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**ACTIVITIES AND
RECOMMENDATIONS OF THE
TEXAS GROUNDWATER
PROTECTION COMMITTEE**

**REPORT TO THE
80TH LEGISLATURE**

Prepared by the
Texas Groundwater Protection Committee

Activities and Recommendations of the Texas Groundwater Protection Committee: A Report to the 80th Legislature

Prepared by
Texas Groundwater Protection Committee

SFR-047/06
January 2007

TEXAS GROUNDWATER PROTECTION COMMITTEE

www.tgpc.state.tx.us



Committee Membership

***Texas Commission on Environmental Quality
Texas Water Development Board
Railroad Commission of Texas
Department of State Health Services
Texas Department of Agriculture
Texas State Soil and Water Conservation Board
Texas Alliance of Groundwater Districts
Texas Agricultural Experiment Station
Bureau of Economic Geology
Texas Department of Licensing and Regulation***

The Joint Groundwater Monitoring and Contamination Report was designed and produced by the Texas Groundwater Protection Committee in fulfillment of requirements given in Section 26.406 of the Texas Water Code. The effort was partially funded by the U.S. Environmental Protection Agency. While the information contained in the report represents the contribution of each individual participating agency and group, the report as a whole is the work of the committee and does not necessarily reflect all of the views and policies of each participating organization.

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Abbreviations Used

AG Chem	agricultural chemicals
BEG	Bureau of Economic Geology
BMP	best management practices
DSHS	Department of State Health Services
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FY	fiscal year
GAM	groundwater availability model
GCD	groundwater conservation district
GDM	groundwater data management
GIS	geographic information system
HAL	health advisory level
Joint Report	Joint Groundwater Monitoring and Contamination Report
MCL	maximum contaminant level
NPS	nonpoint source
NRCS	U.S. Department of Agriculture's Natural Resource Conservation Service
PCB	polychlorinated biphenyl
PMP	pesticide management plan
PWS	public water supply
RCT	Railroad Commission of Texas
RWPG	regional water planning group
SMP	state management plan
<i>Strategy</i>	<i>Texas Groundwater Protection Strategy-2003</i>
SWCD	soil and water conservation district
TAC	Texas Administrative Code
TAES	Texas Agricultural Experiment Station
TAGD	Texas Alliance of Groundwater Districts
TCE	Texas Cooperative Extension
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDLR	Texas Department of Licensing and Regulation
TGIC	Texas Geographic Information Council
TGPC	Texas Groundwater Protection Committee
THSC	Texas Health and Safety Code
TSSWCB	Texas State Soil and Water Conservation Board
TWC	Texas Water Code
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
UIC	underground injection control
USGS	United States Geological Survey
WR	well report
WWD/PI	water well driller/pump installer

Executive Summary

This report was prepared for submission to the 80th Texas Legislature by the Texas Groundwater Protection Committee (TGPC). The TGPC prepared the report as required by state law [Texas Water Code (TWC) Section 26.405]. The report provides recommendations to improve groundwater protection for Legislative consideration and describes the TGPC's activities for the preceding biennium.

Recommendations to the 80th Texas Legislature

High-quality groundwater resources are of vital importance to the state's economy and the public health and welfare. As required by TWC, 26.045, the TGPC submits the following groundwater protection recommendations for legislative consideration. More detailed information is found later in this report.

While the TGPC's recommendations represent the majority opinion of the membership, they do not necessarily reflect the views and policies of each participating organization. The recommendations are not listed in priority order.

Streamline Permitting Efforts

- **Facilitate Disposal/Use of Desalination Concentrate and Drinking Water Treatment Residuals**—Revise portions of the Texas Water Code and the Texas Health and Safety Code (THSC) to streamline the authorization process by allowing a general permit for disposal of nonhazardous waste (desalination concentrate and drinking water treatment residuals) and removing dual permitting requirements for the injection of these fluids for enhanced oil and gas recovery.
- **Evaluate Characteristics of Concentrate and Residuals to Support Streamlined Permitting**—Provide funding of \$100,000 to compile existing data on the chemical composition of the desalination concentrate in FY (fiscal year) 2008, which could support the general permitting process and \$150,000 to complement and match federal funds currently being used by universities to develop advanced desalination technologies. Priority areas for study would be based on identified need in the State Water Plan.

Strengthen Groundwater Conservation and Water Quality Protection Efforts

- **Fund Brush-Control Projects to Increase Groundwater Yield**—Continue to fund the Texas State Soil and Water Conservation Board (TSSWCB) State Brush Control Program and expand it as funds become available in areas where it is found to be cost effective and will

increase long-term availability of groundwater by increasing recharge of aquifers.

- **Encourage On-Farm Agricultural Best Management Practice Incentives through Creation of a Water Conservation Plan Program**—Create a program to implement certified water-conservation plans on irrigated agricultural lands through the TSSWCB, with cost-share to assist in implementation of on-farm best management practices.
- **Protect Groundwater Quality through Education Programs**—Provide funding for new groundwater education, demonstration, and outreach efforts administered by the Texas Water Resources Institute (TWRI). The efforts would be coordinated with the TGPC and other entities. The cost of the proposal is \$250,000.
- **Establish an Abandoned Water Well-Plugging Fund**—Provide positive incentives for landowner-initiated closure of abandoned and/or deteriorated water wells through the establishment of an abandoned well-plugging fund.
- **Fund the Texas Water Development Board’s Municipal Water Conservation Programs**—Restore the Municipal Water Conservation Program to FY 2004-05 funding levels (approximately \$296,000 annually).
- **Continue to Support the Panhandle AgriPartners Program**—Provide \$100,000 per year to Texas Cooperative Extension for one-on-one education of irrigation farmers through the Panhandle AgriPartners Program.

Advance Groundwater Management and Protection through Enhanced Data Collection and Availability

- **Improve the State’s Groundwater Database**—To ensure the usefulness and accuracy of the groundwater database, provide the TWDB with funding for two additional state employees to inventory public supply wells, review existing information, and provide quality assurance and quality control on any new information entered into the database.
- **Establish Statewide Real-Time Groundwater-Level Monitoring System**—Provide additional funding to expand the groundwater-monitoring network from coverage in 65 counties to coverage in all 254 counties.
- **Provide Data and Resources to Support “Desired Future Conditions”**—Provide the TWDB with the funding necessary to implement House Bill 1763, 79th Legislature.
- **Improve Groundwater Availability Modeling**—Continue funding the TWDB’s groundwater availability modeling program to ensure completion of the models for the state’s minor aquifers and to maintain and improve the completed models as additional information on the

aquifers is collected from the TWDB, groundwater conservation districts, and regional water planning groups.

- **Convert State Well Reports to Electronic Format/Database for Ease of Access**—Provide funding of \$340,000 to convert paper water-well records to an electronic format for ease of public use.

Support Groundwater Research

- **Evaluate Impact of Dryland Agriculture on Groundwater Resources in the Texas High Plains Aquifer**—Provide funding for field studies to broadly assess the impacts of dryland agriculture on groundwater recharge.
- **Study the Impact of Irrigation on Groundwater Resources in the High Plains Aquifer**—Provide funding for studies in the High Plains region to determine whether irrigation return flow has reached the aquifer or if it is still within the unsaturated zone.

TGPC Activities 2005-06

The TGPC implements and coordinates projects and administrative requirements that address eight topical areas:

- Implementation of the objectives found in the Texas Groundwater Protection Strategy[2003] (Strategy);
- Agricultural Chemical Activities;
- Groundwater Data Management Activities;
- Nonpoint Source Pollution Activities;
- Public Outreach and Education Activities;
- Groundwater Research Activities;
- Intergovernmental Cooperation Activities; and
- TGPC Administrative Activities.

Implementation of the Objectives Found in the Texas Groundwater Protection Strategy [2003]

The Legislature charged the TGPC with developing and updating a comprehensive groundwater protection strategy that includes guidelines for the prevention of contamination, the conservation of groundwater, and the coordination of the groundwater protection activities of the agencies and entities represented on the TGPC. In February 2003, the TGPC updated the *Texas Groundwater Protection Strategy*. Over the last biennium, the TGPC has continued to use existing policy and programmatic direction given by the Legislature as the basis for *Strategy* implementation. The *Strategy* also provided recommendations and possible actions that should be taken over the next five to 15 years to enhance protec-

tion of groundwater. Progress in implementing these recommendations is delineated within this report and in Appendix 2.

Agricultural Chemical Activities

At the request of the TCEQ, in 2001, the TGPC developed the Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater (SMP). This generic management plan for the state serves as a guide for the prevention of pesticide contamination of groundwater. Over the biennium, the Agricultural Chemicals Subcommittee of the TGPC has been working on three areas of the SMP: (1) continued cooperative groundwater monitoring; (2) responding to confirmed cases of pesticide contamination of groundwater; and (3) identifying and providing outreach on best management practices in problem areas. These efforts are discussed in the report and more detail is provided on the program in Appendix 3.

Groundwater Data Management Activities

Sound management of groundwater data is fundamental to protecting water quality and ensuring adequate groundwater supplies. The TGPC makes use of the expertise of its members and other experts through the Groundwater Data Management (GDM) Subcommittee to address many of the recommendations found in the Texas *Groundwater Protection Strategy*. The TGPC also uses the GDM Subcommittee to make available information on groundwater contamination and water-quality assessments of the state's aquifers to the public through the publication of two reports mandated by both the state and the federal government. The subcommittee coordinates the compilation of data to be assessed by the TGPC and its member agencies and organizations to satisfy direct or indirect state and federal mandates. These efforts are discussed in the report and more detail is provided in Appendix 4 of the Joint Groundwater Monitoring and Contamination Report.

Nonpoint Source Pollution Activities

The Nonpoint Source (NPS) Task Force of the TGPC facilitates and formalizes the state's groundwater NPS program and supports and guides groundwater NPS management policy. The task force facilitates communication between the TGPC and the state's NPS programs, which addresses both ground and surface water.

Public Outreach and Education Activities

Activities during the biennium centered on two overarching themes: the protection of groundwater from contamination, and the protection of human health from contaminated groundwater or water that contains high levels of naturally occurring compounds that could affect human health. The Public Outreach and

Education (POE) Subcommittee coordinates many of the TGPC's educational outreach initiatives. Educational efforts over the biennium focused on:

- demonstrations of procedures to plug abandoned wells;
- developing and publishing fact sheets in both English and Spanish on arsenic, perchlorate, nitrate, and radionuclide contamination for private well owners;
- outreach to users of the pesticide atrazine in the Panhandle on best management practices to prevent contamination of groundwater;
- developing two fact sheets about on-site wastewater treatment systems for homeowners; and
- updating the TGPC web site with new information on groundwater protection.

Groundwater Research Activities

The TGPC identifies interagency research needs and provides a forum for a coordinated approach for discussion about funding with federal agencies through the Groundwater Research (GR) Subcommittee. During the biennium, the subcommittee developed a template for project-specific white papers and identified a number of research topics.

Intergovernmental Cooperation Activities

The TGPC and its subcommittees undertake intergovernmental efforts to fill gaps in service delivery and information exchange. These include: (1) notifying private well owners of groundwater contamination; (2) coordination with regional water planning groups; and (3) coordination with federal agencies.

TGPC Administrative Activities

The TGPC carries out numerous administrative duties required by state law, such as developing this biennial report to the Texas Legislature, holding required quarterly meetings, and ensuring that documents are maintained in a manner that makes them easily accessible to the public. In addition, the TGPC and its subcommittees are subject to the state's open-meeting laws. Periodically, state laws are enacted that require the committee to undertake rulemaking and the TGPC completed its rules review and readoption this biennium. Much of the TGPC's work is performed in quarterly meetings and through the efforts of its subcommittees.

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Recommendations to the 80th Texas Legislature

State law (TWC §26.405) requires the TGPC to develop legislative recommendations. Fifteen groundwater protection recommendations are presented for legislative consideration. The recommendations request legislative streamline of certain permitting efforts and requests additional funding in three topical areas: strengthen groundwater conservation and water quality protection efforts, advance groundwater management and protection through enhanced data collection and availability, and support of groundwater research. Some of these recommendations can be found in the Legislative Appropriation Requests of the individual TGPC member agencies.

While the TGPC's recommendations represent the majority opinion of the membership, they do not necessarily reflect the views and policies of each participating organization. Recommendations are outlined below and are not listed in priority order. A detailed discussion follows.

- **Streamline Permitting Efforts**
 - Facilitate Disposal/Use of Desalination Concentrate and Drinking Water Treatment Residuals
 - Evaluate Characteristics of Concentrate and Residuals to Support Streamlined Permitting
- **Strengthen Groundwater Conservation and Water Quality Protection Efforts**
 - Fund Brush Control Projects to Increase Groundwater Yield
 - Encourage On-Farm Agricultural Best Management Practice Incentives through Creation of a Water Conservation Plan Program
 - Protect Groundwater Quality Through Education Programs
 - Establish an Abandoned Water Well-Plugging Fund
 - Fund TWDB Municipal Water Conservation Programs
 - Continue to Support the Panhandle AgriPartners Program
- **Advance Groundwater Management and Protection through Enhanced Data Collection and Availability**
 - Improve the State's Groundwater Database
 - Establish Statewide Real-Time Groundwater Level Monitoring System
 - Provide Data and Resources to Support "Desired Future Conditions"
 - Improve Groundwater Availability Modeling

- Convert State Well Reports to Electronic Format/Database for Ease of Access
- **Support Groundwater Research**
 - Evaluate Impact of Dryland Agriculture on Groundwater Resources in the Texas High Plains Aquifer
 - Study the Impact of Irrigation on Groundwater Resources in the High Plains Aquifer

Streamline Permitting Efforts

Facilitate Disposal/Use of Desalination Concentrate and Drinking Water Treatment Residuals

Issue. Several statutory impediments exist to the use of certain types of underground injection wells for the use or disposal of desalination concentrate and drinking water treatment residuals resulting from the production of drinking water supplies. There is a need to streamline the authorization process used in the state either to permit underground injection for the disposal of these nonhazardous wastes or to facilitate their use in enhanced oil recovery. Streamlining the approval process should result in reduced cost to both applicants and the state.

Recommendation. Revise portions of the Texas Water Code (TWC) and the Texas Health and Safety Code (THSC) to streamline the authorization process by allowing a general permit for disposal of nonhazardous waste (desalination concentrate and drinking water treatment residuals) and removing dual-permitting requirements for the injection of these fluids for enhanced oil recovery (EOR).

Currently THSC 361.086 requires a separate permit for each solid waste facility. Therefore, an individual permit would be required for each Class I well (injection wells which are used for the injection of hazardous waste below usable quality groundwater) injecting desalination concentrate or drinking water treatment residuals that are nonhazardous waste. Modifying this section of the THSC to allow for the development of a general permit for such wells could expedite the processing of authorizations for wells used for the disposal of the concentrate or treatment residuals resulting from the production of drinking water supplies.

Class II wells are injection wells, which are used for the injection of fluid for EOR or for the disposal of waste resulting from oil and gas exploration and production. Class II wells are permitted by the Railroad Commission (RCT). However, TWC 27.0511(g) requires a permit from the Texas Commission on Environmental Quality (TCEQ) if industrial or municipal waste is used as an injection fluid for EOR. Water of varying quality is commonly used for EOR. Desalination concentrate from the production of

drinking water supplies would provide an alternative to using other fluids, such as fresh water, for EOR. Under TWC 27.0511(d), if the RCT finds that there is a “solid, liquid or gaseous substance other than fresh water available and economically and technically feasible for use” in EOR, the RCT must include as a condition of any permit a requirement that the permittee use that substance for the EOR. Removing the requirement to obtain both a RCT and a TCEQ permit for this activity would facilitate the use of this fluid for EOR and provide a mechanism for addressing the management of desalination concentrate and drinking water treatment residuals, which are not hazardous.

Background. The Governor’s Desalination Initiative and the U.S. Environmental Protection Agency’s (EPA’s) new drinking water standards have created the need to address the management of concentrate resulting from the desalination of saline and brackish water sources and the management of residuals from the treatment of drinking water to meet the EPA drinking water standards. The desalination of saline and brackish water to produce drinking water generates concentrated brine. Treatment of drinking water sources to meet the state’s drinking water standards, which reflect EPA’s drinking water standards, also produces a residual, which must be managed.

The use of injection wells under the Underground Injection Control (UIC) Program is an option for addressing the concentrate from desalination and drinking water treatment residuals. Jurisdiction for the permitting of UIC wells, which could be used for injection of the concentrate and drinking water treatment residuals, is under the TCEQ and the RCT. Class I wells are under the jurisdiction of the TCEQ and Class II wells are under the jurisdiction of the RCT.

Evaluate Characteristics of Concentrate Resulting from Desalination and Drinking Water Treatment to Support Streamlined Permitting

Issue. New regulations present challenges arising from the management of concentrates generated by: (1) treatment of saline waters for public consumption; and (2) treatments resulting from new drinking water standards. The chemical characteristics of the concentrates generated from desalination and other treatment depends on the original concentration in the source water, the degree of concentration that the treatment process provides, any chemicals added during pretreatment of the source water, and cleaning of the treatment membranes.

To appropriately use or dispose of the concentrates, there is a need to know both the chemical constituents, and concentration levels, present in the concentrate. This research will provide information that will be useful in determining the appropriate dis-

posal method(s), such as streamlined general permits for underground injection, and identification of possible disposal problems, such as negative interactions between the concentrate and the targeted injection zone.

Recommendation. Provide funding of \$100,000 to compile existing data on the chemical composition of the desalination concentrate in FY 2008, which could support the general permitting process and \$150,000 to complement and match federal funds currently being used by universities to develop advanced desalination technologies. Priority areas for study would be based on identified need in the State Water Plan. This item has not been identified as an exceptional item request by any of the members of the Texas Groundwater Protection Committee (TGPC).

Background. There are many existing and ongoing studies of desalination or other treatment methods to meet drinking water standards. Once compiled, information on the composition of the treatment by-product waste contained in these studies and contained in existing permits can be used to support the streamlining efforts for disposal permitting. Ongoing long term collaborative research by the University of Texas-Austin and Texas A&M University system to develop information on the chemical constituents and levels contained in brackish/saline water concentrates and drinking water treatment residuals bench testing should be prioritized by identified need in the Texas State Water Plan. This will be accomplished by collecting samples of concentrate and residuals from bench-scale or pilot-scale treatment of water and analyzing them for relevant parameters. The results will then be modeled to determine comparability and compatibility with target injection formations that will typically be used for EOR or disposal.

Strengthen Groundwater Conservation and Water Quality Protection Efforts

Fund Brush-Control Projects to Increase Groundwater Yield

Issue. The U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) estimates that brush in Texas uses approximately 10 million acre-feet (over 3 trillion gallons) of water annually. Control of brush offers a cost-effective means for significantly increasing the availability of both ground and surface water for the growing needs of Texans.

Recommendation. Continue to fund the Texas State Soil and Water Conservation Board (TSSWCB) State Brush Control Program and to expand it as funds become available in areas

where it is found to be cost effective and will increase long-term availability of groundwater by increasing recharge of aquifers.

The TSSWCB is requesting approximately \$3.3 million in its base funding for FY 2008-09 for brush control. Included in TSSWCB legislative request are exceptional items totaling approximately \$24.9 million for additional brush control activities. The requested funding would be for financial and technical assistance for brush control projects.

Background. In 1985, the Legislature, created the Texas Brush Control Program. The goal of this program is to enhance the state's water resources through selective control of brush species. The TSSWCB is designated as the agency responsible for administering the program and is given authority to delegate responsibility for administering certain portions of the program to local soil and water conservation districts (SWCDs).

In 1986, the TSSWCB prepared and adopted a State Brush Control Plan. The plan includes a comprehensive strategy for managing brush in areas where brush is contributing to a substantial water conservation problem and designates areas of critical need in the state in which to implement the brush control program. It was last revised in January 2005.

The Agriculture Code also requires that the TSSWCB submit a report on the activities of the brush control program to the Governor, the Speaker of the House, and the Lieutenant Governor before January 31 of each year. The Agricultural Code created a cost share program for brush control, created the Brush Control Fund, limits the cost share rate to 70% of the total cost of a practice, limits the cost share program to critical areas designated by the TSSWCB, and limits methods of brush control approved by the TSSWCB. It also establishes criteria for approving applications, setting priorities, and contracting for cost sharing.

The North Concho watershed brush control project began in 1999 and is nearing completion. Other brush control projects include Twin Buttes, Pecos River/Upper Colorado River, Lake Ballinger, Oak Creek Lake, Lake Champion, Canadian River, Hubbard Creek Lake, and Pedernales watersheds. Approximately \$18,000,000 is needed to complete these projects.

TSSWCB conducted feasibility studies on these and other watersheds to estimate the probable water yield and cost of the water resulting from a brush control project. These feasibility studies include extensive hydrologic and economic modeling. Over the next 10 years, a substantial investment would be required to complete the brush control for water yield as recommended in the completed feasibility studies. See Table 1 on page 6.

Table 1. Watersheds and Cost from the Feasibility Studies

Watershed	Total Cost	(\$) Average Cost (\$/ac-ft)
Lake Brownwood	\$ 49,948,000	37.95
Fort Phantom Hill Reservoir	10,189,000	29.45
Lake Arrowhead	17,546,000	14.83
Palo Pinto Reservoir	14,332,000	24.09
Frio River Basin	65,368,000	36.95
Nueces River Basin	250,311,000	46.62
Wichita River Basin	43,395,000	36.59
Canadian River Basin	77,845,000	111.37
<i>Edwards Aquifer watersheds:</i>		
• Hondo watershed	2,176,000	29.92
• Medina watershed	10,658,000	26.68
• Sabinal watershed	5,714,000	42.04
• Seco Creek watershed	1,665,000	35.33
• Upper Frio watershed	8,387,000	51.65
• Upper Nueces watershed	85,889,000	97.51

Encourage On-Farm Agricultural Best Management Practice Incentives through Creation of a Water Conservation Plan Program

Issue. In the Draft 2007 State Water Plan, it is reported that in 2000, over 10 million acre-feet of water was used for irrigation. Municipal water usage was reported to be approximately 4 million acre-feet in 2000. However, municipal water usage is expected to double by 2060. Increasing the efficiency of irrigation water usage while maintaining the current level of irrigated land will help ensure the availability of water for Texas' growing population.

Recommendation. Create a program to implement certified water-conservation plans on irrigated agricultural lands through the TSSWCB, with cost-share to assist in implementation of on-farm best management practices (BMPs). These plans would be similar to the TSSWCB water-quality management plans but would require BMPs that have a water conservation component. Cost estimates of a water conservation plan program range from \$100,000 per biennium for implementing 10 water conservation plans per biennium using existing staff to \$2.5 million per biennium for implementing 200 plans, which would require funding for an additional technical employee in each TSSWCB regional office in irrigated areas.

Background. A water conservation plan would be an integrated management plan that comprises a collection of BMPs that are appropriate to the individual agricultural operation. The plan is developed by the farmer or rancher in cooperation with a planner or technician with TSSWCB, SWCD, or NRCS. If it meets all

technical criteria, it is then certified by TSSWCB. The practices that have a cost to implement may be eligible for cost-share assistance. To be eligible for cost-share assistance, the farmer or rancher would have to agree to implement and maintain the plan for the expected life of the practices. After an eligible practice is implemented and implementation is certified by the SWCD, the producer may receive cost-share assistance for that practice. A plan must clearly demonstrate water savings for it to be certified by TSSWCB or to be eligible for cost-share assistance. These plans would be developed and implemented through existing TSSWCB regional offices and SWCD's that currently work with farmers to implement water-quality management plans and administer the TSSWCB water-quality cost-share program. TSSWCB regional offices working in areas with significant irrigation agriculture are located in Hale Center, Harlingen, Wharton, and Dublin.

Costs are estimates based on TSSWCB's experience with the water quality management plan program. There is a wide variety in the number of plans that can be developed, depending on the complexity of the plan, the size of the operation, the number of BMPs, and the type of irrigation systems that are involved. The cost-share per plan can also vary widely for the same reasons.

Implementing a state water conservation plan program will allow the most effective use of cost-share funds and attract federal funds through partnerships with the U.S. Department of Agriculture's NRCS and the EPA in those areas where program goals coincide.

Protect Groundwater Quality through Education Programs

Issue. To best protect groundwater quality, a variety of education programs are needed to transmit information to the public. These programs will provide resources for water resources managers and agency personnel to demonstrate use of innovative technologies and management strategies.

Recommendation. Provide funding for new groundwater education, demonstration, and outreach efforts administered by the TWRI. The efforts would be coordinated with the TGPC and other entities. The cost of the proposal is \$250,000.

Background. Several groundwater education programs are already in place, led both by Texas Cooperative Extension (TCE) and several other agencies and entities. Some of the broad topics addressed by these education programs include the following:

- Protection of drinking water wells;
- Ways to ensure that wellheads are not contaminated;
- Proper selection, use, and management of on-site wastewater treatment systems;

- Actions agricultural producers can take to reduce pesticide use and limit the risk of degrading groundwater quality;
- Give demonstrations that show how to plug abandoned wells and how individuals can take groundwater quality samples.

These educational programs need continued financial support to achieve long-term results. In addition, new efforts needed to address issues include:

- Preparing individuals and groundwater suppliers to deal with threats to water quality;
- Explaining the economic benefits of protecting groundwater quality;
- Encouraging stakeholders to participate in discussions about current groundwater quality and quantity issues and help identify future water needs;
- Identifying new and emerging technologies that have a significant potential to treat and remove groundwater contaminants;
- Providing urban/suburban/rural fringe education:
 - New urban/suburban homeowners/landowners and pesticide/herbicide and fertilizer application;
 - New suburban/rural landowners and their groundwater wells and on-site wastewater treatment systems;
 - New suburban/rural landowners and Groundwater Conservation Districts (GCDs);
 - New rural landowners and oil/gas wells (plugging, conversion into water wells, and groundwater wells supporting oil/gas wells).

Establish an Abandoned Water Well–Plugging Fund

Issue. Numerous state and local programs have identified abandoned and/or deteriorated water wells as having a significant, or potentially significant, negative impact on the quality of groundwater in the state. Abandoned water wells not only serve as conduits or channels for contamination to reach groundwater, but large diameter wells can also be a hazard to human and animal life. Financial resources are not currently available to provide assistance to landowners, groundwater conservation districts, or local governments to plug abandoned wells.

Recommendation. Provide positive incentives for landowner-initiated closure of abandoned and/or deteriorated water wells through the establishment of an abandoned well–plugging fund.

Fund disbursement would be contingent upon prioritization of potential groundwater quality impacts, hazards, and the landowner’s assets. Further, the plugging fund program should be administered by the Texas Department of Licensing and Regulation (TDLR), the agency currently responsible for the oversight of

water well drillers, well drilling and well plugging. TDLR would work cooperatively with local GCD to disburse monies for the plugging of abandoned and/or deteriorated water wells located within GCD jurisdiction. Furthermore, the funds would be disbursed on a regional geographic model based on the areas of selection for member appointment to the Water Well Driller Advisory Council. Because of the number of abandoned wells and the ability to “scale” the program, a cost estimate cannot be provided and has not been submitted by any member agency in a Legislative Appropriation Request.

Background. Abandoned and deteriorated water wells remain at the top of the list of potential groundwater contamination sources, which landowners can identify and eliminate. Uncapped, non-cemented, deteriorated, or uncased wells provide a direct path to groundwater from activities at the surface. Deteriorated wells completed in more than one water-bearing zone may allow poorer-quality water from one zone to commingle with and impact the other(s). Abandoned domestic, municipal, industrial, irrigation, and livestock wells, and unplugged test-holes pose threats to groundwater quality. Abandoned water wells exist in every county of the state and impact all of the State’s aquifers.

The Abandoned Well Notification and Enforcement Program, administered by the TDLR utilizing the Water Well Driller/Pump Installer Program, investigates, compiles, identifies, and processes abandoned water well notifications and enforcement cases. Groundwater quality degradation, due in part to abandoned water wells, has also been documented by GCDs, the Bureau of Economic Geology (BEG), TWDB studies, and the TCEQ’s Source Water Assessment and Protection Program. Furthermore, Senate Bill 279 of the 78th Legislature (TDLR’s Sunset Bill) enhanced the investigatory procedures and referrals of documented abandoned and/or deteriorated wells. A Memorandum of Understanding has been developed to coordinate the efforts of the TDLR, groundwater conservation districts, and the field offices of the TCEQ relating to investigative procedures for referrals of complaints regarding abandoned and/or deteriorated wells.

The exact number of water wells in the state is unknown. However—based on TWDB records and the TDLR/TWDB Online Well Report Submission and Retrieval System—since 1965 (the initial date when well reports were required to be submitted to the state) and through FY 2006, a total of 669,233 State of Texas Well Reports (for water wells drilled) have been submitted (which is not 100% of the wells drilled since 1965). In addition to that amount, it is conservatively estimated that there are 150,000 abandoned and/or deteriorated water wells in Texas.

Texas Occupations Code §1901, “Water Well Drillers,” requires landowners or other persons who possess an abandoned and/or deteriorated well to have the well plugged or capped under stan-

dards and procedures adopted by the TDLR (16 Texas Administrative Code (TAC) § 76.1004). Texas Occupations Code §1901 also authorizes the TDLR to assess administrative and civil penalties against persons who do not comply with the provisions of the chapter. However, these provisions represent a financial burden and provide little incentive for owners of abandoned wells to voluntarily plug abandoned wells. In addition, consideration should be given to the origin of groundwater contamination in the water well to be plugged, if present.

Educational efforts, such as the TGPC's *Landowner's Guide to Plugging Abandoned Water Wells* and the associated video, may initiate some abandoned well plugging. However, a funding source to assist landowners with abandoned well plugging efforts would result in an increase in the number of wells plugged and thus decrease the threats to groundwater quality.

Well-plugging costs to landowners (well owners) could range from approximately \$100 to in excess of \$120,000 per well. Cost is based on well depth, size of casing, and complexity of properly plugging the well in compliance with 16 TAC §76 water well-plugging specifications.

The abandoned well-plugging fund could be a pilot project whereby TDLR, in conjunction with GCDs, would prioritize the abandoned and/or deteriorated water wells with regard to the potential of impacts to groundwater quality and/or human health. Fund disbursement would be contingent upon this prioritization and the landowner's assets.

The development of the plugging fund would provide criteria for the landowner or person possessing the abandoned and/or deteriorated water well who does not have sufficient assets to plug the well. When making application for abandoned water well-plugging fund disbursement, the applicant would be required to submit a signed and notarized affidavit stating that they are financially incapable of plugging the well.

The development of the plugging fund would also provide for a disbursement ceiling approved by the TDLR executive director. Requests for amounts above the set ceiling would require Texas Commission of Licensing and Regulation approval.

Fund TWDB's Municipal Water Conservation Programs

Issue. For the FY 2006-07 biennium, the TWDB did not receive any General Revenue appropriations for its Municipal Water Conservation Program.

Recommendation. Restore the Municipal Water Conservation Program to FY 2004-05 funding levels (approximately \$296,000 annually). Support for the TWDB's Exceptional Item Appropriation request of General Revenue funding for the FY 2008-09 bi-

ennium will help ensure that municipalities and other water suppliers have resources available to help them design and implement programs to conserve water.

Background. The most significant municipal water conservation assistance is provided to small utilities, many of whom depend on groundwater for their water supply, who want to implement water conservation practices but do not have the local resources to provide these services by themselves. Water conservation strategies are often the most cost-effective means of providing additional water supplies and may delay the need to develop more costly additional water supplies. TWDB municipal water conservation program activities include review of water conservation plans required from TWDB loan applicants; technical assistance to entities requesting assistance on conservation activities; surveys and technical assistance for water loss audits; water conservation education programs; water conservation literature distribution; and assistance on water conservation strategies in the Regional Water Plans.

TWDB's FY 2006-07 Legislative Appropriations Request (LAR) for municipal conservation was for \$296,000 annually from General Revenue. However, the FY 2006-07 Appropriations Act zeroed out the General Revenue funding for TWDB's Water Conservation Strategy. To satisfy several statutory and Board rule requirements for municipal water conservation activities, in September 2005 the TWDB approved using funds from other programs to fund a revised reduced municipal water conservation program. Current funding for the TWDB Municipal Water Conservation program is not sustainable, and either General Revenue or some alternative source of funding will be needed to sustain this program in FY 2008-09.

Continue to Support the Panhandle AgriPartners Program

Issue. Water levels in the Ogallala Aquifer are declining. The ongoing Ogallala Aquifer research funded by the US Department of Agriculture along with the TWDB funded demonstration project are generating much needed information on water conservation in the Texas High Plains. However, one-on-one education and assistance to irrigation farmers are needed to deliver this information directly to the producers on their farms to successfully address water conservation.

Recommendation. Provide \$100,000 per year to Texas Cooperative Extension (TCE) for one-on-one education of irrigation farmers through the Panhandle AgriPartners Program.

Background. The Panhandle AgriPartners Program was initiated in 1998 as a means of providing technical support to university research, extension, and industry applied research and demonstration activities.

The mission of AgriPartners is to (1) provide up-to-date information on water use, crop development and growth, and pest status to farmers and consultants to assist in making decisions regarding agricultural operations, (2) conduct irrigation and cropping demonstrations on cooperators' farms to demonstrate and test improved farming and irrigation practices, genetics, new technologies, and (3) provide accurate and current databases for developing and calibrating crop, water use, pest, and economic models and other agriculture modeling and prediction efforts.

Farm Demonstration Assistants are available to take samples, gather data, conduct surveys and perform routine activities associated with demonstrations, surveys, and applied research projects. These on-site farm-based projects serve as building blocks to advance initiatives in water conservation, improved production agriculture, and other programs.

Cooperative ongoing research currently funded by the states of Texas and Kansas and the federal government, is developing technology and science designed to enhance water use efficiency and promote aquifer sustainability. This scientifically sound data is being provided to water users, planners and policymakers in order to develop effective water management policies that balance the economic, environmental, and social concerns for the Ogallala Aquifer.

Concurrently, Texas Tech University in cooperation with TCE, the High Plains Underground Water Conservation District, and agricultural producers in Floyd and Hale Counties are working to verify and demonstrate environmentally sustainable and economically feasible integrated production systems that will ensure the continued viability of agricultural activities in the Texas High Plains. This demonstration effort is funded by the TWDB and is expected to continue through 2013. The integrated agricultural systems identified through these research and demonstration efforts are expected to conserve water and extend the useful life of the Ogallala Aquifer; reduce soil erosion; improve air and water quality, wildlife habitat and recreational opportunities; increase carbon sequestration and opportunities for trading carbon credits; promote soil fertility and soil microbial activity; and enhance individual and community well-being.

Panhandle AgriPartners provides a direct link to producers for disseminating improved technology developed through research and demonstration, like the two projects mentioned above.

Advance Groundwater Management and Protection through Enhanced Data Collection and Availability

To ensure the best management of the state's groundwater supply, local and regional planning groups must develop approaches and management methodologies based on high-quality groundwater data; real-time groundwater data; information developed from the completion of groundwater availability models for all of the state's minor aquifers; and sound, defensible determinations of desired future conditions and calculations of managed available groundwater. Existing data need to be captured into a user friendly database.

Improve the State's Groundwater Database

Issue. The statewide groundwater database operated by the TWDB needs more information, particularly on public supply wells, and more accurate information in the database.

Recommendation. To ensure the usefulness and accuracy of the groundwater database, provide the TWDB with funding for two additional state employees to inventory public supply wells, review existing information, and provide quality assurance and quality control on any new information entered into the database. The TWDB's FY 2008-09 LAR to fund these two positions is \$210,000.

Background. Decisions on groundwater management—including decisions on desired future conditions and managed available groundwater—depend on having reliable and complete information on groundwater wells. This information is widely used by the TGPC member agencies and organizations, local entities, and the public.

The TWDB's groundwater well database—which includes about 20 million pieces of information on 132,000 wells—has been invaluable in supporting groundwater management and water planning decisions. However, the quality and completeness of the state's water well database has suffered due to a reduction in staff.

The TWDB's database only has information (some of which is inaccurate) on 12,000 out of 19,000 wells used for public water supply. Therefore, the TWDB needs one employee to inventory these wells and any new wells that are drilled. One additional employee is needed to assure the quality of the database by reviewing existing information and any new information being entered into the database.

Establish Statewide Real-Time Groundwater-Level Monitoring System

Issue. Texans need real-time water-level information to manage their groundwater resources. Such information helps regional water planning groups (RWPGs), water suppliers develop drought management plans, and individual well owners understand current conditions within an aquifer. Real-time water-level information is used by groundwater conservation districts and interested citizens to monitor the day-to-day changes in water levels in the aquifer. For example, real-time water levels are measured in the Edwards Aquifer to determine different drought stages in the aquifer.

Real-time water-level information is obtained by equipping a well with automated water-level measuring equipment and a transmitter to send information to a central location for posting on the internet. The state's current real-time monitoring network has 82 monitoring stations in 64 counties. However, the current network is inadequate for assessing all of the state's groundwater resources.

Forty-eight predominantly single-county groundwater conservation districts and 97 counties with no districts currently do not have the necessary resources to monitor groundwater levels and host online, real-time water-level information.

Recommendation. Provide additional funding to expand the groundwater-monitoring network from coverage in 65 counties to coverage in all 254 counties. This expansion will help achieve parity in the geographic distribution of all real-time monitoring sites and provide all counties with at least one real-time recorder to complete the network. The TWDB's FY 2008-09 LAR to fund the recorder program is \$1,151,722.

Background. The TWDB has operated recorders throughout the state for several decades. In the past ten years, it has become more important to make the collection of recorder data automatic, through the installation of dataloggers and water-level measuring devices, and to make these data available more quickly. The Legislature's passage of Senate Bill 1 funded TWDB efforts to launch a real-time recorder program and publish water levels online. The agency continues to operate and enhance this program through upgrading its sites to satellite telemetry. Other groundwater conservation districts and universities also are publishing their real-time data on the TWDB web site. The continued development and maintenance of this program will allow for the purchase, installation, and maintenance of recorders in all areas of Texas and the dissemination of this information to the public in "real time."

Provide Data and Resources to Support “Desired Future Conditions”

Issue. House Bill 1763 enacted by the 79th Legislature in 2005 requires GCDs to determine the “desired future conditions” of their groundwater resources and the TWDB to provide estimates of managed available groundwater to the districts and the regional water planning groups (RWPGs). People with defined interests in groundwater can petition the TWDB if they believe that the “desired future conditions” determined by groundwater conservation districts are not reasonable. When House Bill 1763 enacted by the 79th Legislature was being considered, the TWDB submitted a fiscal note, approved by the Legislative Budget Board, included additional employees to implement the bill. House Bill 1763 was approved toward the end of the session and there was insufficient time to consider appropriations for the fiscal note.

Recommendation. Provide the TWDB with the funding necessary to implement House Bill 1763. The TWDB requests four employees to implement the program. Three geologists would provide technical assistance to the districts to help them identify defensible future conditions and to run groundwater availability models. One attorney would assist with legal issues associated with groundwater management areas, including petitions against “desired future conditions” determinations. The TWDB’s FY 2008-09 LAR to fund support for groundwater management areas is \$412,489.

Background. With House Bill 1763, the 79th Legislature greatly expanded the role of groundwater management areas in managing the groundwater resources of Texas. Groundwater conservation districts in each of the sixteen groundwater management areas now are required to meet to decide the “desired future conditions” of their groundwater resources. The “desired future conditions” then are used to calculate the “managed available groundwater,” which is the amount of groundwater available for permitting and the amount of groundwater available to meet future demands in regional water planning.

The process of deciding “desired future conditions,” calculating “managed available groundwater,” and responding to petitions against desired future conditions requires considerable technical and legal support, especially if the state desires defensible numbers.

Improve Groundwater Availability Modeling

Issue. Groundwater availability models provide valuable information to the citizens of Texas as they consider the adequacy of groundwater supplies over a 50-year planning period. The TWDB initiated the development of groundwater availability

models with funding provided in the 76th Legislature for planning that began under Senate Bill 1, 75th Legislature. Currently, TWDB has completed initial models for all the major aquifers, but not for all of the minor aquifers. In addition, enhancement and refinement of existing models is ongoing.

Recommendation. Continue funding the TWDB's groundwater availability modeling program to ensure completion of the models for the state's minor aquifers and to maintain and improve the completed models as additional information on the aquifers is collected from the TWDB, groundwater conservation districts, and regional water planning groups. The TWDB's FY 2008-09 Legislative Appropriation Request to fund the groundwater availability modeling program is \$1,740,000.

Background. The 77th Legislature enacted Senate Bill 2, which amended TWC §16.012 to require that the executive administrator of the TWDB "...obtain or develop groundwater availability models for major and minor aquifers in coordination with groundwater conservation districts and regional water planning groups." The groundwater availability modeling program has been expected to (1) include substantial stakeholder input; (2) produce standardized, thoroughly documented, and publicly available numerical groundwater flow models; (3) be capable of providing predictions of groundwater availability for a 50-year planning horizon; and (4) update and improve the models.

Continued funding is necessary to complete efforts to develop initial models for the minor aquifers and to continue to improve existing models. Existing models be improved by refining aquifer characteristics, such as hydraulic parameters, surface-groundwater interactions, recharge, pumping characteristics, evapotranspiration, and boundary conditions. This information, some of which will come from groundwater conservation districts and regional water planning groups, will be used to update the groundwater availability models.

Convert State Well Reports to Electronic Format/Database for Ease of Access

Issue. There are an estimated 800,000+ well reports in paper format maintained at the TCEQ, which are not easily accessible. These well reports are widely used by TGPC member agencies and organizations, and the public to support environmental regulatory activities and research programs.

Recommendation. Provide funding of \$340,000 to convert paper water well records to an electronic format for ease of public use. This project would: (1) capture and convert 800,000+ water well documents in hard copy format to a digitized format; and (2) develop and maintain a web-access database for use by the pub-

lic and stakeholder agencies; and, (3) create a backup medium for storage and record preservation.

Background. A state well report (WR) is a record of the drilling, including the rock strata encountered, construction and completion of a water well, monitoring well, dewatering well, and certain types of injection wells. State law and TDLR rules specify the form and content of the report. Well drillers are required to prepare and submit the report to the TDLR and the TCEQ. The reports provide valuable information on geology and occurrence of groundwater throughout the state and on the location, construction and use of water wells. The information in these reports is used in assessments of: groundwater occurrence and usability; groundwater geology for contamination and facility investigations; and, water use. The reports are essential to the work of the TWDB, the TDLR, and the TCEQ, and are widely used by the BEG, groundwater conservation districts, universities, water well drillers, environmental consultants and landowners.

Currently, well reports are maintained in three of the above-mentioned agencies both electronically and in hard copy formats. The TWDB maintains information on approximately 130,000 located water wells in digital format. TDLR maintains a database of recent electronically submitted report forms numbering several thousand. There are an estimated 800,000 original, filed well reports housed at the TCEQ, their final repository.

TCEQ regulatory programs require the development of site-specific groundwater data for different types of waste management permits, wastewater discharge permits, and contamination site remediation reports, which are heavily used by TCEQ's regulated community. TDLR uses the WRs in their regulation of licensed well drillers and pump installers. TWDB use the WRs as basic data to model groundwater systems and develop information on water availability. Other agencies also utilize the data on special projects. WRs are heavily used by GCDs to understand groundwater movement and availability for their well use permitting functions. HB 3030, 78th Regular Session, (TWC §26.408) requires notices to private well owners and groundwater conservation districts of groundwater contamination. These WR files can be useful in determining occurrence and use of groundwater, and the more recent files can be utilized to identify well owners for notice purposes.

Converting available paper well report information into electronic format will improve accessibility and provide for needed records preservation. The incorporation of the information in a web-accessible database similar to the database and web interface maintained by TWDB for their inventory of wells would provide access to the information for all agency uses, most groundwater districts, consultants, and the public. Web-based access would save agency staff and storage costs.

TCEQ, TDLR and TWDB are the three agencies that could cooperate on the project. The TCEQ, as the ultimate repository, would be responsible for the electronic scanning and data management portion of this project. TCEQ, TDLR and TWDB would coordinate on quality assurance of the data entry, ensuring that the information is complete and accurate. Backup media would be generated and stored off site to ensure protection in accordance with TCEQ's vital records and disaster recovery program. Funding at the level of \$340,000 would allow for a pilot project for record scanning and database design and the scanning of high priority well records. This item has not been identified in the LARs or as an exceptional item request by any of the agency members of the TGPC.

Support Groundwater Research

Evaluate Impact of Dryland Agriculture on Groundwater Resources in the Texas High Plains Aquifer

Issue. Large-scale groundwater-level rises have been recorded in some areas of the High Plains aquifer. For example, groundwater levels have risen by an average of 20 ft over a 1,300-mi² area near Dawson County. Recent studies indicate that increased recharge in this area is related to conversion of rangeland to dryland agriculture. However, the mechanism or the controls on the increased recharge are not well understood. Increased recharge may be related to winter fallowing in dryland agriculture, to modification of the land surface associated with tillage, or to the shorter crop-growing season. Currently 44% of the southern High Plains is rangeland; therefore, there is potential for further expansion of dryland agriculture; however, potential degradation from wind and water erosion would need to be considered. The Conservation Reserve Program also results in cropland being taken out of production that may return to cropland. The impact of past and projected future land use changes on water resources requires fundamental information on how dryland agriculture impacts water resources, including mechanisms and controls of recharge variations related to cultivation.

Recommendation. Provide funding for field studies to broadly assess the impacts of dryland agriculture on groundwater recharge.

Evapotranspiration (ET) should be monitored using various approaches, including satellite and ground-based point measurements to evaluate differences in ET between rangeland and dryland areas. These measurements would test the hypothesis of whether winter fallowing or shorter summer growing season lengths are possible explanations for increased recharge in dryland areas. Drilling and sampling should be conducted in areas of different soil textures and varying agricultural management

practices, such as conventional versus conservation tillage or different crop rotations, to determine how these factors impact recharge. The results of these studies will provide critical information for linking agricultural land management and its impacts on subsurface groundwater resources and would allow quantification of land use change impacts on groundwater resources. The total cost is \$500,000 over two years.

Background. Recent studies that evaluated groundwater level trends in the Texas High Plains aquifer revealed some large areas, particularly in the vicinity of Dawson county, where groundwater levels had risen by an average of 20 ft in the last few decades. Unsaturated zone studies indicated that the most likely cause of increased recharge was related to land use change and increased recharge correlated with areas of dryland agriculture. However, the studies did not address the actual causes of increased recharge, such as reduced ET during fallow periods, effect of tilling etc., on groundwater recharge. Controls on increased recharge were also not examined in these previous studies. Expanding the previous studies to address mechanisms and controls on recharge related to agriculture through field studies and numerical modeling would provide the necessary information to water resource managers to assess impacts of past and projected future land use changes on groundwater resources.

Study the Impact of Irrigation on Groundwater Resources in the High Plains Aquifer

Issue. Irrigation is the primary consumer of groundwater in the High Plains in Texas. Excess water applied to crops results in drainage of water below the root zone (irrigation return water) that ultimately recharges the underlying aquifer. Limited recent studies by the U.S. Geological Survey (USGS) and the BEG in the Texas High Plains indicate that irrigation return water is still within the unsaturated zone at the three sites tested and has not reached the underlying Ogallala Aquifer. The regional applicability of these results needs to be evaluated. Understanding the location of irrigation return flow and whether it has reached the aquifer or how long it will take to reach the aquifer will have important impacts on future groundwater resources.

Recommendation. Provide funding for studies in the High Plains region to determine whether irrigation return flow has reached the aquifer or if it is still within the unsaturated zone.

If irrigation return flow is still within the unsaturated zone, the timing of when it would reach the saturated zone can be determined from the field studies. Measurements need to be conducted over a broad spectrum of soil and geologic settings and in different types of irrigation practices (furrow irrigated, converted furrow to pivot, and newer pivot systems). Numerical modeling analyses should also be conducted to estimate timing

of irrigation return flow to the aquifer and impacts on water quantity. Characterization of solutes in the soil water that can be mobilized by irrigation return flow will also provide information on the potential negative impacts of irrigation water on groundwater quality in the High Plains, particularly with respect to nitrate. Total cost is \$600,000 over three years.

Background. Recent drilling and sampling studies conducted by the USGS National Water Quality Assessment Program and by the BEG indicated that irrigation return flow is within the unsaturated zone and has not reached the underlying aquifer. Travel velocities of irrigation return flow from these studies ranged from 0.3 to 1 ft per year. These studies were restricted to three sites, and it is important to determine whether these results apply to the regional aquifer, to assess the status of irrigation return flow on a regional scale, and project potential impacts of recharge of irrigation return flow on groundwater levels and water resources.

About the TGPC

Groundwater is vital to the future of Texas. In 2003, Texans used about 16 million acre-feet of water, of which 9.3 million acre-feet was groundwater,¹ or 57 percent of all water used. Approximately 79 percent of groundwater is used for irrigation, with the remainder used for municipal, rural and domestic consumption, livestock, electric utility, and industry. In 2003, approximately 36 percent of municipal water in Texas was obtained from groundwater sources.

Major and minor aquifers underlie approximately 76 percent of the state's 266,807 square mile surface area. Major aquifers are defined as producing large quantities of water in a comparatively large area of the state, whereas minor aquifers produce significant quantities of water within smaller geographic areas or small quantities in large geographic areas. Minor aquifers are important because they may constitute the only significant source of water in some regions. The TWDB has delineated nine major aquifers and 21 minor aquifers. Current maps of the aquifers are available on the TWDB's web site at < www.twdb.state.tx.us/mapping/index.asp > .

In some areas of the state, "undifferentiated" local aquifers may represent the only source of groundwater where major or minor aquifers are absent. These local aquifers vary in extent from being very small to encompassing several hundred square miles.

Because of the importance of groundwater resources in the state, the Legislature created the Texas Groundwater Protection Committee (TGPC) in 1989 to bridge gaps and improve coordination among existing state water and waste regulatory programs. State law [Texas Water Code (TWC), 26.401-26.407] established the TGPC and outlined its powers, duties, and responsibilities.

Creation and Mandate

The Legislature established a policy of nondegradation of the state's groundwater resources as the goal for all state programs. The state's groundwater protection policy recognizes:

- the variability of the state's aquifers in their potential for beneficial use and susceptibility to contamination;
- the value of protecting and maintaining present and potentially usable groundwater supplies;
- the need for keeping present and potential groundwater supplies reasonably free of contaminants for the protection of the environment and public health and welfare; and

¹An acre-foot is 325,851 gallons and would cover one acre a foot deep.

- the importance of existing and potential uses of groundwater supplies to the economic health of the state.

The state's groundwater protection policy provides that discharges of pollutants, disposal of wastes, and other regulated activities be conducted in a manner that will maintain current uses and not impair potential future uses of groundwater or pose a public health hazard. The use of best professional judgment by the responsible state agencies in attaining the goal and policy is also recognized.

The TGPC implements this policy by identifying opportunities to improve existing groundwater quality programs and promote coordination among agencies. The TGPC identifies areas where new or existing programs can be enhanced to provide additional protection. The major responsibilities of the TGPC are:

- improve coordination among member agencies and organizations' groundwater protection activities;
- develop, implement, and update a comprehensive groundwater protection strategy for the state;
- study and recommend to the Legislature groundwater protection programs for each area in which groundwater is not protected by current regulation;
- file with the Governor, Lieutenant Governor, and Speaker of the House of Representatives a biennial report of the TGPC's activities and any recommendations for legislation for groundwater protection;
- publish an annual groundwater monitoring and contamination report describing the current monitoring programs of each member agency and the status of groundwater contamination cases documented or under enforcement during the calendar year; and
- advise the Texas Commission on Environmental Quality on the development of plans for the protection and enhancement of groundwater quality pursuant to federal statute, regulation, or policy, including management plans for the prevention of water pollution by agriculture chemicals and agents.

TGPC Member Programs

State law designated the Texas Commission on Environmental Quality (TCEQ) as the lead agency, with the Executive Director designated as the TGPC's chairman. The Executive Administrator of the Texas Water Development Board (TWDB) is designated as the TGPC's vice chairman. Members of the TGPC are:

- Executive Director of the Texas Commission on Environmental Quality;
- Executive Administrator of the Texas Water Development Board;
- Executive Director of the Railroad Commission of Texas;

- Commissioner of Health of the Department of State Health Services;
- Deputy Commissioner of the Texas Department of Agriculture;
- Executive Director of the Texas State Soil and Water Conservation Board;
- Representative selected by the Texas Alliance of Groundwater Districts;
- Director of the Texas Agricultural Experiment Station;
- The Director of the Bureau of Economic Geology of the University of Texas at Austin; and
- Representative of the Water Well Drillers and Water Well Pump Installers program at the Texas Department of Licensing and Regulation

All members may designate a representative to the TGPC. The current members and their designated representative are listed in Appendix 1.

The TCEQ, through the administration of the majority of the state's environmental and water quality regulatory programs, is primarily responsible for protecting groundwater quality. In addition, groundwater quality regulatory programs exist at: the Railroad Commission of Texas (oil and gas production and surface mining); the Texas Department of Agriculture (pesticide use); the Department of State Health Services (water resource protection); the Texas State Soil and Water Conservation Board (agricultural and silvicultural nonpoint source (NPS) pollution); and the Texas Department of Licensing and Regulation (water well construction).

The TWDB collects and maintains water resource information; conducts statewide water planning; and administers financial assistance programs for water supply, water quality, flood control, and agricultural water conservation projects. The Texas Alliance of Groundwater Districts (TAGD), as a non-governmental organization, has no regulatory or enforcement authority. However, groundwater conservation districts (GCDs) that participate in TAGD have authority over groundwater use and contamination. The Texas Agricultural Experiment Station (TAES) and the Bureau of Economic Geology (BEG) conduct research activities related to groundwater protection.

Texas Commission on Environmental Quality. The Texas Commission on Environmental Quality (TCEQ) has the responsibility for the majority of the state's environmental and water quality regulatory programs. The TCEQ conducts a variety of programs that address groundwater protection and focus on both prevention of contamination and remediation of existing problems. The TCEQ implements these programs through education, voluntary action assistance, permitting, and enforcement.

As the state lead agency for water quality and environmental protection, the TCEQ administers both state and federally mandated programs. Federal programs include:

- the Resource Conservation and Recovery Act for the management of municipal and industrial wastes;
- the Comprehensive Environmental Response, Compensation, and Liability Act or Superfund environmental cleanup program;
- the Clean Water Act for managing pollutant releases to state waters;
- the Safe Drinking Water Act for the protection of public drinking water supplies; and
- the development of pesticide management plans for the protection of groundwater under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

The TCEQ has responsibilities and authorities under state law provided in the TWC and the Texas Health and Safety Code for a number of programs addressing water resource management, waste management, and environmental protection.

The TCEQ is headed by a three-member commission and organized into major functional program areas. The Office of Permitting, Registration, and Remediation is responsible for permitting facility operations that include provisions to prevent groundwater impacts, for remediation and corrective action to address groundwater contamination, and for providing support to the TGPC. The Office of Compliance and Enforcement is responsible for assuring that regulated entities comply with permits and agency rules including provisions related to groundwater quality protection through a network of agency regional offices, facility inspections, enforcement proceedings, professional licensing, and implementation of the Edwards Aquifer Protection Program. The Chief Engineer's Office is responsible for developing and implementing plans for achieving clean water. Programs throughout the TCEQ provide outreach and technical assistance to specific stakeholders and regulated communities. The TCEQ also has outreach programs designed to help small businesses and local governments.

Texas Water Development Board. The Texas Water Development Board (TWDB), created in 1957, is the state agency responsible for collection and maintenance of water resource information; statewide water planning; and administration of financial assistance programs for water supply, water quality, flood control, and agricultural water conservation projects. The TWDB is responsible for the development of the state water plan to provide for the orderly development, management, and conservation of the state's water resources. TWDB provides support to regional water planning groups (RWPG) for the development

of regional water plans that are used to prepare the state water plan.

The TWDB, in support of its water planning and data collection responsibilities, conducts an active groundwater resource assessment program. The TWDB conducts studies to assess the state's aquifers, including occurrence, availability, quality, and quantity of groundwater present. It also identifies major groundwater-using entities and current and projected demands on groundwater resources. The TWDB conducts statewide groundwater level measuring and groundwater quality sampling programs as a part of its assessment effort. The groundwater quality-sampling program permits the TWDB to: (1) monitor changes, if any, in the ambient quality of groundwater over time, and (2) establish the baseline quality of groundwater occurring naturally in the state's aquifers.

As a significant part of the water planning process, the TWDB supports the development of groundwater availability models (GAM), which are state-of-the-art, publicly available numerical groundwater flow models. GAMs provide information on groundwater availability in Texas to ensure adequacy of supplies or recognition of inadequacy of supplies throughout the state water plan's 50-year planning horizon. The TWDB has completed 17 models covering all nine of the state's major aquifers as of October 2004, and is now working on models for the 21 minor aquifers as well as updating existing models to include new aquifer and water use information.

Railroad Commission of Texas. The Railroad Commission of Texas (RCT) regulatory authority includes oil and gas exploration and production, surface mining and mine reclamation, and pipelines. Oil and gas related environmental regulations under the RCT include well drilling and completion; well plugging; surface storage, treatment, and disposal of oil and gas wastes; oil spill response; management of hazardous oil and gas wastes; disposal of non hazardous oil and gas wastes by injection; underground injection of fluids for enhanced recovery of hydrocarbons; underground hydrocarbon storage; solution mining of brine; and remediation associated with the aforementioned activities. The RCT also offers technical guidance through its oil and gas waste minimization program. Environmental activities related to surface mining include surface coal and uranium mine operations, and mine land abandonment. Pipeline regulations primarily are safety regulations, although the routes of new pipelines are reviewed for environmental risk.

Permits to drill oil, gas, and related wells are issued only after the applicant has submitted a letter from the TCEQ that provides information on the depth of usable quality groundwater. The information is used to ensure that the well is constructed and cemented in a manner that protects groundwater. Similarly, the

information is used to ensure that plugs are set to isolate and protect groundwater during plugging operations. Knowledge of the presence of shallow groundwater and the recharge areas of aquifers is vital to the regulation of surface storage and disposal of oil and gas wastes. Underground injection including hydrocarbon storage, and brine mining, are primarily groundwater protection regulations federally delegated under the Safe Drinking Water Act. The RCT requires remediation of sites contaminated by oil and gas exploration, production, disposal, and pipeline operations to prevent groundwater contamination or to mitigate groundwater contamination. Remediation projects include operator-initiated cleanup and state-funded cleanup, if no responsible party exists. Oil spills must be reported, managed and remediated in accordance with state regulations.

The Site Remediation Section of the RCT is responsible for the state funded cleanup of abandoned oil field pollution sites (State-Funded Cleanup Program) and the oversight and monitoring of complex pollution cleanups conducted by responsible operators (Operator Cleanup Program). In addition, the Site Remediation Section administers a Voluntary Cleanup Program, which is an incentive program for remediation of contaminated property under the RCT's jurisdiction by persons not responsible for the contamination. The goal of these programs is to control or cleanup oil and gas waste or other materials that are causing or likely to cause the pollution of surface or subsurface water, to ensure human health and safety and to protect the environment.

A groundwater impact assessment is performed as part of the surface mining permitting process. Permits contain plans to protect the groundwater resources in the area of the permit. Groundwater may be removed during the mining activities; however, if those activities adversely impact a currently used groundwater resource, then the impacts must be mitigated. Abandoned mines are closed to protect natural resources and the public.

Texas Department of Agriculture. The Texas Department of Agriculture (TDA) has lead authority for pesticide regulation in Texas. The TDA recognizes certain pesticides as potential groundwater contaminants and has a primary responsibility in preventing unreasonable risk to human health and the environment from the use of pesticides. The agency conducts a variety of activities designed to reduce the potential of groundwater contamination by pesticides:

- All pesticide products sold and used in Texas must be registered with the TDA. This process ensures these products have met all U.S. Environmental Protection Agency (EPA) requirements for use.
- The agency has responsibility and authority under the Texas Agricultural Code to enforce pesticide labels, which include directions and

precautions that directly or indirectly reduce the potential of groundwater contamination.

- All prospective users of restricted-use or state-limited-use pesticides are required to obtain an applicator's license. This process includes training in the proper and legal use of pesticides, applicator testing, and continuing education.
- The TDA maintains a program to assess the potential impacts of agricultural chemicals on human health and the environment, including groundwater quality.
- The TDA serves as chair of the State Management Plan (SMP) Task Force, under the authority of the TGPC. Staff participates on several interagency subcommittees and task forces charged with conducting various aspects of the State's generic SMP. The Pesticide Division also directs other pesticide-related water quality issues.

These activities are conducted to ensure compliance with federal and state laws and regulations relating to the use of pesticides and the protection of groundwater resources. In addition, the TDA also provides support and assistance in state environmental projects where agricultural pesticides use and regulation are of concern.

The TDA does not routinely conduct groundwater monitoring for pesticides. The agency relies on monitoring data generated by the TCEQ and TWDB to identify sites of concern. In addition, monitoring data of federal, local, and private entities are also evaluated when available. At that point, the TDA may address the situation through any or all of its regulatory activities as well as coordinate prevention efforts with other government, educational, and/or private entities.

Department of State Health Services. The Department of State Health Services (DSHS), formerly the Texas Department of Health, has limited involvement in groundwater protection, although it does provide services that are related to groundwater safety and public health concerns. With regard to groundwater issues, the Community Hygiene Group in the Division of Regulatory Services acts primarily in a nonregulatory manner and serves in an advisory or public service role. When public health is impacted by groundwater contamination, the agency's response would focus on providing advice and assistance to the population affected. Since DSHS' involvement in groundwater issues is primarily advisory, the agency assists in determining the problem and providing help to the affected public. Regulatory aspects and remediation requirements are the responsibility of other state and federal agencies, as appropriate.

Although there are no direct programs that relate to groundwater protection, DSHS does have programs that indirectly provide protection to the state's water resources. Under the Regulatory Licensing Unit, the Chemical Reporting Group administers and

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enforces Tier II reporting of hazardous substances. The Policy Standards and Quality Assurance Unit oversees programs for youth camps, childcare centers and investigates public health nuisance complaints.

The DSHS Division of Regulatory Services Radiation Branch regulates radioactive materials, including uranium recovery and radioactive waste disposal. The Radiation Branch monitors groundwater for radionuclides on a routine basis at several facilities. As needed, the Radiation Branch will sample groundwater because of an incident, complaint, or situation that leads the Radiation Branch to believe there may be groundwater contamination.

The DSHS Laboratory Services Section performs chemical and microbiological analyses for any program at DSHS that needs water quality testing for its samples. For example, the laboratory routinely performs polychlorinated biphenyl (PCB) analyses of surface and groundwater samples for the federal PCB program. The Laboratory Services Section also accepts water samples for routine microbiological analysis from the public for a fee and works under contract with other state agencies such as the TCEQ.

Texas State Soil and Water Conservation Board. The Texas State Soil and Water Conservation Board (TSSWCB) was created in 1939 by the Texas Legislature to organize the state into State Water Conservation Districts (SWCDs) and to serve as a centralized agency for communicating with other state and federal entities as well as the Texas Legislature. Headquartered in Temple, Texas, the TSSWCB offers technical assistance to the state's 217 SWCDs and maintains regional offices in strategic locations in the state to help carry out the agency's water quality responsibilities. The TSSWCB is governed by a seven-member board composed of two Governor appointees and five landowners elected throughout Texas by more than 1,000 SWCD directors.

The TSSWCB is the lead agency for the planning, management and abatement of agricultural and silvicultural NPS pollution, and administers the Texas Brush Control Program. The TSSWCB has no statutory authority in the area of point source pollution, including misuse or accidents involving agricultural chemicals that are defined as point source pollution. The Board cooperates with the TDA and TCEQ in instances of point source agricultural chemical pollution. The TSSWCB also works with other state and federal agencies on NPS issues as they relate to Water Quality Standards and Criteria, Total Maximum Daily Loads, and Coastal Zone Protection. The TSSWCB works to ensure SWCDs and local landowners are adequately represented in these matters that could have a significant impact on future conservation and utilization of natural resources.

The TSSWCB has authority to establish water quality management plans in areas that have developed, or have the potential to develop, agricultural or silvicultural NPS water quality problems. This program provides, through local SWCDs, development, supervision and monitoring of individual water quality management plans for agricultural and silvicultural lands.

Besides their involvement in the abatement of NPS pollution, the Board also helps to preserve groundwater resources with its Cost Share Program and Brush Control Program. The Cost Share Program funds up to 75 percent of the implementation costs for a Water Quality Management Plan, which is developed and approved by the Board. This plan represents a commitment by the landowner to use the BMPs, as laid out in the plan, in order to protect their land and water resources from erosion, pesticide contamination, and overuse of the land. The Brush Control Program also protects groundwater resources by controlling invasive brush species that use large amounts of water. By controlling the brush in an area and restoring the native grasses, more water is available to recharge the underlying aquifer.

Texas Alliance of Groundwater Districts. Texas Alliance of Groundwater Districts (TAGD), formerly the Texas Groundwater Conservation Districts Alliance, was formed on May 12, 1988. Its membership is limited to GCDs in Texas provided their powers and duties allow the district to manage groundwater as expressed in TWC, Chapter 35 and Chapter 36. TAGD is organized exclusively for charitable, educational, or scientific purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code.

TAGD was formed to further the purposes of groundwater conservation and protection activities. TAGD provides a means of communication and exchange of information among individual GCDs on issues ranging from the day-to-day operation of local groundwater management to statewide groundwater resource policy issues. Members of TAGD are part of a network in which valuable technical and operational experience is available to members and the interested public. TAGD maintains contact with members of the private sector and various elected, local, state, and federal officials, providing them with timely information on activities and issues relevant to groundwater management. Members of TAGD also serve on various local, state, and federal agency committees and subcommittees, providing input and information on behalf of member districts. To date, there are 75 district members of the TAGD. A listing of all GCDs is depicted in Figure 1.

Texas Agricultural Experiment Station. The Texas Agricultural Experiment Station (TAES) is the official agricultural research agency in Texas. TAES has no regulatory authority. Headquartered at Texas A&M University, TAES promotes food and fiber

production while emphasizing water conservation and the protection of natural resources. TAES operates a system of 14 research centers that are located in the major land and natural resource regions of Texas. The TWRI is an administrative unit of TAES that guides internal water-related research.

Broad goals of the TAES groundwater research program are to protect, preserve, and efficiently use water resources, and to develop sustainable agricultural production systems. Groundwater programs of TAES stress the development of management strategies, technologies, and educational programs to support sustainable agriculture. TAES groundwater quality research focuses on reductions in chemical use; the control, fate, and transport of agricultural chemicals; and the remediation of contaminated groundwater.

Major efforts are under way to develop strategies to manage brush species on rangelands to increase water yields and protect water quality; to manage solid and liquid wastes from livestock production and processing to prevent water contamination; to develop crop production technologies that produce high yields while minimizing the loss of pesticides, chemicals and nutrients into ground and surface waters; and, to manage contaminants produced during industrial and urban activities.

TAES also trains future professionals through undergraduate and graduate education and research programs at Texas A&M University and other System institutions. Many TAES researchers at Texas A&M University in College Station hold teaching appointments, thus providing the latest research results to students.

TAES research efforts are complemented by the programs of the Texas Cooperative Extension (TCE), also a component of the Texas A&M University System. TCE conducts educational programs on management strategies and BMPs to protect groundwater resources. TCE specialists produce easy-to-read fact sheets and other publications for specific clientele, including agricultural producers. Other activities include field demonstrations and educational programs for youth and adults. The TCE has no regulatory authority.

Bureau of Economic Geology. The Bureau of Economic Geology (BEG), established in 1909, is a research entity of The University of Texas at Austin and functions as the State Geological Survey. BEG is one of three member institutions within the Jackson School of Geosciences. One of the goals of the Jackson School is to conduct research related to water issues in Texas with some

- 1 High Plains UWCD No.1 - 9/29/1951
- 2 North Plains GCD - 1/2/1955
- 3 Panhandle GCD - 1/21/1956
- 4 Hudspeth County UWCD No. 1- 10/5/1957
- 5 Real-Edwards CRD - 5/30/1959
- 6 Evergreen UWCD - 8/30/1965
- 7 Plateau UWCD - 3/4/1974
- 8 Harris-Galveston Subsidence District - 4/23/1975
- 9 Glasscock GCD - 8/22/1981
- 10 Hickory UWCD No. 1 - 8/14/1982
- 11 Irion County WCD - 8/2/1985
- 12 Permian Basin UWCD - 9/21/1985
- 13 Fox Crossing WD - 4/4/1986
- 14 Sutton County UWCD - 4/5/1986
- 15 Coke County UWCD - 11/4/1986
- 16 Collingsworth County UWCD - 11/4/1986
- 17 Hill Country UWCD - 8/8/1987
- 18 Barton Springs/Edwards Aquifer CD - 8/13/1987
- 19 Anderson County UWCD - 10/17/1987
- 20 Lipan-Kickapoo WCD - 11/3/1987
- 21 Sterling County UWCD - 11/3/1987
- 22 Santa Rita UWCD - 8/19/1989
- 23 Fort Bend Subsidence District - 8/28/1989
- 24 Sandy Land UWCD - 11/7/1989
- 25 Saratoga UWCD - 11/7/1989
- 26 Bandera County RA & GWD - 11/7/1989
- 27 Live Oak UWCD - 11/7/1989
- 28 Mesa UWCD - 1/20/1990
- 29 Salt Fork UWCD - 5/5/1990
- 30 Emerald UWCD - 1/26/1991
- 31 Medina County GCD - 8/26/1991
- 32 Headwaters UWCD - 11/5/1991
- 33 South Plains UWCD - 2/8/1992
- 34 Plum Creek CD - 5/1/1993
- 35 Uvalde County UWCD - 9/1/1993
- 36 Jeff Davis County UWCD - 11/2/1993
- 37 Gonzales County UWCD - 11/2/1994
- 38 Edwards Aquifer Authority - 6/28/1996
- 39 Garza County UFWCD - 11/5/1996
- 40 Hemphill County UWCD - 11/4/1997
- 41 Wintergarden GCD - 1/17/1998
- 42 Culberson County GCD - 5/2/1998
- 43 Llano Estacado UWCD - 11/3/1998
- 44 Rolling Plains GCD - 1/26/1999
- 45 Menard County UWCD - 8/14/1999
- 46 Clearwater UWCD - 8/21/1999
- 47 Presidio County UWCD - 8/31/1999
- 48 Guadalupe County GCD - 11/14/1999
- 49 Bee GCD - 1/20/2001
- 50 Blanco-Pedernales GCD - 1/23/2001
- 51 Brewster County GCD - 11/6/2001
- 52 Coastal Bend GCD - 11/6/2001
- 53 Coastal Plains GCD - 11/6/2001
- 54 Fayette County GCD - 11/6/2001
- 55 Goliad County GCD - 11/6/2001
- 56 Lone Star GCD - 11/6/2001
- 57 McMullen GCD - 11/6/2001
- 58 Neches & Trinity Valleys GCD - 11/6/2001
- 59 Pecan Valley GCD - 11/6/2001

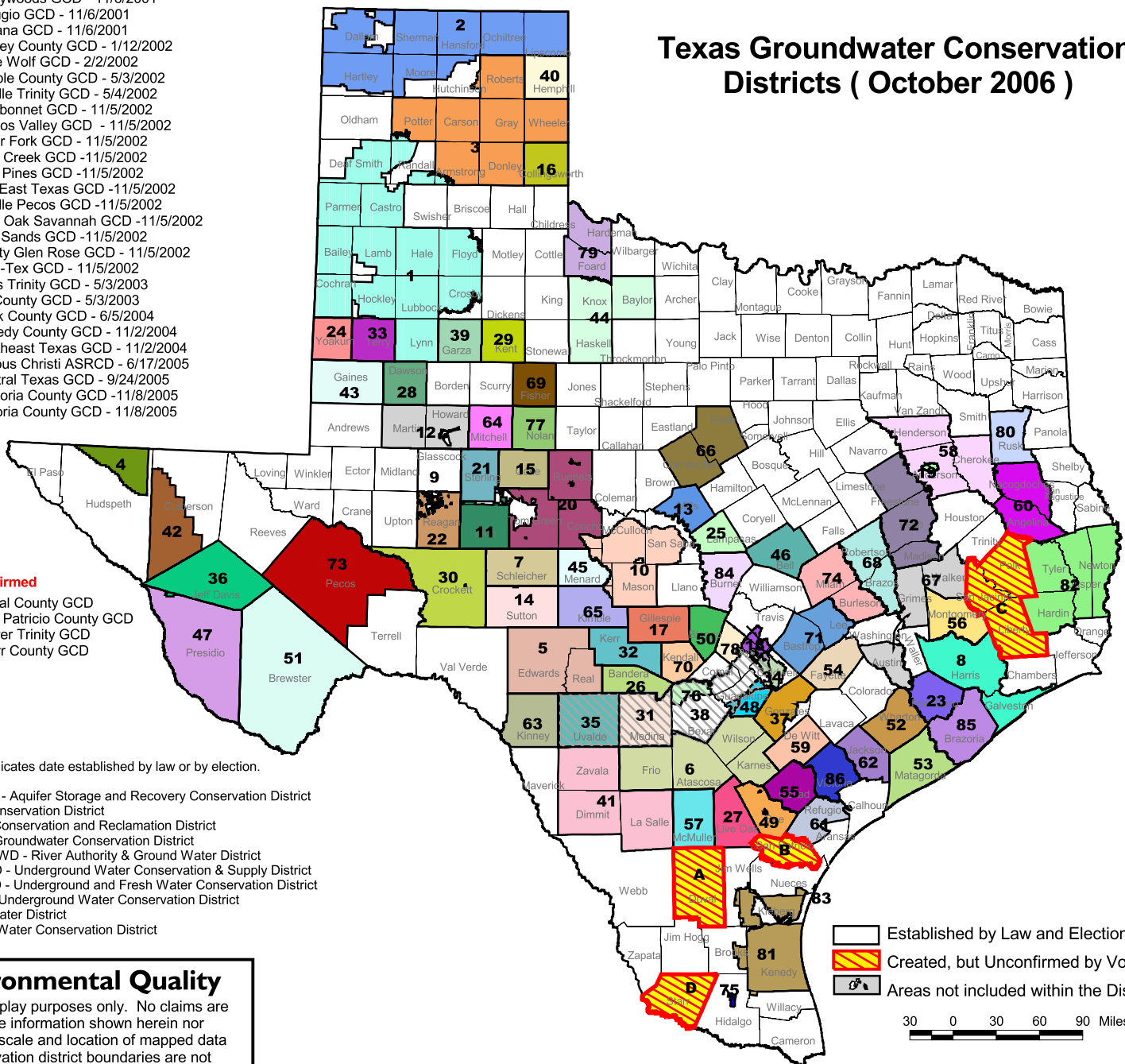
- 60 Pineywoods GCD - 11/6/2001
- 61 Refugio GCD - 11/6/2001
- 62 Texana GCD - 11/6/2001
- 63 Kinney County GCD - 11/2/2002
- 64 Lone Wolf GCD - 2/2/2002
- 65 Kimble County GCD - 5/3/2002
- 66 Middle Trinity GCD - 5/4/2002
- 67 Bluebonnet GCD - 11/5/2002
- 68 Brazos Valley GCD - 11/5/2002
- 69 Clear Fork GCD - 11/5/2002
- 70 Cow Creek GCD - 11/5/2002
- 71 Lost Pines GCD - 11/5/2002
- 72 Mid-East Texas GCD - 11/5/2002
- 73 Middle Pecos GCD - 11/5/2002
- 74 Post Oak Savannah GCD - 11/5/2002
- 75 Red Sands GCD - 11/5/2002
- 76 Trinity Glen Rose GCD - 11/5/2002
- 77 Wes-Tex GCD - 11/5/2002
- 78 Hays Trinity GCD - 5/3/2003
- 79 Tri-County GCD - 5/3/2003
- 80 Rusk County GCD - 6/5/2004
- 81 Kenedy County GCD - 11/2/2004
- 82 Southeast Texas GCD - 11/2/2004
- 83 Corpus Christi ASRCD - 6/17/2005
- 84 Central Texas GCD - 9/24/2005
- 85 Brazoria County GCD - 11/8/2005
- 86 Victoria County GCD - 11/8/2005

- Unconfirmed**
- A - Duval County GCD
 - B - San Patricio County GCD
 - C - Lower Trinity GCD
 - D - Starr County GCD

Date indicates date established by law or by election.

ASRCD - Aquifer Storage and Recovery Conservation District
 CD - Conservation District
 CRD - Conservation and Reclamation District
 GCD - Groundwater Conservation District
 RA & GWD - River Authority & Ground Water District
 UWCD - Underground Water Conservation & Supply District
 UFWCD - Underground and Fresh Water Conservation District
 UWCD-Underground Water Conservation District
 WD - Water District
 WCD - Water Conservation District

Texas Groundwater Conservation Districts (October 2006)



Texas Commission on Environmental Quality

This map was prepared by the TCEQ for display purposes only. No claims are made to the accuracy or completeness of the information shown herein nor is this map suitable for any other use. The scale and location of mapped data are approximate. The groundwater conservation district boundaries are not land survey data and may not accurately depict legal descriptions. For more information about this map, please contact TCEQ Groundwater Planning and Assessment Team.

Figure 1

internal funding for these programs. The BEG conducts basic and applied research projects related to water resources and contaminant transport in support of other state and Federal agencies. The BEG is not a regulatory agency and has no groundwater protection regulatory programs but supports the agencies that fulfill these functions.

The BEG serves as a valuable resource for geologic maps and reports that provide the framework for many environmental studies. The state geological mapping program focuses on developing maps of different geologic units and works with other state agencies to identify priority areas related to environmental issues. The core repository at the BEG contains an extensive collection of cores from many of the geologic units in the state. One of the strengths of environmental studies conducted by the BEG is the integration of geology and hydrology.

Groundwater resources are the focus of several studies conducted by the BEG. Groundwater models have been developed by BEG scientists of many of the major aquifers in the state, including the northern Ogallala, Trinity, Carrizo-Wilcox, Edwards (Barton Springs segment), and Gulf Coast aquifers as part of the TWDB Groundwater Availability Model Program.

The BEG also has unique capabilities in unsaturated zone hydrology including physical, chemical, and isotopic analysis and modeling. The unsaturated zone is extremely important because many contaminants originate near the land surface and have to be transported through the unsaturated zone to reach the water table. In addition, groundwater recharge generally occurs through the unsaturated zone and is a critical issue for assessing groundwater availability in the state. Examples of previous studies in unsaturated zone hydrology include characterization of water fluxes related to proposed low-level radioactive waste disposal sites, quantification of contaminant transport related to the U.S. Department of Energy's Pantex Plant, and estimation of recharge for groundwater modeling studies and for aquifer vulnerability to contamination.

The BEG has conducted many studies evaluating contaminant transport in the state. Examples of the types of studies include evaluation of sources of nitrate contamination in major aquifers for the TCEQ, delineation of salinity contamination related to oil and gas production activities for the RCT, assessment of transport processes at the Department of Energy's Pantex Plant, and evaluation of benzene plumes related to underground fuel tanks. Results of the benzene plume study were extremely valuable for the TCEQ in developing remediation protocols with respect to leaking petroleum storage tanks.

One of the missions of the BEG is public outreach. In its role as the State Geological Survey, the BEG responds to questions and

requests for information from other institutions and the public. The BEG participates in many public education programs, including efforts to engage kindergarten through 12th-grade students and teachers in scientific discovery. The BEG has been actively involved in organizing and promoting Earth Science Week, celebrated both nationally and internationally, which highlights the ways the earth sciences affect our daily lives and features an annual career fair.

Texas Department of Licensing and Regulation. The Texas Department of Licensing and Regulation (TDLR) Water Well Driller/Pump Installer Program (WWD/PI Program) maintains the Water Well Drillers Advisory Council; investigates all alleged violations of Chapters 1901 and 1902 of the Texas Occupations Code and 16 Texas Administrative Code (TAC) Chapter 76 (Water Well Drillers and Pump Installers Rules); investigates consumer complaints filed against regulated well drillers/pump installers; and randomly inspects wells to insure compliance with well construction standards. Investigations also include compliance with rules requiring isolation of zones containing undesirable or poor quality water to prevent commingling with and degradation of fresh water zones. Investigations that involve groundwater contamination are referred to the appropriate state agency with jurisdiction for the activity believed to be the cause of the contamination. In an area where groundwater contamination has been confirmed, the WWD/PI Program notifies licensees of the contamination by letter, including instructions on how to complete wells in the area to avoid further contamination. The WWD/PI Program also works with federal, numerous state and local entities in the area of groundwater protection.

The WWD/PI Program administers the Abandoned Well Notification and Enforcement Program. The Program has created a web site where abandoned or deteriorated wells can be reported online. A person can file a complaint about an abandoned well and track the status of the complaint. Abandoned or deteriorated wells are reported to the TDLR by drillers, pump installers, and neighbors who discover them. The WWD/PI Program contacts the landowners by letter to notify them of the requirement to plug or bring the wells into compliance no later than 180 days from the time of the notice. Only licensed water well drillers, licensed pump installers, or the landowner whose property contains an abandoned or deteriorated well may plug or bring the well into compliance. A State of Texas Plugging Report must be submitted to the TDLR no later than 30 days after the well is plugged or capped. Information is available, from the TDLR and the TGPC, to landowners wishing to plug their own wells. In addition, a joint memo of understanding has been developed to coordinate the efforts of the TDLR, the field offices of the TCEQ, and GCDs, relating to investigative procedures for referrals of complaints regarding abandoned and/or deteriorated wells.

TGPC Activities 2005-2006 Biennium

The TGPC implements and coordinates projects and administrative requirements by subject area. The following section describes TGPC efforts. In general, TGPC activities are a result of four interrelated requirements. They are:

- state laws specific to TGPC functions;
- state requirements of TGPC member agencies and organizations;
- federal law; and
- the *Texas Groundwater Protection Strategy*.

In order to highlight the links between the *Texas Groundwater Protection Strategy (Strategy)* implementation and other TGPC activities, relevant *Strategy* recommendations are featured in text boxes.

The following sections discuss the TGPC activities by subject area. These include:

- Implementation of the objectives found in the *Texas Groundwater Protection Strategy*;
- Agricultural Chemical Activities;
- Groundwater Data Management Activities;
- Nonpoint Source Pollution Activities;
- Public Outreach and Education Activities;
- Groundwater Research Activities;
- Intergovernmental Cooperation Activities; and
- TGPC Administrative Activities.

Implementation of the **Texas Groundwater Protection Strategy**

Background

The Legislature charged the TGPC with developing and updating a comprehensive groundwater protection strategy for the state that includes guidelines for the prevention of contamination and for the conservation of groundwater, and provides for the coordination of the groundwater protection activities of the agencies represented on the TGPC.

With the recent state focus on the need for assuring a high quality supply of groundwater, and recognizing the programmatic changes that have occurred since the state's first groundwater protection strategy was developed in 1988, the TGPC decided in

January 2001 to update the state's groundwater strategy. The TGPC issued the revised *Strategy* in February 2003.

Overview of the *Groundwater Protection Strategy*

In developing the *Strategy*, the TGPC recognized that the state has numerous successful groundwater programs spread among local and state governmental agencies and research institutions. Therefore, a key part of the *Strategy* documented how the current regulatory, outreach, and research programs work to protect groundwater resources. A second component of the *Strategy* was the identification of protection gaps in program implementation or coordination. TGPC believes that the *Strategy*, grounded firmly within the existing policy and programmatic directions given by the Legislature, resulted in a document that sets realistic objectives for success and provides a road map for action over the next five to fifteen years. A detailed discussion of the *Strategy* can be found in Appendix 2.

The *Strategy*:

- details the state's groundwater protection goal as established by the Legislature;
- explains the state's efforts to characterize the occurrence, quality, and quantity of groundwater resources and discusses various assessment approaches used in program implementation;
- describes the roles and responsibilities of the various state agencies involved in groundwater protection and discusses the TGPC as a coordinating mechanism;
- provides examples of how the various state agencies implement groundwater protection programs through regulatory and nonregulatory models;
- explains how local, state, and federal agencies coordinate management of groundwater data for the enhancement of groundwater protection;
- discusses the role that research plays in understanding groundwater's importance and the importance of coordinating research efforts;
- provides an overview groundwater public education efforts in the state;
- discusses public participation in establishing and implementing groundwater policy;
- lays out a planning process for updating the *Strategy*;
- proposes for inclusion in the next *Strategy* an identification and ranking of significant threats to the state's groundwater resources, consideration of the vulnerability of groundwater resources to such threats, and a prioritization of actions to address those threats; and

Increase Public Outreach.

- More water quality information is needed to develop assessments of water quality and health risk for the domestic/private well owner segment of the population.
- The state should undertake a voluntary program targeted at private well owners, designed to identify problem areas and assist private well owners in understanding these groundwater quality issues.
- More support needs to be given to educational efforts for targeted geographic areas of concern for high concentrations of naturally occurring groundwater contaminants and on various treatment options available to the domestic/private well owner.
- Support is also needed for educational efforts to develop and deliver effective educational materials that target potential sources of contamination such as abandoned wells.
- Special effort should be made to develop educational programs designed to reach and serve the state's high-growth areas.
- The TGPC recommends that the state continue to support the efforts of the On-Site wastewater Treatment Research Council, the TCE, the TCEQ's on-site wastewater program, and local governments in their efforts to develop and deliver effective educational material that addresses OSSF maintenance in order to prevent failures.
- Government agencies involved in OSSF regulation and outreach may want to consider developing programs specially designed to reach and serve the state's high growth counties.
- The TGPC should establish, on its web site, links to key groundwater information residing at state agencies and educational institutions.

Commit to Development of Periodic Updates and Improvements to the *State Groundwater Protection Strategy*.

- The TGPC should update the *Strategy* every 6 years.
- The TGPC should conduct an analysis that will identify and rank threats to groundwater quality (taking into consideration the vulnerability of groundwater resources and using available data), and prioritize possible actions that address those threats.

Agricultural Chemicals Activities

TWC, 26.407 requires the TCEQ develop management plans for agricultural chemicals, with the advice of the TGPC. These plans should address agricultural chemicals such as pesticides that may threaten groundwater quality. Specifically, these plans are developed for the protection and enhancement of water quality pursuant to federal statute, regulation, or policy, and include management plans for the prevention of water pollution by agricultural chemicals and agents.

At the request of the TCEQ, in 2001, the TGPC developed the Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater (SMP). This plan, as a generic management plan for the state, serves as a guide for the prevention of pesticide contamination of groundwater. The plan was developed as a joint effort of the agency members of the Agricultural Chemicals (Ag Chem) Subcommittee. A more detailed discussion of the SMP can be found in Appendix 3.

The SMP explains the general policies and regulatory and non-regulatory approaches the state will use to protect groundwater resources from contamination by pesticides. The document explains a generic coordinating mechanism among all responsible and participating agencies during the implementation of the SMP and provides for specific responses when it is deemed necessary to take actions to protect groundwater. The SMP reflects the state's philosophy toward groundwater protection and recognizes the importance of agricultural resources to the state's economy.

Much of the TGPC's work on agricultural chemical follows the SMP and is performed by the Ag Chem Subcommittee. The Ag Chem Subcommittee has designated five task forces:

- The State Management Plan Task Force writes and revises generic and pesticide-specific SMPs [also referred to as the Pesticide Management Plan (PMP)].
- The Education Task Force develops SMP-related educational information and materials and coordinates educational outreach including public presentations, displays, applicator certification curriculum development, and brochures.
- The Site Selection Task Force conducts reviews of pesticide-specific groundwater monitoring and investigation strategies for determining the extent of contamination.
- The Data Evaluation and Interpretation Task Force interprets the available information to determine the probable source and cause of the contamination. The Task Force also coordinates the state's response, under the SMP, to groundwater contamination, if monitoring reveals contamination.
- The Best Management Practices (BMP) Task Force is responsible for developing the preventive component of the generic SMP and identifying pesticide-specific and area-specific BMPs that can be used to prevent or curtail pesticide contamination of groundwater.

Currently, the Ag Chem Subcommittee is working on three areas of the SMP: (1) continued cooperative monitoring, (2) responding to confirmed cases of pesticide contamination of groundwater, and (3) identifying and providing outreach on best management practices (BMPs) in problem areas. These efforts are discussed in detail in Appendix 3.

Monitoring efforts have been significantly enhanced through a cooperative sampling effort among the TWDB, a number of GCDs, and the TCEQ. Approximately 520 samples were taken in 2005, and 330 samples in 2006. Monitoring has revealed a number of atrazine detections in the central Panhandle but only occasional low-level detections of atrazine or metolachlor in the rest of the state. All but one of the cooperative monitoring detections has been below the maximum contaminant level (MCL) for drinking water.

Investigative and follow-up monitoring efforts have been conducted at five sites in the central Panhandle. These activities continued throughout the biennium to track and to address atrazine detections in public water supply (PWS) wells. Monitoring reveals that atrazine concentrations have primarily decreased or remained the same over the past five years.

In response to widespread, low-level detections of the pesticide atrazine in groundwater in the Panhandle, the TGPC worked with the TCE's Lubbock staff to develop a "Best Management Practices Training and Curriculum Manual" in 2005. Presentations were given by TCE in 2005 and 2006, at eight separate events each year. The TDA also utilized some of this material to train their inspectors in 2006. The curriculum and training are a result of interagency coordination and cooperation of monitoring, education and outreach under the SMP.

During the biennium, TGPC sponsored a table display each December at the annual Texas Plant Protection Conference explaining the SMP program in Texas through the distribution of brochures and the exposition of various pesticide groundwater monitoring graphics, including Geographic Information System (GIS) maps of water wells monitored for pesticides in Texas. A presentation on the Interagency Pesticide Database (which contains pesticide groundwater monitoring data acquired from various agencies and other entities from across the state) was given at the TCEQ Environmental Trade Fair and Conference in May 2006.

The Ag Chem Subcommittee held eight meetings during the biennium and is composed of interested TGPC member agencies and organizations, and the Texas Structural Pest Control Board.

Groundwater Data Management Activities

Sound management of groundwater data is essential to protecting water quality and ensuring adequate groundwater supplies. Because of the importance of scientifically sound data, the TGPC, its member organizations, the federal government, local governments, and regulated entities all place a great premium on ensuring its accuracy and availability. The TGPC uses the expertise of its members and other experts through the GDM

Subcommittee to address many of the recommendations found in the *Strategy*.

The TGPC also uses the GDM Subcommittee to make available information on groundwater contamination and water-quality assessments of the state aquifers to the public through the publication of several reports mandated by both the state and the federal government. The subcommittee coordinates the compilation of data to be assessed by the TGPC and its member agencies and organizations to satisfy direct or indirect state and federal mandates such as the following reports:

- *Joint Groundwater Monitoring and Contamination Report (Joint Report)*—the GDM Subcommittee compiles and advises the TGPC on possible improvements, and updates and revises the Joint Report's enforcement status matrix; and
- *Texas Water Quality Inventory Report [305(b) Report]*—The GDM Subcommittee develops and implements a ten-year plan for the selection and subsequent annual assessment of the groundwater quality of the state's aquifers for inclusion in the federally required *305(b) Report*.

Joint Groundwater Monitoring and Contamination Report

The TGPC is required by TWC, 26.406 to publish an annual groundwater monitoring and contamination report. The report:

- describes the current status of groundwater monitoring activities conducted or required by each agency at regulated facilities or associated with regulated activities;
- contains a description of each case of groundwater contamination documented during the previous calendar year;
- provides a description of each case of contamination documented during previous periods for which enforcement action was incomplete at the time of issuance of the preceding report; and
- indicates the status of enforcement action for each case of contamination that is listed.

The TGPC produced and published two monitoring and contamination reports during the previous two years: *Joint Groundwater Monitoring and Contamination Report—2004* (TGPC, 2005) and *Joint Groundwater Monitoring and Contamination Report—2005* (TGPC, 2006) (Joint Reports). The findings are summarized below; however, a more detailed discussion of the Joint Reports and a summary of the report findings can be found in Appendix 4.

Data for the report comes from TGPC members and groundwater districts. Each member agency or organization provides the descriptions of their programs that protect groundwater. Each regulatory agency that requires or conducts groundwater monitoring to assure compliance with guidelines and regulations for

the protection of groundwater from contaminants has its own monitoring program requirements and procedures.

The *Joint Report for 2005* describes 17 regulatory monitoring programs in two state agencies. Monitoring of groundwater quality for permit and operational requirements occurred at approximately 11,000 facilities statewide. Data indicate that an estimated 61,000 monitor and water wells are being used for groundwater monitoring purposes at these facilities. The majority (greater than 94 percent) of the monitored facilities are under the jurisdiction of the TCEQ, with most of the remainder under the jurisdiction of the RCT.

Strategy Recommendation:

All available data sources should be checked for validity via accepted quality assurance and quality control measures and, once accepted, placed into an electronic format with a spatial data element for indexing in a relational database. The location and geometry of contamination plumes should be placed in a GIS format.

The contamination cases identified in the *Joint Report* are primarily those where contaminants have been discharged to the surface, to the shallow subsurface, or directly to groundwater from activities such as the storage, processing, transport, or disposal of products or waste materials.

There were 6,746 documented groundwater contamination cases in the *Joint Report for 2004* and 6,132 cases in 2005. Approximately 94.4 percent of the documented cases in 2005 were under the jurisdiction of the TCEQ. The remainder of the cases were under the jurisdiction of the RCT (with approximately 5.5 percent); GCDs which are members of TAGD (with 2 cases, or less than 0.1 percent); and one case under the jurisdiction of DSHS (with 1 case, or less than 0.1 percent).

The most common contaminants reported in both 2004 and 2005 were gasoline, diesel fuel, and other petroleum products due to the large number of cases related to petroleum storage tank systems. Less common reported contaminants were organic compounds (such as phenol, trichloroethylene, carbon tetrachloride, dichloroethylene, and naphthalene), pesticides (such as alachlor, atrazine, bromacil, dicamba, and prometon), creosote constituents, solvents, heavy metals, and sodium chloride.

Groundwater Data Management

The GDM Subcommittee facilitates much of the TGPC's inter-agency groundwater data communication to ensure that data is more accessible, usable, and valid. The subcommittee encourages uniform groundwater data management practices, the use of spatial data for GIS in groundwater quality/contamination studies, and promotes adherence to state guidelines and standards for

data formats. The GDM Subcommittee met formally three times during the biennium.

The subcommittee maintains and updates the *Texas Groundwater Data Dictionary*, first published in 1995, which serves as the standard reference for encouraging data uniformity.

Strategy Recommendation

The TGPC must review and revise its groundwater data management standards and participate in the various data management advisory groups.

During fiscal year 2005, the GDM Subcommittee submitted this document to the Texas Geographic Information Council (TGIC) for review of the spatial data elements for adequacy. TGIC reported that the spatial data elements in the dictionary met the state's requirement for minimum data elements and did not recommend any changes. Other data elements contained in the dictionary have been informally identified as potentially needing revision. The GDM Subcommittee is currently working on the formal identification of any outdated data elements, and, based on the results of this identification, will determine whether a revision of the dictionary is necessary.

Groundwater Monitoring Strategy

The subcommittee has examined the data needs of the state's groundwater quality assessment programs, and is reviewing the adequacy of existing monitoring efforts in order to develop a comprehensive statewide groundwater quality monitoring strategy. For a more detailed discussion of these efforts, see Appendix 2.

Strategy Recommendation:

The TGPC should develop recommendations on the design of a groundwater monitoring system that will meet the needs of all member agencies and organizations.

Gaps exist in the data collection and data assessment processes. The existing groundwater quality-monitoring program needs more resources to sample additional sites. The parameters that are analyzed need to be expanded to include organic and synthetic chemicals. Staff from member agencies and organizations worked on refining the first phase of a joint groundwater monitoring strategy. This monitoring strategy is intended to meet present and future needs for groundwater quality and quantity data. This first phase identifies a three-tiered monitoring concept that provides a foundation for building a more detailed monitoring program. The second phase of the monitoring strategy is underway, with an emphasis on refining the monitoring concepts, and developing an assessment methodology for data collected under the new monitoring strategy, as well as legacy data.

The development of this monitoring strategy is driven by both the *Strategy* and a need to improve the groundwater portion of the *305(b) Report*. Enhanced monitoring and a new assessment methodology for groundwater quality data will result in a more

concise and usable version of the *305(b) Report* when submitted to EPA. While the current *305(b) Report* is prepared through interagency cooperation, primarily between the TWDB and the TCEQ, data gaps that were identified in the *Strategy* will be filled. Additionally, accurate reporting of specific, as opposed to generalized, groundwater quality issues will be possible.

TGPC member agencies and organizations use the committee as the primary coordination mechanism for exchanging information of various data collection and assessment initiatives. The development of spatial databases for groundwater contamination sites is an example of the type of initiative undertaken by member agencies and organizations. The TCEQ and the RCT are both working on spatial datasets for contamination sites under their individual jurisdictions.

Nonpoint Source Pollution Activities

The Nonpoint Source (NPS) Task Force, co-chaired by the TCEQ and TSSWCB, facilitates and formalizes the state's groundwater NPS program and supports and guides groundwater NPS management policy. The task force facilitates communication between the TGPC and the state's NPS program, which addresses both ground and surface water. The task force ensures consistency with the NPS Management Plan and the *Strategy*. The task force provides input to the Nonpoint Source Pollution Management Program Annual Report submitted to the EPA; updates the state NPS assessment of groundwater conditions and NPS management strategy for groundwater resources; facilitates the submission of NPS project proposals for federal funding; and provides input on groundwater issues to the TSSWCB and the TCEQ for their management plans.

The NPS Task Force met three times during the biennium to discuss Texas' NPS Management Plan, Clean Water Act NPS grants, agency NPS initiatives, and NPS research needs.

Public Outreach and Education Activities

The TGPC Public Outreach and Education activities center on two overarching themes: (1) the protection of human health from contaminated groundwater or water that contains high levels of naturally occurring compounds that could affect human health, and (2) the protection of groundwater from contamination.

The Public Outreach and Education (POE) Subcommittee coordinates many of the TGPC's

Strategy Recommendation

The state should undertake a voluntary program targeted at private well owners, designed to identify problem areas and assist private well owners in understanding these groundwater quality issues.

educational outreach initiatives. The subcommittee develops and implements educational outreach programs on groundwater protection and environmental health issues, which are targeted to serve specific groups.

As part of the effort to increase public outreach about groundwater issues, the TGPC revised, in 2006, the *Texas Groundwater Protection Committee* brochure. In addition, beginning in 2006, the TGPC sponsored exhibitor booths and displays at five Austin-area conferences, seminars, and meetings with over 400 estimated visitors. Available to the public at the booths were the TGPC brochure, maps of various kinds, public outreach brochures and pamphlets, as well as a listing of publications available for download on the TGPC web site.

Abandoned wells provide a direct conduit for pollution occurring at the surface to enter groundwater resources. Recognizing the dangers to human health and groundwater quality that abandoned water wells pose, the POE Subcommittee developed educational materials to promote the low-cost, landowner-initiated capping or plugging of abandoned water wells. The POE Subcommittee released a revised version of the *Landowner's Guide to Plugging Abandoned Water Wells* in March 2006. In addition, TCE held 20 well-plugging demonstrations in 13 counties, with an attendance of almost 300 people.

Strategy Recommendation

Public educational materials and outreach programs are needed to educate domestic/private well owners on drinking water quality and potential health risks.

More support needs to be given to educational efforts for targeted geographic areas of concern for high concentrations of naturally occurring groundwater contaminants and on various treatment options available to the domestic/private well owner.

Support is also needed for educational efforts to develop and deliver effective educational materials that target potential sources of contamination such as abandoned wells.

Special effort should be made to develop programs designed to reach and serve the state's high-growth areas.

Contamination and naturally occurring compounds that can affect health remain a focus of the TGPC's education and public outreach efforts. The TGPC coordinated efforts with TCE in developing a package of educational material for outreach events. Fact sheets were developed and published in both English and Spanish on arsenic, perchlorate, nitrate, and radionuclide contamination for private well owners. The fact sheets contain information on the occurrence, health effects, testing options, and treatment options for these constituents. TCE received an American Society of Agricultural and Biological Engineers (ASABE) Blue Ribbon Award for an outstanding entry in the 2006 Educational Aids Competition, Publications—Fact Sheets

category, for their *Perchlorate Fact Sheet*.

During the biennium, TCE conducted a number of educational events targeting water well owners and used the drinking water fact sheets and presentation materials in conjunction with their water well testing program. Additionally, over 1,700 well samples were screened for nitrates from over 40 counties. TCE also developed a drinking water presentation for their county agents, "Onsite Drinking Water Treatment," along with an accompanying guidance document, *Water Quality—Drinking Water Treatment*.

In conjunction with the Ag Chem Subcommittee, the TDA used the TCE developed material to train their inspectors in 2006. The curriculum and training are a result of interagency coordination and cooperation of monitoring, education and outreach.

An effective on-site sewage facility (OSSF) treatment system removes wastewater from the home, treats and distributes the wastewater, and protects water resources from contamination. An OSSF must be routinely maintained to operate properly. Unlike a centralized sewer system maintained by a city or water district, maintenance of an OSSF is the responsibility of the homeowner. With a state-wide OSSF failure rate of 13 percent and the growing dependence on OSSF systems in the suburban fringe, the TGPC is trying to provide information to individuals who are unaware of proper usage and maintenance of the system.

The TGPC coordinated efforts with the TCE to develop two fact sheets about on-site wastewater treatment systems. One fact sheet addressed commonly occurring issues encountered by homeowners in evaluating on-site wastewater maintenance contract. The second addressed the "how-tos" of homeowner gray water collection systems.

Strategy Recommendation

The TGPC recommends that the state continue to support the efforts of the On-Site Wastewater Treatment Research Council, the TCE Service, the TCEQ's on-site wastewater program, and local governments in their efforts to develop and deliver effective educational material that addresses OSSF maintenance in order to prevent failures.

In addition, the government agencies involved in OSSF regulation and outreach may want to consider developing programs specially designed to reach and serve the state's high-growth counties.

Strategy Recommendation

The TGPC should establish, on its web site, links to key groundwater information residing at state agencies and educational institutions.

Since many of the agencies involved in groundwater protection have several functions, their web sites are not organized around groundwater as a theme, making

it difficult for the general public to find information on the state's groundwater protection efforts.

The TGPC web site, < www.tgpc.state.tx.us >, was established prior to this biennium and is frequently updated with new information on groundwater protection activities. In addition to providing information about TGPC business to its members and the public, the web site is a clearinghouse for many groundwater-related topics, supplying links to the web sites and publications of TGPC members and other organizations. TGPC web site activity for the first five months of 2006 averaged 118 visitors per day.

The subcommittee met six times during the biennium to update Drinking Water Fact Sheets, discuss well plugging events, develop educational outreach plans, and to coordinate activities with other state and federal organizations involved in public outreach.

Groundwater Research Activities

Traditional groundwater research organizations, generally associated with universities, in both the agricultural and natural resource sectors, have developed the experience, infrastructure, and technical expertise needed to address complex research needs. However, there is no formal mechanism to link TGPC members that need research with the organizations that are capable of undertaking the research. The Groundwater Research Subcommittee was formed to identify interagency groundwater research needs and provide a coordinated approach in seeking potential funding sources.

Strategy Recommendation

TGPC should form a research subcommittee to identify interagency research needs and to provide a coordinated approach for discussion with federal agencies for funding. The results of this work should be shared with the TCEQ for its consideration under the research model authorized under TWC 5.1191—5.1193.

The subcommittee has completed work on a template for project-specific white papers. A document/white paper has been prepared by Texas Water Resources Institute (TWRI), "Influences of Natural and Man-Made Sources of Contamination on Water Quality Trends in the Seymour Aquifer: A 2006 Status Report." The subcommittee has identified a number of research topics, and continues to serve as a forum for the exchange of ideas among the various agencies on groundwater research needs and on opportunities for potential sources of funding.

The Groundwater Research Subcommittee met nine times during the biennium. Regularly scheduled items on the subcommittee's agenda included discussion of a Research Needs Matrix, prioritization of research for funding, and development of white papers

(i.e., a one-page grant proposal). Presentations to the subcommittee during the biennium were:

- BEG's presentation on California's Ambient Groundwater Monitoring Program and its applicability to Texas, focusing primarily on the dating of groundwater through the use of tritium and helium-3 analyses; and
- TCEQ's presentation on Clean Water Act Section 319 grant program on providing funding for NPS water quality projects.

Intergovernmental Cooperation Activities

The TGPC and its subcommittees undertake intergovernmental efforts to fill gaps in service delivery and information exchange. These include: (1) notifying private well owners of groundwater contamination, (2) coordination with RWPGs, and (3) coordination with the federal government.

Private Well Owner Notification of Groundwater Contamination

TWC, 26.408 requires the TCEQ to inform owners of private drinking water wells, within 30 days of the date the TCEQ receives notice of groundwater contamination, that their well may be affected by contamination. GCDs in which the contamination is occurring are also notified.

The TGPC was required to develop the form and content of the notice to the owners of private drinking water wells. The TGPC completed that task on November 12, 2003. A copy of the notice can be found under "Notice of Groundwater Contamination" (Appendix 5).

The TCEQ uses the TGPC as an avenue for interagency communication. Staff has held meetings with the RCT, TWDB, TDA, and TDLR to describe the TCEQ responsibilities and internal protocol. The monitoring programs of these agencies were reviewed, and post-monitoring procedures, which might affect a case referral to the TCEQ, were clarified. Similar discussions are planned with TSSWCB, TCE, and TAES.

Coordination with Regional Water Planning Groups

During the development of the *Strategy*, the TGPC recognized that the State's Regional Water Planning Groups (RWPG) were relying heavily on GAMs and quantity information, but may have been failing to account for groundwater availability issues caused by aquifer impairments. TGPC now provides reports, such as the Joint Reports, to RWPGs.

The TWDB representative of the TGPC now reports quarterly on the status of RWPG activities and the TWDB's GAM efforts. In addition, the TWDB representative gave a presentation on "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)" during the April 2006 TGPC meeting.

Strategy Recommendation

The TGPC needs to strengthen the lines of communication and information sharing with the State's RWPG. The lack of communication between these two groups is a gap in the TGPC's ability to coordinate the state's groundwater protection strategy with the state's water supply planning efforts led by the Texas Water Development Board.

Coordination with the Federal Government

EPA, through the Clean Water Act, has provided grants to the state since 1985 to: (1) promote the coordination of groundwater protection activities of federal and federally-delegated regulatory programs; and (2) foster a more comprehensive approach to groundwater protection. In addition, starting in 1992, EPA has provided grants to the state under the FIFRA for groundwater protection activities specifically related to pesticide use and effects on groundwater.

The TGPC leads initiatives, in partnership with federal agencies, to develop a state groundwater protection strategy and multiple pesticide management plans designed to protect groundwater from contamination. Current state and federal cooperative efforts include identifying potential improvements to the state's groundwater quality monitoring effort and ensuring that those efforts are consistent with national monitoring initiatives.

In addition, the TGPC regularly provides input at the national level to federal agencies through the Ground Water Protection Council (an association of state groundwater and underground injection control program directors), the State FIFRA Issues Research Evaluation Group (a group formed by state agricultural regulatory officials and EPA to discuss and evaluate pesticide matters affecting states), the National Water Quality Monitoring Council (an advisory group to the U.S. Geological Survey (USGS) and EPA), and other state and federal stakeholder and regulatory guidance groups.

The TGPC works closely with the USGS, the federal agency with responsibilities that include national level geologic mapping and hydrologic studies. USGS participates in TGPC-sponsored projects and subcommittees, providing both groundwater expertise and opportunities for state input into federally-sponsored research.

TGPC Administrative Activities

The TGPC carries out numerous administrative duties required by state law, such as developing this biennial report to the Legislature, holding required quarterly meetings, and ensuring that documents are maintained in a manner that makes them easily accessible to the public. In addition, the TGPC and its subcommittees are subject to the state's open-meeting laws. Periodically, state laws are enacted that require the TGPC to undertake rulemaking. Much of the TGPC's work is performed in quarterly meetings and through the efforts of its subcommittees.

Legislative Report Development

The Legislative Report Subcommittee met three times during the biennium to coordinate the drafting of the recommendation portion of the Activities and Recommendation of the Texas Groundwater Protection Committee required by TWC, 26.405. The subcommittee develops, for full TGPC approval, groundwater protection recommendations for legislative consideration.

Actions on Recommendations to the 79th Legislature

The 79th Legislature addressed two of the 11 recommendations forwarded by the TGPC in January 2005 by:

- providing funds for the GAMs of minor aquifers and maintenance and improvements of the completed models of the major aquifers as additional information is gathered; and
- continuing funding for brush control in order to enhance the availability of both groundwater and surface water. Funding for the brush control was not increased from the previous legislative session.

Meetings and Presentations

The TGPC met quarterly during the biennium, as required by TWC, 26.404. Regularly scheduled items on the TGPC's agenda included subcommittee reports, presentations and roundtable discussions, business, information exchange, announcements, and public comment. In addition, agencies share and discuss current and ongoing rule development relating to the protection of groundwater.

The TGPC regularly receives groundwater-related presentations. Presentations during biennium were:

- The State Map Project, an undertaking by the BEG, and part of the National Cooperative Geologic Mapping Program administered by the USGS;
- USGS groundwater-related research projects;
- USGS's major springs of Texas initiative;

- TWDB's findings on groundwater availability in Texas; and
- TCEQ's planned electronic data management system that will include spatial, analytical, and geologic data.

Subcommittees

The TGPC uses subcommittees and task forces to perform much of its work and to address issue and program development. The TGPC considers subcommittee findings and recommendations at regular meetings. The following subcommittees and task forces were used during the biennium:

- Agricultural Chemicals Subcommittee
 - State Management Plan Task Force
 - Educational Task Force
 - Site Selection Task Force
 - Data Evaluation and Interpretation Task Force
 - Best Management Practices Task Force
- Groundwater Data Management Subcommittee
- Groundwater Research Subcommittee
- Legislative Report Subcommittee
- Nonpoint Source Task Force
- Public Outreach and Education Subcommittee

Rules and Quadrennial Review

The TGPC rules (Appendix 5) define the environmental conditions that constitute groundwater contamination for inclusion of cases in public files of state agencies having groundwater protection responsibilities. The rules describe the contents of the TGPC's Joint Report and specify the form and content of notices of groundwater contamination.

The TGPC is required to develop and implement a rules review plan for the periodic review and re-adoption of its rules in accordance with Government Code §2001.039. The TGPC began a review of its rules in February 2006. At its April 20, 2006, meeting, the TGPC approved the publication of the quadrennial rules review and approved publication of proposed amendments to its rules. The proposed rule revisions clarified the purpose of the rules and the definitions used in the rule and membership on the TGPC was revised to reflect organizational name changes. The TGPC adopted the rules review, proposed rules, and updated rules review plan at its July 26, 2006, meeting.

Public Records and Public Meetings

State law requires the TCEQ to be the TGPC's administrative agent. As such, the TCEQ maintains a mailing list of the TGPC members, designated and alternate members, subcommittee members, agency staff, and interested parties for meeting notification and correspondence. The TCEQ provides meeting information through the *Texas Register* for public notification, maintains audio tapes of the TGPC meetings, prepares meeting records, and keeps meeting and correspondence files for the TGPC and subcommittees. In addition, the TGPC publishes documents that are available through the TCEQ's Agency Communications Division. See Appendix 6 for a complete list of the TGPC publications.

Like other state agencies, the TGPC is subject to the state's open-meetings laws. Meeting notices are provided to the *Texas Register* and mailed, along with agenda, to individuals on the TGPC mailing list. Meeting notices are also posted on the TPGC web site and email reminders are sent to key stakeholders.

Information is also made available to the public through the TGPC web site at <<http://www.tgpc.state.tx.us>> .

Appendix 1. Texas Groundwater Protection Committee Membership

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Appendix 2. Texas Groundwater Protection Strategy

Background

The Legislature charged the TGPC with developing and updating a comprehensive groundwater protection strategy for the state that provides guidelines for the prevention of contamination and for the conservation of groundwater and provides for the coordination of the groundwater protection activities of the agencies represented on the TGPC.

With the recent state focus on the need for assuring a high quality supply of groundwater, and recognizing the programmatic changes that have occurred since the state's first groundwater protection strategy was developed in 1988, the TGPC decided in January 2001 to update the state's groundwater strategy. The TGPC issued the revised *Strategy* in February 2003.

State Groundwater Protection Strategy

In developing the *Strategy*, the TGPC recognized that the state has numerous successful groundwater programs spread among local and state governmental agencies and research institutions. Therefore, a key part of the *Strategy* documented how the current regulatory, outreach, and research programs work to protect groundwater resources. A second fundamental component of the *Strategy* was the identification of protection gaps in program implementation or coordination. TGPC believes that this approach to developing the *Strategy*, grounded firmly within the existing policy and programmatic directions given by the Legislature, resulted in a document that sets realistic objectives for success and provides a road map for action over the next 5 to 15 years.

The *Strategy* provides recommendations and possible actions to protect groundwater. The following discusses each *Strategy* recommendation that was given in Chapter X: Recommendations for Action and the TGPC's and member agency response to the recommendations.

Implementation of Strategy Recommendations

Over the past two years, the TGPC revised its subcommittee structure to implement the *Strategy's* recommendations. Two new subcommittees were created, the Groundwater Research Subcommittee and the Public Outreach and Education Subcommittee. These two subcommittees and the Data Management Subcommittee were charged with implementing specific recommendations given in the *Strategy*. The charges to the Agricultural

Chemicals Subcommittee and the NPS Task Force were reviewed and revised to provide assistance and further coordination for addressing recommendations and issues identified in the *Strategy*. The subcommittees were given the ongoing responsibility to report quarterly at the TGPC's regularly scheduled meeting on subcommittee activities. A discussion of the progress in implementing the *Strategy's* recommendations follows.

Strengthen Communication with the State's Water Planning Efforts

Strategy Recommendation. *The TGPC needs to strengthen the lines of communication and information sharing with the State's Regional Water Planning Groups (RWPG). The lack of communication between these two programs is a gap in the TGPC's ability to coordinate the state's groundwater protection strategy with the state's water supply planning efforts led by the Texas Water Development Board. (Short-term 5-year Goal)*

Response. The TWDB representative of the TGPC now reports quarterly on the status of RWPG activities and the TWDB's Groundwater Availability Modeling efforts. In addition, the TWDB representative gave a presentation on "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)" during the April 2006 TGPC meeting. TGPC reports, such as the Joint Reports have been provided to RWPGs.

Improve Groundwater Data

Strategy Recommendation. *Gaps exist in the data collection and data assessment processes. The existing groundwater quality monitoring programs need more resources to sample additional sites that will provide a better picture of groundwater conditions statewide. The parameters that are analyzed need to be expanded to include organic and synthetic chemicals. While site-specific assessment of hazardous wastes in groundwater is covered by a number of state and federal programs, other substances in groundwater, such as nitrate and arsenic that may be deemed naturally occurring need better assessment. The TGPC should develop recommendations on the design of a groundwater monitoring system that will meet the needs of all member agencies and organizations. Any new monitoring of domestic water wells would be on a voluntary basis. (Short-term 5-year Goal)*

Response. Throughout the biennium, staff from member agencies and organizations worked on refining the first phase of a groundwater monitoring strategy. This monitoring strategy is intended to address current and future needs for groundwater quality and quantity data. The first phase identified a three-

tiered monitoring concept that provides a foundation for building a more detailed monitoring program. The second phase of the monitoring strategy is underway, with an emphasis on refining the monitoring concepts, and developing an assessment methodology for not only the data collected under the new strategy, but also legacy data.

Once completed, implementing the strategy should improve the groundwater portion of the Texas Water Quality Inventory [305(b) Report]. Enhanced monitoring and a new assessment methodology for groundwater quality data will result in a more concise and usable version of the report when submitted to the EPA. While the current report is prepared by interagency cooperation, primarily between the TWDB and the TCEQ, data gaps that were identified in the *Strategy* will be addressed, and accurate reporting of specific, as opposed to generalized, groundwater quality issues will be possible.

The TGPC has also been the primary coordination mechanism for exchanging information of various data collection and assessment initiatives by the member agencies and organizations. The development of spatial databases for groundwater contamination sites is an example of the type of initiative undertaken by member agencies and organizations—the TCEQ and the RCT are both working on spatial datasets for contamination sites under their individual jurisdictions. These spatial datasets are being developed as needed by specific programs within the agencies, and will be able to be utilized by other programs using common data elements. Progress on these efforts is being monitored by TGPC support staff.

Strategy Recommendation. *Data management is a dynamic process and, as such, accepted data management standards may become outdated or superseded by a better, newer standard. It is imperative that these data management standards be periodically reviewed and amended to facilitate information exchange. The TGPC must review and revise its groundwater data management standards and guidelines, and must actively participate in the various data management advisory groups. (Short-term 5-year Goal)*

Response. The TGPC published the *Texas Groundwater Data Dictionary* in August 1996. During 2005, the GDM Subcommittee of the TGPC submitted this document to the Texas Geographic Information Council (TGIC) for review of the spatial data elements for adequacy. TGIC reported that the spatial data elements in the dictionary met the state's requirement for minimum data elements and did not recommend any changes.

Other data elements contained in the dictionary have been informally identified as potentially needing revision. The TGPC is presently working on the formal identification of any outdated

data elements, and, based on the results of this identification, will determine whether a revision of the dictionary is necessary.

Data management systems are improving daily. Data storage capacity is much larger today than when the *Strategy* was crafted, and retrieval methods are much easier and faster. Despite these improvements, designing a centralized data management system remains an expensive proposition, in terms of both capital expense and workforce allocation. The TGPC has focused efforts toward developing data management methods that will work with existing databases and/or new databases under construction. Identification of common data elements within these databases is essential to provide access to the widest array of data for all users.

Adding new pesticide sampling data is an ongoing effort of the TGPC. During the biennium, available data was evaluated and a report was prepared describing the status of pesticide occurrence in groundwater. The report is available from the TGPC web site.

Strategy Recommendation. *The need for a geographic information systems/relational database for waste site and groundwater contamination site characterizations is critical to any planning process. All available data sources should be checked for validity via accepted quality assurance and quality control measures, and once accepted, placed into an electronic format with a spatial data element for indexing in a relational database. The location and geometry of contamination plumes should be placed in a GIS format. (Medium-term 10-year Goal)*

Response. In 2006, staff preparing the *Joint Groundwater Monitoring and Contamination Report—2005* conducted a trial acquisition of spatial data for groundwater contamination sites in the report. Using existing spatial databases and location matching, staff was able to provide accurate locations for 98% of the 5,792 sites reported by the TCEQ. Nearly 50% of the cases reported by the RCT were similarly located, even though the RCT has not completed their current work on developing a spatial database for these sites. Staff is optimistic about the plan to convert the *Joint Report* to a web-based, spatial presentation format within the next two report cycles.

Strategy Recommendation. *The TDLR has developed a relational database that includes water well driller information, the water well driller's reports, and reports of encountering undesirable water zones when wells are drilled, in a spatial coordinate (latitude and longitude) database. There is a large number of existing hard-copy water well drillers reports that need to be placed in a digital format and made accessible through the existing system. (Medium-term 10-year Goal)*

Response. A cooperative effort between the TDLR and the TCEQ has been initiated to examine feasibility, funding, and data main-

tenance issues related to the conversion of paper Water Well Reports to a digital format. Due to the large number of paper records (800,000+), careful planning is needed for assurance of document integrity, disaster backup and reliable accessibility.

Coordinate Research

Strategy Recommendation. *Traditional groundwater research organizations, generally associated with universities, in both the agricultural and natural resource sectors, have developed the experience, infrastructure, and technical expertise needed to address complex research needs. However, there is no formal mechanism to link the agencies on the TGPC that need research performed together with the organizations that are capable of performing the research. The TGPC should form a research subcommittee to identify interagency research needs and to provide a coordinated approach for discussion with federal agencies for funding. The results of this work should be shared with the TCEQ for its consideration under the research model authorized under TWC Sections 5.1191–5.1193. (Short-term 5-year Goal)*

Response. The Groundwater Research Subcommittee was formed to meet a need for a coordinating group to work with state agencies, such as the TCEQ, TWDB, RCT, TDA, DSHS, the TSSWCB, and with traditional research organizations, such as universities and the USGS, to identify interagency groundwater research needs and provide a coordinated approach in seeking potential funding sources. The subcommittee has completed work on a template for project-specific white papers. A document/white paper has been prepared by TWRI entitled “Influences of Natural and Man-Made Sources of Contamination on Water Quality Trends in the Seymour Aquifer: A 2006 Status Report.” The subcommittee has identified a number of research topics, and continues to serve as a forum for the exchange of ideas between the various agencies on groundwater research needs and opportunities for potential sources of funding.

Increase Public Outreach

Strategy Recommendation. *Virtually all water used in rural homes, not connected to a public drinking water system, comes from domestic/private water wells. There are no specific programs that routinely examine the quality of groundwater being consumed by Texans utilizing these wells. More water quality information is needed to develop assessments of water quality and health risk for the domestic/private well owner segment of the population. The state should undertake a voluntary program targeted at private well owners, designed to identify problem areas and assist private well owners in understanding these groundwater quality issues. (Short-term 5-year and Medium-term 10-year Goal)*

Response. In response to widespread, low level detections of the pesticide atrazine in groundwater, the Agricultural Chemicals Subcommittee worked with the TCE's Lubbock staff to develop a "Best Management Practices Training and Curriculum Manual" in 2005, with an emphasis on atrazine. Presentations were given by TCE in 2005 and 2006, at eight separate events each year. The TDA also utilized some of this material to train their inspectors in 2006. The curriculum and training are a result of interagency coordination and cooperation of monitoring, education and outreach through the Agricultural Chemicals Subcommittee, under the SMP.

Strategy Recommendation. *Public educational materials and outreach programs are needed to educate domestic/private well owners on drinking water quality and potential health risks. More support needs to be given to educational efforts for targeted geographic areas of concern for high concentrations of naturally occurring groundwater contaminants and on various treatment options available to the domestic/private well owner. Support is also needed for educational efforts to develop and deliver effective educational materials that target potential sources of contamination such as abandoned wells. Special effort should be made to develop programs designed to reach and serve the state's high-growth areas. (Short-term 5-year and Medium-term 10-year Goal)*

Response. TCE continued their outreach efforts on abandoned well closures during the biennium. The TGPC coordinated efforts with TCE in developing a package of educational material for outreach events for private/domestic well owners. Fact sheets were developed and published in both English and Spanish on arsenic, perchlorate, nitrate, and radionuclide contamination for private well owners. The fact sheets contain information on the occurrence, health effects, testing options, and treatment options for these constituents. TCE also developed a drinking water presentation for their county agents along with a guidance document to accompany the fact sheets. TCE received an American Society of Agricultural and Biological Engineers (ASABE) Blue Ribbon Award for an outstanding entry in the 2006 Educational Aids Competition, Publications—Fact Sheets category, for their Perchlorate Fact Sheet. During the biennium, TCE conducted a number of educational events targeting water well owners and used the drinking water educational fact sheets and presentation materials in conjunction with their water well testing outreach program.

Strategy Recommendation. *An effective on-site system removes wastewater from the home, treats and distributes the wastewater, and protects our water resources. An on-site wastewater system requires maintenance in order to maintain proper operation and environmental protection. Unlike a centralized sewer system maintained by a city or water district, maintenance of an on-site*

system is the responsibility of the homeowner. A statewide OSSF failure rate of 13 percent and the growing dependence on these systems in the suburban fringe around urban areas continues to create human health and environmental concerns. Therefore, the TGPC recommends that the state continue to support the efforts of the On-Site wastewater Treatment Research Council, the Texas Cooperative Extension Service, the TCEQ's on-site wastewater program, and local governments in their efforts to develop and deliver effective educational material that addresses OSSF maintenance in order to prevent failures. In addition, the government agencies involved in OSSF regulation and outreach may want to consider developing programs specially designed to reach and serve the state's high growth counties. (Short-term 5-year and Medium-term 10-year Goal)

Response. The TGPC coordinated efforts with the TCE to develop two fact sheets about on-site wastewater treatment systems. One fact sheet addressed commonly occurring issues encountered by homeowners in evaluating on-site wastewater maintenance contracts. The second addressed the "how-tos" of homeowner gray water collection systems.

Strategy Recommendation. *Oftentimes, state agency web pages are not organized around groundwater as a theme, making it difficult for the general public to find information on the state's groundwater protection efforts. To remedy this, the TGPC should establish, on its web page, links to key groundwater information residing at state agencies and educational institutions. (Short-term 5-year Goal)*

Response. The TGPC web site (www.tgpc.state.tx.us) was established prior to this biennium and has been frequently updated with new information on groundwater protection activities. In addition to providing information about TGPC activities to its members and the public, the web site serves as a clearinghouse for many groundwater-related topics such as general groundwater information; pesticides; water wells; septic systems; groundwater contamination; oil, gas, and mining; and water conservation. The web site supplies links to other web sites and publications of its members and other organizations. TGPC web site activity for the first five months of 2006 averaged 118 visitors per day.

Commit to Development of Periodic Updates and Improvements to the State Groundwater Protection Strategy

Strategy Recommendation. *The first groundwater strategy was developed in 1988 and has not been updated prior to this document. The TGPC should update the Strategy every 6 years. (Short-term 5-year and Medium-term 10-year Goal)*

January 2007

Response. The TGPC plans to revise the *Strategy* in 2008 for publication in 2009.

Strategy Recommendation. *As part of the ongoing process for developing the next Strategy, the TGPC intends to conduct an analysis that will identify and rank threats to groundwater quality (taking into consideration the vulnerability of groundwater resources and using available data), and prioritize possible actions that address those threats. Such an analysis would provide a valuable tool to both TGPC member agencies and organizations, and state legislators as they go about setting groundwater protection policy. (Short-term 5-year and Medium-term 10-year Goal)*

Response. The compilation of spatial data for cases in the Joint Report represents a major step forward in identifying threats to groundwater quality from regulated activities, or conversely, determining where regulatory programs have been effective in maintaining the quality of groundwater. Use of this data with legacy data in the assessment methodology currently under development for the Joint Groundwater Monitoring Strategy, will assist in establishing locations targeted for more intensive or rigorous groundwater monitoring.

Additionally, the most recent format of the Groundwater Assessment portion of the Texas Water Quality Inventory [305(b) Report] has been adopted in order to make identification and ranking of threats to groundwater quality possible. In the 2004 and 2006 versions of the report, the data, and the graphical presentation of the data, have been expanded to cover all major and minor aquifers in the state.

Concentrations of multiple “constituents of concern” that exceed some generally accepted environmental or health based action levels, are developed using GIS into a graphic format, with symbols showing the locations and relative concentrations of parameters sampled during the most recent round of sampling for each aquifer.

Data from the Texas Water Development Board’s Database is used for this effort, along with data from the TCEQ’s Public Drinking Water Database and Interagency Pesticide Database.

Appendix 3. State Management Plan for the Prevention of Pesticide Contamination of Groundwater

Plan Development

The TCEQ is charged under TWC §26.407 to develop management plans for agricultural chemicals, with the advice of the TGPC. These plans should address agricultural chemicals such as pesticides that may threaten groundwater quality. Specifically, these plans are developed for the protection and enhancement of water quality pursuant to federal statute, regulation, or policy, and include management plans for the prevention of water pollution by agricultural chemicals and agents.

EPA has decided not to finalize rules on this topic which were first proposed in 1996. However, EPA continues to advocate their policy on addressing pesticides in groundwater through the SMP process and provides continued grant support for this program.

At the request of the TCEQ, in 2001, the TGPC developed the Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater (SMP). This plan, as a generic management plan for the state, serves as a guide that addresses the prevention of pesticide contamination and actions that will be used by the state to respond to contamination when it is found. The plan was developed as a joint effort of the agency members of the Agricultural Chemicals Subcommittee. The plan received input from agricultural producers, manufacturers, and environmental interest groups. The TGPC effort considered the guidance provided by the EPA's Ground-Water Protection Strategy and the Final Guidance for Pesticides and Ground-Water State Management Plans. The effort is an update of the Texas State Management Plan for Agricultural Chemicals in Ground Water, published by the TGPC in 1991.

The goal of the SMP is to protect the existing quality of groundwater and to prevent the degradation of state groundwater resources. This goal does not mean zero-contaminant discharge, but rather that the normal use of pesticides is conducted in a manner that will maintain present groundwater uses and not impair potential uses of groundwater or pose a public health hazard. All usable and potentially usable groundwater resources are subject to the same protection afforded by the state's nondegradation policy goal.

The SMP describes the general policies and regulatory approaches the state will use to protect groundwater resources from risk of contamination by pesticides. The document de-

scribes a generic coordinating mechanism among all responsible and participating agencies during the implementation of the SMP and provides for specific responses when it is deemed necessary to take specific actions to protect groundwater. The SMP reflects the state's philosophy toward groundwater protection and recognizes the importance of agricultural resources to the state's economy.

Groundwater Monitoring Plan for Atrazine and Metolachlor

Monitoring efforts have been significantly enhanced through a cooperative sampling effort among the TWDB, a number of GCDs, and the TCEQ. The TWDB or a GCD obtains a groundwater sample, in the course of their regular monitoring program, and then the TCEQ conducts the screening analyses for atrazine and metolachlor. Through this cooperative effort approximately 542 samples were obtained in 2002, 482 samples in 2003, 452 samples in 2004, 520 samples in 2005, and 330 samples in 2006. Using an immunoassay screening method, all samples were analyzed for atrazine and most for metolachlor.

During the first five years of this cooperative sampling effort, samples from all of the aquifers that the TWDB monitors have been screened for atrazine and metolachlor. The monitoring program is well into the second round of TWDB's five-year monitoring cycle. Thus far, monitoring has revealed a number of atrazine detections in the central Panhandle but only occasional low-level detections of atrazine or metolachlor in the rest of the state. The cooperative monitoring atrazine detections lie in the same region of the panhandle as previous investigative monitoring detections. All but one of the cooperative monitoring detections has been below the MCL for drinking water.

Response to Contamination

Response to a confirmed case of pesticide contamination of groundwater is outlined in the SMP. The determination of the appropriate response considers a number of key issues:

- whether the contamination is from a point or NPS;
- the extent of the contamination; the level of contamination, either above or below the drinking water MCL or health advisory level (HAL);
- the travel time from the application of the pesticide at or near the soil surface until it reaches the water table; and
- whether the source of contamination was the result of present usage of the pesticide or usage under previous labels, which allowed greater levels of use.

Investigative and follow-up monitoring efforts have been conducted at five sites in the central Panhandle and these activities continued throughout the biennium to track and to address atrazine detections in PWS wells. Monitoring reveals that atrazine concentrations have primarily decreased or remained the same over the past five years. At present, none of the PWS wells have atrazine concentrations above or even near the MCL.

The investigations of these sites indicate that most of the atrazine contamination cases are due to point sources, such as an improperly abandoned water well that may have served as a migration pathway for atrazine. However, the investigations also found that there is some possibility of NPS contamination where the source of atrazine may be agricultural fields or storm water runoff collection in playa lake basins where public water wells are located.

In response to widespread, low-level detections of the pesticide atrazine in groundwater in this area, the TGPC worked with the TCE's Lubbock staff to develop a "Best Management Practices Training and Curriculum Manual" in 2005. Presentations were given by TCE in 2005 and 2006, at eight separate events for each year. The TDA also utilized some of this material to train their inspectors in 2006. The curriculum and training are a result of interagency coordination and cooperation of monitoring, education and outreach under the SMP.

Appendix 4. Annual Joint Groundwater Monitoring and Contamination Reports

The TGPC is required under TWC §26.406 to publish an annual groundwater monitoring and contamination report which:

- describes the current status of groundwater monitoring activities conducted or required by each agency at regulated facilities or associated with regulated activities;
- contains a description of each case of groundwater contamination documented during the previous calendar year;
- contains a description of each case of contamination documented during previous periods for which enforcement action was incomplete at the time of issuance of the preceding report; and
- indicates the status of enforcement action for each case of contamination that is listed.

The TGPC produced and published two monitoring and contamination reports during the previous two years: *Joint Groundwater Monitoring and Contamination Report—2004* (TGPC, 2005) and *Joint Groundwater Monitoring and Contamination Report—2005* (TGPC, 2006). The *Joint Report* describes the status of groundwater monitoring programs and groundwater contamination cases documented or under enforcement by the participating agencies for the calendar year. Each agency or organization includes a description of their programs that protect groundwater. The Joint Report contains a brief description of each case of groundwater contamination, listed by county and regulatory agency, and includes the enforcement status for the case.

Groundwater Monitoring

The groundwater protection programs of the members of the TGPC generally fall within one of three categories:

- regulatory agencies requiring or conducting groundwater monitoring to assure compliance with guidelines and regulations for the protection of groundwater from discharges of contaminants;
- agencies or entities conducting groundwater monitoring to assess ambient or existing groundwater quality conditions and to track changes in water quality over time; and
- agencies or entities conducting research activities related to groundwater resources and groundwater conservation.

Each regulatory agency that requires or conducts groundwater monitoring to assure compliance with guidelines and regulations

for the protection of groundwater from contaminants has its own monitoring program requirements and procedures. The criteria used to assess the need for groundwater monitoring vary among the regulatory entities. Currently, there are 17 regulatory monitoring programs within two state agencies.

Monitoring of groundwater quality for permit and operational requirements occurred at approximately 11,000 facilities statewide in 2005. Approximately 66,230 monitor wells were used in 2004, and 61,000 in 2005. The majority (approximately 99% in 2004 and 94% in 2005) of the monitored facilities are under the jurisdiction of the TCEQ, with the most of remainder under the jurisdiction of the RCT.

The TWDB, GCDs, and the USGS conduct nonregulatory groundwater monitoring to assess ambient or existing groundwater quality conditions and to track changes in water quality over time. Some monitoring programs are developed for the assessment of water quality that target specific geographic areas, contaminants, constituents, or activities. Contamination cases discovered by these agencies or entities through groundwater studies, or groundwater sampling programs, are referred to the regulatory agency with the appropriate jurisdiction.

The TWDB reported sampling approximately 780 sites in 2004 and 589 sites (wells and springs) in 2005. TWDB's collection of these samples and analysis of additional samples from cooperative entities comprise the state's ambient groundwater quality-sampling program. TWDB enters water-quality data collected under this program in its groundwater database.

Groundwater Contamination

Groundwater contamination is defined by the TGPC for inclusion in the Joint Report (31 TAC Chapter 601, Appendix 2). Contamination is the detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater reasonably suspected of having been caused by the activities of entities under the jurisdiction of the state agencies. The TGPC recognizes that groundwater contamination may result from many sources, including: agricultural activities; commercial and business endeavors; current and past oil and gas production and related practices; domestic activities; industrial and manufacturing processes; and natural sources that may be influenced by, or may be the result of, human activities.

The contamination cases identified in the Joint Report are primarily those where contaminants have been discharged to the surface, to the shallow subsurface, or directly to groundwater from activities such as the storage, processing, transport, or disposal of products or waste materials. The most common contaminants reported in both 2004 and 2005 were gasoline, diesel

fuel, and other petroleum products due to the large number of cases related to petroleum storage tank systems. Less common reported contaminants were organic compounds (such as phenol, trichloroethylene, carbon tetrachloride, dichloroethylene, and naphthalene), pesticides (such as alachlor, atrazine, bromacil, dicamba, and prometon), creosote constituents, solvents, heavy metals, and sodium chloride.

Currently, there are 6,132 documented groundwater contamination. Approximately 94.4 percent of the documented cases in 2005 are under the jurisdiction of the TCEQ. The remainder are under the jurisdiction of the RCT (with approximately 5.5 percent), GCDs which are members of TAGD (with 2 cases, or less than 0.1 percent), and one case under the jurisdiction of DSHS (with 1 case, or less than 0.1 percent)

Table 2 lists the documented groundwater contamination cases reported by each agency with enforcement jurisdiction and is further broken down by program within the agency.

Table 2 illustrates the total percentage of documented cases attributable to each agency and program and the net change and percentage change from 2004 to 2005. The Joint Report for both 2004 and 2005 document the large number of groundwater contamination cases attributed to leaking underground storage tanks. As reported by the TCEQ, the number of documented groundwater contamination cases resulting from the failure of storage tank systems declined from 4,681 in 2004 to 3,867 in 2005. This is down from a high of 4,815 cases in 2003. These cases represent 72% of the total number of documented contamination cases in 2004 and 67% of the total cases in 2005.

While the number of documented contamination cases from underground storage tanks is high compared to other programs, it can be directly linked to the large number of regulated facilities. In 2005, there were 68,680 facilities containing registered storage tanks.

Table 2 illustrates an increase in the number of active cases reported by the RCT. The RCT case count rose 40 percent between 2004 and 2005. Most of these cases are under the jurisdiction of the Oilfield Cleanup Program.

The TCEQ programs with increase in the number of active cases case between 2004 and 2005 are the Voluntary Cleanup/Innocent Owner Program (60 cases), Water Quality Assessment Section (six cases), and Municipal Solid Waste (six cases).

Table 2. Groundwater Contamination Cases by Jurisdictional Agency, 2004–2005

Agency Division Program	Total Cases		Change, 2004-2005		Percent of Total	
	2004	2005	Net	%	2004	2005
Texas Commission on Environmental Quality						
<i>Remediation Division programs:</i>						
Brownfield Site Assessment	12	10	-2	-16.7	0.2	0.2
Corrective Action	545	549	4	0.7	8	17.5
Dry Cleaner Remediation	NA	42	42	100	0	0.7
Innocent Owner/Operator	381	441	60	15.7	5.6	7.2
Petroleum Storage Tank	4,681	3,867	-814	-17.4	69.3	63
Superfund Cleanup	60	65	5	8.3	0.9	1
Superfund Site Discovery and Assessment	19	22	3	15.8	0.3	0.4
Voluntary Cleanup	685	672	-13	-1.9	10.1	11
<i>Waste Permits Division programs:</i>						
Municipal Solid Waste	38	44	6	15.8	0.6	0.7
Industrial and Hazardous Waste	1	2	1	100	0.1	0.1
<i>Water Quality Division</i>						
Water Quality Assessment Program	8	14	6	15.8	0.6	0.7
<i>Water Supply Division programs:</i>						
Public Drinking Water	13	8	-5	-38.5	0.2	0.1
Water Rights Permits and Availability	50	49	-1	-2	0.7	0.6
<i>Enforcement Division</i>	3	4	1	33.3	0.1	0.1
<i>Field Operations Division</i>	6	3	-3	-50	0.1	0.1
Subtotal, all TCEQ programs	6,502	5,792	-710	-10.9	96.4	94.5
Department of State Health Services	1	1	0	0	0.1	0.1
Railroad Commission of Texas						
<i>Oil and Gas Division</i>	241	337	96	40	3.6	5.5
Texas Alliance of Groundwater Districts	2	2	0	0	0.1	0.1
Total	6,746	6,132	-614	-9.1	100	100

The Joint Report also indicates the status of enforcement action for each instance of groundwater contamination. For purposes of the Joint Report, enforcement action includes any agency action that accomplishes or requires the identification, documentation, monitoring, assessing, or remediation of groundwater contamination. In general, regulatory programs are structured to achieve the desired degree of environmental protection and mitigation with the lowest possible level of agency oversight, and while the status of a contamination case may remain at an agency action level for a long period, physical activities related to the assessment and remediation may change often. The comparison of the level of agency action and the status or level of contamination assessment and mitigation allows a one-to-one correspondence between an agency's response (enforcement status) and the completion of the discrete phases in the progression of contamination investigation (activity status).

Table 3 presents the activity status of documented groundwater contamination cases through December 31, 2005. The table indicates the total number of documented cases by the agency (and division or program) with jurisdictional authority and indicates

the activity status for the cases. Once groundwater contamination has been confirmed, either the regulated entity or the agency will address the groundwater contamination incident following a general sequence of actions until the investigation concludes that no further action is necessary. All of the 6,132 cases listed in the 2005 report had documented groundwater contamination (Table 3). The status of these cases is:

- “No Activity” has occurred on 158 reported cases that are awaiting confirmation of contamination.
- “Contamination Confirmed” (validated) for 654 cases.
- “Ongoing Investigation” is taking place at 2,456 cases.
- “Corrective Action Planning” is being conducted for 242 cases.
- “Corrective Action Implemented” on 912 cases.
- “Monitor Action” for effectiveness is occurring in 427 cases.
- “Action Completed” (No further action is necessary) for 1,171 cases.
- “No Activity” was provided for nine cases.

Historically, the number of new groundwater contamination cases documented each year has been greater than the number of cases in which action was completed during the same year. This trend had held since the TGPC began publishing the Joint Report in 1989, but in 2000, the trend reversed. In 2004, 1,277 cases were listed as action completed, and 645 new cases were reported. In 2005, 1,171 cases were listed as action completed, with 654 new cases reported. A summary of the changes since 1998 is contained in the 2005 report.

Table 3. Documented Groundwater Contamination Cases by Agency/Activity Status, 2005

Agency Division Program	Cases, 2005		Cases with an Activity Status Code ^{3,4} of ...							
	Total ¹	New ²	0	1	2	3	4	5	6	None
Texas Commission on Environmental Quality										
<i>Enforcement Division</i>	4	1	0	2	1	0	0	0	0	0
<i>Field Operations Division</i>	3	0	0	0	3	0	0	0	0	0
<i>Remediation Division programs:</i>										
Brownfield Site Assessment	10	1	2	1	1	0	1	0	5	0
Corrective Action	549	21	7	16	216	104	154	131	29	2
Dry Cleaner Remediation	42	21	0	2	60	0	0	0	0	0
Innocent Owner/Operator	441	63	46	96	0	0	0	0	298	0
Petroleum Storage Tank	3,867	361	0	710	1,835	0	485	0	756	0
Superfund Cleanup	65	3	0	17	44	40	24	91	0	5
Superfund Site Discovery and Assessment	22	3	8	26	0	0	0	0	1	0
Voluntary Cleanup	672	53	93	33	243	54	93	87	62	1
<i>Waste Permits Division programs:</i>										
Municipal Solid Waste	44	6	1	1	24	3	15	16	0	0
Industrial and Hazardous Waste	2	1	0	0	0	2	0	0	0	0
<i>Water Quality Division</i>										
Water Quality Assessment Program	14	6	0	1	5	0	5	7	0	0
<i>Water Supply Division programs:</i>										
Public Drinking Water	8	6	0	0	0	0	0	0	8	0
Water Rights Permits and Availability	49	0	0	37	11	0	0	0	1	0
Subtotal, all TCEQ programs	5,792	546	157	942	2,443	203	778	332	1,160	8
Department of State Health Services	1	0	0	0	0	0	0	0	0	0
Railroad Commission of Texas										
<i>Oil and Gas Division</i>	337	108	1	26	12	39	133	95	10	1
Texas Alliance of Groundwater Districts	2	0	0	0	0	0	1	0	1	0
Total	6,132	654	158	968	2,456	242	912	427	1,171	9

1. Total number of groundwater contamination cases documented or under enforcement during calendar year 2005.
2. Number of new cases documented or under enforcement during calendar year 2005.
3. Key to activity status codes: 0—No Activity; 1—Contamination Confirmed; 2—Ongoing Investigation; 3—Corrective Action Planning; 4—Corrective Action Implementation; 5—Monitoring Action; 6—Action Completed
4. Facilities may have more than one activity status code.

Appendix 5. Texas Groundwater Protection Committee Rules

Title 31. NATURAL RESOURCES AND CONSERVATION

Part 18. TEXAS GROUNDWATER PROTECTION COMMITTEE

Chapter 601. GROUNDWATER CONTAMINATION REPORT

Subchapter A. GENERAL PROVISIONS RELATING TO PUBLIC FILES AND JOINT REPORT

§601.1 Purposes of Rules

The purposes of this chapter are:

- (1) to implement duties and responsibilities assigned to the committee under Texas Water Code, §26.406, concerning the maintenance by member agencies of public files containing documented cases of groundwater contamination and the publication by the committee, in conjunction with the commission, of annual groundwater monitoring and contamination reports;
- (2) to establish general policies of the committee to guide that implementation; and
- (3) to specify the form and content of the notice of groundwater contamination required under Texas Water Code, §26.408.

§601.2 Applicability

These rules specifically apply to each state agency or organization having membership on the committee. The committee is composed of:

- (1) the Texas Commission on Environmental Quality;
- (2) the Department of State Health Services;
- (3) the Texas Department of Agriculture;
- (4) the Railroad Commission of Texas;
- (5) the Texas Water Development Board;
- (6) the Texas Alliance of Groundwater Districts;
- (7) the Texas Agricultural Experiment Station;
- (8) the Bureau of Economic Geology of the University of Texas at Austin;
- (9) the State Soil and Water Conservation Board; and
- (10) the Water Well Drillers and Water Well Pump Installers Program of the Texas Department of Licensing and Regulation.

§601.3 Definitions

The following words and terms, when used in this chapter, have the following meanings.

- (1) Act—House Bill 1458 (71st Legislature, 1989) codified, with amendments, as Texas Water Code, §§26.401–26.408.
- (2) Commission—Texas Commission on Environmental Quality.
- (3) Committee—Texas Groundwater Protection Committee.
- (4) Documented groundwater contamination—A case of groundwater contamination in which a member agency has an established procedure for making a determination based on the quality of groundwater and the information pertinent to making the determination is maintained by that member agency under §601.4(b) of this title (relating to Public Files).
- (5) Enforcement action—Any action of the member agencies, identified in §601.2 of this title (relating to Applicability), that accomplishes or requires the identification, documentation, monitoring, assessing, or remediation of groundwater contamination.

- (6) Groundwater—Water below the land surface in a zone of saturation.
- (7) Groundwater contamination—The detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater. Except for an underground source of drinking water granted an aquifer exemption by the commission with concurrence from the United States Environmental Protection Agency in accordance with 40 Code of Federal Regulations Parts 144–146, and 30 TAC Chapter 331 (relating to Underground Injection Control), groundwater contamination, for purposes of inclusion of cases in the public files and the joint groundwater monitoring and contamination report, is limited to contamination reasonably suspected of having been caused by activities or by entities under the jurisdiction of the member agencies identified in §601.2 of this title (relating to Applicability) and affecting groundwater that contains a concentration of:
 - (A) less than or equal to 10,000 milligrams per liter (mg/liter) of dissolved solids; or
 - (B) greater than 10,000 mg/liter of dissolved solids if it is:
 - (i) currently extracted for beneficial use such as domestic, industrial, or agricultural purposes; or
 - (ii) hydrologically connected with, and with the potential for contaminant movement to, a surface water body or another zone of groundwater that has a concentration of less than or equal to 10,000 mg/liter of dissolved solids.
- (8) Member agency—A state agency or organization designated by law under Texas Water Code, §26.403(c), to serve on the committee and be subject to its rules. Member agencies are listed in §601.2 of this title (relating to Applicability). Member agencies having responsibilities related to protection of groundwater include the commission, the Department of Agriculture, the Railroad Commission of Texas, and the State Soil and Water Conservation Board.

§601.4 Public Files

- (a) Subject to the limitations provided by Texas Water Code, §§26.401–26.408 (the Act), and the Texas Public Information Act, Texas Government Code, Chapter 552, information collected, assembled, or maintained by the committee and the member agencies having responsibilities related to protection of groundwater under the Act is a public record open to inspection and copying during regular business hours.
- (b) Each member agency having responsibilities related to the protection of groundwater under the Act shall maintain a public file of all documented cases of groundwater contamination that are reasonably suspected of having been caused by activities regulated by the member agency.

§601.5 Joint Groundwater Monitoring and Contamination Report

In conjunction with the commission, the committee shall publish not later than April 1 of each year a joint groundwater monitoring and contamination report covering the activities and findings of the committee made during the previous calendar year. The report must:

- (1) describe the current status of groundwater monitoring programs conducted by or required by each member agency at regulated facilities or in connection with regulated facilities;
- (2) contain a description of each case of groundwater contamination documented during the previous calendar year and of each case of groundwater contamination documented during previous years for which enforcement action was incomplete at the time of issuance of the preceding report; and
- (3) indicate the status of enforcement action for each case of groundwater contamination that is included in the report.

Subchapter B. NOTICE OF GROUNDWATER CONTAMINATION

§601.10 Form and Content of Groundwater Contamination Notice

When notice of groundwater contamination, as defined in §601.3(7) of this title (relating to Definitions), is provided under Texas Water Code, §26.408 to the owner of a private drinking water well that may be affected by the contamination and to each applicable groundwater conservation district, the notice shall:

- (1) be in writing; and
- (2) contain, at a minimum, the following information:
 - (A) the name of the contaminant or contaminants;
 - (B) the range of analytical results for the contaminant or contaminants measured in the area or well to date;
 - (C) possible health effects of the contaminant or contaminants;
 - (D) possible source or sources for this type of contamination;
 - (E) suggested actions and precautions potentially impacted well owners could take; and
 - (F) who to contact for more information.

Appendix 6. Select Publications of the TGPC

Texas Groundwater Protection Strategy. TCEQ publication AS-188 (February 2003).

< www.tceq.state.tx.us/assets/public/comm_exec/pubs/as/188.pdf>

Joint Groundwater Monitoring and Contamination Report—2005. TCEQ publication SFR-056/05 (July 2006).

< www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/sfr/056_05/index.html>

Joint Groundwater Monitoring and Contamination Report—2004. TCEQ publication SFR-056/04 (July 2005).

< www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/056_04/056_04.pdf>

Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater. TCEQ publication SFR-070 (January 2001).

< www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/070_01.pdf>

Texas Groundwater Data Dictionary. TCEQ publication GI-272 (August 1996). < www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/gi/gi-272.html>

Landowner's Guide to Plugging Abandoned Water Wells. TCEQ publication RG-347 (March 2006).

< www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-347.html>

Drinking Water Problems Fact Sheets

Arsenic. TCE publication L-5467 (December 2005) and L-5467S (June 2006). < tcebookstore.org/pubinfo.cfm?pubid=2186> and

< tcebookstore.org/pubinfo.cfm?pubid=2187> (Spanish)

Perchlorate. TCE publication L-5468 (November 2005) and L-5468S (February 2006). < tcebookstore.org/pubinfo.cfm?pubid=2188> and

< tcebookstore.org/pubinfo.cfm?pubid=2189> (Spanish)

Nitrates. TCE publication B-6184 (May 2006) and B-6184S (May 2006).

< tcebookstore.org/pubinfo.cfm?pubid=2181> and

< tcebookstore.org/pubinfo.cfm?pubid=2183> (Spanish)

Radionuclides. TCE publication B-6192 (July 2006).

< tcebookstore.org/pubinfo.cfm?pubid=2182>

On-site Wastewater Treatment Systems Fact Sheets

Homeowner's Guide to Evaluating Service Contracts. TCE publication B-6171 (July 2005). < tcebookstore.org/pubinfo.cfm?pubid=2107>

Graywater. TCE publication B-6176 (October 2005).

< tcebookstore.org/pubinfo.cfm?pubid=2180> |