semiarid sanctuary

by Kippra D. Hopper

The city of Seminole, located in West Texas about 70 miles south of Lubbock, sits atop the Ogallala Aquifer, the primary source of potable water for the region. The Ogallala has experienced a drawdown and depletion in water volume, thus municipalities are wondering about their futures without the water resources they need to sustain their populations. Seminole is the first municipality to embark on a water desalination project that incorporates wind turbines to provide the electrical energy needed to pump water from a new source, the brackish Santa Rosa Aquifer below the Ogallala.

With depleted water sources, municipalities will experience the downfall of economic vitality and quality of life for the residents of West Texas and other regions of the arid and semiarid Southwest. Texas Tech researchers with the Water Resources Center and the Wind Science and Engineering Research Center are working with Seminole officials to ensure that adequate supplies of water and energy will continue to provide the foundation for economic vitality and sustained growth of the town.

The Ogallala Aquifer is expected to become critically diminished by mid-century. Texas Tech researchers and others are considering accessing water from a much deeper, brackish aquifer. The brackish water to be pumped from the Santa Rosa will be processed using reverse osmosis (RO) systems.

Seminole is a small town that will serve as the demonstration site for the wind-water project. Seminole's population is prosperous through farming and oil and gas production. "It is OK with Seminole leaders to think outside the box," says Water Resources Center Director Ken Rainwater Ph.D., P.E., "That location has about 40 wells in the Ogallala Aquifer, and currently only about half of the wells are useful because the aquifer water levels have dropped. The citizens of Seminole are used to people drilling deep in the oil and gas business, and they are used to moving salty water around. The people are used to providing their needs from their own property, and they want to take care of their needs locally."

photo by Katie Decker

The goal of the desalination program is to serve the citizens of Texas, especially small communities. In Seminole, researchers hope their data collection will lead to the design of a wind-water system that produces 1 million gallons of water per day. The current study will determine how many turbines and how many wells are needed to accomplish the task. "Because people haven't had to produce water from the Santa Rosa, we don't know how productive the aquifer is," Rainwater says. He notes that the Bureau of Reclamation has offered services through the Texas Water Development Board for drilling test holes, to learn about the Santa Rosa and to determine how many wells it will take to produce 1 million gallons of water. The depth of the drilling depends on the topography, he says. Near Hereford and Tulia, north of Lubbock, the communities already have drilled down to the Santa Rosa; however Seminole has not reached that point of need.

Brackish water is defined according to whom one asks, Rainwater says. Some researchers say more than 1,000 per million of total dissolved solids constitutes brackish water. Others say the definition is based on 3,000 parts per million of total dissolved solids.

Rainwater says that, for example, Lake Meredith, located north of Amarillo, also feeds the water needs of Lubbock and its smaller municipalities in the region. The lake water currently has 1,800 parts per million of total dissolved solids. The Environmental Protection Agency has a secondary drinking water standard that encourages 1,000 parts per million or less. "Usually if you have that much dissolved solids, you have a problem. Lake Meredith is salty and has a lot of chloride. The Canadian River Municipal Water Authority now mixes the lake water with groundwater from Roberts County to lower the total dissolved solids and chloride levels for the mixture to more acceptable levels. In the Southern High Plains, the groundwater supply for many places in West Texas has high levels of fluoride. Recently, the primary standard for arsenic in water has been lowered by the EPA from 10 parts per billion to 50 parts per billion, a change that now makes the groundwater supply for Seminole and some other municipalities out of compliance." Rainwater notes that he grew up in Fort Stockton, Texas, where the local groundwater suppy had 3,200 parts per million of total dissolved solids. The community later was the first in the state to have a municipal reverse osmosis system, which was required before the Texas Department of Criminal Justice allowed a prison to be located in that city.

Most reverse osmosis systems are driven by electricity. The process involves pumping raw water through a membrane system that blocks most dissolved molecules but allows the water molecules to pass. The process takes high pressure and significant energy input and generates a more saline wastewater that must be handled, Rainwater explains.

"Through reverse osmosis, we can remove essentially almost everything dissolved in brackish water. Pushing 100 gallons of typical brackish water through a reverse osmosis treatment device will lend about 80 to 90 gallons of clean water, with about 10 to 20 gallons of concentrate wastewater," he says. "That concentrate waste has to be dealt with. Part of the study includes finding what to do with that water. Should we evaporate it and collect the salts? The low energy approach is to let the wastewater evaporate in ponds, but that takes a lot of acreage. Treating 1 million gallons of water per day will leave 100,000 gallons of brine. We could take the concentrate, reduce its volume by another reverse osmosis treatment step to get more fresh water. Other possibilities are to have zero liquid discharge and to use a device to boil or flash off the water solids. Significant attention will be paid to the treatment of the concentrate."

Texas Tech researchers in wind energy are integrating wind generation with the water desalination processes. "Most people look at applications of renewable energy as being more sustainable than extracting and burning fossil fuels, which are a vast but limited resource. Future water quality and availability is a huge issue that is global in scope and becoming more severe all the time," says Andrew Swift, Sc.D., director of the Wind Science and Engineering Research Center (WISE). "Many communities in West Texas are facing future water scarcity. Salty water is available, but unusable without treatment due to its high salt content and the high energy costs of desalination. However, as the costs of wind power have declined in recent years, it may be feasible to use renewable wind energy to drive desalinization units to purify the saline water and make it available at a reasonable cost."

GE Global Research announced late last fall that it is partnering with Texas Tech University to conduct research in developing affordable, wind-driven water desalination systems to increase the quantity and quality of water available in arid areas around the United States and globally.

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The City of Seminole is the first adopter of the new technology project. Already other communities in the region of the Ogallala have approached Texas Tech reseachers for desalination technology for drip irrigation on high-value crops. Small communities in West Texas are taking a far-sighted look at their environments and are addressing the needs for the basics of water for their populace. The Santa Rosa Aquifer is essential to the future of West Texas, and Texas Tech researchers are tapping into the groundwater for usability and affordability for the future.