# BEYOND DROUGHT

## The Search for Solutions as Climate Impacts a Legendary River

*By Matt Jenkins*

Fishing boat in the Colorado River Delta. Credit: Pete McBride

**NINETEEN YEARS AFTER IT BEGAN**, a record-setting drought still grips the Colorado River Basin. The so-called "Millennium Drought" is now recognized as the worst of the past century.

On the rocky walls that hem in Hoover Dam and Lake Mead behind it, the deepening drought can be plainly seen in scaly white "bathtub" rings left behind by the falling water levels. Amazingly, thanks to the river's massive reservoir system, no one has been forced to go without water—yet. But officials throughout seven U.S. states, 28 tribes, and Mexico obsessively monitor mountain snowpack estimates each winter in the hope that the coming year might bring relief.

The drought has haunted water managers not only because it has lasted so long, but also because "things turned really bad really fast—much faster than we thought," says Jeff Kightlinger, head of the Metropolitan Water District of Southern California, which supplies water to 19 million people in Los Angeles, San Diego, and surrounding areas.

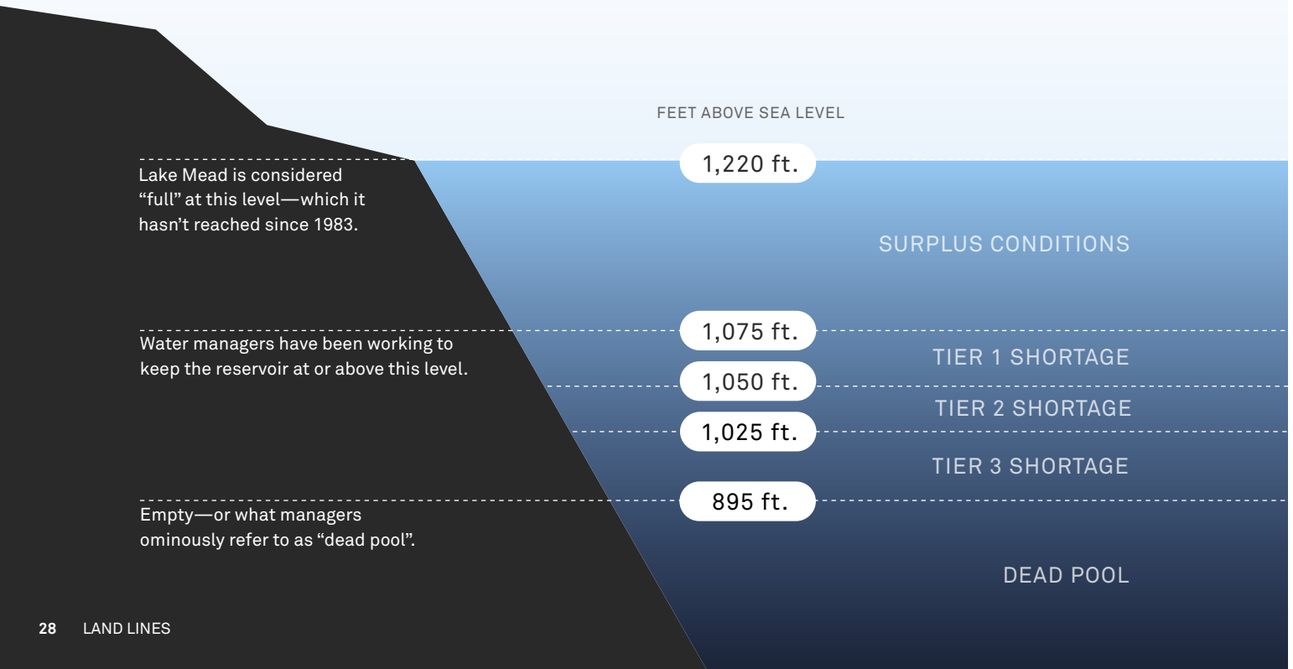
The drought has also brought a series of hard reckonings about the future, and spurred a tremendous amount of soul-searching among those who manage and rely on this river. The unprecedented conditions, along with increasingly available science about the looming impacts of climate change, have forced water managers to contemplate scenarios far outside what they're comfortable with, and to radically rethink some of their most basic assumptions about the river—beginning with how much water it can actually provide.

Over the past decade and a half, water managers have been in near-perpetual negotiations with each other over how to deal with the drought. The tempo of that process has been relentless, and has, at times, had a distinctly Sisyphean air: Negotiators have been working overtime to stay ahead of the problem, yet the drought presses on.

Figure 1

**Lake Mead Key Water Levels**

The shortage levels identified here are found in the 2007 interim shortage guidelines, which provided the first interstate response to the current drought.






The notorious "bathtub ring" at Lake Mead provides inescapable evidence of the severe, ongoing drought. Credit: iStock/Aneese

But something remarkable is happening. The drought has helped bring people together on what has been a famously contentious river. And the so-called "Law of the River"—an accretion of agreements, treaties, acts of Congress, and court rulings often criticized as hopelessly inflexible—may be evolving to meet the hard realities of the twenty-first century.

Throughout much of last year, water managers in the upper and lower Colorado River basins pushed hard to finalize a pair of "drought contingency plans," referred to collectively as the DCP. They are the biggest and most ambitious effort yet to come to terms with the problems on the river. And yet the DCP will ultimately be just a starting point.

"The DCP, in my mind, is like a tourniquet," says Kightlinger—an emergency measure to stanch traumatic fluid loss and stave off shock. "We really need to start pulling together a summit of the states, and say, 'OK, that's bought us a decade or so—but now we need our 50-year plan. So let's get to work.'"

## Dealing with Drought

Like most of us, Colorado River water managers tend to keep a pretty close eye on their gauges. And the single most important indicator on the river is, for a variety of complicated reasons, the water level in Lake Mead, just outside of Las Vegas.

Although it's not necessarily intuitive for laypeople, the water level's elevation above sea level is a proxy for the amount of water in the reservoir. Lake Mead is full when the water level is at roughly 1,220 feet above sea level. "Empty"—or what managers ominously refer to as "dead pool"—lies somewhere around 895 feet (Figure 1).

In 2003, after the severity of the Millennium Drought started becoming apparent, representatives of the seven states that depend on the Colorado—Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming—began meeting to negotiate a plan for softening the blow. Their focus was on holding the water level in Lake Mead at 1,075 feet, or roughly 35 percent of capacity, a level that water managers simply refer to as "ten-seventy-five." If the level dipped down even more, to about 1,025 feet, the U.S. Secretary of the Interior would likely declare a shortage. Avoiding that declaration is important to the states, because if a shortage is declared and the states can't agree how to handle it, the federal government has the authority to take over management of the river.

At press time, Bureau of Reclamation Commissioner Brenda Burman announced a January 31, 2019 deadline for the states to complete their drought contingency plans. Speaking at the annual Colorado River Water Users Association convention, Burman spelled out the consequences of failing to meet this deadline: the federal government will step in to impose cuts in water deliveries. Five of the basin states have approved their plans; Arizona and California announced they are close and expect to finish before the deadline. "'Close' isn't done," Burman said. "Only 'done' will protect this basin."

Together, they came up with the so-called 2007 interim shortage guidelines, the first major interstate agreement about how to respond to the drought. Were Lake Mead to fall below ten-seventy-five, Arizona and Nevada (but not, owing to some complicated legal history, California) would cut back their water allocations in three stages, each progressively more drastic.

Taking this step would force the two states to make do with less water in any given year. But it would also slow the decline in Lake Mead and reduce, or at least delay, reaching more severe drought levels.

The plan included several measures intended to keep Lake Mead above ten-seventy-five for as long as possible. That effort has worked—but just barely. This is in large part because the states and the U.S. Bureau of Reclamation have managed to add an extra 23 feet of water to the lake, primarily due to some irrigation districts and tribes agreeing to cut back on their own water use. But for the past four years, the reservoir has been hovering within feet of 1,075 feet. Meanwhile, scientists have released a succession of increasingly dire projections about the long-term impact that climate change will have on Colorado River water supplies.

To better prepare for worsening conditions, the states' representatives began meeting again to negotiate a new set of drought contingency plans, one for the Upper Basin and one for the Lower Basin. In October 2018, the states, together with the federal Bureau of Reclamation, finally released the draft agreements, which will essentially beef up and expand the 2007 shortage guidelines (Figure 2).

In the Lower Basin, Arizona, Nevada, and California committed to trying to keep Lake Mead above 1,020 feet through the year 2026. To do that, Arizona would progressively reduce its use of Colorado River water by up to 24 percent, a commitment 50 percent bigger than what the state had made under the 2007 guidelines. Nevada agreed to cut its uses by up to 10 percent, also a 50 percent larger commitment than under the 2007 guidelines. Notably, California—whose Colorado River entitlement is effectively the most senior on the river, and therefore is exempt from reductions under the Law of the River and the 2007 guidelines—has agreed to reduce its use by up to eight percent in any given year by "banking" water in Lake Mead. In exchange, California, along with the two other Lower Basin states, will have new flexibility to recover and use this "banked" water for use within its borders when necessary; until it uses the banked water, any such supply will help keep the reservoir elevation higher. The idea is to delay and, with hope, reduce the severity of potential shortages.

In the Upper Basin, meanwhile, the drought contingency plan will set up a "drought operations agreement" to buttress water levels in Lake Powell—which lies to the north of Lake Mead and is now a little less than half full—by sending water down from reservoirs higher in the basin when necessary. Significantly, the Upper Basin DCP will also open the door to a "demand management program"—similar to an arrangement that has existed in the Lower Basin since the 2007 guidelines—that would allow state or municipal water agencies to pay farmers to temporarily cut back on water use in order to put more water in Lake Powell. The DCP also includes a program to augment river flows through cloud seeding—a technology that can increase precipitation levels and has proven popular in the West—and the eradication of water-thirsty plants like tamarisk.

Figure 2

**Proposed DCP Contributions and 2007 Interim Guidelines Shortage Reductions by State**

| PROJECTED JANUARY 1 LAKE MEAD ELEVATION (FEET MSL) | Existing Commitments | | | Proposed Commitments | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 INTERIM GUIDELINES | | MINUTE 323 | DCP CONTRIBUTIONS | | | | BWSCP | |
| | ARIZONA | NEVADA | MEXICO | ARIZONA | NEVADA | CALIFORNIA | USBR | MEXICO | |
| | THOUSAND ACRE-FEET | | | | | | | | |
| At or below 1,090 and above 1,075 | 0 | 0 | 0 | 192 | 8 | 0 | 100 | 41 | 341 |
| At or below 1,075 and above 1,050 | 320 | 13 | 50 | 192 | 8 | 0 | 100 | 30 | 713 |
| At or below 1,050 and above 1,045 | 400 | 17 | 70 | 192 | 8 | 0 | 100 | 34 | 821 |
| At or below 1,045 and above 1,040 | 400 | 17 | 70 | 240 | 10 | 200 | 100 | 76 | 1,113 |
| At or below 1,040 and above 1,035 | 400 | 17 | 70 | 240 | 10 | 250 | 100 | 84 | 1,171 |
| At or below 1,035 and above 1,030 | 400 | 17 | 70 | 240 | 10 | 300 | 100 | 92 | 1,229 |
| At or below 1,030 and above 1,025 | 400 | 17 | 70 | 240 | 10 | 350 | 100 | 101 | 1,288 |
| At or below 1,025 | 480 | 20 | 125 | 240 | 10 | 350 | 100 | 150 | 1,475 |

Mexico, first through Minute 219 and reaffirmed through Minute 323, committed to shortage reductions corresponding to Arizona and Nevada contributions under the 2007 interim guidelines. In Minute 323, Mexico committed to additional BWSCP (Binational Water Scarcity Contingency Plan) contributions, as long as Arizona, Nevada, and California adopt the proposed reductions under the Lower Basin Drought Contingency Plan. The U.S. Bureau of Reclamation (USBR) has also agreed to take reductions in the proposed DCP.

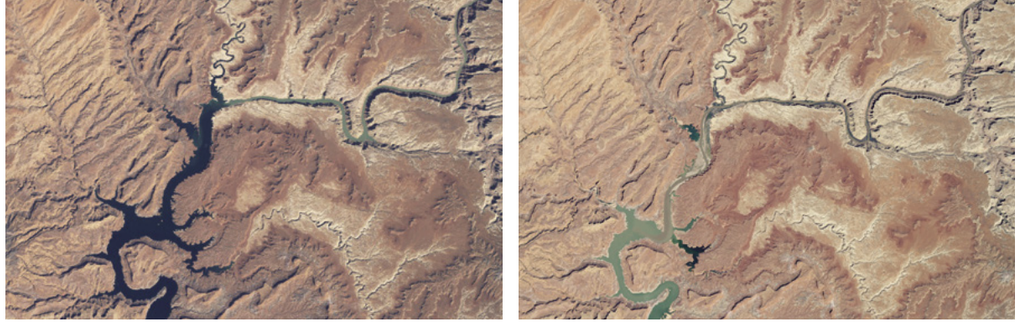
Source: Arizona Department of Water Resources/Central Arizona Project

## Facing Facts

It's never been a secret that there wouldn't be enough water in the river to meet the obligations hammered out among U.S. states, tribes, and Mexico during the twentieth century, and that there would eventually be some hard choices to make. The closest anyone ever got to tackling the issue head-on was in the 1960s, during congressional debates about whether to approve the Central Arizona Project—a massive, 336-mile canal system that diverts water into the southern and central parts of the state—when it became clear that in the future, there would not always be enough water to keep the project's canals full. But Congress essentially punted,

In the course of these complex negotiations, Mexico pledged that if the seven U.S. states could agree on the DCP, it would reduce its use of Colorado River water by up to eight percent. All told, the twin DCPs will be a major step forward. Yet many observers—and water managers themselves—say they still won't resolve the biggest problem that's been haunting the river for decades.

As Doug Kenney, director of the University of Colorado's Western Water Policy program, puts it: "We're just using too much water."



Satellite images reveal the decline in water levels in Lake Powell between 1999 (left) and 2017 (right). Credit: NASA

authorizing studies to evaluate ambitious plans to "augment" the flow of the Colorado River through a number of approaches. Those included cloud seeding, desalination of both ocean water and saline groundwater, and "importing" water from other rivers—including an early attempt to target the Columbia River, more than 800 miles away in the Pacific Northwest, an idea that was swiftly beaten back by the Washington congressional delegation.

For the next several decades, the issue went forgotten, for the simple reason that no one needed augmentation. But the conversation has begun to come full circle as demand has grown, the basin has been in a drought cycle, and climate change has diminished supplies. "Inventing augmentation," says Eric Kuhn, who for decades led the Colorado River Water Conservancy District in western Colorado, "was a way of putting off the pain into the future, and the future is here."

The first hints that the problem was no longer a purely theoretical possibility came in the mid-1990s, when California, Nevada, and Arizona began running up against the limits of their Colorado River entitlements. The Upper Basin states began worriedly asserting that there was not enough water left for them to ever receive their full entitlements under the Colorado River Compact.

Then came the drought, which transformed these pinch points into actual pain. On top of the drought and usage issues, there's some basic math making things even more challenging: Each year, massive amounts of water—some 600,000 acre-feet, enough water for nearly half a million people—simply evaporate from Lake Mead. The traditional accounting system under the Law of the River failed to budget for the water lost to evaporation. In addition, Mexico's share of the river water is simply "deducted" from the shared supply in Lake Mead, rather than being divvied up among the states. Together, evaporation and the Mexico delivery draw roughly 1.2 million acre-feet more water from Lake Mead each year than is released from Lake Powell, upstream—even without a drought (Figure 3).

Under the 2007 shortage guidelines, the Lower Basin states can receive extra water—so-called equalization releases—if river conditions are good enough. But "in most years, we're still going to have a deficit at Mead of a million or more acre-feet," says Terry Fulp, the federal Bureau of Reclamation's Lower Colorado regional director.

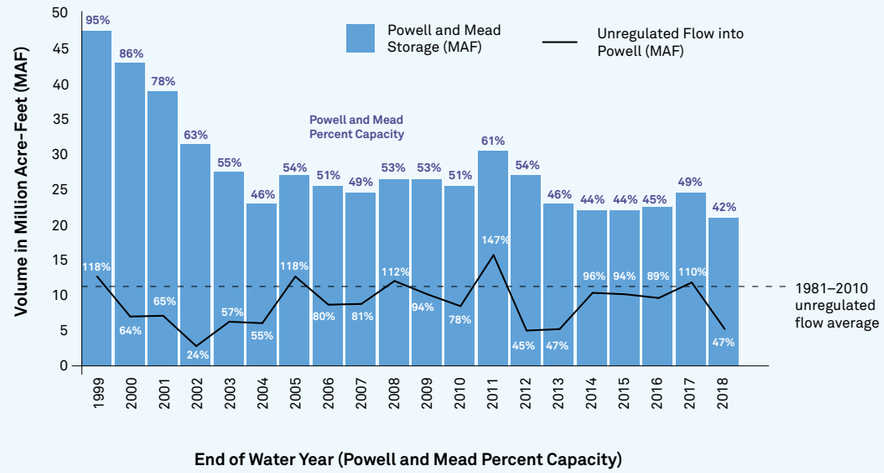
That imbalance has come to be known as "the structural deficit," and it lies at the heart of the Colorado River's problems. "It's a code word, in my mind, for overallocation," says Fulp. "We've got an absolutely overallocated system" (Figure 4).

Untangling this problem will be key to long-term sustainability on the river. It will also be a tremendous challenge—and tremendously expensive. The 23 feet of water the states have managed to add to the water level in Lake Mead since the DCP negotiations began has cost at least $150 million.

That slug of extra water is "important when you're right at the threshold," says Kenney of the University of Colorado. But in the bigger picture, he says, "it's a terribly small amount of water, and it's a terribly big price tag." Truly stabilizing the system will require much bolder action, and will cost far more.

Figure 3

**Combined Lakes Powell & Mead Storage and Percent Capacity and Unregulated Inflow into Lake Powell**




Values for Water Year 2018 are projected. Unregulated inflow is based on the latest Colorado Basin River Forecast Center forecast dated June 18, 2018. Storage and percent capacity are based on the June 2018 24-Month Study. Percentages on the black line represent percent of average unregulated inflow into Lake Powell for a given water year. The percent of average is based on the period of record from 1981–2010. (Unregulated inflow is an estimate of what the natural inflow into Lake Powell would be without upstream dams and diversions.)

Source: U.S. Bureau of Reclamation

## Beyond DCP

So what might efforts beyond DCP actually look like?

"You've got to be focused on reducing the absolute load on the system," says Peter Culp, an Arizona-based water attorney who works on a variety of Colorado River law and policy issues involving municipal, nongovernmental, and private sector interests. But because of wild swings in natural variability like the current drought, he says, "you also need to be prepared to deal with higher levels of instability."

As the states begin to look at longer-term solutions, several broad possible components seem likely to come to the fore:

### AUGMENTATION

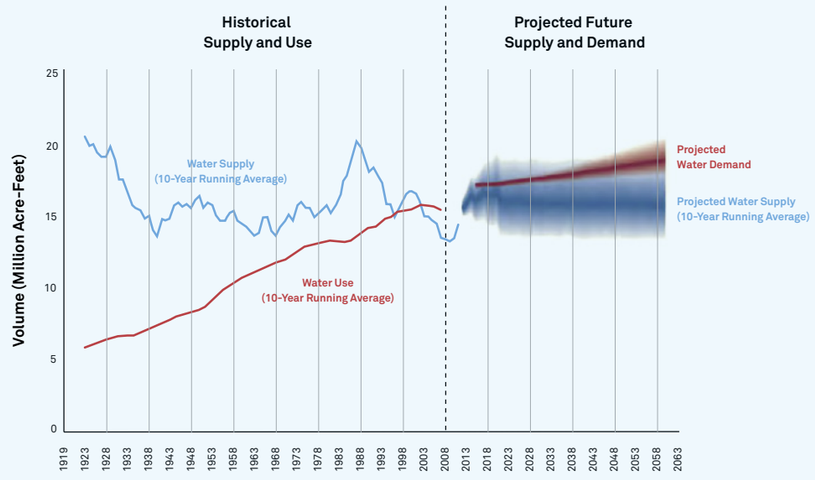
Today, the term has a far more modest connotation than it did in the 1960s, when vast water-importation plans and massive nuclear-powered desalination plants seemed within the realm of feasibility. Conventionally powered desalination of seawater is now the augmentation option cited most frequently, although the sole operating example is the Poseidon desalination plant that serves San Diego. It produces a relatively modest 56,000 acre-feet per year at a cost double that of water supplied from the Colorado River (Hiltzik 2017). Cloud seeding—artificially induced rainfall—has been carried out for decades, but has only limited effectiveness.

"Augmentation is part of the portfolio," says Chuck Cullom, the Central Arizona Project's Colorado River programs manager, "but there aren't, and have never been, any silver bullet answers." Augmentation projects, he says, "are all going to be hard-fought, challenging, modest-sized—and more expensive than we thought."

Figure 4

**Historical Supply and Use and Projected Future Colorado River Basin Water Supply and Demand**

Water use and demand include Mexico's allotment and losses such as those due to reservoir evaporation, native vegetation, and operational inefficiencies.




## MARKETS, LEASING, AND TRANSFERS

The ability to move water between water-rights holders will play a huge role in increasing the flexibility needed to weather the looming problems on the river. Although there are still gains to be made in urban water-use efficiency (think reduced water use for grass and landscaping), the needs of the 40 million primarily urban, individual water users who rely on the basin are relatively inelastic. A discussion is slowly taking shape about ways in which cities can make deals to acquire water from both native tribes and farms in a way that doesn't threaten the survival of any of those three sectors.

## TRIBAL RIGHTS

Local tribes will likely play a bigger role in meeting future demands, particularly in Arizona, where their right to significant amounts of water has recently been affirmed (see map of tribal water rights page 20). "The tribes are increasingly important political players, and they are increasingly important in this idea of leasing and flexibility within the existing rules," says Dave White, who heads Arizona State University's Decision Center for a Desert City, which is largely focused on finding ways to help policy makers make better decisions about uncertain futures. "That makes them an important lynchpin in moving from the current allocation system to the future one." Tribes have rights to an estimated 2.4 million acre-feet of Colorado River water (Pitzer 2017).

Daryl Vigil is the water administrator for the Jicarilla Apache Nation in New Mexico and spokesperson for the Ten Tribes Partnership, which has long pushed for the ability to lease its members' water to other users. Vigil says that in an era of drought and climate change, tribal water can help cities and other users stabilize their water-supply portfolios while securing much-needed revenue. "Right now, there are tribes that, because of infrastructure issues or policy issues, aren't able to develop their water rights, so it's just going downstream" and being used by non-tribal entities without compensation, Vigil says. "To a large degree, we're already the solution to a lot of these issues, but we're not getting any kind of credit for it."

Some tribes have already been able to parlay their water rights into revenue. The Jicarilla Apache tribe, for example, leases water to the federal Bureau of Reclamation to provide minimum river flows for endangered fish, and the Gila River Indian Community in Arizona struck a deal with the Bureau, the State of Arizona, the City of Phoenix, and the Walton Family Foundation to not take 80,000 acre-feet of its water in 2017 to boost levels in Lake Mead.

The Central Arizona Project cuts through farmland that relies on the complex irrigation system. Farmers in central Arizona would be among the first to face cuts under the proposed drought contingency plan. Credit: Central Arizona Project

## AGRICULTURE

Farms will also play a big role in a more comprehensive solution on the river. Although agricultural use has been declining in some areas, it still accounts for around 75 percent of water use in the basin, the vast majority of which is used to grow forage and pasture, like alfalfa, for beef and dairy cattle. Farm water supplies could potentially be used for farm-to-city water transfers, or to help cushion the impact of temporary shortages on cities.

In fact, the framework for agricultural-to-urban water transfers on the Colorado River was first created in the late 1990s. The years since have seen a series of test runs and a slow expansion of the concept throughout the basin and even across the border to Mexico. The terms of the 2007 interim shortage guidelines allow irrigation districts in Arizona, California, and Nevada to "forbear"—that is, to forgo the use of a portion of their water allocation for a year, thereby freeing up water to be stored in Lake Mead for drought protection. The proposed Demand Management Program included in the Upper Basin drought contingency plan would open the door to a similar framework there.

Water for such programs can be generated in a variety of different ways: simply by fallowing farmland (i.e., taking it out of production), thereby freeing up the water that otherwise would have been used to grow crops there; by switching to crops that consume less water; or by improving irrigation efficiency and transferring the conserved water. Although transferring water away from farms is, in the public imagination, often equated with drying up farms and putting them out of business, there is a long history of innovative thinking about how farms can generate water for uses elsewhere while remaining financially viable. In California, for instance, the Palo Verde Irrigation District has been the focus of a long-running "rotational fallowing" program to generate water for the Metropolitan Water District, under which at most 29 percent of the irrigation district's farmland is fallowed in any given year.

The transfer of water from farms to cities, either temporarily or permanently, is an extremely controversial issue. Any discussion of the topic—especially in central Arizona, where farmers would be the first to have their water cut due to contractual agreements made well before the current negotiations began—quickly moves from technical talk of crop consumptive water-use coefficients to basic questions of social equity.

"That's the crux of the problem: Do people perceive that the pain is distributed fairly?" says Cullom. The drought and the contingency-planning process, he says, are forcing people to come to terms with "the visceral understanding of what a future with less water looks like."

## Win, Lose, or Draw

Back in the early 1990s, a consortium of university researchers used computer models to simulate a "severe and sustained drought" on the river, in an effort to see how water users might respond. The simulated drought used in the exercise would ultimately prove to be eerily similar to the Millennium Drought that took hold less than a decade later. But at the time, notes Brad Udall, a senior water and climate research scientist at Colorado State University, barely any water managers bought into the drought-simulation effort. "The academics wanted to go push all this stuff, but they couldn't get any decision makers to participate," he says. "Nobody wanted to lay their cards out."

If there's one upside to a 19-year drought, it may be that it has opened up conversations that wouldn't otherwise be happening. The players are increasingly willing to lay their cards on the table. And the past 19 years have shown that some problems on the Colorado can be addressed, for better or worse, not through radical change but through incrementalism, with the stakeholders gradually playing one hand after another.

But now the stakes are getting higher. Even as representatives of the seven states were in the midst of negotiating the drought contingency plans, climate scientists were delivering more bad news: The Colorado River Basin may be on the brink of a permanent shift into a much drier reality. In 2017, Udall and Jonathan Overpeck, now the dean of the University of Michigan's School for Environment and Sustainability, found that increasing temperatures could cause the flow of the Colorado River to decline by more than 20 percent at mid-century and 35 percent at the end of the century.

"Regardless of what level of demand management you are prepared to do," says Arizona attorney Culp, "that's a really big problem."

The states' negotiators will not get much reprieve before they have to tackle the next round of even tougher questions: The provisions of both the 2007 shortage guidelines and the arduously negotiated DCP, if adopted, will expire in 2026, and the states have agreed on the need to open negotiations for a follow-on agreement just a year from now, in 2020. That next phase will likely serve as the forum for tackling the bigger issues on the river.


A California highway sign urges residents to conserve water. The 2007 shortage guidelines do not require California to reduce the amount of water it takes from the river; the proposed drought contingency plan would change that (see page 31). Credit: Caltrans

"We have to find a way to permanently reduce our demands, and find a way to augment our supply," says Kightlinger of California's Metropolitan Water District. That effort, he says, won't be fast or easy—and Dave White of the Decision Center for Desert City suggests it might require "recalibrating the entire system to what we think is the new availability of water."

Are people willing to commit to a recalibration or radical overhaul of the way the river is managed, or will they simply adopt a more ambitious follow-on to the operational "updates" of the 2007 interim shortage criteria and the drought contingency plan? A wholesale revamp of the Law of the River—what Fulp calls "the start-over scenario"—is politically taboo for water managers.

Yet the DCP may be the first step in subtly steering everyone into that difficult conversation. The emphasis on tackling "drought"—rather than overuse—may have been a considered move on the part of negotiators. "Politically speaking, I think it's a useful word for the states," says Kenney. "To the extent that you talk about drought contingencies and shortage, you're talking about what we're going to have to do in an emergency."

The message, he says, is that "the drought is getting really bad, and we have to make some adjustments. But"—at a time when the Colorado River states are running up against the limits of their allocations—"the reality is that it doesn't take an emergency to get you to shortage. It doesn't take an emergency to crash the systems. Just business as usual [has the potential to] crash the system" if the drought worsens.

In spite of calls for radical reform on the river, the key to a durable solution—which may ultimately be just as important as a comprehensive solution—could, paradoxically, be to go slow. "Incrementalism allows people to get comfortable with changes a little bit at a time," says Kuhn of the Colorado River Water Conservancy District. "And I actually think the incremental change will happen as fast as necessary to adapt to the real-world conditions."

That approach is obviously not without its risks. The primary result of all the negotiations that have occurred since 2003, which have all but consumed the lives of those involved in them, is that water managers have so far managed to push off a shortage declaration by the federal government by just three years. If negotiators continue to work incrementally, will they be able to keep pace with how quickly the system is changing?

No one knows, and the river isn't telling. But for now, the DCP process has bought everyone a little time to catch their breath. "[DCP] will get the risk back down," says Fulp. "It will give us that time to really open up the dialogue on much bigger, and much more difficult, issues."

**Matt Jenkins** has been covering the Colorado River since 2001, primarily as a longtime contributor to *High Country News*. He has also written for *The New York Times*, *Smithsonian*, *Men's Journal*, *Grist*, and numerous other publications.

### ON THE COLORADO RIVER, CHANGE IS THE CONSTANT

After nearly 16 years of negotiations, water managers seemed to have staved off disaster—for now. Will the next round of negotiations, which begins in 2020, be able to keep pace with how quickly the Colorado River system and conditions in the basin are changing? Dr. Jim Holway of the Babbitt Center for Land and Water Policy thinks it's going to take significant change. "I believe we will need institutional, policy, and infrastructure changes to sustainably manage the river," Holway says. Citing challenges including climate change, highly variable conditions, population growth, conflicts over the Law of the River, and increasing water costs, Holway explains that the Babbitt Center exists to recognize and address these challenges, with a particular focus on connecting land use decisions and sustainable water management at the local level (see page 6). Looking beyond 2026, when both the interim shortage guidelines of 2007 and the proposed DCP modifications expire, Holway identifies a central question: "How do we best prepare for this future, and how do we ensure our policies and decision makers at every level are up for the challenge—and able to quickly adapt as conditions change?"

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