REEVES COUNTY
GROUNDWATER CONSERVATION DISTRICT
MANAGEMENT PLAN

Adopted September 28, 2023

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GLOSSARY OF SYMBOLS/TERMS/ACRONYMS IN MANAGEMENT PLAN

§:	Section (referring to a statutory provision)
Board:	Board of Directors of the Reeves County Groundwater Conservation District
District:	Reeves County Groundwater Conservation District
District Act:	Enabling legislation of Reeves County Groundwater Conservation District (codified at Tex. Spec. Dist. Loc. Laws Code Ch. 8859)
DFC:	Desired Future Condition
GPM:	Gallons per minute
GAM:	Groundwater Availability Model
GCD:	Groundwater Conservation District
GMA:	Groundwater Management Area
HB:	House Bill
MAG:	Modeled Available Groundwater
SB:	Senate Bill
TCEQ:	Texas Commission on Environmental Quality
TWDB:	Texas Water Development Board
WUG:	Water user group

1 Introduction

The Reeves County Groundwater Conservation District (the District), after notice and hearing, adopts this Management Plan according to the requirements of Texas Water Code § 36.1071. The District Management Plan represents the management goals of the District for the next five years, including the desired future conditions of the aquifers within the jurisdictional boundaries of the District. These desired future conditions were adopted through the joint planning process in Groundwater Management Area 3 as prescribed in Chapter 36, Texas Water Code.

1.1 District Mission

The Mission of the District is to develop rules to provide protection to existing wells, prevent waste, promote conservation, provide a framework that will allow availability and accessibility of groundwater for future generations, protect the quality of the groundwater in the recharge zone of the aquifer, ensure that the residents of Reeves County maintain local control over their groundwater, and operate the District in a fair and equitable manner for all residents of the District.

1.2 Guiding Principles

The District is committed to managing and protecting the groundwater resources within its jurisdiction and to working with others to ensure a sustainable, adequate, high quality and cost-effective supply of water, now and in the future. The District will strive to develop, promote, and implement water conservation, and management strategies to protect water resources for the benefit of the citizens, economy and environment of the District. The preservation of this most valuable resource can be managed in a prudent and cost-effective manner through conservation, education, and management. The District will endeavor to consider and respect individual property owner rights when acting on related matters.

2 History and Purpose of the 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. In addition, HB 1763 required GCDs to share management plans with and for review by the other GCDs in the GMA. In 2011, Senate Bills 660 and 737 further modified these groundwater laws and GCD management requirements in Texas.

Senate Bill 660 required that GMA representatives must participate within each applicable regional water planning group (RWPG). It also required the Regional Water Plans be consistent with the DFCs in place when the regional plans are initially developed. TWDB technical guidelines for the round of planning associated with Senate Bill 660 established that the managed available groundwater (within each county and basin) was the maximum amount of groundwater that could be used for existing uses and new strategies in Regional Water Plans. In other words, the MAG volumes are a cap on groundwater production for TWDB planning purposes.

"Managed available groundwater" was redefined as "modeled available groundwater" in Senate Bill 737 by the 82nd Legislature. Modeled available groundwater is "the amount of water that can be produced on an average annual basis" to achieve a desired future condition.

The 84th Texas Legislature streamlined permit renewals via Senate Bill 854. House Bill 655 addressed the definition of aquifer storage and recovery (ASR) projects, clarification of ASR and TCEQ permitting roles, and gave TCEQ the ability to limit the volume of recovered water. These changes in law have been incorporated into the Texas Water Code and used as a framework to develop this management plan.

3 District Information

3.1 Creation

The Reeves County Groundwater Conservation District (the "District") was created by the 83rd Texas Legislature under the authority of Section 59, Article XVI, of the Texas Constitution, and in accordance with Chapter 36 of the Texas Water Code ("Water Code"), by the Act of May 17, 2013, 83rd Leg., R.S., Ch. 457, codified at Texas Special District Local Laws Code Chapter 8876.

The District is a governmental agency and a body politic and corporate. The District was created to serve a public use and benefit, and is essential to accomplish the objectives set forth in Section 59, Article XVI, of the Texas Constitution. The District's boundaries are coextensive with the boundaries of Reeves County, Texas, and lands and other property within these boundaries will benefit from the works and projects that will be accomplished by the District.

3.2 Directors

The District is governed by a board of seven appointed directors. Directors serve staggered four-year terms, with the terms of three or four directors expiring on December 1 every other year. A director serves until the director's successor has qualified to serve.

3.3 Authority

The District has the rights and responsibilities provided for in Chapter 36 of the Texas Water Code, Texas Special District Local Laws Code Chapter 8876, and 31 Texas Administrative Code Chapter 356. The District is charged with conducting hydrogeological studies, adopting a management plan, providing for the permitting of non-exempt water wells and implementing programs to achieve statutory mandates. The District has rulemaking authority to implement the policies and procedures needed to manage the groundwater resources of Reeves County.

3.4 Location and Extent

The District's boundaries are coextensive with the boundaries of Reeves County, Texas. The District covers an area of approximately 2,640 square miles. A map is included as Figure 1.

3.5 Topography and Drainage

The District is located within the Rio Grande River Basin. Most surface water drainages within Reeves County flow to the north or northeast towards the Pecos River, except for a few tributaries of Salt Draw in western Reeves County, which flow to the east. Elevations in the District range between approximately 2,460 feet (on the Pecos River) to 5,115 feet (in the Barilla Mountains) above mean sea level (amsl). Portions of several mountain ranges are located in western and southern Reeves County (Apache Mountains, Barilla and Davis Mountains, and the Rustler Hills), and the land surface generally slopes toward the Pecos River to the north. Average annual rainfall is about 13 inches.

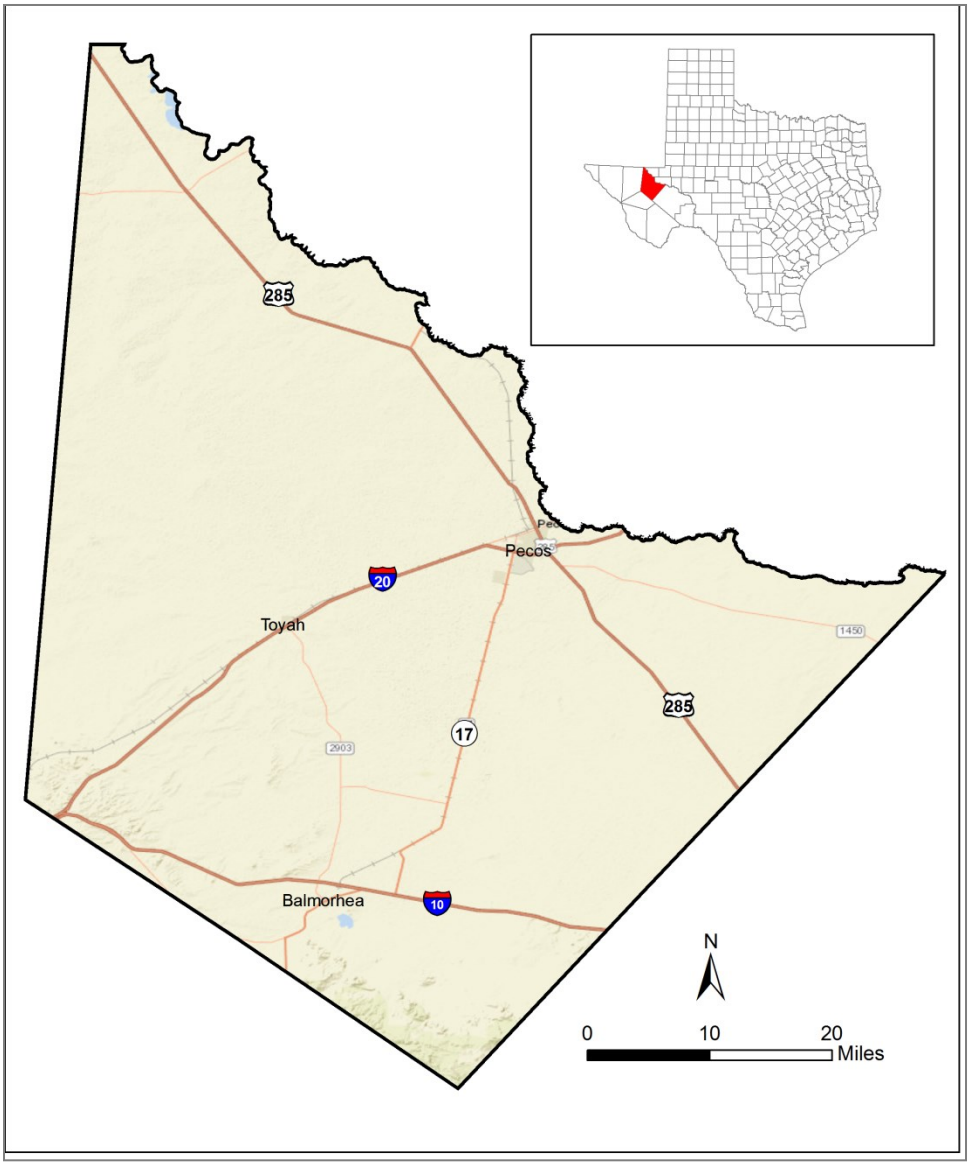


Figure 1. Reeves County GCD

4 Criteria for Plan Approval

4.1 Planning Horizon

This management plan becomes effective upon adoption by the District Board of Directors and subsequent approval by the Executive Administrator of the Texas Water Development Board (TWDB). This management plan incorporates a planning period of five years from the adoption data of this plan in accordance with 31 Texas Administrative Code §356.52(a)(2).

4.2 Board Resolution

A certified copy of the Reeves County Groundwater Conservation District resolution adopting the plan is in Appendix A – Resolution Adopting the Management Plan.

4.3 Plan Adoption

Public notices documenting that the plan was adopted following appropriate public meetings and hearings are in Appendix B – Evidence that the Management Plan was adopted.

4.4 Coordination with Surface Water Management Entities

A template letter transmitting copies of this plan to the surface water management entities in the District along with a list of the surface water management entities to which the plan was sent are in Appendix C – Evidence that the District coordinated development of the Management Plan with surface water entities.

5 Actions, Procedures, Performance, and Avoidance for Plan Implementation, and Management of Groundwater Supplies

The District is only permitted to adopt rules pertaining to well registration, well spacing, and non-wasteful use before the Management Plan is adopted. The District has adopted rules to control subsidence, degradation of water quality, waste of groundwater, and to carry out the powers and duties of Chapter 36, Texas Water Code, and the District Act. The current District rules are available from the District's website. The rules will be used by the District in the exercise of the powers conferred on the District by law and in the accomplishment of the purposes of the law creating the District. The rules may be used as guides in the exercise of discretion, where discretion is warranted. However, under no circumstances and in no particular case will the rules, or any part therein, be construed as a limitation or restriction upon the District to exercise powers, duties, and jurisdiction conferred by law. These rules will create no rights or privileges in any person or water well and shall not be construed to bind the Board in any manner in its application of the management plan, amendments to rules or promulgation of rules.

The District may amend the District rules as necessary to comply with changes to Chapter 36 of the Texas Water Code or to insure the best management of the groundwater within the District. The development and enforcement of the rules of the District will be based on the best scientific and technical evidence available to the District.

The District will encourage public cooperation and coordination in the implementation of the management plan for the District. All operations and activities of the District will be performed in a manner that best encourages cooperation with the appropriate state, regional, or local water entity. The meetings of the Board of Directors will be noticed and conducted at all times in accordance with the Texas Open Meetings Law. The District will also make available for public

inspection all official documents, reports, records and minutes of the District pursuant to the Texas Public Information Act.

6 Methodology to Track District Progress in Achieving Management Goals

An annual report ("Annual Report") will be created by the general manager and District staff and provided to the members of the Board of Directors. The Annual Report will cover the activities of the District including information on the District's performance regarding achieving the District's management goals and objectives. The Annual Report will be delivered to the Board within 180 days following the completion of the District's fiscal year, beginning with the fiscal year that started on January 1, 2019. A hard copy of the Annual Report will be kept on file and will be available for public inspection at the District's offices upon adoption. Annual reports will also be available via the District's website.

7 Management Objectives and Performance Standards

The following goals, management objectives, and performance standards have been developed and adopted to ensure the management and conservation of groundwater resources within the District's jurisdiction.

> For purposes of this management plan, an exempt well means a well that meets any one of the following criteria stated in *Texas Water Code §36.117*, unless a different meaning is set forth in the District rules, or the context clearly provides otherwise:
>
> *(b)(1) drilling or operating a well used solely for domestic use or for providing water for livestock or poultry if the well is:*
>
> > *(A) located or to be located on a tract of land larger than 10 acres; and*
> >
> > *(B) drilled, completed, or equipped so that it is incapable of producing more than 20 gpm or 28,800 gallons of groundwater a day;*
>
> *(2) drilling a water well used solely to supply water for a rig that is actively engaged in drilling or exploration operations for an oil or gas well permitted by the Railroad Commission of Texas provided that the person holding the permit is responsible for drilling and operating the water well and the water well is located on the same lease or field associated with the drilling rig; or*
>
> *(3) drilling a water well authorized under a permit issued by the Railroad Commission of Texas under Chapter 134, Natural Resources Code, or for production from the well to the extent the withdrawals are required for mining activities regardless of any subsequent use of the water.*

(c) A district may not restrict the production of water from any well described by Subsection (b)(1).

All wells that do not meet one of these criteria are considered to be non-exempt for the purposes of this management plan. The characterization of exempt and non-exempt wells is intended to apply only to wells described in this management plan and shall not be interpreted to mean that the wells will be considered exempt or not exempt from permitting under any permanent rules adopted by the District in the future.

Goal 1 - Providing the most efficient use of groundwater

31 TAC § 356.52(a)(1)(A) and Tex. Water Code § 36.1071(a)(1)

The District, through strategies and programs adopted in this management plan and rules, strives to ensure the most efficient use of groundwater in order to sustain available resources for the future while maintaining the economic growth of the District.

Management Objective 1.1

The District will require the registration of wells not otherwise exempt from registration within the District's boundaries each year. Each year the District will locate and register a minimum of one well.

Performance Standard 1.1

The number of new and existing wells registered with the District will be provided in the Annual Report for each fiscal year.

Management Objective 1.2

The District will require permits for all groundwater use considered non-exempt within District boundaries each year.

Performance Standard 1.2

The District will accept and process permit applications for all non-exempt groundwater use pursuant to the permitting process described in the District Rules. The Annual Report will contain a summary for each year of the number of applications submitted to the District requesting authorization for the permitted use of groundwater and the number and type of permits issued by the District.

Goal 2 - Controlling and preventing the waste of groundwater

31TAC § 356.52(a)(1)(B) and Tex. Water Code § 36.1071(a)(2)

Another important goal of the District is to implement strategies that will control and prevent the waste of groundwater. The definitions of waste and beneficial use as defined in the District rules are described here..

*(8) "**Waste**" means any one or more of the following:*

(A) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic, or stock raising purposes;

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

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

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

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

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

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

*(9) "**Use for a beneficial purpose**" means use for:*

(A) agricultural, gardening, domestic, stock raising, municipal, mining, manufacturing, industrial, commercial, recreational, or pleasure purposes;

(B) exploring for, producing, handling, or treating oil, gas, sulfur, or other minerals; or

(C) any other purpose that is useful and beneficial to the user.

Management Objective 2.1

Each year the District will provide information to the public on reducing and preventing the waste of groundwater. The District will use one of the methods set forth below to provide information to the public at least once during each fiscal year:

a. Offer public presentations on groundwater issues, including waste prevention;
b. Sponsor an educational program or course;
c. Distribute literature packets or brochures;
d. Provide information on the District's web site addressing the prevention of waste; or
e. Submit newspaper articles to the newspapers of general circulation within the District for publication;

Performance Standard 2.1

The Annual Report will include a summary of the District's efforts during the previous year to provide information to the public on reducing and preventing the waste of groundwater.

Management Objective 2.2

The District will prohibit waste as defined by Chapter 36 of the Texas Water Code within its boundaries and will implement this prohibition through its rules.

Performance Standard 2.2

The District prefers to work with both the responsible and affected parties to find the best solution for all parties that also protects and enhances the waters of the District. The District's Annual Report will include a summary of:

a. the number of well owners who had complaints made against them alleging waste, and
b. the number of well owners who were found to be wasting water by the District Board of Directors using the definitions included in this management plan, and
c. the actions that were taken to stop the waste of groundwater.

Goal 3 - Controlling and preventing subsidence

31 TAC § 356.52(a)(1)(C) and Tex. Water Code §36.1071(a)(3)

Management Objective 3.1

The District will monitor changes in water levels in its monitoring wells with due consideration to the potential for land subsidence. At least once every three years, the District will assess the potential for land subsidence for areas where water levels have decreased more than 100 feet since the year 2000.

Performance Standard 3.1

Within three years of the approval of this plan and every three years thereafter, the District will map any region where more than 100 feet of drawdown has occurred since the year 2000 and assess the potential for land subsidence. The results of the assessment will be discussed in a District Board meeting and be documented in a presentation or a report.

Management Objective 3.2

The District will review the sections in "Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping" report (TWDB Contract Number 1648302062) when discussing subsidence within the District's aquifers. **Performance Standard 3.2**

As outlined in TWC Ch. 36.108 (d), the District will take into consideration the "Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping" when considering subsidence during joint groundwater planning.

Goal 4 - Addressing conjunctive surface water management issues

31 TAC §356.52(a)(1)(D) and Tex. Water Code §36.1071(a)(4)

Surface water resources represent a vital component in meeting some current and future water demands within the District, in particular for irrigation demands. The District coordinates with surface water management entities within the region by designating a board member or the general manager to attend and coordinate water supply and management issues with the Region F Water Planning Group.

Management Objective 4.1

Participation in the regional water planning process will ensure coordination with surface water management agencies that are participating in the regional water planning process. The designated board member or General Manager will annually do, at a minimum, one of the following:

a. Attend at least one meeting of the Region F Water Planning Group, or
b. Receive regional planning updates or reports from a District representative,
c. Track regional planning group meeting agenda and minutes.

Performance Standard 4.1

The designated board member or General Manager will report on the actions of the Region F Water Planning Group as appropriate to the board, and the General Manager will document meetings attended in the Annual Report.

Management Objective 4.2

Monitor technical assessments, presentations or reporting concerning discharge and water quality of the San Solomon Springs Group and associated surface water features.

Performance Standard 4.2

The General Manager of the District will report relevant findings in the District's Annual Report.

Goal 5 - Addressing natural resource issues

31TAC §356.52(a)(1)(E); and Tex. Water Code §36.1071(a)(5)

The District understands the important nexus between water resources and natural resources. The exploration and production of natural resources such as oil and gas represent potential management issues for the District. For example, improperly plugged oil and gas wells may provide a conduit for various hydrocarbon, drilling fluids, or saline waters to potentially migrate and contaminate groundwater resources in the District.

Management Objective 5.1

The District would like to encourage and actively promote water reuse within the District, especially the reuse of produced water among oil and gas operators.

Performance Standard 5.1

The District will provide information and/or discussion about reuse at least once each year by one of the following methods:

a. Invite operators who are interested in reuse to attend a District Board meeting, or
b. Post relevant educational material on the website, or
c. Host a conference that focuses on reuse applications and methods.

Goal 6 - Addressing drought conditions

31TAC §356.52(a)(1)(F) and Tex. Water Code §36.1071(a)(6)

Management Objective 6.1

The District will monitor drought information each quarter to track developing droughts or current drought conditions. Examples of sites that will be monitored include:

a. the weekly updates to the Palmer Drought Severity Index (PDSI) map for Texas at http://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?TX, and

b. the TWDB Drought Page at https://waterdatafortexas.org/drought.

Performance Standard 6.1

Current drought conditions information from multiple resources including the Palmer Drought Severity Index (PDSI) map for the state and the links to the Drought Preparedness Council Situation Report (http://www.dps.texas.gov/dem/sitrep/default.aspx) is made available to the public through the District's website.

Goal 7 - Addressing conservation, recharge and precipitation enhancement, rainwater harvesting, and brush control

31TAC §356.52(a)(1)(G) and TWC §36.1071(a)(7)

Texas Water Code § 36.1071(a)(7) requires that a management plan include a goal that addresses conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective. The District has determined that a goal addressing recharge is not appropriate or cost-effective, and therefore is not applicable to the District.

Management Objective 7.1

The District will provide information to the public addressing water conservation, brush control, precipitation enhancement and/or rainwater harvesting at least once each fiscal year by one of the following methods:

a. Distribute literature packets or brochures within the District;
b. Provide information to the public at the District office and/or
c. Provide information on the District's website;
c. Conduct public presentations;
d. Submit articles to newspapers of general circulation in the District for publication; or
e. Present exhibits at local public events.

Performance Standard 7.1

The District's Annual Report will provide a description of the District's efforts and a copy of any information provided to the public during the previous year to promote conservation, brush control, precipitation enhancement and/or rainwater harvesting.

Goal 8 - Addressing the desired future conditions of groundwater resources

31TAC §356.52(a)(1)(H) and Tex. Water Code § 36.1071(a)(8)

The desired future conditions of the aquifers in Groundwater Management Area (GMA) 3 represent average water levels in the various aquifers at the end of 50-years based on meeting current and projected groundwater supply needs. The Board of Directors has committed to a strategic approach that includes the adoption of this management plan and rules necessary to achieve the desired future conditions.

Management Objective 8.1

State statute requires GCDs to review, amend as necessary, and readopt management plans at least every five years. The General Manager will annually present a summary report on the status of achieving the adopted desired future conditions. Prior to the adoption date of the next management plan, the General Manager will work with the Board of Directors to conduct a focused review to determine if any elements of this management plan or the District rules need to be amended in order to achieve the adopted desired future conditions, or if the adopted desired future conditions need to be revised to better reflect the needs of the District.

Performance Standard 8.1

The General Manager will include a summary report on the status of addressing the adopted desired future conditions in the Annual Report. This summary report will primarily be based on data collected from the current groundwater monitoring program.

Four years after the adoption of this management plan, and based on the annual review conducted by the General Manager and the Board of Directors, the Board of Directors will determine which of the following apply to the District: (1) the current management plan and rules are working effectively to meet the adopted desired future conditions, (2) specific amendments need to be made to this management plan and/or rules in order to address the adopted desired future conditions, (3) amendments are needed to the adopted desired future conditions in order to better meet the needs of the District, or (4) a combination of (2) and (3). This determination will be made at a regularly scheduled meeting of the Board of Directors.

Management Objective 8.2

The General Manager will participate in GMA-3 meetings and the joint planning process to address the DFCs collaboratively.

Performance Standard 8.2

The designated board member or General Manager will report on actions of GMA-3 as appropriate to the board, and the General Manager will document meetings attended in the Annual Report.

Management Objective 8.3

In order to evaluate continually the effectiveness of the District's rules in meeting the goal of ensuring the efficient use of groundwater, the District has established a groundwater level monitoring network to track water levels of the aquifers in the District (Figure 2).

Performance Standard 8.3

Track the number of wells in Reeves County for which water levels were measured per year and report the results in the Annual Report presented by the General Manager to the Board of Directors.

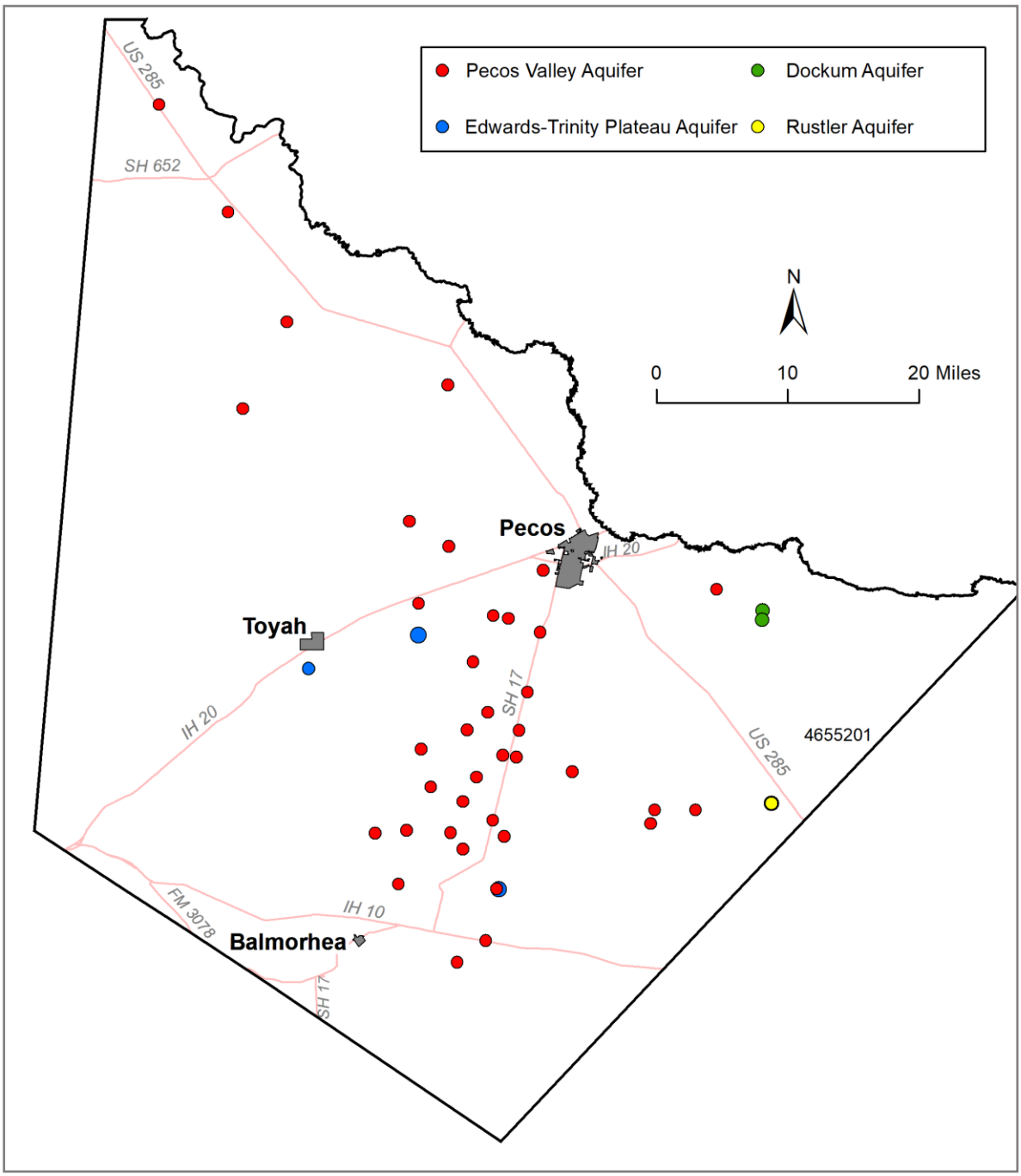


Figure 2. Locations of Reeves County GCD Water Level Monitoring Wells

8 Estimates of Technical Information

8.1 Modeled Available Groundwater 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 future condition established under Section 36.108".

The amount of water that may be permitted from an aquifer is not the same amount as the total amount that can be pumped from an aquifer. Total pumping includes uses of water both subject to permitting and exempt from permitting ("exempt use"). Examples of exempt use include domestic, livestock, and some types of water use associated with oil and gas exploration.

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-3. During the first round of joint planning, GMA-3 passed and adopted a resolution proposing DFCs for all relevant aquifers by letter dated August 9, 2010. The adopted DFCs were then forwarded to the TWDB for development of the MAG calculations.

The DFCs for the third round of joint planning were adopted by resolution by Groundwater Management Area 3 (GMA-3) on February 17, 2021. The MAGs from the third round of joint planning for the aquifers in GMA-3 are documented in GAM Run 21-009 MAG (Boghici, 2022), which is included as Appendix F. The DFCs are based on average drawdown in feet in 2070 for each aquifer.

A summary of the desired future conditions specific to Reeves County and the modeled available groundwater from the second round of joint planning are presented in Tables 1 and 2 below. A map of surrounding GCDs and GMAs is included as Figure 3.

The Capitan Reef and Igneous Aquifers were declared to be non-relevant in Reeves County for joint groundwater planning purposes. This means that GMA-3 has determined that the aquifer characteristics, groundwater demands, and current groundwater uses of these aquifers do not warrant the adoption of DFCs at this time. Even though DFCs were not established in the last round of planning, the District can still manage the aquifers according to to Chapter 36.

Table 1. Current Desired Future Conditions in 2070, in total average feet of drawdown

Aquifer	Desired Future Condition (feet)	Baseline Water Level Year
Edwards-Trinity (Plateau) and Pecos Valley	8	2010
Dockum	20	2012
Rustler	40	2009

Table 2. Modeled Available Groundwater based on GAM Run 21-009 (2020 – 2070)

Aquifer	Modeled Available Groundwater (acre-feet per year)
Edwards-Trinity (Plateau) and Pecos Valley	189,744
Dockum	2,539
Rustler	2,387
District Total	**194,670**

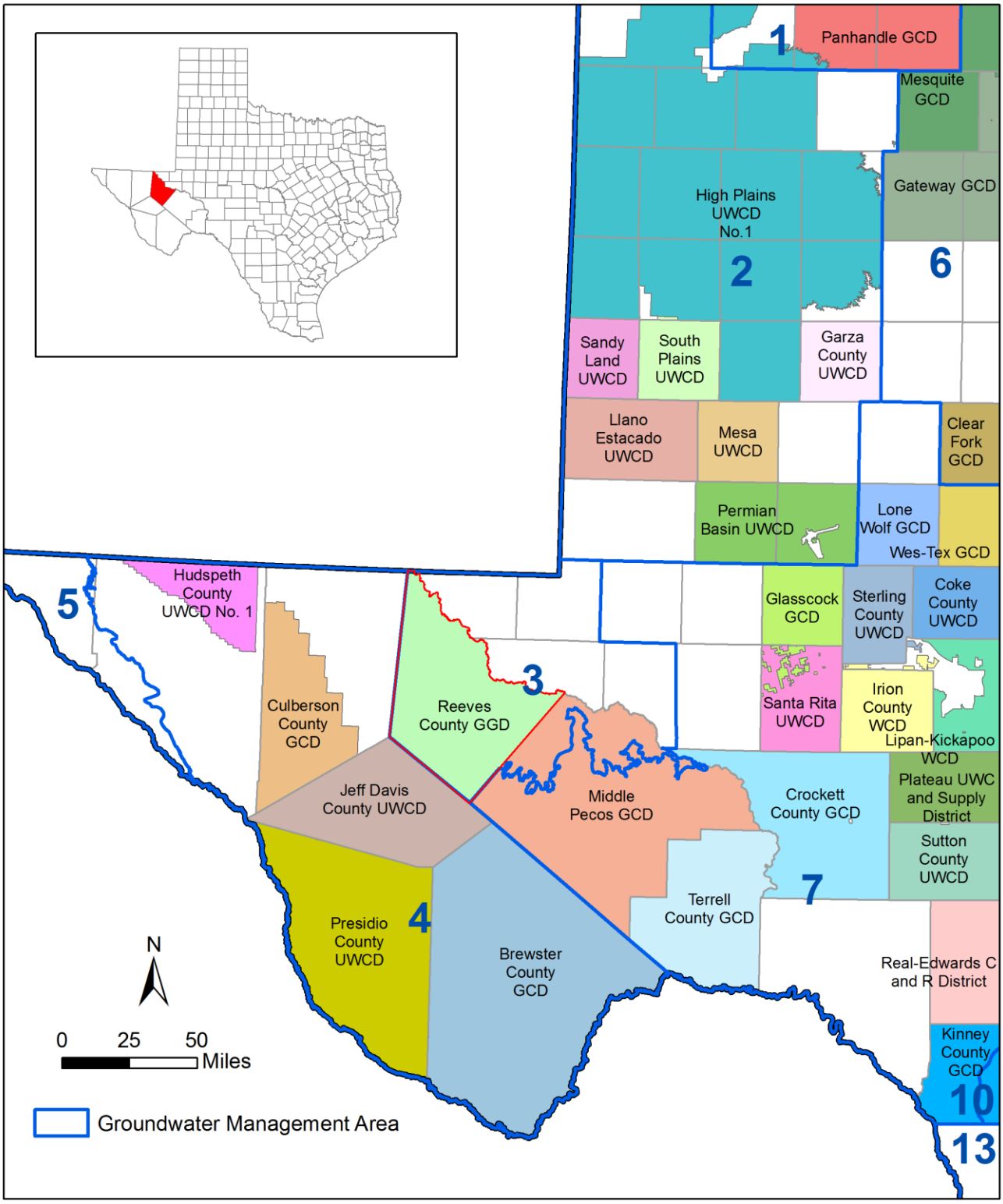


Figure 3. Groundwater Conservation Districts and Groundwater Management Areas

8.2 Amount of Groundwater Being Used within the District

Each year the TWDB conducts an annual survey of ground and surface water use by municipal and industrial entities within the state of Texas. The information obtained is then utilized by the TWDB for water resources planning. The historical water use estimates are subject to revision as additional data and corrections are made available to the TWDB.

Estimated groundwater use in Reeves County by category in 2020 was approximately 86 percent for irrigation, 8 percent for municipal use, 5 percent for mining, 1 percent for livestock use, less than one percent for livestock, and zero percent for manufacturing and steam-electric power use. In the TWDB Water Use Survey, the municipal use category includes small water providers and rural domestic pumping in addition to municipalities.

Figure 4 presents the historic groundwater pumpage estimates for Reeves County from 2000 to 2020. Refer to Appendix E for the data used in Figure 4. TWDB data included in Appendix E do not differentiate between exempt and non-exempt use. Note that the numbers reported by TWDB do not include irrigation for the year 2008.

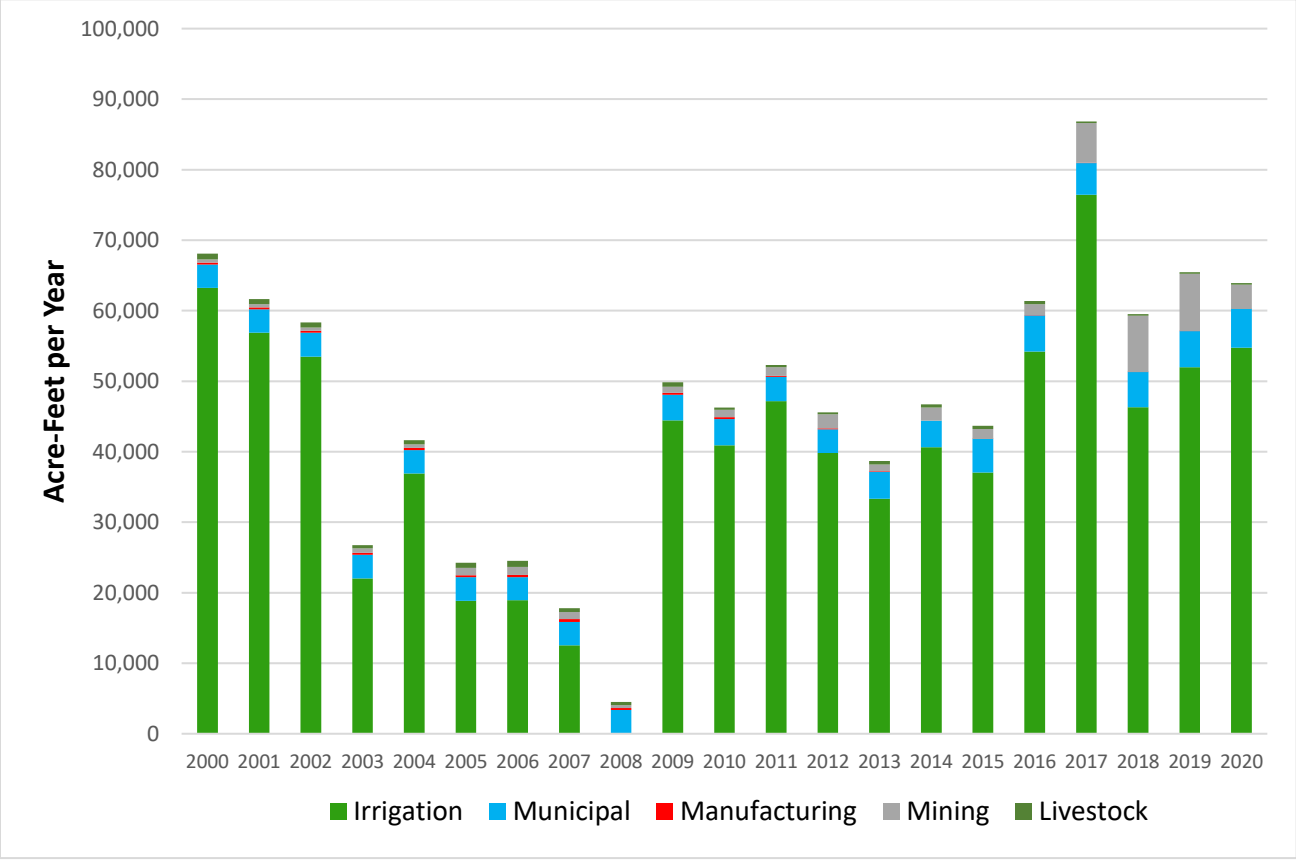


Figure 4. Estimated Historic Groundwater Use for Reeves County

8.3 Annual Amount of Recharge from Precipitation

Recharge from precipitation falling on the outcrop of the aquifer (where the aquifer is exposed to the surface) within the Reeves County GCD was estimated by the TWDB in the GAM Run 23-001 dated May 10, 2023. The TWDB estimated that 65,480 acre-feet per year of recharge from precipitation to the Pecos Valley aquifer within the boundaries of the Reeves County GCD (Appendix D). For the Edwards-Trinity Plateau, Capitan Reef Complex, Rustler, and Dockum Aquifers within the boundaries of Reeves County GCD, the TWDB estimated that recharge from precipitation (acre-feet per year) was 16,037, 0, 147, and 0, respectively.

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

The total water discharged from the aquifer to surface water features such as streams, reservoirs and springs is defined as the surface water outflow. Water budget values of surface water outflow within the Reeves County GCD were estimated by the TWDB in the GAM Run 23-001 (Appendix D). Modeled values are 51,531 acre-feet per year of discharge from the Pecos Valley aquifer to surface water bodies that are located within the Reeves County GCD. For the Edwards-Trinity Plateau, Capitan Reef Complex, Rustler, and Dockum Aquifers within the boundaries of Reeves County GCD, the TWDB estimated that discharge from the aquifer to springs and other surface water bodies (acre-feet per year) was 0, 0, 0, and 0, respectively.

8.5 Annual Volume of Flow In and Out of the District and Between Aquifers in the District

Flow into and out of the District is defined as the lateral flow within an aquifer between the District and adjacent counties. Flow between aquifers is defined as the vertical flow between aquifers or confining units that occurs within the boundaries of the District. The flow is controlled by hydrologic properties as well as relative water levels in the aquifers and confining units. Water budget values of flow for the Reeves County GCD were estimated by the TWDB in the GAM Run 23-001 (Appendix D).

8.6 Projected Surface Water Supply within the District

The tabulated summary of TWDB surface water supply estimates from 2022 Texas State Water Plan in Reeves County are included in Appendix E. The estimated volume of surface water ranges from 21,877 in 2020 to 21,848 acre-feet per year in 2080. This supply is primarily from spring-fed Balmorhea Lake (18,800 acre-feet per year) and Red Bluff Reservoir (ranges from 3,077 to 3,048 acre-feet per year).

8.7 Projected Total Demand for Water within the District

Appendix E contains an estimate of projected net water demand in Reeves County based on the 2022 Texas State Water Plan. The demand projections are primarily conducted in Texas as part of the regional water supply planning Texas Water Code § 36.1071(e)(3)(G) requires that a management plan include projections of the total demand for water (surface water and groundwater) from the most recently adopted state water plan. The projected total demand for Reeves County decreases from 76,288 acre-feet in 2020 to 70,677 acre-feet in 2070 (Figure 5).

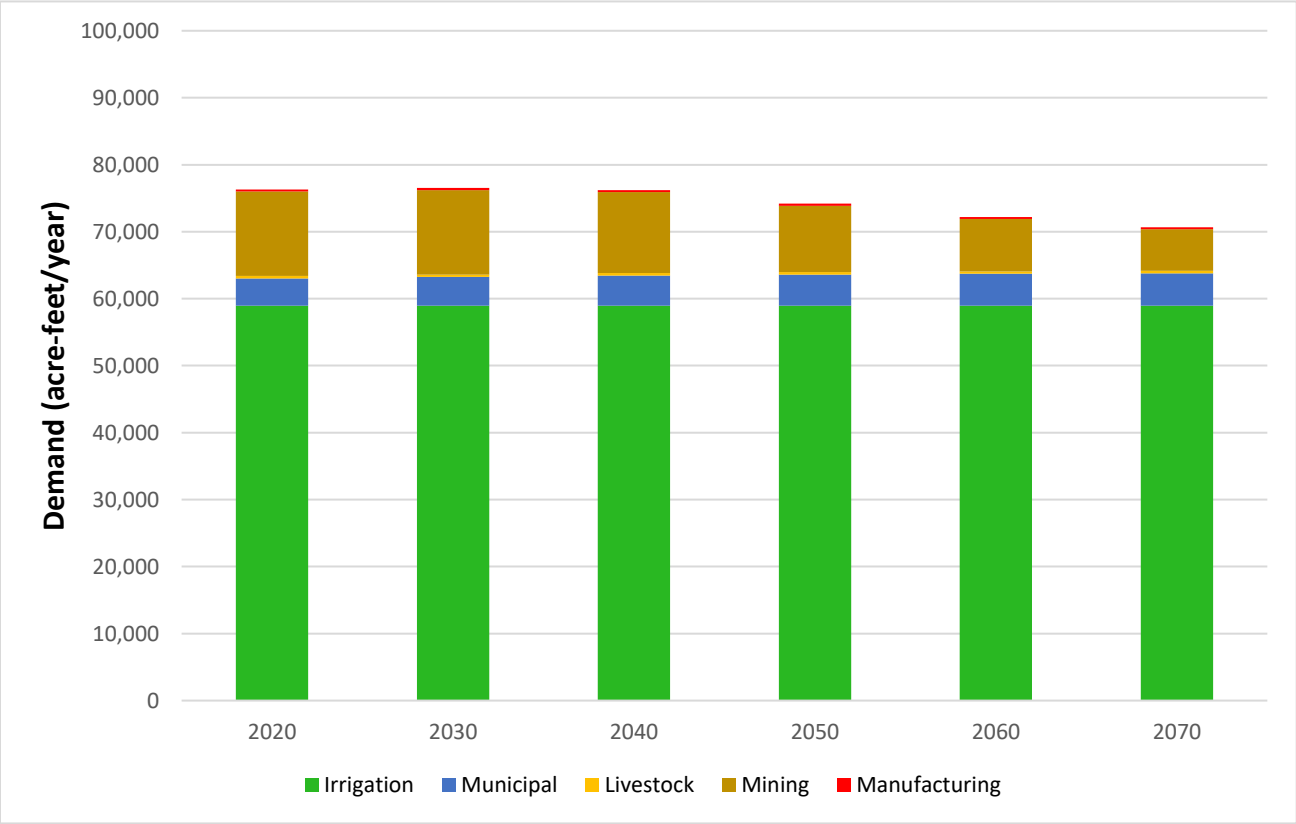


Figure 5. Total Projected Water Demand for Reeves County

8.8 Projected Water Supply Needs

Projected water needs for the counties in the District were developed for the 2022 State Water Plan. Those needs reflect conditions when projected water demands exceed projected water supplies in the event of a drought of record. Appendix E lists the total water supply needs for Reeves County as adopted in the TWDB 2022 State Water Plan. A need exists for Balmorhea and the mining water use group. Reeves County is projected to have needs of 10,507 acre-feet in 2020, decreasing to 4,147 acre-feet in 2070.

8.9 Water Management Strategies

The 2017 State Water Plan assessed and recommended water management strategies to meet the identified needs for every decade from 2020 through 2070.

Potential strategies for Reeves County include: groundwater development and treatment; municipal, industrial, mining, and agricultural conservation; direct potable reuse and other direct reuse; and weather modification.. Weather modification is a recommended strategy because Reeves County lies within the active precipitation enhancement area of the Trans Pecos Weather Modification Association (TPWMA). The projected water management strategies for the District from the 2022 State Water Plan are shown in Appendix E by water user group (WUG).

The sum of projected water management strategies increases from 15,301 acre-feet in 2020 to 33,999 acre-feet in 2070.

9 Geology and Groundwater Resources of Reeves County

Reeves County is located west of the Central Basin Platform, which separates the Delaware Basin from the Midland Basin located further to the east (Figure 6). The Capitan Reef Aquifer defines the outer margins of the Delaware Basin, which contains very thick sequence of evaporites overlain by younger formations shown in Table 3. The western two-thirds of the county is located within the Pecos Trough. The trough is formed by large-scale solution and collapse processes that occur within the evaporitic formations (Salado/ Castile) that underlie the Pecos Valley Alluvium. A table of stratigraphic units and their water-bearing characteristics within Reeves County is included as Table 3. Regional cross sections are included as Figure 7.

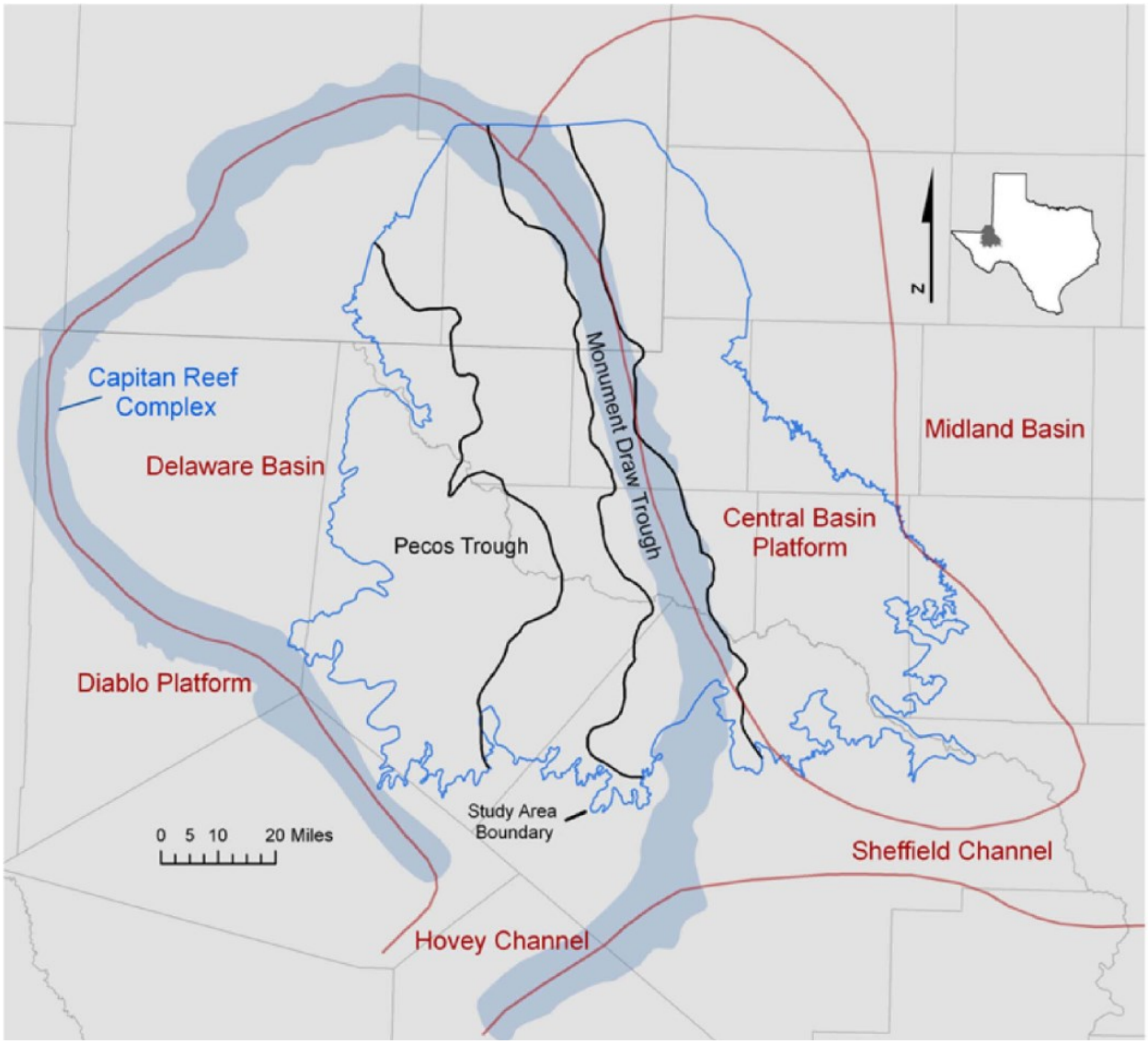


Figure 6. Regional structural features (source: TWDB Report 382).

Table 3. Stratigraphic and Hydrologic Units in Reeves County

System	Stratigraphic Unit	Maximum Thickness (feet)	Lithology	Water-Bearing Characteristics
Quaternary, Tertiary	Pecos Valley Alluvium	1,800	Fine to coarse-grained sand with gravel, typically mixed with clay and interbedded with clay layers	Yields small to large quantities of fresh to moderately saline water to wells
Tertiary	Volcanic Rocks	1,600	Lava, tuff, ash, breccia	Yields small amounts of fresh water to wells and springs in southern Reeves County
Cretaceous	undivided	1,425	Limestone, marl, clay, sand and sandstone	Yields small to moderate amounts of fresh to moderately saline water to wells in southern Reeves and western Pecos Counties
Triassic	Dockum undivided	420	Shale, siltstone, and fine to coarse-grained sandstone	Yields small to moderate amounts of fresh to moderately saline water to wells
Permian	Dewey Lake Redbeds	525	Siltstone	Does not yield water to wells
	Rustler	520	Dolomite, anhydrite, sandstone, conglomerate, and shale	Yields small to large amounts of slightly to moderately saline water to livestock and irrigation wells
	Salado	3,900	Halite, anhydrite	Does not yield water to wells
	Castile		Anhydrite and halite	
	Capitan Reef	1,750	Porous limestone and dolomite, bedded limestone, reef talus	Yields small to large amounts of moderately to very saline water to wells

Modified from TWDB Report 317 and TBWE Bulletin 6214.

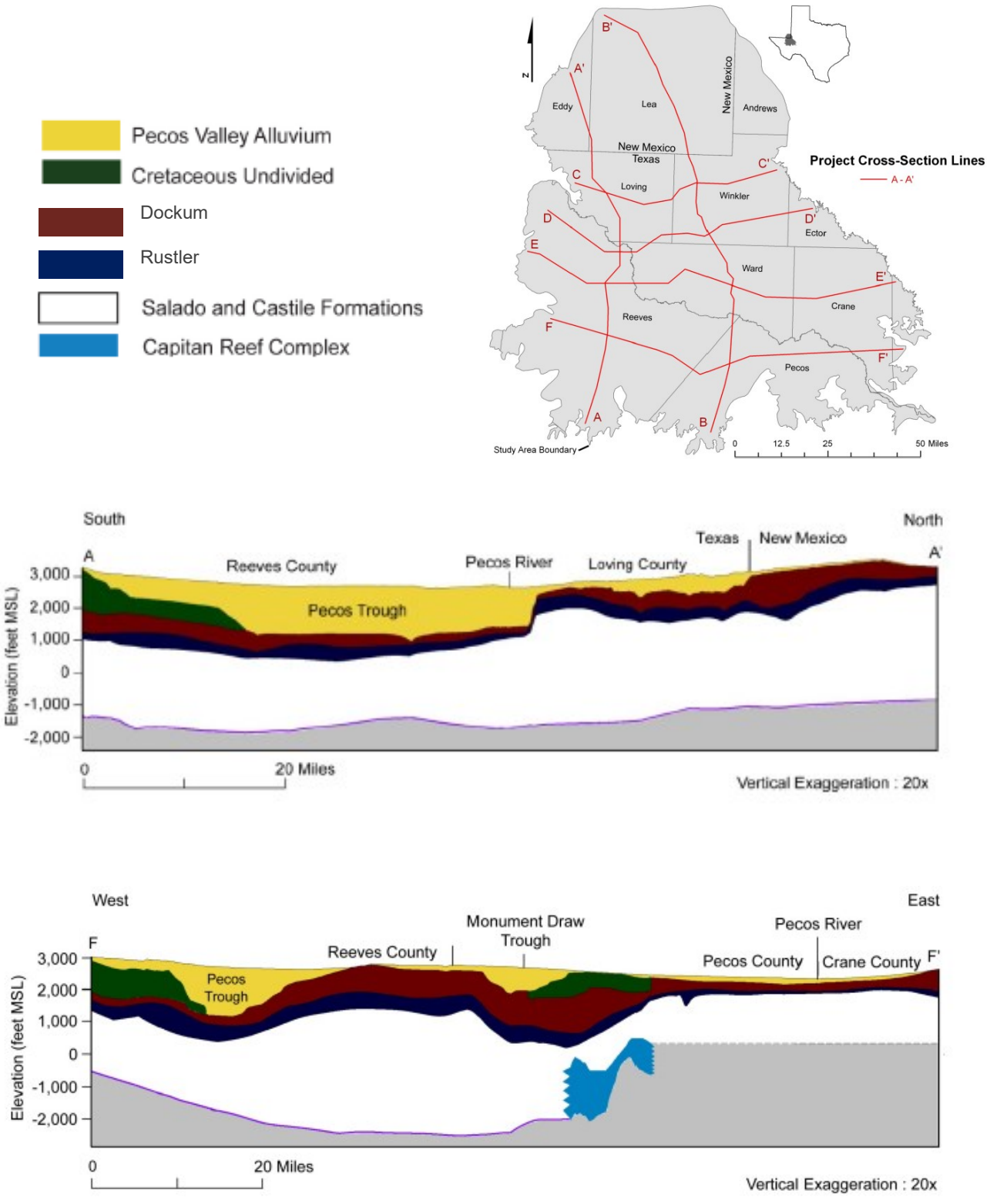


Figure 7. Cross sections (source: TWDB Report 382).

Major aquifers in Reeves County include the Pecos Valley and Edwards-Trinity Plateau; minor aquifers include the Rustler, Dockum, Igneous and Capitan Reef Complex. Maps showing the extent of the aquifers in the District are included as Figure 8. The extent of the Capitan Reef and Igneous aquifers within Reeves County is relatively limited, as shown in Figure 8b. Groundwater Availability Models have been created for all of the aquifers that underlie Reeves County. A summary of characteristics (well depths, well yields, depth to water and total dissolved solids concentrations) for water well completed in Reeves County aquifers is included in Table 4. The data used to compile the table is primarily from the TWDB interactive groundwater database.

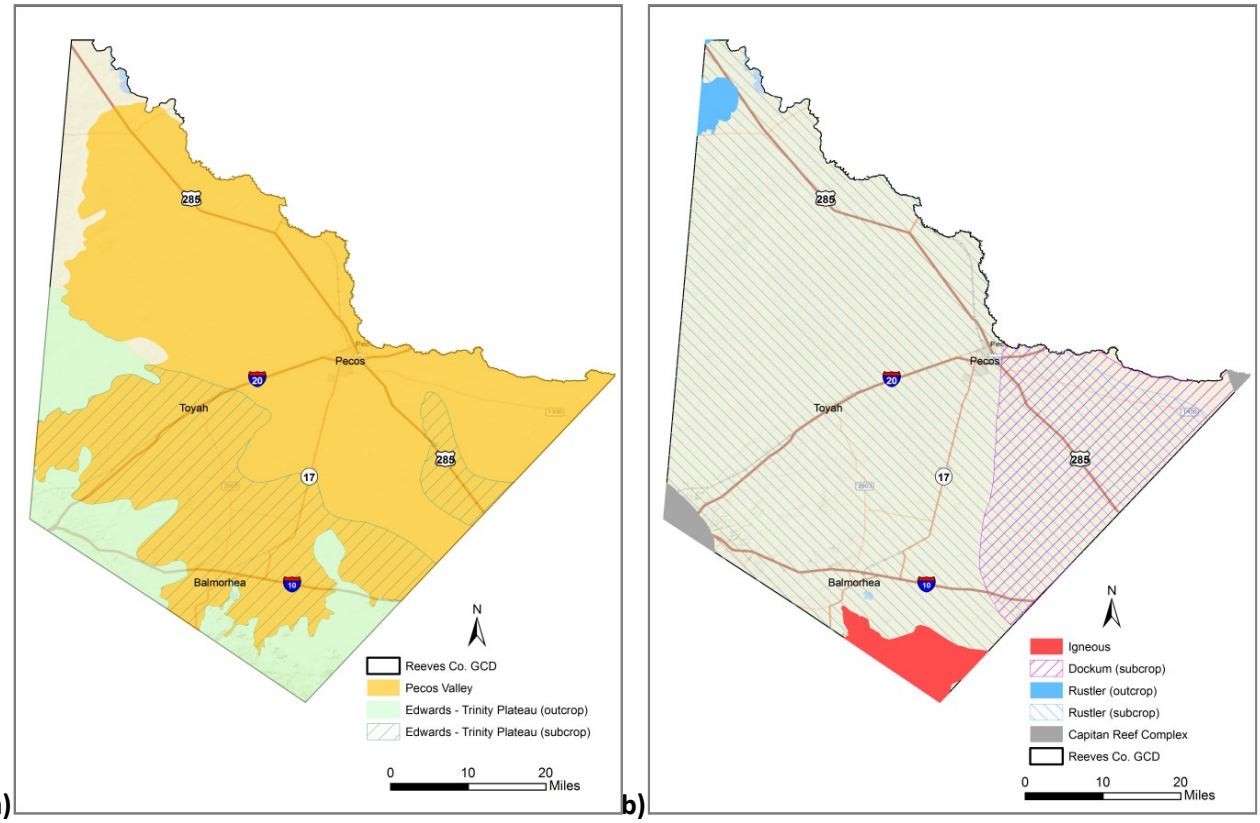


Figure 8. Reeves County a) Major Aquifers, and b) Minor Aquifers.

Pecos Valley

The Pecos Valley aquifer is located in the upper part of the Pecos River Valley of West Texas in Andrews, Crane, Crockett, Ector, Loving, Pecos, Reeves, Upton, Ward and Winkler Counties. Consisting of up to 1,500 feet of alluvial fill, the Pecos Valley occupies two hydrologically separate basins: the Pecos Trough in the west and the Monument Draw Trough in the east. The aquifer is hydrologically connected to underlying water-bearing strata, including the Edwards-Trinity in Pecos and Reeves Counties, and the Rustler in Reeves County. The western basin (Pecos Trough) contains poorer quality water and is used most extensively for irrigation of salt-tolerant crops. The eastern basin (Monument Draw Trough) contains relatively good quality water that is used for a variety of

purposes, including industrial use, power generation, and public water supply. Most pumping occurs in Pecos and Reeves Counties for irrigation. Lateral subsurface flow from the Rustler aquifer into the Pecos Valley has significantly affected the chemical quality of groundwater in the overlying western Pecos Trough aquifer. Most of this basin contains water with greater than 1,000 mg/l TDS, and a significant portion is above 3,000 mg/l TDS.

Static water levels currently range between approximately 20 feet below land surface to over 300 feet below land surface in Reeves County. The saturated thickness of the Pecos Valley Aquifer ranges from zero feet thick near the edges of the outcrop to nearly 1,500 feet along the central axis of the Pecos Trough (Meyer and others, 2012).

Edwards-Trinity (Plateau)

The Edwards-Trinity (Plateau) Aquifer in west Texas is the westernmost extension of a vast groundwater system that underlies the Edwards Plateau east of the Pecos River and the Stockton Plateau west of the river. Groundwater occurs under water-table conditions in the west Texas counties. The hydrogeology of the Edwards-Trinity (Plateau) Aquifer in west Texas is not understood as well as in areas to the east (LBG-Guyton Associates and others, 2016).

In Reeves County, the aquifer consists of saturated sediments of the Cretaceous age Trinity Group formations and the overlying carbonate rocks (limestone and dolomite) of the Fredericksburg and Washita Groups. The basal conglomerate (Yearwood Formation), and the Cox Sandstone (Antlers equivalent) are overlain by the Finlay, Boracho, and Buda limestones. These water-bearing Cretaceous formations are present only in the southwestern half of Reeves County (Ogilbee and Wesselman, 1962). Historic static water levels currently range between approximately 10 and 400 feet below land surface in the Edwards-Trinity (Plateau) Aquifer in Reeves County with depths to water increasing to the south.

Dockum

The Dockum aquifer is used for water supply in several counties, including Andrews, Crane, Ector, Howard, Loving, Mitchell, Reagan, Reeves, Scurry, Upton, Ward and Winkler counties. The Dockum outcrops in Scurry and Mitchell counties, and elsewhere underlie rock formations comprising the Ogallala, Edwards- Trinity, and Pecos Valley aquifers. Although the Dockum aquifer underlies much of the region, its low water yield and generally poor water quality results in its classification as a minor aquifer. The primary water-bearing zone in the Dockum Group, commonly called the “Santa Rosa”, consists of up to 700 feet of sand and conglomerate interbedded with layers of silt and shale. Recharge to the Dockum primarily occurs in Scurry and Mitchell counties where the formation outcrops at the land surface. Recharge potential also occurs where water-bearing units of the Trinity and Pecos Valley directly overlie the Santa Rosa portion of the Dockum. Elsewhere, the Dockum is buried deep below the land surface, is finer grained, and receives very limited lateral

recharge. Groundwater pumped from the aquifer in these areas will come directly from storage and will result in water level declines (Freese and Nichols and LBG-Guyton, 2016).

The Dockum underlies the eastern one-quarter to one-third of Reeves County. Most of the Dockum wells that are operating in Reeves County are used to provide water for livestock and municipal supply for the City of Pecos. Historic static water levels currently range between approximately 20 and 250 feet below land surface in the Dockum Aquifer in Reeves County.

Rustler

The Rustler Aquifer is located in eastern Culberson County, where it is exposed in a southwest-trending belt that begins at the northeast corner of the county. The aquifer dips toward the east and is found in the subsurface in easternmost Culberson County and Jeff Davis County. Approximately 803 square miles of land in West Texas are underlain by the Rustler Aquifer, where it is a source of water for irrigation and livestock. High concentrations of dissolved solids render the formation unsuitable as a source of municipal and domestic supply. The Rustler Aquifer consists mainly of dolomite, limestone, and gypsum of the Permian-age Rustler Formation. Groundwater is produced primarily from solution channels, caverns and collapsed breccia zones. The aquifer is under water-table conditions in the outcrop recharge zone in eastern Culberson County and is under artesian conditions elsewhere (LBG-Guyton Associates and others, 2016).

The Rustler subcrop underlies nearly all of Reeves County, with a small portion of the Rustler Hills outcrop present in far northern Reeves County. There are several well reports for Rustler water wells in Reeves County that are no longer being used; however, a few Rustler wells may still be used for irrigation. Historic static water levels range between approximately 100 and 450 feet below land surface in the Rustler Aquifer in Reeves County.

Igneous

The Igneous Aquifer system comprises all contiguous Tertiary igneous (volcanic) formations underlying the Davis Mountains and adjacent areas primarily in Brewster, Jeff Davis and Presidio Counties. Most of the aquifer's areal extent is underlain by a thickness ranging from 1,000 to 4,000 feet; however, most wells are less than 1,000 feet in depth. The aquifer is not a single homogeneous aquifer but rather a system of complex water-bearing formations that are in varying degrees of hydrologic communication. Groundwater is stored in the fissures and fractures of intrusive and extrusive rocks of volcanic origin. The aquifer generally yields small to moderate quantities of water to wells. Over 40 separately named volcanic units have been identified, each of which are highly variable in nature. The water quality of the aquifer is relatively good to excellent and generally meets safe drinking water standards. Alpine, Marfa and Fort Davis, along with a growing rural population, derive their municipal supplies from this aquifer (LBG-Guyton Associates and others, 2016).

There are only a few water wells completed in the Igneous Aquifer in the Barilla Mountains in extreme southern Reeves County.

Capitan Reef Complex

The Capitan Reef formed along the margins of the Delaware Basin, a Late Paleozoic sea. In Texas, the reef formed along the western and eastern edges of the basin in arcuate strips 10 to 14 miles wide. The reef is exposed in the Guadalupe and Apache Mountains of Culberson County and in the Glass Mountains of Brewster County. In other areas, the reef is found only in the subsurface. It extends northward into New Mexico, where it is a source of fresh water for the City of Carlsbad. The Capitan Reef Aquifer is composed of up to 2,000 feet of massive to cavernous dolomite and limestone, bedded limestone and reef talus. In many areas of Culberson and Hudspeth Counties, the yields of wells are commonly more than 1,000 gpm. Further to the south, in the Apache Mountains of Culberson County, well yields are in the range of 400 gpm. There is no reported production data for the Glass Mountains portion of the Capitan Reef (LBG-Guyton Associates and others, 2016).

Only a small portion of the Capitan Reef Aquifer underlies far southwest Reeves County. No water well completion reports have been found in the Capitan Reef Aquifer in Reeves County. However, it will likely be the best source of water supply for oil and gas exploration in southern Reeves County, based on current available water volume estimates for the aquifers in southern Reeves County.

Table 4. Summary of Reeves County Water Well Characteristics by Aquifer

Aquifer	Well Depths (feet bgl)	Historic Well Yields (gpm)	Historic Depth to Water (feet bgl)	Total Dissolved Solids (mg/L)
Pecos Valley	11 - 1,595	125 - 1,780	0 - 330	100 – 10,000
Edwards-Trinity (Plateau)	43 - 1,581	30 - 1,000	0 - 596	492 - 3,888
Dockum	83 - 455	60 - 697	31 - 241	465 - 3,433
Capitan Reef Complex	1,500 – 2,500	N/A	~600	262 - 6,816 (data from Pecos Co)
Rustler	1,030 - 1,625	650 - 750	129 - 439	1,000 - 10,000
Igneous	85 - 139	3 - 700	8 - 517	164 - 3,230

10 References

Ashworth, J.B., 1990. Evaluation of Groundwater resources in parts of Loving, Pecos, Reeves, Ward, and Winkler Counties, Texas; Texas Water Development Board Report 317; 51 p.

Boghici, R., 2022. GAM Run 21-009 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 3; Texas Water Development Board GAM Report; January 11, 2022; 25 p.

Capus, D.Z.Q. and I. Jones, 2023. GAM Run 23-001: Reeves County Groundwater Conservation District Management Plan; Texas Water Development Board GAM report; May 10, 2023; 26p.

LBG-Guyton Associates, Inc. and Freese and Nichols, 2016. 2016 Far West Texas Water Plan; prepared for Far West Texas Water Planning Group.

Meyer, J.E. and others, 2012. Pecos Valley Aquifer, West Texas Structure and Brackish Groundwater; Texas Water Development Board Report 382; 95 p.

Ogilbee, W. and Wesselman, J.B., 1962. Geology and Groundwater Resources of Reeves County, Texas; Texas Water Development Board Bulletin 6214, Volume 1; coop report with the U.S. Geological Survey, the City of Pecos, and Reeves County; 196 p.

TWDB 2017. Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping". Contract Report 1648302062.

APPENDIX A

RESOLUTION ADOPTING THE MANAGEMENT PLAN

RESOLUTION OF THE BOARD OF DIRECTORS OF THE REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT ADOPTING A DISTRICT MANAGEMENT PLAN

THE STATE OF TEXAS §
§
COUNTY OF REEVES §

WHEREAS, Reeves County Groundwater Conservation District (District) is a duly created and existing groundwater conservation district created and operating under Chapter 8876 of the Texas Special District Laws Code and Chapter 36 of the Texas Water Code, as amended;

WHEREAS, the Management Plan of the District has been developed for the purpose of conserving, preserving, protecting, and recharging the aquifers in the District, and this action is taken under the District's statutory authority to prevent waste and protect rights of owners of interest in groundwater;

WHEREAS, after notice and hearing the Board of Directors ("Board") of the District adopted a Management Plan on July 31, 2018; and

WHEREAS, the Texas Water Development Board ("TWDB") approved the Management Plan; and

WHEREAS, Texas Water Code section 36.1072(e) requires the District to review and readopt the plan with or without revisions at least once every five years; and

WHEREAS, the Board conducted a Public Hearing on September 28, 2023 and following the close of the Public Hearing, the Board considered and readopted with changes the Management Plan on September 28, 2023; and

WHEREAS, the Management Plan meets the requirements of Texas Water Code § 36.1071 and § 36.1072 and 31 TAC § 356. 52.

NOW THEREFORE, BE IT RESOLVED AND ORDERED BY THE BOARD OF DIRECTORS OF REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT THAT:

1. The facts and recitations found in the preamble of this Resolution are hereby found and declared to be true and correct, and are incorporated by reference herein and expressly made a part hereof, as if copied verbatim.

2. The Board of Directors of the District hereby adopts the Management Plan for the District, subject to those amendments necessary based on comments received

from the public at the public hearing or Board meeting, recommendations from the District Board, General Manager, or legal counsel, or to incorporate information received from the Texas Water Development Board (TWDB) and/or District consultants.

3. The General Manager of the District is hereby authorized to take all steps necessary to implement this resolution and submit the Management Plan to TWDB for its approval.

4. The General Manager of the District is further authorized to take any and all action necessary to coordinate with the TWDB as may be required in furtherance of TWDB's approval pursuant to the provisions of Section 36.1072 of the Texas Water Code.

PASSED AND APPROVED this the 28th day of September, 2023.

Larry Turnbough
President, Board of Directors

ATTEST:

James W. Ward
Secretary, Board of Directors

APPENDIX B

EVIDENCE THAT THE MANAGEMENT PLAN WAS ADOPTED

RCGCD
EIN 81-4235351
P.O. Box 809 Pecos, Texas 79772
info@reevescountygcd.org
(432) 445-9961

Texas Water Development Board
Jeff Walker, Executive Administrator
P.O. Box 13231
Austin, Texas 78711-3231

Dear Jeff Walker,

The Reeves County Groundwater Conservation District Board of Directors adopted by resolution the District's Management Plan at a Public Hearing on September 28th, 2023. Approved Board minutes will be made available on October 26, 2023 after the District's next Board meeting.

Please let me know if you need anything else from us. A copy of will also be sent by email to TWDB.

Thank you,

Sincerely,
Greg Perrin
RCGCD
General Manager
P.O. Box 809
Pecos, Texas 79772

APPENDIX C

EVIDENCE THAT THE DISTRICT COORDINATED DEVELOPMENT OF THE MANAGEMENT PLAN WITH SURFACE WATER ENTITIES

Reeves County Groundwater Conservation District

RCGCD
EIN 81-4235351
P.O. Box 809 Pecos, Texas 79772
info@reevescountygcd.org
(432) 445-9961

October 5, 2023

Reeves County Water Improvement District #2
Cecil Lee, Manager
P.O. Box 1331
Pecos, Texas 79772

Enclosed please find a copy of the Reeves County Groundwater Conservation District Management Plan that was adopted by Resolution by the RCGCD Board of Directors on September 28th, 2023. The Management Plan can be accessed on our website: www.revescountygcd.org .

Please let me know if you need anything else from us. There will also be hard copies at our office for your review.

Thank you,

Sincerely,
Greg Perrin
RCGCD
General Manager
P.O. Box 809
119 S. Cedar St
Pecos, Texas 79772

Reeves County Groundwater Conservation District

RCGCD
EIN 81-4235351
P.O. Box 809 Pecos, Texas 79772
info@reevescountygcd.org
(432) 445-9961

October 5, 2023

Red Bluff Water Power Control District
Robin Prewitt, General Manager
111 W. 2nd Street
Pecos, Texas 79772

Enclosed please find a copy of the Reeves County Groundwater Conservation District Management Plan that was adopted by Resolution by the RCGCD Board of Directors on September 28th, 2023. The Management Plan can be accessed on our website: www.revescountygcd.org .

Please let me know if you need anything else from us. There will also be hard copies at our office for your review.

Thank you,

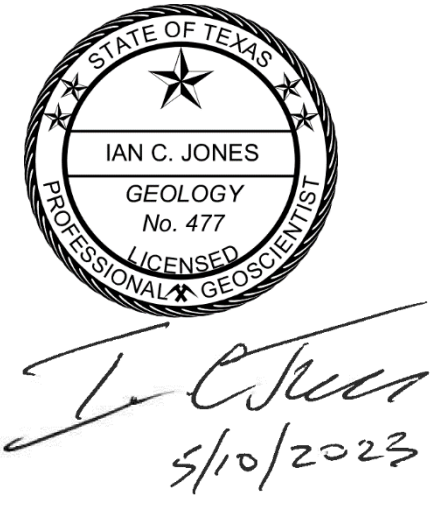
Sincerely,
Greg Perrin, General Manager
RCGCD
P.O. Box 809
119 S. Cedar St
Pecos, Texas 79772

APPENDIX D

GAM RUN 23-001

GAM RUN 23-001: REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Dwight Zedric Q. Capus, G.I.T. and Ian Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-2404
May 10, 2023



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GAM RUN 23-001: REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

Dwight Zedric Q. Capus, G.I.T. and Ian Jones, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-936-2404
May 10, 2023

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), 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 Reeves County Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information, which includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;

2. 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 Reeves County Groundwater Conservation District should be adopted by the district on or before May 107, 2023 and submitted to the executive administrator of the TWDB on or before June 16, 2023. The current management plan for the Reeves County Groundwater Conservation District expires on August 15, 2023.

We used four groundwater availability models for the Reeves County Groundwater Conservation District. Information for Capitan Reef Complex Aquifer is from version 1.01 of the groundwater availability model for the Capitan Reef Complex Aquifer (Jones, 2016). Information for the Rustler Aquifer is from version 1.01 of the groundwater availability model for the Rustler Aquifer (Ewing and others, 2012). Information for the Dockum Aquifer is from version 1.01 of the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015). Information for the Pecos Valley and Edwards-Trinity (Plateau) aquifers is from version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Anaya and Jones, 2009). While a small portion of the Igneous Aquifer underlies the district at the southern tip of Reeves County, the model for Igneous Aquifer does not extend into Reeves County. For more information concerning this aquifer, please contact Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov.

This report replaces the results of GAM Run 18-001 (Jones, 2018). Values may differ from the previous report as a result of routine updates to the spatial grid file used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows. Tables 1 through 5 summarize the groundwater availability model data required by statute. Figures 1, 3, 5, 7, and 9 show the areas of the respective models from which the values in Tables 1 through 5 were extracted. Figures 2, 4, 6, 8, and 10 provide a generalized diagram of the groundwater flow components provided in Tables 1 through 5. If, after review of the figures, the Reeves County Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

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

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model mentioned above was used to estimate information for the Reeves County Groundwater Conservation District management plan. Water budgets were extracted for the historical model period for the Capitan Reef Complex Aquifer (1980 through 2005), Rustler Aquifer (1980 through 2008), Dockum Aquifer (1980 through 2012), and the Edwards-Trinity (Plateau) and Pecos Valley aquifers (1981 through 2000) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Capitan Reef Complex Aquifer

- We used version 1.01 of the groundwater availability model for the Capitan Reef Complex Aquifer (Jones, 2016) to analyze the Capitan Reef Complex Aquifer. See Jones (2016) for assumptions and limitations of the groundwater availability model.
- The model has five active layers representing the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Layer 1); Dockum Aquifer and Dewey Lake Formation (Layer 2); Rustler Aquifer (Layer 3); Artesia Group, Salado Formation, and Castile Formation (Layer 4), and Capitan Reef Complex Aquifer, Delaware Basin, and San Andres Formation (Layer 5).
- While the model for the Capitan Reef Complex Aquifer includes the Pecos Valley Alluvium, Edwards-Trinity (Plateau), Dockum, and Rustler aquifers, the focus of the model run was to extract information for the Capitan Reef Complex Aquifer. Thus, model layer 5 was used for the management plan analysis.
- It should be noted that the model for the Capitan Reef Complex Aquifer only includes the eastern “arm” of the aquifer and does not include the small aquifer extent at the end of the western “arm” located within the district boundary.
- Water budget terms were averaged for the period 1980 through 2005 (stress periods 50 through 75)
- The model was run with MODFLOW-2005 (Harbaugh, 2005).

Rustler Aquifer

- We used version 1.01 of the groundwater availability model for the Rustler Aquifer Groundwater Availability Model (Ewing and Others, 2012) to analyze the Rustler Aquifer. See Ewing and others (2012) for assumptions and limitations of the groundwater availability model.

- The model has two active layers representing the Dewey Lake Formation and Dockum Aquifer (Layer 1) and the Rustler Aquifer (Layer 2). While the model for the Rustler Aquifer includes the Dockum Aquifer, the focus of the model run was to extract information for the Rustler Aquifer. Thus, model layer 2 was used for the management plan analysis.
- Water budget terms were averaged for the period 1980 through 2008 (stress periods 63 through 91).
- The model was run with MODFLOW-2000 (Harbaugh and Others, 2000).

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System to analyze the Dockum Aquifer. See Deeds and others (2015) and Deeds and Jigmond (2015) for assumptions and limitations of the model
- The groundwater availability model for the High Plains Aquifer System contains the following four layers:
    - Layer 1 represents the Ogallala and Pecos Valley aquifers where present.
    - Layer 2 represents the Rita Blanca , Edwards-Trinity (High Plains) , and Edwards-Trinity (Plateau) aquifers where present.
    - Layer 3 represents the upper portion of the Dockum Aquifer and equivalent units.
    - Layer 4 represents the lower portion of the Dockum Aquifer and equivalent units.
- While the model for the High Plains Aquifer System includes the Pecos Valley and Edwards-Trinity (Plateau) aquifers, the focus of the model run was to extract information for the Dockum Aquifer. Thus, model layers 3 and 4 were used for the management plan analysis.
- Water budget terms were averaged for the period 1980 through 2012 (stress periods 52 through 84).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

Edwards-Trinity (Plateau) and Pecos Valley aquifers

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers to analyze the Edwards-Trinity (Plateau) and Pecos Valley aquifers. See Anaya and Jones (2009) for assumptions and limitations of the model.

- The groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers model contains the following two layers:
    - Layer 1 represents the Pecos Valley Aquifer, Edwards Group and equivalent limestone hydrostratigraphic units of the Edwards-Trinity (Plateau) Aquifer, and undifferentiated Trinity Group hydrostratigraphic units or equivalent units of the Edwards-Trinity (Plateau) Aquifer, and
    - Layer 2 represents the Edwards Group and equivalent limestone hydrostratigraphic units of the Edwards-Trinity (Plateau) Aquifer and the undifferentiated Trinity Group hydrostratigraphic units or equivalent units of the Edwards-Trinity (Plateau) Aquifer.
- Water budget terms were averaged for the period 1981 through 2000 (stress periods 2 through 21).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Capitan Reef Complex, Rustler, Dockum, Pecos Valley, and Edwards-Trinity (Plateau) aquifers located within the Reeves County Groundwater Conservation District and averaged over the historical calibration period, as shown in Tables 1 through 5.

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 5. Figures 2, 4, 6, 8, and 10 provide a generalized diagram of the groundwater flow components provided in Tables 1 through 5.

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 CAPITAN REEF COMPLEX AQUIFER THAT IS NEEDED FOR THE REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Capitan Reef Complex Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Capitan Reef Complex Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Capitan Reef Complex Aquifer	878
Estimated annual volume of flow out of the district within each aquifer in the district	Capitan Reef Complex Aquifer	774
Estimated net annual volume of flow between each aquifer in the district	From the Capitan Reef Complex Aquifer to the overlying stratigraphic units	115
	To the Capitan Reef Complex Aquifer from the Delaware basin	2

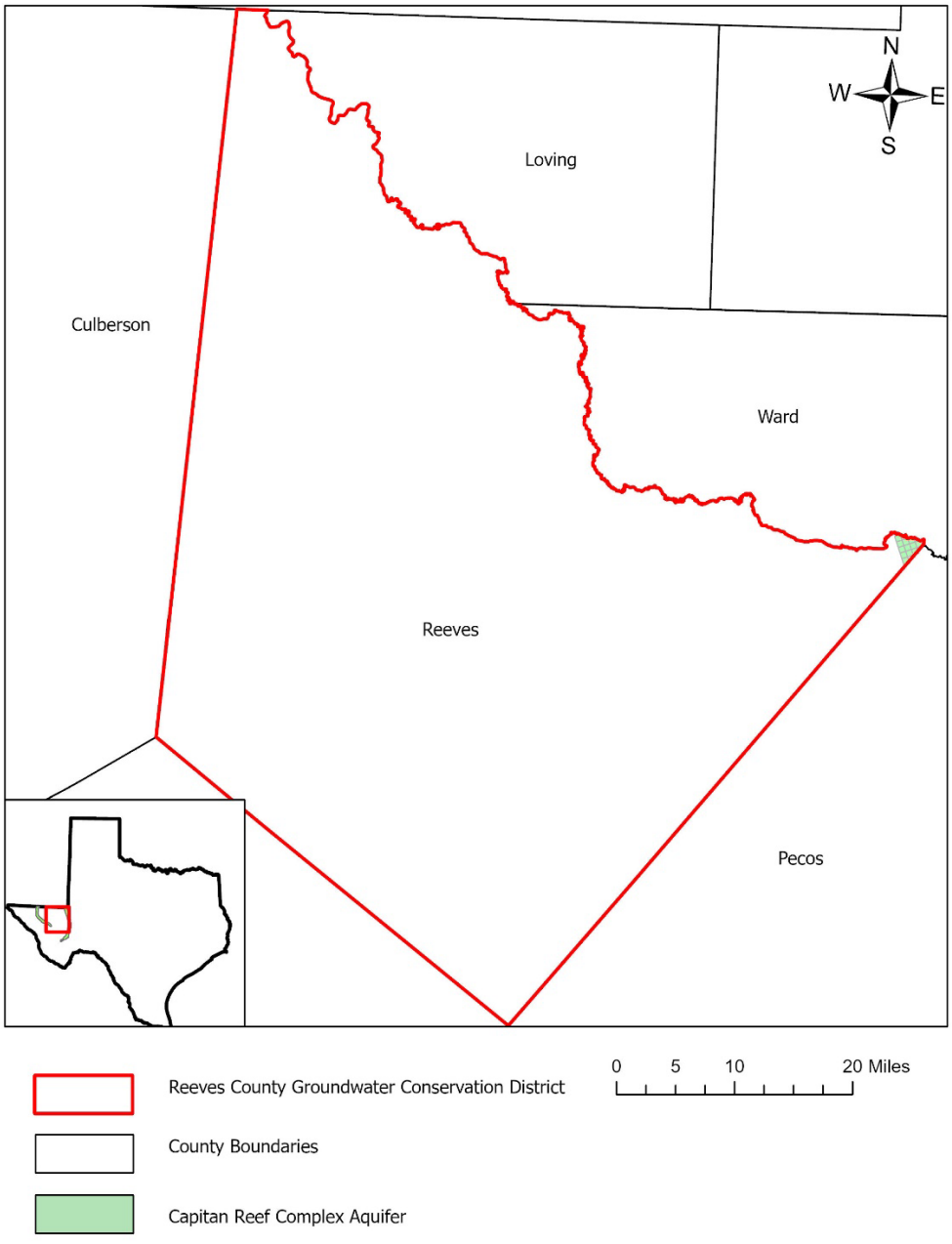
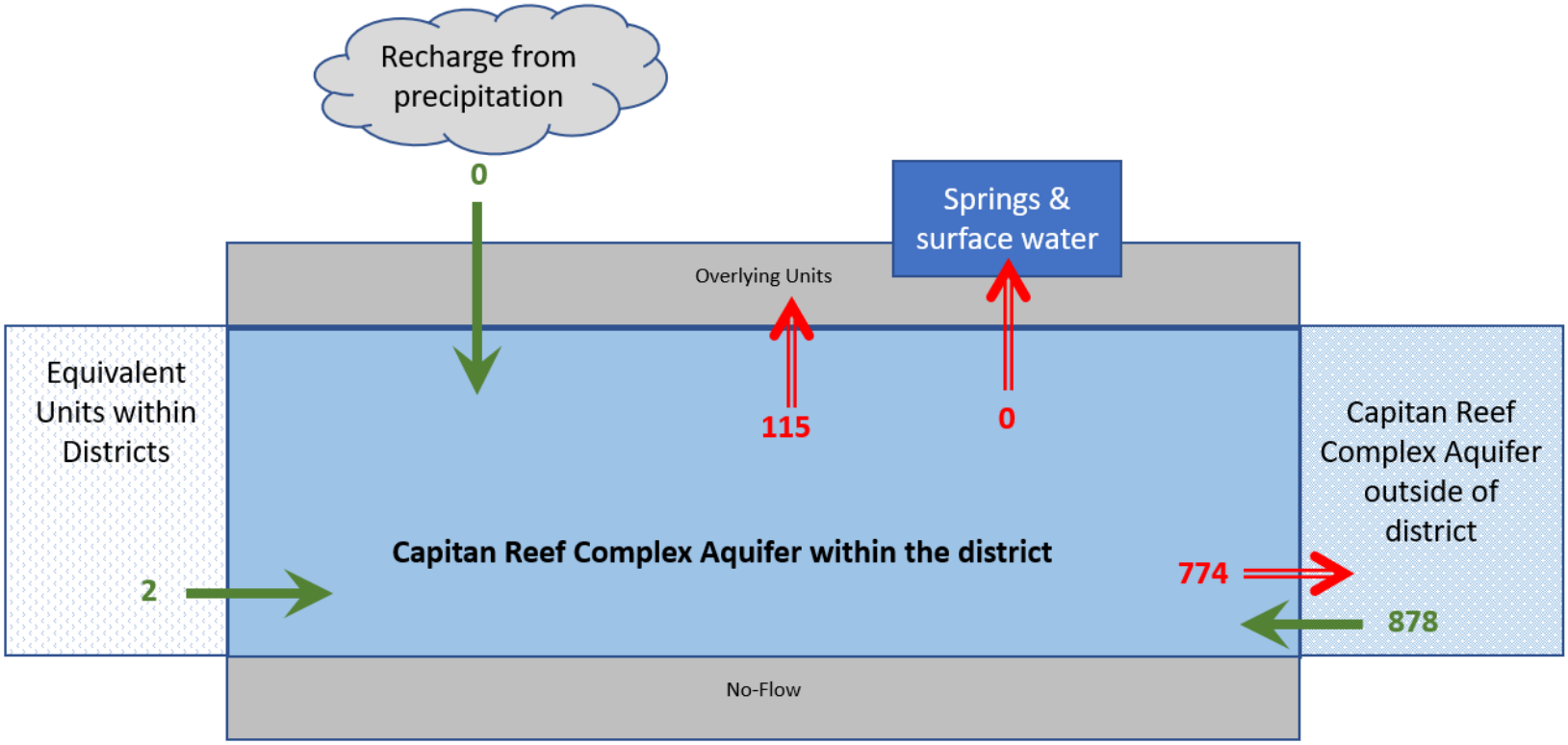


FIGURE 1: AREA OF GROUNDWATER AVAILABILITY MODEL FOR THE CAPITAN REEF COMPLEX AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE CAPITAN REEF COMPLEX AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



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

FIGURE 2: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 1, REPRESENTING DIRECTIONS OF FLOW FOR THE CAPITAN REEF COMPLEX AQUIFER WITHIN REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR.

TABLE 2: SUMMARIZED INFORMATION FOR THE RUSTLER AQUIFER THAT IS NEEDED FOR THE REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Rustler Aquifer	147
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Rustler Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Rustler Aquifer	1,478
Estimated annual volume of flow out of the district within each aquifer in the district	Rustler Aquifer	322
Estimated net annual volume of flow between each aquifer in the district	From the Rustler Aquifer to the Dewey Lake/Dockum Equivalent Aquifer	1,332
	From the Rustler Aquifer to the Dockum Aquifer	1,452
	To the Rustler Aquifer from the Rustler equivalent units	27

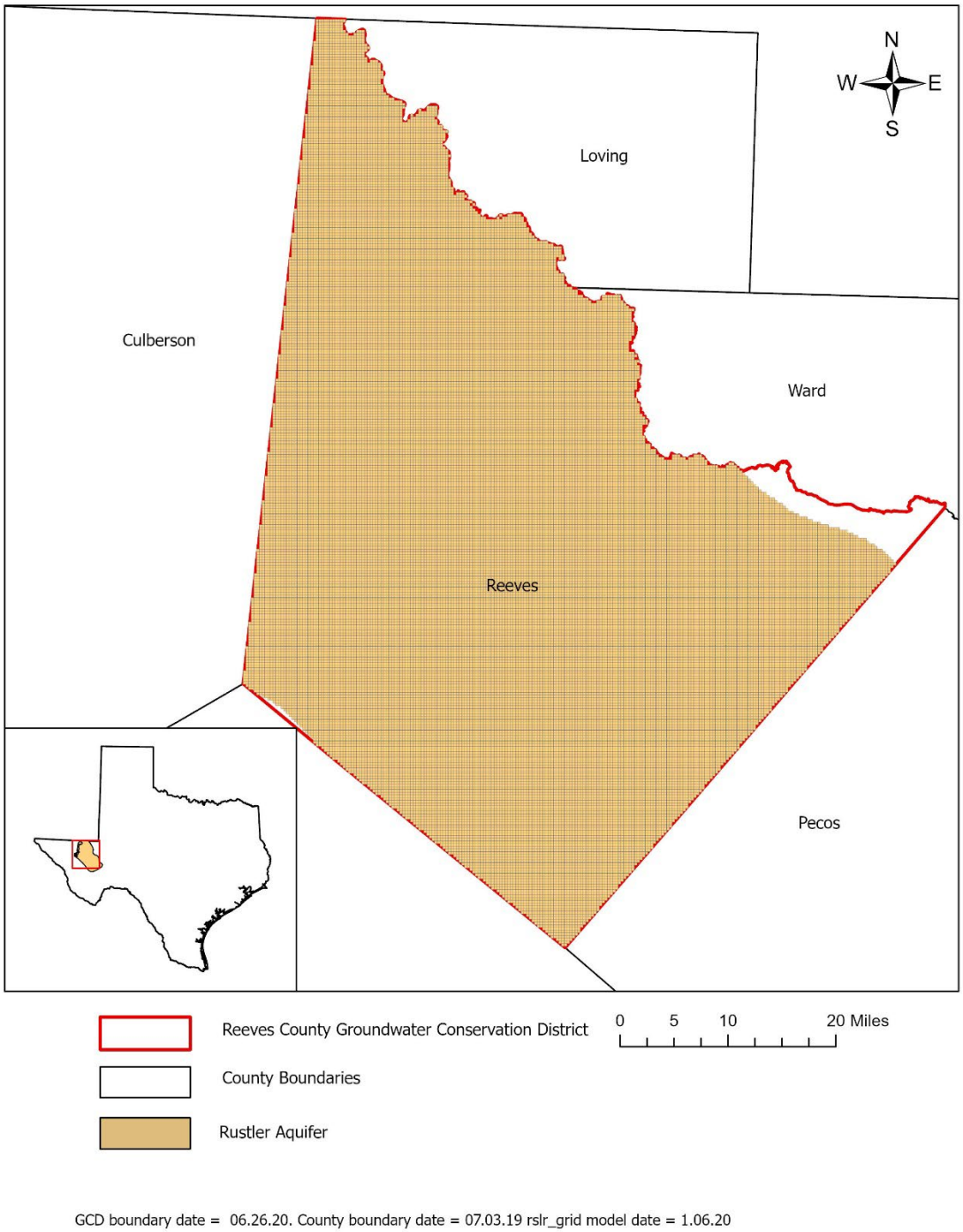
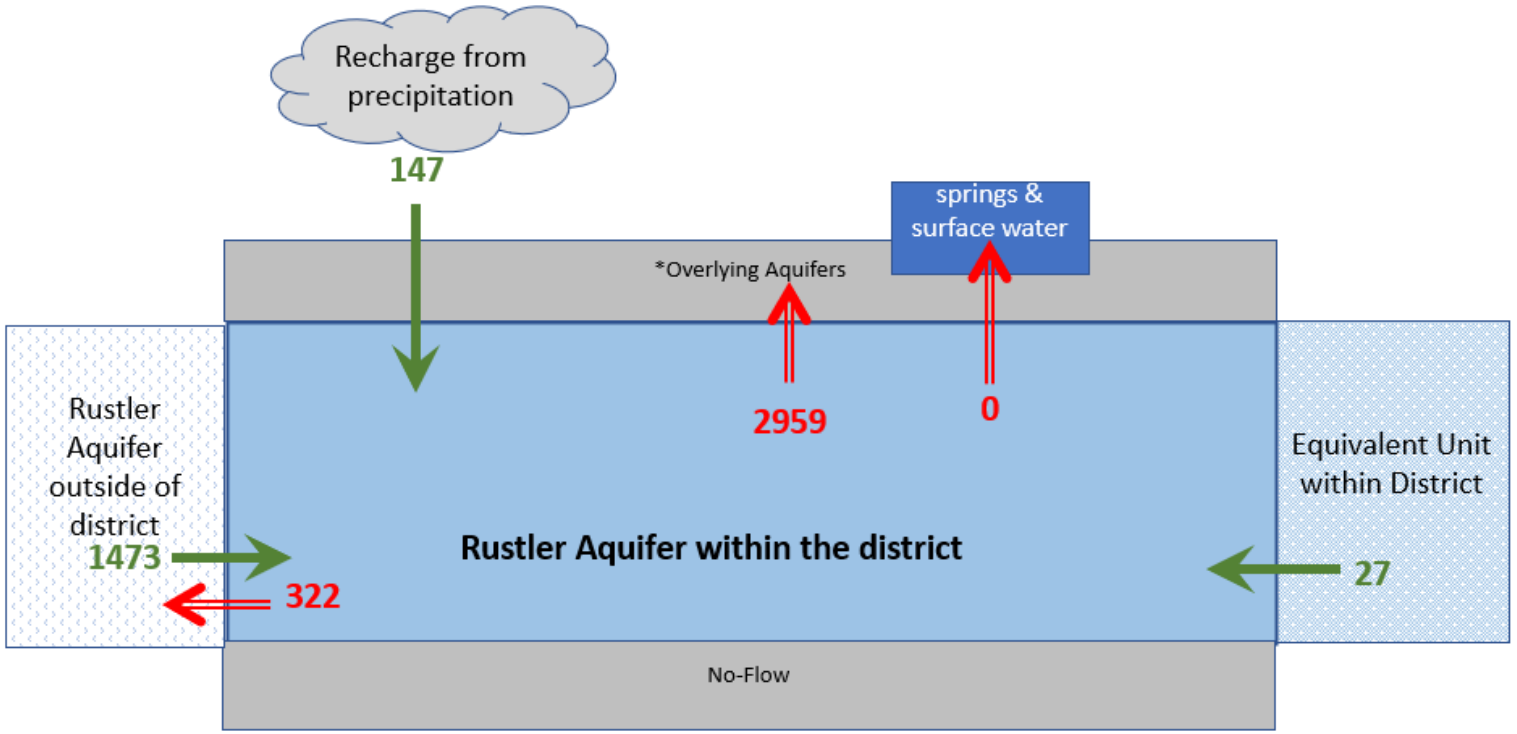


FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR RUSTLER AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE RUSTLER AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



*Flow from Overlying units includes net flow of 1,332 acre-feet per year from Rustler Aquifer to Dockum/Dewey Lake Equivalent Aquifer and 1,452 acre-feet from Rustler Aquifer to Dockum Aquifer

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

FIGURE 4: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 2, REPRESENTING DIRECTIONS OF FLOW FOR THE RUSTLER AQUIFER WITHIN REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR.

TABLE 3: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR THE REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	411
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	351
Estimated net annual volume of flow between each aquifer in the district	From the Dockum Aquifer to the Pecos Valley Aquifer	211
	To the Dockum Aquifer from the Edwards-Trinity (Plateau) Aquifer	285

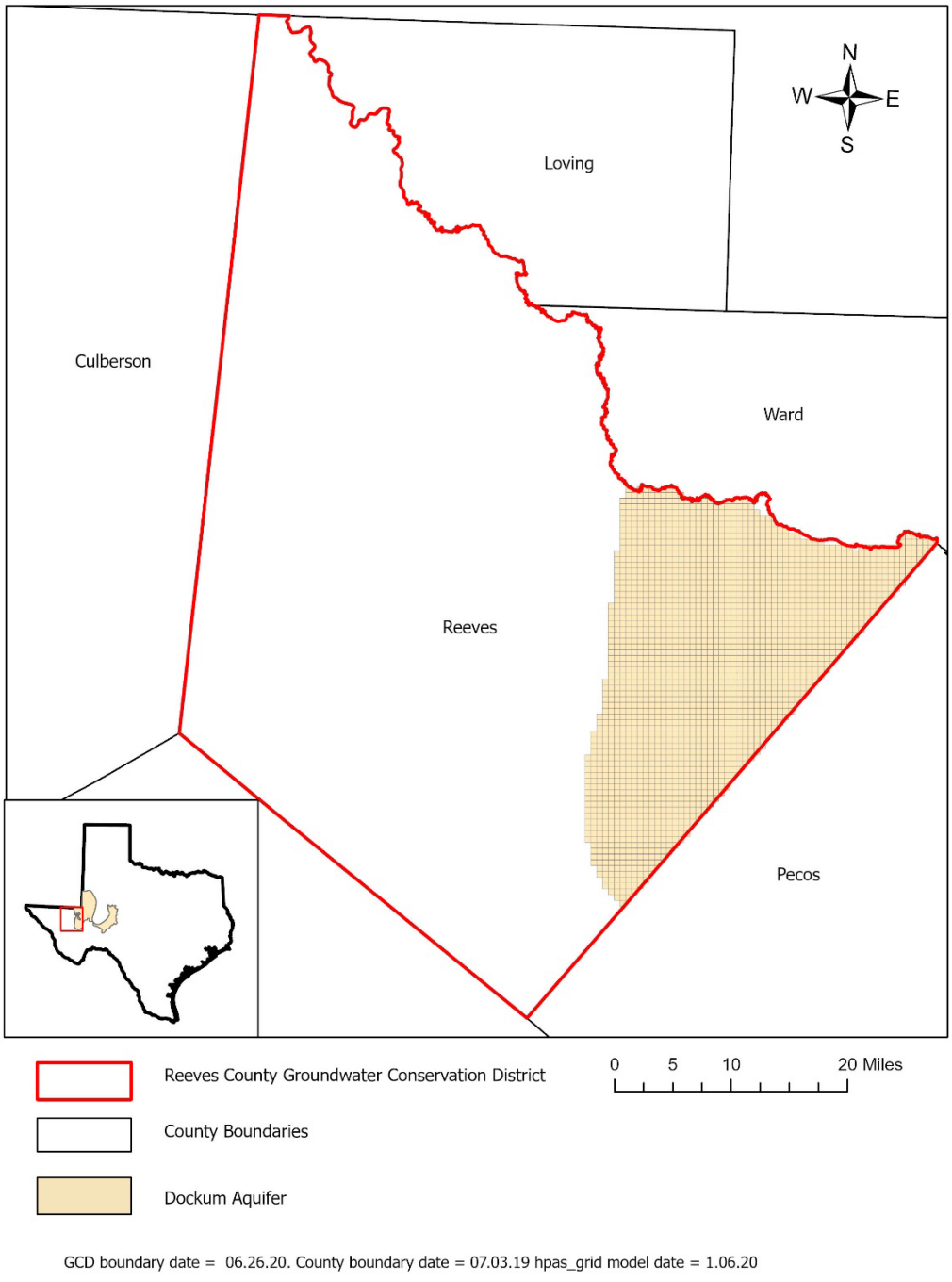
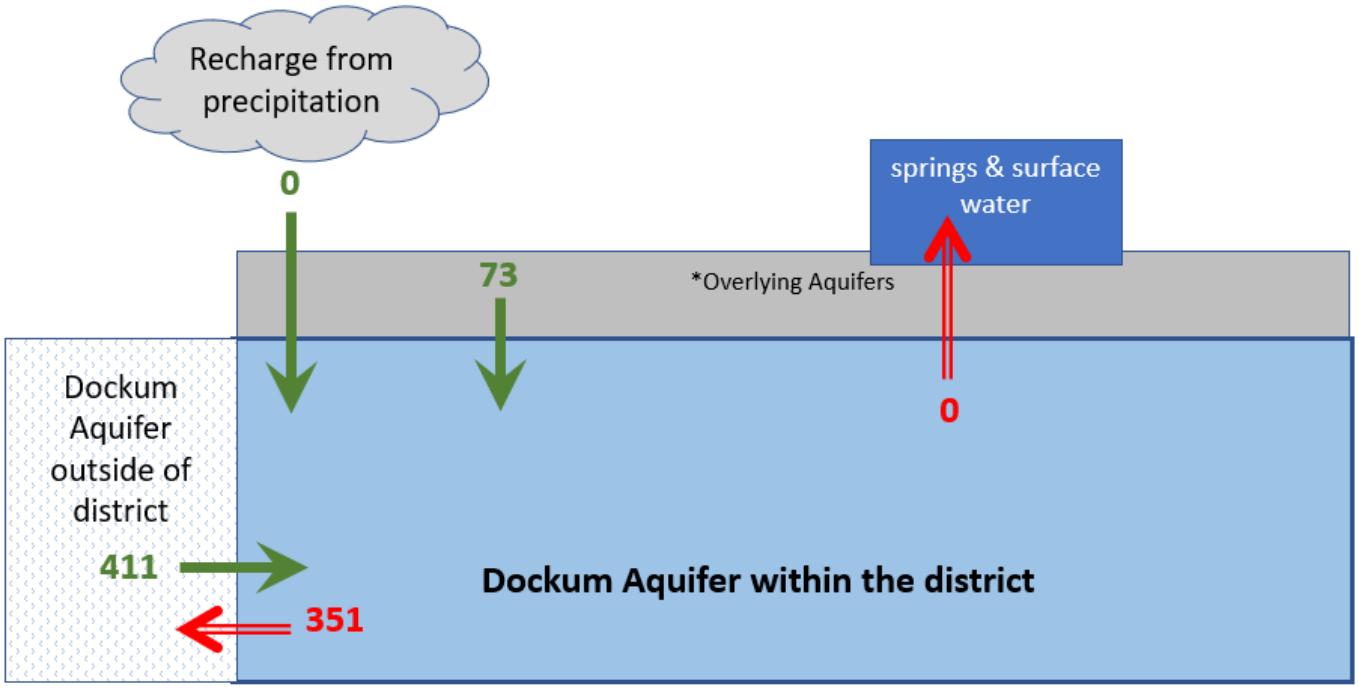


FIGURE 5: AREA OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE DOCKUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



*Flow from Overlying units includes net flow of 211 acre-feet per year to the Pecos Valley Aquifer and net flow of 284 acre-feet per year from Edwards – Trinity (Plateau)

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

FIGURE 6: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 3, REPRESENTING DIRECTIONS OF FLOW FOR THE DOCKUM AQUIFER WITHIN REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR.

TABLE 4: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR THE REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	16,037
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	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	29,331
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	6
Estimated net annual volume of flow between each aquifer in the district	From the Edwards-Trinity (Plateau) Aquifer to the Pecos Valley Aquifer	42,647
	From the Edwards-Trinity (Plateau) Aquifer to the Edwards-Trinity (Plateau) Aquifer Equivalent	1,093

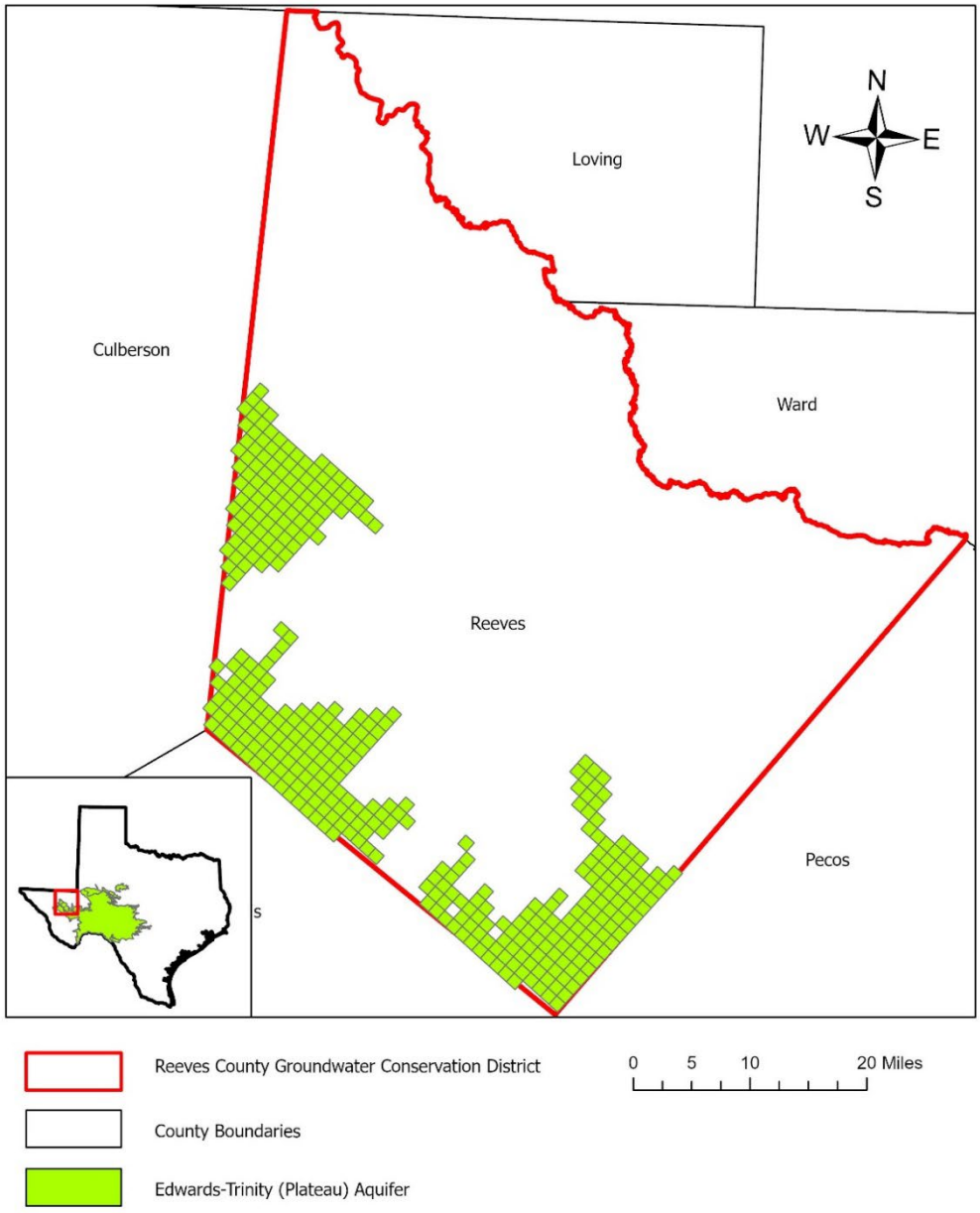
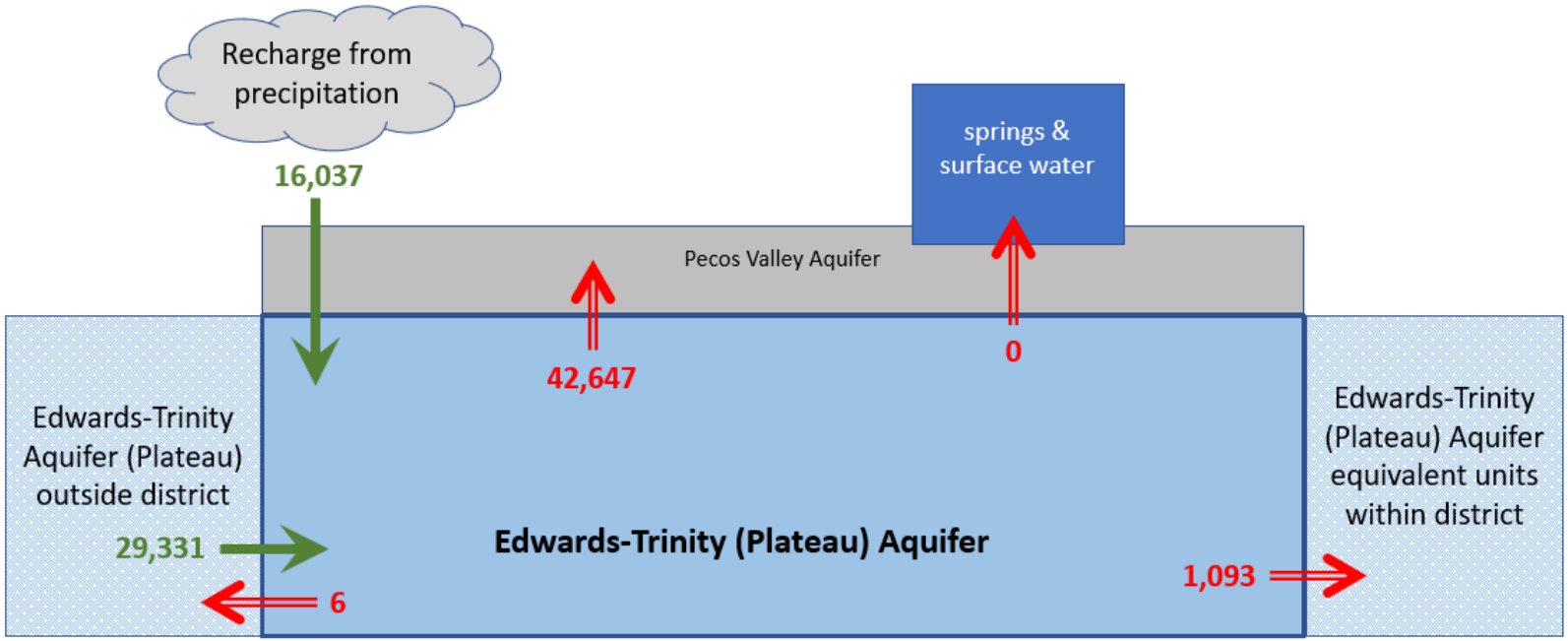


FIGURE 7: AREA OF THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS GROUNDWATER AVAILABILITY MODEL FROM WHICH THE INFORMATION IN TABLE 4 WAS EXTRACTED (THE EDWARDS-TRINITY (PLATEAU) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



Caveat: This diagram only includes the water budget items provided in Table 4. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

FIGURE 8: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 4, REPRESENTING DIRECTIONS OF FLOW FOR THE EDWARDS-TRINITY (PLATAEU) AQUIFER WITHIN REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR.

TABLE 5: SUMMARIZED INFORMATION FOR THE PECOS VALLEY AQUIFER THAT IS NEEDED FOR THE REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Pecos Valley Aquifer	65,480
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Pecos Valley Aquifer	51,531
Estimated annual volume of flow into the district within each aquifer in the district	Pecos Valley Aquifer	12,279
Estimated annual volume of flow out of the district within each aquifer in the district	Pecos Valley Aquifer	17,948
Estimated net annual volume of flow between each aquifer in the district	To the Pecos Valley Aquifer from the Edwards-Trinity (Plateau) Aquifer	42,647
	To the Pecos Valley Aquifer from the Edwards-Trinity (Plateau) Aquifer equivalent units	1,403

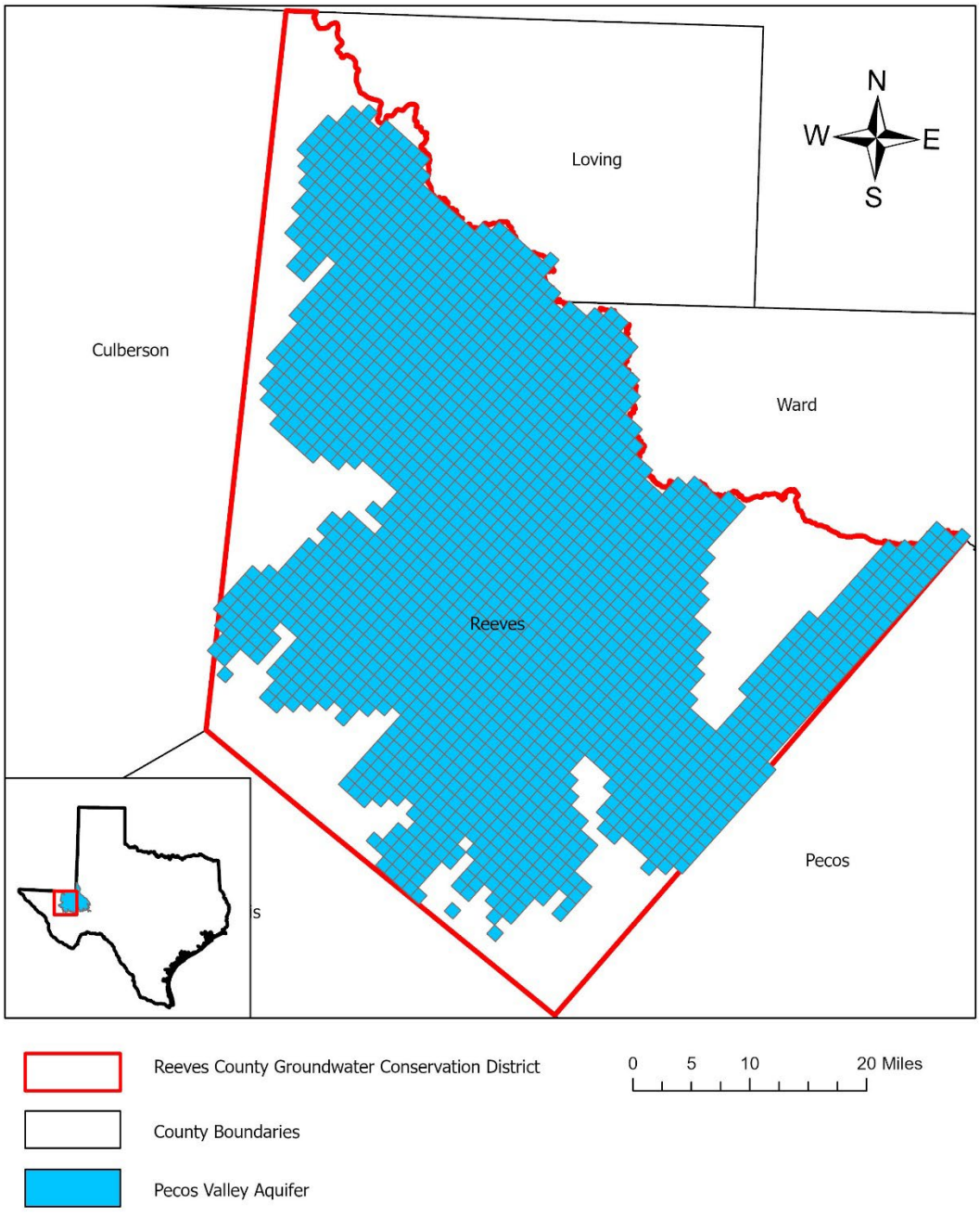
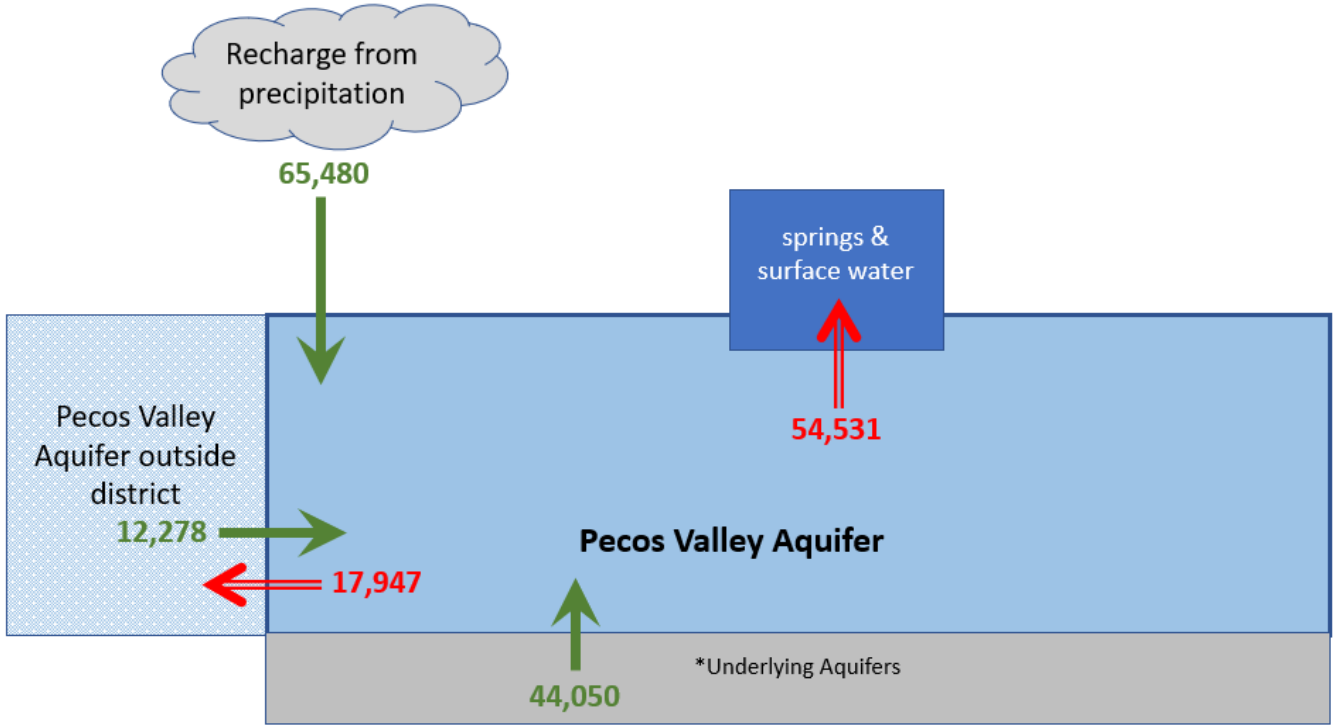


FIGURE 9: AREA OF THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS GROUNDWATER AVAILABILITY MODEL FROM WHICH THE INFORMATION IN TABLE 5 WAS EXTRACTED (THE PECOS VALLEY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



*Flow from Underlying units includes net flow of 42,647 acre-feet per year to Pecos Valley Aquifer from Edwards-Trinity (Plateau), 1,403 acre-feet per year to Pecos Valley Aquifer from Edwards-Trinity (Plateau) equivalent

Caveat: This diagram only includes the water budget items provided in Table 5. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

FIGURE 10: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 5, REPRESENTING DIRECTIONS OF FLOW FOR THE PECOS VALLEY AQUIFER WITHIN REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR.

LIMITATIONS:

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

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

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historical pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.
Because the application of the groundwater models was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

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

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APPENDIX E

ESTIMATED HISTORICAL GROUNDWATER USE AND 2022 STATE WATER PLAN DATASETS: REEVES COUNTY GROUNDWATER CONSERVATION DISTRICT

Estimated Historical Groundwater Use And 2022 State Water Plan Datasets:

Reeves County Groundwater Conservation District

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
January 26, 2023

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 2022 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 Grayson Dowlearn, Grayson.dowlearn@twdb.texas.gov, (512) 475-1552.

DISCLAIMER:

The data presented in this report represents the most up to date WUS and 2022 SWP data available as of 1/26/2023. 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 2022 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 2022 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 ideal 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 2020. TWDB staff anticipates the calculation and posting of these estimates at a later date.

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

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	5,122	4	8,115	0	51,997	208	65,446
	SW	0	0	0	0	5,135	0	5,135
2018	GW	4,994	9	8,000	0	46,300	208	59,511
	SW	0	0	0	0	4,148	0	4,148
2017	GW	4,520	6	5,648	0	76,435	201	86,810
	SW	0	0	0	0	6,878	0	6,878
2016	GW	5,145	6	1,558	0	54,206	468	61,383
	SW	0	0	0	0	11,217	0	11,217
2015	GW	4,741	41	1,371	0	37,049	460	43,662
	SW	0	0	0	0	12,201	0	12,201
2014	GW	4,515	52	1,065	0	40,633	445	46,710
	SW	0	0	0	0	13,712	0	13,712
2013	GW	4,372	96	401	0	33,318	486	38,673
	SW	0	0	0	0	42,382	0	42,382
2012	GW	3,980	114	43	0	39,811	285	44,233
	SW	0	0	0	0	13,797	0	13,797
2011	GW	4,227	121	193	0	47,161	319	52,021
	SW	0	0	0	0	5,500	0	5,500
2010	GW	4,331	286	429	0	40,894	303	46,243
	SW	0	0	178	0	17,475	0	17,653
2009	GW	3,592	286	875	0	44,465	633	49,851
	SW	0	0	114	0	13,484	0	13,598
2008	GW	3,366	286	383	0	0	482	4,517
	SW	0	0	50	0	26,968	0	27,018
2007	GW	3,348	409	972	0	12,521	545	17,795
	SW	27	571	0	0	65,673	0	66,271
2006	GW	3,295	289	1,144	0	18,925	862	24,515
	SW	33	0	0	0	70,000	0	70,033
2005	GW	3,352	291	1,054	0	18,837	693	24,227
	SW	32	0	0	0	73,300	0	73,332
2004	GW	3,313	298	495	0	36,928	601	41,635
	SW	33	0	0	0	52,131	32	52,196

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

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

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	Irrigation, Reeves	Rio Grande	Balmorhea Lake/Reservoir	18,800	18,800	18,800	18,800	18,800	18,800
F	Irrigation, Reeves	Rio Grande	Red Bluff Lake/Reservoir	2,504	2,498	2,492	2,487	2,481	2,475
F	Irrigation, Reeves	Rio Grande	Rio Grande Run-of-River	573	573	573	573	573	573
	Sum of Projected Surface Water Supplies (acre-feet)			**21,877**	**21,871**	**21,865**	**21,860**	**21,854**	**21,848**

Projected Water Demands
TWDB 2022 State Water Plan Data

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

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

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	Balmorhea	Rio Grande	203	214	225	233	238	243
F	County-Other, Reeves	Rio Grande	532	561	586	603	617	628
F	Irrigation, Reeves	Rio Grande	58,937	58,937	58,937	58,937	58,937	58,937
F	Livestock, Reeves	Rio Grande	368	368	368	368	368	368
F	Madera Valley WSC	Rio Grande	446	468	489	506	518	528
F	Manufacturing, Reeves	Rio Grande	286	305	305	305	305	305
F	Mining, Reeves	Rio Grande	12,600	12,600	12,100	9,900	7,800	6,200
F	Pecos	Rio Grande	2,916	3,065	3,215	3,322	3,405	3,468
	Sum of Projected Water Demands (acre-feet)		**76,288**	**76,518**	**76,225**	**74,174**	**72,188**	**70,677**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

REEVES COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	Balmorhea	Rio Grande	-107	-118	-129	-137	-142	-147
F	County-Other, Reeves	Rio Grande	0	0	0	0	0	0
F	Irrigation, Reeves	Rio Grande	0	0	0	0	0	0
F	Livestock, Reeves	Rio Grande	0	0	0	0	0	0
F	Madera Valley WSC	Rio Grande	0	0	0	0	0	0
F	Manufacturing, Reeves	Rio Grande	0	0	0	0	0	0
F	Mining, Reeves	Rio Grande	-10,400	-10,400	-9,900	-7,700	-5,600	-4,000
F	Pecos	Rio Grande	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet)		**-10,507**	**-10,518**	**-10,029**	**-7,837**	**-5,742**	**-4,147**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

REEVES COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Balmorhea, Rio Grande (F)							
Develop Edwards-Trinity-Plateau Aquifer Supplies - Balmorhea	Edwards-Trinity-Plateau and Pecos Valley Aquifers [Reeves]	150	150	150	150	150	150
Municipal Conservation - Balmorhea	DEMAND REDUCTION [Reeves]	2	2	2	2	2	2
		152	**152**	**152**	**152**	**152**	**152**
Irrigation, Reeves, Rio Grande (F)							
Irrigation Conservation - Reeves County	DEMAND REDUCTION [Reeves]	2,947	5,894	8,841	8,841	8,841	8,841
Weather Modification	Weather Modification [Atmosphere]	326	326	326	326	326	326
		3,273	**6,220**	**9,167**	**9,167**	**9,167**	**9,167**
Madera Valley WSC, Rio Grande (F)							
Municipal Conservation - Madera Valley WSC	DEMAND REDUCTION [Reeves]	5	5	5	6	6	6
		5	**5**	**5**	**6**	**6**	**6**
Mining, Reeves, Rio Grande (F)							
Develop Additional Pecos Valley Aquifer Supplies - Reeves County Mining	Edwards-Trinity-Plateau and Pecos Valley Aquifers [Reeves]	10,400	10,400	10,400	10,400	10,400	10,400
Mining Conservation - Reeves County	DEMAND REDUCTION [Reeves]	882	882	847	693	546	434
		11,282	**11,282**	**11,247**	**11,093**	**10,946**	**10,834**
Pecos, Rio Grande (F)							
Advanced Groundwater Treatment - Pecos City	Edwards-Trinity-Plateau and Pecos Valley Aquifers [Reeves]	0	3,360	3,360	3,360	3,360	3,360
Direct Non-Potable Reuse - Pecos City	Direct Reuse [Reeves]	560	560	560	560	560	560
Direct Potable Reuse - Pecos City	Direct Reuse [Reeves]	0	925	925	925	925	925
Municipal Conservation - Pecos	DEMAND REDUCTION [Reeves]	29	31	33	34	35	35
Partner with Madera Valley WSC & Expand Well Field - Pecos City	Edwards-Trinity-Plateau and Pecos Valley Aquifers [Reeves]	0	8,960	8,960	8,960	8,960	8,960
		589	**13,836**	**13,838**	**13,839**	**13,840**	**13,840**
Sum of Projected Water Management Strategies (acre-feet)		**15,301**	**31,495**	**34,409**	**34,257**	**34,111**	**33,999**

APPENDIX F

TWDB GAM RUN 21-009 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3

GAM RUN 21-009 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3

Radu Boghici, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
(512) 463-5808
January 11, 2022

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GAM RUN 21-009 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3

Radu Boghici, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
(512) 463-5808
January 11, 2022

EXECUTIVE SUMMARY:

The modeled available groundwater for the relevant aquifers in Groundwater Management Area 3—the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Pecos Valley, and Rustler aquifers—are summarized by decade for use by the groundwater conservation districts (Tables 1, 3, 5, and 7) and by the regional water planning process (Tables 2, 4, 6, and 8). The modeled available groundwater estimates are: 381 acre-feet per year in the Capitan Reef Complex Aquifer; 17,378 acre-feet per year in the Dockum Aquifer; 420,541 acre-feet per year in the Edwards-Trinity (Plateau) and Pecos Valley aquifers; and 2,590 acre-feet per year in the Rustler Aquifer. The modeled available groundwater estimates were extracted from results of model runs using the following groundwater availability models: Eastern Arm of the Capitan Reef Complex, the alternative model for the Edwards-Trinity (Plateau) and Pecos Valley, High Plains Aquifer System, and Rustler aquifers. The explanatory report and other materials submitted to the Texas Water Development Board (TWDB) were determined to be administratively complete on July 15, 2021.

REQUESTOR:

Mr. Ty Edwards, coordinator of Groundwater Management Area 3.

DESCRIPTION OF REQUEST:

In a letter dated March 31, 2021, Dr. William R. Hutchison, on behalf of Groundwater Management Area 3, provided the TWDB with the desired future conditions of the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Pecos Valley, and Rustler aquifers adopted by the groundwater conservation districts in Groundwater Management Area 3. The groundwater conservation districts in Groundwater Management Area 3 proposed to adopt desired future conditions for these aquifers on October 23, 2020. The groundwater conservation districts in Groundwater Management Area 3 adopted the desired future conditions, described in Resolutions No. 21-01, 21-02, 21-03, 21-04, and 21-05, on February 17, 2021. On June 7, 2021, the groundwater conservation districts revised the baseline year for the desired future conditions for the Edwards-Trinity (Plateau) and Pecos Valley aquifers described in Resolution No. 21-03. The desired future conditions adopted by the groundwater conservation districts in 2020 are unchanged from desired future conditions adopted in 2016. The final desired future conditions for the relevant aquifers in Groundwater Management Area 3 are listed below:

Capitan Reef Complex Aquifer

- Total net drawdown in Pecos County (Middle Pecos Groundwater Conservation District) not to exceed 4 feet in2070 as compared with aquifer levels in 2006;
- Total net drawdown in Ward and Winkler counties not to exceed 2 feet in2070 as compared with aquifer levels in 2006;
- The Capitan Reef Aquifer is not relevant for joint planning purposes in all other areas of Groundwater Management Area 3.

Dockum Aquifer

- Average drawdown in Crane County not to exceed 0 feet in2070 as compared with aquifer levels in 2012;
- Average drawdown in Loving County not to exceed 5 feet in2070 as compared with aquifer levels in 2012;
- Average drawdown in Pecos County (Middle Pecos Groundwater Conservation District) not to exceed 52 feet in2070 as compared with aquifer levels in 2012;
- Average drawdown in Reeves County (Reeves County Groundwater Conservation District) not to exceed 20 feet in2070 as compared with aquifer levels in 2012;
- Average drawdown in Ward County not to exceed 30 feet in2070 as compared with aquifer levels in 2012;
- Average drawdown in Winkler County not to exceed 22 feet in2070 as compared with aquifer levels in 2012.

Edwards-Trinity (Plateau) and Pecos Valley aquifers

- Total net drawdown in Crane County not to exceed 58 feet in2070 as compared with aquifer levels in 2010;
- Total net drawdown in Loving County not to exceed 5 feet in2070 as compared with aquifer levels in 2010;
- Total net drawdown in Pecos County (Middle Pecos Groundwater Conservation District) not to exceed 14 feet in2070 as compared with aquifer levels in 2010;
- Total net drawdown in Reeves County (Reeves County Groundwater Conservation District) not to exceed 8 feet in 2070 as compared with aquifer levels in 2010;
- Total net drawdown in Ward County not to exceed 63 feet in2070 as compared with aquifer levels in 2010;
- Total net drawdown in Winkler County not to exceed 161 feet in2070 as compared with aquifer levels in 2010.

Rustler Aquifer

- Average drawdown in Loving County not to exceed 28 feet in 2070 as compared with aquifer levels in 2009;
- Average drawdown in Pecos County (Middle Pecos Groundwater Conservation District) not to exceed 69 feet in 2070 as compared with aquifer levels in 2009;
- Average drawdown in Reeves County (Reeves County Groundwater Conservation District) not to exceed 40 feet in 2070 as compared with aquifer levels in 2009;
- Average drawdown in Ward County not to exceed 30 feet in 2070 as compared with aquifer levels in 2009;
- Average drawdown in Winkler County not to exceed 31 feet in 2070 as compared with aquifer levels in 2009.

In Resolution 21-05, Groundwater Management Area 3 declared the Igneous and Ogallala aquifers non-relevant for joint planning purposes. Although not addressed specifically by Resolution 21-05, the Capitan Reef Complex Aquifer has been deemed non-relevant in Reeves County in the Capitan Reef Complex Aquifer Explanatory Report (Hutchison, 2021). The districts indicated that these aquifers were declared to be non-relevant for joint planning due to their limited areal extent and low use of groundwater.

TWDB staff reviewed the model files associated with the desired future conditions and received clarification on procedures and assumptions from the Groundwater Management Area 3 Technical Coordinator. The clarification request was about the baseline year for the Desired Future Condition in Edwards-Trinity (Plateau) and Pecos Valley aquifers. Resolution 21-03 listed 2012 as baseline year, while the Explanatory Report listed 2010 as baseline year.

On June 7, 2021, the groundwater conservation districts in Groundwater Management Area 3 clarified that the correct baseline year is 2010.

METHODS:

The TWDB attempted to replicate the predictive modeling scenarios submitted by Groundwater Management Area 3 that achieved the adopted desired future conditions. As part of this investigation, the TWDB used the same models used by Dr. Hutchison to extract simulated water levels for the baseline year (2006, 2009, 2010, and 2012 depending on each aquifer's desired future condition statement) and for year 2070, and drawdown was calculated as the difference between water levels in the start year and water levels in 2070.

The individual drawdowns in all active model cells were averaged by aquifer for each county and groundwater conservation district. Any dry model cells (that is, cells where simulated water levels dropped below the base of the cells) were included in the averaging. The calculated drawdown averages were compared with the desired future conditions to verify that the pumping scenario achieved the desired future conditions within one foot. In addition, we verified the calculated drawdown averages compared well with the desired future conditions; within the assumptions and limitations associated with each groundwater availability model run.

Modeled available groundwater volumes were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are presented by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 3 (Tables 1, 3, 5, and 7). Annual pumping rates by aquifer are also presented by county, river basin, and regional water planning area within Groundwater Management Area 3 (Tables 2, 4, 6, and 8).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to

consider modeled available groundwater, along with several other factors, when issuing permits to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

PARAMETERS AND ASSUMPTIONS:

Capitan Reef Complex Aquifer

- Version 1.01 of the groundwater availability model of the eastern arm of the Capitan Reef Complex Aquifer was used. See Jones (2016) for assumptions and limitations of the groundwater availability model. See Hutchison (2016a) for details on the assumptions used for predictive simulations.
- The model has five layers: Layer 1, the Edwards-Trinity (Plateau) and Pecos Valley aquifers; Layer 2, the Dockum Aquifer, and the Dewey Lake Formation; Layer 3, the Rustler Aquifer; Layer 4, a confining unit made up of the Salado and Castile formations, and the overlying portion of the Artesia Group; and Layer 5, the Capitan Reef Complex Aquifer, part of the Artesia Group, and the Delaware Mountain Group. Layers 1 through 4 are intended to act solely as boundary conditions facilitating groundwater inflow and outflow relative to the Capitan Reef Complex Aquifer (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The model was run for the interval 2006 through 2070 for a 64-year predictive simulation. Drawdowns were calculated by subtracting 2006 simulated water levels from 2070 simulated water levels.
- Desired Future Condition was assumed met when the average drawdown was within 1 foot of the drawdown specified in resolution.
- All active model cells were included in averaging drawdowns.
- Drawdown averages and modeled available groundwater volumes are based on the official aquiferextent within Groundwater Management Area 3.
- Capitan Reef Complex Aquifer in Reeves County in Groundwater Management Area 3 is non-relevant, as noted in the explanatory report.
- Because Groundwater Management Area 3 adopted Desired Future Conditions that are identical with those from the previous planning cycle, the predictive run included

pumping from cycle 2 of the Desired Future Condition process in the neighboring Groundwater Management Areas 4 and 7.

- Model grid file vintage: 01/06/2020.

Dockum Aquifer

- 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 (2016b) 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 3 and 4 where the Upper 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 estimates of 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.
- The model was run for the interval 2012 through 2070 for a 58-year predictive simulation. Drawdowns were calculated by subtracting 2012 simulated water levels from 2070 simulated water levels.
- Desired Future Condition was assumed met when the average drawdown was within 1 foot of the drawdown specified in resolution.
- All active model cells were included in drawdowns' averaging; however, the pass-through model cells in model layers 3 and 4 were excluded as explained above.
- Drawdown averages and modeled available groundwater volumes are based on the model extent within Groundwater Management Area 3.
- Because Groundwater Management Area 3 adopted Desired Future Conditions that are

identical with those from the previous planning cycle, the predictive runs included pumping from cycle 2 of the DFC process in the neighboring Groundwater Management Areas 2 and 7.

- Model grid file vintage: 01/06/2020.

Edwards-Trinity (Plateau) and Pecos Valley Alluvium Aquifers

- The single-layer numerical groundwater flow model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers was used for this analysis. This model is an update to the previously developed groundwater availability model documented in Anaya and Jones (2009). See Hutchison and others (2011) and Anaya and Jones (2009) for assumptions and limitations of the model. See Hutchison (2016c) 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 2005 through 2070 for a 65-year predictive simulation. Drawdowns were calculated by subtracting 2010 simulated water levels from 2070 simulated water levels. The average difference between the 2010 and 2005 (last year of model calibration) measured water levels was 2.5 percent.
- Desired Future Condition was assumed met when the average drawdown was within 1 foot of the drawdown specified in resolution.
- All active model cells were included in averaging drawdowns.
- Drawdown averages and modeled available groundwater volumes are based on the model extent within Groundwater Management Area 3.
- Because Groundwater Management Area 3 adopted Desired Future Conditions that are identical with those from the previous planning cycle, the predictive run included pumping from cycle 2 of the Desired Future Condition process in the neighboring Groundwater Management Areas 4 and 7.
- Grid file vintage: 08/26/2015.

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.

- The model has two layers, the top one representing the Rustler Aquifer, and the second layer 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.
- Desired Future Condition was assumed met when the average drawdown was within 1 foot of the drawdown specified in resolution.
- All active model cells were included in averaging drawdowns.
- Drawdown averages and modeled available groundwater volumes are based on the model extent within Groundwater Management Area 3.
- Because Groundwater Management Area 3 adopted Desired Future Conditions that are identical with those from the previous planning cycle, the predictive run included pumping from cycle 2 of the Desired Future Condition process in the neighboring Groundwater Management Areas 4 and 7.
- Model grid file vintage: 01/06/2020.

RESULTS:

Tables 1 through 8 show the combination of modeled available groundwater for relevant aquifers in Groundwater Management Area 3 summarized (1) by county, river basin, and regional water planning area for use in the regional water planning process; and (2) by groundwater conservation district and county.

The modeled available groundwater for the Capitan Reef Complex Aquifer that achieves the adopted desired future conditions is 381 acre-feet per year between 2020 and 2070 (Tables 1 and 2).

The modeled available groundwater for the Dockum Aquifer that achieves the adopted desired future conditions is 17,378 acre-feet per year between 2020 and 2070 (Tables 3 and 4).

The modeled available groundwater for the Edwards-Trinity (Plateau) and Pecos Valley Alluvium aquifers that achieves the adopted desired future conditions is 420,541 acre-feet per year between 2020 and 2070 (Tables 5 and 6).

The modeled available groundwater for the Rustler Aquifer that achieves the adopted desired future conditions is 2,590 acre-feet per year between 2020 and 2070 (Tables 7 and 8).

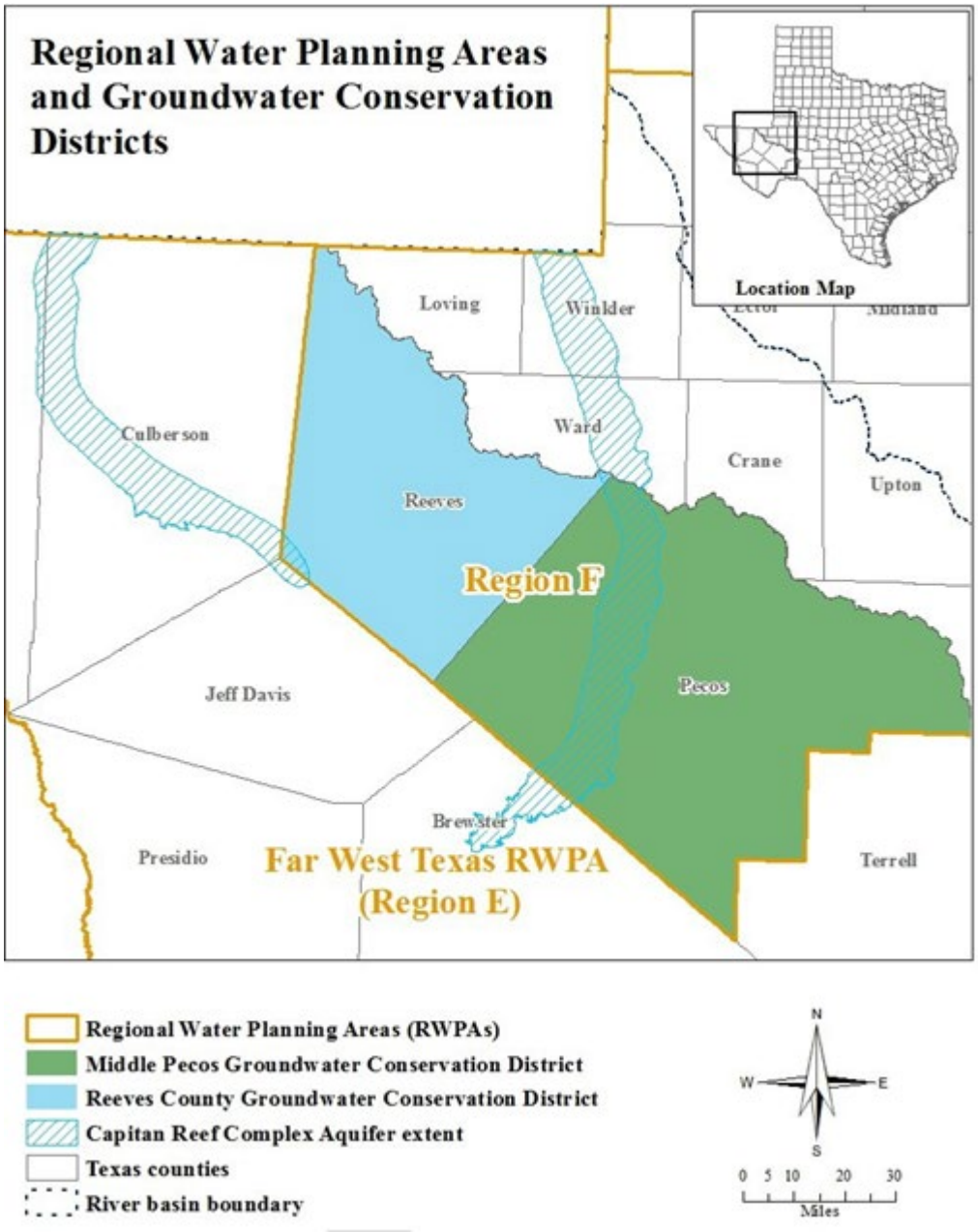

FIGURE 1. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

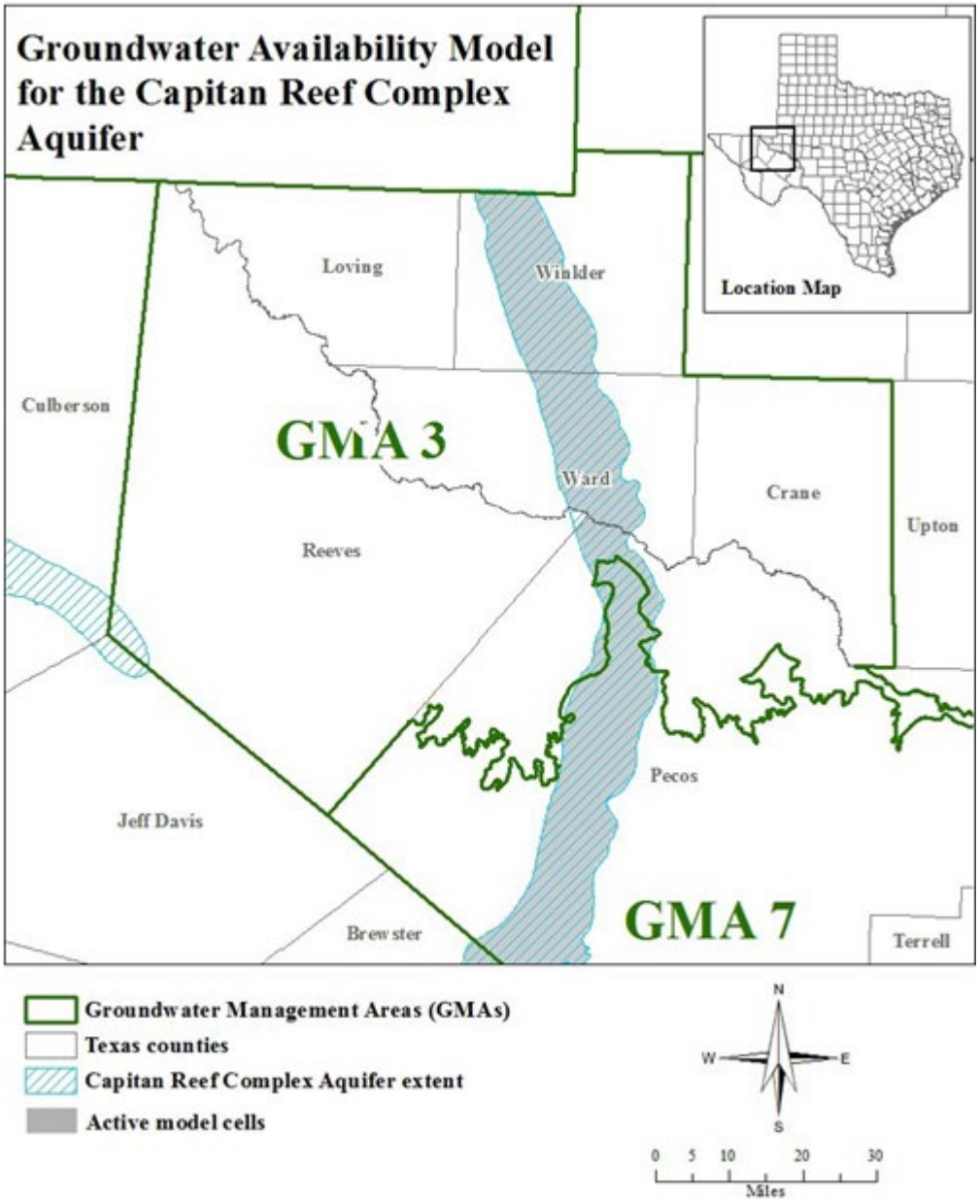

FIGURE 2. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

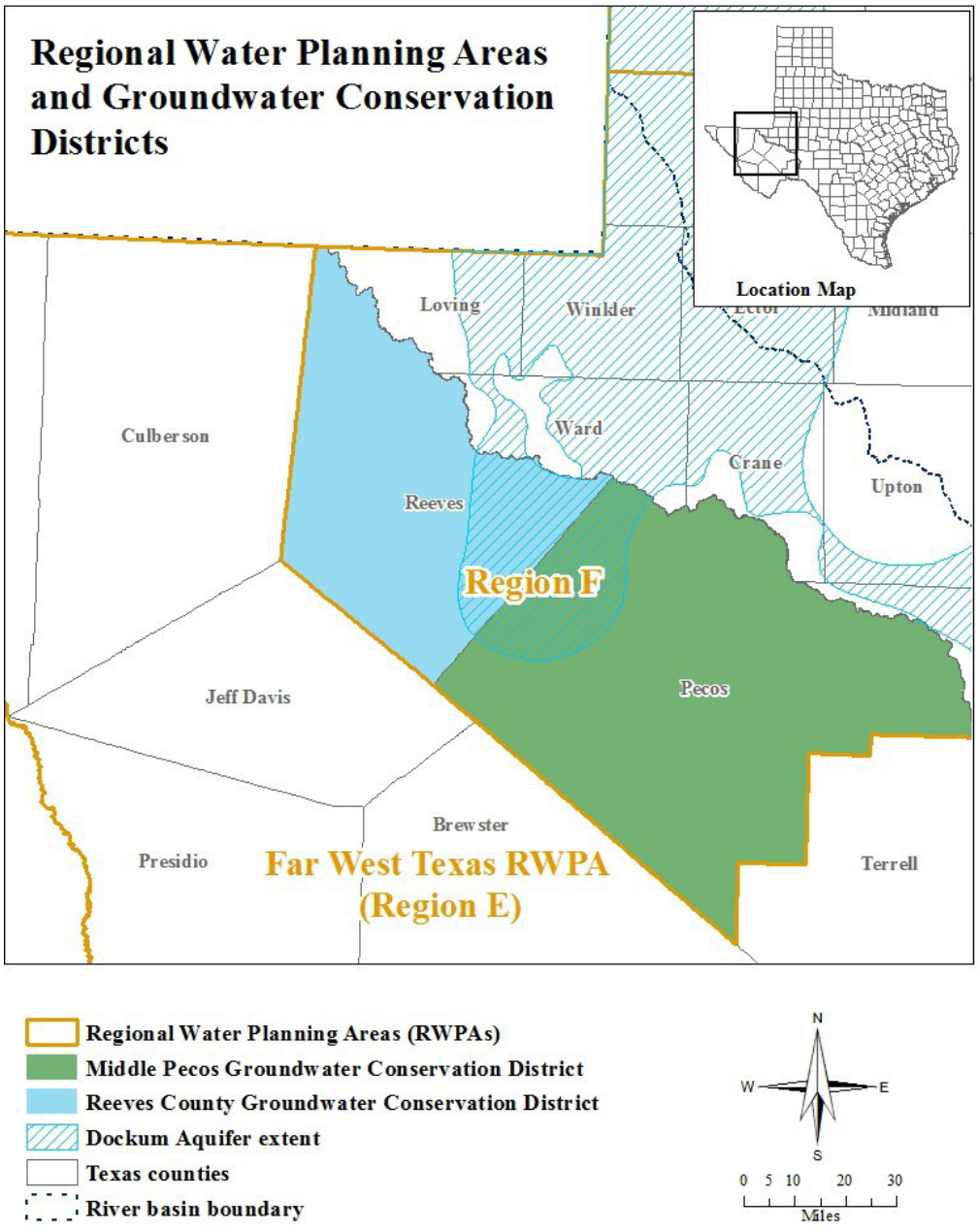

FIGURE 3. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

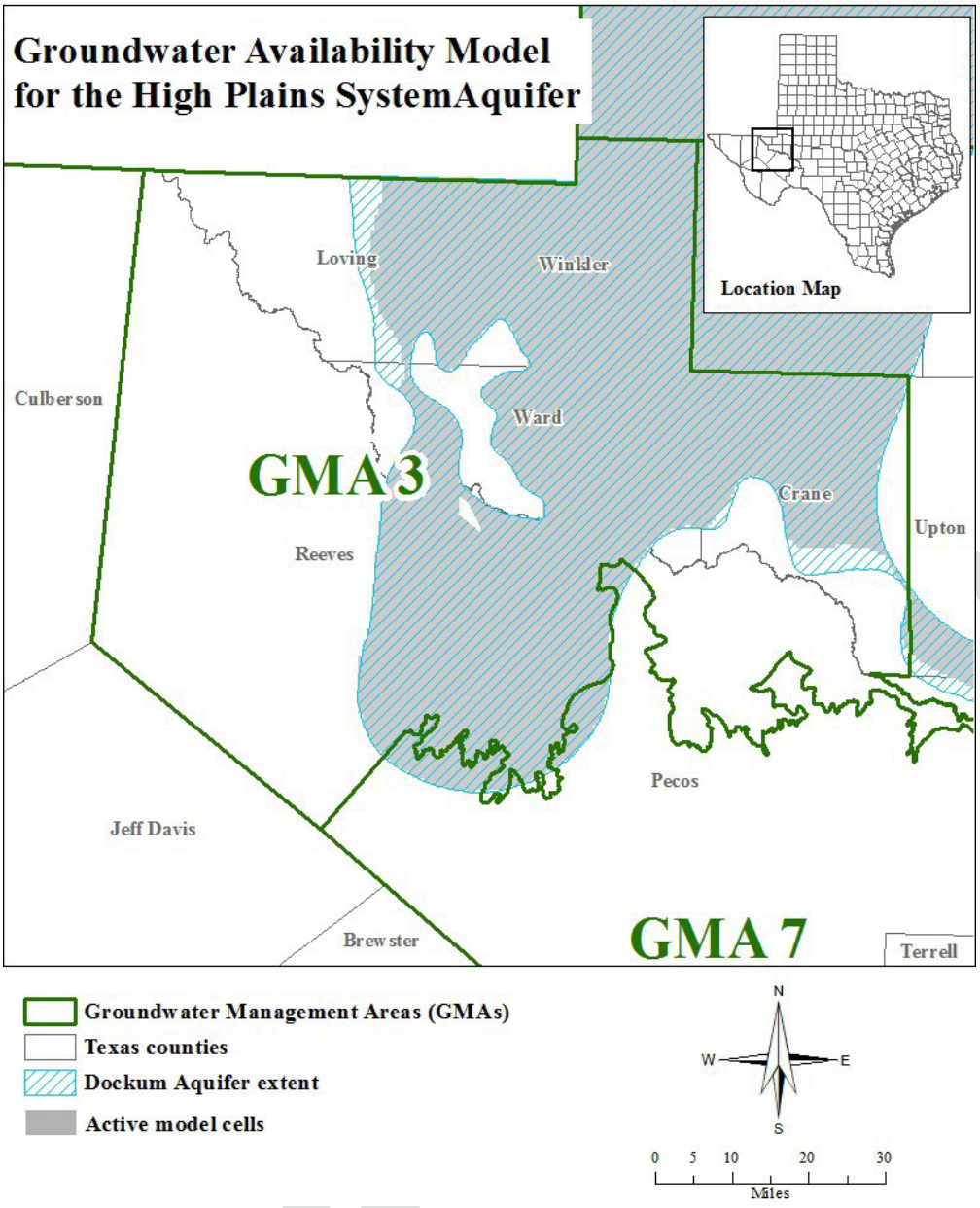

FIGURE 4. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM, INCLUDING THE DOCKUM AQUIFER, IN GROUNDWATER MANAGEMENT AREA 3.

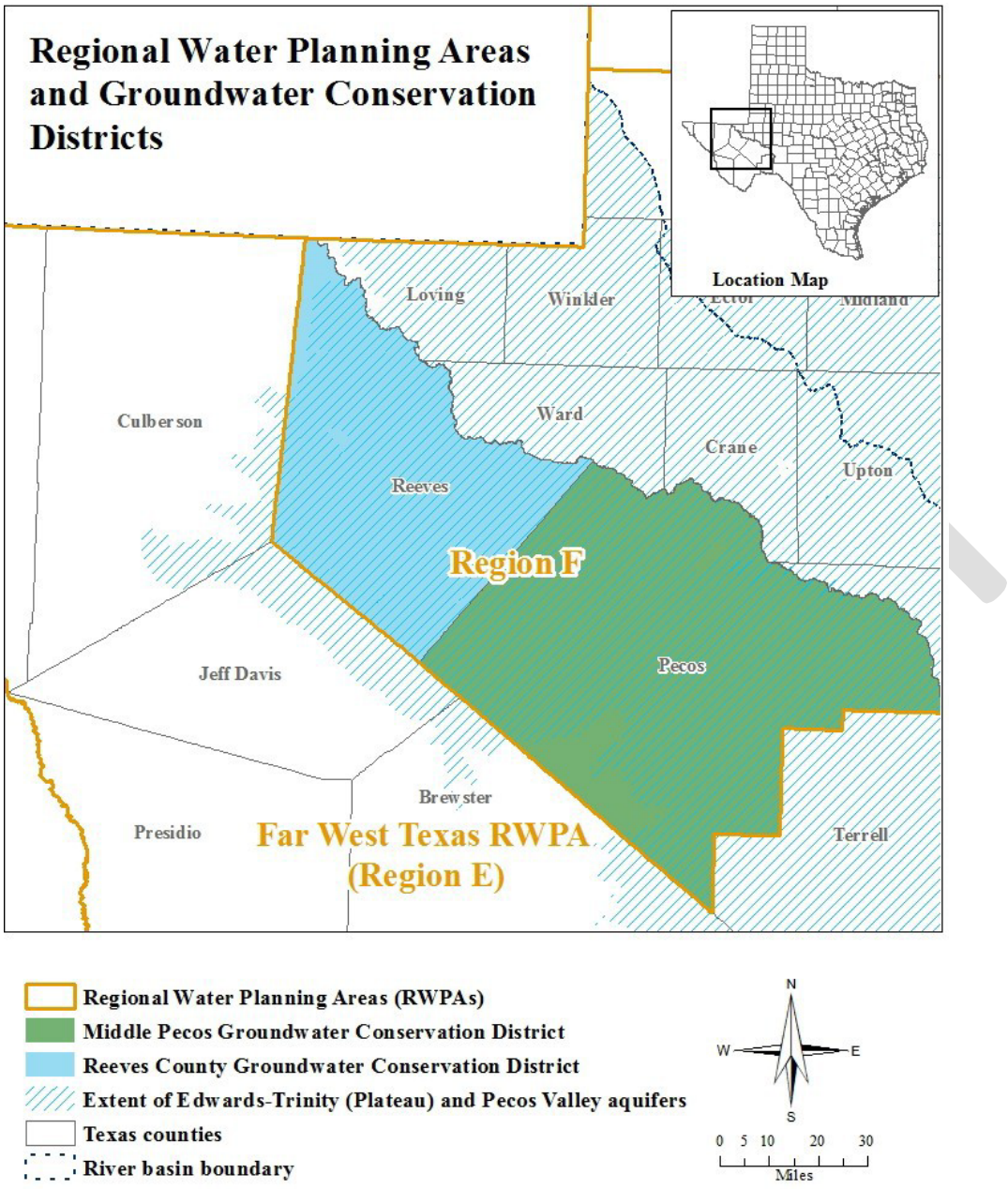

FIGURE 5. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3.

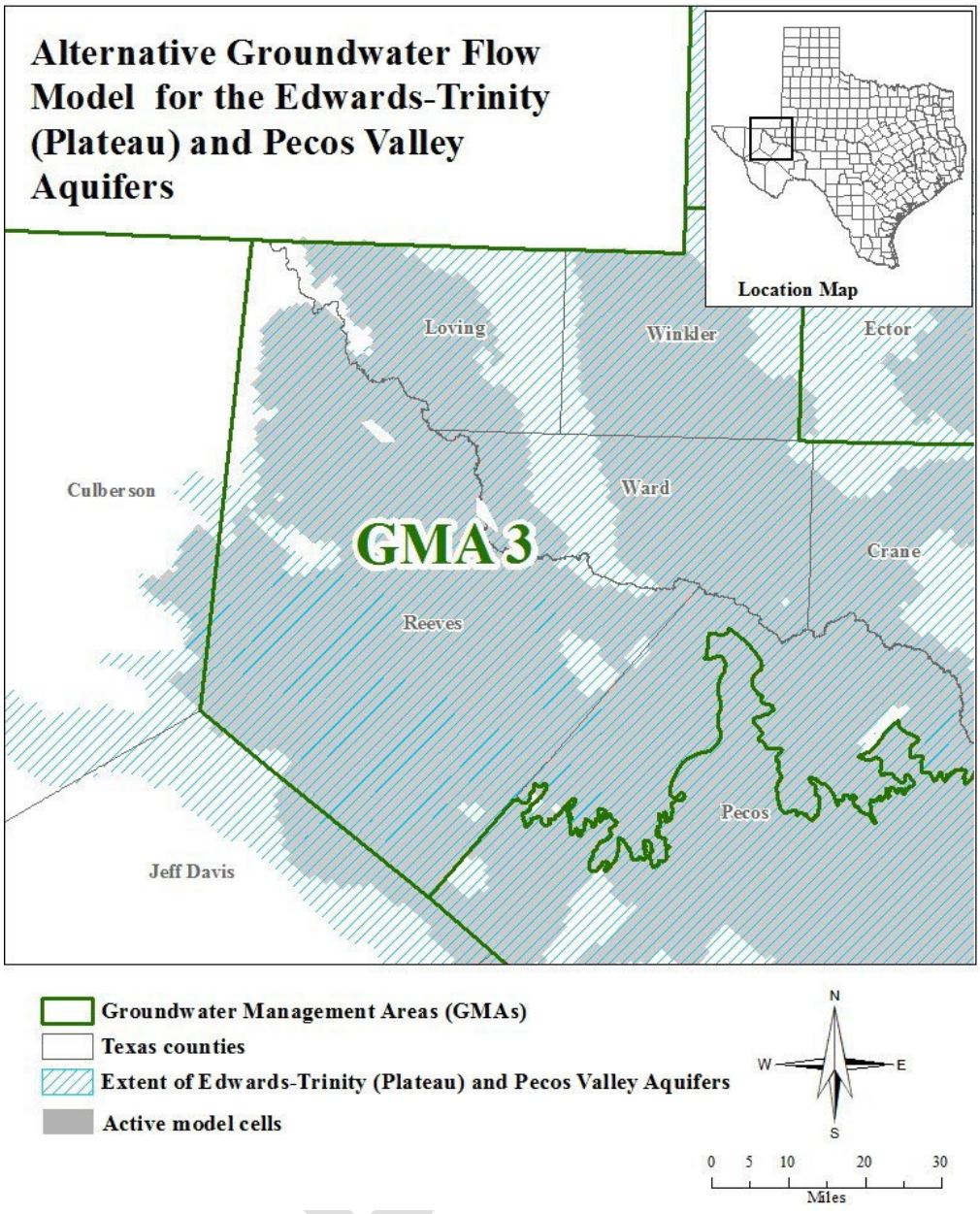

FIGURE 6. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3.

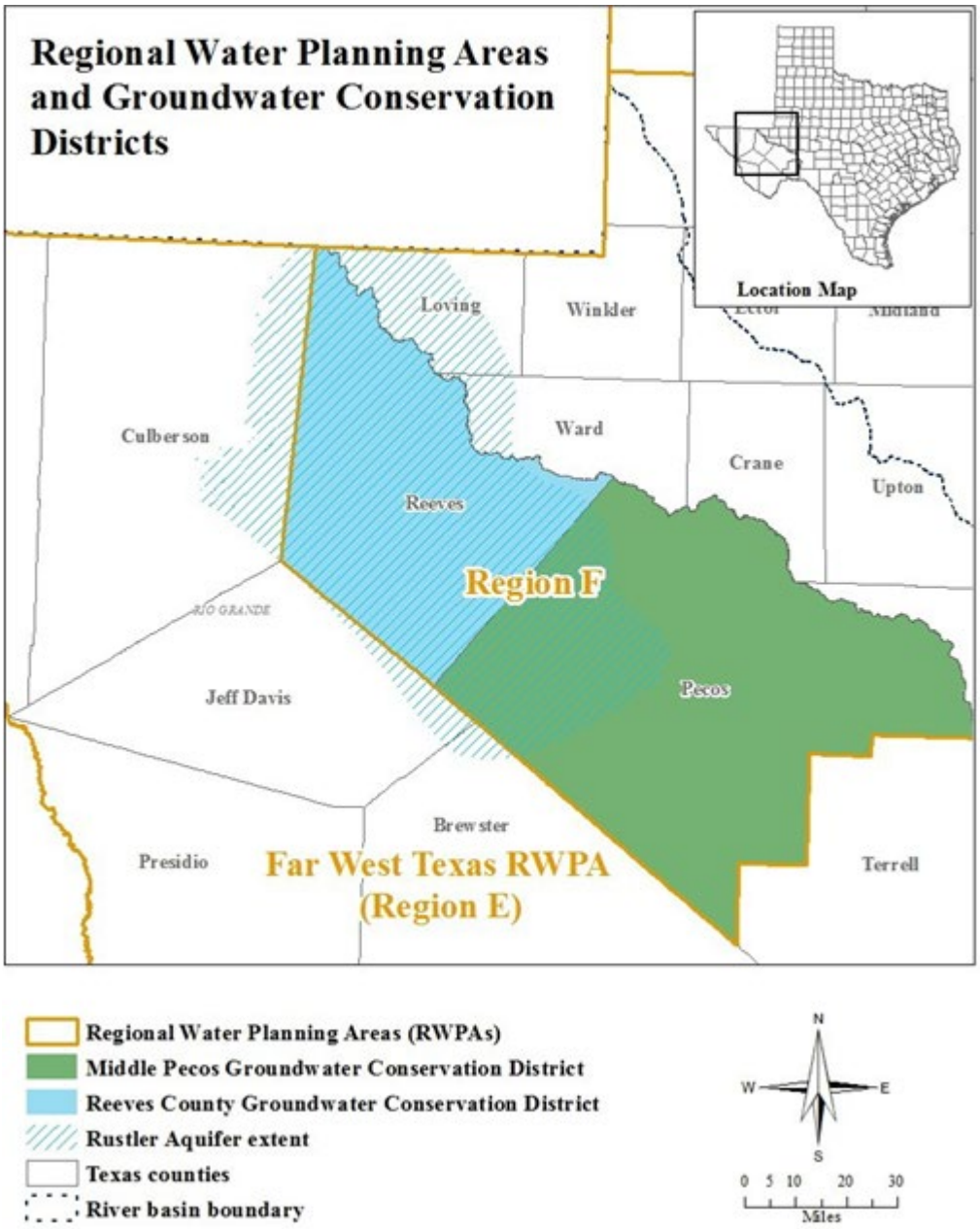

FIGURE 7. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

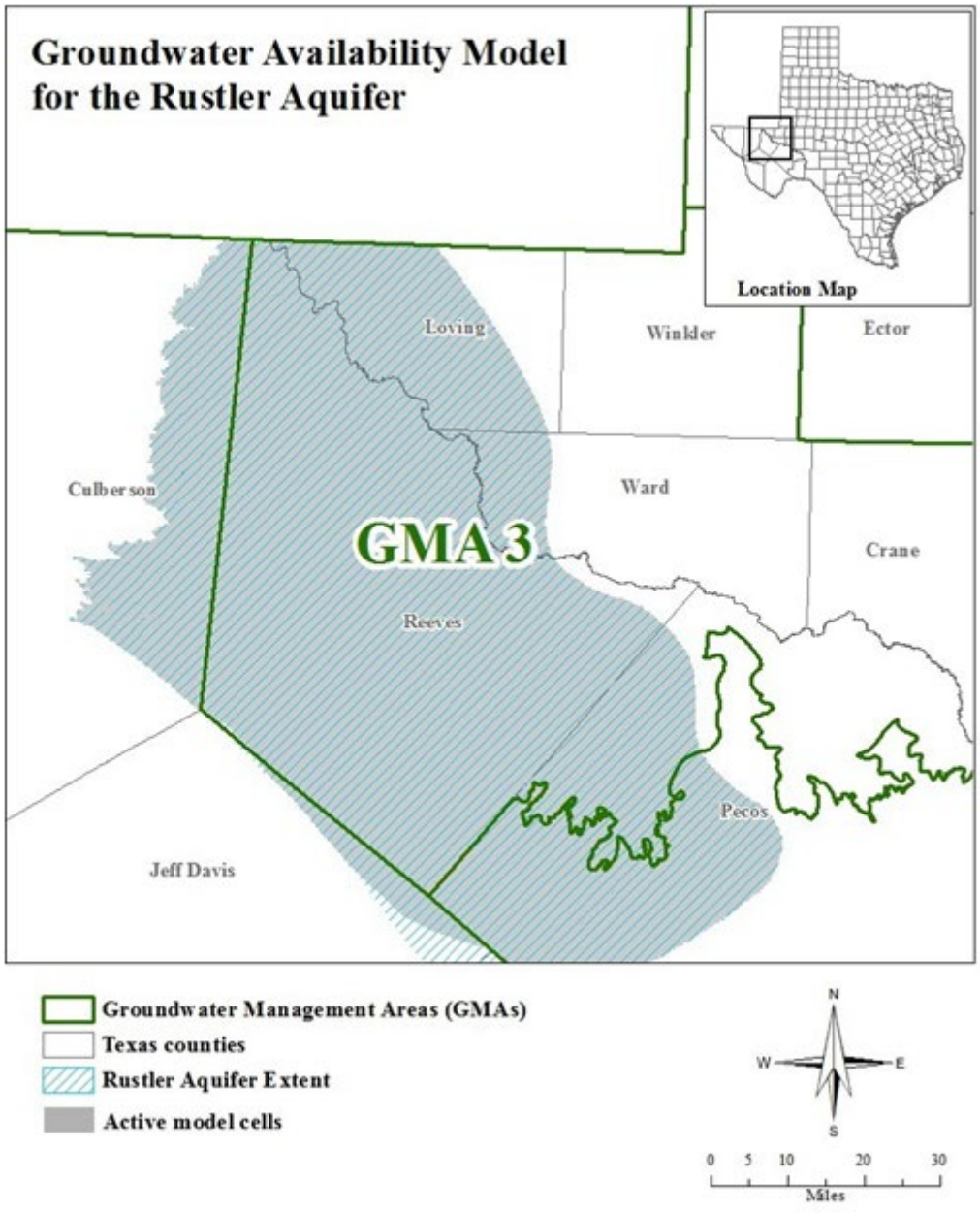

FIGURE 8. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
Middle Pecos GCD	Pecos	4	4	4	4	4	4
-	Ward	103	103	103	103	103	103
-	Winkler	274	274	274	274	274	274
Total		**381**	**381**	**381**	**381**	**381**	**381**

[1]Ward and Winkler counties are not in a groundwater conservation district.

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Pecos	F	Rio Grande	4	4	4	4	4	4
Ward	F	Rio Grande	103	103	103	103	103	103
Winkler	F	Rio Grande	274	274	274	274	274	274
Total			**381**	**381**	**381**	**381**	**381**	**381**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
-	Crane	94	94	94	94	94	94
-	Loving	453	453	453	453	453	453
Middle Pecos GCD	Pecos	6,142	6,142	6,142	6,142	6,142	6,142
Reeves County GCD	Reeves	2,539	2,539	2,539	2,539	2,539	2,539
-	Ward	2,150	2,150	2,150	2,150	2,150	2,150
-	Winkler	6,000	6,000	6,000	6,000	6,000	6,000
Total		**17,378**	**17,378**	**17,378**	**17,378**	**17,378**	**17,378**

[1]Crane, Loving, Ward, and Winkler counties are not in a groundwater conservation district.

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Crane	F	Rio Grande	94	94	94	94	94	94
Loving	F	Rio Grande	453	453	453	453	453	453
Pecos	F	Rio Grande	6,142	6,142	6,142	6,142	6,142	6,142
Reeves	F	Rio Grande	2,539	2,539	2,539	2,539	2,539	2,539
Ward	F	Rio Grande	2,150	2,150	2,150	2,150	2,150	2,150
Winkler	F	Rio Grande	5,987	5,987	5,987	5,987	5,987	5,987
Winkler	F	Colorado	13	13	13	13	13	13
Total			**17,378**	**17,378**	**17,378**	**17,378**	**17,378**	**17,378**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
-	Crane	4,991	4,991	4,991	4,991	4,991	4,991
-	Loving	2,982	2,982	2,982	2,982	2,982	2,982
Middle Pecos GCD	Pecos	122,899	122,899	122,899	122,899	122,899	122,899
Reeves County GCD	Reeves	189,744	189,744	189,744	189,744	189,744	189,744
-	Ward	49,976	49,976	49,976	49,976	49,976	49,976
-	Winkler	49,949	49,949	49,949	49,949	49,949	49,949
Total		**420,541**	**420,541**	**420,541**	**420,541**	**420,541**	**420,541**

[1]Crane, Loving, Ward, and Winkler counties are not in a groundwater conservation district.

TABLE 6. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFES IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Crane	F	Rio Grande	4,991	4,991	4,991	4,991	4,991	4,991
Loving	F	Rio Grande	2,982	2,982	2,982	2,982	2,982	2,982
Pecos	F	Rio Grande	122,899	122,899	122,899	122,899	122,899	122,899
Reeves	F	Rio Grande	189,744	189,744	189,744	189,744	189,744	189,744
Ward	F	Rio Grande	49,976	49,976	49,976	49,976	49,976	49,976
Winkler	F	Rio Grande	49,949	49,949	49,949	49,949	49,949	49,949
Total			**420,541**	**420,541**	**420,541**	**420,541**	**420,541**	**420,541**

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District[1]	County	2020	2030	2040	2050	2060	2070
-	Loving	200	200	200	200	200	200
Middle Pecos GCD	Pecos	3	3	3	3	3	3
Reeves County GCD	Reeves	2,387	2,387	2,387	2,387	2,387	2,387
-	Ward	0	0	0	0	0	0
	Winkler	0	0	0	0	0	0
Total		**2,590**	**2,590**	**2,590**	**2,590**	**2,590**	**2,590**

[1]Loving, Ward, and Winkler counties are not in a groundwater conservation district.

TABLE 8. MODELED AVAILABLE GROUNDWATER FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3 SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE BETWEEN 2020 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	River Basin	2020	2030	2040	2050	2060	2070
Loving	F	Rio Grande	200	200	200	200	200	200
Pecos	F	Rio Grande	3	3	3	3	3	3
Reeves	F	Rio Grande	2,387	2,387	2,387	2,387	2,387	2,387
Ward	F	Rio Grande	0	0	0	0	0	0
Winkler	F	Rio Grande	0	0	0	0	0	0
Total			**2,590**	**2,590**	**2,590**	**2,590**	**2,590**	**2,590**

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 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 streamflow are specific to a particular historic 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.

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