

Supplemental material

Green Light for Adaptive Policies on the Colorado River

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Table S1. Possible near-term unilateral federal actions.

Account for Lower Basin reservoir evaporation as a reduction in water available for delivery:

As a result of the U.S. Supreme Court's decision in the case of *Arizona v. California*, formal water accounting in the Lower Colorado River Basin is limited solely to water released from Hoover Dam for use by parties that hold contracts with the U.S. Department of Interior.[1,2] Evaporation from Lake Mead alone has been estimated at approximately 560,000 acre-feet annually.[3] The lack of accounting for reservoir evaporation, which represents a substantial fraction of the Lower Basin's consumptive use of water, is a major contributor to the gap between water delivered into Lake Mead and water leaving the reservoir. Accounting for evaporative losses from Lower Basin reservoirs as part of the Lower Basin mainstem allocation of 7.5 maf would more accurately reflect the actual water balance in the system.[4]

Account for water ordered but not diverted

Lower Basin water users sometimes order water but later determine not to take delivery. This happens most commonly when agricultural water districts place a water order and then experience rain between the time the water is released from Hoover Dam and the time of delivery. This water is not charged against the users' contracts. While the construction of Brock Reservoir in the Lower Basin and other operational reforms have reduced the amount of this over-delivery, the volume totaled over 40,000 acre feet in 2020.[5] Charging water users with all water ordered would provide additional incentive to use the resource as wisely as possible.

Authorize additional storage credit account volumes in Lake Mead

One of the major policy innovations in the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead was the creation of storage accounts for "Intentionally Created Surplus" (ICS). This overcame the problem of "use it or lose it" – the disincentive for conservation of water because the saved water would be lost to the users doing the conservation.[6] Opportunities for ICS were expanded in the 2019 Drought Contingency Plan. Even so, however, the amount of ICS available to each user is explicitly capped, and access to the mechanism is not universally available. Tribes with Lower Colorado mainstem rights have been concerned with barriers to tribal access to ICS.[7] Raising the caps, expanding the parties eligible, and removal of unnecessary barriers

could create more flexibility for basin water users, encourage additional conservation, and contribute to higher reservoir levels in Lake Mead.

Formation of a sovereign advisory committee with both tribal and state representation for surfacing, discussing, and negotiating tribal issues.

The model for this is the US Sovereign Review Team, formed to assist with the negotiations around the renewal of the Columbia River Treaty between the U.S. and Canada, which includes representatives of the four northwest states, 15 tribal governments, and 11 federal agencies.[8] This type of structure is not intended to substitute for consultation with individual tribes, but can serve as a forum to discuss policy issues and provide tribal perspective.

Table S2: Possible actions that require state concurrence

Limits on new Upper Basin water development to reduce stress on overallocated system.

Limiting future additional water uses in the Upper Basin has been proposed as part of a “Grand Bargain” in which the Upper Basin would commit to limiting its future growth in consumptive use in return for a commitment from the Lower Basin relaxing the requirement of water delivery from the Upper to Lower Basin.[9,10] This concept is difficult as it seems to undermine the intent of the Upper Basin states in negotiating the 1922 Colorado River Compact to avoid having all the water “gobbled up” by the Lower Basin states before the slower developing Upper Basin could use it.[1] But with dependable water supplies significantly lower than existing uses, many stakeholders have noted that additional uses should not be loaded onto an already over-appropriated system.

Measure and account for Lower Basin uses of tributary water

While the Colorado River Compact as written applies to “the Colorado River *and its tributaries*”, the current Lower Basin accounting system as established under the terms of the U.S. Supreme Court’s decision in *Arizona v. California* only accounts for water used from the river’s main stem. Substantial tributary water use, primarily on the Salt-Verde-Gila system in Arizona, is currently not measured and accounted for in Colorado River management, but affects the overall water balance. Lower Basin total use from both the mainstem and tributaries has been estimated at over 9 maf (not including evaporation), significantly more than the 8.5 maf allocated by Articles III(a) and III(b) of the 1922 Compact.[11,12] Accounting for Lower Basin tributary use and limiting total usage to 8.5 maf, would accurately reflect the allocations in the 1922 Compact (though not the interpretation of the U.S. Supreme Court in *Arizona v. California*) and would reduce friction between the basins.

Negotiated reductions in usage in all seven Basin States, considering existing use levels, Compact allocations, Tribal rights, and sector impacts

The Colorado River Compact's fixed allocations of water to the Upper and Lower Basins left little flexibility to manage a river smaller than the framers anticipated. One option that has been proposed, or at least hinted at, is the possibility of negotiated reductions for all users.[13–16]

Adjustment of triggers for balancing releases from Lake Powell to Lake Mead

Under the terms of the 2007 Interim Guidelines, deliveries from the Upper Basin to the Lower Basin vary depending on the levels of each reservoir. In the time since, releases in excess of the amount specified in the Colorado River Compact (7.5 million acre feet or 8.25 million acre feet per year, depending on the interpretation of the Compact's provisions regarding the Upper Basin's share of the Mexican Treaty obligation) have dominated, leaving Lake Powell depleted compared to the amount of water it would otherwise have held, and providing extra water for use in the Lower Basin. Federal statute governs these releases, but provides for reconsideration based on the most critical period of record for streamflow and anticipated future water supplies.[13,17]

Examination of federal permit applications for impact on overall water supplies, with possible requirement for offsets

Federal agencies are required by the National Environmental Policy Act to assess the environmental impacts of proposed federal actions, including permitting decisions. Federal permits are required for almost all significant water projects, including the currently proposed Lake Powell Pipeline and the zombie-like Green River Pipeline project. While NEPA reviews have not historically considered the impact to overall water supplies in the Colorado River Basin or the impact on other water users, the direct effect of new water development on the risk of shortage to other water users in the Basin, and the resulting impact on social, cultural, and economic resources, could be the subject of investigation through an environmental assessment or impact statement.[18]

Federal support for augmentation through recycling and desalination projects.

Water recycling and desalination projects are the only feasible mechanisms for increasing supplies in the Colorado River Basin. They are almost always high cost but have regional and even basin-wide benefits. Planning for one such project, a collaboration among Los Angeles County, the Metropolitan Water District of Southern California, and the Southern Nevada Water Authority, is already underway.[19] The need for federal assistance for these programs has been recognized in the Infrastructure Investment and Jobs Act, HR 3684, through the appropriation of \$1.0 billion for water recycling and reuse projects and \$250 million for desalination projects.

Implement an Upper Basin demand management program

Under the terms of the 2019 Drought Contingency Plan, the states of the Upper Basin agreed to study the creation of a "demand management" program to reduce Upper Basin uses under a voluntary, temporary, and compensated program. The agreement provides that water saved under such a program can be stored in the federal reservoirs in the Upper Basin and will not be subject to balancing releases to Lake Mead pursuant to the 2007 Guidelines. Each of the Upper Basin states is currently investigating the feasibility of a demand management program, but progress has been slow.[20–22] The storage of voluntarily created water savings is currently the only available means for the Upper Basin states to avoid or reduce possible curtailment of water use if the 1922 Compact obligations cannot be met.

Initiation of a process to achieve agreement on measurement of consumptive use.

The creation of a shared and agreed-upon understanding of Basin water use is critical, but remains unresolved.[23] The calculation of consumptive use varies in the Upper and Lower Basin, and among the Upper Basin states.[24] The basic methodology for calculating consumptive use has been a source of controversy for decades.[12]

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