



**EDWARDS AQUIFER**  
A U T H O R I T Y

1615 N. St. Mary's  
San Antonio, Texas 78215  
<http://www.edwardsaquifer.org>

## **EDWARDS AQUIFER BIBLIOGRAPHY THROUGH 2010**

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**August 2011**

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## **INTRODUCTION**

The San Antonio segment of the Balcones Fault Zone Edwards Aquifer (the aquifer) is the primary source of water for approximately 1.7 million people in the San Antonio area. It is also the primary water supply for ranchers and farmers in the south central Texas region. A variety of unique aquatic species also depend on the aquifer for survival. Numerous studies, reports and news articles involving a wide-range of topics pertaining to the aquifer have been published that further explain the economic and environmental importance of the aquifer to south central Texas.

This bibliography comprises multidisciplinary references to technical and general literature for three regions of the aquifer in Texas - the San Antonio segment; the Barton Springs segment, Austin area; and the northern segment, Austin area. The references in this bibliography are compiled from computerized data bases, published bibliographies, and reports. Dates of references range from the late 1800's through 2010.

### **Purpose and Scope**

The purpose of this multidisciplinary bibliography is to provide references to technical and general literature concerning the Edwards Aquifer. This bibliography comprises approximately 2,745 references for books, journals, magazine articles, conference proceedings, abstracts, technical reports, master's theses, doctoral dissertations, maps, regulatory actions, web sites, and videos dating from the late 1800's through 2010. This bibliography does not contain newspaper or newsletter articles relating to the Edwards Aquifer.

Portions of the bibliography were prepared by the United States Geological Survey (USGS). In 1995, Julie A. Menard, with the USGS, prepared the Bibliography of the Edwards Aquifer, Texas, Through 1993, in support of a study by the Center for Research in Water Resources, University of Texas (McKinney and Sharp, 1995). The USGS bibliography, completed in 1995, covered the time period from the late 1800's through 1993.

In 1997, the Edwards Aquifer Authority (the Authority), under contractual agreement with David L. Gregory, and with assistance from Ramona Traynor-USGS librarian, compiled references published from the period 1993 through 1997 using the same computerized data bases from which the USGS prepared the earlier bibliography. Authority staff has updated and published this bibliography annually since 1998.

## **Description of the Edwards Aquifer**

The San Antonio segment of the Balcones Fault Zone Edwards Aquifer in south central Texas is one of the largest and most important karst aquifer systems in the United States. The aquifer extends through parts of Kinney, Uvalde, Zavala, Medina, Frio, Atascosa, Bexar, Comal, Guadalupe, and Hays counties and covers an area approximately 180 miles long and five to 40 miles wide. The aquifer is the primary water source for much of this area, including the City of San Antonio and surrounding communities. Historically the cities of Uvalde, San Antonio, New Braunfels, and San Marcos were founded around large springs that discharge from the aquifer. As the region grew, wells were drilled into the aquifer to supplement water supplied by the springs. In addition, the Edwards Aquifer is the principal source of water for agriculture and industry in the region and provides springflow required for endangered species habitat, as well as recreational purposes and downstream uses in the Nueces, San Antonio, Guadalupe, and San Marcos river basins. The Edwards Aquifer transitions from freshwater to saline water along the south end of the artesian zone.

The Edwards Aquifer is contained within the Cretaceous-age Edwards Group limestone (Edwards Limestone) and associated units. The Edwards Limestone is generally capped by the Del Rio Clay and overlies the Upper Glen Rose Formation (upper unit of the Trinity Aquifer). The Edwards Limestone forms the top of the Edwards Plateau within the drainage area of the aquifer. However, the Edwards Limestone is missing from the south and east flanks of the plateau as a result of erosion along the Balcones Escarpment. Normal faulting, associated with the Balcones Fault Zone, has downfaulted the geologic units in this area, resulting in the formation of the Texas Hill Country by erosion across the fault scarps. Generally, from northwest to southeast across this region, the Edwards Limestone is exposed along much of the plateau area until reaching the Hill Country, where the older Glen Rose Formation is exposed throughout. Moving farther south and east, the Edwards Limestone is again present and exposed at the surface. This surface exposure is the recharge zone of the Edwards Aquifer. Farther south and east, downfaulting has dropped the Edwards Limestone even farther below the surface in the artesian zone of the Edwards Aquifer. Here the Edwards Aquifer produces freshwater from depths as great as 4,000 ft below the surface.

Water circulates through the Edwards Aquifer as part of the hydrologic cycle from recharge areas to discharge points (springs and wells). Approximately 1,250 square miles of Edwards Limestone is exposed at the ground surface and composes the recharge zone where water enters the aquifer. Streams flow south or east from the drainage area (the Texas Hill Country and Edwards Plateau) and lose all or most of their baseflow as they cross the recharge zone. In addition, part of the rain

that falls directly on the recharge zone also enters the aquifer. Groundwater moves through the aquifer and ultimately discharges from a number of locations, such as Leona Springs in Uvalde County, San Pedro and San Antonio springs in Bexar County, Hueco and Comal springs in Comal County, and San Marcos Springs in Hays County. In addition, domestic, livestock, municipal, agricultural, and industrial wells throughout the region withdraw water from the aquifer. The residence time of water in the aquifer ranges from a few hours or days to many years, depending on depth of circulation, location, and other aquifer parameters.

The Edwards Aquifer is a karst aquifer, characterized by the presence of sinkholes, sinking streams, caves, large springs, and a well-integrated subsurface drainage system. Within the artesian zone, it is one of the most productive groundwater systems in the United States, characterized by extremely high capacity water wells and high spring discharges. The aquifer exhibits extremely high (cavernous) porosity and permeability, characteristic of many karst aquifers. In contrast, aquifers that occur in sand and gravel or in other rock types, such as sandstone, have a much lower permeability. Because the Edwards Aquifer is known for having areas of high permeability, it allows the transmission of large volumes of water, enabling groundwater levels to respond quickly to rainfall (recharge) events.

Historically, water quality in the Edwards Aquifer has been protected by its great depth below population centers and undeveloped land in the recharge zone and drainage area. However, there are potential threats to the quality of water in the aquifer from various sources, including the transport and use of hazardous substances and other chemicals on the recharge zone, abandoned or poorly completed water wells, and urban nonpoint runoff. The high porosity and permeability of the Edwards Aquifer allow inflow of contaminants from the ground surface with little or no filtration.

## **Other Edwards Aquifer-related Bibliographies**

As mentioned in Menard (1995): “Other bibliographies on the Edwards Aquifer provide important references, some of which are peripheral to the Edwards Aquifer and therefore, are not included herein. A bibliography of the Edwards Aquifer in the San Marcos area provides many annotated references and abstracts to biological, hydrological, limnological, recreational, and historical publications (Saunders, 1992). A bibliography prepared for the City of San Antonio has references and abstracts concerning pollution, hydrogeology, and runoff associated with the Edwards Aquifer and other limestone aquifers (Metcalf & Eddy, Inc., 1976). Finally, a list of Edwards Aquifer references, available in the University of Texas at Austin, Walter Geology Library, groups the references by document type and includes library call numbers (Trombatore, 1992).”

PBS&J, under an Optimization Technical Study (OTS) contract with the Authority, compiled a bibliographical data base in April 2000. The PBS&J bibliographical data base provided annotated references and incorporated data bases of the Authority, USGS, Texas Parks & Wildlife and other references from studies, vitae, etcetera. BIO-WEST, under an OTS contract with the Authority, updated the PBS&J bibliographical data base in February 2002, February 2003, February 2004, February 2005, February 2006, February 2007, and in May 2008. The BIO-WEST bibliographical data base also provides annotated references and incorporates data bases of the Authority, USGS, Texas Parks & Wildlife, and other references from studies, vitae, etc.

## **Methodology and Approach**

The references contained in this bibliography (through **2010**) were mainly compiled with the assistance of computer searches of many journal articles, conference papers, numerous data bases, and a manual search of published bibliographies and reports. Data bases reviewed by Menard (1995) were selected by conducting a preliminary search to identify the data bases with the most information on the Edwards Aquifer. The bulk of the references are from GeoRef and Water Resources Abstracts. ProCite© Personal Bibliographic Software, Inc., software was used to manage and format the bibliography and to generate subject and author indexes. References in related bibliographies and in key reports were read, and relevant reports not provided by the computerized search were added to the bibliography. Some terms in the subject index originated from the data base producers. References added to the bibliography from print sources were indexed. Many of

the terms were modified or deleted to improve subject access to the references. Additionally, headings and subheadings were created to consolidate related concepts. Modification and indexing decisions were guided by authoritative thesauri: Water Resources Thesaurus (U.S. Office of Water Research and Technology, 1980), GeoRef Thesaurus, and Guide to Indexing (Palmer, 1986).

Data bases searched for compiling the 1993 through 1997 bibliography addendum were selected based on the previous bibliography by Menard (1995) and edited to bring the bibliography addendum up to date. A Boolean search-word process was incorporated to narrow the reference searches to Edwards Aquifer topics. This process allowed the user to manually select word combinations that the data base used to find references containing such word combinations.

## **References Organization**

The references are categorized by discipline, subdiscipline, and specific subdiscipline name. Subdisciplines under major disciplines are denoted with an arrow bullet (►) and specific subdiscipline names are denoted with a dot bullet (●). Entries are in alphabetical order by primary author or organization. Multiple references by one author are arranged in chronological order with the oldest reference listed first. Extensive efforts have been made to ensure that the references are correct. However, because of the manner in which they were compiled, some references might contain errors, or be incomplete.

In cases of overlap in subject matter between certain disciplines and subdisciplines, references were categorized under the predominant discipline, or subdiscipline. References that seemed to apply to more than two disciplines were categorized under “Overview Studies.” Others that did not appear to apply to any discipline were categorized under “Miscellaneous.” The 1993 through 1997 bibliography addendum added three new disciplines not found in Menard (1995). Some disciplines or subdisciplines used in Menard (1995) were omitted from this bibliography because no references appeared to fit them based on the search strategy used in the addendum.

## **Acknowledgments**

From Menard (1995), “The compiler thanks Drs. Daene C. McKinney and Jack M. Sharp of the University of Texas, whose research supported this effort; also, Patrick J. Connor of the U.S. Fish and Wildlife Service; Dr. James F. Garber of Southwest Texas State University; Dr. Clark L. Hubbs of the University of Texas at Austin; and Dr. Glenn Longley of Southwest Texas State University, Edwards Aquifer Research and Data Center, who assisted in completing many references and in providing copies of several useful documents. Ernest T. Baker, Jr., and Marshall E. Jennings, USGS, provided extensive technical assistance. They reviewed the references for pertinence and noted omissions. Additionally, Ernest T. Baker, Jr., reviewed the subject index terms for relevance. George E. Groschen, USGS, provided numerous references.”

From 1997 addendum: “The compiler thanks: Marshall E. Jennings, USGS, and Dr. Glenn Longley of Southwest Texas State University, Edwards Aquifer Research and Data Center for their initial support in this effort. Romana Traynor - USGS librarian, Austin, Texas, provided the technical training and educational resources on the DIALOG Information System (1997). Additionally, I would like to thank Velma Danielson and Brock Curry, of the Authority, who suggested that I undertake this project.”

From updates: “The compiler of this updated bibliography thanks: Authority colleagues for their support, comments, and constructive criticism while proofreading the document. Your changes and comments are greatly appreciated. Dennis Trombatore - Walter Geology Library, and Amanda Masterson - Bureau of Economic Geology Publication Department, University of Texas at Austin, who provided the list of reports written by students, faculty, and researchers. Ed Osborne and BIO-WEST staff for their updated/annotated bibliographical data bases that provided numerous references included in the document they produced for the the Authority since the year 2004.”

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