2021 Water-year in Review

Already in drought at the start of the water year, Nevada experienced worsening drought through July. Summer rains caused flooding and reduced drought severity in parts of the state, but the entire state remained in drought, with significant impacts on water resources, agriculture and recreation.

Key Points

- Drought began developing across Nevada during 2020. By the start of the 2021 water year (October 1, 2020) more than 95% of the state was in drought, and over half of the state was in D3 Extreme or D4 Exceptional Drought.
- Drought worsened through summer of 2021. In late July, more than three-quarters of the state was in D3 Extreme or D4 Exceptional Drought.
- Drought was widespread across the western US, with almost all areas west of the Rockies in drought this summer.
- Over the course of the water year, most of Nevada was both warmer and drier than normal. Spring and autumn were particularly dry.
- The already low Sierra snowpack melted rapidly during April and May, due to clear, sunny, warm weather.
- Rains during the summer reduced drought severity in southern and eastern Nevada and caused localized flooding but did not fully resolve drought.
- Low water levels in Lake Mead instigated a Tier 1 shortage declaration, reducing Colorado River water deliveries to Nevada by 7%.
- Lahontan and Rye Patch Reservoirs dropped to less than 5% of capacity.
- By the end of the water year, the US Department of Agriculture reported that 75% of Nevada pasture and range were in poor or very poor condition.
- Drought triggered restrictions on fire use and recreational activities.
- It is likely that drought contributed to wildfires in the Sierra Nevada and subsequent poor air quality in Nevada. It is possible that drought reduced vegetation growth in Nevada enought to reduce fire risk in lower elevations.
- Anecdotal reports of increased stock water hauling, feed purchases, hay prices and livestock sales suggest that the drought has impacted agriculture.
- Northern Nevada has had a wet start to the 2022 water year, but southern Nevada has not.
- La Niña conditions have developed for a second winter in a row. During La Niña winters, southern Nevada is typically drier than normal, but there is little relationship between La Niña and precipitation in northern Nevada or flow into Lake Mead.

US Drought Monitor Status

Most of Nevada was already in drought at the start of the 2021 water year (Fig. 1-2, Table 1). Drought developed early in 2020 and worsened steadily through the late summer and fall of that year. D4-Exceptional Drought developed first over east-central Nevada, and nearly half of the state was in D3-Extreme drought by September 2020. Only northern Elko County remained drought free.

Drought worsened during the first part of 2021 water year because of low precipitation and high temperatures (Fig. 3-5). Autumn and spring precipitation were particularly low (Fig. 4). High temperatures in the late spring and early summer drove high atmospheric demand that worsened drought (Fig. 5).

Drought was not limited to Nevada. Essentially all of the country west of the Rockies was in drought by the summer of 2021. The vast extent of the drought has likely worsened consequences of the drought by impacting national scale agricultural production and by reducing streamflows and reservoir storage in major systems like the Colorado River.

Date	Sep 29 2020	Jul 20 2021	Sep 28 2021
None	0.44	0	0
Abornmally Dry-D0	2.43	0	0
Moderate Drought-D1	17.75	5.11	4.82
Severe Drought-D2	27.98	16.61	27.57
Extreme Drought-D3	45.61	37.64	42.58
Exceptional Drought-D4	5.80	40.63	25.02

Table 1. Percent of Nevada in each drought class from the US Drought Monitor.

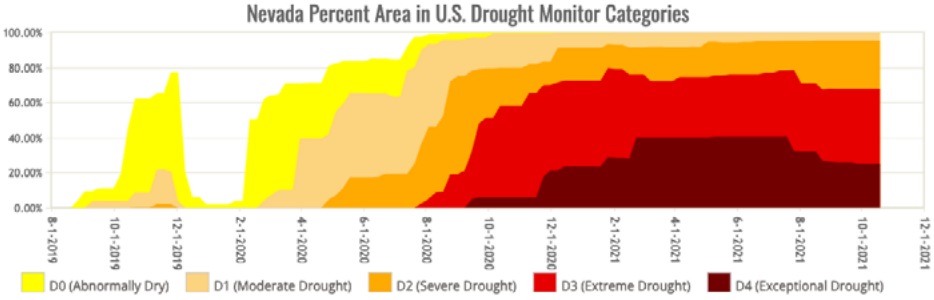

Fig. 1. Time series of drought in Nevada from mid-2019 through 2021 from the US Drought Monitor.

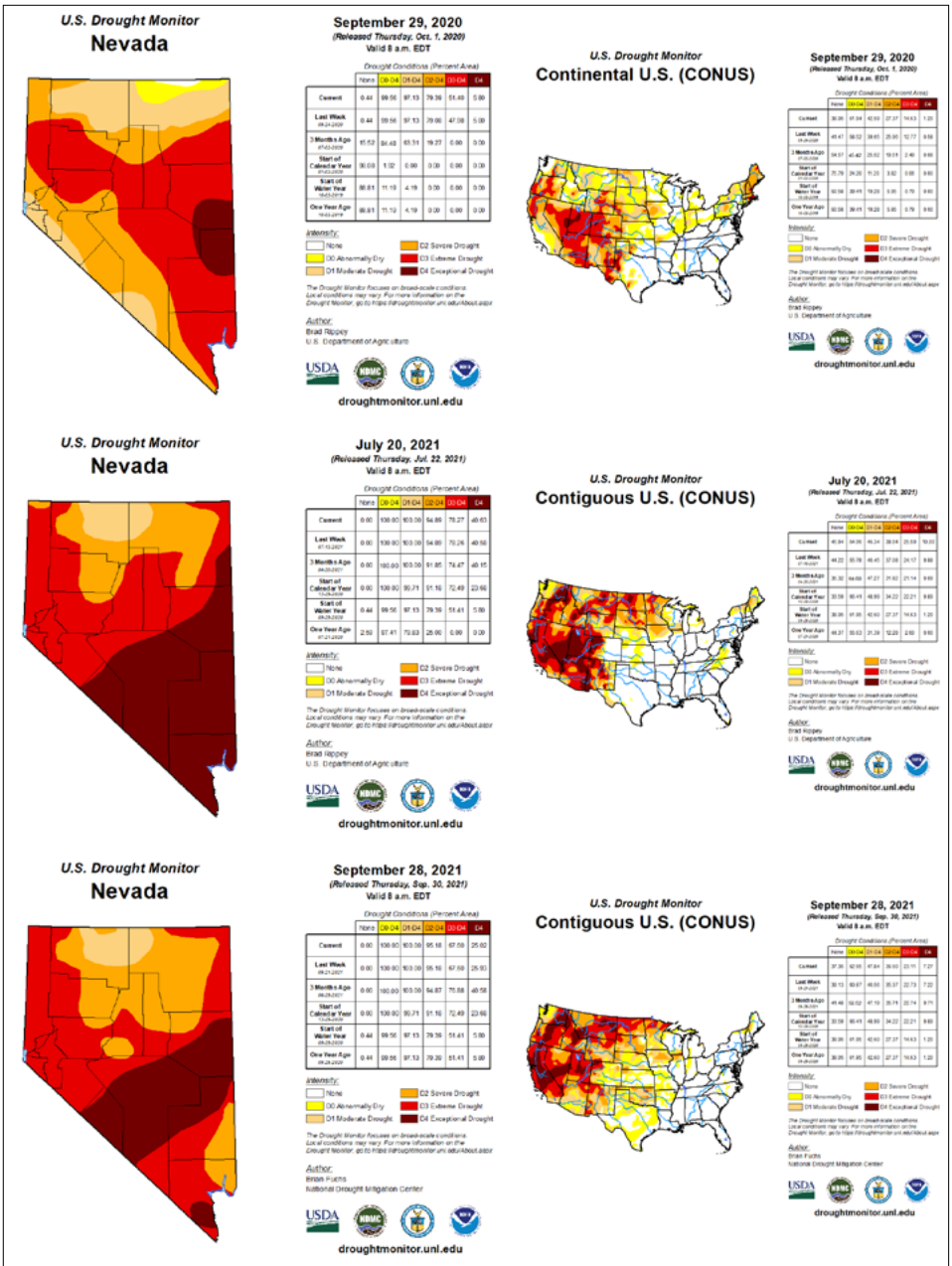

Fig. 2. Drought Monitor maps for Nevada showing conditions on September 29, 2020, near the start of the 2021 water year, July 20, 2021, when drought severity in Nevada was most significant and September 28, 2021, near the end of the water year. Corresponding maps of the contiguous US are shown for context.

Temperature & Precipitation

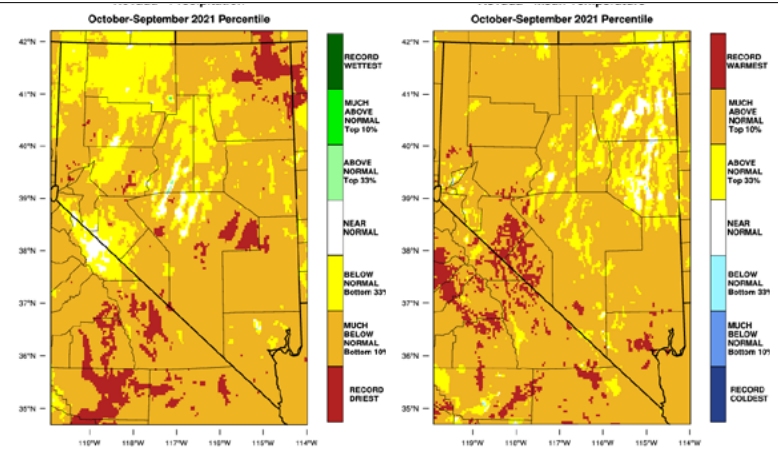

Fig. 3. Water-year total precipitation (left) and average temperature (right) relative to the historical record. Record driest areas are the driest since the 1896 water year. Record warmest areas are the warmest since the 1896 water year. Top and bottom 10% and 33% refer to the range between 1896 and 2010. From the WestWide Drought Tracker.

The 2021 water year was much drier than normal in most of the state (Fig. 3). Preliminary data indicate that parts of Elko and Nye Counties received record low precipitation. Most of the rest of the state had precipitation that was below normal for the water year and in all four seasons (Fig. 4). Parts of northern Nevada received relatively normal winter and late summer precipitation. Although the winter was very dry in southern Nevada, the summer monsoon was active, bringing sometimes heavy rain to the area.

Temperatures were far above normal over most of the state in the autumn, spring and summer, but winter temperatures were near normal (Fig. 5). Overall, the water-year average temperatures reached record highs in parts of Mineral and Esmeralda Counties. The vast majority of the state was much warmer than normal -- near the top 10% of the historical record (Fig 3).

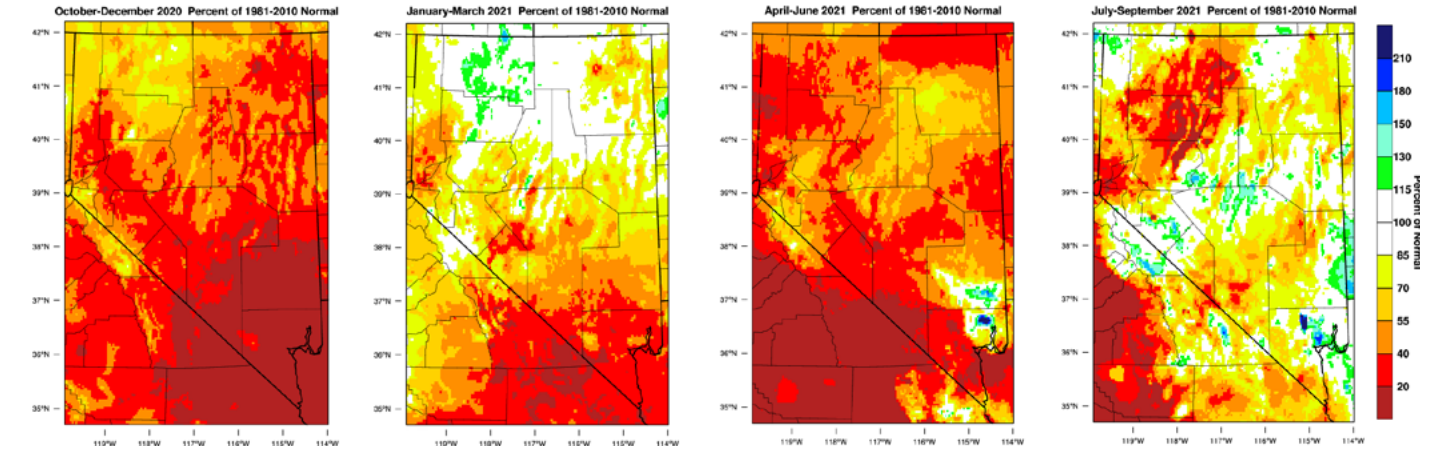

Fig. 4. Percent of seaonal average precipitation. From the WestWide Drought Tracker.

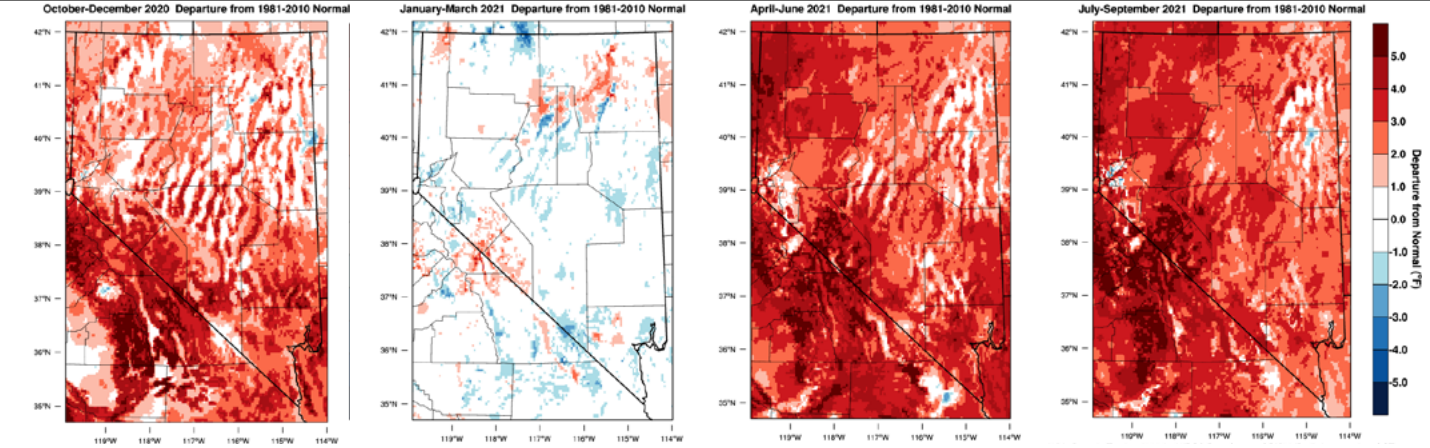

Fig. 5. Difference from seasonal average temperatures (°F). From the WestWide Drought Tracker.

Snowpack

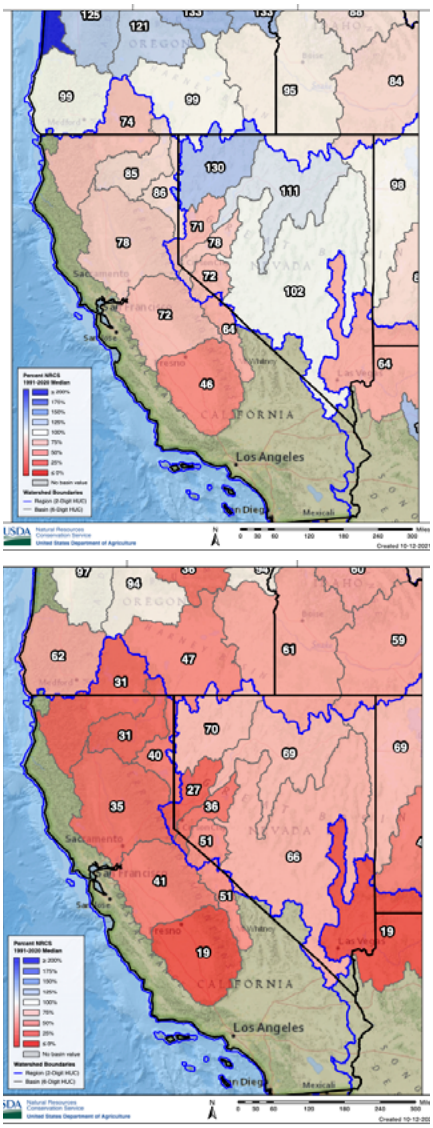

Fig. 6. Percent of normal snowpack in early (left) and late (right) April 2021. From the Natural Resources Conservation Service.

The April 1 snowpack was near or even a bit above normal in much of Nevada. The Sierra Nevada snowpack, however, was about three-quarters of normal (Fig. 6). April was generally warm and dry with many sunny days, leading to rapid snowmelt. More of the snow melted than is usual during April, so by the end of the month, the snowpack was lower, relative to what we expect for that time of year.

Water Resources

Most Nevada reservoirs started the 2021 water year with somewhat less water stored than usual, and many are now even lower. Water levels in Rye Patch, Lake Tahoe and Lahontan were at less than 5% of capacity by late September 2021 (Table 2). A few reservoirs, Boca and Independence Lake in the Truckee system and Lake Mohave in southern Nevada, are somewhat fuller than at the end of the last water year. Only Lake Mohave is close to average end-of water year capacity. Notably, the Lake Mead elevation fell below the Tier 1 cutoff (1075') and was expected to be there in January, triggering a shortage declaration (Fig. 7).

Reservoir	*Average % Capacity*	*Sep 2020 % Capacity*	*Sep 2021 % Capacity*
Lake Tahoe	25	55	4
Marlette Lk nr Carson City	96	94	87
Boca Reservoir	50	34	52
Donner Lake	56	78	35
Independence Lake	87	71	73
Prosser Reservoir	45	44	35
Stampede Reservoir	68	51	35
Lahontan Reservoir	28	19	2
Bridgeport Reservoir	24	20	10
Topaz Lk nr Topaz	21	14	8
Rye Patch Re nr Rye Patch	15	39	3
Wild Horse Reservoir	43	72	49
Lake Mead	53	39	34
Lake Mohave	88	84	87

Table 2. Reservoir storage in Nevada at the end of September 2020 and September 2021. Data from the Natural Resources Conservation Service.

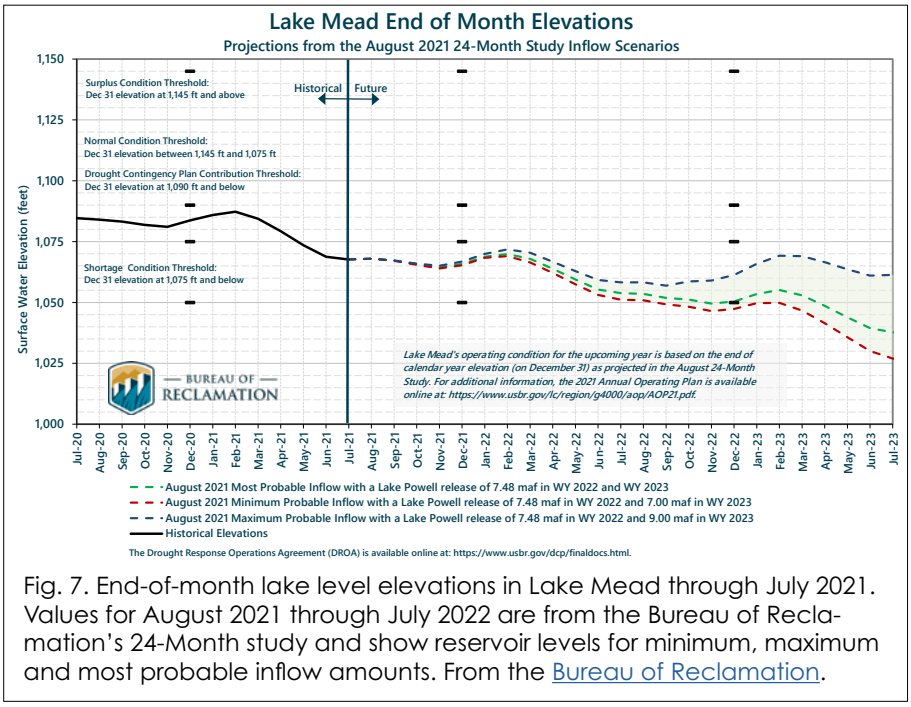

Fig. 7. End-of-month lake level elevations in Lake Mead through July 2021. Values for August 2021 through July 2022 are from the Bureau of Reclamation's 24-Month study and show reservoir levels for minimum, maximum and most probable inflow amounts. From the Bureau of Reclamation.

Floods during a drought?

At the water-year scale -- even at the seasonal scale -- few parts of Nevada received above-normal precipitation. During this summer, parts of Nevada got very heavy rain over fairly short periods of time, leading to flash flooding in places like the Las Vegas Wash and Lamoille Canyon. We can see this situation in the Las Vegas Wash (Fig. 8) where there are short periods of very high flow through mid and late July. That floods don't always end a drought is even clearer on Lamoille Creek. In the early part of July, flow (in blue) is well below the usual flow (orange triangles). In late July and early August, high flows followed fairly intense storms. Once the storms tapered off, flows dropped back below normal, though not as far below normal as they had been. In both cases, the summer storms delivered welcome amounts of water that helped with drought conditions but didn't resolve them entire.

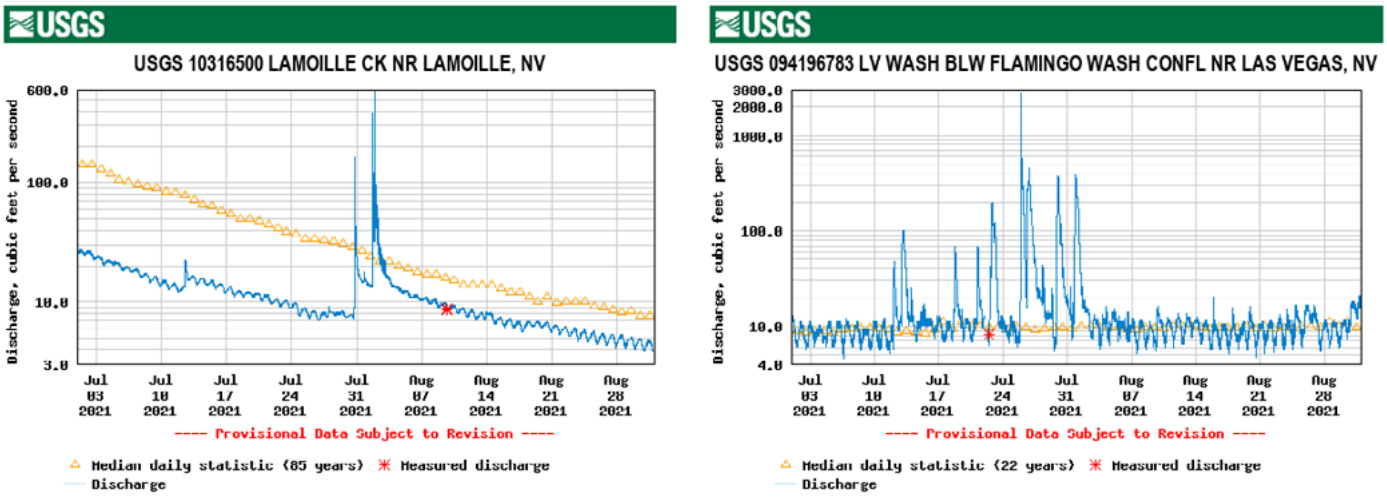

Fig. 8. Streamflow in July - August 2021 (blue line) compared to expected daily flow (orange triangles) in Lamoille Creek (left) and Las Vegas Wash (right) US Geological Survey.

If you're interested in learning more about how much -- or little -- the recent atmospheric river (AR) improved drought conditions in parts of the West, the National Integrated Drought Information System, has put together a Special Report.

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