2018 State of Texas Water Quality Inventory

Groundwater Assessment

May, 2018

TABLE OF CONTENTS

SUMMARY **1**

OVERVIEW – GROUNDWATER RESOURCES **4**

FIGURE 1. MAJOR AQUIFERS OF TEXAS 6
FIGURE 2. MINOR AQUIFERS OF TEXAS 7

GROUNDWATER PROTECTION **8**

TEXAS GROUNDWATER PROTECTION COMMITTEE 8
Coordination with Federal Agencies *9*
DESCRIPTIONS OF GROUNDWATER PROTECTION PROGRAMS 9
Table 1. Summary and Status of State Groundwater Protection Programs *9*
Texas Commission on Environmental Quality *11*
Texas Water Development Board *11*
Railroad Commission of Texas *12*
Department of State Health Services *13*
Texas Department of Agriculture *14*
Texas State Soil and Water Conservation Board *15*
Texas Alliance of Groundwater Districts *15*
Texas A&M AgriLife Research *16*
The Bureau of Economic Geology of The University of Texas at Austin *19*
Texas Department of Licensing and Regulation *20*

GROUNDWATER PROTECTION POLICY **21**

GROUNDWATER CLASSIFICATION SYSTEM 21
STATE GROUNDWATER PROTECTION STRATEGY 23

AMBIENT GROUNDWATER MONITORING **25**

TABLE 2. AMBIENT MONITORING GROUNDWATER QUALITY DATA, 2007 - 2017 27

REGULATORY MONITORING / GROUNDWATER CONTAMINATION **28**

TABLE 3. SOURCES OF GROUNDWATER CONTAMINATION 29
TABLE 4. STATEWIDE GROUNDWATER CONTAMINATION CASES DOCUMENTED OR UNDER ENFORCEMENT IN 2016 32
TABLE 5. SUMMARY OF GROUNDWATER CONTAMINATION SITES ON AQUIFER OUTCROPS IN 2016 33

GROUNDWATER ASSESSMENT **34**

METHODOLOGY USED IN THE PREPARATION OF THIS REPORT 34
LIMITATIONS 35

AMBIENT GROUNDWATER MONITORING DATA TABLES **37**

TABLES 6 THROUGH 35 – AMBIENT GROUNDWATER MONITORING TABULATED DATA BY AQUIFER, 2007 THROUGH 2017 37

REGULATORY MONITORING/GROUNDWATER CONTAMINATION **68**

FIGURE 3A. MAP OF MAJOR AQUIFER OUTCROP AREAS WITH CONFIRMED GROUNDWATER CONTAMINATION 69
FIGURE 3B. MAP OF MINOR AQUIFER OUTCROP AREAS WITH CONFIRMED GROUNDWATER CONTAMINATION 70
TABLES 36 THROUGH 58 – SUMMARY OF SITES WITH CONFIRMED GROUNDWATER CONTAMINATION AT AQUIFER OUTCROP AREAS (2016) 71

CONSTITUENTS OF CONCERN IN SELECTED AQUIFERS **95**

FIGURES 4 THROUGH 34: DISTRIBUTION DIAGRAMS FOR SELECTED CONSTITUENTS 95

SUMMARY

Groundwater in Texas is produced from numerous aquifers, which can provide water for many purposes, including domestic and livestock uses, municipal use, industrial activities, irrigation, and agriculture. As of 2017, there are nine major aquifers and 22 minor aquifers recognized by the Texas Water Development Board (TWDB), and these aquifers underlie about two-thirds of the state's 268,596 square miles of total surface area.

Major aquifers are those that produce large amounts of water over large areas and minor aquifers produce either minor amounts of water over large areas or large amounts of water over small areas. In 2015, aquifers supplied approximately 56 percent of the 12.5 million acre-feet of water used in the state. Irrigation accounts for about 72 percent of the groundwater use, municipal is approximately 21 percent, and other uses include domestic and livestock, manufacturing, mining, and power generation (TWDB, *Texas Water Use Estimates - 2015 Summary*, 2017; see http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/2015TexasWaterUseEstimatesSummary.pdf).

The Texas Groundwater Protection Committee (TGPC) was created by the 71st Texas Legislature in 1989 to bridge gaps between existing state groundwater programs and to optimize water quality protection by improving coordination among agencies involved in groundwater activities.

By statute (see 40 CFR Section 26.403), the TGPC's membership is composed of the following individuals or their designated representative:

- the executive director of the Texas Commission on Environmental Quality (TCEQ);
- the executive administrator of the TWDB;
- the executive director of the Railroad Commission of Texas (RRC);
- the commissioner of health of the Texas Department of State Health Services (formerly the Texas Department of Health);
- the deputy commissioner of the Texas Department of Agriculture (TDA);
- the executive director of the Texas State Soil and Water Conservation Board (TSSWCB);
- a representative selected by the Texas Alliance of Groundwater Districts (TAGD);
- the director of Texas A&M AgriLife Research;
- the director of the Bureau of Economic Geology of the University of Texas at Austin; and

- a representative of the Water Well Drillers and Water Well Pump Installers Program of the Texas Department of Licensing and Regulation selected by the executive director of the department.

The executive director of the TCEQ serves as the TGPC's chairman. The TCEQ is designated as the lead agency for the TGPC and administers its activities. The executive administrator of the TWDB serves as the TGPC's vice-chairman.

The member agencies of the TGPC provide data for its groundwater quality inventory efforts. In 1996, the TGPC began conducting an inventory of groundwater quality of the state's aquifers through the partnership of two of the TGPC member agencies: the TCEQ and the TWDB. This information was published in the State of *Texas Water Quality Inventory 1996*, which is the predecessor to this report. Additional aquifers were included in subsequent reports until inventories of all 30 of the state's aquifers were completed for the 2002 report.

In subsequent *Water Quality Inventory* reports the TCEQ has utilized information from the TWDB's groundwater database to inventory ambient water quality in each of the state's major and minor aquifers for the most recent ten-year period. At the end of 2017, TWDB named a new minor aquifer, the Cross Timbers aquifer. Water quality information for this new aquifer will be included in future reports.

The TGPC also publishes a report each year called the *Joint Groundwater Monitoring and Contamination Report*, which describes the documented cases of groundwater contamination in the state resulting from activities regulated by Texas state agencies <https://www.tceq.texas.gov/publications/sfr/056>. Groundwater contamination is defined in TGPC rules (31 TAC, §601.3) as the detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater, which is based on the definition of "pollution" in the Water Code, §26.001 (see: http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.26.htm#26.001). Further, TGPC describes groundwater contamination in the Joint Report as contamination reasonably suspected of having been caused by activities of entities under the jurisdiction of the TGPC member agencies, as identified in the TWC, §26.406, TGPC rules, and subsequent legislative amendments. Reported contamination cases are generally limited to those affecting usable quality groundwater (less than 10,000 milligrams per liter of dissolved solids).

The most recently published Joint Report (2017, TGPC) includes 3,444 groundwater contamination cases documented or under enforcement during the 2016 calendar year. Approximately 83 percent (2,866) of the documented cases fall under the jurisdiction of the TCEQ. The remainder of the cases fall under the jurisdiction of the RRC (577 cases, or approximately 17 percent) and a groundwater conservation district that is a member of TAGD (one case, or less than 0.1 percent).

The groundwater contamination cases listed in the Joint Report were documented primarily through regulatory requirements for compliance monitoring, with the majority of cases identified by release-detection monitoring in the TCEQ's PST program. The report also identifies groundwater contamination cases that were documented through permit monitoring requirements, investigations of groundwater contamination complaints, or self-reporting. Groundwater contamination is most commonly detected when site-specific groundwater monitoring is conducted at waste disposal or product storage sites (TGPC, 2017).

The most common contaminants reported in the 2016 Joint Report include gasoline, diesel, and other petroleum products. These constituents are reflective of the fact that 34 percent of TCEQ's documented contamination cases were reported by the Petroleum Storage Tank Program. Some of the other contaminants found at the sites in the report include heavy metals; organic compounds such as phenols, trichloroethylene, carbon tetrachloride, dichloroethylene, naphthalene, creosote constituents, and various solvents; and pesticides, such as dieldrin, BHC, and dicamba.

The 2018 groundwater inventory effort shows that ambient groundwater quality in Texas is generally good, but varies somewhat among the aquifers. The ambient concentration in a small percentage of wells in the state exceed the drinking water maximum contaminant level, for some parameters such as nitrate, sulfate, and total dissolved solids. In addition, dissolved fluoride, which is naturally occurring in Texas, appears as a secondary contaminant of concern sporadically throughout the wells sampled during this period.

Groundwater contamination at regulated facilities still occurs principally in heavily populated areas of the state, such as Houston, Dallas, Fort Worth, San Antonio, and El Paso, and primarily at petroleum storage tank facilities. Staff analysis of the geographic data for the joint report suggested that a high concentration of regulated surface activity sites with groundwater contamination does not correlate with area-wide ambient groundwater degradation. This is understandable, given that contamination from most regulated surface activities tends to impact shallow, local water bearing zones that are separated from the major and minor aquifers.

OVERVIEW – GROUNDWATER RESOURCES

Each year the TWDB estimates the water used in Texas by reviewing water use surveys and estimating the amount of water used by municipalities, industrial facilities, irrigation, livestock, and mining. In 2015 Texans used approximately 12.42 million acre-feet of water, most of which was from groundwater sources (approximately 56 percent, or 6.95 million acre-feet). Approximately 42 percent came from surface water sources (about 5.27 million acre-feet) and 2 percent was from reuse (about 250,000 acre-feet) (TWDB, *Texas Water Use Estimates – 2015 Summary,* 2017; see: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/data/2015TexasWaterUseEstimatesSummary.pdf). Groundwater also provides a significant amount of the base flow for Texas rivers and streams, which makes it very important to maintaining the state's environment and economy.

The groundwater used by Texans is produced primarily from aquifers. An aquifer is made of underground layers of rock that store and can transmit water through the pore spaces, cracks, or voids in the rock. Major aquifers are produce large quantities of water over large areas of the state, whereas minor aquifers may produce large quantities of water over small areas or small quantities of water over large areas. All of the aquifers are very important, and some minor aquifers may constitute the only significant source of water supply in some regions of the state. Texas aquifers are composed of a variety of rock types, such as limestone, dolomite, sandstone, gypsum, alluvial gravels, and igneous rocks.

The major aquifers include (see Figure 1):

1. Carrizo-Wilcox
2. Edwards (Balcones Fault Zone / BFZ)
3. Edwards-Trinity (Plateau)
4. Gulf Coast
5. Hueco-Mesilla Bolsons
6. Ogallala
7. Pecos Valley
8. Seymour
9. Trinity

The minor aquifers include (see Figure 2):

1. Blaine
2. Blossom
3. Bone Spring-Victorio Peak
4. Brazos River Alluvium
5. Capitan Reef Complex
6. Cross Timbers (*NEW*)
7. Dockum
8. Edwards-Trinity (High Plains)

9. Ellenburger-San Saba
10. Hickory
11. Igneous
12. Lipan
13. Marathon
14. Marble Falls
15. Nacatoch
16. Queen City
17. Rita Blanca
18. Rustler
19. Sparta
20. West Texas Bolsons
21. Woodbine
22. Yegua-Jackson
23. Cross Timbers (new in 2017)

In addition to the major and minor aquifers, smaller local aquifers may provide groundwater for an area (TWDB Report #380, "Aquifers of Texas," 2011). Groundwater quality of these smaller groundwater sources is not directly addressed in this report, as they are too small and numerous to be characterized within the scope of this document.

FIGURE 1. MAJOR AQUIFERS OF TEXAS

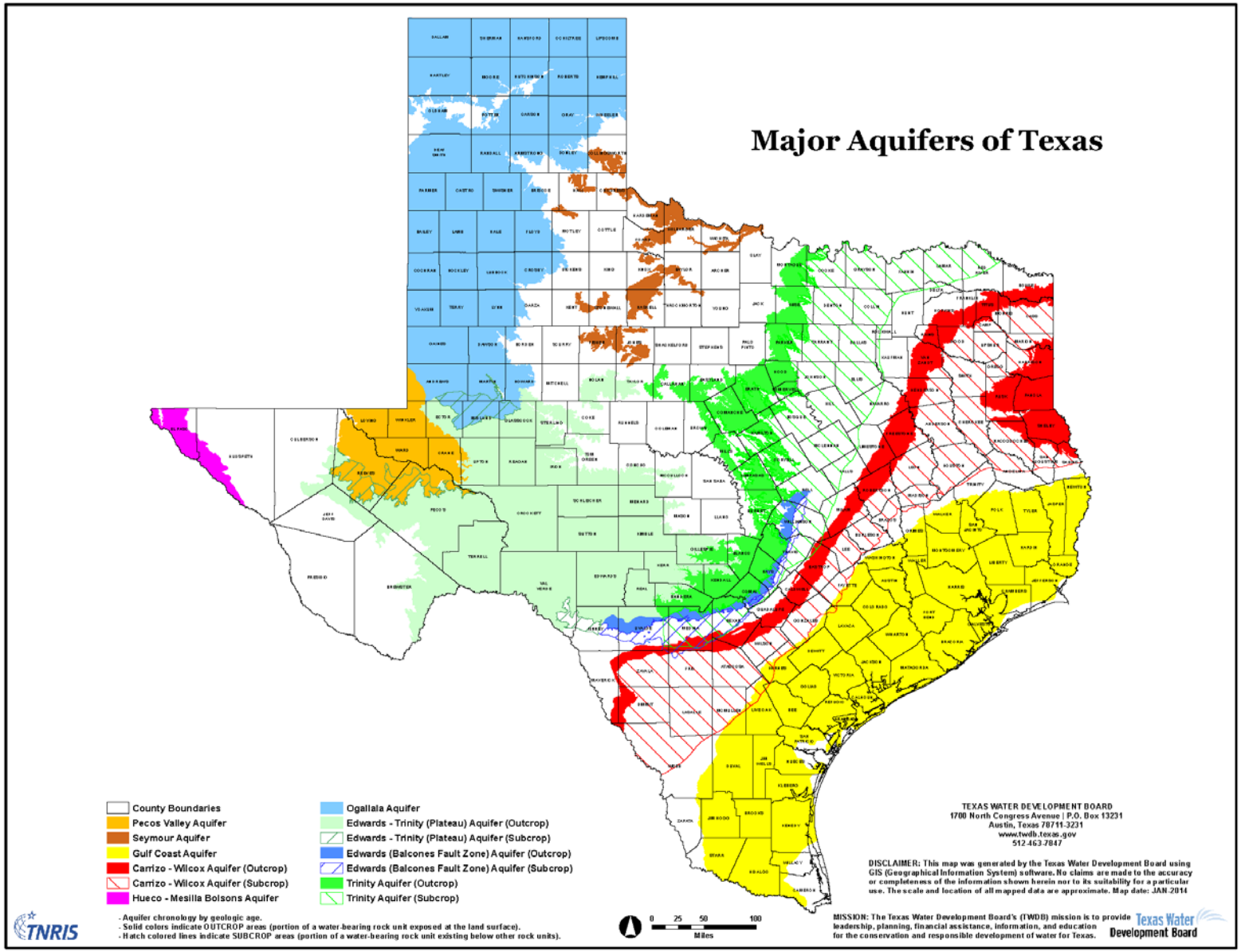
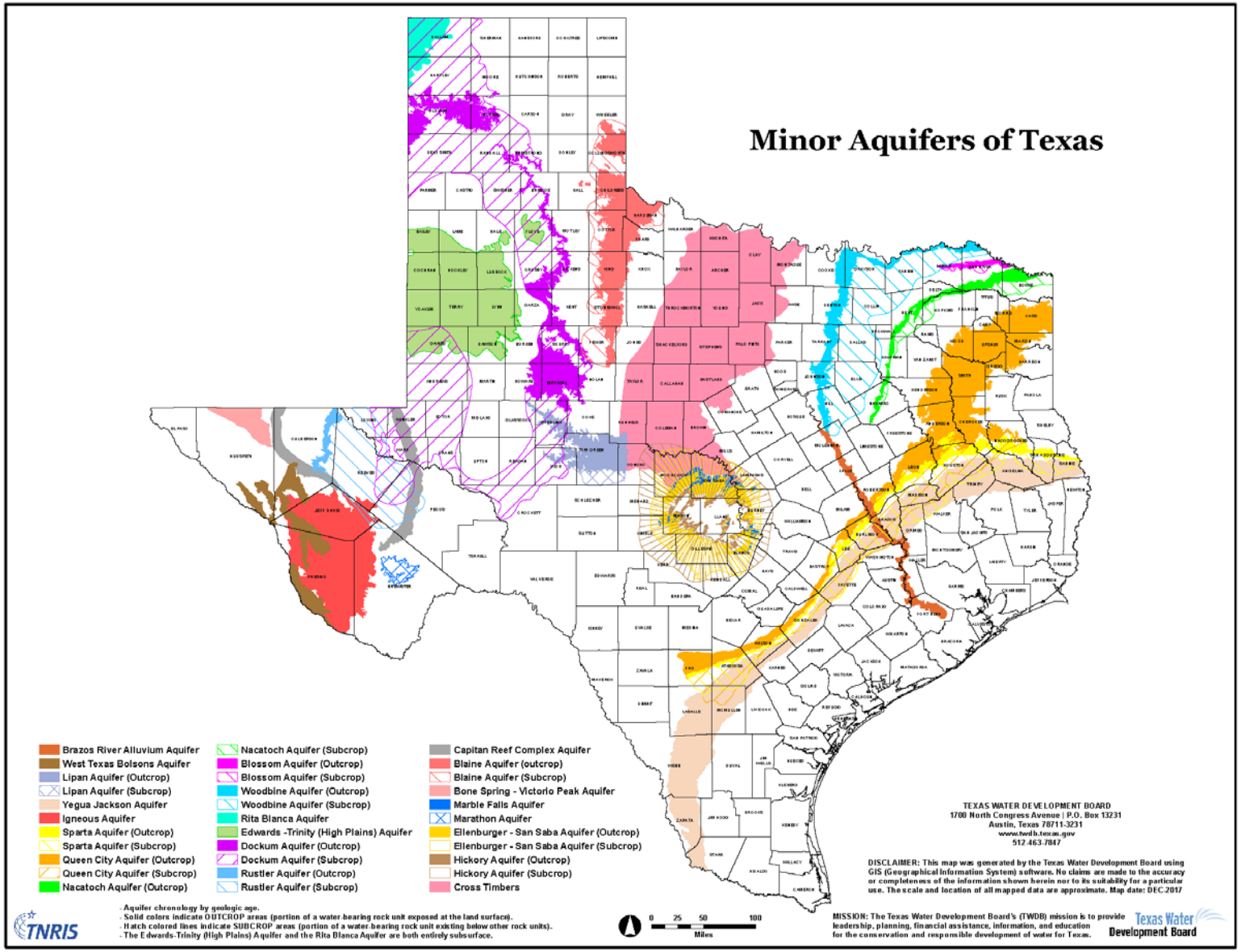


FIGURE 2. MINOR AQUIFERS OF TEXAS



GROUNDWATER PROTECTION

TEXAS GROUNDWATER PROTECTION COMMITTEE

The Texas Groundwater Protection Committee was created by the 71st Texas Legislature in 1989 to bridge gaps between existing state groundwater programs and to optimize water-quality protection by improving coordination among agencies involved in groundwater activities. State law codified in TWC, §§26.401 through 26.408 (see: http://www.statutes.legis.state.tx.us/Docs/WA/htm/WA.26.htm#26.401) establishes the TGPC; outlines the TGPC's powers, duties, and responsibilities; and establishes the state's groundwater protection policy.

The TGPC actively identifies opportunities to improve existing groundwater quality programs and promotes coordination between agencies. The TGPC also strives to improve or identify areas where new or existing programs could be enhanced to provide added protection. Major responsibilities of the TGPC include:

- improving interagency coordination regarding groundwater protection;
- developing and updating a comprehensive groundwater protection strategy for the state;
- studying and recommending to the Legislature groundwater protection programs for areas in which groundwater is not protected by current regulation;
- publishing an interagency groundwater monitoring and contamination report;
- each biennium, prior to each regular legislative session, filing a report of the TGPC's activities with the governor, lieutenant governor, and speaker of the House of Representatives, including any recommendations for legislation related to groundwater protection;
- advising the TCEQ on the development of agricultural chemical plans to prevent groundwater pollution; and
- developing the form and content groundwater contamination notices.

The TGPC includes representatives from ten agencies. The executive director of the TCEQ serves as the TGPC's chairman and the executive administrator of the TWDB serves as the vice chairman. The TCEQ is designated as the lead agency for the TGPC and administers the activities of the TGPC.

Coordination with Federal Agencies

The TGPC actively coordinates with federal agencies on groundwater protection issues that affect the state. The TGPC has worked with federal agencies on issues related to a comprehensive state groundwater protection program and on the development of pesticide management plans to prevent groundwater contamination. In addition, the TGPC has regularly provided national level input to federal agencies on groundwater protection and programmatic issues through the Groundwater Protection Council (an association of state groundwater and underground injection control program directors), the State Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Issues Research Evaluation Group (a group formed by state agricultural regulatory officials and EPA to discuss and evaluate pesticide matters affecting states), and other state and federal stakeholder and regulatory guidance groups.

The TGPC also works closely with the USGS, which is the federal agency that performs national level geologic mapping and hydrologic studies. Staff of the USGS have participated in various TGPC-sponsored projects, providing groundwater expertise and opportunities for state input in federally-sponsored research.

In March 1985, the Texas Department of Water Resources, predecessor to the TCEQ and the TWDB, received a grant from the EPA to improve the coordination of groundwater protection activities undertaken by state agencies. In response to this federal initiative, the interagency Groundwater Protection Committee, predecessor to the Texas Groundwater Protection Committee, was formed. Since that time, the coordination of groundwater protection activities of the various state programs and agencies and the development of a groundwater protection strategy have been funded through EPA grants administered under the Clean Water Act (CWA), §106.

DESCRIPTIONS OF GROUNDWATER PROTECTION PROGRAMS

The groundwater protection programs of TGPC member agencies and organizations are described in this section. Table 1 includes a summary and status of each groundwater protection program.

Table 1. Summary and Status of State Groundwater Protection Programs

Programs or Activities	Implementation Status	Responsible State Agency
Active SARA Title III Program	fully established	TCEQ*
Ambient Groundwater Monitoring System	fully established	TWDB
Aquifer Vulnerability Assessment	continuing efforts	TCEQ*
Aquifer Mapping	fully established	TWDB
Aquifer Characterization	fully established	TWDB

Programs or Activities	Implementation Status	Responsible State Agency
Comprehensive Data Management System	continuing efforts	TGPC*
State Groundwater Protection Strategy	continuing efforts	TGPC*
Dry Cleaner Remediation Program	fully established	TCEQ
Groundwater Best Management Practices	continuing efforts	TGPC*
Groundwater Legislative Goal	fully established	TCEQ*
Groundwater Classification	fully established	TGPC*
Groundwater Quality Standards	fully established	TCEQ
Interagency Coordination for Groundwater Protection Initiatives	fully established	TGPC*
Municipal Setting Designations	fully established	TCEQ
Municipal Solid Waste (Subtitle D) State Authorized Program	fully established	TCEQ
Nonpoint Source Controls/Agricultural & Silvicultural	continuing efforts	TSSWCB
Nonpoint Source Controls/All Others	continuing efforts	TCEQ
Pesticide State Management Plan (Generic)	received EPA concurrence	TGPC*
Pesticide Specific Regulation Programs	fully established	TDA
Pollution Prevention Program	fully established	All Agencies
Radiation Control Program	fully established	DSHS
Radioactive Waste Disposal Program	fully established	TCEQ
Resource Conservation and Recovery Act (RCRA) – State Authorized Program	fully established	TCEQ
State Hydrocarbon Exploration/Production Regulations	fully established	RRC
State Superfund	fully established	TCEQ
State Oilfield Cleanup Fund	fully established	RRC
State Petroleum Storage Tank Remediation Fund	fully established	TCEQ
State Septic System Regulations	fully established	TCEQ*
Surface Mining and Reclamation Regulations	fully established	RRC
Underground Storage Tank Installation Requirements	fully established	TCEQ
UST Registration Program	fully established	TCEQ
Underground Injection Control (UIC) Program/Industrial	fully established	TCEQ
UIC Program/Oil & Gas	fully established	RRC
Vulnerability Assessment for Drinking Water/Source Water Protection	fully established	TCEQ
Wellhead Protection Program (EPA-approved)	fully established	TCEQ
Wastewater Discharge and Disposal Permits	fully established	TCEQ
Water Well Abandonment Regulations	fully established	TDLR
Water Well Installation Regulations	fully established	TDLR

Texas Commission on Environmental Quality

The TCEQ is responsible for regulatory groundwater protection programs that aim to prevent contamination and to identify, assess, and remediate existing problems. The TCEQ implements these programs through education, voluntary action assistance, permitting, and enforcement. As the state's lead agency for water quality protection, the TCEQ administers both state and federally mandated programs. Federal programs that TCEQ administers include the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); the Clean Water Act (CWA); and the Safe Drinking Water Act (SDWA). The TCEQ also develops state management plans under FIFRA aimed to prevent the contamination of groundwater by pesticides.

Many TCEQ programs have responsibilities related to the protection of groundwater resources, including the Office of Compliance and Enforcement, the Office of Waste, and the Office of Water.

Texas Water Development Board

The TWDB conducts an active groundwater resource assessment program. TWDB personnel have identified boundaries and various characteristics for all of the state's major and minor aquifers including geologic information, water availability, and recharge. In addition, TWDB has identified the major entities using groundwater within each river basin, the aquifer(s) from which they pump, the quality of water being developed, and the quantity of water needed for a 50-year planning period. To accomplish this, TWDB has been collecting data on the occurrence, availability, quality, and quantity of groundwater present and the current and projected demands on groundwater resources. The statewide groundwater level measurement programs, groundwater quality sampling program, and groundwater studies are vital to the state's regional water planning efforts.

The purpose of the ambient groundwater quality sampling program is to collect and utilize groundwater data to: 1) monitor changes over time, if any, in groundwater quality, and 2) establish, as accurately as possible, the baseline quality of groundwater occurring naturally in the state's aquifers. TWDB implements the groundwater quality monitoring program according to procedures established in its "Field Manual for Groundwater Sampling, User Manual 51," TWDB, 2003 <see: http://www.twdb.texas.gov/groundwater/docs/UMs/UM-51.pdf>. The Board also obtains data collected by other entities that follow these and similar procedures, such as groundwater conservation districts, the U.S. Geological Survey, and other state and federal agencies.

TWDB personnel process and store collected data by state well number in the TWDB groundwater database, which also contains indicators of sample reliability, collecting entity, and analytical laboratory along with

sample results. Using the geographical coordinates stored in TWDB's groundwater database, statewide water quality data are analyzed using geographical information systems software. Through the TWDB's Water Data Interactive portal, these data are available on the TWDB's Groundwater Data Viewer, an internet-based mapping application:

<https://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer>

They are also available from specific reports at:

<http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp>.

Railroad Commission of Texas

The RRC regulates the disposal by injection of oil and gas wastes generated in connection with activities associated with the exploration, development, and production of oil or gas or geothermal resources (Statewide Rule 9), the injection of fluid for enhanced oil recovery (Statewide Rule 46), and the underground storage of hydrocarbons (Statewide Rules 95, 96, and 97). The RRC's Underground Injection Control Program for these categories of wells (Class II) is administered under authority issued by EPA under the Safe Drinking Water Act. The focus of the UIC program is to protect underground sources of drinking water. Class II wells must meet permitting standards and be tested and monitored to demonstrate mechanical integrity.

Brine mining injection wells (Class III) are typical of solution mining wells. The RRC Class III Brine Mining Injection Well Program was approved on March 29, 2004. Since then, all active brine-mining facilities were re-permitted per the provisions of Statewide Rule 81. A majority of brine mining facilities are required to monitor groundwater quality and submit groundwater-monitoring reports. Groundwater monitoring is not conducted at facilities where usable quality groundwater is not present, typically located on salt domes along the Gulf Coast.

Through the Texas Administrative Code (TAC), Title 16, Part 1, Chapter 3.8 (Statewide Rule 8, Water Protection) and Chapter 4, Subchapter B (Recycling Programs), the RRC regulates the treatment, storage, recycling, and disposal of oil and gas wastes at or near ground surface. These waste streams are generated from activities associated with the exploration, development, and production of oil, gas, or geothermal resources. Statewide Rule 8 prohibits the waste of petroleum resources and the pollution of surface and subsurface waters of the state, and requires permits for various pits and other waste management units that are not specifically authorized by rule. Chapter 4, Subchapter B specifies permit requirements and provides guidance for the recycling of generated fluids and solids into reusable products.

Oil-field cleanup activities also fall under the jurisdiction of the RRC and are subject to regulations under Statewide Rule (SWR) 8, SWR 20, SWR 91,

and RRC Special Orders. Other rules that protect groundwater and influence cleanup activities include: SWR 13 (well completion requirements), SWR 14 (plugging requirements), SWR 9 (injection [disposal] into a non-productive zone), SWR 46 (injection into a productive zone), SWR 57 (reclamation plants), SWR 93 (water quality certification), SWR 98 (standards for management of hazardous oil and gas waste), and 16 TAC §4.601-4.632 (disposal of oil and gas NORM waste).

The Surface Mining and Reclamation Division (SMRD) is authorized to enforce State laws and regulations consistent with the Texas Surface Coal Mining and Reclamation Act (Vernon's Texas Codes Annotated, Ch. 134, Texas Natural Resources Code) and the Texas Uranium Surface Mining and Reclamation Act (Vernon's Texas Codes Annotated, Ch. 131). As part of the groundwater information required in the Regulations, determination of the quality of subsurface water includes the analysis of common inorganic groundwater constituents plus certain trace metals. In addition, monitoring plans for pre-mining, mining, and post-mining conditions are required in order to track variations in water-quality.

Monitoring by the Commission is generally conducted only during investigations for some specific reason, such as water-quality complaints. The Commission no longer maintains a laboratory, and samples collected by enforcement personnel are sent to a commercial laboratory under contract with the Division for chemical and physical analyses. Typically, between one and five water-quality and quantity complaints are investigated annually by RRC field personnel. To date, investigations have not borne out any confirmed contamination cases.

Department of State Health Services

The Texas Department of State Health Services (DSHS) is responsible for promoting and protecting the health and well-being of Texans. Regarding groundwater issues, DSHS has several programs related to groundwater safety and public health concerns.

The DSHS Health Assessment and Toxicology Program offers support when issues arise regarding potential contamination of drinking water, including drinking water that is produced from a groundwater source. DSHS performs Public Health Assessments and Health Consultations to determine if exposures to contaminants are occurring and whether adverse health effects from the exposures are possible.

Through a cooperative agreement with the Agency for Toxic Substances and Disease Registries, DSHS performs health assessments for sites on or proposed for listing on the National Priorities List (NPL) of Superfund sites. In such cases, DSHS provides analytical, toxicological and epidemiological support for protecting the public health.

The DSHS Texas Fluoridation Program assists the Public Water Systems in adjusting the fluoride level in the drinking water thus helping Texans improve their oral health by reducing and preventing tooth decay. TFP promotes community water fluoridation by assisting PWS with the design, installation, maintenance, and inspection of fluoride systems; and providing training on water fluoridation for the PWS personnel engaged in fluoridation. The program also collects and records fluoride levels in the drinking water for quality control.

The DSHS Radiation Control Program regulates radioactive materials in Texas. The RCP monitors groundwater for radionuclides on a routine basis at several facilities. Intermittently, the RCP samples groundwater as a result of an incident, complaint, or situation that leads the RCP to believe there may be groundwater contamination.

The DSHS Laboratory Services Section is the principal drinking water laboratory in the state of Texas. The laboratory performs water quality testing, including chemical and radiological analyses required by the U.S. EPA SDWA, and other analyses in support of any DSHS program requiring testing of drinking water samples. The Laboratory Services Section also accepts water samples for routine microbiological analysis from the public for a fee.

Texas Department of Agriculture

The TDA has lead authority to regulate pesticides in Texas. TDA recognizes certain pesticides as potential groundwater contaminants and is responsible for preventing unreasonable risk to human health and the environment from the use of pesticides.

The agency conducts a variety of activities designed in part or entirely to reduce the potential of groundwater contamination by pesticides:

- Product Registration - All pesticide products sold and used in Texas must be registered with TDA. This process ensures these products have met all USEPA requirements for pesticide product labeling.

- Pesticide Label Compliance and Enforcement - The agency has responsibility and authority under the Texas Agricultural Code to enforce pesticide labels, which include usage information and precautions that directly or indirectly reduce the potential of groundwater contamination.

- Pesticide Applicator Training - All prospective users of restricted-use or state limited-use pesticides are required to obtain an applicator's license. Obtaining a license includes receiving training in the proper and legal use of pesticides, applicator testing, and continuing education. This includes both agricultural pesticide applicators as well as those for structural pest control. Each

structural pest control applicator must be properly registered, trained and supervised or properly licensed to make applications regardless of the classification of the pesticide.

- Pesticide Laboratory Services - Although TDA does not routinely conduct groundwater monitoring for pesticides, the agency maintains a fully equipped laboratory at Texas A&M University. The lab conducts pesticide residue analysis to assist the department's efforts in enforcing pesticide laws and regulations and as a participant in USDA's Pesticide Data Program.

Texas State Soil and Water Conservation Board

The TSSWCB is the state agency that administers Texas' soil and water conservation law, coordinates the state's conservation and nonpoint source pollution abatement programs, and provides technical assistance to the state's 216 Soil and Water Conservation Districts (SWCDs).

Nonpoint source pollution originates from different sources that cannot be traced to any single point, such as a pipe. The TSSWCB administers several programs as the lead state agency for the planning, management, and abatement of agricultural and silvicultural (forestry) nonpoint source pollution.

The Water Quality Management Plan (WQMP) Program offers landowners and operators of agricultural and silvicultural lands a voluntary mechanism for being protective of state water quality with respect to nonpoint source pollution. This program offers cost-share funding for the installation of soil and water land improvement measures to serve as an incentive for participating. Additionally, the TSSWCB offers grants for assessment, demonstration, implementation, education, and research related to nonpoint source pollution.

The Water Supply Enhancement Program (formerly the Texas Brush Control Program) protects groundwater resources by controlling invasive brush species which use a lot of water. Controlling the brush and restoring native grasses leaves more water available to recharge the aquifer below. This program has helped restore seeps and springs that had been dormant for decades due to the invasion of non-native brush species.

The Flood Control Dam Grant Program provides funding to the sponsors of more than 2,000 structures for operation and maintenance, structural repair, and rehabilitation to protect lives, property, and infrastructure.

Texas Alliance of Groundwater Districts

The TAGD, formerly the Texas Groundwater Conservation Districts Association, was formed on May 12, 1988. Its core District Membership is restricted to groundwater conservation districts (GCDs, or districts) in

Texas who have the powers and duties to manage groundwater as defined in TWC, Chapter 36; other organizations with an interest in groundwater management may become Associate Members. TAGD is organized exclusively for charitable, educational, or scientific purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code. As such it can accept tax-deductible donations and use these donations to educate the public to the growing need for water conservation and groundwater protection.

The purpose of TAGD is to educate the public, further groundwater conservation and protection activities, and to provide a communications vehicle for the exchange of information between individual districts and the general public. TAGD maintains contact with members of the private sector and various local, state, and federal officials and their agencies to obtain, and provide, timely information on activities and issues relevant to groundwater conservation districts. To date, there are more than 80 district members of TAGD. Appendix 6 includes a map with all of the current GCDs, including those which are members of TAGD.

The districts are created by the Legislature or by the TCEQ with the purpose and responsibility of preserving and protecting groundwater. GCDs can be created by one of three procedures: (1) special law districts can be established by the legislature; (2) districts can be created through a property-owner petition filed with the TCEQ; and (3) districts can be created in priority groundwater management areas through procedures initiated by the TCEQ. Districts are local or regional in their jurisdiction and typically have elected boards of directors. Among other things, GCDs have been granted authority to monitor groundwater quality. A number of districts also have the authority to bring civil court proceedings for injunctive relief against an entity causing groundwater contamination.

Texas A&M AgriLife Research

Texas A&M AgriLife Research is the state's premier research and technology development agency in agriculture, natural resources, and the life sciences. Headquartered in College Station, AgriLife Research has a statewide presence, with scientists and research staff on other Texas A&M University System campuses and at the 13 regional Texas A&M AgriLife Research and Extension Centers. The agency conducts basic and applied research to improve the productivity, efficiency and profitability of agriculture, with a parallel focus on conserving natural resources and protecting the environment. AgriLife Research has 550 doctoral-level scientists, many of whom are internationally recognized for their work. The Texas Water Resources Institute is an administrative unit of AgriLife Research and coordinates much of the internal water-related research.

Broad goals of the AgriLife Research program include those specifically targeted to protect, preserve and efficiently use groundwater resources. Groundwater programs of AgriLife Research stress the development of

management strategies, technologies and educational programs to support sustainable quality water supplies.

AgriLife Research scientists are working to address a variety of groundwater planning, supply, quality and use issues.

Recent AgriLife Research groundwater-related research activities include:

- Developing technologies, procedures and strategies for deficit irrigation applications and effective water management policies to efficiently use and protect the Ogallala aquifer

- Optimizing limited early season irrigation, overcoming poor germination associated with subsurface drip irrigation and evaluating crop rotations among drought-tolerant crops with the goal of sustaining agriculture through adaptive management to preserve the Ogallala aquifer under a changing climate

- Analyzing current and potential groundwater conservation policies across the Southern Great Plains to determine if they provide profit-driven farmers with incentives to save water

- Investigating the unconfined aquifer as the source of low pH in surface waters

- Developing a novel chemical water treatment technology that can be used to treat impurities in groundwater used in municipal water supplies

- Using remote-sensing technologies to detect plant disease early and save groundwater

- Developing a policy assessment tool for the Texas High Plains to guide impacts of water conservation policies and strategies to manage groundwater resources

- Developing bioenergy crops that can use saline groundwater, among other water

- Assessing the impacts of land-use change, climate change and rangeland management on hydrology and environment

- Developing a web-based irrigation scheduling tool to efficiently irrigate cotton with limited water

- Enhancing the quantitative understanding of the Hueco-Mesilla Bolsons aquifer that underlies El Paso, Texas, and Ciudad Juarez, Mexico, as well as to creating an innovative framework for identifying and assessing all Texas-Mexico border aquifers

- Evaluating the relative risk to vegetation, groundwater and surface water from total dissolved solids of water stored at open impoundments on land

- Determining links between pathogens in surface or near-surface sources, runoff and streams and their impacts on groundwater

- Examining the effects of land-cover change (grasslands versus woodlands) on portfolios of ecosystem services including groundwater recharge and streamflow

- Examining rainfall recharge in semi-arid basin and range landscapes

- Examining different brush management strategies influence groundwater recharge of the Carrizo-Wilcox aquifer

- Developing integrated research to enhance water use, water reuse and brackish and saline groundwater use, including using brackish and saline groundwater as a source water for hydraulic fracturing, to conserve fresh groundwater

- Improving drought tolerance of crops (corn, cotton and others), including plant breeding, conservation tillage systems and water management strategies to conserve groundwater

- Evaluating effects of conservation practices on soil and water resources

- Improving technologies for multi-well managed aquifer recharge systems

- Training future groundwater professionals through undergraduate and graduate education and research programs at Texas A&M University (TAMU) and other System institutions. Many of AgriLife Research scientists at TAMU in College Station also hold joint teaching appointments, thus providing the latest research results to students

AgriLife Research efforts are complemented by the outreach educational programs of the Texas A&M AgriLife Extension Service. For example, AgriLife Extension specialists provide educational and training programs and meetings and provide easy-to-read fact sheets and other publications for specific targeted clientele, such as landowners interested in pumping and desalinating brackish groundwater, proposed guidelines for injection wells and groundwater management among others. Other AgriLife Extension activities include field demonstrations and educational programs for youth and adults.

AgriLife Extension specialists provide leadership for educational programs on educating private water well owners about potential pollutant sources and what steps can be taken to lessen potential impacts from these sources and plugging abandoned wells to protect groundwater quality and groundwater conservation districts. Extension specialists also provide technical leadership for development of pesticide-specific management plans adapted to Texas.

While Texas A&M AgriLife Research has no regulatory monitoring authority, it does operate soil and water testing laboratories in College Station and groundwater samples may be collected and analyzed in connection with research investigations. Through these laboratories and with subject matter specialists and county-based education agents, AgriLife provides information on groundwater quality to thousands of rural Texans.

The Bureau of Economic Geology of The University of Texas at Austin

Established in 1909, UTBEG is a research entity of the university and functions as the State Geological Survey. The Bureau is a research unit of UT Austin's Jackson School of Geosciences. The Bureau conducts basic and applied research projects, including environmental site assessment and investigations of groundwater resources and groundwater quality, in support of other state agency missions. The Bureau's hydrogeologic and environmental efforts continued to emphasize hydrogeologic study of issues related to groundwater quality and quantity. Research activities involve numerical modeling, original field research, and data collection and analysis.

Recent UTBEG groundwater-related research topics include:

- Water quality impacts of energy production, including identification of sources of contamination using isotope modeling
- Groundwater/surface water interactions and impacts on endangered species
- Identifying, evaluating, and ranking localized compliance strategies for selected small public water systems that were noncompliant with one or more of the federal/state chemical maximum contaminant levels (MCLs)

As part of sponsored- research projects, Bureau staff measure groundwater quality and water levels in selected public and private wells. These projects cover many parts of Texas. Most water quality data collected in these studies consist of pH, temperature, conductivity, major and minor inorganic ions, total organic carbon, isotopes, and other constituents of interest. Data are used to interpret rates and modes of hydrologic processes and the source and movement of groundwater. Project-specific data are collected in data reports or topical reports.

Periodically, the digitized data are compiled for inclusion in the Texas Natural Resources Information System data system.

Texas Department of Licensing and Regulation

The need for identification and protection of the state's groundwater resources was recognized by the Legislature through the creation of the Water Well Drillers Board (Board) in 1965. In 1991, the 72nd Legislature expanded the Board's functions to include licensing and regulation of water well pump installers.

Senate Bill 1955 (75th Legislature, 1997) transferred the Water Well Driller Advisory Council and the Well Driller/Pump Installer Program from the Texas Natural Resource Conservation Commission to the Texas Department of Licensing and Regulation (TDLR) effective September 1, 1997.

The Well Driller/Pump Installer/Abandoned Well Referral and Notification Program maintains communications with the Council, industry, various state agencies, and groundwater conservation districts and investigates all alleged violations of Chapters 1901 and 1902 of the Texas Occupations Code and 16 TAC, Chapter 76 (Rules). The Program also investigates consumer complaints filed against well drillers, pump installers, and performs compliance investigations of water, monitor, injection, and dewatering wells to insure compliance with well construction standards.

Investigations include, but are not limited to, surface completions, depth of annular cement, regulated distances from contamination sources and property lines, abandoned and deteriorated water wells, and licensing requirements. In addition, rules requiring isolation of zones containing undesirable or poor-quality water are enforced to prevent commingling with and degradation of fresh water zones.

The TDLR's Well Driller/Pump Installer/Abandoned Well Referral and Notification Program staff also administers the Abandoned Well Notification Program. Chapters 1901 and 1902 of the Texas Occupations Code authorize this function. Investigations are conducted and landowners are notified that within one-hundred eighty (180) days of notification, the abandoned and/or deteriorated water well must be plugged, completed, or capped in accordance with 16 TAC, Chapter 76 specifications.

Violations of Chapters 1901 and 1902 of the Texas Occupations Code and the Rules are enforced by the TDLR's Enforcement Division through TDLR orders requiring administrative penalties and corrective actions, cease and desist orders or referral to the Office of the Attorney General. 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.

GROUNDWATER PROTECTION POLICY

TWC, §26.401 establishes the state's groundwater protection policy (see Appendix 2), which establishes a goal of nondegradation of groundwater resources for all state programs. The policy recognizes the variability of the state's aquifers, the importance of maintaining water quality for existing and potential uses, the protection of the environment and the public health and welfare, and the maintenance and enhancement of the long-term economic health of the state. Further, the policy recognizes that groundwater contamination may result from many sources, including current and past oil and gas production and related practices, agricultural activities, industrial and manufacturing processes, commercial and business endeavors, domestic activities, and natural sources that may be influenced by, or may result from, human activities. The use of the best professional judgment by the responsible state agencies in attaining the goal and policy is also recognized.

The policy states that discharges of pollutants, disposal of wastes, and other regulated activities should be conducted in a manner that will maintain present uses and not impair potential uses of groundwater or pose a public health hazard. The programs of the various state agencies are generally coordinated to attain this goal.

GROUNDWATER CLASSIFICATION SYSTEM

The TGPC and its member agencies recognize that groundwater classification is an important tool to be used in the implementation of the state's groundwater protection policy. Through classification, the groundwater in the state can be categorized and protection or restoration measures can then be specified by member agencies according to the quality and present or potential use of the groundwater.

The TGPC has developed a Groundwater Classification System for use by state agencies. Four groundwater classes are defined based on the concentration of total dissolved solids (TDS). The names and concentration ranges are based on traditional nomenclature associated with each class. Fresh groundwater is classified as having a TDS concentration range from zero to 1,000 milligrams per liter (mg/l); slightly saline groundwater, a TDS concentration range from 1,000 to 3,000 mg/l; moderately saline groundwater, a TDS concentration range from 3,000 to 10,000 mg/l; and very saline groundwater to brine, a TDS concentration greater than 10,000 mg/l. Quality also determines usability; however, it is implicit in the classification that a water-bearing zone must be able to produce sufficient quantities of water to meet its intended use.

The Groundwater Classification System applies to all groundwater in the state. In assigning a classification, the member agencies attempt to use the natural quality of the groundwater that is unaffected by discharges of

pollutants from human activities. All usable and potentially usable groundwater is subject to the same protection provided by the state's groundwater protection policy. Starting with the nondegradation goal, protection or restoration measures may be varied according to the response level set by the classification so long as the following conditions are met:

- current groundwater uses are not impaired;
- potential groundwater uses are not impaired;
- a public health hazard is not created; and
- the quality of groundwater is restored if feasible.

In determining protection or restoration measures, an agency considers all present or potential beneficial uses of groundwater of a given quality. Generally, drinking water for human consumption would require the highest degree of groundwater protection or restoration. Protection for this use will also, arguably, be protective of all other current or potential uses. These considerations facilitated defining two response levels for purposes of assigning protection or restoration measures that are commensurate with the potential to impact human health and the environment.

- Level I response for the fresh, slightly saline, and moderately saline classes should be based on the current or potential use as a human drinking water supply.
- Level II response for the very saline to brine class should be based on indirect exposure (i.e., by means other than drinking) or no human consumption.

In specifying a protection or restoration measure, member agencies should apply best professional judgment on a case-by-case basis. Evaluations to be made include such factors as productivity, the availability of alternate sources of water, background concentrations of naturally occurring constituents, the effects of constituents on usability, traditional and potential beneficial uses of the water, economic and technical feasibility of treatment, and projected needs for and types of impacts on these groundwaters.

The classification system is intended to be implemented by member agencies as an integral part of their groundwater protection programs. In addition to its response-setting function, the classification system fosters consistency among the various programs.

STATE GROUNDWATER PROTECTION STRATEGY

In evaluating the states' activities under the groundwater protection strategy initiative begun in the early 1980s, the EPA concluded that additional efforts were needed to protect the nation's groundwater. EPA found that existing groundwater protection programs were a patchwork of federal, state, and local efforts that addressed individual sources of contamination rather than attempting to protect the resource as a whole. During fiscal years 1992 and 1993, the EPA published guidance for the development of comprehensive state groundwater protection programs (CSGWPP). Published early in 1993, the CSGWPP guidance encourages the states to further develop existing programs into a more comprehensive approach.

While the CSGWPP program is no longer an active EPA program, the TGPC is required by statute to develop a comprehensive strategy that coordinates the activities of all the participating agencies and documents what needs to be done to protect groundwater in the State of Texas. The TGPC addressed this duty directly in 1988 through the formal publication of the Texas Ground Water Protection Strategy. Since that time, there have been several documents published that describe changes to the groundwater protection programs and authorities of state agencies with respect to groundwater. This includes the Texas Ground Water Protection Profiles, 1991, and later the annual Joint Groundwater Monitoring and Contamination Report. There have been many changes in agencies and the programs that they administer since 1988. The more recent publications have focused on the water quality aspects of various programs rather than the state strategy for groundwater protection.

Recognizing the changes that have occurred since the state's first groundwater protection strategy was developed, the TGPC decided in January 2001 to begin the process to update it. That process resulted in the document, *Texas Groundwater Protection Strategy*, TCEQ Publication No. AS-188, February 2003 <https://www.tceq.texas.gov/assets/public/comm_exec/pubs/as/188.pdf>. This document provides a road map for the current activities of the TGPC. It is divided into thematic sections designed to highlight the state's current protection activities, and importantly, identify any gaps that may need to be filled among those programs.

A summary of the information in the *Strategy* (2003) includes:

- the state's groundwater protection goal as established by the Legislature;
- the statewide groundwater classification system and how the state identifies contamination and quantity issues;

- the roles and responsibilities of the various state agencies involved in groundwater protection and discusses the TGPC as a coordinating mechanism;

- examples of how the various state agencies implement groundwater protection programs through regulatory and non-regulatory models;

- how the local, state, and federal agencies coordinate management of groundwater data for the enhancement of groundwater protection;

- the role that research plays in understanding groundwater's importance and the importance of coordinating research;

- public education related to groundwater being performed in the state;

- public participation in establishing and implementing groundwater policy;

- a plan to update the groundwater strategy;

- proposals for the next document to identify and rank significant threats to the state's groundwater resources, consideration of the vulnerability of groundwater resources, and a prioritization of actions to address those threats; and

- recommendations and possible actions that could be taken to protect groundwater.

The TGPC is currently revising the 2003 *Strategy* to provide an updated road map and address new challenges. Once finalized, this updated *Strategy* will be made available on the TGPC's website.

AMBIENT GROUNDWATER MONITORING

The TWDB administers an ambient groundwater monitoring program which collects data on the occurrence, availability, quality, and quantity of groundwater present. This information helps to assess the current and projected demands on groundwater resources. Accordingly, the statewide groundwater level measurement programs, groundwater quality sampling program, and groundwater studies are vital to the state's regional water planning efforts.

The purpose of the ambient groundwater quality sampling program is to collect data to: 1) monitor changes, if any, in the quality of groundwater over time and 2) establish, as accurately as possible, the baseline quality of groundwater occurring naturally in the state's aquifers. TWDB conducts the groundwater quality monitoring program in accordance with procedures established in its "Field Manual for Groundwater Sampling" <https://www.twdb.texas.gov/groundwater/docs/UMs/UM-51.pdf>. TWDB performs ambient groundwater monitoring on water wells throughout the extent of an aquifer, such that each of the major and minor aquifers of the state are monitored approximately every four years. This data is available in several reports on the TWDB's web site <https://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp>.

It also obtains data collected by other entities that follow these and similar procedures, such as groundwater conservation districts, the U.S. Geological Survey, and other state and federal agencies.

The TWDB sampled 217 wells in 2016, and cooperators sampled at 127 sites (wells and springs). Data collected under this program was entered into the agency's groundwater database. The TWDB's Water Data Interactive web-based mapping application contains information on selected water wells, springs, oil/gas tests, water levels, and water quality data:

<https://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer>

The TGPC relies upon ambient monitoring data available from the TWDB's Groundwater Database (GWDB). This database is maintained by the TWDB and it includes years of sampling and analysis. According to TWDB the GWDB contained information for nearly 140,000 sites in 2013, including water wells, springs, oil/gas tests that were originally intended to be or were converted to water wells, water levels, and water quality. This report includes data from over 3,200 water wells across the state that were sampled between September 1, 2007 and August 31, 2017.

Ambient monitoring groundwater quality data for all major and minor aquifers used in this report are tabulated in Table 2, with data on each aquifer on Tables 6 through 35. In addition to the ambient water quality data tables, the TWDB has published detailed reports of some of its

collected groundwater quality data in Hydrologic Atlases of certain individual aquifers, which can be found at: <www.twdb.texas.gov/publications/reports/numbered_reports/index.asp>.

TABLE 2. AMBIENT MONITORING GROUNDWATER QUALITY DATA, 2007 - 2017

Parameter Groups	MCL[1]	Number of Wells Sampled	Number of Wells < MDL[2]	Number of Wells < MCL (other than <MDL)	Number of Wells ≥ MCL
Primary Constituents (dissolved phase unless noted)					
Arsenic	10 µg/l	3,152	1,898	978	276
Barium	2 mg/l	3,147	4	3,141	2
Cadmium	5 µg/l	3,122	3,033	87	2
Chromium	100 µg/l	3,146	708	2,438	-
Fluoride[3]	4 mg/l	3,260	110	2,989	161
Mercury	2 µg/l	3,119	3,083	36	-
Nitrate (N)	10 mg/l	3,216	988	1,334	894
Selenium	50 µg/l	3,147	1,973	1,072	102
Secondary Constituents (dissolved phase unless noted)					
Chloride	300 mg/l	3,232	2	2,804	426
Copper	1 mg/l	3,151	895	2,256	-
Fluoride[3]	2 mg/l	3,260	110	2,445	705
Iron	0.3 mg/l	3,217	1,719	1,075	423
Manganese	50 µg/l	3,146	914	1,948	284
Sulfate	300 mg/l	3,186	145	2,514	527
Dissolved Solids	1,000 mg/l	3,289	-	2,604	685
Zinc	5 mg/l	3,150	828	2,317	5
Radioactivity					
Gross Alpha	15 pCi/l	7	2	5	0

Notes:

(1) MCL = Maximum Contamination Level. The MCL is the maximum analysis level for safe drinking water for a parameter. The MDL for certain constituents at certain sampling events were greater than the MCL for that constituent; therefore, analyses from those events were not utilized when counting samples less than or greater than the parameter's MCL.

(2) MDL = Method Detection Limit. The MDL is the lowest analysis value available for a parameter at a particular sampling event. The MDL is determined by the analyzing laboratory.

(3) Fluoride has a health based MCL as a primary drinking water standard, and an aesthetic-based MCL as a secondary MCL.

REGULATORY MONITORING / GROUNDWATER CONTAMINATION

The groundwater monitoring programs of the participating agencies or entities generally fall within one of three categories:

- monitoring that a regulatory agency requires or conducts to ensure compliance with guidelines and regulations to protect groundwater quality from contamination;
- monitoring that agencies or entities conduct to assess ambient or existing groundwater quality conditions and track changes in water quality over time; or
- research activities related to groundwater resources and groundwater conservation.

Each regulatory agency that requires or conducts groundwater monitoring to ensure compliance with guidelines and regulations to protect groundwater from discharges of contaminants has its own monitoring program requirements and procedures. Criteria used to assess the need for groundwater monitoring vary among the regulatory entities. Major sources of documented or potential groundwater contamination are tabulated in Table 3.

Data indicate that as of 2016, more than 50,000 monitoring and water wells are utilized for groundwater monitoring purposes at regulated facilities statewide. The majority of the facilities being monitored (approximately 92 percent) are under the jurisdiction of the TCEQ, with the remainder under the jurisdiction of the RRC (8 percent) and TAGD.

The TWDB and the member districts of the TAGD perform groundwater monitoring activities to assess ambient groundwater quality conditions by sampling for and tracking particular constituents over time. In 2016, monitoring program activities reported by the TWDB and participating organizations involved over 364 water wells and monitoring sites (including springs).

The historical sampling that was performed for the ambient groundwater monitoring network have some limitations in that there are few analyses for constituents that can generally be attributed to anthropogenic (human-induced) sources. For example, there are limited analyses of constituents such as volatile and synthetic organic compounds and certain heavy metals, and ambient monitoring has not traditionally targeted pesticides. While drinking water analyses conducted under the SDWA included some pesticides in their suite of chemicals, the program targets “finished” water rather than raw groundwater specifically. However, the USGS National Water Quality Assessment program includes pesticide analyses; plus, the TCEQ, TWDB, and members of TAGD have

recently begun a cooperative program where ambient groundwater samples collected by TWDB and GCDs are analyzed by TCEQ staff for certain pesticides.

At times, water quality assessment studies targeting specific geographic areas, specific contaminants or constituents, or specific activities include a groundwater monitoring component. If an agency or entity discovers any contamination during groundwater studies or groundwater sampling programs, they will refer the contamination information to the regulatory agency with appropriate jurisdiction.

In general, the waste disposal programs — primarily the TCEQ's Office of Waste and the RRC — monitor existing, permitted facilities.

Several programs at the TCEQ have groundwater monitoring requirements, including petroleum storage tanks, industrial and hazardous waste disposal facilities, municipal solid waste disposal sites, underground injection control sites, and agency enforcement programs. In addition, the municipal and industrial wastewater permitting program require groundwater monitoring at facilities where activities pose a higher risk to groundwater quality.

In the TCEQ's drinking water program, public water supply wells are monitored to ensure that potential violations of drinking water standards are detected and addressed before water is distributed to consumers.

Currently, there is no state program for monitoring domestic wells, although some GCDs have programs to routinely monitor private water wells for ambient conditions or suspected contamination. The TDLR is responsible for oversight of licensed water well drillers, responding to complaints, and routinely checking compliance with TDLR rules. In 2016 TDLR conducted 345 investigations and worked on 40 reports of abandoned water wells.

At the RRC, permits for the surface storage or disposal of oil and gas waste and brine retention require controls to protect groundwater. This may include pond liners, leak detection systems, groundwater monitoring, or a combination of these methods.

TABLE 3. SOURCES OF GROUNDWATER CONTAMINATION

Contaminant Source	Factors Considered in Selecting a Contaminant Source*	Contaminants**
Storage, Treatment, and Disposal Activities		
Storage tanks (underground or above ground)	A, B, C, D	C, D
Surface impoundments	A, C, D, F, G	A, B, D, G, H

Landfills	A, D, E, F, G	A, B, C, G, H
Septic systems	B, C, D, E, F, G	A, B, E
Agricultural Activities		
Unknown/not quantified	A, C, D, E, F, G	A, B, E
Other		
Abandoned wells	A, C, D, E, F, G	NA
Oil & Gas activities	C, D, E, F, G	D, G
Grandfathered sites/past practices	A, D, E, F, G	A, B, D, E, G, H
Natural sources	E, F, G, I	E, F, G, H

*__Factors Considered for Selection__:

A. Documented from mandatory reporting
B. Size of population at risk
C. Location of the sources relative to drinking water sources
D. Number or size of contaminant sources
E. Hydrogeologic sensitivity
F. Potential from state and other findings
G. Geographic distribution/occurrence
H. Human health or environmental risk (toxicity)
I. Other criteria (described in narrative)

**__Contaminants__:

A. Inorganic compounds
B. Organic compounds
C. Halogenated solvents
D. Petroleum compounds
E. Nitrate
F. Fluoride
G. Salinity/brine
H. Metals

TABLE 4. STATEWIDE GROUNDWATER CONTAMINATION CASES DOCUMENTED OR UNDER ENFORCEMENT IN 2016

Agency/Division	Total Cases	*New Cases*	Activity Status Code**							
			0	***1***	***2***	***3***	***4***	***5***	***6***	***None***
TCEQ – Office of Waste (OOW)										
Remediation Division (REM)/Corrective Action (CA)	536	*15*	2	34	70	57	59	300	19	0
REM/Dry Cleaners Remediation (DCRP)	210	*12*	104	0	67	0	23	11	5	0
REM/Petroleum Storage Tanks (PST)	1,170	*261*	0	139	667	0	77	0	287	0
REM/Superfund Cleanup Program (SF)	84	*1*	0	0	23	9	6	43	3	0
REM/Superfund Site Discovery & Assessment (SSDA)	9	*3*	0	0	9	0	0	0	0	0
REM/Voluntary Cleanup (VC)	541	*50*	0	74	89	85	55	184	54	0
REM/Innocent Landowner (VCIO)	227	*56*	109	85	0	0	0	0	33	0
Waste Permits Division/Industrial & Hazardous Waste (IHW)	3	*0*	0	3	0	0	0	0	0	0
Waste Permits Division/Municipal Solid Waste (MSW)	55	*1*	1	0	36	0	16	15	2	0
Radioactive Materials Division (RMD)	4	*0*	0	0	1	0	0	0	0	3
TCEQ - Office of Compliance & Enforcement (OCE)										
Enforcement Division	3	*0*	0	0	0	0	0	0	0	3
Regional Offices	0	*0*	0	0	0	0	0	0	0	0
TCEQ - Office of Water (OW)										0
Water Availability Division/Groundwater Planning & Assessment Team (GPAT)	5	*0*	0	3	2	0	0	0	0	0
Water Supply Division/Public Drinking Water	4	*4*	0	0	0	0	0	0	4	0
Water Quality Division	15	*0*	1	0	4	1	8	8	0	0
SUBTOTAL:	**2,866**	***403***	**217**	**338**	**968**	**152**	**244**	**561**	**407**	**6**
Railroad Commission of Texas/Oil & Gas Division	577	*37*	0	35	87	77	230	113	35	0
Texas Alliance of Groundwater Districts	1	*0*	0	0	0	0	1	0	0	0
TOTAL:	**3,444**	***440***	**217**	**373**	**1,055**	**229**	**475**	**674**	**442**	**6**

0-No Activity; **1-Confirmed Contamination; **2**-Ongoing Investigation; **3**-Corrective Action Planning; **4**-Corrective Action Implementation; **5**-Monitoring Action; **6**-Activity Completed

TABLE 5. SUMMARY OF GROUNDWATER CONTAMINATION SITES ON AQUIFER OUTCROPS IN 2016

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**71**	0	19	5	7	38	2	VOCs, chlorinated solvents, metals, dioxins, BTEX, benzene, TPH, PAH, nitrates, etc.
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**645**	94	108	48	57	141	60	VOC's, chlorinated solvents, metals, TPH, BTEX, etc.
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**952**	100	553	0	91	0	208	gasoline, diesel, waste oil
RCRA Corrective Action – • TCEQ CA program	**395**	28	52	36	44	224	12	VOCs/SVOCs, metals, nitrates, hydrocarbons, BTEX, and others
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**4**	0	1	0	0	0	0	VOCs, BTEX, TPH, chromium, lead, etc.
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**35**	3	19	0	12	12	0	VOCs, metals, and others
Nonpoint Sources – • Includes TCEQ's GPAT	**6**	4	1	0	1	0	0	Hydrocarbons, arsenic, heptachlor epoxide, nitrates
Oil/Gas Activities – • Texas Railroad Commission	**577**	38	86	77	224	119	33	Chloride, TPH, BTEX, metals, PSH, PCB, natural gas
Totals	**2,700**	266	842	166	444	542	318	

(1) NPL means "National Priority List;" CERCLIS is "Comprehensive Environmental Response, Compensation, and Liability Information System;" US DOD/DOE means "United States Department of Defense/Department of Energy;" LUST is Leaking Underground Storage Tanks; RCRA means "Resource Conservation and Recovery Act;" MSW is Municipal Solid Waste; IHW means Industrial or Hazardous Waste; and GPAT is Groundwater Planning and Assessment program.
(2) 1=Confirmed Contamination; 2=Ongoing Investigation; 3=Corrective Action Planning; 4=Corrective Action Implementation; 5=Monitoring of Corrective Action; 6=Activity Completed
(3) VOCs are volatile organic compounds; BTEX is benzene, toluene, ethylbenzene, and xylenes; TPH is total petroleum hydrocarbons, PAH is polycyclic aromatic hydrocarbons
(4) These state sites may be combined with NPL and RCRA sites

GROUNDWATER ASSESSMENT

This section describes the methodology and limitations of this groundwater assessment report.

METHODOLOGY USED IN THE PREPARATION OF THIS REPORT

The member agencies of the TGPC provide data for its groundwater quality inventory efforts. In 1996, the TGPC began conducting an inventory of groundwater quality of the state's aquifers through the partnership of two of the TGPC member agencies: the TCEQ and the TWDB. This information was published in the State of Texas Water Quality Inventory 1996, which is a predecessor to this report.

US EPA representatives requested that the 1998 report update emphasize the spatial and graphical representation of the most recent available groundwater quality data, with maps showing examples of groundwater quality in wells located in the selected aquifers. Subsequent reports continued this spatial and graphical representation as additional aquifers were inventoried.

In subsequent Water Quality Inventory reports the TCEQ has utilized information from the TWDB's groundwater database to inventory ambient water quality in each of the state's major and minor aquifers for the most recent ten-year period. At the end of 2017, TWDB named a new minor aquifer, the Cross Timbers aquifer. Water quality information for this new aquifer will be included in future reports.

For the 2018 report, TCEQ evaluated ambient groundwater data for Fiscal Year 2008 through FY 2017 (September 1, 2007 through August 31, 2017) from the TWDB's groundwater database (see http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp). The following constituents were chosen from all the analyses conducted, because they are listed in state rules related to drinking water standards: arsenic, barium, cadmium, chromium, copper, iron, manganese, selenium, zinc, sulfate, chloride, nitrate, and total dissolved solids, and gross Alpha radiation.

This data was selected data was then transferred into smaller aquifer-specific Excel (".xls") files for use in Geographic Information System (GIS) projects.

It is important to note here that for all the constituents of interest, the data were sorted and culled to eliminate duplicate samples for any given well, giving a "snapshot" of the highest concentration value for each well that is available. The purpose for choosing the highest concentration at each sampled well during the ten-year period is to be very conservative in estimating concentrations for each constituent in a given aquifer.

Concentrations illustrated in previous reports may have changed at specific sampling sites since each report looks at the most recent ten-year period.

With each of the constituents, the Excel files were transferred to Access database and were evaluated to determine how many wells in each sampled aquifer was above an accepted regulatory value, typically the maximum contaminant level (MCL) established by the USEPA. For those aquifers in which a significant number of samples demonstrated concentrations above the MCL, the Excel table values were imported into a GIS application and presented spatially on a map of the aquifer (Figures 3 through 36). For this report, there is no specific number or percentage of samples that demonstrated what a "significant" quantity of samples above the MCL would be. Instead, staff examined the data and weighed the numbers of samples, the extent of the aquifer, the demand in or use of the aquifer, and the distribution of the concentrations to determine the relative importance of the concentration data. After these constituents are identified for each aquifer, staff generated GIS-based maps for those select aquifers and constituents (See Figures 3 through 36, in the "Constituents of Concern" section of this report).

As an example of this process, from FY2008 through FY2017, the Edwards-Trinity (High Plains) aquifer had nitrate values exceeding the MCL in 64 percent of the water wells sampled and the Ellenburger-San Saba aquifer had nitrate values that exceed the MCL in only 19 percent of the wells sampled. Staff determined that the nitrate concentrations in the Ellenburger-San Saba aquifer is of greater concern than the situation in the Edwards-Trinity (High Plains) aquifer, because only eleven wells were sampled in the Edwards-Trinity (High Plains) aquifer and 70 wells were sampled in the Ellenburger-San Saba aquifer. Seven of the wells sampled in the Edwards-Trinity (High Plains) aquifer showed nitrate values above the MCL, while 13 wells in the Ellenburger-San Saba aquifer showed similar results. Both are minor aquifers, but the higher number of samples in the Ellenburger-San Saba aquifer suggest a more statistically relevant sample size.

In another example related to nitrate, the number of samples in the Gulf Coast aquifer that exceeded the MCL was 87 of 580 total, or only 15 percent; however, the Gulf Coast aquifer is a major aquifer and most of the higher concentrations occurred in wells near one section of the aquifer.

Still, for those analyses that are not represented spatially, Tables 6 through 35 still provide the total number of wells sampled as well as the number of wells that exceeded the MCL.

LIMITATIONS

Data from the TWDB's ambient groundwater quality database contains a large amount of data collected over a span of several decades.

Quantitative laboratory methods used to analyze water samples have changed over time, and even in recent years, analysis may be performed by a lab, or by Hach "kits." Consequently, the data is not directly comparable without qualification.

Additionally, wells are sampled on a cycle, and there may be several intervening years between sample events. The sampling program does not consider differences in aquifer conditions due to drought, seasonal variation, or local flow directions. Therefore, the analytical results, even if performed using the same laboratory methods, may still not be directly comparable over time due to cyclical variation in aquifer conditions.

This analysis is intended as an overview to recognize areas where there could be potential water quality issues, so variability of results from different methods of analysis is not considered, nor is cyclical variation due to aquifer conditions. Again, this report is intended to present a "snapshot" of the state's groundwater quality conditions for each of the major and minor aquifers.

While MCLs for drinking water are based on "total" values for a constituent, the greatest amount of data available is for "dissolved" concentrations. Because of the amount of data available, this report described the dissolved concentrations of each constituent. In general, dissolved concentrations are slightly lower than the total values. The tables and figures in this report might portray a slightly lower concentration of constituents in groundwater than exists in the field, nonetheless they serve to illustrate a general trend or areas of potential concern.

In a few cases, analyses were available for naturally occurring radioactive elements. Gross Alpha values are used as an indicator for these parameters, and a value of 15 pCi/l at a public drinking water system is used as a screening value that may warrant additional analysis to determine the source. In the ten-year period evaluated, only four aquifers were sampled for Gross Alpha, and none exceeded 15 pCi/l.

Another limitation is the relative simplicity of the assessment methodology for this report. The data is evaluated using an "eyeball" approach to the character of water quality. However, given the size of the state and the volume of data available, this approach is adequate for presenting general information on ambient groundwater quality in the state and identify areas of potential concern.

This report is a general water quality inventory, and the various limitations discussed should restrict the conclusions that can be drawn from this data. This report may provide guidance to researchers for future investigations to better characterize aquifer quality. Similarly, water resource planners, water suppliers, and regulators could use this report to add a water quality component to future planning efforts.

AMBIENT GROUNDWATER MONITORING DATA TABLES

TABLES 6 THROUGH 35 – AMBIENT GROUNDWATER MONITORING TABULATED DATA BY AQUIFER, 2007 THROUGH 2017

Note: For each of the following tables (Table 6 through Table 35), the following footnotes and definitions apply:

1. MCL = Maximum Contamination Level. The MCL is the maximum analysis level for safe drinking water for a parameter. Note that in certain cases an MDL was greater than the MCL for a constituent, and analyses from those events were not utilized when counting samples less than or greater than the MCL.
2. MDL = Method Detection Limit. The MDL is the lowest analysis value available for a parameter at a sampling event, as determined by the analyzing laboratory.
3. mg/l = milligrams per liter; µg/l = micrograms per liter; pCi/l = picocuries per liter

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List and Location of Data Tables:

Table 6. Blaine Aquifer---39
Table 7. Blossum Aquifer---40
Table 8. Bone Spring-Victorio Peak Aquifer---41
Table 9. Brazos River Alluvium Aquifer---42
Table 10. Capitan Reef Complex Aquifer---43
Table 11. Carrizo-Wilcox Aquifer---44
Table 12. Dockum Aquifer---45
Table 13. Edwards (BFZ) Aquifer---46
Table 14. Edwards–Trinity (Plateau) Aquifer---47
Table 15. Edwards–Trinity (High Plains) Aquifer---48
Table 16. Ellenburger–San Saba Aquifer---49
Table 17. Gulf Coast Aquifer---50
Table 18. Hickory Aquifer---51
Table 19. Hueco–Mesilla Bolsons Aquifer---52
Table 20. Igneous Aquifer---53
Table 21. Lipan Aquifer---54
Table 22. Marathon Aquifer---55
Table 23. Marble Falls Aquifer---56
Table 24. Nacatoch Aquifer---57
Table 25. Ogallala Aquifer---58
Table 26. Pecos Valley Aquifer---59
Table 27. Queen City Aquifer---60
Table 28. Rita Blanca Aquifer---61
Table 29. Rustler Aquifer---62
Table 30. Seymour Aquifer---63
Table 31. Sparta Aquifer---64
Table 32. Trinity Aquifer---65
Table 33. West Texas Bolsons Aquifer---66
Table 34. Woodbine Aquifer---67
Table 35. Yegua-Jackson Aquifer---68

Table 6. Blaine Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Arsenic, dissolved	10 µg/l	36	24	12	0
Barium, dissolved	2 mg/l	36	0	36	0
Cadmium, dissolved	5 µg/l	36	35	1	0
Chromium, dissolved	100 µg/l	36	2	34	0
Fluoride, dissolved	4 mg/l	36	2	34	0
Mercury, dissolved	2 µg/l	36	36	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	36	1	7	28
Selenium, dissolved	50 µg/l	36	2	26	8
Secondary Constituents					
Chloride, dissolved	300 mg/l	36	0	21	15
Copper, dissolved	1 mg/l	36	1	35	0
Fluoride, dissolved	2 mg/l	36	2	33	1
Iron, dissolved	0.3 mg/l	36	25	7	4
Manganese, dissolved	50 µg/l	36	15	19	2
Sulfate, dissolved	300 mg/l	36	0	0	36
Total Dissolved Solids	1,000 mg/l	36	0	0	36
Zinc, dissolved	5 mg/l	36	1	35	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 7. Blossum Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Arsenic, dissolved	10 µg/l	1	1	0	0
Barium, dissolved	2 mg/l	1	0	1	0
Cadmium, dissolved	5 µg/l	1	1	0	0
Chromium, dissolved	100 µg/l	1	0	1	0
Fluoride, dissolved	4 mg/l	1	0	1	0
Mercury, dissolved	2 µg/l	1	1	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	1	1	0	0
Selenium, dissolved	50 µg/l	1	1	0	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	1	0	1	0
Copper, dissolved	1 mg/l	1	1	0	0
Fluoride, dissolved	2 mg/l	1	0	1	0
Iron, dissolved	0.3 mg/l	1	1	0	0
Manganese, dissolved	50 µg/l	1	0	1	0
Sulfate, dissolved	300 mg/l	1	0	1	0
Total Dissolved Solids	1,000 mg/l	1	0	0	1
Zinc, dissolved	5 mg/l	1	1	0	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 8. Bone Spring-Victorio Peak Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	2	0	2	0
Cadmium, dissolved	5 µg/l	2	2	0	0
Chromium, dissolved	100 µg/l	2	2	0	0
Fluoride, dissolved	4 mg/l	2	2	0	0
Mercury, dissolved	2 µg/l	2	2	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	2	0	0	0
Selenium, dissolved	50 µg/l	2	0	2	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	2	0	0	2
Copper, dissolved	1 mg/l	2	1	1	0
Fluoride, dissolved	2 mg/l	2	2	0	0
Iron, dissolved	0.3 mg/l	2	0	2	0
Manganese, dissolved	50 µg/l	2	1	1	0
Sulfate, dissolved	300 mg/l	2	0	0	2
Total Dissolved Solids	1,000 mg/l	2	0	0	2
Zinc, dissolved	5 mg/l	2	0	2	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 9. Brazos River Alluvium Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	9	0	8	1
Cadmium, dissolved	5 µg/l	9	3	0	0
Chromium, dissolved	100 µg/l	9	0	9	0
Fluoride, dissolved	4 mg/l	9	0	9	0
Mercury, dissolved	2 µg/l	9	3	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	9	1	3	5
Selenium, dissolved	50 µg/l	9	8	1	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	9	0	9	0
Copper, dissolved	1 mg/l	9	3	6	0
Fluoride, dissolved	2 mg/l	9	0	9	0
Iron, dissolved	0.3 mg/l	9	5	1	3
Manganese, dissolved	50 µg/l	9	2	1	6
Sulfate, dissolved	300 mg/l	9	0	9	0
Total Dissolved Solids	1,000 mg/l	9	0	7	2
Zinc, dissolved	5 mg/l	9	3	6	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 10. Capitan Reef Complex Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	13	0	13	0
Cadmium, dissolved	5 µg/l	13	13	0	0
Chromium, dissolved	100 µg/l	13	10	3	0
Fluoride, dissolved	4 mg/l	13	4	9	0
Mercury, dissolved	2 µg/l	7	7	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	13	8	5	0
Selenium, dissolved	50 µg/l	13	4	7	2
Secondary Constituents					
Chloride, dissolved	300 mg/l	13	0	8	5
Copper, dissolved	1 mg/l	13	5	8	0
Fluoride, dissolved	2 mg/l	13	4	2	7
Iron, dissolved	0.3 mg/l	13	1	9	3
Manganese, dissolved	50 µg/l	13	0	10	3
Sulfate, dissolved	300 mg/l	13	0	5	8
Total Dissolved Solids	1,000 mg/l	13	0	5	8
Zinc, dissolved	5 mg/l	13	3	10	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 11. Carrizo-Wilcox Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	404	0	404	0
Cadmium, dissolved	5 µg/l	404	404	0	0
Chromium, dissolved	100 µg/l	404	151	253	0
Fluoride, dissolved	4 mg/l	423	12	409	2
Mercury, dissolved	2 µg/l	403	403	403	0
Nitrate-Nitrogen, dissolved	10 mg/l	427	307	106	14
Selenium, dissolved	50 µg/l	404	353	43	8
Secondary Constituents					
Chloride, dissolved	300 mg/l	420	0	404	15
Copper, dissolved	1 mg/l	404	183	221	0
Fluoride, dissolved	2 mg/l	423	12	403	8
Iron, dissolved	0.3 mg/l	422	248	70	104
Manganese, dissolved	50 µg/l	399	24	302	73
Sulfate, dissolved	300 mg/l	405	51	348	6
Total Dissolved Solids	1,000 mg/l	446	0	420	26
Zinc, dissolved	5 mg/l	404	199	205	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 12. Dockum Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	60	0	60	0
Cadmium, dissolved	5 µg/l	59	55	4	0
Chromium, dissolved	100 µg/l	60	20	40	0
Fluoride, dissolved	4 mg/l	60	3	53	4
Mercury, dissolved	2 µg/l	60	60	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	60	15	22	23
Selenium, dissolved	50 µg/l	60	18	42	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	60	0	46	14
Copper, dissolved	1 mg/l	60	11	49	0
Fluoride, dissolved	2 mg/l	60	3	30	27
Iron, dissolved	0.3 mg/l	60	23	31	6
Manganese, dissolved	50 µg/l	60	8	47	5
Sulfate, dissolved	300 mg/l	60	0	44	16
Total Dissolved Solids	1,000 mg/l	60	0	41	19
Zinc, dissolved	5 mg/l	60	6	52	2
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 13. Edwards (Balcones Fault Zone) Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	168	0	168	0
Cadmium, dissolved	5 µg/l	168	168	0	0
Chromium, dissolved	100 µg/l	168	45	123	0
Fluoride, dissolved	4 mg/l	180	8	169	3
Mercury, dissolved	2 µg/l	167	167	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	180	21	130	29
Selenium, dissolved	50 µg/l	168	159	8	1
Secondary Constituents					
Chloride, dissolved	300 mg/l	179	0	176	3
Copper, dissolved	1 mg/l	168	58	110	0
Fluoride, dissolved	2 mg/l	180	8	154	18
Iron, dissolved	0.3 mg/l	178	135	29	14
Manganese, dissolved	50 µg/l	168	114	52	2
Sulfate, dissolved	300 mg/l	179	0	172	7
Total Dissolved Solids	1,000 mg/l	173	0	165	7
Zinc, dissolved	5 mg/l	168	62	106	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 14. Edwards–Trinity (Plateau) Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	328	0	328	0
Cadmium, dissolved	5 µg/l	328	326	1	1
Chromium, dissolved	100 µg/l	328	49	279	0
Fluoride, dissolved	4 mg/l	328	3	322	3
Mercury, dissolved	2 µg/l	326	325	1	0
Nitrate-Nitrogen, dissolved	10 mg/l	327	23	146	158
Selenium, dissolved	50 µg/l	328	225	103	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	328	1	283	44
Copper, dissolved	1 mg/l	328	52	276	0
Fluoride, dissolved	2 mg/l	328	3	235	90
Iron, dissolved	0.3 mg/l	328	265	38	25
Manganese, dissolved	50 µg/l	328	192	128	8
Sulfate, dissolved	300 mg/l	328	0	215	113
Total Dissolved Solids	1,000 mg/l	328	0	224	104
Zinc, dissolved	5 mg/l	327	38	289	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 15. Edwards–Trinity (High Plains) Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	11	0	11	0
Cadmium, dissolved	5 µg/l	11	11	0	0
Chromium, dissolved	100 µg/l	11	0	11	0
Fluoride, dissolved	4 mg/l	11	0	6	5
Mercury, dissolved	2 µg/l	11	11	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	11	1	3	7
Selenium, dissolved	50 µg/l	11	2	7	2
Secondary Constituents					
Chloride, dissolved	300 mg/l	11	0	7	4
Copper, dissolved	1 mg/l	11	1	10	0
Fluoride, dissolved	2 mg/l	11	0	1	10
Iron, dissolved	0.3 mg/l	11	7	3	1
Manganese, dissolved	50 µg/l	11	4	7	0
Sulfate, dissolved	300 mg/l	11	0	8	3
Total Dissolved Solids	1,000 mg/l	11	0	6	5
Zinc, dissolved	5 mg/l	11	0	11	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 16. Ellenburger–San Saba Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	70	0	70	0
Cadmium, dissolved	5 µg/l	70	70	0	0
Chromium, dissolved	100 µg/l	70	19	51	0
Fluoride, dissolved	4 mg/l	80	13	66	1
Mercury, dissolved	2 µg/l	70	70	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	70	7	50	13
Selenium, dissolved	50 µg/l	70	58	12	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	80	0	77	3
Copper, dissolved	1 mg/l	70	15	55	0
Fluoride, dissolved	2 mg/l	80	13	62	5
Iron, dissolved	0.3 mg/l	80	53	18	9
Manganese, dissolved	50 µg/l	70	39	30	1
Sulfate, dissolved	300 mg/l	70	0	68	2
Total Dissolved Solids	1,000 mg/l	81	0	74	7
Zinc, dissolved	5 mg/l	70	20	50	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	1	0	1	0

Table 17. Gulf Coast Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	580	0	579	1
Cadmium, dissolved	5 µg/l	580	579	1	0
Chromium, dissolved	100 µg/l	580	106	474	0
Fluoride, dissolved	4 mg/l	580	3	576	1
Mercury, dissolved	2 µg/l	576	576	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	580	305	188	87
Selenium, dissolved	50 µg/l	580	444	133	3
Secondary Constituents					
Chloride, dissolved	300 mg/l	578	0	436	142
Copper, dissolved	1 mg/l	580	198	382	0
Fluoride, dissolved	2 mg/l	580	3	544	33
Iron, dissolved	0.3 mg/l	580	304	179	97
Manganese, dissolved	50 µg/l	580	120	335	125
Sulfate, dissolved	300 mg/l	578	87	435	56
Total Dissolved Solids	1,000 mg/l	587	0	456	131
Zinc, dissolved	5 mg/l	580	184	395	1
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	2	1	1	0

Table 18. Hickory Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	54	0	54	0
Cadmium, dissolved	5 µg/l	54	54	0	0
Chromium, dissolved	100 µg/l	54	30	24	0
Fluoride, dissolved	4 mg/l	54	17	37	0
Mercury, dissolved	2 µg/l	54	54	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	54	18	24	12
Selenium, dissolved	50 µg/l	54	42	12	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	54	0	51	3
Copper, dissolved	1 mg/l	54	14	40	0
Fluoride, dissolved	2 mg/l	54	17	35	2
Iron, dissolved	0.3 mg/l	54	12	29	13
Manganese, dissolved	50 µg/l	54	9	39	6
Sulfate, dissolved	300 mg/l	54	1	53	0
Total Dissolved Solids	1,000 mg/l	54	0	51	3
Zinc, dissolved	5 mg/l	54	11	42	1
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	2	0	2	0

Table 19. Hueco–Mesilla Bolsons Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	11	0	11	0
Cadmium, dissolved	5 µg/l	11	11	0	0
Chromium, dissolved	100 µg/l	11	5	6	0
Fluoride, dissolved	4 mg/l	11	4	7	0
Mercury, dissolved	2 µg/l	11	11	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	11	5	5	1
Selenium, dissolved	50 µg/l	11	5	6	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	11	0	8	3
Copper, dissolved	1 mg/l	11	8	3	0
Fluoride, dissolved	2 mg/l	11	4	6	1
Iron, dissolved	0.3 mg/l	11	1	10	0
Manganese, dissolved	50 µg/l	11	0	7	4
Sulfate, dissolved	300 mg/l	11	0	8	3
Total Dissolved Solids	1,000 mg/l	11	0	7	4
Zinc, dissolved	5 mg/l	11	0	11	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 20. Igneous Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	14	2	12	0
Cadmium, dissolved	5 µg/l	14	14	0	0
Chromium, dissolved	100 µg/l	14	4	10	0
Fluoride, dissolved	4 mg/l	32	0	31	1
Mercury, dissolved	2 µg/l	14	14	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	27	2	22	3
Selenium, dissolved	50 µg/l	14	13	1	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	32	0	32	0
Copper, dissolved	1 mg/l	14	9	5	0
Fluoride, dissolved	2 mg/l	32	0	21	11
Iron, dissolved	0.3 mg/l	14	14	0	0
Manganese, dissolved	50 µg/l	14	8	5	1
Sulfate, dissolved	300 mg/l	31	0	31	0
Total Dissolved Solids	1,000 mg/l	31	0	31	0
Zinc, dissolved	5 mg/l	14	6	8	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 21. Lipan Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	25	0	25	0
Cadmium, dissolved	5 µg/l	25	25	0	0
Chromium, dissolved	100 µg/l	25	10	15	0
Fluoride, dissolved	4 mg/l	25	0	25	0
Mercury, dissolved	2 µg/l	25	25	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	25	1	2	22
Selenium, dissolved	50 µg/l	25	9	16	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	25	0	14	11
Copper, dissolved	1 mg/l	25	0	25	0
Fluoride, dissolved	2 mg/l	25	0	25	0
Iron, dissolved	0.3 mg/l	25	24	1	0
Manganese, dissolved	50 µg/l	25	20	5	0
Sulfate, dissolved	300 mg/l	25	0	16	9
Total Dissolved Solids	1,000 mg/l	25	0	13	12
Zinc, dissolved	5 mg/l	25	5	20	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 22. Marathon Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	21	0	21	0
Cadmium, dissolved	5 µg/l	21	21	0	0
Chromium, dissolved	100 µg/l	21	0	21	0
Fluoride, dissolved	4 mg/l	21	0	21	0
Mercury, dissolved	2 µg/l	21	21	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	21	3	14	4
Selenium, dissolved	50 µg/l	21	14	6	1
Secondary Constituents					
Chloride, dissolved	300 mg/l	21	0	21	0
Copper, dissolved	1 mg/l	21	7	14	0
Fluoride, dissolved	2 mg/l	21	0	21	0
Iron, dissolved	0.3 mg/l	21	18	2	1
Manganese, dissolved	50 µg/l	21	9	10	2
Sulfate, dissolved	300 mg/l	21	0	15	6
Total Dissolved Solids	1,000 mg/l	21	0	17	4
Zinc, dissolved	5 mg/l	21	2	19	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 23. Marble Falls Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	6	0	6	0
Cadmium, dissolved	5 µg/l	6	6	0	0
Chromium, dissolved	100 µg/l	6	1	5	0
Fluoride, dissolved	4 mg/l	6	0	6	0
Mercury, dissolved	2 µg/l	6	6	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	6	0	5	1
Selenium, dissolved	50 µg/l	6	6	0	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	6	0	6	0
Copper, dissolved	1 mg/l	6	2	4	0
Fluoride, dissolved	2 mg/l	6	0	5	1
Iron, dissolved	0.3 mg/l	6	6	0	0
Manganese, dissolved	50 µg/l	6	1	5	0
Sulfate, dissolved	300 mg/l	6	0	6	0
Total Dissolved Solids	1,000 mg/l	6	0	6	0
Zinc, dissolved	5 mg/l	6	3	3	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 24. Nacatoch Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	4	0	4	0
Cadmium, dissolved	5 µg/l	4	4	0	0
Chromium, dissolved	100 µg/l	4	1	3	0
Fluoride, dissolved	4 mg/l	4	0	4	0
Mercury, dissolved	2 µg/l	4	4	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	4	3	1	0
Selenium, dissolved	50 µg/l	4	4	0	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	4	0	3	1
Copper, dissolved	1 mg/l	4	4	0	0
Fluoride, dissolved	2 mg/l	4	0	3	1
Iron, dissolved	0.3 mg/l	4	3	1	0
Manganese, dissolved	50 µg/l	4	1	3	0
Sulfate, dissolved	300 mg/l	4	1	3	0
Total Dissolved Solids	1,000 mg/l	4	0	4	0
Zinc, dissolved	5 mg/l	4	0	4	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 25. Ogallala Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	718	0	718	0
Cadmium, dissolved	5 µg/l	695	616	78	1
Chromium, dissolved	100 µg/l	718	122	596	0
Fluoride, dissolved	4 mg/l	718	25	575	118
Mercury, dissolved	2 µg/l	705	670	35	0
Nitrate-Nitrogen, dissolved	10 mg/l	716	1	342	373
Selenium, dissolved	50 µg/l	718	79	564	75
Secondary Constituents					
Chloride, dissolved	300 mg/l	712	0	615	97
Copper, dissolved	1 mg/l	718	108	610	0
Fluoride, dissolved	2 mg/l	718	25	338	355
Iron, dissolved	0.3 mg/l	718	144	499	75
Manganese, dissolved	50 µg/l	718	158	546	14
Sulfate, dissolved	300 mg/l	712	0	597	115
Total Dissolved Solids	1,000 mg/l	722	0	585	137
Zinc, dissolved	5 mg/l	718	45	672	1
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 26. Pecos Valley Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	35	0	25	0
Cadmium, dissolved	5 µg/l	35	35	0	0
Chromium, dissolved	100 µg/l	35	3	32	0
Fluoride, dissolved	4 mg/l	35	1	32	2
Mercury, dissolved	2 µg/l	35	35	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	35	3	18	14
Selenium, dissolved	50 µg/l	35	19	15	1
Secondary Constituents					
Chloride, dissolved	300 mg/l	35	0	21	14
Copper, dissolved	1 mg/l	35	8	27	0
Fluoride, dissolved	2 mg/l	35	1	22	12
Iron, dissolved	0.3 mg/l	35	20	11	4
Manganese, dissolved	50 µg/l	35	13	17	5
Sulfate, dissolved	300 mg/l	35	0	18	17
Total Dissolved Solids	1,000 mg/l	35	0	17	18
Zinc, dissolved	5 mg/l	35	8	27	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 27. Queen City Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	38	1	37	0
Cadmium, dissolved	5 µg/l	38	38	0	0
Chromium, dissolved	100 µg/l	38	16	22	0
Fluoride, dissolved	4 mg/l	48	5	42	1
Mercury, dissolved	2 µg/l	38	38	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	45	22	20	3
Selenium, dissolved	50 µg/l	38	35	3	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	52	0	48	4
Copper, dissolved	1 mg/l	38	9	29	0
Fluoride, dissolved	2 mg/l	48	5	42	1
Iron, dissolved	0.3 mg/l	48	22	15	11
Manganese, dissolved	50 µg/l	38	4	25	9
Sulfate, dissolved	300 mg/l	45	3	38	4
Total Dissolved Solids	1,000 mg/l	52	0	43	9
Zinc, dissolved	5 mg/l	38	7	31	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 28. Rita Blanca Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	8	0	8	0
Cadmium, dissolved	5 µg/l	8	8	0	0
Chromium, dissolved	100 µg/l	8	3	5	0
Fluoride, dissolved	4 mg/l	8	1	4	3
Mercury, dissolved	2 µg/l	8	8	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	8	0	8	0
Selenium, dissolved	50 µg/l	8	4	4	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	8	0	8	0
Copper, dissolved	1 mg/l	8	3	5	0
Fluoride, dissolved	2 mg/l	8	1	4	3
Iron, dissolved	0.3 mg/l	8	1	5	2
Manganese, dissolved	50 µg/l	8	1	6	1
Sulfate, dissolved	300 mg/l	8	0	7	1
Total Dissolved Solids	1,000 mg/l	8	0	6	2
Zinc, dissolved	5 mg/l	8	1	7	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 29. Rustler Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	7	0	7	0
Cadmium, dissolved	5 µg/l	7	7	0	0
Chromium, dissolved	100 µg/l	7	4	3	0
Fluoride, dissolved	4 mg/l	7	0	7	0
Mercury, dissolved	2 µg/l	7	7	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	7	4	1	2
Selenium, dissolved	50 µg/l	7	6	1	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	7	0	3	4
Copper, dissolved	1 mg/l	7	1	6	0
Fluoride, dissolved	2 mg/l	7	0	3	4
Iron, dissolved	0.3 mg/l	7	2	5	0
Manganese, dissolved	50 µg/l	7	2	5	0
Sulfate, dissolved	300 mg/l	7	0	0	7
Total Dissolved Solids	1,000 mg/l	7	0	1	6
Zinc, dissolved	5 mg/l	7	2	5	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 30. Seymour Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	50	0	50	0
Cadmium, dissolved	5 µg/l	50	50	0	0
Chromium, dissolved	100 µg/l	50	0	50	0
Fluoride, dissolved	4 mg/l	50	2	47	1
Mercury, dissolved	2 µg/l	50	50	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	50	1	3	46
Selenium, dissolved	50 µg/l	50	19	30	1
Secondary Constituents					
Chloride, dissolved	300 mg/l	50	0	40	10
Copper, dissolved	1 mg/l	50	2	48	0
Fluoride, dissolved	2 mg/l	50	2	47	1
Iron, dissolved	0.3 mg/l	50	49	1	0
Manganese, dissolved	50 µg/l	50	41	9	0
Sulfate, dissolved	300 mg/l	50	0	40	10
Total Dissolved Solids	1,000 mg/l	50	0	35	15
Zinc, dissolved	5 mg/l	50	5	45	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 31. Sparta Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	19	0	19	0
Cadmium, dissolved	5 µg/l	19	19	0	0
Chromium, dissolved	100 µg/l	19	10	9	0
Fluoride, dissolved	4 mg/l	26	0	26	0
Mercury, dissolved	2 µg/l	19	19	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	23	11	12	0
Selenium, dissolved	50 µg/l	19	17	2	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	29	0	24	5
Copper, dissolved	1 mg/l	19	8	11	0
Fluoride, dissolved	2 mg/l	26	0	25	1
Iron, dissolved	0.3 mg/l	26	14	10	2
Manganese, dissolved	50 µg/l	19	1	18	0
Sulfate, dissolved	300 mg/l	22	2	16	4
Total Dissolved Solids	1,000 mg/l	30	0	22	8
Zinc, dissolved	5 mg/l	19	11	8	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 32. Trinity Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	387	0	387	0
Cadmium, dissolved	5 µg/l	386	385	1	0
Chromium, dissolved	100 µg/l	386	74	302	0
Fluoride, dissolved	4 mg/l	420	3	405	12
Mercury, dissolved	2 µg/l	387	387	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	398	184	172	42
Selenium, dissolved	50 µg/l	387	365	22	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	397	1	380	16
Copper, dissolved	1 mg/l	391	163	228	0
Fluoride, dissolved	2 mg/l	420	3	315	102
Iron, dissolved	0.3 mg/l	400	282	80	38
Manganese, dissolved	50 µg/l	390	121	265	5
Sulfate, dissolved	300 mg/l	393	0	306	87
Total Dissolved Solids	1,000 mg/l	414	0	317	97
Zinc, dissolved	5 mg/l	931	171	220	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	2	1	1	0

Table 33. Ambient Monitoring Groundwater Quality Data

Table 33. West Texas Bolsons Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	7	0	7	0
Cadmium, dissolved	5 µg/l	7	7	0	0
Chromium, dissolved	100 µg/l	7	0	7	0
Fluoride, dissolved	4 mg/l	9	0	9	0
Mercury, dissolved	2 µg/l	7	7	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	9	0	5	4
Selenium, dissolved	50 µg/l	7	4	3	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	9	0	9	0
Copper, dissolved	1 mg/l	7	3	7	0
Fluoride, dissolved	2 mg/l	9	0	6	3
Iron, dissolved	0.3 mg/l	7	7	0	0
Manganese, dissolved	50 µg/l	7	5	2	0
Sulfate, dissolved	300 mg/l	9	0	8	1
Total Dissolved Solids	1,000 mg/l	9	0	7	2
Zinc, dissolved	5 mg/l	7	3	4	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 34. Woodbine Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

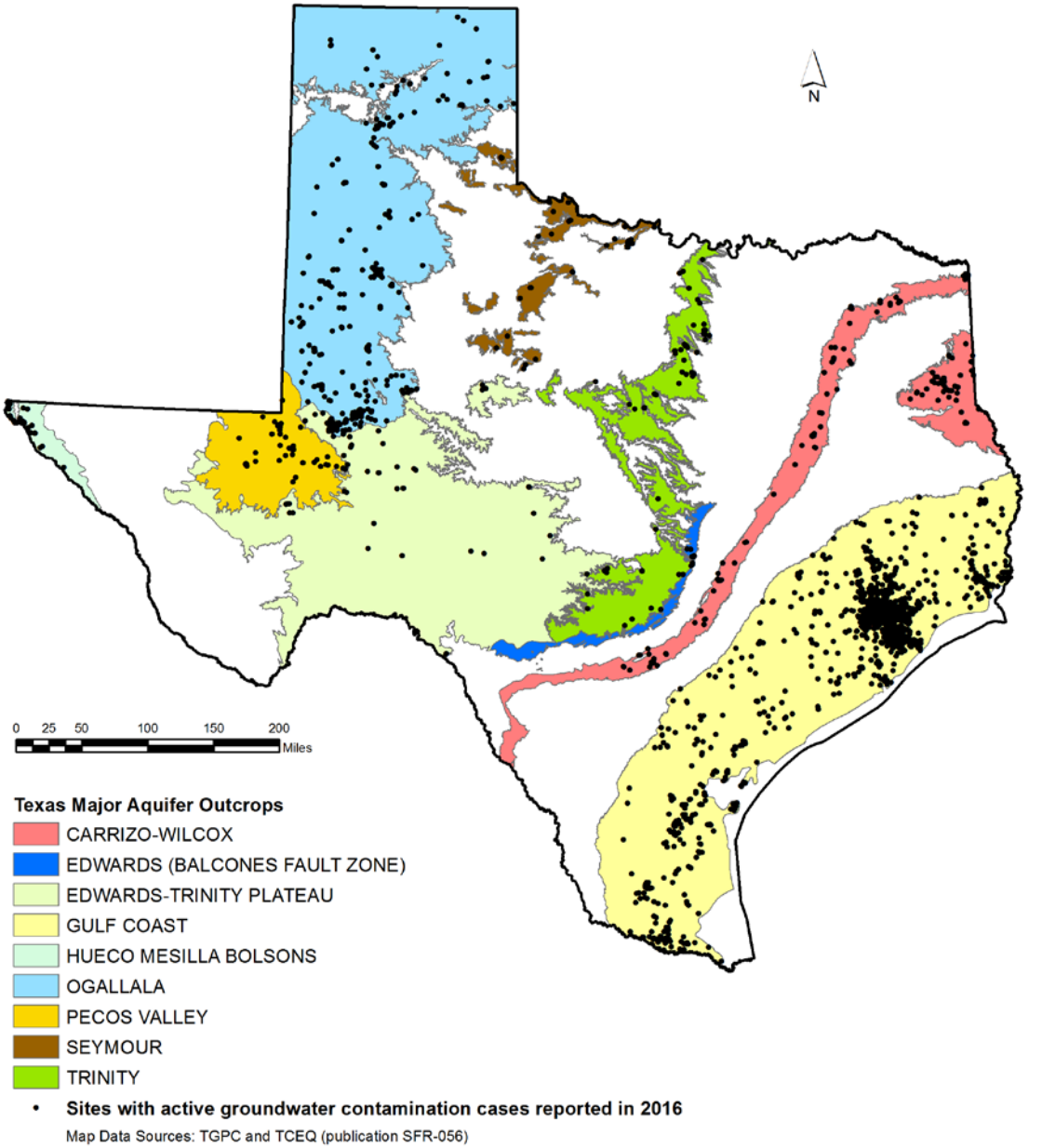
Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	35	0	35	0
Cadmium, dissolved	5 µg/l	35	35	0	0
Chromium, dissolved	100 µg/l	35	5	30	0
Fluoride, dissolved	4 mg/l	35	0	31	4
Mercury, dissolved	2 µg/l	35	35	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	35	28	6	1
Selenium, dissolved	50 µg/l	35	34	1	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	35	0	35	0
Copper, dissolved	1 mg/l	35	11	24	0
Fluoride, dissolved	2 mg/l	35	0	28	7
Iron, dissolved	0.3 mg/l	35	23	12	0
Manganese, dissolved	50 µg/l	35	1	34	0
Sulfate, dissolved	300 mg/l	35	0	29	6
Total Dissolved Solids	1,000 mg/l	35	0	27	8
Zinc, dissolved	5 mg/l	35	21	14	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

Table 35. Yegua-Jackson Aquifer - Ambient Groundwater Monitoring Data (2007-2017)

Parameter Group	**MCL**	*Total Number of Wells Sampled*	*<MDL*	*<MCL (other than <MDL)*	*≥MCL*
Primary Constituents					
Barium, dissolved	2 mg/l	26	1	25	0
Cadmium, dissolved	5 µg/l	26	25	1	0
Chromium, dissolved	100 µg/l	26	6	20	0
Fluoride, dissolved	4 mg/l	28	2	26	0
Mercury, dissolved	2 µg/l	25	25	0	0
Nitrate-Nitrogen, dissolved	10 mg/l	26	12	14	0
Selenium, dissolved	50 µg/l	26	24	2	0
Secondary Constituents					
Chloride, dissolved	300 mg/l	28	0	18	10
Copper, dissolved	1 mg/l	26	6	20	0
Fluoride, dissolved	2 mg/l	28	2	25	1
Iron, dissolved	0.3 mg/l	28	10	7	11
Manganese, dissolved	50 µg/l	26	0	14	12
Sulfate, dissolved	300 mg/l	26	0	18	8
Total Dissolved Solids	1,000 mg/l	28	0	16	12
Zinc, dissolved	5 mg/l	26	10	16	0
Radioactivity					
Gross Alpha, total	15 pCi/l[3]	0	0	0	0

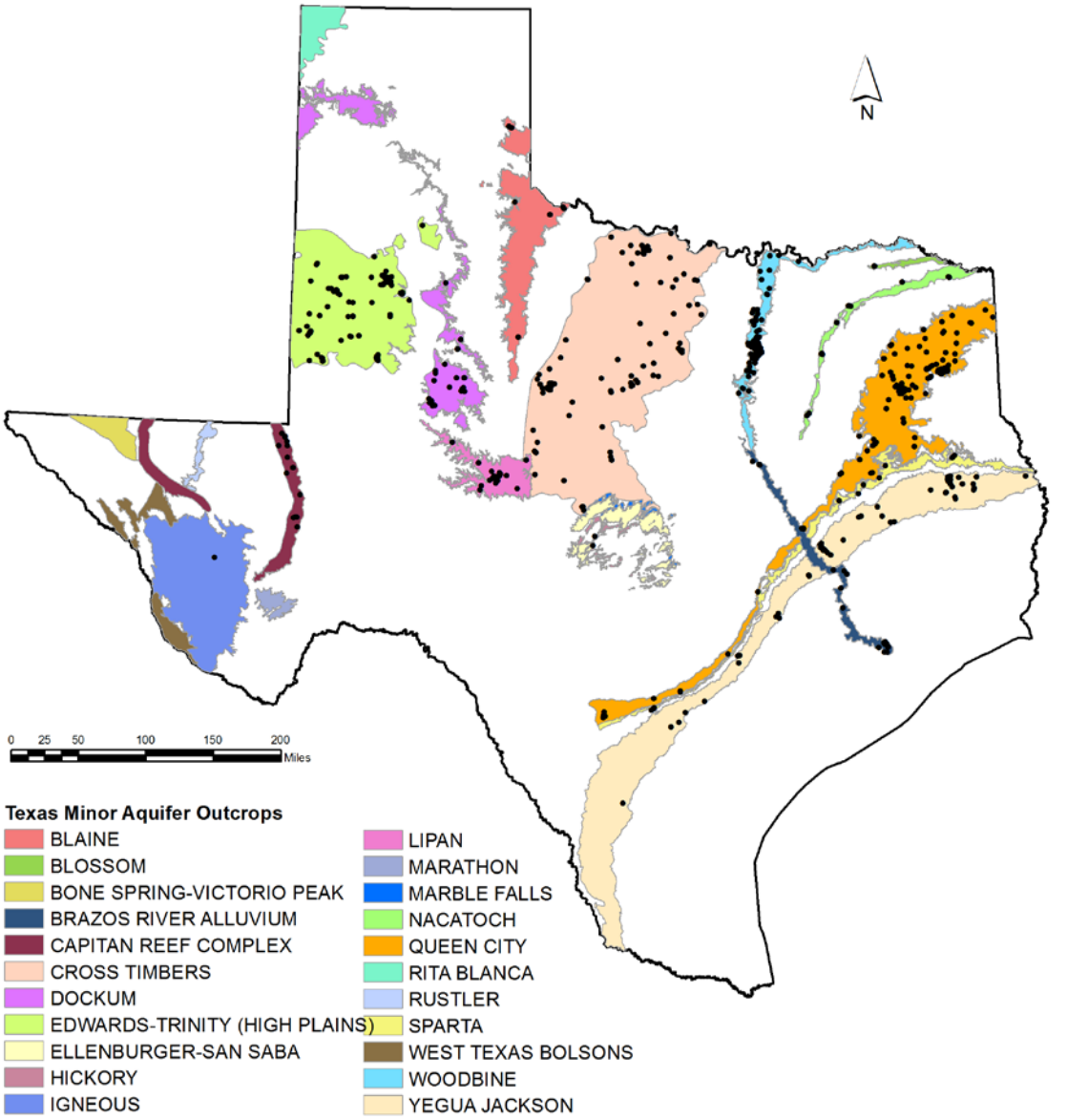
REGULATORY MONITORING/GROUNDWATER CONTAMINATION

FIGURE 3A. MAP OF MAJOR AQUIFER OUTCROP AREAS WITH CONFIRMED GROUNDWATER CONTAMINATION



This map was generated by the Water Availability Division of the Texas Commission on Environmental Quality. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries. For more information concerning this map, contact the Water Availability Division at (512) 239-4691.

FIGURE 3B. MAP OF MINOR AQUIFER OUTCROP AREAS WITH CONFIRMED GROUNDWATER CONTAMINATION



Map Data Sources: TGPC and TCEQ (publication SFR-056)

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TABLES 36 THROUGH 58 – SUMMARY OF SITES WITH CONFIRMED GROUNDWATER CONTAMINATION AT AQUIFER OUTCROP AREAS (2016)

Note: For each of the following tables (Table 36 through Table 58), the following footnotes and definitions apply:

(1) NPL means "National Priority List;" CERCLIS is "Comprehensive Environmental Response, Compensation, and Liability Information System;" US DOD/DOE means "United States Department of Defense/Department of Energy;" LUST is Leaking Underground Storage Tanks; RCRA means "Resource Conservation and Recovery Act;" MSW is Municipal Solid Waste; IHW means Industrial or Hazardous Waste; and GPAT is Groundwater Planning and Assessment program.

(2) 1=Confirmed Contamination; 2=Ongoing Investigation; 3=Corrective Action Planning; 4=Corrective Action Implementation; 5=Monitoring of Corrective Action; 6=Activity Completed

(3) *Note that a site may have more than one activity status code*

(4) VOCs are volatile organic compounds; BTEX is benzene, toluene, ethylbenzene, and xylenes; PSH is phase-separated hydrocarbons; TPH is total petroleum hydrocarbons; PAH is polycyclic aromatic hydrocarbons

(5) These state sites may be combined with NPL and RCRA site

Table 36. Blaine Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	**Number of Sites with Confirmed Groundwater Contamination**	**Site Activity Status**[2]						**Contaminants**[3]
		1	***2***	***3***	***4***	***5***	***6***	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**0**	0	0	0	0	0	0	
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**7**	0	7	0	0	0	0	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**0**	0	0	0	0	0	0	
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**3**	0	0	0	1	1	1	TPH, BTEX, PSH
Totals	**10**	0	7	0	1	1	1	

Table 37. Blossom Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**0**	0	0	0	0	0	0	
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**2**	1	0	0	0	0	1	unknown
RCRA Corrective Action – • TCEQ CA program	**0**	0	0	0	0	0	0	
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**2**	1	0	0	0	0	1	

Table 38. Brazos River Alluvium Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**1**	0	0	0	0	1	0	VOCs, TCE, arsenic, benzene
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**7**	0	4	0	0	1	6	Chlorinated solvents, VOCs, PCBs
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**5**	0	1	0	0	0	4	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**8**	0	1	0	3	4	0	BTEX, MTBE, TPH, metals, chlorinated solvent
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**5**	0	1	2	0	2	0	Chloride, TPH, BTEX, benzene, metals, PSH, SVOCs
Totals	**26**	0	7	2	3	8	10	

Table 39. Capitan Reef Complex Outcrop Summary of Sites with Confirmed Groundwater Contamination (2016) -

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**1**	0	1	0	0	0	0	VOCs (PCE and TCE)
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**2**	0	1	0	0	0	1	gasoline, diesel
RCRA Corrective Action – • TCEQ CA program	**0**	0	0	0	0	0	0	
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**12**	1	0	0	6	5	0	Benzene, TCEQ, TPH, PSH, chloride, pH, natural gas
Totals	**15**	1	2	0	6	5	0	

Table 40. Carrizo-Wilcox Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**5**	0	1	0	0	4	0	VOCs, metals, perchlorate, PAH, benzene, TPH, pentachlorophenol, dioxin
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**29**	8	0	2	3	6	1	VOCs, SVOCs, TPH, chlorinated solvents, metals, BTEX, PAH, PCBs, nitrate, ammonia
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**49**	5	29	0	3	0	12	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**21**	4	1	0	1	14	1	BTEX, benzene, TPH, inorganics, fuel oil, naphthalene, VOCs, metals, halogenated hydrocarbons, fluoride, chloride, sulfate, chlorinated solvents, PSH, creosote
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**1**	1	0	0	0	0	0	Metals (selenium and cadmium)
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**28**	0	7	2	11	8	0	Chloride, TPH, BTEX, metals, PSH, pH, PCBs
Totals	**134**	18	38	4	18	32	14	

Table 41. Dockum Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**2**	0	1	0	0	0	1	PAH, naphthalene, phenol, BTEX, benzo-a-anthracene, phenanthrene, metals
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**0**	0	0	0	0	0	0	
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**2**	0	2	0	0	0	0	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**1**	0	0	0	0	1	0	BTEX, TPH, VOCs
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**21**	0	2	2	7	9	1	Chloride, TPH, BTEX, PSH, PAH, TDS
Totals	**26**	0	5	2	7	10	2	

Table 42. Edwards (Balcones Fault Zone) Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**3**	0	2	1	0	0	0	Chlorinated solvents, VOCs, SVOCs, metals, TPH, PCBs
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**1**	0	1	0	0	0	0	gasoline
RCRA Corrective Action – • TCEQ CA program	**2**	0	0	0	0	1	1	VOCs, TCE
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**6**	0	3	0	0	2	1	

Table 43. Edwards-Trinity (Plateau) Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**3**	0	1	0	1	1	0	PCE, TCE, VOCs, metals
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**4**	0	1	0	1	0	2	Chlorinated solvents, metals, TPH, PCBs
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**14**	2	10	0	0	0	2	gasoline, diesel, waste oil, unknown
RCRA Corrective Action – • TCEQ CA program	**8**	0	2	2	1	3	0	VOCs, BTEX, TPH, metals, TCE
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**1**	0	1	0	0	0	0	VOCs
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**25**	1	0	0	14	8	2	Chloride, TPH, BTEX, metals, PSH, PAH, VOCs, SVOCs, PCBs
Totals	**55**	3	15	2	17	12	6	

Table 44. Edwards-Trinity (High Plains) Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**1**	0	0	0	1	0	0	Benzene, iron, 1,2-DCA, metals
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**11**	1	2	0	4	3	1	PCE, pesticides, chloride, VOCs, SVOCs, BTEX, MTBE, carbon tetrachloride, dieldrin, chlorinated solvents, metals, PCBs, nitrate, TPH, herbicides
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**44**	0	20	0	18	0	6	gasoline, diesel, waste oil, unknown
RCRA Corrective Action – • TCEQ CA program	**7**	0	2	1	1	3	0	VOCs, BTEX, TPH, metals, 1,2-dibromoethane, pentachlorphenol, fuel oil, organics
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**2**	0	1	0	1	1	0	Metals, VOCs, benzene, DBCM, PCE, TCE
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**24**	5	2	3	7	7	0	Chloride, TPH, BTEX, VOCs, SVOCs, PSH, natural gas
Totals	**89**	6	29	4	32	14	7	

Table 45. Gulf Coast Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**37**	0	2	4	3	27	1	Metals, VOCs, SVOCs, arsenic, PAH, dioxins, creosote components, chlorobenzene, pyrene, pentachlorphenol, PCBs, PCE, etc.
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**456**	66	79	35	39	100	39	Chlorinated solvents, VOCs, metals, TPH
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**426**	61	245	0	15	0	105	gasoline, diesel, waste oil, unknown
RCRA Corrective Action – • TCEQ CA program	**213**	17	32	22	20	113	10	VOCs, chlorinated solvents, arsenic, metals, TPH, BTEX, PCE, TCE, DCE, organics, etc.
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**3**	0	1	0	0	0	0	Uranium, molybdenum, radium, gross alpha, tritium
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**14**	2	7	0	5	5	0	VOCs, metals
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**262**	14	60	56	86	32	14	Chloride, TPH, BTEX, metals, glycol, VOCs, SVOCs, PSH, PAH, amine, natural gas
Totals	**1,416**	160	426	117	168	277	169	

Table 46. Hickory Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**0**	0	0	0	0	0	0	
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**1**	0	1	0	0	0	0	unknown
RCRA Corrective Action – • TCEQ CA program	**0**	0	0	0	0	0	0	
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**1**	0	0	0	0	0	0	Copper wire, tires
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**2**	0	1	0	0	0	0	

Table 47. Hueco-Mesilla Bolsons Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**7**	1	0	0	1	2	2	VOCs, SVOCs, chlorinated solvents, metals, TPH
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**19**	1	13	0	2	0	3	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**11**	1	0	1	2	7	0	BTEX, LNAPL, TPH, MTBE, metals, VOCs, PSH
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**37**	3	13	1	5	9	5	

Table 48. Igneous Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	**Number of Sites with Confirmed Groundwater Contamination**	**Site Activity Status**[2]						**Contaminants**[3]
		1	***2***	***3***	***4***	***5***	***6***	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**1**	0	1	0	0	0	0	Nitrate
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**0**	0	0	0	0	0	0	
RCRA Corrective Action – • TCEQ CA program	**0**	0	0	0	0	0	0	
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**1**	0	1	0	0	0	0	

Table 49. Lipan Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**2**	0	0	0	0	1	0	VOCs, chlorinated solvents, TPH, nitrates, nitrites
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**10**	2	6	0	0	0	2	gasoline, diesel, other, unknown
RCRA Corrective Action – • TCEQ CA program	**6**	0	2	0	0	4	0	Hydrocarbons, chlorinated hydrocarbons, benzene, ethylbenzene, lead, arsenic, carbon tetrachloride
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**1**	0	0	0	1	1	0	VOCs
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**3**	1	0	0	1	1	0	Chloride, TPH, BTEX, VOCs, SVOCs
Totals	**22**	3	8	0	2	7	2	

Table 50. Nacatoch Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**1**	0	1	0	0	0	0	TCE, chromium, hexavalent chromium
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**1**	0	0	0	0	1	0	VOCs, metals
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**10**	2	6	0	0	0	2	gasoline, unknown
RCRA Corrective Action – • TCEQ CA program	**1**	0	0	0	0	1	0	BTEX, TCE
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**13**	2	7	0	0	2	2	

Table 51. Ogallala Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**10**	0	5	1	1	3	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**43**	5	6	1	11	16	4	
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**122**	5	61	1	11	16	4	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**41**	1	5	4	6	24	0	VOCs, BTEX, TPH, MTBE, metals, LNAPL, gasoline, fuel oil
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**5**	0	3	0	2	2	0	VOCs, metals
Nonpoint Sources – • Includes TCEQ's GPAT	**3**	3	0	0	0	0	0	Arsenic, heptachlor epoxide
Oil/Gas Activities – • Texas Railroad Commission	**96**	9	3	6	44	26	8	Chloride, TPH, BTEX, PSH, benzene, natural gas
Totals	**321**	23	83	13	75	87	16	

Table 52. Pecos Valley Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	**Number of Sites with Confirmed Groundwater Contamination**	**Site Activity Status**[2]						**Contaminants**[3]
		1	***2***	***3***	***4***	***5***	***6***	
NPL • TCEQ's Superfund program	**1**	0	1	0	0	0	0	VOCs (PCE, TCE)
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**0**	0	0	0	0	0	0	
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**12**	0	9	0	1	0	2	gasoline, diesel
RCRA Corrective Action – • TCEQ CA program	**2**	0	0	0	1	1	0	VOCs, varsol solvent
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**30**	1	3	1	14	11	0	TPH, BTEX, PSH, chloride, glycol, PCBs
Totals	**45**	1	13	1	16	12	2	

Table 53. Queen City Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**4**	0	3	0	0	1	0	VOCs, arsenic, metals, benzene, vinyl chloride
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**18**	5	3	2	2	4	2	Chlorinated solvents, VOCs, TPH, VOCs, metals, nitrates
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**61**	4	38	0	5	0	14	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**22**	0	3	2	2	15	0	VOCs, petroleum hydrocarbons, metals, phenols, TCE, pH
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**2**	0	1	0	1	0	0	petroleum hydrocarbons
Oil/Gas Activities – • Texas Railroad Commission	**18**	1	4	1	7	5	0	TPH, BTEX, chloride, PSH, metals, PCB
Totals	**125**	10	52	5	17	25	16	

Table 54. Seymour Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**2**	0	1	0	0	1	0	Chlorinated solvents, TPH, VOCs
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**26**	1	15	0	7	0	3	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**5**	0	0	0	1	4	0	TPH, VOCs, arsenic, BTEX, MTBE, lead
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**1**	0	1	0	0	0	0	Metals, VOCs
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**9**	1	2	1	3	1	1	Chloride, TPH, BTEX, PSH, natural gas
Totals	**43**	2	19	1	11	6	4	

Table 55. Sparta Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	**Number of Sites with Confirmed Groundwater Contamination**	**Site Activity Status**[2]						**Contaminants**[3]
		1	***2***	***3***	***4***	***5***	***6***	
NPL • TCEQ's Superfund program	**1**	0	1	0	0	0	0	Arsenic, benzene, TPH
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**3**	0	2	1	0	0	0	TPH, chlorinated solvents, metals
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**4**	1	3	0	0	0	0	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**3**	0	0	0	2	1	0	Chlorinated solvents, gasoline, nitrates, cadmium, SVOCs
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**0**	0	0	0	0	0	0	
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**1**	0	0	0	1	0	0	TPH, BTEX
Totals	**12**	1	6	1	3	1	0	

Table 56. Trinity Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**2**	0	1	0	1	0	0	PCE, TCE, cis 1,2-DCE
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**4**	0	0	1		1	0	VOCs, benzene, TPH, metals
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**37**	3	26	0	3	0	5	gasoline, diesel, waste oil, unknown
RCRA Corrective Action – • TCEQ CA program	**9**	2	2	0	0	6	0	VOCs, BTEX, benzene, hydrocarbons, MTBE, metals, halogenated VOCs, TCA, 1,2-DCE
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**3**	0	2	0	1	1	0	Metals, VOCs
Nonpoint Sources – • Includes TCEQ's GPAT	**1**	0	1	0	0	0	0	Nitrates
Oil/Gas Activities – • Texas Railroad Commission	**8**	0	0	1	4	2	6	TPH, BTEX, benzene, PSH, chloride
Totals	**64**	5	32	2	9	10	11	

Table 57. Woodbine Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**39**	4	5	0	2	4	6	Chlorinated solvents, VOCs, SVOCs, TPH, PFC, metals, BTEX
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**36**	6	19	0	0	0	11	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**9**	2	1	1	0	5	0	BTEX, TPH, MTBE, lead, chromium, chlorinated solvents, PSH, TCE, PCE
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**0**	0	0	0	0	0	0	
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**2**	0	1	0	1	1	0	VOCs, metals
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**0**	0	0	0	0	0	0	
Totals	**86**	12	26	1	3	10	17	

Table 58. Yegua-Jackson Aquifer Outcrop - Summary of Sites with Confirmed Groundwater Contamination (2016)

Source Type[1]	Number of Sites with Confirmed Groundwater Contamination	Site Activity Status[2]						Contaminants[3]
		1	*2*	*3*	*4*	*5*	*6*	
NPL • TCEQ's Superfund program	**0**	0	0	0	0	0	0	
CERCLIS / Non-NPL – • Includes TCEQ's Voluntary Cleanup, VCIO, DCRP, and SSDAP programs	**15**	1	1	4	1	4	1	VOCs, SVOCs, chlorinated solvents, TPH, metals, benzene
US DOD/DOE	**0**	0	0	0	0	0	0	
LUST • TCEQ Petroleum Storage Tank / LPST program	**17**	3	10	0	0	0	4	gasoline, diesel, unknown
RCRA Corrective Action – • TCEQ CA program	**14**	1	1	0	3	9	0	BTEX, VOCs, SVOCs, TPH, hydrocarbons, MTBE, creosote, pentachlophenol, napthalene
Underground Injection • Includes TCEQ Radioactive Materials Division sites	**1**	0	0	0	0	0	0	Uranium, cadmium, arsenic, radium, gross alpha
State Sites[4] • Includes TCEQ's MSW, IHW permitting	**2**	0	1	0	1	1	0	VOCs, metals
Nonpoint Sources – • Includes TCEQ's GPAT	**0**	0	0	0	0	0	0	
Oil/Gas Activities – • Texas Railroad Commission	**7**	0	0	0	4	0	3	Chloride, TPH, BTEX, PSH
Totals	**56**	5	13	4	9	14	8	

CONSTITUENTS OF CONCERN IN SELECTED AQUIFERS

FIGURES 4 THROUGH 34: DISTRIBUTION DIAGRAMS FOR SELECTED CONSTITUENTS

List and Locations of Figures:

Figure 4. Distribution of Nitrate - Blaine Aquifer.....97
Figure 5. Distribution of Selenium - Blaine Aquifer.....98
Figure 6. Distribution of Nitrate - Carrizo-Wilcox Aquifer.....99
Figure 7. Distribution of Nitrate - Dockum Aquifer.....100
Figure 8. Distribution of Arsenic - Dockum Aquifer.....101
Figure 9. Distribution of Fluoride - Edwards (BFZ) Aquifer.....102
Figure 10. Distribution of Nitrate - Edwards (BFZ) Aquifer.....103
Figure 11. Distribution of Arsenic - Edwards–Trinity (Plateau) Aquifer.....104
Figure 12. Distribution of Fluoride - Edwards–Trinity (Plateau) Aquifer.....105
Figure 13. Distribution of Nitrate - Edwards–Trinity (Plateau) Aquifer.....106
Figure 14. Distribution of Nitrate - Ellenburger–San Saba Aquifer.....107
Figure 15. Distribution of Arsenic - Gulf Coast Aquifer.....108
Figure 16. Distribution of Manganese - Gulf Coast Aquifer.....109
Figure 17. Distribution of Nitrate - Gulf Coast Aquifer.....110
Figure 18. Distribution of Nitrate - Hickory Aquifer.....111
Figure 19. Distribution of Arsenic - Hueco–Mesilla Bolsons Aquifer.....112
Figure 20. Distribution of Nitrate - Lipan Aquifer.....113
Figure 21. Distribution of TDS - Lipan Aquifer.....114
Figure 22. Distribution of Arsenic - Ogallala Aquifer.....115
Figure 23. Distribution of Fluoride - Ogallala Aquifer.....116
Figure 24. Distribution of Nitrate - Ogallala Aquifer.....117
Figure 25. Distribution of TDS - Ogallala Aquifer.....118
Figure 26. Distribution of Nitrate - Pecos Valley Aquifer.....119
Figure 27. Distribution of Sulfate - Pecos Valley Aquifer.....120
Figure 28. Distribution of TDS - Pecos Valley Aquifer.....121
Figure 29. Distribution of Nitrate - Seymour Aquifer.....122
Figure 30. Distribution of TDS - Seymour Aquifer.....123
Figure 31. Distribution of Nitrate - Trinity Aquifer.....124
Figure 32. Distribution of TDS - Trinity Aquifer.....125
Figure 33. Distribution of Arsenic - West Texas Bolsons Aquifer.....126
Figure 34. Distribution of Nitrate - West Texas Bolsons Aquifer.....127

Figure 4. Distribution of Nitrate in the Blaine Aquifer, 2007-2017

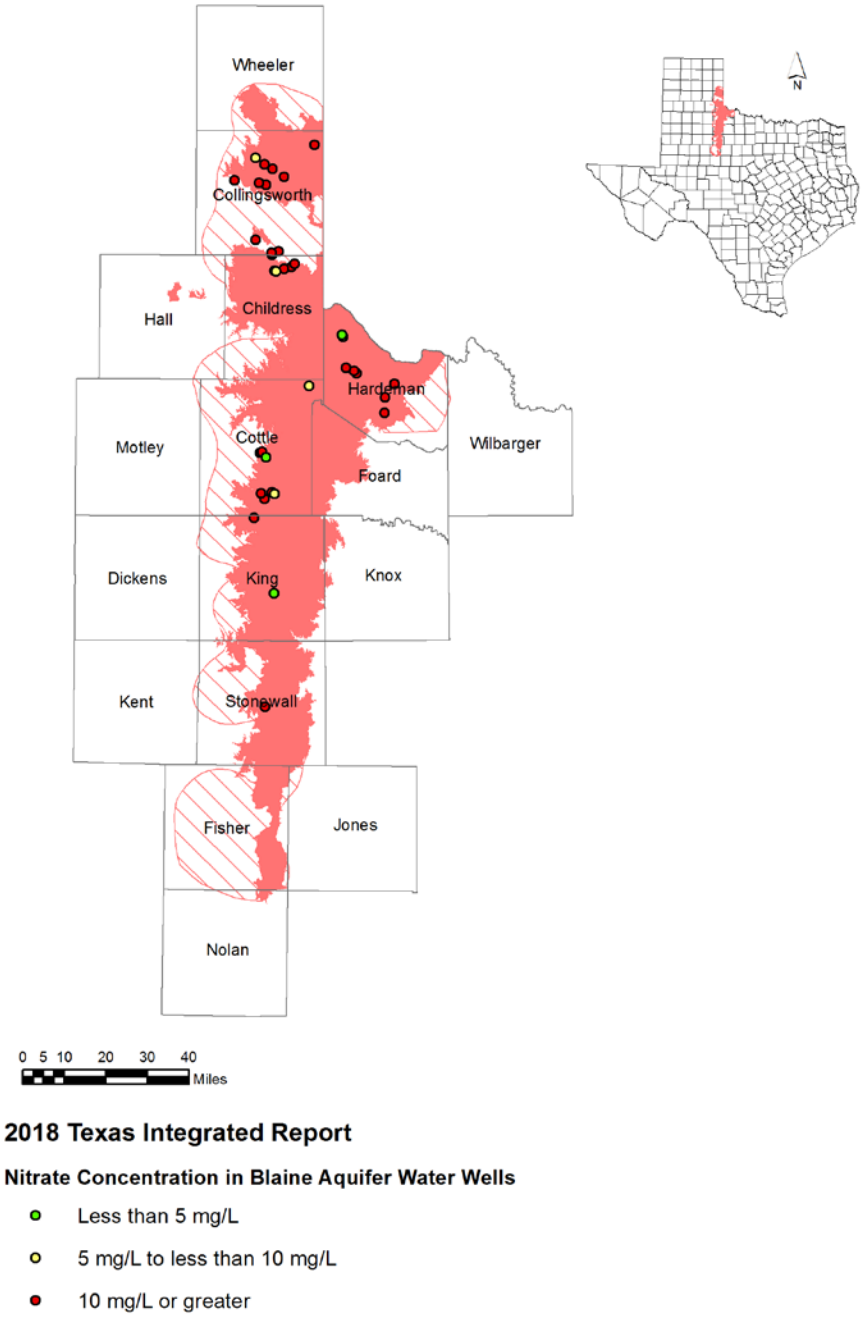


Figure 5. Distribution of Selenium in the Blaine Aquifer, 2007-2017

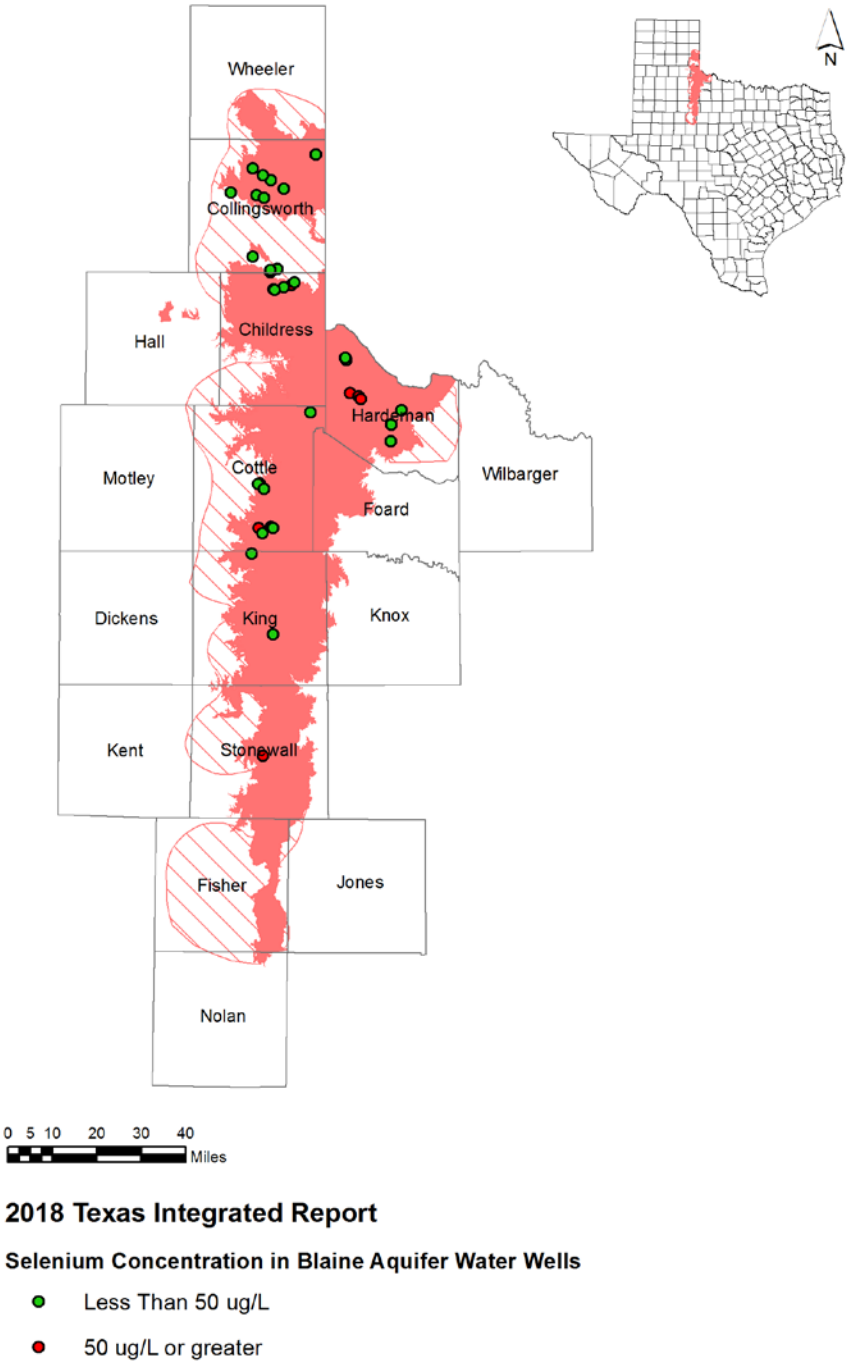
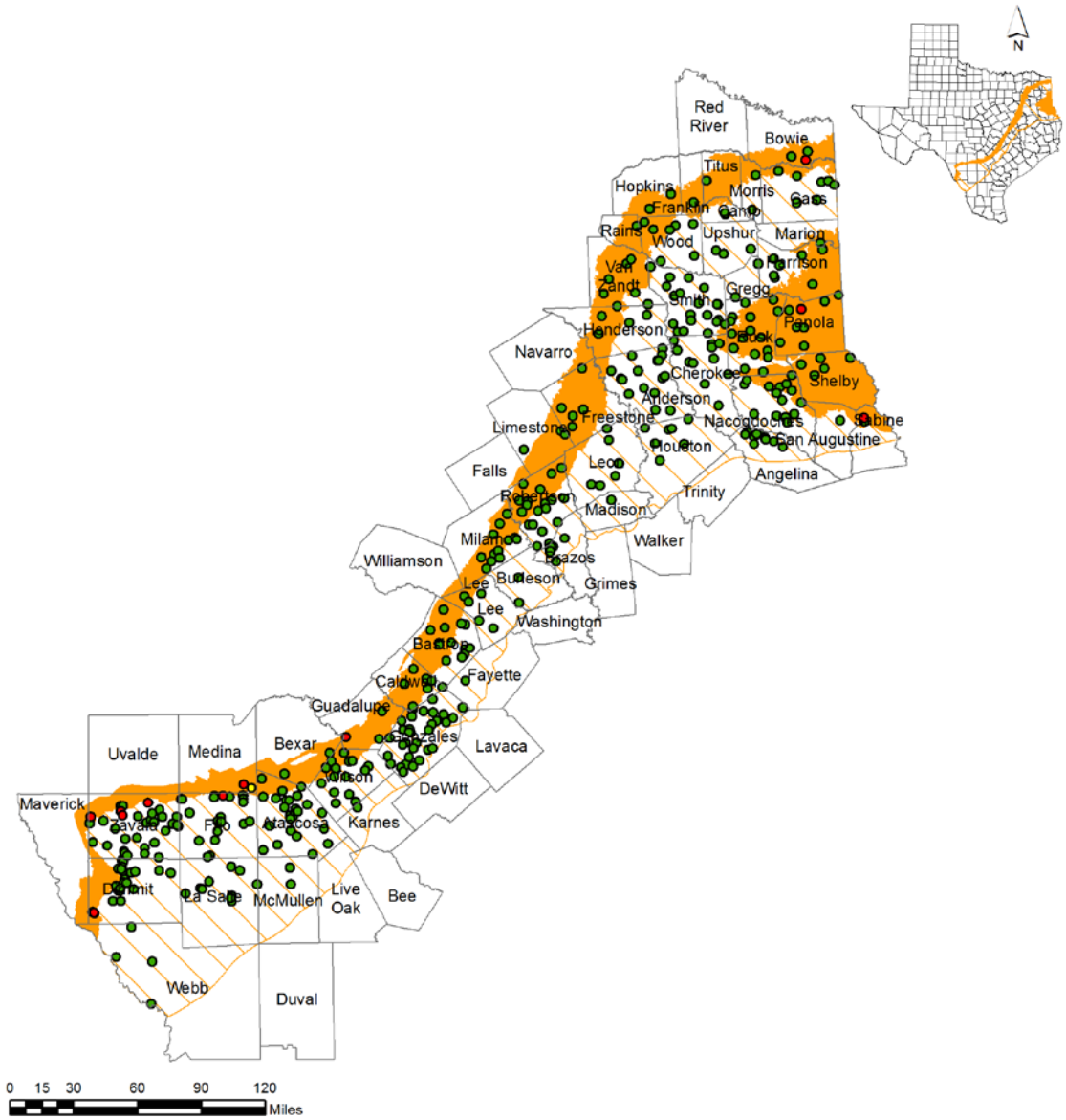


Figure 6. Distribution of Nitrate in the Carrizo-Wilcox Aquifer, 2007-2017

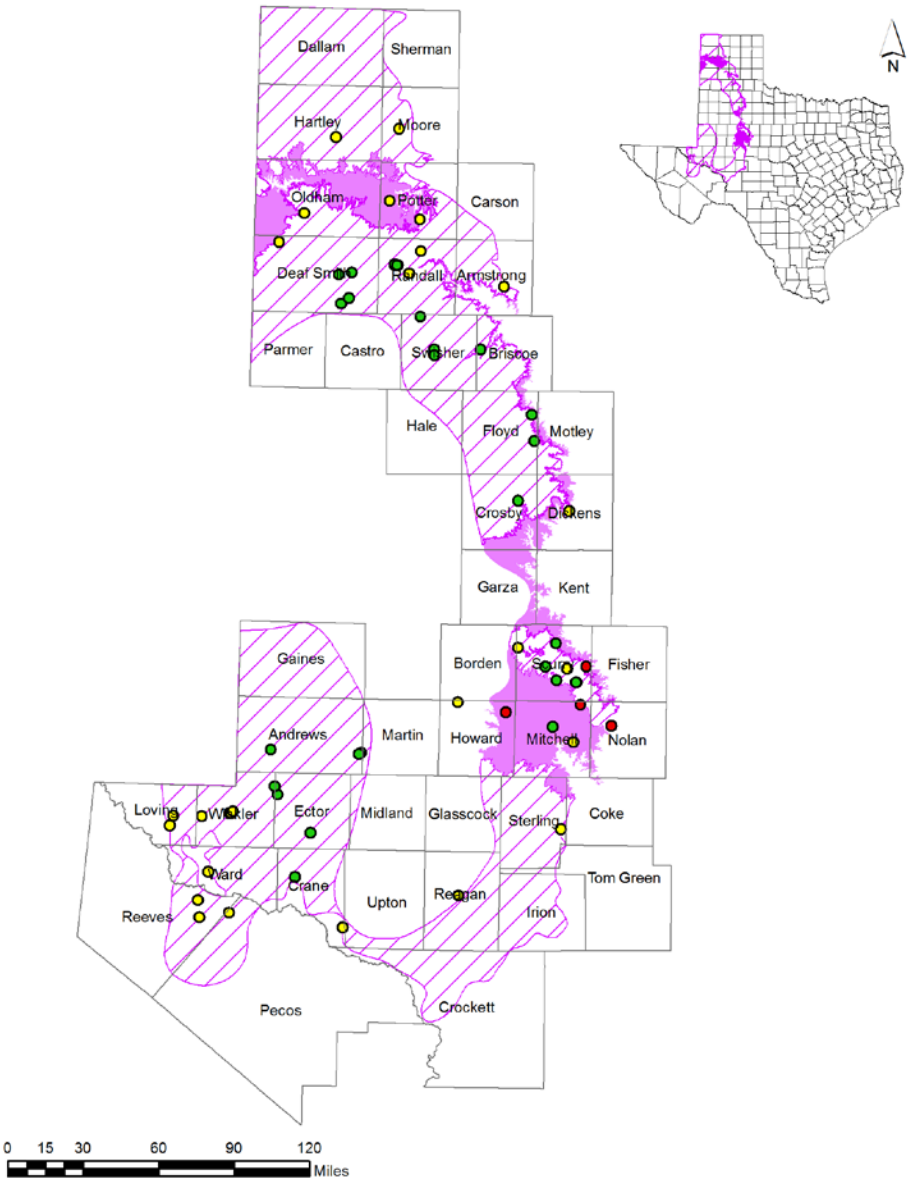


2018 Texas Integrated Report

Nitrate Concentration in Carrizo-Wilcox Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to 10 mg/L
- 10 mg/L or greater

Figure 7. Distribution of Nitrate in the Dockum Aquifer, 2007-2017

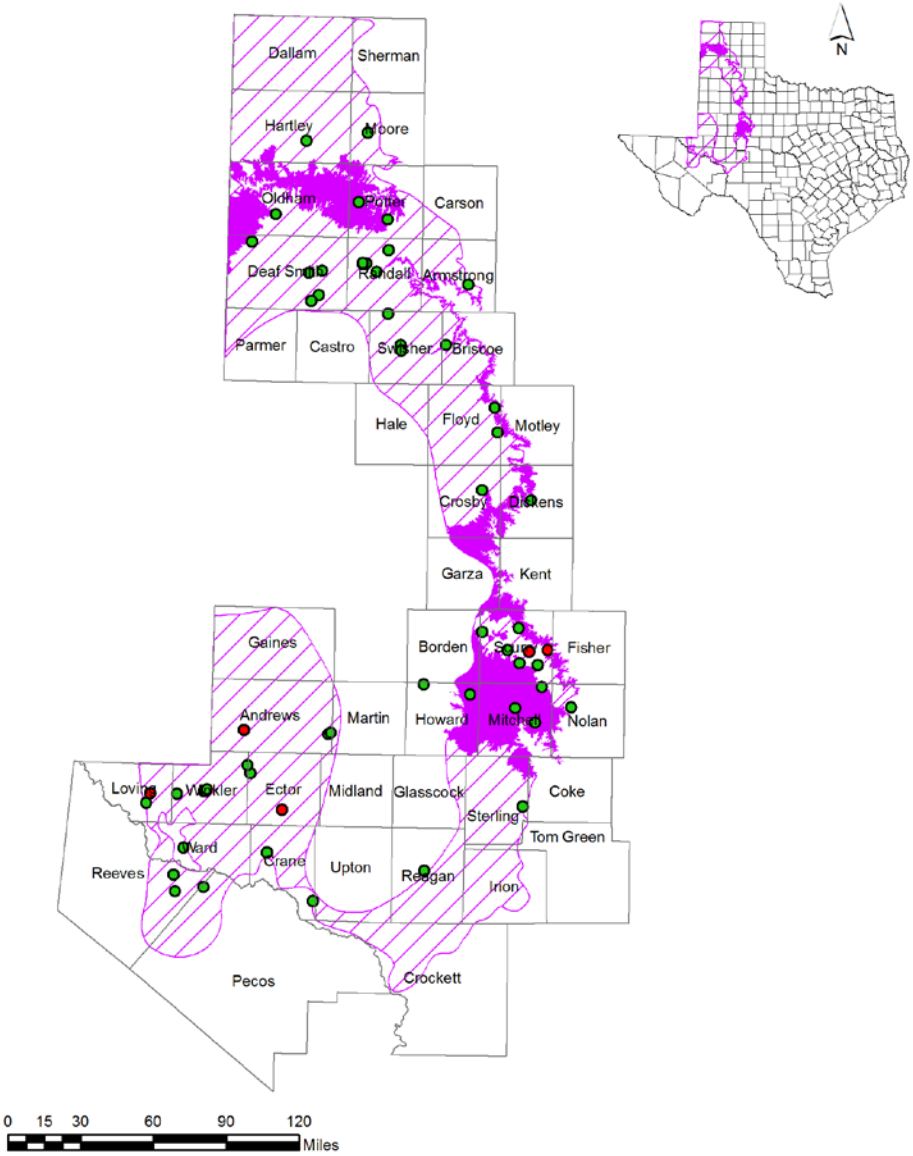


2018 Texas Integrated Report

Nitrate Concentration in Dockum Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 8. Distribution of Arsenic in the Dockum Aquifer, 2007-2017



2018 Texas Integrated Report

Arsenic Concentration in Dockum Aquifer Water Wells

- Less than 10 µg/L
- 10 µg/L or greater

Figure 9. Distribution of Fluoride in the Edwards (Balcones Fault Zone) Aquifer, 2007-2017

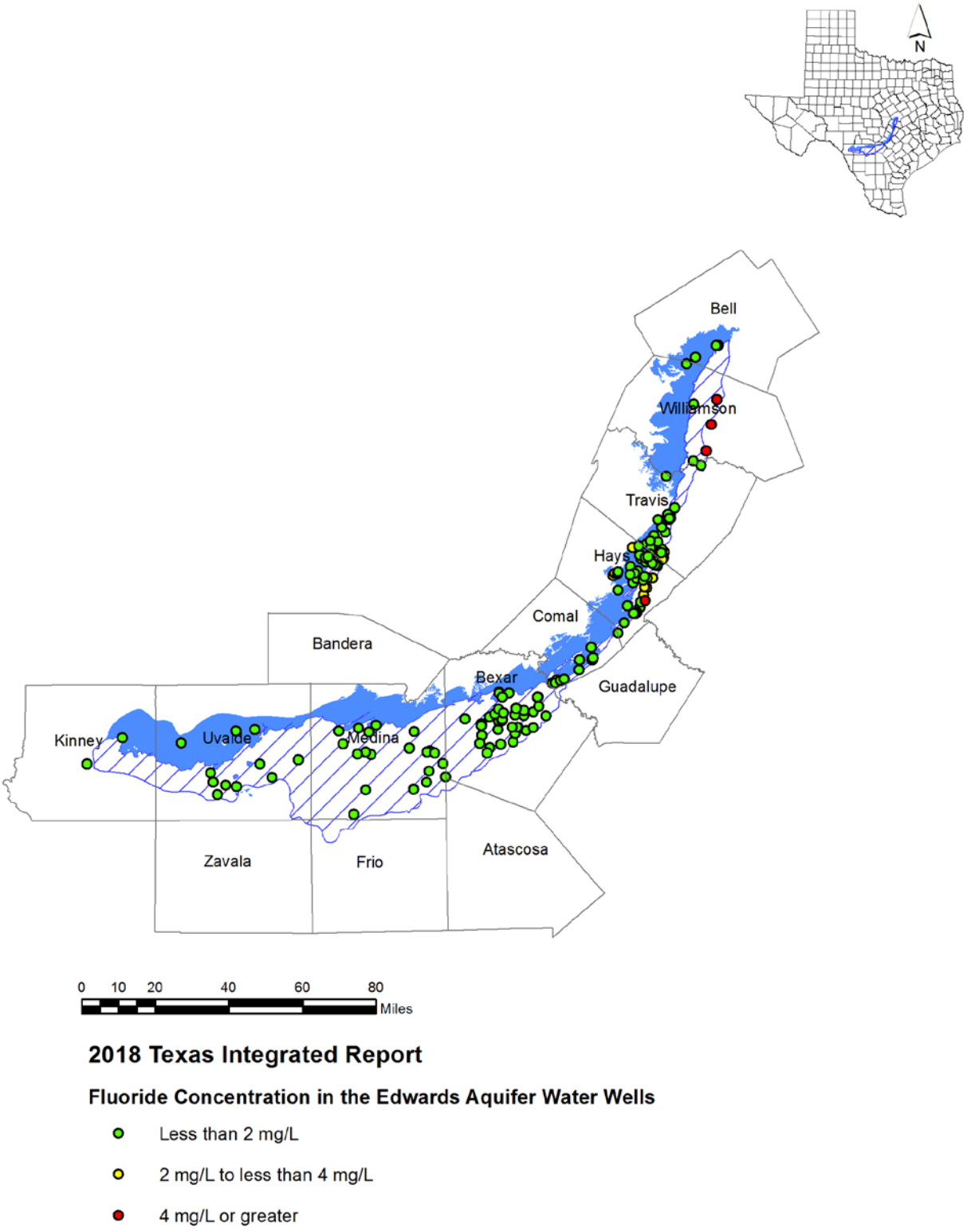


Figure 10. Distribution of Nitrate in the Edwards (Balcones Fault Zone) Aquifer, 2007-2017

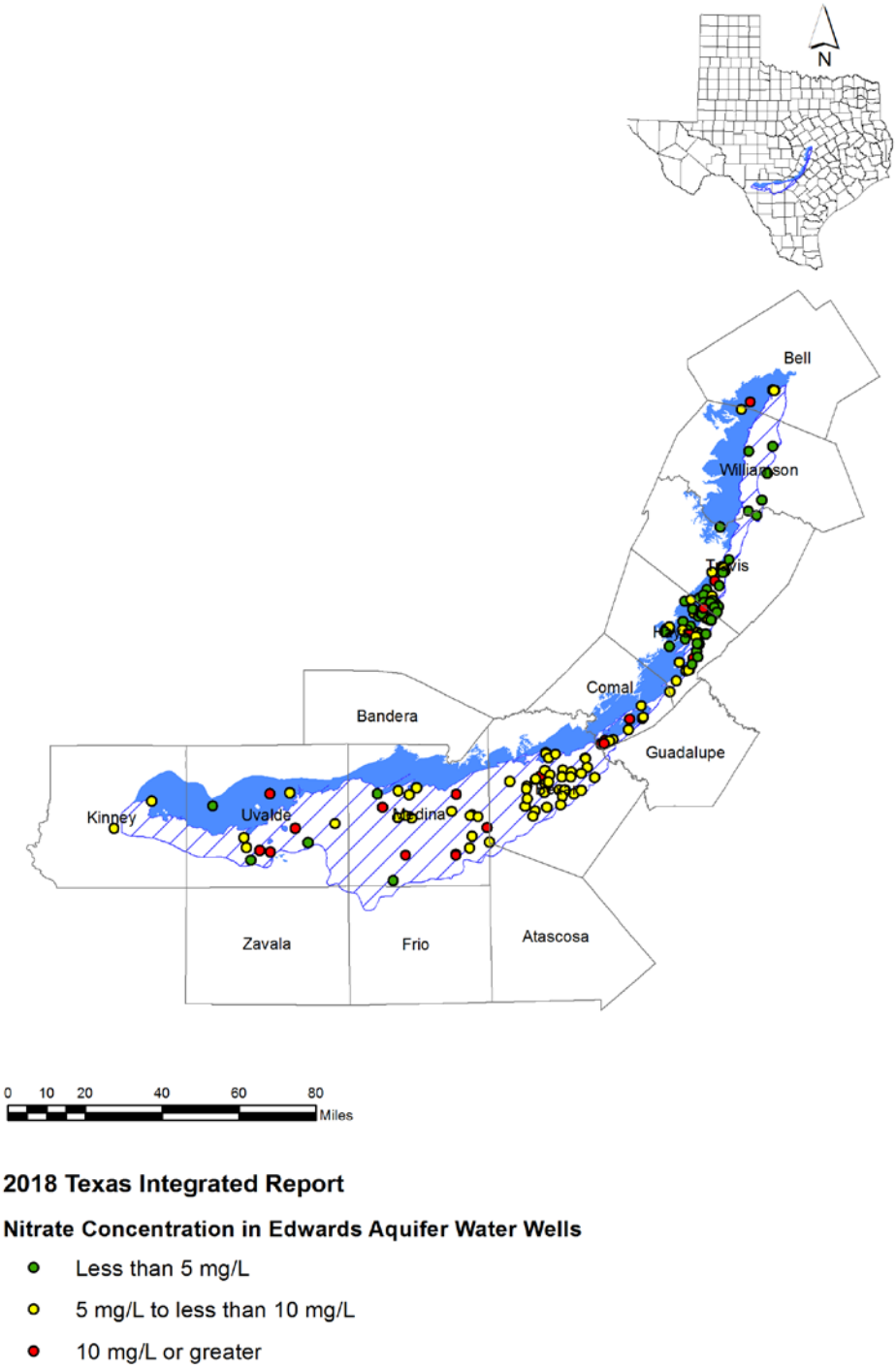
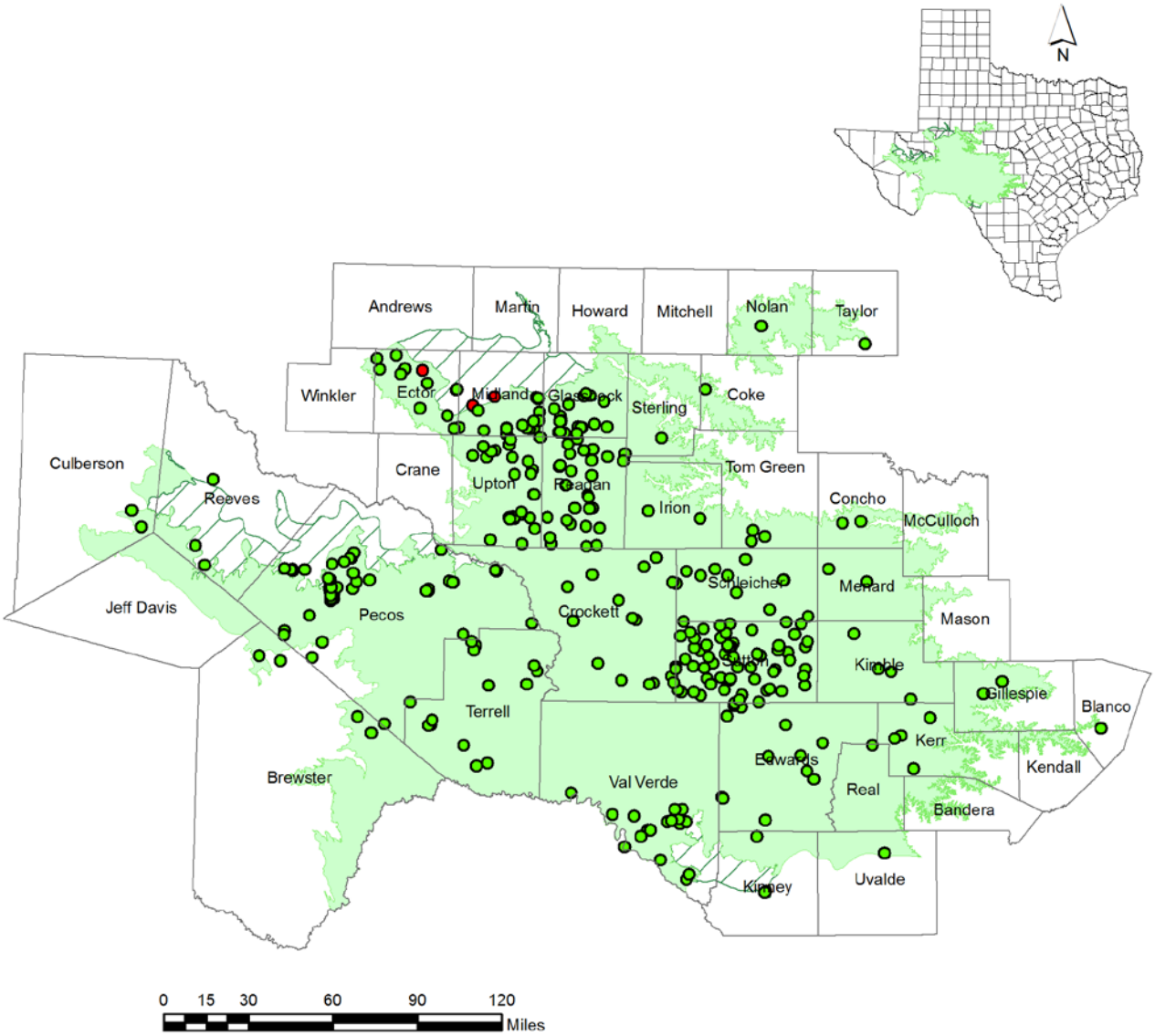


Figure 11. Distribution of Arsenic in the Edwards–Trinity (Plateau) Aquifer, 2007-2017

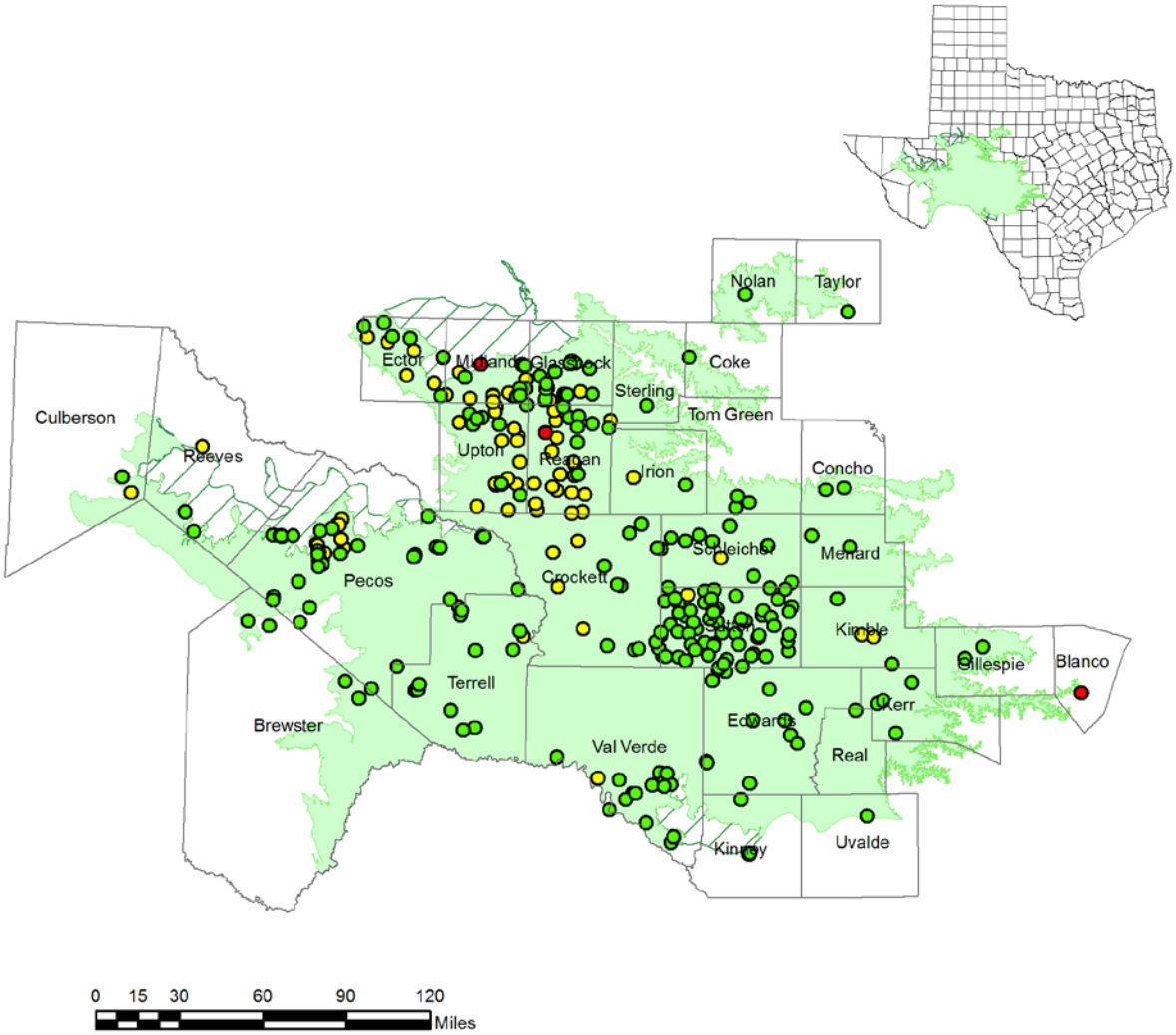


2018 Texas Integrated Report -

Arsenic Concentration in Edwards Trinity Aquifer Water Wels

- Less than 10 µg/L
- 10 µg/L or greater

Figure 12. Distribution of Fluoride in the Edwards-Trinity (Plateau) Aquifer, 2007-2017



2018 Texas Integrated Report

Fluoride Concentration in Water Wells in the Edwards Trinity Aquifer

- Less than 2 mg/L
- 2 mg/L less than 4 mg/L
- 4 mg/L or greater

Figure 13. Distribution of Nitrate in the Edwards–Trinity (Plateau) Aquifer, 2007-2017

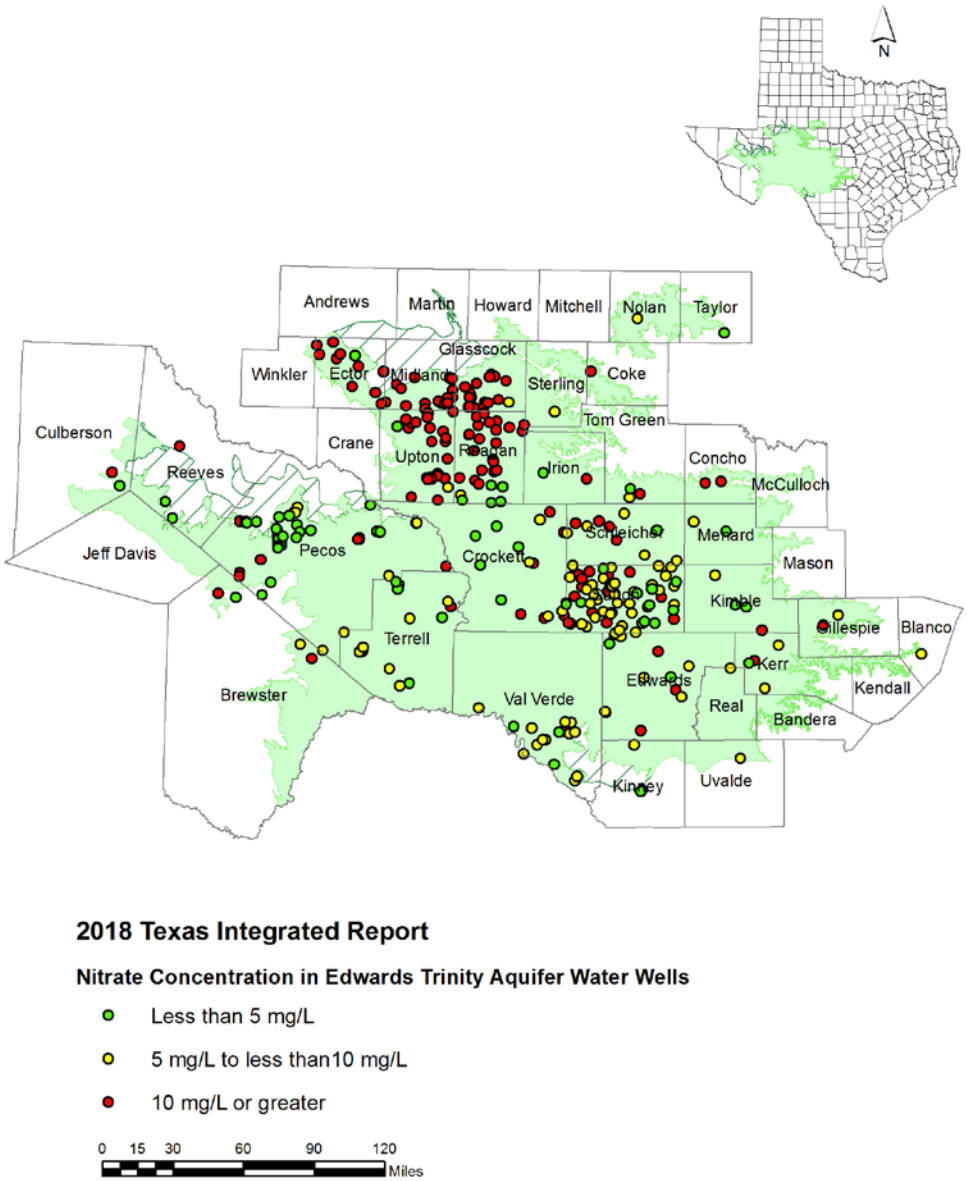


Figure 14. Distribution of Nitrate in the Ellenburger–San Saba Aquifer, 2007-2017

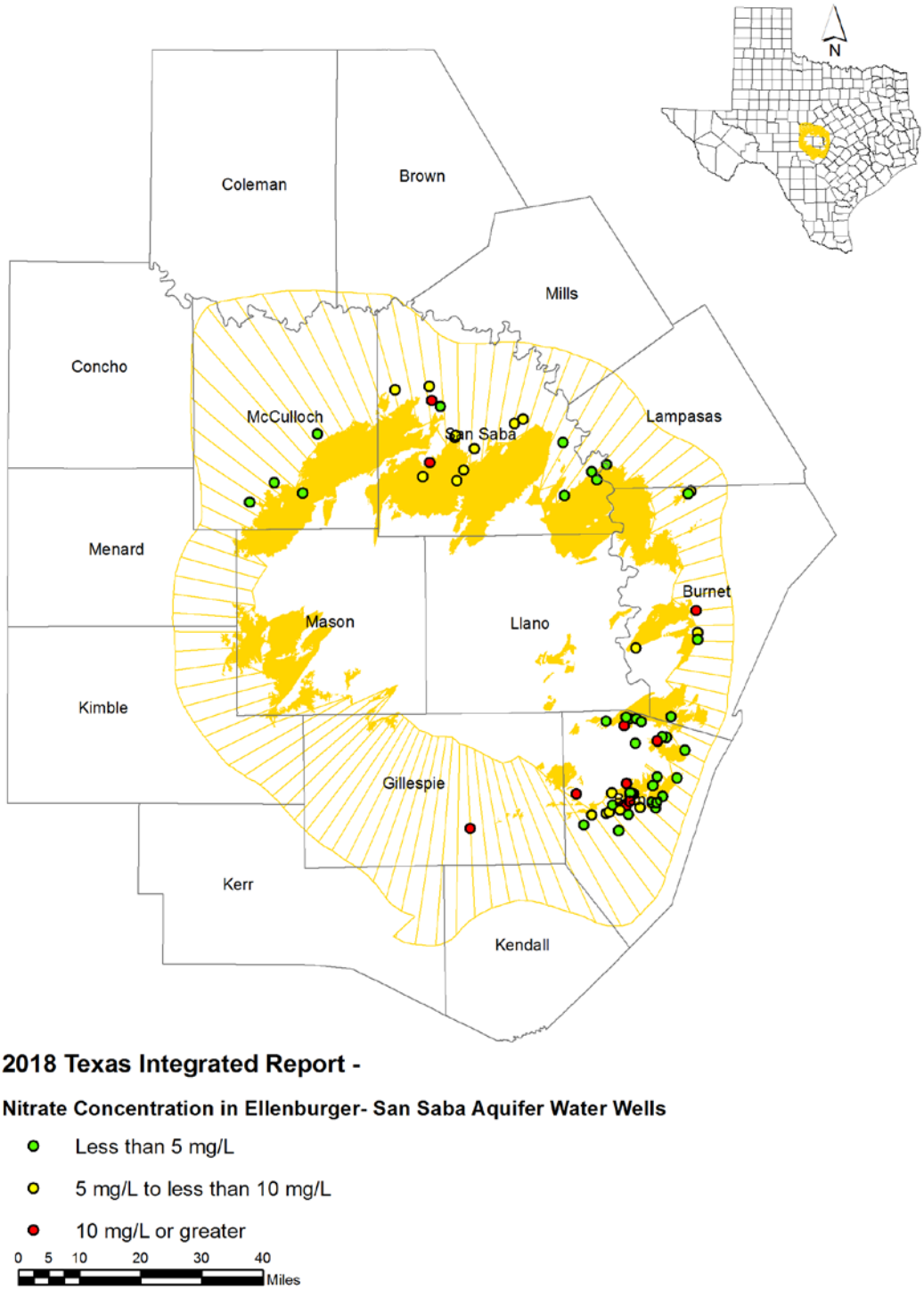


Figure 15. Distribution of Arsenic in the Gulf Coast Aquifer, 2007-2017

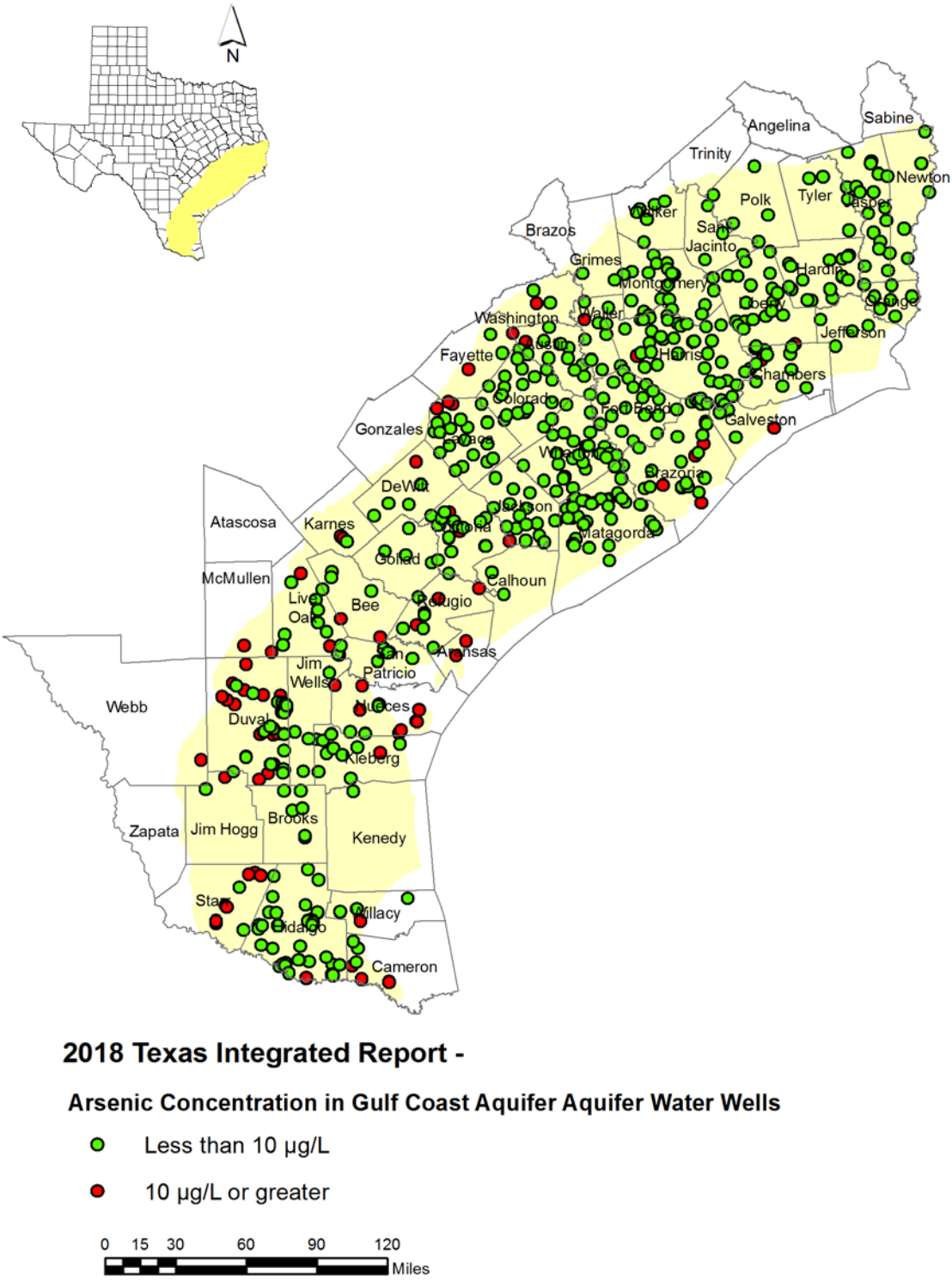


Figure 16. Distribution of Manganese in the Gulf Coast Aquifer, 2007-2017

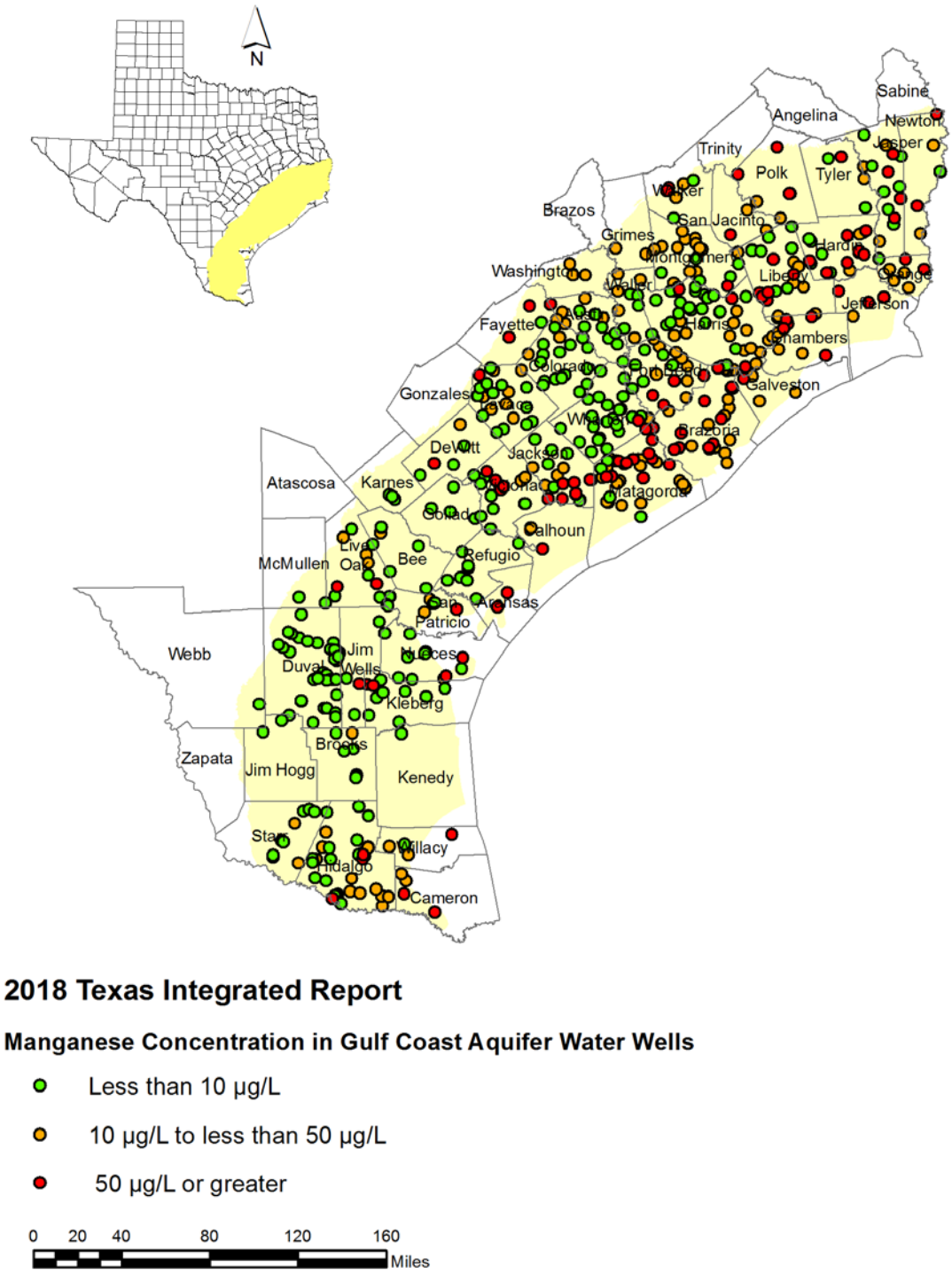
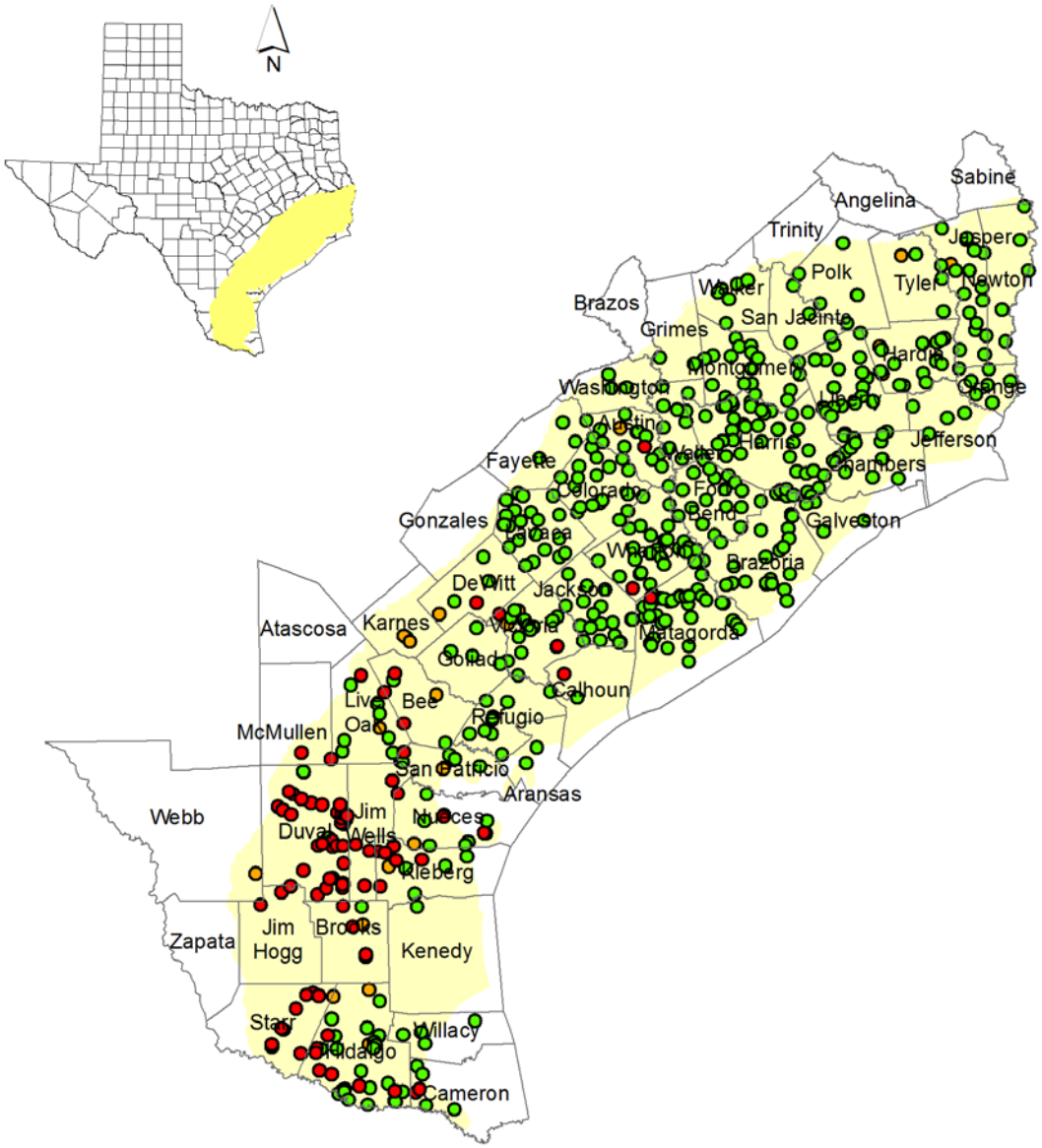


Figure 17. Distribution of Nitrate in the Gulf Coast Aquifer, 2007-2017



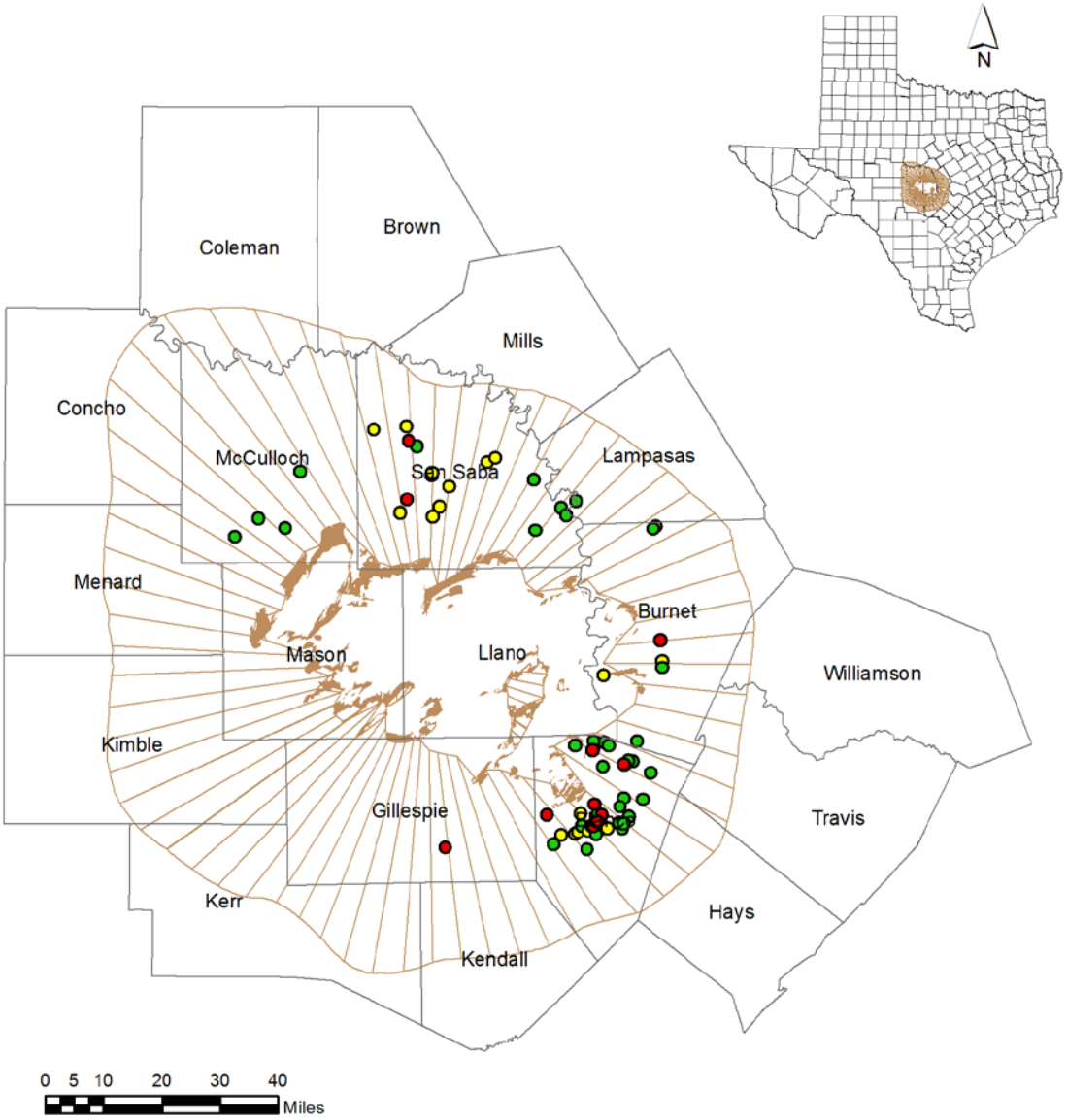
2018 Texas Integrated Report

Nitrate Concentration in Water Wells in the Gulf Coast Aquifer

- Less than 5 mg/L
- 5 mg/L to less than10 mg/L
- 10 mg/L or greater

0 20 40 80 120 160 Miles

Figure 18. Distribution of Nitrate in the Hickory Aquifer, 2007-2017

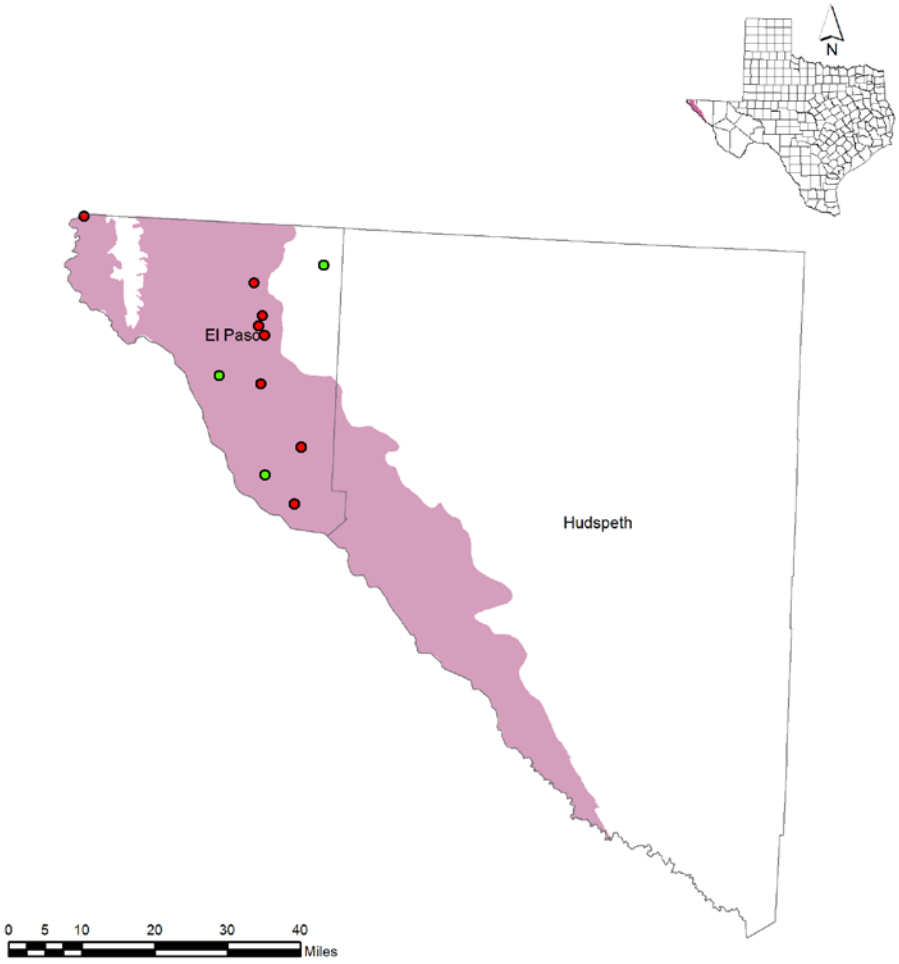


2018 Texas Integrated Report

Nitrate Concentration in Water Wells in the Hickory Aquifer

- Less than 5 mg/L
- 5 mg/L to less than10 mg/L
- 10 mg/L or greater

Figure 19. Distribution of Arsenic in the Hueco-Mesilla Bolsons Aquifer, 2007-2017

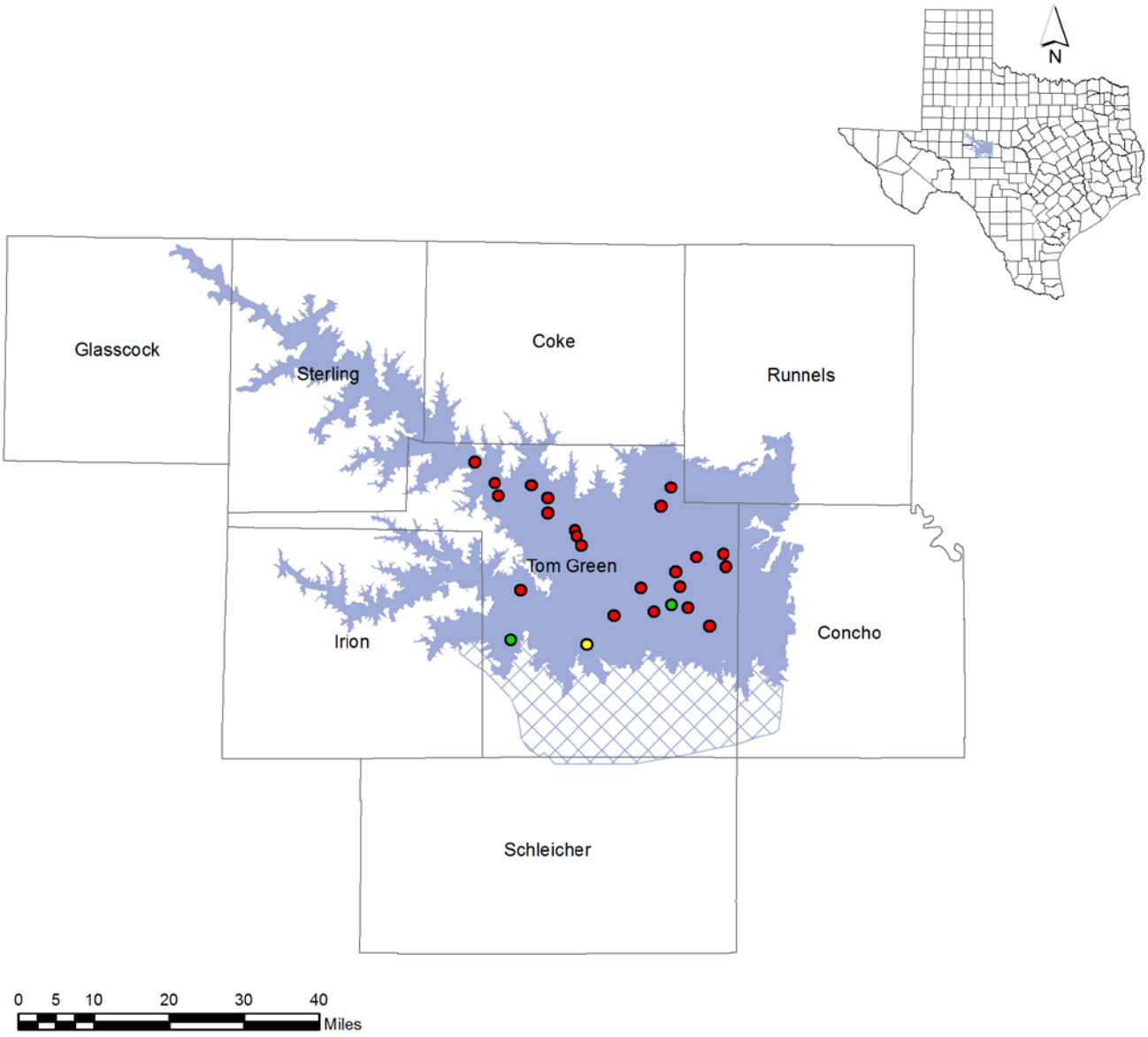


2018 Texas Integrated Report

Arsenic Concentration in Hueco - Mesilla Bolson Aquifer Water Wells

- Less than 10 µg/L
- 10 µg/L or greater

Figure 20. Distribution of Nitrate in the Lipan Aquifer, 2007-2017



2018 Texas Integrated Report

Nitrate Concentration in Lipan Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 21. Distribution of Total Dissolved Solids in the Lipan Aquifer, 2007-2017

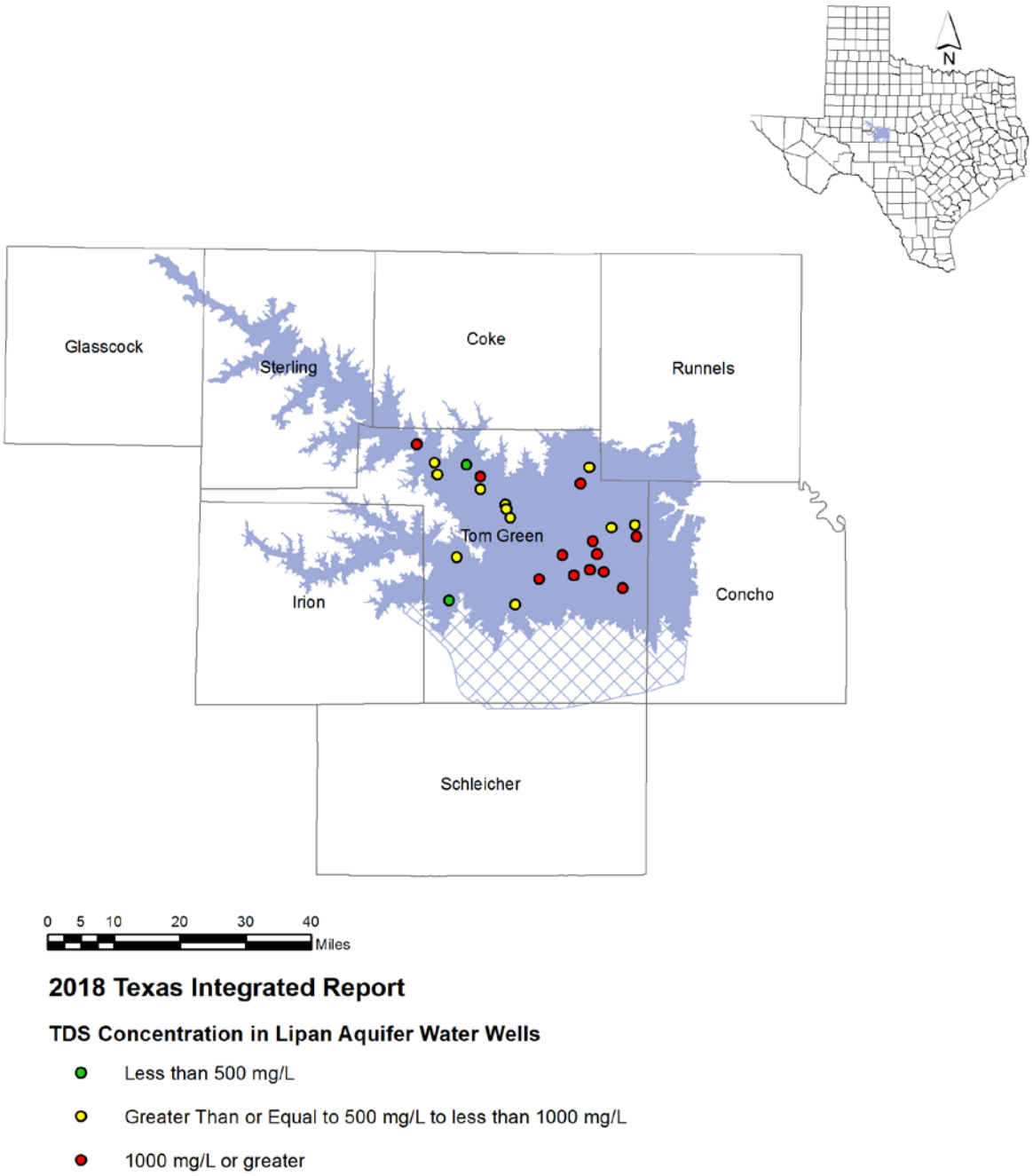
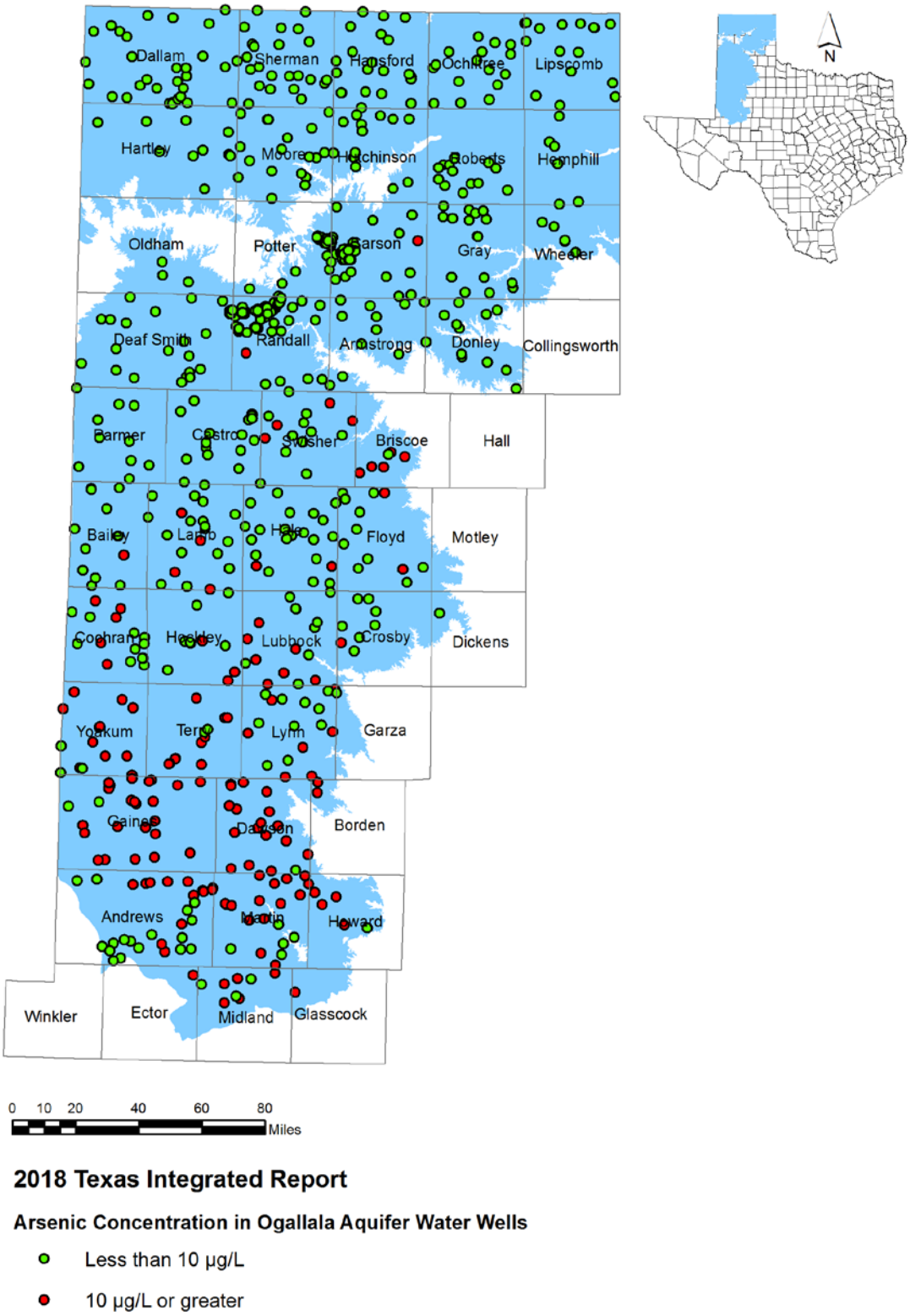


Figure 22. Distribution of Arsenic in the Ogallala Aquifer, 2007-2017

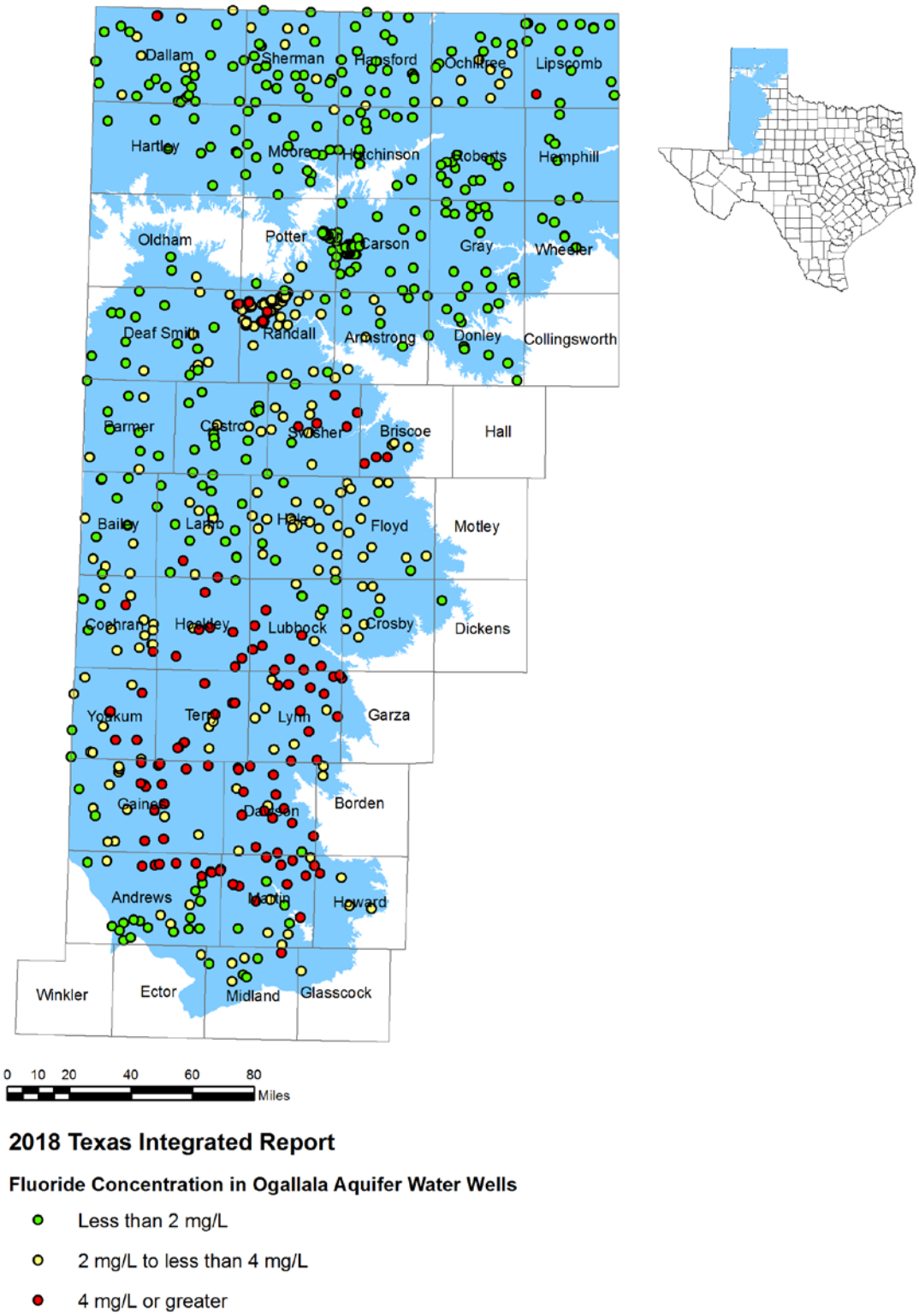


2018 Texas Integrated Report

Arsenic Concentration in Ogallala Aquifer Water Wells

- Less than 10 µg/L
- 10 µg/L or greater

Figure 23. Distribution of Fluoride in the Ogallala Aquifer, 2007-2017



2018 Texas Integrated Report

Fluoride Concentration in Ogallala Aquifer Water Wells

- Less than 2 mg/L
- 2 mg/L to less than 4 mg/L
- 4 mg/L or greater

Figure 24. Distribution of Nitrate in the Ogallala Aquifer, 2007-2017

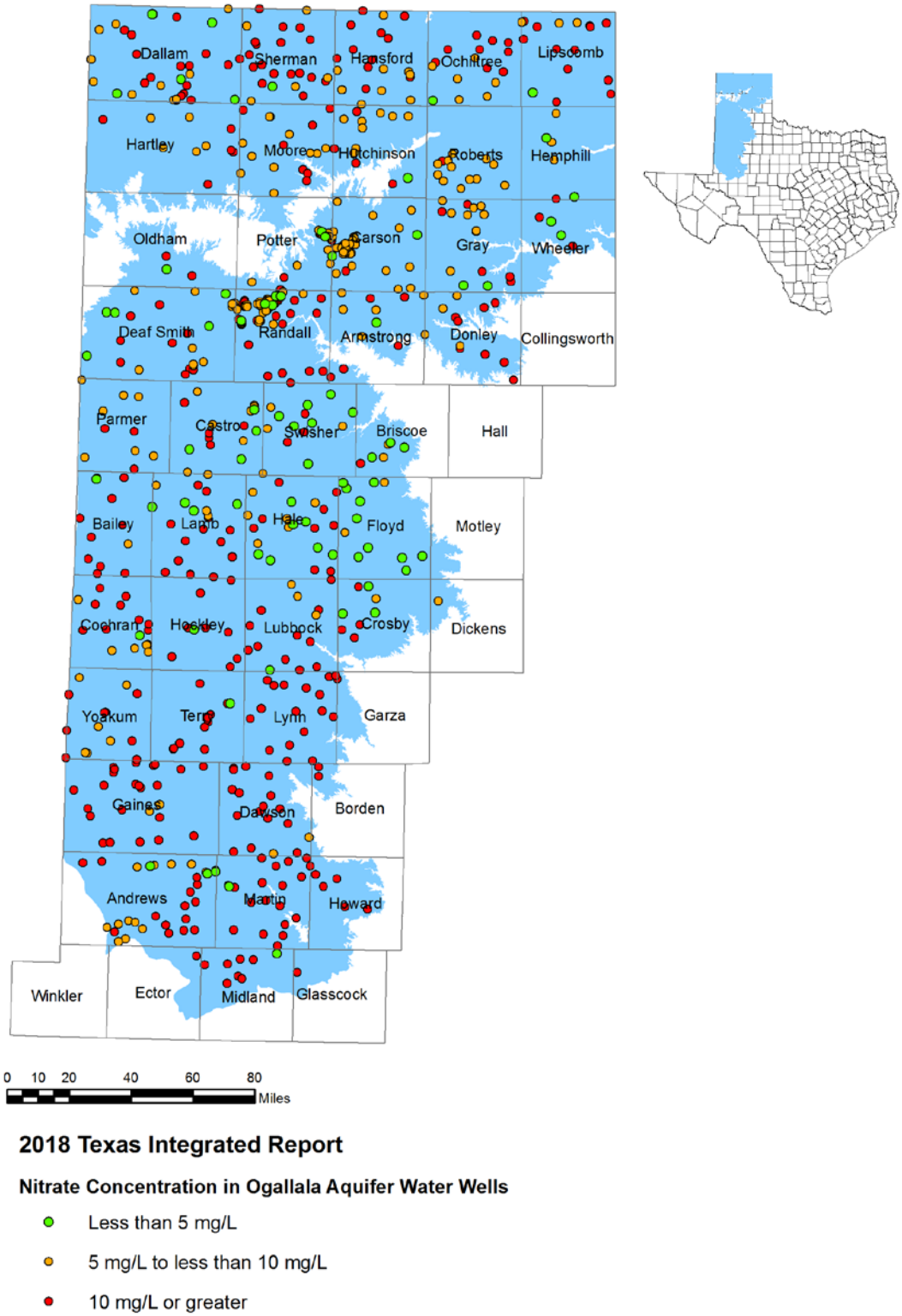
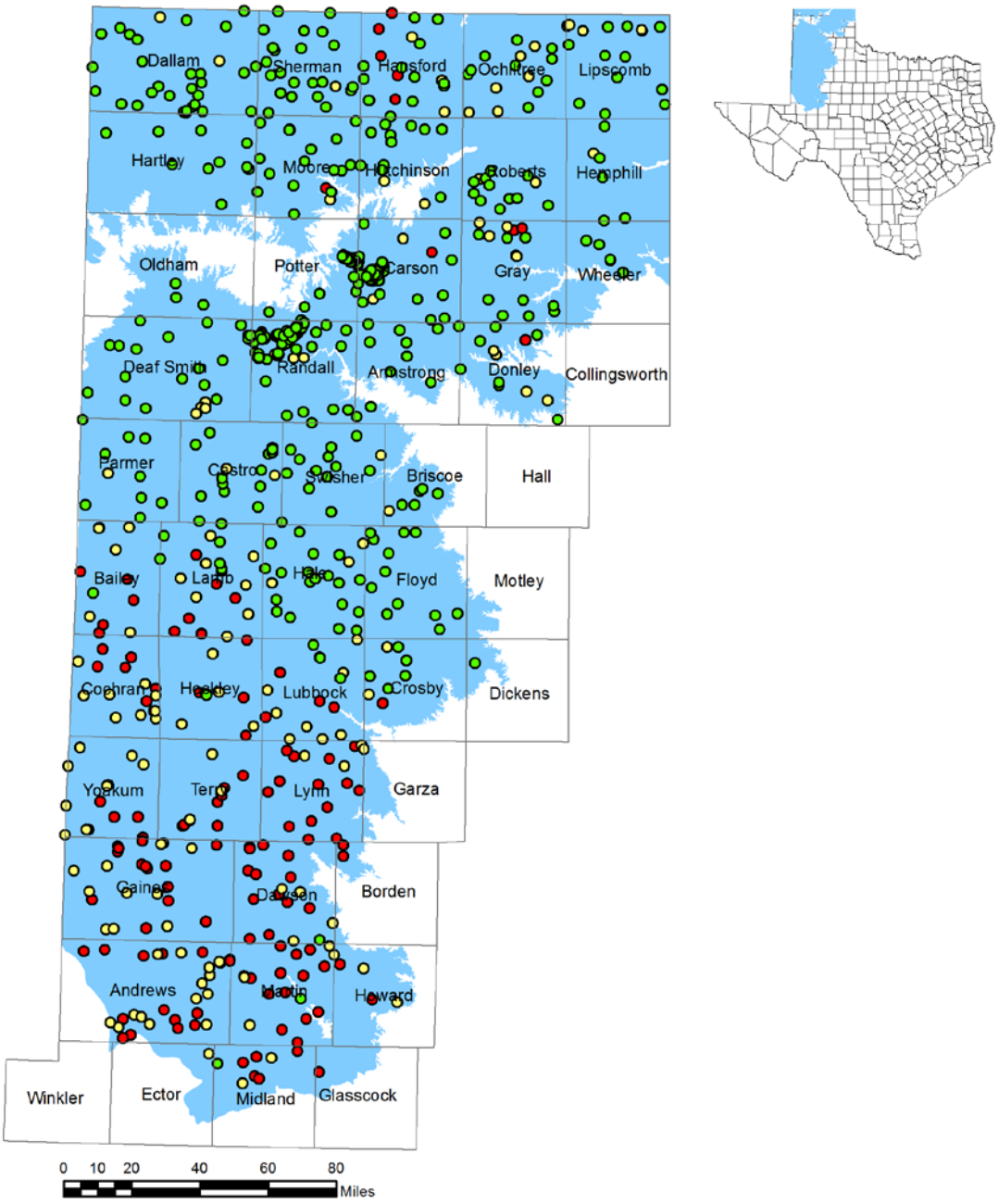


Figure 25. Distribution of Total Dissolved Solids in the Ogallala Aquifer, 2007-2017



2018 Texas Integrated Report -

TDS Concentration in Ogallala Aquifer Water Wells

- Less than 500 mg/L
- 500 mg/L to less than 1000 mg/L
- 1000 mg/L or greater

Figure 26. Distribution of Nitrate in the Pecos Valley Aquifer, 2007-2017

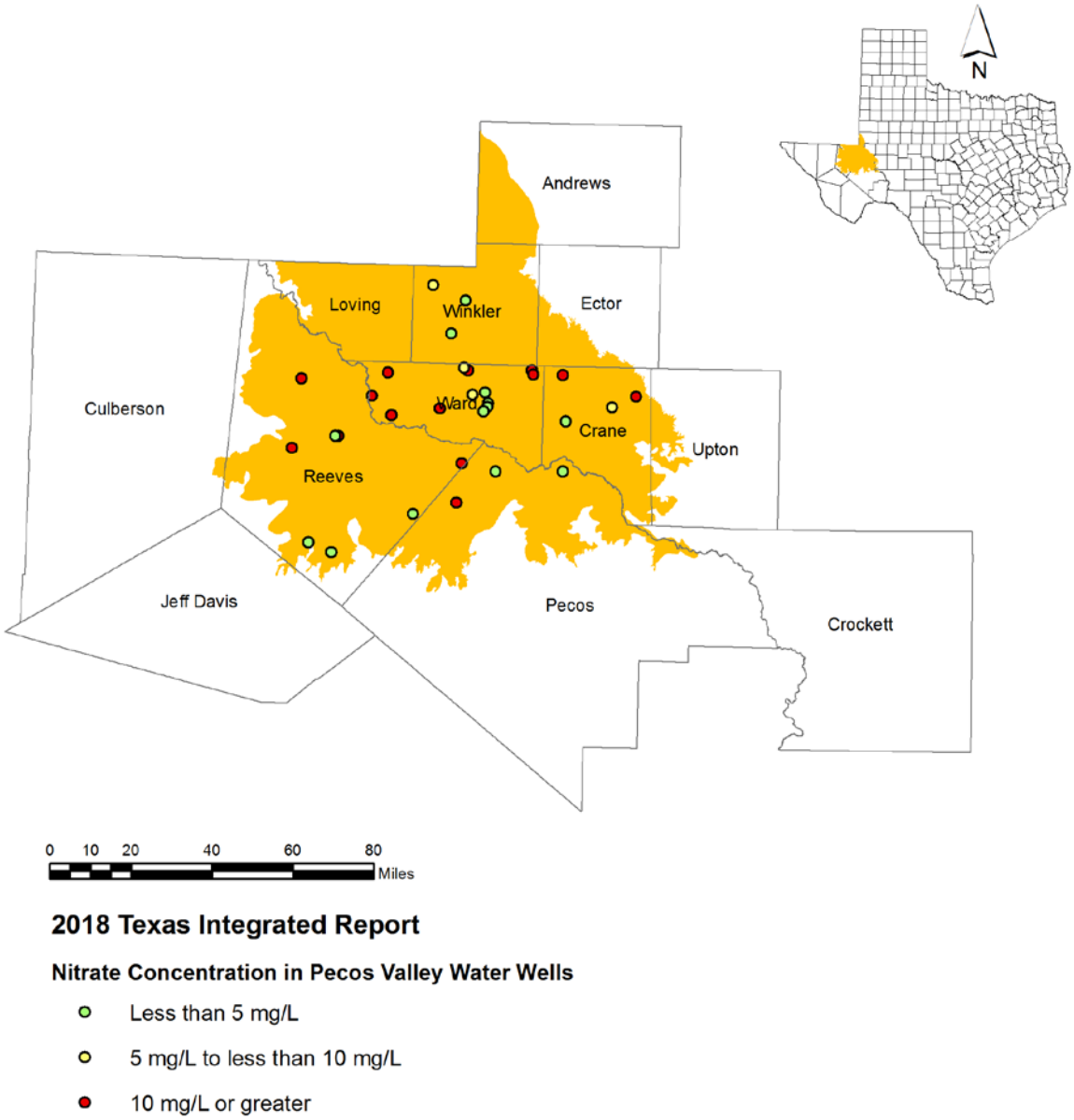


Figure 27. Distribution of Sulfate in the Pecos Valley Aquifer, 2007-2017

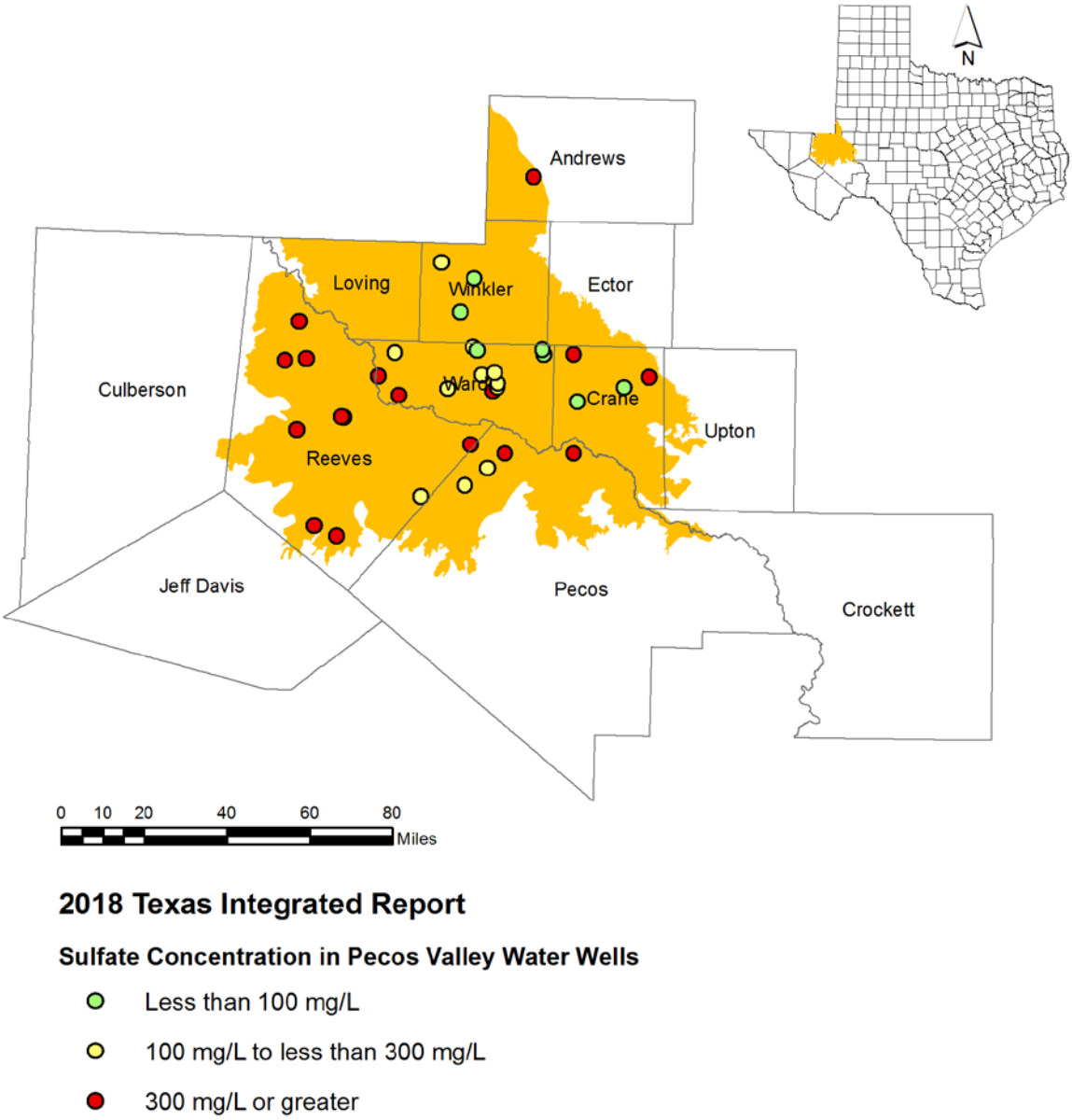


Figure 28. Distribution of Total Dissolved Solids in the Pecos Valley Aquifer, 2007-2017

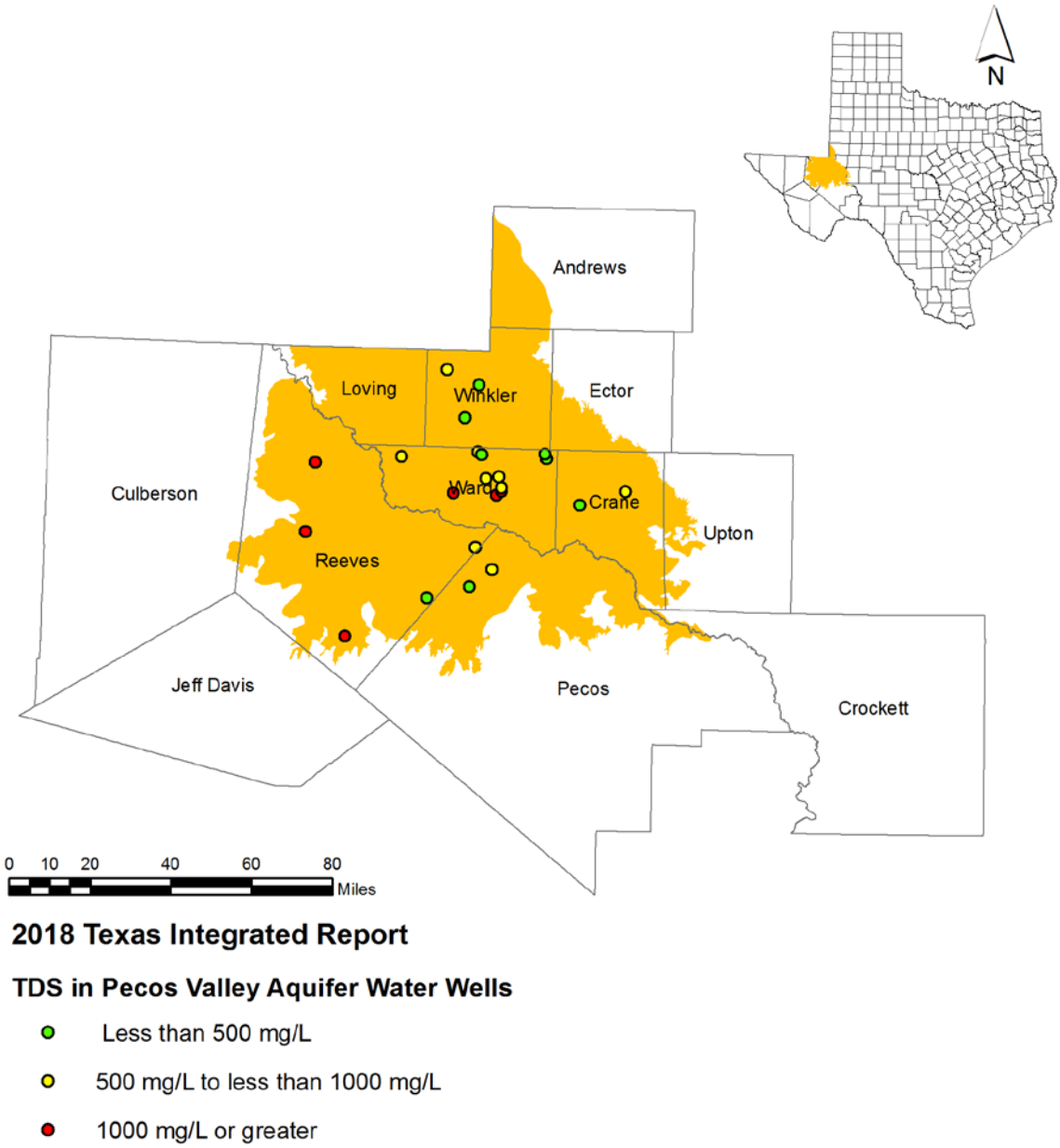
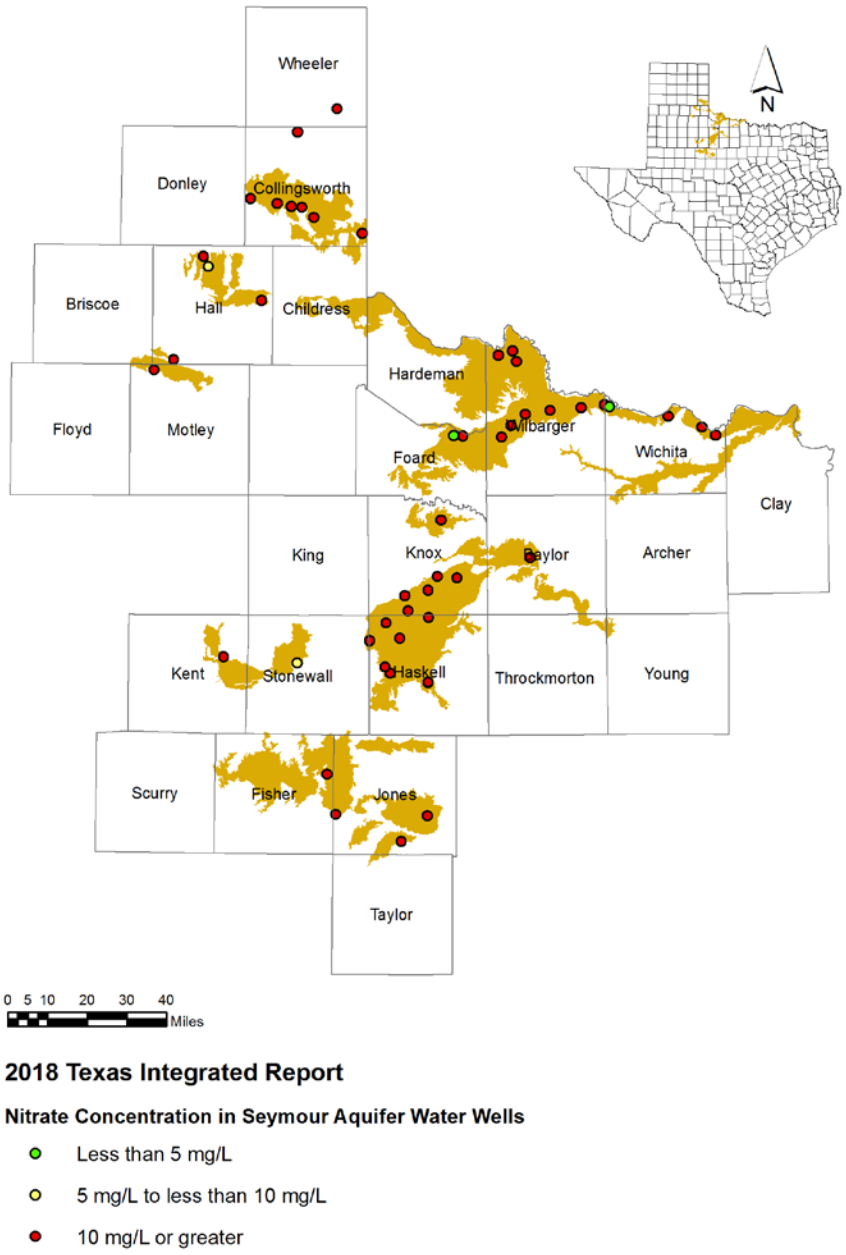


Figure 29. Distribution of Nitrate in the Seymour Aquifer, 2007-2017



2018 Texas Integrated Report

Nitrate Concentration in Seymour Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 30. Distribution of Total Dissolved Solids in the Seymour Aquifer, 2007-2017

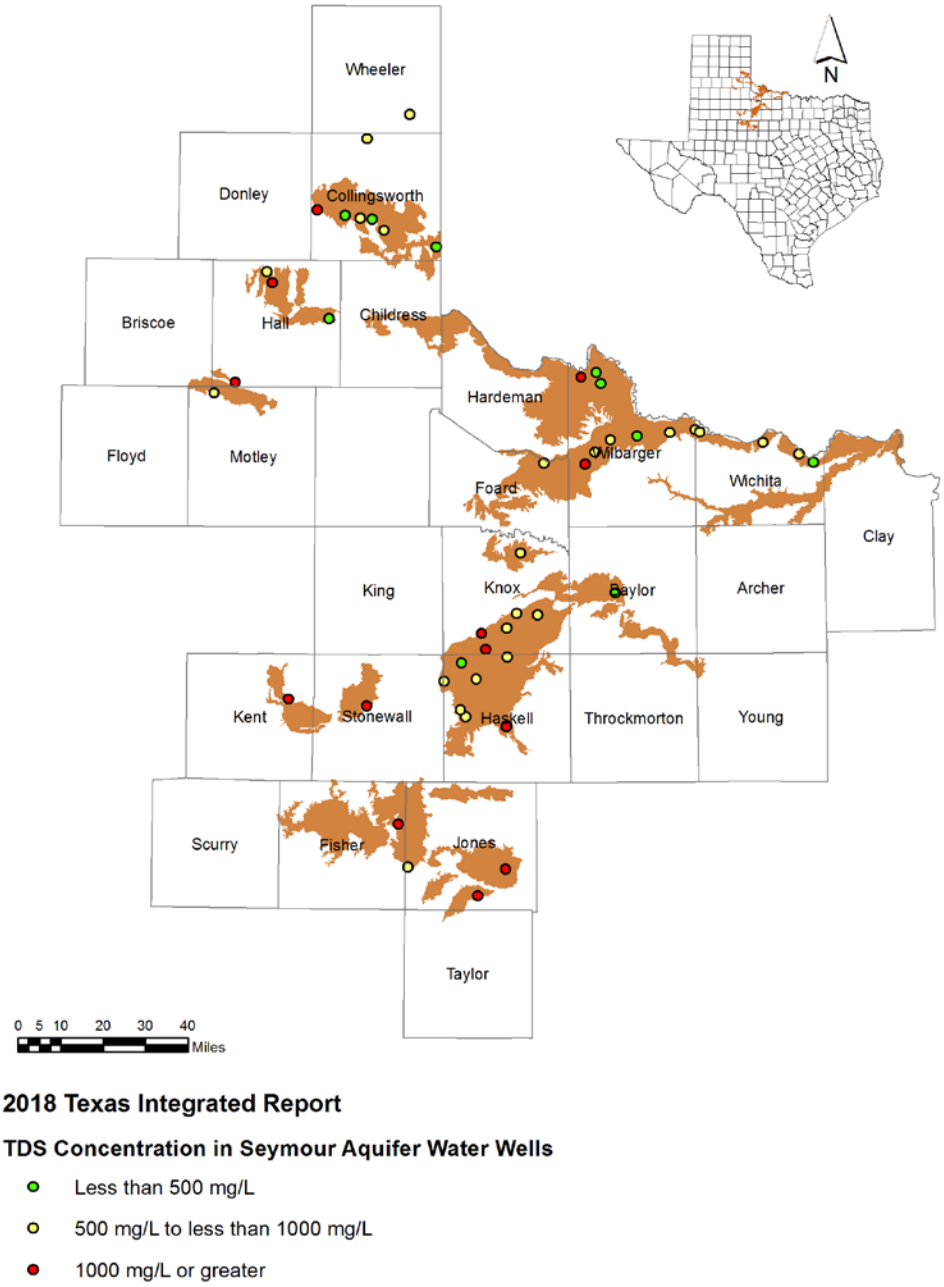
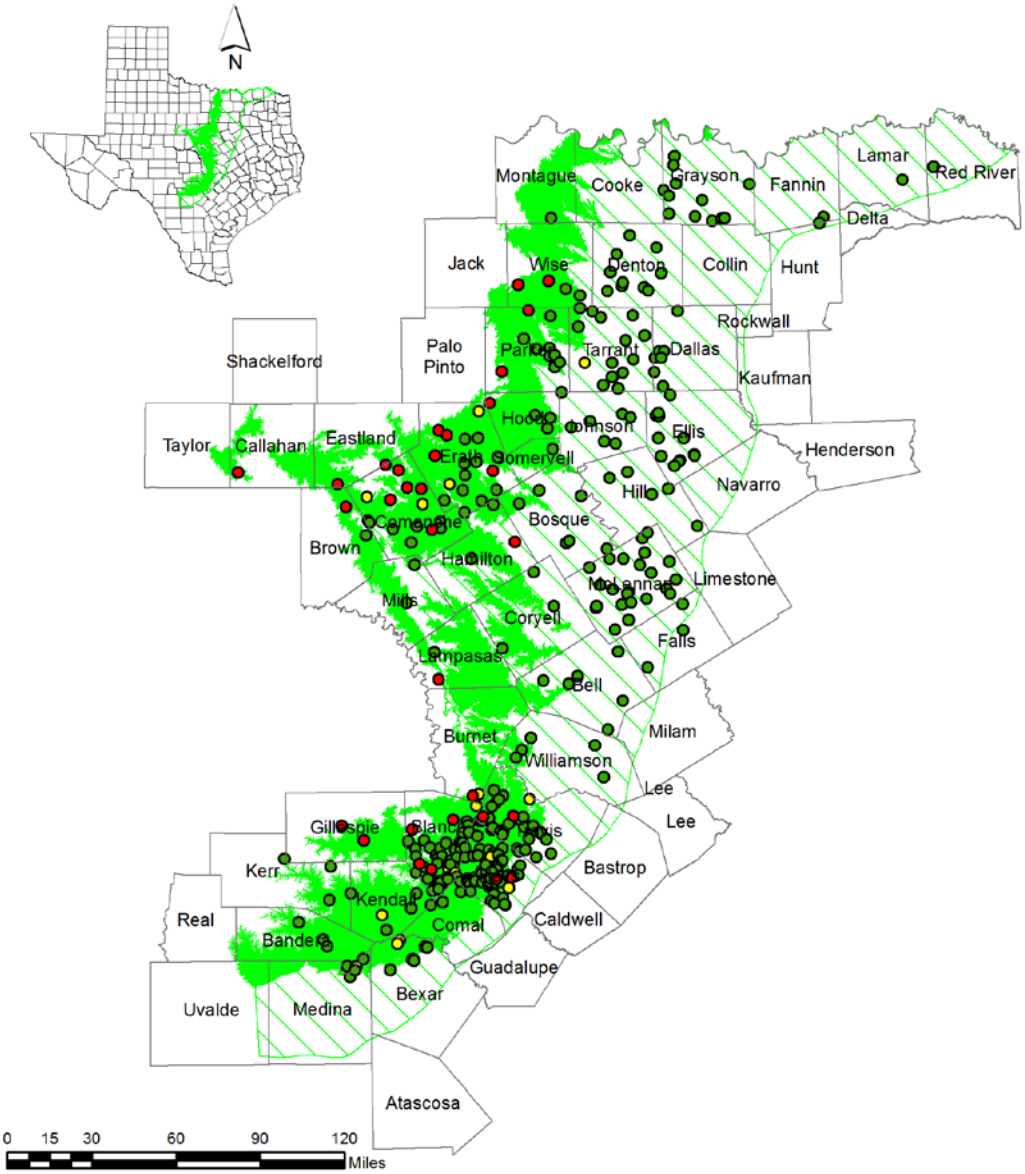


Figure 31. Distribution of Nitrate in the Trinity Aquifer, 2007-2017

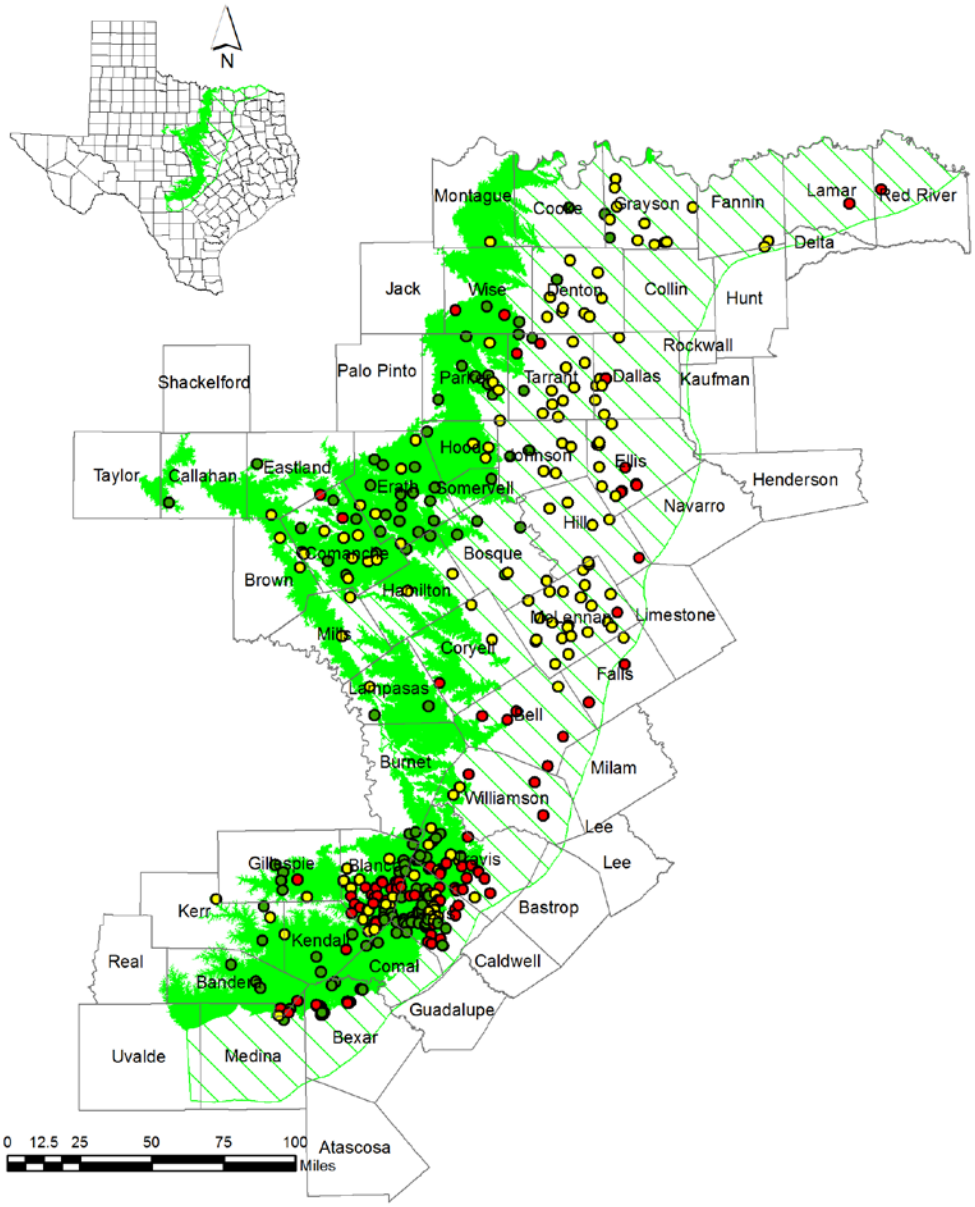


2018 Texas Integrated Report

Nitrate Concentration in Trinity Aquifer Water Wells

- Less than 5 mg/L
- 5 mg/L to less than 10 mg/L
- 10 mg/L or greater

Figure 32. Distribution of Total Dissolved Solids in the Trinity Aquifer, 2007-2017



2018 Texas Integrated Report

TDS Concentration in Trinity Aquifer Water Wells

- Less than 500 mg/L
- 500 mg/L to less than 1000 mg/L
- 1000 mg/L or greater

Figure 33. Distribution of Arsenic in the West Texas Bolsons Aquifer, 2007-2017

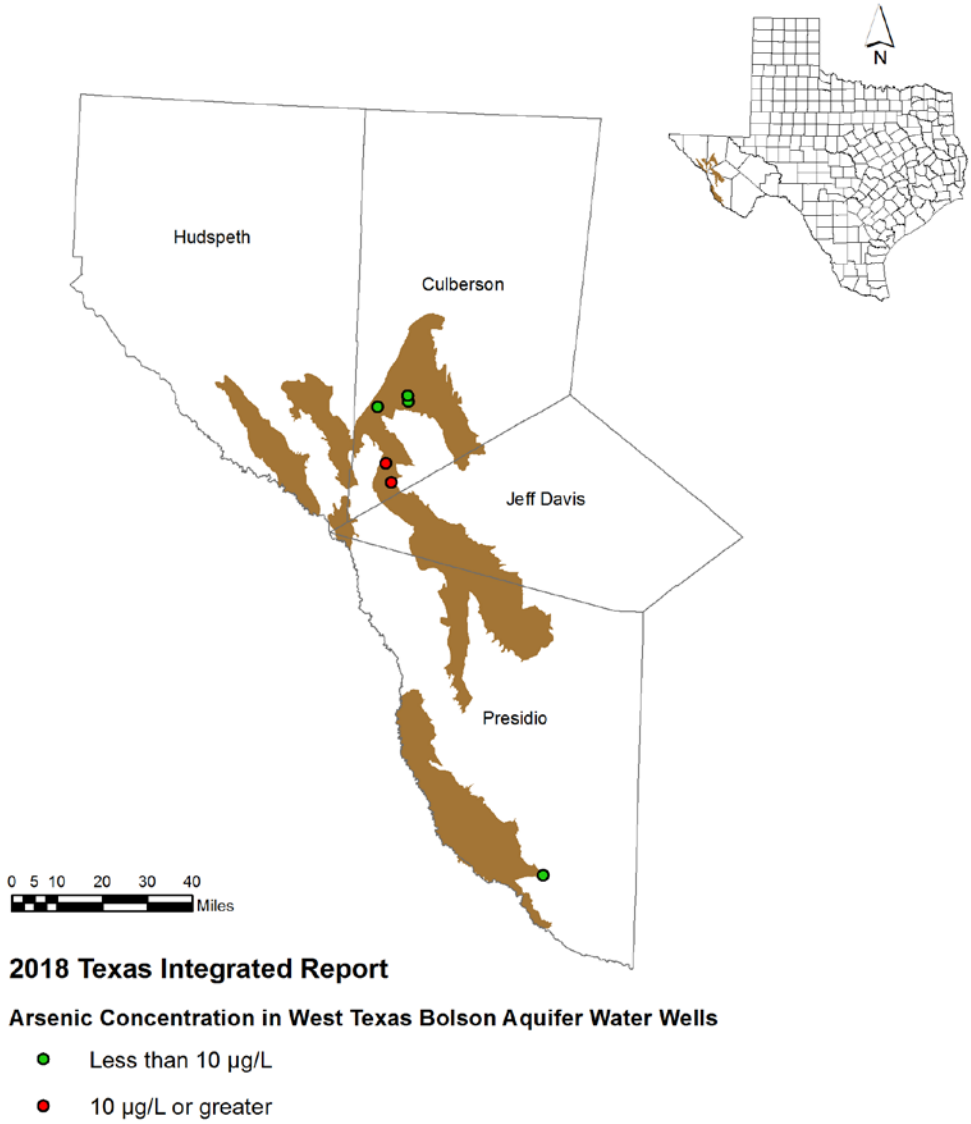
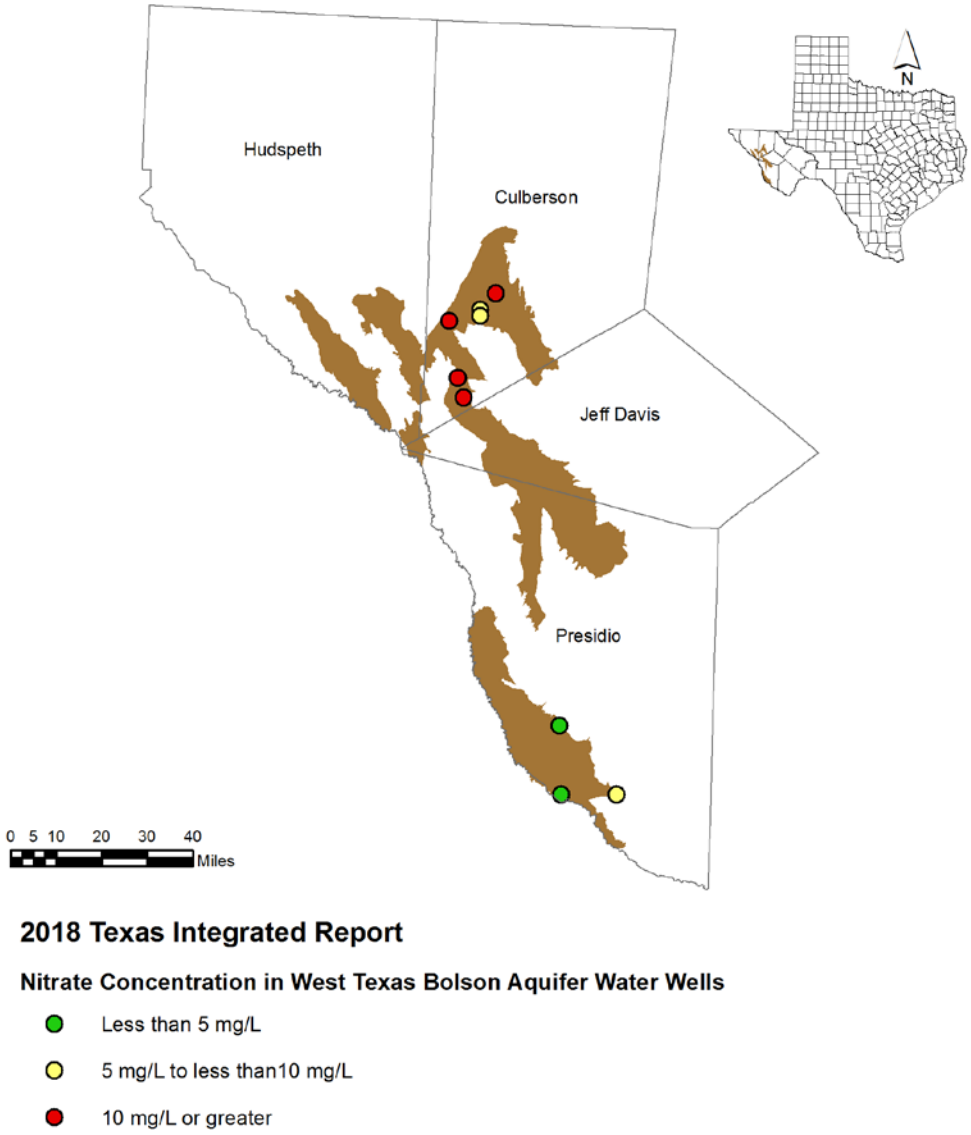



Figure 34. Distribution of Nitrate in the West Texas Bolsons Aquifer, 2007-2017