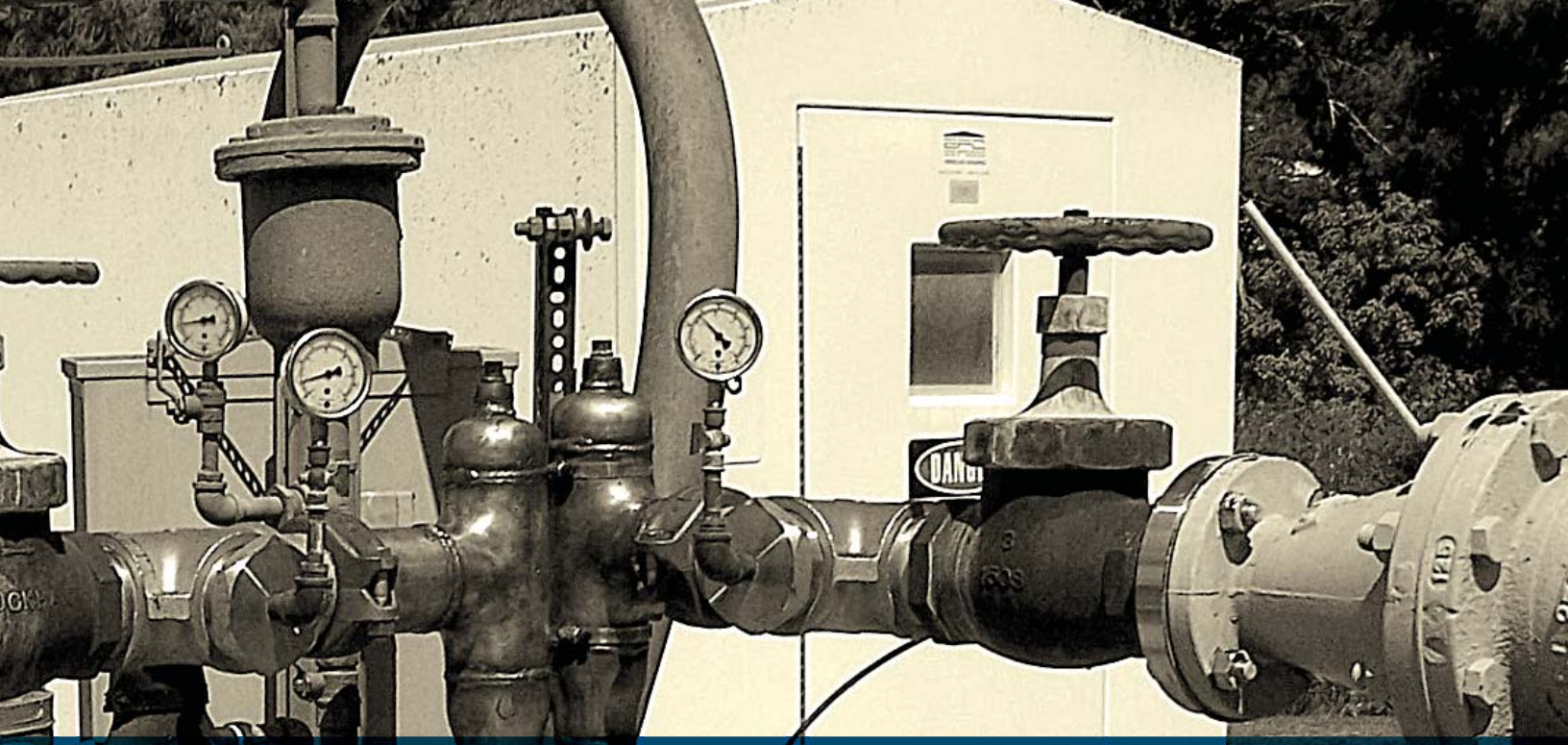
Story by Kathy Wythe

Saving for dry days



Aquifer storage and recovery may help

With reoccurring droughts and growing population, Texas will always be looking for better ways to save or use water. Some water suppliers in Texas are turning to aquifer storage and recovery.

During the dry summer of 2008, the San Antonio Water System (SAWS) had enough assets in its "bank" (of water) to make withdrawals to meet the needs of its customers. The water bank is the utility's Twin Oaks Aquifer Storage and Recovery Facility.

When demand is low and supply is plentiful, SAWS–the city-owned utility that serves more than 1 million consumers–takes its excess permitted water from the Edwards Aquifer and stores it underground in its bank, the nearby Carrizo Aquifer. When needed–usually during hot dry summers, the utility can reverse the process and withdraw the same water out of the Carrizo, into its water delivery system, and on to its customers.

This type of water management system is called *aquifer storage and recovery* (ASR). Although definitions vary, ASR is generally defined as the deliberate recharge and temporary storage of excess water in an aquifer with the intent of recovering the water for future use, according to Southwest Hydrology in its May/June 2008 issue.

A National Research Council (NRC) committee charged with evaluating past ASR projects and identifying research priorities for future projects selected the term *managed underground storage* (MUS) of recoverable water. The Committee on Sustainable Underground Storage of Recoverable Water uses MUS "to denote purposeful recharge of water into an aquifer system for intended recovery and use as an element of long-term water resource management." According to the committee, MUS includes both systems in which water is recharged directly using wells (including dual-purpose recharge and recovery wells) and systems that use infiltration basins.

Although dams and reservoirs have traditionally stored water, high evaporation rates, sediment accumulation, environmental ⇨

Photo by Grant Terry, City of Kerrville

costs, and the decreasing availability of land for dam and reservoir construction are major reasons for increasing interest in ASR. Water stored in ASR systems offers many benefits, including less evaporation, increased water supplies, emergency supplies for droughts, and reduced need for water infrastructure development.

Dr. Robert Mace, director of Texas Water Development Board's groundwater resources division, said ASR allows communities and water suppliers to maximize their water resources by managing their water conjunctively.

"Texas needs every tool in the toolbox for its water resources, and ASR is one of those tools," Mace said.

Dr. Zhuping Sheng, associate professor at the Texas AgriLife Research and Extension Center at El Paso, who served on the NRC's committee, agreed: "It (ASR) is a viable management tool in addressing water shortage because seasonal and multi-year storage of water is often a necessary component of integrated water resources management strategies."

The NRC committee also concluded that underground storage of recoverable water holds potential as a national strategy. In its report, "Prospects for Managed Underground Storage of Recoverable Water," the committee said, "Given the growing magnitude and complexity of the nation's water management challenges, managed underground storage should be seriously considered as one means to satisfy the demand for water and cope with water scarcity."

How ASR Works

ASR projects vary widely in the type of source water, method of recharge, aquifer type (storage space), and method of recovery. The source water for ASR systems can be surface water diverted from lakes or rivers, excess water from an aquifer, stormwater runoff, or reclaimed wastewater. The water is then recharged into the aquifer through injection wells, infiltration basins, and/or natural drainages. The stored water forms a lens or a "bubble" atop the water already in the aquifer, depending on recharge methods and aquifer characterization. The water is then recovered through wells (which may be the same as the injection wells) or natural discharge of groundwater to a stream.

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Some recharge systems also include infiltration galleries that use slotted pipelines buried underground to recharge the aquifer through the vadose or unsaturated zone above the water level, Sheng said.

Examples of ASR in Texas

The SAWS Twin Oaks Aquifer Storage and Recovery facility, which started operations in 2004, was the first project to come on line after San Antonio began shifting its needs from a total reliance on the Edwards Aquifer, said Steve Clouse, SAWS chief operating officer.

A key component of its 50-year water supply plan, the facility in south Bexar County includes a treatment plant, 16 wells that draw excess water from the Edwards Aquifer, and a 30-mile pipeline that moves the water into a large-scale underground storage facility in the Carrizo Aquifer.

Current storage at Twin Oaks — the second largest facility of its kind in the country — is about 48,000 acre-feet of water, or 16 billion gallons.

Clouse said that when San Antonio has rainy periods and water levels in the Edwards

The City of Kerrville has stored excess Guadalupe River water in its ASR system since 1990. The city currently has two ASR wells. Photo by Grant Terry, city of Kerrville.

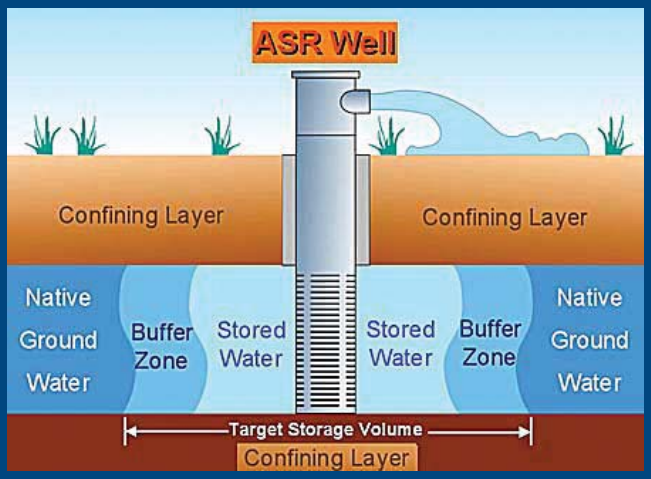
Aquifer are high, the utility diverts the water into ASR storage.

"When we have those really wet summers like we saw in 2007, it's really ideal to continue to store while we are in that time of surplus because we know that drought is coming around the corner," he said.

Besides 2008, the facility proved its value in the summers of 2005 and 2006 when the region experienced droughts. The retrieval of ASR water during those summers helped the region avoid strict drought restrictions.

"Conservation is a really high profile issue in San Antonio," Clouse said. "We have the lowest per capita water use in Texas and probably one of the lowest in the country. Our Twin Oaks ASR facility is another tool to help us to conserve during times of plenty so we have water when need it, during periods of drought."

The City of Kerrville has been storing its excess permitted water in an ASR system since 1990. The city draws water from the Guadalupe River during the wet season—usually September through the middle of May—treats the water, and injects it into the underlying Lower Trinity Aquifer



After a buffer zone is formed, recovery efficiency from ASR wells is usually close to 100 percent, according to David Pyne, an expert in ASR systems. Drawing courtesy of David Pyne, ASR Systems, LLC

(Hosston and Sligo formations) for storage. During the dry season, the city recovers, re-treats, and uses the stored water, said Grant Terry, Kerrville's water production division superintendent.

The city has two ASR wells and will add another within the next couple of years, Terry said.

Because the aquifer is a confined aquifer, the water displaces the native groundwater and stays in place. "It's just like a bubble of ⇨

stored water," he said. "We have the right type of aquifer and the right type of water beneath us."

With the city currently relying on ASR stored water for 5 percent of its water needs, with another 5 percent coming from native groundwater and the rest from the Guadalupe River, Terry said Kerrville officials see the ASR water as an "insurance policy" during water shortages.

More than an insurance plan

Besides using ASR as a savings plan when water is scarce, some water utilities also use ASR as a groundwater management tool.

The El Paso Water Utilities (EPWU) has injected highly treated wastewater from the Fred Hervy Reclamation Plant in northeast El Paso into the Hueco Bolson Aquifer since 1985.

Dr. Bill Hutchison, EPWU's water resources manager, said EPWU began using ASR as part of a strategy to solve the groundwater overdraft problem and as a way to dispose of effluent from its wastewater treatment plant. The utility has the capacity to inject 10 million gallons a day into the aquifer and at one point was putting approximately 16,000 to 17,000 acre-feet a year into the aquifer. However, the utility currently only injects about 1,500 acre-feet a year through its spreading basin.

Hutchison said EPWU no longer needs to inject large amounts of water because the groundwater level has stabilized, and golf courses and power plants have increased their uses of the reclaimed water.

"We have cut (groundwater) pumping by more than one-half in the last 25 years," he said.

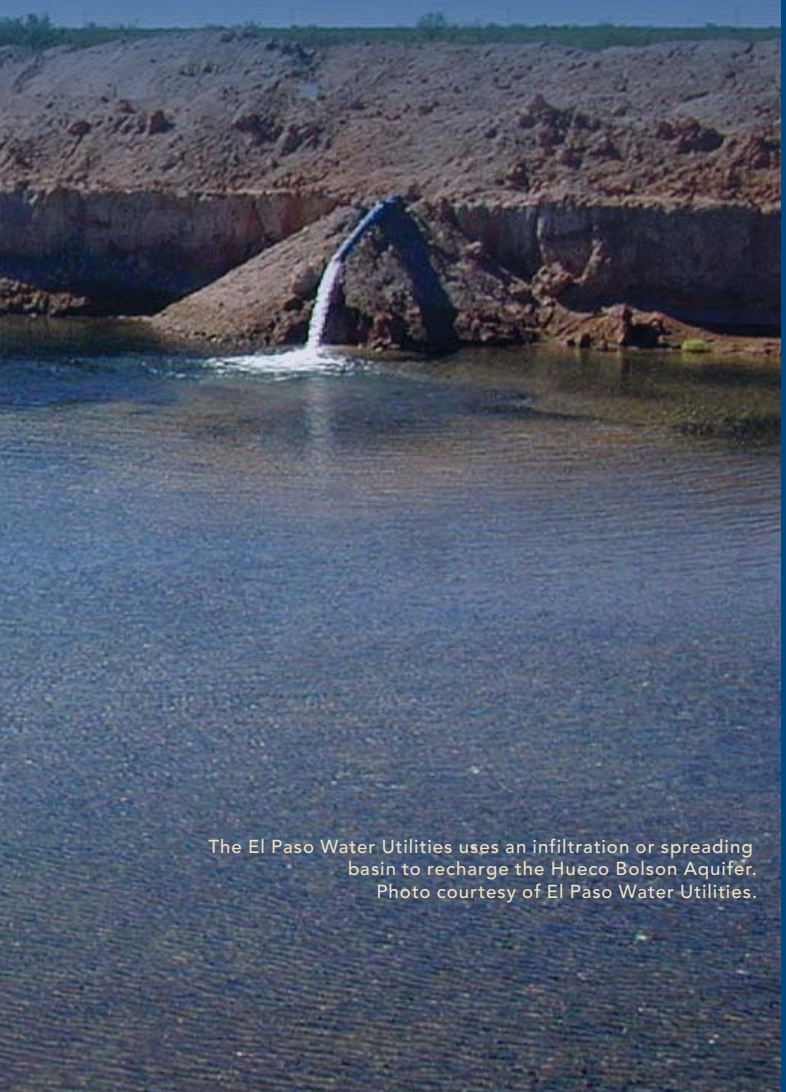
Although EPWU currently does not need to inject large amounts of water into its ASR wells, Hutchison said the system will continue to be an important part of the utility's management plan.

"In the future it may be advantageous (to inject), so it's a matter of maintaining flexibility at this point," he said.

The Future of ASR

The City of Corpus Christi is setting the stage for ASR to "stretch out its water supply," said Max Castaneda, water resources management advisor for the City of Corpus Christi.

The first step was to create the Corpus Christi Aquifer Storage and Recovery Conservation District in 2005 by the Texas Legislature. The district was formed to protect the rights of the stored water once the city begins the project, Castaneda said.



The El Paso Water Utilities uses an infiltration or spreading basin to recharge the Hueco Bolson Aquifer. Photo courtesy of El Paso Water Utilities.

Although still developing an action plan, the city plans to use excess water from its O.N. Stevens Treatment Plant as the source water for injecting into ASR wells. The district is still studying the locations of the injection/recovery wells, Castaneda said. Total target storage volume for the ASR wellfields is approximately 6.1 billion gallons, or about 19,000 acre-feet.

Castaneda said not only will ASR water not evaporate like surface water, but it also will provide extra, needed water when the city has to close part of its water treatment system for repairs. "We will have the ability to tap into the stored water while we are doing operation and maintenance to the treatment system," he said.

Along with developing the ASR facility within Corpus Christi, the city's current long-range planning includes development of up to two ASR wellfields on North Padre and Mustang Islands. Total target storage volume for the two ASR wellfields on the islands is approximately 1.2 billion gallons, or about 3,700 acre-feet.

With only three ASR facilities in Texas, Mace believes Texas will eventually see more ASR projects.

"I think ASR would be a good option for some communities to look to more efficiently manage their water resources," Mace said, "because it has worked for Kerrville and for San Antonio. It's not too much of a stretch to think that it would work elsewhere in the state."

Mace said that the Texas Legislature has encouraged ASR as an option for water management by including it in the 1997 Senate Bill 1. This legislation established a statewide comprehensive regional water planning program.

In the 2007 Water for Texas state water plan, several regional water planning groups mentioned ASR as considerations in their water management strategies.

"As the population in Texas grows, we are going to have to use our water more efficiently, and ASR is definitely one of the tools to allow people to do that," Mace said.