GAM Run 09-020

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EXECUTIVE SUMMARY:

Texas 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 Rusk County Groundwater Conservation District for its groundwater management plan. The groundwater management plan for Rusk County Groundwater Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before October 17, 2010.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the northern portion of the Carrizo-Wilcox, Queen City, and Sparta aquifers. 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 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) for the portions of the aquifers located within the district.

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 Fryar and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Queen City, Sparta, and Carrizo-Wilcox 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 mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 21 feet for the Queen City Aquifer, 25 feet for the Carrizo Aquifer, 21 feet for the Upper Wilcox Aquifer, 26 feet for the Middle Wilcox Aquifer, and 20 feet for the Lower Wilcox Aquifer for the calibration period (1980 through 1989) and 24, 28, 24, 29, and 25 feet for the same aquifers respectively in the verification period (1990 through 1999), or between three and nine 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 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.

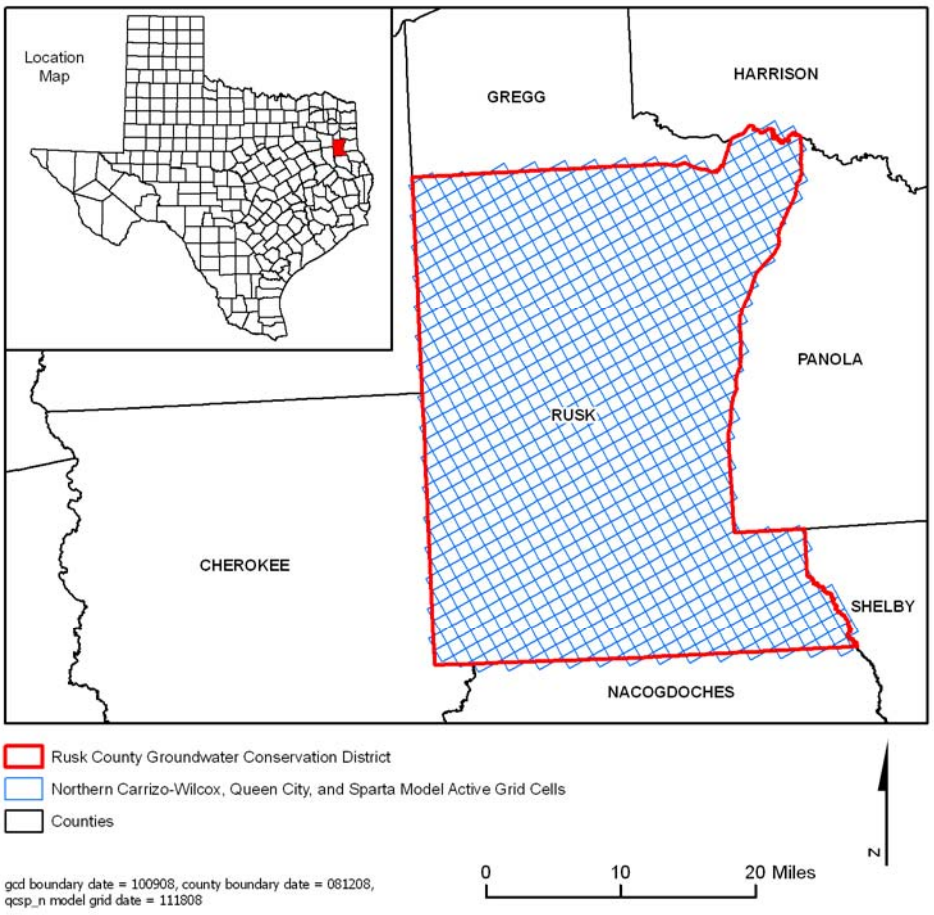
- Flow between aquifers—This describes the vertical flow, or leakage, between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs. “Inflow”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

Table 1: Summarized information needed for Rusk County 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	Sparta Aquifer	0
	Weches Confining Unit	0
	Queen City Aquifer	1,200
	Reklaw Confining Unit	4,237
	Carrizo Aquifer	47,719
	Wilcox (upper) Aquifer	22,609
	Wilcox (middle) Aquifer	36
	Wilcox (lower) Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	0
	Weches Confining Unit	0
	Queen City Aquifer	227
	Reklaw Confining Unit	1,545
	Carrizo Aquifer	18,080
	Wilcox (upper) Aquifer	7,774
	Wilcox (middle) Aquifer	0
	Wilcox (lower) Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	0
	Weches Confining Unit	0
	Queen City Aquifer	199
	Reklaw Confining Unit	252
	Carrizo Aquifer	982
	Wilcox (upper) Aquifer	1,244
	Wilcox (middle) Aquifer	1,595
	Wilcox (lower) Aquifer	169
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	0
	Weches Confining Unit	0
	Queen City Aquifer	121
	Reklaw Confining Unit	417
	Carrizo Aquifer	3,484
	Wilcox (upper) Aquifer	5,656
	Wilcox (middle) Aquifer	4,338
	Wilcox (lower) Aquifer	864
Estimated net annual volume of flow between each aquifer in the district	Queen City Aquifer into the Reklaw Confining Unit	1,182
	Reklaw Confining Unit into the Carrizo Aquifer	2,196
	Carrizo Aquifer into the Wilcox (upper) Aquifer	8,081
	Wilcox (upper) Aquifer into the Wilcox (middle) Aquifer	9,623
	Wilcox (middle) Aquifer into the Wilcox (lower) Aquifer	943

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



REFERENCES:

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

Fryar, D., Senger, R., Deeds, N., Pickens, J., Jones, T., Whallon, A. J., and Dean, K. E., 2003, Groundwater Availability Model for the Northern Carrizo-Wilcox Aquifer: contract report to the Texas Water Development Board, 529 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.

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 6, 2009.