ARIZONA DROUGHT PREPAREDNESS ANNUAL REPORT

FOR WATER YEAR 2023:
OCTOBER 1, 2022 - SEPTEMBER 30,2023

Acknowledgments

The Arizona Drought Preparedness Plan was adopted in 2004 and its continued implementation was ordered in 2007 (Executive Order 2007-10). The Arizona Department of Water Resources (ADWR) prepares an annual report based on drought updates from the Drought Monitoring Technical Committee (MTC), Governor's Drought Interagency Coordinating Group (ICG), Local Drought Impact Groups (LDIGs), and others. The 2023 Arizona Drought Preparedness Annual Report covers the drought conditions and preparedness activities for Water Year 2023, from October 1, 2022, through September 30, 2023.

ADWR acknowledges and thanks all who contributed to this report:

Andrew Muniz, ADWR
Amanda Overholt, ADWR
Carol Ward, ADWR
Charlie Ester, Salt River Project
Colby Bowser, Pima County
Emilio Carrillo, NRCS
Erinanne Saffell, ASU
Hsini Lin, ADHS
John Riggins, ADWR
Eleonora Dmaria, Pima County
Kristen Johnson, ADWR
Kurt Schonauer, USGS
Mark O'Malley, National Weather Service
Maggie Martin, ADWR
Mitchell Lannan, DFFM
Némesis Ortiz-Declet, ADWR
Niki Lajevardi-Khosh, ADHS
James Heffner, ADWR
James Taylor, ADWR
Ryan Hunt, USDA Farm Service Agency
Shauna Evans, ADWR
Stephen Flora, Salt River Project
Travis Kolling, NRCS
Trent Blomberg, ADWR

Contents

1. Introduction

The arid to semi-arid climate of Arizona builds highly variable precipitation, both spatially and temporally. Drought in Arizona is marked by a series of dry years that are occasionally interrupted by wet years. Water Year 2023[1] marks the 30th year of Arizona's latest long-term drought, in which 20 of the last 30 water years have been dry.

Statewide precipitation for WY2023 was 12.49 inches, slightly above the long-term average of 12.27 inches (1896-2023). In the past 30 water years, statewide precipitation averaged 11.29 inches per water year, an 8% precipitation deficit from the long-term average (**figure 1**).

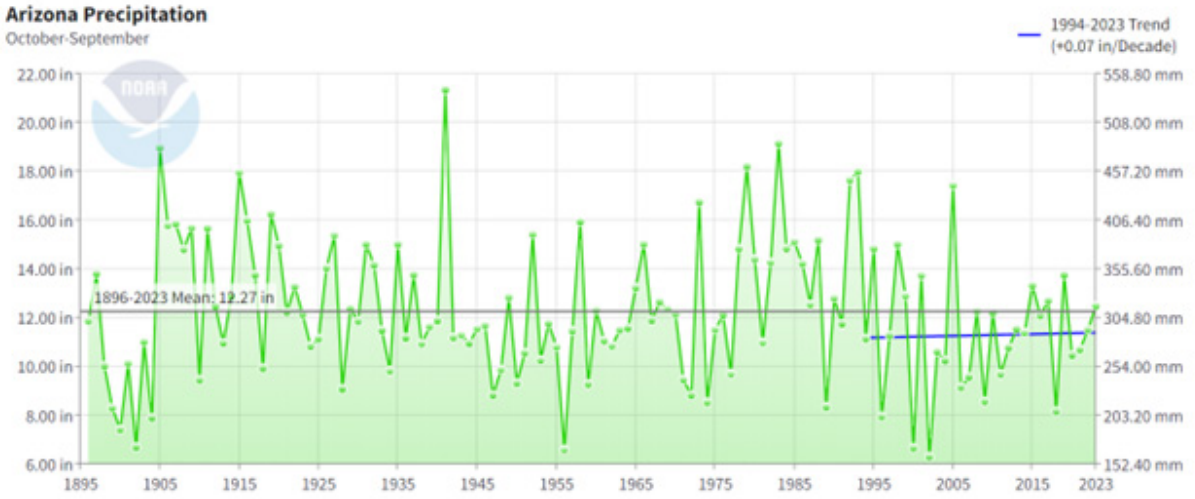


Figure 1. Arizona precipitation from October-September from 1896 to 2023. Statewide, WY2023 precipitation was slightly above the long-term average.

Water year 2023 precipitation was only above average due to a very wet winter. January was the wettest month for the water year and was the 17th wettest January on record (2.21 inches statewide precipitation). March was also very wet as several frontal systems crossed the state, with 2.11 inches statewide precipitation and ranking as the 15th wettest March on record. April through July was the 2nd driest April to July on record, receiving 36% of normal statewide precipitation (1.09 inches statewide precipitation; 3.00 inches normal statewide precipitation). Monsoon activity was delayed through July, but tropical remnants in August assisted precipitation in western and northern counties.

Portions of Mohave, Coconino, and Navajo counties received up to 150% of average water year precipitation, with Yavapai, Apache, Gila, Pinal, and much of Yuma County receiving up to 100% of average water year precipitation (**figure 2**). Cochise County and portions of Maricopa and Pima counties received less than 75% of average water year precipitation.

[1] A water year consists of 12 consecutive months starting October 1 and ending September 30.

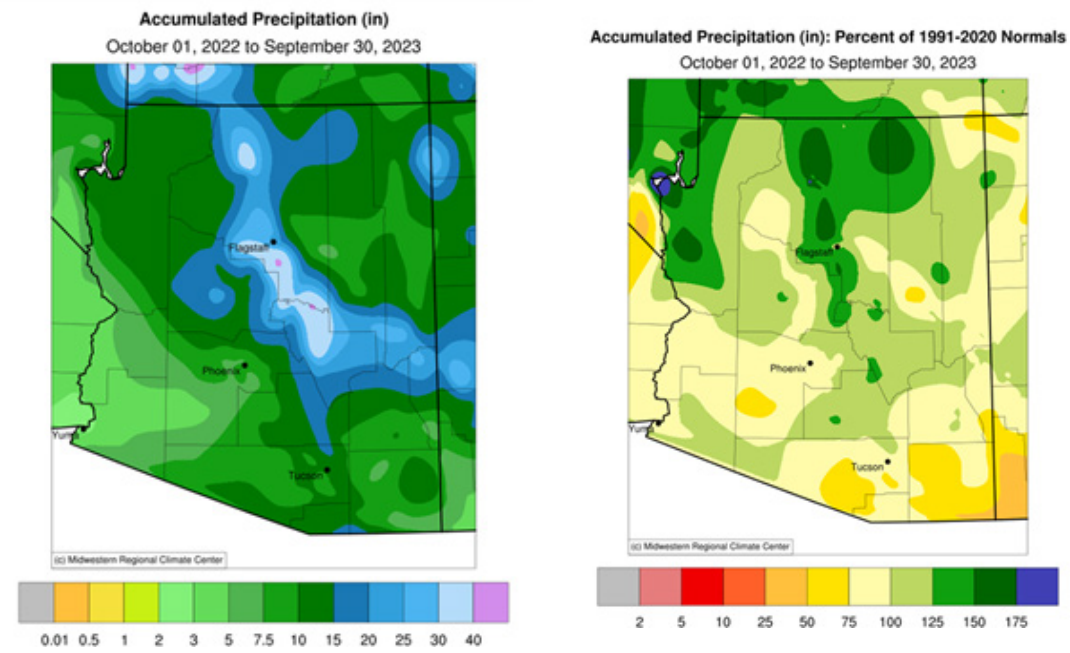


Figure 2. Accumulated precipitation for WY2023.

Mohave, Coconino, Yavapai, and Navajo counties ended WY2023 with above average precipitation, while Cochise, Santa Cruz, and Pima counties ended the water year with below average precipitation (**figure 3**).

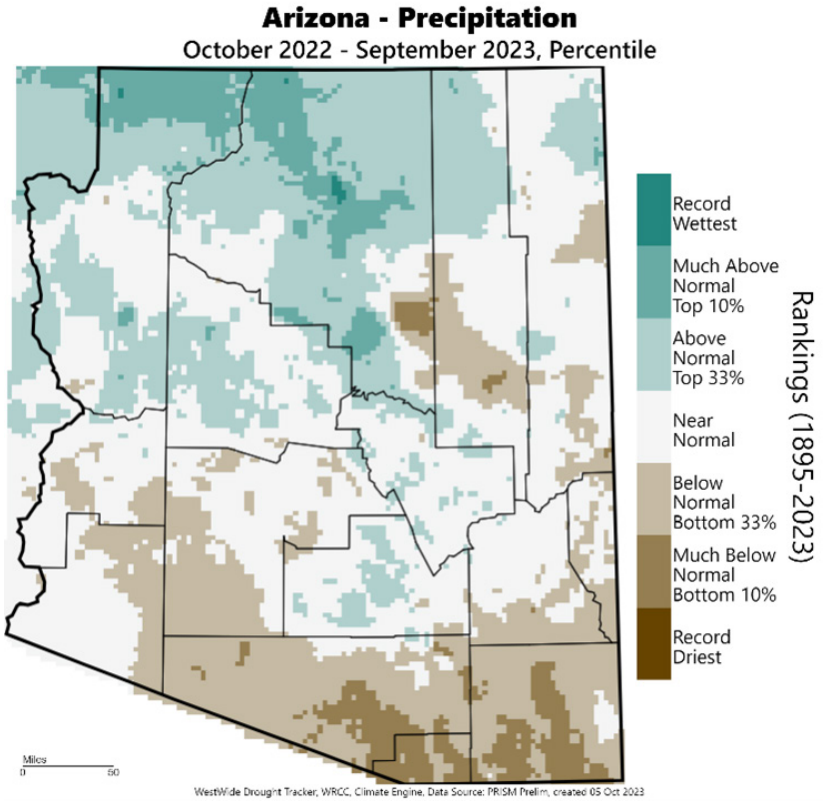


Figure 3. WY2023 was dry in southern counties and wet in northern counties.

Statewide, WY2023 ranked as the 50th wettest water year on record (1896-2023) (**figure 4**).

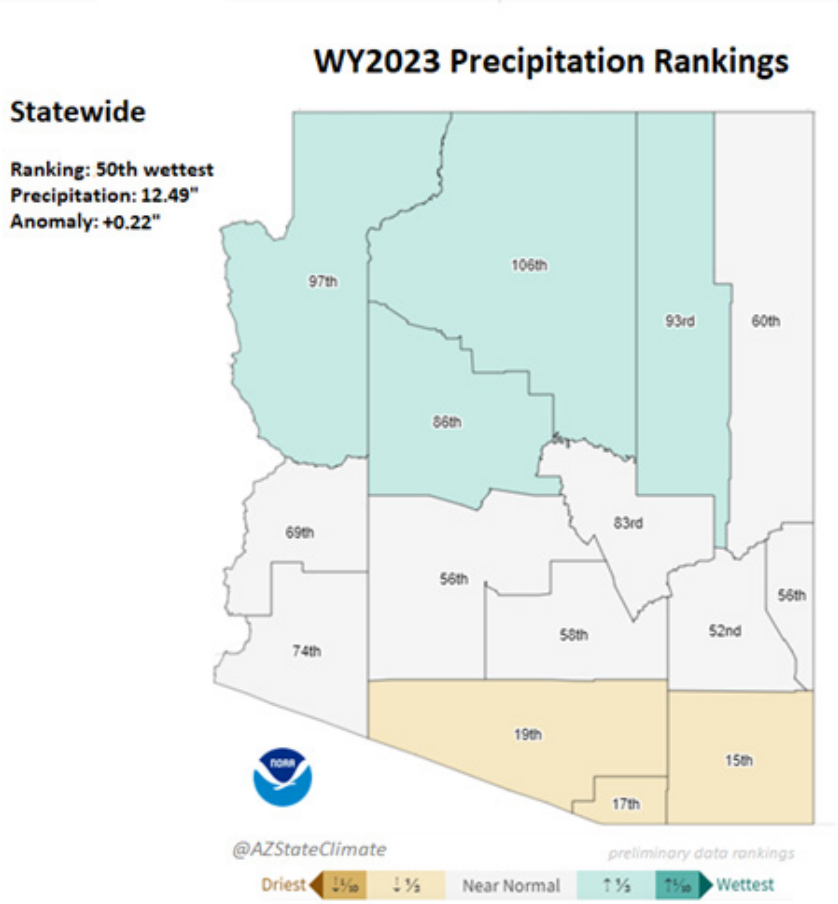


Figure 4. The average statewide precipitation for WY2023 was 12.49 inches.

The statewide average temperature for WY2023 was 59.7°F which is exactly the long-term average temperature. Since WY1994, only two years (WY1997 and WY2023) have been average or below average temperatures (**figure 5**).

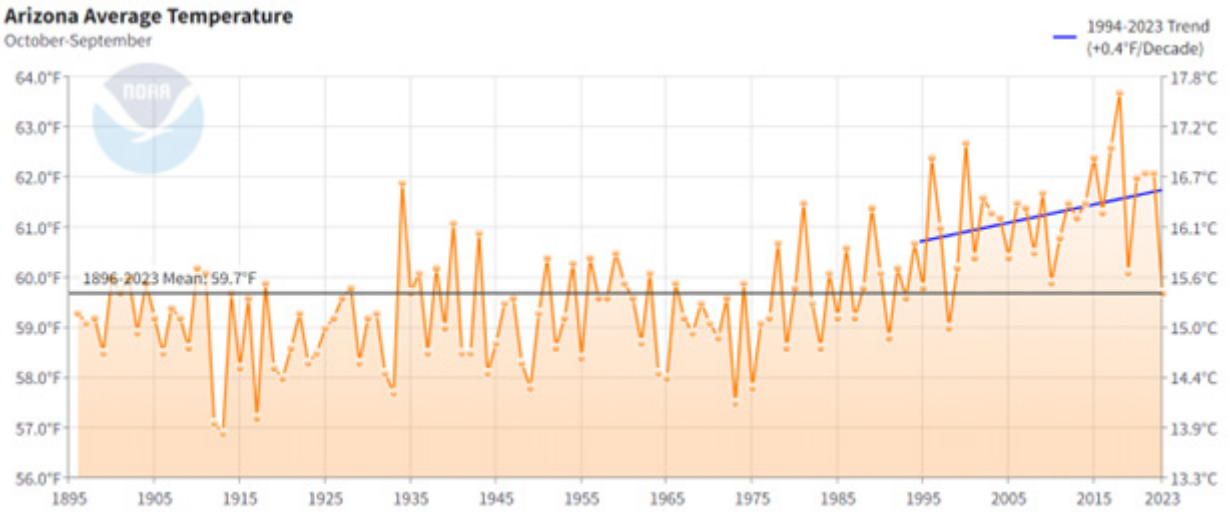


Figure 5. Arizona Average Temperature from 1896 to 2022 for October-September. The average annual statewide temperature per water year is 59.7°F. Statewide, the WY2023 average temperature tied with the long-term average.

Air temperature affects the type of winter precipitation as well as overall atmospheric humidity conditions. Colder statewide temperatures through March delayed the peak snow melting in both Upper and Lower Colorado River basins this water year. Hotter temperatures in July decreased soil moisture, exacerbating drought conditions. All told, the average statewide temperature for WY2023 was balanced by seasonal and geographic extremes. Northern counties had largely below average annual statewide temperature while central and southeastern counties had above average annual statewide temperature (**figure 6**).

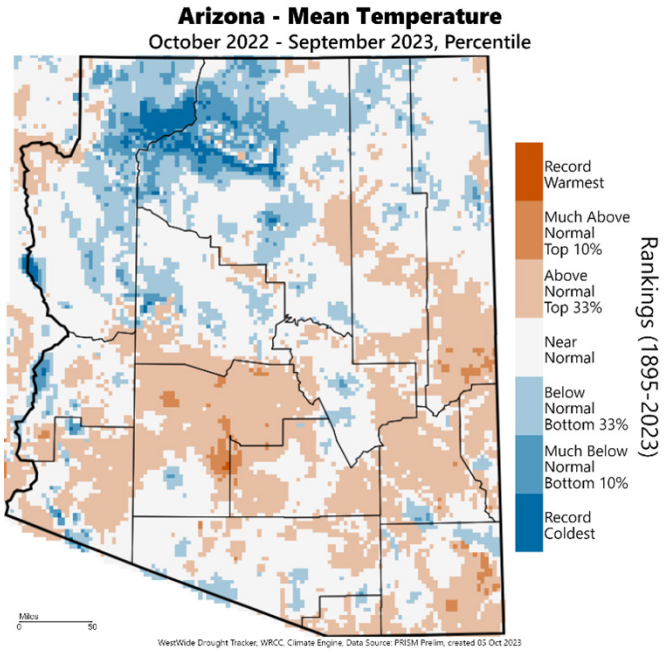


Figure 6. Mean temperatures for WY2023.

Overall, WY2023 ranked as the 58th warmest water year on record (1896-2023) (**figure 7**).

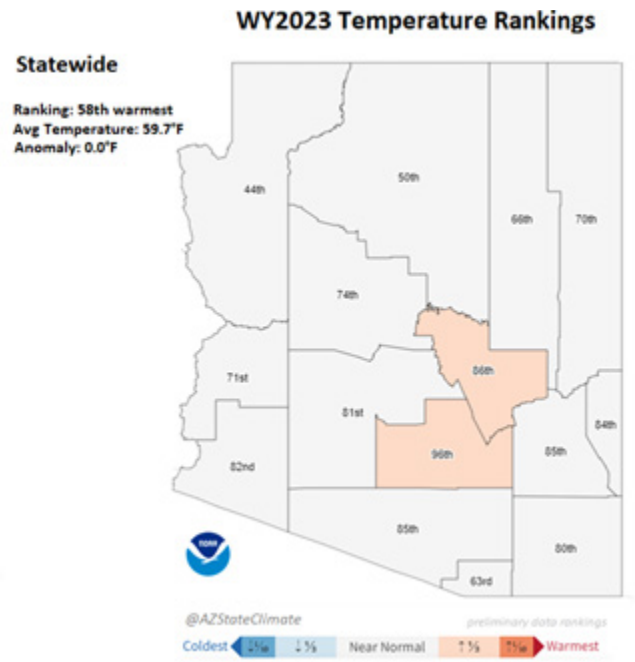


Figure 7. The average statewide temperature for WY2023 was 59.7°F.

A wet summer 2022, followed by a very wet winter 2022-2023, removed much of short-term drought across the state by the end of June 2023. A record hot July and delayed monsoon activity ended September 2023 with the first Extreme (D3) short-term drought degradation in over a year **(figure 8)**.

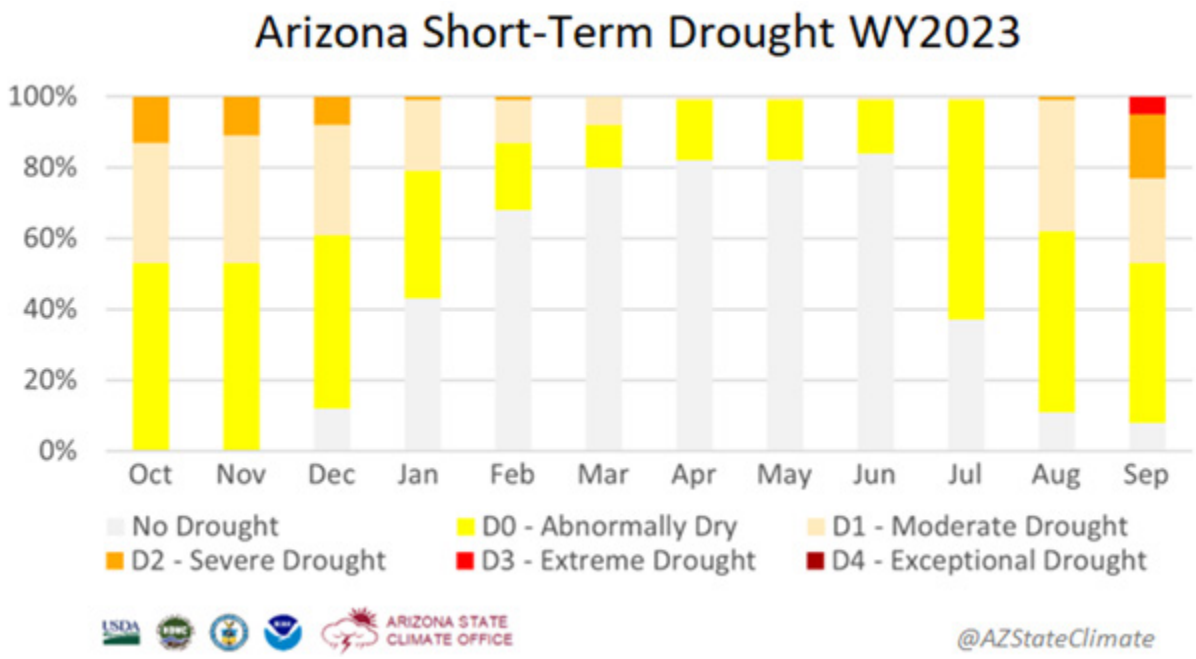


Figure 8. Extreme (D3) short-term drought returned at the end of WY2023.

The Upper and Lower Colorado River Basins (CRBs; **figure 9**) received above average snowpack during winter 2022-23, increasing streamflow into the Colorado River. Water levels in the Lake Mead reservoir increased by 1.46 million acre-feet (MAF) from WY2022; water levels in the Lake Powell reservoir increased by 2.99 MAF from WY2022[2]. Water in the Salt and Verde system increased by 480,001 acre-feet (33%) from WY2022[3]. See **Section 2.D** for more information about the CRB and the Salt and Verde rivers system.

The Arizona Drought Preparedness Plan provides the framework to improve drought-resilience across the state and communities of the state by monitoring drought conditions, increasing understanding of drought impacts, and determining mechanisms for limiting future vulnerability.

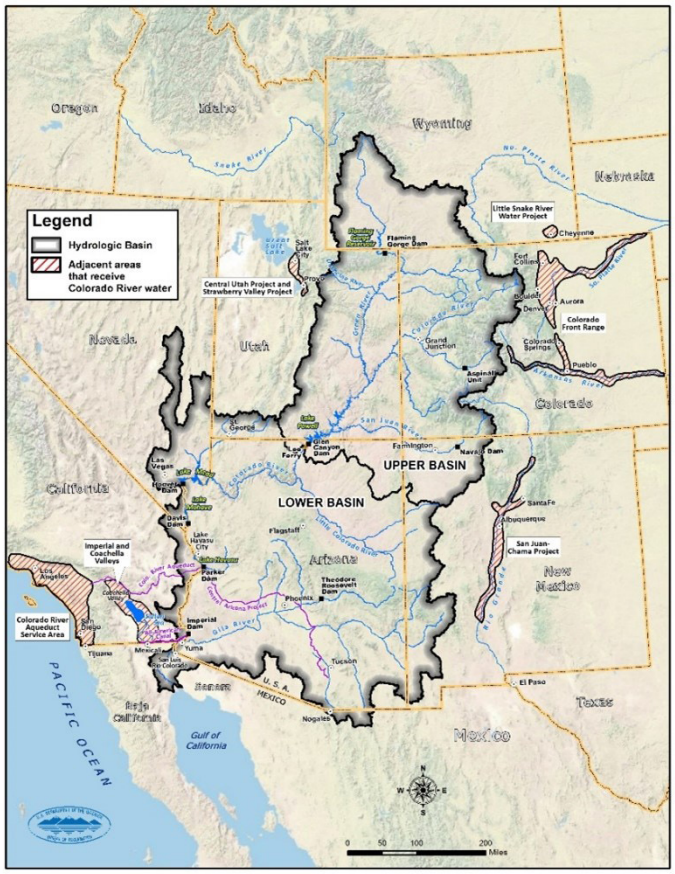


Figure 9. Upper and Lower Colorado River Basins.

[2] United States Bureau of Reclamation (BOR): Lake Mead Elevation (https://www.usbr.gov/uc/water/hydrodata/reservoir_data/921/dashboard.html#pool_elevation/); Lake Powell Elevation (https://www.usbr.gov/uc/water/hydrodata/reservoir_data/919/dashboard.html#pool_elevation/); Lower Colorado Region Daily Reservoir & River Conditions (https://www.usbr.gov/lc/region/g4000/levels_archive.html).

[3] Salt River Project (SRP) Watershed Connection reservoir data: https://streamflow.watershedconnection.com/DWR?reportDate=2022-9-29

2. Drought Status Summary for the Water Year

2.A. Winter Precipitation: October 2022-April 2023

Following a wet monsoon 2022 season, WY2023 began with the 30th wettest October on record (since 1895). November was dry but also the 14th coldest November on record. Anomalous troughing and a very active atmospheric river series contributed to a cold and wet winter. December to March was the 31st coldest December to March on record, with a statewide temperature of 43.0°F (1.1°F below average). December to March was the 19th wettest on record, with a statewide total of 6.84 inches of precipitation (2.25 inches above average). April started warming and drying, becoming the 3rd driest April on record (statewide) with only 0.02 inches of measurable statewide precipitation. Most southern, central, and eastern counties experienced their driest or tied for the driest April on record.

Statewide precipitation for October 2022 to April 2023 was 8.50 inches, ranked as the 28th wettest October-April in the period of record (128 years). The long-term October-April statewide average for Arizona is 6.89 inches of precipitation (**figure 10**).

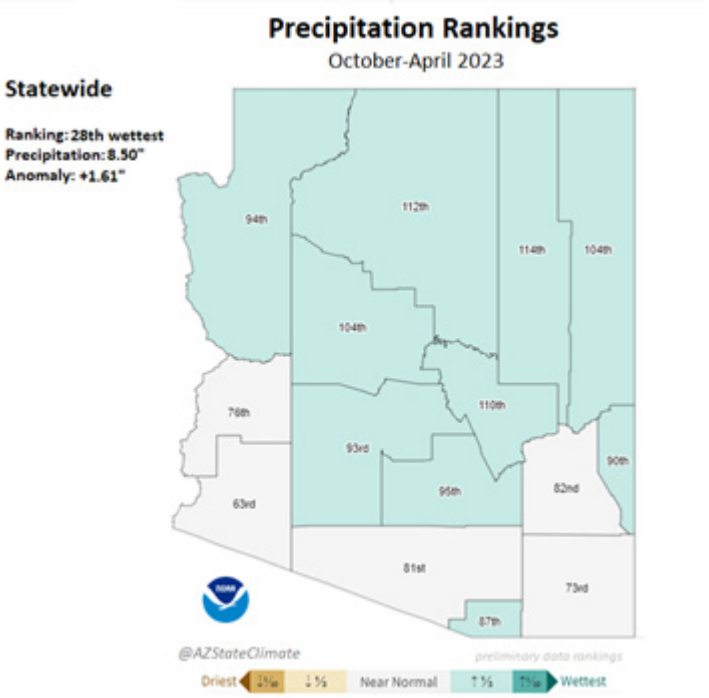


Figure 10. Statewide precipitation rankings from October-April 2023; precipitation was above average across most of the state.

At the end of April, water year precipitation for the Lower Colorado River region basins (CRB) reached 100% to 200% of average water year precipitation (October to April) (**figure 11**).

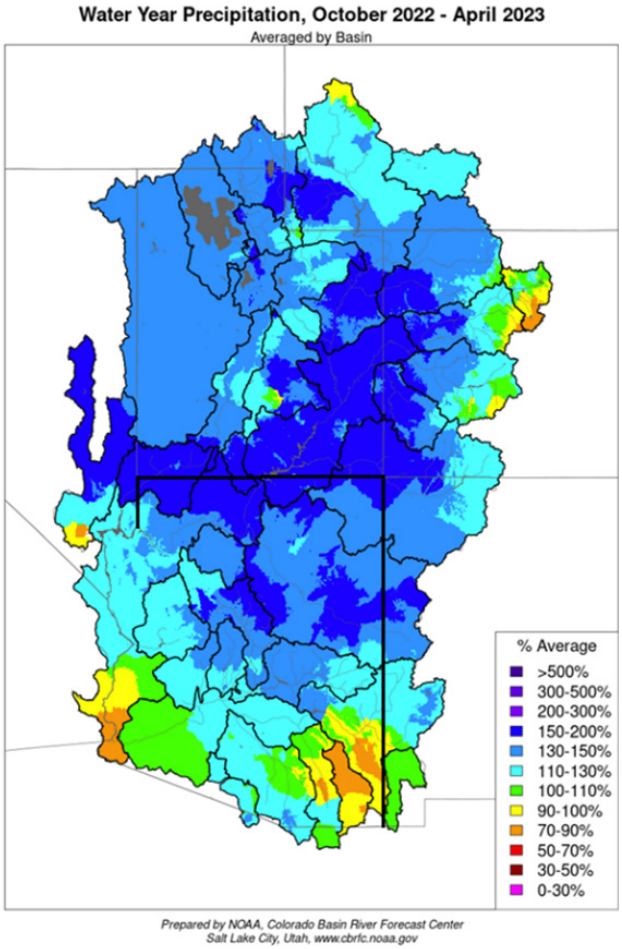


Figure 11. Most CRB region basins received more than 100% of normal October to April 2023 precipitation.

For WY2023, snow water equivalent (SWE) was well above median values for Lower Colorado River region basins. The peak SWE for the Lower Colorado River region basins was 437% of median (on the peak date April 1). The peak SWE for the Verde basin was 716% of median (on the peak date March 26).

The most recent water year with similar Lower Colorado River region basins SWE amounts was 2010 (peak SWE 17.5 inches), with 2023 peak SWE (16.6 inches) approaching those levels. For the Verde basin, 2010 marked the maximum SWE on record, with 2023 arriving at a later peak than in 2010. A very wet and cold March contributed to the snow melt delay (**figure 12**).

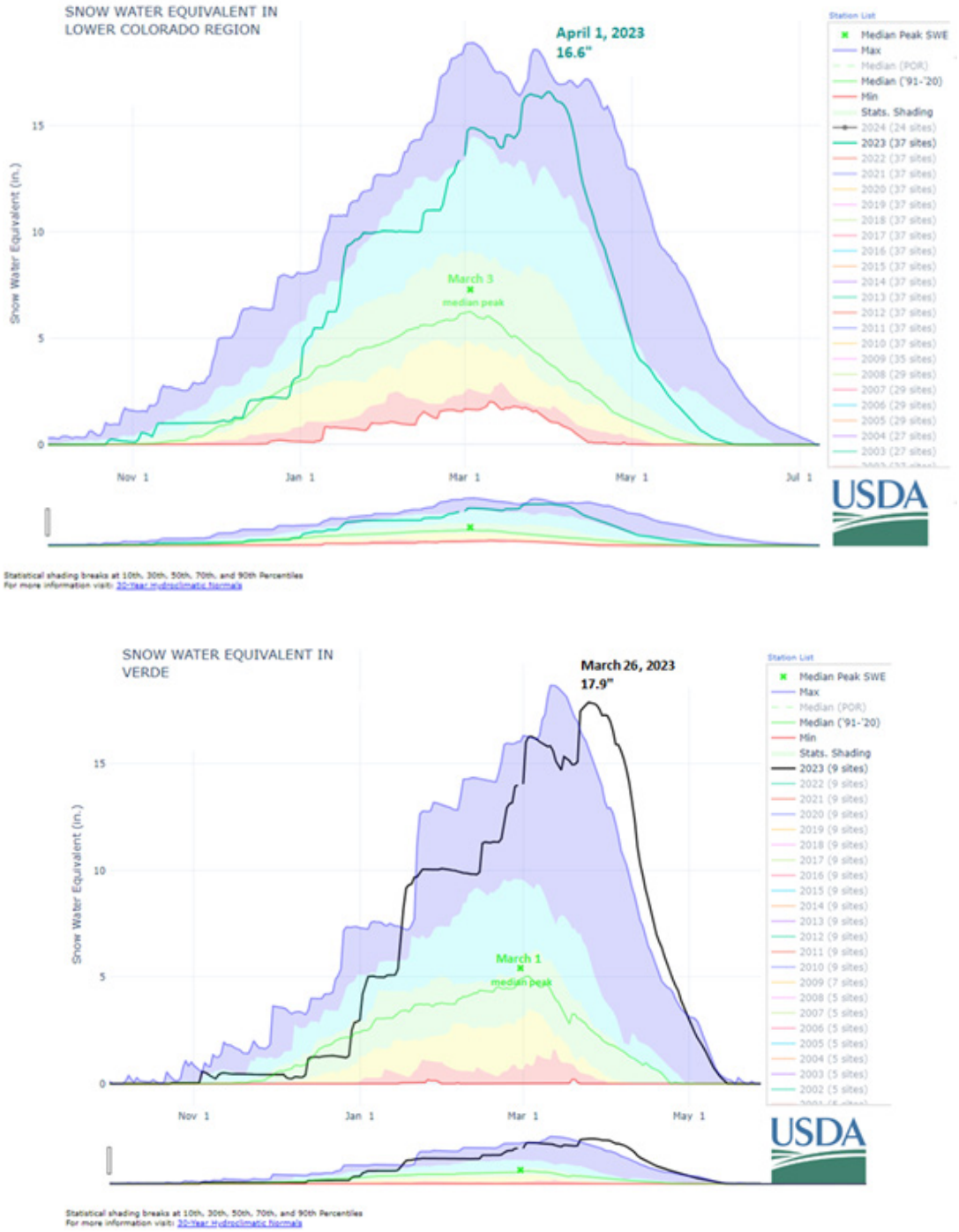


Figure 12. Snow melt was delayed across the Lower Colorado River region basins in WY2023.

2.B. Monsoon Precipitation: June-September 2023

An anomalous trough of low pressure brought the 18th coldest statewide June on record (1895-2023), delaying the buildup of the monsoon ridge and thunderstorm activity across the state. In July, most locations across the state broke multiple high temperature records as an extensive ridge of high pressure persisted across much of the Southwest, further blocking monsoon activity (**figure 13**).

July 2023 was the hottest month statewide on record. Every county experienced its hottest July on record. Together, June to July 2023 was the 2nd driest June to July on record (0.61 inches statewide precipitation; 1.48 inches departure from mean).

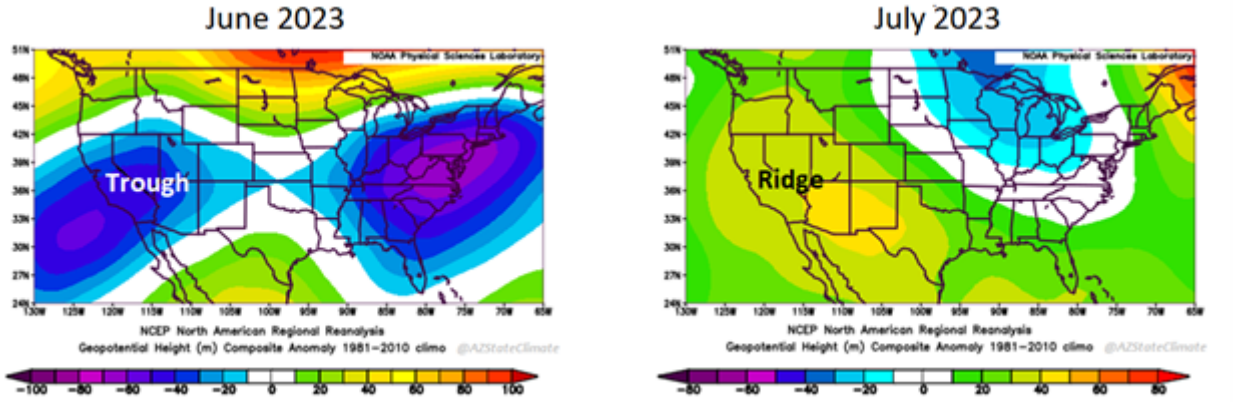


Figure 13. A cold June and an extensive ridge in July delayed the monsoon.

As the strong July ridge relented, monsoon activity eventually arrived in August with much of the state already below average monsoon precipitation levels. Remnants of tropical cyclones Hilary and Harold built precipitation in western and northern counties, contributing to and ending the monsoon season with above average precipitation in these locations (**figure 14**).

Mohave County had the 18th wettest August-September on record, while Yuma County had the 21st wettest August-September on record. Through September, thunderstorm activity remained inconsistent in southeastern and central counties. Weather stations in these counties experienced some of the lowest rankings of historical monsoon precipitation. The Phoenix Sky Harbor (KPHX) weather station experienced its lowest monsoon precipitation (0.15 inches) on record (128 years).

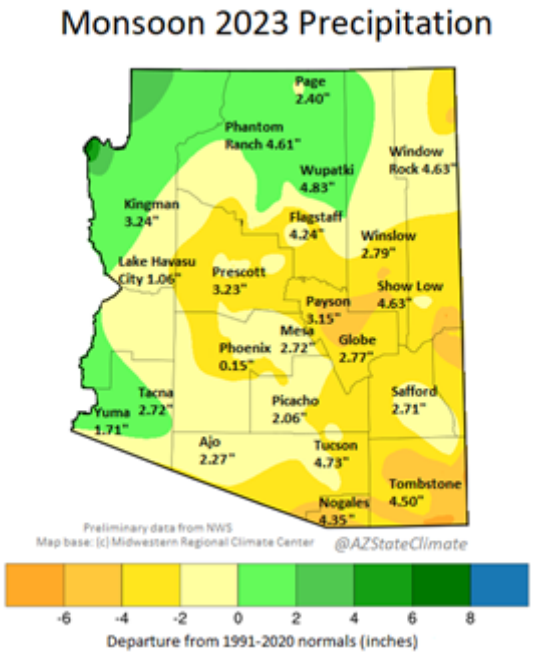


Figure 14. Most locations received below average 2023 monsoon precipitation.

Statewide precipitation for June to September 2023 was 3.53 inches and ranked as the 15th driest June-September in the period of record (128 years). The long-term June-September statewide average for Arizona is 5.37 inches of precipitation (**figure 15**).

June through September resulted in much above average temperatures, especially in central and southeastern counties. Most counties experienced below average June through September precipitation, with Gila, Santa Cruz, southern Apache, southern Cochise, and portions of Maricopa and Pima counties experiencing areas with the record driest June to September on record (**figure 16**).

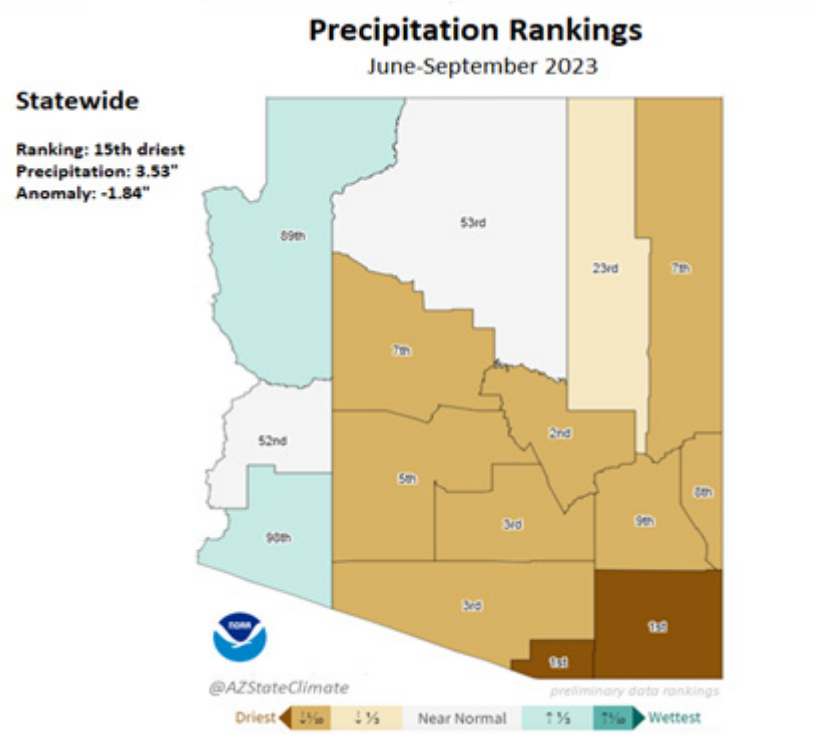


Figure 15. June to September 2023 precipitation was the 15th driest on record.

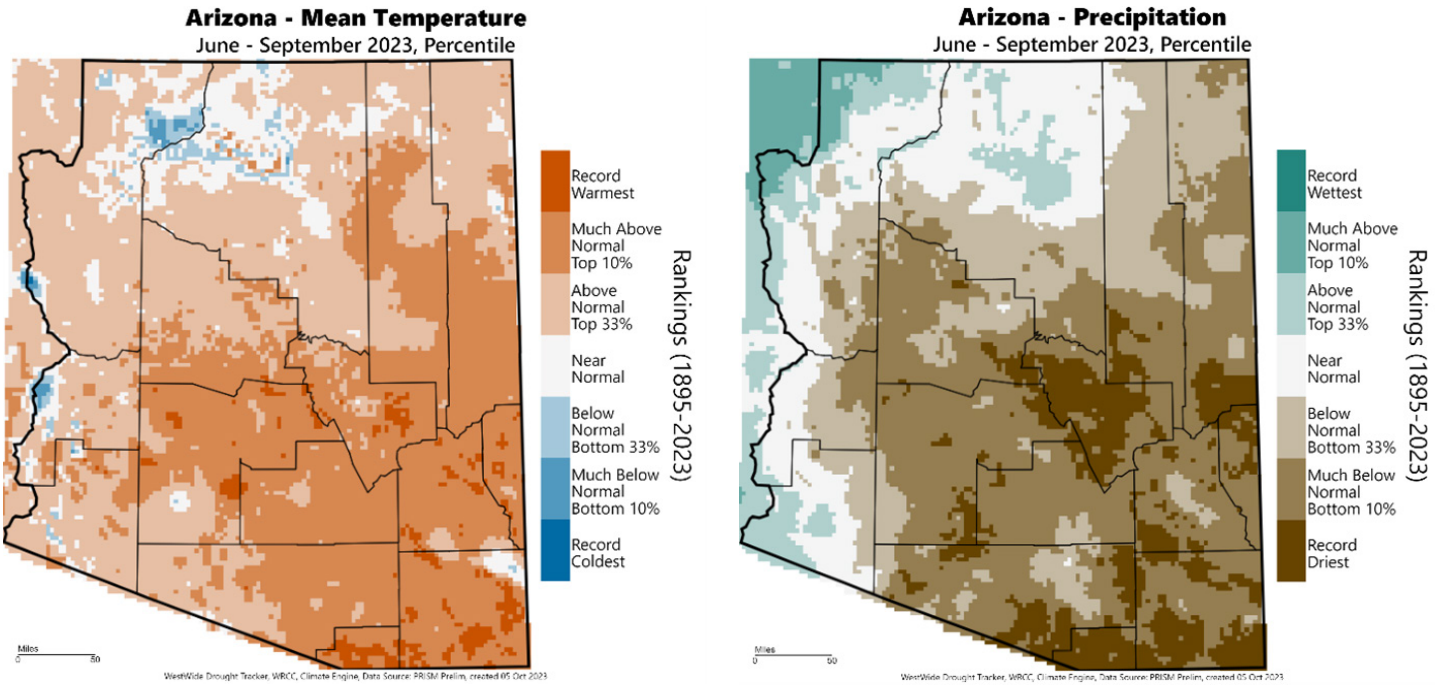


Figure 16. Much of the state experienced a very hot and dry 2023 summer.

2.C. Cumulative Precipitation and Streamflow Summary

Precipitation

Cumulative precipitation for WY2023 was at median levels to well above median throughout the mountainous areas of Arizona, ranging from 105-143% of median in the major river basins. The strong winter precipitation was the main factor in the cumulative precipitation maintaining above median levels (**table 1**).

Table 1. Water Year 2023 Mountain Precipitation (as of September 30, 2023)

Major Basin	Percent of 30-year Average Precipitation
Salt River Basin	121%
Verde River Basin	143%
San Francisco-Upper Gila River Basin	105%
Little Colorado River Basin	140%

Streamflow

Drought status, as indicated by streamflow data (**figure 17**), shows normal drought conditions throughout Arizona in the beginning of WY2023. During the period from December to January streamflow was characterized by above normal flow. Multiple winter precipitation events resulted in increased streamflow that surpassed the 2022 water year. During the spring, especially March and April, flows were significantly above normal because the large snowpack deposited in the winter and early spring, melted quicky due to an increase in temperatures. Through late spring streamflow conditions in Arizona remained in the range of normal. A late monsoon season resulted in conditions that were characterized by below normal and moderate hydrologic drought. Generally, streamflow during the 2023 water year showed an improvement from the 2022 water year.

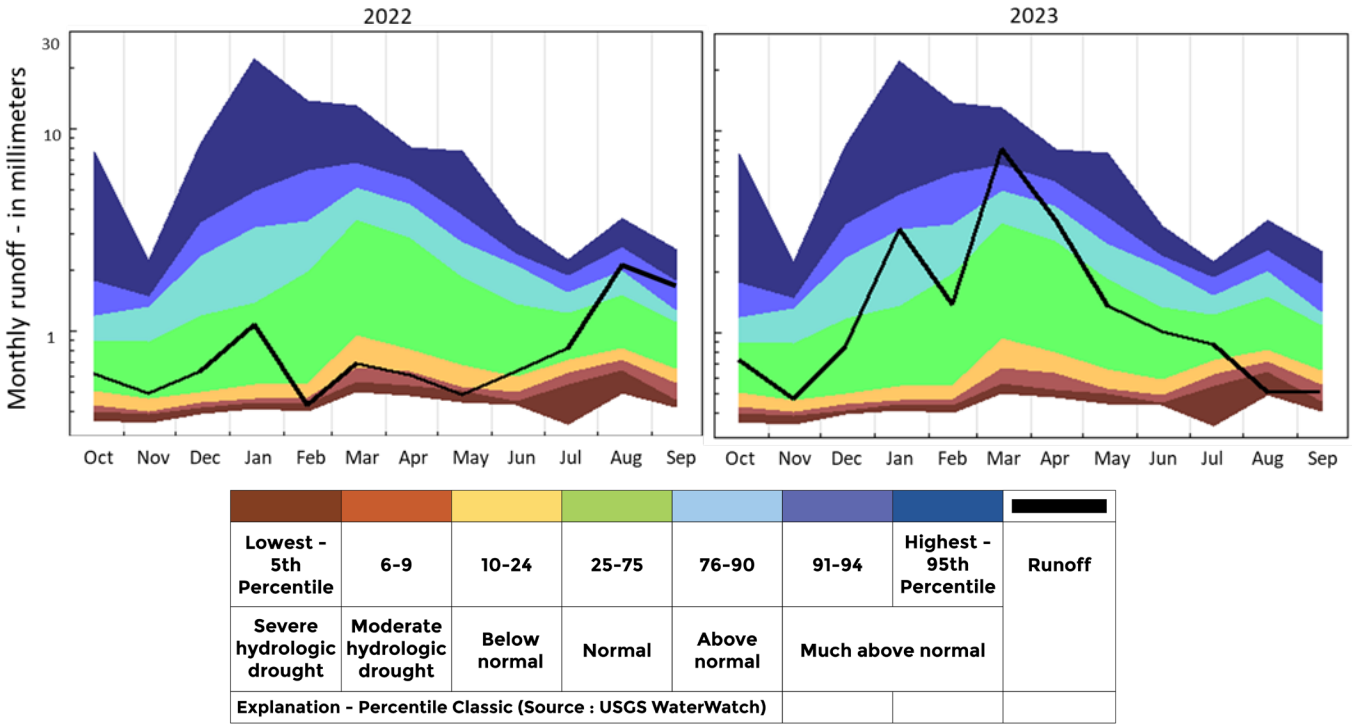


Figure 17. Area-based monthly runoff as determined by United States Geological Survey (USGS) streamflow gages for 2022 and 2023 representing the entire state of Arizona. The hydrograph (black line) represents runoff per unit area and is plotted over the long-term statistics of runoff for each month. The statistics include the maximum runoff during the period of record for each month of the year (top of the dark blue area); the 90th percentile runoff for each month (top of the light blue area); the interquartile range (the green area bounded by the 75th percentile on top and 25th percentile on the bottom); the 10th percentile runoff for each month (the bottom of the orange area); and the minimum discharge for each month (bottom of dark brown area). The plot covers a period of one year with the statistics being identical for each year. Some provisional data was used in this figure.

2.D. Water Supply Status

Colorado River Basin and Reservoir Status[4]

The Colorado River total system storage experienced a net increase of 5.71 million acre-feet (MAF) in WY2023. Colorado River total system storage was 33% of capacity at the beginning of the water year, and by the end, it was at 43% of capacity. Reservoir storage in Lake Powell increased by 2.99 MAF, and reservoir storage in Lake Mead increased by 1.54 MAF.

Precipitation in the Upper CRB was above average[5] during WY2023. On September 30, 2023, the cumulative precipitation received within the Upper CRB for WY2023 was 114% of median. Snowpack conditions trended much above average across most of the CRB throughout the snow accumulation season. The basin-wide SWE peaked at 161% of average on April 7, 2023, which is one day later than the peak date (April 6) for the total seasonal accumulation period. On April 1, 2023, the SWEs for the Green River, Upper Colorado River Headwaters, and San Juan River Basins were 125%, 122%, and 174% of median, respectively.

Much above average streamflows[6] were observed throughout much of the CRB during WY2023. Unregulated[7] inflow into Lake Powell was 13.42 MAF, or 140% of the 30-year average[8]. During the Spring 2023 runoff period, inflows to Lake Powell peaked on May 30, 2023, at approximately 148,900 cubic feet per second (cfs). The April through July unregulated inflow volume for Lake Powell was 10.62 MAF (166% of average). Unregulated inflows for WY2023 into Flaming Gorge, Blue Mesa, and Navajo Reservoirs was 131%, 117%, and 134% of average, respectively.

Lower CRB tributary inflows above Lake Mead were much above average for WY2023. Tributary inflow measured at the Little Colorado River near Cameron gage totaled 0.237 MAF, or 200% of average. Tributary inflow measured at the Virgin River at Littlefield gage totaled 0.281 MAF, or 163% of average. Below Hoover Dam, tributary inflow for WY2022 measured at the Bill Williams River below Alamo Dam gage totaled 0.147 MAF, and tributary inflow measured at the Gila River near Dome gage totaled 0.092 MAF.

Lower CRB tributary inflows above Lake Mead were much above average for WY2023. Tributary inflow measured at the Little Colorado River near Cameron gage totaled 0.255 MAF, or 216% of average. Tributary inflow measured at the Virgin River at Littlefield gage totaled 0.270 MAF, or 157% of average. Below Hoover Dam, tributary inflow for WY2022 measured at the Bill Williams River below Alamo Dam gage totaled 0.150 MAF, and tributary inflow measured at the Gila River near Dome gage totaled 0.102 MAF.

Salt & Verde Reservoirs

Water year 2023 on the Salt and Verde Watershed started with above normal precipitation leading to improved watershed conditions going into the winter runoff season. Increased runoff response was observed on the Salt River as early as December 2022, with 400% of median streamflow during the month. As of January 1, the watershed had 125% (Salt) to 200% (Verde) of normal snowpack, setting up conditions for a productive runoff season. January and February 2023 received above normal precipitation (6.55 inches, 170% of normal) continuing to accumulate snowpack across the watershed. The snow-dominated winter storm events favored the Verde Watershed and led to well above median snowpack conditions (350% of median) with snow depths up to five feet in some areas of the watershed as of March 1. This was followed by the wettest March observed on the Salt and Verde Watershed in the last 30 years (4.18 inches, 279% of normal). Two significant storm events during March 2023, combined with well above normal snowpack, resulted in peak flows on the Verde River up to 68,000 cubic feet per second (cfs) on March 22 and the 2nd highest total runoff on record along the Verde River for the month of March. The Salt and Verde Watershed observed 882,000 acre-feet (AF) (570% of

[4] This section and associated footnotes are from the Bureau of Reclamation's August 31, 2023, draft "Annual Operating Plan for Colorado River Reservoirs 2024." The information has been updated to the end of Water Year 2023 where appropriate and data was available.

[5] Snowpack, snow water equivalent, and precipitation statistics are provided by the Natural Resources Conservation Service and are based on the median for the 30-year period 1991-2020. Hydrologic conditions are described in the following manner: much above average/median (greater than 130%), above average/median (111%-130%), near average/median (90%-110%), below average/median (70%-89%), and much below average/median (less than 70%). Reservoir specific ROD descriptions are used in place of this terminology where applicable.

[6] Streamflow statistics are provided by the National Water Service's Colorado Basin River Forecast Center and are based on the average/median for the 30-year period 1991-2020. Hydrologic conditions are described in the following manner: much above average/median (greater than 130%), above average/median (111%-130%), near average/median (90%-110%), below average/median (70%-89%), and much below average/median (less than 70%).

[7] Unregulated inflow adjusts for the effects of operations at upstream reservoirs. It is computed by adding the change in storage and the evaporation losses from upstream reservoirs to the observed inflow. Unregulated inflow is used because it provides an inflow time series that is not biased by upstream reservoir operations.

[8] All unregulated inflow, precipitation, and snowpack statistics are based on the 30-year period 1991-2020. The average for this 30-year period is 9.60 MAF.

median) of total runoff in the month of March alone and SRP reservoir storage went from 65% full on January 1 to 100% by late March. Spill from SRP reservoirs began in early March, with releases occurring primarily from Horseshoe and Bartlett (Verde Reservoirs). Roosevelt Lake entered Flood Control Space (FCS) in late March and reached its highest lake elevation on record. While March storms produced significant runoff, they also increased snowpack, and the Verde Watershed had the highest April 1 snowpack in the last 50 years. Higher snowmelt runoff continued in April and May, with spills occurring primarily from the Salt reservoirs and Roosevelt Lake operating within FCS. A total of 732,000 AF was spilled at Granite Reef Dam into the Salt River between March 2 and May 12, and the SRP reservoir system remained at 99% full as late as June 1. Overall, the wettest October through March (15.96 inches) was observed on the Salt and Verde Watershed since 2005, resulting in the 12th highest January 1 through May 31 streamflow for the Salt and Verde Rivers, totaling 1,802,000 AF (400% of median).

On the Salt and Verde Watershed, summer monsoon seasons following wet winters tend to have a greater chance for below normal precipitation, and 2023 followed this trend. The 2023 monsoon season started extremely dry, with only 0.62 inches (27% of normal) of precipitation in June and July, and Salt and Verde River streamflow dropped to below median flows by July. Several additional storm events were observed across the watershed in August and September, but overall precipitation remained well below normal, and only minimal additional runoff was observed on the watershed throughout the monsoon season. Total Salt and Verde Watershed average precipitation was 3.46 inches (55% of normal) and total runoff along the Salt and Verde Rivers was 43,000 AF (46% of median) from July to September, ranking as the 2nd lowest on record for both (2020 was the lowest for both). The dry monsoon season shifted drought conditions across the watershed from no drought following the wet winter to portions of moderate drought conditions by the end of the water year. Overall, total SRP reservoir inflow for water year 2023 was well above median, with approximately 2,021,000 AF (290% of median) and average watershed precipitation was 19.99 inches (120% of normal). As a result, total SRP storage on the Salt and Verde reservoir system remains in good condition at 85% full (1,950,000 AF) as of September 30, 2023, compared to 64% at the same time last year.

2.E Drought Index Wells

ADWR maintains groundwater index wells throughout the state (**figure 18**). Using criteria established by the USGS, nine wells in Arizona have been utilized as qualitative supplements to existing drought indicators. Depth-to-water measurements are collected at these sites, multiple times per day, by means of a pressure transducer. Automated, or transducer, measurements are later verified with less frequent discrete measurements taken by ADWR field staff. For additional information regarding the USGS climate response network criteria:

https://azwatermaps.azwater.gov/gwsi/content/drought_site_criteria.pdf

Figures 19 through **27** are hydrographs showing the groundwater level record and the historical daily median. Automated groundwater levels for each well site are plotted in blue, the historical daily median is plotted in green, and provisional data is plotted in red. The gray area on the right-hand side of the graph indicates the extent of WY2023, beginning on October 1st, 2022.

Figure 18. Location map of drought monitoring index wells and Arizona watersheds.

Little Colorado River

ADWR Monitoring Site 'A-20-07 25DCB1'

ADWR Index Well "A-20-07 25DCB1" is located within the Little Colorado River Watershed. Situated in Priest Draw, this well is completed in the deeper Coconino Sandstone.

This well is one of two additions to the drought groundwater monitoring program for WY2023. A transducer was installed April 19th, 2022, and has been collecting daily water level measurements ever since. After monitoring for over a year, ADWR determined this site would make an excellent addition to the drought program.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 35° 04' 54.54", W 111° 36' 13.34"	1200 feet	6842 feet	173.35 feet	169.14 feet	170.99 feet

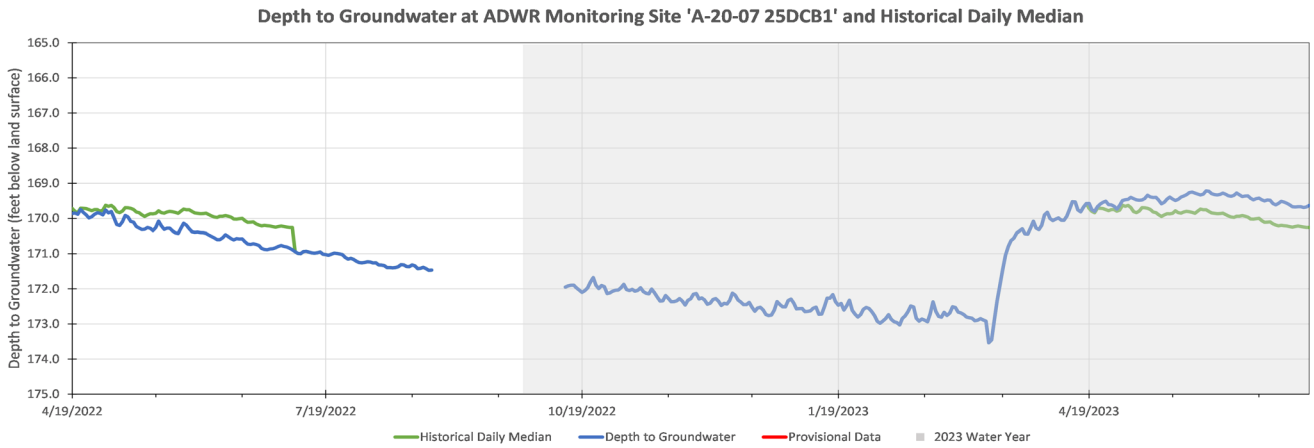


Figure 19. Automated groundwater level data for ADWR drought index well 'A-20-07 25DCB1' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=320901110175301.

ADWR Monitoring Site 'A-20-07 25DCB2'

ADWR Index Well "A-20-07 25DCB2" is located within the Little Colorado River Watershed. Situated in Priest Draw, this well is completed in the shallow Kaibab Formation.

The second, and newest, drought well was added to the groundwater monitoring program in WY2023. A transducer was installed May 4th, 2022, and has been collecting daily water level measurements ever since. While still very new to the program, a significant response is shown on the hydrograph from this winter's tremendous runoff.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 35° 04' 54.6", W 111° 36' 12.77"	100 feet	6841 feet	83.5 feet	21.43 feet	80.37 feet

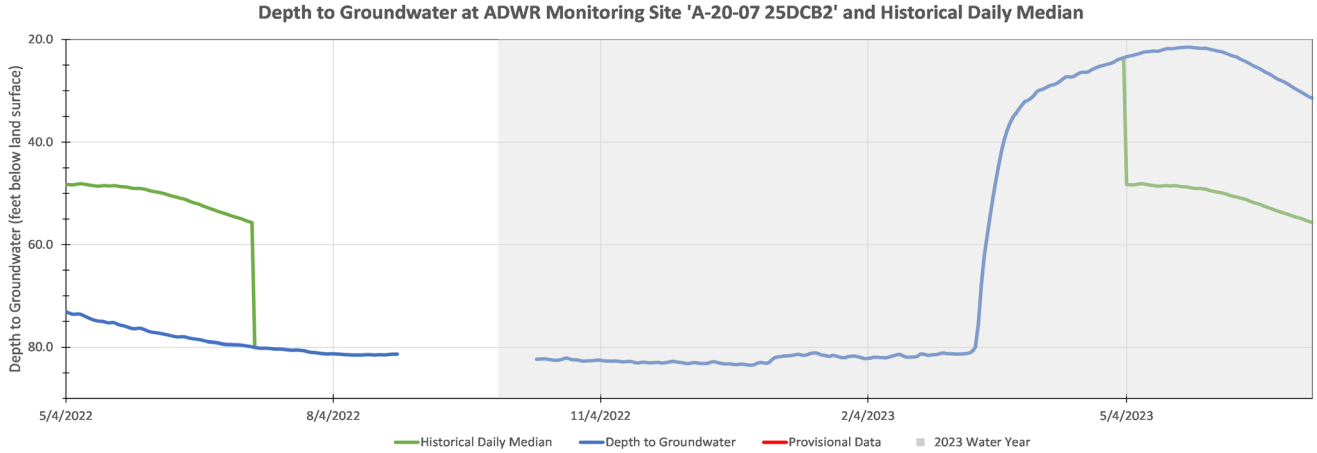


Figure 20. Automated groundwater level data for ADWR drought index well 'A-20-07 25DCB2' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=320901110175301.

San Pedro River Watershed

ADWR Monitoring Site 'D-15-20 09AAB2'

ADWR Index Well 'D-15-20 09AAB2' is located within the San Pedro River Watershed and in the Lower San Pedro Groundwater Basin. Situated on the bank of the San Pedro River, this well is completed in a shallow alluvial aquifer system and is in the rivers floodplain.

Water levels at this monitoring site have consistently remained below the historical daily median since mid-November 2022. Water levels remained consistent from November 2022 through April 2023, before a steep decline was seen through the remainder of WY2023. A lack of recharge from the monsoon contributed to a rapid decline in depth to water. As a result, a new record maximum depth to water was observed on September 30th, 2023, of 35.32 feet.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 32° 09' 02.74", W 110° 17' 53.34"	89 feet	3307 feet	35.32 feet	26.10 feet	32.94 feet

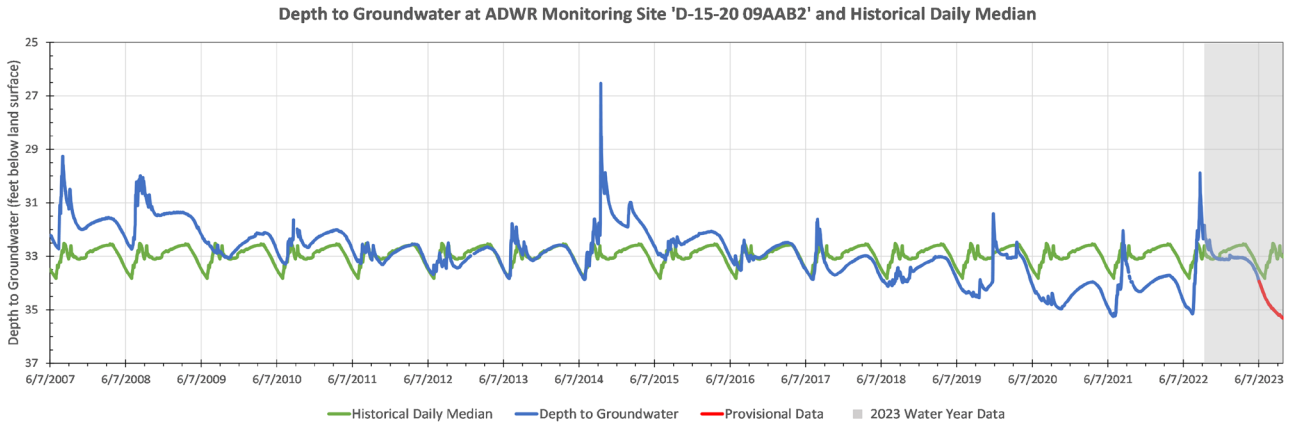


Figure 21. Automated groundwater level data for ADWR drought index well 'D-15-20 09AAB2' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=320901110175301.

USGS Monitoring Site 'D-24-21 17BCB3'

Monitoring well 'D-24-21 17BCB3' is operated through USGS and is located to the southeast of the Huachuca Mountains in the San Pedro River Watershed.

A strong monsoon in 2022 helped water levels recover to near historical daily median values to begin the 2023 water year. However, due to a lack of continued moisture during the winter and summer months this year, water levels sharply declined to near records to close out the water year.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 31° 20' 43.90", W 110° 14' 19.70"	123.6 feet	5100 feet	36.70 feet	30.10 feet	33.50 feet

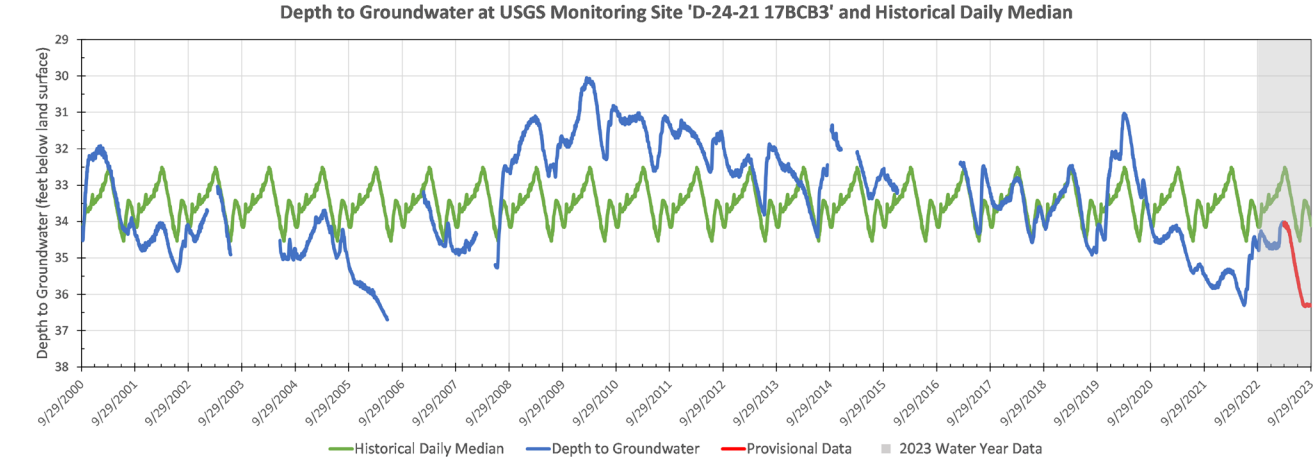


Figure 22. Automated groundwater level data for USGS drought index well 'D-24-21 17BCB3' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through USGS, located here: https://waterdata.usgs.gov/nwis/uv?site_no=312044110141901&legacy=1.

Santa Cruz River Watershed

ADWR Monitoring Site 'D-16-16 14CAC'

ADWR Index Well 'D-16-16 14CAC' is located along Pantano Wash within the Santa Cruz River Watershed. This monitor well is completed in a shallow alluvial aquifer system.

Following a strong monsoon the year prior, significant recharge from winter precipitation was observed at this site, and it was consistently above its historical daily median through August 2023. Since then, depth to water has remained steady to close out the water year.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 32° 02' 16.17", W 110° 40' 58.77"	105 feet	3179 feet	60.62 feet	18.42 feet	51.00 feet

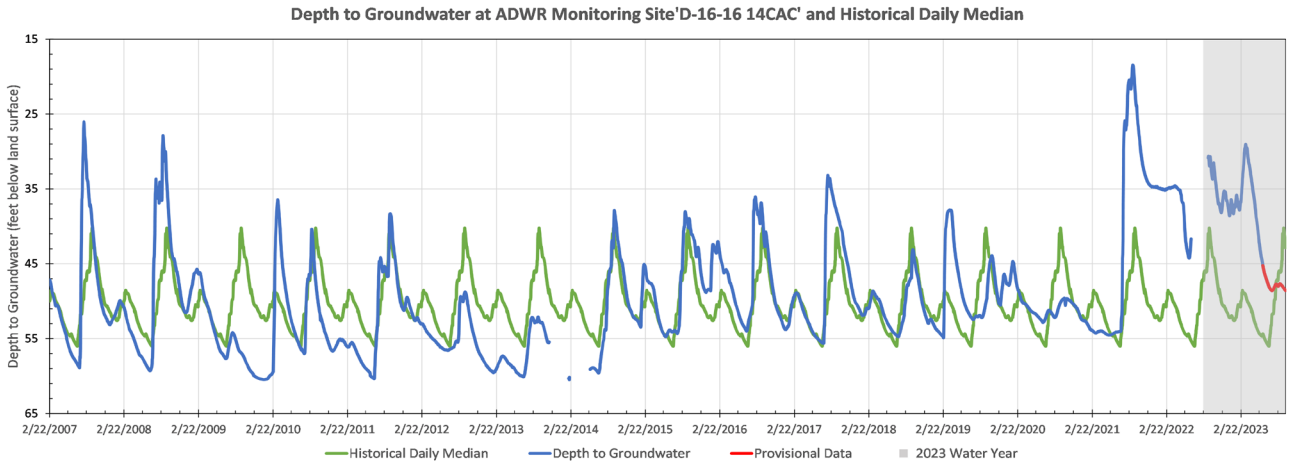


Figure 23. Automated groundwater level data for ADWR drought index well "D-16-16 14CAC" plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=320216110405901.

ADWR Monitoring Site 'D-21-10 29ADB'

ADWR Index Well 'D-21-10 29ADB' is situated along Arivaca Creek in the Santa Cruz River Watershed. This well is completed in shallow alluvial materials.

Water levels remained below the historical daily median for the entirety of WY2023. A greater recovery in water levels during the winter months as opposed to the summer months, is typically seen at this well. Below normal recharge was observed over recent years and has resulted in depth-to-water below historical averages for the past three years.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 31° 35' 32.74", W 111° 20' 13.63"	38 feet	3609 feet	14.85 feet	5.43 feet	9.74 feet

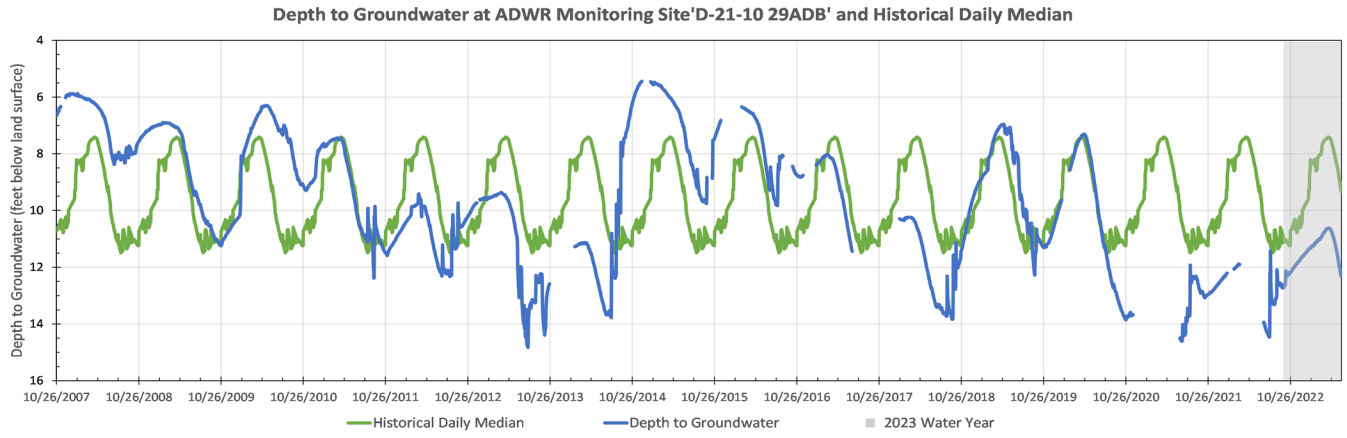


Figure 24. Automated groundwater level data for ADWR drought index well 'D-21-20 29ADB' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=313433111201601.

Verde River Watershed

ADWR Monitoring Site 'B-18-03 26BDD'

ADWR Index Well 'B-18-03 26BDD' is situated along Big Chino Wash in the Verde River Watershed. This monitoring well is completed in a shallow conglomerate unit.

This well was introduced to the drought program in October 2021. This site shows a significant response to precipitation and winter runoff events, as observed most notably in March 2023. A steady decline was observed since April with little precipitation in the area. Water levels were below the site's historical daily median at the close of the year.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 34° 55' 02.03", W 112° 32' 55.99"	609 feet	4403 feet	19.24 feet	11.84 feet	18.12 feet

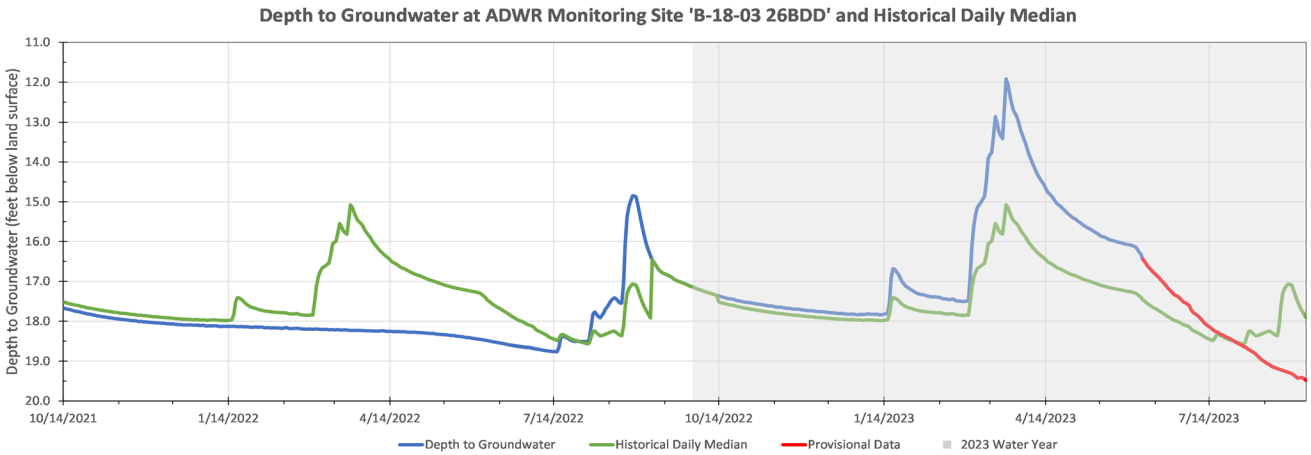


Figure 25. Automated groundwater level data for ADWR drought index well 'B-18-03 26BDD' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=345500112324501.

ADWR Monitoring Site 'B-17-02 26CCD3'

ADWR Index Well 'B-17-02 26CCD3' is located at Del Rio Springs in the Verde River Watershed. This monitoring well is completed in a shallow conglomerate unit.

Seasonal fluctuations continue to be observed. A consistent rise in water level through Spring 2023 was followed by a decrease in later Spring 2023 through the end of the year. This closely follows the year over year trend for this location.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 34° 49' 11.86", W 112° 26' 40.83"	206 feet	4456 feet	15.35 feet	13.05 feet	14.03 feet

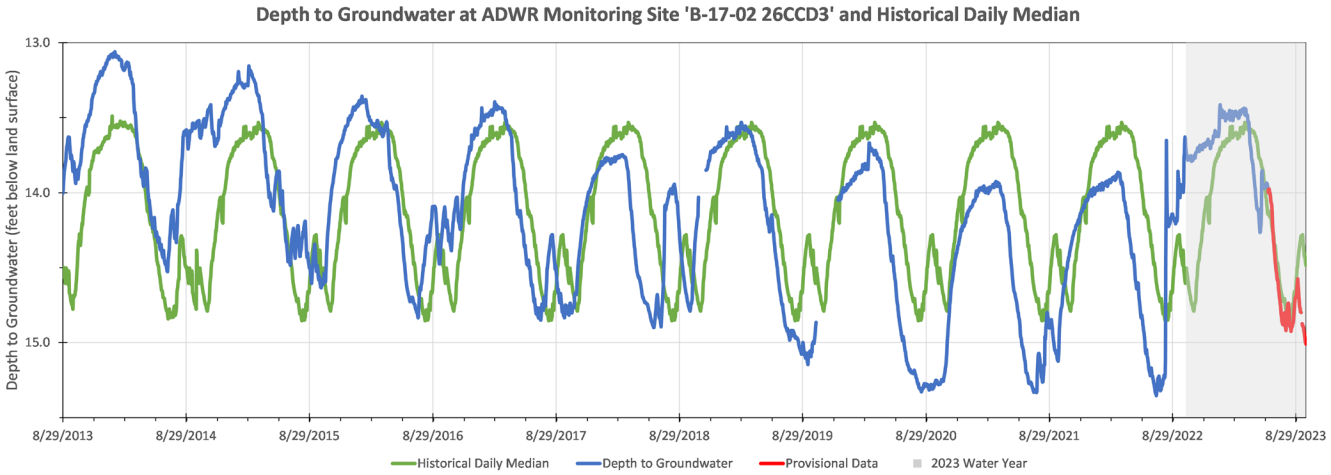


Figure 26. Automated groundwater level data for ADWR drought index well 'B-17-02 26CCD3' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=344912112264101.

Whitewater Draw Watershed

ADWR Monitoring Site 'D-21-28 21BCB1'

ADWR Index Well 'D-21-28 21BCB1' is located within the Whitewater Draw Watershed and in the Willcox Groundwater Basin. Adjacent to the Leslie Creek drainage, this well is completed in shallow alluvial material.

Water levels at this site remained well above historical daily median values to begin WY2023. However, minimal monsoon precipitation this summer caused the water level to continue dropping since January 2023. While still near normal, water levels have dropped below daily median value to close out the 2023 water year.

Location (NAD 27)	Depth of Well	Altitude (above sea level)	Record Maximum Depth to Water	Record Minimum Depth to Water	Median Depth to Water
N 31° 35' 29.87", W 109° 30' 18.00"	25 feet	4648 feet	18.35 feet	1.40 feet	8.52 feet

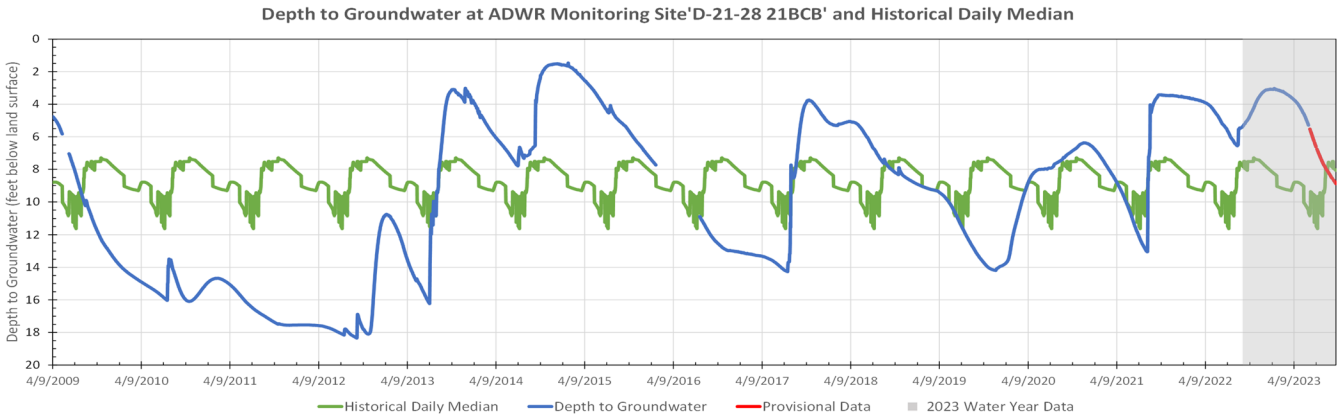


Figure 27. Automated groundwater level data for ADWR drought index well 'D-21-28 21BCB1' plotted with historical daily median groundwater levels. Water level data and additional information for this site are available through ADWR's GWSI web application, located here: https://azwater.gov/gwsi/Detail.aspx?SiteID=313533109301801.

ADWR Drought Index Wells

ADWR's Field Services Section collects groundwater levels statewide from approximately 1,800 index wells, including the state's nine drought index wells. ADWR also maintains a statewide network of roughly 130 automated groundwater monitoring sites and an ORACLE database that contains field-verified data, including discrete water level measurements, location, and other well-specific information.

ADWR staff developed a Monitoring Well Network Optimization Plan in 2015, which in part focuses on the identification of additional drought monitoring index wells within the state. Water level data from continuous monitoring sites statewide are being reviewed and evaluated with respect to meeting the criteria for the USGS Climate Response Network.

ADWR has plans to continue expanding its Drought Monitoring Network in WY2024 with the addition of a few automated groundwater sites. The wells will be added to the network over the next 12 months in order to obtain an improved spatial representation of drought sites throughout the State of Arizona.

2.F. Forest Health

Drought is a key factor in the health of Arizona's forests. Extreme drought has lasting effects on trees, and symptoms can persist for years after the event. In severe drought conditions, the lack of water can lead to direct drought related tree mortality. Those trees that do not perish from drought will likely be weakened. Trees weakened and stressed by drought conditions produce and collect more ethanol and terpenes in their tissues. Tree-killing insects such as bark beetles, are able to detect and target these chemicals when finding new trees to attack. In the years following major drought events, lingering effects on the trees can cause them to remain in a weakened and stressed state, making them more susceptible to insects and diseases.

In 2023, the Arizona Department of Forestry and Fire Management aided the USDA- Forest Service in their annual aerial detection surveys, which record changes in forest health conditions, and determine the primary causal agents of tree mortality for the given year. This year, direct drought mortality was extremely low compared to previous years, along with significant decreases in insect and disease related mortality. These decreases were seen throughout the state, and on a variety of tree species.

Winter of 2022-2023 had significantly more rainfall than in past years, providing many areas of the state with above average precipitation. These wet conditions likely contributed to the decrease in drought mortality and helped reduce the overall weakened state of the trees. Forest health conditions are always changing, and with drought an ongoing issue in Arizona, we expect to continue seeing frequent fluctuations in drought related tree mortality and stress.

2.G. Drought Declarations

A Drought Emergency Declaration has been in effect in Arizona since 1999. The current declaration, PCA 99006, was issued by the Governor in June 1999 and continued by Executive Order 2007-10. The declaration maintains the state's ability to provide an emergency response if needed and enables farmers and ranchers to obtain funding assistance through the Farm Service Agency (FSA) if they experience significant production losses due to drought.

The Governor's Drought Interagency Coordinating Group (ICG) is responsible for providing recommendations to the Governor regarding drought declarations based on presentations and discussions at the spring and fall ICG meetings (see **Section 3.B**).

2.H. Disaster Designations

A disaster designation from the Secretary of the U.S. Department of Agriculture (USDA) is necessary for farm operators in both primary and contiguous disaster areas to be considered for assistance from the FSA.

The USDA uses the U.S. Drought Monitor to determine designations. Extreme (D3) or Exceptional (D4) drought qualify as automatic designations, while Severe (D2) drought for eight consecutive weeks during the growing season qualifies for nearly automatic designation. This "Fast Track" authority designation process delivers fast and flexible assistance to farmers and ranchers. The disaster designations by the USDA in **Table 2** occurred during WY2023:

Date of Designations	Primary Disaster Counties	Contiguous Disaster Counties (AZ)
December 30, 2022	Havasupai Reservation	Coconino
March 17, 2023	Coconino | Mohave	Gila | Navajo | La Paz | Yavapai
March 17, 2023		Mohave | La Paz
March 17, 2023		Apache
March 17, 2023		Mohave
March 17, 2023		Apache | Navajo | Coconino | Mohave
April 3, 2023		La Paz | Mohave
April 11, 2023	Navajo Nation	Apache | Coconino | Navajo
April 27, 2023		Mohave
September 11, 2023		Apache | Greenlee

2.I. Drought Status Changes

Following directives within the Arizona Drought Preparedness Plan, Arizona's drought status is continuously evaluated and updated throughout the water year. The short-term drought status is monitored on a weekly basis, with the Arizona Drought Monitoring Technical Committee (MTC) providing weekly recommendations to the U.S. Drought Monitor[9] authors. The long-term drought status is analyzed monthly by the Arizona State Climate Office and updated quarterly by the Arizona Drought Monitoring Technical Committee.

The U.S. Drought Monitor categorizes drought based on precipitation and environmental impacts. Different aspects of drought (hydrological, meteorological, and agricultural) are encapsulated within the U.S. Drought Monitor categories.

The U.S. Drought Monitor began reporting on drought in January 2000, and Arizona evaluates these maps as short-term drought (**figure 28**). Arizona has recorded some aspect of short-term drought almost continuously since 2002, with the largest statewide expansion of Exceptional (D4) short-term drought occurring in WY2021.

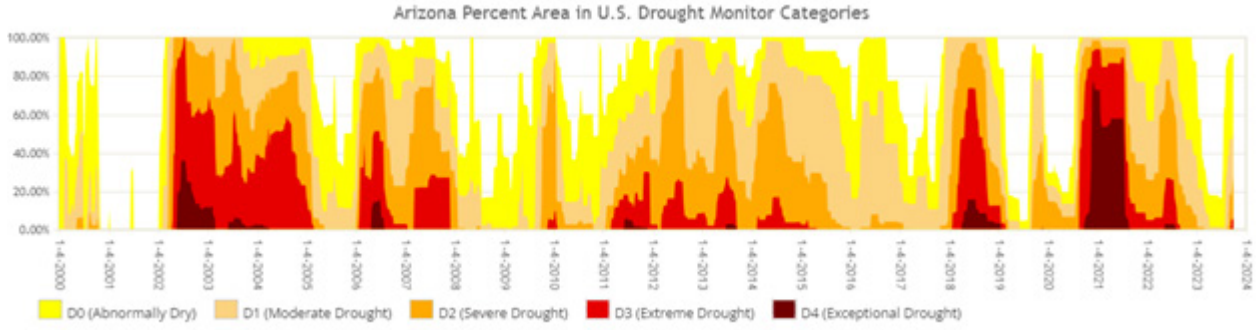


Figure 28. Short-term drought has been shown on the U.S. Drought Monitor since 2000.

The first half of WY2023 removed much of Moderate (D1) and Severe (D2) short-term drought, where 98% of the state was no longer in short-term drought by the end of June. Following a very hot and dry July and late-starting monsoon, Extreme (D3) short-term drought advanced at the end of the water year (**table 3**).

Table 3. Percentage of change in short-term drought WY2022 vs WY2023.

Category	End of WY2022	End of WY2023	Change from last WY
No Drought	0	8	+8
D0 – Abnormally Dry	43	45	+2
D1 – Moderate Drought	38	24	-14
D2 – Severe Drought	19	18	-1
D3 – Extreme Drought	0	5	+5
D4 – Exceptional Drought	0	0	0

[9] The U.S. Drought Monitor is a map released every Thursday, showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4): https://droughtmonitor.unl.edu/

Short-Term Drought Status

Water Year 2023 began with 47% of the state in Moderate (D1) or Severe (D2) short-term drought. Severe (D2) short-term drought had spread in Mohave, Coconino, northern Apache and Navajo, eastern Pima and southeastern Cochise counties.

A cold and wet winter removed much of short-term drought across 93% of the state by the end of March. Only 1% of Moderate (D1) short-term drought remained in the state by the end of June, located in northwestern Mohave County.

A very hot and dry July quickly advanced Abnormally Dry (D0) conditions across 62% of the state by the end of the month. A late-starting monsoon expanded Moderate (D1) and Severe (D2) short-term drought in central and southeastern counties (38% of state). By the end of September, Extreme (D3) short-term drought returned to Santa Cruz, Pima, and Greenlee counties (5% of total state), with Moderate (D1) and Severe (D2) short-term drought expanding in central, southeastern and eastern counties (42% of state) (**figure 29**)

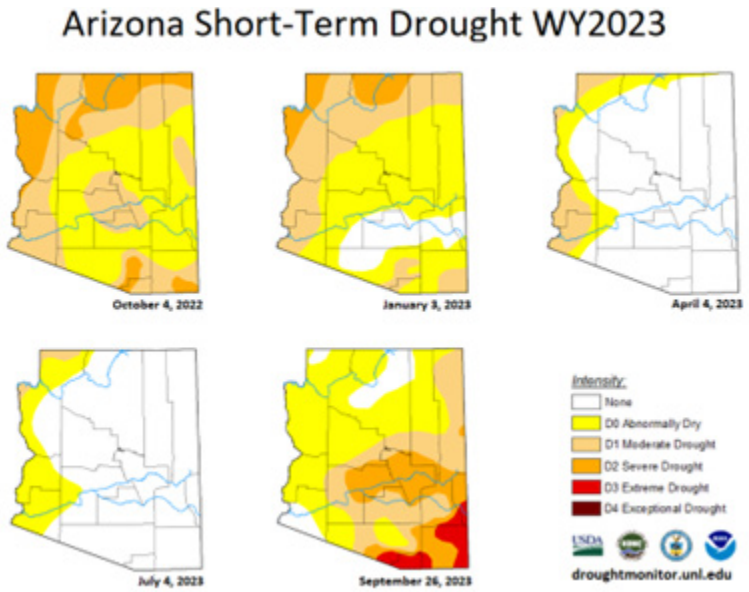


Figure 29. U.S. Drought Monitor maps for WY2023. Short-term drought degradation returned following a hot and dry 2023 summer.

Long-Term Drought Status

Arizona evaluates long-term drought with the Standardized Precipitation and Evapotranspiration Index (SPEI). The SPEI incorporates precipitation and potential evapotranspiration as a tool for evaluating drought. Evapotranspiration is water lost in vapor form from evaporation and transpiration, and potential evapotranspiration considers temperature and wind conditions that influence aspects of water loss. Long-term drought is analyzed from the previous 24-, 36-, and 48-month periods that are updated and evaluated quarterly.

At the start of WY2023, Moderate (D1) to Extreme (D3) long-term drought was found largely across western and northern counties, as well as portions of Maricopa and Pinal counties. By December 2022, long-term drought was no longer in areas of southeastern counties or along the Mogollon Rim.

Long-term drought improved across the state after a very wet winter 2023, with Extreme (D3) and Severe (D2) long-term drought decreasing to only areas in Yuma, La Paz, Mohave, Coconino, and Maricopa counties by March 2023.

A late-starting monsoon 2023 expanded Arizona's long-term drought. By the end of WY2023, Exceptional (D4) long-term drought had developed in central Maricopa and southwestern Santa Cruz counties, while Extreme (D3) and Severe (D2) long term drought advanced in central and southwestern counties. Moderate (D1) long-term drought expanded across much of the state. Areas in Coconino, northern Mohave, central Yavapai, northern Apache and Navajo, and Cochise counties remained without long-term drought at the end of WY2023 (**figure 30**).

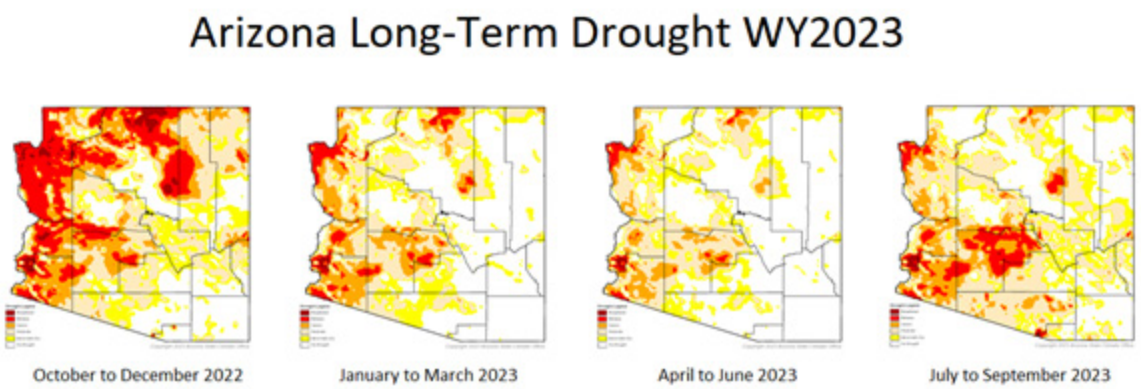


Figure 30. Quarterly SPEI long-term drought map WY2023.

Above-average amounts of precipitation received in 2018 and 2019 (48-month data), along with two wetter monsoon seasons (2021 and 2022), alleviated much of the Exceptional (D4) long-term drought across the state by the end of WY2022. Only small areas of north central Coconino, western La Paz, and southern Yuma counties remained in Exceptional (D4) long-term drought. Long-term Extreme (D3) drought continued in La Paz, Yuma, and Mohave counties, large areas of western, northern, and eastern Coconino County, and portions of Maricopa, Navajo, and Apache counties. Locations without any long-term drought at the end of WY2022 included Cochise, Santa Cruz, eastern Pima, and central Yavapai counties, as well as areas along the Mogollon Rim.

2.J. Outlook for 2023-2024

Winter 2023-2024

El Niño conditions have rapidly developed over the summer with the magnitude continuing to grow into the autumn season. This El Niño phase will persist through winter 2023-24, peaking in a moderate to strong category around the end of the calendar year. Historically, many of the wettest winters recorded in Arizona since 1950 (**figure 31**) have been observed during El Niño episodes. However, a few of these El Niño winters have resulted in drier than normal weather, as El Niño is not the only influence on seasonal climate.

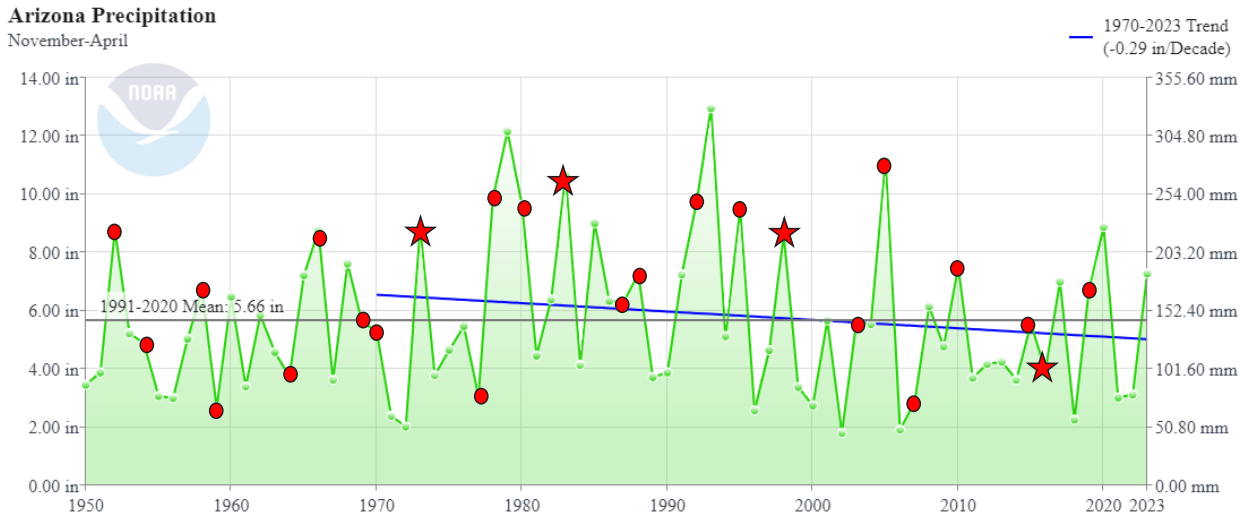


Figure 31. Historical November-April precipitation in Arizona since 1950.
Red dots are El Niño winters since 1950. Red stars indicate the strongest El Niño events.

Arizona winters over the past 30 to 40 years have been steadily warming (**figure 32**) due to the rapidly changing climate with a trend of +0.6°C/decade. This trend of warming has been problematic for the Southwest over the past couple of decades, negatively affecting average snow levels over the winter season, as well as soil moisture profiles. In turn, these impacts have resulted in a detrimental effect on spring runoff and reservoir recharge.

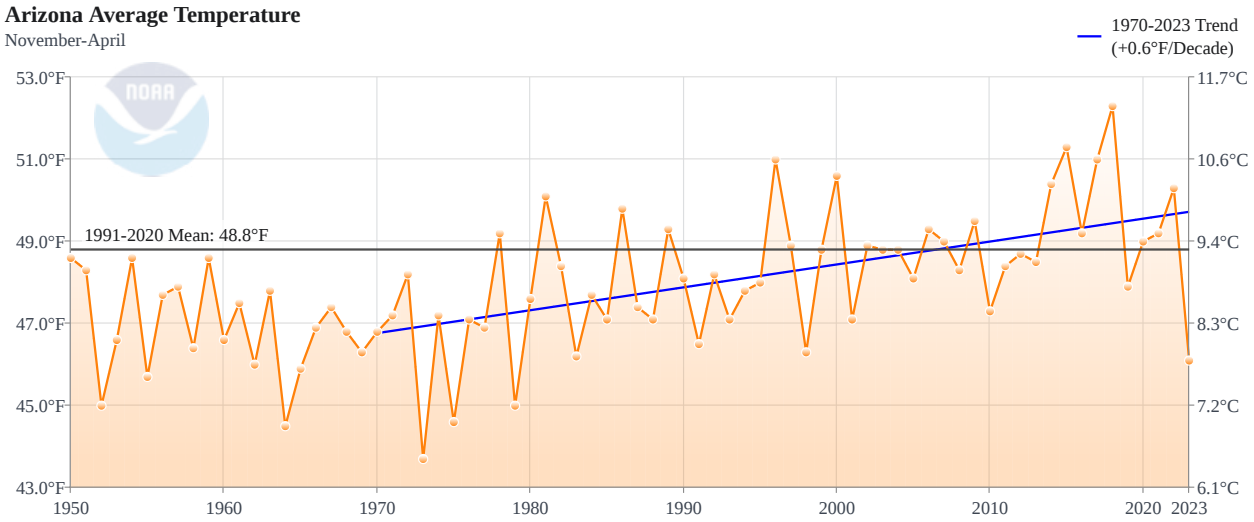


Figure 32. Historical November-April average temperature in Arizona since 1950.
Blue line defines the 50-year trend.

The outlook from NOAA's Climate Prediction Center (**figure 33**) for January-March 2024 reveals near equal chances that the average temperatures fall into an above, below, or near normal category. The precipitation outlook suggests slightly better chances for above normal precipitation across the far northern part of the state with no notable shift in odds over the majority of central and southern Arizona. These forecasts are based on a consensus of dynamic, seasonal climate models along with historical weather composites during El Niño winters.

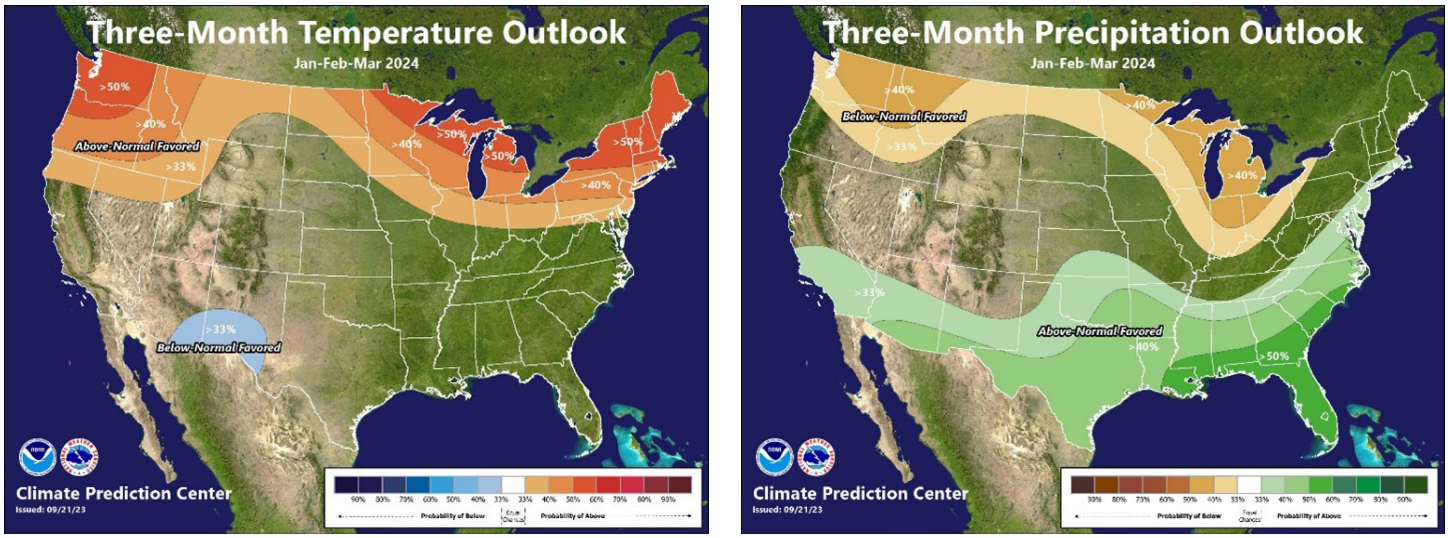


Figure 33. Climate Prediction Center outlook for temperature (left) and precipitation (right) for January-March 2024.
Shading indicates a tilt in odds towards being above or below normal. Unshaded areas indicate
equal chances of above, below, or near normal temperatures and precipitation.

Summer 2024

The Climate Prediction Center's outlook for July-September 2024 (**figure 34**) indicates the average temperature during Summer 2024 has better odds of falling in an above normal range. This outlook is strongly based on trends of climate change and steady regional warming over the past several decades when compared to the climatological average. The precipitation outlook shows no trend or signal during this period over Arizona; that is, there are equal chances for the 2024 monsoon season having above, below, or near normal rainfall. This is typical for the monsoon in the Southwest where thunderstorm activity is generally not influenced by larger scale climate patterns and rainfall amounts can become extremely varied over the region.

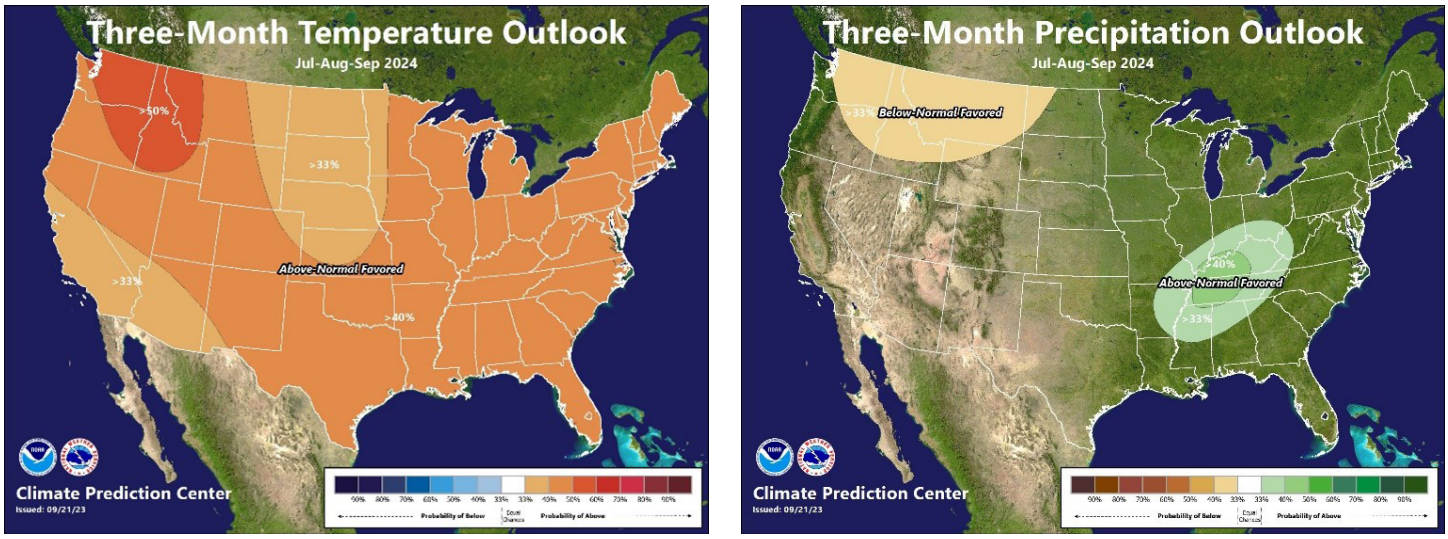


Figure 34. Climate Prediction Center outlook for temperature (left) and precipitation (right) for July – September 2024. Shading indicates a tilt in odds towards being above or below normal. Unshaded areas indicate equal chances of above, below, or near normal temperature and precipitation.

3. Drought Preparedness Plan Implementation Highlights

3.A. State Drought Monitoring Technical Committee (MTC) Efforts

The MTC is responsible for gathering drought, climate, and weather data, then disseminating and interpreting that information to water and land managers, policymakers, and the general public. Specifically, the MTC prepares short- and long-term drought status reports, facilitates multi-agency conversations regarding drought impacts, briefs the ICG on drought conditions, and provides assistance to Local Drought Impact Groups (LDIGs). The current two co-chairs of the MTC are State Climatologist Dr. Erinanne Saffell and National Weather Service Lead Forecaster Mark O'Malley.

Communicating Drought Status

In accordance with the ADWR mission to safeguard the health, safety and economic welfare of the public by protecting, conserving and enhancing Arizona's water supplies, the MTC and ADWR coordinate to improve the accessibility of drought information to resource managers, state decision-makers, and the general public. To enhance communication, information is updated on the ADWR Drought Status webpage (https://www.azwater.gov/drought) on a weekly, monthly, and quarterly basis as follows:

Weekly - The MTC confers weekly with the National Weather Service offices that cover Arizona, Flood Control Districts, LDIGs, water and rangeland managers, agricultural extension offices, and others who observe and report drought impacts. This is done to advise the U.S. Drought Monitor authors on the state's current drought conditions and provide recommendations on drought designation in Arizona. The U.S. Drought Monitor is the official record of drought for federal drought relief claims. Information used by the MTC in advising the U.S. Drought Monitor authors includes, but is not limited to, numerous drought indices, precipitation and streamflow data, and impacts data. Every Thursday, ADWR's Drought Status webpage automatically updates with the latest U.S. Drought Monitor map of Arizona.

Monthly - At the end of each month, the MTC produces a web-based, short-term drought status update based on the U.S. Drought Monitor's maps for the past four weeks, with an explanation of how drought conditions have changed in Arizona over the preceding month. An email with the latest map and summary is sent to stakeholders, partners, and MTC members.

Quarterly - The MTC meets every quarter with numerous federal, state, and local partners to discuss drought conditions and impacts across the state. Objective climate data such as SPI and SPEI are analyzed as an initial proxy for drought conditions. Vegetation indices, snowpack, temperature anomalies, reservoir levels, and county-scale drought impact information are used to verify or modify the initial estimates of the objective data. The long-term drought status reports are posted on the ADWR Drought webpage and disseminated via email quarterly: in April (for January-March); July (for April-June); October (for July-September); and January (for October-December).

Supplemental Tools Supporting MTC Efforts

Arizona DroughtView

DroughtView, a University of Arizona program, is an online tool for collecting drought impact data incorporating remote sensing and climate monitoring products. The tool can be used to track high-resolution (~250 meters) changes in remotely sensed 'greenness' using Normalized Differenced Vegetation Index (NDVI) data collected on a bi-weekly basis from the National Aeronautical and Space Administration's (NASA) Moderate Resolution Imaging Spectroradiometer (MODIS) satellite. This index can be particularly useful for tracking changes in rangeland conditions related to livestock forage production and forest drought stress. These measures can indicate long-term drought impacts and wildfire risk. For more information, visit the University of Arizona DroughtView website at http://droughtview.arizona.edu/.

Community Collaborative Rain, Hail, and Snow (CoCoRaHS) Network

The CoCoRaHS network is a crowd-sourced observing system where citizens report daily precipitation. A drought impact reporting tool called "Condition Monitoring" is part of the CoCoRaHS interface where some of the observers in Arizona add weekly observations of the condition of vegetation, water bodies, and wildlife that reflect drought impacts. Since the observers simply note the conditions they detect, they do not require extensive training to provide useful information. In addition to the drought reports, the CoCoRaHS precipitation reports are incorporated into the products used by the U.S. Drought Monitor authors and by the Parameter Elevation Regression on Independent Slopes Model (PRISM) group who generate gridded SPI and SPEI data. For more information, visit the CoCoRaHS Network website at https://www.cocorahs.org/.

Drought Detection for Ranch-Scale Tools

Drought creates both production and legal risks to ranchers as they typically rely on federal lands for 50-90% of their forage. Policies for these rangelands dictate responses regarding herd reduction, reduced access to forage, and a lengthy approval process to change infrastructure and management. In many cases, patchy spatial distribution of drought in Arizona means that some ranches experience drought while others do not. However, the spatial resolution of most objective drought information is too coarse to represent this difference among ranches.

Dr. Mike Crimmins, University of Arizona faculty and MTC member, and his team developed two online tools to support the deployment of rain gauges for ranchers and federal managers in Arizona to detect drought more precisely at the ranch-scale. These precipitation monitoring tools help reduce production and legal risk by focusing responses only on drought-affected ranches. View a specific example of the tool here: https://myraingelog.arizona.edu/.

Standardized Precipitation Index (SPI) Explorer

SPI is a widely used drought index that has several strengths including the ability to calculate precipitation anomalies at different timescales and interpret SPI units (standard deviations) in probabilistic terms. This tool was created to explore SPI values at specific locations by using a gridded PRISM climate database to estimate local precipitation time series. Data are accessed through the Applied Climate Information Web Service and analyzed and plotted using several R-based packages. This version of the tool includes the calculation of the SPEI, as well. For more information, visit the SPI tool website at https://uaclimateextension.shinyapps.io/SPItool/.

Grassland Productivity Forecast

The "Grass-Cast" Grassland Productivity Forecast was released for the Southwest in Spring 2020. Grass-Cast is an optional tool that managers can use to develop well-informed expectations about grassland productivity. The model provides three "what-if" scenarios that show how much grass might grow during the upcoming season depending on whether precipitation is above, near, or below-normal. Grass-Cast can be used in the design of proactive drought management plans, trigger dates, stocking dates, and grazing rotations.

Grass-Cast is the result of a collaboration between the USDA Research Service, USDA's "Climate Hubs," and the Natural Resource Conservation Service (NRCS). Visit the Grass-Cast website for more information: https://grasscast.unl.edu/.

Interactive Drought Dashboard

ADWR's Drought Program developed an Interactive Drought Dashboard (figure 35) that depicts short-term drought conditions in Arizona from 2000 to the present. This tool utilizes U.S. Drought Monitor maps and allows users to explore drought conditions for the entire period or for specific time frames. Viewers can access drought data on the state as a whole or a selected county. Visit the Interactive Drought Dashboard on the ADWR Drought website for more information: https://www.azwater.gov/drought/drought-dashboard.

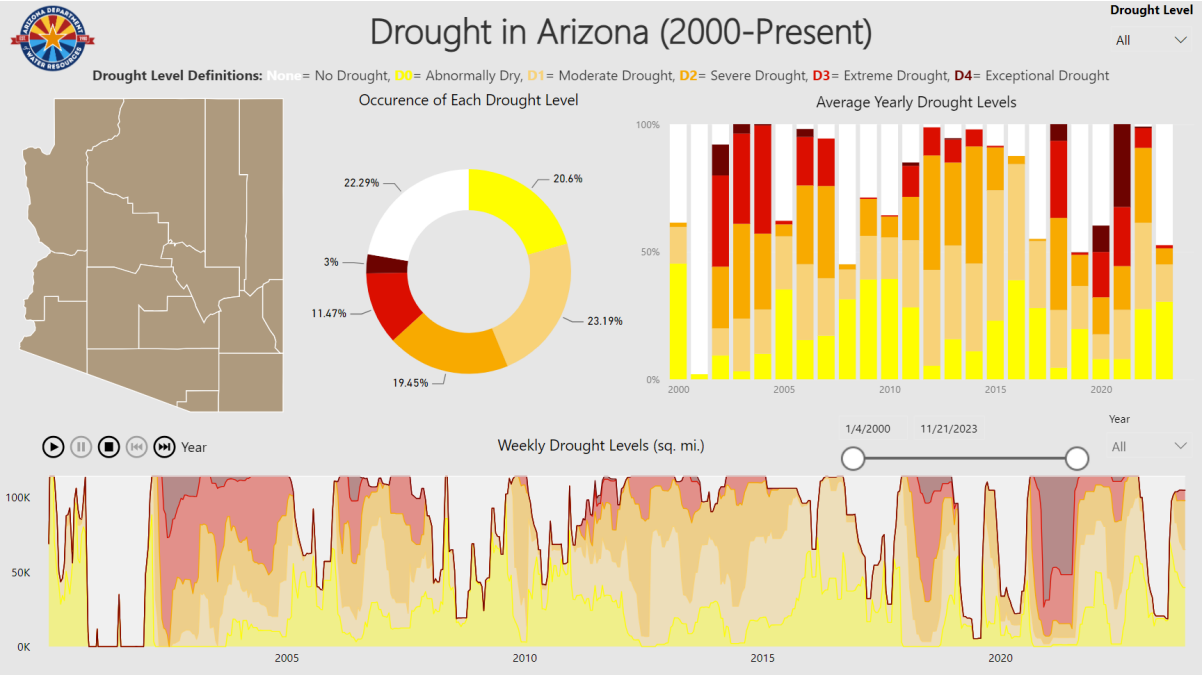


Figure 35. ADWR Drought Interactive Dashboard.

Drought Impact Reports from State and Federal Agencies

Drought impact data is used by the MTC in its efforts to correlate on-the-ground drought conditions with precipitation and streamflow data. Impact information is received from hydrologists, researchers, and other field staff from the Bureau of Land Management (BLM), USGS, USDA, NRCS, DFFM, Arizona Game and Fish Department, Arizona State Parks, Native American communities, and other state and federal groups. The NRCS submits a water year report (**Appendix B**), which identifies the impacts of drought on range and farmland.

MTC Presentations and workshops

Publications: Intermountain West Monthly Drought Update, Dr. Erinanne Saffell

Drought Early Warning Updates are issued in partnership with NOAA's National Integrated Drought Information System (NIDIS), the National Weather Service (NWS), and the State Climatologist for Arizona. The purpose of the update is to communicate changes in drought conditions within the Intermountain West based on recent conditions and the upcoming forecast.

Presentation: NIDIS Southwest Drought Briefing, Dr. Erinanne Saffell, January 24, 2023

The National Integrated Drought Information System (NIDIS) Southwest Drought Briefing provided an overview of current drought conditions and drought outlook for Arizona, Colorado, New Mexico, Utah, and Nevada.

Attendance: United States Drought Monitoring Forum, Arizona State Climate Office, April 11-13, 2023

The biennial USDM Forum in Boulder City, Nevada provides the latest information on techniques, processes, and practices of the USDM, focusing on regional drought issues and drought monitoring.

Presentation/Planning Committee: Southwest Tribal Drought Conversation, Dr. Erinanne Saffell, April 26, 2023

The SW Tribal Drought Conversation, supported by NDMC, USDA, NOAA, and NIDIS, provided an overview of current drought conditions in the Southwest, as well as a discussion on challenges, needs, resources, and tools for drought. Dr. Erinanne Saffell presented in Flagstaff, Arizona, and provided an overview of drought conditions and monsoon expectations.

Presentation: Navajo Sustainable Agricultural Project Seasonal Outlook, Dr. Erinanne Saffell, May 2, 2023

The Navajo Sustainable Agricultural Project Seasonal Outlook provided an overview of current drought conditions and drought outlook for the Four Corners region.

Presentation: NIDIS Southwest Drought Briefing, Dr. Erinanne Saffell, August 22, 2023

The National Integrated Drought Information System (NIDIS) Southwest Drought Briefing provided an overview of current drought conditions and drought outlook for Arizona, Colorado, New Mexico, Utah, and Nevada.

Publication: Intermountain West Drought Status Update, Dr. Erinanne Saffell, September 21, 2023

Together with the National Oceanic and Atmospheric Administration (NOAA), the National Weather Service (NWS), and the State Climatologists, the National Integrated Drought Information System (NIDIS) provided an overview of recent drought conditions and the upcoming forecast for the Intermountain West.

Panelist: Southwest Drought Learning Network Annual Meeting, Dr. Erinanne Saffell, September 27-28, 2023

The goal of the DLN Annual Meeting was to interact and share current drought conditions, approaches, and outlooks regionally and statewide in the Southwest. The State Climatologist panel shared current drought conditions, challenges, and opportunities for their state.

Workshop: Southwest Water Resiliency Workshop

Hosted by Salt River Project and attended by MTC co-chairs Dr. Erinanne Saffel and Mark O'Malley, along with ADWR's Némesis Ortiz-Declet. This workshop brought together scientists and regional decision makers discussing the history of water resilience in the Southwest along with future plans, both regional and local towards additional water conservation. These water conservation plans were also placed in the perspective of regional drought and climate variability.

3.B. Governor's Drought Interagency Coordinating Group (ICG) Efforts

The ICG has met biannually since 2006 and advises the Governor on drought status, impacts, and any necessary preparedness and response actions.

The Fall 2022 meeting included a review of 2022 drought status, Winter 2022-2023 weather outlook, 2022 wildfire season update, 2021-2022 forest health update, impacts of drought wildlife, and water supplies updates for the Colorado River and Salt River and Verde River Watersheds.

The Spring 2023 meeting included a review of 2021-2022 winter precipitation, Summer 2023 weather outlook, 2023 wildfire outlook, impacts of drought on hydropower, the Gila River Indian Community, and on Navajo Nation, as well as water supply updates for the Colorado River and Salt River and Verde River Watersheds.

At both the Fall 2022 and Spring 2023 meetings, the ICG recommended the continuation of the Drought Emergency Declaration (PCA 99006) and the Drought Declaration (Executive Order 2007-10) for the State of Arizona. The presentations and subsequent decisions are on the ADWR ICG webpage: https://www.azwater.gov/drought/interagency-coordinating-group.

3.C. Drought Planning for Community Water Systems

Drought planning requirements and water use reporting regulations for Community Water Systems (CWSs) were recommended in the Arizona Drought Preparedness Plan and established by the State Legislature in 2005 to help CWSs reduce their vulnerability to drought and water shortages. These reports provide a means for the state to gather water-use data and offer assistance to CWSs where needed. ADWR aids water providers in meeting these requirements through web-based resources, online reporting tools, and phone or in-person consultations. For more information, see the ADWR CWS webpage: https://www.azwater.gov/cws.

All CWSs in the state are required to submit a Drought Preparedness Plan to ADWR every five years. The Drought Preparedness Plan is part of the required System Water Plan (SWP), which includes a Water Supply Plan and a Conservation Plan. The Drought Plan requires water systems to describe their drought stages and triggers, emergency sources of water, customer communication strategies, and other planning actions.

Drought stages declared by CWSs under "Current" status for SWP update year 2022-2023 can be seen below in comparison to update year 2017-2018.

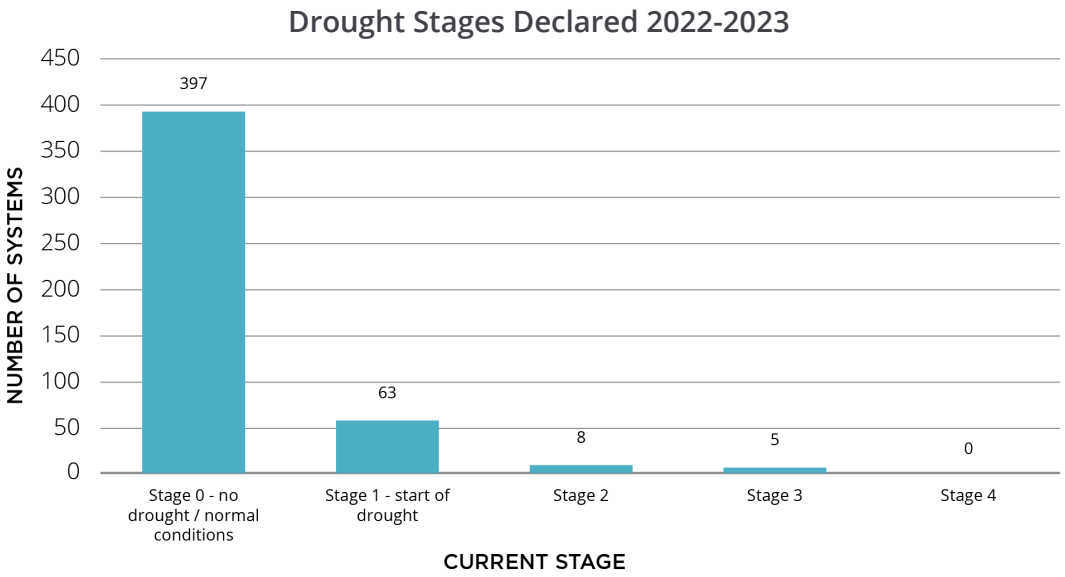


Figure 36: Drought stages declared from 2022-2023.

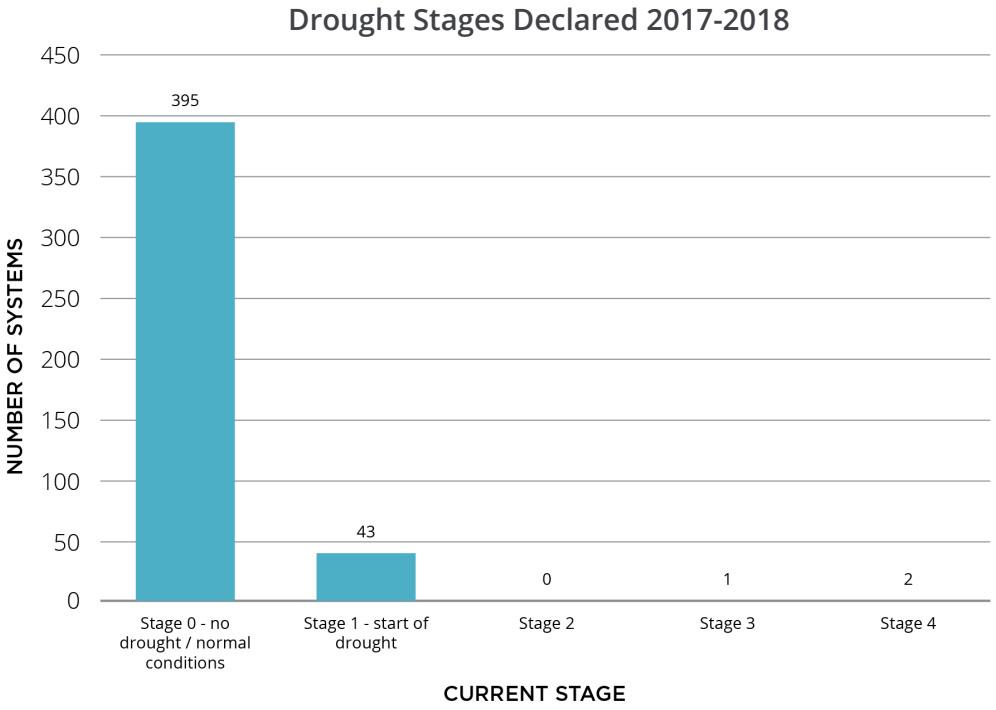


Figure 37: Drought stages declared from 2017-2018.

To date, the CWS program has received 473 SWPs out of 742 active systems, which is 63.75% compliance for the 2022-2023 year. This is an improvement from previous years in which 441 SWPs were received out of 714 active systems, or a 61.76% compliance rate.

In June of 2022, ADWR released the CWS Data Dashboard online. The dashboard is designed to improve public access to water planning data as well as to increase the State's ability to identify communities at high-risk of drought or shortage conditions. Data reported within CWS Drought Preparedness Plans, such as drought stage declarations or emergency water supply plans, are displayed through the dashboard and can be filtered to highlight specific criteria or timeframes, see **figure 38**. The dynamic nature of the dashboard allows any user to rapidly identify communities that have experienced drought conditions or those that have an increased risk of experiencing a shortage event in the future. For more information, see the CWS Data Dashboard online: https://www.azwater.gov/cws/community-water-systems-data.

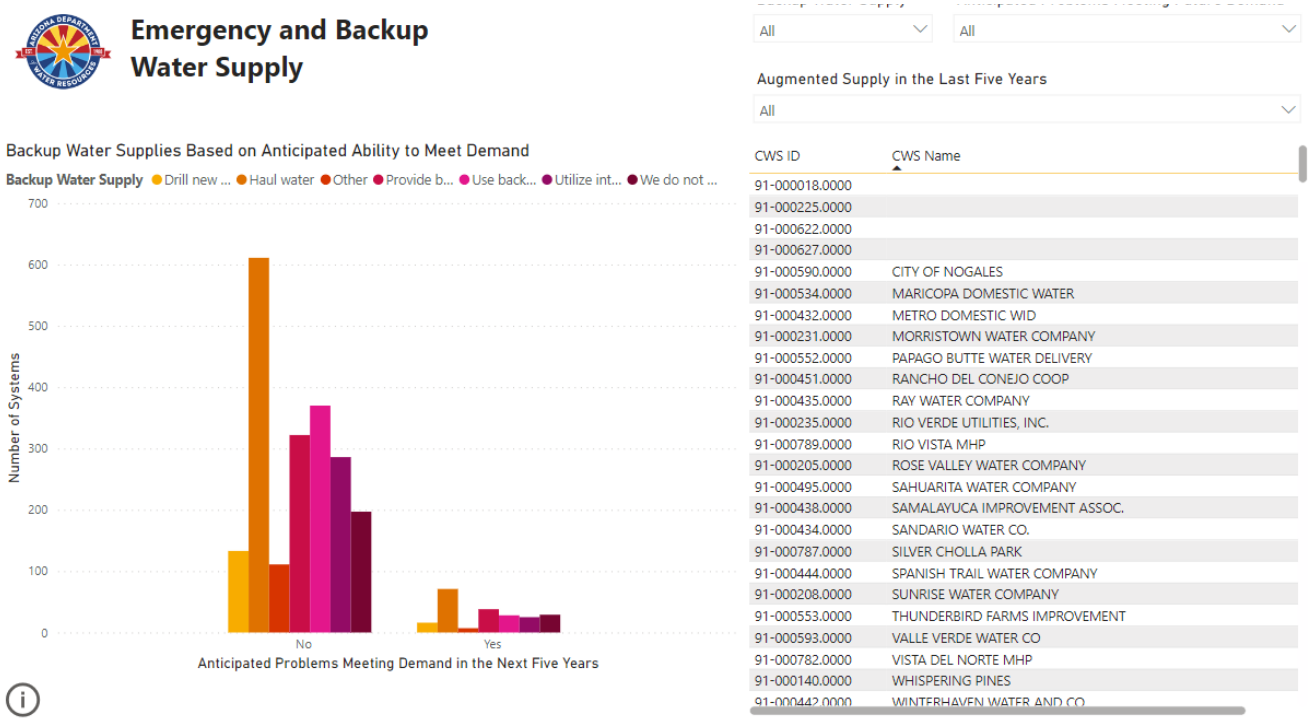


Figure 38. CWS Data Dashboard, Emergency and Backup Water Supply.

3.D. Local Drought Impact Group (LDIG) Efforts

LDIGs participate in monitoring, education, and local mitigation, mainly through Cooperative Extension and county emergency management programs. Initial planning efforts included ten LDIGs, and as many as eight LDIGs have been active in the past. Since 2008, in response to local fiscal and staffing limitations, the focus of the LDIGs has been entirely on drought impact monitoring and reporting. Currently, only Pima County has an active LDIG program inclusive of many stakeholders, from water providers to ranch and creek managers. See **Appendix C** for the full Pima County LDIG WY2023 Annual Report.

3.E. Colorado River Drought Response Efforts[10]

The Colorado River is a highly variable system, subject to dramatic change in runoff from year to year. In general, the average annual natural flow of the Colorado River at Lee's Ferry has averaged around 15 MAF over a 115-year period (WY1906 through 2020) but has ranged from as little as 5.4 MAF to as much as 24.4 MAF in a single year. The Colorado River Basin is experiencing a prolonged period of drought resulting in historically low reservoir levels at Lake Powell and Lake Mead. The period from 2000 through 2022 is the lowest 23-year inflow in the historic record and one of the lowest in the past 1,200 years. As a result of the exceptionally low runoff conditions over the past three years (2020, 2021, and 2022), drought response operations have been triggered at Lake Powell and Lake Mead, consistent with the 2007 Interim Guidelines and 2019 DCPs.

2007 Interim Guidelines

In December 2007, the Secretary of the U.S. Department of the Interior adopted the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead[11] (2007 Interim Guidelines). The 2007 Interim Guidelines created a novel approach to Colorado River operations that incentivized conservation and augmentation through the creation of Intentionally Created Surplus (ICS). In addition, the Guidelines defined the criteria for shortages in the Lower CRB based on elevations in Lake Mead, implemented closer coordination of operations of Lake Powell and Lake Mead, and preserved flexibility to deal with further challenges such as climate variability and deepening drought.

[10] Substantial portions of this section and associated footnotes are from the Bureau of Reclamation's August 31, 2023, draft "Annual Operating Plan for Colorado River Reservoirs 2024."

[11] Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead: https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf

Pilot System Conservation Program (PSCP)

More recent drought mitigation planning efforts include the PSCP and the Lower Basin Drought Memorandum of Understanding (MOU) agreements. The PSCP involves water agencies from both the Upper and Lower CRB that agreed to jointly fund water conservation projects in both the Upper and Lower Basins to benefit the Colorado River system. The purpose of the Lower Basin Drought MOU was to generate additional water to be left in Lake Mead to reduce the risk of reaching critical reservoir elevations. Both programs were voluntary and were initiated in 2014. The Pilot Program in the Lower Basin is expected to create 175,347 AF of system conservation in Lake Mead by 2035 for a cost of approximately $29.8 million or $170.14/AF. The Federal/Non-Federal cost share is 47/53%, respectively. The majority of the conservation was completed by 2019, with the exception of Bullhead City and the City of Needles continuing through 2023.

Drought Contingency Plan (DCP)

In 2013, the seven CRB States, the United States, and the Republic of Mexico started drought contingency planning discussions in response to the ongoing historic drought in the CRB.

Arizona's participation in this effort proceeded along two tracks: one was the intra-Arizona pursuit of a plan to implement the DCP within Arizona and to authorize the Director of ADWR to sign the DCP on behalf of the state. That effort became known as Arizona's DCP Implementation Plan. The other track involved the negotiations among the CRB States and the Interior to finalize the DCPs.

The agreements include an Upper CRB DCP and a Lower CRB DCP. They are designed to help reduce the risk of Colorado River reservoirs, particularly Lake Powell and Lake Mead, declining to critical elevations.

The Lower CRB DCP agreement was made and entered on May 20, 2019, by and among the United States, represented by the Secretary of the Interior; the State of Arizona, acting through the Director of the ADWR; the Metropolitan Water District of Southern California (Metropolitan); the Coachella Valley Water District (CVWD); the Palo Verde Irrigation District (PVID; the City of Needles, California; the Colorado River Commission of Nevada (CRCNV); and the Southern Nevada Water Authority (SNWA).

The Lower CRB DCP is designed to protect Lake Mead from declining to critically low elevations by requiring water delivery reductions at higher elevations than specified in the Interim Guidelines and providing enhanced incentives for conservation of water to be stored in Lake Mead by Arizona, California, and Nevada. Adoption of the Lower CRB DCP is important to Arizona, which is at risk of potentially catastrophic reductions in water deliveries if elevations in Lake Mead continue to fall to critically low elevations. To adopt and implement the Lower CRB DCP, Arizona established a Steering Committee, composed of key water leaders, water users, and representatives from various sectors across Arizona in a way that is acceptable to Arizona water users.

Upper Basin Drought Response Operations Agreement (DROA)

Hydrologic projections in early 2021 indicated that Lake Powell could decline to below the Drought Response Operations Agreement's (DROA) Target Elevation of 3,525 feet, prompting the Bureau of Reclamation (Reclamation) to work with DROA[12] parties to develop the 2022 Plan (i.e., a Framework document and attachments identifying operations).

In July 2021, Reclamation initiated an emergency release of 0.161 MAF from Flaming Gorge, Blue Mesa, and Navajo reservoirs in accordance with the DROA.

After consultation and coordination with the Upper Division States, Reclamation initiated a second DROA action in January 2022. Pursuant to DROA, the first drought response that is considered is the modification of monthly release volumes from Lake Powell while maintaining the annual release volume pursuant to the 2007 Interim Guidelines.

Reclamation modified Lake Powell release volumes by reducing the monthly releases from January through April 2022 by a total volume of 0.350 MAF. This volume was scheduled to be added back into releases scheduled for June through September 2022; however, in May 2022, the Department of the Interior modified the annual release volume from Lake Powell from 7.48 MAF to 7.00 MAF, in accordance with Sections 6 and 7.D of the 2007 Interim Guidelines.

In April of 2022, the DROA parties finalized the 2022 Plan for the duration of May 2022 through April 2023[13]. The Secretary of the Interior, through her designee, approved the 2022 Plan on April 29, 2022[14], as summarized and including the following key operational elements:

1. Drought Response Operations releases approximately 0.500 MAF from Flaming Gorge Dam
2. Possible Drought Response Operations releases from Blue Mesa Reservoir in Fall 2022 and Winter 2023, contingent upon available release volumes
3. Possible Drought Response Operations releases from Navajo Reservoir in Fall 2022 or Winter 2023, contingent upon available release volume
4. Possible operational adjustments at Glen Canyon Dam in Winter 2023
5. No anticipated recovery of DROA release volumes through the term of the 2022 Plan

Based on projections of Powell elevations in the November 2022 24-month study, Reclamation adjusted monthly release volume patterns for Glen Canyon Dam under the 2022 Plan to hold back a total of 0.523 MAF in Lake Powell from December 2022 through April 2023. The 0.523 MAF was subsequently released from Glen Canyon Dam in May through September of 2023.

Due to the improved hydrologic conditions in the Colorado River Basin, DROA releases from Flaming Gorge were suspended on March 6, 2023. At the time of the suspension, the total 2022 DROA release from Flaming Gorge was 0.463 MAF. On March 16, 2023, Reclamation reduced releases from Flaming Gorge even further to initiate recovery of previous DROA releases and continued recovery operations through the end of DROA year 2022[15], resulting in 0.135 MAF in recovered volume in Flaming Gorge.

On May 26, 2023, the DROA Parties agreed to the 2023 Plan. The 2023 Plan does not include any DROA releases, but rather provides for recovery of prior DROA releases from the units upstream of Powell. The Secretary of the Interior through her designee approved the 2023 Plan, as summarized in the following key operational elements:

1. Anticipate full recovery of DROA release volumes at Flaming Gorge and Blue Mesa through the term of the 2023 Plan.
2. No additional action is anticipated during the 2023 Plan; the DROA Parties will continue to monitor hydrological conditions and, if needed, will make adjustments at Glen Canyon Dam, and then the upstream initial units (Flaming Gorge, Aspinall, and Navajo).

2022 Powell Release Reduction; Operational Neutrality and Protection of the Glen Canyon Dam Facilities and Operations

In light of the prolonged drought, low runoff conditions, and depleted storage at Lake Powell, the Department of the Interior implemented an action under Sections 6 and 7.D of the 2007 Interim Guidelines specifically reducing the Glen Canyon Dam annual release from 7.48 MAF to 7.00 MAF in WY2022. This action, issued on May 3, 2022 , was undertaken in conjunction with 2022 DROA actions resulting in the addition of approximately one million additional acre-feet of storage, or 16.00 feet of pool elevation, by April 2023.

The reduction of releases from Lake Powell from 7.48 MAF to 7.00 MAF in WY2022 resulted in a reduced release volume of 0.480 MAF that, consistent with routine operations under the 2007 Interim Guidelines, normally would have been released from Glen Canyon Dam to Lake Mead as part of the 7.48 MAF annual release volume. The reduction of releases from Glen Canyon Dam in WY2022 (resulting in increased storage in Lake Powell) was considered "Operationally Neutral" and accounted for "as if" this volume of water had been delivered to Lake Mead for the purpose of determining future operating conditions. Operational Neutrality was

[12] See: https://www.usbr.gov/dcp/docs/final/Attachment-A1-Drought-Response%20Operations-Agreement-Final.pdf.

[13] Drought Response Operations Framework and Plan: https://www.usbr.gov/uc/DocLibrary/Plans/20220420-2022DroughtResponseOperationsPlan-Signed-508-UCRO.pdf.

[14] Department of Interior Approval Memo: https://www.usbr.gov/uc/DocLibrary/Plans/20220429-2022DroughtResponseOperationsPlan-ApprovalMemo-508-DOI.pdf.

[15] A DROA operational year spans from May through April

[16] More information about Lake Powell's operating decision for Water Year 2022 is available online: https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf.

removed by Reclamation beginning with the April 2023 24-month study, such that balancing releases are based on the physical storages of Lake Powell and Lake Mead, but could be as low as 7.00 MAF and as high as 9.50 MAF consistent with the Interim Guidelines and to protect Lake Powell from declining below elevation 3,525.00 feet at the end of December 2023.

The Commissioner of the Bureau of Reclamation announced the Lower Colorado River will operate in a Tier 1 Shortage condition in calendar year 2024 when operating under Operational Neutrality. In Arizona, a Tier 1 Shortage requires total reductions of 512,000 AF when Lake Mead is below elevation 1,075 feet[17].

500+ Plan Memorandum of Understanding

The August 2021 24-Month Study Minimum Probable inflow scenario projected the elevation at Lake Mead falling below elevation 1,030 feet in July 2023. Consistent with Section V.B.2 of Exhibit 1 to the Lower Basin DCP, this projection triggered consultation among the Secretary and Lower Division States to determine what additional measures will be taken to avoid and protect against the potential for Lake Mead to decline below 1,020 feet.

In December 2021, an MOU was executed, with the aim to conserve 500,000 AF of water in Lake Mead in both 2022 and 2023 in addition to required 2007 Interim Guidelines reductions and 2019 Drought Contingency Plan contributions. The plan outlined in the MOU, known as the "500+ Plan", includes conservation efforts in both urban and agricultural communities, such as funding crop fallowing on farms to save water or urban conservation to reduce diversions from Lake Mead. Reclamation, ADWR, Central Arizona Water Conservation District, Metropolitan, and SNWA committed to investing up to $200 million in projects at Lake Mead over the next two years.

In late 2022, the Department of Interior created the Lower Colorado Conservation and Efficiency Program (LC Conservation Program) to address the unprecedented drought in the basin. Many multi-year contracts and projects under the 500+ Plan were terminated in 2023 and subsequently reapplied for funding under that program. The LC Conservation Program is described in more detail below.

Lower Colorado Conservation and Efficiency Program

In September 2022, the Department of Interior announced additional steps to address drought in the Colorado River Basin. Subsequent guidance was released in an October 12, 2023 Letter to Interested Parties.

The LC Conservation Program is intended to provide new opportunities to fund system conservation and efficiencies in the Lower Colorado River Basin that lead to additional conservation and bridge the immediate need while moving toward improved system efficiency and more durable long-term solutions for the Colorado River system. The LC Conservation Program has three components:

1.a.) Proposals for system conservation resulting in additional volumes of water remaining in Lake Mead at a set price of:

One-year agreement: $330 per acre-foot

Two-year agreement: $365 per acre-foot

Three-year agreement: $400 per acre-foot

1.b.) Proposals describing lower Colorado River Basin water conservation plans that can be implemented resulting in reductions in consumptive use of lower Colorado River water having a recent history of use.

2) Proposals for long-term system efficiency improvements that will result in multi-year system conservation.

As of September 30, 2023, agreements have been reached for a total of up to ~786,000 AF through 2025[18].

[17] The 2007 Interim Guidelines require a reduction of 400,000 AF and the DCP requires a contribution of an additional 192,000 AF, totaling 592,000 AF.

[18] https://www.usbr.gov/lc/LCBConservation.html, accessed September 28, 2023.

Supplemental Environmental Impact Statement (SEIS)

As directed by the Secretary, on November 17, 2022, Reclamation published a Federal Register Notice indicating its intent to prepare a SEIS. The purpose of the SEIS is to supplement the Environmental Impact Statement completed in 2007 for the 2007 Interim Guidelines in order to modify operating guidelines for the operation of Glen Canyon and Hoover Dam to address the historic drought and low runoff conditions in the Colorado River Basin. The need for the revised operating guidelines is based on the potential that continued low runoff conditions in the Colorado River Basin could lead to critically low reservoir conditions at Lake Powell and Lake Mead that impact both water delivery and hydropower operations in 2023 and 2024.

Reclamation published the draft SEIS on April 14, 2023. The 45-day public commenting period was scheduled to end on May 30, 2023; however, an additional action alternative was submitted to Reclamation for consideration prior to the closing date by the Lower Division States. With the submission of this proposed alternative, Reclamation suspended the initial comment period withdrew the draft SEIS on May 24, 2023 and is currently analyzing the effects of the proposal under the National Environmental Policy Act (NEPA). Reclamation will publish an updated draft SEIS for public comment that will include the proposal as an action alternative. It is premature at this time to identify any potential changes to Glen Canyon Dam or Hoover Dam operations. Any potential changes to such operations may be adopted and implemented in 2024 and/or subsequent years.

Arizona's Reconsultation

Arizona continues to build on the success of the DCP process by utilizing the same approach at the intrastate level to develop an Arizona consensus on the "reconsultation" of the 2007 Interim Guidelines. On June 25, 2020, Arizona reconvened Arizona's Lower Basin DCP Steering Committee delegates to form the "Arizona Reconsultation Committee" or ARC.

In all, the ARC set out four primary goals:

- Establish a process for continued engagement within Arizona throughout the Reconsultation process.
- Provide a venue for developing and sharing stakeholder perspectives and values to guide Arizona's perspectives in the Reconsultation process.
- Identify risks and benefits to inform Arizona's input to the Reconsultation process.
- Continue the transparency that was established during the successful DCP Steering Committee effort.

As Reclamation initiates the formal Reconsultation process with the anticipated publication of a Notice of Intent in 2023, the ARC will continue to provide guidance to the co-chairs as requested.

3.F. Drought and Health Efforts

The Arizona Department of Health Services (ADHS) Office of Environmental Health addresses and monitors the public health effects of drought in Arizona. Drought can negatively impact water quality and quantity and increase incidences of zoonotic disease. Drought can intensify heat waves causing increased risk of health-related illness and cause respiratory distress from wildfire smoke, dust storms, pollen, and airborne particles.

Water Quality

Potable water quality can be threatened during drought which in turn can impact availability of water supplies. Drought affects groundwater table levels, resulting in the fluctuating concentration of metals and minerals. Arizona groundwater is known to contain naturally occurring arsenic, fluoride, and uranium. The Arizona Environmental Public Health Tracking (EPHT) Data Explorer tracks the levels of these contaminants in drinking water from public drinking water systems and private wells throughout Arizona with data available from 2006-2022[19].

Droughts produce conditions that can exacerbate wildfires or flooding events that can compromise well water quality. A wildfire can damage well components and mobilize pollutants into aquifers. A flood may pollute wells

[19] Arizona EPHT Explorer: https://gis.azdhs.gov/ephtexplorer/

with contaminated surface water carrying sewage and runoff from farms or waste disposal sites. There are over 120,000 registered private wells in Arizona. These well owners are dependent on groundwater as their primary water source. To protect the health of well owners, ADHS offers free well water testing. Participants will receive a comprehensive well water quality report and treatment recommendations.

ADHS connects private well owners with water safety information to protect their health. The ADHS well water website provides private well owners with guidance on where to get their private well water tests for bacteria, nitrates, arsenic, fluoride, and uranium and how to treat their contaminated well. Additionally, through a partnership with ADWR, ADHS provides well water and health safety materials, including information on testing, treatment, health effects, and a well owner guide that describes drought impacts on well water and health[20]. In 2022, developed a magnet (**figure 39**) for an online interactive tool called the Be Well Informed App. This application provides recommendations for treatment and health safety based on water results. These magnets are distributed to private well owners to help them make informed decisions when using and treating their water.

Figure 39: Be Well Informed App.

ADHS conducts outreach to promote drought awareness. Private well owners are especially vulnerable to drought because they live in rural areas and are solely responsible for their water quality and quantity. ADHS is updating drought safety materials for private well owners to help them be prepared for extreme drought conditions.

Air Quality

Drought can affect air quality in several ways. For example, drought and heat waves can cause vegetation to dry up, which can then become fuel for wildfires leading to more smoke and an increase in health problems[21]. In addition, drought conditions can intensify and increase the number of dust storms, which reduces air quality.

Poor air quality can exacerbate chronic respiratory conditions such as asthma and chronic obstructive pulmonary disease. Several counties in Arizona, notably, Pinal and Maricopa experienced, 3.01% and 0.82% of days of particulate matter 2.5 (PM2.5) levels and 7.4% and 3.29% of days of PM10 levels above the National Ambient Air Quality Standards (NAAQS) in 2021, respectively. In 2021, the state age-adjusted rates for emergency care visits for asthma and chronic obstructive pulmonary disease were 26.0 and 19.7 per 10,000 population, respectively.18 In response to these challenges, ADHS's Office of Environmental Health has published bilingual brochures on what to do during (español) and after (español) (**figure 40**) a wildfire as well as launched health safety pages on dust storms and air quality.

[20] Arizona Well Owner's Guide to Water Supply 2nd Edition: https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/environmental-toxicology/well-water/arizona-well-owners-guide.pdf

[21] CDC Health Implications of Drought: https://www.cdc.gov/nceh/drought/implications.htm

Visibility in Miles	$PM_{2.5}$ or PM_{10} µg/m3, 1 to 3hr avg.	Health Category (AQI)	Cautionary Statements
10+	0–38	Good (0-50)	None
5–10	39–88	Moderate (51-100)	Unusually sensitive people should consider reducing prolonged or heavy exertion.
3–5	89–138	Unhealthy for Sensitive Groups (101-150)	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
1.5–3	139–350	Unhealthy (151-200)	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
1–1.5	351–526	Very Unhealthy (201-300)	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.
1 or less	526+	Hazardous (≥300)	Everyone should avoid all physical activity outdoors; people with heart or lung disease, older adults, and children should remain indoors and keep activity levels low.

Figure 40. Arizona Department of Health Services, Office of Environmental Health (2021) What To Do During a Wildfire Brochure (Spanish)

Extreme Heat

Drought and extreme heat are intertwined. Unusually high temperatures and dry spells can contribute to drought severity. In addition, drought can intensify extreme heat health effects, such as heat exhaustion or heat stroke. In 2022, there were 3,286 heat-related illness emergency department visits and 671 heat-related deaths recorded in Arizona, occurring in predominantly Maricopa, Mohave, Pima, Pinal, and Yuma counties[22]. Over the last four years, heat-related deaths have increased, exceeding 500 deaths annually.

To address the impacts of extreme heat ADHS collaborates with universities to update heat vulnerability assessments for Arizona. These assessments identify the impacts of extreme heat among vulnerable populations, such as Native Americans (5%) and the Hispanic population (32%) in Arizona, based on the 2019 U.S. Census American Community Survey. To protect vulnerable populations (e.g., children, older adults, low-income/unemployed, unsheltered populations, and residents without access to air conditioning) from extreme heat, ADHS collaborates with county and university partners to evaluate cooling centers and conduct a spatial analysis to identify the optimal locations for cooling centers to assist planning efforts.

[22] ADHS Extreme Weather & Public Health: https://azdhs.gov/preparedness/epidemiology-disease-control/extreme-weather/index.php#news-publications

Beyond tracking heat illness and vulnerabilities, ADHS promotes heat safety through several communication channels, including the Heat Safety website. On the website, you can find a cooling center map that can easily be accessed by the public to find information on cooling centers. A heat-related illness dashboard that uses Syndromic Surveillance data to provide near real-time trends in emergency department heat-related illness visits during the heat season (May-Sept). On this dashboard, you can visualize the near real-time impacts of heat on community health. Agencies can use this information to coordinate and respond to extreme heat events during the summer. Heat safety brochures on protecting children, pets, and hiking safety can also be found on the website. In 2023 heat safety materials were translated to multiple languages to provide resources to refugee populations. During the heat season, ADHS sends out excessive heat warnings to promote heat safety prevention strategies during extreme heat days. Currently, there are over 33,000 subscribers to ADHS heat alerts. Anyone can sign up for heat alerts, to stay informed on extreme heat days and strategies to stay safe during the hot summer months. In addition to heat alerts ADHS promotes heat safety messages through social media. At the beginning of the heat season, through a partnership with National Weather Services, ADHS promotes heat safety messages through HEAT Awareness Week. Further resources are available through the Extreme Heat Network, of which ADHS is a partner. This network is a community of research and practice regarding the causes, impacts, and strategies to increase resilience to extreme heat.

Zoonotic Diseases

Drought conditions can create an environment ripe for transmission of zoonotic diseases, including Valley fever and West Nile virus (WNV)[23]. Dust that is blown by dust storms throughout the year can carry the fungal spores, Coccidioides, which are the source of infection for coccidioidomycosis, also known as Valley fever. It is a fungus that is commonly found in the southwestern United States. People can acquire Valley fever by breathing in the microscopic fungal spores from the air, although most people who breathe in the spores don't get sick[24]. Symptoms are similar to the flu and include fatigue, cough, fever, shortness of breath, headache, night sweats, muscle aches, and rash.

From 2015 to 2021, Valley fever incidence ranged from 112.8 to 157.7 per 100,000 population in Arizona[25]. Drought increases the opportunity for WNV transmission by reducing the size of water bodies, causing them to become stagnant; this provides additional breeding grounds for certain types of mosquitoes[26]. WNV disease symptoms include acute febrile illness with headache, myalgia or arthralgia, and gastrointestinal issues. WNV disease is reported mostly in Maricopa, Pima and Pinal counties, where the majority of WNV cases occurred in 2023 to date[27].

[23] Projections of Climate Impacts on Vector-Borne Diseases and Valley Fever in Arizona: http://azdhs.gov/documents/preparedness/epidemiology-disease-control/extreme-weather/pubs/projections-climate-impacts-vector-borne.pdf

[24] CDC Symptoms of Valley Fever (Coccidioidomycosis): https://www.cdc.gov/fungal/diseases/coccidioidomycosis/symptoms.html

[25] ADHS Epidemiology & Disease Control: https://www.azdhs.gov/preparedness/epidemiology-disease-control/index.php#data-stats-past-years

[26] Drought and immunity determine the intensity of West Nile virus epidemics and climate change impacts: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5310598/

[27] Arizona 2022 West Nile Virus Statistics: https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/mosquito-borne/west-nile/data/west-nile-virus-stats-2022.pdf?v=20220914

AZ Environmental Public Health Tracking (EPHT)

The ADHS EPHT program monitors population health status during moderate to extreme drought conditions. Public health partners can access and track environmental and health indicators in one location at different spatial scales, such as county, sub-county, and public water system levels (**figure 41**). Drought-related environmental topics tracked include drought indices, extreme precipitation, flood vulnerability, temperature, heat vulnerability, wildfires, hazard losses, water quality, and air quality. Drought-related health topics tracked include asthma, heat-related illness, chronic obstructive pulmonary disease (COPD) hospitalizations, heat-related deaths, WNV, and social vulnerability factors. Data is visualized in an online interactive Data Explorer in maps, tables, graphs, and charts and can be viewed at https://gis.azdhs.gov/ephtexplorer/.

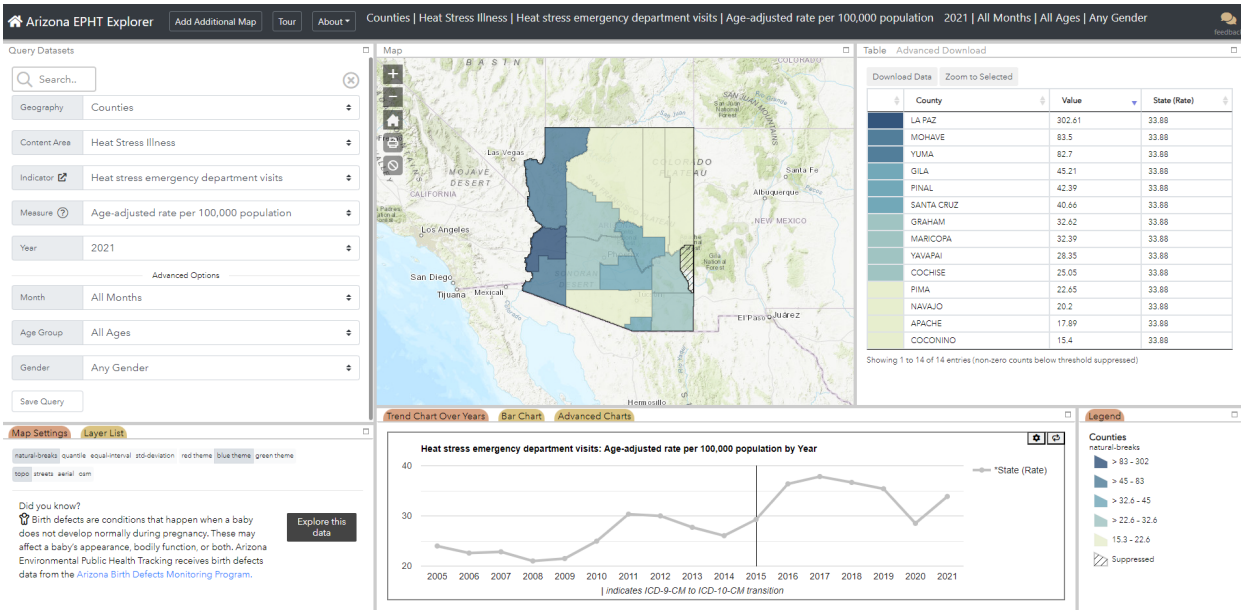


Figure 41. ADHS EPHT Data Explorer displaying the number of summertime (May-September) heat-related emergency department visits by county for 2021.

The ADHS EPHT program also partnered with the ADHS Syndromic Surveillance Program to monitor health impacts and trends in near-real-time during wildfire and extreme heat events in the last year. ADHS EPHT monitored respiratory illnesses, like asthma or COPD, air quality indicators, like PM 2.5, and wildfire-related emergency department visits in wildfire-prone areas of the state to support public health decision-makers and respond to public health emergencies.

Climate and Health

ADHS incorporates the CDC's Building Resilience against Climate Effects (BRACE) Framework (figure 42) and partners with organizations to implement public health interventions aimed at protecting Arizonans against climate-sensitive hazards including drought.

Figure 42. CDC BRACE Framework.

ADHS partnered with Arizona State University and the University of Arizona to produce reports such as a Profile on Extreme Weather, Climate and Health; Climate and Health Adaptation Plan; and an Assessment of Climate and Health Impacts on Vector-Borne Diseases and Valley Fever in Arizona.20 The ADHS Extreme Weather and Public Health Program has also worked with Public Health Emergency Preparedness to develop and update public health emergency response plans for extreme and wildfires.

ADHS continues its collaborative efforts to update the BRACE reports with a greater focus on health equity and new climate data. ADHS works with county health departments and universities to develop local climate and health strategic plans addressing topics such as drought, wildfires, heat, dust storms, air quality, and vector-borne diseases related to climate-sensitive hazards.

3.G. ADWR Outreach & Assistance

ADWR Leadership Drought Activities

During WY 2023, ADWR Director Tom Buschatzke and ADWR Deputy Director Clint Chandler actively promoted drought preparedness efforts and activities around the State of Arizona, not only by leading many of these efforts, but also by discussing and presenting these activities to a wide array of stakeholders, groups, and organizations, as those listed below. Their discussions included topics such as Arizona's Reconsultation Committee; Governor Hobb's Water Policy Council (GWPC; Appendix A); Arizona's water resource challenges; and the first-ever Tier 2a Shortage declared for Colorado River operations in 2023. ADWR is committed to transparency and is passionate about providing water information to interested parties.

- Irrigation & Electrical Districts Association of Arizona Annual Meeting, January 6, 2023
- Arizona House of Representatives: Committee on Natural Resources, Energy & Water, January 10, 2023
- Arizona Chamber of Commerce & Arizona Manufacturers Council Legislative Panel Discussion, January 17, 2023
- U.S. Section of the International Boundary and Water Commission Board Meeting, January 18, 2023
- Las Vegas Chamber of Commerce: Preview Las Vegas 2023, January 23, 2023
- Salt River Project: The Colorado River and our Region Discussion, January 24, 2023
- Arizona State Senate: Natural Resources, Energy & Water Committee, February 2, 2023
- Utah State University Colorado River Studies Course, February 6, 2023
- Phoenix East Valley Partnership Critical Infrastructure & Transportation Committee Meeting, February 9, 2023
- Arizona Farm and Ranch Group & the Arizona Cattle Feeders Association's Joint Board Meeting, February 16, 2023
- County Supervisors Association Board Meeting, February 16, 2023
- Arizona Alliance for Golf Water Discussion, February 17, 2023
- Environmental Professionals of Arizona Annual Conference, March 1, 2023
- REALTOR® Annual Conference, March 13, 2023
- Arizona Congressman Gosar Water Roundtable, March 16, 2023
- EPCOR Leadership West Water Summit, March 30, 2023
- RHP Real Estate Arizona's Water Situation Meeting, April 5, 2023
- The Chandler Chamber of Commerce: Thirsty for Change: The Arizona Water Crisis and Solutions for a Sustainable Future, April 7, 2023
- WESTMARC Economic Development Summit, May 3, 2023
- Seed Trade Association of Arizona Annual Convention, May 4, 2023
- City of Phoenix: Arizona Water Annual Conference, May 9, 2023
- Scottsdale REALTORS® Water Summit, May 16, 2023
- WTI Getches Wilkinson Center Law Conference, June 8, 2023
- Level Up Mortgage Meeting, July 12, 2023
- Arizona Cattle Growers' Association 120th Annual Summer Convention, July 20, 2023
- CLE International's Arizona Water Law Conference, August 3, 2023
- Independent Insurance Agents & Brokers of Arizona Water Presentation, August 9, 2023
- Cox Votes Virtual Event: Today's Water Climate, August 23, 2023
- 2023 Summer Policy Summit, August 24, 2023
- Arizona Capitol Times Morning Scoop: A Dive into Arizona's Water Management, September 12, 2023
- Greystone Title Agency Meeting, September 13, 2023
- Agribusiness & Water Council Watery Going to Do? Conference, September 15, 2023
- Flinn-Brown Academy: Collaborative Solutions to Secure the Future of Water in Arizona, September 21, 2023
- American Society of Civil Engineers Annual Conference, September 28, 2023

ADWR Communication Activities

ADWR promotes and encourages efficient use of water throughout Arizona by developing conservation tools and resources, assisting Arizona communities and water providers, presenting on drought and conservation issues and solutions, collaborating with regional and national partners, and participating in outreach activities. Staff provide materials and responds to inquiries from the public, businesses, press, water professionals, students, researchers, and others about water conservation and drought. Below are a few highlighted efforts and activities by ADWR staff during WY2023 that promoted water conservation and awareness:

Drought Status and Preparedness Presentations

The former ADWR Drought Program Coordinator, Némesis Ortiz-Declet and the current ADWR Drought Program Coordinator, Maggie Martin prepared and delivered presentations about Arizona drought status and preparedness activities, as well as weather projections in the state. During WY2023, presentations were delivered to multiple groups, committees, and agencies.

Arizona Water News

ADWR's Arizona Water News (figure 43), a weekly newsletter featuring articles on Arizona and Colorado River water-related issues, was launched in March 2016. The newsletter articles help stakeholders stay up to date on the latest developments regarding Arizona water. Since its launch, Arizona Water News articles have received over 100,000 views. Visit the Arizona Water News website to read past news articles:

https://www.azwater.gov/news.

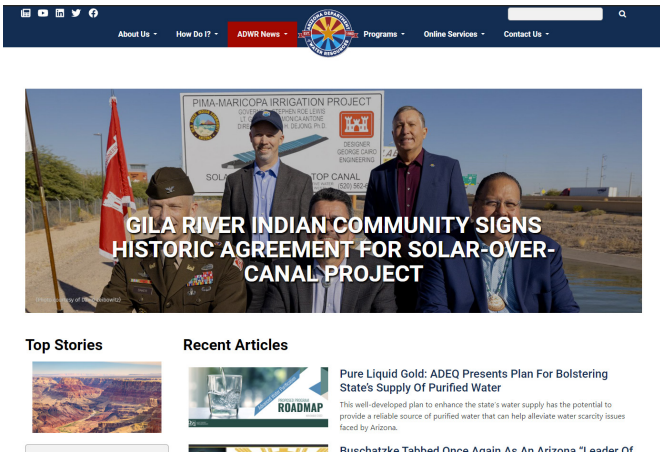


Figure 43. ADWR Arizona Water News.

Below are a few drought-related WY2023 Arizona Water News articles:

- Arizona's Colorado River Leaders Provide Update On Discussions To Save The System
  November 10, 2022
- Arizona Weather And Climate Experts Report On The Moisture Conditions In The Southwest
  November 11, 2022
- How A Productive Burst Of Winter Moisture May (Or May Not) Impact Drought In The Southwest – Part 1
  January 26, 2023
- How A Productive Burst Of Winter Moisture May (Or May Not) Impact Drought In The Southwest – Part 2
  February 16, 2023
- Soaring July Temps, A Late Monsoon: The Savvy "ICG" Pros Called It All... In May
  July 28, 2023
- National Weather Service Forecaster Takes A Look At The Balance Of Our Long, Hot Summer
  August 8, 2023

Water Awareness Month

In April 2023, Governor Katie Hobbs re-designated the month of April as Water Awareness Month, originally established through Executive Order 2008-19 in 2008. ADWR also hosted the state's first-ever Water Awareness Month (WAM) Festival at Wesley Bolin Plaza (**figure 44**). ADWR and its partners celebrated water awareness and promoted water conservation with over 30 interactive education booths from different organizations, cities, and agencies. The festival was a success in that it brought a diverse group of partners directly to the public to promote the story of Conservation in Arizona.

Figure 44. April 2023 Water Awareness Month festival at Wesly Bolin Plaza.

ADWR Drought Website

ADWR's Drought website features the weekly, monthly, and quarterly drought statuses for Arizona as well as updates regarding MTC, ICG, and LDIG activities (see **Section 3**). The website also provides a historical background on drought planning in Arizona, and an archive for past drought preparedness annual reports that are easily accessible to the public. Visit ADWR's Drought website here: https://www.azwater.gov/drought.

Arizona Water Facts Website

On June 1, 2016, ADWR launched Arizonawaterfacts.com (**figure 45**). This website is dedicated to promoting Arizona's success in managing its water resources, presenting current water resource challenges, and planning for the future. Arizona Water Facts is intended to build confidence in our water resources – a necessity for fostering a thriving economy and communities.

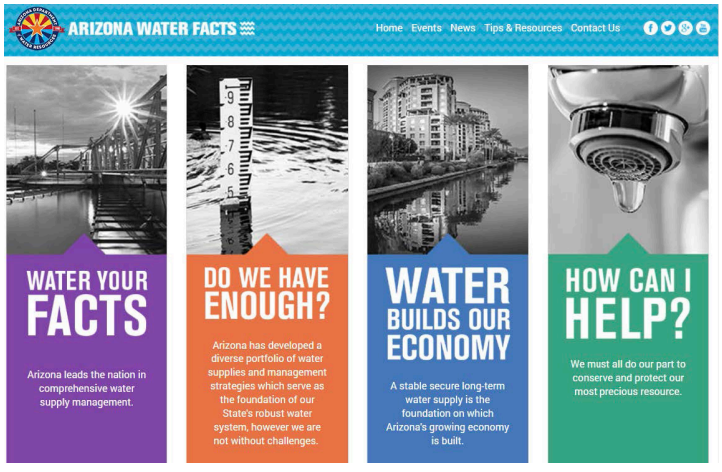


Figure 45. Arizona Water Facts webpage.

Appendix A.
Governor's Water Policy Council

Council Overview

On January 9, 2023, Governor Katie Hobbs issued an Executive Order to establish the Governor's Water Policy Council (the "Council"), which is tasked with developing policy and legislative recommendations for Governor Hobbs to update and improve Arizona's water management framework. The Council will update groundwater management tools and protect groundwater, which serves as 41 percent of the state's water supply.

The Council currently comprises 34 individuals, appointed by the Governor, and three legislators. The Council is chaired by the Director of ADWR. Council members come from diverse organizations and backgrounds, including local and state government, Tribal communities, non-profits, business associations, academia, public and private water providers, and Arizona agriculture, mining, and homebuilding.

The Council may form committees to identify and discuss issues and to develop, evaluate, and prioritize recommendations for the Council to consider. Based on the Council's focus areas and objectives, two committees were formed: Assured Water Supply (AWS) and Rural Groundwater Management.

Council Activities

During 2023, the Council met twice and was briefed on significant water issues, particularly around the Assured Water Supply program and the status of rural groundwater management. The Council continues to receive updates on the activities and findings of the two committees. Based on the work of the committees, the Council will submit final policy recommendations to the Governor's office by December 2023.

The Assured Water Supply Committee was established to review and make recommendations for changes to Assured Water Supply policies - legislatively, administratively, or by executive action - to address the challenges revealed by Assured Water Supply modeling projections, while continuing to:

- Strengthen the integrity of the Assured Water Supply program.
- Protect consumers and aquifers.
- Ensure future growth is not reliant on mined groundwater.

The Rural Groundwater Management Committee was established to develop recommendations for a water management framework to assist rural Arizona communities to manage their groundwater resources.

Appendix B.
2023 Natural Resources Conservation Service Drought Report

United States Department of Agriculture

USDA-Natural Resources Conservation Service, Phoenix, AZ
Prepared by Emilio Carrillo
State Rangeland Management Specialist
September 2023.

Natural Resources Conservation Service (NRCS)

As the USDA's primary private lands conservation agency, we generate, manage, and share the data, technology, and standards that enable partners and policymakers to make decisions informed by objective, reliable science.

Through one-on-one, personalized advice, we work voluntarily with producers and communities to find the best solutions to meet their unique conservation and business goals. By doing so, we help ensure the health of our natural resources and the long-term sustainability of American agriculture.

General

The annual Drought Survey was sent out to all Field Offices (FO's) in Arizona in late Summer 2023. The purpose of the survey was to gather feedback on drought conditions and effects in NRCS Service Center work areas for the water year. Feedback provided was based on observations and field data collected (qualitative & quantitative) during routine work with our clients.

This report is a summary of responses provided from 14 of the 19 NRCS offices polled. Survey results are based on individual NRCS staff (i.e., an office could have >1 response) in their work areas.

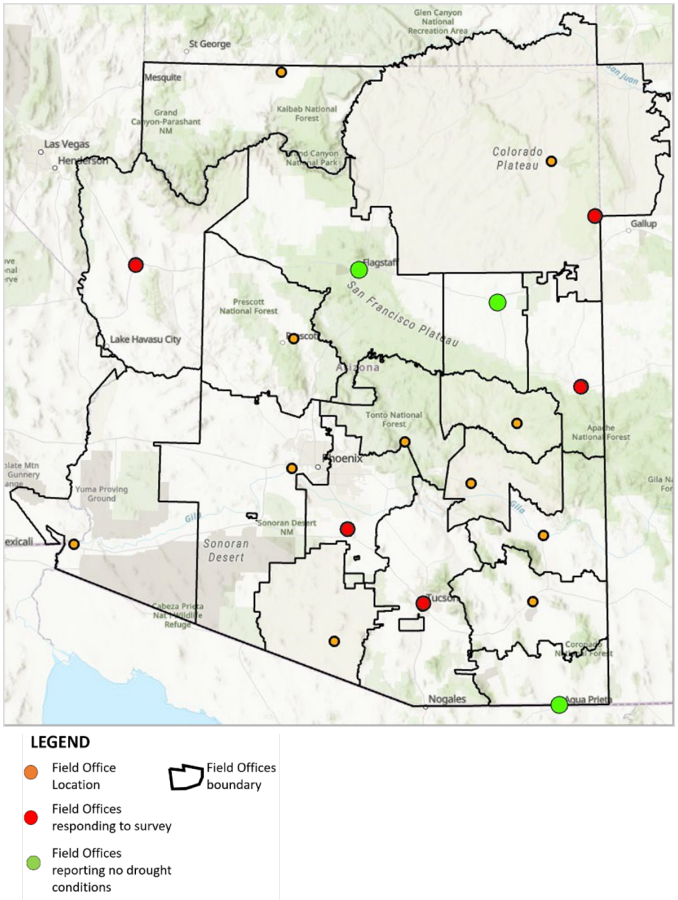
Survey questions listed below focused on drought related effects. Participants also had the opportunity to provide a narrative response to elaborate on any additional information.

1) Drought conditions clients experienced.
2) Dryland Farming
3) Irrigation Water Supply
4) Rangeland Water Supply
5) Rangeland Conservation Practices (specifically to address drought)
6) Rangeland Forage Supply
7) Rangeland Precipitation data

Nineteen responses were collected from all NRCS offices in Arizona (**Figure 1**). Offices were allowed to submit more than 1 response to capture different locations in their work area (e.g., Major Land Resource Areas or Conservation Districts).

NRCS Offices participating in Survey

- Avondale
- Casa Grande
- Douglas
- Flagstaff
- Fredonia
- Holbrook
- Peridot
- Roosevelt
- Safford
- Springerville
- St. Michaels
- Tucson
- Whiteriver
- Willcox

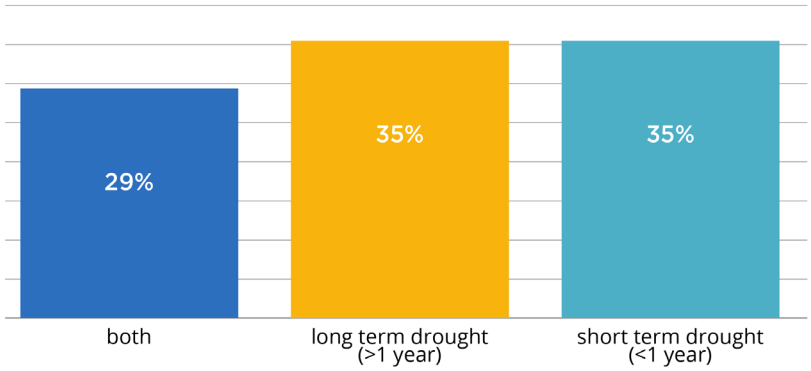


The following are the results of the survey. The survey was established that an individual could respond more than once to account for differences in their Service Center work area. Office work boundaries cover a large geographic area, comprised of various local climate regimes and bio-geographic areas (i.e., plant communities; **Figure 1**).

Drought across the state was not as extreme as in previous years. Some areas received average and above average precipitation. However, most of NRCS clients experienced some effect due to the ongoing long-term drought. Effects ranged from crop production, irrigation, livestock water, and livestock forage on rangelands. Although some areas received near normal precipitation, timing of rainfall was not conducive for forage production on rangelands (i.e., rains arrived in fall and winter) nor dryland farms. Generally, higher elevations in mountainous areas had descent forage production, while lower elevations where suffered. Many ranches reduced stock numbers to from last year which is a continuance from prior years since the onset of the drought in the early 2000's. Some irrigation districts had to rely on pump water instead of river water for most of the summer growing season.

Survey Results

89% of NRCS Offices reported that their work areas and/or clients experienced drought conditions. Clients reported experiencing short term (< 1 year), long term (> 1 year), or both for the water year.



Dryland Farms

Question 1: Crops that were affected

Corn and Squash

Question 2: Estimate the number of acres of dryland cropland affected?

51- 100

Question 3: What Percent loss of dryland crop production occurred or is expected? (Oct. 2021 - Sept. 2022)

81-100%

Additional Information for Dryland Farming:

Stunted growth on crops, low yield.

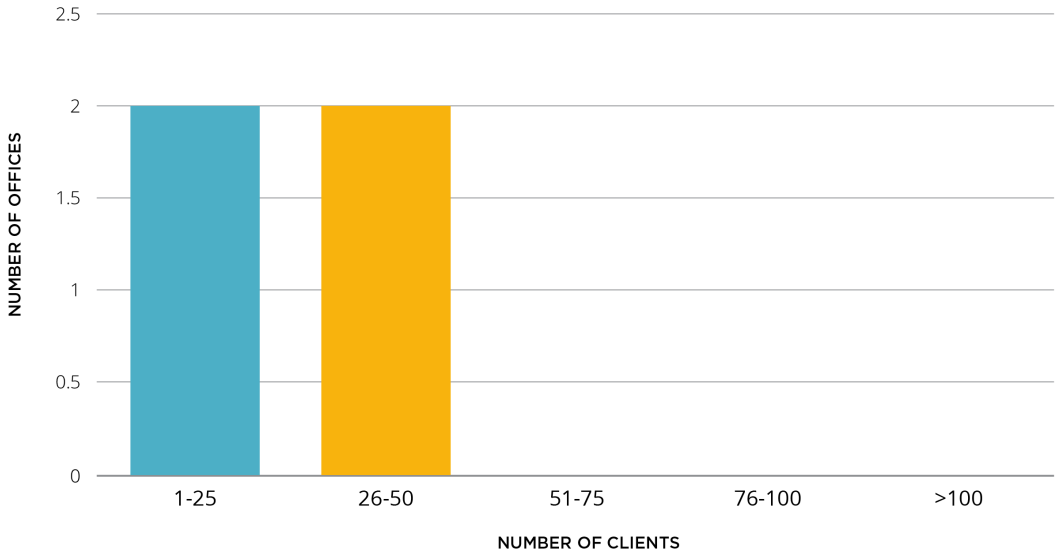
Irrigated Farms

Question 1: How many clients have irrigated cropland?

1 office = 1-25 clients

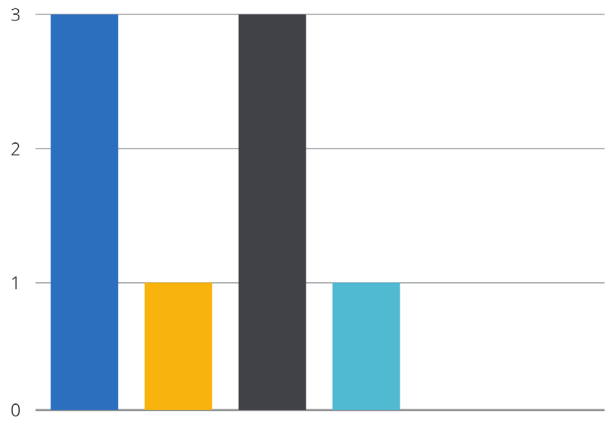
2 offices = 26-50 clients

Question 2: How many clients had irrigation water shortages?



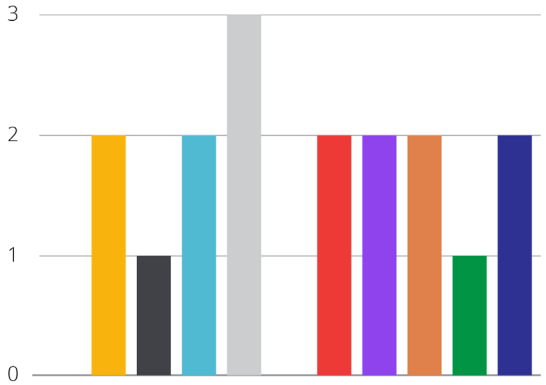
Question 3: What water sources were affected?

Well	3
Surface Diversion	1
Irrigation District	3
CAP (Central Arizona Project)	1
Unknown	0
Other	0



Question 4: List crops that were affected.

Barley	0
Cotton	2
Corn	1
Fruits (general)	2
Hay	3
Nuts	0
Oats	2
Vegetables (general)	2
Wheat	2
Unknown	1
Other	2



Question 5: Estimate the number of acres of irrigated cropland affected?

1 office = 50-179 acres

1 office = 500-999 acres

Question 6: What Percent Loss of crop production occurred or is expected? (Oct. 2022 - Sept. 2023)

1 office = 1-20%

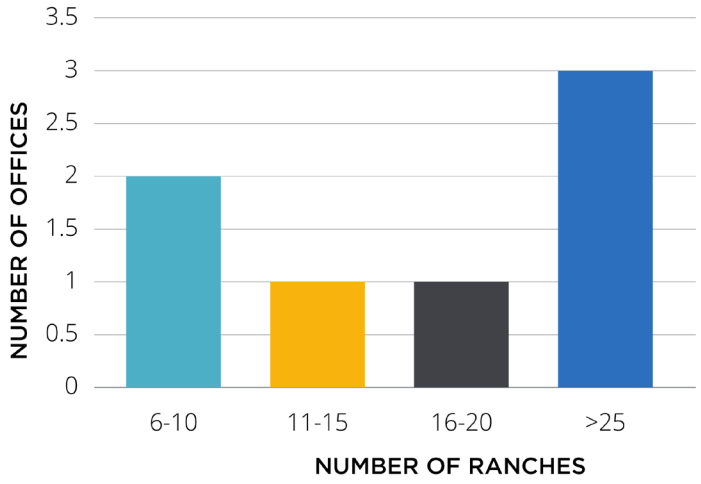
1 office =21-40%

Additional Information for Irrigated Farming

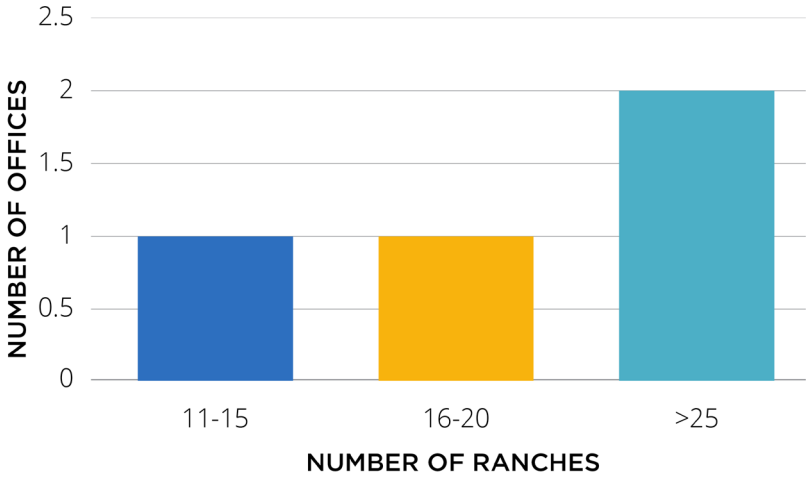
1. Many Producers do not get the amount of water needed due to inadequate water shares from the irrigation district.
2. The irrigation district had to rely on pump water instead of river water for most of the summer growing season.

Livestock Water

Question 1: How many ranchers do you work with?



Question 2: How many of your clients (ranches) experienced a shortage of livestock water?

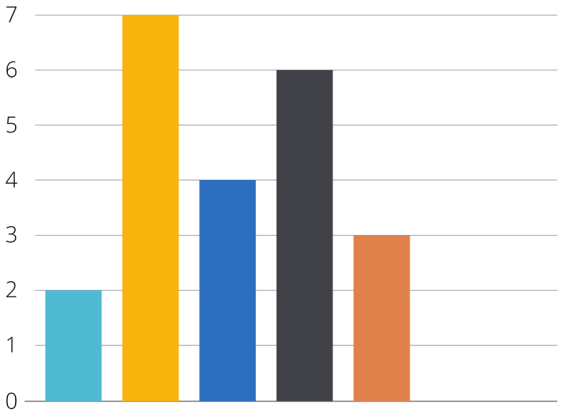


Question 3: Are any ranches out of livestock water?

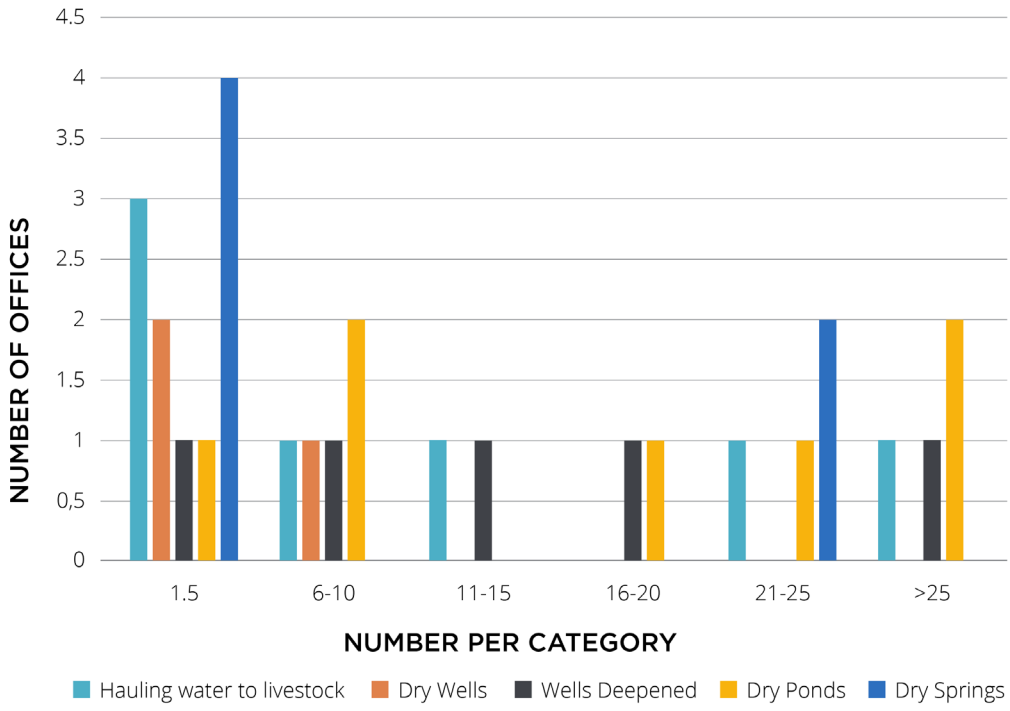
Field Office	Response
Avondale	No answer
Casa Grande	No answer
Douglas	No
Flagstaff	Unknown
Fredonia	Unknown
Holbrook	No answer
Peridot	No answer
Roosevelt	No
Safford	No answer
Saint Michaels	No
Springerville	Unknown
Tucson	No
Whiteriver	No answer
Willcox	No answer

Question 4: What water sources were affected?

Wells	2
Ponds (dirt tanks)	2
Surface Flow	4
Springs	6
Water Catchments	3
Unknown	0
Other	0



Question 5: Livestock Water Supply. Affected sources of water.



Livestock Forage

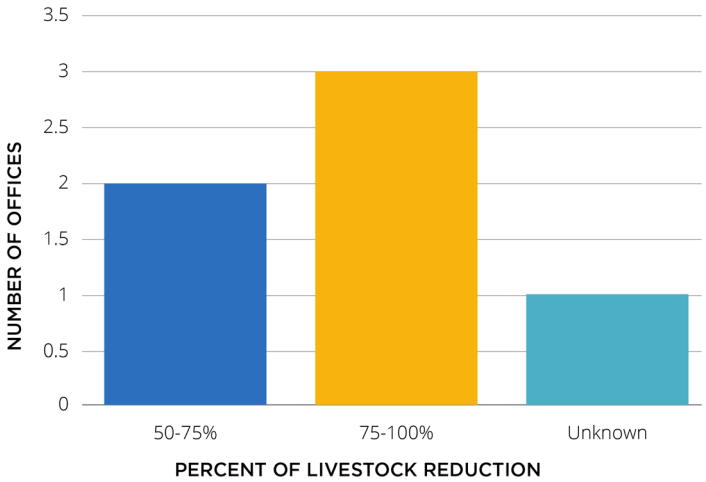
Question 1: Is there a shortage of spring and/or summer livestock forage in the work area?

Field Office	Response
Avondale	No answer
Casa Grande	No answer
Douglas	Yes
Flagstaff	No
Fredonia	Yes
Holbrook	No answer
Peridot	No answer
Roosevelt	Yes
Safford	No answer
Saint Michaels	Yes
Springerville	Yes
Tucson	No
Whiteriver	Yes
Willcox	No answer

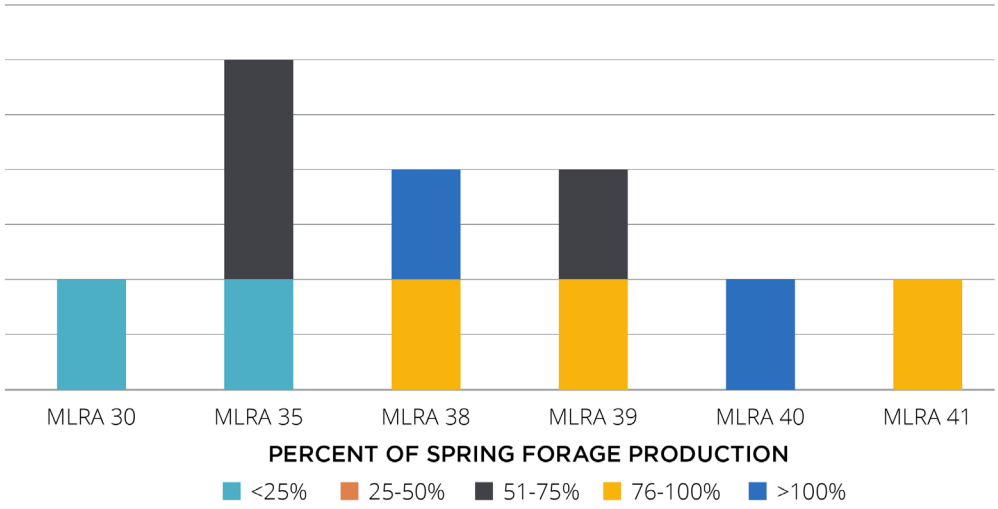
Question 2: Have livestock numbers been reduced from last year (2022) due to drought?

Field Office	Response
Avondale	No answer
Casa Grande	No answer
Douglas	Yes
Flagstaff	No answer
Fredonia	Yes
Holbrook	No answer
Peridot	No answer
Roosevelt	Yes
Safford	No answer
Saint Michaels	Yes
Springerville	Yes
Tucson	No answer
Whiteriver	No
Willcox	No answer

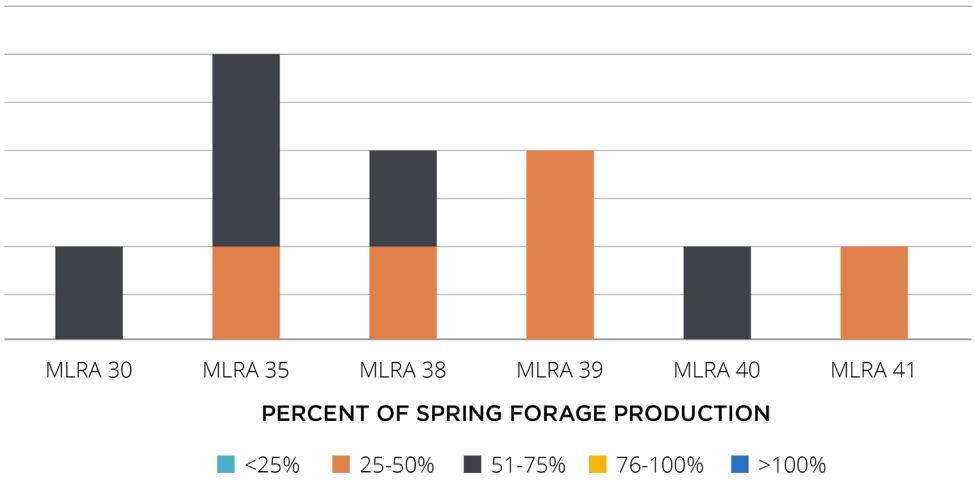
Question 3: What percent of normal livestock numbers (historic or permitted numbers) are currently being grazed (i.e., pre-drought)?



Question 4: What percent of Normal Year Forage production was available this PAST SPRING (2023) for applicable MLRA(s) within the work area?



Question 5: What percent of Normal Year Forage production is expected by the end of this year's GROWING SEASON for applicable MLRA(s) within the work area?



Additional Information

1. Last year's good monsoon created forage that has persisted into this summer and therefore, has helped to soften the blow of the low producing monsoon season this year. We had an above average precipitation last summer and this past winter which helped with increased forage and filled livestock ponds and increased some water tables in well. This summer the precipitation has been below average and I know some ranchers are having trouble with the lack of water this monsoon season. Most of the cattle number reductions on the ranches that I work with have occurred very late in the summer.

2. Rangeland has suffered greatly due to the long-term drought. Summer rains have brought good growth this spring, but inventories consistently show numbers that are well below average %. Most Ranchers are looking for water development via financial assistance programs.

3. Very poor precipitation summer so far and we are nearing the end of the growing season with nights becoming cooler across the region. Little to no perennial forage green up and there is lack of tank water on ranches. Honestly it looks like May/June not August across most of the FO area.

4. This year we had good snow for the clients I work with. Rain was still sparse though, so rangelands are still experiencing drought.

5. Ponds (dirt tanks) were low, but mostly holding water. MLRAs 38 and 39 received good to fair precipitation for 2023. Forage production was good in most locations.
6. Based upon average, summer precipitation, according to what has already occurred, is predicted to finish out at 45% of normal.
7. Warm season grasses did well with good spring rainfall throughout the area. We would hope with the rainfall that we have received this fall, that the cool season grasses are able to have enough time to have good growth before the winter.
8. Good 2022 Fall and 2022/2023 Winter Moisture. Dry in April, June and most of July. No precipitation to speak of. Water supplies low in July and August. Forecast is not looking good either.
9. Monsoons for this growing season have been very widespread and spotty. Some locations have received near normal precipitation for the monsoon season while others have barely gotten any. Based on conditions I have seen in the field I would definitely say that this year's growing season has resulted overall in less than half of normal forage production across the conservation district.
10. Based upon average, spring precipitation was 29% of normal -AND- winter precipitation was 77% of normal.
11. We experienced above average rainfall in both the Fredonia and Littlefield Hurricane Vally conservation districts this spring. Due to this, the warm season perennial grasses did very well in most areas and had good growth.
12. ~200% of average precipitation in most areas of the Sonoran Desert this spring.
13. Good 2022 Fall and 2022/2023 Winter Moisture. Dry in April, June, and most of July. No precipitation to speak of. Water supply low in July and August. Forecast is not looking good either.
14. After a strong monsoon season in 2022 and a wet winter, forage for livestock this spring was greater than has been for many years, however still not where it should be with normal conditions.

Appendix C.

Pima County Local Drought Impact Group Regional Flood Control District 2023 Water Year Annual Report

The Pima County Local Drought Impact Group (LDIG) has been an active component of county operations since 2006 when the Board of Supervisors adopted the Drought Response Plan and Water Wasting Ordinance (Chapter 8.70).

LDIG consists of water providers and local, state, and federal agencies interested in the cause and effect of drought conditions in Pima County. LDIG meets bi-monthly to monitor the short-term and long-term drought status, discuss drought impacts, and coordinate drought declarations and responses.

The county's Drought Response Plan and Water Wasting Ordinance established a four-stage trigger category corresponding to the Arizona Drought Monitor Report and their declaration of a watershed drought condition from "Abnormally Dry" to "Exceptional." With each "Stage" declaration the county can consider drought stage response measures established in the ordinance.

LDIG explores drought impacts on various sectors in Pima County, including agricultural water use, ranching, wildfire, hydrology, and flooding. Because many water providers depend on Central Arizona Project (CAP) water, LDIG also monitors the status of the Colorado River, the El Niño Southern Oscillation (ENSO), and other climate weather patterns concerning their effect on drought conditions and climate variability in the Southwest. LDIG also monitors the status of the summer monsoon season and convenes roundtable discussions of drought and water conservation outreach programs. For a list of presentations and agendas, please visit Pima County's LDIG website.

This report is provided for inclusion in the Arizona Drought Preparedness Annual Report and submitted to the Pima County Administrator's Office.

Weather (National Weather Service-Tucson)

In Pima County, the WY2023 began after a drier than average 2022 monsoon, with 4.94 inches of precipitation, 0.75 inches below normal. October and November 2022 were dry with cooler temperatures, the average temperature as low as 3.6°F below normal in November. Overall, the fall season was cool and dry. Warmer temperatures developed in December with above-normal precipitation.

January 2023 began with winter storms and colder air mass, cooling off average temperatures and delivering above-normal precipitation. Cool temperatures extended into February and March, accompanied by below-normal and slightly above normal precipitation respectively. Winter was cooler and wetter than normal, not consistent with La Niña conditions.

April 2023 was dry with no rain and warm, 1.9°F above normal, ending a very cool January-March trend. May was warm but without triple digit temperatures and above normal rainfall.

June 2023 received no rainfall and below normal temperatures, the first cool June since 2009 and coolest since 1991. July was the hottest July on record and hottest month on record, with over 40 records set or tied.

It was the 2nd calendar month to record triple digit high temperatures every day. The average high, low and average temperature were +8.2°F, +3.7°F and +6.0°F above normal. At least July received 2.00 inches of rain, just -0.21 inches below normal. August produced 0.41 inches above-normal precipitation but high temperatures continued, although not as record breaking as July, August was the 3rd hottest. In total, summer was the 3 rd hottest on record and 0.03 inches drier than normal. In September, triple digit highs early on pushed this month to tie for the hottest September on record. A deficit of nearly an inch of precipitation ended the water year drier than average. The monsoon was the hottest on record and dry, -0.96 inches below average rainfall.

Precipitation (in inches, recorded at Tucson International Airport)*

WY22-23	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Precipitation	0.53	Trace	1.27	1.76	0.59	0.66	0.00	0.53	0.00	2.00	2.39	0.34
Normal Precip.	0.67	0.56	0.96	0.84	0.84	0.56	0.24	0.20	0.23	2.21	1.98	1.32
Difference +/-	-0.14	-0.55	+0.31	+0.92	-0.25	+0.10	-0.24	+0.33	-0.23	-0.21	+0.41	-0.98
Cumulative	-0.14	-0.69	-0.38	+0.54	+0.29	+0.39	-0.15	+0.18	-0.05	-0.26	+0.15	-0.83
Rank	55th Wet	16th Dry	37th Wet	16th Wet	60th Wet	42nd Wet	Driest	16th Wet	Driest	61st Wet	48th Wet	29th Dry

Monthly Average Temperature (in °F, recorded at Tucson International Airport)*

WY22-23	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average Temperature	71.4	57.9	54.0	51.6	53.3	59.1	70.0	77.3	84.5	94.2	89.9	85.7
Normal Temperature	72.6	61.5	53.0	53.6	56.2	61.9	68.1	76.8	86.1	88.2	86.9	82.8
Difference +/-	-1.2	-3.6	+1.0	-2.0	-2.9	-2.8	+1.9	+0.5	-1.6	+6.0	+3.0	+2.9
Rank	40th Hot	44th Cool	-25th Hot	60th Hot	54th Cool	63rd Hot	14th Hot	22nd Hot	44th Hot	ALL HOT	3rd Hot	1st Hot

Season Ranking (NWS-Tucson)*

WY22-23	Fall	Winter	Spring	Summer	Monsoon
Precipitation Rank	13th Dry	26th Wet	53rd Wet	62nd Dry	39th Dry
Temperature Rank	37th Hot	54th Hot	27th Hot	3rd Hot	1st Hot

****Period of record is from 1890 for Tucson***

Pima County Drought Status

(US Drought Monitor & State Monitoring Technical Committee)

Arizona's Short-Term drought status is based on the U.S. Drought Monitor and is updated monthly. Long-Term drought status is derived from the 24-, 36- and 48-month Standard Precipitation and Evapotranspiration Index (SPEI) datasets and is updated quarterly by the Arizona State Climate Office. Both are reviewed by ADWR's Drought Monitoring Technical Committee.

Short-Term

In Pima County WY2023 started with Abnormally Dry conditions in east and central Pima County with Moderate drought surrounding and Severe drought in the eastern part of the County. By the end of November, beginning of December drought conditions eased as Abnormally Dry conditions and Moderate drought receded in north central Pima County. Severe drought was removed.

Area of no drought expanded from central Pima County to the east and west, leaving small bands of Abnormally Dry conditions and Moderate drought in February. Area of no drought expanded through March and by April all drought had been removed from the county. Pima County was drought free through mid-July. By the end of July, all of the county was in an Abnormally Dry condition.

By the end of August, Moderate drought developed in the east. In September, drought conditions worsened with expansion of Moderate and Severe drought in the east. Extreme drought began spreading from the southeastern corner of the county.

Long-Term

From October to December, western Pima County was in Moderate drought easing to the east with pockets of Abnormally Dry conditions and no drought in the east. That pattern held January through March. Drought improved April through June with Moderate drought almost eliminated and small areas of Abnormally Dry conditions in the west and central with no drought in the majority of Pima County. In September, Moderate drought returned covering most of the county.

Pima County Drought Conditions

WY22-23	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Short Term	D0(62) D1(26) D2(12)	D0(62) D1(26) D2(12)	No(24) D0(52) D1(24)	No(32) D0(49) D1(18)	No(69) D0(24) D1(9)	No(87) D0(13)	No(100)	No(100)	No(100)	No(100)	D0(100)	D1(34) D2(17) D3(8)
Short-Term DSCI	150	150	100	86	42	13	0	0	0	0	100 132	184 192
Long Term	D2 D3			None D0/D1			None D0/D1			Not Available		

D0-Abnormally Dry, D1-Moderate, D2-Severe, D3-Extreme, D4-Exceptional. (percentage)

Colorado River Basin & Central Arizona Project (CAP)

Nine water providers deliver CAP municipal water to Pima County water users. Tucson Water has the largest CAP annual municipal allocation in the state. Agricultural and industrial users and the Tohono O'odham Nation have access to and use CAP water. The drought status of the Colorado River Basin and probabilities of shortage declarations and impacts to these sectors are monitored by the Pima County LDIG.

Lake Mead and Lake Powell

The August 2023 the U.S. Bureau of Reclamation (Reclamation) 24-Month Study projected Lake Mead to be above elevation 1,050' above mean sea level on December 31. Concurrent with the 2007 Operating Guidelines and the Drought Contingency Plan, Lake Mead will be operating in a Tier 1 Shortage beginning 2024. This is the third consecutive declared shortage, but is less severe than the current Tier 2a shortage. This will impact Arizona's CAP water supplies by reducing 512,000 AF, cutting all Excess water, eliminating Agricultural Pool water and mitigation water for the sector as part of the Drought Contingency Plan. The Non-Indian Agriculture Pool will be mitigated at 75% of normal allocation. Arizona, the Colorado River Basin states, and the federal government continue to work in re-consultation of the 2007 Operating Guidelines to reduce the decline of Lake Powell and Lake Mead in light of a hotter and drier climate.

In April of 2023, the US Bureau of Reclamation published a Supplemental Environmental Impact Statement (SEIS) in the Federal Register. This SEIS was developed after the Basin states could not reach consensus on a proposal to meet new operating guidelines that would protect critical lake elevations with significant additional conservation. However, the seven basin states did reach a consensus and agreed to a new proposal in May. The Bureau withdrew the non-consensus SEIS and will publish an updated SEIS for public comment based on the consensus proposal. The process will be finalized later this year.

The consensus proposal will conserve 3 MAF through 2026, 1.5 MAF by 2024. Up to 2.5 MAF of conservation will be federally compensated. Arizona's share of the conservation is 1.15 MAF.

The process for developing post 2026 Operating Guidelines is concurrent with finalizing an interim SEIS. A notice was published in the Federal Register in June 2023 opening a public comment period on the scoping phase of the post 2026 Environmental Impact Statement. The seven basin states and water users submitted comment both collectively and individually in multiple letters.

Water Year 2023 unregulated inflow into Lake Powell was 142 percent of average. At the end of WY2023 storage will be 38% of average. The Operating Guidelines will change operation tiers from a Lower Elevation Balancing Tier to a Mid-Elevation Balancing Tier in 2024. Releases from Lake Powell will be 7.48 MAF in WY2024.

Drought Impacts

Wildfire

Wildfire activity in Pima County was limited to one large wildfire, the Molina 3 fire on Mt Lemmon. It was contained at 2,500 acres. In comparison, the 2020 Bighorn fire burned approximately 120,000 acres. Ash and debris flow from the Bighorn fire scar had affected infiltration rates in the Lower Santa Cruz River, increasing flow extent and decreasing infiltration. In 2022 recharge increased after 2021 floods scoured the channel.

Groundwater

Pima County Regional Flood Control District (RFCD) monitors groundwater levels within various watersheds to help assess the effects of climate and land-use changes on the overall health of floodplains in Pima County. There are a few shallow groundwater areas along Cienega Creek, Davidson Canyon, and Tanque Verde Creek. Groundwater levels have recovered in many of these areas since 2014 though there is an established long-term downward trend in groundwater levels for most areas.

Groundwater conditions varied in the monitored shallow groundwater areas in eastern Pima County in 2022. Declines were reported along the Lower Santa Cruz River, in Cienega Creek at Pantano Dam, along Davidson Canyon above I-10, along Tanque Verde Creek above Houghton Road, and along Sopori Wash between the towns of Arivaca and Amado. Rising water levels were reported along Canada Del Oro Wash in Catalina, along the Santa Cruz River near Canoa Ranch, along Cienega Creek upstream and downstream of Pantano Dam, along Tanque Verde Creek downstream of Houghton Road and in the upstream and downstream portions of Sopori Wash. Mixed groundwater conditions were the result of highly variable rainfall, light in the valleys and heavier in the upper elevations, leading to variable stream flows throughout the county.

Living River Report WY2022

This annual report, released in September 2023, documents benefits of improved water quality released into the Lower Santa Cruz River from Pima County's water reclamation facilities (WRF). Water quality in the river improved following significant upgrade of the metropolitan treatment facilities in 2013. A supplemental report compares annual report conditions from 2013 through 2022.

Discharge of high-quality (Class A+) reclaimed water from Pima County's wastewater reclamation facilities into the Santa Cruz River is a drought-proof water source providing many environmental benefits to the river. Over 6,000 AF was released from the Agua Nueva WRF and 33,000 AF from the Tres Rios WRF in 2022. This discharge creates a 16 to 23-mile flow extent (depending on infiltration and seasonality) of established riparian habitat and wetland. This multi-benefit project serves as environmental restoration, aquifer replenishment and public recreation.

Important new developments this water year include the implementation of artificial intelligence program at the Regional Wastewater Reclamation Department that reduces energy use by up to 20 percent, resulting in savings and emission reduction. The Pima County Regional Flood Control District hosted 44 clean up events in the Santa Cruz River, removing over 10 tons of trash and treated over 638 acres for buffelgrass and other non-natives. This effort, in combination with the Tucson Audubon removal of invasive species, 50 acrs of invasive grass and 27 acres of tamarisk, has improved the river channel. Pima County will continue follow treatment to control tamarisk.

As invasive species are removed the Flood Control District utilizes a "rapid recruiter remediation" seed spot treatment as part of the management of the floodplains. This treatment introduces native species and seed diversity to inhibit non-native reestablishment.

Otherwise, the high level of water quality continues with dissolved oxygen levels improving. Both vegetative and aquatic invertebrate diversity increased in the multiple reaches. In 2022, recharge increased likely due to scouring from 2021 floods that removed ash layers from the 2020 Bighorn fire burn scar. Flows past the end point gage of Trico Road were one of the highest since 2014.

Kino Environmental Restoration Project

Kino Environmental Restoration Project (KERP) harvests urban storm water and controls flooding in Tucson. KERP covers 121 acres with 28 acres of open water and riparian habitat. The six-acre, 50-foot "Deep Pond" stores stormwater for irrigation within KERP plus the Kino Sports Park Complex. KERP has suffered from reduced availability of stormwater for internal irrigation needs over the past several years, with less basin inflow in WY2023.

Cienega Creek and Davidson Canyon

Located in eastern Pima County, Cienega Creek continues to show the impacts of sustained drought and shifts to seasonal patterns of flow. Pima Association of Governments' (PAG) Monitoring Year (MY) mentioned below runs from July 1 to June 30. This year the results continue to demonstrate the impact of climate extremes from the driest conditions on record in MY 2020-21 to record high base-flows seen in two decades in MY 2021-22 and MY 2022-23. PAG's reporting depicts the localized drought impacts on a shallow groundwater-dependent system and designated Outstanding Arizona Water (OAW), representing drought conditions for local wildlife habitat and human activities dependent on shallow groundwater. It is valuable for drought reporting to represent areas that do not currently benefit from artificial recharge and CAP.

PAG and its partners have monitored Pima County's Cienega Creek Natural Preserve since the mid-1980s to provide reliable data and trend analysis for the riparian area including water quality, groundwater, and streamflow. Hot and dry June conditions typically represent the minimum extent of perennial flow within a year. The 2021 monsoon season was the third wettest on record, leading to a drastic recovery in baseflows and breaking perennial baseflow records for most flow from the past two decades of drought. The Tucson region also experienced a productive monsoon season in 2022, resulting in additional groundwater recharge and once again breaking perennial baseflow records from the past two decades. In June 2023, PAG recorded 5.44 miles of flow in the monitored stretch of Cienega Creek, up from 3.40 miles of flow in June 2022. This was the highest perennial baseflow recorded since PAG re-initiated monitoring to assess the impacts of drought in June 1999. This translates to 58% of the 9.3-miles that flowed perennially and throughout the monitoring area in 1985. In addition, at 7.39 miles, March 2023 baseflows in Cienega Creek were the highest observed by PAG for any quarter since PAG resumed wet/dry mapping in 1999. After observing the lowest perennial baseflows on record through June 2021, these observations demonstrate the impacts of climate extremes on shallow groundwater-dependent streams and the riparian areas that they sustain. This highlights the importance of long-term, consistent seasonal monitoring. As PAG completes annual reports for July through June, this does not reflect the monsoon season of 2023.

In June 2023, there were 1.35 miles of baseflow in the monitored stretches of Davidson Canyon, a major tributary to Cienega Creek that is an OAW as well. Davidson Canyon continued to experience strong baseflows all four quarters of MY 2022-23, with baseflows ranging from 1.35 miles to 2.89 miles within the Cienega Creek Natural Preserve and a portion of Pima County's Bar V Ranch. While lower than the record high flows observed in MY 2021-22, prior to June 2022, perennial baseflows in Davidson Canyon had never been observed longer than one quarter mile. Baseflow extents over 1 mile had been last observed in September 2009, at 1.32 miles.

Although water levels rose, drought's previous impacts on erosion, sediment movement, wildlife, and vegetation are still apparent. The moisture swing over the past two monitoring years did provide notable improvements. As water levels rose over the past two years, PAG observed native longfin dace, county-protected lowland leopard frogs, and endangered Gila topminnow in Davidson Canyon. These species had been absent from Davidson Canyon for a long time, as they depend on more regular surface water supplies to survive.

Drought Response Actions

Pima County continues to adhere to its water resources and drought management policy framework including implementation of goals and recommendations from planning documents and annual reports cataloging progress and resources. These documents are posted on the County's Drought Management webpage:

- Water & Wastewater Infrastructure, Supply and Planning Study, Action Plan and Annual Report Cards.
- Water Resources Asset Management Plan
- Strategic Plan for Use of Reclaimed Water
- Sustainable Action Plan for County Operations
- Drought Response Plan and Water Wasting Ordinance

Environmental Water – Conservation Effluent Pool

Through intergovernmental agreements, Pima County and the City of Tucson have established a Conservation Effluent Pool (CEP) reserving up to 10,000 acre-feet of effluent a year generated from metropolitan water reclamation facilities for dedicated use in environmental projects. The 2023 CEP Annual Report to the Board of Supervisors confirms continued operation of the two projects authorized in 2021, the City's Heritage Project and the RFCD Agua Nueva Project.

Tucson Mayor and Council and the Board of Supervisors approved the Heritage Project, allocating up to 110 AF per year for evapotranspiration. In total, 29.7 AF was requested in 2022.

As part of an Endangered Species Act stipulation, the RFCD Agua Nueva Project was approved in 2021 by the City of Tucson and Pima County CEP Administrators; not requiring Council or Board approval. This project will ensure a weekly average of 5 MGD of flow from Agua Nueva WRF to maintain the endangered Gila Topminnow in the established riparian habitat downstream of the outfall. Maximum use is limited to 5,600 AF per year; no CEP water was used for this project in 2022 as Pima County had monitoring equipment issues and estimates provided by the Agua Nueva WRF showed monthly discharges of greater than 5 MGD. RFCD is seeking to amend the project for CEP use up to 5,600 AF per year rather than the difference between the actual and desired discharge amounts.

Lower Santa Cruz River Basin Study

Pima County participated with Reclamation in a six-year study of the Lower Santa Cruz River Basin. The study brought Reclamation's technical expertise in applying climate change models, surface water modeling and groundwater modeling to water supply and demand scenarios, charting the potential range of water imbalance in the region and developing adaptive management strategies to address water imbalance and climate change.

The Study identified areas of concern and developed adaptation strategies for each area and region wide strategies. Technical memoranda have been completed and are available on the Phoenix Area Office website.

The Bureau's Policy Office has finished review of the Basin Study and an internal review with the Bureau's Commissioner could occur first of next year. The Office of Management and Budget will conduct a review after the Bureau. The final report will be available next year.

Pima County Water Working Group

County Administration established and continues to utilize an in-house Water Working Group (WWG) to ensure the appropriate knowledge base and expertise is maintained to develop strategic plans for water storage, conveyance, treatment infrastructure and funding during this historical period of drought and looming water scarcity challenge facing Pima County and the Basin states. The WWG will be cooperating with the County's water providers as needed.

Drought Stage

Currently, Tucson Water is in Drought Stage 2. The Town of Marana is in Drought Stage 2. Metro Water is in Stage 1. The Town of Oro Valley is in Water Conservation Level 1. The remaining water providers are in Drought Stage 1 or its equivalent (voluntary reductions). Pima County remains at Drought Stage 1.

Summary

Pima County had a near record summer monsoon in 2021, but a very hot and drier than average monsoon in 2022. Leaving the 2022 monsoon, fall was dry but cooler than average. Winter was wetter and a cooler pattern continued. Spring 2023 precipitation was just above average and remained cool, followed by the Summer and monsoon 2023 seasons that were hot and drier. Short term drought conditions have worsened ending the water year. Long term drought conditions have benefited from previous wetter seasons, but Moderate drought has returned and expanded. Pima County has begun to experience a small area of Extreme short term drought conditions.

While conditions improved during the spring and into summer, a lackluster monsoon season re-introduced short term drought development. After three consecutive La Nina years, the upcoming fall and winter seasons are expected to enter an El Nino phase and are likely to be wetter than average.


ARIZONA DEPARTMENT
EST.
1980
of
WATER RESOURCES