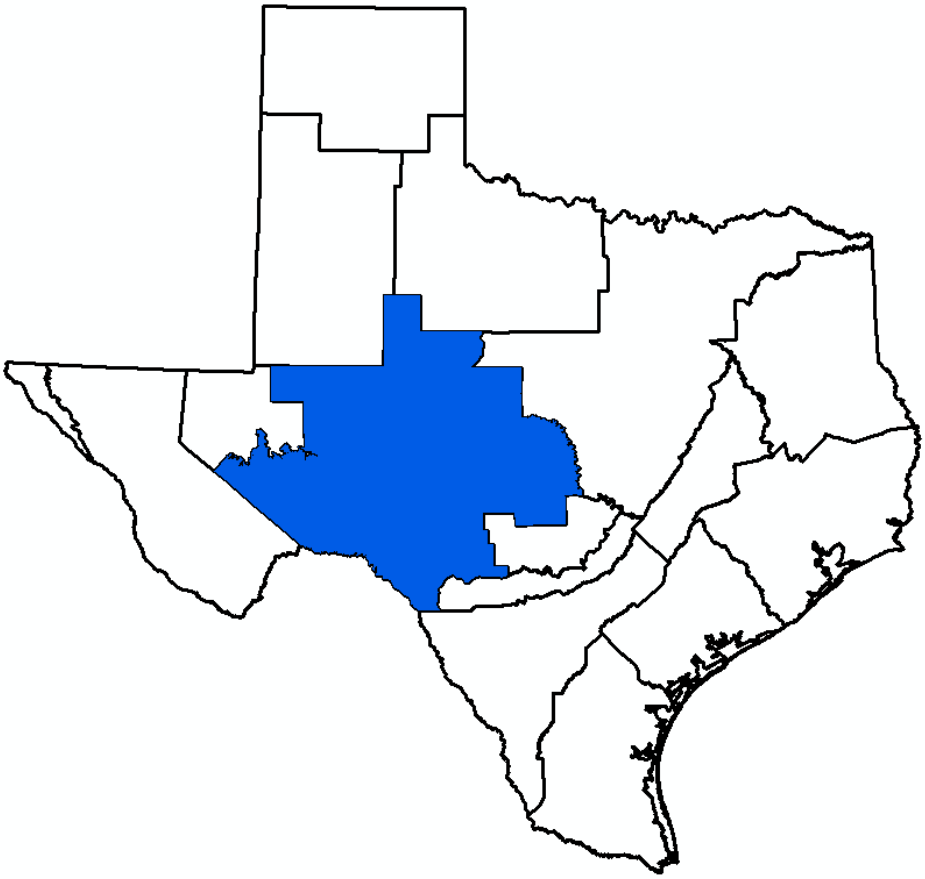
GMA 7 Explanatory Report – Final
Rustler Aquifer



Prepared for:
Groundwater Management Area 7

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August 28, 2021

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1.0 Groundwater Management Area 7

Groundwater Management Area 7 is one of sixteen groundwater management areas in Texas and covers that portion of west Texas that is underlain by the Edwards-Trinity (Plateau) Aquifer (Figure 1).

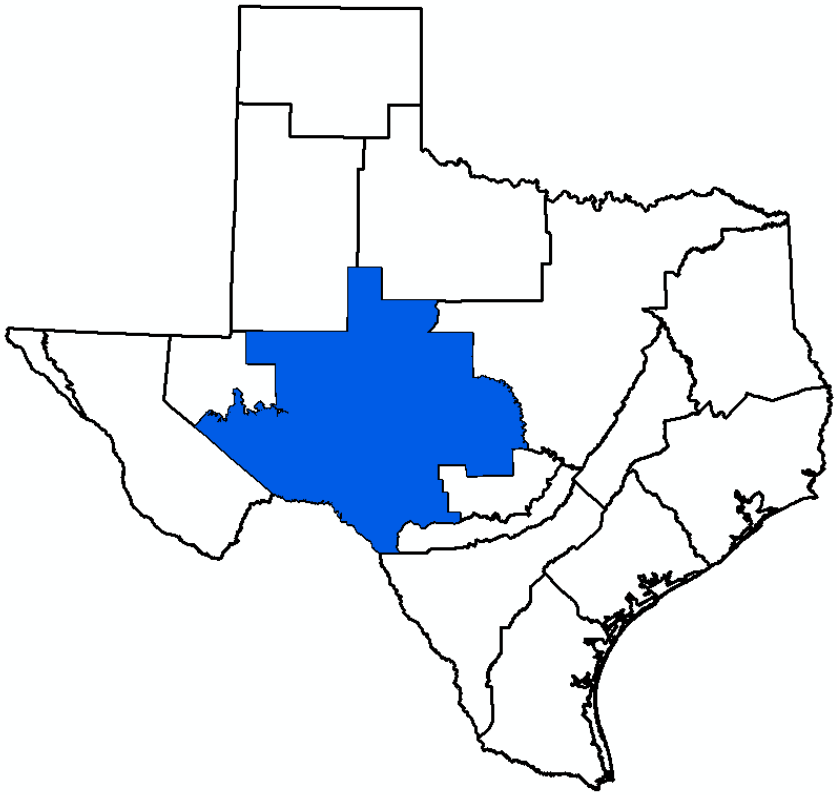

Figure 1. Groundwater Management Area 7

Groundwater Management Area 7 covers all or part of the following counties: Coke, Coleman, Concho, Crockett, Ector, Edwards, Gillespie, Glasscock, Irion, Kimble, Kinney, Llano, Mason, McCulloch, Menard, Midland, Mitchell, Nolan, Pecos, Reagan, Real, Runnels, San Saba, Schleicher, Scurry, Sterling, Sutton, Taylor, Terrell, Tom Green, Upton, and Uvalde (Figure 2).

GMA

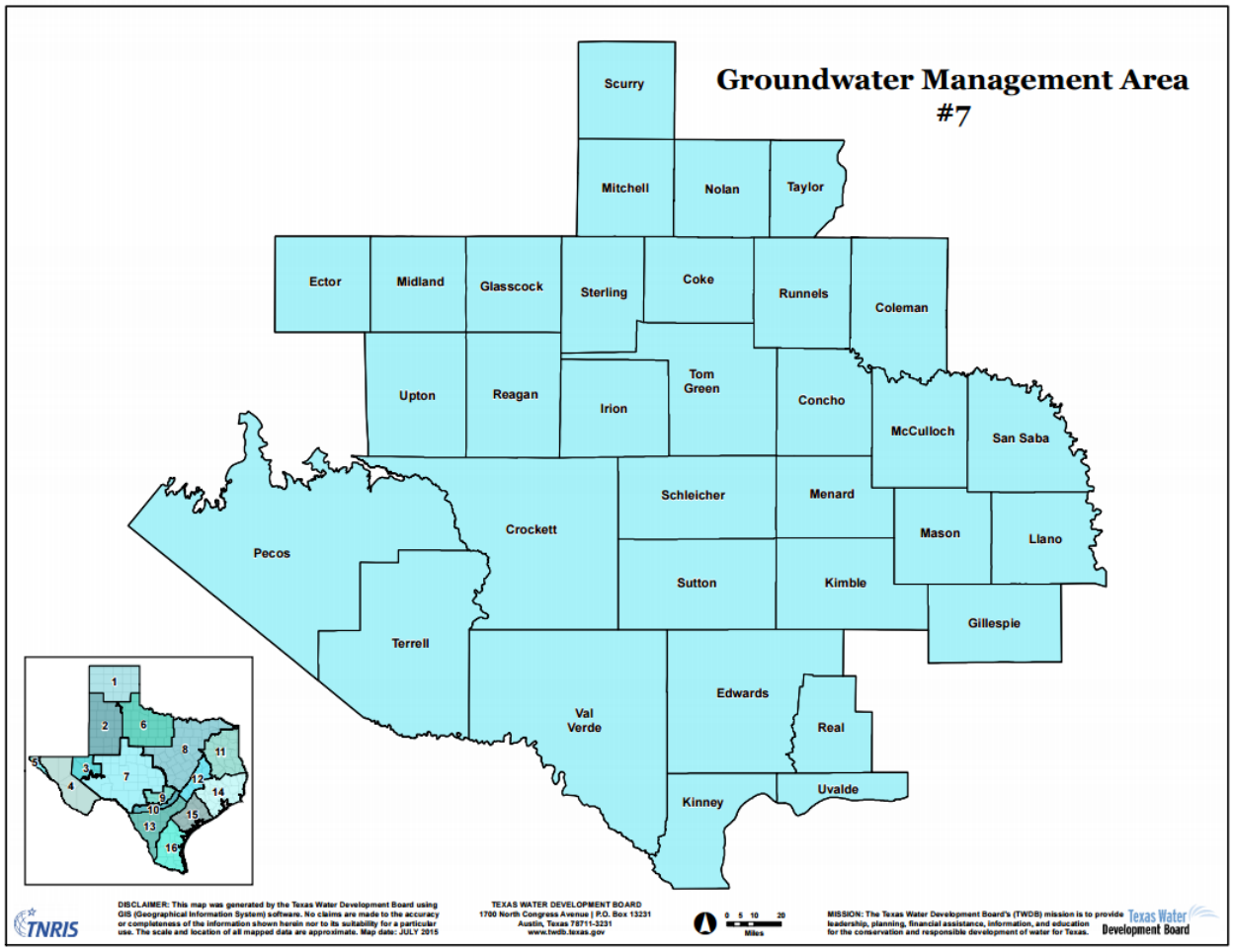

Figure 2. GMA 7 Counties (from TWDB)

There are 20 groundwater conservation districts in Groundwater Management Area 7: Coke County Underground Water Conservation District, Crockett County Groundwater Conservation District, Glasscock Groundwater Conservation District, Hickory Underground Water Conservation District No. 1, Hill County Underground Water Conservation District, Irion County Water Conservation District, Kimble County Groundwater Conservation District, Kinney County Groundwater Conservation District, Lipan-Kickapoo Water Conservation District, Lone Wolf Groundwater Conservation District, Menard County Underground Water District, Middle Pecos Groundwater Conservation District, Plateau Underground Water Conservation and Supply District, Real-Edwards Conservation and Reclamation District Santa Rita Underground Water Conservation District, Sterling County Underground Water Conservation District, Sutton County Underground Water Conservation District, Terrell County Groundwater Conservation District, Uvalde County Underground Water Conservation District, and Wes-Tex Groundwater Conservation District (Figure 3).

The Edwards Aquifer Authority is also partially inside of the boundaries of GMA 7, but are exempt from participation in the joint planning process.

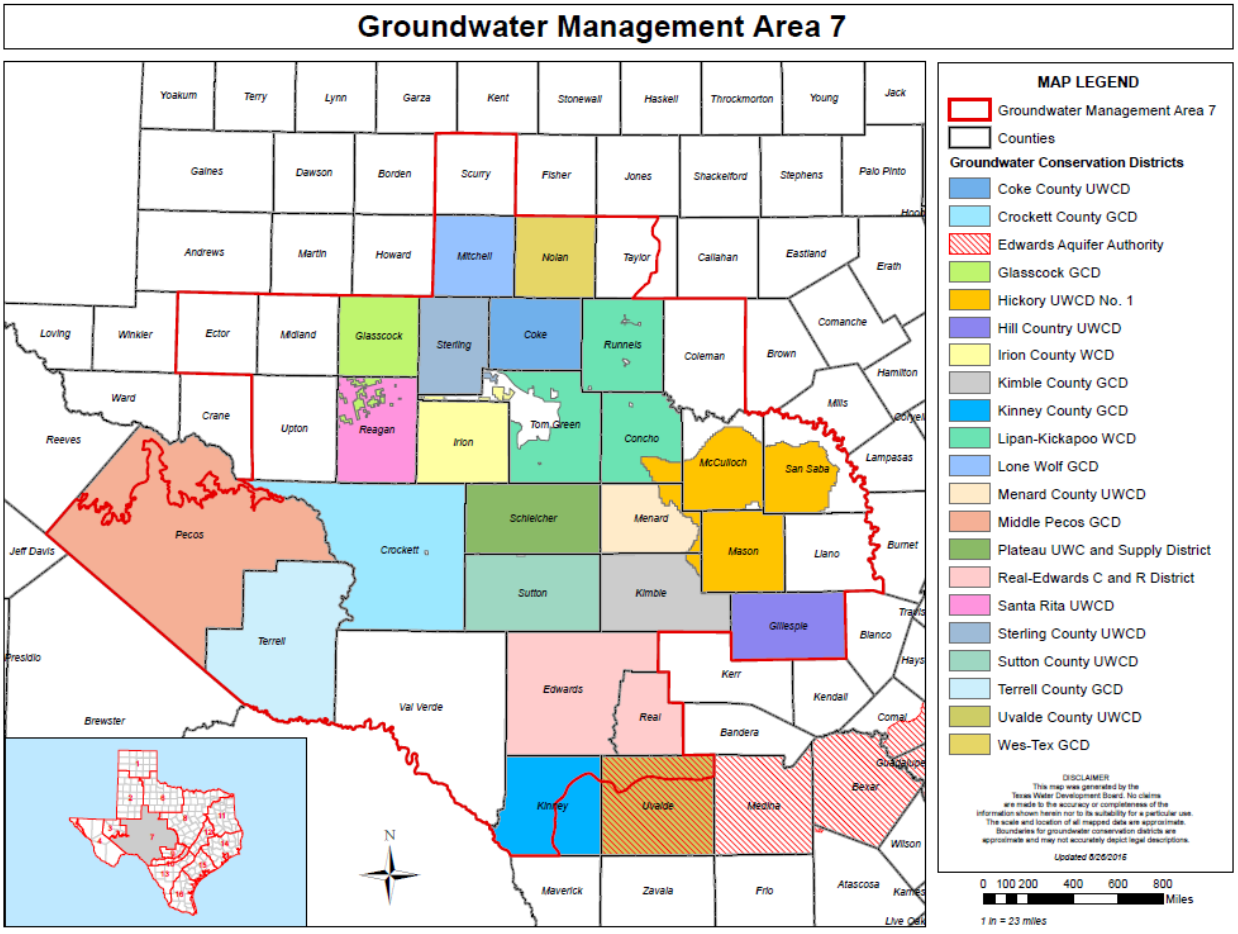

Figure 3. Groundwater Conservation Districts in GMA 7 (from TWDB)

The explanatory report covers the Rustler Aquifer. As described in George and others (2011):

> *The Rustler Aquifer is a minor aquifer located in Brewster, Culberson, Jeff Davis, Loving, Pecos, Reeves, and Ward counties. The aquifer consists of the carbonates and evaporites of the Rustler Formation, which is the youngest unit of the Late Permian Ochoan Series. The Rustler Formation is 250 to 670 feet thick and extends downdip into the subsurface toward the center of the Delaware Basin to the east. It becomes thinner along the eastern margin of the Delaware Basin and across the Central Basin Platform and Val Verde Basin. There it conformably overlies the Salado Formation. Groundwater occurs in partly dissolved dolomite, limestone, and gypsum. Most of the water production comes from fractures solution openings in the upper part of the formation. Although some parts of the aquifer produce freshwater containing less than 1,000 milligrams per liter of total dissolved solids, the water is generally slightly to moderately saline and contains total dissolved solids ranging between 1,000 and 4,600 milligrams per liter. The water is used*

primarily for irrigation, livestock, and waterflooding operations in oil-producing areas. Fluctuations in water levels over time most likely reflect long-term variations in water use patterns. The regional water planning groups in their 2006 Regional Water Plans did not propose any water management strategies for the Rustler Aquifer.

2.0 Desired Future Condition

2.1 2010 Desired Future Conditions

GMA 7 adopted a desired future condition for the Rustler Aquifer on July 29, 2010 as follows:

".. through the year 2060:

1) *total net decline in water levels within the Middle Pecos GCD at the end of the fifty-year period shall not exceed three hundred (300) feet below water levels in the aquifer in the year 2010; and,*
2) *the aquifer is not relevant for joint planning purposes outside the boundaries of the Middle Pecos GCD."*

The desired future condition was developed after considering a water budget analysis was that was completed on behalf of Middle Pecos GCD and reviewed by the Texas Water Development Board (Bradley, 2011). A groundwater model of the aquifer was not available at the time of the initial desired future condition.

2.2 Rustler Groundwater Availability Model

In 2012, the Texas Water Development Board released the groundwater availability model (GAM) for the Rustler Aquifer (Ewing and others, 2012). This model was used as a tool to set the desired future conditions. Documentation of the GAM runs is in Technical Memorandum 15-05.

One of the critical features of the Rustler Aquifer GAM is the conceptualization and simulation of interaction with overlying formations with a general head boundary. The alternative simulations considered the sensitivity of the change in the head specification of the overlying formations and included evaluating the assumption of a declining head in the overlying formations. After review and discussion, the groundwater conservation districts found that the 0.5 ft/yr decline for the overlying formations was reasonable, and Scenario 4 was a reasonable scenario as a basis for the desired future condition.

2.3 2016 Desired Future Condition

On April 21, 2016, the groundwater conservation districts in Groundwater Management Area 7 voted on proposed desired future conditions for the Rustler Aquifer. A public hearing on the proposed desired future condition was held by the Middle Pecos Groundwater Conservation

District (the only district for which a desired future condition was proposed). No public comments were submitted.

At a meeting on September 22, 2016, the groundwater conservation districts in Groundwater Management Area 7 voted final approval of these desired future conditions for the Rustler Aquifer as follows:

- Total net drawdown of the Rustler Aquifer in Pecos County (Middle Pecos GCD) in 2070 not to exceed 94 feet as compared with 2009 aquifer levels (Reference: Table 7, Scenario 4, GMA 7 Technical Memorandum 15-05, Draft 1, 4-7-2015)
- The Rustler Aquifer is not relevant for joint planning purposes in all other areas of GMA 7.

2.4 Third Round Desired Future Conditions

After review and discussion, the groundwater conservation districts in Groundwater Management Area 7 found that the desired future conditions approved in 2016 would remain unchanged.

Because Middle Pecos Groundwater Conservation District is in the process of developing a groundwater flow model that covers all the aquifers in the District, it is expected that the new model will be used in updating the desired future condition in 2026. One of the main objectives of the new model development was to eliminate the need for *a priori* specifications of head in the overlying formations and provide a more robust method to simulate vertical connections between aquifers.

The resolution that documents the adoption of the desired future condition for the Capitan Reef Complex Aquifer is presented in Appendix A and was adopted on August 19, 2021 by a 14-0 vote at a properly noticed meeting of Groundwater Management Area 7.

3.0 Policy Justification

As developed more fully in this report, the proposed desired future condition was adopted after considering:

- Aquifer uses and conditions within Groundwater Management Area 7
- Water supply needs and water management strategies included in the 2012 State Water Plan
- Hydrologic conditions within Groundwater Management Area 7 including total estimated recoverable storage, average annual recharge, inflows, and discharge
- Other environmental impacts, including spring flow and other interactions between groundwater and surface water
- The impact on subsidence
- Socioeconomic impacts reasonably expected to occur

- The impact on the interests and rights in private property, including ownership and the rights of landowners and their lessees and assigns in Groundwater Management Area 7 in groundwater as recognized under Texas Water Code Section 36.002
- The feasibility of achieving the desired future condition
- Other information

In addition, the proposed desired future condition provides a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater in Groundwater Management Area 7.

There is no set formula or equation for calculating groundwater availability. This is because an estimate of groundwater availability requires the blending of policy and science. Given that the tools for scientific analysis (groundwater models) contain limitations and uncertainty, policy provides the guidance and defines the bounds that science can use to calculate groundwater availability.

As developed more fully below, many of these factors could only be considered on a qualitative level since the available tools to evaluate these impacts have limitations and uncertainty.

4.0 Technical Justification

The process of using the groundwater model in developing desired future conditions revolves around the concept of incorporating many of the elements of the nine factors (e.g. current uses and water management strategies in the regional plan). For the Rustler Aquifer, 12 scenarios were completed (5 scenarios that investigated the effect of declining groundwater levels in the aquifers that overlie the Rustler Aquifer, and seven scenarios that evaluated different pumping amounts assuming a decline in the overlying aquifers of 0.5 feet/yr), and the results discussed prior to adopting a desired future condition.

Some critics of the process asserted that the districts were "reverse-engineering" the desired future conditions by specifying pumping (e.g., the modeled available groundwater) and then adopting the resulting drawdown as the desired future condition. However, it must be remembered that among the input parameters for a predictive groundwater model run is pumping, and among the outputs of a predictive groundwater model run is drawdown. Thus, an iterative approach of running several predictive scenarios with models and then evaluating the results is a necessary (and time-consuming) step in the process of developing desired future conditions.

One part of the reverse-engineering critique of the process has been that "science" should be used in the development of desired future conditions. The critique plays on the unfortunate name of the groundwater models in Texas (Groundwater Availability Models) which could suggest that the models yield an availability number. This is simply a mischaracterization of how the models work (i.e. what is a model input and what is a model output).

The critique also relies on a fairly narrow definition of the term *science* and fails to recognize that the adoption of a desired future condition is primarily a policy decision. The call to use science in

the development of desired future conditions seems to equate the term *science* with the terms *facts* and *truth*. Although the Latin origin of the word means knowledge, the term *science* also refers to the application of the scientific method. The scientific method is discussed in many textbooks and can be viewed as a means to quantify cause-and-effect relationships and to make useful predictions.

In the case of groundwater management, the scientific method can be used to understand the relationship between groundwater pumping and drawdown, or groundwater pumping and spring flow. A groundwater model is a tool that can be used to run "experiments" to better understand the cause-and-effect relationships within a groundwater system as they relate to groundwater management.

Much of the consideration of the nine statutory factors involves understanding the effects or the impacts of a desired future condition (e.g. groundwater-surface water interaction and property rights). The use of the models in this manner in evaluating the impacts of alternative futures is an effective means of developing information for the groundwater conservation districts as they develop desired future conditions.

5.0 Factor Consideration

Senate Bill 660, adopted by the legislature in 2011, changed the process by which groundwater conservation districts within a groundwater management area develop and adopt desired future conditions. The new process includes nine steps as presented below:

- The groundwater conservation districts within a groundwater management area consider nine factors outlined in the statute.
- The groundwater conservation districts adopt a "proposed" desired future condition
- The "proposed" desired future condition is sent to each groundwater conservation district for a 90-day comment period, which includes a public hearing by each district
- After the comment period, each district compiles a summary report that summarizes the relevant comments and includes suggested revisions. This summary report is then submitted to the groundwater management area.
- The groundwater management area then meets to vote on a desired future condition.
- The groundwater management area prepares an "explanatory report".
- The desired future condition resolution and the explanatory report are then submitted to the Texas Water Development Board and the groundwater conservation districts within the groundwater management area.
- Districts then adopt desired future conditions that apply to that district.

The nine factors that must be considered before adopting a proposed desired future condition are:

1. Aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another.
2. The water supply needs and water management strategies included in the state water plan.

3. Hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator (of the Texas Water Development Board), and the average annual recharge, inflows and discharge.
4. Other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water.
5. The impact on subsidence.
6. Socioeconomic impacts reasonably expected to occur.
7. The impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002 (of the Texas Water Code).
8. The feasibility of achieving the desired future condition.
9. Any other information relevant to the specific desired future condition.

In addition to these nine factors, statute requires that the desired future condition provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area.

5.1 Groundwater Demands and Uses

Table 1 summarizes county-level groundwater demands and uses from 2000 to 2012 for the Rustler Aquifer in GMA 7. Data were obtained from the Texas Water Development Board historic pumping database:

http://www.twdb.state.tx.us/waterplanning/waterusesurvey/historical-pumpage.asp

Table 1. Historic Pumping Estimates for the Rustler Aquifer in GMA 7

Year	County	Aquifer	Irrigation	Livestock	Total
2000	PECOS	RUSTLER AQUIFER	2,085	4	2,089
2001	PECOS	RUSTLER AQUIFER	1,851	4	1,855
2002	PECOS	RUSTLER AQUIFER	1,764	3	1,767
2003	PECOS	RUSTLER AQUIFER	1,084	3	1,087
2004	PECOS	RUSTLER AQUIFER	1,223	14	1,237
2005	PECOS	RUSTLER AQUIFER	1,192	15	1,207
2006	PECOS	RUSTLER AQUIFER	1,783	17	1,800
2007	PECOS	RUSTLER AQUIFER	1,571	13	1,584
2008	PECOS	RUSTLER AQUIFER	1,639	15	1,654
2009	PECOS	RUSTLER AQUIFER	2,616	14	2,630
2010	PECOS	RUSTLER AQUIFER	3,533	14	3,547
2011	PECOS	RUSTLER AQUIFER	3,603	13	3,616
2012	PECOS	RUSTLER AQUIFER	3,175	12	3,187

The Modeled Available Groundwater for the Rustler Aquifer in the GMA 7 portion of Pecos County is 7,040 AF/yr.

5.2 Groundwater Supply Needs and Strategies

The 2021 Region F Plan lists county-by-county shortages and strategies. Shortages are identified when current supplies (e.g. existing wells) cannot meet future demands. Strategies are then recommended (e.g. new wells) to meet the future demands. No strategies are listed for the Rustler Aquifer in GMA 7.

A comparison of the historic pumping and the current modeled available groundwater for Pecos County and the historic pumping is shown in Figure 4.

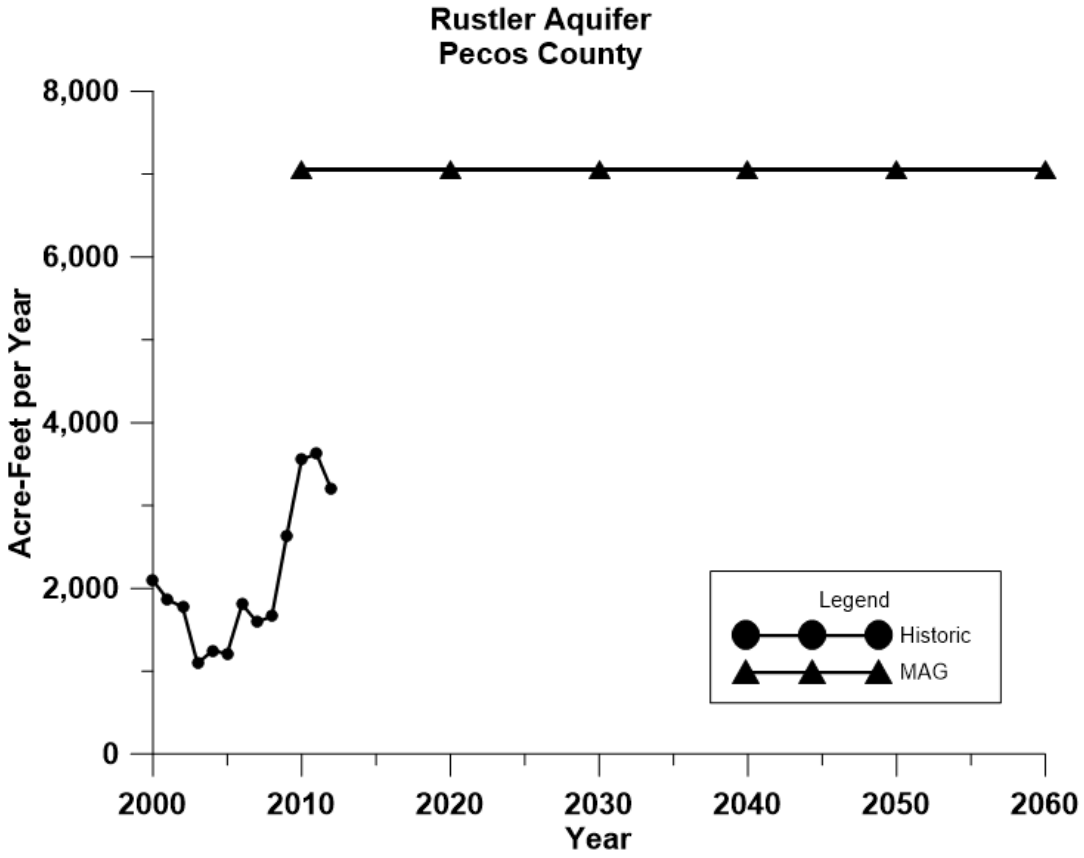

Figure 4. Comparison of Current MAG and Historic Pumping - Rustler Aquifer in Pecos County

5.3 Hydrologic Conditions, including Total Estimated Recoverable Storage

The groundwater budget for 2008 as presented by Ewing and others (2008) for the Pecos County portion of the Rustler Aquifer is presented in Table 2. Jones and others (2013) documented the

total estimated recoverable storage for the GMA 7 portion of the Rustler Aquifer in Pecos County. Total storage estimates are presented in Table 3.

Table 2. Groundwater Budget of Rustler Aquifer in GMA 7 for 2008
Data from Ewing and others (2012)
All Values in AF/yr except as noted

Inflow	**Pecos County**
Lateral Flow from other Counties	2,761
Recharge from Precipitation	0
Total	2,761

Outflow	
Outflow to overlying formations	1,523
Pumping	220
Flowing Wells	1,254
Spring Flow	342
Total	3,339

Outflow-Inflow	578
Model Estimated Storage Decline	586
Model Error	8

Table 3. Total Estimated Recoverable Storage - Rustler Aquifer

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Pecos	5,000,000	1,250,000	3,750,000
Total	5,000,000	1,250,000	3,750,000

5.4 Other Environmental Impacts, including Impacts on Spring Flow

Table 2 above includes groundwater budget estimates of spring flow for 2008 as estimated by the Rustler Aquifer GAM.

5.5 Subsidence

The subsidence tool developed by the Texas Water Development Board was used to assess the potential for subsidence in the five aquifers in the District using the default values provided. The tool can be accessed at:

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

The tool provides a numeric total weighted risk factor that ranges from 0 (low risk) to 10 (high risk). The results of applying the default values from the tool yield a score of 3.59 for the Rustler Aquifer in Pecos County (the only relevant area in Groundwater Management Area 7):

Based on applying the tool, subsidence is not an important factor for the Rustler Aquifer in Pecos County.

5.6 Socioeconomic Impacts

The Texas Water Development Board prepared reports on the socioeconomic impacts of not meeting water needs for each of the Regional Planning Groups during development of the 2021 Regional Water Plans. Because the development of this desired future condition used the State Water Plan demands and water management strategies as an important foundation, it is reasonable to conclude that the socioeconomic impacts associated with this proposed desired future condition can be evaluated in the context of not meeting the listed water management strategies. Groundwater Management Area 7 is covered by Regional Planning Group F. The socioeconomic impact report for Region F is included in Appendix B.

5.7 Impact on Private Property Rights

The impact on the interests and rights in private property, including ownership and the rights of landowners and their lessees and assigns in Groundwater Management Area 3 in groundwater is recognized under Texas Water Code Section 36.002.

The desired future conditions adopted by GMA 7 are consistent with protecting property rights of landowners who are currently pumping groundwater and landowners who have chosen to conserve groundwater by not pumping. All current and projected uses (as defined in the 2021 Region F plan) can be met based on the simulations. In addition, the pumping associated with achieving the desired future condition (the modeled available groundwater) will cause impacts to exiting well owners and to surface water. However, as required by Chapter 36 of the Water Code, GMA 7 considered these impacts and balanced them with the increasing demand of water in the GMA 7 area, and concluded that, on balance and with appropriate monitoring and project specific review during the permitting process, the desired future condition is consistent with protection of private property rights.

5.8 Feasibility of Achieving the Desired Future Condition

Groundwater levels are routinely monitored by the districts and by the TWDB in GMA 7. Evaluating the monitoring data is a routine task for the districts, and the comparison of these data with the model results that were used to develop the DFCs is covered in each district's management plan. These comparisons will be useful to guide the update of the DFCs that are required every five years.

5.9 Other Information

GMA 7 did not consider any other information in developing these DFCs.

6.0 Discussion of Other Desired Future Conditions Considered

There were 7 GAM scenarios completed that included a range of future pumping scenarios. Results of these scenarios were originally presented at the GMA 7 meeting of April 23, 2015. The model results of all 12 scenarios were summarized in GMA 7 Technical Memorandum 15-05.

After review and discussion, the groundwater conservation districts found that the 0.5 ft/yr decline for the overlying formations was reasonable, and Scenario 4 was a reasonable scenario as a basis for the desired future condition.

7.0 Discussion of Other Recommendations

Public comments were invited, and each district held a public hearing on the proposed desired future condition for aquifers within their boundaries. Since the Rustler Aquifer is only within the boundaries of the Middle Pecos County GCD in GMA 7, it was the only district that held a public hearing on this desired future condition:

Groundwater Conservation District	Date of Public Hearing	Number of Comments Received
Middle Pecos GCD	6/15//2021	None

8.0 References

Bradley, R.G., 2011, GTA Aquifer Assessment 10-13 MAG. Texas Water Development Board, Groundwater Technical Assistance Section, November 18, 2011, 8p.

Ewing, J.E., Kelley, V.A., Jones, T.L., Yan, T., Singh, A., Powers, D.W., Holt, R.M., and Sharp, J.M., 2012. Final Groundwater Availability Model Report for the Rustler Aquifer. Prepared for the Texas Water Development Board, 460p.

George, P.G., Mace, R.E., and Petrossian, R., 2011. Aquifers of Texas. Texas Water Development Board Report 380, July 2011, 182p.

Jones, I.C., Bradley, R., Boghici, R., Kohlrenken, W., Shi, J., 2013. GAM Task 13-030: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 7. Texas Water Development Board, Groundwater Resources Division, October 2, 2013, 53 p.