

Irion County
Water Conservation District
Management Plan

2018 - 2023

Amended: November 12, 2018

Irion County Water Conservation District

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Table of Contents

District Mission	1
Purpose of Management Plan	1
Time Period for this Plan	2
Statement of Guiding Principles	2
General Description	3
History	3
Location and Extent	3
Regional Cooperation and Coordination	3
Groundwater Resources	5
Edwards-Trinity (Plateau) Aquifer	5
Dockum Aquifer	5
Lipan Aquifer	6
Technical District Information Required by Texas Administrative Code	6
Modeled Available Groundwater in the District	8
Amount of Groundwater being Used within the District on an Annual Basis	8
Annual Amount of Recharge from Precipitation to the Groundwater Resources within the District	8
Annual Volume of Water that Discharges from the Aquifer to Springs and Surface Water Bodies	8
Estimate of the Annual Volume of Flow into the District, out of the District and Between Aquifers in the District	8
Projected Surface Water Supplies within the District	8
Projected Total Demand for Water within the District	8
Water Supply Needs	8
Water Management Strategies	8
Actions, Procedures, Performance and Avoidance for Plan Implementation	9
Methodology for Tracking Progress	9
Goals, Management Objectives and Performance Standards	10
Goal 1.0 - §36.1071(a)(1) Providing the Efficient Use of Groundwater	10
Goal 2.0 - §36.1071(a)(2) Controlling and Preventing Waste of Groundwater	10
Goal 3.0 - §36.1071(a)(6) Addressing Drought Conditions	10
Goal 4.0 - §36.1071(a)(7) Addressing Conservation and Precipitation Enhancement	11
Goal 5.0 - §36.1071(a)(8) Addressing the Desired Future Conditions established under §36.108	11

Management Goals Determined Not-Applicable	11
Goal 6.0 - §36.1071(a)(3) Controlling and Preventing Subsidence	11
Goal 7.0 - §36.1071(a)(4) Addressing Conjunctive Surface Water Management Issues .	12
Goal 8.0 - §36.1071(a)(5) Addressing Natural Resource Issues.	12
Goal 9.0 - §36.1071(a)(7) Addressing Recharge Enhancement.	12
Goal 10.0 - §36.1071(a)(7) Addressing Rainwater Harvesting	12
Goal 11.0 - §36.1071(a)(7) Addressing Brush Control	12
Appendix A - GAM Run 16-026 MAG Version 2	12
Appendix B - Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Irion County Water Conservation District.	12
Appendix C - GAM Run 17-013: Irion County Water Conservation District Management Plan .	12
Appendix D - District Rules	12
Appendix E - Resolutions Adopting and Amending the Management Plan.	12
Appendix F - Evidence of Notice and Hearing.	12
Appendix G - Evidence of letters to Surface Water Entities and Region F	12

Irion County Water Conservation District Management Plan 2018-2023

The Irion County Water Conservation District (the “District”) was created by the 69th Texas Legislature under the authority of Section 59, Article XVI, of the Texas Constitution, and in accordance with Chapter 51 and 52 of the Texas Water Code (“Water Code”) as recorded in Section 6, Chapter 65, Acts of the 69th Legislature, Regular Session, 1985. In 1995, by Acts of the 74th Legislature, Chapter 52 of the Water Code was repealed and replaced with Chapter 36 of the Water Code effective September 1, 1995. In 2011, by Acts of the 82nd Legislature, the enabling legislation for the District was recodified in Texas Special District Local Laws Code Ann. ch. 8845 Irion County Water Conservation District.

The District is a governmental agency and a body politic and corporate. The District was created “to provide for the conservation, preservation, protection, recharge, and prevention of waste and pollution of the district’s groundwater and surface water” consistent with the objectives set forth in Section 59, Article XVI, of the Texas Constitution, and Chapter 36, Water Code. The District is composed of the territory described by Section 6, Chapter 65, Acts of the 69th Legislature, Regular Session, 1987, and as that territory has been modified under Chapter 36, Water Code, or other law.

District Mission

The mission of the District is to develop, promote and implement water conservation and management strategies to:

- a) conserve, preserve, and protect the groundwater supplies of the District,
- b) protect and enhance recharge,
- c) prevent waste and pollution, and
- d) to effect the efficient, beneficial and wise use of water for the benefit of the citizens and economy of the District.

The District seeks to protect the groundwater quality and quantity within the District, pursuant to the powers and duties granted under Chapter 36, Subchapter D of the Texas Water Code. Any action taken by the District shall only be after full consideration and respect has been afforded to the individual property rights of all citizens of the District.

The District also seeks to maintain groundwater ownership and rights of the landowners and their lessees as provided in the Texas Water Code §36.002.

Purpose of Management Plan

The 75th Texas Legislature in 1997 enacted Senate Bill 1 (“SB 1”) to establish a comprehensive statewide water planning process. In particular, SB 1 contained provisions that required groundwater conservation districts to prepare management plans to identify the water supply resources and water

demands that will shape the decisions of each district. SB 1 designed the management plans to include management goals for each district to manage and conserve the groundwater resources within their boundaries. In 2001, the Texas Legislature enacted Senate Bill 2 (“SB 2”) to build on the planning requirements of SB 1 and to further clarify the actions necessary for districts to manage and conserve the groundwater resources of the state of Texas.

The Texas Legislature 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 conservation 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 1, 2010 and every five years thereafter. In addition, HB 1763 required GCDs, to share management plans with the other GCDs in the GMA for review by the other GCDs.

The Irion County Water Conservation District’s 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.

Time Period for this Plan

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

Statement of Guiding Principles

The District recognizes that groundwater resources are of the utmost importance for the economy for all groundwater users, first for the residents of the District, and then the region. Also recognized is the importance of understanding the aquifers and aquifer characteristics for proper management of these resources. Integrity and ownership of groundwater are also recognized as important for the management of this precious resource.

The primary goal of the District is to preserve the integrity of the groundwater in the district from all potential contamination sources, mainly oil and gas production and related activities. This is accomplished as the District sets objectives to provide for the conservation, preservation, protection, recharge, prevention of waste and pollution, and efficient use of water including:

- a) acquiring additional hydrogeologic data for the aquifers within the District;
- b) protecting the landowner’s right to the beneficial use of groundwater resources beneath his land;
- c) promulgating rules for the protection of all users while maintaining adequate future supplies and;
- d) cooperation with other local GCD to manage shared groundwater resources.

These objectives are best achieved through guidance from the locally elected board members who

understand the local conditions and can manage the resource for the benefit of the residents of the district and region. The District shall seek to ensure that maximum groundwater withdrawals do not exceed amounts that would be significantly detrimental for future residents of the District.

General Description

History

The residents of Irion County, recognizing the benefit of local control of groundwater resources and the importance of protecting the integrity of groundwater from potential contamination from the vast amount of oil and gas production and associated activities, introduced legislation in the 69th Regular Legislative Session (1985) for creation of the District. A confirmation election was held on August 24, 1985 with a 72% voter turnout and 97% of the voters approving the creation of the District and taxing authority.

Government of the District is by a five member locally elected board with four single member precincts, based on County Precincts, and one member At Large. The directors serve staggered four year terms which provide the voters an opportunity to voice approval or disapproval of the local management of their groundwater resources and/or the services provided by the District.

Location and Extent

The District has an areal extent of 712,800 acres (1,114 square miles) in Irion and Tom Green Counties located in the west-central part of Texas. Elevation ranges from approximately 2,000 to 2,700 feet above mean sea level. Estimated 2020 population is 1,684¹ including the Irion County Seat, the City of Mertzon, and the unincorporated City of Barnhart. Economy in the District consists of agriculture and oil and gas activities. Agriculture land use is mainly range land with limited crop land. The vast majority of irrigated crop land is along Spring Creek using surface water while there is limited groundwater use in other parts of the District.

The majority of the District overlies the Edwards-Trinity (Plateau) Aquifer. Minor aquifers of Dockum and Lipan are also present. The District is included in the Upper Colorado Region of the Colorado River Basin, Region F Regional Water Planning Group and Groundwater Management Area 7.

Regional Cooperation and Coordination

West Texas Regional Groundwater Alliance

Since 1988 the District has been involved in coordination of district activities with other GCD managing the Edwards-Trinity (Plateau) Aquifer. In 1988, four groundwater conservation districts;

¹ Table 2-1, Historical and Projected Population by County, 2016 Region F Water Plan

Coke County UWCD, Glasscock County UWCD, Irion County WCD, and Sterling County UWCD signed an original Cooperative Agreement. As new districts were created, they too signed the Cooperative Agreement. In the fall of 1996, the original Cooperative Agreement was redrafted and the West Texas Regional Groundwater Alliance was created.

The regional alliance consists of seventeen locally created and locally funded groundwater conservation districts covering all or part of twenty-two counties, that encompass approximately 18.2 million acres or 28,368 square miles, of West Central Texas. This West Texas region is as diverse as the State of Texas. Due to the diversity of this region, each member district provides its own unique programs to best serve its constituents. Current member districts are:

Coke Co. UWCD	Crockett Co. GCD	Glasscock GCD
Hickory UWCD # 1	Hill Country UWCD	Irion Co. WCD
Kimble Co. GCD	Lipan-Kickapoo WCD	Lone Wolf GCD
Menard Co. UWD	Middle Pecos GCD	Permian Basin UWCD
Plateau UWC & SD	Santa Rita UWCD	Sterling Co. UWCD
Sutton Co. UWCD	Wes-Tex GCD	

This Alliance was created because the local districts have a common objective: to facilitate the conservation, preservation, protection of groundwater supplies, protection and enhancement of recharge, prevention of waste and pollution, and beneficial use of water and related resources. Local districts monitor water-related activities which include but are not limited to the State’s largest industries of farming, ranching and oil and gas production. The alliance provides coordination essential to the activities of these member districts as they monitor these activities in order to accomplish their objectives.

West Texas Weather Modification Association

In 1996, in response to the resident landowners of seven groundwater conservation districts, the West Texas Weather Modification Association was formed for the purpose of providing weather modification (cloud seeding) for rainfall and recharge enhancement throughout the geographical region of its members. The target area of the Association includes all of seven counties and part of an 8th for a total area of over 5.8 million acres or 9,000 square miles of West Central Texas.

Current membership includes:

City of San Angelo	Crockett Co GCD	Irion County WCD
Plateau UWC & SD	Santa Rita UWCD	Sterling County UWCD
	Sutton County UWCD	

Recognizing the importance of rainfall in the region, this Association was formed to provide benefits from enhanced rainfall which includes a reduction of groundwater withdrawals, increase in runoff, increase in agricultural productivity with the resulting economic impact for the region, provide additional recharge, and increase spring flow. These benefits are not only realized within the region

but also downwind and down stream of the target area.

Regional Water Planning

The District has been active in the Region F, Regional Water Planning Group meetings to provide input in developing and adopting the 2001, 2006, 2011 and 2016 Regional plans. As the Regional Planning Group moves toward adopting future Regional Plans the District will continue to participate in the planning process.

Groundwater Management Area

Groundwater Management Area 7 covers all or part of thirty-three counties and includes twenty-one groundwater conservation districts. These GCD's manage groundwater resources at the local level in all or part of twenty-four counties within GMA 7 and surrounding areas. The District continues to actively participate in meetings and discussions to determine a feasible future desired condition of the aquifers within the management area and district.

Groundwater Resources

Edwards-Trinity (Plateau) Aquifer

Edwards-Trinity (Plateau) Aquifer is a major aquifer extending across much of the southwestern part of the state. The water-bearing units are composed predominantly of limestone and dolomite of the Edwards Group and sands of the Trinity Group. Although maximum saturated thickness of the aquifer is greater than 800 feet, freshwater saturated thickness averages 433 feet. Water quality ranges from fresh to slightly saline, with total dissolved solids ranging from 100 to 3,000 milligrams per liter, and water is characterized as hard within the Edwards Group. Water typically increases in salinity to the west within the Trinity Group. Elevated levels of fluoride in excess of primary drinking water standards occur within Glasscock and Irion counties. Springs occur along the northern, eastern, and southern margins of the aquifer primarily near the bases of the Edwards and Trinity groups where exposed at the surface. San Felipe Springs is the largest exposed spring along the southern margin. Of groundwater pumped from this aquifer, more than two-thirds is used for irrigation, with the remainder used for municipal and livestock supplies. Water levels have remained relatively stable because recharge has generally kept pace with the relatively low amounts of pumping over the extent of the aquifer.²

Dockum Aquifer

The Dockum Aquifer is a minor aquifer found in the northwest part of the state. It is defined stratigraphically by the Dockum Group and includes, from oldest to youngest, the Santa Rosa Formation, the Tecovas Formation, the Trujillo Sandstone, and the Cooper Canyon Formation. The

² Texas Water Development Board, Report 380, Aquifers of Texas

Dockum Group consists of gravel, sandstone, siltstone, mudstone, shale, and conglomerate. Groundwater located in the sandstone and conglomerate units is recoverable, the highest yields coming from the coarsest grained deposits located at the middle and base of the group. Typically, the water-bearing sandstones are locally referred to as the Santa Rosa Aquifer. The water quality in the aquifer is generally poor—with freshwater in outcrop areas in the east and brine in the western subsurface portions of the aquifer—and the water is very hard. Naturally occurring radioactivity from uranium present within the aquifer has resulted in gross alpha radiation in excess of the state’s primary drinking water standard. Radium-226 and -228 also occur in amounts above acceptable standards. Groundwater from the aquifer is used for irrigation, municipal water supply, and oil field waterflooding operations, particularly in the southern High Plains. Water level declines and rises have occurred in different areas of the aquifer.³

Lipan Aquifer

The Lipan Aquifer is a minor aquifer found in parts of Coke, Concho, Glasscock, Irion, Runnels, Schleicher, Sterling, and Tom Green counties in west-central Texas. The aquifer includes water-bearing alluvium and the updip portions of older, underlying strata. The alluvium includes as much as 125 feet of saturated sediments of the Quaternary Leona Formation. These deposits consist mostly of gravels and conglomerates cemented with sandy lime and layers of clay. The formation generally fines upward with conglomerates existing mainly in locations of thicker alluvium. The underlying strata include the San Angelo Sandstone of the Pease River Group and the Choza Formation, Bullwagon Dolomite, Vale Formation, Standpipe Limestone, and Arroyo Formation of the Clear Fork Group. These units are predominantly limestones and shales. Groundwater in the alluvial deposits and the upper parts of the older rocks is hydraulically connected, and most wells in the area are completed in both units. Groundwater flow in the Lipan Aquifer does not appear to be structurally controlled. Higher production wells appear to correspond to alluvial deposits overlying the Choza, Bullwagon, and Vale formations. In these areas, thick alluvial deposits with conglomerates lie near the contact with the Permian. Groundwater in the alluvium ranges from fresh to slightly saline, containing between 350 and 3,000 milligrams per liter of total dissolved solids, and is very hard. Water in the underlying parts of the Choza Formation and Bullwagon Dolomite tends to be moderately saline with total dissolved solids in excess of 3,000 milligrams per liter. The aquifer is primarily used for irrigation but also supports livestock and municipal, domestic, and manufacturing uses. Because of drought and heavy irrigation pumping in the late 1990s, water levels decreased significantly in some areas, and the aquifer could not be pumped through the entire irrigation season. In other areas, however, the aquifer could be pumped, but only at a reduced rate.⁴

Technical District Information Required by Texas Administrative Code

Estimate of modeled available groundwater in District based on desired future conditions. Texas Water Code § 36.001 defines modeled available groundwater as “the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired

³ Ibid

⁴ Ibid

future condition established under Section 36.108.”

The joint planning process set forth in Texas Water Code § 36.108 must be collectively conducted by all groundwater conservation districts within the same GMA. The District is a member of GMA 7. GMA 7 declared the Dockum and Lipan Aquifers as not relevant for regional planning purposes in the Irion County Water Conservation District on September 22, 2016 and adopted DFCs for the Edwards/Trinity (Plateau) Aquifer on March 22, 2018. The adopted DFCs were forwarded to the TWDB for development of the MAG calculations. The submittal package for the DFCs can be found here: http://www.twdb.texas.gov/groundwater/management_areas/DFC.asp.

A summary of the desired future conditions and the modeled available groundwater are summarized below.

Edwards/Trinity (Plateau) Aquifer: An average drawdown of 10 feet for the Edwards-Trinity (Plateau) aquifer, except for the Kinney County GCD, based on the GMA 7 Technical Memorandum 18-01.

Dockum Aquifer: Not relevant for joint planning purposes within the boundaries of Irion County Water Conservation District.

Lipan Aquifer: Not relevant for joint planning purposes within the boundaries of Irion County Water Conservation District.

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

	Year					
	2010	2020	2030	2040	2050	2060
Irion Co WCD	3,289	3,289	3,289	3,289	3,289	3,289

Modeled Available Groundwater in the District.

Please refer to Appendix A

Amount of Groundwater being Used within the District on an Annual Basis

Please refer to Appendix B

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

Please refer to Appendix C

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

Please Refer to Appendix C

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

Please refer to Appendix C

Projected Surface Water Supplies within the District

Please refer to Appendix B

Projected Total Demand for Water within the District

Projected water demands exceed projected available groundwater for mining in Irion. Please refer to Appendix B

Water Supply Needs

Projected supply needs exceed the projected demands for Irrigation and Mining in Irion County. The portion of Tom Green County within the district has sufficient supply to meet demands.

Please refer to Appendix B

Water Management Strategies

The district continues to encourage conservation, reuse and weather modification to meet the projected strategies in the TWDB 2017 State Water Plan. Please refer to Appendix B

Actions, Procedures, Performance and Avoidance for Plan Implementation

The District will implement and utilize the provisions of this plan as a guide for determining the direction and/or priority for District activities. Operations of the District and all agreements entered into by the District will be consistent with the provisions of this plan.

The District has adopted rules for the management of groundwater resources and will amend those rules as necessary pursuant to TWC Chapter 36 and the provisions of this plan. The promulgation of the rules will be based on the best technical evidence available. Current rules are available at <http://www.irionwcd.org/rules>.

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

Methodology for Tracking Progress

The methodology that the District will use to track the progress in achieving the management goals will be as follows: the District holds a regular monthly Board Meeting for the purpose of conducting District business. Each month the Managers Report will reflect meetings attended, water samples collected and analyzed, water levels monitored, fluid injection permit applications, reports on any school or civic group programs, resulting action regarding potential contamination or remediation of actual contamination, and other matters of district importance.

Goals, Management Objectives and Performance Standards

Goal 1.0 - §36.1071(a)(1) Providing the Efficient Use of Groundwater

Gather groundwater data both to improve the understanding of the aquifers and their hydrogeologic properties and to quantify this resource for prudent planning and efficient use.

1.1. Management Objective

The District will measure, record, and accumulate a historic record of static water levels in the monitoring network quarterly.

1.1a. Performance Standard

Water level measurements will be reported quarterly at regular board meetings.

Goal 2.0 - §36.1071(a)(2) Controlling and Preventing Waste of Groundwater

Minimize potential contamination of the groundwater by monitoring the drilling, spacing and completion of wells.

2.1. Management Objective

The District will register new wells drilled within the district in accordance with District Rules.

2.1a. Performance Standard

The District will maintain files including information on the drilling, spacing and completion of all new wells drilled within the District. Wells registered will be reported quarterly at regular board meetings.

Goal 3.0 - §36.1071(a)(6) Addressing Drought Conditions

3.1. Management Objective

The District will monitor the NOAA Climate Prediction Center, <http://www.cpc.ncep.noaa.gov/> and the TWDB drought page, <https://waterdatafortexas.org/drought/>, and report quarterly at regular board meetings

3.1a. Performance Standard

Number of times index is reported.

3.2 .Management Objective

The District will maintain the rainfall monitor network.

3.2a. Performance Standard

Number of times rainfall network is monitored.

Goal 4.0 - §36.1071(a)(7) Addressing Conservation and Precipitation Enhancement

4.1 Management Objective - Conservation

The District will continue to be a source for available informational materials and programs to improve public awareness of efficient use, wasteful practices and conservation measures including the water conservation best management practices guide presented by the Water Conservation Advisory Council: <http://www.savetexaswater.org/bmp/>.

4.1a. Performance Standard

Number of informational materials and programs provided.

4.2 Management Objective - Precipitation Enhancement

The District will continue to participate in the West Texas Weather Modification Association.

4.2a. Performance Standard

Number of meetings attended.

Goal 5.0 - §36.1071(a)(8) Addressing the Desired Future Conditions established under §36.108

Gather groundwater and rainfall data both to improve the understanding of the aquifers and their hydrogeologic properties and to achieve desired future conditions.

5.1 Management Objective

The District will each year measure, record, and accumulate an historic record of static water levels and rainfall accumulation in the well and rainfall monitoring networks to evaluate adherence to adopted desired future conditions.

5.1a. Performance Standard

The District will maintain files including number of water levels measured and static levels information on the well monitoring network. Water level measurements will be reported quarterly at regular board meetings and wells tracked by the TWDB will be reported annually.

5.1b. Performance Standard

The District will maintain files including number of rain gauges downloaded and rainfall accumulation from the rainfall monitoring network.

Management Goals Determined Not-Applicable

Goal 6.0 - §36.1071(a)(3) Controlling and Preventing Subsidence

The rigid geologic framework of the region precludes significant subsidence from occurring. This management goal is not applicable to the operations of the District.

Goal 7.0 - §36.1071(a)(4) Addressing Conjunctive Surface Water Management Issues

There are no surface water management entities within the District. This management goal is not applicable to the operations of the District.

Goal 8.0 - §36.1071(a)(5) Addressing Natural Resource Issues

The District has no documented occurrence of endangered or threatened species dependent upon groundwater. This management goal is not applicable to the operations of the District.

Goal 9.0 - §36.1071(a)(7) Addressing Recharge Enhancement

The diverse topography, and limited knowledge of any specific recharge sites makes any type of recharge enhancement project economically unfeasible. This management goal is not applicable to the operation of the District.

Goal 10.0 - §36.1071(a)(7) Addressing Rainwater Harvesting

The semiarid nature of the area within the District makes the cost of rainwater harvesting projects economically unfeasible. Educational material and programs on rainwater harvesting are provided by the Texas AgriLife Extension Service. This management goal is not applicable to the operations of the District.

Goal 11.0 - §36.1071(a)(7) Addressing Brush Control

The District recognizes the benefits of brush control through increased spring flows and the enhancement of native turf which limits runoff. However, most brush control projects within the District are carried out and funded through the Natural Resources Conservation Service (NRCS) and ample educational material and programs on brush control are provided by the Texas AgriLife Extension Service. This management goal is not applicable to the operations of the District.

Appendix A - GAM Run 16-026 MAG Version 2

Appendix B - Estimated Historical Groundwater Use and 2017 State Water Plan Datasets: Irion County Water Conservation District

Appendix C - GAM Run 17-013: Irion County Water Conservation District Management Plan

Appendix D - District Rules

Appendix E - Resolutions Adopting and Amending the Management Plan

Appendix F - Evidence of Notice and Hearing

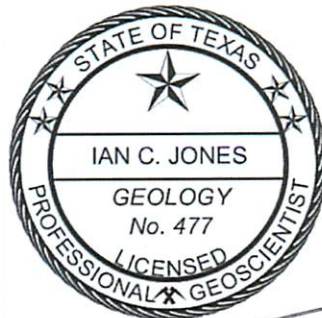
Appendix G - Evidence of letters to Surface Water Entities and Region F

APPENDIX A

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

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



I. C. Jones
9/24/2018

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

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

EXECUTIVE SUMMARY:

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

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

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

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

REQUESTOR:

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

DESCRIPTION OF REQUEST:

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

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

Capitan Reef [Complex] Aquifer

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

Dockum Aquifer

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

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

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

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

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

Taylor	0
Terrell	2
Upton	20
Uvalde	2

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

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

Minor Aquifers of the Llano Uplift Area

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

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

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

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

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

Ogallala Aquifer

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

Rustler Aquifer

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

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

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

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

Capitan Reef Complex Aquifer

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

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

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

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

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

Kinney County

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

Val Verde County

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

Minor Aquifers of the Llano Uplift Area

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

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

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

Dockum Aquifer

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

Modeled available groundwater analysis excludes pass-through cells.

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

Ogallala Aquifer

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

Modeled available groundwater analysis excludes pass-through cells.

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

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

Rustler Aquifer

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

Use 2008 recharge conditions throughout the predictive period.

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

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

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

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

METHODS:

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

For relevant aquifers with desired future conditions based on water-level drawdown, water levels simulated at the end of the predictive simulations were compared to specified

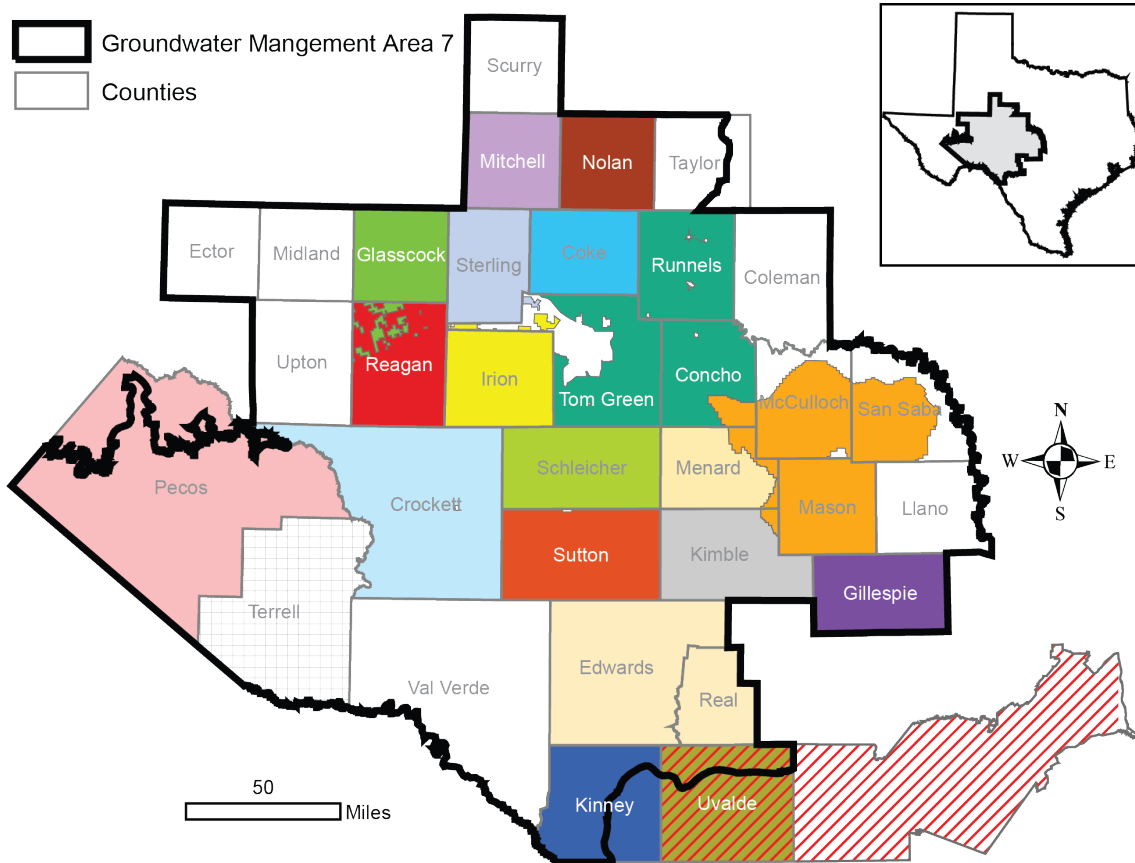
baseline water levels. In the case of the High Plains Aquifer System (Dockum and Ogallala aquifers) and the minor aquifers of the Llano Uplift area (Ellenburger-San Saba and Hickory aquifers), baseline water levels represent water levels at the end of the calibrated transient model are the initial water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

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

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

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

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



Groundwater Conservation Districts

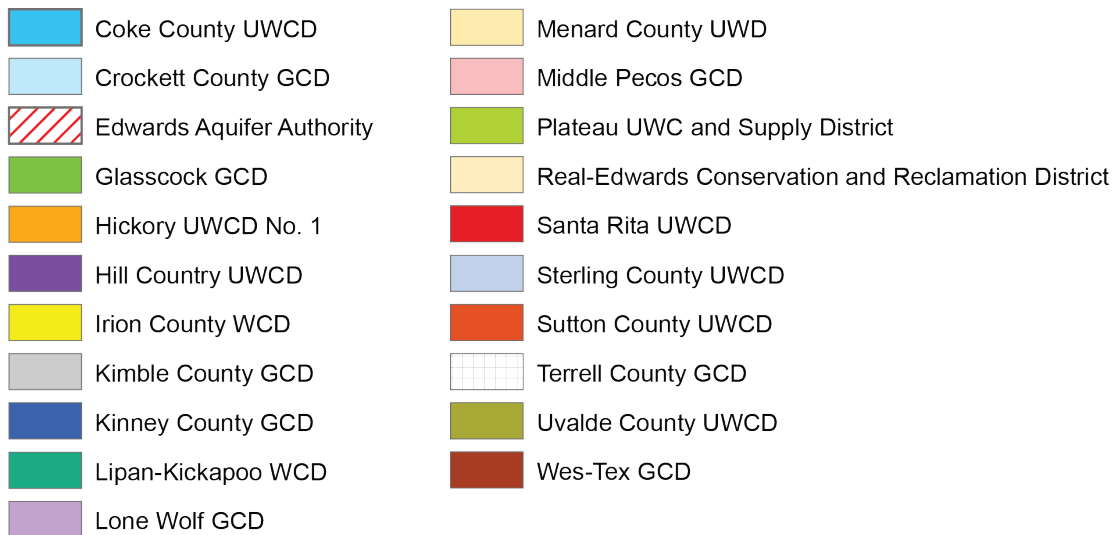


FIGURE 1. MAP SHOWING THE GROUNDWATER CONSERVATION DISTRICTS (GCD) IN GROUNDWATER MANAGEMENT AREA 7. NOTE: THE BOUNDARIES OF THE EDWARDS AQUIFER AUTHORITY OVERLAP WITH THE UVALDE COUNTY UNDERGROUND WATER CONSERVATION DISTRICT (UWCD).

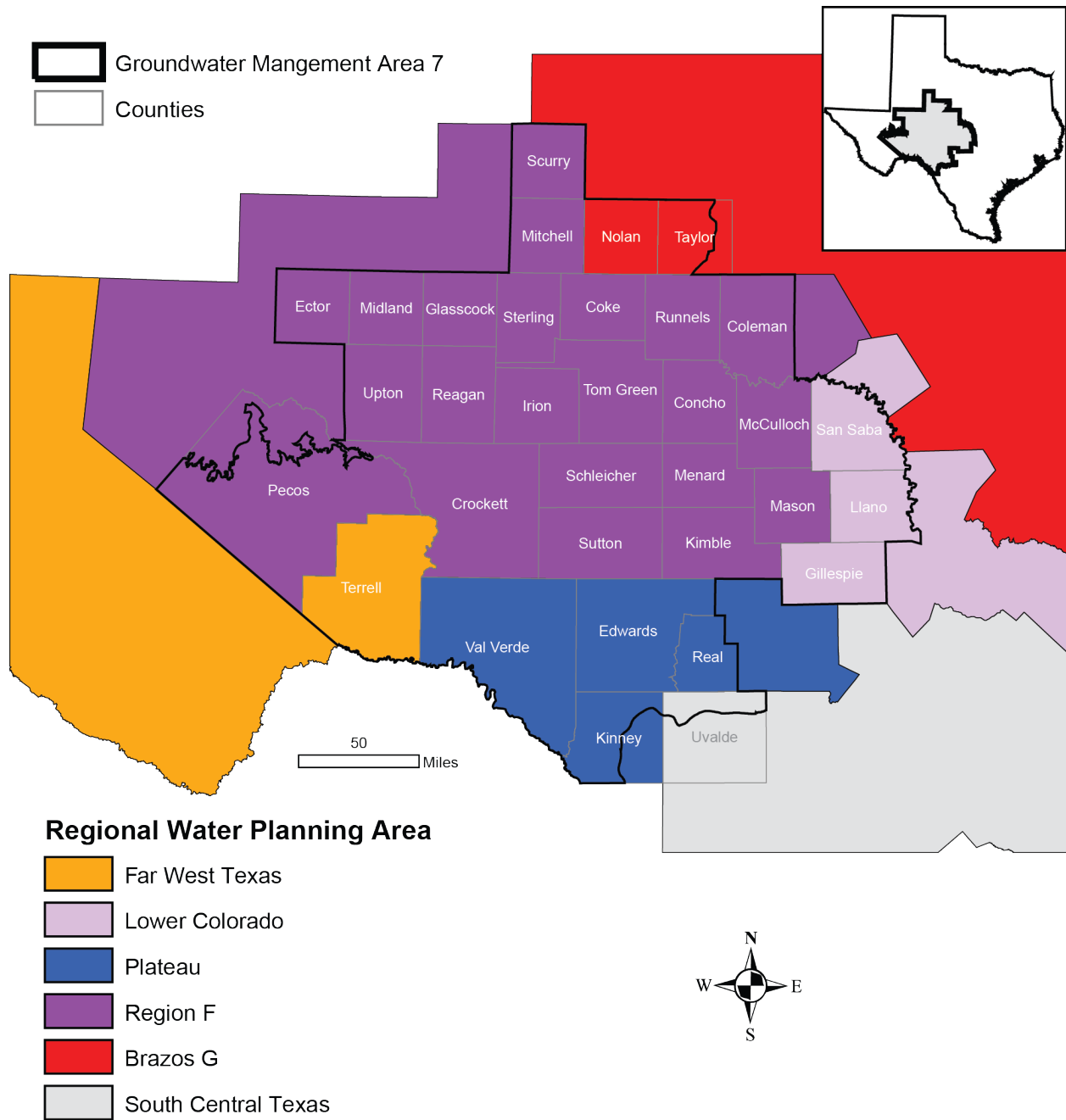


FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS IN GROUNDWATER MANAGEMENT AREA 7.

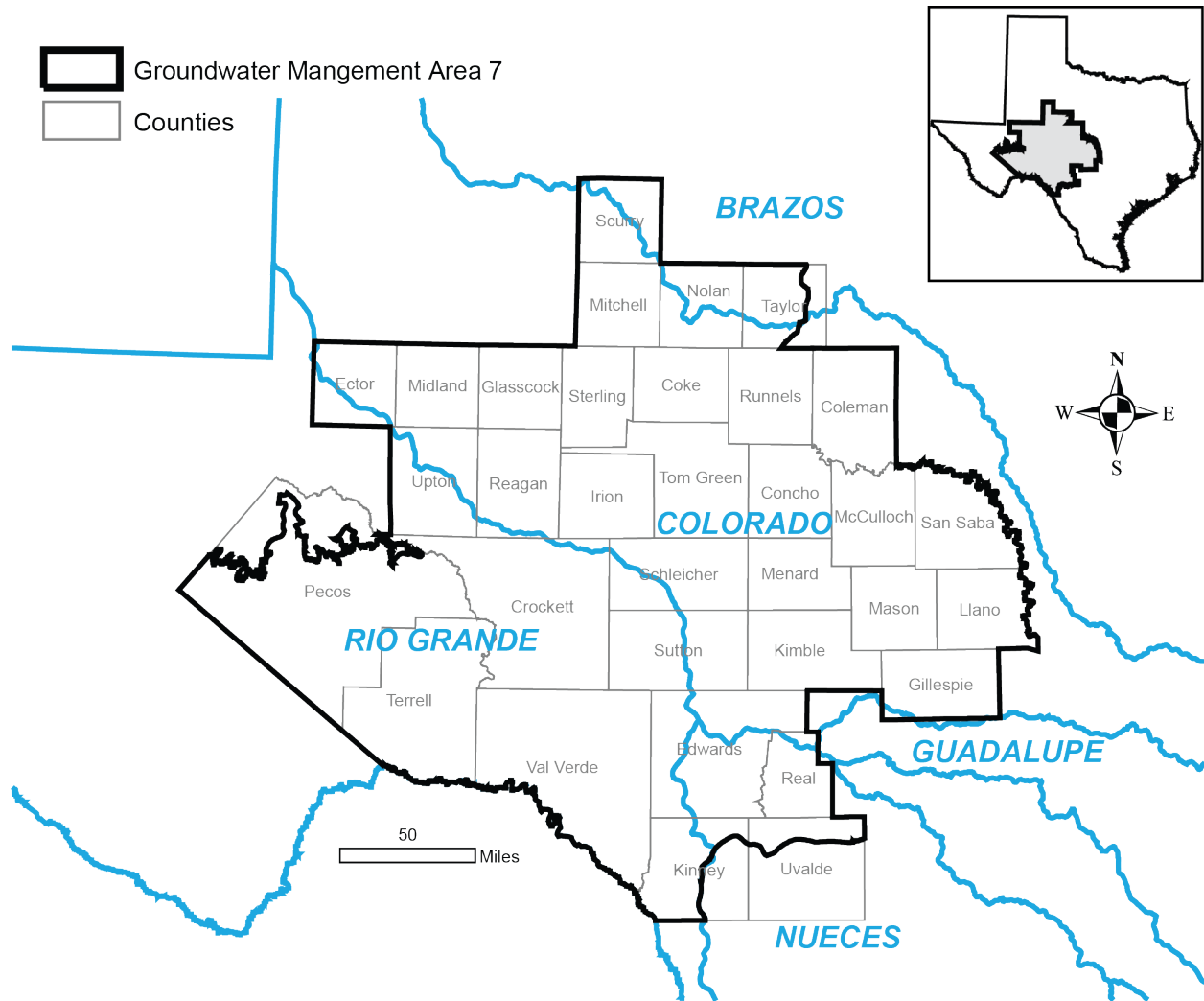


FIGURE 3. MAP SHOWING RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 7. THESE INCLUDE PARTS OF THE BRAZOS, COLORADO, GUADALUPE, NUECES, AND RIO GRANDE RIVER BASINS.

PARAMETERS AND ASSUMPTIONS:

Capitan Reef Complex Aquifer

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

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

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

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

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

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

Dockum and Ogallala Aquifers

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

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

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

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

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

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

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

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

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

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

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

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

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

Edwards-Trinity (Plateau) Aquifer of Kinney County

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

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

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

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

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

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

Edwards-Trinity (Plateau) Aquifer of Val Verde County

The single-layer numerical groundwater flow model for the Edwards-Trinity (Plateau) Aquifer of Val Verde County was used for this analysis. This model is based on the previously developed alternative groundwater model of the Kinney County area documented in Hutchison and others (2011b). See EcoKai (2014) for assumptions and

limitations of the model. See Hutchison (2016e; 2018b) for details on the assumptions used for predictive simulations, including recharge and pumping assumptions.

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

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

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

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

Rustler Aquifer

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

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

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

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

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

Minor aquifers of the Llano Uplift Area

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

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

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

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

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

Therefore, all drawdowns were included in the averaging.

RESULTS:

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

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

water levels were below the base elevation of the cell ("dry" cells) in parts of Glasscock County. Please note that MODFLOW-NWT automatically reduces pumping as water levels decline.

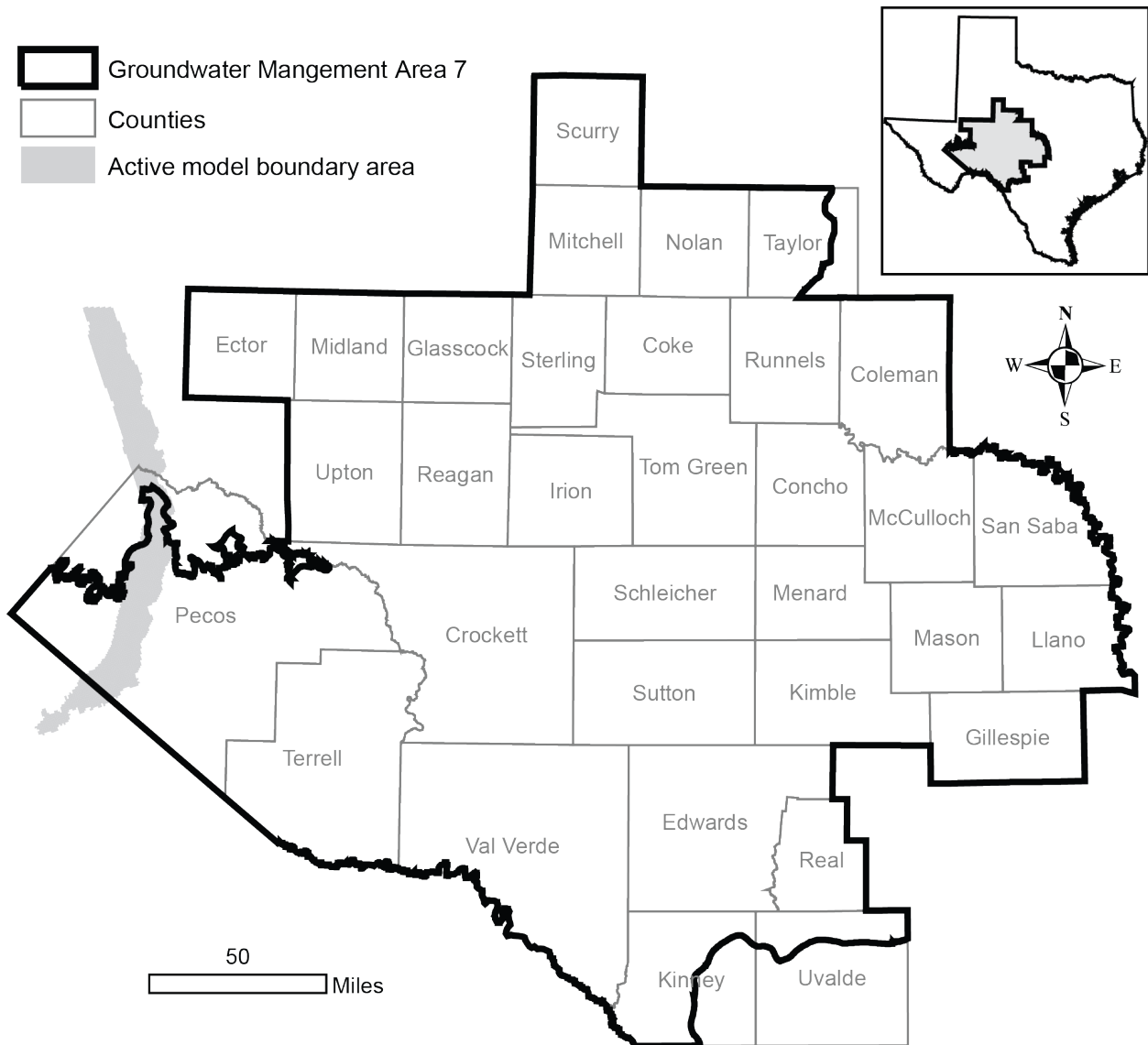


FIGURE 4. MAP SHOWING THE AREAS COVERED BY THE CAPITAN REEF COMPLEX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EASTERN ARM OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.

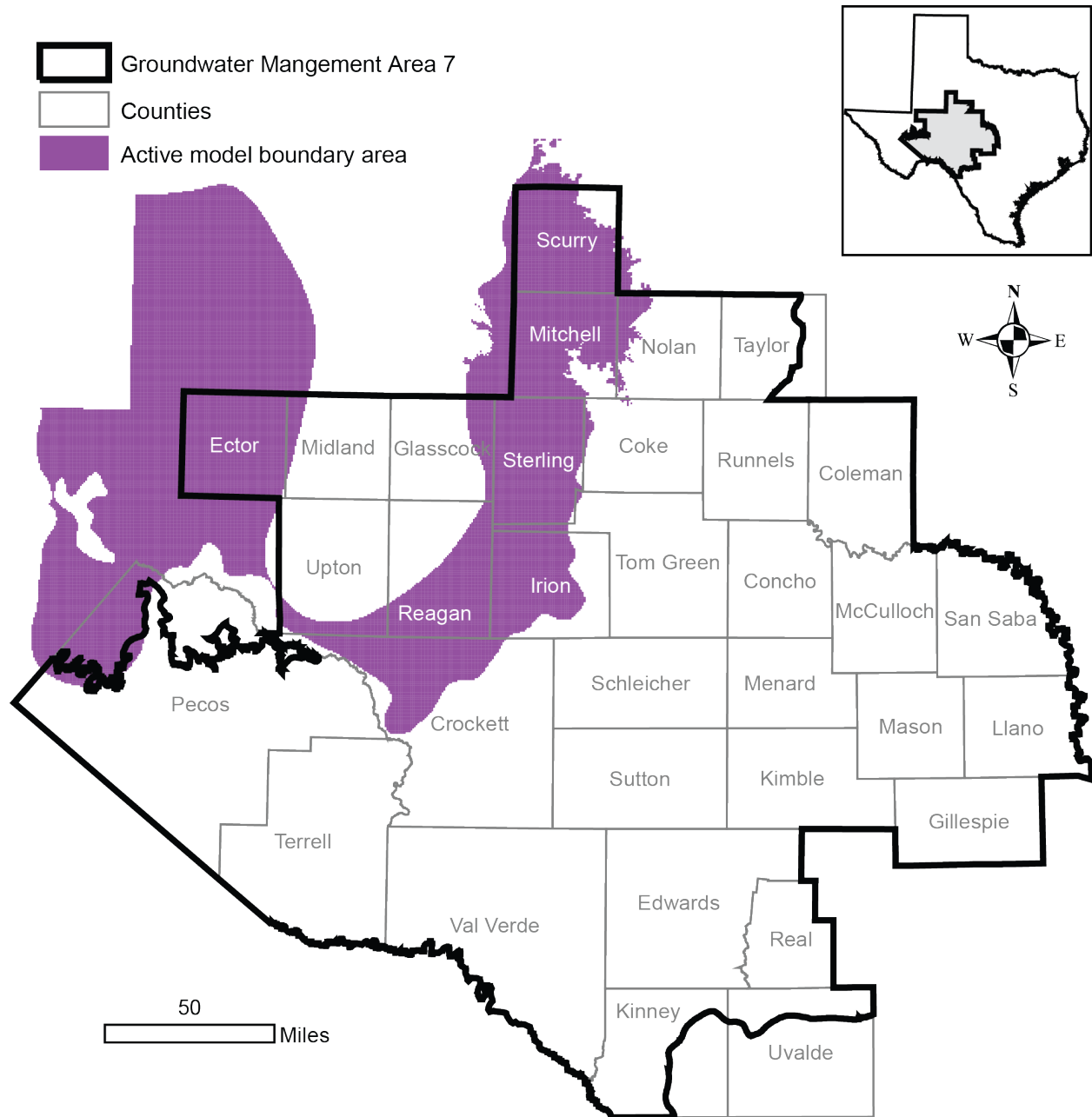


FIGURE 5. MAP SHOWING AREAS COVERED BY THE DOCKUM AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.

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

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

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

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

County	RWPA	River Basin	Year					
			2020	2030	2040	2050	2060	2070
Pecos	F	Rio Grande	2,022	2,022	2,022	2,022	2,022	2,022
		Total	2,022	2,022	2,022	2,022	2,022	2,022
Reagan	F	Colorado	302	302	302	302	302	302
		Rio Grande	0	0	0	0	0	0
		Total	962	962	962	962	962	962
GMA 7			2,324	2,324	2,324	2,324	2,324	2,324

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

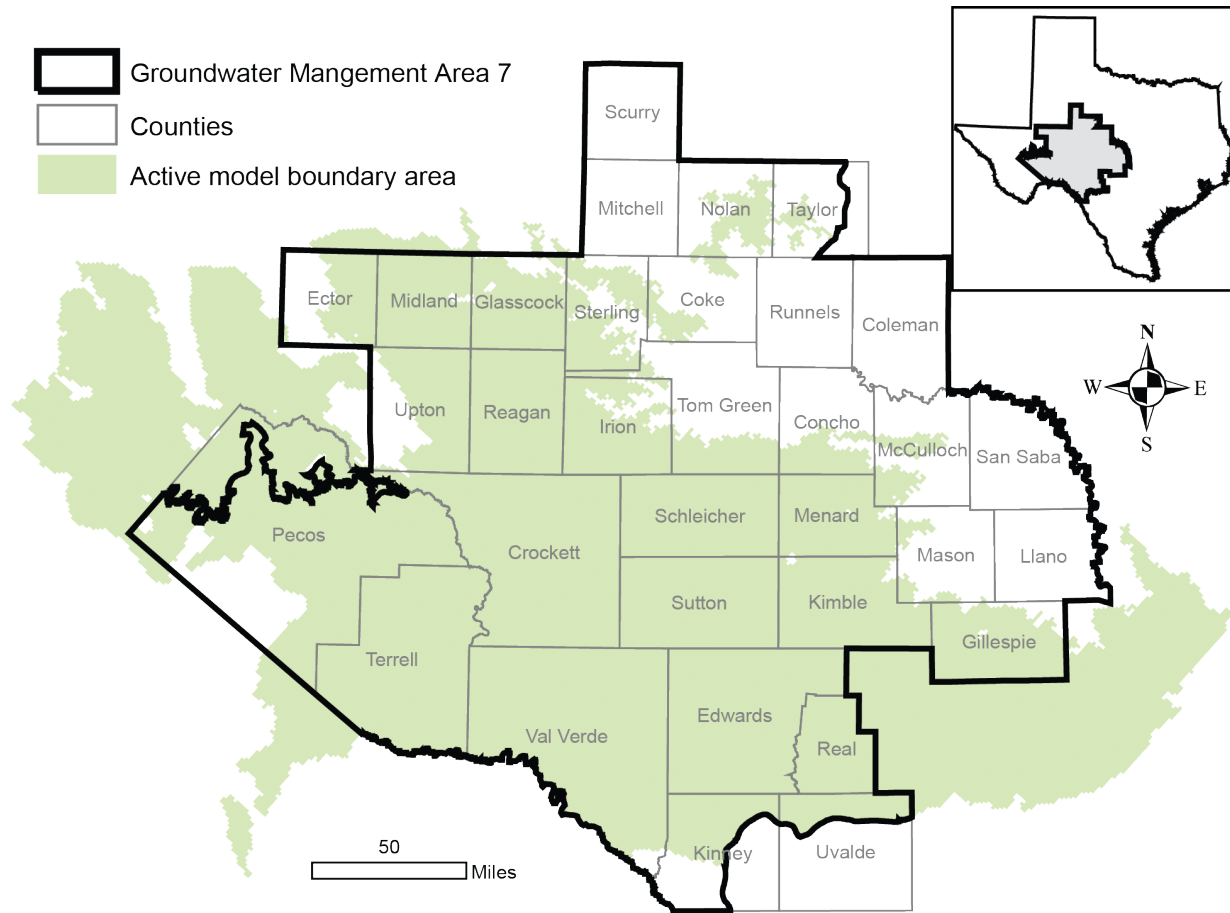


FIGURE 6. MAP SHOWING THE AREAS COVERED BY THE UNDIFFERENTIATED EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS IN THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7.

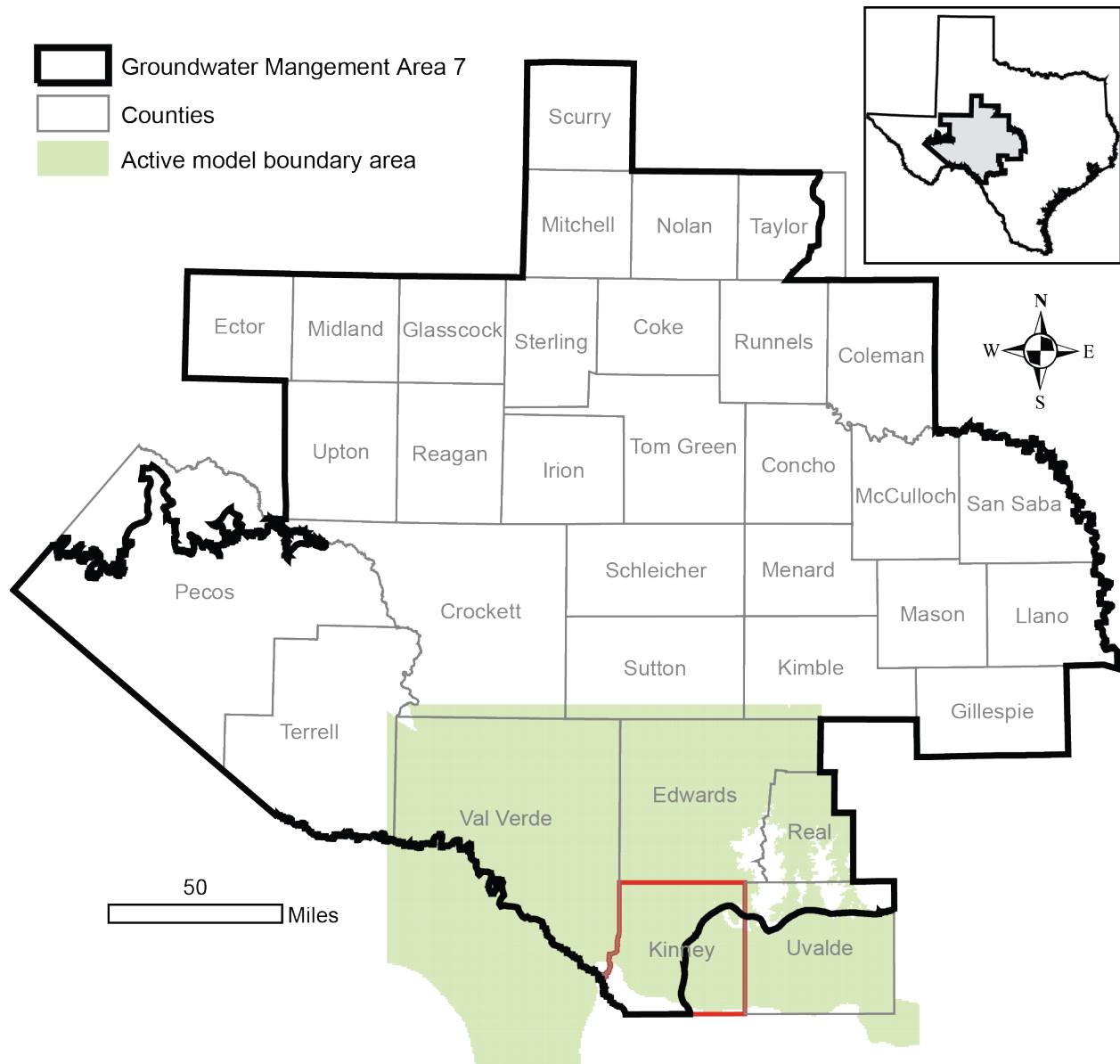


FIGURE 7. MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE ALTERNATIVE MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN KINNEY COUNTY.

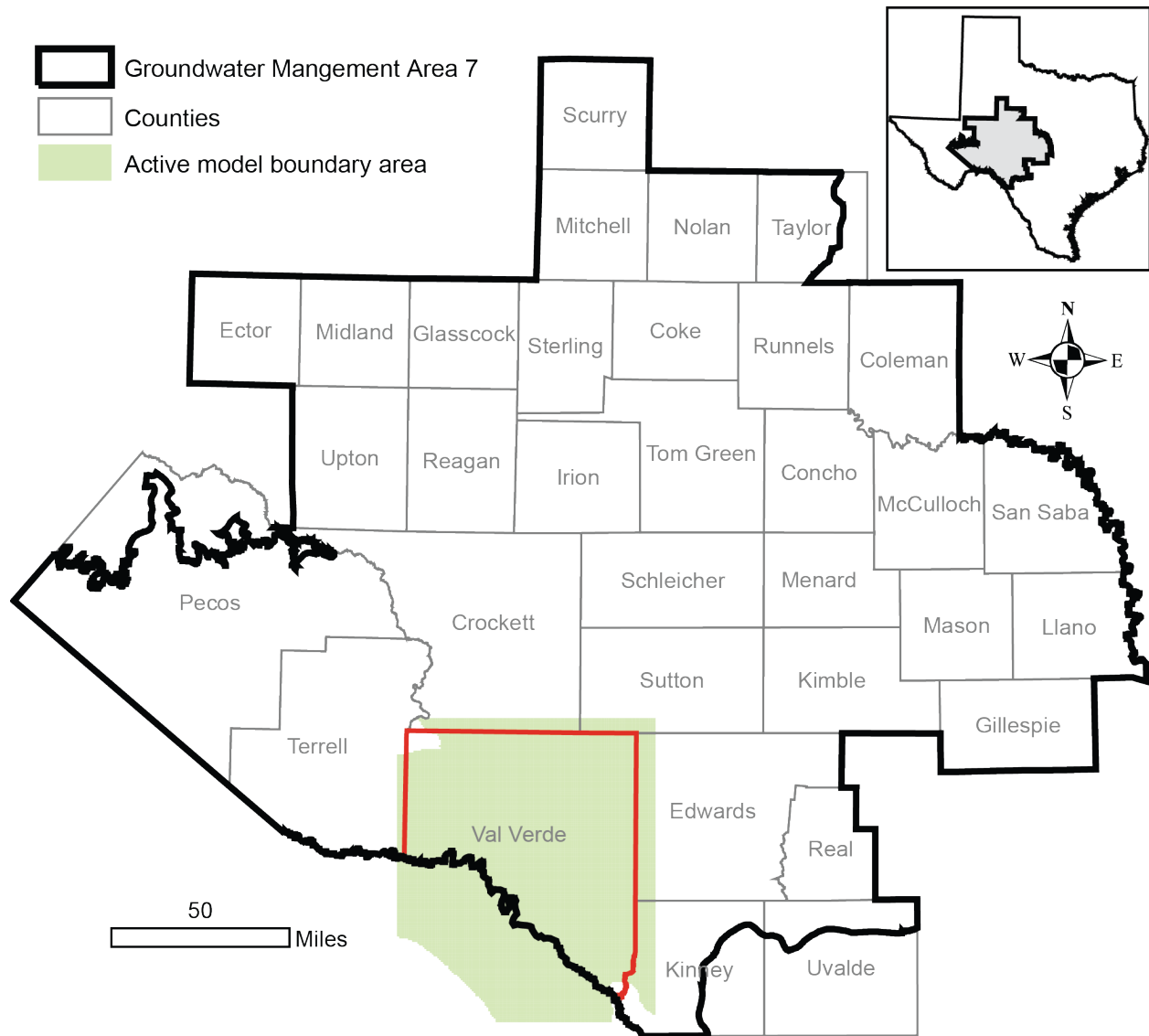


FIGURE 8. MAP SHOWING THE AREAS COVERED BY THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN THE GROUNDWATER FLOW MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN VAL VERDE COUNTY.

TABLE 5. (CONTINUED).

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

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

TABLE 6. (CONTINUED).

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

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

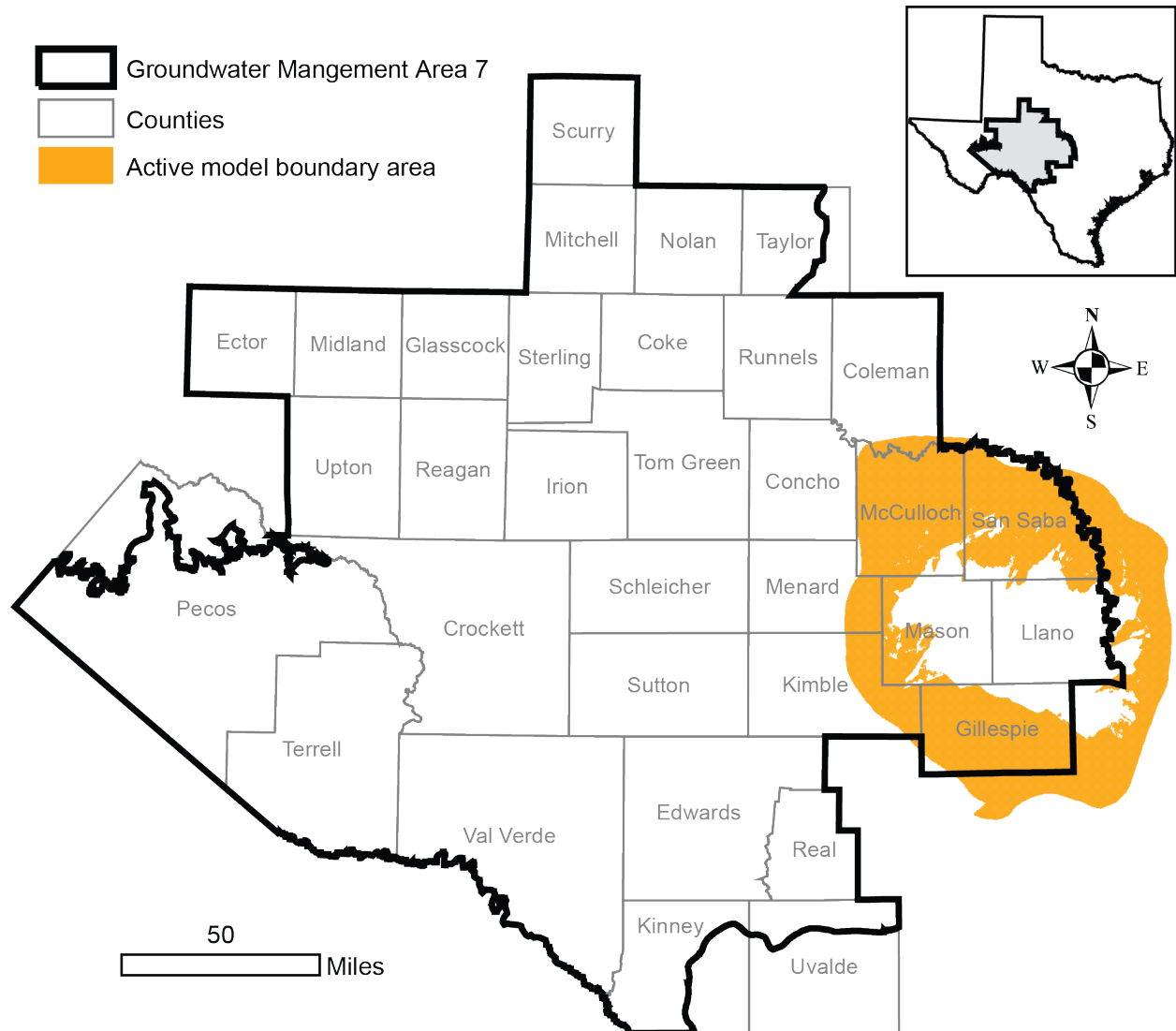


FIGURE 9. MAP SHOWING THE AREAS COVERED BY THE ELLENBURGER-SAN SABA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.

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

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

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

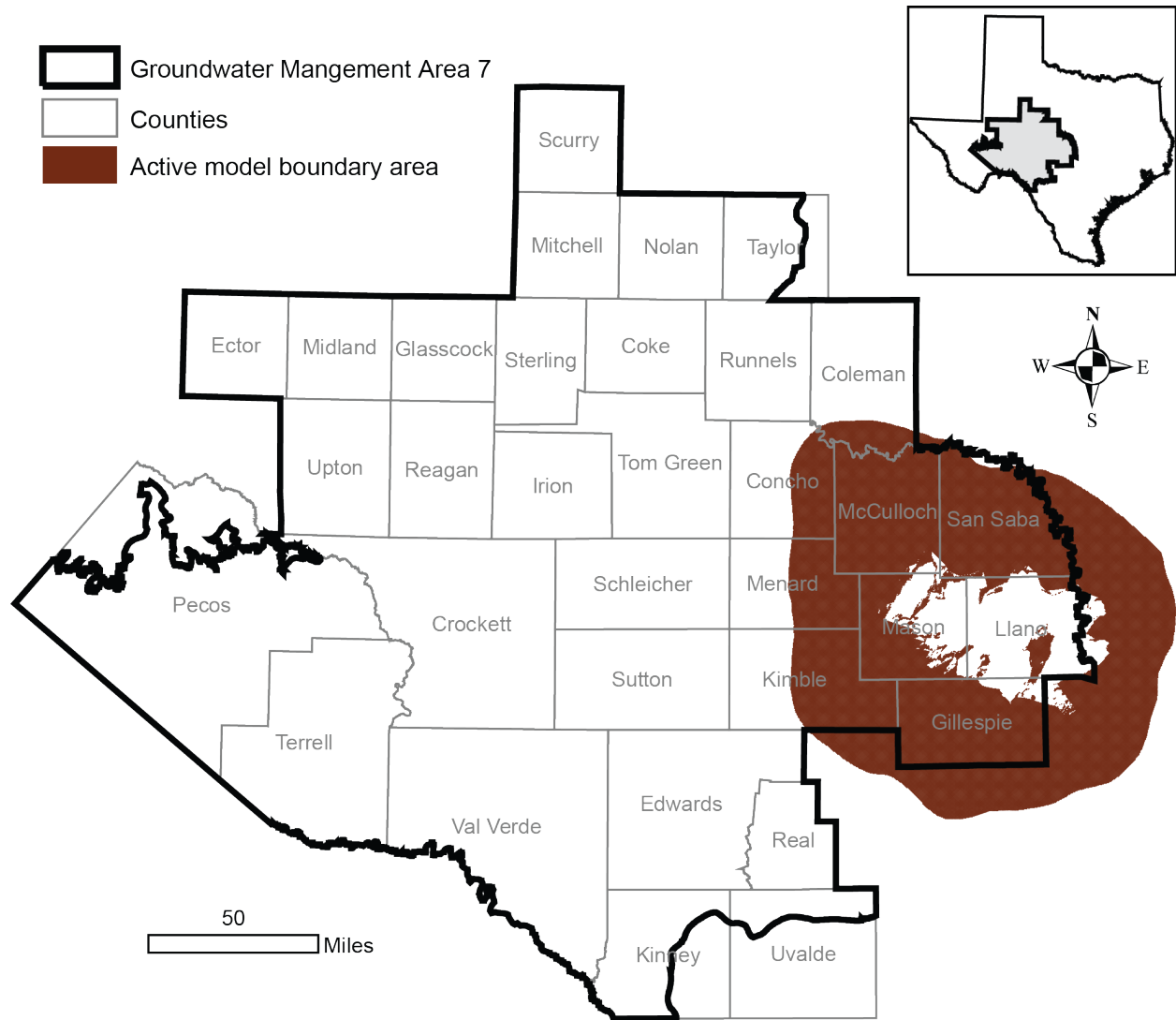


FIGURE 10. MAP SHOWING AREAS COVERED BY THE HICKORY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS OF THE LLANO UPLIFT AREA IN GROUNDWATER MANAGEMENT AREA 7.

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

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

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

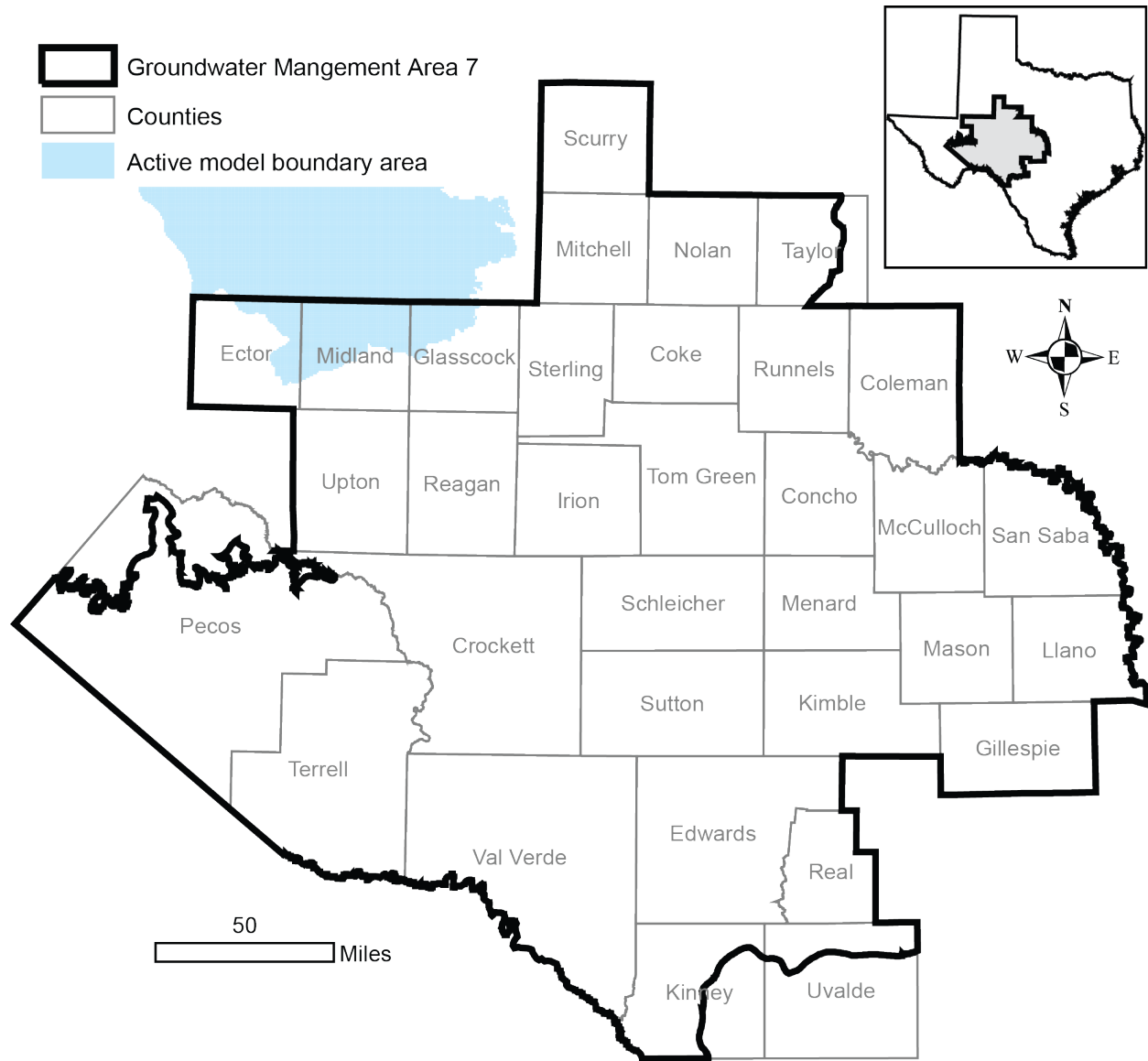


FIGURE 11. MAP SHOWING THE AREAS COVERED BY THE OGALLALA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM IN GROUNDWATER MANAGEMENT AREA 7.

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

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

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

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

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

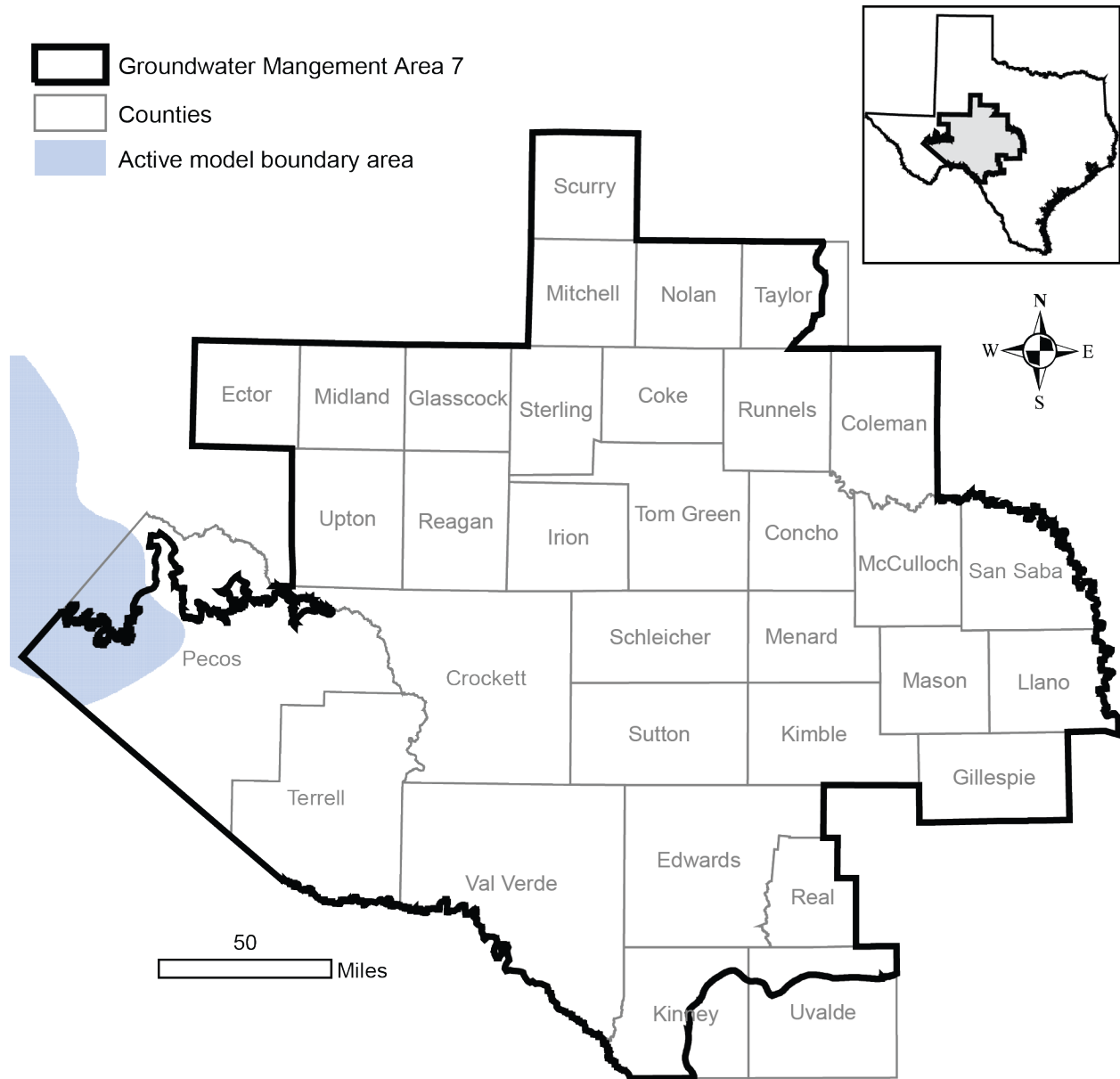


FIGURE 12. MAP SHOWING AREAS COVERED BY THE RUSTLER AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 7.

LIMITATIONS:

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

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

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

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

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

Model “Dry” Cells

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

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APPENDIX B

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Estimated Historical Groundwater Use And 2017 State Water Plan Datasets:

Irion County Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
February 13, 2018

GROUNDWATER MANAGEMENT PLAN DATA:

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

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

The five reports included in this part are:

1. Estimated Historical Groundwater Use (checklist item 2)
from the TWDB Historical Water Use Survey (WUS)
2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)
from the 2017 Texas State Water Plan (SWP)

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

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 2/13/2018. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

<http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/>

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

The values presented in the data tables of this report 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 ask each district to identify these entity locations).

The remaining SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not modified because district-specific values are not statutorily required. Each district needs only "consider" the county values in these tables.

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 perfect but it is the best available process with respect to time and staffing constraints. If a district believes it has data that is more accurate it 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

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2016. TWDB staff anticipates the calculation and posting of these estimates at a later date.

IRION COUNTY

100% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2015	GW	157	6	1,610	0	93	159	2,025
	SW	0	0	0	0	554	40	594
2014	GW	181	6	3,163	0	100	157	3,607
	SW	0	0	0	0	686	39	725
2013	GW	178	3	3,119	0	137	153	3,590
	SW	0	0	0	0	607	38	645
2012	GW	220	2	2,371	0	57	167	2,817
	SW	0	0	0	0	918	42	960
2011	GW	201	2	1,076	0	315	230	1,824
	SW	0	0	297	0	1,060	57	1,414
2010	GW	194	1	323	0	52	220	790
	SW	0	0	89	0	1,334	55	1,478
2009	GW	182	3	240	0	275	208	908
	SW	0	0	66	0	1,200	52	1,318
2008	GW	176	2	157	0	662	214	1,211
	SW	0	0	43	0	0	54	97
2007	GW	172	1	0	0	417	178	768
	SW	0	0	0	0	0	44	44
2006	GW	195	1	0	0	700	179	1,075
	SW	0	0	0	0	0	45	45
2005	GW	191	1	0	0	220	167	579
	SW	0	0	0	0	1,280	42	1,322
2004	GW	186	1	0	0	127	156	470
	SW	0	0	0	0	1,478	39	1,517
2003	GW	190	2	0	0	352	154	698
	SW	0	0	0	0	2,123	38	2,161
2002	GW	208	1	0	0	782	223	1,214
	SW	0	0	0	0	882	56	938
2001	GW	173	1	0	0	782	231	1,187
	SW	0	0	0	0	882	58	940
2000	GW	182	1	0	0	987	254	1,424
	SW	0	0	0	0	1,118	64	1,182

TOM GREEN COUNTY

3.35% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2015	GW	150	18	0	0	1,607	17	1,792
	SW	433	6	0	0	84	4	527
2014	GW	119	15	0	0	1,415	16	1,565
	SW	466	8	0	0	104	4	582
2013	GW	136	13	0	0	1,140	17	1,306
	SW	465	8	0	0	102	4	579
2012	GW	131	13	0	0	1,768	37	1,949
	SW	503	9	0	0	99	9	620
2011	GW	157	15	16	0	264	42	494
	SW	610	13	15	0	94	11	743
2010	GW	128	12	17	0	1,268	39	1,464
	SW	558	10	16	0	219	10	813
2009	GW	88	15	16	0	2,234	38	2,391
	SW	548	9	16	0	134	9	716
2008	GW	54	17	15	0	2,875	41	3,002
	SW	527	11	15	0	0	10	563
2007	GW	53	15	0	0	2,304	30	2,402
	SW	500	9	0	0	179	8	696
2006	GW	54	14	0	0	1,108	45	1,221
	SW	579	8	0	0	538	11	1,136
2005	GW	54	14	0	0	932	41	1,041
	SW	460	53	0	0	436	10	959
2004	GW	46	14	0	0	816	5	881
	SW	451	57	0	0	440	43	991
2003	GW	50	14	0	0	867	6	937
	SW	437	57	0	8	451	51	1,004
2002	GW	52	9	0	0	955	7	1,023
	SW	405	56	0	17	471	60	1,009
2001	GW	51	9	0	0	896	6	962
	SW	429	74	0	18	491	52	1,064
2000	GW	53	3	0	0	687	6	749
	SW	562	58	1	21	331	57	1,030

Projected Surface Water Supplies TWDB 2017 State Water Plan Data

IRION COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	IRRIGATION, IRION	COLORADO	COLORADO RUN-OF-RIVER	221	221	221	221	221	221
F	LIVESTOCK, IRION	COLORADO	COLORADO LIVESTOCK LOCAL SUPPLY	57	57	57	57	57	57
Sum of Projected Surface Water Supplies (acre-feet)				278	278	278	278	278	278

TOM GREEN COUNTY

3.35% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, TOM GREEN	COLORADO	MOUNTAIN CREEK LAKE/RESERVOIR	0	0	0	0	0	0
F	COUNTY-OTHER, TOM GREEN	COLORADO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
F	IRRIGATION, TOM GREEN	COLORADO	COLORADO RUN-OF-RIVER	59	59	59	59	59	59
F	IRRIGATION, TOM GREEN	COLORADO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
F	LIVESTOCK, TOM GREEN	COLORADO	COLORADO LIVESTOCK LOCAL SUPPLY	55	55	55	55	55	55
F	MANUFACTURING, TOM GREEN	COLORADO	COLORADO RUN-OF-RIVER	1	1	1	1	1	1
F	MANUFACTURING, TOM GREEN	COLORADO	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	23	22	23	22	22	21
F	MANUFACTURING, TOM GREEN	COLORADO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
F	MILLERSVIEW-DOOLE WSC	COLORADO	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM	136	190	179	166	155	144
F	SAN ANGELO	COLORADO	COLORADO RUN-OF-RIVER	189	189	188	188	188	187
F	SAN ANGELO	COLORADO	OH IVIE LAKE/RESERVOIR NON-SYSTEM PORTION	5,270	5,122	4,949	4,790	4,632	4,476
F	SAN ANGELO	COLORADO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM	0	0	0	0	0	0
Sum of Projected Surface Water Supplies (acre-feet)				5,733	5,638	5,454	5,281	5,112	4,943

Estimated Historical Water Use and 2017 State Water Plan Dataset:

Irion County Water Conservation District

February 13, 2018

Page 5 of 10

Projected Water Demands

TWDB 2017 State Water Plan Data

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

IRION COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, IRION	COLORADO	105	102	98	97	97	97
F	IRRIGATION, IRION	COLORADO	1,467	1,435	1,402	1,370	1,338	1,307
F	LIVESTOCK, IRION	COLORADO	268	268	268	268	268	268
F	MERTZON	COLORADO	102	99	96	95	95	95
F	MINING, IRION	COLORADO	3,192	3,357	2,423	1,487	713	342
Sum of Projected Water Demands (acre-feet)			5,134	5,261	4,287	3,317	2,511	2,109

TOM GREEN COUNTY

3.35% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	CONCHO RURAL WATER CORPORATION	COLORADO	538	548	559	572	590	607
F	COUNTY-OTHER, TOM GREEN	COLORADO	44	44	46	48	49	51
F	IRRIGATION, TOM GREEN	COLORADO	3,135	3,127	3,120	3,112	3,104	3,096
F	LIVESTOCK, TOM GREEN	COLORADO	57	57	57	57	57	57
F	MANUFACTURING, TOM GREEN	COLORADO	80	88	95	102	110	118
F	MILLERSVIEW-DOOLE WSC	COLORADO	272	279	285	293	302	311
F	MINING, TOM GREEN	COLORADO	35	36	37	37	38	39
F	SAN ANGELO	COLORADO	18,244	20,002	20,851	21,930	23,240	24,665
Sum of Projected Water Demands (acre-feet)			22,405	24,181	25,050	26,151	27,490	28,944

Projected Water Supply Needs

TWDB 2017 State Water Plan Data

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

IRION COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	COUNTY-OTHER, IRION	COLORADO	0	0	0	0	0	0
F	IRRIGATION, IRION	COLORADO	-359	-359	-359	-359	-359	-359
F	LIVESTOCK, IRION	COLORADO	0	0	0	0	0	0
F	MERTZON	COLORADO	0	0	0	0	0	0
F	MINING, IRION	COLORADO	-1,819	-1,984	-1,050	-114	0	0
Sum of Projected Water Supply Needs (acre-feet)			-2,178	-2,343	-1,409	-473	-359	-359

TOM GREEN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	CONCHO RURAL WATER CORPORATION	COLORADO	69	59	48	35	17	0
F	COUNTY-OTHER, TOM GREEN	COLORADO	-556	-573	-629	-678	-724	-768
F	IRRIGATION, TOM GREEN	COLORADO	-31,651	-31,422	-31,243	-31,061	-30,832	-30,604
F	LIVESTOCK, TOM GREEN	COLORADO	17	17	17	17	17	17
F	MANUFACTURING, TOM GREEN	COLORADO	-1,211	-1,459	-1,657	-1,853	-2,094	-2,357
F	MILLERSVIEW-DOOLE WSC	COLORADO	37	87	76	60	43	26
F	MINING, TOM GREEN	COLORADO	0	0	0	0	0	0
F	SAN ANGELO	COLORADO	-9,250	-11,156	-12,167	-13,397	-14,870	-16,462
Sum of Projected Water Supply Needs (acre-feet)			-42,668	-44,610	-45,696	-46,989	-48,520	-50,191

Projected Water Management Strategies

TWDB 2017 State Water Plan Data

IRION COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
IRRIGATION, IRION, COLORADO (F)							
IRRIGATION CONSERVATION - IRION COUNTY	DEMAND REDUCTION [IRION]	73	144	210	210	210	210
WEATHER MODIFICATION	WEATHER MODIFICATION [ATMOSPHERE]	110	110	110	110	110	110
		183	254	320	320	320	320
MERTZON, COLORADO (F)							
MUNICIPAL CONSERVATION - MERTZON	DEMAND REDUCTION [IRION]	5	5	5	5	5	5
		5	5	5	5	5	5
MINING, IRION, COLORADO (F)							
DEVELOP ADDITIONAL DOCKUM AQUIFER SUPPLIES - IRION COUNTY MINING	DOCKUM AQUIFER [IRION]	150	150	150	50	0	0
DEVELOP ADDITIONAL EDWARDS-TRINITY PLATEAU AQUIFER SUPPLIES - IRION COUNTY MINING	EDWARDS-TRINITY-PLATEAU AQUIFER [IRION]	500	500	500	100	0	0
MINING CONSERVATION - IRION COUNTY	DEMAND REDUCTION [IRION]	223	235	170	104	50	24
		873	885	820	254	50	24
Sum of Projected Water Management Strategies (acre-feet)		1,061	1,144	1,145	579	375	349

TOM GREEN COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
CONCHO RURAL WATER CORPORATION, COLORADO (F)							
DESALINATION OF OTHER AQUIFER SUPPLIES IN TOM GREEN COUNTY - CONCHO RURAL WSC	OTHER AQUIFER [TOM GREEN]	150	150	150	150	150	150
MUNICIPAL CONSERVATION - CONCHO RURAL WSC	DEMAND REDUCTION [TOM GREEN]	33	35	37	38	40	41
		183	185	187	188	190	191
COUNTY-OTHER, TOM GREEN, COLORADO (F)							
ABILENE REDUCTION FOR WEST TEXAS WATER PARTNERSHIP	FORT PHANTOM HILL LAKE/RESERVOIR [RESERVOIR]	0	60	69	61	68	73
BRUSH CONTROL - SAN ANGELO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM [RESERVOIR]	41	25	29	26	28	31

Estimated Historical Water Use and 2017 State Water Plan Dataset:

Irion County Water Conservation District

February 13, 2018

Page 8 of 10

CEDAR RIDGE RESERVOIR	CEDAR RIDGE LAKE/RESERVOIR [RESERVOIR]	0	89	104	92	101	110
DESALINATION OF OTHER AQUIFER SUPPLIES IN TOM GREEN COUNTY - SAN ANGELO	OTHER AQUIFER [TOM GREEN]	0	0	0	96	105	115
REUSE - SAN ANGELO	DIRECT REUSE [TOM GREEN]	290	174	202	179	197	214
SUBORDINATION - SAN ANGELO SYSTEM	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM [RESERVOIR]	225	225	225	225	225	225
		556	573	629	679	724	768

IRRIGATION, TOM GREEN, COLORADO (F)

IRRIGATION CONSERVATION - TOM GREEN COUNTY	DEMAND REDUCTION [TOM GREEN]	4,679	9,335	11,175	11,175	11,175	11,175
WEATHER MODIFICATION	WEATHER MODIFICATION [ATMOSPHERE]	4,945	4,945	4,945	4,945	4,945	4,945
		9,624	14,280	16,120	16,120	16,120	16,120

MANUFACTURING, TOM GREEN, COLORADO (F)

ABILENE REDUCTION FOR WEST TEXAS WATER PARTNERSHIP	FORT PHANTOM HILL LAKE/RESERVOIR [RESERVOIR]	0	181	216	200	235	273
BRUSH CONTROL - SAN ANGELO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM [RESERVOIR]	98	75	90	83	98	113
CEDAR RIDGE RESERVOIR	CEDAR RIDGE LAKE/RESERVOIR [RESERVOIR]	0	271	324	299	351	409
DESALINATION OF OTHER AQUIFER SUPPLIES IN TOM GREEN COUNTY - SAN ANGELO	OTHER AQUIFER [TOM GREEN]	0	0	0	312	366	425
REUSE - SAN ANGELO	DIRECT REUSE [TOM GREEN]	685	528	631	582	683	794
SUBORDINATION - SAN ANGELO SYSTEM	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM [RESERVOIR]	428	404	396	378	361	343
		1,211	1,459	1,657	1,854	2,094	2,357

MILLERSVIEW-DOOLE WSC, COLORADO (F)

MUNICIPAL CONSERVATION - MILLERSVIEW-DOOLE WSC	DEMAND REDUCTION [TOM GREEN]	10	11	11	12	12	13
SUBORDINATION - CRMWD SYSTEM	COLORADO RIVER MWD LAKE/RESERVOIR SYSTEM [RESERVOIR]	105	56	74	92	108	122
		115	67	85	104	120	135

MINING, TOM GREEN, COLORADO (F)

MINING CONSERVATION - TOM GREEN COUNTY	DEMAND REDUCTION [TOM GREEN]	74	76	78	78	79	81
		74	76	78	78	79	81

SAN ANGELO, COLORADO (F)

ABILENE REDUCTION FOR WEST TEXAS WATER PARTNERSHIP	FORT PHANTOM HILL LAKE/RESERVOIR [RESERVOIR]	0	1,383	1,587	1,875	1,664	1,903
BRUSH CONTROL - SAN ANGELO	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM [RESERVOIR]	747	576	661	781	693	793

Estimated Historical Water Use and 2017 State Water Plan Dataset:

Irion County Water Conservation District

February 13, 2018

Page 9 of 10

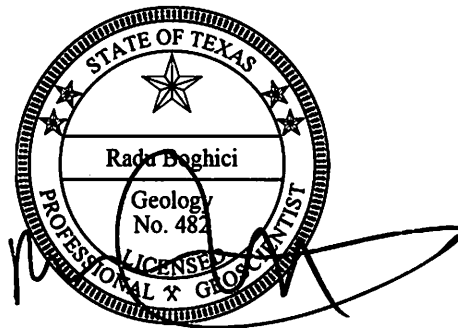
CEDAR RIDGE RESERVOIR	CEDAR RIDGE LAKE/RESERVOIR [RESERVOIR]	0	2,074	2,381	2,810	2,497	2,854
DESALINATION OF OTHER AQUIFER SUPPLIES IN TOM GREEN COUNTY - SAN ANGELO	OTHER AQUIFER [TOM GREEN]	0	0	0	2,928	2,600	2,973
HICKORY WELL FIELD EXPANSION IN MCCULLOCH COUNTY - SAN ANGELO	HICKORY AQUIFER [MCCULLOCH]	0	0	0	0	0	0
MUNICIPAL CONSERVATION - SAN ANGELO	DEMAND REDUCTION [TOM GREEN]	656	753	793	842	894	949
REUSE - SAN ANGELO	DIRECT REUSE [TOM GREEN]	5,232	4,033	4,629	5,466	4,854	5,550
SUBORDINATION - SAN ANGELO SYSTEM	SAN ANGELO LAKES LAKE/RESERVOIR SYSTEM [RESERVOIR]	3,570	3,389	3,207	3,034	2,858	2,685
		10,205	12,208	13,258	17,736	16,060	17,707
Sum of Projected Water Management Strategies (acre-feet)		21,968	28,848	32,014	36,759	35,387	37,359

APPENDIX C

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GAM RUN 17-013: IRION COUNTY WATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Radu Boghici, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 463-5808
August 15, 2017



8/15/2017

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GAM RUN 17-013: IRION COUNTY WATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

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(512) 463-5808
August 15, 2017

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), 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 Irion County 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 Section. 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 and this information includes

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers; and
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 Irion County Water Conservation District should be adopted by the district on or before May 28, 2018, and submitted to the Executive Administrator of the TWDB on or before June 27, 2018. The current management plan for Irion County Water Conservation District expires on August 26, 2018.

We used version 1.01 of the groundwater availability model for Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009), version 1.01 of the groundwater availability model for the Lipan Aquifer, and version 1.01 of the groundwater availability model for the High Plains Aquifer System to estimate the management plan information for the aquifers within Irion County Water Conservation District. This report replaces the results of GAM Run 12-017. GAM Run 17-013 meets current standards set after the release of GAM Run 12-017 and includes results for the Dockum Aquifer from the recently released groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015). Tables 1 through 3 summarize the groundwater availability model data required by the statute, and Figures 1 through 3 show the area of the models from which the values in the tables were extracted. If, after review of this report, the Irion County 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.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), we ran the groundwater availability models for the Edwards-Trinity (Plateau) Aquifer, Lipan Aquifer, and High Plains Aquifer System for this analysis. We extracted water budgets for each year of the historical model periods (1981 through 2000 for the Edwards-Trinity (Plateau) Aquifer, 1980 through 1998 for the Lipan Aquifer, and 1980 through 2012 for the Dockum Aquifer) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Then we summarized in this report the average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions of the aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

Edwards-Trinity (Plateau) Aquifer

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers for this analysis. See Anaya and Jones (2009) for assumptions and limitations of the model. The Pecos Valley Aquifer does not occur within the Irion County Water Conservation District and therefore no groundwater budget values are included for it in this report.
- The groundwater availability model includes three layers, with Layer 1 representing the Edwards Group and associated limestone hydrostratigraphic

units and Layer 2 representing the undifferentiated Trinity Group hydrostratigraphic units. The lowermost layer, Layer 3, is inactive.

- Recharge rates are based on (1980 – 2000) precipitation (Anaya and Jones, 2009).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Lipan Aquifer

- We used version 1.01 of the groundwater availability model for the Lipan Aquifer for this analysis. See Beach and others (2004) for assumptions and limitations of the model.
- The Lipan Aquifer model includes one layer representing the Quaternary Leona Formation, portions of the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north. The model does not include all of the aquifer within the district boundaries.
- The model uses general head boundaries to simulate the eastern and western aquifer boundaries. Inflow on the general-head boundary to the west represents inflow from the Edwards-Trinity (Plateau) Aquifer.
- Recharge rates are based on (1980 – 2000) precipitation (Beach and others, 2004).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System. See Deeds and Jigmond (2015) for assumptions and limitations of the model.
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).
- The groundwater availability model for the High Plains Aquifer System contains four layers:
 - Layer 1—the Ogallala Aquifer and the Pecos Valley Alluvium Aquifer
 - Layer 2—the Rita Blanca Aquifer, the Edwards-Trinity (High Plains) Aquifer, the Edwards-Trinity (Plateau) Aquifer, and pass-through cells of the Dockum Aquifer

- Layer 3—the upper Dockum Group and pass-through cells of the lower Dockum Group
- Layer 4—the lower Dockum Group
- Perennial rivers and reservoirs were simulated using the MODFLOW-NWT river package. Springs, seeps, and draws were simulated using the MODFLOW-NWT drain package. For this analysis, groundwater discharge to surface water includes groundwater leakage to the river and drain packages.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability models for the Edwards-Trinity (Plateau) and Pecos Valley aquifers, for the Lipan Aquifer, and for the minor aquifers of the High Plains Aquifer System within Irion County Water Conservation District, and averaged over the historical calibration periods, as shown in Tables 1 through 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 through 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 EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR IRION COUNTY WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE FOOT. THESE FLOWS INCLUDE FRESH AND BRACKISH WATERS.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	16,694
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	20,858
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	10,544
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	5,618
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) Aquifer into adjacent Lipan	1,002

TABLE 2: SUMMARIZED INFORMATION FOR THE LIPAN AQUIFER THAT IS NEEDED FOR IRION COUNTY WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS MAY INCLUDE FRESH AND BRACKISH WATERS. THE MODEL EXTENT DOES NOT COVER ALL OF THE LIPAN AQUIFER WITHIN THE DISTRICT BOUNDARIES.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Lipan Aquifer	2,246
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	230
Estimated annual volume of flow out of the district within each aquifer in the district	Lipan Aquifer	2,890
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) Aquifer and other units into the Lipan Aquifer	4,288

TABLE 3: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR IRION COUNTY WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE FOOT. THESE FLOWS MAY INCLUDE FRESH AND BRACKISH WATERS.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum	0
Estimated annual volume of flow into the district within each aquifer in the district	Dockum	151
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum	17
Estimated net annual volume of flow between aquifers in the district	From Dockum Aquifer to Overlying Units	164

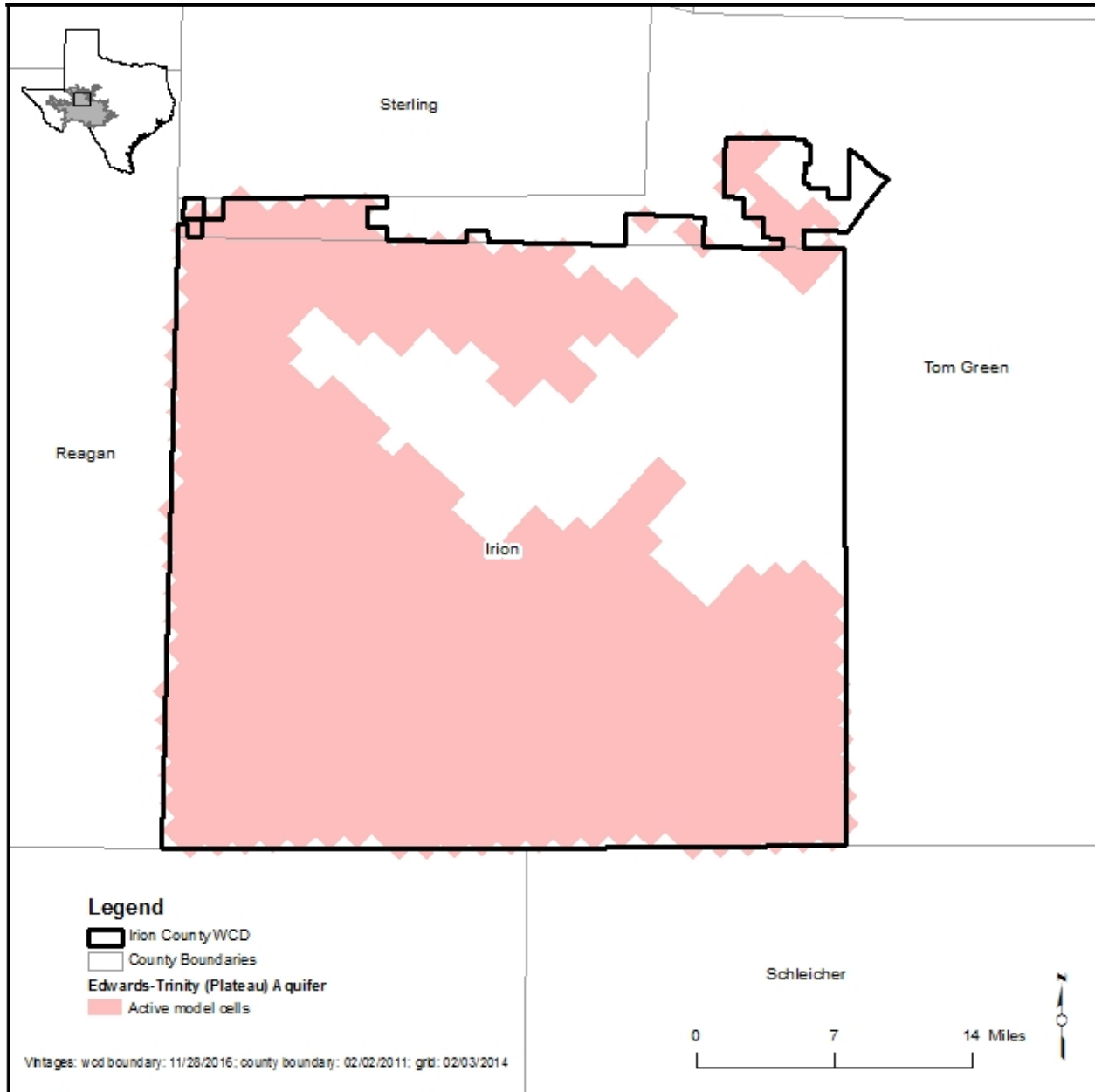


FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

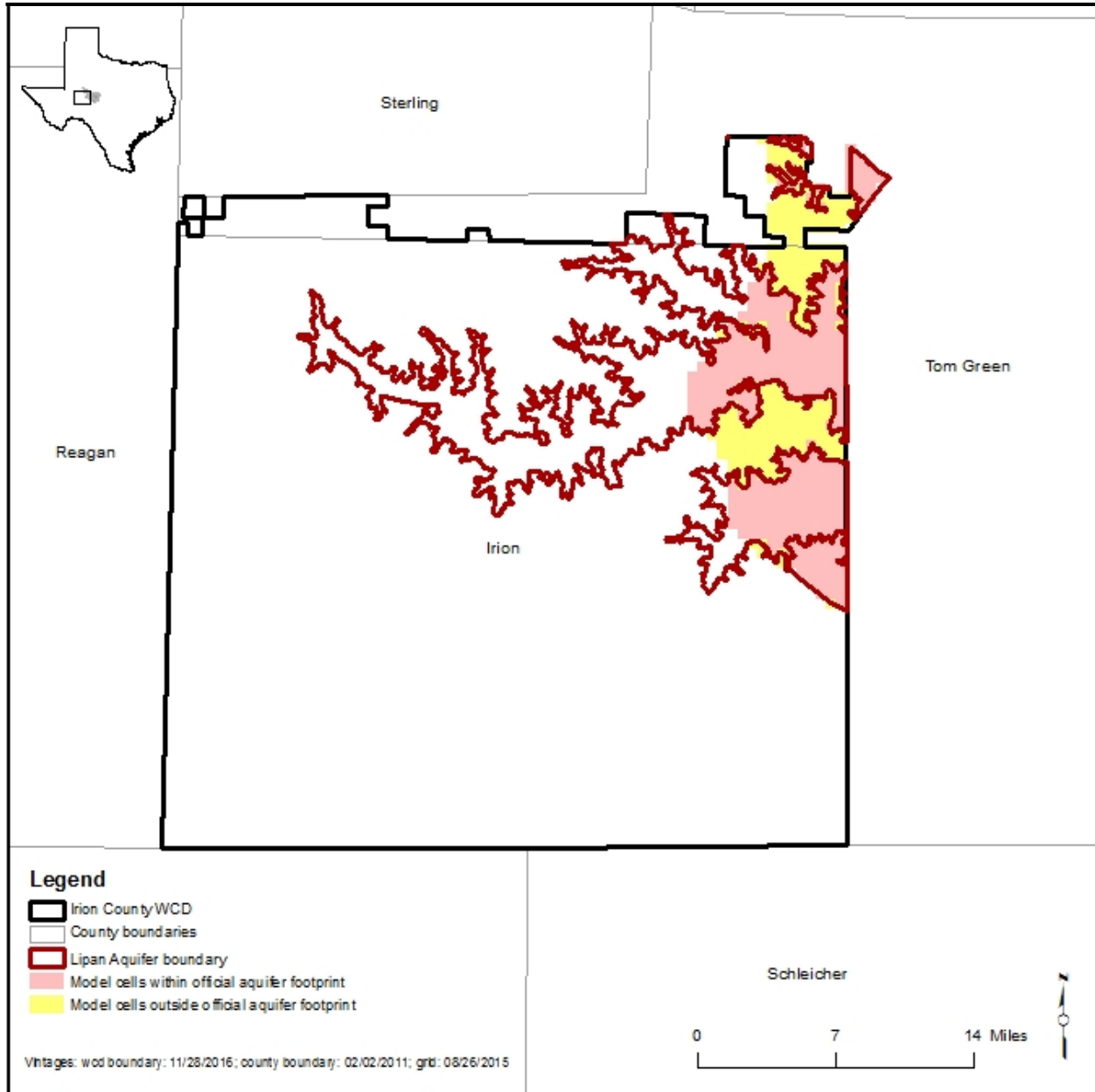


FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE LIPAN AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

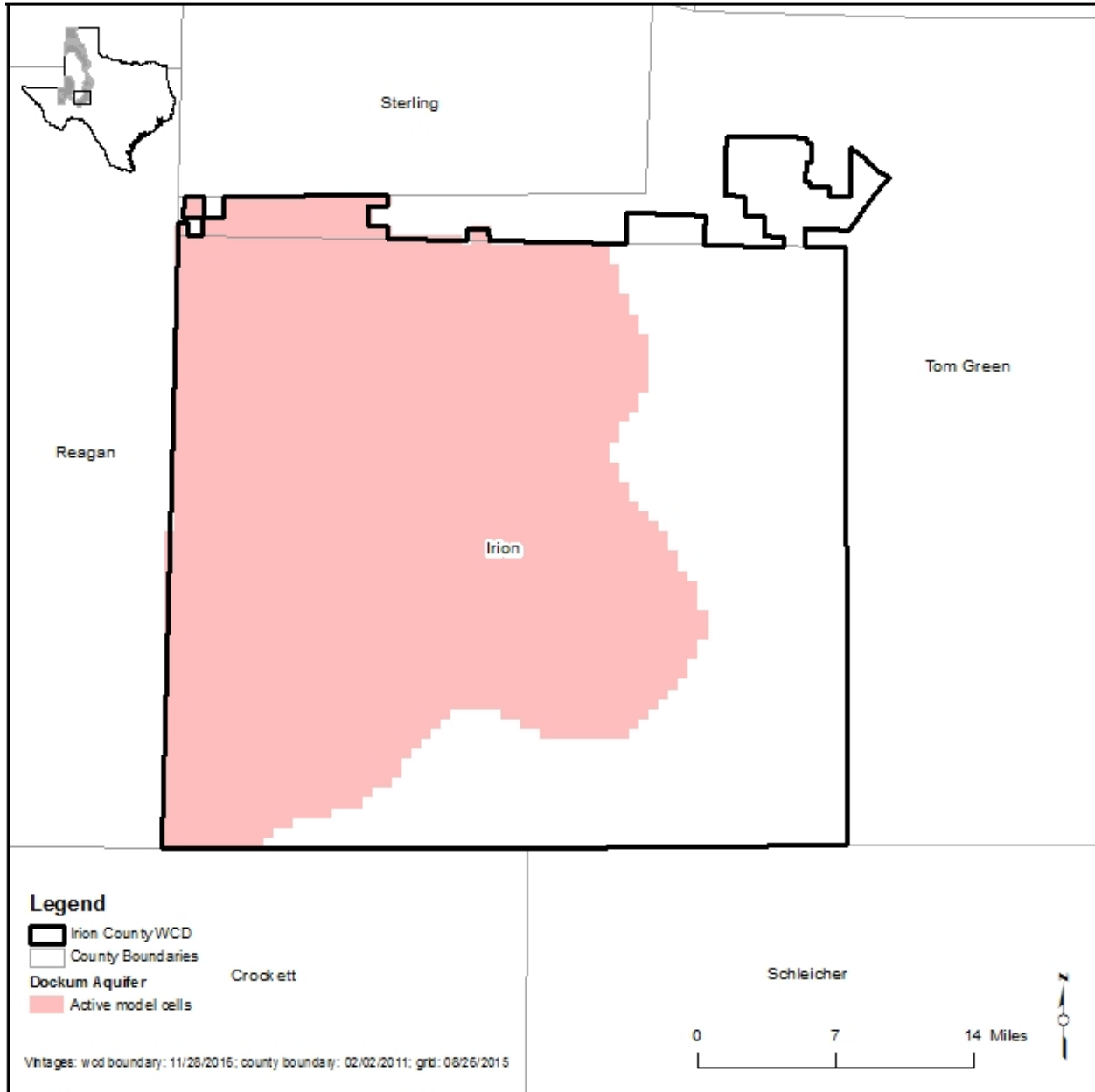


FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE DOCKUM AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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 historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

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

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

REFERENCES:

- Anaya, R., and Jones, I., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas: Texas Water Development Board Report 373, 103 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm.
- Beach, J. A., Burton, S., and Kolarik, B., 2004, Groundwater availability model for the Lipan Aquifer in Texas: final report prepared for the Texas Water Development Board by LBG-Guyton Associates, 246 p.,
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- National Research Council, 2007, Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.
- Niswonger, R.G., Panday, S., and Ibaraki, M., 2011, MODFLOW-NWT, a Newton formulation for MODFLOW-2005: USGS, Techniques and Methods 6-A37, 44 p.

APPENDIX D

DISTRICT RULES

<http://www.irionwcd.org/rules>

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APPENDIX E

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IRION COUNTY WATER CONSERVATION DISTRICT

P.O. Box 10 Mertzon, TX 76941 OFFICE (325) 835-2015 FAX (325) 835-2366 e-mail: icwcd@verizon.net

Adoption of Management Plan 2018-2023

WHEREAS, the Irion County Water Conservation District was created by Acts of the 69th Legislature (1985), S.B. 206, in accordance with Article 16, Section 59 of the Constitution of Texas and Chapters 51 and 52 of the Texas Water Code, as amended; and

WHEREAS, S.B. 206 was amended by Acts of the 81st Legislature (2009), H.B. 1923, in accordance with Chapters 36 and 49 of the Texas Water Code, as amended; and

WHEREAS, Acts of the 82nd Legislature (2011), the enabling legislation for the District was recodified in Texas Special District Local Laws Code Ann. ch. 8845 Irion County Water Conservation District.

WHEREAS, the District is required by Chapter 36, §36.1071 of the Texas Water Code to develop and adopt a Management Plan; and

WHEREAS, the District is required by Chapter 36, §36.1072 of the Texas Water Code to review and re-adopt the plan with or without revisions at least once every five years and to submit the adopted Management Plan to the Executive Administrator of the Texas Water Development Board for review and approval; and

WHEREAS, the District's readopted revised Management Plan shall be approved by the Executive Administrator if the plan is administratively complete; and

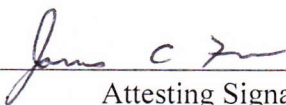
WHEREAS, the District Board of Directors, after reviewing the existing Management Plan, has determined that this plan should be revised and replaced with a new 5-Year Management Plan expiring in 2023; and

WHEREAS, the District Board of Directors has determined that the 5-Year Management Plan addresses the requirements of Chapter 36, §36.1071.

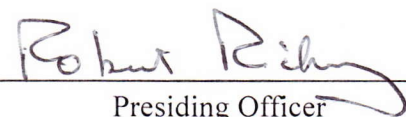
NOW, THEREFORE, be it resolved, that the Board of Directors of the Irion County Water Conservation District, following notice and hearing, hereby adopts this 5-Year Management Plan; and

FURTHER, be it resolved, that this new Management Plan shall become effective immediately upon adoption.

Adopted this 14th day of May, 2018 by the Board of Directors of the Irion County Water Conservation District.



Attesting Signature



Presiding Officer



IRION COUNTY WATER CONSERVATION DISTRICT

P.O. Box 10 Mertzon, TX 76941 OFFICE (325) 835-2015 FAX (325) 835-2366 e-mail: icwed@verizon.net

Amendment of Management Plan 2018-2023

WHEREAS, the Irion County Water Conservation District was created by Acts of the 69th Legislature (1985), S.B. 206, in accordance with Article 16, Section 59 of the Constitution of Texas and Chapters 51 and 52 of the Texas Water Code, as amended; and

WHEREAS, S.B. 206 was amended by Acts of the 81st Legislature (2009), H.B. 1923, in accordance with Chapters 36 and 49 of the Texas Water Code, as amended; and

WHEREAS, Acts of the 82nd Legislature (2011), the enabling legislation for the District was recodified in Texas Special District Local Laws Code Ann. ch. 8845 Irion County Water Conservation District.

WHEREAS, the District is required by Chapter 36, §36.1071 of the Texas Water Code to develop and adopt a Management Plan; and

WHEREAS, the District is required by Chapter 36, §36.1072 of the Texas Water Code to review and re-adopt the plan with or without revisions at least once every five years and to submit the adopted Management Plan to the Executive Administrator of the Texas Water Development Board for review and approval; and

WHEREAS, the District's amended Management Plan shall be approved by the Executive Administrator if the plan is administratively complete; and

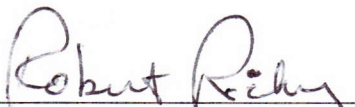
WHEREAS, the District Board of Directors, after reviewing the existing Management Plan, has determined that this plan should be amended; and

WHEREAS, the District Board of Directors has determined that the amended 5-Year Management Plan addresses the requirements of Chapter 36, §36.1071.

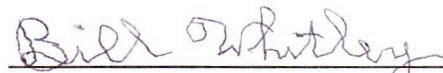
NOW, THEREFORE, be it resolved, that the Board of Directors of the Irion County Water Conservation District, following notice and hearing, hereby amends this 5-Year Management Plan; and

FURTHER, be it resolved, that this amended Management Plan shall become effective immediately upon adoption.

Adopted this 12th day of November, 2018 by the Board of Directors of the Irion County Water Conservation District.



Attesting Signature



Presiding Officer

APPENDIX F

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Standard-Times

PART OF THE USA TODAY NETWORK

PROOF OF PUBLICATION

IRION COUNTY WATER CONSERVATION DISTRICT

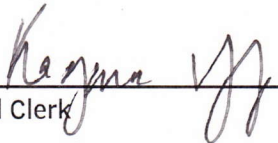
PO BOX 10
MERTZON, TX 76941

State of Wisconsin, County of Brown

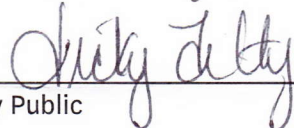
On **April 16, 2018**, personally appeared before me the undersigned, a Notary Public in and for said county and state, legal clerk of the **SAN ANGELO STANDARD-TIMES**, a daily newspaper published in San Angelo, County of TOM GREEN, State of Texas and of general circulation in the following counties: **Tom Green, Coke, Concho, Crockett, Irion, Kimble, Mason, McCulloch, Menard, Reagan, Runnels, Schleicher, Sterling, Sutton**. The attached advertisement, a true copy of which is hereto annexed, was published in said newspaper in its issues thereof the following dates:

April 16, 2018

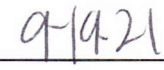
Subscribed and sworn to before me on **April 16, 2018**.



Legal Clerk



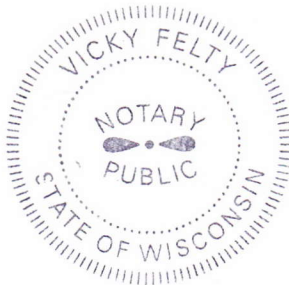
Notary Public



My commission expires

Public Notice

The Irion County Water Conservation District will hold a Public Hearing at 6:00 pm on May 14, 2018 at the Irion County Courthouse Annex, 208 N Park View, Mertzon, TX, to receive public comment on a proposed revised 2018-2023 Management Plan. Copies of the proposed plan may be obtained by contacting the District Office at 325 835-2015, email: icwcd@verizon.net or website: <http://www.irionwcd.org/>. Written comments will be received through May 10, 2018 by mail, email or hand delivery.



Ad#: 1985327

P.O.:

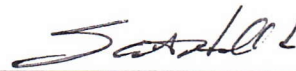
of Affidavits: 0

NOTICE OF MEETING OF THE IRION COUNTY
WATER CONSERVATION DISTRICT

A PUBLIC HEARING will convene at 6:00 PM on the 14th day of MAY, 2018, in the Irion County Courthouse Annex , 208 N Park View, Mertzon, Texas. The purpose of this hearing is to accept public comment on the proposed 2018-2023 Management Plan.

The REGULAR term of the Irion County Water Conservation District meeting will convene immediately following on the 14th day of MAY, 2018, in the Irion County Courthouse Annex, 208 N Park View, Mertzon, Texas, to transact the following business:

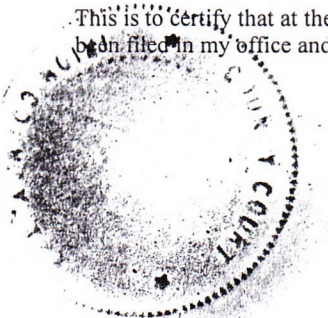
1. Public Comment - limit 5 minutes each person.
(Must sign and submit a Public Participation Form prior to Meeting)
2. Approve Minutes of the prior meeting.
3. Consider and take action on Payment of Bills due.
4. Receive Manager's Report on the following topics:
 - (a) Meetings attended
 - (b) Well Surveillance reports
 - (c) Fluid Injection Application.
5. Consider and take action on the 2018-2023 Management Plan.
6. Administer Oath of Office to Directors.
7. Elect Board Officers.
8. Consider and take action on Scholarship applications.
9. Adjourn



Scott Holland, Manager

THE STATE OF TEXAS:
COUNTY OF IRION:

This is to certify that at the time and on the date stamped thereon, this notice of a meeting, a copy of which is attached hereto, has been filed in my office and was posted on the bulletin board in the Courthouse, as is required by Chapter 551, Government Code.



Executed on May 9, 2018 @ 8:27am

Molly Criner
Molly Criner, County Clerk, Irion County, Texas

By Shirley Graham
Deputy Clerk

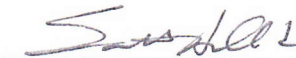
These public hearings and meetings are available to all persons regardless of disability. If you require special assistance to attend the meeting or hearing, please contact the Irion County WCD at 325/835-2015 at least 24 hours in advance of the meeting.

NOTICE OF MEETING OF THE IRION COUNTY
WATER CONSERVATION DISTRICT

A PUBLIC HEARING will convene at 6:00 PM on the 12th day of NOVEMBER, 2018, in the Irion County Courthouse Annex , 208 N Park View, Mertzon, Texas. The purpose of this hearing is to accept public comment on the proposed amended 2018-2023 Management Plan.

The REGULAR term of the Irion County Water Conservation District meeting will convene immediately following on the 12th day of NOVEMBER, 2018, in the Irion County Courthouse Annex, 208 N Park View, Mertzon, Texas, to transact the following business:

1. Public Comment - limit 5 minutes each person.
(Must sign and submit a Public Participation Form prior to Meeting)
2. Approve Minutes of the prior meeting.
3. Consider and take action on Payment of Bills due.
4. Receive Manager's Report on the following topics:
 - (a) Meetings attended
 - (b) Well Surveillance reports
 - (c) Fluid Injection Application.
5. Consider and take action on the amended 2018-2023 Management Plan.
6. Accept the 2018 Q3 Investment Report
7. Accept the Annual Review of District Investment Policy
8. Rules Workshop
9. Adjourn



Scott Holland, Consulting Manager

THE STATE OF TEXAS:
COUNTY OF IRION:

This is to certify that at the time and on the date stamped thereon, this notice of a meeting, a copy of which is attached hereto, has been filed in my office and was posted on the bulletin board in the Courthouse, as is required by Chapter 551, Government Code.

Executed on November 7, 2018 9:00AM

Molly Criner
Molly Criner, County Clerk, Irion County, Texas

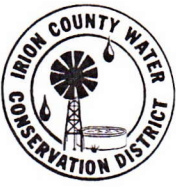
By Bobby Moore
Deputy Clerk



These public hearings and meetings are available to all persons regardless of disability. If you require special assistance to attend the meeting or hearing, please contact the Irion County WCD at 325/835-2015 at least 24 hours in advance of the meeting.

APPENDIX G

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IRION COUNTY WATER CONSERVATION DISTRICT

P.O. Box 10 Mertzon, TX 76941 OFFICE (325) 835-2015 FAX (325) 835-2366 e-mail: icwcd@verizon.net

November 19, 2018

Mr John Grant, General Manager
Colorado River Municipal Water District
400 E 24th St
Big Spring, TX 79720

RE: Irion County WCD Management Plan - Amended November 12, 2018

Chapter 36,, Water Code, requires groundwater conservation districts to adopt a Management Plan addressing several issues concerning groundwater management in coordination with surface water management entities and regional planning. Although the Upper Colorado River Authority is the only surface water management entity within the Irion County Water Groundwater District, the district would accept and review any comments you might have. Therefore please go to <http://www.irionwcd.org> for a copy of the Irion Co. WCD 2018-2023 Management Plan as amended November 12, 2018 for review.

If you have any questions or need further information on the management plan please contact me at 325 835-2015 or icwcd@verizon.net.

Sincerely,

Scott Holland
Consulting Manager



IRION COUNTY WATER CONSERVATION DISTRICT

P.O. Box 10 Mertzon, TX 76941 OFFICE (325) 835-2015 FAX (325) 835-2366 e-mail: icwcd@verizon.net

November 19, 2018

Upper Colorado River Authority
512 Orient
San Angelo, TX 76903

RE: Irion County WCD Management Plan - Amended November 12, 2018

Chapter 36, §36.1071. Management Plan, Water Code, requires groundwater conservation districts to adopt a Management Plan addressing several issues concerning groundwater and in coordination with surface water management entities. And 31 TAC §356.51 requires evidence that a groundwater conservation district coordinate with all surface water management entities. The Upper Colorado River Authority is the only surface water management entity within the Irion County Water Groundwater District. Therefore please go to <http://www.irionwcd.org> for a copy of the Irion Co. WCD 2018-2023 Management Plan as amended November 12, 2018 for review.

If you have any questions or need further information on the management plan please contact me at 325 835-2015 or icwcd@verizon.net.

Sincerely,

A handwritten signature in blue ink, appearing to read "Scott Holland".

Scott Holland
Consulting Manager



IRION COUNTY WATER CONSERVATION DISTRICT

P.O. Box 10 Mertzon, TX 76941 OFFICE (325) 835-2015 FAX (325) 835-2366 e-mail: icwcd@verizon.net

November 19, 2018

Mr John Grant, Chairman Region F Water Planning Group
Colorado River Municipal Water District
400 E 24th St
Big Spring, TX 79720

RE: Irion County WCD Management Plan - Amended November 12, 2018

Chapter 36, Water Code, requires groundwater conservation districts to adopt a Management Plan addressing several issues concerning groundwater management in coordination with surface water management entities and regional planning. Therefore please go to <http://www.irionwcd.org> for a copy of the Irion Co. WCD 2018-2023 Management Plan as amended November 12, 2018 for review.

If you have any questions or need further information on the management plan please contact me at 325 835-2015 or icwcd@verizon.net.

Sincerely,

A handwritten signature in blue ink, appearing to read "Scott Holland".

Scott Holland
Consulting Manager