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

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Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
(512) 463-5808
January 11, 2022

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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).

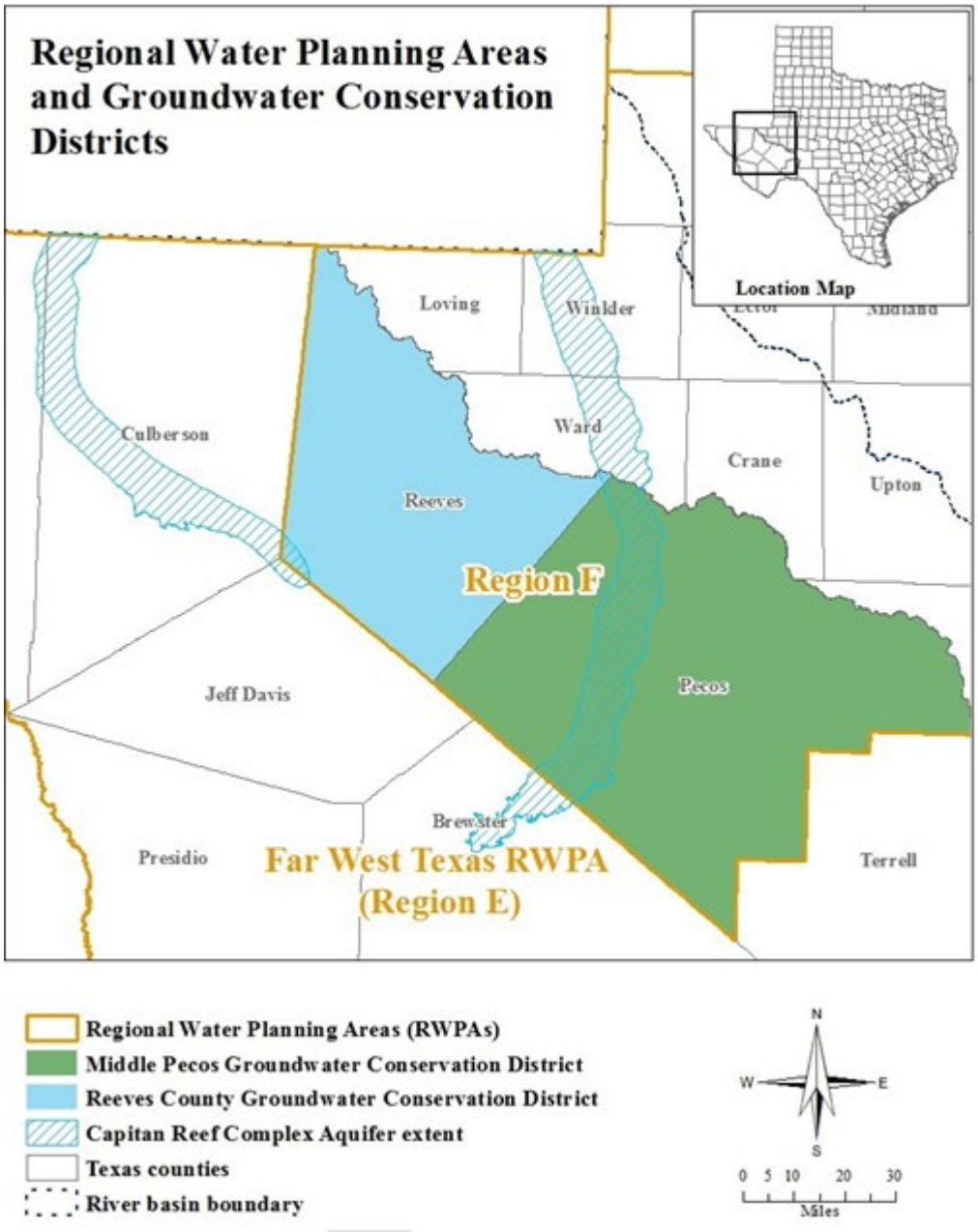

FIGURE 1. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

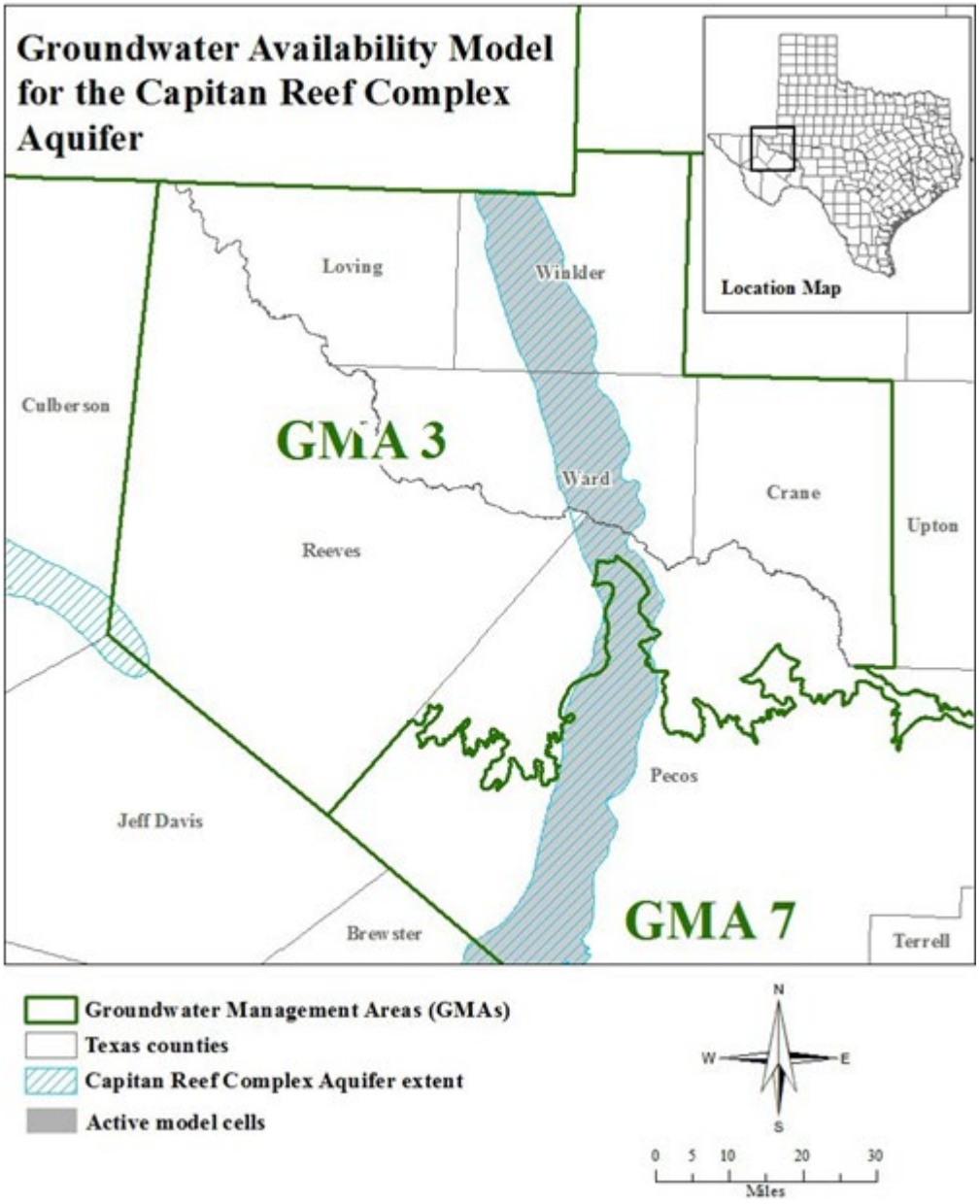

FIGURE 2. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR CAPITAN REEF COMPLEX AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

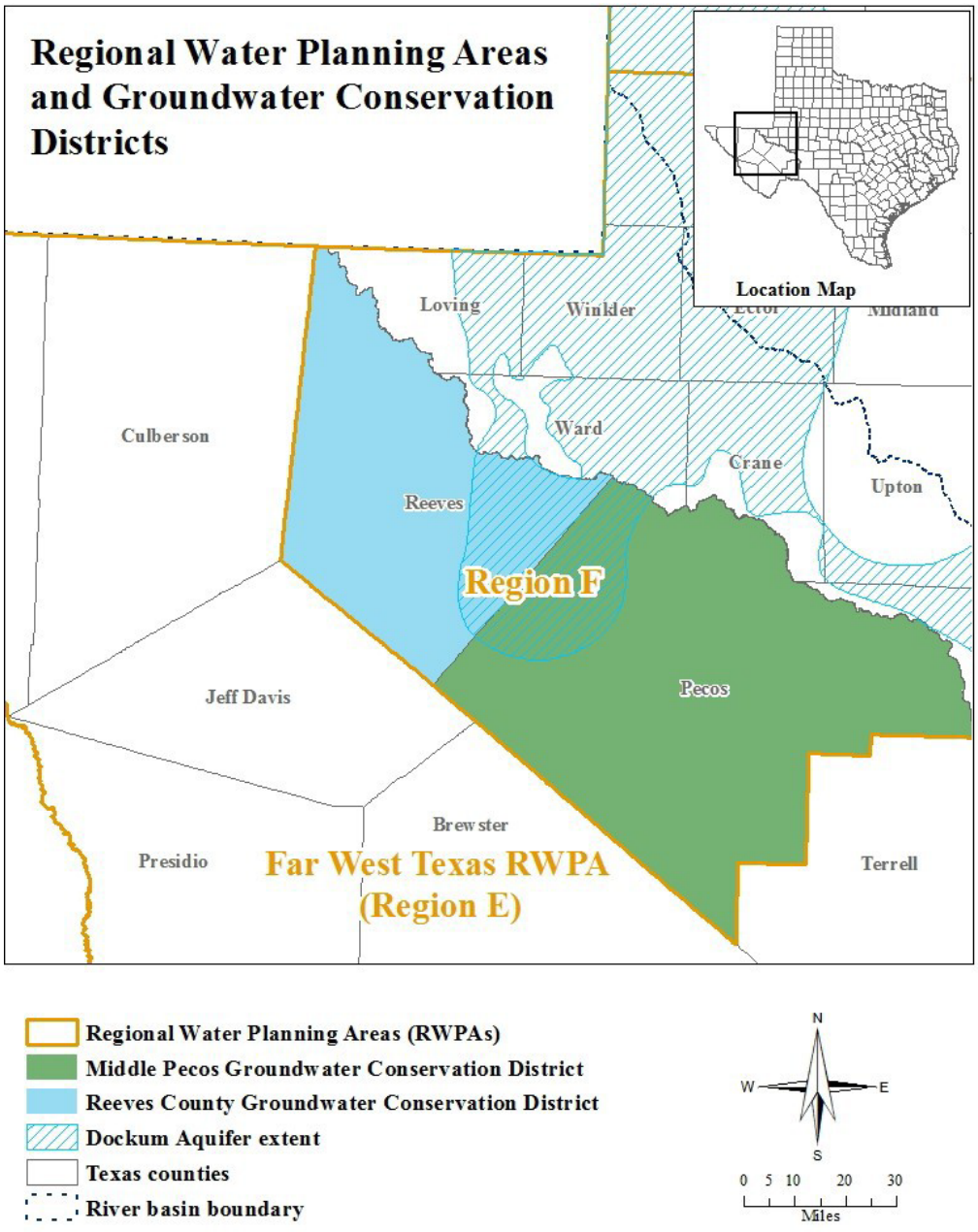

FIGURE 3. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

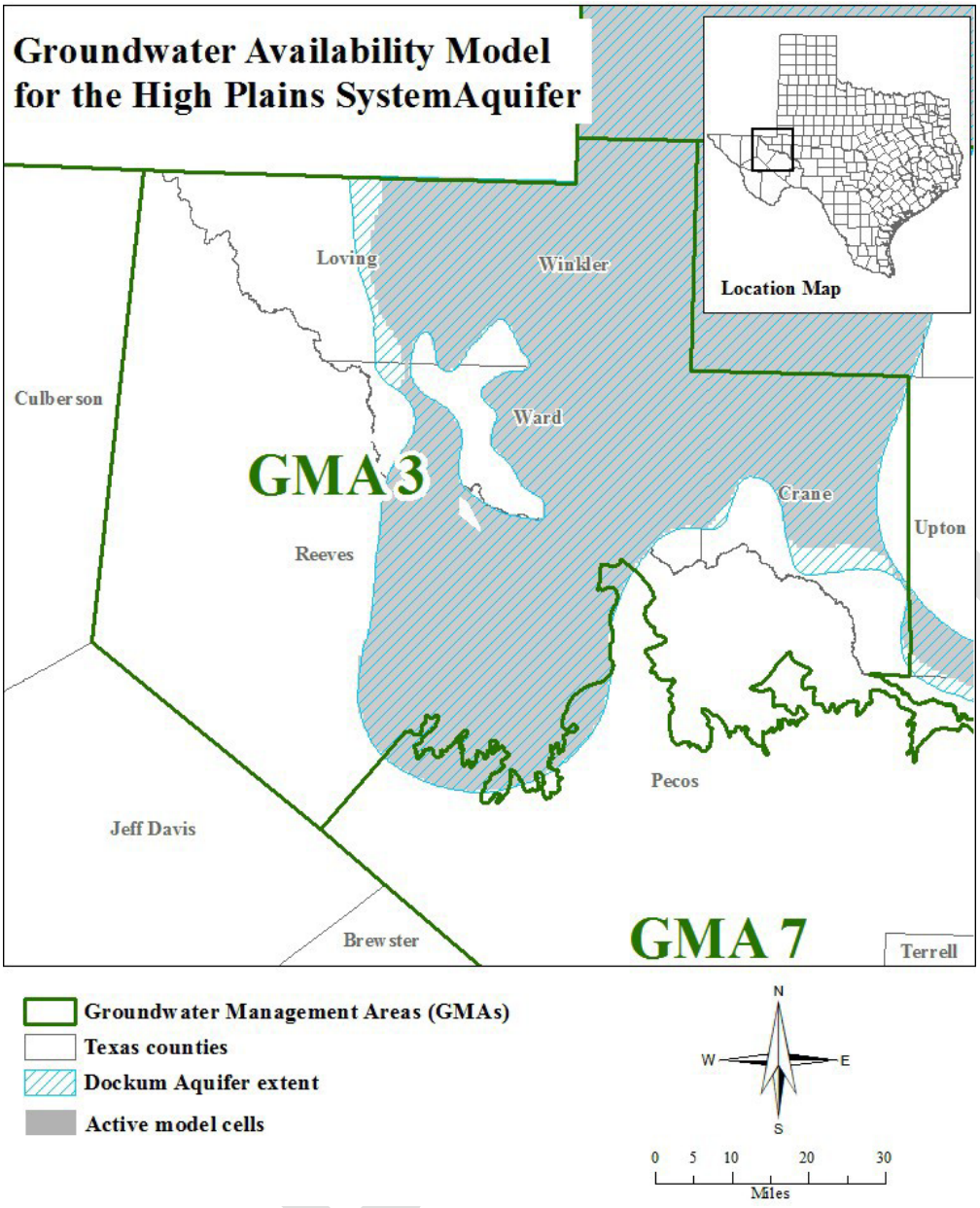

FIGURE 4. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM, INCLUDING THE DOCKUM AQUIFER, IN GROUNDWATER MANAGEMENT AREA 3.

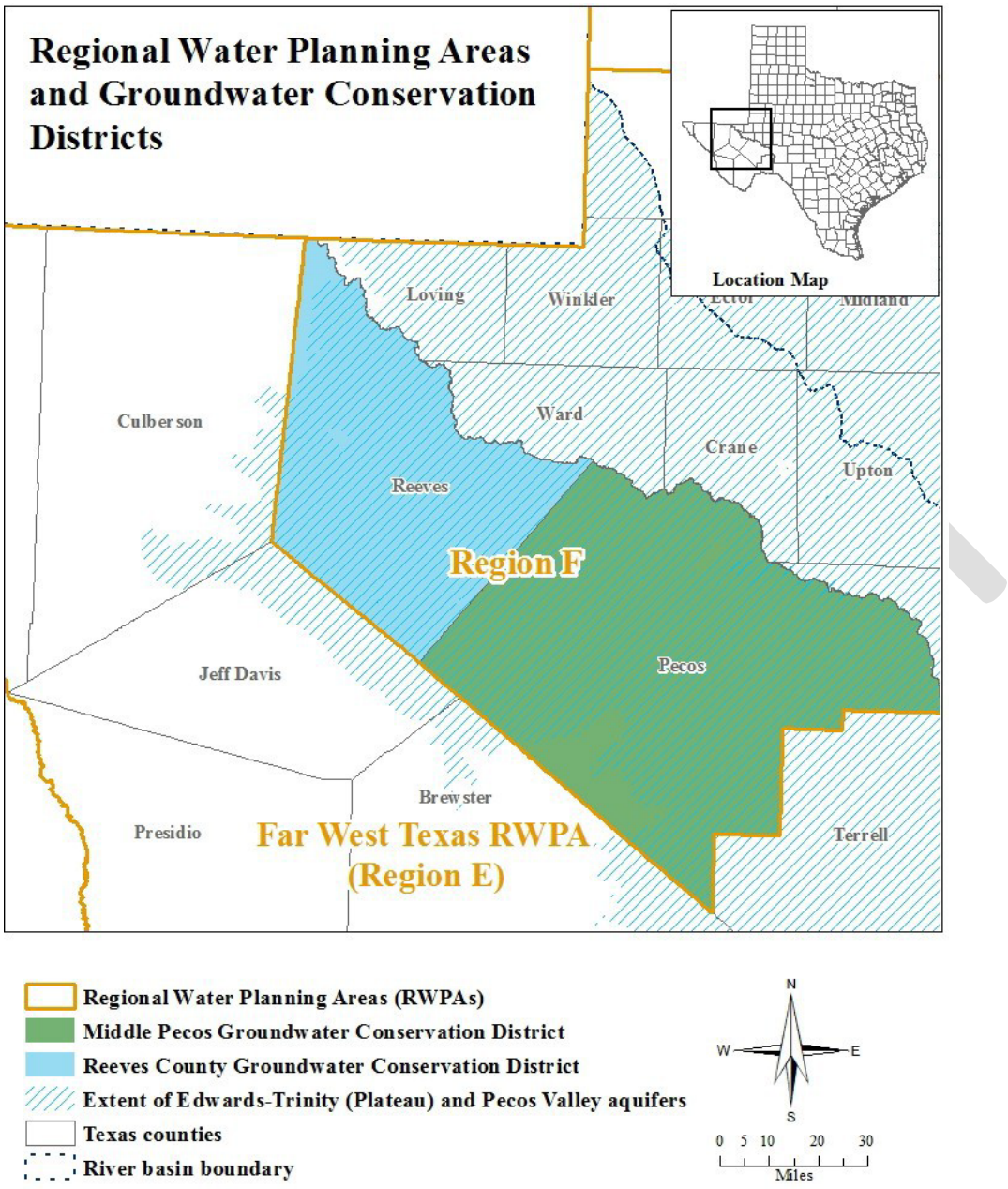

FIGURE 5. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3.

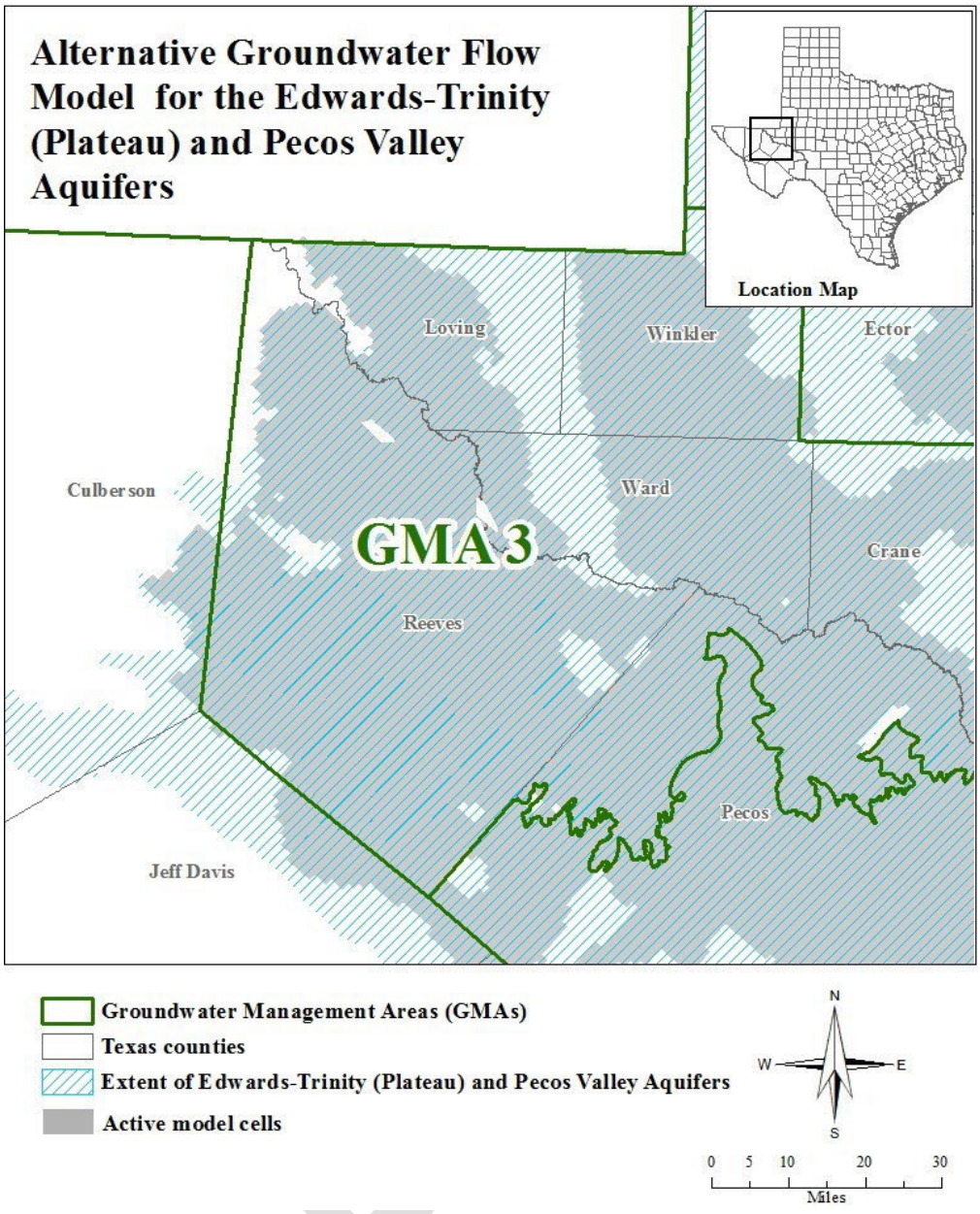

FIGURE 6. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 3.

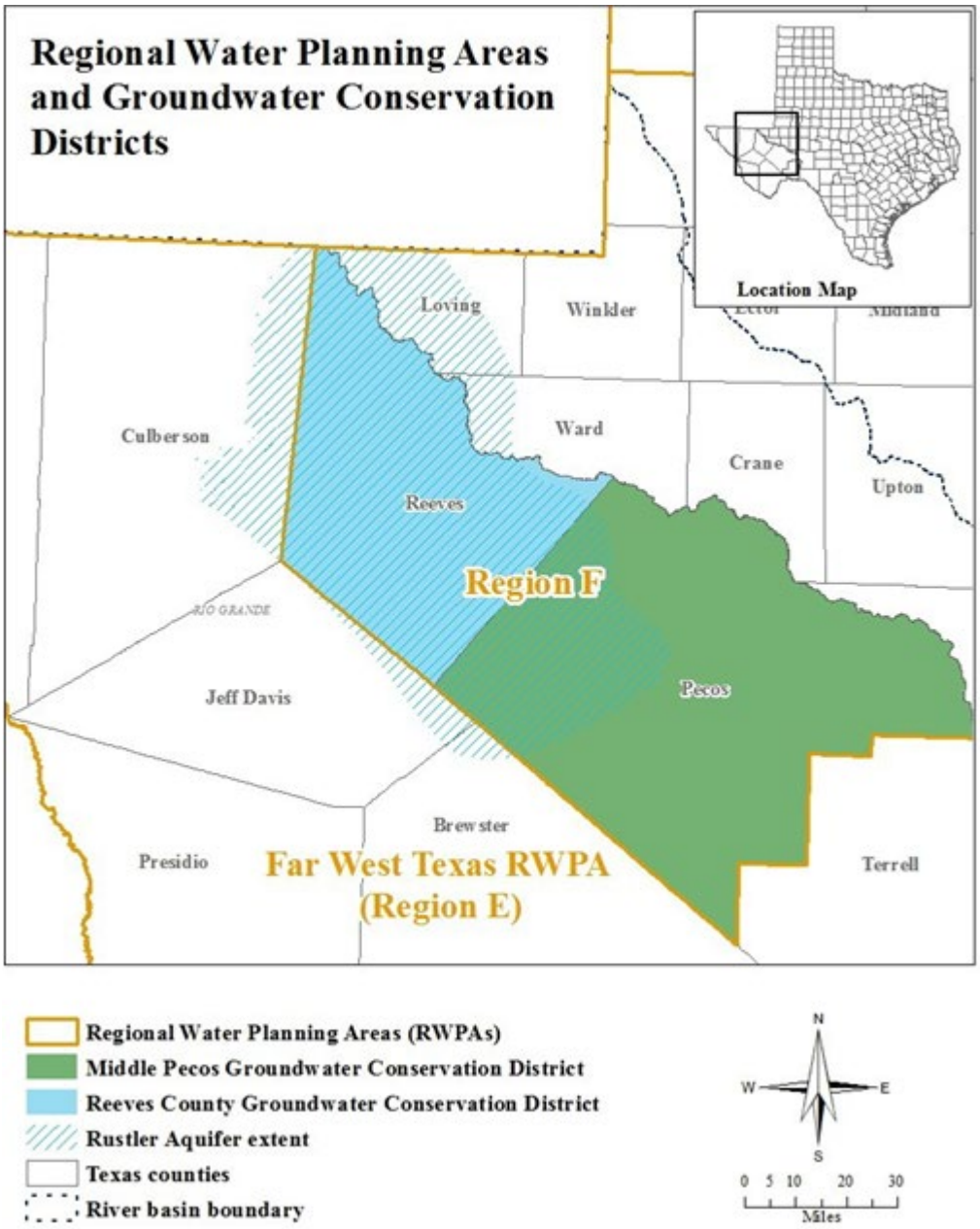

FIGURE 7. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAS), GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES IN THE VICINITY OF THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

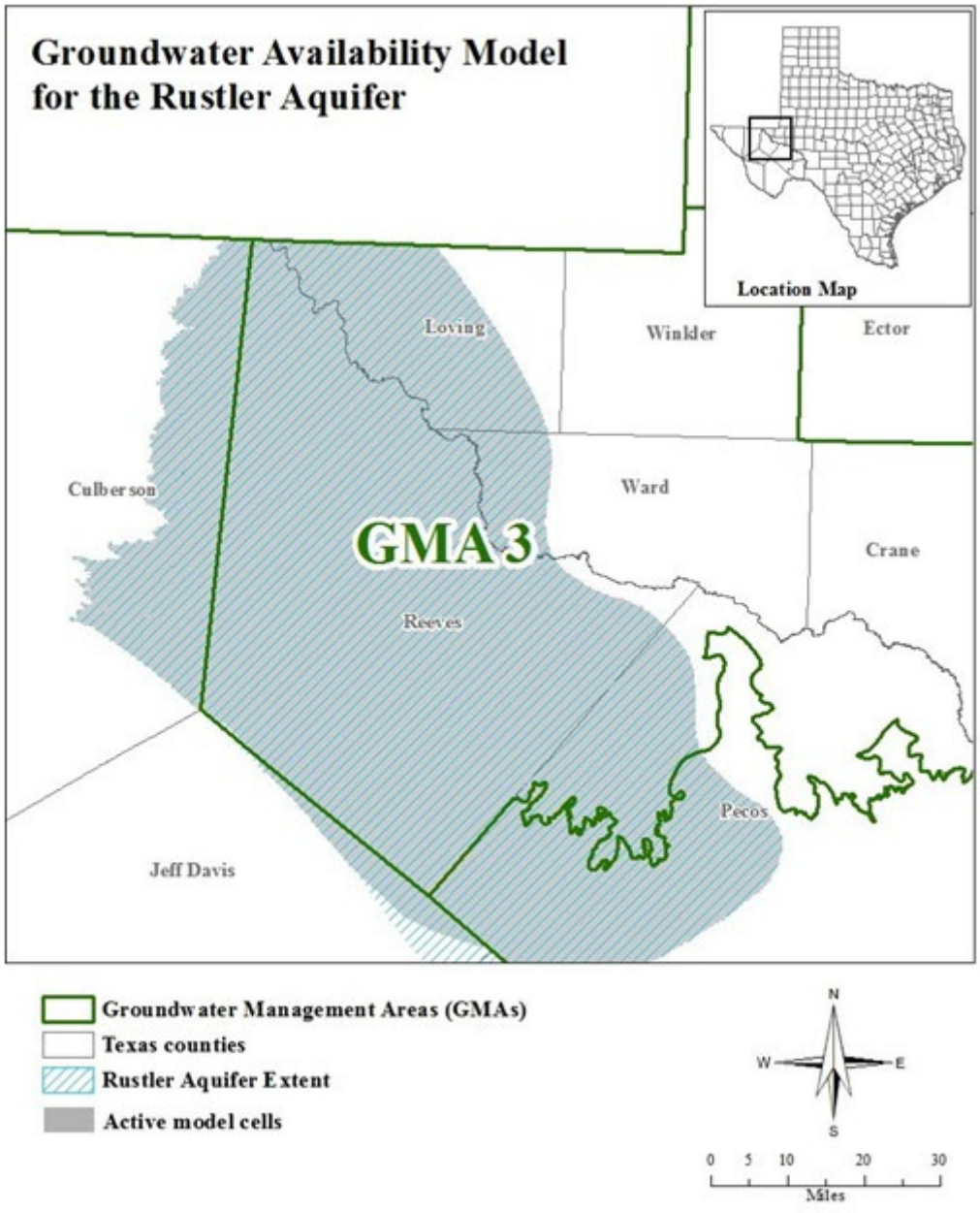

FIGURE 8. MAP SHOWING THE AREAS COVERED BY THE GROUNDWATER AVAILABILITY MODEL FOR THE RUSTLER AQUIFER IN GROUNDWATER MANAGEMENT AREA 3.

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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