

GAM Run 07-25

by Shirley C. Wade, P.G.

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 936-0877
September 6, 2007

REQUESTOR:

Ms. Rima Petrossian on behalf of the Guadalupe County Groundwater Conservation District

DESCRIPTION OF REQUEST:

The following information was requested for the District from the groundwater availability model for the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers:

- 1) estimated annual amount of recharge from precipitation to the District;
- 2) estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers; and
- 3) estimated annual volume of flow into and out of the District within each aquifer and between each aquifer in the District.

METHODS:

To address the request, we:

- ran the transient groundwater availability model for the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers and extracted water budgets for each year of the 1980 through 1999 period and
- averaged the twenty-year period for recharge, surface water inflow, 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:

- 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 Queen City, Sparta, and Carrizo-Wilcox aquifers.
- We used Version 2.01 of the groundwater availability model for the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers.

- The groundwater availability model includes eight layers, representing:
 1. Sparta Aquifer (Layer 1),
 2. Weches Confining Unit (Layer 2),
 3. Queen City Aquifer (Layer 3),
 4. Reklaw Confining Unit (Layer 4),
 5. Carrizo Aquifer (Layer 5),
 6. Upper Wilcox Aquifer (Layer 6),
 7. Middle Wilcox Aquifer (Layer 7), and
 8. Lower Wilcox Aquifer (Layer 8).

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the entire model for 1999 is 23 feet for the Sparta Aquifer, 18 feet for the Queen City Aquifer, and 33 feet for the Carrizo Aquifer (Kelley and others, 2004).

RESULTS:

Recharge and water budget

A groundwater budget summarizes how the model estimates water entering and leaving the aquifer. The groundwater budget for the average values from the transient model (1980 to 1999) is shown in Table 1. The components of the budgets shown in Table 1 include:

- Surface water inflow and outflow—This is the total surface water entering the aquifer (inflow) through streams or reservoirs, or total surface water exiting the aquifer (outflow) to streams, reservoirs, drains (springs), or through evapotranspiration (return of moisture to the air through both evaporation from the soil and transpiration or loss of water vapor by plants).
- Lateral flow into and out of District—This component describes lateral flow within the aquifer between the District and adjacent counties.
- Net inter-aquifer flow—This describes the vertical flow, or leakage, between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer that define the amount of leakage that can occur. “Inflow” to an aquifer from an overlying or underlying aquifer will always equal the “Outflow” from the other aquifer, except for the top layer where flow from and to overlying younger aquifers are simulated with a general head boundary condition.
- Recharge from precipitation is the areally distributed recharge due to precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the District. The information needed for the District’s management plan is summarized in Table 2.

REFERENCES:

Deeds, N., Kelley, V., Fryar, D., Jones, T., Whallon, A. J., and Dean, K. E., 2003, Groundwater Availability Model for the Southern Carrizo-Wilcox Aquifer: contract report to the Texas Water Development Board, 452 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.



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Table 1: Selected flow terms for each aquifer layer, into and out of the Guadalupe County Groundwater Conservation District, averaged for the years 1980 to 1999 from the groundwater availability model of the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers. Flows are in acre-feet per year. Note: a negative sign refers to flow out of the aquifer in the District. A positive sign refers to flow into the aquifer in the District. All numbers are rounded to the nearest acre-foot.

Aquifer	Surface water inflow	Surface water outflow	Lateral inflow into district	Lateral outflow from district	Net inter-aquifer flow (upper)	Net inter-aquifer flow (lower)
Sparta Aquifer (Layer 1)	0	0	0	0	0	0
Queen City Aquifer (Layer 3)	0	0	3	2	0	-3
Carrizo Aquifer (Layer 5)	75	-287	10	-6,752	390	-738
Upper Wilcox (Layer 6)	0	0	1	-48	738	-99
Middle Wilcox (Layer 7)	1,896	-3,965	1,045	-4,874	99	-557
Lower Wilcox (Layer 8)	719	-605	596	-4,378	557	0

Table 2: Summarized information needed for the District’s management plan. All values reported in acre-feet per year. All numbers are rounded to the nearest acre-foot.

Management Plan requirement	Aquifer	Results from model simulation
Estimated annual amount of recharge from precipitation to the District	All aquifers and confining units	18,184
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta, Queen City, Carrizo, and Upper, Middle and Lower Wilcox Aquifers	4,857
Estimated annual volume of flow into the District within each aquifer in the District	Sparta Aquifer	0
	Queen City Aquifer	3
	Carrizo Aquifer	10
	Upper Wilcox	1
	Middle Wilcox	1,045
	Lower Wilcox	596
Estimated annual volume of flow out of the District within each aquifer in the District	Sparta Aquifer	0
	Queen City Aquifer	2
	Carrizo Aquifer	6,752
	Upper Wilcox	48
	Middle Wilcox	4,874
	Lower Wilcox	4,378
Estimated annual volume of flow between each aquifer in the District	Younger units and Sparta Aquifer	0
	Sparta Aquifer and Weches Confining Unit	0
	Weches Confining Unit and Queen City Aquifer	0
	Queen City Aquifer and Reklaw Confining Unit	3
	Reklaw Confining Unit and Carrizo Aquifer	390
	Carrizo Aquifer and Upper Wilcox Aquifer	738
	Upper Wilcox Aquifer and Middle Wilcox Aquifer	99
	Middle Wilcox Aquifer and Lower Wilcox Aquifer	557