GAM Run 10-020 MAG

by Mr. Wade Oliver

Texas Water Development Board
Groundwater Availability Modeling Section
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EXECUTIVE SUMMARY:

The estimated total pumping from the Blaine Aquifer that achieves the desired future condition adopted by the members of Groundwater Management Area 1 of 50 percent of the volume of water in storage in the aquifer remaining after 50 years is approximately 99,000 acre-feet per year between 2010 and 2060. This pumping is located entirely within Wheeler County, the Panhandle Regional Water Planning Area (Region A), and the Red River Basin as shown in Table 2. The estimated managed available groundwater, the amount available for permitting, for Panhandle Groundwater Conservation District is shown in Table 3. The pumping required to achieve the desired future condition for the Blaine Aquifer in Groundwater Management Area 1 was determined by iteratively adjusting the pumping in the area between 2010 and 2060 in the groundwater availability model.

REQUESTOR:

Mr. Kyle Ingham of the Panhandle Regional Planning Commission on behalf of Groundwater Management Area 1

DESCRIPTION OF REQUEST:

In a letter received June 14, 2010, Mr. Kyle Ingham provided the Texas Water Development Board (TWDB) with the desired future condition of the Blaine Aquifer adopted by the members of Groundwater Management Area 1. The desired future condition for the Blaine Aquifer, as presented in Resolution No. 2010-01 and adopted June 3, 2010 by the groundwater conservation districts within Groundwater Management Area 1, is shown below:

> *The Joint Planning Committee sets the* [Desired Future Condition] *of the Blaine Aquifer at 50 percent of the volume in storage remaining in 50 years in Wheeler County.*

In response to receiving the adopted desired future condition, the Texas Water Development Board has estimated the managed available groundwater that achieves the above desired future condition for the Blaine Aquifer.

METHODS:

Groundwater Management Area 1 contains a portion of the Blaine Aquifer, a minor aquifer in Texas as defined in the 2007 State Water Plain (TWDB, 2007). The location of the Blaine Aquifer and the groundwater availability model cells that represent the aquifer are shown in Figure 1. The portion of the Blaine Aquifer in Groundwater Management Area 1 is located entirely within Wheeler County, the Panhandle Regional Water Planning Area (Region A), the Red River Basin, and Panhandle Groundwater Conservation District.

The groundwater availability model for the Seymour and Blaine aquifers was used in order to determine the amount of pumping necessary to achieve the above desired future condition (Ewing and others, 2004). Specifically, the model was run iteratively between 2010 and 2060 with different levels of pumping in the area to determine the amount of pumping that achieved

the 50 percent decline over the 50-year period from 2010 through 2059. This pumping was based on the pumping distribution for the preceding year (2009) described in Ewing and others (2004). The amount of the increase in pumping over the year 2009 was distributed evenly over the area of the Blaine Aquifer in Wheeler County.

All information necessary to calculate the volume of water in the Blaine Aquifer in Wheeler County was extracted directly from the groundwater availability model. This includes the hydraulic head (water level as measured in a well), top and bottom of the aquifer, and the storage properties that define the amount of water released from the aquifer as water levels decline. This assumption for storage properties is a change from what was previously reported in GAM Run 04-22 (Anaya and others, 2005). In GAM Run 04-22, the specific yield (storativity of an unconfined aquifer) of the Blaine Aquifer was assumed to be 0.05. However, in the groundwater availability model the specific yield of the Blaine Aquifer is 0.15 as described in Ewing and others (2004). Because the water level fluctuations in the model simulation are a function of the specific yield value of 0.15, it is more appropriate to use this value in the volumetric calculations. It is important to note, however, that this higher specific yield results in a significantly higher estimated volume of water in the Blaine Aquifer than what was previously reported in GAM Run 04-22.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the Seymour and Blaine aquifers are described below:

- Version 1.01 of the groundwater availability model for the Seymour and Blaine aquifers was used for this analysis. See Ewing and others (2004) for assumptions and limitations of the model.

- The model includes two layers representing the Seymour Aquifer (Layer 1) and the Blaine Aquifer and other Permian sediments (Layer 2). Only those areas in Layer 2 representing the Blaine Aquifer in Wheeler County were used when evaluating the pumping necessary to achieve the desired future condition.

- The root mean squared error (a measure of the difference between simulated and measured water levels during model calibration) for the entire model between 1990 and 1999 is 19.6 feet for the Seymour Aquifer and 26.4 feet for the Blaine Aquifer. This represents one percent and three percent of the range of measured water levels in each aquifer, respectively (Ewing and others, 2004).

- The Blaine Aquifer boundary used in the groundwater availability model run was the official boundary during development of the groundwater availability model in 2004. Though the official boundary of the Blaine Aquifer has changed since model development, the model is only applicable in areas within this older boundary. For this reason, the results presented in this report reflect the previous Blaine Aquifer boundary.

- The recharge applied in the model simulations represents average conditions based on climate data from 1975 to 1999.

- The historical-calibration period of the model ends in 1999 while the time period over which the predictive pumping was adjusted began in 2010. Hydrographs during the interim period of 2000 to 2009 were assessed for wells in the Blaine Aquifer in Wheeler County to confirm that simulated water levels reasonably corresponded to measured water levels.

Determining Managed Available Groundwater

As defined in Chapter 36 of the Texas Water Code, "managed available groundwater" is the amount of water that may be permitted. The pumping output from groundwater availability models, however, represents the total amount of pumping from the aquifer. The total pumping includes uses of water both subject to permitting and exempt from permitting. Examples of exempt uses include domestic, livestock, and oil and gas exploration. Each district may also exempt additional uses as defined by its rules or enabling legislation.

Since exempt uses are not available for permitting, it is necessary to account for them when determining managed available groundwater. To do this, the Texas Water Development Board developed a standardized method for estimating exempt use for domestic and livestock purposes based on projected changes in population and the distribution of domestic and livestock wells in the area. Because other exempt uses can vary significantly from district to district, and there is much higher uncertainty associated with estimating use due to oil and gas exploration, estimates of exempt pumping outside domestic and livestock uses have not been included. Districts were also encouraged to evaluate the estimates of exempt pumping and, if desired, provide updated estimates. Once established, the estimates of exempt pumping are subtracted from the total pumping output from the groundwater availability model to yield the estimated managed available groundwater for permitting purposes.

RESULTS:

As described above, the amount of pumping in the Blaine Aquifer in Groundwater Management Area 1 was adjusted iteratively until 50 percent of the volume of water in the aquifer remained after 50 years. Specifically, the pumping was systematically increased until the volume of water remaining in 2059 was less than 50 percent of the initial volume of water at the beginning of 2010. The pumping that would achieve 50 percent was then estimated and a final simulation was run to confirm that this achieved the desired future condition. The pumping, drawdown, and percent volume remaining associated with each of the iterative model simulations are shown in Table 1 below.

The estimated total pumping from the Blaine Aquifer in Groundwater Management Area 1 that achieves the above desired future condition is approximately 99,000 acre-feet per year. This is shown as the last simulation in Table 1 and also by decade in Table 2. In Table 2, the pumping is associated with a county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process. Also notice that the values in Table 2 are slightly less than the 99,000 acre-feet per year reported in Table 1. This is because

these values account for cells which become inactive during the model simulation. A cell becomes inactive when the water level in the cell drops below the base of the aquifer. In this situation pumping can no longer occur.

The total pumping by decade for the Blaine Aquifer in Groundwater Management Area 1, located wholly within Panhandle Groundwater Conservation District, is shown in Table 3. These values are the same as the total pumping shown in Table 2 since Wheeler County is located entirely within the district. The estimated exempt use of the aquifer for livestock and domestic purposes is approximately 175 acre-feet per year. The managed available groundwater, the difference between the total pumping and the estimated exempt use is also shown in Table 3. Note that the estimated exempt pumping accounts for only a very small fraction of the total pumping in the district from the Blaine Aquifer based on the above desired future condition.

LIMITATIONS:

Managed available groundwater numbers included in this report are the result of subtracting the estimated future exempt use from the estimated total pumping that would achieve the desired future condition adopted by the groundwater conservation districts in the groundwater management area. These numbers, therefore, are the result of (1) running the groundwater model to estimate the total pumping required to achieve the desired future condition and (2) estimating the future exempt use in the area.

The groundwater model used in developing estimates of total pumping is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future condition. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to develop estimates of total pumping is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.

In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing these total pumping estimates. Those assumptions also need to be

considered and compared to actual future data when evaluating compliance with the desired future condition.

In the case of TWDB's estimates of future exempt use, key assumptions were made as to the pattern of population growth relative to the need for domestic wells or supplied water, per capita use from domestic wells, and livestock uses of water. In the case of district estimates of future exempt use, including exempt use associated with the exploration of oil and gas, the assumptions are specific to that district. In either case, these assumptions need to be considered when reviewing future data related to exempt use.

Given these limitations, users of this information are cautioned that the total pumping numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine these managed available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES AND ASSOCIATED MODEL RUNS:

Anaya, R., Hamlin, S., Wade, S., 2005, GAM Run 04-22: Texas Water Development Board GAM Run 04-22 Report, 3 p.

Ewing, J.E., Jones, T.L., Pickens, J.F., Chastain-Howley, A., Dean, K.E., Spear, A.A., 2004, Groundwater availability model for the Seymour Aquifer: Final report prepared for the Texas Water Development Board by INTERA, Inc., 533 p.

National Research Council, 2007. Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.

Texas Water Development Board, 2007, Water for Texas – 2007—Volumes I-III; Texas Water Development Board Document No. GP-8-1, 392 p.

Table 1. Pumping, average drawdown, and percent volume remaining for each iterative groundwater availability model simulation of the Blaine Aquifer in Groundwater Management Area 1.

Pumping (acre-feet per year)	Average Drawdown (feet)	Percent Remaining
100	8	98
300	8	98
500	8	98
1,000	9	97
3,000	12	97
5,000	14	96
10,000	21	93
30,000	49	84
50,000	80	75
100,000	167	49
Additional simulation to meet request		
99,000	165	50

Table 2. Estimated total annual pumping in acre-feet for the Blaine Aquifer in Groundwater Management Area 1 by county, regional water planning area, and river basin.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Wheeler	A	Red River	98,997	98,997	98,997	98,997	98,997	97,695

Table 3. Estimated total pumping, exempt use, and managed available groundwater for the Blaine Aquifer in Groundwater Management Area 1. All results are for Panhandle Groundwater Conservation District and are in acre-feet per year. Estimated exempt use was calculated by the TWDB and accepted by the district.

Panhandle Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Total Pumping	98,997	98,997	98,997	98,997	98,997	97,695
Estimated Exempt Use	175	175	174	176	175	172
Managed Available Groundwater	98,822	98,822	98,823	98,821	98,822	97,523

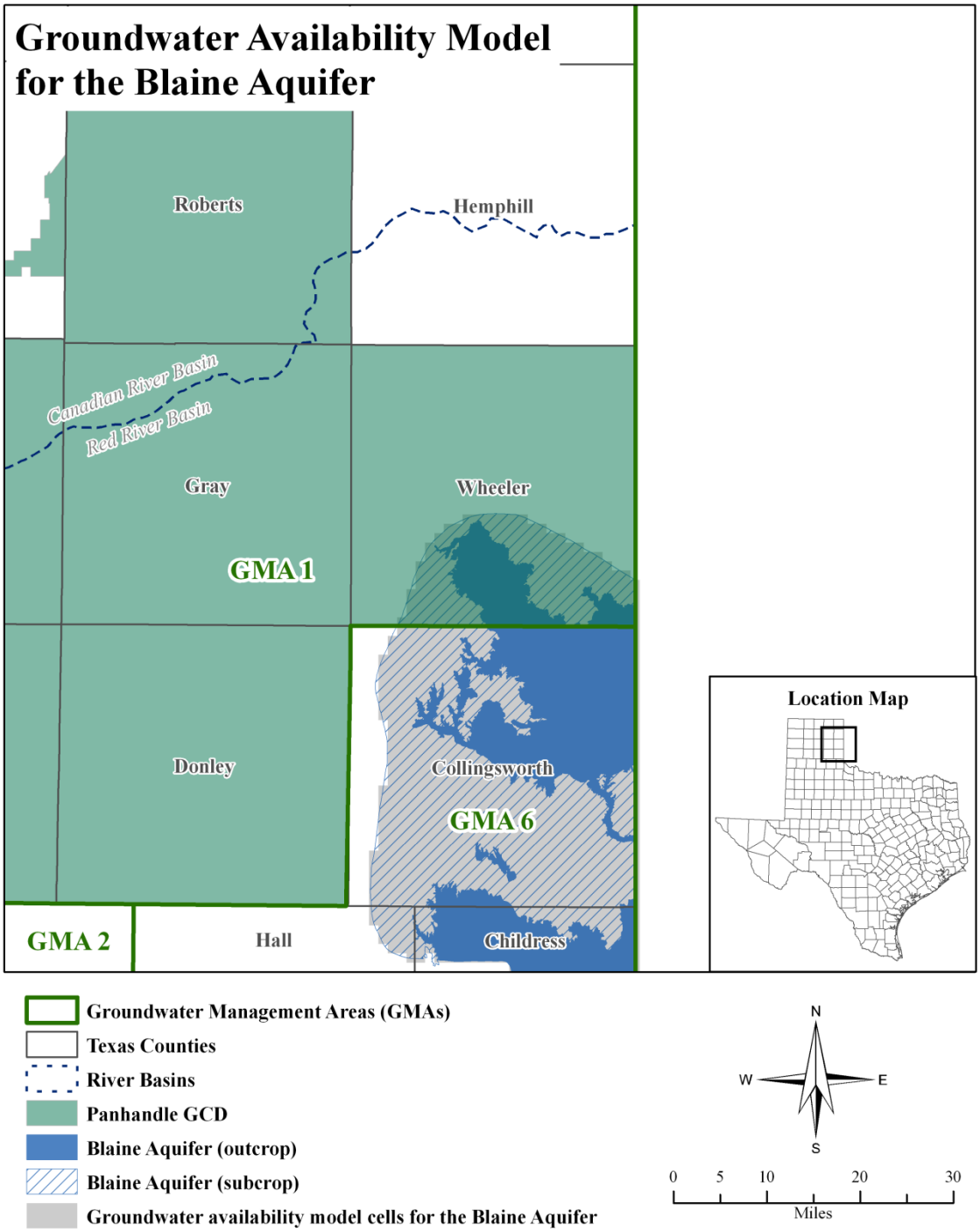

Figure 1. Map showing groundwater management areas, counties, and river basins in the vicinity of the Blaine Aquifer in Groundwater Management Area 1. Panhandle Groundwater Conservation District (GCD) is also shown since it is the only district within the management area containing the Blaine Aquifer.