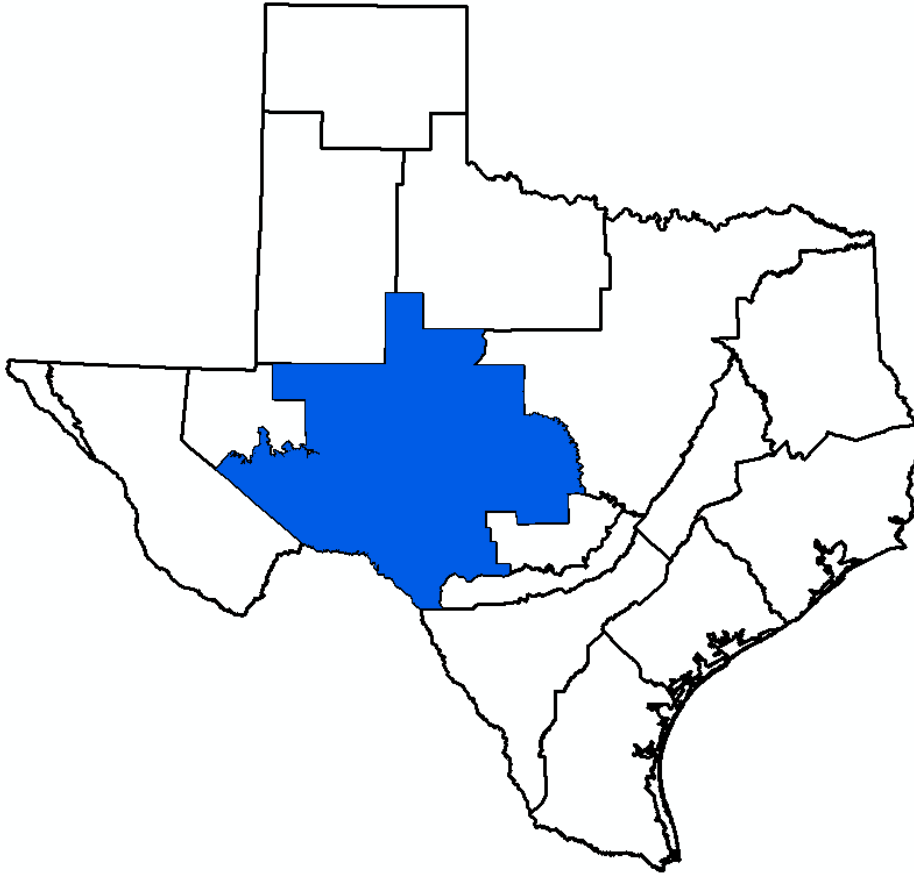


**Comparison of Measured Drawdown with Simulated Drawdowns
from the Desired Future Conditions Adopted in 2021 in
Groundwater Management Area 7**



Prepared for:
Groundwater Management Area 7

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April 16, 2026

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Professional Engineer and Professional Geoscientist Seals

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Draft Report for Review – To be Stamped when Finalized

1.0 Review of HB 2078

The 89th Texas Legislature passed HB 2078 with an effective date of September 1, 2025. HB 2078 includes changes to GCD management plans (36.1071(e)), and changes in the joint planning process (36.108) by amending subsections (c) and (d-3) and adding subsections (c-1) and (d-1a).

The new management plan requirements include adding an “explanation in plain language” on:

- How the district is monitoring and tracking the achievement of desired future conditions (DFCs)
- How the district has performed in achieving the desired future conditions (DFCs) over the preceding five-year joint planning cycle.

The new joint planning requirements are:

- Changes annual review of district management plans to “not less than once during each five-year period”
- As part of the required management plan review: “the degree to which each district is achieving the desired future conditions established during the joint planning process through the implementation of the district's management plan and rules”
- Identify interim values for the desired future conditions (not to exceed 10 years) to assist the district monitoring interim progress in achieving desired future conditions (DFCs)
- Include an explanation in plain language of why a desired future condition (DFC) was changed if the DFC is different from the DFC from the previous round of joint planning
- Include a summary of how each district is performing in achieving the desired future condition

Based on these changes, it appears that efforts at the GMA level during joint planning and documented in the explanatory report for the desired future condition can be used in district management plans. Ultimately, decisions by the Texas Water Development Board (TWDB) will determine the how to implement these statutory changes into its administrative rules regarding management plan review and explanatory report review.

It is unknown when TWDB will complete these needed rule changes. In anticipation of these changes and because the changes will be in effect before the deadline for joint planning submittals (January 5, 2027), this technical memorandum outlines an approach to satisfy the requirements of HB 2078.

1.1 Summary of Results and Conclusions

1.1.1 Capitan Reef Complex Aquifer

Given the requirements of HB 2078 and the lack of data, it is recommended that the Capitan Reef Complex Aquifer be classified as not relevant for purposes of joint planning since there is no

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means of tracking progress on achieving the desired future condition. In addition, there is limited groundwater use from this aquifer.

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

Given the requirements of HB 2078 and the importance of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, it is recommended that the desired future conditions be updated once the Alternative GAM is updated. Classification of specific counties as “not relevant for purposes of joint planning” can be revised by GMA 7 representative as needed based on the data in Table 5.

Val Verde County has no representation at GMA 7, but does have representation at Region J, classifying Val Verde County as “not relevant for purposes of joint planning” would shift the responsibility of specifying “groundwater availability” to Region J. Based on these practical considerations, it is recommended that Val Verde County be classified as not relevant for purposes of joint planning by GMA 7.

In Kinney County, KCGCD consultants have developed an update to the DFC and MAG calculation given the limitations of the model that was used in 2010 to set the original DFC and MAG.

1.1.3 High Plains Aquifer System

Given the requirements of HB 2078 and the limited data in counties with groundwater conservation districts, it is recommended that the Dockum and Ogallala aquifers be classified as not relevant for purposes of joint planning since there limited means of tracking progress on achieving the desired future condition. In addition, there is limited groundwater use from this aquifer.

1.1.4 Llano Uplift Aquifer System

The comparison yielded reasonable comparisons between actual drawdown and simulated drawdown for each GCD in both the Ellenburger-San Saba and Hickory aquifers. The overall annual comparison included a comparison with annual precipitation which suggests that the recent drought is likely the most reasonable explanation for the increase in actual drawdown the last few years.

1.1.5 Rustler Aquifer

Due to severe limitations with the Rustler Aquifer GAM, the lack of monitoring data during the baseline period, and the geographic isolation (i.e. only Pecos County has a DFC for the Rustler Aquifer in GMA 7), it is recommended that the Rustler Aquifer be classified as not relevant for purposes of joint planning.

If the Rustler Aquifer GAM is updated, either as a stand-alone GAM or combined with the Edwards-Trinity (Plateau) and Pecos Valley GAM, this classification should be reevaluated.

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2.0 GAM Simulation Results and Averaged Drawdowns

Desired future conditions are often expressed as average drawdowns for a defined area over a specific period time. The defined area can be GMA-wide, GCD-wide, county-wide, aquifer-wide (model layer), and various combinations of GCDs, counties, and aquifers. The time period usually starts at the end of the calibration period of the specific GAM and, in the last round of joint planning ended in 2080.

2.1 Example: Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers

As an example, desired future conditions for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers in GMA 3 and GMA 7 were based on the average drawdowns for each county using the Alternative GAM for these aquifer. The GAM subdivides the groundwater flow system into cells. Each cell covers 640 acres, or one square mile. Table 1 presents the cell count for each county in GMA 3 and GMA 7.

Table 1. GAM Cell Counts for GMA 3 and GMA 7 by County

County Name	County Code	Cell Count	
		GMA 3	GMA 7
Coke	41	0	205
Concho	48	0	320
Crane	52	441	0
Crockett	53	0	2,791
Ector	68	0	469
Edwards	69	0	2,124
Gillespie	86	0	933
Glasscock	87	0	797
Irion	118	0	886
Kimble	134	0	1,222
Kinney	136	0	559
Loving	151	385	0
Mason	160	0	257
Menard	164	0	884
Midland	165	0	889
Nolan	177	0	315
Pecos	186	993	2,997
Reagan	192	0	1,176
Real	193	0	700
Reeves	195	2,373	0
Schelicher	207	0	1,310
Sterling	216	0	615
Sutton	218	0	1,458
Taylor	221	0	102
Terrell	222	0	2,355
TomGreen	226	0	479
Upton	231	0	844
Uvalde	232	0	395
ValVerde	233	0	3,169
Ward	238	666	0
Winkler	248	560	0

Results from the GAM simulation that was used as the basis for the desired future condition (reference) included groundwater elevations for each cell for each year of the simulation. Although the GAM calibration period ended in 2005 and the DFC simulation (predictive

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simulation) started in 2006, for purposes of DFCs in GMA 3 and GMA 7, the drawdowns were calculated using a base year of 2010. This was a policy decision of GMA 3 and GMA 7.

Average drawdowns for each county were calculated as the sum of all drawdowns for the county and divided by the number of cells in the county. These calculations can be completed for each year of the simulation. The results for the full simulation period (drawdown from 2010 to 2070) are summarized in Table 2 for each county. These average drawdowns are the basis for the desired future conditions adopted by GMA 3 and GMA 7. Please recall that the average drawdowns for Kinney and Val Verde counties are not used for the DFCs in GMA 7.

Table 2. Average Drawdown for GMA 3 and GMA 7

GMA 3			GMA 7		
County Name	County Code	Average Drawdown (2010 to 2070) (ft)	County Name	County Code	Average Drawdown (2010 to 2070) (ft)
Crane	52	57.93	Coke	41	0.04
Loving	151	5.39	Concho	48	0.37
Pecos	186	13.79	Crockett	53	10.03
Reeves	195	7.80	Ector	68	4.05
Ward	238	62.61	Edwards	69	1.78
Winkler	248	160.53	Gillespie	86	5.20
			Glasscock	87	41.90
			Irion	118	10.35
			Kimble	134	1.13
			Kinney	136	0.20
			Mason	160	0.02
			Menard	164	0.63
			Midland	165	11.93
			Nolan	177	0.02
			Pecos	186	13.67
			Reagan	192	41.55
			Real	193	4.14
			Schelicher	207	8.23
			Sterling	216	7.03
			Sutton	218	6.43
			Taylor	221	0.03
			Terrell	222	2.43
			Tom Green	226	2.89
			Upton	231	20.31
			Uvalde	232	2.07
			Val Verde	233	1.35

2.2 Cell-by-Cell Drawdowns in Pecos County

Please note that Pecos County is in both GMA 3 and GMA 7, and the average drawdown is similar in each (13.79 ft in GMA 3 and 13.67 ft in GMA 7). The actual DFCs for Pecos County are rounded to 14 feet for both GMA 3 and GMA 7 portions of Pecos County. As seen in Table 1, the Pecos County area in GMA 7 is about three times the area of Pecos County in GMA 3. More significantly, the nature of the aquifer in each GMA is different. The GMA 3 portion is dominated by the Pecos Valley aquifer, an alluvial aquifer. The GMA 7 portion is dominated by the Edwards-Trinity (Plateau) Aquifer, a fractured and karstic limestone aquifer.

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The cell-by-cell drawdowns for Pecos County from 2010 to 2070 are summarized in Figure 1 (GMA 3 portion) and Figure 2 (GMA 7 portion).

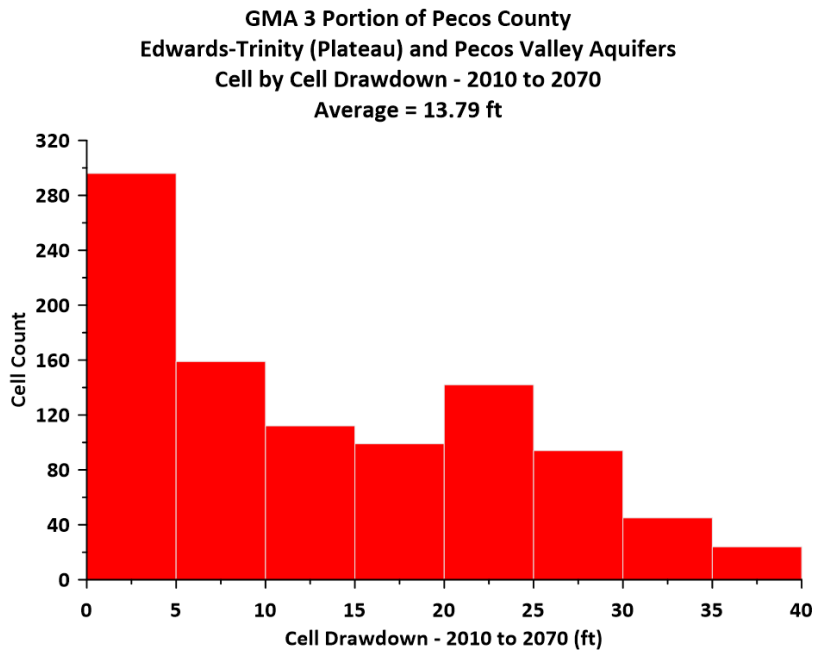


Figure 1. Drawdown Distribution - Pecos County, GMA 3

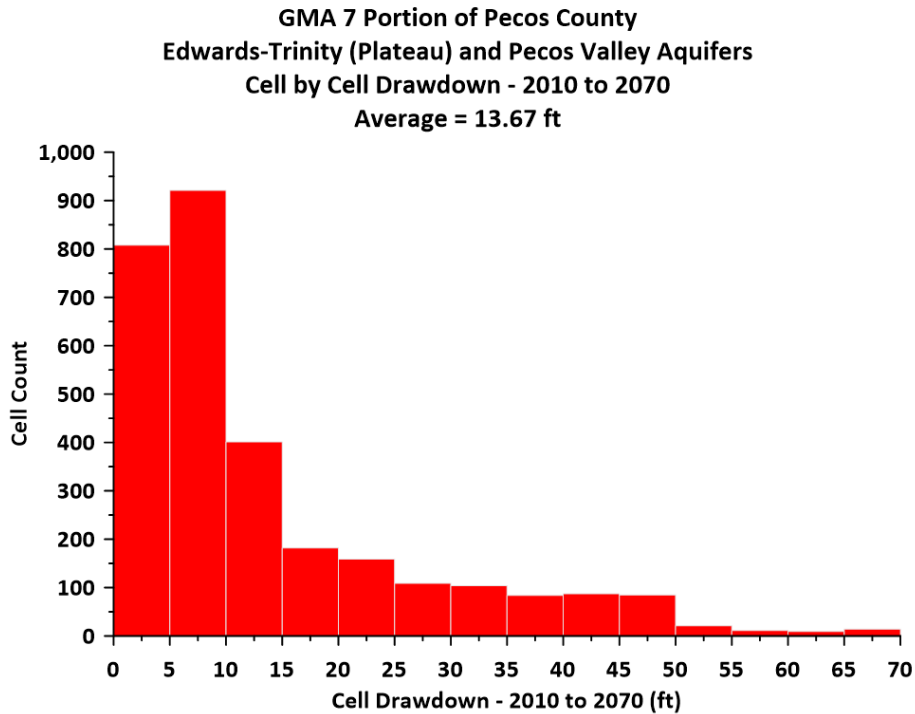


Figure 2. Drawdown Distribution - Pecos County, GMA 7

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In GMA 3, cell-by-cell drawdown varies from zero to about 40 feet. In GMA 7, cell-by-cell drawdown varies from zero to about 70 feet. There is a common misperception that a DFC is applicable over the entire area. In this case, an incorrect interpretation of the DFCs in Pecos County is that the DFC (or drawdown) is 14 feet in all areas of Pecos County. The model results shown in Figures 1 and 2 demonstrate that this is not correct.

There are 85 cells in the GMA 7 portion of Pecos County where the simulated average drawdown from 2010 to 2070 is between 45 and 50 feet. It is likely that a monitoring well at any of these locations would measure drawdown higher than the DFC value of 14 feet. Yet, it is also likely that such a measurement would be consistent with the DFC simulation. Thus, any legitimate comparison between actual drawdown data from a monitoring well and the simulated drawdown from the DFC simulation must take location of the monitoring well into consideration.

3.0 Overview of Data and Analysis

This report describes the comparison of actual drawdown data and simulated drawdown. The simulated drawdown is extracted from the model simulations that were the basis for the desired future conditions. In GMA 7, five models were used in the development of the desired future conditions that covered 10 aquifers as summarized in Table 3.

Table 3. Summary of GAMs and Aquifers for GMA 7

Groundwater Availability Model (GAM)	Aquifer
Capitan Reef Complex	Capitan
Edwards-Trinity (Plateau), Pecos Valley, Trinity Alternative GAM	Edwards-Trinity (Plateau), Pecos Valley, Trinity
High Plains Aquifer System	Dockum
	Ogallala
Llano Uplift	Ellenburger-San Saba
	Hickory
	Marble Falls
Rustler	Rustler

Please note that in the High Plains Aquifer System GAM and the Llano Uplift GAM, individual aquifers are represented as layers. However, the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers are lumped into a single layer in the Alternative GAM.

A key consideration of the comparison include finding monitoring wells with a groundwater elevation measurement in the baseline year. Absent a groundwater elevation measure in the baseline year, the drawdown calculation (groundwater elevation of the baseline year minus the groundwater elevation in the “current” year) cannot be completed. While it is possible to estimate a baseline groundwater elevation through extrapolation or interpolation, the analyses presented in this technical memorandum only uses actual data.

Actual groundwater elevation data were downloaded from the TWDB Groundwater Database on July 9, 2025.

All files associated with this report are available for download at the following Google Drive link:

<https://drive.google.com/drive/folders/14vciEugFabrYfA9MxuSTuv6g2sOfdWic?usp=sharing>

4.0 Capitan Reef Complex Aquifer

4.1 Current Desired Future Condition

The current desired future condition adopted August 19, 2021 was developed based on simulations using the GAM of the Capitan Reef Aquifer Complex Aquifer:

- Total net drawdown not to exceed 56 feet in 2070 as compared with 2006 aquifer levels

The final year of the calibration period of the GAM is 2005, thus, actual groundwater elevation data from late 2005 to early 2006 are needed to complete the comparison.

4.2 Groundwater Elevation Data

Actual groundwater elevation data were downloaded from the TWDB Groundwater Database on July 9, 2025. There were 139 groundwater elevation data points in the GMA 3 and GMA 7 portions of the Capitan Reef Complex Aquifer. Of these, 42 were taken between 1957 and 1987. No data were taken from 1988 to 2004.

Four data points from two wells in 2005 are available, all of which show groundwater elevations above land surface. Three of the data points were taken from the same well in the same month with over 200 feet difference between the highest and lowest. No data points were taken in 2006. From 2007 to 2024, 93 data points were collected.

Based on the lack of data during the baseline period, it is not possible to compare drawdowns with the results of the DFC simulation.

4.3 Recommendation

Given the requirements of HB 2078 and the lack of data, it is recommended that the Capitan Reef Complex Aquifer be classified as not relevant for purposes of joint planning since there is no means of tracking progress on achieving the desired future condition. In addition, there is limited groundwater use from this aquifer.

A GAM update should consider the choice of calibration period so that baseline data can be established in the future.

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

The Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers are lumped together for purposes of joint planning because the Alternative Groundwater Availability Model (GAM) used to develop the desired future conditions (DFCs) is a single layer model that combines the three aquifers. In the future if the GAM is updated to treat these aquifers as distinct layers, it is possible that separate DFCs could be adopted. However, since the 2010, 2016, and 2021 DFCs are based on the Alternative GAM, the comparison to evaluate achievement of DFCs will reflect the combined aquifers.

As developed below, the Alternative GAM was not used for the desired future conditions in Kinney and Val Verde counties. These counties are discussed after the analysis of the data for the counties for which the Alternative GAM was the basis for the DFCs.

5.1 Current Desired Future Conditions

The desired future conditions for the Edwards-Trinity (Plateau) and Pecos Valley aquifers adopted on August 19, 2021 for GMA 7 are expressed as “total net drawdown not to exceed x feet in 2070 as compared with 2009 aquifer levels for all counties except Kinney and Val Verde. The values of drawdown are county specific as presented in Table (taken from the GMA 7 Explanatory Report of August 28, 2021).

Table 4. Summary of Desired Future Conditions Expressed as Average Drawdown

County	Corrected Desired Future Conditions: Average Drawdowns from 2010 to 2070 (ft)
Coke	0
Crockett	10
Ector	4
Edwards	2
Gillespie	5
Glasscock	42
Irion	10
Kimble	1
Menard	1
Midland	12
Pecos	14
Reagan	42
Real	4
Schelicher	8
Sterling	7
Sutton	6
Taylor	0
Terrell	2
Upton	20
Uvalde	2

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For Kinney and Val Verde counties, GMA 7 expressed the desired future conditions as follows:

- a) Total net drawdown in Kinney County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an annual average flow of 23.9 cfs and an annual median flow of 23.9 cfs at Las Moras Springs (Reference: Groundwater Flow Model of the Kinney County Area by W.R. Hutchison, Ph.D., P.E., P.G., Jerry Shi, Ph.D. and Marius Jigmond, TWDB, dated August 26, 2011).
- b) Total net drawdown in Val Verde County in 2070, as compared with 2010 aquifer levels, shall be consistent with maintenance of an average annual flow of 73-75 mgd at San Felipe Springs

These desired future conditions were a GAM simulation using the Alternative GAM designated as Scenario 2 in Technical Memorandum 18-01. These values are labeled “corrected” because the original calculation of averages across counties relied on an outdated grid file of the model. Using the output from the same model run with an updated grid file yielded slightly different average drawdown results.

5.2 Groundwater Elevation Data

Because the starting point for the drawdown calculations in the GAM simulation is 2010, monitoring wells with a measurement point from late 2010 to early 2011 can be used as a basis for comparison with the simulation results.

Actual groundwater elevation for this effort came from three sources:

- TWDB groundwater database with actual groundwater elevation data from late 2010 to early 2011 for use as a baseline (17 counties)
- TWDB groundwater database with interpolated groundwater levels for baseline purposes (late 2010 to early 2011) in three counties (Coke, Kimble, and Taylor)
- GCD provided data where no TWDB groundwater database were available (Irion and Sterling counties)

Figure 3 presents the locations of these well. Model row and column assignments for each well were based on TWDB’s 2015 grid file using the Fortran program *PointRCbaseline.exe* for TWDB database wells and *PointRC.exe* for the Irion and Sterling County wells.

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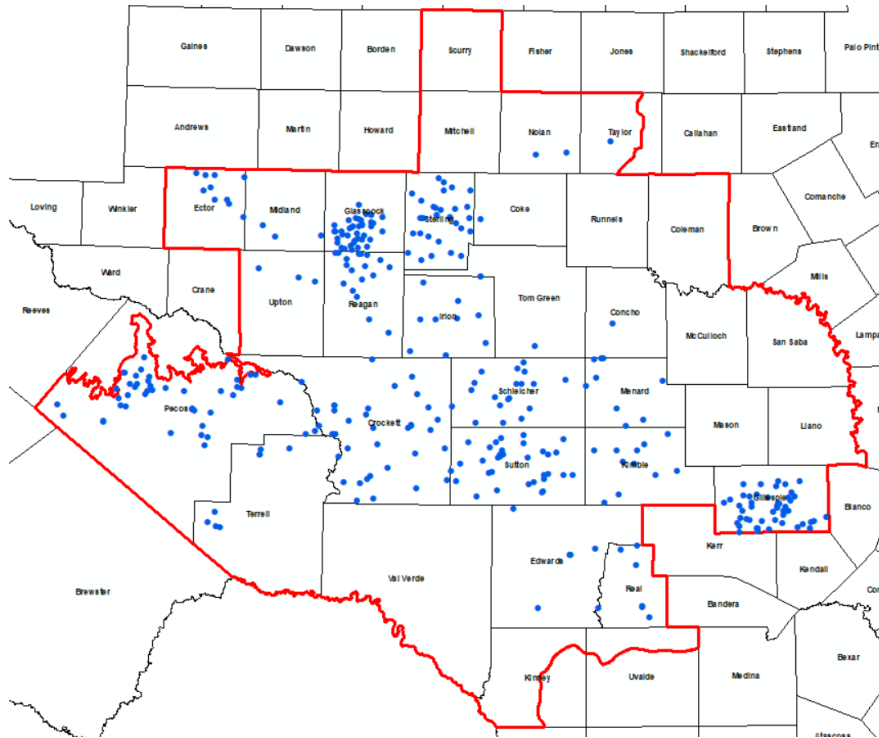


Figure 3. Baseline Well Locations for Edwards-Trinity, Pecos Valley, and Trinity Aquifers - GMA 7

5.3 Actual and Simulated Drawdowns

5.3.1 TWDB Database Wells

The Fortran program *ActSimDD.exe* was written to obtain actual and simulated drawdowns. The baseline well locations and baseline groundwater elevations (*GMA 7 Base Wells.csv*) are read along with list of the well numbers for all wells with data after the baseline (*Post2010WellList.csv*).

Post baseline data are then read from *Post 2010 ETP GWE.csv*. These data are organized in monthly data arrays for each well. These monthly arrays are then used to choose an annual groundwater elevation data for each year after the baseline. The program specified a preference: 1) December, 2) January (of the following year), 3) November, 4) February (of the following year), 5) October, and 6) March (of the following year). In summary, if a December measurement is available, it is used; if March (of the following year) is the only one in this period, it is used.

These annual groundwater elevations are written to *ETP7ActGWE.dat* are then used in the subsequent comparison with simulated data.

Simulated groundwater elevations for Scenario 2 (the basis for the current desired future conditions in GMA 7 or *pred.hds*) is then read.

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Actual and simulated drawdown from the baseline year (2010) for each year is then calculated and the results are written to *ETP GMA 7 Act Sim DD.dat*. This file was imported into Excel and saved as *GMA 7 ETP Act Sim DD.xlsx*.

5.3.2 GCD Wells

Actual groundwater elevation data for Irion and Sterling counties were processed and saved in a file named *IrionSterlingGWE.csv*.

Simulated groundwater elevation data for Irion and Sterling counties were processed using the Fortran program *SimDD.exe*. The program reads the simulated for Scenario 2 (the basis for the current desired future conditions in GMA 7 or *pred.hds*). Well locations are read from *IrionSterlingRC.dat* (which was derived from *IrionSterlingGWE.csv*), and the simulated drawdown is written to *IrionSterlingSDD.dat*.

The actual and simulated drawdown data were then combined into a file named *Irion Sterling ADD SDD.xlsx*.

5.4 Results

Results of the comparison included hydrograph comparison of actual and simulated drawdowns for the full dataset in Figure 4. The numbers above the simulated drawdown data the number of readings in that year.

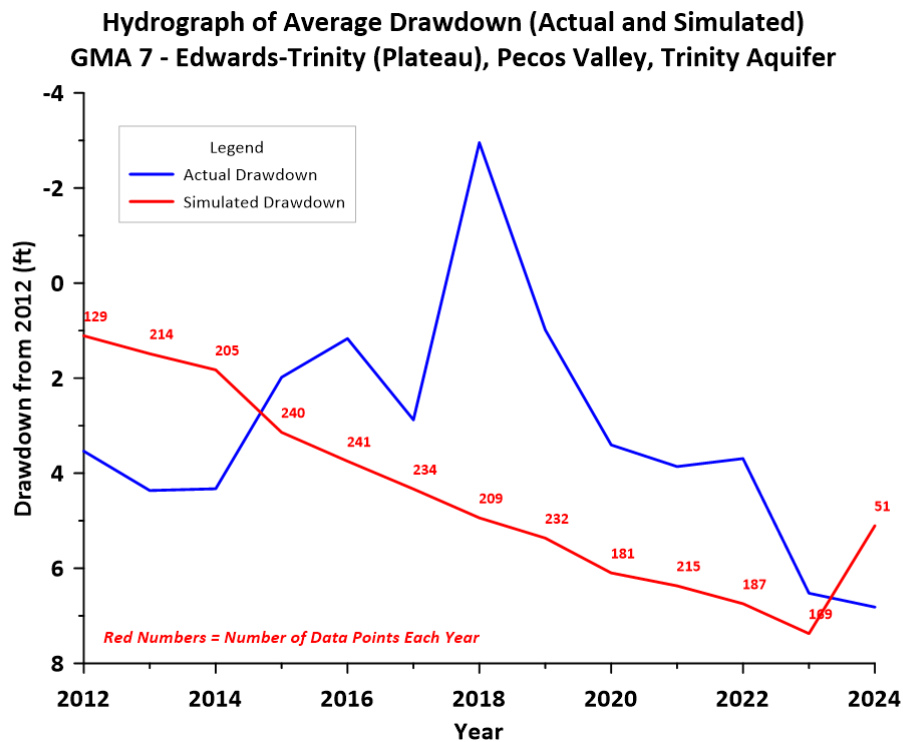


Figure 4. Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifer Average Drawdown Comparison

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Please note that, in general, the actual drawdown is less than the simulated drawdown, which suggests that the DFC is being achieved.

More comprehensive summaries of the data is presented in Figures 5 and 6. Figure 5 is a frequency diagram of the difference between actual and simulated drawdowns for each of the 2,507 data points. The difference is calculated as simulated minus actual, so a positive “difference” means that the actual drawdown is less than the simulated drawdown, and a negative “difference” means that the actual drawdown is greater than the simulated drawdown. Figure 6 presents a cross-plot of individual data points (actual drawdown vs. simulated drawdown) for the 2,507 data points. In Figures 5 and 6, the positive differences are shown in blue, and the negative differences are shown in red.

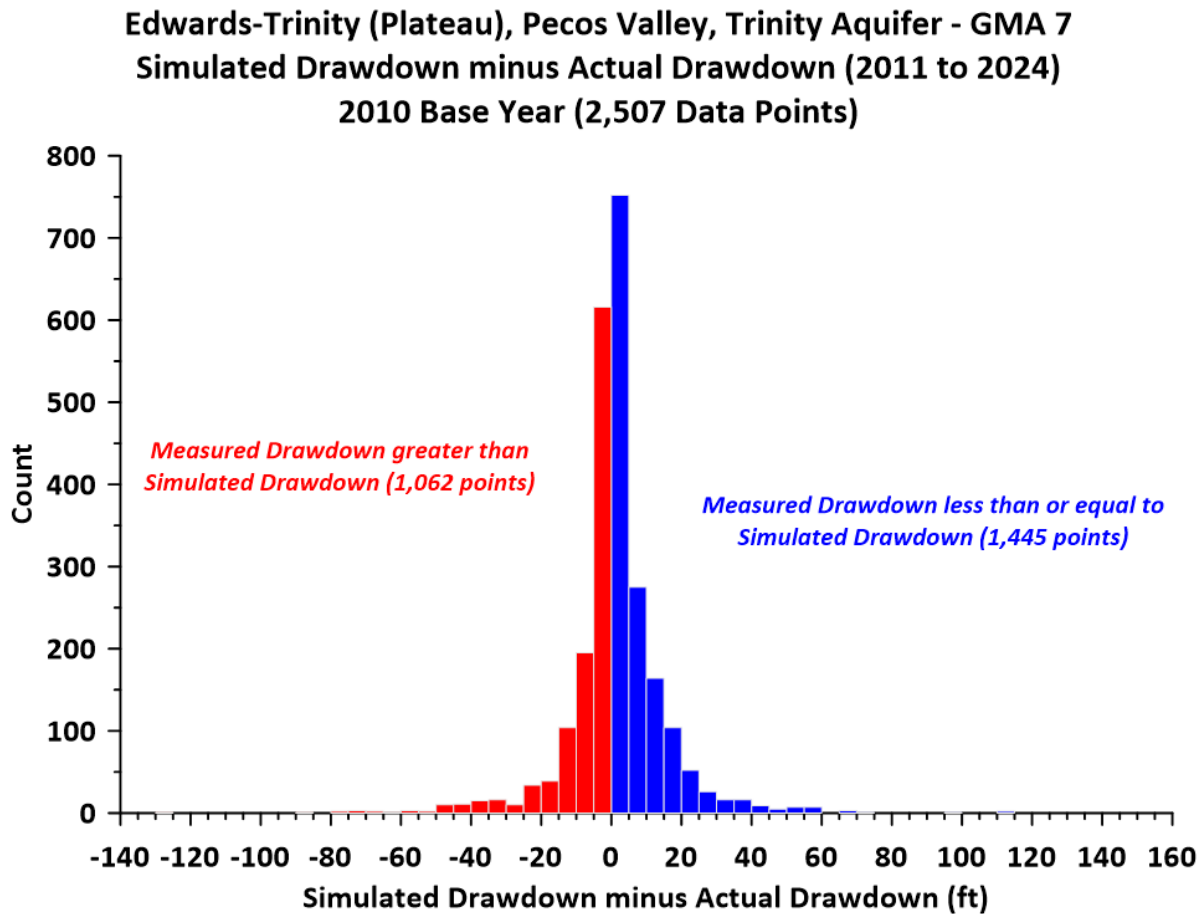


Figure 5. Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers Drawdown Differences

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**Edwards-Trinity (Plateau), Pecos Valley, Trinity Aquifer - GMA 7
Actual Drawdown vs. Simulated Drawdown (2011 to 2024)
2010 Base Year (2,507 Data Points)**

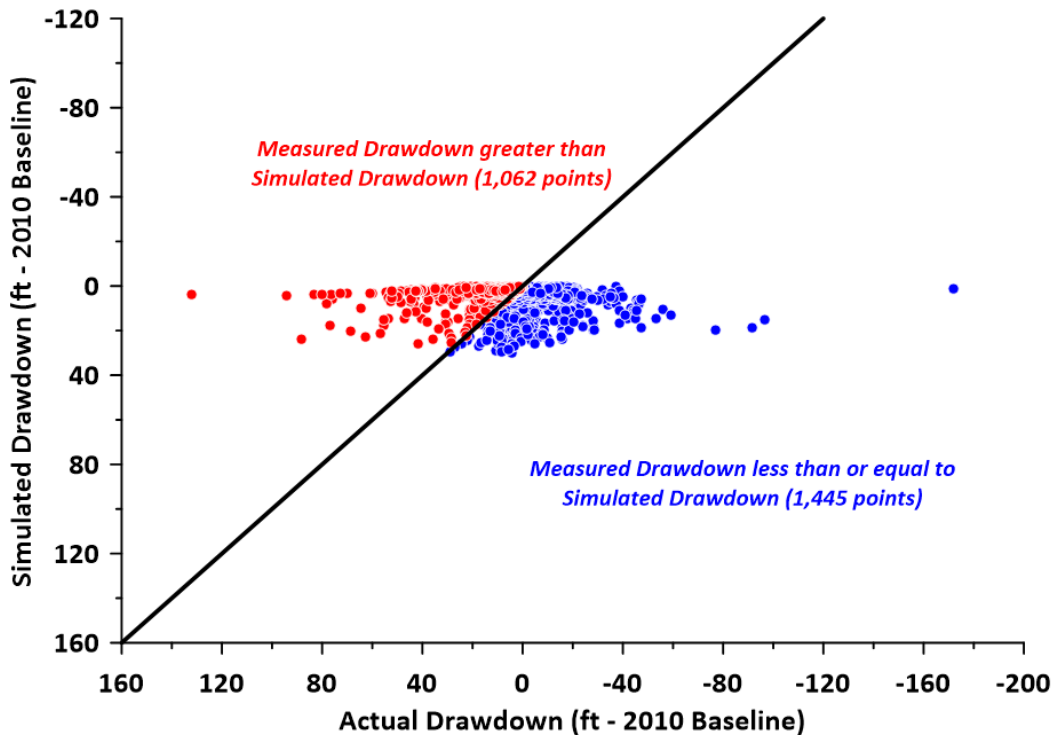


Figure 6. Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers Actual Drawdown vs. Simulated Drawdown

The county-level summary of these results are presented in Table 5. Please note the number of annual data points are listed and the current DFC in 2070 are listed for context. Average simulated drawdown is generally more than average actual drawdown, and, because this analysis only covers through 2024, the average simulated drawdown is generally less than the DFC drawdown (as expected). However, two notable exceptions are presented in Real and Terrell counties. The negative “differences” in actual and simulated drawdown appear to be associated with model limitation that can be addressed in this current round of joint planning. Similar differences are also present in Reeves County and the GMA 3 portion of Pecos County.

The negative difference (simulated minus actual) in Reeves County was known previously and discussed at the GMA 3 meeting on May 21, 2025. As discussed at that meeting, the issue is related to the Alternative GAM that was used to develop the DFCs in 2010, 2016, and 2021. An analysis presented at that meeting identified aquifer transmissivity in the GAM needs to be updated in Reeves County, and the work was authorized at that meeting. This update will now be extended to include the GMA 3 portion of Pecos County, Real, and Terrell counties. The objective of the GAM update is to provide a rational means to update the DFC in light of the data comparison. An alternative to simply “increase the predictive pumping” (i.e. increase the MAG) to set a different DFC was rejected. The update to the Alternative GAM was deferred until this analysis of GMA 7 data was completed.

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Table 5. Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifer County Summary

County	Data Source	Number of Actual Drawdown Measurements	Average Drawdown (ft - 2010 Base, 2011 to 2024 Data)		Average Simulated minus Measured (ft)	DFC Drawdown (ft - 2010 to 2070)	
			Measured	Simulated			
Coke	TWDB - Int	7	5.04	0.09	-4.95	0	
Concho	TWDB	4	1.07	0.03	-1.04	NR	
Crockett	TWDB	239	-0.15	3.10	3.25	10	
Ector	TWDB	104	-3.12	0.47	3.59	4	
Edwards	TWDB	34	2.27	1.21	-1.06	2	
Gillespie	TWDB	435	5.10	2.25	-2.84	5	
Glasscock	TWDB	269	0.59	13.85	13.26	42	
Irion (Nearest Active)	GCD	148	2.04	3.07	1.03	10	
Irion (Honor Grid)	GCD	122	2.78	3.64	0.86	10	
Kimble	TWDB - Int	130	-1.02	0.55	1.57	1	
Menard	TWDB	39	-9.87	0.57	10.43	1	
Midland	TWDB	33	1.67	2.02	0.35	12	
Nolan	TWDB	11	9.37	0.00	-9.37	NR	
Pecos	TWDB	463	2.90	3.44	0.53	14	
Reagan	TWDB	114	9.01	16.32	7.31	42	
Real	TWDB	58	23.79	1.53	-22.26	4	
Schleicher	TWDB	169	1.62	4.29	2.67	8	
Sterling (Nearest Active)	GCD	394	1.50	1.07	-0.43	7	
Sterling (Honor Grid)	GCD	141	1.87	2.33	0.46	7	
Sutton	TWDB	292	0.38	2.95	2.58	6	
Taylor	TWDB - Int	7	0.14	0.00	-0.14	0	
Terrell	TWDB	93	10.75	1.65	-9.10	2	
TomGreen	TWDB	2	-2.23	0.42	2.64	NR	
Upton	TWDB	4	0.44	2.06	1.63	20	
Uvalde			No Suitable Wells				2

TWDB Int = Interpolated Baseline Estimated
 TWDB = TWDB Groundwater Database
 GCD = GCD Data (not in TWDB Database)
 NR = County is Not Relevant for Purposes of Joint Planning

5.5 Recommendation

Given the requirements of HB 2078 and the importance of the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers, it is recommended that the desired future conditions be updated once the Alternative GAM is updated. Classification of specific counties as “not relevant for purposes of joint planning” can be revised by GMA 7 representative as needed based on the data in Table 5.

5.6 Val Verde County

The DFC for Val Verde County was developed using a simulation from the EcoKai developed in 2014. This work documented the connection between Amistad Reservoir elevation and the spring flow as measured in San Felipe Creek downstream from the San Felipe Spring. The model was calibrated with monthly stress period from June 1968 to August 2013.

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For this effort, San Felipe Creek flow and Amistad Reservoir elevation data were downloaded from IBWC on July 26, 2025 to complete an updated evaluation of Amistad Reservoir and San Felipe Creek flow. Creek flow is expressed in million gallons per day (mgd).

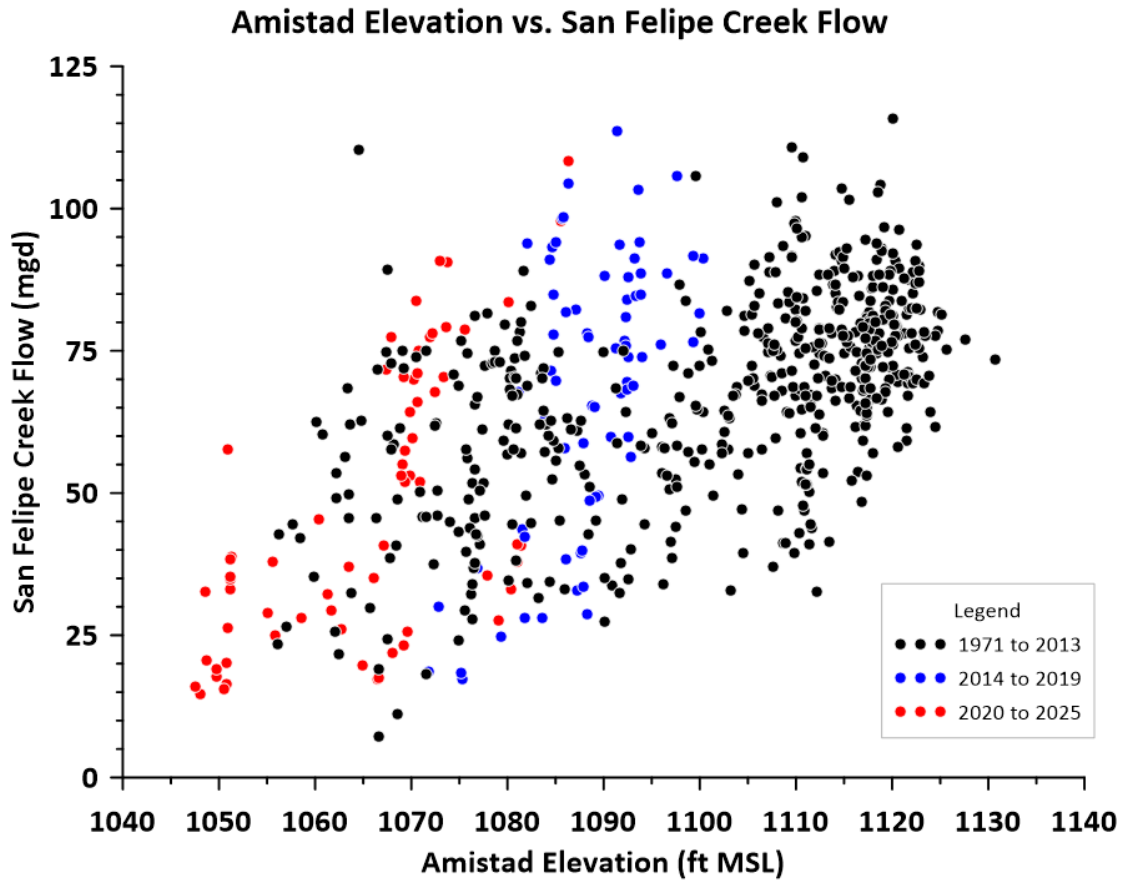


Figure 7. Amistad Reservoir Elevation vs. San Felipe Creek Flow

The black point represent the period that corresponds to the period when the EcoKai study was completed (1971 to 2013), which includes both wet and dry years. The blue points cover the period cover a generally wet period (2014 to 2019), and the red points cover a general dry period (2020 to 2025). Reservoir levels in recent years (and spring flow) have been lower in recent years than during 2014 to 2019. The highest reservoir levels are all before 2013. A summary of the averages for these time periods is presented in Table 6.

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Table 6. Summary Averages of Reservoir Elevation and San Felipe Creek Flow

Period	Average Amistad Elevation (ft MSL)	Average San Felipe Creek Flow (mgd)
1971 to 2013	1,102.05	68.59
2013 to 2019	1,085.61	64.35
2020 to 2025	1,065.28	46.94

Please note that from 1971-2013 to 2013-2019, there was an average decline in the reservoir elevation and a 4 mgd decline in spring flow. However, a 20 ft decline in average reservoir elevation between 2013-2019 and 2020 to 2025 resulted in a spring flow decline of 17 mgd. This non-linearity is an important characteristic to consider when characterizing the relationship between reservoir elevation and spring flow.

Groundwater pumping in Val Verde County has not increased in recent years and the spring flow decline in recent years is primarily due to low reservoir levels due mainly to persistent drought conditions. The current DFC is based on a simulation that assumed 1971 to 2013 reservoir levels. Since 2013, reservoir levels have been consistently lower than those of the study period, and therefore, spring flow has been lower.

Given that there is no GCD in Val Verde County and the spring flow is primarily a function of reservoir level and drought conditions, it is difficult to update the DFC with these updated data. Moreover, the modeled available groundwater that would be associated with the DFC has meaning only to the Regional Planning Group (Region J).

Val Verde County has no representation at GMA 7, but does have representation at Region J, classifying Val Verde County as “not relevant for purposes of joint planning” would shift the responsibility of specifying “groundwater availability” to Region J. Based on these practical considerations, it is recommended that Val Verde County be classified as not relevant for purposes of joint planning by GMA 7.

5.7 Kinney County

5.7.1 Background

The DFC for Kinney County expressed a qualitative goal to maintain historic spring flow from Las Moras Spring, and was expressed as an average of 23.9 cubic feet per second (cfs). This average was developed from a model simulation for end-of-year spring flow because of limitations of the actual data. The underlying assumption of this DFC was that “current” pumping would result in “current” spring flow.

The groundwater model that was the basis for the DFC was completed in 2010 by TWDB and was developed with erroneous pumping data provided to TWDB by the Kinney County Groundwater Conservation District. Permit totals were represented as actual historic pumping and the initial

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DFC developed in 2010 was adopted when Chapter 36 of the Texas Water Code required districts to permit to the Modeled Available Groundwater (previously known as Managed Available Groundwater). Thus, there is a fundamental disconnect between the DFC and MAG that was recognized in 2013. Kinney County Groundwater Conservation District initiated a data collection program that has grown every year from 2013 to present.

Among the district's data collection efforts since 2013:

- Groundwater level instrumentation (now over 60 wells)
- Rainfall gages (8 KCGCD gages and 8 TexMesoNet gages)
- Satellite analysis of irrigated acreage (annual analysis from 1995 to 2023) which were used to quality control permit pumping reports
- Detailed review of permit pumping reports and changes to procedures to receive pumping data from permittees

This multi-year and multidisciplinary effort identified errors in meter reports that were subsequently corrected and found that some data were missing.

While it was recognized that pumping at levels approaching the MAG would result in not meeting the DFC, the work to collect more complete data had to be completed before the DFC could be updated. Pumping from 2013 to present was generally consistent with historic amounts until drought conditions returned and pumping increased. A combination of drought and increased pumping resulted in no spring flows during the summer months, but the spring flow at the end of the year was the metric to compare to the DFC, as described above.

5.7.2 DFC Achievement

Methods to assess annual DFC achievement have been documented since 2013 in KCGCD management plans. In 2014, the spring flow gage was moved by USGS. The data from the new gage could not be tied directly to the historic data or the DFC until 2022. A reasonable amount data in the new gage was needed to understand the implications of changing gage locations. This did not present a serious concern at the time due to the relatively wet conditions and relatively low pumping.

In 2023, the updated KCGCD management plan documented the updated method to assess DFC achievement. The most recent evaluation was dated May 31, 2025. The method basically involves comparing annual rainfall in the region and spring flow at the end of the year. Figure 8 presents the most recent assessment.

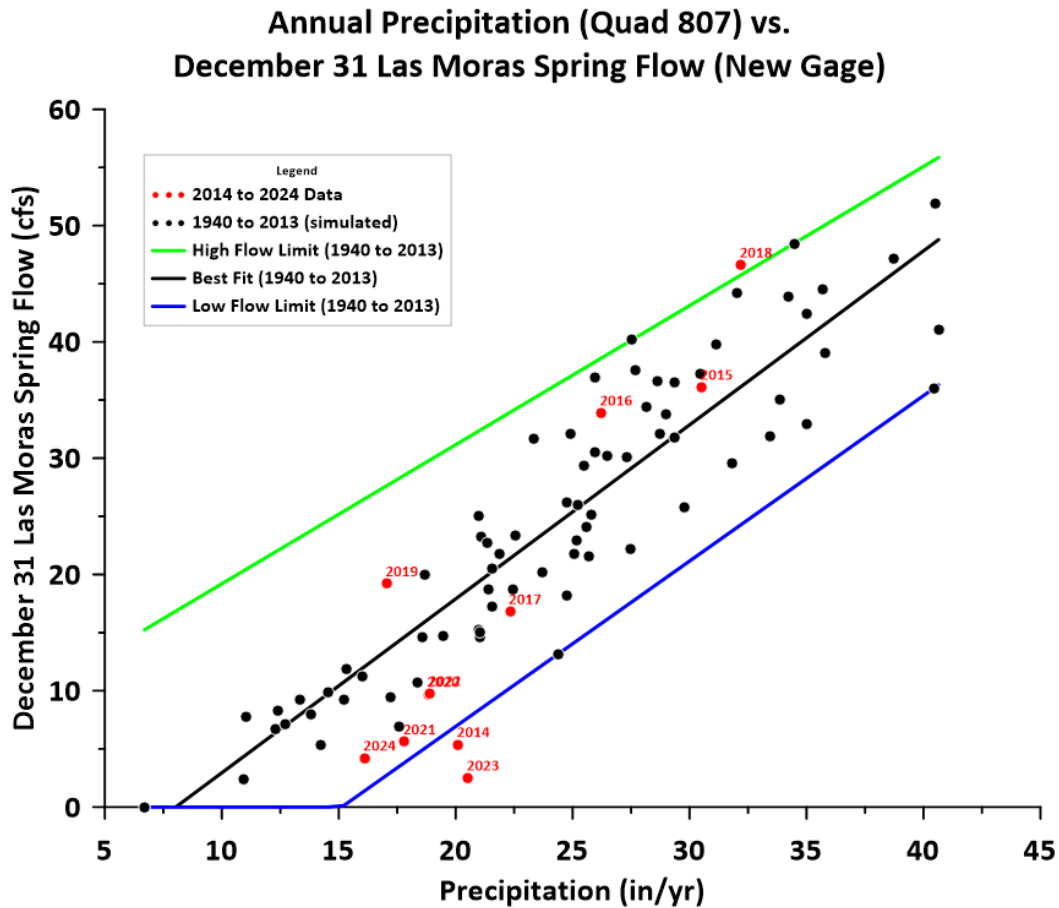


Figure 8. KCGCD Assessment of DFC Achievement

Please note that the black points represent the annual precipitation and spring flow from 1940 to 2018 (simulated to extend the new gage data back to 1940), and the black line represents the best linear fit of that relationship. The blue line and green line represent the bounds of variability of the black point. Red points are the data from 2014 to 2024 (with red numerals noting the year of the data point). Thus, if a red point is between the green and blue lines, it is interpreted as achieving the DFC. If a red point lies outside the boundaries of the blue and green lines, it is an indication that the DFC was not achieved.

Based on this plot, it can be seen that the DFC was not achieved in 2014 and 2023 but was achieved from 2015 to 2022 and in 2024. The 2025 assessment also included an analysis of the years when the DFC was not achieved.

The most important factor in the recent decline of Las Moras Spring flow is the persistent drought (6 years and counting). Moreover, evaporation has dramatically increased in recent years. Table 7 summarizes pertinent data for two periods, 2004 to 2013 and 2014 to 2024 to put the changes in evaporation, pumping, and irrigated acreage into context.

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Table 7. Kinney County Precipitation, Evaporation, Pumping and Irrigated Acreage Summary

Parameter	Average for the Time Period	
	2004 to 2013	2014 to 2024
Precipitation (in/yr)	21.80	21.87
Evaporation (in/yr)	68.22	79.88
Pumping (AF/yr)	4,832	6,929
Irrigated Acreage (winter)	1,462	1,193
Irrigated Acreage (summer)	2,345	2,668

Please note that length of the periods and the average precipitation are nearly equal for the two periods. However, the evaporation and pumping are higher in the more recent period. Irrigated acreage in the winter is lower in the more recent period, but irrigated acreage in the summer is higher in the more recent period. The increase in pumping could be partially explained by the drier conditions (i.e. higher evaporation) and an increase in summer irrigation (higher seasonal evaporation as well as higher annual evaporation).

Actual average pumping during the current drought (2020 to 2024) has ranged from 8,231 to 10,606 AF/yr. These data are currently being updated by KCGCD consultants and may change slightly.

In Kinney County, KCGCD consultants have developed an update to the DFC and MAG calculation given the limitations of the model that was used in 2010 to set the original DFC and MAG.

6.0 High Plains Aquifer System GAM Aquifers

The High Plains Aquifer System Groundwater Availability Model (HPAS) was used in the development of desired future conditions for the Dockum and Ogallala Aquifers.

6.1 Dockum Aquifer

6.1.1 Current Desired Future Conditions

The current desired future condition was developed based on the HPAS that covers the Dockum Aquifer:

- Average drawdown of 52 feet from 2012 to 2070 in Pecos County
- Average drawdown of 14 feet from 2012 to 2070 in Reagan County

The final year of the calibration period in the GAM is 2012, thus, actual groundwater elevation data from late 2012 to early 2013 are needed to complete the comparison. Please note that Technical Memorandum 16-01 and the Explanatory Report for the Dockum and Ogallala Aquifers for GMA 7 use 2012 as the base year for drawdown calculations. Unfortunately, the resolution that was submitted to TWDB lists 2010 as the base year, which is incorrect. The 2010 base year for the Dockum and Ogallala Aquifers is also listed in the TWDB summary for GMA 7 desired future conditions that is available for download from the TWDB website for GMA 7.

The Dockum Aquifer in all other counties in GMA 7 was classified as “not relevant for purposes of joint planning” due to limited areal extent, limited groundwater use, limited impacts across county lines, and no groundwater conservation district.

6.1.2 Baseline Groundwater Elevation Data

Actual groundwater elevation data were downloaded from the TWDB Groundwater Database on July 9, 2025. There were 26 wells in the GMA 7 portion of the Dockum Aquifer that had a groundwater elevation measurement from late 2010 to early 2011 that could be used to establish a baseline. The location of these wells is presented in Figure 9. The wells are also listed in Table 8.

Please note that 14 wells are located in Mitchell County, nine wells are located in Scurry County, two wells are located in Sterling County, and one well is located in Upton County. Thus, all of these wells are located in areas classified as “not relevant for purposes of joint planning”.

No wells are located in Pecos or Reagan counties, for which desired future conditions have been adopted.

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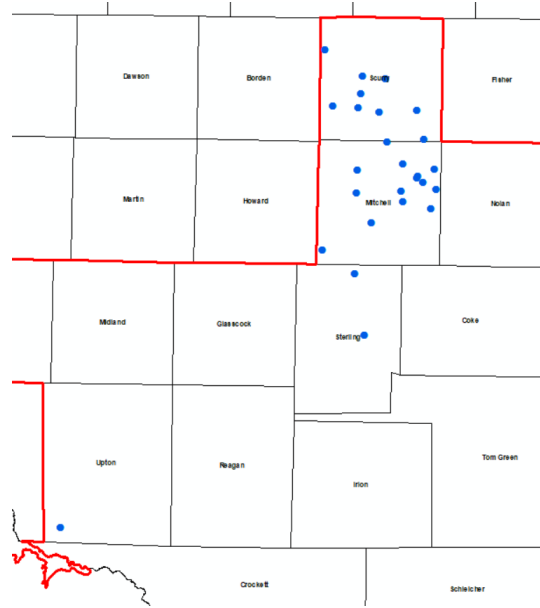


Figure 9. Location of GMA 7 Baseline Wells - Dockum Aquifer

Table 8. GMA 7 Baseline Wells - Dockum Aquifer

Well Number	County	X-Coordinate (ft)	Y-Coordinate (ft)	HPAS Row	HPAS Column	Baseline Groundwater Elevation (ft MSL)
2840602	Mitchell	4609587	20113554	692	372	2,129.99
2848303	Mitchell	4607948	20084100	704	371	2,162.00
2855903	Mitchell	4564356	20009792	732	355	2,283.00
2925901	Mitchell	4647695	20149984	679	386	2,150.35
2934507	Mitchell	4668336	20121472	689	394	2,093.62
2934901	Mitchell	4687987	20105736	695	402	2,158.65
2934931	Mitchell	4686706	20102808	697	401	2,106.00
2935501	Mitchell	4709396	20113920	692	410	2,163.17
2935724	Mitchell	4694524	20097896	698	404	2,134.00
2942208	Mitchell	4665846	20085946	703	393	2,096.26
2942501	Mitchell	4668746	20072760	708	394	2,069.35
2943214	Mitchell	4711574	20088258	702	411	2,203.00
2943801	Mitchell	4704232	20063100	712	408	2,195.90
2949201	Mitchell	4627945	20045204	718	379	2,089.50
2815301	Scurry	4566890	20268798	634	356	2,562.02
2824704	Scurry	4577686	20196800	661	360	2,181.91
2824904	Scurry	4610917	20193626	662	373	2,255.63
2909704	Scurry	4616405	20235094	646	375	2,344.91
2917302	Scurry	4645655	20230932	648	386	2,308.50
2917402	Scurry	4614206	20211774	655	374	2,322.53
2917802	Scurry	4638140	20188004	664	383	2,225.30
2918902	Scurry	4686936	20191034	663	401	2,284.72
2927702	Scurry	4695538	20153058	678	405	2,366.88
2864601	Sterling	4605956	19979408	743	371	2,341.10
4309102	Sterling	4618477	19899394	774	375	2,233.50
4555702	Upton	4224235	19650462	868	226	2,381.88

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6.1.3 Actual and Simulated Drawdown

The Fortran program *ActSimDD.exe* was written to obtain actual and simulated drawdowns. The baseline well locations and baseline groundwater elevations presented above in Table 4 (*Dockum GMA 7 Baseline.csv*) are read along with list of the well numbers for all wells with data after the baseline (*Dockum Post 2012 Well List.dat*).

Post baseline data are then read from *Dockum Post 2012 TWDB Data.csv*. These data are organized in monthly data arrays for each well. These monthly arrays are then used to choose an annual groundwater elevation data for each year after the baseline. The program specified a preference: 1) December, 2) January (of the following year), 3) November, 4) February (of the following year), 5) October, and 6) March (of the following year). In summary, if a December measurement is available, it is used; if March (of the following year) is the only measurement available, it is used.

These annual groundwater elevations are written to *DockumActGWE.dat* are then used in the subsequent comparison with simulated data.

Simulated groundwater elevations for Scenario 17 (the basis for the current desired future conditions in GMA 7) are then read. The simulated starting head data (to establish baseline groundwater elevations) are read in four files by model layer (*ihds1.2012.ref*, *ihds2.2012.ref*, *ihds3.2012.ref*, *ihds4.2012.ref*).

Actual and simulated drawdown from the baseline period for each year is then calculated and the results are written to *Dockum GMA 7 Act Sim DD.dat*. This file was imported into Excel and saved as *Dockum GMA 7 Act Sim DD.xlsx*.

6.1.4 Results

Results of the comparison included:

- A hydrograph comparison of actual and simulated drawdown (Figure 10)
- A histogram of differences in actual and simulated drawdown (Figure 11)
- A graph that compares individual points of actual and simulated drawdown (Figure 12)

On average across the GMA, actual drawdown from 2013 to 2024 has been about -3 feet (a 3 ft increase or recovery) and the simulated drawdown from 2013 to 2024 has been about 3 feet. Because the actual drawdown is less than the simulated drawdown, it can be concluded that the actual data are consistent with the results of the simulation that was the basis for the desired future conditions. As noted above, these conclusions are limited to counties where there is no DFC (i.e. the counties have been classified as “not relevant for purposes of joint planning”). Because there are no available data for the counties with DFCs (Pecos and Reagan), there is limited basis to conclude if the DFC is being achieved.

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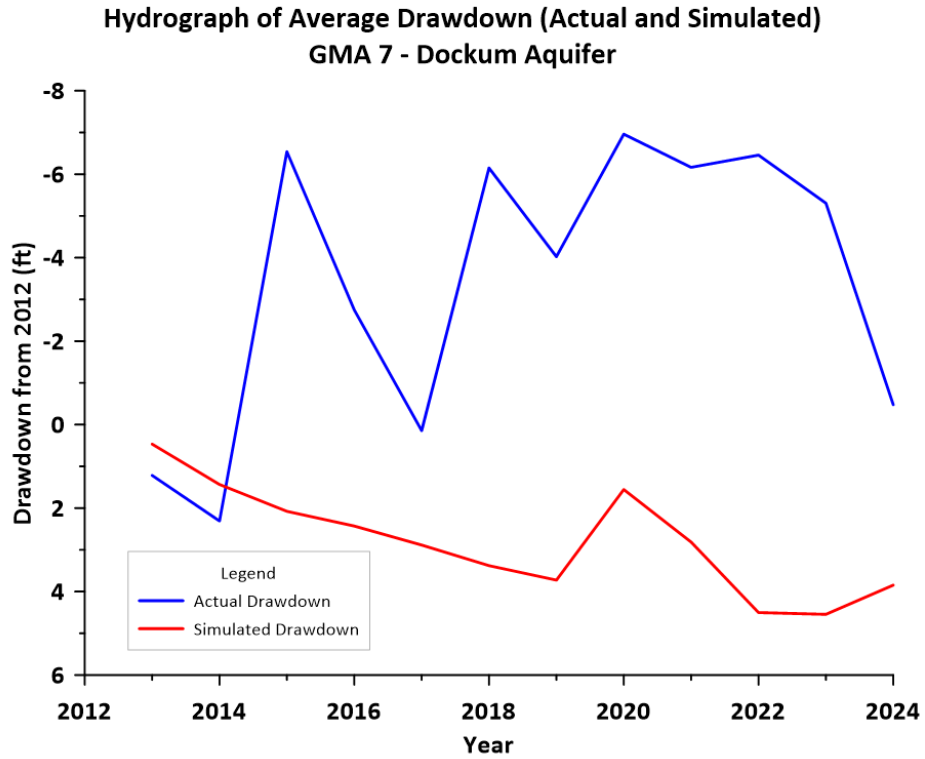


Figure 10. Dockum Aquifer Average Drawdown Comparison

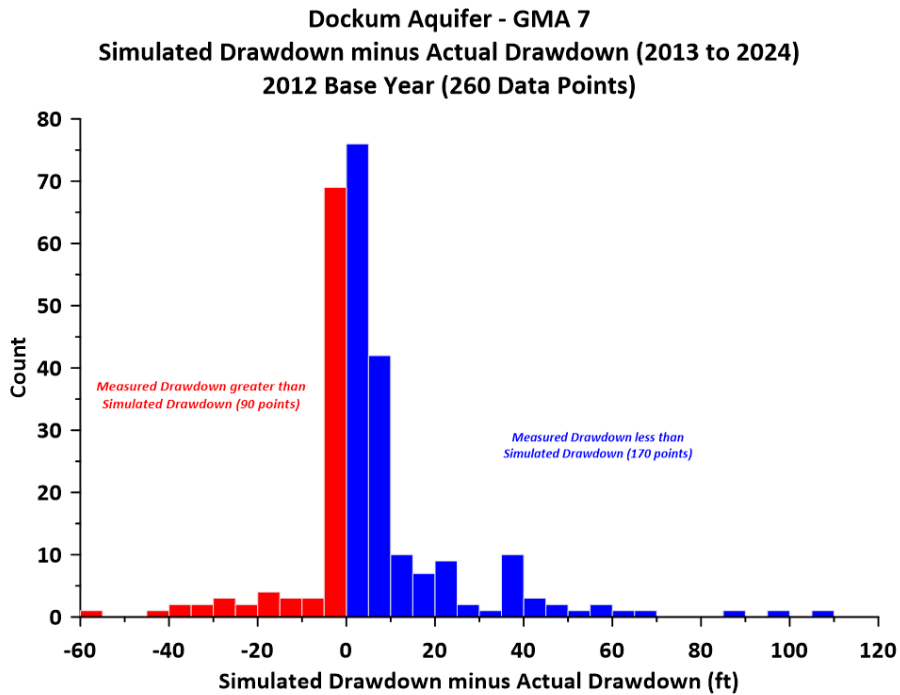


Figure 11. Dockum Aquifer Average Drawdown Differences

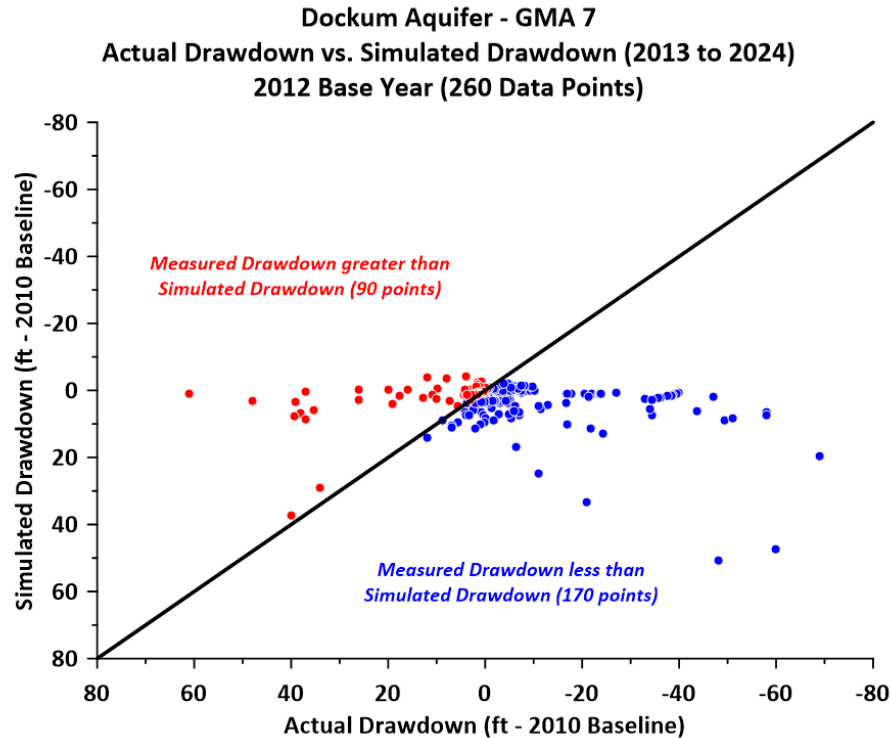


Figure 12. Dockum Aquifer Actual Drawdown vs. Simulated Drawdown

6.1.5 Recommendation

Given the requirements of HB 2078 and the limited data in counties with groundwater conservation districts, it is recommended that the Dockum Aquifer be classified as not relevant for purposes of joint planning since there limited means of tracking progress on achieving the desired future condition. In addition, there is limited groundwater use from this aquifer.

6.2 Ogallala Aquifer

6.2.1 Current Desired Future Conditions

The current desired future condition was developed based on the HPAS that covers the Ogallala Aquifer:

- Average drawdown of 6 feet from 2010 to 2070 in Glasscock

The final year of the calibration period in the GAM is 2010, thus, actual groundwater elevation data from late 2010 to early 2011 are needed to complete the comparison.

The Ogallala Aquifer in all other counties in GMA 7 (Ector and Midland) was classified as “not relevant for purposes of joint planning” due to limited areal extent, limited groundwater use, limited impacts across county lines, and no groundwater conservation district.

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6.2.2 Baseline Groundwater Elevation Data

Actual groundwater elevation data were downloaded from the TWDB Groundwater Database on July 9, 2025. There were 12 wells in the GMA 7 portion of the Ogallala Aquifer that had a groundwater elevation measurement from late 2012 to early 2013 that could be used to establish a baseline. The location of these wells is presented in Figure 13. The wells are also listed in Table 9.

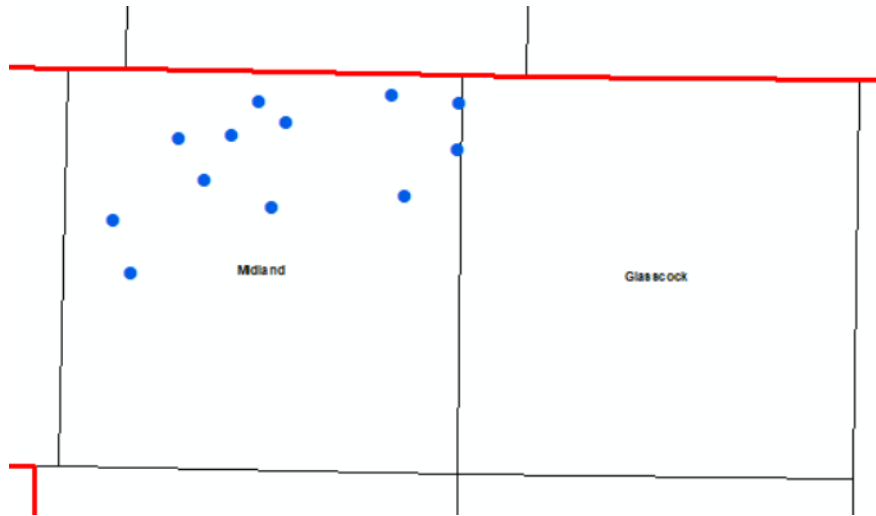


Figure 13. Location of GMA 7 Baseline Wells - Ogallala Aquifer

Table 9. GMA 7 Baseline Wells – Ogallala Aquifer

Well Number	County	X-Coordinate (ft)	Y-Coordinate (ft)	HPAS Row	HPAS Column	Baseline Groundwater Elevation (ft MSL)
2763901	Midland	4259079	19968837	747	239	2,811.70
2764602	Midland	4290694	19984109	742	251	2,743.19
2764802	Midland	4279791	19970700	747	247	2,751.87
2764901	Midland	4301482	19975454	745	255	2,733.93
2858402	Midland	4343973	19986459	741	271	2,635.85
2858601	Midland	4370992	19982987	742	282	2,591.69
2858903	Midland	4370010	19964779	749	281	2,565.68
4402410	Midland	4348987	19946078	756	273	2,609.73
4507421	Midland	4232864	19936263	760	229	2,833.79
4508101	Midland	4269243	19952435	754	243	2,784.61
4508602	Midland	4296192	19941734	758	253	2,688.20
4515201	Midland	4239504	19915468	768	232	2,772.78

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Please note that no wells are located in Glasscock County in which a desired future condition has been established. There are several wells in the TWDB Groundwater Database in Glasscock County, just none with data during the baseline period. All 12 wells are located in Midland County that has been classified as “not relevant for purposes of joint planning”.

6.2.3 Actual and Simulated Drawdown

The Fortran program *ActSimDD.exe* was written to obtain actual and simulated drawdowns. The baseline well locations and baseline groundwater elevations presented above in Table 5 (*Ogallala Base RC.csv*) are read along with list of the well numbers for all wells with data after the baseline (*Ogallala Post 2012 Well List.dat*).

Post baseline data are then read from *Ogallala Post 2012 TWDB Data.csv*. These data are organized in monthly data arrays for each well. These monthly arrays are then used to choose an annual groundwater elevation data for each year after the baseline. The program specified a preference: 1) December, 2) January (of the following year), 3) November, 4) February (of the following year), 5) October, and 6) March (of the following year). In summary, if a December measurement is available, it is used; if March (of the following year) is the only measurement available, it is used.

These annual groundwater elevations are written to *OgallalaActGWE.dat* are then used in the subsequent comparison with simulated data.

Simulated groundwater elevations for Scenario 17 (the basis for the current desired future conditions in GMA 7) are then read. The simulated starting head data (to establish baseline groundwater elevations) are read in four files by model layer (*ihds1.2012.ref*, *ihds2.2012.ref*, *ihds3.2012.ref*, *ihds4.2012.ref*).

Actual and simulated drawdown from the baseline period for each year is then calculated and the results are written to *Ogallala GMA 7 Act Sim DD.dat*. This file was imported into Excel and saved as *Ogallala GMA 7 Act Sim DD.xlsx*.

6.1.4 Results

Results of the comparison included:

- A hydrograph comparison of actual and simulated drawdown (Figure 14)
- A histogram of differences in actual and simulated drawdown (Figure 15)
- A graph that compares individual points of actual and simulated drawdown (Figure 16)

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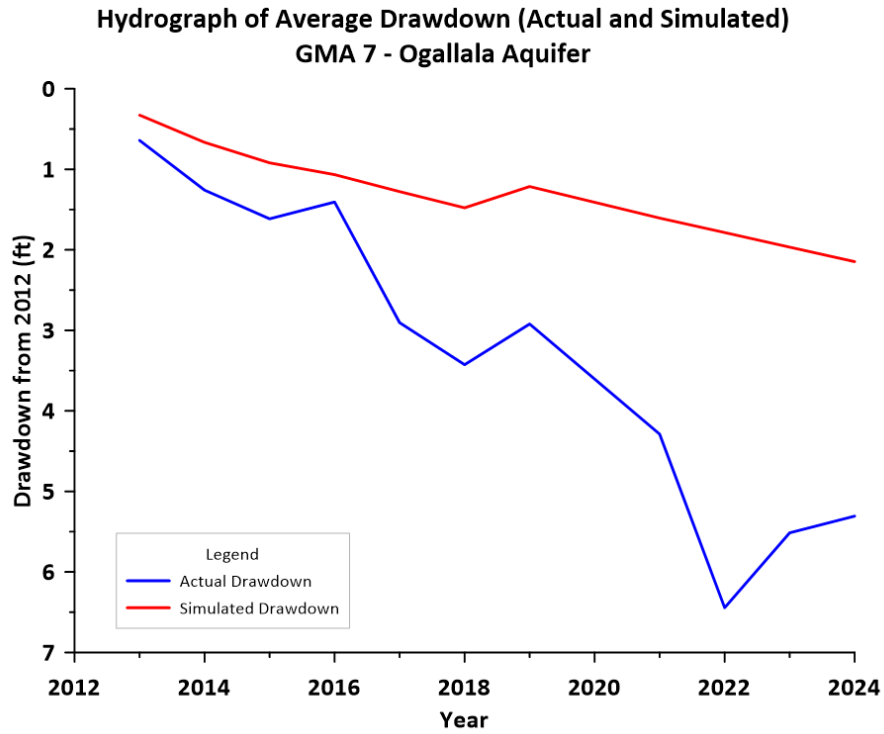


Figure 14. Ogallala Aquifer Average Drawdown Comparison

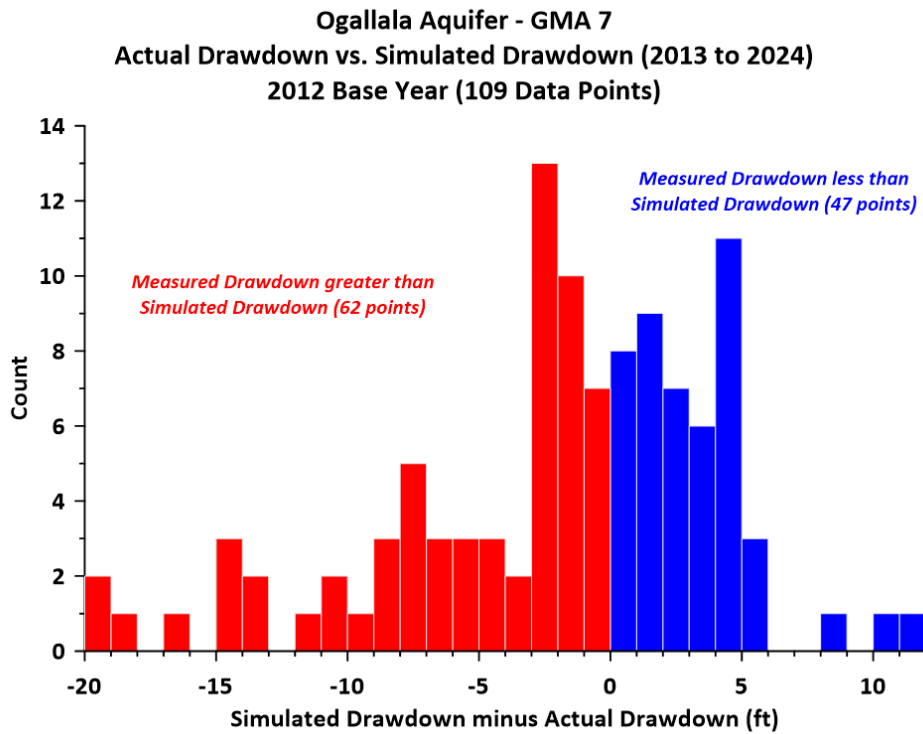


Figure 15. Ogallala Aquifer Average Drawdown Differences

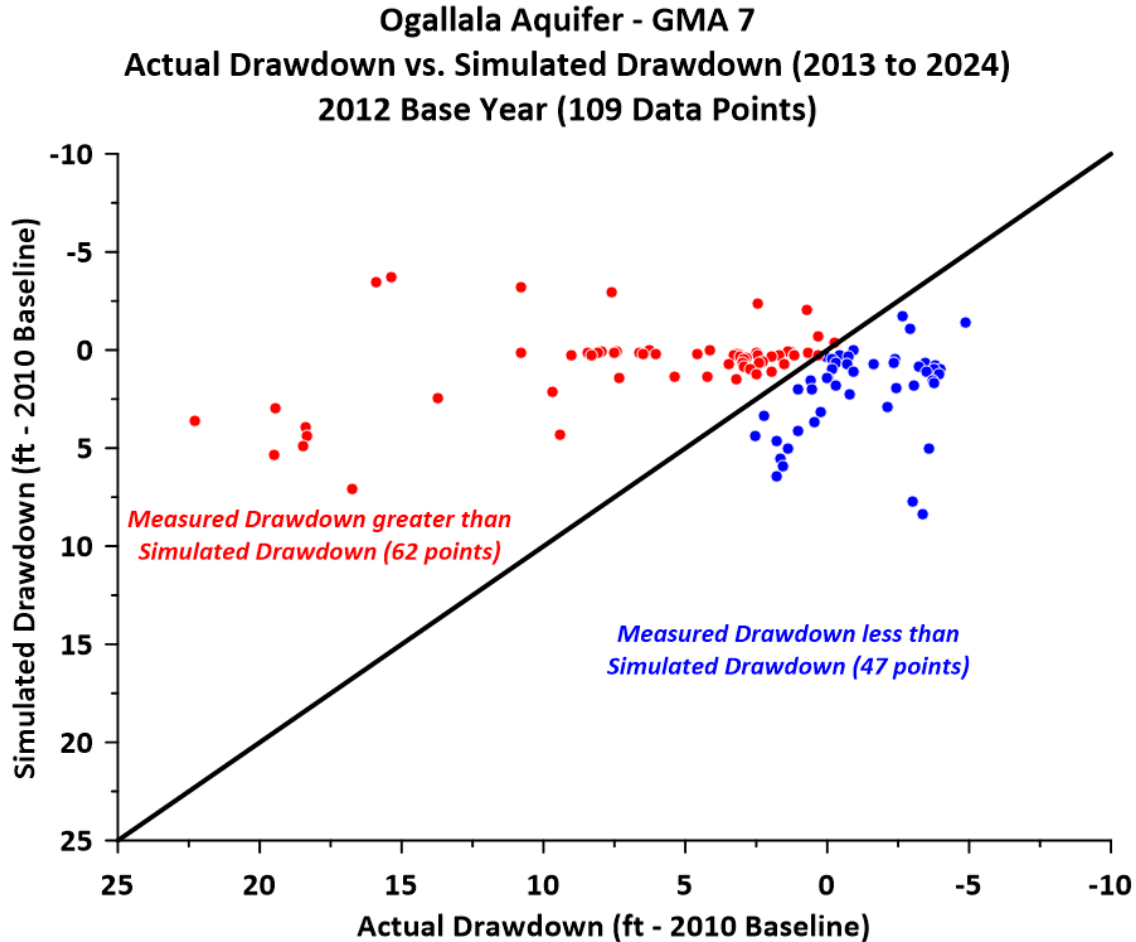


Figure 16. Ogallala Aquifer Actual Drawdown vs. Simulated Drawdown

On average across the GMA, actual drawdown from 2013 to 2024 has been about 3 ft and the simulated drawdown from 2013 to 2024 has been about 1 ft. Because the actual drawdown is within two feet of the simulated drawdown, it can be concluded that the actual data are generally consistent with the results of the simulation that was the basis for the desired future conditions. As noted above, these conclusions are limited to counties where there is no DFC (i.e. the counties have been classified as “not relevant for purposes of joint planning”). Because there are no available data for the county with DFCs (Glasscock), there is limited basis to conclude if the DFC is being achieved.

6.2.5 Recommendation

Given the requirements of HB 2078 and the limited data in the county with a groundwater conservation district, it is recommended that the Ogallala Aquifer be classified as not relevant for purposes of joint planning since there limited means of tracking progress on achieving the desired future condition. In addition, there is no other GCD in GMA 7 with Ogallala wells.

7.0 Llano Uplift System Aquifers

The Llano Uplift GAM was used to develop the desired future conditions in GMA 7 for:

- Marble Falls Aquifer (Layer 3)
- Ellenburger San Saba Aquifer (Layer 5)
- Hickory Aquifer (Layer 7)

Unlike other aquifers in GMA 7 that were evaluated by county, the Llano Uplift Aquifers were evaluated by groundwater conservation district (GCD) because of the unique boundaries of the Hickory UWCD No. 1, which covers all or part of six counties (Figure 17).

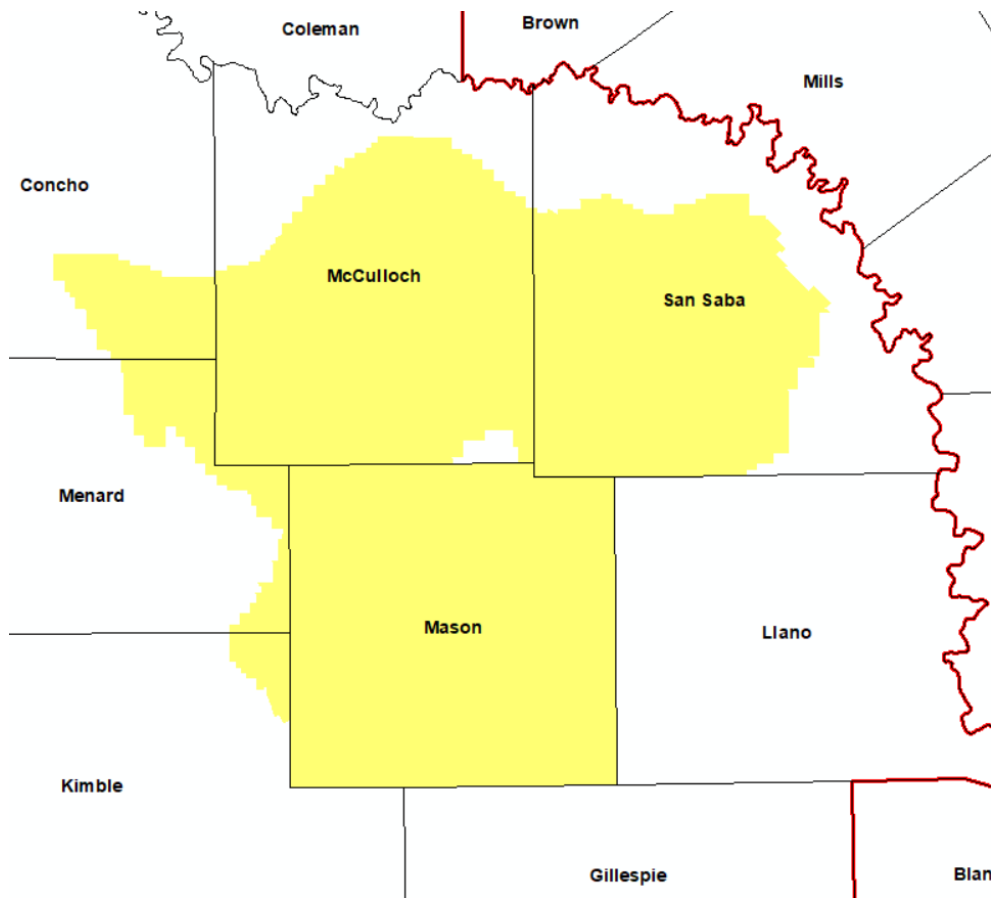


Figure 17. Hickory UWCD No. 1 Boundaries

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7.1 Marble Falls Aquifer

The Marble Falls Aquifer was classified as not relevant for purposes of joint planning in 2016 and 2021 by GMA 7. No comparison was made because there is no desired future condition for this aquifer in GMA 7.

7.2 Ellenburger-San Saba Aquifer

7.2.1 Current Desired Future Conditions

The current desired future condition was developed based on the Llano Uplift GAM that covers the Ellenburger-San Saba Aquifer:

- Average drawdown of 8 feet from 2010 to 2070 in Gillespie County
- Average drawdown of 18 feet from 2010 to 2070 in Kimble County
- Average drawdown of 14 feet from 2010 to 2070 in Mason County
- Average drawdown of 29 feet from 2010 to 2070 in McCulloch County
- Average drawdown of 46 feet from 2010 to 2070 in Menard County
- Average drawdown of 5 feet from 2010 to 2070 in San Saba County

The final year of calibration in the GAM is 2009, thus, the actual groundwater elevation from late 2009 to early 2010 are needed to complete the comparison.

7.2.2 Baseline Groundwater Elevation Data

Actual groundwater elevation data were downloaded from the TWDB Groundwater Database on July 9, 2025. A total of 63 wells were used in the analysis, 60 had actual measurements during the baseline period, and the baseline groundwater elevation for the other 3 wells were interpolated based on data prior to and after the baseline period. Figure 18 presents the locations of these wells.

The Fortran program *PointRC.exe* was written to obtain the model cell associated with each well.

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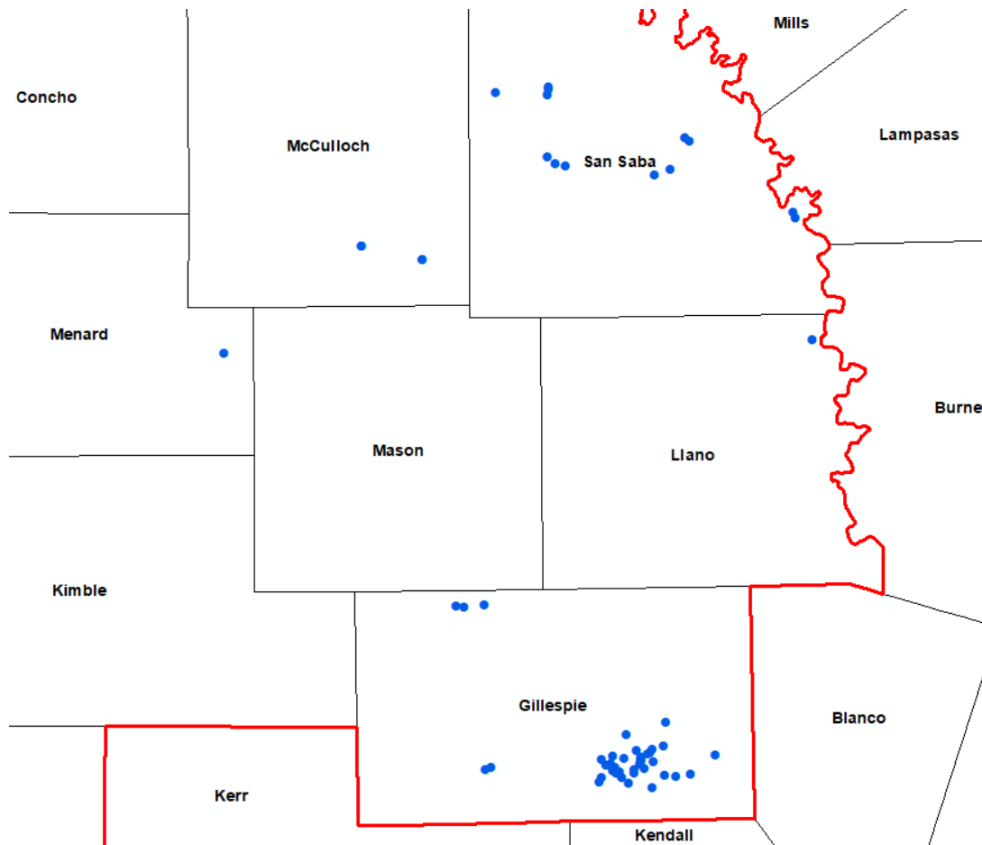


Figure 18. Location of GMA 7 Baseline Wells - Ellenburger-San Saba Aquifer

7.2.3 Actual and Simulated Drawdown

The Fortran program *ActSimDD.exe* was written to obtain actual and simulated drawdown. Output from the file includes results from the Ellenburger-San Saba Aquifer in the output file *Llano GMA 7 Act Sim DD.dat*. These results were imported into an Excel spreadsheet named *LlanoGCDActSimGWE.xlsx*. The tab named *Ellenburger-San Saba* contains the completed analyses organized by GCD.

7.2.4 Results

Results of the comparison included:

- Tabular summary of average measured and simulated drawdown by GCD (Table 10)
- A hydrograph of annual average measured and simulated drawdown (Figure 19)

Please note that the hydrograph also includes data on annual precipitation (expressed as a percentage of long term average). The precipitation data show that the increase in drawdown the last few years is likely due to extended drought conditions and does not affect the conclusion that the DFC is being achieved.

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Table 10. Average Measured and Simulated Drawdown by GCD - Ellenburger-San Saba Aquifer

Groundwater Conservation District (GCD)	Number of Actual Drawdown Measurements	Average Drawdown ft - 2010 Base, 2011 to 2024 Data)		Average Simulated minus Measured (ft)
		Measured	Simulated	
Hickory UWCD No. 1	47	10.72	2.90	-7.82
Hill Country UWCD	429	5.28	2.48	-2.80
Menard UWD	11	10.07	22.86	12.80
No GCD (Llano)	12	2.50	0.00	-2.50
No GCD (San Saba)	22	1.15	-1.82	-2.97

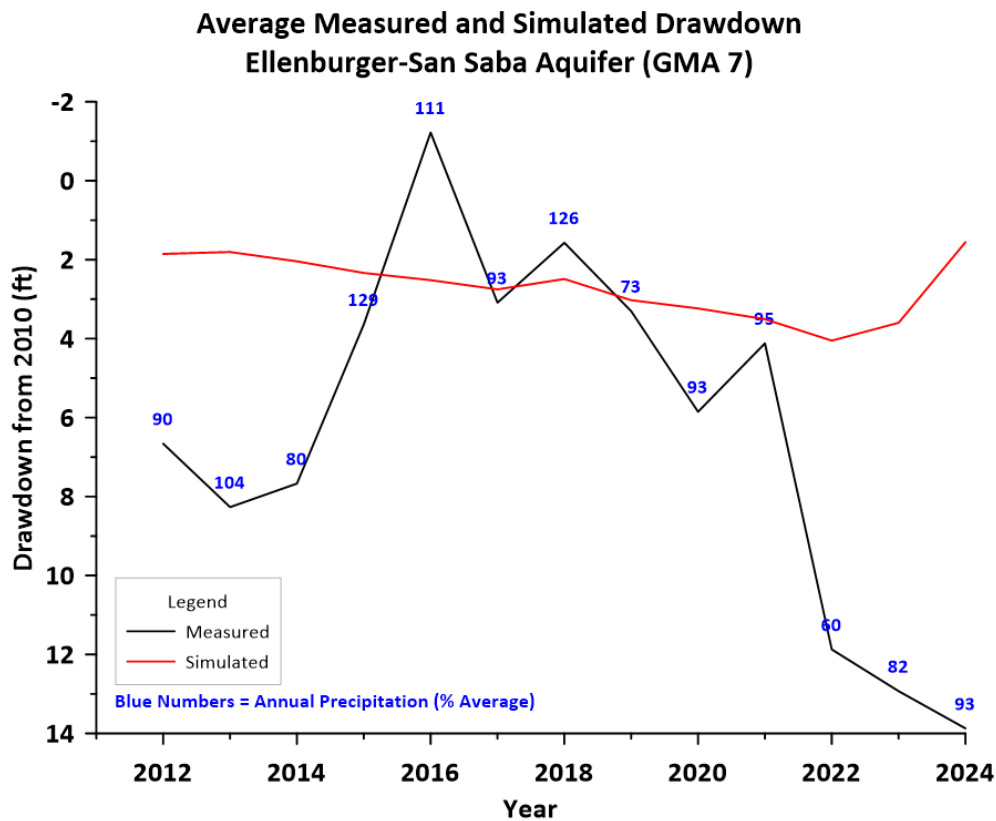


Figure 19. Average Measured and Simulated Drawdown - Ellenburger-San Saba Aquifer

7.2.5 Recommendation

The comparison yielded reasonable comparisons between actual drawdown and simulated drawdown for each GCD. The overall annual comparison included a comparison with annual precipitation which suggests that the recent drought is likely the most reasonable explanation for the increase in actual drawdown the last few years.

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7.3 Hickory Aquifer

7.3.1 Current Desired Future Conditions

The current desired future condition was developed based on the Llano Uplift GAM that covers the Hickory Aquifer:

- Average drawdown of 53 feet from 2010 to 2070 in Concho County
- Average drawdown of 9 feet from 2010 to 2070 in Gillespie County
- Average drawdown of 18 feet from 2010 to 2070 in Kimble County
- Average drawdown of 17 feet from 2010 to 2070 in Mason County
- Average drawdown of 29 feet from 2010 to 2070 in McCulloch County
- Average drawdown of 46 feet from 2010 to 2070 in Menard County
- Average drawdown of 6 feet from 2010 to 2070 in San Saba County

The final year of calibration in the GAM is 2009, thus, the actual groundwater elevation from late 2009 to early 2010 are needed to complete the comparison.

7.3.2 Baseline Groundwater Elevation Data

Actual groundwater elevation data were downloaded from the TWDB Groundwater Database on July 9, 2025. A total of 79 wells with actual measurements during the baseline period were used in the analysis. Figure 20 presents the locations of these wells. Additional groundwater elevation in the Hickory Aquifer from the City of San Angelo were identified but were not made available for this analysis despite numerous requests.

The Fortran program *PointRC.exe* was written to obtain the model cell associated with each well.

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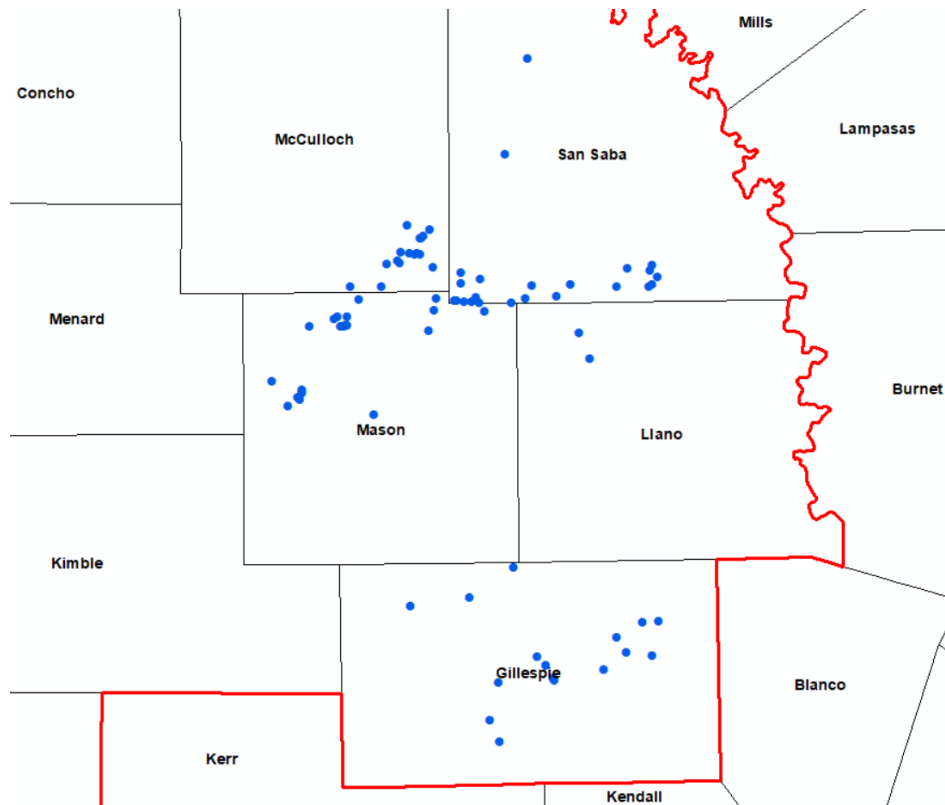


Figure 20. Location of GMA 7 Baseline Wells – Hickory Aquifer

7.3.3 Actual and Simulated Drawdown

The Fortran program *ActSimDD.exe* was written to obtain actual and simulated drawdown. Output from the file includes results from the Hickory Aquifer in the output file *Llano GMA 7 Act Sim DD.dat*. These results were imported into an Excel spreadsheet named *LlanoGCDActSimGWE.xlsx*. The tab named *Hickory* contains the completed analyses organized by GCD.

7.3.4 Results

Results of the comparison included:

- Tabular summary of average measured and simulated drawdown by GCD (Table 11)
- A hydrograph of annual average measured and simulated drawdown (Figure 21)

Please note that the hydrograph also includes data on annual precipitation (expressed as a percentage of long term average). The precipitation data show that the increase in drawdown the last few years is likely due to extended drought conditions and does not affect the conclusion that the DFC is being achieved.

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Table 11. Average Measured and Simulated Drawdown by GCD - Hickory Aquifer

Groundwater Conservation District (GCD)	Number of Actual Drawdown Measurements	Average Drawdown ft - 2010 Base, 2011 to 2024 Data)		Average Simulated minus Measured (ft)
		Measured	Simulated	
Hickory UWCD No. 1	291	4.86	7.55	2.69
Hill Country UWCD	177	0.34	4.54	4.20
Menard UWD	0	NA	NA	NA
No GCD (Llano)	23	3.41	-2.49	-5.91
No GCD (San Saba)	5	2.50	-0.50	-3.00

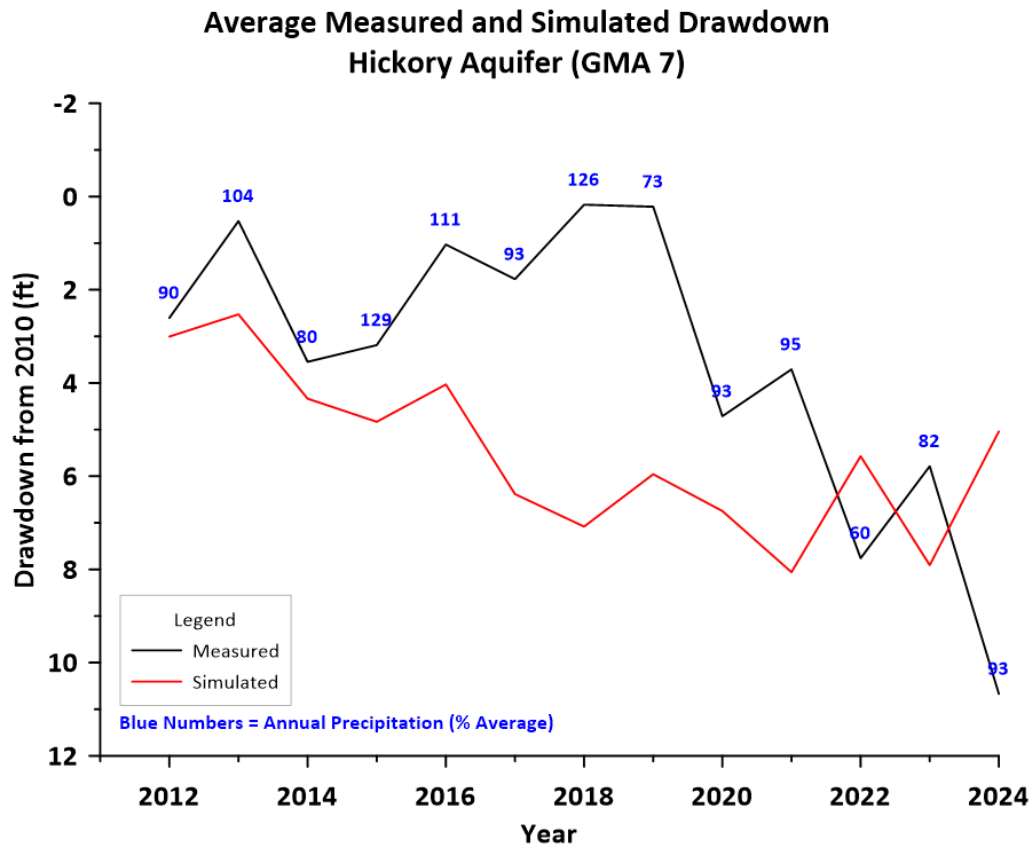


Figure 21. Average Measured and Simulated Drawdown - Hickory Aquifer

7.3.5 Recommendation

The comparison yielded reasonable comparisons between actual drawdown and simulated drawdown for each GCD. The overall annual comparison included a comparison with annual precipitation which suggests that the recent drought is likely the most reasonable explanation for the increase in actual drawdown the last few years.

8.0 Rustler Aquifer

8.1 Current Desired Future Condition

The desired future conditions for the Rustler Aquifer adopted on August 19, 2021 for GMA 7 are as follows:

- Pecos County: Total Net Drawdown not to exceed 94 feet in 2070 as compared with 2009 aquifer levels.

The desired future condition was based on a GAM simulation using the Rustler Aquifer Groundwater Availability Model designated as Scenario 4 as documented in Technical Memorandum 16-02.

7.2 Groundwater Elevation Data

Because the starting point for the drawdown calculations in the GAM simulation is 2009, monitoring wells with a measurement point from late 2009 to early 2010 can be used as a basis for comparison with the simulation results.

The TWDB Groundwater database includes one well in GMA 7 that had a data point from late 2009 to early 2010. The location of the single well with a baseline groundwater elevation (located in the GMA 7 portion of Pecos County) is presented in Figure 22. A closer view of the well location on an aerial photo base is presented in Figure 23. Please note that the well is adjacent to the Leon-Belding area of Pecos County.

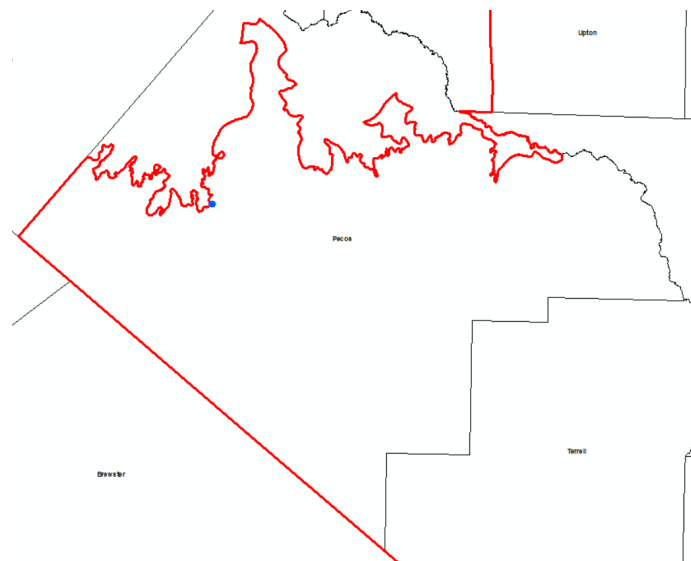


Figure 22. Location of GMA 7 Baseline Well - Rustler Aquifer

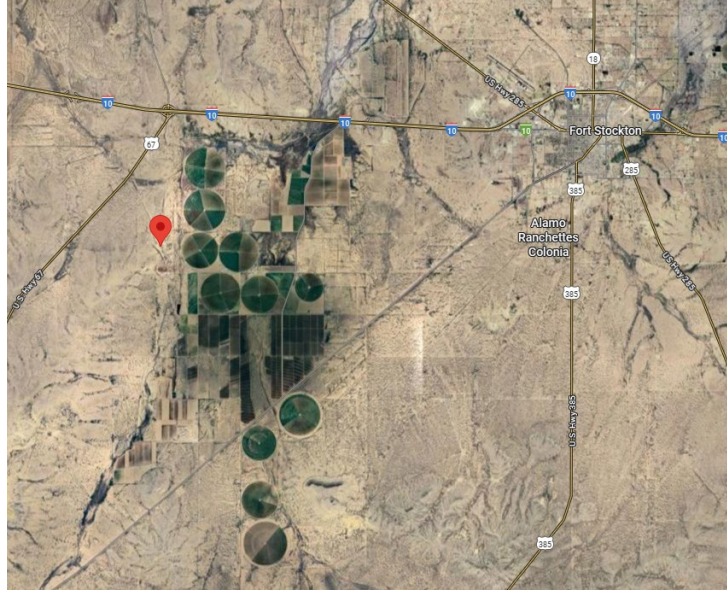


Figure 23. Rustler Aquifer Baseline Well Location Map on Aerial Photo Base

7.3 Results

The data for the well were saved in the file named *Rustler Baseline.csv*. Model row and column assignments for the well were based on TWDB's October 12, 2023 grid file using the Fortran program *PointRC.exe*.

The well number is 52-16-202 and has 149 post-baseline data points from February 2006 to April 2024. These data are presented in hydrograph form in Figure 24.

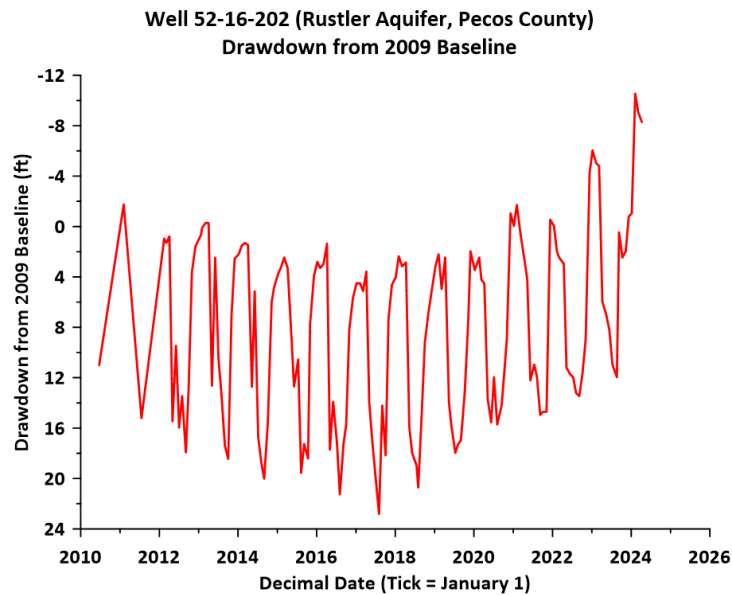


Figure 24. Post Baseline Drawdown of Well 52-16-202 (Rustler Aquifer)

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Please note that Figure 24 includes all data (not just annual/end-of-year data). The hydrograph shows the seasonal nature of groundwater elevation changes in response to irrigation pumping. Groundwater levels decline during the irrigation season (typically March to September) and recover during the non-irrigation season (typically October to February of the following year). Groundwater pumping for irrigation in the Leon-Belding area is from the Rustler Aquifer and from the overlying Edwards-Trinity (Plateau) Aquifer.

The hydrograph has characteristics similar to Edwards-Trinity (Plateau) wells in the Leon Belding area. The response may be from the Rustler wells that pump irrigation water, but it is possible that pumping from the overlying Edwards-Trinity (Plateau) Aquifer may also induce updated flow from the Rustler. A data collection program including a new Rustler Aquifer monitoring well is an ongoing research priority of the Middle Pecos Groundwater Conservation District.

The average monthly drawdown (using end-of-2009 as a baseline) is presented in Figure 25. Please note that as pumping for irrigation begins in the spring, drawdown exceeds 10 feet by May and reaches a maximum of about 17 feet in August. Drawdown then declines through the fall and is about two feet in December.

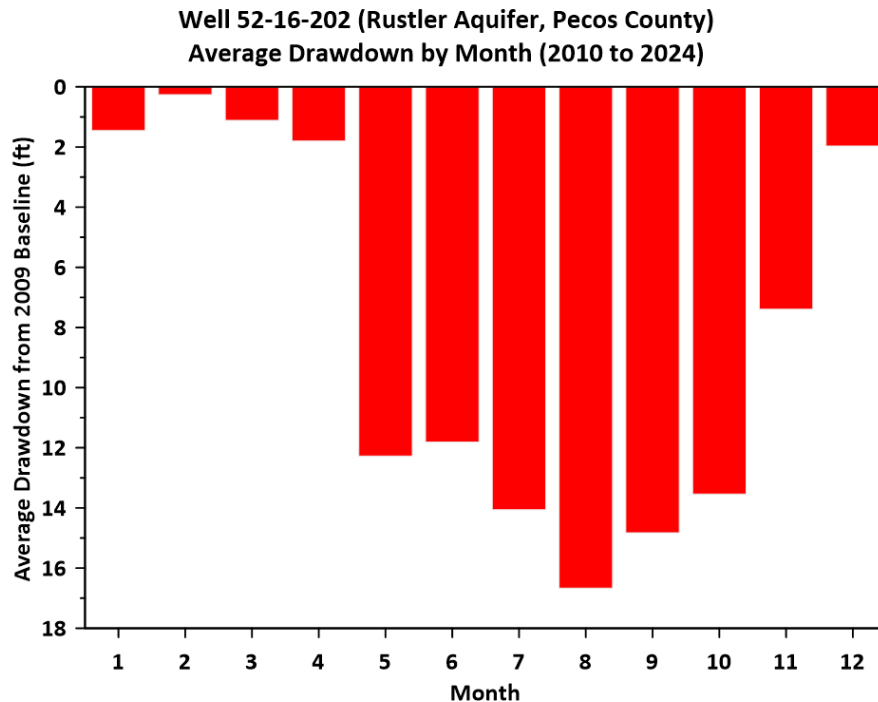


Figure 25. Average Monthly Drawdown in Well 52-16-202 (2009 Baseline)

Figure 26 presents the comparison of the actual drawdown in Well 52-16-202 with the simulated drawdown from the DFC simulation.

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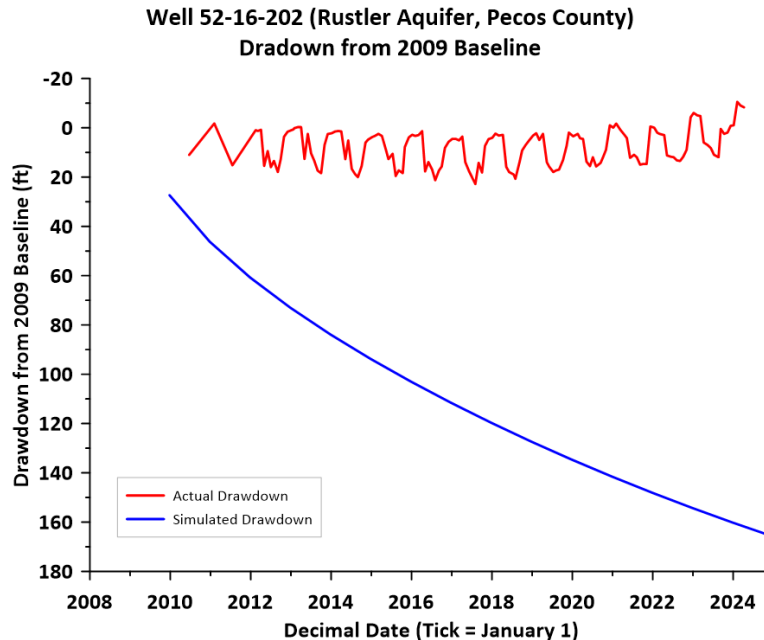


Figure 26. Comparison of Actual and Simulated Drawdown (Well 52-16-202)

Please note that the actual drawdown is less than the simulated drawdown. However, the conclusion has minimal significance because of the severe limitation of the Rustler GAM, which requires the specification of heads in Layer 1 of the model (the layer that overlies the Rustler Aquifer). As documented in the Explanatory Report and associated Technical Memoranda for the Rustler Aquifer, assumptions must be made for predictive simulation regarding head declines in these overlying formations. In the current DFC, an assumption of head decline in the overlying formation was 0.5 ft/yr, which appears to be an overestimate based on the results in Figure 15.

It is possible to update the estimate of overlying head decline in the formations that overlie the Rustler Aquifer and develop a more accurate assessment based on data from 2009 to 2025, the same problems would exist past 2025. The GAM is not a useful tool to make these type of predictive simulations because of the need to make estimates of future head declines.

7.4 Recommendations

Due to severe limitations with the Rustler Aquifer GAM, the lack of monitoring data during the baseline period, and the geographic isolation (i.e. no other GCDs in GMA 7 have a DFC for the Rustler Aquifer), it is recommended that the Rustler Aquifer be classified as not relevant for purposes of joint planning.

If the Rustler Aquifer GAM is updated, either as a stand-alone GAM or combined with the Edwards-Trinity (Plateau) and Pecos Valley GAM, this classification should be reevaluated.