

txu-0735

Water for Texas

Desalination: Brackish Groundwater

Once only a potential resource, brackish groundwater is now becoming an important source of new water supply. Texas has an abundance of brackish groundwater, estimated at more than 2.7 billion acre-feet.

Brackish groundwater contains dissolved minerals measured in units of milligrams per liter and can be classified as fresh (0–1,000 milligrams per liter), brackish (1,000–10,000 milligrams per liter), and saline (greater than 10,000 milligrams per liter). For comparison, seawater contains approximately 35,000 milligrams per liter of total dissolved solids.

If used for potable purposes, brackish groundwater needs to be treated (desalinated). Without treatment, brackish groundwater can cause scaling and corrosion problems in water wells and treatment equipment and cannot be used in many industrial processes. The Texas Commission on Environmental Quality has established a primary standard of 500 milligrams per liter of total dissolved solids and a secondary standard of 1,000 milligrams per liter for public water supply systems. Groundwater above that concentration can be used for irrigation; however, a total dissolved solids concentration greater than 3,000 milligrams per liter is not usable for irrigation without dilution or desalination and, although considered satisfactory for most poultry and livestock watering, can cause health problems at increasingly higher concentrations.

Brackish Groundwater Desalination in Texas

Currently, there are 44 municipal brackish water desalination facilities in Texas. Twelve of these facilities use brackish surface water as a source of raw water, which accounts for a design capacity of 50 million gallons per day (56,000 acre-feet per year). Thirty-two facilities use brackish groundwater as a raw water source, which accounts for

a design capacity of 70 million gallons per day (78,400 acre-feet per year). Among the brackish groundwater desalination facilities, El Paso Water Utilities' Kay Bailey Hutchison Desalination facility has the highest design capacity in the state (27.5 million gallons per day or 30,800 acre-feet per year). In total, the state has a desalination design capacity of 120 million gallons per day.

Reverse osmosis is the predominant desalination technology in Texas; 42 of 44 desalination facilities use reverse osmosis technology. To track the growth of desalination in Texas, the Texas Water Development Board (TWDB) operates and manages a desalination database for Texas (<http://www.twdb.state.tx.us/apps/desal/ChoosePlant.aspx>).

Brackish Groundwater Desalination in Regional Water Plans

In the 2011 Regional Water Plans, 5 of the 16 regional water planning groups recommended brackish groundwater desalination as a water management strategy to meet at least some of their projected water needs. In total, the regional water planning groups project that desalting brackish groundwater can create about 181,568 acre-feet of new water per year by 2060.

Brackish Groundwater Desalination Demonstration Projects

To encourage and facilitate the development of brackish groundwater in the state, the TWDB proposed the Brackish Groundwater Desalination Initiative in 2004. The goal of the initiative was to develop models of brackish groundwater desalination that illustrate the use of innovative, cost-effective technologies and offer practical solutions to key challenges to implementing desalination projects.

In 2005, the 79th Texas Legislature appropriated \$3.1 million to TWDB for planning, permitting, designing, and developing seawater and brackish groundwater desalination demonstration projects. In 2007 and 2009, the 80th and 81st Texas Legislatures, respectively, appropriated \$600,000 each for brackish groundwater desalination demonstration projects. With financial assistance from the Texas Legislature, the TWDB has to date funded 12 brackish groundwater projects for a total amount of about \$2.6 million (see Table 1).

More Information

Detailed information on the TWDB's brackish groundwater desalination projects is available at <http://www.twdb.texas.gov/innovativewater> or by contacting Dr. Saqib Shirazi at saqib.shirazi@twdb.texas.gov or (512) 463-7932. You may also contact Dr. Sanjeev Kalaswad at Sanjeev.Kalaswad@twdb.texas.gov or (512) 936-0838.

Table 1: List of Projects Funded Under the Brackish Groundwater Desalination Demonstration Program

| Project | Dates | | Costs | | Short Description |
|---|------------|---------------------|-------------------------|--------------------------|--|
| | Start Date | End Date | Total Project Cost (\$) | TWDB's Grant Amount (\$) | |
| Affordable Desalination Collaboration | Apr 2008 | Completed Jun 2011 | \$1,356,683 | \$496,783 | This study assessed and demonstrated energy optimization strategies for brackish groundwater desalination. |
| Carollo Engineers | May 2010 | Apr 2012 | \$211,091 | \$188,403 | Permeate produced during desalination of brackish groundwater by reverse osmosis is corrosive in nature. This study will develop design criteria using upflow calcite contactors to treat the product water. |
| CDM | May 2010 | Mar 2013 | \$280,000 | \$130,000 | An instruction manual will be developed that will include a road map for small utilities documenting the specific process to follow for permitting a Class II well for dual Class II and Class I purposes. |
| City of Kenedy/San Antonio River Authority | Apr 2006 | Aug 2012 | \$730,300 | \$150,000 | The project will demonstrate the efficiencies gained by installing a new reverse osmosis system in an existing brackish groundwater desalination plant in the City of Kenedy, Karnes County. |
| City of San Angelo/Upper Colorado River Authority | Apr 2006 | Completed May 2008 | \$549,200 | \$300,000 | The project assessed the feasibility of the Whitehorse aquifer in Irion County as a source of brackish water that can be desalinated and used by the City of San Angelo for municipal purposes. |
| City of Seminole | Apr 2008 | Mar 2013 | \$1,625,000 | \$300,000 | The City of Seminole plans to desalinate brackish water from the Dockum Aquifer in Gaines County using wind energy. |
| El Paso Water Utilities - PSB | Oct 2007 | Completed May 2011 | \$505,982 | \$228,557 | Using the Kay Bailey Hutchison desalination plant, El Paso Water Utilities conducted large-scale testing to evaluate silica reduction in concentrate through the addition of lime, Vibratory Shear Enhanced Process, and seawater reverse osmosis. |
| North Alamo Water Supply Corporation | May 2010 | Aug 2012 | \$787,500 | \$100,000 | The project will demonstrate the technical and economic viability of fiberglass well casing in water wells installed in brackish aquifers. |
| North Cameron Regional Water Supply Corporation | Apr 2006 | Completed June 2008 | \$735,000 | \$150,000 | The project involved preparing a brackish groundwater desalination guidance manual using the North Cameron Regional Water Supply Corporation's desalination plant in Cameron County as an example. |
| Texas Tech University | May 2010 | Dec 2012 | \$194,609 | \$101,597 | The primary objective of this project is to demonstrate a reverse osmosis system with a configuration of parallel elements for small-scale desalination with high recovery and energy efficiency. |
| The University of Texas - Austin | Feb 2007 | Completed Aug 2010 | \$323,010 | \$235,500 | The study developed strategies that can be used to increase recovery in reverse osmosis desalination of brackish groundwater. The researchers investigated two possible systems: 1) anti-scalant deactivation and precipitation, and 2) electrodialysis. |
| San Antonio Water System (SAWS) | Feb 2007 | Completed Aug 2010 | \$877,000 | \$205,000 | SAWS conducted a pilot test to assess the cost and technical feasibility of the Vibratory Shear Enhanced Process as a tool for reducing the volume of desalination concentrate. |

