GAM run 06-06

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Groundwater Availability Modeling Section
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April 20, 2006

REQUESTOR:

Mr. John Stover, Southeast Texas Groundwater Conservation District (GCD).

DESCRIPTION OF REQUEST:

Mr. Stover requested that we provide him with the required numbers for his district's management plan using the groundwater availability model (GAM) for the northern part of the Gulf Coast aquifer (Kasmarek and Robinson, 2004; Kasmarek and others, 2005).

METHODS:

We analyzed for average recharge from precipitation, average surface-water inflow, average surface-water outflow, average inflow into the district, average outflow from the district, average net inter-aquifer flow (upper), and average net inter-aquifer flow (lower) using the period 1980 to1999. MODFLOW's general head boundary (GHB) package was used to simulate recharge and discharge in the GAM for the northern part of the Gulf Coast aquifer. The GHB package simulates flow across the boundary using differences in water-level elevations at or beyond the boundary and the aquifer and conductance of the aquifer materials. The amount of water that recharges the aquifer from rainfall, irrigation return flow, and river leakage and naturally discharges in the form of baseflow to streams and evapotranspiration are all accounted for in the GHB. Evapotranspiration is the water that is lost out of the aquifer due to direct evaporation from the water table (when water table is shallow) and plant transpiration. To calculate surface water interaction, we assumed the uppermost block or GHB cell in the model with a river, stream, spring, lake, or reservoir represented groundwater/surface-water interactions. All other cells using the GHB package were assumed to represent net recharge from precipitation.

To address the request, we:

- ran the transient GAM for the northern part of the Gulf Coast aquifer and extracted water budgets for each year of the 1980 through 1999 period;
- 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:

- For detailed discussion on assumptions and limitations of the northern part of the Gulf Coast aquifer GAM, refer to Kasmarek and Robinson (2004) and Kasmarek and others (2005).

- The model includes four layers, representing the Chicot aquifer (Layer 1), the Evangeline aquifer (Layer 2), the Burkeville confining unit (Layer 3), and the Jasper aquifer (Layer 4).

- Quality of model calibration can be estimated using root mean square (RMS) error. RMS error evaluates differences between measured and simulated water levels in the wells considered for calibration. The RMS error is 31 feet for the Chicot aquifer, 45 feet for the Evangeline aquifer, and 38 feet for the Jasper aquifer for the calibration year 2000.

RESULTS:

The Chicot, Evangeline, and Jasper are the principal aquifers in the Southeast Texas GCD with the Burkeville functioning as a confining unit. The components of the budgets shown in Table 1 include:

- Precipitation recharge—This component represents areally distributed recharge due to precipitation falling on the outcrop areas of aquifers. This value reflects the average precipitation from 1980 to 1999.

- Surface water inflow and outflow—This describes the interaction between the aquifer and streams, springs, lakes, wetlands, and possibly irrigation return flow.

- Net inter-aquifer flow upper and lower—This describes the vertical flow, or leakage, between two aquifers. This flow is controlled by the 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.

- Inflow into and outflow from the district—This component describes the lateral flow of groundwater within the aquifer between the GCD and adjacent counties.

The water budgets for an individual cell containing a GCD boundary are assigned to either the GCD or the surrounding county.

REFERENCES:

Kasmarek , M. C., and Robinson, J. L., 2004, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast aquifer system, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5102, 111p.

Kasmarek , M. C., Reece, B. D., and Houston, N. A., 2005, Evaluation of groundwater flow and land-surface subsidence caused by hypothetical withdrawals in the northern part of the northern part of the Gulf Coast aquifer system, Texas: U.S. Geological Survey Scientific Investigations Report 2005-5024, 70p.

Table 1: All values are averages of the 1980 to 1999 water budgets. All values are in acre-feet per year. Note: negative values mean flow out of the district and positive values mean flow into the district.

GCD	Model	Aquifer	Precipitation recharge (acft/yr)	Surface water inflow (acft/yr)	Surfac water outflow (acft/yr	Inflow into district (acft/yr	Outflow from district (acft/yr	Net inter-aquifer flow (upper(acft/yr	Av. Net inter-aquifer flow (lower) (acft/yr)
Southeast Texas GCD	Gulf Coast-North	Chicot aquifer	74,796	11,933	37,043	51,203	60,365	0	-24,850
Southeast Texas GCD	Gulf Coast-North	Evangeline aquifer	11,021	636	4,636	51,984	55,372	24,850	866
Southeast Texas GCD	Gulf Coast-North	Burkeville Confining Unit	11	1	2	78	89	-866	334
Southeast Texas GCD	Gulf Coast-North	Jasper aquifer	13,610	607	10,774	13,686	14,656	-334	0