GAM Run 08-38

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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 include:

(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 Pecan Valley Groundwater Conservation District for its groundwater management plan. The groundwater management plan for the Pecan Valley Groundwater Conservation District is due for approval by the executive administrator of the Texas Water Development Board before December 29, 2008.

This report discusses the method, assumptions, and results from model runs using the groundwater availability models for the central part of the Gulf Coast Aquifer and the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. Table 1 summarizes the groundwater availability model data required by statute for the Pecan Valley Groundwater Conservation Districts groundwater management plan.

METHODS:

We ran the groundwater availability models for the central part of the Gulf Coast Aquifer and the southern 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) for the portions of the Gulf Coast Aquifer and the Carrizo-Wilcox, Queen City and Sparta aquifers located within the district.

PARAMETERS AND ASSUMPTIONS:

Groundwater availability model for the central part of the Gulf Coast Aquifer

- We used Version 1.01 of the groundwater availability model for the central part of the Gulf Coast Aquifer. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model for the central part of the Gulf Coast Aquifer.

- The model simulates groundwater flow through four hydrostratigraphic layers. From top to bottom, these layers are: the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining System, and the Jasper Aquifer.

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the entire model for 1999 is 26 feet, which is 4.6 percent of the hydraulic head drop across the model area (Chowdhury and others, 2004).

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

Groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers

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

- The groundwater availability model includes eight layers, representing:

    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 squared error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 23 feet for the Sparta Aquifer, 18 feet for the Queen City Aquifer, and 33 feet for the Carrizo Aquifer for the calibration period (1980 to 1989) and 19, 22, and 48 feet for the same aquifers, respectively, in the verification period (1990 to 1999) (Kelley and others, 2004). These root mean squared errors are between seven and ten percent of the range of measured water levels (Kelley 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:

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). 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.

As depicted by Kalaswad and Arroyo (2006) and Kelley and others (2004), groundwater in the Gulf Coast Aquifer and the Carrizo-Wilcox, Queen City, and Sparta aquifers ranges from fresh to saline. The reported values in this report for flow terms include fresh (less than 1,000 milligrams per liter total dissolved solids), brackish (1,000 to 10,000 milligrams per liter total dissolved solids), and saline (greater than 10,000 milligrams per liter total dissolved solids) groundwater.

REFERENCES:

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Chowdhury, A.H., Wade, S.W., Mace, R.E., and Ridgeway, C., 2004, Groundwater availability model of the central Gulf Coast Aquifer system—Numerical simulations through 1999: Unpublished Texas Water Development Board report, 114 p. http://www.twdb.state.tx.us /gam /glfc_c/glfc_c_TWDB_SummaryReport.pdf

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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.

Waterstone Environmental Hydrology and Engineering Inc. and Parsons, 2003, Groundwater availability of the Central Gulf Coast Aquifer: Numerical Simulations to 2050, Central Gulf Coast, Texas Contract report to the Texas Water Development Board, 157 p.

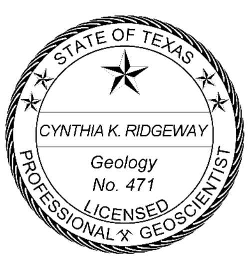

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Table 1: Summarized information needed for the Pecan Valley Groundwater Conservation District's groundwater management plan. All values are reported in acre-feet per year. All numbers are rounded to the nearest 1 acre-foot. Flows include fresh, brackish, and saline waters.

Management Plan requirement	**Aquifer or confining unit**	**Results**
Estimated annual amount of recharge from precipitation to the district	Chicot	4,246
	Evangeline	5,362
	Burkeville	10
	Jasper	225
	Sparta	0
	Weches	0
	Queen City	0
	Reklaw	0
	Carrizo	0
	Wilcox (upper)	0
	Wilcox (middle)	0
	Wilcox (lower)	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Chicot	1,045
	Evangeline	8,671
	Burkeville	75
	Jasper	1,556
	Sparta	0
	Weches	0
	Queen City	0
	Reklaw	0
	Carrizo	0
	Wilcox (upper)	0
	Wilcox (middle)	0
	Wilcox (lower)	0

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual volume of flow into the district within each aquifer in the district	Chicot	3
	Evangeline	987
	Burkeville	6
	Jasper	662
	Sparta	20
	Weches	46
	Queen City	23
	Reklaw	133
	Carrizo	1,477
	Wilcox (upper)	110
	Wilcox (middle)	258
	Wilcox (lower)	1,732
Estimated annual volume of flow out of the district within each aquifer in the district	Chicot	1,519
	Evangeline	7,515
	Burkeville	40
	Jasper	1,151
	Sparta	13
	Weches	42
	Queen City	3
	Reklaw	6
	Carrizo	32
	Wilcox (upper)	7
	Wilcox (middle)	33
	Wilcox (lower)	2
Estimated net annual volume of flow between each aquifer in the district	Chicot into Evangeline	3,895
	Evangeline into Burkeville	597
	Burkeville into Jasper	823
	Weches into Sparta	790
	Queen City into Weches	895
	Reklaw into Queen City	1,261
	Carrizo into Reklaw	1,192
	Carrizo into Wilcox (upper)	194
	Wilcox (upper) into Wilcox (middle)	51
	Wilcox (lower) into (middle)	112