COKE COUNTY
UNDERGROUND
WATER CONSERVATION
DISTRICT

Groundwater Management Plan

2024-2029

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COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT

DISTRICT MISSION

The overall objective of the Coke County Underground Water Conservation District (District) is to preserve the integrity of the groundwater in the aquifer over which the land in the District is located. This objective may be accomplished as the District provides for the conservation, preservation, protection, recharge. and prevention of waste of the groundwater reservoirs. This groundwater management plan will help provide guidance to accomplish the overall objective of the District. The plan is an open-ended document and can be revised or updated as needed to help meet the District goals and objectives.

PURPOSE OF MANAGEMENT PLAN

The 75th Texas Legislative in 1997 enacted Senate Bill 1 ("SB I") to establish a comprehensive statewide water planning process. SB I contained provisions that required groundwater conservation districts to prepare management plan to identify the water supply resources and water demands that will shape the decisions of each district. SB I designed the plans to include management goals for each district to manage and conserve the groundwater resources within their boundaries. In 200 I, the Texas Legislature enacted Senate Bill 2 ("SB2") to build on the planning requirements of SB I and to future clarify the actions necessary for districts to manage and conserve the groundwater resources of the state of Texas.

The Texas Legislative enacted significant changes to the management of groundwater resources in Texas with the passage of House Bill 1763 (HB 1763) in 2005. HB 1763 created a long-term planning process in which groundwater conservative districts (GCDs) in each Groundwater Management Area (GMA) are required to meet and determine the Desired Future Conditions (DFCs) for the groundwater resources within their boundaries by September J, 2010. In addition, HB 1763 required GCDs. to share management plans with the other GCDs in the GMA for review by the other GCDs.

The Coke County Underground Water Conservation District's groundwater management plan satisfies the statutory requirements of Chapter 36 of the Texas Water Code, and the administrative requirements of the Texas Water Development Board's (TWDB) rules.

REGIONAL COOPERATION AND COORDINATION

The District is a member of the West Texas Regional Groundwater Alliance (WTRGA). This WTRGA consists of eighteen (18) locally created and locally funded districts that encompass

approximately eighteen (18.2) million acres or twenty-eight thousand three hundred sixty-eight (28,368) square miles of West Texas.

In May of 1988 four (4) groundwater districts; Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD adopted the original Cooperative Agreement.

As new districts were created. they too adopted the Cooperative Agreement. In the fall of 1996, the original Cooperative Agreement was redrafted, and the West Texas Regional Groundwater Alliance was created. The current member districts are:

Coke County (1988)	Crockett County GCD (1992)
Glasscock County GCD (1988)	Hickory UWCD No 1(1997)
Hill Country UWCD (2005)	Irion County WCD (1988)
Kimble County GCD (2004)	Lipan-Kickapoo GCD (1989)
Lone Wolf GCD (2002)	Menard County UWD (2000)
Middle Pecos GCD (2005)	Permian Basin UWCD (2006)
Plateau UWCSD (1991)	Santa Rita UWCD (1990)
Sterling County UWCD (1988)	Sutton County UWCD (1991)
Wes-Tex GCD (2005)	

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 the 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 the activities of these member districts as they monitor these activities to accomplish their objectives.

TIME PERIOD FOR THIS PLAN

This amended plan becomes effective upon adoption by the Board of Directors and reapproved by the Texas Water Development Board executive. The plan remains in effect for five years with the required review and re-adoption, with or without revisions, every five years.

STATEMENT OF GUIDING PRINCIPLE

The District recognizes that the groundwater resources of the region are of vital importance. The preservation of this most valuable resource can be managed in a prudent and cost-effective manner through regulation and permitting. The greatest threat to prevent the District from achieving the stated mission *is* inappropriate management. based in part on a lack of understanding of local conditions. A basic

understanding of the aquifers and their hydrogeologic properties, as well as a quantification of resources is the foundation from which to build prudent planning measures. This management document is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of District activities.

GENERAL DESCRIPTION

The Coke County Underground Water District was created by Acts of 69th Legislature (1985). p. 6960. Ch. 950. H.B. 2418 under authority y of Articles XVI, Section 59 of the Constitution of Texas.

The residents confirmed the District and voted to fund the District operations through local property taxes. It became an active district on April 5. 1986.

On April 5. 1986. the District adopted rules and by-laws which became effective immediately and on this date the District adopted a management plan. With the adoption of these rules, the District implemented a well permitting and registration program. The current members of the Board of Directors are: President Wes Washam, Vice-President Mike Arrott, Secretary Jimmie Byrne and members Mike Pinard, Tim Smith. The District General Manager is Jnae Walls.

The Coke County UWCD covers all of Coke County. Recreational areas include golf, hunting and fishing.

LOCATION AND EXTENT

The District has an area extent of 911 square miles located approximately 32 miles north of San Angelo and 65 miles southwest of Abilene. The population of the District was about 3,285 in 2020. Two incorporated cities lie within the boundaries of the District: Robert Lee, the county seat and Bronte.

The economy of Coke County is based on ranching. Farming, oil and gas production. The annual income from agriculture is derived from: cattle. sheep and goats' sales. The water used in Coke County comes from both groundwater and surface water sources. The District has one small lake: Mountain Creek and two major reservoirs in the county impounding surface water runoff. The largest reservoir is E.V. Spence Reservoir which is formed on the Colorado River near Robert Lee. Oak Creek Reservoir is in the northeast corner of the county and furnishes water to the towns of Sweetwater, Bronte, Robert Lee and Blackwell. Bronte's water well field supplements Oak Creek water. Water for livestock needs is furnished by either small surface water catchment tanks or by wells.

TOPOGRAPHY AND DRAINAGE

The southwestern part of Coke County is in the Edwards Plateau section of the Great Plains physiographical province; the northwestern part of the county is in the Central Texas section which includes the Callahan Divide. The county is bisected diagonally by the southeastward flowing Colorado River. Altitudes range from about 1,700 feet above mean sea level in the river valley to more than 2.600 feet on the Edwards Plateau.

Except for the rugged and dissected escarpment, the Edwards Plateau is relatively flat. The soils are mostly thin, dark-colored, calcareous loams. The Central Texas sect

ion is characterized by a rolling topography and deep red-brown loam soils. Much of the area, however. is capped with caliche.

Surface drainage on the plateau is mostly internal but during periods of heavy rainfall some intermittent low-gradient streams flow southward to the North Concho River. Intermittent streams in canyons along the escarpment flow to the Colorado River. The Central Texas section is drained by the Colorado River and its intermittent tributaries, many of which enter Robert Lee Reservoir.

GROUNDWATER RESOURCES OF THE COKE COUNTY UWCD

The oldest geologic units cropping out in the county are the westward-dipping Permian "red beds". These rocks are composed mainly of shale and fine-grained sandstone and scattered beds, lenses and stringers of gypsum, anhydrite and dolomite. In the western and southern plateau areas, the Permian rocks are overlain by eastward-dipping sand, clay and limestone of Cretaceous age. Alluvial deposits of Quaternary age occur in the Valleys of the Colorado River and its tributaries.

Water in the alluvium and in the Cretaceous rocks (Fredericksburg and Trinity Groups) occurs under water table conditions. Water in the Permian rocks (Clear Fork, Pease River and Artesian Groups and Ochoa Series) occurs under both water tables and artesian conditions. The water producing zones in the geological units are (1) sand and gravel in the alluvium. (2) fine sands or fractures and solution openings in limestone beds of the Fredericksburg and Trinity Groups and

(3) sand, gypsum and dolomite strings or lenses in the Permian rocks.

The Edwards-Trinity (Plateau) Aquifer enters Coke County on the West and progresses to the southeast. Wells in the southeast corner of the county produce

large volumes of water. The northeast part of the county lies over the Trinity Aquifer.

Chemical quality of the Edwards-Trinity (Plateau) groundwater ranges from fresh to slightly saline. The water is typically hard and may vary widely in concentrations of dissolved solids made up mostly of calcium and bicarbonate. The principal sources of recharge to the aquifers of Coke County are (1) direct precipitation on the outcrops: (2) infiltration of water from surface reservoirs, rivers, and numerous intermittent streams: and (3) subsurface inflow from adjoining counties.

DESIRED FUTURE CONDITIONS

On August 19, 2021 upon completion of the second cycle of joint planning among districts in Groundwater Management Area 7 mandated by section 36.108 of the Texas Water Code. GMA 7 adopted the following Desired Future Conditions for aquifers of the Coke County Underground

Water District as an average drawdown of 0 feet.

Groundwater Management Area (GMA) 7
Modeled Available Groundwater for Relevant Aquifers by Groundwater Conservation District (GCD)
2021 Joint Planning

Coke County UWCD								
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)					
			2020	2030	2040	2050	2060	2070
Coke County UWCD	Edwards-Trinity (Plateau), Pecos Valley, and Trinity	Coke	997	997	997	997	997	997

REQUIRED DISTRICT SPECIFIC INFORMATION

Modeled Available Groundwater in the District

The modeled available groundwater report (GAM Run 21-012 MAG) is provided in Appendix C.

Amount of Groundwater Being Used Within the District

The estimated historical groundwater use from the TWDB Historical Water Use Survey is provided in Appendix A.

Projected Surface Water Supply within the District

There are 3 surface water lakes in Coke County UWCD. Lake Spence, Mountain Creek Lake located at Robert Lee and Oak Creek Lake located near Blackwell. The projected surface water supply within the District can be found in Appendix A.

Projected Total Demand for Water within the District

The projected total demand for water within the district is provided in Appendix A.

Current sources of supply are shown to be adequate to meet demands for all users throughout the planning horizon, except for irrigation and mining.

Water Supply Needs within the District

Within Coke County UWCD there are projected water supply needs identified in the 2022 State Water Plan. Needs are identified for the cities of Bronte and Robert Lee. Details on these projected water supply needs are listed in Appendix A.

Water Management Strategies within the District

Water management strategies identified in the 2017 State Water Plan that impact Coke County UWCD are development of groundwater supplies from the Edwards-Trinity (Plateau) Aquifer for mining and the City of Bronte. Details on the water management strategies are listed in Appendix.

Estimates of aquifer recharge, discharge, and flows

The required estimates from GAM Run 23-021 of annual amount of recharge from precipitation, discharge from the aquifer to springs and any surface water bodies. and annual flow into the district. out of the district, and between aquifers are included in Appendix B.

GOALS, MANAGEMENT OBJECTIVES AND PERFORMANCE STANDARDS

Goal 1.0 Providing the most efficient use of groundwater

Management Objective

Each year the District will locate at least one or more water wells for map location, check water levels and chemical analysis.

Performance Standards

~~1.1a A~~nnual report to the Board of Directors will include: the number of wells located, number of wells measured for water levels and the number of wells sampled for chemical analysis.

Goal 2.0 **Controlling and preventing waste of groundwater**

Management Objective

Annually investigate every wasteful practice reported by the public or identified by District personnel within the District.

Performance Standards

Annual report to Board of Directors will include the number of wasteful practices identified and a summary of action taken to resolve the waste of groundwater in each identified case.

Goal 3.0 Addressing conjunctive surface water management issues

Management Objective

Monitor rainfall events on the watersheds within the District that will impact surface water runoff and groundwater recharge.

Performance Standards

District will maintain files on rainfall events to monitor surface water runoff and underground recharge within the District through a voluntary rainfall network. These rainfall totals will be reported annually to the Board.

Goal 4.0 Addressing natural resource issues that impact the use and availability of groundwater and which are impacted by the use of groundwater

Management Objective

To measure, record and accumulate a historic record of static water levels in monitor network wells on a periodic basis.

Performance Standards

The District will establish a water level monitoring network and annually measure at least five wells in the network. The number of wells in the monitor network will be reported to the board annually.

Goal 5.0 Addressing drought conditions

Management Objective

District will monitor the Palmer Drought Severity Index (PDSI) by Texas Climate Divisions. If PDSI indicates that the District will experience severe drought conditions, the District will provide information concerning the drought index upon request.

Performance Standard

The District staff will monitor the PDSI and report to the District Board of Directors annually the number of times information about the PDSI was requested.

Goal 6.0 Conservation, Recharge E11ha11ceme11t, Rainwater-Harvesting, Precipitation Enhancement and Brush Control where appropriate and cost effective

Management Objective

Each year the District will provide and distribute literature on water conservation to promote conservation and efficient use of water.

Performance Standard

Annual report to Board of Directors on the number of times literature on water conservation was provided to the public.

Management Objective: Recharge Enhancement

District staff will provide information, upon request, to area residents about recharge enhancement.

Performance Standard

An annual report to the Board of Directors on the number of times information on the recharge enhancement was provided to the area residents.

Management Objective: Rainwater Harvesting

Provide information to area residents about rainwater harvesting.

Performance Standard

An annual report to the Board of Directors on the number of times information on rainwater harvesting was provided to area residents.

Management Objective: Precipitation Enhancement

Provide information to area residents about precipitation enhancement.

Performance Standard

An annual report to the Board of Directors on the number of times information on precipitation enhancement was provided to area residents.

<u>Management Objective Brush Control</u>

Provide information to area residents about brush control.

<u>Performance Standard</u>

An annual report to the Board of Directors on the number of times information on brush control was provided to the area residents.

Goal 7.0 Addressing the Desired Future Conditions Adopted by the District

<u>Management Objective</u>

Each year the District will measure the water levels in at least five monitoring and determine the five year water level averages based on the measures taken. The district will compare the five year water level averages to the corresponding five year increments of its desired future conditions in order to track its progress in achieving the desired future conditions.

<u>Performance Standard</u>

The districts' annual report will include the water level measurements taken each year to address the districts progress towards achieving its desired future conditions. Once the district has obtained water level measurements for five consecutive years and is able to calculate water level averages over five year periods, the district will include a discussion of its comparison of water level averages to the corresponding five year increment of its desired future conditions in order to track its progress in achieving the desired future conditions.

Management Goal Determined Not-Applicable

Goal - Controlling and preventing subsidence

There is no history of subsidence of aquifer formations within the district upon water level depletion and available scientific information is that the formations are of sufficient rigidity that subsidence will not occur.

SUMMARY DEFINITIONS.

"Abandoned Well" - shall mean:

1) a well or borehole the condition of which is causing or is likely Lo cause pollution of groundwater in the District. A well is considered to be in use in the following cases:

(A) a well which contains the casing. pump and pump column in good
condition: or

(B) a well in good condition which has been capped.

2) a well or borehole which is not in compliance with applicable law, including the Rules and Regulations of the District. the Texas Water well Drillers' Act, Texas Natural Resource Conservation Commission, or any other state or federal agency or political subdivision having jurisdiction, if presumed to be an abandoned or deteriorated well.

"Board" - the Board of Directors of the Coke County Underground Water Conservation District

"District" - the Coke County Underground Water Conservation District "TCEQ" - Texas Commission on Environmental Quality.
"TWDB" - Texas Water Development Board

"Waste" as defined by Chapter 36 of the Texas Water Code means any one or more of the following:
withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that caused or threatens to cause intrusion into the reservoir of water unsuitable for agricultural. gardening. domestic or stock raising purposes;

(2) the flowing or producing of wells from a groundwater reservoir if the water produced
is not used for a beneficial purpose;

(3) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that does not contain groundwater:

(4) pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(5) willfully or negligently causing. suffering, or allowing groundwater to escape into any river. natural watercourse, depression, lake. reservoir. drain, sewer, street, highway, road or creek, ditch. or onto any land other than that of the owner of the well unless such discharge is authorized by permit, rule or order issued by the commission under Chapter 26:

(6) groundwater pumped for irrigation that escapes as irrigation tail water onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge; or

(7) for water produced from an artesian well," waste" has the meaning assigned by Section 11.205.

"Well"- means an artificial excavation that is dug or drilled for the purpose of producing groundwater.

Appendix A

TWDB Estimated Historical Groundwater Use and 2022 State Water Plan Datasets

Coke County Underground Water Conservation District

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Department
stephen.allen@twdb.texas.gov
(512) 463-7317
October 17, 2024

GROUNDWATER MANAGEMENT PLAN DATA

This set of water data tables (part one of a two-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 table addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan review checklist. The checklist can be found at this web address:

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

The five tables included in part one of this data package are:

TWDB Historical Water Use Survey (WUS)

- Estimated Historical Water Use (checklist item 2)

State Water Plan (SWP)

- Projected Surface Water Supplies (checklist item 6),
- Projected Water Demands (checklist item 7),
- Projected Water Supply Needs (checklist item 8),
- Projected Water Management Strategies (checklist item 9)

Part two of the two-part package is the groundwater availability model (GAM) run report for the district (checklist items 3 through 5). The district should have received, or will receive, this report from the TWDB Groundwater Modeling Department. Questions about the GAM can be directed to Grayson Dowlearn, grayson.dowlearn@twdb.texas.gov, (512) 475-1552.

DISCLAIMER:

Data presented in these tables are the most up to date WUS and SWP data available as of 10/17/2024. Although it does not happen often, these data are subject to change pending the availability of more accurate WUS data or an amendment to the 2022 SWP. District personnel should review the data table values and correct any discrepancies to ensure approval of their groundwater management plan.

The WUS data can be verified at this web address:

https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/

The 2022 SWP data can be verified by contacting Sabrina Anderson, (sabrina.anderson@twdb.texas.gov or 512-936-0886).

The values presented in the data tables are county based. In cases where groundwater conservation districts cover only a portion of one or more counties the data values are modified with an apportioning multiplier to create new values that more accurately represent conditions within district boundaries. The multiplier used in the following formula is a land area ratio: (data value * (land area of district in county / land area of county)). For two of the four SWP tables (Projected Surface Water Supplies and Projected Water Demands) only the county-wide water user group (WUG) data values (county other, manufacturing, steam electric power, irrigation, mining, and livestock) are modified using the multiplier. WUG values for municipalities, water supply corporations, and utility districts are not apportioned; instead, their full values are retained when they are located within the district and eliminated when they are located outside (we offer districts the opportunity to review this determination).

The county values in two of the SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not apportioned because district-specific values are not required to be presented in the groundwater management plan. However, a district is required to "consider" the county values in these two tables by drafting a short summary of the needs and strategies values in the groundwater management plan.

In the WUS table every category of water use (including municipal) is apportioned. Staff determined that breaking down the annual municipal values into individual WUGs was too complex.

TWDB recognizes that the apportioning formula used is not ideal but it is the best available process with respect to time and staffing constraints. If a district believes it has data that are more accurate, they can add those data to the plan with an explanation of how the data were derived. Apportioning percentages that the TWDB used are listed above each applicable table.

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

COKE COUNTY *100% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2021	GW	182	0	3	0	750	213	1,148
	SW	404	0	60	0	0	60	524
2020	GW	180	0	3	0	984	220	1,387
	SW	386	0	47	0	0	62	495
2019	GW	101	0	3	0	647	219	970
	SW	332	0	37	0	0	62	431
2018	GW	109	0	6	0	553	219	887
	SW	424	0	16	0	0	62	502
2017	GW	117	0	9	0	572	212	910
	SW	389	0	6	0	0	60	455
2016	GW	92	0	31	0	511	193	827
	SW	396	0	8	0	0	54	458
2015	GW	81	0	0	0	429	191	701
	SW	234	0	1	0	0	54	289
2014	GW	91	0	10	0	580	167	848
	SW	175	0	0	0	0	47	222
2013	GW	255	0	54	0	567	168	1,044
	SW	166	0	11	0	0	48	225
2012	GW	170	0	1	0	522	267	960
	SW	373	0	45	0	0	75	493

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

COKE COUNTY *100% (multiplier)* All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	Bronte	Colorado	Oak Creek Lake/Reservoir	0	0	0	0	0	0
F	County-Other, Coke	Colorado	Oak Creek Lake/Reservoir	0	0	0	0	0	0
F	Irrigation, Coke	Colorado	Colorado Run-of-River	11	11	11	11	11	11
F	Livestock, Coke	Colorado	Colorado Livestock Local Supply	84	84	84	84	84	84
F	Robert Lee	Colorado	EV Spence Lake/Reservoir Non-System Portion	0	0	0	0	0	0
F	Robert Lee	Colorado	Oak Creek Lake/Reservoir	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**95**	**95**	**95**	**95**	**95**	**95**

Projected Water Demands
TWDB 2022 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.

COKE COUNTY *100% (multiplier)* All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	Bronte	Colorado	273	269	265	262	262	262
F	County-Other, Coke	Colorado	118	112	107	105	105	105
F	Irrigation, Coke	Colorado	689	689	689	689	689	689
F	Livestock, Coke	Colorado	306	306	306	306	306	306
F	Mining, Coke	Colorado	488	482	430	376	328	286
F	Robert Lee	Colorado	295	290	286	286	285	285
		Sum of Projected Water Demands (acre-feet)	**2,169**	**2,148**	**2,083**	**2,024**	**1,975**	**1,933**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

COKE COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	Bronte	Colorado	-212	-210	-209	-207	-207	-207
F	County-Other, Coke	Colorado	0	0	0	0	0	0
F	Irrigation, Coke	Colorado	0	0	0	0	0	0
F	Livestock, Coke	Colorado	0	0	0	0	0	0
F	Mining, Coke	Colorado	0	0	0	0	0	0
F	Robert Lee	Colorado	-237	-234	-231	-231	-230	-230
	Sum of Projected Water Supply Needs (acre-feet)		**-449**	**-444**	**-440**	**-438**	**-437**	**-437**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

COKE COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Bronte, Colorado (F)							
Develop Other Aquifer Supplies in Southwest Coke County - Bronte	Other Aquifer [Coke]	561	800	800	800	800	800
Municipal Conservation - Bronte	DEMAND REDUCTION [Coke]	3	3	3	3	3	3
Subordination - Oak Creek Reservoir	Oak Creek Lake/Reservoir [Reservoir]	0	210	209	207	207	207
		564	**1,013**	**1,012**	**1,010**	**1,010**	**1,010**
Irrigation, Coke, Colorado (F)							
Irrigation Conservation - Coke County	DEMAND REDUCTION [Coke]	34	69	83	83	83	83
		34	**69**	**83**	**83**	**83**	**83**
Mining, Coke, Colorado (F)							
Mining Conservation - Coke County	DEMAND REDUCTION [Coke]	20	20	18	16	14	12
		20	**20**	**18**	**16**	**14**	**12**
Robert Lee, Colorado (F)							
Develop Other Aquifer Supplies in Southwest Coke County - Bronte	Other Aquifer [Coke]	239	0	0	0	0	0
Municipal Conservation - Robert Lee	DEMAND REDUCTION [Coke]	3	3	3	3	3	3
Subordination - Oak Creek Reservoir	Oak Creek Lake/Reservoir [Reservoir]	0	238	239	239	239	239
		242	**241**	**242**	**242**	**242**	**242**
Sum of Projected Water Management Strategies (acre-feet)		**860**	**1,343**	**1,355**	**1,351**	**1,349**	**1,347**

Appendix B

GAM Run 23-021: Coke County Underground Water Conservation District Management Plan

Tim Cawthon, GIT and Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-5076
September 22, 2023

STATE OF TEXAS
R. GRAYSON DOWLEARN
GEOLOGY
No. 15293
LICENSED
PROFESSIONAL GEOSCIENTIST

9/22/2023

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GAM RUN 23-021: COKE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

Tim Cawthon, GIT and Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-5076
September 22, 2023

EXECUTIVE SUMMARY:

Texas Water Code § 36.1071(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.

The TWDB provides data and information to the Coke County Underground Water Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information, which includes:

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

The groundwater management plan for the Coke County Underground Water Conservation District should be adopted by the district on or before December 20, 2023 and submitted to the TWDB Executive Administrator on or before January 19, 2024. The current management plan for the Coke County Underground Water Conservation District expires on March 19, 2024.

This analysis used version 1.01 of the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015), version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009), and version 1.01 of the groundwater availability model for the Lipan Aquifer (Beach and others, 2004), to estimate the management plan information for the aquifers within the Coke County Underground Water Conservation District.

This report replaces the results of GAM Run 17-014 (Anaya, 2018). Values may differ from the previous report as a result of routine updates to the spatial grid files used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows. Tables 1, 2, and 3 summarize the groundwater availability model data required by statute. Figures 1, 3, and 5 show the areas of the respective models from which the values in Tables 1, 2, and 3 were extracted. Figures 2, 4, and 6 provide generalized diagrams of the groundwater flow components provided in Tables 1, 2, and 3. If, after review of the figures, the Coke County Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

The flow components presented in this report do not represent the full groundwater budget. If additional inflow and outflow information would be helpful for planning purposes, the district may submit a request in writing to the TWDB Groundwater Modeling Department for the full groundwater budget.

METHODS:

In accordance with Texas Water Code § 36.1071(h), the groundwater availability models mentioned above were used to estimate information for the Coke County Underground Water Conservation District management plan. Water budgets were extracted for the historical model periods for the Dockum Aquifer (1980 through 2012), Edwards-Trinity (Plateau) Aquifer (1981 through 2000), and Lipan Aquifer (1980 through 1998) 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, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Groundwater availability model for the High Plains Aquifer System

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System to analyze the Dockum Aquifer. See Deeds and others (2015) and Deeds and Jigmond (2015) for assumptions and limitations of the model.
- The groundwater availability model for the High Plains Aquifer System contains the following four layers:
    - Layer 1 represents the Ogallala and Pecos Valley aquifers
    - Layer 2 represents the Rita Blanca, Edwards-Trinity (High Plains), and Edwards-Trinity (Plateau) aquifers
    - Layer 3 represents the upper portion of the Dockum Aquifer and equivalent units
    - Layer 4 represents the lower portion of the Dockum Aquifer and equivalent units
- Water budget values for the district were determined for the Dockum Aquifer (Layers 3 and 4). Interaction between the Edwards-Trinity (Plateau) and Dockum aquifers was determined using water budget information for layers 2, 3, and 4.
- The MODFLOW-NWT River package was used to simulate rivers and general head boundaries within the district.
- Water budget terms were averaged for the historical calibration period 1980 through 2012 (stress periods 52 through 84).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

Groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers to analyze the Edwards-Trinity (Plateau) Aquifer. See Anaya and Jones (2009) for assumptions and limitations of the model. The Pecos Valley Aquifer does not occur within the Coke County Underground Water Conservation District and therefore no groundwater budget values are included for it in this report.
- Within Coke County Underground Water Conservation District only layer two of the groundwater availability model is active and generally represents the Edwards Group and the Trinity Group of the Edwards-Trinity (Plateau) Aquifer.
- Seeps and springs were simulated with the MODFLOW Drain package and streams were simulated with the MODFLOW Streamflow-Routing package.
- Water budget terms were averaged for the period 1981 through 2000 (stress periods 2 through 21).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Groundwater availability model for the Lipan Aquifer

- We used version 1.01 of the groundwater availability model for the Lipan Aquifer to analyze the Lipan Aquifer. See Beach and others (2004) for assumptions and limitations of the model.
- The groundwater availability model contains one layer with a constant thickness of 400 feet. The layer represents portions of the Quaternary Leona Formation, underlying Permian units, adjacent Permian units, and the Edwards-Trinity (Plateau) Aquifer.
- Water budgets terms were averaged for the period of 1980 through 1998 (stress periods 2 through 20). The last stress period representing the year 1999 was not included because of incorrect pumping values.
- The model does not cover the entire Lipan Aquifer (Figure 5). Consequently, please contact Mr. Stephen Allen with the TWDB at (512) 463-7317 or stephen.allen@twdb.texas.gov for additional information on the aquifer in areas not covered by the groundwater availability model in the Coke County Underground Water Conservation District.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving an aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the aquifers located within the Coke County Underground Water Conservation District and averaged over the historical calibration periods, as shown in Tables 1, 2, and 3.

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.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.
4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1, 2, and 3. Figures 1, 3, and 5 show the area of the model from which the values in Tables 1, 2, and 3 were extracted. Figures 2, 4, and 6 provide generalized diagrams of the groundwater flow components provided in Tables 1, 2, and 3. 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 Dockum Aquifer for the Coke County Underground Water Conservation District 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	Dockum Aquifer	133
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	295
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	79
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	35
Estimated net annual volume of flow between each aquifer in the district	To Dockum Aquifer from Dockum equivalent units	15
	To Dockum Aquifer from Edwards-Trinity (Plateau) Aquifer	63

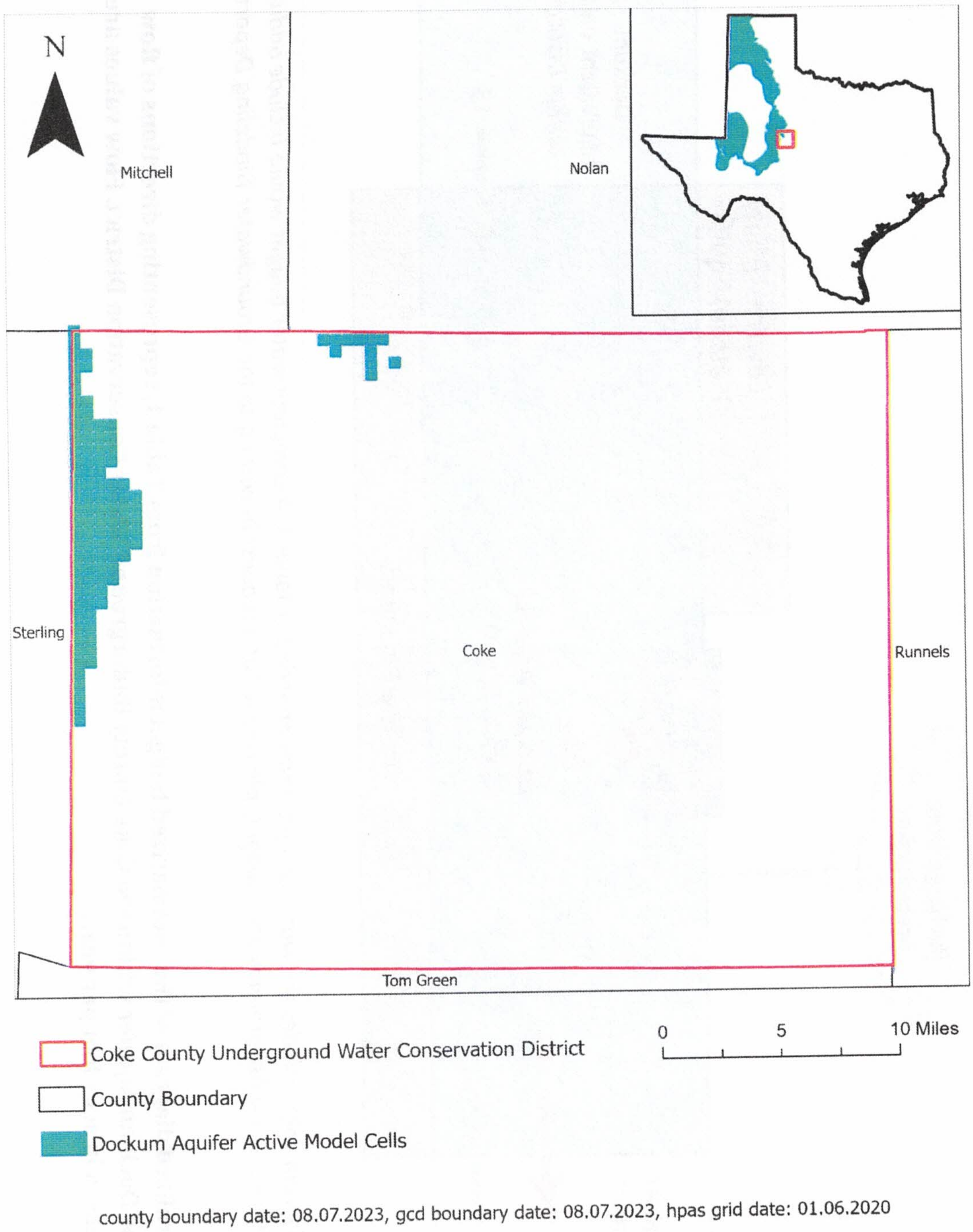
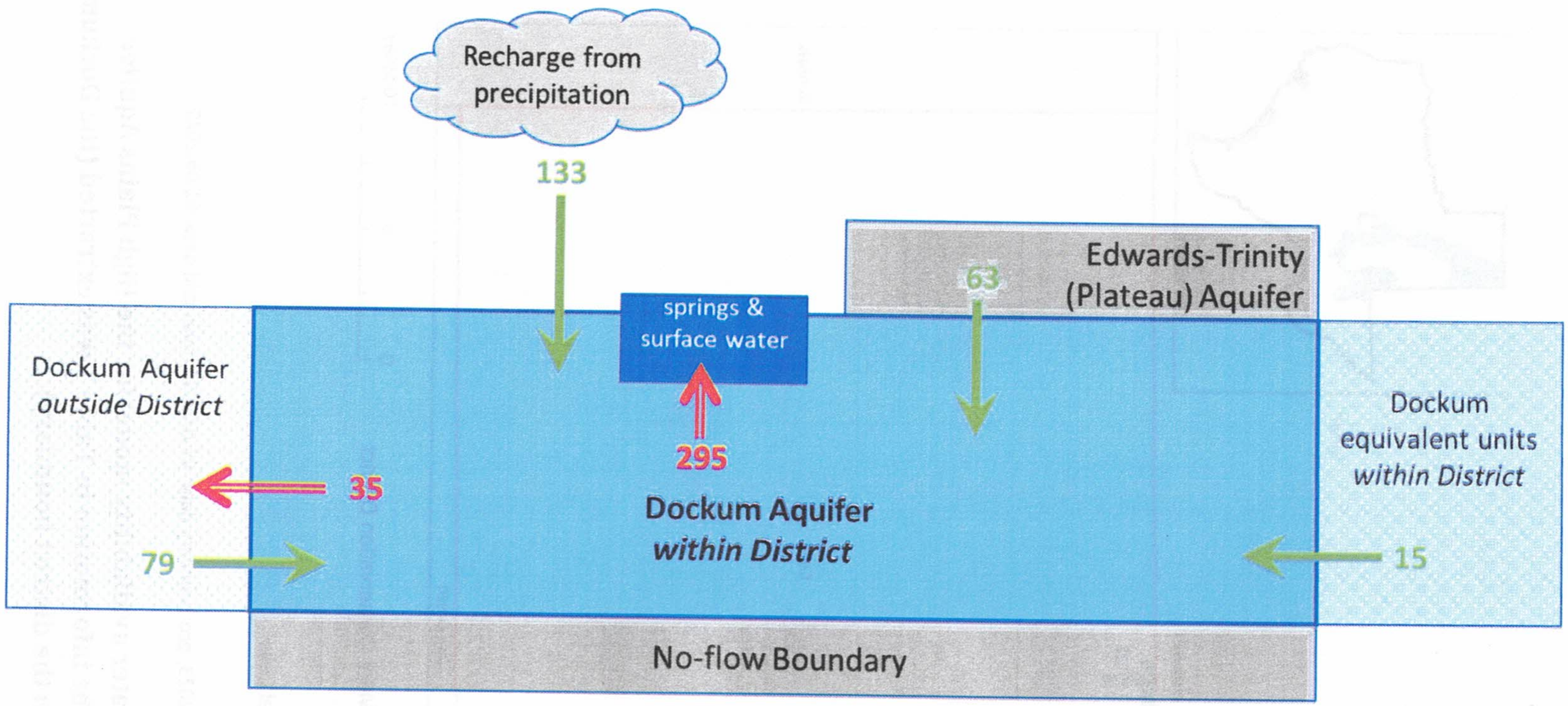


Figure 1: Area of the groundwater availability model for the High Plains Aquifer System from which the information in Table 1 was extracted (the Dockum Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 1. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 2: Generalized diagram of the summarized budget information from Table 1, representing directions of flow for the Dockum Aquifer within the Coke County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

Table 2: Summarized information for the Edwards-Trinity (Plateau) Aquifer for the Coke County Underground Water Conservation District 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	5,832
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	6,693
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	1,235
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	545
Estimated net annual volume of flow between each aquifer in the district	From Edwards-Trinity (Plateau) Aquifer to Dockum Aquifer	63*
*Flow from the Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer is provided by the High Plains Aquifer System groundwater availability model.		

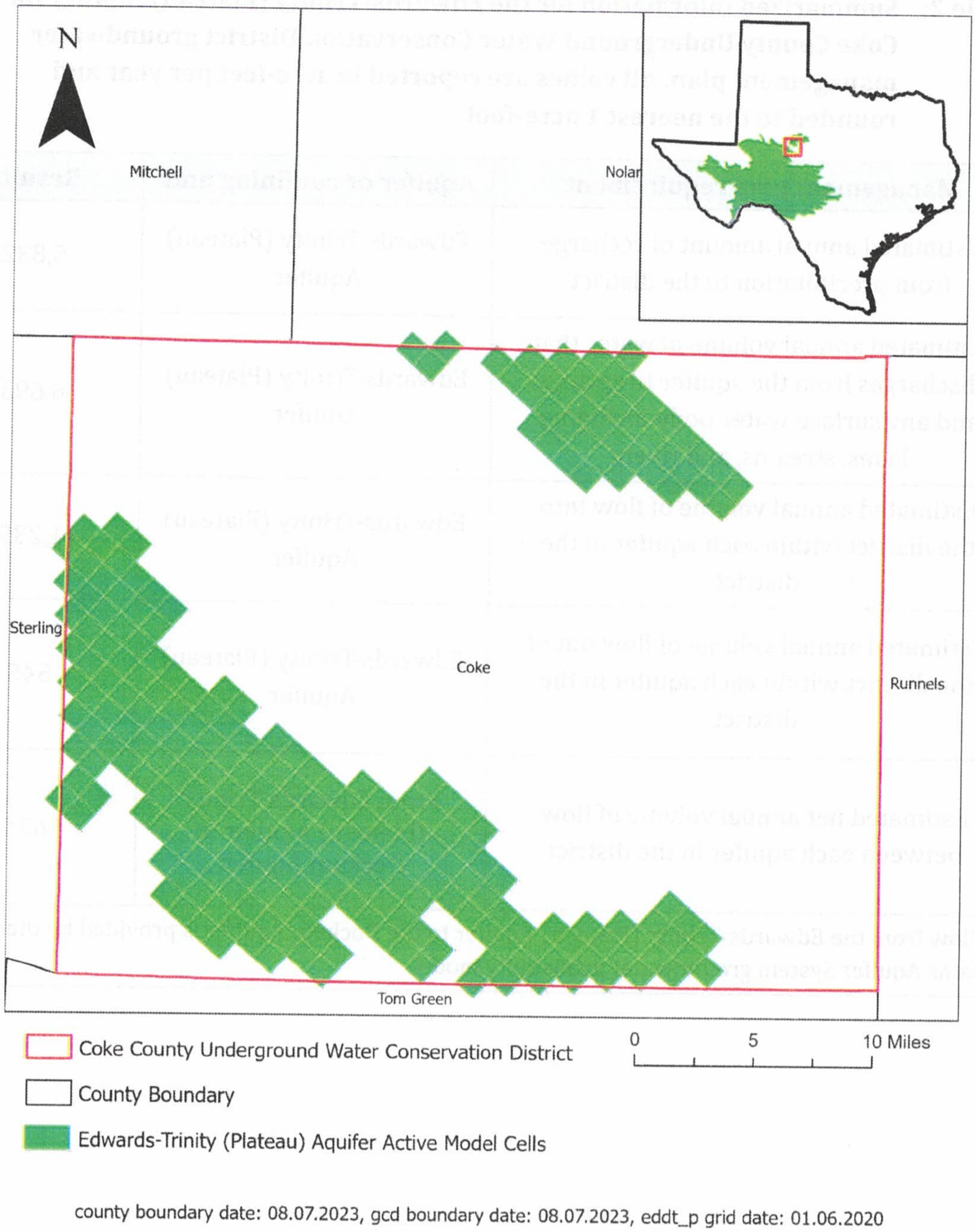
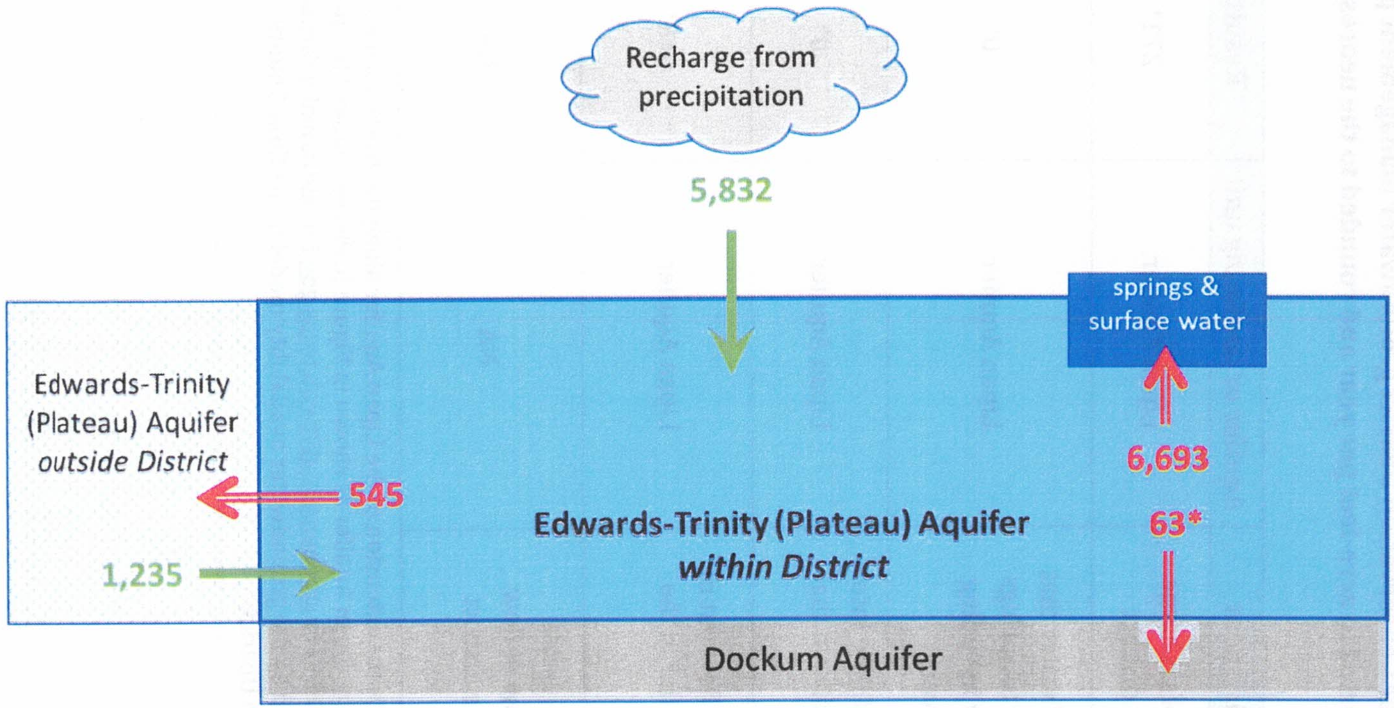


Figure 3: Area of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers from which the information in Table 2 was extracted (the Edwards-Trinity [Plateau] Aquifer extent within the district boundary).



* Flow from the Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer is provided by the High Plains Aquifer System groundwater availability model.

Caveat: This diagram only includes the water budget items provided in Table 2. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 4: Generalized diagram of the summarized budget information from Table 2, representing directions of flow for the Edwards-Trinity (Plateau) Aquifer within the Coke County Underground Water Conservation District. Flow values expressed in acre-feet per year.

Table 3: Summarized information for the Lipan Aquifer for the Coke County Underground Water Conservation District 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	271*
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	0*
Estimated annual volume of flow out of the district within each aquifer in the district	Lipan Aquifer	648*
Estimated net annual volume of flow between each aquifer in the district	NA	NA *

*The model was developed prior to the extension of the Lipan Aquifer along the North Concho River. The model does not cover the entire Lipan Aquifer as shown in Figure 5. Please contact Mr. Stephen Allen with the TWDB at 512-463-7317 or stephen.allen@twdb.texas.gov for additional information on the aquifer in areas not covered by the groundwater availability model in the Coke County Underground Water Conservation District.

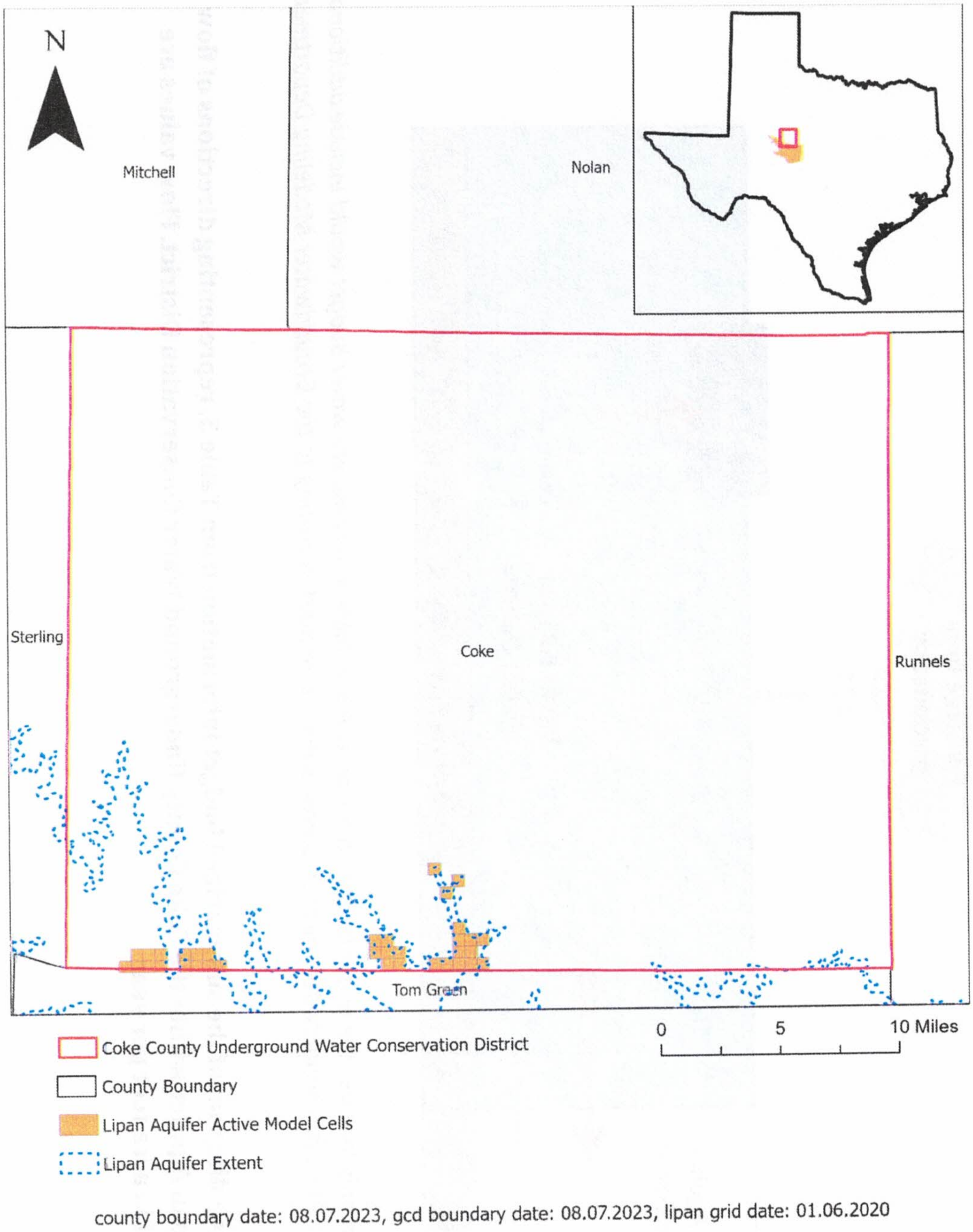
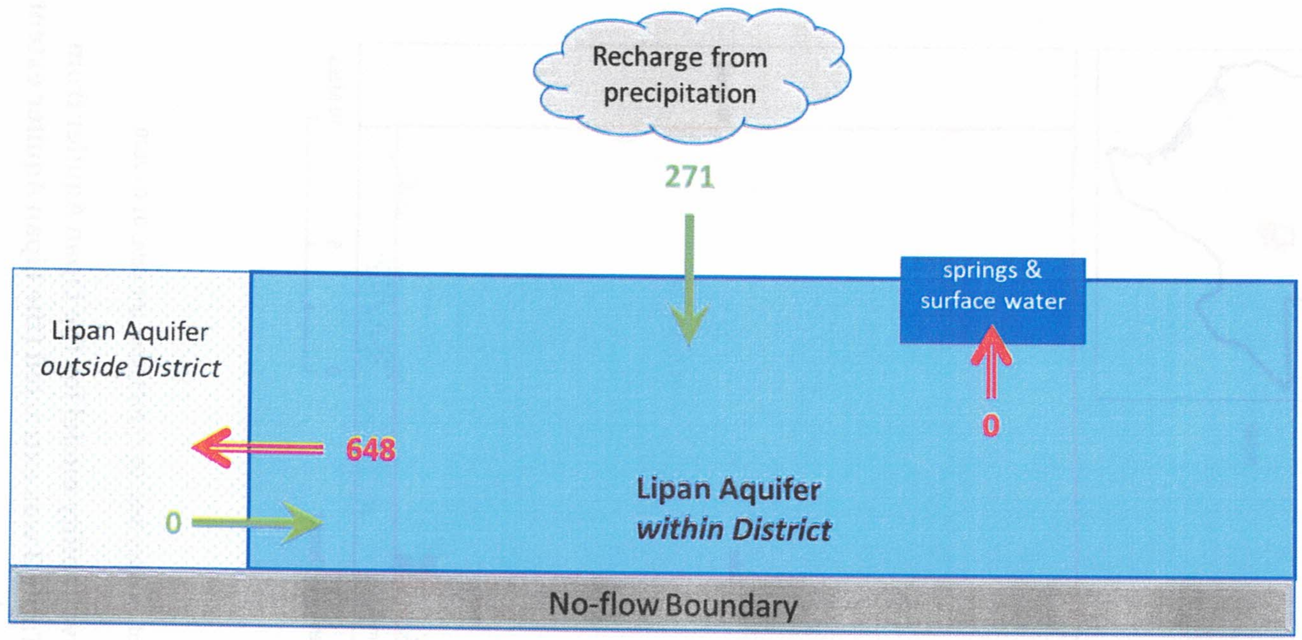


Figure 5: Area of the groundwater availability model for the Lipan Aquifer from which the information in Table 3 was extracted (the Lipan Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 3. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 6: Generalized diagram of the summarized budget information from Table 3, representing directions of flow for the Lipan Aquifer within the Coke County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools 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 historic 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 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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Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models, U.S. Geological Survey Groundwater Software.

Harbaugh, A. W., and McDonald, M. G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference groundwater-water flow model: U.S. Geological Survey Open-File Report 96-485, 56 p.

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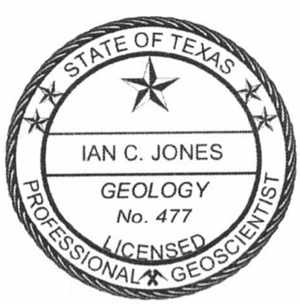
Texas Water Code § 36.1071

APPENDIX C

GAM Run 21-012 MAG: 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 Modeling Department
512-463-6641
August 12, 2022



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GAM Run 21-012 MAG: 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 Modeling Department
512-463-6641
August 12, 2022

EXECUTIVE SUMMARY:

The Texas Water Development Board (TWDB) has 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 August 19, 2021. The explanatory reports and other materials submitted to the TWDB were determined to be administratively complete on February 23, 2022.

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 for each decade from 2020 through 2070 are:

- 26,164 acre-feet per year in the Capitan Reef Complex Aquifer,
- 2,324 acre-feet per year in the Dockum Aquifer,
- 6,570 to 7,925 acre-feet per year in the Ogallala Aquifer,
- 479,063 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, 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 [Version

1.01] (Jones, 2016) for the Capitan Reef Complex Aquifer; the High Plains Aquifer System [Version 1.01] (Deeds and Jigmond, 2015) for the Dockum and Ogallala aquifers; the minor aquifers of the Llano Uplift Area [Version 1.01] (Shi and others, 2016) for the Ellenburger-San Saba and Hickory aquifers, and the Rustler Aquifer [Version 1.01] (Ewing and others, 2012) for the Rustler Aquifer. In addition, the alternative 1-layer model for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers (Hutchison and others, 2011a) 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, 2011b) and the model associated with a hydrogeological study for Val Verde County and the City of Del Rio (EcoKai and Hutchison, 2014), respectively, were used to estimate modeled available groundwater.

REQUESTOR:

Ms. Meredith Allen, coordinator of Groundwater Management Area 7 districts.

DESCRIPTION OF REQUEST:

In an email dated August 28, 2021, Dr. William Hutchison on behalf of Groundwater Management Area 7 provided the TWDB with the desired future conditions for the Capitan, Dockum, Ellenburger-San Saba, Hickory, Ogallala, and Rustler aquifers, as well as for the undifferentiated Edwards-Trinity (Plateau), Pecos Valley and Trinity aquifers, in Groundwater Management Area 7. Groundwater Management Area 7 provided additional clarifications through an email to the TWDB on November 12, 2021, for the assumptions and model files to be used to calculate modeled available groundwater.

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

Capitan Reef Complex Aquifer *(Resolution #08-19-2021-2)*

a) Total net drawdown of the Capitan Reef Complex Aquifer not to exceed 56 feet in Pecos County (Middle Pecos GCD) in 2070 as compared with 2006 aquifer levels.
**(Reference: Scenario 4, GMA 7 Technical Memorandum 16-03)*

b) The Capitan Reef Complex Aquifer is not relevant for joint planning purposes in all other areas of GMA 7.

Dockum and Ogallala aquifers *(Resolution #08-19-2021-5)*

Ogallala Aquifer:

a) Total net drawdown of the Ogallala Aquifer not to exceed **6 feet in Glasscock County** in 2070 as compared with 2010 aquifer levels.

Dockum Aquifer:

b) Total net drawdown of the Dockum Aquifer not to exceed **52 feet in Pecos County** in 2070 as compared with 2010 aquifer levels.

c) Total net drawdown of the Dockum Aquifer not to exceed **14 feet in Reagan County** in 2070 as compared with 2010 aquifer levels.

**(Reference items a) through c): Scenario 17, GMA 7 Technical Memorandum 16-01)*

d) The Ogallala and Dockum Aquifers are not relevant for joint planning purposes in all other areas of GMA 7.

Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers *(Resolution #08-19-2021-3)*

a) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **0 feet in Coke County** in 2070 as compared with 2010 aquifer levels.
b) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **10 feet in Crockett County** in 2070 as compared with 2010 aquifer levels.
c) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **4 feet in Ector County** in 2070 as compared with 2010 aquifer levels.
d) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **2 feet in Edwards County** in 2070 as compared with 2010 aquifer levels.
e) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **5 feet in Gillespie County** in 2070 as compared with 2010 aquifer levels.
f) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **42 feet in Glasscock County** in 2070 as compared with 2010 aquifer levels.
g) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **10 feet in Irion County** in 2070 as compared with 2010 aquifer levels.
h) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **1 foot in Kimble County** in 2070 as compared with 2010 aquifer levels.
i) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **1 foot in Menard County** in 2070 as compared with 2010 aquifer levels.
j) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **12 feet in Midland County** in 2070 as compared with 2010 aquifer levels.
k) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **14 feet in Pecos County** in 2070 as compared with 2010 aquifer levels.
l) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **42 feet in Reagan County** in 2070 as compared with 2010 aquifer levels.
m) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **4 feet in Real County** in 2070 as compared with 2010 aquifer levels.
n) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **8 feet in Schleicher County** in 2070 as compared with 2010 aquifer levels.
o) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **7 feet in Sterling County** in 2070 as compared with 2010 aquifer levels.
p) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **6 feet in Sutton County** in 2070 as compared with 2010 aquifer levels.
q) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **0 feet in Taylor County** in 2070 as compared with 2010 aquifer levels.
r) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **2 feet in Terrell County** in 2070 as compared with 2010 aquifer levels.
s) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **20 feet in Upton County** in 2070 as compared with 2010 aquifer levels.
t) Total net drawdown of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers not to exceed **2 feet in Uvalde County** in 2070 as compared with 2010 aquifer levels.

*(Reference items *a)* through *t)*: GMA 7 Technical Memorandum 18-01)

Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers *(continued)*

u) Total net drawdown in **Kinney County** in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an annual average flow of 23.9 cfs and an annual median flow of **23.9 cfs at Las Moras Springs.**
**(Reference: Groundwater Flow Model of the Kinney County Area by W.R. Hutchison and others, 2011).*

v) Total net drawdown 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 mgd at San Felipe Springs.**
**(Reference: EcoKai, 2014)*

w) The Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers are not relevant for joint planning purposes in all other areas of GMA 7.

Minor Aquifers of the Llano Uplift Area *(Resolution #08-19-2021-4)*

Ellenburger-San Saba Aquifer:

a) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **8 feet in Gillespie County** in 2070 as compared with 2010 aquifer levels.
b) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **18 foot in Kimble County** in 2070 as compared with 2010 aquifer levels.
c) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **14 foot in Mason County** in 2070 as compared with 2010 aquifer levels.
d) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **29 feet in McCulloch County** in 2070 as compared with 2010 aquifer levels.
e) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **46 feet in Menard County** in 2070 as compared with 2010 aquifer levels.
f) Total net drawdown of the Ellenburger-San Saba Aquifer not to exceed **5 feet in San Saba County** in 2070 as compared with 2010 aquifer levels.

Hickory Aquifer:

g) Total net drawdown of the Hickory Aquifer not to exceed **53 feet in Concho County** in 2070 as compared with 2010 aquifer levels.
h) Total net drawdown of the Hickory Aquifer not to exceed **9 feet in Gillespie County** in 2070 as compared with 2010 aquifer levels.
i) Total net drawdown of the Hickory Aquifer not to exceed **18 feet in Kimble County** in 2070 as compared with 2010 aquifer levels.
j) Total net drawdown of the Hickory Aquifer not to exceed **17 feet in Mason County** in 2070 as compared with 2010 aquifer levels.

Minor Aquifers of the Llano Uplift Area *(continued)*

k) Total net drawdown of the Hickory Aquifer not to exceed **29 feet in McColloch County** in 2070 as compared with 2010 aquifer levels.

l) Total net drawdown of the Hickory Aquifer not to exceed **46 feet in Menard County** in 2070 as compared with 2010 aquifer levels.

m) Total net drawdown of the Hickory Aquifer not to exceed **6 feet in San Saba County** in 2070 as compared with 2010 aquifer levels.
**(Reference items a) through m): Scenario 3, GMA 7 Technical Memorandum 16-02)*

n) The Llano Uplift Region (Ellenburger-San Saba, Hickory, Marble Falls) Aquifers are not relevant for joint planning purposes in all other areas of GMA 7.

Rustler Aquifer *(Resolution #08-19-2021-6)*

a) Total net drawdown of the Rustler Aquifer not to exceed **94 feet in Pecos County** in 2070 as compared with 2010 aquifer levels.
**(Reference: Scenario 4, GMA 7 Technical Memorandum 15-05)*

b) The Rustler Aquifer not relevant for joint planning purposes in all other areas of GMA 7.

In addition to the non-relevant statements provided above in the individual resolutions, Groundwater Management Area 7 also provided additional non-relevant documentation dated August 27, 2021 and January 20, 2022 as part of their submittal to TWDB. The following aquifers or parts of aquifers are non-relevant for the purposes of joint planning:

- The entirety of the Blaine, Cross Timbers, Igneous, Lipan, Marble Falls, and Seymour aquifers.
- The Capitan Reef Complex Aquifer outside of the boundaries of the Middle Pecos Groundwater Conservation District.
- The Edwards-Trinity (Plateau) Aquifer in Concho, Mason, McCulloch, Nolan, and Tom Green counties.
- The Ellenburger-San Saba Aquifer in Coleman, Concho, and Mason counties.
- The Hickory Aquifer in Coleman and Llano counties.
- The Dockum Aquifer outside of Reagan and Pecos counties.
- The Ogallala Aquifer outside of Glasscock County.

CLARIFICATIONS:

In response to a request for clarifications from the TWDB in 2021, the Groundwater Management Area 7 Chair, Ms. Meredith Allen, and Groundwater Management Area 7 consultant, Dr. William R. Hutchison, provided the following clarifications regarding the definition of the desired future conditions. These clarifications were necessary for verifying that the desired future conditions of the aquifers were attainable and for confirming approval of the TWDB methodology to calculate modeled available groundwater volumes in Groundwater Management Area 7:

Capitan Reef Complex Aquifer

- The calculated modeled available groundwater values are based on the official TWDB aquifer boundary.
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions are acceptable).
- Drawdown calculations used to define the desired future conditions value take into consideration the occurrence of "dry" cells, where water levels are below the base of the aquifer.

Dockum Aquifer

- The calculated modeled available groundwater values are based on the spatial extent of the Dockum Formation, as represented in the groundwater availability model for the High Plains Aquifer System, rather than the official TWDB aquifer boundary.
- Modeled available groundwater analysis excludes model pass-through cells.
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions are acceptable).

Ogallala Aquifer

- The calculated modeled available groundwater values are based on the official TWDB aquifer boundary and use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 16-01 (Hutchison, 2016c).
- Drawdown calculations used to define the desired future conditions do not take into consideration the occurrence of "dry" cells, where water levels are below the base of the aquifer.

- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions are acceptable).

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

- The calculated modeled available groundwater values are based on the official TWDB aquifer boundaries.
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions value are acceptable).
- Drawdown calculations used to define the desired future conditions include drawdowns for cells with water levels below the base elevation of the cell ("dry" cells).

Kinney County

- The modeled available groundwater values, model assumptions, and simulated springflow are from GAM Run 10-043 MAG Version 2 (Shi, 2012).

Val Verde County

- There is no associated drawdown as a desired future condition. The desired future condition is based solely on simulated spring flow 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 2021).

Minor Aquifers of the Llano Uplift Area

- The calculated modeled available groundwater values are based on the full spatial extent of the Ellenburger-San Saba and Hickory formations in the groundwater availability model for the aquifers of the Llano Uplift Area rather than the official TWDB aquifer boundaries and use the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 16-02 (Hutchison 2016b).
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions value are acceptable).

- The drawdown calculations used to define desired future conditions did not include "dry" cells, where water levels are below the base of the aquifer.

Rustler Aquifer

- The model used to define desired future conditions and calculate modeled available groundwater assumes that the initial model heads represent the heads at the end of 2008 (the baseline for calculating desired future conditions drawdown values).
- Calculated modeled available groundwater values are based on the full spatial extent of the Rustler Formation, as represented in the groundwater availability model for the Rustler Aquifer, rather than the official TWDB aquifer boundary.
- The predictive model used to define desired future conditions and calculate modeled available groundwater uses the same model assumptions used in Groundwater Management Area 7 Technical Memorandum 15-05 (Hutchison, 2016d).
- The modeled available groundwater calculations are based on the desired future conditions with a one-foot tolerance (that is, modeled drawdown verifications within one foot of the desired future conditions value are acceptable).

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 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 the water levels in the baseline year. These baseline years are 2005 in the groundwater availability model for the Capitan Reef Complex Aquifer and the alternative model for the Edwards-Trinity (Plateau) and Pecos Valley 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 2008 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. In most cases, these model runs were supplied by Groundwater Management Area 7 for review by TWDB staff before they were used to calculate the modeled available groundwater. 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 for all aquifers 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 was 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 was 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 is 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).

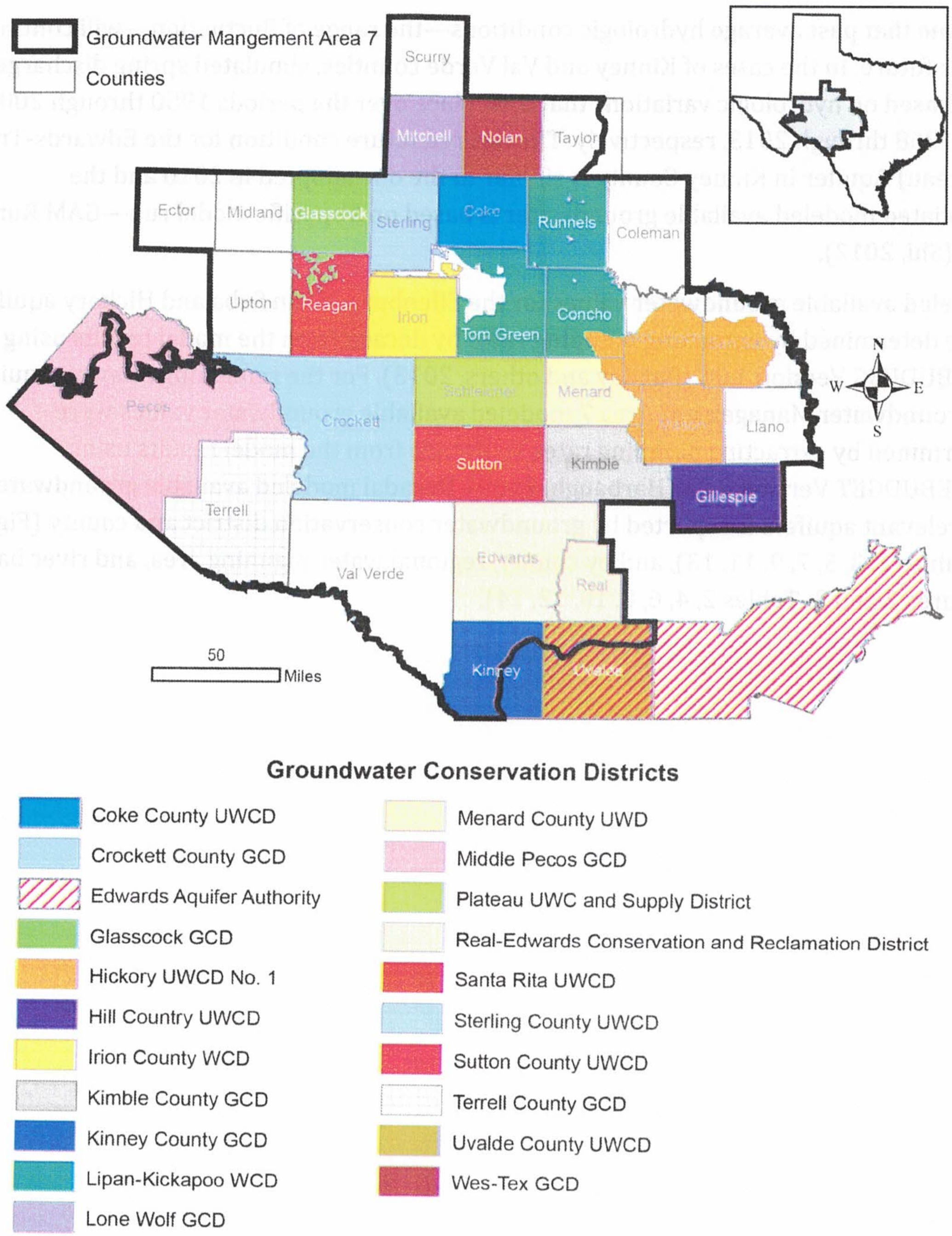

FIGURE 1. **MAP SHOWING THE GROUNDWATER CONSERVATION DISTRICTS (GCD) IN GROUNDWATER MANAGEMENT AREA 7. NOTE: THE BOUNDARIES OF THE EDWARDS AQUIFER AUTHORITY OVERLAP WITH THE UVALDE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT (UWCD).**

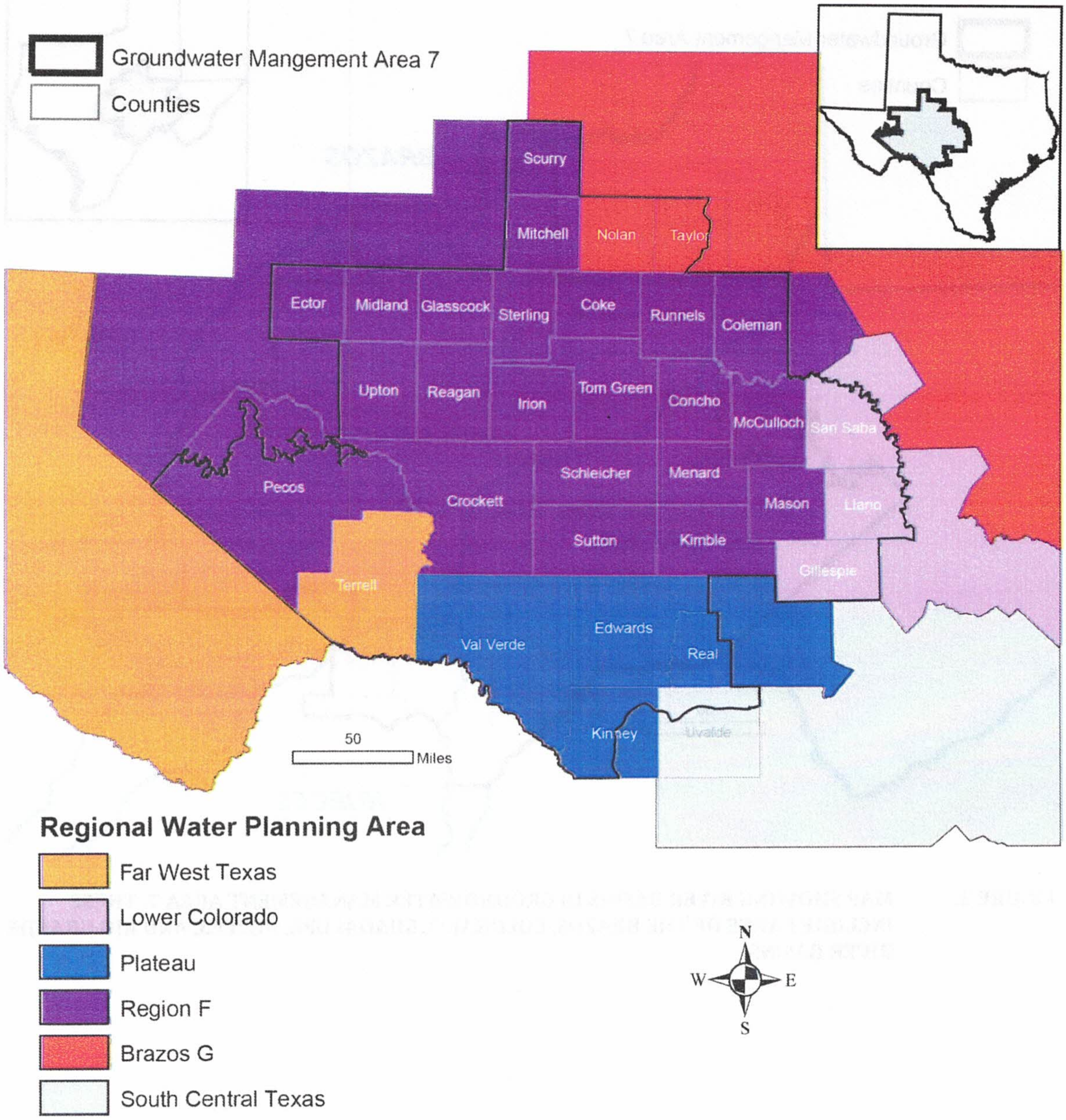

FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS IN GROUNDWATER MANAGEMENT AREA 7.

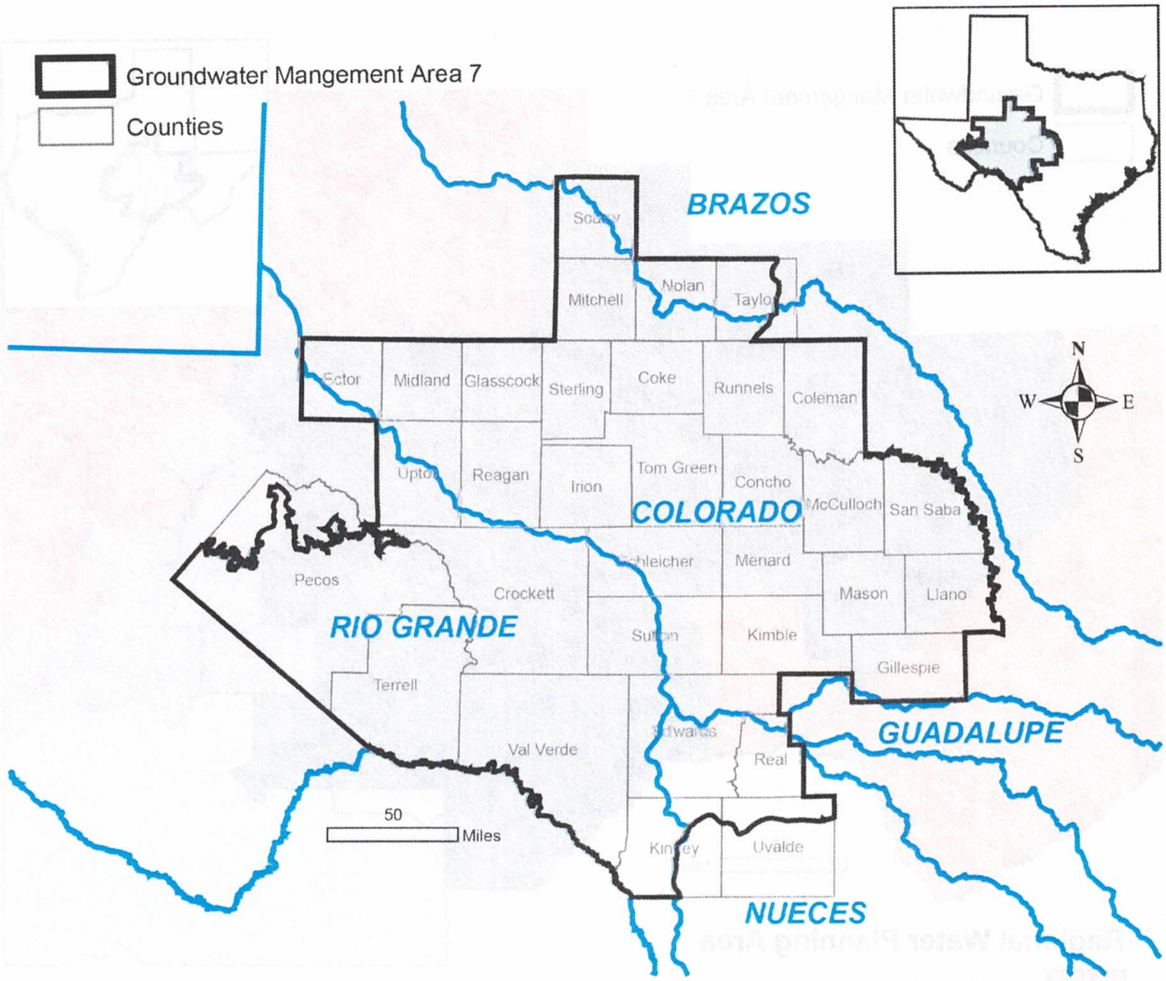

FIGURE 3. **MAP SHOWING RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 7. THESE INCLUDE PARTS OF THE BRAZOS, COLORADO, GUADALUPE, NUECES, AND RIO GRANDE RIVER BASINS.**

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 (2016a) 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 TWDB 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 (2016c) 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 to hydraulically connect the Ogallala Aquifer to the Lower Dockum where the Edwards-Trinity (High Plains)

and Upper Dockum aquifers are absent. 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. Therefore, the groundwater management area should be aware that the modeled available groundwater values will be less than pumping input values if the modeled saturated thickness drops below that threshold.
- The model was run for the interval 2013 through 2070 for a 58-year predictive simulation. Drawdowns were calculated by subtracting initial 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 in the Dockum Aquifer where water levels were below the base elevation of the cell ("dry" cells). Therefore, all drawdowns were included in the averaging. However, in the Ogallala Aquifer, dry cells occurred during the predictive simulation. These dry cells were excluded from the modeled available groundwater calculations.
- Drawdown averages and modeled available groundwater volumes are based on the model boundary within Groundwater Management Area 7 for the Dockum Aquifer and the official TWDB aquifer boundary 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 was 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; 2018) 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.
- Because simulated water levels for the baseline year (2010) are not included in the original calibrated historical model, these water levels had to be verified against measured water levels to confirm that the predictive model satisfactorily matched real-world conditions. Comparison of 2010 simulated and measured water levels indicated a root mean squared error of 100 feet or 4 percent of the range in water-level elevations, which is within acceptable limits. Based on these results, we consider the predictive model an appropriate tool for evaluating the attainability of desired future conditions and for calculating modeled available groundwater.
- 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 TWDB 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 56 annual stress periods under the conditions set in Scenario 3 in Task 10-027 (Hutchison, 2011).
- Modeled available groundwater volumes are based on the official TWDB aquifer boundary 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 and Hutchison (2014) for assumptions and limitations of the model. See Hutchison (2016e; 2021) 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 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 TWDB aquifer boundary within Groundwater Management Area 7 in Val Verde County.

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 (2016b) 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.
- The model was run for the interval 2011 through 2070 for a 60-year predictive simulation. Drawdowns were calculated by subtracting initial 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.

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.
- The predictive model used to define desired future conditions uses 2008 recharge conditions throughout the predictive period.
- The predictive model used to define desired future conditions has general-head boundary heads that decline at a rate of 1.5 feet per year.
- 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.

RESULTS:

The modeled available groundwater estimates for each decade from 2020 through 2070 are:

- 26,164 acre-feet per year in the Capitan Reef Complex Aquifer,
- 2,324 acre-feet per year in the Dockum Aquifer,
- 6,570 to 7,925 acre-feet per year in the Ogallala Aquifer,

- 479,063 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, 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 5 and 6). 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.

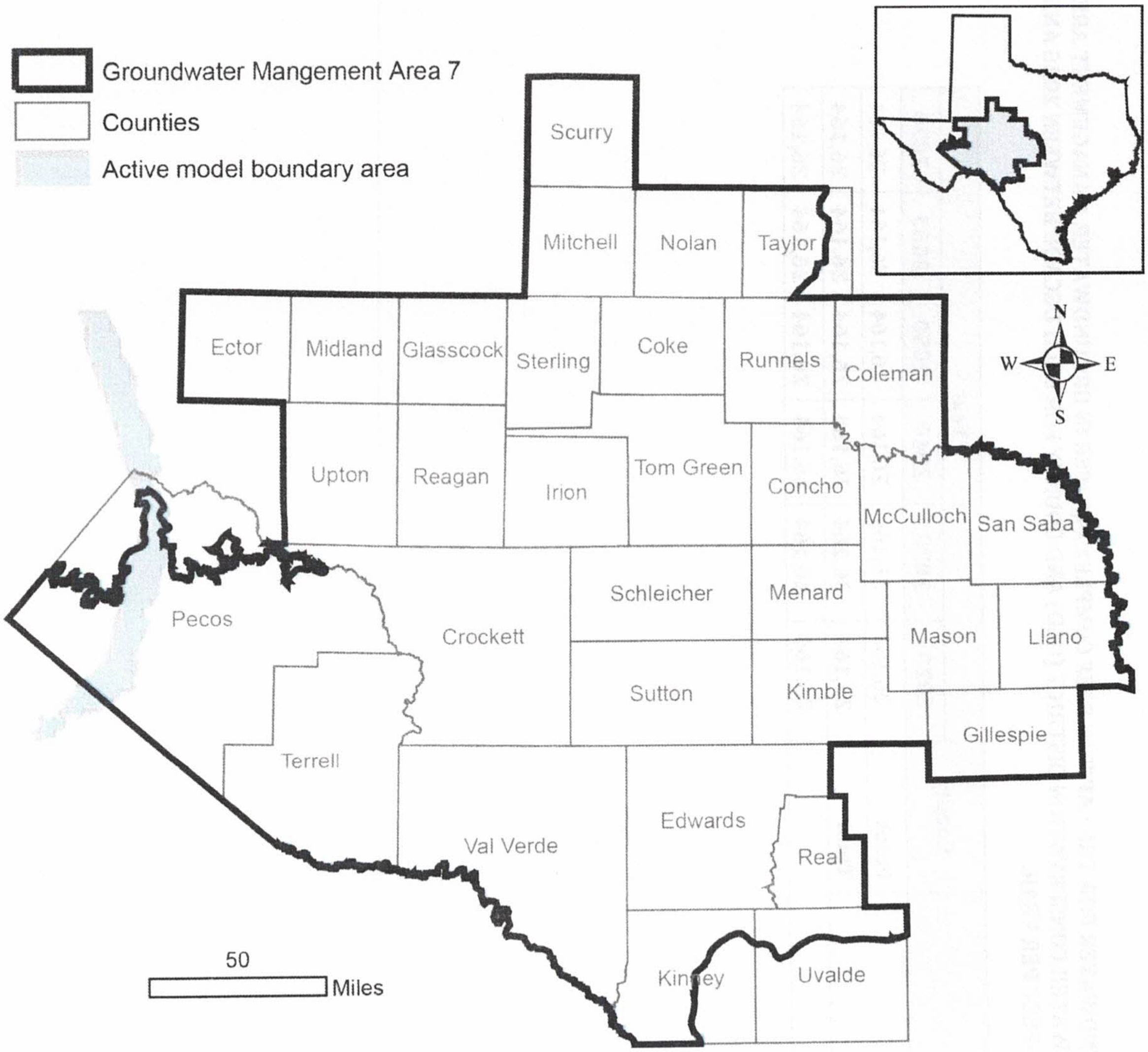

FIGURE 4. **MAP SHOWING THE AREAS COVERED BY THE CAPITAN REEF COMPLEX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EASTERN ARM OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year					
		2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	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**

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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.**

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

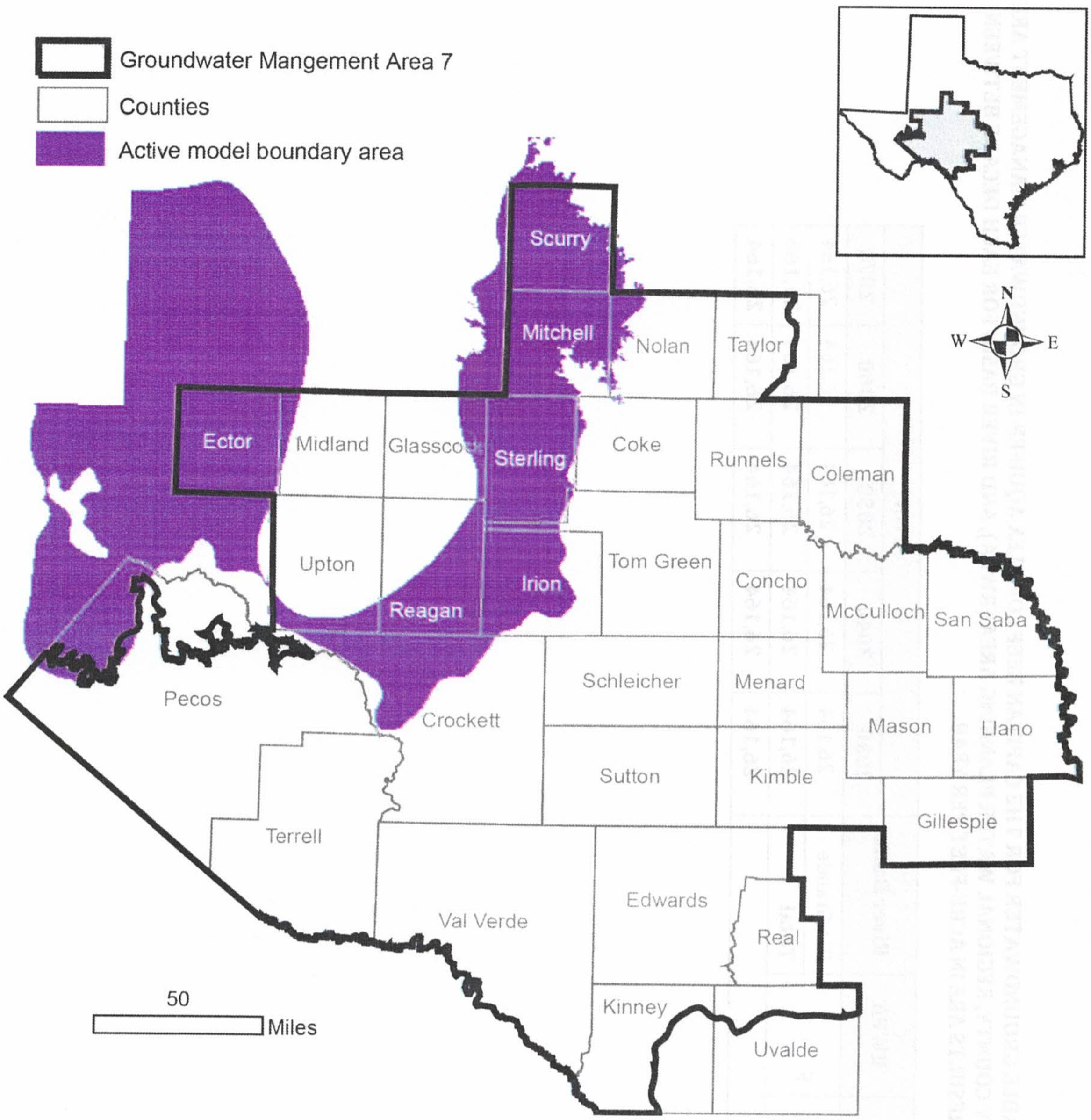

FIGURE 5. **MAP SHOWING AREAS COVERED BY THE DOCKUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

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 2020 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					
		2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	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**
Santa Rita UWCD	Reagan	302	302	302	302	302	302
	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 Santa Rita Underground Water Conservation District excludes parts of Reagan County that fall within Glasscock Groundwater Conservation District.

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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

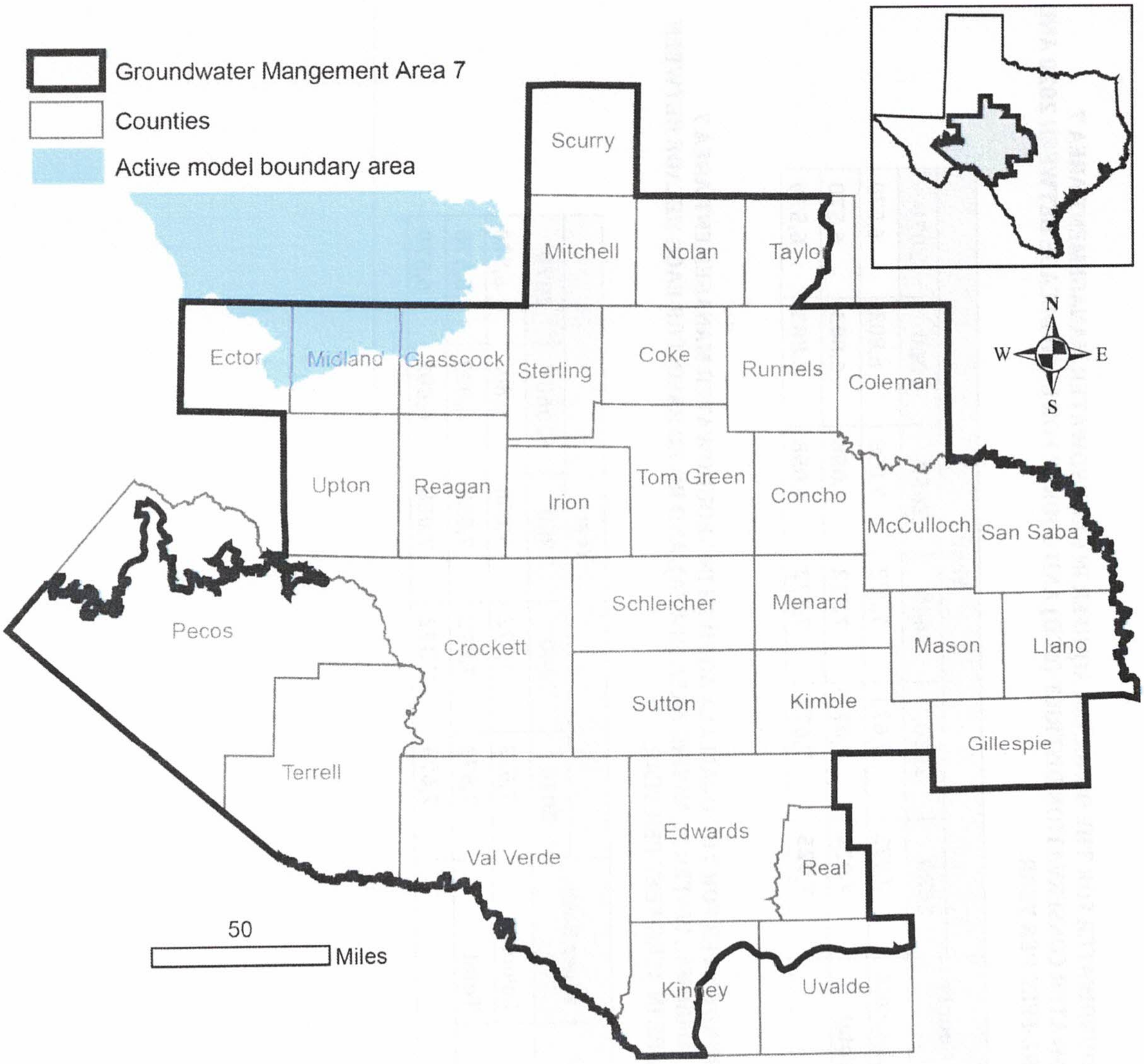

FIGURE 6. **MAP SHOWING THE AREAS COVERED BY THE OGALLALA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year					
		2020	2030	2040	2050	2060	2070
Glasscock GCD	Glasscock	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**

TABLE 6. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

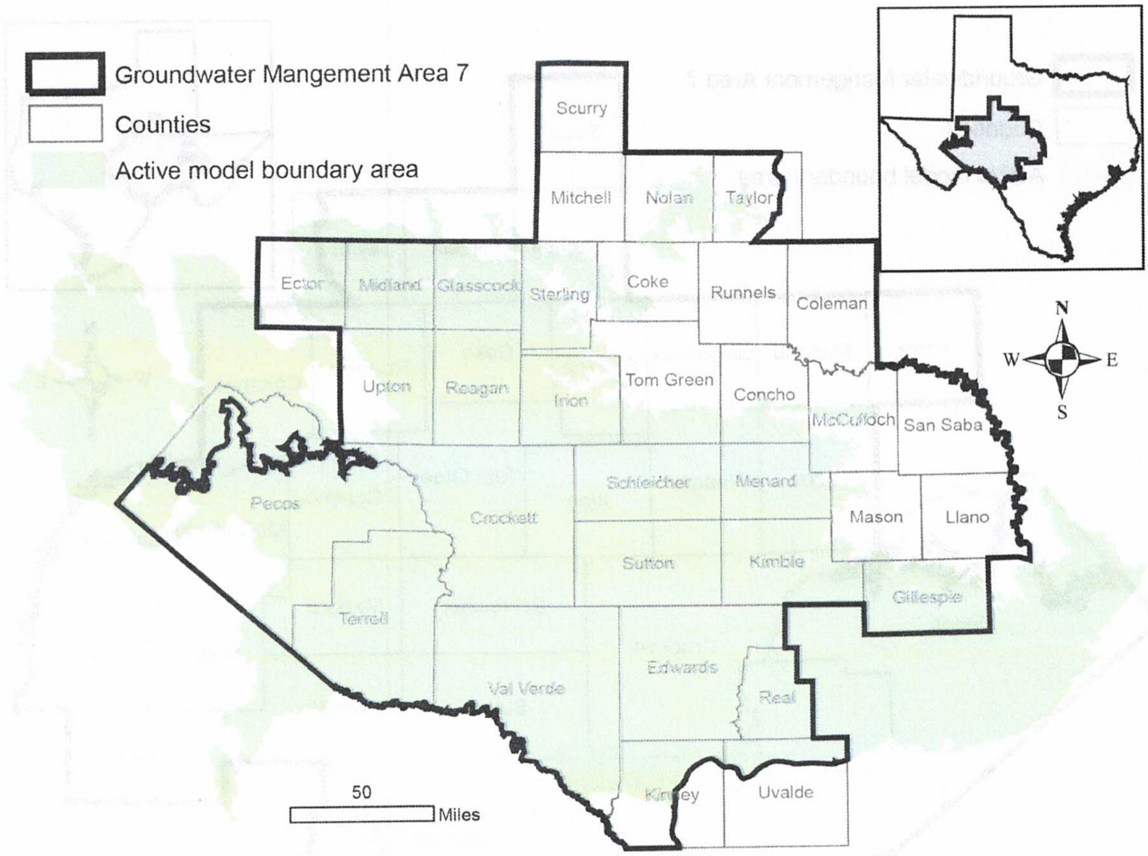

FIGURE 7. **MAP SHOWING THE AREAS COVERED BY THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7.**

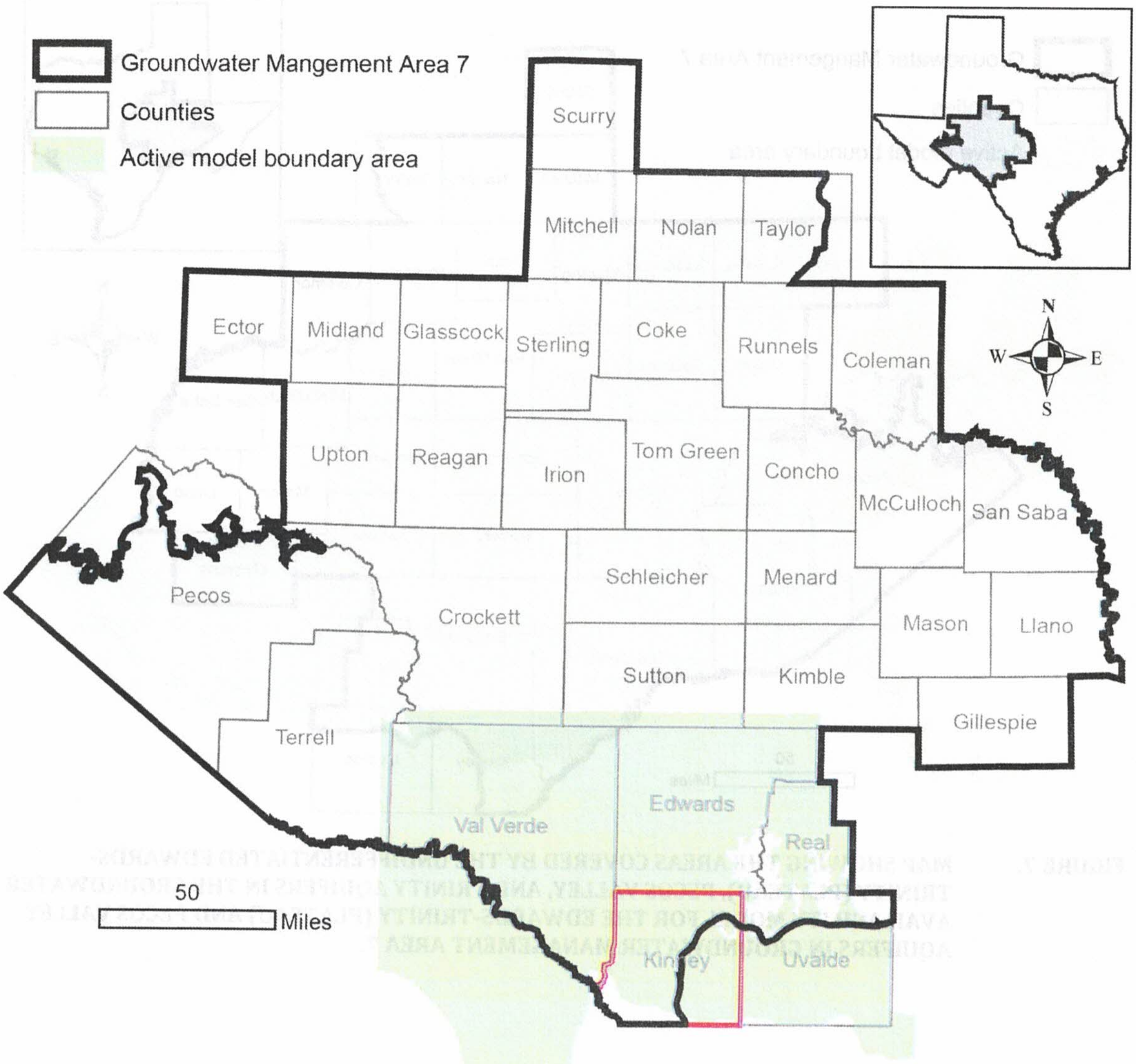

FIGURE 8. **MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE ALTERNATIVE MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN KINNEY COUNTY [HIGHLIGHTED IN RED].**

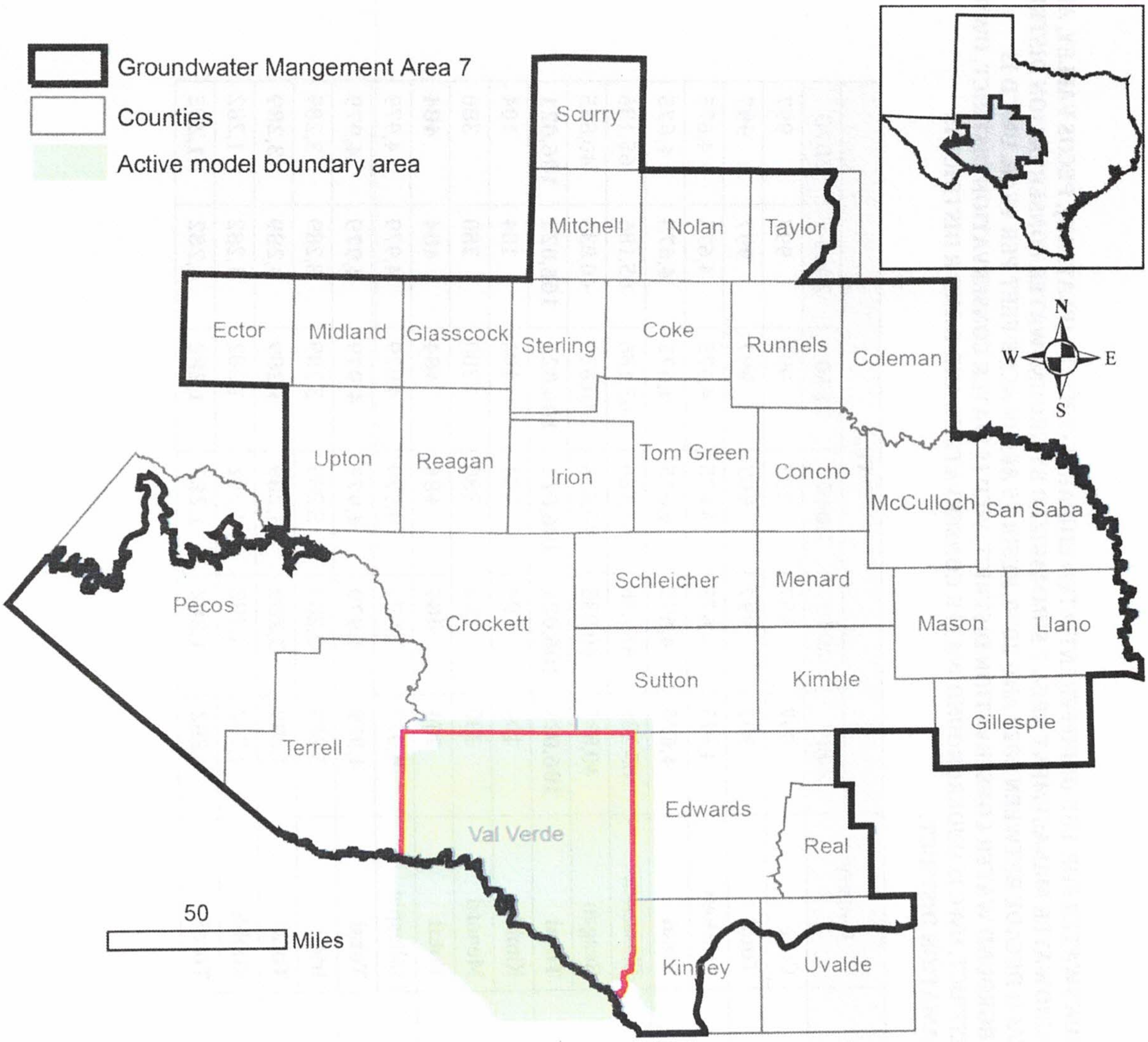

FIGURE 9. **MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE GROUNDWATER FLOW MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN VAL VERDE COUNTY [HIGHLIGHTED IN RED].**

TABLE 7. 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 2020 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					
		2020	2030	2040	2050	2060	2070
Coke County UWCD	Coke	997	997	997	997	997	997
	Total	**997**	**997**	**997**	**997**	**997**	**997**
Crockett County GCD	Crockett	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**
Glasscock GCD	Glasscock	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
	Total	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**	**106,021**
Hickory UWCD No. 1	Kimble	104	104	104	104	104	104
	Menard	380	380	380	380	380	380
	Total	**484**	**484**	**484**	**484**	**484**	**484**
Hill Country UWCD	Gillespie	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**
Irion County WCD	Irion	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 County GCD	Kimble	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**

TABLE 7. (CONTINUED).

District	County	Year					
		2020	2030	2040	2050	2060	2070
Kinney County GCD	Kinney	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**
Menard County UWD	Menard	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**
Middle Pecos GCD	Pecos	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**
Plateau UWC and Supply District	Schleicher	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**
Real-Edwards C and R District	Edwards	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
	Total	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**	**13,199**

TABLE 7. (CONTINUED).

District	County	Year					
		2020	2030	2040	2050	2060	2070
Santa Rita UWCD	Reagan	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**
Sterling County UWCD	Sterling	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 County UWCD	Sutton	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**
Terrell County GCD	Terrell	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**
Uvalde County UWCD	Uvalde	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**
No district		102,703	102,703	102,703	102,703	102,703	102,703
GMA 7		**475,236**	**475,236**	**475,236**	**475,236**	**475,236**	**475,236**

TABLE 8. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

TABLE 8. (CONTINUED).

County	RWPA	River Basin	Year				
			2030	**2040**	**2050**	**2060**	**2070**
Irion	F	Colorado	3,289	3,289	3,289	3,289	3,289
		Total	**3,289**	**3,289**	**3,289**	**3,289**	**3,289**
Kimble	F	Colorado	1,386	1,386	1,386	1,386	1,386
		Total	**1,386**	**1,386**	**1,386**	**1,386**	**1,386**
Kinney	J	Nueces	12	12	12	12	12
		Rio Grande	70,329	70,329	70,329	70,329	70,329
		Total	**70,341**	**70,341**	**70,341**	**70,341**	**70,341**
Menard	F	Colorado	2,597	2,597	2,597	2,597	2,597
		Total	**2,597**	**2,597**	**2,597**	**2,597**	**2,597**
Midland	F	Colorado	23,233	23,233	23,233	23,233	23,233
		Total	**23,233**	**23,233**	**23,233**	**23,233**	**23,233**
Pecos	F	Rio Grande	117,309	117,309	117,309	117,309	117,309
		Total	**117,309**	**117,309**	**117,309**	**117,309**	**117,309**

TABLE 8. (CONTINUED).

County	RWPA	River Basin	Year				
			2030	2040	2050	2060	2070
Reagan	F	Colorado	68,205	68,205	68,205	68,205	68,205
		Rio Grande	28	28	28	28	28
		Total	**68,233**	**68,233**	**68,233**	**68,233**	**68,233**
Real	J	Colorado	277	277	277	277	277
		Guadalupe	3	3	3	3	3
		Nueces	7,243	7,243	7,243	7,243	7,243
		Total	**7,523**	**7,523**	**7,523**	**7,523**	**7,523**
Schleicher	F	Colorado	6,403	6,403	6,403	6,403	6,403
		Rio Grande	1,631	1,631	1,631	1,631	1,631
		Total	**8,034**	**8,034**	**8,034**	**8,034**	**8,034**
Sterling	F	Colorado	2,495	2,495	2,495	2,495	2,495
		Total	**2,495**	**2,495**	**2,495**	**2,495**	**2,495**
Sutton	F	Colorado	388	388	388	388	388
		Rio Grande	6,022	6,022	6,022	6,022	6,022
		Total	**6,410**	**6,410**	**6,410**	**6,410**	**6,410**
Taylor	G	Brazos	331	331	331	331	331
		Colorado	158	158	158	158	158
		Total	**489**	**489**	**489**	**489**	**489**
Terrell	E	Rio Grande	1,420	1,420	1,420	1,420	1,420
		Total	**1,420**	**1,420**	**1,420**	**1,420**	**1,420**

TABLE 8. (CONTINUED).

County	RWPA	River Basin	Year				
			2030	2040	2050	2060	2070
Upton	F	Colorado	21,243	21,243	21,243	21,243	21,243
		Rio Grande	1,126	1,126	1,126	1,126	1,126
		Total	**22,369**	**22,369**	**22,369**	**22,369**	**22,369**
Uvalde	L	Nueces	1,993	1,993	1,993	1,993	1,993
		Total	**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
		Total	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**
GMA 7			**479,063**	**479,063**	**479,063**	**479,063**	**479,063**

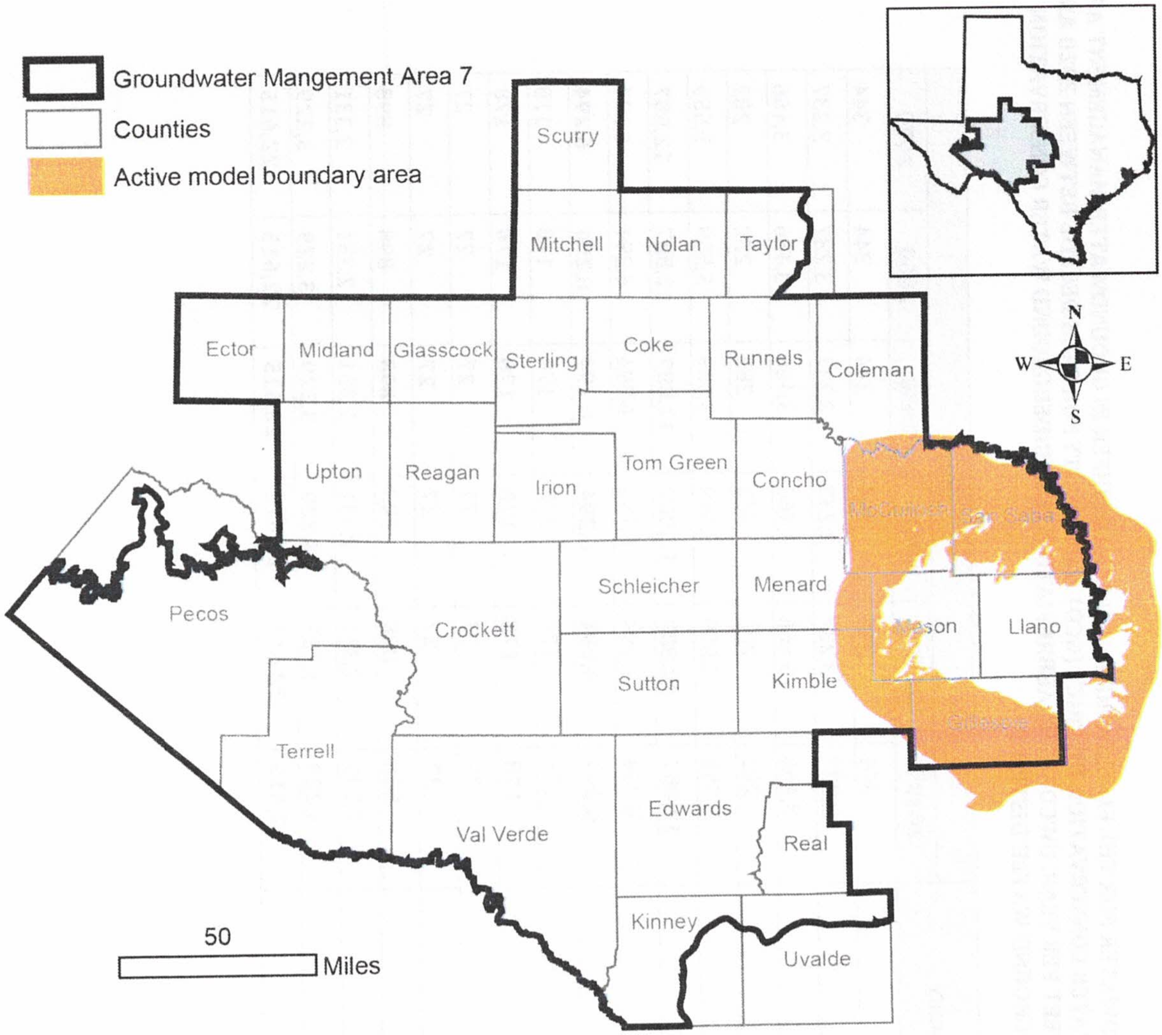

FIGURE 10. MAP SHOWING THE AREAS COVERED BY THE ELLENBURGER-SAN SABA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.

TABLE 9. 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 2020 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					
		2020	2030	2030	2050	2060	2070
Hickory UWCD No. 1	Kimble	344	344	344	344	344	344
	Mason	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
	Menard	282	282	282	282	282	282
	San Saba	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**
Hill Country UWCD	Gillespie	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 County GCD	Kimble	178	178	178	178	178	178
	Total	**178**	**178**	**178**	**178**	**178**	**178**
Menard County UWD	Menard	27	27	27	27	27	27
	Total	**27**	**27**	**27**	**27**	**27**	**27**
No District	McCulloch	898	898	898	898	898	898
	San Saba	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**
GMA 7		**22,615**	**22,615**	**22,615**	**22,615**	**22,615**	**22,615**

TABLE 10. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year				
			2030	2040	2050	2060	2070
Gillespie	K	Colorado	6,294	6,294	6,294	6,294	6,294
		Total	**6,294**	**6,294**	**6,294**	**6,294**	**6,294**
Kimble	F	Colorado	521	521	521	521	521
		Total	**521**	**521**	**521**	**521**	**521**
Mason	F	Colorado	3,237	3,237	3,237	3,237	3,237
		Total	**3,237**	**3,237**	**3,237**	**3,237**	**3,237**
McCulloch	F	Colorado	4,364	4,364	4,364	4,364	4,364
		Total	**4,364**	**4,364**	**4,364**	**4,364**	**4,364**
Menard	F	Colorado	309	309	309	309	309
		Total	**309**	**309**	**309**	**309**	**309**
San Saba	K	Colorado	7,890	7,890	7,890	7,890	7,890
		Total	**7,890**	**7,890**	**7,890**	**7,890**	**7,890**
GMA 7			**22,615**	**22,615**	**22,615**	**22,615**	**22,615**

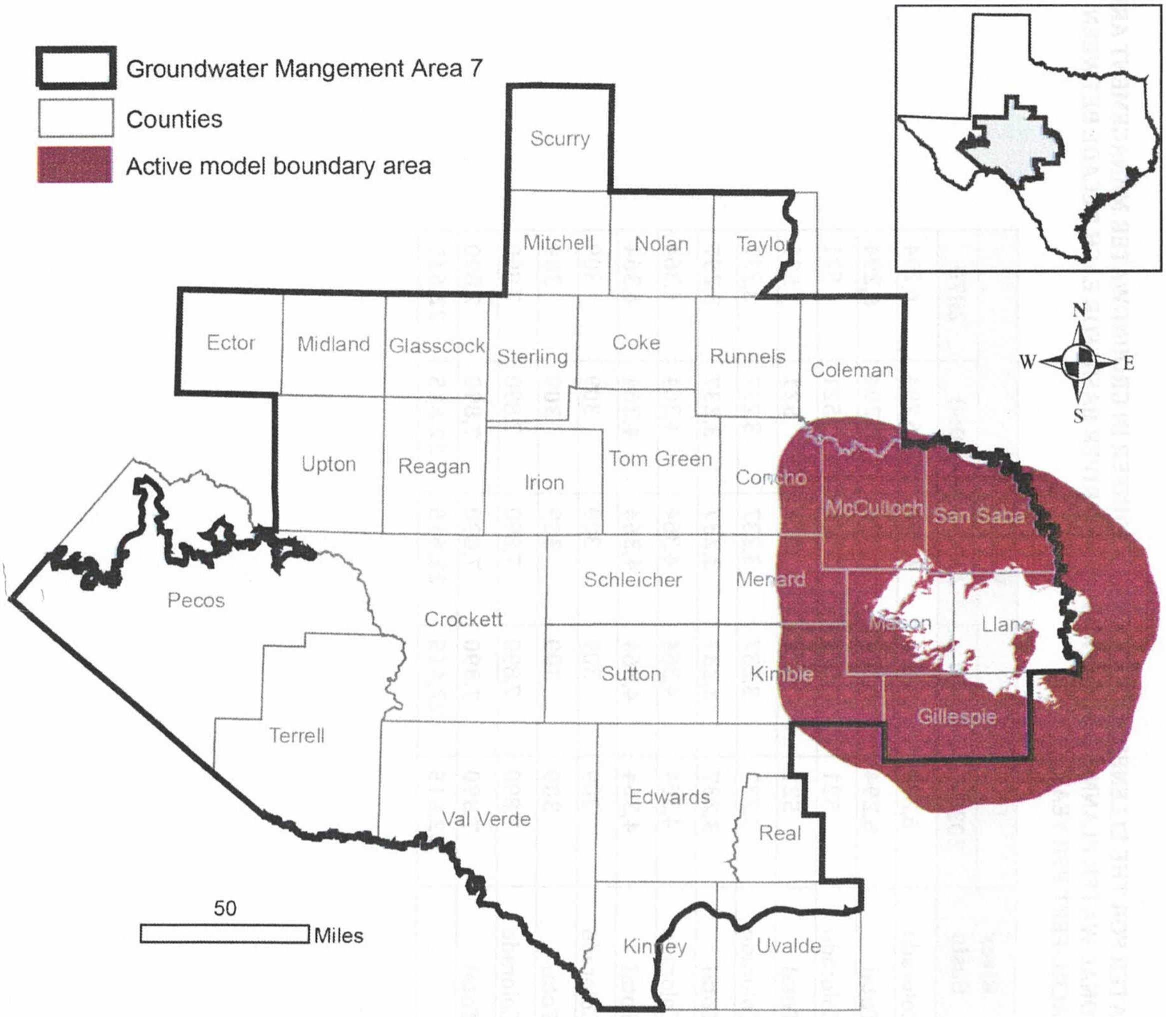

FIGURE 11. **MAP SHOWING AREAS COVERED BY THE HICKORY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 11. MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 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					
		2020	2030	2040	2050	2060	2070
Hickory UWCD No. 1	Concho	13	13	13	13	13	13
	Kimble	42	42	42	42	42	42
	Mason	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
	Menard	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
	Total	**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
	Total	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**
Kimble County GCD	Kimble	123	123	123	123	123	123
	Total	**123**	**123**	**123**	**123**	**123**	**123**
Lipan-Kickapoo WCD	Concho	13	13	13	13	13	13
	Total	**13**	**13**	**13**	**13**	**13**	**13**
Menard County UWD	Menard	126	126	126	126	126	126
	Total	**126**	**126**	**126**	**126**	**126**	**126**
No District	McCulloch	2,427	2,427	2,427	2,427	2,427	2,427
	San Saba	652	652	652	652	652	652
	Total	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**	**3,080**
GMA 7		**49,937**	**49,937**	**49,937**	**49,937**	**49,937**	**49,937**

TABLE 12. 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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	Year				
			2030	2040	2050	2060	2070
Concho	F	Colorado	27	27	27	27	27
		Total	**27**	**27**	**27**	**27**	**27**
Gillespie	K	Colorado	1,751	1,751	1,751	1,751	1,751
		Total	**1,751**	**1,751**	**1,751**	**1,751**	**1,751**
Kimble	F	Colorado	165	165	165	165	165
		Total	**165**	**165**	**165**	**165**	**165**
Mason	F	Colorado	13,212	13,212	13,212	13,212	13,212
		Total	**13,212**	**13,212**	**13,212**	**13,212**	**13,212**
McCulloch	F	Colorado	24,377	24,377	24,377	24,377	24,377
		Total	**24,377**	**24,377**	**24,377**	**24,377**	**24,377**
Menard	F	Colorado	2,725	2,725	2,725	2,725	2,725
		Total	**2,725**	**2,725**	**2,725**	**2,725**	**2,725**
San Saba	K	Colorado	7,680	7,680	7,680	7,680	7,680
		Total	**7,680**	**7,680**	**7,680**	**7,680**	**7,680**
GMA 7			**49,937**	**49,937**	**49,937**	**49,937**	**49,937**

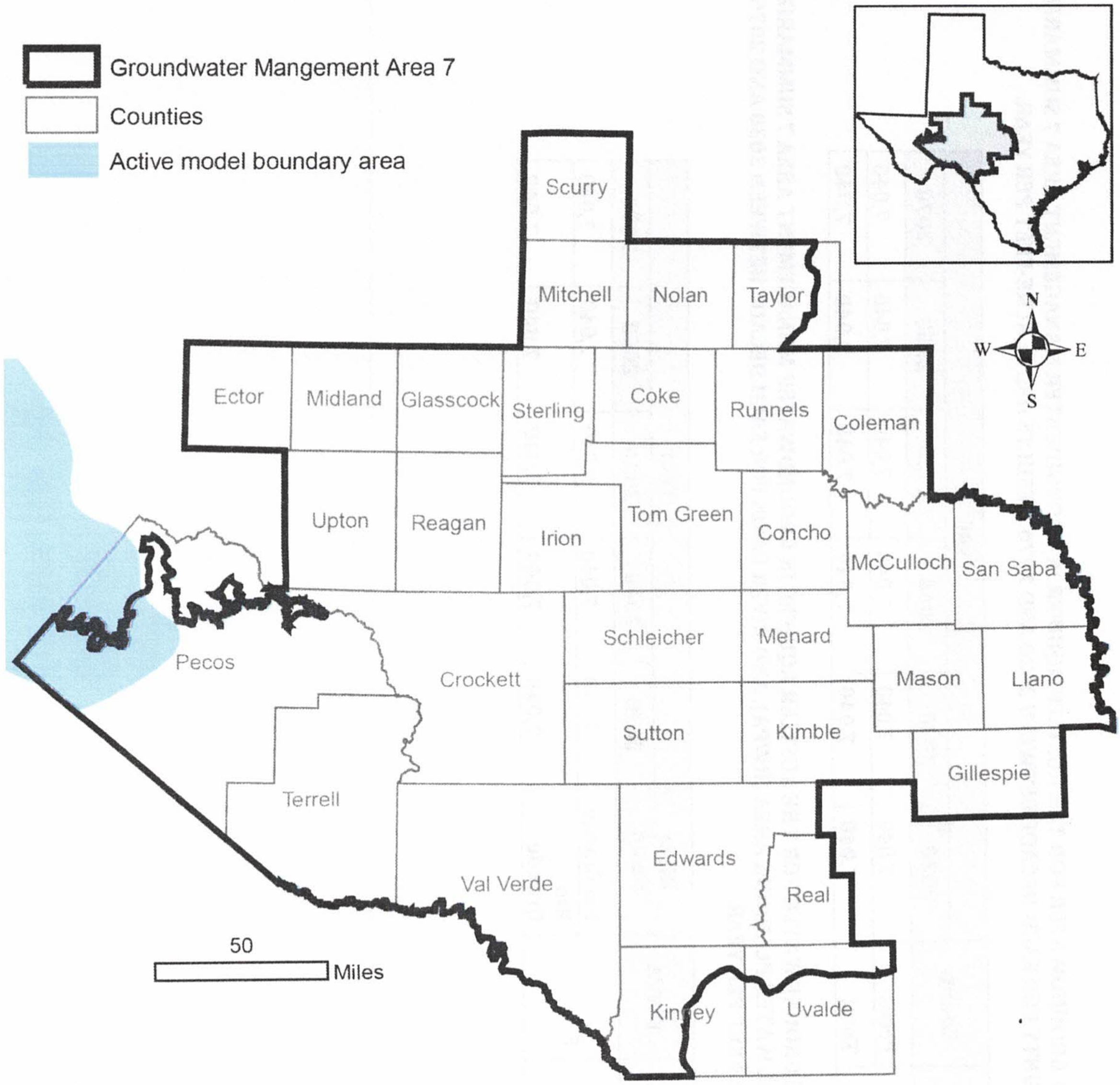

FIGURE 13. **MAP SHOWING AREAS COVERED BY THE RUSTLER AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.**

TABLE 13. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7 SUMMARIZED BY DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

District	County	Year					
		2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	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**

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 2030 AND 2070. RESULTS ARE IN ACRE-FEET PER YEAR.

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

In some cases, the predictive model run for this analysis could result 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. This would mean that the modeled available groundwater would include imaginary "pumping" values that are coming from cells that are actually dry.

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