DRAFT

![Clearwater Underground Water Conservation District logo — Every drop counts!]

**Clearwater Underground Water
Conservation District**

District Groundwater Management Plan

Original Plan Adopted October 24, 2000
(Certified by TWDB February 21, 2001)

Revisions Adopted
December 13, 2005 (Approved by TWDB March 6, 2006)
February 8, 2011 (Approved by TWDB April 13, 2011)
January 13, 2016 (Approved by TWDB February 19, 2016)
January 9, 2019 (Approved by TWDB March 12, 2019)
November 11, 2020 (Approved by CUWCD Board)
December 30, 2020 (Approved by TWDB)
October 11, 2023 (Approved by CUWCD Board)

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I. DISTRICT MISSION

The mission of the Clearwater Underground Water Conservation District (District) is to develop and implement an efficient, economical and environmentally sound groundwater management program to protect and enhance the water resources of the District.

II. PURPOSE OF THE GROUNDWATER MANAGEMENT PLAN

Senate Bill 1 (SB 1), enacted by the 75th Texas Legislature in 1997, and Senate Bill 2 (SB 2), enacted by the 77th Texas Legislature in 2001, established a comprehensive statewide planning process and the actions necessary for districts to manage and conserve the groundwater resources of the state of Texas. These bills required all underground water conservation districts to develop a management plan which defines the water needs and supply within each district and the goals each district will use to manage the underground water in order to meet their needs. In addition, the 79th Texas Legislature enacted HB 1763 in 2005 that requires joint planning among districts that are in the same groundwater management area (GMA). These districts must establish the desired future conditions of the aquifers within their respective GMAs. Through this process, the districts will submit the desired future conditions to the Executive Administrator of the Texas Water Development Board (TWDB) who will provide each district with the modeled available groundwater in the groundwater management area based on the desired future conditions of the aquifers in the area. Technical information, such as the desired future conditions of the aquifers within the District's jurisdiction and the amount of modeled available groundwater from such aquifers is required to be included in the District's management plan and will guide the District's regulatory and management policies.

The District's management plan satisfies the requirements of SB 1, SB 2, HB 1763, the statutory requirements of Texas Water Code (TWC) Chapter 36, and the rules and requirements of the TWDB.

III. DISTRICT INFORMATION

A. Creation

Clearwater Underground Water Conservation District (CUWCD) is a political subdivision of the State of Texas and underground water conservation district created and operating under and by virtue of Article XVI, Section 59, of the Texas Constitution; Texas Water Code Chapter 36; the District's enabling act, Act of May 27, 1989, 71st Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77th Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81st Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84th Legislature, Regular Session, Chapter 1196, Section 2 (Senate Bill 1336)(omnibus districts bill); and the applicable general laws of the State of Texas; and confirmed by voters of Bell County on August 21, 1999.

The District was formed to protect the underground water resources for the citizens of Bell County. Beyond its enabling legislation, the District is governed primarily by the provisions of Chapter 36 of the Texas Water Code, the District's groundwater management plan, and the District's rules.

Exhibit A

CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT BOUNDARY

Fort Hood
Killeen
Harker Heights
Belton
Temple
Bell County

50 0 50 100 Miles

N

10 0 10 Miles

Prepared By: Central Texas Council of Governments—September 2000
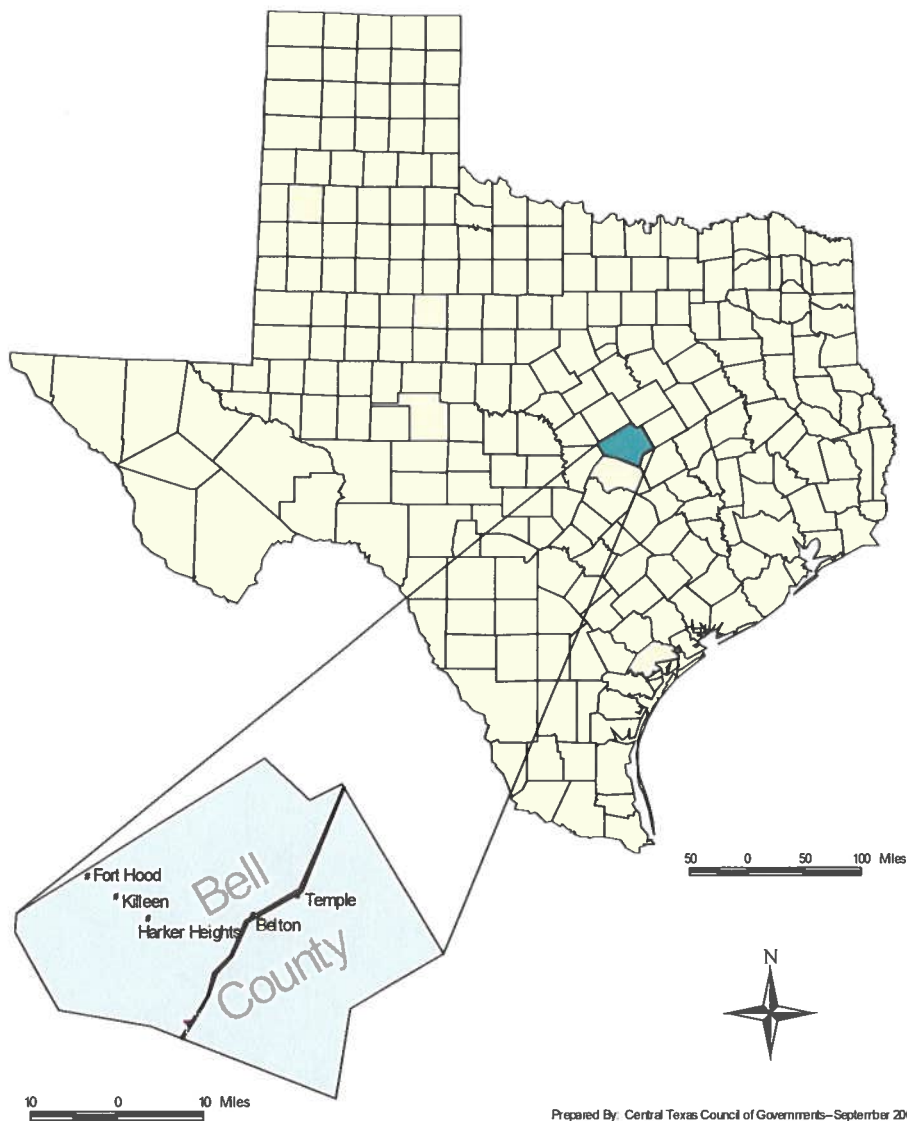
B. Directors

The Board of Directors consists of five members. These five directors are elected by the voters of Bell County and serve a four-year term. CUWCD observes the same precincts as the Bell County Commissioners—four precincts with one at-large position. Director terms are staggered with a two-year interval. Directors from Precincts 1 and 3 serve the same term while directors from Precincts 2, 4 and the at-large position serve the same term. Elections are held in November in even numbered years.

C. Authority

CUWCD is governed by the provisions of TWC Chapter 36. CUWCD has the power and authority to undertake various hydrogeological studies, to adopt a management plan, to establish a program for the permitting of certain water wells, and to implement programs to achieve its statutory mandates. CUWCD has rule-making authority to implement its policies and procedures and to help ensure the management of the groundwater resources of Bell County.

D. Location and Extent

The jurisdiction of CUWCD includes all territory located within Bell County (Exhibit A). This area encompasses approximately 1,088 square miles. CUWCD is bounded by McLennan County to the north; Falls and Milam Counties to the east; Williamson County to the south; and Burnet, Lampasas, and Coryell Counties to the west. Bell County has a vibrant economy dominated by the military, medical, manufacturing, and agricultural communities. Based on the 2012 Census of Agriculture, approximately 421,362 of Bell County's 675,200 acres, or 62.4% of this area, is farmland.

E. Topography and Drainage

Bell County is divided into two separate ecological regions by the Balcones Escarpment, which runs from the southeast part of the county to the northwest. The region east of the Balcones Escarpment is the Blackland Prairie while the Grand Prairie is located to the west.

In the Grand Prairie area drainage flows to the Little River and its tributaries. The Leon and Lampasas rivers and Salado Creek converge at Three Forks.

F. Groundwater Resources of Bell County

Bell County enjoys a variety of groundwater resources. The two primary sources of groundwater in Bell County are the Edwards Balcones Fault Zone (BFZ) Aquifer and the Trinity Aquifer. These aquifers are recognized as major aquifers by the TWDB. The Edwards (BFZ) Aquifer is the source of Salado Springs and is the primary source of water supply for the City of Salado. The Trinity Aquifer consists of three distinct subdivisions. It is the primary source of groundwater in much of western Bell County. The deepest subdivision of the Trinity Aquifer also serves or has served the Cities of Rogers, Holland,

and Bartlett in eastern Bell County. The portion of Bell County east of IH-35 also has a number of groundwater sources that are not widely recognized as aquifers outside of the County but are of vital importance. Approximately 40 percent of the wells registered with the District are located in eastern Bell County and produce water from alluvium, the Lake Waco Formation (Fm), the Kemp Formation, the Ozan Formation, the Pecan Gap Formation, the Austin Chalk, or the Buda Limestone. Additionally, there are wells which produce water from the Edwards Formation and associated limestones outside of the recognized limits of the Edwards (BFZ) Aquifer which are recognized by CUWCD as producing water from the Edwards Equivalent Aquifer.

See Appendix A1: Groundwater Resources of Bell County
See Appendix A2: Delineation of Proposed Management Zones within Bell County, Texas
See Appendix B: CUWCD - Bell County Historical Groundwater use (2011-2015).
See Appendix C: TWDB Estimated Historical Water Use for Bell County.
See Appendix D: TWDB Data Definitions

Exhibit B -- Major Aquifers in Bell County
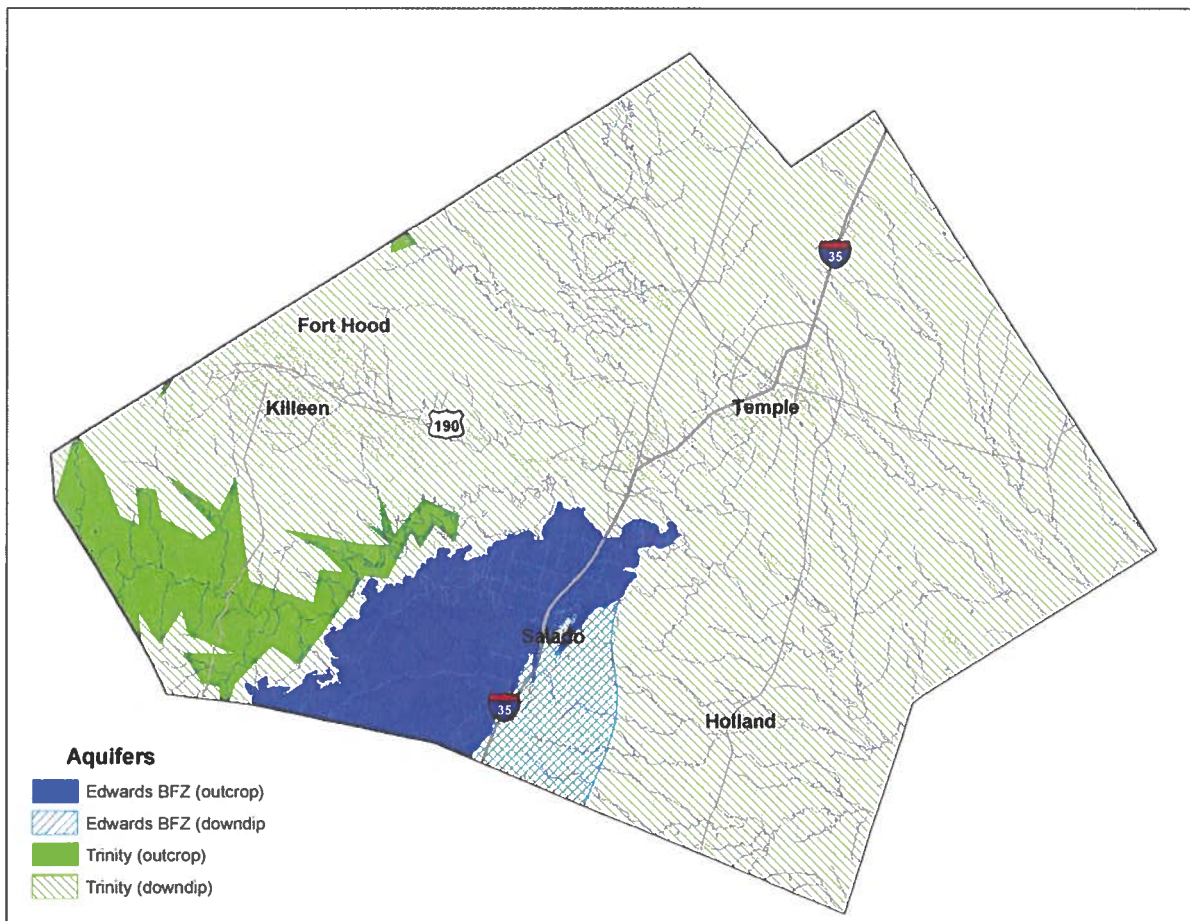
IV.   STATEMENT OF GUIDING PRINCIPLES

CUWCD recognizes that the groundwater resources of Bell County and the Central Texas region are of vital importance and that local management provides essential localized leadership, local discernment, local accountability, based on local oversite, and local expert understanding of the resource. Preservation of this most valuable resource can be managed in a prudent and cost-effective manner through education, cooperation, and developing a comprehensive understanding of the aquifers. The greatest threat to CUWCD in achieving its stated mission is the misunderstanding of the resource by elected officials, property owners, and water users. Scientific understanding can support localized management of the groundwater resources if the District continues to invest in science-based research to bolster understanding of local conditions. CUWCD's management plan is intended to serve as a tool to focus the thoughts and actions of those given the responsibility for the execution of the District's activities.

V.   CRITERIA FOR PLAN APPROVAL

A.   Planning Horizon

The time period for this plan is five years from the date of approval by the Executive Administrator or, if appealed, on approval by the TWDB. The original management plan was approved by the TWDB in February 2001. The District's Board of Directors adopted a revised groundwater management plan on December 13, 2005 and approved by TWDB in March 2006. This plan was revised and amended by the Board of Directors on February 8, 2011 and approved by TWDB April 13, 2011, will expire on April 13, 2016. The current plan was revised and amended by the Board of Directors on January 13, 2016 and approved by TWDB February 19, 2016 and will expire on February 19, 2021. The previous plan was amended for the sole purpose of incorporating the language of the second round of joint planning by GMA 8, effective December 12, 2018. This plan is being amended for the sole purpose of ~~incorportating~~incorporating the language of the third ~~roundw~~round of joint planning by GMA8, effective August 23, 2023 ~~This plan is being~~ and submitted ~~as part of the next five-year review for~~ final approval by TWDB Executive Administrator 60 days and re-adoption process as required by TWC 36.1072(e). This groundwater management plan will remain in effect until a revised management plan is approved by the Executive Administrator of the TWDB. The plan shall be reviewed (annually) and updated and readopted in accordance with the requirements of the Texas Water Code and remain effective for five years from the approval date by the Executive Administrator.

B.   Board Resolution

Copy of the Clearwater Underground Water Conservation District resolution adopting the plan.

A copy of the Clearwater Underground Water Conservation District resolution adopting the plan is located. *See Appendix E: CUWCD Resolution*

C. Plan Adoption

Evidence that the plan was adopted after notice and hearing.

Public notices documenting that the plan was adopted following appropriate public meetings and hearings are located. *See Appendix F: CUWCD Notice of Public Hearing*

D. Coordination with Surface Water Management Entities

Evidence that following notice and hearing the District coordinated in the development of its management plan with surface water management entities.

CUWCD reference letter documenting transmitting a copy of this plan to surface water management entities after adoption of the plan. S*ee Appendix G: Notice to Surface Water Management Entities.*

VI   ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY TEXAS WATER CODE CHAPTER 36.

A. Modeled available groundwater in the district based on the desired future condition established

Modeled available groundwater is defined in TWC §36.001 as the amount of water the Executive Administrator determines may be produced on an average annual basis to achieve a desired future condition established under section 36.108. The desired future condition of the aquifer may only be determined through joint planning with other groundwater conservation districts (GCDs) in the same groundwater management area (GMA) as required by the 79th Legislature with the passage of HB 1763 into law. The District is in GMA 8. The GCDs of GMA 8 have completed the joint planning process to determine the desired future condition of the aquifers in the GMA.

To determine the desired future conditions, the District conducted a series of simulations using the TWDB's Groundwater Availability Models (GAMs) for the Northern Edwards (BFZ) and the Northern Trinity/Woodbine aquifers. Each series of GAM simulations was conducted by iteratively applying varying amounts of simulated groundwater pumping from the aquifer over a predictive period that included a simulated repeat of the drought of record. Pumping was increased until the amount of pumping that could be sustained by the aquifer without impairing the aquifer conditions selected for consideration as the indicator of the aquifer desired future condition was identified.

See Appendix H: TWDB Map of the GMA boundaries

1. Edwards (BFZ) Aquifer

a. Desired Future Conditions
The desired future condition of the Edwards (BFZ) Aquifer is based on maintaining Salado Spring discharge into Salado Creek during a repeat of conditions like those in the 1950's drought of record. Under the drought of record conditions, a spring

discharge of 200 acre-feet per month is preferred and 100 acre-feet per month is the minimum acceptable spring flow.

b. Modeled Available Groundwater

The modeled available groundwater value for the Edwards (BFZ) Aquifer in Bell County, as given in TWDB GAM Run ~~17-029~~21-013 MAG for the ~~current~~ decades ~~2010~~2020-~~2020~~2080, is 6,469 acre-feet per year, and is based on the desired future condition discussed above. CUWCD estimates that by year 2070, exempt use of the Edwards (BFZ) Aquifer may reach approximately 825 acre-feet per year and that volume of water is allocated for exempt well users on an annual basis. This leaves approximately 5,644 acre-feet per year as the volume of groundwater available for permitting in the Edwards (BFZ) aquifer.
See Appendix I: TWDB GAM Run ~~17-029~~21-013 MAG
See Appendix J: TWDB GAM Run 15-003

2. Trinity Aquifer

a. Desired Future Conditions

There are three recognized subdivisions in the Trinity Aquifer: the Upper, Middle and Lower Trinity aquifers. In Bell County the three subdivisions of the Trinity Aquifer are made up of several geologic units. The geologic units are: the Paluxy Sand; the Glen Rose Limestone and; the Hensell Sand and Hosston Conglomerate of the Travis Peak Formation. GMA 8 developed a desired future condition for each of the water-bearing geologic units which make up the Trinity Aquifer in Bell County. The desired future conditions for the several water-bearing units describe the amount of water-level draw down which may occur after ~~60~~70 years when the draw down is averaged across the area of occurrence of the water bearing unit in the District. The amount of draw down described in the desired future conditions is indexed to year 2010 water levels.

- From estimated year 2010 conditions, the average draw down of the Paluxy Aquifer should not exceed approximately ~~190~~0 feet after ~~60~~70 years.
- From estimated year 2010 conditions, the average draw down of the Glen Rose Aquifer should not exceed approximately 83 feet after ~~60~~70 years.
- From estimated year 2010 conditions, the average draw down of the Hensell Aquifer should not exceed approximately ~~137~~ 145 feet after ~~60~~70 years.
- From estimated year 2010 conditions, the average draw down of the Hosston Aquifer should not exceed approximately ~~330~~375 feet after ~~60~~ 70 years.

For the purpose of managing groundwater in the District, CUWCD subdivides the water-bearing geologic units into the three Trinity Aquifer subdivisions as follows: the Upper Trinity (Glen Rose Limestone); the Middle Trinity (Hensell Sand); and the Lower Trinity (Hosston Conglomerate) aquifers.

b. Modeled Available Groundwater 2020

The total of modeled available groundwater values for the Trinity Aquifer in Bell County, as given in GAM Run ~~17-029~~21-013 MAG for ~~the current decade 2010~~

decades from 2020 through 2070, is 9,266 9,275 acre-feet per year which is based on the amounts of groundwater that could be pumped while maintaining the desired future conditions in each water-bearing geologic unit discussed above. CUWCD estimates that by year 207080, total exempt use of the Trinity Aquifer may reach approximately 1,419 acre-feet per year, and that volume of water is allocated for exempt well users on an annual basis. The subdivision allocation for exempt use is currently at 400 acre feet for the Glen Rose Limestone, 650 acre feet for the Hensell Sand and 369 acre feet for the Hosston Conglomerate. This leaves a total of approximately 7,847 856 acre-feet per year as the an estimate of the volume of groundwater available for permittingthat could be pumped to comply with the dDesired fFuture cConditions -in the Trinity Aquifer.

The modeled available groundwater values of the several water-bearing geologic units of the Trinity Aquifer in Bell County, as given in TWDB GAM Run 17-02921-1321-013 MAG, are as follows:

a. Paluxy – 0 ac-ft per year
b. Glen Rose – 974 275 ac-ft per year
c. Hensell – 1,099 1,100 ac-ft per year
d. Hosston – 7,193 7,900 ac-ft per year

These modeled available groundwater values are for 2020., for For a full listing of values for every year, please refer to the MAG report TWDB GAM Run 17-02921-1321-013 MAG in Appendix I. CUWCD intends through its rules to regulate manages the Trinity Aquifer within the District by aquifer subdivision and geographic "management zones" established and identified by CUWCD's rules adopted in accordance with TWC § 36.116(d), and according to the finding of the report commissioned by CUWCD (*see Appendix A2: Delineation of Proposed Management Zones within Bell County, Texas*). While management is by subdivision the district reserves the right to implement management areas and management zones by geologic unit through the District's rules. The modeled available groundwater values for each Trinity Aquifer subdivision and management areas zone within the water-bearing unit that has a required separate allocation of water for exempt well use.
See Appendix I: TWDB GAM Run 17-02921-1321-013 MAG

3. Other Water Bearing Formations

Other groundwater sources in Bell County include Alluvium, the Austin Chalk, the Buda Limestone, the Edwards Group and equivalent rocks outside the recognized bounds of the Edwards (BFZ) Aquifer (Edwards Equivalent Aquifer), the Kemp, Lake Waco, Ozan, and Pecan Gap formations. These sources of groundwater produce limited water supply in limited areas in the District. GMA 8 did not find these aquifers relevant for planning purposes at the present time or develop desired future conditions for them; as a result, there are no modeled available groundwater values for these sources of groundwater. See *Appendix A1 and A2* for a more detailed discussion of these water bearing formations.

B. Amount of groundwater being used within the district on an annual basis.

The amount of groundwater used in Bell County from 2016 to 2020~~0~~2 is shown in the *Appendix B*. Data from 2002-2017 is provided by the Texas Water Development Board from their Water Use Survey database, *Appendix C*. The CUWCD data, *Appendix B*, does distinguish between exempt and non-exempt wells. Exempt wells are wells that are used for domestic use or livestock watering (including certain additional uses defined in State law) and not capable of producing more than approximately 17 gallons per minute. Groundwater use data for 2016 through 2020 is provided from the District's records. The District began registering wells in February 2002 and began recording production from non-exempt wells during 2003. At the end of September 2019, approximately 5,794 wells were registered. Although CUWCD has made considerable progress in registering wells, it is likely there are still 1-2% of wells in Bell County that are not registered, and are therefore not considered in *Appendix B*. The District requires monthly production reports for all Classification 2 non-exempt wells (commercial). Classification 1 non-exempt wells are wells that would otherwise be considered exempt but are located on a tract of land of less than 10 acres and greater than 2 acres subdivided after March 1, 2004. Production reports are not required for Classification 1 wells; however, production cannot exceed 25,000 gallons per day. In 2004, the District began estimating production from exempt wells. *See Appendix B: CUWCD - Bell County Historical Groundwater Use (~~2015-2019~~2015-2022)*

C. Annual amount of recharge from precipitation to the groundwater resources within the district.

The estimates of the annual amount of recharge to the groundwater resources of the District that are recognized as Major Aquifers by TWDB are based on the GAM simulations provided by TWDB to the District for use in this plan. The District has made no estimate of the amount of annual recharge to the local sources of groundwater in the District.

 1. Edwards (BFZ) Aquifer Recharge   27,565 acre-feet per year

 2. Trinity Aquifer Recharge   2,816 acre-feet per year

See Appendix J: Estimate source: TWDB GAM Run 15-003; November 24, 2015

D. For each aquifer, annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers.

The estimates of the annual amount of water discharged to surface water systems by the groundwater resources of the District recognized as Major Aquifers by TWDB are based the GAM simulations provided by TWDB to the District for use in this plan. The District has made no estimate of the amount of the annual discharge to surface water systems by the minor sources of groundwater in the District.

 1. Edwards (BFZ) Aquifer   27,566 acre-feet per year

2. Trinity Aquifer   11,131 acre-feet per year

See Appendix J: Estimate source: TWDB GAM Run 15-003; November 24, 2015

E. Annual volume of flow into and out of the district within each aquifer and between aquifers in the district, if a groundwater availability model is available

There are two aquifers in the District for which a TWDB GAM is available; the Trinity and the Edwards (BFZ) Aquifers. The estimates of the amount of water flowing into and out of the District within each aquifer and between aquifers in the District are based on the GAM simulations provided by TWDB to the District for use in this plan.

1. Edwards (BFZ) Aquifer

   Flow into the aquifer within the District: 5,853 acre-feet/year

   Flow out of the aquifer in the District: 1,090 acre-feet/year

   Net flow out of the aquifer to overlying units in the District: 121 acre-feet/year

   Net flow to downdip* Edwards (BFZ) Aquifer: 3,957 acre-feet/year

2. Trinity Aquifer

   Flow into the aquifer within the District: 7,230 acre-feet/year

   Flow out of the aquifer within the District: 5,659 acre-feet/year

   Net flow into the aquifer from the overlying Washita-Fredericksburg Confining Unit in the District: 5,587 acre-feet/year

Estimate source: TWDB GAM Run 15-003; November 24, 2015
*The model extends beyond the TWDB official Edwards (Balcones Fault Zone) Aquifer boundary. This is the amount of brackish and/or saline groundwater (greater than 1,000 total dissolved solid) that exits the downdip boundary limit of the [official] aquifer within the district boundaries and into deeper portions of the Edwards Group formations.

F. Projected surface water supply in the district, according to the most recently adopted state water plan.

The most recently adopted state water plan is the 2017 State Water Plan. The 2017 State Water Plan indicates a projected surface water supply for Bell County of 93,515 acre-feet/year for year 2070.

Two major water reservoirs located in Bell County are Lake Belton and Lake Stillhouse Hollow. The 2016 Brazos G Initially Prepared Regional Water Plan (*Appendix L:* Table 3.1-1, Major Reservoirs of the Brazos River Basin) identifies 100,257 acre-feet/year as the authorized diversion, or permitted yield, from Lake Belton, and 67,768 acre-feet/year for Lake Stillhouse Hollow. This provides a total yield of 168,025 acre-feet/year for the two lakes. Currently, the Brazos River Authority has under contract approximately 113,906 acre-feet/year to Bell County entities. The US Corps of Engineers is the owner and operator of Lakes Belton and Stillhouse Hollow. The Brazos River Authority manages water rights in both lakes. The Department of the Army (Fort ~~Hood~~ Cavazos) also manages the water rights from Lake Belton.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

G. Projected total demand for water in the district according to the most recently adopted state water plan.

The most recently adopted state water plan is the 2017 State Water Plan. The 2017 State Water Plan indicates a projected total water demand for Bell County of 134,411 acre-feet/year for year 2070. The projections are from year 2020 to 2070 and include demands that may be met by water from either or both surface water and groundwater. District records indicate that actual groundwater usage in Bell County during year 2019 by the Water Utility Groups totaled 2,417 acre-feet or approximately 3.18% of the County's projected 2020 total demand for water in the 2017 State Water Plan.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

VII. CONSIDER THE WATER SUPPLY NEEDS AND WATER MANAGEMENT STRATEGIES INCLUDED IN THE ADOPTED STATE WATER PLAN.

The most recently adopted state water plan is the 2017 State Water Plan. In the 2017 State Water Plan, water needs were identified for sixteen Water User Groups (WUGs) in Bell County. Water needs are identified when the projected water demand of a WUG exceeds the projected water supplies of the WUG, *Appendix C*. Positive values given in the tables indicate a water surplus and negative values (expressed as values with a " − " symbol) indicate a water need.

In the 2017 State Water Plan twenty water management strategies (WMSs) were recommended for the sixteen Bell County WUGs with identified water needs. Seven of the WMSs involved conservation of existing water supplies. Four have recommended WMSs involve the redistribution and/or increase of surface water supplies of the respective WUGs. There is the conjunctive use strategy for Georgetown Utilities~~Chisholm Trail SUD~~, to increase groundwater with surface water based on the WMS, yet Georgetown Utilities~~Chisholm Trail SUD~~ has no groundwater wells in Bell County with no delivery of public water supply to the 65,000 acres of their respective CCN that lies in Bell County. This strategy is recommended in the 2012 State Water Plan and is stated as the WTP

expansion in the 2017 State Water plan may enhance the WUGs in Bell County who serve in other counties with conjunctive use of groundwater and surface water from Bell County. The desired future conditions and amounts of groundwater available for annual use in modeled available groundwater values for the Edwards (BFZ) and Trinity Aquifers in the District will not prevent the implementation of any recommended WMS or restrict the amount of groundwater considered available in the 2017 State Water Plan.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

A. Water Shortages

Of the 30 Bell County WUGs identified in the 2017 State Water Plan, sixteen were projected to have water shortages by the year 2070. The projected shortage of water for these sixteen users ranges from approximately 10,026 acre-feet/year in 2020 to approximately 43,762 acre-feet/year in 2070. Nine of these users use only surface water (439 WSC, City of Belton, Kempner WSC, City of Nolanville, City of Temple; , County-Other Bell, Steam Electric Power). Four of these WUGs use a mixture of groundwater and surface water (City of Little River-Academy, Georgetown Utilities~~Chisholm Trail SUD~~, Elm Creek WSC, Salado WSC, Manufacturing), and three use only groundwater (City of Bartlett, Mining, Agriculture Irrigation). The source of groundwater for these users is identified as the Other Alluvial groundwater formation, Trinity Aquifer and the Edwards (BFZ) Aquifer. Some of the management strategies involve purchasing additional surface water, implementing conservation measures, Trinity ASR, direct reuse and groundwater from the Carrizo-Wilcox Aquifer in both Burleson and Milam Counties. Additional use of groundwater from the Trinity and Edwards BFZ Aquifers within CUWCD's jurisdiction been identified as strategies for the named as County-Other (identified as Edwards Aquifer Development, small Municipal Water Conservation, purchases from Central Texas WSC and Williamson County ASR).

Jarrell-Schwertner WSC's service area includes southern Bell County and northern Williamson County and is in the State Water Plan identified as a water user in Williamson County. Their primary water supply is both surface and groundwater in Bell County from the Edwards (BFZ) Aquifer. Their recommended management strategies include implementing conservation measures and purchasing surface water. Additional use of groundwater in Bell County is not identified as part of the management strategies. Through participation in a local water supply planning initiative, Jarrell-Schwertner WSC is participating in the Lake Granger Conjunctive Use Project.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

B. Water Surplus

Fourteen of the Water User Groups identified in the Brazos G Regional Water Plan are projected to have surplus water through the year 2070. Eight of these are identified as using both surface water and groundwater (Armstrong WSC, Bell-Milam-Falls WSC, City of Holland, East Bell WSC, Morgan's Point Resort, Pendleton WSC, City of Rogers Moffat WSC; City of Troy). The source of groundwater is identified as the Hensell Layer of the

Trinity Aquifer. Since these users are projected to have a surplus of water or no projected needs, no changes in water supply are recommended.

Source Appendix C: TWDB 2017 State Water Plan Datasets for Bell County

VIII. MANAGEMENT OF GROUNDWATER SUPPLIES

TWC Section 36.0015 states that groundwater conservation districts (GCDs) are the state's preferred method of groundwater management and establishes that GCDs will manage groundwater resources through rules developed and implemented in accordance with TWC Chapter 36. Chapter 36 gives directives to GCDs and the statutory authority to carry out such directives, so that GCDs are provided the proper tools to protect and manage the groundwater resources within their boundaries.

CUWCD will manage the supply of groundwater within the District in order to conserve the groundwater resources while seeking to maintain the economic viability of all groundwater user groups - public and private. In consideration of the economic and cultural activities occurring within the District, CUWCD will identify and engage in such activities and practices which, if implemented, would result in a reduction of groundwater use. The existing observation network of groundwater wells will be used to monitor the changing conditions of the groundwater resources within the District. The observation network has been expanded on an annual basis as opportunities for the District to fund new wells and include permitted wells on the network.

The regulatory tools granted to GCDs by TWC Chapter 36 enable GCD's to preserve historic and existing users of groundwater. CUWCD protects historic and existing users by granting such groundwater users historic and existing use permits that have priority over operating permits. TWC Chapter 36 also allows GCDs to establish management zones within an aquifer or aquifer subdivision. The District's rules provide for the designation of "management ~~areas~~ zones" as needed to better manage and regulate the groundwater resources of Bell County.

CUWCD may deny a water well drilling permit or limit groundwater withdrawals in accordance with the requirements stated in the rules of the District. In making a determination to deny a permit or limit groundwater withdrawals, the District will consider criteria identified in TWC Section 36.113.

In accordance with CUWCD's mission of protecting the groundwater resources of Bell County, the District may require reduction of groundwater withdrawals to amounts that will not cause harm to the aquifer when considering the desired future condition of the District's aquifers and the amount of modeled available groundwater within the District. To achieve this purpose, the District may, at the discretion of the Board, amend or revoke any permits after notice and hearing. The determination to seek the amendment or revocation of a permit by the District will be based on aquifer conditions as observed by the District. The District will enforce the terms and conditions of permits and the rules of the District by injunction or other appropriate relief in a court of competent jurisdiction as provided for in TWC §36.102.

A contingency plan to cope with the effects of water supply deficits due to climatic or other conditions has been developed by CUWCD and adopted by the Board after notice and hearing. In developing the contingency plan, CUWCD considered the economic effect of conservation measures upon all water resource user groups, the local implications of the extent and effect of changes in water storage conditions, the unique hydrogeologic conditions of the aquifers within the District, and the appropriate conditions under which the voluntary drought contingency plan is implemented. CUWCD evaluates the groundwater resources available within the District and determines the effectiveness of regulatory or conservation measures.

A public or private user may appeal to the Board for discretion in enforcement of the provisions of the water supply deficit contingency plan on grounds of adverse economic hardship or unique local conditions. The exercise of said discretion by the Board shall not be construed as limiting the power of the Board.

IX.   ACTIONS, PROCEDURES, PERFORMANCE AND AVOIDANCE FOR PLAN IMPLEMENTATION

CUWCD 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, and 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.

Rules adopted by the District for the permitting of wells and the production of groundwater shall comply with TWC Chapter 36, including §36.113, and the provisions of this management 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 to the District. District Rules are available on the District website at http://www.cuwcd.org/regulatory-program/district-rules/.

X.   METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS.

CUWCD general manager will prepare a draft Annual Report to the Board of Directors on District performance in regard to achieving management goals and objectives in each fiscal year for consideration for adoption by the Board of Directors. The report is to be presented within 180 days following the completion of each fiscal year of the District. The Board will maintain the report on file for public inspection at the District's offices and on the District Website upon adoption. Link to CUWCD-annual-reports

XI.   GOALS, MANAGEMENT OBJECTIVES and PERFORMANCE STANDARDS

The management goals, objectives, and performance standards of the District in the areas specified in **31TAC§356.5** are addressed below.

Management Goals

A. **Providing the Most Efficient Use of Groundwater –31TAC 356.52(a)(1)(A) (Implementing TWC §36.1071(a)(1))**

1. Objective: Each year, CUWCD will require the registration of all wells within the District's jurisdiction.

    Performance Standard: Each year, the number of new and existing wells registered with CUWCD will be presented in the District's Annual Report located or public viewing on the district's website http://www.cuwcd.org/ and maintained data base management system as an internet webpage https://clearwater.lre-up.com

2. Objective: Each year, CUWCD will require permits for all non-exempt use of groundwater in the District as defined in the District rules, in accordance with adopted procedures.

    Performance Standard: Each year, CUWCD will prepare a summary of the number of applications for the drilling of non-exempt wells, the number of applications for the permitted use of groundwater and the disposition of the applications will be will be presented in the District's annual report.

3. Objective: Each year, CUWCD will maintain a groundwater database to include information relating to well location, production volume, and other pertinent information deemed necessary by the District to enable effective monitoring of groundwater in Bell County.

    Performance Standard:
    a. Each year, CUWCD's annual report will include a status report of the database repository and enhancements to the platform.
    b. Each year, CUWCD's annual report will include a summary of changes in the water-level condition of the aquifers included in the district water-level monitoring program.

4. Objective: Each year, CUWCD will disseminate educational information on groundwater through publication of a District newsletter, Quarterly Webnews, and website.

    Performance Standard: The CUWCD annual report will include a copy of the District newsletter published each year, with select examples of the Quarterly Webnews on Mailchimp/~~Twitter/Facebook~~.

B. **Controlling and Preventing Waste of Groundwater –31TAC 356.52(a)(1)(B) ((Implementing TWC §36.1071(a)(2))**

Objective: Each year, CUWCD will disseminate educational information on controlling and preventing the waste of groundwater focusing on water quality

protection through at least one classroom or public presentations to civic organizations and invited opportunities to speak

Performance Standard: The CUWCD annual report will include a summary of the District presentations to disseminate educational information on controlling and preventing the waste of groundwater focusing on water quality protection.

C. Addressing Conjunctive Surface Water Management Issues-31TAC356.52 (a)(1)(D) ((Implementing TWC §36.1071(a)(4))

Objective: Each year, CUWCD will participate in the regional planning process by attending a minimum of two meetings of the Brazos G Regional Water Planning Group per fiscal year.

Performance Standard: Each year, CUWCD will report attendance at Region G meetings by a representative of the District will be reflected in the District's annual report and will include the number of meetings attended and the dates.

D. Addressing Natural Resource Issues that Impact the Use and Availability of Groundwater, and which are Impacted by the Use of Groundwater – 31TAC§356.52 (a)(1)(E) ((Implementing TWC §36.1071(a)(5))

1) Objective: Each year CUWCD will monitor water quality within the District by obtaining water samples from all newly constructed wells and testing the water quality of a minimum 90% of newly constructed wells.

   Performance Standard: Each year, CUWCD's Annual Report will provide a status report on the number of wells tested, by aquifers, aquifer subdivisions and the testing results. District will document the results and make them publicly available on the district web-maps for each well tested.

2) Objective: Each quarter of the year, CUWCD will monitor the water quality and spring-flow of the Salado Springs Complex and the Robertson springs of Salado in accordance with the necessary agreements under the Endanger Species Act (ESA) and a proposed, soon to be negotiated 4(d)rule with United States Fish and Wildlife Service (USFWS) and such, per Chapter 36.108 GMA8 Joint Planning, to manage to the Edwards BFZ Aquifer DFC.

   Performance Standard: Each year, CUWCD's Annual Report will provide a status summary report of the quarterly water quality assessments for nitrate, nitrite and dissolved oxygen of the both Salado Spring Complex and groundwater flow from all seven of the downtown springs collectively known as the Salado Spring Complex.

3) Objective: Each year CUWCD, in accordance with the an agreed upon five year reimbursable-task-order with Texas Fish and Wildlife Conservation Office

(TXFWCO), will fund and support the efforts of the assigned research biologist, to assess the status the Threatened Salado Salamander by systematically monitoring under the federal permit TE676811-9 and state permit SPR-0111-03.

Performance Standard: Each year, CUWCD's Annual Report will provide a summary of the formal findings of the assigned research biologist and accordingly maintain such findings and formal report from TXFWCO on the district website in a defined location assessable to all parties.

E. Addressing Drought Conditions – 31TAC356.52 (a)(1)(F) ((Implementing TWC §36.1071(a)(6))

1. Objective: Each month, CUWCD will monitor drought conditions in the Edwards (BFZ) Aquifer through the process established in the drought management plan for the Edwards (BFZ) Aquifer adopted by the Board of Directors.
    Performance Standard: Each year, a summary of CUWCD's monthly monitoring of drought conditions in the Edwards (BFZ) Aquifer and the implementation of any conservation measures will be provided in the annual report, on the District website http://cuwcd.org as well as the TWDB drought resources https://www.waterdatafortexas.org/drought . The Salado Salamander is protected by the District per the drought contingency plan in accordance with agreements with all non-exempt permit holders producing from the Edwards (BFZ) Aquifer and in accordance with elements of the pending 4(d)rule under the Endangered Species Act.

2. Objective: Each month, CUWCD will monitor drought conditions in the Trinity Aquifer through the process established in the drought management plan for the Trinity Aquifer adopted by the Board of Directors.

    Performance Standard: Each year, a summary of CUWCD's monthly monitoring of drought conditions in the Trinity Aquifer and the implementation of any conservation measures will be provided in the annual report.

F. Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and Brush Control, Where Appropriate and Cost-Effective – 31TAC356.52 (a)(1)(G) (Implementing TWC §36.1071(a)(7))

Conservation
Objective: Each year, CUWCD will promote conservation by conducting and hosting educational events with AgriLife Extension Service and Texas 4-H2O Ambassadors on water conservation and by distributing conservation brochures and literature to the public at a minimum two educational events attended by district

staff and directors (ex. Bell County Annual Water Symposium, Bell County Annual Grounds Conference and Bell County Annual Crops Conference)

Performance Standard: Each year, CUWCD's annual report will include a summary of the District activity during the year to promote conservation.

Rainwater Harvesting

Objective: Each year, CUWCD will promote rainwater harvesting by posting information on rainwater harvesting on the District website.

Performance Standard: Each year, CUWCD's annual report will include a copy of the information on rainwater harvesting that is provided on the District website.

Brush Control

Objective: Each year, the District will provide information relating to brush control on the District website.

Performance Standard: Each year, the District annual report will include a copy of the information that has been provided on the District website relating to brush control.

Recharge Enhancement

Objective: Each year, CUWCD will provide information relating to recharge enhancement on the District website.

Performance Standard: Each year, CUWCD's annual report will include a copy of the information that has been provided on the District website relating to recharge enhancement.

G. Addressing in a Quantitative Manner the Desired Future Conditions of the Groundwater Resources – TWC §36.108, 31TAC 356.52(a)(1)(H), (Implementing TWC §36.1071(a)(8))

1. Objective – Each month, CUWCD will operate a gauge system on Salado Creek by contract with USGS Water Science Team in Austin Texas, to accurately record the estimates of the discharge from the Edwards (BFZ) Aquifer at the Salado Springs Complex, Robertson, Big Boiling, Little Bubbly, Side Spring, Critchfield, Benedict and Anderson Springs.

   Performance Standard – Each month, CUWCD will include a summary of the monthly average discharge rate of Salado Springs and a discussion of the conservation measures implemented (if any are necessary) to avoid impairment of the Desired Future Conditions for the Edwards (BFZ) Aquifer established by GMA 8, and documented in the Annual Report to the Board of Directors.

2. <u>Objective</u> – Each month, CUWCD will collect at least 15 water-level measurements from the Trinity Aquifer monitor wells located in the District.
<u>Performance Standard</u>
   a. Each year, the CUWCD Annual Report to the Board of Directors will post the water-level measurements collected from the Trinity Aquifer by each confining layer and identify the aquifer subdivision from which the measurement is taken.

   b. Each year, the CUWCD Annual Report to the Board of Directors will include a discussion of the change in water-levels in each Trinity Aquifer subdivision for which a Desired Future Condition is stablished by GMA 8.

   b. Every year, the CUWCD Annual Report to the Board of Directors will include a discussion of the trends and changes of water-levels in each Trinity Aquifer subdivision for which a Desired Future Condition is established by GMA 8 comparing the change to the incremental time-appropriate change in water-levels indicated by the established Desired Future Condition of the aquifer.

H. Controlling and Preventing Subsidence 31TAC§356.52(a)(1)(C), TWC §36.1071(a)(6)

This category of management goal is now applicable to the District even though the major water producing formations in the District are composed primarily of competent limestone are thought to be very low risk because the structural competency of the aquifer materials significantly limits the potential for the occurrence of land surface subsidence in the District. In ~~2016~~ 2017, the Texas Water Development Board (TWDB) ~~Contract Number 1648302062) contracted with LRE Water, LLC to identify and characterize areas within Texas' major and minor aquifers that are susceptible to land subsidence related to groundwater pumping.~~ released a report "Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping - TWDB Contract Number 1648302062". This TWDB resource also includes a subsidence calculation tool known as "Subsidence Prediction Tool and User Guide". These two resources are the basis for the subsidence review completed by the district.

https://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp

1) Objective – Each year the district will apply the subsidence prediction tool for the purpose of identifying and characterizing the areas of the district that might be experiencing land subsidence

   Performance Standard – Each year the district with the assistance of TWDB and LRE will deploy the tool and results after calculating subsidence predictions based on the results generated from the subsidence prediction tool and report the findings in the annual report.

XII. MANAGEMENT GOALS DETERMINED NOT-APPLICABLE TO THE DISTRICT

B. Precipitation Enhancement – 31TAC§356.52(a)(1)(G), TWC §36.107(a)(7)

Precipitation enhancement is not an appropriate or cost-effective program for the District at this time because there is not an existing precipitation enhancement program operating in nearby counties in which the District could participate and share costs. The cost of operating a single-county precipitation enhancement program is prohibitive and would require the District to increase taxes in Bell County.

APPENDIX A1

Groundwater Resources of Bell County

The Texas Water Development Board classifies groundwater sources as major or minor aquifers. Major aquifers are aquifers that are capable of producing large yields to wells or that produce groundwater over a large area. Minor aquifers are aquifers that may be capable of producing only limited yields to wells or that produce groundwater over a limited area. Many localized sources of groundwater may not be listed as a major or minor aquifer by TWDB. However, TWDB recognizes that whether an aquifer is classified as a major aquifer, a minor aquifer or not included in either list may have no bearing on the local importance of a particular source of groundwater.

Major Aquifers

Two major aquifers are located in Bell County. They are the Trinity and Edwards Balcones Fault Zone (BFZ) aquifers (Exhibit I). Several water supply corporations in Bell County have the ability to utilize groundwater in an emergency situation.

Edwards (BFZ) aquifer

The Edwards (BFZ) aquifer is composed of the Edwards and Associated Limestones. It is located in the southern part of the county and serves as the water supply for the City of Salado and other communities in the area. The outcrop of the aquifer is generally found to the west of I-35 and the down-dip portion of the aquifer is generally to the east of I-35. Recharge to the Edwards aquifer generally is from percolation of storm run-off water in intermittent streams flowing across the outcrop area, as well as direct infiltration of rainfall over the outcrop area. Water quality in the Edwards aquifer is generally high; however, within a relatively short distance east of IH 35 the water quality is rapidly reduced. In Bell County water in the aquifer generally moves from the recharge zone toward natural discharge via the Salado Springs. Within Bell County the availability of groundwater from the Edwards aquifer water is based on maintaining at least a minimum spring flow at Salado Springs during a repeat of the drought of record.

Trinity aquifer

The Trinity aquifer is composed of three subdivisions; the Upper Trinity; the Middle Trinity and the Lower Trinity aquifers. The Upper Trinity aquifer is composed of the Glen Rose Formation; the Middle Trinity aquifer is composed of the Hensell Sand and Cow Creek Limestone; and the Lower Trinity aquifer is composed of the Sligo Limestone and Hosston Sand. The Upper Trinity aquifer crops out in western Bell County and is located generally west of the Edwards aquifer outcrop. The Middle and Lower Trinity aquifers do not outcrop in Bell County. However, the Trinity aquifer underlies all of Bell County. Water quality in the Trinity aquifer is good to moderate in western Bell County. East of IH 35 the water quality in the Upper and Middle Trinity aquifers deteriorates, but the water quality of the Lower Trinity aquifer remains useable for most purposes over most of Bell County. The availability of groundwater from the subdivisions of the Trinity aquifer is based on the management of aquifer pumping to maintain the resulting draw down within acceptable limits. The Trinity aquifer has established management targets for the limit of acceptable draw down.

Other Local Sources of Groundwater

The <u>local</u> sources of groundwater which are not recognized as major or minor aquifers by TWDB are particularly important to Bell County. A significant percentage of the wells registered with CUWCD are completed in formations which are not widely recognized as aquifers but are vitally important sources of water. In the area of Bell County east of IH-35, the majority of wells registered with CUWCD are completed in these water bearing formations. A brief description of these groundwater sources follows:

Alluvium / Terrace deposits

Alluvium and Terrace deposits consist of sand, gravel, silt and clay deposited by streams. Alluvium deposits are unconsolidated; terrace deposits may have some cement. Alluvium is closely associated with stream channels and terrace deposits are found at higher elevation across the broader floodplain of the stream. Well yields range from low to moderate.

Austin Chalk

The Austin Chalk consists of nodular chalk and marl with some clay seams. Well yields are typically low with generally fresh water.

Buda Limestone

The Buda Limestone is a fine grained hard limestone with abundant fossils or fossil fragments. Wells completed in this formation may yield little or no water.

Edwards Equivalent

The term Edwards Equivalent aquifer refers to the areas in Bell County where the limestones and associated formations of the Edwards Group are productive of generally limited volumes of groundwater and which are located outside of the TWDB recognized bounds of the Edwards (BFZ) aquifer.

Kemp Clay-Marlbrook Marl / Pecan Gap Fm / Ozan Fm

These three geologic units are distinguishable from each other but consist of similar materials and have similar water bearing properties. They consist of thick beds of marl, chalky marl or calcareous clays containing thin beds of silt. Well yields are typically low with fresh to moderately saline water. These geologic units are all associated as members of the Taylor Marl.

Lake Waco Fm

The Lake Waco Fm is a member of the Eagle Ford Group. The formation consists of limestone and shale. While not generally recognized as productive of water it appears to produce limited amounts of useable quality water in limited areas of Bell County.

Exhibit I -- Geologic and Hydrologic Units of Bell County

Group	Formation	Member	Hydrologic Unit
N/A	Alluvium		Alluvium and terrace deposits
	Terrace deposits		
Navarro/Taylor	Kemp Clay / Marlbrook Marl		Kemp Clay/ Marlbrook Marl
	Pecan Gap Chalk		Pecan Gap Formation
	Ozan Formation		Ozan Formation
Austin	Austin Chalk		Austin Chalk
Eagle Ford	Eagle Ford Shale Lake Waco Fm		Eagle Ford not recognized as a groundwater source; Lake Waco has limited production in limited areas
Washita	Buda Formation		Buda Limestone
	Del Rio Clay		Not recognized as a groundwater source
Edwards	Georgetown		Edwards (Balcones Fault Zone) aquifer
	Kiamichi		
	Edwards		
	Comanche Peak		
	Walnut		Not recognized as a groundwater source
Trinity	Paluxy		Upper Trinity aquifer
	Glen Rose		
	Travis Peak	Hensell Sand	Middle Trinity aquifer
		Cow Creek Limestone	
		Hammett Shale	Not recognized as a groundwater source
		Sligo limestone	Lower Trinity aquifer
		Hosston Sand/Conglomerate	

Source: Geologic and Hydrologic Units of Bell County, after Duffin and Musick, 1991

APPENDIX A2

Delineation of Proposed Management Zones within Bell County, Texas

Prepared for

CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT

Prepared by

Michael R. Keester, P.G. – R. W. Harden & Associates, Inc.

Allan R. Standen, P.G. – Allan R. Standen, LLC

Vince Clause, GISP – Allan R. Standen, LLC

Dr. Joe C. Yelderman Jr., P.G. – Baylor University

February 2022

GEOSCIENTIST SEALS

This report documents the work of the following licensed professional geoscientists.

Michael R. Keester, P.G.

Mr. Keester was primarily responsible for preparing report sections on Water Levels, Proposed Management Areas, Proposed Rule Changes, and Summary and Conclusions.
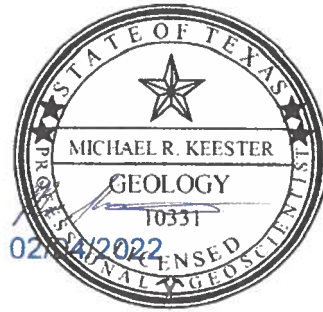
Principal Hydrogeologist – R. W. Harden & Associates, Inc. (TX Geoscientist Firm License #50033)

Allan R. Standen, P.G.

Mr. Standen was primarily responsible for preparing the report sections on hydrostratigraphy. He also provided review and QA/QC of the final report.
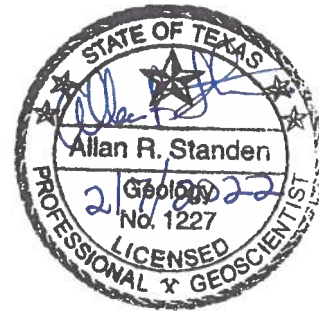
Principal – Allan R Standen, LLC

Dr. Joe Yelderman, P.G.

Dr. Yelderman was primarily responsible for preparing the report sections on Hydraulic Characteristics and Water Quality. He also provided review and QA/QC of the final report.

Chair, Department of Geosciences – Baylor University

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INTRODUCTION

Over the past several years Clearwater Underground Water Conservation District ("CUWCD") has directed hydrogeologic investigations of its managed aquifers. These investigations have helped further quantify the observations of local landowners and area water well drillers regarding the difference in the hydrogeologic conditions in southwestern Bell County compared to other parts of the county. To synthesize the scientific investigations into policy recommendations, members of CUWCD's technical consulting team applied our respective area of expertise to delineate a distinct management area in southwestern Bell County.

Our study area for this investigation focused on southwestern Bell County. The study area extended into northwestern Williamson County to allow for the investigation of the geology, structure, historical water levels, and hydraulic properties that informed how groundwater moves through the subsurface into Bell County. We also reviewed information from previous investigations across the county and extending into McLennan County. Using this information, we delineated proposed management areas with recommendations for the modification of the District Rules to account for policy variations in different parts of Bell County. Within this report, we briefly discuss the variations in hydrogeologic characteristics that dictated our recommendations for the proposed management zones.

HYDROSTRATIGRAPHY

Standen and Clause (2021) built upon their previous research to refine the understanding of the lithology, stratigraphy, and structure of the Trinity Aquifer in southwestern Bell County. Their study area was 491 square miles and included portions of southwestern Bell County, northwestern Williamson County, and eastern Burnet County (see Figure 1). Within this area, they conducted a detailed stratigraphic investigation to identify possible geologic variabilities within the units making up the Trinity Aquifer, particularly, those units of the Middle and Lower Trinity as identified on Table 1.

The Cretaceous Hosston, Pearsall, Hammett Shale, Cow Creek Limestone, and Hensell Sand Members have historically been referred to as the Travis Peak Formation. However, this generalized classification does not account for differences in hydraulic characteristics, groundwater chemistry, and water levels between hydrologic units. Instead, the aquifer system is better described as the Middle Trinity Aquifer comprised of the Hensell Sand and Cow Creek Limestone, and the Lower Trinity Aquifer comprised of the Hosston.

Figure 1. Study area for Standen and Clause (2021).
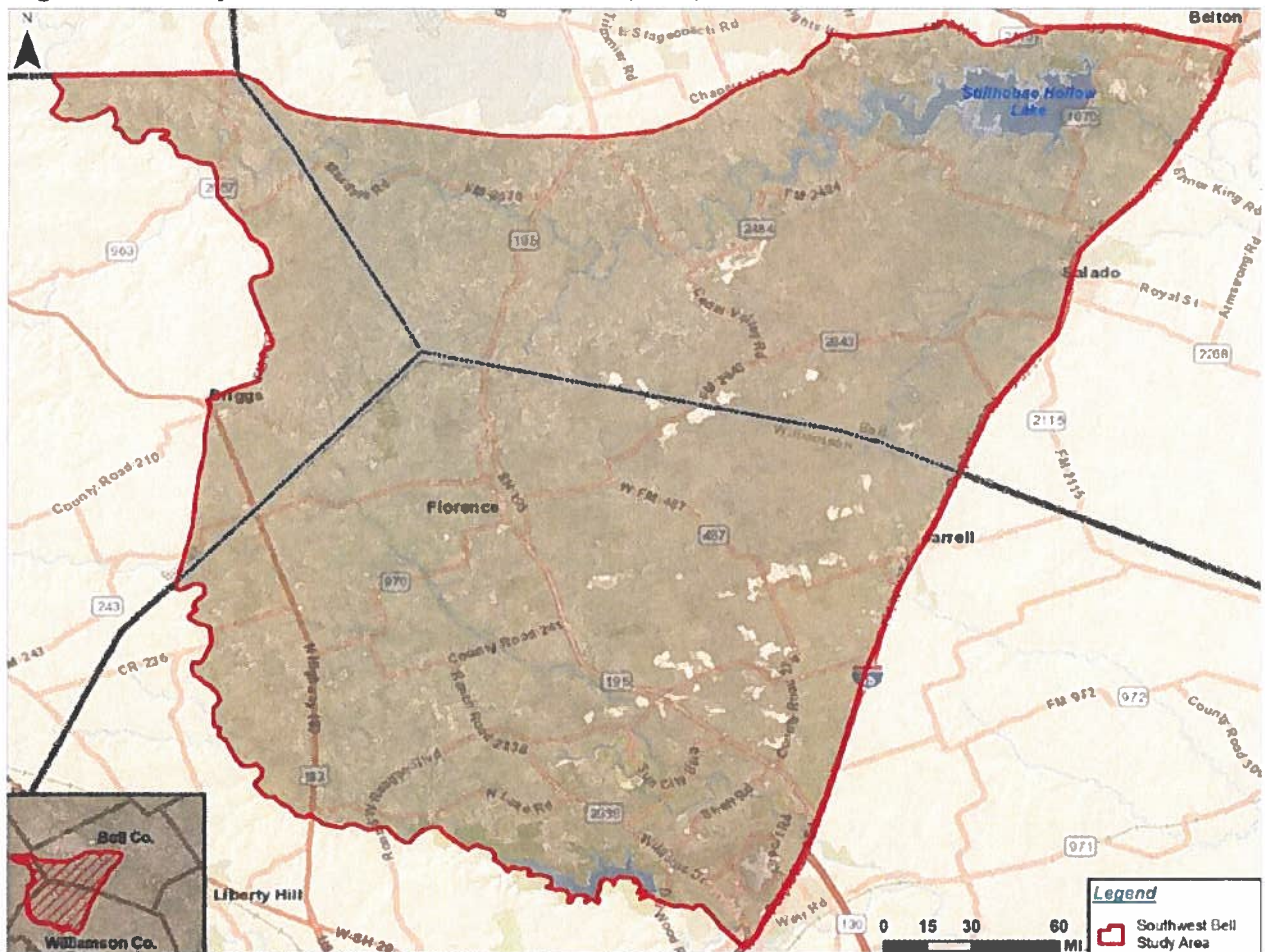
Table 1. **Study Area Middle and Lower Trinity Stratigraphic Column. Modified from Klemt and others (1975) and Duffin and Musick (1991).**

System	Group	Stratigraphic Units		Hydrologic Unit	Lithologic Description
Cretaceous	Middle Trinity	Travis Peak Formation	Hensell Sand Member	Middle Trinity Aquifer	Composed of sands and sandstones, gravels and conglomerates that are poorly to well cemented, and sometimes interbedded with sandy limestone lenses, multicolored clays, and gray to green shales.
			Cow Creek Limestone Member		Cream to tan color limestones that are fossiliferous, sometimes sandy, and can locally contain fractures and cavities.
			Hammett Shale ⟋ Pearsall Member	Aquitard	Hammett Shale ⟋ Pearsall Member — Gray to dark gray silty sandy shale with streaks of dolomite. ⟋ "Redbeds" Limestones, multi-colored clays, and sand lenses
	Lower Trinity		Hosston Member	Lower Trinity Aquifer	"Lower Trinity Sand," composed of poorly sorted multicolored conglomerate, poorly sorted to well sorted fine and coarse grain sand and sandstones, streaks of shale and occasional limestone.

The stratigraphic units of the Middle and Lower Trinity are present at depth and underlie the entire study area. These units dip to the east being shallower in the northwestern portion of the study area and deeper to the east. Along the eastern edge of the study area, the Middle and Lower Trinity are approximately 900 and 1,100 feet below land surface, respectively, while in the northwestern portion of the study area along the Lampasas River, the Middle and Lower Trinity is less than 100 and 200 feet below land surface, respectively.

The Middle Trinity is composed of both the Hensell Sands and Cow Creek Limestone. It is hydrologically separated from the Lower Trinity Aquifer by the Hammett Shale or Pearsall Member. The Lower Trinity Group includes the Hosston Member which lies unconformably on an irregular erosional surface of Paleozoic strata. Within the study area, sand grain size decreases in a westward direction and calcium carbonate materials increase in both the Hensell Sands and Hosston Member, while the Cow Creek Limestones grades into the Pearsall formation. These changes occur in the Middle and Lower Trinity calcareous facies transition zone that primarily occurs west of Texas Highway 195 in Bell County.

Middle and Lower Trinity faults with a NE-SW orientation are present throughout the study area. These are normal faults with the up blocks located along the west side of each fault that follow the known Balcones Fault Zone structure and surface faults mapped in the Geologic Atlas of Texas. Although faults are observed throughout the study area, only faults near and around Stillman Valley Road and FM 2484 appear to form a noticeable boundary condition for water chemistry, groundwater production, and water level surfaces.

HYDRAULIC CHARACTERISTICS

Through evaluations of the well spacing requirements (Keester, 2020), we have considered the hydraulic characteristics of the Middle and Lower Trinity aquifers based on the datasets used in the groundwater availability model (Kelley and others, 2014; Keester and Konetchy, 2016; Konetchy and Beach, 2020). Based on these datasets, the transmissivity of the Middle Trinity Aquifer decreases to the west and south (Figure 2). The Middle Trinity Aquifer transmissivity data for the eastern portion of the county is uncertain due to a lack of available pumping test results. However, the lower transmissivity values in the southwestern portion of the county are consistent with recent pumping test results from RS Materials and River Ridge Ranch which had transmissivity values of 1,800 gallons per day per foot (gpd/ft) and 31 gpd/ft, respectively.

For the Lower Trinity Aquifer, the transmissivity dataset from Kelley and others (2014) was not consistent with available pumping test data. To improve the transmissivity dataset, CUWCD updated the model within Bell County (Keester and Konetchy, 2016; Konetchy and Beach, 2020). The results of this work showed generally increasing transmissivity values from west to east across the county (Figure 3). However, results from recent pumping tests associated with the Brookings Ranch (Yelderman, Jr. and others, 2022) and Stillman Valley Ranchettes (Worsley, 2021) wells indicate the transmissivity values for the southwestern portion of the county are overestimated.

The pumping test at the Brookings Ranch location indicated transmissivity values of about 160 gpd/ft (Yelderman, Jr. and others, 2022) while the results at the Stillman Valley Ranchettes test was about 85 gpd/ft (Worsley, 2021). Both of these tests demonstrated our understanding of the hydraulic properties of the Lower Trinity Aquifer need to be updated. In addition, the test at the Brookings Ranch site showed the existence of a negative flow barrier which impeded flow to the well. Based on the hydrostratigraphic understanding of the area, we believe this barrier is a fault located between the wells (Figure 4).

The hydraulic properties observed in the southwest area of the county are consistent with the hydrostratigraphy for the area. The pumping tests indicate at least some of the faults identified are barriers to groundwater flow. While barriers to groundwater flow have been observed in pumping test data in other areas of the county, the low transmissivity of the aquifers in the southwest corner of Bell County along with the barriers contribute to low aquifer productivity.

Figure 2. Middle Trinity Aquifer transmissivity (Kelley and others, 2014).
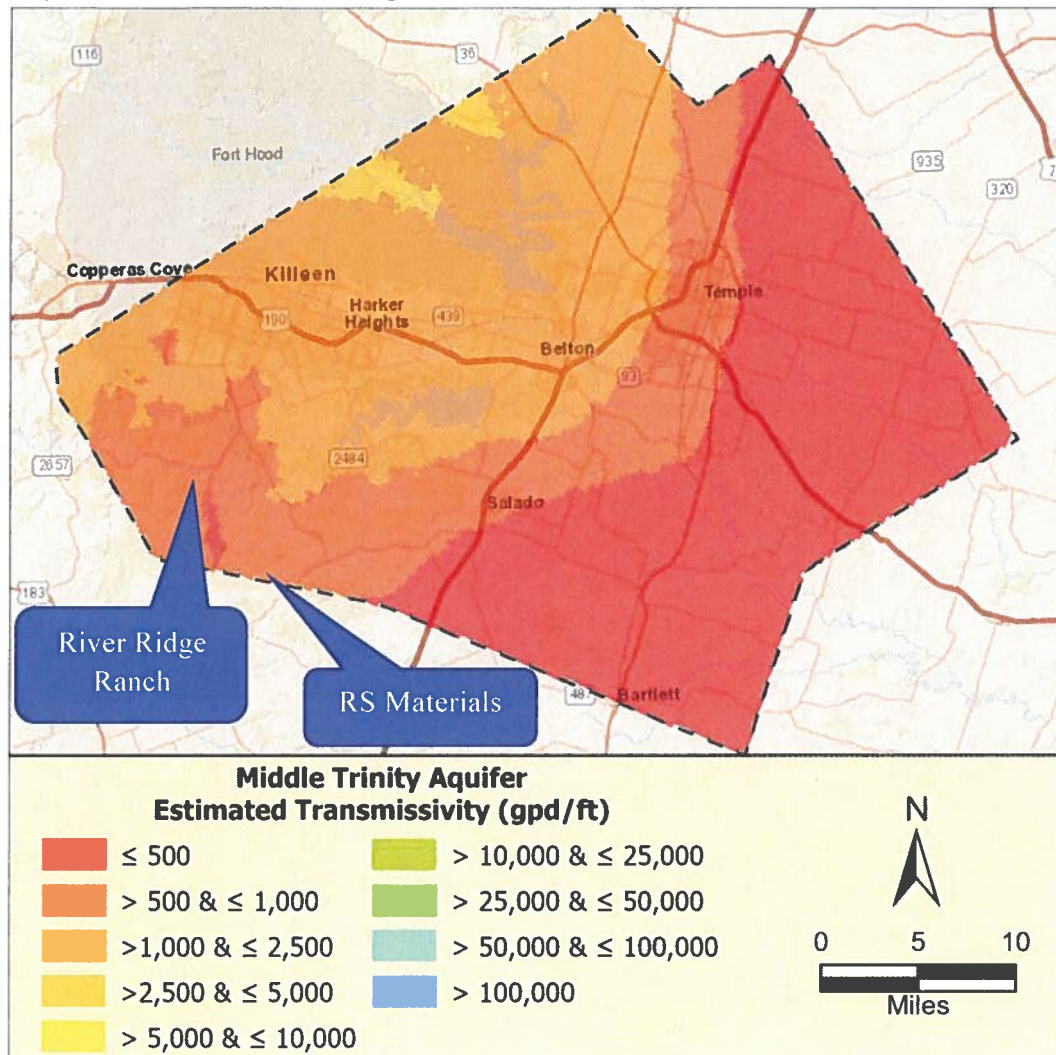
Figure 3.   Lower Trinity Aquifer transmissivity.

**Lower Trinity Aquifer
Estimated Transmissivity (gpd/ft)**

Color	Range	Color	Range
≤ 500		> 10,000 & ≤ 25,000	
> 500 & ≤ 1,000		> 25,000 & ≤ 50,000	
>1,000 & ≤ 2,500		> 50,000 & ≤ 100,000	
>2,500 & ≤ 5,000		> 100,000	
> 5,000 & ≤ 10,000			
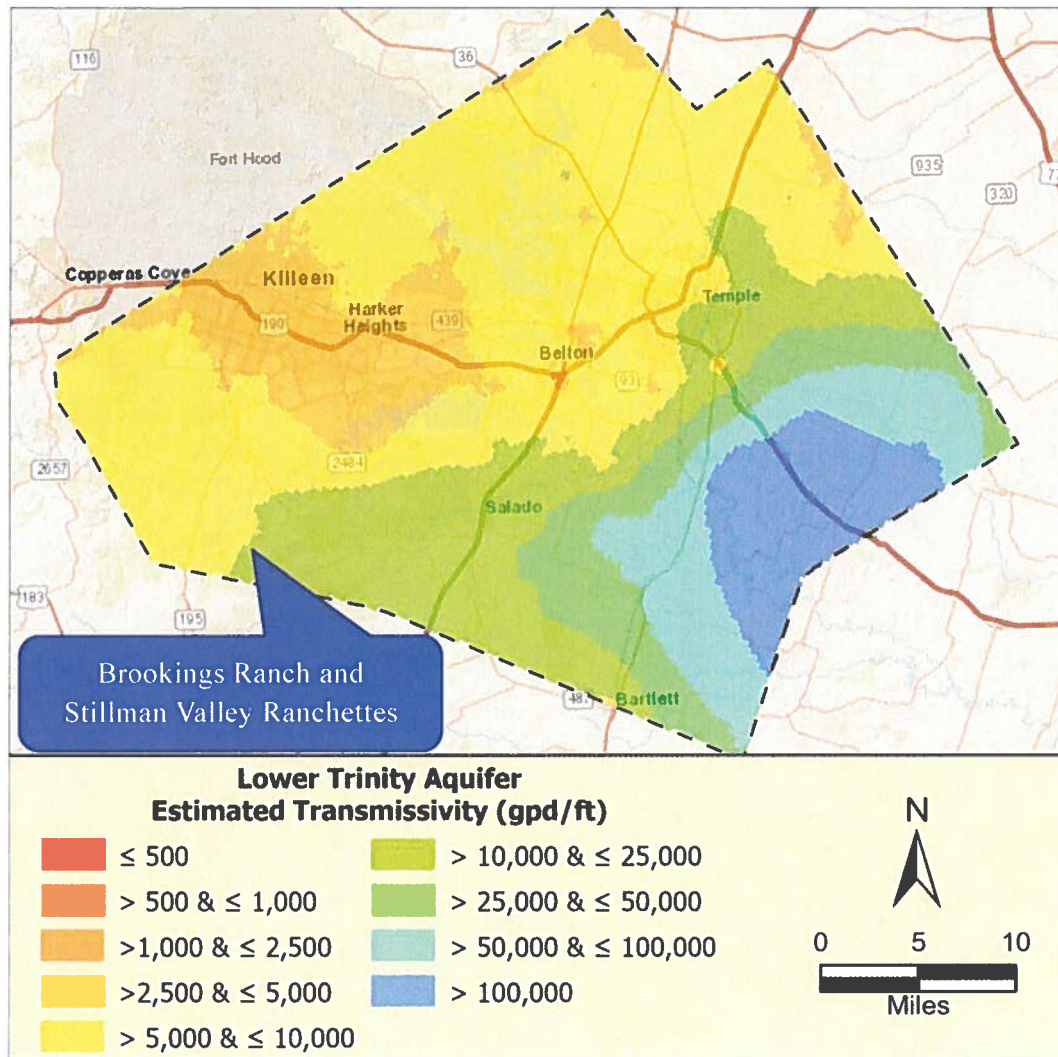
Figure 4.   Drawdown in wells completed in the Lower Trinity Aquifer at the Hines site.
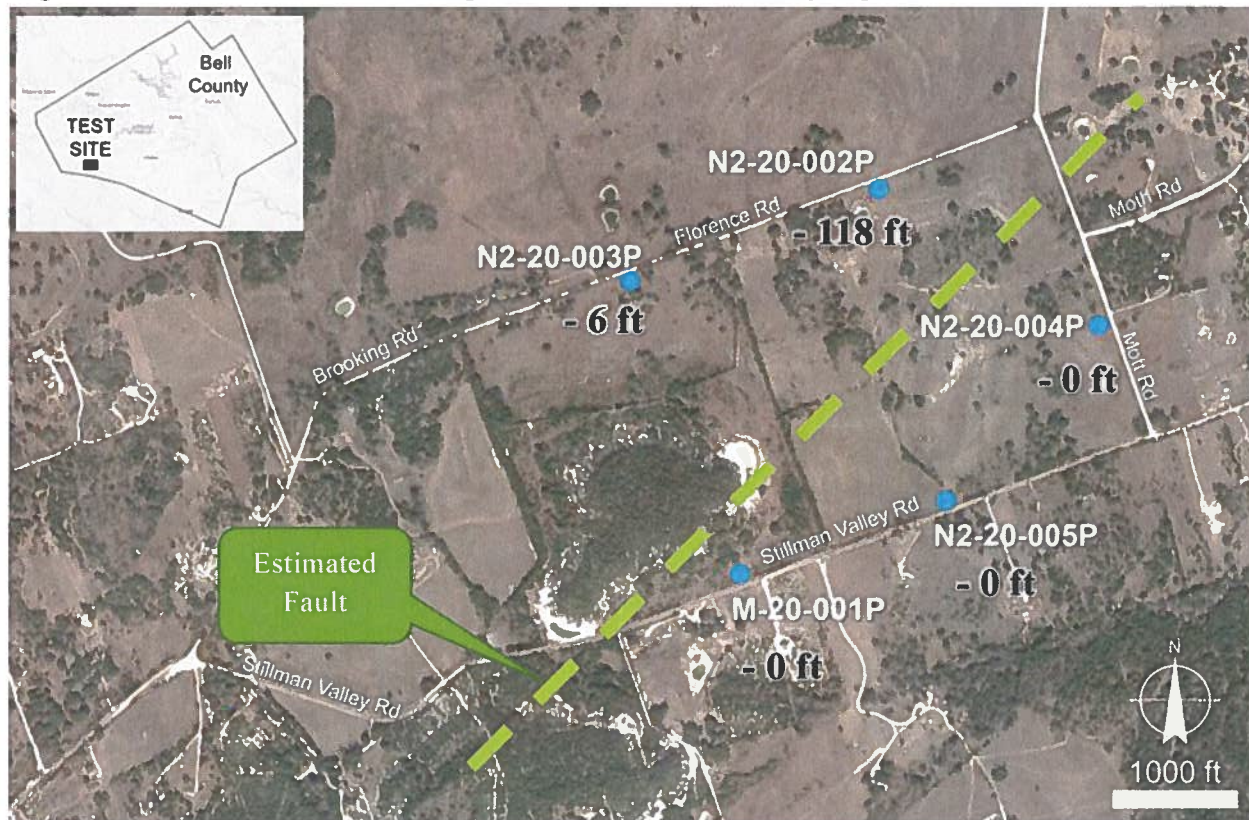
WATER LEVELS

Since 2006, water levels in the Middle Trinity have declined by more than 150 feet in the southwest portion of Bell County (Figure 5). These declines in water levels are due to groundwater production in the area as well as in Williamson County. The water level declines in the Middle Trinity are nearly 10 feet per year in some wells and recent measurements suggest similar declines are occurring in the deeper Lower Trinity Aquifer.

In southwestern Bell County, water levels in the Middle Trinity are deeper than water levels in the Lower Trinity. As Figure 6 indicates, the depth to water is more than 700 feet in an area of southwestern Bell County with the top of the screen interval only about 50 feet below the water level. Due to the dip of the aquifer and a lower ground surface elevation, the depth to the top of the screen is deeper and the depth to water is shallower, respectively. However, in both areas we observe a general decline in water level over time.

In southwestern Bell County, water levels in wells completed the Lower Trinity Aquifer are closer to the surface than they are in wells completed the Middle Trinity. In the northern and eastern portions of the county the water levels are generally deeper due to more production from the Lower Trinity in these areas. Water levels in the Lower Trinity are deepest in the northern portion of the county exceeding 500 feet locally (Figure 7). In eastern Bell County there is an area of locally shallow water levels (less then 200 feet) associated with high-capacity water wells completed to the base of the Hosston.

Figure 5.   Middle Trinity Aquifer water level declines from 2006 through 2019.
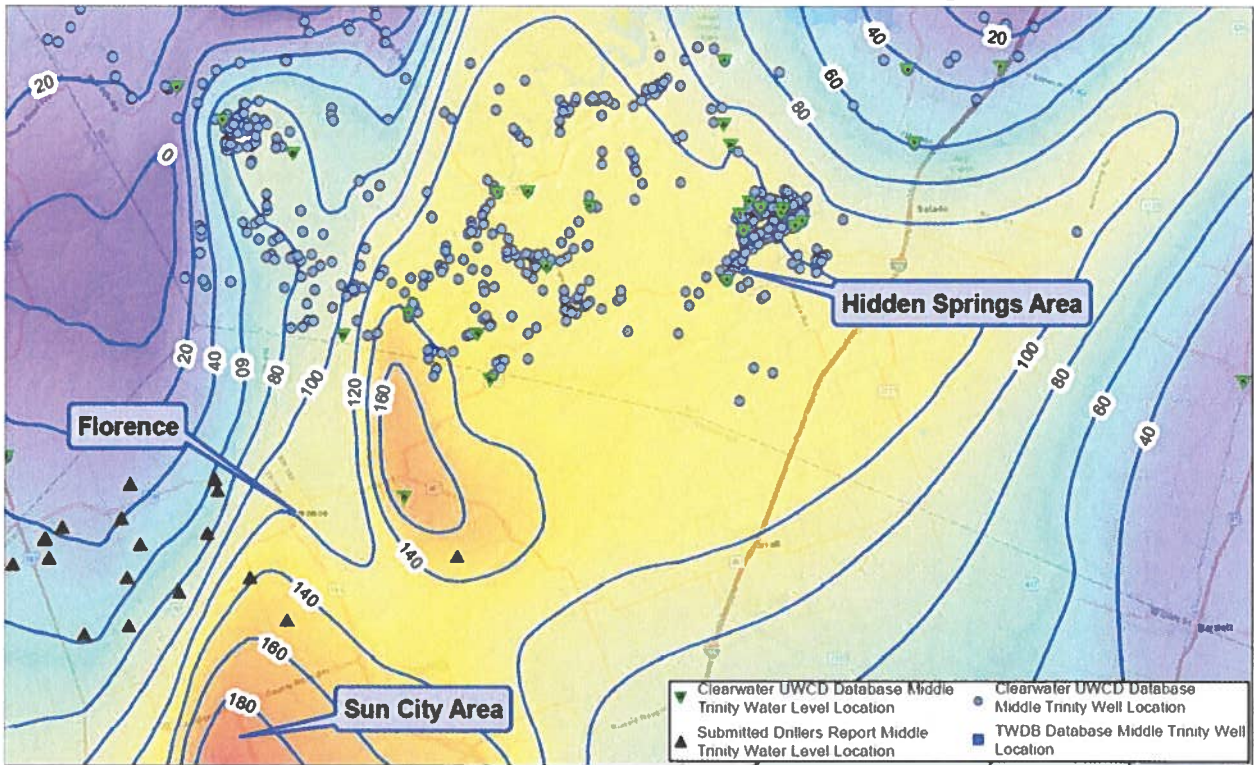
Figure 6. **December 2021 Middle Trinity Aquifer measured (hydrographs) and estimated (contour map) depth to water.**
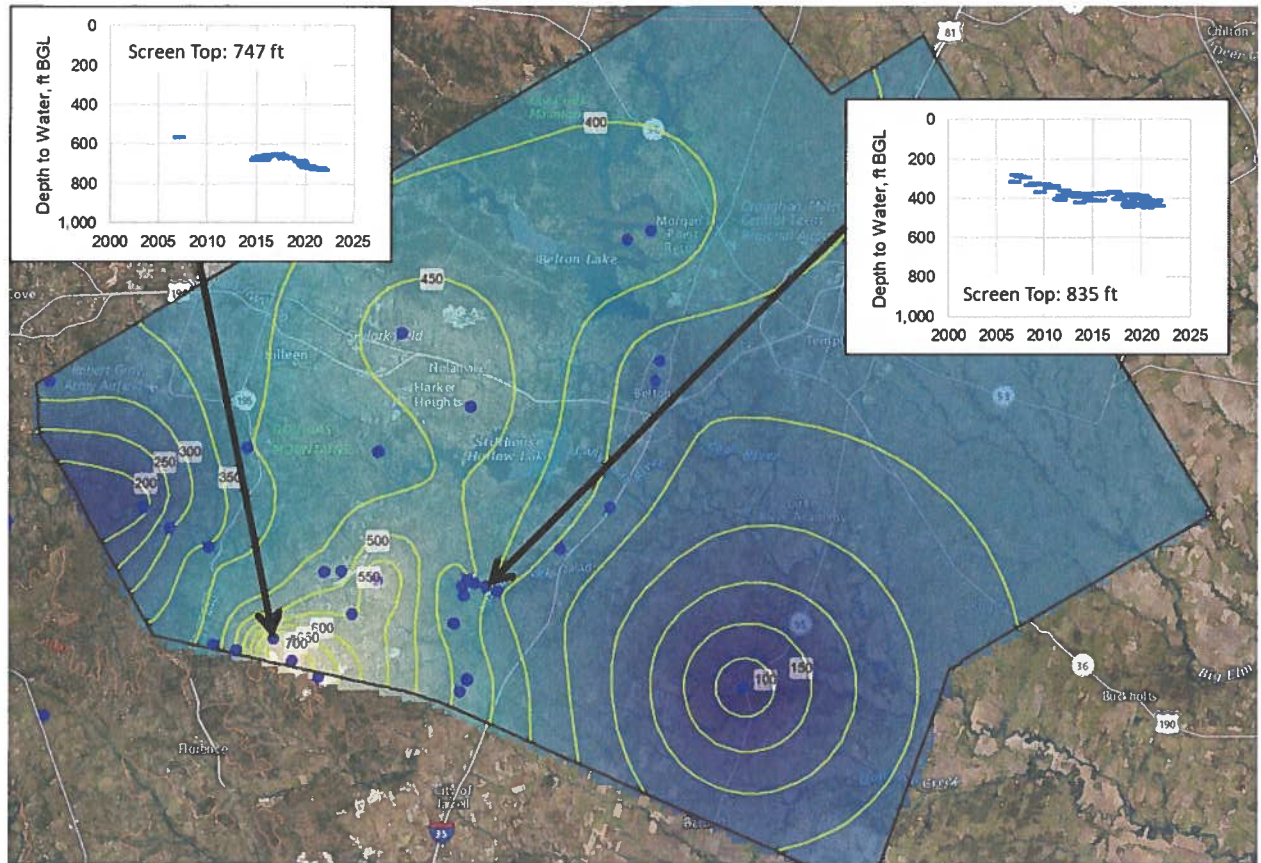
Figure 7. December 2021 Lower Trinity Aquifer measured (hydrographs) and estimated (contour map) depth to water.
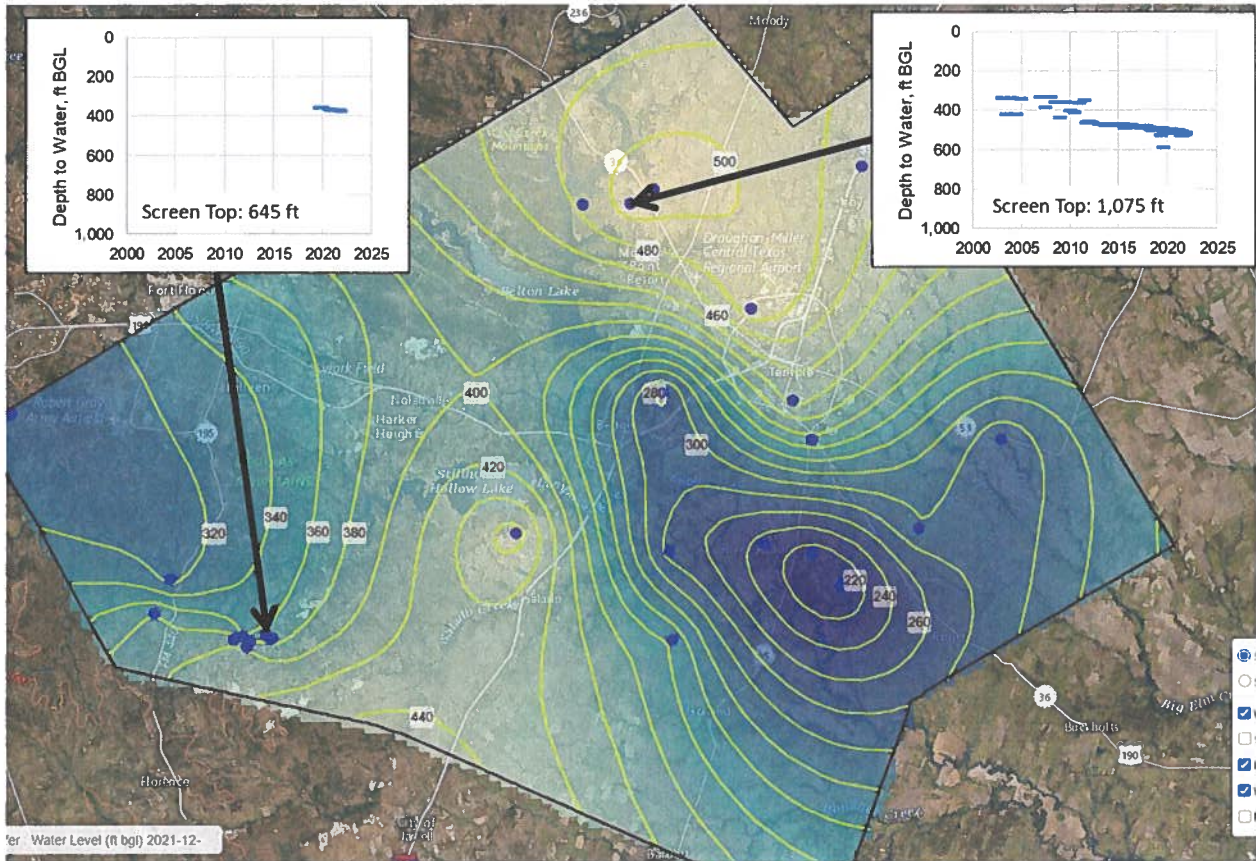
WATER QUALITY

Tucker (2018) discussed variations in water quality within the Middle Trinity Aquifer throughout Bell and McLennan counties. He identified an area of increasing total dissolved solids (TDS) and changing ionic concentrations from south to north across Bell County. These higher TDS concentrations are reflected in the increasing conductivity values as measured in microSiemens per centimeter (μS/cm). Figure 8 illustrates the change in groundwater conductivity and ionic concentrations in the Middle Trinity Aquifer. Figure 9 is an example of the Stiff Diagrams shown on Figure 8 illustrating the ionic constituents symbolized.

The cause of the water quality changes in the Middle Trinity Aquifer is not known. However, it may be related to surface water infiltrating through the subsurface and dissolve soluble minerals in the shallower formations. As the water seeps downward, these minerals are carried into the deeper Middle Trinity Aquifer. Additional research is needed to assess this hypothesis.

Groundwater samples from wells completed in the Lower Trinity Aquifer are mostly in the southwest portions of the county (Figure 10). There are two wells from which collected samples had a TDS concentration of more than 2,000 mg/L. However, most of the samples indicated TDS concentrations of less than 1,500 mg/L with two samples in the deeper portions of aquifer in eastern Bell County have concentrations of less than 1,000 mg/L which is indicative of fresh water.

Figure 8. Groundwater quality in the Middle Trinity Aquifer. Modified from Tucker (2018).
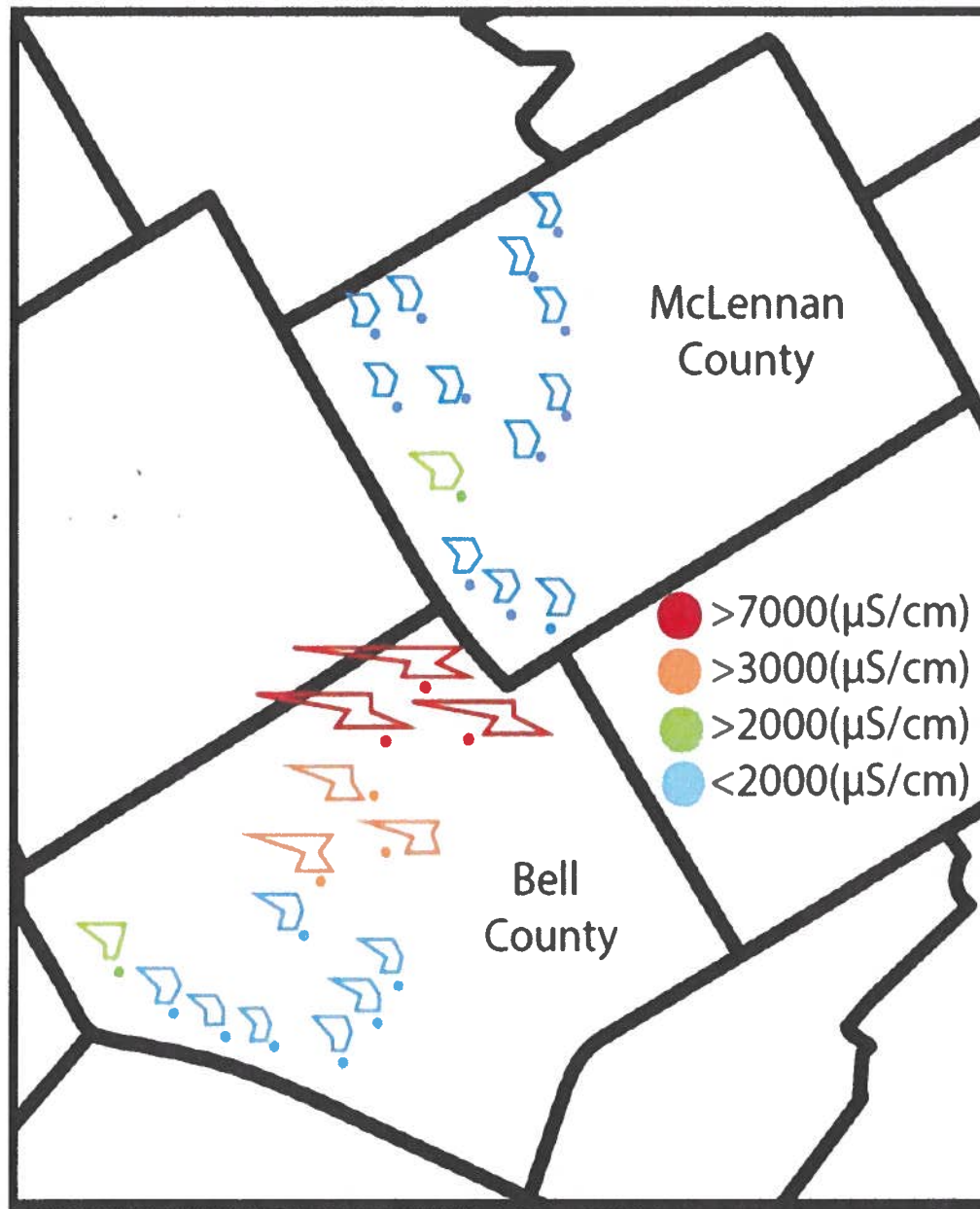
Figure 9. Stiff diagram of the common Middle Trinity water type ($Na^+ + K^+$ and $HCO_3^- + CO_3^-$ dominated).
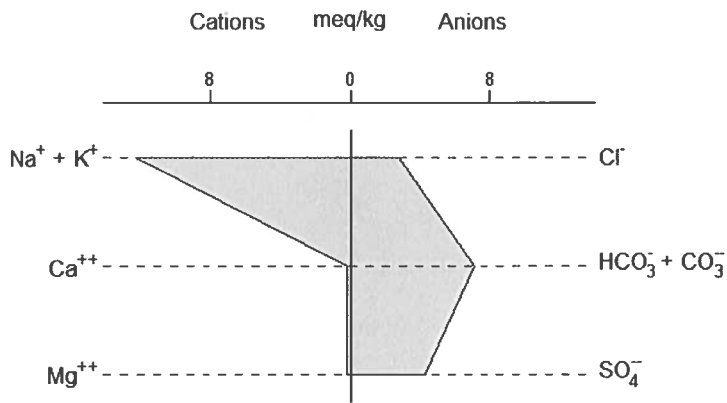
Figure 10. Groundwater total dissolved solids concentration for samples collected from wells completed in the Lower Trinity Aquifer.
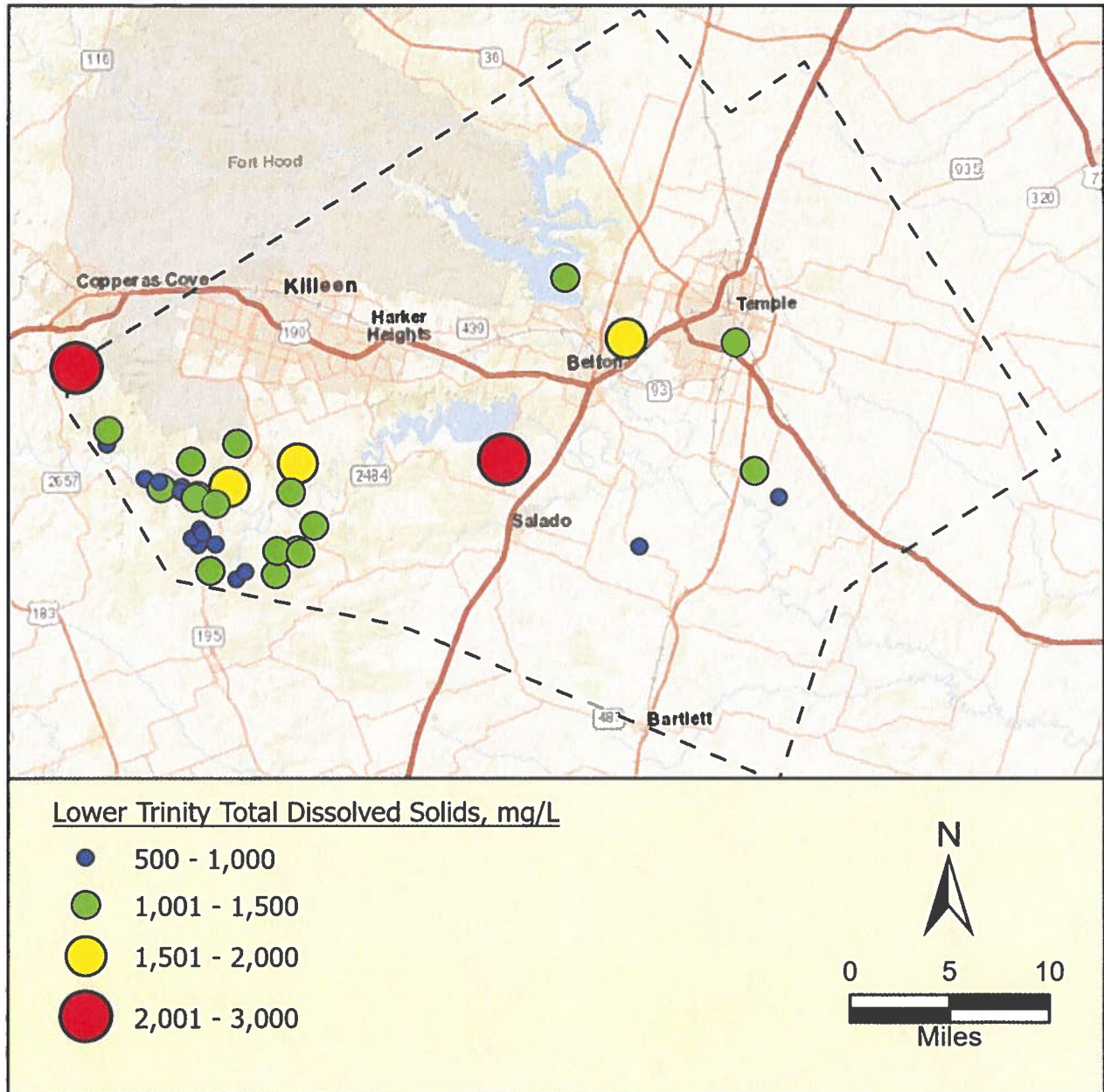
PROPOSED MANAGEMENT AREAS

Based on our current understanding of the hydrogeologic characteristics of the Trinity Aquifer, we identified four proposed management areas. We identified these areas based on the hydrogeologic characteristics unique to the area. We then delineated the area using existing roads and the county line to provide recognizable landmarks for each boundary and for consistency with CUWCD Rule 7.1. Figure 11 illustrates the location of each proposed Trinity Aquifer management area.

Figure 11. Proposed Trinity Aquifer management areas.
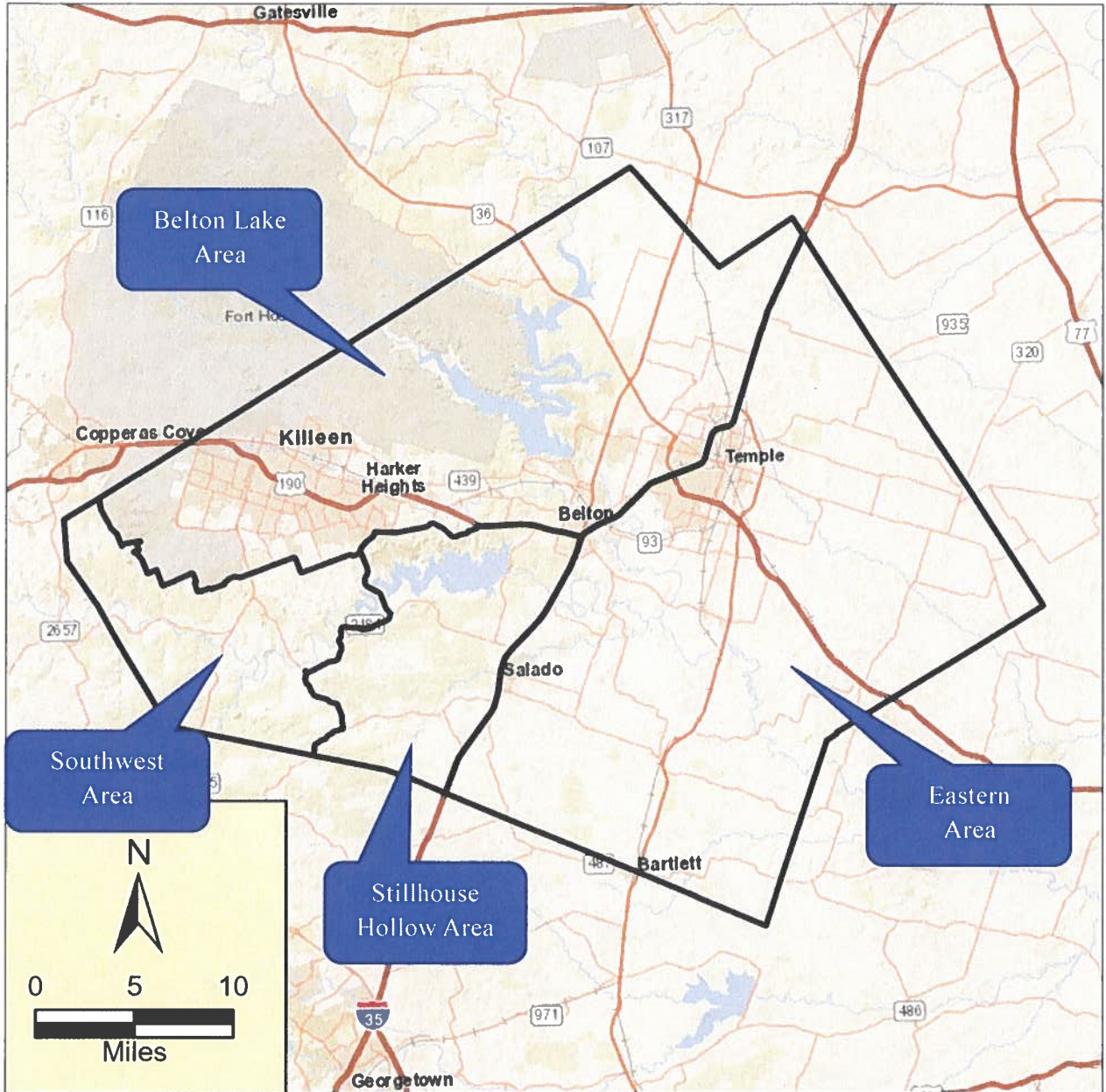
Table 2 and Table 3 summarize the aquifer characteristics for each proposed management area based on our current understanding. Each table provides the range in values for the area followed by the median value in parentheses. The depth to the top of the aquifer and aquifer thickness are based on the structural data developed for CUWCD. The transmissivity values are based on input datasets for the groundwater availability model. The available drawdown values are based on estimated water levels and the proposed definition discussed in the following section of this report.

Table 2. Middle Trinity summary aquifer characteristics per proposed management area.*

Management Area	Depth to Top (ft)	Thickness (ft)	Transmissivity (gpd/ft)	Available Drawdown (ft)
Southwest	190–820 (470)	0–170 (40)	370–1,600 (830)	70–210 (140)
Stillhouse Hollow	490–1,080 (800)	20–110 (50)	180–1,670 (940)	110–730 (330)
Belton Lake	400–1,580 (770)	10–280 (40)	300–3,040 (1,610)	70–1,110 (300)
Eastern	900–2,520 (1,960)	20–300 (80)	20–1,500 (140)	570–2,480 (1,840)

*Values shown as: minimum–maximum (median)

Table 3. Lower Trinity summary aquifer characteristics per proposed management area.*

Management Area	Depth to Top (ft)	Thickness (ft)	Transmissivity (gpd/ft)	Available Drawdown (ft)
Southwest	190–1,060 (570)	40–150 (90)	3,160–17,430 (6,660)	180–590 (250)
Stillhouse Hollow	680–1,410 (1,070)	40–290 (100)	3,020–23,320 (10,960)	350–1,040 (640)
Belton Lake	450–1,840 (920)	0–190 (60)	1,880–12,780 (5,750)	190–1,320 (450)
Eastern	1,080–3,050 (2,230)	40–540 (260)	1,520–247,470 (32,330)	830–2,850 (1,980)

*Values shown as: minimum–maximum (median)

The Southwest Area generally has the lowest amount of available groundwater for users. The transmissivity values in the aquifers are low and there have been large water level declines over the last several years. The stratigraphy and structure in the area are not conducive to rapidly transmitting groundwater in the subsurface to wells for production. Numerous faults and changing lithology inhibit the flow of groundwater. The range and median depth to the top of the aquifer are the lowest of the four areas. While the transmissivity range is similar to the other proposed areas, the available drawdown is lower which limits the long-term groundwater availability.

For the Lower Trinity in the Southwest Area, the transmissivity values shown in Table 3 are likely too high. Recent aquifer tests indicate the lower range of the transmissivity values in the area should be lower with recent aquifer tests indicating a transmissivity value of less than 100 gpd/ft. While these new data are not yet incorporated into the model datasets, they are applied to our understanding of the local hydrogeologic conditions.

In the Stillhouse Hollow Area, water levels have declined by more than 100 feet in the Middle Trinity Aquifer since 2006. However, due to the dip of the stratigraphic units there is more water above the top of the aquifer than there is in the Southwest Zone. As shown in Table 2, there is more than 700 feet of available drawdown in some areas with a median value of more than 300 feet. While water levels will continue to decline and reduce the available drawdown, the stress on the aquifer is not as significant as in the Southwest Zone due to less development and the availability of groundwater from the shallower Edwards Aquifer in some parts of the area.

The Lower Trinity Aquifer in the Stillhouse Hollow Area is not well understood at this time. There are few wells in this deeper zone of the aquifer. However, indication of the aquifer conditions at the Doc Curb Well near the Stillhouse Hollow Lake dam indicate the aquifer may not be as transmissive as Table 3 suggests. Also, the quality of the water from this non-exempt well does not meet potable water standards.

For the Belton Lake Area, there are some observed changes in the water quality in the Middle Trinity Aquifer compared to the areas to the south. The salinity of the groundwater generally increases from south to north within the aquifer. However, the water quality in the Lower Trinity remains fresh and is used by public water suppliers such as Moffat Water Supply Corporation and the City of Troy.

The Eastern Area is primarily for the Lower Trinity Aquifer. The area east of Interstate 35 has fewer users of the aquifer due to the depth of the formations and associated cost for completing a well. As suggested by the median transmissivity value shown in Table 3, the Lower Trinity Aquifer in the area generally is highly productive with transmissivity values several times greater than in areas to the west and well yields may exceed 1,000 gallons per minute. Faulting may limit the flow of groundwater from the west to the east, but the high transmissivity and height of water above the top of the aquifer allow for a large amount of groundwater availability.

PROPOSED RULE MODIFICATIONS

With the unique hydrogeologic conditions associated with each Trinity Aquifer proposed management area, the groundwater resources in these areas may be managed differently. The variations in resource management may be addressed through different rules for each zone. The following provides proposed rule changes associated with each management zone.

Proposed Management Area Rule Changes

CUWCD Rule 7.2 addresses adjusting groundwater withdrawals in a management area based on an assessment of availability. Considerations of availability in this Rule focus on the amount of recharge available for withdrawal from each aquifer in the management area. Based on the determination of the amount of recharge available for production from wells, permitted pumping may be adjusted to equal the amount of recharge available. The term "recharge" in the Rule suggests the total amount of inflows to the management area rather than just the amount of precipitation that infiltrates into the aquifer.

While we have not developed the groundwater availability values per CUWCD Rule 7.2, we have prepared proposed well spacing rules following the current framework of CUWCD Rule 9.5.2. The revised spacing requirements are designed to minimize interference drawdown as much as practicable. As the focus is on minimizing the interference drawdown between wells, we focused on the spacing from existing wells completed in the same aquifer with spacing based on column pipe size. While we propose revised spacing requirements below, we also recommend that the rules allow for an exemption when physical conditions may not allow the landowner to meet the spacing requirements.

Middle Trinity Aquifer

For the Middle Trinity Aquifer, we would not expect a well to be completed with a column pipe of more four inches in diameter (Keester, 2020). As such, based on the hydrogeologic characteristics of the Middle Trinity Aquifer, we recommend the rules prohibit completion of well in the Middle Trinity Aquifer with a column pipe of more four inches in diameter. In lieu of a prohibition, the minimum spacing should be at least 5,280 feet from an existing well completed in the Middle Trinity Aquifer if the proposed well will have a pipe of more four inches in diameter. For smaller diameter column pipe diameters, Table 4 provides the recommended spacing between a new well completed in the Middle Trinity Aquifer and an existing well completed in the same aquifer.

Table 4.   Middle Trinity Aquifer proposed minimum spacing for a new well from existing wells completed in the same aquifer.

Management Area	District Column Pipe Diameter Range (in)*			
	1¼ (≤18 gpm)	1½ (≤35 gpm)	2 (≤60 gpm)	>2 to 4 (≤225 gpm)
Southwest	150 feet	660 feet (1/8 mile)	Not Allowed	Not Allowed
Stillhouse Hollow			1,320 feet (1/4 mile)	Not Allowed
Belton Lake				Not Allowed
Eastern				5,280 feet (1 mile)

*rate (gpm) associated with column pipe is for reference only

In addition to the spacing requirement, for a new Middle Trinity well in the Belton Lake area we recommend requiring water quality analysis of the produced groundwater once the well is completed. We also recommend requiring the driller to obtain a geophysical log of the open borehole prior to well completion. These items will aid in assessing the cause of the poorer water quality in the northern part of Bell County in the aquifer. As data are collected, the District may determine that new wells completed in the Middle Trinity Aquifer for domestic use in the Belton Lake should be prohibited to protect human health.

For the Stillhouse Hollow Area, all Middle Trinity wells should be completed with a measuring tube to allow for continued monitoring of water level declines. As development continues in the area, production may need to be limited to extend the duration of groundwater availability. For permitted wells in the Middle Trinity Aquifer in the Stillhouse Hollow Area, we recommend the applicant consider the duration of groundwater availability taking into consideration the current trend in water level decline, anticipated drawdown associated with the new pumping, and the minimum pumping water level to obtain the proposed pumping.

Lower Trinity Aquifer

Unlike the Middle Trinity Aquifer, there are areas where production from the Lower Trinity Aquifer may require a column pipe of more than 10 inches in diameter. Generally, the current spacing requirements are sufficient for proposed wells with a column pipe diameter of 6 inches or less (Keester, 2020). However, we recommend increasing the spacing requirement for consistency with the Middle Trinity and preservation of groundwater availability. Recent pumping tests suggest wells with a proposed column pipe of more than two inches in diameter are not feasible in the Southwest Area. Table 5, for column pipe sizes up to four (4) inches, and Table 6, for column pipe sizes greater than four (4) inches, provides the recommended spacing between a new well completed in the Lower Trinity Aquifer and an existing well completed in the same aquifer based on the local hydrogeologic conditions.

Table 5. **Lower Trinity Aquifer proposed minimum spacing for a new well with a column pipe up to four (4) inches from existing wells completed in the same aquifer.**

Management Area	District Column Pipe Diameter Range (in)*			
	1¼ (≤18 gpm)	1½ (≤35 gpm)	2 (≤60 gpm)	>2 to 4 (≤225 gpm)
Southwest	150 feet	660 feet (1/8 mile)	Not Allowed	
Stillhouse Hollow	150 feet	330 feet (1/16 mile)	660 feet (1/8 mile)	1,320 feet (1/4 mile)
Belton Lake				
Eastern				660 feet (1/8 mile)

*rate (gpm) associated with column pipe is for reference only

Table 6. **Lower Trinity Aquifer proposed minimum spacing for a new well with a column pipe greater than four (4) inches from existing wells completed in the same aquifer.**

Management Area	District Column Pipe Diameter Range (in)*		
	>4 to 6 (≤450 gpm)	>6 to 8 (≤800 gpm)	>8 (>800 gpm)
Southwest	Not Allowed		
Stillhouse Hollow	2,640 feet (1/2 mile)	5,280 feet (1 mile)	5,280 feet (1 mile)
Belton Lake			
Eastern	1,320 feet (1/4 mile)	2,640 feet (1/4 mile)	

*rate (gpm) associated with column pipe is for reference only

For the Stillhouse Hollow Area, we recommend the driller be required to obtain a geophysical log of the well, preferably with the open borehole though local subsurface conditions may require the well be obtained through the cased well. We also recommend obtaining a water quality sample once the well is completed to assess changes in water quality in the aquifer.

Hydrogeologic Report

CUWCD Rule 6.9.2(e) requires the submission of a hydrogeologic report in support of an operating permit application for use of more than 37 acre-feet per year. Subsequent District Rule 6.9.2(f) lists four requirements of the hydrogeologic report which are summarized as follows:

1. Pumping test results (which can be deferred under certain circumstances)
2. Identify impacts to nearby wells
3. Describe local geology and aquifer
4. Be completed in compliance with the hydrogeologic report guidelines

The current hydrogeologic report guidelines were last revised on March 24, 2009. Since the most recent revision, CUWCD has gained additional information and understanding regarding the aquifers within Bell County. In addition, the District has developed several tools to assist with evaluating the aquifer conditions at the location where pumping associated with a proposed operating permit would occur. To take advantage of the data and analysis tools developed since the last revision of the guidelines, we recommend the District consider updating the hydrogeologic report guidelines.

Hydrogeologic Report Related Rules Revisions

Before considering revisions to the hydrogeologic report guidelines, we must first consider potential revisions to the District's Rules. First, we recommend the District add a definition for a "Hydrogeologic Report" to clarify exactly what the phrase means within the Rules. A possible definition to include is:

> "Hydrogeologic Report" means a report prepared by a professional engineer or professional geoscientist licensed in the State of Texas for the purpose of improving the best available science related to the groundwater resources managed by Clearwater Underground Water Conservation District.

The District Rules currently define "best available science" as "conclusions that are logically and reasonably derived using statistical or quantitative data, techniques, analyses, and studies that are publicly available to reviewing scientists and can be employed to address a specific scientific question." By defining that the purpose of a hydrogeologic report is to improve the best available science, the report is not simply a technical hurdle for obtaining an operating permit. Rather, it is a joint effort by the applicant and the District to improve understanding of the groundwater resources and to answer the specific questions the Board may have related to the proposed production.

When acting on a permit application, the Board must consider several items including whether "the proposed use of water does or does not unreasonably affect existing groundwater and surface water resources or existing permit holders" (Rule 6.10.24(c)). It is this specific consideration that a hydrogeologic report can help to address. However, currently the Board can only consider this issue qualitatively because an "unreasonable affect" is not defined in the Rules. To quantitatively address this consideration, a possible definition to include in the District Rules or a possible addition to current District Rule 6.10.24(c) is:

To "unreasonably affect" means:

- To cause or likely cause the District to exceed an adopted Desired Future Condition;
- To cause or likely cause a reduction in water level that prevents use of the resource by existing users;
- To cause or likely cause more than one (1) percent reduction in available drawdown in wells completed in the same aquifer that are located beyond the spacing requirement after one (1) year of operation;
- To cause or likely cause degradation of water quality that makes the resource unsuitable for use by existing users; or,
- To cause or likely cause land surface subsidence that damages existing infrastructure due to land deformation or flooding resulting from land deformation, or prevents use of the land by existing users.

The third point in the above list will require the addition of a definition for "available drawdown" in the District Rules. To define "available drawdown" we recommend the District rely on its geologic model and the water level analysis tools. The geologic model provides the top and bottom elevation of the aquifer and the water-level analysis tool provides the estimated elevation of the water level in the aquifer. Using these elevations we are able to calculate the aquifer thickness, the saturated thickness (if unconfined), artesian head (if confined), or the water level above any point in the aquifer.

To account for aquifer conditions ranging from unconfined to confined, a possible definition to include in the District Rules is:

"Available drawdown" is the amount of water-level decline that could potentially occur within an aquifer and is calculated as follows:

- If the water level elevation is 200 feet or more above the top of the aquifer, it is the water level minus the top of the aquifer;
- If the water level elevation is less than the top of the aquifer, it is the water level minus the 30 percent saturated thickness level in the aquifer; and,

- If the water level elevation is less 200 feet above the top of the aquifer and greater than the top of the aquifer, it is the water level minus the 30 percent saturated thickness level in the aquifer with a maximum value of 200 feet.

Figure 12 illustrates how the available drawdown declines with the declining water level. Based on the declining available drawdown, at no more than a one (1) percent reduction in available drawdown the impact on well could be no more than about four (4) feet after one (1) year. In wells with less available drawdown, the allowable impact would be less. Figure 13 illustrates how the pumping rate also declines when the available drawdown and the saturated thickness decline. However, Figure 13 does not consider the effect of increased lift on a pump which would likely cause pumping rates to approach zero faster than Figure 13 suggests.

Figure 12. Illustration of changing available drawdown with changing water levels assuming the top and bottom of the aquifer are at 100 and 0 feet MSL, respectively.
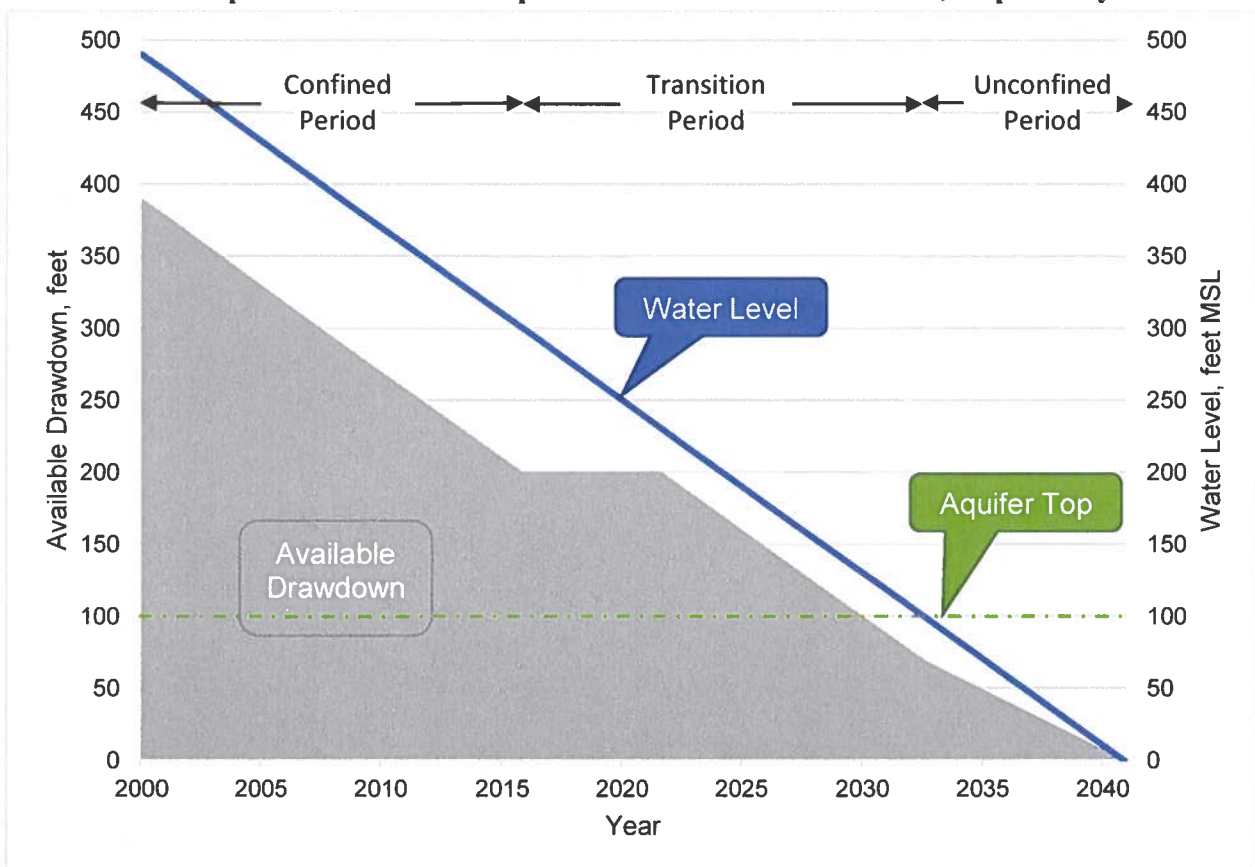
Figure 13. Illustration of changing water levels relative to the aquifer interval. The change in pumping rate reflects the effect of declining available drawdown and the change in aquifer transmissivity with the declining water level.
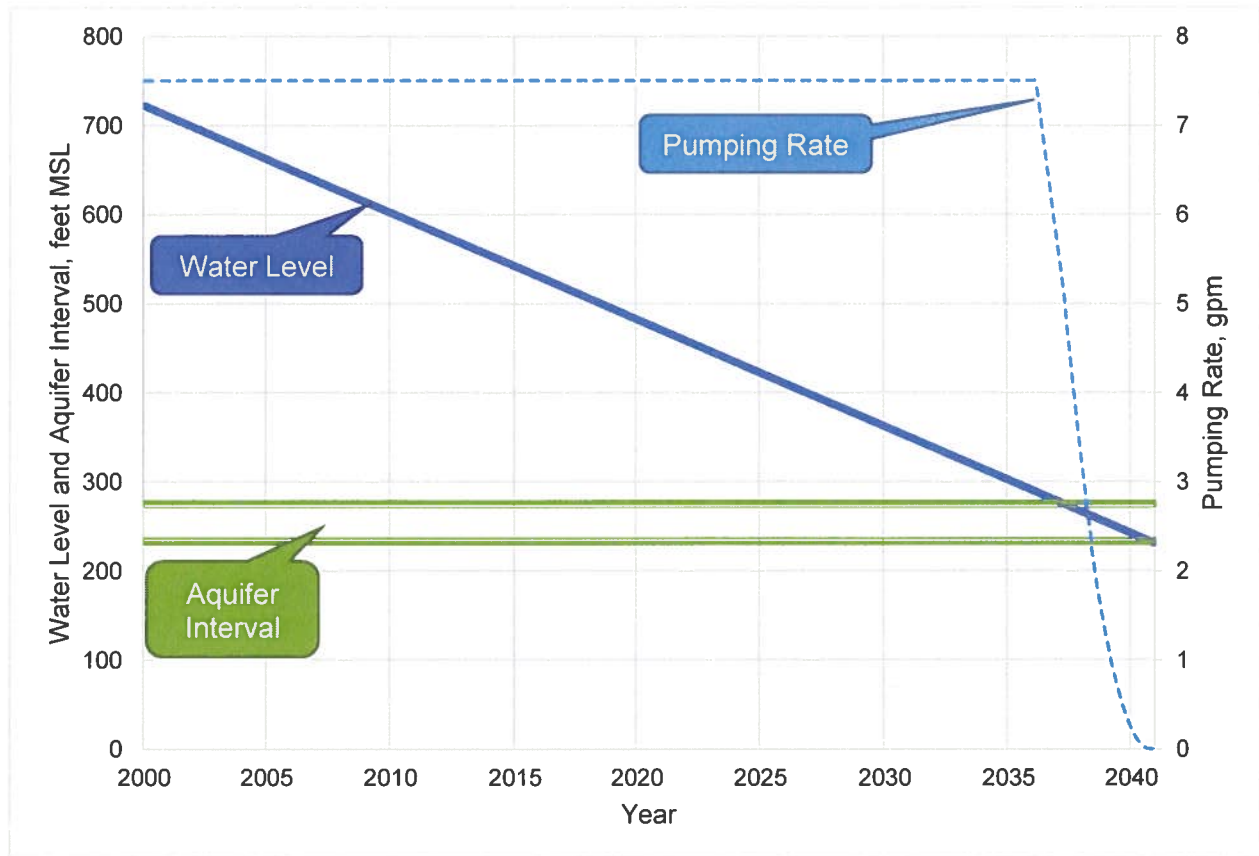
The variables presented provide a starting point for District consideration. For future permit applications, inclusion of these definitions will help the Board quantifiably consider whether "the proposed use of water does or does not unreasonably affect existing groundwater and surface water resources or existing permit holders." In addition, for the hydrogeologic report to address each of the potential unreasonable effects, the list of hydrogeologic report requirements under current District Rule 6.9.2(f) should be expanded to include: "Describe the results of a water quality analysis for a sample collected from the well for which a permit is being requested."

Hydrogeologic Report Guideline Revisions

We recommend a simplification of the Hydrogeologic Report Guidelines so that they reflect both the District's need for site-specific aquifer data and the District's practical approach to permit application review. As such, for a new well we recommend that in lieu of a hydrogeologic report the District require a well completion report as part of the operating permit application for production greater than annual volume defined by the Board. This well completion report should include:

- A lithology log based on the cuttings collected during drilling;
- Chip trays containing samples of the formation cuttings collected during drilling with depth interval for each sample clearly marked;

- Geophysical log with the well name, location, depth, and drilling fluid properties recorded on the log header
- Well completion diagram identifying (as applicable) the open and cased intervals, casing and screen type and size, filter pack interval, cement interval, pump and motor (model number, pump bowls, horsepower, etc.), pump setting, column pipe type and size, pump head, and other pertinent information related to the well construction
- Pump curve for the final or proposed pump
- Data and analysis from a minimum 24-hour pumping test
- Water quality analysis results

While the report may also include the predicted impacts of the proposed production from the well, District staff or consultants will also perform an analysis of the predicted effects of production using analytical or numerical modeling tools. As such, it may not be necessary for the applicant to perform the impact analysis and the applicant may focus on providing the well and aquifer data to the District.

SUMMARY AND CONCLUSIONS

The hydrogeologic investigations directed by CUWCD over the last several years have verified distinct hydrogeologic conditions in different parts of Bell County. Pumping tests associated with permit applications have also informed the District's understanding of groundwater flow. In addition, ongoing monitoring efforts have shown water level declines in some areas that may soon limit the ability of landowners to produce groundwater.

The conditions identified support the delineation of management areas within Bell County. For effectively managing the groundwater resources of the District, we have delineated these proposed management areas. Within each of these areas, CUWCD may adopt different rules or guidelines for permitting and assessing groundwater availability.

As a first step, we recommend adopting revised spacing requirements to help minimize the interference drawdown on existing wells from a proposed well being completed in the same aquifer. While we recommend revised spacing requirements, we also recommend that the rules allow for an exemption when physical conditions may not allow the landowner to meet the spacing requirements.

Along with the spacing requirement, we recommend CUWCD work with its legal council to develop a definition of what it means to the Board to "Unreasonably Affect" an existing user. Including such a definition in the District Rules would help clarify the District's management of the groundwater resources.

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APPENDIX B

Clearwater Underground Water Conservation District
P.O. Box 1989, Belton, Texas 76513
Phone: 254/933-0120   Fax: 254/933-8396
www.cuwcd.org

Every drop counts!

2016-2020
Historical Groundwater Use by WUG's
All Values in acre-feet/year
(Non-Exempt and Exempt Use Combined)

Table 1

Year	Municipal	Manu	Mining	Steam Electric	Irrigation	Livestock	Domestic	*Other	Total GW USE
2020 YTD	1,336.21	0	72.33	0	348.38	363.61	729.00	1.16	2,850.69
2019	2,566.89	0	117.66	0	350.72	768.32	1,169.00	1.84	4,974.43
2018	2,795.91	0	294.90	0	809.90	575.03	1,133.00	1.83	5,610.57
2017	2,410.38	0	96.95	0	540.24	573.45	1,088.00	3.30	4,712.32
2016	2,197.31	18.19	52.52	0	448.61	571.94	1,612.00	3.13	4,903.70

2016-2020
Historical Groundwater Use by Non-Exempt Permittees
All Values in acre-feet/year

Table 2

Year	Edwards BFZ Aquifer	Trinity Aquifer Glen Rose Layer	Trinity Aquifer Hensell Layer	Trinity Aquifer Hosston Layer	Other	Total GW USE
2020 YTD	1,141.90	11.96	51.81	395.54	167.61	1,768.82
2019	1,994.46	48.25	91.20	1,008.17	256.72	3,398.80
2018	2,077.92	49.88	89.61	1,345.30	356.96	3,919.67
2017	1,969.76	58.00	91.99	858.76	102.27	3,080.78
2016	1,775.78	23.80	101.32	713.17	123.71	2,737.78

2016-2020
Historical (Estimates) of Groundwater Use by Source Aquifer
by Exempt Well Owners
All Values in acre-feet/year

Table 3

Year	Edwards BFZ Aquifer	Trinity Aquifer Glen Rose Layer	Trinity Aquifer Hensell Layer	Trinity Aquifer Hosston Layer	Other Formations	Total GW USE
2020 YTD	256	145	202	32	448	1,083
2019	361	223	490	52	790	1,916
2018	484	223	258	48	676	1,689
2017	453	223	243	49	677	1,645
2016	455	327	392	70	926	2,107

2016-2020
Historical Groundwater Beneficial Use
By Exempt Well Owners
All Values in acre-feet/year

Table 4

Year	Domestic Use	Livestock & Poultry	Total GW USE
2020 YTD	729	353	1,082
2019	1,169	747	1,916
2018	1,133	556	1,689
2017	1,088	557	1,645
2016	1,612	558	2,170

Source: CUWCD annual estimates and CUWCD annual production reports
*represents production for small business, restaurants, funeral homes, auto repairs, churches

APPENDIX C

Estimated Historical Water Use And 2017 State Water Plan Datasets:

Clearwater 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
June 29, 2020

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 Water 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 2017 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 2017 SWP data available as of 6/29/2020. 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 2017 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 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

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 2018. TWDB staff anticipates the calculation and posting of these estimates at a later date.

BELL COUNTY

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2017	GW	2,663	13	11	0	817	218	3,722
	SW	50,719	604	0	0	2,653	509	54,485
2016	GW	2,490	2	11	0	585	271	3,359
	SW	48,391	618	0	0	2,210	632	51,851
2015	GW	2,411	2	10	0	839	259	3,521
	SW	48,857	769	0	565	1,002	604	51,797
2014	GW	2,497	2	9	0	693	250	3,451
	SW	52,531	639	0	0	1,762	583	55,515
2013	GW	3,616	2	6	0	1,259	233	5,116
	SW	50,974	608	0	0	1,500	544	53,626
2012	GW	4,046	0	6	0	897	242	5,191
	SW	58,035	601	0	0	1,618	564	60,818
2011	GW	4,619	0	0	0	1,474	524	6,617
	SW	63,159	559	0	0	1,658	1,222	66,598
2010	GW	3,568	0	1,155	0	1,560	510	6,793
	SW	51,877	521	1,383	0	1,300	1,190	56,271
2009	GW	3,110	0	1,106	0	583	311	5,110
	SW	58,056	652	1,562	0	1,836	727	62,833
2008	GW	2,592	0	1,056	0	63	293	4,004
	SW	49,832	664	1,515	0	1,769	684	54,464
2007	GW	2,158	0	0	0	308	292	2,758
	SW	41,932	706	140	0	2,013	681	45,472
2006	GW	2,489	0	0	0	60	311	2,860
	SW	46,584	818	306	0	2,119	727	50,554
2005	GW	2,182	50	0	0	222	306	2,760
	SW	43,973	490	305	0	2,103	715	47,586
2004	GW	2,305	0	0	0	173	92	2,570
	SW	41,056	542	193	0	749	828	43,368
2003	GW	2,550	0	0	0	454	92	3,096
	SW	42,117	517	456	0	2,553	828	46,471
2002	GW	2,551	0	0	0	611	94	3,256
	SW	42,248	491	552	0	1,241	846	45,378

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

BELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	439 WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,499	1,489	1,475	1,398	1,443	1,550
G	ARMSTRONG WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	392	392	392	392	392	392
G	BELL-MILAM FALLS WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	475	471	474	478	476	474
G	BELTON	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	7,349	7,305	7,235	6,864	6,771	6,625
G	CHISHOLM TRAIL SUD	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	259	238	216	197	180	165
G	COUNTY-OTHER, BELL	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,297	1,293	1,286	1,248	1,238	1,223
G	DOG RIDGE WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,638	1,631	1,623	1,583	1,573	1,557
G	EAST BELL WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	317	320	323	326	327	329
G	ELM CREEK WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	334	337	339	336	335	331
G	FORT HOOD	BRAZOS	BRAZOS RUN-OF-RIVER	5,732	5,479	5,290	5,102	4,913	4,725

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	HARKER HEIGHTS	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	7,155	7,103	7,103	7,565	8,112	7,935
G	HOLLAND	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	166	166	166	166	166	166
G	IRRIGATION, BELL	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	308	307	304	288	284	278
G	IRRIGATION, BELL	BRAZOS	BRAZOS RUN-OF-RIVER	355	355	356	356	357	357
G	JARRELL-SCHWERTNER WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	457	466	485	444	412	381
G	KEMPNER WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	277	283	293	302	311	319
G	KILLEEN	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	39,957	39,761	39,377	37,343	36,833	36,028
G	LITTLE RIVER-ACADEMY	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	323	323	323	323	323	323
G	LIVESTOCK, BELL	BRAZOS	BRAZOS LIVESTOCK LOCAL SUPPLY	1,009	1,009	1,009	1,009	1,009	1,009
G	MANUFACTURING, BELL	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	497	497	497	497	497	497
G	MINING, BELL	BRAZOS	BRAZOS RUN-OF-RIVER	0	0	0	0	0	0
G	MOFFAT WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,112	1,107	1,095	1,059	1,044	1,021

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
G	MORGAN'S POINT RESORT	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,935	1,935	1,935	1,935	1,935	1,935
G	NOLANVILLE	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	990	985	976	925	913	893
G	PENDLETON WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	380	378	373	361	355	345
G	ROGERS	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	400	400	400	400	400	400
G	SALADO WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	183	183	183	183	183	183
G	TEMPLE	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	19,952	18,494	19,018	18,384	18,158	19,586
G	TEMPLE	BRAZOS	BRAZOS RUN-OF-RIVER	1,706	1,739	1,771	1,804	1,836	1,869
G	TROY	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	959	959	959	959	959	959
G	WEST BELL COUNTY WSC	BRAZOS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM	1,660	1,660	1,660	1,660	1,660	1,660
	Sum of Projected Surface Water Supplies (acre-feet)			**99,073**	**97,065**	**96,936**	**93,887**	**93,395**	**93,515**

Projected Water Demands
TWDB 2017 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.

BELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	439 WSC	BRAZOS	1,044	1,134	1,233	1,351	1,489	1,644
G	ARMSTRONG WSC	BRAZOS	406	418	434	454	478	502
G	BARTLETT	BRAZOS	159	179	202	226	252	277
G	BELL-MILAM FALLS WSC	BRAZOS	344	356	371	390	411	432
G	BELTON	BRAZOS	3,807	4,306	4,872	5,480	6,099	6,715
G	CHISHOLM TRAIL SUD	BRAZOS	553	632	721	814	906	998
G	COUNTY-OTHER, BELL	BRAZOS	870	1,716	2,711	3,733	4,719	5,668
G	DOG RIDGE WSC	BRAZOS	438	488	547	613	682	751
G	EAST BELL WSC	BRAZOS	442	497	560	630	702	775
G	ELM CREEK WSC	BRAZOS	254	288	327	370	413	457
G	FORT HOOD	BRAZOS	3,954	3,870	3,815	3,810	3,804	3,804
G	HARKER HEIGHTS	BRAZOS	6,224	7,079	8,042	9,061	10,087	11,106
G	HOLLAND	BRAZOS	112	108	106	105	106	107
G	IRRIGATION, BELL	BRAZOS	2,205	2,174	2,147	2,117	2,086	2,058
G	JARRELL-SCHWERTNER WSC	BRAZOS	186	209	235	264	294	324
G	KEMPNER WSC	BRAZOS	350	398	451	507	565	622
G	KILLEEN	BRAZOS	19,467	21,902	24,713	27,748	30,864	33,969
G	LITTLE RIVER-ACADEMY	BRAZOS	377	409	447	490	534	578
G	LIVESTOCK, BELL	BRAZOS	1,009	1,009	1,009	1,009	1,009	1,009
G	MANUFACTURING, BELL	BRAZOS	1,370	1,490	1,607	1,711	1,847	1,994
G	MINING, BELL	BRAZOS	3,242	3,980	4,599	5,349	6,105	6,968
G	MOFFAT WSC	BRAZOS	479	481	487	500	517	536
G	MORGAN'S POINT RESORT	BRAZOS	595	684	787	897	1,009	1,121
G	NOLANVILLE	BRAZOS	1,382	1,749	2,154	2,575	2,991	3,401
G	PENDLETON WSC	BRAZOS	245	246	255	266	277	289
G	ROGERS	BRAZOS	172	177	183	192	202	213
G	SALADO WSC	BRAZOS	1,726	1,863	2,017	2,182	2,348	2,514
G	STEAM ELECTRIC POWER, BELL	BRAZOS	4,220	4,934	5,804	6,865	8,157	9,693
G	TEMPLE	BRAZOS	19,485	22,186	25,212	28,415	31,644	34,842
G	TROY	BRAZOS	169	180	193	209	228	247

Projected Water Demands
TWDB 2017 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.

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	WEST BELL COUNTY WSC	BRAZOS	789	816	800	798	797	797
		Sum of Projected Water Demands (acre-feet)	**76,075**	**85,958**	**97,041**	**109,131**	**121,622**	**134,411**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

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

BELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
G	439 WSC	BRAZOS	455	355	242	47	-46	-94
G	ARMSTRONG WSC	BRAZOS	865	853	837	817	793	769
G	BARTLETT	BRAZOS	-126	-145	-166	-189	-215	-240
G	BELL-MILAM FALLS WSC	BRAZOS	713	690	683	673	648	623
G	BELTON	BRAZOS	3,592	3,049	2,413	1,434	722	-40
G	CHISHOLM TRAIL SUD	BRAZOS	-263	-366	-478	-592	-703	-811
G	COUNTY-OTHER, BELL	BRAZOS	1,084	234	-768	-1,828	-2,824	-3,788
G	DOG RIDGE WSC	BRAZOS	1,200	1,143	1,076	970	891	806
G	EAST BELL WSC	BRAZOS	893	850	800	742	676	610
G	ELM CREEK WSC	BRAZOS	80	49	12	-34	-78	-126
G	FORT HOOD	BRAZOS	1,778	1,609	1,475	1,292	1,109	921
G	HARKER HEIGHTS	BRAZOS	931	24	-939	-1,496	-1,975	-3,171
G	HOLLAND	BRAZOS	377	381	383	384	383	382
G	IRRIGATION, BELL	BRAZOS	-1,157	-1,127	-1,102	-1,088	-1,060	-1,038
G	JARRELL-SCHWERTNER WSC	BRAZOS	288	270	259	185	119	57
G	KEMPNER WSC	BRAZOS	-73	-115	-158	-205	-254	-303
G	KILLEEN	BRAZOS	20,490	17,859	14,664	9,595	5,969	2,059
G	LITTLE RIVER-ACADEMY	BRAZOS	11	-21	-59	-102	-146	-190
G	LIVESTOCK, BELL	BRAZOS	0	0	0	0	0	0
G	MANUFACTURING, BELL	BRAZOS	-873	-993	-1,110	-1,214	-1,350	-1,497
G	MINING, BELL	BRAZOS	-3,242	-3,980	-4,599	-5,349	-6,105	-6,968
G	MOFFAT WSC	BRAZOS	839	832	814	765	733	691
G	MORGAN'S POINT RESORT	BRAZOS	1,340	1,251	1,148	1,038	926	814
G	NOLANVILLE	BRAZOS	-72	-444	-858	-1,330	-1,758	-2,188
G	PENDLETON WSC	BRAZOS	257	254	240	217	200	178
G	ROGERS	BRAZOS	435	430	424	415	405	394
G	SALADO WSC	BRAZOS	510	373	219	54	-112	-278
G	STEAM ELECTRIC POWER, BELL	BRAZOS	-4,220	-4,934	-5,804	-6,865	-8,157	-9,693
G	TEMPLE	BRAZOS	2,223	-1,903	-4,373	-8,177	-11,600	-13,337
G	TROY	BRAZOS	1,011	1,000	987	971	952	933
G	WEST BELL COUNTY WSC	BRAZOS	871	844	860	862	863	863
	Sum of Projected Water Supply Needs (acre-feet)		**-10,026**	**-14,028**	**-20,414**	**-28,469**	**-36,383**	**-43,762**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

BELL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
439 WSC, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	4	11	49	59	74
REUSE- BCWCID #1 SOUTH	DIRECT REUSE [BELL]	0	0	0	0	0	20
		0	**4**	**11**	**49**	**59**	**94**
ARMSTRONG WSC, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - ARMSTRONG WSC	DEMAND REDUCTION [BELL]	14	39	32	29	30	32
		14	**39**	**32**	**29**	**30**	**32**
BARTLETT, BRAZOS (G)							
ADDITIONAL ADVANCED CONSERVATION - BARTLETT	DEMAND REDUCTION [BELL]	0	0	0	3	18	34
MUNICIPAL WATER CONSERVATION (SUBURBAN) - BARTLETT	DEMAND REDUCTION [BELL]	5	19	29	31	34	37
TRINITY AQUIFER DEVELOPMENT	TRINITY AQUIFER [BELL]	144	151	156	159	323	327
		149	**170**	**185**	**193**	**375**	**398**
BELTON, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - BELTON	DEMAND REDUCTION [BELL]	119	340	318	321	347	379
TRINITY - WILLIAMSON COUNTY ASR	TRINITY AQUIFER ASR [WILLIAMSON]	0	29	87	390	466	586
		119	**369**	**405**	**711**	**813**	**965**
CHISHOLM TRAIL SUD, BRAZOS (G)							
ADDITIONAL ADVANCED CONSERVATION - CHISHOLM TRAIL SUD	DEMAND REDUCTION [BELL]	0	0	1	45	96	153
CHISHOLM TRAIL SUD WTP EXPANSION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	387	340	344	407	490	583
GEORGETOWN WTP EXPANSION	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	38	35	0	0
MUNICIPAL WATER CONSERVATION (SUBURBAN) - CHISHOLM TRAIL SUD	DEMAND REDUCTION [BELL]	23	76	100	110	122	134
		410	**416**	**483**	**597**	**708**	**870**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
COUNTY-OTHER, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	0	0	161	718	1,417	2,081
MUNICIPAL WATER CONSERVATION (RURAL) - COUNTY-OTHER, BELL	DEMAND REDUCTION [BELL]	14	62	73	94	117	138
PURCHASE FROM CENTRAL TEXAS WSC	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	500	500	500	500
TRINITY - WILLIAMSON COUNTY ASR	TRINITY AQUIFER ASR [WILLIAMSON]	0	4	34	516	790	1,069
		14	**66**	**768**	**1,828**	**2,824**	**3,788**
ELM CREEK WSC, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	34	78	126
		0	**0**	**0**	**34**	**78**	**126**
FORT HOOD, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - FORT HOOD	DEMAND REDUCTION [BELL]	152	432	705	998	1,094	1,094
		152	**432**	**705**	**998**	**1,094**	**1,094**
HARKER HEIGHTS, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	1,645	1,697	1,697	1,235	688	865
KILLEEN REDUCTION TO HARKER HEIGHTS	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	0	0	0	0	302
MUNICIPAL WATER CONSERVATION (SUBURBAN) - HARKER HEIGHTS	DEMAND REDUCTION [BELL]	262	836	1,367	1,499	1,656	1,819
REUSE- BCWCID #1 SOUTH	DIRECT REUSE [BELL]	185	185	185	185	185	185
		2,092	**2,718**	**3,249**	**2,919**	**2,529**	**3,171**
IRRIGATION, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	1,091	1,019	953	940	915	754
IRRIGATION WATER CONSERVATION	DEMAND REDUCTION [BELL]	66	109	150	148	146	144
TRINITY AQUIFER DEVELOPMENT	TRINITY AQUIFER [BELL]	0	0	0	0	0	140
		1,157	**1,128**	**1,103**	**1,088**	**1,061**	**1,038**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
KEMPNER WSC, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	554	570	589	636	653	673
MUNICIPAL WATER CONSERVATION (SUBURBAN) - KEMPNER WSC	DEMAND REDUCTION [BELL]	14	34	33	34	37	40
		568	**604**	**622**	**670**	**690**	**713**
KILLEEN, BRAZOS (G)							
REUSE- BCWCID #1 SOUTH	DIRECT REUSE [BELL]	563	563	563	563	563	543
REUSE-BCWCID #1 NORTH	DIRECT REUSE [BELL]	1,925	1,925	1,925	1,925	1,925	1,925
		2,488	**2,488**	**2,488**	**2,488**	**2,488**	**2,468**
LITTLE RIVER-ACADEMY, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	180	180	180	180	180
MUNICIPAL WATER CONSERVATION (SUBURBAN) - LITTLE RIVER-ACADEMY	DEMAND REDUCTION [BELL]	12	19	13	11	11	11
		12	**199**	**193**	**191**	**191**	**191**
MANUFACTURING, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	1,000	1,000	1,000	1,360	1,360	1,360
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [BELL]	41	75	112	120	129	140
		1,041	**1,075**	**1,112**	**1,480**	**1,489**	**1,500**
MINING, BELL, BRAZOS (G)							
EDWARDS AQUIFER DEVELOPMENT	EDWARDS-BFZ AQUIFER [BELL]	2,104	2,176	2,081	1,177	503	0
INDUSTRIAL WATER CONSERVATION	DEMAND REDUCTION [BELL]	97	199	322	374	427	488
TRINITY AQUIFER DEVELOPMENT	TRINITY AQUIFER [BELL]	582	582	582	582	260	120
		2,783	**2,957**	**2,985**	**2,133**	**1,190**	**608**
NOLANVILLE, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	0	5	14	65	77	97
MUNICIPAL WATER CONSERVATION (SUBURBAN) - NOLANVILLE	DEMAND REDUCTION [BELL]	67	224	444	721	884	1,003

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
VOLUNTARY REDISTRIBUTION OF BELL COUNTY WCID#1 SUPPLY	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	5	215	401	544	798	1,088
		72	**444**	**859**	**1,330**	**1,759**	**2,188**
SALADO WSC, BRAZOS (G)							
MUNICIPAL WATER CONSERVATION (SUBURBAN) - SALADO WSC	DEMAND REDUCTION [BELL]	97	255	431	624	830	1,044
		97	**255**	**431**	**624**	**830**	**1,044**
STEAM ELECTRIC POWER, BELL, BRAZOS (G)							
REUSE- TEMPLE	DIRECT REUSE [BELL]	8,407	8,407	8,407	8,407	8,407	9,707
		8,407	**8,407**	**8,407**	**8,407**	**8,407**	**9,707**
TEMPLE, BRAZOS (G)							
BRA SYSTEM OPERATIONS-LITTLE RIVER	BRAZOS RIVER AUTHORITY LITTLE RIVER LAKE/RESERVOIR SYSTEM [RESERVOIR]	3,080	4,262	3,994	314	2,447	2,245
MUNICIPAL WATER CONSERVATION (URBAN) - TEMPLE	DEMAND REDUCTION [BELL]	914	2,740	5,015	7,724	10,771	11,850
TRINITY - WILLIAMSON COUNTY ASR	TRINITY AQUIFER ASR [WILLIAMSON]	4,761	3,759	3,323	7,727	5,730	4,504
		8,755	**10,761**	**12,332**	**15,765**	**18,948**	**18,599**
Sum of Projected Water Management Strategies (acre-feet)		**28,330**	**32,532**	**36,370**	**41,534**	**45,563**	**48,594**

APPENDIX D

Data Definitions*

1. <u>Projected Water Demands*</u>
From the 2012 State Water Plan Glossary: "**WATER DEMAND** Quantity of water projected to meet the overall necessities of a water user group in a specific future year." (See 2012 State Water Plan Chapter 3 for more detail.)
Additional explanation: These are water demand volumes as projected for specific Water User Groups in the 2011 Regional Water Plans. This is NOT groundwater pumpage or demand based on any existing water source. This demand is how much water each Water User Group is projected to require in each decade over the planning horizon.

2. <u>Projected Surface Water Supplies*</u>
From the 2012 State Water Plan Glossary: "**EXISTING** *[surface]* **WATER SUPPLY** - Maximum amount of *[surface]* water available from existing sources for use during drought of record conditions that is physically and legally available for use." (See 2012 State Water Plan Chapter 5 for more detail.)
Additional explanation: These are the existing surface water supply volumes that, without implementing any recommended WMSs, could be used during a drought (in each planning decade) by Water User Groups located within the specified geographic area.

3. <u>Projected Water Supply Needs*</u>
From the 2012 State Water Plan Glossary: "**NEEDS** -Projected water demands in excess of existing water supplies for a water user group or a wholesale water provider." (See 2012 State Water Plan Chapter 6 for more detail.)
Additional explanation: These are the volumes of water that result from comparing each Water User Group's projected existing water supplies to its projected water demands. If the volume listed is a negative number, then the Water User Group shows a projected need during a drought if they do not implement any water management strategies. If the volume listed is a positive number, then the Water User Group shows a projected surplus. Note that if a Water User Group shows a need in any decade, then they are considered to have a potential need during the planning horizon, even if they show a surplus elsewhere.

4. <u>Projected Water Management Strategies*</u>
From the 2012 State Water Plan Glossary: "**RECOMMENDED WATER MANAGEMENT STRATEGY** - Specific project or action to increase water supply or maximize existing supply to meet a specific need." (See 2012 State Water Plan Chapter 7 for more detail.)
Additional explanation: These are the specific water management strategies (with associated water volumes) that were recommended in the 2011 Regional Water Plans.

Terminology used by TWDB staff in providing data for 'Estimated Historical Water Use And 2012 State Water Plan Datasets' reports issued by TWDB.

APPENDIX E

RESOLUTION
OF THE BOARD OF DIRECTORS OF THE
CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT
MEETING HELD OCTOBER 11, 2023

A RESOLUTION ADOPTING AMENDED MANAGEMENT PLAN

WHEREAS, Clearwater Underground Water Conservation District is a political subdivision of the State of Texas and underground water conservation district created and operating under and by virtue of Article XVI, Section 59, of the Texas Constitution; Texas Water Code Chapter 36; the District's enabling act, Act of May 27, 1989, 71st Legislature, Regular Session, Chapter 524 (House Bill 3172), as amended by Act of April 25, 2001, 77th Legislature, Regular Session, Chapter 22 (Senate Bill 404), Act of May 7, 2009, 81st Legislature, Regular Session, Chapter 64 (Senate Bill 1755), and Act of May 27, 2015, 84th Legislature, Regular Session, Chapter 1196, Section 2 (Senate Bill 1336)(omnibus districts bill); and the applicable general laws of the State of Texas; and confirmed by voters of Bell County in 1999.

WHEREAS, under the direction of the Board of Directors, and in accordance with Texas Water Code §§ 36.1071 and 36.1072, Title 31, Chapter 356 of the Texas Administrative Code, and the District's rules, the District has timely undertaken the requisite five-year review of its existing Groundwater Management Plan, initially adopted by the District's Board on October 24, 2000, and certified by the Texas Water Development Board (the "TWDB") on February 21, 2001, and revised and readopted by the District's Board on December 13, 2005, and certified by TWDB on March 6, 2006; and revised and readopted by the District's Board on February 8, 2011 and certified by TWDB on April 13, 2011, and revised and readopted by the Districts Board on January 13, 2016 and certified by TWDB on February 19, 2016, and revised and readopted by the District's Board on January 9, 2019 and certified by TWDB on March 12, 2019 revised and readopted by the District's Board on November 11, 2020 and certified by TWDB on December 30, 2020;

WHEREAS, in conducting a the requisite five-year review of its existing Groundwater Management Plan, the District and its consultants reviewed, analyzed, and factored in the District's best available data, the groundwater availability modeling information provided by the TWDB, the technical information and estimates required by the TWDB, for Third Round of Desired Future Conditions GMA8 of the aquifers within the District, and the available site-specific information that has previously been provided by the District to the TWDB for review and comment;

WHEREAS, the District issued the appropriate notices and held a public hearing to receive public comments on the proposed amendments to the Groundwater Management Plan at the District's office located at 700 Kennedy Court, Belton, Texas, on October 11, 202;

WHEREAS, the District obtained comments from the TWDB through a preliminary review process the District's Groundwater Management Plan conducted by TWDB staff, and the District has considered and addressed all such comments in the development of its Management Plan;

WHEREAS, the District requested, received, reviewed, and took into consideration comments from the Brazos River Authority and all other Surface Water Management Entities during preparation of its Groundwater Management Plan;

WHEREAS, the Board of Directors finds that the Groundwater Management Plan meets all

of the requirements of Chapter 36 of the Texas Water Code, the District's enabling act, Chapter 356, Title 31, Texas Administrative Code, and the District's rules; and

WHEREAS, the Board of Directors, upon proper notice and in an open meeting, seeks to readopt its amended Groundwater Management Plan pursuant to Texas Water Code § 36.1072(e).

NOW THEREFORE BE IT RESOLVED THAT:

The above recitals are true and correct;

The Groundwater Management Plan is hereby readopted with those changes reflected in the proposed, draft Groundwater Management Plan before the District's Board of Directors on this date, along with those changes agreed upon during deliberation and after formal action on this date by the District's Board of Directors;

The Board of Directors further instructs the General Manager to compile a final, readopted Groundwater Management Plan, and file it with the TWDB's Executive Director within 60 calendar days from the date of re-adoption, pursuant to Texas Water Code § 36.1072(e); and

The Board of Directors and General Manager are further authorized to take any and all action necessary to coordinate with the TWDB as may be required in furtherance of TWDB's approval pursuant to the provisions of § 36.1072 of the Texas Water Code.

AND IT IS SO ORDERED.

Upon motion duly made by _____, and seconded by Director _____, and upon discussion, the Board of Directors voted ___ in favor and ___opposed, ___ abstained, and ___ absent, and the motion thereby PASSED on this 11th day of October 2023.

CLEARWATER UNDERGROUND WATER CONSERVATION DISTRICT

By: _____
    Leland Gersbach, Board President

ATTEST:

_____
C. Gary Young, Board Secretary
Dirk Aaron, Assistant Secretary

APPENDIX F

Clearwater Underground Water Conservation District
Notice of Public Hearing on Groundwater Management Plan

The Clearwater Underground Water Conservation District (CUWCD) will hold a public hearing and consider adopting the proposed update with revisions to the District Groundwater Management Plan at 1:30 p.m., October 11, 2023, at the District Office located at 700 Kennedy Court, Belton, Texas. Copies of the revised Management Plan are available for review at the CUWCD District Office Building and on the CUWCD website at https://www.cuwcd.org. Contact the CUWCD at 254/933-0120 for additional information.

Dated: September 20, 2023

By: _Dirk Aaron_

Dirk Aaron
General Manager
Clearwater Underground Water Conservation District

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12 Notices

127 Legal Notices

NOTICE OF PUBLIC HEARING

The Clearwater Underground Water Conservation District (CUWCD) will hold a public hearing and consider adopting proposed update with revisions to the District Groundwater Management Plan at 1 30 p m , October 11, 2023, in the District Headquarters Building located at 700 Kennedy Court, Belton, Texas Copies of the revised Management Plan are available for review at the CUWCD Headquarters Building and on the CUWCD website at *https://www.cuwcd.org* Contact the CUWCD at 254/933-0120 for additional information

(Legal notice published in the Killeen Daily Herald on September 20, 2023.)

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Clearwater Underground Water Conservation District Notice of Public Hearing on District Rules

Notice is hereby given that the Board of Directors of the Clearwater Underground Water Conservation District ("District") will hold a public hearing on Wednesday, October 11, 2023, 1 30 p m at the District Office located at 700 Kennedy Court, Belton, Texas 76513 to discuss, consider, receive public comment, and potentially act on proposed amendments to the District Rules to comply with action by the Texas Legislature. The proposed amendments to the District Rules include changes to (1) the District's procedure for finalizing a decision in a groundwater permit contested case hearing (2) the list of wells exempt from permitting requirements, (3) the allowable rate at which the District may assess a transport fee, (4) the rulemaking process, (5) defines Well Completion Inspection and (6) additional non-substantive changes

All interested members of the public are invited to participate and comment orally and in writing A copy of the proposed amendments to the District Rules may be requested by email at *schapman@cuwcd.org* and may be reviewed or copied on the District's website at *https://cuwcd.org/*

(Legal notice published in the Killeen Daily Herald on September 20, 2023.)

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12 Notices

127 Legal Notices

Application has been made with the Texas Alcoholic Beverage Commission for a Mixed Beverage Permit & Late Hours Certificate by Alexander's Music Box LLC dba Alexander's Music Box to be located at 313 N. 8th Street, Killeen, Bell Co., Texas. Manager of said LLC is Jessica A Gonzalez – Manager.

(Legal notice published in the Killeen Daily Herald on September 20 & 21, 2023)

17 Employment

175 General

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BUSINESS DIGEST

Did your kids buy gear in Fortnite without asking you? The FTC says you could get a refund

WASHINGTON — Parents whose kids bought virtual gear without their knowledge on the popular Fortnite video game could soon be able to get a refund.

U.S. regulators are starting to notify more than 37 million people by email that they may be eligible for compensation as part of a legal settlement with Fortnite's maker, Epic Games Inc.

The Federal Trade Commission announced late last year that Epic Games would pay $520 million in penalties and refunds to settle complaints revolving around children's privacy and its payment methods that tricked players into making unintended purchases.

Part of that $520 million consists of $245 million in customer refunds, as part of a settlement finalized in March. It's meant to cover some of the costs of unwanted V-Bucks, the game's in-game currency, or virtual items such as outfits or cartoonish purple llama loot crates.

Consumers have until Jan. 17 to submit a claim.

Epic Games had also agreed to pay a $275 million fine for allegedly collecting personal information on Fortnite players under the age of 13 without informing their parents or getting their consent. It was the biggest penalty ever imposed for breaking an FTC rule.

According to the FTC, those eligible for refunds include Fortnite users charged in-game currency for items they didn't want between January 2017 and September 2022; those whose child made charges to their credit card without their knowledge between January 2017 and November 2018; and those whose account was locked after they complained to their credit card company about wrongful charges.

Epic Games said after settling the case in December that it implemented additional safeguards to prevent unintended purchases. In an updated statement Tuesday, it referred people to the FTC's page.

For filmmakers, $900M-plus haul of 'Oppenheimer' is important

Hopes were always high for Christopher Nolan's "Oppenheimer." The studio knew the film was great, and commercial. But no one in the industry expected that a long, talky, R-rated drama released at the height of the summer movie season would earn over $900 million at the box office.

After an early screening, "Dune" filmmaker Denis Villeneuve said he knew he'd just seen "a masterpiece." He even remembered saying that it would be a big success.

"But where it is right now has blown the roof off of my projection," Villeneuve told The Associated Press. "It's a three-hour movie about people talking about nuclear physics."

As of Monday, "Oppenheimer's" global total was nearly $913 million, making it Nolan's third highest grossing film, trailing only the "Dark Knight" sequels. It's also the third biggest film of the year behind "Barbie" and "The Super Mario Bros. Movie" and the most successful biopic ever, surpassing "Bohemian Rhapsody." It's a staggering sum that has been driven by audiences of all ages and an enthusiasm for film and large format screenings.

"When you make a film, you hope that you're going to connect with an audience in some form or another," "Oppenheimer" producer Emma Thomas told the AP. "But, particularly with a three-hour film that has a serious subject and is challenging in many ways, this sort of success is beyond our wildest imaginings."

Even after nine weeks in theaters, 11 of the 25 screens capable of projecting the coveted IMAX 70mm prints (Nolan's preferred format) continued to play the film on some of the busiest screens, such as the TCL Chinese Theatre in Los Angeles and the AMC Lincoln Square in New York.

"The reason we're still in those theaters is because the audience is demanding it," Thomas said. "This is not something that we can impose — I wish we could, but it's genuine."

Thomas, who is married to Nolan, has produced all of his films going back to his short "Doodlebug." From "Memento" and "The Prestige" to "Inception," "Interstellar" and "Dunkirk," their original films often have defied conventional box-office logic. With "Oppenheimer," they felt good about what they'd made but also knew that the marketplace, and box-office tracking, has been a little unpredictable since the pandemic.

"Chris has always made films that challenge audiences," Thomas said. "He has faith in his audiences and, generally, they've met him where he is."

Their "pipe dream," she said, was that it would beat "Dunkirk's" opening weekend. Instead, it nearly doubled it.

ASSOCIATED PRESS

SELECTED STOCKS

NEW YORK (AP) - Closing stocks.

	Sales	Close	Change
AT&T Inc	111	3374%	15.21	+ 12
AEP	33%	14357	82.16	17
ATMOS	2.3%	523	114.19	-11
BP PLC	1.74	44749	35.12	+ 25
BrstAm	99%	33363.1	29.45	-11
Caterpillar	5.20	22063	279.47	127
CenterPnt	.74	4720	26.36	17
Chevron	6.04	6900	167.20	01
Citigroup	2.03	13027.4	42.95	+.04
CocaCola	1.64	11422.3	56.16	17
ColgPalm	1.91	3139	73.02	03
OmcMds	.94	9403	51.64	67
ConocoPhil	2.00e	41184	123.16	1.37
Dillards	1.00	1001	352.46	+3.55
DuPont	1.44	10075	74.47	31
EastChem	3.16	3671	76.71	+ 26
Entergy	4.26	3037	96.46	31
ExxonMbl	3.64	123229	117.33	31
FordLuck	1.90	35164	12.15	+ 26
GenDynam	5.36	9747	226.45	1.16
GenElec	.32	23310	116.21	31
GenMds	2.36	52146	65.64	29
Goodyear		6010	12.63	+.07
Halliburn	.64	14627	41.61	1.21
HomeDp	6.36	27141	314.61	2.65
Honeywel	4.12	23475	185.43	+ 97
IBM	6.64	31854	146.32	+1.10
IntlPap	1.85	12543	34.10	01
Johnrh	5.97	51021	162.20	37
Kroger	1.16	37436	45.09	-.16
Lowes	4.40	21462	217.30	28
MarathnO	.43	103091	26.75	-.15
Medtrnc	2.72	46526	80.63	17
NCR Corp		1016	17.25	+ 02
FNM Res	1.47	7434	44.29	+ 49
PepsiCo	5.09	33574	176.39	1.35
ProctGam	3.76	40541	153.99	-6
ScrppsEW	.20	3614	6.55	22
Shrwin	2.46	17623	261.47	+1.47
SouthnCo	2.72	33614	70.91	04
SwstAir	.72	65021	26.91	17
Tandrel	4.16	32216	163.14	+31
Textron	.06	12674	75.54	40
Trinity	5.92	6516	24.90	+.14
TylerTech		2713	392.65	+2.19
UnionPac	5.20	21560	211.77	1.35
USSteel	20	12625	31.66	+1.13
VerizonCm	2.69	23211.6	33.10	13
WalMart	2.28	49564	163.36	04
WellsFargo	1.20	36100	42.01	21
XeroxHld	1.00	11031	16.16	+.39
YumBrnds	2.43	12672	125.77	30

DIVIDEND FOOTNOTES
e - amount declared or paid in last 12 months
f - current annual rate, which was increased by most recent dividend announcement

LOCAL INTEREST STOCKS

	Symbol	Close	Change
Alcoa	AA	28.34	-0.51
Blackstone	BX	115.12	+0.75
Dine Equity Inc.	DIN	53.28	+0.14
Dover	DOV	143.75	+0.22
Ill. Tool Works	ITW	237.52	-0.19
Manpower	MAN	74.50	+0.10
McDonald's	MCD	278.13	+0.41
Molson Coors	TAP	63.85	-0.57
Morgan Stanley	MS	88.51	-0.20
Raymond James	RJF	106.46	-0.70
Teleglobe	BCE	40.57	-0.21
Tractor Supply	TSCO	210.15	+0.66
Tupperware	TUP	1.86	+0.17
Valero	VLO	142.66	-3.62
Wendy's	WEN	20.41	-0.04

COTTON FUTURES

Cotton No. 2 Futures on the New York Board of Trade Tuesday

	Open	High	Low	Settle	Chg
Oct 23	66.53	66.53	66.06	66.06	+ .52
Nov 23				67.52	+ .52
Dec 23	67.06	66.42	66.79	67.52	+ .52
Jan 24				66.26	+ .37
Mar 24	67.47	69.09	67.70	66.26	+ .37
May 24	66.23	69.40	66.16	66.64	+ .27
Jul 24	67.75	66.75	67.63	66.06	+ .50
Sep 24				61.24	+ .50
Oct 24				60.36	+ .36
Nov 24				61.24	+ .50
Dec 24	60.60	61.50	60.60	61.24	+ .50
Jan 25				61.37	+ .53
Mar 25				61.37	+ .53
May 25				61.27	+ .53
Jul 25				61.17	+ .53
Sep 25				78.17	+ .53
Oct 25				79.17	+ .53
Nov 25				78.17	+ .53
Dec 25				78.17	+ .53
Jan 26				76.42	+ .53
Mar 26				76.42	+ .53
May 26				76.67	+ .53
Jul 26				78.92	+ .53

Est. sales 23,363 Tue's sales 21,306
Tue's open interest 155

METAL PRICES

NEW YORK (AP) - (troy oz.)

	Tuesday	Monday
NY Merc Gold	$1,931.455	$1,933.44
NY Merc Silver	$23.475	$23.525

STOCK MARKETS

Wall Street slips ahead of Fed decision on rates

NEW YORK — U.S. stocks edged lower, and yields climbed Tuesday as Wall Street waits for the Federal Reserve's latest decision on interest rates.

The S&P 500 slipped 9.58 points, or 0.2%, to 4,443.95. The Dow Jones Industrial Average dropped 106.57, or 0.3%, to 34,517.73, and the Nasdaq composite lost 32.05, or 0.2%, to 13,678.19.

Stocks have been see-sawing for weeks on uncertainty about whether the Fed is done with its market-shaking hikes to interest rates. By pulling its main interest rate to the highest level in more than two decades, the Fed has helped inflation to cool from its peak last year but at the cost of hurting prices for investments and damaging some corners of the economy.

The Fed began its latest meeting on interest rates Tuesday, with an announcement scheduled for Wednesday. The overwhelming expectation is for the Fed to announce no change to rates. More focus will be on updated projections Fed officials give for where they see rates heading in upcoming years.

Traders are split on whether the Fed may raise rates again this year, but they're largely expecting the Fed to begin cutting rates next year. Such cuts can act like steroids for financial markets, giving a lift to all kinds of investments.

Optimists say inflation has come down enough for the Fed to cut rates meaningfully next year, while the economy continues to hum due to a solid job market. Others say the Fed may need to keep rates higher for longer than investors expect to get inflation down to its 2% target, while the threat of a recession still looms.

A soft landing, where inflation gets back to the Fed's target without the economy having to suffer a painful recession, "is still possible, but not probable in our view," according to Joe Davis, chief global economist and head of Vanguard's investment strategy group.

A risk remains that the Fed could misread a temporary slowdown in inflation as having accomplished its mission, which could lead to a cycle reminiscent of the late 1960s where inflation reaccelerates, the Fed hikes rates further and a recession eventually hits.

High rates have already hit the manufacturing and housing industries. A report Tuesday showed that homebuilders broke ground on fewer new homes in August than economists expected. The 11.3% drop from July's level was much worse than the 0.8% forecasted. But activity for building permits, a possible indicator of future activity, rose more than expected.

On Wall Street, shares of Instacart climbed 12.3% in their first day of trading. The company raised $660 million in its initial public offering, which priced the stock at $30 per share.

It arrived on the heels of another highly anticipated IPO by chip designer Arm Holdings. The offerings could mark a warming environment for IPOs, which fell off sharply after stocks tumbled last year with worries about higher interest rates. Arm jumped in its first day of trading on Thursday but has since followed that with three days of losses.

The Walt Disney Co. fell 3.6% for one of the largest losses in the S&P 500 after it announced a big investment plan for its theme parks and cruise lines. It plans to double its investment in its parks, experiences and products business to $60 billion over the next 10 years versus the prior decade.

Shares of AutoZone slipped 1.9% despite its reporting stronger profit for the latest quarter than analysts expected. The auto parts retailer said growth in its domestic commercial business was weaker during the quarter than expected.

ASSOCIATED PRESS

Sept. 19, 2023 — Dow Jones industrials — -106.57 — 34,517.73 — Pct. change from previous -0.31% — High 34,697.58 — Low 34,311.69

Sept. 19, 2023 — Nasdaq composite — -32.05 — 13,678.19 — Pct. change from previous -0.23% — High 13,705.15 — Low 13,678.61

Sept. 19, 2023 — Standard & Poor's 500 — -9.58 — 4,443.95 — Pct. change from previous -0.22% — High 4,449.65 — Low 4,416.61

AP

APPENDIX G

WSC	Contact	Phone	Address	City	State	Zip	Email
439 WSC	Jamie Davlin	254-933-2133	5041 West Dr	Belton	TX	76513	439water@439watersupply.com
Armstrong WSC	Billy James Smith	254-657-2429	P.O. Box 155	Holland	Texas	76534	bsmith@embarqmail.com
Bell County MUD #1	Roger Hunter	512-435-2300	100 Congress Avenue	Austin	Texas	78701	
Bell County MUD #2	Roger Hunter	512-435-2300	100 Congress Avenue	Austin	Texas	78701	
Bell County WCID #1	Ricky Garrett	254-501-9243	201 S. 38th Street	Killeen	Texas	76543	r.garrett@wcid1.org
Bell County WCID #2	Bill Easley	254-982-4685	P.O. Box 338	Little River	Texas	76554	belcountywater@embarqmail.com
Bell County WCID #3	Blake Stapp	254-771-0061	303 N Main Street	Nolanville	Texas	76559	bstapp@lms-cpa.com
Bell County WCID #5	Robert Jekel	254-697-4016	P. O. Drawer 150	Cameron	Texas	76520	dlservice@farm-market.net
Bell County WCID #6	Glen Grandy	254-290-0222	P.O. Box 817	Killeen	Texas	76540	.
Bell Milam Falls WSC	Robert Jekel	254-697-4016	P. O. Drawer 150	Cameron	Texas	76520	dlservice@farm-market.net
Central Texas WSC	Lee Kelley	254-698-3583	4020 Lakecliff Drive	Harker Heights	Texas	76548	ctwscgm@embarqmail.com
City of Troy	Gary O. Smith	254-938-2505	P.O. Box 389	Troy	Texas	76579	gsmith@cityoftroy.us
Dog Ridge WSC	Michelle	254-939-6533	P.O. Box 232	Belton	Texas	76513	Michelle@dogridgewsc.com
Donahoe Creek Watershed Authority	Jon Fischer	254-527-3271	PO Box Q	Bartlett	Texas	76511	
East Bell WSC	Cheryl Walden	254-985-2611	16490 Hwy 53	Temple	Texas	76501	eastbellwsc@embarqmail.com
Elm Creek WSC	Kyle Bloodworth	254-853-3838	603 Avenue E.	Moody	Texas	76557	kyle@elmcreekwatersupply.com
Jarrell Schwertner WSC	Joe Simmons	903-391-2730	P.O. Box 40	Jarrell	Texas	76537	gm@jswatersupply.com
Kempner WSC	Bruce Sorenson	512-932-3701	PO Box 103	Kempner	Texas	76539	bruce@kempnerwsc.com
Little Elm Valley WSC	Robert Jekel	254-697-4016	P. O. Drawer 150	Cameron	Texas	76520	dlservice@farm-market.net
Moffat WSC	Damon Boniface	254-986-2457	5456 Lakeaire Blvd	Temple	Texas	76502	dboniface@moffatwatersupply.com
Oenavile & Belfalls WSC	Randy Frei	254-985-2243	11821 State Hwy 53	Temple	Texas	76501	freienterprises@embarqmail.com
Pendleton WSC	Velva Moody	254-773-5876	P.O. Box 100	Pendleton	Texas	76564	pwsc@mygrande.net
Salado WSC	Ricky Preston	254-947-5425	P.O. Box 128	Salado	Texas	76571	swsc1@embarqmail.com
The Grove WSC	Amy Veazey	254-865-5567	1903 Straws Mills Rd	Gatesville	Texas	76528	thegrovewsc@icloud.com
West Bell County WSC	Bob Whitson	254-634-1727	4201 Chaparral Road	Killeen	Texas	76542	westbellwater@hotmail.com
Brazos River Authority	David Collinsworth	254-761-3100	4600 Cobbs Drive	Waco	Texas	76710	david.collinsworth@brazos.org
City of Bartlett	Sabra Davis	254-527-0196	P.O. Drawer H	Bartlett	Texas	76511	cityadmin@bartlett-tx.us
City of Belton	Matthew Bates	254-933-5818	P.O. Box 120	Belton	Texas	76513	MBates@BeltonTexas.Gov
City of Gatesville	Scott Albert	254-290-0545	803 Main Street	Gatesville	Texas	76528	salbert@gatesvilletx.com
City of Harker Heights	David Mitchell	254-953-5600	305 Millers Crossing	Harker Heights	Texas	76548	dmitchell@harkerheights.gov
River Farm MUD #1	Rex Baird	972-788-1600	16000 North Dallas Parkway, Suite 350	Dallas	Texas	75248	rfmud1@districtdirectory.org
City of Holland	Johnny Kallus	254-657-2460	P.O. Box 157	Holland	Texas	76534	jkallus@cityofholland.org
City of Lampasas	Finley deGraffenried	512-556-6831	312 E. Third St.	Lampasas	Texas	76550	finley@cityoflampasas.com
City of Killeen	Steve Kana	254-501-6500	101 N. College Street	Killeen	Texas	76541	skana@killeentexas.gov
City of Morgan's Point Resort	Camille Browser	254-780-1334	8 Morgan's Point Blvd.	Morgan's Point Resort	Texas	76513	Camille.Bowser@mprtx.us
City of Rogers	Tammy Cockrum	254-642-3312	P.O. Box 250	Rogers	Texas	76569	cityadministrator@CityOfRogersTX.gov
City of Temple	David Olson	254-298-5600	2 North Main Street	Temple	Texas	76501	dolson@templetx.gov

Every drop counts!

September 20, 2023

David Collinsworth, General Manager david.Collinsworth@brazos.org   *(via email)*
Brazos River Authority
P.O. Box 7555
Waco, TX 76714-7555

Dear Mr. Collinsworth,

The Clearwater Underground Water Conservation District (CUWCD) is conducting a review of its management plan as required by Texas Water Code (TWC) Chapter 36.1072(e). Standard revisions are proposed to update this plan. One major component of the plan is evidence of its coordination with surface water management entities pursuant to TWC 36.1071 (a):

> *Evidence that following notice and hearing the Clearwater Underground*
> *Water Conservation District coordinated in the development of its*
> *Management plan with surface water management entities.*

The draft of the revised management plan is at located at https://cuwcd.org/district-management-plan/ and notice will hold a public hearing on October 11, 2023 at 1:30 p.m. at our District Headquarters located at 700 Kennedy Court in Belton. We are looking forward to your input regarding this plan. After your review, please provide us with a letter confirming your review of the revised plan and any comments or concerns you may have.

The District will after conducting the public hearing of the draft plan on October 11, 2023 will deliberate the same day for final adoption of all proposed and agreed upon revisions to the plan at our District Headquarters located at 700 Kennedy Court in Belton.

We are looking forward to your input regarding this plan. After your review, please provide us with a letter confirming your review of the revised plan and any comments or concerns you may have.

Sincerely,

Dirk Aaron
General Manager
Clearwater UWCD
Electronic copy to: Brad Brunett (bradb@brazos.org); Stephen Allen stephen.allen@twdb.texas.gov

Clearwater Underground Water Conservation District
P.O. Box 1989, Belton, Texas 76513
Phone: 254/933-0120   Fax: 254/933-8396
www.cuwcd.org

Every drop counts!

Leland Gersbach, President
Jody Williams, Vice President
C. Gary Young, Secretary
Scott A. Brooks
James Brown

September 20, 2023

TO: Surface Water Management Entities   (via email)

RE: Revised Management Plan

Dear Manager:

The Clearwater Underground Water Conservation District (CUWCD) is conducting a review of its management plan as required by Texas Water Code (TWC) Chapter 36.1072(e). Standard revisions are proposed to update this plan. One major component of the plan is evidence of its coordination with surface water management entities pursuant to TWC 36.1071 (a):

> *Evidence that following notice and hearing the Clearwater Underground*
> *Water Conservation District coordinated in the development of its*
> *Management plan with surface water management entities.*

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We are looking forward to your input regarding this plan. After your review, please provide us with a letter confirming your review of the revised plan and any comments or concerns you may have.
Sincerely,

Dirk Aaron
General Manager
Clearwater UWCD

Electronic copy to: Stephen Allen stephen.allen@twdb.texas.gov

APPENDIX H

Groundwater Management Areas
of
Texas

Legend
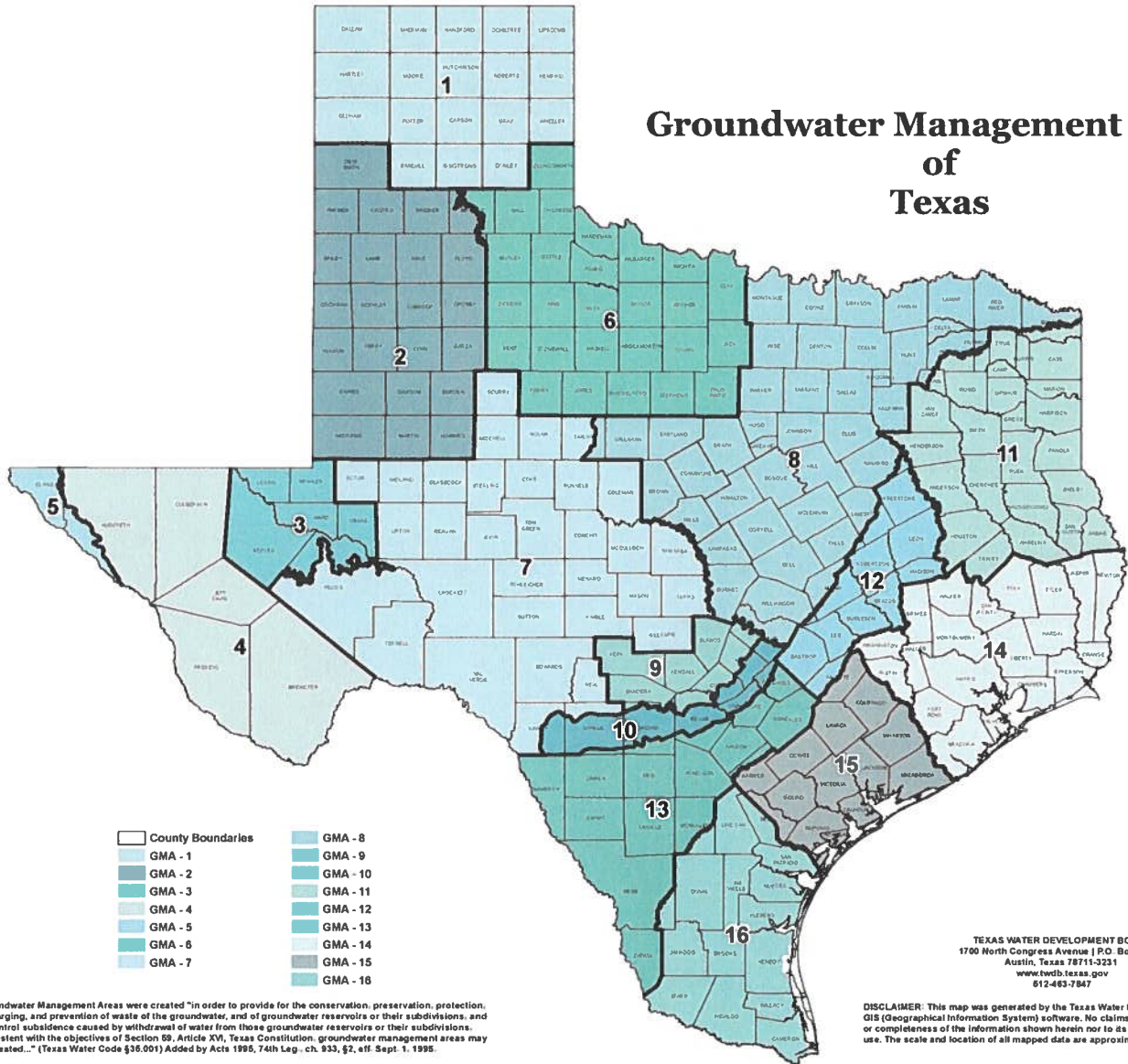
County Boundaries	GMA - 8
GMA - 1	GMA - 9
GMA - 2	GMA - 10
GMA - 3	GMA - 11
GMA - 4	GMA - 12
GMA - 5	GMA - 13
GMA - 6	GMA - 14
GMA - 7	GMA - 15
	GMA - 16

Groundwater Management Areas were created "in order to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater management areas may be created..." (Texas Water Code §35.001) Added by Acts 1995, 74th Leg., ch. 933, §2, eff. Sept. 1, 1995.

The responsibility for Groundwater Management Area delineation was delegated to the Texas Water Development Board (Section 35.004, Chapter 35, Title 2, Texas Water Code) The initial Groundwater Management Area delineations were adopted on December 15, 2002 (356.23, TWDB Rules)

TNRIS

DISCLAIMER: This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Map date: JULY 2015

0 25 50 100
Miles

MISSION: The Texas Water Development Board's (TWDB) mission is to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.

Texas Water Development Board

APPENDIX I

GAM Run 21-013 MAG:
Modeled Available Groundwater for the Aquifers in Groundwater Management Area 8

Jerry Shi, Ph.D., P.G. and Jevon Harding, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-5076
November 1, 2022

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Geoscientist Seals

The following professional geoscientists contributed to this conceptual model report and associated data compilation and analyses:

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

> Dr. Shi was responsible for the calculations to verify the attainability of desired future conditions and the calculations of modeled available groundwater values. He was the primary author of the report.
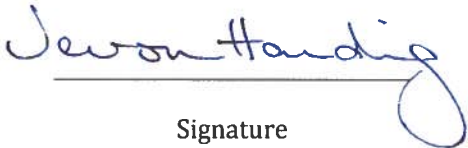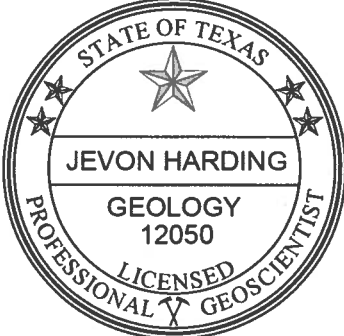
Signature   11/10/2022 Date

Jevon Harding, P.G.

> Ms. Harding was responsible for editing the report and adding additional documentation as necessary to meet TWDB standards after Dr. Shi had left the agency.

Signature   11/3/2022   Date

GAM Run 21-013 MAG:
Modeled Available Groundwater for the Aquifers in Groundwater Management Area 8

Jerry Shi, Ph.D., P.G. and Jevon Harding, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-5076
November 1, 2022

EXECUTIVE SUMMARY:

The Texas Water Development Board (TWDB) has prepared estimates of the modeled available groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Groundwater Management Area 8. The modeled available groundwater estimates are based on the revised desired future conditions for these aquifers adopted by groundwater conservation districts in Groundwater Management Area 8 on July 26, 2022. The district representatives declared the Nacatoch, Blossom, Brazos River Alluvium, and Cross Timbers aquifers to be non-relevant for purposes of joint planning. After review, the TWDB determined that the explanatory report and other materials submitted by the district representatives were administratively complete on September 23, 2022.

The modeled available groundwater values are summarized by decade by groundwater conservation district and county (Tables 1 through 12) and by county, regional water planning area, and river basin for use in the regional water planning process (Tables 13 through 24). The modeled available groundwater in Groundwater Management Area 8 is described below:

- Trinity Aquifer (Paluxy aquifer) – The modeled available groundwater is approximately 24,520 acre-feet per year during the period from 2020 to 2080.

- Trinity Aquifer (Glen Rose Formation) – The modeled available groundwater is approximately 12,410 acre-feet per year during the period from 2020 to 2080.

- Trinity Aquifer (Twin Mountains Formation) – The modeled available groundwater is approximately 45,510 acre-feet per year during the period from 2020 to 2080.

- Trinity Aquifer (Travis Peak Formation) – The modeled available groundwater is approximately 98,230 acre-feet per year during the period from 2020 to 2080.

- Trinity Aquifer (Hensell aquifer) – The modeled available groundwater is approximately 27,120 acre-feet per year during the period from 2020 to 2080.

- Trinity Aquifer (Hosston aquifer) – The modeled available groundwater is approximately 67,730 acre-feet per year during the period from 2020 to 2080.

- Trinity Aquifer (Antlers Formation) – The modeled available groundwater is approximately 78,440 acre-feet per year during the period from 2020 to 2080.

- Woodbine Aquifer – The modeled available groundwater is approximately 30,570 acre-feet per year during the period from 2020 to 2080.

- Edwards (Balcones Fault Zone) Aquifer – The modeled available groundwater is approximately 15,170 acre-feet per year during the period from 2020 to 2080.

- Marble Falls Aquifer – The modeled available groundwater is approximately 5,630 acre-feet per year during the period from 2020 to 2080.

- Ellenburger-San Saba Aquifer – The modeled available groundwater is approximately 14,060 acre-feet per year during the period from 2020 to 2080.

- Hickory Aquifer – The modeled available groundwater is approximately 3,580 acre-feet per year during the period from 2020 to 2080.

Modeled available groundwater estimates are also provided by outcrop and downdip areas for the counties within Upper Trinity Groundwater Conservation District to be consistent with that district's desired future conditions statements.

The modeled available groundwater values estimated for counties may be slightly different from those estimated for groundwater conservation districts because of the process for rounding the values.

REQUESTOR:

Mr. Drew Satterwhite, General Manager of North Texas Groundwater Conservation District and Groundwater Management Area 8 Coordinator at the time of request.

DESCRIPTION OF REQUEST:

In a letter dated January 4, 2022, Mr. Drew Satterwhite provided the TWDB with the desired future conditions of the Trinity Aquifer subunits (Paluxy, Glen Rose, Twin Mountains, Travis Peak, Hensell, Hosston, and Antlers formations), and the Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers. After review of the submittal, the TWDB identified missing or corrupted model files and received updated versions from Groundwater Management Area 8 on March 3, 2022. Following the TWDB analysis to verify the achievability of the adopted desired future conditions, the TWDB identified desired future conditions that were unachievable. Groundwater Management Area 8 confirmed that these were typos and adopted a revised version of the desired future conditions resolution on July 26, 2022. The following sections present the final adopted desired future conditions:

Trinity and Woodbine aquifers

The desired future conditions for the Trinity and Woodbine aquifers are expressed as water level decline, or drawdown, in feet from January 1, 2010, to December 31, 2080 (Groundwater Management Area 8, 2021).

The county-based desired future conditions for the Trinity Aquifer subunits, excluding counties in the Upper Trinity Groundwater Conservation District, are listed in Table 1 (dashes indicate areas where the subunits do not exist):

TABLE 1. **DESIRED FUTURE CONDITIONS IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY COUNTY FOR THE NORTHERN TRINITY AND WOODBINE AQUIFERS. VALUES REPRESENT AVERAGE DRAWDOWN IN FEET BETWEEN JANUARY 1, 2010, AND DECEMBER 31, 1980.**

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Bell	—	17	83	—	333	145	375	—
Bosque	—	6	53	—	189	139	232	—
Bowie	—	—	—	—	—	—	—	—
Brown	—	—	1	—	2	1	1	2
Burnet	—	—	2	—	19	7	21	—
Callahan	—	—	—	—	—	—	—	1
Collin	482	729	366	560	—	—	—	596
Comanche	—	—	2	—	4	2	3	12

TABLE 2 (CONT). **DESIRED FUTURE CONDITIONS IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY COUNTY FOR THE NORTHERN TRINITY AND WOODBINE AQUIFERS. VALUES REPRESENT AVERAGE DRAWDOWN IN FEET BETWEEN JANUARY 1, 2010, AND DECEMBER 31, 1980.**

County	Woodbine	Paluxy	Glen Rose	Twin Mountains	Travis Peak	Hensell	Hosston	Antlers
Cooke	2	—	—	—	—	—	—	191
Coryell	—	5	15	—	107	70	141	—
Dallas	137	346	288	515	415	362	419	—
Delta	—	279	198	—	202	—	—	—
Denton	22	558	367	752	—	—	—	416
Eastland	—	—	—	—	—	—	—	4
Ellis	76	128	220	413	380	290	390	—
Erath	—	6	6	8	25	12	35	14
Falls	—	159	238	—	505	296	511	—
Fannin	259	709	305	400	291	—	—	269
Franklin	—	—	—	—	—	—	—	—
Grayson	163	943	364	445	—	—	—	364
Hamilton	—	2	4	—	26	14	38	—
Hill	20	45	149	—	365	211	413	—
Hopkins	—	—	—	—	—	—	—	—
Hunt	631	610	326	399	350	—	—	—
Johnson	4	-57	66	184	235	120	329	—
Kaufman	242	311	305	427	372	349	345	—
Lamar	42	100	107	—	125	—	—	132
Lampasas	—	—	1	—	6	1	11	—
Limestone	—	199	301	—	433	214	445	—
McLennan	6	41	148	—	504	242	582	—
Milam	—	—	241	—	412	261	412	—
Mills	—	1	1	—	9	2	13	—
Navarro	110	139	266	—	343	295	343	—
Rains	—	—	—	—	—	—	—	—
Red River	2	24	40	—	57	—	—	15
Rockwall	275	433	343	466	—	—	—	—
Somervell	—	4	4	50	64	17	120	—
Tarrant	6	105	163	348	—	—	—	177
Taylor	—	—	—	—	—	—	—	0
Travis	—	—	90	—	219	68	226	—
Williamson	—	—	78	—	220	89	225	—

The desired future conditions for the counties in the Upper Trinity Groundwater Conservation District are further divided into outcrop and downdip areas, and are listed in Table 2 (dashes indicate areas where the subunits do not exist):

TABLE 2.   **THE DESIRED FUTURE CONDITIONS FOR THE UPPER TRINITY GROUNDWATER CONSERVTION DISTRICT IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY AQUIFER. VALUES REPRESENT AVERAGE DRAWDOWN IN FEET BETWEEN JANUARY 1, 2010, AND DECEMBER 31, 1980.**

County	Antlers	Paluxy	Glen Rose	Twin Mountains
Hood -Outcrop	—	6	9	13
Hood-Downdip	—	—	39	72
Montague-Outcrop	40	—	—	—
Montague-Downdip	—	—	—	—
Parker-Outcrop	42	6	20	7
Parker-Downdip	—	2	50	68
Wise-Outcrop	60	—	—	—
Wise-Downdip	154	—	—	—

Edwards (Balcones Fault Zone) Aquifer

The desired future conditions adopted by Groundwater Management Area 8 for the Edwards (Balcones Fault Zone) Aquifer are to maintain minimum streamflow and springflow under a repeat of the drought of record in Bell, Travis, and Williamson counties from January 1, 2010, to December 31, 2080 (Groundwater Management Area 8, 2021). The desired future conditions are listed in Table 3:

TABLE 3.   **THE DESIRED FUTURE CONDITIONS IN GROUNDWATER MANAGEMENT AREA (GMA) 8 BASED ON SPRING/STREAM FLOW FOR SELECTED COUNTIES. THESE CONDITIONS ARE TO BE MAINTAINED BETWEEN JANUARY 1, 2010, AND DECEMBER 31, 1980.**

County	Adopted Desired Future Condition
Bell	Maintain at least 100 acre-feet per month of stream/spring flow in Salado Creek during a repeat of the drought of record
Travis	Maintain at least 42 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record
Williamson	Maintain at least 60 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record

Marble Falls, Ellenburger-San Saba, and Hickory aquifers

The desired future conditions for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties are defined as water level decline, or drawdown, in feet from January 1, 2010, to December 31, 2080 (Groundwater Management Area 8, 2021). The desired future conditions are listed in Table 4:

TABLE 4.   DESIRED FUTURE CONDITIONS IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY COUNTY FOR THE LLANO UPLIFT AQUIFERS. VALUES REPRESENT AVERAGE DRAWDOWN IN FEET BETWEEN JANUARY 1, 2010, AND DECEMBER 31, 1980.

County	Ellenburger-San Saba	Hickory	Marble Falls
Brown	3	3	3
Burnet	12	11	11
Lampasas	16	16	16
Mills	9	9	9

METHODS:

The desired future conditions for Groundwater Management Area 8 are based on multiple criteria. The methods to calculate the desired future conditions are discussed below.

Trinity and Woodbine aquifers

The desired future conditions for the Trinity and Woodbine aquifers in Groundwater Management Area 8 are based on the predictive simulation "Run 11" (Groundwater Management area 8, 2021), which was constructed as an extension of the groundwater availability model for the northern portion of the Trinity and Woodbine aquifers (Kelley and others, 2014).

The average drawdowns between January 1, 2010 (initial water levels) and December 31, 2080 (stress period 71) were calculated using a composite water levels methodology, described in Appendix A. Appendix A also presents the calculated average drawdown results for the Trinity and Woodbine aquifers that the TWDB used to verify that the pumping scenario in the submitted model files achieved the desired future conditions. The modeled available groundwater values were determined by extracting pumping rates by decade from the MODFLOW cell-by-cell budget files using custom Fortran scripts developed by the TWDB.

Edwards (Balcones Fault Zone) Aquifer

Groundwater Management Area 8 requested that the results from the previous GAM Run 08-010 MAG (Anaya, 2008) be used, unchanged, for the current round of joint planning. That model run includes a ten-year predictive period that represents a simulated repeat of the drought of record in the 1950s. The modeled available groundwater values were determined using the monthly stress period within that predictive period with the lowest monthly springflow volume, which was assumed to represent the worst-case scenario for Salado Springs during a potential repeat of the 1950s drought of record.

Marble Falls, Ellenburger-San Saba, and Hickory aquifers

The desired future conditions for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties within Groundwater Management Area 8 are based on a predictive simulation constructed by Groundwater Management Area 8 for planning purposes (Groundwater Management Area 8, 2021). This simulation is an extension of the groundwater availability model for the minor aquifers in the Llano Uplift region by Shi and others (2016). Modeled water levels were extracted for January 1, 2010 (initial water levels) and December 31, 2080 (stress period 71) and drawdown calculated as the difference in water level between those two endpoints. Drawdown averages were calculated by aquifer for each area specified in the desired future conditions. Additional details on the predictive simulation and methods to calculate the drawdowns are described in Appendix B. Appendix B also presents the calculated average drawdown results for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers that the TWDB used to verify that the pumping scenario in the submitted model files achieved the desired future conditions. The modeled available groundwater values were determined by extracting pumping rates by decade from the MODFLOW cell-by-cell budget files using custom Fortran scripts developed by the TWDB.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), "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 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.

PARAMETERS AND ASSUMPTIONS:

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

Trinity and Woodbine Aquifers

- Version 2.01 of the updated groundwater availability model for the northern Trinity and Woodbine aquifers was the base model for this analysis. See Kelley and others (2014) for the assumptions and limitations of the historical calibrated model. Groundwater Management Area 8 constructed a predictive model simulation to

extend the base model to 2080 for planning purposes. See Appendix E of Groundwater Management Area 8 (2021) for the assumptions of this predictive model simulation.

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

- The model has eight layers that represent units younger than the Woodbine Aquifer and the shallow outcrop of all aquifers (Layer 1), the Woodbine Aquifer (Layer 2), the Fredericksburg and Washita units (Layer 3), and various combinations of the subunits that comprise the Trinity Aquifer (Layers 4 to 8).

- To be consistent with Groundwater Management Area 8, the TWDB model grid files dated August 26, 2015 (*trnt_n_grid_poly082615.csv* and *wdbn_grid_poly082615.csv* for the Trinity and Woodbine aquifers, respectively) were used to assign model cells to counties, groundwater management areas, groundwater conservation districts, river basins, and regional water planning areas.

- Drawdown was calculated as the difference in modeled water levels between the baseline date of January 1, 2010 (initial water levels) and the final date of December 31, 2080 (stress period 71) using a composite water level methodology described in Appendix A.

- During the predictive simulation model run, some model cells went dry, meaning the modeled water level fell below the bottom of the cell. The dry cell count at the baseline date of January 1, 2010 (initial water levels) and final date of December 31, 2080 (stress period 71) is presented in Table C1 of Appendix C. Appendix A describes how dry cells were handled in the drawdown calculations using the composite water level methodology. Pumping in dry cells was excluded from the modeled available groundwater calculations.

- The drawdown averages and modeled available groundwater values were calculated using the official TWDB boundaries for the Trinity and Woodbine aquifers.

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

Edwards (Balcones Fault Zone) Aquifer

- Version 1.01 of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer was the base model for this analysis. See Jones (2003) for the assumptions and limitations of the historical calibrated model. During the previous planning cycle, a predictive model simulation was constructed

to extend the base model and include a simulated repeat of the 1950s drought of record for planning purposes. See the previous GAM Run 08-010 MAG (Anaya, 2008) for the assumptions of this predictive model simulation.

- The model has one layer that represents the Edwards (Balcones Fault Zone) Aquifer.

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

- The modeled available groundwater values were determined using the monthly stress period within the predictive drought period with the lowest monthly springflow volume, which was assumed to represent the worst-case scenario for Salado Springs during a potential repeat of the 1950s drought of record.

- The modeled available groundwater values were calculated using the official TWDB Edwards (Balcones Fault Zone) Aquifer boundary.

- To be consistent with Groundwater Management Area 8, the TWDB model grid file dated August 26, 2015 (*ebfz_n_grid_poly082615.csv*) was used to assign model cells to counties, groundwater management areas, groundwater conservation districts, river basins, and regional water planning areas.

- Estimates of modeled streamflow and springflow from the model simulation were rounded to whole numbers.

Marble Falls, Ellenburger-San Saba, and Hickory Aquifers

- Version 1.01 of the groundwater availability model for the minor aquifers in the Llano Uplift region was the base model for this analysis. See Shi and others (2016) for the assumptions and limitations of the historical calibrated model. Groundwater Management Area 8 constructed a predictive model simulation to extend the base model to 2080 for planning purposes. See Groundwater Management Area 8 (2021) for the assumptions of this predictive model simulation.

- The model has eight layers: Layer 1 (the Trinity Aquifer, Edwards-Trinity (Plateau) Aquifer, and younger alluvium deposits), Layer 2 (confining units), Layer 3 (the Marble Falls Aquifer and equivalent unit), Layer 4 (confining units), Layer 5 (Ellenburger-San Saba Aquifer and equivalent unit), Layer 6 (confining units), Layer 7 (the Hickory Aquifer and equivalent unit), and Layer 8 (Precambrian units).

- The model was run with MODFLOW-USG beta (development) version (Panday and others, 2013).

- To be consistent with Groundwater Management Area 8, the TWDB model grid file dated January 7, 2016 (*lnup_grid_poly010716.csv*) was used to assign model cells to

counties, groundwater management areas, groundwater conservation districts, river basins, and regional water planning areas.

- Drawdown was calculated as the difference in modeled water level between the baseline date of January 1, 2010 (initial water levels) and the final date of December 31, 2080 (stress period 71), using the methodology described in Appendix B.

- During the predictive model run, some active model cells went dry, meaning the modeled water level fell below the bottom of the cell. The dry cell count at the baseline date of January 1, 2010 (initial water levels) and final date of December 31, 2080 (stress period 71) is presented in Table C2 of Appendix C). Appendix B describes how dry cells were handled in the drawdown calculations. Pumping in dry cells was excluded from the modeled available groundwater.

- To be consistent with the desired future conditions defined by Groundwater Management Area 8, the drawdown averages and modeled available groundwater values were calculated using the active model extent of Layers 3, 5, and 7 (Figures 10 through 12) for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers, respectively, rather than the official TWDB boundaries for these aquifers.

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

RESULTS:

The modeled available groundwater for the Trinity, Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers are listed below:

- Trinity Aquifer (Paluxy aquifer) – The modeled available groundwater is approximately 24,520 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 5) and by county, regional water planning group, and river basin (Table 17).

- Trinity Aquifer (Glen Rose Formation) – The modeled available groundwater is approximately 12,410 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 6) and by county, regional water planning group, and river basin (Table 18).

- Trinity Aquifer (Twin Mountains Formation) – The modeled available groundwater is approximately 45,510 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 7) and by county, regional water planning group, and river basin (Table 19).

- Trinity Aquifer (Travis Peak Formation) – The modeled available groundwater is approximately 98,230 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 8) and by county, regional water planning group, and river basin (Table 20).

- Trinity Aquifer (Hensell aquifer) – The modeled available groundwater is approximately 27,120 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 9) and by county, regional water planning group, and river basin (Table 21).

- Trinity Aquifer (Hosston aquifer) – The modeled available groundwater is approximately 67,730 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 10) and by county, regional water planning group, and river basin (Table 22).

- Trinity Aquifer (Antlers Formation) – The modeled available groundwater is approximately 78,440 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 11) and by county, regional water planning group, and river basin (Table 23).

- Woodbine Aquifer – The modeled available groundwater is approximately 30,570 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 12) and by county, regional water planning group, and river basin (Table 24).

- Edwards (Balcones Fault Zone) Aquifer – The modeled available groundwater is approximately 15,170 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 13) and by county, regional water planning group, and river basin (Table 25).

- Marble Falls Aquifer – The modeled available groundwater is approximately 5,630 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 14) and by county, regional water planning group, and river basin (Table 26).

- Ellenburger-San Saba Aquifer – The modeled available groundwater is approximately 14,060 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 15) and by county, regional water planning group, and river basin (Table 27).

- Hickory Aquifer – The modeled available groundwater is approximately 3,580 acre-feet per year during the period from 2020 to 2080. Values are summarized by groundwater conservation district and county (Table 16) and by county, regional water planning group, and river basin (Table 28).

Figures 1 through 7 show the extent of the Trinity Aquifer subunits (Paluxy, Glen Rose, Twin Mountains, Travis Peak, Hensell, Hosston, and Antlers formations, respectively). Figures 8 through 12 show the extent of the Woodbine, Edwards (Balcones Fault Zone), Marble Falls, Ellenburger-San Saba, and Hickory aquifers, respectively. Figure 13 shows the county, groundwater conservation district, regional water planning area, and river basin boundaries represented by the divisions in Tables 5 to 28.
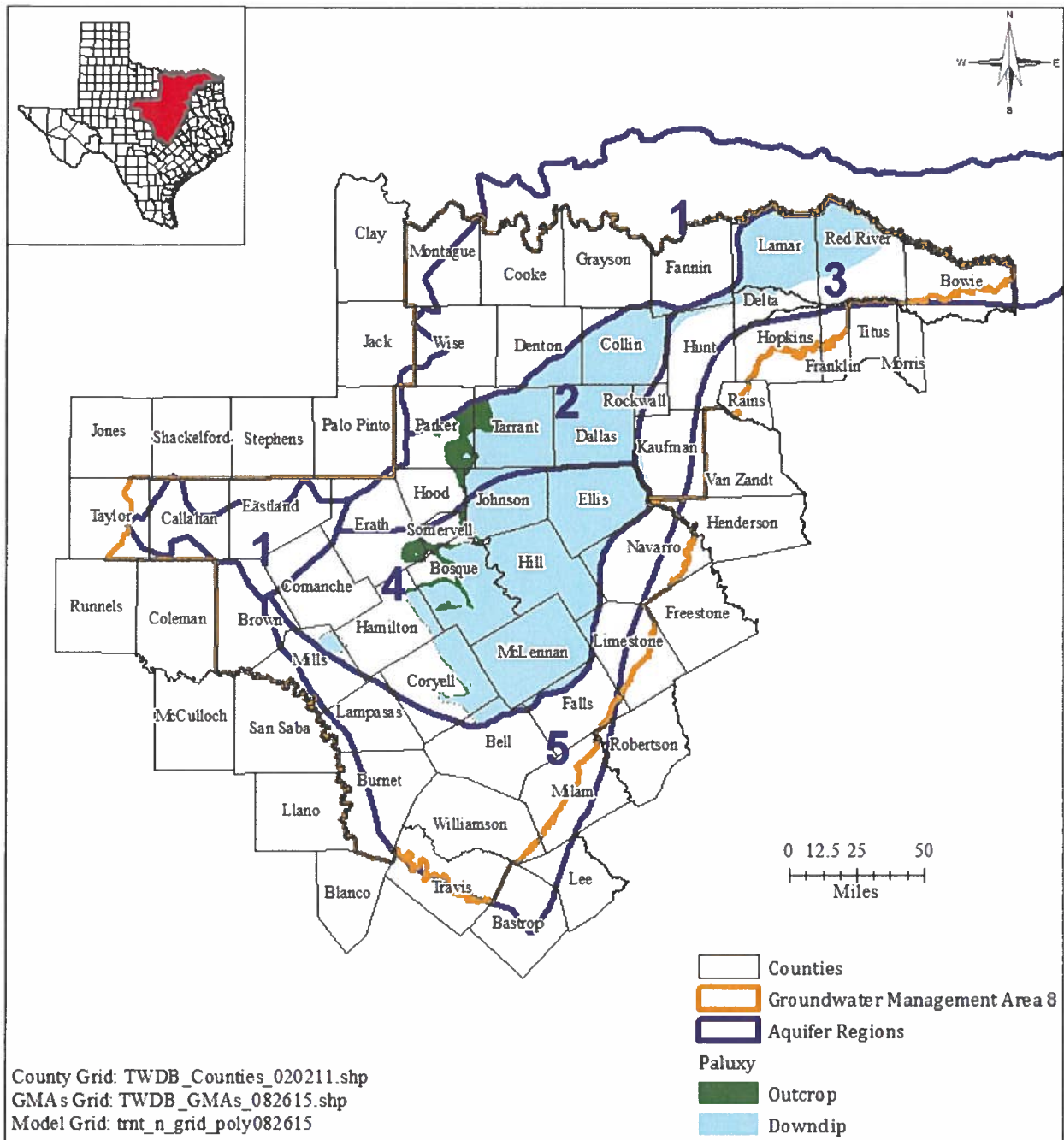
FIGURE 1. **MAP SHOWING THE TRINITY AQUIFER (PALUXY) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
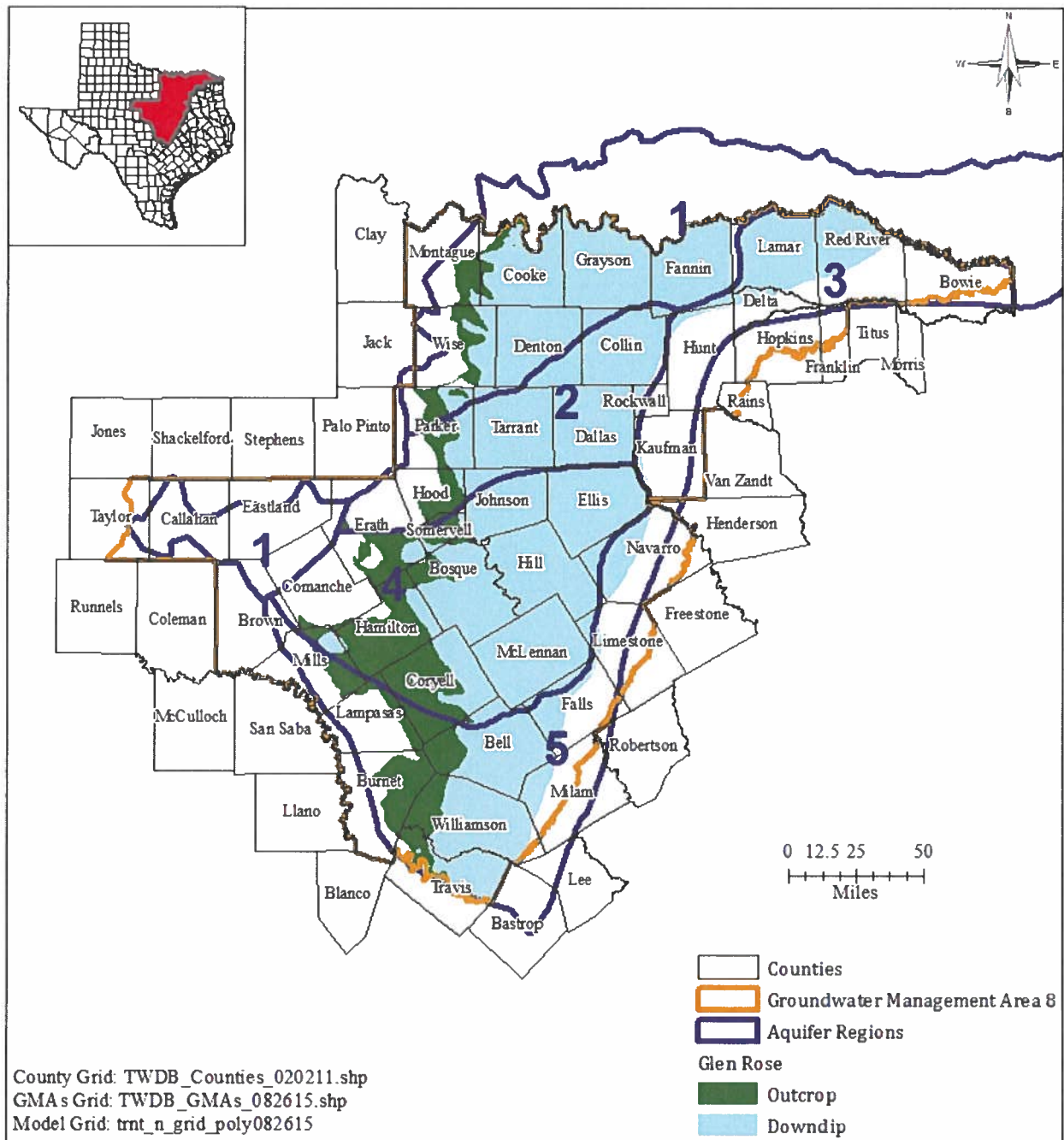
FIGURE 2. **MAP SHOWING THE TRINITY AQUIFER (GLEN ROSE) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
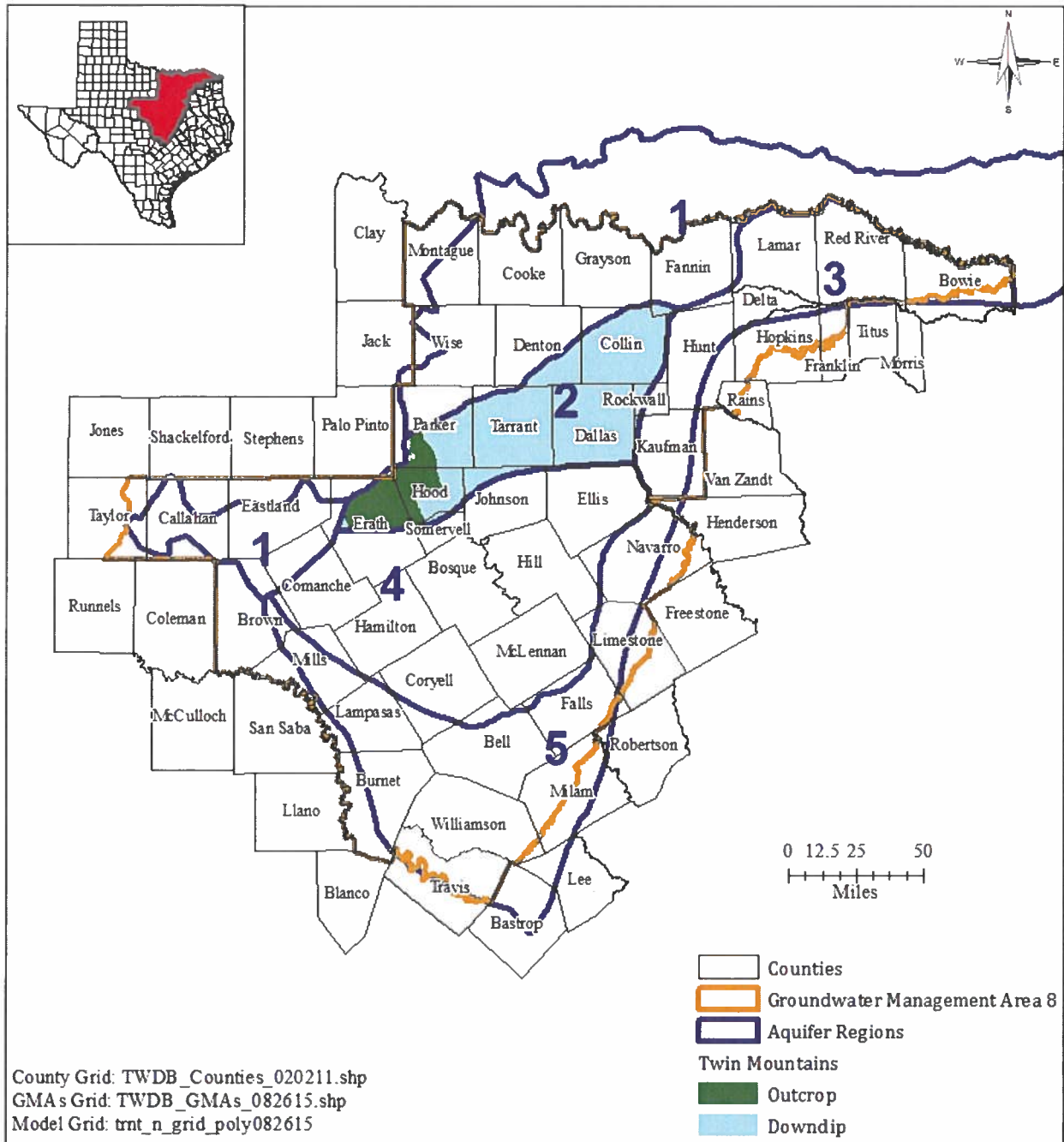
FIGURE 3. **MAP SHOWING THE TRINITY AQUIFER (TWIN MOUNTAINS) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
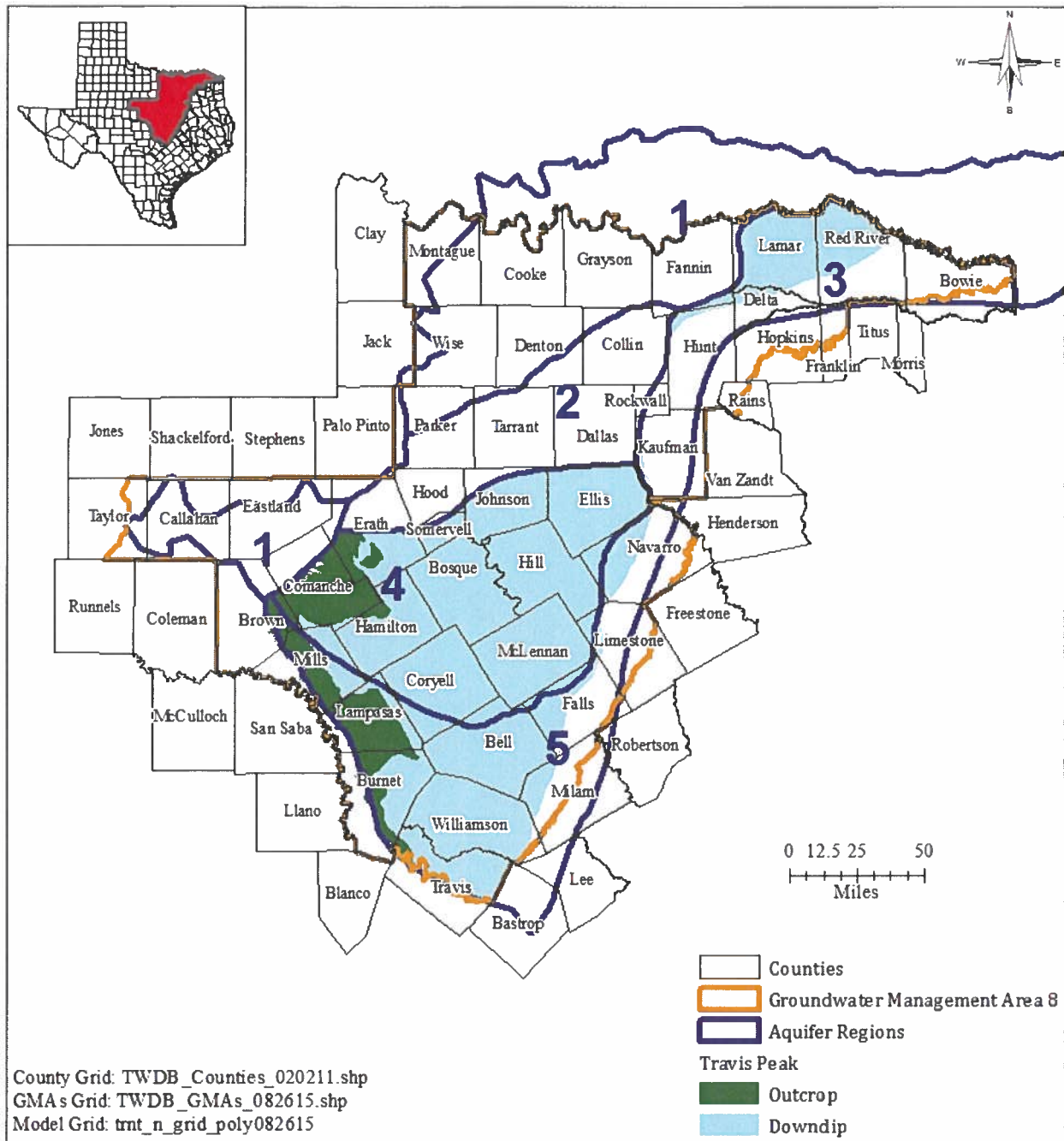
FIGURE 4. **MAP SHOWING THE TRINITY AQUIFER (TRAVIS PEAK) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
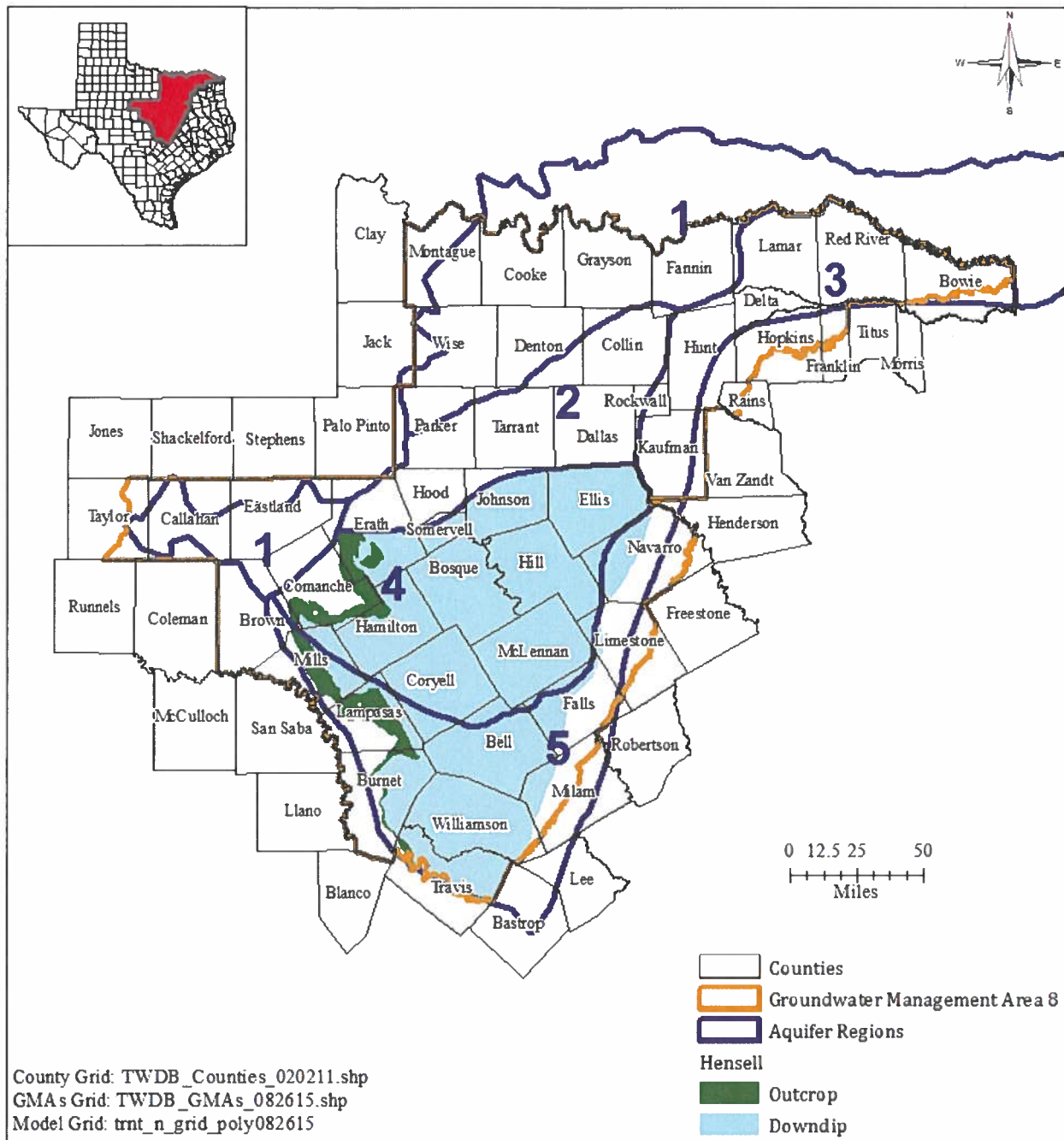
FIGURE 5. **MAP SHOWING THE TRINITY AQUIFER (HENSELL) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
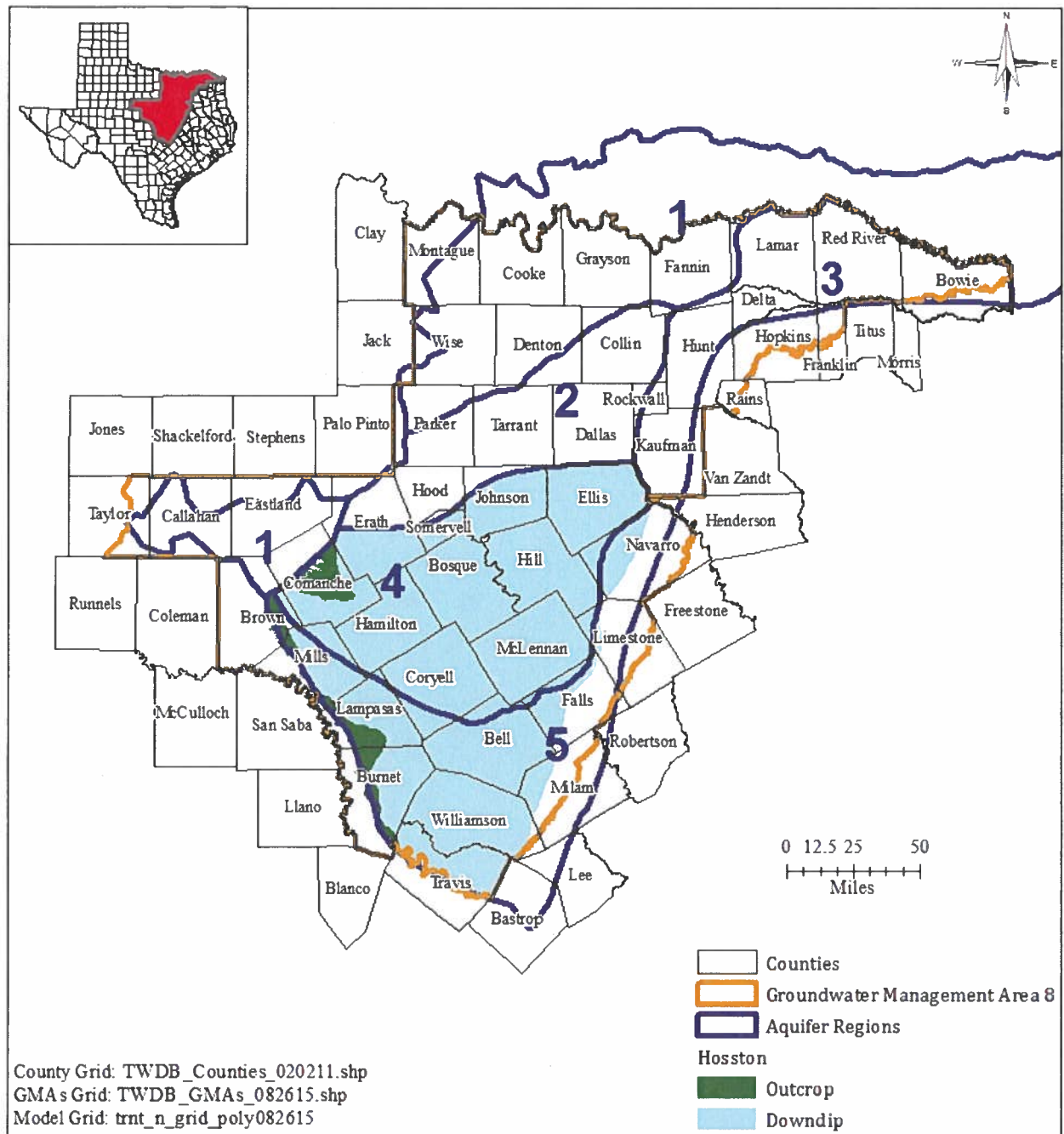
FIGURE 6. **MAP SHOWING THE TRINITY AQUIFER (HOSSTON) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR NORTHERN PORTION OF THE TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
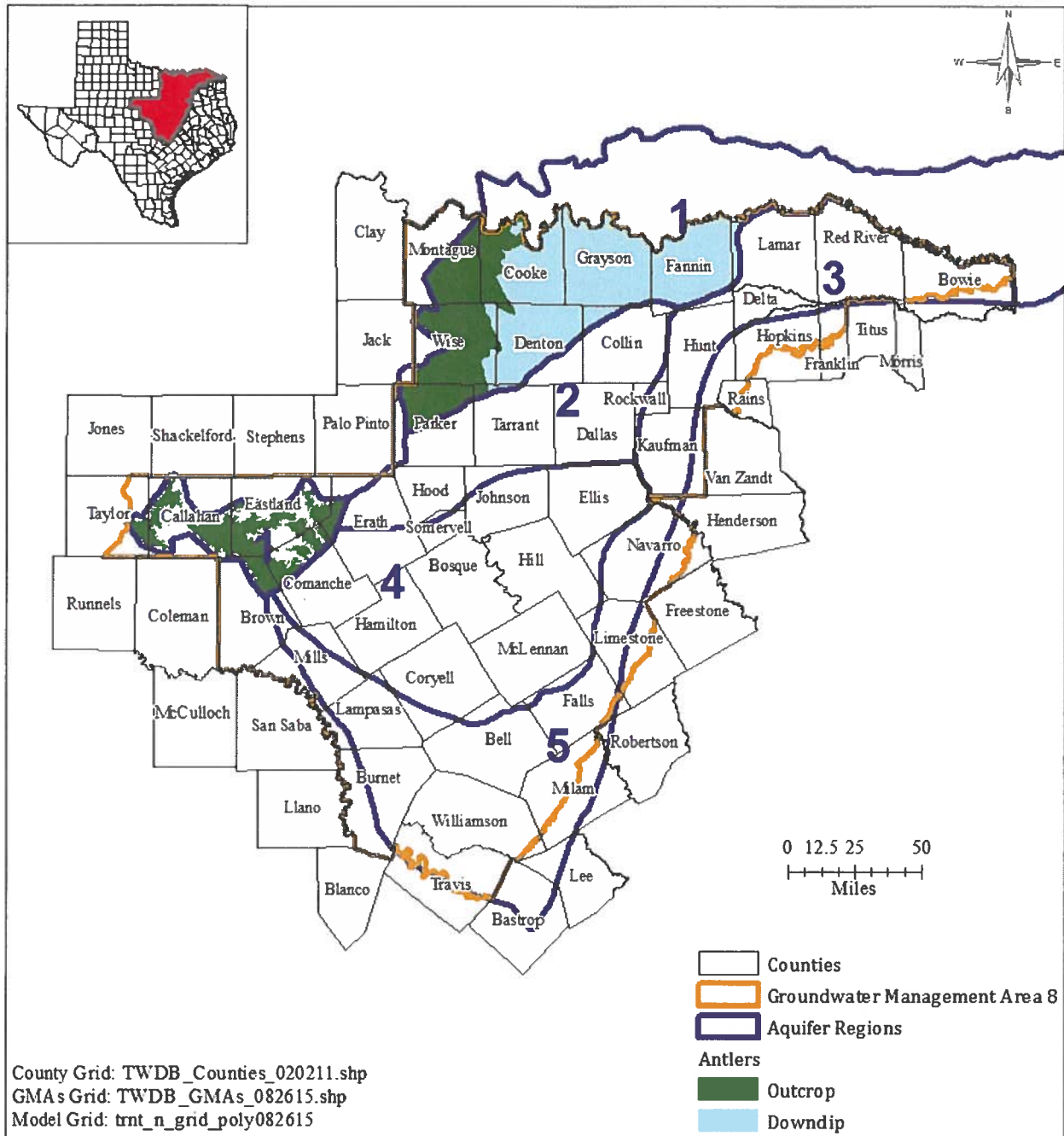
FIGURE 7. **MAP SHOWING THE TRINITY AQUIFER (ANTLERS) WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS. SEE APPENDIX A FOR AQUIFER REGION DETAILS.**
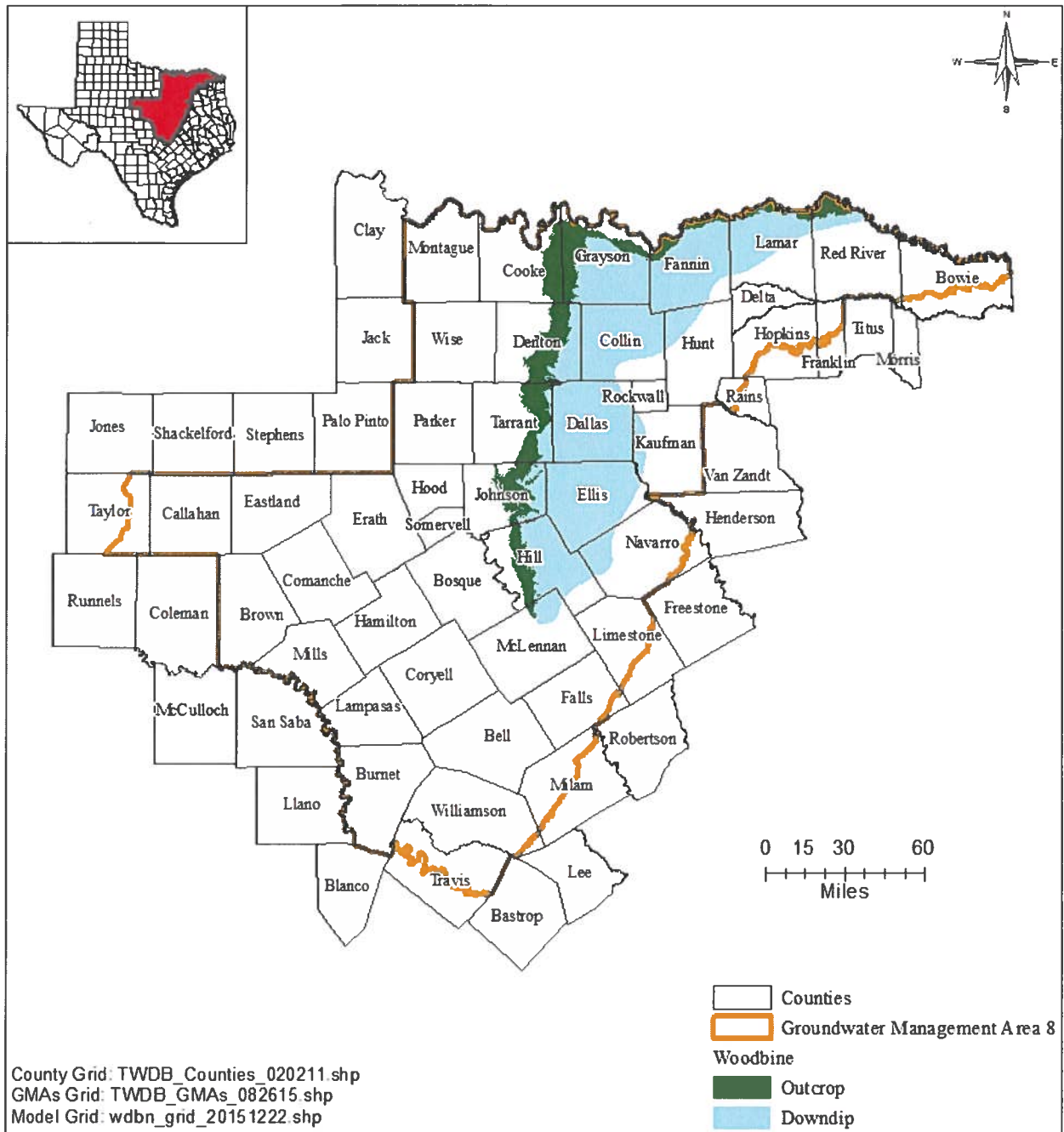
FIGURE 8. **MAP SHOWING THE WOODBINE AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF TRINITY AND WOODBINE AQUIFERS.**
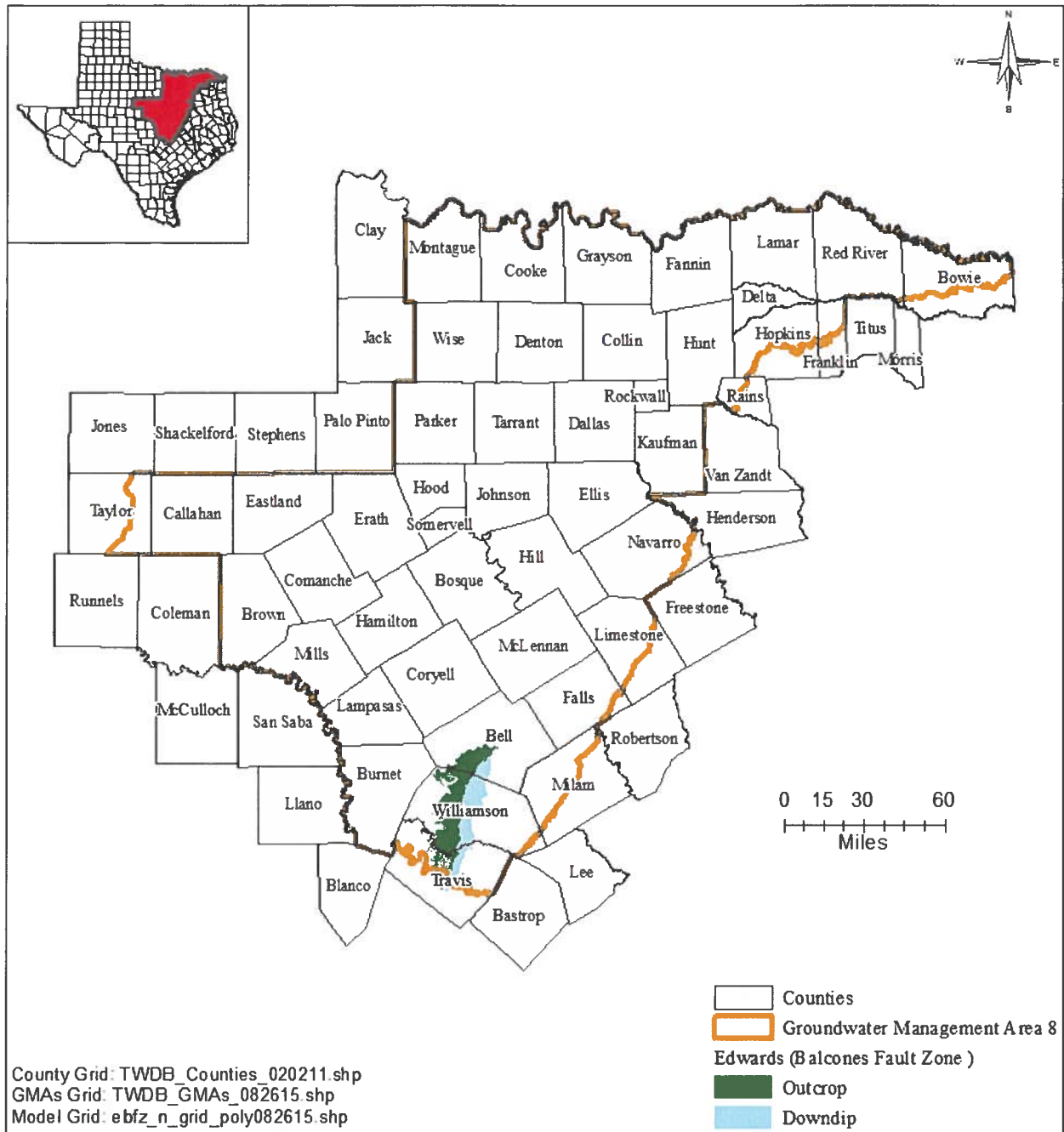
FIGURE 9. **MAP SHOWING THE EDWARDS (BALCONES FAULT ZONE) AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN SEGMENT OF EDWARDS (BALCONES FAULT ZONE) AQUIFER.**
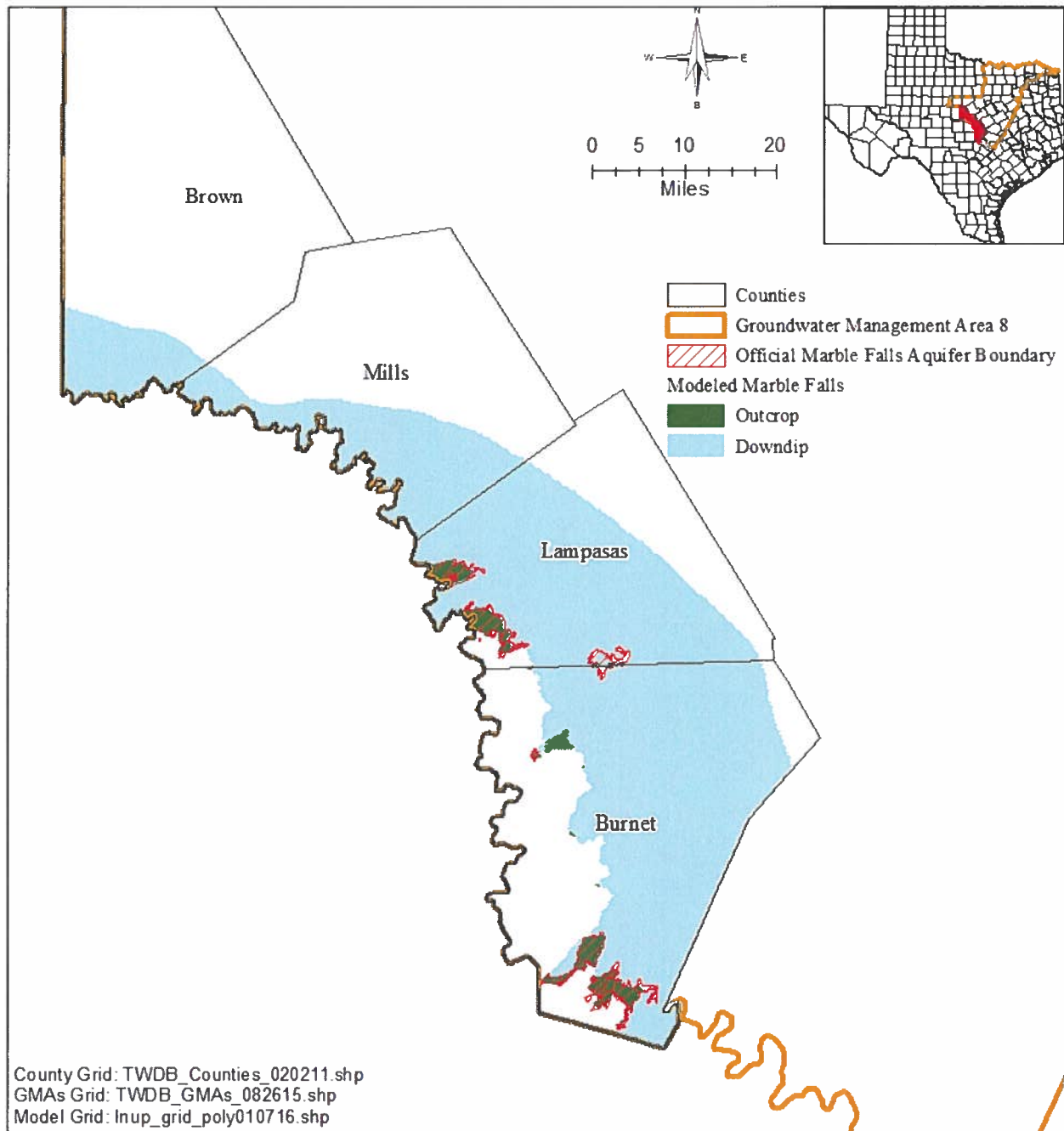
FIGURE 10. **MAP SHOWING THE MARBLE FALLS AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN THE LLANO UPLIFT REGION.**
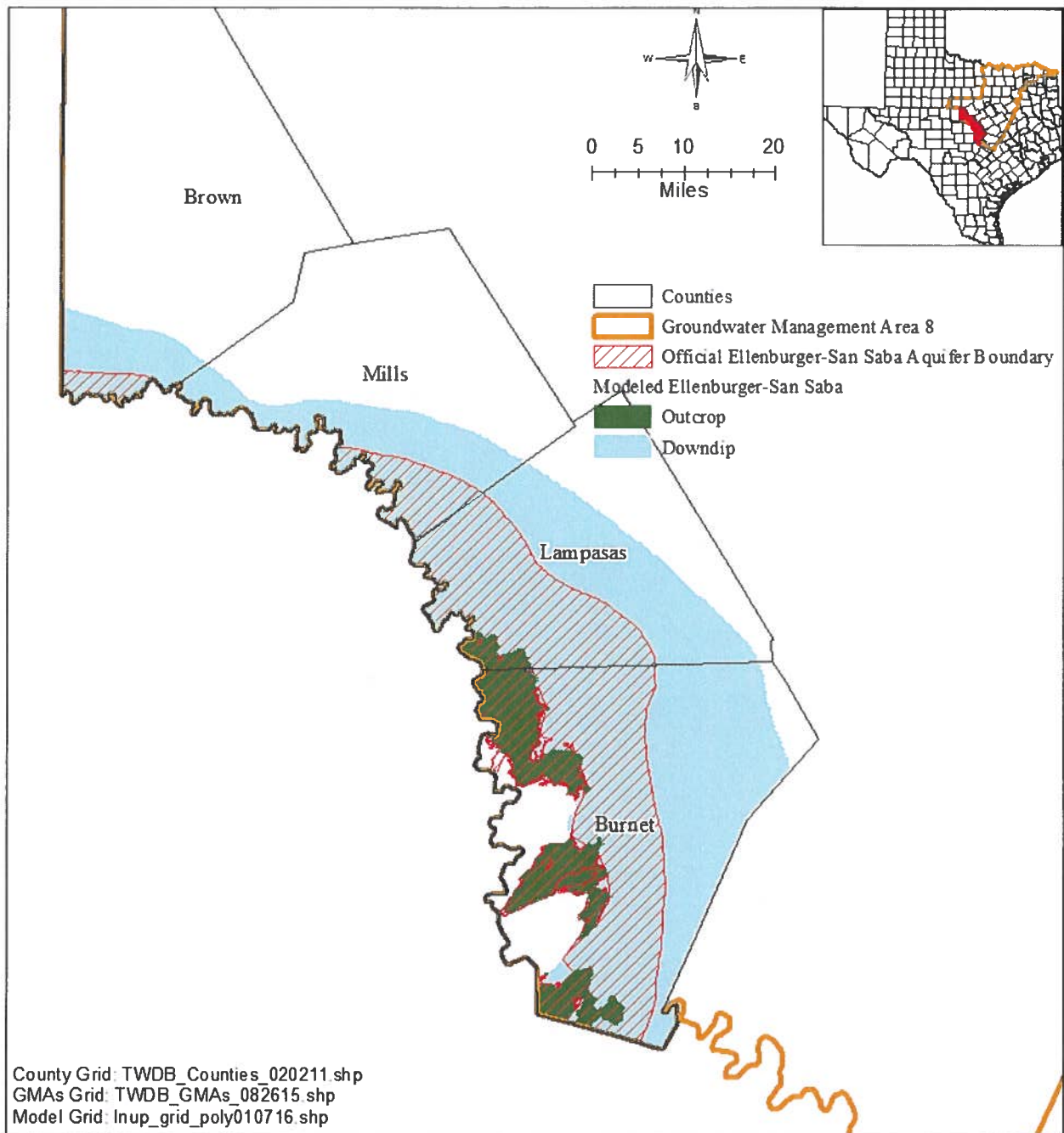
FIGURE 11.   MAP SHOWING THE ELLENBURGER-SAN SABA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN THE LLANO UPLIFT REGION.
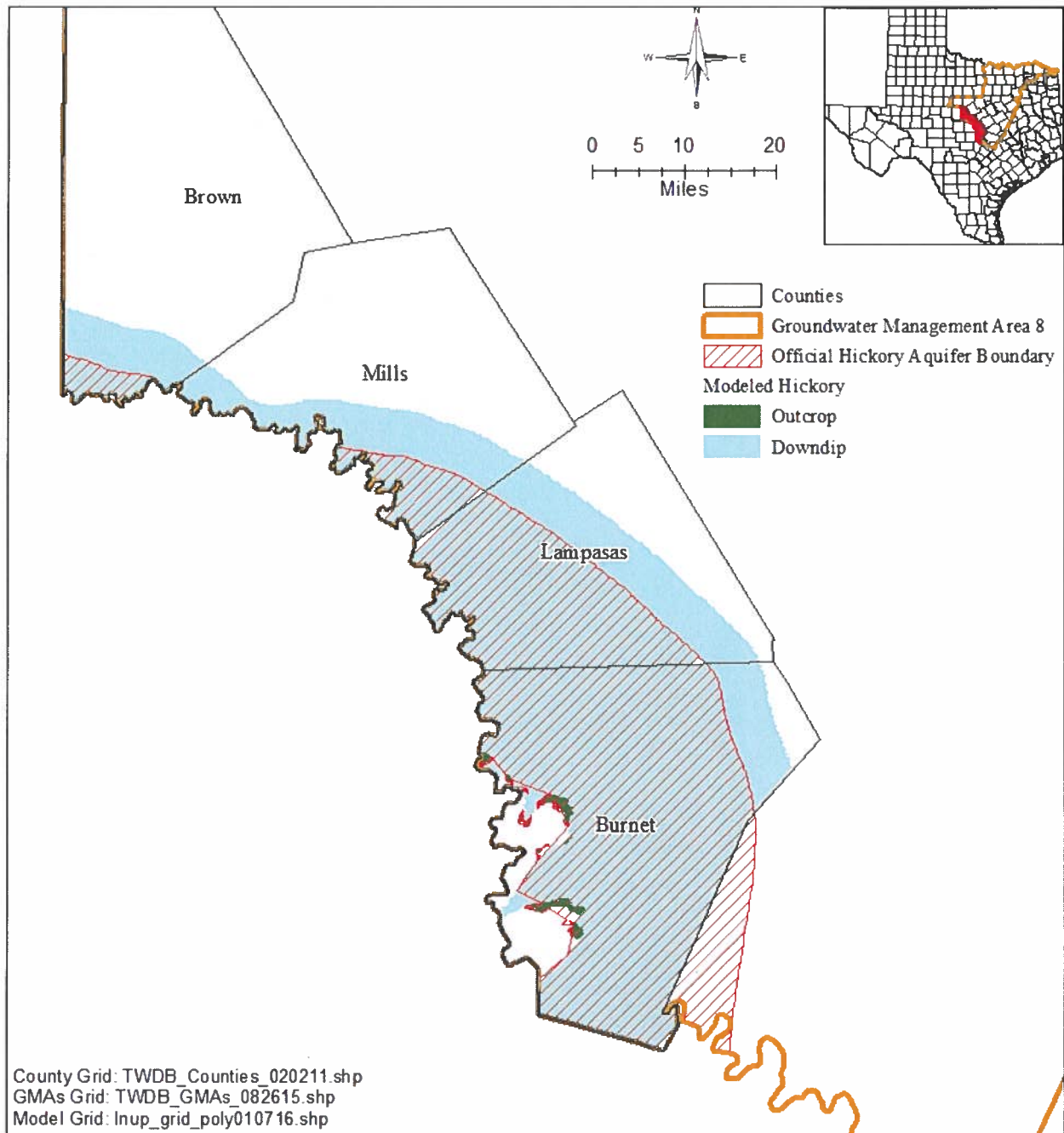
FIGURE 12.   MAP SHOWING THE HICKORY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 8 FROM THE GROUNDWATER AVAILABILITY MODEL FOR THE MINOR AQUIFERS IN THE LLANO UPLIFT REGION.
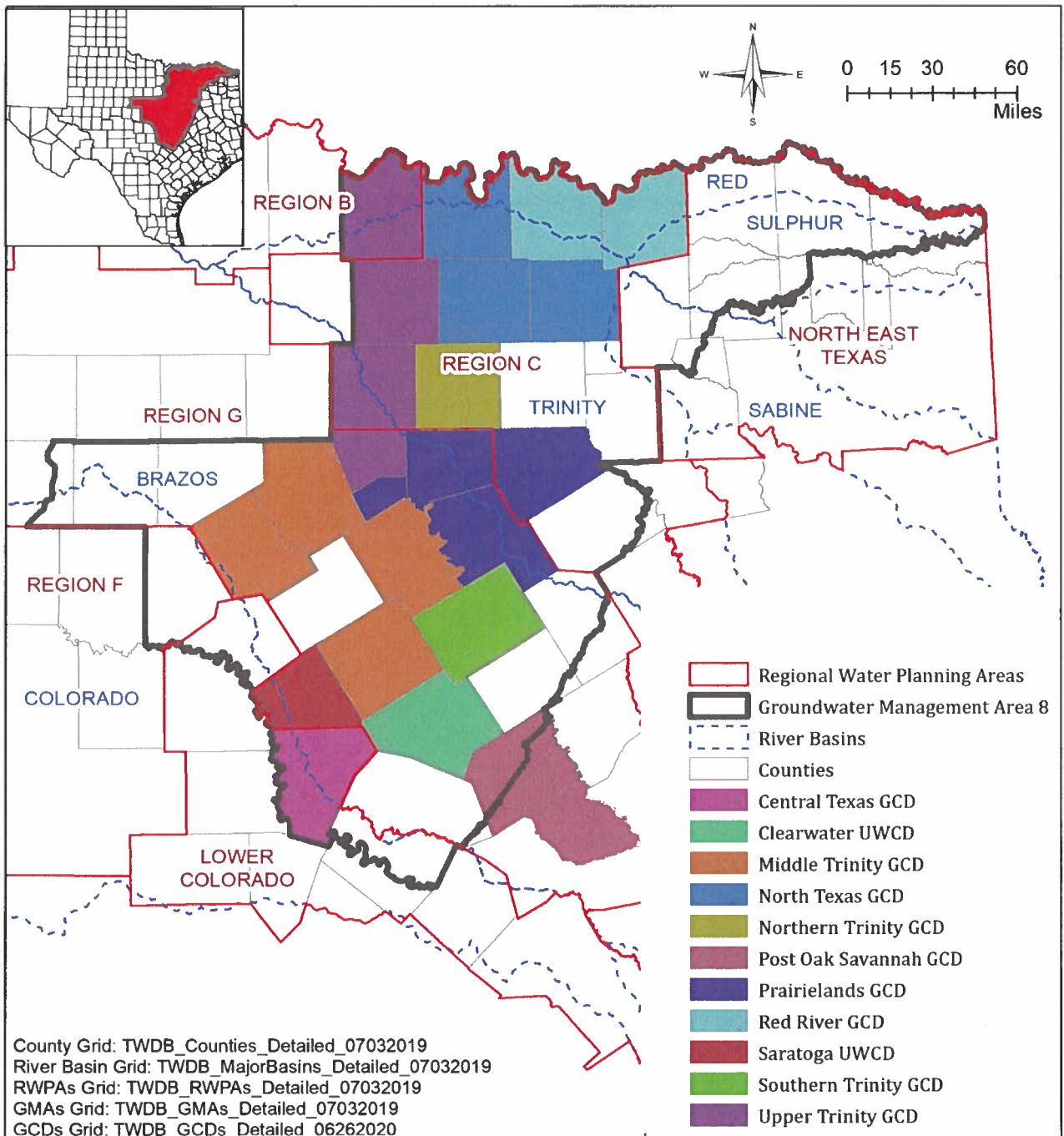
FIGURE 13. MAP SHOWING REGIONAL WATER PLANNING AREAS (RWPAs), GROUNDWATER CONSERVATION DISTRICTS (GCDs), AND RIVER BASINS ASSOCIATED WITH GROUNDWATER MANAGEMENT AREA 8.

TABLE 5.   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (PALUXY) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Clearwater UWCD*	Bell	Paluxy	0	0	0	0	0	0	0
Clearwater UWCD Total		**Paluxy**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Middle Trinity GCD	Bosque	Paluxy	357	357	357	357	357	357	357
Middle Trinity GCD	Coryell	Paluxy	0	0	0	0	0	0	0
Middle Trinity GCD	Erath	Paluxy	61	61	61	61	61	61	61
Middle Trinity GCD Total		**Paluxy**	**418**	**418**	**418**	**418**	**418**	**418**	**418**
North Texas GCD	Collin	Paluxy	1,548	1,548	1,548	1,548	1,548	1,548	1,548
North Texas GCD	Denton	Paluxy	4,823	4,823	4,823	4,823	4,823	4,823	4,823
North Texas GCD Total		**Paluxy**	**6,371**	**6,371**	**6,371**	**6,371**	**6,371**	**6,371**	**6,371**
Northern Trinity GCD	Tarrant	Paluxy	8,963	8,963	8,963	8,963	8,963	8,963	8,963
Northern Trinity GCD Total		**Paluxy**	**8,963**	**8,963**	**8,963**	**8,963**	**8,963**	**8,963**	**8,963**
Prairielands GCD	Ellis	Paluxy	442	442	442	442	442	442	442
Prairielands GCD	Hill	Paluxy	352	352	352	352	352	352	352
Prairielands GCD	Johnson	Paluxy	2,442	2,442	2,442	2,442	2,442	2,442	2,442
Prairielands GCD	Somervell	Paluxy	14	14	14	14	14	14	14
Prairielands GCD Total		**Paluxy**	**3,250**	**3,250**	**3,250**	**3,250**	**3,250**	**3,250**	**3,250**
Red River GCD	Fannin	Paluxy	2,088	2,088	2,088	2,088	2,088	2,088	2,088
Red River GCD	Grayson	Paluxy	0	0	0	0	0	0	0
Red River GCD Total		**Paluxy**	**2,088**	**2,088**	**2,088**	**2,088**	**2,088**	**2,088**	**2,088**
Southern Trinity GCD	McLennan	Paluxy	0	0	0	0	0	0	0
Southern Trinity GCD Total		**Paluxy**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

TABLE 5 (CONT).   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (PALUXY) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Upper Trinity GCD	Hood	Paluxy (outcrop)	159	159	159	159	159	159	159
Upper Trinity GCD	Parker	Paluxy (outcrop)	2,609	2,609	2,609	2,609	2,609	2,609	2,609
Upper Trinity GCD	Parker	Paluxy (downdip)	50	50	50	50	50	50	50
Upper Trinity GCD Total		**Paluxy**	**2,818**	**2,818**	**2,818**	**2,818**	**2,818**	**2,818**	**2,818**
No District	Dallas	Paluxy	359	359	359	359	359	359	359
No District	Delta	Paluxy	56	56	56	56	56	56	56
No District	Falls	Paluxy	0	0	0	0	0	0	0
No District	Hamilton	Paluxy	0	0	0	0	0	0	0
No District	Hunt	Paluxy	3	3	3	3	3	3	3
No District	Kaufman	Paluxy	0	0	0	0	0	0	0
No District	Lamar	Paluxy	8	8	8	8	8	8	8
No District	Limestone	Paluxy	0	0	0	0	0	0	0
No District	Mills	Paluxy	6	6	6	6	6	6	6
No District	Navarro	Paluxy	0	0	0	0	0	0	0
No District	Red River	Paluxy	177	177	177	177	177	177	177
No District	Rockwall	Paluxy	0	0	0	0	0	0	0
No District Total		**Paluxy**	**609**	**609**	**609**	**609**	**609**	**609**	**609**
GMA 8 Total		**Paluxy**	**24,517**	**24,517**	**24,517**	**24,517**	**24,517**	**24,517**	**24,517**

*UWCD: Underground Water Conservation District.

TABLE 6. **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (GLEN ROSE) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Glen Rose	148	148	148	148	148	148	148
Central Texas GCD Total		**Glen Rose**	**148**	**148**	**148**	**148**	**148**	**148**	**148**
Clearwater UWCD	Bell	Glen Rose	275	275	275	275	275	275	275
Clearwater UWCD Total		**Glen Rose**	**275**	**275**	**275**	**275**	**275**	**275**	**275**
Middle Trinity GCD	Bosque	Glen Rose	729	729	729	729	729	729	729
Middle Trinity GCD	Comanche	Glen Rose	41	41	41	41	41	41	41
Middle Trinity GCD	Coryell	Glen Rose	120	120	120	120	120	120	120
Middle Trinity GCD	Erath	Glen Rose	1,078	1,078	1,078	1,078	1,078	1,078	1,078
Middle Trinity GCD Total		**Glen Rose**	**1,968**	**1,968**	**1,968**	**1,968**	**1,968**	**1,968**	**1,968**
North Texas GCD	Collin	Glen Rose	83	83	83	83	83	83	83
North Texas GCD	Denton	Glen Rose	339	339	339	339	339	339	339
North Texas GCD Total		**Glen Rose**	**422**	**422**	**422**	**422**	**422**	**422**	**422**
Northern Trinity GCD	Tarrant	Glen Rose	793	793	793	793	793	793	793
Northern Trinity GCD Total		**Glen Rose**	**793**	**793**	**793**	**793**	**793**	**793**	**793**
Post Oak Savannah GCD	Milam	Glen Rose	0	0	0	0	0	0	0
Post Oak Savannah GCD Total		**Glen Rose**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Prairielands GCD	Ellis	Glen Rose	50	50	50	50	50	50	50
Prairielands GCD	Hill	Glen Rose	115	115	115	115	115	115	115
Prairielands GCD	Johnson	Glen Rose	1,633	1,633	1,633	1,633	1,633	1,633	1,633
Prairielands GCD	Somervell	Glen Rose	146	146	146	146	146	146	146
Prairielands GCD Total		**Glen Rose**	**1,944**	**1,944**	**1,944**	**1,944**	**1,944**	**1,944**	**1,944**
Red River GCD	Fannin	Glen Rose	0	0	0	0	0	0	0
Red River GCD	Grayson	Glen Rose	0	0	0	0	0	0	0
Red River GCD Total		**Glen Rose**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

TABLE 6 (CONT).   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (GLEN ROSE) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Saratoga UWCD	Lampasas	Glen Rose	68	68	68	68	68	68	68
Saratoga UWCD Total		**Glen Rose**	**68**	**68**	**68**	**68**	**68**	**68**	**68**
Southern Trinity GCD	McLennan	Glen Rose	0	0	0	0	0	0	0
Southern Trinity GCD Total		**Glen Rose**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Upper Trinity GCD	Hood	Glen Rose (outcrop)	790	790	790	790	790	790	790
Upper Trinity GCD	Hood	Glen Rose (downdip)	124	124	124	124	124	124	124
Upper Trinity GCD	Parker	Glen Rose (outcrop)	3,685	3,685	3,685	3,685	3,685	3,685	3,685
Upper Trinity GCD	Parker	Glen Rose (downdip)	1,406	1,406	1,406	1,406	1,406	1,406	1,406
Upper Trinity GCD Total			**6,005**	**6,005**	**6,005**	**6,005**	**6,005**	**6,005**	**6,005**
No District	Brown	Glen Rose	0	0	0	0	0	0	0
No District	Dallas	Glen Rose	131	131	131	131	131	131	131
No District	Delta	Glen Rose	0	0	0	0	0	0	0
No District	Falls	Glen Rose	0	0	0	0	0	0	0
No District	Hamilton	Glen Rose	218	218	218	218	218	218	218
No District	Hunt	Glen Rose	0	0	0	0	0	0	0
No District	Kaufman	Glen Rose	0	0	0	0	0	0	0
No District	Lamar	Glen Rose	0	0	0	0	0	0	0
No District	Limestone	Glen Rose	0	0	0	0	0	0	0
No District	Mills	Glen Rose	189	189	189	189	189	189	189
No District	Navarro	Glen Rose	0	0	0	0	0	0	0
No District	Red River	Glen Rose	0	0	0	0	0	0	0
No District	Rockwall	Glen Rose	0	0	0	0	0	0	0
No District	Travis	Glen Rose	100	100	100	100	100	100	100
No District	Williamson	Glen Rose	149	149	149	149	149	149	149
No District Total		**Glen Rose**	**787**	**787**	**787**	**787**	**787**	**787**	**787**
GMA 8 Total		**Glen Rose**	**12,410**	**12,410**	**12,410**	**12,410**	**12,410**	**12,410**	**12,410**

*UWCD: Underground Water Conservation District.

TABLE 7. **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Middle Trinity GCD	Erath	Twin Mountains	5,017	5,017	5,017	5,017	5,017	5,017	5,017
Middle Trinity GCD Total		**Twin Mountains**	**5,017**	**5,017**	**5,017**	**5,017**	**5,017**	**5,017**	**5,017**
North Texas GCD	Collin	Twin Mountains	2,202	2,202	2,202	2,202	2,202	2,202	2,202
North Texas GCD	Denton	Twin Mountains	8,372	8,372	8,372	8,372	8,372	8,372	8,372
North Texas GCD Total		**Twin Mountains**	**10,574**	**10,574**	**10,574**	**10,574**	**10,574**	**10,574**	**10,574**
Northern Trinity GCD	Tarrant	Twin Mountains	6,922	6,922	6,922	6,922	6,922	6,922	6,922
Northern Trinity GCD Total		**Twin Mountains**	**6,922**	**6,922**	**6,922**	**6,922**	**6,922**	**6,922**	**6,922**
Prairielands GCD	Ellis	Twin Mountains	0	0	0	0	0	0	0
Prairielands GCD	Johnson	Twin Mountains	278	278	278	278	278	278	278
Prairielands GCD	Somervell	Twin Mountains	65	65	65	65	65	65	65
Prairielands GCD Total		**Twin Mountains**	**343**	**343**	**343**	**343**	**343**	**343**	**343**
Red River GCD	Fannin	Twin Mountains	0	0	0	0	0	0	0
Red River GCD	Grayson	Twin Mountains	0	0	0	0	0	0	0
Red River GCD Total		**Twin Mountains**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Upper Trinity GCD	Hood (outcrop)	Twin Mountains (outcrop)	5,024	5,024	5,024	5,024	5,024	5,024	5,024
Upper Trinity GCD	Hood	Twin Mountains (downdip)	10,619	10,619	10,619	10,619	10,619	10,619	10,619
Upper Trinity GCD	Parker	Twin Mountains (outcrop)	1,282	1,282	1,282	1,282	1,282	1,282	1,282
Upper Trinity GCD	Parker	Twin Mountains (downdip)	2,528	2,528	2,528	2,528	2,528	2,528	2,528
Upper Trinity GCD Total		**Twin Mountains**	**19,453**	**19,453**	**19,453**	**19,453**	**19,453**	**19,453**	**19,453**

TABLE 7 (CONT).   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District	Dallas	Twin Mountains	3,201	3,201	3,201	3,201	3,201	3,201	3,201
No District	Hunt	Twin Mountains	0	0	0	0	0	0	0
No District	Kaufman	Twin Mountains	0	0	0	0	0	0	0
No District	Rockwall	Twin Mountains	0	0	0	0	0	0	0
No District Total		**Twin Mountains**	3,201	3,201	3,201	3,201	3,201	3,201	3,201
GMA 8 Total		**Twin Mountains**	45,510	45,510	45,510	45,510	45,510	45,510	45,510

TABLE 8. **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Travis Peak	3,742	3,742	3,742	3,742	3,742	3,742	3,742
Central Texas GCD Total		**Travis Peak**	**3,742**	**3,742**	**3,742**	**3,742**	**3,742**	**3,742**	**3,742**
Clearwater UWCD[1]	Bell	Travis Peak	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Clearwater UWCD Total		**Travis Peak**	**9,000**	**9,000**	**9,000**	**9,000**	**9,000**	**9,000**	**9,000**
Middle Trinity GCD	Bosque	Travis Peak	7,683	7,683	7,683	7,683	7,683	7,683	7,683
Middle Trinity GCD	Comanche	Travis Peak	6,164	6,164	6,164	6,164	6,164	6,164	6,164
Middle Trinity GCD	Coryell	Travis Peak	4,374	4,374	4,374	4,374	4,374	4,374	4,374
Middle Trinity GCD	Erath	Travis Peak	11,824	11,824	11,824	11,824	11,824	11,824	11,824
Middle Trinity GCD Total		**Travis Peak**	**30,045**	**30,045**	**30,045**	**30,045**	**30,045**	**30,045**	**30,045**
Post Oak Savannah GCD	Milam	Travis Peak	0	0	0	0	0	0	0
Post Oak Savannah GCD Total		**Travis Peak**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Prairielands GCD	Ellis	Travis Peak	5,676	5,676	5,676	5,676	5,676	5,676	5,676
Prairielands GCD	Hill	Travis Peak	4,685	4,685	4,685	4,685	4,685	4,685	4,685
Prairielands GCD	Johnson	Travis Peak	4,472	4,472	4,472	4,472	4,472	4,472	4,472
Prairielands GCD	Somervell	Travis Peak	1,763	1,763	1,763	1,763	1,763	1,763	1,763
Prairielands GCD Total		**Travis Peak**	**16,596**	**16,596**	**16,596**	**16,596**	**16,596**	**16,596**	**16,596**
Red River GCD	Fannin	Travis Peak	0	0	0	0	0	0	0
Red River GCD Total		**Travis Peak**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Saratoga UWCD	Lampasas	Travis Peak	1,593	1,593	1,593	1,593	1,593	1,593	1,593
Saratoga UWCD Total		**Travis Peak**	**1,593**	**1,593**	**1,593**	**1,593**	**1,593**	**1,593**	**1,593**
Southern Trinity GCD	McLennan	Travis Peak	20,649	20,649	20,649	20,649	20,649	20,649	20,649
Southern Trinity GCD Total		**Travis Peak**	**20,649**	**20,649**	**20,649**	**20,649**	**20,649**	**20,649**	**20,649**
Upper Trinity GCD[2]	Hood	Travis Peak	122	122	122	122	122	122	122
Upper Trinity GCD Total[2]		**Travis Peak**	**122**	**122**	**122**	**122**	**122**	**122**	**122**

TABLE 8 (CONT).   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District	Brown	Travis Peak	384	384	384	384	384	384	384
No District	Dallas	Travis Peak	0	0	0	0	0	0	0
No District	Delta	Travis Peak	0	0	0	0	0	0	0
No District	Falls	Travis Peak	1,435	1,435	1,435	1,435	1,435	1,435	1,435
No District	Hamilton	Travis Peak	2,209	2,209	2,209	2,209	2,209	2,209	2,209
No District	Hunt	Travis Peak	0	0	0	0	0	0	0
No District	Kaufman	Travis Peak	0	0	0	0	0	0	0
No District	Lamar	Travis Peak	0	0	0	0	0	0	0
No District	Limestone	Travis Peak	0	0	0	0	0	0	0
No District	Mills	Travis Peak	2,264	2,264	2,264	2,264	2,264	2,264	2,264
No District	Navarro	Travis Peak	0	0	0	0	0	0	0
No District	Red River	Travis Peak	0	0	0	0	0	0	0
No District	Travis	Travis Peak	6,644	6,644	6,644	6,644	6,644	6,644	6,644
No District	Williamson	Travis Peak	3,548	3,548	3,548	3,548	3,548	3,548	3,548
No District Total		**Travis Peak**	**16,484**	**16,484**	**16,484**	**16,484**	**16,484**	**16,484**	**16,484**
GMA 8 Total		**Travis Peak**	**98,231**	**98,231**	**98,231**	**98,231**	**98,231**	**98,231**	**98,231**

[1]UWCD: Underground Water Conservation District.
[2]Splits for Upper Trinity GCD are presented since they are included in the GMA 8-wide desired future conditions.

TABLE 9. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (HENSELL) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Hensell	2,662	2,662	2,662	2,662	2,662	2,662	2,662
Central Texas GCD Total		**Hensell**	**2,662**	**2,662**	**2,662**	**2,662**	**2,662**	**2,662**	**2,662**
Clearwater UWCD[1]	Bell	Hensell	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Clearwater UWCD Total		**Hensell**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**
Middle Trinity GCD	Bosque	Hensell	3,837	3,837	3,837	3,837	3,837	3,837	3,837
Middle Trinity GCD	Comanche	Hensell	204	204	204	204	204	204	204
Middle Trinity GCD	Coryell	Hensell	2,197	2,197	2,197	2,197	2,197	2,197	2,197
Middle Trinity GCD	Erath	Hensell	5,141	5,141	5,141	5,141	5,141	5,141	5,141
Middle Trinity GCD Total		**Hensell**	**11,379**	**11,379**	**11,379**	**11,379**	**11,379**	**11,379**	**11,379**
Post Oak Savannah GCD	Milam	Hensell	0	0	0	0	0	0	0
Post Oak Savannah GCD Total		**Hensell**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Prairielands GCD	Ellis	Hensell	0	0	0	0	0	0	0
Prairielands GCD	Hill	Hensell	25	25	25	25	25	25	25
Prairielands GCD	Johnson	Hensell	119	119	119	119	119	119	119
Prairielands GCD	Somervell	Hensell	217	217	217	217	217	217	217
Prairielands GCD Total		**Hensell**	**361**	**361**	**361**	**361**	**361**	**361**	**361**
Saratoga UWCD	Lampasas	Hensell	713	713	713	713	713	713	713
Saratoga UWCD Total		**Hensell**	**713**	**713**	**713**	**713**	**713**	**713**	**713**
Southern Trinity GCD	McLennan	Hensell	4,701	4,701	4,701	4,701	4,701	4,701	4,701
Southern Trinity GCD Total		**Hensell**	**4,701**	**4,701**	**4,701**	**4,701**	**4,701**	**4,701**	**4,701**
Upper Trinity GCD[2]	Hood	Hensell	50	50	50	50	50	50	50
Upper Trinity GCD Total[2]		**Hensell**	**50**	**50**	**50**	**50**	**50**	**50**	**50**

TABLE 9 (CONT).   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (HENSELL) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District	Brown	Hensell	4	4	4	4	4	4	4
No District	Dallas	Hensell	0	0	0	0	0	0	0
No District	Falls	Hensell	0	0	0	0	0	0	0
No District	Hamilton	Hensell	1,672	1,672	1,672	1,672	1,672	1,672	1,672
No District	Kaufman	Hensell	0	0	0	0	0	0	0
No District	Limestone	Hensell	0	0	0	0	0	0	0
No District	Mills	Hensell	607	607	607	607	607	607	607
No District	Navarro	Hensell	0	0	0	0	0	0	0
No District	Travis	Hensell	2,269	2,269	2,269	2,269	2,269	2,269	2,269
No District	Williamson	Hensell	1,599	1,599	1,599	1,599	1,599	1,599	1,599
No District Total		**Hensell**	**6,151**	**6,151**	**6,151**	**6,151**	**6,151**	**6,151**	**6,151**
GMA 8 Total		**Hensell**	**27,117**	**27,117**	**27,117**	**27,117**	**27,117**	**27,117**	**27,117**

[1]UWCD: Underground Water Conservation District.
[2]Splits for Upper Trinity GCD are presented since they are included in the GMA 8-wide desired future conditions.
*Note that the Hensell values in this table represent a portion of the total Travis Peak values already provided in Table 8 and do not represent an additional source of water.

TABLE 10.   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (HOSSTON) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Hosston	883	883	883	883	883	883	883
Central Texas GCD Total		**Hosston**	**883**	**883**	**883**	**883**	**883**	**883**	**883**
Clearwater UWCD[1]	Bell	Hosston	7,900	7,900	7,900	7,900	7,900	7,900	7,900
Clearwater UWCD Total		**Hosston**	**7,900**	**7,900**	**7,900**	**7,900**	**7,900**	**7,900**	**7,900**
Middle Trinity GCD	Bosque	Hosston	3,765	3,765	3,765	3,765	3,765	3,765	3,765
Middle Trinity GCD	Comanche	Hosston	5,869	5,869	5,869	5,869	5,869	5,869	5,869
Middle Trinity GCD	Coryell	Hosston	2,163	2,163	2,163	2,163	2,163	2,163	2,163
Middle Trinity GCD	Erath	Hosston	6,387	6,387	6,387	6,387	6,387	6,387	6,387
Middle Trinity GCD Total		**Hosston**	**18,184**	**18,184**	**18,184**	**18,184**	**18,184**	**18,184**	**18,184**
Post Oak Savannah GCD	Milam	Hosston	0	0	0	0	0	0	0
Post Oak Savannah GCD Total		**Hosston**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Prairielands GCD	Ellis	Hosston	5,545	5,545	5,545	5,545	5,545	5,545	5,545
Prairielands GCD	Hill	Hosston	3,610	3,610	3,610	3,610	3,610	3,610	3,610
Prairielands GCD	Johnson	Hosston	4,251	4,251	4,251	4,251	4,251	4,251	4,251
Prairielands GCD	Somervell	Hosston	930	930	930	930	930	930	930
Prairielands GCD Total		**Hosston**	**14,336**	**14,336**	**14,336**	**14,336**	**14,336**	**14,336**	**14,336**
Saratoga UWCD	Lampasas	Hosston	849	849	849	849	849	849	849
Saratoga UWCD Total		**Hosston**	**849**	**849**	**849**	**849**	**849**	**849**	**849**
Southern Trinity GCD	McLennan	Hosston	15,948	15,948	15,948	15,948	15,948	15,948	15,948
Southern Trinity GCD Total		**Hosston**	**15,948**	**15,948**	**15,948**	**15,948**	**15,948**	**15,948**	**15,948**
Upper Trinity GCD[2]	Hood	Hosston	72	72	72	72	72	72	72
Upper Trinity GCD Total[2]		**Hosston**	**72**	**72**	**72**	**72**	**72**	**72**	**72**

TABLE 10 (CONT).   **MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (HOSSTON) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
No District	Brown	Hosston	346	346	346	346	346	346	346
No District	Dallas	Hosston	0	0	0	0	0	0	0
No District	Falls	Hosston	1,435	1,435	1,435	1,435	1,435	1,435	1,435
No District	Hamilton	Hosston	385	385	385	385	385	385	385
No District	Kaufman	Hosston	0	0	0	0	0	0	0
No District	Limestone	Hosston	0	0	0	0	0	0	0
No District	Mills	Hosston	1,455	1,455	1,455	1,455	1,455	1,455	1,455
No District	Navarro	Hosston	0	0	0	0	0	0	0
No District	Travis	Hosston	4,185	4,185	4,185	4,185	4,185	4,185	4,185
No District	Williamson	Hosston	1,750	1,750	1,750	1,750	1,750	1,750	1,750
No District Total		**Hosston**	**9,556**	**9,556**	**9,556**	**9,556**	**9,556**	**9,556**	**9,556**
GMA 8 Total		**Hosston**	**67,728**	**67,728**	**67,728**	**67,728**	**67,728**	**67,728**	**67,728**

[1]UWCD: Underground Water Conservation District.

[2]Splits for Upper Trinity GCD are presented since they are included in the GMA 8-wide desired future conditions.

*Note that the Hosston values in this table represent a portion of the total Travis Peak values already provided in Table 8 and do not represent an additional source of water.

TABLE 11. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER (ANTLERS) IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Middle Trinity GCD	Comanche	Antlers	5,843	5,843	5,843	5,843	5,843	5,843	5,843
Middle Trinity GCD	Erath	Antlers	2,627	2,627	2,627	2,627	2,627	2,627	2,627
Middle Trinity GCD Total		**Antlers**	**8,470**	**8,470**	**8,470**	**8,470**	**8,470**	**8,470**	**8,470**
North Texas GCD	Collin	Antlers	1,962	1,962	1,962	1,962	1,962	1,962	1,962
North Texas GCD	Cooke	Antlers	10,522	10,522	10,522	10,522	10,522	10,522	10,522
North Texas GCD	Denton	Antlers	16,557	16,557	16,557	16,557	16,557	16,557	16,557
North Texas GCD Total		**Antlers**	**29,041**	**29,041**	**29,041**	**29,041**	**29,041**	**29,041**	**29,041**
Northern Trinity GCD	Tarrant	Antlers	1,248	1,248	1,248	1,248	1,248	1,248	1,248
Northern Trinity GCD Total		**Antlers**	**1,248**	**1,248**	**1,248**	**1,248**	**1,248**	**1,248**	**1,248**
Red River GCD	Fannin	Antlers	0	0	0	0	0	0	0
Red River GCD	Grayson	Antlers	10,716	10,716	10,716	10,716	10,716	10,716	10,716
Red River GCD Total		**Antlers**	**10,716**	**10,716**	**10,716**	**10,716**	**10,716**	**10,716**	**10,716**
Upper Trinity GCD	Montague	Antlers (outcrop)	6,103	6,103	6,103	6,103	6,103	6,103	6,103
Upper Trinity GCD	Parker	Antlers (outcrop)	2,889	2,889	2,889	2,889	2,889	2,889	2,889
Upper Trinity GCD	Wise	Antlers (outcrop)	9,013	9,013	9,013	9,013	9,013	9,013	9,013
Upper Trinity GCD	Wise	Antlers (downdip)	2,439	2,439	2,439	2,439	2,439	2,439	2,439
Upper Trinity GCD Total		**Antlers**	**20,444**	**20,444**	**20,444**	**20,444**	**20,444**	**20,444**	**20,444**
No District	Brown	Antlers	1,043	1,043	1,043	1,043	1,043	1,043	1,043
No District	Callahan	Antlers	1,726	1,726	1,726	1,726	1,726	1,726	1,726
No District	Eastland	Antlers	5,736	5,736	5,736	5,736	5,736	5,736	5,736
No District	Lamar	Antlers	0	0	0	0	0	0	0
No District	Red River	Antlers	0	0	0	0	0	0	0
No District	Taylor	Antlers	13	13	13	13	13	13	13
No District Total		**Antlers**	**8,518**	**8,518**	**8,518**	**8,518**	**8,518**	**8,518**	**8,518**
GMA 8 Total		**Antlers**	**78,437**	**78,437**	**78,437**	**78,437**	**78,437**	**78,437**	**78,437**

TABLE 12.   MODELED AVAILABLE GROUNDWATER FOR THE WOODBINE AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
North Texas GCD	Collin	Woodbine	4,254	4,254	4,254	4,254	4,254	4,254	4,254
North Texas GCD	Cooke	Woodbine	800	800	800	800	800	800	800
North Texas GCD	Denton	Woodbine	3,609	3,609	3,609	3,609	3,609	3,609	3,609
North Texas GCD Total		**Woodbine**	**8,663**	**8,663**	**8,663**	**8,663**	**8,663**	**8,663**	**8,663**
Northern Trinity GCD	Tarrant	Woodbine	1,139	1,139	1,139	1,139	1,139	1,139	1,139
Northern Trinity GCD Total		**Woodbine**	**1,139**	**1,139**	**1,139**	**1,139**	**1,139**	**1,139**	**1,139**
Prairielands GCD	Ellis	Woodbine	2,074	2,074	2,074	2,074	2,074	2,074	2,074
Prairielands GCD	Hill	Woodbine	587	587	587	587	587	587	587
Prairielands GCD	Johnson	Woodbine	1,981	1,981	1,981	1,981	1,981	1,981	1,981
Prairielands GCD Total		**Woodbine**	**4,642**	**4,642**	**4,642**	**4,642**	**4,642**	**4,642**	**4,642**
Red River GCD	Fannin	Woodbine	4,924	4,924	4,924	4,924	4,924	4,924	4,924
Red River GCD	Grayson	Woodbine	7,526	7,526	7,526	7,526	7,526	7,526	7,526
Red River GCD Total		**Woodbine**	**12,450**	**12,450**	**12,450**	**12,450**	**12,450**	**12,450**	**12,450**
Southern Trinity GCD	McLennan	Woodbine	0	0	0	0	0	0	0
Southern Trinity GCD Total		**Woodbine**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
No District	Dallas	Woodbine	2,798	2,798	2,798	2,798	2,798	2,798	2,798
No District	Hunt	Woodbine	763	763	763	763	763	763	763
No District	Kaufman	Woodbine	0	0	0	0	0	0	0
No District	Lamar	Woodbine	49	49	49	49	49	49	49
No District	Navarro	Woodbine	68	68	68	68	68	68	68
No District	Red River	Woodbine	2	2	2	2	2	2	2
No District	Rockwall	Woodbine	0	0	0	0	0	0	0
No District Total		**Woodbine**	**3,680**	**3,680**	**3,680**	**3,680**	**3,680**	**3,680**	**3,680**
GMA 8 Total		**Woodbine**	**30,574**	**30,574**	**30,574**	**30,574**	**30,574**	**30,574**	**30,574**

TABLE 13. **MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Clearwater UWCD*	Bell	Edwards (Balcones Fault Zone)	6,469	6,469	6,469	6,469	6,469	6,469	6,469
Clearwater UWCD Total		**Edwards (Balcones Fault Zone)**	**6,469**	**6,469**	**6,469**	**6,469**	**6,469**	**6,469**	**6,469**
No District	Travis	Edwards (Balcones Fault Zone)	5,237	5,237	5,237	5,237	5,237	5,237	5,237
No District	Williamson	Edwards (Balcones Fault Zone)	3,462	3,462	3,462	3,462	3,462	3,462	3,462
No District Total		**Edwards (Balcones Fault Zone)**	**8,699**	**8,699**	**8,699**	**8,699**	**8,699**	**8,699**	**8,699**
GMA 8 Total		**Edwards (Balcones Fault Zone)**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**	**15,168**

*UWCD: Underground Water Conservation District.

TABLE 14. **MODELED AVAILABLE GROUNDWATER FOR THE MARBLE FALLS AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Marble Falls	2,738	2,738	2,738	2,738	2,738	2,738	2,738
Central Texas GCD Total		**Marble Falls**	**2,738**	**2,738**	**2,738**	**2,738**	**2,738**	**2,738**	**2,738**
Saratoga UWCD*	Lampasas	Marble Falls	2,839	2,839	2,839	2,839	2,839	2,839	2,839
Saratoga UWCD Total		**Marble Falls**	**2,839**	**2,839**	**2,839**	**2,839**	**2,839**	**2,839**	**2,839**
No District	Brown	Marble Falls	25	25	25	25	25	25	25
No District	Mills	Marble Falls	25	25	25	25	25	25	25
No District Total		**Marble Falls**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
GMA 8 Total		**Marble Falls**	**5,627**	**5,627**	**5,627**	**5,627**	**5,627**	**5,627**	**5,627**

*UWCD: Underground Water Conservation District.

TABLE 15. **MODELED AVAILABLE GROUNDWATER FOR ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Ellenburger-San Saba	10,835	10,835	10,835	10,835	10,835	10,835	10,835
Central Texas GCD Total		**Ellenburger-San Saba**	**10,835**	**10,835**	**10,835**	**10,835**	**10,835**	**10,835**	**10,835**
Saratoga UWCD*	Lampasas	Ellenburger-San Saba	2,595	2,595	2,595	2,595	2,595	2,595	2,595
Saratoga UWCD Total		**Ellenburger-San Saba**	**2,595**	**2,595**	**2,595**	**2,595**	**2,595**	**2,595**	**2,595**
No District	Brown	Ellenburger-San Saba	131	131	131	131	131	131	131
No District	Mills	Ellenburger-San Saba	499	499	499	499	499	499	499
No District Total		**Ellenburger-San Saba**	**630**	**630**	**630**	**630**	**630**	**630**	**630**
GMA 8 Total		**Ellenburger-San Saba**	**14,060**	**14,060**	**14,060**	**14,060**	**14,060**	**14,060**	**14,060**

*UWCD: Underground Water Conservation District.

TABLE 16. **MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

GCD	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Central Texas GCD	Burnet	Hickory	3,415	3,415	3,415	3,415	3,415	3,415	3,415
Central Texas GCD Total		**Hickory**	**3,415**	**3,415**	**3,415**	**3,415**	**3,415**	**3,415**	**3,415**
Saratoga UWCD*	Lampasas	Hickory	113	113	113	113	113	113	113
Saratoga UWCD Total		**Hickory**	**113**	**113**	**113**	**113**	**113**	**113**	**113**
No District	Brown	Hickory	12	12	12	12	12	12	12
No District	Mills	Hickory	36	36	36	36	36	36	36
No District Total		**Hickory**	**48**	**48**	**48**	**48**	**48**	**48**	**48**
GMA 8 Total		**Hickory**	**3,576**	**3,576**	**3,576**	**3,576**	**3,576**	**3,576**	**3,576**

*UWCD: Underground Water Conservation District.

TABLE 17.   MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (PALUXY) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties Not in Upper Trinity GCD
Bell	G	Brazos	Paluxy	0	0	0	0	0	0
Bosque	G	Brazos	Paluxy	357	357	357	357	357	357
Collin	C	Sabine	Paluxy	0	0	0	0	0	0
Collin	C	Trinity	Paluxy	1,548	1,548	1,548	1,548	1,548	1,548
Coryell	G	Brazos	Paluxy	0	0	0	0	0	0
Dallas	C	Trinity	Paluxy	359	359	359	359	359	359
Delta	D	Sulphur	Paluxy	56	56	56	56	56	56
Denton	C	Trinity	Paluxy	4,823	4,823	4,823	4,823	4,823	4,823
Ellis	C	Trinity	Paluxy	442	442	442	442	442	442
Erath	G	Brazos	Paluxy	61	61	61	61	61	61
Falls	G	Brazos	Paluxy	0	0	0	0	0	0
Fannin	C	Sulphur	Paluxy	2,088	2,088	2,088	2,088	2,088	2,088
Fannin	C	Trinity	Paluxy	0	0	0	0	0	0
Grayson	C	Trinity	Paluxy	0	0	0	0	0	0
Hamilton	G	Brazos	Paluxy	0	0	0	0	0	0
Hill	G	Brazos	Paluxy	347	347	347	347	347	347
Hill	G	Trinity	Paluxy	5	5	5	5	5	5
Hunt	D	Sabine	Paluxy	0	0	0	0	0	0
Hunt	D	Sulphur	Paluxy	3	3	3	3	3	3
Hunt	D	Trinity	Paluxy	0	0	0	0	0	0
Johnson	G	Brazos	Paluxy	878	878	878	878	878	878
Johnson	G	Trinity	Paluxy	1,563	1,563	1,563	1,563	1,563	1,563
Kaufman	C	Trinity	Paluxy	0	0	0	0	0	0
Lamar	D	Red	Paluxy	0	0	0	0	0	0
Lamar	D	Sulphur	Paluxy	8	8	8	8	8	8
Limestone	G	Brazos	Paluxy	0	0	0	0	0	0
Limestone	G	Trinity	Paluxy	0	0	0	0	0	0
McLennan	G	Brazos	Paluxy	0	0	0	0	0	0
Mills	K	Brazos	Paluxy	6	6	6	6	6	6
Mills	K	Colorado	Paluxy	0	0	0	0	0	0
Navarro	C	Trinity	Paluxy	0	0	0	0	0	0
Red River	D	Red	Paluxy	52	52	52	52	52	52
Red River	D	Sulphur	Paluxy	125	125	125	125	125	125
Rockwall	C	Trinity	Paluxy	0	0	0	0	0	0
Somervell	G	Brazos	Paluxy	14	14	14	14	14	14
Tarrant	C	Trinity	Paluxy	8,963	8,963	8,963	8,963	8,963	8,963
Subtotal			**Paluxy**	**21,698**	**21,698**	**21,698**	**21,698**	**21,698**	**21,698**

TABLE 17 (CONT).   **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (PALUXY) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties in Upper Trinity GCD									
Hood	G	Brazos	Paluxy (outcrop)	159	159	159	159	159	159
Hood	G	Trinity	Paluxy (outcrop)	0	0	0	0	0	0
Parker	C	Brazos	Paluxy (outcrop)	34	34	34	34	34	34
Parker	C	Trinity	Paluxy (outcrop)	2,575	2,575	2,575	2,575	2,575	2,575
Parker	C	Trinity	Paluxy (downdip)	50	50	50	50	50	50
Subtotal			**Paluxy**	**2,818**	**2,818**	**2,818**	**2,818**	**2,818**	**2,818**
GMA 8 Total			**Paluxy**	**24,516**	**24,516**	**24,516**	**24,516**	**24,516**	**24,516**

TABLE 18.   **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (GLEN ROSE) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties Not in Upper Trinity GCD									
Bell	G	Brazos	Glen Rose	275	275	275	275	275	275
Bosque	G	Brazos	Glen Rose	729	729	729	729	729	729
Brown	F	Colorado	Glen Rose	0	0	0	0	0	0
Burnet	K	Brazos	Glen Rose	66	66	66	66	66	66
Burnet	K	Colorado	Glen Rose	82	82	82	82	82	82
Collin	C	Sabine	Glen Rose	0	0	0	0	0	0
Collin	C	Trinity	Glen Rose	83	83	83	83	83	83
Comanche	G	Brazos	Glen Rose	22	22	22	22	22	22
Comanche	G	Colorado	Glen Rose	18	18	18	18	18	18
Coryell	G	Brazos	Glen Rose	120	120	120	120	120	120
Dallas	C	Trinity	Glen Rose	131	131	131	131	131	131
Delta	D	Sulphur	Glen Rose	0	0	0	0	0	0
Denton	C	Trinity	Glen Rose	339	339	339	339	339	339
Ellis	C	Trinity	Glen Rose	50	50	50	50	50	50
Erath	G	Brazos	Glen Rose	1,078	1,078	1,078	1,078	1,078	1,078
Falls	G	Brazos	Glen Rose	0	0	0	0	0	0
Fannin	C	Sulphur	Glen Rose	0	0	0	0	0	0
Fannin	C	Trinity	Glen Rose	0	0	0	0	0	0
Grayson	C	Trinity	Glen Rose	0	0	0	0	0	0
Hamilton	G	Brazos	Glen Rose	218	218	218	218	218	218
Hill	G	Brazos	Glen Rose	114	114	114	114	114	114
Hill	G	Trinity	Glen Rose	1	1	1	1	1	1
Hunt	D	Sabine	Glen Rose	0	0	0	0	0	0
Hunt	D	Sulphur	Glen Rose	0	0	0	0	0	0
Hunt	D	Trinity	Glen Rose	0	0	0	0	0	0
Johnson	G	Brazos	Glen Rose	951	951	951	951	951	951
Johnson	G	Trinity	Glen Rose	682	682	682	682	682	682
Kaufman	C	Trinity	Glen Rose	0	0	0	0	0	0
Lamar	D	Red	Glen Rose	0	0	0	0	0	0
Lamar	D	Sulphur	Glen Rose	0	0	0	0	0	0
Lampasas	G	Brazos	Glen Rose	68	68	68	68	68	68
Limestone	G	Brazos	Glen Rose	0	0	0	0	0	0
Limestone	G	Trinity	Glen Rose	0	0	0	0	0	0
McLennan	G	Brazos	Glen Rose	0	0	0	0	0	0
Milam	G	Brazos	Glen Rose	0	0	0	0	0	0
Mills	K	Brazos	Glen Rose	96	96	96	96	96	96
Mills	K	Colorado	Glen Rose	93	93	93	93	93	93
Navarro	C	Trinity	Glen Rose	0	0	0	0	0	0
Red River	D	Red	Glen Rose	0	0	0	0	0	0

TABLE 18 (CONT). **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (GLEN ROSE) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Red River	D	Sulphur	Glen Rose	0	0	0	0	0	0
Rockwall	C	Trinity	Glen Rose	0	0	0	0	0	0
Somervell	G	Brazos	Glen Rose	146	146	146	146	146	146
Tarrant	C	Trinity	Glen Rose	793	793	793	793	793	793
Travis	K	Brazos	Glen Rose	0	0	0	0	0	0
Travis	K	Colorado	Glen Rose	100	100	100	100	100	100
Williamson	G	Brazos	Glen Rose	135	135	135	135	135	135
Williamson	G	Colorado	Glen Rose	0	0	0	0	0	0
Williamson	K	Brazos	Glen Rose	0	0	0	0	0	0
Williamson	K	Colorado	Glen Rose	15	15	15	15	15	15
Subtotal			**Glen Rose**	**6,405**	**6,405**	**6,405**	**6,405**	**6,405**	**6,405**
Counties in Upper Trinity GCD									
Hood	G	Brazos	Glen Rose (outcrop)	790	790	790	790	790	790
Hood	G	Brazos	Glen Rose (downdip)	100	100	100	100	100	100
Hood	G	Trinity	Glen Rose (downdip)	24	24	24	24	24	24
Parker	C	Brazos	Glen Rose (outcrop)	140	140	140	140	140	140
Parker	C	Brazos	Glen Rose (downdip)	11	11	11	11	11	11
Parker	C	Trinity	Glen Rose (outcrop)	3,545	3,545	3,545	3,545	3,545	3,545
Parker	C	Trinity	Glen Rose (downdip)	1,395	1,395	1,395	1,395	1,395	1,395
Subtotal			**Glen Rose**	**6,005**	**6,005**	**6,005**	**6,005**	**6,005**	**6,005**
GMA 8 Total			**Glen Rose**	**12,410**	**12,410**	**12,410**	**12,410**	**12,410**	**12,410**

TABLE 19. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Counties Not in Upper Trinity GCD									
Collin	C	Sabine	Twin Mountains	0	0	0	0	0	0
Collin	C	Trinity	Twin Mountains	2,202	2,202	2,202	2,202	2,202	2,202
Dallas	C	Trinity	Twin Mountains	3,201	3,201	3,201	3,201	3,201	3,201
Denton	C	Trinity	Twin Mountains	8,372	8,372	8,372	8,372	8,372	8,372
Ellis	C	Trinity	Twin Mountains	0	0	0	0	0	0
Erath	G	Brazos	Twin Mountains	5,017	5,017	5,017	5,017	5,017	5,017
Fannin	C	Sulphur	Twin Mountains	0	0	0	0	0	0
Fannin	C	Trinity	Twin Mountains	0	0	0	0	0	0
Grayson	C	Trinity	Twin Mountains	0	0	0	0	0	0
Hunt	D	Sabine	Twin Mountains	0	0	0	0	0	0
Hunt	D	Trinity	Twin Mountains	0	0	0	0	0	0
Johnson	G	Brazos	Twin Mountains	127	127	127	127	127	127
Johnson	G	Trinity	Twin Mountains	152	152	152	152	152	152
Kaufman	C	Trinity	Twin Mountains	0	0	0	0	0	0
Rockwall	C	Trinity	Twin Mountains	0	0	0	0	0	0
Somervell	G	Brazos	Twin Mountains	65	65	65	65	65	65
Tarrant	C	Trinity	Twin Mountains	6,922	6,922	6,922	6,922	6,922	6,922
Subtotal			**Twin Mountains**	**26,058**	**26,058**	**26,058**	**26,058**	**26,058**	**26,058**

TABLE 19 (CONT). **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TWIN MOUNTAINS) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Counties in Upper Trinity GCD									
Hood	G	Brazos	Twin Mountains (outcrop)	5,024	5,024	5,024	5,024	5,024	5,024
Hood	G	Brazos	Twin Mountains (downdip)	10,594	10,594	10,594	10,594	10,594	10,594
Hood	G	Trinity	Twin Mountains (downdip)	26	26	26	26	26	26
Parker	C	Brazos	Twin Mountains (outcrop)	1,282	1,282	1,282	1,282	1,282	1,282
Parker	C	Brazos	Twin Mountains (downdip)	942	942	942	942	942	942
Parker	C	Trinity	Twin Mountains (downdip)	1,586	1,586	1,586	1,586	1,586	1,586
Subtotal			**Twin Mountains**	**19,454**	**19,454**	**19,454**	**19,454**	**19,454**	**19,454**
GMA 8 Total			**Twin Mountains**	**45,512**	**45,512**	**45,512**	**45,512**	**45,512**	**45,512**

TABLE 20. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties Not in Upper Trinity GCD									
Bell	G	Brazos	Travis Peak	9,000	9,000	9,000	9,000	9,000	9,000
Bosque	G	Brazos	Travis Peak	7,683	7,683	7,683	7,683	7,683	7,683
Brown	F	Brazos	Travis Peak	3	3	3	3	3	3
Brown	F	Colorado	Travis Peak	381	381	381	381	381	381
Burnet	K	Brazos	Travis Peak	3,297	3,297	3,297	3,297	3,297	3,297
Burnet	K	Colorado	Travis Peak	445	445	445	445	445	445
Comanche	G	Brazos	Travis Peak	6,115	6,115	6,115	6,115	6,115	6,115
Comanche	G	Colorado	Travis Peak	49	49	49	49	49	49
Coryell	G	Brazos	Travis Peak	4,374	4,374	4,374	4,374	4,374	4,374
Dallas	C	Trinity	Travis Peak	0	0	0	0	0	0
Delta	D	Sulphur	Travis Peak	0	0	0	0	0	0
Ellis	C	Trinity	Travis Peak	5,676	5,676	5,676	5,676	5,676	5,676
Erath	G	Brazos	Travis Peak	11,824	11,824	11,824	11,824	11,824	11,824
Falls	G	Brazos	Travis Peak	1,435	1,435	1,435	1,435	1,435	1,435
Fannin	C	Sulphur	Travis Peak	0	0	0	0	0	0
Fannin	C	Trinity	Travis Peak	0	0	0	0	0	0
Hamilton	G	Brazos	Travis Peak	2,209	2,209	2,209	2,209	2,209	2,209
Hill	G	Brazos	Travis Peak	4,404	4,404	4,404	4,404	4,404	4,404
Hill	G	Trinity	Travis Peak	281	281	281	281	281	281
Hunt	D	Sabine	Travis Peak	0	0	0	0	0	0
Hunt	D	Sulphur	Travis Peak	0	0	0	0	0	0
Hunt	D	Trinity	Travis Peak	0	0	0	0	0	0

TABLE 20 (CONT). **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Johnson	G	Brazos	Travis Peak	1,581	1,581	1,581	1,581	1,581	1,581
Johnson	G	Trinity	Travis Peak	2,891	2,891	2,891	2,891	2,891	2,891
Kaufman	C	Trinity	Travis Peak	0	0	0	0	0	0
Lamar	D	Red	Travis Peak	0	0	0	0	0	0
Lamar	D	Sulphur	Travis Peak	0	0	0	0	0	0
Lampasas	G	Brazos	Travis Peak	1,525	1,525	1,525	1,525	1,525	1,525
Lampasas	G	Colorado	Travis Peak	68	68	68	68	68	68
Limestone	G	Brazos	Travis Peak	0	0	0	0	0	0
Limestone	G	Trinity	Travis Peak	0	0	0	0	0	0
McLennan	G	Brazos	Travis Peak	20,649	20,649	20,649	20,649	20,649	20,649
Milam	G	Brazos	Travis Peak	0	0	0	0	0	0
Mills	K	Brazos	Travis Peak	704	704	704	704	704	704
Mills	K	Colorado	Travis Peak	1,560	1,560	1,560	1,560	1,560	1,560
Navarro	C	Trinity	Travis Peak	0	0	0	0	0	0
Red River	D	Red	Travis Peak	0	0	0	0	0	0
Red River	D	Sulphur	Travis Peak	0	0	0	0	0	0
Somervell	G	Brazos	Travis Peak	1,763	1,763	1,763	1,763	1,763	1,763
Travis	K	Brazos	Travis Peak	1	1	1	1	1	1
Travis	K	Colorado	Travis Peak	6,642	6,642	6,642	6,642	6,642	6,642
Williamson	G	Brazos	Travis Peak	3,543	3,543	3,543	3,543	3,543	3,543
Williamson	G	Colorado	Travis Peak	5	5	5	5	5	5
Williamson	K	Brazos	Travis Peak	0	0	0	0	0	0

TABLE 20 (CONT). **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (TRAVIS PEAK) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Williamson	K	Colorado	Travis Peak	0	0	0	0	0	0
Subtotal			**Travis Peak**	**98,108**	**98,108**	**98,108**	**98,108**	**98,108**	**98,108**
Counties in Upper Trinity GCD[1]									
Hood	G	Brazos	Travis Peak	122	122	122	122	122	122
Subtotal			**Travis Peak**	**122**	**122**	**122**	**122**	**122**	**122**
GMA 8 Total			**Travis Peak**	**98,230**	**98,230**	**98,230**	**98,230**	**98,230**	**98,230**

[1]Splits for Upper Trinity GCD are presented since they are included in the GMA 8-wide desired future conditions.

TABLE 21. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (HENSELL) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties Not in Upper Trinity GCD[1]									
Bell	G	Brazos	Hensell	1,100	1,100	1,100	1,100	1,100	1,100
Bosque	G	Brazos	Hensell	3,837	3,837	3,837	3,837	3,837	3,837
Brown	F	Colorado	Hensell	4	4	4	4	4	4
Burnet	K	Brazos	Hensell	2,477	2,477	2,477	2,477	2,477	2,477
Burnet	K	Colorado	Hensell	186	186	186	186	186	186
Comanche	G	Brazos	Hensell	180	180	180	180	180	180
Comanche	G	Colorado	Hensell	24	24	24	24	24	24
Coryell	G	Brazos	Hensell	2,197	2,197	2,197	2,197	2,197	2,197
Dallas	C	Trinity	Hensell	0	0	0	0	0	0
Ellis	C	Trinity	Hensell	0	0	0	0	0	0
Erath	G	Brazos	Hensell	5,141	5,141	5,141	5,141	5,141	5,141
Falls	G	Brazos	Hensell	0	0	0	0	0	0
Hamilton	G	Brazos	Hensell	1,672	1,672	1,672	1,672	1,672	1,672
Hill	G	Brazos	Hensell	25	25	25	25	25	25
Hill	G	Trinity	Hensell	0	0	0	0	0	0
Johnson	G	Brazos	Hensell	68	68	68	68	68	68
Johnson	G	Trinity	Hensell	51	51	51	51	51	51
Kaufman	C	Trinity	Hensell	0	0	0	0	0	0
Lampasas	G	Brazos	Hensell	712	712	712	712	712	712
Lampasas	G	Colorado	Hensell	1	1	1	1	1	1
Limestone	G	Brazos	Hensell	0	0	0	0	0	0
Limestone	G	Trinity	Hensell	0	0	0	0	0	0
McLennan	G	Brazos	Hensell	4,701	4,701	4,701	4,701	4,701	4,701
Milam	G	Brazos	Hensell	0	0	0	0	0	0
Mills	K	Brazos	Hensell	172	172	172	172	172	172
Mills	K	Colorado	Hensell	435	435	435	435	435	435
Navarro	C	Trinity	Hensell	0	0	0	0	0	0
Somervell	G	Brazos	Hensell	217	217	217	217	217	217
Travis	K	Brazos	Hensell	1	1	1	1	1	1
Travis	K	Colorado	Hensell	2,268	2,268	2,268	2,268	2,268	2,268
Williamson	G	Brazos	Hensell	1,599	1,599	1,599	1,599	1,599	1,599
Williamson	G	Colorado	Hensell	0	0	0	0	0	0
Williamson	K	Brazos	Hensell	0	0	0	0	0	0
Williamson	K	Colorado	Hensell	0	0	0	0	0	0
Subtotal			**Hensell**	**27,068**	**27,068**	**27,068**	**27,068**	**27,068**	**27,068**

TABLE 21 (CONT). **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (HENSELL) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties in Upper Trinity GCD[1]									
Hood	G	Brazos	Hensell	50	50	50	50	50	50
Subtotal			**Hensell**	**50**	**50**	**50**	**50**	**50**	**50**
GMA 8 Total			**Hensell**	**27,118**	**27,118**	**27,118**	**27,118**	**27,118**	**27,118**

[1]Splits for Upper Trinity GCD are presented since they are included in the GMA 8-wide desired future conditions.
*Note that the Hensell values in this table represent a portion of the total Travis Peak values already provided in Table 20 and do not represent an additional source of water.

TABLE 22. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (HOSSTON) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties Not in Upper Trinity GCD[1]									
Bell	G	Brazos	Hosston	7,900	7,900	7,900	7,900	7,900	7,900
Bosque	G	Brazos	Hosston	3,765	3,765	3,765	3,765	3,765	3,765
Brown	F	Brazos	Hosston	3	3	3	3	3	3
Brown	F	Colorado	Hosston	343	343	343	343	343	343
Burnet	K	Brazos	Hosston	659	659	659	659	659	659
Burnet	K	Colorado	Hosston	224	224	224	224	224	224
Comanche	G	Brazos	Hosston	5,863	5,863	5,863	5,863	5,863	5,863
Comanche	G	Colorado	Hosston	6	6	6	6	6	6
Coryell	G	Brazos	Hosston	2,163	2,163	2,163	2,163	2,163	2,163
Dallas	C	Trinity	Hosston	0	0	0	0	0	0
Ellis	C	Trinity	Hosston	5,545	5,545	5,545	5,545	5,545	5,545
Erath	G	Brazos	Hosston	6,387	6,387	6,387	6,387	6,387	6,387
Falls	G	Brazos	Hosston	1,435	1,435	1,435	1,435	1,435	1,435
Hamilton	G	Brazos	Hosston	385	385	385	385	385	385
Hill	G	Brazos	Hosston	3,330	3,330	3,330	3,330	3,330	3,330
Hill	G	Trinity	Hosston	280	280	280	280	280	280
Johnson	G	Brazos	Hosston	1,442	1,442	1,442	1,442	1,442	1,442
Johnson	G	Trinity	Hosston	2,809	2,809	2,809	2,809	2,809	2,809
Kaufman	C	Trinity	Hosston	0	0	0	0	0	0
Lampasas	G	Brazos	Hosston	785	785	785	785	785	785
Lampasas	G	Colorado	Hosston	65	65	65	65	65	65
Limestone	G	Brazos	Hosston	0	0	0	0	0	0
Limestone	G	Trinity	Hosston	0	0	0	0	0	0
McLennan	G	Brazos	Hosston	15,948	15,948	15,948	15,948	15,948	15,948
Milam	G	Brazos	Hosston	0	0	0	0	0	0
Mills	K	Brazos	Hosston	375	375	375	375	375	375
Mills	K	Colorado	Hosston	1,081	1,081	1,081	1,081	1,081	1,081

TABLE 22 (CONT).   **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (HOSSTON) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Navarro	C	Trinity	Hosston	0	0	0	0	0	0
Somervell	G	Brazos	Hosston	930	930	930	930	930	930
Travis	K	Brazos	Hosston	0	0	0	0	0	0
Travis	K	Colorado	Hosston	4,185	4,185	4,185	4,185	4,185	4,185
Williamson	G	Brazos	Hosston	1,746	1,746	1,746	1,746	1,746	1,746
Williamson	G	Colorado	Hosston	5	5	5	5	5	5
Williamson	K	Brazos	Hosston	0	0	0	0	0	0
Williamson	K	Colorado	Hosston	0	0	0	0	0	0
Subtotal			**Hosston**	**67,659**	**67,659**	**67,659**	**67,659**	**67,659**	**67,659**
Counties in Upper Trinity GCD[1]									
Hood	G	Brazos	Hosston	72	72	72	72	72	72
Subtotal			**Hosston**	**72**	**72**	**72**	**72**	**72**	**72**
GMA 8 Total			**Hosston**	**67,731**	**67,731**	**67,731**	**67,731**	**67,731**	**67,731**

[1]Splits for Upper Trinity GCD are presented since they are included in the GMA 8-wide desired future conditions.

*Note that the Hosston values in this table represent a portion of the total Travis Peak values already provided in Table 20 and do not represent an additional source of water.

TABLE 23. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE TRINITY AQUIFER (ANTLERS) IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Counties Not in Upper Trinity GCD									
Brown	F	Brazos	Antlers	48	48	48	48	48	48
Brown	F	Colorado	Antlers	995	995	995	995	995	995
Callahan	G	Brazos	Antlers	443	443	443	443	443	443
Callahan	G	Colorado	Antlers	1,283	1,283	1,283	1,283	1,283	1,283
Collin	C	Trinity	Antlers	1,962	1,962	1,962	1,962	1,962	1,962
Comanche	G	Brazos	Antlers	5,843	5,843	5,843	5,843	5,843	5,843
Cooke	C	Red	Antlers	2,186	2,186	2,186	2,186	2,186	2,186
Cooke	C	Trinity	Antlers	8,335	8,335	8,335	8,335	8,335	8,335
Denton	C	Trinity	Antlers	16,557	16,557	16,557	16,557	16,557	16,557
Eastland	G	Brazos	Antlers	5,184	5,184	5,184	5,184	5,184	5,184
Eastland	G	Colorado	Antlers	552	552	552	552	552	552
Erath	G	Brazos	Antlers	2,627	2,627	2,627	2,627	2,627	2,627
Fannin	C	Red	Antlers	0	0	0	0	0	0
Fannin	C	Sulphur	Antlers	0	0	0	0	0	0
Fannin	C	Trinity	Antlers	0	0	0	0	0	0
Grayson	C	Red	Antlers	6,665	6,665	6,665	6,665	6,665	6,665
Grayson	C	Trinity	Antlers	4,051	4,051	4,051	4,051	4,051	4,051
Lamar	D	Red	Antlers	0	0	0	0	0	0
Lamar	D	Sulphur	Antlers	0	0	0	0	0	0
Red River	D	Red	Antlers	0	0	0	0	0	0
Tarrant	C	Trinity	Antlers	1,248	1,248	1,248	1,248	1,248	1,248
Taylor	G	Brazos	Antlers	5	5	5	5	5	5
Taylor	G	Colorado	Antlers	9	9	9	9	9	9
Subtotal			**Antlers**	**57,993**	**57,993**	**57,993**	**57,993**	**57,993**	**57,993**
Counties in Upper Trinity GCD									
Montague	B	Red	Antlers (outcrop)	238	238	238	238	238	238
Montague	B	Trinity	Antlers (outcrop)	5,866	5,866	5,866	5,866	5,866	5,866
Parker	C	Brazos	Antlers (outcrop)	247	247	247	247	247	247
Parker	C	Trinity	Antlers (outcrop)	2,642	2,642	2,642	2,642	2,642	2,642
Wise	C	Trinity	Antlers (outcrop)	9,013	9,013	9,013	9,013	9,013	9,013
Wise	C	Trinity	Antlers (downdip)	2,439	2,439	2,439	2,439	2,439	2,439
Subtotal			**Antlers**	**20,445**	**20,445**	**20,445**	**20,445**	**20,445**	**20,445**
GMA 8 Total			**Antlers**	**78,438**	**78,438**	**78,438**	**78,438**	**78,438**	**78,438**

TABLE 24.   **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE WOODBINE AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Collin	C	Sabine	Woodbine	0	0	0	0	0	0
Collin	C	Trinity	Woodbine	4,254	4,254	4,254	4,254	4,254	4,254
Cooke	C	Red	Woodbine	262	262	262	262	262	262
Cooke	C	Trinity	Woodbine	539	539	539	539	539	539
Dallas	C	Trinity	Woodbine	2,798	2,798	2,798	2,798	2,798	2,798
Denton	C	Trinity	Woodbine	3,609	3,609	3,609	3,609	3,609	3,609
Ellis	C	Trinity	Woodbine	2,074	2,074	2,074	2,074	2,074	2,074
Fannin	C	Red	Woodbine	3,547	3,547	3,547	3,547	3,547	3,547
Fannin	C	Sulphur	Woodbine	550	550	550	550	550	550
Fannin	C	Trinity	Woodbine	827	827	827	827	827	827
Grayson	C	Red	Woodbine	5,603	5,603	5,603	5,603	5,603	5,603
Grayson	C	Trinity	Woodbine	1,923	1,923	1,923	1,923	1,923	1,923
Hill	G	Brazos	Woodbine	284	284	284	284	284	284
Hill	G	Trinity	Woodbine	302	302	302	302	302	302
Hunt	D	Sabine	Woodbine	268	268	268	268	268	268
Hunt	D	Sulphur	Woodbine	165	165	165	165	165	165
Hunt	D	Trinity	Woodbine	330	330	330	330	330	330
Johnson	G	Brazos	Woodbine	24	24	24	24	24	24
Johnson	G	Trinity	Woodbine	1,957	1,957	1,957	1,957	1,957	1,957
Kaufman	C	Trinity	Woodbine	0	0	0	0	0	0
Lamar	D	Red	Woodbine	0	0	0	0	0	0
Lamar	D	Sulphur	Woodbine	49	49	49	49	49	49
McLennan	G	Brazos	Woodbine	0	0	0	0	0	0
Navarro	C	Trinity	Woodbine	68	68	68	68	68	68
Red River	D	Red	Woodbine	2	2	2	2	2	2
Rockwall	C	Trinity	Woodbine	0	0	0	0	0	0
Tarrant	C	Trinity	Woodbine	1,139	1,139	1,139	1,139	1,139	1,139
GMA 8 Total			**Woodbine**	**30,574**	**30,574**	**30,574**	**30,574**	**30,574**	**30,574**

TABLE 25. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN. MODELED AVAILABLE GROUNDWATER VALUES ARE FROM GAM RUN 08-010MAG BY ANAYA (2008).

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Bell	G	Brazos	Edwards (Balcones Fault Zone)	6,469	6,469	6,469	6,469	6,469	6,469
Travis	K	Brazos	Edwards (Balcones Fault Zone)	275	275	275	275	275	275
Travis	K	Colorado	Edwards (Balcones Fault Zone)	4,962	4,962	4,962	4,962	4,962	4,962
Williamson	G	Brazos	Edwards (Balcones Fault Zone)	3,351	3,351	3,351	3,351	3,351	3,351
Williamson	G	Colorado	Edwards (Balcones Fault Zone)	101	101	101	101	101	101
Williamson	K	Brazos	Edwards (Balcones Fault Zone)	6	6	6	6	6	6
Williamson	K	Colorado	Edwards (Balcones Fault Zone)	4	4	4	4	4	4
GMA 8 Total			Edwards (Balcones Fault Zone)	15,168	15,168	15,168	15,168	15,168	15,168

TABLE 26. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE MARBLE FALLS AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Brown	F	Colorado	Marble Falls	25	25	25	25	25	25
Burnet	K	Brazos	Marble Falls	1,384	1,384	1,384	1,384	1,384	1,384
Burnet	K	Colorado	Marble Falls	1,354	1,354	1,354	1,354	1,354	1,354
Lampasas	G	Brazos	Marble Falls	1,954	1,954	1,954	1,954	1,954	1,954
Lampasas	G	Colorado	Marble Falls	885	885	885	885	885	885
Mills	K	Brazos	Marble Falls	1	1	1	1	1	1
Mills	K	Colorado	Marble Falls	24	24	24	24	24	24
GMA 8 Total			Marble Falls	5,627	5,627	5,627	5,627	5,627	5,627

TABLE 27. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Brown	F	Colorado	Ellenburger-San Saba	131	131	131	131	131	131
Burnet	K	Brazos	Ellenburger-San Saba	3,825	3,825	3,825	3,825	3,825	3,825
Burnet	K	Colorado	Ellenburger-San Saba	7,010	7,010	7,010	7,010	7,010	7,010
Lampasas	G	Brazos	Ellenburger-San Saba	1,681	1,681	1,681	1,681	1,681	1,681
Lampasas	G	Colorado	Ellenburger-San Saba	914	914	914	914	914	914
Mills	K	Brazos	Ellenburger-San Saba	93	93	93	93	93	93
Mills	K	Colorado	Ellenburger-San Saba	406	406	406	406	406	406
GMA 8 Total			Ellenburger-San Saba	**14,060**	**14,060**	**14,060**	**14,060**	**14,060**	**14,060**

TABLE 28. **MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA (GMA) 8. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN.**

County	RWPA	River Basin	Aquifer	2030	2040	2050	2060	2070	2080
Brown	F	Colorado	Hickory	12	12	12	12	12	12
Burnet	K	Brazos	Hickory	1,237	1,237	1,237	1,237	1,237	1,237
Burnet	K	Colorado	Hickory	2,178	2,178	2,178	2,178	2,178	2,178
Lampasas	G	Brazos	Hickory	79	79	79	79	79	79
Lampasas	G	Colorado	Hickory	34	34	34	34	34	34
Mills	K	Brazos	Hickory	7	7	7	7	7	7
Mills	K	Colorado	Hickory	29	29	29	29	29	29
GMA 8 Total			**Hickory**	**3,576**	**3,576**	**3,576**	**3,576**	**3,576**	**3,576**

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.

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Appendix A

Comparison between Desired Future Conditions and Simulated Drawdowns for the Trinity and Woodbine Aquifers

Drawdown values for the Trinity and Woodbine aquifers between 2009 and 2080 were based on the simulated water level values at individual model cells extracted from predictive simulation water level file submitted by Groundwater Management Area 8.

The Paluxy, Glen Rose, Twin Mountains, Travis Peak, Hensell, Hosston, and Antlers are subunits of the Trinity Aquifer. These subunits and Woodbine Aquifer exist in both outcrop and downdip areas (Figures 1 through 8). Kelley and others (2014) further divided these aquifers into five (5) regions, each with unique aquifer combinations and properties (table below and Figures 1 through 8).

Model Layer	Region 1	Region 2	Region 3	Region 4		Region 5	
2		Woodbine			Woodbine (no sand)			
3		Washita/Fredericksburg						
4		Paluxy				Paluxy (no sand)		
5		Glen Rose						
6	Antlers	Twin Mountains	Travis Peak	Hensell	Travis Peak	Hensell	
7				Pearsall/Sligo		Pearsall/Sligo	
8				Hosston		Hosston	

Vertically, the Trinity and Woodbine aquifers could contain multiple model layers and some of the model cells are pass-through cells with a thickness of one foot. To account for variable model cells from multiple model layers for the same aquifer, Groundwater Management Area 8 (2021) adopted a method presented by Van Kelley of INTERA, Inc., which calculated a single composite water level from multiple model cells with each adjusted by transmissivity. This composite water level took both the water level and hydraulic transmissivity at each cell into calculation, as shown in the following equation:

$$Hc = \frac{\sum_{i=UL}^{LL} T_i H_i}{\sum_{i=UL}^{LL} T_i}$$

Where:

Hc = Composite Water Level (feet above mean sea level)

T_i = Transmissivity of model layer i (square feet per day)

H_i = Water Level of model layer i (feet above mean sea level)

LL = Lowest model layer representing the regional aquifer

UL = Uppermost model layer representing the regional aquifer.

Note that multiple model layers can represent a single aquifer or subunit, so the aquifer or subunit designation should be determined by the IBOUND value of a model cell rather than the model layer. When a model cell goes dry, the water level was set to the cell bottom. However, if an aquifer completely goes dry, TWDB assigns the bottom elevation from the lowest model cell of the aquifer to the composite water level.

The average water level for the same aquifer in a county (*Hc_County*) was then calculated using the following equation:

$$Hc\_County = \frac{\sum_{i=1}^{n} Hc_i}{n}$$

Where:

Hc_County = Average composite water level for a county (feet above mean sea level)

Hc_i = Composite Water Level at a lateral location as defined in last step (feet above mean sea level)

n = Total lateral (row, column) locations of an aquifer in a county.

Drawdown of the aquifer in a county (*DD_County*) was calculated using the following equation:

$$DD\_County = Hc\_County_{2009} - Hc\_County_{2080}$$

Where:

Hc_County_{2009} = Average water level of an aquifer in a county in 2009 as defined above (feet above mean sea level)

Hc_County_{2080} = Average water level of an aquifer in a county in 2080 as defined above (feet above mean sea level).

If an aquifer went dry in 2009, that lateral location was excluded from the calculation.

In comparison with a simple average calculation based on total model cell count, use of composite water level gives less weight to cells with lower transmissivity values (such as pass-through cells, cells with low saturation in outcrop area, or cells with lower hydraulic conductivity) in water level and drawdown calculation.

Per Groundwater Management Area 8, a desired future condition was met if the simulated drawdown was within five percent or five feet of the desired future condition. Using the water level output file submitted by Groundwater Management Area 8 and the method described above, the TWDB calculated the drawdowns and then compared with the correlated desired future conditions. The comparisons are presented in Tables A1, A2, A3, and A4. The comparison indicates that the predictive simulation meets the desired future conditions of the Trinity and Woodbine aquifers in Groundwater Management Area 8.

TABLE A1. **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY GROUNDWATER CONSERVATION DISTRICT (GCD), EXCLUDING UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

GCD	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Central Texas GCD	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	2	2	No
	Twin Mountains	—	—	—
	Travis Peak	19	11	No
	Hensell	7	9	No
	Hosston	21	21	No
	Antlers	—	—	—
Clearwater UWCD	Woodbine	—	—	—
	Paluxy	17	18	No
	Glen Rose	83	83	No
	Twin Mountains	—	—	—
	Travis Peak	333	333	No
	Hensell	145	145	No
	Hosston	375	375	No
	Antlers	—	—	—
Middle Trinity GCD	Woodbine	—	—	—
	Paluxy	5	7	No
	Glen Rose	29	29	No
	Twin Mountains	8	6	No
	Travis Peak	98	98	No
	Hensell	77	77	No
	Hosston	124	124	No
	Antlers	12	12	No
North Texas GCD	Woodbine	263	263	No
	Paluxy	690	690	No
	Glen Rose	366	366	No
	Twin Mountains	601	601	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	305	296	No

TABLE A1 (CONT).   **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY GROUNDWATER CONSERVATION DISTRICT (GCD), EXCLUDING UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

GCD	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Northern Trinity GCD	Woodbine	6	6	No
	Paluxy	105	105	No
	Glen Rose	163	163	No
	Twin Mountains	348	232	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	177	83	No
Post Oak Savannah GCD	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	241	241	No
	Twin Mountains	—	—	—
	Travis Peak	412	412	No
	Hensell	261	261	No
	Hosston	412	412	No
	Antlers	—	—	—
Prairielands GCD	Woodbine	44	44	No
	Paluxy	44	46	No
	Glen Rose	142	142	No
	Twin Mountains	170	46	No
	Travis Peak	323	311	No
	Hensell	201	207	No
	Hosston	364	369	No
	Antlers	—	—	—
Red River GCD	Woodbine	209	211	No
	Paluxy	830	720	No
	Glen Rose	335	308	No
	Twin Mountains	405	405	No
	Travis Peak	291	291	No
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	321	321	No
Saratoga UWCD	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	1	1	No
	Twin Mountains	—	—	—
	Travis Peak	6	6	No
	Hensell	1	2	No
	Hosston	11	12	No
	Antlers	—	—	—

TABLE A1 (CONT). COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY GROUNDWATER CONSERVATION DISTRICT (GCD), EXCLUDING UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.

GCD	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Southern Trinity GCD	Woodbine	6	6	No
	Paluxy	41	41	No
	Glen Rose	148	148	No
	Twin Mountains	—	—	—
	Travis Peak	504	499	No
	Hensell	242	242	No
	Hosston	582	582	No
	Antlers	—	—	—

TABLE A2. COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS FOR UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.

GCD	Portion	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Upper Trinity GCD	outcrop	Woodbine	—	—	—
		Paluxy	6	6	No
		Glen Rose	15	14	No
		Twin Mountains	10	6	No
		Travis Peak	—	—	—
		Hensell	—	—	—
		Hosston	—	—	—
		Antlers	47	16	No
Upper Trinity GCD	subcrop	Woodbine	—	—	—
		Paluxy	2	2	No
		Glen Rose	45	49	No
		Twin Mountains	70	46	No
		Travis Peak	—	—	—
		Hensell	—	—	—
		Hosston	—	—	—
		Antlers	154	92	No

TABLE A3.   **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Bell	Woodbine	—	—	—
	Paluxy	17	18.46	No
	Glen Rose	83	82.74	No
	Twin Mountains	—	—	—
	Travis Peak	333	332.79	No
	Hensell	145	144.73	No
	Hosston	375	374.76	No
	Antlers	—	—	—
Bosque	Woodbine	—	—	—
	Paluxy	6	6.78	No
	Glen Rose	53	53.38	No
	Twin Mountains	—	—	—
	Travis Peak	189	188.88	No
	Hensell	139	139.01	No
	Hosston	232	232.23	No
	Antlers	—	—	—
Brown	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	1	1.9	No
	Twin Mountains	—	—	—
	Travis Peak	2	1.23	No
	Hensell	1	1.14	No
	Hosston	1	1.3	No
	Antlers	2	2.56	No
Burnet	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	2	2.39	No
	Twin Mountains	—	—	—
	Travis Peak	19	10.76	No
	Hensell	7	8.89	No
	Hosston	21	21.2	No
	Antlers	—	—	—
Callahan	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	—	—	—
	Twin Mountains	—	—	—
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	1	1.38	No

TABLE A3 (CONT).   **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Collin	Woodbine	482	481.88	No
	Paluxy	729	728.64	No
	Glen Rose	366	365.79	No
	Twin Mountains	560	559.87	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	596	583.45	No
Comanche	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	2	1.44	No
	Twin Mountains	—	—	—
	Travis Peak	4	2.4	No
	Hensell	2	1.76	No
	Hosston	3	2.86	No
	Antlers	12	12.08	No
Cooke	Woodbine	2	2.41	No
	Paluxy	—	—	—
	Glen Rose	—	—	—
	Twin Mountains	—	—	—
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	191	178.36	No
Coryell	Woodbine	—	—	—
	Paluxy	5	7.5	No
	Glen Rose	15	15.37	No
	Twin Mountains	—	—	—
	Travis Peak	107	107.32	No
	Hensell	70	70.02	No
	Hosston	141	140.6	No
	Antlers	—	—	—
Dallas	Woodbine	137	137.41	No
	Paluxy	346	345.58	No
	Glen Rose	288	288.24	No
	Twin Mountains	515	515.09	No
	Travis Peak	415	414.61	No
	Hensell	362	361.55	No
	Hosston	419	418.84	No
	Antlers	—	—	—

TABLE A3 (CONT). **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Delta	Woodbine	—	—	—
	Paluxy	279	278.97	No
	Glen Rose	198	197.8	No
	Twin Mountains	—	—	—
	Travis Peak	202	202.1	No
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	—	—	—
Denton	Woodbine	22	20.37	No
	Paluxy	558	557.89	No
	Glen Rose	367	367.03	No
	Twin Mountains	752	742.97	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	416	404.5	No
Eastland	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	—	—	—
	Twin Mountains	—	—	—
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	4	4.11	No
Ellis	Woodbine	76	76.07	No
	Paluxy	128	127.51	No
	Glen Rose	220	220.03	No
	Twin Mountains	413	413.29	No
	Travis Peak	380	380.25	No
	Hensell	290	290.49	No
	Hosston	390	390.34	No
	Antlers	—	—	—
Erath	Woodbine	—	—	—
	Paluxy	6	1.01	No
	Glen Rose	6	5.07	No
	Twin Mountains	8	6.4	No
	Travis Peak	25	20.18	No
	Hensell	12	11.45	No
	Hosston	35	35	No
	Antlers	14	13.56	No

TABLE A3 (CONT). COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Falls	Woodbine	—	—	—
	Paluxy	159	159.35	No
	Glen Rose	238	238.09	No
	Twin Mountains	—	—	—
	Travis Peak	505	504.77	No
	Hensell	296	296.31	No
	Hosston	511	511.14	No
	Antlers	—	—	—
Fannin	Woodbine	259	259.23	No
	Paluxy	709	708.85	No
	Glen Rose	305	305.1	No
	Twin Mountains	400	400.17	No
	Travis Peak	291	291.45	No
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	269	268.98	No
Grayson	Woodbine	163	162.86	No
	Paluxy	943	942.74	No
	Glen Rose	364	363.85	No
	Twin Mountains	445	445.2	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	364	363	No
Hamilton	Woodbine	—	—	—
	Paluxy	2	2.77	No
	Glen Rose	4	4.25	No
	Twin Mountains	—	—	—
	Travis Peak	26	25.93	No
	Hensell	14	13.99	No
	Hosston	38	38.2	No
	Antlers	—	—	—
Hill	Woodbine	20	19.71	No
	Paluxy	45	44.9	No
	Glen Rose	149	148.93	No
	Twin Mountains	—	—	—
	Travis Peak	365	364.39	No
	Hensell	211	211.07	No
	Hosston	413	412.6	No
	Antlers	—	—	—

TABLE A3 (CONT). **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Hunt	Woodbine	631	630.96	No
	Paluxy	610	610.15	No
	Glen Rose	326	326.15	No
	Twin Mountains	399	398.85	No
	Travis Peak	350	349.84	No
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	—	—	—
Johnson	Woodbine	4	3.55	No
	Paluxy	-57	-57.56	No
	Glen Rose	66	65.87	No
	Twin Mountains	184	33.24	No
	Travis Peak	235	178.04	No
	Hensell	120	120.41	No
	Hosston	329	329.41	No
	Antlers	—	—	—
Kaufman	Woodbine	242	241.7	No
	Paluxy	311	311.43	No
	Glen Rose	305	304.98	No
	Twin Mountains	427	427	No
	Travis Peak	372	371.84	No
	Hensell	349	348.53	No
	Hosston	345	344.74	No
	Antlers	—	—	—
Lamar	Woodbine	42	42.07	No
	Paluxy	100	100.09	No
	Glen Rose	107	106.9	No
	Twin Mountains	—	—	—
	Travis Peak	125	124.5	No
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	132	132.31	No
Lampasas	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	1	1.22	No
	Twin Mountains	—	—	—
	Travis Peak	6	6.31	No
	Hensell	1	1.56	No
	Hosston	11	11.64	No
	Antlers	—	—	—

TABLE A3 (CONT). **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Limestone	Woodbine	—	—	—
	Paluxy	199	198.7	No
	Glen Rose	301	300.8	No
	Twin Mountains	—	—	—
	Travis Peak	433	433.11	No
	Hensell	214	214.2	No
	Hosston	445	444.63	No
	Antlers	—	—	—
McLennan	Woodbine	6	6.49	No
	Paluxy	41	41.02	No
	Glen Rose	148	147.65	No
	Twin Mountains	—	—	—
	Travis Peak	504	498.88	No
	Hensell	242	242.36	No
	Hosston	582	581.81	No
	Antlers	—	—	—
Milam	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	241	240.72	No
	Twin Mountains	—	—	—
	Travis Peak	412	411.52	No
	Hensell	261	260.7	No
	Hosston	412	412.3	No
	Antlers	—	—	—
Mills	Woodbine	—	—	—
	Paluxy	1	0.64	No
	Glen Rose	1	1.2	No
	Twin Mountains	—	—	—
	Travis Peak	9	7.36	No
	Hensell	2	2.16	No
	Hosston	13	13.67	No
	Antlers	—	—	—
Navarro	Woodbine	110	110.34	No
	Paluxy	139	139.22	No
	Glen Rose	266	265.96	No
	Twin Mountains	—	—	—
	Travis Peak	343	343.14	No
	Hensell	295	295.18	No
	Hosston	343	343.41	No
	Antlers	—	—	—

TABLE A3 (CONT). **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Red River	Woodbine	2	2.28	No
	Paluxy	24	23.74	No
	Glen Rose	40	39.58	No
	Twin Mountains	—	—	—
	Travis Peak	57	56.88	No
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	15	14.51	No
Rockwall	Woodbine	275	274.86	No
	Paluxy	433	432.69	No
	Glen Rose	343	342.57	No
	Twin Mountains	466	466.49	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	—	—	—
Somervell	Woodbine	—	—	—
	Paluxy	4	1.62	No
	Glen Rose	4	4.45	No
	Twin Mountains	50	50.27	No
	Travis Peak	64	64.26	No
	Hensell	17	16.57	No
	Hosston	120	120.22	No
	Antlers	—	—	—
Tarrant	Woodbine	6	6.41	No
	Paluxy	105	105.14	No
	Glen Rose	163	163.16	No
	Twin Mountains	348	231.93	No
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	177	83.43	No
Taylor	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	—	—	—
	Twin Mountains	—	—	—
	Travis Peak	—	—	—
	Hensell	—	—	—
	Hosston	—	—	—
	Antlers	0	0.26	No

TABLE A3 (CONT). **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY, EXCLUDING COUNTIES IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Travis	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	90	89.73	No
	Twin Mountains	—	—	—
	Travis Peak	219	215.69	No
	Hensell	68	69.19	No
	Hosston	226	224.15	No
	Antlers	—	—	—
Williamson	Woodbine	—	—	—
	Paluxy	—	—	—
	Glen Rose	78	79.23	No
	Twin Mountains	—	—	—
	Travis Peak	220	220.43	No
	Hensell	89	90.6	No
	Hosston	225	225.78	No
	Antlers	—	—	—

TABLE A4.   **COMPARISON BETWEEN DRAWDOWN AND DESIRED FUTURE CONDITIONS BY COUNTY IN UPPER TRINITY GROUNDWATER CONSERVATION DISTRICT.**

County	Portion	Aquifer	Desired Future Condition (feet of drawdown between January 1, 2010 and December 31, 2080)	Simulated Drawdown between Initial Water Levels and Stress Period 71 (feet)	Is Desired Future Condition Violated (Exceeded by 5 feet and 5%)?
Hood	outcrop	Antlers	—	—	—
		Paluxy	6	5.68	No
		Glen Rose	9	9.41	No
		Twin Mountains	13	8.14	No
	subcrop	Antlers	—	—	—
		Paluxy	—	—	—
		Glen Rose	39	39.41	No
		Twin Mountains	72	20.57	No
Montague	outcrop	Antlers	40	20.37	No
		Paluxy	—	—	—
		Glen Rose	—	—	—
		Twin Mountains	—	—	—
	subcrop	Antlers	—	—	—
		Paluxy	—	—	—
		Glen Rose	—	—	—
		Twin Mountains	—	—	—
Parker	outcrop	Antlers	42	8.76	No
		Paluxy	6	5.69	No
		Glen Rose	20	20.06	No
		Twin Mountains	7	2.42	No
	subcrop	Antlers	—	—	—
		Paluxy	2	1.81	No
		Glen Rose	50	50.41	No
		Twin Mountains	68	61.87	No
Wise	outcrop	Antlers	60	16.44	No
		Paluxy	—	—	—
		Glen Rose	—	—	—
		Twin Mountains	—	—	—
	subcrop	Antlers	154	92.38	No
		Paluxy	—	—	—
		Glen Rose	—	—	—
		Twin Mountains	—	—	—

Appendix B

Comparison between Desired Future Conditions and Drawdowns for the Marble Falls, Ellenburger-San Saba, and Hickory Aquifers in Brown, Burnet, Lampasas, and Mills Counties

The water level file from the predictive model output was used to calculate the drawdown (D) within the modeled extent for each aquifer between 2009 and 2080 using the following equation:

$$D = \frac{\sum_{i=1}^{n}(h2009_i - h2080_i)}{n}$$

Where:

   n = Total model cells in a county

   $h2009_i$ = Water level of 2009 at model cell i (feet)

   $h2080_i$ = Water level of 2080 at model cell i (feet)

Model cells with water level values below the cell bottom in 2009 were excluded from the calculation. Also, water level was set at the cell bottom if it fell below the cell bottom in 2080.

The comparison between the simulated drawdowns and the desired future conditions is presented in Table B1. The comparison indicates that the predictive simulation meets the desired future conditions of the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Brown, Burnet, Lampasas, and Mills counties.

TABLE B1. **COMPARISON BETWEEN SIMULATED REMAINING AQUIFER SATURATED THICKESS AND DESIRED FUTURE CONDITIONS OF MARBLE FALLS, ELLENBURGER-SAN SABA, AND HICKORY AQUIFERS IN BROWN, BURNET, LAMPASAS, AND MILLS COUNTIES.**

County	Aquifer	Desired Future Condition (feet of drawdown between 2009 and 2080)	Simulated Drawdown between 2009 and 2080 (feet)	Is Desired Future Condition Violated?
Brown	Marble Falls	3	3	no
	Ellenburger-San Saba	3	3	no
	Hickory	3	3	no
Burnet	Marble Falls	11	11	no
	Ellenburger-San Saba	12	9	no
	Hickory	11	11	no
Lampasas	Marble Falls	16	16	no
	Ellenburger-San Saba	16	16	no
	Hickory	16	16	no
Mills	Marble Falls	9	9	no
	Ellenburger-San Saba	9	9	no
	Hickory	9	9	no

Appendix C

Summary of Dry Model Cell Count for the Trinity, Woodbine, Marble Falls, Ellenburger-San Saba, and Hickory Aquifers

TABLE C1.   SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Bell	Paluxy	2009	1,767	0
		2080	1,767	0
	Glen Rose	2009	23,737	0
		2080	23,737	8
	Hensell	2009	17,390	0
		2080	17,390	0
	Hosston	2009	17,390	0
		2080	17,390	0
	Travis Peak	2009	52,170	0
		2080	52,170	0
Bosque	Paluxy	2009	13,818	0
		2080	13,818	0
	Glen Rose	2009	22,360	0
		2080	22,360	0
	Hensell	2009	16,034	0
		2080	16,034	0
	Hosston	2009	16,034	0
		2080	16,034	0
	Travis Peak	2009	48,102	0
		2080	48,102	0
Brown	Glen Rose	2009	36	0
		2080	36	0
	Hensell	2009	1,608	0
		2080	1,608	0
	Hosston	2009	10,258	0
		2080	10,258	0
	Travis Peak	2009	15,847	0
		2080	15,847	0
	Antlers	2009	12,354	0
		2080	12,354	0

TABLE C1 (CONT).   SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Burnet	Glen Rose	2009	22,534	0
		2080	22,534	0
	Hensell	2009	12,332	0
		2080	12,332	0
	Hosston	2009	22,320	217
		2080	22,320	765
	Travis Peak	2009	44,433	217
		2080	44,433	828
Callahan	Antlers	2009	34,576	0
		2080	34,576	0
Collin	Woodbine	2009	11,762	0
		2080	11,762	2
	Paluxy	2009	12,062	0
		2080	12,062	319
	Glen Rose	2009	12,062	0
		2080	12,062	0
	Twin Mountains	2009	36,186	0
		2080	36,186	0
	Antlers	2009	7,055	0
		2080	7,055	172
Comanche	Glen Rose	2009	1,440	0
		2080	1,440	0
	Hensell	2009	22,362	0
		2080	22,362	0
	Hosston	2009	41,062	0
		2080	41,062	353
	Travis Peak	2009	78,137	0
		2080	78,137	353
	Antlers	2009	23,711	123
		2080	23,711	3,149
Cooke	Woodbine	2009	5,700	0
		2080	5,700	26
	Antlers	2009	77,047	0
		2080	77,047	839

TABLE C1 (CONT). **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Coryell	Paluxy	2009	6,512	0
		2080	6,512	0
	Glen Rose	2009	41,647	11
		2080	41,647	25
	Hensell	2009	16,914	0
		2080	16,914	0
	Hosston	2009	16,914	0
		2080	16,914	0
	Travis Peak	2009	50,742	0
		2080	50,742	0
Dallas	Woodbine	2009	14,152	0
		2080	14,152	0
	Paluxy	2009	14,532	0
		2080	14,532	10
	Glen Rose	2009	14,532	0
		2080	14,532	0
	Hensell	2009	80	0
		2080	80	0
	Hosston	2009	80	0
		2080	80	0
	Twin Mountains	2009	43,353	0
		2080	43,353	0
	Travis Peak	2009	243	0
		2080	243	0
Delta	Paluxy	2009	1,217	0
		2080	1,217	0
	Glen Rose	2009	1,217	0
		2080	1,217	0
	Travis Peak	2009	3,651	0
		2080	3,651	0

TABLE C1 (CONT). SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Denton	Woodbine	2009	11,991	3
		2080	11,991	10
	Paluxy	2009	3,520	0
		2080	3,520	2,115
	Glen Rose	2009	3,520	0
		2080	3,520	0
	Twin Mountains	2009	10,560	0
		2080	10,560	84
	Antlers	2009	59,107	0
		2080	59,107	5,738
Eastland	Antlers	2009	44,009	74
		2080	44,009	1,116
Ellis	Woodbine	2009	14,207	0
		2080	14,207	0
	Paluxy	2009	15,173	0
		2080	15,173	0
	Glen Rose	2009	15,209	0
		2080	15,209	0
	Hensell	2009	15,120	0
		2080	15,120	0
	Hosston	2009	15,120	0
		2080	15,120	0
	Twin Mountains	2009	225	0
		2080	225	0
	Travis Peak	2009	45,402	0
		2080	45,402	0

TABLE C1 (CONT). SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Erath	Paluxy	2009	1,443	0
		2080	1,443	0
	Glen Rose	2009	20,905	0
		2080	20,905	32
	Hensell	2009	21,880	0
		2080	21,880	83
	Hosston	2009	8,464	0
		2080	8,464	372
	Twin Mountains	2009	46,114	20
		2080	46,114	286
	Travis Peak	2009	39,220	0
		2080	39,220	1,006
	Antlers	2009	8,983	0
		2080	8,983	962
Falls	Paluxy	2009	1,439	0
		2080	1,439	0
	Glen Rose	2009	5,840	0
		2080	5,840	0
	Hensell	2009	5,840	0
		2080	5,840	0
	Hosston	2009	5,840	0
		2080	5,840	0
	Travis Peak	2009	17,520	0
		2080	17,520	0
Fannin	Woodbine	2009	15,443	3
		2080	15,443	60
	Paluxy	2009	1,582	0
		2080	1,582	0
	Glen Rose	2009	1,582	0
		2080	1,582	0
	Twin Mountains	2009	1,758	0
		2080	1,758	0
	Travis Peak	2009	2,988	0
		2080	2,988	0
	Antlers	2009	63,730	0
		2080	63,730	0

TABLE C1 (CONT). **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Grayson	Woodbine	2009	17,911	2
		2080	17,911	58
	Paluxy	2009	77	0
		2080	77	0
	Glen Rose	2009	77	0
		2080	77	0
	Twin Mountains	2009	231	0
		2080	231	0
	Antlers	2009	77,954	0
		2080	77,954	327
Hamilton	Paluxy	2009	1,897	0
		2080	1,897	0
	Glen Rose	2009	36,944	0
		2080	36,944	13
	Hensell	2009	16,890	0
		2080	16,890	0
	Hosston	2009	13,373	0
		2080	13,373	0
	Travis Peak	2009	43,636	0
		2080	43,636	0
Hill	Woodbine	2009	12,602	0
		2080	12,602	0
	Paluxy	2009	15,648	0
		2080	15,648	0
	Glen Rose	2009	15,766	0
		2080	15,766	0
	Hensell	2009	15,766	0
		2080	15,766	0
	Hosston	2009	15,766	0
		2080	15,766	0
	Travis Peak	2009	47,298	0
		2080	47,298	157

TABLE C1 (CONT).   **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Hood	Paluxy	2009	434	0
		2080	434	0
	Glen Rose	2009	14,461	0
		2080	14,461	74
	Hensell	2009	117	0
		2080	117	0
	Hosston	2009	117	0
		2080	117	5
	Twin Mountains	2009	37,444	0
		2080	37,444	1,710
	Travis Peak	2009	351	0
		2080	351	5
Hunt	Woodbine	2009	2,193	0
		2080	2,193	0
	Paluxy	2009	1,362	0
		2080	1,362	0
	Glen Rose	2009	1,362	0
		2080	1,362	0
	Twin Mountains	2009	492	0
		2080	492	0
	Travis Peak	2009	3,594	0
		2080	3,594	0
Johnson	Woodbine	2009	8,407	14
		2080	8,407	68
	Paluxy	2009	11,627	17
		2080	11,627	0
	Glen Rose	2009	12,342	15
		2080	12,342	37
	Hensell	2009	9,462	0
		2080	9,462	0
	Hosston	2009	9,462	0
		2080	9,462	1,278
	Twin Mountains	2009	6,816	0
		2080	6,816	1,836
	Travis Peak	2009	28,386	0
		2080	28,386	1,278

TABLE C1 (CONT). **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Kaufman	Woodbine	2009	1,616	0
		2080	1,616	0
	Paluxy	2009	1,321	0
		2080	1,321	0
	Glen Rose	2009	1,331	0
		2080	1,331	0
	Hensell	2009	82	0
		2080	82	0
	Hosston	2009	82	0
		2080	82	0
	Twin Mountains	2009	960	0
		2080	960	0
	Travis Peak	2009	3,033	0
		2080	3,033	0
Lamar	Woodbine	2009	9,839	0
		2080	9,839	0
	Paluxy	2009	12,260	0
		2080	12,260	0
	Glen Rose	2009	12,260	0
		2080	12,260	0
	Travis Peak	2009	36,780	0
		2080	36,780	0
	Antlers	2009	7,995	0
		2080	7,995	0
Lampasas	Glen Rose	2009	8,692	0
		2080	8,692	0
	Hensell	2009	25,364	1
		2080	25,364	1
	Hosston	2009	23,100	0
		2080	23,100	0
	Travis Peak	2009	62,529	1
		2080	62,529	1

TABLE C1 (CONT).   **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Limestone	Paluxy	2009	962	0
		2080	962	0
	Glen Rose	2009	1,760	0
		2080	1,760	0
	Hensell	2009	1,760	0
		2080	1,760	0
	Hosston	2009	1,760	0
		2080	1,760	0
	Travis Peak	2009	5,280	0
		2080	5,280	0
McLennan	Woodbine	2009	1,909	0
		2080	1,909	0
	Paluxy	2009	16,952	0
		2080	16,952	0
	Glen Rose	2009	16,991	0
		2080	16,991	0
	Hensell	2009	16,991	0
		2080	16,991	0
	Hosston	2009	16,991	0
		2080	16,991	16
	Travis Peak	2009	50,973	0
		2080	50,973	16
Milam	Glen Rose	2009	2,579	0
		2080	2,579	0
	Hensell	2009	2,579	0
		2080	2,579	0
	Hosston	2009	2,579	0
		2080	2,579	0
	Travis Peak	2009	7,737	0
		2080	7,737	0

TABLE C1 (CONT).   **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Mills	Paluxy	2009	936	0
		2080	936	0
	Glen Rose	2009	10,615	0
		2080	10,615	2
	Hensell	2009	18,539	0
		2080	18,539	0
	Hosston	2009	14,226	0
		2080	14,226	0
	Travis Peak	2009	42,934	0
		2080	42,934	0
Montague	Antlers	2009	52,693	0
		2080	52,693	417
Navarro	Woodbine	2009	1,578	0
		2080	1,578	0
	Paluxy	2009	1,755	0
		2080	1,755	0
	Glen Rose	2009	6,326	0
		2080	6,326	0
	Hensell	2009	6,326	0
		2080	6,326	0
	Hosston	2009	6,326	0
		2080	6,326	0
	Travis Peak	2009	18,978	0
		2080	18,978	0
Parker	Paluxy	2009	5,637	0
		2080	5,637	0
	Glen Rose	2009	11,389	8
		2080	11,389	753
	Twin Mountains	2009	30,326	0
		2080	30,326	223
	Antlers	2009	40,600	0
		2080	40,600	435

TABLE C1 (CONT).   **SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.**

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Red River	Woodbine	2009	4,222	0
		2080	4,222	0
	Paluxy	2009	8,494	0
		2080	8,494	0
	Glen Rose	2009	8,494	0
		2080	8,494	0
	Travis Peak	2009	25,482	0
		2080	25,482	0
	Antlers	2009	1,065	0
		2080	1,065	0
Rockwall	Woodbine	2009	33	0
		2080	33	0
	Paluxy	2009	711	0
		2080	711	0
	Glen Rose	2009	711	0
		2080	711	0
	Twin Mountains	2009	2,133	0
		2080	2,133	0
Somervell	Paluxy	2009	851	0
		2080	851	0
	Glen Rose	2009	11,274	0
		2080	11,274	0
	Hensell	2009	3,045	0
		2080	3,045	0
	Hosston	2009	2,640	0
		2080	2,640	0
	Twin Mountains	2009	1,660	0
		2080	1,660	0
	Travis Peak	2009	8,325	0
		2080	8,325	0

TABLE C1 (CONT).   SUMMARY OF DRY MODEL CELLS FOR TRINITY AND WOODBINE AQUIFERS FROM PREDICTIVE SIMULATION.

County	Aquifer	Year	Total Aquifer Cells	Dry Cells
Tarrant	Woodbine	2009	8,901	2
		2080	8,901	3
	Paluxy	2009	15,389	3
		2080	15,389	1,926
	Glen Rose	2009	13,571	0
		2080	13,571	0
	Twin Mountains	2009	40,713	0
		2080	40,713	6,065
	Antlers	2009	5,009	0
		2080	5,009	1,033
Taylor	Antlers	2009	6,176	0
		2080	6,176	0
Travis	Glen Rose	2009	14,314	25
		2080	14,314	0
	Hensell	2009	11,310	0
		2080	11,310	0
	Hosston	2009	9,400	57
		2080	9,400	123
	Travis Peak	2009	30,124	57
		2080	30,124	124
Williamson	Glen Rose	2009	24,271	0
		2080	24,271	0
	Hensell	2009	17,454	0
		2080	17,454	0
	Hosston	2009	17,454	0
		2080	17,454	0
	Travis Peak	2009	52,362	0
		2080	52,362	0
Wise	Antlers	2009	90,469	0
		2080	90,469	3,563

TABLE C2. **SUMMARY OF DRY MODEL CELLS FOR MARBLE FALLS, ELLENBURGER-SAN SABA, AND HICKORY AQUIFERS IN BROWN, BURNET, LAMPASAS, AND MILLS COUNTIES FROM PREDICTIVE SIMULATION.**

County	Aquifer	Active Cells	Dry Cells (2009)	Dry Cells (2080)
Brown	Marble Falls	1,635	0	0
	Ellenburger-San Saba	1,635	0	0
	Hickory	1,635	0	0
Burnet	Marble Falls	10,810	2,298	2,450
	Ellenburger-San Saba	13,618	709	851
	Hickory	14,334	111	131
Lampasas	Marble Falls	7,614	611	683
	Ellenburger-San Saba	7,895	0	0
	Hickory	7,895	0	0
Mills	Marble Falls	3,540	0	0
	Ellenburger-San Saba	3,540	0	0
	Hickory	3,540	0	0

APPENDIX J

GAM Run 15-003: Clearwater Underground Water Conservation District Management Plan

by Roberto Anaya, P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-6115
November 24, 2015
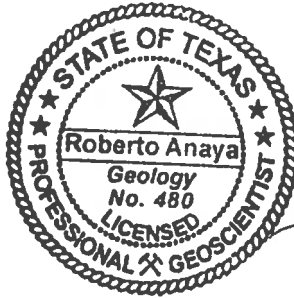
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GAM Run 15-003: Clearwater Underground Water Conservation District Management Plan

by Roberto Anaya, P.G.
Texas Water Development Board
Groundwater Resources Division
Groundwater Availability Modeling Section
(512) 463-6115
November 24, 2015

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the executive administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the executive administrator. Information derived from groundwater availability models that shall be included in the groundwater management plan includes:

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

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

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

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

The groundwater management plan for the Clearwater Underground Water Conservation District should be adopted by the district on or before January 14, 2016 and submitted to the executive administrator of the TWDB on or before February 13, 2016. The current management plan for the Clearwater Underground Water Conservation District expires on April 13, 2016.

This report discusses the methods, assumptions, and results from a model run using the most current groundwater availability models for the Trinity (northern portion) and Woodbine aquifers, version 2.01 (Kelley and others, 2014) and the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Jones, 2003). This model run replaces the results of GAM Run 10-009 (Hassan, 2010) that used version 1.01 of the groundwater availability model for the Trinity (northern portion) and Woodbine aquifers (Bené and others, 2004). Tables 1 and 2 summarize the groundwater availability model data required by statute to be included in the district's groundwater conservation management plan, and Figures 1 and 2 show the areas of the model from which the values in the table were extracted. If after review of the figures, Clearwater 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 updated groundwater availability model for the northern portion of the Trinity and Woodbine aquifers (Kelley and others, 2014) and the original groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Jones, 2003) was used for this analysis. Water budgets for the Clearwater Underground Water Conservation District were extracted for the historical model calibration periods of 1980-2012 for the Trinity Aquifer and 1980-2000 for the Edwards (Balcones Fault Zone) Aquifer using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface water outflow, inflow to the district, outflow from the district, net inter-aquifer flow (upper), and net inter-aquifer flow (lower) for the portion of the aquifers located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Northern portion of the Trinity Aquifer and Woodbine Aquifer

- We used the updated groundwater availability model for the northern portion of the Trinity Aquifer and Woodbine Aquifer (Version 2.01). See

Kelley and others (2014) for assumptions and limitations of the updated groundwater availability model.

- The groundwater availability model includes eight layers, that generally correspond to:

    o the surficial outcrop area of the units in layers 2 through 8 and the younger formations overlying the downdip portions of the Woodbine Aquifer and Washita and Fredericksburg groups (Layer 1),

    o the Woodbine Aquifer (Layer 2),

    o the Washita and Fredericksburg groups (Layer 3),

    o the Paluxy Aquifer (Layer 4),

    o the Glen Rose Formation (Layer 5),

    o the Hensell Sand (Layer 6),

    o the Pearsall Formation (Layer 7), and

    o The Hosston Formation (Layer 8).

- The Trinity Aquifer is a major source of groundwater in the Clearwater Underground Water Conservation District. Most of the Trinity Aquifer occurs as subcrop within the district boundaries. A small amount of the aquifer outcrops in the western portion of the district. All of the eight numerical layers in the model are designated as active in the Clearwater Underground Water Conservation District. The Trinity Aquifer is represented by Model Layers 1 through 8 in the outcrop area and by Model Layers 4 through 8 in the subcrop area. These layers were combined to calculate water budget values for the Trinity Aquifer in the district.

- Groundwater in the Trinity Aquifer within the Clearwater Underground Water Conservation District is primarily fresh water, with total dissolved solids concentrations less than 1,000 milligrams per liter (see Figures 4.4.11 through 4.4.15 in Kelley and others (2014)).

- The Woodbine Aquifer does not exist within the Clearwater Underground Water Conservation District and thus water budgets for this aquifer were not calculated or included for this report.

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

Northern Segment of the Edwards (Balcones Fault Zone) Aquifer

- We used the original groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer (Version 1.01). See Jones (2003) for assumptions and limitations of the groundwater availability model.

- The groundwater availability model includes one layer, that generally corresponds to:

  ○ The Edwards (Balcones Fault Zone) Aquifer.

- The Edwards (Balcones Fault Zone) Aquifer is a major source of groundwater in the Clearwater Underground Water Conservation District. Most of the Edwards (Balcones Fault Zone) Aquifer occurs as outcrop within the district boundaries (72 percent). The remainder of the aquifer subcrops to the southwest. The single numerical layer in the model is designated as active in the Clearwater Underground Water Conservation District. This layer was used to calculate water budget values for the Edwards (Balcones Fault Zone) Aquifer in the district.

- Groundwater in the Edwards (Balcones Fault Zone) Aquifer within the Clearwater Underground Water Conservation District is primarily fresh water, with total dissolved solids concentrations less than 1,000 milligrams per liter (see pages 37 through 39 in Jones (2003)).

- 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 model results for the Trinity Aquifer and Edwards (Balcones Fault Zone) Aquifer located within the district and averaged over the duration of the calibration and verification portion of the model run, as shown in Tables 1 and 2.

- Precipitation recharge—the areally-distributed recharge sourced from precipitation falling on the outcrop areas of the Trinity Aquifer or Edwards (Balcones Fault Zone) Aquifer (where the aquifers are exposed at land surface) within the district.

- Surface water outflow—the total volume of 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 aquifers between the district and adjacent counties.

- Flow between aquifers—the net vertical flow between aquifers or confining units. This flow is controlled by the relative water levels in each aquifer or confining unit and hydraulic properties of each aquifer or confining unit. In the Clearwater Underground Water Conservation District, this net vertical flow represents the net groundwater flow between the Trinity Aquifer and the immediate geologic unit overlying the aquifer in the subcrop area or the net groundwater flow between the Edwards (Balcones Fault Zone) Aquifer and the immediate geologic units overlying and underlying the aquifer in the subcrop area.

The information needed for the Clearwater Underground Water Conservation District's management plan is summarized in Tables 1 and 2. It is important to note that sub-regional water budgets are approximate. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located (Figures 1 and 2). Please note that the results of this model run are different from the results of the model run 10-009 that were obtained from the older groundwater availability model for the Trinity Aquifer. The changes can be attributed to several characteristics of the new model, such as differences in model layering, geologic boundaries, hydraulic properties distribution, and the use of different MODFLOW modeling packages.

TABLE 1: SUMMARIZED INFORMATION FOR THE TRINITY AQUIFER THAT IS NEEDED FOR THE CLEARWATER 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	Trinity Aquifer	2,816
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Trinity Aquifer	11,131
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	7230
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	5659
Estimated net annual volume of flow between each aquifer in the district	From younger overlying Washita and Fredericksburg Confining Units into the Trinity Aquifer	5,587

Legend

County Boundary
Clearwater Underground Water Conservation District
Trinity Aquifer (North) Active Model Cells (outcrop)
Trinity Aquifer (North) Active Model Cells (subcrop)

County Boundary Date = 02/02/2011
GCD Boundary Date = 07/01/2015
trnt_n Grid Date = 08/26/2015

FIGURE 1: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PORTION OF THE TRINITY AQUIFER AND WOODBINE AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE TRINITY AQUIFER FOOTPRINT EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2: SUMMARIZED INFORMATION FOR THE EDWARDS (BALCONES FAULT ZONE) AQUIFER THAT IS NEEDED FOR THE CLEARWATER 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 (Balcones Fault Zone) Aquifer	27,565
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards (Balcones Fault Zone) Aquifer	27,566
Estimated annual volume of flow into the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	5,853
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards (Balcones Fault Zone) Aquifer	1,090
Estimated net annual volume of flow between each aquifer in the district	From Edwards (Balcones Fault Zone) Aquifer to the overlying younger units	121
	From Edwards (Balcones Fault Zone) Aquifer to the downdip portion of the Edwards (Balcones Fault Zone) Aquifer	3,957*

* The model extends beyond the TWDB official Edwards (Balcones Fault Zone) Aquifer boundary. This is the amount of saline groundwater (greater than 1,000 total dissolved solid) that exits in the downdip boundary limit of the aquifer within the district boundaries and into deeper portions of the Edwards Group formations.

Legend

☐	County Boundary
☐ (red outline)	Clearwater Underground Water Conservation District
■ (dark navy)	Edwards Aquifer (North) Active Model Cells (outcrop)
■ (light blue)	Edwards Aquifer (North) Active Model Cells (subcrop)

County Boundary Date = 02/02/2011

GCD Boundary Date = 07/01/2015

ebfz_n Grid Date = 08/26/2015

FIGURE 2: AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE EDWARDS (BALCONES FAULT ZONE) AQUIFER FOOTPRINT EXTENT WITHIN THE DISTRICT BOUNDARY).

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 interaction with streams are specific to particular historic time periods.

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

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

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APPENDIX K

Table 3.1-1. Major Reservoirs[1] of the Brazos River Basin

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Alan Henry	City of Lubbock	115,937	35,200	10/5/1981	Garza	O
Allens Creek	Brazos River Authority/City of Houston	145,553	202,000	9/1/1999	Austin	H
Aquilla	Brazos River Authority	52,400	13,896	10/25/1976	Hill	G
Belton	Brazos River Authority	457,600	100,257	12/16/1963	Bell	G
Belton	U.S. Dept. of the Army[2]	12,000	10,000 2,000	8/24/1953 8/23/1954	Bell	G
Dow - Brazoria Reservoir	Dow Chemical[3]	21,973	--	4/7/1952	Brazoria	H
Dow - Harris Reservoir	Dow Chemical[3]	10,200	--	2/14/1942	Brazoria	H
Cisco	City of Cisco	45,110	1,971 1,000	4/16/1920 11/8/1954	Eastland	G
Daniel	City of Breckenridge	11,400	2,100	4/26/1946	Stephens	G
Dansby Power Plant	City of Bryan	15,227	850	5/30/1972	Brazos	G
Eagle Nest Lake	U.S. Dept. of the Interior	11,315	1,800	1/15/1948	Brazoria	H
Fort Phantom Hill	City of Abilene	73,960	30,690	3/25/1937	Jones	G
Georgetown	Brazos River Authority	37,100	13,610	2/12/1968	Williamson	G
Gibbons Creek Power	Texas Municipal Power Agency	26,824 5,260	9,740	2/22/1977 3/9/1989	Grimes	G
Graham/Eddleman	City of Graham	4,503 39,000 8,883	5,000 15,000	11/21/1927 11/15/1954 9/16/1957	Young	G
Granbury	Brazos River Authority	155,000	64,712	2/13/1964	Hood	G
Granger	Brazos River Authority	65,500	19,840	2/12/1968	Williamson	G
Hubbard Creek Lake	West Central Texas MWD	317,750	52,800 3,200	5/28/1957 8/14/1972	Stephens	G
Leon	Eastland Co WSD	28,000	1,265 2,438 2,597	5/17/1931 3/21/1952 3/25/1986		

Table 3.1-1. Major Reservoirs[1] of the Brazos River Basin

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Limestone	Brazos River Authority	225,400	65,074	5/6/1974	Robertson	G
Miller's Creek	North Central Texas MWA	30,696	5,000	10/1/1958	Baylor	B
Palo Pinto	Palo Pinto County MWD No. 1	44,100 24	16,000 2,500	7/3/1962 9/8/1964	Palo Pinto	G
Pat Cleburne Reservoir	City of Cleburne	25,600	5,760 240	8/6/1962 3/29/1976	Johnson	G
Possum Kingdom	Brazos River Authority	724,739	230,750	4/6/1938	Palo Pinto	G
Proctor	Brazos River Authority	59,400	19,658	12/16/1963	Comanche	G
Smithers Lake	Houston L&P	18,750	28,711	12/16/1955	Fort Bend	H
Somerville	Brazos River Authority	160,110	48,000	12/16/1963	Washington	G
Squaw Creek Reservoir	Luminant	151,500	23,180	4/25/1973	Somervell	G
Stamford	City of Stamford	60,000	10,000	6/8/1949	Haskell	G
Stillhouse Hollow	Brazos River Authority	235,700	67,768	12/16/1963	Bell	G
Sweetwater	City of Sweetwater	10,000	3,740	10/17/1927	Nolan	G
Tradinghouse Steam	Luminant	37,800	12,000 15,000	8/21/1926 9/16/1966	McLennan	G
Twin Oak Steam Electric	Luminant	30,319	13,200	7/1/1974	Robertson	G
Waco	City of Waco	104,100 87,962	39,100 19,100 900 20,770	1/10/1929 4/16/1985 2/21/1979 9/12/1986	McLennan	G
Whitney	Brazos River Authority	50,000	18,336	8/30/1982	Hill	G
White River Reservoir	White River MWD	33,160 5,072 6,665	6,000	9/22/1958 11/21/1960 8/16/1971	Crosby	O

1 – A major reservoir is defined as one with an authorized capacity equal to or greater than 5,000 acft
2 – The Dept. of the Army (Fort Hood) owns water rights in Lake Belton alongside the BRA.
3 – The Dow Chemical Company holds diversion rights from the Brazos River totaling 238,156 acft/yr with priority dates ranging from 1929 to 1976, which are used in conjunction with the two off-channel reservoirs.