GAM Run 10-011

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district 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 the groundwater management plan includes:

(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 Starr County Ground Water Conservation District for its groundwater management plan based on the district boundaries. The groundwater management plan for Starr County Ground Water Conservation District is due for approval by the Executive Administrator of the Texas Water Development Board before November 6, 2010. Starr County Ground Water Conservation District falls within one existing major aquifer , the south section of the Gulf Coast Aquifer, and another minor aquifer , Yegua-Jackson Aquifer.

This report discusses the method, assumptions, and results from model runs using the groundwater availability models for the southern portion of the Gulf Coast Aquifer and the Yegua-Jackson Aquifer. Tables 1 through 2 summarize the groundwater availability model data required by statute for Starr County Ground Water Conservation District's groundwater management plan. Figures 1 through 2 show the areas of the model from which the values in tables were extracted.

METHODS:

We ran the groundwater availability model for the southern portion of the Gulf Coast Aquifer and (1) extracted the water budget for each year of the transient calibration period, 1981 through 1999, 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 southern section of the Gulf Coast Aquifer located within the district.

We ran the groundwater availability model for Yegua-Jackson Aquifer and (1) extracted water budgets for each year of the 1980 through 1997 transient calibration period and (2) averaged the annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district for the portions of the western section of the Yegua-Jackson Aquifer located within the district.

PARAMETERS AND ASSUMPTIONS:

Gulf Coast Aquifer

- We used version 2.01 of the groundwater availability model for the southern portion of the Gulf Coast Aquifer. See Chowdhury and others (2003) for assumptions and limitations of the model.
- The southern section of the Gulf Coast Aquifer model includes four layers representing:
  1. the Chicot Aquifer (Layer 1),

2. the Evangeline Aquife (Layer 2),
3. the Burkeville Confining System (Layer 3), and
4. the Jasper Aquifer (Layer 4),

- Information was extracted and summarized for layers 1 to 4 and reported for the Gulf Coast Aquifer located within the district.
- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the aquifers in the model for the calibration and verification time period of 1980 through 1990 is 14 feet. It is 15 feet for the calibration and verification time period of 1990 through 2000. The root mean squared error (RMS) is 17 feet for 1980-1990 and 18 feet for 1990-2000 (Ali and others, 2003).
- We used Processing MODFLOW for Windows (PMWIN) (Version 5.3.0, W. H. Chiang & W. Kinzelbach 1991-2001) as the interface to process model output.

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Kelley and others (2010) for assumptions and limitations of the model.
- The Yegua-Jackson Aquifer model includes five layers representing:
    1. outcrop section for the Yegua-Jackson Aquifer and younger overlying units,
    2. the upper portion of the Jackson Group,
    3. the lower portion of the Jackson Group,
    4. the upper portion of the Yegua Group, and
    5. the lower portion of the Yegua Group.
- Information was extracted and summarized for portions of layer 1 that represent the Yegua-Jackson as well as layers 2 to 5 for the portions of the aquifer located within the district.
- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) for the aquifers in the model (Jackson Group and Yegua Group) for the transient calibration period (1980 through 1997) ranged from approximately 31 to 23 feet. The root mean squared error was about ten percent (or less) of the maximum change in water levels across the model (Deeds and others, 2010).
- The recharge used for the model run represents average recharge as described in Deeds and others (2010).
- We used Groundwater Vistas Version 5 (Environmental Simulations, Inc. 2007) as the interface to process model output.
- The model results presented in this report were extracted from all areas of the model representing the units comprising the Yegua-Jackson Aquifer. For this reason, the reported values may reflect water of quality ranging from fresh to brackish and saline. This is especially true for the subcrop portions of the aquifer in the western section of the district.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability models. Selected components were extracted from the groundwater budget for the aquifers located within the district and averaged over the duration of the calibration and verification portion of each model run: 1981 through 1999 for the southern section of the Gulf Coast Aquifer and 1980 through 1997 for the Yegua-Jackson Aquifer. The components of the modified budget shown in Tables 1 through 2 include:

- Precipitation recharge—This is the 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 (Only Trinity Aquifer)—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 tables 1 through 2. 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 (see figures 1 to 2).

Table 1: Gulf Coast Aquifer's summarized information required for the Starr County Ground Water 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. Reported flow estimates include both fresh and brackish waters present in the aquifers.

Management Plan requirement	Aquifer	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer	4,132
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Gulf Coast Aquifer	168
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer	1,301
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer	5,241
Estimated net annual volume of flow between each aquifer in the district	Not Applicable	Not Applicable

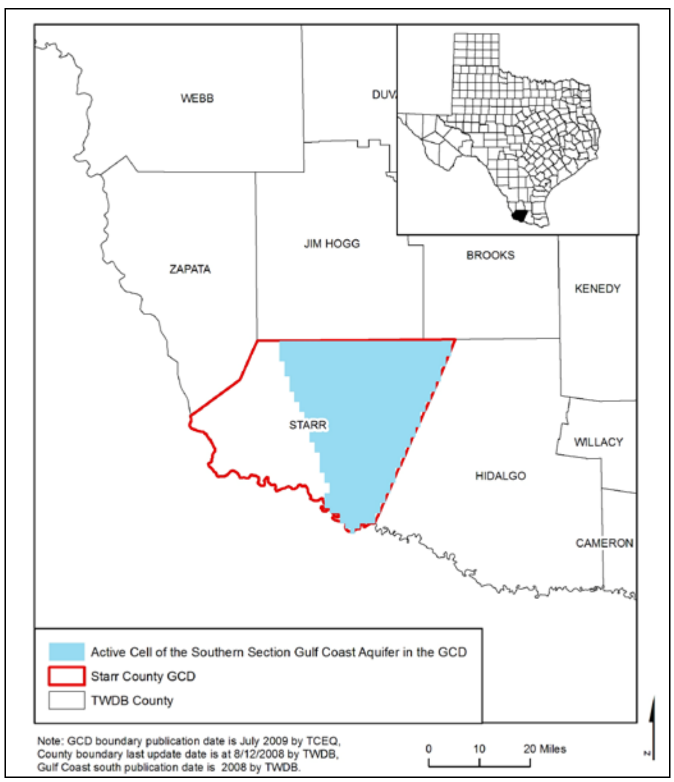

Figure 1: Area of the groundwater availability model for the Gulf Coast Aquifer from which the information in Table 1 was extracted (the aquifer extent within the Starr County Ground Water Conservation District boundary).

Table 2: Yegua-Jackson Aquifer's summarized information required for the Starr County Ground Water 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. Reported flow estimates include both fresh and brackish waters present in the aquifers.

Management Plan requirement	Aquifer	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	705
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	2,076
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	657
Estimated net annual volume of flow between each aquifer in the district	Not Applicable	Not Applicable

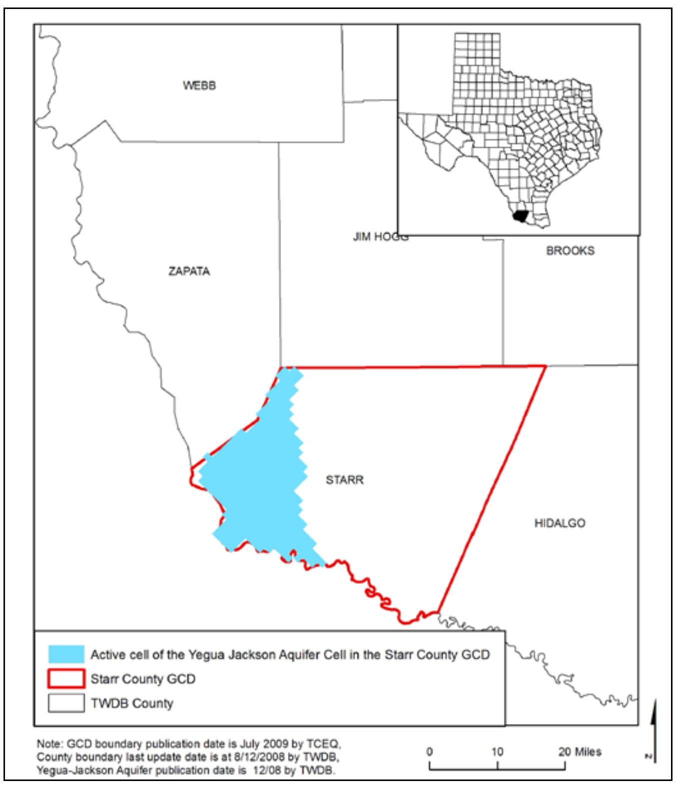

Figure 2: Area of the groundwater availability model for the Yegua-Jackson Aquifer from which the information in Table 2 was extracted (the aquifer extent within the Starr County Ground Water Conservation District boundary).

REFERENCES:

Chowdhury, Ali H. and Mace Robert, 2003, A Groundwater Availability Model of the Gulf Coast Aquifer in the Lower Rio Grande Valley, Texas: Numerical Simulations through 2050: a report by the Texas Water Development Board,176 p., http://www.twdb.state.tx.us/gam/glfc_s/Glfc_s_Oct2003Report.pdf

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Environmental Simulations, Inc., 2007, Guide to Using Groundwater Vistas Version 5, 381 p.

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