
REMAPPING DEBATE

Asking "Why" and "Why Not"

Day of reckoning for the parched Southwest: technology and conservation won't be enough

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Feb. 19, 2014 — When it comes to water in America, this truth is self-evident: We are guzzlers from sea to shining sea. Nowhere, though, are the effects of our thirst as visible and self-destructive as they are in the Southwest, the fastest-growing and driest region of the country, where just one long and lonely river, the Colorado, must slake the needs of seven states.



Lake Powell, the meandering reservoir that straddles the border of Arizona and Utah, has lost half of its water since 1999 because of drought and human water use. The drop in water levels is evidenced by the pale pink "bathtub rings" along the canyon's iconic sandstone walls.

The 1,450-mile river, once broad and blue, has in many places shriveled to a muddy trickle. On the Arizona-Nevada line, Lake Mead, our biggest reservoir and a crucial water source for cities from Las Vegas to Los Angeles, sits below half-capacity, as does its sister lake, Powell. In New Mexico, Arizona, and southern California, the earth is fissuring and subsiding in spots – picture sinkholes in Florida – because aquifers are excessively drained. And from California to Colorado to Wyoming, farmers are bulldozing orchards, fallowing alfalfa fields, and unloading herds of cattle because soil moisture is so low.

Atop the Rocky Mountains, another warning sign: dust-darkened snow, tinged the color of cinnamon. Increasingly vehement windstorms – *haboobs*, as some locals refer to them – are depositing more and more desert dust and sand on the peaks, which does more than gum up slopes for skiers: The dark film hastens absorption of sunlight, thereby melting snow faster and speeding runoff, a problem for farmers and water managers who rely on slowly thawing snow packs to deliver water downstream in regular volumes year-round.

It's not seriously disputed that the region's water shortfall is large and will become worse, even in the absence of drought. Likewise, it is widely acknowledged that increasingly strict conservation measures will soon become the norm in the region. What is striking, however, is the reluctance of state officials, builders, and others to acknowledge two more truths that the weight of evidence points to: first, that the relentless growth the Southwest has become accustomed to over the last half-century is unsustainable; second, that either in a planned way executed over time to cushion shock or disruptively after more years of whistling past the graveyard, growth of population and industry will slow and stop.

As of now, no one in a position of authority appears to be giving any thought to what a non-growth environment would look like and how it could be managed.

There's no light at the end of this tunnel

A 2012 report by the U.S. Bureau of Reclamation included a remarkably ominous projection: By 2060, it said, water demand in the Colorado River Basin states of Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, and California is likely to outstrip supply by more than 10 times what Las Vegas uses each year. Meanwhile, a spate of climate-change studies by the National Academy of Sciences shows that rising global temperatures will diminish the Colorado's average flow after 2050 by 5 to 35 percent. Those projections are premised on rainfall levels remaining the same as they are now; most models predict drier years ahead, not wetter ones.

Were nothing done to change our current trajectory, Remapping Debate asked Carly Jerla, a hydrologic engineer with the Reclamation Bureau and a co-manager of its 2012 Basin study, how would a water emergency play out by, say, 2050?

Could dropping water levels cause hydroelectric dams like the Hoover and Glen Canyon to churn out significantly less energy or stop altogether? (Possibly.) Could aqueducts that serve the cities of Phoenix, Tucson, San Diego and Los Angeles – not to mention the factory farms of California's Imperial and Coachella valleys – start drying up? (Possibly.) Could America's playground, Las Vegas, actually have to ration water? (Again: possibly.)

The obvious expedient of cutting back on water consumption is already happening, albeit in a patchwork manner. Water-saving efficiencies in the home (the unfortunately phrased "toilet-to-tap" solutions) are what allow Las Vegas officials to boast that everybody can take 20-minute showers every day without raising the city's consumption a drop. In southern California, the metropolitan water district gives away high-efficiency water nozzles and subsidizes artificial turf and zero-water urinals. The Palo Verde nuclear station just west of Phoenix is the only nuclear power plant to use reclaimed wastewater for cooling. Prescott Valley, Arizona, whose population has ballooned 50 percent since 2000, irrigates golf courses with treated wastewater and sells permits to its future supply of treated effluent to developers who need to show they have a proven, 100-year source of water before they can build new homes. On the farm, growers are flattening fields with lasers to reduce runoff. Others are turning to water-efficient drip and microsprinkler systems and gizmos with names like "AquaSpy," sensors planted at a crop's root zones to monitor soil moisture in real time, to reduce water use and increase yields.

Recycle and re-use water by all means, says Brian Czech, but at the end of the day "the natural water cycle cannot pump perpetually faster. There is a finite stock of water, a finite rate of water cycling," which limit the size of a sustainable economy. "Wishful thinking won't change that. It won't make your water supply infinite."

But conservation isn't bringing water use into balance with available supply – the water deficit remains. Take Arizona, often lauded for its water-saving efforts. Since 1980, the state has had a groundwater management act that, in theory, permits residential construction only if builders can demonstrate the existence of a 100-year water supply and show how they will “recharge” what future homeowners draw from local aquifers. That program is what Spencer Kamps, a spokesman for the Home Builders Association of Central Arizona, pointed to when he told Remapping Debate, “We’re in a sustainable model for many years ... We don’t have a water problem in Arizona.”

Yet Arizona’s Department of Water Resources released a report last month, “A Strategic Vision for Water Supply Sustainability,” which concluded: “Although the State has an existing solid water management foundation, water demands driven by future economic development are anticipated to outstrip existing supplies.”

K. Bruce Jones says that if population growth and economic activity are not curbed or managed in a sustainable way, the result will be constant, ever-steepening increases in water prices – a situation that will become so untenable “at some point you’ll have a reverse trend – massive depopulation.”

By how much? “When we looked at some of the studies that were done for Arizona,” says Sandra Fabritz-Whitney, the department’s director, “what we found is our imbalance in a hundred years could be 3 million acre-feet” – in other words, roughly the same deficit that the U.S. Bureau of Reclamation projects for all seven Basin states by 2060.

Indeed, despite the 1980 Groundwater Act, a 2010 study on aquifer water levels by the U.S. Geological Survey found mixed results; while many developed areas around Phoenix and Tucson showed levels that are nearly stable or rising, they remain hundreds of feet below what they originally were. And in many other aquifer areas where farmers rely on groundwater to irrigate crops, water tables are declining steeply.

Around Prescott, Pinal, Santa Cruz, and Tucson, groundwater levels are down anywhere from 50 to 400 feet, according to Fred Tillman of the Geological Survey in Tucson, the study’s author. “So, we are actually running a water deficit now, one that’s absolutely not sustainable.”

The problem, of course, isn’t limited to Arizona: Aquifers across the Southwest are declining, says Leonard Konikow, an emeritus scientist with the U.S. Geological Survey in Reston, Va., who published a report last May on groundwater depletion in the United States between 1900 and 2008. During that time, Konikow found that American aquifers had lost the equivalent of two Lake Eries; alarmingly, the rate of decline increased between 2000 and 2008.

The situation in the American Southwest is particularly critical, he told Remapping Debate. “We’re already seeing areas where the water levels of wells have dropped so low that the costs of pumping the groundwater are too high for some farmers.”

Above ground, the scarcity is no less dire. A 2010 analysis funded by the National Academy of Sciences concluded that cities, industries and farms soak up 76 percent of all freshwater stream flow in the Basin region – nearly double the sustainable rate. “We’re leaving less than a quarter of what used to be in rivers,” the lead author of the study, John Sabo, a professor at Arizona State University’s School of Life Sciences, says. Besides putting farms at risk during droughts, he says, the environmental impact of this “is staggering.”

And there’s this elephant in the room: Population within the Basin states is projected to nearly double from about 40 million in 2015 to 76.5 million by 2060, according to the Reclamation Bureau study, which based its forecast on state and U.S. Census Bureau figures. The arrival of more water consumers will itself eat into gains that would otherwise be made through conservation. On top of that, the region will have to deal with the consequences of the jobs that are created for those new arrivals – a requisite for that level of growth. Added workplace water use will further tax water supply than would be the case under a stable population scenario.

Facing a no-growth future

Of the several dozen people we interviewed, Brian Czech, an economist and president of the Center for the Advancement of the Steady State Economy, a nonprofit in Virginia, was the most outspoken in saying that the region’s growth was unsustainable and would come to a stop – one way or another.

In Czech’s view, the Southwest’s conundrum is long in the making and derives from a basic flaw in its economic model: that non-stop growth is possible as long as enough money and labor is spent trying to achieve it, mindless of natural-resource limits.

Recycle and re-use water by all means, he says, but at the end of the day “the natural water cycle cannot pump perpetually faster. There is a finite stock of water, a finite rate of water cycling,” which limit the size of a sustainable economy. “Wishful thinking won’t change that. It won’t make your water supply infinite.”

As the Southwest continues to grow beyond what Czech calls “sustainable scale,” it will ultimately suffer “a great depression,” he says. “Water is not a luxury, and as the price of it becomes too much for people and their economic activities, why, that’s the very definition of poverty. Rising water prices mean wide-spreading poverty.”

What to do? Start curbing growth now by scrapping tax incentives and subsidies to homebuilding, mining, and high-tech industries, and fixing growth caps on the energy industry, Czech says. Won’t that be painful? Yes, Czech agrees, but the economy will gradually stabilize while businesses get more in sync with the environment – in other words, become more sustainable.

“To use a train metaphor,” Czech says, “you could say that we want to put the brakes on this runaway train now and try to get it to a stable speed and recognize at some point that we may need to slow it down even more to avoid a train wreck further down the line.”

Czech isn't alone in recognizing limits. Water resource officials from states around the region gave us candid responses when asked whether conservation and the application of high technology would be enough to close the gap between water demand and supply.

Pat Mulroy, director of the Southern Nevada Water Authority: "We can't conserve our way out of this. And technology is not something we can pull out of our back pockets tomorrow ... There are no silver bullets here."

Our troubled aquifers: low in many areas, and going lower

Aquifers across our nation are in trouble, but across the Southwest subterranean stores of water are in particularly dismal shape.

In New Mexico, a half-century of intense pumping has dramatically drained the aquifers around Albuquerque, says Nathan Myers, a groundwater specialist with the U.S. Geological Survey's Water Science Center. Since 2008, the first year the city began drawing surface water from the Rio Grande, water levels have since risen 10 to 20 feet – but they're still 100 feet lower than they were in the 1950s, Myers says.

Elsewhere in the state, aquifer depletion is worse. In Clovis – whose motto is "A City on the Move – Come Grow With Us!" – groundwater levels have steadily declined for 30 years, says George Sieber, a hydrologist at the Water Science Center. Around Clovis the aquifers "are virtually being mined. There's very little hope of recharge there."

The aquifer picture in Nevada is mixed, but "I'd say on balance that groundwater levels are declining," Kip Allander, a hydrologist at the U.S. Geological Survey's Science Center in Carson City. In the Diamond Valley, water-level declines are on the order of 150 feet, he says, and "there are regions in the state that have declined hundreds of feet as a result of irrigation use and over-appropriation of water rights."

A half-century of groundwater pumping in California's Central Valley has diminished aquifers in some areas by 300 feet, according to Claudia Faunt, a supervisory hydrologist for the U.S. Geological Survey in San Diego. "During wet periods the water levels stabilize or go up a bit, but they aren't enough to make up for what we pump out of the system in the dry years." Water banking and artificial aquifer recharging help, Faunt says, "but they're not enough to keep up with the pumping."

And even in sparsely populated Utah, which doesn't yet utilize its full Colorado River allocation but projects a water deficit of 734,000 acre-feet by 2060, the groundwater picture is grim. In at least seven areas statewide, groundwater pumping is outpacing the natural rate of recharge, Kurt Vest, an engineer with the state's Division of Water Rights, says.

Most critical is the Beryl-Enterprise area, a region that largely cultivates alfalfa, which is water-intensive. There, farmers pump 45 percent more groundwater than is naturally replenished; aquifer levels are down 70 to 120 feet, he says.

Ted Kowalski, water manager for the state of Colorado: “I don’t believe that conservation in itself is enough to meet the growing needs that we see, especially if an additional five million people move into our state.”

Eric Millis, director of the Utah Division of Water Resources: “No, conservation can’t do it all. And technology can only take you so far, even less than conservation would.”

Higher water costs are coming...and those costs bring consequences?

There are water mavens who would say that water supply *isn't* as limited as we think – that, as a final fallback position, we can always tap the oceans to make up for shortages.

One is Herb Guenther, a former state senator and director of Arizona’s water resources department from 2003 to 2011. He envisions a day when desalination plants mushroom up and down the Mexican and Californian coasts and water pipelines carry blue gold into the desert. Another tack, he says, would be for states like Arizona or Nevada to pay for those desalination plants in exchange for using Mexico’s and California’s allotments of Colorado River water.

“The only thing that will limit our ability to meet demands is if we don’t eventually go to ocean desalination,” Guenther says.



Groundwater pumping for irrigation, mining, and municipal use is depleting aquifers across the Southwest, in some places by hundreds of feet. Increasingly, as more aquifers are drawn down, the earth above them is subsiding and splitting open – as it did in this area near Hunt Highway in Pinal County, Arizona. Fissures like this one sometimes damage roads, dams, canals, bridges and utilities, posing threats to public safety – and public coffers.

To Frank Ackerman, a senior economist at Synapse Energy Economics, a consulting firm in Cambridge, Mass., that analyzes the energy industry’s footprint on the environment, that scenario “sounds like dreaming.”

Desalting plants are extremely expensive, and the costs of building and maintaining a network of water pipelines into the interior would be astronomical, Ackerman says. Disposing of the brine concentrate is a major environmental concern, and communities aren’t going to welcome not-very-attractive desalting plants to California shores with open arms. Desalting plants “don’t really add to your property value, if you buy a house at the beach,” he says.

Already facing an energy crunch, California would have to generate enormous amounts of power to run the desalting plants and pump the treated water into the vast, high-plains desert. And don’t forget the cost of separating salt from seawater – currently around \$2,000 an acre-foot. (One acre-foot is enough to supply two average homes for a year.) Those costs follow inflation; as energy gets pricier, so does desalted water, Ackerman says.

Guenther concedes that homeowners would pay “significantly” more for desalted seawater – \$500 a month, or higher. “Water would probably be the highest demand on a family’s budget as you get out to those crisis points.” But because water “is such a necessary commodity for existence, I think you’d pay what you need to pay in order to exist. So, it’s just a matter of adjusting the economies of it, and being able to move desal water to the areas where you are going to need it.”

His successor, Fabritz-Whitney, who also views desalination as a viable solution to future water shortages, acknowledges that “it’s going to cost people money ... We’re talking millions to a billion dollars, up-front.” If people aren’t willing to pay, “you aren’t going to achieve those growth projections. You can’t.”

Even optimists about water supply can’t see anywhere for costs to go but up. Elliott D. Pollack, an economist and real estate consultant in Scottsdale, projects annual home sales in Phoenix to double by the mid-2020s, reflecting renewed population inflow to Arizona. He asserts that there won’t be a water shortage, but says that “absolutely” Phoenix will have to raise water rates.

Jay Lund, director of the Center for Watershed Sciences at the University of California, Davis, recalls an old economics axiom: “There’s never a shortage of water; there’s only a shortage of cheap water.” In the Southwest, the cost and price of water will rise, he says, and “if we’re smart about it, we’ll allow some regulated trading to even things out.”

Voice from the past: John Wesley Powell on sustainable development

John Wesley Powell, the legendary geologist who led the first known expedition down the Colorado River and through the Grand Canyon in 1869, knew a thing or two about the Southwest. It was he, after all, who provided the earliest available blueprint of what we now describe as “sustainable development” in the Southwest.

In his 1876 account, “A Report on the Arid Regions of the United States, with a More Detailed Account of the Lands of Utah,” Powell had already recognized a special difficulty that water managers would forever struggle against in the Southwest: the psychological desire to deny that the region is fundamentally dry, and that the rules for building, living, and working there are different from those in wet regions.

Powell defined the region as arid – land that received less than 20 inches of rain a year – and wrote that the West was not suitable for agricultural development, except for about 2 percent of land near water sources. Water scarcity, he predicted, would place limits on the growth of a new civilization in the Southwest.

Prophetically, he remarked at an irrigation conference in 1883: “Gentlemen, you are piling up a heritage of conflict and litigation over water rights, for there is not sufficient water to supply the land.”

But whom will these increases hurt? “As always, those at the bottom of the economic ladder will feel it the most,” says Czech, the steady state proponent. Later, as more people get squeezed, “it’ll be like a rising blood pressure scenario for the Body Economic: The damage starts at the extremities and then spreads throughout the entire body.” As more people are forced to devote larger and larger shares of their budgets to paying for water, he explains, they’ll have less to spend on other goods and services, which in turn will further dampen economic activity, thereby causing more pain to more people.

K. Bruce Jones, executive director of the Division of Earth and Ecosystem Sciences at the Desert Research Institute in Las Vegas, says that if population growth and economic activity are not curbed or managed in a sustainable way, the result will be constant, ever-steepening increases in water prices – a situation that will become so untenable “at some point you’ll have a reverse trend – massive depopulation.”

That’s not unheard of in the American experience, he notes. Indeed, Americans once believed that cities such as Detroit, St. Louis, Pittsburgh, Youngstown, Cleveland, and Buffalo would perpetually grow – until they started hemorrhaging people.

So why so much resistance to the idea of bending the growth curve?

“The entire culture of the Southwest is based on building more houses, more subdivisions, more oases in the desert,” says David Zetland, a water economist and author of the forthcoming book “Living With Water Scarcity.”

“That’s how politicians get re-elected, how cities collect tax revenue. It’s the way people in the Southwest have profited, politically and economically, for generations – by living off of water that comes from far away.”

Avoidance still rules the day, but there are some answers

From time to time, Doug Kemper, executive director of the Colorado Water Congress, a nonprofit that promotes water sustainability, hears talk of limits. As the drought has deepened, he says, “I’ve heard people raise this alarm: ‘We’ve got to do something about growth.’ And then you say: ‘Okay, what?’ And then everything just kind of gets real squishy.” Does Kemper think there’s a limit to how much the region can grow? “I think that certainly at some point there is a limit, but I don’t think we know where that limit is.”

One adaptation already underway involves dramatic changes in the built environment. What is zoned and built in Las Vegas today “looks very different,” Mulroy, southern Nevada’s water chief, says, than the Vegas of the ‘50s, even the ‘90s. Soon, “you’re going to see denser cities. You’re going to see a lot of building inside urban cores: the creation of a new urban look in the Southwest. We are going to build up, instead of out. You’re no longer going to see that southern California urban sprawl.”

Still, urban savings aren't going to erase even the *current* water deficit. To do that, water managers told Remapping Debate, massive change is needed in the agricultural sector, which consumes four-fifths of the region's water.

Sabo, the Arizona State professor who is also director of research development at the school's Global Institute of Sustainability, says farms may have to forego raising cattle and cultivating water-intensive staples such as alfalfa, cotton, corn, rice, and "definitely lettuce." Of the 75,000 acres of lettuce planted annually in the Southwest, 55,000 are grown in Arizona – 95 percent of them in Yuma County, in the state's southwestern corner. Each year, Yuma receives on average 3.6 inches of rainfall.

"Why are we growing lettuce in the desert?" Sabo asks. "Because people want lettuce in their salads in the winter." If not lettuce or alfalfa, what should farmers grow? Fruits, vegetables, and crops like soybeans, Sabo suggests, which require a lot less water than alfalfa and provide more protein.

He proposes spending on modernizing farm irrigation – money to come from tiered state taxes on drinking water, based on usage. Water surcharges could fund small, inland desalination plants, aquifer recharging and wastewater recycling projects, and funding could be given to non-governmental organizations so that they could "retire" rivers and streams by paying farmers to fallow fields on a rotating basis – compensating growers for not drawing water they are entitled to use.

"Unless we freeze population growth, which I think is unrealistic, these steps might help us increase our wiggle room for some time," Sabo responds. "At some point technological fixes won't be able to provide enough water for more growth. Ultimately, we're going to be growth-limited any way you look at it."

Sabo is not the only one to describe Czech's vision for zero population growth in the Southwest as "unrealistic." "Myopic" and "silly" are some similarly dismissive descriptors Remapping Debate heard when asking people about the benefits of a steady state economy.



Excessive groundwater pumping often leads to permanent land subsidence. This photo, taken by the U.S. Geological Survey in the San Joaquin Valley southwest of Mendota, California, shows dramatically how much land can compact when aquifers are overdrawn. The signs on the pole mark the sinking of the Earth's surface from where it once was in 1925, 1955, and 1977. The man depicted in the photo is Dr. Joseph F. Poland, a researcher who in the 1970s studied how aquifer overdraft contributed to land subsidence in the West.

Brian Czech responds to these sorts of criticisms by saying: "The steady state economy is not a flat-lined, static economy. It's a dynamic economy, in which consumer preferences change, technologies change, production patterns change, sector ratios change – but the size of the whole damn thing stays the same or fluctuates mildly."

On the other hand, no one we spoke to said that stabilizing the population or reducing it to 1990s levels would be a bad thing for the region's water supply. Indeed, Kowalski, the Colorado water manager, told us that having the same or fewer water consumers in his state "would alleviate a lot of pressure, actually, on our existing and future water supplies. It would make things easier for us, water-wise."

Likewise, nearly everybody acknowledged that the Southwest's economy hummed along just fine in the '90s, when population levels were lower – including Nat Hodgson, the executive officer of the Southern Nevada Home Builders Association. Between 1993 and 2000 "the economy was pretty strong" in Nevada, he admits.

He insists, though, that those good times were the result of surging population. "It was good because a lot of new people came here and new businesses opened up," he says. "Stagnant growth in southern Nevada is death for our economy."

But would a no-growth scenario, one in which the region's population holds or declines slightly, necessarily spell doom? Hardly, says Zetland, the water economist. Like Czech, Zetland says that a sustainable, steady state economy isn't flat-lined or static; it can be dynamic and adapt to evolving consumer and production trends. "People would still play with their children, go to work in their cars, get their food at the market," he says. "The sky won't fall."

We'd just see cactus gardens adjacent to freeways instead of lush lawns; backyards without private swimming pools; golf courses with wider sand traps and artificial turf. But most industries – aerospace, software, computer chip manufacturing, car manufacturing and many services – would do just fine under a less water-intensive, sustainable model, Zetland says. These industries will not only sustain lots of jobs, he says, but could also "employ more people by using less water per job. The whole idea is to squeeze more productivity out of the water."

The big losers, he says, will be investors in "cheap-water" businesses: grass clippers, swimming pool installers, car washers to name a few – and some players in the agricultural industry. Water-intensive produce would be grown in regions that get more water naturally, and ranchers would go back to raising cattle on ranges, instead of growing dairy cows inside air-conditioned tents. Not all agricultural water would necessarily be transferred to the cities; farmers will sell water to one another.

Of course, if word gets out that a monthly water bill is higher than a mortgage payment, builders – or anyone else who promises cheap living with inexpensive water and air conditioning – are going to have a tough slog, says Ackerman, the economist and energy consultant.

"The Western dream," he says, "is going to come with an asterisk that says 'P.S. Bring your own water.'"

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