

GAM run 05-36

by **Richard Smith, P.G.**

Texas Water Development Board
Groundwater Availability Modeling Section
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REQUESTOR:

Lonnie Stewart, McMullen Water Conservation District (MGCD).

DESCRIPTION OF REQUEST:

Mr. Stewart requested that we use the groundwater availability models (GAMs) for the central part of the Gulf Coast aquifer and the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers to help him determine the total useable groundwater for the McMullen Groundwater Conservation District (GCD) management plan. Mr. Stewart requested the model runs to estimate the amount of pumpage in McMullen County that will result in the following water-level declines:

- 0 feet
- 10 feet
- 25 feet

Close examination of the hydrogeology of McMullen County reveals that only the bottom two layers of the Central Gulf Coast GAM are present. These layers (the Burkville and Jasper) are not suitable sources for groundwater withdrawal and therefore are not modeled for this request. The only model used was the Queen City – Sparta GAM. McMullen County contains all eight layers modeled in this GAM, although only the Carrizo aquifer (layer 5) is actually utilized as a groundwater source in the county.

METHODS:

To address the request, we:

- ran the transient model and extracted water budgets for each year of the 1980 through 1999 period;
- removed outliers (1980,1981, and 1999) and averaged the remaining seventeen years, outliers being years with pumpage far lower than average;
- extracted the pumpage from the transient model year 1984, which corresponded to the seventeen-year average of 187,000 cubic feet per day;
- ran the steady-state predevelopment GAM for reference water levels;
- ran the steady-state GAM using the 1984 year pumpage as a baseline (pre-development steady-state model were chosen for the analysis because they will simulate long-term water-level declines);
- ran the steady-state GAM with no pumpage in McMullen County but with average year pumpage in all surrounding counties;

- calculated water-level declines by subtracting long-term pumped water levels from predevelopment water levels; and
- uniformly adjusted pumping volumes in McMullen County for layer 5 in the GAM of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers, which represents the Carrizo aquifer and is the only pumping source for the county in that GAM, until the average water-level decline in the county was 0, 10, and 25 feet for that layer.

PARAMETERS AND ASSUMPTIONS:

- In the analysis, we assumed that the pumpage distribution would remain as it was in the baseline case (1984 spatial and vertical pumpage distribution). The only pumpage in McMullen County in the GAM of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers is from the Carrizo aquifer.
- The Chicot aquifer (layer 1) and the Evangeline aquifer (layer 2) in the GAM of the central part of the Gulf Coast aquifer are not present in McMullen County. Only the Burkeville confining unit (layer 3) and the Jasper aquifer (layer 4) are present in the GAM and no pumping takes place from these layers in McMullen County. Layers 1 through 8 in the GAM of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers are present in McMullen County. These correspond to the Sparta, Weches, Queen City, Reklaw, Carrizo, Upper Wilcox, Middle Wilcox and Lower Wilcox formations, respectively.
- See Deeds and others (2003) for additional information concerning the Carrizo-Wilcox aquifer and Kelley and others (2004) for Queen City and Sparta aquifers assumptions and limitations. Root mean squared error of the calibrated transient model is 23 feet for the Sparta aquifer, 18 feet for the Queen City aquifer, and 33 feet for the Carrizo aquifer. The pre-development steady-state models assume average recharge conditions.

RESULTS:

Water-level declines in excess of 80 feet occur in all eight layers modeled in the GAM of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers in McMullen County with no pumpage in McMullen County (Table 1). This is due to the effects of pumpage in the surrounding counties. Therefore, limiting water-level declines in McMullen County to 0, 10, and 15 feet will be impossible as long as there is pumping outside of the county.

Because water levels in McMullen County are determined to a large degree by pumpage in adjacent counties, we calculated the amount of pumping that would result in 0, 10, and 15 feet of additional drawdown due to pumping in the county. The additional drawdown is relative to the 1984 reference water level, which is based on average pumpage for the transient period of 1980 through 1999. If 1984 pumpage is used as the baseline, 1,570 acre-feet per year, 3,140 acre-feet per year and 5,620 acre-feet per year of pumping will result in 0 feet, 10.1 feet, and 25.2 feet of additional water-level decline, respectively (Table 2).

REFERENCES:

Deeds, N., Kelley, V., Fryar, D., and Jones, T., 2003, Groundwater availability model for the southern Carrizo-Wilcox aquifer: Final report prepared for the Texas Water Development Board by INTERA Inc.

Kelley, V. A., Deeds, N. E., Fryar, D. G., Nicot, J. P., Jones, T. L., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin J. L., 2004, Groundwater availability model for the Queen City and Sparta aquifers: Final report prepared for the Texas Water Development Board by INTERA Inc.

Table 1: Average water-level declines in McMullen County in the GAM of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers with pumpage occurring outside the county relative to the base year of 1984.

Aquifer	Pumpage within McMullen County (acre-feet per year)	Average water-level decline (feet¹)
Sparta	0	81
Weches	0	96
Queen City	0	109
Reklaw	0	145
Carrizo	0	175
Wilcox - Upper	0	177
Wilcox - Middle	0	191
Wilcox - Lower	0	197

¹ Within one foot – relative to 1984 water levels. Water levels are averaged over the entire county and do not represent declines in any one particular well.

Table 2: Water-level decline in McMullen County in the GAM of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers with 1984 as the base year.

Aquifer	Pumpage within McMullen County (acre-feet per year)	Average water-level decline (feet¹)	Pumpage within McMullen County (acre-feet per year)	Average water-level decline (feet)
Sparta	0	5	0	12
Weches	0	6	0	14
Queen City	0	7	0	16
Reklaw	0	9	0	21
Carrizo	3,140	10	5,620	25
Wilcox-Upper	0	8	0	23
Wilcox-Middle	0	5	0	13
Wilcox-Lower	0	2	0	6

¹ Within one foot – relative to 1984 water levels. Water levels are averaged over the entire county and do not represent declines in any one particular well.