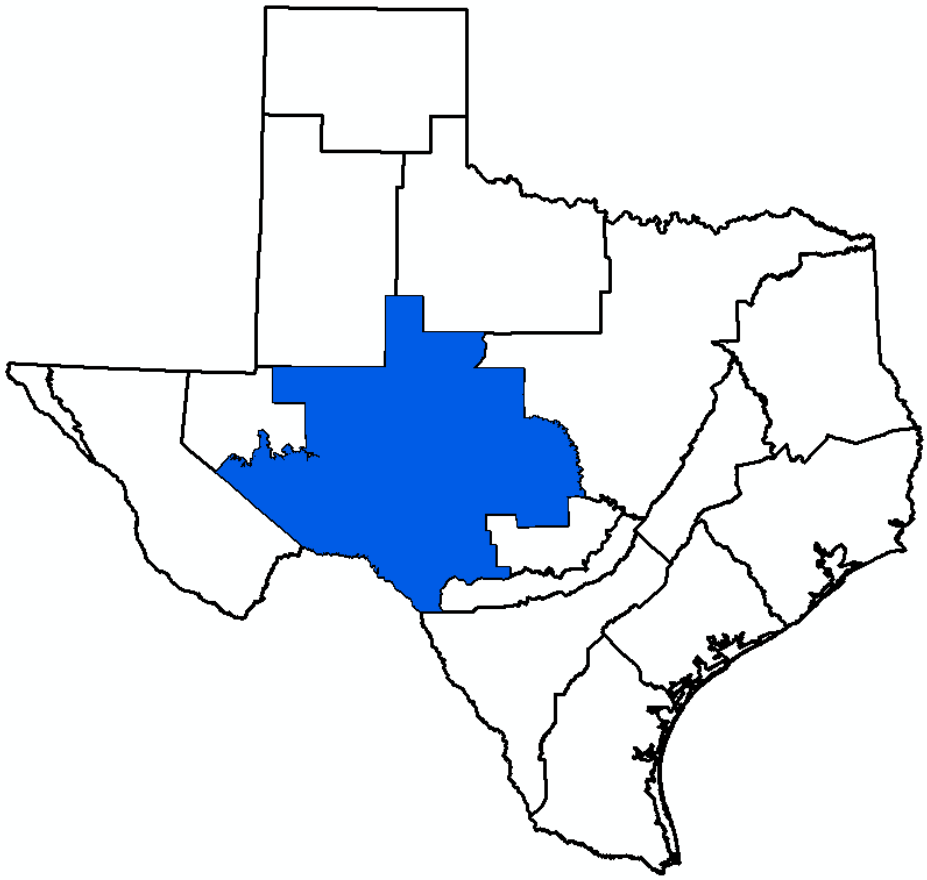
GMA 7 Technical Memorandum 26-03 (Draft 1)

Documentation of Scenarios 26.1, 26.2, and 26.3 Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers with Updated Alternative GAM



Prepared for:
Groundwater Management Area 7

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Draft Report for Review – To be Stamped when Finalized

1.0 Introduction

On August 19, 2021, the groundwater conservation districts in Groundwater Management Area 7 adopted desired future conditions (DFCs) for the Edwards-Trinity (Plateau), Pecos Valley, and Trinity aquifers based on a simulation with the Alternative Groundwater Availability Model (GAM), also known as the One Layer Model. The adoption of the desired future condition is documented in Hutchison (2021). The GAM simulation that was the basis for the DFCs was Scenario 2 of Hutchison (2018a and 2018b)

The time period of the simulation that was the basis for the DFC was 2011 to 2070. During the current round of joint planning, TWDB is requiring a planning period through the year 2080. Consequently, Scenario 2 from Hutchison (2018a and 2018b) needs to be extended 10 years.

In addition, in order to correct an issue in GMA 3, the Alternative GAM has been updated (Hutchison 2026). Finally, representatives from Plateau UWC and Supply District in Schleicher County requested simulations with two alternative pumping totals.

Consequently, this technical memorandum documents an updated Scenario 2 from Hutchison (2018a and 2018b) that extends the simulation an additional 10 years (through 2080) and provides decadal output of drawdown to comply with HB 2078 requirements. This simulation was named Scenario 26.1. Scenarios 26.2 and 26.3 were also completed in response to the request of Plateau UWC and Supply District.

Please note that the simulations cover both GMA 3 and GMA 7. Results for GMA 7 are included in the Technical Memorandum. Results for GMA 3 are included in GMA 3 Technical Memorandum 26-01.

All files associated with this technical memorandum (GMA 3 and GMA 7) can be accessed in a Google Drive folder:

https://drive.google.com/drive/folders/1BejBNcUGY0eav2R84R11_C5we6yl6GzW?usp=sharing

2.0 Updated Simulations

2.1 Simulation Files

Scenario 26.1 uses the same input files as Scenario 2 documented in Hutchison (2018a and 2018b) but using the updated version of the Alternative GAM (Hutchison 2026a). The simulation period has also been extended 10 years (to 2080).

Table 1 summarizes the input files that were used in Scenario 26.1 but were also used in Scenarios 26.2 and 26.3.

Table 1. Simulation Input Files (Unmodified from Scenario 3)

MODFLOW Package	Unit Number	File Name	Desciption
BAS6	1	pred.bas	Basic Input
DIS	29	pred.dis	Discretization
LPF	11	etppv4.lpf	Aquifer Parameters Control
DRN	13	etppv4.drn	Drain (Springs)
RIV	14	etppv4.riv	River
GHB	17	etppv4.ghb	General Head Boundary
RCH	18	pred.rch	Recharge
OC	22	etppv4.oc	Output Control
GMG	19	etppv4.gmg	Solver
DATA	71	top.dat	Cell Top Elevations
DATA	72	bot.dat	Cell Bottom Elevations
DATA	60	ib.dat	Active/Non Active Cells
DATA	61	hcx2.dat	Hydraulic Conductivity
DATA	62	anis.dat	Horizontal Anisotropy
DATA	63	hcz.dat	Vertical Hydraulic Condutivity
DATA	64	ss.dat	Specific Storage
DATA	32	predshed2.dat	Initial Heads

Pumping (WEL) files for each scenario are as follows:

- Scenario 26.1: Scen26.1.wel
- Scenario 26.2: Scen26.2.wel
- Scenario 26.3: Scen26.3.wel

All pumping in Scenarios 26.2 and 26.3 are the same as Scenario 26.1, except for Schleicher County as follows:

- Scenario 26.1 = 8,034 AF/yr
- Scenario 26.2 = 15,639 AF/yr
- Scenario 26.3 = 17,344 AF/yr

Table 2 summarizes the output files.

Table 2. Simulation Output Files

MODFLOW Package	Unit Number	Desciption	Scenario File Names		
			Scen 26.1	Scen 26.2	Scen 26.3
GLOBAL	6	Global Output	pred26.1.glo	pred26.2.glo	pred26.3.glo
LIST	7	Standard Output	pred26.1.lst	pred26.2.lst	pred26.3.lst
DATA(BINARY)	50	Cell-by cell flows	pred26.1.cbb	pred26.2.cbb	pred26.3.cbb
DATA(BINARY)	30	Heads	pred26.1.hds	pred26.2.hds	pred26.3.hds
DATA(BINARY)	31	Drawdown	pred26.1.ddn	pred26.2.ddn	pred26.3.ddn

2.2 Post-Processing of Model Output

The Fortran program *CellCount.exe* was written to obtain cell counts by county (for averaging drawdown) and for use in summing pumping by county. This program used the current version of the model grid file was used (updated in 2015). This file was downloaded from the TWDB website. To facilitate reading of the grid file, it was edited for use in these programs by eliminating some of the columns that were not pertinent for these analyses *(2015_grid_r2.csv*). The program:

- Reads the grid file
- Reads a list of county names and codes
- Counts cells in GMA 3 and GMA 7
- Writes cell counts in two separate files (one for GMA 3 and one for GMA 7)

Output from the simulation was processed with two Fortran programs. The groundwater elevation data was processed and drawdowns were calculated with the program *getheds.exe*. Output pumping was processed with the program *getpump.exe.*

The drawdown postprocessor:

- Reads the simulation heads
- Calculates drawdown in each cell using 2010 as the baseline year
- Reads the grid file
- Reads the GMA 3 county codes and cell totals from *CellCount.exe*
- Reads the GMA 7 county codes and cell totals from *CellCount.exe*
- Sums drawdown by county
- Calculates average drawdown (summed drawdown divided by cell count)
- Writes decadal average drawdown by county in two files (one for GMA 3 and one for GMA 7)

The pumping postprocessor:

- Reads the grid file
- Reads the GMA 3 county codes from *CellCount.exe*

- Reads the GMA 7 county codes from *CellCount.exe*
- Reads the simulation cell-by-cell flow output file
- Sums pumping for GMA 3 counties and GMA 7 counties
- Writes decadal pumping totals by county in two files (one for GMA 3 and one for GMA 7)

3.0 Drawdown Results

3.1 Scenario 26.1

Scenario 26.1 decadal drawdowns from 2030 to 2080 for the are presented in Table 3. The current DFC (drawdown from 2010 to 2070) is also included for comparison purposes.

Table 3. Decadal Drawdown – Scenario 26.1

Scenario 26.1

County	Current DFC (ft in 2010 to 2070, adopted in 2021)	Average Drawdown (ft - 2010 to Year Listed)					
		2030	2040	2050	2060	2070	2080
Coke	0	0	0	0	0	0	0
Crockett	10	8	9	10	10	11	11
Ector	4	1	2	3	4	5	5
Edwards	2	1	2	2	2	2	2
Gillespie	5	4	4	5	5	5	6
Glasscock	42	16	23	29	36	42	48
Irion	10	8	9	10	10	11	12
Kimble	1	1	1	1	1	1	1
Menard	1	1	1	1	1	1	1
Midland	12	4	6	8	11	13	15
Pecos	14	6	8	10	12	14	16
Reagan	42	22	28	33	37	41	45
Real	4	2	3	3	4	4	4
Schleicher	8	7	8	8	8	9	9
Sterling	7	3	4	5	6	7	8
Sutton	6	5	6	6	7	7	7
Taylor	0	0	0	0	0	0	0
Terrell	2	2	2	2	3	3	3
Upton	20	9	12	15	18	21	23
Uvalde	2	1	2	2	2	2	2

Please recall that Scenario 26.1 is the same as the simulation that was the basis for the 2021 DFC, but with an updated model and with the simulation time extended to 2080.

3.2 Scenario 26.2

Scenario 26.2 decadal drawdowns from 2030 to 2080 for the are presented in Table 4. The current DFC (drawdown from 2010 to 2070) is also included for comparison purposes.

Table 4. Decadal Drawdown – Scenario 26.2

Scenario 26.2

County	Current DFC (ft in 2010 to 2070, adopted in 2021)	Average Drawdown (ft - 2010 to Year Listed)					
		2030	2040	2050	2060	2070	2080
Coke	0	0	0	0	0	0	0
Crockett	10	10	11	12	12	13	13
Ector	4	1	2	3	4	5	5
Edwards	2	2	2	2	2	2	2
Gillespie	5	4	4	5	5	5	6
Glasscock	42	16	23	29	36	42	48
Irion	10	9	10	11	12	13	14
Kimble	1	1	1	1	1	1	1
Menard	1	1	1	1	1	1	1
Midland	12	4	6	8	11	13	15
Pecos	14	6	8	10	12	14	16
Reagan	42	23	29	34	39	43	47
Real	4	2	3	4	4	4	4
Schleicher	8	10	11	11	11	12	12
Sterling	7	3	4	5	6	7	8
Sutton	6	8	8	9	9	9	9
Taylor	0	0	0	0	0	0	0
Terrell	2	2	2	2	3	3	3
Upton	20	9	12	15	18	21	24
Uvalde	2	1	2	2	2	2	2

Please recall that Scenario 26.2 is the same as Scenario 26.1 except for pumping in Schleicher County (increased from about 8,000 AF/yr to about 15,600 AF/yr), but with an updated model and with the simulation time extended to 2080.

3.3 Scenario 26.3

Scenario 26.3 decadal drawdowns from 2030 to 2080 for the are presented in Table 5. The current DFC (drawdown from 2010 to 2070) is also included for comparison purposes.

Table 5. Decadal Drawdown – Scenario 26.3

Scenario 26.3

County	Current DFC (ft in 2010 to 2070, adopted in 2021)	Average Drawdown (ft - 2010 to Year Listed)					
		2030	2040	2050	2060	2070	2080
Coke	0	0	0	0	0	0	0
Crockett	10	10	11	12	13	13	14
Ector	4	1	2	3	4	5	5
Edwards	2	2	2	2	2	2	2
Gillespie	5	4	4	5	5	5	6
Glasscock	42	16	23	29	36	42	48
Irion	10	9	11	12	13	13	14
Kimble	1	1	1	1	1	1	1
Menard	1	1	1	1	1	1	1
Midland	12	4	6	8	11	13	15
Pecos	14	6	8	10	12	14	16
Reagan	42	24	29	34	39	43	47
Real	4	2	3	4	4	4	4
Schleicher	8	10	11	12	12	13	13
Sterling	7	3	4	5	6	7	8
Sutton	6	8	9	9	10	10	10
Taylor	0	0	0	0	0	0	0
Terrell	2	2	2	2	3	3	3
Upton	20	9	13	16	18	21	24
Uvalde	2	1	2	2	2	2	2

Please recall that Scenario 26.3 is the same as Scenario 26.1 except for pumping in Schleicher County (increased from about 8,000 AF/yr to about 17,300 AF/yr), but with an updated model and with the simulation time extended to 2080.

3.4 Drawdown Comparison

Table 6 presents a comparison of the drawdown from 2010 to 2080 for all three scenarios. The current DFC (drawdown from 2010 to 2070) is also included for comparison purposes.

Table 6. Comparison of Drawdowns from 2010 to 2080

County	Current DFC (ft in 2010 to 2070, adopted in 2021)	Average Drawdown 2010 to 2080 (ft)		
		Scenario 26.1	Scenario 26.2	Scenario 26.3
Coke	0	0	0	0
Crockett	10	11	13	14
Ector	4	5	5	5
Edwards	2	2	2	2
Gillespie	5	6	6	6
Glasscock	42	48	48	48
Irion	10	12	14	14
Kimble	1	1	1	1
Menard	1	1	1	1
Midland	12	15	15	15
Pecos	14	16	16	16
Reagan	42	45	47	47
Real	4	4	4	4
Schleicher	8	9	12	13
Sterling	7	8	8	8
Sutton	6	7	9	10
Taylor	0	0	0	0
Terrell	2	3	3	3
Upton	20	23	24	24
Uvalde	2	2	2	2

The comparison shows that, as pumping in Schleicher County increases, drawdown increases slightly not only in Schleicher County, but in Crockett, Irion, Reagan, Sutton, and Upton counties. None of these increases appear to be significant.

4.0 Pumping Results

The modeled available groundwater (MAG) is the average pumping to achieve the DFC based on the GAM simulation and is calculated by TWDB. The pumping values presented in this technical memorandum are included to provide an initial estimate of the MAGs. Small differences between these values and the MAGs are generally due to differences in calculation methods. This technical memorandum provides documentation for use by TWDB in calculating the MAG, if they choose to adopt this method.

Decadal pumping values from 2030 to 2080 do not change by decade (i.e. pumping remains constant for all years in each county). A comparison of the pumping in 2080 for each scenarios is presented in Table 7. The current MAG for 2070 is also included for comparison purposes.

Table 7. Comparison of Pumping

County	Current MAG (AF/yr in 2070, adopted in 2021)	Pumping in 2080 (AF/yr)		
		Scenario 26.1	Scenario 26.2	Scenario 26.3
Coke	997	997	997	997
Crockett	5,447	5,447	5,447	5,447
Ector	5,542	5,542	5,542	5,542
Edwards	5,676	5,676	5,676	5,676
Gillespie	4,979	4,979	4,979	4,979
Glasscock	65,186	65,186	65,186	65,186
Irion	3,289	3,289	3,289	3,289
Kimble	1,386	1,387	1,387	1,387
Menard	2,597	2,597	2,597	2,597
Midland	23,233	23,232	23,232	23,232
Pecos	117,309	117,309	117,309	117,309
Reagan	68,233	68,233	68,233	68,233
Real	7,523	7,524	7,524	7,524
Schleicher	8,034	8,034	15,639	17,344
Sterling	2,495	2,495	2,495	2,495
Sutton	6,410	6,411	6,411	6,411
Taylor	489	489	489	489
Terrell	1,420	1,420	1,420	1,420
Upton	22,369	22,369	22,369	22,369
Uvalde	1,993	1,993	1,993	1,993

As noted above, Scenarios 26.2 and 26.3 represent alternative increases in pumping in Schleicher County only as compared to Scenario 26.1, which is a simulation of the current MAGs with the updated Alternative GAM. Pumping in all other counties in Scenarios 26.2 and 26.3 is the same as Scenario 26.1.

5.0 References

Hutchison, W.R., 2018a. Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers: Nine Factor Documentation and Predictive Simulations. GMA 7 Technical Memorandum 15-06. March 26, 2018, 61p.

Hutchison, W.R., 2018b. Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers: Update of Average Drawdown Calculation. GMA 7 Technical Memorandum 18-01. March 26, 2018, 11p.

Hutchison, W.R., 2021. GMA 7 Explanatory Report: Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers. Prepared for Groundwater Management Area 7, August 28, 2021. 177p.

Hutchison, W.R., 2026. Documentation for Update of Alternative Groundwater Availability Model of Edwards-Trinity (Plateau) and Pecos Valley Aquifers. Prepared for Groundwater Management Area 3 and Groundwater Management Area 7, April 16, 2026, 19p.