GAM Run 08-77

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district 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 Mid-East Texas Groundwater Conservation District for its groundwater management plan. The groundwater management plan for Mid-East Texas Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before September 10, 2009.

This report discusses the method, assumptions, and results from model runs using the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. Table 1 summarizes the groundwater availability model results required by statute for Mid-East Texas Groundwater Conservation District's groundwater management plan. Figure 1 shows the area of the model from which the values in Table 1 were extracted.

The Yegua Jackson Aquifer also underlies the Mid-East Texas Groundwater Conservation District. However, a groundwater availability model for this minor aquifer has not been completed at this time. If the district would like information for the Yegua Jackson Aquifer, they may request it from the Groundwater Technical Assistance Section of the Texas Water Development Board.

METHODS:

We ran the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers, 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).

PARAMETERS AND ASSUMPTIONS:

- We used Version 2.01 of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Dutton and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.

- This groundwater availability model includes eight layers, representing (from top to bottom):

  1. the Sparta Aquifer (Layer 1),
  2. the Weches Confining Unit (Layer 2),
  3. the Queen City Aquifer (Layer 3),
  4. the Reklaw Confining Unit (Layer 4),
  5. the Carrizo Aquifer (Layer 5),
  6. the Upper Wilcox Aquifer (Calvert Bluff Formation—Layer 6),
  7. the Middle Wilcox Aquifer (Simsboro Formation—Layer 7), and
  8. the Lower Wilcox Aquifer (Hooper Formation—Layer 8).

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 22 feet for the Sparta Aquifer, 27 feet for the Queen City Aquifer, 36 feet for the Carrizo Aquifer, and 31 feet for the Simsboro Aquifer for the calibration period (1980 to 1990) and 24, 33, 32, and 43 feet for the same aquifers, respectively, in the verification period (1991 to 1999) (Kelley and others, 2004). These root mean square errors are between four and eleven percent of the range of measured water levels (Kelley 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 groundwater flow components were extracted from the water 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 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 the upper and lower faces of the aquifers or confining units. This flow is controlled by the relative water level elevations 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.

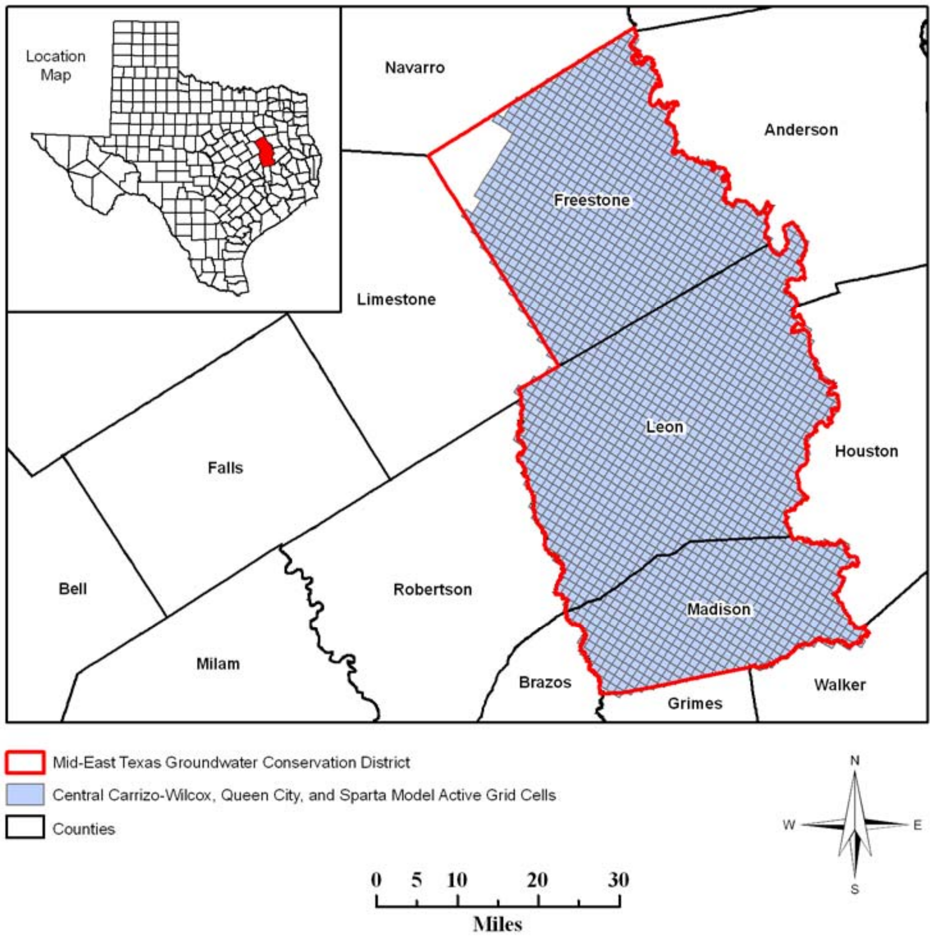
The information needed for the district’s management plan is summarized in Table 1. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles 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).

Groundwater in the Carrizo-Wilcox, Queen City, and Sparta aquifers ranges from fresh to brackish in composition (Kelley and others, 2004). Groundwater with total dissolved solids of less than 1,000 milligrams per liter are considered fresh and total dissolved solids of 1,000 to 10,000 milligrams per liter are considered brackish.

Table 1: Summarized information needed for Mid-East Texas 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. Reported flow estimates include both fresh and brackish waters present in the aquifers.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	15,101
	Weches Confining Unit	1,941
	Queen City Aquifer	26,646
	Reklaw Confining Unit	2,545
	Carrizo Aquifer	14,884
	Wilcox (upper) Aquifer	19,987
	Wilcox (middle) Aquifer	10,056
	Wilcox (lower) Aquifer	3,674
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	3,702
	Weches Confining Unit	225
	Queen City Aquifer	16,397
	Reklaw Confining Unit	678
	Carrizo Aquifer	5,633
	Wilcox (upper) Aquifer	16,580
	Wilcox (middle) Aquifer	10,197
	Wilcox (lower) Aquifer	3,443
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	1,488
	Weches Confining Unit	460
	Queen City Aquifer	2,150
	Reklaw Confining Unit	227
	Carrizo Aquifer	3,883
	Wilcox (upper) Aquifer	2,582
	Wilcox (middle) Aquifer	6,517
	Wilcox (lower) Aquifer	4,428
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	1,384
	Weches Confining Unit	92
	Queen City Aquifer	2,539
	Reklaw Confining Unit	247
	Carrizo Aquifer	7,715
	Wilcox (upper) Aquifer	4,275
	Wilcox (middle) Aquifer	7,483
	Wilcox (lower) Aquifer	4,634
Estimated net annual volume of flow between each aquifer in the district	Sparta Aquifer into the Weches Confining Unit	1,127
	Weches Confining Unit into the Queen City Aquifer	2,131
	Reklaw Confining Unit into the Queen City Aquifer	111
	Reklaw Confining Unit into the Carrizo Aquifer	27
	Carrizo Aquifer into the Wilcox (upper) Aquifer	491
	Wilcox (upper) Aquifer into the Wilcox (middle) Aquifer	3,544
	Wilcox (middle) Aquifer into the Wilcox (lower) Aquifer	162

Figure 1: Area of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers from which the information in Table 1 was extracted (the aquifer extent within the Mid-East Texas Groundwater Conservation District boundary).



REFERENCES:

Dutton, A.R., Harden, B., Nicot, J.P., and O'Rourke, D., 2003, Groundwater availability model for the central part of the Carrizo-Wilcox Aquifer in Texas: Contract report to the Texas Water Development Board, 295 p., http://www.twdb.state.tx.us/gam/czwx_c/czwx_c.htm.

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

Kelley, V.A., Deeds, N.E., Fryar, D.G., and Nicot, J.P., 2004, Groundwater availability models for the Queen City and Sparta aquifers: Contract report to the Texas Water Development Board, 867 p., http://www.twdb.state.tx.us/gam/qc_sp/qc_sp.htm.

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 February 25, 2009.