# GAM run 07-08

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## EXECUTIVE SUMMARY:

The Brewster County Groundwater Conservation District requested water budget values to be used in their groundwater management plan. We ran the Edwards-Trinity (Plateau) and the Igneous and parts of West Texas Bolsons groundwater availability models for the 1980 to 1999 period; extracted the water budgets for each year; averaged the yearly values; and generated tables to show the results.

## REQUESTOR:

Mr. Conrad Arriola, Brewster County Groundwater Conservation District.

## DESCRIPTION OF REQUEST:

Mr. Arriola requested that we run the Edwards-Trinity (Plateau) Aquifer groundwater availability model and the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers to provide him with water budgets for his district's groundwater management plan. The run is a standard transient calibration-verification model run, which includes the years 1980 to 1999. The management plan requires estimated budgets for recharge from precipitation, surface-water inflow, surface-water outflow, inflow into the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower). Groundwater availability models have not been developed for the Marathon, Capitan Reef Complex, and Rustler aquifers; therefore, this report does not directly address information concerning these aquifers or how they relate to the Igneous, Edwards, and Trinity aquifers.

## METHODS:

To address the request, we:

- ran the transient groundwater availability model for the Edwards-Trinity (Plateau) Aquifer and the transient groundwater availability model for the Igneous and parts of West Texas Bolsons aquifers and extracted water budgets for each year of the 1980 through 1999 period and

- averaged the budgets from 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) for the portions of the Igneous, Edwards, and Trinity aquifers located within the district.

## PARAMETERS AND ASSUMPTIONS:

- We used Version 1.01 of the groundwater availability model for the Igneous and parts of the West Texas Bolsons aquifers.

- We used Version 1.0 of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer.

- In the analysis, the pumpage distribution is the same for both of the transient calibrated models as described in Anaya and Jones (2004) and Beach and others (2004).

- The root mean squared error (a measure of the difference between simulated and actual water levels during model calibration) in the entire Edwards-Trinity (Plateau) groundwater availability model for the period of 1990 to 2000 is 143 feet, or six percent of the range of measured water levels (Anaya and Jones, 2004).

- The mean absolute error (a measure of the difference between simulated and actual water levels during model calibration) in the entire Igneous and parts of West Texas Bolsons groundwater availability model for the period of 1990 to 2000 is 64 feet, or four percent of the range of measured water levels (Beach and others, 2004).

- The Edwards-Trinity (Plateau) model includes two layers, representing the Edwards and associated limestones (Layer 1) and undifferentiated Trinity units (Layer 2) in the district.

- The Igneous and West Texas Bolsons model includes three layers, representing the Salt Basin Bolson Aquifer (Layer 1), the Igneous Aquifer (Layer 2), and the underlying Cretaceous and Permian units (Layer 3).

## RESULTS:

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

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.

It is important to note that sub-regional water budgets for individual counties, such as Brewster are not exact. This is due to the one-mile spacing of the model grid and because we assumed each model cell is assigned to a single county. The water budgets for an individual cell containing a county boundary are assigned to either one county or the other and therefore very minor variations in the county-wide budgets may be observed.

## REFERENCES:


Anaya, R., and Jones, I., 2004, Groundwater availability model for the Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifer systems, Texas: Texas Water Development Board, GAM Report, 208 p.

Beach, J. A., Ashworth, J. B., Finch, Jr., S. T., Chastain-Howley, A., Calhoun, K., Urbanczyk, K. M., Sharp, J. M., and Olson, J., 2004, Groundwater availability model for the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat and Lobo Flat) aquifers: contract report to the Texas Water Development Board, 208 p.

Brackish Groundwater Manual for Texas Regional Water Planning Groups, 2003, prepared for the Texas Water Development Board by LBG-Guyton Associates, 199 p.

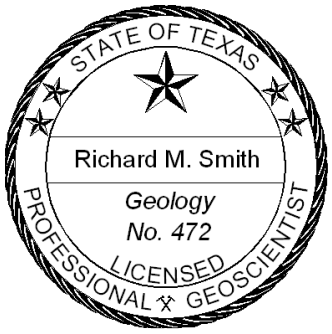

Table 1: Selected flow terms for each aquifer layer, into and out of the Brewster County Groundwater Conservation District, averaged for the years 1980 to 1999 from the groundwater availability models of the Edwards-Trinity (Plateau) aquifer and the Igneous and parts of West Texas Bolsons aquifers. Flows 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. Flow into and out of the confining layers are negligible compared to the aquifers and are not included.

| 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) |
|---|---|---|---|---|---|---|
| Edwards aquifer (Layer 1) | 0 | -22.642 | 7,340 | 4,104 | 0 | -50 |
| Trinity aquifer (Layer 2) | 1,088 | -7,830 | 6,710 | -5,116 | 50 | 0 |
| Igneous aquifer (Layer 2) | 0 | -145 | 1,105 | -1,239 | 0 | -3,568 |

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 |
|---|---|---|
| Estimated annual amount of recharge from precipitation to the district | All aquifers exposed at land surface in the district: | *55,629 |
| Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers | Edwards (Plateau) Aquifer, Trinity (Plateau) Aquifer, Igneous Aquifer | -30,617 |
| Estimated annual volume of flow into the district within each aquifer in the district | Edwards (Plateau) Aquifer | 7,340 |
| | Trinity (Plateau) Aquifer | 6,710 |
| | Igneous Aquifer | 1,105 |
| Estimated annual volume of flow out of the district within each aquifer in the district | Edwards (Plateau) Aquifer | -4,104 |
| | Trinity (Plateau) Aquifer | -5,116 |
| | Igneous Aquifer | -1,239 |
| Estimated annual volume of flow between each aquifer in the district | Edwards (Plateau) Aquifer to the Trinity (Plateau) Aquifer | 50 |
| | Base of Trinity (Plateau) Aquifer | 0 |
| | Base of Igneous Aquifer | -3,568 |

*Includes the precipitation recharge estimated from the groundwater availability models for the Edwards (Plateau)—18,906, Trinity (Plateau)—5,049, and Igneous—6,674, as well as an estimate for the Marathon—25,000. Please note the Marathon Aquifer is a non-modeled area. We used the Brackish Groundwater Manual for Texas Regional Water Planning Groups, p 77, for reference.

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