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Groundwater gains show Arizona's policies are working, yet climate risks still threaten water supply

by University of Texas at Austin

The Superstition Mountains Recharge Project is part of the Phoenix active management area. Water from the Colc River is brought to the basins so they can recharge groundwater levels. Credit: Central Arizona Project / Philip A. Fortnam

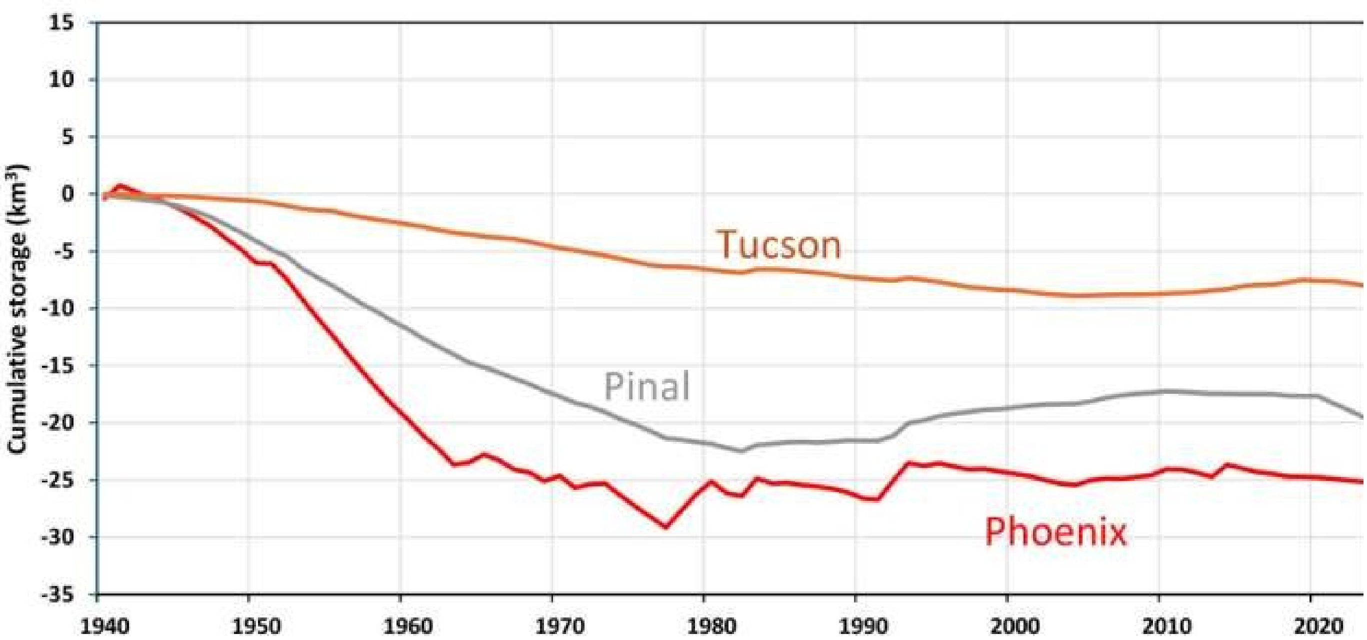
A combination of water management practices has contributed to notable groundwater gains in Central Arizona despite the region dealing with long-term water stress, according to a study led researchers at The University of Texas at Austin and collaborators in Arizona and Colorado.

Since 1980, Central Arizona has been working to recharge its depleted aquifers. Much of that recharge depends on water from the Colorado River of the southwestern United States. That w which accounts for 36% of Arizona's water supply, is brought to the state from over 300 miles a via the Central Arizona Project's system of aqueducts.

Some of the state's policies incentivize farmers to use surface water from the river rather than t into groundwater. Other policies channel the river water directly to aquifer recharge zones, whe can seep down to the groundwater.

According to the study, published in *Communications Earth & Environment*, these policies have helped save a total of 10.5 cubic kilometers of groundwater water from 1989–2019 in the Phoe Tucson and Pinal active management areas, where these policies are in place. Moreover, the researchers found that an additional 14.2 cubic kilometers in the aquifers can be attributed to w seeping in from surface-water irrigation that is not part of an active management program.

Together, the nearly 25 cubic kilometers of water is about five times the annual demand for wat the three active management areas, which are the largest of the state's seven. These are sizab agricultural districts with a combined size larger than the state of Maryland.



After decades of depletion, groundwater levels are stabilizing in the three largest active management areas in Ariz These groundwater gains are due in part to policies that encourage groundwater banking, according to research. Credit: Scanlon et al

"The research shows the value of conjunctive management of surface and groundwater," said l author Bridget Scanlon, a research professor at the UT Jackson School of Geosciences Bureau

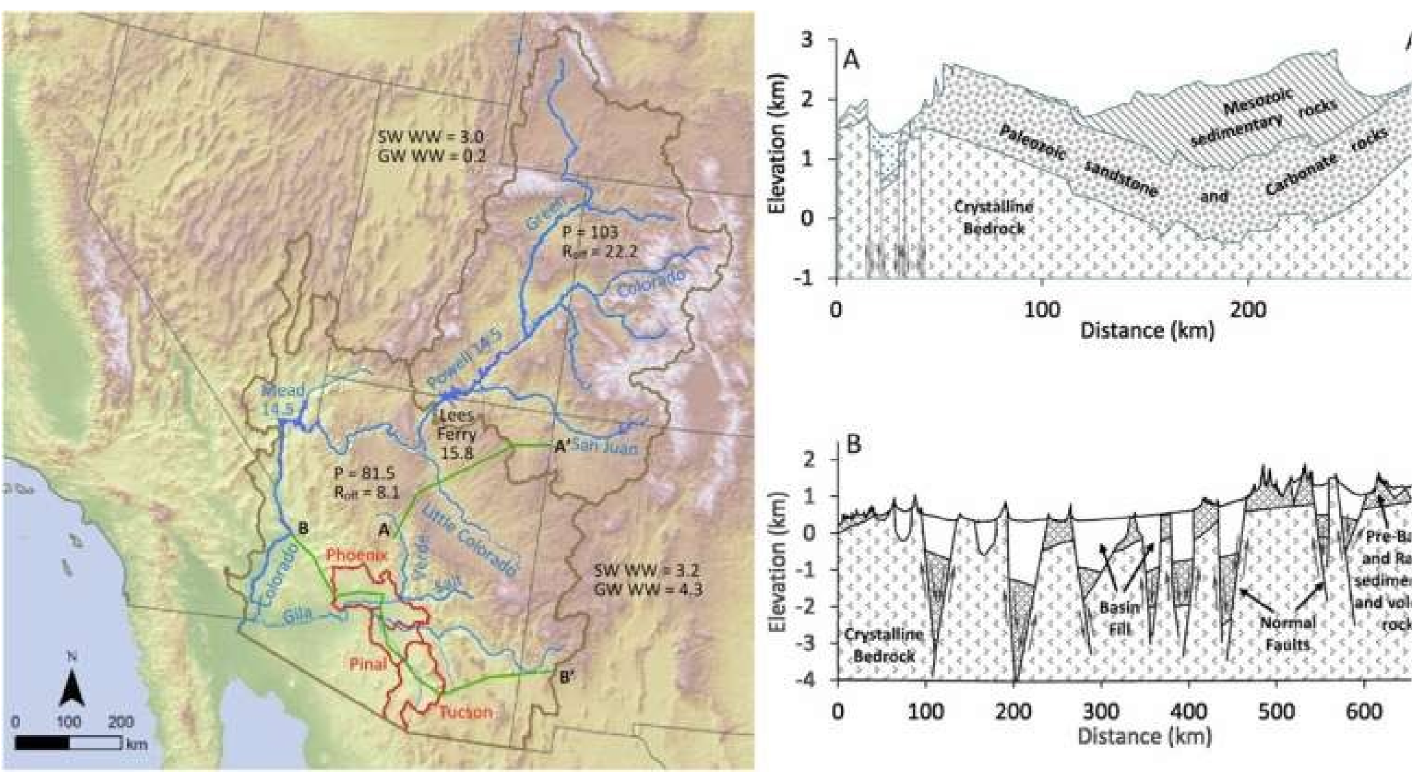
Economic Geology.

The researchers note that these gains demonstrate that Arizona's groundwater recharge policie are working—and that these policies could provide a roadmap for other water-strapped regions However, the water provided by the Colorado River faces an uncertain future. Two decades of extreme drought have led to big water declines: the country's two largest reservoirs, Lake Powe and Lake Mead, have gone from 90% capacity in 2000 to about 30% capacity in 2025 due to th river's declining flow, and the river is expected to face further declines due to climate change.

That means that even with these groundwater gains, sound aquifer management in Central Arizona will face new challenges, said co-author Kathryn Sorensen, the director of research at Arizona State University's Kyl Center for Water Policy and the former director of Phoenix Water Services.

"It's a lot of water, and that's great. We should celebrate that. But shortages on the Colorado Ri mean we'll have less water to boost our aquifers, and more pressure to pull groundwater out as replacement supply," Sorensen said.

The research findings on the Arizona aquifers are just one aspect of the study, which tracked surface water and groundwater gains and losses across the entire Colorado River Basin over decades. The researchers drew on GRACE satellite data, regional models and groundwater lev monitoring data to show how water levels have changed in response to wet and dry periods an human interventions.



Colorado River Basin map, hydrologic parameters, and representative geologic cross-sections. Credit: *Communications Earth & Environment* (2025). DOI: 10.1038/s43247-025-02149-9

In addition to showing the importance of intentional groundwater banking policies, the study showed how incidental seepage from irrigation has also helped recharge the aquifers, which we initially depleted by intensive groundwater pumping from the 1940s–1970s, and how a wet peri from the 1980s–1990s provided an additional boost.

"I don't know if we'll ever see a wet period like the '70s through the early '90s again, but we nee take advantage of those wet periods and get the water into the ground whenever and wherever can," said study co-author Don Pool, a retired former hydrologist for the U.S. Geological Survey Arizona Water Science Center.

Water allocations from the Colorado River are governed by a 1922 compact and reservoir operating rules that are set to expire in 2026. Policymakers from different states, Indigenous communities and Mexico are convening to renegotiate water draws. Scanlon said that the broa scope and span of the research can help with planning sustainable water use from the river.

"You can see how things have been changing over time," Scanlon said. "And that's important if you're trying to understand climate variability, variations in irrigation pumpage, conjunctive management and put it into context."

The study's additional co-authors are Ashraf Rateb and Robert Reedy of the Bureau of Econom Geology, Brain Conway of the Arizona Department of Water Resources, and Bradley Udall of Colorado State University.

More information: Bridget R. Scanlon et al, Multidecadal drought impacts on the Lower Colorado Basin with implications for future management, *Communications Earth & Environment* (2025). DOI: 10.1038/s43247-025-02149-9

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