GAM Run 13-001: Blanco-Pedernales Groundwater Conservation District Management Plan

by Ian C. Jones, Ph.D., P.G.
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Groundwater Resources Division
Groundwater Availability Modeling Section
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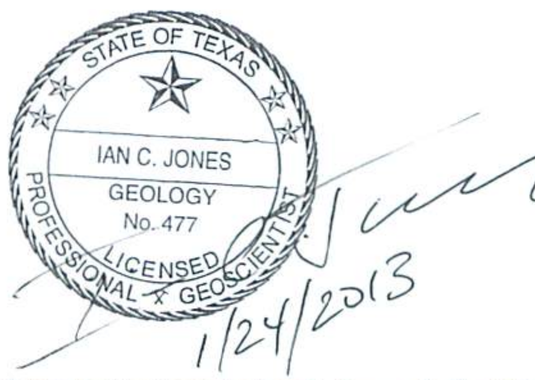
January 24, 2013



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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 (TWDB) 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:

- the annual amount of recharge from precipitation to the groundwater resources within the district, if any;
- 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
- the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The purpose of this report is to provide Part 2 of a two-part package of information from the TWDB to the Blanco-Pedernales Groundwater Conservation District to fulfill the requirements noted above. The groundwater management plan for the Blanco-Pedernales Groundwater Conservation District is due for approval by the executive administrator of the TWDB before January 7, 2014.

This report discusses the methods, assumptions, and results from a model run using the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. This groundwater availability model also includes part of the Trinity Aquifer. Tables 1 and 2 summarize the groundwater availability model data required by the statute, and Figures 1 and 2 show the areas of the model from which the values in the tables were extracted. This model run replaces the results of GAM Run 08-11. This model run—GAM Run 13-001—meets current standards set after the release of GAM Run 08-11.

If after review of the figures, Blanco-Pedernales Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB immediately. The TWDB has also approved, for planning purposes, an alternative model that can have water budget information extracted for the district. The alternative model is the 1-layer alternative model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers. Please contact the author of this report if a comparison report using these models is desired.

The Hickory, Marble Falls, and Ellenburger-San Saba aquifers also underlie the Blanco-Pedernales Groundwater Conservation District. If the district would like information for the Hickory, Marble Falls, and Ellenburger-San Saba aquifers, they may request it from the Groundwater Technical Assistance Section of the TWDB.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers was run for this analysis. The groundwater availability model for the Hill Country portion of the Trinity Aquifer was considered but not used because it does not include parts of northern Blanco County. Water budgets within Blanco-Pedernales Groundwater Conservation District for 1981 through 1999 were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average 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)—where applicable—for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Edwards-Trinity (Plateau) Aquifer

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer. See Anaya and Jones (2009) for assumptions and limitations of this model.
- The Edwards-Trinity (Plateau) Aquifer model includes two layers representing the Edwards Group and equivalent limestone hydrostratigraphic units (Layer 1) and the undifferentiated Trinity Group hydrostratigraphic units (Layer 2) in the district.
- We elected to use the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer instead of the groundwater availability model for the Hill Country portion of the Trinity Aquifer because the model for the Edwards-Trinity (Plateau) Aquifer covers the entire district. Because the two models are aligned in slightly different orientations, we could not combine the results from each without either double accounting or omitting important information.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the model results for the aquifers located within the district and averaged over the duration of the calibration and verification portion of the model run in the district, as shown in Tables 1 and 2.

- Precipitation recharge—The areally 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—The total water discharging from the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).
- Flow into and out of district—The lateral flow within the aquifer between the district and adjacent counties.

- Flow between aquifers—The net vertical flow 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 and 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 a district or county boundary, 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 (Figures 1 and 2).

TABLE 1: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR BLANCO-PEDERNALES GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS MAY INCLUDE BRACKISH WATERS.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	571
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	204
Estimated net annual volume of flow between each aquifer in the district	From Trinity Aquifer into Edwards-Trinity (Plateau) Aquifer	164

TABLE 2: SUMMARIZED INFORMATION FOR THE TRINITY AQUIFER THAT IS NEEDED FOR BLANCO-PEDERNALES GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT. THESE FLOWS MAY INCLUDE BRACKISH WATERS.

Management Plan requirement	*Aquifer or confining unit*	*Results*
Estimated annual amount of recharge from precipitation to the district	Trinity Aquifer	44,469
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Trinity Aquifer	25,450
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	4,461
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	19,416
Estimated net annual volume of flow between each aquifer in the district	From the Trinity Aquifer into the Edwards-Trinity (Plateau) Aquifer	164

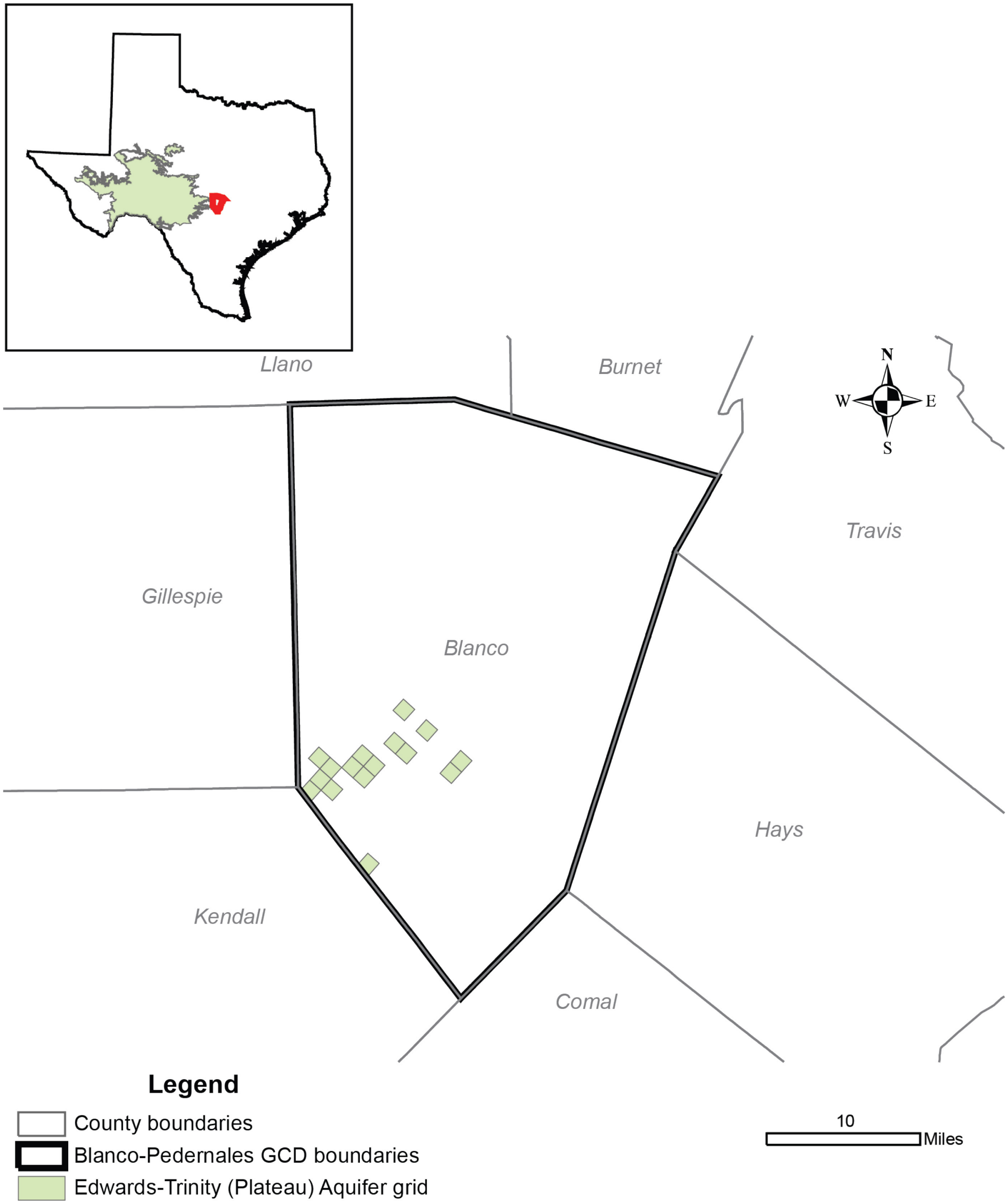

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE EDWARDS-TRINITY (PLATEAU) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

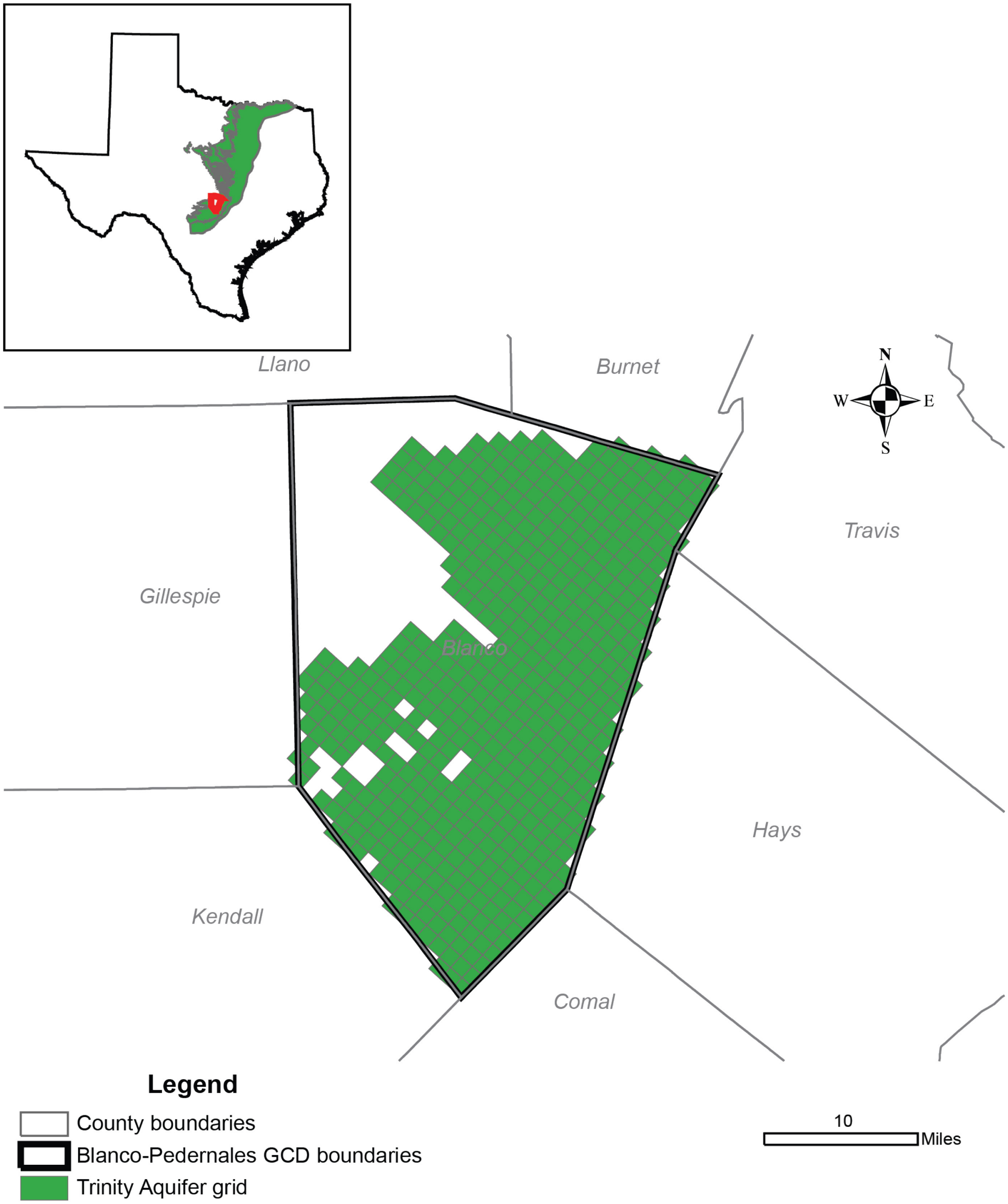

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE TRINITY AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE TRINITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS

The groundwater model(s) used in completing this analysis is the best available scientific tool that can be used to meet the stated objective(s). To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

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