GAM Run 08-54

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, groundwater conservation districts shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator. Information derived from groundwater availability models that shall be included in groundwater management plans includes:

(1) the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
(2) for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers; and
(3) the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The purpose of this model run is to provide information to the Mesquite Groundwater Conservation District for its groundwater management plan. The groundwater management plan for the Mesquite Groundwater Conservation District is due for approval by the executive administrator of the Texas Water Development Board before January 16, 2009.

This report discusses the method, assumptions, and results from model runs using the groundwater availability model for the Seymour and Blaine aquifers. Table 1 summarizes the groundwater availability model data required by statute for the Mesquite Groundwater Conservation District's groundwater management plan.

METHODS:

We ran the groundwater availability model for the Seymour and Blaine aquifers and (1) extracted water budgets for each month of the 1980 through 1999 period and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portions Seymour/Blaine groundwater availability model located within the district.

PARAMETERS AND ASSUMPTIONS:

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

- The groundwater availability model includes two layers, representing the Seymour (Layer 1) and Blaine (Layer 2) aquifers. In areas where the Blaine Aquifer does not exist the model roughly replicates the various Permian units located in the study area.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) of the entire model for the period of 1990 to 1999 ranges from 19.6 feet (Seymour Aquifer) to 26.4 feet (Blaine Aquifer), representing one percent and three percent of the range of measured water levels respectively (Ewing and others, 2004).

- All stress periods of the groundwater availability model for the Seymour and Blaine aquifers are monthly. The current model run for 1980 through 1999, therefore, consisted of 240 individual stress periods.

- The areas from which water budgets were extracted were different for each layer of the groundwater availability model. In layer 1, all active model cells within the district were used, representing the Seymour Aquifer. In Layer 2, only those active cells within the district representing the Blaine Aquifer were used. This excludes active cells outside the Blaine Aquifer in Layer 2 representing other Permian sediments.

- We used Processing Modflow for Windows (PMWIN) version 5.3 (Chiang and Kinzelbach, 2001) as the interface to process model output for the groundwater availability model for the Seymour and Blaine aquifers.

RESULTS:

A groundwater budget summarizes the water entering and leaving the aquifer according to the groundwater availability model. Selected components were extracted from the groundwater budget for the aquifers located within the district and averaged over the duration of the calibrated portion of the model run (1980 to 1999) in the district, as shown in Table 1. The components of the modified budgets shown in Table 1 include:

- Precipitation recharge—This is the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.

- Surface water outflow—This is the total water exiting the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).

- Flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—This describes the vertical flow, or leakage, between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Table 1. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as district or county boundaries, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Table 1: Summarized information needed for the Mesquite Groundwater Conservation District's groundwater management plan[a]. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot.

Management Plan requirement	Aquifer or confining unit	Results[a]
Estimated annual amount of recharge from precipitation to the district	Seymour	44,907
	Blaine	23,892
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Seymour	4,336
	Blaine	21,639
Estimated annual volume of flow into the district within each aquifer in the district	Seymour	1,708
	Blaine	25,112
Estimated annual volume of flow out of the district within each aquifer in the district	Seymour	1,050
	Blaine	21,933
Estimated net annual volume of flow between each aquifer in the district	Net flows leaving Seymour to Blaine and other Permian Units	9,655[b]
	Net flows entering Blaine from Seymour	15,454[b]

[a] A mass balance error of one percent or less is normally considered acceptable for water budgets extracted from numerical flow models (Anderson and Woessner, 1992); however, the water budgets for some stress periods of the groundwater availability model for the Seymour and Blaine aquifers exceeded one percent After investigating the cause

and several alternative approaches to defining the water budget it was determined that, after averaging all 240 stress periods together, the results are reasonable and appropriate for the purposes of the district's management plan.

[b] Because the Seymour is not always underlain by the Blaine and the Blaine is not always overlain by the Seymour, the amount of water exiting the Seymour Aquifer may not equal the amount of water entering the Blaine Aquifer.

REFERENCES:

Anderson, M.P., and Woessner, W.W., 1992, Applied Groundwater Modeling, Simulation of Flow and Advective Transport, Academic Press, Inc., New York, 381 p.

Chiang, W., and Kinzelbach, W., 2001, Groundwater Modeling with PMWIN, 346 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.

Cynthia K. Ridgeway is Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G., on August 1, 2008.