# Upper Missouri River Basin
# July 2020 Calendar Year Runoff Forecast
**July 6, 2020**

**U.S. 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 is available at http://www.nwd-mr.usace.army.mil/rcc/reports/runoff.pdf. 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. 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 total Missouri Basin above Sioux City (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 5.2 MAF (94% of average) in the upper Basin above Sioux City, about 0.5 MAF less than what was forecast on June 1. Below-normal precipitation over most of the upper Basin resulted in below-average runoff in the Fort Peck, Garrison and Oahe reaches. Above-normal precipitation over central South Dakota kept tributary flows high in the Fort Randall, Gavins Point and Sioux City reaches. Runoff in these three reaches was above average.

### 2020 Calendar Year Forecast Synopsis

The 2020 calendar year runoff forecast for the upper Missouri Basin above Sioux City, IA is **31.2 MAF, 121% of average**. The 2020 calendar year runoff forecast for the Missouri Basin above Gavins Point is **25.3 MAF**, **108% of average**. Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 6 months, expected inflow could range from the 34.2 MAF upper basic forecast to the 28.5 MAF lower basic forecast. The upper and lower 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 6 months are being forecast for this July 1 forecast (6 months observed/6 months forecast), the range of

possible wetter-than-expected (upper basic) and drier-than-expected (lower basic) conditions is very large, and is attributed to all six reaches for the remaining 6 months of the 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 June 23, 2020 is shown in **Figure 1**. The drought monitor is available at http://droughtmonitor.unl.edu/. The U.S. Drought Monitor shows Moderate Drought (D1) is present in much of Wyoming, western North Dakota, and western South Dakota. Abnormally Dry (D0) conditions are present in southern and eastern Montana, central North Dakota, parts of Wyoming, isolated areas of Iowa and South Dakota, and along the Nebraska-Kansas border. This is a reflection of much drier conditions that have occurred in 2020. The National Weather Service (NWS) Climate Prediction Center's (CPC) Seasonal Drought Outlook in **Figure 2**, which extends through the end of September, shows the drought in North Dakota, Wyoming, Montana and South Dakota expanding.

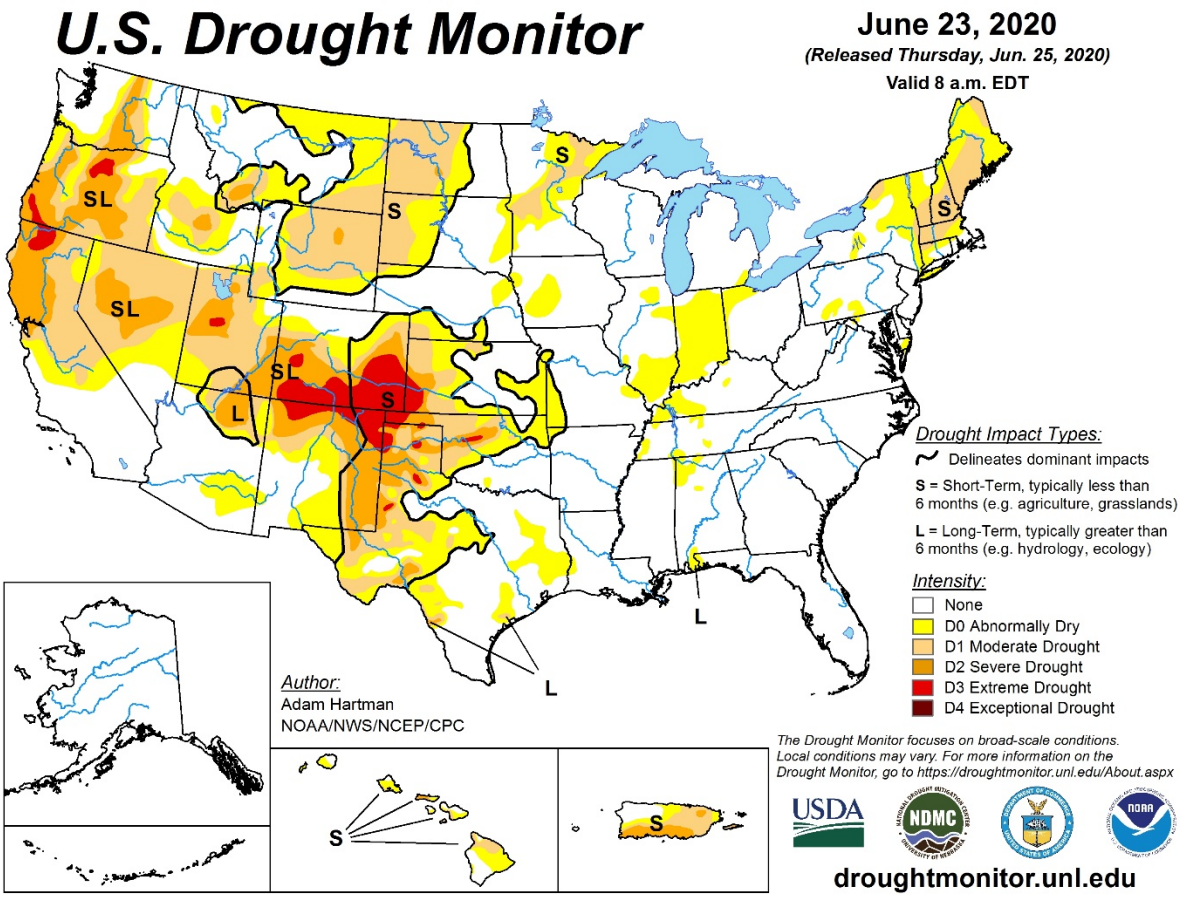


**Figure 1. National Drought Mitigation Center U.S. Drought Monitor for June 23, 2020.**

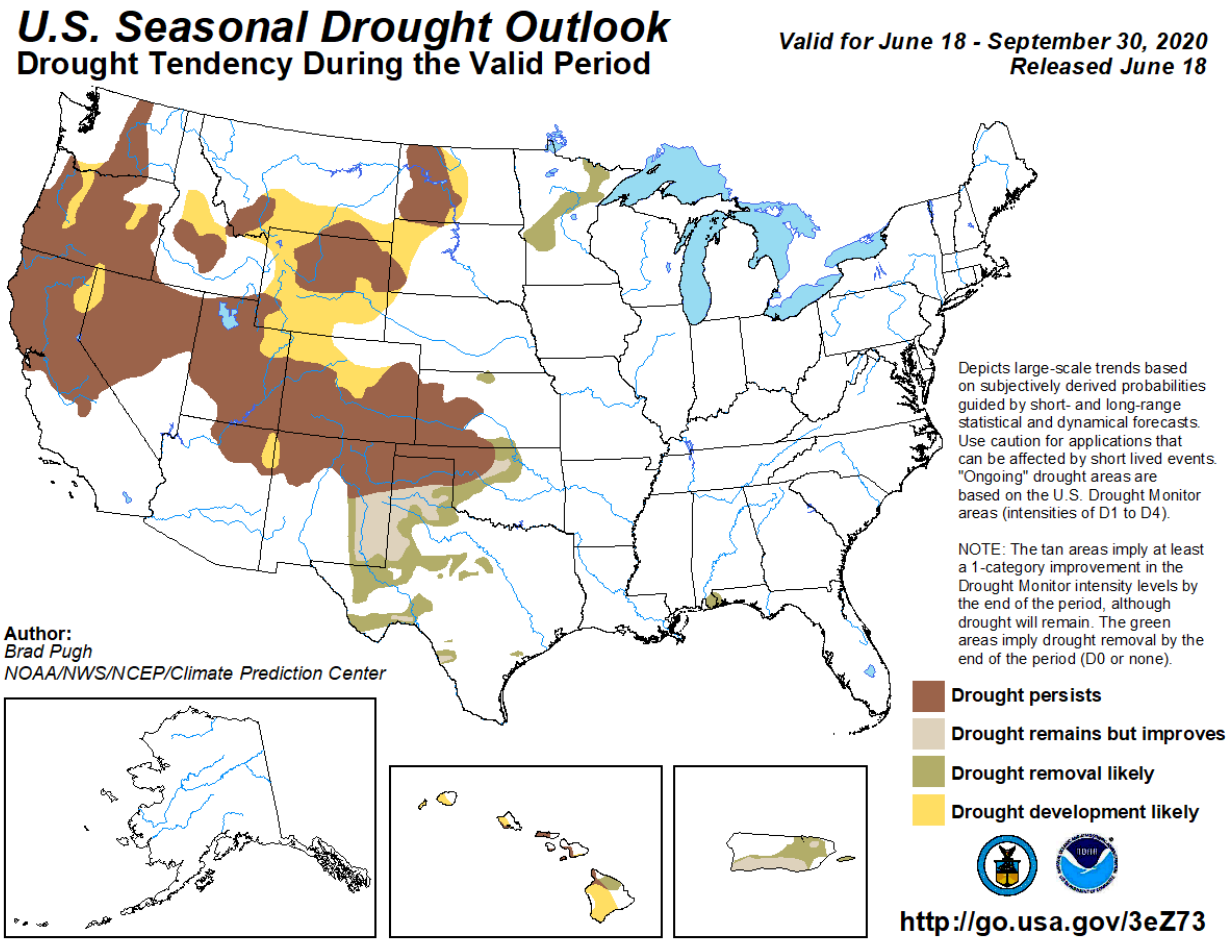


**Figure 2. NWS CPC Seasonal Drought Outlook.**

## Precipitation

Monthly precipitation accumulations are shown using High Plains Regional Climate Center images available at http://www.hprcc.unl.edu/. The June precipitation accumulation map is shown in **Figure 3** as a percent of normal precipitation. June precipitation was below normal over most of the upper Basin, with the exception of central South Dakota and areas of Montana, which received from 130% to 200% of normal precipitation. June precipitation for Wyoming, North Dakota and Nebraska was as low as 5% of normal.

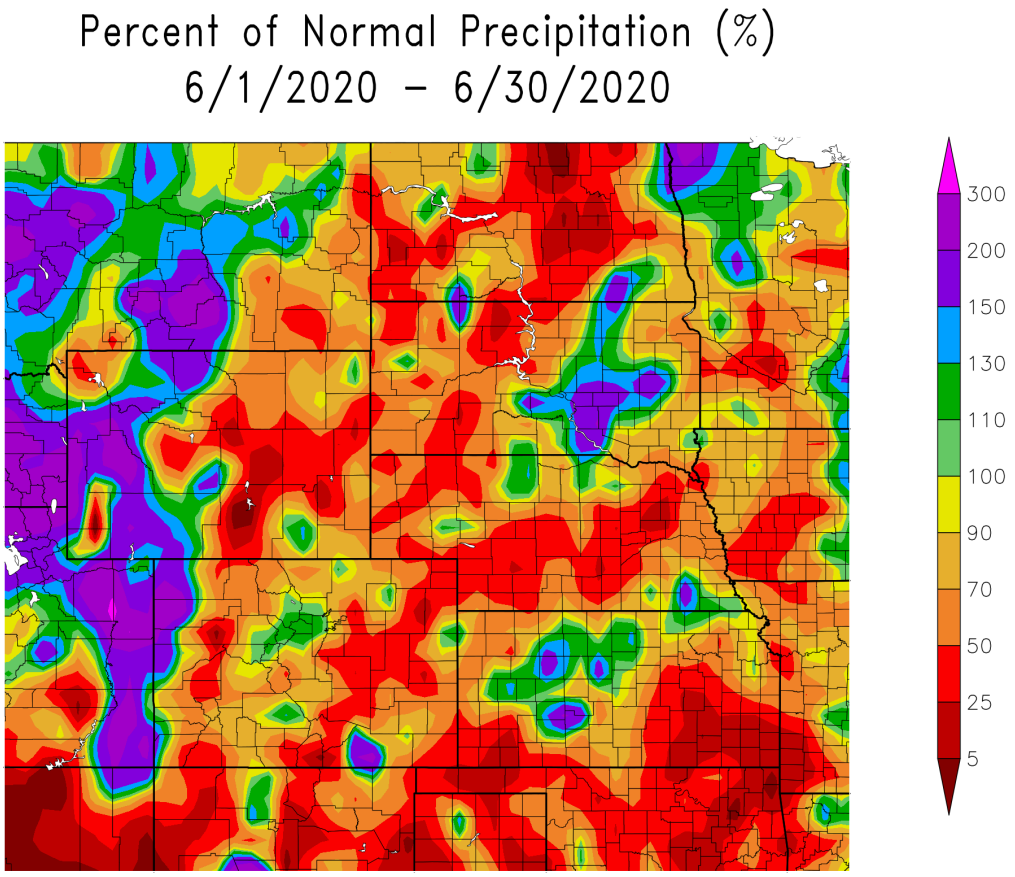


**Figure 3. June 2020 Percent of Normal Precipitation. Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

Since January 1, the upper Basin has received less than 70% of normal precipitation (see **Figure 4**) in most areas except for areas of Montana, central South Dakota, and northern Nebraska. Western and central North Dakota received as low as 25% of normal precipitation since January 1.

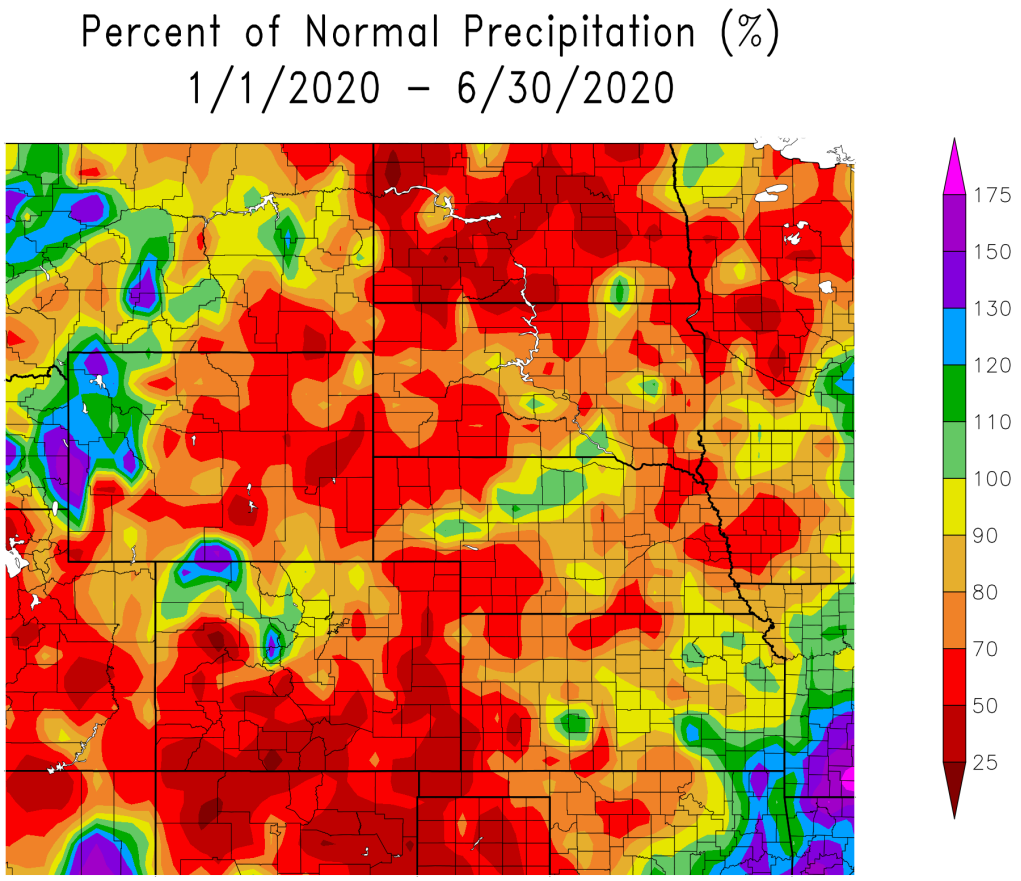


**Figure 4. January 1 – June 30 Percent of Normal Precipitation. Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

## Temperature

June temperature departures in degrees Fahrenheit (deg F) in **Figure 5** were 2 to 8 deg F above normal in most of the Basin. In the Rocky Mountains, June temperatures were normal to about 2 deg F below normal.

April-May-June temperature departures are shown in **Figure 6.** The average three-month temperatures were generally near-normal, with areas of slightly warmer temperatures in Colorado and southern Wyoming, and areas of slightly cooler temperatures in northern Montana and North Dakota.

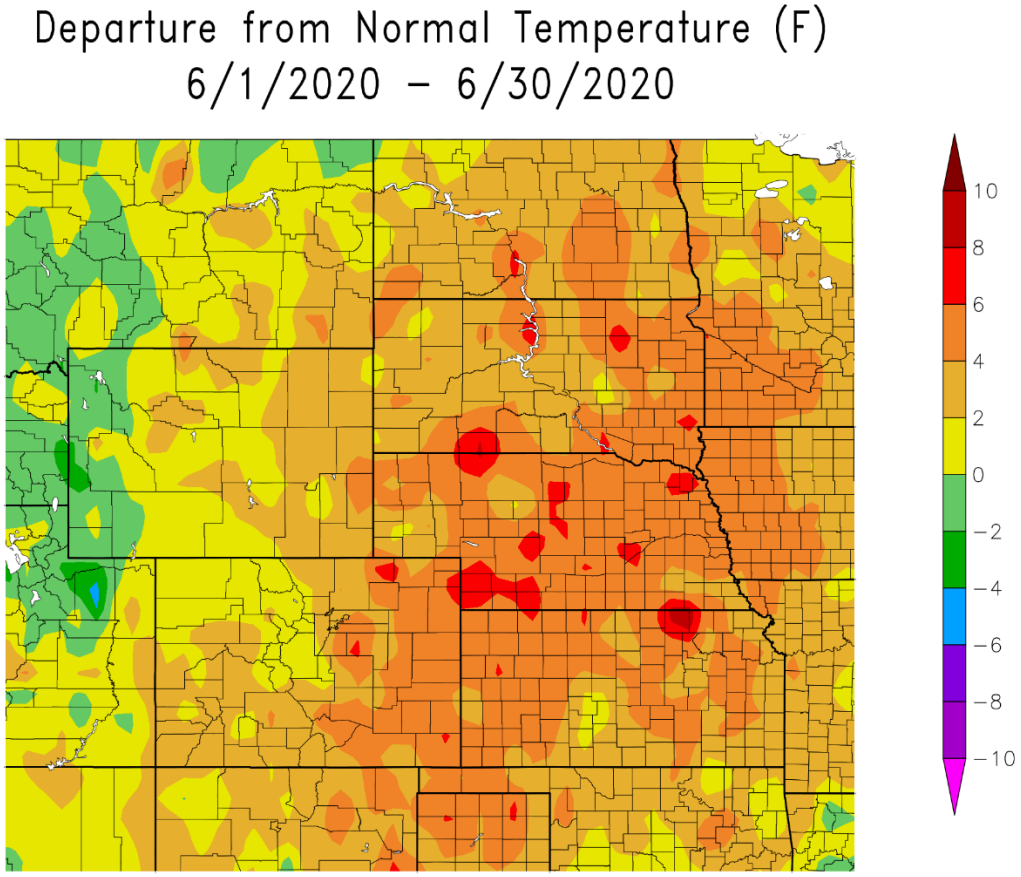


**Figure 5. June 2020 Departure from Normal Temperature (deg F). Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

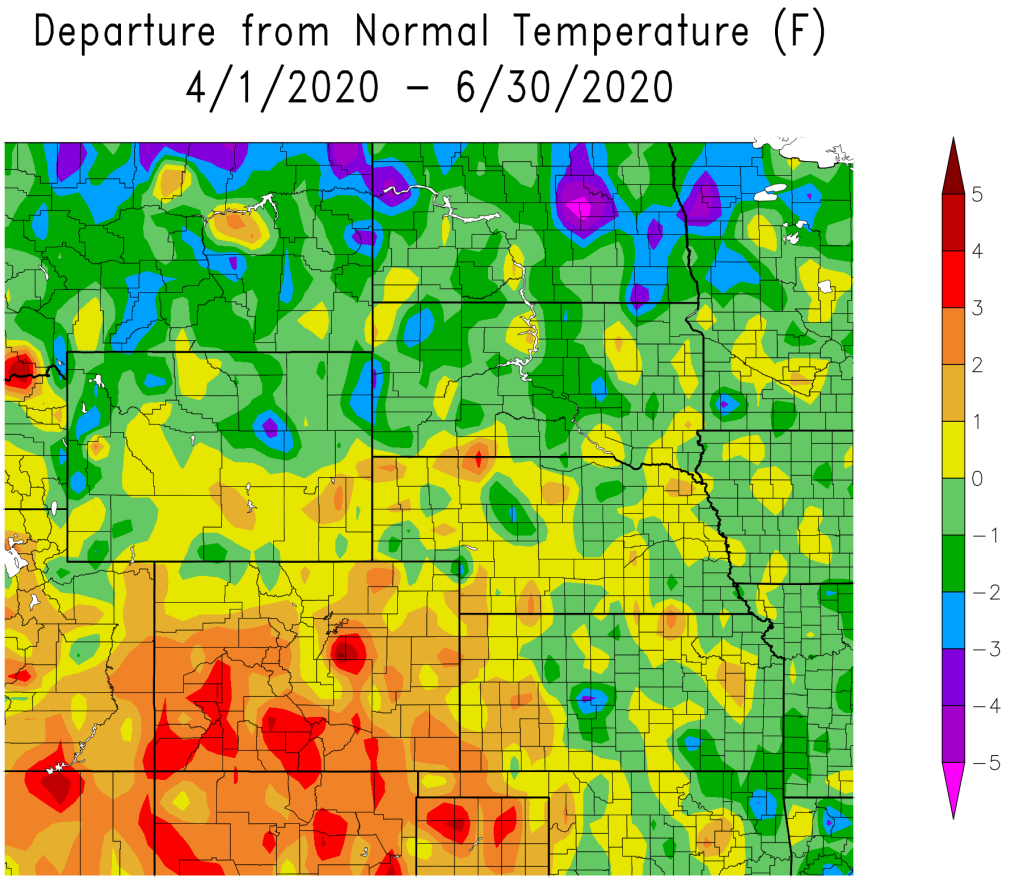


**Figure 6. April-May-June 2020 Departure from Normal Temperature (deg F). Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

## Soil Moisture

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

Soil moisture percentiles on March 31 based on the CPC's soil moisture model ranged from the 70th to 99th percentile ranking. Much of eastern Montana, North Dakota, South Dakota and Nebraska soils ranked above the 95th percentile, indicating soil conditions were very wet. Since March 31, soils have dried out considerably (see **Figure 7**). Based on the CPC's soil moisture model, the soil moisture anomaly has decreased by 60 to 140 mm over most of the Basin. Soil moisture is still in the 70th to 80th percentile in north-central Nebraska, central South Dakota, and eastern North Dakota (see **Figure 8**).

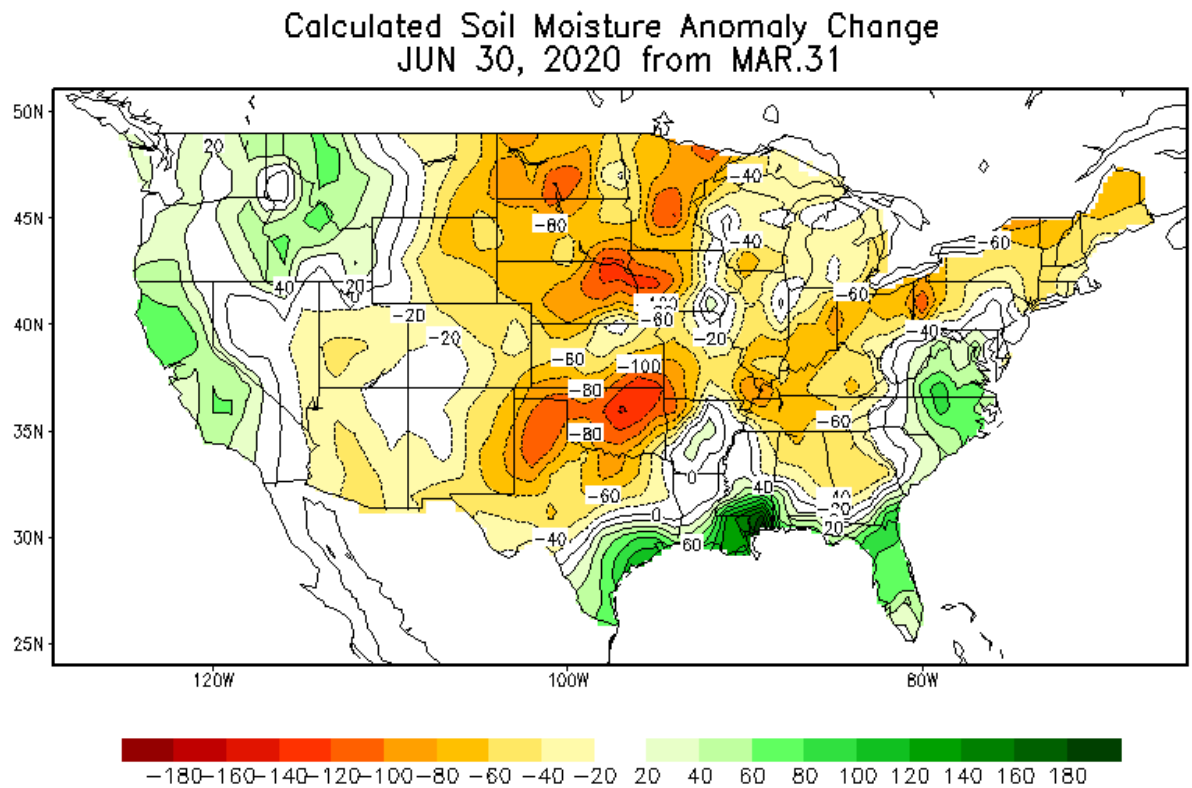


**Figure 7. NOAA CPC Soil Moisture Anomaly Change (mm) March 31 to June 30. Source:** https://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml

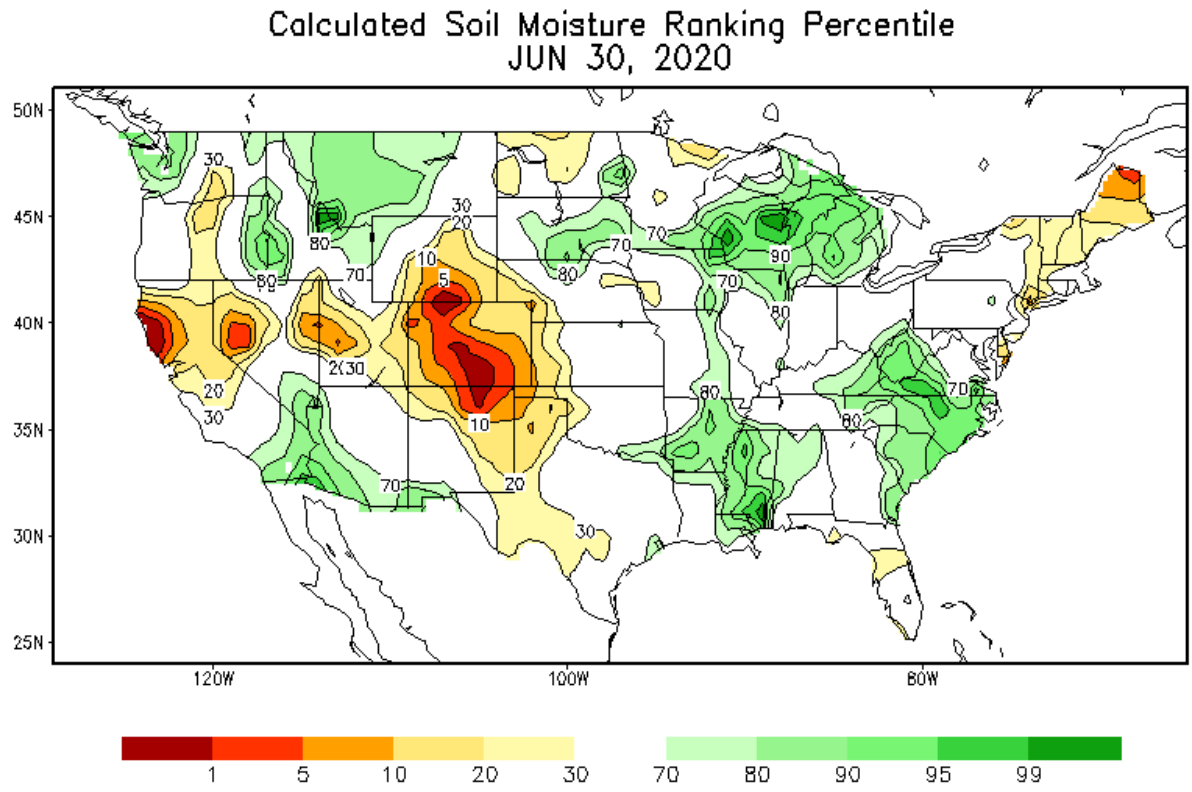


**Figure 8. Calculated soil moisture anomaly change since March 31, 2020. Source: https://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml**

## 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 of plains snowmelt only. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due to both 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 are 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, which for this year primarily includes long-term precipitation outlooks.

While snow may have occurred in some areas of the plains during May, this did not contribute to increasing flows. Plains snowpack was not a factor in this July 1 forecast.

## Mountain Snowpack

Mountain snowpack is the primary factor used to predict May, June and July runoff volumes in the Fort Peck and Fort Peck to Garrison reaches. As the date of peak snowpack accumulation, usually around April 15, approaches, the correlation between the level of mountain snowpack and May, June and July runoff increases. Mountain snowpack becomes a better predictor of Fort Peck and Garrison reach runoff once it reaches its peak.

**Figure 9** includes time-series plots of the mountain SWE beginning on October 1, 2019 based on the NRCS SNOTEL data for the 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 1981-2010 basin average SWE (bold red line), a recent low SWE year in 2001 (green line), and two historic high SWE years occurring in 1997 (purple) and 2011 (dark blue).

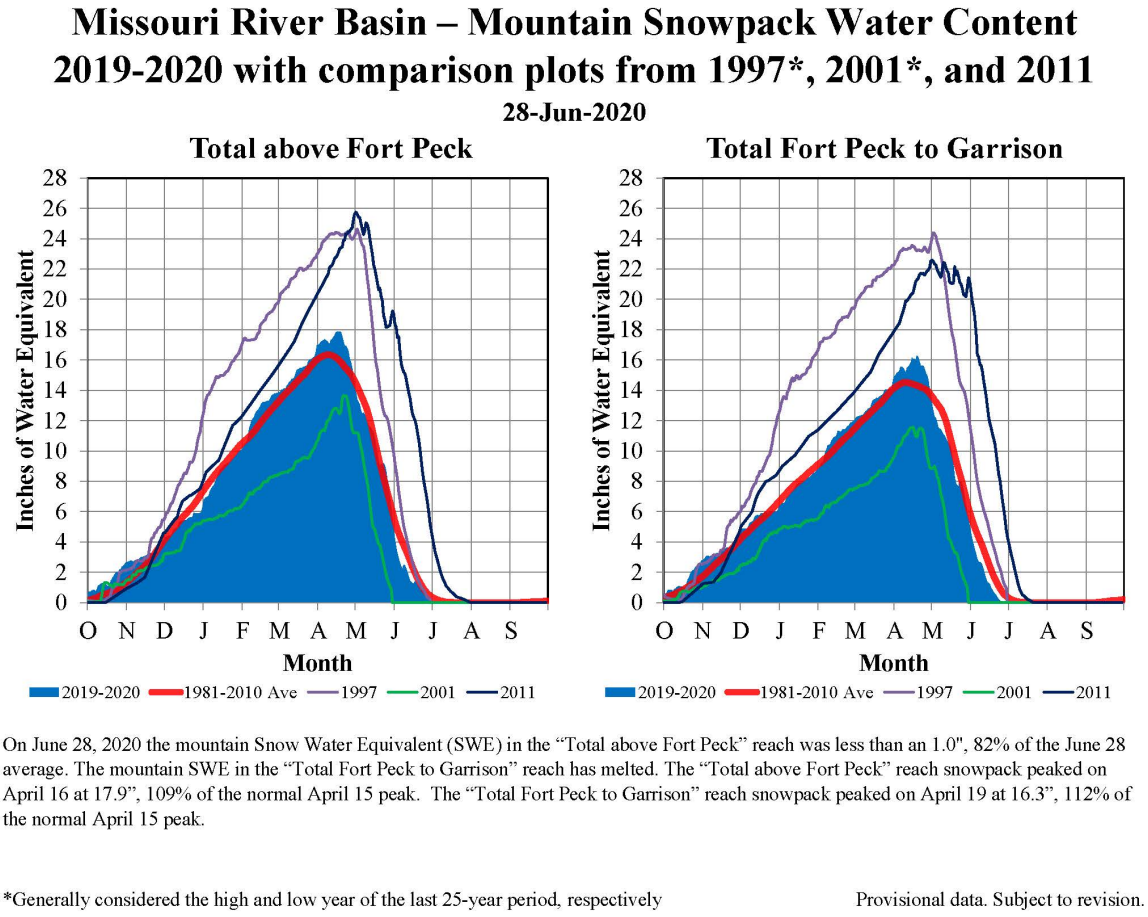


**Figure 9. Mountain snowpack water content on June 28, 2020 compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management.**

Mountain snowpack peaked in the Fort Peck reach at 17.9 inches (109% of average) on April 16. Mountain snowpack peaked in the Garrison reach at 16.3 inches (112% of average) on April 19. Mountain snowpack normally peaks on April 15. Mountain snowpack as of June 28 had essentially melted in both reaches. Inflows into Fort Peck and Garrison have peaked and receded in both the Fort Peck and Garrison reaches.

## Climate Outlook

MRBWM participates in the monthly North Central U.S. Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists (AASC). These webinars provide updates on near-term climate outlooks and impacts including the ENSO climate pattern and its implications on winter temperature and precipitation patterns in the Missouri Basin.

### ENSO (El Niño Southern Oscillation)

The latest ENSO Outlook indicates that ENSO-neutral conditions are present, and will likely remain neutral during the Northern Hemisphere summer 2020 with a 60 percent probability. During ENSO-neutral conditions there are no strong climate indicators to provide much certainty on the precipitation and temperature outlooks beyond the winter and early spring seasons. There are equal chances of La Niña or ENSO-neutral during the autumn and winter months. During La Niña winters, the probability for a colder-than-normal and slightly wetter-than-normal weather pattern in the Northern Rockies and Northern Plains is higher.

### Temperature and Precipitation Outlooks

The CPC outlooks provide the forecasted probability (or chance) of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available at http://www.cpc.ncep.noaa.gov/.

The CPC temperature outlook for the forecast period from July 7-11 is shown in **Figure 10.** The outlook is indicating an increase in the chances for below-normal temperatures in western Montana, with an increase in the chances for above-normal temperatures across the rest of the Basin. With regard to precipitation, there is an increase in the chances for above-normal precipitation in the northern portion of the Missouri Basin. During the month of July (**Figure 11**), the temperature outlook is indicating increased chances for above-normal temperatures throughout the Basin. With regard to precipitation for July, there are increased chances of above-normal precipitation in the northern portion of the Basin and a slight increase in chances of below-normal precipitation in the southern portion of the Basin.

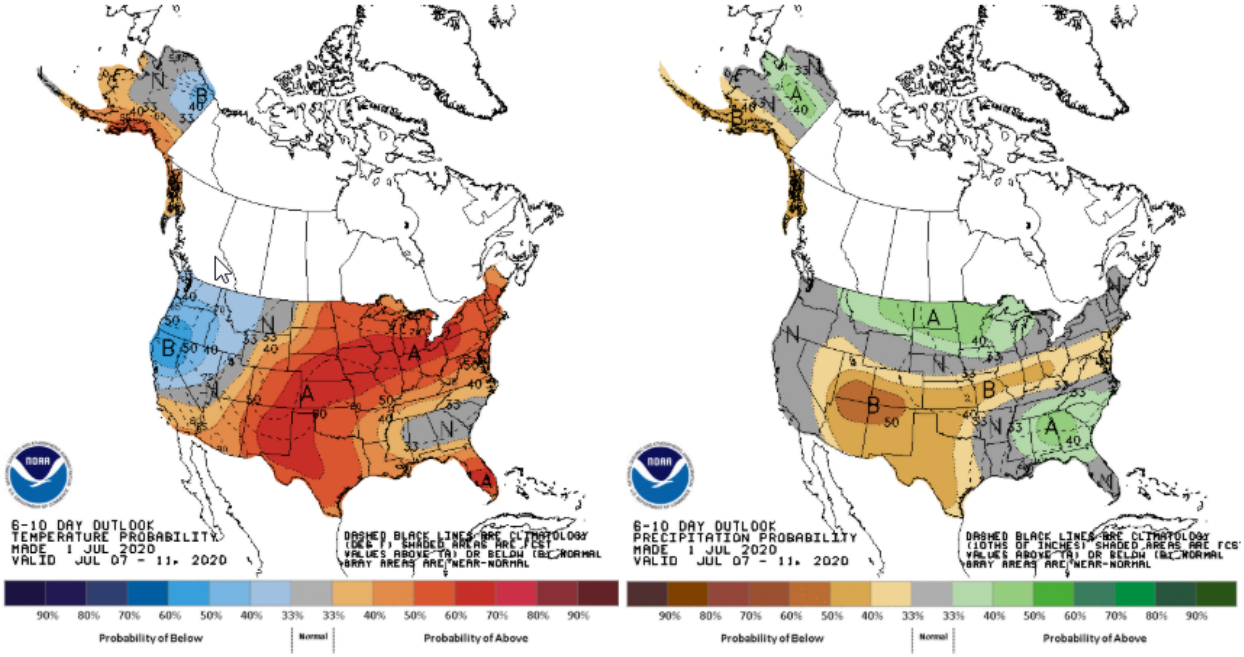


**Figure 10. CPC 6-10 Day temperature and precipitation outlooks through July 11, 2020.**

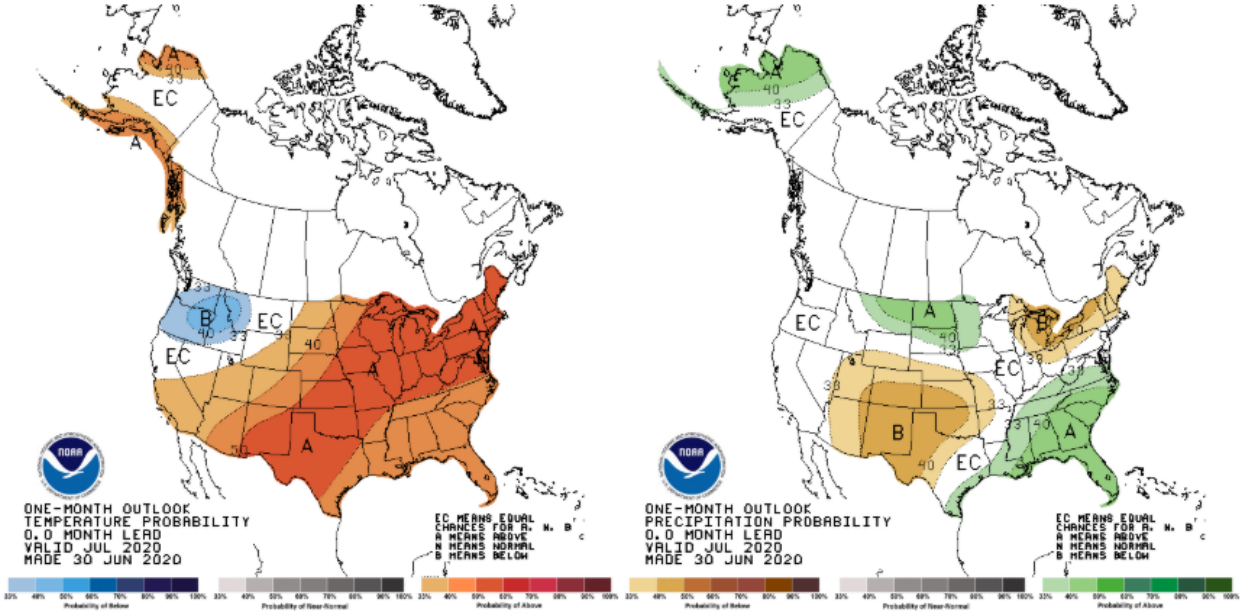


**Figure 11. CPC July 2020 temperature and precipitation outlooks.**

Three-month temperature and precipitation outlooks for the three-month periods from August through December 2020 are shown below in **Figure 12** and **Figure 13**. During August-September-October 2020 (**Figure 12**), the CPC indicates increased chances for above-normal temperatures across the entire Basin. With regard to precipitation, there are increased chances for above-normal precipitation in the eastern portion of the Basin, a slight increase in chances for

below-normal precipitation in the far western portions of the Basin, and equal chances over the remainder of the Basin.

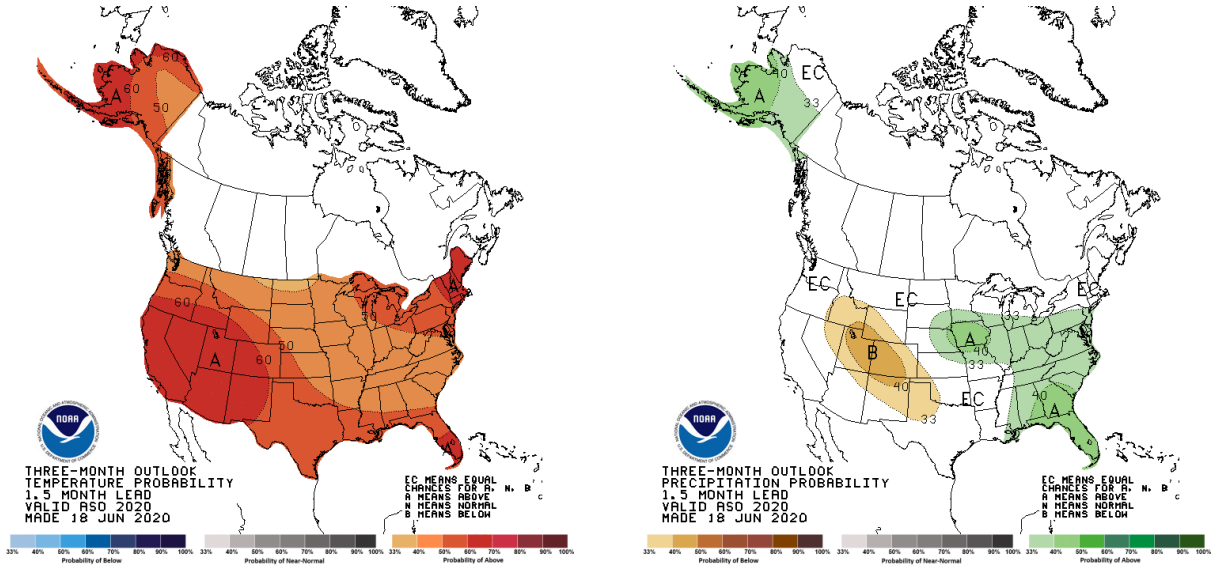


**Figure 12. CPC August-September-October 2020 temperature and precipitation outlooks.**

During the October-November-December 2020 forecast period (**Figure 13**), there are increased chances for above-normal temperatures throughout the entire Missouri Basin. With regard to precipitation during the October-November-December period, CPC is indicating increased chances for above-normal precipitation in most of the upper Basin, and a slight tilt toward below-normal precipitation in southern areas of the lower Basin.

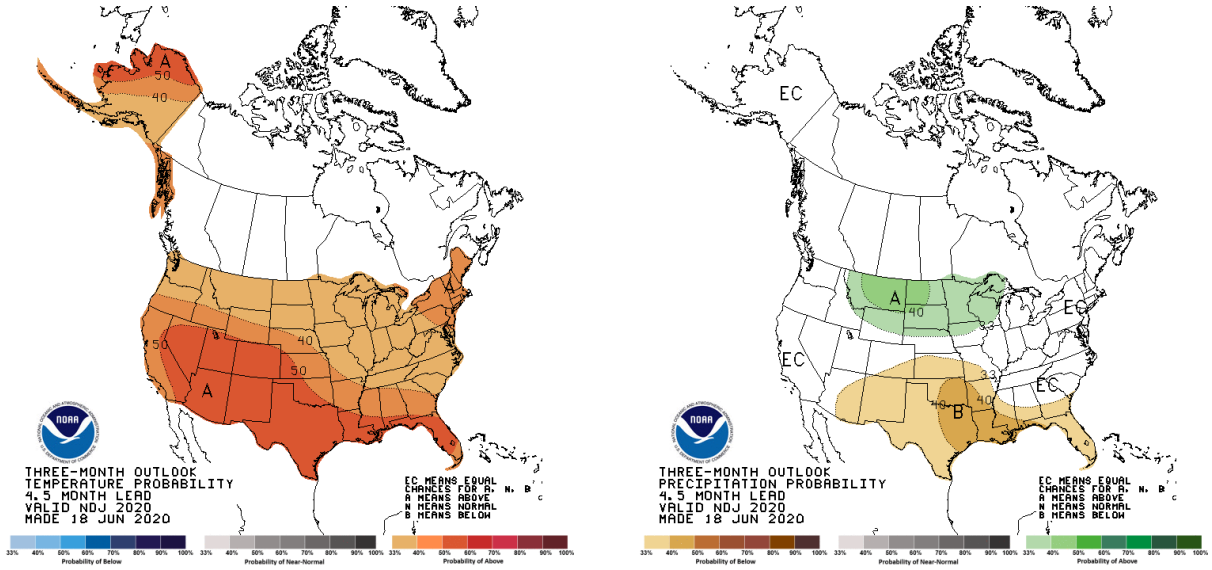


**Figure 13. CPC November-December-January 2020 temperature and precipitation outlooks.**

## Summary

In summary, the 2020 calendar year runoff forecast is **31.2 MAF** (**121%** of average). The July 1 calendar year runoff forecast is about midway between an upper quartile and upper decile runoff volume.

## Water Supply Forecasts

No water supply forecast sent by NRCS