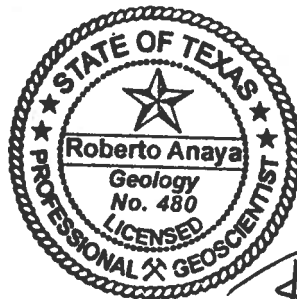

GAM RUN 19-003: LOWER TRINITY GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Roberto Anaya, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-462-6115
June 24, 2019



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6/24/19

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EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), 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.

The TWDB provides data and information to the Lower Trinity Groundwater Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
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 groundwater management plan for the Lower Trinity Groundwater Conservation District should be adopted by the district on or before July 2, 2019 and submitted to the Executive Administrator of the TWDB on or before August 1, 2019. The current management plan for the Lower Trinity Groundwater Conservation District expires on September 30, 2019.

We used two groundwater availability models to estimate the management plan information for the aquifers within the Lower Trinity Groundwater Conservation District. Information for the Yegua-Jackson Aquifer is from version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer (Deeds and others, 2010). Information for the Gulf Coast Aquifer System is from version 3.01 of the groundwater availability model for the northern portion of the Gulf Coast Aquifer System (Kasmareck, 2013).

This report replaces the results of GAM Run 14-006 (Wade, 2014), as the approach used for analyzing model results has been since refined to more accurately delineate flows for recharge and surface water discharge and between hydraulically connected units. Tables 1 and 2 summarize the groundwater availability model data required by statute and Figures 1 and 2 show the area of the models from which the values in the tables were extracted. If, after review of the figures, the Lower Trinity Groundwater Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the two groundwater availability models mentioned above were used to estimate information for the Lower Trinity Groundwater Conservation District management plan. Water budgets were extracted for the Yegua-Jackson Aquifer (1980 through 1997) and Gulf Coast Aquifer System (1980 through 2009). We used ZONEBUDGET Version 3.01 (Harbaugh, 2009) to extract water budgets from the model results. The average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers that represent the shallow outcrop portion of the Yegua-Jackson Aquifer and the younger overlying Catahoula Formation (Layer 1), the Upper Jackson Group (Layer 2), the Lower Jackson Group (Layer 3), the upper member(s) of the Yegua Formation (Layer 4), and the lower member(s) of the Yegua Formation (Layer 5).
- An overall water budget for the district was determined for the Yegua-Jackson Aquifer (Layer 1 through Layer 5, collectively, for the portions of the model that represent the Yegua-Jackson Aquifer). The net flow between aquifers within the district were determined by separating Layer 1 from the combined Layers of 2 through 5 from portions outside of the Yegua-Jackson Aquifer outcrop areas.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

Gulf Coast Aquifer System

- We used version 3.01 of the groundwater availability model for the northern part of the Gulf Coast Aquifer System for this analysis. See Kasmarek (2013) for assumptions and limitations of the groundwater availability model.
- The model has four layers which represent the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer and parts of the Catahoula Formation in direct hydrologic communication with the Jasper Aquifer (Layer 4).
- Water budgets for the district were determined for the Gulf Coast Aquifer System (Layers 1 through 4, collectively).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- Because this model assumes a no-flow boundary condition at the base of the Gulf Coast Aquifer System, we used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer to investigate groundwater flows between parts of the Catahoula Formation in direct hydrologic communication with the Gulf Coast Aquifer System and the Yegua-Jackson Aquifer and its equivalent downdip Yegua-Jackson confined units. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model for the Yegua-Jackson Aquifer.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Yegua-Jackson aquifer and the Gulf Coast Aquifer System located within Lower Trinity Groundwater Conservation District and averaged over the historical calibration periods, as shown in Tables 1 and 2.

1. 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.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.
4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

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.

TABLE 1. SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER FOR LOWER TRINITY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	4,114
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	3,879
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	1,950
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	2,826
Estimated net annual volume of flow between each aquifer in the district	Into Yegua-Jackson Aquifer from confined Yegua-Jackson units	286
	Into Yegua-Jackson Aquifer from the Catahoula Formation ¹ part of Gulf Coast Aquifer System	148

¹ The Catahoula Formation within and near its outcrop is considered part of the Gulf Coast Aquifer System by the TWDB. Flow values from the Catahoula Formation outcrop portion of the Gulf Coast Aquifer System into the Yegua-Jackson Aquifer were extracted from the groundwater availability model for the Yegua-Jackson Aquifer.

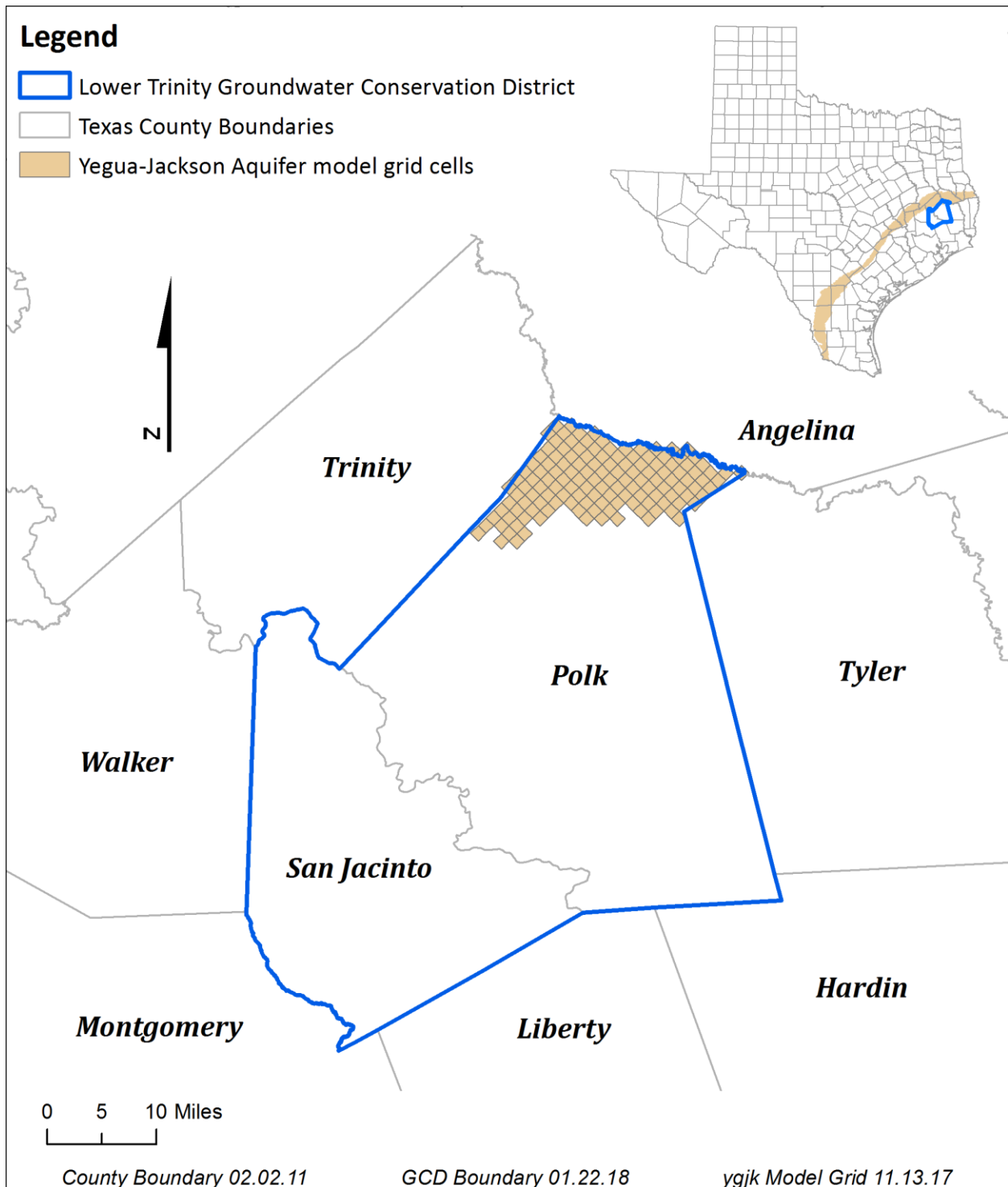


FIGURE 1 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2. SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER SYSTEM FOR LOWER TRINITY GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	17,705
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 System	9,698
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	3,618
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	11,614
Estimated net annual volume of flow between each aquifer in the district	From the Catahoula Formation ² part of Gulf Coast Aquifer System into Yegua-Jackson Aquifer	148
	Flow through the Catahoula Formation ³ from the Gulf Coast Aquifer System into confined Yegua-Jackson units	227

² The Catahoula Formation within and near its outcrop is considered part of the Gulf Coast Aquifer System by the TWDB. Flow values from the Catahoula Formation outcrop portion of the Gulf Coast Aquifer System into the Yegua-Jackson Aquifer were extracted from the groundwater availability model for the Yegua-Jackson Aquifer.

³ Deeper parts of the Catahoula Formation in direct hydrologic communication with the Gulf Coast Aquifer System provide a semi-confined boundary between the Gulf Coast Aquifer System and the underlying confined Yegua-Jackson units (not considered part of the Yegua-Jackson Aquifer by the TWDB). Flow values from the Catahoula Formation in direct hydrologic communication with the Gulf Coast Aquifer System and into the confined Yegua-Jackson units were extracted from the groundwater availability model for the Yegua-Jackson Aquifer.

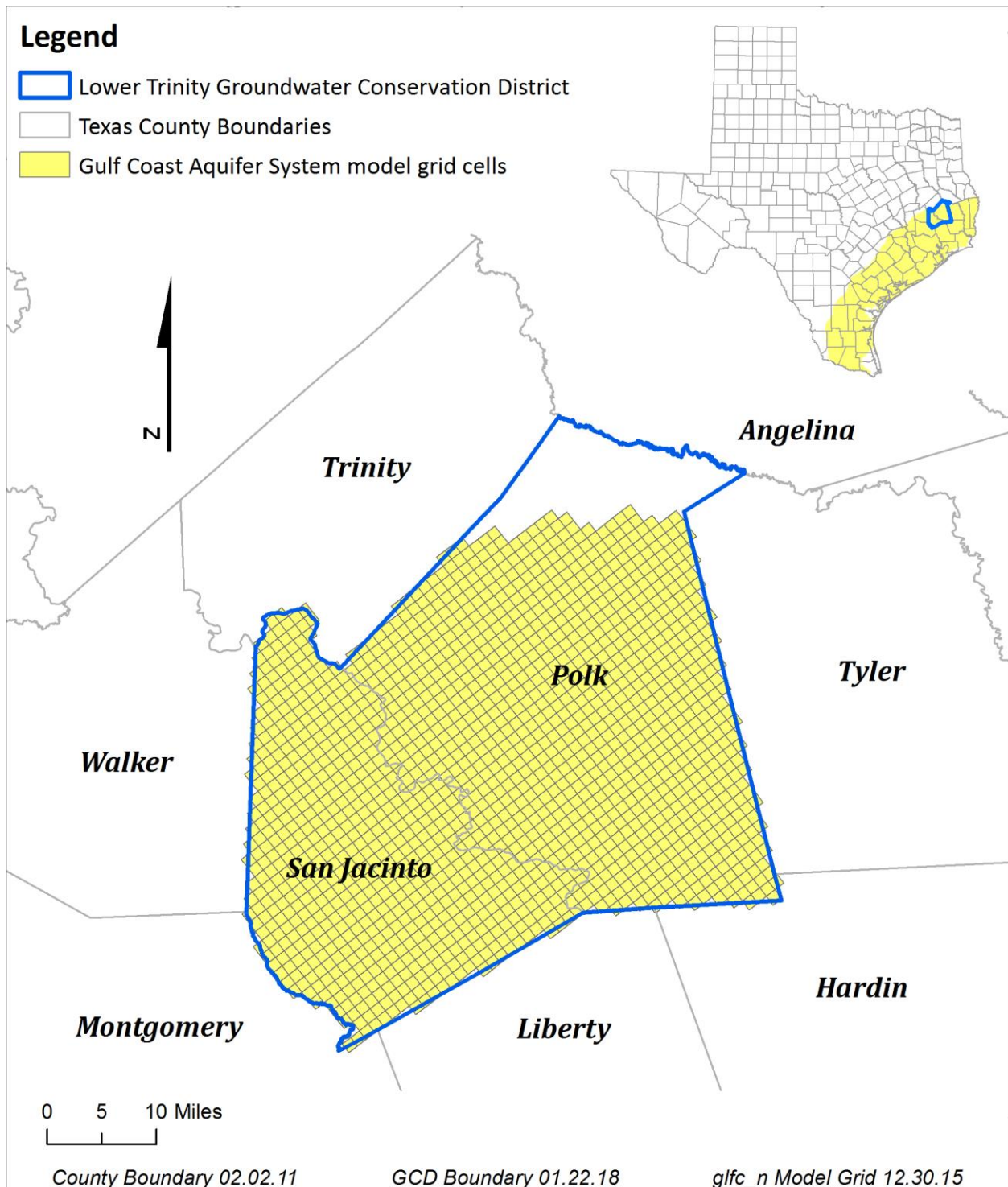


FIGURE 2 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objectives. 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 historical groundwater flow conditions includes the assumptions about the location in the aquifer where historical pumping was placed. Understanding the amount and location of historical 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 historical time periods.

Because the application of the groundwater models 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. Historical 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.

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