170 | 895 | 525 | 250 | 785 |
| Greybull R at Meeteetse | APR-JUL | 171 | 121 | 240 | 198 | 144 | 103 | 141 |
| | APR-SEP | 235 | 118 | 310 | 265 | 205 | 159 | 199 |
| Shell Ck nr Shell | APR-JUL | 46 | 78 | 64 | 53 | 39 | 28 | 59 |
| | APR-SEP | 57 | 80 | 76 | 65 | 49 | 38 | 71 |
| Bighorn R at Kane (2) | APR-JUL | 935 | 94 | 1550 | 1190 | 685 | 315 | 1000 |
| | APR-SEP | 990 | 95 | 1660 | 1260 | 720 | 315 | 1040 |
| NF Shoshone R at Wapiti | APR-JUL | 425 | 94 | 570 | 485 | 365 | 280 | 450 |
| | APR-SEP | 475 | 92 | 630 | 535 | 415 | 320 | 515 |
| SF Shoshone R nr Valley | APR-JUL | 192 | 85 | 255 | 220 | 166 | 128 | 225 |
| | APR-SEP | 215 | 83 | 290 | 245 | 185 | 141 | 260 |
| Buffalo Bill Reservoir Inflow (2) | APR-JUL | 570 | 85 | 810 | 665 | 475 | 330 | 670 |
| | APR-SEP | 630 | 86 | 885 | 735 | 525 | 375 | 730 |
| Bighorn R nr St. Xavier (2) | APR-JUL | 1470 | 91 | 2220 | 1770 | 1170 | 715 | 1610 |
| | APR-SEP | 1520 | 88 | 2340 | 1850 | 1190 | 695 | 1720 |
| Tongue R nr Dayton (2) | APR-JUL | 78 | 89 | 108 | 90 | 66 | 48 | 88 |
| | APR-SEP | 82 | 80 | 114 | 95 | 69 | 50 | 102 |
| Tongue River Reservoir Inflow (2) | APR-JUL | 172 | 78 | 240 | 182 | 102 | 43 | 220 |
| | APR-SEP | 182 | 73 | 285 | 225 | 140 | 78 | 250 |
| NF Powder R nr Hazelton | APR-JUL | 7.2 | 70 | 10.2 | 8.4 | 6.0 | 4.2 | 10.3 |
| | APR-SEP | 7.1 | 64 | 10.2 | 8.4 | 5.8 | 4.0 | 11.1 |
| Powder R at Moorhead | APR-JUL | 146 | 76 | 265 | 194 | 98 | 27 | 191 |
| | APR-SEP | 149 | 73 | 275 | 199 | 99 | 25 | 205 |

PRELIMINARY RAPID VALLEY UNIT FORECASTS

| | | 50% | % of | max | 30% | 70% | min | 30-yr |
|---|---|---|---|---|---|---|---|---|

| Forecast Point | period | (KAF) | med | (KAF) | (KAF) | (KAF) | (KAF) | med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow (2) | MAR-JUL | 5.8 | 89 | 9.8 | 7.4 | 4.2 | 1.78 | 6.5 |
| | APR-JUL | 4.6 | 87 | 8.2 | 6.1 | 3.1 | 0.96 | 5.3 |
| Pactola Reservoir Inflow (2) | MAR-JUL | 25 | 89 | 43 | 32 | 17.7 | 7.0 | 28 |
| | APR-JUL | 22 | 88 | 39 | 29 | 15.1 | 4.9 | 25 |

PRELIMINARY PLATTE RIVER BASIN FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | max (KAF) | 30% (KAF) | 70% (KAF) | min (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate (2) | APR-JUL | 157 | 79 | 295 | 210 | 102 | 20 | 200 |
| | APR-SEP | 165 | 75 | 310 | 225 | 106 | 19.7 | 220 |
| Encampment R nr Encampment (2) | APR-JUL | 101 | 75 | 173 | 130 | 72 | 29 | 135 |
| | APR-SEP | 103 | 73 | 178 | 133 | 73 | 28 | 141 |
| Rock Ck ab King Canyon Cnl nr Arlington | APR-JUL | 36 | 73 | 56 | 44 | 28 | 16.1 | 49 |
| | APR-SEP | 40 | 78 | 61 | 48 | 32 | 19.2 | 51 |
| Seminoe Reservoir Inflow (2) | APR-JUL | 395 | 60 | 765 | 540 | 290 | 148 | 660 |
| | APR-SEP | 420 | 59 | 795 | 565 | 295 | 162 | 715 |
| Sweetwater R nr Alcova | APR-JUL | 40 | 89 | 81 | 57 | 23 | 0.25 | 45 |
| | APR-SEP | 43 | 88 | 87 | 61 | 25 | 0.69 | 49 |
| La Prele Ck nr Douglas | APR-JUL | 13.4 | 64 | 32 | 19.0 | 8.6 | 4.3 | 21 |
| | APR-SEP | 14.9 | 76 | 36 | 23 | 9.3 | 4.8 | 19.5 |
| North Platte R bl Glendo Reservoir (2) | APR-JUL | 465 | 62 | 1060 | 705 | 225 | 100 | 745 |
| | APR-SEP | 475 | 63 | 1090 | 725 | 225 | 1.25 | 760 |
| North Platte R bl Guernsey Reservoir (2) | APR-JUL | 520 | 70 | 1280 | 775 | 275 | 54 | 745 |
| | APR-SEP | 570 | 74 | 1380 | 845 | 305 | 65 | 775 |
| Laramie R and Pioneer Cnl nr Woods Lg (2) | APR-JUL | 92 | 79 | 153 | 115 | 72 | 44 | 117 |
| | APR-SEP | 98 | 78 | 158 | 120 | 77 | 49 | 126 |
| Little Laramie R nr Filmore | APR-JUL | 34 | 64 | 56 | 42 | 27 | 17.8 | 53 |
| | APR-SEP | 38 | 68 | 57 | 45 | 31 | 23 | 56 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# February 2024 Calendar Year Runoff Forecast
# February 5, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

January runoff was 0.4 MAF, 56% of average. Runoff was well-below average in every reach except Gavins Point due to extreme below-normal temperatures over the whole Basin and below-normal precipitation over most of the upper Basin.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **18.8 MAF, 73% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **16.4 MAF, 70% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 11 months, expected inflow could range from the 12.4 MAF lower basic forecast to the 26.0 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that 11 months are being forecast for this February 1 forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches for the next 11 months. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for January 30 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 56% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of April, indicates drought conditions are likely to persist or worsen in the upper Basin, but improve in the lower Basin.

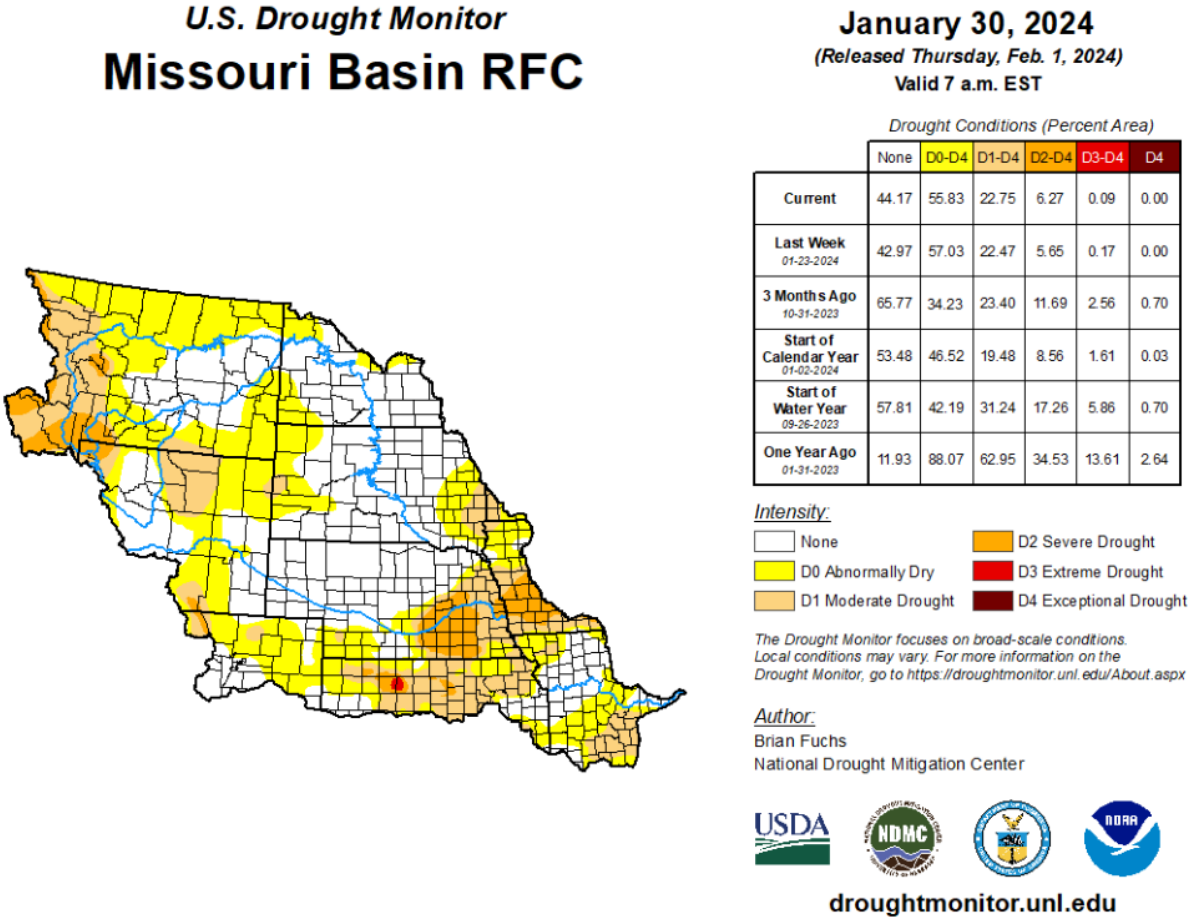


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

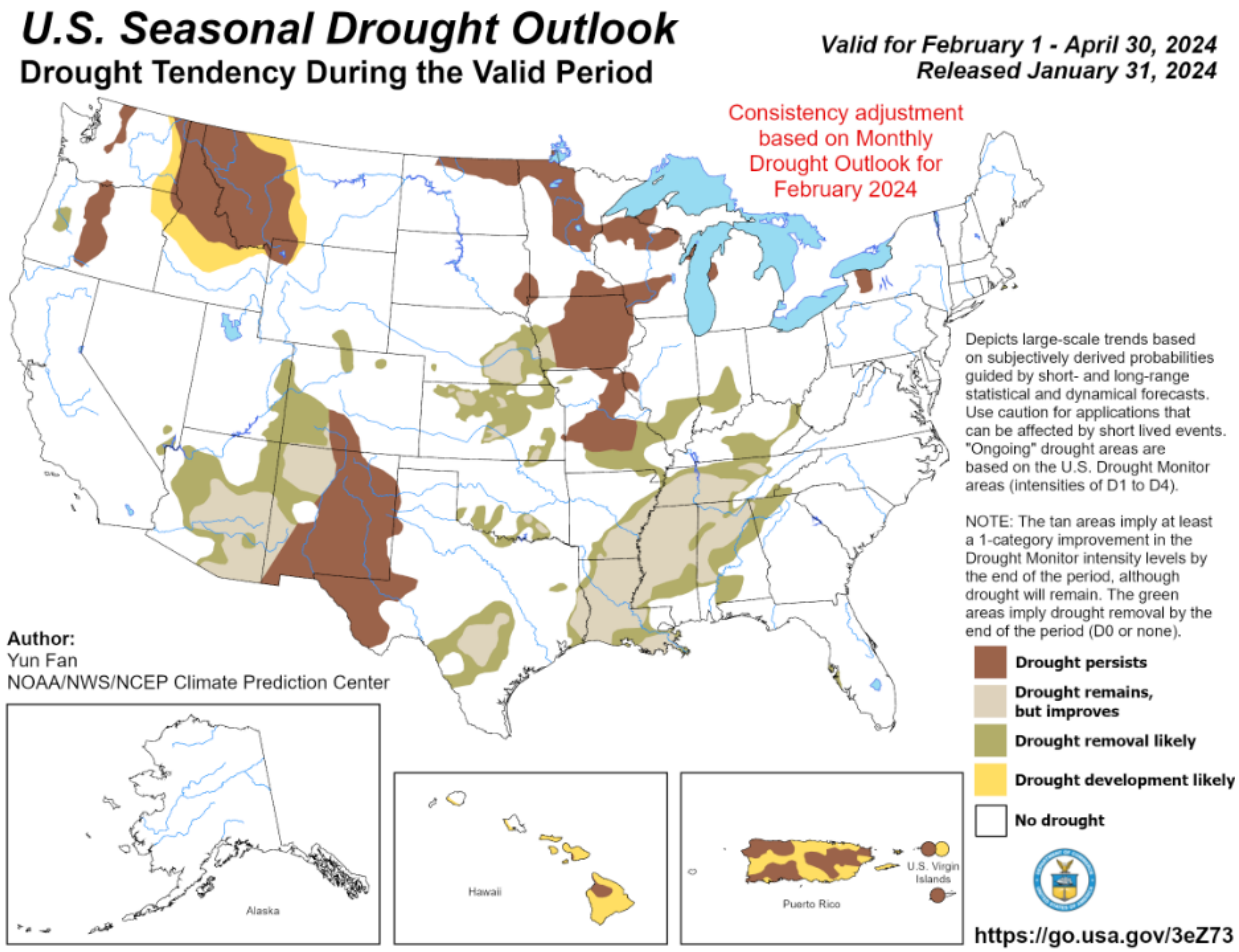


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The January precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was below normal over most of the upper Basin, and above normal in the lower Basin.

Precipitation as a percent of normal for the November-December-January period (**Figure 4**) was more mixed. Above-normal precipitation was observed in eastern South Dakota, central and eastern Nebraska, and most of Kansas. Precipitation was below-normal or near-normal across most of the remainder of the Basin over the past three months.

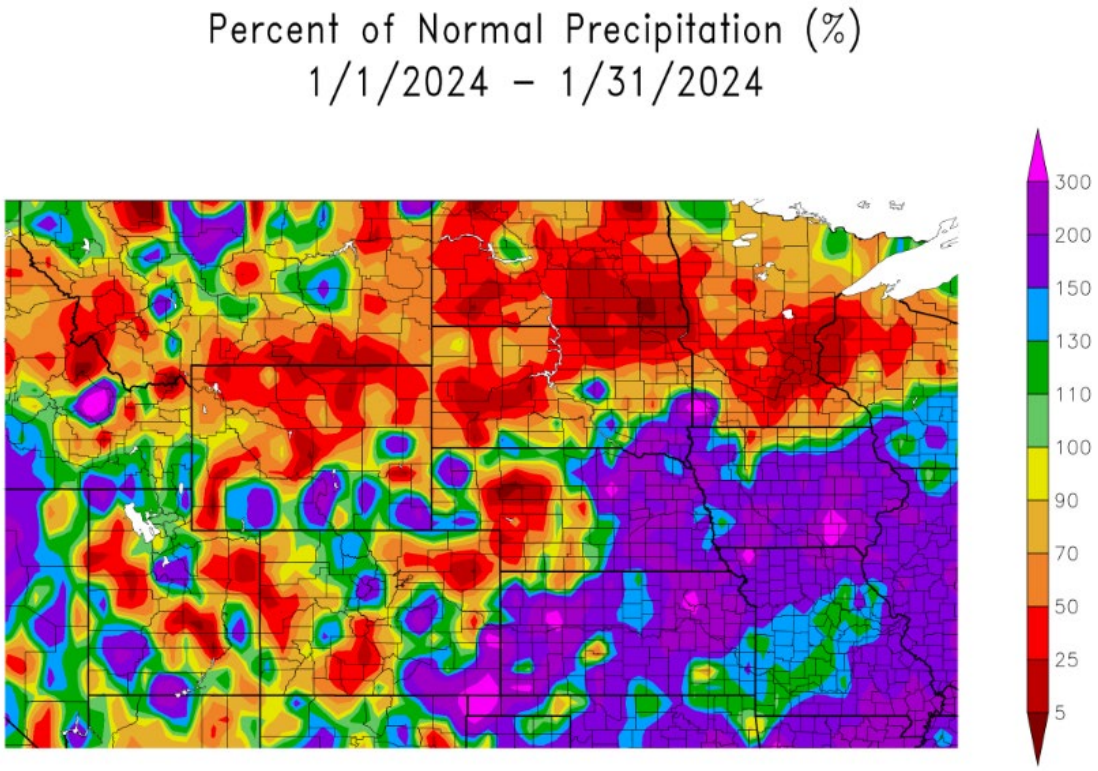


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

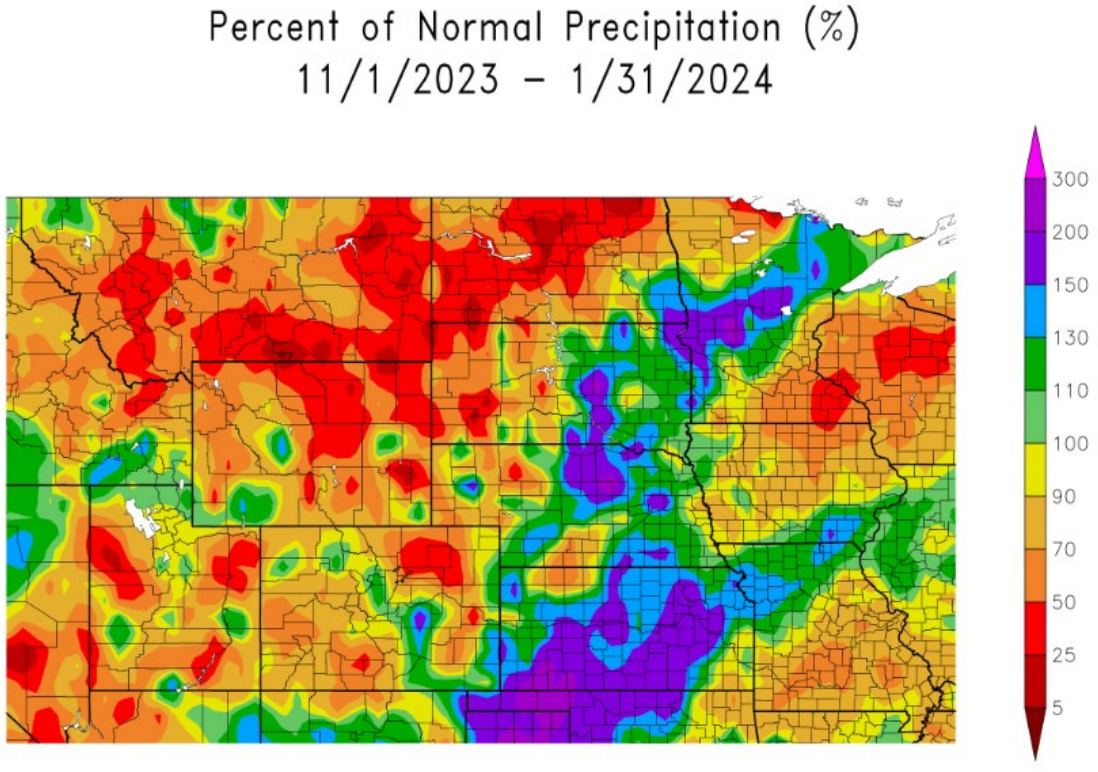


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

January temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate cooler-than-normal temperatures across the Basin. Temperatures in some areas were up to 10 degrees cooler than normal, and record lows were broken during January in many locations across the Basin. November-December-January temperature departures are shown in **Figure 6**. The three-month average temperature departures were above normal across the Basin.

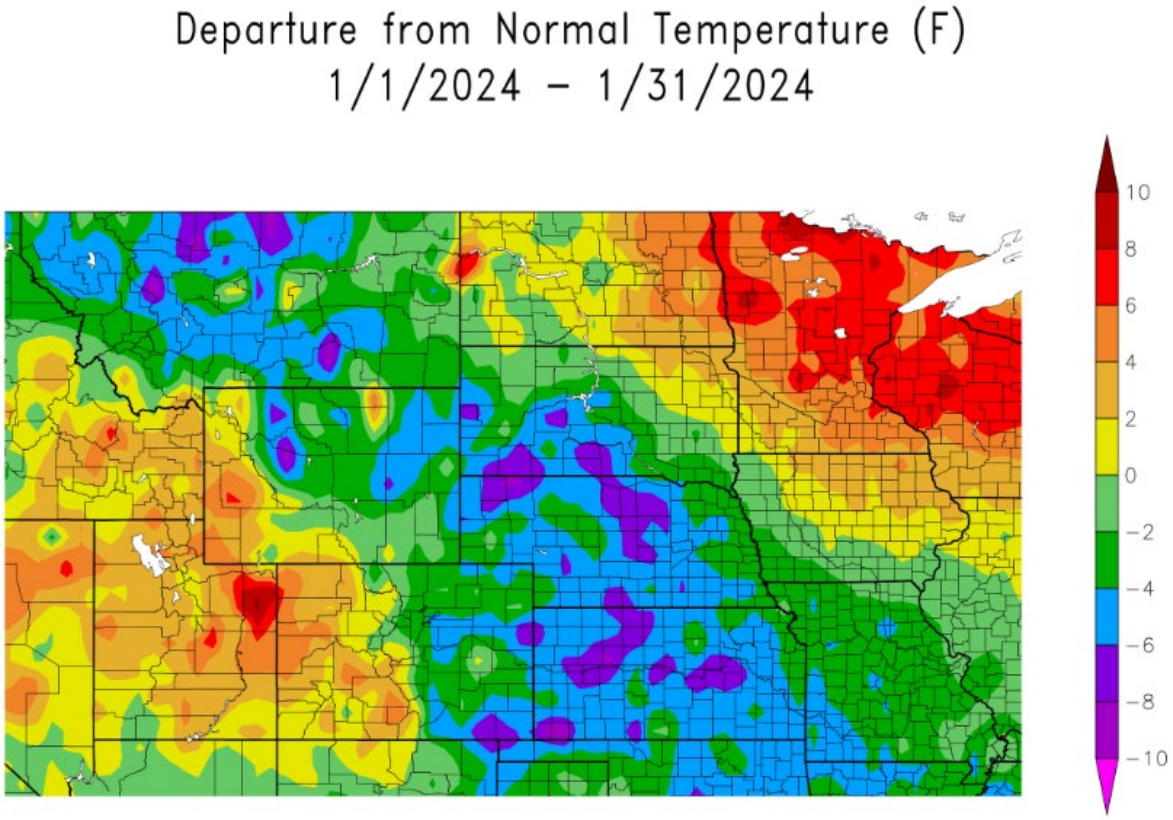


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

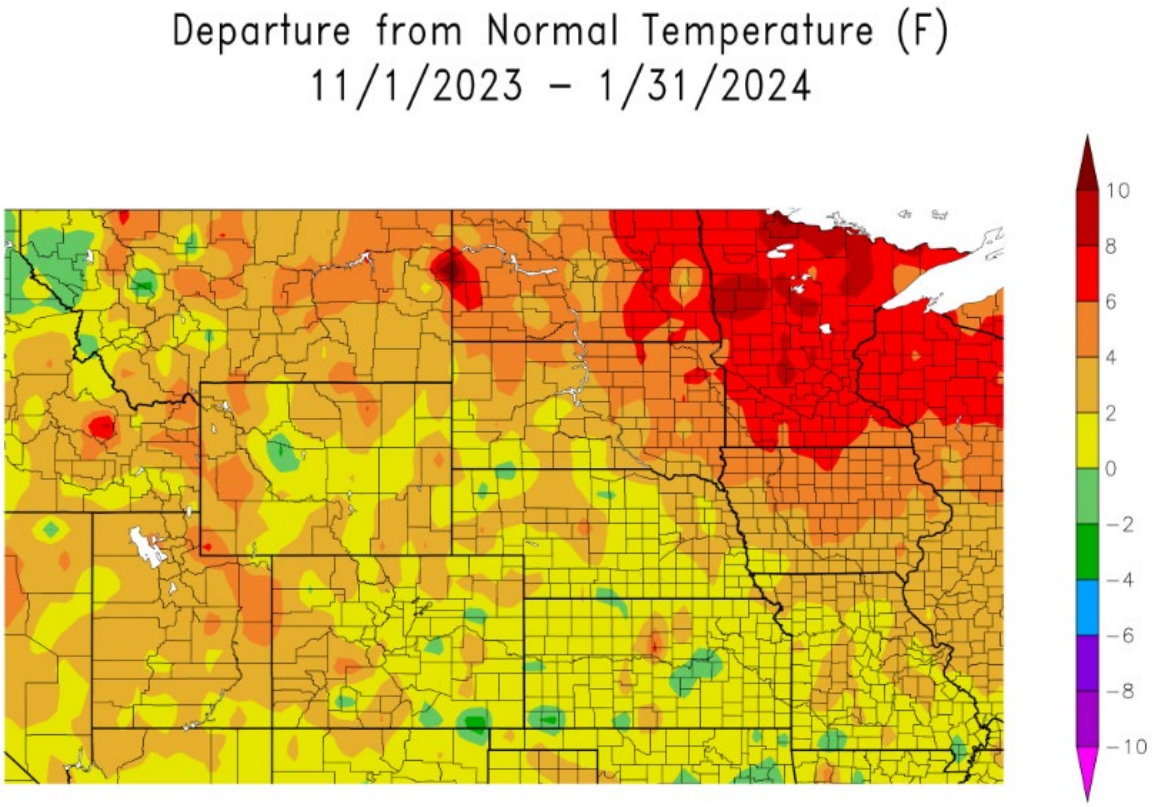


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff. As the calendar year approaches winter, the soil moisture conditions will provide some insight into late winter and early spring runoff potential.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture at the end of January 2024 is shown in **Figure 7**. Soil moisture is drier than normal across the northern edge of the Basin and in the lower Basin, and is wetter than normal in South Dakota, northern Nebraska, and part of Wyoming.

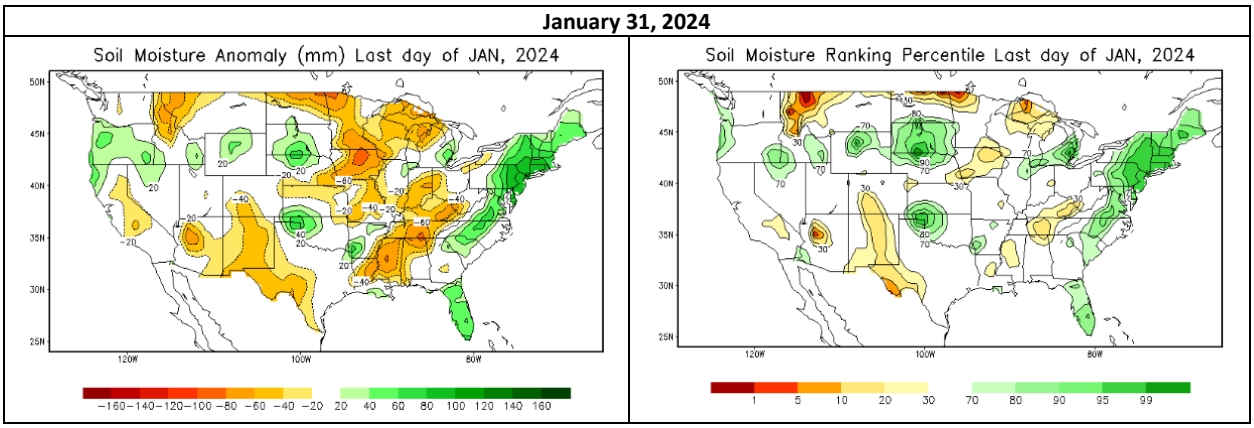


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

### Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts. At this time of year, plains snowpack provides some indication of March-April runoff; however, as the snowpack reaches its ultimate peak accumulation, better forecasts of future runoff can be made.

The National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) modeled snow assessment (available here) from February 1, 2024, shown in **Figure 8**, shows below-normal accumulated plains snowpack for this time of year. Trace to 3" of snow water equivalent (SWE) is modeled across areas of eastern South Dakota and northeastern Nebraska, with no plains snowpack present in the remainder of the Basin at the beginning of February. The amount of runoff received in February, March and April will depend greatly on precipitation and temperatures over the next few months.

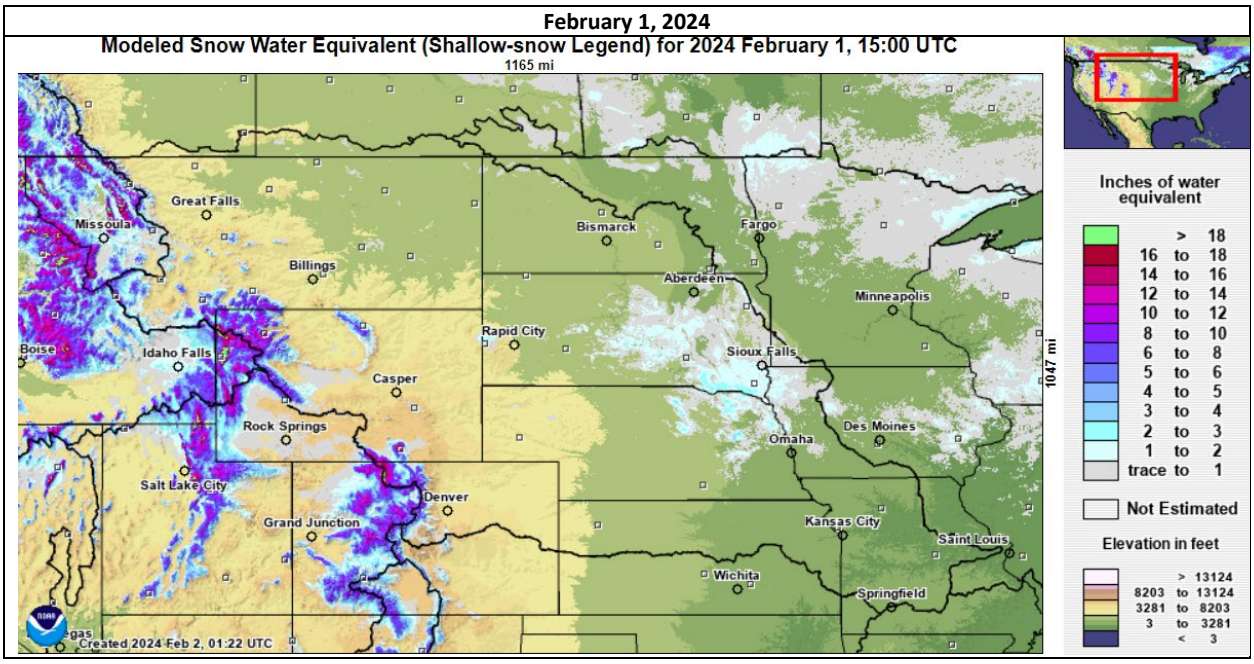


**Figure 8. NOHRSC Modeled Snow Water Equivalent**

## Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has little correlation to the February 1 snowpack, because around 60 percent of the mountain snowpack accumulation period has elapsed by February 1. Mountain snowpack typically peaks in mid-April; therefore, later measurements of mountain snowpack are better runoff indicators.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 9** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE year between 1991-2020 (green line) and the historic high SWE year between 1991-2020 (dark blue line).

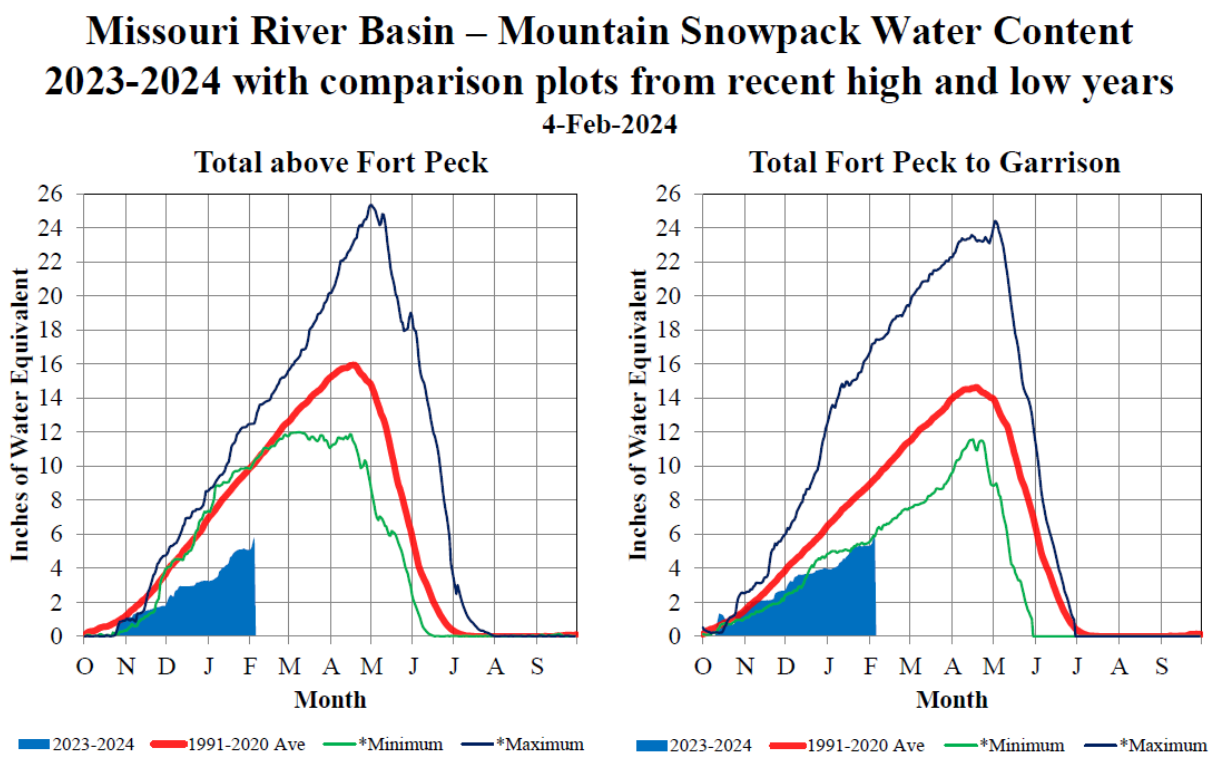


**Figure 9. Mountain Snowpack Water Content**

As of February 4, the average mountain SWE in the Fort Peck reservoir reach was 5.8”, 57% of average. In the reservoir reach between Fort Peck and Garrison dams, the average mountain SWE was 5.9”, 64% of average. Typically, 64% of the total mountain SWE accumulation has occurred by February 1, and snowpack generally peaks near April 17.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### El Niño Southern Oscillation (ENSO)

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña

winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

El Niño conditions are currently observed and are expected to continue through winter, with a 73% chance of transitioning to ENSO-neutral conditions during April-June.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for February (**Figure 10**) indicates increased chances for above-normal temperatures across the entire Basin. The February precipitation outlook (**Figure 10**) shows equal chances for below-normal, normal, or above-normal precipitation for most of the upper Basin, and increased chances for above-normal precipitation in southwestern South Dakota, Nebraska, Colorado, and Kansas.

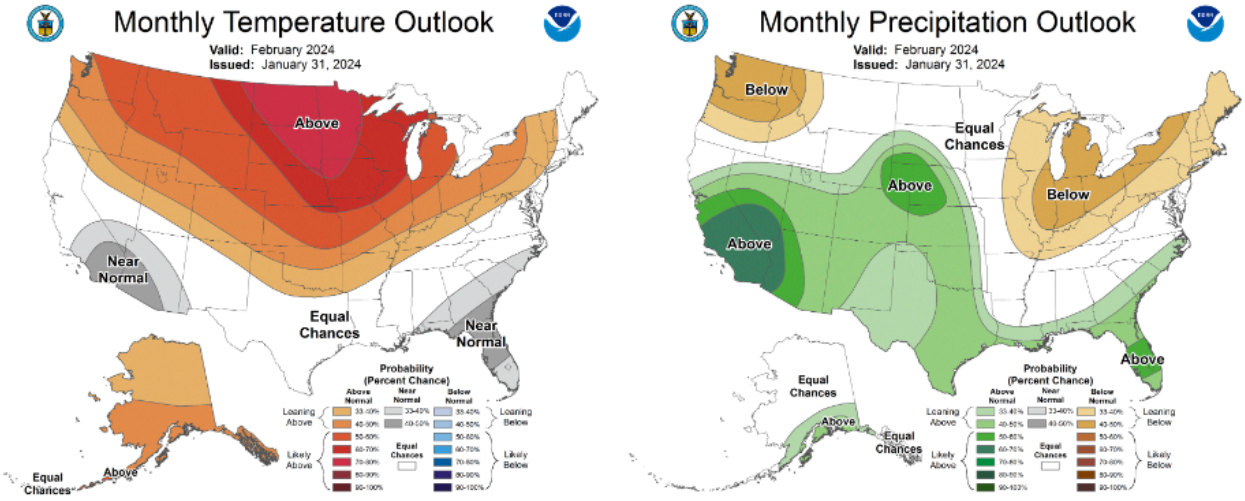


**Figure 10. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the four 3-month periods in 2024 are shown in **Figure 11**. The March-April-May temperature outlook indicates increased chances for above-normal temperatures across the upper Basin and equal chances for below-normal, normal, or above-normal temperatures in the lower Basin. The precipitation outlook for the same period indicates increased chances for below-normal precipitation in northwestern Montana, equal chances for below-normal, normal, or above-normal precipitation across the rest of the upper Basin, and increased chances for above-normal precipitation in the lower Basin.

The June-July-August temperature and precipitation outlooks show increased chances for above-normal temperatures in Colorado, Wyoming, Kansas, and Missouri, with equal chances for below-normal, normal, or above-normal temperature across the rest of the Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation across most of the Basin.

The September-October-November temperature outlook shows increased chances for above-normal temperatures across the entire Basin. The precipitation outlook shows increased chances for below-normal precipitation in Wyoming and Colorado, with equal chances for the rest of the Basin.

The December 2024-January 2025-February 2025 outlooks have no strong indicators, showing equal chances for below-normal, normal, or above-normal temperatures and precipitation across the entire Basin.

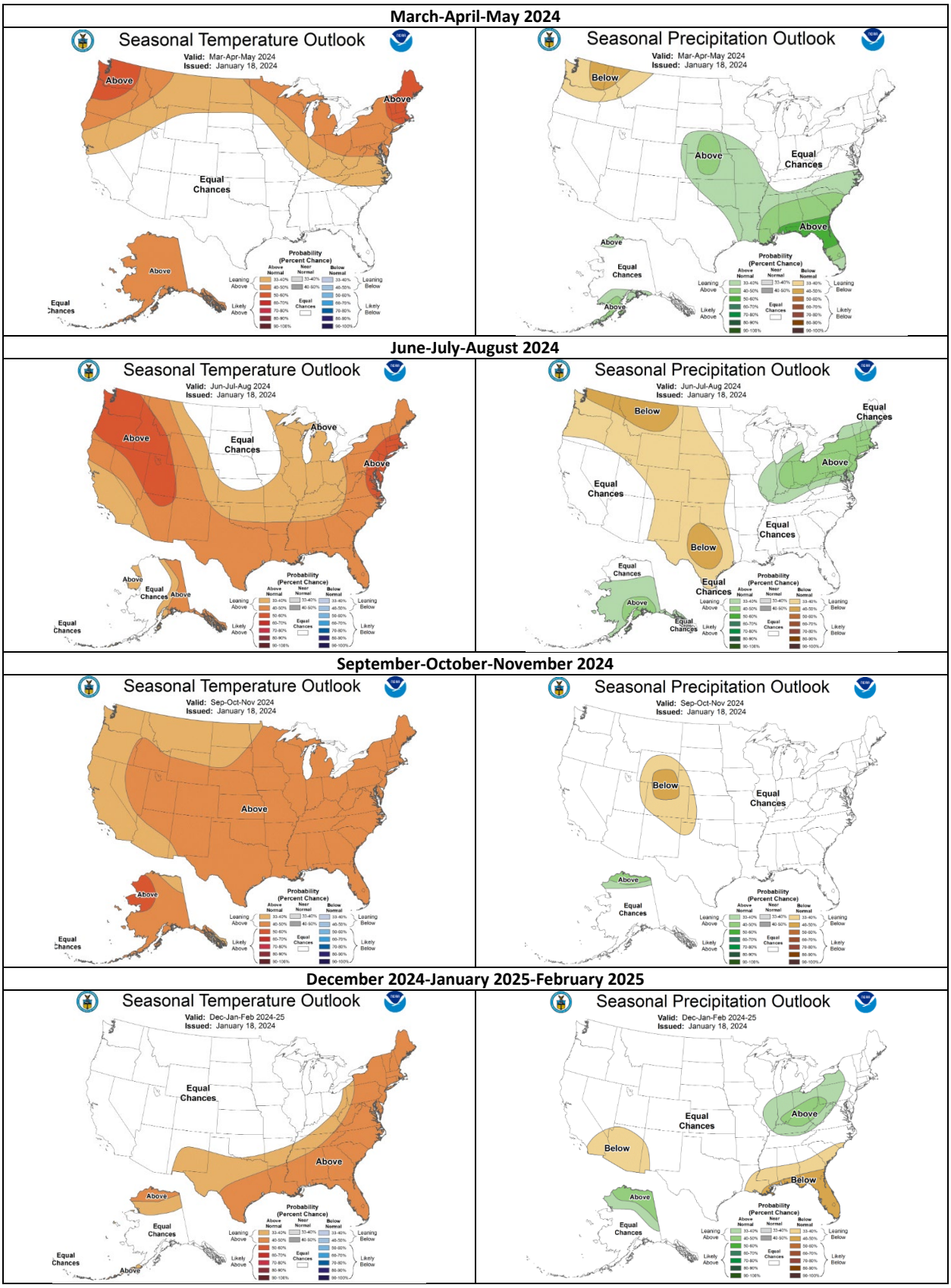


**Figure 11. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

Given current reach runoff and outlooks, we expect runoff in February to remain below normal for most reaches. March and April runoff potential is slightly below normal in most reaches due to the below-normal plains snowpack and soil moisture conditions but will depend greatly on the accumulation of additional plains snowpack and temperatures over the next 2 to 3 months. During May, June, and July, Fort Peck and Garrison runoff is forecast to be below average due to the below-normal mountain snowpack.

In summary, the 2024 calendar year runoff forecast is **18.8 MAF, 73% of average**.

# NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: Mon, 05 Feb 2024 22:25:18 GMT
   - Based on 02-01-2024 forecast values  - Not filtered by publish status(es)

PRELIMINARY MISSOURI RIVER BASIN FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Hebgen Lake Inflow (2) | Apr F-Jul L | 245 | 70 | 335 | 280 | 210 | 157 | 350 |
| | Apr F-Sep L | 320 | 70 | 425 | 360 | 275 | 215 | 455 |

PRELIMINARY YELLOWSTONE RIVER BASIN FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Mystic Lake Inflow (2) | Apr F-Jul L | 49 | 84 | 59 | 53 | 46 | 42 | 58 |
| | Apr F-Sep L | 62 | 83 | 74 | 66 | 57 | 51 | 75 |
| Wind R Ab Bull Lake Ck (2) | Apr F-Jul L | 360 | 75 | 500 | 415 | 305 | 245 | 480 |
| | Apr F-Sep L | 375 | 80 | 520 | 435 | 320 | 250 | 470 |
| Bull Lake Ck nr Lenore (2) | Apr F-Jul L | 158 | 112 | 198 | 174 | 144 | 126 | 141 |
| | Apr F-Sep L | 188 | 112 | 230 | 205 | 172 | 152 | 168 |
| Boysen Reservoir Inflow (2) | Apr F-Jul L | 510 | 70 | 995 | 665 | 365 | 225 | 730 |
| | Apr F-Sep L | 545 | 69 | 1050 | 715 | 410 | 260 | 785 |
| Greybull R at Meeteetse | Apr F-Jul L | 147 | 104 | 210 | 174 | 123 | 91 | 141 |
| | Apr F-Sep L | 205 | 103 | 275 | 235 | 178 | 137 | 199 |
| Shell Ck nr Shell | Apr F-Jul L | 45 | 76 | 62 | 52 | 38 | 28 | 59 |
| | Apr F-Sep L | 57 | 80 | 77 | 66 | 49 | 37 | 71 |
| Bighorn R at Kane (2) | Apr F-Jul L | 845 | 85 | 1640 | 1210 | 615 | 340 | 1000 |
| | Apr F-Sep L | 1020 | 98 | 1640 | 1330 | 755 | 295 | 1040 |
| NF Shoshone R at Wapiti | Apr F-Jul L | 470 | 104 | 585 | 520 | 430 | 370 | 450 |
| | Apr F-Sep L | 540 | 105 | 650 | 590 | 500 | 435 | 515 |
| SF Shoshone R nr Valley | Apr F-Jul L | 178 | 79 | 225 | 196 | 161 | 138 | 225 |
| | Apr F-Sep L | 200 | 77 | 250 | 220 | 179 | 152 | 260 |
| Buffalo Bill Reservoir Inflow (2) | Apr F-Jul L | 650 | 97 | 855 | 725 | 575 | 490 | 670 |
| | Apr F-Sep L | 760 | 104 | 990 | 845 | 685 | 585 | 730 |
| Bighorn R nr St. Xavier (2) | Apr F-Jul L | 1280 | 80 | 2300 | 1670 | 980 | 695 | 1610 |
| | Apr F-Sep L | 1430 | 83 | 2510 | 1850 | 1090 | 710 | 1720 |
| Tongue R nr Dayton (2) | Apr F-Jul L | 72 | 82 | 102 | 86 | 60 | 42 | 88 |
| | Apr F-Sep L | 82 | 80 | 114 | 96 | 70 | 51 | 102 |
| Tongue River Reservoir Inflow (2) | Apr F-Jul L | 145 | 66 | 250 | 187 | 107 | 46 | 220 |
| | Apr F-Sep L | 151 | 60 | 270 | 196 | 106 | 58 | 250 |
| NF Powder R nr Hazelton | Apr F-Jul L | 5.0 | 49 | 7.7 | 5.9 | 3.8 | 2.4 | 10.3 |
| | Apr F-Sep L | 6.2 | 56 | 9.6 | 7.3 | 4.5 | 3.2 | 11.1 |
| Powder R at Moorhead | Apr F-Jul L | 117 | 61 | 315 | 210 | 71 | 22 | 191 |
| | Apr F-Sep L | 136 | 66 | 330 | 220 | 77 | 22 | 205 |

PRELIMINARY RAPID VALLEY UNIT FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow (2) | Mar F-Jul L | 5.0 | 77 | 8.0 | 6.3 | 3.9 | 2.6 | 6.5 |
| | Apr F-Jul L | 3.9 | 74 | 6.7 | 5.1 | 2.8 | 1.77 | 5.3 |
| Pactola Reservoir Inflow (2) | Mar F-Jul L | 15.6 | 56 | 33 | 21 | 10.3 | 5.2 | 28 |
| | Apr F-Jul L | 14.6 | 58 | 31 | 21 | 10.1 | 5.6 | 25 |

PRELIMINARY PLATTE RIVER BASIN FORECASTS

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate (2) | Apr F-Jul L | 168 | 84 | 295 | 210 | 128 | 82 | 200 |
| | Apr F-Sep L | 177 | 80 | 310 | 225 | 137 | 93 | 220 |
| Encampment R nr Encampment (2) | Apr F-Jul L | 105 | 78 | 157 | 124 | 85 | 62 | 135 |
| | Apr F-Sep L | 111 | 79 | 167 | 133 | 93 | 69 | 141 |
| Rock Ck ab King Canyon Cnl nr Arlington | Apr F-Jul L | 36 | 73 | 52 | 43 | 30 | 16.8 | 49 |
| | Apr F-Sep L | 39 | 76 | 55 | 46 | 33 | 26 | 51 |
| Seminoe Reservoir Inflow (2) | Apr F-Jul L | 445 | 67 | 760 | 550 | 340 | 225 | 660 |
| | Apr F-Sep L | 480 | 67 | 820 | 610 | 365 | 240 | 715 |
| Sweetwater R nr Alcova | Apr F-Jul L | 41 | 91 | 82 | 54 | 29 | 16.9 | 45 |
| | Apr F-Sep L | 43 | 88 | 85 | 58 | 31 | 17.0 | 49 |
| La Prele Ck nr Douglas | Apr F-Jul L | 17.3 | 82 | 36 | 24 | 10.7 | 0.68 | 21 |
| | Apr F-Sep L | 18.3 | 94 | 43 | 27 | 12.0 | 6.6 | 19.5 |
| North Platte R bl Glendo Reservoir (2) | Apr F-Jul L | 465 | 62 | 1030 | 640 | 315 | 159 | 745 |
| | Apr F-Sep L | 480 | 63 | 1060 | 680 | 325 | 170 | 760 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| North Platte R bl Guernsey Reservoir (2) | Apr F-Jul | L | 505 | 68 | 1120 | 735 | 315 | 133 | 745 |
| | Apr F-Sep | L | 510 | 66 | 1350 | 790 | 305 | 87 | 775 |
| Laramie R and Pioneer Cnl nr Woods Lg (2) | Apr F-Jul | L | 92 | 79 | 151 | 115 | 74 | 52 | 117 |
| | Apr F-Sep | L | 103 | 82 | 166 | 127 | 84 | 60 | 126 |
| Little Laramie R nr Filmore | Apr F-Jul | L | 35 | 66 | 52 | 41 | 30 | 26 | 53 |
| | Apr F-Sep | L | 39 | 70 | 59 | 46 | 33 | 26 | 56 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# March 2024 Calendar Year Runoff Forecast
# March 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

January runoff was 1.8 MAF, 161% of average. Runoff was above average in every reach except Sioux City, which was near average. Warmer temperatures have melted most of the plains snowpack in the Basin, resulting in some of the normal March-April runoff occurring in February.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **17.0 MAF, 66% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **15.6 MAF, 67 of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 10 months, expected inflow could range from the 12.0 MAF lower basic forecast to the 22.7 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that 10 months are being forecast for this March 1 forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches for the next 10 months. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for January 30 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 65% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of May, indicates drought conditions are likely to persist or worsen in the upper Basin, but improve in the lower Basin.

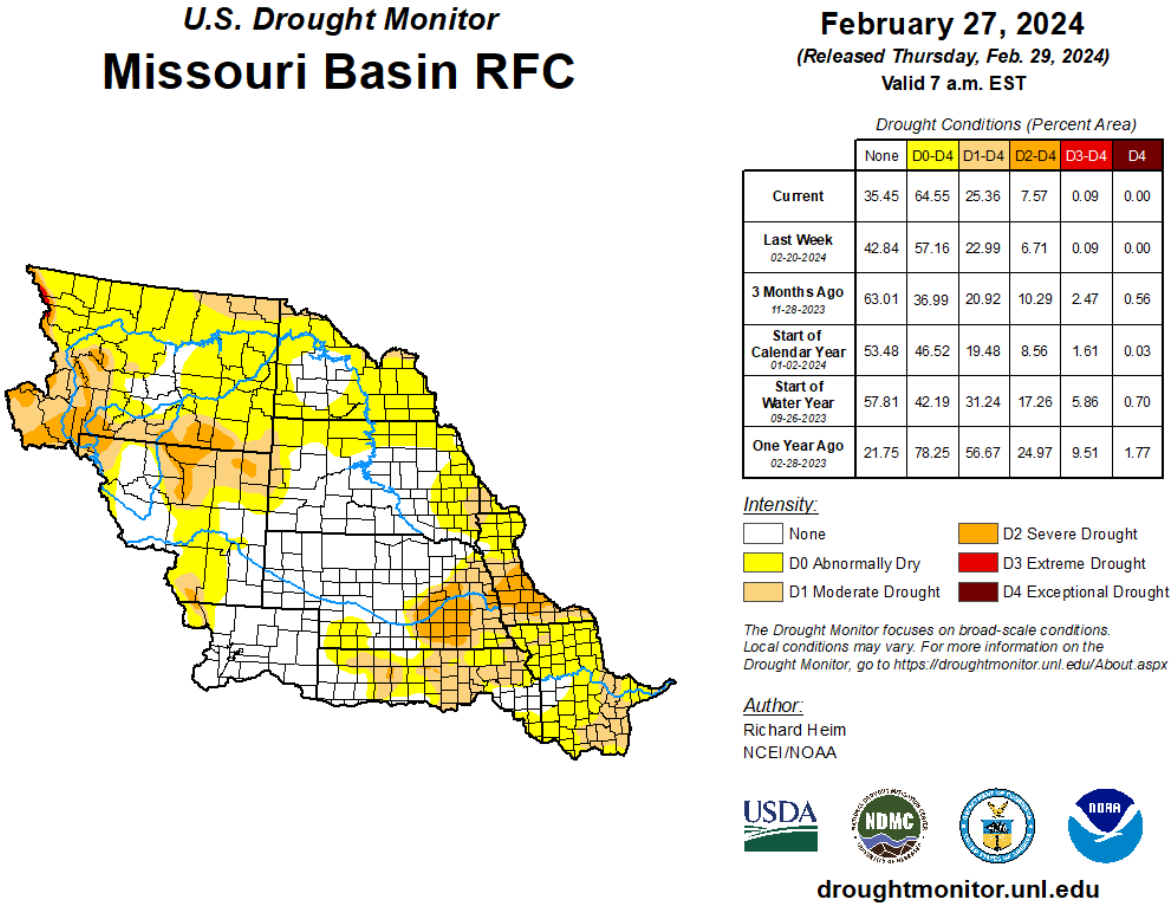


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

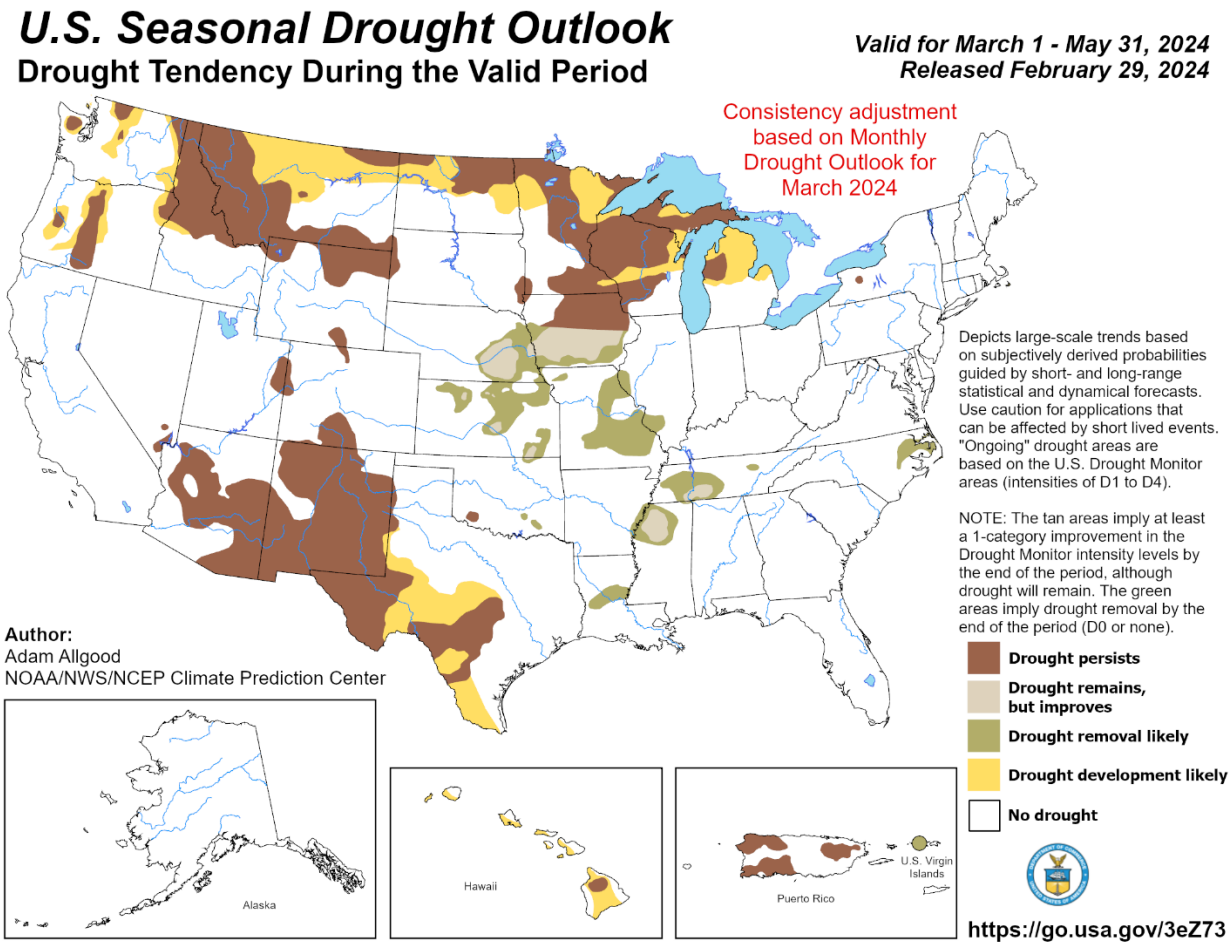


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

## Precipitation

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The February precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was above normal in much of Montana and into parts of Wyoming and western Nebraska. Precipitation was mostly below normal in the rest of the Basin.

Precipitation as a percent of normal for the December-January-February period (**Figure 4**) was mostly below normal in Montana, North Dakota, Wyoming and western South Dakota and mostly above normal for eastern South Dakota and into the lower Basin.

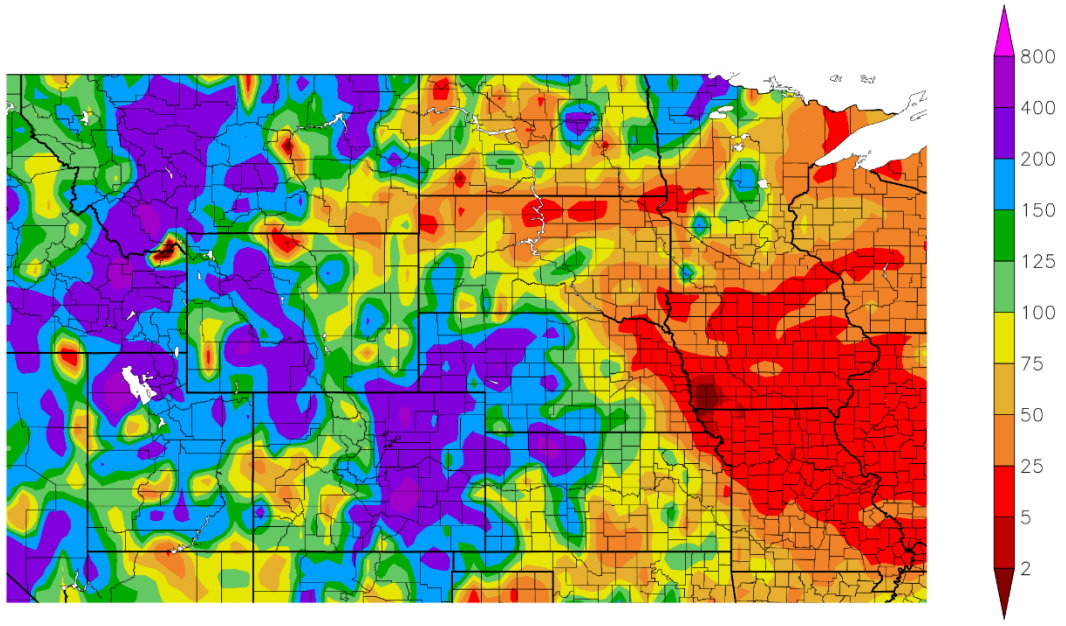


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

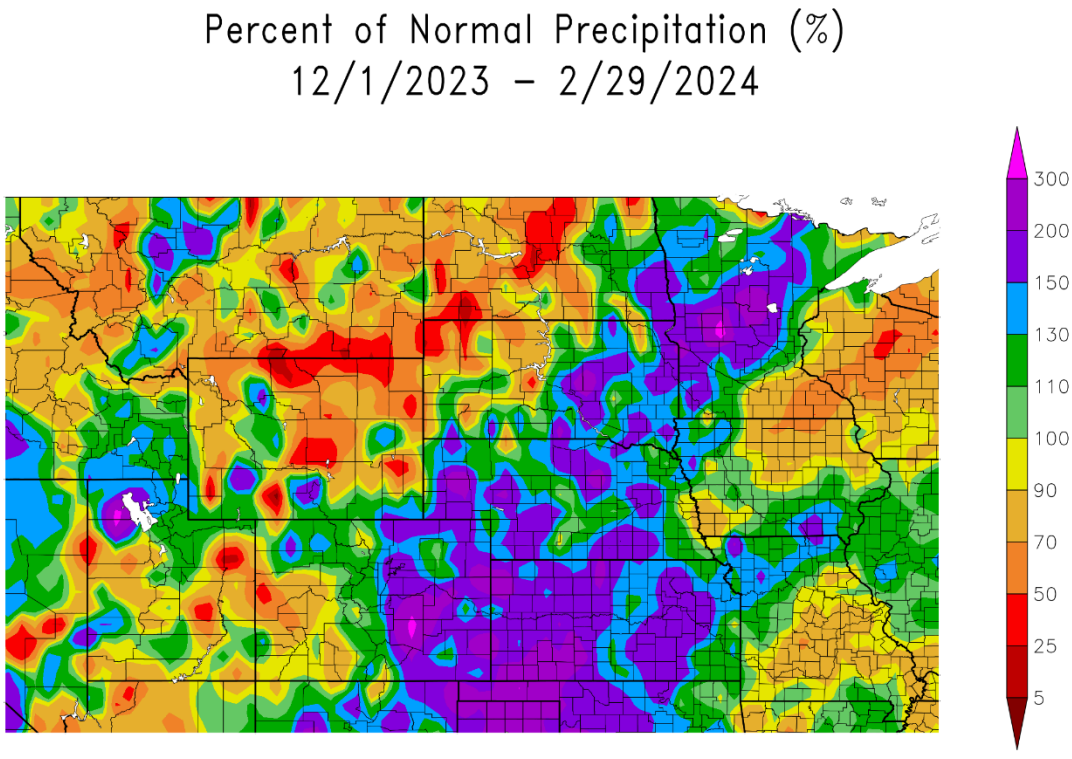


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

February temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures across the Basin. On the eastern side of the basin, temperature departures were as high as 9-15 degrees above normal. December-January-February temperature departures are shown in **Figure 6**. The three-month average temperature departures were above normal across the Basin.

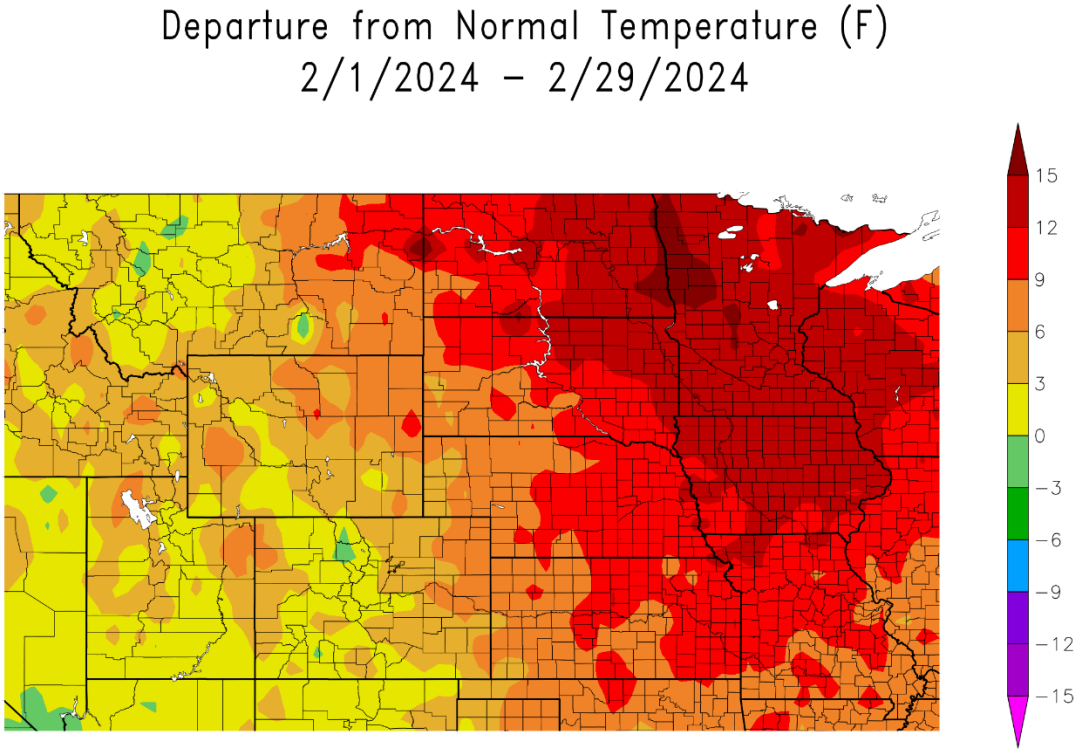


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

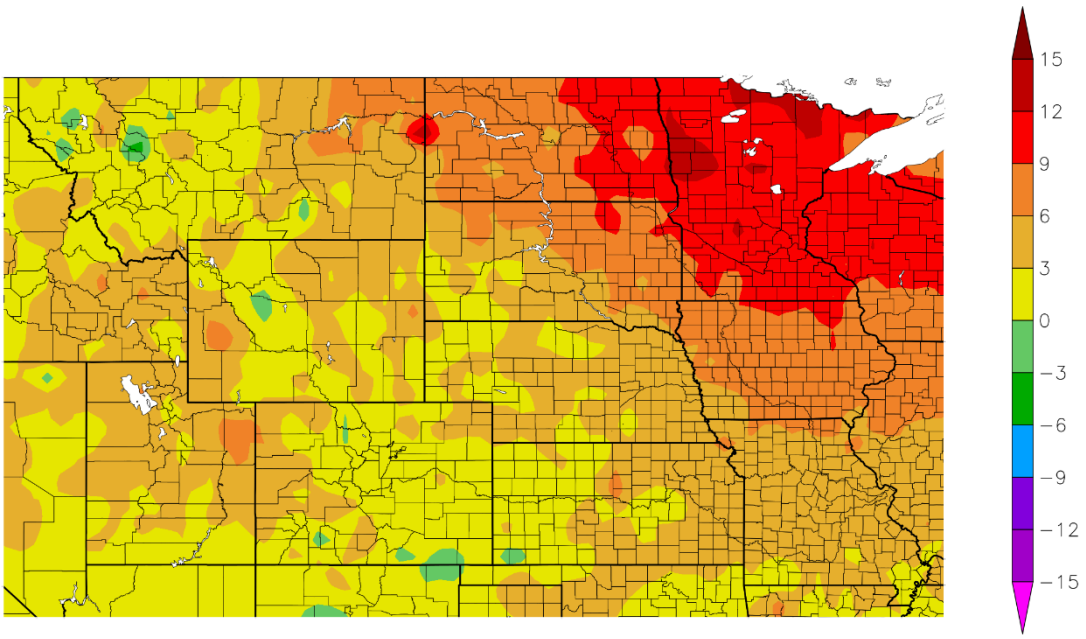


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

## Soil Moisture

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomaly and percentile at the end of February are shown in **Figure 7**. Soil moisture is drier than normal in parts of North Dakota, western Montana, eastern Nebraska, western Iowa, eastern Kansas, and most of Missouri. Soil conditions are wetter than normal in South Dakota and parts of Wyoming.

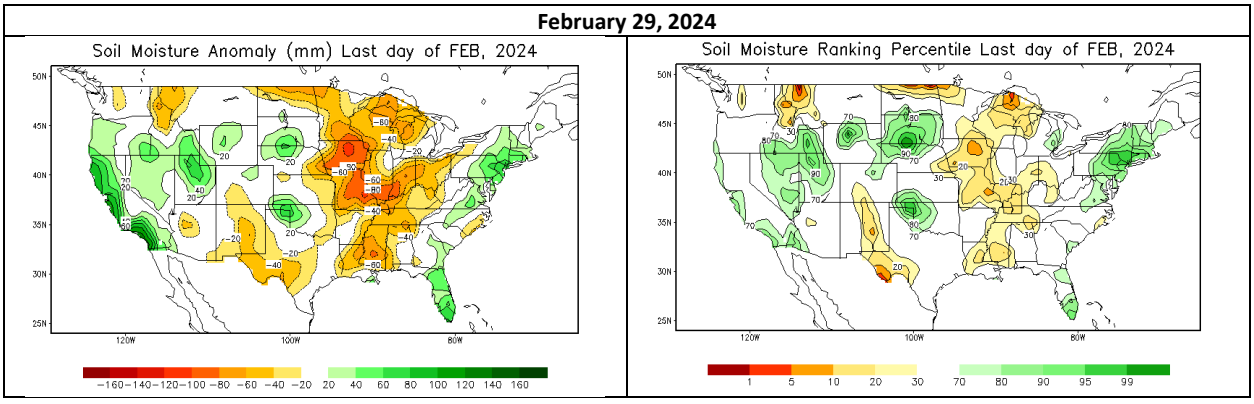


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

## Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

The National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) modeled snow assessment (available here) from March 1, 2024, shown in **Figure 8**, shows below-normal accumulated plains snowpack for this time of year. Trace to 1" of snow water equivalent is modeled in eastern North Dakota, but no other plains snowpack is present. Warmer-than-normal temperatures in February contributed to the melting of accumulated snow during that month. The amount of runoff received in March and April will depend on precipitation and temperatures over the next two months.

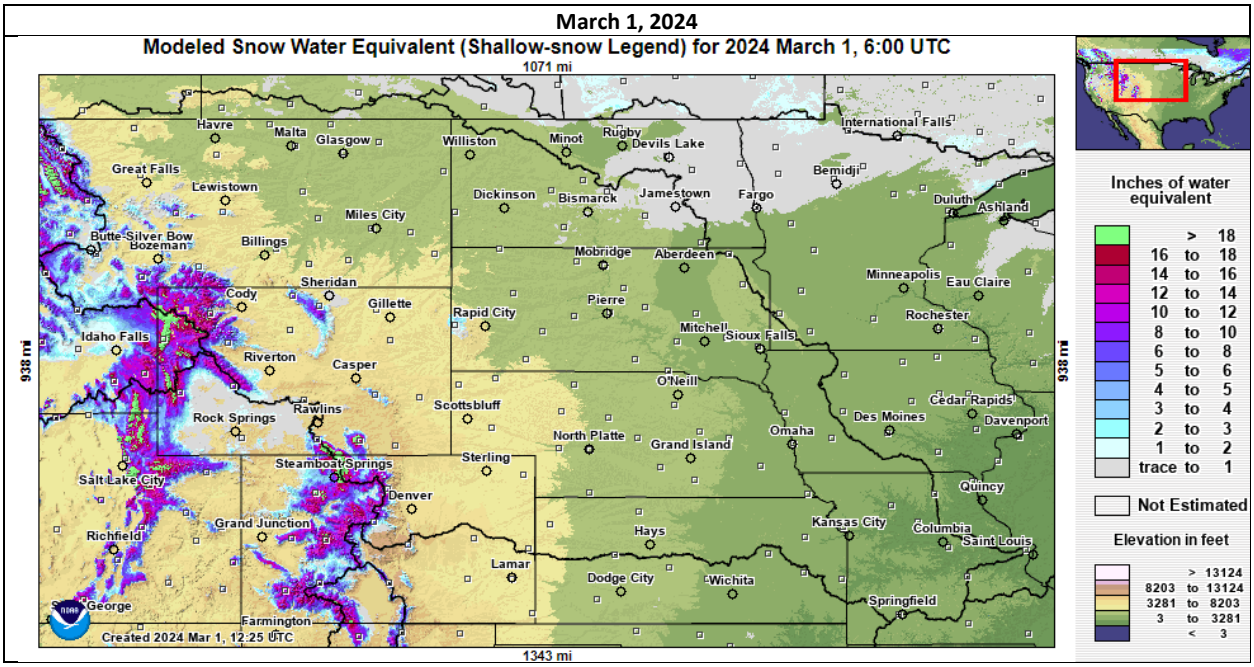


**Figure 8. NOHRSC Modeled Snow Water Equivalent**

## Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has little correlation to the March 1 snowpack, because around 80 percent of the mountain snowpack accumulation period has elapsed by March 1. Mountain snowpack typically peaks in mid-April; therefore, later measurements of mountain snowpack are better runoff indicators.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 9** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural

Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

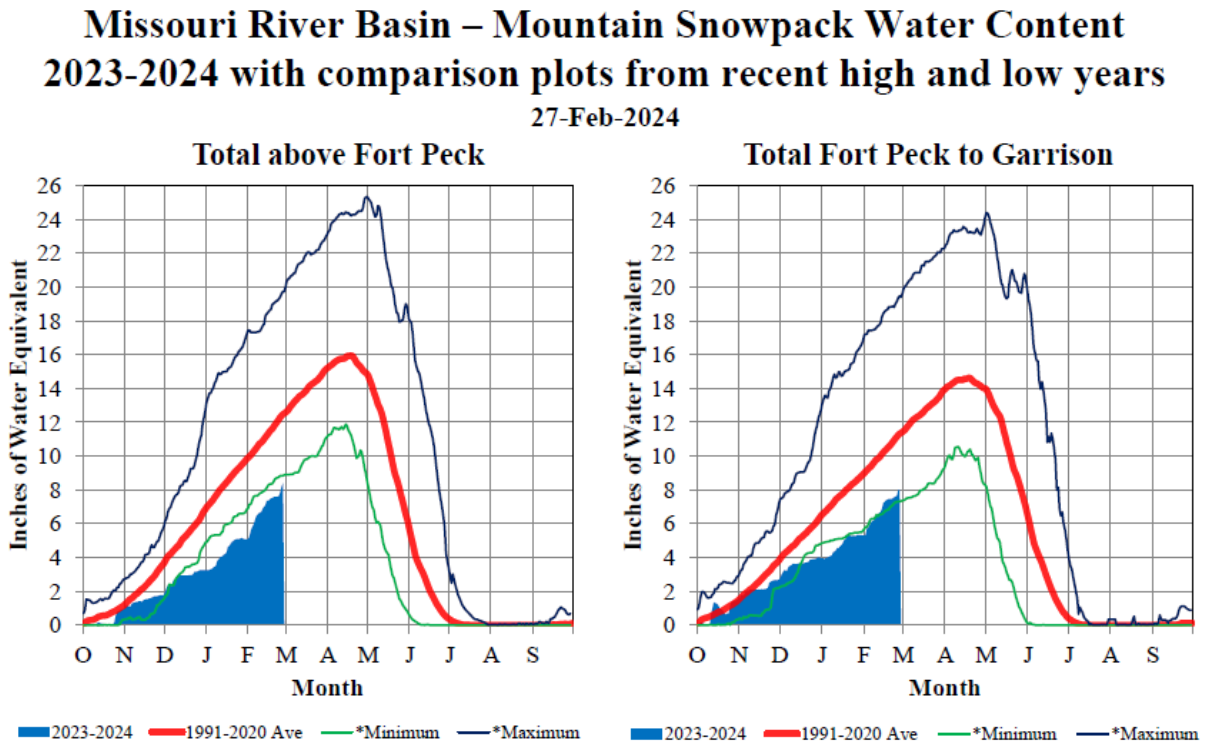


**Figure 9. Mountain Snowpack Water Content**

As of February 27, the average mountain SWE in the Fort Peck reservoir reach was 8.4”, 67% of average. In the reservoir reach between Fort Peck and Garrison dams, the average mountain SWE was 8.0”, 71% of average.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

**El Niño Southern Oscillation (ENSO)**

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

El Niño conditions are currently observed. A transition to ENSO-neutral is 79% likely by April-June, with a 55% chance of La Niña developing in June-August.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for March (**Figure 10**) indicates increased chances for above-normal temperatures across much of the Basin. The March precipitation outlook (**Figure 10**) shows increased chances for above-normal precipitation in most of the Basin except Montana and North Dakota, which have equal chances of below-normal, normal, or above-normal precipitation.

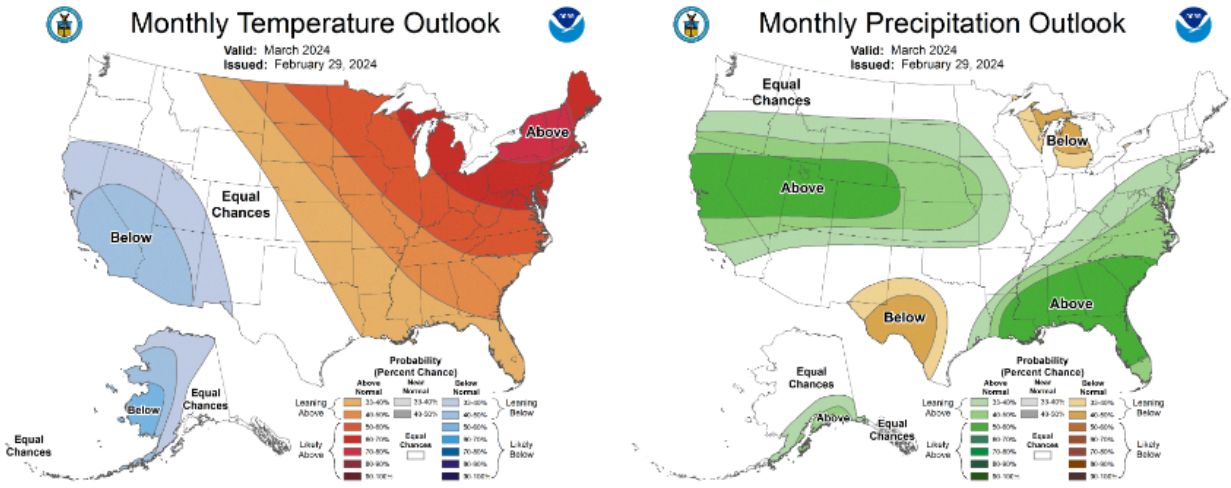


**Figure 10. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 11**. The April-May-June temperature outlook indicates equal chances for above-normal, normal, or below-normal temperatures for much of the Basin, with some areas seeing increased chances of above-normal temperatures. The precipitation outlook for the same period indicates equal chances across the Basin of above-normal, normal, or below-normal precipitation.

The July-August-September temperature outlook indicates increased chances for warmer-than-normal temperatures across the Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation across most of the Basin.

The October-November-December temperature outlook shows increased chances for warmer-than-normal temperatures in the lower Basin and equal chances in the upper Basin. The precipitation outlook shows equal chances for above-normal, normal, or below-normal precipitation across the Basin.

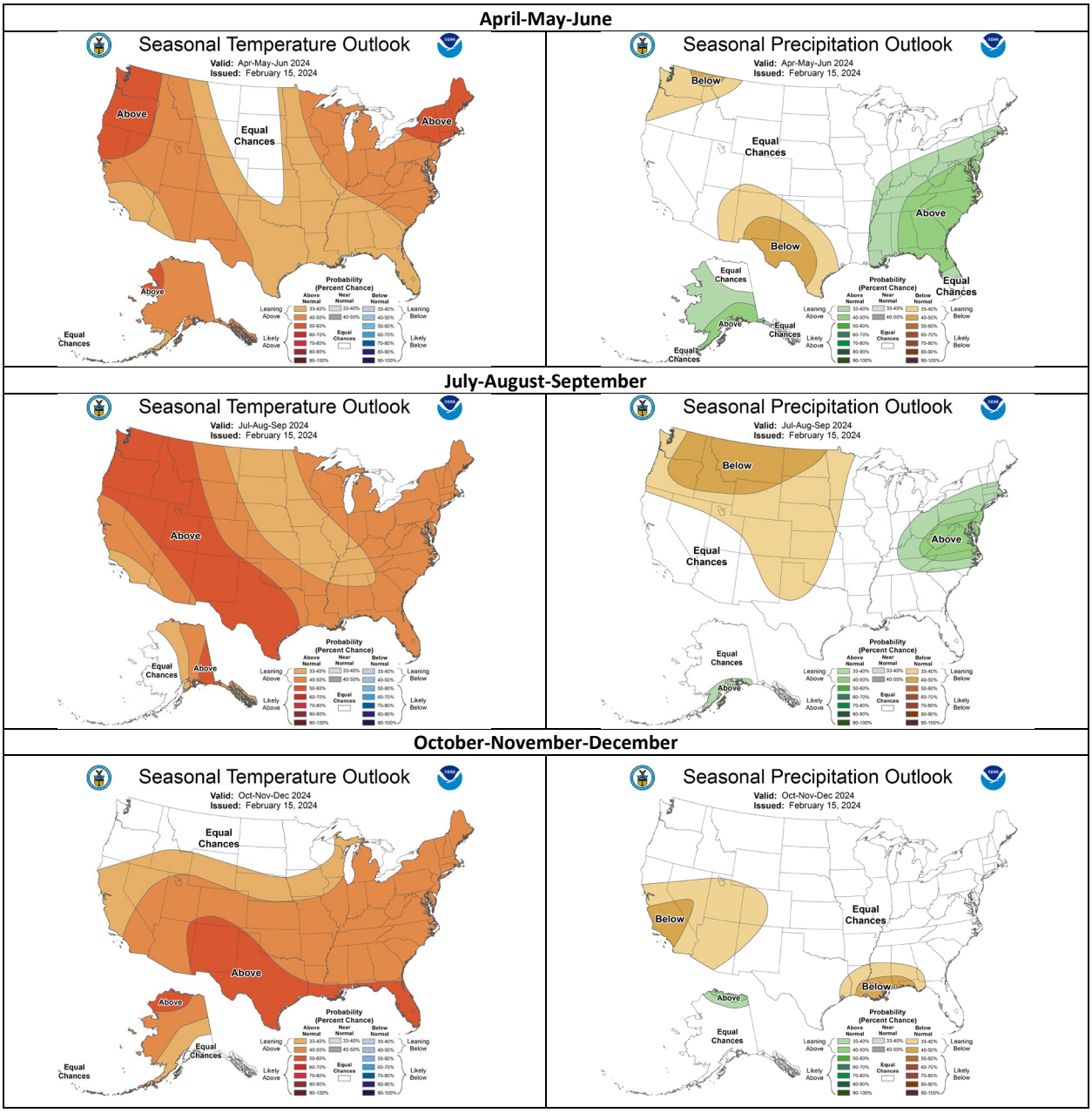


**Figure 11. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

Given current reach runoff and outlooks, we expect runoff in March and April to remain below normal for most reaches but will depend on the accumulation of additional plains snowpack and temperatures over the next couple months. During May, June, and July, Fort Peck and Garrison runoff is forecast to be below average due to the below-normal mountain snowpack. In summary, the 2024 calendar year runoff forecast is **17.0 MAF, 66% of average**.

# NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: March 06, 2024 01:11:11 PM
   - Based on March 01, 2024 forecast values

Upper South Saskatchewan River

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sherburne Inflow | APR-JUL | 78 | 78 | 100 | 87 | 69 | 56 | 99 |
| | APR-SEP | 96 | 82 | 120 | 106 | 86 | 72 | 116 |
| St. Mary R nr Babb | APR-JUL | 325 | 84 | 410 | 360 | 290 | 240 | 385 |
| | APR-SEP | 380 | 85 | 475 | 420 | 340 | 285 | 445 |
| St. Mary R at Intl Boundary | APR-JUL | 365 | 81 | 485 | 415 | 315 | 245 | 450 |
| | APR-SEP | 410 | 80 | 540 | 465 | 355 | 280 | 510 |

Missouri Headwaters

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lima Reservoir Inflow | APR-JUL | 56 | 88 | 92 | 70 | 42 | 20 | 63 |
| | APR-SEP | 63 | 86 | 102 | 79 | 47 | 24 | 73 |
| Clark Canyon Inflow | APR-JUL | 49 | 77 | 107 | 73 | 25 | 1 | 63 |
| | APR-SEP | 59 | 84 | 122 | 84 | 34 | 2 | 70 |
| Beaverhead R at Barretts | APR-JUL | 68 | 72 | 137 | 96 | 40 | 3 | 94 |
| | APR-SEP | 83 | 76 | 158 | 113 | 53 | 8 | 108 |
| Ruby R Reservoir Inflow | APR-JUL | 58 | 82 | 86 | 69 | 47 | 30 | 70 |
| | APR-SEP | 70 | 83 | 102 | 83 | 57 | 38 | 84 |
| Big Hole R at Wisdom | APR-JUL | 49 | 55 | 124 | 79 | 19 | 2 | 89 |
| | APR-SEP | 55 | 59 | 135 | 87 | 23 | 3 | 92 |
| Big Hole R nr Melrose | APR-JUL | 330 | 62 | 565 | 425 | 235 | 96 | 525 |
| | APR-SEP | 360 | 63 | 610 | 460 | 260 | 110 | 570 |
| Jefferson R nr Twin Bridges | APR-JUL | 400 | 60 | 790 | 560 | 240 | 9 | 665 |
| | APR-SEP | 425 | 62 | 835 | 590 | 260 | 16 | 675 |
| Willow Ck Reservoir Inflow | APR-JUL | 10.3 | 66 | 21 | 14.8 | 5.8 | 1.8 | 15.5 |
| Jefferson R nr Three Forks | APR-JUL | 435 | 60 | 860 | 605 | 265 | 10 | 720 |
| | APR-SEP | 445 | 63 | 875 | 620 | 270 | 17 | 705 |
| Boulder R nr Boulder | APR-JUL | 55 | 83 | 87 | 68 | 42 | 23 | 66 |
| | APR-SEP | 56 | 81 | 91 | 70 | 42 | 21 | 69 |
| Hebgen Lake Inflow | APR-JUL | 275 | 78 | 360 | 310 | 240 | 190 | 350 |
| | APR-SEP | 365 | 80 | 465 | 405 | 325 | 265 | 455 |
| Ennis Lake Inflow | APR-JUL | 455 | 73 | 605 | 515 | 395 | 305 | 615 |
| | APR-SEP | 575 | 76 | 750 | 645 | 505 | 400 | 750 |
| Gallatin R nr Gallatin Gateway | APR-JUL | 300 | 74 | 395 | 340 | 260 | 205 | 405 |
| | APR-SEP | 355 | 76 | 470 | 405 | 310 | 245 | 465 |
| Hyalite Reservoir Inflow | APR-JUL | 15.3 | 78 | 21 | 17.8 | 12.8 | 9.1 | 19.6 |
| | APR-SEP | 17.6 | 80 | 25 | 20 | 14.8 | 10.7 | 22 |
| Gallatin R at Logan | APR-JUL | 280 | 65 | 445 | 345 | 215 | 116 | 425 |
| | APR-SEP | 330 | 68 | 510 | 400 | 260 | 152 | 485 |

Upper Missouri

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R at Toston | APR-JUL | 1200 | 67 | 1870 | 1470 | 930 | 530 | 1780 |
| | APR-SEP | 1400 | 71 | 2140 | 1700 | 1100 | 660 | 1970 |
| Missouri R at Fort Benton | APR-JUL | 1880 | 71 | 2920 | 2300 | 1460 | 840 | 2620 |
| | APR-SEP | 2230 | 72 | 3450 | 2730 | 1730 | 1010 | 3060 |
| Smith R bl Eagle Ck | APR-JUL | 68 | 62 | 119 | 89 | 47 | 17 | 108 |
| | APR-SEP | 77 | 67 | 133 | 99 | 55 | 21 | 114 |
| Gibson Reservoir Inflow | APR-JUL | 265 | 70 | 375 | 310 | 220 | 153 | 375 |
| | APR-SEP | 295 | 71 | 415 | 345 | 245 | 173 | 415 |

Marias

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Two Medicine R bl SF nr Browning | APR-JUL | 126 | 65 | 192 | 153 | 99 | 60 | 191 |
| | APR-SEP | 135 | 69 | 205 | 162 | 108 | 67 | 195 |
| Badger Ck nr Browning | APR-JUL | 50 | 70 | 83 | 63 | 37 | 17 | 71 |
| | APR-SEP | 58 | 71 | 94 | 72 | 43 | 21 | 81 |
| Dupuyer Ck nr Valier | APR-JUL | 7.7 | 77 | 16 | 11 | 4.4 | 0.1 | 9.9 |
| | APR-SEP | 8.8 | 75 | 17.5 | 12.3 | 5.3 | 0.1 | 11.7 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Swift Reservoir Inflow | APR-JUL | 38 | 76 | 59 | 46 | 30 | 17.2 | 50 |
| | APR-SEP | 45 | 77 | 69 | 55 | 35 | 21 | 58 |
| Marias R nr Shelby | APR-JUL | 225 | 68 | 395 | 295 | 157 | 56 | 330 |
| | APR-SEP | 230 | 67 | 410 | 300 | 158 | 51 | 340 |
| Teton R nr Dutton | APR-JUL | 18.2 | 65 | 50 | 29 | 9.8 | 2.2 | 28 |
| | APR-SEP | 19.8 | 68 | 54 | 32 | 10.7 | 2.3 | 29 |

Fort Peck Lake

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R nr Virgelle | APR-JUL | 2150 | 70 | 3340 | 2630 | 1670 | 960 | 3060 |
| | APR-SEP | 2520 | 72 | 3900 | 3080 | 1960 | 1140 | 3500 |
| Missouri R nr Landusky | APR-JUL | 2210 | 70 | 3510 | 2730 | 1690 | 915 | 3150 |
| | APR-SEP | 2560 | 70 | 4080 | 3180 | 1940 | 1040 | 3630 |

Musselshell

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Musselshell R at Harlowton | APR-JUL | 39 | 69 | 93 | 61 | 17.2 | 2.1 | 56 |
| | APR-SEP | 40 | 71 | 96 | 63 | 17.3 | 1.1 | 56 |
| Musselshell R nr Roundup | APR-JUL | 31 | 50 | 135 | 73 | 10 | 2 | 61 |
| | APR-SEP | 29 | 52 | 136 | 72 | 12 | 2 | 55 |

Missouri-Poplar

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R bl Fort Peck Dam | APR-JUL | 2110 | 68 | 3470 | 2660 | 1560 | 750 | 3060 |
| | APR-SEP | 2380 | 71 | 4080 | 3070 | 1690 | 680 | 3320 |

Upper Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Yellowstone Lake Outlet | APR-JUL | 515 | 87 | 635 | 560 | 470 | 415 | 590 |
| | APR-SEP | 630 | 81 | 800 | 700 | 580 | 500 | 775 |
| Yellowstone R at Corwin Springs | APR-JUL | 1280 | 77 | 1620 | 1420 | 1170 | 1030 | 1650 |
| | APR-SEP | 1520 | 80 | 1930 | 1690 | 1370 | 1210 | 1900 |
| Yellowstone R at Livingston | APR-JUL | 1500 | 78 | 1860 | 1640 | 1340 | 1180 | 1900 |
| | APR-SEP | 1650 | 75 | 2110 | 1840 | 1450 | 1230 | 2200 |
| Boulder R at Big Timber | APR-JUL | 230 | 79 | 290 | 255 | 205 | 175 | 290 |
| | APR-SEP | 245 | 79 | 315 | 275 | 220 | 185 | 310 |
| Shields R nr Livingston | APR-JUL | 46 | 36 | 103 | 70 | 24 | 8 | 127 |
| | APR-SEP | 57 | 41 | 118 | 81 | 37 | 8 | 138 |
| Yellowstone R at Billings | APR-JUL | 2450 | 77 | 3360 | 2810 | 2140 | 1760 | 3180 |
| | APR-SEP | 2630 | 69 | 3630 | 3100 | 2320 | 1950 | 3760 |
| Mystic Lake Inflow | APR-JUL | 51 | 87 | 60 | 55 | 48 | 43 | 58 |
| | APR-SEP | 65 | 86 | 76 | 69 | 59 | 53 | 75 |
| Stillwater R nr Absarokee | APR-JUL | 370 | 85 | 490 | 420 | 330 | 270 | 435 |
| | APR-SEP | 415 | 78 | 555 | 470 | 360 | 300 | 530 |
| Clarks Fk Yellowstone R nr Belfry | APR-JUL | 445 | 83 | 560 | 495 | 400 | 340 | 535 |
| | APR-SEP | 485 | 85 | 605 | 540 | 435 | 380 | 565 |
| Cooney Reservoir Inflow | APR-JUL | 27 | 75 | 55 | 37 | 18.7 | 8.6 | 36 |
| | APR-SEP | 34 | 72 | 62 | 44 | 23 | 7.5 | 47 |

Big Horn

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Dinwoody Ck nr Burris | APR-JUL | 63 | 87 | 77 | 69 | 58 | 48 | 72 |
| | APR-SEP | 96 | 98 | 110 | 102 | 90 | 80 | 97 |
| Bull Lake Ck nr Lenore | APR-JUL | 161 | 114 | 199 | 175 | 147 | 130 | 141 |
| | APR-SEP | 189 | 112 | 235 | 205 | 172 | 152 | 168 |
| Wind R Ab Bull Lake Ck | APR-JUL | 450 | 93 | 625 | 520 | 385 | 310 | 480 |
| | APR-SEP | 475 | 101 | 655 | 545 | 410 | 335 | 470 |
| Wind R at Riverton | APR-JUL | 460 | 92 | 640 | 530 | 390 | 320 | 495 |
| | APR-SEP | 550 | 98 | 755 | 635 | 475 | 390 | 560 |
| Little Wind R nr Riverton | APR-JUL | 325 | 116 | 635 | 430 | 245 | 165 | 280 |
| | APR-SEP | 355 | 118 | 695 | 470 | 265 | 179 | 300 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Little Popo Agie R nr Lander | APR-JUL | 44 | 104 | 71 | 54 | 35 | 26 | 42 |
| | APR-SEP | 55 | 114 | 84 | 66 | 45 | 35 | 48 |
| Boysen Reservoir Inflow | APR-JUL | 705 | 96 | 1260 | 900 | 530 | 355 | 730 |
| | APR-SEP | 790 | 100 | 1430 | 1020 | 595 | 390 | 785 |
| Greybull R at Meeteetse | APR-JUL | 162 | 114 | 240 | 194 | 136 | 105 | 141 |
| | APR-SEP | 220 | 110 | 320 | 260 | 190 | 149 | 199 |
| Shell Ck nr Shell | APR-JUL | 46 | 77 | 65 | 55 | 39 | 29 | 59 |
| | APR-SEP | 59 | 83 | 80 | 68 | 52 | 40 | 71 |
| Bighorn R at Kane | APR-JUL | 1130 | 113 | 1790 | 1410 | 825 | 485 | 1000 |
| | APR-SEP | 1340 | 128 | 2030 | 1640 | 1020 | 635 | 1040 |
| NF Shoshone R at Wapiti | APR-JUL | 405 | 90 | 505 | 445 | 370 | 315 | 450 |
| | APR-SEP | 490 | 95 | 610 | 540 | 445 | 385 | 515 |
| SF Shoshone R nr Valley | APR-JUL | 188 | 83 | 240 | 210 | 170 | 145 | 225 |
| | APR-SEP | 225 | 86 | 285 | 250 | 200 | 173 | 260 |
| SF Shoshone R ab Buffalo Bill Reservoir | APR-JUL | 210 | 93 | 305 | 250 | 176 | 132 | 225 |
| | APR-SEP | 220 | 97 | 320 | 260 | 181 | 134 | 225 |
| Buffalo Bill Reservoir Inflow | APR-JUL | 605 | 90 | 795 | 680 | 535 | 455 | 670 |
| | APR-SEP | 685 | 93 | 925 | 785 | 610 | 505 | 730 |
| Bighorn R nr St. Xavier | APR-JUL | 1330 | 82 | 2370 | 1710 | 1000 | 635 | 1610 |
| | APR-SEP | 1450 | 84 | 2790 | 1930 | 1050 | 610 | 1720 |
| Little Bighorn R nr Hardin | APR-JUL | 76 | 74 | 155 | 108 | 46 | 6 | 102 |
| | APR-SEP | 74 | 61 | 157 | 105 | 47 | 16 | 121 |

Tongue

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Big Goose Ck nr Sheridan | APR-JUL | 39 | 75 | 61 | 48 | 30 | 14.9 | 52 |
| | APR-SEP | 48 | 78 | 70 | 58 | 40 | 29 | 61 |
| Little Goose Ck nr Big Horn | APR-JUL | 24 | 75 | 37 | 29 | 18.9 | 9.3 | 32 |
| | APR-SEP | 30 | 71 | 43 | 36 | 23 | 10.6 | 42 |
| Tongue R nr Dayton | APR-JUL | 77 | 87 | 106 | 88 | 66 | 49 | 88 |
| | APR-SEP | 87 | 85 | 119 | 100 | 75 | 56 | 102 |
| Tongue River Reservoir Inflow | APR-JUL | 161 | 73 | 275 | 210 | 118 | 60 | 220 |
| | APR-SEP | 173 | 69 | 280 | 215 | 118 | 61 | 250 |

Powder

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| MF Powder R nr Barnum | APR-JUL | 13.6 | 86 | 23 | 17 | 9.7 | 6.8 | 15.7 |
| | APR-SEP | 14.7 | 88 | 24 | 18.9 | 10.9 | 7.6 | 16.6 |
| NF Powder R nr Hazelton | APR-JUL | 8 | 77 | 11.4 | 9.3 | 6.5 | 4.4 | 10.3 |
| | APR-SEP | 8.9 | 80 | 12.3 | 10.2 | 7.4 | 4.4 | 11.1 |
| Rock Ck nr Buffalo | APR-JUL | 15.7 | 74 | 27 | 22 | 11.4 | 6.3 | 21 |
| | APR-SEP | 17.8 | 71 | 29 | 24 | 13.6 | 7.9 | 25 |
| Piney Ck at Kearny | APR-JUL | 38 | 76 | 66 | 49 | 27 | 12.5 | 50 |
| | APR-SEP | 41 | 78 | 70 | 54 | 30 | 15.3 | 52 |
| Powder R at Moorhead | APR-JUL | 174 | 91 | 340 | 245 | 110 | 26 | 191 |
| | APR-SEP | 185 | 90 | 370 | 270 | 116 | 40 | 205 |
| Powder R nr Locate | APR-JUL | 196 | 87 | 440 | 285 | 117 | 22 | 225 |
| | APR-SEP | 200 | 83 | 490 | 290 | 129 | 59 | 240 |

Lower Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Miles City | APR-JUL | 3400 | 67 | 4900 | 4040 | 2910 | 2280 | 5040 |
| | APR-SEP | 3720 | 65 | 5480 | 4410 | 3170 | 2340 | 5670 |
| Yellowstone R nr Sidney | APR-JUL | 3570 | 71 | 5130 | 4190 | 2980 | 2240 | 5000 |
| | APR-SEP | 3680 | 65 | 5350 | 4310 | 3130 | 2480 | 5580 |

Lake Sakakawea

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sakakawea Inflow | APR-JUL | 5690 | 62 | 8640 | 6880 | 4500 | 2740 | 9080 |
| | APR-SEP | 6170 | 61 | 9630 | 7570 | 4770 | 2710 | 10100 |

Cheyenne

| | | 50% | % of | 10% | 30% | 70% | 90% | 30-yr |
|---|---|---|---|---|---|---|---|---|

| Forecast Point | period | (KAF) | med | (KAF) | (KAF) | (KAF) | (KAF) | med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow | MAR-JUL | 3.9 | 60 | 6.6 | 5.2 | 2.8 | 1.5 | 6.5 |
| | APR-JUL | 3.1 | 58 | 5.5 | 4 | 2.3 | 1.2 | 5.3 |
| Pactola Reservoir Inflow | MAR-JUL | 16.8 | 60 | 35 | 23 | 11.5 | 5.1 | 28 |
| | APR-JUL | 11.1 | 44 | 25 | 15.9 | 6.4 | 3.1 | 25 |

North Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate | APR-JUL | 170 | 85 | 300 | 215 | 131 | 87 | 200 |
| | APR-SEP | 179 | 81 | 310 | 225 | 140 | 96 | 220 |
| Encampment R nr Encampment | APR-JUL | 140 | 103 | 215 | 165 | 116 | 90 | 135 |
| | APR-SEP | 144 | 102 | 220 | 170 | 121 | 95 | 141 |
| Seminoe Reservoir Inflow | APR-JUL | 600 | 90 | 1030 | 755 | 460 | 325 | 660 |
| | APR-SEP | 670 | 93 | 1120 | 820 | 545 | 375 | 715 |
| Rock Ck ab King Canyon Cnl nr Arlington | APR-JUL | 46 | 93 | 63 | 52 | 40 | 33 | 49 |
| | APR-SEP | 50 | 98 | 70 | 58 | 44 | 37 | 51 |
| Sweetwater R nr Alcova | APR-JUL | 56 | 124 | 102 | 71 | 41 | 27 | 45 |
| | APR-SEP | 61 | 124 | 112 | 77 | 46 | 31 | 49 |
| La Prele Ck nr Douglas | APR-JUL | 21 | 100 | 33 | 26 | 15.5 | 8.7 | 21 |
| | APR-SEP | 22 | 112 | 38 | 27 | 17 | 9.4 | 19.5 |
| North Platte R bl Glendo Reservoir | APR-JUL | 635 | 85 | 1410 | 890 | 440 | 255 | 745 |
| | APR-SEP | 675 | 88 | 1410 | 920 | 490 | 235 | 760 |
| North Platte R bl Guernsey Reservoir | APR-JUL | 635 | 85 | 1470 | 930 | 405 | 185 | 745 |
| | APR-SEP | 675 | 87 | 1540 | 985 | 435 | 205 | 775 |
| Laramie R and Pioneer Cnl nr Woods Lg | APR-JUL | 96 | 82 | 160 | 119 | 77 | 57 | 117 |
| | APR-SEP | 110 | 87 | 177 | 134 | 90 | 66 | 126 |
| Little Laramie R nr Filmore | APR-JUL | 49 | 92 | 75 | 58 | 41 | 32 | 53 |
| | APR-SEP | 55 | 98 | 83 | 65 | 47 | 37 | 56 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# April 2024 Calendar Year Runoff Forecast
# April 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

March runoff was 1.8 MAF, 59% of average. Runoff was below average in every reach, and well below average in the Oahe, Fort Randall, and Sioux City reaches.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **17.5 MAF, 68% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **16.2 MAF, 70% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 9 months, expected inflow could range from the 13.1 MAF lower basic forecast to the 22.4 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that 9 months are being forecast for this April 1 forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches for the next 9 months. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for March 26 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 62% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of June, indicates drought conditions are likely to persist or worsen in northern and western Montana and North Dakota, but improve in the lower Basin and along the Montana-Wyoming border.

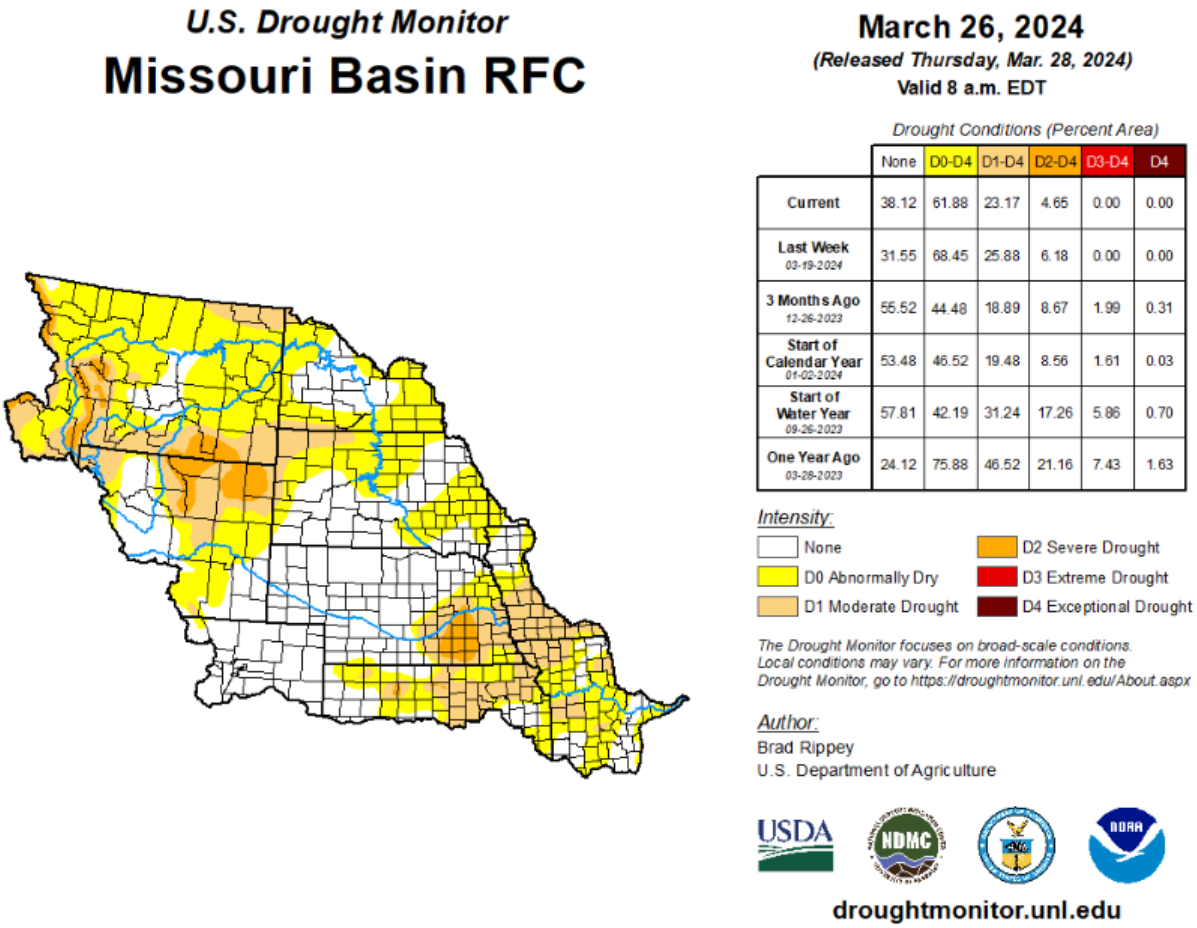


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

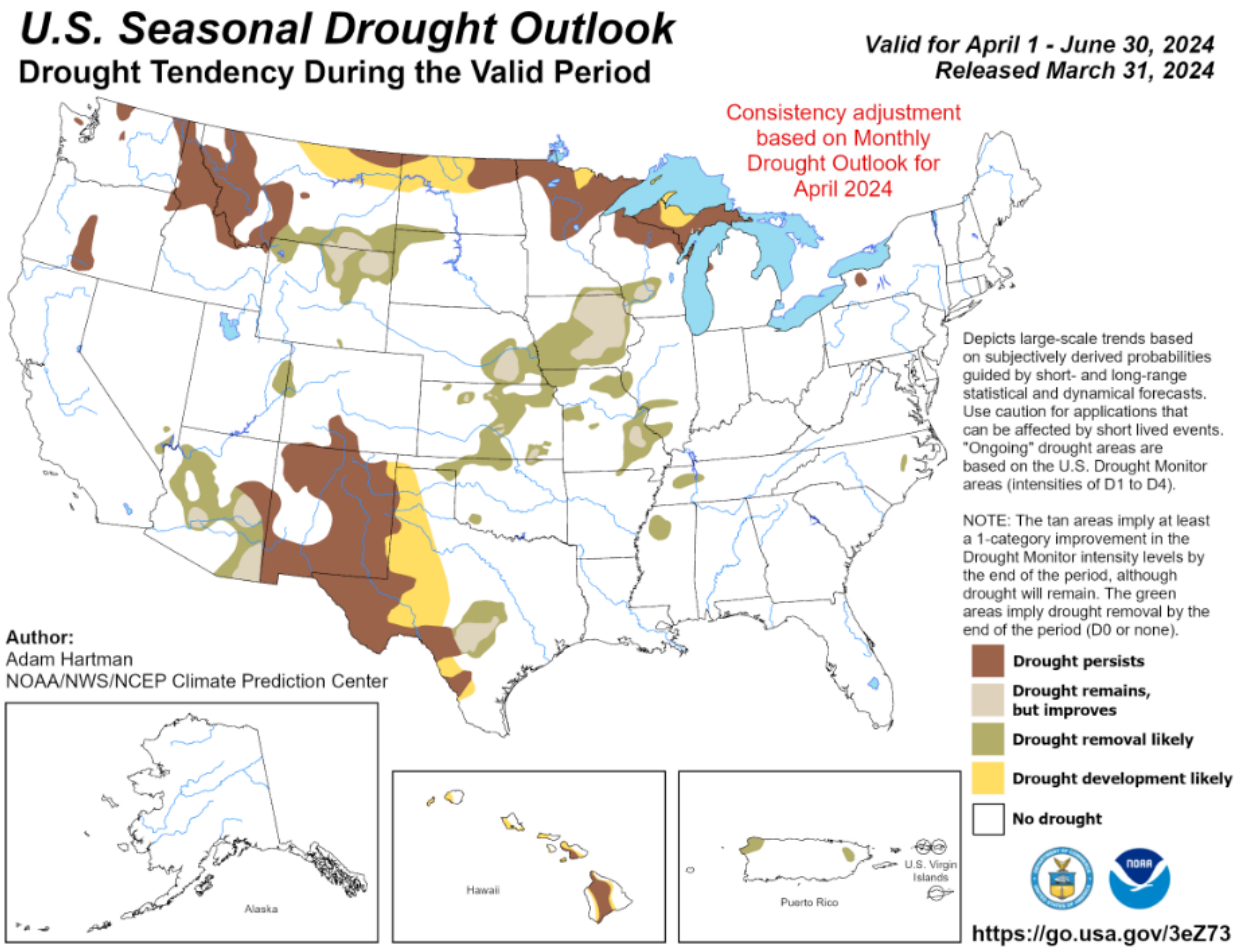


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The March precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was above normal in parts of Montana and into eastern North Dakota, and also in Colorado. Precipitation was below normal in the rest of the upper Basin.

Precipitation as a percent of normal for the January-February-March period (**Figure 4**) was mostly below normal in the upper Basin. Areas of Montana, western Wyoming, and Colorado saw above-normal precipitation over the past three months.

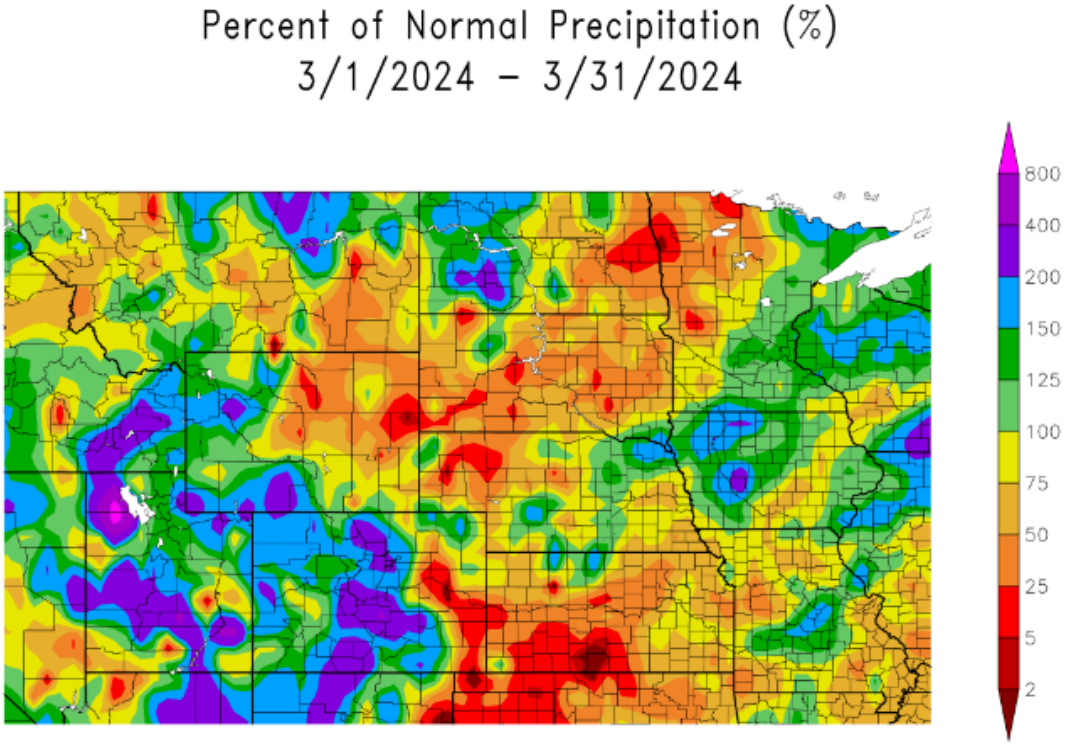


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

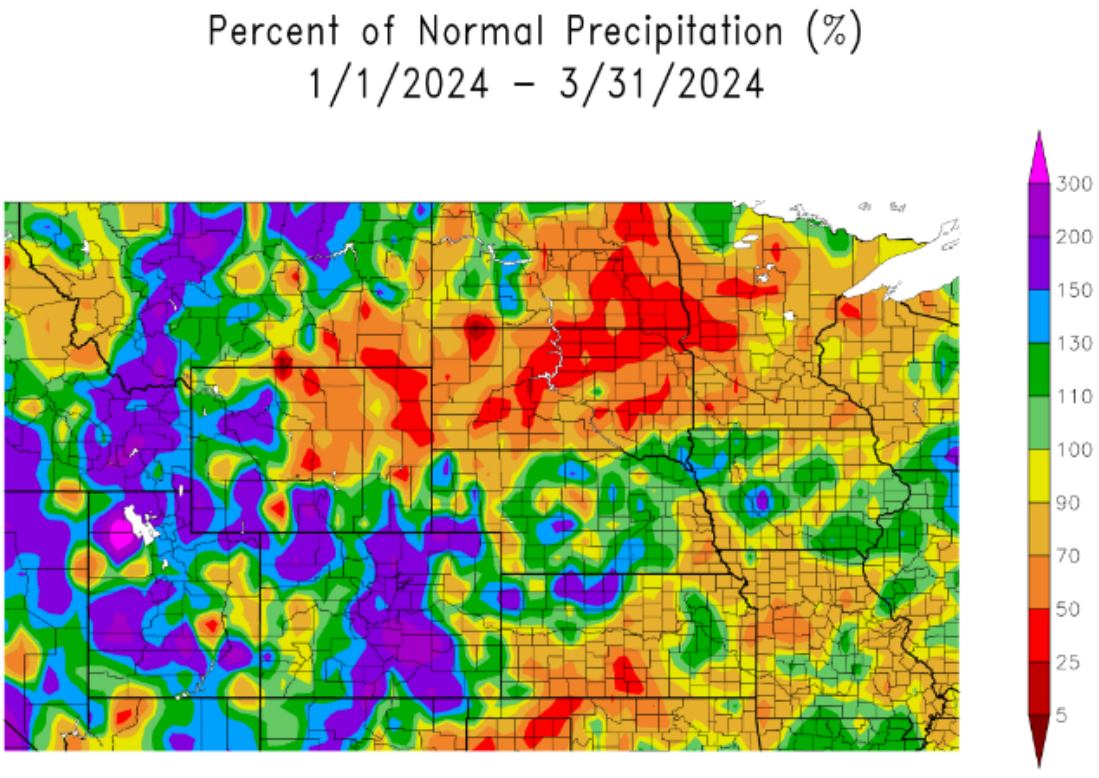


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

March temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures in the eastern portion of the Basin. In Montana and North Dakota, temperatures were more than five degrees below normal in some areas. January-February-March temperature departures are shown in **Figure 6**. The three-month average temperature departures were above normal across most of the Basin, except for western Montana and small areas of other states.

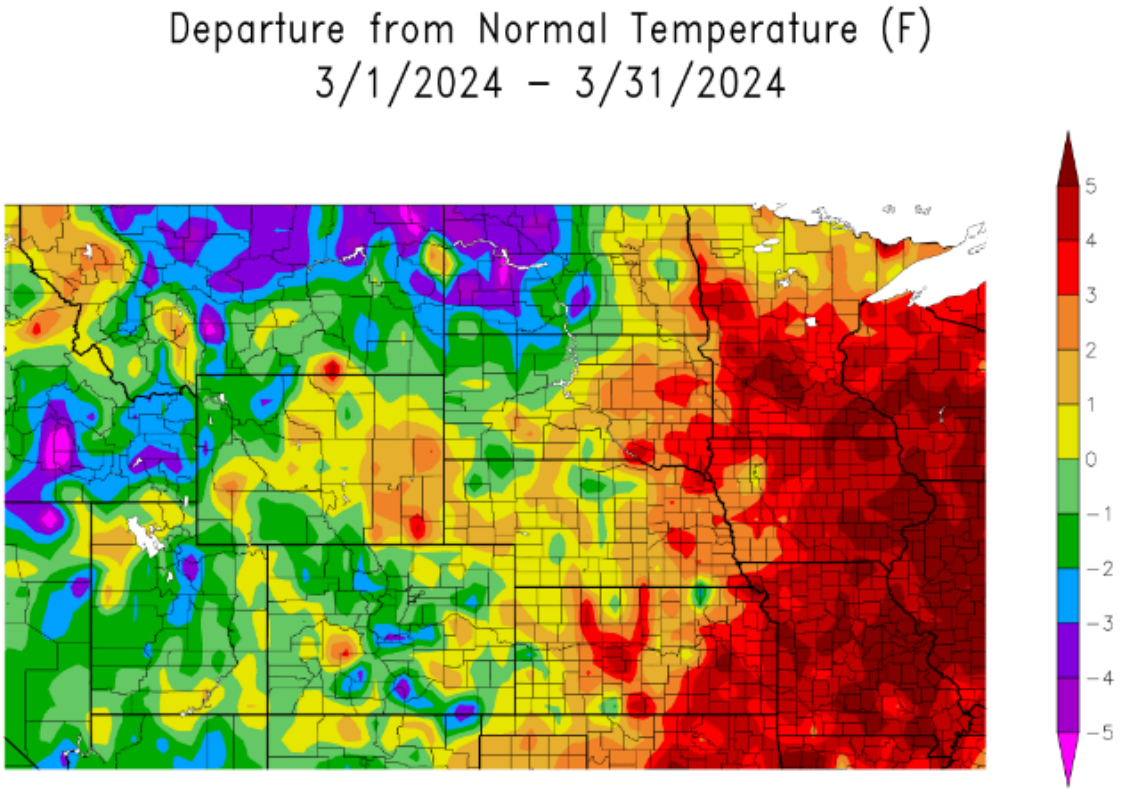


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

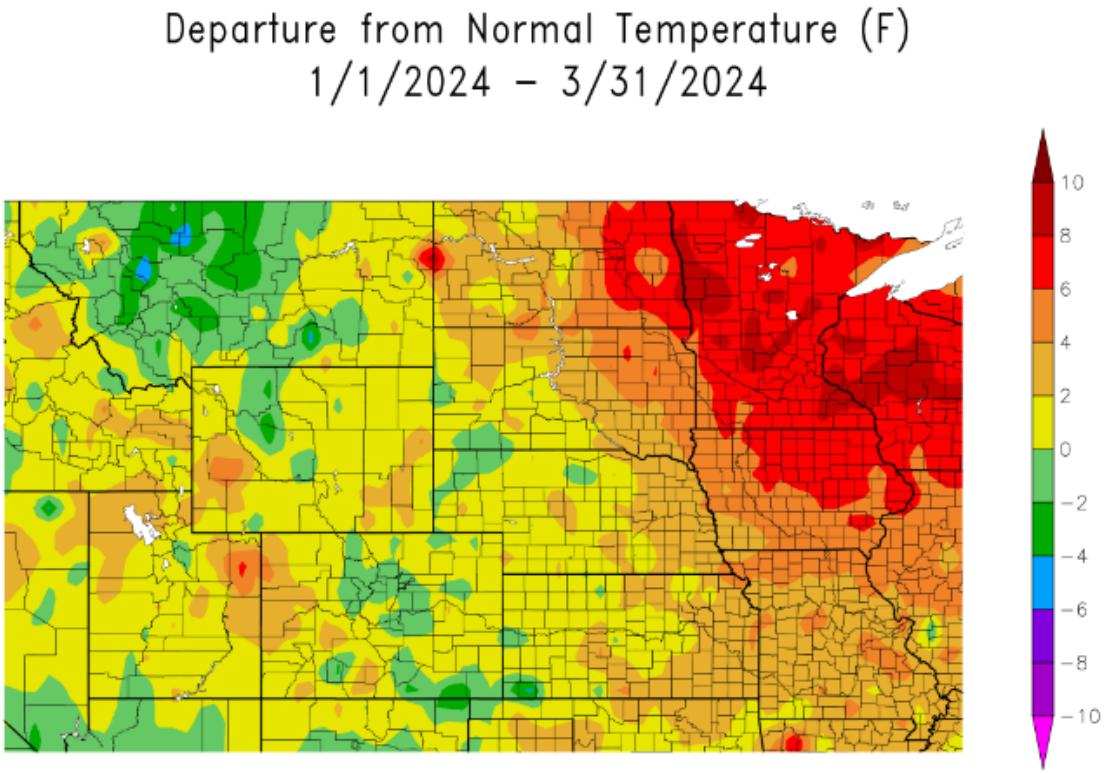


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

### Soil Moisture

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomaly and percentile at the end of March are shown in **Figure 7**. Soil moisture is drier than normal in parts of North Dakota, western Montana, eastern Nebraska, Iowa, eastern Kansas, and most of Missouri. Soil conditions are wetter than normal in South Dakota, northern Nebraska, central Colorado, and parts of Wyoming.

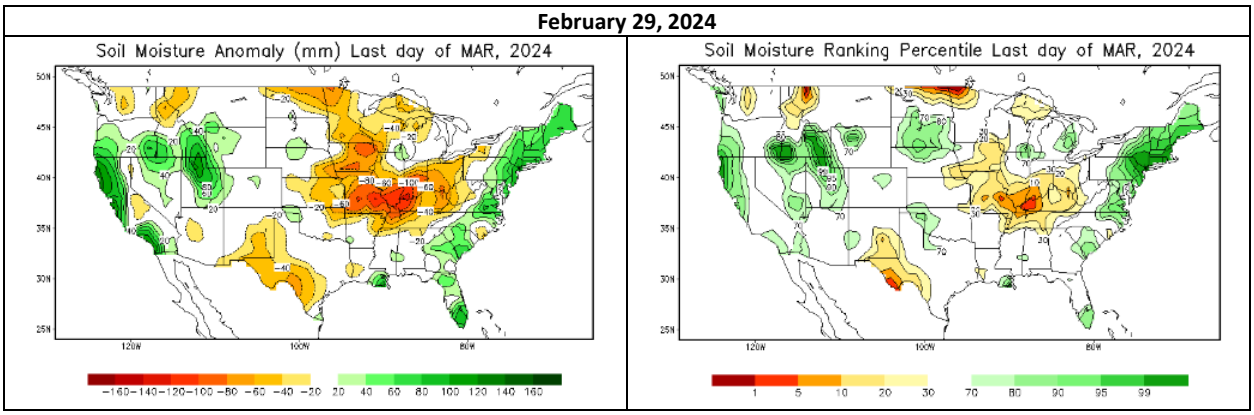


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

### Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

The National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) modeled snow assessment (available here) from March 31, 2024, shown in **Figure 8**, shows below-normal accumulated plains snowpack for this time of year. Trace to 1" of snow water equivalent is modeled in scattered areas of Montana, North Dakota, and South Dakota. Warmer-than-normal temperatures in February contributed to the melting of accumulated snow during that month. The amount of runoff received in April will depend on precipitation and temperatures over the next month.

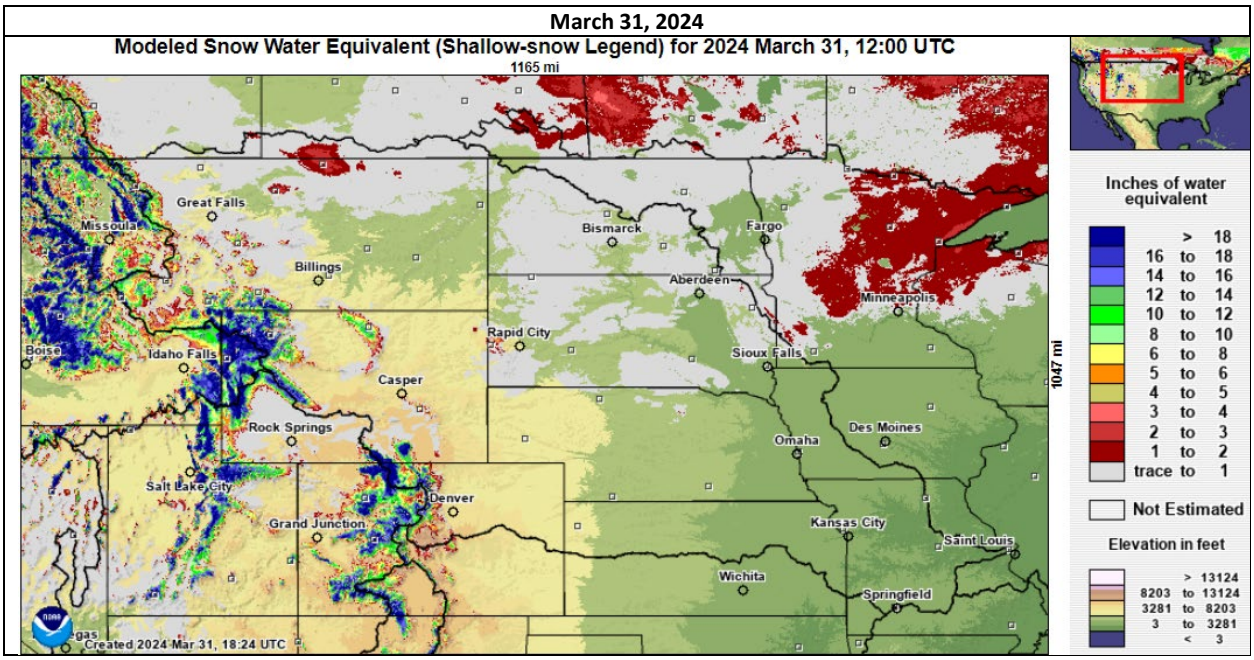


**Figure 8. NOHRSC Modeled Snow Water Equivalent**

### Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has little correlation to the March 1 snowpack, because around 80 percent of the mountain snowpack accumulation period has elapsed by March 1. Mountain snowpack typically peaks in mid-April; therefore, later measurements of mountain snowpack are better runoff indicators.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 9** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

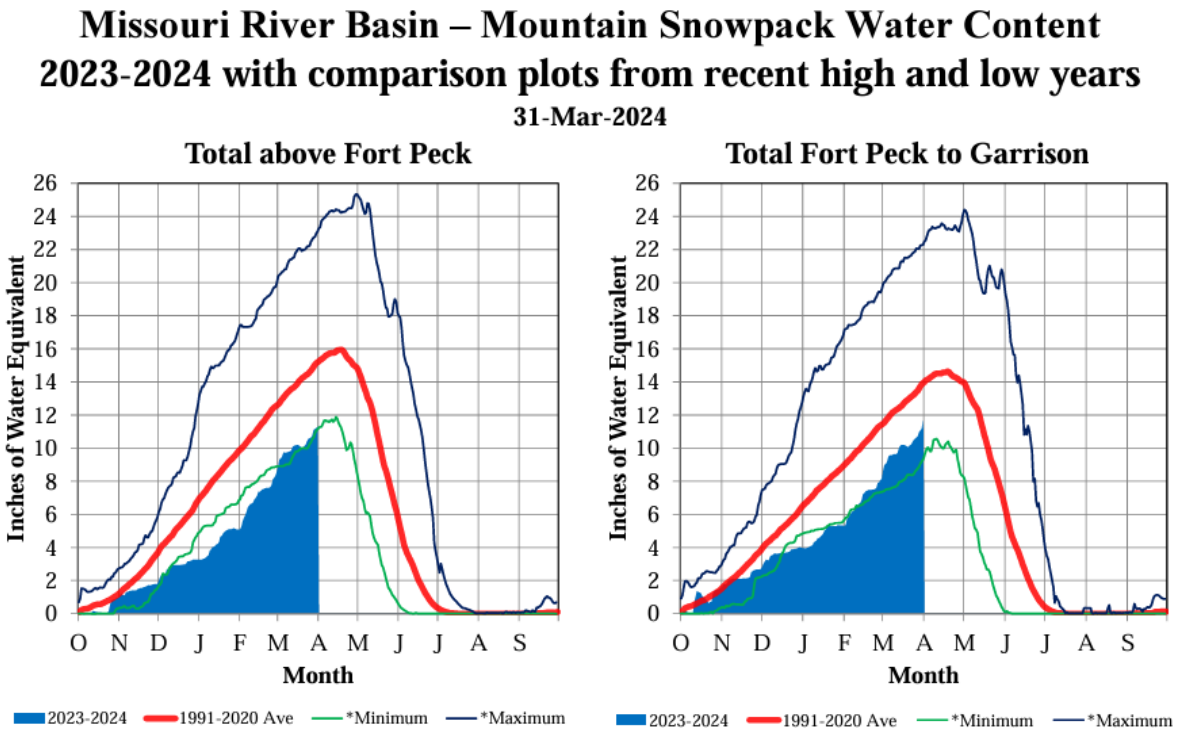


**Figure 9. Mountain Snowpack Water Content**

As of March 31, the average mountain SWE in the Fort Peck reservoir reach was 11.3”, 74% of average. In the reservoir reach between Fort Peck and Garrison dams, the average mountain SWE was 11.7”, 84% of average. Mountain snowpack in the Fort Peck reach is trending very closely to the observed minimum over the past 30 year period from 1991-2020. Mountain snowpack in the Garrison reach is slightly above the observed minimum.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

**El Niño Southern Oscillation (ENSO)**

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

El Niño conditions are currently observed. A transition to ENSO-neutral is 83% likely by April-June, with a 62% chance of La Niña developing in June-August.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for April (**Figure 10**) indicates increased chances for above-normal temperatures across much of the Basin. The April precipitation outlook (**Figure 10**) shows equal chances of below-normal, normal, or above-normal precipitation over most of the upper Basin. There are slightly increased chances for above-normal precipitation in Wyoming and the lower Basin.

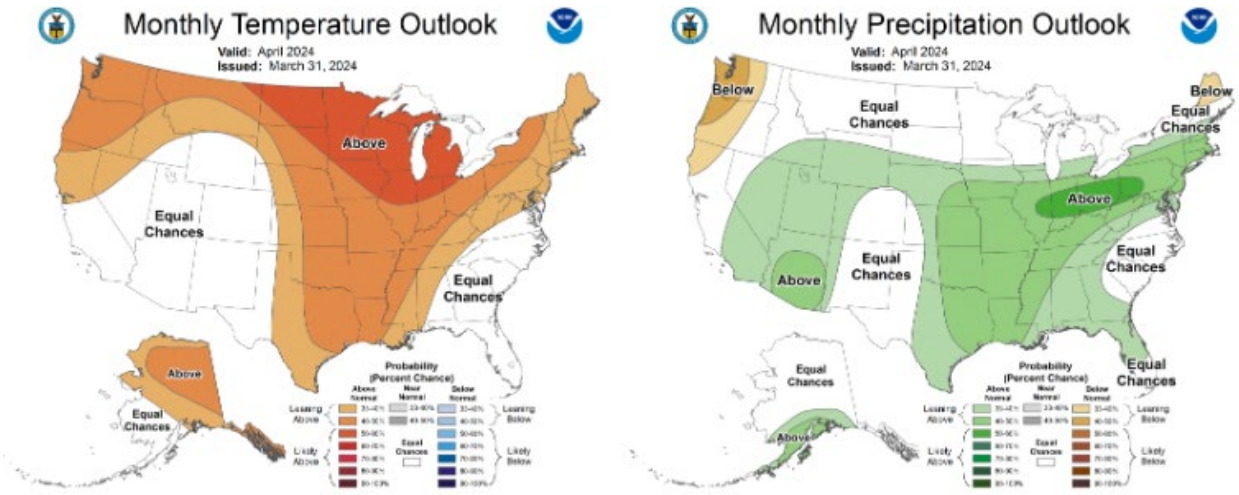


**Figure 10. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 11**. The May-June-July temperature outlook indicates equal chances for above-normal, normal, or below-normal temperatures for much of the Basin, with some areas seeing increased chances of above-normal temperatures. The precipitation outlook for the same period indicates equal chances across most of the Basin for above-normal, normal, or below-normal precipitation. There is a slightly increased chance for below-normal precipitation in western Montana.

The August-September-October temperature outlook indicates increased chances for warmer-than-normal temperatures across the Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation across the entire Basin.

The November-December 2024-January 2025 temperature outlook shows equal chances for above-normal, normal, or below-normal temperatures across the entire Basin. The precipitation outlook shows equal chances for above-normal, normal, or below-normal precipitation across the entire Basin.

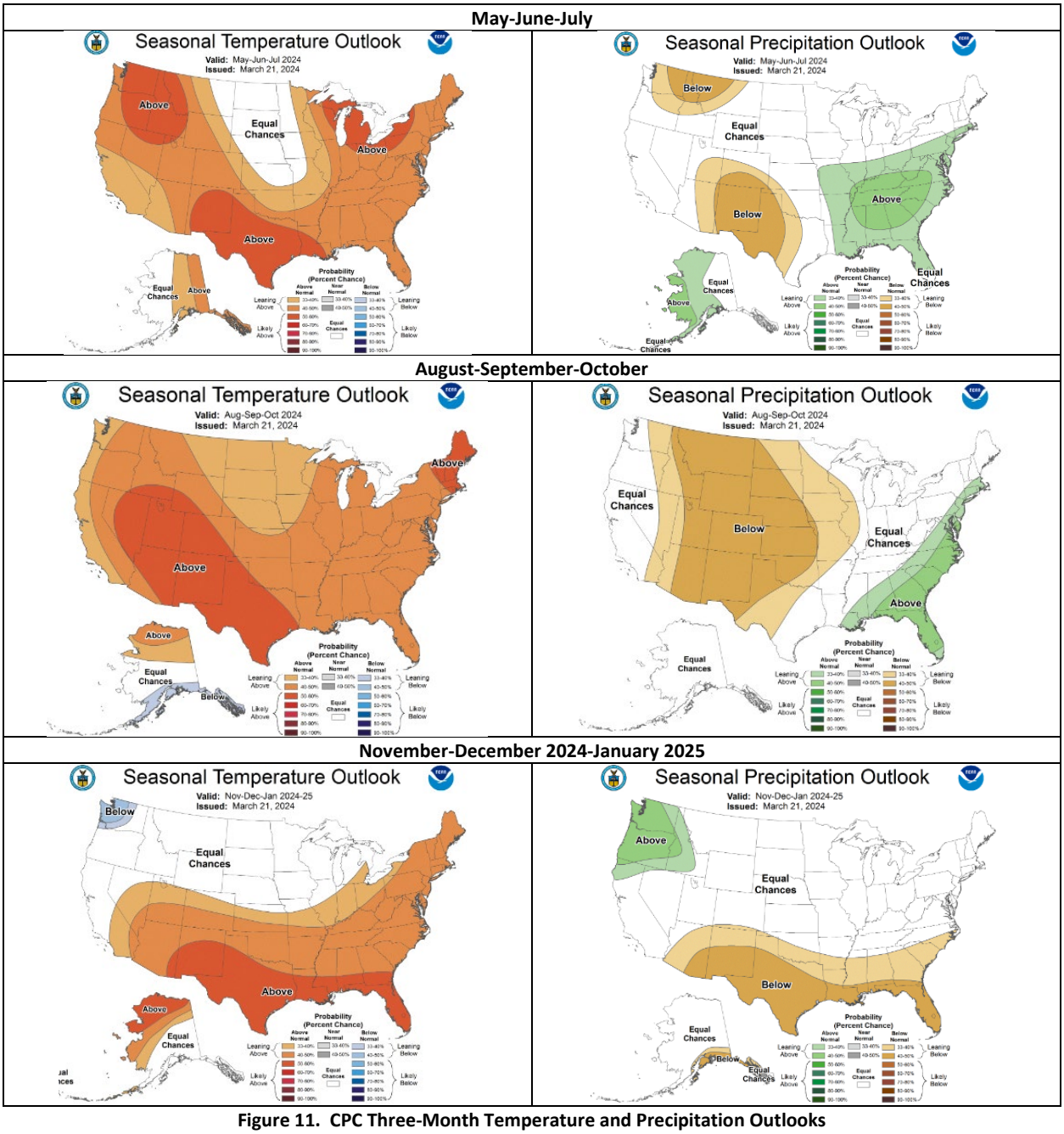


**Figure 11. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

Given current reach runoff and outlooks, we expect runoff in April to remain below normal for all reaches, but will depend on precipitation and temperatures over the next month. During May, June, and July, Fort Peck and Garrison runoff is forecast to be below average due to the below-normal mountain snowpack. In summary, the 2024 calendar year runoff forecast is **17.5 MAF, 68% of average**.

# NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: April 05, 2024 11:11:11 AM
   - Based on April 01, 2024 forecast values

Upper South Saskatchewan River

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sherburne Inflow | APR-JUL | 85 | 85 | 101 | 92 | 78 | 71 | 99 |
| | APR-SEP | 100 | 86 | 119 | 107 | 93 | 84 | 116 |
| St. Mary R nr Babb | APR-JUL | 335 | 87 | 390 | 360 | 310 | 280 | 385 |
| | APR-SEP | 380 | 85 | 455 | 415 | 355 | 320 | 445 |
| St. Mary R at Intl Boundary | APR-JUL | 390 | 86 | 470 | 420 | 355 | 315 | 450 |
| | APR-SEP | 450 | 88 | 550 | 490 | 410 | 365 | 510 |

Missouri Headwaters

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lima Reservoir Inflow | APR-JUL | 67 | 106 | 94 | 77 | 58 | 45 | 63 |
| | APR-SEP | 76 | 104 | 109 | 88 | 64 | 49 | 73 |
| Clark Canyon Inflow | APR-JUL | 61 | 96 | 115 | 82 | 42 | 20 | 63 |
| | APR-SEP | 73 | 104 | 136 | 96 | 54 | 32 | 70 |
| Beaverhead R at Barretts | APR-JUL | 84 | 89 | 146 | 109 | 65 | 42 | 94 |
| | APR-SEP | 93 | 86 | 158 | 118 | 71 | 47 | 108 |
| Ruby R Reservoir Inflow | APR-JUL | 63 | 90 | 86 | 71 | 55 | 45 | 70 |
| | APR-SEP | 81 | 96 | 107 | 90 | 72 | 60 | 84 |
| Big Hole R at Wisdom | APR-JUL | 50 | 56 | 103 | 70 | 33 | 19 | 89 |
| | APR-SEP | 54 | 58 | 112 | 77 | 33 | 20 | 92 |
| Big Hole R nr Melrose | APR-JUL | 325 | 61 | 480 | 390 | 275 | 193 | 525 |
| | APR-SEP | 335 | 58 | 510 | 400 | 275 | 195 | 570 |
| Jefferson R nr Twin Bridges | APR-JUL | 460 | 69 | 805 | 585 | 365 | 210 | 665 |
| | APR-SEP | 490 | 72 | 820 | 605 | 375 | 230 | 675 |
| Willow Ck Reservoir Inflow | APR-JUL | 11.5 | 74 | 24 | 16 | 7.9 | 4.5 | 15.5 |
| Jefferson R nr Three Forks | APR-JUL | 520 | 72 | 875 | 640 | 390 | 255 | 720 |
| | APR-SEP | 505 | 71 | 910 | 650 | 395 | 260 | 705 |
| Boulder R nr Boulder | APR-JUL | 54 | 81 | 85 | 66 | 45 | 34 | 66 |
| | APR-SEP | 60 | 86 | 97 | 74 | 49 | 37 | 69 |
| Hebgen Lake Inflow | APR-JUL | 310 | 88 | 370 | 335 | 285 | 255 | 350 |
| | APR-SEP | 390 | 85 | 455 | 420 | 360 | 325 | 455 |
| Ennis Lake Inflow | APR-JUL | 505 | 82 | 615 | 555 | 460 | 405 | 615 |
| | APR-SEP | 635 | 84 | 780 | 695 | 585 | 520 | 750 |
| Gallatin R nr Gallatin Gateway | APR-JUL | 325 | 80 | 395 | 350 | 300 | 265 | 405 |
| | APR-SEP | 370 | 79 | 460 | 405 | 335 | 290 | 465 |
| Hyalite Reservoir Inflow | APR-JUL | 16 | 81 | 19.8 | 17.5 | 14.7 | 13.1 | 19.6 |
| | APR-SEP | 19.1 | 86 | 23 | 21 | 17.7 | 15.8 | 22 |
| Gallatin R at Logan | APR-JUL | 305 | 71 | 445 | 350 | 255 | 210 | 425 |
| | APR-SEP | 350 | 72 | 495 | 400 | 300 | 245 | 485 |

Upper Missouri

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R at Toston | APR-JUL | 1360 | 76 | 1980 | 1590 | 1150 | 930 | 1780 |
| | APR-SEP | 1480 | 75 | 2160 | 1720 | 1240 | 1000 | 1970 |
| Missouri R at Fort Benton | APR-JUL | 1990 | 75 | 2970 | 2360 | 1660 | 1300 | 2620 |
| | APR-SEP | 2420 | 79 | 3640 | 2880 | 2030 | 1630 | 3060 |
| Smith R bl Eagle Ck | APR-JUL | 67 | 62 | 114 | 84 | 53 | 37 | 108 |
| | APR-SEP | 70 | 61 | 113 | 87 | 54 | 36 | 114 |
| Gibson Reservoir Inflow | APR-JUL | 240 | 64 | 310 | 270 | 197 | 125 | 375 |
| | APR-SEP | 280 | 67 | 365 | 310 | 240 | 164 | 415 |

Marias

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Two Medicine R bl SF nr Browning | APR-JUL | 137 | 71 | 177 | 152 | 124 | 106 | 191 |
| | APR-SEP | 146 | 74 | 188 | 162 | 131 | 113 | 195 |
| Badger Ck nr Browning | APR-JUL | 54 | 76 | 75 | 62 | 45 | 37 | 71 |
| | APR-SEP | 63 | 77 | 92 | 73 | 51 | 38 | 81 |
| Dupuyer Ck nr Valier | APR-JUL | 7.3 | 73 | 14.8 | 10.3 | 4.3 | 0 | 9.9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | APR-SEP | 8.2 | 70 | 16.2 | 11.4 | 4.9 | 0.1 | 11.7 |
| Swift Reservoir Inflow | APR-JUL | 38 | 76 | 58 | 46 | 30 | 18.4 | 50 |
| | APR-SEP | 45 | 77 | 68 | 54 | 36 | 22 | 58 |
| Marias R nr Shelby | APR-JUL | 245 | 74 | 405 | 305 | 168 | 68 | 330 |
| | APR-SEP | 250 | 73 | 440 | 325 | 161 | 63 | 340 |
| Teton R nr Dutton | APR-JUL | 12.5 | 44 | 42 | 21 | 6.9 | 2.6 | 28 |
| | APR-SEP | 14.4 | 49 | 46 | 23 | 7.9 | 3.1 | 29 |

Fort Peck Lake

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R nr Virgelle | APR-JUL | 2400 | 78 | 3430 | 2810 | 2050 | 1550 | 3060 |
| | APR-SEP | 2770 | 79 | 4200 | 3280 | 2300 | 1690 | 3500 |
| Missouri R nr Landusky | APR-JUL | 2500 | 79 | 3770 | 2970 | 2070 | 1580 | 3150 |
| | APR-SEP | 2830 | 77 | 4230 | 3400 | 2260 | 1430 | 3630 |

Musselshell

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Musselshell R at Harlowton | APR-JUL | 41 | 73 | 98 | 59 | 27 | 12.7 | 56 |
| | APR-SEP | 42 | 75 | 110 | 63 | 27 | 12 | 56 |
| Musselshell R nr Roundup | APR-JUL | 35 | 57 | 138 | 77 | 5 | 0 | 61 |
| | APR-SEP | 33 | 60 | 141 | 77 | 7 | 0 | 55 |

Missouri-Poplar

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R bl Fort Peck Dam | APR-JUL | 2430 | 79 | 3540 | 2830 | 2040 | 1630 | 3060 |
| | APR-SEP | 2650 | 79 | 4120 | 3180 | 2160 | 1710 | 3320 |

Upper Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Yellowstone Lake Outlet | APR-JUL | 570 | 96 | 680 | 610 | 525 | 475 | 590 |
| | APR-SEP | 695 | 89 | 850 | 755 | 645 | 580 | 775 |
| Yellowstone R at Corwin Springs | APR-JUL | 1400 | 84 | 1690 | 1510 | 1280 | 1130 | 1650 |
| | APR-SEP | 1700 | 89 | 2060 | 1840 | 1570 | 1400 | 1900 |
| Yellowstone R at Livingston | APR-JUL | 1620 | 85 | 2010 | 1760 | 1500 | 1310 | 1900 |
| | APR-SEP | 1960 | 89 | 2420 | 2130 | 1790 | 1570 | 2200 |
| Boulder R at Big Timber | APR-JUL | 245 | 84 | 295 | 265 | 220 | 196 | 290 |
| | APR-SEP | 270 | 87 | 340 | 295 | 240 | 210 | 310 |
| Shields R nr Livingston | APR-JUL | 64 | 50 | 112 | 81 | 46 | 33 | 127 |
| | APR-SEP | 75 | 54 | 121 | 92 | 58 | 40 | 138 |
| Yellowstone R at Billings | APR-JUL | 2500 | 78 | 3290 | 2800 | 2240 | 1900 | 3180 |
| | APR-SEP | 2810 | 74 | 3760 | 3180 | 2440 | 2070 | 3760 |
| Mystic Lake Inflow | APR-JUL | 52 | 89 | 60 | 56 | 49 | 45 | 58 |
| | APR-SEP | 68 | 90 | 78 | 73 | 65 | 59 | 75 |
| Stillwater R nr Absarokee | APR-JUL | 400 | 91 | 505 | 445 | 365 | 315 | 435 |
| | APR-SEP | 470 | 88 | 595 | 530 | 430 | 365 | 530 |
| Clarks Fk Yellowstone R nr Belfry | APR-JUL | 475 | 88 | 565 | 515 | 435 | 390 | 535 |
| | APR-SEP | 500 | 88 | 610 | 545 | 460 | 410 | 565 |
| Cooney Reservoir Inflow | APR-JUL | 26 | 72 | 49 | 35 | 18.3 | 10.9 | 36 |
| | APR-SEP | 37 | 78 | 63 | 47 | 30 | 21 | 47 |

Big Horn

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Dinwoody Ck nr Burris | APR-JUL | 69 | 95 | 82 | 74 | 64 | 57 | 72 |
| | APR-SEP | 95 | 97 | 110 | 102 | 89 | 81 | 97 |
| Bull Lake Ck nr Lenore | APR-JUL | 182 | 129 | 220 | 196 | 167 | 148 | 141 |
| | APR-SEP | 225 | 133 | 280 | 250 | 205 | 180 | 168 |
| Wind R Ab Bull Lake Ck | APR-JUL | 485 | 101 | 680 | 565 | 420 | 350 | 480 |
| | APR-SEP | 530 | 112 | 730 | 610 | 455 | 380 | 470 |
| Wind R at Riverton | APR-JUL | 575 | 116 | 770 | 650 | 510 | 420 | 495 |
| | APR-SEP | 665 | 118 | 895 | 760 | 580 | 485 | 560 |
| Little Wind R nr Riverton | APR-JUL | 395 | 141 | 590 | 475 | 325 | 230 | 280 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | APR-SEP | 435 | 145 | 665 | 520 | 355 | 255 | 300 |
| Little Popo Agie R nr Lander | APR-JUL | 54 | 128 | 78 | 63 | 46 | 36 | 42 |
| | APR-SEP | 65 | 135 | 88 | 74 | 57 | 46 | 48 |
| Boysen Reservoir Inflow | APR-JUL | 885 | 121 | 1430 | 1080 | 725 | 525 | 730 |
| | APR-SEP | 955 | 121 | 1730 | 1200 | 765 | 525 | 785 |
| Greybull R at Meeteetse | APR-JUL | 175 | 124 | 245 | 205 | 149 | 113 | 141 |
| | APR-SEP | 235 | 118 | 320 | 270 | 193 | 151 | 199 |
| Shell Ck nr Shell | APR-JUL | 40 | 67 | 56 | 46 | 35 | 28 | 59 |
| | APR-SEP | 51 | 71 | 69 | 59 | 45 | 36 | 71 |
| Bighorn R at Kane | APR-JUL | 1330 | 133 | 2520 | 1750 | 1000 | 650 | 1000 |
| | APR-SEP | 1450 | 139 | 3220 | 2010 | 1040 | 645 | 1040 |
| NF Shoshone R at Wapiti | APR-JUL | 475 | 105 | 570 | 515 | 440 | 390 | 450 |
| | APR-SEP | 505 | 98 | 615 | 550 | 465 | 415 | 515 |
| SF Shoshone R nr Valley | APR-JUL | 215 | 95 | 260 | 235 | 200 | 179 | 225 |
| | APR-SEP | 240 | 92 | 300 | 265 | 220 | 195 | 260 |
| SF Shoshone R ab Buffalo Bill Reservoir | APR-JUL | 205 | 91 | 285 | 235 | 178 | 141 | 225 |
| | APR-SEP | 220 | 97 | 305 | 255 | 184 | 144 | 225 |
| Buffalo Bill Reservoir Inflow | APR-JUL | 660 | 98 | 845 | 735 | 595 | 520 | 670 |
| | APR-SEP | 715 | 97 | 930 | 795 | 640 | 555 | 730 |
| Bighorn R nr St. Xavier | APR-JUL | 1740 | 108 | 3010 | 2250 | 1380 | 800 | 1610 |
| | APR-SEP | 1870 | 108 | 3440 | 2490 | 1420 | 945 | 1720 |
| Little Bighorn R nr Hardin | APR-JUL | 59 | 57 | 130 | 81 | 33 | 7 | 102 |
| | APR-SEP | 62 | 51 | 117 | 83 | 42 | 18 | 121 |

Tongue

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Big Goose Ck nr Sheridan | APR-JUL | 34 | 65 | 55 | 44 | 27 | 19.2 | 52 |
| | APR-SEP | 44 | 72 | 69 | 55 | 36 | 27 | 61 |
| Little Goose Ck nr Big Horn | APR-JUL | 25 | 78 | 38 | 30 | 20 | 14.8 | 32 |
| | APR-SEP | 33 | 78 | 50 | 41 | 27 | 21 | 42 |
| Tongue R nr Dayton | APR-JUL | 65 | 73 | 99 | 80 | 55 | 41 | 88 |
| | APR-SEP | 75 | 73 | 108 | 88 | 63 | 49 | 102 |
| Tongue River Reservoir Inflow | APR-JUL | 140 | 63 | 295 | 215 | 98 | 48 | 220 |
| | APR-SEP | 151 | 60 | 250 | 191 | 115 | 69 | 250 |

Powder

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| MF Powder R nr Barnum | APR-JUL | 13.4 | 85 | 24 | 17.2 | 9.9 | 6.6 | 15.7 |
| | APR-SEP | 15.9 | 95 | 25 | 19.8 | 12.4 | 8.6 | 16.6 |
| NF Powder R nr Hazelton | APR-JUL | 7.4 | 71 | 10.7 | 8.9 | 6 | 4.5 | 10.3 |
| | APR-SEP | 8.2 | 73 | 11.7 | 9.6 | 6.6 | 5 | 11.1 |
| Rock Ck nr Buffalo | APR-JUL | 15.7 | 74 | 25 | 20 | 11.6 | 4.2 | 21 |
| | APR-SEP | 17.6 | 70 | 27 | 22 | 14.1 | 10 | 25 |
| Piney Ck at Kearny | APR-JUL | 35 | 70 | 62 | 47 | 26 | 15.4 | 50 |
| | APR-SEP | 37 | 71 | 67 | 49 | 27 | 16.4 | 52 |
| Powder R at Moorhead | APR-JUL | 162 | 84 | 395 | 250 | 105 | 47 | 191 |
| | APR-SEP | 181 | 88 | 440 | 280 | 120 | 61 | 205 |
| Powder R nr Locate | APR-JUL | 200 | 88 | 530 | 310 | 121 | 59 | 225 |
| | APR-SEP | 215 | 89 | 480 | 320 | 132 | 34 | 240 |

Lower Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Miles City | APR-JUL | 3950 | 78 | 5970 | 4660 | 3160 | 1530 | 5040 |
| | APR-SEP | 4460 | 78 | 6550 | 5170 | 3720 | 2850 | 5670 |
| Yellowstone R nr Sidney | APR-JUL | 4150 | 83 | 6490 | 4920 | 3340 | 2200 | 5000 |
| | APR-SEP | 4520 | 81 | 7170 | 5510 | 3670 | 2650 | 5580 |

Lake Sakakawea

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sakakawea Inflow | APR-JUL | 7210 | 79 | 10600 | 8440 | 6200 | 4920 | 9080 |
| | APR-SEP | 7920 | 78 | 12100 | 9470 | 6810 | 5160 | 10100 |

Cheyenne

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow | MAR-JUL | 5.1 | 78 | 9.7 | 6.9 | 3.7 | 1.3 | 6.5 |
| | APR-JUL | 4.4 | 83 | 7.8 | 5.5 | 3.2 | 2 | 5.3 |
| Pactola Reservoir Inflow | MAR-JUL | 24 | 85 | 46 | 33 | 17.1 | 9 | 28 |
| | APR-JUL | 21 | 84 | 45 | 28 | 12.8 | 3.6 | 25 |

North Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate | APR-JUL | 187 | 93 | 295 | 225 | 155 | 115 | 200 |
| | APR-SEP | 210 | 95 | 330 | 255 | 175 | 133 | 220 |
| Encampment R nr Encampment | APR-JUL | 166 | 122 | 220 | 186 | 147 | 120 | 135 |
| | APR-SEP | 174 | 123 | 230 | 194 | 154 | 128 | 141 |
| Seminoe Reservoir Inflow | APR-JUL | 825 | 125 | 1290 | 990 | 695 | 545 | 660 |
| | APR-SEP | 885 | 123 | 1350 | 1060 | 740 | 515 | 715 |
| Rock Ck ab King Canyon Cnl nr Arlington | APR-JUL | 53 | 108 | 69 | 59 | 48 | 40 | 49 |
| | APR-SEP | 55 | 107 | 72 | 61 | 50 | 43 | 51 |
| Sweetwater R nr Alcova | APR-JUL | 77 | 171 | 124 | 95 | 62 | 46 | 45 |
| | APR-SEP | 83 | 169 | 131 | 101 | 67 | 51 | 49 |
| La Prele Ck nr Douglas | APR-JUL | 15.2 | 72 | 28 | 20 | 10.3 | 5.1 | 21 |
| | APR-SEP | 16.1 | 82 | 30 | 22 | 11.2 | 5.8 | 19.5 |
| North Platte R bl Glendo Reservoir | APR-JUL | 1010 | 135 | 1600 | 1220 | 825 | 585 | 745 |
| | APR-SEP | 1040 | 136 | 1640 | 1260 | 815 | 520 | 760 |
| North Platte R bl Guernsey Reservoir | APR-JUL | 1010 | 135 | 1630 | 1220 | 785 | 465 | 745 |
| | APR-SEP | 1050 | 135 | 1640 | 1280 | 745 | 280 | 775 |
| Laramie R and Pioneer Cnl nr Woods Lg | APR-JUL | 117 | 100 | 173 | 138 | 100 | 81 | 117 |
| | APR-SEP | 127 | 100 | 190 | 149 | 107 | 84 | 126 |
| Little Laramie R nr Filmore | APR-JUL | 63 | 118 | 86 | 71 | 55 | 45 | 53 |
| | APR-SEP | 65 | 116 | 92 | 74 | 57 | 47 | 56 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# May 2024 Calendar Year Runoff Forecast
# May 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

March runoff was 2.1 MAF, 71% of average. Runoff was below average in every reach except the Fort Randall and Gavins Point reaches.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **19.2 MAF, 75% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **17.3 MAF, 75% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next eight months, expected inflow could range from the 15.0 MAF lower basic forecast to the 23.8 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that eight months are being forecast for this April 1 forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for April 30 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 46% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of July, indicates drought conditions are likely to persist or worsen in Montana but improve in North Dakota and the lower Basin.

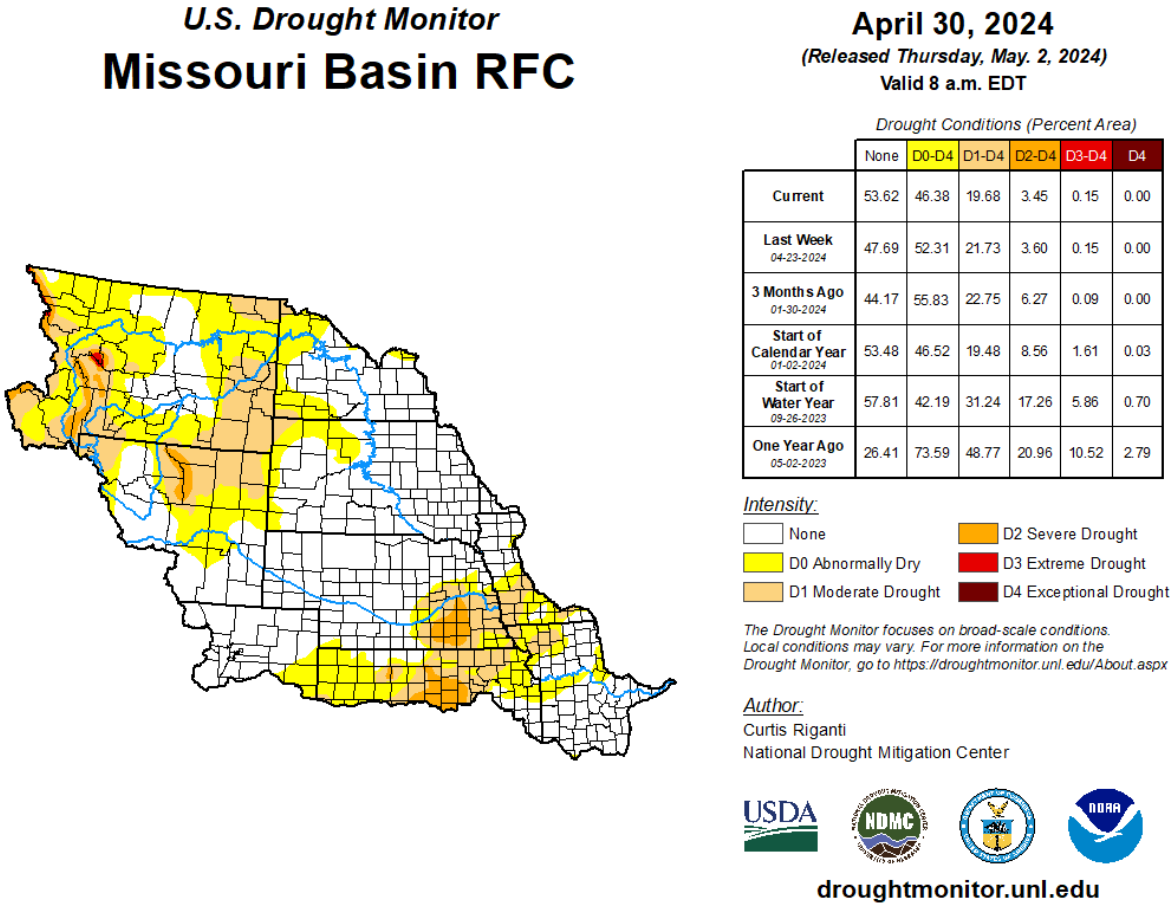


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

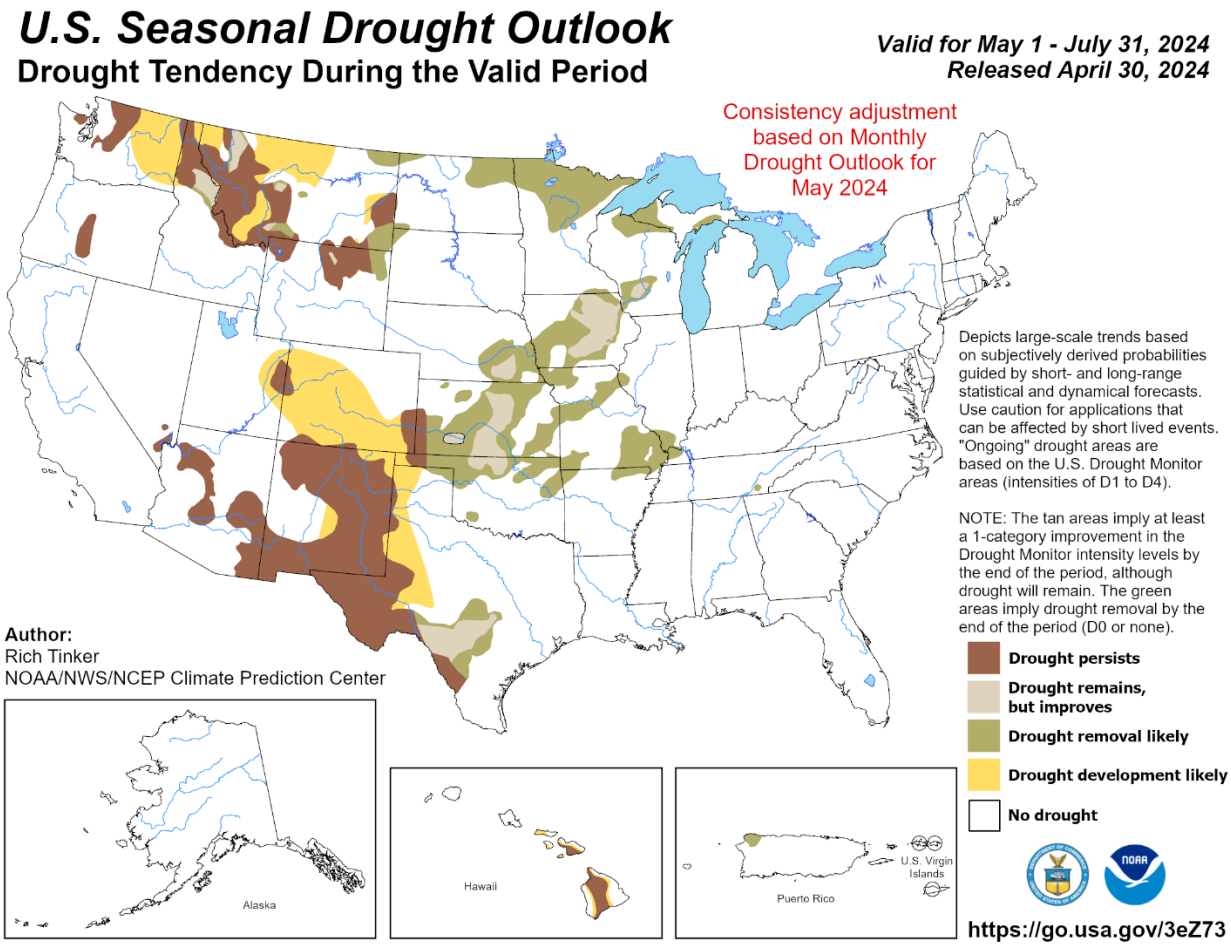


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The April precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was below normal in Montana and western North Dakota and was above normal across the Dakotas.

Precipitation as a percent of normal for the February-March-April period (**Figure 4**) was also mixed over the upper Basin. Precipitation in parts of Montana, western North Dakota, and into eastern Wyoming was below normal, and in much of the Dakotas and north-central Montana it was above normal.

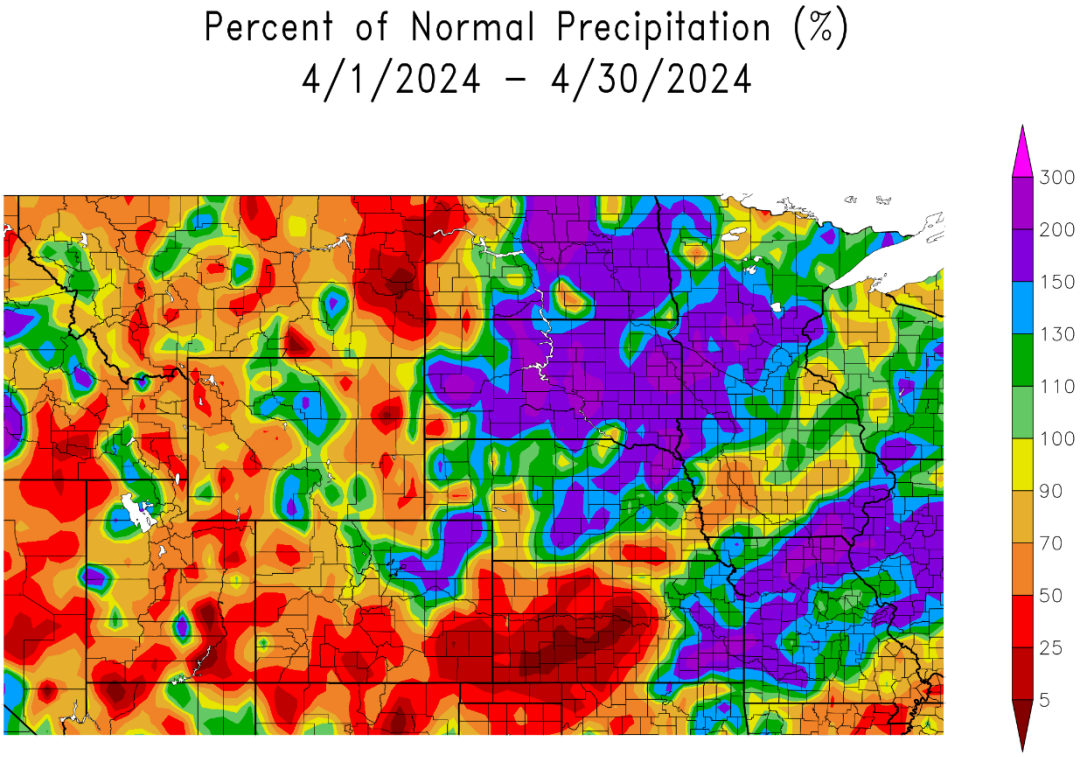


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

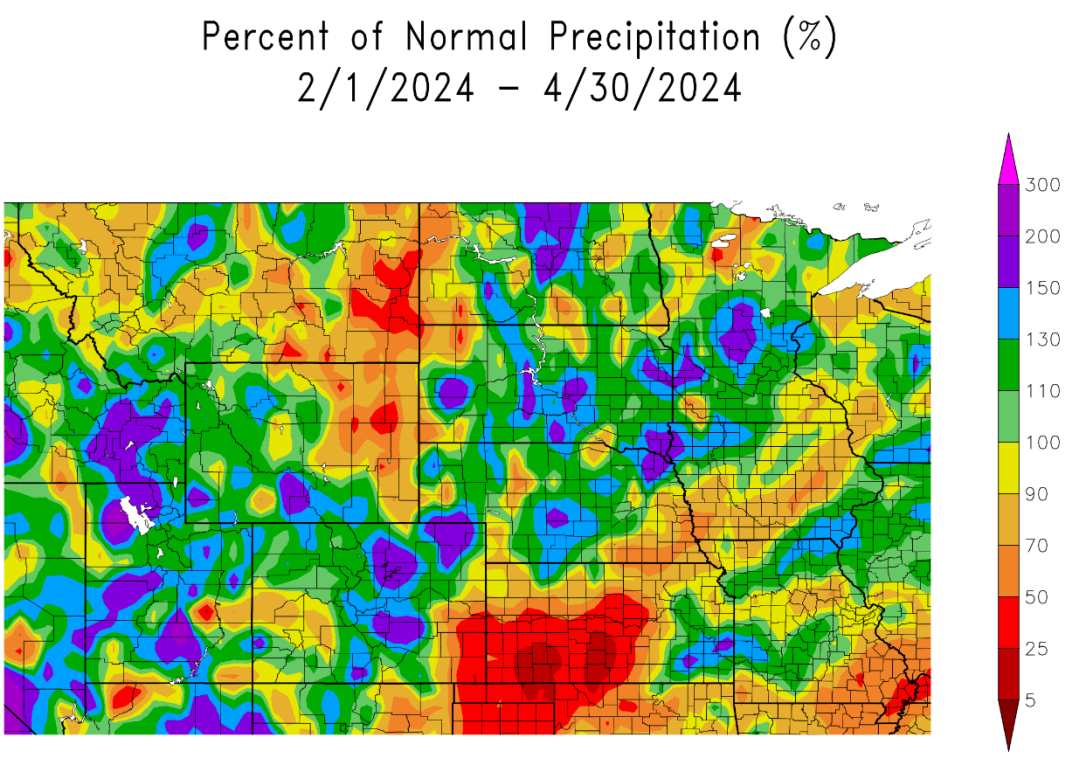


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

April temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures the Basin. February-March-April temperature departures are shown in **Figure 6**. The three-month average temperature departures were above normal across the Basin.

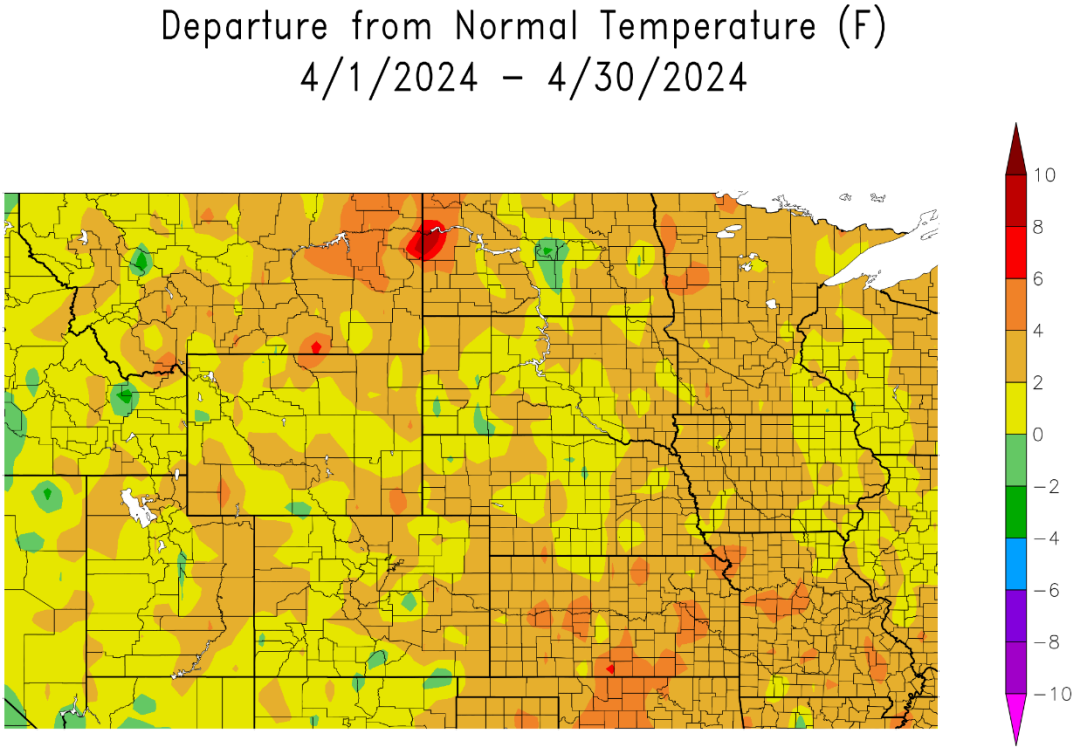


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

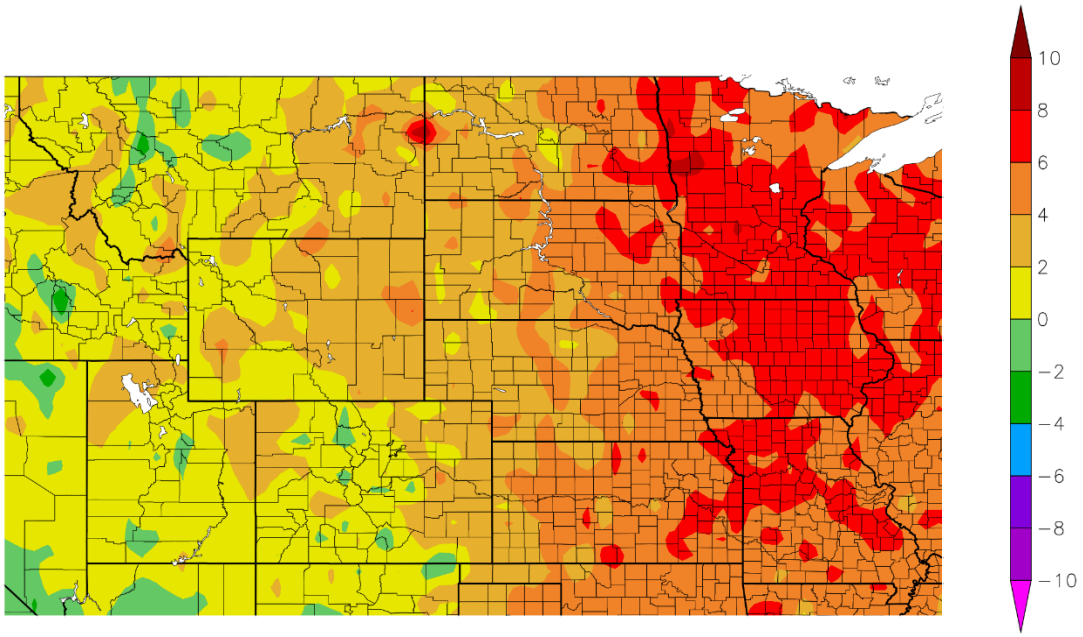


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

## Soil Moisture

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomaly and percentile at the beginning of May are shown in **Figure 7**. Soil moisture is drier than normal in much of Montana, western and northern North Dakota, and eastern Wyoming. Soil moisture is wetter than normal in much of South Dakota and south-central North Dakota.

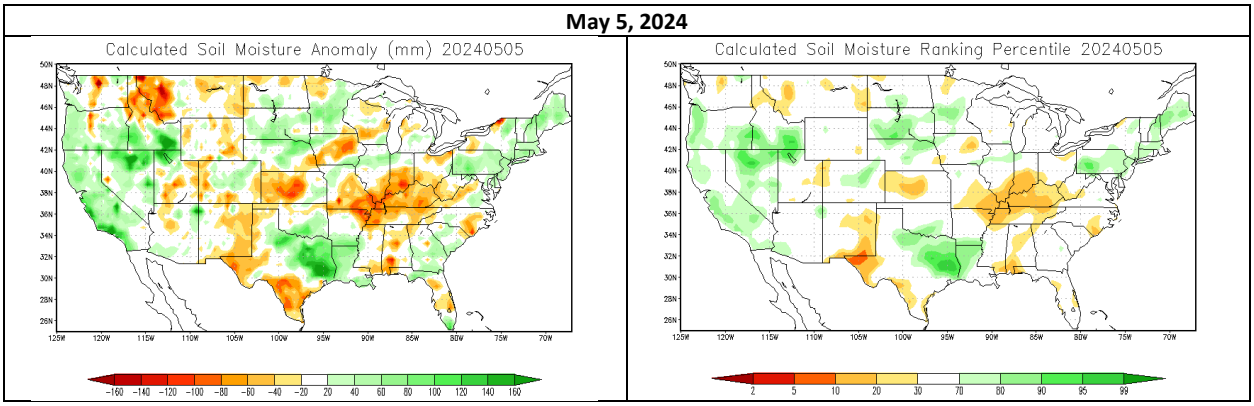


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

## Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

The National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) modeled snow assessment (available here) from May 1, 2024, shown in **Figure 8**, shows no plains snowmelt remaining.

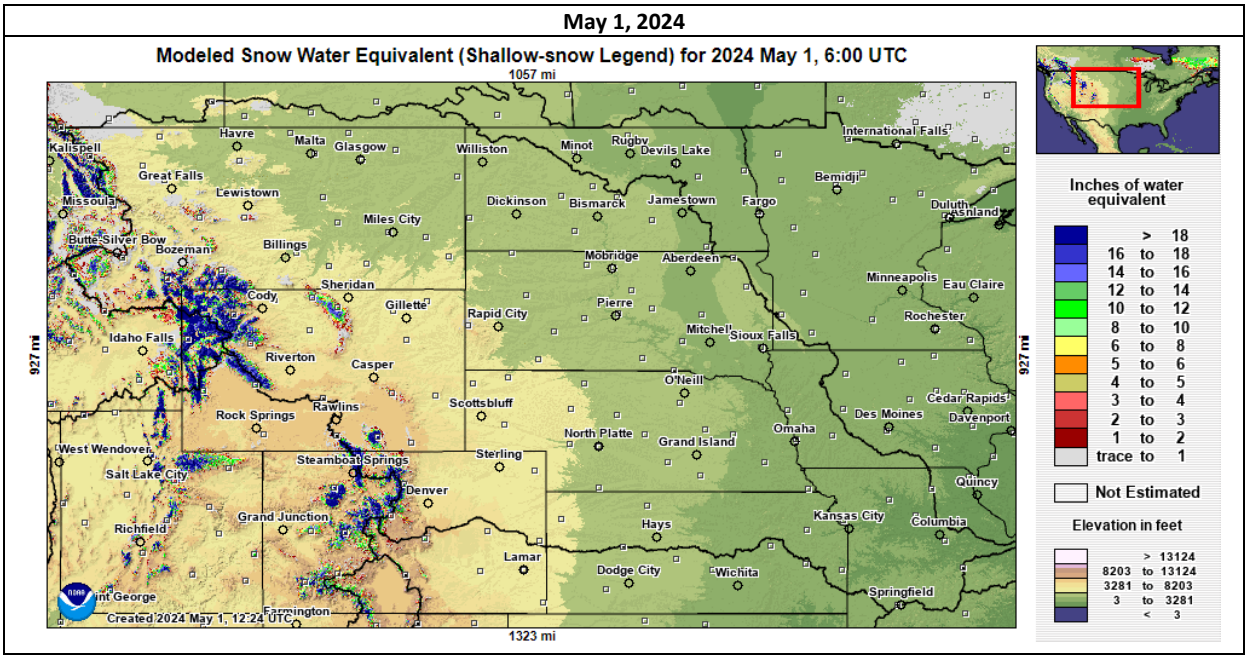


**Figure 8. NOHRSC Modeled Snow Water Equivalent**

## Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 9** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

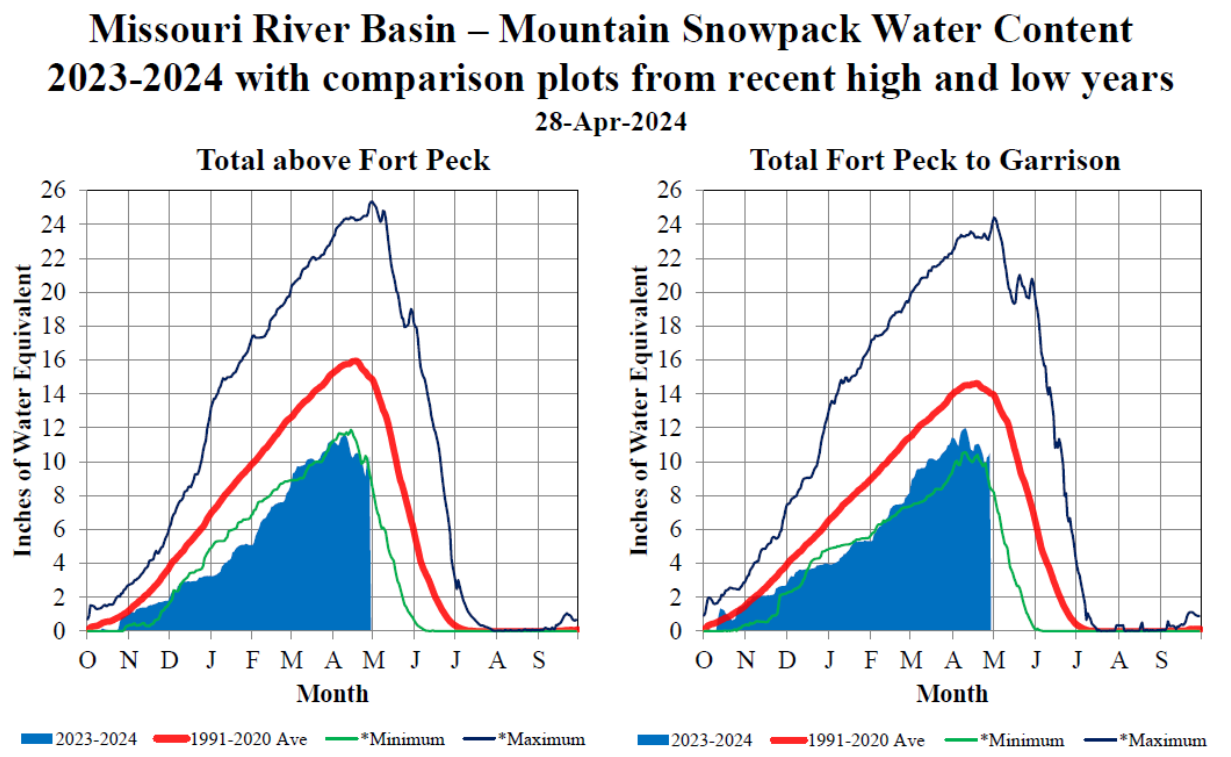


**Figure 9. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of April 28, 2024 the mountain Snow Water Equivalent (SWE) in the "Total above Fort Peck" reach is 10.3" and 89% of the annual peak remains. The mountain SWE in the "Fort Peck to Garrison" reach is 10.5" and 88% of the annual peak remains.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

**El Niño Southern Oscillation (ENSO)**

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

El Niño conditions are currently observed. A transition to ENSO-neutral is 85% likely by April-June, and there is a 60% chance of La Niña developing by June-August.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for May (**Figure 10**) indicates equal chances for below-normal, normal, or above-normal temperatures across the Basin. The May precipitation outlook (**Figure 10**) shows equal chances of below-normal, normal, or above-normal precipitation over most of the upper Basin. There are slightly increased chances for above-normal precipitation in the eastern Dakotas.

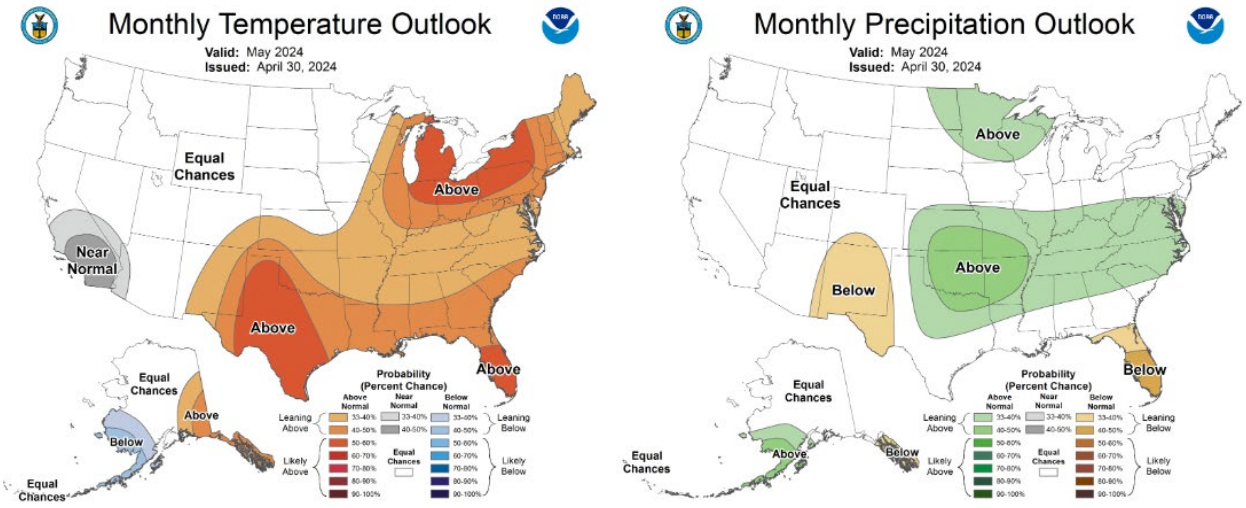


**Figure 10. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 11**. The June-July-August temperature outlook indicates equal chances for below-normal, normal, or above-normal temperatures in North Dakota, and slightly increased chances for warmer-than-normal temperatures in the rest of the Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation in most of the Basin.

The September-October-November temperature outlook indicates increased chances for warmer-than-normal temperatures across the Basin. The precipitation outlook for the same period shows equal chances for below normal, normal, or above normal precipitation.

The December 2024-January-February 2025 outlooks show equal chances for above-normal, normal, or below-normal temperatures and precipitation across the entire Basin.

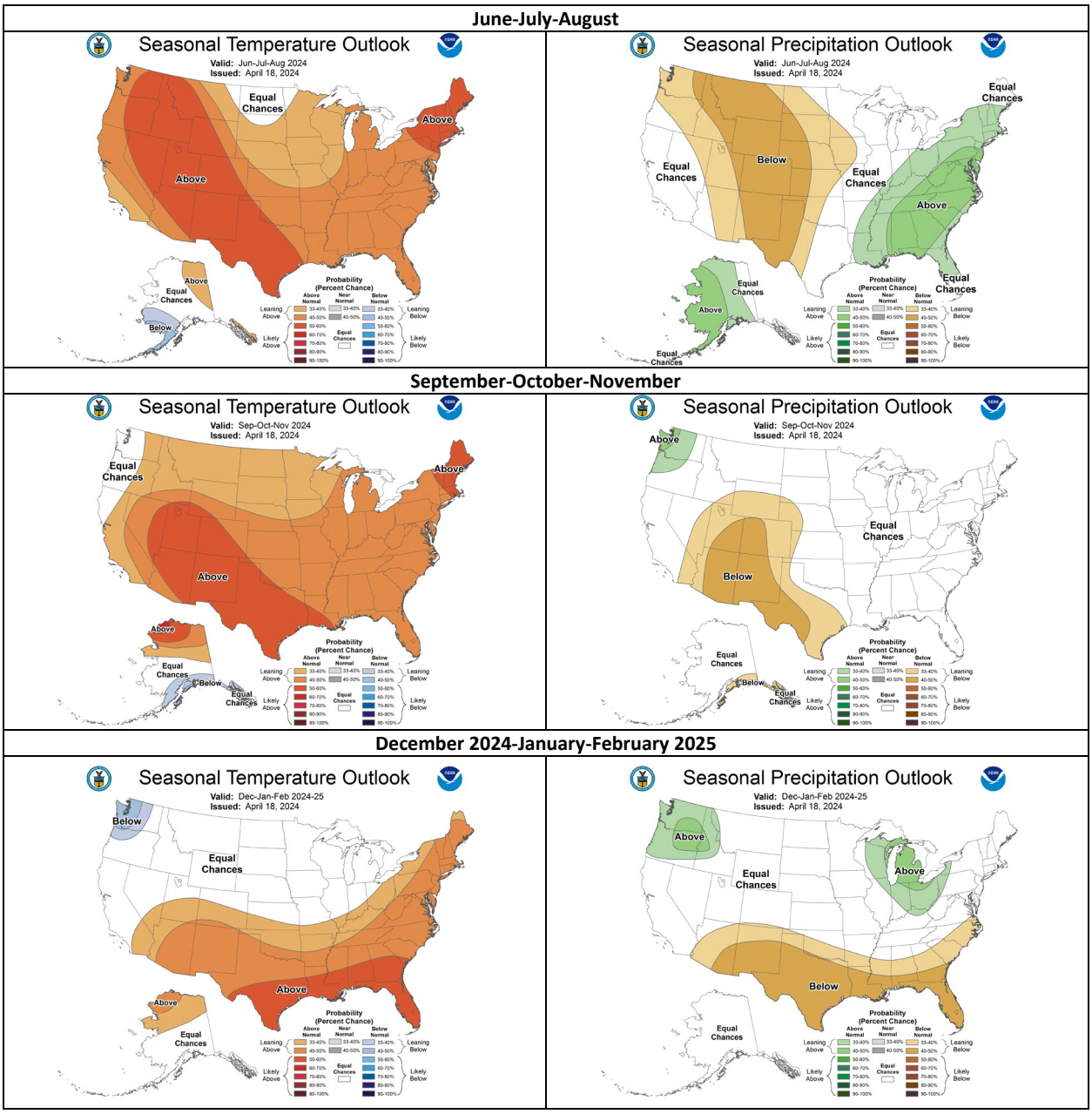


**Figure 11. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, mountain snowpack, and forecast temperatures and precipitation. Given these factors we expect runoff during May, June, and July for Fort Peck and Garrison to be below average. Runoff in the Oahe and Sioux City reaches during this time is also expected to be below normal, and runoff in the Fort Randall and Gavins Point reaches is expected to be near normal. In summary, the 2024 calendar year runoff forecast is **19.2 MAF, 75% of average**.

# NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: May 07, 2024 11:11:11 AM
   - Based on May 01, 2024 forecast values

Upper South Saskatchewan River

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sherburne Inflow | MAY-JUL | 71 | 78 | 85 | 76 | 65 | 59 | 90 |
| | MAY-SEP | 85 | 80 | 102 | 92 | 78 | 70 | 105 |
| St. Mary R nr Babb | MAY-JUL | 300 | 83 | 360 | 325 | 280 | 250 | 360 |
| | MAY-SEP | 345 | 84 | 410 | 370 | 320 | 285 | 410 |
| St. Mary R at Intl Boundary | MAY-JUL | 335 | 80 | 415 | 370 | 305 | 270 | 415 |
| | MAY-SEP | 395 | 84 | 490 | 435 | 355 | 315 | 470 |

Missouri Headwaters

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lima Reservoir Inflow | MAY-JUL | 31 | 77 | 52 | 40 | 24 | 15.6 | 40 |
| | MAY-SEP | 34 | 68 | 57 | 43 | 25 | 16.5 | 50 |
| Clark Canyon Inflow | MAY-JUL | 18.9 | 59 | 61 | 36 | 2 | -23 | 32 |
| | MAY-SEP | 24 | 64 | 68 | 40 | 7.9 | -14.8 | 37 |
| Beaverhead R at Barretts | MAY-JUL | 34 | 62 | 76 | 53 | 17.5 | -5.5 | 54 |
| | MAY-SEP | 44 | 65 | 98 | 62 | 30 | 17.1 | 67 |
| Ruby R Reservoir Inflow | MAY-JUL | 47 | 78 | 64 | 53 | 41 | 31 | 60 |
| | MAY-SEP | 58 | 78 | 75 | 65 | 50 | 40 | 74 |
| Big Hole R at Wisdom | MAY-JUL | 27 | 40 | 67 | 42 | 16.2 | 7.3 | 67 |
| | MAY-SEP | 30 | 40 | 76 | 45 | 16.8 | 4.9 | 75 |
| Big Hole R nr Melrose | MAY-JUL | 240 | 57 | 380 | 285 | 200 | 154 | 415 |
| | MAY-SEP | 260 | 55 | 405 | 300 | 230 | 174 | 465 |
| Jefferson R nr Twin Bridges | MAY-JUL | 250 | 58 | 475 | 325 | 191 | 118 | 430 |
| | MAY-SEP | 260 | 57 | 530 | 365 | 179 | 90 | 450 |
| Willow Ck Reservoir Inflow | MAY-JUL | 7.6 | 55 | 16.1 | 10.1 | 5.6 | 3.3 | 13.7 |
| Jefferson R nr Three Forks | MAY-JUL | 220 | 40 | 430 | 285 | 162 | 97 | 540 |
| | MAY-SEP | 250 | 44 | 485 | 340 | 169 | 85 | 560 |
| Boulder R nr Boulder | MAY-JUL | 34 | 59 | 57 | 41 | 27 | 18.6 | 57 |
| | MAY-SEP | 39 | 65 | 68 | 48 | 31 | 20 | 60 |
| Hebgen Lake Inflow | MAY-JUL | 240 | 84 | 295 | 255 | 215 | 190 | 285 |
| | MAY-SEP | 315 | 81 | 385 | 345 | 290 | 260 | 385 |
| Ennis Lake Inflow | MAY-JUL | 400 | 77 | 510 | 440 | 360 | 285 | 515 |
| | MAY-SEP | 525 | 80 | 650 | 580 | 465 | 390 | 655 |
| Gallatin R nr Gallatin Gateway | MAY-JUL | 285 | 77 | 335 | 305 | 265 | 245 | 370 |
| | MAY-SEP | 335 | 77 | 395 | 355 | 310 | 280 | 430 |
| Hyalite Reservoir Inflow | MAY-JUL | 14.9 | 80 | 17.8 | 16.1 | 13.8 | 12.3 | 18.6 |
| | MAY-SEP | 17.4 | 82 | 20 | 18.6 | 16.1 | 14.4 | 21 |
| Gallatin R at Logan | MAY-JUL | 230 | 63 | 310 | 255 | 200 | 160 | 365 |
| | MAY-SEP | 275 | 66 | 370 | 305 | 245 | 199 | 415 |

Upper Missouri

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R at Toston | MAY-JUL | 805 | 52 | 1230 | 950 | 695 | 540 | 1520 |
| | MAY-SEP | 1010 | 59 | 1510 | 1180 | 845 | 655 | 1700 |
| Missouri R at Fort Benton | MAY-JUL | 1230 | 56 | 1780 | 1430 | 1040 | 790 | 2160 |
| | MAY-SEP | 1580 | 60 | 2670 | 2020 | 1140 | 485 | 2600 |
| Smith R bl Eagle Ck | MAY-JUL | 41 | 51 | 73 | 54 | 32 | 20 | 80 |
| | MAY-SEP | 49 | 56 | 85 | 64 | 39 | 26 | 87 |
| Gibson Reservoir Inflow | MAY-JUL | 193 | 57 | 235 | 210 | 170 | 150 | 335 |
| | MAY-SEP | 230 | 61 | 280 | 250 | 210 | 188 | 375 |

Marias

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Two Medicine R bl SF nr Browning | MAY-JUL | 88 | 57 | 123 | 99 | 77 | 65 | 152 |
| | MAY-SEP | 91 | 56 | 124 | 102 | 79 | 67 | 161 |
| Badger Ck nr Browning | MAY-JUL | 39 | 63 | 58 | 46 | 32 | 25 | 61 |
| | MAY-SEP | 45 | 60 | 66 | 52 | 38 | 31 | 74 |
| Dupuyer Ck nr Valier | MAY-JUL | 5.2 | 69 | 12.7 | 7.3 | 3.1 | 1.4 | 7.5 |
| | MAY-SEP | 5.9 | 78 | 13.1 | 8.1 | 3.7 | 1.7 | 7.5 |
| Swift Reservoir Inflow | MAY-JUL | 29 | 69 | 43 | 34 | 25 | 21 | 42 |
| | MAY-SEP | 35 | 70 | 51 | 40 | 30 | 24 | 50 |
| Marias R nr Shelby | MAY-JUL | 184 | 64 | 305 | 230 | 137 | 94 | 285 |
| | MAY-SEP | 182 | 62 | 315 | 235 | 138 | 92 | 290 |
| Teton R nr Dutton | MAY-JUL | 8.9 | 35 | 29 | 15 | 5 | 3 | 25 |
| | MAY-SEP | 9.2 | 35 | 31 | 15.8 | 5 | 2.6 | 26 |

Fort Peck Lake

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R nr Virgelle | MAY-JUL | 1380 | 54 | 2080 | 1650 | 1180 | 835 | 2530 |
| | MAY-SEP | 1810 | 60 | 2650 | 2160 | 1550 | 1140 | 2970 |
| Missouri R nr Landusky | MAY-JUL | 1510 | 58 | 2250 | 1800 | 1290 | 850 | 2590 |
| | MAY-SEP | 1880 | 61 | 2760 | 2240 | 1600 | 1130 | 3070 |

Musselshell

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Musselshell R at Harlowton | MAY-JUL | 25 | 50 | 79 | 47 | 0.2 | -0.4 | 50 |
| | MAY-SEP | 24 | 48 | 82 | 48 | 1.2 | -0.8 | 49 |
| Musselshell R nr Roundup | MAY-JUL | 21 | 45 | 89 | 49 | -5.9 | -46 | 46 |
| | MAY-SEP | 19 | 45 | 114 | 58 | -13 | -49 | 42 |

Missouri-Poplar

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R bl Fort Peck Dam | MAY-JUL | 1400 | 54 | 2770 | 1950 | 845 | 32 | 2580 |
| | MAY-SEP | 1700 | 59 | 2710 | 2040 | 1410 | 1020 | 2840 |

Upper Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Yellowstone Lake Outlet | MAY-JUL | 495 | 89 | 580 | 525 | 460 | 415 | 555 |
| | MAY-SEP | 650 | 87 | 755 | 695 | 610 | 550 | 740 |
| Yellowstone R at Corwin Springs | MAY-JUL | 1190 | 77 | 1390 | 1270 | 1120 | 1010 | 1530 |
| | MAY-SEP | 1390 | 78 | 1630 | 1490 | 1300 | 1180 | 1780 |
| Yellowstone R at Livingston | MAY-JUL | 1320 | 74 | 1540 | 1400 | 1250 | 1120 | 1780 |
| | MAY-SEP | 1560 | 75 | 1820 | 1660 | 1470 | 1350 | 2060 |
| Boulder R at Big Timber | MAY-JUL | 210 | 77 | 255 | 230 | 193 | 169 | 270 |
| | MAY-SEP | 225 | 76 | 275 | 245 | 205 | 179 | 295 |
| Shields R nr Livingston | MAY-JUL | 36 | 35 | 71 | 51 | 22 | 2.2 | 102 |
| | MAY-SEP | 42 | 36 | 89 | 59 | 26 | 5.5 | 116 |
| Yellowstone R at Billings | MAY-JUL | 2010 | 68 | 2500 | 2240 | 1830 | 1640 | 2930 |
| | MAY-SEP | 2280 | 64 | 2780 | 2480 | 2090 | 1860 | 3530 |
| Mystic Lake Inflow | MAY-JUL | 49 | 85 | 55 | 52 | 46 | 43 | 57 |
| | MAY-SEP | 61 | 82 | 70 | 65 | 58 | 54 | 74 |
| Stillwater R nr Absarokee | MAY-JUL | 330 | 79 | 400 | 355 | 300 | 270 | 415 |
| | MAY-SEP | 390 | 76 | 480 | 420 | 360 | 325 | 510 |
| Clarks Fk Yellowstone R nr Belfry | MAY-JUL | 395 | 77 | 475 | 430 | 365 | 330 | 510 |
| | MAY-SEP | 425 | 79 | 505 | 460 | 385 | 350 | 535 |
| Cooney Reservoir Inflow | MAY-JUL | 17.3 | 52 | 34 | 23 | 12.3 | 7.5 | 33 |
| | MAY-SEP | 26 | 59 | 41 | 32 | 20 | 15.1 | 44 |

Big Horn

| | | 50% | % of | 10% | 30% | 70% | 90% | 30-yr |
|---|---|---|---|---|---|---|---|---|

| Forecast Point | period | (KAF) | med | (KAF) | (KAF) | (KAF) | (KAF) | med |
|---|---|---|---|---|---|---|---|---|
| Dinwoody Ck nr Burris | MAY-JUL | 66 | 94 | 77 | 70 | 62 | 55 | 70 |
| | MAY-SEP | 93 | 97 | 106 | 99 | 88 | 81 | 95 |
| Bull Lake Ck nr Lenore | MAY-JUL | 136 | 100 | 163 | 146 | 127 | 116 | 135 |
| | MAY-SEP | 164 | 100 | 190 | 175 | 154 | 140 | 163 |
| Wind R Ab Bull Lake Ck | MAY-JUL | 450 | 100 | 580 | 495 | 400 | 345 | 450 |
| | MAY-SEP | 465 | 105 | 600 | 525 | 415 | 355 | 440 |
| Wind R at Riverton | MAY-JUL | 475 | 102 | 605 | 520 | 430 | 380 | 465 |
| | MAY-SEP | 545 | 102 | 675 | 595 | 490 | 440 | 530 |
| Little Wind R nr Riverton | MAY-JUL | 310 | 119 | 475 | 370 | 260 | 205 | 260 |
| | MAY-SEP | 335 | 119 | 500 | 400 | 280 | 215 | 280 |
| Little Popo Agie R nr Lander | MAY-JUL | 43 | 107 | 55 | 47 | 39 | 34 | 40 |
| | MAY-SEP | 50 | 108 | 62 | 54 | 45 | 40 | 46 |
| Boysen Reservoir Inflow | MAY-JUL | 690 | 101 | 1020 | 815 | 575 | 460 | 680 |
| | MAY-SEP | 720 | 99 | 1030 | 830 | 605 | 495 | 725 |
| Greybull R at Meeteetse | MAY-JUL | 181 | 132 | 240 | 205 | 160 | 130 | 137 |
| | MAY-SEP | 240 | 126 | 310 | 270 | 215 | 182 | 190 |
| Shell Ck nr Shell | MAY-JUL | 36 | 64 | 51 | 43 | 32 | 26 | 56 |
| | MAY-SEP | 46 | 67 | 63 | 54 | 40 | 32 | 68 |
| Bighorn R at Kane | MAY-JUL | 1050 | 113 | 1840 | 1340 | 845 | 600 | 925 |
| | MAY-SEP | 1160 | 121 | 1660 | 1350 | 980 | 745 | 955 |
| NF Shoshone R at Wapiti | MAY-JUL | 380 | 89 | 460 | 415 | 350 | 315 | 425 |
| | MAY-SEP | 415 | 85 | 495 | 450 | 385 | 340 | 485 |
| SF Shoshone R nr Valley | MAY-JUL | 183 | 87 | 225 | 197 | 168 | 148 | 210 |
| | MAY-SEP | 210 | 84 | 260 | 230 | 195 | 176 | 250 |
| SF Shoshone R ab Buffalo Bill Reservoir | MAY-JUL | 172 | 81 | 235 | 197 | 149 | 120 | 210 |
| | MAY-SEP | 181 | 86 | 245 | 205 | 156 | 125 | 210 |
| Buffalo Bill Reservoir Inflow | MAY-JUL | 570 | 91 | 700 | 625 | 525 | 465 | 620 |
| | MAY-SEP | 630 | 92 | 770 | 690 | 580 | 525 | 680 |
| Bighorn R nr St. Xavier | MAY-JUL | 1420 | 95 | 2250 | 1720 | 1180 | 905 | 1480 |
| | MAY-SEP | 1510 | 93 | 2440 | 1900 | 1260 | 930 | 1610 |
| Little Bighorn R nr Hardin | MAY-JUL | 58 | 64 | 101 | 75 | 44 | 24 | 90 |
| | MAY-SEP | 69 | 63 | 113 | 88 | 53 | 32 | 108 |

Tongue

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Big Goose Ck nr Sheridan | MAY-JUL | 34 | 68 | 51 | 42 | 27 | 21 | 50 |
| | MAY-SEP | 42 | 71 | 61 | 51 | 36 | 28 | 59 |
| Little Goose Ck nr Big Horn | MAY-JUL | 22 | 73 | 32 | 26 | 18.4 | 14.2 | 30 |
| | MAY-SEP | 30 | 75 | 41 | 35 | 26 | 21 | 40 |
| Tongue R nr Dayton | MAY-JUL | 63 | 75 | 90 | 76 | 53 | 39 | 83 |
| | MAY-SEP | 71 | 73 | 99 | 83 | 59 | 46 | 96 |
| Tongue River Reservoir Inflow | MAY-JUL | 123 | 61 | 215 | 160 | 87 | 40 | 200 |
| | MAY-SEP | 145 | 64 | 235 | 183 | 106 | 52 | 225 |

Powder

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| MF Powder R nr Barnum | MAY-JUL | 10.6 | 78 | 17.7 | 13.2 | 8.5 | 6.2 | 13.5 |
| | MAY-SEP | 11.8 | 81 | 18.4 | 14.2 | 9.8 | 7.5 | 14.4 |
| NF Powder R nr Hazelton | MAY-JUL | 6.2 | 64 | 9.2 | 7.4 | 5 | 3.2 | 9.6 |
| | MAY-SEP | 6.6 | 62 | 10.2 | 7.9 | 5.3 | 4 | 10.5 |
| Rock Ck nr Buffalo | MAY-JUL | 13.9 | 69 | 24 | 18.6 | 10.3 | 3.8 | 20 |
| | MAY-SEP | 17.2 | 68 | 29 | 22 | 13.2 | 6.1 | 25 |
| Piney Ck at Kearny | MAY-JUL | 24 | 52 | 50 | 33 | 17.1 | 9.8 | 46 |
| | MAY-SEP | 26 | 54 | 55 | 36 | 18.4 | 10.5 | 48 |
| Powder R at Moorhead | MAY-JUL | 117 | 72 | 330 | 179 | 72 | 35 | 161 |
| | MAY-SEP | 120 | 69 | 305 | 181 | 71 | 29 | 173 |
| Powder R nr Locate | MAY-JUL | 141 | 76 | 440 | 235 | 77 | 28 | 184 |
| | MAY-SEP | 146 | 73 | 435 | 235 | 81 | 8 | 199 |

Lower Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Miles City | MAY-JUL | 3200 | 70 | 4290 | 3560 | 2900 | 2430 | 4570 |
| | MAY-SEP | 3600 | 68 | 4790 | 4010 | 3180 | 2640 | 5220 |
| Yellowstone R nr Sidney | MAY-JUL | 2990 | 66 | 4110 | 3390 | 2620 | 2190 | 4490 |
| | MAY-SEP | 3400 | 67 | 4930 | 3920 | 2890 | 2270 | 5060 |

Lake Sakakawea

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sakakawea Inflow | MAY-JUL | 5260 | 67 | 7170 | 6050 | 4570 | 3800 | 7830 |
| | MAY-SEP | 5880 | 66 | 8460 | 6900 | 5040 | 4110 | 8830 |

Cheyenne

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow | MAY-JUL | 2.1 | 55 | 3.3 | 2.6 | 1.7 | 1.1 | 3.8 |
| Pactola Reservoir Inflow | MAY-JUL | 12.7 | 65 | 35 | 18.4 | 8.1 | 4 | 19.5 |

North Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate | MAY-JUL | 161 | 94 | 250 | 192 | 130 | 97 | 170 |
| | MAY-SEP | 177 | 90 | 280 | 220 | 144 | 108 | 196 |
| Encampment R nr Encampment | MAY-JUL | 125 | 104 | 177 | 143 | 107 | 86 | 120 |
| | MAY-SEP | 129 | 104 | 183 | 148 | 111 | 91 | 124 |
| Seminoe Reservoir Inflow | MAY-JUL | 590 | 102 | 865 | 695 | 510 | 405 | 575 |
| | MAY-SEP | 660 | 105 | 955 | 775 | 575 | 465 | 625 |
| Rock Ck ab King Canyon Cnl nr Arlington | MAY-JUL | 53 | 112 | 65 | 57 | 49 | 44 | 47 |
| | MAY-SEP | 57 | 114 | 70 | 62 | 53 | 48 | 50 |
| Sweetwater R nr Alcova | MAY-JUL | 43 | 116 | 76 | 55 | 33 | 22 | 37 |
| | MAY-SEP | 46 | 112 | 84 | 60 | 35 | 24 | 41 |
| La Prele Ck nr Douglas | MAY-JUL | 7.8 | 58 | 15.3 | 10.8 | 5.2 | 2.1 | 13.4 |
| | MAY-SEP | 8.6 | 66 | 16.8 | 11.6 | 5.9 | 2.6 | 12.9 |
| North Platte R bl Glendo Reservoir | MAY-JUL | 655 | 103 | 985 | 790 | 525 | 365 | 635 |
| | MAY-SEP | 670 | 101 | 965 | 795 | 550 | 390 | 660 |
| North Platte R bl Guernsey Reservoir | MAY-JUL | 665 | 107 | 1000 | 810 | 520 | 335 | 620 |
| | MAY-SEP | 680 | 104 | 955 | 760 | 570 | 465 | 650 |
| Laramie R and Pioneer Cnl nr Woods Lg | MAY-JUL | 117 | 105 | 163 | 134 | 104 | 86 | 111 |
| | MAY-SEP | 126 | 105 | 174 | 145 | 111 | 91 | 120 |
| Little Laramie R nr Filmore | MAY-JUL | 56 | 114 | 73 | 63 | 50 | 43 | 49 |
| | MAY-SEP | 58 | 109 | 78 | 66 | 51 | 43 | 53 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# June 2024 Calendar Year Runoff Forecast
# June 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

May runoff was 3.5 MAF, 104% of average and 1.0 MAF higher than forecast. Runoff was below average in the Fort Peck, Oahe, and Fort Randall reaches, but well-above average in the Garrison, Gavins Point, and Sioux City reaches.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **21.0 MAF, 82% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **18.9 MAF, 81% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next seven months, expected inflow could range from the 17.5 MAF lower basic forecast to the 25.1 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that seven months are being forecast for this June 1 forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for June 4 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 30% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of August, indicates drought conditions are likely to persist or worsen in Montana and the upper Basin, but improve in the lower Basin.

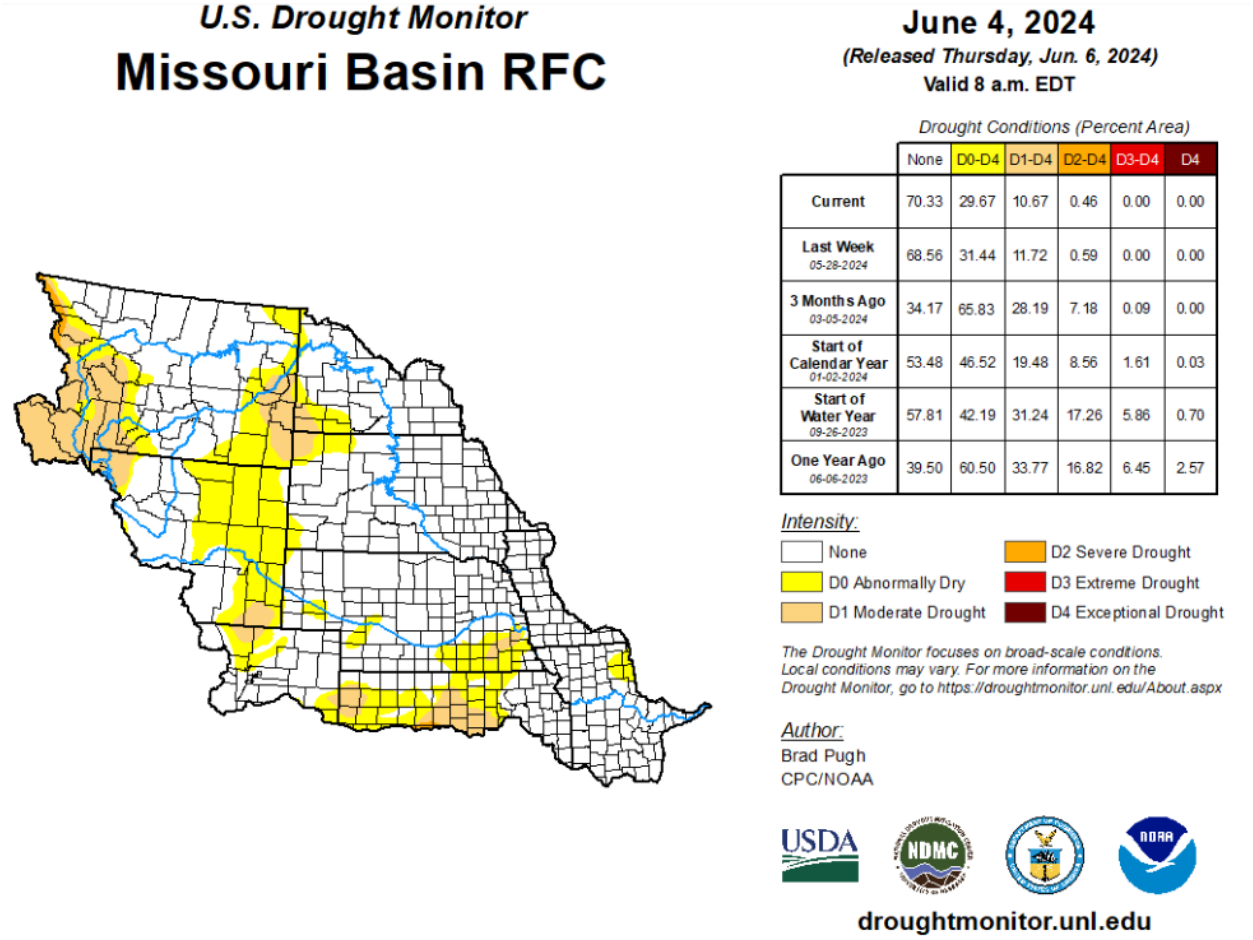


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

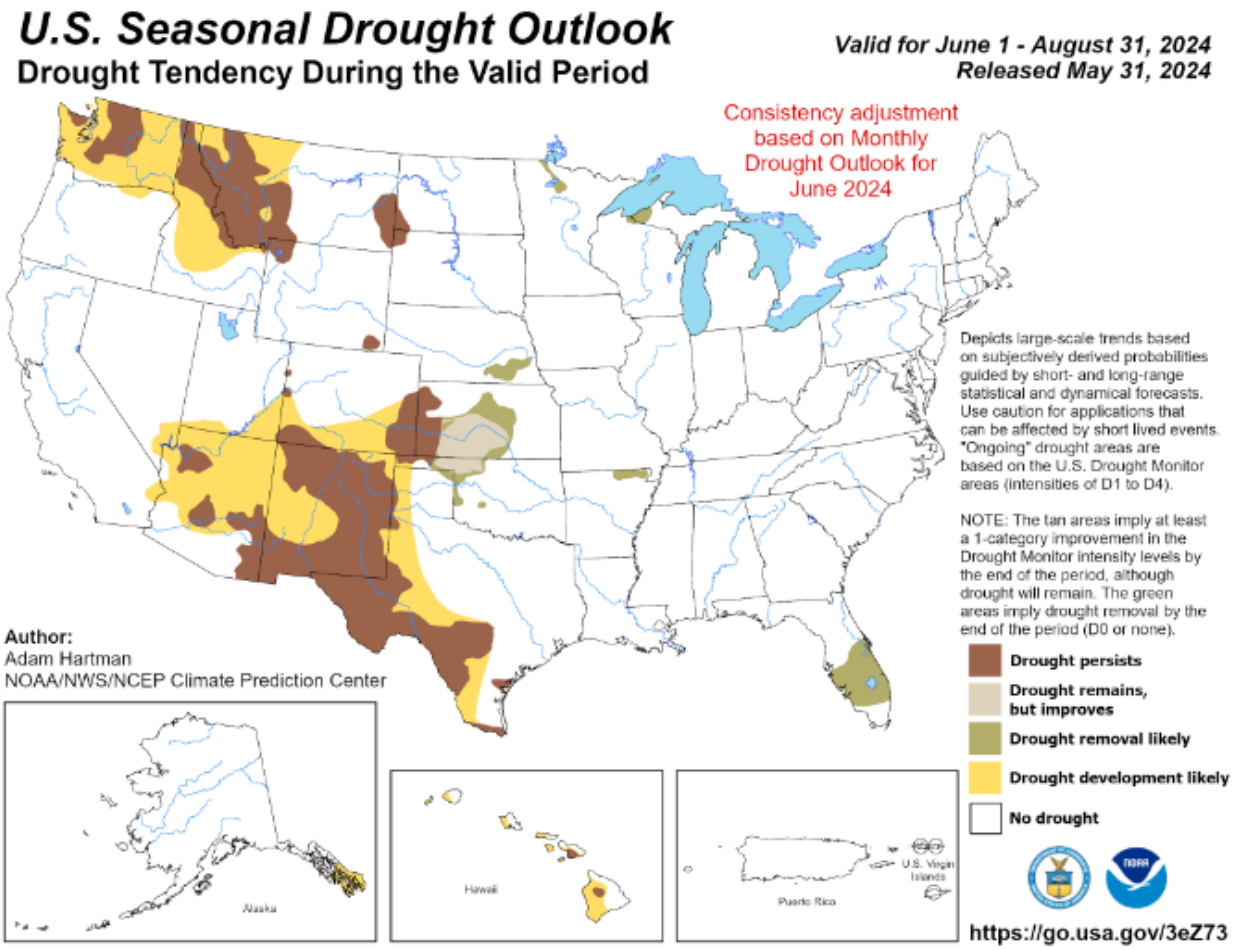


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The May precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was mixed across the Basin, with up to 300 percent of normal in areas of Montana, North Dakota, Nebraska, and Iowa. Areas of South Dakota, Colorado, and Wyoming saw as little as 5 percent of normal precipitation.

Precipitation as a percent of normal for the March-April-May period (**Figure 4**) was also mixed over the upper Basin. Precipitation in parts of Montana, the western Dakotas, and into eastern Wyoming was below normal, and in much of the Dakotas and north-central Montana, it was above normal.

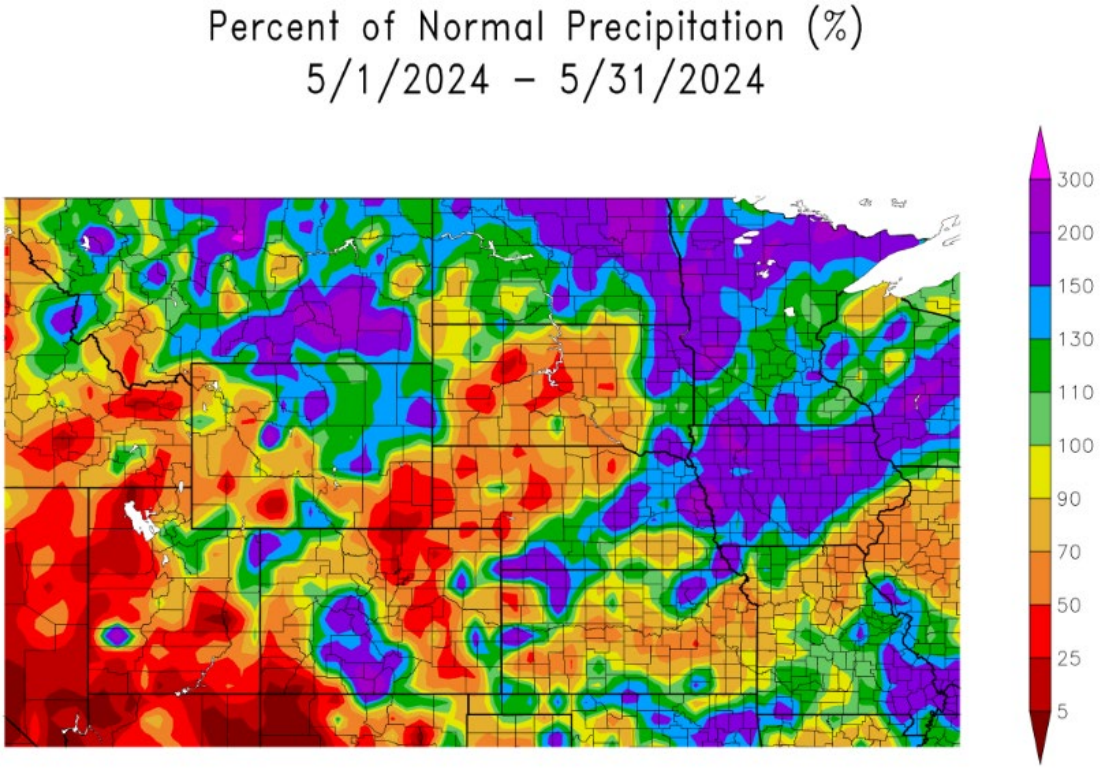


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

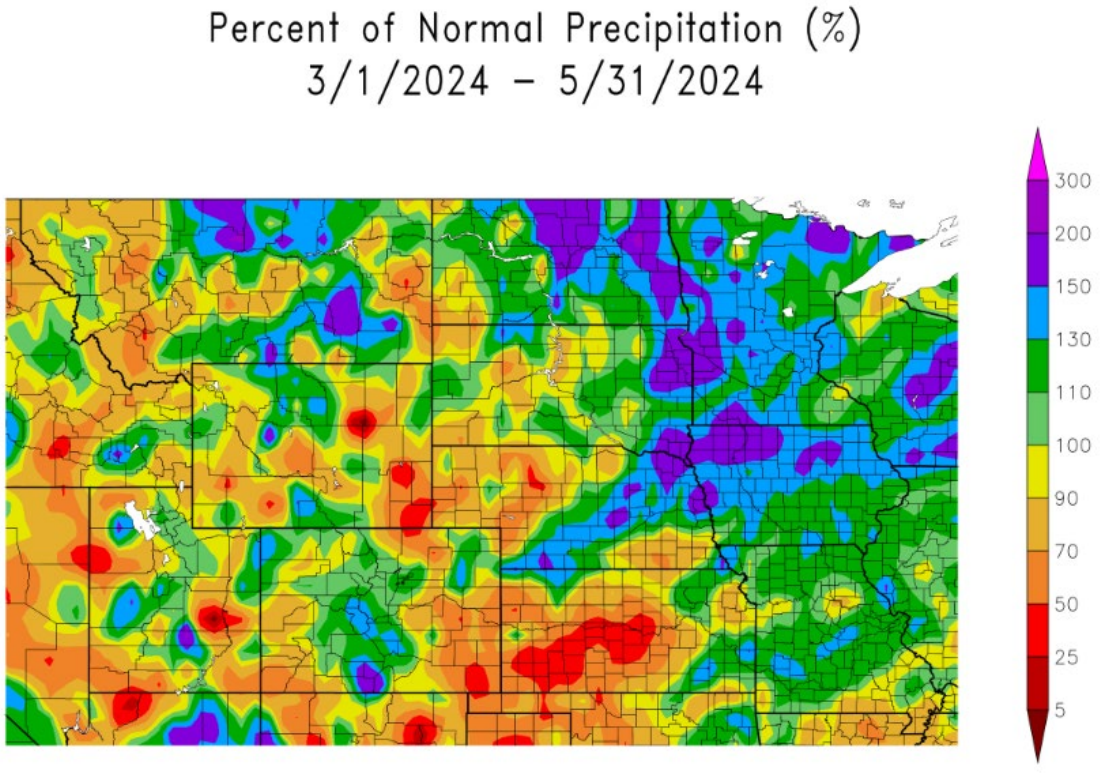


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

May temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures in the eastern portion of the Basin, and cooler-than-normal temperatures in the western portion. March-April-May temperature departures are shown in **Figure 6**. The three-month average temperature departures follow the same pattern, with slightly warmer temperatures everywhere.

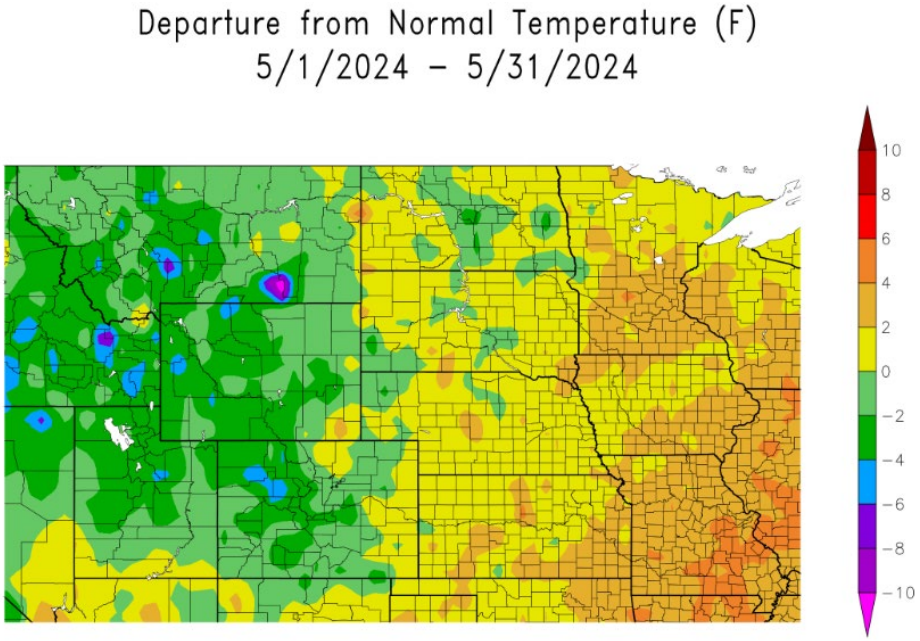


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

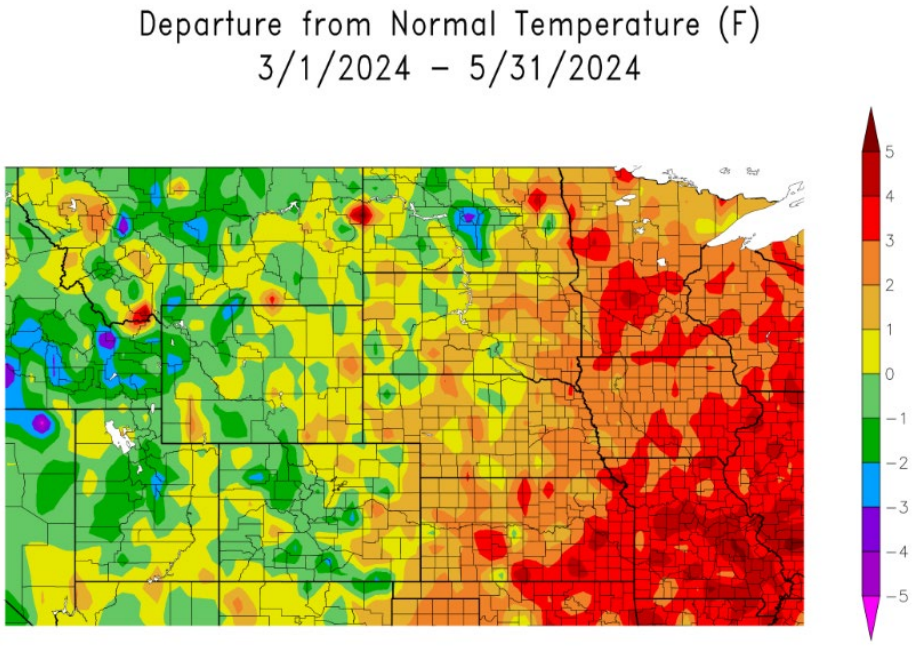


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

## Soil Moisture

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile at the beginning of June are shown in **Figure 7**. Soil moisture is below normal in Montana, northern North Dakota, Wyoming, western Colorado, and most of the lower Basin. Soil moisture is above normal in South Dakota, most of Nebraska, and eastern Colorado.

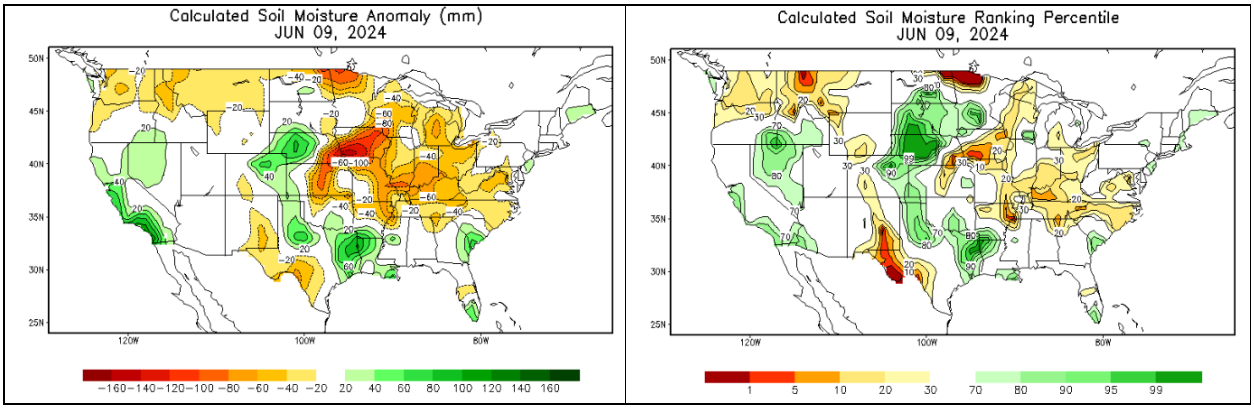


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

## Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

The National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) modeled snow assessment (available here) from June 1, 2024, shown in **Figure 8**, shows no plains snowmelt remaining.

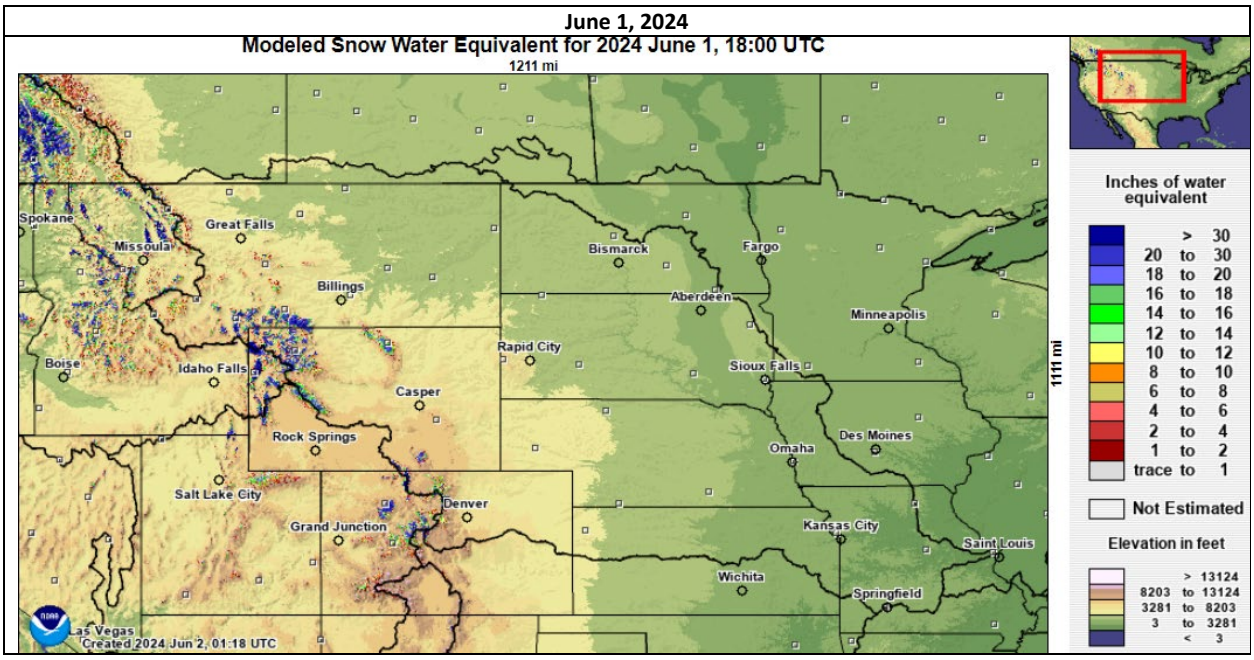


**Figure 8. NOHRSC Modeled Snow Water Equivalent**

### Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 9** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

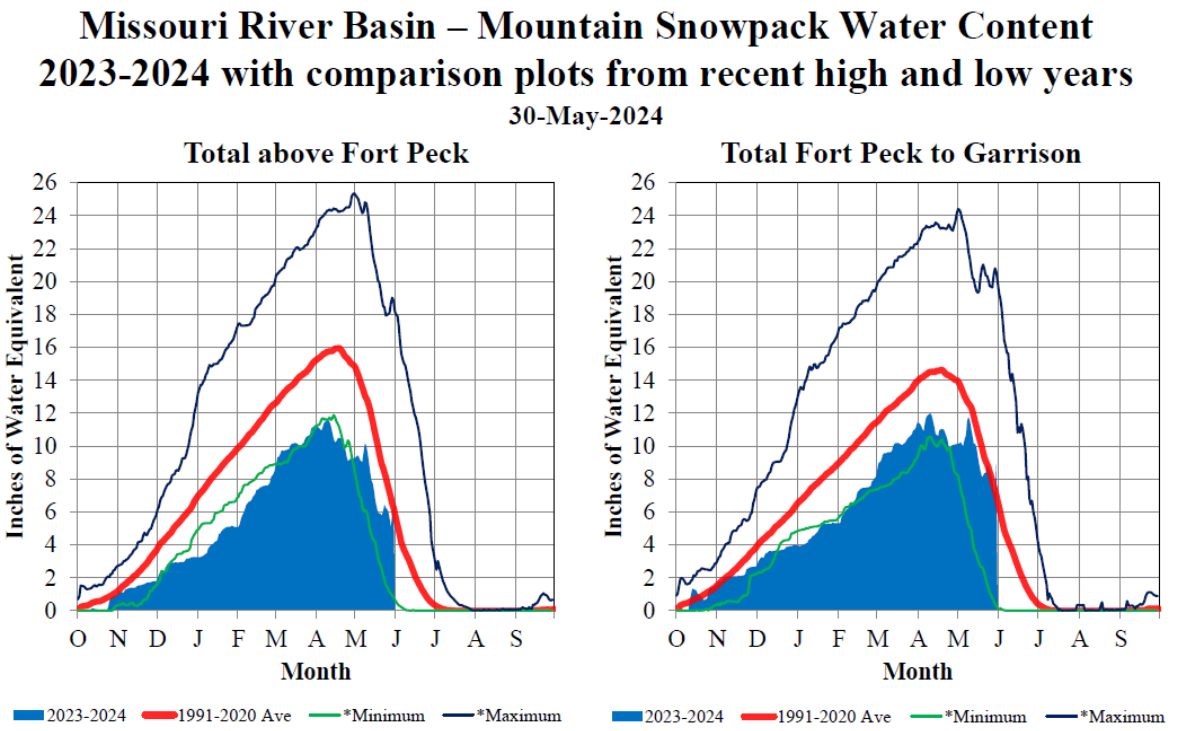


**Figure 9. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of May 30, 2024 the mountain Snow Water Equivalent (SWE) in the "Total above Fort Peck" reach is 6.5" and 56% of the annual peak remains. The mountain SWE in the "Fort Peck to Garrison" reach is 8.9" and 74% of the annual peak remains.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

**El Niño Southern Oscillation (ENSO)**

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

El Niño conditions are currently transitioning towards ENSO-Neutral and should be complete this month. La Niña may develop in June-August 2024 (49% chance) or July-September (69% chance).

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for June (**Figure 10**) indicates increased chances for above-normal temperatures across the Basin. The June precipitation outlook (**Figure 10**) shows equal chances of below-normal, normal, or above-normal precipitation over most of the Basin. There are increased chances for below-normal precipitation in Montana, Wyoming, and the western Dakotas.

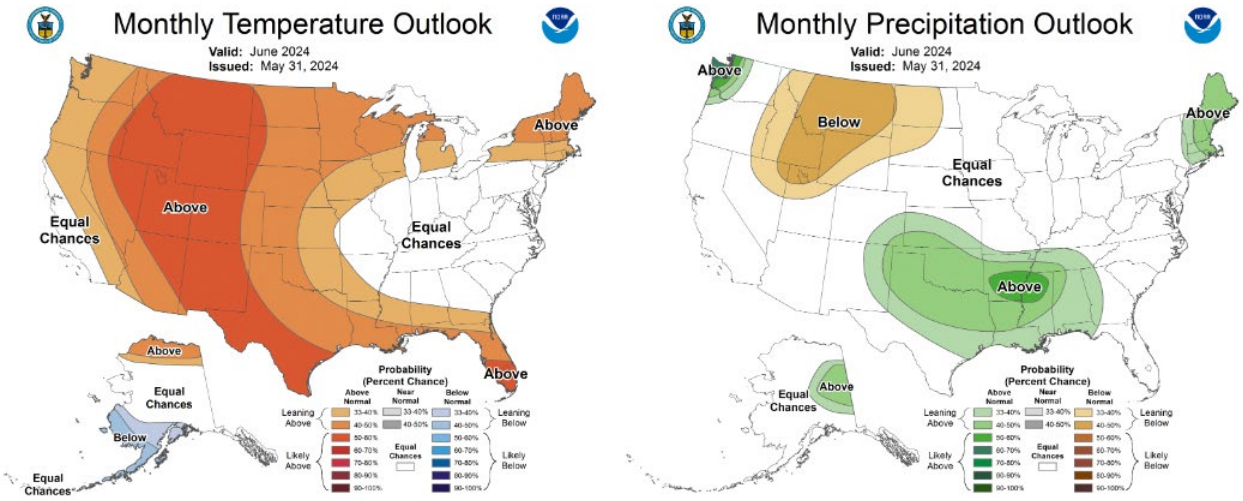


**Figure 10. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 11**. The July-August-September temperature outlook indicates increased chances for warmer-than-normal temperatures across the entire Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation in most of the Basin.

The October-November-December temperature outlook indicates increased chances for warmer-than-normal temperatures across most of the Basin, with equal chances for cooler-than-normal, normal, or warmer-than-normal temperatures in Montana, North Dakota, and South Dakota. The precipitation outlook for the end of the year shows equal chances for below-normal, normal, or above-normal precipitation for most of the Basin, and slightly increased chances for below-normal precipitation in Colorado, Nebraska, and Kansas.

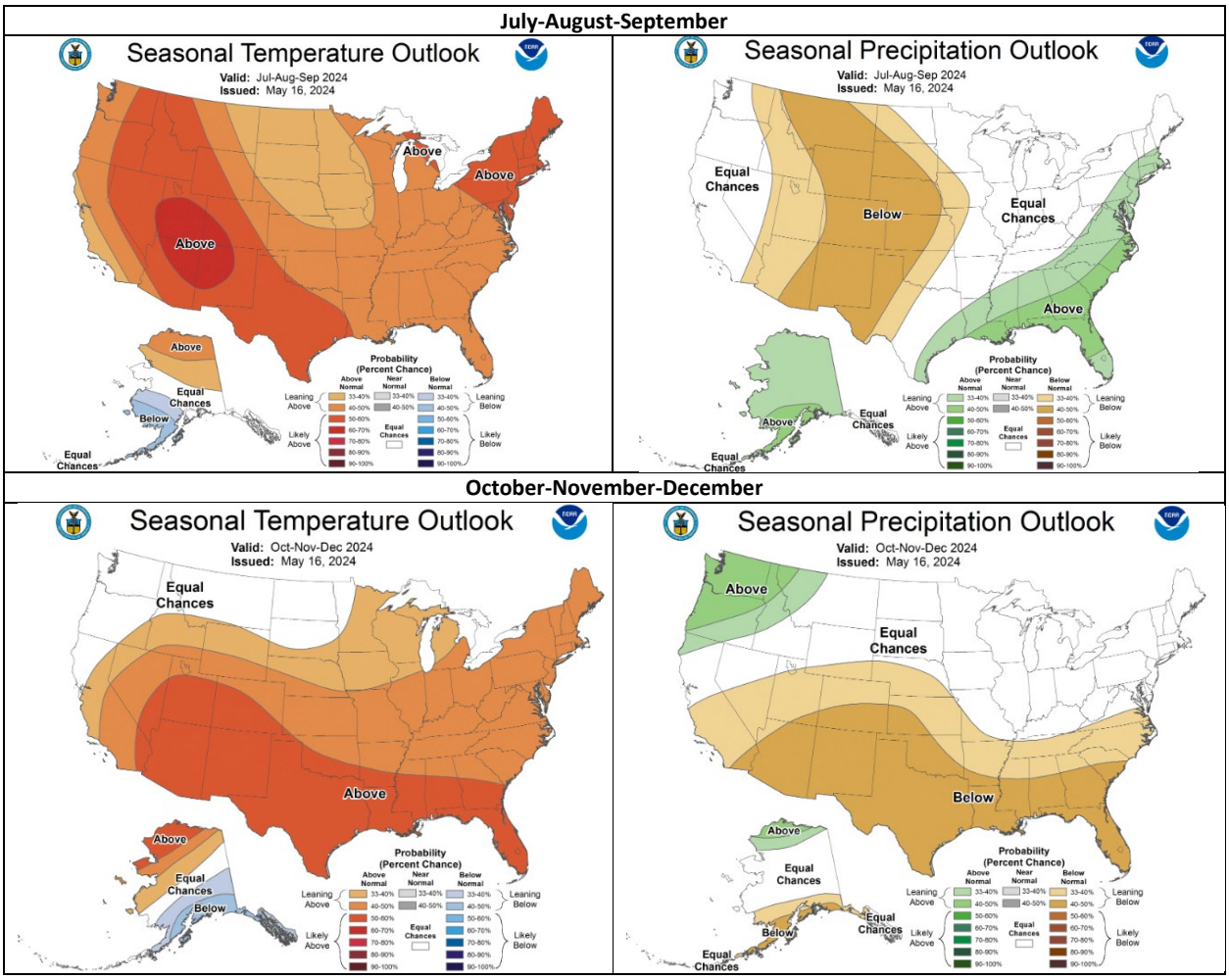


**Figure 11. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, mountain snowpack, and forecast temperatures and precipitation. Given these factors we expect runoff during June and July for Fort Peck and Garrison to be below average. Runoff in all other reaches except Sioux City during the same period is also expected to be below average. The Sioux City reach is expected to have near normal runoff in June and July. In summary, the 2024 calendar year runoff forecast is **21.0 MAF, 82% of average**.

# NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: 06 Jun 2024 11:30 AM
   - Based on 06-01-2024 forecast values  - Not filtered by publish status(es)

Upper South Saskatchewan River

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sherburne Inflow | JUN-JUL | 50 | 96 | 62 | 55 | 45 | 40 | 52 |
| | JUN-SEP | 65 | 98 | 79 | 70 | 59 | 52 | 66 |
| St. Mary R nr Babb | JUN-JUL | 220 | 95 | 270 | 240 | 205 | 185 | 230 |
| | JUN-SEP | 270 | 96 | 330 | 295 | 250 | 220 | 280 |
| St. Mary R at Intl Boundary | JUN-JUL | 250 | 96 | 320 | 275 | 230 | 199 | 260 |
| | JUN-SEP | 315 | 95 | 395 | 345 | 285 | 250 | 330 |

Missouri Headwaters

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lima Reservoir Inflow | JUN-JUL | 17.8 | 68 | 32 | 23 | 13 | 7.5 | 26 |
| | JUN-SEP | 24 | 68 | 43 | 31 | 18.9 | 12.5 | 35 |
| Clark Canyon Inflow | JUN-JUL | 7.3 | 75 | 37 | 19.5 | -4.9 | -23 | 9.7 |
| | JUN-SEP | 16 | 84 | 53 | 31 | 1 | -21 | 18.9 |
| Beaverhead R at Barretts | JUN-JUL | 16.8 | 70 | 59 | 31 | 7.1 | 0.4 | 24 |
| | JUN-SEP | 30 | 78 | 74 | 48 | 11.5 | -14.8 | 38 |
| Ruby R Reservoir Inflow | JUN-JUL | 31 | 88 | 46 | 37 | 25 | 15.8 | 35 |
| | JUN-SEP | 44 | 89 | 62 | 51 | 37 | 26 | 49 |
| Big Hole R at Wisdom | JUN-JUL | 13.5 | 38 | 38 | 22 | 7.1 | 1.4 | 35 |
| | JUN-SEP | 16.6 | 40 | 44 | 26 | 9.2 | 2.2 | 41 |
| Big Hole R nr Melrose | JUN-JUL | 117 | 48 | 225 | 161 | 74 | 10 | 240 |
| | JUN-SEP | 146 | 48 | 270 | 195 | 97 | 24 | 300 |
| Jefferson R nr Twin Bridges | JUN-JUL | 84 | 39 | 275 | 162 | 6 | 1 | 215 |
| | JUN-SEP | 98 | 41 | 310 | 184 | 12 | 1 | 235 |
| Willow Ck Reservoir Inflow | JUN-JUL | 5.3 | 51 | 11.2 | 7.5 | 3.4 | 0.8 | 10.2 |
| Jefferson R nr Three Forks | JUN-JUL | 151 | 51 | 335 | 225 | 76 | 1 | 295 |
| | JUN-SEP | 153 | 47 | 375 | 245 | 64 | 1 | 320 |
| Boulder R nr Boulder | JUN-JUL | 16.8 | 60 | 33 | 23 | 12.1 | 6.9 | 28 |
| | JUN-SEP | 19.3 | 64 | 41 | 27 | 13.4 | 6.8 | 30 |
| Hebgen Lake Inflow | JUN-JUL | 142 | 91 | 177 | 155 | 130 | 114 | 155 |
| | JUN-SEP | 215 | 86 | 270 | 240 | 192 | 159 | 250 |
| Ennis Lake Inflow | JUN-JUL | 270 | 87 | 335 | 295 | 250 | 220 | 310 |
| | JUN-SEP | 405 | 89 | 485 | 440 | 380 | 340 | 455 |
| Gallatin R nr Gallatin Gateway | JUN-JUL | 220 | 89 | 280 | 245 | 195 | 159 | 245 |
| | JUN-SEP | 280 | 91 | 355 | 310 | 250 | 205 | 305 |
| Hyalite Reservoir Inflow | JUN-JUL | 13.2 | 97 | 16.4 | 14.4 | 12.1 | 10.9 | 13.6 |
| | JUN-SEP | 15.5 | 97 | 19.9 | 17 | 14.2 | 12.6 | 15.9 |
| Gallatin R at Logan | JUN-JUL | 183 | 83 | 280 | 225 | 143 | 84 | 220 |
| | JUN-SEP | 230 | 86 | 345 | 275 | 183 | 115 | 265 |

Upper Missouri

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R at Toston | JUN-JUL | 585 | 62 | 900 | 705 | 475 | 340 | 935 |
| | JUN-SEP | 785 | 69 | 1190 | 940 | 650 | 475 | 1130 |
| Missouri R at Fort Benton | JUN-JUL | 895 | 67 | 1390 | 1100 | 695 | 400 | 1320 |
| | JUN-SEP | 1250 | 70 | 1860 | 1500 | 1000 | 635 | 1780 |
| Smith R bl Eagle Ck | JUN-JUL | 27 | 60 | 64 | 39 | 17 | 8.9 | 45 |
| | JUN-SEP | 29 | 55 | 63 | 41 | 20 | 12.1 | 52 |
| Gibson Reservoir Inflow | JUN-JUL | 98 | 55 | 159 | 123 | 73 | 37 | 176 |
| | JUN-SEP | 129 | 57 | 200 | 159 | 82 | 39 | 225 |

Marias

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Two Medicine R bl SF nr Browning | JUN-JUL | 50 | 65 | 71 | 58 | 41 | 32 | 76 |
| | JUN-SEP | 56 | 64 | 83 | 67 | 48 | 39 | 87 |
| Badger Ck nr Browning | JUN-JUL | 21 | 58 | 35 | 26 | 16.8 | 11.4 | 36 |
| | JUN-SEP | 29 | 60 | 46 | 35 | 23 | 16.3 | 48 |
| Dupuyer Ck nr Valier | JUN-JUL | 2.9 | 65 | 6.7 | 4.4 | 1.4 | 1 | 4.4 |
| | JUN-SEP | 3.6 | 69 | 7.6 | 5.2 | 2 | 1 | 5.2 |
| Swift Reservoir Inflow | JUN-JUL | 18 | 69 | 27 | 22 | 14.8 | 11.2 | 26 |
| | JUN-SEP | 24 | 72 | 37 | 29 | 21 | 16.9 | 33 |
| Marias R nr Shelby | JUN-JUL | 75 | 49 | 220 | 121 | 38 | 12 | 153 |
| | JUN-SEP | 79 | 58 | 245 | 135 | 44 | 11 | 135 |
| Teton R nr Dutton | JUN-JUL | 2.9 | 20 | 13.3 | 6.2 | 0.8 | 0 | 14.1 |
| | JUN-SEP | 4.1 | 24 | 17.1 | 8.3 | 1.4 | 0 | 16.5 |

Fort Peck Lake

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R nr Virgelle | JUN-JUL | 1060 | 65 | 1670 | 1280 | 900 | 685 | 1630 |
| | JUN-SEP | 1410 | 67 | 2230 | 1670 | 1070 | 785 | 2090 |
| Missouri R nr Landusky | JUN-JUL | 1130 | 66 | 1750 | 1380 | 880 | 510 | 1690 |
| | JUN-SEP | 1510 | 67 | 2270 | 1820 | 1210 | 755 | 2230 |

Musselshell

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Musselshell R at Harlowton | JUN-JUL | 21 | 77 | 49 | 32 | 9.5 | -4.4 | 27 |
| | JUN-SEP | 22 | 81 | 52 | 33 | 10 | -5.5 | 27 |
| Musselshell R nr Roundup | JUN-JUL | 19.2 | 64 | 71 | 40 | -1.8 | -30 | 30 |
| | JUN-SEP | 15 | 60 | 64 | 35 | -5.8 | -35 | 25 |

Missouri-Poplar

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R bl Fort Peck Dam | JUN-JUL | 1110 | 67 | 1880 | 1420 | 795 | 335 | 1640 |
| | JUN-SEP | 1390 | 71 | 2470 | 1830 | 950 | 310 | 1950 |

Upper Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Yellowstone Lake Outlet | JUN-JUL | 455 | 96 | 545 | 490 | 420 | 375 | 470 |
| | JUN-SEP | 635 | 93 | 755 | 680 | 585 | 520 | 680 |
| Yellowstone R at Corwin Springs | JUN-JUL | 970 | 88 | 1180 | 1050 | 895 | 790 | 1100 |
| | JUN-SEP | 1220 | 85 | 1470 | 1320 | 1130 | 1000 | 1420 |
| Yellowstone R at Livingston | JUN-JUL | 1130 | 88 | 1380 | 1230 | 1040 | 915 | 1280 |
| | JUN-SEP | 1460 | 92 | 1770 | 1580 | 1350 | 1210 | 1580 |
| Boulder R at Big Timber | JUN-JUL | 215 | 100 | 260 | 235 | 196 | 173 | 215 |
| | JUN-SEP | 235 | 97 | 295 | 260 | 210 | 186 | 240 |
| Shields R nr Livingston | JUN-JUL | 42 | 75 | 70 | 52 | 34 | 25 | 56 |
| | JUN-SEP | 44 | 68 | 76 | 56 | 35 | 24 | 64 |
| Yellowstone R at Billings | JUN-JUL | 1990 | 86 | 2530 | 2200 | 1800 | 1570 | 2290 |
| | JUN-SEP | 2410 | 84 | 3130 | 2710 | 2160 | 1880 | 2860 |
| Mystic Lake Inflow | JUN-JUL | 47 | 97 | 53 | 49 | 44 | 41 | 48 |
| | JUN-SEP | 63 | 96 | 72 | 67 | 59 | 54 | 65 |
| Stillwater R nr Absarokee | JUN-JUL | 330 | 98 | 400 | 355 | 305 | 275 | 335 |
| | JUN-SEP | 395 | 94 | 495 | 435 | 365 | 320 | 420 |
| Clarks Fk Yellowstone R nr Belfry | JUN-JUL | 350 | 94 | 425 | 385 | 325 | 290 | 370 |
| | JUN-SEP | 385 | 96 | 470 | 425 | 355 | 310 | 400 |
| Cooney Reservoir Inflow | JUN-JUL | 19.1 | 86 | 32 | 24 | 15.4 | 11 | 22 |
| | JUN-SEP | 26 | 81 | 40 | 32 | 22 | 17.3 | 32 |

Big Horn

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Dinwoody Ck nr Burris | JUN-JUL | 52 | 89 | 60 | 56 | 49 | 45 | 58 |
| | JUN-SEP | 78 | 92 | 89 | 82 | 73 | 68 | 84 |
| Bull Lake Ck nr Lenore | JUN-JUL | 108 | 104 | 132 | 117 | 99 | 88 | 103 |
| | JUN-SEP | 137 | 105 | 168 | 149 | 127 | 112 | 130 |
| Wind R Ab Bull Lake Ck | JUN-JUL | 335 | 95 | 525 | 405 | 280 | 205 | 350 |
| | JUN-SEP | 350 | 97 | 535 | 415 | 290 | 220 | 360 |
| Wind R at Riverton | JUN-JUL | 340 | 91 | 420 | 370 | 310 | 270 | 370 |
| | JUN-SEP | 405 | 96 | 515 | 450 | 365 | 310 | 420 |
| Little Wind R nr Riverton | JUN-JUL | 235 | 129 | 350 | 275 | 200 | 157 | 181 |
| | JUN-SEP | 250 | 121 | 390 | 300 | 210 | 158 | 205 |
| Little Popo Agie R nr Lander | JUN-JUL | 31 | 110 | 40 | 34 | 28 | 24 | 28 |
| | JUN-SEP | 38 | 115 | 47 | 41 | 35 | 31 | 33 |
| Boysen Reservoir Inflow | JUN-JUL | 490 | 107 | 755 | 585 | 405 | 300 | 455 |
| | JUN-SEP | 545 | 112 | 855 | 660 | 445 | 325 | 485 |
| Greybull R at Meeteetse | JUN-JUL | 134 | 131 | 184 | 152 | 117 | 96 | 102 |
| | JUN-SEP | 171 | 111 | 225 | 191 | 152 | 128 | 153 |
| Shell Ck nr Shell | JUN-JUL | 44 | 129 | 57 | 49 | 40 | 34 | 34 |
| | JUN-SEP | 56 | 119 | 70 | 61 | 51 | 44 | 47 |
| Bighorn R at Kane | JUN-JUL | 755 | 111 | 1060 | 875 | 640 | 480 | 675 |
| | JUN-SEP | 800 | 108 | 1140 | 935 | 665 | 480 | 740 |
| NF Shoshone R at Wapiti | JUN-JUL | 330 | 104 | 395 | 355 | 305 | 270 | 315 |
| | JUN-SEP | 385 | 104 | 455 | 415 | 355 | 320 | 370 |
| SF Shoshone R nr Valley | JUN-JUL | 148 | 92 | 182 | 161 | 135 | 116 | 160 |
| | JUN-SEP | 170 | 87 | 205 | 185 | 156 | 137 | 194 |
| SF Shoshone R ab Buffalo Bill Reservoir | JUN-JUL | 134 | 88 | 178 | 152 | 117 | 93 | 151 |
| | JUN-SEP | 147 | 91 | 197 | 167 | 128 | 102 | 160 |
| Buffalo Bill Reservoir Inflow | JUN-JUL | 445 | 96 | 565 | 490 | 400 | 340 | 460 |
| | JUN-SEP | 520 | 100 | 665 | 575 | 470 | 400 | 520 |
| Bighorn R nr St. Xavier | JUN-JUL | 1080 | 102 | 1880 | 1360 | 855 | 600 | 1050 |
| | JUN-SEP | 1170 | 105 | 1870 | 1430 | 950 | 675 | 1110 |
| Little Bighorn R nr Hardin | JUN-JUL | 79 | 143 | 137 | 99 | 63 | 44 | 55 |
| | JUN-SEP | 93 | 136 | 156 | 116 | 74 | 51 | 68 |

Tongue

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Big Goose Ck nr Sheridan | JUN-JUL | 40 | 125 | 50 | 44 | 36 | 31 | 32 |
| | JUN-SEP | 47 | 114 | 59 | 52 | 43 | 38 | 41 |
| Little Goose Ck nr Big Horn | JUN-JUL | 23 | 118 | 30 | 26 | 20 | 17.3 | 19.4 |
| | JUN-SEP | 30 | 103 | 38 | 33 | 27 | 23 | 29 |
| Tongue R nr Dayton | JUN-JUL | 61 | 127 | 75 | 67 | 56 | 49 | 48 |
| | JUN-SEP | 71 | 114 | 91 | 79 | 65 | 56 | 62 |
| Tongue River Reservoir Inflow | JUN-JUL | 148 | 120 | 197 | 167 | 129 | 103 | 123 |
| | JUN-SEP | 167 | 115 | 235 | 194 | 143 | 111 | 144 |

Powder

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| MF Powder R nr Barnum | JUN-JUL | 5.1 | 130 | 8.7 | 6.4 | 4.1 | 2.8 | 3.9 |
| | JUN-SEP | 6.8 | 138 | 11.6 | 8.5 | 5.4 | 3.7 | 4.9 |
| NF Powder R nr Hazelton | JUN-JUL | 4.1 | 93 | 6.5 | 5 | 3.4 | 2.5 | 4.4 |
| | JUN-SEP | 4.8 | 90 | 7.5 | 5.8 | 4 | 3.1 | 5.3 |
| Rock Ck nr Buffalo | JUN-JUL | 15.7 | 131 | 23 | 18.4 | 13.4 | 10.7 | 11.9 |
| | JUN-SEP | 17.6 | 109 | 26 | 21 | 15 | 11.9 | 16.1 |
| Piney Ck at Kearny | JUN-JUL | 34 | 130 | 54 | 41 | 27 | 19.9 | 26 |
| | JUN-SEP | 39 | 125 | 62 | 47 | 31 | 23 | 31 |
| Powder R at Moorhead | JUN-JUL | 126 | 143 | 220 | 158 | 100 | 69 | 88 |
| | JUN-SEP | 170 | 160 | 305 | 215 | 131 | 87 | 106 |
| Powder R nr Locate | JUN-JUL | 152 | 153 | 360 | 215 | 105 | 61 | 99 |
| | JUN-SEP | 205 | 169 | 545 | 305 | 138 | 77 | 121 |

Lower Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Miles City | JUN-JUL | 3010 | 88 | 4170 | 3440 | 2640 | 2180 | 3390 |
| | JUN-SEP | 3420 | 83 | 4860 | 3950 | 2960 | 2410 | 4100 |
| Yellowstone R nr Sidney | JUN-JUL | 3050 | 90 | 4210 | 3480 | 2680 | 2220 | 3360 |
| | JUN-SEP | 3310 | 83 | 4700 | 3820 | 2820 | 2130 | 3950 |

Lake Sakakawea

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sakakawea Inflow | JUN-JUL | 4720 | 84 | 6840 | 5490 | 4040 | 3280 | 5560 |
| | JUN-SEP | 5520 | 85 | 8590 | 6550 | 4490 | 3460 | 6450 |

Cheyenne

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow | JUN-JUL | 1.5 | 62 | 2.5 | 1.8 | 1.2 | 0.8 | 2.4 |
| Pactola Reservoir Inflow | JUN-JUL | 4.9 | 47 | 12.1 | 7.5 | 2.7 | 0 | 10.3 |

North Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate | JUN-JUL | 108 | 88 | 155 | 125 | 93 | 75 | 122 |
| | JUN-SEP | 138 | 96 | 205 | 162 | 117 | 94 | 143 |
| Encampment R nr Encampment | JUN-JUL | 81 | 122 | 111 | 92 | 72 | 60 | 66 |
| | JUN-SEP | 95 | 130 | 134 | 110 | 83 | 68 | 73 |
| Seminoe Reservoir Inflow | JUN-JUL | 435 | 122 | 595 | 495 | 380 | 320 | 355 |
| | JUN-SEP | 455 | 113 | 630 | 520 | 400 | 330 | 400 |
| Rock Ck ab King Canyon Cnl nr Arlington | JUN-JUL | 39 | 130 | 48 | 42 | 36 | 31 | 30 |
| | JUN-SEP | 42 | 127 | 52 | 46 | 39 | 35 | 33 |
| Sweetwater R nr Alcova | JUN-JUL | 25 | 108 | 48 | 33 | 19.1 | 12.6 | 23 |
| | JUN-SEP | 30 | 115 | 50 | 37 | 24 | 17.4 | 26 |
| La Prele Ck nr Douglas | JUN-JUL | 3.9 | 144 | 11.8 | 6.1 | 2.4 | 1.2 | 2.7 |
| | JUN-SEP | 5.6 | 147 | 17 | 8.9 | 3.6 | 1.9 | 3.8 |
| North Platte R bl Glendo Reservoir | JUN-JUL | 435 | 119 | 640 | 515 | 360 | 260 | 365 |
| | JUN-SEP | 435 | 111 | 695 | 535 | 345 | 230 | 390 |
| North Platte R bl Guernsey Reservoir | JUN-JUL | 440 | 123 | 615 | 510 | 370 | 265 | 355 |
| | JUN-SEP | 445 | 117 | 720 | 550 | 350 | 230 | 380 |
| Laramie R and Pioneer Cnl nr Woods Lg | JUN-JUL | 62 | 86 | 80 | 69 | 55 | 47 | 72 |
| | JUN-SEP | 75 | 92 | 94 | 82 | 69 | 61 | 81 |
| Little Laramie R nr Filmore | JUN-JUL | 41 | 117 | 54 | 46 | 37 | 31 | 35 |
| | JUN-SEP | 44 | 112 | 58 | 49 | 39 | 33 | 39 |

South Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Antero Reservoir Inflow | JUN-JUL | 11.6 | 128 | 15.2 | 13 | 10.4 | 8.8 | 9 |
| | JUN-SEP | 15.2 | 135 | 18.1 | 16.4 | 14 | 12.4 | 11.2 |
| Spinney Mountain Reservoir Inflow | JUN-JUL | 45 | 140 | 52 | 48 | 42 | 38 | 32 |
| | JUN-SEP | 59 | 137 | 68 | 63 | 56 | 51 | 43 |
| Elevenmile Canyon Reservoir Inflow | JUN-JUL | 44 | 133 | 53 | 48 | 41 | 38 | 33 |
| | JUN-SEP | 60 | 133 | 70 | 64 | 57 | 52 | 45 |
| Cheesman Lake Inflow | JUN-JUL | 66 | 124 | 75 | 70 | 62 | 58 | 53 |
| | JUN-SEP | 91 | 116 | 107 | 98 | 85 | 76 | 78 |
| South Platte R at South Platte | JUN-JUL | 107 | 116 | 125 | 115 | 101 | 90 | 92 |
| | JUN-SEP | 150 | 114 | 176 | 162 | 140 | 127 | 131 |
| Bear Ck ab Evergreen | JUN-JUL | 6.5 | 101 | 9.9 | 7.7 | 5.3 | 4.1 | 6.4 |
| | JUN-SEP | 10.7 | 102 | 17.5 | 13.2 | 8.6 | 6.3 | 10.4 |
| Clear Ck at Golden | JUN-JUL | 77 | 101 | 88 | 82 | 73 | 67 | 76 |
| | JUN-SEP | 99 | 99 | 113 | 105 | 92 | 85 | 100 |
| Boulder Ck nr Orodell | JUN-JUL | 36 | 100 | 45 | 39 | 32 | 28 | 36 |
| | JUN-SEP | 44 | 97 | 55 | 48 | 39 | 33 | 45 |
| South Boulder Ck nr Eldorado Springs | JUN-JUL | 22 | 95 | 27 | 24 | 20 | 17.8 | 23 |
| | JUN-SEP | 28 | 103 | 35 | 30 | 25 | 21 | 27 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| St. Vrain Ck at Lyons | JUN-JUL | 59 | 100 | 73 | 65 | 54 | 48 | 59 |
| | JUN-SEP | 78 | 104 | 95 | 85 | 72 | 64 | 75 |
| Big Thompson R at Canyon Mouth | JUN-JUL | 59 | 96 | 74 | 65 | 54 | 46 | 61 |
| | JUN-SEP | 80 | 101 | 99 | 87 | 74 | 63 | 79 |
| Cache La Poudre R at Canyon Mouth | JUN-JUL | 148 | 103 | 174 | 159 | 137 | 123 | 143 |
| | JUN-SEP | 174 | 102 | 210 | 188 | 161 | 144 | 169 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# July 2024 Calendar Year Runoff Forecast
# July 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

June runoff was 6.6 MAF, 119% of average and 2.6 MAF higher than forecast. Runoff was below average in the Fort Peck, Garrison, and Oahe reaches, and above average in the Fort Randall, Gavins Point, and Sioux City reaches. In particular, the Sioux City reach runoff was 681% of normal.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **24.6 MAF, 96% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **19.5 MAF, 84% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next six months, expected inflow could range from the 22.1 MAF lower basic forecast to the 27.2 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that six months are being forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for July 2 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over 50% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of September, indicates drought conditions are likely to persist or worsen in the upper Basin and in Kansas.

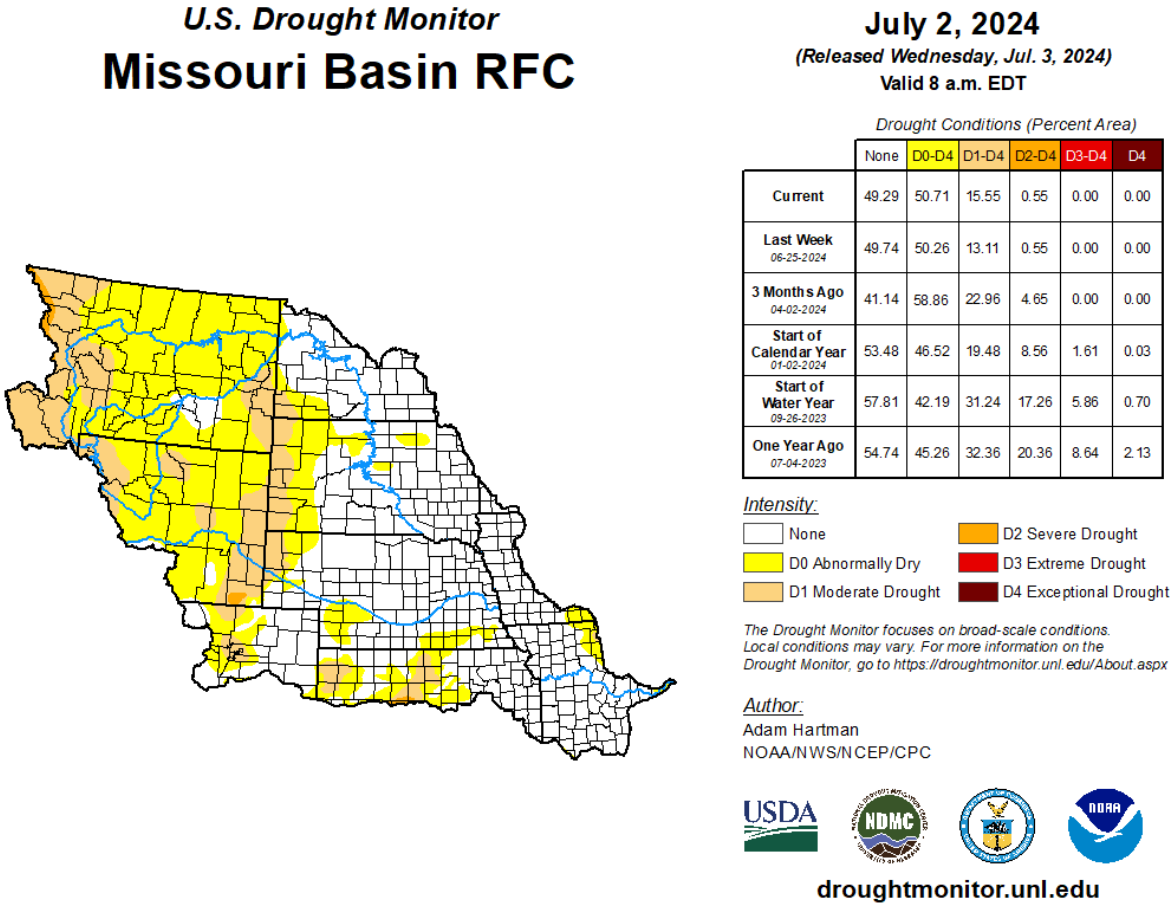


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

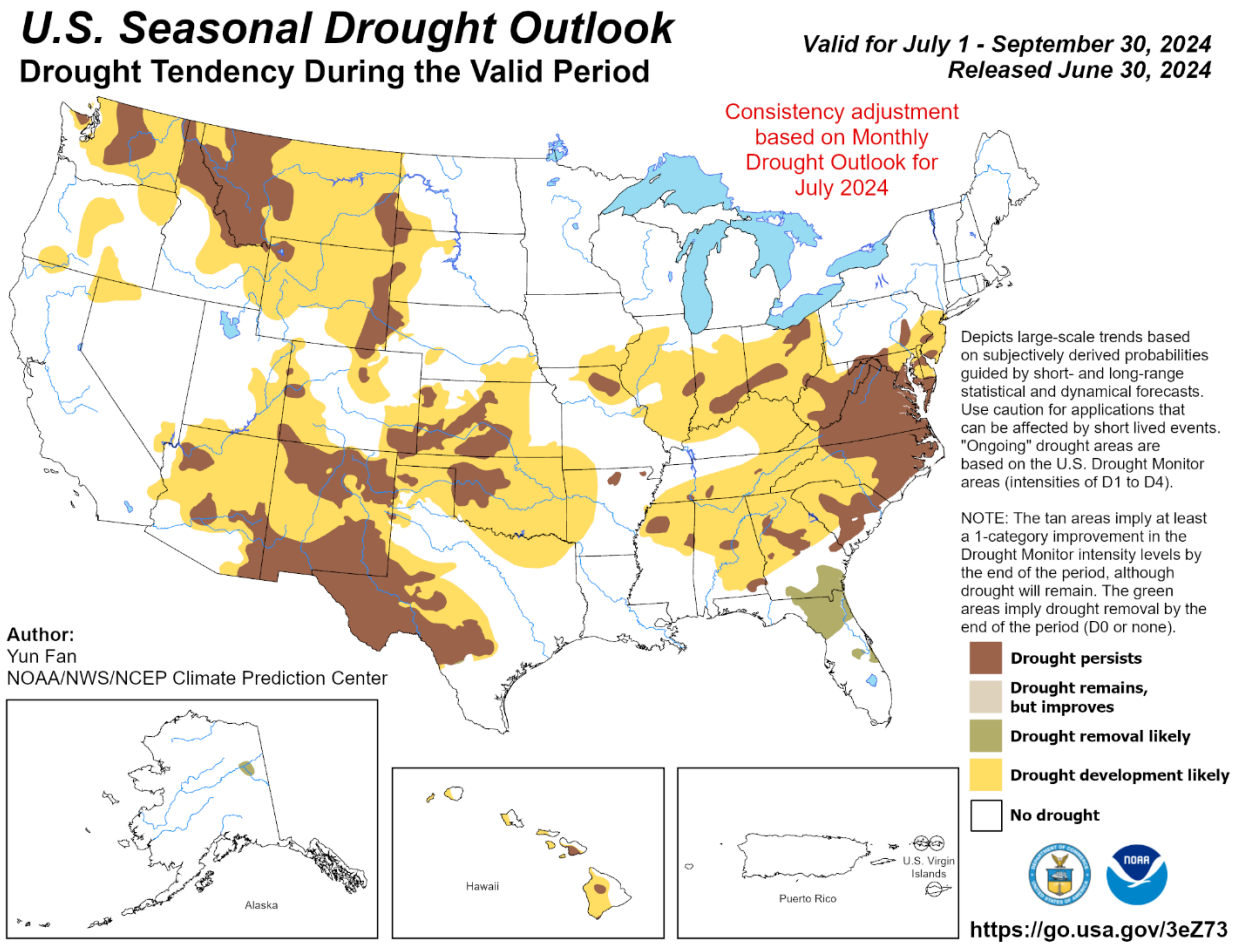


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

## Precipitation

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The June precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was below normal in Montana and Wyoming, and mixed in the rest of the Basin. In southeast South Dakota, a pocket of 200-400% of normal precipitation was observed.

Precipitation as a percent of normal for the April-May-June period (**Figure 4**) was mostly below normal in the western parts of the Basin and mostly above normal in the eastern parts of the Basin.

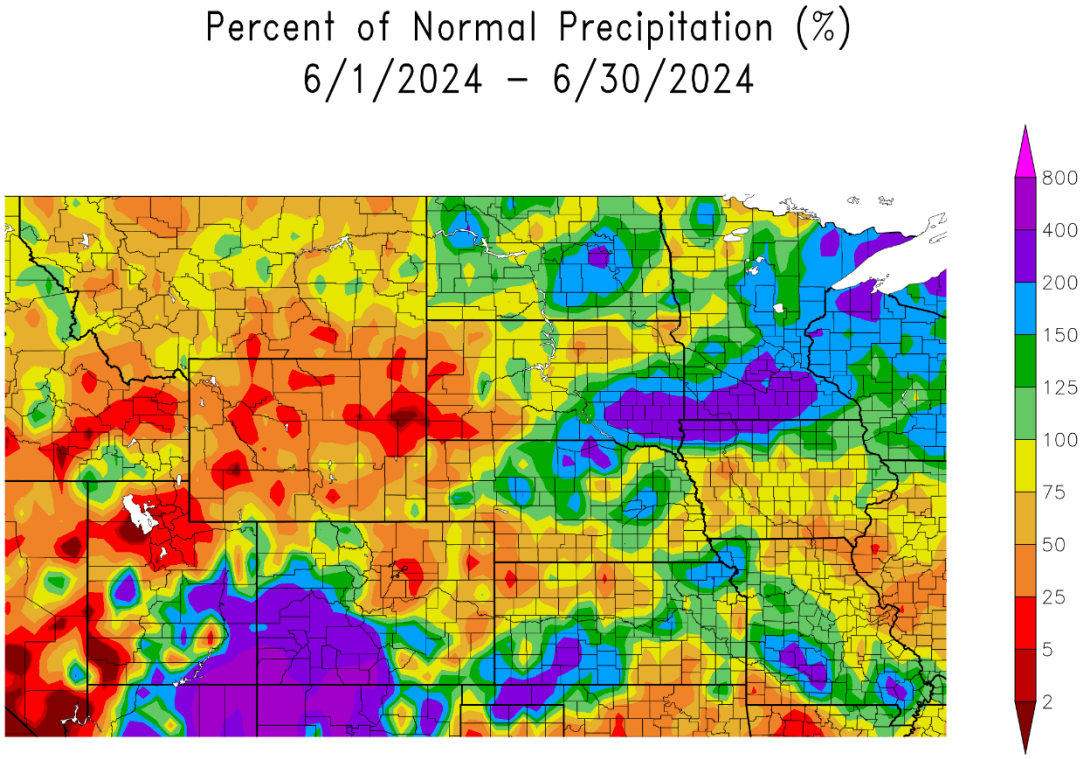


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

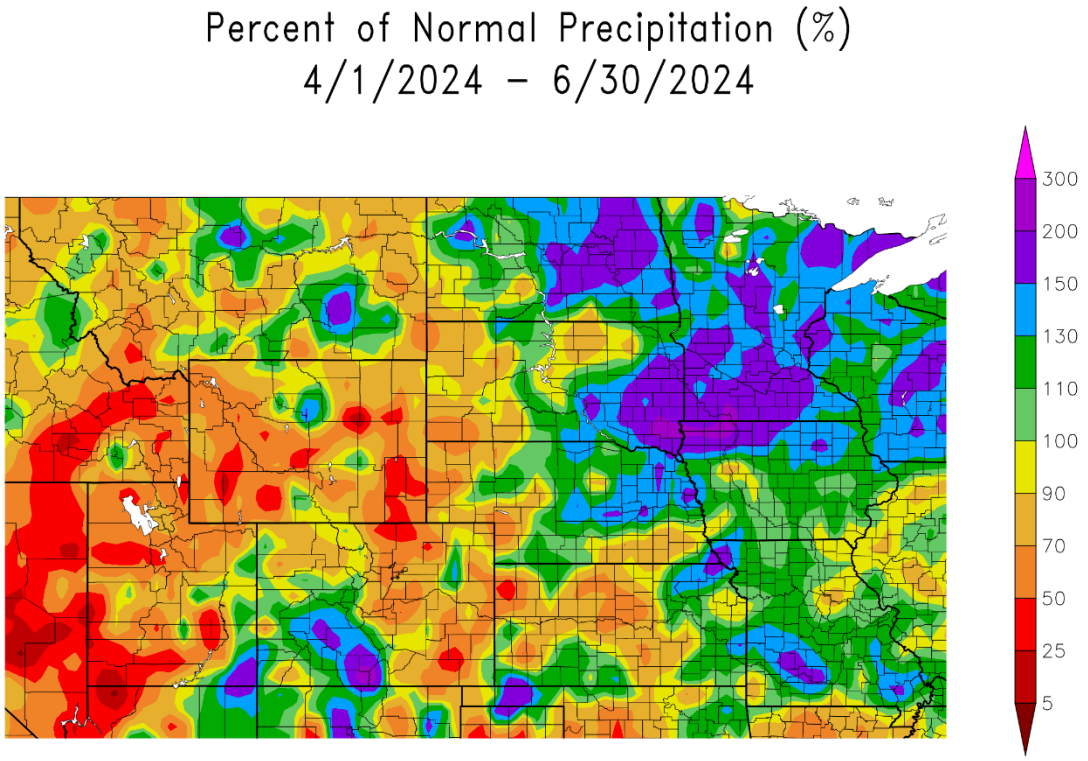


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

June temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures in the most of the Basin except northern Montana and North Dakota, which were normal or slightly cooler-than-normal. April-May-June temperature departures are shown in **Figure 6**. The three-month average temperature departures are mostly warmer-than-normal everywhere.

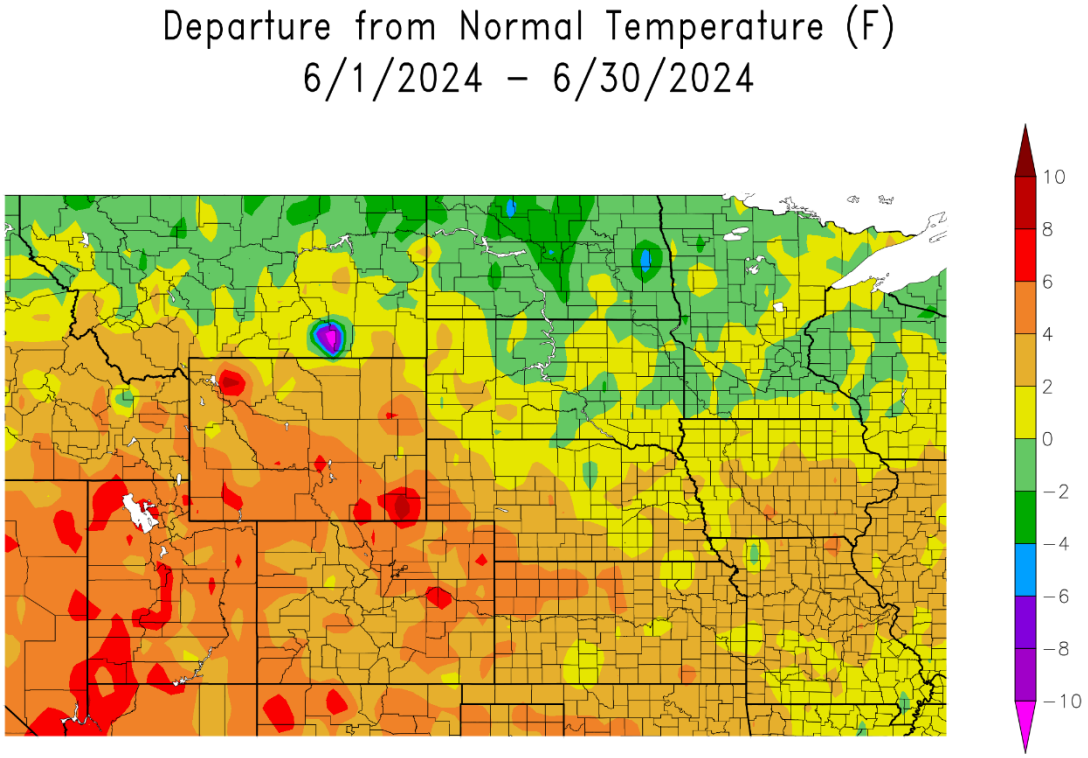


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

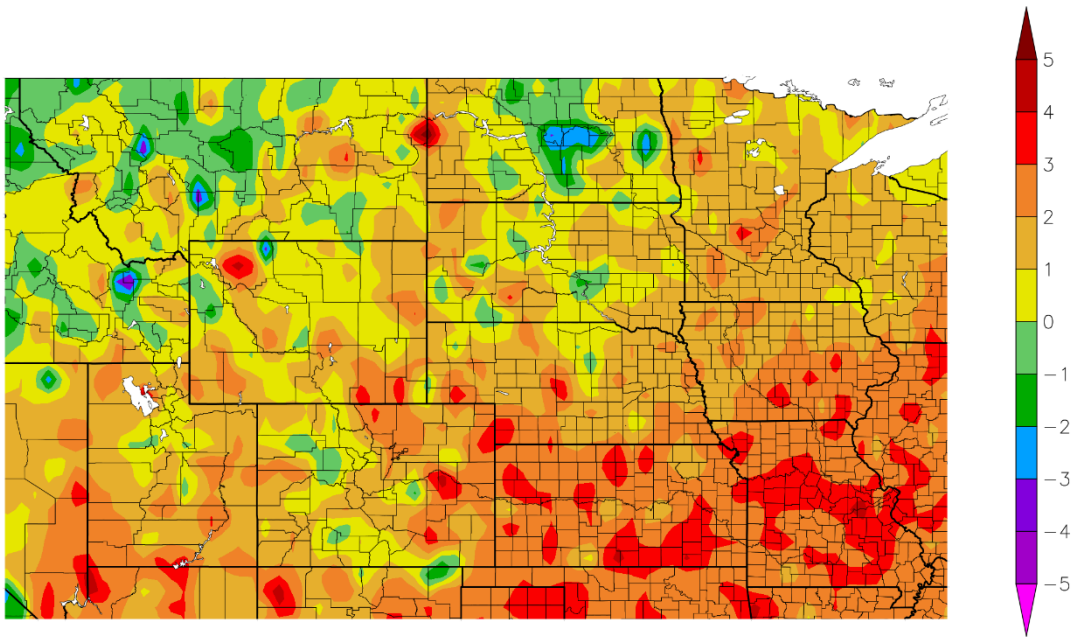


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile at the beginning of June are shown in **Figure 7**. Soil moisture is below normal in Montana, northern North Dakota, Wyoming, western Colorado, and most of the lower Basin. Soil moisture is above normal in South Dakota, most of Nebraska, and eastern Colorado.

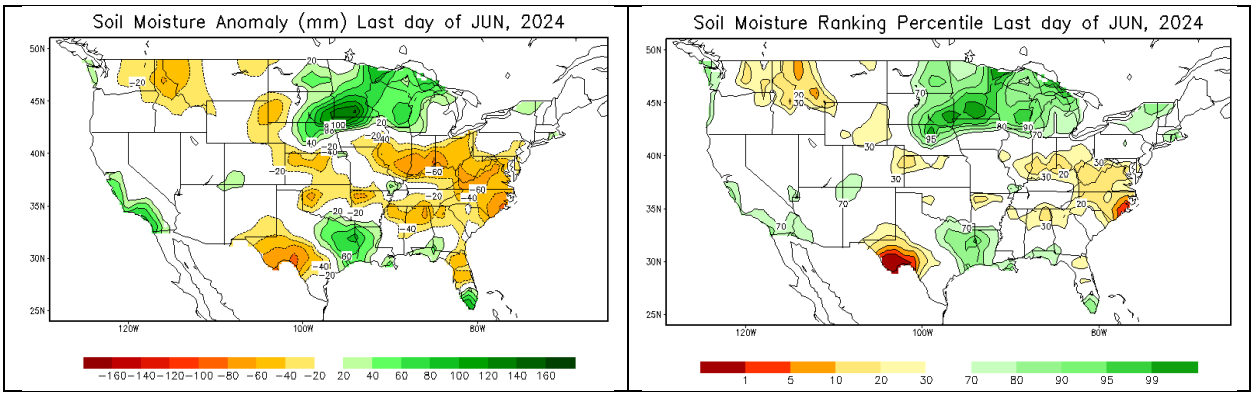


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

### Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

Plains snowpack is not a factor in the July runoff forecast.

### Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 8** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

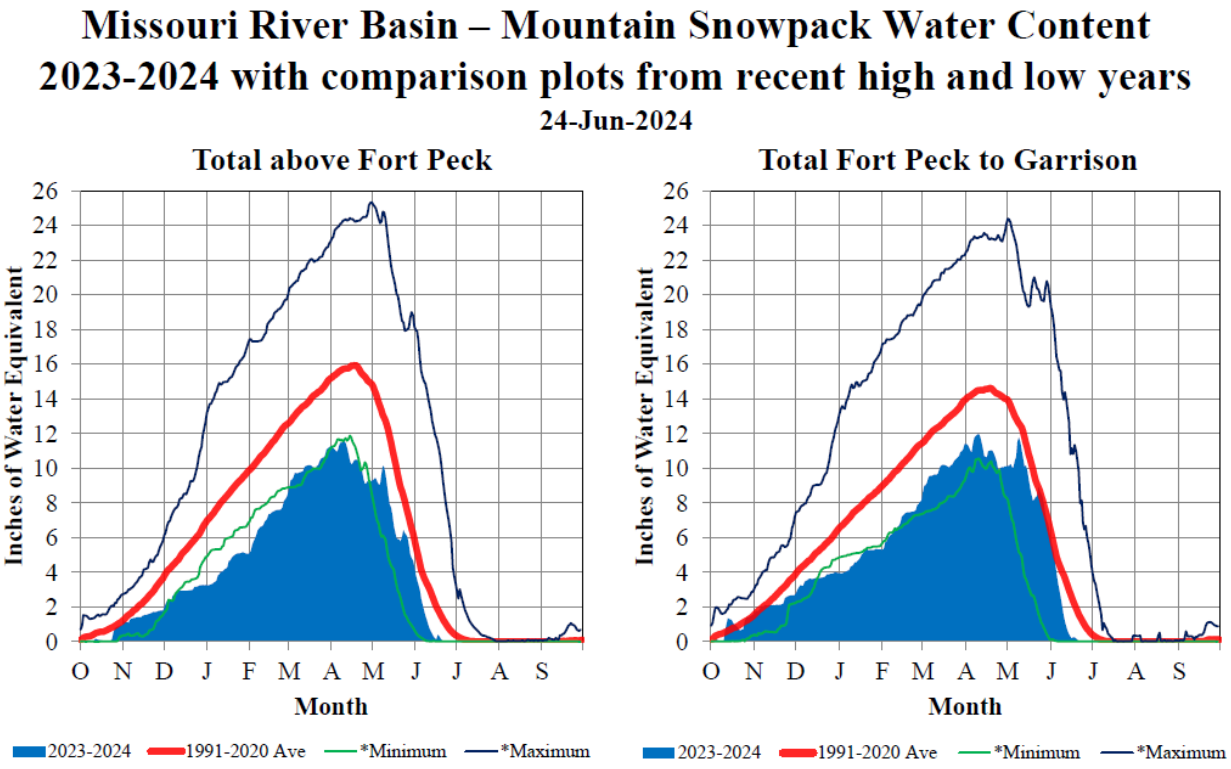


**Figure 8. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of June 24, 2024 all mountain snowpack has melted in both reaches.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### El Niño Southern Oscillation (ENSO)

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

ENSO-neutral conditions are currently present, and La Niña conditions have a 65% chance to develop during July-September. La Niña conditions are 85% likely to persist over the winter.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for July (**Figure 9**) indicates increased chances for above-normal temperatures across the Basin. The July precipitation outlook (**Figure 9**) shows increased chances for below-normal precipitation across the western side of the Basin, and equal chances for below-normal, normal, or above-normal precipitation in most of the rest of the Basin. Eastern South Dakota has a slightly increased chance for above-normal precipitation.

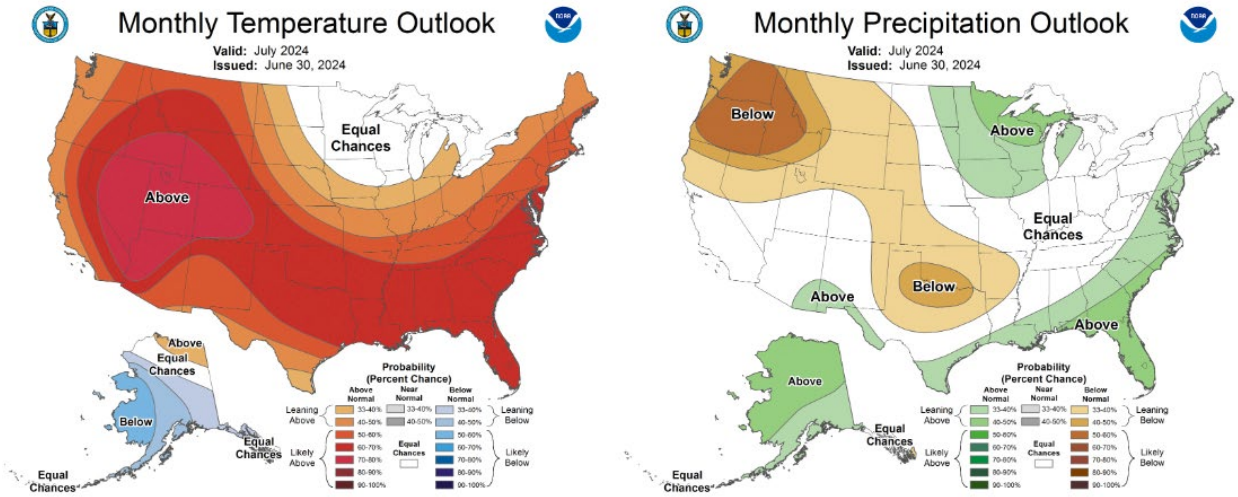


**Figure 9. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 10**. The July-August-September temperature outlook indicates increased chances for warmer-than-normal temperatures across the entire Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation in the western side of the Basin and equal chances on the eastern side of the Basin.

The October-November-December temperature outlook indicates increased chances for warmer-than-normal temperatures across the southern part of the Basin and equal chances for cooler-than-normal, normal, or warmer-than-normal temperatures in the northern part of the Basin. The precipitation outlook for the same period shows equal chances for below-normal, normal, or above-normal precipitation for most of the Basin, and slightly increased chances for below-normal precipitation in Colorado, Nebraska, and Kansas.

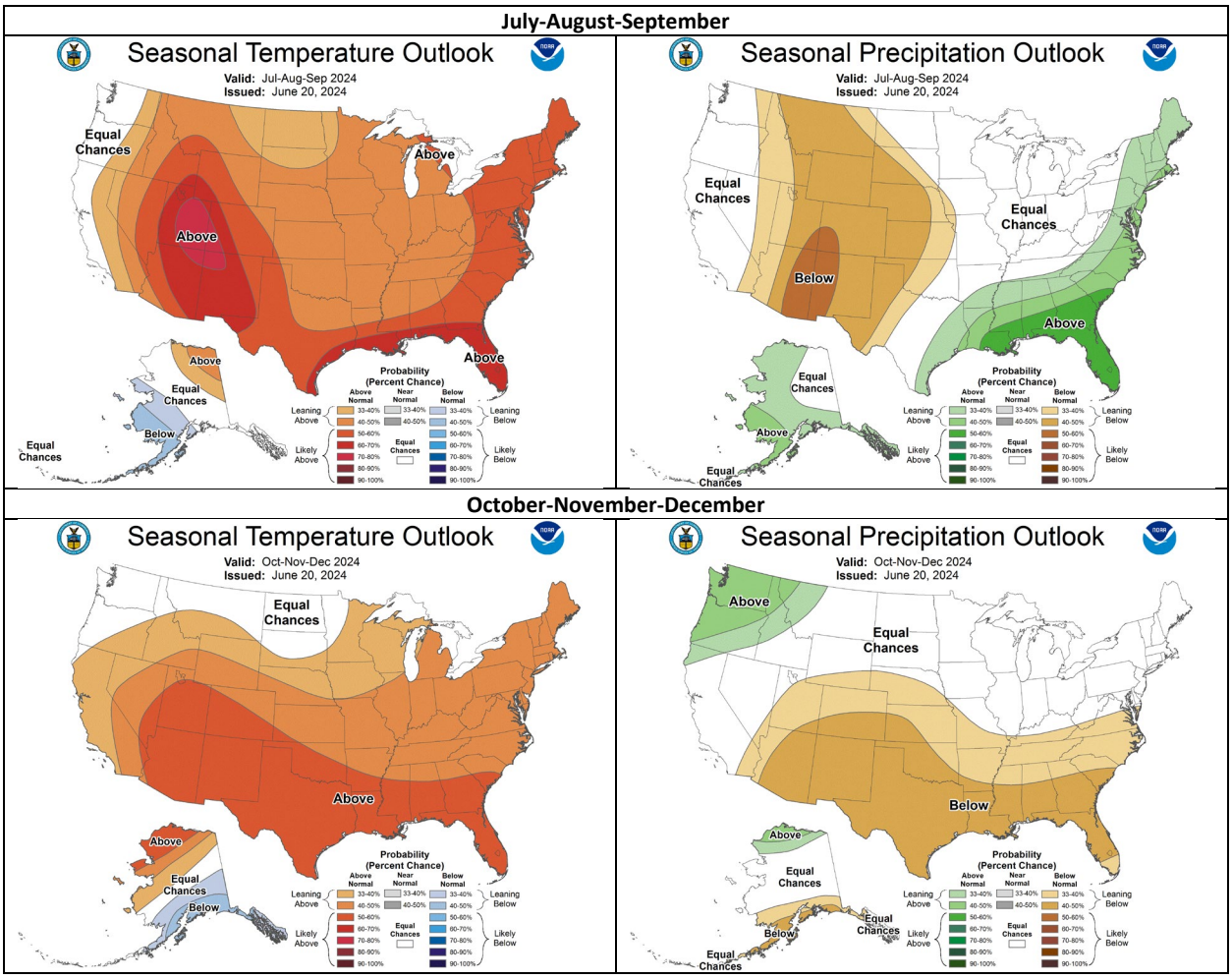


**Figure 10. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, mountain snowpack, and forecast temperatures and precipitation. Given these factors we expect runoff during July for Fort Peck and Garrison to be below average. Runoff in all other reaches except Oahe during the same period is expected to be above average. The Sioux City reach is expected to have below average runoff in July. In summary, the 2024 calendar year runoff forecast is **24.6 MAF, 96% of average**.

# NRCS Water Supply Forecasts

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: 06 Jun 2024 11:30 AM
   - Based on 06-01-2024 forecast values  - Not filtered by publish status(es)

Upper South Saskatchewan River

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sherburne Inflow | JUN-JUL | 50 | 96 | 62 | 55 | 45 | 40 | 52 |
| | JUN-SEP | 65 | 98 | 79 | 70 | 59 | 52 | 66 |
| St. Mary R nr Babb | JUN-JUL | 220 | 95 | 270 | 240 | 205 | 185 | 230 |
| | JUN-SEP | 270 | 96 | 330 | 295 | 250 | 220 | 280 |
| St. Mary R at Intl Boundary | JUN-JUL | 250 | 96 | 320 | 275 | 230 | 199 | 260 |
| | JUN-SEP | 315 | 95 | 395 | 345 | 285 | 250 | 330 |

Missouri Headwaters

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lima Reservoir Inflow | JUN-JUL | 17.8 | 68 | 32 | 23 | 13 | 7.5 | 26 |
| | JUN-SEP | 24 | 68 | 43 | 31 | 18.9 | 12.5 | 35 |
| Clark Canyon Inflow | JUN-JUL | 7.3 | 75 | 37 | 19.5 | -4.9 | -23 | 9.7 |
| | JUN-SEP | 16 | 84 | 53 | 31 | 1 | -21 | 18.9 |
| Beaverhead R at Barretts | JUN-JUL | 16.8 | 70 | 59 | 31 | 7.1 | 0.4 | 24 |
| | JUN-SEP | 30 | 78 | 74 | 48 | 11.5 | -14.8 | 38 |
| Ruby R Reservoir Inflow | JUN-JUL | 31 | 88 | 46 | 37 | 25 | 15.8 | 35 |
| | JUN-SEP | 44 | 89 | 62 | 51 | 37 | 26 | 49 |
| Big Hole R at Wisdom | JUN-JUL | 13.5 | 38 | 38 | 22 | 7.1 | 1.4 | 35 |
| | JUN-SEP | 16.6 | 40 | 44 | 26 | 9.2 | 2.2 | 41 |
| Big Hole R nr Melrose | JUN-JUL | 117 | 48 | 225 | 161 | 74 | 10 | 240 |
| | JUN-SEP | 146 | 48 | 270 | 195 | 97 | 24 | 300 |
| Jefferson R nr Twin Bridges | JUN-JUL | 84 | 39 | 275 | 162 | 6 | 1 | 215 |
| | JUN-SEP | 98 | 41 | 310 | 184 | 12 | 1 | 235 |
| Willow Ck Reservoir Inflow | JUN-JUL | 5.3 | 51 | 11.2 | 7.5 | 3.4 | 0.8 | 10.2 |
| Jefferson R nr Three Forks | JUN-JUL | 151 | 51 | 335 | 225 | 76 | 1 | 295 |
| | JUN-SEP | 153 | 47 | 375 | 245 | 64 | 1 | 320 |
| Boulder R nr Boulder | JUN-JUL | 16.8 | 60 | 33 | 23 | 12.1 | 6.9 | 28 |
| | JUN-SEP | 19.3 | 64 | 41 | 27 | 13.4 | 6.8 | 30 |
| Hebgen Lake Inflow | JUN-JUL | 142 | 91 | 177 | 155 | 130 | 114 | 155 |
| | JUN-SEP | 215 | 86 | 270 | 240 | 192 | 159 | 250 |
| Ennis Lake Inflow | JUN-JUL | 270 | 87 | 335 | 295 | 250 | 220 | 310 |
| | JUN-SEP | 405 | 89 | 485 | 440 | 380 | 340 | 455 |
| Gallatin R nr Gallatin Gateway | JUN-JUL | 220 | 89 | 280 | 245 | 195 | 159 | 245 |
| | JUN-SEP | 280 | 91 | 355 | 310 | 250 | 205 | 305 |
| Hyalite Reservoir Inflow | JUN-JUL | 13.2 | 97 | 16.4 | 14.4 | 12.1 | 10.9 | 13.6 |
| | JUN-SEP | 15.5 | 97 | 19.9 | 17 | 14.2 | 12.6 | 15.9 |
| Gallatin R at Logan | JUN-JUL | 183 | 83 | 280 | 225 | 143 | 84 | 220 |
| | JUN-SEP | 230 | 86 | 345 | 275 | 183 | 115 | 265 |

Upper Missouri

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R at Toston | JUN-JUL | 585 | 62 | 900 | 705 | 475 | 340 | 935 |
| | JUN-SEP | 785 | 69 | 1190 | 940 | 650 | 475 | 1130 |
| Missouri R at Fort Benton | JUN-JUL | 895 | 67 | 1390 | 1100 | 695 | 400 | 1320 |
| | JUN-SEP | 1250 | 70 | 1860 | 1500 | 1000 | 635 | 1780 |
| Smith R bl Eagle Ck | JUN-JUL | 27 | 60 | 64 | 39 | 17 | 8.9 | 45 |
| | JUN-SEP | 29 | 55 | 63 | 41 | 20 | 12.1 | 52 |
| Gibson Reservoir Inflow | JUN-JUL | 98 | 55 | 159 | 123 | 73 | 37 | 176 |
| | JUN-SEP | 129 | 57 | 200 | 159 | 82 | 39 | 225 |

Marias

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Two Medicine R bl SF nr Browning | JUN-JUL | 50 | 65 | 71 | 58 | 41 | 32 | 76 |
| | JUN-SEP | 56 | 64 | 83 | 67 | 48 | 39 | 87 |
| Badger Ck nr Browning | JUN-JUL | 21 | 58 | 35 | 26 | 16.8 | 11.4 | 36 |
| | JUN-SEP | 29 | 60 | 46 | 35 | 23 | 16.3 | 48 |
| Dupuyer Ck nr Valier | JUN-JUL | 2.9 | 65 | 6.7 | 4.4 | 1.4 | 1 | 4.4 |
| | JUN-SEP | 3.6 | 69 | 7.6 | 5.2 | 2 | 1 | 5.2 |
| Swift Reservoir Inflow | JUN-JUL | 18 | 69 | 27 | 22 | 14.8 | 11.2 | 26 |
| | JUN-SEP | 24 | 72 | 37 | 29 | 21 | 16.9 | 33 |
| Marias R nr Shelby | JUN-JUL | 75 | 49 | 220 | 121 | 38 | 12 | 153 |
| | JUN-SEP | 79 | 58 | 245 | 135 | 44 | 11 | 135 |
| Teton R nr Dutton | JUN-JUL | 2.9 | 20 | 13.3 | 6.2 | 0.8 | 0 | 14.1 |
| | JUN-SEP | 4.1 | 24 | 17.1 | 8.3 | 1.4 | 0 | 16.5 |

Fort Peck Lake

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R nr Virgelle | JUN-JUL | 1060 | 65 | 1670 | 1280 | 900 | 685 | 1630 |
| | JUN-SEP | 1410 | 67 | 2230 | 1670 | 1070 | 785 | 2090 |
| Missouri R nr Landusky | JUN-JUL | 1130 | 66 | 1750 | 1380 | 880 | 510 | 1690 |
| | JUN-SEP | 1510 | 67 | 2270 | 1820 | 1210 | 755 | 2230 |

Musselshell

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Musselshell R at Harlowton | JUN-JUL | 21 | 77 | 49 | 32 | 9.5 | -4.4 | 27 |
| | JUN-SEP | 22 | 81 | 52 | 33 | 10 | -5.5 | 27 |
| Musselshell R nr Roundup | JUN-JUL | 19.2 | 64 | 71 | 40 | -1.8 | -30 | 30 |
| | JUN-SEP | 15 | 60 | 64 | 35 | -5.8 | -35 | 25 |

Missouri-Poplar

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Missouri R bl Fort Peck Dam | JUN-JUL | 1110 | 67 | 1880 | 1420 | 795 | 335 | 1640 |
| | JUN-SEP | 1390 | 71 | 2470 | 1830 | 950 | 310 | 1950 |

Upper Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Yellowstone Lake Outlet | JUN-JUL | 455 | 96 | 545 | 490 | 420 | 375 | 470 |
| | JUN-SEP | 635 | 93 | 755 | 680 | 585 | 520 | 680 |
| Yellowstone R at Corwin Springs | JUN-JUL | 970 | 88 | 1180 | 1050 | 895 | 790 | 1100 |
| | JUN-SEP | 1220 | 85 | 1470 | 1320 | 1130 | 1000 | 1420 |
| Yellowstone R at Livingston | JUN-JUL | 1130 | 88 | 1380 | 1230 | 1040 | 915 | 1280 |
| | JUN-SEP | 1460 | 92 | 1770 | 1580 | 1350 | 1210 | 1580 |
| Boulder R at Big Timber | JUN-JUL | 215 | 100 | 260 | 235 | 196 | 173 | 215 |
| | JUN-SEP | 235 | 97 | 295 | 260 | 210 | 186 | 240 |
| Shields R nr Livingston | JUN-JUL | 42 | 75 | 70 | 52 | 34 | 25 | 56 |
| | JUN-SEP | 44 | 68 | 76 | 56 | 35 | 24 | 64 |
| Yellowstone R at Billings | JUN-JUL | 1990 | 86 | 2530 | 2200 | 1800 | 1570 | 2290 |
| | JUN-SEP | 2410 | 84 | 3130 | 2710 | 2160 | 1880 | 2860 |
| Mystic Lake Inflow | JUN-JUL | 47 | 97 | 53 | 49 | 44 | 41 | 48 |
| | JUN-SEP | 63 | 96 | 72 | 67 | 59 | 54 | 65 |
| Stillwater R nr Absarokee | JUN-JUL | 330 | 98 | 400 | 355 | 305 | 275 | 335 |
| | JUN-SEP | 395 | 94 | 495 | 435 | 365 | 320 | 420 |
| Clarks Fk Yellowstone R nr Belfry | JUN-JUL | 350 | 94 | 425 | 385 | 325 | 290 | 370 |
| | JUN-SEP | 385 | 96 | 470 | 425 | 355 | 310 | 400 |
| Cooney Reservoir Inflow | JUN-JUL | 19.1 | 86 | 32 | 24 | 15.4 | 11 | 22 |
| | JUN-SEP | 26 | 81 | 40 | 32 | 22 | 17.3 | 32 |

Big Horn

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Dinwoody Ck nr Burris | JUN-JUL | 52 | 89 | 60 | 56 | 49 | 45 | 58 |
| | JUN-SEP | 78 | 92 | 89 | 82 | 73 | 68 | 84 |
| Bull Lake Ck nr Lenore | JUN-JUL | 108 | 104 | 132 | 117 | 99 | 88 | 103 |
| | JUN-SEP | 137 | 105 | 168 | 149 | 127 | 112 | 130 |
| Wind R Ab Bull Lake Ck | JUN-JUL | 335 | 95 | 525 | 405 | 280 | 205 | 350 |
| | JUN-SEP | 350 | 97 | 535 | 415 | 290 | 220 | 360 |
| Wind R at Riverton | JUN-JUL | 340 | 91 | 420 | 370 | 310 | 270 | 370 |
| | JUN-SEP | 405 | 96 | 515 | 450 | 365 | 310 | 420 |
| Little Wind R nr Riverton | JUN-JUL | 235 | 129 | 350 | 275 | 200 | 157 | 181 |
| | JUN-SEP | 250 | 121 | 390 | 300 | 210 | 158 | 205 |
| Little Popo Agie R nr Lander | JUN-JUL | 31 | 110 | 40 | 34 | 28 | 24 | 28 |
| | JUN-SEP | 38 | 115 | 47 | 41 | 35 | 31 | 33 |
| Boysen Reservoir Inflow | JUN-JUL | 490 | 107 | 755 | 585 | 405 | 300 | 455 |
| | JUN-SEP | 545 | 112 | 855 | 660 | 445 | 325 | 485 |
| Greybull R at Meeteetse | JUN-JUL | 134 | 131 | 184 | 152 | 117 | 96 | 102 |
| | JUN-SEP | 171 | 111 | 225 | 191 | 152 | 128 | 153 |
| Shell Ck nr Shell | JUN-JUL | 44 | 129 | 57 | 49 | 40 | 34 | 34 |
| | JUN-SEP | 56 | 119 | 70 | 61 | 51 | 44 | 47 |
| Bighorn R at Kane | JUN-JUL | 755 | 111 | 1060 | 875 | 640 | 480 | 675 |
| | JUN-SEP | 800 | 108 | 1140 | 935 | 665 | 480 | 740 |
| NF Shoshone R at Wapiti | JUN-JUL | 330 | 104 | 395 | 355 | 305 | 270 | 315 |
| | JUN-SEP | 385 | 104 | 455 | 415 | 355 | 320 | 370 |
| SF Shoshone R nr Valley | JUN-JUL | 148 | 92 | 182 | 161 | 135 | 116 | 160 |
| | JUN-SEP | 170 | 87 | 205 | 185 | 156 | 137 | 194 |
| SF Shoshone R ab Buffalo Bill Reservoir | JUN-JUL | 134 | 88 | 178 | 152 | 117 | 93 | 151 |
| | JUN-SEP | 147 | 91 | 197 | 167 | 128 | 102 | 160 |
| Buffalo Bill Reservoir Inflow | JUN-JUL | 445 | 96 | 565 | 490 | 400 | 340 | 460 |
| | JUN-SEP | 520 | 100 | 665 | 575 | 470 | 400 | 520 |
| Bighorn R nr St. Xavier | JUN-JUL | 1080 | 102 | 1880 | 1360 | 855 | 600 | 1050 |
| | JUN-SEP | 1170 | 105 | 1870 | 1430 | 950 | 675 | 1110 |
| Little Bighorn R nr Hardin | JUN-JUL | 79 | 143 | 137 | 99 | 63 | 44 | 55 |
| | JUN-SEP | 93 | 136 | 156 | 116 | 74 | 51 | 68 |

Tongue

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Big Goose Ck nr Sheridan | JUN-JUL | 40 | 125 | 50 | 44 | 36 | 31 | 32 |
| | JUN-SEP | 47 | 114 | 59 | 52 | 43 | 38 | 41 |
| Little Goose Ck nr Big Horn | JUN-JUL | 23 | 118 | 30 | 26 | 20 | 17.3 | 19.4 |
| | JUN-SEP | 30 | 103 | 38 | 33 | 27 | 23 | 29 |
| Tongue R nr Dayton | JUN-JUL | 61 | 127 | 75 | 67 | 56 | 49 | 48 |
| | JUN-SEP | 71 | 114 | 91 | 79 | 65 | 56 | 62 |
| Tongue River Reservoir Inflow | JUN-JUL | 148 | 120 | 197 | 167 | 129 | 103 | 123 |
| | JUN-SEP | 167 | 115 | 235 | 194 | 143 | 111 | 144 |

Powder

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| MF Powder R nr Barnum | JUN-JUL | 5.1 | 130 | 8.7 | 6.4 | 4.1 | 2.8 | 3.9 |
| | JUN-SEP | 6.8 | 138 | 11.6 | 8.5 | 5.4 | 3.7 | 4.9 |
| NF Powder R nr Hazelton | JUN-JUL | 4.1 | 93 | 6.5 | 5 | 3.4 | 2.5 | 4.4 |
| | JUN-SEP | 4.8 | 90 | 7.5 | 5.8 | 4 | 3.1 | 5.3 |
| Rock Ck nr Buffalo | JUN-JUL | 15.7 | 131 | 23 | 18.4 | 13.4 | 10.7 | 11.9 |
| | JUN-SEP | 17.6 | 109 | 26 | 21 | 15 | 11.9 | 16.1 |
| Piney Ck at Kearny | JUN-JUL | 34 | 130 | 54 | 41 | 27 | 19.9 | 26 |
| | JUN-SEP | 39 | 125 | 62 | 47 | 31 | 23 | 31 |
| Powder R at Moorhead | JUN-JUL | 126 | 143 | 220 | 158 | 100 | 69 | 88 |
| | JUN-SEP | 170 | 160 | 305 | 215 | 131 | 87 | 106 |
| Powder R nr Locate | JUN-JUL | 152 | 153 | 360 | 215 | 105 | 61 | 99 |
| | JUN-SEP | 205 | 169 | 545 | 305 | 138 | 77 | 121 |

Lower Yellowstone

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Yellowstone R at Miles City | JUN-JUL | 3010 | 88 | 4170 | 3440 | 2640 | 2180 | 3390 |
| | JUN-SEP | 3420 | 83 | 4860 | 3950 | 2960 | 2410 | 4100 |
| Yellowstone R nr Sidney | JUN-JUL | 3050 | 90 | 4210 | 3480 | 2680 | 2220 | 3360 |
| | JUN-SEP | 3310 | 83 | 4700 | 3820 | 2820 | 2130 | 3950 |

Lake Sakakawea

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Lake Sakakawea Inflow | JUN-JUL | 4720 | 84 | 6840 | 5490 | 4040 | 3280 | 5560 |
| | JUN-SEP | 5520 | 85 | 8590 | 6550 | 4490 | 3460 | 6450 |

Cheyenne

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Deerfield Reservoir Inflow | JUN-JUL | 1.5 | 62 | 2.5 | 1.8 | 1.2 | 0.8 | 2.4 |
| Pactola Reservoir Inflow | JUN-JUL | 4.9 | 47 | 12.1 | 7.5 | 2.7 | 0 | 10.3 |

North Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| North Platte R nr Northgate | JUN-JUL | 108 | 88 | 155 | 125 | 93 | 75 | 122 |
| | JUN-SEP | 138 | 96 | 205 | 162 | 117 | 94 | 143 |
| Encampment R nr Encampment | JUN-JUL | 81 | 122 | 111 | 92 | 72 | 60 | 66 |
| | JUN-SEP | 95 | 130 | 134 | 110 | 83 | 68 | 73 |
| Seminoe Reservoir Inflow | JUN-JUL | 435 | 122 | 595 | 495 | 380 | 320 | 355 |
| | JUN-SEP | 455 | 113 | 630 | 520 | 400 | 330 | 400 |
| Rock Ck ab King Canyon Cnl nr Arlington | JUN-JUL | 39 | 130 | 48 | 42 | 36 | 31 | 30 |
| | JUN-SEP | 42 | 127 | 52 | 46 | 39 | 35 | 33 |
| Sweetwater R nr Alcova | JUN-JUL | 25 | 108 | 48 | 33 | 19.1 | 12.6 | 23 |
| | JUN-SEP | 30 | 115 | 50 | 37 | 24 | 17.4 | 26 |
| La Prele Ck nr Douglas | JUN-JUL | 3.9 | 144 | 11.8 | 6.1 | 2.4 | 1.2 | 2.7 |
| | JUN-SEP | 5.6 | 147 | 17 | 8.9 | 3.6 | 1.9 | 3.8 |
| North Platte R bl Glendo Reservoir | JUN-JUL | 435 | 119 | 640 | 515 | 360 | 260 | 365 |
| | JUN-SEP | 435 | 111 | 695 | 535 | 345 | 230 | 390 |
| North Platte R bl Guernsey Reservoir | JUN-JUL | 440 | 123 | 615 | 510 | 370 | 265 | 355 |
| | JUN-SEP | 445 | 117 | 720 | 550 | 350 | 230 | 380 |
| Laramie R and Pioneer Cnl nr Woods Lg | JUN-JUL | 62 | 86 | 80 | 69 | 55 | 47 | 72 |
| | JUN-SEP | 75 | 92 | 94 | 82 | 69 | 61 | 81 |
| Little Laramie R nr Filmore | JUN-JUL | 41 | 117 | 54 | 46 | 37 | 31 | 35 |
| | JUN-SEP | 44 | 112 | 58 | 49 | 39 | 33 | 39 |

South Platte

| Forecast Point | period | 50% (KAF) | % of med | 10% (KAF) | 30% (KAF) | 70% (KAF) | 90% (KAF) | 30-yr med |
|---|---|---|---|---|---|---|---|---|
| Antero Reservoir Inflow | JUN-JUL | 11.6 | 128 | 15.2 | 13 | 10.4 | 8.8 | 9 |
| | JUN-SEP | 15.2 | 135 | 18.1 | 16.4 | 14 | 12.4 | 11.2 |
| Spinney Mountain Reservoir Inflow | JUN-JUL | 45 | 140 | 52 | 48 | 42 | 38 | 32 |
| | JUN-SEP | 59 | 137 | 68 | 63 | 56 | 51 | 43 |
| Elevenmile Canyon Reservoir Inflow | JUN-JUL | 44 | 133 | 53 | 48 | 41 | 38 | 33 |
| | JUN-SEP | 60 | 133 | 70 | 64 | 57 | 52 | 45 |
| Cheesman Lake Inflow | JUN-JUL | 66 | 124 | 75 | 70 | 62 | 58 | 53 |
| | JUN-SEP | 91 | 116 | 107 | 98 | 85 | 76 | 78 |
| South Platte R at South Platte | JUN-JUL | 107 | 116 | 125 | 115 | 101 | 90 | 92 |
| | JUN-SEP | 150 | 114 | 176 | 162 | 140 | 127 | 131 |
| Bear Ck ab Evergreen | JUN-JUL | 6.5 | 101 | 9.9 | 7.7 | 5.3 | 4.1 | 6.4 |
| | JUN-SEP | 10.7 | 102 | 17.5 | 13.2 | 8.6 | 6.3 | 10.4 |
| Clear Ck at Golden | JUN-JUL | 77 | 101 | 88 | 82 | 73 | 67 | 76 |
| | JUN-SEP | 99 | 99 | 113 | 105 | 92 | 85 | 100 |
| Boulder Ck nr Orodell | JUN-JUL | 36 | 100 | 45 | 39 | 32 | 28 | 36 |
| | JUN-SEP | 44 | 97 | 55 | 48 | 39 | 33 | 45 |
| South Boulder Ck nr Eldorado Springs | JUN-JUL | 22 | 95 | 27 | 24 | 20 | 17.8 | 23 |
| | JUN-SEP | 28 | 103 | 35 | 30 | 25 | 21 | 27 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| St. Vrain Ck at Lyons | JUN-JUL | 59 | 100 | 73 | 65 | 54 | 48 | 59 |
| | JUN-SEP | 78 | 104 | 95 | 85 | 72 | 64 | 75 |
| Big Thompson R at Canyon Mouth | JUN-JUL | 59 | 96 | 74 | 65 | 54 | 46 | 61 |
| | JUN-SEP | 80 | 101 | 99 | 87 | 74 | 63 | 79 |
| Cache La Poudre R at Canyon Mouth | JUN-JUL | 148 | 103 | 174 | 159 | 137 | 123 | 143 |
| | JUN-SEP | 174 | 102 | 210 | 188 | 161 | 144 | 169 |

Max (10%), 30%, 50%, 70% and Min (90%) chance that actual volume will exceed forecast.
Medians are for the 1991-2020 period.
All volumes are in thousands of acre-feet.

footnotes:
1) Max and Min are 5% and 95% chance that actual volume will exceed forecast
2) streamflow is adjusted for upstream storage

# Upper Missouri River Basin
# August 2024 Calendar Year Runoff Forecast
# August 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

July runoff was 2.8 MAF (85% of average) for the basin above Sioux City, 1.7 MAF (55% of average) above Gavins Point. Runoff was below average in the upper three reaches and above average in the lower three reaches. The Sioux City reach was over 300% of normal, while the Fort Peck reach was only 38% of normal.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **23.9 MAF, 93% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **18.7 MAF, 80% of average**.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next five months, expected inflow could range from the 22.8 MAF lower basic forecast to the 25.1 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to “bracket” the range of expected runoff given much wetter or drier conditions, respectively. Given that five months are being forecast, the range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is large, and is attributed to all six reaches. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for July 30 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over approximately 59% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of October, indicates drought conditions are likely to persist or worsen in the upper Basin and in Kansas.

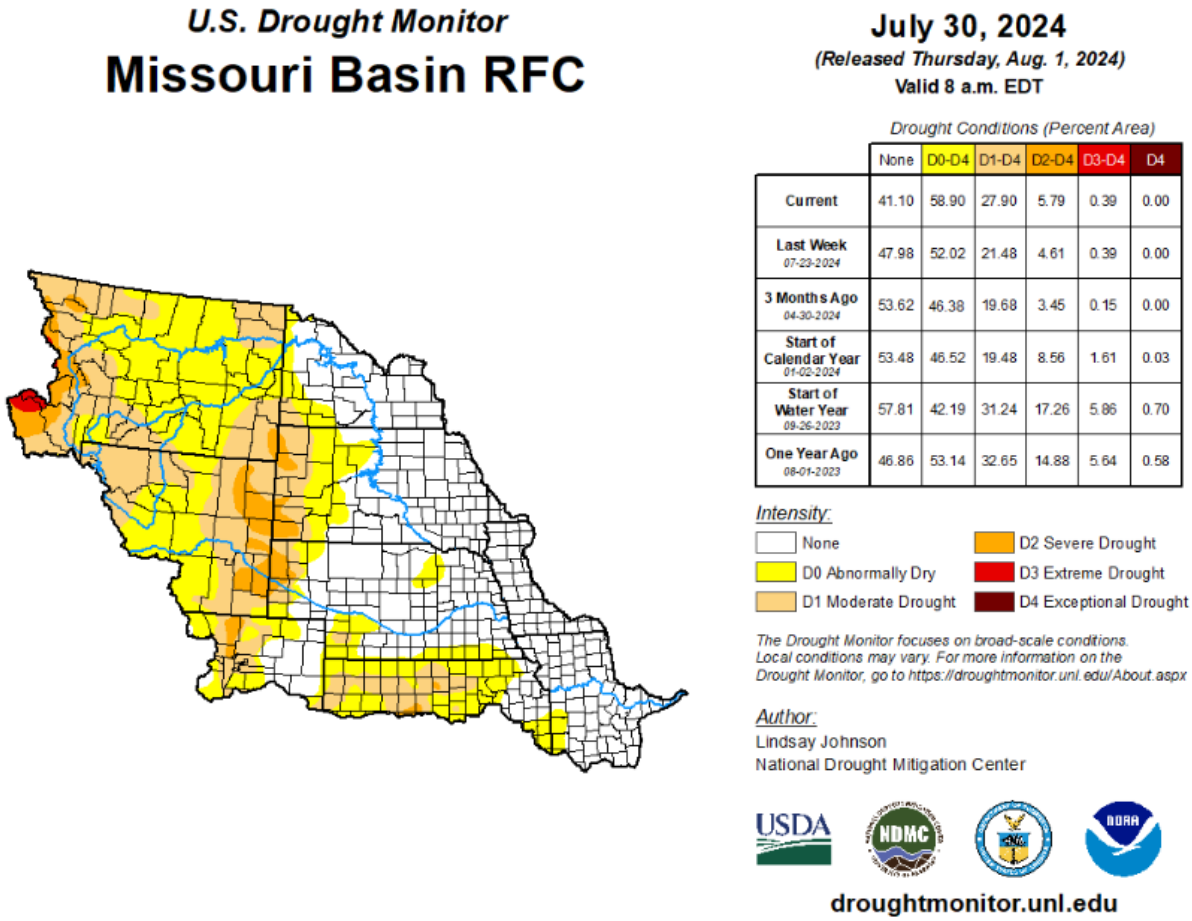


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

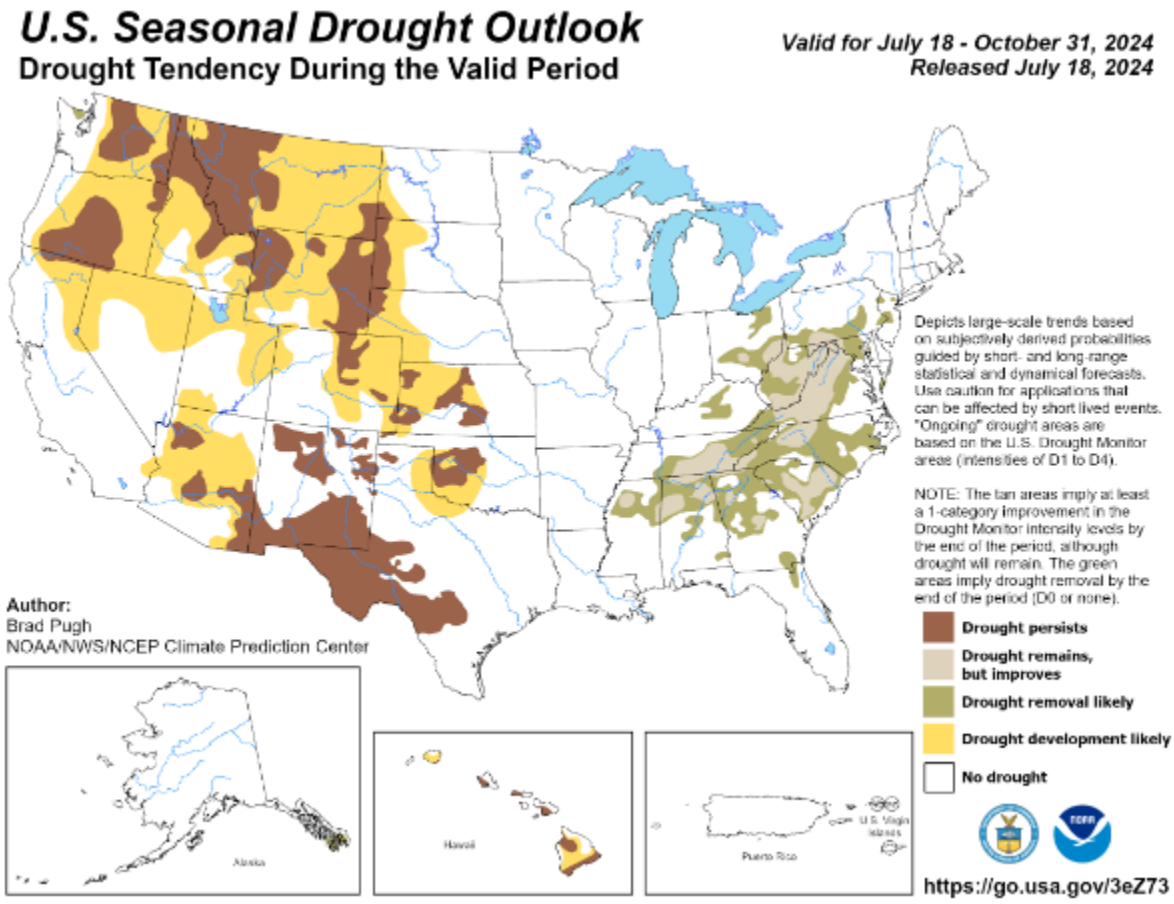


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The July precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was generally below normal across the entire Basin, with small pockets of above-normal precipitation in every state.

Precipitation as a percent of normal for the May-June-July period (**Figure 4**) was mostly below normal in the western parts of the Basin and mostly above normal in the eastern parts of the Basin.

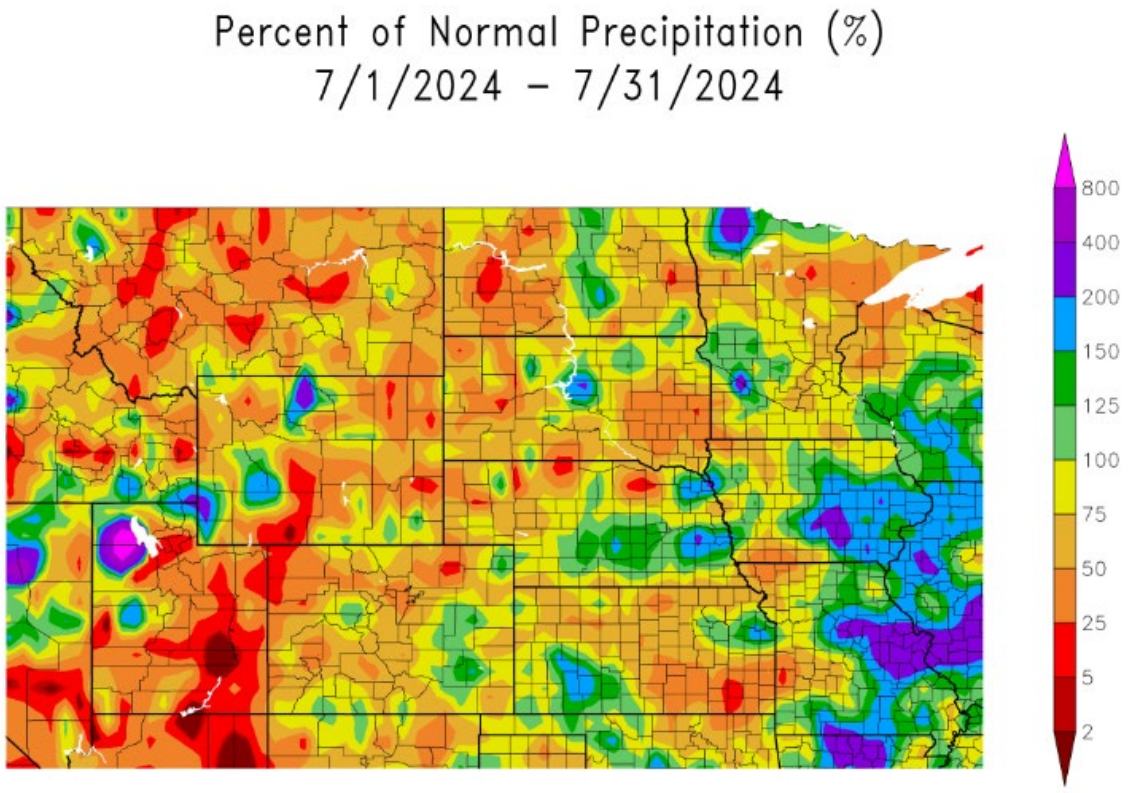


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

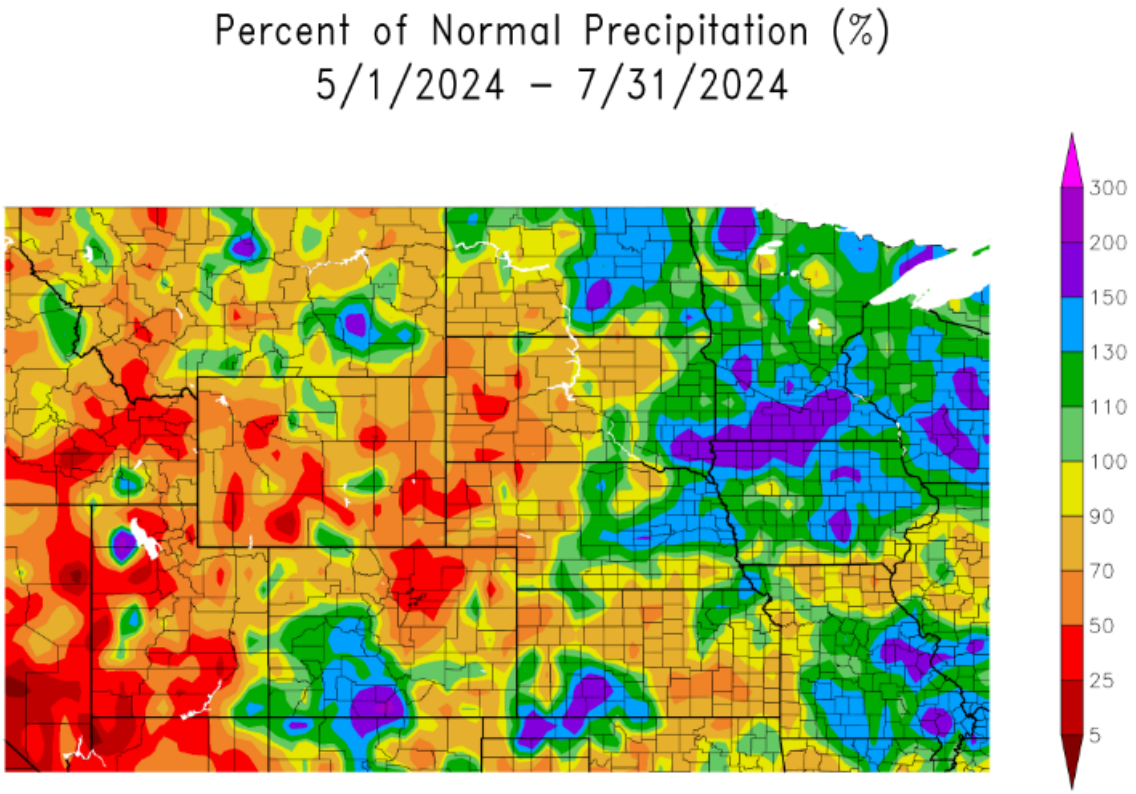


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

July temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures in the northern portion of the Basin, and slightly cooler-than-normal temperatures in the southern portion of the Basin. May-June-July temperature departures are shown in **Figure 6**. The three-month average temperature departures are mostly warmer-than-normal everywhere, with small pockets of cooler-than-normal temperatures in most states.

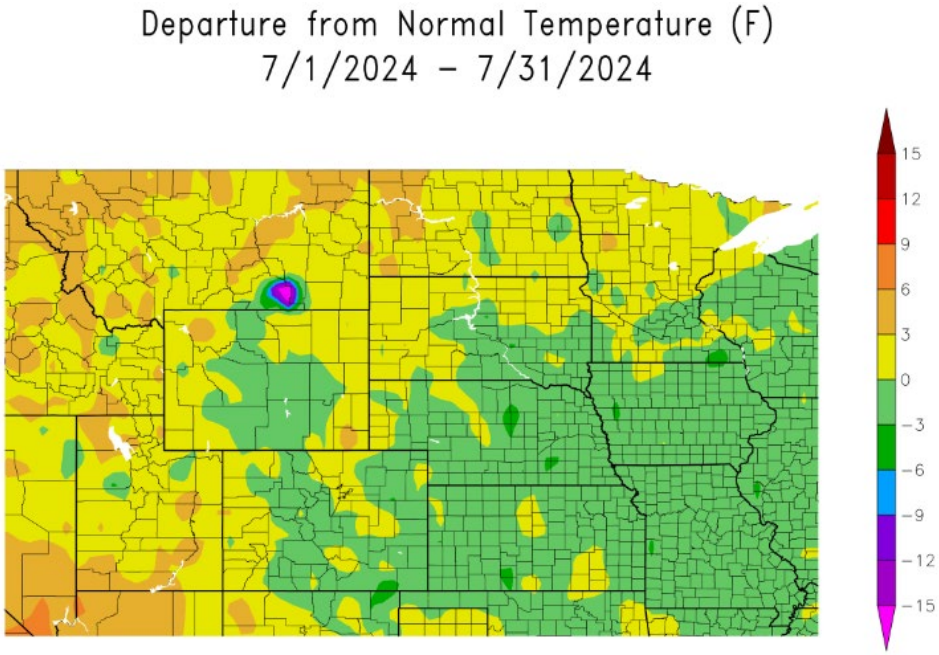


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

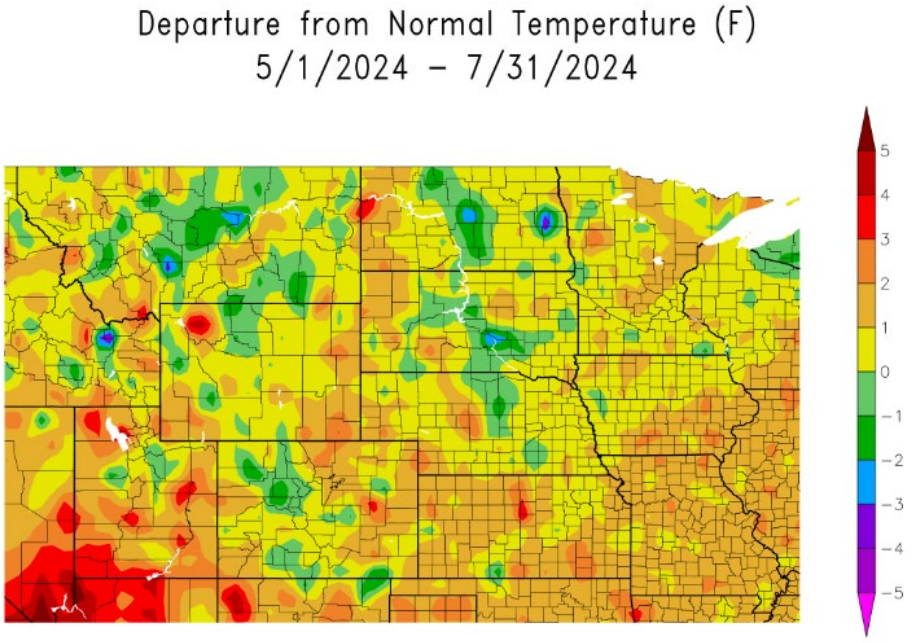


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

## Soil Moisture

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile at the end of July are shown in **Figure 7**. Soil moisture is below normal in Montana, western North Dakota, western South Dakota, Wyoming, western Nebraska, and Kansas. Soil moisture is above normal in the eastern portion of the Basin.

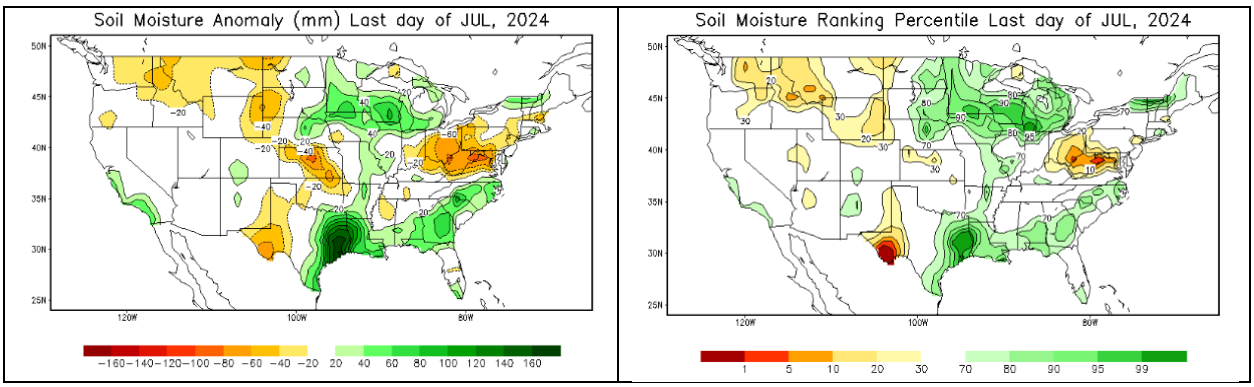


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

## Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

Plains snowpack is not a factor in the August runoff forecast.

## Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 8** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural

Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

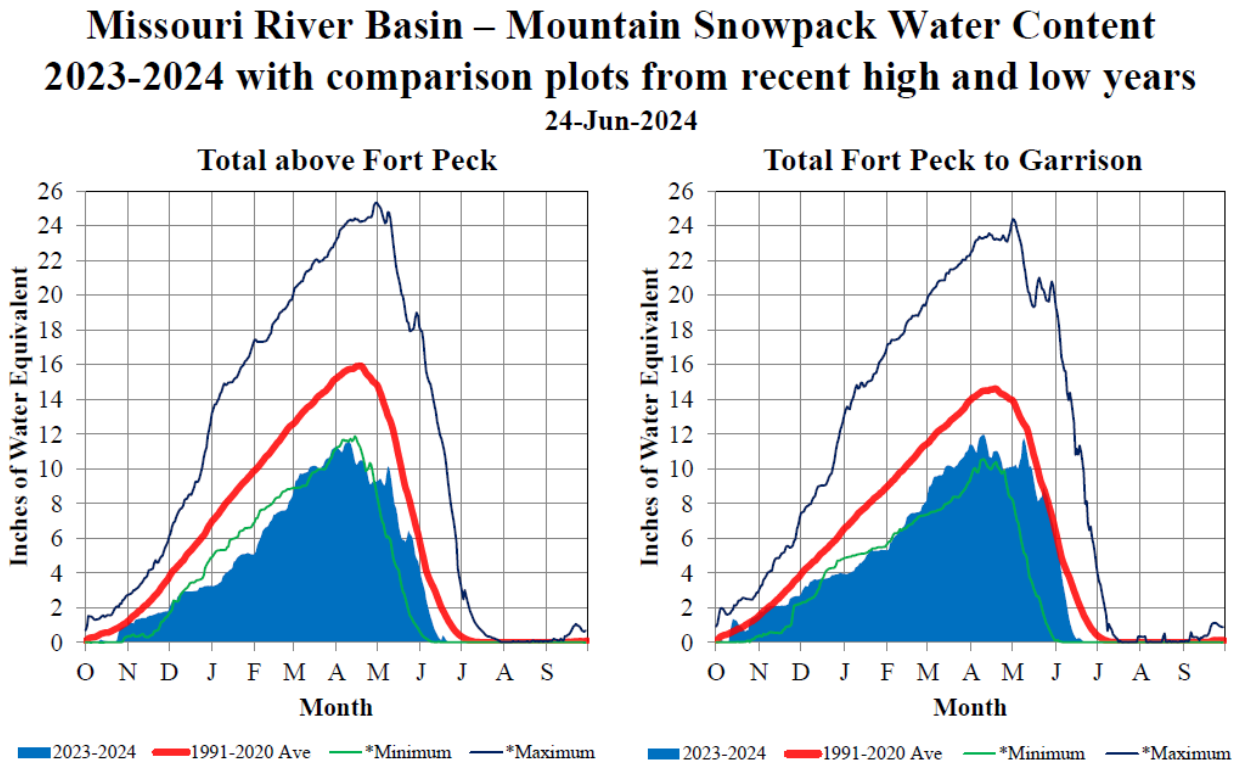


**Figure 8. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of June 24, 2024 all mountain snowpack has melted in both reaches.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

**El Niño Southern Oscillation (ENSO)**

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

ENSO-neutral conditions are currently present, and La Niña conditions have a 70% chance to develop during August-October. La Niña conditions are 79% likely to persist over the winter.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for August (**Figure 9**) indicates increased chances for above-normal temperatures across most of the Basin. The August precipitation outlook (**Figure 9**) shows increased chances for below-normal precipitation across the western side of the Basin, and equal chances for below-normal, normal, or above-normal precipitation in most of the rest of the Basin. Eastern South Dakota, eastern North Dakota and Iowa have a slightly increased chance for above-normal precipitation.

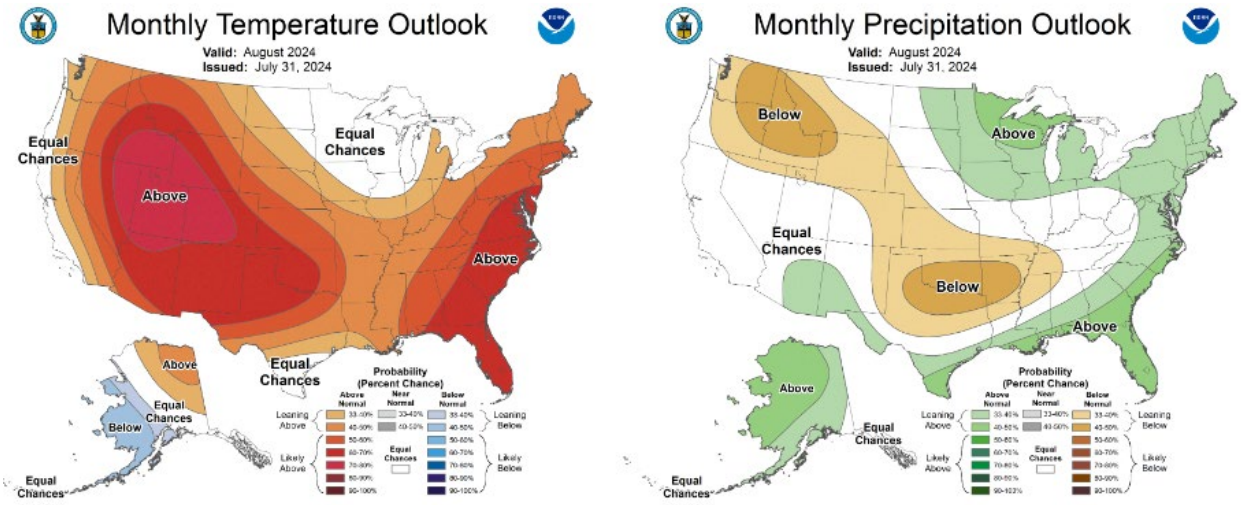


**Figure 9. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 10**. The September-October-November temperature outlook indicates increased chances for warmer-than-normal temperatures across most of the Basin. The precipitation outlook for the same period shows increased chances for below-normal precipitation in Colorado, Nebraska, Kansas, and portions of Wyoming and Missouri.

The December 2024-Janaury 2025-February 2025 temperature outlook indicates increased chances for warmer-than-normal temperatures across the southern part of the Basin, increased chances for cooler-than-normal temperatures across the northern part of the Basin, and equal chances for cooler-than-normal, normal, or warmer-than-normal temperatures in between. The precipitation outlook for the

same period shows equal chances for below-normal, normal, or above-normal precipitation for most of the Basin, with slightly increased chances for below-normal precipitation in Colorado and slightly increased chances for above-normal precipitation in Montana.

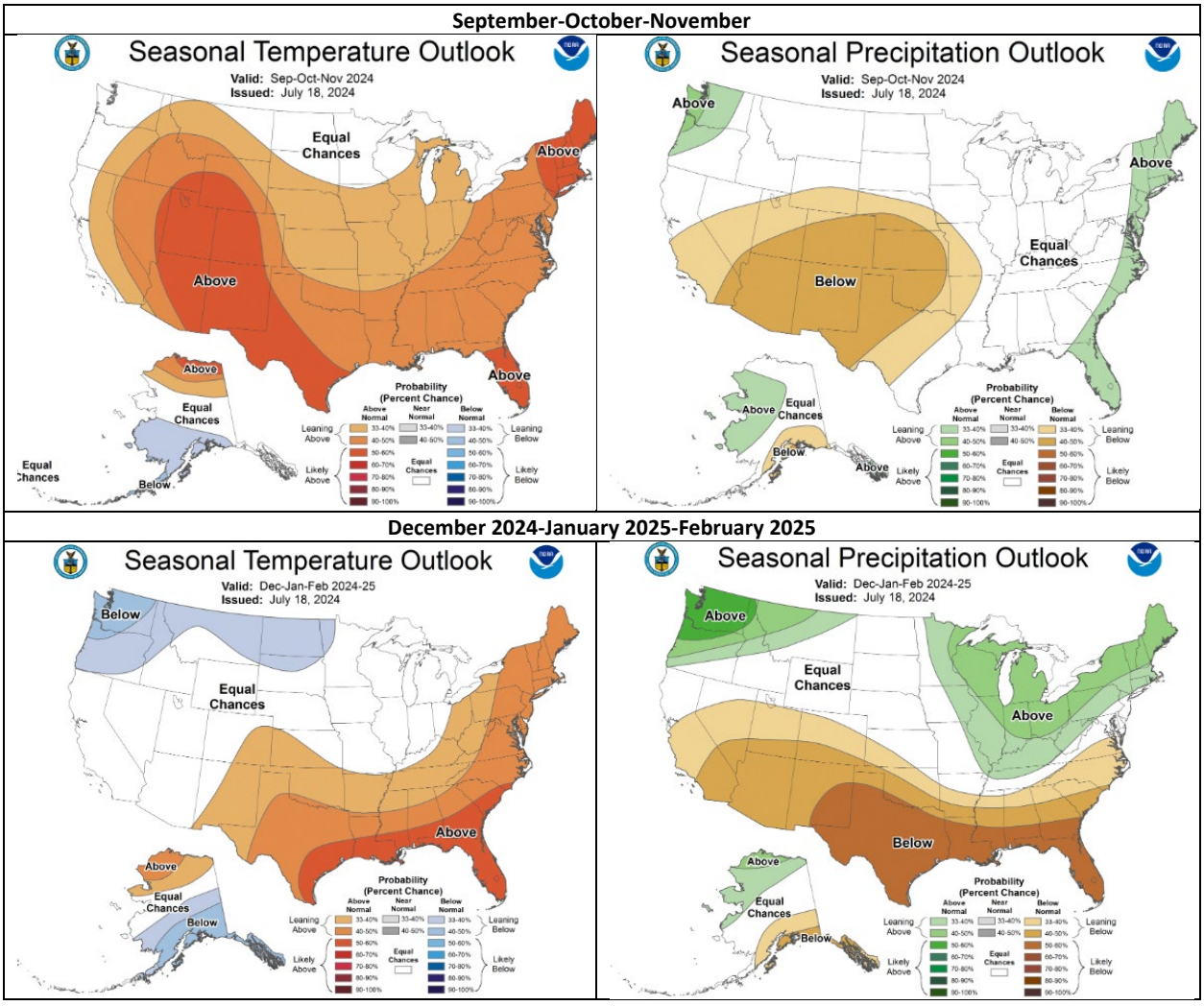


**Figure 10. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, and forecast temperatures and precipitation. Given these factors we expect runoff during August for Fort Peck, Garrison, and Oahe to be below average. Runoff in the Fort Randall reach is expected to be near average during August. The Gavins Point and Sioux City reaches are expected to have above average runoff in August. In summary, the 2024 calendar year runoff forecast is **23.9 MAF, 93% of average**.

# Upper Missouri River Basin
# September 2024 Calendar Year Runoff Forecast
# September 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

August runoff was 1.2 MAF (86% of average) for the basin above Sioux City, and 0.9 MAF (72% of average) above Gavins Point. Runoff was below average in the upper two reaches and above average in the lower four reaches. The Sioux City reach was 193% of normal, while the Garrison reach was only 53% of normal.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **23.8 MAF, 92% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **18.6 MAF, 80% of average**.

Due to the variability in precipitation and other hydrologic factors that can occur over the next four months, expected inflow could range from the 23.1 MAF lower basic forecast to the 24.6 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. The range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is attributed to all six reaches. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for September 3 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over approximately 77% of the Basin. The Monthly Drought Outlook in **Figure 2**, which extends through the end of September, indicates drought conditions are likely to persist in the upper Basin and worsen in northeast Nebraska, southeast South Dakota, and into northwest Iowa.

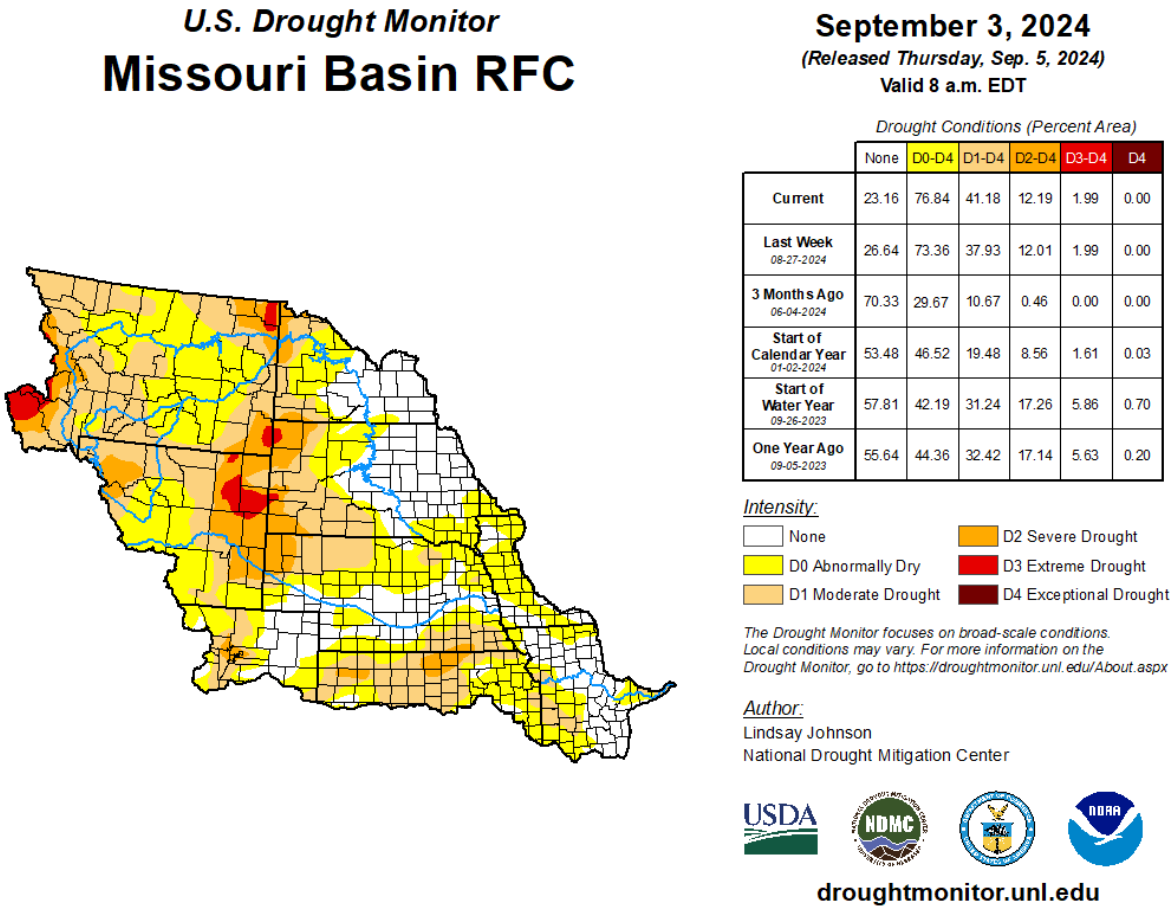


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

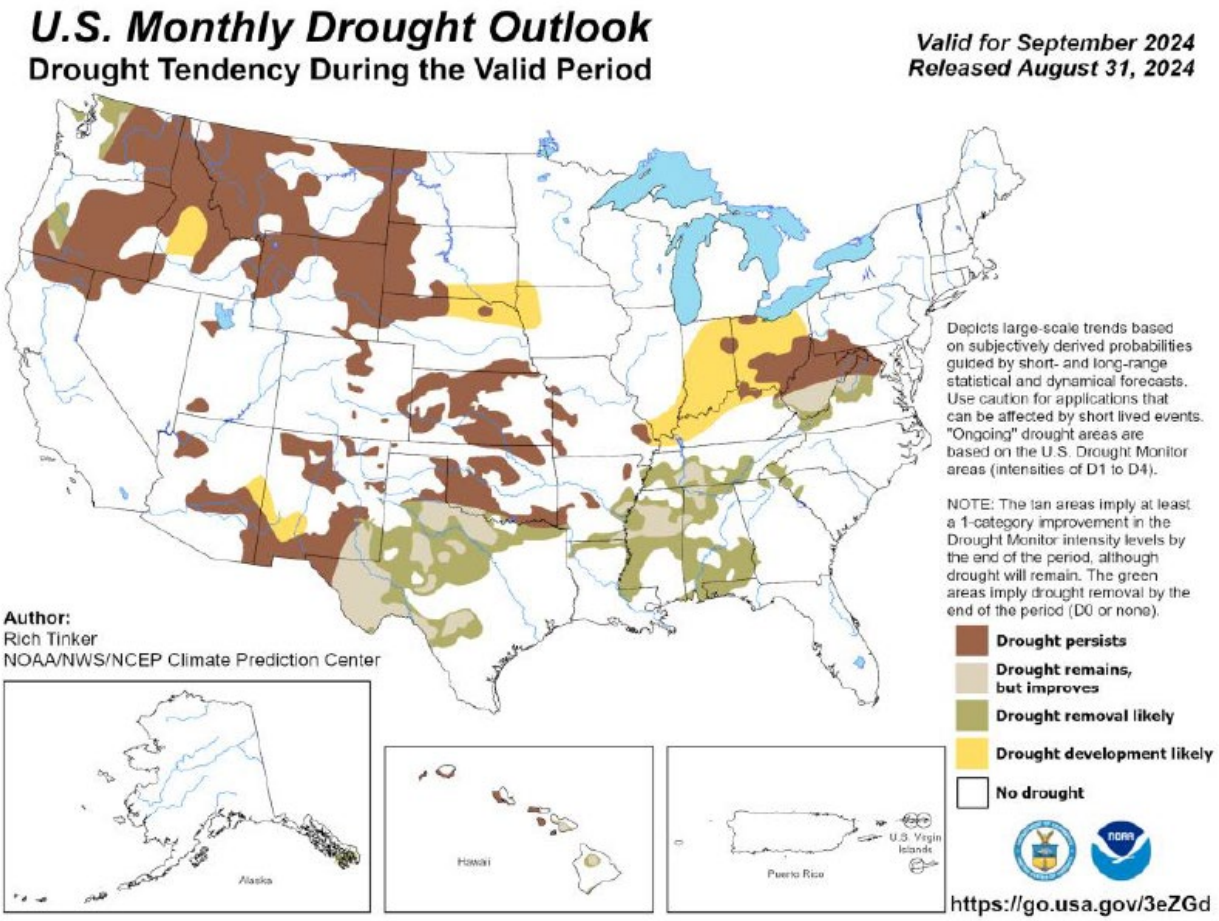


**Figure 2. Climate Prediction Center US Monthly Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The August precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was mixed with pockets of above-normal and below-normal precipitation in every state.

Precipitation as a percent of normal for the June-July-August period (**Figure 4**) was mostly below normal in the western parts of the Basin and mostly near normal in the eastern parts of the Basin.

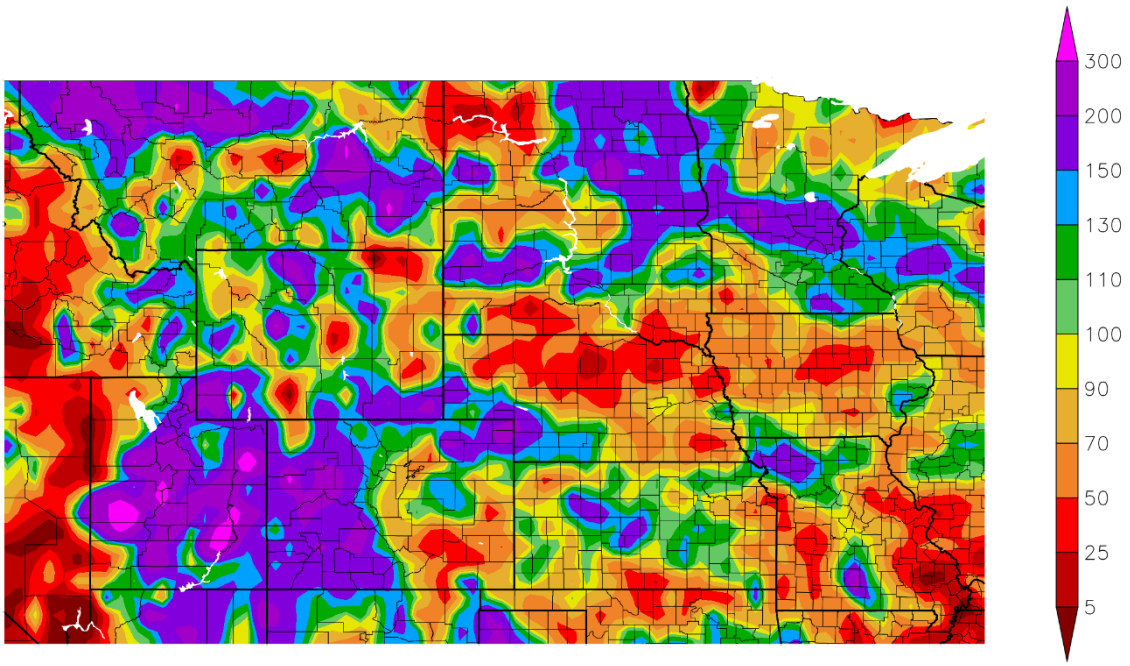


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

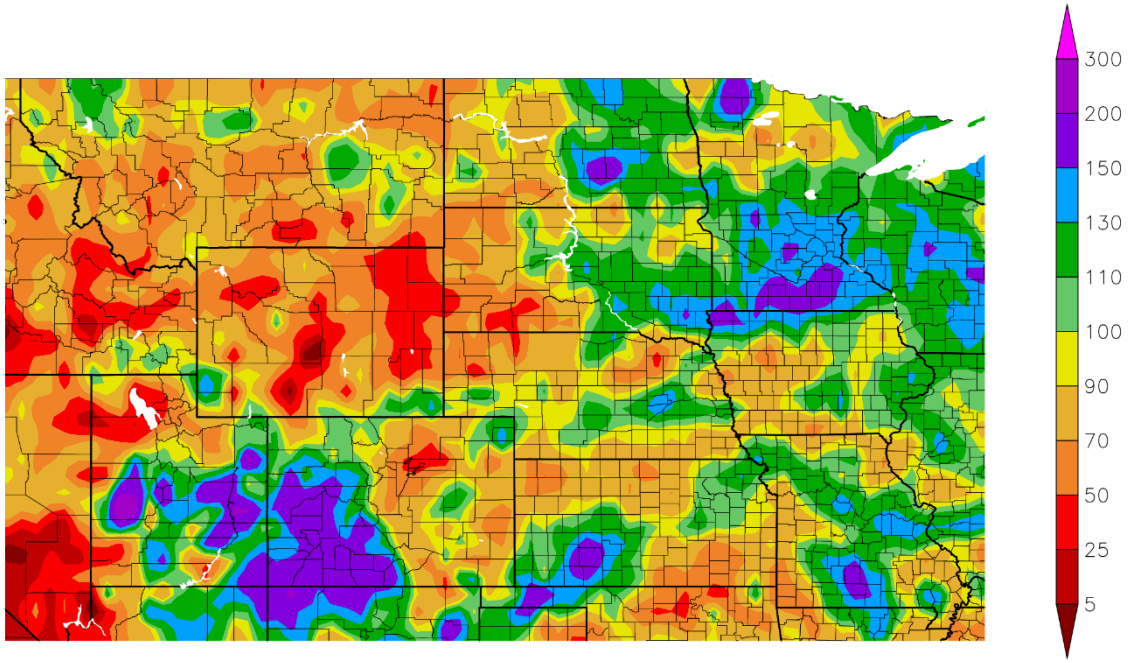

**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

## Temperature

August temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures across the western parts of the Basin and near-normal or slightly below-normal temperatures across the eastern parts of the Basin. June-July-August temperature departures are shown in **Figure 6**. The three-month average temperature departures are mostly warmer than normal except across the central Dakotas and into central Nebraska, where temperatures were slightly cooler than normal.

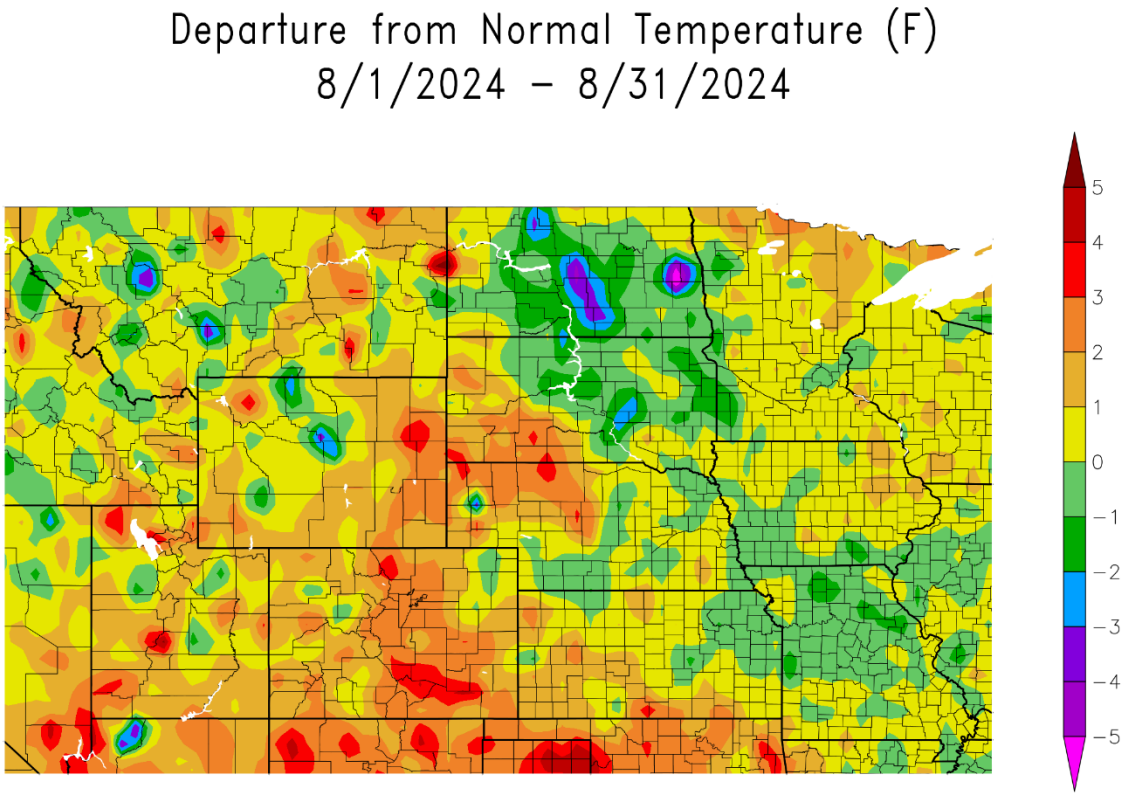


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

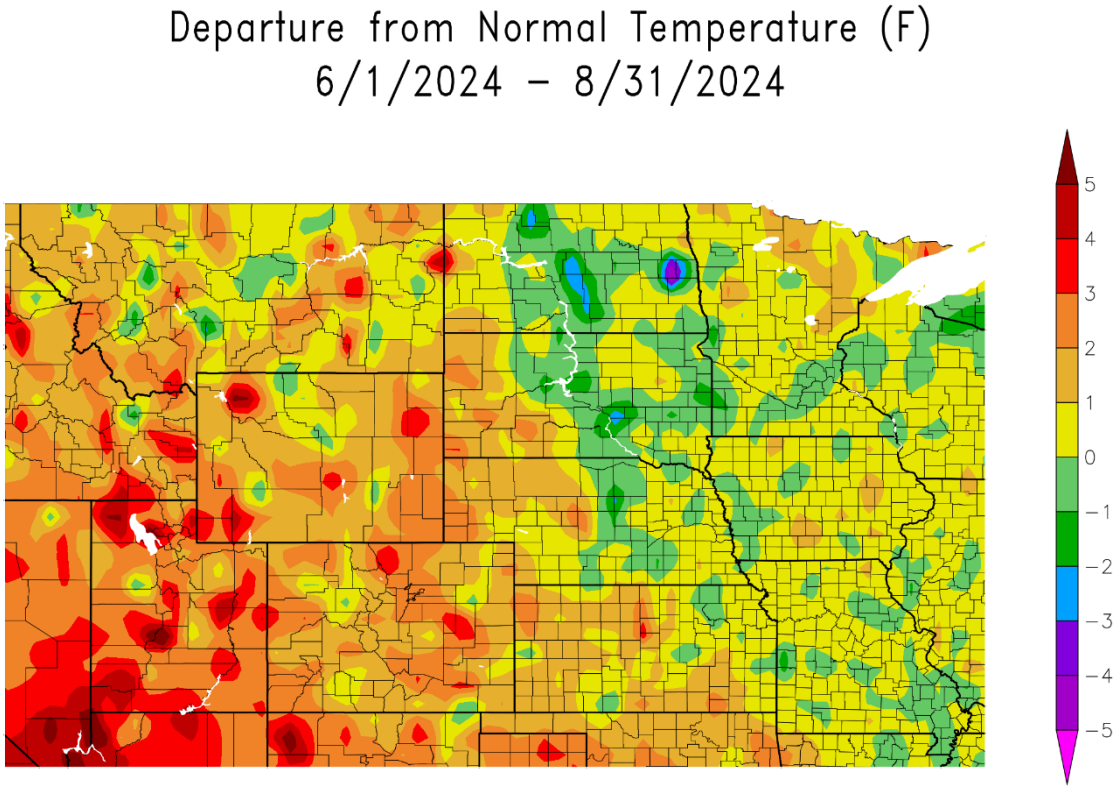


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile for the month of August are shown in **Figure 7**. Soil moisture is below normal in western Montana, along the MT-ND and WY-SD borders, and in central Kansas. Soil moisture is above normal in the eastern Dakotas and parts of northeastern Nebraska.

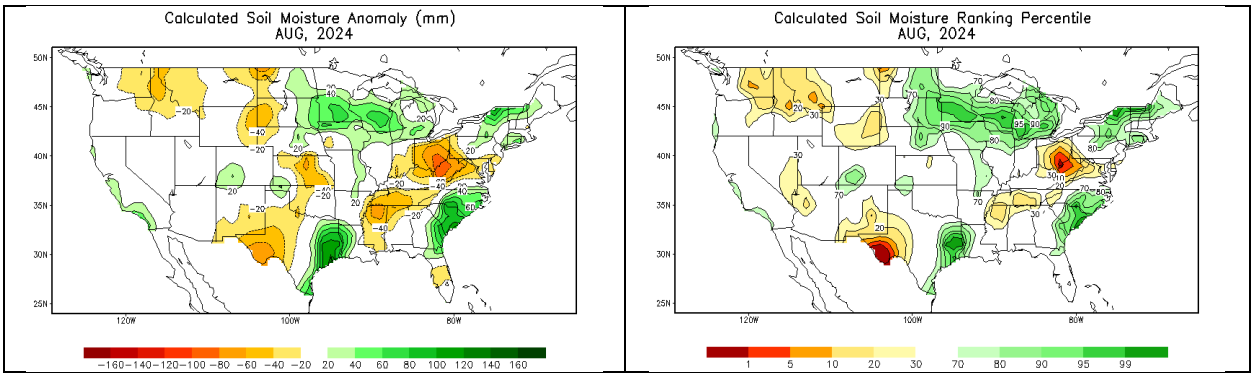


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

**Plains Snowpack**

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

Plains snowpack is not a factor in the August runoff forecast.

**Mountain Snowpack**

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 8** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

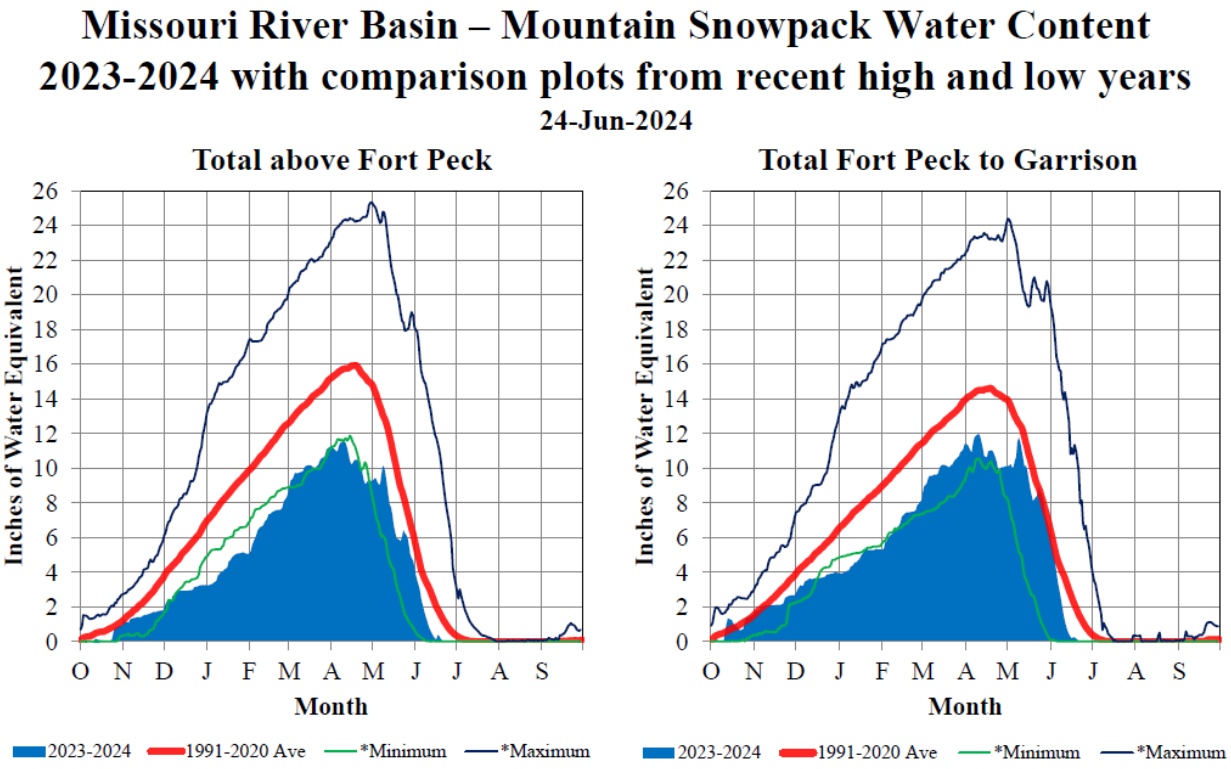


**Figure 8. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of June 24, 2024 all mountain snowpack has melted in both reaches.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### El Niño Southern Oscillation (ENSO)

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

ENSO-neutral conditions are currently present.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for September (**Figure 9**) indicates increased chances for above-normal temperatures across most of the Basin. The September precipitation outlook (**Figure 9**) shows increased chances for below-normal precipitation across the Basin.

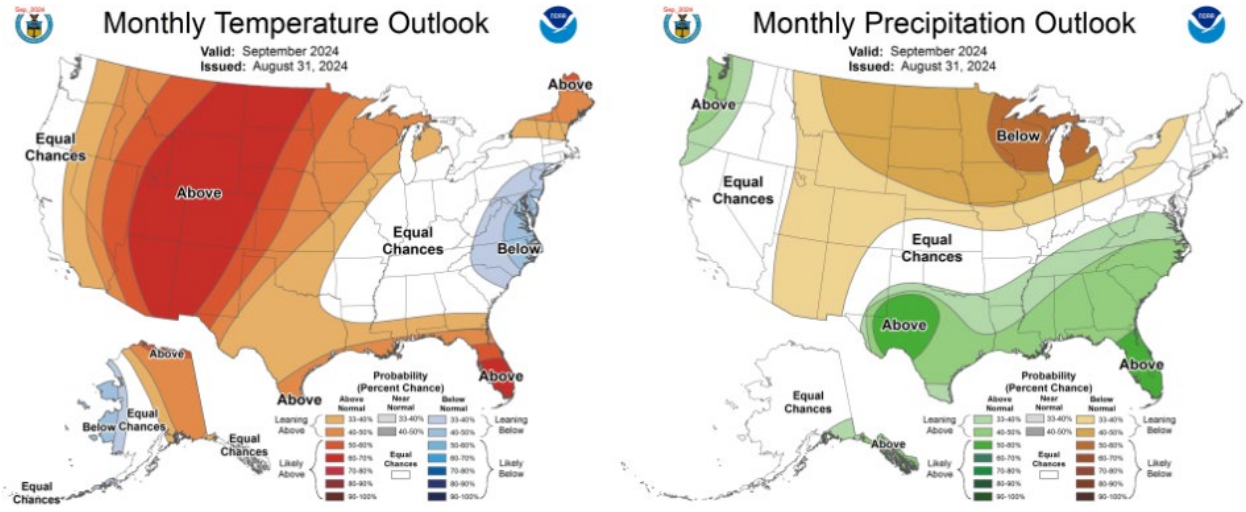


**Figure 9. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 10**. The September-October-November temperature outlook indicates increased chances for warmer-than-normal temperatures across most of the Basin. The precipitation outlook for the same period shows equal chances for below-normal, normal, or above-normal precipitation in the upper Basin and increased chances for below-normal precipitation in the lower Basin.

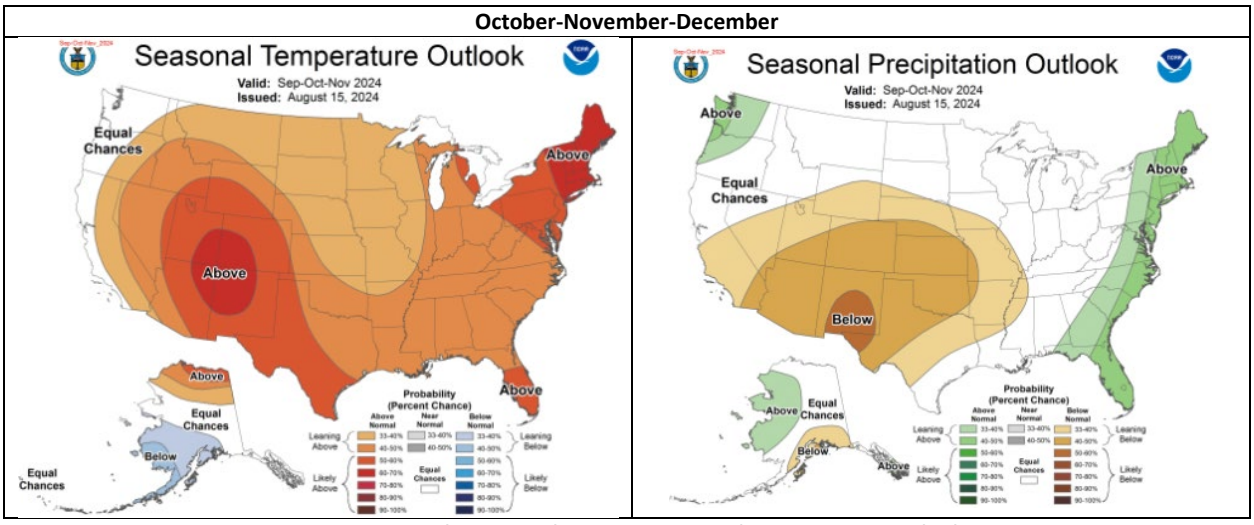


**Figure 10. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, and forecast temperatures and precipitation. Given these factors we expect runoff during September to be below average or near average for all the reaches. In summary, the 2024 calendar year runoff forecast is **23.8 MAF, 92% of average**.

# Upper Missouri River Basin
# October 2024 Calendar Year Runoff Forecast
# October 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

September runoff was 0.8 MAF (66% of average) for the basin above Sioux City, and 0.6 MAF (58% of average) above Gavins Point. Runoff was below average in all the reaches except Sioux City, which was slightly above average.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **23.5 MAF, 91% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **18.3 MAF, 79% of average**.

Due to the variability in precipitation and other hydrologic factors that can occur over the next three months, expected inflow could range from the 23.0 MAF lower basic forecast to the 24.0 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. The range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is attributed to all six reaches. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for September 24 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over approximately 81% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of December, indicates drought conditions are likely to improve in western Montana and expand in eastern South Dakota, northwestern Nebraska, western Nebraska, Kansas, and western Missouri.

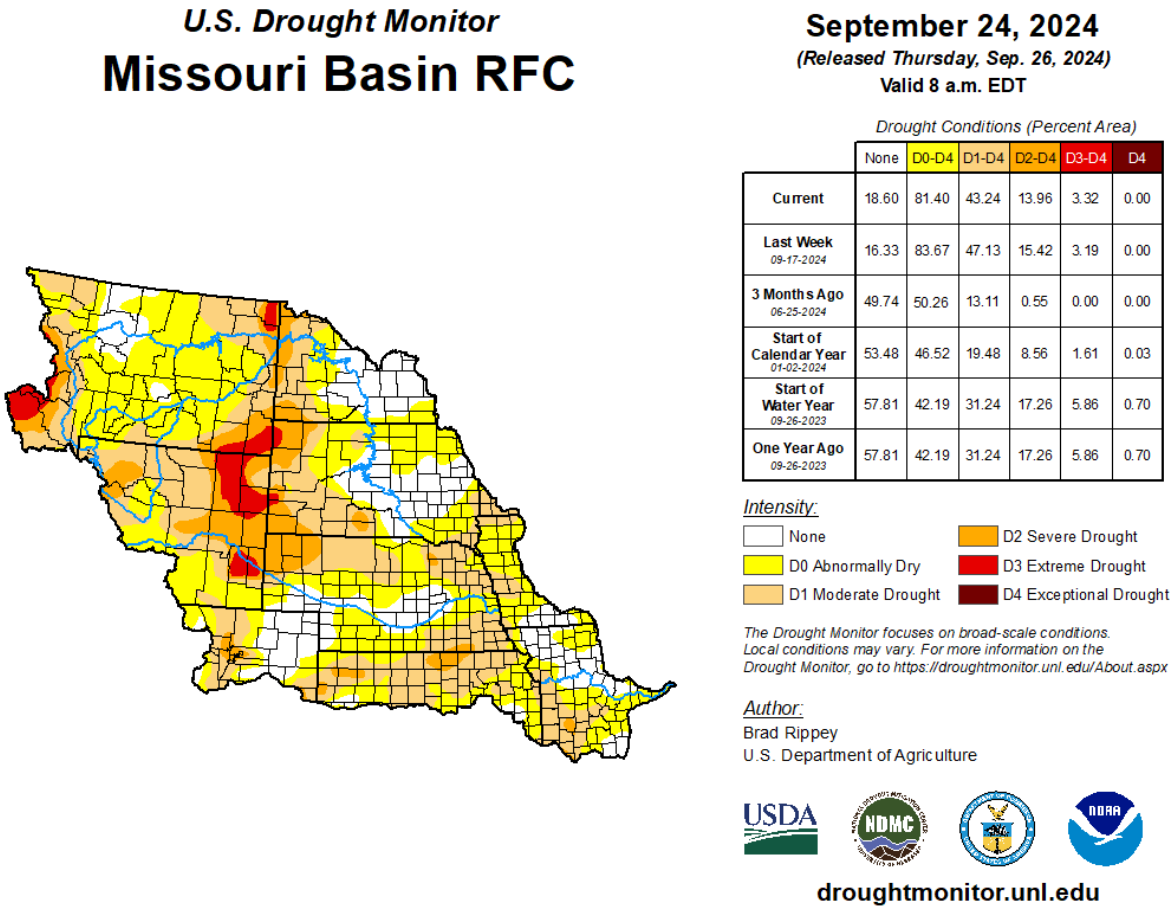


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

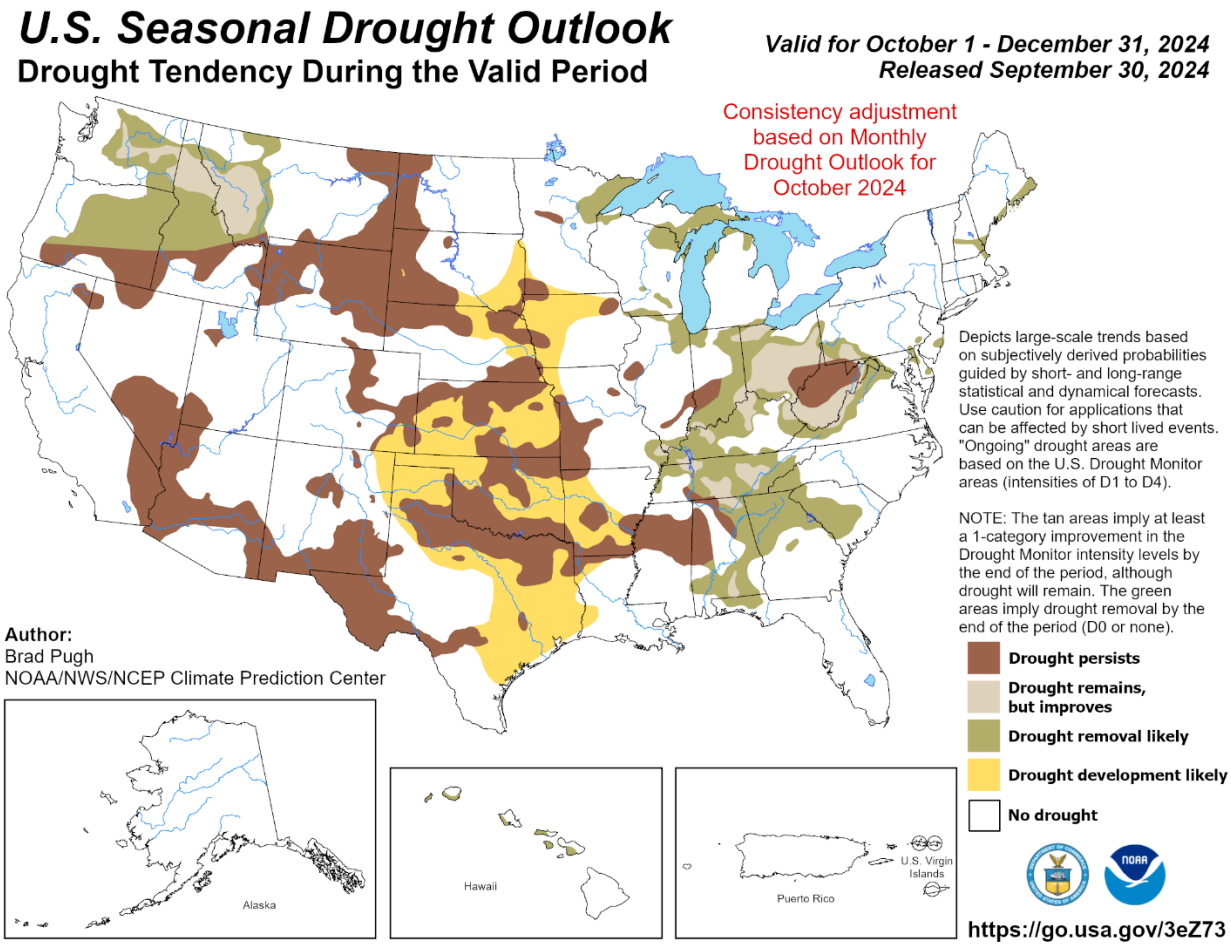


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

## Precipitation

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The September precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was well below normal, except in central and northeastern Montana. Much of the Basin saw widespread areas of less than 25% of normal precipitation.

Precipitation as a percent of normal for the July-August-September period (**Figure 4**) was mostly below normal except for pockets of above-normal precipitation in central Montana and northeastern North Dakota.

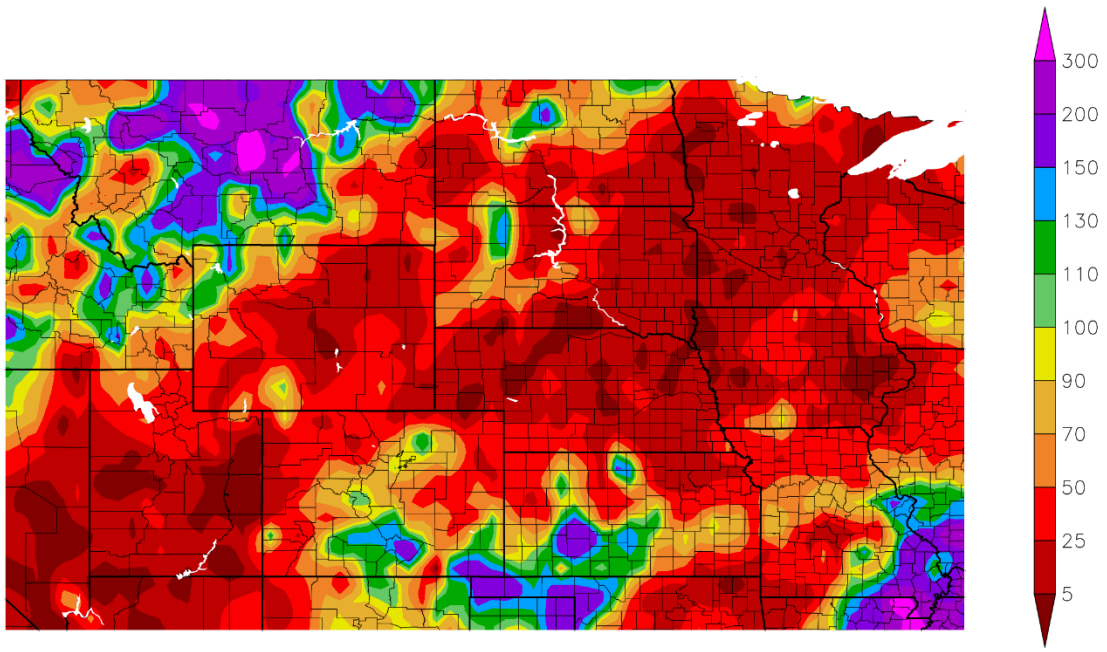


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

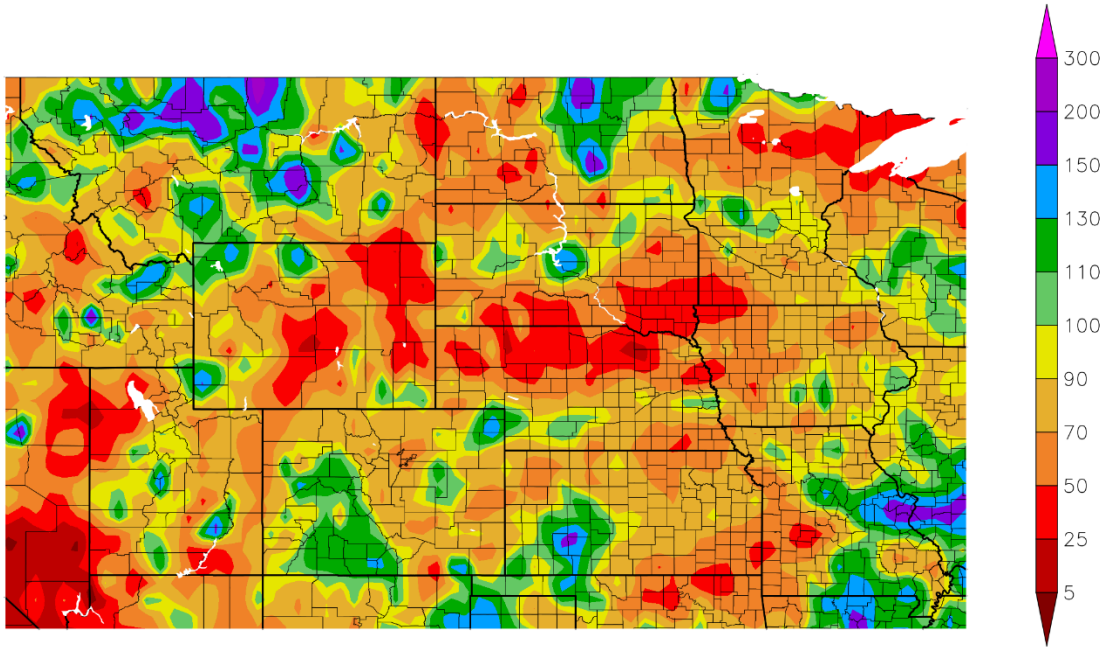


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

September temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures across the Basin. July-August-September temperature departures are shown in **Figure 6**. The three-month average temperature departures are also warmer than normal across the Basin.

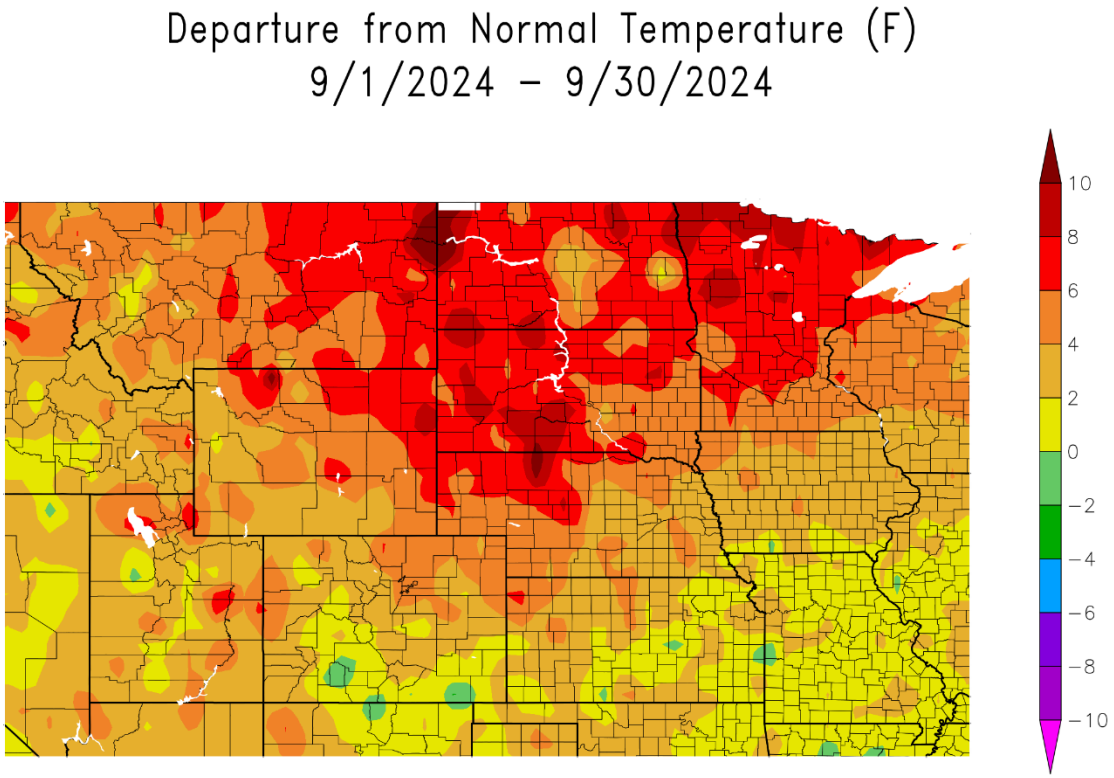


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

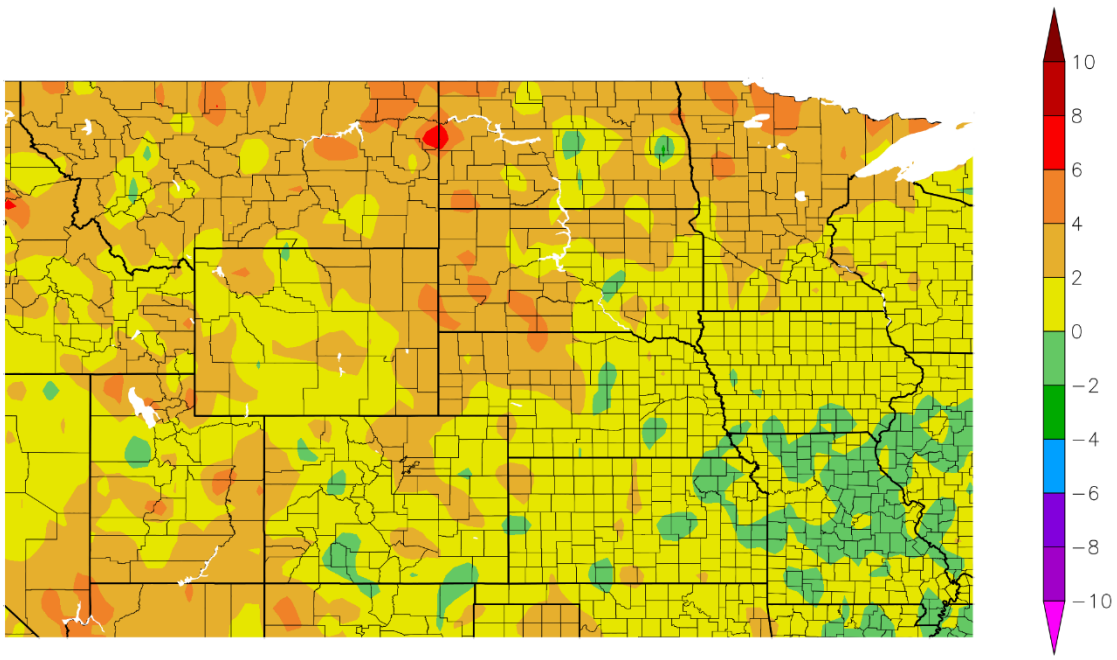


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile at the end of September are shown in **Figure 7**. Soil moisture has dried out over the last month for most of the Basin except in Montana, which saw some improvement due to the above-normal precipitation.

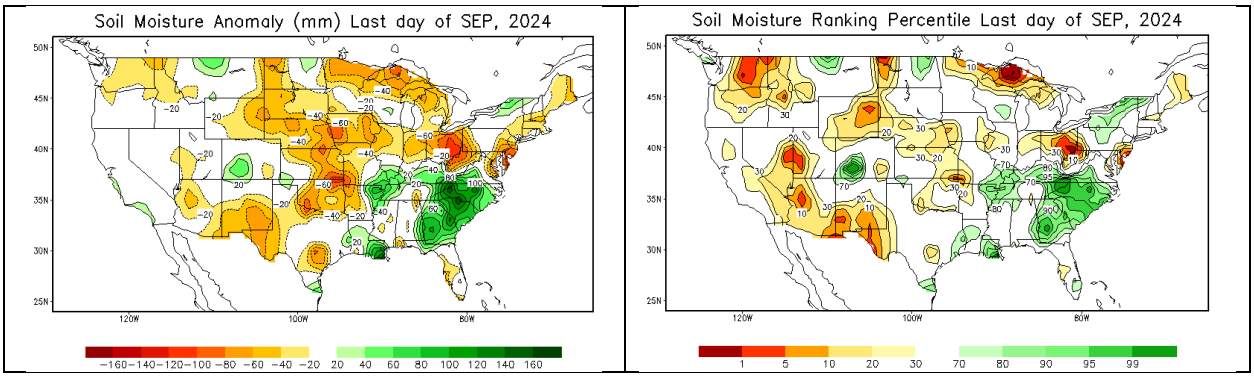


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

**Plains Snowpack**

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

Plains snowpack is not a factor in the August runoff forecast.

**Mountain Snowpack**

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 8** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

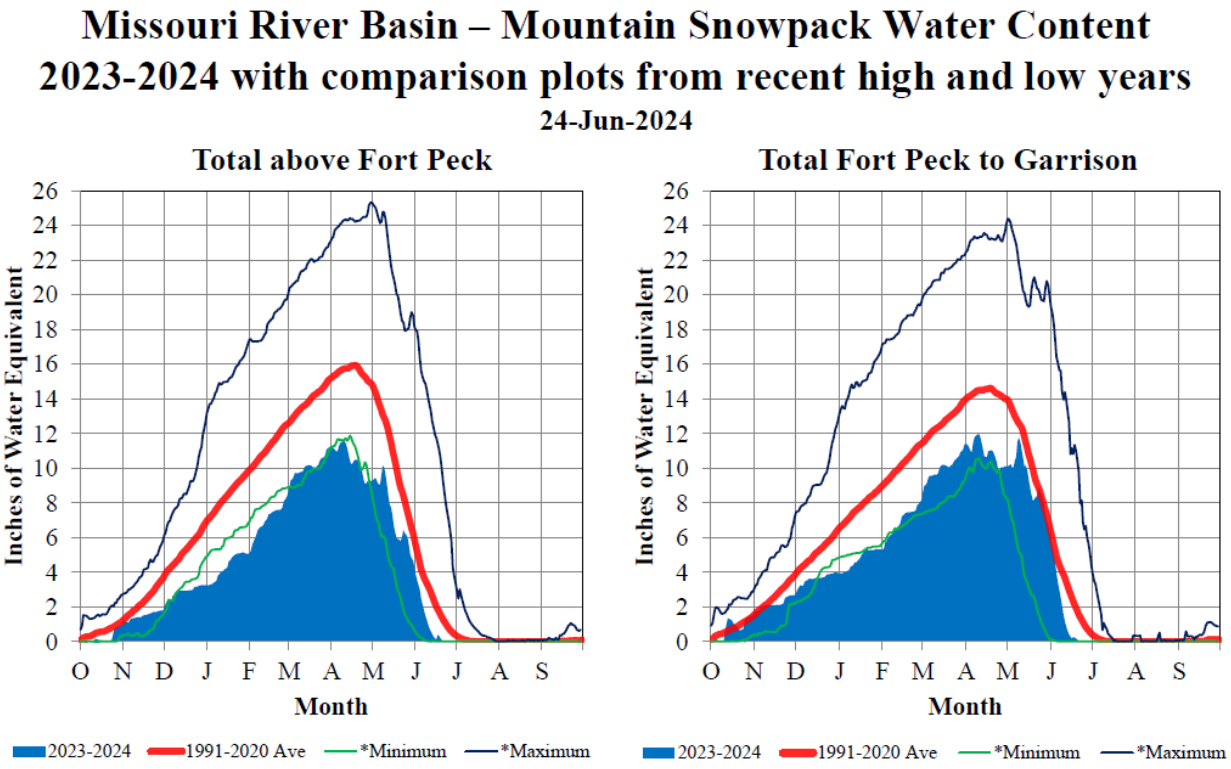


**Figure 8. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of June 24, 2024 all mountain snowpack has melted in both reaches.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### El Niño Southern Oscillation (ENSO)

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

ENSO-neutral conditions are currently present. La Niña conditions are 71% likely to occur during the September-November period, and are likely to persist through winter 2025.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for October (**Figure 9**) indicates increased chances for above-normal temperatures across most of the Basin. The October precipitation outlook (**Figure 9**) shows increased chances for below-normal precipitation across most of the Basin.

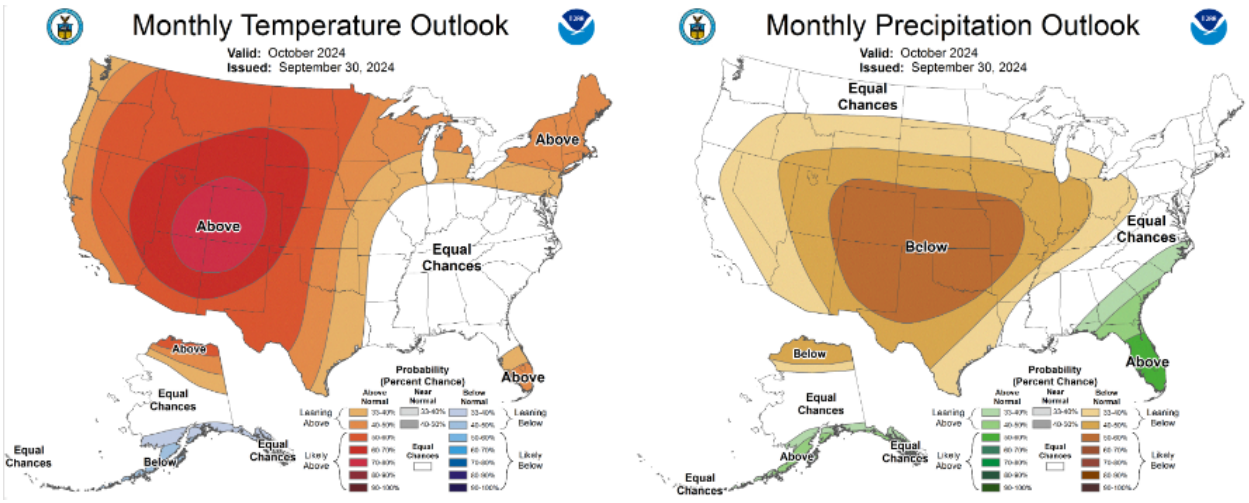


**Figure 9. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 10**. The October-November-December temperature outlook indicates equal chances for warmer-than-normal, normal, or lower-than-normal temperatures across most of the Basin and increased chances for warmer-than-normal temperatures in Kansas and Missouri. The precipitation outlook for the same period shows equal chances for below-normal, normal, or above-normal precipitation in the Basin except for western Montana, which has a slight indication of increased chances for above-normal precipitation.

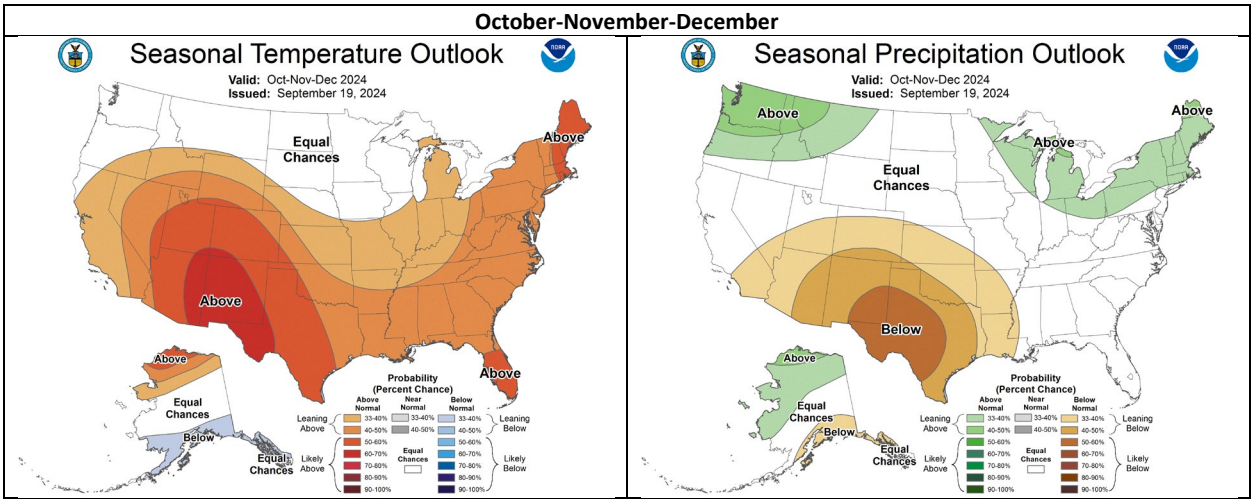


**Figure 10. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, and forecast temperatures and precipitation. Given these factors we expect runoff during October to be below average or near average for all the reaches. In summary, the 2024 calendar year runoff forecast is **23.5 MAF, 91% of average**.

# Upper Missouri River Basin
# November 2024 Calendar Year Runoff Forecast
# November 1, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

October runoff was 0.5 MAF (43% of average) for the basin above Sioux City, and 0.4 MAF (35% of average) above Gavins Point. Runoff was well below average in all reaches except Sioux City, which was slightly above average. October reach runoff for Garrison was the 3rd lowest on record, Fort Randall reach runoff was the 8th lowest, and Gavins Point reach runoff tied for the 5th lowest in 126 years of record-keeping. The runoff summation above Gavins Point for October of 0.4 MAF set a new record low, and the runoff summation above Sioux City of 0.5 MAF was the 2nd lowest on record.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **23.0 MAF, 90% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **17.8 MAF, 76% of average**.

Due to the variability in precipitation and other hydrologic factors that can occur over the next two months, expected inflow could range from the 22.8 MAF lower basic forecast to the 23.3 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. The range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is attributed to all six reaches. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for October 29 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over approximately 95% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of January 2025, indicates drought conditions are likely to improve in western Montana and the lower Basin, but expand in South Dakota and persist for the rest of the upper Basin.

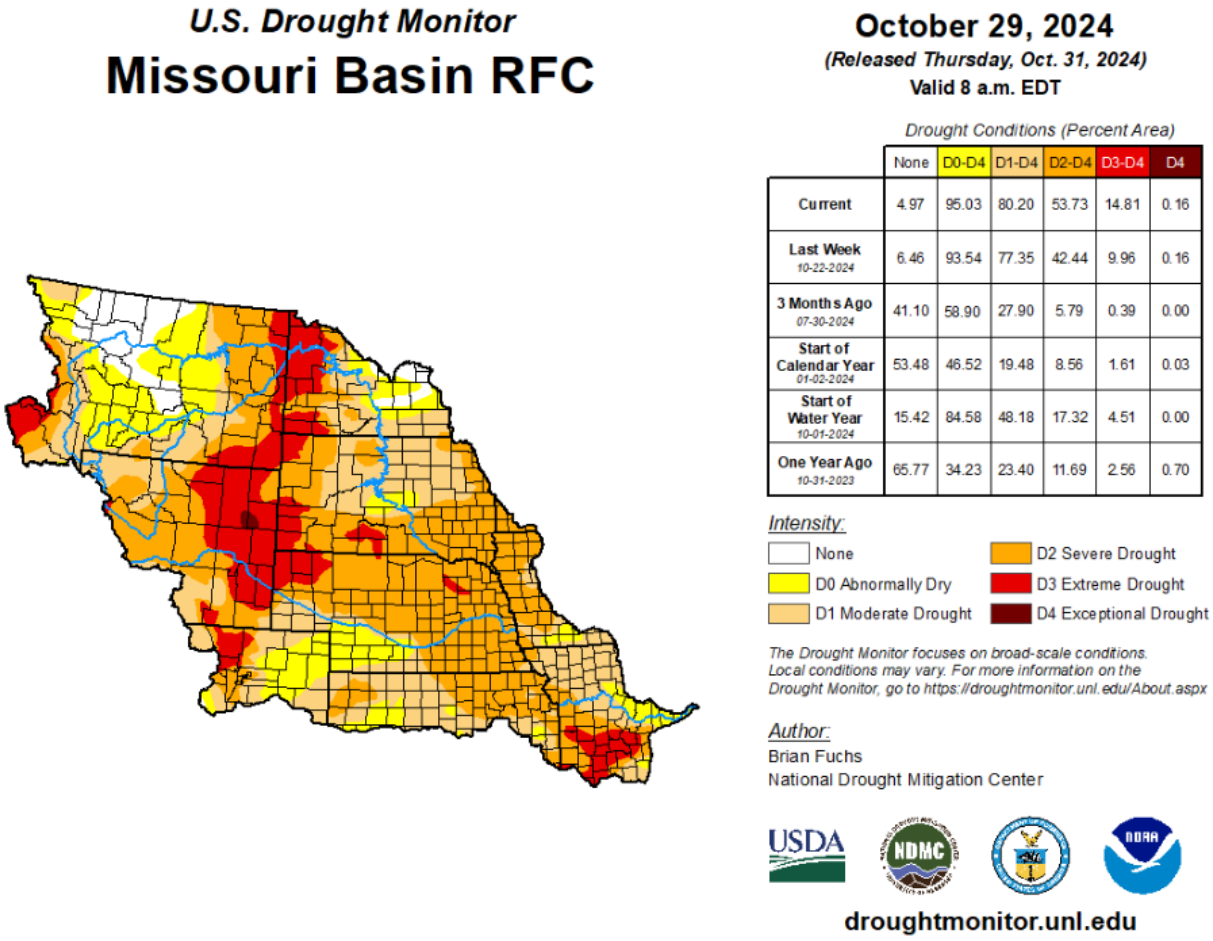


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

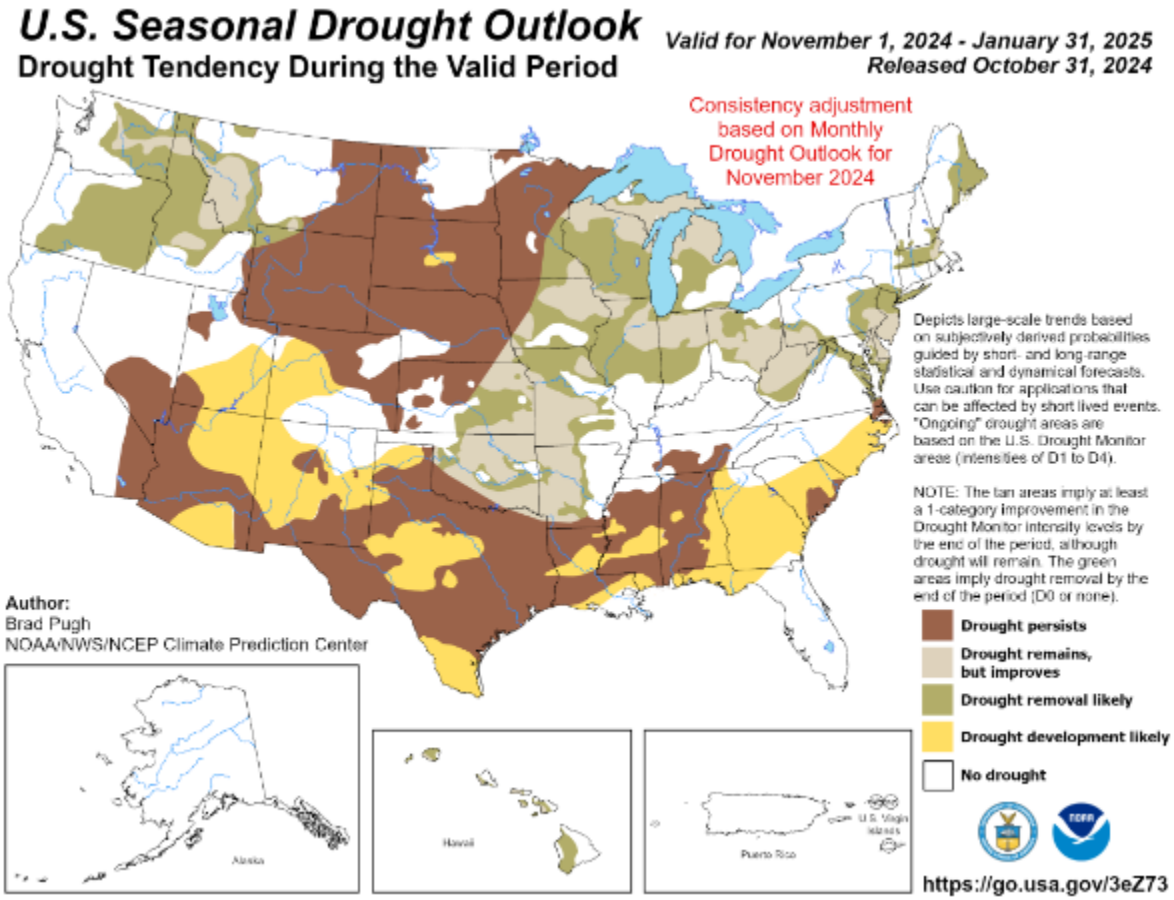


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

**Precipitation**

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The October precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was well below normal, except in small areas of Wyoming and Colorado. Much of the Basin saw widespread areas of less than 25% of normal precipitation.

Precipitation as a percent of normal for the August-September-October period (**Figure 4**) was mostly below normal except for pockets of above-normal precipitation in central Montana and northeastern North Dakota, and small isolated areas of near normal in other states.

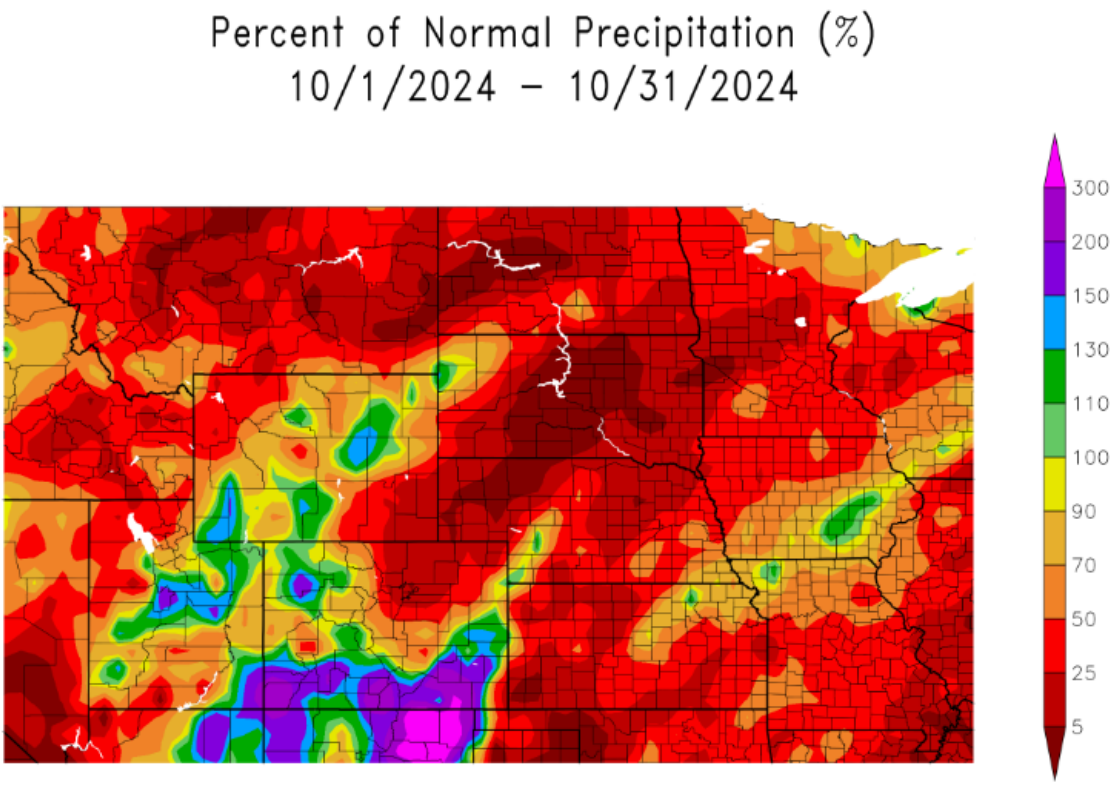


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

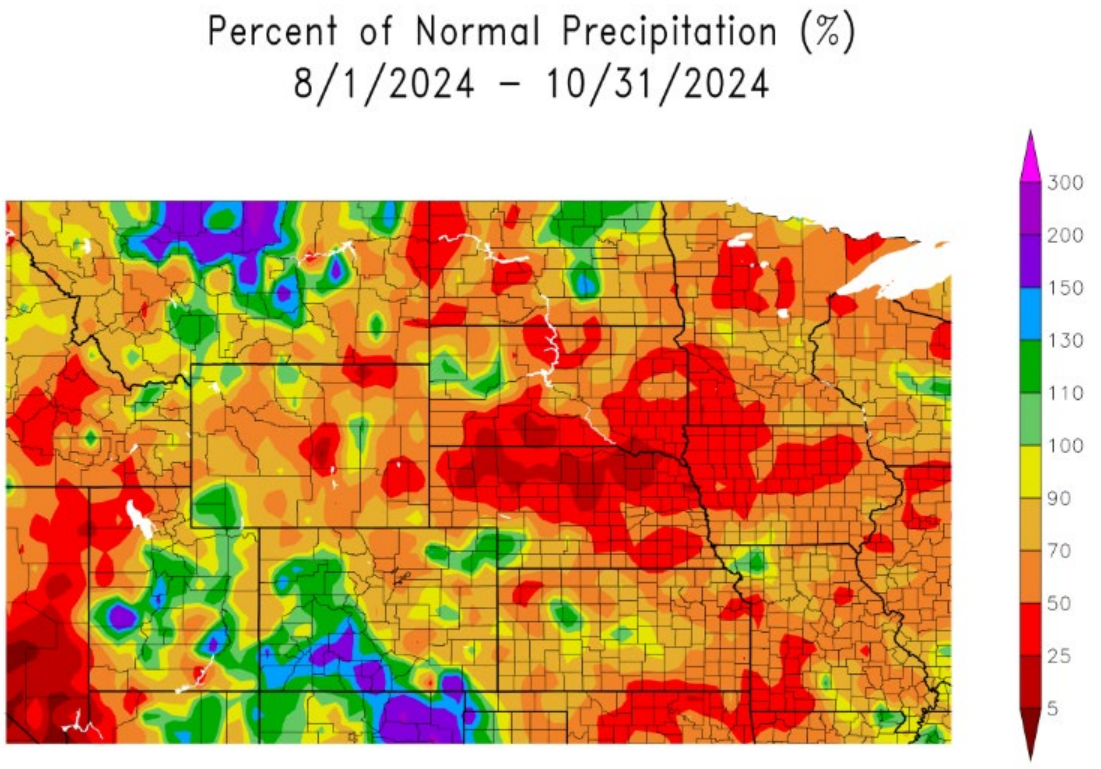


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

October temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, indicate warmer-than-normal temperatures across the Basin of 2 degrees to more than 10 degrees Fahrenheit above normal. August-September-October temperature departures are shown in **Figure 6**. The three-month average temperature departures are also warmer than normal across the Basin.

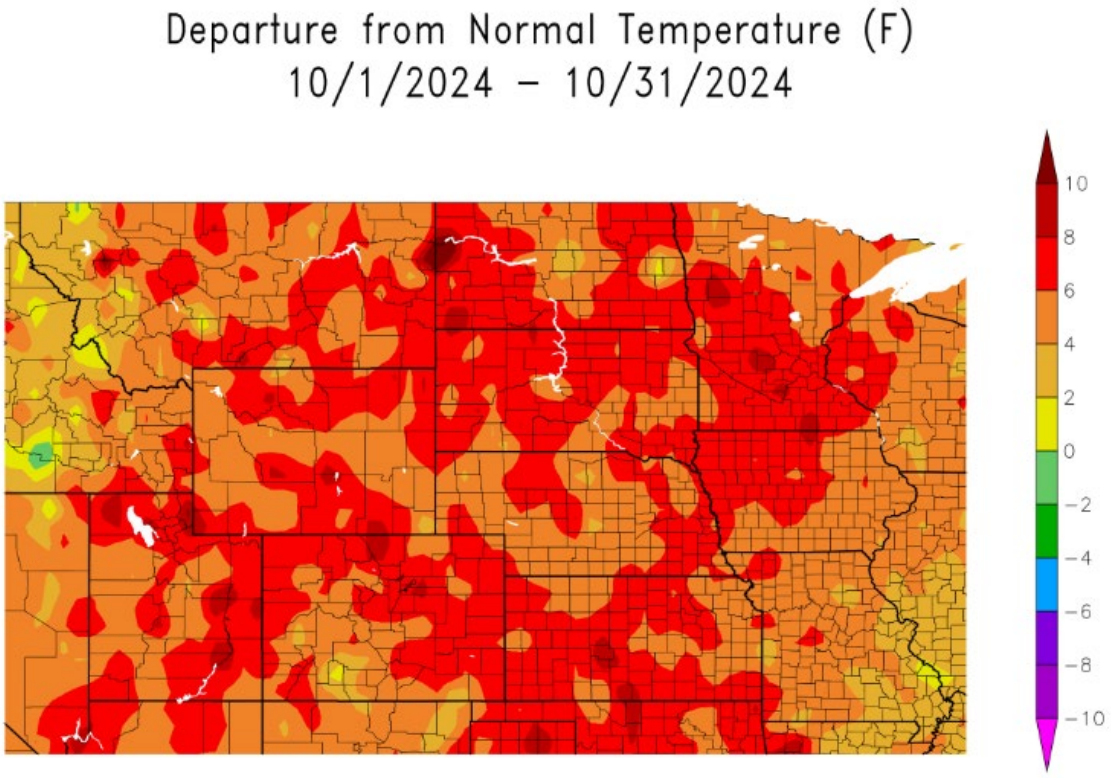


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

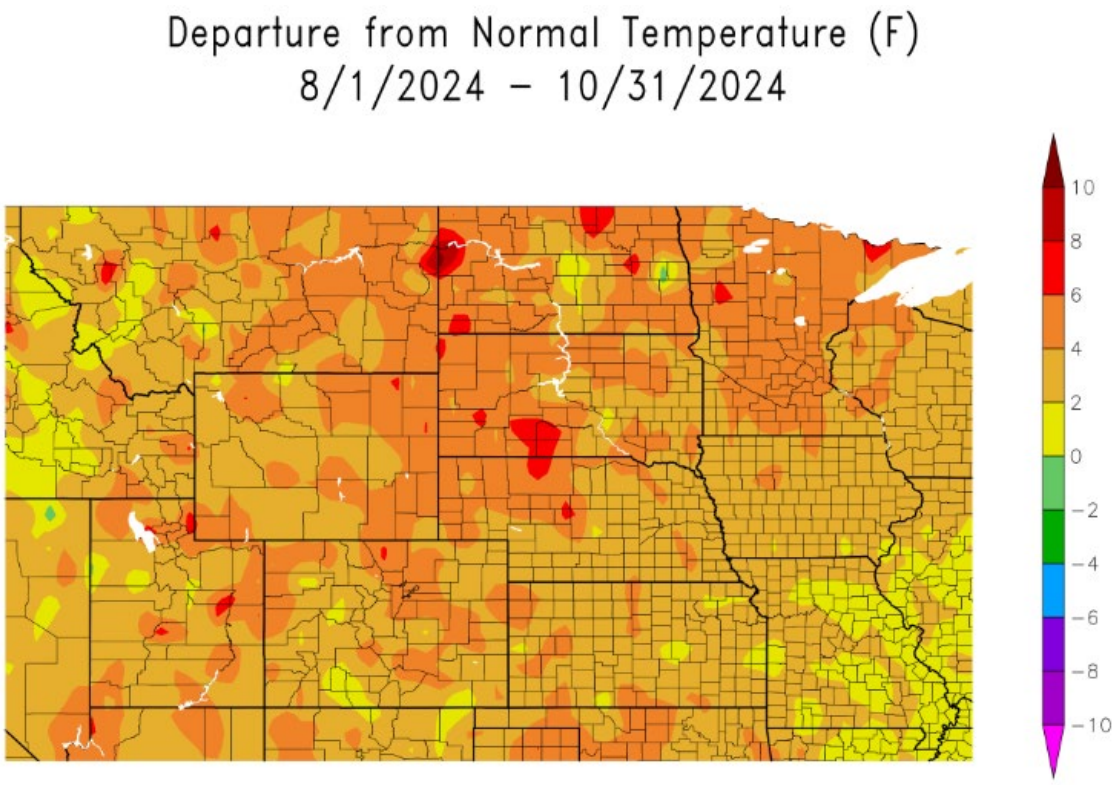


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile at the end of October are shown in **Figure 7**. Soil moisture has dried out over the last month everywhere in the Basin, but Montana and northern North Dakota still have pockets of above-normal soil moisture. The rest of the Basin has well-below-normal soil moisture.

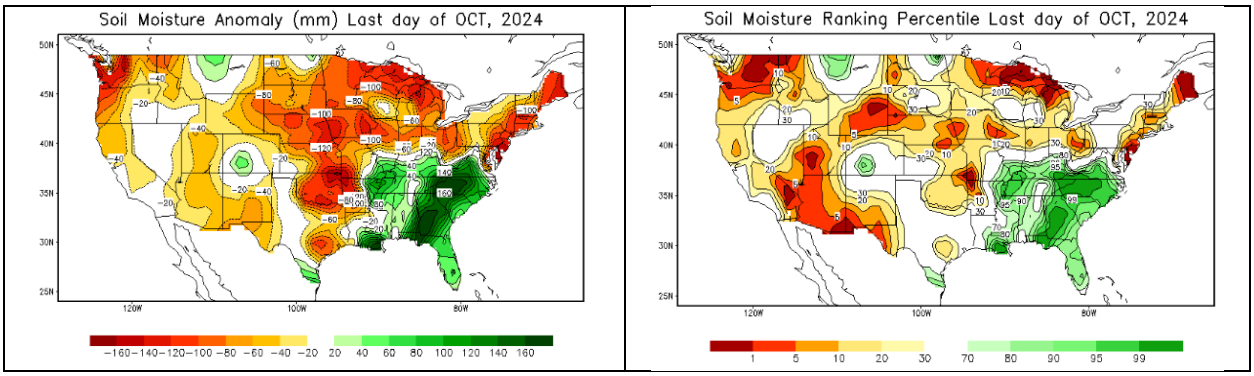


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

### Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

Plains snowpack is not a factor in the November runoff forecast.

### Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 8** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

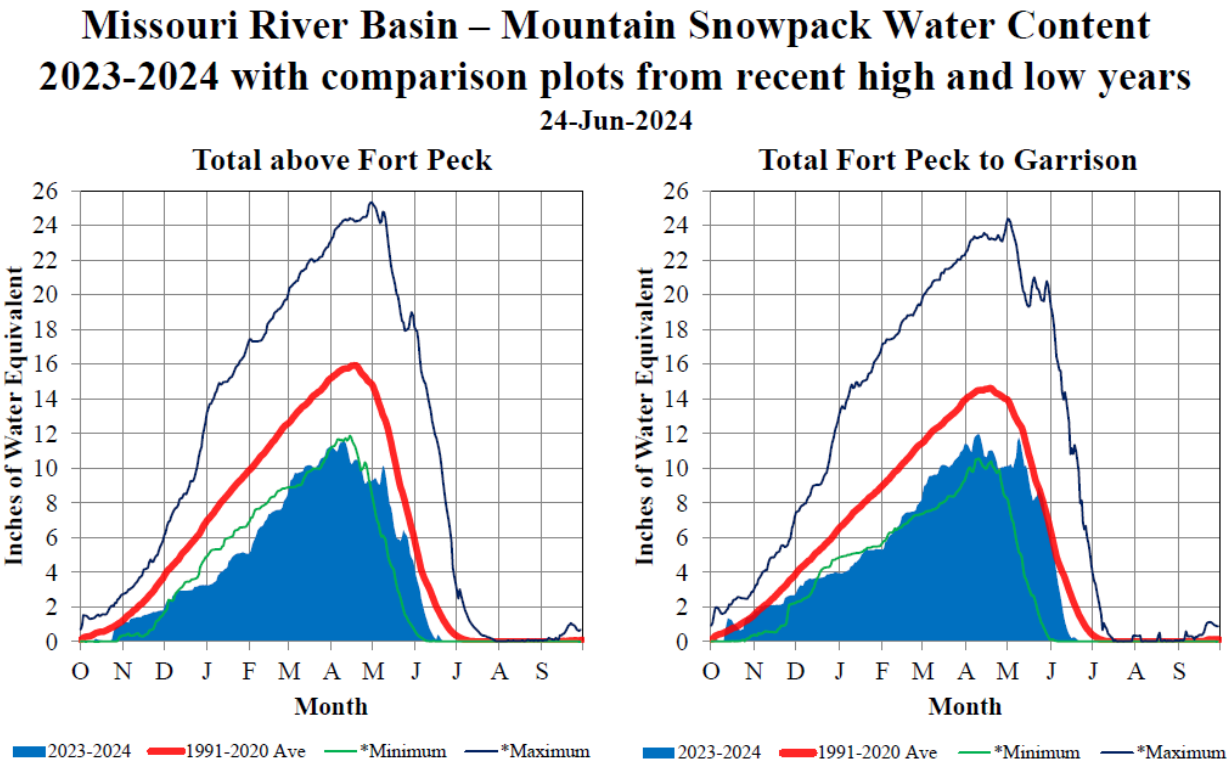


**Figure 8. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of June 24, 2024 all mountain snowpack has melted in both reaches.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### El Niño Southern Oscillation (ENSO)

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

ENSO-neutral conditions are currently present. La Niña conditions are 60% likely to occur during the September-November period and are likely to persist through winter 2025.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for November (**Figure 9**) indicates increased chances for above-normal temperatures across most of the Basin. The November precipitation outlook (**Figure 9**) shows increased chances for above-normal precipitation in the lower Basin, with equal chances of above-normal, normal, or below-normal precipitation in the upper Basin.

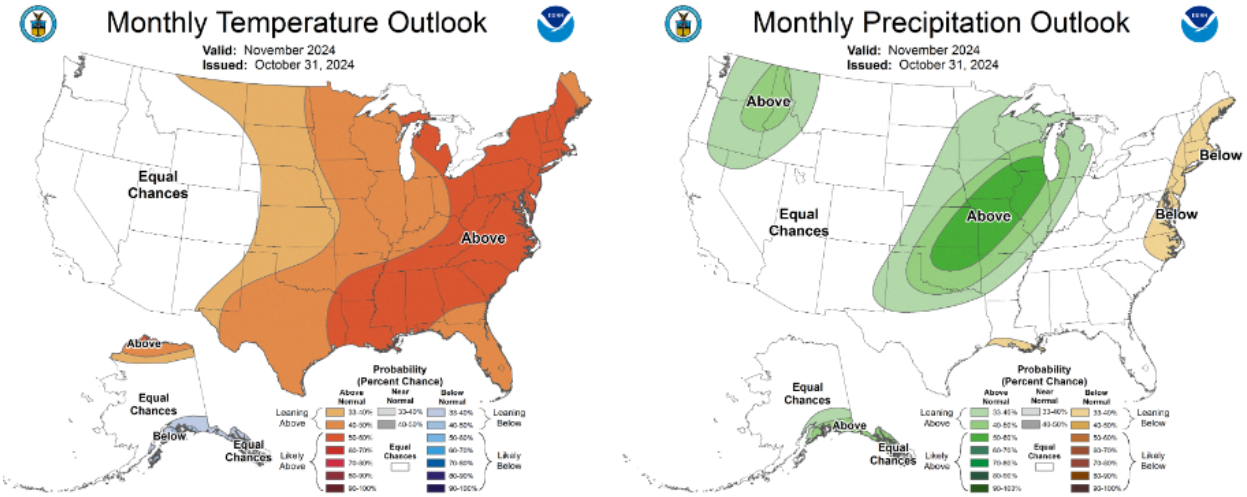


**Figure 9. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 10**. The November-December 2024-January 2025 temperature outlook indicates equal chances for warmer-than-normal, normal, or lower-than-normal temperatures across most of the upper Basin and increased chances for warmer-than-normal temperatures in the lower Basin. The precipitation outlook for the same period shows equal chances for below-normal, normal, or above-normal precipitation in the Basin except for western Montana, which has a slight indication of increased chances for above-normal precipitation.

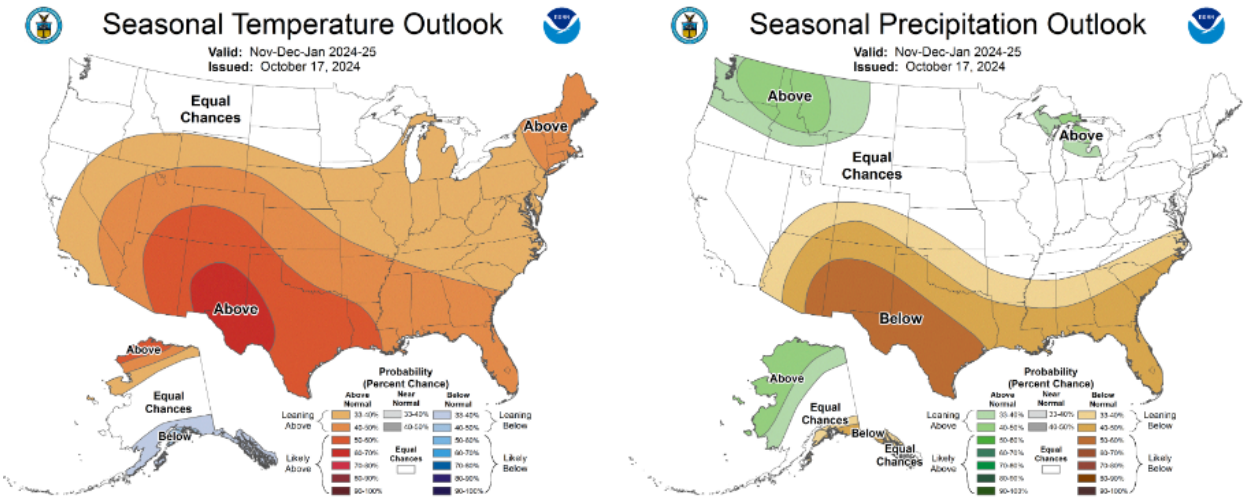


**Figure 10. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, and forecast temperatures and precipitation. Given these factors we expect runoff during November to be below average or near average for all reaches. In summary, the 2024 calendar year runoff forecast is **23.0 MAF, 90% of average**.

# Upper Missouri River Basin
# December 2024 Calendar Year Runoff Forecast
# December 2, 2024

**US Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast for the Missouri River Basin above Sioux City, IA (upper Basin) is available here. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects plus the incremental drainage area between Gavins Point Dam and Sioux City, IA. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the upper Basin. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

November runoff was 0.7 MAF (67% of average) for the basin above Sioux City, and 0.6 MAF (62% of average) above Gavins Point. Runoff was below average in all reaches except Oahe and Sioux City, which were slightly above average.

### Calendar Year Runoff Forecast Synopsis

The 2024 calendar year runoff forecast for the Missouri Basin above Sioux City, IA is **22.9 MAF, 89% of average**. The 2024 calendar year runoff forecast for the Missouri Basin above Gavins Point Dam is **17.7 MAF, 76% of average**.

Due to the variability in precipitation and other hydrologic factors that can occur over the next month, expected inflow could range from the 22.8 MAF lower basic forecast to the 23.0 MAF upper basic forecast. The lower and upper basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. The range of possible drier-than-expected (lower basic) and wetter-than-expected (upper basic) conditions is attributed to all six reaches. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for October 29 is shown in **Figure 1**. The drought monitor is available here. The US Drought Monitor for the Missouri Basin (Basin) shows at least Abnormally Dry conditions are present over approximately 93% of the Basin. The Seasonal Drought Outlook in **Figure 2**, which extends through the end of February 2025, indicates drought conditions are likely to improve in Montana, Wyoming, and much of the lower Basin, and persist for the rest of the Basin.

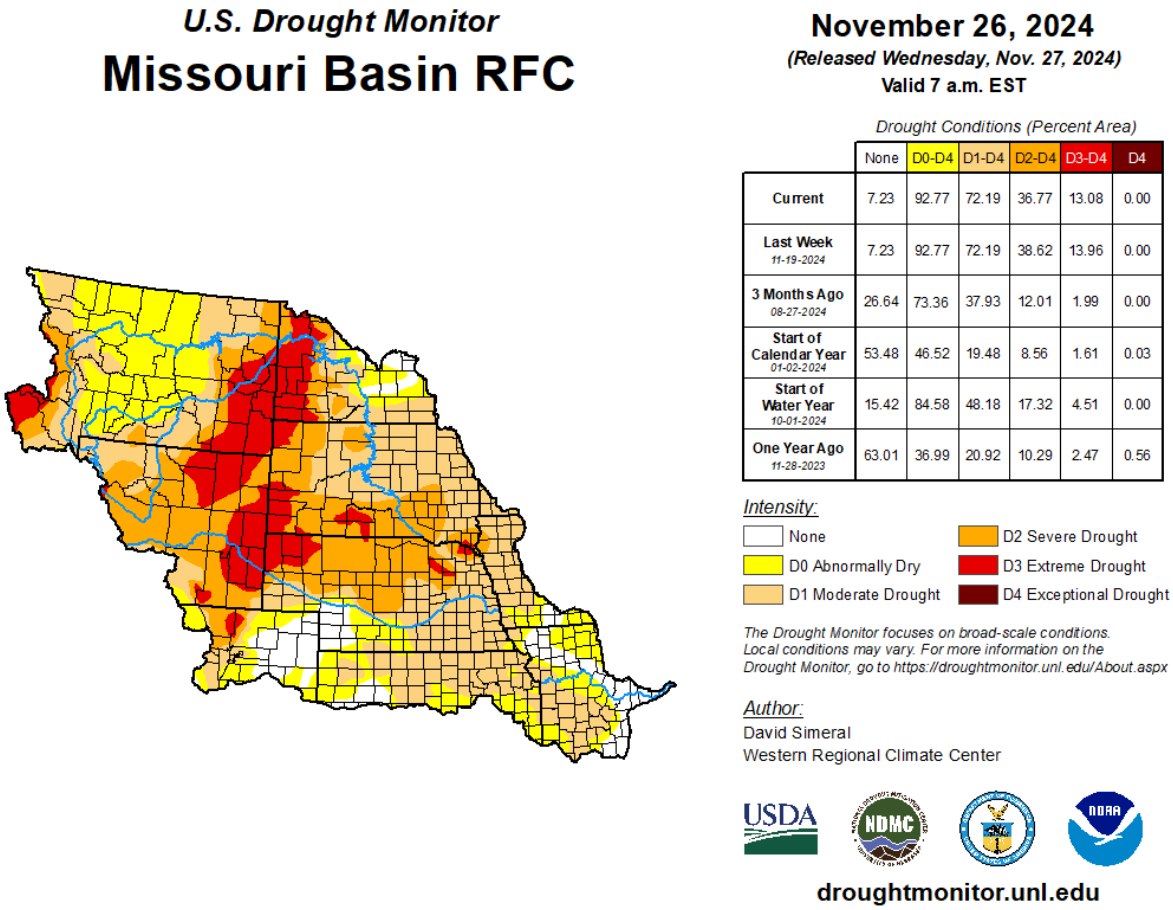


**Figure 1. National Mitigation Center US Drought Monitor for the Missouri Basin**

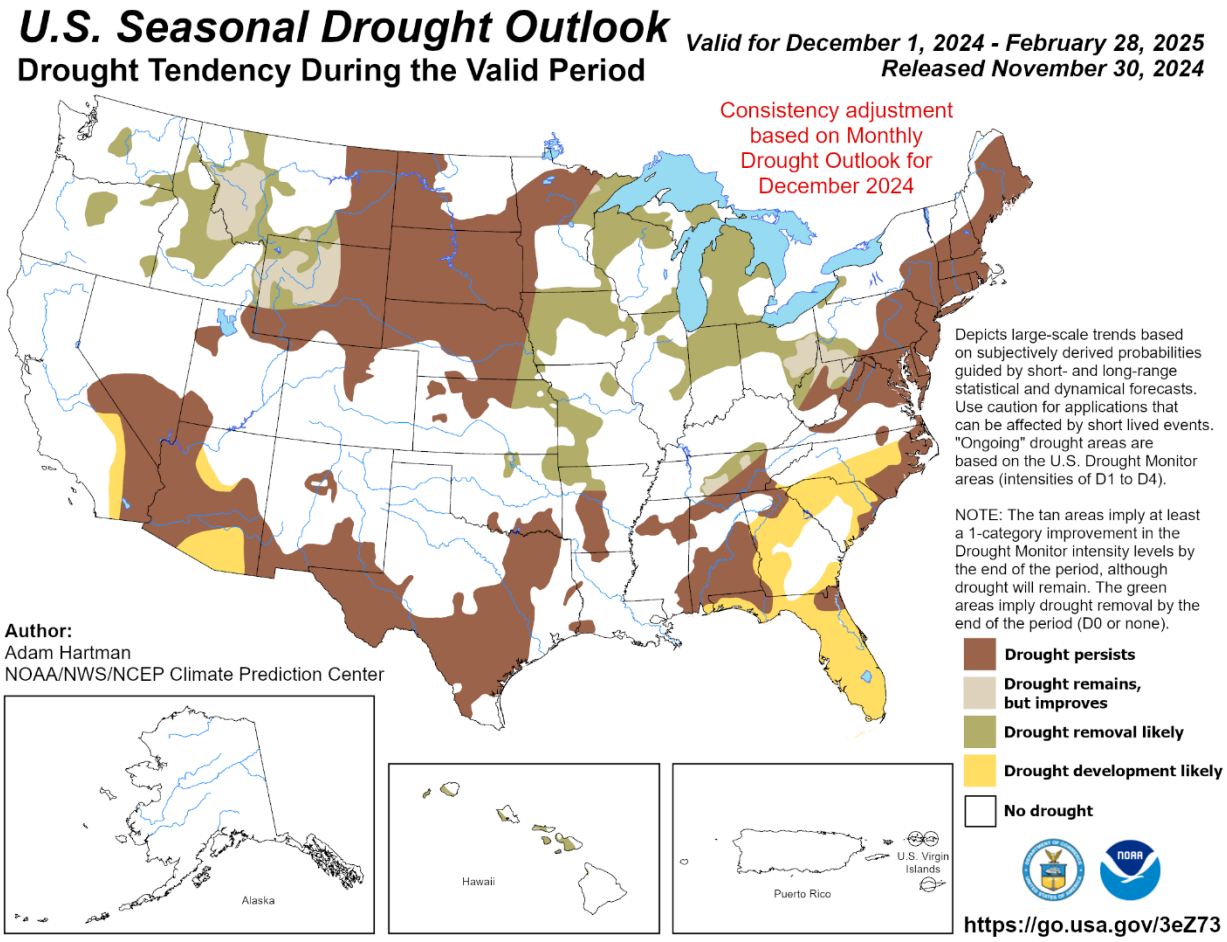


**Figure 2. Climate Prediction Center US Seasonal Drought Outlook**

## Precipitation

Monthly precipitation accumulations are shown using the High Plains Regional Climate Center (HPRCC) images available here. The November precipitation accumulations are shown in **Figure 3** as a percent of normal precipitation. Precipitation was mixed across the Basin. Montana, Wyoming, and the western Dakotas saw below normal precipitation, while the eastern Dakotas and the lower Basin saw well above normal precipitation – in many cases more than 200% of normal.

Precipitation as a percent of normal for the September-October-November period (**Figure 4**) was mostly below normal across the Basin except a small pocket in north-central Montana as well as some areas of Kansas.

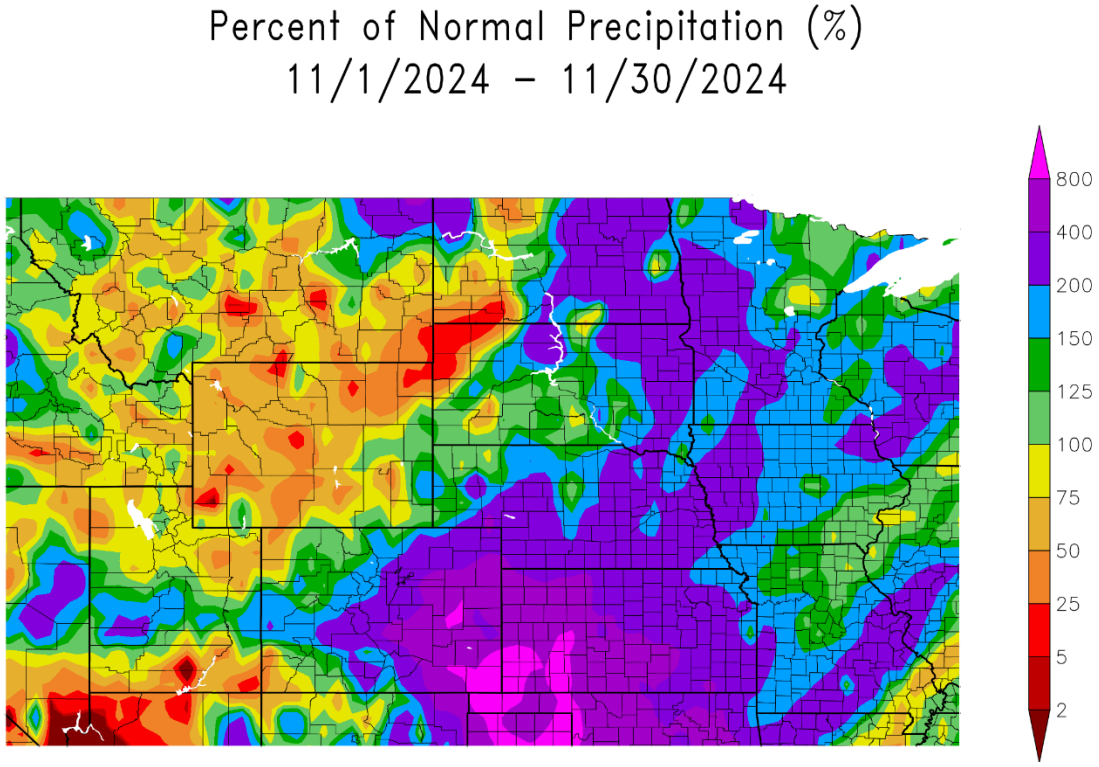


**Figure 3. HPRCC Last Full-Month Percent of Normal Precipitation**

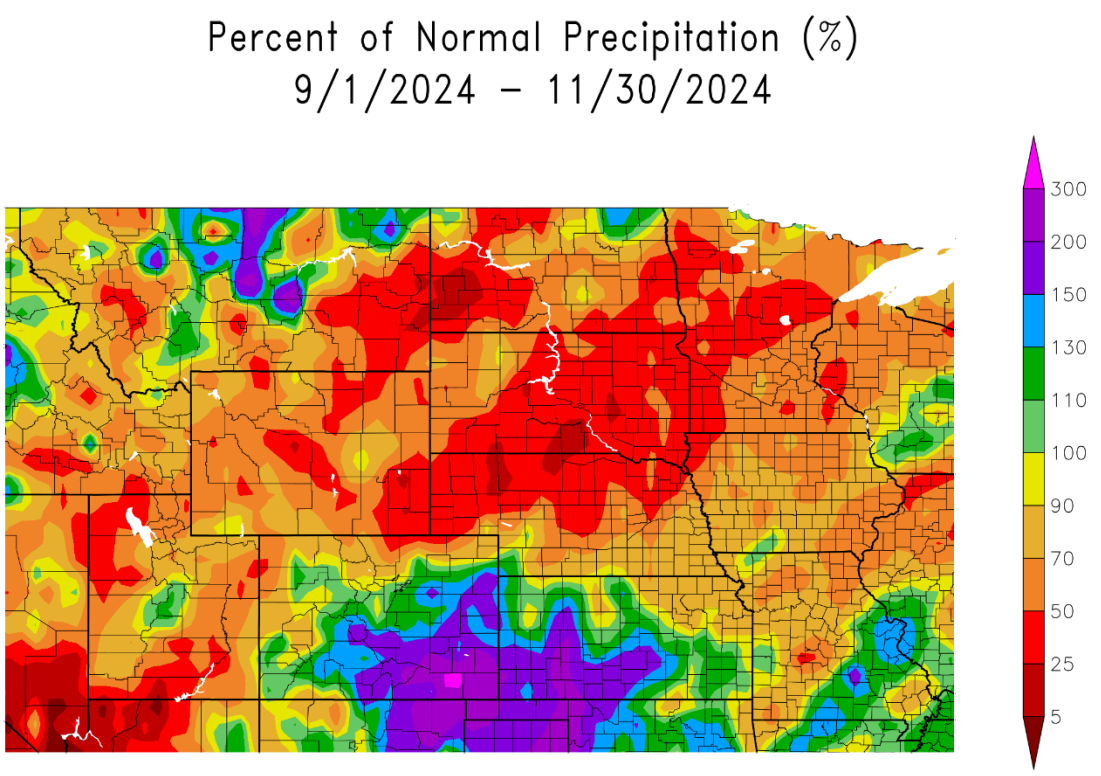


**Figure 4. HPRCC Last 3-Month Percent of Normal Precipitation**

**Temperature**

November temperature departures from normal in degrees Fahrenheit (deg F), shown in **Figure 5**, were near normal in the western side of the Basin and warmer than normal in the eastern side of the Basin. September-October-November temperature departures are shown in **Figure 6**. The three-month average temperature departures are also warmer than normal across the Basin.

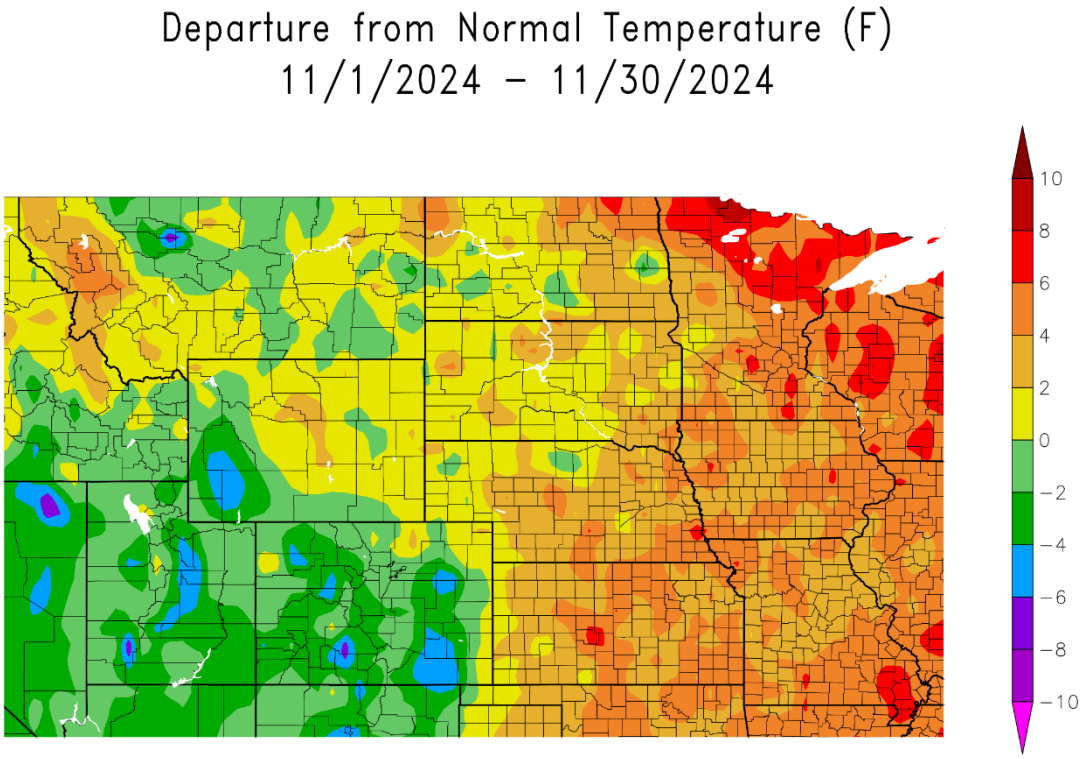


**Figure 5. HPRCC Previous Month Departure from Normal Temperature**

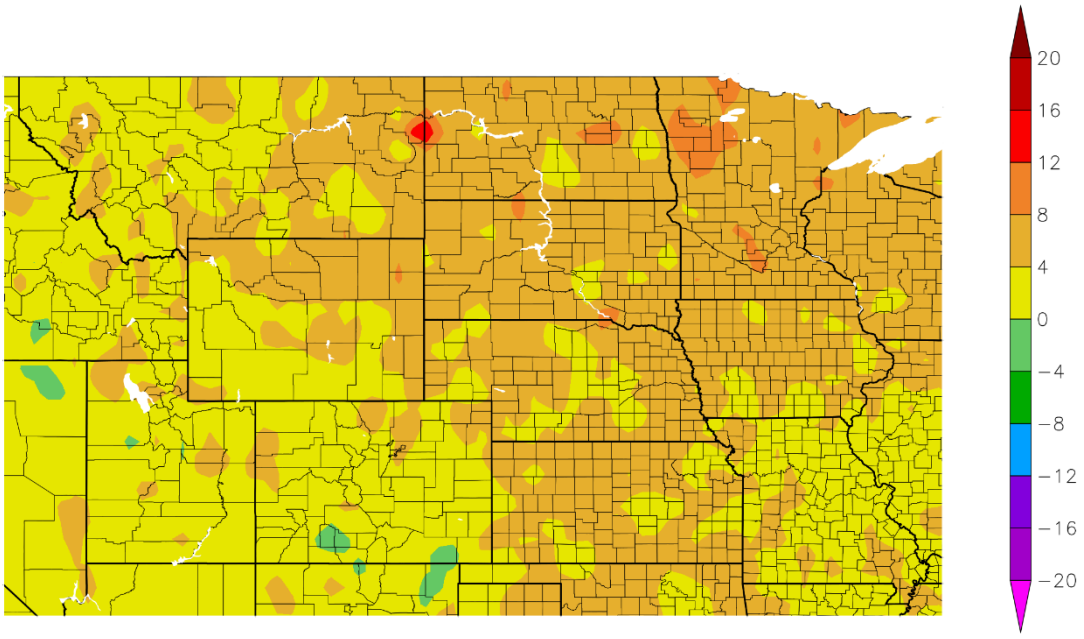


**Figure 6. HPRCC Last 3-Month Departure from Normal Temperature**

**Soil Moisture**

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, rainfall and snowmelt runoff are greater when soil moisture conditions are above normal than when soil moisture conditions are below normal. Not only is soil moisture a physical parameter that influences runoff, but it can also be used as an indicator of future runoff.

Soil moisture anomalies and soil moisture percentiles are shown using the Climate Prediction Center (CPC) images available here. Soil moisture anomalies are defined as deviations from the 1991-2020 daily climatology while the percentiles are based on the comparison between the current soil moisture estimate to the 1895 to present period. Soil moisture anomaly and percentile at the end of November are shown in **Figure 7**. Soil moisture continues to be dry across most of the Basin except in areas of Kansas.

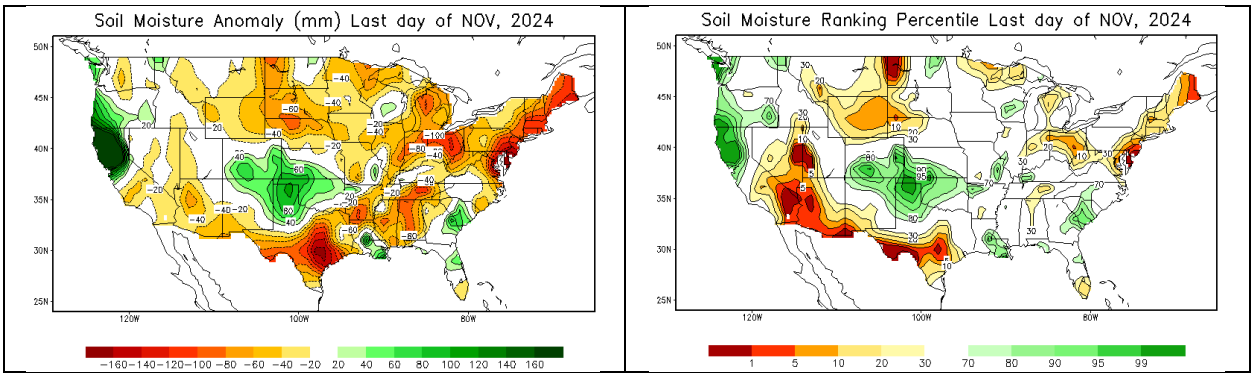


**Figure 7. CPC Soil Moisture Anomaly and Soil Moisture Percentile**

**Plains Snowpack**

Plains snowpack is an important parameter that influences the volume of runoff occurring in the Basin during the months of March and April. A common misperception is that the March-April runoff is a result only of plains snowmelt. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due both to melting snowpack and rainfall runoff. Runoff occurs in March and April whether there is any plains snow to melt. Determining exact rainfall amounts and locations is nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing Basin conditions and hydrologic forecasts.

Plains snowpack is not a factor in the November runoff forecast.

**Mountain Snowpack**

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reservoir reaches. May, June, and July runoff in the Fort Peck and Garrison reaches has a strong correlation to the May 1 snowpack or peak SWE, because the mountain snowpack typically peaks in mid-April.

Mountain snowpack for the Fort Peck and Fort Peck to Garrison reaches can be found here. **Figure 8** includes time series plots of the average mountain SWE beginning on October 1 based on the Natural Resources and Conservation District SNOw TELemetry (SNOTEL) data for the headwater basin above Fort Peck and the incremental basin from Fort Peck to Garrison. The current average SWE values (shaded blue area) are plotted against the 1991-2020 basin average SWE (bold red line), the historic low SWE between 1991-2020 (green line) and the historic high SWE between 1991-2020 (dark blue line).

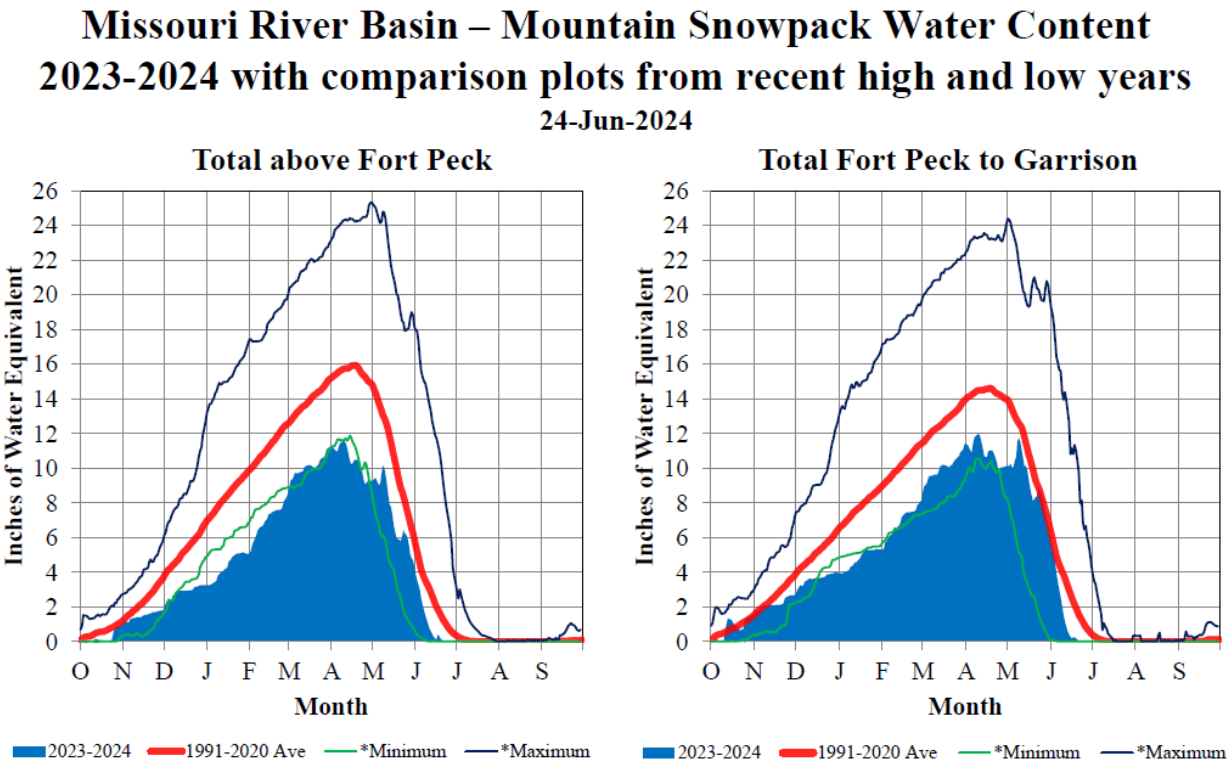


**Figure 8. Mountain Snowpack Water Content**

The "Total above Fort Peck" reach peaked on April 9 at 11.6" SWE and 73% of the normal peak. The "Fort Peck to Garrison" reach peaked on April 10 at 12.0" SWE and 82% of the normal peak. As of June 24, 2024 all mountain snowpack has melted in both reaches.

## Climate Outlook

The Missouri River Basin Water Management office participates in the monthly North Central US Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists. These webinars provide updates on near-term climate outlooks and impacts, including the El Niño Southern Oscillation (ENSO) climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### El Niño Southern Oscillation (ENSO)

ENSO is an oscillation that occurs in the tropical Pacific Ocean and fluctuates between warm episodes (El Niño), neutral conditions, and cold episodes (La Niña). During El Niño winters, the favored storm track is typically across Canada, resulting in warm temperatures and less snowfall in the Basin. During La Niña winters, the storm track typically favors northwest flow across the Basin, resulting in cooler temperatures and above-normal snowfall across the northern Rockies.

ENSO-neutral conditions are currently present. La Niña conditions are 57% likely to occur during the October-December period and are likely to persist through January-March 2025.

**Temperature and Precipitation Outlooks**

The CPC outlooks provide the forecasted probability of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available here.

The temperature outlook for December (**Figure 9**) indicates increased chances for above-normal temperatures across the west and equal chances of above-normal, normal, or below normal temperatures in the eastern side of the Basin. The precipitation outlook (**Figure 9**) for the same period shows increased chances for above-normal precipitation across Montana and into the western Dakotas with equal chances for above-normal, normal, or below-normal precipitation in the rest of the Basin.

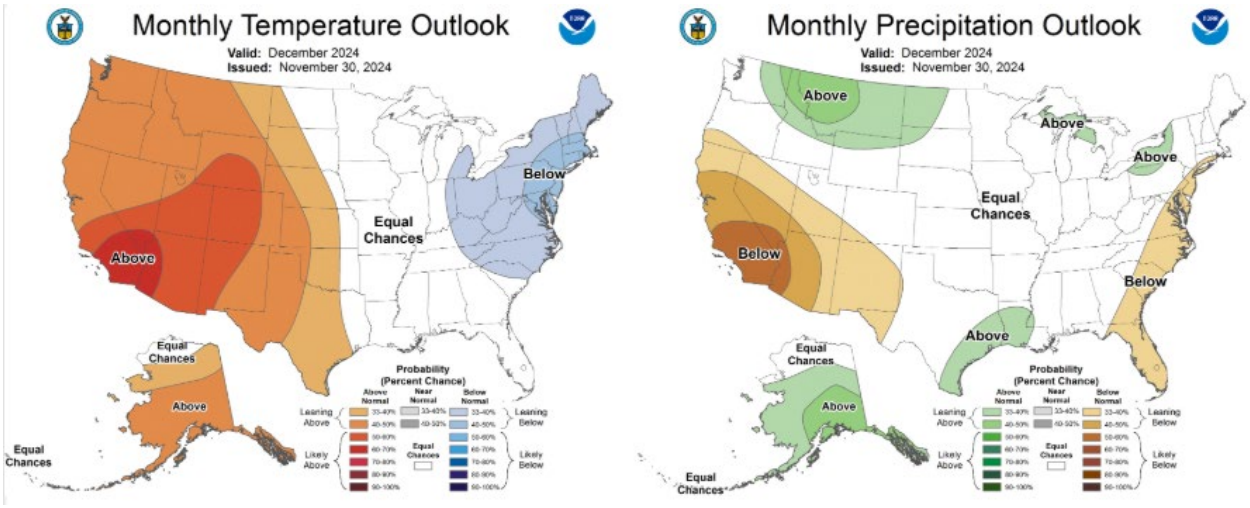


**Figure 9. CPC Monthly Temperature and Precipitation Outlooks**

Three-month temperature and precipitation outlooks for the remaining months of the year are shown in **Figure 10**. The December 2024-February 2025 temperature outlook indicates increased chances for below-normal temperatures in the upper Basin and equal chances for above-normal, normal, or below-normal temperatures in the lower Basin. The precipitation outlook for the same period indicates increased chances for above-normal precipitation in Montana and Wyoming and equal chances for above-normal, normal, or below-normal precipitation in the rest of the Basin.

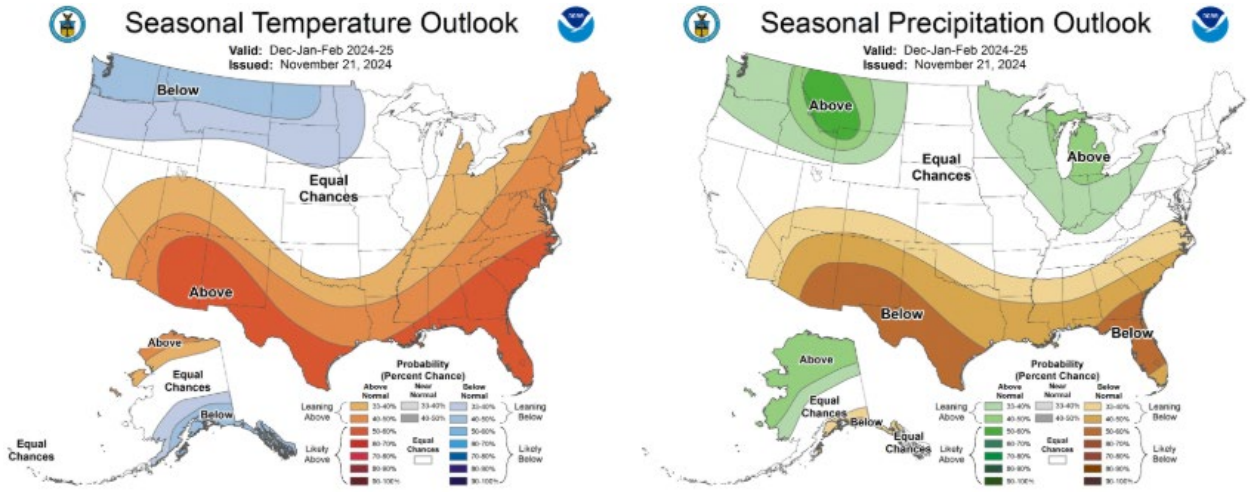


**Figure 10. CPC Three-Month Temperature and Precipitation Outlooks**

## Summary

This forecast considers reach runoff, basin conditions, and forecast temperatures and precipitation. Given these factors we expect runoff during November to be below average or near average for all reaches. In summary, the 2024 calendar year runoff forecast is **22.9 MAF, 89% of average**.