Chapter 16

History of Production and Potential Future Production of the Gulf Coast Aquifer

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Introduction

The Gulf Coast aquifer system is an expansive aquifer providing water to approximately 50 Texas counties. Groundwater use from the system ranks second in the state behind the Ogallala aquifer of the Texas High Plains. Groundwater development began initially with the construction of shallow wells and increased with the development of deeper well drilling equipment and the vertical turbine pump. The aquifer has been an important source of water for centuries and will continue to be an important source of water for various uses. It is estimated that overall Gulf Coast aquifer pumping was about 1.2 million acre-feet in 1985 and about 1.05 million acre-feet in 2000 with a decrease in pumping attributable to lower usage for industrial and irrigation in the Gulf Coast region.

In the future, utilization of groundwater from the aquifer system will include development of fresh water and also the development of brackish water that will be treated to provide a product acceptable for municipal, industrial, and other uses.

History of Groundwater Development

The Gulf Coast aquifer system, composed of the Chicot, Evangeline, and Jasper aquifers, encompasses an area from the Rio Grande in the south to the Sabine River to the east and also extends to the south and east outside the borders of Texas. An illustration showing counties that can obtain groundwater from the Gulf Coast aquifer system is provided as Figure 16-1. The illustration further is shaded to show counties in the southern part of the state where groundwater is an important resource for municipal, industrial, and irrigation uses, but where the quantity of water available is lower than in other areas further to the northeast. The central counties are principally an area where the primary use of groundwater is for irrigation. In the northern counties, groundwater is used principally for municipal purposes followed by industrial and irrigation uses.

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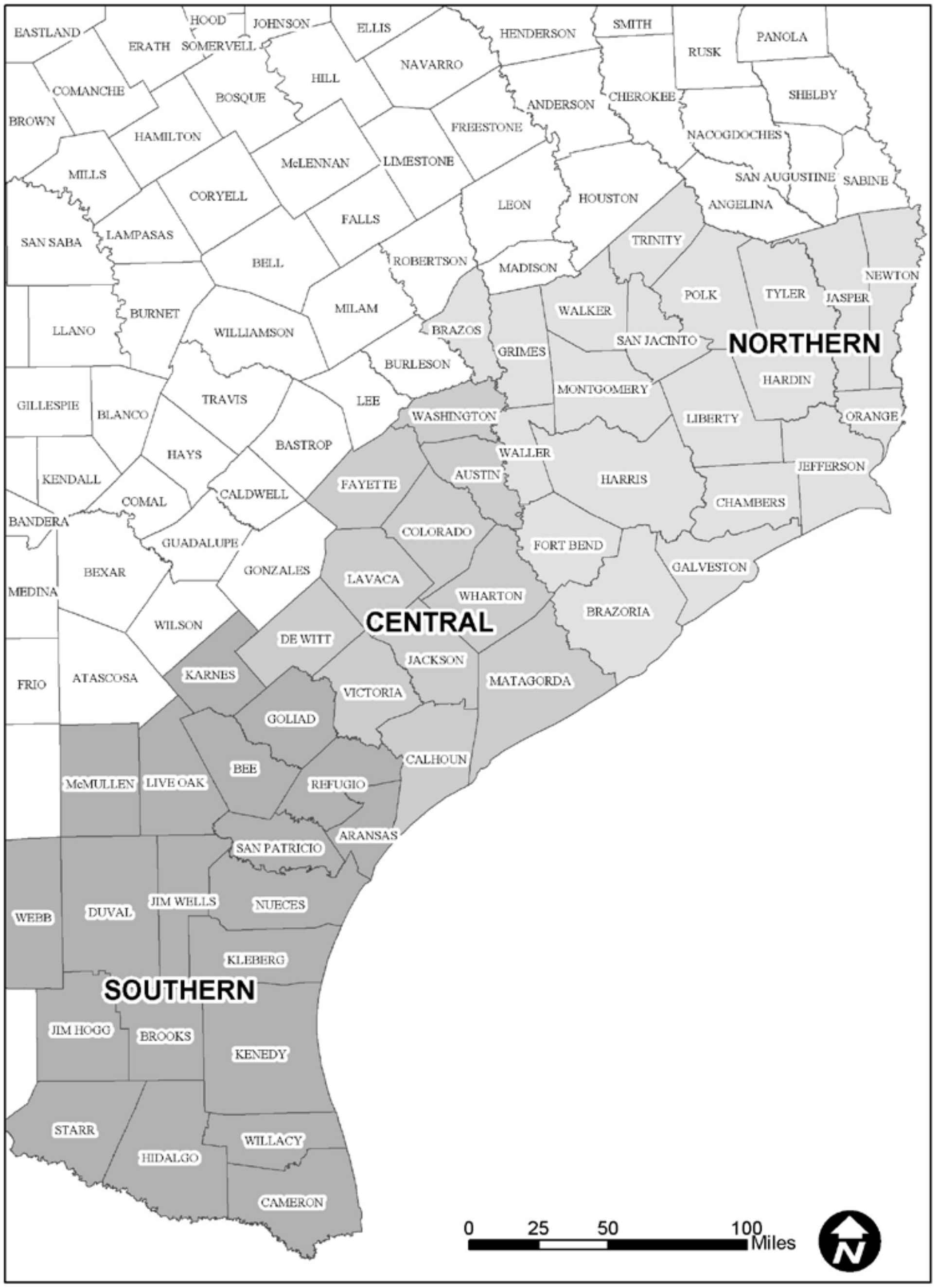

Figure 16-1. Counties that obtain water from the Gulf Coast aquifer.

An illustration of groundwater development for the period 1985 through 2000 is given on Figure 16-2. The illustration shows that groundwater use in 1985 was about 1.2 million acre-feet with about 749,000 acre-feet of that total, or 62 percent, occurring in the northern counties.

Groundwater use decreased slightly through the two decades and by 2000 the water use inventory by the TWDB showed an overall usage of 1,048,347 acre-feet, with about 70 percent

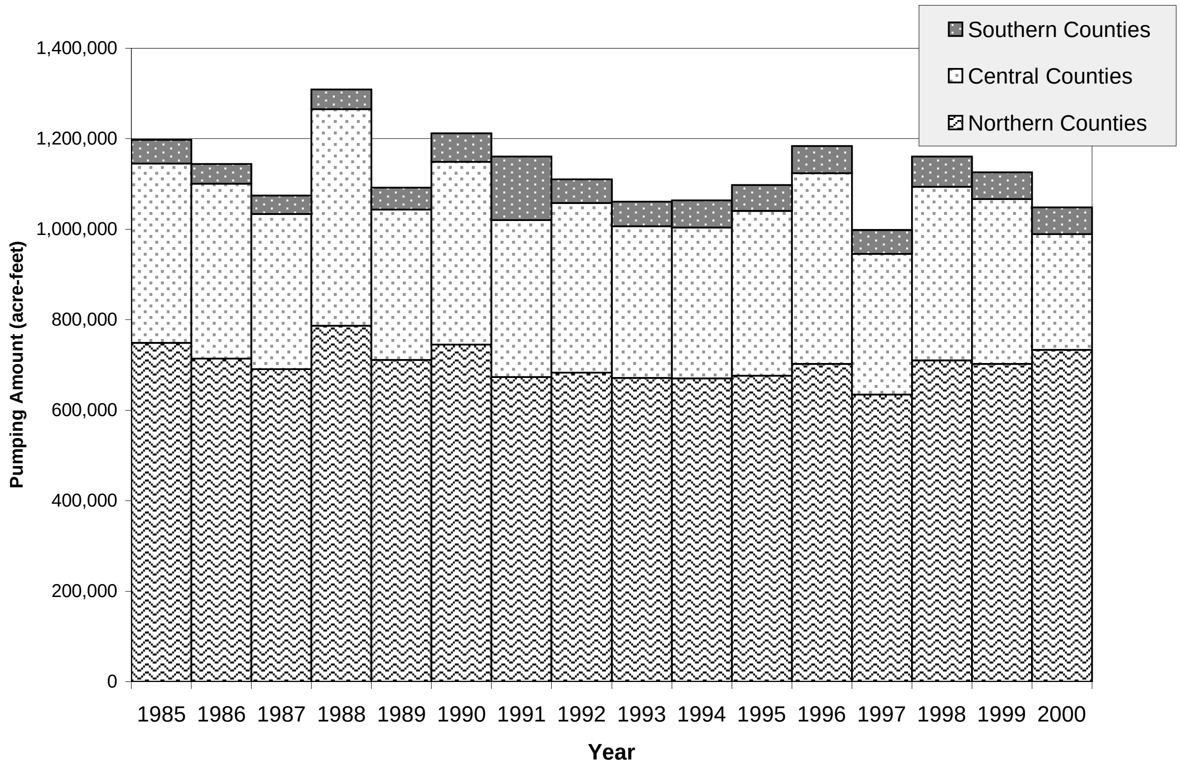

Figure 16-2. Groundwater pumpage by area from the Texas Gulf Coast aquifer for 1985 to 2000.

of that total usage occurring in the northern counties. The decrease in usage is attributable to a reduction in the quantity of water pumped for irrigation and industrial uses.

Pumpage in the southern counties ranged from about 41,000 to 67,000 acre-feet per year between 1985 and 2000. The development of groundwater in the southern counties is an essential part of the municipal supply for many of the cities and towns. Pumpage in Duval, Kleberg, Hidalgo, San Patricio, and Jim Wells counties constituted about 64 percent, or 37,890 acre-feet per year, of the total pumpage in the southern counties in 2000. The development of brackish groundwater is occurring in the Rio Grande Valley to provide water for municipal and industrial uses.

The groundwater pumpage by use category is shown on Figure 16-3. The data show that the vast majority of groundwater is pumped for municipal and irrigation uses, followed by industrial use. In 1985, approximately 47 percent of the groundwater pumped from the Gulf Coast aquifer was for municipal use and 42 percent was for irrigation. By 1999, approximately 52 percent of the groundwater pumped was for municipal use and 37 percent for irrigation. This shows the value of groundwater for municipal use and a reduction in irrigation demand due to higher fuel prices and lower relative commodity prices. A review of the data for the past 15 years shows that pumping for municipal use has fluctuated and increased gradually from 562,922 to 591,088 to 624,334 acre-feet per year in 1985, 1999, and 2000, respectively. Additional surface water supplies being routed to the Houston area probably will result in a reduction in the overall

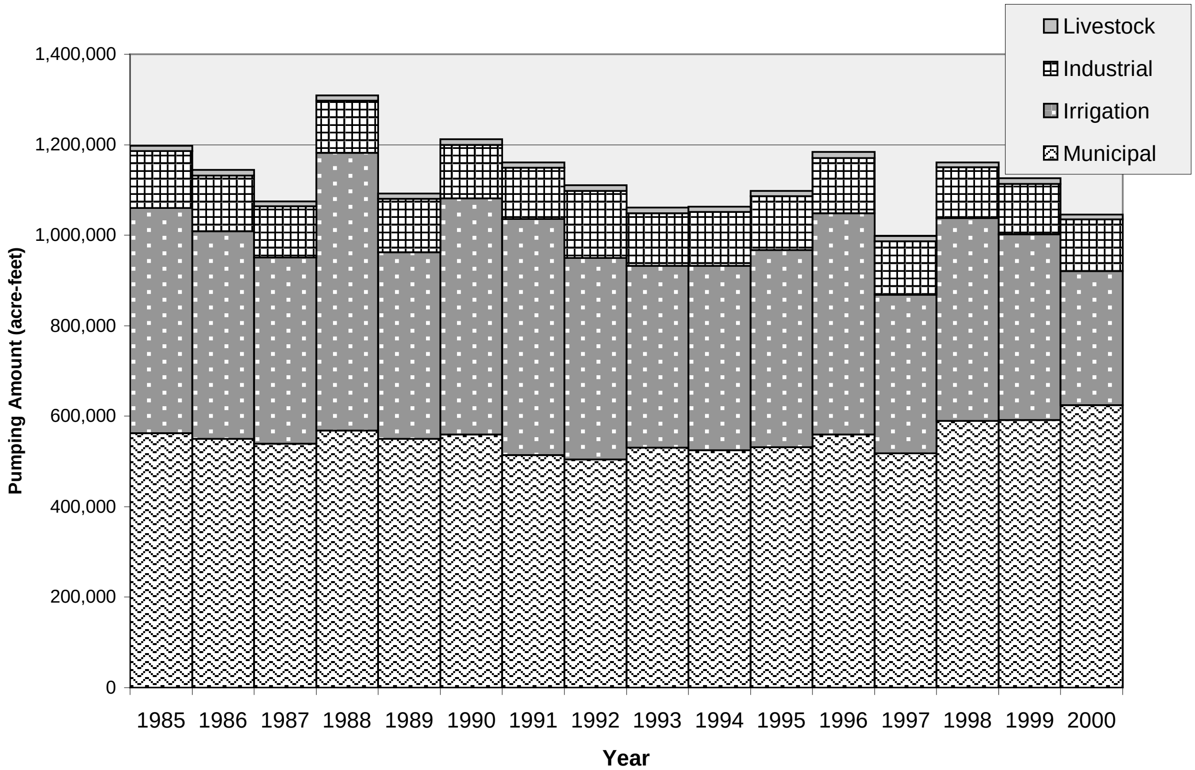

Figure 16-3. Total Gulf Coast aquifer pumpage by use for 1985 to 2000.

amount of groundwater pumped for municipal needs in that part of the state. A vast majority of the overall pumping for irrigation occurs in the central counties of the Gulf Coast aquifer region. Within these counties, irrigation constituted approximately 87 and 86 percent of the total groundwater pumped in 1985 and 1999, respectively. The groundwater withdrawal for irrigation in the central counties in 1985 and 1999 was 344,277 and 312,037 acre-feet per year, respectively. The use of groundwater for irrigation in this area is estimated to continue in the future as long as commodity prices are sufficient for continued irrigation of crops, principally rice, and as long as energy costs are not so high that they preclude the pumping of groundwater. Further reductions in groundwater withdrawals in the central counties could allow for the pumping of the water for other uses.

Houston-Galveston Area

Groundwater use in the area began probably with the arrival of American Indians. As settlers came in the 1800s, shallow wells were dug, which provided water for domestic and livestock uses. Organized records of groundwater development in terms of pumping amounts began in the late 1880s. In 1890, based on records obtained from the U.S. Geological Survey, pumping was about 2.5 million gallons per day, or 2,800 acre-feet per year. An illustration of historical pumping is included as Figure 16-4 and the Houston-Galveston area is shown on Figure 16-5. As

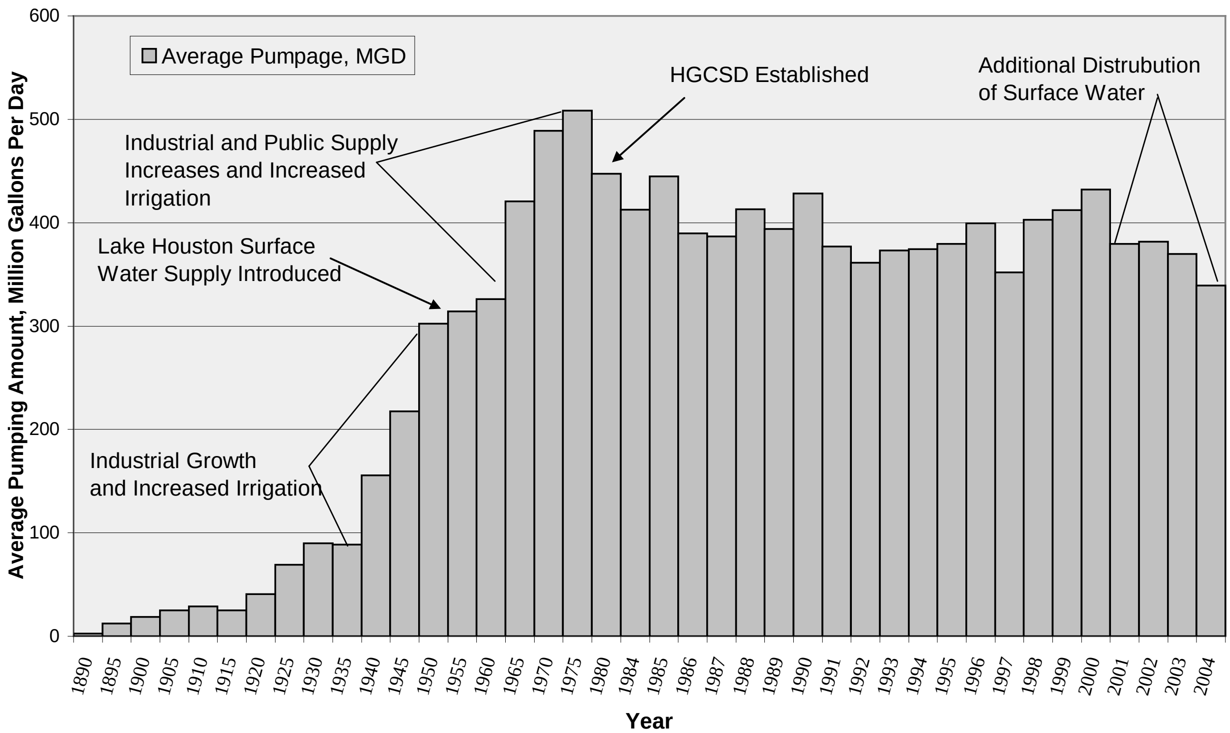

Figure 16-1. Historical groundwater pumpage for the Houston-Galveston area for 1890 to 2004.

the population of the area increased and industrialization was occurring, groundwater pumping reached about 90 million gallons per day, or 100,818 acre-feet per year, by 1930 and was somewhat stable through the years of the Great Depression. From 1935 to 1950, overall pumping increased dramatically from about 90 million gallons per day, or 100,818 acre-feet per year, to 300 million gallons per day, or 336,060 acre-feet per year, as industrialization occurred in the area bordering Galveston Bay, the population of the area grew dramatically, and irrigation increased in the area west of Houston. Large-capacity wells were constructed to obtain the ever-increasing amount of water.

In 1953–1954, Lake Houston was constructed and began providing a supply of surface water, which resulted in a reduction of the rate of growth of groundwater usage from 1950 to 1960. Lake Houston continues to be a major source of water for the Harris-Galveston area. Groundwater pumping peaked in the area in 1975 at just over 500 million gallons per day, or 560,100 acre-feet per year. A pumping rate of one million gallons per day for a year is equivalent to about 1,120 acre-feet of pumping per year. The pumping of large quantities of groundwater caused significant artesian head declines in the Gulf Coast aquifer that reached about 400 feet in the Houston Ship Channel area by 1975. After about 1976, pumping along the Houston Ship Channel began to decrease as the result of the introduction of surface water from the Coastal Industrial Water Authority. Overall pumping in the Houston-Galveston area decreased significantly from 1975 to 1980 and has decreased gradually from 1980 to 2004. By 2004,

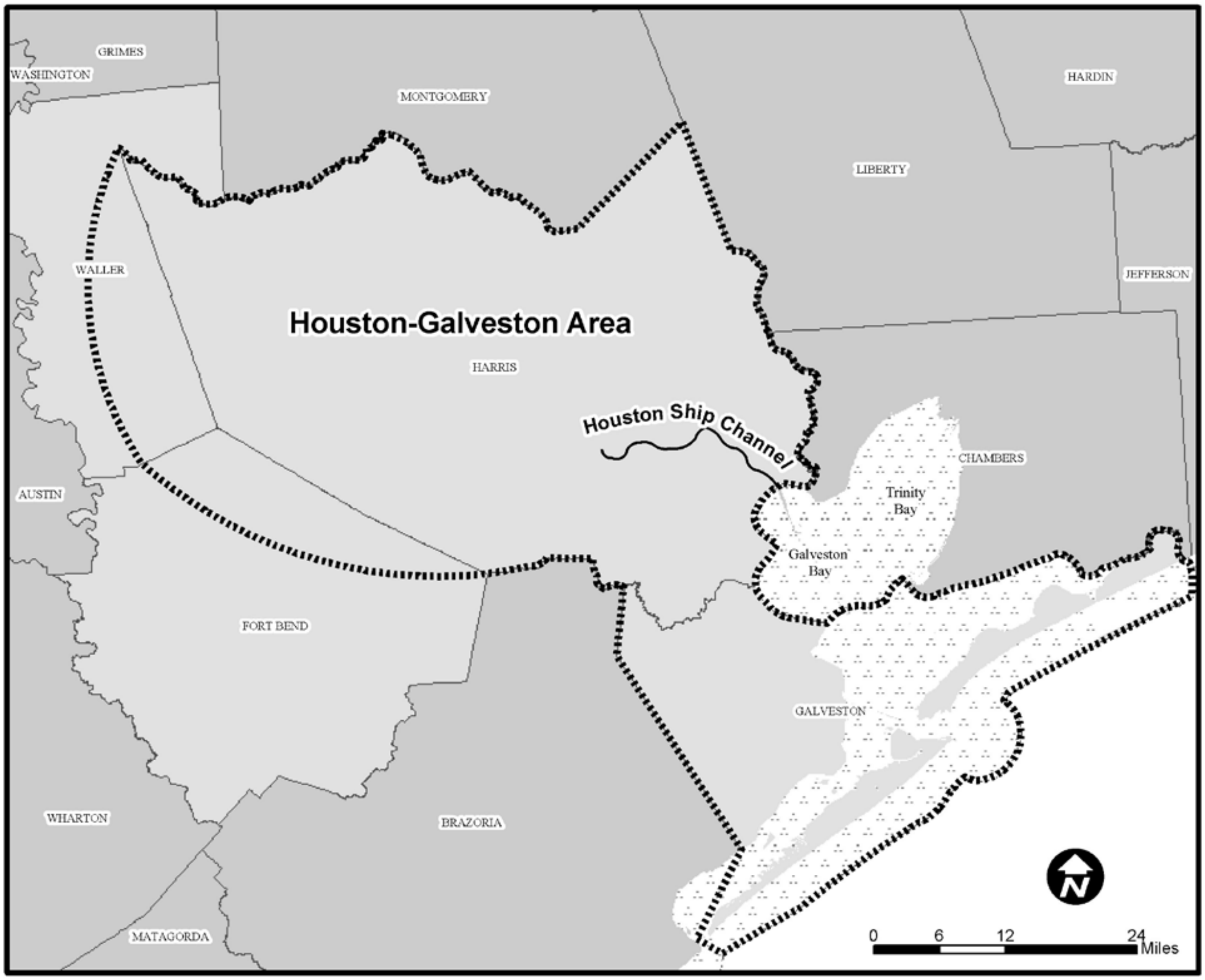

Figure 16-5. The Houston-Galveston area.

pumping in the area was about 339 million gallons per day, or 379,747 acre-feet per year. Artesian heads have rebounded about 200 to 240 feet in the Evangeline aquifer in the Ship Channel area since 1977 as the result of reductions in pumpage in that area and in surrounding areas.

Since the establishment of the Harris-Galveston Subsidence District, groundwater usage has decreased in the continuing effort to address land surface subsidence. Surface water usage has increased and is planned to continue to increase in the future as the demand for water in Harris, Galveston, Fort Bend, and Montgomery counties is estimated to be 1,524 million gallons per day (1,707,184 acre-feet per year) and 1,841 million gallons per day (2,062,288 acre-feet per year) by 2020 and 2040, respectively, based on the Region H regional water plan completed in 2005.

Future Groundwater Development

Groundwater supplies will continue to provide an important source of water for the Gulf Coast area. The aquifer system is capable of supplying large quantities of good quality water and has a greater potential for providing water in the area from about Victoria County northeastward toward the border with Louisiana. This same aquifer system is a prolific source of water in Louisiana.

In a high population growth area such as the Houston metropolitan region, groundwater will continue providing part of the supply with surface water from the Brazos, San Jacinto, and Trinity rivers being a larger water source. Development of groundwater resources in this region should be accomplished while being mindful of land surface subsidence constraints. The Harris-Galveston and Fort Bend subsidence districts have been instrumental in developing regulatory plans that include limits on the amount of groundwater pumping that can occur.

To the east of Harris County in Liberty, Hardin, Tyler, Jasper, and Newton counties, the Gulf Coast aquifer system is capable of providing large quantities of good quality water. In these counties groundwater usage is somewhat limited because of the lower population, availability of surface water, and generally small industrial groundwater demand. The City of Beaumont pumps groundwater in the south part of Hardin County and a paper mill in Jasper County pumps about 30,000 to 35,000 acre feet per year to supplement a supply of surface water for its paper production operations. Additional supplies of groundwater could be developed in the five counties (see Figure 16-6) if needed for local use or for transport to an area with a water need. Whether this will occur is not known, but the water resource would be a replenishable supply with abundant precipitation in the area serving as a source of recharge to the aquifer system.

Potential Groundwater Development Projects

There have been a few projects proposed that would involve development of groundwater from the Gulf Coast aquifer for use in other areas of the state or for use during times of limited surface water availability. Two projects in this category include the Lower Guadalupe Water Supply Project and the Lower Colorado River Authority-San Antonio Water System Water Project.

Lower Guadalupe Water Supply Project

This project was proposed in 2002 and included the conjunctive use of surface water and groundwater with the surface water coming from the Guadalupe River and the groundwater potentially coming from well fields in Refugio, Goliad, and Victoria counties. Objectives of the project were to develop groundwater from deeper depths of the Evangeline aquifer of the Gulf Coast aquifer system. The project would comply with the requirements of groundwater conservation district rules regarding well permitting, pumping, and the monitoring of the aquifer response to pumping. Within the last few months, the groundwater component of the project was removed. Prior to its removal, the project included the development of an average of about 14,000 acre-feet per year of groundwater to supplement surface water. There would be years when groundwater would be pumped at higher rates and years when groundwater would be pumped at lower rates to help firm up the overall yield of the project of about 80,000 to 90,000 acre-feet per year. The water was destined for use in the Bexar County area and potentially at

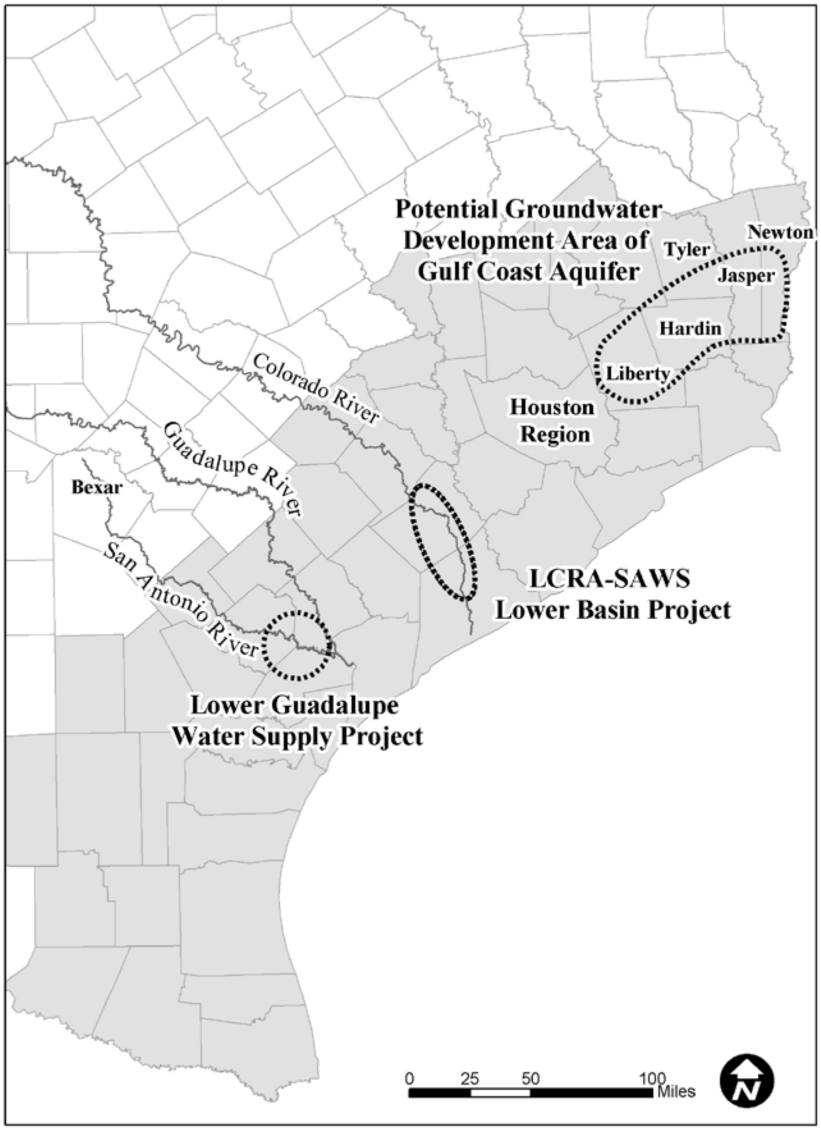

Figure 16-6. Potential groundwater development areas.

other locations between the southeast part of Refugio County and Bexar County. The project was a joint effort of the San Antonio Water System, the San Antonio River Authority, and the Guadalupe-Blanco River Authority.

Lower Colorado River Authority-San Antonio Water System Water Project

Another groundwater development project that would conjunctively use groundwater and surface water is the Lower Colorado River Authority-San Antonio Water System Water Project. Objectives of the project are to provide additional water to the San Antonio area and to the lower part of the Colorado River basin during drought periods. The project components include the off channel storage of surface water and additional conservation of irrigation water. The project also includes the development of groundwater from the Gulf Coast aquifer, potentially in Matagorda and Wharton counties (Figure 16-6) to supply local irrigation needs during drought years so that surface water from the Colorado River can be used upstream. Potentially about 62,000 acre-feet of groundwater could be pumped during drought years for local irrigation needs. Studies are currently being performed regarding the project and, if results are favorable, water from the project could be delivered by the next decade.

Potential Brackish Groundwater Development

In addition to providing large quantities of good quality water, the Gulf Coast aquifer system also contains a substantial quantity of brackish groundwater. For this paper, brackish groundwater is defined as water containing more than 1,000 milligrams per liter total dissolved solids and less than 10,000 milligrams per liter of total dissolved solids. Areas that have been outlined as containing brackish groundwater are shown on Figure 16-7. In general, the aquifer system contains groundwater of good quality from its outcrop area to within 10 to 30 miles of the coast. In the area south of Victoria County brackish groundwater extends further inland from the coast than in the area northeast of Victoria County. Some of the same sands that contain good quality water away from the coast contain brackish water closer to the coast.

There is the potential to develop supplies of brackish groundwater and, through a total dissolved solids reduction process, normally reverse osmosis, improve the quality of the water so that it can be used for public supply, industrial, and other uses. Issues to address with this type of development include the cost of developing and treating the water and then transporting it from areas of supply to areas of use. Other issues include maintaining a reasonably stable quality of brackish water through the duration of a project, disposal of the concentrate that is a product of the reverse osmosis treatment, and potential land surface subsidence. These issues can be addressed, and the cost of addressing them affects the viability of a project.

Supplies of brackish water are being successfully developed in the Rio Grande Valley in Cameron County for the Southmost Regional Water Authority with facilities that provide about 7.5 million gallons per day, or 8,401 acre-feet per year, of desalinated water. Another desalination project was developed by the North Cameron Regional Water Authority to treat brackish groundwater and provide a supply of about 2 million gallons per day, or 2,240 acre-feet per year. These projects are examples of developing the important brackish groundwater resources that exist in the Gulf Coast aquifer system. The potential exists to develop larger desalination projects in areas along the coast and this will occur in the coming decades.

Conclusions

The Gulf Coast aquifer system is an important source of water for the Gulf Coast region. The unconsolidated sediments provide a structure and medium for drilling small and large-capacity production wells that provide water for a range of uses. The aquifer system helps sustain the economic viability of the Gulf Coast region and provides the largest supplies of good quality groundwater in the area northeast of Victoria County where the aquifer system is composed of greater thicknesses of sand containing water with low levels of total dissolved solids. The aquifer system is an important source of water in the area south of Victoria County where it is still

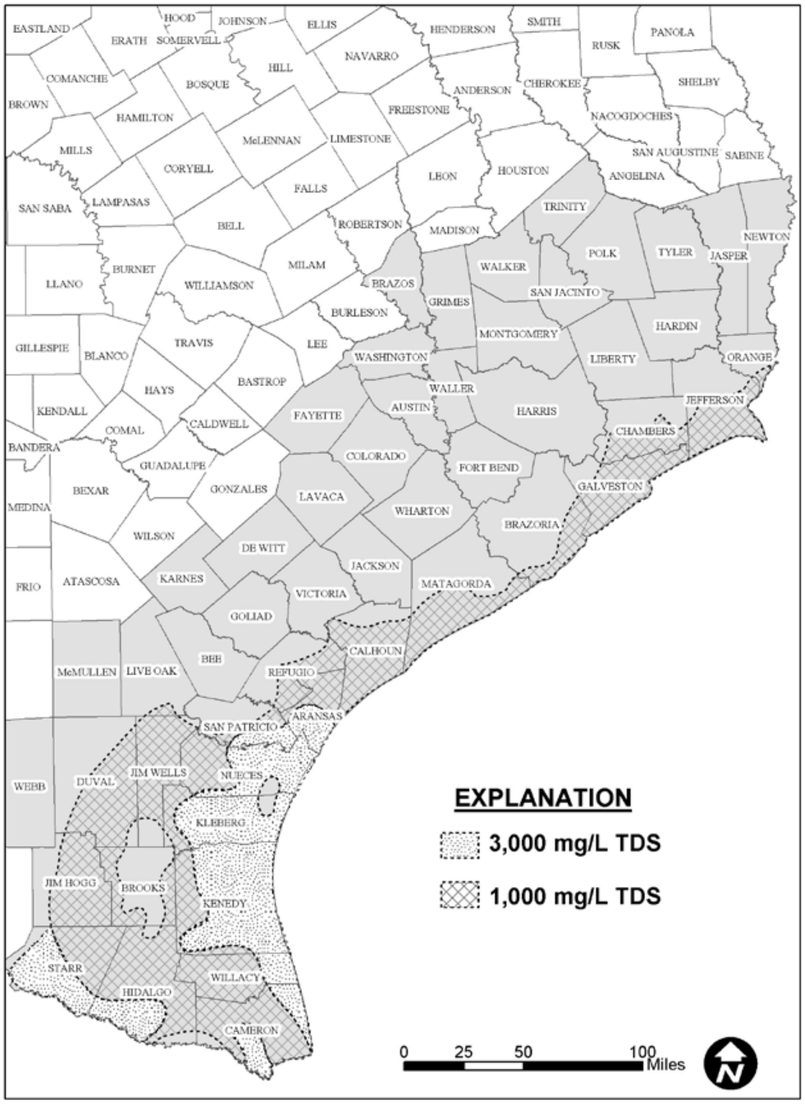

Figure 16-7. Brackish groundwater areas.

capable of providing significant quantities of groundwater ranging in quality from fresh to brackish. Total pumping from the aquifer system was about 1,046,000 acre-feet in 2000.

In the future the aquifer system will continue providing large quantities of groundwater with the three main use categories being irrigation, public supply and industry. There is the potential that groundwater will be developed from the aquifer for use in other areas of the state or for transport from one part of the Gulf Coast to another. Undeveloped Gulf Coast aquifer resources occur in the east Texas area where abundant precipitation provides replenishment to the aquifer. The Gulf Coast aquifer can also provide large quantities of brackish water that can be treated to provide additional supplies for public supply, industry, and other uses. The desalination of brackish groundwater is occurring in the Rio Grande Valley and providing an additional water source to an area with an increasing water demand that relies heavily on surface water from the Rio Grande River.

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