

In 1991, the U.S. Geological Survey (USGS), Department of the Interior, began a National Water-Quality Assessment (NAWQA) Program. The long-term goals of the NAWQA Program are to describe the status of and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources and to identify the major natural and human factors that affect the quality of these resources. In addressing these goals, the program will produce a wealth of water-quality information that will be useful to policymakers and managers at national, State, and local levels.

The NAWQA Program emphasis is on regional water-quality problems. The program will not diminish the need for smaller studies and monitoring presently designed and conducted by Federal, State, and local agencies to meet their individual needs. The NAWQA Program, however, will provide a large-area framework for conducting many of these activities and an understanding about national and regional water-quality conditions that

cannot be acquired from individual, local programs and studies.

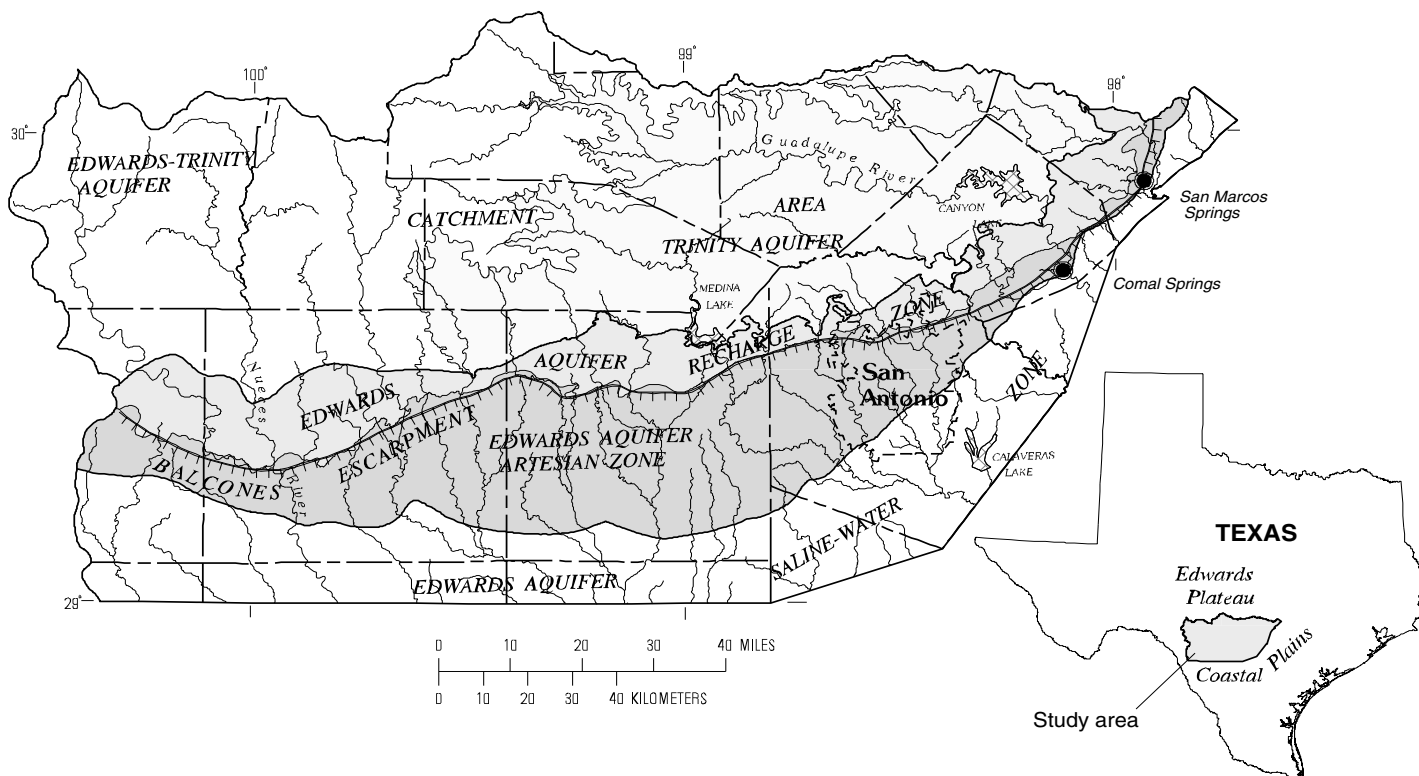
Studies of 60 hydrologic systems that include parts of most major river basins and aquifer systems (study-unit investigations) are the building blocks of the national assessment. Areas of the 60 study units range in size from less than 1,000 to more than 60,000 square miles (mi²) and represent 60 to 70 percent of the Nation's water use and population served by public water supplies. Twenty study-unit investigations were started in 1991, 20 additional started in 1994, and 20 are planned to start in 1997. Assessment activities in the South-Central Texas study area (see fig.) began in 1994.

The South-Central Texas Study Area

The 10,500-mi² South-Central Texas study area comprises the Edwards aquifer in the San Antonio region and its catchment area. In addition to the Edwards aquifer, the study area includes parts of two other major aquifers, the Edwards-

Trinity and the Trinity. The study area also is coincident with the upper parts of the Nueces and Guadalupe River Basins in which several major streams originate. The highly productive Edwards aquifer, the first to be designated a sole-source aquifer as defined under the Safe Drinking Water Act of 1974, is the source of water for about 1.3 million people in the greater San Antonio area and for ranchers and farmers in the region. The aquifer also supplies water to sustain threatened and endangered species associated with major springs in the region and provides base flow to streams downgradient of the springs and study area.

The study area divides into two distinct landforms along the Balcones escarpment, a line of low hills that separates the vast Great Plains physiographic province (locally, the southeastern part of the Edwards Plateau) from the Coastal Plains. North and west of the escarpment is a rugged terrain of upland plateaus and rolling hills dissected by many small creeks that descend into the deeply incised valleys of several major streams. The land ranges in



altitude from about 1,000 to 2,300 feet (ft) above sea level and is used mostly for grazing cattle, sheep, and goats. Across the escarpment to the south and east, the terrain smooths noticeably into rolling prairies and broad stream valleys. The land ranges in altitude from about 600 to 1,000 ft above sea level and is used primarily for grazing cattle, farming (mostly corn, cotton, sorghum), or urban development.

Average annual rainfall in the study area ranges from about 22 inches (in.) in the western part to about 34 in. in the eastern part. The seasonal distribution of rainfall is highly variable. Meteorological and physiographic factors can combine to produce large, very intense storms that result in rapidly rising flood flows.

The Edwards aquifer is a dipping sequence of extensively faulted, fractured, and dissolutioned limestone and dolostone that yields large quantities of water to wells and springs. The aquifer crops out and is unconfined in the recharge zone. The aquifer is confined (the artesian zone) beneath much less permeable rocks down dip from the recharge zone. Farther down dip, where the rocks are virtually impermeable, they contain moderately saline to very saline water (the saline-water zone). The large water-yielding and transmitting characteristics of the Edwards aquifer result from a network of open fractures and solution channels associated with a series of southwest-to-northeast trending faults in the aquifer that generally parallel the Balcones escarpment.

The Edwards-Trinity and Trinity aquifers underlie the western and eastern parts of the catchment area, respectively. Although both aquifers yield and transmit much less water than the Edwards aquifer, they provide substantial base flow to streams.

The Nueces and Guadalupe Rivers and many of their tributary streams originate in the Edwards Plateau and flow toward the Coastal Plains. They cross the highly permeable, faulted, and fractured rocks of the Edwards aquifer outcrop where all the base flow and much of the storm flow are lost to the Edwards aquifer. Much of this

recharge becomes spring flow at Comal and San Marcos Springs, the principal natural discharge features of the aquifer.

The average annual recharge to the Edwards aquifer is highly variable and ranged from about 39 million gallons per day (Mgal/d) in 1956 to about 2,200 Mgal/d in 1992. Average annual spring flow, most of which is from Comal and San Marcos Springs, is also highly variable and ranged from about 62 Mgal/d in 1956 to about 717 Mgal/d in 1992.

Water use in the study area has been about 535 Mgal/d in the late 1980's and early 1990's. About 80 percent is withdrawals from the aquifers, and the remainder is from streams and reservoirs. Almost all the ground-water withdrawals are from the Edwards aquifer. The major uses of the water are municipal supply and crop irrigation.

Major Water-Quality Issues

The following major water-quality issues in the study area are readily identifiable:

- *Potential contamination due to urbanization*—Runoff from urban areas often contains contaminants that could adversely affect streams and aquifers. The area of greatest concern is the recharge zone of the Edwards aquifer, where point and nonpoint source runoff readily infiltrates the porous rock and flows into the main water-yielding zones of the aquifer. Although most of the recharge zone currently (1994) is undeveloped, substantial increases in development activity have occurred in the San Antonio area.
- *Potential for contamination of the Edwards aquifer from the saline-water zone*—The threat of saline-water intrusion into the freshwater artesian zone of the aquifer during drought conditions is a perennial concern, particularly as pumping from the artesian zone increases.
- *Survival of spring-dependent threatened or endangered species*—Various threatened or endangered fish and amphibians and an endangered plant are dependent on flow from Comal and San Marcos Springs. The quality of the spring dis-

charge represents an integration of all the natural and human factors that affect the quality of water in the aquifer. Several species potentially are at risk from changes in habitat associated with changes in the flow regimes of the springs due to increased pumpage and from contaminants introduced by human activities.

Communication And Coordination

Communication and coordination between the USGS and water-management, water-protection, and other scientific organizations are critical components of the NAWQA Program. Study-unit liaison committees have proven to be highly effective in this process and comprise representatives from Federal, State, and local agencies, universities, and the private sector who have water-resources responsibilities. Specific activities of each liaison committee include the following:

- Exchange of information on and prioritization of water-quality issues of regional and local interest
- Identification of sources of water-quality data and other information (for example, land use, demographics, soils, land management practices, pesticide use)
- Assisting in design and scope of project elements
- Review of project-planning activities, study findings, interpretations, and reports

Information on technical reports and hydrologic data related to the NAWQA Program can be obtained from:

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