Permian Basin Underground Water Conservation District

708 W. St. Peter · P.O. Box 1314 · Stanton, Texas 79782
Bus: (432) 756-2136 · Fax: (432) 756-2068
E-mail: permianbasin@pbuwcd.com
www.pbuwcd.com

September 16, 2022

Mr. Allen,

Please find attached our adopted management plan and the notices of hearing that were posted. This Plan was adopted by a unanimous vote of the PBUWCD Board on (8-25-2022). I have already forwarded you the email where I shared the plan with Colorado River Municipal Water District. I believe this should finalize our plan with TWDB.

Thank you,

John Dallen Skinner

Permian Basin Underground Water Conservation District Management Plan

Adopted 8-25-2022

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District Mission Statement

The Permian Basin Underground Water Conservation District (the District) will develop, promote, and implement management strategies to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources, over which it has jurisdictional authority, for the benefit of the people that the District serves.

Time Period for this Plan

This plan becomes effective upon adoption by the Permian Basin Underground Water Conservation District Board of Directors and approved as administratively complete by the Texas Water Development Board. The plan will remain in effect for five years from the date of approval or until a revised plan is adopted and approved.

Statement of Guiding Principles

The District was formed, and has been operated from its inception, with the guiding belief that the ownership and pumpage of groundwater is a private property right. The Board will continue to support that right.

The Board is elected by the registered voters of the District, under the general Election laws of Texas. The rules promulgated to date by the Board were carefully thought out, were the result of specific needs, and were adopted after public input. These rules provide a fair and equitable opportunity for all water users to produce and use water from the aquifer for beneficial purposes. Interpretation and enforcement of the rules of the District are carried out by the District's staff, at the direction of the Board.

This management document is intended to be used as a tool to provide continuity in the management of the District. It will be used by the District staff as a guide to ensure that all aspects of the goals of the District are carried out. It will be referred to by the Board for future planning, as well as a document to measure the performance of the staff on an annual basis.

Conditions can change over time which may cause the Board to modify this document. The dynamic nature of this plan shall be maintained so the District can continue to best serve the needs of the constituents. At the very least, the Board will review and readopt this plan every five years according to Statute.

In the opinion of the Board, the goals, management objectives, and performance standards put forth in this planning document have been set at a reasonable level considering existing and future fiscal and technical resources. Conditions may change which could cause change in the management objectives defined to reach the stated goals. Whatever the future holds, the following guidelines will be used to insure that the management objectives are set at a sufficient level to be realistic and effective:

- The District's constituency will determine if the District's goals are set at a level that is both meaningful and attainable; through their voting right, the public will appraise the District's overall performance in the process of electing or re-electing Board members.

- The duly elected Board will guide and direct the District staff and will gauge the achievement of the goals set forth in this document.

- The interests and needs of the District's constituency shall control the direction of the management of the District.

- The Board will endeavor to maintain local control of the privately owned resource over which the District has jurisdictional authority.

General Description, Location and Extent

The District was created on April 25, 1985 when Governor Mark White signed HB 2382, 69th Legislature, in to law. The District was confirmed by voter approval, the initial Board elected, and an ad valorem tax rate cap of $0.02/$100 valuation was set in an election held in September 1985. Table 1 lists the current Board of Directors, office held, County served, and term.

Office	Name	County	Term Ends
President	Richie Tubb	Howard	May 2024
Vice-President	Raymond Straub Jr.	Martin	May 2026
Secretary	Brad Tunnell	Martin	May 2024
Member	Brandon Borgstedt	Martin	May 2026
Member	Ed Miller	Howard	May 2026

Table 1: Board of Directors of the Permian Basin Underground Water Conservation District

Originally, the jurisdictional extent of the District was the same as Martin County, Texas. However, in 1991, the voters in the northwest portion of Howard County approved the annexation of that portion of their county into the District.

In 2001 the District annexed all of Howard County save and except City Limits of Big Spring, Texas, the City Limits of Coahoma, Texas, and adjacent areas as shown in figure 1.

The District now covers approximately 1754 square miles of West Texas (Figure 1). Stanton, the county seat of Martin County, is the largest municipality in the District, having a population of 2492.

The District is bordered on the west by Andrews County, on the north by Dawson and Borden Counties, on the south by Midland and Glasscock Counties, and on the east by Mitchell County with Scurry County to the Northeast and Sterling County to the Southeast.

The economy of the District is predominated by the oil and gas industry and to a lesser extent by agriculture. The major agricultural products coming from the area include beef cattle, cotton and grain sorghum.

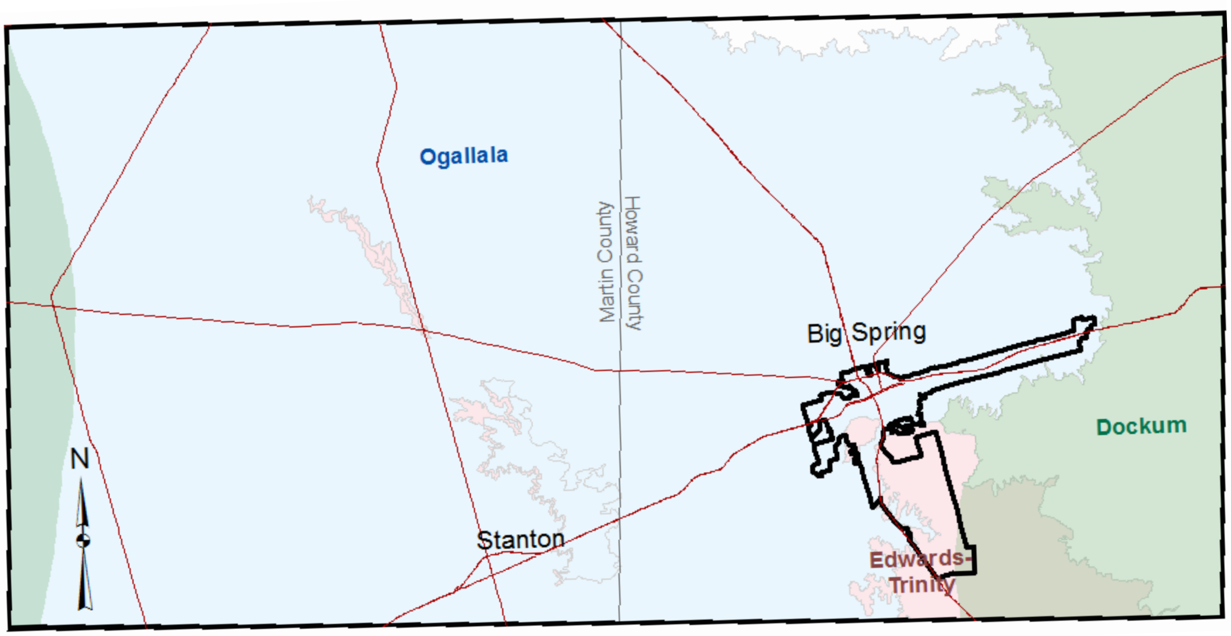


Figure 1: District Boundaries and Aquifers of the Permian Basin Underground Water Conservation District

Groundwater Resources

The District has jurisdictional authority over all groundwater that lies within the District's boundaries. There are two major aquifers that occur within the District: the Ogallala and the Edwards-Trinity (Plateau). The following is a description of these formations that may be beneficial to District constituents.

Ogallala Aquifer

The Ogallala Aquifer is the primary source of groundwater in the District (Fig. 2). The aquifer extends from the ground surface downward, ranging in thickness from less than 20 feet to more than 100 feet.

The formation consists of heterogeneous sequences of clay, silt, sand, and gravel. These sediments are thought to have been deposited by eastward flowing aggrading streams that filled and buried valleys eroded into pre-Ogallala rocks (Ashworth and Hopkins, 1995).

Water levels in the Ogallala Aquifer are primarily influenced by the rate of recharge to and discharge from the aquifer. Recharge to the aquifer occurs primarily by infiltration of precipitation falling on the surface.

Groundwater in the aquifer generally flows from northwest to southeast, normally at right angles to water level contours. Velocities of less than one foot per day are typical, but higher velocities may occur along filled erosion valleys where coarser grained deposits have greater permeabilities.

Discharge from the Ogallala aquifer within the District occurs through the pumping of wells; primarily for municipal, oil and gas production, and irrigation. Groundwater pumpage typically exceeds recharge and results in water-level declines (Ashworth and Hopkins, 1995).

The chemical quality of Ogallala groundwater varies greatly across the District. The suitability of groundwater for irrigation purposes is largely dependent on the chemical composition of the water and is determined primarily by the total concentration of soluble salts.

This district lies at the very southern end of the Ogallala. As such, the Ogallala formation here is thinning and less productive than in other areas. It is also intermingled with other formations, including the Edwards, Fredericksburg, and Antlers Sands in some places in this District.

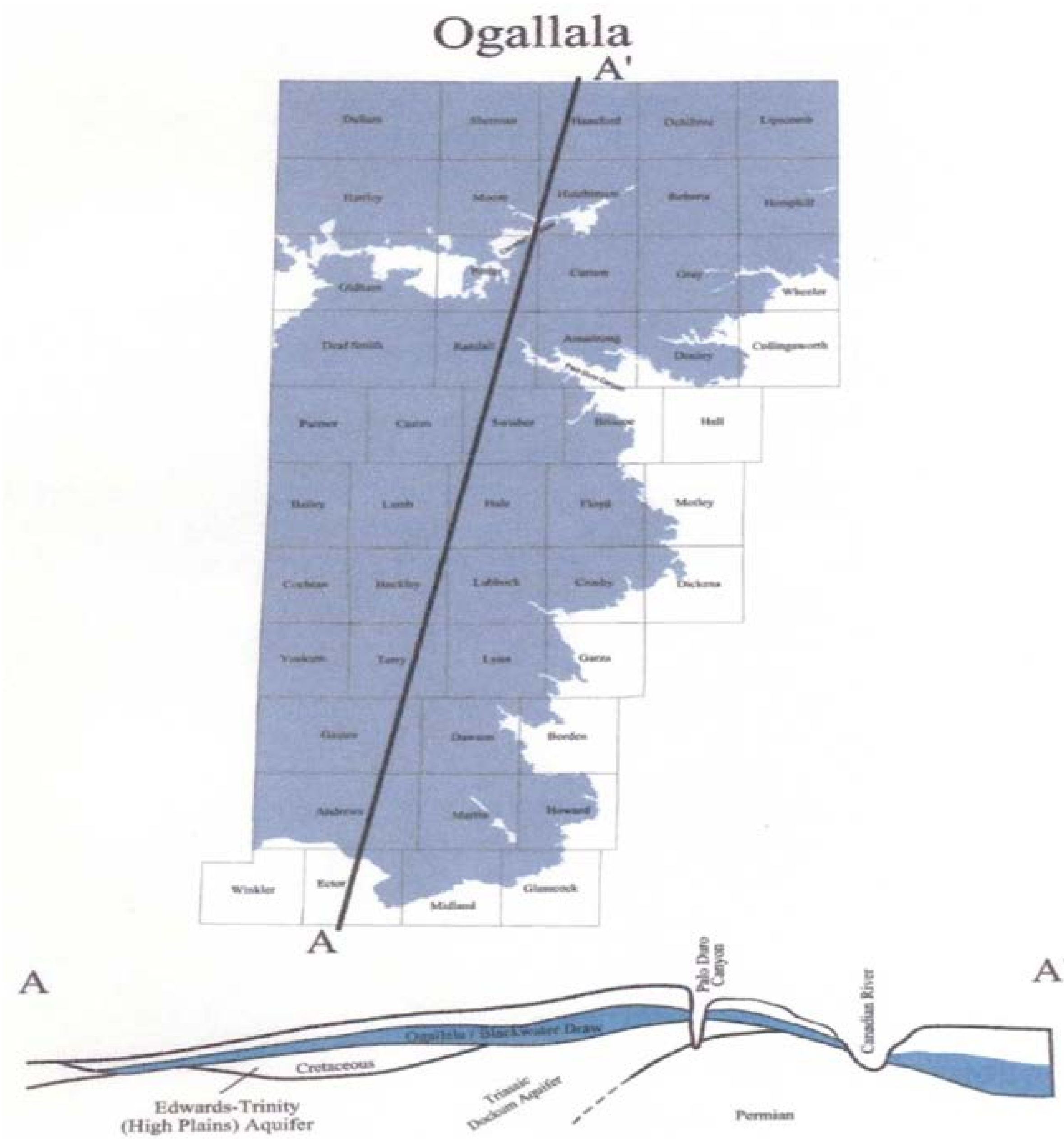


Figure 2: Aerial extent of the Ogallala Aquifer in Texas (Adapted from Ashworth and Hopkins 1995)

Edwards – Trinity (Plateau) Aquifer

The Edward –Trinity (Plateau) Aquifer underlies a small portion of east central and southern Martin County as well as the eastern portions of Howard County within the District (Fig. 3). The aquifer consists of saturated sediments of lower Cretaceous Epoch Trinity Group formations and overlying limestones and dolomites of the Edwards formations.

Chemical quality of the 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. There is little pumpage from the aquifer, and water levels remain relatively constant.

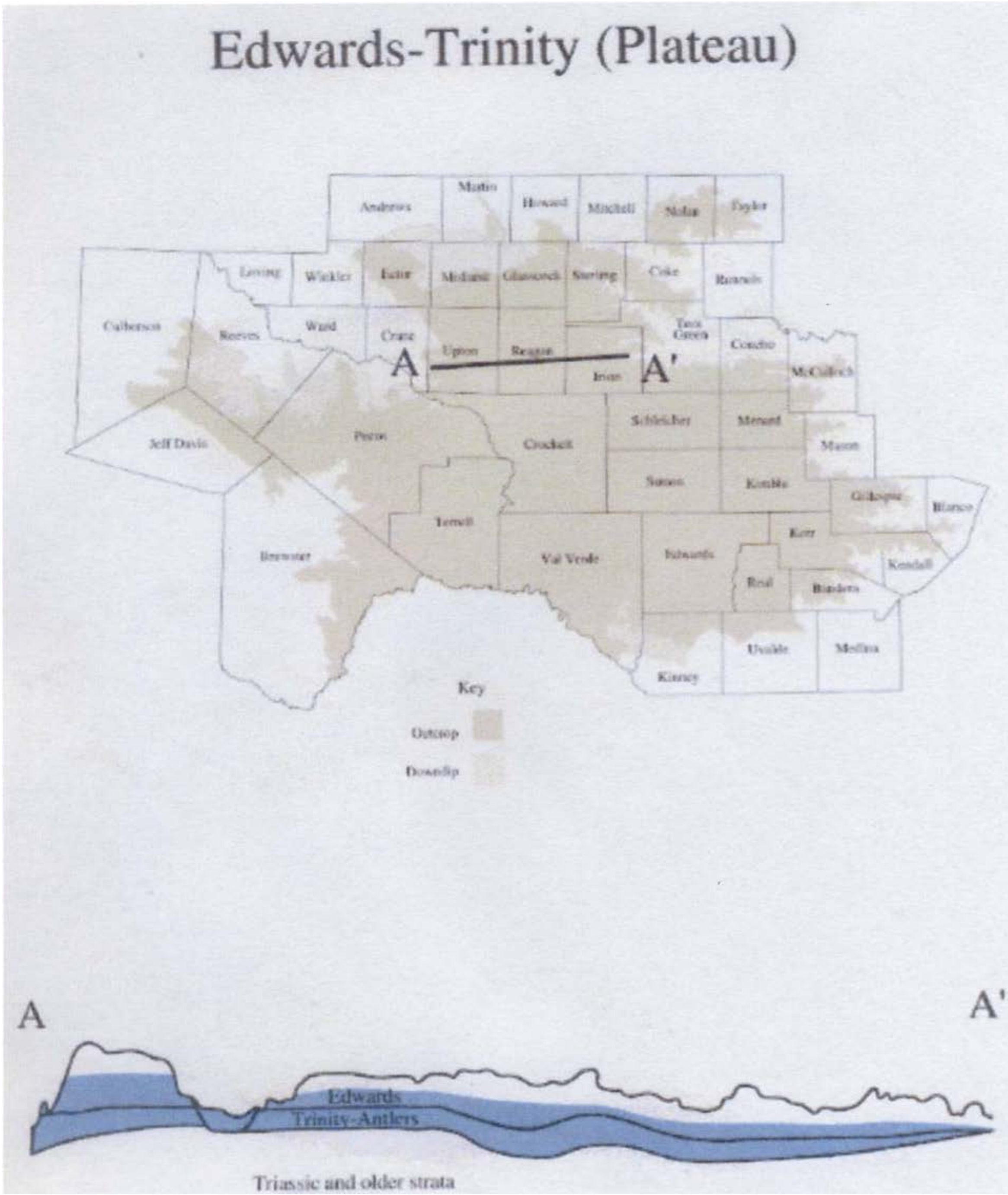


Figure 3: Aerial extent of the Edwards-Trinity (Plateau) Aquifer in Texas (Adapted from Ashworth and Hopkins, 1995)

Modeled Available Groundwater and Desired Future Condition

The District originally adopted Desired Future Conditions (DFC) for relevant aquifers in July 2010 in accordance with Chapter 36.108 of the Texas Water Code. The aquifer conditions were reviewed in the joint planning process and new DFCs were adopted in January 2017 and August 2021. The relevant aquifers are the Ogallala, Edwards-Trinity (High Plains), and the Dockum Aquifers. The District Board in review of the new High Plains Aquifer System GAM Run and Scenario 16 GAM Run by Bill Hutchison developed during the joint planning process decided the Edwards Trinity (Plateau) and Pecos Valley Aquifers are not relevant aquifers for the Permian Basin UWCD at this time.

During the joint planning process, this District and six other Groundwater Conservation Districts of Groundwater Management Area 2 (GMA2) adopted DFC's for the Ogallala, Edwards-Trinity (High Plains), and the Dockum Aquifers based on the average drawdown as documented in GMA 2 Technical Memorandum 20-01 and GMA 2 Technical Memorandum 16-01. In the Permian Basin UWCD, the Ogallala and Edwards Trinity (High Plains) Aquifer cumulative drawdown is predicted to be 28 feet by 2080. For the Dockum Aquifer cumulative drawdown is predicted to be 31 feet by 2080. However, the District is required to evaluate the DFCs every 5 years which will allow us to make any changes accordingly.

The Texas Water Development Board (TWDB) provided the District with the GAM Run 21-008 MAG Addendum modeled available groundwater calculation based on their DFCs. A new MAG will be calculated later this year based on the DFC adopted in GMA 2 in August 2021. Please refer to Appendix C.

The District currently has Rules in effect and is considering amendments in order to better meet the adopted Desired Future Conditions.

Amount of Groundwater Being Used within the District on an Annual Basis

- The Estimated Historical Water Use from the TWDB Historical Water Use Survey (WUS) are estimations of the historical quantity of groundwater used in the area served by the District. It will be used as a guide to estimate future demands on the resource in the District. It should be emphasized that the quantities shown are estimates.

  Please refer to Appendix A.

- Annual Amount of Recharge From Precipitation to the Groundwater Resources within the District (GAM Run 22-005)

  Please refer to Appendix B.

- Annual Amount of Water that Discharges from the Aquifer to Springs and any Surface Water Bodies within each aquifer of the District (GAM Run 22-005)

Please refer to Appendix B.

- Annual Volume of Flow into the District, out of the District, and Between Aquifers in the District (GAM Run 22-005)

  Please refer to Appendix B.

Surface Water Resources

- The most significant surface water resource of benefit to the District is water pumped from the Colorado River Municipal Water District watershed to the City of Stanton.

  We will provide Colorado River Municipal Water District a copy of our Management Plan for their comments.

- Projected Surface Water Supply within the District

  Please refer to Appendix A, page 5.

- Projected Groundwater Supply and Demand

  Projecting groundwater supply and demand is an arduous process. In order to make such projections, one must predict trends of groundwater use. Assumptions must be made regarding population changes, changing agricultural cropping strategies, economic development patterns, and future weather patterns. Naturally, the farther into the future one projects, the less accurate the projections become.

- Projected Total Demand for Water within the District

  Please refer to Appendix A, page 6.

Water Supply Needs

Water supply needs exist in the District in these categories: irrigation (Martin County) municipal (Stanton), manufacturing (Howard County), and steam electric (Howard County). The District has considered these water supply needs.

Please refer to Appendix A, page 7.

Water Management Strategies

All water supply needs in the District are addressed with the water management strategies of demand reduction and the Colorado River MWD Lake/Reservoir System. The District has considered these water management strategies.

Please refer to Appendix A, pages 8-11.

Management of Groundwater Resources

The District will endeavor to manage groundwater resources, over which it has jurisdictional authority, in order to conserve the resource while seeking to maintain the economic viability of the District's constituents. A water level monitoring network has been established in order to track water level changes in aquifers each year. The District will employ all technical resources at its disposal to monitor and evaluate the groundwater resource and programs designed to encourage conservation of the same.

Method for Tracking the District's Progress in Achieving Management Goals

The District staff will prepare an annual report to the Board of Directors of the District's performance with regard to achieving management goals and objectives. The report will be maintained on file in the open records of the District.

Actions, Procedures, Performance and Avoidance for Plan Implementation as required by {TWC §36.1071(e)(2)}

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 rules relating to the permitting of wells. The rules adopted by the District are pursuant to TWC §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. District rules are available on the District's website at http://www.pbuwcd.com under the rules tab.

The District will seek the cooperation in the implementation of this plan and the management of groundwater supplies within the District. All activities of the District will be undertaken in cooperation and coordinated with the appropriate state, regional or local management entity.

Management Goals and Performance Standards

Goal 1.0 Providing the Most Efficient Use of Groundwater

1.01 - Objective: Water Level Monitoring

Annually measure and record water level measurements within the District's water level monitoring network.

1.01 - Performance Standard:

The District will maintain a water level monitoring network, annually measuring 80 percent of the wells in the network, and report in the annual report to the Board of Directors.

1.02 - Objective: Well Permitting and Well Completion

The District will issue water well drilling permits for non-exempt water wells in accordance with the District rules.

1.02 - Performance Standard:

The Board of Directors will vote on approval of permits at the regularly scheduled meeting after the permit has been issued, and the total annual number of issued water well drilling permits will be reported in the annual report to the Board of Directors.

Goal 2.0 Controlling and Preventing Waste of Groundwater

2.01 - Objective: Laboratory Services

2.01 - Performance Standard:

The District will provide basic and/or coliform water quality testing upon request, communicate test results to constituents, and report the total annual number of water quality tests performed in the annual report to the Board of Directors.

2.02 – Objective: Open or Uncovered Wells

2.02 - Performance Standard:

The District will inspect any open or uncovered wells found or reported each year, ensure that a found or open hole is properly closed according to statute to prevent potential contamination of the aquifer, and report the total annual number of open or uncovered wells in the annual report to the Board of Directors.

Goal 3.0 Addressing Drought Conditions

Drought information by the Texas Water Development Board (TWDB) is available online:

https://www.waterdatafortexas.org/drought/

3.01 – Objective: Drought Education

3.01 - Performance Standard:

The District will monitor the drought conditions and submit a minimum of one article annually to a newspaper of general circulation within the District focused on water conservation and drought awareness if necessary. The annual number of articles submitted to the newspaper will be reported in the annual report to the Board of Directors.

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

4.01 – Objective: Conservation

4.01 - Performance Standard:

Each year the District will provide a minimum of one educational material regarding water conservation to public schools within the District and report it in the annual report to the Board of Directors.

4.02 – Objective: Recharge Enhancement

This goal is not appropriate at present due to cost ineffectiveness; therefore, this goal is not applicable.

4.03 – Objective: Rainwater Harvesting

The District will provide and distribute literature on rainwater harvesting and promote the conservation and efficient use of water.

4.03 - Performance Standard

Each year the District staff will submit a minimum of one article on rainwater harvesting to a newspaper of general circulation located within the District and report it in the annual report to the Board of Directors.

4.04 – Objective: Precipitation Enhancement

A review of past work conducted by others indicates this goal is not appropriate at present due to cost ineffectiveness; therefore, this goal is not applicable.

4.05 – Objective: Brush Control

The Distrcit will provide and distribute literature on brush control and promote the conservation and efficient use of water.

4.05 - Performance Standard

Each year the District staff will submit a minimum of one article on brush control to a newspaper of general circulation located within the District and report it in the annual report to the Board of Directors.

Goal 5.0 Addressing the Desired Future Conditions adopted by the District

5.01 - Objective - Calculate Annual Drawdown

5.01 - Performance Standards

5.01.a The District will maintain a water level monitoring network, annually measure 80% of the wells in the network, and report in the annual report to the Board of Directors.

5.01.b Using the results from the annual water level measurement program, the District will calculate the average annual drawdown and long term decline. This analysis will be compared to the currently stated DFC to ensure the District is on track to meet the desired future conditions listed in the earlier section of this plan. These results will be reported in the annual report to the Board of Directors.

5.01.c The District will also submit an article detailing the average drawdown results to at least one newspaper of general circulation within the District each year.

Goal 6.0 Addressing natural resource issues

6.01 - Objective - Saltwater Disposal Well Monitoring

6.01 - Performance Standards

Each year the District will inspect 80 percent of known saltwater disposal sites for indications of pollution potential and report in the annual report to the Board of Directors.

6.02 – Objective – Reporting on Well Usage

6.02- Performance Standards

The District will report the number of wells permitted that are intended to be used for oil and gas production each year in the annual report to the Board of Directors.

Goal 7.0 - Addressing Conjunctive Surface Water Management Issues

7.01 Objective – Participating in Regional Water Planning Group

7.01 – Performance Standards

The district will, in each annual report, document the participation of district representatives in Region F meetings and the number of meetings attended in the preceding calendar year. Documentation will consist of a table listing all Region F meetings scheduled during the preceding 12 months, and the name(s) of district staff attending.

Goals Determined not to be Applicable to the District

The following goals referenced in Chapter 36, Texas Water Code, have been determined not applicable to the District;

- TWC §36.1071 (a) (3) Controlling and preventing subsidence

Subsidence was evaluated using the Texas Aquifer Potential Subsidence Prediction Screening Tool Version 1.0, TWDB, 2018. Representative wells from both Howard & Martin counties were evaluated. The evaluation period was 2012 – 2080. District water level data was used. Well data was extracted from District & TWDB files. The model default aquifer properties for the selected aquifers were accepted. Calculated Risk for Howard County was 3.75; Martin County Risk was 3.59, based on a scale of 0 (no risk) to 10 (highest risk). No measurable subsidence was predicted by the model. Based on the low calculated risk values and the lack of predicted subsidence, subsidence is not currently a relevant concern to the District.

- TWC §36.1071 (a) (7)   Addressing recharge and precipitation enhancement issues

Appendix A

Estimated Historical Groundwater Use

And 2022 State Water Plan Datasets:

Permian Basin Underground Water Conservation District

by Stephen Allen

Texas Water Development Board

Groundwater Division

Groundwater Technical Assistance Section

stephen.allen@twdb.texas.gov

(512) 463-7317

April 28, 2022

Estimated Historical Groundwater Use And 2022 State Water Plan Datasets:

Permian Basin Underground Water Conservation District

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
stephen.allen@twdb.texas.gov
(512) 463-7317
April 28, 2022

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 this part 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)

   from the 2022 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). 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 2022 SWP data available as of 4/28/2022. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2022 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 2022 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 conditions within district boundaries. 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 entity locations).

The remaining 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 these 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).

Estimated Historical Water Use

TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2020. TWDB staff anticipates the calculation and posting of these estimates at a later date.

HOWARD COUNTY *94.81% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	335	294	12,821	267	3,187	153	17,057
	SW	5,797	2,731	0	813	0	27	9,368
2018	GW	655	378	12,211	223	1,963	153	15,583
	SW	4,183	2,821	0	248	0	27	7,279
2017	GW	719	377	9,434	137	3,555	148	14,370
	SW	3,634	3,010	0	55	0	27	6,726
2016	GW	835	365	3,155	165	3,472	178	8,170
	SW	3,676	2,060	0	149	0	31	5,916
2015	GW	1,100	413	1,964	160	3,509	172	7,318
	SW	4,574	1,434	0	146	0	30	6,184
2014	GW	959	671	1,430	210	5,451	171	8,892
	SW	3,937	1,066	0	94	0	30	5,127
2013	GW	2,682	749	802	0	4,733	176	9,142
	SW	2,076	1,040	0	301	0	31	3,448
2012	GW	2,138	525	161	0	6,337	168	9,329
	SW	2,533	946	0	405	0	29	3,913
2011	GW	4,555	638	122	0	9,738	210	15,263
	SW	173	1,340	0	283	0	37	1,833
2010	GW	4,560	1,666	299	0	6,372	200	13,097
	SW	173	1,231	95	367	0	35	1,901
2009	GW	4,288	457	189	0	6,447	174	11,555
	SW	278	2,176	60	433	0	31	2,978
2008	GW	4,477	2,164	79	0	4,599	188	11,507
	SW	324	1,007	24	493	0	33	1,881
2007	GW	5,498	593	3	0	5,878	255	12,227
	SW	338	2,578	0	662	0	45	3,623
2006	GW	3,578	557	4	0	2,991	174	7,304
	SW	396	1,448	0	573	0	30	2,447
2005	GW	4,660	426	3	0	2,682	160	7,931
	SW	1,995	2,647	0	679	0	28	5,349
2004	GW	4,812	394	1	0	2,628	143	7,978
	SW	337	1,702	0	509	0	36	2,584

MARTIN COUNTY *100% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2019	GW	386	0	19,926	0	26,984	49	47,345
	SW	290	0	0	0	0	21	311
2018	GW	333	0	16,437	0	29,266	49	46,085
	SW	314	0	0	0	0	21	335
2017	GW	389	0	11,884	0	26,890	46	39,209
	SW	286	0	0	0	0	20	306
2016	GW	350	0	4,509	0	28,245	59	33,163
	SW	319	0	0	0	0	25	344
2015	GW	394	0	4,545	0	35,488	58	40,485
	SW	310	0	0	0	0	25	335
2014	GW	414	0	3,317	0	37,632	58	41,421
	SW	308	0	0	0	0	25	333
2013	GW	501	0	2,094	0	41,967	67	44,629
	SW	310	0	0	0	0	29	339
2012	GW	468	0	892	0	31,757	76	33,193
	SW	320	0	0	0	0	33	353
2011	GW	557	0	1,002	0	34,940	111	36,610
	SW	291	0	0	0	0	47	338
2010	GW	344	0	497	0	36,160	103	37,104
	SW	332	0	226	0	0	44	602
2009	GW	157	0	514	0	36,970	66	37,707
	SW	294	0	234	0	0	29	557
2008	GW	88	0	531	0	28,482	72	29,173
	SW	294	0	242	0	0	31	567
2007	GW	79	0	39	0	25,872	90	26,080
	SW	294	0	0	0	0	38	332
2006	GW	86	0	53	0	15,626	90	15,855
	SW	294	0	0	0	0	39	333
2005	GW	73	0	36	0	16,152	55	16,316
	SW	297	0	0	0	0	23	320
2004	GW	73	0	24	0	14,652	81	14,830
	SW	315	0	0	0	0	20	335

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

HOWARD COUNTY

94.81% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	Big Spring	Colorado	Colorado River MWD Lake/Reservoir System	1,433	1,842	1,663	1,484	1,333	1,203
F	Coahoma	Colorado	Colorado River MWD Lake/Reservoir System	121	154	140	126	113	102
F	Livestock, Howard	Colorado	Colorado Livestock Local Supply	37	37	37	37	37	37
F	Manufacturing, Howard	Colorado	Colorado River MWD Lake/Reservoir System	327	411	371	334	301	271
F	Mining, Howard	Colorado	Colorado Other Local Supply	58	58	58	58	58	58
F	Steam-Electric Power, Howard	Colorado	Colorado River MWD Lake/Reservoir System	46	57	51	46	42	38
	Sum of Projected Surface Water Supplies (acre-feet)			**2,022**	**2,559**	**2,320**	**2,085**	**1,884**	**1,709**

MARTIN COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
F	Livestock, Martin	Colorado	Colorado Livestock Local Supply	47	47	47	47	47	47
F	Mining, Martin	Colorado	Colorado Other Local Supply	132	132	132	132	132	132
F	Stanton	Colorado	Colorado River MWD Lake/Reservoir System	74	93	83	75	68	61
	Sum of Projected Surface Water Supplies (acre-feet)			**253**	**272**	**262**	**254**	**247**	**240**

Projected Water Demands
TWDB 2022 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.

HOWARD COUNTY

94.81% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	Big Spring	Colorado	6,227	6,368	6,379	6,327	6,316	6,316
F	Coahoma	Colorado	526	534	537	537	536	536
F	County-Other, Howard	Colorado	618	616	612	611	609	609
F	Irrigation, Howard	Colorado	6,526	6,526	6,526	6,526	6,526	6,526
F	Livestock, Howard	Colorado	217	217	217	217	217	217
F	Manufacturing, Howard	Colorado	3,530	3,552	3,552	3,552	3,552	3,552
F	Mining, Howard	Colorado	3,224	3,224	2,275	1,327	569	284
F	Steam-Electric Power, Howard	Colorado	405	405	405	405	405	405
		Sum of Projected Water Demands (acre-feet)	**21,273**	**21,442**	**20,503**	**19,502**	**18,730**	**18,445**

MARTIN COUNTY

100% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	County-Other, Martin	Colorado	358	380	394	410	426	438
F	Irrigation, Martin	Colorado	36,491	36,491	36,491	36,491	36,491	36,491
F	Livestock, Martin	Colorado	119	119	119	119	119	119
F	Mining, Martin	Colorado	7,200	7,200	5,400	3,500	1,900	1,000
F	Stanton	Colorado	514	552	578	605	628	646
		Sum of Projected Water Demands (acre-feet)	**44,682**	**44,742**	**42,982**	**41,125**	**39,564**	**38,694**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

HOWARD COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	Big Spring	Colorado	-611	0	0	-647	-1,233	-1,785
F	Coahoma	Colorado	-51	0	0	-56	-105	-152
F	County-Other, Howard	Colorado	0	0	0	0	0	0
F	Irrigation, Howard	Colorado	0	0	0	0	0	0
F	Livestock, Howard	Colorado	40	40	40	40	40	40
F	Manufacturing, Howard	Colorado	-147	0	0	-153	-293	-424
F	Mining, Howard	Colorado	0	0	0	0	0	0
F	Steam-Electric Power, Howard	Colorado	-7	14	14	-8	-26	-45
	Sum of Projected Water Supply Needs (acre-feet)		**-816**	**0**	**0**	**-864**	**-1,657**	**-2,406**

MARTIN COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
F	County-Other, Martin	Colorado	0	0	0	0	0	0
F	Irrigation, Martin	Colorado	0	0	0	-685	-3,165	-4,882
F	Livestock, Martin	Colorado	0	0	0	0	0	0
F	Mining, Martin	Colorado	0	0	0	1,117	2,717	3,617
F	Stanton	Colorado	23	16	0	-33	-62	-90
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**-718**	**-3,227**	**-4,972**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

HOWARD COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Big Spring, Colorado (F)							
MUNICIPAL CONSERVATION - BIG SPRING	DEMAND REDUCTION [Howard]	131	138	140	139	139	139
SUBORDINATION - CRMWD SYSTEM	Colorado River MWD Lake/Reservoir System [Reservoir]	611	0	0	647	1,233	1,785
		742	**138**	**140**	**786**	**1,372**	**1,924**
Coahoma, Colorado (F)							
MUNICIPAL CONSERVATION - COAHOMA	DEMAND REDUCTION [Howard]	8	8	8	8	8	8
SUBORDINATION - CRMWD SYSTEM	Colorado River MWD Lake/Reservoir System [Reservoir]	51	0	0	56	105	152
		59	**8**	**8**	**64**	**113**	**160**
Irrigation, Howard, Colorado (F)							
IRRIGATION CONSERVATION - HOWARD COUNTY	DEMAND REDUCTION [Howard]	344	688	757	757	757	757
		344	**688**	**757**	**757**	**757**	**757**
Manufacturing, Howard, Colorado (F)							
SUBORDINATION - CRMWD SYSTEM	Colorado River MWD Lake/Reservoir System [Reservoir]	147	500	500	653	793	924
		147	**500**	**500**	**653**	**793**	**924**
Mining, Howard, Colorado (F)							
MINING CONSERVATION - HOWARD COUNTY	DEMAND REDUCTION [Howard]	143	143	101	59	25	13
		143	**143**	**101**	**59**	**25**	**13**
Steam-Electric Power, Howard, Colorado (F)							
SUBORDINATION - CRMWD SYSTEM	Colorado River MWD Lake/Reservoir System [Reservoir]	21	0	0	22	40	59
		21	**0**	**0**	**22**	**40**	**59**
Sum of Projected Water Management Strategies (acre-feet)		**1,456**	**1,477**	**1,506**	**2,341**	**3,100**	**3,837**

MARTIN COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Irrigation, Martin, Colorado (F)							

IRRIGATION CONSERVATION - MARTIN COUNTY	DEMAND REDUCTION [Martin]	1,825	3,649	5,474	5,474	5,474	5,474
		1,825	**3,649**	**5,474**	**5,474**	**5,474**	**5,474**
Mining, Martin, Colorado (F)							
MINING CONSERVATION - MARTIN COUNTY	DEMAND REDUCTION [Martin]	302	302	227	49	27	14
		302	**302**	**227**	**49**	**27**	**14**
Stanton, Colorado (F)							
MUNICIPAL CONSERVATION - STANTON	DEMAND REDUCTION [Martin]	8	9	10	10	11	11
SUBORDINATION - CRMWD SYSTEM	Colorado River MWD Lake/Reservoir System [Reservoir]	31	0	0	33	62	90
		39	**9**	**10**	**43**	**73**	**101**
Sum of Projected Water Management Strategies (acre-feet)		**2,166**	**3,960**	**5,711**	**5,566**	**5,574**	**5,589**

Appendix B

GAM Run 22-005: Permian Basin Underground Water Conservation District Management Plan

Jerry (Jianyou) Shi, Ph.D., P.G.

Texas Water Development Board

Groundwater Division

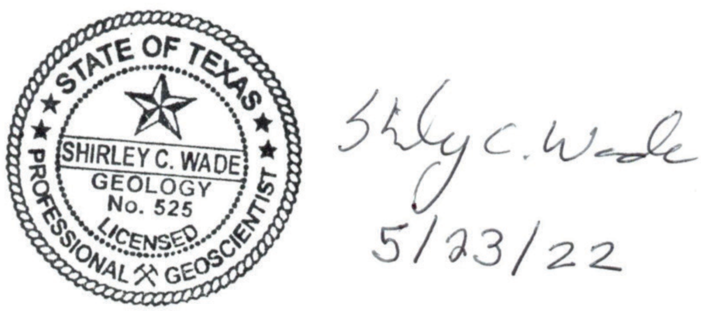
Groundwater Availability Modeling Section

(512) 463-5076

May 2, 2022

GAM RUN 22-005: PERMIAN BASIN UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
(512) 936-0883
May 23, 2022



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GAM Run 22-005: Permian Basin Underground Water Conservation District Management Plan

Shirley Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
(512) 936-0883
May 23, 2022

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2011), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the Permian Basin Underground Water Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information, and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;

2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers; and

3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Permian Basin Underground Water Conservation District should be adopted by the district on or before May 31, 2022 and submitted to the executive administrator of the TWDB on or before June 30, 2022. The current management plan for the Permian Basin Underground Water Conservation District expires on August 29, 2022.

We used the groundwater availability models for the High Plains Aquifer System (Deeds and others, 2015; Deeds and Jigmond, 2015) and the Edwards-Trinity (Plateau) Aquifer (Anaya and Jones, 2009) to estimate the management plan information for the Dockum, Edwards-Trinity (Plateau), and Ogallala aquifers within the Permian Basin Underground Water Conservation District. This report replaces the results of GAM Run 16-013 (Shi, 2016). Values may differ from the previous report as a result of routine updates to the spatial grid file used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows. This report also includes a new figure not included in the previous report to help groundwater conservation districts better visualize water budget components. Tables 1 through 3 summarize the groundwater availability model data required by statute and Figures 1, 3, and 5 show the area of the models from which the values in Tables 1 through 3 were extracted. Figures 2, 4, and 6 provide generalized diagrams of the groundwater flow components provided in Tables 1 through 3. If, after review of the figures, the Permian Basin Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability models mentioned above were used to estimate information for the Permian Basin Underground Water Conservation District management plan. Water budgets were extracted for the historical model periods for the Dockum and Ogallala aquifers (1980 through 2012) and the Edwards-Trinity (Plateau) Aquifer (1981 through 2000) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Dockum and Ogallala aquifers

- We used version 1.01 of the groundwater availability model for the High Plains Aquifer System to analyze the Dockum and Ogallala aquifers. See Deeds and others (2015) and Deeds and Jigmond (2015) for assumptions and limitations of the model.

- The groundwater availability model for the High Plains Aquifer System contains four layers. In the model, Layer 1 represents the Ogallala Aquifer, Layer 2 represents the Rita Blanca, Edwards-Trinity (High Plains), and Edwards-Trinity (Plateau) aquifers where present, Layer 3 represents the upper portion of the Dockum Aquifer and equivalent units, and Layer 4 represents the lower portion of the Dockum Aquifer and equivalent units.

- Water budget values for the district were determined for the Ogallala Aquifer (Layer 1) and the Dockum Aquifer (Layers 3 and 4). The Rita Blanca and Edwards-Trinity (High Plains) do not occur within the Permian Basin Underground Water Conservation District and therefore no groundwater budget values are included for them in this report.

- Water budget terms were averaged for the period 1980 to 2012 (stress periods 52 through 84).

- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

Edwards-Trinity (Plateau) Aquifer

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers to analyze the Edwards-Trinity (Plateau) Aquifer. See Anaya and Jones (2009) for assumptions and limitations of the model.

- The groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers contains two layers. Layer 1 represents the Edwards-Trinity (Plateau) Aquifer and the Pecos Valley Alluvium Aquifer and Layer 2 represents the Edwards-Trinity (Plateau) Aquifer.

- Water budget values for the district were determined for the Edwards-Trinity (Plateau) Aquifer (Layers 1 and 2, combined). The Pecos Valley Aquifer does not occur within the Permian Basin Underground Water District and therefore no groundwater budget values are included for it in this report.

- Water budget terms were averaged for the period 1981 to 2000 (stress periods 2 through 21).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability models results for the Dockum, Edwards-Trinity (Plateau), and Ogallala aquifers located within the Permian Basin Underground Water Conservation District and averaged over the historical calibration period, as shown in Tables 1 through 3.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.
4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1 through 3. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

TABLE 1: SUMMARIZED INFORMATION FOR THE DOCKUM AQUIFER THAT IS NEEDED FOR THE PERMIAN BASIN UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Dockum Aquifer	4,678
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Dockum Aquifer	1,696
Estimated annual volume of flow into the district within each aquifer in the district	Dockum Aquifer	40
Estimated annual volume of flow out of the district within each aquifer in the district	Dockum Aquifer	1,282
Estimated net annual volume of flow between each aquifer in the district	From the Dockum Aquifer to the Ogallala Aquifer	13
	To the Dockum Aquifer from the Edwards-Trinity (Plateau) Aquifer	44
	To the Dockum Aquifer from Dockum equivalents units	359
	Flow between the Dockum Aquifer and underlying units	Not Applicable[1]

[1] Not applicable because the model assumes a no flow barrier at the base of the Dockum Aquifer.

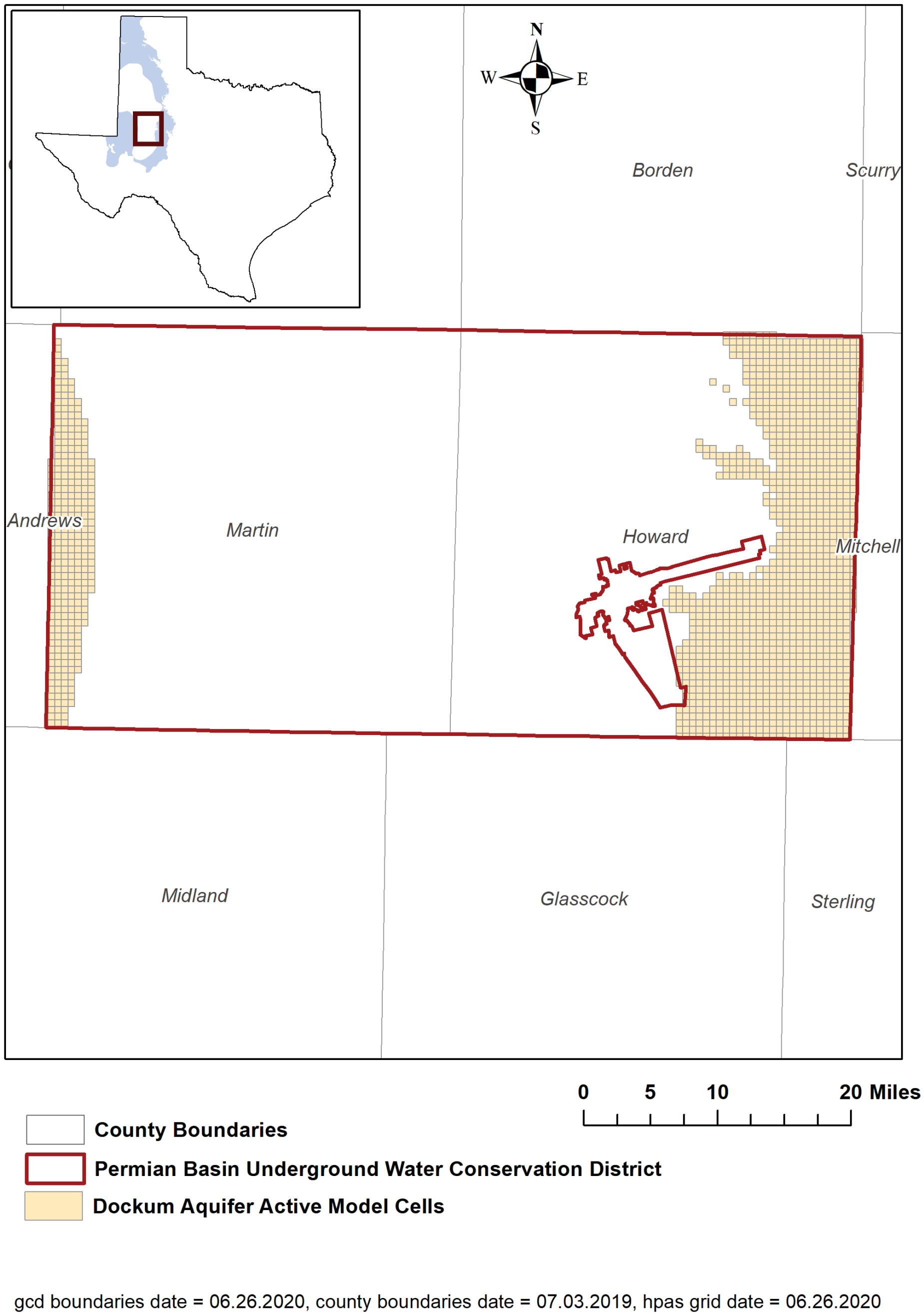
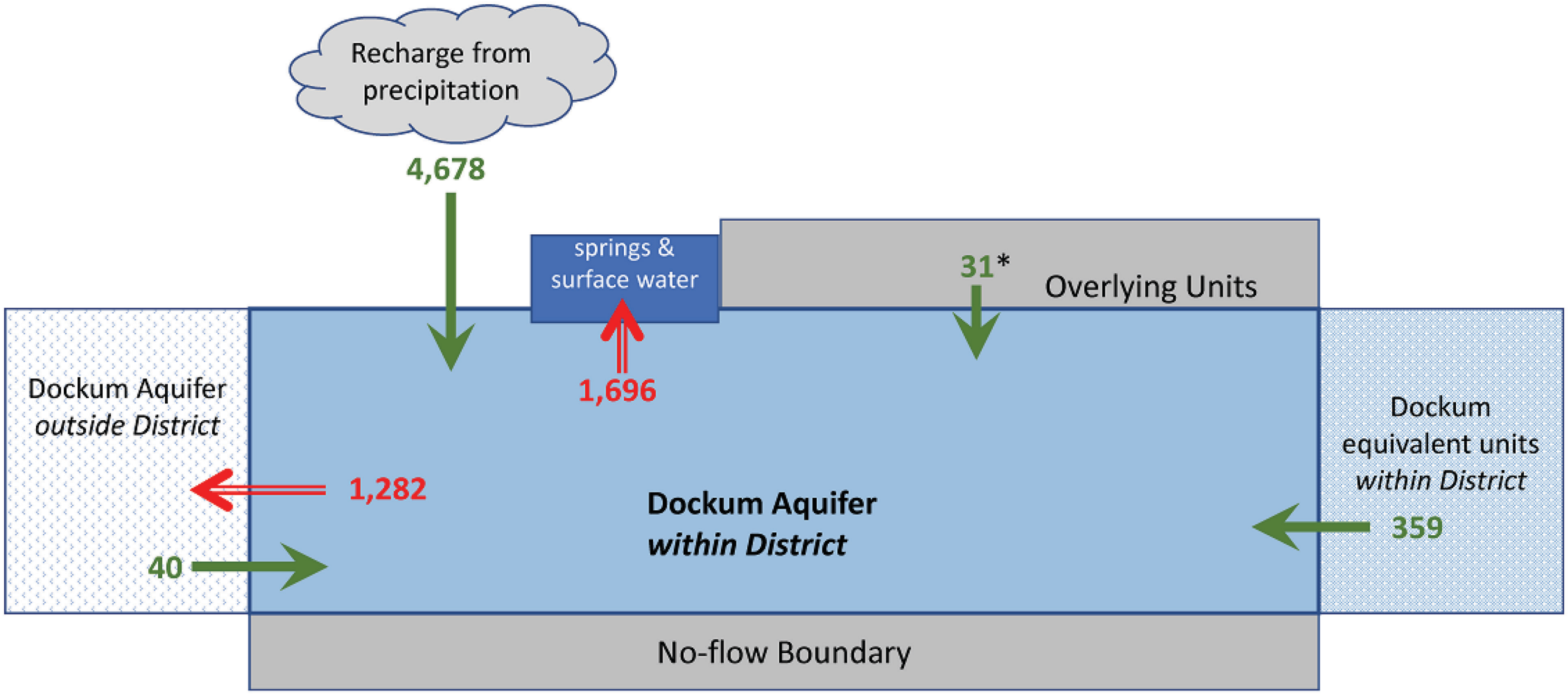


FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE DOCKUM AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



* Flow from overlying units includes net outflow of 13 acre-feet per year to the Ogallala Aquifer, and net inflow of 44 acre-feet per year from the Edwards-Trinity (Plateau) Aquifer.

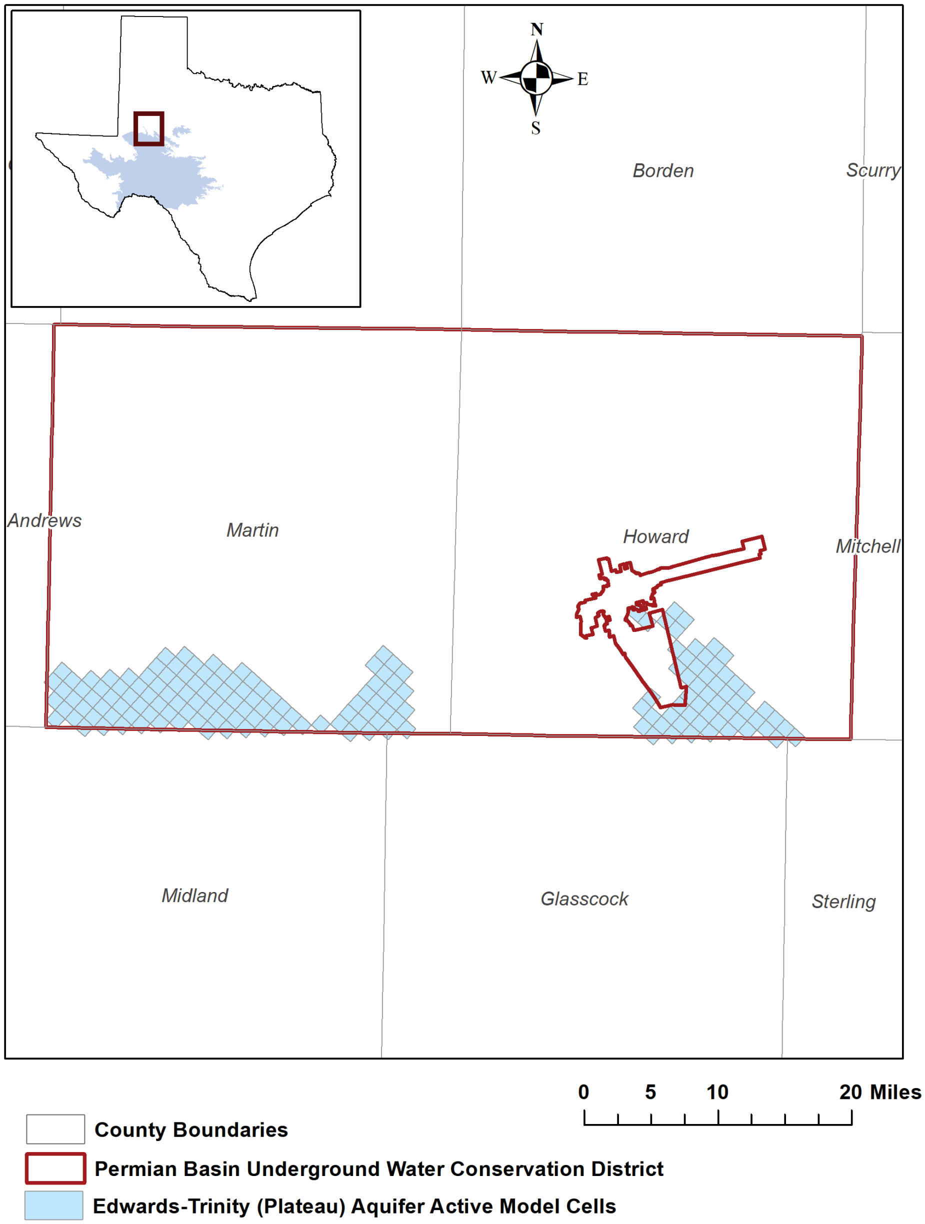
Caveat: This diagram only includes the water budget items provided in Table 1. A complete water budget would include additional inflows and outflows. If the District requires values for additional water budget items, please contact TWDB.

FIGURE 2: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 1, REPRESENTING DIRECTIONS OF FLOW FOR THE DOCKUM AQUIFER WITHIN THE PERMIAN BASIN UNDERGROUND WATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR (AFY).

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

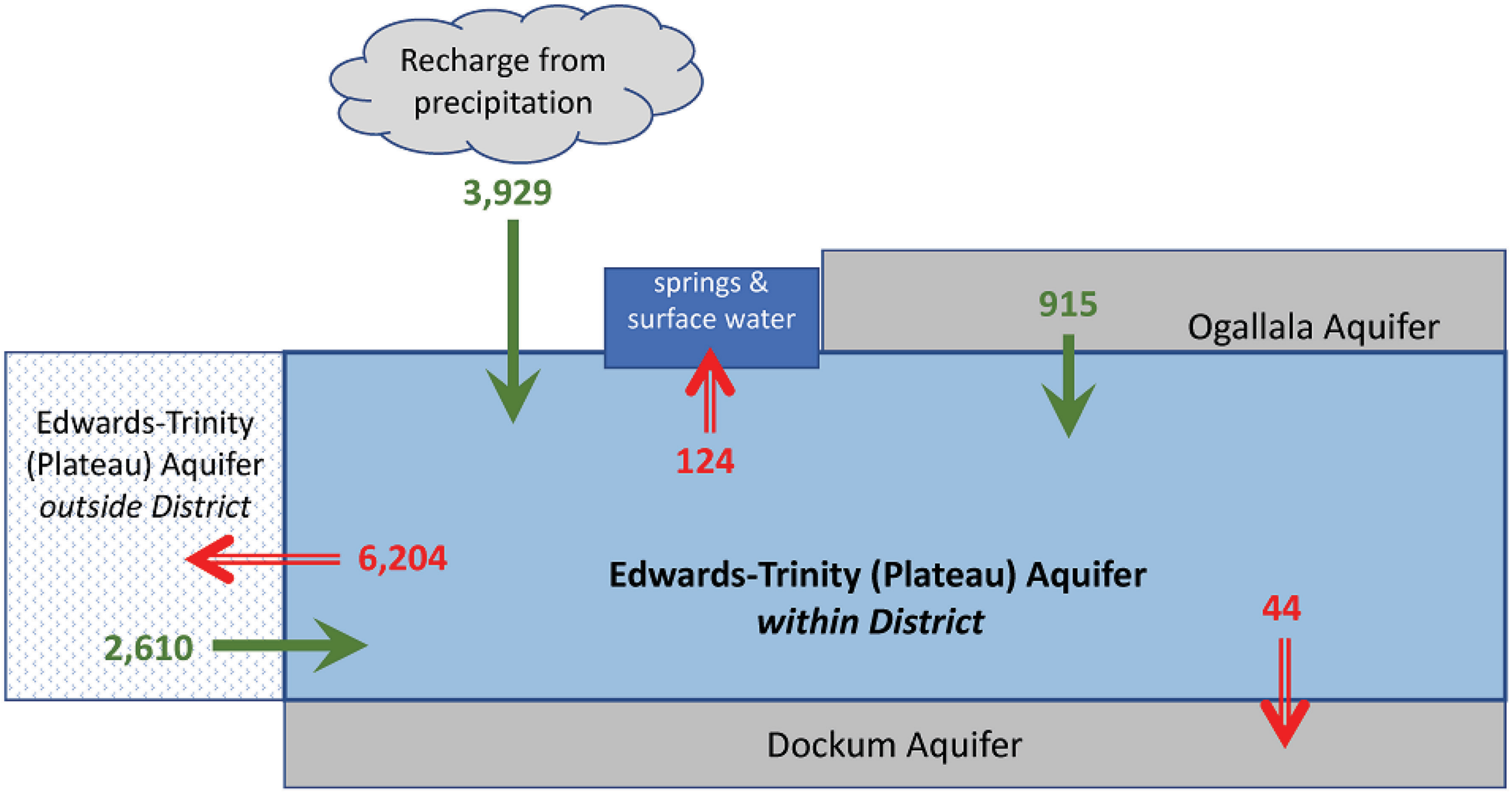
Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	3,929
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Edwards-Trinity (Plateau) Aquifer	124
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	2,610
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	6,204
Estimated net annual volume of flow between each aquifer in the district	To the Edwards-Trinity (Plateau) Aquifer from the Ogallala Aquifer[2]	915
	From the Edwards-Trinity (Plateau) Aquifer to the Dockum Aquifer[2]	44

[2] Value extracted from the groundwater availability model for the High Plains Aquifer System.



gcd boundaries date = 06.26.2020, county boundaries date = 07.03.2019, eddt_p grid date = 01.06.2020

FIGURE 3: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE EDWARDS-TRINITY [PLATEAU] AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



Caveat: This diagram only includes the water budget items provided in Table 2. A complete water budget would include additional inflows and outflows. If the District requires values for additional water budget items, please contact TWDB.

FIGURE 4: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 2, REPRESENTING DIRECTIONS OF FLOW FOR THE EDWARDS-TRINITY (PLATEAU) AQUIFER WITHIN THE PERMIAN BASIN UNDERGROUND WATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR (AFY).

TABLE 3: SUMMARIZED INFORMATION FOR THE OGALLALA AQUIFER THAT IS NEEDED FOR THE PERMIAN BASIN UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Ogallala Aquifer	50,317
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers.	Ogallala Aquifer	11,848
Estimated annual volume of flow into the district within each aquifer in the district	Ogallala Aquifer	5,225
Estimated annual volume of flow out of the district within each aquifer in the district	Ogallala Aquifer	3,532
Estimated net annual volume of flow between each aquifer in the district	To the Ogallala Aquifer from the Dockum Aquifer	13
	From the Ogallala Aquifer to the Edwards-Trinity (Plateau) Aquifer	915
	To the Ogallala Aquifer from Dockum equivalent units	593

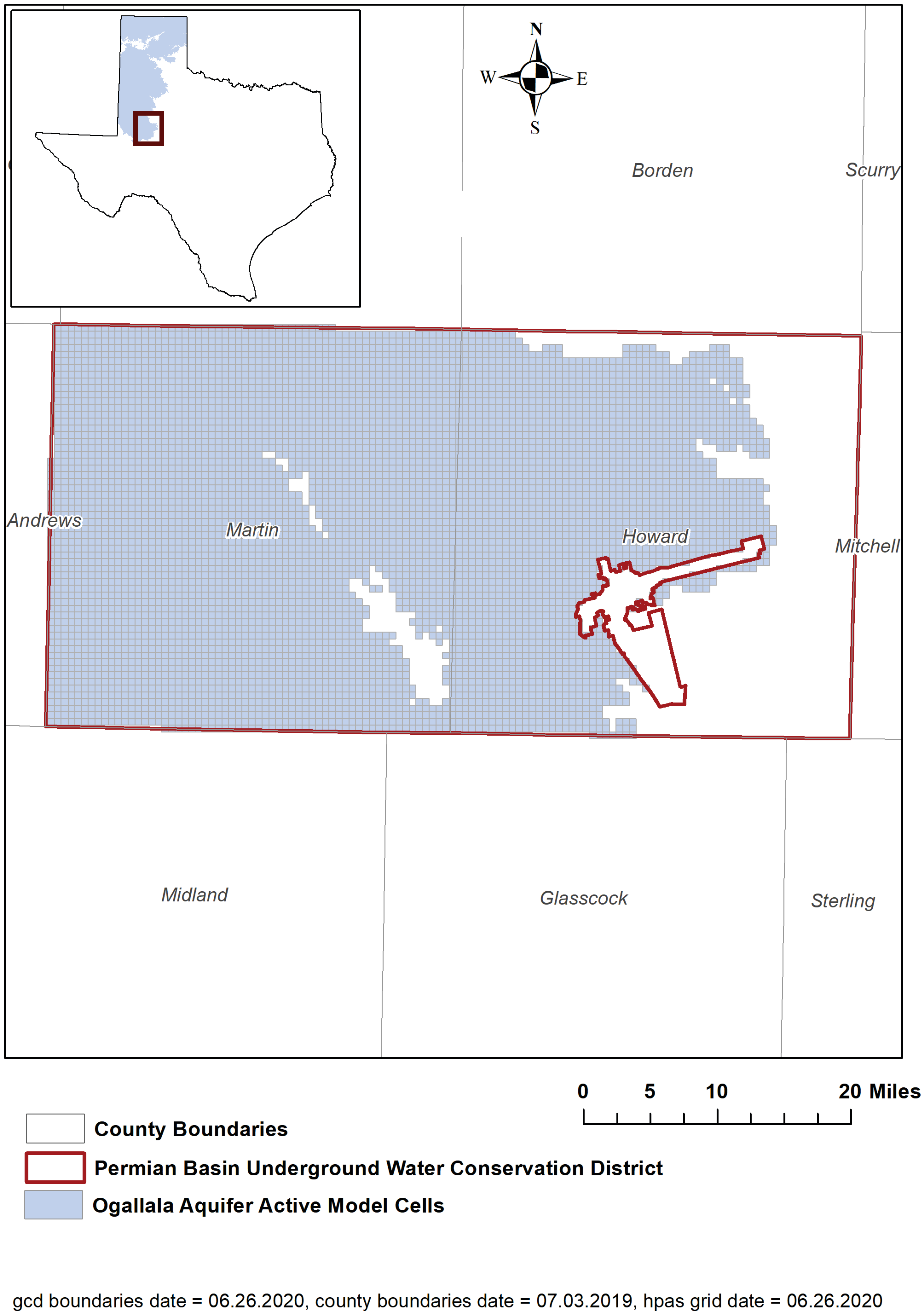
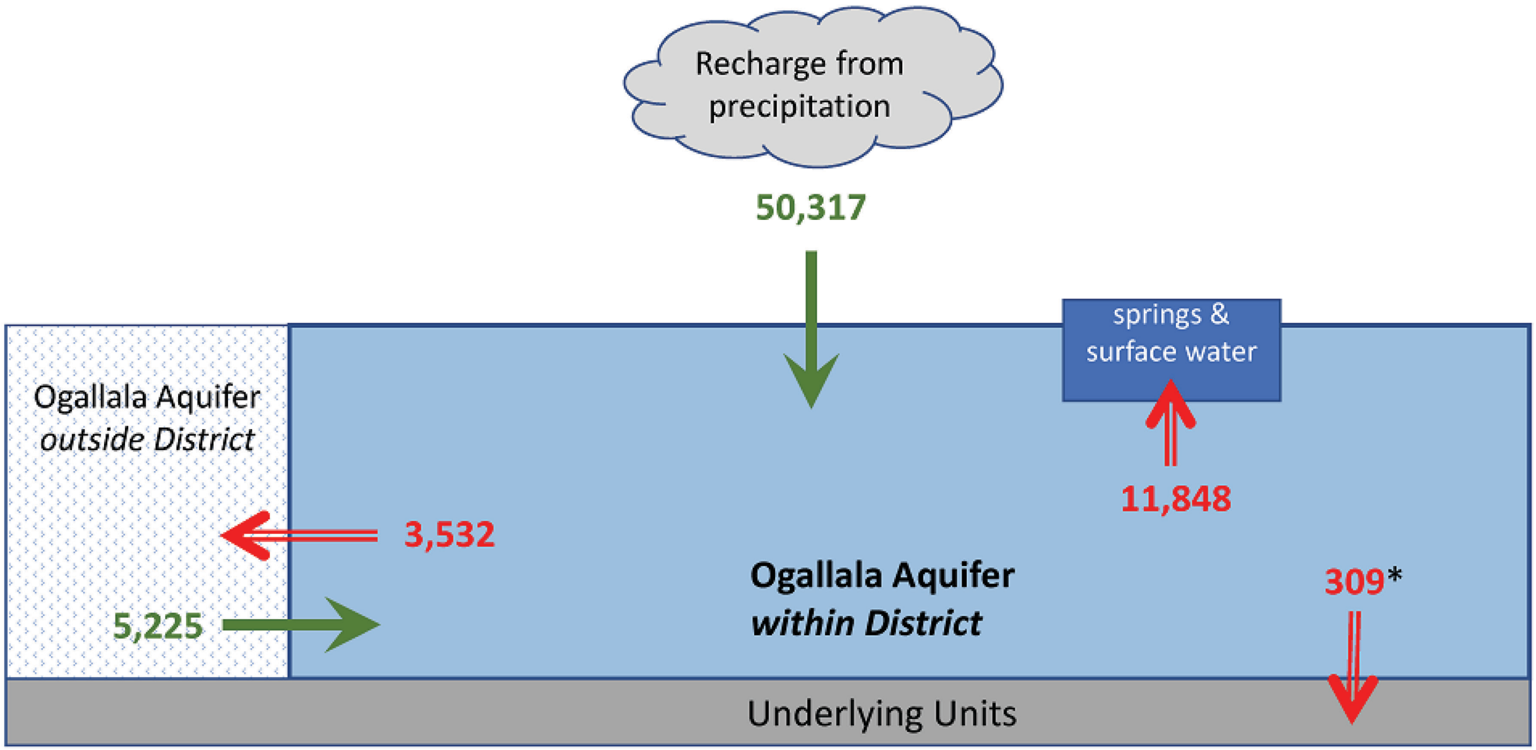


FIGURE 5: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HIGH PLAINS AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (OGALLALA AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).



* Flow to underlying units includes net outflow of 915 acre-feet per year to Edwards-Trinity (Plateau) Aquifer, and net inflow of 593 acre-feet per year from Dockum equivalent units and 13 acre-feet per year from the Dockum Aquifer.

Caveat: This diagram only includes the water budget items provided in Table 3. A complete water budget would include additional inflows and outflows. If the District requires values for additional water budget items, please contact TWDB.

FIGURE 6: GENERALIZED DIAGRAM OF THE SUMMARIZED BUDGET INFORMATION FROM TABLE 3, REPRESENTING DIRECTIONS OF FLOW FOR THE OGALLALA AQUIFER WITHIN THE PERMIAN BASIN UNDERGROUND WATER CONSERVATION DISTRICT. FLOW VALUES EXPRESSED IN ACRE-FEET PER YEAR (AFY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historical pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

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Appendix C

GAM Run 21-008 MAG Addendum

Jerry Shi, Ph.D., P.G.

Texas Water Development Board

Groundwater Division

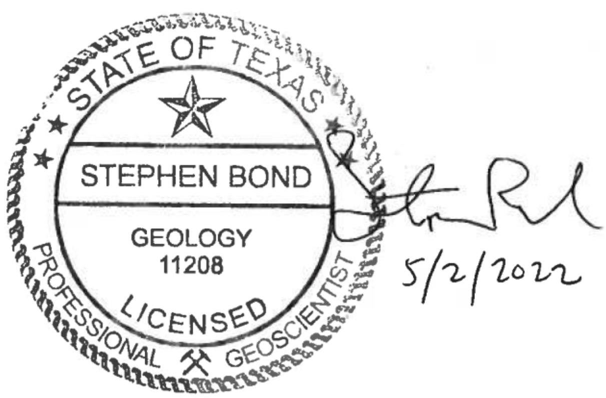
Groundwater Availability Modeling Section

(512) 463-5076

May 12, 2017

GAM Run 21-008 MAG: Modeled Available Groundwater for the High Plains Aquifer System (Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers) in Groundwater Management Area 2

Stephen Bond, P.G. and Grayson Dowlearn
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 475-1552
May 2, 2022



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GAM RUN 21-008 MAG: MODELED AVAILABLE GROUNDWATER FOR THE HIGH PLAINS AQUIFER SYSTEM (OGALLALA, EDWARDS-TRINITY (HIGH PLAINS), AND DOCKUM AQUIFERS) IN GROUNDWATER MANAGEMENT AREA 2

Stephen Bond, P.G. and Grayson Dowlearn
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Section
(512) 475-1552
May 2, 2022

EXECUTIVE SUMMARY:

Modeled available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers in Groundwater Management Area 2 decreases from 2,041,501 acre-feet per year in 2030 to 950,014 acre-feet per year in 2080. Modeled available groundwater for the Dockum Aquifer decreases from 52,735 acre-feet per year in 2030 to 51,710 acre-feet per year in 2080. The modeled available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers is summarized by groundwater conservation districts and counties in Table 1, and by river basins, regional planning areas, and counties in Table 3. The modeled available groundwater for the Dockum Aquifer is summarized by groundwater conservation districts and counties in Table 2, and by river basins, regional planning areas, and counties in Table 4.

The estimates are based on the desired future conditions for the High Plains Aquifer System (the Ogallala, Edwards-Trinity (High Plains), and Dockum aquifers) adopted by groundwater conservation district representatives in Groundwater Management Area 2 on August 17, 2021. The Pecos Valley Alluvium and Edwards-Trinity (Plateau) aquifers were declared not relevant for the purpose of joint planning. The Texas Water Development Board (TWDB) determined that the explanatory report and other materials submitted by the district representatives were administratively complete on February 25, 2022.

Please note that, for the High Plains Underground Water Conservation District No. 1, only the portion of relevant aquifers within Groundwater Management Area 2 is covered in this report.

REQUESTOR:

Mr. Jason Coleman, General Manager of High Plains Underground Water Conservation District No. 1 and Coordinator of Groundwater Management Area 2.

DESCRIPTION OF REQUEST:

In an email dated August 26, 2021, Dr. William Hutchison, on behalf of Groundwater Management Area (GMA) 2, provided the TWDB with the desired future conditions of the High Plains Aquifer System. The desired future conditions (defined by drawdown) were determined using several predictive groundwater flow simulations (Hutchison, 2021a). The predictive simulations were developed from the groundwater availability model for the High Plains Aquifer System (Version 1.01; Deeds and Jigmond, 2015) from 2013 through 2080 under different pumping scenarios, with an initial water level equal to that of the model's last stress period (i.e., year 2012). The drawdown was calculated as the water level difference between 2012 and 2080.

The desired future conditions for the High Plains Aquifer System, as described in Resolution No. 21-01, were adopted on August 17, 2021 by the groundwater conservation district representatives in Groundwater Management Area 2. The desired future conditions are described below:

Ogallala and Edwards-Trinity (High Plains) Aquifers

- An average drawdown of 28 feet for all of GMA 2 between the years 2013 and 2080.

Dockum Aquifer

- An average drawdown of 31 feet for all of GMA 2 between the years 2013 and 2080.

After review of the submittal, TWDB sent an email on November 16, 2021 to Mr. Jason Coleman, Coordinator of Groundwater Management Area 2, to clarify if Groundwater Management Area 2 accepted the tolerance of three (3) feet and assumptions used to calculate average drawdown. On November 19, 2021 TWDB received the final clarification email from Mr. Jason Coleman confirming the three (3) feet of tolerance and drawdown calculation assumptions, specified in the Methods and Parameters and Assumptions sections below, can be used. TWDB then proceeded with the calculation of the modeled available groundwater which is summarized in the following sections.

METHODS:

To estimate the modeled available groundwater, TWDB used the predictive simulation for Scenario 19 (Hutchison, 2021a). TWDB reviewed the submitted model files and attempted to replicate the adopted desired future conditions using these files. Since groundwater conservation districts in GMA 2 manage groundwater with total dissolved solids concentrations above 3,000 mg/L (Hutchison, 2021b), active model cells, rather than official aquifer boundaries, were used for the basis of the average drawdown calculations. Cell-by-cell drawdowns were calculated based on the difference between modeled head values at the end of 2012 and model heads extracted for the year 2080. Average heads were calculated by summing cell-by-cell heads and dividing by the total number of cells in each aquifer or set of aquifers considered.

Average drawdown results matched the adopted desired future conditions precisely if all active cells were included in the calculations. Excluding cells that went dry during the model run, or cells that were part of the Pecos Alluvium or Edwards-Trinity (Plateau) aquifers changed the results by less than half a foot. Excluding pass-through cells, modeled cells which are not representative of a rock unit but hydraulically connect two model layers when one or more layers between the two is no longer present (for example, the Lower Dockum is connected to the Ogallala Aquifer through two layers of pass-through cells where the Upper Dockum and Edwards-Trinity (High Plains) aquifers are absent) reduced average drawdown for the Ogallala and Edwards-Trinity (High Plains) aquifers from 28 feet to 25 feet.

Modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates were then divided by county, river basin, regional water planning area, and groundwater conservation district within Groundwater Management Area 2 (Figure 5 and Tables 1 through 4).

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. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits to manage groundwater production to achieve the desired future condition(s). The districts must also consider 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.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the groundwater availability are described below:

- Version 1.01 of the groundwater availability model for the High Plains Aquifer System by Deeds and Jigmond (2015) was revised to construct the predictive model simulation for this analysis. See Hutchison (2021b) for details of the initial assumptions.

- The model has four layers which represent the Ogallala and Pecos Valley Alluvium aquifers (Layer 1), the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) aquifers (Layer 2), the Upper Dockum Aquifer (Layer 3), and the Lower Dockum Aquifer (Layer 4). The Pecos Valley Alluvium and Edwards-Trinity (Plateau) aquifers were declared not relevant for the purpose of joint planning and were excluded from the modeled available groundwater calculation. Model layers are shown in Figures 1 through 4.

- Where the Upper Dockum and Edwards-Trinity (High Plains) aquifers are absent in layers 3 and 2, respectively, pass-through cells hydraulically connect the Ogallala Aquifer to the Upper or Lower Dockum, or connect the Edwards-Trinity (High Plains) Aquifer to the Lower Dockum. These pass-through cells contain no pumping and were excluded from the drawdown calculation.

- The model was run with MODFLOW-NWT (Niswonger and others, 2011). The model uses the Newton Formulation and the upstream weighting package which automatically reduces pumping as heads drop in a particular cell as defined by the user. This feature may simulate the declining production of a well as saturated thickness decreases. Deeds and Jigmond (2015) modified the MODFLOW-NWT code to use a saturated thickness of 30 feet as the threshold (instead of percent of the saturated thickness) when pumping reductions occur during a simulation.

- During the predictive model run, some model cells within Groundwater Management Area 2 went dry in each model layer by the end of the simulation in the year 2080.

- Drawdown averages and modeled available groundwater volumes were calculated based on the extent of the model area. The most recent available model grid file (dated January 6,2020) was used to determine which model cells were assigned to specific county, groundwater management area, groundwater conservation district, river basin, or regional water planning area.

- A tolerance of three feet was assumed when comparing desired future conditions to modeled drawdown results.

- For the High Plains Underground Water Conservation District No. 1, only the portion within Groundwater Management Area 2 is covered in this report.

- Estimates of modeled drawdown and available groundwater from the model simulation were rounded to nearest whole numbers.

RESULTS:

The modeled available groundwater for the Ogallala and Edwards-Trinity (High Plains) aquifers combined that achieves the desired future condition adopted by Groundwater Management Area 2 decreases from 2,041,501 to 950,014 acre-feet per year between 2030 and 2080. The modeled available groundwater is summarized by groundwater conservation district and county in Table 1. Table 3 summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

The modeled available groundwater for the Dockum Group and Aquifer that achieves the desired future condition adopted by Groundwater Management Area 2 decreases from 52,735 to 51,710 acre-feet per year between 2030 and 2080. The modeled available groundwater is summarized by groundwater conservation district and county in Table 2. Table 4 summarizes the modeled available groundwater by county, river basin, and regional water planning area for use in the regional water planning process.

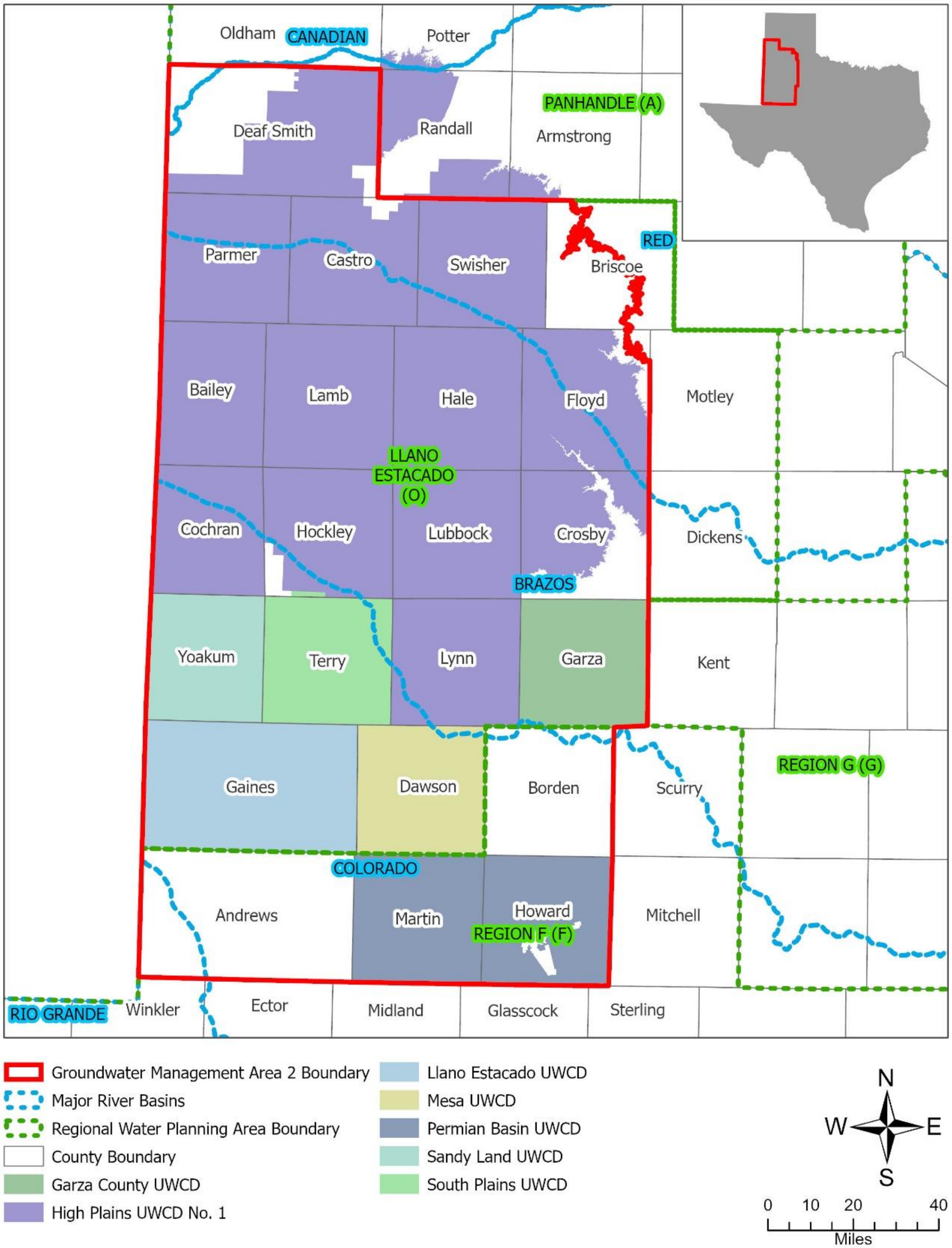

FIGURE 1. MAP SHOWING REGIONAL WATER PLANNING AREAS, GROUNDWATER CONSERVATION DISTRICTS (ALSO KNOWN AS UNDERGROUND WATER CONSERVATION DISTRICT OR UWCD), COUNTIES, AND RIVER BASINS IN GROUNDWATER MANAGEMENT AREA 2

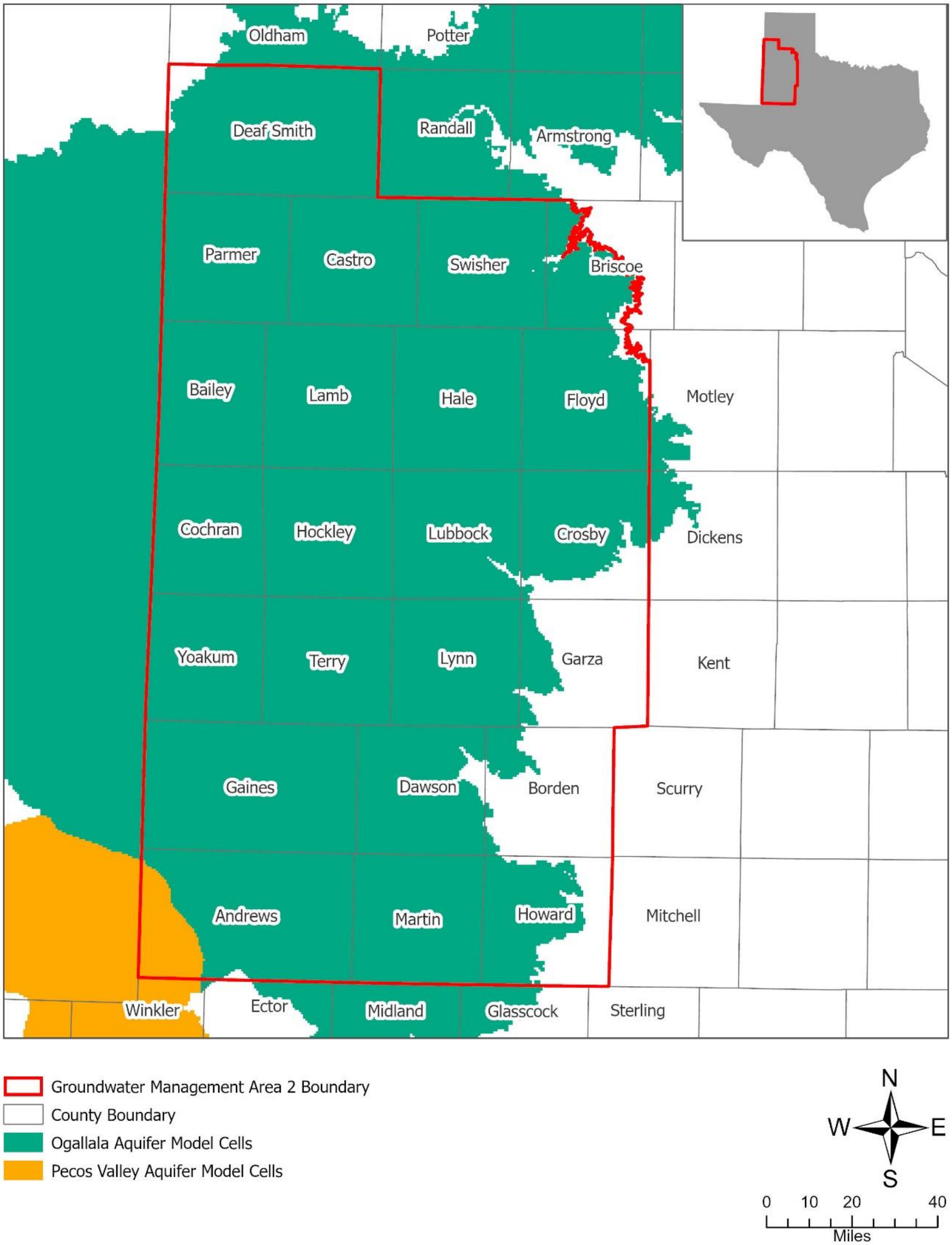

FIGURE 2. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE OGALLALA AQUIFER AND THE PECOS VALLEY AQUIFER IN LAYER 1 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

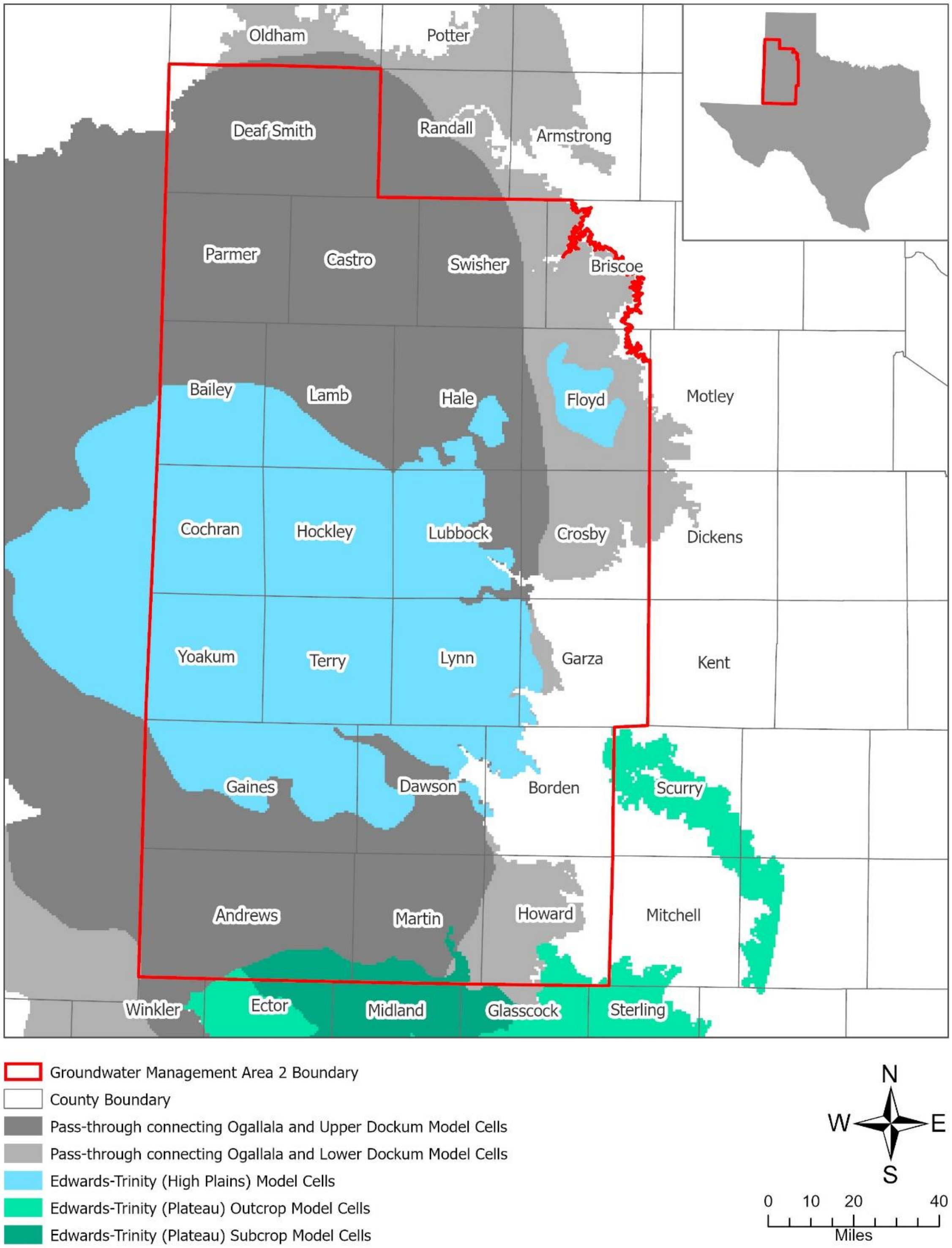

FIGURE 3. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE EDWARDS-TRINITY (HIGH PLAINS) AQUIFER, THE EDWARDS-TRINITY (PLATEAU) AQUIFER, AND PASS-THROUGH CELLS IN LAYER 2 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

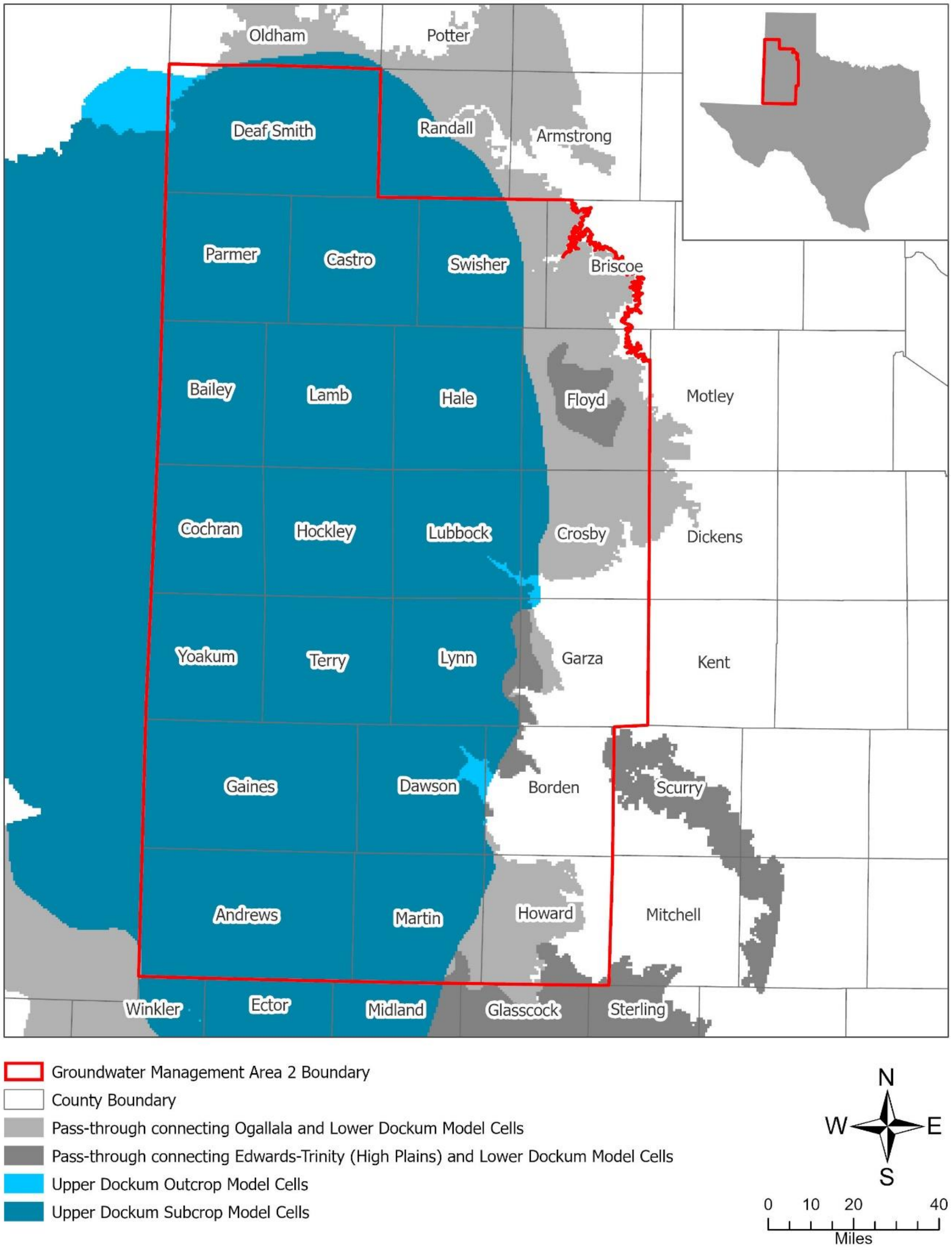

FIGURE 4. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE UPPER PORTION OF THE DOCKUM AQUIFER AND PASS-THROUGH CELLS IN LAYER 3 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

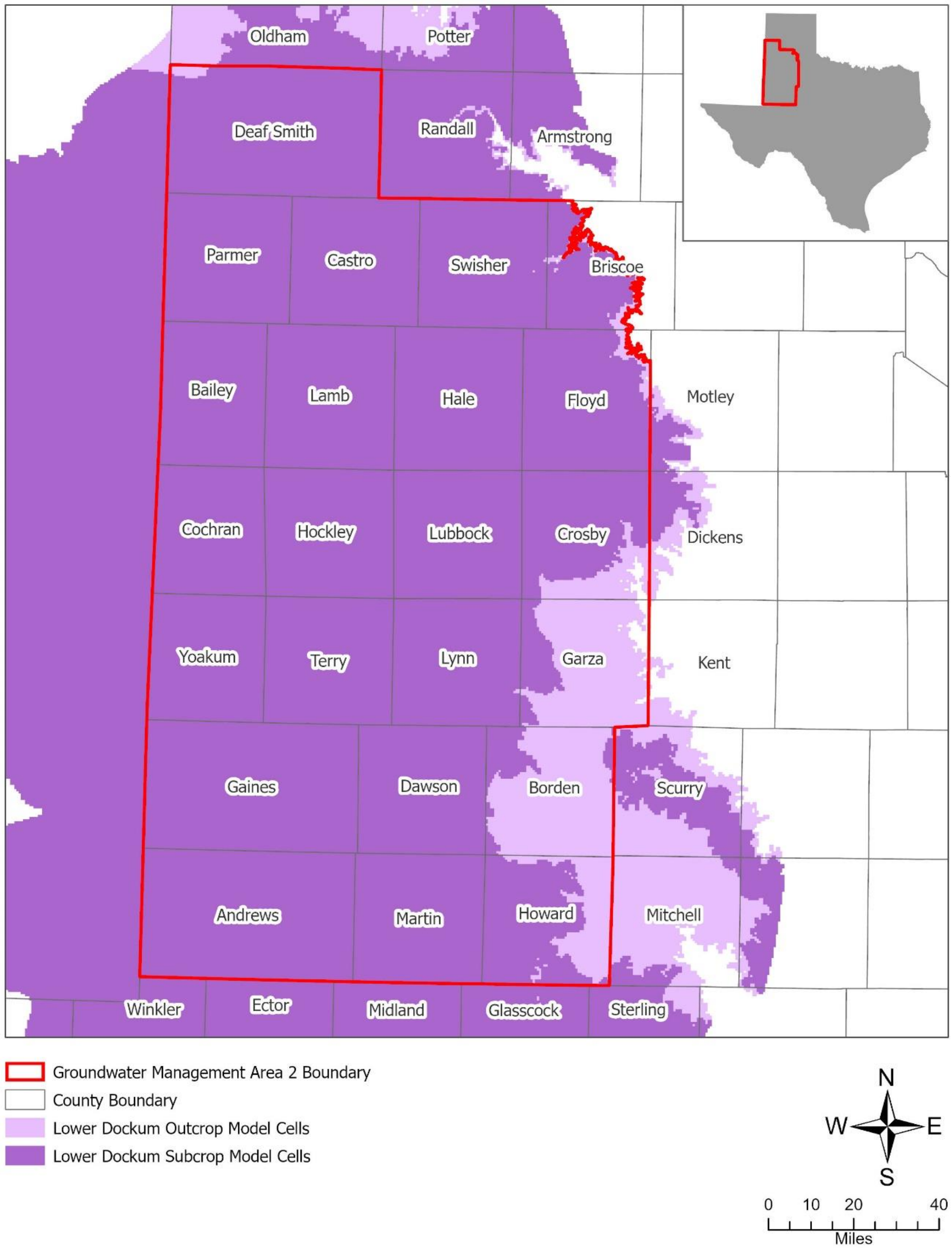

FIGURE 5. MAP SHOWING ACTIVE MODEL CELLS REPRESENTING THE LOWER PORTION OF THE DOCKUM AQUIFER IN LAYER 4 OF THE HIGH PLAINS AQUIFER SYSTEM GROUNDWATER AVAILABILITY MODEL

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE OGALLALA AND EDWARDS-TRINITY (HIGH PLAINS) AQUIFERS IN GROUNDWATER MANAGEMENT AREA 2 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
Garza County UWCD Total	**Garza**	**13,508**	**12,402**	**11,717**	**11,263**	**10,948**	**10,721**
High Plains UWCD No.1	Bailey	65,138	50,725	42,532	37,743	34,724	32,675
	Castro	176,186	116,578	68,325	42,856	30,477	23,914
	Cochran	73,991	62,095	54,265	48,561	43,632	40,036
	Crosby	105,559	73,026	51,628	39,354	32,169	27,680
	Deaf Smith	117,359	80,488	56,872	43,574	35,948	31,405
	Floyd	93,953	65,087	52,305	44,155	39,232	35,987
	Hale	116,615	75,108	53,298	41,142	34,308	30,298
	Hockley	96,747	73,687	62,502	56,622	53,198	51,064
	Lamb	120,172	77,677	60,088	52,063	47,868	45,425
	Lubbock	110,472	100,950	95,478	91,655	88,877	86,735
	Lynn	88,768	82,064	77,033	73,324	70,707	68,886
	Parmer	92,025	63,568	46,835	37,743	32,290	28,757
	Swisher	73,407	48,754	35,887	28,541	23,972	20,935
High Plains UWCD No.1 Total		**1,330,392**	**969,807**	**757,048**	**637,333**	**567,402**	**523,797**
Llano Estacado UWCD Total	**Gaines**	**205,486**	**177,777**	**159,523**	**147,028**	**138,157**	**131,974**
Mesa UWCD Total	**Dawson**	**121,336**	**98,590**	**84,192**	**75,448**	**70,262**	**66,945**

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
No District County	Andrews	19,391	17,897	16,937	16,260	15,764	15,378
	Borden	4,432	3,893	3,591	3,393	3,227	3,072
	Briscoe	17,859	12,598	9,600	7,844	6,743	6,016
	Castro	3,742	2,496	1,874	1,475	1,214	1,039
	Crosby	2,506	2,276	1,897	1,685	1,562	1,479
	Deaf Smith	18,024	15,387	13,553	12,267	11,301	10,556
	Floyd	0	0	0	0	0	0
	Hockley	12,402	7,093	3,411	2,028	1,419	1,102
	Howard	471	474	483	494	504	513
No District County Total		**78,827**	**62,114**	**51,346**	**45,446**	**41,734**	**39,155**
Permian Basin UWCD	Howard	15,160	14,344	13,882	13,596	13,411	13,287
	Martin	48,293	43,032	39,019	36,358	34,521	33,171
Permian Basin UWCD Total		**63,453**	**57,376**	**52,901**	**49,954**	**47,932**	**46,458**
Sandy Land UWCD Total	**Yoakum**	**90,983**	**70,810**	**59,346**	**53,002**	**49,187**	**46,687**
South Plains UWCD	Hockley	2,638	1,005	493	331	265	234
	Terry	134,878	108,182	96,190	89,977	86,343	84,043
South Plains UWCD Total		**137,516**	**109,187**	**96,683**	**90,308**	**86,608**	**84,277**
Groundwater Management Area 2 Total		**2,041,501**	**1,558,063**	**1,272,756**	**1,109,782**	**1,012,230**	**950,014**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 2 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2030 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR. (UWCD = UNDERGROUND WATER CONSERVATION DISTRICT)

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
Garza County UWCD Total	**Garza**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**	**1,038**
High Plains UWCD No.1	Bailey	949	949	949	949	949	949
	Castro	484	484	484	484	484	484
	Cochran	1,106	1,106	1,106	1,106	1,106	1,106
	Crosby	4,312	4,312	4,312	4,312	4,312	4,312
	Deaf Smith	5,006	5,006	5,006	5,006	5,006	5,006
	Floyd	3,674	3,674	3,674	3,674	3,674	3,674
	Hale	1,277	1,277	1,277	1,277	1,277	1,277
	Hockley	1,109	1,109	1,109	1,109	1,109	1,109
	Lamb	1,051	1,051	1,051	1,051	1,051	1,051
	Lubbock	1,236	1,236	1,236	1,236	1,236	1,236
	Lynn	1,039	1,039	1,039	1,039	1,039	1,039
	Parmer	6,207	6,207	6,207	5,202	5,188	5,182
	Swisher	1,796	1,796	1,796	1,796	1,796	1,796
	Gaines	880	880	880	880	880	880
High Plains UWCD No.1 Total		**30,126**	**30,126**	**30,126**	**29,121**	**29,107**	**29,101**
Mesa UWCD Total	**Dawson**	**640**	**640**	**640**	**640**	**640**	**640**

Groundwater Conservation District	County	2030	2040	2050	2060	2070	2080
No District County	Andrews	1,503	1,503	1,503	1,503	1,503	1,503
	Borden	1,026	1,026	1,026	1,026	1,026	1,026
	Briscoe	0	0	0	0	0	0
	Castro	0	0	0	0	0	0
	Crosby	81	81	81	81	81	81
	Deaf Smith	7	7	7	7	7	7
	Floyd	0	0	0	0	0	0
	Hockley	95	95	95	95	95	95
	Howard	134	134	134	134	134	134
No District County Total		**2,846**	**2,846**	**2,846**	**2,846**	**2,846**	**2,846**
Permian Basin UWCD	Howard	6,636	6,636	6,636	6,636	6,636	6,636
	Martin	11,449	11,449	11,449	11,449	11,449	11,449
Permian Basin UWCD Total		**18,085**	**18,085**	**18,085**	**18,085**	**18,085**	**18,085**
Sandy Land UWCD Total	**Yoakum**	**0**	**0**	**0**	**0**	**0**	**0**
South Plains UWCD	Hockley	0	0	0	0	0	0
	Terry	0	0	0	0	0	0
South Plains UWCD Total		**0**	**0**	**0**	**0**	**0**	**0**
Groundwater Management Area 2 Total		**52,735**	**52,735**	**52,735**	**51,730**	**51,716**	**51,710**

TABLE 3. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE OGALLALA AND EDWARDS-TRINITY (HIGH PLAINS) AQUIFERS IN GROUNDWATER MANAGEMENT AREA 2. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Andrews	Region F	Colorado	19,391	17,897	16,937	16,260	15,764	15,378
Andrews	Region F	Rio Grande	0	0	0	0	0	0
Bailey	Llano Estacado	Brazos	65,138	50,725	42,532	37,743	34,724	32,675
Borden	Region F	Brazos	673	615	581	559	543	532
Borden	Region F	Colorado	3,759	3,278	3,010	2,834	2,684	2,540
Briscoe	Llano Estacado	Red	17,859	12,598	9,600	7,844	6,743	6,016
Castro	Llano Estacado	Brazos	106,971	71,565	40,493	24,591	17,282	13,530
Castro	Llano Estacado	Red	72,957	47,509	29,706	19,740	14,409	11,423
Cochran	Llano Estacado	Brazos	20,220	18,297	17,034	16,204	15,655	15,283
Cochran	Llano Estacado	Colorado	53,771	43,798	37,231	32,357	27,977	24,753
Crosby	Llano Estacado	Brazos	105,148	72,526	50,976	38,890	31,952	27,655
Crosby	Llano Estacado	Red	2,917	2,776	2,549	2,149	1,779	1,504
Dawson	Llano Estacado	Brazos	1,390	1,294	1,230	1,187	1,156	1,134
Dawson	Llano Estacado	Colorado	119,946	97,296	82,962	74,261	69,106	65,811
Deaf Smith	Llano Estacado	Canadian	0	0	0	0	0	0
Deaf Smith	Llano Estacado	Red	135,383	95,875	70,425	55,841	47,249	41,961

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Floyd	Llano Estacado	Brazos	73,465	45,024	32,571	24,708	20,244	17,492
Floyd	Llano Estacado	Red	20,488	20,063	19,734	19,447	18,988	18,495
Gaines	Llano Estacado	Colorado	205,486	177,777	159,523	147,028	138,157	131,974
Garza	Llano Estacado	Brazos	13,508	12,402	11,717	11,263	10,948	10,721
Garza	Llano Estacado	Colorado	0	0	0	0	0	0
Hale	Llano Estacado	Brazos	116,240	74,782	53,039	40,940	34,150	30,172
Hale	Llano Estacado	Red	375	326	259	202	158	126
Hockley	Llano Estacado	Brazos	84,987	67,316	58,259	53,255	50,258	48,358
Hockley	Llano Estacado	Colorado	26,800	14,469	8,147	5,726	4,624	4,042
Howard	Region F	Colorado	15,631	14,818	14,365	14,090	13,915	13,800
Lamb	Llano Estacado	Brazos	120,172	77,677	60,088	52,063	47,868	45,425
Lubbock	Llano Estacado	Brazos	110,472	100,950	95,478	91,655	88,877	86,735
Lynn	Llano Estacado	Brazos	82,425	76,194	71,817	68,689	66,499	64,962
Lynn	Llano Estacado	Colorado	6,343	5,870	5,216	4,635	4,208	3,924
Martin	Region F	Colorado	48,293	43,032	39,019	36,358	34,521	33,171
Parmer	Llano Estacado	Brazos	51,129	37,132	28,030	22,549	19,129	16,878

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Parmer	Llano Estacado	Red	40,896	26,436	18,805	15,194	13,161	11,879
Swisher	Llano Estacado	Brazos	11,508	6,845	4,598	3,421	2,759	2,360
Swisher	Llano Estacado	Red	61,899	41,909	31,289	25,120	21,213	18,575
Terry	Llano Estacado	Brazos	6,825	6,322	5,998	5,776	5,612	5,487
Terry	Llano Estacado	Colorado	128,053	101,860	90,192	84,201	80,731	78,556
Yoakum	Llano Estacado	Colorado	90,983	70,810	59,346	53,002	49,187	46,687
Groundwater Management Area 2 Total			**2,041,501**	**1,558,063**	**1,272,756**	**1,109,782**	**1,012,230**	**950,014**

TABLE 4. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE DOCKUM AQUIFER IN GROUNDWATER MANAGEMENT AREA 2. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Andrews	Region F	Colorado	1,503	1,503	1,503	1,503	1,503	1,503
Andrews	Region F	Rio Grande	0	0	0	0	0	0
Bailey	Llano Estacado	Brazos	949	949	949	949	949	949
Borden	Region F	Brazos	323	323	323	323	323	323
Borden	Region F	Colorado	703	703	703	703	703	703
Briscoe	Llano Estacado	Red	0	0	0	0	0	0
Castro	Llano Estacado	Brazos	0	0	0	0	0	0
Castro	Llano Estacado	Red	484	484	484	484	484	484
Cochran	Llano Estacado	Brazos	118	118	118	118	118	118
Cochran	Llano Estacado	Colorado	988	988	988	988	988	988
Crosby	Llano Estacado	Brazos	4,393	4,393	4,393	4,393	4,393	4,393
Crosby	Llano Estacado	Red	0	0	0	0	0	0
Dawson	Llano Estacado	Brazos	0	0	0	0	0	0
Dawson	Llano Estacado	Colorado	640	640	640	640	640	640
Deaf Smith	Llano Estacado	Canadian	0	0	0	0	0	0
Deaf Smith	Llano Estacado	Red	5,013	5,013	5,013	5,013	5,013	5,013
Floyd	Llano Estacado	Brazos	3,389	3,389	3,389	3,389	3,389	3,389
Floyd	Llano Estacado	Red	285	285	285	285	285	285
Gaines	Llano Estacado	Colorado	880	880	880	880	880	880
Garza	Llano Estacado	Brazos	1,038	1,038	1,038	1,038	1,038	1,038
Garza	Llano Estacado	Colorado	0	0	0	0	0	0
Hale	Llano Estacado	Brazos	1,244	1,244	1,244	1,244	1,244	1,244
Hale	Llano Estacado	Red	33	33	33	33	33	33
Hockley	Llano Estacado	Brazos	1,013	1,013	1,013	1,013	1,013	1,013
Hockley	Llano Estacado	Colorado	191	191	191	191	191	191

County	RWPA	River Basin	2030	2040	2050	2060	2070	2080
Howard	Region F	Colorado	6,770	6,770	6,770	6,770	6,770	6,770
Lamb	Llano Estacado	Brazos	1,051	1,051	1,051	1,051	1,051	1,051
Lubbock	Llano Estacado	Brazos	1,236	1,236	1,236	1,236	1,236	1,236
Lynn	Llano Estacado	Brazos	901	901	901	901	901	901
Lynn	Llano Estacado	Colorado	138	138	138	138	138	138
Martin	Region F	Colorado	11,449	11,449	11,449	11,449	11,449	11,449
Parmer	Llano Estacado	Brazos	3,590	3,590	3,590	2,585	2,571	2,565
Parmer	Llano Estacado	Red	2,617	2,617	2,617	2,617	2,617	2,617
Swisher	Llano Estacado	Brazos	29	29	29	29	29	29
Swisher	Llano Estacado	Red	1,767	1,767	1,767	1,767	1,767	1,767
Terry	Llano Estacado	Brazos	0	0	0	0	0	0
Terry	Llano Estacado	Colorado	0	0	0	0	0	0
Yoakum	Llano Estacado	Colorado	0	0	0	0	0	0
Groundwater Management Area 2 Total			**52,735**	**52,735**	**52,735**	**51,730**	**51,716**	**51,710**

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and 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 groundwater levels in the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

Deeds, Neil E. and Jigmond, Marius, 2015, Numerical Model Report for the High Plains Aquifer System Groundwater Availability Model: Prepared for Texas Water Development Board, 640 p., http://www.twdb.texas.gov/groundwater/models/gam/hpas/HPAS_GAM_Numerical_Report.pdf .

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

Hutchison, William, 2021a, GMA 2 Technical Memorandum 20-01 (Final): Joint Planning Simulations with High Plains Aquifer System Groundwater Availability Model: Updated Dockum Aquifer Pumping (Scenarios 16 to 21)

Hutchison, William, 2021b, Explanatory Report For Desired Future Conditions, Ogallala, Edwards-Trinity (High Plains), and Dockum Aquifers, Groundwater Management Area 2 (Final)

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.

Niswonger, R.G., Panday, S., and Ibaraki, M., 2011, MODFLOW-NWT, a Newton formulation for MODFLOW-2005: United States Geological Survey, Techniques and Methods 6-A37, 44 p.

Texas Water Code, 2011, http://www.statutes.legis.state.tx.us/docs/WA/pdf/WA.36.pdf.

PBUWCD
Board of Directors Meeting
AGENDA
August 25th, 2022
REGULAR BOARD MEETING

PUBLIC HEARING

1. The Board will call the public hearing to order at 7:00 p.m. to consider:
   A. the proposed amendments to the District Management Plan 2022-2027

Regular Board Meeting

1. The President will call the meeting to order.
2. The Board will consider and take possible action to adopt the proposed amendments to the District Management Plan 2022-2027.
3. Public Comment (Limited to 5 minutes and may speak on any agenda item).
4. The Board will consider approval of the minutes from the board meeting on July 21st, 2022.
5. The Board will consider approval of a report on the district's financial status and bills incurred since last meeting.
6. The Board will consider approval of applications, extensions, and amended permits received since the last meeting.
7. Discuss and take possible action regarding current well spacing requirements and district rules.
8. Manager's Report
   A. Discuss and set time for the current protest.
9. The Board will consider and take action to adopt a budget for 2022-2023.
10. The Board will consider and take action to set the proposed tax rate for 2023.
11. The Board will consider adjourning into Executive Session in accordance with the Open Meeting Act, Texas Government Code 551.074 (A) (1) 1.
    a. Adjourn to Executive Session to discuss personnel matters.
    b. Adjourn to Executive Session for Legal Counsel
12. The Board will reconvene in Open Session.
13. The Board may take action on items discussed in Executive Session.
14. Adjourn

POSTED ~~FILED~~ at 1:35 P M O'clock 8/15/22
BRENT ZITTERKOPF, County Clerk, Howard County, Texas
By Jessica Berman Deputy

Permian Basin Underground Water Conservation District

Notice is hereby given that a meeting of the above named Board will be held the 25th day of August, 2022 at 7:00 p.m. in the PBUWCD Office, 708 W. St. Peter St., Stanton, Texas, at which time the Board of Directors will discuss and may take action on the following well permits, which will be a separate item on the regular agenda.

Permit #	County	Location
9589-9590	Howard	Sec. 17 Blk. 31 T&PRR T1S
9591	Howard	Sec. 42 Blk. 30 T&PRR T1N
9592	Howard	Sec. 31 Blk. 41 T&PRR T1N
9593-9594	Howard	Sec. 2 Blk. 32 T&PRR T2N
9595	Howard	Sec. 17 Blk. 33 T&PRR T2N
9596-9598	Howard	Sec. 12 Blk. 25 H&TC RR Co
9599-9601	Howard	Sec. 34 Blk. 26 H&TC RR Co
9602	Howard	Sec. 35 Blk. 34 T&PRR T3N
9603-9304	Martin	Sec. 24 Blk. 36 T&PRR T1S
9605-9606	Martin	Lab. 77 Leag. B Bauer & Cockrell

The Board of Directors of the Permian Basin Underground Water Conservation District reserves the right to go into Executive Session at any time during the course of this meeting to discuss any of the matters listed on this agenda, as authorized by the Texas Open Meetings Act, Chapter 551, Government Code. No final action or decision will be made in Executive Session.

PBUWCD
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12. The Board will reconvene in Open Session.

13. The Board may take action on items discussed in Executive Session.

14. Adjourn

POSTED & FILED
August 15, 2022 @2:03P M
LINDA GONZALES
District & County Clerk Martin Co., Texas
By Stefanie Alcorta, Deputy

Permian Basin Underground Water Conservation District

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9593-9594	Howard	Sec. 2 Blk. 32 T&PRR T2N
9595	Howard	Sec. 17 Blk. 33 T&PRR T2N
9596-9598	Howard	Sec. 12 Blk. 25 H&TC RR Co
9599-9601	Howard	Sec. 34 Blk. 26 H&TC RR Co
9602	Howard	Sec. 35 Blk. 34 T&PRR T3N
9603-9304	Martin	Sec. 24 Blk. 36 T&PRR T1S
9605-9606	Martin	Lab. 77 Leag. B Bauer & Cockrell

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Send

To

PBUWCD Office <permianbasin@pbuwcd.com>

Cc

Subject RE: Adopted Management Plan

From: PBUWCD Office <permianbasin@pbuwcd.com>
Sent: Thursday, September 8, 2022 9:53 AM
To: Stephen Allen <Stephen.Allen@twdb.texas.gov>
Cc: ahoback@crmwd.org; jgrant@crmwd.org; cwalker@crmwd.org
Subject: Adopted Management Plan

Good morning,

Attached is a copy of the adopted Management Plan for PBUWCD.

Thanks and have a great day,

John Dallen Skinner
Manager
Permian Basin UWCD
Phone: 432-756-2136