GAM Run 08-51

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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 Plateau Underground Water Conservation and Supply District for its groundwater management plan. The groundwater management plan for the Plateau Underground Water Conservation and Supply District is due for approval by the executive administrator of the Texas Water Development Board before March 5, 2009.

This report discusses the method, assumptions, and results from model runs using the groundwater availability models for the Edwards-Trinity (Plateau) Aquifer and the Lipan Aquifer. Table 1 summarizes the groundwater availability model data required by statute for the Plateau Underground Water Conservation and Supply District's groundwater management plan.

METHODS:

We ran the groundwater availability models for the Edwards-Trinity (Plateau) Aquifer and the Lipan Aquifer and (1) extracted water budgets for each year of the 1980 through 1999 period for the Edwards-Trinity (Plateau) Aquifer and the 1980 through 1998 period for the Lipan Aquifer 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 of the Edwards-Trinity (Plateau) and Lipan aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

- We used versions 1.01 of the groundwater availability models for the Edwards-Trinity (Plateau) Aquifer and the Lipan Aquifer.

- The Edwards-Trinity (Plateau) Aquifer model includes two layers representing the Edwards Group and equivalent limestone hydrostratigraphic units (Layer 1) and the undifferentiated Trinity Group hydrostratigraphic units (Layer 2) in the district.

- The Lipan Aquifer model includes one layer representing the Quaternary Leona Formation, portions of the underlying Permian Formations, and the Edwards-Trinity (Plateau) Aquifer to the west, south, and north.

- See Anaya and Jones (2004) for assumptions and limitations of the model for the Edwards-Trinity (Plateau) Aquifer. See Beach and others (2004) for assumptions and limitations of the groundwater availability model for the Lipan Aquifer.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) of the Edwards-Trinity (Plateau) groundwater availability model for the period of 1990 to 2000 is 143 feet, or six percent of the range of measured water levels.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model for the Lipan Aquifer is 18 feet for the calibration period (1980 to 1989) and 17 feet for the verification period (1990 to 1999: Beach and others, 2004).

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

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 1998 for the Lipan; 1980 to 1999 for the Edwards-Trinity Plateau) 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. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer.

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 Plateau Underground Water Conservation and Supply District's groundwater management plan. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot.

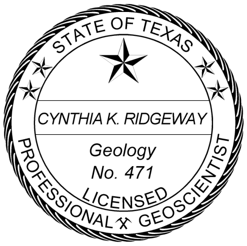
Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Lipan Aquifer	387
	Edwards Group and equivalent limestone	22,410
	Undifferentiated Trinity Group	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Lipan Aquifer	0
	Edwards Group and equivalent limestone	8,379
	Undifferentiated Trinity Group	0
Estimated annual volume of flow into the district within each aquifer in the district	Lipan Aquifer	19
	Edwards Group and equivalent limestone	5,001
	Undifferentiated Trinity Group	2,441
Estimated annual volume of flow out of the district within each aquifer in the district	Lipan Aquifer	411
	Edwards Group and equivalent limestone	20,582
	Undifferentiated Trinity Group	7,776
Estimated net annual volume of flow between each aquifer in the district	Trinity into Edwards	5,329

REFERENCES:

Anaya, R., and Jones, I., 2004, Groundwater availability model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifer systems, Texas: Texas Water Development Board, GAM Report, 208 p., http://www.twdb.state.tx.us/gam/eddt_p/eddt_p.htm

Beach, J.A., Burton, S., and Kolarik, B., 2004, Groundwater availability model for the Lipan Aquifer in Texas: final report prepared for the Texas Water Development Board by LBG-Guyton Associates, 157 p.

Chiang, W., and Kinzelbach, W., 2001, Groundwater Modeling with PMWIN, 346 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 July 7, 2008.