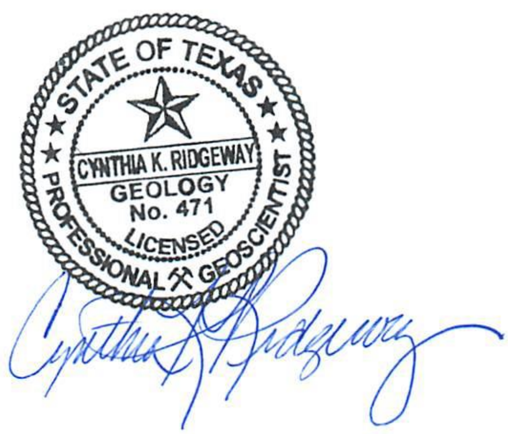
GAM Run 19-024: Clear Fork Groundwater Conservation District Management Plan

Ki Young Cha, Ph.D.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-463-5604

September 6, 2019



Cynthia K. Ridgeway is the manager of the Groundwater Availability Department and is responsible for the oversight of work performed by Ki Young Cha under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on September 6, 2019.

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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 Clear Fork 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 Clear Fork Groundwater Conservation District should be adopted by the district on or before July 22, 2020 and submitted to the Executive Administrator of the TWDB on or before August 21, 2020. The current management plan for the Clear Fork Groundwater Conservation District expires on October 20, 2020.

We used two groundwater availability models to estimate the management plan information for the aquifers within the Clear Fork Groundwater Conservation District. Information for the Dockum Aquifer is from version 1.01 of the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015). Information for the Seymour and Blaine aquifers is from version 1.01 of the groundwater availability model for the Seymour Aquifer (Ewing and others, 2004).

This report replaces the results of GAM Run 14-007 (Wade, 2014), as the approach used for analyzing model results has been since refined and GAM Run 19-024 includes results from the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015), which was released after GAM Run 14-007. Tables 1, 2 and 3 summarize the groundwater availability model data required by statute and Figures 1, 2 and 3 show the area of the models from which the values in the tables were extracted. If, after review of the figures, the Clear Fork 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) (Texas Water Code, 2011), the two groundwater availability models mentioned above were used to estimate information for the Clear Fork Groundwater Conservation District management plan. Water budgets were extracted for the historical model periods for the Dockum Aquifer (1980 through 2012) and Seymour and Blaine aquifers (1980 through 1999). 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:

Dockum Aquifer

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System for this analysis. See Deeds and Jigmond (2015) for assumptions and limitations of the model.
- The model has four layers which represent the Ogallala Aquifer (Layer 1), the Edwards-Trinity (High Plains) Aquifer and the Edwards-Trinity (Plateau) Aquifer (Layer 2), the upper Dockum Aquifer (Layer 3) and the lower Dockum Aquifer (Layer 4). The Ogallala and Edward-Trinity (High Plains and Plateau) aquifers do not occur within the Clear Fork Groundwater Conservation District and the Dockum Aquifer (layers 3 and 4) are lumped for calculating water budgets within the district.
- Water budgets for the Dockum Aquifer within the district were averaged over the historical calibration period (1980 to 2012).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

Seymour and Blaine aquifers

- We used version 1.01 of the groundwater availability model for the Seymour Aquifer for this analysis. See Ewing and others (2004) for assumptions and limitations of the groundwater availability model.
- The official boundary of the Blaine Aquifer was expanded after GAM Run 14-007 (Wade, 2014) was provided to the district; therefore, the values reported in this report are different.
- The model includes two layers which represent the Seymour Aquifer (Layer 1) and the Blaine Aquifer or various Permian units (Layer 2).
- Water budgets for the Seymour and Blaine Aquifers within the district were averaged over the historical calibration period (1980 to 1999).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

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 Dockum, Seymour and Blaine aquifers located within Clear Fork Groundwater Conservation District and averaged over the historical calibration periods, as shown in Tables 1 through 3.

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 through 3. 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 DOCKUM AQUIFER FOR CLEAR FORK 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	Result
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	735
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Dockum Aquifer	762
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	145
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	9
Estimated net annual volume of flow between each aquifer in the district	From overlying units to Dockum Aquifer	115

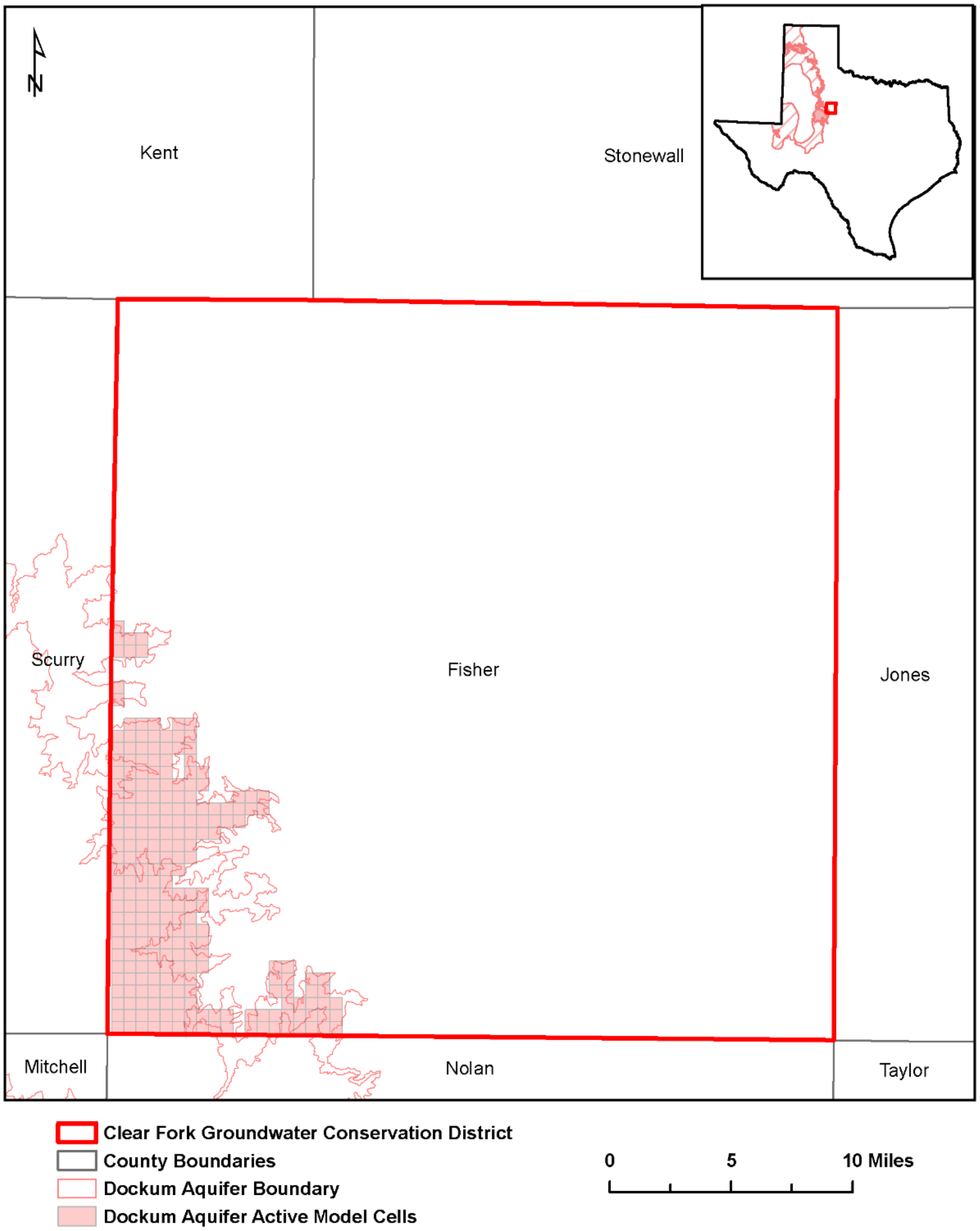

FIGURE 1: AREA OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL FROM WHICH THE DOCKUM AQUIFER INFORMATION IN TABLE 1 WAS EXTRACTED (THE DOCKUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY)

TABLE 2. SUMMARIZED INFORMATION FOR THE SEYMOUR AQUIFER FOR CLEAR FORK 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	Result
Estimated annual amount of recharge from precipitation to the district	Seymour Aquifer	12,261
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Seymour Aquifer	3,011
Estimated annual volume of flow into the district within each aquifer in the district	Seymour Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Seymour Aquifer	459
Estimated net annual volume of flow between each aquifer in the district	From underlying Permian units to Seymour Aquifer	436

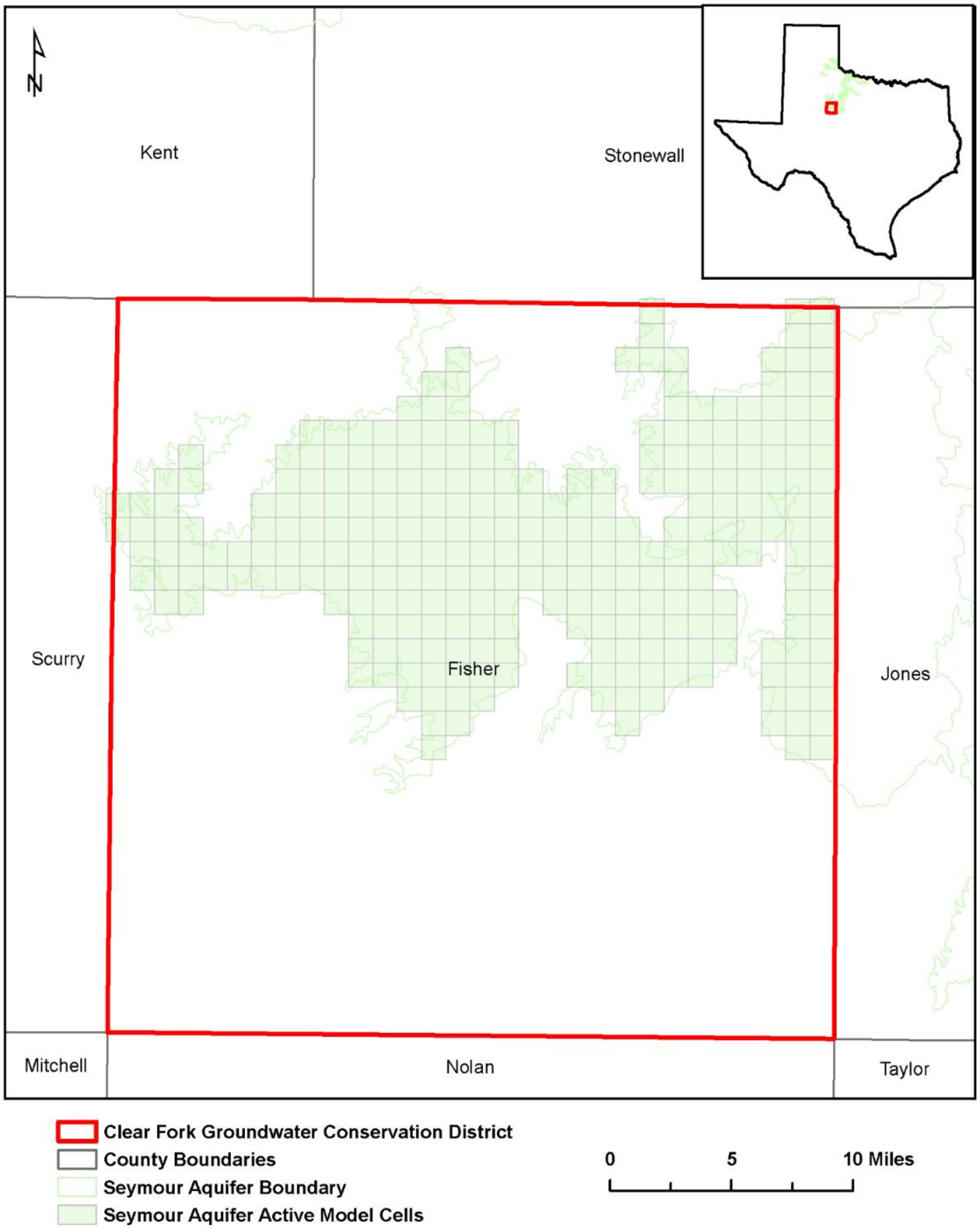

FIGURE 2: AREA OF THE SEYMOUR AQUIFER GROUNDWATER AVAILABILITY MODEL FROM WHICH THE SEYMOUR AQUIFER INFORMATION IN TABLE 2 WAS EXTRACTED (THE SEYMOUR AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY)

TABLE 3. SUMMARIZED INFORMATION FOR THE BLAINE AQUIFER FOR CLEAR FORK 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	Result
Estimated annual amount of recharge from precipitation to the district	Blaine Aquifer	12,307
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Blaine Aquifer	3,299
Estimated annual volume of flow into the district within each aquifer in the district	Blaine Aquifer	592
Estimated annual volume of flow out of the district within each aquifer in the district	Blaine Aquifer	3,349
Estimated net annual volume of flow between each aquifer in the district	From Blaine Aquifer to overlying Seymour Aquifer	1,266
	From other Permian units to Blaine Aquifer	3,202

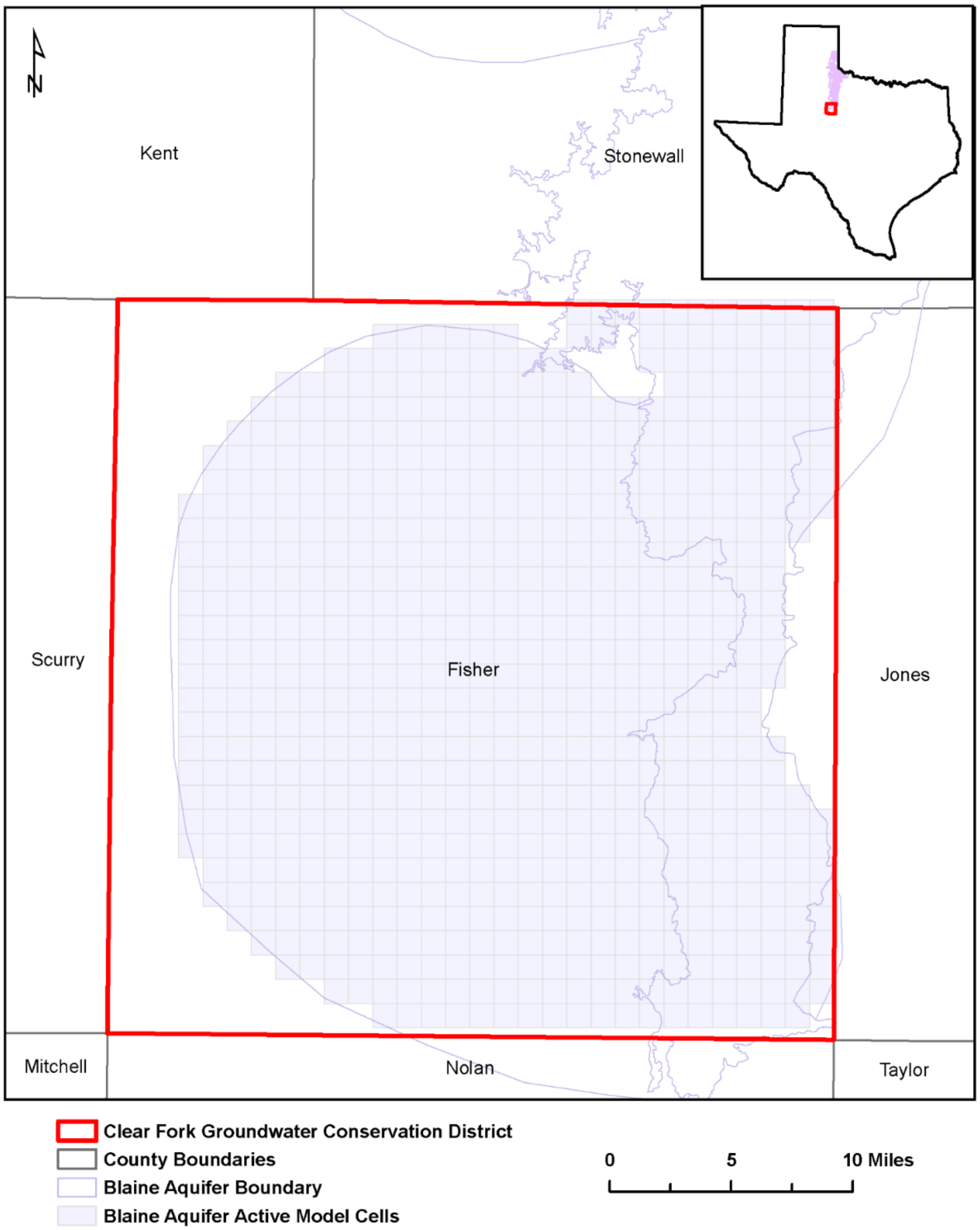

FIGURE 3: AREA OF THE SEYMOUR AQUIFER GROUNDWATER AVAILABILITY MODEL FROM WHICH THE BLAINE AQUIFER INFORMATION IN TABLE 3 WAS EXTRACTED (THE BLAINE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY)

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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