GAM Run 19-027: Southwestern Travis County Groundwater Conservation District Groundwater Management Plan

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Groundwater Division
Groundwater Availability Modeling Department
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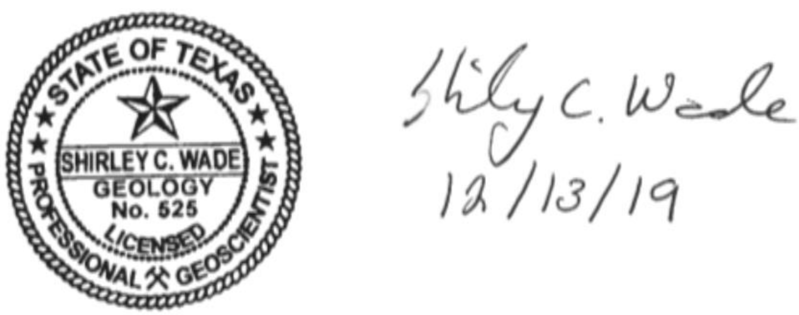
December 13, 2019



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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 Southwestern Travis County 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 Southwestern Travis County Groundwater Conservation District is due by November 5, 2022.

We used three groundwater availability models to estimate the management plan information for the aquifers within the Southwestern Travis County Groundwater Conservation District. Information for the Hickory Aquifer is from version 1.01 of the groundwater availability model for the minor aquifers in the Llano Uplift Region (Shi and others, 2016a and b). The model does not cover the entire Hickory Aquifer within the district. Please contact Mr. Stephen Allen with the TWDB at (512) 463-7317 or stephen.allen@twdb.texas.gov for additional information on the aquifer in areas not covered by the groundwater availability model. Information for the Trinity Aquifer is from the groundwater availability model for the Hill Country portion of the Trinity Aquifer System (Jones and others, 2011). Information for the Edwards (Balcones Fault Zone) Aquifer is from the groundwater availability model for the Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer (Scanlon and others, 2001).

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models mentioned above were used to estimate information for the Southwestern Travis Groundwater Conservation District management plan. Water budgets were extracted for the historical model periods for the Trinity Aquifer (1981 through 1997) and Edwards (Balcones Fault Zone) Aquifer (1989 through 1998) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Water budgets were extracted for the historical model period for the Hickory Aquifer (1981 through 2010) using ZONEBUDGET USG Version 1.00 (Panday and others, 2013). The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and net inter-aquifer flow (lower) for the portion of the aquifer located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Hickory Aquifer

- We used version 1.01 of the groundwater availability model for the minor aquifers in the Llano Uplift Region to analyze the Hickory Aquifer. See Shi and others (2016a and b) for assumptions and limitations of the model.

- The groundwater availability model for the minor aquifers in the Llano Uplift Region contains eight active layers (from top to bottom):

- Layer 1 — the Trinity Aquifer, Edwards-Trinity (Plateau) Aquifer, and younger alluvium deposits,
- Layer 2 — Permian and Pennsylvanian age confining units,
- Layer 3 — the Marble Falls Aquifer and equivalent,
- Layer 4 — Mississippian age confining units,
- Layer 5 — the Ellenburger-San Saba Aquifer and equivalent,
- Layer 6 — Cambrian age confining units,
- Layer 7 — the Hickory Aquifer and equivalent, and
- Layer 8 — Precambrian age confining units.

- The Hickory Aquifer is the only aquifer from the Llano Uplift Aquifer System present in southwestern Travis County.
- The groundwater availability model does not include the entire Hickory Aquifer within the district boundaries. The area east of the Ouachita Thrust Fault is not active in the model because research suggests the fault wall may likely act as a flow barrier.
- Perennial rivers and reservoirs were simulated using the MODFLOW-USG river package. Springs were simulated using the MODFLOW-USG drain package. However, for this analysis, surface water discharge does not occur from the Hickory Aquifer within the groundwater district boundaries.
- The model was run with MODFLOW-USG (Panday and others, 2013).

Hill Country portion of the Trinity Aquifer System

- We used version 2.01 of the groundwater availability model for the Hill Country portion of the Trinity Aquifer System. See Jones and others (2011) for assumptions and limitations of the groundwater availability model.
- The groundwater availability model includes four layers, representing (from top to bottom):
    - Layer 1 – the Edwards Group of the Edwards-Trinity (Plateau) Aquifer,
    - Layer 2 – the Upper Trinity Aquifer,

- Layer 3 – the Middle Trinity Aquifer, and
- Layer 4 – the Lower Trinity Aquifer.

- Layer 1 is not present in the district. An individual water budget for the district was determined for the remaining layers of the Hill Country portion of the Trinity Aquifer System (Layer 2 to Layer 4, collectively).

- The General-Head Boundary (GHB) package of MODFLOW was used to represent flow out of the study area between the Hill Country portion of the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer or the confined parts of the Trinity Aquifer underlying the Edwards (Balcones Fault Zone) Aquifer.

- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer

- We used version 1.01 of the groundwater availability model for the Barton Springs segment of the Edwards (Balcones Fault Zone) Aquifer. See Scanlon and others (2001) for assumptions and limitations of the groundwater availability model.

- The transient model has monthly stress periods and covers the time period of 1989 through 1998.

- The groundwater availability model is a one-layer model and assumes no interaction with the underlying Trinity Aquifer. The cells are 1,000 feet long parallel to the strike of the faults and 500 feet wide.

- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

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 Hickory Aquifer, the Hill Country potion of the Trinity Aquifer System, and the Edwards (Balcones Fault Zone) Aquifer located within the Southwestern Travis County Groundwater Conservation District and averaged over the historical calibration periods, as shown in Table 1.

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.

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 HICKORY AQUIFER FOR SOUTHWESTERN TRAVIS COUNTY 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	Hickory Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Hickory Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Hickory Aquifer	3,121
Estimated annual volume of flow out of the district within each aquifer in the district	Hickory Aquifer	1,114
Estimated net annual volume of flow between each aquifer in the district	From the Hickory Aquifer into overlying younger units.	2,153
	To the Hickory Aquifer from underlying Precambrian Formations	145

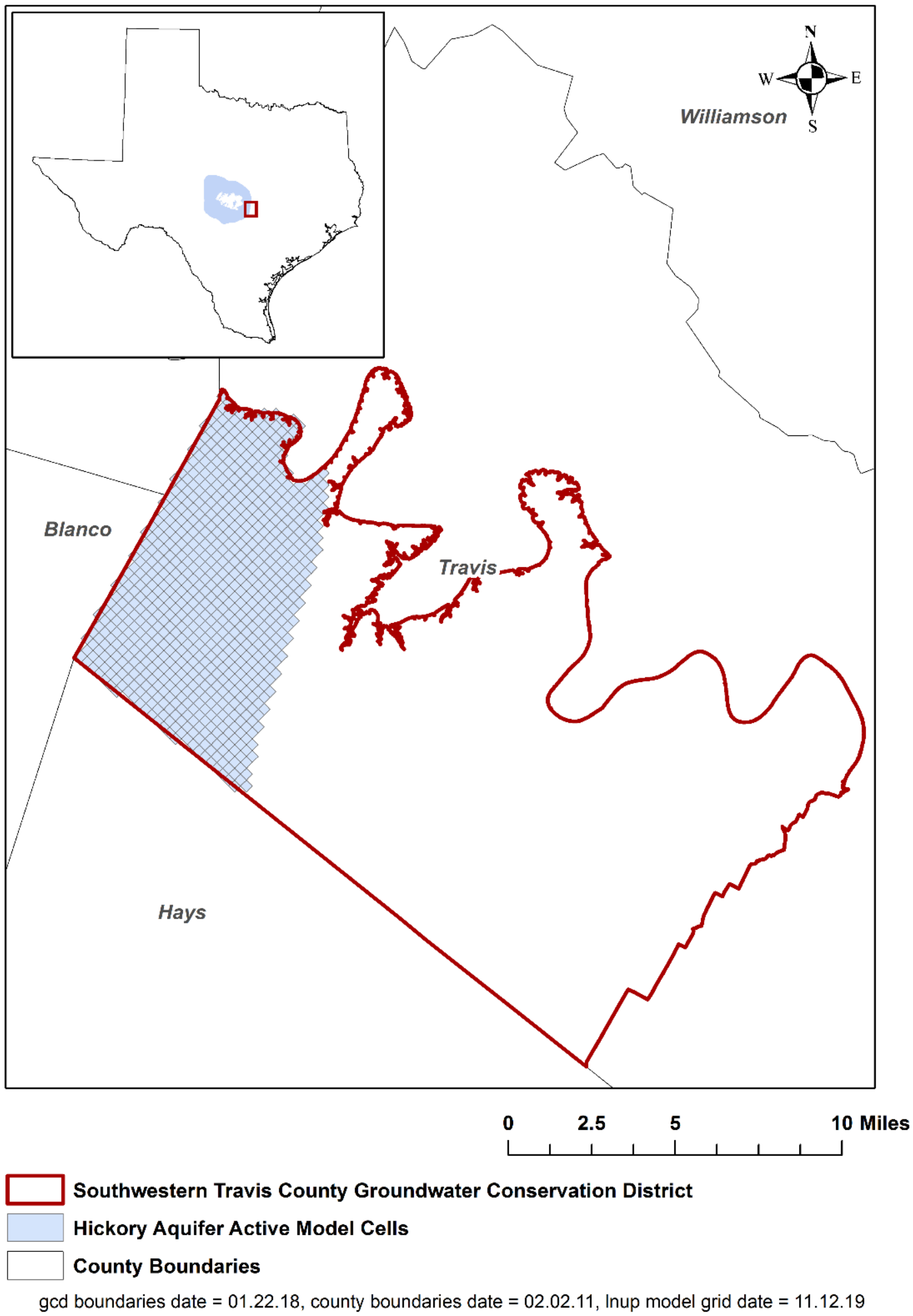

FIGURE 1 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN THE LLANO UPLIFT REGION FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE HICKORY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2. SUMMARIZED INFORMATION FOR THE HILL COUNTRY PORTION OF THE TRINITY AQUIFER SYSTEM FOR SOUTHWESTERN TRAVIS COUNTY 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	Trinity Aquifer	12,167
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Trinity Aquifer	12,654
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	10,024
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	9,205
Estimated net annual volume of flow between each aquifer in the district	From the Hill Country portion of the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer and the Trinity Aquifer underlying the Edwards (Balcones Fault Zone) Aquifer.	2,333

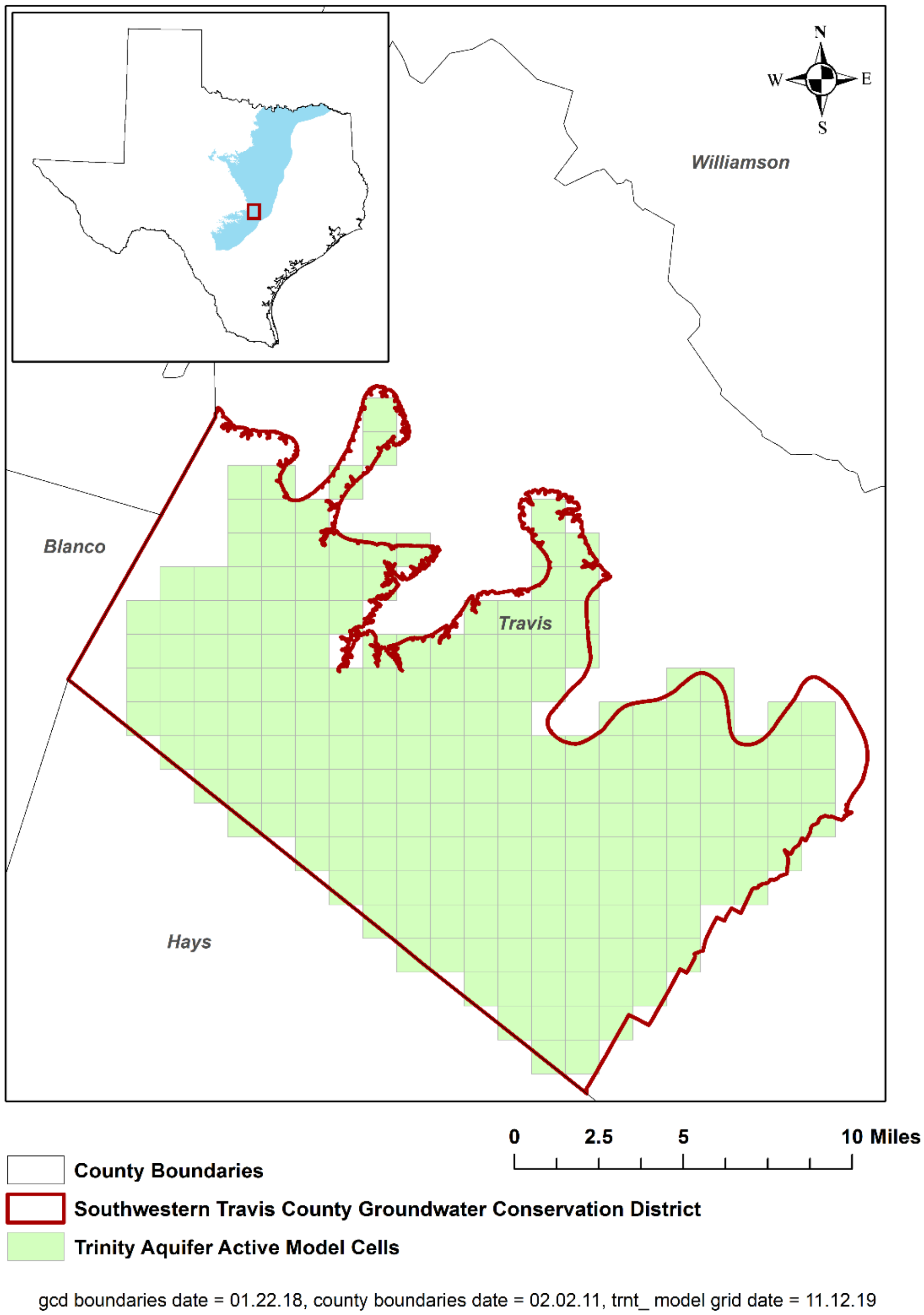

FIGURE 2 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HILL COUNTRY PORTION OF THE TRINITY AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE TRINITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 3. SUMMARIZED INFORMATION FOR THE BARTON SPRINGS SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER FOR SOUTHWESTERN TRAVIS COUNTY 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	Edwards (Balcones Fault Zone) Aquifer	79
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Edwards (Balcones Fault Zone) Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	306
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	615
Estimated net annual volume of flow between each aquifer in the district	From the Hill Country portion of the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer and the Trinity Aquifer underlying the Edwards (Balcones Fault Zone) Aquifer.	2,333[1]

[1] From the Groundwater Availability Model for the Hill Country portion of the Trinity Aquifer

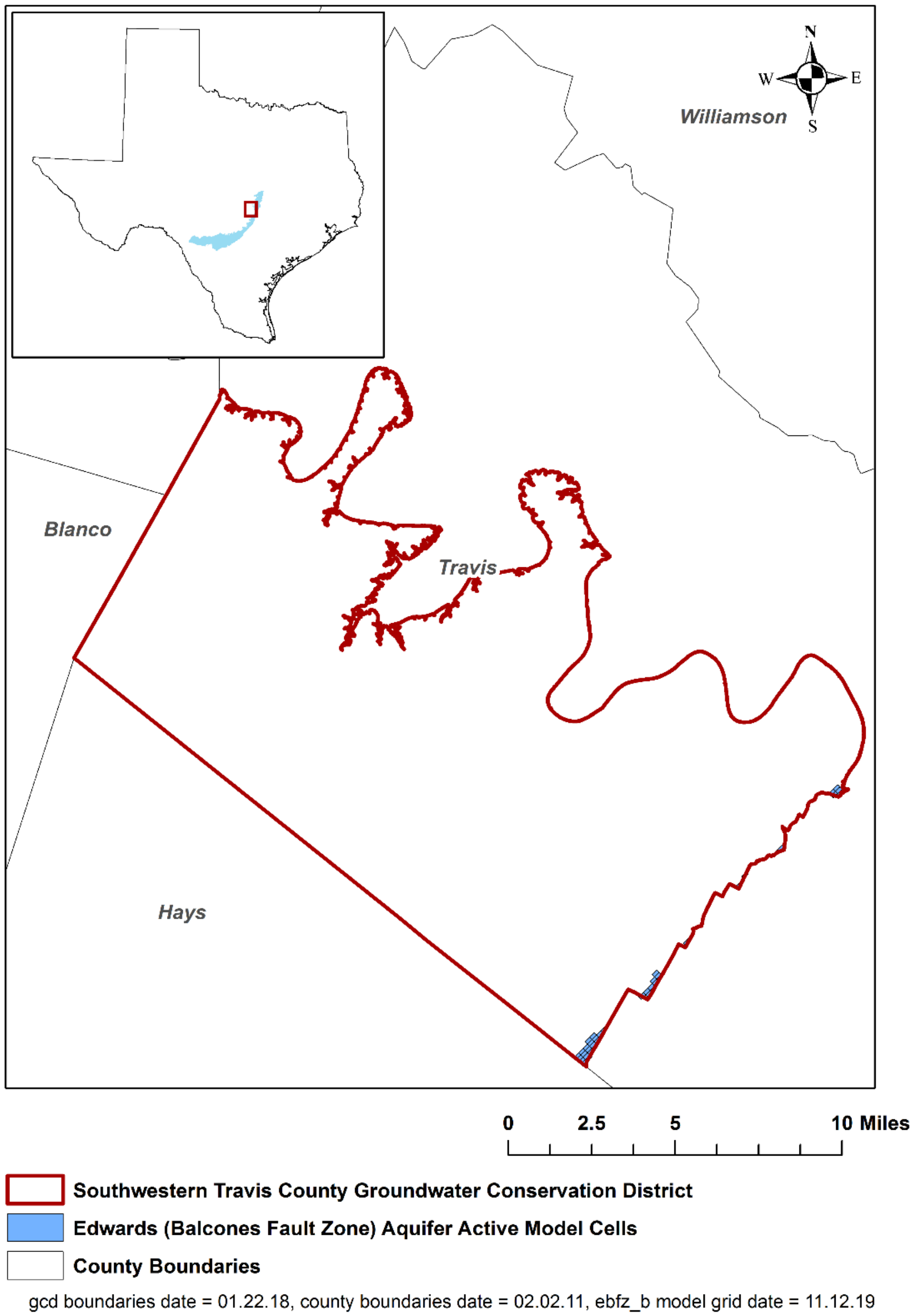

FIGURE 3 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE BARTON SPRINGS SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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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