

PERCREPORTS

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The United States is experiencing its worst drought in more than a millennium. In August, the federal government issued its first-ever “Tier 2” shortage declaration for the Colorado River, which supplies water to seven western states and Mexico. Lake Mead and Lake Powell—the river basin’s two largest reservoirs—have dipped to all-time lows, exposing dry lakebed, sunken boats, and even dead bodies.

The shortages are not limited to the Colorado River. Utah’s Great Salt Lake is now at its lowest level ever recorded. Groundwater wells in California are running dry. Most of Oregon is under emergency drought conditions. Even the Mississippi River, which typically receives abundant rainfall, has fallen to record low levels, clogging one of the nation’s busiest waterways.

In the American West, the response to drought has historically been to divert more water, build dams, or pump groundwater. But many of those options are no longer politically or economically feasible. To adapt, western communities are going to have to find ways to do more with less water—and to do so through cooperation instead of conflict.

Times of crisis can spur innovation. Western cities are already taking creative steps to cut water use even while their populations grow. And water districts and agencies are exploring ways to pay farmers—which consume the majority of water used in the West—to voluntarily reduce water use.

But policy barriers stand in the way of more widespread adaptation to the West’s drier future. Restrictions on water trading prevent water from being moved from lower-valued to higher-valued uses. Legal rules prohibit water users from leasing or selling their conserved water. Prices are distorted in ways that result in overuse. And regulations can have the perverse effect of discouraging voluntary water conservation efforts.

This special issue of *PERC Reports* explores the West’s water crisis and how markets can address today’s shortages. In the pages that follow, you’ll hear about farmers getting paid to cut water use (p. 16), groundwater users trading pumping rights to allocate a scarce resource (p. 30), and states reforming water policies to encourage conservation (p. 38). You’ll also read about how federal laws are preventing Native American tribes from leasing their water rights like other Americans can (p. 24), and how one family’s fight with the federal government over expansive water regulations could affect the future of wetland conservation (p. 46).

While people can’t control drought conditions, the policies and laws they choose affect the severity of water shortages. The essays in this issue demonstrate that, while the current drought may be severe, it can spur policy reforms and water-saving innovations that enable humans and the environment to flourish, even amidst historic challenges.



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Cover Photo:
Great Salt Lake, Utah
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Keep It in the Ground

Innovative use of an old conservation tool helps save a western aquifer



Flowering potato plants in Colorado's San Luis Valley

The San Luis Valley of Colorado has been described as “a bowl of high desert” and “one of the largest alpine valleys in the world.” Flanked by the towering San Juan and Sangre de Cristo Mountain Ranges, you won’t find the crowded subdivisions of the state’s Front Range here. This is arid farm country, uniquely suited to growing potatoes, barley, and alfalfa. There’s a good chance that if you’ve ever savored a cold Coors beer, you can trace its birth to barley grown in the San Luis Valley. The area is blessed with interspersed wetlands too, making it a key Central and Pacific Flyway stopover for migratory ducks, water birds, shorebirds, and the iconic sandhill crane.

As with most of the West, the San Luis Valley also has a drinking problem: Its irrigators are consuming too much of what is already too little water available due to historic droughts.

The region receives less than eight inches of precipitation each year, and its surface water has been over-appropriated since the early 1900s. At that time, farmers and ranchers turned to extracting groundwater from the two aquifers underneath the valley. But by 1981, groundwater depletion had become such a concern that a moratorium was imposed on new well permits. Today, continued groundwater overdraft threatens not only injurious depletion of water for more senior rights holders, but also wetland ecosystems.

Many places in the West are, like the San Luis Valley, at a tipping point. As PERC’s Shawn Regan notes in these pages, “In the American West, the response to drought has historically been to divert more water, build dams, or pump groundwater.” That is simply not an option in this treasured part of Colorado, where the state has already issued more well permits than the aquifers can support, and the forced shutdown of thousands of wells by regulatory action is imminent. The circumstances have called for more innovative solutions.

That is where Colorado Open Lands came in. The not-for-profit land trust and other partners conducted a groundwater feasibility study in 2018 to explore how traditional, voluntary land conservation tools could be applied to groundwater conservation in the San Luis Valley. One of the voluntary tools considered was a conservation easement.

Conservation easements are legal agreements with landowners to protect open space, wildlife habitat, and even streams and wetlands by forgoing development rights in exchange for cash payments and tax benefits. Beginning in 1980 with changes to federal tax laws, conservation easements became a frontier of conservation, accelerating the creation of land trusts, such as Colorado Open Lands, to facilitate these agreements.

Over the past 50 years, an estimated 40 million acres—an area the size of Wisconsin—have been conserved by conservation easements on private lands. Colorado Open Lands alone has conserved more than half a million acres in the state. But the organization found a way to dig deeper into innovative ways to use conservation easements to support the region's two underground aquifers.

In 2022, Colorado Open Lands entered into a conservation contract with a farmer in the San Luis Valley who historically used 1,800 acres of his land to grow peas and oats. Now called a “groundwater conservation easement,” the contract ends the farmer's water rights to grow food, regardless of who owns the land in the future. In exchange for compensation and tax benefits, the landowner has agreed to stop irrigating, conserving nearly 400 million gallons of water in the aquifers underneath the San Luis Valley. According to Colorado Open Lands, the arrangement could be the first of its kind in the country.

While the groundwater conservation easement will help recharge the aquifer underneath it, notably, it will help save other farms in the valley too. Not because the farms would be entitled to use the surplus water—they won't. But it will benefit neighboring agricultural operations because the additional 400 million gallons will restore the aquifer to a sustainable level that avoids a mandated state shutdown of wells—an outcome that would be catastrophic not only to farms in the valley, but also to habitat for waterfowl and wildlife that's supported by irrigated water.

Moreover, the innovative agreement to conserve groundwater is a permanent solution. The inflexibility inherent to such permanence has been a criticism of conservation easements by some. But the reality in the San Luis Valley is that the use of temporary solutions, such as voluntary seasonal cutbacks by ranchers and farmers or water leases, have not been enough to avoid state-imposed mandates to reduce water use.

While forgoing agriculture operations on a farm that has existed for 150 years may not always be an optimal outcome, it worked in this specific case. The farmer had no children, was looking to exit the business, and wanted to find a way to help

the larger community. And not all farms using this innovation would have to stop farming. In practice, farmers could suspend a portion of their groundwater use through an easement, while retaining enough groundwater to convert to less water-intensive crops or agricultural activities.

Cleave Simpson, a neighboring rancher and farmer who also serves as the region's state senator and manager of the Rio Grande Water Conservation District, says that groundwater conservation easements can be one tool that helps avoid economic disaster in the valley. For one thing, it can give landowners more options to make money off of their water rights. And for another, it is also a way of keeping water in the valley rather than selling it to support further development on the Front Range.

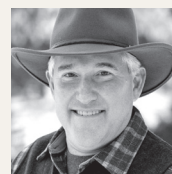
There is no simple solution to western water shortages, and tools that work in one place will often not be appropriate even in the next valley over. The groundwater crisis in the San Luis Valley is dire, yet it has primed the pump of innovation. It remains to be seen whether the groundwater conservation easement will become as widely

deployed as its older sister, the land conservation easement. But the more options that we can add to the conservation toolkit, the better the West will fare in facing down its water woes.



© Colorado Farm Bureau

In exchange for compensation and tax benefits, the landowner has agreed to stop irrigating, conserving nearly 400 million gallons of water in the aquifers underneath the San Luis Valley. According to Colorado Open Lands, the “groundwater conservation easement” could be the first of its kind in the country.



Brian Yablonski is the CEO of PERC. In “Frontiers,” he describes how PERC seeks to advance creative conservation through incentives, innovation, and cooperation.

© Judy Callagher



Contracting conservation. A new Maryland law is clearing the path for private investment to improve the environment. The Conservation Finance Act allows the state to contract for environmental outcomes, such as the restoration of habitat, the same way it does for traditional infrastructure projects. The law not only engages businesses in the state’s conservation efforts but also harnesses the power of environmentally conscious investors who are increasingly backing up their concern for the planet with targeted investments. Moreover, the act establishes a commission to expedite permitting reviews, ensuring that bureaucratic processes do not unduly delay work that benefits fish, wildlife, and the climate.

Don’t fear the coral reefer? The Nature Conservancy has taken out a \$2 million insurance policy for Hawaii’s coral reefs. The group is paying a \$110,000 premium to insure reefs along the Hawaiian Islands against damages from severe storms through 2023. Payouts begin if wind speeds reach 50 knots. The money would be used to repair reefs by reattaching fractured fragments using cement and epoxy or growing new corals in a nursery. The group previously helped develop a similar policy for reefs off the coast of Mexico’s Yucatán Peninsula, resulting in the first-ever coral reef insurance payout in 2020 after Hurricane Delta battered the region.



© SnorkelingDives



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Up in smoke. With policy moves like a 2035 ban on new gas-powered cars, California fashions itself as a leader in environmental progress. News from a recent UCLA study, then, makes for tough reading in the Golden State. Researchers found that the devastating wildfire season of 2020 emitted so much carbon that it wiped out 18 years of greenhouse gas reductions in the state. The authors noted that “decades of fire suppression and underinvestment in preventive measures such as mechanical clearing or prescribed burns” had exacerbated fire risk, a well-trodden topic at PERC.

Dude, where’s my parking revenue? Great Smoky Mountains National Park has announced a novel initiative to raise dedicated revenue for the park. Starting in March 2023, all visitors will need a parking pass, priced at \$5 per day, \$15 per week, or \$40 per year. A new parking scheme may not seem like much of an innovation, but it is in the nation’s most visited park, where state law prohibits charging the entry fees required at many other national parks. The program will generate much-needed revenue given that visits have jumped by 57 percent over the past decade, yet the park’s budget has flatlined. All of the funds collected will be retained in the Smokies to protect park assets, make needed repairs, and enhance the visitor experience.



© GSMNP



Hannah Downey and Jonathan Wood

Conservation should unite. In September, PERC launched the Conservation Law and Policy Center to establish a direct pipeline from its research and idea generation to legal and policy reform. Too often, regulations penalize conservation rather than reward it. The center advances reforms that respect property rights, expand incentives for voluntary stewardship, and empower people to improve conservation through markets. Led by PERC Vice President of Law and Policy Jonathan Wood and Policy Director Hannah Downey, the center will coordinate PERC’s legal research, policy outreach and education, amicus briefs, agency comments, and related work to help put market solutions to conservation into action.



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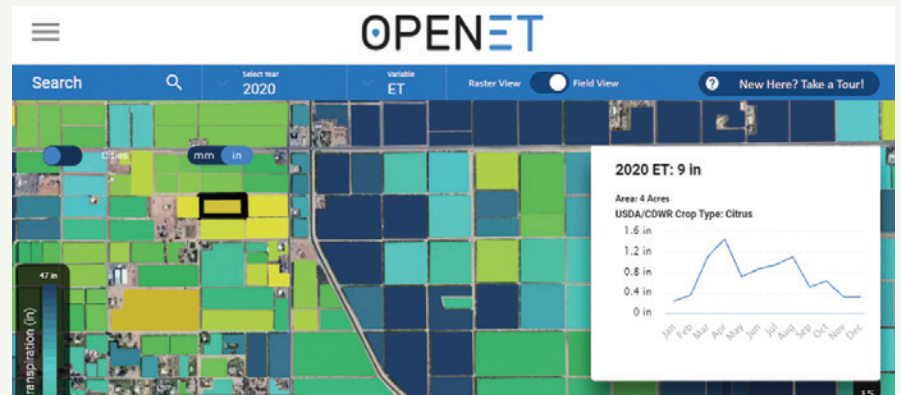
Saving water by cutting taxes?

Several western states use property taxes to subsidize municipal water, rather than having consumers pay usage rates that reflect the full price of water. The approach discourages conservation and almost guarantees overuse. A new report by the Utah Rivers Council calls for a change as the West faces severe drought and the Great Salt Lake dwindles. The report estimates that Utah, which has some of the highest rates of municipal water use per person in the nation, could lower demand by one-quarter if it stopped subsidizing water for consumers through property taxes.

Incentives matter. A 2021 state law in Utah could help explain a recent surge in child support payments. The law stipulates that anyone past due on child support by \$2,500 or more cannot receive a hunting or fishing license. State Rep. Karianne Lisonbee, author of the bill, told NewsNation that she heard from constituents who “had noncustodial partners that were overdue on child support and going out and spending lots and lots of money hunting and fishing.” Last July, about 3,000 people were blocked from receiving licenses; 12 months later, nearly 500 of them had come into compliance.



© USFWS Pacific Southwest Region



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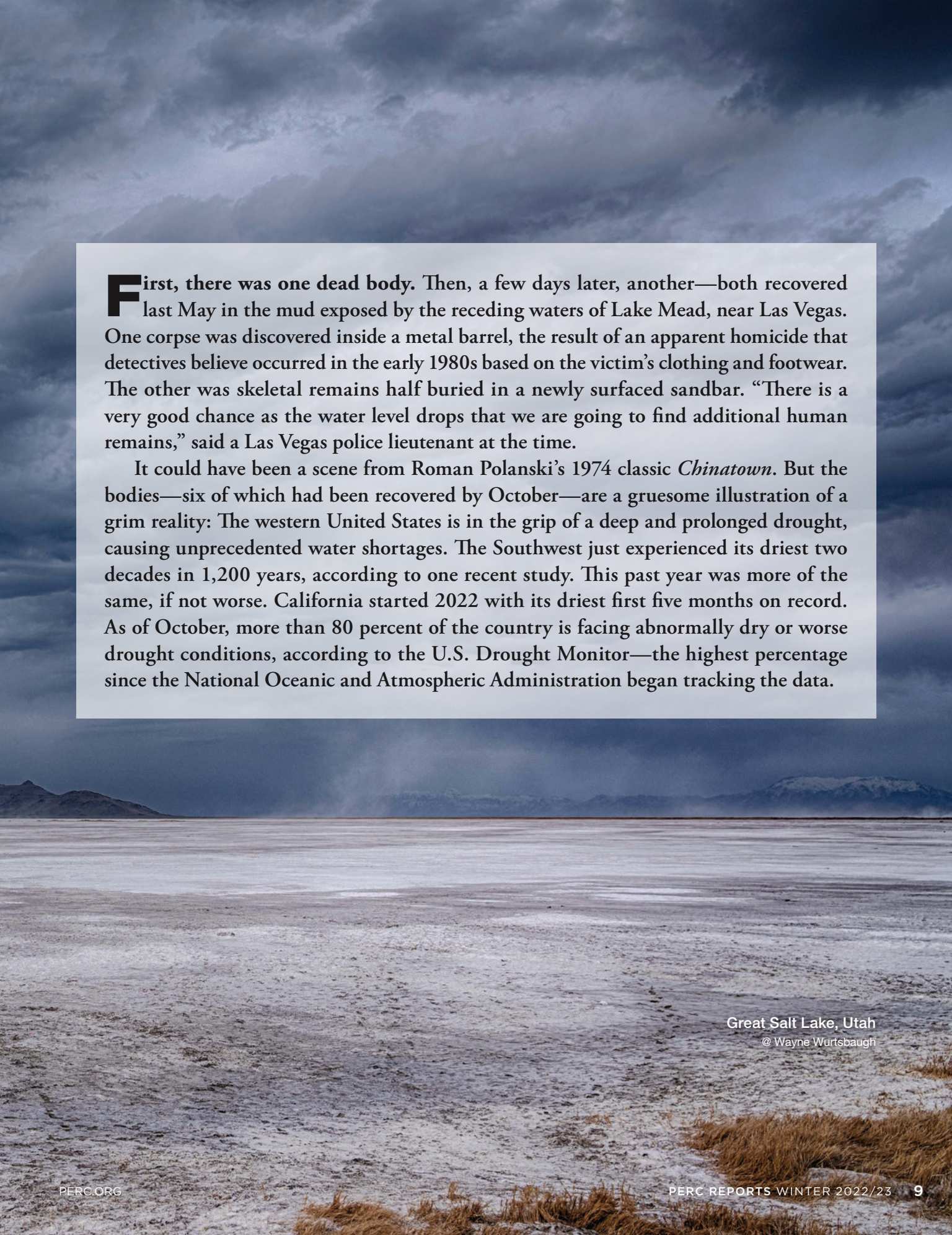
Tracking water from space. For many western farmers, an affordable and precise way to measure their water use remains elusive. OpenET aims to change that by making satellite-based evapotranspiration data available to growers in 17 states from Texas to Washington. As water evaporates from vegetation into the atmosphere, plants cool. Thermal and optical sensors on satellites can measure that cooling effect, allowing OpenET to estimate water use down to the field level. The initiative, which uses publicly available data, is already helping bridge one of the biggest information gaps in water management in several places in the West.



DOWN TO THE LAST DROP

Can the West adapt to its even drier future?

BY SHAWN REGAN



First, there was one dead body. Then, a few days later, another—both recovered last May in the mud exposed by the receding waters of Lake Mead, near Las Vegas. One corpse was discovered inside a metal barrel, the result of an apparent homicide that detectives believe occurred in the early 1980s based on the victim’s clothing and footwear. The other was skeletal remains half buried in a newly surfaced sandbar. “There is a very good chance as the water level drops that we are going to find additional human remains,” said a Las Vegas police lieutenant at the time.

It could have been a scene from Roman Polanski’s 1974 classic *Chinatown*. But the bodies—six of which had been recovered by October—are a gruesome illustration of a grim reality: The western United States is in the grip of a deep and prolonged drought, causing unprecedented water shortages. The Southwest just experienced its driest two decades in 1,200 years, according to one recent study. This past year was more of the same, if not worse. California started 2022 with its driest first five months on record. As of October, more than 80 percent of the country is facing abnormally dry or worse drought conditions, according to the U.S. Drought Monitor—the highest percentage since the National Oceanic and Atmospheric Administration began tracking the data.

Great Salt Lake, Utah
@ Wayne Wurtsbaugh

The drought is especially pronounced in the Colorado River Basin, which supplies water to 40 million people across seven states and Mexico and provides irrigation to more than 5 million acres of farmland. Water levels in Lake Mead and Lake Powell, the basin's two largest reservoirs, have dropped to their lowest levels since they were filled in the early to mid 20th century. In response, the federal government has recently issued its first formal shortage declarations for the river, triggering a series of mandatory water-delivery reductions. Additional cutbacks are likely coming soon.

The region's water supply has plummeted to levels unanticipated even just a few years ago. At the start of the 21st century, Lakes Mead and Powell were nearly full. Now both are below 30 percent capacity. If water levels drop much farther, officials warn, the dams' turbines will no longer be able to generate

electricity, creating additional power-supply challenges for a region already at elevated risk of rolling blackouts this summer because of extreme heat and increased reliance on intermittent wind and solar energy. And if they decline farther still, the reservoirs could reach "dead pool" conditions, in which water is unable to flow downstream from the dams.

The consequences of the drought are being felt throughout the West. In Utah, the Great Salt Lake dipped to a historic low in 2022, exposing the lakebed to windstorms that pick up dust containing arsenic and other toxic elements and blow it to nearby cities on the Wasatch Front. New Mexico's parched landscape helped fuel the largest wildfire ever recorded in state history. And in California, a lack of surface water is accelerating groundwater pumping that is depleting aquifers and causing the land itself to sink in some areas.

Drought is the proximate cause of today's water shortages, but in the Colorado River Basin, the root of the problem dates back a century. In 1922, the Colorado River Compact divvied up the river's water, allocating 7.5 million acre-feet to the Upper Basin states of Wyoming, Utah, Colorado, and New Mexico and 7.5 million acre-feet to the Lower Basin states of California, Arizona, and Nevada. What water managers didn't understand at the time was that the river's flows had been abnormally high. The compact anticipated annual flows of at least 17 million acre-feet; this century the river has averaged closer to 12 million acre-feet. The compact's allocations, it turns out, were made during what we now know was the region's wettest period in the past 500 years.

By the second half of the 20th century, it was clear the river had been overallocated—but the damage was done. Renegotiating the compact has proven difficult, since infrastructure and industries have been built around the expectation of the compact's original water allocations. And as climate change appears to be locking in a drier future for the region—a phenomenon some have termed "aridification," to distinguish it from temporary drought—the problem has gotten worse. Water consumption from the basin has exceeded supply by an average of 1.1 million acre-feet each year over the past decade—a gap equal to four Las Vegases' worth of water. Today, the Colorado River typically runs dry long before it reaches the Gulf of California.

The story is much the same throughout most of the American West: There are more water rights on paper than there is actual water to go around, and everyone has legal arguments for why cuts should fall on others instead of themselves. But if the arid West is to



Hoover Dam and Lake Mead

The Colorado River Basin



There are more water rights on paper than there is actual water to go around, and everyone has legal arguments for why cuts should fall on others instead of themselves.

to meet urban water demands, often by transferring water from agricultural to municipal uses. At the same time, environmental and recreational interests have placed new demands on conserving water for fish and wildlife habitat. And groundwater resources, which are a primary water source for many western communities, are being depleted faster than they can be replenished—all at a time when there is less water to go around.

At a Senate hearing in June 2022, Bureau of Reclamation commissioner Camille Touton said the Colorado River Basin states will need to conserve 2 million to 4 million acre-feet of water in 2023 to reduce the risk that supplies will reach critically low levels. An August deadline came and went, however, with no agreement hashed out among the states. As populations continue to grow in western states, and global food shortages stemming from the war in Ukraine put pressure on U.S. agriculture, the question is where those cuts will come from.

In the face of such challenges, however, there are reasons for optimism. John Fleck, a prominent western water writer, has long argued that the West has a remarkable and underappreciated ability to adapt to water scarcity. “When people have less water,” Fleck has written, “they use less water”—whether through wastewater recycling, stormwater capture, lawn buybacks,

adapt to its even drier future, it’s going to have to find ways to use its limited water resources more effectively through cooperation instead of litigation, and nearly everyone is going to have to do with less.

Doing More with Less

When it comes to water in the West, navigating the future requires understanding the past. Western water rights are allocated under a doctrine known as “prior appropriation,” in which water was claimed by early settlers

on a first-come, first-served basis as long as it was put to a “beneficial use.” This typically meant diverting water to irrigate crops. The oldest, most senior water-right claims—often of agricultural producers—get first dibs during times of scarcity, regardless of whether the claimants are upstream or downstream of other users. Water that is not used may be deemed abandoned and reallocated to someone else.

Today, new challenges are emerging. In addition to drought, the growth of western cities has required finding ways



Albuquerque, New Mexico

Water use in the Colorado River Basin has declined over the past two decades, even as the region's population has grown. In fact, the same is true across the West.

water-banking agreements, or just good old-fashioned conservation. Predictions of catastrophe are often overstated by the media, according to Fleck.

“Fear of water shortage is greater than reality, as communities underestimate their ability to cope when supplies run dry,” Fleck wrote in 2016. To capitalize on this flexibility, he said, “we need to develop institutions that both respect current water users and

provide tools for moving water around more easily” to where it's most valued. That can include the difficult tasks of arranging deals between willing buyers and sellers, agreeing on how to measure saved water and get it to alternative uses, and sometimes even changing the rules so that water can be transferred from one use to another.

Fleck pointed to a surprising fact that is often overlooked: Water use in the Colorado River Basin has declined over the past two decades, even as the region's population has grown. In fact, the same is true across the West as well as nationwide: Overall U.S. water use has fallen 25 percent since 1980, even as population increased more than 40 percent. Clearly, more conservation will be needed—drought-induced reductions in the Colorado River's water supply, for example, have exceeded the basin's water-use declines—but Fleck's point is

that we have the ability to reduce water consumption, often by a lot.

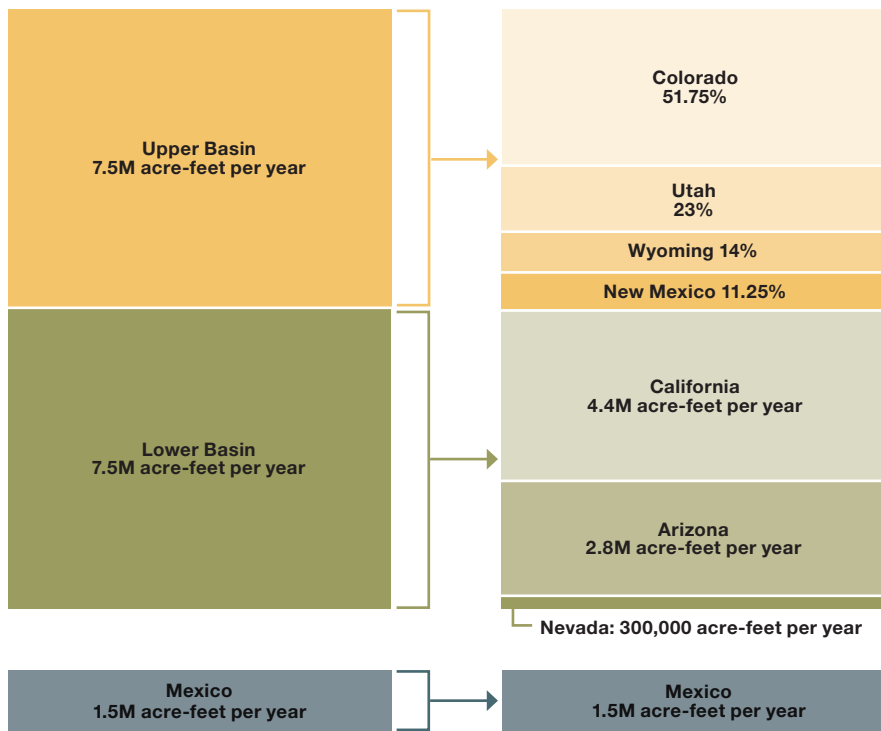
In the West, part of the reason for the overall decline in water use is that subdivisions are less water-intensive than agricultural fields, especially those for thirsty (and often lower-value) crops such as alfalfa and cotton. To facilitate these changes, institutions have to be in place that allow water rights to be leased or transferred from agricultural to municipal uses. Arizona has drastically cut its water use in this way, in large part by building houses instead of growing cotton, with water rights exchanged between willing buyers and sellers.

Another reason is that cities have become more water-savvy, often by recycling wastewater, conserving storm-water runoff, or investing in more-efficient water-distribution systems. Fleck's hometown of Albuquerque is illustrative: Even as the city's population has grown during the recent drought, its total water use has declined. This decoupling of water from growth has occurred in city after city. Las Vegas, often derided as a symbol of environmental waste, has cut its per capita water use almost in half since 2002, and its overall water use has declined as well. Phoenix's water consumption has declined by one-third since 1980, even while its population has doubled. San Diego now uses 40 percent less water than it did in 2007.

All of this points to the impressive ability of water users to adapt to scarcity without sacrificing economic growth. The biggest opportunity to continue this progress is in the agricultural sector, which uses more than 80 percent of the water consumed in the West. Farmers also have found ways to increase yields and earnings in the face of shrinking water supplies, sometimes by switching to less water-intensive crops or installing more-efficient irrigation systems. The

Colorado River Basin Allocations

The Colorado River Basin is divided into two parts: the upper and lower basins. Each basin is allocated 7.5 million acre-feet of water per year, and Mexico receives 1.5 million acre-feet annually. Upper basin states are allocated a percentage of the total upper basin allocation. Lower basin states and Mexico are entitled to specific amounts of water each year, which are subject to cuts based on shortages declared at Lake Mead.



Note: Arizona is allocated 50,000 acre-feet in addition to its lower basin allocation because a small portion of the state is in the upper basin.

Source: Congressional Research Service

challenge, according to Fleck, is “getting the institutional infrastructure right” to facilitate such adaptations and to move water to where it’s most needed.

Use It or Lose It

Unfortunately, western water laws can discourage conservation and limit the flexibility to move water to higher-valued uses. In many cases, legal rules can discourage or prevent water-right holders from leasing or selling their conserved water. To encourage greater adaptation, water policies should allow someone who needs water to pay another user to forgo water use or to invest in water conservation. But, in reality, a variety of

procedural and regulatory requirements can thwart even the most sensible win-win water trades.

Part of the challenge is that, under the prior-appropriation doctrine, the status of conserved water is often unclear. For example, if a water user adopts more efficient practices that result in unused water, the “beneficial-use” requirement could cause that user to lose that portion of their water right. In some states, farmers who take steps to save water—perhaps by updating an irrigation system or lining leaky ditches—risk forfeiting the unused amount. “Use it or lose it” rules can also make it difficult to lease or acquire water for nonuse purposes, such

as boosting instream flows for fish and wildlife habitat.

Regulatory procedures also impede the flow of water to other uses. Transfers typically require the pre-approval of regulators, and numerous stakeholders can block trades. Regulators must consider a range of potential impacts of any water transfer, including how a water-use change would affect other rights-holders, the environmental impact of the transfer, and the economic effects that the transfer might have on the surrounding community.

In practice, these rules create significant obstacles to moving water to where it’s most needed. They can also discourage simple, short-term exchanges that have potentially big water-saving benefits. For example, an alfalfa farmer may agree to forgo irrigation in a dry year to send water to a nearby city, or an environmental group may lease agricultural water during low-flow periods to protect vulnerable fish populations. According to Mammoth Water, a company that facilitates water trades, short-term-lease approvals can often take a year or more—sometimes longer than the proposed lease is for, defeating the whole purpose of the exchange.

The transaction costs of trading water are preventing more widespread adoption of water markets. As a result, much of the West’s water gets spread on low-value agricultural crops, and users in need of additional water are often forced to tap into limited groundwater reserves, which are typically open-access and prone to overuse.

Reducing barriers to water trading would enable the West to better adapt to water shortages while also addressing environmental concerns. A 2018 report published by PERC and the R Street Institute offered several reform ideas, including allowing users to keep or sell unused water, eliminating restrictions



Wastewater treatment facility



Desalination plant canal

When water is abundant, the next drops are worth little. But when it is scarce—as it is now in the West—water can be extremely valuable.

on changing the use of water, expediting short-term lease approvals, and recognizing aquifer storage as a valid water use. In California, for example, recharging depleted groundwater aquifers is not considered a “beneficial use” and therefore is not a legally valid use of water rights.

There is also the issue of prices. Higher prices are an obvious way to encourage conservation, but some western cities have been reluctant to raise rates, even amid dire shortages. Salt Lake City, for example, has one

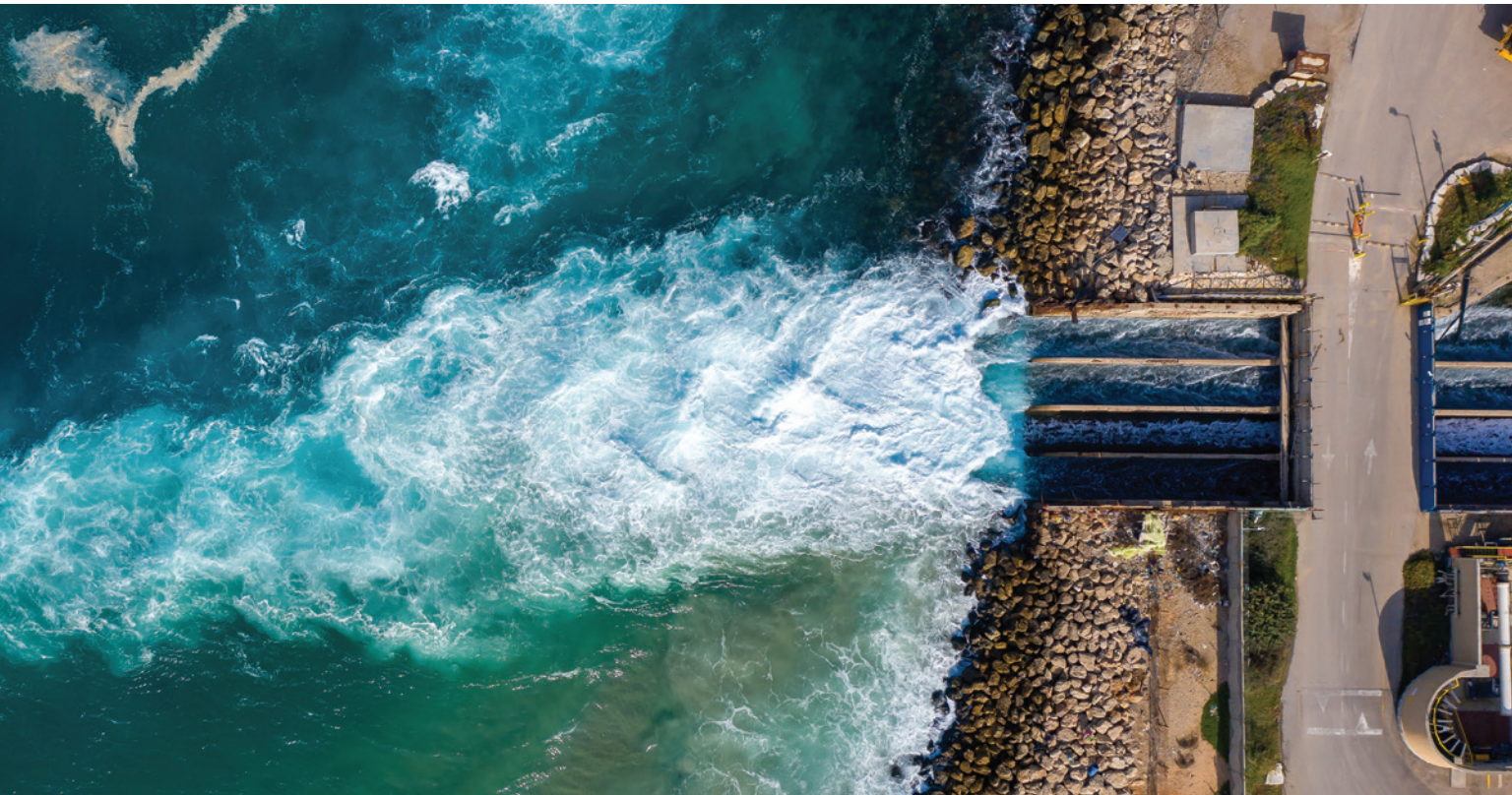
of the lowest per-gallon water rates in the country—and, not surprisingly, its residents consume more water than those in most other desert cities. Agricultural water prices in the West are even lower—sometimes only a few pennies per thousand gallons—owing in part to federally subsidized water projects and limitations on transferring water to municipal uses that are valued more highly. Pricing water efficiently for both agriculture and urban uses is crucial to managing scarce water resources, especially during drought.

Despite these obstacles, progress is happening. In parts of the West, water districts are experimenting with paying farmers to temporarily fallow some fields or to plant crops that are less water-intensive (see Tate Watkins’ essay on page 16). In California, groundwater markets are emerging to sustainably manage aquifers, with tradeable pumping rights

allocated to users within a groundwater basin (see Andrew Ayres’ essay on page 30). And in 2022, Utah began allowing water rights to be leased by environmental groups for conservation purposes, to leave more water in streams for fish and wildlife habitat (see Tim Hawkes’ essay on page 38).

Technological advancements also give water users the ability to do more with less. Recycling treated wastewater has proven to be an effective water-saving tool in many western communities. Desalination is a viable solution for some coastal cities—although building desalination plants has proven difficult in places such as California.

And there are market innovations as well: Online water-rights marketplaces and clearinghouses can reduce the transaction costs of trading water, and new satellite-based methods to measure consumptive water use can help address



measurement and verification challenges that prevented otherwise viable water transfers in the past. Both of these tools are emerging in response to today's shortages.

Incentives to Conserve

There is a classic paradox in economics: Water is cheap, but diamonds are expensive, though one is essential for life and the other is not. Even Adam Smith was puzzled by this. "Nothing is more useful than water," Smith wrote in *The Wealth of Nations*, but "scarce any thing can be had in exchange for it." A diamond has little practical value, he wrote, "but a very great quantity of other goods may frequently be had in exchange for it." Economists have since solved the mystery, recognizing that value lies on the margin. When water is abundant, the next drops are worth little. But when it is scarce—as it is now in the West—water can be extremely valuable.

If water markets are allowed to function, prices provide incentives to conserve, and markets enable water to be moved from lower-valued to higher-valued uses. Sometimes this means transferring water rights from farms to municipalities, which can have broader economic implications for rural communities dependent on agriculture. Or it can mean finding ways to increase the economic return on water used for agriculture. In California, markets have been shifting more water to higher-revenue perennial crops, such as nuts, grapes, and fruit. Because of this, farm earnings in the state are increasing while agricultural water use is declining.

Water markets aren't the answer to every water-scarcity problem—an "all of the above" approach is needed, including desalination, wastewater recycling, stormwater capture, and, in some places, increased storage capacity. But markets are a proven way to effectively allocate

scarce resources among competing uses through voluntary negotiation instead of legal or political conflict, of which there is no shortage in the world of western water.

In the West, old rules die hard, and outdated institutions can remain stubbornly in place in the face of new realities. But the West has the need, and the ability, to adapt to an even drier future. The question is how bad the shortages will need to get in order to force those changes.

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Shawn Regan is the vice president of research at PERC and executive editor of *PERC Reports*.

Pay a Farmer, Save the Colorado?

Agriculture uses the vast majority of water in the arid West. Shouldn't there be simple ways to trade the valuable resource?

BY TATE WATKINS



Alalfa often gets an unfair rap. As a legume, its deep root system and ability to fix nitrogen improves soil. It provides essential forage for dairy cows and other livestock. Yet it is often criticized for being one of the thirstiest crops western farmers can grow. And from Wyoming to California, farmers in the Colorado River Basin grow lots of it—several million acres each year—even as the region struggles to adapt to a historic drought affecting the river that supplies water to 40 million people.

Imagine if a farmer in the drought-stricken basin could profit by cutting back on alfalfa production and leasing the saved water to a far-off city. He might generate the water savings by skipping a third cutting of hay, making do with income from the first two and the water lease. Or he might take a parcel of marginal farmland out of production entirely and then use the new water revenue to invest in boosting yields on the rest of the farm.

The water would not be physically moved anywhere. The farmer would simply leave it in the river to be taken out by a municipality downstream. An urban area in need of water would benefit, and the farmer would have a new source of revenue, plus the flexibility to decide whether or how to alter agricultural operations to get by with less irrigation. Or perhaps a conservation group pays the farmer for the water and chooses to leave it instream to further environmental aims, such as bolstering fish habitat.



This seemingly simple idea—that someone who needs water should be able to pay another user to voluntarily forgo water use—turns out to be exceedingly difficult in many cases.

With about 80 percent of western water used in agriculture, momentum is building to find ways to do just that—buy or lease water from farmers to help address the region’s severe drought conditions. But in reality, the challenge of putting water to use where it’s most valued is complicated. Throughout much of the West, this hypothetical trade with an alfalfa farmer is difficult if not impossible due to a lack of well-functioning water markets and barriers to water leasing.

If more basin users could trade with each other, water could be directed to places most in need of it. But this seemingly simple idea—that someone who needs water should be able to pay another user to voluntarily forgo water use—turns out to be exceedingly difficult in many cases.

Simple Idea, Complex Reality

In theory, it should be straightforward for one basin user to trade or lease their water rights to another. But as PERC’s Bruce Yandle recently wrote in *The Hill*, throughout the American West “there is no institutional arrangement enabling any state or large water-using entity to trade with another. No regional market where water rights are priced or otherwise valued in a way that fully leverages economic incentives to balance demand with diminishing supply and pays for creative ways to conserve.”

Alfalfa farmers in Wyoming or Utah, for example, cannot cut back on irrigation and lease their saved water to Las Vegas or Phoenix. That lack of a framework for trading water across state lines—efficient markets that match sellers with buyers willing to trade an increasingly valuable resource—is one reason for current shortages. It’s especially relevant in the Colorado River Basin, which encompasses a quarter of a million square miles across seven states, more than two dozen tribal nations, and Mexico.

Even within a single state, several barriers impede water trades. Water rights are often bundled to a particular parcel of land, and it can be difficult to transfer those rights to another party. Water that is not put to “beneficial use” could

be forfeited, and in some cases water that is conserved may be claimed by other users; this punishes rather than rewards people for conserving water and encourages overuse.

The reality is that the allocation of water among states in the Colorado River Basin has always been based on political, not economic, considerations. But with severe drought facing the West, it’s clear that something’s got to give. People in the region will have to use less water in coming years, and much of the savings will likely come from the agricultural sector given how much it uses. How those reductions will happen—whether through mandated cutbacks, regulations, or voluntary conservation efforts—is the big question.

Paying to Cut Back

“Honestly, I think I could make more money farming,” Brad Robinson, a third-generation farmer in Blythe, California, recently told the *Los Angeles Times*. “But for the sake of the Colorado River, I think it’s the right thing to do.” Robinson and other farmers in the Palo Verde Irrigation District participate in a program that pays farmers to temporarily fallow fields—in other words, to not farm. The water the farmers would use to irrigate alfalfa, cotton, and other crops instead stays in Lake Mead, the largest reservoir in the Colorado River Basin. The program is funded by a combination of federal, state, and local entities. “In a perfect world,” Robinson said, “a farmer wants to farm. But the reality of the situation is that we have a certain amount of population and people, and don’t have unlimited water.”

Due to barriers that keep people from purchasing or leasing water directly from farmers, many have looked for alternative ways to reward farmers who reduce water use and free up flows for other users or conservation purposes. These include governments compensating farmers to cut back on irrigation, municipalities paying farmers to fallow fields, and conservation groups seeking reforms that allow instream flow rights for fish and wildlife habitat.

Two factors help such efforts overcome obstacles that hinder direct water trades. First, deals that do not involve a formal exchange of water rights avoid the various legal and policy barriers to trading water. Second, such efforts are usually carried out on a local scale and within a single state. That proximity reduces jurisdictional complexity and increases assurances that a third party cannot divert the saved water for their own purposes. The water conserved by Palo Verde farmers in Lake Mead, for example, can be drawn from the reservoir by nearby cities. The Metropolitan Water District of Southern California, which supplies 19 million people across Los Angeles, San Diego, and other municipalities, has paid



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farmers in the Palo Verde Valley a total of \$180 million since 2005 to fallow farmland.

Efforts to pay farmers to cut back are ramping up in light of today's shortages in the Colorado River Basin. In September, the Bureau of Reclamation announced a major new effort to pay for water conservation. The agency will pay farmers in lower basin states—Arizona, California, and Nevada—to voluntarily cut water use. One part of the program will offer \$330 to \$400 per acre-foot forgone, and the unused water will remain in Lake Mead. While the payments may end up providing some relief, many questions remain. How will the agency decide which farmers to pay? Will the prices offered be enough to produce the necessary water savings?

PERC's Bryan Leonard and Montana State University economist Nick Hagerty recently outlined one way to address those issues: use a reverse auction. "In most auctions, people bid what they are willing to pay to acquire something," they wrote in October for *High Country News*. "Here, water users would bid what they are willing to accept in order to forgo a certain quantity of water deliveries. The government would then accept the lowest bids." They noted that a reverse auction would get more conservation "bang for its buck" than Reclama-

tion's proposed fixed-price contracts. Using rough estimates, they calculate that the approach could generate enough water savings to satisfy all needed reductions in the lower basin for two to seven years with the program's \$4 billion budget.

A key benefit of a reverse auction is that it would help direct water cuts to where they are most economically feasible and rational—for example, toward lower-margin crops such as alfalfa instead of higher-margin ones. Water could remain in agricultural areas where it is most valuable.

One of those areas is Yuma, Arizona. Nestled along the Colorado River in the southwestern corner of the state, Yuma is home to a relatively high-value agricultural sector. During the winter, roughly three-quarters of store-bought leafy greens from coast to coast come from the area surrounding the city. It's unlikely that farmers there will be attracted to the government payments, and it's not hard to understand why. Yuma farmers have already signaled that it would take \$1,500 per acre-foot for them to consider cutting water use—far more than what the Bureau of Reclamation is offering. Growers in Imperial Valley, California, who also farm a great deal of vegetables and fruits and have the most senior water rights in the lower basin, have floated a figure of \$2,300 per acre-foot.

This illustrates one of the key benefits of Leonard and Hagerty’s reverse-auction approach: If an acre-foot of water produces significant revenue from vegetables grown during the Southwest winter, then a farmer will demand a high price to stop irrigating with that acre-foot. The opportunity cost of irrigating, say, an alfalfa field in the basin, however, is likely much lower. Consequently, lower-value producers should have lower asking prices for their water.

Don’t Sell the Farm?

Whether through a fallowing program or another type of agreement, there are various environmental and economic concerns over any efforts to move water from agricultural to urban uses. Leonard recognizes that a reverse auction wouldn’t be perfect. “One big concern,” he said, “is that there are a lot of real externalities from agricultural water use that wouldn’t get priced into bids.” Some of those issues relate to what happens to return flows—when a field is irrigated, where does the water that drains away end up? In California, water that drains off of irrigated fields helps control dust pollution from the Salton Sea and feeds wetlands elsewhere. “If I’m a farmer making my bid,” said Leonard, “I wouldn’t necessarily take those issues into account.”

There are other concerns as well, such as how paying farmers for surface water affects groundwater pumping. PERC’s Sheila Olmstead, an economist at the University of Texas’s School of Public Affairs, has explored the interaction between surface water and groundwater, noting that the latter is “a connected resource that is regulated differently all over the West.” In many states, groundwater is a common-pool resource, and anyone who can drill and access the aquifers lying below their land can pump and use as much as they please.

“In a variety of contexts,” Olmstead said, “research shows that markets and trade can accelerate depletion of natural resources when the local price isn’t driving demand, but the state or even regional price is.” She noted that a program like Reclamation’s could have a similar effect: “You definitely could have a situation where the federal incentive payments could make things worse where groundwater is poorly regulated.” If farmers are free to pump more groundwater after getting paid to reduce their surface water use, then the consequence may simply be that aquifers, rather than above-ground reservoirs, get depleted.

Another major concern of moving water to cities comes from agricultural communities who rightly worry about the consequences for their ways of life. PERC’s Gary Libecap recently described how the media often portrays this dynamic: “Private buyers strip a region of its water, leave it ‘high and dry,’



Micro-irrigation in an avocado orchard
© Lance Cheung/USDA

Revenue from a few years of leasing might fund transformation of irrigation infrastructure, measurement, and efficiency—or help a farmer switch to less water-intensive crops. The options offered along all of these margins could be what helps keep a farm farming.

ship the water elsewhere, and get rich. Local economies and the natural environment are devastated.” Indeed, these potential community impacts are a major source of opposition to large-scale ag-to-urban water transfers.

Compensating farmers for conservation at least provides flexibility. A water lease or fallowing program, for instance, could be short term or much longer in duration. Revenue from a few years of leasing or participating might fund transformation of irrigation infrastructure, measurement, and efficiency—

Any future that involves moving water from agricultural to urban uses will have to address concerns of farming communities. Markets at least offer flexibility, and in principle they can be designed to ensure people in rural areas aren't left behind even if water flows elsewhere.

or help a farmer switch to less water-intensive crops. The options offered along all of these margins could be what helps keep a farm farming. And whether a farm keeps farming has repercussions beyond its property lines.

Many industries that surround and support agriculture exist based on economies of scale—packaging houses, processing plants, suppliers, distributors, and seasonal farm laborers themselves. If there's a threshold needed for a mill or processor to be viable in an area, for example, then it's only logical that farmers worry about moving water to cities. And if rural economic changes risk population leaving, property values decreasing, and tax revenues falling, then it would be a wonder if locals were not wary of water transfers.

“One solution,” Libecap recently wrote in a report on water markets published by PERC, “is to broaden the benefits of water transactions via local mitigation funds. The evidence suggests that there are sufficient gains from moving water from low- to high-valued uses to support such efforts.” He pointed to an estimated 18-fold difference in the value of water on Colorado's West Slope, largely agricultural, and its East Slope, home to Denver and other urban areas. “There clearly are enough monetary gains to contribute to a mitigation fund,” he noted, suggesting a county-level tax on water transfers, similar to severance taxes on oil and gas extraction, could be a vehicle to implement such a policy.

When it comes to the Colorado River Basin specifically, Libecap highlighted the inability to transfer water rights across state boundaries as an enormous challenge. He acknowledged that changing the multistate compact that governs the river “would seem like a very slow, cumbersome process,” likening



Greenhouse micro-irrigation (top); precision-irrigated strawberries (bottom) © Lance Cheung/USDA



Tomato harvest © Bob Nichols/USDA

it to rewriting a state constitution. “But some structure to allow for water to flow instream to meet some of the compact’s requirements would make sense,” he said. “It ought to be the case that there’s some marginal water used in Imperial Irrigation District,” he continued, “or for that matter Palo Verde, that would be more valuable if used in Arizona, or Las Vegas, or someplace else, and the water could be transferred. You wouldn’t need infrastructure to move the water itself, you’d just withdraw less downstream and take more upstream.”

Any future that involves moving water from agricultural to urban uses will have to address concerns of farming communities. Markets at least offer flexibility, and in principle they can be designed to ensure people in rural areas aren’t left behind even if water flows elsewhere.

Trading Off

While western states may have systems of water rights, significant challenges and uncertainties remain embedded within them. The upshot is that they lack a foundation of transferable rights that would be needed to promote widespread, mutually beneficial trades to allocate scarce water throughout the basin.

Still, there are several ways to spur institutional innovation for the future. For one thing, policymakers could establish clear property rights to groundwater pumping to make sure

that users can’t simply substitute unsustainable aquifer use for surface water use. They could also help usher in better measurement and data gathering when it comes to water use—a huge issue for countless irrigators—and maybe even build in funding to help farmers implement ways to measure use. And as Leonard and Hagerty point out, they could adopt reverse auctions and other tools that harness market mechanisms to ensure that conservation efforts are as efficient and effective as possible.

Ultimately, as shortages get worse, the payoff to innovation will increase, including for reforms that allow water markets to thrive. Solving the West’s water crisis will require coordination across states encompassing dozens of watersheds and tens of millions of people. Markets have the capacity to spread information, harmonize activity, and make trade-offs in ways that few other tools can. Pioneering new ways to harness their power will unleash the type of bottom-up conservation that can help the basin adapt to its drier reality.



Tate Watkins is a research fellow at PERC and managing editor of *PERC Reports*.

How Federal Laws Undermine Native American Water Rights

Tribes could help bridge gaps between water supply and demand in the Colorado River Basin—if it weren't for federal restrictions

BY LESLIE SANCHEZ



The Gila River in eastern Arizona
© Chris Morris

As the water-starved West grapples with historic drought conditions, water managers are scrambling to reduce withdrawals. In Southern California, for example, the Metropolitan Water District—which supplies municipal water to Los Angeles and other cities throughout the region—has staved off cuts by leasing senior water rights from nearby farmers. Under the arrangement, water that would have gone to the Palo Verde and Imperial Irrigation Districts is instead stored in Lake Mead to supply cities in the region.

In return, the districts have netted hundreds of millions of dollars. The districts' ability to choose whether to use their entire water allocations for agriculture or to lease or sell those rights to others enables them to capture the full value of their water rights. It also injects an element of flexibility into an otherwise rigid water rights system.

Such arrangements, however, are often out of reach for another group of senior water users in the basin: the Native American tribes who are entitled to some of the river's oldest water rights. Because most tribes have never had their water rights legally quantified, their rights cannot be enforced, let alone leased. As a result, tribes forgo billions of dollars annually in potential leasing revenue and lack influence over important basin-wide water policy decisions. Meanwhile, the basin has one less tool with which to address water shortages.

The high stakes of inaction underscore the need for water markets that encourage conservation. Yet federal laws and policies systematically exclude Native American tribes from participating in such markets. Not only are these policies inequitable, but they also perpetuate inefficient water use and severely hamstring the collective capacity of the basin's 40 million residents to adapt to increasing water scarcity.

Inequitable Water Policies

The 29 federally recognized tribes in the Colorado River Basin hold rights to a combined 3.6 million acre-feet—roughly 25 percent of the river's annual flow. With some of the most extensive and senior water rights in the West, tribes should have immense influence over water use. Yet many struggle to capture the benefits of their valuable water rights due to federal restrictions on marketing their water. In addition, capital constraints and a chronic lack of water infrastructure to connect reservations to remote water sources mean that many tribes have water rights that they cannot physically access or use.

Nearly half of reservation households lack basic drinking water connections, and tribes use only a fraction of their deeded rights, mostly for agriculture, while the remainder flows downstream to be used by other appropriators. Marketing tribal water rights could provide much-needed capital for water

Because most tribes have never had their water rights legally quantified, their rights cannot be enforced, let alone leased. As a result, tribes forgo billions of dollars annually in potential leasing revenue.

infrastructure while also providing relief for off-reservation water users during times of extreme drought.

As Amelia Flores, chairwoman of the Colorado River Indian Tribes, stated in her 2021 congressional testimony, the ability to lease water rights would “provide our tribe with the financial resources to fund improvements to the [tribe's] irrigation project so that our water use may become efficient. Greater efficiency on our reservation means we can do more to help the river.”

But tribes such as hers cannot market their water rights off-reservation without congressional authorization. In general, tribes cannot sell their water rights, and most cannot lease their water rights for off-reservation uses without federal approval. The few tribes who can lease secured authorization to do so as part of congressionally enacted settlements that defined their water rights in the first place.

Tribal water settlements often take decades to negotiate between tribes and neighboring water users. Tribes have to retroactively quantify their rights in fully appropriated basins where reservation water access is already limited. Because all negotiating parties must agree to the terms that ultimately formalize tribes' water rights, other parties like cities and irrigation districts can influence whether and how tribes are allowed to market their water.

Several agreements permit leases with only the entities who were party to the settlements themselves. The Salt River Indian Community's settlement limits off-reservation water marketing to 99-year leases with Arizona cities that participated in the negotiation. Others restrict leases to certain parties, water sources, and geographical locations. For instance, most Arizona settlements only authorize tribes to lease their rights to Central Arizona Project water—sourced from the system of canals that deliver Colorado River water to the center of the state—and restrict such leases to water users in a handful of counties.

The layers of restrictions on tribal water marketing deprive tribes of the same ability that other water rights holders have to generate revenues through water leasing. As of 2012, Colorado River Basin tribes were potentially forgoing as much

as \$1.6 billion in annual leasing revenues that could have been reinvested in reservation economies—an amount equal to \$8,000 per tribal resident.

High Costs of Restrictions

The high costs of leasing restrictions are especially evident in the Lower Colorado River Basin. A 1963 Supreme Court ruling, *Arizona v. California*, gave tribes on five reservations located along the mainstem of the Colorado River the senior-most rights to 952,000 acre-feet of the river's flow. The magnitude of the tribes' water rights should be an economic windfall. They are located just upstream from thirsty cities such as Phoenix and Los Angeles, which currently pay millions of dollars a year to lease similar high-priority water rights from Imperial and Palo Verde farmers.

The ruling, however, stipulated that water use must be confined to reservations, and to date, none of the five tribes have been authorized by Congress to lease water. There have been some creative workarounds. The Colorado River Indian Tribes entered into a forbearance agreement, technically not a lease, under which it banked water in Lake Mead for three years in exchange for \$150 million, raising water levels by three feet. But such one-off agreements take years to negotiate.

Legislation authorizing all tribes to lease their water rights could alleviate substantial pain as the West gets drier and water demand continues to grow. Tribes would be able to generate much-needed leasing revenues to reinvest in reservation economies. Further, while tribes do not currently use all of their water rights, they plan to eventually, most likely by expanding irrigated agriculture. Rather than relying on tribes' unused water, off-reservation parties could proactively shore up their water security through legally enforceable agreements with tribes. But without authorization to lease, tribes lack both the incentive and capital to conserve water. Meanwhile, some off-reservation water users in Arizona and Nevada—the most junior users in the lower basin—are facing mandatory curtailments during the current drought but have few options to lease water.

Fairness and Efficiency

The Gila River Indian Community in Arizona offers an example of what could be if leasing were an option for more tribes. The tribe settled its water rights in 2004, and it is unencumbered by many of the restrictions facing other tribes. Since then, the tribe has entered several short- and long-term leasing agreements with Arizona cities, generating hundreds of millions of dollars in leasing revenues by storing nearly 600,000



Gila River Indian Community © Kevin Dooley



Restrictions on tribal water marketing are inequitable and perpetuate inefficiencies at a time when conservation is especially critical.

acre-feet in Lake Mead. It has also partnered with the Salt River Project to store its unused water underground and then lease its groundwater storage credits to municipal water users in Arizona.

Moreover, since settling its water rights, the Gila River Indian Community has been diligently constructing irrigation infrastructure necessary to restore reservation agriculture. With the ability to both use and lease portions of its 600,000 acre-foot entitlement, the tribe has assumed a leadership role in lower basin efforts to reduce Colorado River water use. States' lackluster commitments to shore up Lake Mead this past summer prompted the tribe to withdraw from water conservation agreements, thereby raising basin-wide shortage risks. Only after California water agencies committed to conservation measures did the tribe recommit to leasing 750,000 acre-feet of its water rights to the federal government over the next three years, to be stored in Lake Mead. "Using our water resources as leverage," Gila River Indian Community Governor Steven Roe Lewis said on Marketplace, "that was an important strategic move to really advance a plan."

Broader Implications

Restrictions on tribal water marketing are inequitable and perpetuate inefficiencies at a time when conservation is

especially critical. Such policies exclude tribes from important water policy decisions and deprive them of the same choices that other water rights holders have.

Arizona Senators Mark Kelly and Kyrsten Sinema have recently proposed legislation authorizing the Colorado River Indian Tribes to market their water rights. "They can conserve more water, they can lease more water, and they will have the resources to become more resilient and water efficient," Sen. Kelly recently remarked. The legislation is a positive development—but it only applies to one tribe. A blanket legislative authorization to lease water off-reservation would be a crucial step toward restoring Native American sovereignty over tribal resources while also bolstering the Colorado River Basin's adaptive capacity to drought.

Read more in the PERC Policy Brief "Addressing Institutional Barriers to Native American Water Marketing," by Leslie Sanchez. To read, visit perc.org/tribal-water



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The Water Beneath the Desert

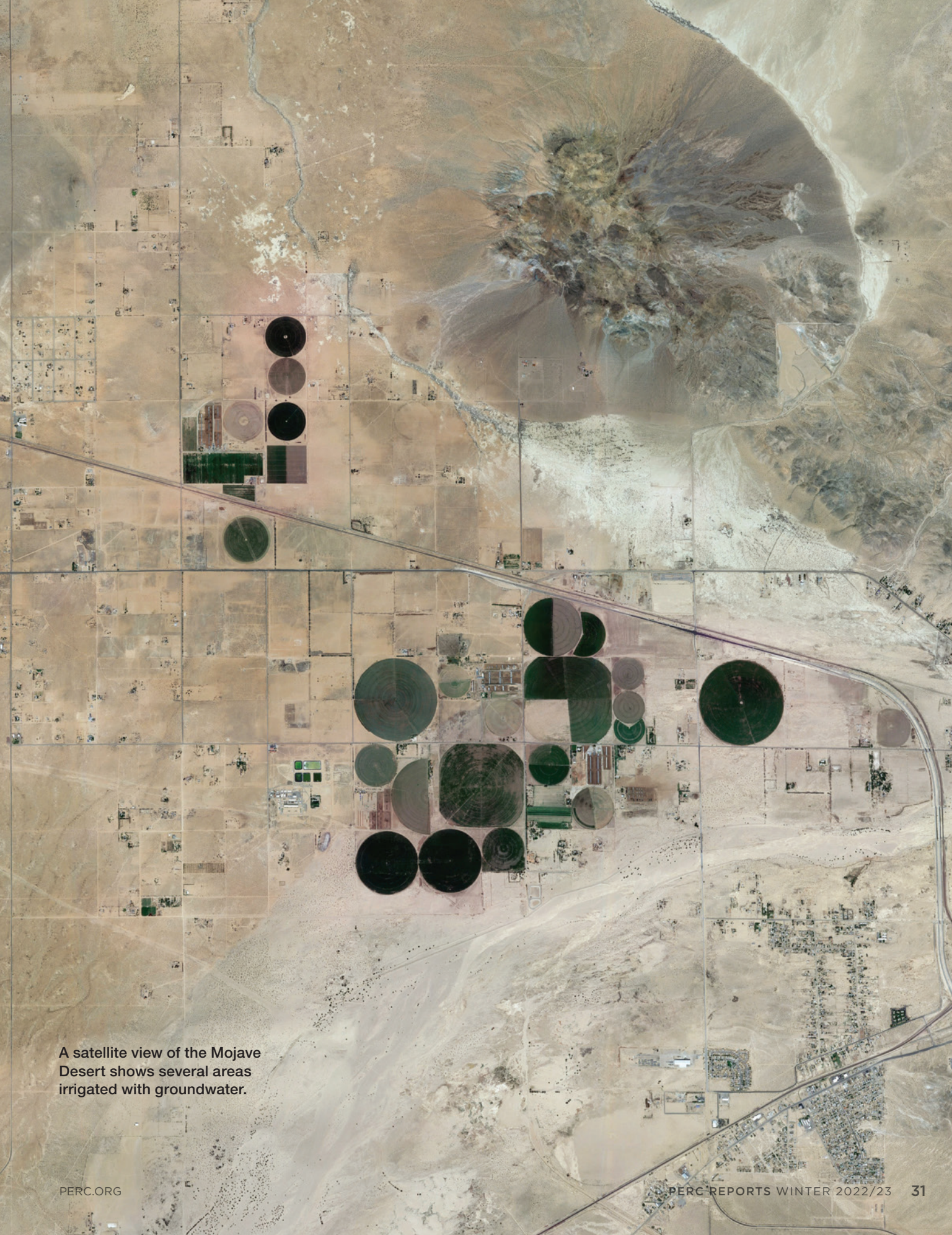
A groundwater market in the Mojave Desert offers lessons for California and beyond

BY ANDREW AYRES

California's Mojave Desert has long been home to productive agricultural operations and growing communities. Located northeast of Los Angeles, the area is also host to dairies, solar installations, man-made recreational lakes, and unique habitats. One thing lives and livelihoods in the area have in common is their dependence on groundwater, a resource that is in short supply in North America's driest desert.

Residents struggled for many years with how best to manage water scarcity, but today the Mojave is home to one of the most liquid groundwater markets in the western United States. Introducing this system stabilized water levels in the area and generated significant economic benefits for local communities. The story of its development and operation offers lessons to other basins in California and across the West.

Today, access to groundwater in the Mojave is managed to ensure pumpers do not deplete underground aquifers, and the long-term prospects for resource users are promising. But this was not always the case.



A satellite view of the Mojave Desert shows several areas irrigated with groundwater.

Forging the Mojave Agreement

As in much of California, groundwater in the Mojave's aquifers was historically available to virtually anyone who could access and pump it to the surface. That included overlying landowners for use on their lands, but other parties, such as cities, could also establish rights to groundwater for other uses. Only small amounts of water, however, seep from the Mojave's dry, desert surface into aquifers each year to refill them, a process known as recharge. Most natural recharge is provided by seepage from the Mojave River as it flows north from the San Bernardino Mountains, as well as the small amount of precipitation that falls in the desert.

Throughout the 20th century, increased groundwater extraction—in large part for agriculture, and enabled by advances in pumping technology—unbalanced the aquifer system. Pumping rates began to exceed the reliable recharge of aquifers. As water tables fell, pumping costs rose and concerns about long-term storage and water availability grew. Average water table heights fell by 30 feet from the early 1900s to the end of the 1950s, and similar declines occurred through the end of the 1980s. Other impacts emerged, such as subsidence of the land surface.

In response, local governments and concerned users started early discussions around a solution, which focused on augmenting water supply. In the late 1950s, the state embarked on its efforts to build the State Water Project—a system of dams, canals, and other infrastructure that captures water in the wetter north and conveys it to the drier south—and local users worked with state legislators to form the Mojave Water Agency to contract for water from the project. The agency

would use the project water to recharge the aquifer. Given the high cost of water delivered through these contracts, the agency attempted to delineate by volume the groundwater rights of individual pumpers to constrain overuse of both native basin water and imported water. In addition to improving groundwater conditions, a major goal of this effort was to assign responsibility for paying for imported water. Over the years, a proposal for a court process to adjudicate water rights and alternative proposals for pumping taxes were all met with controversy and ultimately unsuccessful. Overdraft of the region's aquifer system persisted.

It was not until 1990 that a successful adjudication of the region's groundwater began. A lawsuit filed by one growing municipality alleged that overpumping by other users would constrain its future access to groundwater. The Mojave Water Agency joined the process and prompted the court to consider the unsustainable pumping as well as the nature of water rights in the basin more broadly. By 1996, Mojave's groundwater pumpers had negotiated a settlement that set total limits on extraction and allocated pumping rights to individual users and municipalities.

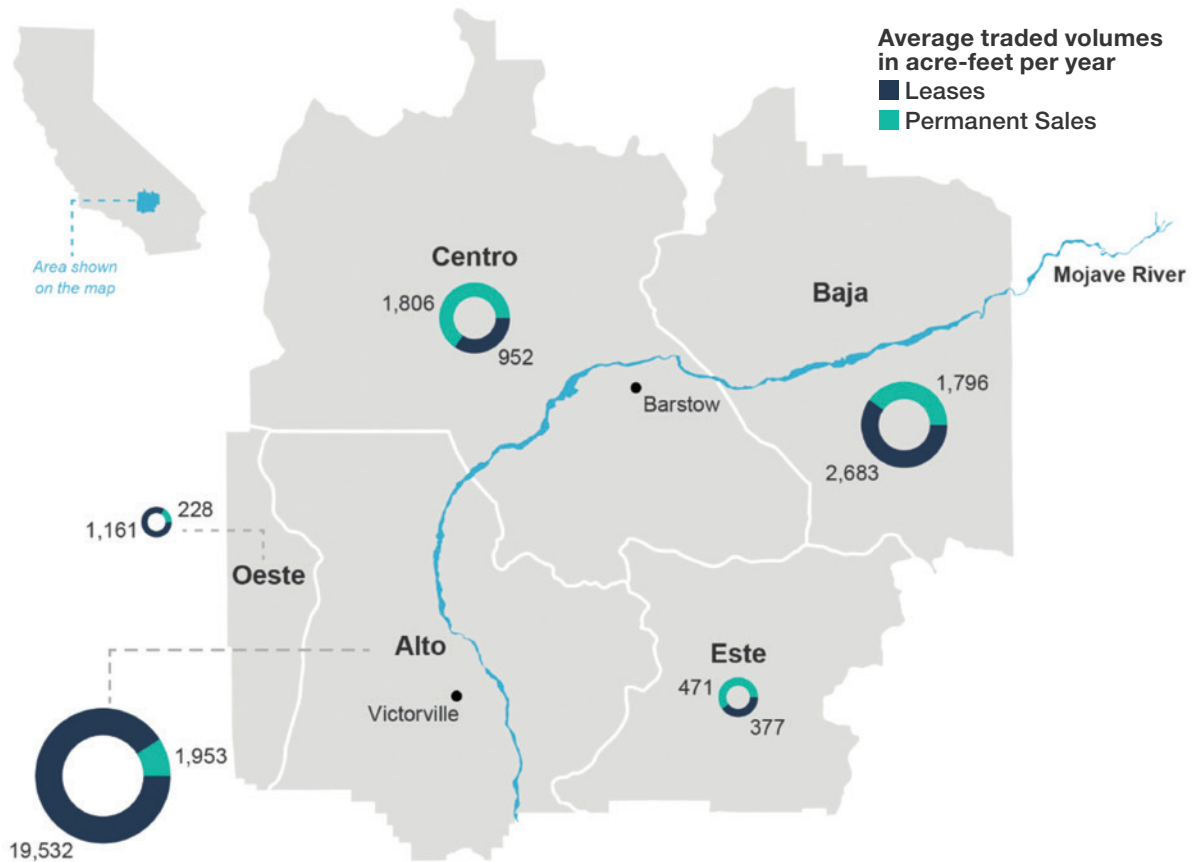
The Mojave's adjudication of its groundwater rights represented an effort to both constrain overuse of the region's native natural resources and establish an incentive to conserve expensive imported water. Without a way to control pumping, users could continue or even expand extraction, relying on but not directly paying for the imported water. To address this, the new system included individual entitlements for large pumpers—with fees for exceeding them linked to the cost of imported water—and exemptions for small pumpers. It also

The Mojave is now home to one of the most liquid groundwater markets in the western United States.



Barstow, California

Water Leases and Sales in the Mojave Groundwater Market



The Mojave adjudicated area is in gray, with its subareas outlined. Circles are sized by 2014-15 production and show annual averages for water leased (blue) and sold (green) in acre-feet per year. Data cover water years 1994-95 to 2018-19.

Source: Andrew Ayres, Technical Appendix C: Mojave Groundwater Market Assessment, in “Improving California’s Water Market: How Water Trading and Banking Can Support Groundwater Management,” Public Policy Institute of California (2021).

established pumping fees to fund additional agency activities. The system generated significant changes, leading to reductions in baseline pumping of more than 50 percent in some areas, helping to stabilize water levels.

Earlier cases in Southern California had paved the way for users to reconcile competing claims and define volumetric entitlements. But the Mojave agreement was one of the first to lay out clear foundational rules for trading pumping rights, setting the stage for what is today one of the most active groundwater markets in the western United States. Because the degree of necessary cutbacks in the Mojave was quite large, allowing flexibility for water users to reallocate resources to high-value uses was important. In large part, this has involved agricultural users leasing and selling pumping entitlements to cities. Some cities in the region have experienced double-digit growth rates decade after decade. Recent research has estimated the economic benefits of trading for the region

(see text box on p. 35), and gains for individual landowners played a role in generating support for the new management structure.

Interest in groundwater allocation systems of this sort has grown in response to California’s Sustainable Groundwater Management Act, adopted in 2014. This legislation requires groundwater users in other overdrafted basins throughout the state to achieve sustainable management by 2040. In some of these basins, absent a significant expansion in recharge, pumpers can expect cutbacks similar to those in the Mojave. For example, in Southern California’s Borrego Springs, some estimates suggest reductions of roughly 75 percent may be needed to stabilize water tables.

Three aspects of the Mojave experience show that setting up a successful management system is about more than just capping the use of a proverbial bathtub of water. First, there are hydrologic realities that need to be taken into account.

The market gives water an opportunity cost, which is reflected in the price of pumping permits. Conservation becomes a tool with a payoff, coordinated by the market.

Second, market systems can prompt useful adjustments by users. Finally, regulators may need to adapt over time to ensure the integrity of the system.

Going with the Flow

Most aquifers are not bathtubs. They may have areas of greater and lesser recharge, varying subsurface flow rates, upstream and downstream sections, and fault lines that buffer some areas from others, among other unique characteristics. As groundwater users contemplate how to address aquifer depletion, these factors require additional consideration beyond simply capping individual users and metering their use.

The city of Barstow, California, is a desert outpost with approximately 25,000 residents and lies along the Mojave River roughly in the center of the basin's adjudicated area. It also lies downstream of some larger water users nearer the San Bernardino Mountains. Due to physical constraints in the flow of water from this upstream area to the city, its section of the aquifer may receive less recharge if water levels in the upstream area decline substantially.

The city's concerns about flow—both surface and subsurface—to its segment of the basin prompted the 1990 lawsuit that spurred the region's groundwater adjudication. Barstow's complaint focused on ensuring sufficient flows between upstream and downstream sections of the aquifer. Taking this concern seriously meant defining subareas of the aquifer to govern basin management decisions. The 1996 agreement defined annual flow obligations between subareas to ensure that any changes in pumping in one subarea that might impact water levels in another are addressed.

Today, flows across these boundaries are estimated by the Mojave Water Agency and, in the event flows fall below negotiated thresholds, users in the upstream area must make up the shortfall for the downstream subarea. Planning around these basin idiosyncrasies was ultimately necessary to effectively address users' concerns about water availability.

An Underground Market

In addition to playing an important role in the formation of the new management system, the city of Barstow has also been an active participant in Mojave's market for pumping

permits. Capping individual and aggregate extraction helped improve groundwater levels throughout the basin. But the market helps to ensure that these goals are met at lower cost by allowing users to flexibly adapt to increasing scarcity. The market gives water an opportunity cost, which is reflected in the price of pumping permits. Conservation becomes a tool with a payoff, coordinated by the market.

Every year in the Mojave upwards of 20,000 acre-feet of water are leased across all subareas. These leases represent a temporary reallocation of the right to pump groundwater from one user to another. Public water supply systems are typically buyers, and much of this transferred water originates in agriculture, but not all of it does. Barstow's water use and marketing activity, for example, has shifted substantially over time.

Early on in the new management regime, Barstow's water purveyor pumped approximately 8,000 acre-feet of water annually to meet public supply in its service territory. Since then, conservation efforts have reduced annual pumping to roughly 5,000 acre-feet per year—all while the population in the city has remained relatively unchanged. Over the same period, leased amounts from the city's system operator to other pumpers have increased from almost nothing to roughly 3,000 acre-feet on average. In the span of roughly two decades, the city that kicked off a basin-wide groundwater adjudication by suing its neighbors to ensure its own water supply has undertaken conservation efforts that allowed it to help them meet theirs through the market.

Regulatory Adaptation

The market helps users adapt to changing conditions, but sometimes regulators have to adapt as well. One important provision of the Mojave adjudication, which is also typical of other adjudications, was the designation of *de minimis*, or minimal, groundwater users. Minimal users may pump small amounts of water for domestic uses and are assumed in aggregate not to affect the overall hydrologic system appreciably. One goal of designating minimal users is to make sure households in rural areas have access to drinking water; another is to avoid complexity in negotiations over the design of the management regime by exempting small users from it. In the Mojave, minimal producers are allowed to pump up to 10 acre-feet per year.

Recently, though, concerns have arisen in the Mojave that minimal users may be affecting the system—and potentially jeopardizing other users' water reliability. The Mojave Water Agency began to note increases in total minimal producer pumping in 2015. These increases could affect others by pushing total aggregate use beyond sustainable levels. That

How Environmental Markets Help Get the Most From Every Drop

PERC researchers quantify enormous benefits from instituting a groundwater market in the Mojave Desert



A field in the Mojave Desert being irrigated with center pivot irrigation equipment

© Jim West

Economists have long suggested that environmental markets, such as the one developed in the Mojave, are useful tools for resolving disputes over resource allocation and reducing the costs of achieving environmental goals. Market incentives help increase the value of water use and avoid the costliest of cutbacks. While previous research has focused on the conditions that led to a new management regime in the Mojave, a full accounting of the benefits was conducted only recently. A 2021 paper by Andrew Ayres (2017 PERC Graduate Fellow), Kyle Meng (2015 PERC Lone Mountain Fellow), and Andrew Plantinga (2020 PERC Lone Mountain Fellow), published in the *Journal of Political Economy*, estimated the net benefits of instituting a market for groundwater in the Mojave.

One challenge in estimating the benefits of environmental markets is that areas with and without markets cannot be compared directly—they typically differ in more ways than one, including in ways that affect the value of water, and researchers cannot effectively control for the differences. To isolate the effect of marketability on the value of water rights, the authors statistically analyzed differences in land values on either side of the adjudicated area’s boundary, including land parcels on either side that overlie the aquifer. (Land values

in this case include the value of associated water rights.) Because the adjudication’s boundaries were not all drawn precisely around hydrologic distinctions, the nature and value of water rights on either side of the boundary differ due to only the effects of the adjudication.

The findings suggest large gains in the value of water use inside the adjudicated area, totaling more than \$400 million in net economic benefits by 2015. One way the market helped increase water values is by allowing water used on lands for growing low-value agricultural products to instead be reallocated to higher-value urban uses. It also provided incentives to improve agricultural water productivity, such as by growing pistachios instead of alfalfa hay. These benefits reflect only the economic gains of reallocating permissible pumping to higher-value uses; they do not include any benefits derived from stabilizing groundwater tables. Despite this, they still greatly exceed the relatively modest legal and administrative costs of establishing the system, estimated at \$40 million.

Read more:

“Do Environmental Markets Improve on Open Access? Evidence from California Groundwater Rights,” by A.B. Ayres, K.C. Meng, and A.J. Plantinga. *Journal of Political Economy* 129(10) (2021)



could cause overdraft in the basin again or, depending on where new extraction occurs, restrict downstream flow and threaten the subarea delivery obligations described earlier.

The expansion of pumping by previously exempt parties can compromise the integrity of the adjudicated rights system. After 2015, the water agency worked with minimal producers to bring some of them into the adjudication system—quantifying their claims and subjecting them to the same rules as other significant producers. In addition, the agency has adopted a new ordinance to help control the impacts of minimal producers: New producers issued well permits for *de minimis* use will be subject to charges to help offset the impact of any new pumping on the system. The offsets occur through the purchase of imported water.

In short, changing economic conditions in the basin and associated increases in demands on water prompted adjustment to the management system. As the Mojave example demonstrates, effective management requires more than just caps; ongoing attention and action from regulators is necessary when system-wide benefits are at risk.

Learning from Mojave

Groundwater users elsewhere in California and throughout the American West have begun to study previous groundwater allocation and market systems for insights, including the Mojave's approach. Several practical lessons for designing systems include incorporating hydrologic connections and using market approaches to resolve management issues.

The Mojave adjudication also highlights the importance of effective stakeholder engagement when it comes to implementing California's Sustainable Groundwater Management Act (SGMA). While most major users accepted Mojave's new

management system in the early 1990s, several parties decided to challenge it in court, arguing it abridged their water rights. Even as trading commenced in 1994 with most groundwater pumpers on board, litigation and appeals kept in question the participation of some influential holdouts. The resulting California Supreme Court decision affirmed the holdouts' rights. Coupled with court decisions from other groundwater adjudications, precedents may restrict the ability of groundwater managers to limit pumping under SGMA without broad stakeholder buy-in. In essence, bringing large pumpers into a binding agreement to constrain their entitlements could be difficult without their consent.

Absent such agreement, lengthy delays to resolve claims could arise. Given that efforts to implement SGMA in the past several years have been accompanied by a prolonged drought—and that droughts in the future will likely be more intense, heightening stresses on groundwater resources—there is an advantage to moving swiftly. Adopting systems that manage demand and allocate pumping rights sooner than later can avoid undesirable impacts of aquifer drawdown. Two pieces of California state legislation passed in 2015 attempted to streamline future adjudications and reduce the power of holdouts to stall the process; however, SGMA is explicit that it does not alter existing groundwater rights. The upshot is that implementing significant constraints on groundwater use without broad stakeholder buy-in may very well face strong pushback and delays.

Groundwater pumpers in the Mojave today have benefited greatly from their new management system. Stabilized water tables have reduced pumping costs and assuaged concerns about future water reliability. The market has facilitated flexible reallocation and increased the value of water in the basin. And the basin's accounting framework provided a foundation for it to become a regional water bank, storing excess flows for out-of-basin water users during wet years to be extracted during droughts.

Groundwater users and managers throughout California and in other parts of the West may need to make similar transitions in the coming years, and they may need to do so quickly. But they cannot skimp on the details. A functioning system that meets users' needs often requires more than just an aggregate cap and individual entitlements. A system designed for a desert can provide important lessons for them along the way.



Andrew Ayres is a research fellow at the Public Policy Institute of California and a 2017 PERC Graduate Fellow.

THE FUTURE OF WATER MARKETS

OBSTACLES AND OPPORTUNITIES



In recent decades, the idea of using markets to allocate water has gained traction in the United States. Water markets are now being harnessed in a variety of contexts, including markets for traditional surface water rights, instream flows, groundwater, water quality, stream mitigation banking, and even financial derivatives.

The essays in this report address timely water topics and provide policy recommendations to enhance the future of water markets. Together, they explore how markets can continue to be harnessed to allow competing water users to cooperate rather than fight over scarce water resources, encourage conservation, and alleviate the economic and environmental effects of water scarcity now and in the future. Featuring essays by **Andrew Ayres, Christina Babbitt, Daniel Bigelow, Ellen M. Bruno, Gary D. Libecap, Sarah E. Null, Zach Raff, Leslie Sanchez, Heidi Schweizer,** and **Arthur R. Wardle.**

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PERC.ORG/WATER-FUTURE



TROUT

A firsthand account of the legislative quest to reform Utah water law and allow conservationists to protect fish and wildlife habitat

BY TIM HAWKES



WATER

In June 2004, my friend and I took a turn around Lafayette Square in Washington, D.C., to commiserate. Both of us had concluded that we weren't cut out for life at a big law firm, but we didn't know what to do next. "Here's your problem," Mike said to me, "You're a conservative Republican who wants to save the environment. You've got nowhere to go." He was right. My initial job applications went nowhere. A few came back with what felt like a sympathetic pat on the head: "You seem like an interesting guy. Hope you find something that works out."

In the end, however, I took Mike's advice to explore "hook and bullet" organizations, eventually landing a job with Trout Unlimited in my home state of Utah. The job paid little, but the mission intrigued me: reform Utah water law to make it easier for conservationists to protect habitat for trout by leasing water from farmers.

Seemed simple enough to a policy hack like me: Why shouldn't Trout Unlimited be able to pay a farmer to leave a little water in the stream? What I failed to grasp at the time was the accumulated weight of the prior appropriation doctrine, the legal framework that underpins western water law. The doctrine allocates water rights based on who first diverted water and put it to "beneficial use," a term that historically included water for consumptive use in farms, homes, and industry, but not habitat for fish and wildlife. In the eyes of the prior appropriation doctrine, water left instream hasn't been put to beneficial use, and it is therefore "wasted" and available to satisfy any new or existing consumptive water right.

While Utah law modified the doctrine to recognize the value of water left instream as far back as the early 1980s, it allowed only two state agencies—the Divisions of Wildlife Resources and State Parks—to acquire and hold instream rights, and that authority had seldom been used. To my mind, extending that right to a private entity made for an easy sell to a legislature dominated by conservative Republicans who mistrust government: If the state could be trusted to hold such rights, why not private actors?

If the theory seemed easy, the application proved hard. A colleague had once shown a photo of a dry stream to a group of farmers to illustrate the problem we were trying to solve. They cheered—not for our proposal, but for the dry stream bed, a "fully allocated" system.

My own initial efforts fared little better. In debates over relicensing a hydroelectric project in which we hoped to secure a modest instream flow to mitigate environmental harms, I told an irrigator that the babble of a small stream in the high desert was a "hymn to all Creation" that we shouldn't silence. In response, he told me, in so many words, to go to Hell. My initial efforts to lobby the legislature were met with similar

welcome. I crafted a one-paragraph amendment to existing law that would have allowed private entities to lease water for instream flows on a temporary basis. No one showed much interest. Many said we should work through existing law. One person told me bluntly that changing the law to allow private leasing would prove "impossible."

Cracks in the Wall

One day, after another setback, I expressed frustration to a well-respected water lawyer. "But this will benefit agriculture!" I protested. "Tim," he said, "They don't know you, so they don't trust you." I let that sink in. Not long after, I invited members of the Utah Farm Bureau to take a trip with me to Montana where they could meet farmers and ranchers who had real-world experience with private leases for instream flows. I figured Utah ranchers would trust Montana ranchers more than a city slicker like me, and they did. But the trip also helped build lasting relationships with the Farm Bureau, which opened the door to real conversations about private leasing, the



Bear River, Utah © Edgar Zuniga Jr.

opportunities it could provide to agricultural producers, and potential safeguards that we could build into legislation.

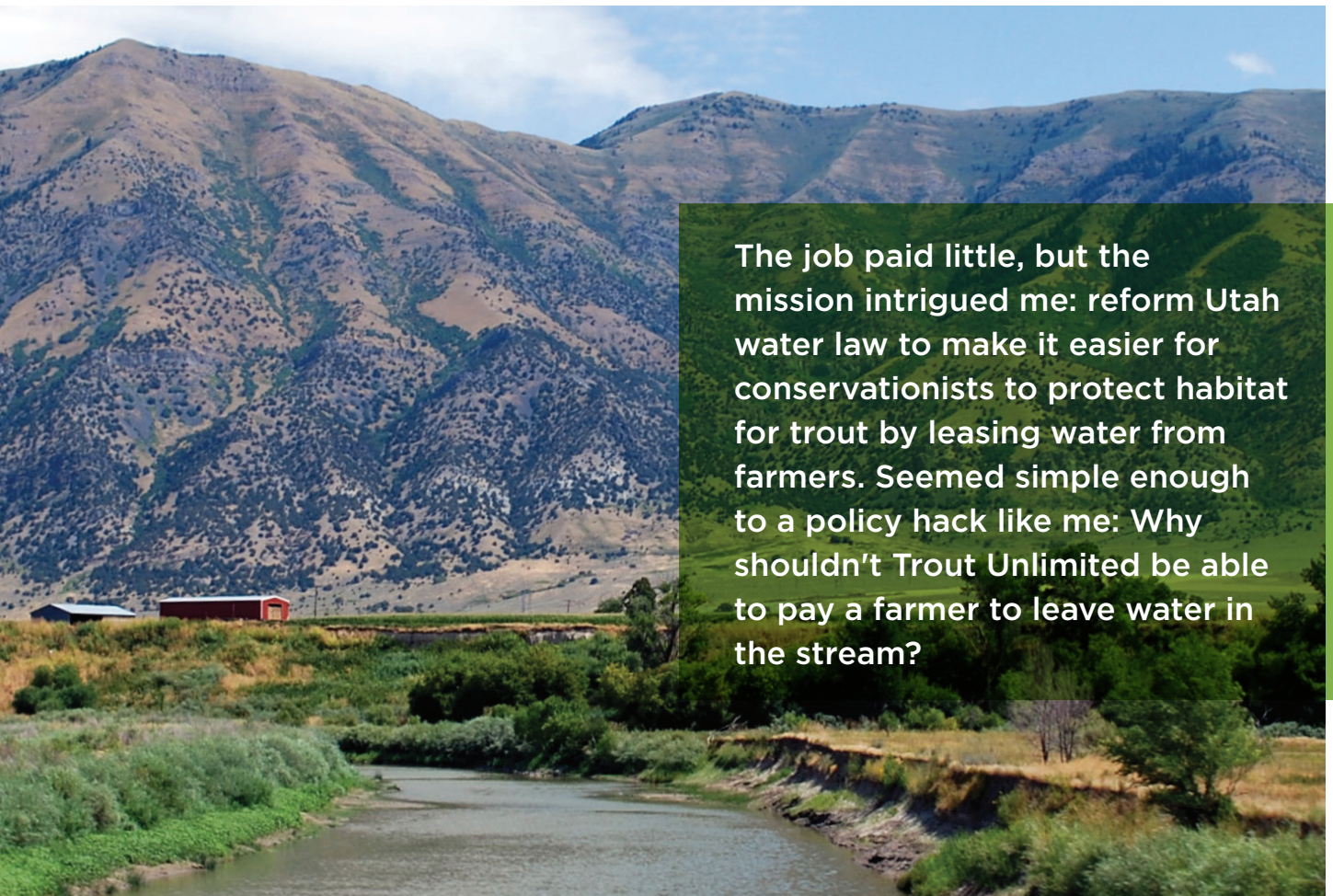
To address concerns, I began adding restrictions to the draft bill. The idea was this: We needed proof of concept—to show that the sky wouldn't fall if Utah allowed private leasing on a limited basis. As long as we could demonstrate the concept, we could live with all kinds of restrictions. Soon the draft included a 10-year sunset, a 10-year time limit on leases, restrictions on how far downstream protected flows could go, loss of seniority for leased instream rights, restrictions on who could hold the rights (only "private fishing groups"), and more.

The day of the first legislative hearing arrived. By then I'd refined my talking points down to three central principles: private property rights, free enterprise, and limited government. My presentation included a photo of Karl Marx, with a quote from Marx about how the government alone should control the means of production. I reasoned that defenders of the status quo wouldn't want to align themselves with Karl Marx, and I was right. The work group recommended the bill favorably.

Stuffed at the Goal Line

Over three years, the bill, now called "Instream Flows to Protect Trout Habitat," had ballooned from a few sentences to more than 400 lines. Along with all of that weight, however, it now had positive momentum. Significantly, the Utah Farm Bureau took a position of support. After being introduced in the 2007 legislative session, a Senate committee unanimously approved the bill, after which the chair said to me: "You know I've struggled with this one, but my father owns a ranch on the Bear River, and he's been working with Warren Colyer of Trout Unlimited on a restoration project on his ranch. Warren has done everything he said he'd do, so I think you guys deserve a chance."

The bill sailed through the Senate, and my confidence grew. It hit a rough patch in the House, however, where it barely passed committee by a vote of 7-6. The key detractor was Rep. Mike Noel, from southern Utah, who feared that a water user who entered into a voluntary agreement with Trout Unlimited could be forced by the federal government to keep



The job paid little, but the mission intrigued me: reform Utah water law to make it easier for conservationists to protect habitat for trout by leasing water from farmers. Seemed simple enough to a policy hack like me: Why shouldn't Trout Unlimited be able to pay a farmer to leave water in the stream?

Progress always stalled higher up in the bureaucracy. Every time I thought we'd made progress and advanced to the next level, someone would say, "Wait, you mean fish could die?" ignoring the species-wide conservation benefits.

water instream if the trout species benefited by the lease were later listed under the Endangered Species Act. In other words, he feared that a voluntary lease could be converted into an involuntary one through application of federal law. It seemed like a remote risk, and the U.S. Fish and Wildlife Service reassured me that they'd never do such a thing, so we decided to press forward rather than craft a difficult amendment for the House floor.

After rigorous debate, the bill drew 36 "yes" votes and 32 "no" votes, with seven absent. In Utah a bill requires 38 votes to pass, and so "Instream Flows to Protect Trout Habitat," after three years of blood, sweat, and tears, failed by a mere two votes. In a private meeting with a few legislators afterwards, I broke down in tears. I couldn't believe we'd come so close.

If at First You Don't Succeed

The setback stung, but we had reasons for optimism. The concept now had strong support from many quarters, and opposition in the House was driven largely by one person with a specific concern that felt solvable. So I went to work solving it. As it turned out, the representative's concerns weren't entirely unfounded. There *was* a possibility that a voluntary lease could become an involuntary one under the worst-case scenario he described.

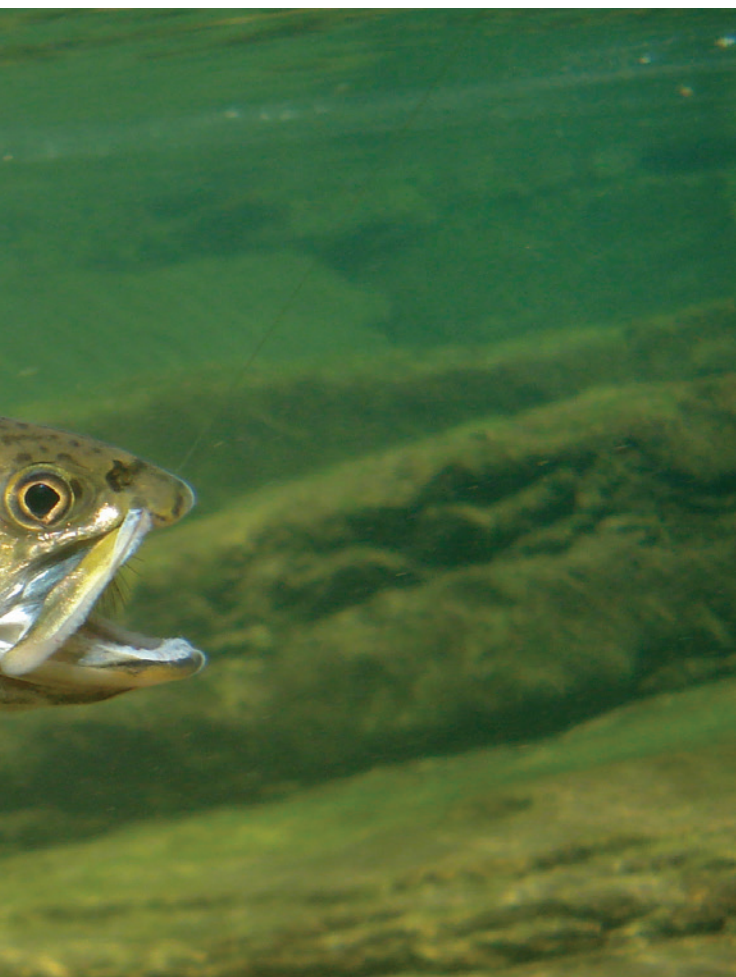
A potential solution soon took shape: something called a Candidate Conservation Agreement with Assurances (CCA)



Brook trout

with the U.S. Fish and Wildlife Service, which operates like a safe harbor agreement for species at risk for listing under the Endangered Species Act. In this case, an instream flow lease to benefit one of Utah's four species of native trout would offer species-level benefits in the form of expanded habitat. Because such leases are temporary and voluntary, however, individual leases could eventually terminate, affecting habitat and, potentially, killing some fish. The CCAA would shield participants in the leasing program from punitive measures if the Fish and Wildlife Service later decided to list the trout species that the lease protected.

I traveled to southern Utah to meet with Rep. Noel, explained the idea, and he agreed to support the bill if it required a CCAA be in place before leasing could occur. We added that requirement, and in 2008, with support from Rep. Noel and little opposition, the bill sailed through the House with unanimous support. That momentum carried over in the Senate, where the bill passed easily and was signed into law.



The Devil's in the Details

At long last, Utah law now allowed a private entity to hold instream flow rights, at least in theory. While we had the statutory authorization, we did not have a CCAA in place. Biologists from the Fish and Wildlife Service grasped the concept and did their best to help, but progress always stalled higher up in the bureaucracy. Every time I thought we'd made progress and advanced to the next level, someone would say, "Wait, you mean fish could die?" ignoring the species-wide conservation benefits. I repeatedly explained it this way: "Let's say that the leasing program creates habitat for an additional 50,000 fish. If a lease terminates and we lose 500 fish, we're still 49,950 fish ahead, right?" Wrong, apparently. After years of trying, we failed to secure a CCAA, which meant that we had no opportunity to actually use the new legislative authority.

Ultimately, I concluded that it would be easier to change Utah water law again than to navigate the federal bureaucracy. So, in 2013, a full five years after passage of the original bill, the Utah legislature unanimously passed a bill amending the original instream flow law, with none other than Rep. Mike Noel as the principal sponsor. The solution to the CCAA problem? Create a second path, whereby, absent a CCAA, a lease could go forward provided the lessee agreed in the contract to assume any Endangered Species Act liability and protect the owner of the water right against that risk.

Finally, Trout Unlimited was free to pursue private leases, and, over the next five years, did just that, securing several modest leases around the state. The sky did not fall. The farmers who participated benefited either through lease payments or other in-kind benefits such as the installation of irrigation pivots or other labor-saving technologies. In short, the proof of concept effort delivered as promised.

In 2015, I was elected to the Utah House of Representatives, which put me in a position, in 2019, to introduce another bill that removed the 10-year sunset on the private leasing program, making it permanent. The Utah Farm Bureau, now a trusted partner, again spoke in favor. The bill passed unanimously.

Kicking Open the Door

If the 2008 legislation opened the door for private leasing, it opened it just a crack. Over time the restrictive nature of the legislation became clear, not just to Trout Unlimited, but also to the State Engineer's Office, which had to help parties navigate the law's many obstacles. The restrictions also frustrated farmers, some of whom wanted to participate but could not on account of the many restrictions.

In 2019, Utah State Engineer Teresa Wilhelmsen suggested to a group of stakeholders that the legislature tweak the

instream flow program to make it easier to use and administer. By that time, at least three strong supporters of private leasing were serving in the Utah House: myself, Rep. Joel Ferry, and Rep. Casey Snider. The three of us decided that, if we were going to go to the trouble to modify the statute, we shouldn't just tune up an what amounted to an old kid's bike with "20 training wheels dangling off of it," but rather take off all the training wheels, scale up the size, and let it run like a proper bicycle.

That line of thinking ushered in House Bill 33, a significant policy shift that rolled through the legislature with minimal opposition in 2022. The bill's principal sponsor was Rep. Ferry, a full-time farmer and rancher and an early advocate of private leasing for its potential to benefit agricultural producers. The Senate sponsor was Scott Sandall, another full-time farmer and rancher. While some in the agricultural community expressed concerns about the scale of the changes, that opposition carried little weight in the face of broad support in the water community and leadership from two senior Republican legislators who make their livelihoods in agriculture.

What does that bill do? It 1) allows *any* private person or entity to lease water for instream flows; 2) allows a water right

holder to convert an existing right to an instream flow on a temporary basis without involving any other party; 3) allows the Division of Forestry, Fire, and State Lands to acquire and hold instream flow rights to benefit state sovereign lands, including the Great Salt Lake; and 4) removes the CCAA requirement and many other restrictions. In short, it treats instream flows like more traditional, consumptive rights, and it reflects a fully mature policy response—16 years in the making.

Lessons Learned

My hard-won experience pursuing instream flow reform in Utah taught me many valuable lessons that could be applied by those trying to promote leasing and other free-market environmental reforms elsewhere.

1. One cannot change deeply rooted institutions such as western water law on the cheap or on the fly. It requires time, patience, and sustained effort. Earning trust takes time. It also requires playing it straight with stakeholders and living up to commitments.

2. Solving complex challenges requires extensive engagement with those most affected. In most states that means working with—not against—the agricultural community.



Bonneville cutthroat trout, the state fish of Utah
© Bryant Olsen



Fly fishing on Utah's Provo River

With a lot of time, effort, and engagement by many stakeholders over several years, Utah law now provides significant tools to protect water in our rivers, lakes, and streams.

It also requires spending significant time on the ground in rural areas and genuinely understanding rural concerns.

3. Identify the most credible voices and engage them early on. Too many advocates engage only allies or start with the media, which risks backlash if the media frames the issue in unhelpful ways.

4. Lasting solutions must do more than pay lip service to the idea of win-win. Solutions that don't work for major stakeholders don't work at all because resistance will only grow over time. On the other hand, support for genuine win-win solutions grows as stakeholders see and recognize the program's value. That paves the way for bigger successes later.

5. Pay attention to transaction costs. Expensive or difficult-to-use legal tools have little value because no one will use them. Don't build into legislation requirements—like the CCAA—that turn on federal actors or other remote decision makers.

6. Pilot programs help reassure policymakers and other stakeholders because they allow a window to test proof of concept without making permanent changes to long-standing law.

7. Get to know the political landscape. Advocates for the environment tend to gravitate to left-leaning legislators who

represent urban districts. In a state like Utah, that's a recipe for disaster. Winning over opponents carries far more value than preaching to the already converted.

What's Next?

With a lot of time, effort, and engagement by many stakeholders over several years, Utah law now provides significant tools to protect water in our rivers, lakes, and streams. The challenge now lies less in the legal framework than in the implementation. How do we deploy these new tools? How do we make them work in ways that share scarce water resources between competing uses? How do we fund innovations that will help during times of scarcity? While those challenges remain daunting, the good news is this: In Utah, we can and will solve them by working together.



Tim Hawkes represents Utah's House District 18 and works in the brine shrimp industry to help protect the Great Salt Lake. Prior to that, he spent more than a decade as Utah state director for Trout Unlimited.



Whether a lot near Priest Lake, Idaho, qualifies as a wetland became the subject of drawn-out litigation that has risen all the way to the U.S. Supreme Court.

© Pacific Legal Foundation



Clear As Mud

A half-century after the Clean Water Act was enacted, there's still no clear answer as to what it regulates. A new Supreme Court case may finally provide some clarity

BY JONATHAN WOOD

In 2004, Mike and Chantell Sackett purchased a lot in a residential subdivision near Priest Lake, Idaho, where they planned to build their dream home. When they graded the lot to prepare it for construction, however, that dream was abruptly put on hold. An official from the Environmental Protection Agency ordered their crew to stop their work. A few weeks later, the agency sent the Sacketts a compliance order accusing them of filling a federally regulated wetland without a permit. The order demanded they restore the wetland to the EPA's satisfaction—or else face fines of up to \$75,000 per day and possible criminal prosecution.

That order has spawned a 15-year fight between the Sacketts and the EPA over whether the property is covered by the notoriously unclear Clean Water Act. The law established federal authority over “navigable waters,” but Congress unhelpfully defined “navigable waters” as the “waters of the United States.” It has never said what, beyond actual navigable waters, this phrase is supposed to include. Thus, regulators, landowners, and conservationists have been left to guess what counts under the act.

In the Sacketts' case, the EPA says their land is covered because it contains a wetland that is similar to another wetland across the street, and that other wetland drains into a man-made ditch, and that ditch connects to a creek, and that

creek empties into Priest Lake, which is navigable. The Sacketts respond that if such Rube Goldberg-esque theories suffice, no landowner can know whether their land is regulated. After all, when they purchased the lot, it seemed no different from the neighboring lots that had been developed without objection.

In October, the U.S. Supreme Court heard the Sacketts' challenge to the EPA's assertion of authority over their land. This marks the second time the Sacketts have been to the Supreme Court, having won a unanimous decision in 2012 that they had a right to challenge the EPA's order. If the court finally brings some clarity to the Clean Water Act's cryptic terms, it would obviously benefit hapless landowners like the Sacketts. But it would also benefit conservation efforts by reducing conflict, better focusing federal enforcement efforts, and encouraging states and private conservation groups to make wetlands an asset rather than a liability for private landowners.

A 50-year Quagmire

A half-century after the Clean Water Act was enacted, there's still no clear answer as to what it regulates. Despite repeated calls from landowners, regulators, and even the Supreme Court, Congress has never elaborated on “waters of the United States”—sometimes abbreviated as WOTUS.



The Sacketts' home-building plans have been put on hold. © Pacific Legal Foundation

Instead, legislators have left the EPA to figure it out through a series of interpretations of the phrase, all of which have been struck down by courts as too broad, too narrow, or simply arbitrary.

The Supreme Court has considered the meaning of waters of the United States several times, only siding with the EPA once. But those cases have usually concerned extreme examples that shed little light. The court has held, for instance, that the Clean Water Act covers a wetland on the shore of a navigable lake if it is unclear where the lake ends and the wetland begins. And the court has said that if migratory birds land in a remote, flooded gravel pit, then the pit is covered under the act. But there is a vast number of water features, soggy lands, and other areas between these two extremes that have been left unresolved.

When the court confronted a more difficult situation, in a 2006 case called *Rapanos*, it fractured and produced no majority opinion. The late Justice Antonin Scalia, writing for four justices, interpreted the Clean Water Act to reach only a) navigable waters; b) relatively permanent, standing, or continuously flowing tributaries of navigable waters; and c) wetlands with a continuous surface connection to a navigable water or regulated tributary. Justice Anthony Kennedy, writing only for himself, however, interpreted the act to apply to any water or

Despite repeated calls from landowners, regulators, and even the Supreme Court, Congress has never elaborated on “waters of the United States.” Instead, legislators have left the EPA to figure it out through a series of interpretations of the phrase.

wetland with a “significant nexus” to a navigable water. Four other justices dissented, favoring an even broader interpretation of EPA’s power.

Because there was no majority opinion, *Rapanos* has only increased confusion and uncertainty. The EPA has generally favored Justice Kennedy’s significant nexus approach, but it has struggled to convert that into a real standard. Each of the last three presidential administrations have issued regulations attempting to define waters of the United States more precisely. But each of those regulations have been upended by courts, causing the EPA’s approach to dramatically change from



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SCOTUS considers WOTUS, again

Oral arguments in *Sackett v. Environmental Protection Agency*, held in October, revealed little support for the “significant nexus” approach that the EPA relied on to assert authority over the Sacketts’ property. When the government was unable to give a clear, objective standard for determining significant nexus, Justice Neil Gorsuch asked: “So, if the federal government doesn’t know, how is a person subject to criminal time in federal prison supposed to know?”

But the justices were likewise concerned about the consequences of the narrower interpretation suggested by Justice Antonin Scalia in *Rapanos*. Justice Ketanji Brown-Jackson, in her first argument since her appointment to the court, questioned how a narrow interpretation that would leave most wetlands unregulated, at least under federal law, could be squared with the Clean Water Act’s purpose

year to year and state to state. Ultimately, Justice Kennedy even soured on the approach, suggesting in one of his final arguments before his retirement that the Clean Water Act is so vague that it may be unconstitutional.

Bogged Down in Bureaucracy

In many ways, the Sacketts’ case gives the court a do-over for *Rapanos*, at least when it comes to federal regulation of wetlands. If a majority of justices can coalesce around any approach, they will finally give some clarity to the agencies, regulated landowners, and environmentalists with an interest in stream and wetland conservation.

Assuming the court adopts a clear but narrower interpretation of the Clean Water Act, what would this mean for wetland conservation? In an amicus brief supporting the Sacketts, PERC argued that vague federal regulation is no panacea for

given the importance of wetlands to water quality. Justice Elena Kagan asked the Sacketts’ lawyer for “a compromise position” that would give the Sacketts a win without narrowing federal authority so much, and Justice Sonia Sotomayor asked the government’s lawyer a similar question. Neither attorney could identify this Goldilocks solution.

Several of the justices suggested that an obscure reference in the Clean Water Act to wetlands “adjacent” to navigable waters might offer a way out of the quagmire. The Sacketts’ property is about 300 feet from Priest Lake, although there’s a road and a row of houses in between. Perhaps this proximity to the lake would be enough, several justices offered. Justice Gorsuch pushed back, questioning whether this approach offered any meaningful clarity. He asked the EPA’s lawyer whether 3,000 feet or three miles would also be close enough, but the answer—“I don’t ... I don’t know the answer to that, Justice Gorsuch. ... I don’t think it could be three miles”—did not seem to provide much comfort.

Ultimately, the discussion of adjacent wetlands may have been merely academic. The EPA’s lawyer acknowledged that the agency abandoned in the lower courts any argument that the property is regulated because it is adjacent to Priest Lake, and, therefore, it could not win on that basis. Justice Amy Coney Barrett, who may well be the deciding vote, summed up the EPA’s predicament by underscoring that, to side with the EPA, the court would have to agree with Justice Kennedy’s significant nexus approach. Based on the oral argument, that outcome seems unlikely.

conservation. It can cause federal enforcement efforts to be unfocused or haphazard, make wetlands a liability for private landowners, and breed ill will between landowners, conservationists, and regulators. This can ultimately discourage wetland conservation and restoration. A clear rule, on the other hand, gives states, landowners, and conservation groups certainty where their conservation efforts are needed and helpful.

It is not a coincidence that so much of the conflict over the Clean Water Act has concerned wetlands. Navigable waters and the land underlying them are public property, subject to a federal servitude for navigation, and are governed by the public trust doctrine. Thus, no one would reasonably expect that they could pollute or fill the Chesapeake Bay or Mississippi River without government permission, and no one’s rights are curtailed if the government refuses to issue a permit.



Wetlands, on the other hand, are mostly found on private property. According to the EPA, 75 percent of wetlands in the lower 48 states are privately owned. Yet most landowners would struggle to identify wetlands because, according to the Congressional Research Service, the EPA's interpretation of wetlands includes areas that "either may have wetland characteristics only some portion of the time, or may not look like what many people visualize as wetland." Moreover, the activities being regulated—home building, farming, and logging—are not the sort of intrinsically harmful activity, like dumping traditional pollution into a stream, that people expect to require federal approval.

When landowners discover that they might need a federal permit, the process for obtaining one can be extremely costly and time-consuming. Because the act's application, under the current significant nexus approach, cannot be determined

Vague federal regulation is no panacea for conservation. It can cause federal enforcement efforts to be unfocused or haphazard, make wetlands a liability for private landowners, and breed ill will between landowners, conservationists, and regulators.

by simply looking at the property and public sources of information to determine whether an area is regulated or not, the landowner must hire one or more experts to make an assessment. According to EPA estimates, permit applicants spend between \$1 billion and \$1.6 billion on these costs annually. But this is only the beginning of the expense. If a permit is granted, the EPA may demand mitigation that can cost more than \$500,000 per acre. Therefore, the presence of a wetland potentially regulated by the act can be a significant liability for landowners.

For Peat's Sake

The Clean Water Act regulates all discharges to and filling of waters of the United States, including activities that improve the environment. For example, this burdensome process can penalize landowners who maintain or restore wetlands on their property, discouraging them from making such investments.

In 2012, Wyoming landowner Andy Johnson dammed a small stream on his property to create a pond for his daughters' horses and other livestock. The stream had been heavily eroded by decades of livestock use by prior owners. Johnson worked with the state to design the pond so that it would help to restore the stream's function and produce other environmental benefits, including restoring habitat for fish and wildlife, improving water quality by removing sediment, and creating a ring of wetlands around the pond. By all accounts, the project was a success. Nonetheless, the EPA issued a compliance order against Johnson because he did not get a federal permit before damming the trickling stream.

For two years, the agency subjected the Johnsons to the same treatment as the Sacketts, threatening significant fines and imprisonment if the family didn't rip out the pond. It did so despite never questioning the environmental benefits that had been created. In the end, the Johnsons sued the agency,



Seventy-five percent of wetlands in the lower 48 states are privately owned. © USDA NRCS Texas

which promptly settled once the family proved that the stream had no connection to navigable waters. Despite the happy ending, the ordeal was not something any other family considering a similar restoration project would want to experience.

Or consider the “permitting hell” that Scott and Sandy Campbell, owners of Silvies Valley Ranch in Oregon’s high desert, went through after restoring a watershed on their property. To mimic the impacts that beavers had historically had on the ecosystem before being extirpated decades earlier, the landowners created artificial beaver dams in a desert gully that flowed only a few weeks every year during snowmelt. The dams slowed the flow of water and reduced erosion. It created ponds that recharged groundwater and promoted riparian and wetland vegetation. It made the soil more productive, reducing the need to divert water from other sources. And it created natural fire breaks.

Under a state analog to the Clean Water Act, a permit is required for work in perennial streams, but not ephemeral features like desert gullies. Because the Campbells’ restoration work converted the desert gullies into perennial streams and ponds, they were fined for doing the work without a permit. And their future use of the property is subject to regulation and permitting.

Restoration work like that undertaken by the Johnsons and the Campbells is not easy or cheap. Penalizing it is likely to substantially discourage others from undertaking similar efforts. And uncertain standards like the significant nexus approach can be especially discouraging, as rational landowners will avoid taking a chance that their restoration efforts will be penalized by regulation that reduces the value of their property and hamstring their future use of it.

Liability or Asset?

While the Clean Water Act makes wetlands a liability for landowners, this needn’t be so. Wetlands provide numerous benefits which, under the right policy, could make them an asset to landowners who conserve or restore them. Wetlands rival the biological productivity of rainforests and coral reefs, producing 31 percent of the nation’s plant species. They provide habitat for wildlife and waterfowl, including a third of the species listed under the Endangered Species Act. And they store and filter water, serving a critical function for flood control and water quality.

All of these benefits are potential sources of value for landowners who conserve and restore wetlands. Some landowners, like the Johnsons and Campbells, will do so



All of these benefits are potential sources of value for landowners who conserve and restore wetlands. Some landowners will do so because they personally value the environmental benefits they create. Markets, however, can encourage more landowners to pursue similar work.

activities under the act. Rewarding wetland owners for mitigating the impacts of pollution by others is a superior approach to the status quo because it puts the cost on polluters rather than interfering with the property rights of the owners of wetlands who boost water quality.

Markets can also empower conservation groups to protect wetlands. Ducks Unlimited, for instance, has worked with landowners in Montana, Wyoming, and the Dakotas to conserve prairie potholes, a type of small, shallow wetland that collects rainwater and snowmelt. Due to their remoteness, potholes are unlikely to be covered by the Clean Water Act. The group is motivated to conserve these features because they provide critical nesting habitat for ducks and other waterfowl valued by hunters, birders, and other conservationists. Through land purchases, conservation easements, and financial incentives for landowners to adopt duck- and wetland-friendly practices, the group conserved 500,000 acres of these “duck factories” between 2012 and 2017.

If federal regulation were clearer, utilities, regulated entities, and conservation groups would have greater certainty where similar market approaches are needed and would be most impactful. And, importantly, they will be motivated to make these investments based on the value that different wetlands provide. This would be a significant improvement over the inconsistent and haphazard regulation under the Clean Water Act on display in the Sacketts’ case before the Supreme Court today.



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For instance, New York City lies at the end of a 2,000-square-mile watershed that provides clean drinking water to 8 million people. Conserving and restoring upstream wetlands can significantly improve downstream water quality and lower the city’s treatment costs. Between 1996 and 2009, the city purchased or acquired conservation easements covering 143,212 acres of wetlands. It has also provided incentive payments to upstream farmers and forest owners to conserve wetlands, restore stream buffers, and limit pollution from stormwater and agricultural runoff, with agreements reached with 95 percent of commercial farms in the watershed. These programs make wetlands a source of value for upstream landowners rather than a toehold for regulation and conflict.

Similar incentives could be developed to mitigate other types of pollution and water quality concerns. Under the Clean Water Act, the EPA can allow polluters to offset their impacts by conserving and restoring wetlands that filter a similar amount of pollution. In this way, efforts to restore or conserve wetlands could help mitigate traditional sources of pollution, rather than directly regulating those conservation



Indus River © lensnmatter

The Water Wars That Weren't

Technology and trade can ensure water scarcity is not a constraint on progress

Nearly three decades ago, while I was a graduate student in Washington, D.C., I worked on a Defense Department project forecasting future international conflict. My task was to write about the risk of an India-Pakistan war over access to water from the Indus River. To be honest, I can't remember the details of what I said, but I can imagine my outlook colored dire.

If that's right, the prognosis was off. India and Pakistan have not gone to war over water. Nor have any other countries, thanks in no small part to the continuing relevance of Julian Simon's insight that human ingenuity, combined with global markets, can both mitigate and adapt to natural resource scarcity.

Predictions of a near future of water wars have a long history. Former U.N. Secretary General Boutros Boutros-Ghali warned in 1985 that the next war in the Middle East

would be "fought over water, not politics." It wasn't. (Nor was the one after that, or the one after that ...) But Kofi Annan, Boutros-Ghali's successor, was happy to double down and suggest that "competition for fresh water may well become a source of conflict and wars in the future." In fact, in a list of 1,298 conflicts involving water going back over 3,000 years maintained by the Pacific Institute, none are interstate wars actually *caused* by conflict over water—though it has been a contributing factor, and lives have certainly been lost over water access and rights.

Looking forward, there are increasing challenges to sustainable water provision in regions from California to the Aral Sea and the Indus River Basin to the Jordan River Valley. Globally, as much as a third of the world's population already lives in areas that have access to fewer than 1,700 cubic meters of fresh water per person per year, the tipping point



A richer world with an additional two billion people in it in 2050 will likely demand more fresh water than ever. But the combination of further technological advances and trade can ensure water scarcity won't become a binding constraint on progress, limiting water wars to works of fiction.

Drip irrigation in Spain © François Molle/IRD

into “moderate water shortage,” according to one measure of water stress. That’s up from 9 percent in 1960. And many aquifers worldwide are being drained at unsustainable rates.

But it is worth noting that this challenge has grown while global life expectancy has climbed from 50 to 73 years and extreme poverty rates have dramatically declined. World famine deaths plummeted from about 16 million in the 1960s to around a quarter of a million in the first half of the 2010s, while global calorie supplies have risen from 2,192 per person per day in 1961 to 2,928 in 2018. And that’s particularly relevant because about 70 percent of global freshwater use is for agriculture.

The decoupling is the result of new technologies that reduce the amount of water needed to grow crops as well as international trade in food. Drip irrigation practices and drought resistant crops are just two of the innovations that allow crops to be produced even with limited, erratic water supply. Meanwhile, more than a fifth of global food production is traded, with world prices for foodstuffs declining over time: The inflation-adjusted global price of soybeans, wheat, and maize in 2020 was less than half of that in the 1960s. As recent conflicts in Yemen and Ukraine demonstrate, in the modern world, famine is an act of war rather than an inevitable Malthusian endpoint, and shortages are linked to barriers to trade.

Meanwhile, water for direct domestic consumption—about 12 percent of total freshwater withdrawal worldwide—remains very cheap. If anything, the price is often too low, generating insufficient revenues for water and sewage companies to extend and maintain their systems. The Water Security Solutions Center suggests the average combined water and wastewater rate is about \$4.00 per cubic meter in Europe and North America and between \$0.50 and \$1.50 in the rest

of the world. The World Health Organization recommends a minimum of between 50 and 100 liters of water per person per day. At \$1.50 per cubic meter, the daily minimum would cost on the order of \$27 per year. For the 690 million people worldwide in extreme poverty, meaning they live on less than \$1.90 a day, that’s a lot—about 4 percent of their total expenditure. But the bigger problem is that the majority of extremely poor households aren’t connected to the water network at all. Higher prices would help provide the investment resources to get them connected. Meanwhile, as a proportion of global average income, \$27 is about 0.2 percent.

A richer world with an additional two billion people in it in 2050 will likely demand more fresh water than ever. But the combination of further technological advances and trade can ensure water scarcity won’t become a binding constraint on progress, limiting water wars to works of fiction. Not least, the cost of desalination has fallen as much as 90 percent since the 1960s, and in many countries it is now less than \$1.00 per cubic meter. If renewable energy costs decline and technologies continue to improve, the price will fall further.

As Julian Simon and Herman Khan argued nearly 40 years ago in *The Resourceful Earth*, we could surely do with better institutional management of water in the United States and worldwide. Even so, we aren’t going to run out or have to fight it out over what is left.



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