GAM Task 10-024: Model Report

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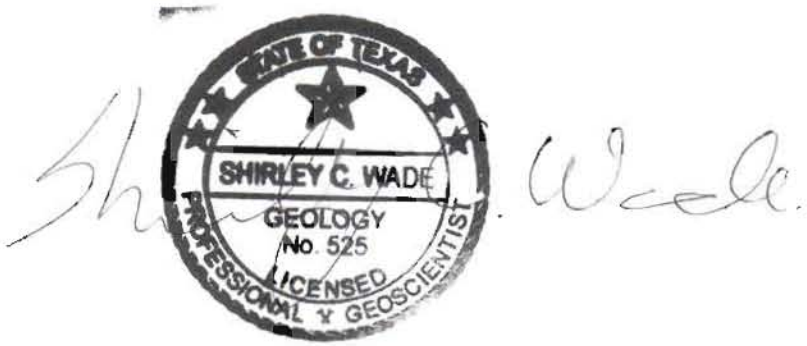
July 16, 2010



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EXECUTIVE SUMMARY:

Starting with a well file provided by Groundwater Management Area 12, pumping was adjusted to try to match adopted desired future conditions adopted on May 26, 2010. An exact match to the desired future conditions (Table 1) could not be achieved because pumping in one area affects drawdown in the same area and in adjoining areas. Two best fit scenarios were determined: (1) average drawdowns do not exceed the desired future conditions by more than 1 foot (Run 33) and (2) average drawdowns are within 5 feet of the desired future conditions (Run 34). In comparison to the submitted pumping file, Run 33 results in an overall increase in pumping of about 5,000 acre-feet per year and Run 34 results in an overall increase in pumping of about 9,000 acre-feet per year. On a district level, a comparison of Runs 33 and 34 to the submitted well file shows pumping increases in Post Oak Savannah and Mid-East Texas groundwater conservation districts and decreases in Lost Pines, Fayette County, and Brazos Valley groundwater conservation districts.

PURPOSE AND DESCRIPTION OF THE MODEL RUNS:

Consultants working for Groundwater Management Area 12 (GMA 12) submitted a well file to TWDB, GMA12_7A.txt, which they used to develop the desired future conditions (DFCs) for GMA 12. Shortly after TWDB received the well file, GMA 12 adopted desired future conditions for the Queen City, Sparta, and Carrizo-Wilcox aquifers (Table 1). The purpose of this task was to run the groundwater availability model for the central part of the Queen City, Sparta, and Carrizo-Wilcox aquifers using the submitted well file and compare the average drawdowns from the run with the desired future conditions for GMA 12. If the well file did not produce the desired future conditions of GMA 12, a second task was to determine whether the DFCs were compatible and physically possible by adjusting the pumping amounts in the submitted well file to try to match the desired future conditions.

METHODS:

Task 1

The groundwater availability model for the central part of the Queen City, Sparta, and Carrizo-Wilcox aquifers was run using the submitted well file, GMA12_7A.txt, and average drawdowns from the run (Table 2) were compared with the desired future conditions for GMA 12 (Table 1).

Task 2

Pumping was adjusted incrementally within each model layer and groundwater conservation district to better match the desired future conditions. The difference between the desired future conditions and the average drawdown for each model run were calculated and a standard

deviation of those differences was also calculated. Pumping was adjusted until it was clear that additional adjustments would not improve the overall match with the DFCs.

PARAMETERS AND ASSUMPTIONS:

This groundwater availability model includes eight layers, representing the following formations (from top to bottom):

1. the Sparta,
2. the Weches,
3. the Queen City,
4. the Reklaw,
5. the Carrizo,
6. the Calvert Bluff,
7. the Simsboro, and
8. the Hooper.

It should be noted that in the deep, eastern portion of the model the aquifer layers extend beyond the official aquifer boundaries and may contain brackish to saline waters with total dissolved solids exceeding 3,000 parts per million.

Further details about the model can be found in Dutton and others (2003) and Kelley and others (2004).

RESULTS AND DISCUSSION:

Two best fit scenarios were determined, (1) average drawdowns do not exceed the desired future conditions by more than 1 foot (Run 33, Tables 3 and 9) and (2) average drawdowns are within 5 feet of the desired future conditions (Run 34, Tables 4 and 10).

Two best fit scenarios were selected for two reasons-

(1) After 34 model runs it was clear that an exact fit to the desired future conditions (Table 1) was not possible because pumping in one area affects drawdowns in the same area and in adjoining areas. For example, in Run 34 (Table 10) if pumping were increased in the Simsboro to better match the Simsboro DFC then drawdowns in the Hooper would also go up resulting in a poorer match in the Hooper. The condition of no drawdowns exceeding DFCs by more than one foot in scenario 33 was made possible by eliminating pumping in the Hooper formation in Post Oak Savannah GCD, so a good match for most of the DFCs can be achieved if one of the DFCs deviates significantly.

(2) Constraint statements were not provided with the submittal of the adopted desired future conditions. In other words, the desired future conditions were provided as single numbers with no statements such as “drawdowns should not exceed …” or “drawdown should be within …”.

Runs 33 and 34 both include more pumping than the submitted well file, GMA12_7A.txt (Tables 5, 6, and 7). Run 33 (Table 6) includes approximately 9,000 acre-feet per year additional pumping in Post Oak Savannah GCD, and 2,000 acre-feet per year additional in Mid-East Texas GCD, with 3,000 acre-feet per year less in Brazos Valley GCD, 1,000 acre-feet per year less in Fayette County, and 2,000 acre-feet per year less in Lost Pines GCD.

Run 34 (Table 7) includes approximately 13,000 acre-feet per year additional pumping in Post Oak Savannah GCD, and 2,000 acre-feet per year additional in Mid-East Texas GCD, with 3,000 acre-feet per year less in Brazos Valley GCD, 1,000 acre-feet per year less in Fayette County, and 2,000 acre-feet per year less in Lost Pines GCD.

REFERENCES:

Dutton, A.R., Harden, B., Nicot, J.P., and O'Rourke, D., 2003, Groundwater availability model for the central part of the Carrizo-Wilcox Aquifer in Texas: Contract report to the Texas Water Development Board, 295 p.,

Kelley, V. A., Deeds, N. E., Fryar, D. G., and Nicot, J. P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p.

Table 1. Desired Future Conditions (DFCs) for GMA 12

Groundwater Conservation District	Average drawdown from 1999 to 2060 (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	15	12	47	106	270	170
Fayette County Subcrop	60	60	60	NA	NA	NA
Lost Pines	10	13	47	99	237	129
Mid-East Texas	0	0	55	70	115	95
Post Oak Savannah	30	40	70	150	300	180
Fayette County Outcrop	5	5	NA	NA	NA	NA

Table 2. Average drawdowns in feet resulting from model run with well file GAM12_7A. Standard deviation of differences between DFC and model result equal to 4.3 (excluding Fayette Outcrop[1]).

Groundwater Conservation District	Average drawdown from 1999 to 2060 (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	14	12	48	108	269	176
Fayette County Subcrop	62	58	59	NA	NA	NA
Lost Pines	4	13	48	95	238	135
Mid-East Texas	0	-3	53	67	114	96
Post Oak Savannah	28	28	62	137	298	179
Fayette County Outcrop	-1	NA	NA	NA	NA	NA

1. **Fayette County outcrop consists of only 4 model cells so this DFC was not included in calculation of standard deviation.**

Table 3. Model run 33 with drawdowns exceeding DFCs by no more than 1 foot. Standard deviation of differences between DFC and model result equal to 3.2 (excluding Fayette Outcrop[1])

Groundwater Conservation District	Average drawdown from 1999 to 2060 (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	14	12	48	107	269	169
Fayette County Subcrop	59	56	58	NA	NA	NA
Lost Pines	9	14	48	96	233	128
Mid-East Texas	1	-2	55	68	114	95
Post Oak Savannah	31	38	71	148	301	165
Fayette County Outcrop	-1	NA	NA	NA	NA	NA

1. **Fayette County outcrop consists of only 4 model cells so this DFC was not included in calculation of standard deviation.**

Table 4. Model run 34 with closest match to DFCs. Standard deviation of differences between DFC and model result equal to 2.0 (excluding Fayette Outcrop). All drawdowns within 5 feet of DFCs except for Fayette County Outcrop[1].

Groundwater Conservation District	Average drawdown from 1999 to 2060 (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	14	12	48	108	266	174
Fayette County Subcrop	59	56	58	NA	NA	NA
Lost Pines	9	14	48	96	234	133
Mid-East Texas	1	-2	55	68	114	96
Post Oak Savannah	31	38	71	148	300	178
Fayette County Outcrop	-1	NA	NA	NA	NA	NA

1. **Fayette County outcrop consists of only 4 model cells so this DFC was not included in calculation of standard deviation.**

Table 5. Well file GMA12_7A 2060 pumping.

Groundwater Conservation District	2060 Pumping (acre-feet per year)						
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper	Total
Brazos Valley	7,923	528	5,495	1,754	90,405	316	**106,422**
Fayette County	7,249	1,857	1,000	0	0	0	**10,106**
Lost Pines	1,876	1,134	12,053	3,984	37,248	2,591	**58,886**
Mid-East Texas	3,334	974	11,087	3,912	7,169	827	**27,302**
Post Oak Savannah	6,734	503	7,059	1,037	48,501	4,432	**68,266**
Total	27,115	4,995	36,694	10,688	183,324	8,167	**270,982**

Table 6. Pumping for model run 33 with drawdowns exceeding DFCs by no more than 1 foot (see Table 3).

Groundwater Conservation District	2060 Pumping (acre-feet per year)						
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper	Total
Brazos Valley	7,923	422	4,671	0	90,405	0	**103,422**
Fayette County	6,162	2,043	1,000	0	0	0	**9,204**
Lost Pines	5,552	0	10,848	3,984	33,523	2,332	**56,239**
Mid-East Texas	3,334	1,947	11,641	4,303	7,528	827	**29,580**
Post Oak Savannah	6,060	4,901	8,824	6,402	51,170	0	**77,357**
Total	29,030	9,314	36,983	14,689	182,626	3,160	**275,802**

Table 7. Pumping for model run 34 with closest match to DFCs (see Table 4).

Groundwater Conservation District	2060 Pumping (acre-feet per year)						
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper	Total
Brazos Valley	7,923	422	4,671	877	89,460	0	**103,353**
Fayette County	6,162	2,043	1,000	0	0	0	**9,204**
Lost Pines	5,552	0	10,848	3,984	33,523	2,332	**56,239**
Mid-East Texas	3,334	1,947	11,641	4,303	7,528	827	**29,580**
Post Oak Savannah	6,060	4,901	8,824	6,402	51,170	4,432	**81,789**
Total	29,030	9,314	36,983	15,566	181,681	7,592	**280,166**

Table 8. Difference between desired future condition and drawdowns from GMA12_7A. Standard deviation of differences between DFC and model result equal to 4.3 (excluding Fayette Outcrop[1]).

Groundwater Conservation District	Difference between DFC and 2060 model drawdown for GMA12_7A (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	1	0	-1	-2	1	-6
Fayette County Subcrop	-2	2	1	NA	NA	NA
Lost Pines	6	0	-1	4	-1	-6
Mid-East Texas	0	3	2	3	1	-1
Post Oak Savannah	2	12	8	13	2	1
Fayette County Outcrop	6	NA	NA	NA	NA	NA

1. **Fayette County outcrop consists of only 4 model cells so this DFC was not included in calculation of standard deviation.**

Table 9. Difference between desired future condition and drawdowns from model run 33 with drawdowns exceeding DFCs by no more than 1 foot. Standard deviation of differences between DFC and model result equal to 3.2 (excluding Fayette Outcrop[1])

Groundwater Conservation District	Difference between DFC and 2060 model drawdown for run 33 (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	1	0	-1	-1	1	1
Fayette County Subcrop	1	4	2	NA	NA	NA
Lost Pines	1	-1	-1	3	4	1
Mid-East Texas	-1	2	0	2	1	0
Post Oak Savannah	-1	2	-1	2	-1	15
Fayette County Outcrop	6	NA	NA	NA	NA	NA

1. **Fayette County outcrop consists of only 4 model cells so this DFC was not included in calculation of standard deviation.**

Table 10. Difference between desired future condition and drawdowns from model run 34 with closest match to DFCs. Standard deviation of differences between DFC and model result equal to 2.0 (excluding Fayette Outcrop). All drawdowns within 5 feet of DFCs except for Fayette County Outcrop[1].

Groundwater Conservation District	Difference between DFC and 2060 model drawdown for run 34 (feet)					
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
Brazos Valley	1	0	-1	-2	4	-4
Fayette County Subcrop	1	4	2	NA	NA	NA
Lost Pines	1	-1	-1	3	3	-4
Mid-East Texas	-1	2	1	2	1	-1
Post Oak Savannah	-1	2	-1	2	0	2
Fayette County Outcrop	6	NA	NA	NA	NA	NA

1. **Fayette County outcrop consists of only 4 model cells so this DFC was not included in calculation of standard deviation.**