
GAM RUN 13-022: SANDY LAND UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

by William Kohlrenken
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-8279
August 28, 2013



Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by William Kohlrenken under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on August 28, 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.

This report—Part 2 of a two-part package of information from the TWDB to Sandy Land Underground Water Conservation District—fulfills the requirements noted above. Part 1 of the two-part package is the Historical Water Use/State Water Plan data report. The District should have received, or will receive, this data report from the TWDB Groundwater Technical Assistance Section. Questions about the data report can be directed to Mr. Stephen Allen, stephen.allen@twdb.texas.gov, (512) 463-7317.

The groundwater management plan for Sandy Land Underground Water Conservation District should be adopted by the district on or before April 14, 2014 and submitted to the executive administrator of the TWDB on or before May 14, 2014. The current management plan for Sandy Land Underground Water Conservation District expires on July 13, 2014.

This report discusses the methods, assumptions, and results from model runs using the groundwater availability model for the Ogallala and Edwards-Trinity (High Plains), aquifers. This model run replaces the results of GAM Run 09-05 (Oliver, 2009). GAM Run 13-022 meets current standards set after the release of GAM Run 09-05 including use of the extent of the official aquifer boundaries within the district rather than the entire active area of the model within the district. Tables 1 and 2 summarize the groundwater availability model data required by the statute, and Figures 1 and 2 show the area of the model from which the values in the tables were extracted. If after review of the figures, Sandy Land Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the Texas Water Development Board immediately.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model for the southern portion of the Ogallala and the Edwards-Trinity (High Plains) aquifers was run for this analysis. Sandy Land Underground Water Conservation District water budgets were extracted for the historical model period (1980-2000) 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) for the portion of the aquifer located within the district is summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Southern portion of the Ogallala Aquifer and Edwards-Trinity (High Plains) Aquifer

- Version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer was used for this analysis. This model is an expansion on and update to the previously developed southern portion of the Ogallala Aquifer described in Blandford and others (2003). See Blandford and others (2008) and Blandford and others (2003) for assumptions and limitations of the model.
- The model includes four layers representing the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. The units comprising the Edwards-Trinity (High Plains) Aquifer (primarily Edwards, Comanche Peak, and Antlers Sand formations) are separated from the overlying Ogallala Aquifer by a layer of Cretaceous shale, where present. Water budgets for the district have been determined for the Ogallala Aquifer (Layer 1), as well as the Edwards-Trinity (High Plains) Aquifer (Layer 2 through Layer 4, collectively).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

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 Table 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 OGALLALA AQUIFER THAT IS NEEDED FOR SANDY LAND UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
Estimated annual amount of recharge from precipitation to the district	Ogallala Aquifer	40,447
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	1,417
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	1,856
Estimated net annual volume of flow between each aquifer in the district	Net flow from the Ogallala Aquifer to the Edwards-Trinity (High Plains) Aquifer, Duck Creek Formation, and the Kiamichi Formation.	808

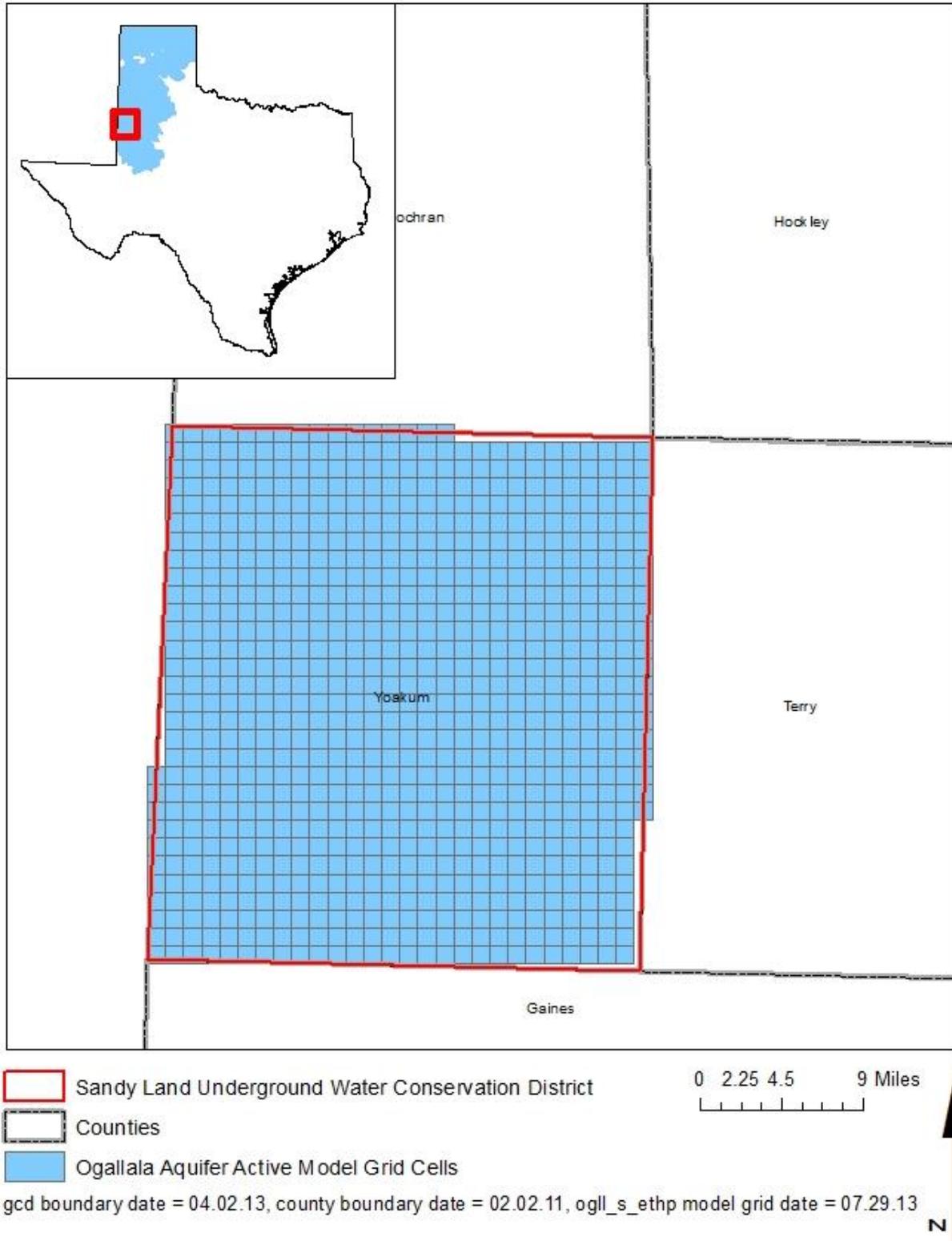


FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE OGALLALA AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE OGALLALA AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER THAT IS NEEDED FOR SANDY LAND UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

<i>Management Plan requirement</i>	<i>Aquifer or confining unit</i>	<i>Results</i>
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (High Plains) Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (High Plains) Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	1,331
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (High Plains) Aquifer	224
Estimated net annual volume of flow between each aquifer in the district	Net flow from the Ogallala Aquifer, Duck Creek Formation, and Kiamichi Formation into the Edwards-Trinity (High Plains) Aquifer	58
	Net lateral flow from the Edwards-Trinity (High Plains) Aquifer to the Duck Creek and Kiamichi Formations.	188

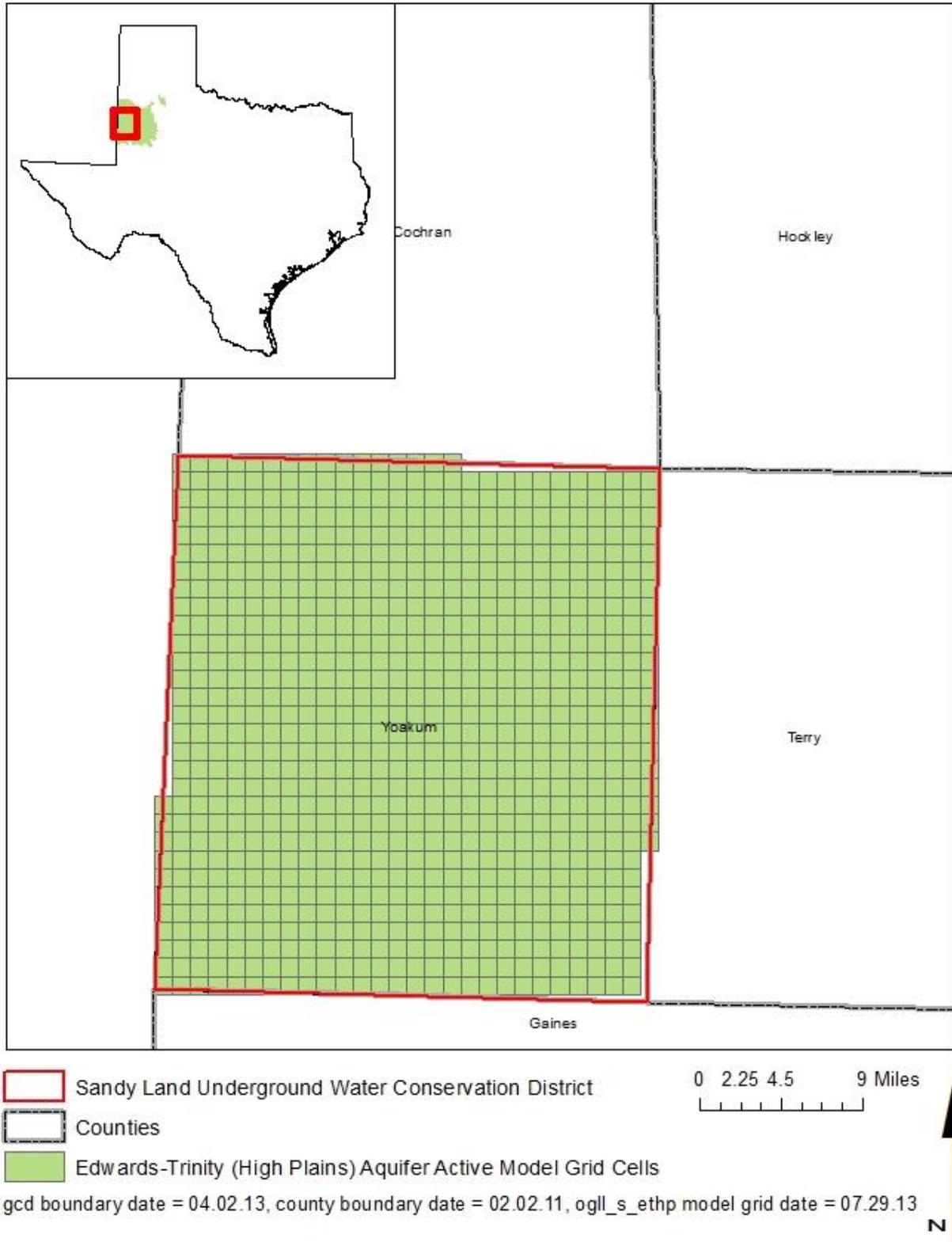


FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

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 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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