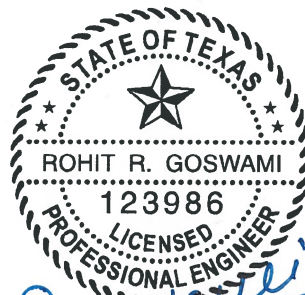


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# GAM RUN 17-008: NORTH PLAINS GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

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Texas Water Development Board  
Groundwater Division  
Groundwater Availability Modeling Section  
(512) 463-0495  
April 7, 2017



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## *EXECUTIVE SUMMARY:*

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), 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 North Plains 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 Section. Please direct questions about the water data report to Mr. Stephen Allen at (512) 463-7317 or [stephen.allen@twdb.texas.gov](mailto: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 North Plains Groundwater Conservation District should be adopted by the district on or before April 30, 2018, and submitted to the Executive Administrator of the TWDB on or before May 30, 2018. The current management plan for the North Plains Groundwater Conservation District expires on July 29, 2018.

We used version 1.01 of the groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015) to estimate the management plan information for the aquifers within North Plains Groundwater Conservation District. This report replaces the results of GAM Run 12-003 (Kohlrenken, 2012). GAM Run 17-008 meets current standards set after the release of GAM Run 12-003 and includes results from the recently released groundwater availability model for the High Plains Aquifer System (Deeds and Jigmond, 2015). Tables 1 through 3 summarize the groundwater availability model data required by statute and Figures 1 through 3 show the area of the model from which the values in the table were extracted. If after review of the figure, the North Plains 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 groundwater availability model for the High Plains Aquifer System was used to estimate information for the North Plains Groundwater Conservation District management plan. Water budgets were extracted for the historical model period (1980 through 2012) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). 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:*

#### ***High Plains Aquifer System***

- 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, in the area under the North Plains Groundwater Conservation District, represent the Ogallala Aquifer (Layer 1), the Rita Blanca Aquifer (Layer 2), and the Dockum Aquifer (Layers 3 and 4).
- Water budgets for the district were determined for the Ogallala Aquifer (Layer 1), Rita Blanca Aquifer (Layer 2) and Dockum Aquifer (Layers 3 and 4 collectively).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

## *RESULTS:*

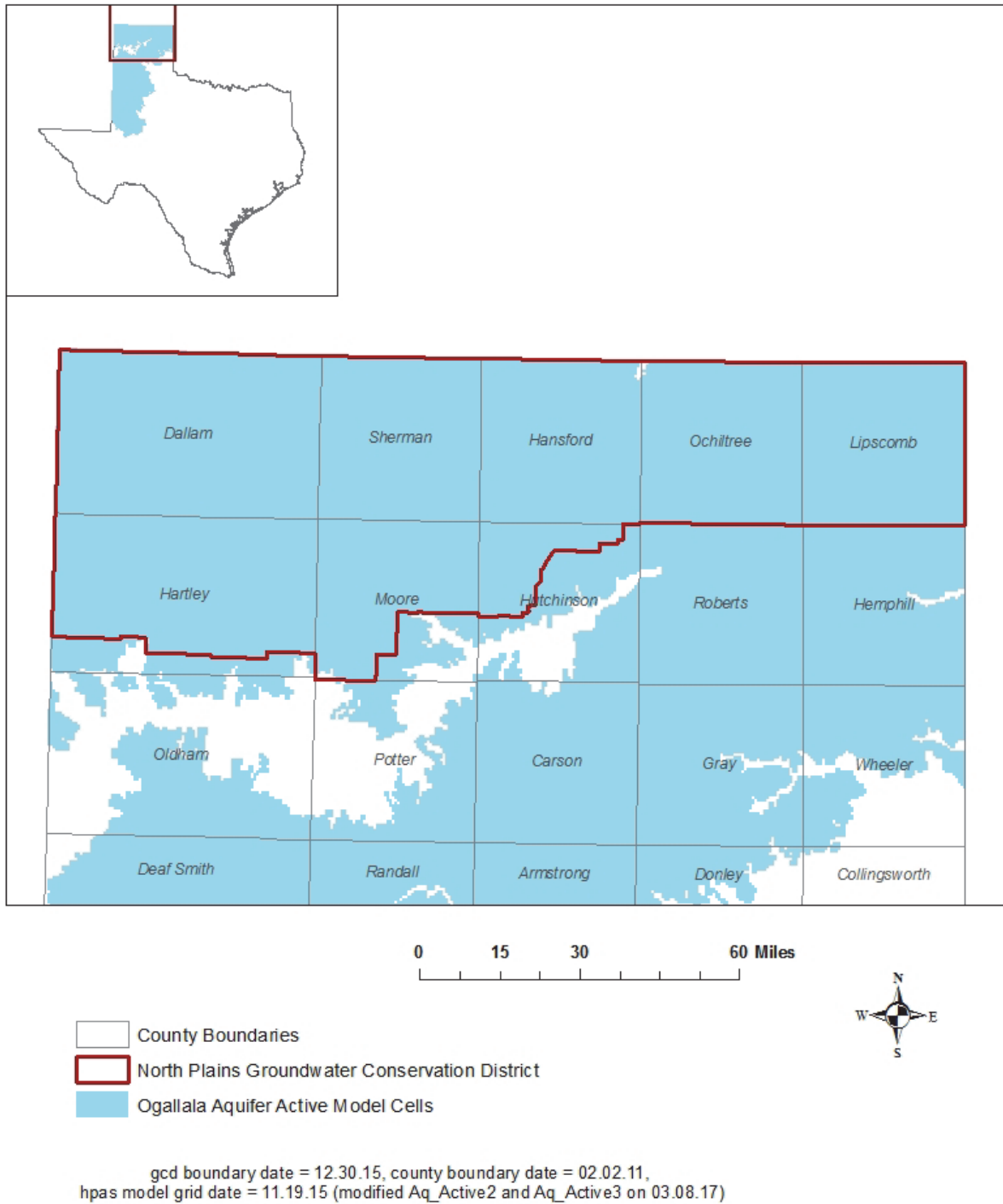
A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model for the High Plains Aquifer System within North Plains Groundwater 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 OGALLALA AQUIFER FOR THE NORTH PLAINS 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	Ogallala Aquifer	137,029
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Ogallala Aquifer	26,368
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	50,186
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	94,559
Estimated net annual volume of flow between each aquifer in the district	From Ogallala Aquifer to Rita Blanca and Dockum Aquifers	3,807

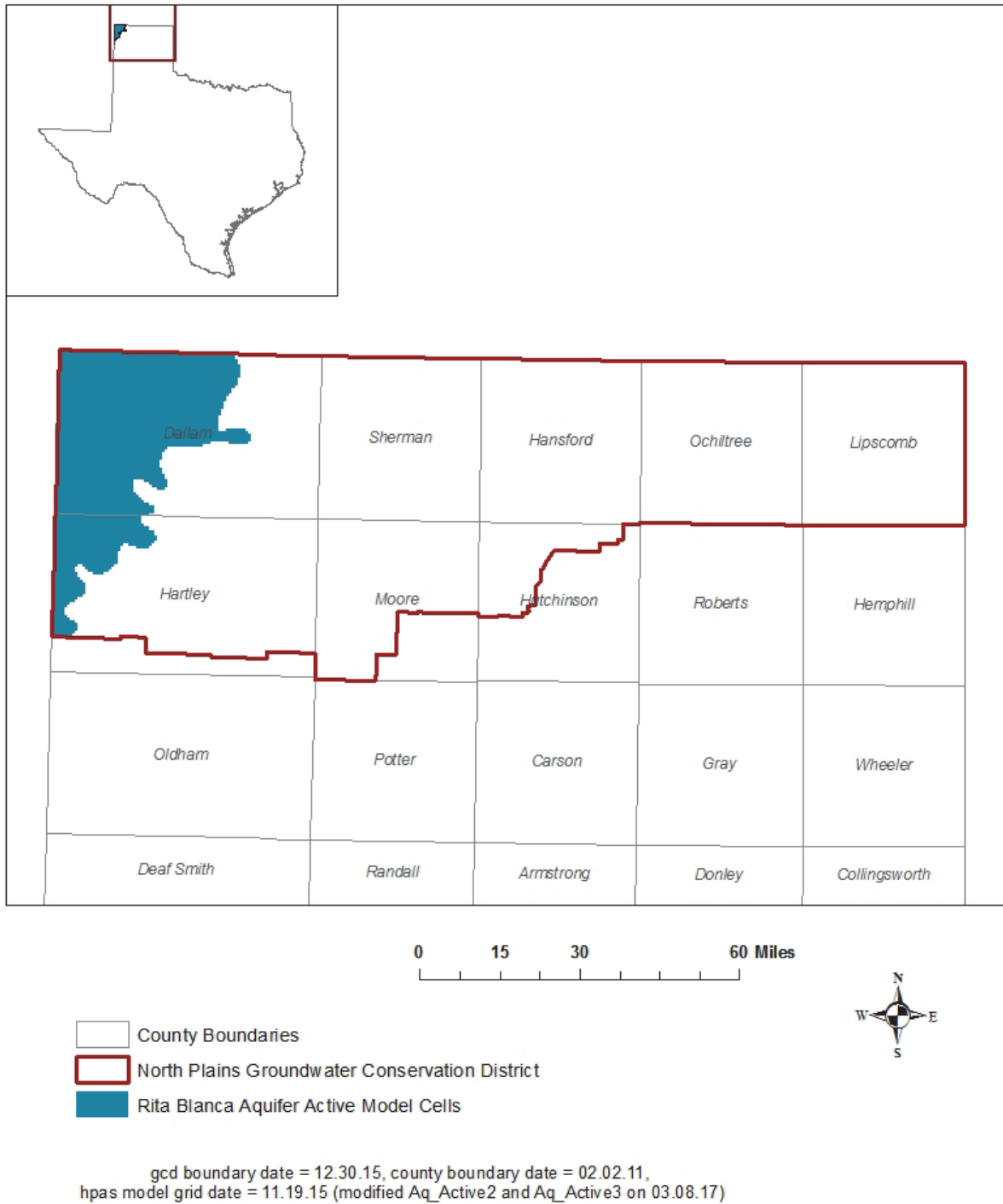


**FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE OGALLALA AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).**

**TABLE 2: SUMMARIZED INFORMATION FOR THE RITA BLANCA AQUIFER FOR THE NORTH PLAINS 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	Rita Blanca Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Rita Blanca Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Rita Blanca Aquifer	902
Estimated annual volume of flow out of the district within each aquifer in the district	Rita Blanca Aquifer	229
Estimated net annual volume of flow between each aquifer in the district	From Ogallala Aquifer to Rita Blanca Aquifer	2,909
	From Dockum Aquifer to Rita Blanca Aquifer	555





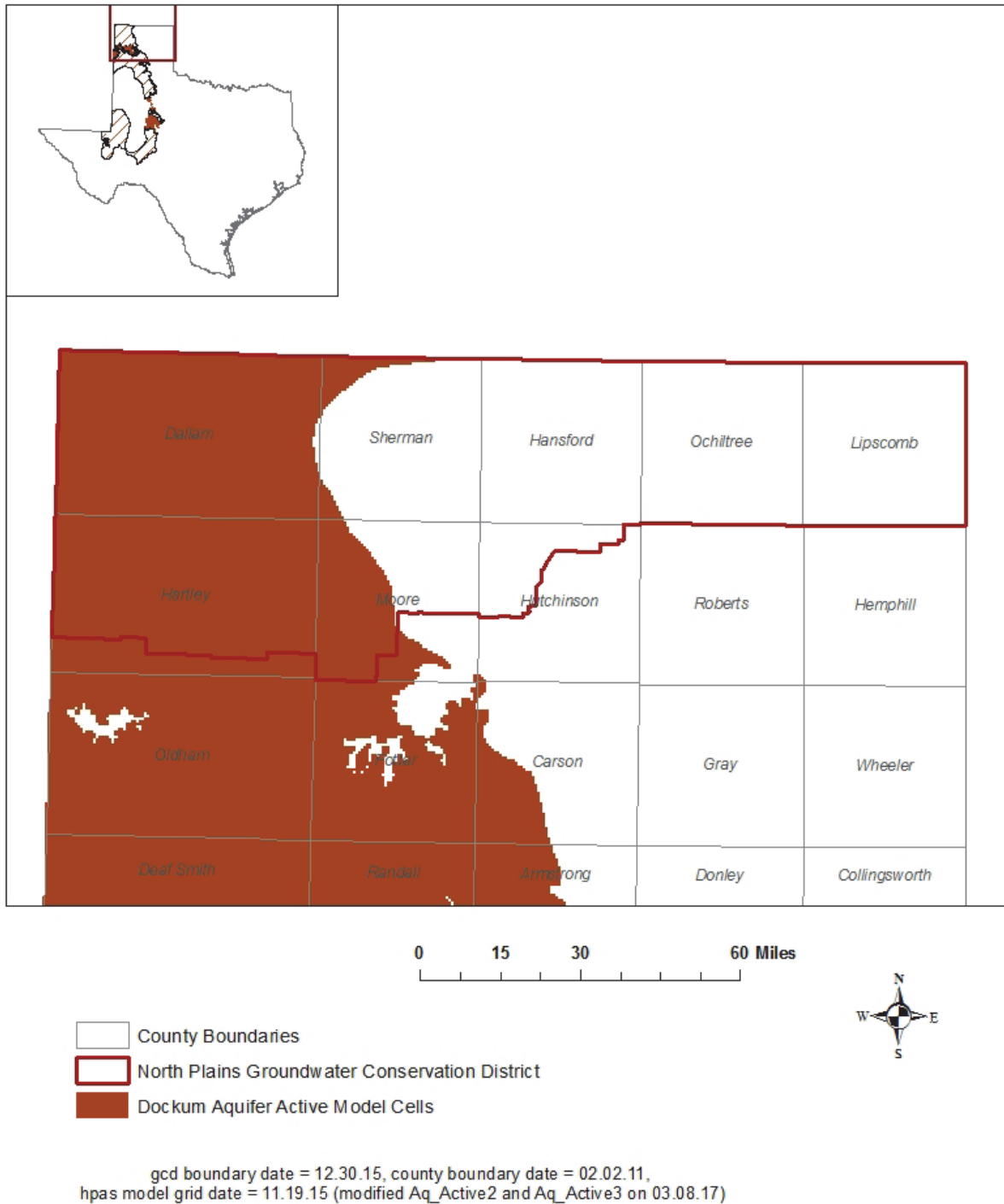
**FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE RITA BLANCA AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).**

**TABLE 3: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER FOR THE NORTH PLAINS 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	Dockum Aquifer	49
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Dockum Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	4,097
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	2,293
Estimated net annual volume of flow between each aquifer in the district <sup>1</sup>	From Dockum Aquifer to Ogallala and Rita Blanca Aquifers	1,997

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<sup>1</sup> Please note that the model assumes no-flow boundary condition at the base of the Dockum Aquifer



**FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE DOCKUM AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE 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 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 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. 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.

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Kohlrenken, W., 2012, GAM Run 12-003, 12 p.,

<http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR12-003.pdf>

Harbaugh, A. W., 2009, Zonebudget Version 3.01, A computer program for computing subregional water budgets for MODFLOW ground-water flow models: U.S. Geological Survey Groundwater Software.

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Texas Water Code, 2015, <http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf>.