GAM run 06-18

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Groundwater Availability Modeling Section
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REQUESTOR:

Mr. Josh Grimes, General Manager for the Plum Creek Conservation District (district).

DESCRIPTION OF REQUEST:

Mr. Grimes requested the following information for his district from the groundwater availability model (GAM) 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;
3) estimated annual volume of flow into and out of the district within each aquifer and between each aquifer in the district; and
4) estimated annual amount of groundwater being used in the district on an annual basis.

METHODS:

To address the request, we ran the GAM for the southern part of the Queen City, Sparta, and Carrizo-Wilcox aquifers for the 1980 to 1999 period and averaged the results for each layer in the model to obtain values. The results for items 1 through 3 are addressed in Table 1 and include all layers that exist in the GAM within the district boundaries. We did not analyze the Edwards (Balcones Fault Zone) aquifer since this aquifer is controlled by the Barton Springs/Edwards Aquifer Conservation District or the Edwards Aquifer Authority. Item 4 is addressed in Table 2.
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PARAMETERS AND ASSUMPTIONS:

We used the following assumptions in this analysis:

- See Deeds and others (2003) and Kelley and others (2004) for assumptions and limitations of the GAM.
- The model includes eight layers representing: the Sparta aquifer (Layer 1), Weches confining unit (Layer 2), Queen City aquifer (Layer 3), Reklaw confining

unit (Layer 4), Carrizo aquifer (Layer 5), Calvert Bluff Formation (Layer 6), Simsboro Formation (Layer 7), and Hooper Formation (Layer 8).

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the entire GAM for the period of 1980 to 1999 ranges from 6.5 percent (Carrizo aquifer) to 9.8 percent (Queen City aquifer) of measured water levels (Kelley and others, 2004).

- Diffuse precipitation recharge on the outcrop varies annually in the model during the period 1980 to 1999. The recharge incorporates the effects of average annual precipitation, topography, and underlying geology.

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:

- Precipitation recharge—This is the areally distributed recharge due to precipitation falling on the outcrop areas of the aquifers within the district.

- 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, or through evapotranspiration.

- Net inter–aquifer flow—This describes the vertical flow, or leakage, between two aquifers. 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.

- Lateral flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

REFERENCES:

Deeds, N., Kelley, V., Fryar, D., and Jones, T., 2003, Groundwater availability model for the southern Carrizo-Wilcox aquifer: final report prepared for the Texas Water Development Board by INTERA Inc.

Kelley, V. A., Deeds, N. E., Fryar, D. G., Nicot, J. P., Jones, T. L., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin J. L., 2004, Groundwater availability model for the Queen City and Sparta aquifers: final report prepared for the Texas Water Development Board by INTERA Inc.

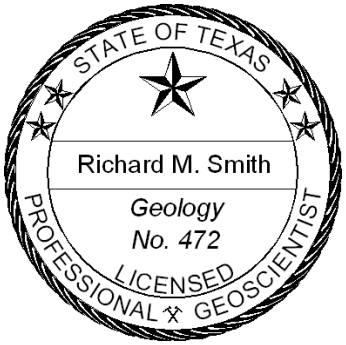

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Table 1: Groundwater flow budget for each aquifer layer, into and out of the Plum Creek Conservation District, averaged for the years 1980 to1999 from the GAM of the southern part of the Queen City and Sparta aquifers. Flows are in acre-feet per year. **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 1 acre-foot and are probably only accurate to two significant figures.**

Aquifer / layer	Precipitation recharge	Average. surface water inflow	Average. surface water outflow	Average. inflow into district	Average. outflow from district	Average. net Inter-aquifer flow (upper)	Average. net Inter-aquifer flow (lower)
Sparta aquifer / layer 1	0	0	0	0	0	0	0
Weches confining unit / layer 2	0	0	0	0	0	0	0
Queen City aquifer / layer 3	0	0	0	0	0	0	0
Reklaw confining unit / layer 4	0	0	0	0	0	0	0
Carrizo aquifer / layer 5	121	0	0	0	-128	0	-5
Wilcox(upper) / layer 6 (Calvert Bluff Formation)	0	0	0	0	-3	5	-2
Wilcox(middle) / layer 7 (Simsboro Formation)	3,062	574	-5,743	1,398	-1,037	2	625
Wilcox(lower) / layer 8 (Hooper Formation)	2,867	634	-1,164	845	-444	-625	0

Table 2: Groundwater usage for the Plum Creek Conservation District in 1999 as the base year. All values are in acre-feet per year.

Aquifer / layer	Groundwater usage
Sparta aquifer / layer 1	0
Weches confining unit / layer 2	0
Queen City aquifer / layer 3	0
Reklaw confining unit / layer 4	0
Carrizo aquifer / layer 5	3
Wilcox(upper) / layer 6 (Calvert Bluff Formation)	0
Wilcox(middle) / layer 7 (Simsboro Formation)	650
Wilcox(lower) / layer 8 (Hooper Formation)	1,889

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