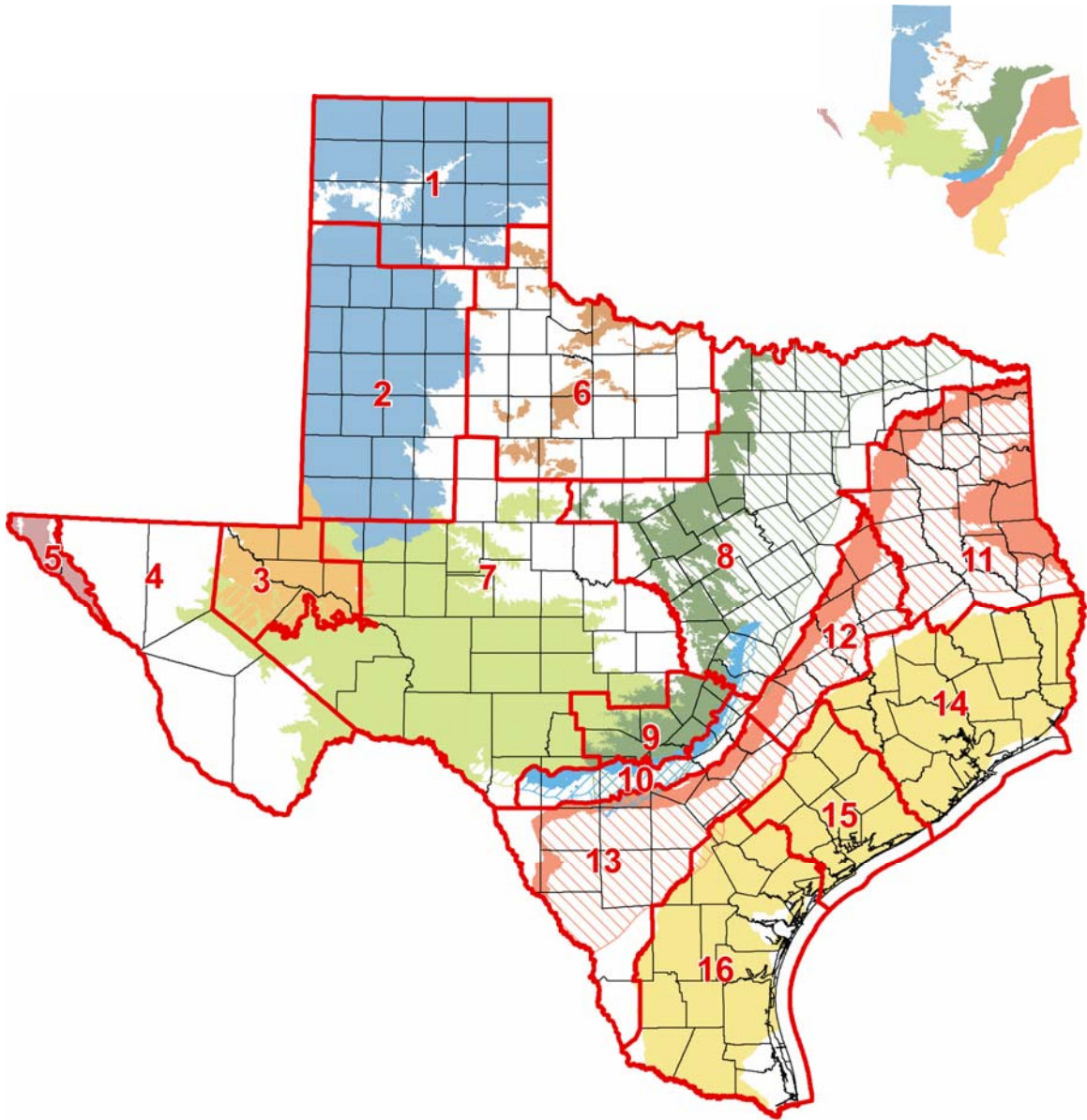


groundwater resources division



fiscal year 2006
annual report



***About the cover:** Chapter 35, Section 35.004, of the Texas Water Code directed the Texas Water Development Board to designate groundwater management areas covering all major and minor aquifers in Texas. House Bill 1763, passed during fiscal year 2006, directs groundwater managers to work cooperatively within these groundwater management areas. The image on the cover illustrates the 16 groundwater management areas along with the state's major aquifers.*



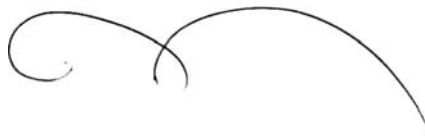
director's message

One of the reasons I came to the Texas Water Development Board was the awesome challenge of developing groundwater availability models for the state's aquifers. Our staff, our consultants, our cooperators, and our stakeholders pulled together to meet the legislative deadline of developing models for the major aquifers. After racing across the finish line with our team, I became concerned that I might get a little (yawn...) bored with my job at the Board.

Well, what a difference a legislative session makes! In 2005, the 79th Legislature passed House Bill 1763, a bill that changed the process of developing groundwater availability estimates. Groundwater conservation districts are now required to meet and decide the desired future conditions of the groundwater resources in their groundwater management areas. The Texas Water Development Board is charged with providing estimates of managed available groundwater to the districts to include in their groundwater management plans and to the regional water planning groups to include in their regional water plans. This process is another awesome challenge for both the groundwater districts and the Texas Water Development Board and is an effort that will require a lot of cooperation, creative thinking, and work. I don't foresee too many dull days for groundwater folks in the future...

In addition to the groundwater management area process, we continue to tackle our other challenges: assisting in the production of the 2007 State Water Plan, measuring thousands of wells, developing models for the minor aquifers, improving existing models, responding to the drought, and providing technical assistance on groundwater resources. The reality is that there are no dull days in the groundwater world in Texas. For that, and for the outstanding people I work with in and outside the office, I am grateful.

I hope you enjoy this year's annual report. As always, you are welcome to contact me or any of our staff with comments, suggestions, or questions.





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groundwater resources division



groundwater monitoring
section

groundwater technical assistance
section

groundwater availability modeling
section

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Groundwater Resources Division — FY2006 Annual Report —



introduction

The mission of the Texas Water Development Board's Groundwater Resources Division is to collect, interpret, and provide accurate, objective information on the groundwater resources of Texas. We accomplish this mission by monitoring the levels and quality of the state's groundwater resources, answering public requests for groundwater information, conducting special studies and writing reports, developing and running groundwater availability models, and providing technical support to groundwater conservation districts and regional water planning groups.

The purpose of this annual report is to document some of the primary accomplishments of the Groundwater Resources Division in fiscal year 2006 (September 1, 2005, to August 31, 2006).

The mission of the Groundwater Resources Division of the Texas Water Development Board is to collect, interpret, and provide accurate, objective information on the groundwater resources of Texas.



organization, purpose, and core duties

The Groundwater Resources Division is divided into three sections: Groundwater Monitoring, Groundwater Availability Modeling, and Groundwater Technical Assistance (Figure 1). At the end of fiscal year 2006, the Division had 27 full-time permanent employees.

The purpose of the **Groundwater Monitoring Section** is to monitor the state of the state's groundwater resources. This information is one of the cornerstones upon which regional and state water planning and groundwater management are built. The section's core duties include measuring water levels, sampling water quality, maintaining the state's water well database, and communicating the results of their work to Texans.

The purpose of the **Groundwater Availability Modeling Section** is to provide technical expertise on groundwater availability in Texas. This expertise, which builds on the data collected by the Groundwater Monitoring Section, is used for regional and state water planning and for assisting groundwater conservation districts in managing groundwater. The section's core duties include obtaining and developing groundwater availability models for the state's major and minor aquifers, running these models or using other tools to help assess groundwater availability, maintaining and updating the models, and communicating the results of their work to Texans.

The purpose of the **Groundwater Technical Assistance Section** is to provide technical information to Texans on the groundwater resources of the state. Using information collected and processed by the other two groundwater sections, this group provides citizens, municipalities, groundwater conservation districts, groundwater management areas, and regional water planning groups with technical assistance on groundwater resources. The core duties of the section include answering groundwater questions from the public, assisting groundwater conservation districts with developing their groundwater management plans, aiding groundwater management areas with developing their desired future conditions, reviewing groundwater management plans for administrative completeness, and providing technical assistance to groundwater conservation districts.

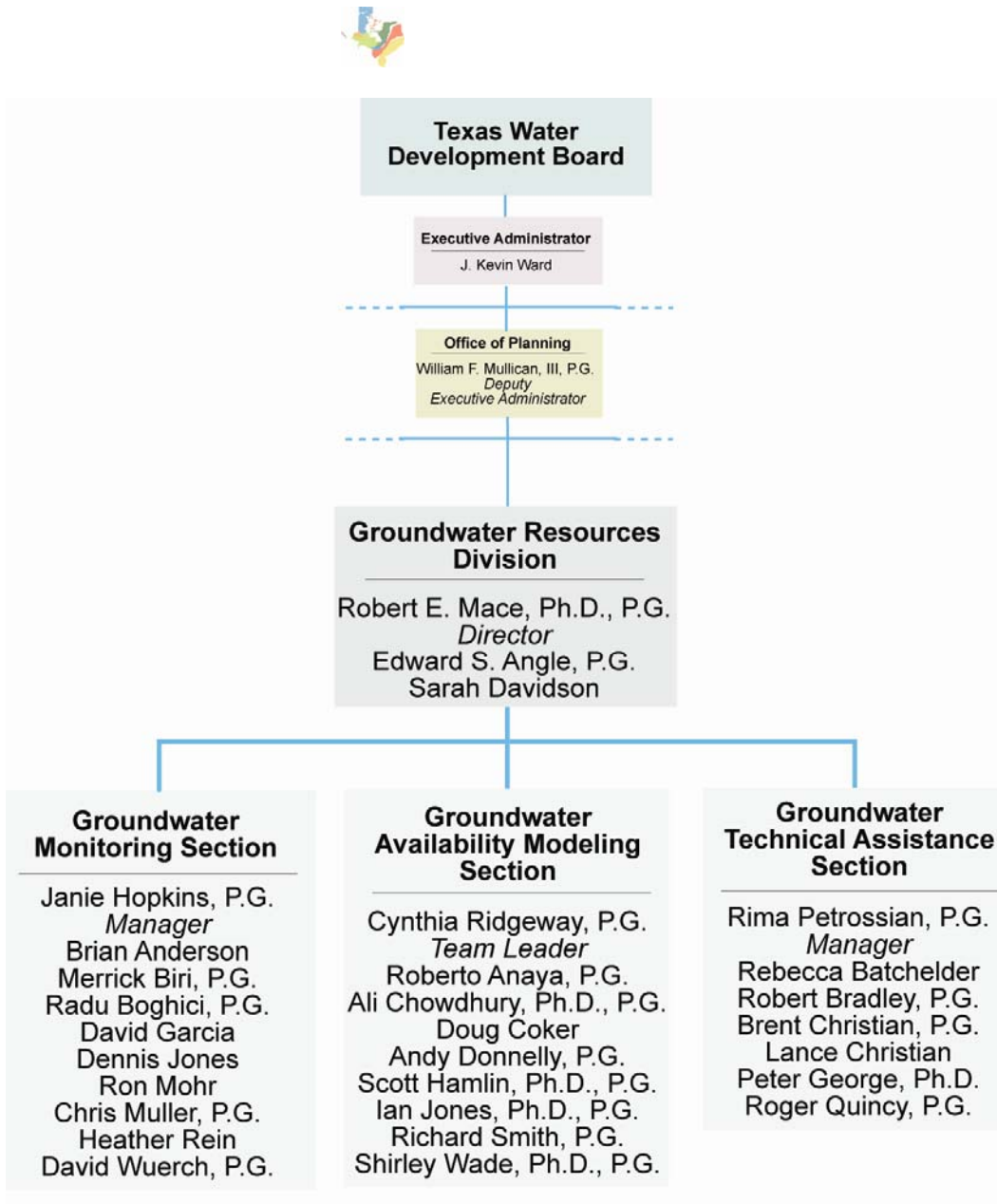


Figure 1. Organization of the Groundwater Resources Division as of August 2006. Since August 2006, Rebecca Batchelder, Lance Christian, and Sarah Davidson have joined the Groundwater Technical Assistance Section.



Staff members from the entire Division represent the agency and the Division on a number of committees, participate in special studies to better understand the groundwater resources of Texas, and communicate results and information on groundwater. The Division communicates with the public by holding conferences, making presentations, and publishing reports, abstracts, and papers. Committee responsibilities and communication activities, as well as major accomplishments of the Division, are summarized below.

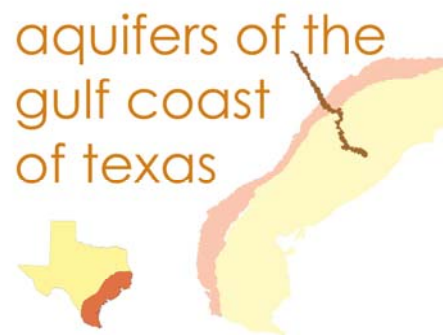
major accomplishments

The Division was busy, as always, with a number of projects during fiscal year 2006. Significant accomplishments and events include (1) the Aquifers of the Gulf Coast of Texas Conference; (2) work on the 2007 State Water Plan; (3) continued publication of *The Aquifer Monitor* e-newsletter; (4) additional work on groundwater availability models for aquifers throughout Texas; (5) continued support for the groundwater management area process; (6) collection of more than 17,000 water levels and chemical analysis of over 700 water samples; (7) operation, maintenance, and funding of more than 70 real-time water level monitoring stations; (8) continued work on the springs of Texas project; and (9) drought monitoring. Read more about each of these major accomplishments below.

aquifers of the gulf coast conference

The Aquifers of the Gulf Coast of Texas Conference—held February 15–17, 2006, at the Harte Research Institute on the Texas A&M University campus in Corpus Christi—was the third in a series of conferences led by the Groundwater Resources Division. The purpose of the conference series is to bring together experts on a diverse range of groundwater science and management issues relevant to each region of the state and to provide a forum to share their expertise with stakeholders in the region in a two-day event. In addition, each speaker contributes a chapter on their topic to a report published by the Texas Water Development Board, which provides a comprehensive view of regional groundwater science and management issues.

The Aquifers of the Gulf Coast Conference consisted of a workshop on groundwater



Report 365

edited by
Robert E. Mace
Sarah C. Davidson
Edward S. Angle and
William F. Mullican, III

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Austin, Texas 78711-3231
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monitoring, one-on-one consultations with groundwater conservation districts, an all-day technical session, and a field trip on coastal geology and its relationship to groundwater in the Corpus Christi area. The technical session included talks by groundwater experts from academia, state and federal agencies, and private firms discussing the aquifers and groundwater-related issues in the region. Topics included the hydrogeology and management of the Gulf Coast, Brazos River Alluvium, and Yegua-Jackson aquifers, as well as regional issues of concern, including drought, land subsidence, water quality, salt domes, groundwater flow to estuaries, effects of oil and gas production on groundwater, and the use of brackish groundwater desalination technologies.

The conference initiated the Texas Water Development Board's online payment option—for the first time, attendees were able to register and pay for the conference on the agency Web site. Division staff worked with staff in the Resource Information Office and the Office of the Chief Financial Officer to set up the system, which the agency is now considering using for other product and event registration purchases.

the aquifer monitor

Keeping people informed can sometimes be a struggle. One measure the Division has developed to address that issue is a monthly e-letter called *The Aquifer Monitor*. First introduced in October 2004, the e-letter is sent out after Board meetings, noting new products and services and advertising

groundwater funding opportunities from TWDB. The response to *The Aquifer Monitor* has been positive, and the distribution list has grown to more than 700 people. Past issues can be found here: <http://www.twdb.state.tx.us/groundwater> and people can sign up to receive the e-letter here:

<http://www.twdb.state.tx.us/GwRD/pages/gwrsubscribe.asp>.

we're still GAMin'

A fundamental question concerning aquifers is: how much groundwater is available for use? The answer to this question affects aquifer water levels, spring flows, stream flows, and the water supply for farms, cities, industries, and the environment. The best tool for estimating groundwater availability is often a





groundwater availability model (GAM). Similar in concept to the models used by meteorologists to predict weather, hydrogeologists develop and use GAMs to predict how aquifers respond to drought and pumping.

The Legislature first approved funding for the GAM program in 1999 and has continued to do so in the ensuing sessions. The GAM program includes

- substantial stakeholder involvement;
- standardized, thoroughly documented, and publicly available numerical groundwater flow models and support data; and
- information and tools for managing the groundwater resources of Texas.

The Texas Water Development Board continued the GAM effort in August 2000 by authorizing the publication of a request for qualifications and subsequently awarding contracts for GAM work on several major aquifers that was completed in early 2003. Because GAMs were recognized as valuable planning tools, Senate Bill 2 (77th Texas Legislature, 2001) mandated that TWDB "shall obtain or develop groundwater availability models for all major and minor aquifers in coordination with groundwater conservation districts and regional water planning groups"(Texas Water Code §16.012).

In April 2002, the Texas Water Development Board initiated the second round of GAM studies (which completed the initial models for the major aquifers and began work on models for the minor aquifers) by authorizing five additional studies. Thus far, the GAM program has developed or obtained 19 models (Figures 2 and 3) at a total cost of \$7,389,879 that incorporate the following major and minor aquifers:

1. Rita Blanca Aquifer and northern part of the Ogallala Aquifer,
2. southern part of the Ogallala Aquifer,
3. Seymour and Blaine aquifers,
4. Woodbine and northern part of the Trinity Aquifer,
5. Hill Country part of the Trinity Aquifer,
6. northern segment of the Edwards (Balcones Fault Zone) Aquifer,
7. Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer,
8. San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer,
9. northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers,



10. central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers,
11. southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers,
12. northern part of the Gulf Coast Aquifer,
13. central part of the Gulf Coast Aquifer,
14. southern part of the Gulf Coast Aquifer,
15. Edwards-Trinity (Plateau) and Pecos Valley aquifers,
16. Mesilla Bolson part of the Hueco-Mesilla Bolsons Aquifer,
17. Hueco Bolson part of the Hueco-Mesilla Bolsons Aquifer
18. Lipan Aquifer,
19. Igneous Aquifer and Wildhorse Flat, Michigan Flat, Ryan Flat, and Lobo Flat parts of the West Texas Bolsons Aquifer.

Before initiating the third phase of contracting GAMs, staff ranked the remaining minor aquifers by considering available data, groundwater use, management efforts by groundwater conservation districts, and any other relevant issues. Staff met in August 2005 with the GAM technical advisory group and advisory committee to discuss the next phase of the GAM program. In response to this meeting and earlier evaluations of the minor aquifers, staff determined the third phase of contracting GAMs would include the following aquifers:

1. Edwards-Trinity (High Plains) Aquifer as a separate layer in the GAM of the southern part of the Ogallala Aquifer,
2. Dockum Aquifer, and
3. Nacatoch Aquifer, and
4. Red Light, Green River, and Eagle Flat parts of the West Texas Bolsons Aquifer.

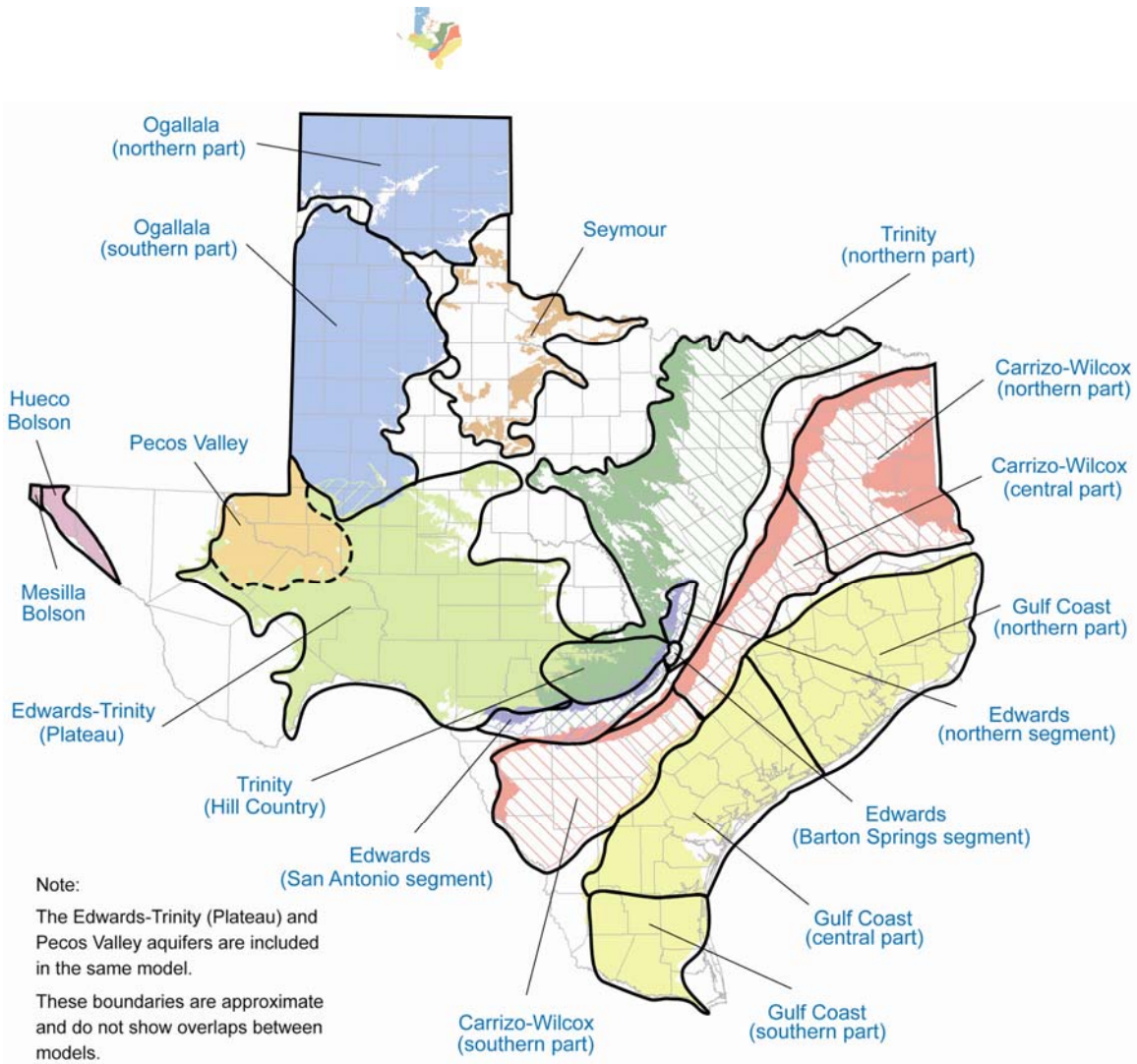


Figure 2. Map showing the general location of groundwater availability models (GAMs) for the major aquifers of Texas as of October 2006.

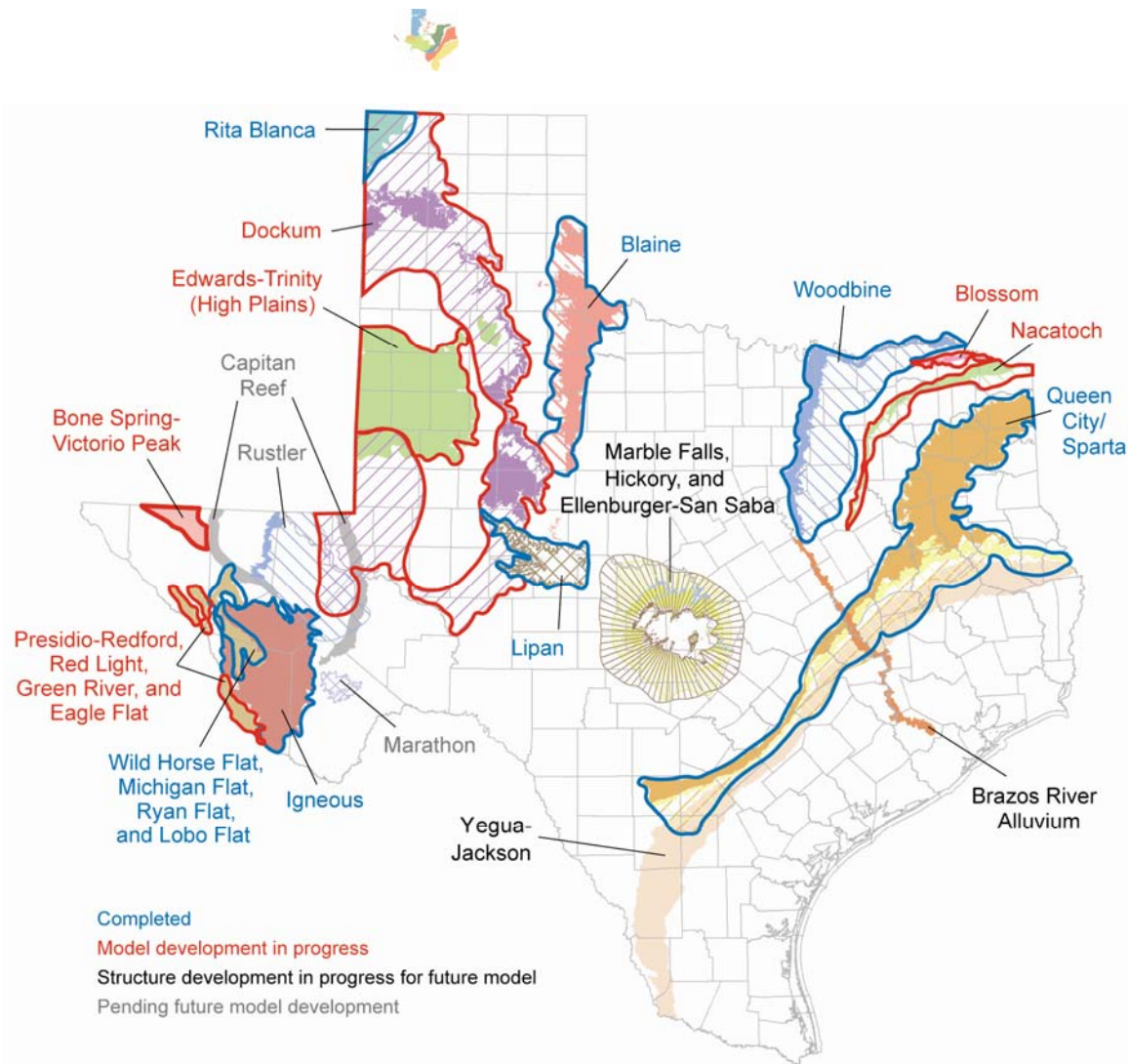


Figure 3. Map showing the general location and status of groundwater availability models (GAMs) for the minor aquifers of Texas as of October 2006.



The Blossom Aquifer and Presidio-Redford Bolsons part of the West Texas Bolsons Aquifer will be modeled by staff. El Paso Water Utilities is also expected to submit a model to TWDB for consideration as the GAM for the Bone Spring-Victorio Peak Aquifer.

This leaves the following minor aquifers yet to be modeled:

1. Ellenburger-San Saba, Hickory, and Marble Falls aquifers (Llano Uplift aquifers),
2. Yegua-Jackson Aquifer,
3. Brazos River Alluvium Aquifer,
4. Marathon Aquifer,
5. Capitan Reef Aquifer, and
6. Rustler Aquifer.

A critical piece of information required for these aquifers before they can be modeled is the geologic structure. The structure describes the top and bottom elevations and lateral extent of the aquifer or subaquifers. In addition to providing necessary information for the GAMs, the elevations are also useful to users who need to know where the aquifer is below the land surface. Structure studies generally involve looking at well and geophysical logs, considering faulting, and then mapping the surfaces in a geographical information system. TWDB initiated one-year contracts in 2006 to develop the structure for the Llano Uplift aquifers and the Yegua-Jackson Aquifer for a total cost of \$300,000. We also negotiated a one-year contract with the U.S. Geological Survey for a total cost of \$160,000—\$90,000 from TWDB and \$70,000 from the U.S. Geological Survey—to develop structure and hydraulic properties for the Brazos River Alluvium Aquifer. This project will complement future work TWDB will be doing with the U.S. Geological Survey, funded by the U.S. Army Corps of Engineers, to study surface-water/groundwater interaction in the lower part of the Brazos River.

Once the initial versions of the GAMs are completed, they become the state's best available "living tools" for groundwater conservation districts, planning groups, and others to use in estimating groundwater availability and predicting future water levels and regional groundwater flow in their aquifers based on different scenarios. We continually review existing GAMs and update them as new information is brought to our attention, aquifer conditions change, or we find necessary improvements.

For example, one area that is experiencing new pumping is the Dallas-Fort Worth area. Groundwater development due to urban growth, recent gas exploration of the Barnett Shale, and recent drought have all led to increased pumping of the Trinity Aquifer in



north central Texas. These groundwater pumping activities have raised concerns with regard to how this increased pumping has and potentially may affect groundwater conditions in the future.

To address some of these concerns, TWDB contracted with R.W. Harden & Associates Inc., Freese & Nichols Inc., and the Bureau of Economic Geology to study the effects of pumping on the Trinity Aquifer in the Dallas-Fort Worth area. The study area includes all or parts of Bosque, Comanche, Cooke, Dallas, Denton, Ellis, Erath, Hamilton, Hill, Hood, Jack, Johnson, Montague, Palo Pinto, Parker, Somervell, Tarrant, and Wise counties. The main objectives of this study are to (1) assess how water levels have changed in response to additional pumping, (2) estimate current and future pumping in these counties, and (3) run the previously constructed groundwater availability model of the northern part of the Trinity Aquifer with this increased pumping to predict possible groundwater conditions in the future. The study began in May 2006 and a summary of the results is expected in January 2007.

As part of the study, TWDB measured water levels in wells of the Trinity Aquifer in part of the study area. This effort will supplement the annual TWDB water level measurement program, which collected 187 measurements in the 18-county study area during fiscal year 2006.

Another major accomplishment in the past year for the GAM program was the development of the GAM geodatabases. In 2006, the GAM program initiated using ArcGIS geodatabases for organizing the data used to develop the GAMs, as well as for providing a tool to automate processing pumpage information. ArcGIS geodatabases



Capitan Reef well at Old Diablo Farms, 1992.

are state-of-the-art graphical information system (GIS) models developed for data management. GAM staff reviewed data received from completed GAMs and designed a relational “Source” geodatabase that not only organizes a wide range of data but also allows all spatially oriented data to be viewed and manipulated both with Microsoft© Access and ESRI© ArcGIS software. In addition, the staff released a “Pumpage” geodatabase



(the “Pumpmatic”) that standardizes the pumpage methodology for the GAM program yet allows for future enhancements. A technical memorandum (06-01) was posted on the GAM Web page that describes the geodatabases in more detail (http://www.twdb.state.tx.us/gam/GAM_documents/GAM_Memo_06-01.pdf).

In addition, between September 1, 2004, and September 1, 2005, staff received 44 requests to run the completed models in order to answer various groundwater-related questions. Since the program started in 2002, GAM staff have received 132 GAM run requests:

- 3 requests in FY2002
- 37 requests in FY2003
- 22 requests in FY2004
- 43 requests in FY2005
- 27 requests in FY 2006

The Bureau of Economic Geology and School of Biological Studies with The University of Texas at Austin and INTERA, Inc. completed their project to assess the state of knowledge on evapotranspiration rates and processes and to determine possible approaches for providing reliable data for the groundwater availability modeling program. A GIS coverage and supporting database were also developed. The work was done as a research contract for the Texas Water Development Board. The final report, "Evapotranspiration estimates with emphasis on groundwater evapotranspiration in Texas," was released in February 2006.

GMA's and house bill 1763

The passage of House Bill 1763 in 2005 requires groundwater conservation districts to do joint planning within groundwater management areas. The presiding officer, or the presiding officer's designee, of each district located in a management area is required to meet at least annually to conduct joint planning with the other districts in the management area. The members are required to review management plans and accomplishments for the management area. In addition, the statute requires members to establish desired future conditions for the pertinent aquifers in the management area. The desired future conditions are due to the Texas Water Development



Water from this former well on the State Capital Grounds was once reputed to have curative powers and was bottled in the late 1800s.



Board no later than September 1, 2010, and at least every five years thereafter. TWDB is responsible for calculating or verifying the managed available groundwater, based on the submitted desired future conditions. TWDB will then provide the managed available groundwater to the individual groundwater conservation districts and the regional water planning groups.

The Groundwater Resources Division supported the joint planning process by attending groundwater management area meetings, giving presentations on the process, answering questions from groundwater conservation districts and the public, and outlining procedures for developing desired future conditions and managed available groundwater. Staff attended 34 meetings in 12 groundwater management areas. In addition, staff gave two presentations on the joint planning process to regional water planning groups.

more than 18,000 measurements

Because water levels and water quality in aquifers respond to pumping and climate, it is important to monitor our aquifers to understand how they are responding to current conditions. This information is useful to anyone who wants to drill a well or needs to know water levels and water quality in the area. Water level and water quality information is also valuable for research studies seeking to better understand how groundwater flows and for GAM development.

Division staff and TWDB cooperators monitored more than 7,400 wells to obtain 18,551 water levels and water quality analyses in fiscal year 2006. The Division added 12,451 measurements of water levels from yearly well visits to our database (Figure 4). Of that total, Division staff collected 2,278 measurements, cooperating groundwater conservation districts collected 6,754, the U.S. Geological Survey contributed 2,564, and various others reported on another 855 (Table 1). In addition, TWDB added 5,387 measurements taken from automatic recorder wells at five-day intervals.



Ron Mohr measuring the water level of a well at Mt Baldy.

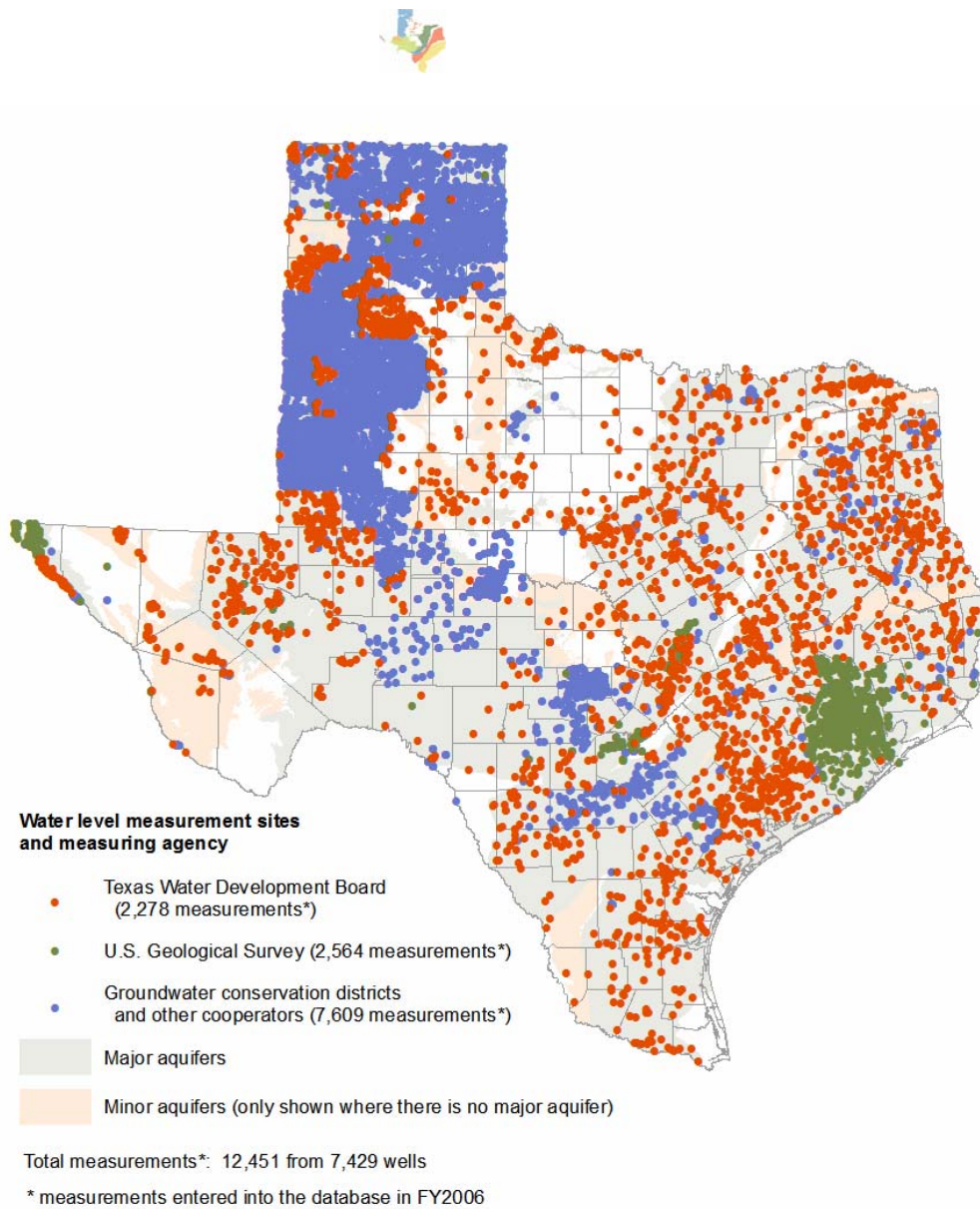


Figure 4. Locations of water levels measured in wells by Division staff and cooperators.



Table 1. Water level measurements made in fiscal year 2006.

<u>Measuring entity</u>	<u>Number of measurements</u>
Groundwater conservation districts	6,754
U.S. Geological Survey.....	2,564
Texas Water Development Board.....	2,278
Other federal agencies.....	392
Municipal/public water supply corporations	226
Registered water well drillers	198
Groundwater Consultants.....	24
Private firm/industry	7
Well owner/operator	7
<u>Other state agencies</u>	<u>1</u>
Total	12,451

The following groundwater conservation districts provided us water level information:

- Bandera County River Authority and Groundwater District
- Barton Springs/Edwards Aquifer Conservation District
- Blanco-Pedernales Groundwater Conservation District
- Clearwater Underground Water Conservation District
- Collingsworth Underground Water Conservation District
- Coke County Underground Water Conservation District
- Edwards Aquifer Authority
- Emerald Water Conservation District
- Evergreen Underground Water Conservation District
- Fort Bend Subsidence District
- Glasscock County Groundwater Conservation District
- Goliad Water Conservation District
- Gonzales County Underground Water Conservation District
- Harris-Galveston Coastal Subsidence District
- Headwaters Groundwater Conservation District
- Hemphill County Underground Water Conservation District
- Hickory Underground Water Conservation District #1
- High Plains Underground Water Conservation District #1
- Hill Country Underground Water Conservation District
- Irion County Underground Water Conservation District
- Kimble County Groundwater Conservation District
- Lipan-Kickapoo Water Conservation District
- Llano Estacado Underground Water Conservation District
- Mesa Underground Water Conservation District
- North Plains Groundwater Conservation District #2
- Panhandle Groundwater Conservation District #3
- Permian Basin Underground Water Conservation District
- Rolling Plains Groundwater Conservation District
- Sandy Land Underground Water Conservation District
- Schleicher County Groundwater Conservation District
- South Plains Underground Water Conservation District
- Sterling County Underground Water Conservation District



TWDB analyzed 713 water samples for water quality in fiscal year 2006 (Figure 5). Division staff collected 576 samples, groundwater conservation districts collected 100 samples, and other cooperators collected 37 samples (Table 2). Staff focused their water-sampling efforts on the Carrizo-Wilcox, Seymour, and Gulf Coast aquifers. Division staff was also involved in sampling for several special studies in cooperation with the Texas Commission on Environmental Quality, the Bureau of Economic Geology, and the Texas Parks and Wildlife Department.

While completing these monitoring tasks around the state, Division staff also collected samples for the Texas Commission on Environmental Quality to use in pesticide analysis. Division staff have participated in this cooperative effort for six years, an activity that continues to save the state money by collecting multiple analyses at one site.

Monitoring staff measured dissolved oxygen and performed additional sampling with portable spectrophotometers in wells completed in the Carrizo-Wilcox and Seymour aquifers. This information will help the Bureau of Economic Geology determine the sources of excess nitrate in the Seymour Aquifer and the processes leading to de-nitrification in parts of the Carrizo-Wilcox Aquifer.

Texas Parks and Wildlife Department staff collected samples for isotopic analysis through our contract with Energy Laboratories Inc. at springs previously visited by TWDB in 2005. The results of these analyses will help TWDB better estimate groundwater recharge rates and the transfer of chemical constituents between the land surface and groundwater.

Monitoring staff also performed additional sampling in two Gulf Coast counties, Goliad and Refugio, to determine the extent of natural contamination by arsenic and radionuclides.

eye in the sky

The Texas Water Development Board operates or helps fund the operation of almost 80 real-time water level monitoring stations across Texas. These stations, or automatic recorder wells, measure water levels in various aquifers and remotely report their measurements to a central location from which the information is posted on a Web page (<http://www.twdb.state.tx.us/data/waterwells/default.asp>) for immediate access. These stations allow Texans to observe the state of their groundwater resources at any time.

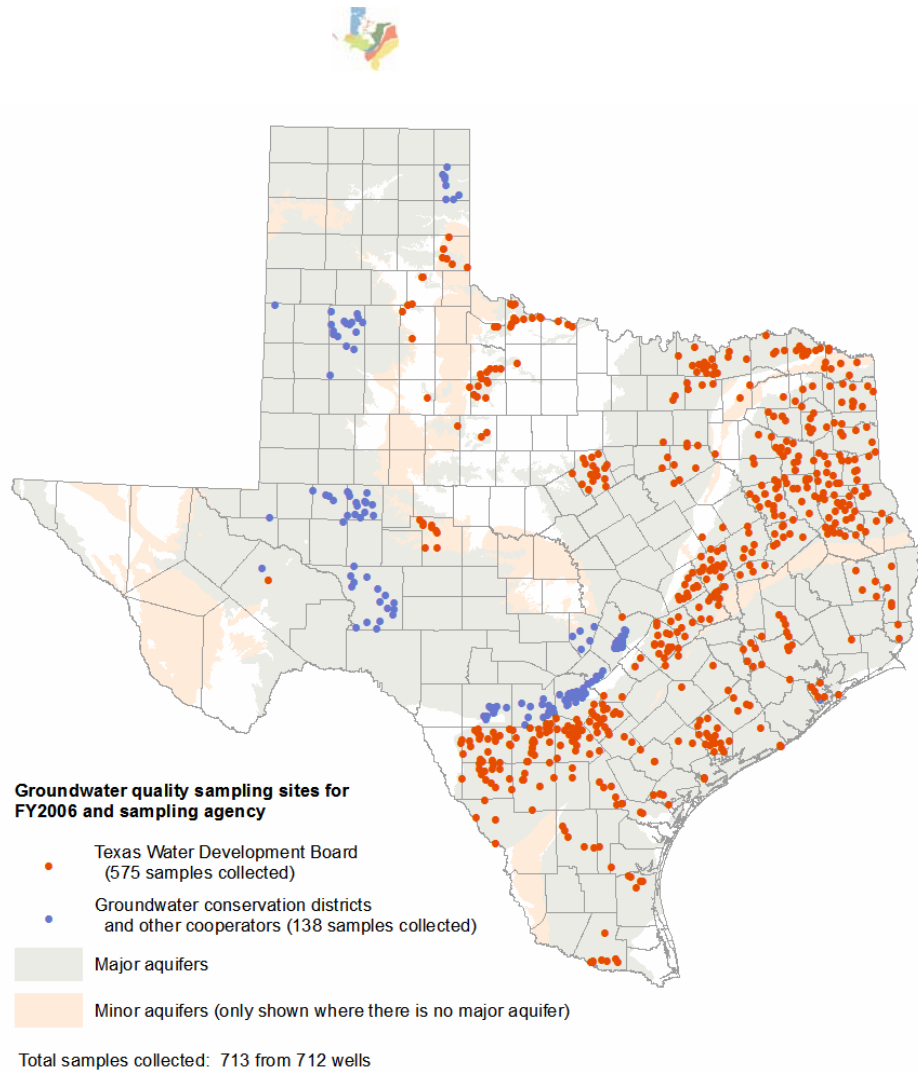
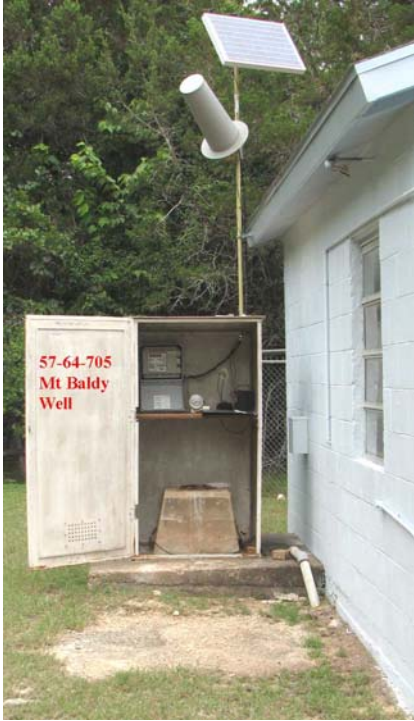


Figure 5. Locations of wells sampled for water quality by Division staff and cooperators. TWDB collects samples from a representative number of wells in each major and minor aquifer over a four-year period.

Table 2. Water quality measurements collected in fiscal year 2006.

<u>Measuring entity</u>	<u>Number of samples</u>
Texas Water Development Board.....	576
Other cooperators.....	37
Edwards Aquifer Authority.....	30
Barton Springs Edwards Aquifer District.....	20
San Antonio Water System.....	20
High Plains UWCD #1.....	17
Hemphill UWCD	8
<u>Blanco-Pedernales GCD.....</u>	<u>5</u>
Total.....	713

UWCD = underground water conservation district
GCD = groundwater conservation district



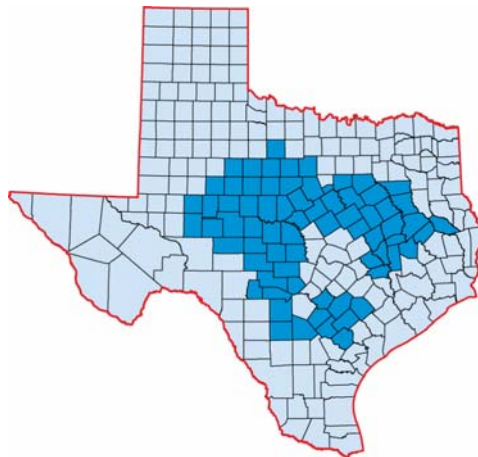
During fiscal year 2006, Texas Water Development Board funding helped support the installation and online posting of data from nine recorder wells operated by the Panhandle Groundwater Conservation District #2. Division staff hopes to expand funding in the future to support records in more groundwater conservation districts. Some of the 35 sites previously operated under a joint funding agreement between the U.S. Geological Survey and TWDB were also taken over as part of the overall total 77. Division staff and the Edwards Aquifer Authority are in the process of continuing to take

over, move, or eliminate the remaining wells previously operated under the agreement.

Another initiative begun in fiscal year 2006 that is continuing into subsequent fiscal years: the replacement of analog cellular modems with transmitters sending water level information via the Geostationary Orbiting Environmental Satellites (GEOS) operated by the National Oceanic and Atmospheric Administration. This information is then downloaded and made available to the public on our Web site. This initiative to upgrade our network to satellite communication is crucial in maintaining the real-time well recorder program as analog cell phone towers become obsolete. During the year we were able to upgrade an additional 29 stations to satellite telemetry.

springs inventory

TWDB and the Ecological Recovery Foundation initiated a two-year contract at the beginning of fiscal year 2005 for the inventory of springs in 71 Texas counties. Former Texas Water Development Board geologist Gunnar Brune, in





TWDB Report 189, *Major and historical springs of Texas* (1975) and *Springs of Texas Volume 1* (1981), published geological, hydrological, archeological, historical, and ecological information on approximately 2,000 springs in the other 183 Texas counties not covered by this current inventory. Federal funds through the U.S. Army Corps of Engineers' Texas Water Assessment Allocation Program will cover the \$110,000 two-year contract amount.

Spring studies help us learn more about the effects of drought, pumping, and other human activity on the water quality and hydrologic flow of our aquifers. To simulate aquifers accurately, groundwater availability models need to include information on the location and flow of springs.

During the next three years, the Ecological Recovery Foundation will be responsible for accomplishing three primary tasks: the identification of at least 1,500 spring locations; a field survey of 400 springs selected by TWDB from among the originally identified 1,500 springs; and a final report that will include a description of the overall project, an explanation of methodologies used to produce the data, and various digitized data and map sets formatted with technology compatible with and transferable to TWDB databases. TWDB plans to put this information into our groundwater water well database available on the Web.

drought in texas

During the fiscal year, drought conditions persisted in the state. Routine tasks for drought monitoring included posting graphics for drought indices, including the Palmer Drought Severity Index, Crop Moisture Index, Standardized Precipitation Index, and reservoir conservation storage capacity. In addition, monthly drought updates were provided on the TWDB's drought Web page (http://www.twdb.state.tx.us/DATA/DROUGHT/drought_toc.asp) and to the Texas Drought Preparedness Council.

Robert Bradley and John Sutton (from the Texas Water Development Board's Conservation Division) are tasked to give briefings at Board meetings on current drought conditions. These drought updates were started in August 2006 and will be ongoing while the current drought persists.

The Texas Water Development Board also signed a contract with Texas A&M University to research and develop drought indices specific for Texas. A final report is expected in January 2007.

public information requests

Division staff often receive questions about water from individuals, private entities, and local, state, and federal agencies.



Our responses can sometimes be handled immediately over the phone, or the information requested can be delivered electronically in a digital format or provided in the form of a map or report through the U.S. Post Office. In fiscal year 2006, staff logged 1,893 inquiries from a variety of individuals and entities.

The Division assisted with these inquiries through Quick Responses, Data Deliveries, or Professional Services. Quick Responses are requests for information that are answered quickly (approximately five minutes or less). Data Deliveries are the deliveries of prepackaged information in the form of maps, digital data, handouts, and publications. Professional Services involve compiling, searching, or analyzing water resource data that is not prepackaged.

In all, the Division had 666 Quick Responses, 169 Data Deliveries, and 1,058 Professional Services. Most requests came by telephone or email. Roger Quincy handled many (1,428) of the requests.

new staff members



Bryan Anderson began working as a Natural Resources Specialist in the Groundwater Resources Division in November 2005. Bryan received a B.S. Degree in Geography from Southwest Texas State University in 2001. He received his Master of Applied Geography—Resource and Environmental Studies in 2006 from Texas State University at San Marcos. His graduate research focused on water quality and regulatory enforcement in the Upper Plum Creek Watershed of Central Texas. Bryan is very interested in water policy and has been known to spend his Friday nights watching C-SPAN. When not engrossed in vigorous policy debates, he enjoys hiking, biking, swimming, and exploring every part of Austin and the Hill Country.



Andy Donnelly joined the Groundwater Availability Modeling Section in October 2005. Andy has been working on importing all of the GAMs into Groundwater Vistas, doing additional QA/QC on all of the model files, writing reference manuals for each of the GAMs, assisting with GAM run requests, and helping groundwater management areas with modeling runs. Andy is originally from upstate New York, and he received his B.S. degree in Geology from Penn State University in 1986 and his Master's degree in Geological Sciences from The University of Texas at Austin in 1988. After graduating, Andy



stayed in Austin, working from 1989 to 1994 as a hydrogeologist for Radian Corporation, focusing primarily on environmental geology, and from 1994 to 2005 at LBG-Guyton Associates, working primarily in groundwater resources and groundwater modeling. When he is not at work, most of his time is spent trying to corral his five-year old daughter and six-year old son or doing fun things like gardening, hiking, and bird watching.



Heather Rein moved to Austin two years ago from Fort Myers, Florida. She received a B.A. degree in Environmental Studies from Florida Gulf Coast University and is currently working on a Master's degree in Environmental Science from the same university. Her

master's thesis is on the effect of late Holocene sea level rise on the morphology of Estero Bay, Florida. She has worked for the Marine Sciences department at Florida Gulf Coast University, the South Florida Water Management District, and the Texas Commission on Environmental Quality here in Austin. When Heather is not at TWDB or working on her thesis, she enjoys competing in triathlons, traveling with friends, playing with her nieces and nephews, and watching Gator football.

staff news



Wedding bells were ringing for the Groundwater Resources Division this year. Robert Mace's long time girlfriend of 19 years, Wendy Weiss, decided she would make him a permanent feature around the house. They were married in a cozy and eclectic wedding at their house in Austin on June 10, 2006.

Ian Jones and his lovely fiancé

Lesa decided to celebrate their wedding vows at the beautiful Barr Mansion in Sprinkle Community, in North Austin on August 5, 2006. The Barr Mansion is a historic landmark that is a





favorite wedding location for in-the-know local Austinites. Staff is very happy for both lucky couples, and we wish them all the best on their new life adventures.

committee responsibilities

The Texas Water Development Board is legislatively required to participate on and with a number of committees. Other committee memberships are not required by law but, because of our related legislatively mandated duties and expertise, we participate. Staff committee responsibilities for the Groundwater Resources Division during fiscal year 2006 were the following:

- Boghici, R, Member, Research Subcommittee, Texas Groundwater Protection Committee (2004–present).
- Boghici, R., Member, Public Outreach Subcommittee, Texas Groundwater Protection Committee (2005–present).
- Bradley, R.G., Chair, Drought Monitoring and Water Supply Committee, Texas Drought Preparedness Council (2000–present).
- Bradley, R.G., Executive Secretary/Administrative Co-Chair, Texas Water Monitoring Council, (2000–present).
- Donnelly, A., Member, Aquifer Science Advisory Panel, Edwards Aquifer Authority (2006–present).
- Hopkins, J., Co-chair, Data Management Subcommittee, Texas Groundwater Protection Committee (2003-present).
- Hopkins, J., Member, Agricultural Chemicals Subcommittee, Texas Groundwater Protection Committee (2000-present).
- Hopkins, J., Chair, Site Selection Task Force, Agricultural Chemicals Subcommittee, Texas Groundwater Protection Committee (2000-present).
- Mace, R.E., Member, Aquifer Sciences Advisory Panel, Edwards Aquifer Authority (2006–present).
- Mace, R.E., Vice Chair, Texas Groundwater Protection Committee (2005–present).
- Mace, R.E., Member, FutureGen Texas Task Force (2005–present).
- Mace, R.E., Member, Jackson School Water Initiative Committee (2005–present).
- Muller, C., TWDB Representative/Chair, Groundwater Focus Group, Texas Water Monitoring Council (2005–present).
- Wade, S.C., TWDB Representative, Saltcedar Biological Control Consortium, Texas/New Mexico/Mexico Section (2005–present).



reports

Reports are an important legacy of the Texas Water Development Board that document and make available information and analysis important to groundwater resources in Texas. Division staff wrote or were involved in the development of six reports during fiscal year 2006:

- Dozier, M.C., Melton, R.H., Hare, M.F., Hopkins, J., and Lesikar, B.J., 2006, Drinking water problems—Nitrate: Texas Cooperative Extension, Publication B-6184, 8 p.
- Lesikar, B.J., Melton, R.H., Hare, M.F., Hopkins, J., and Dozier, M.C., 2005, Drinking Water problems—Arsenic: Texas Cooperative Extension, Publication L-5467, 8 p.
- Lesikar, B.J., Melton, R.H., Hare, M.F., Hopkins, J., and Dozier, M.C., 2005, Drinking water problems—Radionuclides: Texas Cooperative Extension, Publication L-5467, 12 p.
- Mace, R.E., Davidson, S.C., Angle, E.S., and Mullican, W.F., III, editors, 2006, Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, 304 p.
- Mace, R.E., and Wade, S., 2005, The effect of bifurcated permits on spring flow in the San Antonio segment of the Edwards aquifer: Texas Water Development Board Open File Report 05-02, 37 p.
- Mace, R.E., Nicot, J.P., Chowdhury, A.H., Dutton, A.R., and Kalaswad, S., 2005, Please pass the salt—Using oil fields for the disposal of concentrate from desalination plants: Texas Water Development Board Report 366, 198 p.

abstracts and papers

Publishing abstracts and papers is another way staff disseminate information and analysis about Division projects, research, and programs. Abstracts are often associated with conferences. Papers are associated with conferences and professional publications. We published the following 17 abstracts and papers in fiscal year 2006:

- Bradley, R.G., 2006, Dry periods and drought events of the Gulf Coastal region, *in* Mace, R.E., Davidson, S.C., Angle, E.S., and Mullican, W.F., III, editors, Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, p. 149–163.
- Chowdhury, A.H., Bogichi, R., and Hopkins, J., 2006, Hydrochemistry, salinity distribution, and trace constituents—Implications for salinity sources, geochemical evolution, and groundwater flow characterization, Texas Gulf Coast, *in* Mace,



R.E., Davidson, S.C., Angle, E.S., and Mullican, W.F., III, eds., *Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365*, p. 81–128.

- Chowdhury A.H., Uliana, M., and Wade, S., 2006, Chemical and isotope hydrology of the Presidio-Bolson aquifer, West Texas—Recharge and groundwater flow implications: National Ground Water Association, Abstract Book of the 2006 Ground Water Summit, April 22–27, 2006, San Antonio, Texas, p. 87–88.
- Chowdhury A.H., Uliana, M., and Wade, S., 2005, Conceptualization of groundwater flow system using hydrochemistry and isotopic compositions, Presidio County, Texas: Geological Society of America Annual Meeting, Salt Lake City, Utah, Abstracts Volume 37, no. 7, p. 248.
- Chowdhury, A.H., and Turco, M.J., 2006, Geology of the Gulf Coast aquifer, Texas, *in* Mace, R.E., Davidson, S.C., Angle, E.S., and Mullican, W.F., III, editors, *Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365*, p. 23–50.
- Chowdhury, A.H., and Mace, R.E., 2006, Groundwater models of the Gulf Coast of Texas, *in* Mace, R.E., Davidson, S.C., Angle, E.S., and Mullican, W.F., III, editors, *Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365*, p. 173–203.
- Davidson, S.C., and Mace, R.E., 2006, Aquifers of the Gulf Coast of Texas—An overview, *in* Mace, R.E., Davidson, S.C., Angle, E.S., and Mullican, W.F., III, editors, *Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365*, p. 1–21.
- Hamlin, H. S., 2006, Salt domes in the Gulf Coast Aquifer, *in* Mace, R. E., Davidson, S. C., Angle, E. S., and Mullican, W. F., III, editors, *Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365*, p. 217–230.
- Jones, I.C., 2005, Anthropogenic impacts on groundwater quality and hydrology in the Cenozoic Pecos Alluvium aquifer, Texas: Geological Society of America, Abstracts and Programs, v. 37, no. 7, p. 248.
- Mace, R.E., Petrossian, R., Bradley, R., and Mullican, W.F., III, 2006, A streetcar named desired future conditions—The new groundwater availability for Texas: State Bar of Texas, 7th Annual The Changing Face of Water Rights in Texas, May 18–19, 2006, San Antonio, Texas, 23 p.
- Mace, R.E., Marrett, R.A., and Hovorka, S.D., 2005, Fractal scaling of secondary porosity in karstic exposures of the



Edwards aquifer, *in* Beck, B.F., editor, Sinkholes and the engineering and environmental impacts of karst: American Society of Civil Engineers, Geotechnical Special Publication No. 144, p. 178–187.

- Mace, R.E., 2006, Gone with the wind—The history of windmills: 2006 AWBD [Association of Water Board Directors] Annual Conference Notebook, Section III-A, p. 3.
- Mace, R.E., Petrossian, R., and Bradley, R., 2006, A streetcar named desired future conditions—Starting over with groundwater availability in Texas: National Ground Water Association, Abstract Book of the 2006 Ground Water Summit, April 22–27, 2006, San Antonio, Texas, p. 132.
- Mace, R.E., 2006, Groundwater in Texas: Journal of the Association of Water Board Directors—Texas, Winter 2006, p. 30–31.
- Mace, R.E., 2005, Trip summary of “Geology, frontier history, and selected wineries of the Hill Country appellation, Central Texas:” Austin Geological Society Bulletin, v. 1, p. 48–52.
- Mace, R.E., 2005, Water Works—A field guide to American windmills by T. Lindsay Baker: Book review in Water for Texas, v. 15, no. 4, p. 6.
- Nicot, J.P., and Chowdhury, A.H., 2005, Disposal of brackish water concentrate into depleted oil and gas fields—A Texas study: Desalination Journal, v. 181, p. 61–74.

presentations

Division staff are often invited to speak about our projects and programs. We make presentations to local groups, groundwater conservation districts, regional water planning groups, and technical groups. This list does not include presentations we made associated with published abstracts and papers. We made 22 formal presentations in fiscal year 2006:

- Bradley, R.G., “Groundwater management area joint planning and you (Brazos G RWPG).” Presented to the Brazos G Regional Water Planning Group, Waco, Texas, May 3, 2006.
- Bradley, R.G., “Groundwater management area joint planning and you (East Texas RWPG).” Presented to the East Texas Regional Water Planning Group, Nacogdoches, Texas, June 21, 2006.
- Bradley, R.G., “Groundwater management area joint planning and you.” Presented at the Texas Forestry Association Landowners Council Water Symposium, Nacogdoches, Texas, August 11, 2006.



- Bradley, R.G., “Overview of current drought.” Presented at Effective Drought Strategies, Pflugerville, Texas, August 29, 2006.
- Chowdhury, A.H., “Groundwater availability in the Gulf Coast Aquifer.” Presented at the International Boundary and Water Commission Binational Groundwater Summit, Reynosa, Tamaulipas, Mexico, November 17–18, 2005.
- Hopkins, J., “Groundwater Monitoring Programs at the Texas Water Development Board.” Presented at the Aquifers of the Gulf Coast Conference, Corpus Christi, Texas, February 15, 2006.
- Hopkins, J., “All in Good Taste: Water Quality in Texas.” Presented at the National Ground Water Association Ground Water Summit Workshop, San Antonio, Texas, April 27, 2006.
- Jones, I.C., “Groundwater availability modeling.” Presented at the Dockum Groundwater Availability Model Stakeholder Advisory Forum #1, High Plains Underground Water Conservation District #1 headquarters, Lubbock, Texas, July 20, 2006.
- Mace, R.E., “The Trinity to infinity?” Presented at the Wimberley Water Conference, Wimberley, Texas, August 18, 2006.
- Mace, R.E., “Groundwater in Burnet County, Texas.” Presented to the Central Texas Groundwater Conservation District, Burnet, Texas, July 10, 2006.
- Mace, R.E., “A streetcar named desired future conditions—HB 1763 and you.” Presented to the Texas Alliance of Groundwater Districts, Kerrville, Texas, June 29, 2006.
- Mace, R.E., “Groundwater availability in Texas: The past (2002 State Water Plan and before), the present (2006 Regional Water Plans), and the future (joint planning in groundwater management areas).” Presented to the Texas Groundwater Protection Committee, Austin, Texas, April 20, 2006.
- Mace, R.E., “Groundwater in Texas.” Presented to the Association of Water Board Directors, San Antonio, Texas, February 4, 2006.
- Mace, R.E., “The history, culture, and water resources of Iceland.” Presented at the Texas Water Development Board, Austin, Texas, January 26, 2006.
- Mace, R.E., “Groundwater in Texas.” Presented to the Texas Ag Industries Association, 8th Annual Membership Conference, Fort Worth, Texas, January 16, 2006.



- Mace, R.E., “Gone with the wind—The history of pumping water with windmills.” Presented to the U.S. Geological Survey, Austin, Texas, December 15, 2005.
- Mace, R.E., “Gone with the wind—The history of pumping water with windmills.” Presented to the Austin Geological Society, Austin, Texas, November 7, 2005.
- Mace, R.E., “Aquifers in Texas—Wet sands and wetlands.” Presented at the annual meeting of the South Central Chapter of the Society of Wetlands Scientists, Texas State University, San Marcos, Texas, October 7, 2005.
- Mohr, R., “TWDB Water-Level Recorder and Telemetry Program.” Presented at the Aquifers of the Gulf Coast Conference, Corpus Christi, Texas, February 15, 2006.
- Muller, C., “TWDB groundwater monitoring procedures.” Presented at the Aquifers of the Gulf Coast Conference, Corpus Christi, Texas, February 15, 2006.
- Wade, S.C., “Groundwater Availability Model (GAM) for the Presidio-Redford Bolsons.” Presented at the Stakeholders’ Advisory Forum for the Presidio-Redford Bolsons’ Groundwater Availability Model, Presidio, Texas, November 4, 2005.
- Wade, S.C., “Status of Presidio-Redford Bolsons’ Groundwater Availability Model (GAM).” Presented to the Presidio County Underground Water Conservation District Board, Marfa, Texas, March 20, 2006.

resources

- Web page for the TWDB:
<http://www.twdb.state.tx.us/>
- Questions about groundwater:
Roger Quincy, (512) 936-0833, roger.quincy@twdb.state.tx.us
- Groundwater Resources Division Web site:
<http://www.twdb.state.tx.us/groundwater>
- Groundwater availability modeling (GAM) Web page:
<http://www.twdb.state.tx.us/gam/>
- Real-time water level monitoring Web page:
<http://hyper20.twdb.state.tx.us/twdbwells/twdbwells.html>
- Groundwater database:
<http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWDatabaseReports/GWdatabaserpt.htm>
<http://wiid.twdb.state.tx.us/>



- Groundwater reports:
<http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/GWreports.asp>
- Aquifers of Texas:
<http://www.twdb.state.tx.us/publications/reports/GroundWaterReports/GWReports/Individual%20Report%20htm%20files/Report%20345.htm>
- Aquifer maps:
<http://www.twdb.state.tx.us/mapping/index.asp>

contact us

Robert Mace, Director
Groundwater Resources Division
Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711-3231
Telephone: (512) 936-0861
Fax: (512) 936-0889
robert.mace@twdb.state.tx.us