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Subject: New White Paper: The Future Hydrology of the Colorado River Basin
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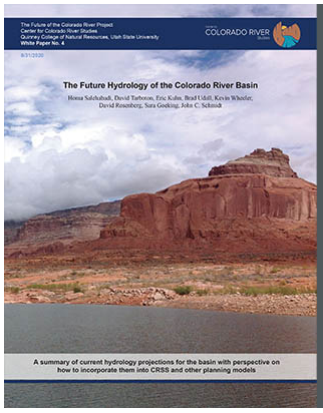

"How dry might future conditions in the Colorado River watershed become? Our analysis is guided by the principle that what has happened in the past might happen again in the future."

A New White Paper from CCRS

The Future Hydrology of the Colorado River Basin

Read the Two-Page Brief
Read the Complete Paper

Long-range planning of the water supply provided by the Colorado River requires realistic assessments of the impact of a continuation of the current drought that began in 2000, the impact of potentially extreme future droughts, and the long-term and progressive decline in watershed runoff that is caused by a warming climate.

In this white paper, we've developed methods to make quantitative estimates of likely future conditions, thereby providing an approximate answer to the question "*How dry might future conditions in the Colorado River*

question, "***How dry might future conditions in the Colorado River watershed become?***" Our analysis is guided by the principle that ***what has happened in the past might happen again in the future***. When viewed from the perspective of past flows reconstructed from tree-rings, or future flows projected from climate models, significantly more severe droughts are not only plausible, but increasingly likely, recognizing that hotter and drier conditions are making matters worse.

We identified the magnitude and duration of the most severe droughts of the past 600 years. Three past droughts stand out in the record of prior flows. We use the term **millennium drought** to refer to the period between 2000 and 2018—mean flow of 12.44 million acre feet/year (maf/yr) for 19 years; 2.3 maf/yr less than the long term mean of 14.76 maf/yr computed from the 1906-2018 natural flow record. The **mid-20th century drought** was the period between 1953 and 1977—mean flow of 12.89 maf/yr for 25 years; 1.9 maf/yr less than the long term mean. Both of these are plausible scenarios of future droughts, because they have occurred in the recent past and indeed may be continuing today. We use the term **paleo tree-ring drought** to refer to the period between 1576 and 1600 that is based on tree ring estimates of streamflow—mean flow of 11.76 maf/yr for 25 years; 3 maf/yr less than the long term mean.

Our results demonstrate that planning in which the 1988-2018 period containing the current drought is used as a stress test might not consider drought scenarios that are sufficiently extreme. The future might be far drier than managers currently anticipate.

An additional aspect of our research is that *we developed and implemented a scheme for incorporation of our estimates of future drought at Lees Ferry into the Colorado River Simulation System (CRSS).*

In the paper:

- Details of three drought scenarios that would severely test the operational rules, and planning and management strategies of the Colorado River system.
- An example of the stresses that a severe sustained drought would place on the Colorado River possibly lowering pool elevations of Lake Powell to levels less than needed to produce hydropower

levels less than needed to produce hydropower.

- An examination of whether the declining streamflow trend in the 20th century is due to the anomalous wet period from 1906-1929.
- Separate sidebar analyses on historical flow in the Colorado River, natural flow losses below Hoover Dam, the estimation of streamflow in the absence of human influence, details of the unusual Early 20th century pluvial period from 1906-1929, and the effects of climate related forest change on runoff.

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