# Plateau Underground Water Conservation & Supply District

# Management Plan 2019-2024

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# Management Plan

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# Mission Statement

**The Plateau Underground Water Conservation & Supply District was created by Acts of the 59th Texas Legislature in 1965. The District was created to provide for the conservation, preservation, protection, recharge and prevention of waste of the underground water reservoirs located within the District, consistent with Article XVI, Section 59, of the Texas Constitution, and Chapter 36 of the Texas Water Code. The District strives to bring about conservation, preservation, and the efficient, beneficial and wise use of water for the benefit of the citizens and economy of the District through monitoring and protecting the quality of the groundwater. The District also strives to maintain groundwater ownership and rights of landowners as provided in Texas Water Code 36.002.**

# Time Period for this Plan

**This plan becomes effective upon certification by the Texas Water Development Board and replaces the existing management plan adopted by the Board of Directors. The new plan remains in effect until a revised plan is certified. This plan will be reviewed and amended at least once every five years.**

# General Description

**The District is governed by a Board of five Directors elected by local voters. Serving on the current Board are Ray Lewis Ballew, Chairman, Cindy Cawley, Vice-Chairman, Johnny Powell, Secretary, Steve Williams, and Kary Gibson. District rules have been in effect since 1992 which effectuate the management plan. The District encompasses Schleicher County, Texas. Schleicher County's economy is based in agriculture with a significant contribution from the oil and gas industry.**

## Management of Groundwater Supplies

**The District aids in the management of groundwater in order to conserve the resource while seeking to maintain the economic viability of all resource user groups, public and private. In consideration of the economic and cultural activities occurring within the District, the District will identify and engage in such activities and practices that could result in reduction in a reduction of groundwater use. An observation network shall be maintained in order to monitor changing quality and storage conditions of groundwater supplies within the District. The District will employ all technical resources at its disposal to evaluate the resources available within the District and to determine the effectiveness of management or conservation measures.**

**The District has adopted rules to manage groundwater withdrawals by means of spacing and production limits. The District may deny a well construction permit or limit groundwater withdrawals in accordance with the guidelines stated in the rules of the District. In making a decision to approve or deny a permit or limit groundwater withdrawals, the District will consider public benefit against individual hardship after considering all appropriate testimony. The relevant factors to be considered in making a determination to deny a permit or limit groundwater withdrawals include: the purpose of District rules, legal rights equitable distribution of the resource, and economic hardship to both individual surface owners and the surrounding community.**

## Regional Cooperation and Coordination

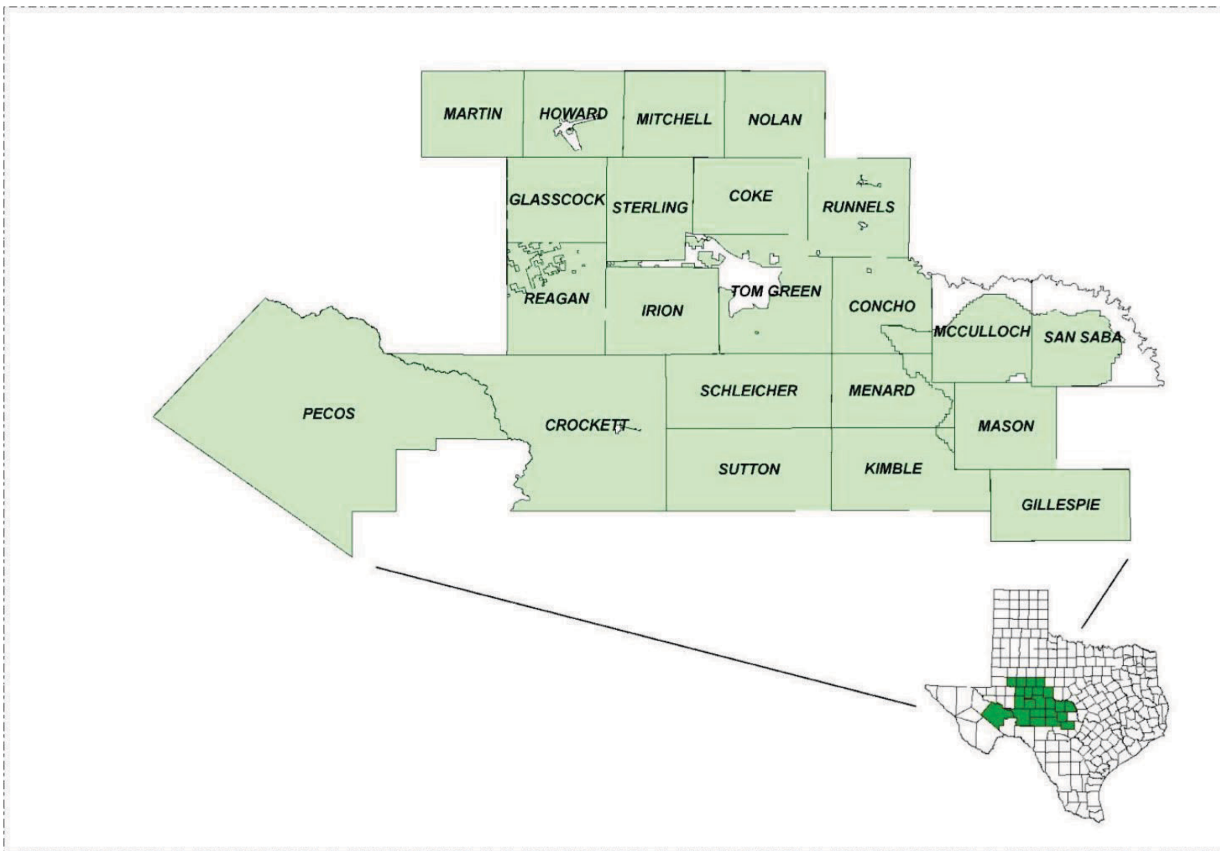
**In 1988, four groundwater conservation districts, Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD signed an original Cooperative Agreement. More districts came in and signed this agreement, and in the fall of 1996, the original Cooperative Agreement was redrafted, and the West Texas Regional Groundwater Alliance (WTRGA) was created. The WTRGA now consists of seventeen locally created and locally founded groundwater conservation districts that encompass twenty-nine thousand eight hundred square miles of West Texas. Due to the diversity of the region, each member district provides its own unique programs to best serve its constituents.**

**The following districts are currently members of the WTRGA: Coke County UWCD, Crockett County GCD, Glasscock GCD, Hill Country UWCD, Hickory UWCD, Irion County WCD, Kimble**

County GCD, Lipan-Kickapoo WCD, Lone Wolf GCD, Menard County UWD, Middle Pecos GCD, Permian Basin UWCD, Plateau UWC&SD, Santa Rita UWCD, Sterling County UWCD, Sutton County UWCD, and Wes-Tex GCD.

This Alliance was created because the local districts have a common objective to facilitate the conservation, preservation, and beneficial use of water and related resources. Local districts monitor water related activities of the state's largest industries, such as farming and ranching, oil and gas, and municipalities. The Alliance provides coordination essential to effect region-wide planning in an area which has common water resource allocation problems that are unique to this part of Texas.

## West Texas Regional Groundwater Alliance



## **Geographical Information**

**The District lies within the Edwards Plateau and consists of approximately 838,000 acres In Schleicher County, Texas.**

## **Groundwater Resources**

**The Edwards-Trinity (Plateau) Aquifer underlies the Edwards Plateau east of the Pecos River and the Stockton Plateau west of the Pecos River, extending from the Hill Country of Central Texas to the Trans-Pecos region of West Texas, providing water to all or parts of 38 counties. The aquifer consists of saturated sediments of lower Cretaceous Age Trinity Group formations and overlying limestone and dolomites of the Comanche Peak, Edwards, and Georgetown formations. (1) The Edwards-Trinity (Plateau) Aquifer is the freshwater source for Schleicher County and includes all rocks from the base of the Antlers to the top of the Georgetown Formation (Washita Group). Limestone is the predominant rock underlying the Edwards Plateau soils. The permeability of the limestone is not necessarily due to intergranular pore space as in sandstones, but more to joints, crevices, and solution openings that have been enlarged by solvent action of water charged with carbon dioxide.**

**Permian limestone contains fresh to slightly saline water in the area of the common corners of Kimble, Menard, Schleicher, and Sutton Counties. The Permian is overlain by the Edwards and associated limestone in this area and is recharged by water from the Cretaceous. (2)**

## **Technical Information Required by Texas Administrative Code**

### **Estimate of Modeled Available Groundwater in District Based on Desired Future Conditions**

**The Desired Future Conditions for the aquifers located within the District boundaries and Groundwater Management Area 7 were adopted on March 22, 2018. Texas Water Code 36.001 defines modeled available groundwater as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108". The Lipan Aquifer was deemed by GMA 7 as not relevant for planning purposes in the Plateau UWC&SD. The adopted DFCs were forwarded to the TWDB for**

**development of the MAG calculations. The submittal package for the DFCs can be found here:**

**http://www.twdb.texas.gov/groundwater/management_areas/DFC.asp.**

**A summary of the desired future conditions and the modeled available groundwater is presented below.**

**Edwards-Trinity (Plateau) Aquifer-an average drawdown of eight feet for the Edwards-Trinity (Plateau) Aquifer, except for the Kinney County GCD, based on the GMA 7 Technical Memorandum 10-01.**

**Lipan Aquifer-not relevant for planning purposes within the boundaries of Plateau UWC&SD.**

**Estimated Modeled Available Groundwater in ac/ft for the Edwards-Trinity (Plateau) Aquifer by the District from GAM Run 16-026 MAG Version 2:**

| County | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Schleicher | 8,034 | 8,034 | 8,034 | 8,034 | 8,034 | 8,034 | 8,034 |

## Modeled Available Groundwater in the District

**Please refer to appendix A – GAM RUN 16-026 MAG VERSION 2**

## Amount of Groundwater Being Used within the District on an Annual Basis

**Please refer to Appendix B – Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Plateau Underground Water Conservation & Supply District**

## Annual Amount of Recharge from Precipitation to the Groundwater Resources within the District

**Please refer to Appendix C – GAM RUN 13-009: Plateau Underground Water Conservation & Supply District Management Plan**

## Annual Amount of Water that Discharges from the Aquifer to Springs and Surface Water Bodies

**Please refer to Appendix C**

## Estimate of the Annual Volume of Flow into the District, out of the District, and between Aquifers in the District

**Please refer to Appendix C**

## Projected Surface Water Supplies within the District

**Please refer to Appendix B**

## Projected Total Demand for Water within the District

**The 2017 State Water Plan projects a 16% decrease in water demands from 2020 to 2070.**

**Please refer to Appendix B**

## Water Supply Needs

**The 2017 State Water Plan projects water supply needs through 2070 at zero acre-feet.**

**Please refer to Appendix B**

## Water Management Strategies

**The District encourages conservation through outreach to school groups as well as other local organizations. The District Rules include production limits as well as spacing regulations. Also, the District endeavors to enhance recharge through weather modification.**

**Please refer to Appendix B**

## Additional Recharge

**Methods of additional recharge:**

1. **Flood prevention Sites – In 1962, Public Law 566 mandated the construction of thirteen dam sites on the Dry Devil's River Draw for the prevention of flooding in Sonora, Texas. Of the two sites located within Schleicher County, site #1 is capable of detaining 4,866 acre feet, and site #2 is capable of detaining 5,000 acre feet. (1) The dams were designed to regulate flow of floodwater, thereby releasing water at a predetermined rate to prevent flooding.**

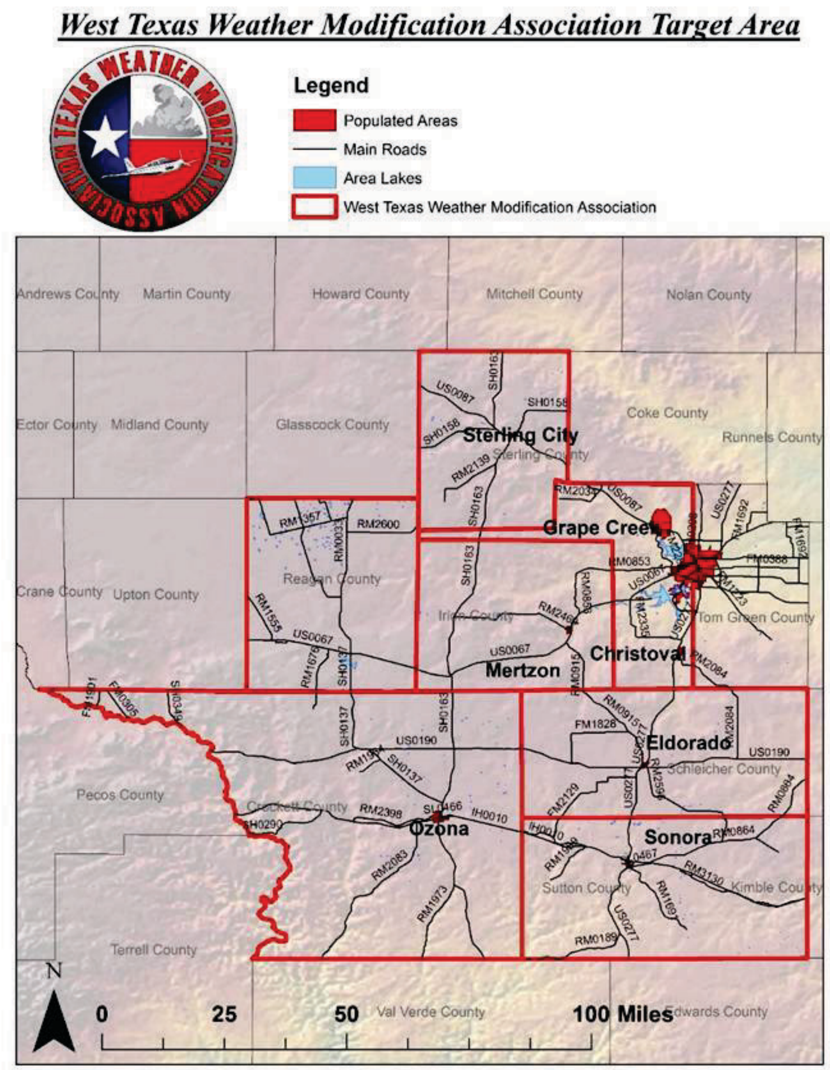
**Site 1**


Image © 2009 DigitalGlobe
©2008 Google
30°46'40.82" N 100°39'52.28" W
elev 2317 ft
Jun 28, 2005
Eye alt 9609 ft

**Site 2**


2. **Weather Modification – Weather modification is another tool considered effective for increased aquifer recharge. The Colorado River Municipal Water District Weather Modification Program indicated a 23% increase in rainfall within the target area over a 26 year period. San Angelo conducted a weather enhancement program from 1985 to 1989 with a result of 15% increase in rainfall. The Plateau UWC&SD has been a member of the West Texas Weather Modification Association since the initial season of 1996. The average rainfall for the District is 19.0"/year and 11.2" from May to September when weather modification activities occur. (2)**

**A 10% increase of one inch of rainfall during the growing season results in a reduction of pumping for all users, a potential increase in runoff, increases in productivity of crops and rangeland, additional moisture infiltration below root depth, and increases in spring flow.**




## Area covered by the West Texas Weather Modification Association

(1) Workplan for Watershed Protection and Flood Protection, U.S. Dept. of Agriculture Soil Conservation Service, 1958.
(2) Texas Almanac, 2007.

**Under ideal conditions, with 20% of rainfall infiltrating beyond the root zine for potential recharge, increased rainfall would result in additional potential recharge from May1 to Sept. 30 as follows:**

| <u>**10% Increase**</u> | <u>**15% Increase**</u> | <u>**23% Increase**</u> |
|---|---|---|
| **1.12 inches** | **1.68 inches** | **2.58 inches** |
| **15,642 ac-ft** | **23,464 ac-ft** | **36,034 ac-ft** |

## Actions, Procedures, Performance and Avoidance for Plan Implementation

**The District will implement the provisions of this plan and will utilize the provisions of this plan as a guidepost for determining the direction and priority for all District activities. All operations of the District and all agreements entered into by the District will be consistent with this plan.**

**The District has adopted and will amend as necessary rules relating to the permitting of wells and the production of groundwater. The rules adopted by the District shall be pursuant to TWC Chapter 36 and the provision of the plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical evidence available.**

**The District shall treat all citizens equally. Citizens may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local character. In granting of discretion to any rule, the Board shall consider the potential for adverse effect on adjacent landowners. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board. The District will seek cooperation in the implementation of this plan and the management of groundwater supplies within the District.**

**In an effort to recognize all potential contamination sources, the District will work to promote capping and plugging of abandoned water wells. The District will also coordinate efforts with the Texas Railroad Commission in identifying abandoned oil and gas wells that pose potential threats to the integrity of the groundwater.**

**The Board shall review the District rules and determine if there is a need to update rules at least every two years.**

**District Rules: http://www.plateauuwcsd.com/files/plateaurules2016.pdf**

## Methodology for Tracking Progress

**The methodology that the District will use to track progress on an annual basis in achieving its management goals will be as follows: The District manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives. The annual report will be maintained at the District office.**

## Coordination with Surface Water Entities

**There are two adjudication certificates held by water users within the District. The District has no authority over surface water.**

## Goals

### 1.0 To provide for the most efficient use of groundwater.

**Management Objective (1.1)** **The District realizes the importance of public education of groundwater use and conservation practices. Each year, the District will publish at least one educational article identifying conservation practices for the efficient use of groundwater. Each year the District will respond to invitations to speak on groundwater topics to at least one group, if requested.**

**Performance Effectiveness Standard (1.1a)** **Number of articles published identifying conservation practices for the efficient use of groundwater each year.**

**Performance Effectiveness Standard (1.1b)** **Number of requests for speaking engagements and the number of speaking engagements responded to on groundwater topics each year.**

**Management Objective (1.2)** According to District Rules, wells within the District are required to be registered and/or permitted. As part of daily operations, all wells will be registered with the District upon notification by well drillers or landowners. The District will permit all wells after determination by District personnel that all well construction criteria have been met. **Upon request by the Board, District personnel shall evaluate total water usage on the requested section(s) including permitted wells and exempt wells.**

**Performance Effectiveness Standard (1.2a)** Number of wells registered annually will be reported in the annual report to the District Board.

**Performance Effectiveness Standard (1.2b)** Number of wells permitted annually will be reported in the annual report to the District Board.

**Performance Effectiveness Standard (1.2c)** Number of evaluations performed will be reported in the annual report to the District Board.

**Management Objective (1.3)** The District is included in the Region F Regional Water Planning Group. Each year that District personnel serve on the Region F Board, any committee, or office, the District will actively participate in Region F Regional Water Planning Group, and attend at least 50% of meetings.

**Performance effectiveness Standard (1.3a)** Percentage of Region F Regional Water Planning Group meetings attended each year.

**Performance Effectiveness Standard (1.3b)** Number of committees, offices, and duties performed by the District each year will be reported in the annual report to the District Board.

**Management Objective (1.4)** The District has entered into a Cooperative Management Agreement with the WTRGA. The purpose of the WTRGA is to facilitate the conservation, preservation, protection, and most efficient use of groundwater. Each year the District will attend at least 80% of WTRGA meetings.

**Performance Effectiveness Standard (1.4a)** Percentage of WTRGA meetings attended each year.

**Management Objective (1.5)** A water quality baseline will be established for the District through a monitor well program of approximately sixty wells. At least 33% of these wells will be sampled each year. All test results will be entered into the database and a copy mailed to the landowners within 30 days of testing.

**Performance Effectiveness Standard (1.5a)** Percentage of monitor wells sampled each year.

**Performance Effectiveness Standard (1.5b)** Number of days required to enter data into database and mail lab results to landowner each year.

**Management Objective (1.6)** The District will regularly measure the water levels in selected wells within the District in order to determine increases or decreases which will inform the Board as to reasonable pumping limits. A record of these well measurements will be maintained by the District.  If a well cannot be measured, the reason shall be stated in the water level report.

**Performance Effectiveness Standard(1.6a)** Number of water levels obtained on an annual basis from selected monitor well each year will be reported in the annual report to the District Board.

## 2.0 Implement strategies to control and prevent waste of groundwater.

Management Objective (2.1) **Each year the District will identify and respond to reports of wasteful practices within five working days. Each year at least one article will be published on wasteful practices.**

Performance Effectiveness Standard (2.1a) **Number of reported wasteful practices identified and responded to each year will be reported in the annual report to the District Board.**

Performance Effectiveness Standard (2.1b) **Number of articles published on wasteful practices each year.**

Management Objective (2.2) **As a service to water well owners within the District, a field lab service for water analysis is available. Annually, at least one article will be published advertising the availability of water analysis service performed by the District. Each year the District will continue to perform water quality analysis for all residents of the District upon request.**

Performance Effectiveness Standard (2.2a) **Number of articles published advertising the availability of water analysis service performed by the District each year.**

Performance Effectiveness Standard (2.2b) **Number of water analyses requested and performed each year will be reported in the annual report to the District Board.**

Management Objective (2.3) **In order to prevent waste of groundwater within the District, the Board shall review annually all long term detected contamination sites to determine status and further needed activity by the District.**

**Performance Effectiveness Standard (2.3a)** A report summarizing the annual review of contamination sites by the Board will be reported in the annual report to the District Board.

## 3.0 Control and prevent subsidence

Following District review of the Texas Water Development Board report, "Identification of the Vulnerability of the Major and Minor Aquifers of Texas with Subsidence with Regard to Groundwater Pumping", the District concluded that this goal is not applicable to the operation of the District. The report may be accessed at

https://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp

## 4.0 Address conjunctive surface water management issues

All surface water impoundments located within the District are used to supply water for livestock consumption. The are no surface water management entities with surface water storage located within the District. This management goal is not applicable to the operations of the District.

## 5.0 Address natural resources that impact the use and availability of groundwater or are impacted by the use of groundwater within the District

The District has no documented occurrences of endangered or threatened species dependent on groundwater. Other issues related to resources – air, water, soil, etc. supplied by nature that are useful to life are likewise not documented. Therefore, this management goal is not applicable.

## 6.0 Address drought conditions

**Management Objective** The district will monitor the Palmer Drought Severity Index by Texas Climatic Divisions at least once a month by downloading the PDSI map. If PDSI indicates that the District will experience severe drought conditions, the District will notify all public water suppliers within the District. TWDB drought information: http://waterdatafortexas.org/drought/

Performance effectiveness Standard (6.1) **Number of months the PDSI map was downloaded each year.**

Performance Effectiveness Standard (6.2) **Number of times the District experienced severe drought according to the monthly PDSI download maps and the number of times that notification was sent to public water suppliers will be included in the annual report to the District Board.**

## 7.0 Address Conservation

Management Objective **The District personnel will meet with City of Eldorado personnel at least once annually to discuss water usage and conservation techniques implemented.**

Performance Effectiveness Standard (7.1) **The number of annual meetings with City of Eldorado personnel to discuss water usage and conservation techniques implemented. TWDB "Water Conservation Best Management Practices" page is here:**

**http://www.twdb.texas.gov/conservation/BMPs/index.asp**

## 8.0 Address the desired future conditions of the groundwater resources

Management Objective **To address the desired future conditions adopted by GMA 7, the District will measure water levels in at least 25 monitor wells in the District at least five times per year and evaluate whether the average change in water levels conforms with the DFCs adopted by the District. The District will estimate total annual groundwater production based on water use reports, estimated exempt use, and other relevant information and compare these estimates to the MAG.**

Performance Effectiveness Standard (8.1) **To record the water level data and average annual change in water levels and compare to the DFCs, and to include this information in the District's annual report.**

**9.0** Precipitation Enhancement **The District will participate in weather enhancement for the purpose of aquifer recharge, reduction of groundwater use, and economic benefit. Each year, at least one article will be published on weather modification. All flight paths, if provided by the West**

**Texas Weather Modification Association, will be available at the District office for public view. All rainfall date will be recorded on a monthly basis during the program schedule. An annual report of all program results will be given to the Board of Directors.**

__Performance Effectiveness Standard (9.1a)__ **Number of articles written on weather modification each year.**

__Performance Effectiveness Standard (9.1b)__ **Number of flight paths available for public view each year.**

__Performance Effectiveness Standard (9.1c)__ **Number of gauges with recorded rainfall each month.**

__Performance Effectiveness Standard (9.1d)__ **An annual report of program results to the Board of Directors.**

## Management Goals Determined Non-Applicable

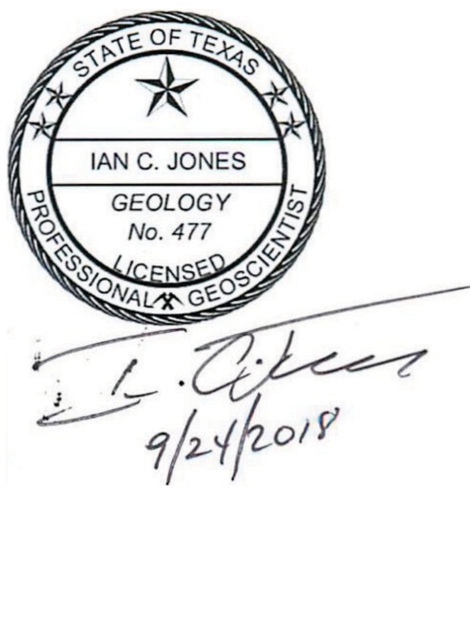
1. **Recharge Enhancement is not within the District's ability to be cost effective.**
2. **Rainwater Harvesting is not within the District's ability to be cost effective.**
3. **Brush Control is not within the District's ability to be cost effective.**

# APPENDIX A

# GAM RUN 16-026 MAG VERSION 2: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7


Ian C. Jones, Ph. D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-6641


September 21, 2018



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# GAM RUN 16-026 MAG VERSION 2: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

Ian C. Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-6641
September 21, 2018

## EXECUTIVE SUMMARY:

We have prepared estimates of the modeled available groundwater for the relevant aquifers of Groundwater Management Area 7—the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Ellenburger-San Saba, Hickory, Ogallala, Pecos Valley, Rustler, and Trinity aquifers. The estimates are based on the desired future conditions for these aquifers adopted by the groundwater conservation districts in Groundwater Management Area 7 on September 22, 2016 and March 22, 2018. The explanatory reports and other materials submitted to the Texas Water Development Board (TWDB) were determined to be administratively complete on June 22, 2018.

The original version of GAM Run 16-026 MAG inadvertently included modeled available groundwater estimates for areas declared not relevant by the groundwater management area and areas that had no desired future conditions for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers. GAM Run 16-026 MAG Version 2 (this report) contains updates to reported total modeled available groundwater estimates and to Tables 5 and 6 that reflect only relevant portions of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers.

The modeled available groundwater values are summarized by decade for the groundwater conservation districts (Tables 1, 3, 5, 7, 9, 11, 13) and for use in the regional water planning process (Tables 2, 4, 6, 8, 10, 12, 14). The modeled available groundwater estimates are 26,164 acre-feet per year in the Capitan Reef Complex Aquifer; 2,324 acre-feet per year in the Dockum Aquifer; 474,464 acre-feet per year in the undifferentiated Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers; 22,616 acre-feet per year in the Ellenburger-San Saba Aquifer; 49,936 acre-feet per year in the Hickory Aquifer; 6,570 to 8,019 acre-feet per year in the Ogallala Aquifer; and 7,040 acre-feet per year in the Rustler Aquifer. The modeled available groundwater estimates were extracted from results of model runs using

the groundwater availability models for the Capitan Reef Complex Aquifer (Jones, 2016); the High Plains Aquifer System (Deeds and Jigmond, 2015); the minor aquifers of the Llano Uplift Area (Shi and others, 2016), and the Rustler Aquifer (Ewing and others, 2012). In addition, the alternative 1-layer model for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers (Hutchison and others, 2011) was used for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, except for Kinney and Val Verde counties. In these two counties, the alternative Kinney County model (Hutchison and others, 2011) and the model associated with a hydrogeological study for Val Verde County and the City of Del Rio (EcoKai Environmental, Inc. and Hutchison, 2014), respectively, were used to estimate modeled available groundwater. The Val Verde County/Del Rio model covers Val Verde County. This model was used to simulate multiple pumping scenarios indicating the effects of a proposed wellfield. The model indicated the effects of varied pumping rates and wellfield locations. These model runs were used by Groundwater Management Area 7 as the basis for the desired future conditions for Val Verde County.

## REQUESTOR:

Mr. Joel Pigg, chair of Groundwater Management Area 7 districts.

## DESCRIPTION OF REQUEST:

In letters dated November 22, 2016 and March 26, 2018, Dr. William Hutchison on behalf of Groundwater Management Area 7 provided the TWDB with the desired future conditions for the Capitan, Dockum, Edwards-Trinity (Plateau), Ellenburger-San Saba, Hickory, Ogallala, Pecos Valley, Rustler, and Trinity aquifers in Groundwater Management Area 7. Groundwater Management Area 7 provided additional clarifications through emails to the TWDB on March 23, 2018 and June 12, 2018 for the use of model extents (Dockum, Ellenburger-San Saba, Hickory, Ogallala, Rustler aquifers), the use of aquifer extents (Capitan Reef Complex, Edwards-Trinity [Plateau], Pecos Valley, and Trinity aquifers), and desired future conditions for the Edwards-Trinity (Plateau) Aquifer of Kinney and Val Verde counties.

The final adopted desired future conditions as stated in signed resolutions for the aquifers in Groundwater Management Area 7 are reproduced below:

### Capitan Reef [Complex] Aquifer

> Total net drawdown of the Capitan Reef [Complex] Aquifer not to exceed 56 feet in Pecos County (Middle Pecos [Groundwater Conservation District]) in 2070 as compared with 2006 aquifer levels (Reference: Scenario 4, GMA 7 Technical Memorandum 15-06, 4-8-2015).

### Dockum Aquifer

Total net drawdown of the Dockum Aquifer not to exceed 14 feet in Reagan County (Santa Rita [Groundwater Conservation District]) in 2070, as compared with 2012 aquifer levels.

Total net drawdown of the Dockum Aquifer not to exceed 52 feet in Pecos County (Middle Pecos [Groundwater Conservation District]) in 2070, as compared with 2012 aquifer levels.

### Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers

Average drawdown for [the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers] in the following [Groundwater Management Area] 7 counties not to exceed drawdowns from 2010 to 2070 […].

| County | […] Average Drawdowns from 2010 to 2070 [feet] |
|---|---|
| Coke | 0 |
| Crockett | 10 |
| Ector | 4 |
| Edwards | 2 |
| Gillespie | 5 |
| Glasscock | 42 |
| Irion | 10 |
| Kimble | 1 |
| Menard | 1 |
| Midland | 12 |
| Pecos | 14 |
| Reagan | 42 |
| Real | 4 |
| Schleicher | 8 |
| Sterling | 7 |
| Sutton | 6 |

| | |
|---|---|
| Taylor | 0 |
| Terrell | 2 |
| Upton | 20 |
| Uvalde | 2 |

Total net drawdown *[of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers]* in Kinney County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an annual average flow of 23.9 [cubic feet per second] and an annual median flow of 23.9 [cubic feet per second] at Las Moras Springs […].

Total net drawdown [of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers] in Val Verde County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an average annual flow of 73-75 [million gallons per day] at San Felipe Springs.

**Minor Aquifers of the Llano Uplift Area**

Total net drawdowns of [Ellenburger-San Saba Aquifer] levels in 2070, as compared with 2010 aquifer levels, shall not exceed the number of feet set forth below, respectively, for the following counties and districts:

| County | [Groundwater Conservation District] | Drawdown in 2070 (feet) |
|---|---|---|
| Gillespie | Hill Country [Underground Water Conservation District] | 8 |
| Mason | Hickory [Underground Water Conservation District] no. 1 | 14 |
| McCulloch | Hickory [Underground Water Conservation District] no. 1 | 29 |
| Menard | Menard County [Underground Water District] and Hickory [Underground Water Conservation District] no. 1 | 46 |
| Kimble | Kimble County [Groundwater Conservation District] and Hickory | 18 |

| | | |
|---|---|---|
| | [Underground Water Conservation District] no. 1 | |
| San Saba | Hickory [Underground Water Conservation District] no. 1 | 5 |

Total net drawdown of [Hickory Aquifer] levels in 2070, as compared with 2010 aquifer levels, shall not exceed the number of feet set forth below, respectively, for the following counties and districts:

| County | [Groundwater Conservation District] | Drawdown in 2070 (feet) |
|---|---|---|
| Concho | Hickory [Underground Water Conservation District No. 1] | 53 |
| Gillespie | Hill Country UWCD | 9 |
| Mason | Hickory [Underground Water Conservation District No. 1] | 17 |
| McCulloch | Hickory [Underground Water Conservation District No. 1] | 29 |
| Menard | Menard UWD and Hickory [Underground Water Conservation District No. 1] | 46 |
| Kimble | Kimble County [Groundwater Conservation District] and Hickory [Underground Water Conservation District No. 1] | 18 |
| San Saba | Hickory [Underground Water Conservation District No. 1] | 6 |

### Ogallala Aquifer

> Total net [drawdown] of the Ogallala Aquifer in Glasscock County (Glasscock [Groundwater Conservation District]) in 2070, as compared with 2012 aquifer levels, not to exceed 6 feet […].

### Rustler Aquifer

> Total net drawdown of the Rustler Aquifer in Pecos County (Middle Pecos GCD) in 2070 not to exceed 94 feet as compared with 2009 aquifer levels.

Additionally, districts in Groundwater Management Area 7 voted to declare that the following aquifers or parts of aquifers are non-relevant for the purposes of joint planning:

- The Blaine, Igneous, Lipan, Marble Falls, and Seymour aquifers.
- The Edwards-Trinity (Plateau) Aquifer in Hickory Underground Water Conservation District No. 1, the Lipan-Kickapoo Water Conservation District, Lone Wolf Groundwater Conservation District, and Wes-Tex Groundwater Conservation District.
- The Ellenburger-San Saba Aquifer in Llano County.
- The Hickory Aquifer in Llano County.
- The Dockum Aquifer outside of Santa Rita Groundwater Conservation District and Middle Pecos Groundwater Conservation District.
- The Ogallala Aquifer outside of Glasscock County.

In response to a several requests for clarifications from the TWDB in 2017 and 2018, the Groundwater Management Area 7 Chair, Mr. Joel Pigg, and Groundwater Management Area 7 consultant, Dr. William R. Hutchison, indicated the following preferences for verifying the desired future condition of the aquifers and calculating modeled available groundwater volumes in Groundwater Management Area 7:

### Capitan Reef Complex Aquifer

> Calculate modeled available groundwater values based on the official aquifer boundaries.
>
> Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

### Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers

Calculate modeled available groundwater values based on the official aquifer boundaries.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

#### *Kinney County*

Use the modeled available groundwater values and model assumptions from GAM Run 10-043 MAG Version 2 (Shi, 2012) to maintain annual average springflow of 23.9 cubic feet per second and a median flow of 24.4 cubic feet per second at Las Moras Springs from 2010 to 2060.

#### *Val Verde County*

There is no associated drawdown as a desired future condition. The desired future condition is based solely on simulated springflow conditions at San Felipe Spring of 73 to 75 million gallons per day. Pumping scenarios—50,000 acre-feet per year—in three well field locations, and monthly hydrologic conditions for the historic period 1969 to 2012 meet the desired future conditions set by Groundwater Management Area 7 (EcoKai and Hutchison, 2014; Hutchison 2018b).

### Minor Aquifers of the Llano Uplift Area

Calculate modeled available groundwater values based on the spatial extent of the Ellenburger-San Saba and Hickory aquifers in the groundwater availability model for the aquifers of the Llano Uplift Area and use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 16-02 (Hutchison 2016g).

Drawdown calculations do not take into consideration the occurrence of dry cells where water levels are below the base of the aquifer.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

### Dockum Aquifer

Calculate modeled available groundwater values based on the spatial extent of the groundwater availability model for the Dockum Aquifer.

Modeled available groundwater analysis excludes pass-through cells.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

### Ogallala Aquifer

Calculate modeled available groundwater values based on the official aquifer boundary and use the same model assumptions used in Groundwater Management Area Technical Memorandum 16-01 (Hutchison, 2016f).

Modeled available groundwater analysis excludes pass-through cells.

Well pumpage decreases as the saturated thickness of the aquifer decreases below a 30-foot threshold.

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

### Rustler Aquifer

Use 2008 as the baseline year and run the model from 2009 through 2070 (end of 2008/beginning of 2009 as initial conditions), as used in the submitted predictive model run.

Use 2008 recharge conditions throughout the predictive period.

Calculate modeled available groundwater values based on the spatial extent of the groundwater availability model for the Rustler Aquifer.

General-head boundary heads decline at a rate of 1.5 feet per year.

Use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 15-05 (Hutchison, 2016d).

Assume that modeled drawdown verifications within 1 foot achieve the desired future conditions.

## METHODS:

As defined in Chapter 36 of the Texas Water Code (TWC, 2011), "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

For relevant aquifers with desired future conditions based on water-level drawdown, water levels simulated at the end of the predictive simulations were compared to specified baseline water levels. In the case of the High Plains Aquifer System (Dockum and Ogallala aquifers) and the minor aquifers of the Llano Uplift area (Ellenburger-San Saba and Hickory aquifers), baseline water levels represent water levels at the end of the calibrated transient model are the initial water level conditions in the predictive simulation—water levels at the end of the preceding year. In the case of the Capitan Reef Complex, Edwards-Trinity (Plateau), Pecos Valley, and Trinity, and Rustler aquifers, the baseline water levels may occur in a specified year, early in the predictive simulation. These baseline years are 2006 in the groundwater availability model for the Capitan Reef Complex Aquifer, 2010 in the alternative model for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, 2012 in the groundwater availability model for the High Plains Aquifer System, 2010 in the groundwater availability model for the minor aquifers of the Llano Uplift area, and 2009 in the groundwater availability model for the Rustler Aquifer. The predictive model runs used average pumping rates from the historical period for the respective model except in the aquifer or area of interest. In those areas, pumping rates are varied until they produce drawdowns consistent with the adopted desired future conditions. Pumping rates or modeled available groundwater are reported in 10-year intervals.

Water-level drawdown averages were calculated for the relevant portions of each aquifer. Drawdown for model cells that became dry during the simulation—when the water level dropped below the base of the cell—were excluded from the averaging. In Groundwater Management Area 7, dry cells only occur during the predictive period in the Ogallala Aquifer of Glasscock County. Consequently, estimates of modeled available groundwater decrease over time as continued simulated pumping predicts the development of increasing numbers of dry model cells in areas of the Ogallala Aquifer in Glasscock County. The calculated water-level drawdown averages were compared with the desired future conditions to verify that the pumping scenario achieved the desired future conditions.

In Kinney and Val Verde counties, the desired future conditions are based on discharge from selected springs. In these cases, spring discharge is estimated based on simulated average spring discharge over a historical period maintaining all historical hydrologic conditions—such as recharge and river stage—except pumping. In other words, we assume that past average hydrologic conditions—the range of fluctuation—will continue in the future. In the cases of Kinney and Val Verde counties, simulated spring discharge is based on hydrologic variations that took place over the periods 1950 through 2005 and 1968 through 2013, respectively. The desired future condition for the Edwards-Trinity (Plateau) Aquifer in Kinney County is similar to the one adopted in 2010 and the associated modeled available groundwater is based on a specific model run—GAM Run 10-043 (Shi, 2012).

Modeled available groundwater values for the Ellenburger-San Saba and Hickory aquifers were determined by extracting pumping rates by decade from the model results using

ZONBUDUSG Version 1.01 (Panday and others, 2013). For the remaining relevant aquifers in Groundwater Management Area 7 modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Decadal modeled available groundwater for the relevant aquifers are reported by groundwater conservation district and county (Figure 1; Tables 1, 3, 5, 7, 9, 11, 13), and by county, regional water planning area, and river basin (Figures 2 and 3; Tables 2, 4, 6, 8, 10, 12, 14).

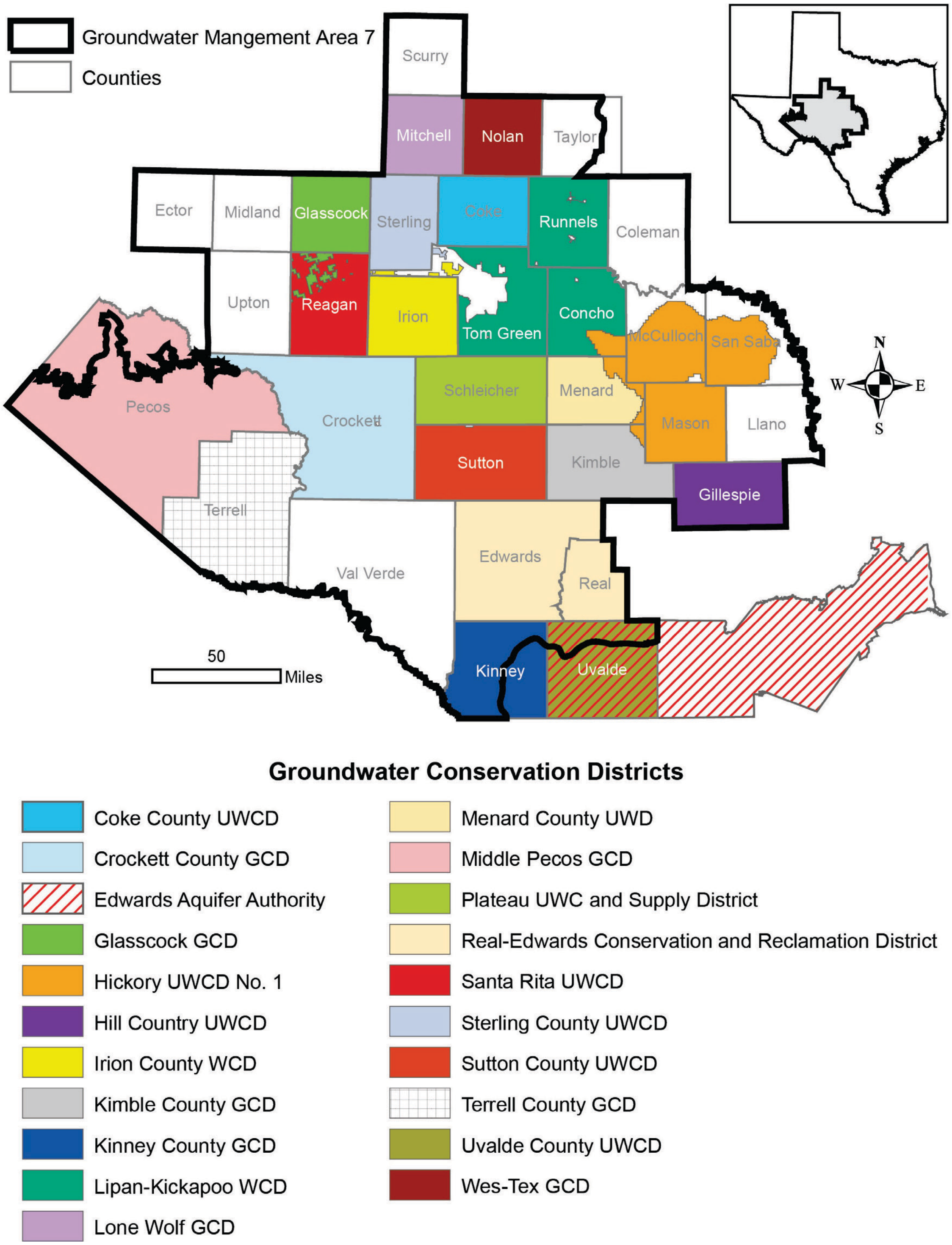


**FIGURE 1.** **MAP SHOWING THE GROUNDWATER CONSERVATION DISTRICTS (GCD) IN GROUNDWATER MANAGEMENT AREA 7. NOTE: THE BOUNDARIES OF THE EDWARDS AQUIFER AUTHORITY OVERLAP WITH THE UVALDE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT (UWCD).**

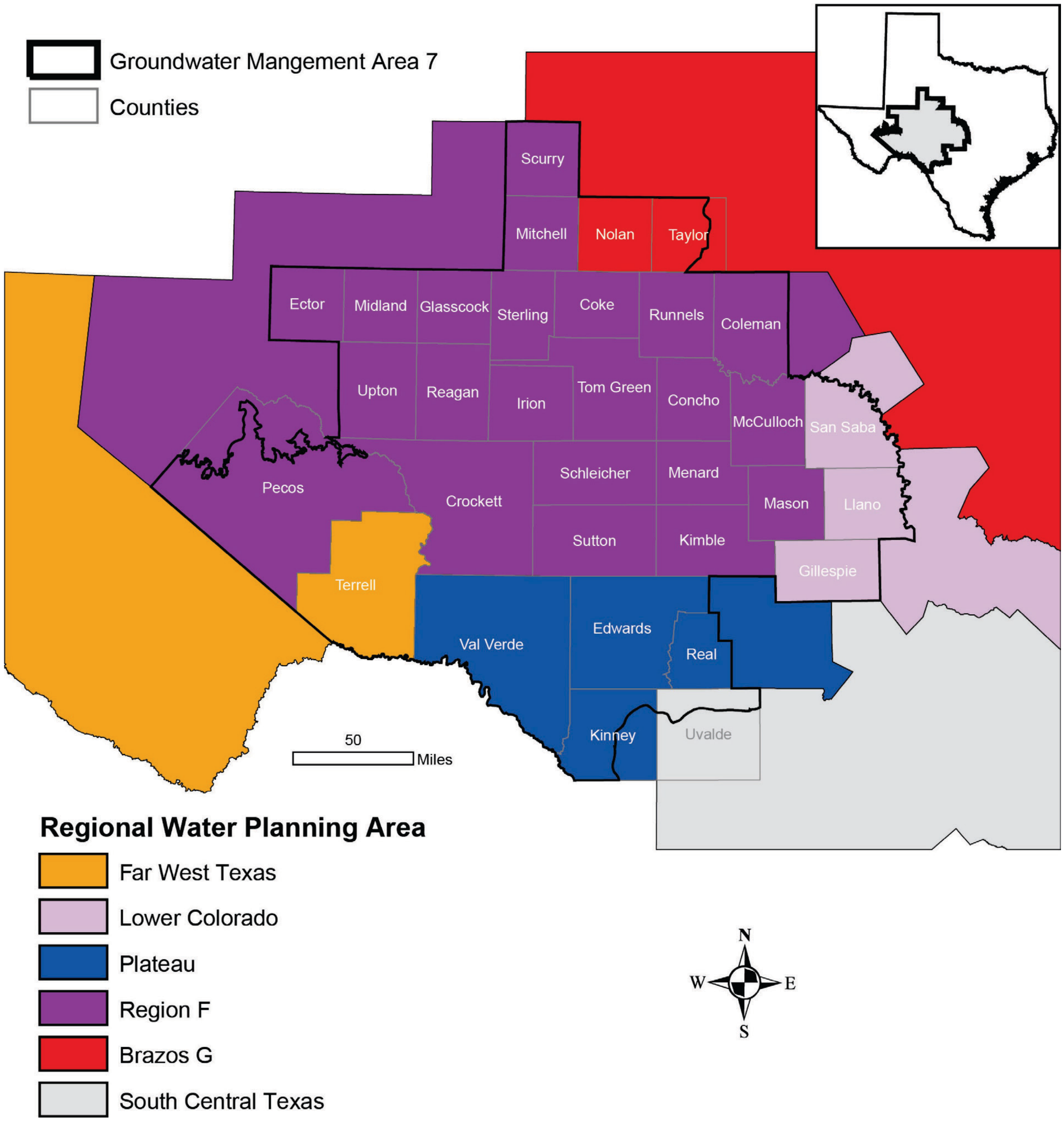


**FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS IN GROUNDWATER MANAGEMENT AREA 7.**

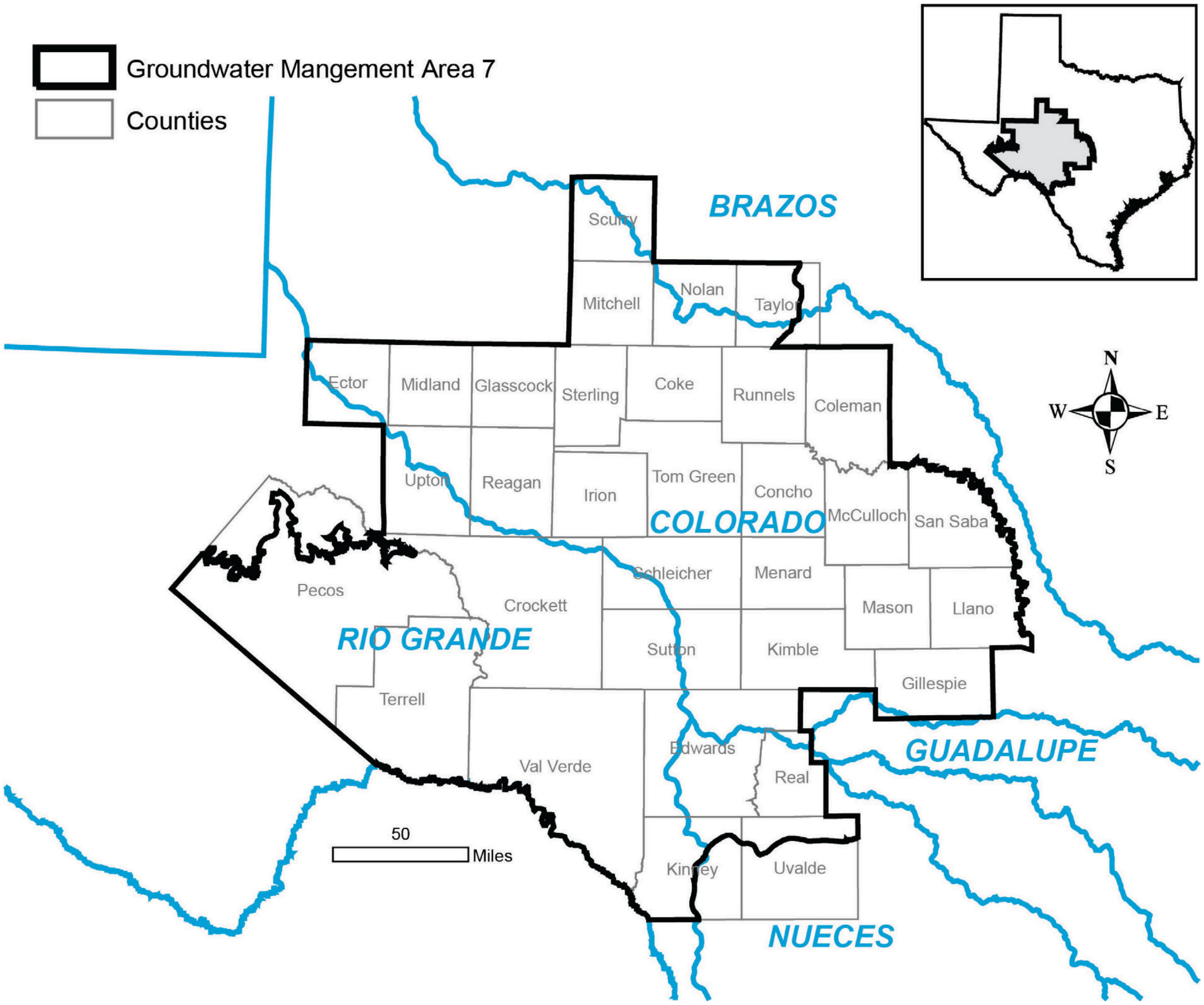


**FIGURE 3.** **MAP SHOWING RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 7. THESE INCLUDE PARTS OF THE BRAZOS, COLORADO, GUADALUPE, NUECES, AND RIO GRANDE RIVER BASINS.**

# PARAMETERS AND ASSUMPTIONS:

## Capitan Reef Complex Aquifer

Version 1.01 of the groundwater availability model of the eastern arm of the Capitan Reef Complex Aquifer was used. See Jones (2016) for assumptions and limitations of the groundwater availability model. See Hutchison (2016h) for details on the assumptions used for predictive simulations.

The model has five layers: Layer 1, the Edwards-Trinity (Plateau) and Pecos Valley aquifers; Layer 2, the Dockum Aquifer and the Dewey Lake Formation; Layer 3, the Rustler Aquifer; Layer 4, a confining unit made up of the Salado and Castile formations, and the overlying portion of the Artesia Group; and Layer 5, the Capitan Reef Complex Aquifer, part of the Artesia Group, and the Delaware Mountain Group. Layers 1 through 4 are intended to act solely as boundary conditions facilitating groundwater inflow and outflow relative to the Capitan Reef Complex Aquifer (Layer 5).

The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

The model was run for the interval 2006 through 2070 for a 64-year predictive simulation. Drawdowns were calculated by subtracting 2006 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7.

During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

Drawdown averages and modeled available groundwater volumes are based on the official aquifer boundary within Groundwater Management Area 7.

## Dockum and Ogallala Aquifers

Version 1.01 of the groundwater availability model for the High Plains Aquifer System by Deeds and Jigmond (2015) was used to construct the predictive model simulation for this analysis. See Hutchison (2016f) for details of the initial assumptions.

The model has four layers which represent the Ogallala and Pecos Valley Alluvium aquifers (Layer 1), the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) aquifers (Layer 2), the Upper Dockum Aquifer (Layer 3), and the Lower Dockum Aquifer (Layer 4). Pass-through cells exist in layers 2 and 3 where the Dockum Aquifer was absent but provided pathway for flow between the Lower Dockum and the Ogallala or Edwards-Trinity (High Plains) aquifers vertically. These pass-through cells were excluded from the calculations of drawdowns and modeled available groundwater.

The model was run with MODFLOW-NWT (Niswonger and others, 2011). The model uses the Newton formulation and the upstream weighting package, which automatically reduces pumping as heads drop in a particular cell, as defined by the user. This feature may simulate the declining production of a well as saturated thickness decreases. Deeds and Jigmond (2015) modified the MODFLOW-NWT code to use a saturated thickness of 30 feet as the threshold—instead of percent of the saturated thickness—when pumping reductions occur during a simulation. It is important for groundwater management areas to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

The model was run for the interval 2013 through 2070 for a 58-year predictive simulation. Drawdowns were calculated by subtracting 2012 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7.

During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging. Modeled available groundwater analysis excludes pass-through cells.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 7 for the Dockum Aquifer and official aquifer boundaries for the Ogallala Aquifer.

### Pecos Valley, Edwards-Trinity (Plateau) and Trinity Aquifers

The single-layer alternative groundwater flow model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers used for this analysis. This model is an update to the previously developed groundwater availability model documented in Anaya and Jones (2009). See Hutchison and others (2011a) and Anaya and Jones (2009) for assumptions and limitations of the model. See Hutchison (2016e; 2018c) for details on the assumptions used for predictive simulations.

The groundwater model has one layer representing the Pecos Valley Aquifer and the Edwards-Trinity (Plateau) Aquifer. In the relatively narrow area where both aquifers are present, the model is a lumped representation of both aquifers.

The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

The model was run for the interval 2006 through 2070 for a 65-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7. Comparison of 2010 simulated and measured water levels indicate a root mean squared error of 84 feet or 3 percent of the range in water-level elevations.

Drawdowns for cells with water levels below the base elevation of the cell ("dry" cells) were included in the averaging.

Drawdown averages and modeled available groundwater volumes are based on the official aquifer boundaries within Groundwater Management Area 7.

**Edwards-Trinity (Plateau) Aquifer of Kinney County**

All parameters and assumptions for the Edwards-Trinity (Plateau) Aquifer of Kinney County in Groundwater Management Area 7 are described in GAM Run 10-043 MAG Version 2 (Shi, 2012). This report assumes a planning period from 2010 to 2070.

The Kinney County Groundwater Conservation District model developed by Hutchison and others (2011b) was used for this analysis. The model was calibrated to water level and spring flux collected from 1950 to 2005.

The model has four layers representing the following hydrogeologic units (from top to bottom): Carrizo-Wilcox Aquifer (layer 1), Upper Cretaceous Unit (layer 2), Edwards (Balcones Fault Zone) Aquifer/Edwards portion of the Edwards-Trinity (Plateau) Aquifer (layer 3), and Trinity portion of the Edwards-Trinity (Plateau) Aquifer (layer 4).

The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

The model was run for the interval 2006 through 2070 for a 65-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7.

Modeled available groundwater volumes are based on the official aquifer boundaries within Groundwater Management Area 7 in Kinney County.

**Edwards-Trinity (Plateau) Aquifer of Val Verde County**

The single-layer numerical groundwater flow model for the Edwards-Trinity (Plateau) Aquifer of Val Verde County was used for this analysis. This model is based on the previously developed alternative groundwater model of the Kinney County area documented in Hutchison and others (2011b). See EcoKai (2014) for assumptions and limitations of the model. See Hutchison (2016e; 2018b) for details on the assumptions used for predictive simulations, including recharge and pumping assumptions.

The groundwater model has one layer representing the Edwards-Trinity (Plateau) Aquifer of Val Verde County.

The model was run with MODFLOW-2005 (Harbaugh, 2005).

The model was run for a 45-year predictive simulation representing hydrologic conditions of the interval 1968 through 2013. Simulated spring discharge from San Felipe Springs was then averaged over duration of the simulation. The resultant pumping rate that met the desired future conditions was applied to the predictive period—2010 through 2070—based on the assumption that average conditions over the predictive period are the same as those over the historic period represented by the model run.

Modeled available groundwater volumes are based on the official aquifer boundaries within Groundwater Management Area 7 in Val Verde County.

### Rustler Aquifer

Version 1.01 of the groundwater availability model for the Rustler Aquifer by Ewing and others (2012) was used to construct the predictive model simulation for this analysis. See Hutchison (2016d) for details of the initial assumptions, including recharge conditions.

The model has two layers, the top one representing the Rustler Aquifer, and the other representing the Dewey Lake Formation and the Dockum Aquifer.

The model was run with MODFLOW-NWT (Niswonger and others, 2011).

The model was run for the interval 2009 through 2070 for a 61-year predictive simulation. Drawdowns were calculated by subtracting 2009 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7. During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 7.

### Minor aquifers of the Llano Uplift Area

We used version 1.01 of the groundwater availability model for the minor aquifers in the Llano Uplift Area. See Shi and others (2016) for assumptions and limitations of the model. See Hutchison (2016g) for details of the initial assumptions.

The model contains eight layers: Trinity Aquifer, Edwards-Trinity (Plateau) Aquifer, and younger alluvium deposits (Layer 1), confining units (Layer 2), Marble Falls Aquifer and equivalent units (Layer 3), confining units (Layer 4), Ellenburger-San Saba Aquifer and equivalent units (Layer 5), confining units (Layer 6), Hickory Aquifer and equivalent units (Layer 7), and Precambrian units (Layer 8).

The model was run with MODFLOW-USG beta (development) version (Panday and others, 2013). Perennial rivers and reservoirs were simulated using the MODFLOW-USG river package. Springs were simulated using the MODFLOW-USG drain package.

Drawdown averages and modeled available groundwater volumes are based on the model boundaries within Groundwater Management Area 7.

The model was run for the interval 2011 through 2070 for a 60-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels, which were then averaged over the portion of the aquifer in Groundwater Management Area 7. During predictive simulations, there were no cells where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging.

## RESULTS:

The modeled available groundwater estimates are 26,164 acre-feet per year in the Capitan Reef Complex Aquifer, 474,464 acre-feet per year in the undifferentiated Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, 22,616 acre-feet per year in the Ellenburger-San Saba Aquifer, 49,936 acre-feet per year in the Hickory Aquifer, 6,570 to 7,925 acre-feet per year in the Ogallala Aquifer, 2,324 acre-feet per year in the Dockum Aquifer, and 7,040 acre-feet per year in the Rustler Aquifer.

The modeled available groundwater for the respective aquifers has been summarized by aquifer, county, and groundwater conservation district (Tables 1, 3, 5, 7, 9, 11, and 13). The modeled available groundwater is also summarized by county, regional water planning area, river basin, and aquifer for use in the regional water planning process (Tables 2, 4, 6, 8, 10, 12, and 14). The modeled available groundwater for the Ogallala Aquifer that achieves the desired future conditions adopted by districts in Groundwater Management Area 7 decreases from 7,925 to 6,570 acre-feet per year between 2020 and 2070 (Tables 9 and 10). This decline is attributable to the occurrence of increasing numbers of cells where water levels were below the base elevation of the cell ("dry" cells) in parts of Glasscock County. Please note that MODFLOW-NWT automatically reduces pumping as water levels decline.

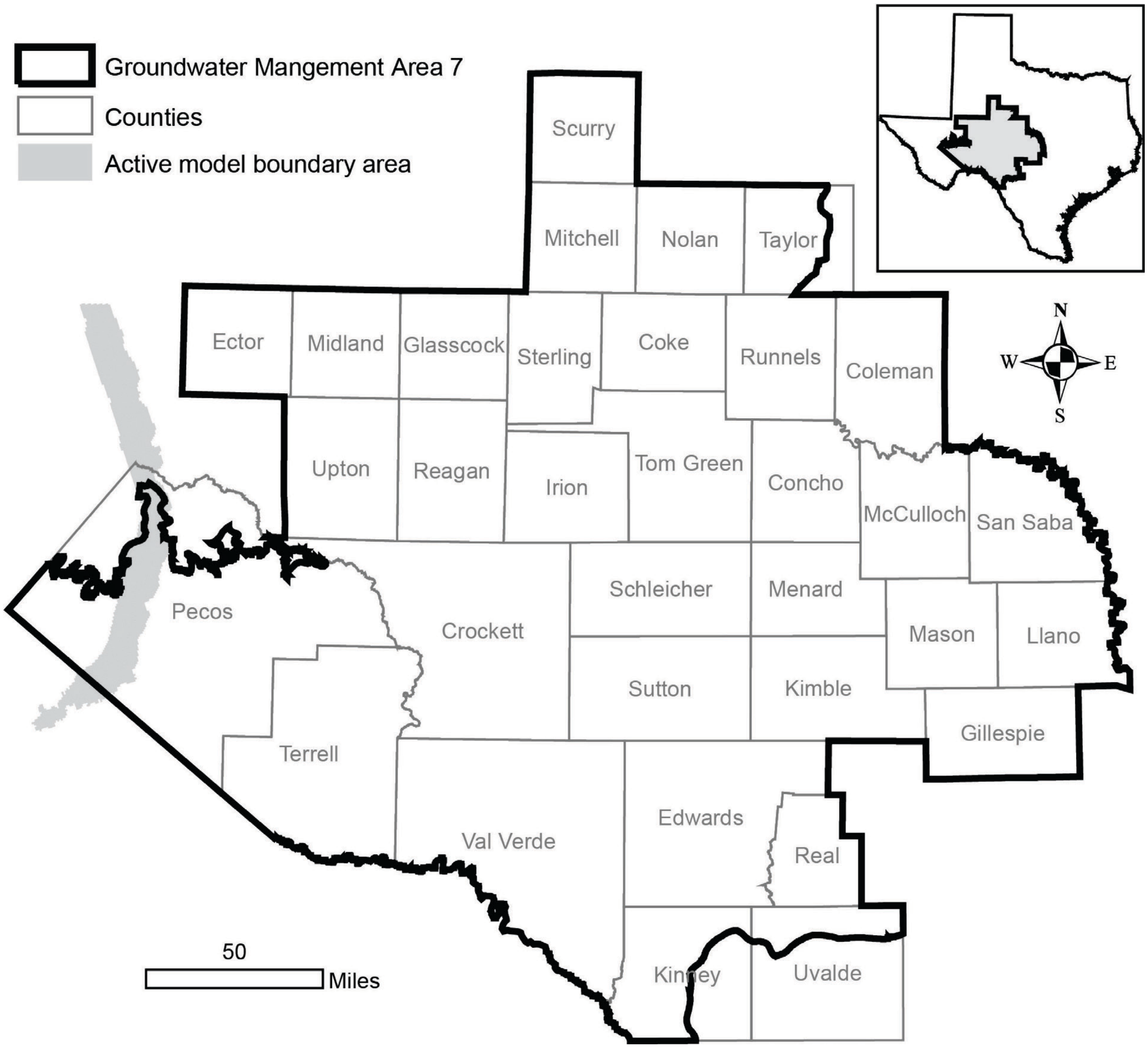


**FIGURE 4.** **MAP SHOWING THE AREAS COVERED BY THE CAPITAN REEF COMPLEX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EASTERN ARM OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

**TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2006 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. GCD IS THE ABBREVIATION FOR GROUNDWATER CONSERVATION DISTRICT.**

| District | County | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Middle Pecos GCD | Pecos | 26,164 | 26,164 | 26,164 | 26,164 | 26,164 | 26,164 | 26,164 | 26,164 |
| | **Total** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** |
| GMA 7 | | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** |

**TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Pecos | F | Rio Grande | 26,164 | 26,164 | 26,164 | 26,164 | 26,164 | 26,164 |
| | | **Total** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** |
| **GMA 7** | | | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** | **26,164** |

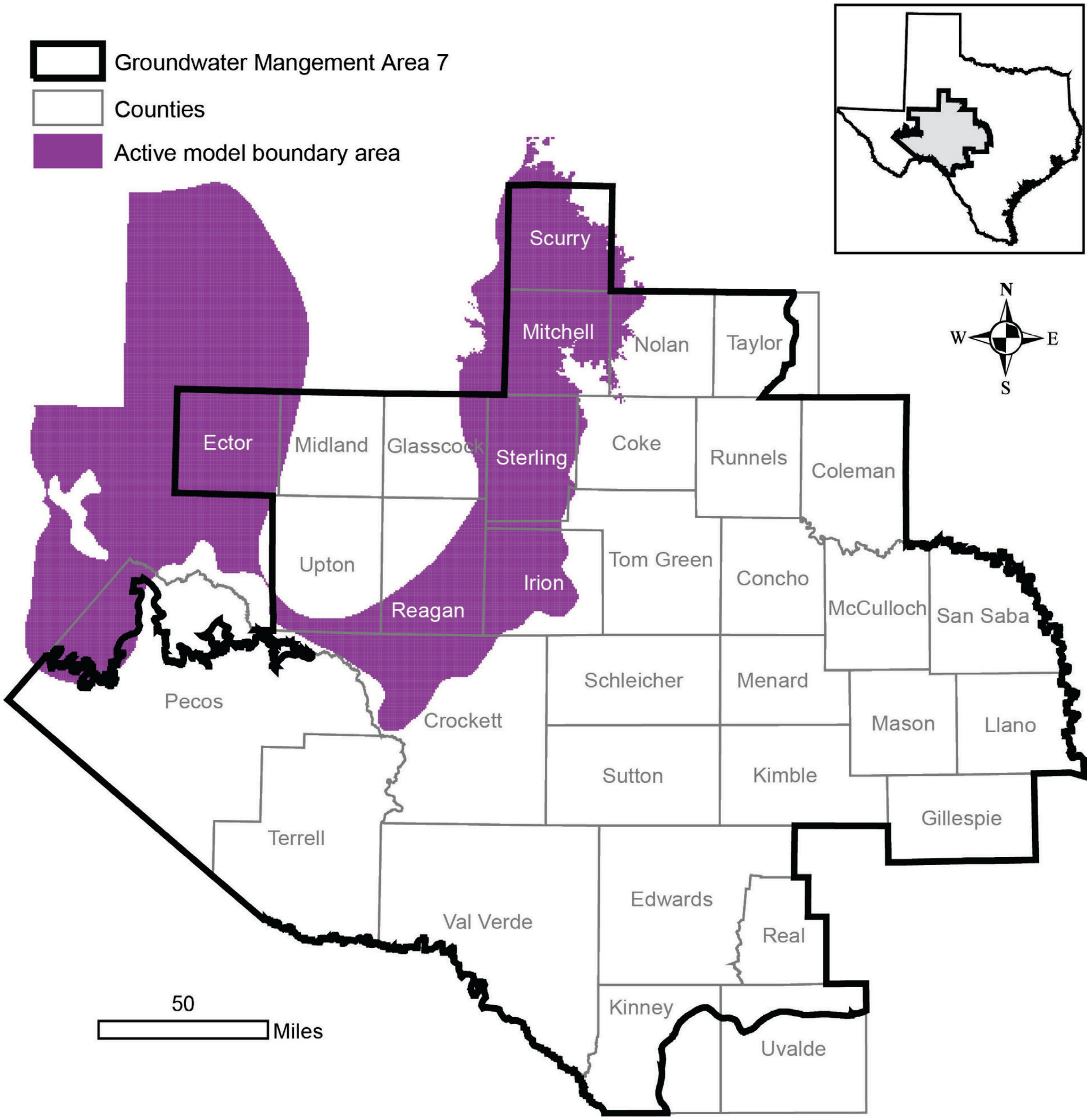


**FIGURE 5.** **MAP SHOWING AREAS COVERED BY THE DOCKUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

**TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2013 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. GCD AND UWCD ARE THE ABBREVIATIONS FOR GROUNDWATER CONSERVATION DISTRICT AND UNDERGROUND WATER CONSERVATION DISTRICT,RESPECTIVELY.**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2013 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Middle Pecos GCD | Pecos | 2,022 | 2,022 | 2,022 | 2,022 | 2,022 | 2,022 | 2,022 |
| | **Total** | **2,022** | **2,022** | **2,022** | **2,022** | **2,022** | **2,022** | **2,022** |
| Santa Rita UWCD | Reagan | 302 | 302 | 302 | 302 | 302 | 302 | 302 |
| | **Total** | **302** | **302** | **302** | **302** | **302** | **302** | **302** |
| **GMA 7** | | **2324** | **2,324** | **2,324** | **2,324** | **2,324** | **2,324** | **2,324** |

Note: The modeled available groundwater for Santa Rita Underground Water Conservation District excludes parts of Reagan County that fall within Glasscock Groundwater Conservation District. The year 2013 is used because the 2012 desired future condition baseline year for the Dockum Aquifer is an initial condition in the predictive model run.

**TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Pecos | F | Rio Grande | 2,022 | 2,022 | 2,022 | 2,022 | 2,022 | 2,022 |
| | | **Total** | **2,022** | **2,022** | **2,022** | **2,022** | **2,022** | **2,022** |
| Reagan | F | Colorado | 302 | 302 | 302 | 302 | 302 | 302 |
| | | Rio Grande | 0 | 0 | 0 | 0 | 0 | 0 |
| | | **Total** | **302** | **302** | **302** | **302** | **302** | **302** |
| **GMA 7** | | | **2,324** | **2,324** | **2,324** | **2,324** | **2,324** | **2,324** |

Note: The modeled available groundwater for Reagan County excludes parts of Reagan County that fall outside of Santa Rita Underground Water Conservation District.

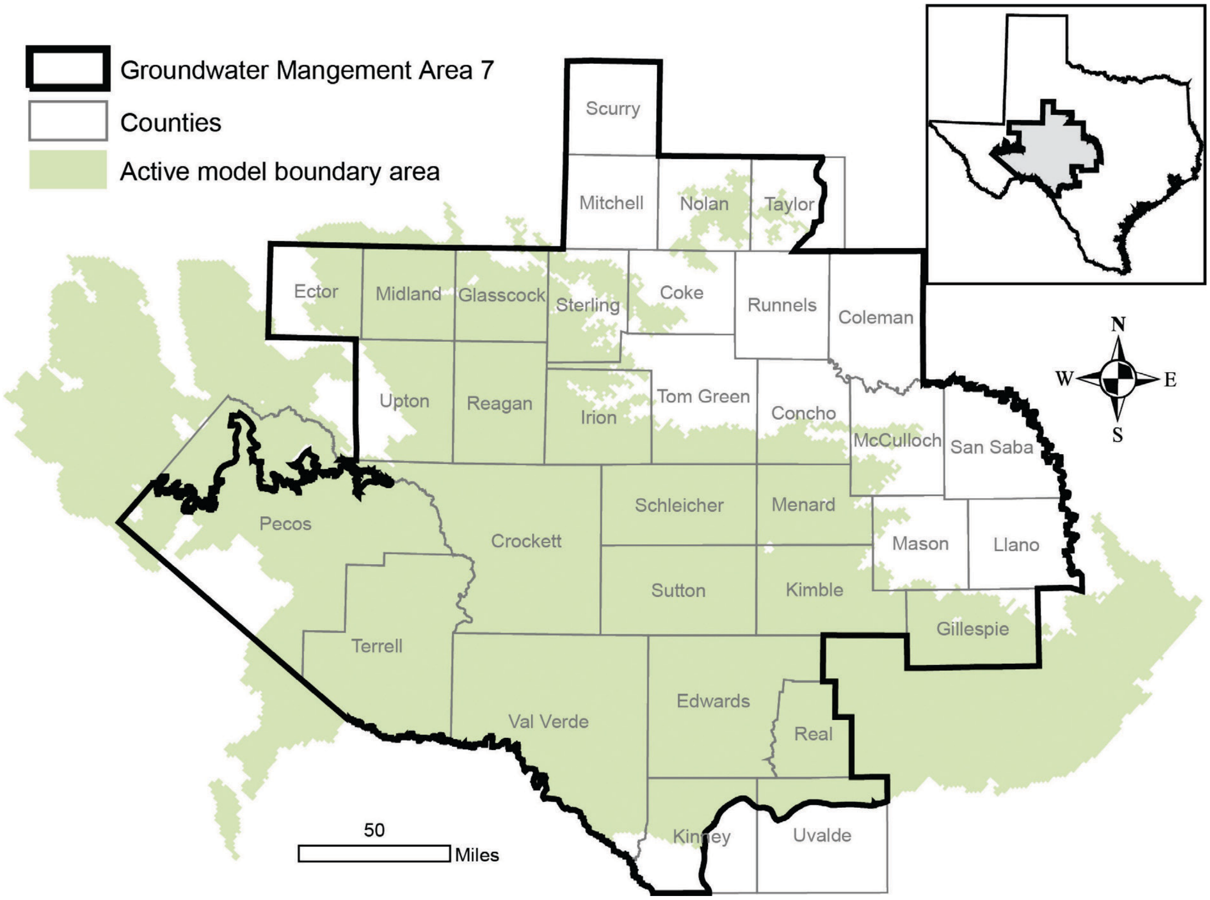


**FIGURE 6. MAP SHOWING THE AREAS COVERED BY THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7.**

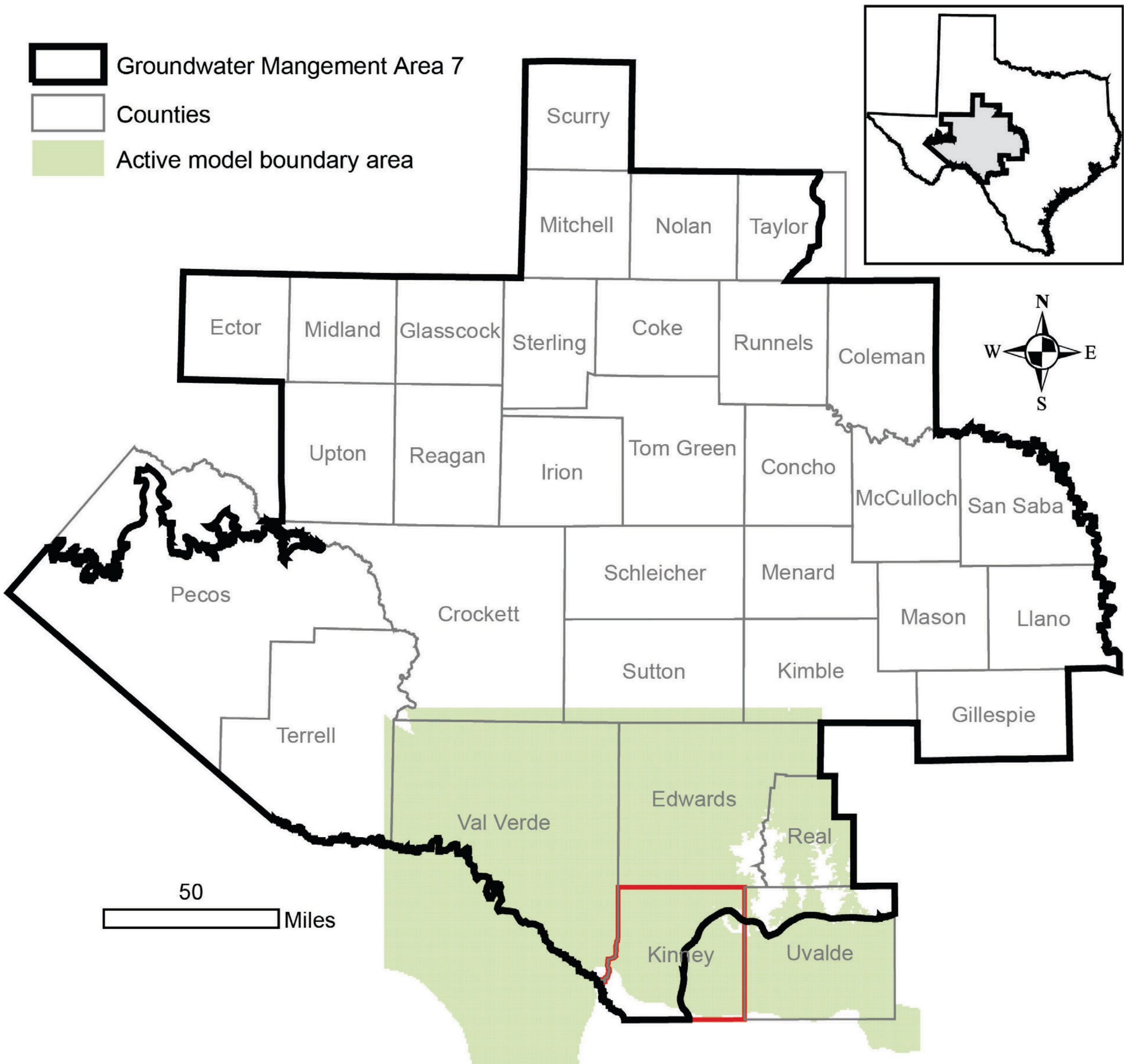


**FIGURE 7.** **MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE ALTERNATIVE MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN KINNEY COUNTY.**

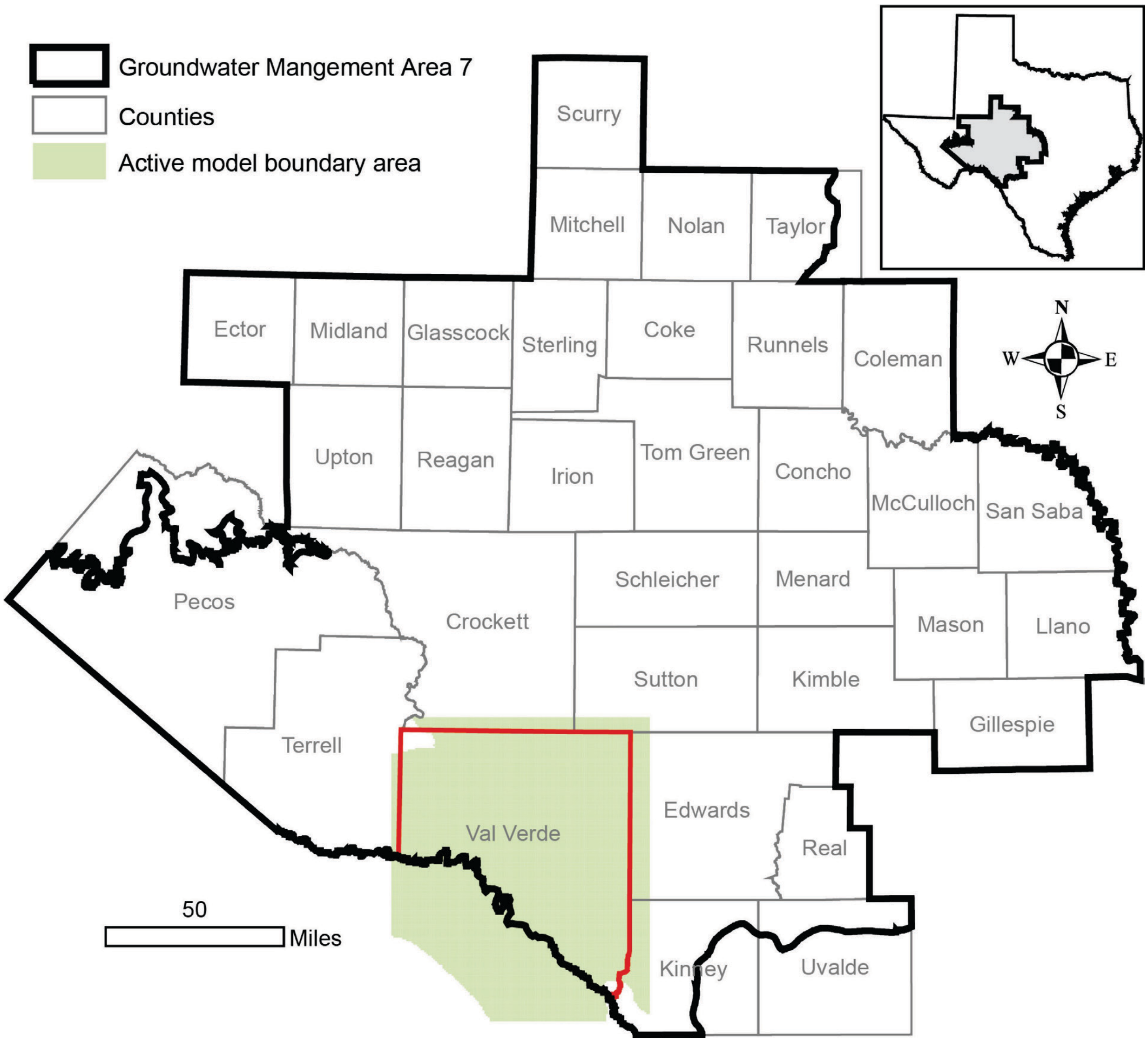


**FIGURE 8.** MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE GROUNDWATER FLOW MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN VAL VERDE COUNTY.

**TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY, FOR EACH DECADE BETWEEN 2006 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD IS ABBREVIATION FOR UNDERGROUND WATER CONSERVATION DISTRICT, WCD IS WATER CONSERVATION DISTRICT, UWD IS UNDERGROUND WATER DISTRICT, UWC IS UNDERGROUND WATER CONSERVATION, AND C AND R DISTRICT IS CONSERVATION AND RECLAMATION DISTRICT.**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Coke County UWCD | Coke | 997 | 997 | 997 | 997 | 997 | 997 | 997 |
| | **Total** | **997** | **997** | **997** | **997** | **997** | **997** | **997** |
| Crockett County GCD | Crockett | 4,675 | 4,675 | 4,675 | 4,675 | 4,675 | 4,675 | 4,675 |
| | **Total** | **4,675** | **4,675** | **4,675** | **4,675** | **4,675** | **4,675** | **4,675** |
| Glasscock GCD | Glasscock | 65,186 | 65,186 | 65,186 | 65,186 | 65,186 | 65,186 | 65,186 |
| | Reagan | 40,835 | 40,835 | 40,835 | 40,835 | 40,835 | 40,835 | 40,835 |
| | **Total** | **106,021** | **106,021** | **106,021** | **106,021** | **106,021** | **106,021** | **106,021** |
| Hill Country UWCD | Gillespie | 4,979 | 4,979 | 4,979 | 4,979 | 4,979 | 4,979 | 4,979 |
| | **Total** | **4,979** | **4,979** | **4,979** | **4,979** | **4,979** | **4,979** | **4,979** |
| Irion County WCD* | Irion | 3,289 | 3,289 | 3,289 | 3,289 | 3,289 | 3,289 | 3,289 |
| | **Total** | **3,289** | **3,289** | **3,289** | **3,289** | **3,289** | **3,289** | **3,289** |
| Kimble County GCD | Kimble | 1,282 | 1,282 | 1,282 | 1,282 | 1,282 | 1,282 | 1,282 |
| | **Total** | **1,282** | **1,282** | **1,282** | **1,282** | **1,282** | **1,282** | **1,282** |
| Kinney County GCD | Kinney | 70,341 | 70,341 | 70,341 | 70,341 | 70,341 | 70,341 | 70,341 |
| | **Total** | **70,341** | **70,341** | **70,341** | **70,341** | **70,341** | **70,341** | **70,341** |

**TABLE 5. (CONTINUED).**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **2010** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Menard County UWD | Menard | 2,217 | 2,217 | 2,217 | 2,217 | 2,217 | 2,217 | 2,217 |
| | **Total** | **2,217** | **2,217** | **2,217** | **2,217** | **2,217** | **2,217** | **2,217** |
| Middle Pecos GCD | Pecos | 117,309 | 117,309 | 117,309 | 117,309 | 117,309 | 117,309 | 117,309 |
| | **Total** | **117,309** | **117,309** | **117,309** | **117,309** | **117,309** | **117,309** | **117,309** |
| Plateau UWC and Supply District | Schleicher | 8,034 | 8,034 | 8,034 | 8,034 | 8,034 | 8,034 | 8,034 |
| | **Total** | **8,034** | **8,034** | **8,034** | **8,034** | **8,034** | **8,034** | **8,034** |
| Real-Edwards C and R District | Edwards | 5,676 | 5,676 | 5,676 | 5,676 | 5,676 | 5,676 | 5,676 |
| | Real | 7,523 | 7,523 | 7,523 | 7,523 | 7,523 | 7,523 | 7,523 |
| | **Total** | **13,199** | **13,199** | **13,199** | **13,199** | **13,199** | **13,199** | **13,199** |
| Santa Rita UWCD | Reagan | 27,398 | 27,398 | 27,398 | 27,398 | 27,398 | 27,398 | 27,398 |
| | **Total** | **27,398** | **27,398** | **27,398** | **27,398** | **27,398** | **27,398** | **27,398** |
| Sterling County UWCD | Sterling | 2,495 | 2,495 | 2,495 | 2,495 | 2,495 | 2,495 | 2,495 |
| | **Total** | **2,495** | **2,495** | **2,495** | **2,495** | **2,495** | **2,495** | **2,495** |
| Sutton County UWCD | Sutton | 6,400 | 6,400 | 6,400 | 6,400 | 6,400 | 6,400 | 6,400 |
| | **Total** | **6,400** | **6,400** | **6,400** | **6,400** | **6,400** | **6,400** | **6,400** |
| Terrell County GCD | Terrell | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 |
| | **Total** | **1,420** | **1,420** | **1,420** | **1,420** | **1,420** | **1,420** | **1,420** |
| Uvalde County UWCD | Uvalde | 1,993 | 1,993 | 1,993 | 1,993 | 1,993 | 1,993 | 1,993 |
| | **Total** | **1,993** | **1,993** | **1,993** | **1,993** | **1,993** | **1,993** | **1,993** |

**TABLE 5. (CONTINUED).**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **2010** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| No district | | 102,415 | 102,415 | 102,415 | 102,415 | 102,415 | 102,415 | 102,415 |
| **GMA 7** | | **474,464** | **474,464** | **474,464** | **474,464** | **474,464** | **474,464** | **474,464** |

*The modeled available groundwater for Irion County WCD only includes the portion of the district that falls within Irion County.

**TABLE 6. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Coke | F | Colorado | 997 | 997 | 997 | 997 | 997 | 997 |
| | | **Total** | **997** | **997** | **997** | **997** | **997** | **997** |
| Crockett | F | Colorado | 20 | 20 | 20 | 20 | 20 | 20 |
| | | Rio Grande | 5,427 | 5,427 | 5,427 | 5,427 | 5,427 | 5,427 |
| | | **Total** | **5,447** | **5,447** | **5,447** | **5,447** | **5,447** | **5,447** |
| Ector | F | Colorado | 4,925 | 4,925 | 4,925 | 4,925 | 4,925 | 4,925 |
| | | Rio Grande | 617 | 617 | 617 | 617 | 617 | 617 |
| | | **Total** | **5,542** | **5,542** | **5,542** | **5,542** | **5,542** | **5,542** |
| Edwards | J | Colorado | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 |
| | | Nueces | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 |
| | | Rio Grande | 1,740 | 1,740 | 1,740 | 1,740 | 1,740 | 1,740 |
| | | **Total** | **5,676** | **5,676** | **5,676** | **5,676** | **5,676** | **5,676** |
| Gillespie | K | Colorado | 4,843 | 4,843 | 4,843 | 4,843 | 4,843 | 4,843 |
| | | Guadalupe | 136 | 136 | 136 | 136 | 136 | 136 |
| | | **Total** | **4,979** | **4,979** | **4,979** | **4,979** | **4,979** | **4,979** |
| Glasscock | F | Colorado | 65,186 | 65,186 | 65,186 | 65,186 | 65,186 | 65,186 |
| | | **Total** | **65,186** | **65,186** | **65,186** | **65,186** | **65,186** | **65,186** |

**TABLE 6. (CONTINUED).**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Irion | F | Colorado | 3,289 | 3,289 | 3,289 | 3,289 | 3,289 | 3,289 |
| | | **Total** | **3,289** | **3,289** | **3,289** | **3,289** | **3,289** | **3,289** |
| Kimble* | F | Colorado | 1,282 | 1,282 | 1,282 | 1,282 | 1,282 | 1,282 |
| | | **Total** | **1,282** | **1,282** | **1,282** | **1,282** | **1,282** | **1,282** |
| Kinney | J | Nueces | 12 | 12 | 12 | 12 | 12 | 12 |
| | | Rio Grande | 70,329 | 70,329 | 70,329 | 70,329 | 70,329 | 70,329 |
| | | **Total** | **70,341** | **70,341** | **70,341** | **70,341** | **70,341** | **70,341** |
| Menard* | F | Colorado | 2,217 | 2,217 | 2,217 | 2,217 | 2,217 | 2,217 |
| | | **Total** | **2,217** | **2,217** | **2,217** | **2,217** | **2,217** | **2,217** |
| Midland | F | Colorado | 23,233 | 23,233 | 23,233 | 23,233 | 23,233 | 23,233 |
| | | **Total** | **23,233** | **23,233** | **23,233** | **23,233** | **23,233** | **23,233** |
| Pecos | F | Rio Grande | 117,309 | 117,309 | 117,309 | 117,309 | 117,309 | 117,309 |
| | | **Total** | **117,309** | **117,309** | **117,309** | **117,309** | **117,309** | **117,309** |
| Reagan | F | Colorado | 68,205 | 68,205 | 68,205 | 68,205 | 68,205 | 68,205 |
| | | Rio Grande | 28 | 28 | 28 | 28 | 28 | 28 |
| | | **Total** | **68,233** | **68,233** | **68,233** | **68,233** | **68,233** | **68,233** |
| Real | J | Colorado | 277 | 277 | 277 | 277 | 277 | 277 |
| | | Guadalupe | 3 | 3 | 3 | 3 | 3 | 3 |
| | | Nueces | 7,243 | 7,243 | 7,243 | 7,243 | 7,243 | 7,243 |
| | | **Total** | **7,523** | **7,523** | **7,523** | **7,523** | **7,523** | **7,523** |

**TABLE 6. (CONTINUED).**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Schleicher | F | Colorado | 6,403 | 6,403 | 6,403 | 6,403 | 6,403 | 6,403 |
| | | Rio Grande | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 | 1,631 |
| | | **Total** | **8,034** | **8,034** | **8,034** | **8,034** | **8,034** | **8,034** |
| Sterling | F | Colorado | 2,495 | 2,495 | 2,495 | 2,495 | 2,495 | 2,495 |
| | | **Total** | **2,495** | **2,495** | **2,495** | **2,495** | **2,495** | **2,495** |
| Sutton | F | Colorado | 388 | 388 | 388 | 388 | 388 | 388 |
| | | Rio Grande | 6,022 | 6,022 | 6,022 | 6,022 | 6,022 | 6,022 |
| | | **Total** | **6,410** | **6,410** | **6,410** | **6,410** | **6,410** | **6,410** |
| Taylor | G | Brazos | 331 | 331 | 331 | 331 | 331 | 331 |
| | | Colorado | 158 | 158 | 158 | 158 | 158 | 158 |
| | | **Total** | **489** | **489** | **489** | **489** | **489** | **489** |
| Terrell | E | Rio Grande | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 | 1,420 |
| | | **Total** | **1,420** | **1,420** | **1,420** | **1,420** | **1,420** | **1,420** |
| Upton | F | Colorado | 21,243 | 21,243 | 21,243 | 21,243 | 21,243 | 21,243 |
| | | Rio Grande | 1,126 | 1,126 | 1,126 | 1,126 | 1,126 | 1,126 |
| | | **Total** | **22,369** | **22,369** | **22,369** | **22,369** | **22,369** | **22,369** |
| Uvalde | L | Nueces | 1,993 | 1,993 | 1,993 | 1,993 | 1,993 | 1,993 |
| | | **Total** | **1,993** | **1,993** | **1,993** | **1,993** | **1,993** | **1,993** |
| Val Verde | J | Rio Grande | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| | | **Total** | **50,000** | **50,000** | **50,000** | **50,000** | **50,000** | **50,000** |
| **GMA 7** | | | **474,464** | **474,464** | **474,464** | **474,464** | **474,464** | **474,464** |

*The modeled available groundwater for Kimble and Menard counties excludes the parts of the counties that fall within Hickory Underground Water Conservation District No. 1.

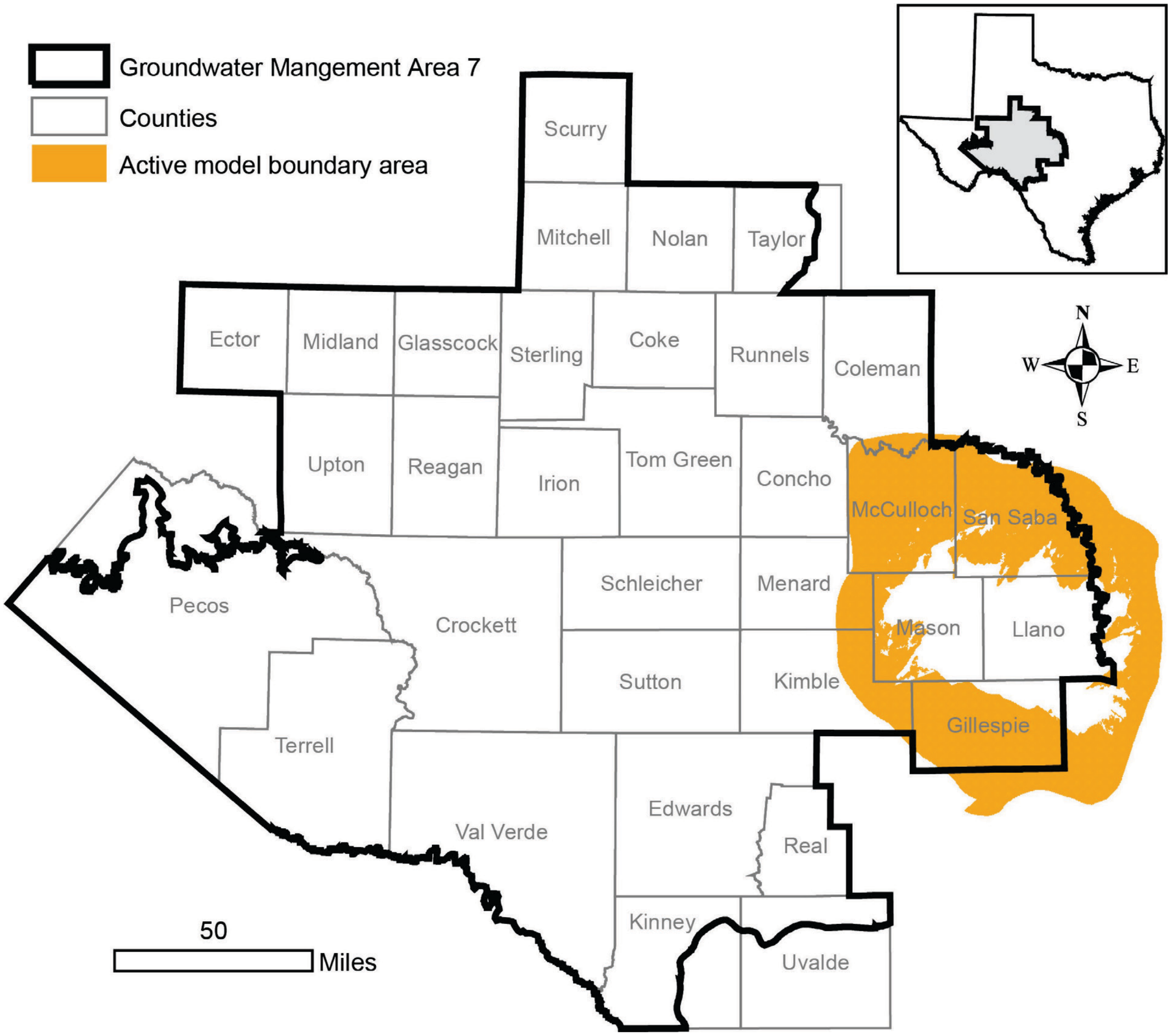


**FIGURE 9. MAP SHOWING THE AREAS COVERED BY THE ELLENBURGER-SAN SABA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.**

**TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2011 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD IS THE ABBREVIATION FOR UNDERGROUND WATER CONSERVATION DISTRICT AND UWD IS UNDERGROUND WATER DISTRICT.**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Hickory UWCD No. 1 | Kimble | 344 | 344 | 344 | 344 | 344 | 344 | 344 |
| | Mason | 3,237 | 3,237 | 3,237 | 3,237 | 3,237 | 3,237 | 3,237 |
| | McCulloch | 3,466 | 3,466 | 3,466 | 3,466 | 3,466 | 3,466 | 3,466 |
| | Menard | 282 | 282 | 282 | 282 | 282 | 282 | 282 |
| | San Saba | 5,559 | 5,559 | 5,559 | 5,559 | 5,559 | 5,559 | 5,559 |
| | **Total** | **12,887** | **12,887** | **12,887** | **12,887** | **12,887** | **12,887** | **12,887** |
| Hill Country UWCD | Gillespie | 6,294 | 6,294 | 6,294 | 6,294 | 6,294 | 6,294 | 6,294 |
| | **Total** | **6,294** | **6,294** | **6,294** | **6,294** | **6,294** | **6,294** | **6,294** |
| Kimble County GCD | Kimble | 178 | 178 | 178 | 178 | 178 | 178 | 178 |
| | **Total** | **178** | **178** | **178** | **178** | **178** | **178** | **178** |
| Menard County UWD | Menard | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| | **Total** | **27** | **27** | **27** | **27** | **27** | **27** | **27** |
| No District | McCulloch | 898 | 898 | 898 | 898 | 898 | 898 | 898 |
| | San Saba | 2,331 | 2,331 | 2,331 | 2,331 | 2,331 | 2,331 | 2,331 |
| | **Total** | **3,229** | **3,229** | **3,229** | **3,229** | **3,229** | **3,229** | **3,229** |
| **GMA 7** | | **22,616** | **22,616** | **22,616** | **22,616** | **22,616** | **22,616** | **22,616** |

Note: The year 2011 is used because the 2010 desired future condition baseline year for the Ellenburger-San Saba Aquifer is an initial condition in the predictive model run.

**TABLE 8. MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Gillespie | K | Colorado | 6,294 | 6,294 | 6,294 | 6,294 | 6,294 | 6,294 |
| | | **Total** | **6,294** | **6,294** | **6,294** | **6,294** | **6,294** | **6,294** |
| Kimble | F | Colorado | 521 | 521 | 521 | 521 | 521 | 521 |
| | | **Total** | **521** | **521** | **521** | **521** | **521** | **521** |
| Mason | F | Colorado | 3,237 | 3,237 | 3,237 | 3,237 | 3,237 | 3,237 |
| | | **Total** | **3,237** | **3,237** | **3,237** | **3,237** | **3,237** | **3,237** |
| McCulloch | F | Colorado | 4,364 | 4,364 | 4,364 | 4,364 | 4,364 | 4,364 |
| | | **Total** | **4,364** | **4,364** | **4,364** | **4,364** | **4,364** | **4,364** |
| Menard | F | Colorado | 309 | 309 | 309 | 309 | 309 | 309 |
| | | **Total** | **309** | **309** | **309** | **309** | **309** | **309** |
| San Saba | K | Colorado | 7,890 | 7,890 | 7,890 | 7,890 | 7,890 | 7,890 |
| | | **Total** | **7,890** | **7,890** | **7,890** | **7,890** | **7,890** | **7,890** |
| **GMA 7** | | | **22,616** | **22,616** | **22,616** | **22,616** | **22,616** | **22,616** |

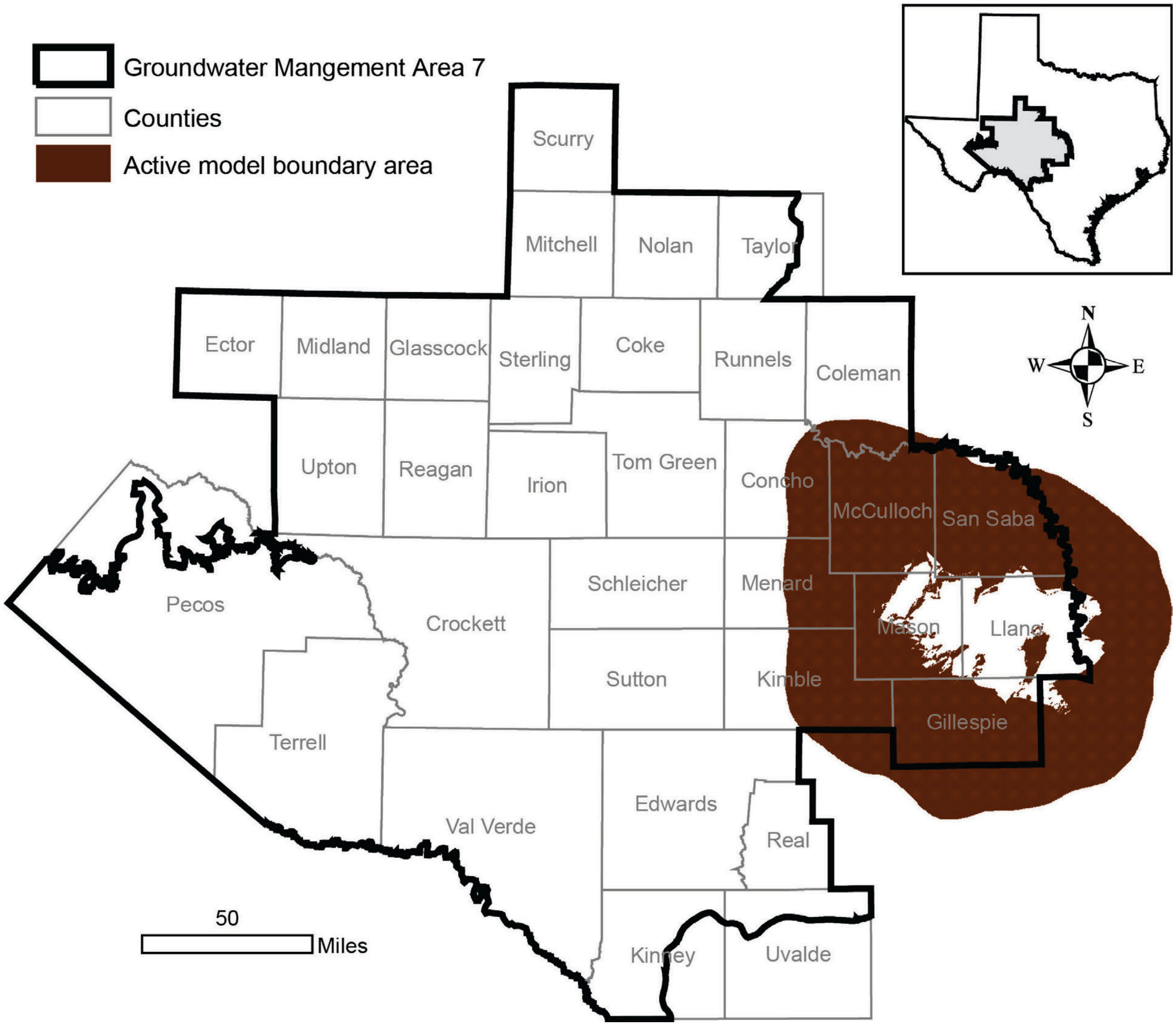


**FIGURE 10. MAP SHOWING AREAS COVERED BY THE HICKORY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.**

**TABLE 9. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2011 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR. UWCD IS THE ABBREVIATION FOR UNDERGROUND WATER CONSERVATION DISTRICT AND UWD IS UNDERGROUND WATER DISTRICT.**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Hickory UWCD No. 1 | Concho | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| | Kimble | 42 | 42 | 42 | 42 | 42 | 42 | 42 |
| | Mason | 13,212 | 13,212 | 13,212 | 13,212 | 13,212 | 13,212 | 13,212 |
| | McCulloch | 21,950 | 21,950 | 21,950 | 21,950 | 21,950 | 21,950 | 21,950 |
| | Menard | 2,600 | 2,600 | 2,600 | 2,600 | 2,600 | 2,600 | 2,600 |
| | San Saba | 7,027 | 7,027 | 7,027 | 7,027 | 7,027 | 7,027 | 7,027 |
| | **Total** | **44,843** | **44,843** | **44,843** | **44,843** | **44,843** | **44,843** | **44,843** |
| Hill Country UWCD | Gillespie | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 |
| | **Total** | **1,751** | **1,751** | **1,751** | **1,751** | **1,751** | **1,751** | **1,751** |
| Kimble County GCD | Kimble | 123 | 123 | 123 | 123 | 123 | 123 | 123 |
| | **Total** | **123** | **123** | **123** | **123** | **123** | **123** | **123** |
| Lipan-Kickapoo WCD | Concho | 13 | 13 | 13 | 13 | 13 | 13 | 13 |
| | **Total** | **13** | **13** | **13** | **13** | **13** | **13** | **13** |
| Menard County UWD | Menard | 126 | 126 | 126 | 126 | 126 | 126 | 126 |
| | **Total** | **126** | **126** | **126** | **126** | **126** | **126** | **126** |
| No District | McCulloch | 2,427 | 2,427 | 2,427 | 2,427 | 2,427 | 2,427 | 2,427 |
| | San Saba | 652 | 652 | 652 | 652 | 652 | 652 | 652 |
| | **Total** | **3,080** | **3,080** | **3,080** | **3,080** | **3,080** | **3,080** | **3,080** |
| **GMA 7** | | **49,936** | **49,936** | **49,936** | **49,936** | **49,936** | **49,936** | **49,936** |

Note: The year 2011 is used because the 2010 desired future condition baseline year for the Hickory Aquifer is an initial condition in the predictive model run.

**TABLE 10. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Concho | F | Colorado | 27 | 27 | 27 | 27 | 27 | 27 |
| | | **Total** | **27** | **27** | **27** | **27** | **27** | **27** |
| Gillespie | K | Colorado | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 | 1,751 |
| | | **Total** | **1,751** | **1,751** | **1,751** | **1,751** | **1,751** | **1,751** |
| Kimble | F | Colorado | 165 | 165 | 165 | 165 | 165 | 165 |
| | | **Total** | **165** | **165** | **165** | **165** | **165** | **165** |
| Mason | F | Colorado | 13,212 | 13,212 | 13,212 | 13,212 | 13,212 | 13,212 |
| | | **Total** | **13,212** | **13,212** | **13,212** | **13,212** | **13,212** | **13,212** |
| McCulloch | F | Colorado | 24,377 | 24,377 | 24,377 | 24,377 | 24,377 | 24,377 |
| | | **Total** | **24,377** | **24,377** | **24,377** | **24,377** | **24,377** | **24,377** |
| Menard | F | Colorado | 2,725 | 2,725 | 2,725 | 2,725 | 2,725 | 2,725 |
| | | **Total** | **2,725** | **2,725** | **2,725** | **2,725** | **2,725** | **2,725** |
| San Saba | K | Colorado | 7,680 | 7,680 | 7,680 | 7,680 | 7,680 | 7,680 |
| | | **Total** | **7,680** | **7,680** | **7,680** | **7,680** | **7,680** | **7,680** |
| **GMA 7** | | | **49,936** | **49,936** | **49,936** | **49,936** | **49,936** | **49,936** |

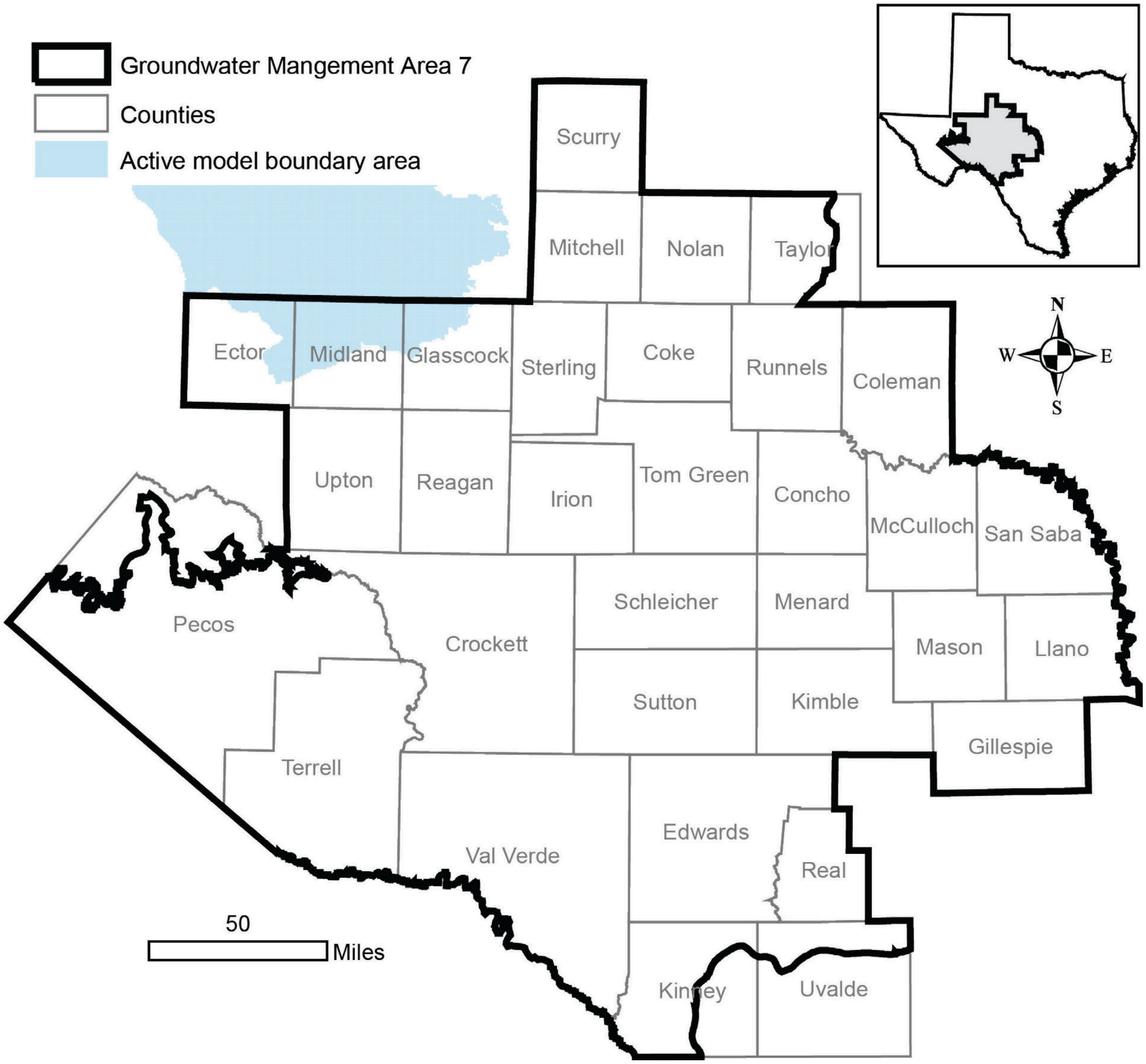


**FIGURE 11.** **MAP SHOWING THE AREAS COVERED BY THE OGALLALA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

**TABLE 11. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2013 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| District | County | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2013 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Glasscock GCD | Glasscock | 8,019 | 7,925 | 7,673 | 7,372 | 7,058 | 6,803 | 6,570 |
| | **Total** | **8,019** | **7,925** | **7,673** | **7,372** | **7,058** | **6,803** | **6,570** |
| **GMA 7** | | **8,019** | **7,925** | **7,673** | **7,372** | **7,058** | **6,803** | **6,570** |

Note: The year 2013 is used because the 2012 desired future condition baseline year for the Ogallala Aquifer is an initial condition in the predictive model run.

**TABLE 12. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Glasscock | F | Colorado | 7,925 | 7,673 | 7,372 | 7,058 | 6,803 | 6,570 |
| | | **Total** | **7,925** | **7,673** | **7,372** | **7,058** | **6,803** | **6,570** |
| **GMA 7** | | | **7,925** | **7,673** | **7,372** | **7,058** | **6,803** | **6,570** |

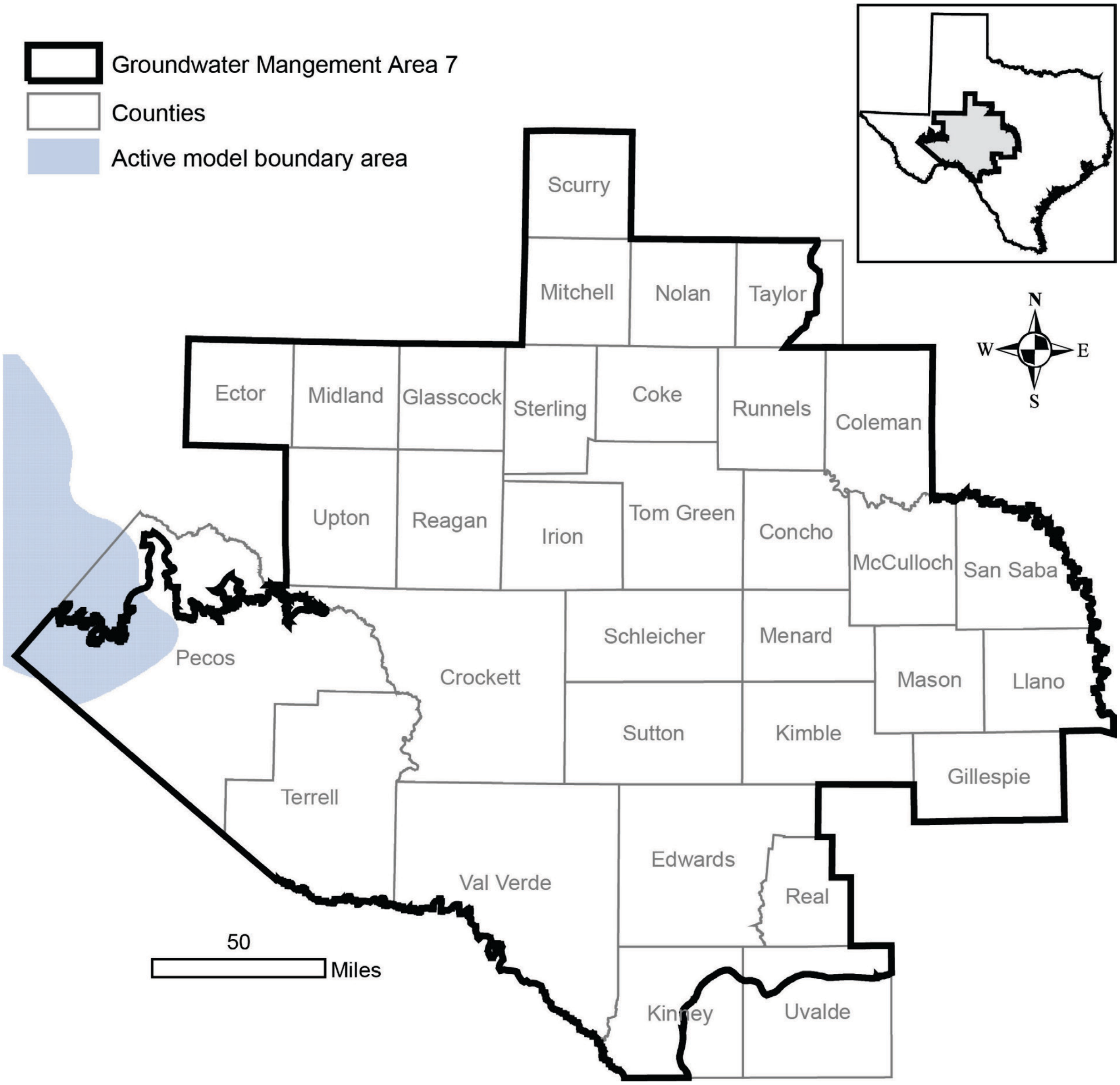


**FIGURE 12. MAP SHOWING AREAS COVERED BY THE RUSTLER AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

**TABLE 13. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2009 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| District | County | Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Middle Pecos GCD | Pecos | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 |
| | **Total** | **7,040** | **7,040** | **7,040** | **7,040** | **7,040** | **7,040** | **7,040** | **7,040** |

**TABLE 14. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

| County | RWPA | River Basin | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| Pecos | F | Rio Grande | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 | 7,040 |
| | | **Rio Grande** | **7,040** | **7,040** | **7,040** | **7,040** | **7,040** | **7,040** |

## LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historical groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historical pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and streamflow are specific to a particular historical time period.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and groundwater levels in the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

### Model "Dry" Cells

The predictive model run for this analysis results in water levels in some model cells dropping below the base elevation of the cell during the simulation. In terms of water level, the cells have gone dry. However, as noted in the model assumptions the transmissivity of the cell remains constant and will produce water.

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# APPENDIX B

# Estimated Historical Water Use And 2017 State Water Plan Datasets:

## Plateau Underground Water Conservation And Supply District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
November 27, 2018

## *GROUNDWATER MANAGEMENT PLAN DATA:*

This package of water data reports (part 1 of a 2-part package of information) is being provided to groundwater conservation districts to help them meet the requirements for approval of their five-year groundwater management plan. Each report in the package addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan checklist. The checklist can be viewed and downloaded from this web address:

*http://www.twdb.texas.gov/groundwater/docs/GCD/GMPChecklist0113.pdf*

The five reports included in this part are:

1. Estimated Historical Water Use (checklist item 2)

   *from the TWDB Historical Water Use Survey (WUS)*

2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   *from the 2017 Texas State Water Plan (SWP)*

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

## *DISCLAIMER:*

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 11/27/2018. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

*http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/*

The 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317).

# Estimated Historical Water Use
# TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2017. TWDB staff anticipates the calculation and posting of these estimates at a later date.

## SCHLEICHER COUNTY

All values are in acre-feet

| Year | Source | Municipal | Manufacturing | Mining | Steam Electric | Irrigation | Livestock | Total |
|---|---|---|---|---|---|---|---|---|
| 2016 | GW | 467 | 0 | 7 | 0 | 2,209 | 302 | 2,985 |
| | SW | 0 | 0 | 2 | 0 | 0 | 16 | 18 |
| 2015 | GW | 491 | 0 | 40 | 0 | 1,751 | 301 | 2,583 |
| | SW | 0 | 0 | 10 | 0 | 0 | 16 | 26 |
| 2014 | GW | 731 | 0 | 91 | 0 | 1,924 | 343 | 3,089 |
| | SW | 0 | 0 | 23 | 0 | 0 | 18 | 41 |
| 2013 | GW | 626 | 0 | 171 | 0 | 1,729 | 304 | 2,830 |
| | SW | 0 | 0 | 42 | 0 | 0 | 16 | 58 |
| 2012 | GW | 652 | 0 | 105 | 0 | 2,020 | 364 | 3,141 |
| | SW | 0 | 0 | 0 | 0 | 0 | 19 | 19 |
| 2011 | GW | 807 | 0 | 160 | 0 | 1,941 | 415 | 3,323 |
| | SW | 0 | 0 | 27 | 0 | 0 | 21 | 48 |
| 2010 | GW | 617 | 0 | 72 | 0 | 1,442 | 421 | 2,552 |
| | SW | 0 | 0 | 12 | 0 | 0 | 23 | 35 |
| 2009 | GW | 614 | 0 | 58 | 0 | 1,432 | 463 | 2,567 |
| | SW | 0 | 0 | 9 | 0 | 0 | 24 | 33 |
| 2008 | GW | 611 | 0 | 44 | 0 | 1,095 | 467 | 2,217 |
| | SW | 0 | 0 | 7 | 0 | 0 | 24 | 31 |
| 2007 | GW | 484 | 0 | 17 | 0 | 500 | 508 | 1,509 |
| | SW | 0 | 0 | 0 | 0 | 0 | 27 | 27 |
| 2006 | GW | 481 | 0 | 18 | 0 | 1,005 | 506 | 2,010 |
| | SW | 0 | 0 | 0 | 0 | 0 | 27 | 27 |
| 2005 | GW | 473 | 0 | 18 | 0 | 762 | 477 | 1,730 |
| | SW | 0 | 0 | 0 | 0 | 0 | 25 | 25 |
| 2004 | GW | 485 | 0 | 18 | 0 | 734 | 247 | 1,484 |
| | SW | 0 | 0 | 0 | 0 | 0 | 253 | 253 |
| 2003 | GW | 461 | 0 | 18 | 0 | 964 | 222 | 1,665 |
| | SW | 0 | 0 | 0 | 0 | 0 | 228 | 228 |
| 2002 | GW | 591 | 0 | 17 | 0 | 1,300 | 243 | 2,151 |
| | SW | 0 | 0 | 0 | 0 | 0 | 249 | 249 |
| 2001 | GW | 552 | 0 | 18 | 0 | 1,294 | 273 | 2,137 |
| | SW | 0 | 0 | 0 | 0 | 0 | 279 | 279 |

# Projected Surface Water Supplies
# TWDB 2017 State Water Plan Data

## SCHLEICHER COUNTY

All values are in acre-feet

| RWPG | WUG | WUG Basin | Source Name | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|---|
| F | LIVESTOCK, SCHLEICHER | COLORADO | COLORADO LIVESTOCK LOCAL SUPPLY | 83 | 83 | 83 | 83 | 83 | 83 |
| F | LIVESTOCK, SCHLEICHER | RIO GRANDE | RIO GRANDE LIVESTOCK LOCAL SUPPLY | 29 | 29 | 29 | 29 | 29 | 29 |
| | **Sum of Projected Surface Water Supplies (acre-feet)** | | | **112** | **112** | **112** | **112** | **112** | **112** |

# Projected Water Demands
# TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

## SCHLEICHER COUNTY

All values are in acre-feet

| RWPG | WUG | WUG Basin | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|
| F | COUNTY-OTHER, SCHLEICHER | COLORADO | 238 | 272 | 288 | 297 | 304 | 309 |
| F | COUNTY-OTHER, SCHLEICHER | RIO GRANDE | 31 | 32 | 33 | 34 | 34 | 34 |
| F | ELDORADO | COLORADO | 614 | 605 | 597 | 594 | 593 | 593 |
| F | IRRIGATION, SCHLEICHER | COLORADO | 904 | 885 | 867 | 848 | 830 | 812 |
| F | IRRIGATION, SCHLEICHER | RIO GRANDE | 510 | 500 | 489 | 479 | 468 | 458 |
| F | LIVESTOCK, SCHLEICHER | COLORADO | 403 | 403 | 403 | 403 | 403 | 403 |
| F | LIVESTOCK, SCHLEICHER | RIO GRANDE | 132 | 132 | 132 | 132 | 132 | 132 |
| F | MINING, SCHLEICHER | COLORADO | 460 | 542 | 416 | 290 | 178 | 110 |
| F | MINING, SCHLEICHER | RIO GRANDE | 161 | 190 | 146 | 102 | 63 | 38 |
| | | **Sum of Projected Water Demands (acre-feet)** | **3,453** | **3,561** | **3,371** | **3,179** | **3,005** | **2,889** |

# Projected Water Supply Needs
# TWDB 2017 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

## SCHLEICHER COUNTY

All values are in acre-feet

| RWPG | WUG | WUG Basin | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|---|
| F | COUNTY-OTHER, SCHLEICHER | COLORADO | 14 | 19 | 22 | 24 | 25 | 25 |
| F | COUNTY-OTHER, SCHLEICHER | RIO GRANDE | 9 | 7 | 6 | 5 | 5 | 5 |
| F | ELDORADO | COLORADO | 0 | 0 | 0 | 0 | 0 | 0 |
| F | IRRIGATION, SCHLEICHER | COLORADO | 0 | 0 | 0 | 0 | 0 | 0 |
| F | IRRIGATION, SCHLEICHER | RIO GRANDE | 0 | 0 | 0 | 0 | 0 | 0 |
| F | LIVESTOCK, SCHLEICHER | COLORADO | 17 | 17 | 17 | 17 | 17 | 17 |
| F | LIVESTOCK, SCHLEICHER | RIO GRANDE | 0 | 0 | 0 | 0 | 0 | 0 |
| F | MINING, SCHLEICHER | COLORADO | 34 | 41 | 32 | 22 | 14 | 8 |
| F | MINING, SCHLEICHER | RIO GRANDE | 6 | 0 | 4 | 8 | 2 | 2 |
| | **Sum of Projected Water Supply Needs (acre-feet)** | | **0** | **0** | **0** | **0** | **0** | **0** |

# Projected Water Management Strategies
# TWDB 2017 State Water Plan Data

## SCHLEICHER COUNTY

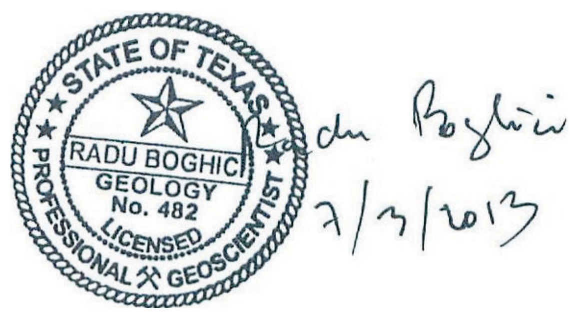
**WUG, Basin (RWPG)** — All values are in acre-feet

| Water Management Strategy | Source Name [Origin] | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **ELDORADO, COLORADO (F )** | | | | | | | |
| MUNICIPAL CONSERVATION - EL DORADO | DEMAND REDUCTION [SCHLEICHER] | 11 | 11 | 11 | 11 | 11 | 11 |
| WATER AUDITS AND LEAK - EL DORADO | DEMAND REDUCTION [SCHLEICHER] | 25 | 24 | 24 | 24 | 24 | 24 |
| | | **36** | **35** | **35** | **35** | **35** | **35** |
| **IRRIGATION, SCHLEICHER, COLORADO (F )** | | | | | | | |
| IRRIGATION CONSERVATION - SCHLEICHER COUNTY | DEMAND REDUCTION [SCHLEICHER] | 45 | 53 | 52 | 52 | 52 | 52 |
| WEATHER MODIFICATION | WEATHER MODIFICATION [ATMOSPHERE] | 65 | 65 | 65 | 65 | 65 | 65 |
| | | **110** | **118** | **117** | **117** | **117** | **117** |
| **IRRIGATION, SCHLEICHER, RIO GRANDE (F )** | | | | | | | |
| IRRIGATION CONSERVATION - SCHLEICHER COUNTY | DEMAND REDUCTION [SCHLEICHER] | 26 | 30 | 29 | 29 | 29 | 29 |
| WEATHER MODIFICATION | WEATHER MODIFICATION [ATMOSPHERE] | 37 | 37 | 37 | 37 | 37 | 37 |
| | | **63** | **67** | **66** | **66** | **66** | **66** |
| **MINING, SCHLEICHER, COLORADO (F )** | | | | | | | |
| MINING CONSERVATION - SCHLEICHER COUNTY | DEMAND REDUCTION [SCHLEICHER] | 32 | 38 | 29 | 20 | 13 | 7 |
| | | **32** | **38** | **29** | **20** | **13** | **7** |
| **MINING, SCHLEICHER, RIO GRANDE (F )** | | | | | | | |
| MINING CONSERVATION - SCHLEICHER COUNTY | DEMAND REDUCTION [SCHLEICHER] | 11 | 13 | 10 | 7 | 4 | 3 |
| | | **11** | **13** | **10** | **7** | **4** | **3** |
| **Sum of Projected Water Management Strategies (acre-feet)** | | **252** | **271** | **257** | **245** | **235** | **228** |

# APPENDIX C

# GAMRUN 13-009: PLATEAU UNDERGROUND WATER CONSERVATION AND SUPPLY DISTRICT MANAGEMENT PLAN

by Radu Boghici, P. G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-5808
July 3, 2013




*The seal appearing on this document was authorized by Radu Boghici, P.G. 482 on July 3, 2013.*

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# GAM RUN 13-009: PLATEAU UNDERGROUND WATER CONSERVATION AND SUPPLY DISTRICT MANAGEMENT PLAN

by Radu Boghici, P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-5808
July 3, 2013

## *EXECUTIVE SUMMARY:*

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the executive administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

This report (Part 2 of a two-part package of information from the TWDB to Plateau Underground Water Conservation and Supply District) fulfills the requirements noted above. Part 1 of the 2-part package is the Historical Water Use/State Water Plan data report. The District will receive this data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, Stephen.Allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for the Plateau Underground Water Conservation and Supply District should be adopted by the district on or before January 24, 2014 and submitted to the executive administrator of the TWDB on or before February 23, 2014. The current management plan for the Plateau Underground Water Conservation and Supply District expires on April 24, 2014.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model (version 1.01) for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Anaya and Jones, 2009), and the groundwater availability model (version 1.01) for the Lipan Aquifer (Beach and others, 2004). Tables 1 and 2 summarize the groundwater availability model data required by the statute for each aquifer, and Figures 1 and 2 show the areas of the models from which the values in the tables were extracted. This model run replaces the results of GAM Run 08-051. GAM Run 13-009 meets current standards set after the release of GAM Run 08-051 including a refinement of using the extent of the official aquifers boundaries within the district. The water budget values listed in the two model runs may differ because of this change in methodology. If, after review of the figures, Plateau Underground Water Conservation and Supply District determines that the district boundaries used in the assessment do not reflect current conditions, the District should notify the Texas Water Development Board immediately. Per statute, TWDB is required to provide the districts with data from the official groundwater availability models; however, the TWDB has also approved, for planning purposes, an alternative model for the Edwards-Trinity (Plateau) Aquifer that can have water budget information extracted for the district. The alternative model is the 1-layer alternative model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Hutchison and others, 2011). Please contact the author of this report if a comparison table using this model is desired.

## *METHODS:*

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers and the groundwater availability model for the Lipan Aquifer were run for this analysis. Plateau Underground Water Conservation and Supply District Water budgets for the historical model periods were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009) The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district are summarized in this report.

## *PARAMETERS AND ASSUMPTIONS:*

### *Edwards-Trinity (Plateau) Aquifer*

- ☐ We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. See Anaya and Jones (2009) for assumptions and limitations of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. The Pecos Valley Aquifer does not occur within the boundaries of the Plateau Underground Water and Supply District, and therefore no groundwater budget values are included for it in this report.

- ☐ This groundwater availability model includes two layers within the boundaries of the Plateau Underground Water and Supply District, which generally represent the Edwards Group (Layer 1) and the Trinity Group (Layer 2) of the Edwards-Trinity (Plateau) Aquifer. Individual water budgets for the District were determined for the Edwards-Trinity (Plateau) Aquifer (Layer 1 and Layer 2 combined).

- ☐ For Plateau Underground Water and Supply District, groundwater in the Edwards-Trinity (Plateau) Aquifer ranges from fresh to saline, with total dissolved solids of less than 1,000 milligrams per liter in nearly 99 percent of the wells in the TWDB groundwater database. (TWDB Groundwater Database, queried June 2013).

- ☐ The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

### *Lipan Aquifer*

- ☐ We used version 1.01 of the groundwater availability model for the Lipan Aquifer for this analysis. See Beach and others (2004) for assumptions and limitations of the model.

- ☐ The Lipan Aquifer model includes one layer representing the Quaternary Leona Formation, portions of the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north.

- ☐ There are no groundwater quality data in the TWDB groundwater database for Plateau Underground Water and Supply District. Twenty miles north of the district, in Tom Green County, groundwater in the Lipan Aquifer is brackish, with total dissolved solids ranging from 1,200 to 2,900 milligrams per liter. (TWDB Groundwater Database, queried June 2013).

- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

## *RESULTS:*

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model runs in the district, as shown in Table 1.

- Precipitation recharge—The areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
- Surface water outflow—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).
- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.
- Flow between aquifers—The net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer.

The information needed for the District’s management plan is summarized in Table 1. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

**TABLE 1: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR THE PLATEAU UNDERGROUND WATER CONSERVATION AND SUPPLY DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.**

| *Management Plan requirement* | *Aquifer or confining unit* | *Results* |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Edwards-Trinity (Plateau) Aquifer | 22,337 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers | Edwards-Trinity (Plateau) Aquifer | 8,317 |
| Estimated annual volume of flow into the district within each aquifer in the district | Edwards-Trinity (Plateau) Aquifer | 7,791 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Edwards-Trinity (Plateau) Aquifer | 28,701 |
| Estimated net annual volume of flow between each aquifer in the district | Edwards-Trinity (Plateau) Aquifer into/from adjacent formations | Not applicable |

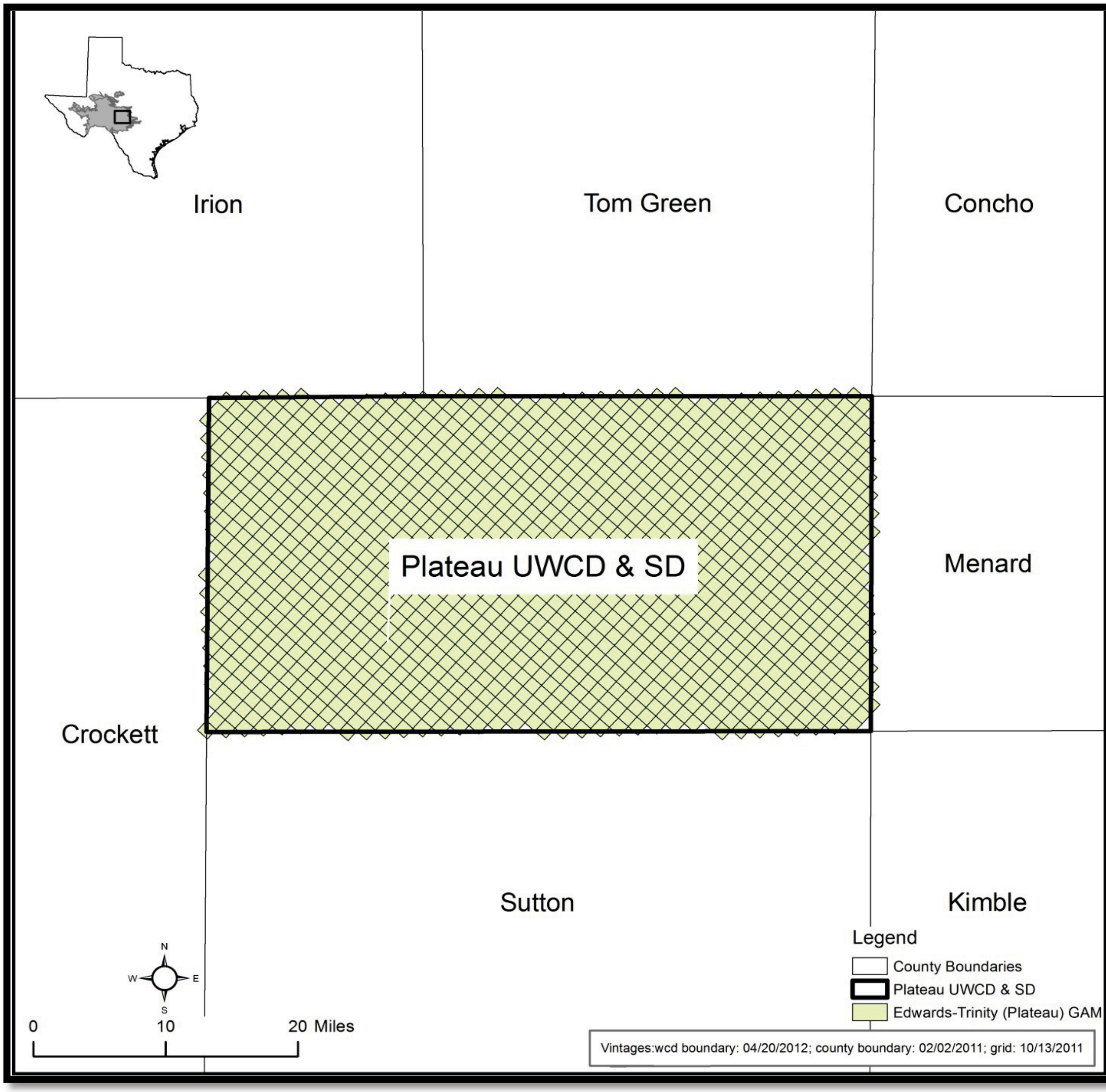


**FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED FORTHE EDWARDS-TRINITY (PLATEAU) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY.**

**TABLE 2: SUMMARIZED INFORMATION FOR THE LIPAN AQUIFER THAT IS NEEDED FOR THE PLATEAU UNDERGROUND WATER CONSERVATION AND SUPPLY DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.**

| *Management Plan requirement* | *Aquifer or confining unit* | *Results* |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | Lipan Aquifer | 397 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers | Lipan Aquifer | 0 |
| Estimated annual volume of flow into the district within each aquifer in the district | Lipan Aquifer | 18 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Lipan Aquifer | 413 |
| Estimated net annual volume of flow between each aquifer in the district | Lipan Aquifer into/from the underlying formations | Not Applicable |

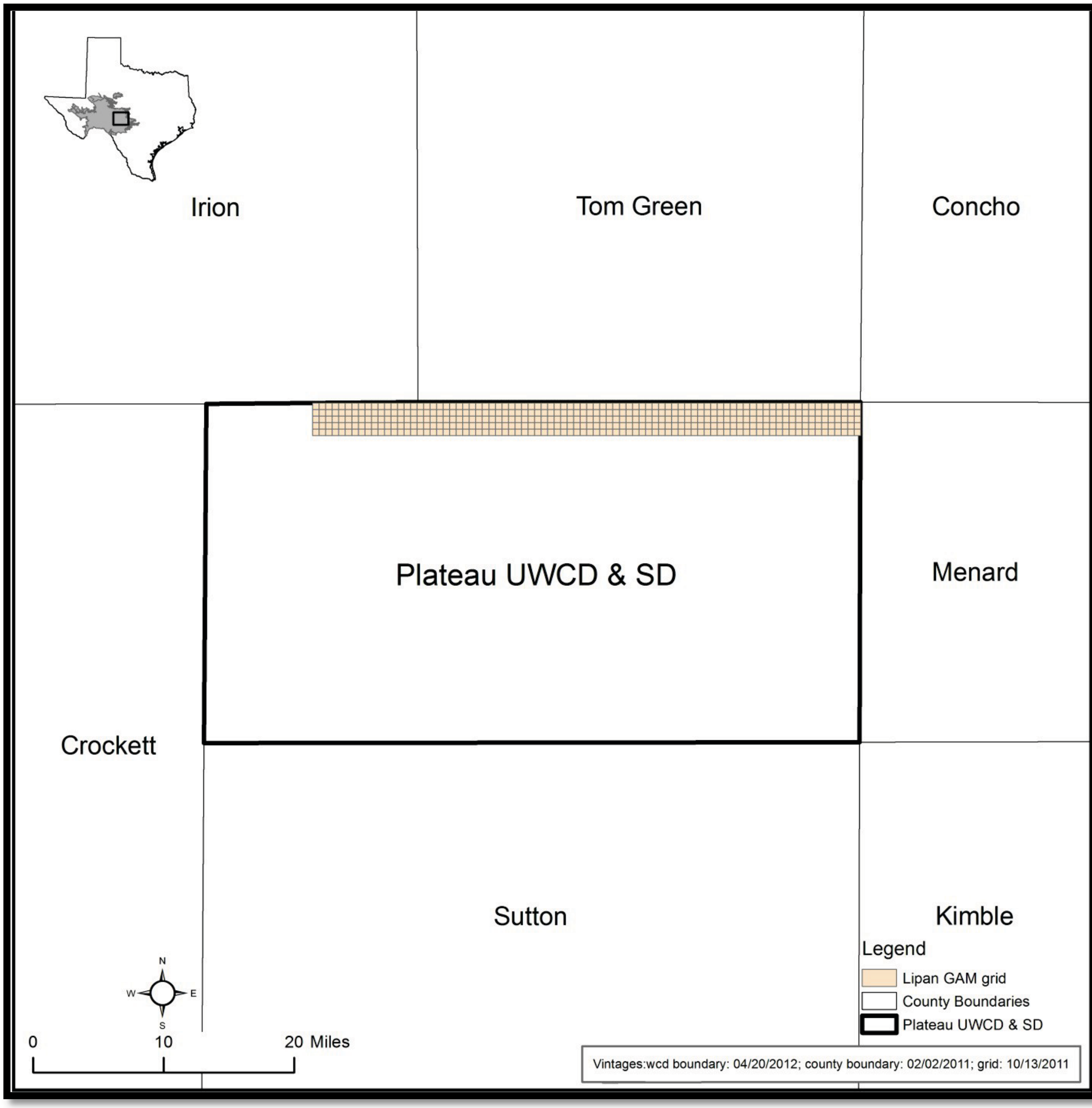


**FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE LIPAN AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED FORTHE EXTENT OF THE LIPAN AQUIFER WITHIN THE DISTRICT BOUNDARY.**

## *LIMITATIONS*

The groundwater model(s) used in completing this analysis is the best available scientific tool that can be used to meet the stated objective(s). To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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