GAM Run 09-022

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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 the groundwater management plan 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 Upper Trinity Groundwater Conservation District for its groundwater management plan. The groundwater management plan for Upper Trinity Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before November 6, 2010.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the northern portion of the Trinity Aquifer. Table 1 summarizes the groundwater availability model data required by statute, and Figure 1 shows the area of the model from which the values in Table 1 were extracted.

METHODS:

We ran the groundwater availability model for the northern portion of the Trinity Aquifer and (1) extracted water budgets for each year 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 of the aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

- We used version 1.01 of the groundwater availability model for the northern section of the Trinity Aquifer. See Bené and others (2004) for assumptions and limitations of the model.

- The northern section of the Trinity Aquifer model includes seven layers representing:

    1. the Woodbine Aquifer (Layer 1),
    2. the Washita and Fredericksburg Confining Unit (Layer 2),
    3. the Paluxy Aquifer (Layer 3),
    4. the Glen Rose Confining Unit (Layer 4),
    5. the Hensell Aquifer (Layer 5),
    6. the Pearsall/Cow Creek/Hammett/Sligo Confining Unit (Layer 6), and
    7. the Hosston Aquifer (Layer 7).

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the four main aquifers in the model (Woodbine, Paluxy, Hensell, and Hosston) for the calibration and verification time periods (1980 through 1999) ranged from approximately 37 to 75 feet. The root mean squared error was less than ten percent of the maximum change in water levels across the model (Bené and others, 2004).

- The evapotranspiration package of the groundwater availability model was used to represent evaporation, transpiration, springs, seeps, and discharge to streams not modeled by the streamflow-routing package as described in Bené and others (2004).

- We used Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) as the interface to process model output.

RESULTS:

A groundwater budget summarizes the amount of 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 calibration and verification portion of the model run (1980 through 1999) in the district, as shown in Table 1. The components of the modified budget 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 (see Figure 1).

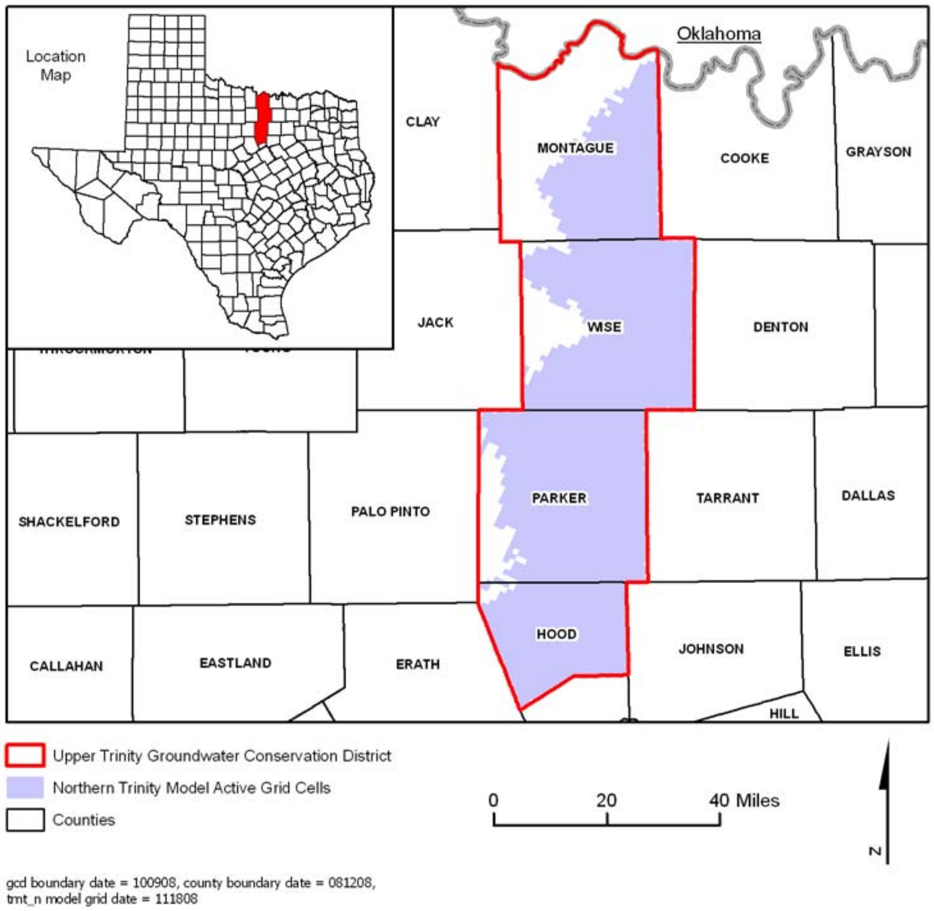
As depicted by Bené and others (2004) and LBG-Guyton Associates (2003), groundwater in the Trinity Aquifer within the Upper Trinity Groundwater Conservation District ranges predominantly from fresh (less than 1,000 milligrams per liter total dissolved solids) to brackish (1,000 to 10,000 milligrams per liter total dissolved solids). The values reported for the flow terms in Table 1 of this report include fresh and brackish groundwater.

Table 1: Summarized information needed for Upper Trinity Groundwater Conservation 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	Woodbine Aquifer	0
	Washita and Fredericksburg series	39,760
	Paluxy Aquifer	83,812
	Glen Rose Formation	28,139
	Hensell Aquifer	40,407
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	34,629
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers*	Woodbine Aquifer	0
	Washita and Fredericksburg series	5,530
	Paluxy Aquifer	12,318
	Glen Rose Formation	5,588
	Hensell Aquifer	12,526
	Pearsall/Cow Creek/Hammett/Sligo formations	0
	Hosston Aquifer	7,544
Estimated annual volume of flow into the district within each aquifer in the district	Woodbine Aquifer	0
	Washita and Fredericksburg series	784
	Paluxy Aquifer	393
	Glen Rose Formation	310
	Hensell Aquifer	1,852
	Pearsall/Cow Creek/Hammett/Sligo formations	4
	Hosston Aquifer	1,805
Estimated annual volume of flow out of the district within each aquifer in the district	Woodbine Aquifer	0
	Washita and Fredericksburg series	1,565
	Paluxy Aquifer	3,602
	Glen Rose Formation	1,246
	Hensell Aquifer	7,258
	Pearsall/Cow Creek/Hammett/Sligo formations	16
	Hosston Aquifer	8,462
Estimated net annual volume of flow between each aquifer in the district	Washita and Fredericksburg series into the Paluxy Aquifer	190
	Paluxy Aquifer into the Glen Rose Formation	2,678
	Glen Rose Formation into the Hensell Aquifer	3,937
	Hensell Aquifer into the Pearsall/Cow Creek/Hammett/Sligo formations	6,821
	Pearsall/Cow Creek/Hammett/Sligo formations into the Hosston Aquifer	7,294

* The evapotranspiration package of the groundwater availability model includes evaporation, transpiration, springs, seeps, and discharge to streams not modeled by the streamflow-routing package as described in Bené and others (2004). The surface water outflow estimate in Table 1 includes the results from the evapotranspiration package for model grid cells containing springs and streams not modeled by the streamflow-routing package.

Figure 1: Area of the groundwater availability model for the northern portion of the Trinity Aquifer from which the information in Table 1 was extracted (the aquifer extent within the Upper Trinity Groundwater Conservation District boundary).



REFERENCES:

Bené, J., Harden, B., O'Rourke, D., Donnelly, A., and Yelderman, J., 2004, Northern Trinity/Woodbine Groundwater Availability Model: contract report to the Texas Water Development Board by R.W. Harden and Associates, 391 p., http://www.twdb.state.tx.us/gam/trnt_n/trnt_n.htm.

Environmental Simulations, Inc., 2007, Guide to Using Groundwater Vistas Version 5, 381 p.

LBG-Guyton Associates, 2003, Brackish Groundwater Manual for Texas Regional Water Planning Groups: contract report to the Texas Water Development Board, 188 p., http://www.twdb.state.tx.us/RWPG/rpgm_rpts/2001483395.pdf.

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 November 20, 2009.