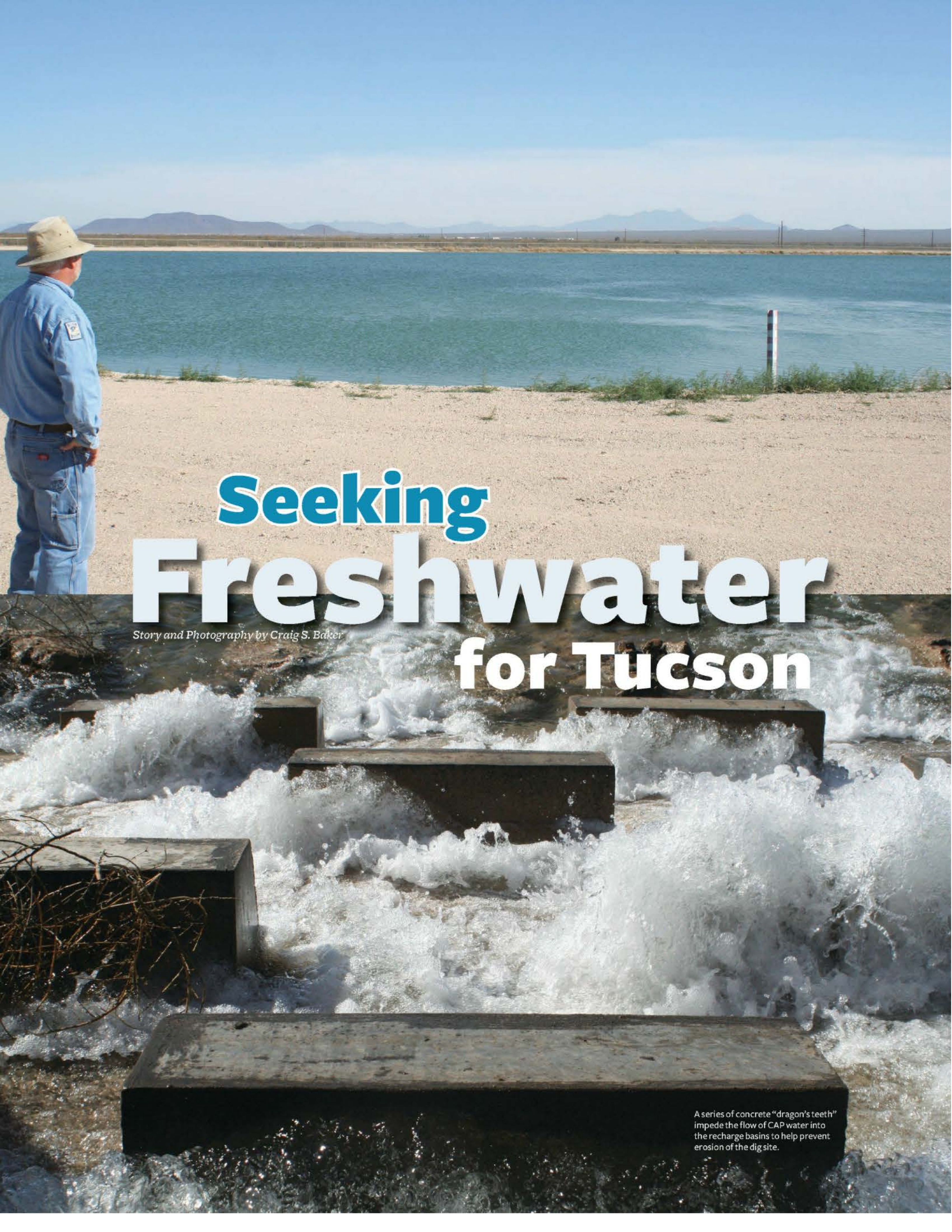
Seeking Freshwater for Tucson

Story and Photography by Craig S. Baker



A series of concrete "dragon's teeth" impede the flow of CAP water into the recharge basins to help prevent erosion of the dig site.

The Colorado River is an iconic image of the desert Southwest. Most of us have seen it in photographs, if not first hand—the muddy (occasionally green and white) ribbon at the bottom of the Grand Canyon. That image alone is testament to the longevity of the water source, marking eons in geological history through stratified layers of stone more than a mile deep in some places.

Today, the Colorado River supplies 30 million people in seven states and Mexico with potable freshwater, including providing Tucsonans with more than 144,000 acre feet of water per year—enough to meet almost all of our current demands.

But the question remains, for how long?

According to the city of Tucson's Water Plan: 2000-2050, in the year 2000, Tucsonans used approximately 128,000 acre feet of water (one acre foot is equivalent to about 326,000 gallons). When population growth is accounted for, experts estimate that Tucson will need to provide about 200,000 acre feet of freshwater by 2030 to meet increasing demand.

Today, the Central Arizona Project brings Colorado River water via canals to Pima, Pinal and Maricopa counties. With completion of the CAP Clearwater Reservoirs west of town and the Southern Avra Valley Storage and Recovery Project still pending, the city of Tucson has not yet been able to effectively utilize all of its allocated Colorado River water. To date, that inability has been overcome by pumping groundwater to meet the city's needs, but the use of groundwater can be a delicate balancing act, because it's a limited resource.

According to Dr. Robert Arnold, professor of chemical and environmental engineering at the University of Arizona, though a certain amount of groundwater is replenished naturally through downward percolation of surface water, and more still—CAP water—is deliberately recharged to underground aquifers, as it stands the city of Tucson uses more groundwater than it replenishes.

State law requires that the city reach a rough balance between withdrawal and replenishment by 2025. Though it is close to achieving that balance now, according to Professor Arnold, "Future growth will create some problems."

Tucson Water has a limited supply of groundwater credits that it can pump without consequence under Arizona's Assured Water Supply Program, but once those credits are exhausted, any groundwater pumped from the Tucson Basin will have to be recharged by a renewable source—presumably one which has yet to be tapped.

The supply from the Colorado River is not going to be enough to meet Tucson's freshwater demand indefinitely. And research conducted by the University of Arizona Tree Ring Lab suggests that there is not as much water flowing through the river as initially estimated. So how is Tucson going to meet demand in the coming years?

The Water Plan proposes a few ideas, which include the enactment of public education programs to promote water conservation with the goal of reducing citywide per-capita usage by 10 percent.

Some have suggested pumping

Birds pick through a layer of natural algae as it dries in search of any small carp that may have made their way into the reservoir through the CAP canal system. Algae impede groundwater penetration, and so must be dried before a basin can be refilled.

Top Left: Hydrologist Dick Thompson, Tucson Water, surveys SB201, a 43-acre groundwater recharge basin, at the Southern Avra Valley Storage and Recovery Project.

Workers are busy laying the foundation for an eight million-gallon storage reservoir at the Southern Avra Valley Storage and Recovery Project, or SAVSRP. When finished, this entire pit will be lined with concrete and covered with a steel roof to prevent evaporation.

groundwater from areas in Arizona of lower population density and transporting it to areas of higher population density, though this is considered a temporary solution to a growing problem. Satellite imagery has shown a global drop in groundwater levels, according to a December 2011 report by United Press International, though the extent of this loss has not been determined.

Perhaps one of the most effective ways of managing water levels is through loss prevention. Where loss due to downward percolation of CAP water is minimized by the concrete lining of its canals, evaporation is also a factor, and one which is currently unmanaged. Covering the canals is an option, though potentially a costly one.

The costs, though, can be offset if the space is utilized wisely. For instance, the city of Punjab, India, has a project under way in which its canal systems will be covered with floating solar panels, simultaneously reducing evaporation and converting the canal space into a productive, revenue-generating power source.

With respect to adding to the Colorado River water table, one of the least expensive methods, according to CAP communications representative Mitch Basefsky, has been artificial snowmaking efforts, primarily in Colorado and Utah. Snowmaking has proven to increase freshwater runoff to the Colorado River, though the extent of its success has been difficult to quantify.

Others have suggested the use of cloud seeding, which involves pumping silver-iodide particles into the air. These particles, under certain conditions, become the nuclei of snowflakes, encouraging the saturation of clouds, and thus precipitation in the form of snow. This practice is not feasible in an arid climate like that of Tucson, Basefsky says.

Another perhaps more obvious solution to our potential freshwater shortage is the desalination of brackish groundwater or ocean water. But desalination through reverse osmosis, like that performed at a plant in Yuma—one of the largest desalting plants in the world—is expensive. Operating expenses for the Yuma plant, for instance, have been estimated at more than four times that of the entire CAP, which operates about 336 miles of canals.

Enter Dr. Stuart A. Hoenig, professor emeritus of the University of Arizona's Biosystems and Agricultural Engineering Department. Professor Hoenig claims to have come up with a way to desalinize water, and do it cheaply. "It's easy," he says, leaning over a homemade contraption in his backyard. It is a box made of plywood and plastic, about six feet long, by four feet tall, by three feet deep. Inside are two tubs—one filled with saltwater, which he mixed himself from aquarium-use saline tablets bought at a pet store. The other is full of freshwater, which was extracted from the salt water.

"All you need is a receptacle for the salt water, a clear plastic cover and a condenser of some kind—here I'm just using an old radiator." He says his miniature model makes about a gallon of freshwater per day, during the warmer months.

His plan seems simple: Pump water from the Sea of Cortez north through a

Hydrologist Dick Thompson poses next to the level marker in an empty basin.


A special texture is applied to certain sides of the recharge basins to protect against erosion caused by wind.

pipeline about 60 miles to Yuma using a wave-powered pump—a non-mechanized delivery method that is self-driven and would require minimal maintenance, according to its creator, German engineer Gangolf Jobb. Once at its final destination, the sea water would be stored in a large reservoir and covered with clear plastic. As the water heated and evaporated, it would pass through a cool area where it would condense into potable freshwater.

Hoenig even has an idea for what to do with the remaining salt: "Sell it," he says matter-of-factly. He said he has received some attention for his idea from Gangolf Jobb, though this application remains untested and would likely need reworking for large-scale use.

Professor Arnold offers a word of caution on the plan, saying that the water industry is "fairly conservative," and it is hard to imagine a project such as that proposed by Hoenig being put into action using an "uncharacterized process, [meaning a process whose] principles have not been demonstrated at a variety of scales over a significant period to demonstrate costs and reliability."

Arnold's alternate suggestion: a large scale reverse-osmosis plant in Mexico, the freshwater from which could be pumped northward.

Though the details of how may yet be debated for the next decade, one thing remains clear—Tucson needs to find an additional renewable source of freshwater to help buffer against future growth, and the sooner the better.

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