GAM Run 07-06

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Groundwater Availability Modeling Section
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REQUESTOR:

Mr. Dale Hallmark of the North Plains Groundwater Conservation District.

DESCRIPTION OF REQUEST:

Mr. Hallmark requested the following information for his district from the groundwater availability model for the northern part of the Ogallala Aquifer:

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 northern part of the Ogallala Aquifer 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:

- Used version 2.01 of the groundwater availability model for the northern part of the Ogallala Aquifer (2004, Dutton)

- See Dutton and others (2001) and Dutton (2004) for assumptions and limitations of the groundwater availability model for the northern part of the Ogallala Aquifer. Root mean squared error for this model is 53 feet.

- Recharge was reappraised in the updated groundwater availability model of the northern part of the Ogallala Aquifer (Dutton, 2004).
- The Rita Blanca Aquifer is included in the groundwater availability model and is not separate from the Ogallala Aquifer. The Dockum Aquifer is not included and no groundwater model exists to determine the selected flow terms from the Dockum.

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 uptake of water 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. Due to the fact that the Ogallala Aquifer is the only layer modeled, vertical flow does not apply in this case.

- Precipitation recharge 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:

Dutton, A., Reedy, R., and Mace, R., 2001, Saturated thickness of the Ogallala Aquifer in the Panhandle Water Planning Area – Simulation of 2000 through 2050 Withdrawal Projections: prepared for the Panhandle Water Planning Group by the Bureau of Economic Geology, The University of Texas at Austin, 54 p.

Dutton, A., 2004, Adjustments of parameters to improve the calibration of the Og-N model of the Ogallala aquifer, Panhandle Water Planning Area: Bureau of Economic Geology, The University of Texas at Austin, 9 p

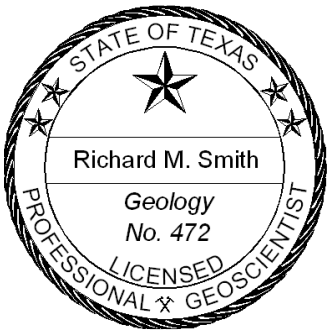

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Table 1: Selected flow terms for the Ogallala Aquifer, into and out of the North Plains Groundwater Conservation District, averaged for the years 1980 to 1999 from the groundwater availability model of the northern part of the Ogallala Aquifer. Flows are expressed in acre-feet per year. Note: a negative sign refers to flow out of the aquifer in the district. A positive value 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.

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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)
Qgallala Aquifer	27,463	-31,663	65,259	-67,455	0	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 1 acre-foot and are probably only accurate to two significant figures.

Management Plan requirement	**Aquifer**	**Results from model simulation**
Estimated annual amount of recharge from precipitation to the district	Ogallala	85,732
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala	31,663
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala	65,259
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala	67,455
Estimated annual volume of flow between each aquifer in the district	Ogallala	0