Texas Water Resources Institute

March/April 1983
Volume 9
No. 2

Pumping Beyond Our Means

By Lou Ellen Ruesink, Editor, Texas Water Resources

More than half the state of Texas is blessed with enough water stored underground to supply cities, industries, and irrigated agriculture, Tommy Knowles told participants at the 1982 Water for Texas Conference held on the Texas A&M University campus. Most other parts of the state, he said, have access to enough groundwater to at least supply domestic needs.

Knowles should know. He serves as chief of Data Collection and Evaluation, the Texas Department of Water Resources section responsible for measuring and evaluating groundwater resources in Texas.

Knowles estimates that underground formations called aquifers receive a total average annual effective recharge of about 5.1 million acre-feet with a total recoverable reserve storage of about 430 million acre-feet in the state. Effective recharge is the amount of water that enters an aquifer and can be pumped to the surface.

Texas aquifers store many times more water than the 430 million acre-feet, but not all water is available for development. Recoverable storage, according to Knowles, is that amount of water which can be recovered from storage after a specified period of time without causing irreversible harm such as land-surface subsidence or water-quality deterioration.

Depletion of the amount of water in storage, called groundwater mining, is one of the major problems facing Texas, Knowles told participants at the conference sponsored by the Texas Water Resources Institute. He reminded those attending the conference on Texas water issues that in 1980 Texas pumped 10.8 million acre-feet per year from underground sources--5.7 million acre-feet more than the average effective recharge per year.

The TDWR section which Knowles heads has identified those areas of the state where significant depletion has recently occurred. Water level records from over 4,220 wells across the state were used in gathering data to illustrate those areas where significant groundwater depletion occurred between 1970 and 1980.

Knowles divided aquifers into two types in order to evaluate water level because the types respond quite differently to withdrawals. Declines in artesian aquifers were differentiated from declines in water table aquifers since the change in storage per unit decline in water level is so much less for artesian conditions than for water table conditions.

One of the major differences between the two types--artesian and water table aquifers--is how the water level reacts when the aquifer is penetrated. Because the water in an artesian aquifer is held under pressure by a layer of highly compacted material such as impermeable rock or clay, the water rises above the top of the formational material in which it is stored when the impermeable layer is penetrated by a well. In a water table aquifer, the water is generally stored in a sand and gravel material and will not rise above the level of the rest of the water in the aquifer when penetrated by a well. An artesian aquifer will generally show a much greater decline than a water table aquifer with the same amount of water withdrawn.

Artesian aquifers, according to Knowles, have shown the greatest declines in water levels during the past ten years. For artesian areas, declines of between 50 and 100 feet were shown along with those in excess of 100 feet. A decline of 100 feet over the period averages to 10 feet per year. For water table areas, declines between 20 to 40 feet are shown along with those of greater than 40 feet. A 40-foot decline equates to 4 feet per year.

During his presentation to the Water for Texas Conference, Knowles emphasized that while water depletion problems occur in many areas of the state, they are basically unrelated. Reduced pumping of water in one area, he said, would not necessarily mean more water for another area. Because underground reservoirs do not connect, because underground water storage areas differ structurally, and because water demands vary greatly from one area of the state to another, it is virtually impossible to find statewide solutions to groundwater depletion problems.

As groundwater levels decline and as water demands increase, the competition for remaining groundwater resources will certainly continue to increase. The Texas Department of Water Resources notes that neither local nor state water planners have adequate information about the future use of groundwater by the many groundwater users to be able to predict future quantities of groundwater in specific areas of the state. As a consequence, water planners tend to use past trends to predict future use of groundwater in an area. Knowles feels, however, that the solution to water depletion should not necessarily be based on past trends, but on best judgment for the future.

Sixty-one percent of all the water used in Texas in 1980 came from underground sources. Of the groundwater pumped, a whopping 82.6 percent was used for irrigation; 11 percent for municipal uses, 2.3 percent for manufacturing purposes, 1.6 percent for mining, and 1.1 percent for livestock watering.

Knowles concluded his presentation to the Water for Texas Conference by reminding Texans that they are exceeding the average annual effective recharge rate by some 5.7 million acre-feet. In other words, 5.7 million acre-feet of fresh water which has been stored underground throughout geologic time is pumped to the surface every year, used, and eventually allowed to evaporate into the atmosphere or drain into the Gulf of Mexico.

"This mining cannot continue indefinitely," says Knowles. "Some day the wells will be dry or the water produced by them will be unfit to use. We must continue to use available resources to appraise our groundwater supplies and make every effort to reduce groundwater mining while maintaining economic growth and prosperity in the state."

Knowles recommended conservation practices and development of surface water supplies to augment groundwater resources. "We should also continue to study how best to use our groundwater resources at least to the full extent of their annual effective recharge rates," he says. "To do otherwise wastes a valuable resource we cannot afford to waste."

Depletion Problem Areas

The Texas Department of Water Resources (TDWR) has identified areas in Texas with the most serious groundwater level declines between 1970 and 1980. Six of the ten largest cities in the state fall into one of the designated problem areas. Millions of acres of the state's most productive land are also included in the areas with the most serious water level decline.

1. Two-thirds of all groundwater pumped in the state--7.234 million acre-feet per year--comes from the Ogallala Aquifer. Over 96 percent of all water pumped from this aquifer, recently renamed the High Plains Aquifer, irrigates farmland. The Texas Water Development Board predicted in 1977 that if extremely effective water conservation programs were not implemented immediately, groundwater depletion would reduce the present 5.9 million acres of irrigated production to 3.2 million acres in the year 2000 and to 2.1 million acres by 2030.

2. Groundwater mining around El Paso has increased pumping costs, deteriorated water quality, and forced the city to seek new sources of water by the year 1995. Most of the water withdrawn from the Hueco Bolson Aquifer in El Paso County goes for municipal and manufacturing uses.

Complicating groundwater issues in this area are the fact that the Mexican border town of Ciudad Juarez pumps from the same formation and the fact that available groundwater lies beneath land across the New Mexico border. The decision on whether El Paso can transport groundwater across the state line will probably be decided by the United States Supreme Court.

3. An area of West Texas where irrigation pumpage has caused water level declines and water quality deterioration is southeast of Odessa and west of San Angelo. Water from the Edwards-Trinity Aquifer was withdrawn in 1979 to irrigate over 87 thousand acres in Midland, Glasscock, Upton, and Reagan Counties.

4. Serious water decline levels in the Dallas-Fort Worth area and around Waco are due to the large municipal and industrial users of water from the Trinity Group and Woodbine Aquifers. Large declines have also occurred in western Travis and Williamson Counties and in water table areas of Erath County due to irrigation.

5. The Carrizo-Wilcox Aquifer stretches underneath East Texas counties all the way to the Winter Garden area. In the Winter Garden area, irrigation is the primary use of groundwater, but the water level is declining there. Other areas of decline in the Carrizo-Wilcox Aquifer are in Nacogdoches, Angelina, Wood, and Hopkins Counties. Cities and manufacturers are the primary pumpers in these areas.

6. Municipal and manufacturing demand in the Houston area account for most of the water pumped from the Gulf Coast Aquifer. Recent efforts to convert to surface water along the western side of Galveston Bay and along the Houston Ship Channel, however, have decreased pumping and reduced the threat of further subsidence caused by over pumping the aquifer. Other areas of decline in the Gulf Coast Aquifer are around Anderson, Conroe, and south of Huntsville.

Unless water users in the state implement radical changes in groundwater use during the 1980s, areas designated on a water level decline map are sure to be larger, darker and more numerous in 1990.