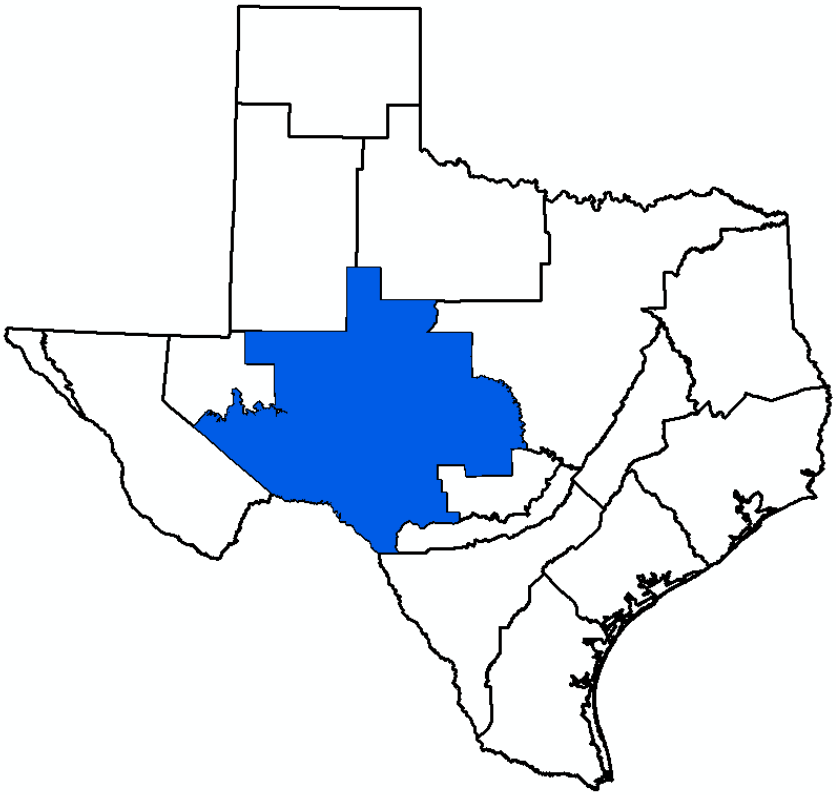
GMA 7 Technical Memorandum 16-03
Draft 1

Capitan Reef Complex Aquifer: Initial Predictive Simulations with Draft GAM



Prepared for:
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GMA 7 Technical Memorandum 16-03 (Final)
Capitan Reef Complex Aquifer: Initial Predictive Simulations with Draft GAM

Geoscientist and Engineering Seal

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1.0 Introduction and Objective

This technical memorandum documents initial simulations using the recently released draft numerical model of the minor aquifers of the eastern arm of the Capitan Reef Complex Aquifer (Jones, 2016).

Because the DFCs that were developed in 2010 were based on analytical water budget methods, these runs are particularly significant in that it is the first time that a numerical evaluation of the relationship between pumping and drawdown can be made.

2.0 Description of Simulations

Simulations were run for 65 years (2006 to 2070). Model files for the scenarios were taken from the calibrated model, and modified for purposes of the simulation. Table 1 summarizes how predictive simulation files were developed.

Table 1. Summary of Input Files for Simulations

File Type	File Name	Changes from Calibrated Model
BAS6	cappred.bas	External ibound arrays and starting head arrays. Now reads external files of starting heads taken from last stress period of calibrated model (2005)
DIS	cappred.dis	Changed number of stress periods to 65
LPF	capitan.lpf	No change
WEL	scenXX.wel	Specific pumping file for each scenario (described below)
DRN	cappred.drn	Changed number of stress periods to 65
RIV	cappred.riv	Changed number of stress periods to 65
GHB	cappred.ghb	Changed number of stress periods to 65
RCH	avgrech.rch	Cell-by-cell average from the calibrated model to achieve "average" recharge for simulation
HFB6	capitan.hfb	No change
OC	capitan.oc	Changed number of stress periods to 65
PCG	capitan.pcg	No change
DATA	shed1.dat	Initial head for Layer 1 (for BAS6 input)
DATA	shed2.dat	Initial head for Layer 2 (for BAS6 input)
DATA	shed3.dat	Initial head for Layer 3 (for BAS6 input)
DATA	shed4.dat	Initial head for Layer 4 (for BAS6 input)
DATA	shed5.dat	Initial head for Layer 5 (for BAS6 input)

A base case was developed using the historic pumping from the calibrated model using the 2005 pumping (last stress period of the calibrated model) to test the stability of the model for predictive simulations. Four predictive scenarios were also completed based on input from Steve finch, hydrogeology consultant to La Escalera Ranch. For the four predictive scenarios, the default was

to use 2005 pumping. In addition, pumping in the GMA 7 portion of Pecos County was added as recommended by Mr. Finch:

- Scenario 1 had 8 wells, pumping 7,560 AF/yr
- Scenario 2 had 15 wells, pumping 15,000 AF/yr
- Scenario 3 had 25 wells, pumping 25,000 AF/yr
- Scenario 4 had 28 wells, pumping 34,500 AF/yr

3.0 Simulation Results

Simulated average drawdown for the five simulations (base case and Scenarios 1 to 4) show the impact of the increased pumping in the GMA 7 portion of Pecos County in Pecos County, and the lack of significant impact in other counties (GMA 3 portion of Pecos County, Ward County and Winkler County). The predicted drawdown for these areas is as follows:

- Figure 1: Pecos County (GMA 3 portion)
- Figure 2: Pecos County (GMA 7 portion)
- Figure 3: Ward County (GMA 3)
- Figure 4: Winkler County (GMA 3)

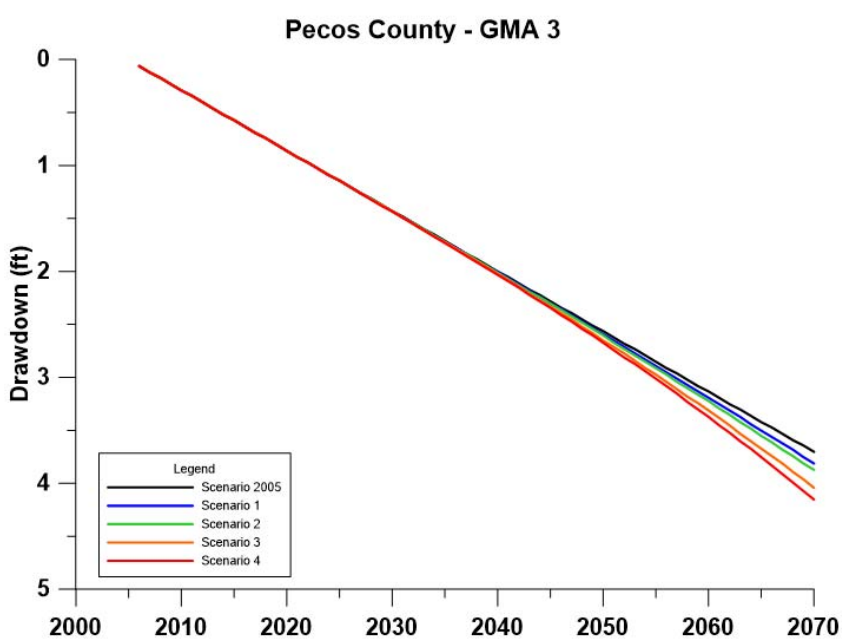

Figure 1. Simulated Drawdown - Pecos County (GMA 3 Portion)

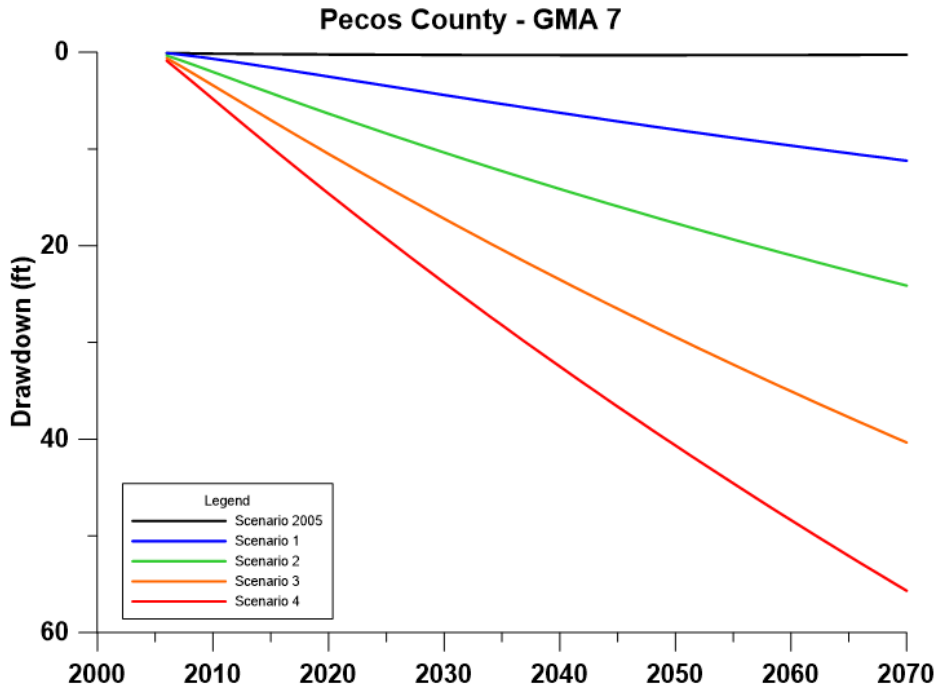

Figure 2. Simulated Drawdown - Pecos County (GMA 7 Portion)

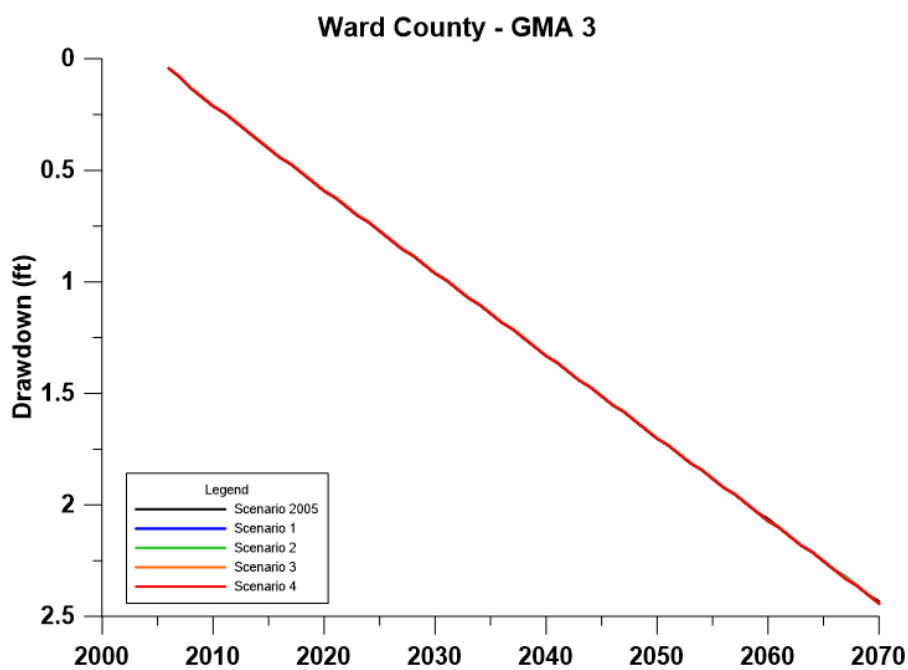

Figure 3. Simulated Drawdown - Ward County (GMA 3)

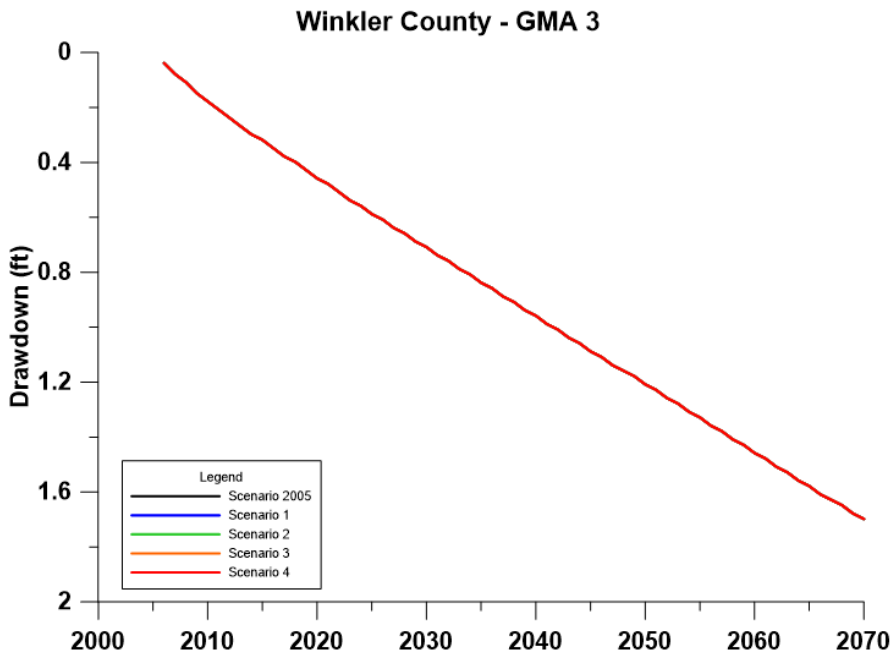

Figure 4. Simulated Drawdown - Winkler County (GMA 3)

These simulated drawdowns are not considered reliable due to issues with the model, but are useful for comparative purposes.

Jones (2016, pp. 164 to 166) reported that lateral inflow to Pecos County during the calibration period was about 17,000 AF/yr in 1931 and increased to 18,268 AF/yr in 2005. Jones (2016) did not subdivide the lateral inflow.

Water budget calculations from the output of the scenarios shows that in Scenario 1 (lowest additional La Escalera Ranch pumping) showed 38,089 AF/yr inflow to the GMA 7 portion of Pecos County from Brewster County in 2006, increasing to 40,024 AF/yr in 2070. Outflow to the GMA 3 portion of Pecos County was 21,524 AF/yr in 2006 and decreased to 16,592 AF/yr in 2070. Thus, the net lateral inflow for the GMA 7 portion of Pecos County was 16,565 AF/yr in 2006 (similar to Jones' 2005 values) and was 23,432 AF/yr in 2070.

There is some question as to the large amount of inflow from Brewster County and the effect of this inflow can be seen in plots of pumping vs. drawdown in 2070 for individual cells in the GMA 7 portion of Pecos County. Figure 5 shows all of the GMA 7 portion of Pecos County and Figure 6 is limited to the outcrop area of the GMA 7 portion of Pecos County.

Please note that there are several cells with "negative" drawdown, even in areas where pumping occurs. The model is simulating a groundwater level increase from 2006 to 2070 that appears to be caused by some boundary condition that results in increased flow.

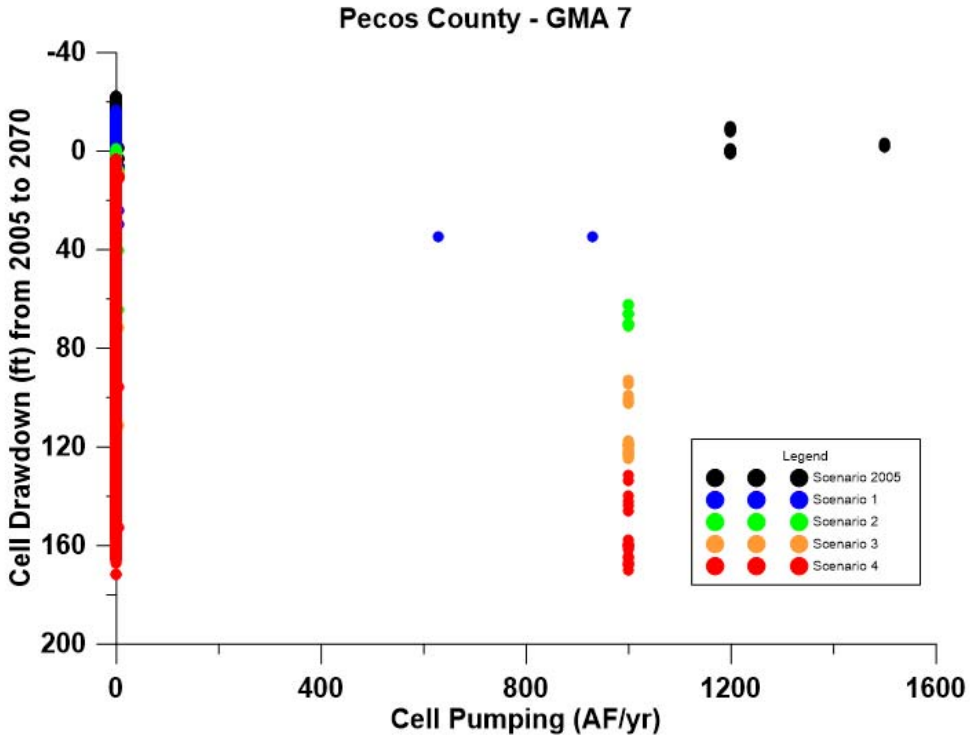

Figure 5. Cell Pumping vs. Cell Drawdown in 2070 (GMA 7 Portion of Pecos County)

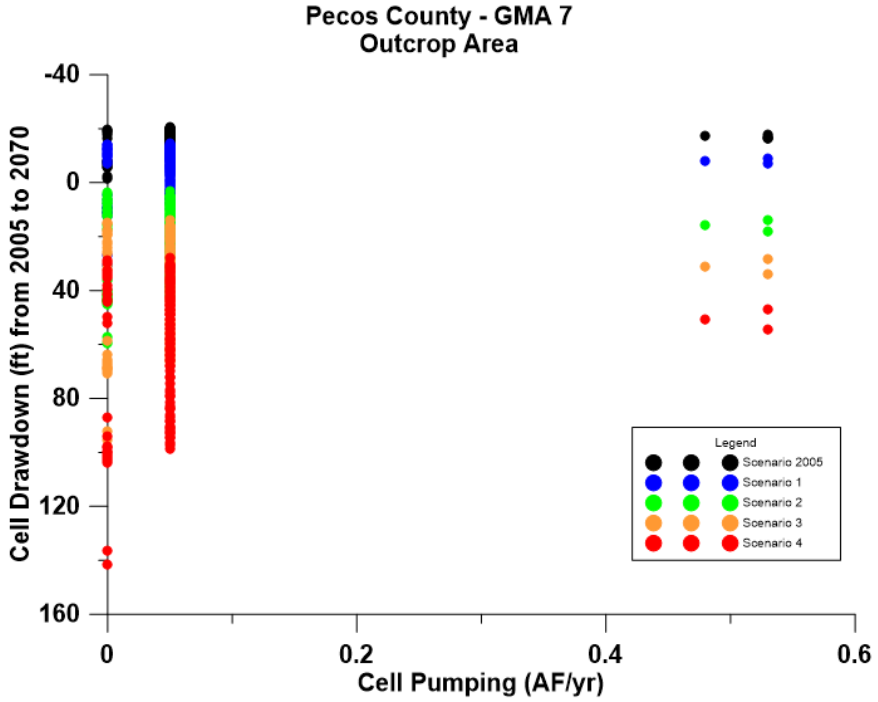

Figure 6. Cell Pumping vs. Cell Drawdown in 2070 (Outcrop Area of GMA 7 Portion of Pecos County)

Table 2 summarizes the average drawdown in feet between 2006 and 2070. These values are not particularly reliable given the issues with the model. However, for purposes of meeting the requirements of the Texas Water Development Board in linking DFCs with MAGs, they are superior to the Aquifer Analysis approach taken in 2010. It is recommended that these values be updated if and when the GAM is improved.

Table 2. Summary of Average Drawdown Results (ft, 2006 to 2070)

County	Scenario 2005	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Pecos (GMA 3)	4	4	4	4	4
Pecos (GMA 7)	0	11	24	40	56
Ward	2	2	2	2	2
Winkler	2	2	2	2	2

It is also recommended that these values not be relied upon in the evaluation of any permit applications. Essentially, the simulations with the draft GAM have shown that the GAM cannot be considered reliable in the context of permit review. An alternative tool should be developed as part of any permit application and/or review process.

4.0 References

Jones, Ian C., 2016. Groundwater Availability Model: Eastern Arm of the Capitan Reef Complex Aquifer of Texas. Texas Water Development Board, March 2016. 488p.