GLASSCOCK GROUNDWATER CONSERVATION DISTRICT

MANAGEMENT PLAN

2014-2019

P.O. Box 208
Garden City, Texas 79739
Ph: 432-354-2430 Fax: 432-354-2322 E-mail: ggcdone@crcom.net

TABLE OF CONTENTS

DISTRICT MISSION

The Glasscock Groundwater Conservation District strives to bring about conservation, preservation, and the efficient, beneficial and wise use of water for the benefit of the citizens and economy of the District through monitoring and protecting the quality of the groundwater.

TIME PERIOD FOR THIS PLAN

This plan becomes effective upon adoption by the District Board of Directors and approval by the Texas Water Development Board (TWDB) affirming the plan is administratively complete. This plan replaces the existing plan adopted by the District Board of Directors on March 17, 1998. This District management plan will remain in effect until a revised plan is certified or October 1, 2013, whichever is earlier.

STATEMENT OF GUIDING PRINCIPLES

The primary concern of the residents of this area of the State regarding groundwater is the potential contamination of the groundwater from the vast amount of oil and gas production and the activities involved in the production of oil and gas. For this reason, the residents asked Representative Tom Craddick to introduce legislation to create this groundwater conservation district. The District recognizes that the groundwater resources of this region are of vital importance to the residents and that this resource must be managed and protected from contamination. The greatest threat to prevent the District from achieving the stated mission is from state mandates and agency bureaucrats who have no understanding of local conditions. A basic understanding of the aquifers and their hydro geologic properties, as well as a quantification of resources is the foundation from which to build prudent planning measures. This management plan is intended as a tool to focus the thoughts and actions of those given the responsibility for the execution of District activities.

General Description

The Glasscock Groundwater Conservation District (GCD) was created by Acts of the 67th Legislature (1981). In August, 1981, the residents confirmed the District and also voted to fund the district operations through local property taxes. It became an active District in August, 1981. On April 15, 1986, the District adopted Rules and By-Laws which became effective immediately and on February 21, 1989 the District adopted a management plan. With the adoption of these rules, the District implemented a well permitting and registration program. The District rules were amended on June 20, 2000. The current members of the Board of Directors are: Russell Halfmann, Chairman, Allan Fuchs, Vice-Chairman, Galen Schwartz, Secretary, Kenneth Braden, Member, and Wayne Hirt, Member. The District General Manager is Tisha Burnett and Rhetta Yanez is the office secretary. The Glasscock GCD covers all of Glasscock County and a portion of Northwest Reagan County. The District's economy is based primarily on agriculture, and oil and gas production. The agricultural income is derived primarily from cotton, grain sorghum, wheat, alfalfa, pecans, as well as sheep, goats, and beef cattle production. Recreational hunting leases also contribute to the income of the area.

Location and Extent

The Glasscock GCD has an aerial extent of approximately 900 square miles or approximately 571,499 acres of land in Glasscock County and 65,350 acres in Northwest Reagan County. The total population of the District is approximately 1400 people. There are no incorporated cities within the District boundaries. The two communities within the District are Garden City and St. Lawrence. Land use in the District is for agricultural purposes of which 151,000 acres is crop or farm land, 85,009 acres is improved pasture, and the balance of 400,840 acres is range land. The majority of the District is over the Edwards-Trinity (Plateau) aquifer with exception of the northwest part of Glasscock County which is over the Ogallala aquifer. The crop land is located primarily in the southern and northwest portions of the District, with the balance being in pasture and range land. Irrigation covers approximately 36,529 acres of the District's crop land. Of these acres, 26,529 are located in Glasscock County and 10,000 acres are located in Reagan County. Historically, the principal method of irrigation had been furrow irrigation. However, within recent years there has been a gradual trend to change to more highly efficient subsurface drip irrigation and low energy precision application (LEPA) center pivots. There is currently, approximately 28,400 acres of subsurface drip irrigation and 5,129 acres of LEPA center pivots within the District. The remaining 3,000 acres is furrow irrigation.

Topography and Drainage

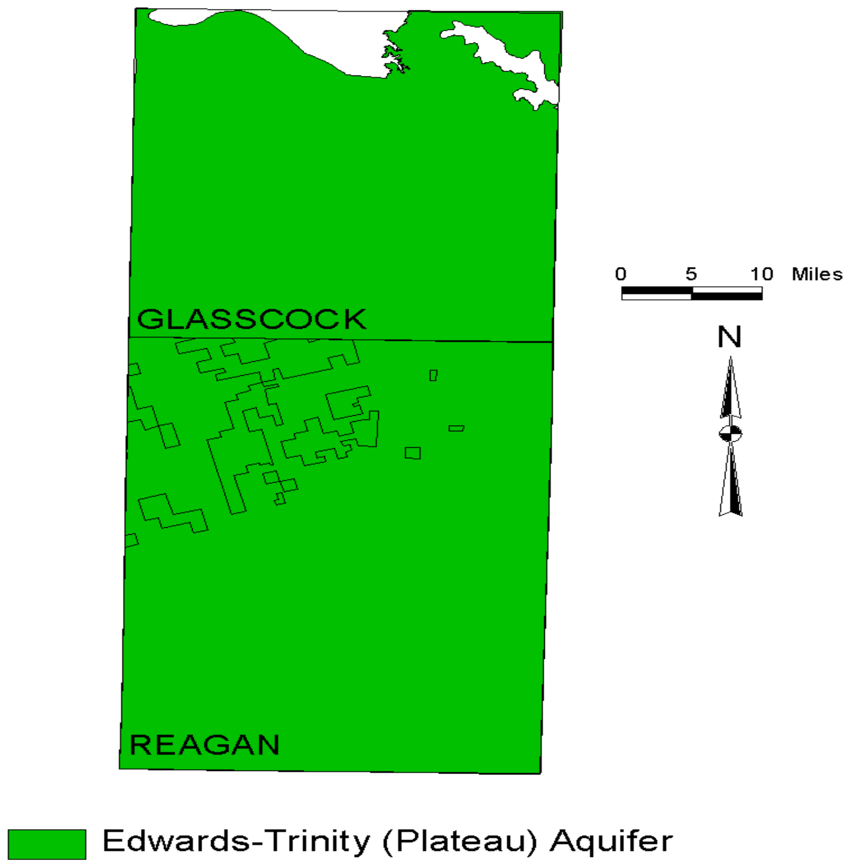
The District is within what is known as the Permian Basin of Texas. Topographically, the area within the District is generally a nearly level to undulating plain that slopes upward from the east to the west. The altitude of the land surface ranges from 2,300 feet above sea level in the eastern part of the District to about 2,750 feet above sea level in the western part of the District.

The Glasscock GCD lies within the Colorado River Basin. The North Concho River is a tributary of the Colorado River and is located in the northeast part of the District.

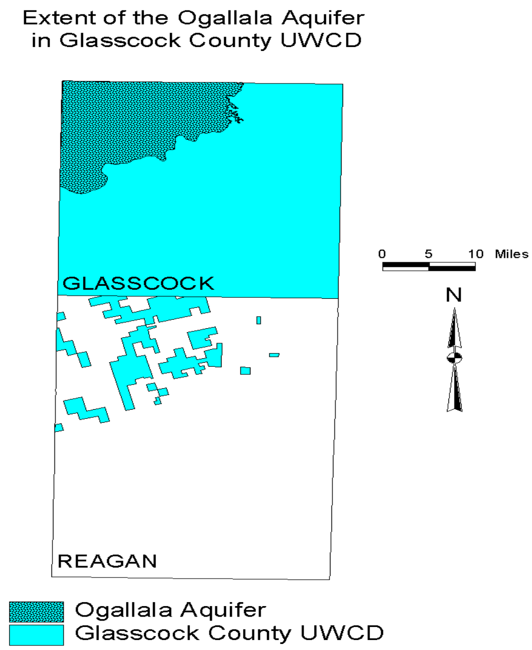
Groundwater Resources of the Glasscock GCD

The Edwards-Trinity (Plateau) aquifer is located in the entire District except in the northwest portion of Glasscock County. Water from this aquifer is principally used for irrigation, rural domestic, and livestock needs. This aquifer consists of saturated sediments of lower Cretaceous age Trinity Group formations and overlying limestones and dolomite of the Comanche Peak, Edwards, and Georgetown formations. The Glen Rose Limestone is the primary unit of the Trinity in the southern part of the plateau and is replaced by the Antlers Sand north of the Glen Rose pinch out. Reported well yields range from 20 gal/min, where saturated thickness is thin, to more than 300 gal/min, within the District. Chemical quality of Edwards-Trinity (Plateau) water ranges from fresh to slightly saline. The water is typically hard and may vary widely in concentrations of dissolved solids made up mostly of calcium and bicarbonate. The salinity of the groundwater tends to increase toward the west. Certain areas have unacceptable levels of fluoride. Water levels have declined as a result of increased pump age and the increase of harmful vegetation such as mesquite and prickly pear. The average decline has been approximately 20 feet since 1980. (See map on next page)

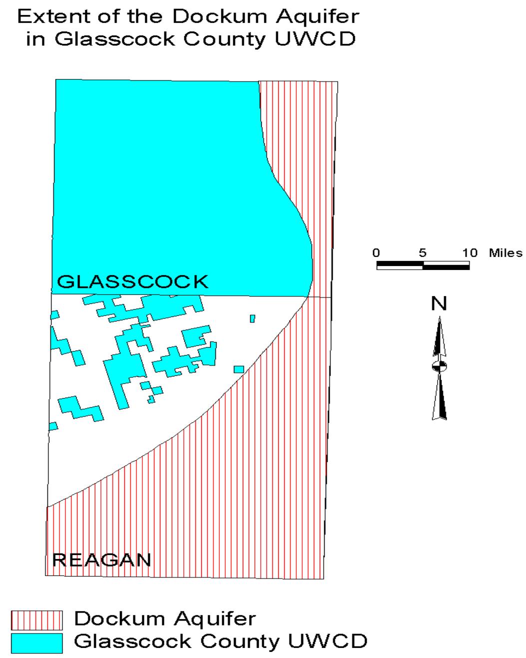
Extent of the Edwards-Trinity (Plateau)
Aquifer in Glasscock County UWCD



The Ogallala aquifer is located in northwest Glasscock County. The Ogallala is composed primarily of sand, gravel, clay and silts deposited during the Tertiary Period. Water from this aquifer is principally used for irrigation, rural domestic, and livestock needs. Water yields from this aquifer are generally greater than 150 gal/min. The chemical quality of the water in the aquifer is generally fresh; however, higher levels of dissolved-solids and chloride concentrations can be found within the District. Water levels have fluctuated in this area due to several acres participating in the USDA Conservation Reserve Program being removed and put back into production. (See map below)



The Dockum Group of Triassic age is located in the extreme eastern portion of the District. This aquifer is used principally for livestock needs. (See map below)



Dockum Aquifer
Glasscock GCD

The aquifer explanations above were taken from Texas Water Development Board's Report 345 Aquifers of Texas (1995).

Currently the District is using the 2012 State Water Plan Projected Water Availability as well as estimates of recharge and availability rates. The data sets describe the saturated thickness and yield, which the product describes as water in storage. When combined with recharge and production values, these estimates can be used by the District to derive goals for future estimates of available groundwater. Currently within the District, there is an estimated 23,637 acre-feet of recoverable water in storage in the Edwards-Trinity (Plateau) aquifer, 3,928 acre-feet in the Ogallala aquifer, and 145 acre-feet in the Dockum Aquifer. There is an estimated 42 acre-feet in surface water from private stock tanks. The existing total usable amount of groundwater in the District is 27,752 acre-feet on an annual basis.

Groundwater Availability Model (GAM RUN 12-020)
Please refer to Appendix A

Surface Water Resources
No surface water management entities exist within the District. There are no surface water impoundments within the District except for livestock consumption. There are no surface water entities located within the District to coordinate the development of this plan.

Estimated Historical Groundwater Use
Please refer to Appendix B.

Projected Surface Water Supplies
Please refer to Appendix B.

Projected Water Demands
Please refer to Appendix B

Projected Water Supply Needs

Based on supply and demand calculations and projections it is obvious that there will be times that demands exceed supply. In this area of the State and with the type of aquifer that serves the area, this is a normal occurrence that is recognized by the local residents. This information can be found in Appendix B from the 2012 State Water Plan. Negative values reflect a projected water supply need, positive values a surplus.

The residents of the District understand that groundwater supplies are limited and have modified farming and ranching techniques to match the availability of water. There are currently, approximately 28,400 acres of subsurface drip irrigation and 5,129 acres of LEPA center pivots within the District, with more acres going in every year. Efforts are being made by the residents of the District to use the available groundwater resources with maximum efficiency, while monitoring the quality of the groundwater to protect this resource for the years to come.

Projected Water Strategies
Please refer to Appendix B

Management of Groundwater Supplies

For the past 32 years, the District has and will continue to manage the supply of groundwater within the District, in order to conserve the resource while seeking to maintain the economic viability of all resource user groups, public and private. In consideration of the economic and cultural activities occurring within the District, the District will continue to identify and engage in such activities and practices, that if implemented, would result in preservation and protection of the groundwater. The observation network will continue to be reviewed and maintained in order to monitor changing conditions of groundwater within the District. The District will undertake investigations of the groundwater resources within the District and will make the results of investigations available to the public.

The District has, or will amend as necessary, rules to regulate groundwater withdrawals by means of spacing and/or production limits. The relevant factors to be considered in making the determination to grant a permit or limit groundwater withdrawal will include:

1. The purpose of the District and its rules;
2. The equitable conservation and preservation of the resource; and
3. The economic hardship resulting from granting or denying a permit or the terms prescribed by the rules.

In pursuit of the District's mission of preserving and protecting the resource, the District will enforce the terms and conditions of permits and the rules of the District by enjoining the permit holder in a court of competent jurisdiction, as provided for in TWC Chapter 36.102, if necessary.

Actions, Procedures, Performance and Avoidance for Plan Implementation

The District will implement the provisions of this plan and will utilize the provisions of this plan as a guidepost for determining the direction or priority for all District activities. All operations of the District, all agreements entered into by the District, and any additional planning efforts in which the District may participate will be consistent with the provisions of this plan.

The District has adopted and will amend, as necessary, rules relating to the implementation of this plan. The rules adopted by the District shall be pursuant to TWC Chapter 36 and the provisions of this plan. All rules will be adhered to and enforced. The promulgation and enforcement of the rules will be based on the best technical evidence available.

The District shall treat all citizens with equality. Citizens may apply to the District for discretion in enforcement of the rules on grounds of adverse economic effect or unique local characteristics. In granting of discretion to any rule, the Board shall consider the potential for adverse effect on adjacent owners and aquifer conditions. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

District rules can be viewed at http://glasscock-groundwater.org/rules__by-laws

Modeled Available Groundwater

Refer to Appendix C (GAM Run 10-033 MAG) and Appendix D (GAM Run 10-043 MAG v. 2)

GOALS, MANAGEMENT OBJECTIVES and PERFORMANCE STANDARDS

Methodology
The methodology that the District will use to trace its progress on an annual basis in achieving all of its management goals will be as follows: The District manager will prepare and present an annual report to the Board of Directors on District performance in regards to achieving management goals and objectives (during the first monthly Board of Directors meeting each fiscal year, beginning December 31, 2000). The report will include the number of instances each activity was engaged in during the year. The annual report will be maintained on file at the District office.

Goal 1.0 Control and Prevent the Waste of Groundwater
Management Objective

1.1Each month, the District will investigate all identified wasteful practices within two (2) working days of identification or complaint received.

Performance Standard

1.1a - Number of wasteful practices identified and the average number of days District personnel took to respond or investigate after identification or complaint received, during the month.

Goal 2.0 Providing for the Efficient Use of Groundwater within the District
Management Objective

2.1 Each year, the District will provide laser plane leveling equipment (based upon availability) to producers for better irrigation planning and contour farming.

Performance Standard

2.1a – Annual report to the Board of Directors the number of times District's leveling equipment was loaned to producers.

Goal 3.0 Addressing Drought Conditions
Management Objective

3.1 The District will monitor the Palmer Drought Severity Index (PDSI) by Texas Climatic Divisions. If the PDSI indicates that the District will experience severe drought conditions, the District will notify all public water suppliers within the District. An additional source of information on drought can be accessed at:

http://www.waterdatafortexas.org/drought/

Performance Standard

3.1a-The District staff will monitor the PDSI and report findings and actions to the District Board on a quarterly basis.

Goal 4.0 Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and Brush Control where appropriate and cost effective.
(36.1071(a)(7)

Management Objective: Conservation

4.1 Provide information to area residents about water conservation.
http://www.savetexaswater.org

Performance Standard: Conservation

4.1a- The District staff will publish an article concerning water conservation in a local newsletter or newspaper at least once a year.

Management Objective: Recharge Enhancement

4.2 Provide and distribute literature on recharge enhancement to area residents.

Performance Standards: Recharge Enhancement

4.2a The District staff will provide information to area residents about recharge enhancement.

4.2b Annual report to the Board of Directors listing the number of times recharge enhancement information was distributed.

Management Objective: Rainwater Harvesting

4.3 Provide and distribute literature on rainwater harvesting to area residents.

Performance Standards: Rainwater Harvesting

4.3a The District staff will provide information to area residents about rainwater harvesting.

4.3b Annual report to the Board of Directors listing the number of times rainwater harvesting information was distributed.

Management Objective: Precipitation Enhancement

4.4 The District will participate in the West Texas Weather Modification Association rainfall enhancement program.

Performance Standards: Precipitation Enhancement

4.4a - Report monthly to the Board of Directors on West Texas Weather Modification Association activities.

4.4b - Annually provide to the Board of Directors the West Texas Weather Modification Association Annual Report.

Management Objective: Brush Control

4.5 Provide and distribute literature on brush control to area residents.

Performance Standards: Brush Control

4.5a The District staff will provide information to area residents about brush control.

4.5b Annual report to the Board of Directors listing the number of times brush control information was distributed.

Goal 5.0 Addressing Natural Resource Issues. Gather and maintain groundwater data to improve the understanding of the aquifers and their hydro geologic properties. This data will help in determining groundwater availability and future planning. (36.1071(a) (5))

Management Objective

5.1 Annually measure 85 percent of wells in the water level monitoring network within the District.

Performance Standard

5.1a Annual report to the Board of Directors the number of wells monitored in the District's water level monitoring network and the results.

Goal 6.0 Addressing Desired Future Conditions (DFCs) adopted by GMA 7

Management Objective

6.1 The District will monitor water levels and evaluate whether the average change in water well levels is in conformance with the Desired Future Conditions adopted by the District. The District will estimate total annual groundwater production for each aquifer based on water use reports, estimated exempt use and other relevant information and compare these production estimates to the MAGs. The DFCs for GMA 7 can be seen here:
http://www.twdb.texas.gov/groundwater/docs/DFC/GMA7_DFC_Adopted_2010-0729.pdf

Performance Standards

6.1a Record the water level data and average annual change in water levels for each aquifer and compare to the DFCs. Include this information in the District's Annual Report.

6.1b Record the total estimated annual productions for each aquifer and compare these amounts to the MAG. Include this information in the District's Annual Report.

MANAGEMENT GOALS DETERMINED NOT-APPLICABLE

Goal 7.0 Control and prevention of subsidence.

The rigid geologic framework of the region precludes significant subsidence from occurring. This goal is not applicable to the operations of the District.

Goal 8.0 Conjunctive surface water management issues.

No surface water management entities exist within the District. There are no surface water impoundments within the District except for livestock consumption. The Glasscock GCD has no jurisdiction over surface water. The groundwater within the district is used primarily for irrigated agriculture, rural domestic and livestock needs. This goal is not applicable to the operations of the District.

Summary Definitions.

"Abandoned Well" - shall mean:

1) A well or borehole the condition of which is causing or is likely to cause pollution of groundwater in the District. A well is considered to be in use in the following cases:

(A) A well which contains the casing, pump, and pump column in good condition; or

(B) A well in good condition which has been capped.

2) a well or borehole which is not in compliance with applicable law, including the Rules and Regulations of the District, the Texas Water Well Drillers' Act, Texas Natural Resource Conservation Commission, or any other state or federal agency or political subdivision having jurisdiction, if presumed to be an abandoned or deteriorated well.

"Board" - the Board of Directors of the Glasscock Groundwater Conservation District.

"District" - the Glasscock Groundwater Conservation District.

"TCEQ" - Texas Commission on Environmental Quality.

"TWDB" - Texas Water Development Board.

"Waste" - as defined by Chapter 36 of the Texas Water Code means any one or more of the following:

(1) withdrawal of groundwater from a groundwater reservoir at a rate and in an amount that causes or threatens to cause intrusion into the reservoir of water unsuitable for agricultural, gardening, domestic, or stock raising purposes;

(2) The flowing or producing of wells from a groundwater reservoir if the water produced is not used for a beneficial purpose;

(3) escape of groundwater from a groundwater reservoir to any other reservoir or geologic strata that do not contain groundwater;

(4) Pollution or harmful alteration of groundwater in a groundwater reservoir by saltwater or by other deleterious matter admitted from another stratum or from the surface of the ground;

(5) willfully or negligently causing, suffering, or allowing groundwater to escape into any river, creek, natural watercourse, depression, lake, reservoir, drain, sewer, street, highway, road, or road ditch, or onto any land other than that of the owner of the well unless such discharge is authorized by permit, rule, or order issued by the commission under Chapter 26;

(6) groundwater pumped for irrigation that escapes as irrigation tail water onto land other than that of the owner of the well unless permission has been granted by the occupant of the land receiving the discharge; or

(7) For water produced from an artesian well, "waste" has the meaning assigned by Section 11.205.

Appendix A

GAM RUN 12-020: GLASSCOCK GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
October 19, 2012

STATE OF TEXAS
SHIRLEY C. WADE
GEOLOGY
No. 525
LICENSED
PROFESSIONAL GEOSCIENTIST

10/19/2012

The seal appearing on this document was authorized by Shirley C. Wade, Ph.D., P.G. 525 on October 19, 2012.

This page is intentionally blank

GAM RUN 12-020: GLASSCOCK GROUNDWATER CONSERVATION DISTRICT MANAGEMENT PLAN

by Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 936-0883
October 19, 2012

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, groundwater conservation districts shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board 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.

The purpose of this report is to provide Part 2 of a two-part package of information to Glasscock Groundwater Conservation District for its groundwater management plan. The groundwater management plan for the Glasscock Groundwater Conservation District is due for approval by the Executive Administrator of the TWDB before December 4, 2013.

This report discusses the method, assumptions, and results from GAM run 12-020 using the groundwater availability model for the southern portion of the Ogallala aquifer, which includes the Edwards-Trinity (High Plains) Aquifer, the modified version of the groundwater model for the Dockum Aquifer, and the alternate one-layer groundwater flow model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers. Tables 1, 2, and 3 summarize the groundwater availability model data required by the statute, and Figures 1, 2, and 3 show the area of the models from which the values in the tables were extracted. This model run replaces the results of GAM Run 08-25 (Ridgeway, 2008). GAM Run 12-020 meets current standards set after the release of GAM Run 08-25 and also includes information for the Dockum Aquifer. If after review of the figures, the Glasscock Groundwater 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:

The groundwater availability model for the southern portion of the Ogallala Aquifer, which includes the Edwards-Trinity (High Plains) Aquifer, the modified version of the groundwater model for the Dockum Aquifer, and the alternate one-layer groundwater flow model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers were used for this analysis. Water budgets for selected years were extracted using ZONEBUDGET Version 3.01 (Harbaugh, 2009) and the average annual water budget values for recharge, surface water outflow, lateral inflow to the district, lateral outflow from the district, and vertical flow for the portions of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Ogallala Aquifer and the 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 groundwater availability model for the 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 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 (Layer1). The Edwards-Trinity (High Plains) Aquifer (Layer 2 through Layer 4, collectively) is not present in Glasscock Groundwater Conservation District.

- The mean absolute error (a measure of the difference between simulated and actual water levels during the transient model calibration) for the Ogallala Aquifer in 2000 is 33 feet. The mean absolute error for the Edwards-Trinity (High Plains) Aquifer in 1997 is 25 feet (Blandford and others, 2008). This represents 1.8 and 3.0 percent of the hydraulic head drop across the model area for each aquifer, respectively.

- Irrigation return-flow was accounted for in the groundwater availability model by a direct reduction in agricultural pumping as described in Blandford and others (2003).

- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

Dockum Aquifer

- We used a modified version of the groundwater model for the Dockum Aquifer as described in Oliver and Hutchison (2010) for this analysis. This model is an update to the previously developed groundwater availability model for the Dockum Aquifer described in Ewing and others (2008). The modified model version was completed to more effectively simulate the relationship between the Ogallala Aquifer and the Dockum Aquifer. See Oliver and Hutchison (2010) and Ewing and others (2008) for assumptions and limitations of the model.

- The model includes two active layers. Layer 2 represents the upper portion of the Dockum Aquifer and Layer 3 represents the lower portion of the Dockum Aquifer. Layer 1, which is active in version 1.01 of the model documented in Ewing and others (2008), was inactivated in the modified version of the model as described in Oliver and Hutchison (2010). An individual water budget for the district was determined for the Dockum Aquifer (Layers 2 and Layer 3, collectively). It should be noted that pumping only occurs in the lower portion of the Dockum Aquifer in the groundwater model.

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the lower portion of the Dockum Aquifer between 1980 and 1997 is 53 feet. This represents 2.5 percent of the hydraulic head drop across the model area (Oliver and Hutchison 2010).

- The MODFLOW Drain package was used to simulate both evapotranspiration and springs. However, there were no model grid cells representing drains within the district so there was no drain flow incorporated into the surface water outflow value shown in Table 2.

- The MODFLOW General-Head Boundary (GHB) package was applied to the areas in Layer 1 with a high conductance in order to properly mimic water levels in these units. Where the General-Head Boundary correlates with the Ogallala Aquifer, transient head values for the General-Head Boundary were taken from the historical portion of the groundwater availability model (Blandford and others, 2003; Dutton, 2004; Ewing and others, 2008). Outside of the footprint of the Ogallala Aquifer, General-Head Boundary values for the Dockum Aquifer model were estimated from land surface elevation (Ewing and others, 2008; discussed in Oliver and Hutchison, 2010).

- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

Edwards-Trinity (Plateau) Aquifer

- The recently modified and calibrated one-layer groundwater flow model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Hutchison and others, 2011) was used for these simulations. The modified model version was developed to more effectively simulate groundwater conditions. The model was calibrated based on groundwater elevation data from 1930 to 2005; however, water budget data was only extracted from the period 1980 to 1999 to be consistent with the analysis completed for the other aquifers.

- The model has one layer which represents the Pecos Valley Aquifer in the northwest portion of the model area, the Edwards-Trinity (Plateau) Aquifer in the middle, and the Hill Country portion of the Trinity Aquifer in the southeast portion of the model area. A lumped representation of both the Pecos Valley and Edwards-Trinity (Plateau) aquifers was used in the relatively narrow area where the Pecos Valley Aquifer overlies the Edwards-Trinity (Plateau) Aquifer.

- The standard deviation of groundwater elevation residuals (a measure of the difference between simulated and actual water levels during model calibration) for the entire model domain is 70 feet and the average residual is -1.3 feet.
- 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 components were extracted from the groundwater budgets for the Ogallala, Dockum, and Edwards-Trinity (Plateau) aquifers and averaged over select portions of the calibration and verification period of the model runs in the district, as shown in Tables 1, 2, and 3. The components of the modified budget include:

- Precipitation recharge—The spatially-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 and other areas.
- Flow between aquifers—The 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.

The information needed for the District's management plan is summarized in Tables 1, 2, and 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 district or county boundaries, 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 (see Figures 1, 2, and 3).

Comparison of the alternative model for the Edwards-Trinity (Plateau) Aquifer and the groundwater availability model for the Edwards-Trinity (Plateau) Aquifer

The alternative one-layer groundwater flow model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Hutchison and others, 2011) was developed to more effectively simulate groundwater conditions, particularly in the area of Glasscock and Reagan counties. We ran both the groundwater availability model (Anaya and Jones, 2009) and the alternative one-layer model for this analysis and compared the resulting water budgets.

The estimated annual amount of recharge from precipitation to the district from the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers is 17,570 acre-feet per year and the estimated annual amount from the alternative model is 22,976 acre-feet per year.

The estimated annual volume of water that discharges from springs and any surface water body within the district from the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers is 1,642 acre-feet per year and the estimated annual amount from the alternative model is 437 acre-feet per year. For both models this flow includes discharge represented by the MODFLOW drain package.

The estimated annual volume of flow into the district for the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers is 51,196 acre-feet per year and the estimated annual amount for the alternative model is 49,739 acre-feet per year.

The estimated annual volume of flow out of the district for the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers is 22,886 acre-feet per year and the estimated annual amount for the alternative model is 51,225 acre-feet per year. The flows into and out of the district are a sum of flows into and out of surrounding districts and counties.

The estimated net annual volume of flow from the Ogallala Aquifer into the Edwards-Trinity (Plateau) Aquifer in the district for the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers is 6,435 acre-feet per year and the estimated annual amount for the alternative model is 5,499 acre-feet per year. For both models, these are general-head boundary flows.

We used the alternative one-layer groundwater flow model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers to meet the management plan requirements (see Table 2 for a summary) because of improved model calibration in the areas of Glasscock and Reagan counties and because it was used to estimate the modeled available groundwater (MAG) in Groundwater Management Area 7.

Comparison of the modified model for the Dockum Aquifer and the groundwater availability model for the Dockum Aquifer

The modified version of the groundwater model for the Dockum Aquifer (Oliver and Hutchison, 2010) was completed to more effectively simulate the relationship between the Ogallala Aquifer and the Dockum Aquifer. We ran both the groundwater availability model (Ewing and others, 2008) and the modified version of the model for this analysis and compared the resulting water budgets.

Because the Dockum Aquifer does not crop out within the district, the estimated annual amount of recharge from precipitation to the district from both the groundwater availability model for the Dockum Aquifer and the modified model is zero acre-feet per year. The estimated annual volume of water that discharges from springs and any surface water body within the district from both the groundwater availability model for the Dockum Aquifer and the modified model is also zero acre-feet per year.

The estimated annual volume of flow into the district for the groundwater availability model for the Dockum Aquifer is zero acre-feet per year and the estimated annual amount for the modified model is 61 acre-feet per year.

The estimated annual volume of flow out of the district for the groundwater availability model for the Dockum Aquifer is 204 acre-feet per year and the estimated annual amount for the modified model is 5,606 acre-feet per year. The flows into and out of the district are a sum of flows into and out of surrounding districts and counties.

The estimated net annual volume flowing into the Dockum Aquifer from other hydrogeologic units in the district for the groundwater availability model for the Dockum Aquifer is 204 acre-feet per year and the estimated annual amount for the modified model is 5,532 acre-feet per year. For the groundwater availability model this flow is a combination of vertical leakage from the layer representing overlying younger hydrogeologic units and lateral flow from areas of the Dockum that are outside the TWDB delineation of the Dockum Aquifer. For the modified model this flow is a combination of general head boundary fluxes representing overlying younger hydrogeologic units and lateral flow from areas of the Dockum that are outside the TWDB delineation of the aquifer.

We used the modified version of the groundwater flow model for the Dockum Aquifer to meet the management plan requirements (see Table 3 for a summary) because of enhancements in the calibration and because it was used to estimate the modeled available groundwater (MAG) for Groundwater Management Area 7.

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 streamflow are specific to a particular historic time period.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating 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(s) 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.

TABLE 1: SUMMARIZED INFORMATION FOR THE OGALLALA AQUIFER THAT IS NEEDED FOR THE GLASSCOCK 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	1,298
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Ogallala Aquifer	610
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	1,430
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	893
Estimated net annual volume of flow between each aquifer in the district	From the Ogallala Aquifer into the Edwards-Trinity (Plateau) Aquifer	5,499

TABLE 2: SUMMARIZED INFORMATION FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER THAT IS NEEDED FOR THE GLASSCOCK 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-Trinity (Plateau) Aquifer	22,976
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	437
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	49,739
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	51,225
Estimated net annual volume of flow between each aquifer in the district	From the Ogallala Aquifer into the Edwards-Trinity (Plateau) Aquifer	5,499

TABLE 3: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR THE GLASSCOCK 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	0
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	61
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	5,606
Estimated net annual volume of flow between each aquifer in the district	From overlying younger units and from areas of the Dockum that are outside the TWDB delineation of the Dockum Aquifer	5,532*

*4,636 acre-feet per year is contributed by the portion of the Dockum that is outside the TWDB delineation of the Dockum Aquifer.

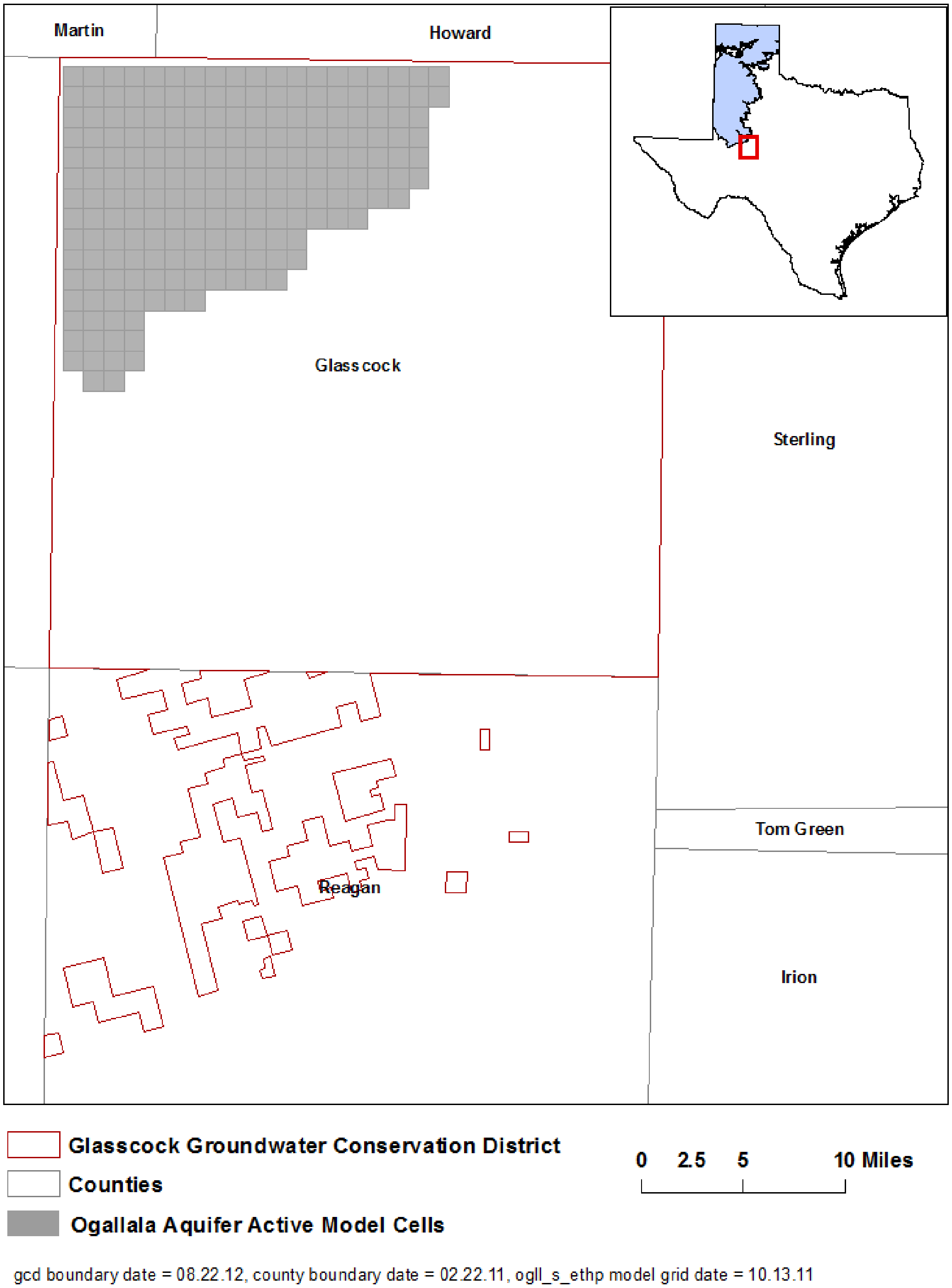


FIGURE 1: AREA OF THE GROUNDWATER MODEL FOR THE SOUTHERN PORTION OF THE OGALLALA AQUIFER AND THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

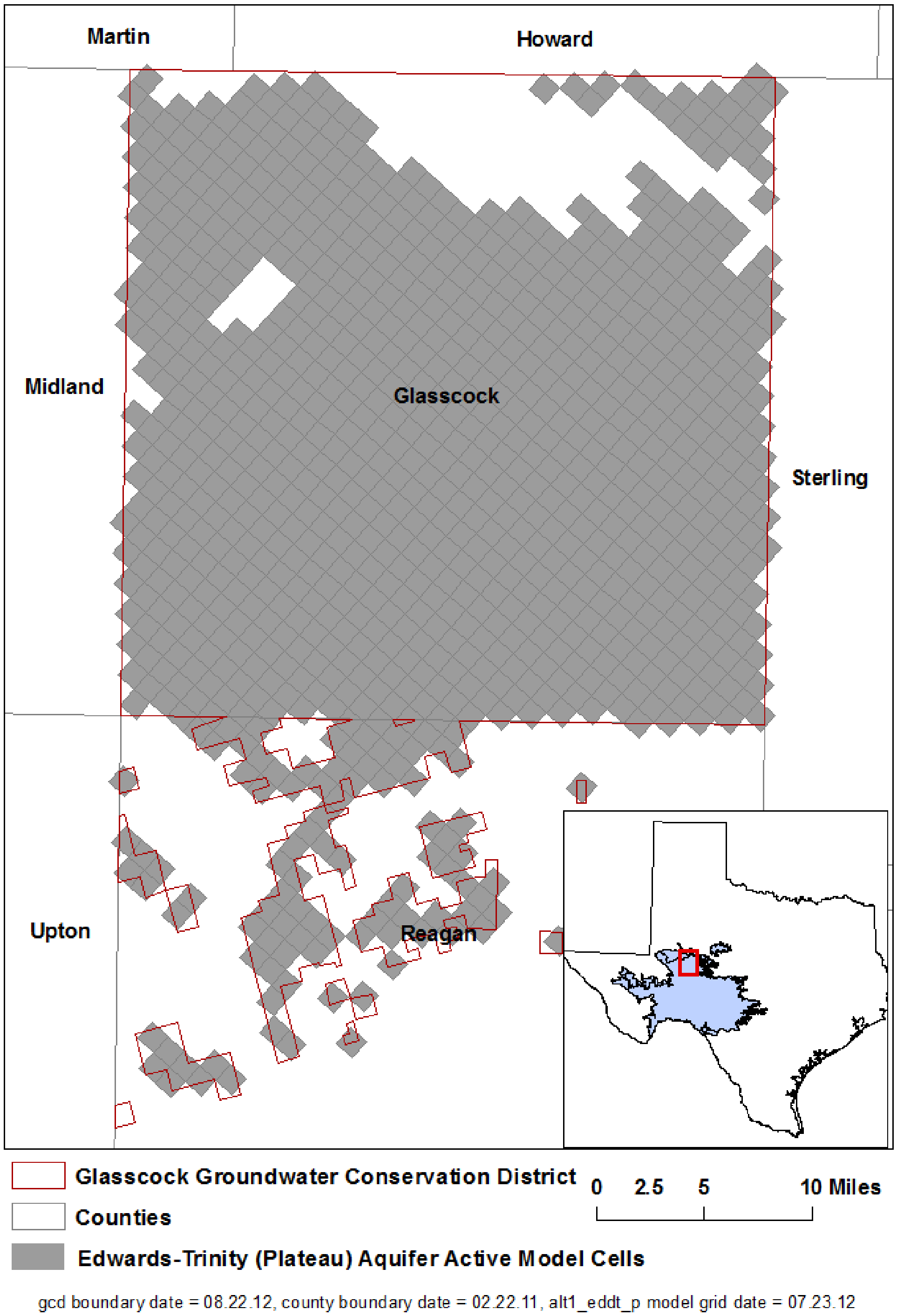


FIGURE 2: AREA OF THE ALTERNATE MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AND PECOS VALLEY AQUIFERS FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

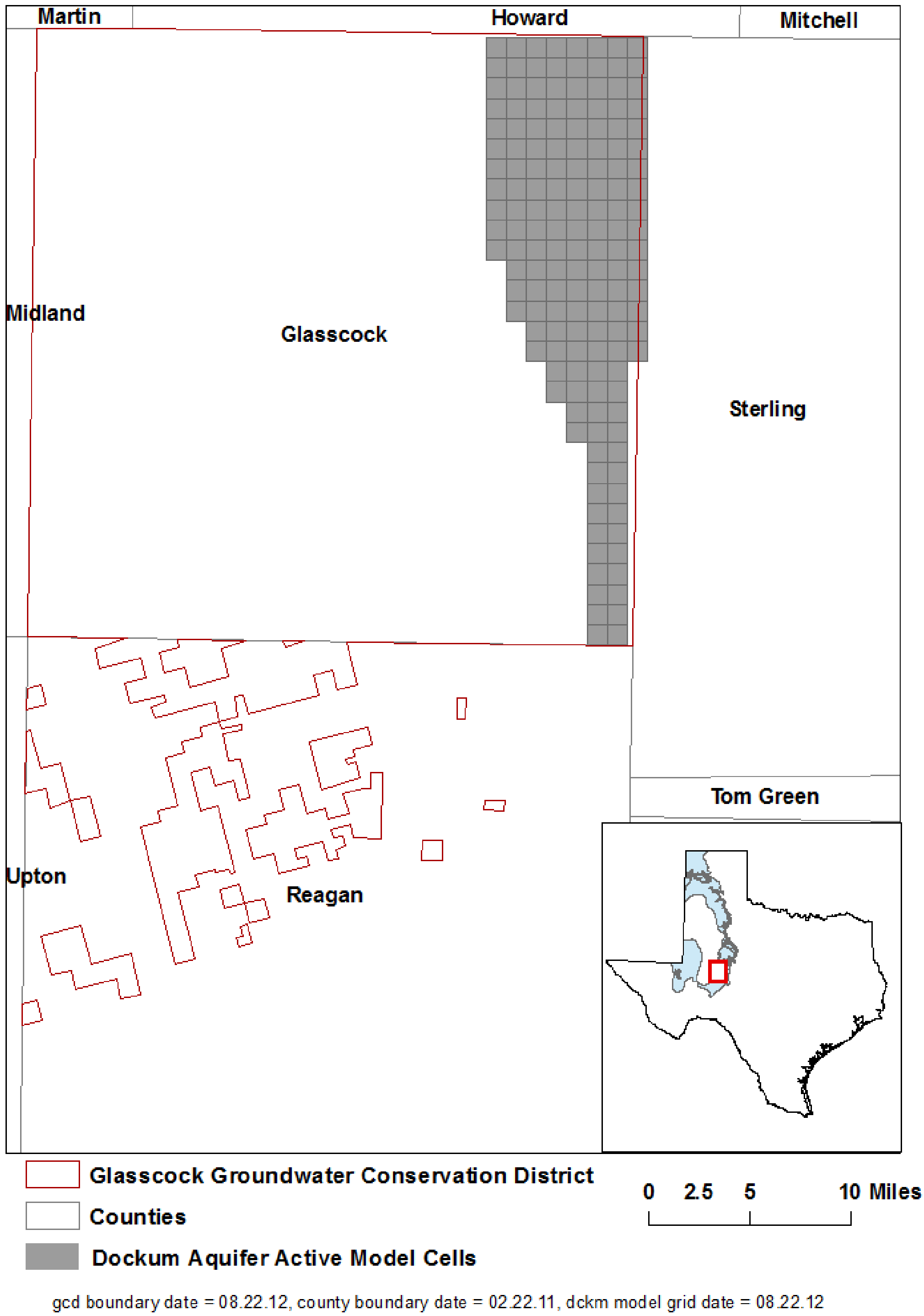


FIGURE 3: AREA OF THE GROUNDWATER MODEL FOR THE DOCKUM AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

REFERENCES:

Anaya, R., and Jones, I., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas: Texas Water Development Board Report 373, 103 p., http://www.twdb.texas.gov/groundwater/models/gam/eddt_p/ET-Plateau_Full.pdf.

Blandford, T.N., Blazer, D.J., Calhoun, K.C., Dutton, A.R., Naing, T., Reedy, R.C., and Scanlon, B.R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico—Numerical simulations through 2050: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 158 p., http://www.twdb.texas.gov/groundwater/models/gam/ogll_s/ogll_s.asp.

Blandford, T.N., Kuchanur, M., Standen, A., Ruggiero, R., Calhoun, K.C., Kirby, P., and Shah, G., 2008, Groundwater availability model of the Edwards-Trinity (High Plains) Aquifer in Texas and New Mexico: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 176 p., http://www.twdb.texas.gov / groundwater/models/gam/ethp/ethp.asp .

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., and Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 p., http://www.twdb.texas.gov/groundwater/models/gam/dckm/DCKM_Model_Report.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.

Harbaugh, A. W., Banta, E. R., Hill, M. C., and McDonald, M. G., 2000. MODFLOW-2000, the U.S. Geological Survey modular ground-water model -- User guide to modularization concepts and the Ground-Water Flow Process: U.S. Geological Survey Open-File Report 00-92, 121 p.

Hutchison, W., Jones, I., and Anaya, R., 2011. Update of the Groundwater Availiability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas. Texas Water Development Board Unpublished Report. http://www.twdb.texas.gov/groundwater/models/alt/eddt_p_2011/ETP_PV_One_Layer_Model.pdf

National Research Council, 2007. Models in Environmental Regulatory Decision Making: Committee on Models in the Regulatory Decision Process, National

Academies Press, Washington D.C., 287 p., http://www.nap.edu/catalog.php?record_id=11972.

Ridgeway, C. K., 2008, GAM run 08-25: Texas Water Development Board, GAM Run 08-25 Report, 4 p. http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR08-25.pdf

Appendix B

Estimated Historical Groundwater Use And 2012 State Water Plan Datasets:

Glasscock Groundwater Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Resources Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
March 26, 2014

GROUNDWATER MANAGEMENT PLAN DATA:

This package of water data reports (part 1 of a 2-part package of information) is being provided to groundwater conservation districts to help them meet the requirements for approval of their five-year groundwater management plan. Each report in the package addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan checklist. The checklist can be viewed and downloaded from this web address:

http://www.twdb.texas.gov/groundwater/docs/GCD/GMPChecklist0113.pdf

The five reports included in part 1 are:

1. Estimated Historical Groundwater Use (checklist Item 2)

    from the TWDB Historical Water Use Survey (WUS)

2. Projected Surface Water Supplies (checklist Item 6)
3. Projected Water Demands (checklist Item 7)
4. Projected Water Supply Needs (checklist Item 8)
5. Projected Water Management Strategies (checklist Item 9)

    reports 2-5 are from the 2012 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report. The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2012 SWP data available as of 3/26/2014. Although it does not happen frequently, neither of these datasets are static so they are subject to change pending the availability of more accurate WUS data or an amendment to the 2012 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/

The 2012 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

The values presented in the data tables of this report are county-based. In cases where groundwater conservation districts cover only a portion of one or more counties the data values are modified with an apportioning multiplier to create new values that more accurately represent district conditions. The multiplier used in the following formula is a land area ratio: (data value * (land area of district in county / land area of county)). For two of the four SWP tables (Projected Surface Water Supplies and Projected Water Demands) only the county-wide water user group (WUG) data values (county other, manufacturing, steam electric power, irrigation, mining and livestock) are modified using the multiplier. WUG values for municipalities, water supply corporations, and utility districts are not apportioned; instead, their full values are retained when they are located within the district, and eliminated when they are located outside (we ask each district to identify these locations).

The other two SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not modified because district-specific values are not statutorily required. Each district needs only "consider" the county values in those tables.

In the WUS table every category of water use (including municipal) is apportioned. Staff determined that breaking down the annual municipal values into individual WUGs was too complex.

TWDB recognizes that the apportioning formula used is not perfect but it is the best available process with respect to time and staffing constraints. If a district believes it has data that is more accurate it can add those data to the plan with an explanation of how the data were derived. Apportioning percentages that the TWDB used are listed above each applicable table.

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317) or Rima Petrossian (rima.petrossian@twdb.texas.gov or 512-936-2420).

Estimated Historical Water Use
TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2012. TWDB staff anticipates the calculation and posting of these estimates at a later date.

GLASSCOCK COUNTY *100.00 % (multiplier)* All values are in acre-fee/year

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2011	GW	164	0	1,251	0	53,250	153	54,818
	SW	0	0	789	0	0	38	827
2010	GW	144	3	510	0	57,164	138	57,959
	SW	0	0	322	0	0	35	357
2009	GW	142	3	446	0	45,852	115	46,558
	SW	0	0	281	0	0	29	310
2008	GW	140	0	381	0	42,879	108	43,508
	SW	0	0	240	0	0	27	267
2007	GW	124	1	0	0	37,816	210	38,151
	SW	0	0	0	0	0	52	52
2006	GW	153	0	0	0	46,579	154	46,886
	SW	0	0	0	0	0	39	39
2005	GW	147	0	0	0	44,231	141	44,519
	SW	0	0	0	0	0	35	35
2004	GW	126	0	0	0	44,305	111	44,542
	SW	0	0	0	0	0	28	28
2003	GW	148	0	0	0	45,092	112	45,352
	SW	0	0	0	0	0	28	28
2002	GW	150	0	0	0	26,398	143	26,691
	SW	0	0	0	0	0	36	36
2001	GW	160	0	0	0	25,756	156	26,072
	SW	0	0	0	0	0	40	40
2000	GW	159	0	0	0	35,456	158	35,773
	SW	0	0	0	0	0	40	40

REAGAN COUNTY *8.22 % (multiplier)* All values are in acre-fee/year

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2011	GW	63	0	81	0	2,167	16	2,327
	SW	0	0	31	0	0	2	33
2010	GW	49	0	47	0	1,593	16	1,705
	SW	0	0	18	0	0	2	20
2009	GW	62	0	41	0	1,373	19	1,495
	SW	0	0	16	0	0	2	18
2008	GW	61	0	34	0	1,599	19	1,713
	SW	0	0	14	0	0	2	16
2007	GW	61	0	0	0	1,397	11	1,469
	SW	0	0	0	0	0	1	1
2006	GW	115	0	0	0	1,541	10	1,666
	SW	0	0	0	0	0	1	1
2005	GW	114	0	0	0	1,008	13	1,135
	SW	0	0	0	0	0	1	1
2004	GW	114	0	0	0	853	7	974
	SW	0	0	0	0	0	3	3
2003	GW	114	0	0	0	822	7	943
	SW	0	0	0	0	0	3	3
2002	GW	61	0	0	0	1,223	12	1,296
	SW	0	0	0	0	0	5	5
2001	GW	61	0	0	0	964	12	1,037
	SW	0	0	0	0	0	5	5
2000	GW	74	0	0	0	1,305	15	1,394
	SW	0	0	0	0	0	3	3

Projected Surface Water Supplies
TWDB 2012 State Water Plan Data

GLASSCOCK COUNTY

100.00 % (multiplier)

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
F	LIVESTOCK	COLORADO	LIVESTOCK LOCAL SUPPLY	40	40	40	40	40	40
	Sum of Projected Surface Water Supplies (acre-feet/year)			**40**	**40**	**40**	**40**	**40**	**40**

REAGAN COUNTY

8.22 % (multiplier)

All values are in acre-feet/year

RWPG	WUG	WUG Basin	Source Name	2010	2020	2030	2040	2050	2060
F	LIVESTOCK	COLORADO	LIVESTOCK LOCAL SUPPLY	3	3	3	3	3	3
F	LIVESTOCK	RIO GRANDE	LIVESTOCK LOCAL SUPPLY	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet/year)			**3**	**3**	**3**	**3**	**3**	**3**

Projected Water Demands
TWDB 2012 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

GLASSCOCK COUNTY

100.00 % (multiplier)

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
F	COUNTY-OTHER	COLORADO	181	196	203	200	197	201
F	MINING	COLORADO	5	5	5	5	5	5
F	IRRIGATION	COLORADO	52,272	51,854	51,438	51,021	50,603	50,190
F	LIVESTOCK	COLORADO	232	232	232	232	232	232
		Sum of Projected Water Demands (acre-feet/year)	**52,690**	**52,287**	**51,878**	**51,458**	**51,037**	**50,628**

REAGAN COUNTY

8.22 % (multiplier)

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
F	COUNTY-OTHER	COLORADO	10	11	12	11	11	10
F	BIG LAKE	COLORADO	910	988	1,026	1,010	970	923
F	LIVESTOCK	COLORADO	21	21	21	21	21	21
F	IRRIGATION	COLORADO	3,008	2,958	2,909	2,859	2,809	2,760
F	MINING	COLORADO	167	178	184	189	195	200
F	LIVESTOCK	RIO GRANDE	2	2	2	2	2	2
		Sum of Projected Water Demands (acre-feet/year)	**4,118**	**4,158**	**4,154**	**4,092**	**4,008**	**3,916**

Projected Water Supply Needs
TWDB 2012 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

GLASSCOCK COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
F	COUNTY-OTHER	COLORADO	0	0	0	0	0	0
F	IRRIGATION	COLORADO	-27,784	-27,381	-26,972	-26,552	-26,131	-25,722
F	LIVESTOCK	COLORADO	0	0	0	0	0	0
F	MINING	COLORADO	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet/year)		**-27,784**	**-27,381**	**-26,972**	**-26,552**	**-26,131**	**-25,722**

REAGAN COUNTY

All values are in acre-feet/year

RWPG	WUG	WUG Basin	2010	2020	2030	2040	2050	2060
F	BIG LAKE	COLORADO	0	0	0	0	0	0
F	COUNTY-OTHER	COLORADO	0	0	0	0	0	0
F	IRRIGATION	COLORADO	-10,997	-10,607	-10,116	-9,559	-8,976	-8,393
F	LIVESTOCK	COLORADO	0	0	0	0	0	0
F	LIVESTOCK	RIO GRANDE	7	7	7	7	7	7
F	MINING	COLORADO	0	0	0	0	0	0
	Sum of Projected Water Supply Needs (acre-feet/year)		**-10,997**	**-10,607**	**-10,116**	**-9,559**	**-8,976**	**-8,393**

Projected Water Management Strategies
TWDB 2012 State Water Plan Data

GLASSCOCK COUNTY

WUG, Basin (RWPG) All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
IRRIGATION, COLORADO (F)							
IRRIGATION CONSERVATION	CONSERVATION [GLASSCOCK]	0	3,631	7,262	7,262	7,262	7,262
Sum of Projected Water Management Strategies (acre-feet/year)		**0**	**3,631**	**7,262**	**7,262**	**7,262**	**7,262**

REAGAN COUNTY

WUG, Basin (RWPG) All values are in acre-feet/year

Water Management Strategy	Source Name [Origin]	2010	2020	2030	2040	2050	2060
IRRIGATION, COLORADO (F)							
IRRIGATION CONSERVATION	CONSERVATION [REAGAN]	0	1,968	3,936	3,936	3,936	3,936
Sum of Projected Water Management Strategies (acre-feet/year)		**0**	**1,968**	**3,936**	**3,936**	**3,936**	**3,936**

Appendix C

GAM Run 10-033 MAG

by Mr. Wade Oliver

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
November 18, 2011

Cynthia K. Ridgeway, the Manager of the Groundwater Availability Modeling Section and Interim Director of the Groundwater Resources Division, is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on November 18, 2011.

This page is intentionally left blank.

EXECUTIVE SUMMARY:

The modeled available groundwater for the Ogallala Aquifer as a result of the desired future condition adopted by the members of Groundwater Management Area 7 declines from approximately 69,600 acre-feet per year to 52,900 acre-feet per year between 2010 and 2060. This is shown divided by county, regional water planning area, and river basin as shown in Table 1 for use in the regional water planning process. Modeled available groundwater is summarized by groundwater conservation district in Table 2. The estimates were extracted from Groundwater Availability Model Run 09-027, which meets the desired future condition adopted by the members of Groundwater Management Area 7.

REQUESTOR:

Mr. Allan Lange of Lipan-Kickapoo Water Conservation District on behalf of Groundwater Management Area 7

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. Lange provided the Texas Water Development Board (TWDB) with the desired future condition of the Ogallala Aquifer adopted by the members of Groundwater Management Area 7. The desired future condition for the Ogallala Aquifer through 2060, as described in Resolution No. 07-29-10-5 and adopted July 29, 2010, is described below:

1) *total decline in volume of water within Ector, Glasscock, and Midland counties in the southern portion of the Ogallala aquifer within* [Groundwater Management Area] *7 at the end of the fifty-year period shall not exceed 50 percent of the volume in the aquifer in the year 2010.*
2) *the Ogallala Aquifer is not relevant for joint planning purposes in all other areas of* [Groundwater Management Area] *7.*

In response to receiving the adopted desired future condition, the Texas Water Development Board has estimated the modeled available groundwater for the Ogallala Aquifer within Groundwater Management Area 7.

METHODS:

Groundwater Management Area 7 contains part of the southern portion of the Ogallala Aquifer. The location of Groundwater Management Area 7, the Ogallala Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1.

The Texas Water Development Board previously completed a predictive groundwater availability model simulation of the Ogallala Aquifer to assist the members of Groundwater Management Area 7 in developing a desired future condition. As stated in Resolution No. 07-29-10-5, the members of Groundwater Management Area 7 considered Groundwater Availability Model (GAM) Run 09-027 when developing the desired future condition statement above (Oliver, 2010). The results presented in this report were taken directly from the "base" scenario in Oliver (2010), which meets the desired future condition adopted by the members of Groundwater Management Area 7.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the groundwater availability model for the southern portion of the Ogallala Aquifer are described below:

- The results presented in this report are based on GAM Run 09-027 (Oliver, 2010). See GAM Run 09-027 for a full description of the methods, assumptions, and results of the groundwater availability model run.

- We used version 2.01 of the groundwater availability model for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer. This model is an expansion on and update to the previously developed groundwater availability model for the 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 groundwater availability model.

- The model includes four layers representing the southern portion of the Ogallala and Edwards-Trinity (High Plains) aquifers. 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. Note that the Edwards-Trinity (High Plains) Aquifer is not present within Groundwater Management Area 7.

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the Ogallala Aquifer in 2000 is 33 feet (Blandford and others, 2008).

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of the file that associates the model grid to political and natural boundaries for the southern portion of the Ogallala Aquifer and the Edwards-Trinity (High Plains) Aquifer.

- The recharge used for the model run represents average recharge as described in Blandford and others (2003).

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code, “modeled available groundwater” is the estimated average amount of water that may be produced annually to achieve a desired future condition. This is distinct from “managed available groundwater,” shown in the draft version of this report dated November 22, 2010, which was a permitting value and accounted for the estimated use of the aquifer exempt from permitting. This change was made to reflect changes in statute by the 82nd Texas Legislature, effective September 1, 2011.

Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits. The estimated amount of pumping exempt from permitting, which the Texas Water Development Board is now required to develop after soliciting input from applicable groundwater conservation districts, will be provided in a separate report.

RESULTS:

The modeled available groundwater for the Ogallala Aquifer in Groundwater Management Area 7 as a result of the desired future condition declines from approximately 69,600 acre-feet per year in 2010 to 52,900 acre-feet per year in 2060. This pumping has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 1).

The modeled available groundwater for the Ogallala Aquifer is also summarized by groundwater conservation district as shown in Table 2. Note that Glasscock Groundwater Conservation District is the only district within Groundwater Management Area 7 that contains the Ogallala Aquifer.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. 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 develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition(s).

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating 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 future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine the modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES:

Blandford, T.N., Blazer, D.J., Calhoun, K.C., Dutton, A.R., Naing, T., Reedy, R.C., and Scanlon, B.R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico—Numerical simulations through 2050: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 158 p.

Blandford, T.N., Kuchanur, M., Standen, A., Ruggiero, R., Calhoun, K.C., Kirby, P., and Shah, G., 2008, Groundwater availability model of the Edwards-Trinity (High Plains) Aquifer in Texas and New Mexico: Final report prepared for the Texas Water Development Board by Daniel B. Stephens & Associates, Inc., 176 p.

National Research Council, 2007, Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.

Oliver, W., 2010, GAM Run 09-027: Texas Water Development Board, GAM Run 09-027 Report, 23 p.

Table 1. Modeled available groundwater for the Ogallala Aquifer in Groundwater Management Area 7. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Regional Water Planning Area	Basin	Year					
			2010	2020	2030	2040	2050	2060
Ector	F	Colorado	8,665	8,026	7,730	7,171	7,135	6,727
Glasscock	F	Colorado	21,773	21,322	20,875	19,691	17,289	14,868
Midland	F	Colorado	39,149	38,388	36,824	34,623	32,693	31,325
Total			**69,587**	**67,736**	**65,429**	**61,485**	**57,117**	**52,920**

Table 2. Modeled available groundwater for the Ogallala Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 7 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Glasscock GCD	21,773	21,322	20,875	19,691	17,289	14,868
No District	47,814	46,414	44,554	41,794	39,828	38,052
Total	**69,587**	**67,736**	**65,429**	**61,485**	**57,117**	**52,920**

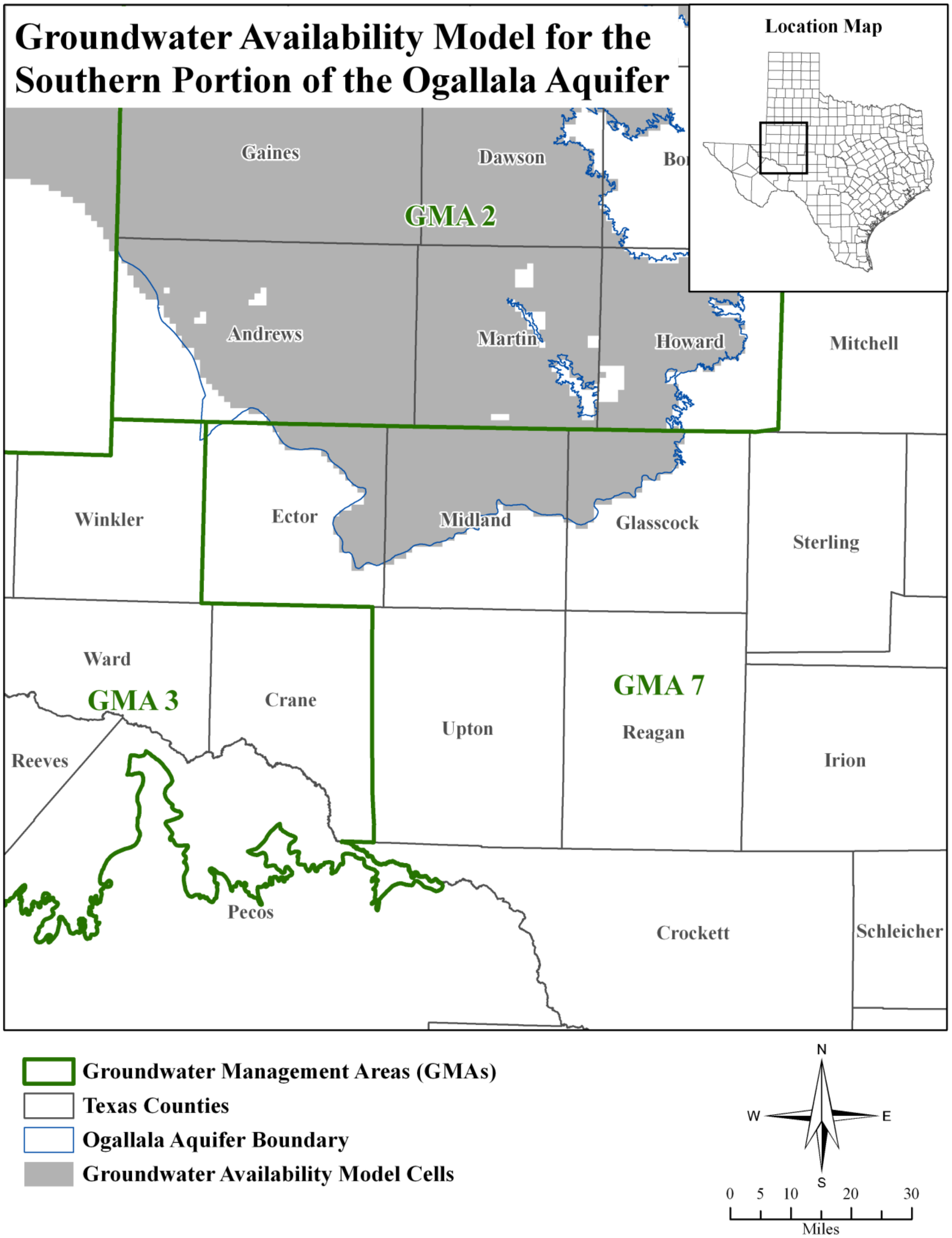


Figure 1. Map showing the areas covered by the groundwater availability model for the southern portion of the Ogallala Aquifer.

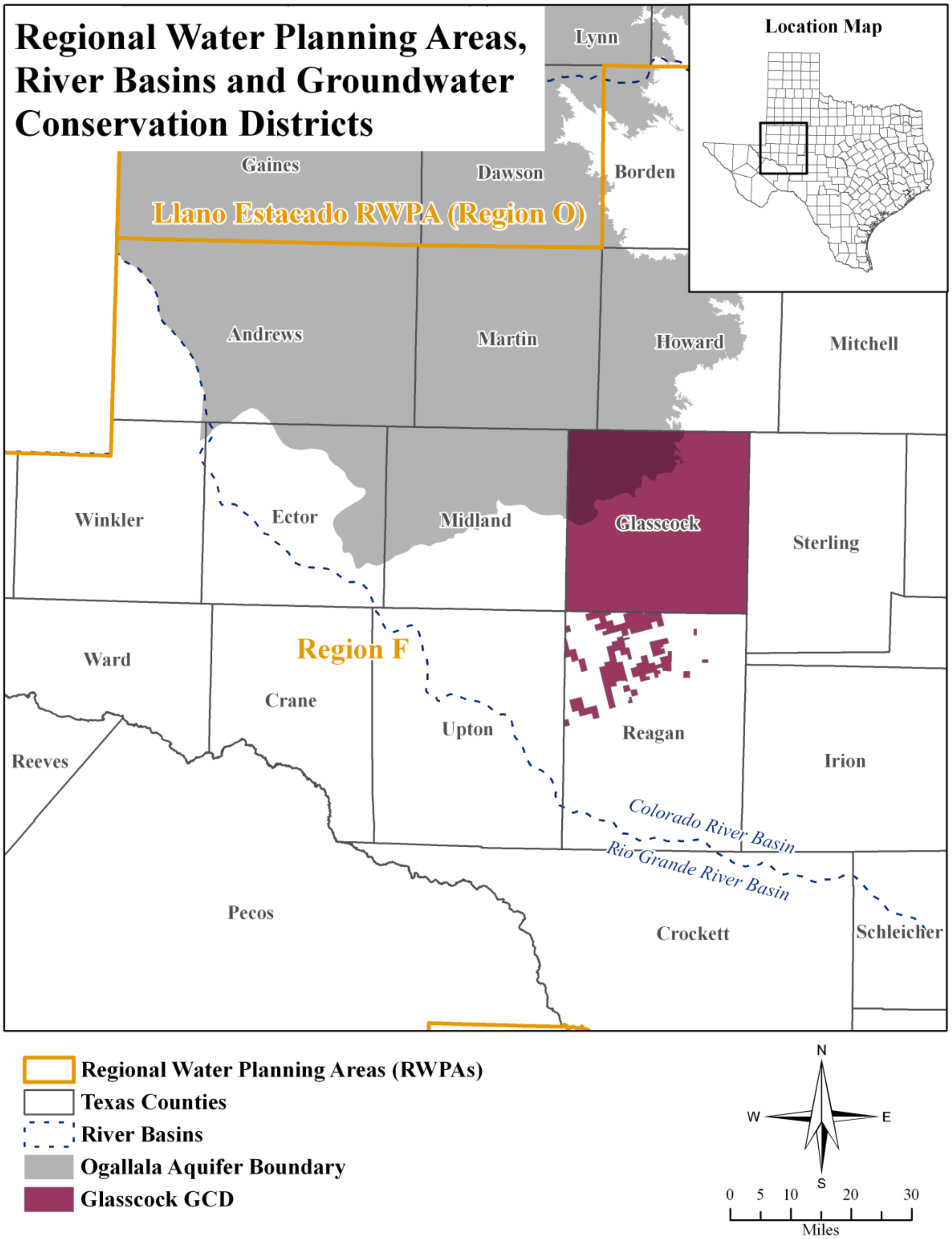


Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in Groundwater Management Area 7.

Appendix D

GAM Run 10-043 MAG (Version 2): Modeled Available Groundwater for the Edwards-Trinity (Plateau), Trinity, and Pecos Valley Aquifers in Groundwater Management Area 7

by Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-5076
November 12, 2012

The seal appearing on this document was authorized by Jianyou (Jerry) Shi, P.G. 11113 on November 12, 2012.

This page is intentionally blank.

GAM RUN 10-043 MAG (VERSION 2): MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7

by Jerry Shi, Ph.D., P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-5076
November 12, 2012

EXECUTIVE SUMMARY:

The modeled available groundwater values for Groundwater Management Area 7 for the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers are summarized in Table 1. These values are also listed by county (Table 2), river basin (Table 3), and regional water planning area (Table 3). The modeled available groundwater values for the relevant aquifers in Groundwater Management Area 7 were initially based on Scenario 10 of GAM Run 09-035. In GAM Run 09-035, the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers were simulated and reported together. Though the desired future condition statement, specifying an average drawdown of 7 feet, only explicitly references the Edwards-Trinity (Plateau) Aquifer, it is the intent of the districts to also incorporate the Trinity and Pecos Valley aquifers. This was confirmed by Ms. Caroline Runge of Menard Underground Water District acting on behalf of Groundwater Management Area 7 in an e-mail to Ms. Sarah Backhouse at the Texas Water Development Board on June 6, 2012. The results here, therefore, contain information for each of these three aquifers. The modeled available groundwater from the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers in Groundwater Management Area 7 that achieves the requested desired future conditions is approximately 449,400 acre-feet per year from 2010 to 2060.

Earlier draft versions of this report showed modeled available groundwater for portions of the Edwards-Trinity (Plateau) Aquifer within the Lipan-Kickapoo Water Conservation District, the Lone Wolf Groundwater Conservation District, the Hickory Underground Water Conservation District No. 1, and the portion of the Trinity Aquifer within the Uvalde Underground Water Conservation District. However, Groundwater Management Area 7 declared those counties “not relevant” for joint planning purposes. Since modeled available groundwater only applies to areas with a specified desired future condition, we updated this report to depict modeled available groundwater only in counties with specified desired future conditions.

The modeled available groundwater for Kinney County Groundwater Conservation District previously reported in Draft GAM Run 10-043 MAG (Shi and Oliver, 2011) dated January 26, 2011, has been updated in a new model run and is presented in this report. The new model run is an update of Scenario 3 of Groundwater Availability Modeling Task 10-027, which meets the desired future conditions for the area adopted by the districts of Groundwater Management Area 7.

REQUESTOR:

Mr. Allan Lange of Lipan-Kickapoo Water Conservation District on behalf of Groundwater Management Area 7.

DESCRIPTION OF REQUEST:

In a letter dated August 13, 2010, Mr. Lange provided the Texas Water Development Board (TWDB) with the desired future conditions of the Edwards-Trinity (Plateau) Aquifer in Groundwater Management Area 7. On June 6, 2012 TWDB clarified through e-mail with Ms. Caroline Runge of Menard Underground Water District acting on behalf of Groundwater Management Area 7 that the intent of the districts within Groundwater Management Area 7 was to also incorporate the Trinity and Pecos Valley aquifers, except where explicitly stated as non-relevant in the desired future conditions of the Edwards-Trinity (Plateau) Aquifer. The desired future conditions for the aquifer[s], as described in Resolution # 07-29-10-9 and adopted July 29, 2010 by the groundwater conservation districts within Groundwater Management Area 7, are described below:

1) An average drawdown of 7 feet for the Edwards-Trinity (Plateau)[, Pecos Valley, and Trinity] aquifer[s], except for the Kinney County [Groundwater Conservation District], based on Scenario 10 of the TWDB [Groundwater Availability Model] run 09-35 which is incorporated in its entirety into this resolution; and

2) In Kinney County, that drawdown which is consistent with maintaining, at Las Moras Springs, an annual average flow of 23.9 [cubic feet per second] and a median flow of 24.4 [cubic feet per second] based on Scenario 3 of the Texas Water Development Board's flow model presented on July 27, 2010; and

3) the Edwards-Trinity [Aquifer] is not relevant for joint planning purposes within the boundaries of the Lipan-Kickapoo [Water Conservation District], the Lone Wolf [Groundwater Conservation District], and the Hickory Underground Water Conservation District No. 1; and

4) the Trinity (Hill Country) portion of the aquifer is not relevant for joint planning purposes within the boundaries of the Uvalde [Underground Water Conservation District] in [Groundwater Management Area] 7.

METHODS, PARAMETERS AND ASSUMPTIONS:

The desired future condition for Kinney County was evaluated in a new model run (Shi and others, 2012). The new model run is an update of Scenario 3 of Groundwater Availability Modeling (GAM) Task 10-027 (Hutchison, 2010a). Both model runs were based on the MODFLOW-2000 model developed by the TWDB to assist with the joint planning process regarding the Kinney County Groundwater Conservation District (Hutchison and others, 2011b). In both model runs, the total pumping in Kinney County, which lies within Groundwater Management Areas 7 and 10, was maintained at approximately 77,000 acre-feet per year to achieve the desired future conditions at Las Moras Springs. Details regarding this new model run are summarized in Shi and others (2012).

The desired future condition for the remaining areas in Groundwater Management Area 7 was based on Scenario 10 of GAM Run 09-035 using a MODFLOW-2000 model developed by the TWDB (Hutchison and others, 2011a). Details regarding this scenario can be found in Hutchison (2010b). In GAM Run 09-035, the Edwards-Trinity (Plateau), Trinity, Pecos Valley, and Trinity aquifers were simulated and reported together. The desired future condition statement specifying of an average drawdown of 7 feet, which is achieved in the above simulation, only explicitly references the Edwards-Trinity (Plateau) Aquifer. By stating that the above simulation is "incorporated in its entirety" into the resolution, it is the intent of the districts to also incorporate the Trinity and Pecos Valley aquifers. The results below, therefore, contain information on the Trinity and Pecos Valley aquifers in addition to the Edwards-Trinity (Plateau) Aquifer. This interpretation has been confirmed by Ms. Caroline Runge on behalf of Groundwater Management Area 7 to Ms. Sarah Backhouse at the Texas Water Development Board.

The locations of the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers are shown in Figure 1.

RESULTS:

The modeled available groundwater values from aquifers in Groundwater Management Area 7 that achieve the desired future conditions is approximately 445,000 acre-feet per year for the Edwards-Trinity (Plateau) aquifer, 2,500 acre-feet per year for the Trinity Aquifer, and 1,600 acre-feet per year for the Pecos Valley Aquifer (Tables 1, 2, and 3). These tables contain the modeled available groundwater for the aquifers subdivided by county, regional water planning area, and river basin for use in the regional water planning process. These areas are shown in Figure 2.

Tables 4, 5, and 6 show the modeled available groundwater for the Edwards-Trinity (Plateau), Trinity, and Pecos Valley aquifers summarized by county, regional water planning area, and river basin, respectively, within Groundwater Management Area 7.

The modeled available groundwater for the aquifers within and outside the groundwater conservation districts in Groundwater Management Area 7 where they were determined to be relevant for the purposes of joint planning are presented in Table 7. As shown in Table 7, the modeled available groundwater within the groundwater conservation districts in Groundwater Management Area 7 is approximately 370,000 acre-feet per year from 2010 to 2060.

LIMITATIONS:

The groundwater model used in developing estimates of modeled available groundwater is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future conditions. Although the groundwater model used in this analysis is the best available scientific tool for this purpose, it, like all models, has limitations. 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 develop estimates of modeled available groundwater is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.

Given these limitations, users of this information are cautioned that the modeled available groundwater numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. Texas Water Development Board Makes no warranties or representations relating 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 future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with Texas Water Development Board to refine these modeled available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES:

Hutchison, William R., 2010a, GAM Task 10-027: Texas Water Development Board, GAM Task 10-027 Report, 7 p.

Hutchison, William R., 2010b, GAM Run 09-035 (version 2): Texas Water Development Board, GAM Run 09-035 Report, 10 p.

Hutchison, William R., Jones, Ian, and Anaya, Roberto, 2011a, Update of the Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas, Texas Water Development Board, 59 p.

Hutchison, William R., Shi, Jerry, and Jigmond, Marius, 2011b, Groundwater Flow Model of the Kinney County Area, Texas Water Development Board, 138 p.

Shi, Jerry, Ridgeway, Cindy, and French, Larry, 2012, Draft GAM Task Report 12-002: Modeled Available Groundwater in Kinney County (April 11, 2012).

Shi, Jerry and Oliver, Wade, 2011, GAM Run 10-043 MAG (January 26, 2011).

Texas Water Development Board, 2007, Water for Texas – 2007—Volumes I-III; Texas Water Development Board Document No. GP-8-1, 392 p.

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Coke	F	Colorado	998	998	998	998	998	998
Crockett	F	Colorado	19	19	19	19	19	19
		Rio Grande	5,407	5,407	5,407	5,407	5,407	5,407
Ector	F	Colorado	4,918	4,918	4,918	4,918	4,918	4,918
		Rio Grande	504	504	504	504	504	504
Edwards	J	Colorado	2,306	2,306	2,306	2,306	2,306	2,306
		Nueces	1,632	1,632	1,632	1,632	1,632	1,632
		Rio Grande	1,700	1,700	1,700	1,700	1,700	1,700
Gillespie	K	Colorado	2,378	2,378	2,378	2,378	2,378	2,378
		Guadalupe	136	136	136	136	136	136
Glasscock	F	Colorado	65,213	65,213	65,213	65,213	65,213	65,213
Irion	F	Colorado	2,293	2,293	2,293	2,293	2,293	2,293
Kimble	F	Colorado	1,283	1,283	1,283	1,283	1,283	1,283
Kinney	J	Nueces	12	12	12	12	12	12
		Rio Grande	70,326	70,326	70,326	70,326	70,326	70,326
McCulloch	F	Colorado	4	4	4	4	4	4
Menard	F	Colorado	2,194	2,194	2,194	2,194	2,194	2,194
Midland	F	Colorado	23,251	23,251	23,251	23,251	23,251	23,251
Nolan	G	Brazos	302	302	302	302	302	302
		Colorado	391	391	391	391	391	391
Pecos	F	Rio Grande	115,938	115,938	115,938	115,938	115,938	115,938
Reagan	F	Colorado	68,250	68,250	68,250	68,250	68,250	68,250
		Rio Grande	28	28	28	28	28	28
Real	J	Colorado	278	278	278	278	278	278
		Guadalupe	3	3	3	3	3	3
		Nueces	7,196	7,196	7,196	7,196	7,196	7,196
Schleicher	F	Colorado	6,410	6,410	6,410	6,410	6,410	6,410
		Rio Grande	1,640	1,640	1,640	1,640	1,640	1,640
Sterling	F	Colorado	2,497	2,497	2,497	2,497	2,497	2,497
Sutton	F	Colorado	386	386	386	386	386	386
		Rio Grande	6,052	6,052	6,052	6,052	6,052	6,052

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Taylor	G	Brazos	331	331	331	331	331	331
		Colorado	158	158	158	158	158	158
Terrell	E	Rio Grande	1,421	1,421	1,421	1,421	1,421	1,421
Tom Green	F	Colorado	426	426	426	426	426	426
Upton	F	Colorado	21,257	21,257	21,257	21,257	21,257	21,257
		Rio Grande	1,122	1,122	1,122	1,122	1,122	1,122
Uvalde	L	Nueces	1,635	1,635	1,635	1,635	1,635	1,635
Val Verde	J	Rio Grande	24,988	24,988	24,988	24,988	24,988	24,988
Grand Total			**445,283**	**445,283**	**445,283**	**445,283**	**445,283**	**445,283**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Gillespie	K	Colorado	2,482	2,482	2,482	2,482	2,482	2,482
Real	J	Nueces	52	52	52	52	52	52
Total			**2,534**	**2,534**	**2,534**	**2,534**	**2,534**	**2,534**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE PECOS VALLEY AQUIFER IN GROUNDWATER MANAGEMENT AREA 7. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE DIVIDED BY COUNTY, REGIONAL WATER PLANNING AREA, AND RIVER BASIN.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Crockett	F	Rio Grande	31	31	31	31	31	31
Ector	F	Rio Grande	113	113	113	113	113	113
Pecos	F	Rio Grande	1,448	1,448	1,448	1,448	1,448	1,448
Upton	F	Rio Grande	2	2	2	2	2	2
Total			**1,594**	**1,594**	**1,594**	**1,594**	**1,594**	**1,594**

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	2010	2020	2030	2040	2050	2060
Coke	998	998	998	998	998	998
Crockett	5,457	5,457	5,457	5,457	5,457	5,457
Ector	5,535	5,535	5,535	5,535	5,535	5,535
Edwards	5,638	5,638	5,638	5,638	5,638	5,638
Gillespie	4,996	4,996	4,996	4,996	4,996	4,996
Glasscock	65,213	65,213	65,213	65,213	65,213	65,213
Irion	2,293	2,293	2,293	2,293	2,293	2,293
Kimble	1,283	1,283	1,283	1,283	1,283	1,283
Kinney	70,338	70,338	70,338	70,338	70,338	70,338
Mcculloch	4	4	4	4	4	4
Menard	2,194	2,194	2,194	2,194	2,194	2,194
Midland	23,251	23,251	23,251	23,251	23,251	23,251
Nolan	693	693	693	693	693	693
Pecos	117,386	117,386	117,386	117,386	117,386	117,386
Reagan	68,278	68,278	68,278	68,278	68,278	68,278
Real	7,529	7,529	7,529	7,529	7,529	7,529
Schleicher	8,050	8,050	8,050	8,050	8,050	8,050
Sterling	2,497	2,497	2,497	2,497	2,497	2,497
Sutton	6,438	6,438	6,438	6,438	6,438	6,438

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY COUNTY FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

County	2010	2020	2030	2040	2050	2060
Taylor	489	489	489	489	489	489
Terrell	1,421	1,421	1,421	1,421	1,421	1,421
Tom Green	426	426	426	426	426	426
Upton	22,381	22,381	22,381	22,381	22,381	22,381
Uvalde	1,635	1,635	1,635	1,635	1,635	1,635
Val Verde	24,988	24,988	24,988	24,988	24,988	24,988
Total	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

TABLE 5. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY REGIONAL WATER PLANNING AREA FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Regional Water Planning Area	Year					
	2010	2020	2030	2040	2050	2060
E	1,421	1,421	1,421	1,421	1,421	1,421
F	331,684	331,684	331,684	331,684	331,684	331,684
G	1,182	1,182	1,182	1,182	1,182	1,182
J	108,493	108,493	108,493	108,493	108,493	108,493
K	4,996	4,996	4,996	4,996	4,996	4,996
L	1,635	1,635	1,635	1,635	1,635	1,635
Total	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

TABLE 6. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY RIVER BASIN FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

River Basin	Year					
	2010	2020	2030	2040	2050	2060
Brazos	633	633	633	633	633	633
Colorado	207,392	207,392	207,392	207,392	207,392	207,392
Guadalupe	139	139	139	139	139	139
Nueces	10,527	10,527	10,527	10,527	10,527	10,527
Rio Grande	230,720	230,720	230,720	230,720	230,720	230,720
Total	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY GROUNDWATER CONSERVATION DISTRICT FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Coke County UWCD	998	998	998	998	998	998
Crockett County GCD	4,685	4,685	4,685	4,685	4,685	4,685
Glasscock GCD	106,075	106,075	106,075	106,075	106,075	106,075
Hill Country UWCD	4,996	4,996	4,996	4,996	4,996	4,996
Irion County WCD	2,435	2,435	2,435	2,435	2,435	2,435
Kimble County GCD	1,283	1,283	1,283	1,283	1,283	1,283
Kinney County GCD	70,338	70,338	70,338	70,338	70,338	70,338
Menard County UWD	2,194	2,194	2,194	2,194	2,194	2,194
Middle Pecos GCD	117,386	117,386	117,386	117,386	117,386	117,386
Plateau UWC and SD	8,050	8,050	8,050	8,050	8,050	8,050
Real-Edwards CRD	13,167	13,167	13,167	13,167	13,167	13,167
Santa Rita UWCD	27,416	27,416	27,416	27,416	27,416	27,416
Sterling County UWCD	2,497	2,497	2,497	2,497	2,497	2,497
Sutton County UWCD	6,438	6,438	6,438	6,438	6,438	6,438
Uvalde County UWCD (Edwards-Trinity Plateau)	1,635	1,635	1,635	1,635	1,635	1,635
Wes-Tex GCD	693	693	693	693	693	693

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS-TRINITY (PLATEAU), TRINITY, AND PECOS VALLEY AQUIFERS IN GROUNDWATER MANAGEMENT AREA 7 BY GROUNDWATER CONSERVATION DISTRICT FOR EACH DECADE BETWEEN 2010 AND 2060. RESULTS ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	Year					
	2010	2020	2030	2040	2050	2060
Total (areas in districts relevant for joint planning)	**370,286**	**370,286**	**370,286**	**370,286**	**370,286**	**370,286**
No District	79,125	79,125	79,125	79,125	79,125	79,125
Total (all areas)	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**	**449,411**

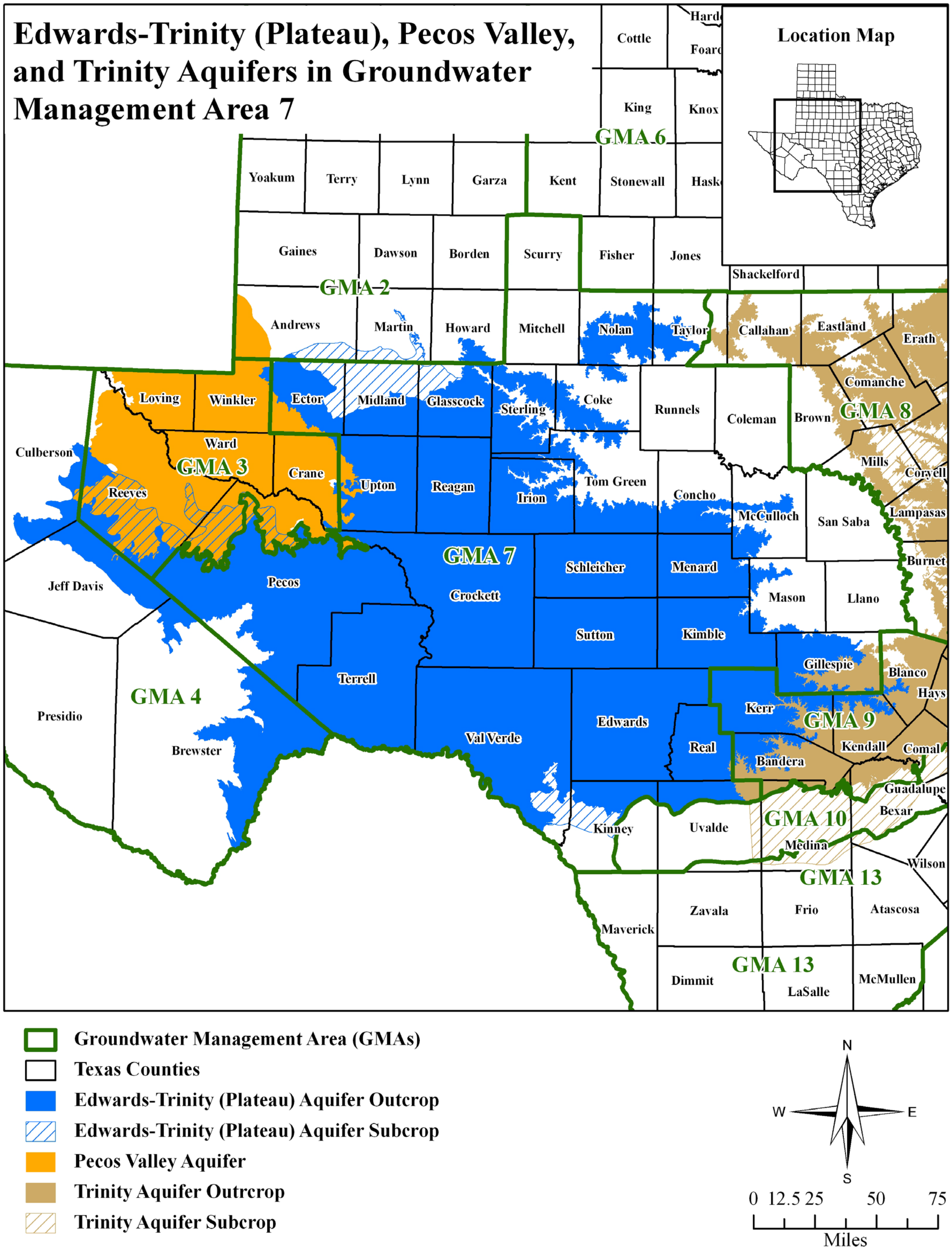


FIGURE 1. MAP SHOWING THE BOUNDARY OF THE EDWARDS-TRINITY (PLATEAU), PECOS VALLEY, AND TRINITY AQUIFERS ACCORDING TO THE 2007 STATE WATER PLAN (TWDB, 2007).

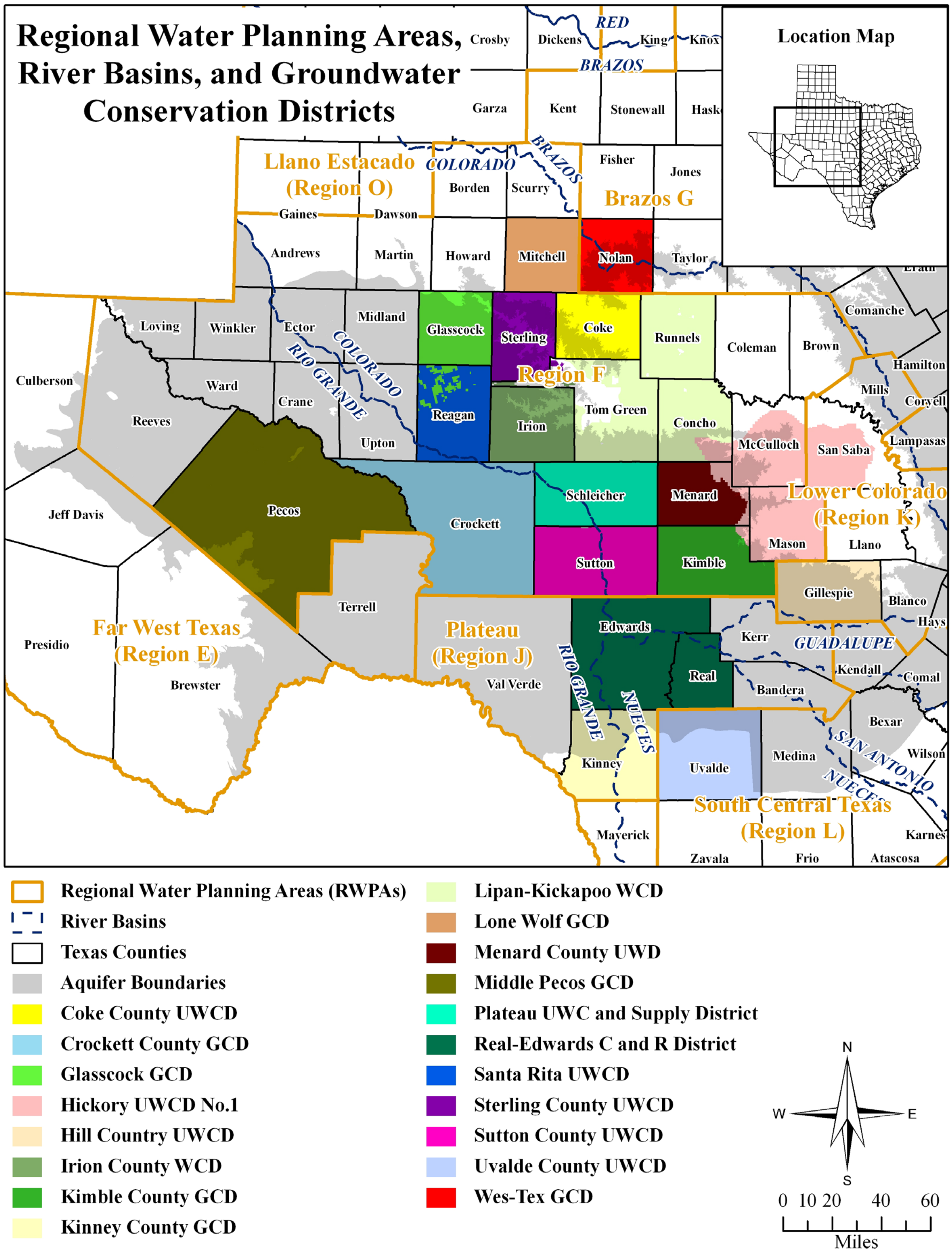


FIGURE 2. MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER CONSERVATION DISTRICTS, COUNTIES, AND RIVER BASINS IN AND NEIGHBORING GROUNDWATER MANAGEMENT AREA 7.