TRINITY GLEN ROSE
GROUNDWATER
CONSERVATION
DISTRICT

GROUNDWATER MANAGEMENT PLAN

ADOPTED NOVEMBER 6, 2025

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TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

BOARD OF DIRECTORS

Member	District	Position
Joe duMenil…………………..	District 2	……………………………President
Stuart Birnbaum……………	District 1	………………………Vice President
Katrina Waring Castillo….	District 5	……………………………Secretary
Joe Silman…………………….	District 4	……………………………Treasurer
Steve Peterson………………	District 3	…Asst. Secretary/Treasurer

DISTRICT STAFF

Amanda Maloukis……………………General Manager
Emily Green……Administrative Program Manager

REVISION RECORD

Date Adopted	Version/Resolution
October 14, 2004	Original Adoption, Board Resolution
October 14, 2010	Revision/Re-Adoption
November 12, 2015	Revision/Re-Adoption
December 10, 2020	Revision/Re-Adoption
June 15, 2023	Revision/Re-Adoption
November 6, 2025	Revision/Re-Adoption, Board Resolution

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TABLE OF CONTENTS

I. District Mission

The mission of the Trinity Glen Rose Groundwater Conservation District (District or TGR) is to conserve and protect the Trinity Group of Aquifers within the District using sound science, best management practices, community involvement and peer partnerships to preserve the resource for future generations.

II. Purpose of 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 water resource planning process and the actions necessary for the groundwater conservation districts (GCDs) to manage and conserve the groundwater resources of the State of Texas. These bills required all GCDs to develop a management plan defining the groundwater needs and groundwater supplies within each district and the goals each district has set to achieve its mission. Additionally, the 79th Texas Legislature enacted House Bill 1763 (HB 1763) in 2005 that requires joint planning among GCDs that are in the same groundwater management area (GMA).

III. District Information

A. District Creation and Background

The Texas Hill Country Area, which includes the District, was declared a priority groundwater management area (PGMA) by the then Texas Water Commission in 1990 (now the Texas Commission on Environmental Quality or TCEQ). This declaration, now known as the Hill Country PGMA, gave notice to the residents of the area that water availability and quality would be at risk within the next 25 years in the Trinity Group of Aquifers.

The District was created in 2001 during the 77th Texas Legislature and confirmed by voters in 2002 in response to the Hill Country PGMA designation. The District was created for the purpose of conserving, preserving, recharging, protecting and preventing waste of groundwater from the Trinity Aquifer in northern Bexar County.

In 2004, the City of Fair Oaks Ranch held an election and voted to become a part of the District, expanding the District to include those portions of Kendall and Comal counties within the boundaries of the City of Fair Oaks Ranch.

In 2009, the Texas Legislature passed HB 1518 allowing an increase of production fees and allowing municipalities to request inclusion of annexed areas into the District as provided by Chapter 36 Texas Water Code, thereby expanding the District boundaries. The District operates under the authority of these house bills, as well as the authority and duties set forth in Chapter 36 of the Texas Water Code.

The District's Act is codified in Chapter 8870 of the Texas Special District and Local Laws Code, which incorporates the various legislation of the District, as follows:
- Act of May 27, 2001, 77th Leg., R.S., Ch. 1312, § 1, 2001 Tex. Gen. Laws 3222 *(Enacting Legislation);*

- Act of May 28, 2003, 78th Leg., R.S. *(timely completion of well, non-prohibition of sale, purchase, lease or trade of groundwater by private well owner);*
- Act of May 25, 2005, 79th Leg., R.S. *(exemption for municipal supplier or consumer of water from source other than Trinity Aquifer);* and
- Act of May 26, 2009, 81st R.S. *(fees, annexation of land).*

B. AUTHORITY

Beyond its enabling legislation, the District is governed primarily by the provisions of Chapter 36 of the Texas Water Code. The District has the capability and authority to undertake various studies and promote conservation; to adopt and amend, as needed, a management plan and rules; to establish a program for the registration and permitting of groundwater wells; and to implement structural facilities and non-structural programs to achieve its statutory mandates.

The District has rule-making authority to implement its policies and procedures of the groundwater resources it has jurisdiction over. The District is charged with developing and implementing regulatory programs for the Trinity Group of Aquifers within District boundaries. With continued growth in northern Bexar County, the District is challenged with balancing the needs of families and businesses with the need to maintain groundwater resources of the Trinity Group of Aquifers in this area.

To effectively meet these needs, the District's mission and activities include conducting research, regulating water well drilling and production from wells, collecting and analyzing well water and aquifer data, issuing permits for well drilling, modification, and plugging, promote the capping or plugging of abandoned wells, developing education and conservation programming, providing information and educational material to local property owners, interacting with other governmental or organizational entities, working with stakeholders to ensure a comprehensive management strategy, and undertaking other groundwater-related activities that may help meet the purposes of the District.

The District's enabling legislation, creates limitations in preserving and protecting groundwater resources as addressed in Chapter 36 of the Texas Water Code. According to language within the enabling legislation, the District must recognize all public water supply wells drilled and completed prior to September 1, 2002 as exempt from District regulation.

C. DIRECTORS

The District is comprised of a five-member Board of Directors elected to serve four-year rotating terms. Director boundaries or precincts are re-drawn with each 10-year census based on population. Elections are held during the May General Election in even-numbered years.

D. DISTRICT LOCATION & EXTENT

The District is located in northern Bexar County and extends into portions of Kendall and Comal counties, encompassing approximately 311 square miles (199,574 acres). The

District's boundary overlies the Trinity Group of Aquifers with its jurisdiction limited to this groundwater resource.

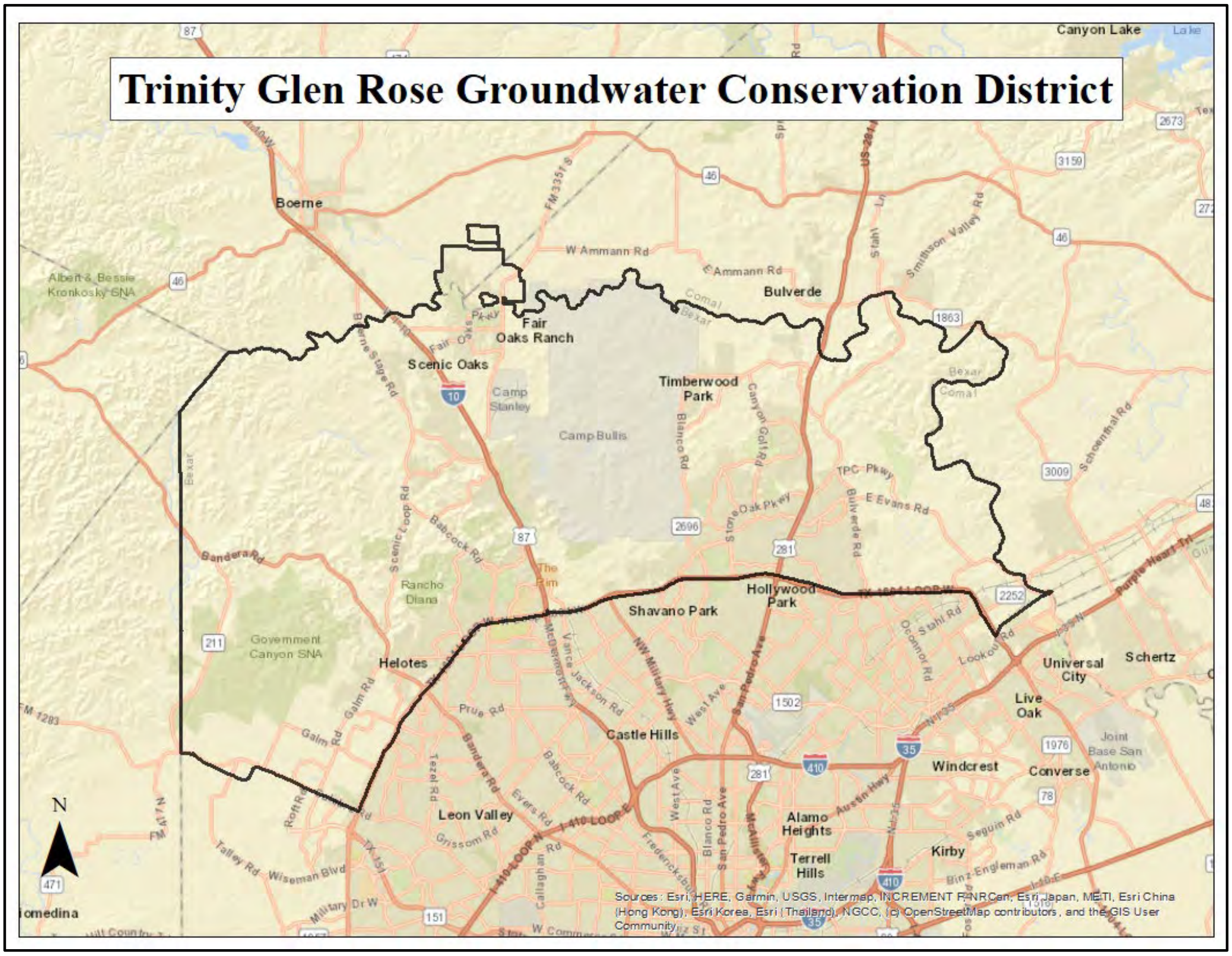

Figure 1. Trinity Glen Rose Groundwater Conservation District Location Map.

E. WATER RESOURCES

i. TOPOGRAPHY AND DRAINAGE

The District includes the northern third of Bexar County as well as small parts of Comal and Kendall counties within the City of Fair Oaks Ranch. This area is part of the Edwards Plateau, where the sedimentary Cretaceous units, including the Trinity Group and Edwards limestone, are on the upthrown side of the Balcones Fault Zone. This area is broad and topographically high, and is composed of Cretaceous Period limestone, dolomite, and marl. Deep erosion and downcutting by streams and rivers in the area have resulted in a unique landscape, typically characterized by rugged topography with steep stream valleys dissecting the limestone outcrop with juniper and oak woodlands being the primary vegetation in much of the area. Elevation within the District ranges from approximately 730 feet above sea level where the Cibolo Creek leaves northeastern Bexar County to approximately 1,892 feet above sea level at Mount Smith in the northwestern portion of the District.

The District is located entirely within the San Antonio River basin and is divided by three sub-basins: the Cibolo Creek, Medina River, and Upper San Antonio River sub-basins (Figure 2). The Cibolo Creek, Leon Creek, Salado Creek, and the Upper San Antonio River watersheds provide for surface drainage generally from the northwest to the southeast within the District. Cibolo Creek is a tributary of the San Antonio River and drains from northwest to southeast across the Trinity Group of Aquifers, where it is a major recharge feature of these aquifers. Cibolo Creek is also the county boundary between portions of northern Bexar County and adjacent counties to the north and east. Salado and Leon Creeks flow from northwest to southeast through the middle of the District, eventually joining the San Antonio and Medina Rivers to the south.

ii. GEOLOGY

The rocks that make up the aquifers of the District are Cretaceous-age limestones, dolomites, and sandstones of the Trinity Group. A simplified stratigraphic and hydrostratigraphic section of the Edwards and Trinity Groups in the Hill Country area (Figure 3) shows the various units that underlie the District, including the Glen Rose Limestone, Hensell Sand, Cow Creek Limestone, Hammett Shale, Sligo Limestone, and Hosston Sand. The geologic formations that are present at the surface of most of the District (Figure 4) include the Glen Rose Limestone and the Edwards Limestone, as well as small outcrops of several other younger Cretaceous formations that are present at the surface in the southern parts of the District, including the Anacacho Limestone, Austin Chalk, Pecan Gap Chalk, and Buda Limestone. Quaternary deposits are also present along some streams and rivers, including the Leona Formation and Uvalde Gravel. The other important Trinity Group formations are present only in the subsurface in the District, including the Hensell Sand, Cow Creek Limestone, Sligo Limestone and Hosston Sand, which are sometimes referred to collectively as the Travis Peak Formation in the region (Figure 3). Although the Edwards Limestone and other younger formations are present in the southern portion of the District, and there are wells that produce groundwater from this formation, groundwater production from these units do not fall within the District's authority and therefore are not described in this plan.

Figure 4 also illustrates many northeast-southwest trending faults that are part of the Balcones Fault Zone. This fault zone is a series of normal faults that run from Del Rio to Dallas and form the Balcones Escarpment, which is the eastern edge of the Texas Hill Country. A generalized cross-section across the Balcones Fault Zone is shown in Figure 5, which reflects how the formations that make up the Trinity Aquifer get progressively deeper across the fault zone.

Figure 2. River sub-basins in the TGRGCD.

Stratigraphic Units of the Trinity Group in South Central Texas
(adapted from Ashworth, 1983)

Stratigraphic Unit		Hydrologic Unit	Approx. Maximum Thickness (feet)	Character of Rocks	Water-Bearing Properties
Glen Rose Limestone	upper member	Upper Trinity	500	Alternating resistant and non-resistant beds of blue shale, nodular marl, and impure fossiliferous limestone. Also contains two distinct evaporite zones.	Yields very small to small quantities of relatively highly mineralized water.
	lower member	Middle Trinity	320	Massive, fossiliferous limestone grading upward into thin beds of limestone, dolomite, marl, and shale. Numerous caves and reefs occur in the lower portion of the member.	Yields small to moderate quantities of fresh to slightly saline water.
Travis Peak Formation	Hensell Sand Member / Bexar Shale Member		300	Red to gray clay, silt, sand, conglomerate, and thin limestone beds grading downdip into silty dolomite, marl, calcerous shale, and shaley limestone.	
	Cow Creek Limestone Member		90	Massive, fossiliferous, white to gray, argillaceous to dolomitic limestone with local thinly bedded layers of sand, shale, and lignite.	
	Hammett Shale Member		80	Dark blue to gray, fossiliferous, calcareous and dolomitic shale with thinly interbedded layers of limestone and sand.	Not known to yield water.
	Sligo Limestone Member	Lower Trinity	120	Sandy dolomitic limestone.	Yields small to large quantities of fresh to slightly saline water.
	Hosston Sand Member		350	Red and white conglomerate, sandstone, claystone, shale, dolomite, and limestone.	

Figure 3. Generalized stratigraphic and hydrostratigraphic section of the Trinity Group (source: edwardsaquifer.net).

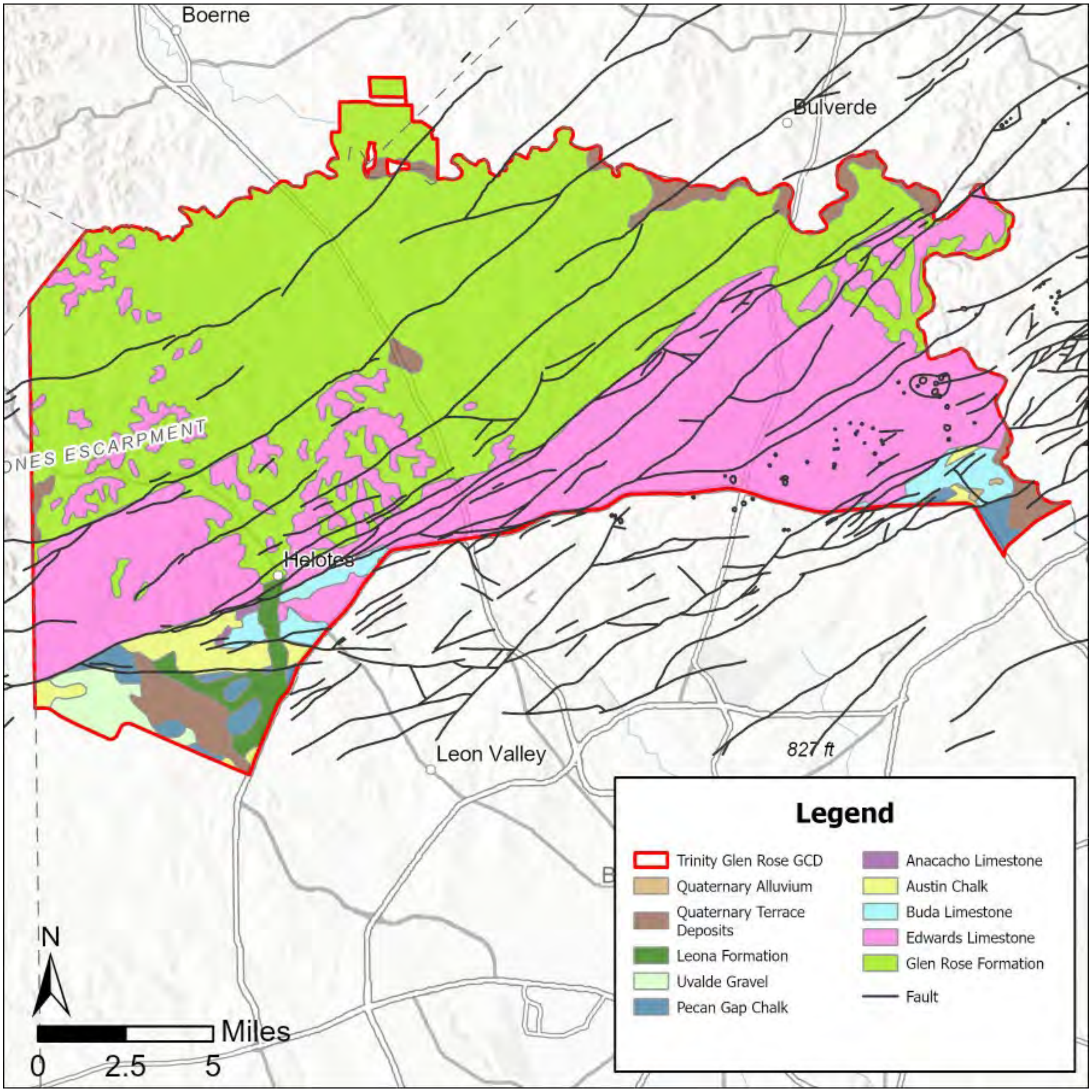

Figure 4. Surface geology map in the TGRGCD.

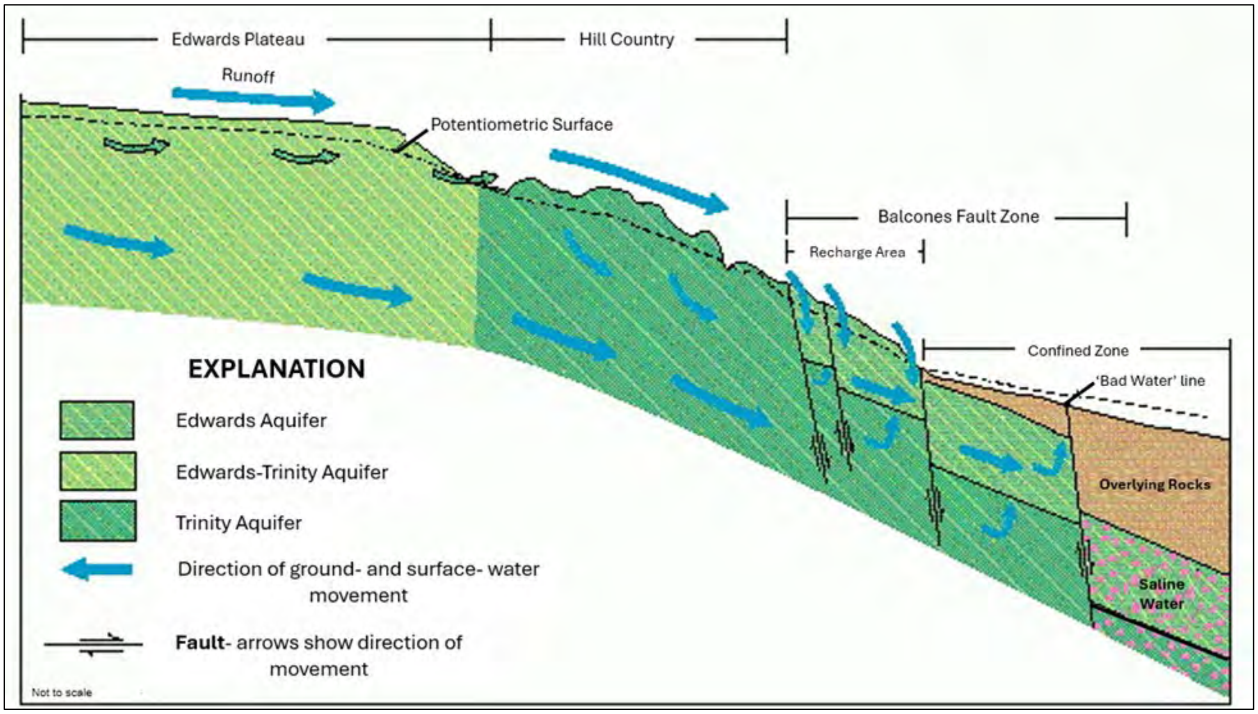

Figure 5. Generalized cross-section across the Balcones Fault Zone (from Ryder, 1996).

The main Trinity Group of Aquifers that make up the groundwater resources managed by the District are the Glen Rose Limestone, the Cow Creek Limestone, the Sligo Limestone, and the Hosston Sand. Each of these are described below (descriptions based on Manford and others (1959), Jones and others (2011), and Robinson and others (2022)).

Glen Rose Limestone- The Glen Rose Formation is up to 1,500 feet thick in the Hill Country and is generally subdivided into the Upper Glen Rose Limestone and the Lower Glen Rose Limestone. The Upper Glen Rose represents the top of the Trinity Group and is characterized by thin to medium beds of marl, limestone, and dolostone. The alternating beds of nonresistant marl and resistant limestone and dolostone give the classic stair-step topography that is characteristic of much of the Texas Hill Country. The Upper Glen Rose makes up the Upper Trinity hydrologic unit.

The Lower Glen Rose is composed of massive beds of limestone, dolostone, and dolomitic limestone separated by clay-rich intervals. The Lower Glen Rose is the upper member of the Middle Trinity hydrologic unit.

Bexar Shale/Hensell Sand- The Bexar Shale/Hensell Sand can be up to 200 feet thick and is composed of poorly cemented clay, quartz, calcareous sand, chert, and dolomitic gravel. In Bexar County, this unit is characterized by shales, silts, and fine sand layers. The Hensell is the middle member of the Middle Trinity hydrologic unit.

Cow Creek Limestone- The Cow Creek Limestone is a relatively thin unit, up to 90 feet thick, in the Hill Country. The lower part consists of fine- to coarse-grained calcareous sandstone, which is overlain by silty calcareous sandstone in the middle portion of the unit, and a coarse-grained fossiliferous limestone in the upper part of the unit. The Cow Creek is the basal member of the Middle Trinity hydrologic unit.

Hammett Shale - The Hammett Shale is up to 80 feet thick and is a dark dolomitic shale with thin interbedded limestone layers. The Hammett is not known to yield water in the region.

Sligo Limestone- The Sligo Formation is composed of up to 250 feet of evaporites, limestone, and dolostone with some interbedded shale. The Sligo represents the upper member of the Lower Trinity hydrologic unit.

Hosston Sand- The Hosston Sand can be up to 900 feet thick and consists of sandstone and shale. The sandstones are generally fine-grained, can be massive, and contain some silt and clay. Some conglomerates have been found at the base of the Hosston. The Hosston is the basal member of the Lower Trinity hydrologic unit.

iii. HYDROGEOLOGY

The Trinity Aquifer is the primary water source within the District. The Trinity Aquifer is one of nine major aquifers defined by the state, stretching from the Texas Hill Country into Oklahoma. The District is located in the southern portion of the Trinity Aquifer where it underlies the Texas Hill Country as shown in Figure 6. Although it is defined by the state as a major aquifer, the water quality and productivity of the Trinity Aquifer throughout the region, including the District, varies greatly. Trinity Aquifer water well depths vary from shallow, hand-dug wells to drilled wells ranging from 100 feet deep to over 1,200 feet deep based on TWDB records for Bexar County. Depths are highly variable and depend entirely on site-specific topography and geology, especially faulting. Well yields in the Trinity are typically dependent on the nature of fractures and dissolution features intersected by the well bore, which can be highly variable over short distances (Jones and others, 2011). Well yields are typically low (less than 20 gallons per minute (gpm)) but may occasionally be significantly higher, with yields of 400-600 gpm being reported in some wells. Water quality within a specific aquifer can be defined or characterized in a general sense, but can vary significantly based on local geology, hydrology, and structure.

The Trinity Aquifer is generally subdivided into the Upper, Middle, and Lower Trinity Aquifers in the Hill Country region. Each of these is described below (descriptions based on Manford and others (1959), Ashworth (1983), Jones and others (2011), and Robinson and others (2022)).

Upper Trinity Aquifer- The Upper Trinity Aquifer is composed of the Upper Glen Rose Limestone. This part of the Glen Rose has been shown to be hydrologically separated from the Lower Glen Rose by numerous permeability barriers and so forms a separate aquifer unit. The Glen Rose Limestone has limited permeability, although in the outcrop area joint and fissures have allowed solution channels to form in some areas. The Upper Trinity Aquifer generally yields only small quantities of water to wells that may be sufficient for domestic or livestock use in and near the outcrop. However, some larger producing wells may be possible where the solution channels are intersected by the well. Water from deeper wells producing from the Upper Trinity can have poorer water quality than shallow wells producing in or near the outcrop. Water is often produced from the layers that contain gypsum, and the dissolution of gypsum results in relatively poor water quality in wells completed in Upper Glen Rose unit. Wells producing from the underlying Middle Trinity Aquifer are required to seal off the Upper Glen Rose to reduce the potential for lower quality water from the Upper Trinity Aquifer from moving into the Middle Trinity Aquifer.

Middle Trinity Aquifer- The Middle Trinity Aquifer is composed of the Lower Glen Rose Limestone, the Hensell Sand, and the Cow Creek Limestone and is the main aquifer unit that is used within the District. Wells producing from the Middle Trinity have highly variable productivity, with many wells only producing less than 20 gallons per minute, but some capable of producing 400 to 600 gpm in some areas. Wells producing from the Middle Trinity are typically between 400 and 700 feet deep in the northern part of the District but can be nearly 1,200 feet deep in the southern and western portions of the District. In Bexar County, very little groundwater production occurs from the Bexar Shale/Hensell Sand layers because it is generally too shaley. The top 20 feet of the Cow Creek Limestone is often the best producing unit of the Middle Trinity Aquifer, and, occasionally, the reef deposits in the Lower Glen Rose can also be good groundwater producers. Water levels in the Lower Glen Rose portion of the Middle Trinity Aquifer tend to fluctuate in some areas, resulting in many wells being drilled deeper into the Cow Creek Limestone where water levels are more stable. Historically, some wells in the Middle Trinity requiring larger production have been "acidized" to dissolve limestones near the wellbore and produce higher capacity wells.

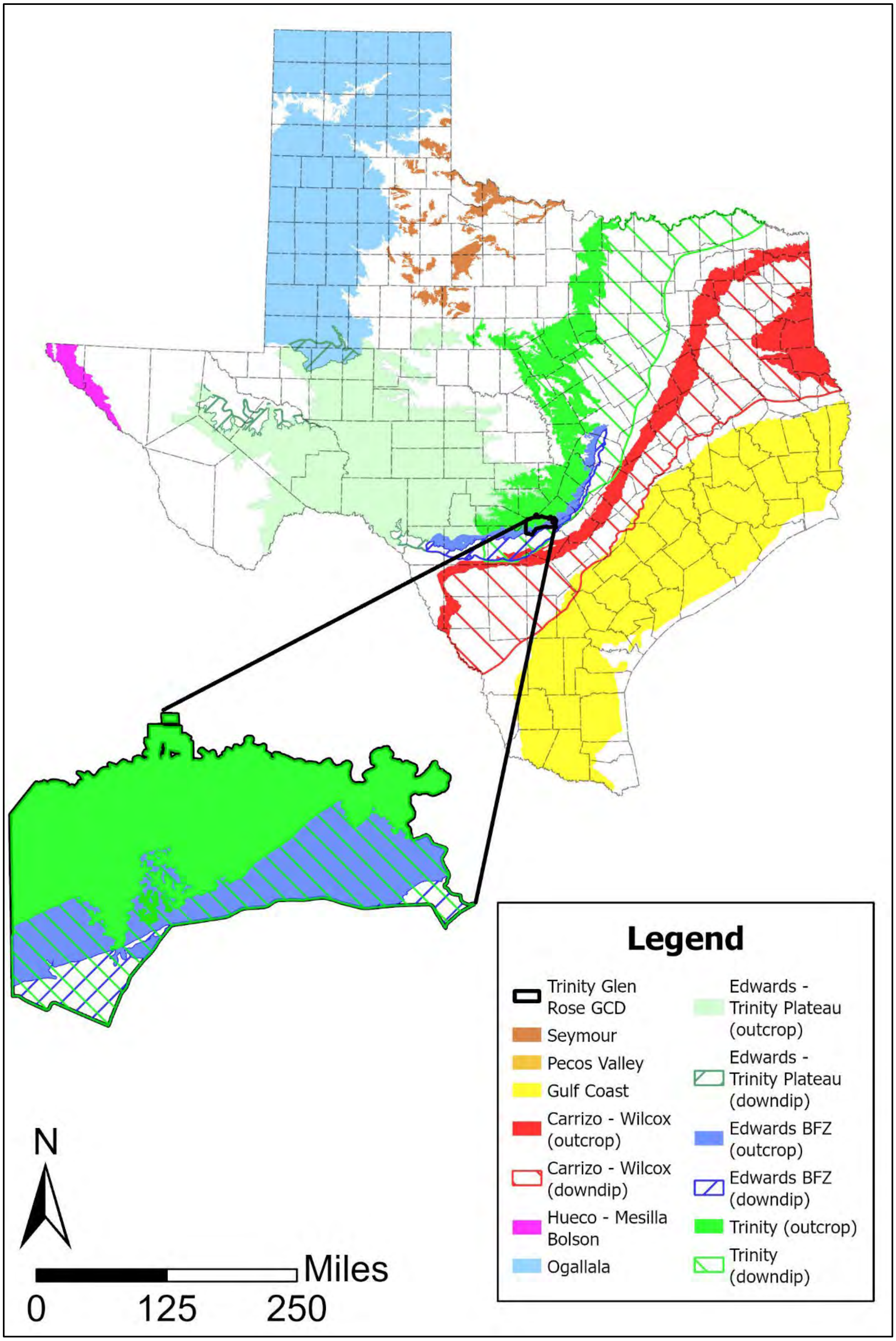

Figure 6. The major aquifers of Texas and the Trinity Glen Rose GCD.

Lower Trinity Aquifer- The Lower Trinity Aquifer is composed of the Sligo Limestone and the Hosston Sand. These units do not crop out within the District but are present in the subsurface beneath the Glen Rose and Cow Creek formations. A fewer number of wells within the District produce from the Lower Trinity Aquifer from wells that are generally at least 900 feet deep in the northern part of the District. A few higher capacity wells produce from the Lower Trinity Aquifer in the Fair Oaks Ranch area. The Lower Trinity is a less productive unit than the Middle Trinity Aquifer within the District, and the water quality is generally poorer than in the overlying Middle Trinity.

Vertical hydraulic conductivities have not been investigated but are likely to be much lower than lateral hydraulic conductivities in the aquifer system (Jones and others, 2011). Historic estimates of vertical conductivity in the Trinity Group of Aquifer have been low, and past investigators have noted the preferential movement of water laterally along low-permeability beds rather than vertically through them (Baker and Ardis, 1996; Jones and others, 2011). This relatively low vertical connectivity results in the three separate aquifer units described above.

iv. RECHARGE AND DISCHARGE

Recharge to the Trinity Group of Aquifers occurs via local precipitation on its outcrop, infiltration of flows in Cibolo Creek, and through the overlying units where the Trinity is present in the subsurface. The quantification of recharge to the Trinity Aquifer in the Hill Country is difficult and estimates of recharge to the Trinity Aquifer vary significantly, from as low as 1.5 percent of precipitation to as much as 11 percent of precipitation (Muller and Prince, 1979; Kuniansky, 1989). Most estimates are between 4 and 7 percent of precipitation (Mace and others, 2000). However, the recharge dynamics in the District are quite different than the Trinity Aquifer throughout much of the Hill Country due to the rapid recharge that occurs through large recharge features, which are present in many areas of the District, but most prevalent in the Cibolo Creek area. When Cibolo Creek has water in the stretches along northern Bexar County, the losses of water from the creek are substantial and serve as a significant recharge source to the Trinity Aquifer in the District. Although this rapid recharge can occur in other isolated areas of the Trinity Aquifer in the Hill Country, it is a dominant recharge mechanism in the District. The substantial volume of recharge that periodically occurs during wet periods and flooding along Cibolo Creek creates relatively large variations in water levels in the Trinity Aquifer in the District. When water levels are high in the District, there is a natural hydraulic gradient that drives groundwater laterally to the southeast into the Edwards Aquifer.

After groundwater is recharged to the aquifer, the karstic nature of many of the formations allow the rapid movement of groundwater through the aquifer. The result can be large fluctuations in water levels in wells as groundwater moves quickly through the aquifer. Water levels in the Boerne Stage Road well are shown in Figure 7, where rapid increases in water levels of over 200 feet are repeatedly observed, followed by almost equally rapid declines in the water levels. Water levels in the La Escondida well are shown in Figure 8, which shows a similar water level dynamic through time. Although the water level changes are not as "flashy" as the Boerne Stage well, they also indicate periods of rapid recharge in the Trinity Aquifer.

The cross-formational flow of groundwater from the Trinity units into the Edwards-BFZ Aquifer is also a significant source of discharge from the Trinity Aquifer in the region. The quantification of this regional movement of groundwater from the Trinity to the Edwards is not directly measurable but has been estimated as being tens to hundreds of thousands of acre-feet per year in the region, making it a significant component of the overall water budget of the Trinity Aquifer. Dye tracing studies conducted by the Edwards Aquifer Authority have shown that this interaction is significant and have shown a direct connection between water in the Trinity and in the Edwards through preferential flow pathways (Johnson and others, 2010).

Discharge from the Trinity Aquifers is to wells and springs in the region as well as cross-formational flow to the Edwards Aquifer. Spring discharge from karst aquifers such as the Trinity can be significant, although most of the spring discharge within the District is not from larger, regional springs but rather smaller, intermittent, and/or lower discharge springs that are discharging on the hillsides in the deeply incised topography that characterizes much of the District. These springs are not typically sourced from pressurized aquifers of the District but rather are sourced from downward moving groundwater from infiltrated precipitation on the land surface during wet periods, which continues downward until encountering a less permeable bed. The infiltrating water then moves laterally until it discharges in a small spring or seep on a hillside. The groundwater sourcing these springs is often referred to as "perched" groundwater because it is not sourced from the deeper portions of the aquifers where wells are typically screened. Clark and others (2013) inventoried 141 springs within Northern Bexar County, noting they all discharged at rates of less than 1.5 cubic feet per second (cfs). Overall, discharge from these relatively small springs is seasonal and account for only a small portion of the discharge from the Trinity Aquifer in the District.

Wells are a primary source of discharge from the aquifer. Historic pumping from the Trinity Aquifer within Bexar County has increased over time, from approximately 11,000 acre-feet in 2009 to greater than 23,000 acre-feet per year in 2016. Production from wells can vary significantly based on water levels in the Trinity. Water demand will continue to increase in the Hill Country, and this may add more pressure to increase groundwater production from the Trinity Aquifer in the District. Production from the Trinity Aquifer is primarily used for municipal purposes, with some production for domestic, irrigation, livestock and mining.

Over 80 percent of the current groundwater production from the Trinity in the District is used for public water supply.

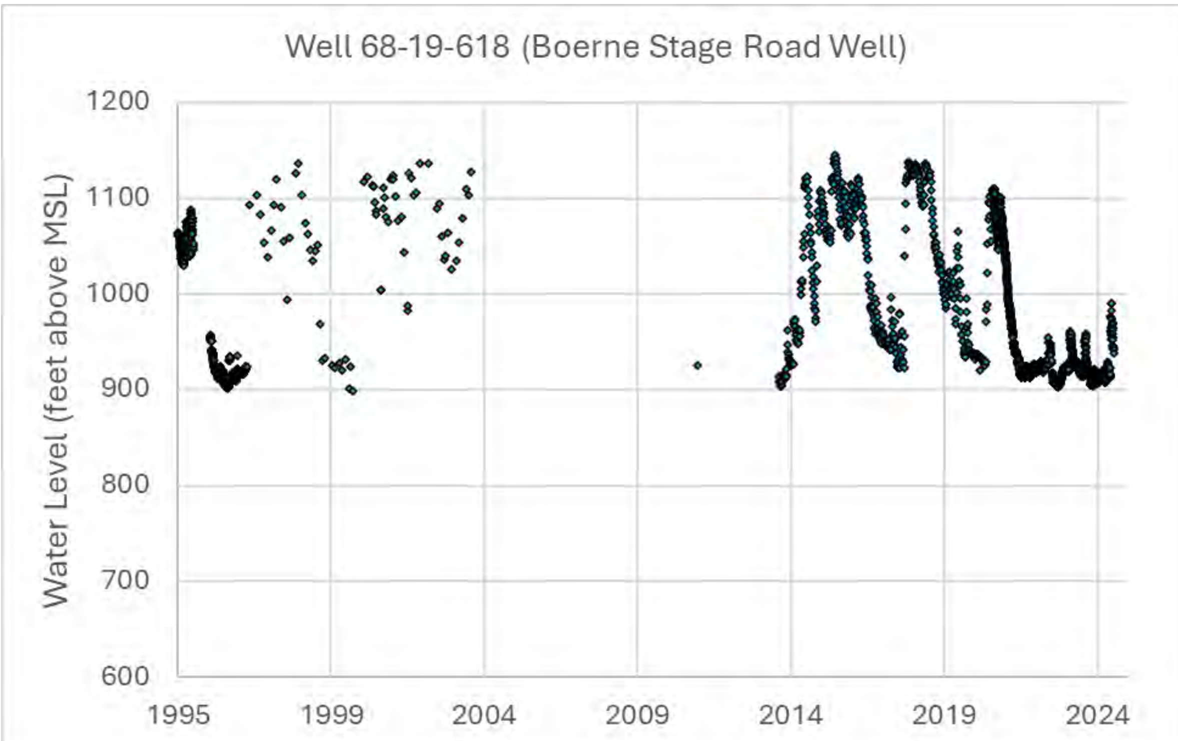

Figure 7. Historic water levels in the Boerne Stage well.

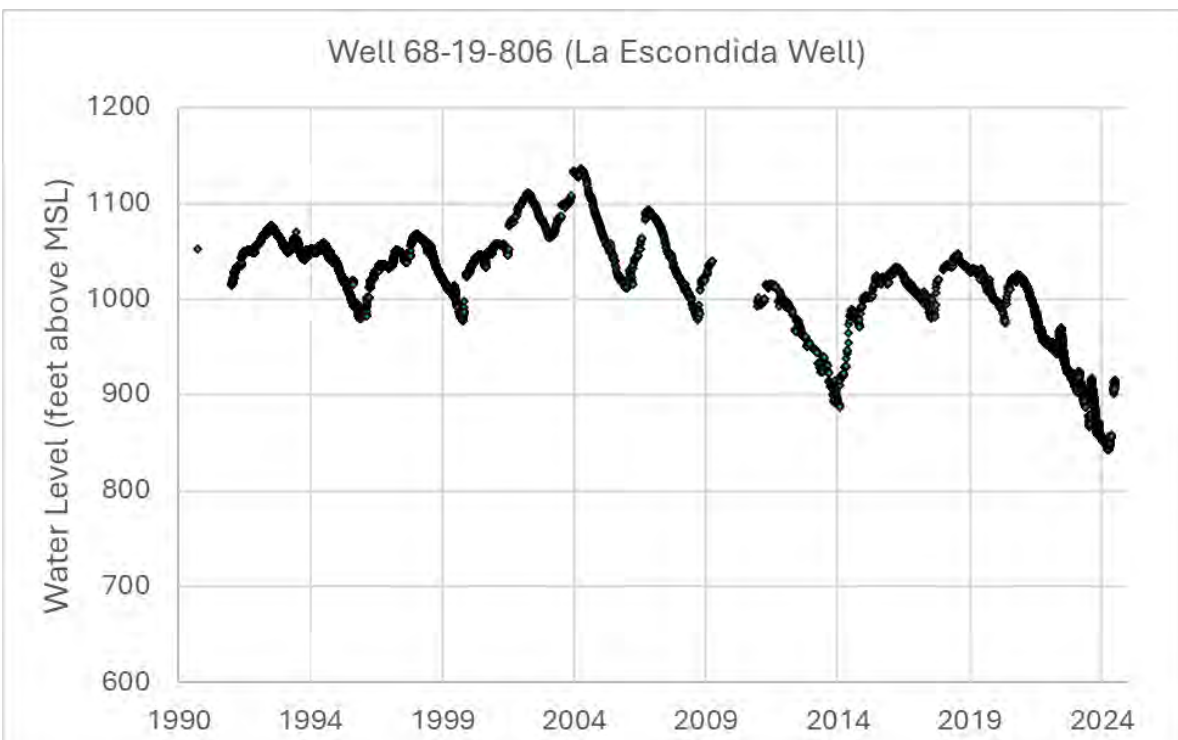

Figure 8. Historic water levels in the La Escondida well.

IV. ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY THE TEXAS WATER CODE § 36.1071 & 31 TAC 356.52

A. MODELED AVAILABLE GROUNDWATER

The 79th Texas Legislature enacted HB 1763 in 2005 that required joint planning among GCDs that are in the same GMA. These GCDs must jointly agree upon and establish the desired future condition (DFC) of the aquifers within their respective GMAs. Through this process, the GCDs will submit the DFC to the Executive Administrator of the Texas Water Development Board (TWDB) who, in turn, will provide each district within the GMA the amount of modeled available groundwater (MAG) within each district. The MAG will be based on the DFCs jointly established for each aquifer within the GMA.

According to the Texas Water Code Section 36.001, MAG is defined as "the amount of water that the Executive Administrator (of the TWDB) determines may be produced on an average annual basis to achieve a DFC established under §36.108." The DFC is defined in §36.001 of the Texas Water Code as "a quantitative description, adopted in accordance with §36.108 of the Texas Water Code, of the desired condition of the groundwater resources in a management area at one or more specified future times."

GMA 9 has adopted DFCs for the aquifers located within the planning area. Current groundwater availability for the District has been estimated by the TWDB using GAM Run 21-014 MAG, located in Appendix B. The total MAG for the Trinity Aquifer within the District is 25,511 acre-feet per year (2020-2060) as identified in Appendix E. The DFCs for the aquifers located within the District boundaries and within GMA 9 is documented by the TWDB and included in Appendix D.

County	Aquifer	Year				
		2020	**2030**	**2040**	**2050**	**2060**
Bexar	Trinity	24,856	24,856	24,856	24,856	24,856
Comal	Trinity	138	138	138	138	138
Kendall	Trinity	517	517	517	517	517
	Total	**25,511**	**25,511**	**25,511**	**25,511**	**25,511**

Table 1: MAG values for Trinity Aquifer as documented in TWDB GAM Run 21-014. Units are in acre-feet per year. See appendix B for complete report.

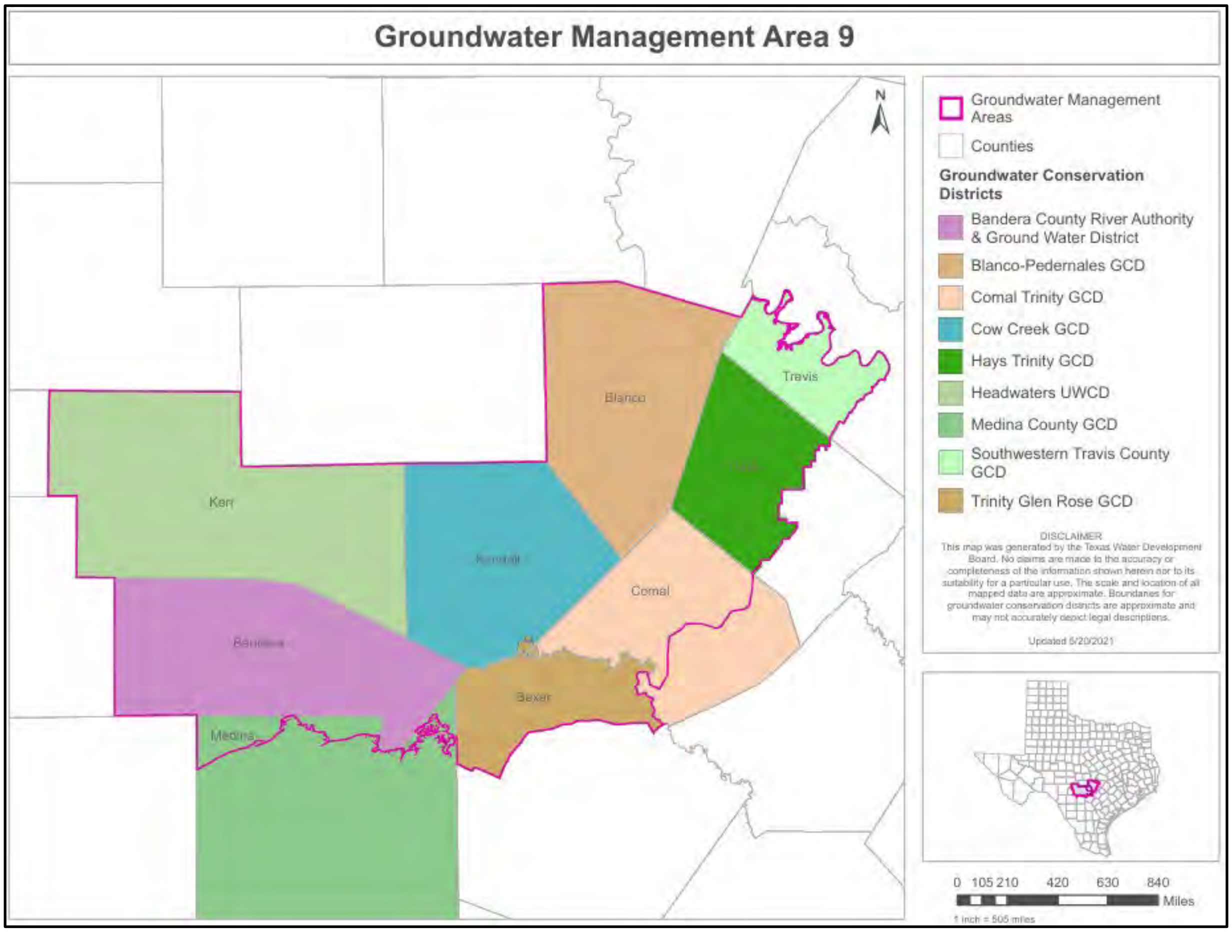

Figure 9: Map of Groundwater Management Area 9.

B. ANNUAL GROUNDWATER USE

To estimate the annual amount of groundwater being used within the District, the District refers to the TWDB Annual Water Use Survey Data located within the "TWDB Estimated Historical Groundwater Use and 2022 State Water Plan Datasets", in Appendix A and develops its own estimates using District-reported actual and estimated usage. The TWDB Water Use Survey Data for the District creates an inaccurate representation by applying a multiplier to create values for user groups within the District, this does not represent actual production within the District by user groups. TWDB data on estimated groundwater use is available from 2013 to 2023.

Table 2 displays the amount of groundwater being used within the District on an annual basis from 2017-2024, pursuant to the District's required groundwater production reports on metered wells.

The projected estimates of exempt use wells are those that meet Chapter 36 of the Texas Water Code definitions, so domestic and livestock wells that have the capability to produce less than 25,000 gallons per day is the data depicted. The total estimates are on a 10-year basis with 2020 estimated at 1,686 acre-feet and 2030 estimated at 1,847 acre-feet a year. To account for this anticipated increase, the total increase between 2020 and 2030 is divided by 10 resulting in an estimated accruing increase per year of 16.1 acre-feet.

It is important to note that TGR also has exempt use definitions different from the standard Chapter 36 of the Texas Water Code definitions. TGR's District Rules influenced by its enabling act, define exempt well use as a domestic, livestock, or poultry wells located on a tract of land larger than 10 acres and is incapable of producing more than 10,000 gallons of groundwater per day (7 gallons per minute). The TWDB estimates do not currently include these criteria.

It is important to note that the water available from other sources will fluctuate depending on demand and the service plans managed by major water utilities operating within the District.

Historical Groundwater Production by Type of Use

User Group	2017	2018	2019	2020	2021	2022	2023	2024
PWS	14,530	10,313	18,615	8,120	12,638	7,988	4,608	4,668
Irrigation	2,294	2,049	2,124	1,911	1,432	1,665	2,046	1,849
Industrial	956	1,162	796	939	681	909	617	609
Agriculture	100	100	100	74	74	74	74	74
Commercial	1.56	0.36	0.28	0.66	0.22	0.18	0.36	0.00
Exempt	1,500	1,500	1,500	1,686	1,702	1,718	1,734	1,750
Total acre-feet	**19,382**	**15,124**	**23,135**	**12,731**	**16,527**	**12,354**	**9,080**	**8,950**

Table 2: District Historical Groundwater Usage as documented by the District's pumpage reports and estimated exempt use. Units are in acre-feet per year.

C. ESTIMATES OF TECHNICAL INFORMATION REQUIRED BY TWC § 36.1071 / 31 TAC 356.52

The estimate of the annual amount of recharge from precipitation to the aquifers within the District is based on GAM Run 19-025 based on a water-budget analyses conducted by the TWDB. The TWDB utilizes extensive amounts of data and incorporates it into Groundwater Availability Model (GAM) runs. This assists in understanding recharge, discharge, groundwater and surface water interactions, and cross-formational flows through the aquifer. These GAM runs and aquifer assessments from the TWDB are included in Appendix C. The amount of recharge from precipitation and aquifer flow values for the District are displayed in Table 3.

Management Plan Requirement	Aquifer or confining unit	Results (acre-feet)
Estimated annual amount of recharge from precipitation to the district	Trinity Aquifer	44,992
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Trinity Aquifer	10,347
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	36,079
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	26,417
Estimated net annual volume of flow between each aquifer in the district	From the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer.	39,006

Table 3: Aquifer flow values for the District as documented in the TWDB GAM Run 19-025. See Appendix C for complete report. Units are in acre-feet per year.

D. PROJECTED SURFACE WATER SUPPLY IN THE DISTRICT

The TWDB State Water Plan is a 50-year guide for water management in Texas. It outlines how the state will meet its future water needs, considering population growth, drought conditions, and other factors, with the goal of ensuring sufficient water for public health, safety, and welfare, as well as supporting economic development and environmental resources. The plan is updated every five years, incorporating regional water plans from across the state.

The most recently adopted State Water Plan is the 2022 State Water Plan, which describes the projected water supplies. This Plan incorporated the most recent Region L Water Plan, which provided projected surface water supplies in the District, including Bexar, Comal, and Kendall counties. The Projected Surface Water Supply Survey Data from the TWDB is included in Appendix A.

Canyon Lake/Reservoir is the only major surface water supplier to entities within the District. Fair Oaks Ranch has up to 1,850 acre-feet of surface water supply from Canyon Lake (Guadalupe-Blanco River Authority, GBRA). The San Antonio Water System (SAWS) has up to 6,082 acre-feet of surface water supply from Canyon Lake (GBRA). With variable surplus water available from Canyon Lake (GBRA) that will decline annually due to increased demand from a growing population in Comal and Kendall counties, with the agreement expiring in 2037. The total surface water supplies in 2030 are 39,138 acre-feet and in year 2070 will be 35,232 acre-feet.

E. PROJECTED TOTAL DEMAND FOR WATER WITHIN THE DISTRICT

The population and water demand projections for Bexar County are in the Region L Plan of the State Water Plan. The projected total annual water demand within the District, including Bexar, Comal, and Kendall counties is summarized in Appendix A. As future demands increase, changes in the infrastructure will be necessary. It is projected that the greatest demand on water resources will be from municipal suburban users who will rely on groundwater and other supplies provided by municipal providers. The majority of infrastructure improvements necessary to service these new groundwater users will be provided by either developers or municipal water supply companies. Therefore, it is anticipated that the amount of water supplied at any given time will be primarily related to suburban growth patterns. The Regional Water Planning Group L and local water use data indicate the total water demands for all counties the District lies within, will be 478,780 acre-feet, by year 2070. This is 37.65% increase in demand from the plans 2030 projected demand numbers.

i. PROJECTED POPULATION WITHIN THE DISTRICT

Population Projections for Bexar County	
2020	1,974,041
2030	2,231,550
2040	2,468,254
2050	2,695,668
2060	2,904,319
2070	3,094,726

Table 4: Bexar County Population Projections as documented in the 2021 Region L Initially Prepared Plan.

Much of the growth now occurring in northern Bexar County is focused on the major thoroughfares north of Loop 1604, including Highway 281 North, Interstate 10 West, and Highway 16 to Bandera as well as along the 1604 North corridor. These areas are generally served by municipal suppliers and private water wells producing from the middle Trinity stratigraphic units of the Trinity Group of Aquifers. Municipal water systems and the influx of non-Trinity based water may reduce dependence on the Trinity Group of Aquifers. At the same time, continued regional growth may have an impact on the Trinity Group of Aquifers and may lead to overextension of the resources available.

Northern Bexar County is comprised of primarily commercial, industrial, and residential developments. There are also large ranch holdings and military reservations in the area. The past 25 years have seen a dramatic increase in suburban development and increased residential population density. There is limited agricultural activity in the area that consists of small pastures, grazing, and native grassland open areas.

The population estimate within the District from its most recent 2020 District Precinct Census review is 302,274. The largest city within the District is the City of San Antonio with a population of approximately 1.5 million, according to the U.S. Census Bureau most recent estimates. The District boundaries incorporate a portion of the City of San Antonio with the remainder of the District being comprised of smaller cities including Fair Oaks Ranch, Helotes, and Grey Forest, as well as smaller subdivisions and rural residential populations. The District encompasses a high-growth area with ongoing plans for future development.

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

A. PROJECTED WATER SUPPLY NEEDS

The most recently adopted State Water Plan is the 2022 State Water Plan. This Plan incorporated the 2021 Region L Water Plan, which provided the estimated water supply needs in the District including Bexar, Comal, and Kendall counties. These data appear in Appendix A's, TWDB Estimated Historical Water Use and 2022 State Water Plan packet. The tables in Appendix A for "Projected Water Supply Needs" provides a listing of individual WUGs with identified water supply needs (negative numbers in the table indicate a water supply need).

The projected water supply needs listed in Appendix A are primarily municipal. Municipal needs in the District exist for the following water user groups: Fair Oaks Ranch, San Antonio Water System, and The Oaks WSC. The projected total water supply needs for all counties the District lies within, indicates a water supply need for 2030 at -42,720 acre-feet and in year 2070, a water supply need of -156,841 acre-feet.

B. WATER MANAGEMENT STRATEGIES

Water management strategies are specific plans to increase water supply or maximize existing water supply to meet a specific need. The Regional Water Planning Group L has several recommendations throughout the planning area. Multiple strategies were identified for Bexar, Comal,, and Kendall counties within and outside of the District. The data appears in Appendix A.

The projected water management strategies list in Appendix A within the District are: Municipal Water Conservation (County-Other, Bexar, San Antonio, Fair Oaks Ranch, SAWS, The Oaks WSC, and Water Services) Reuse (Fair Oaks Ranch, and SAWS), Drought Management (The Oaks WSC), Entity Purchase to Meet Shortages (The Oaks WSC), and Local Trinity Development (Water Services and San Antonio). The projected total water management strategies for all counties the District lies within are projected to increase from 247,853 acre-feet in 2030 to 483,442 acre-feet in 2070.

The District's enabling legislation, creates limitations in preserving and protecting groundwater resources as addressed in Chapter 36 of the Texas Water Code. According to language within the enabling legislation, the District must recognize all public water supply wells drilled and completed prior to September 1, 2002 as exempt from District regulation.

The District is aware of private water marketers within the District that have plans and rights to activate existing exempt wells they own, with a goal to produce a high volume of groundwater to be utilized for communities outside of the District. Currently, these water management strategies have not been clearly identified in the State Regional Water Plan by a water marketer.

Private water marketers are not entities planned for in the regional and state plans. The water marketer could be shown as either existing water supply or a water management strategy in the plan if they are selling the water to a municipality or other WUG. In order to be considered an existing supply in the regional plans, the supply must be physically and legally available to the WUG. A strategy would make the supply accessible in future decades. If a WUG's supply and strategy information is not correct/up to date in the plans, it could lead to eligibility issues for state funding of water development projects (S. Backhouse, personal communication, September 22, 2020).

The District has developed a detailed groundwater availability model down to half-a-square-mile grid cell within the District only, as a tool to evaluate estimated influence across the District for these large-scale projects and has made it available to these companies and the study available to the public, to show predictive pumping scenarios and potential impacts.

VI. PERFORMANCE IN ACHIEVING THE DFCS

The main purpose of a management plan is to develop goals, management objectives, and performance standards that, when successfully implemented, will work in conjunction to achieve the adopted DFCs. DFCs adopted for the Trinity Aquifer by Groundwater Management Area 9 (GMA 9) and subsequently adopted by TGR are set on a 50-year planning horizon and re-evaluated every 5-years in the joint planning process. The adopted DFC for the Trinity Aquifer in GMA 9 is documented by the TWDB and included in Appendix D.

Modeled available groundwater (MAG) is the estimated amount of water that may be produced on an average annual basis assigned to TGR by the Executive Administrator of TWDB in correspondence to the associated DFC. The modeled available groundwater for the District is documented by the TWDB and included in Appendix E.

During the preceding five-year joint planning period, the District maintained its monitoring well network and incorporated data from additional well sites managed by TWDB and the Edwards Aquifer Authority. Staff report at board meetings on the current static groundwater elevations of the monitoring well sites and annually evaluates recorded groundwater levels, averaged for the year to the adopted DFC. The District's groundwater elevations are compared to the 2008 baseline year and is set to achieve a 30-foot average of groundwater drawdown across the GMA 9 planning boundaries.

Based on the statistics for the current trends in the measured well data, the District measures a 16.6-foot average drawdown with its most recent 2024 data.

Water Level (WL) Below Ground Surface

Monitor Well	2018	2019	2020	2021	2022	2023	2024	Average WL (2009-2024)	Δ from 2008	Δ from first recording
Shadow Canyon	-235.6	-179.2	-221.4	-240.6	-275.5	-320.7	-330.6	-256.7	n/a	-14.6
Boerne Stage	-181.1	-98.2	-203.1	-163.4	-243.8	-261.3	-258.2	-193.5	2.9	n/a
La Escondida	-229.4	-195.0	-213.8	-230.3	-249.2	-293.7	-342.9	-242.7	-65.8	n/a
Ralph Fair	-253.4	-231.3	-281.1	-272.1	-296.8	-295.2	-290.7	-269.7	8.0	n/a
Blanco CC	-269.6	-232.5	-271.8	-287.8	-320.0	-337.0	-337.6	-285.1	-17.9	n/a
Blanco LG	-255.5	-234.7	-254.8	-262.9	-266.4	-369.6	-270.3	-263.2	-10.2	n/a
IH-10	-463.5	-462.0	-460.7	-458.1	-458.9	-462.8	-466.3	-463.1	n/a	3.4
Oak Moss	-241.8	-318.2		-296.0		-424.0	-447.9	-348.2	n/a	64.2
Bulverde	-292.2	-314.8		-297.9		-337.3		-328.7	n/a	19.9
								Average Drawdown	-16.6	

*Shadow Canyon, IH-10, Oak Moss, & Bulverde monitor wells have no 2008 recordings to measure from.

Table 5: TGR Monitor Well Averaged Data Chart

VII. MANAGEMENT OF GROUNDWATER SUPPLIES

The Texas Legislature has determined that GCDs are the State's preferred method of groundwater management in order to protect property rights, balance conservation, and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater. Chapter 36 of the Texas Water Code and the individual District's enabling act gives GCDs authority to manage groundwater resources by developing and implementing management plans and rules, while providing necessary tools to assist GCDs to be successful in this endeavor.

The District's enabling legislation creates limitations in preserving and protecting groundwater resources as addressed in Chapter 36 of the Texas Water Code. According to language within the enabling legislation, the District must recognize all public water supply wells drilled or completed prior to September 1, 2002, as exempt from District regulation. This creates a projection in which exempt groundwater production within the District exceeds the MAG and compromises the adopted DFC. The District strives to protect existing wells as empowered by the Texas Legislature.

The District may manage groundwater supplies, except as exempted by the Texas Legislature, by regulating the spacing and production of wells, to minimize drawdown of the water table or reduction of artesian pressure, to control subsidence, to prevent interference between wells, to prevent degradation of water quality, or to prevent waste (TWC §36.116). The method of groundwater production regulation must be based on hydrogeological conditions of aquifers in the District.

The District, as authorized by law, has adopted the following groundwater management strategy:

A. Beneficial Use

The District will regulate non-exempt groundwater withdrawal by setting production limits on wells based on evidence of beneficial use; and the District will continue to study various management methods including regulating groundwater production based on surface acreage which may become appropriate for effective management of groundwater withdrawal.

B. Pumping Rate Limit

Permitted Annual Production Limit by Acreage

District Rules, as authorized by State law, limit all new permitted groundwater production to no more than 1 acre-foot/acre/year on tracts over 10 acres.

Registered Instantaneous Production Limits for Smaller Tracts

District Rules also limit the instantaneous production rate of a well and the number of wells that may be placed on a small tract of land. With verification of the wells pumping capability this provides a limit applied fairly by tract size.

Defining Wells Exclusions or Exemptions

A well in the District is considered registered, whether exempt or non-exempt. A well incapable of producing more than 10,000 gallons of groundwater per day (7 gallons per minute) on over 10 acres of land for domestic, livestock or poultry use is part of the District's definition of exempt criteria.

Production Limit

All new wells within the District that are drilled in the Trinity Aquifer, must be designed and quipped to not exceed a maximum production limit of 800 gallons per minute under normal operating conditions.

The District's enabling act definitions of exempt wells creates alternate classifications that are not common across the state or the standard Chapter 36 Texas Water Code definitions.

C. Well Spacing

The District will require well spacing on new water wells and wells requesting to increase production, with minimum distances to property lines and other registered or permitted wells based on the pumping capacity of the well.

The District has incorporated these management strategies into its Rules, the District's Rules are available on the District's website.

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

To meet the requirements of Texas Water Code §36.1071(e)(2), the District will act on the goals and directives established in this District Management Plan. The District will use the objectives and provisions of the Management Plan as guidelines in its policy implementation and decision making. In both its daily operations and long-term planning efforts, the District will continuously strive to comply with the initiatives and standards created by the Management Plan for the District.

The District will amend rules in accordance with Chapter 36 of the Texas Water Code and rules will be followed and enforced. The District may amend the District Rules as necessary to comply with changes to Chapter 36 of the Texas Water Code and to ensure the best management of the groundwater within the District. The development and enforcement of the rules of the District will be based on the best scientific and technical evidence available to the District.

The District will encourage public cooperation and coordination in the implementation of the District Management Plan. All operations and activities of the District will be performed in a manner that best encourages cooperation with the appropriate state, regional, and local water entities as well as landowners and the general public. Meetings of the District's Board of Directors will be noticed (announced) and conducted in accordance with the Texas Open Meetings Act. The District will also make available for public inspection all official documents, reports, records, and minutes of the District pursuant with the Texas Public Information Act.

District Rules are available on the District's website: https://www.trinityglenrose.com/rule-sandforms.

IX. METHODOLOGY FOR TRACKING PROGRESS IN ACHIEVING MANAGEMENT GOALS

An annual report will be prepared and presented to the Board of Directors on District performance with regard to achieving management goals and objectives. The presentation of this report will occur within the first or second quarter of the following calendar year. The District will maintain the reports on file for public inspection at the District's office upon adoption.

X. DISTRICT GOALS, MANAGEMENT OBJECTIVES, AND PERFORMANCE STANDARDS

The management goals, objectives, performance standards and tracking methods of the District in the emphasis areas defined in 31 TAC §356 as follows.

1.0 Providing the Most Efficient Use of Groundwater

1.1 Maintain a Well Registration & Permitting Process

Management Objective

The District will require all wells to be registered and permitted in accordance with District Rules. The District will compile records within a database to evaluate statistics.

Performance Standard

A report of well registrations and permitting statistics will be provided at regular District Board meetings and a summary provided in the District's Annual Report.

1.2 Maintain a Well Metering Program

Management Objective

The District will require the installation of meters on all required wells in accordance with District Rules and monitor production. The District will compile records and document information within a database to evaluate the volume of groundwater produced.

Performance Standard

The District will require installation of meters on required wells in accordance with District Rules. The District will include a summary of the reported and estimated volume of water produced within District in the District's Annual Report.

1.3 Maintain Electronic Databases

Management Objective

Maintain the necessary electronic databases for registrations, permits, and groundwater production. The databases shall include information deemed necessary by the District to enable effective monitoring and regulation of groundwater in the District.

Performance Standard

The District will document all new and plugged wells in the District's database. A summary of totals for new and plugged wells documented will be included in the District's Annual Report.

1.4 Maintain Production Spacing Requirements

Management Objective

To reduce and prevent interference between wells, the District will mandate and maintain minimum spacing regulations from property lines and other registered or permitted wells in accordance with District Rules.

Performance Standard

Authorizations to construct for registered or permitted wells will list the minimum production spacing requirement for the well applied for. A summary of applied for registered or permitted wells minimum production spacing requirements will be included in the District's Annual Report.

2.0 Controlling and Preventing Waste of Groundwater

2.1 Disseminate Information on Waste Prevention

Management Objective

The District will provide information on an annual basis for the purpose of educating the public on elimination, reduction, and prevention of the waste of groundwater. The District will use at least one of the following methods to provide information to the public annually:

a. Distribute literature packets or brochures;
b. Distribute the District's newsletter;
c. Conduct public or school presentations;
d. Sponsor an educational program or course;
e. Provide information on the District's web site;
f. Submit an article for publication with local papers;
g. Present displays at public events.

Performance Standard

A summary of the District's efforts to disseminate information on waste prevention will be included in the District's Annual Report.

2.2 Maintain Water Well Metering and Reporting

Management Objective

The District will encourage the elimination and reduction of groundwater waste through monitoring production for metered wells in accordance with District Rules.

Performance Standard

The District will require the installation of meters on required wells in accordance with District Rules and reporting of production to the District. A summary of groundwater production from metered wells will be included in the District's Annual Report.

3.0 Controlling and Preventing Subsidence

The District considered the applicable information regarding subsidence in the District in the TWDB's 2017 report *Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping - TWDB Contract Number 1648302062*, by LRE Water: https://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp. It was determined that this management goal is not relevant due to the surface elevation and the compacted nature of the geologic units in the District. On Pages, 1-5 and 4-79 of LRE Water (2017), it lists the Trinity Aquifer as having a "Medium" risk of subsidence. Figures 1.1 and 4.49 of the report shows a map depicting the distribution of subsidence risk based on the methodology described therein. The assessment indicates the downdip portion of the aquifer on the eastern and southern sides of the aquifer, outside of the District, have the greatest risk for subsidence. Despite the significant water level declines that have occurred in the Trinity Aquifer, the District has not observed subsidence as an issue of concern. The District will investigate all reports of possible subsidence brought to its attention.

4.0 Addressing Conjunctive Surface Water Management Issues

Northern Bexar County lies within the San Antonio River basin. For statewide water planning purposes, it is part of the South Central Texas Regional Water Planning Group (Region L). The District is also the southernmost portion of GMA 9. The region is unique in comparison to other areas within GMA 9 due to the population density, impact of increasing development, and recharge impact from Cibolo Creek Watershed.

4.1 Participating in the Regional Water Planning Process

Management Objective

The District will participate in the Region L regional water planning process to be informed of water demand projections and supply strategies in the District and to coordinate the District's groundwater management strategies with the regional water planning groups that include surface water management issues and foster an understanding of regional management practices.

Performance Standard

The District will participate in the regional water planning process by having a representative attend at least one meeting of the Region L. District representative attendance and report of the meeting for Region L will be presented to the Board of Directors at the following board meeting and dates of attendance will be included in the District's Annual Report.

5.0 Addressing Natural Resource Issues that Impact the Use and Availability of Groundwater and which are impacted by the use of Groundwater

5.1 Collaborate on Research Projects

Management Objective

The District will collaborate and/or partner with appropriate agencies, consultants, and research groups and document in-house efforts to advance projects and research that might impact the use and availability of groundwater.

Performance Standard

If projects are identified, then a summary of District efforts for any research project that might impact the use and availability of groundwater—such as water quality sampling or District support to a program/project—will be included in the District's Annual Report.

5.2 Address Abandoned & Deteriorated Wells and Proper Well Maintenance

Management Objective

The District will encourage the plugging of abandoned & deteriorated groundwater wells and provide guidance on proper well maintenance. The District or its authorized agents will document and conduct inspections of groundwater wells within the District's boundaries to encourage proper construction, plugging and maintenance of groundwater wells.

Performance Standard

A summary of the number of wells plugged and inspected will be included in the District's Annual Report.

6.0 Addressing Drought Conditions

6.1 Track Drought Conditions

Management Objective

The District will track information on weather, precipitation and drought data on the TWDB drought page and other key sites and post key information and links on the District website.

Performance Standard

A summary report of monitored drought conditions will be provided to the District Board of Directors at least quarterly.

Performance Standard

A link to the TWDB's website on drought information will be made available to the public on the District's webpage, https://www.waterdatafortexas.org/drought.

6.2 Drought Contingency Plan

Management Objective

The District will monitor conditions that trigger action of its Drought Contingency Plan.

Performance Standard

The District at least quarterly will evaluate the need to implement the drought contingency plan and will document implementation in the District's Annual Report.

7.0 Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, and Brush Control Where Appropriate and Cost Effective

7.1 Disseminate Information on Water Conservation

Management Objective

The District will provide information on an annual basis for the purpose of educating the public on the importance of water conservation and water conservation methods. The District will use at least one of the following methods to provide information to the public annually:

a. Distribute literature packets or brochures;
b. Distribute the District's newsletter;
c. Conduct public or school presentations;
d. Sponsor an educational program or course;
e. Provide information on the District's web site;
f. Submit an article for publication with local papers;
g. Present displays at public events.

Performance Standard

A summary of the District's efforts to disseminate information on water conservation and water conservation methods will be included in the District's Annual Report.

7.2 Evaluation on Potential Recharge Enhancement Projects

The District may solicit ideas and information and may investigate any potential recharge enhancement opportunities, natural or artificial, that are brought to the District's attention. Such projects may include but are not limited to: cleanup or site protection projects at any identified significant recharge feature, encouragement of prudent brush control/water enhancement projects, non-point source pollution mitigation projects, aquifer storage and recovery projects, development of recharge ponds or small reservoirs, and the encouragement of appropriate and practical erosion and sedimentation control at construction projects located near surface streams.

Management Objective

The District will investigate potential natural or artificial recharge enhancement projects.

Performance Standard

Annually, any findings related to recharge enhancement will be included in the District's Annual Report.

7.3 Monitor Ways to Emphasize Rainwater Harvesting and Brush Control

Management Objective

The District may provide information on an annual basis for the purpose of educating the public on rainwater harvesting and Brush Control for land management practices. The District will use at least one of the following methods to provide information to the public annually:

a. Distribute literature packets or brochures;
b. Distribute the District's newsletter;
c. Conduct public or school presentations;

d. Sponsor an educational program or course;
e. Provide information on the District's web site;
f. Submit an article for publication with local papers;
g. Present displays at public events.

Performance Standard

A summary of the District's efforts to disseminate information on rainwater harvesting and brush control will be included in the District's Annual Report.

7.4 Precipitation Enhancement

The District's small geographic area and the imprecision in the delivery location of enhanced precipitation combine to make such a water management strategy impractical and is cost prohibitive at this time. Therefore, this goal is not applicable to the operations of this District at this time.

8.0 Addressing the Desired Future Conditions

See section VI. Performance in Achieving DFCs in conjunction with objectives. **8.1 Manage and Maintain a Water Level Monitoring Program**

Management Objective

The District maintains a water-level monitoring network and will monitor and measure water levels in the Trinity Aquifer annually within District boundaries. The District at least annually, will evaluate the annual average water level measurements and trends to track progess in achievement of the DFCs.

Performance Standard

The District's Annual Report will include averaged annual water level measurements to assess and track progress in achievement of the DFCs.

8.2 Monitor Estimated Annual Production

Management Objective

The District will estimate the total annual groundwater production based on groundwater production reports, estimated exempt use, and other relevant information and evaluate production estimates to the MAG.

Performance Standard

An annual comparison of total recorded and estimated annual production to the District's MAG will be evaluated and included in the District's Annual Report.

REFERENCES

Ashworth, John B., 1983, Ground-Water Availability of the Lower Cretaceous Formations in the Hill Country of South-Central Texas; Texas Water Development Board Report 273; January 1983; 39p.

Clark, Allan K., Diana E. Pedraza, Robert R. Morris, and Travis J. Garcia, 2013, Geodatabase and Characteristics of Springs Within and Surrounding the Trinity Aquifer Outcrops in Northern Bexar County, Texas, 2010-11; United States Geological Survey Data Series 750; 31p.

Eckhardt, Gregg, [undated], The Edwards Aquifer Website: The Trinity Aquifer; website hosted at edwardsaquifer.net.

Johnson, Steven, Geary Schindel, and George Veni, 2010, Tracing Groundwater Flowpaths in the Edwards Aquifer Recharge Zone, Panther Springs Creek Basin, Northern Bexar County, TX; Edwards Aquifer Authority Report 10-01; 112p.

Jones, Ian C., Roberto Anaya, and Shirley C. Wade, 2011, Groundwater Availability Model: Hill Country Portion of the Trinity Aquifer of Texas; Texas Water Development Board Report 377; June 2011; 175p.

Kuniansky, E.L., 1989, Precipitation, streamflow, and baseflow, in west-central Texas, December 1974 through March 1977; U.S. Geological Survey Water- Resources Investigations Report 89-4208; 2 sheets.

LRE Water and Others. (2017) *Final Report: Identification of the Vulnerability of the Major and Minor Aquifers of Texas to Subsidence with Regard to Groundwater Pumping*. Texas Water Development Board Contract Number 1648302062. Retrieved from https://www.twdb.texas.gov/groundwater/models/research/subsidence/subsidence.asp.

Mace, Robert E., Ali H. Chowdhury, Roberto Anaya, and Shao-Chih (Ted) Way, 2000, Groundwater Availability of the Trinity Aquifer, Hill Country Area, Texas: Numerical Simulations through 2050; Texas Water Development Board Report 353; September 2000; 122p.

Manford, Durwood, R.M. Dixon, and O.F. Dent, 1959, Ground-Water Geology of Bexar County, Texas; Texas Board of Water Engineers Bulletin 5911; October 1959; 49p.

Muller, D. A. and Price, R. D., 1979, Ground-water Availability in Texas, Estimates and Projections Through 2030; Texas Department of Water Resources Report 238; 77 p.

Robinson, Mark C., Alysa K. Suydam, Evan D. Strickland, and Azzah AlKurdi, 2022, Brackish Groundwater in the Hill Country Trinity Aquifer and Trinity Group Formations, Texas; Texas Water Development Board Report 388; September 2022; 282p.

Ryder, Paul D., 1996, Ground Water Atlas of the United States- Oklahoma, Texas; United States Geological Survey Hydrologic Atlas HA 730-E; in Ground water atlas of the United States, James A. Miller, editor; accessed online at https://pubs.usgs.gov/ha/ha730/ch_e/index.html

Simpson, W.E. Co., Inc. and William F. Guyton Associates, Inc., 1993, Northern Bexar County Water Resources Study for the Edwards Underground Water District; report prepared by the W.E. Simpson Company, Inc.; September 1993; 413p.

Texas Water Code, 2023, https://statutes.capitol.texas.gov/docs/wa/pdf/wa.36.pdf
Texas Water Development Board, *Bexar County, 2022 Regional Water Plan, Population & Water Demand Projections*.(n.d.) Retrieved August 28, 2025, from https://2022.texasstatewaterplan.org/county/Bexar

Texas Water Development Board, *Groundwater Management Area 9 Map*, https://www.twdb.texas.gov/groundwater/management_areas/gma9.asp

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APPENDIX A – TWDB ESTIMATED HISTORICAL GROUNDWATER USE AND 2022 STATE WATER PLAN DATASETS

TWDB Estimated Historical Groundwater Use and 2022 State Water Plan Datasets

Trinity Glen Rose Groundwater Conservation District

Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Department
stephen.allen@twdb.texas.gov
(512) 463-7317
October 3, 2025

GROUNDWATER MANAGEMENT PLAN DATA

This set of water data tables (part one of a two-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 table addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan review checklist. The checklist can be found at this web address:

https://www.twdb.texas.gov/groundwater/docs/GCD/GCD_Mgmt_Plan_Checklist_2025.pdf

The five tables included in part one of this data package are:

TWDB Historical Water Use Survey (WUS)

- Estimated Historical Water Use (checklist item 2)

State Water Plan (SWP)

- Projected Surface Water Supplies (checklist item 6),
- Projected Water Demands (checklist item 7),
- Projected Water Supply Needs (checklist item 8),
- Projected Water Management Strategies (checklist item 9)

Part two of the two-part package is the groundwater availability model (GAM) run report for the district (checklist items 3 through 5). The district should have received, or will receive, this report from the TWDB Groundwater Modeling Department. Questions about the GAM can be directed to the Groundwater Modeling Team at GAM@twdb.texas.gov.

DISCLAIMER:

Data presented in these tables are the most up to date WUS and SWP data available as of 10/3/2025. Although it does not happen often, these data are subject to change pending the availability of more accurate WUS data or an amendment to the 2022 SWP. District personnel should review the data table values and correct any discrepancies to ensure approval of their groundwater management plan.

The WUS data can be verified at this web address:

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

The 2022 SWP data can be verified by contacting WRPdatarequests@twdb.texas.gov

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

The county values in two of the SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not apportioned because district-specific values are not required to be presented in the groundwater management plan. However, a district is required to “consider” the county values in these two tables by drafting a short summary of the needs and strategies values in the groundwater management plan.

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

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

For additional questions regarding this data, please contact GWMPlans (GWMPlans@twdb.texas.gov)

Estimated Historical Water Use

TWDB Historical Water Use Survey (WUS) Data

BEXAR COUNTY *24.36% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2023	GW	75,155	1,243	1,367	251	2,434	43	80,493
	SW	1,565	219	0	1,506	135	102	3,527
2022	GW	74,524	1,419	1,708	211	2,191	45	80,098
	SW	1,726	216	0	2,193	805	105	5,045
2021	GW	67,290	1,393	1,605	191	1,922	58	72,459
	SW	1,905	197	15	1,035	669	136	3,957
2020	GW	68,171	2,047	1,397	205	2,131	60	74,011
	SW	2,051	218	15	8,099	935	138	11,456
2019	GW	65,806	1,569	1,031	208	1,979	60	70,653
	SW	1,975	183	18	8,473	718	139	11,506
2018	GW	64,194	1,394	1,708	229	2,319	60	69,904
	SW	2,019	181	18	1,027	610	139	3,994
2017	GW	62,619	1,256	1,846	223	2,546	58	68,548
	SW	1,969	224	0	8,300	672	134	11,299
2016	GW	61,166	1,197	1,903	206	1,978	53	66,503
	SW	2,097	256	0	4,748	483	125	7,709
2015	GW	60,513	1,149	1,640	196	1,841	53	65,392
	SW	2,548	210	0	5,966	367	124	9,215
2014	GW	60,173	1,004	1,338	266	1,780	52	64,613
	SW	2,741	261	0	8,768	185	122	12,077

COMAL COUNTY

0.34% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2023	GW	56	1	19	0	2	0	78
	SW	54	0	0	0	1	0	55
2022	GW	54	1	21	0	1	0	77
	SW	56	0	0	0	1	0	57
2021	GW	52	1	16	0	1	0	70
	SW	47	0	0	0	1	1	49
2020	GW	55	2	13	0	1	0	71
	SW	34	0	0	0	1	1	36
2019	GW	53	2	20	0	1	0	76
	SW	44	0	0	0	1	1	46
2018	GW	46	2	18	0	1	0	67
	SW	31	0	0	0	1	1	33
2017	GW	41	2	12	0	1	0	56
	SW	33	0	0	0	2	1	36
2016	GW	39	1	21	0	1	0	62
	SW	30	0	0	0	2	1	33
2015	GW	39	1	18	0	1	0	59
	SW	31	0	0	0	1	1	33
2014	GW	37	2	29	0	0	0	68
	SW	33	0	0	0	0	1	34

KENDALL COUNTY

0.48% (multiplier)

All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2023	GW	18	0	0	0	6	1	25
	SW	19	0	0	0	0	0	19
2022	GW	19	0	0	0	1	1	21
	SW	20	0	0	0	1	0	21
2021	GW	16	0	0	0	1	1	18
	SW	16	0	0	0	0	0	16
2020	GW	18	0	0	0	1	1	20
	SW	15	0	0	0	0	0	15
2019	GW	17	0	0	0	1	1	19
	SW	15	0	0	0	0	0	15
2018	GW	17	0	0	0	1	1	19
	SW	13	0	0	0	0	0	13
2017	GW	17	0	0	0	1	1	19
	SW	12	0	0	0	0	0	12
2016	GW	17	0	0	0	1	1	19
	SW	12	0	0	0	1	0	13
2015	GW	15	0	0	0	1	1	17
	SW	10	0	0	0	0	0	10
2014	GW	16	0	0	0	1	1	18
	SW	11	0	0	0	0	0	11

Projected Surface Water Supplies
TWDB 2022 State Water Plan Data

BEXAR COUNTY

24.36% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	County-Other, Bexar	San Antonio	San Antonio Run-of-River	0	0	0	0	0	0
L	East Central SUD	San Antonio	Canyon Lake/Reservoir	1,217	1,204	1,216	1,219	1,233	1,234
L	Fair Oaks Ranch	San Antonio	Canyon Lake/Reservoir	1,170	1,064	979	912	857	811
L	Green Valley SUD	San Antonio	Canyon Lake/Reservoir	341	323	307	294	283	271
L	Irrigation, Bexar	San Antonio	San Antonio Run-of-River	28	28	28	28	28	28
L	Livestock, Bexar	Nueces	Nueces Livestock Local Supply	33	33	33	33	33	33
L	Livestock, Bexar	San Antonio	Nueces Livestock Local Supply	10	10	10	10	10	10
L	Manufacturing, Bexar	San Antonio	San Antonio Run-of-River	0	0	0	0	0	0
L	San Antonio Water System	San Antonio	Canyon Lake/Reservoir	6,082	3,993	0	0	0	0
L	San Antonio Water System	San Antonio	Guadalupe Run-of-River	270	270	270	270	270	270
L	San Antonio Water System	San Antonio	San Antonio Run-of-River	0	0	0	0	0	0
L	Steam-Electric Power, Bexar	San Antonio	Calaveras Lake/Reservoir	8,989	8,989	8,989	8,989	8,989	8,989
L	Steam-Electric Power, Bexar	San Antonio	Victor Braunig Lake/Reservoir	2,923	2,923	2,923	2,923	2,923	2,923
			Sum of Projected Surface Water Supplies (acre-feet)	**21,063**	**18,837**	**14,755**	**14,678**	**14,626**	**14,569**

COMAL COUNTY

0.34% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	Canyon Lake Water Service	Guadalupe	Canyon Lake/Reservoir	5,571	5,571	5,571	5,571	5,571	5,570
L	Canyon Lake Water Service	San Antonio	Canyon Lake/Reservoir	1,173	1,172	1,173	1,173	1,173	1,173
L	County-Other, Comal	Guadalupe	Canyon Lake/Reservoir	2	2	2	2	2	2
L	Crystal Clear WSC	Guadalupe	Canyon Lake/Reservoir	153	149	144	140	136	133
L	Fair Oaks Ranch	San Antonio	Canyon Lake/Reservoir	95	96	96	98	98	99
L	Green Valley SUD	Guadalupe	Canyon Lake/Reservoir	44	47	48	51	51	53
L	Guadalupe-Blanco River Authority	San Antonio	Canyon Lake/Reservoir	12	12	13	14	15	16
L	Guadalupe-Blanco River Authority	San Antonio	Guadalupe Run-of-River	33	35	37	39	42	45

L	Irrigation, Comal	Guadalupe	Canyon Lake/Reservoir	1	1	1	1	1	1
L	Irrigation, Comal	Guadalupe	Guadalupe Run-of-River	0	0	0	0	0	0
L	Livestock, Comal	Guadalupe	Guadalupe Livestock Local Supply	0	0	0	0	0	0
L	Livestock, Comal	San Antonio	San Antonio Livestock Local Supply	0	0	0	0	0	0
L	Manufacturing, Comal	Guadalupe	Canyon Lake/Reservoir	0	0	0	0	0	0
L	Manufacturing, Comal	Guadalupe	Guadalupe Run-of-River	0	0	0	0	0	0
L	New Braunfels	Guadalupe	Canyon Lake/Reservoir	8,072	8,124	8,158	8,188	8,207	8,218
L	New Braunfels	Guadalupe	Guadalupe Run-of-River	87	88	88	89	89	89
L	San Antonio Water System	Guadalupe	Canyon Lake/Reservoir	4	2	0	0	0	0
L	San Antonio Water System	Guadalupe	San Antonio Run-of-River	0	0	0	0	0	0
L	San Antonio Water System	San Antonio	Canyon Lake/Reservoir	4	2	0	0	0	0
L	San Antonio Water System	San Antonio	San Antonio Run-of-River	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**15,251**	**15,301**	**15,331**	**15,366**	**15,385**	**15,399**

KENDALL COUNTY

0.48% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	Boerne	San Antonio	Boerne Lake/Reservoir	647	647	647	647	647	647
L	Boerne	San Antonio	Canyon Lake/Reservoir	3,611	3,611	3,611	3,611	3,611	3,611
L	County-Other, Kendall	Guadalupe	Canyon Lake/Reservoir	7	7	7	7	7	7
L	Fair Oaks Ranch	San Antonio	Canyon Lake/Reservoir	585	690	775	840	895	940
L	Guadalupe-Blanco River Authority	Guadalupe	Canyon Lake/Reservoir	11	11	12	13	14	15
L	Guadalupe-Blanco River Authority	Guadalupe	Guadalupe Run-of-River	30	32	34	36	39	42
L	Guadalupe-Blanco River Authority	San Antonio	Guadalupe Run-of-River	1	1	1	1	1	1
L	Irrigation, Kendall	Guadalupe	Guadalupe Run-of-River	0	0	0	0	0	0
L	Livestock, Kendall	Colorado	Colorado Livestock Local Supply	0	0	0	0	0	0
L	Livestock, Kendall	Guadalupe	Guadalupe Livestock Local Supply	1	1	1	1	1	1
L	Livestock, Kendall	San Antonio	San Antonio Livestock Local Supply	0	0	0	0	0	0
	Sum of Projected Surface Water Supplies (acre-feet)			**4,893**	**5,000**	**5,088**	**5,156**	**5,215**	**5,264**

Projected Water Demands

TWDB 2022 State Water Plan Data

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

BEXAR COUNTY

24.36% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Air Force Village II Inc	San Antonio	188	210	229	228	228	228
L	Alamo Heights	San Antonio	2,210	2,261	2,233	2,221	2,218	2,218
L	Atascosa Rural WSC	Nueces	75	87	99	111	122	132
L	Atascosa Rural WSC	San Antonio	1,406	1,642	1,864	2,087	2,299	2,495
L	Bexar County WCID 10	San Antonio	1,174	1,195	1,219	1,249	1,281	1,312
L	Converse	San Antonio	2,554	2,764	2,951	2,925	2,919	2,917
L	County-Other, Bexar	Nueces	249	257	176	256	340	415
L	County-Other, Bexar	San Antonio	256	264	181	263	349	427
L	East Central SUD	San Antonio	1,826	1,973	2,150	2,337	2,547	2,731
L	Elmendorf	San Antonio	307	393	473	551	624	691
L	Fair Oaks Ranch	San Antonio	1,328	1,401	1,437	1,418	1,483	1,543
L	Fort Sam Houston	San Antonio	2,596	2,592	2,588	2,587	2,587	2,586
L	Green Valley SUD	San Antonio	364	393	423	456	490	522
L	Irrigation, Bexar	Nueces	286	286	286	286	286	286
L	Irrigation, Bexar	San Antonio	2,619	2,619	2,619	2,619	2,619	2,619
L	Kirby	San Antonio	930	999	973	964	962	961
L	Lackland Air Force Base	San Antonio	1,209	1,163	1,125	1,104	1,100	1,100
L	Leon Valley	San Antonio	1,401	1,454	1,507	1,886	1,968	2,046
L	Live Oak	San Antonio	1,650	1,657	1,633	1,619	1,616	1,616
L	Livestock, Bexar	Nueces	45	45	45	45	45	45
L	Livestock, Bexar	San Antonio	247	247	247	247	247	247
L	Lytle	Nueces	15	20	24	28	32	35
L	Manufacturing, Bexar	San Antonio	1,443	1,651	1,651	1,651	1,651	1,651
L	Mining, Bexar	San Antonio	1,905	2,129	2,322	2,534	2,777	3,045
L	Randolph Air Force Base	San Antonio	121	136	151	165	177	189
L	San Antonio Water System	San Antonio	238,114	261,305	284,407	307,453	330,693	352,390
L	Schertz	San Antonio	243	300	374	454	551	639
L	Selma	San Antonio	825	920	1,015	1,106	1,190	1,268
L	Shavano Park	San Antonio	693	775	851	927	997	1,062
L	Steam-Electric Power, Bexar	San Antonio	12,739	12,739	12,739	12,739	12,739	12,739
L	The Oaks WSC	San Antonio	298	349	397	444	488	528
L	Universal City	San Antonio	3,155	3,170	3,112	3,080	3,073	3,072
L	Water Services	San Antonio	581	636	689	749	808	864
		Sum of Projected Water Demands (acre-feet)	**283,052**	**308,032**	**332,190**	**356,789**	**381,506**	**404,619**

COMAL COUNTY

0.34% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Canyon Lake Water Service	Guadalupe	5,059	6,536	8,166	9,827	11,433	12,951
L	Canyon Lake Water Service	San Antonio	1,036	1,290	1,594	1,920	2,249	2,545
L	Clear Water Estates Water System	Guadalupe	677	856	1,037	1,221	1,402	1,578
L	County-Other, Comal	Guadalupe	3	3	3	3	3	3
L	County-Other, Comal	San Antonio	1	1	1	1	1	1
L	Crystal Clear WSC	Guadalupe	279	313	348	386	426	465
L	Fair Oaks Ranch	San Antonio	107	126	142	152	170	188
L	Garden Ridge	Guadalupe	1,140	1,347	1,601	1,696	1,949	2,193
L	Garden Ridge	San Antonio	645	761	904	959	1,102	1,239
L	Green Valley SUD	Guadalupe	51	61	73	84	97	109
L	Guadalupe-Blanco River Authority	San Antonio	45	47	50	53	57	61
L	Irrigation, Comal	Guadalupe	1	1	1	1	1	1
L	Irrigation, Comal	San Antonio	0	0	0	0	0	0
L	KT Water Development	Guadalupe	432	542	655	770	885	995
L	Livestock, Comal	Guadalupe	1	1	1	1	1	1
L	Livestock, Comal	San Antonio	0	0	0	0	0	0
L	Manufacturing, Comal	Guadalupe	16	20	20	20	20	20
L	Mining, Comal	Guadalupe	28	33	37	41	46	51
L	Mining, Comal	San Antonio	1	1	2	2	2	2
L	New Braunfels	Guadalupe	16,019	20,103	24,012	28,179	32,251	36,240
L	San Antonio Water System	Guadalupe	128	141	152	165	177	189
L	San Antonio Water System	San Antonio	150	164	178	192	207	220
L	Schertz	Guadalupe	251	400	596	825	1,111	1,402
L	Schertz	San Antonio	6	10	15	21	28	35
L	Selma	San Antonio	3	4	5	6	6	7
L	Water Services	San Antonio	479	523	567	616	665	711
L	Wingert Water Systems	Guadalupe	283	359	436	436	436	436
		Sum of Projected Water Demands (acre-feet)	**26,841**	**33,643**	**40,596**	**47,577**	**54,725**	**61,643**

KENDALL COUNTY

0.48% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Boerne	San Antonio	3,169	4,086	5,067	6,049	7,063	8,062
L	County-Other, Kendall	Colorado	0	0	0	0	0	0
L	County-Other, Kendall	Guadalupe	8	7	8	8	8	9
L	County-Other, Kendall	San Antonio	3	3	3	4	4	4
L	Fair Oaks Ranch	San Antonio	665	910	1,139	1,306	1,550	1,790
L	Guadalupe-Blanco River Authority	Guadalupe	41	43	46	49	53	57
L	Guadalupe-Blanco River Authority	San Antonio	1	1	1	1	1	1

L	Irrigation, Kendall	Guadalupe	2	2	2	2	2	2
L	Irrigation, Kendall	San Antonio	0	0	0	0	0	0
L	Kendall County WCID 1	Guadalupe	283	318	358	401	448	495
L	Kendall West Utility	San Antonio	311	782	1,061	1,402	1,865	2,096
L	Livestock, Kendall	Colorado	0	0	0	0	0	0
L	Livestock, Kendall	Guadalupe	2	2	2	2	2	2
L	Livestock, Kendall	San Antonio	0	0	0	0	0	0
L	Manufacturing, Kendall	Guadalupe	0	0	0	0	0	0
		Sum of Projected Water Demands (acre-feet)	**4,485**	**6,154**	**7,687**	**9,224**	**10,996**	**12,518**

Projected Water Supply Needs
TWDB 2022 State Water Plan Data

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

BEXAR COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Air Force Village II Inc	San Antonio	-104	-126	-145	-144	-144	-144
L	Alamo Heights	San Antonio	-942	-993	-965	-953	-950	-950
L	Atascosa Rural WSC	Nueces	-44	-56	-68	-80	-91	-101
L	Atascosa Rural WSC	San Antonio	-827	-1,063	-1,285	-1,508	-1,720	-1,916
L	Bexar County WCID 10	San Antonio	-417	-438	-462	-492	-524	-555
L	Converse	San Antonio	-350	-560	-747	-721	-715	-713
L	County-Other, Bexar	Nueces	1,308	1,339	1,662	1,336	1,690	2,007
L	County-Other, Bexar	San Antonio	2,377	2,346	2,685	2,349	1,995	1,678
L	East Central SUD	San Antonio	958	780	630	451	272	91
L	Elmendorf	San Antonio	-31	-117	-197	-275	-348	-414
L	Fair Oaks Ranch	San Antonio	222	9	-140	-210	-348	-469
L	Fort Sam Houston	San Antonio	-1,919	-1,736	-1,551	-1,366	-1,185	-1,008
L	Green Valley SUD	San Antonio	784	694	609	531	459	390
L	Irrigation, Bexar	Nueces	3,318	3,318	3,318	3,318	3,318	3,318
L	Irrigation, Bexar	San Antonio	-3,318	-3,318	-3,318	-3,318	-3,318	-3,318
L	Kirby	San Antonio	-191	-260	-234	-225	-223	-222
L	Lackland Air Force Base	San Antonio	-9	37	75	96	100	100
L	Leon Valley	San Antonio	-263	-316	-369	-748	-830	-908
L	Live Oak	San Antonio	-482	-489	-465	-451	-448	-448
L	Livestock, Bexar	Nueces	0	0	0	0	0	0
L	Livestock, Bexar	San Antonio	0	0	0	0	0	0
L	Lytle	Nueces	-7	-10	-14	-17	-20	-23
L	Manufacturing, Bexar	San Antonio	936	85	85	85	85	85
L	Mining, Bexar	San Antonio	0	0	0	0	0	0
L	Randolph Air Force Base	San Antonio	79	64	49	35	23	11
L	San Antonio Water System	San Antonio	7,619	-13,874	-34,102	-53,717	-75,049	-96,746
L	Schertz	San Antonio	8	6	-31	-117	-221	-325
L	Selma	San Antonio	337	-29	-82	-136	-189	-240
L	Shavano Park	San Antonio	-264	-346	-422	-498	-568	-633
L	Steam-Electric Power, Bexar	San Antonio	-2,782	-2,782	-2,782	-2,782	-2,782	-2,782
L	The Oaks WSC	San Antonio	-138	-189	-237	-284	-328	-368
L	Universal City	San Antonio	-299	-314	-256	-224	-217	-216
L	Water Services	San Antonio	66	196	98	0	0	0
		Sum of Projected Water Supply Needs (acre-feet)	**-12,387**	**-27,016**	**-47,872**	**-68,266**	**-90,218**	**-112,499**

COMAL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Canyon Lake Water Service	Guadalupe	7,019	5,575	3,955	2,291	675	-844
L	Canyon Lake Water Service	San Antonio	1,469	1,173	857	532	210	-87
L	Clear Water Estates Water System	Guadalupe	-627	-806	-987	-1,171	-1,352	-1,528
L	County-Other, Comal	Guadalupe	1,418	1,440	1,458	1,467	1,469	1,469
L	County-Other, Comal	San Antonio	1	-43	-52	-80	-119	-164
L	Crystal Clear WSC	Guadalupe	-5	37	-9	-57	-107	-154
L	Fair Oaks Ranch	San Antonio	19	1	-15	-22	-40	-57
L	Garden Ridge	Guadalupe	-586	-793	-1,047	-1,142	-1,395	-1,639
L	Garden Ridge	San Antonio	-332	-448	-591	-646	-789	-926
L	Green Valley SUD	Guadalupe	107	105	98	97	86	79
L	Guadalupe-Blanco River Authority	San Antonio	0	0	0	0	0	0
L	Irrigation, Comal	Guadalupe	244	244	244	244	244	244
L	Irrigation, Comal	San Antonio	-33	-33	-33	-33	-33	-33
L	KT Water Development	Guadalupe	-26	-136	-249	-364	-479	-589
L	Livestock, Comal	Guadalupe	0	0	0	0	0	0
L	Livestock, Comal	San Antonio	0	0	0	0	0	0
L	Manufacturing, Comal	Guadalupe	-2,786	-3,768	-3,768	-3,768	-3,768	-3,768
L	Mining, Comal	Guadalupe	-3,861	-5,201	-6,491	-7,617	-8,849	-8,849
L	Mining, Comal	San Antonio	0	0	0	0	0	0
L	New Braunfels	Guadalupe	144	-3,812	-7,678	-11,786	-15,821	-19,787
L	San Antonio Water System	Guadalupe	-9	-23	-36	-47	-58	-70
L	San Antonio Water System	San Antonio	-10	-26	-43	-55	-69	-82
L	Schertz	Guadalupe	8	8	-48	-213	-445	-714
L	Schertz	San Antonio	0	0	-1	-6	-12	-18
L	Selma	San Antonio	2	0	0	-1	-1	-1
L	Water Services	San Antonio	0	-224	-226	-241	-352	-457
L	Wingert Water Systems	Guadalupe	-32	-108	-185	-185	-185	-185
		Sum of Projected Water Supply Needs (acre-feet)	**-8,307**	**-15,421**	**-21,459**	**-27,434**	**-33,874**	**-39,952**

KENDALL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	Boerne	San Antonio	2,644	1,727	746	-236	-1,250	-2,249
L	County-Other, Kendall	Colorado	53	54	52	49	49	45
L	County-Other, Kendall	Guadalupe	1,112	1,086	1,136	1,083	1,091	1,007
L	County-Other, Kendall	San Antonio	297	322	274	330	322	347
L	Fair Oaks Ranch	San Antonio	110	4	-112	-193	-364	-544
L	Guadalupe-Blanco River Authority	Guadalupe	0	0	0	0	0	0
L	Guadalupe-Blanco River Authority	San Antonio	0	0	0	0	0	0

L	Irrigation, Kendall	Guadalupe	17	17	17	17	17	17
L	Irrigation, Kendall	San Antonio	-1	-1	-1	-1	-1	-1
L	Kendall County WCID 1	Guadalupe	444	409	369	326	279	232
L	Kendall West Utility	San Antonio	189	-282	-561	-902	-1,365	-1,596
L	Livestock, Kendall	Colorado	0	0	0	0	0	0
L	Livestock, Kendall	Guadalupe	0	0	0	0	0	0
L	Livestock, Kendall	San Antonio	0	0	0	0	0	0
L	Manufacturing, Kendall	Guadalupe	0	0	0	0	0	0
		Sum of Projected Water Supply Needs (acre-feet)	**-1**	**-283**	**-674**	**-1,332**	**-2,980**	**-4,390**

Projected Water Management Strategies
TWDB 2022 State Water Plan Data

BEXAR COUNTY

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

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Air Force Village II Inc, San Antonio (L)							
Drought Management - Air Force Village II	DEMAND REDUCTION [Bexar]	3	0	0	0	0	0
Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	107	114	114	97	81	74
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	9	27	46	62	78	85
		119	**141**	**160**	**159**	**159**	**159**
Alamo Heights, San Antonio (L)							
Drought Management - Alamo Heights	DEMAND REDUCTION [Bexar]	50	0	0	0	0	0
Edwards Transfers	Edwards-BFZ Aquifer [Bexar]	464	388	307	181	105	32
Edwards Transfers	Edwards-BFZ Aquifer [Medina]	340	341	233	188	108	41
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	103	279	440	600	752	892
		957	**1,008**	**980**	**969**	**965**	**965**
Atascosa Rural WSC, Nueces (L)							
Drought Management - Atascosa Rural WSC	DEMAND REDUCTION [Bexar]	3	0	0	0	0	0
FE - Atascosa Rural WSC	Edwards-BFZ Aquifer [Medina]	2	2	2	2	2	2
Local Carrizo Aquifer Development	Carrizo-Wilcox Aquifer [Atascosa]	53	106	106	106	106	105
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	0	0	3
		58	**108**	**108**	**108**	**108**	**110**
Atascosa Rural WSC, San Antonio (L)							
Drought Management - Atascosa Rural WSC	DEMAND REDUCTION [Bexar]	56	0	0	0	0	0
FE - Atascosa Rural WSC	Edwards-BFZ Aquifer [Medina]	29	29	29	29	29	29
Local Carrizo Aquifer Development	Carrizo-Wilcox Aquifer [Atascosa]	996	1,992	1,992	1,992	1,992	1,993
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	0	0	47
		1,081	**2,021**	**2,021**	**2,021**	**2,021**	**2,069**
Bexar County WCID 10, San Antonio (L)							
Drought Management - Bexar County WCID 10	DEMAND REDUCTION [Bexar]	33	0	0	0	0	0

	Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	348	312	243	197	199	198
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	51	141	234	310	340	372
			432	**453**	**477**	**507**	**539**	**570**
Converse, San Antonio (L)								
	CRWA - Wells Ranch (Phase 3)	Carrizo-Wilcox Aquifer [Guadalupe]	264	575	762	736	730	720
	Drought Management - Converse	DEMAND REDUCTION [Bexar]	101	0	0	0	0	0
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	0	0	8
			365	**575**	**762**	**736**	**730**	**728**
County-Other, Bexar, Nueces (L)								
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	0	0	8
			0	**0**	**0**	**0**	**0**	**8**
County-Other, Bexar, San Antonio (L)								
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	0	0	8
			0	**0**	**0**	**0**	**0**	**8**
Elmendorf, San Antonio (L)								
	Drought Management – Elmendorf	DEMAND REDUCTION [Bexar]	8	0	0	0	0	0
	Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	45	131	211	288	346	394
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	1	17	35
			53	**131**	**211**	**289**	**363**	**429**
Fair Oaks Ranch, San Antonio (L)								
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	74	192	310	410	528	624
	Reuse - Fair Oaks Ranch Non-Potable Reuse	Direct Reuse [Bexar]	0	386	355	331	311	294
			74	**578**	**665**	**741**	**839**	**918**
Fort Sam Houston, San Antonio (L)								
	Drought Management - Fort Sam Houston	DEMAND REDUCTION [Bexar]	5	0	0	0	0	0
	Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	1,716	1,315	927	557	207	0
	Municipal Water Conservation	DEMAND REDUCTION [Bexar]	213	436	639	824	993	1,144
			1,934	**1,751**	**1,566**	**1,381**	**1,200**	**1,144**
Green Valley SUD, San Antonio (L)								
	ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	147	135	124	114
	ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	33	30
	ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	132	113	105	97	88	82
			132	**113**	**252**	**232**	**245**	**226**
Kirby, San Antonio (L)								

Drought Management - Kirby	DEMAND REDUCTION [Bexar]	32	0	0	0	0	0
Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	174	275	249	240	238	237
		206	**275**	**249**	**240**	**238**	**237**

Lackland Air Force Base, San Antonio (L)

Drought Management - Lackland Air Force Base	DEMAND REDUCTION [Bexar]	67	0	0	0	0	0
		67	**0**	**0**	**0**	**0**	**0**

Leon Valley, San Antonio (L)

Drought Management - Leon Valley	DEMAND REDUCTION [Bexar]	65	0	0	0	0	0
Edwards Transfers	Edwards-BFZ Aquifer [Bexar]	92	115	150	299	328	356
Edwards Transfers	Edwards-BFZ Aquifer [Medina]	79	113	122	300	304	302
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	42	102	112	165	212	265
		278	**330**	**384**	**764**	**844**	**923**

Live Oak, San Antonio (L)

Drought Management - Live Oak	DEMAND REDUCTION [Bexar]	48	0	0	0	0	0
Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	392	333	297	261	226	192
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	57	171	183	205	237	271
		497	**504**	**480**	**466**	**463**	**463**

Lytle, Nueces (L)

Edwards Transfers	Edwards-BFZ Aquifer [Medina]	7	9	11	12	16	17
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	2	4	5	6	8
		7	**11**	**15**	**17**	**22**	**25**

San Antonio Water System, San Antonio (L)

Drought Management - SAWS	DEMAND REDUCTION [Bexar]	11,906	31,356	45,506	49,192	52,911	56,383
FE - SAWS ASR Treatment Plant Expansion	Carrizo-Aquifer ASR [Bexar]	0	33,472	33,474	33,475	33,476	33,478
FE - SAWS Western Integration Pipeline	Carrizo-Wilcox Aquifer [Gonzales]	389	389	389	389	389	389
FE - SAWS Western Integration Pipeline	Canyon Lake/Reservoir [Reservoir]	499	3,082	3,082	3,082	3,082	3,082
FE - SAWS Western Integration Pipeline	Guadalupe Run-of-River [Hays]	515	515	515	515	515	515
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	23,877	50,195	73,867	89,140	102,249	115,479
Reuse - SAWS - Reuse Water Programs	Direct Reuse [Bexar]	0	4,982	4,982	14,944	24,906	39,855
SAWS - Expanded Brackish Wilcox Project	Carrizo-Wilcox Aquifer [Wilson]	0	0	20,083	20,084	61,292	61,299
SAWS - Expanded Brackish Wilcox Project (GW Conversion)	Carrizo-Wilcox Aquifer [Wilson]	0	0	0	0	8,605	8,606
SAWS - Expanded Local Carrizo	Carrizo-Wilcox Aquifer [Bexar]	0	0	20,921	20,922	20,922	20,924

SAWS Advanced Meter Infrastructure	DEMAND REDUCTION [Bexar]	424	604	508	0	0	0
		37,610	**124,595**	**203,327**	**231,743**	**308,347**	**340,010**

Schertz, San Antonio (L)

CVLGC Carrizo Project	Carrizo-Wilcox Aquifer [Gonzales]	0	64	68	71	75	78
CVLGC Carrizo Project	Carrizo-Wilcox Aquifer [Wilson]	0	97	102	107	103	106
CVLGC Carrizo Project (GW Conversion)	Carrizo-Wilcox Aquifer [Wilson]	0	0	0	0	10	11
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	8	12	21	35	54	76
SSLGC Expanded Brackish Wilcox Groundwater	Carrizo-Wilcox Aquifer [Gonzales]	0	0	85	89	94	97
SSLGC Expanded Carrizo Project	Carrizo-Wilcox Aquifer [Guadalupe]	103	97	102	107	113	116
		111	**270**	**378**	**409**	**449**	**484**

Selma, San Antonio (L)

Edwards Transfers	Edwards-BFZ Aquifer [Bexar]	0	31	88	123	172	223
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	42	57	84	93	112	139
		42	**88**	**172**	**216**	**284**	**362**

Shavano Park, San Antonio (L)

Drought Management - Shavano Park	DEMAND REDUCTION [Bexar]	47	0	0	0	0	0
Edwards Transfers	Edwards-BFZ Aquifer [Bexar]	103	129	139	117	113	104
Edwards Transfers	Edwards-BFZ Aquifer [Medina]	87	123	113	127	114	99
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	42	109	185	269	356	444
		279	**361**	**437**	**513**	**583**	**647**

Steam-Electric Power, Bexar, San Antonio (L)

Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	2,797	2,797	2,797	2,797	2,797	2,797
FE - CPS Direct Recycle Pipeline	Direct Reuse [Bexar]	0	50,000	50,000	50,000	50,000	50,000
		2,797	**52,797**	**52,797**	**52,797**	**52,797**	**52,797**

The Oaks WSC, San Antonio (L)

Drought Management - The Oaks WSC	DEMAND REDUCTION [Bexar]	9	0	0	0	0	0
Entity Purchase to Meet Shortages - SAWS	Carrizo-Wilcox Aquifer [Bexar]	132	170	208	242	271	294
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	12	34	44	57	72	89
		153	**204**	**252**	**299**	**343**	**383**

Universal City, San Antonio (L)

Drought Management - Universal City	DEMAND REDUCTION [Bexar]	192	0	0	0	0	0
Edwards Transfers	Edwards-BFZ Aquifer [Bexar]	175	171	150	114	115	119
Edwards Transfers	Edwards-BFZ Aquifer [Medina]	0	158	121	124	50	0

Municipal Water Conservation	DEMAND REDUCTION [Bexar]	0	0	0	0	67	140
		367	**329**	**271**	**238**	**232**	**259**
Water Services, San Antonio (L)							
Local Trinity Aquifer Development	Trinity Aquifer [Bexar]	0	18	19	76	34	68
Municipal Water Conservation	DEMAND REDUCTION [Bexar]	12	13	16	30	51	74
		12	**31**	**35**	**106**	**85**	**142**
Sum of Projected Water Management Strategies (acre-feet)		**47,631**	**186,674**	**265,999**	**294,951**	**371,856**	**404,066**

COMAL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Canyon Lake Water Service, Guadalupe (L)							
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	0	0	0	0	145
Municipal Water Conservation	DEMAND REDUCTION [Comal]	0	0	0	75	318	699
		0	**0**	**0**	**75**	**318**	**844**
Canyon Lake Water Service, San Antonio (L)							
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	0	0	0	0	29
Municipal Water Conservation	DEMAND REDUCTION [Comal]	0	0	0	14	62	60
		0	**0**	**0**	**14**	**62**	**89**
Clear Water Estates Water System, Guadalupe (L)							
Drought Management - Clear Water Estates Water System	DEMAND REDUCTION [Comal]	4	0	0	0	0	0
Local Trinity Aquifer Development	Trinity Aquifer [Comal]	627	806	987	1,171	1,352	1,528
Municipal Water Conservation	DEMAND REDUCTION [Comal]	54	142	253	386	534	695
		685	**948**	**1,240**	**1,557**	**1,886**	**2,223**
County-Other, Comal, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Comal]	82	185	208	272	365	471
		82	**185**	**208**	**272**	**365**	**471**
County-Other, Comal, San Antonio (L)							
Municipal Water Conservation	DEMAND REDUCTION [Comal]	35	79	88	116	155	200
		35	**79**	**88**	**116**	**155**	**200**
Crystal Clear WSC, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	391	380	369	358
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	98	95
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	296	288	279	271	263	255
Drought Management - Crystal Clear WSC	DEMAND REDUCTION [Comal]	11	0	0	0	0	0

Municipal Water Conservation	DEMAND REDUCTION [Comal]	0	0	0	0	0	8
		307	**288**	**670**	**651**	**730**	**716**
Fair Oaks Ranch, San Antonio (L)							
Municipal Water Conservation	DEMAND REDUCTION [Comal]	6	17	31	44	61	76
Reuse - Fair Oaks Ranch Non-Potable Reuse	Direct Reuse [Bexar]	0	35	35	36	36	36
		6	**52**	**66**	**80**	**97**	**112**
Garden Ridge, Guadalupe (L)							
Drought Management - Garden Ridge	DEMAND REDUCTION [Comal]	30	0	0	0	0	0
Local Trinity Aquifer Development	Trinity Aquifer [Comal]	586	793	1,047	1,142	1,395	1,639
Municipal Water Conservation	DEMAND REDUCTION [Comal]	69	192	353	499	704	926
		685	**985**	**1,400**	**1,641**	**2,099**	**2,565**
Garden Ridge, San Antonio (L)							
Drought Management - Garden Ridge	DEMAND REDUCTION [Comal]	17	0	0	0	0	0
Local Trinity Aquifer Development	Trinity Aquifer [Comal]	332	448	591	646	789	926
Municipal Water Conservation	DEMAND REDUCTION [Comal]	39	108	200	282	398	523
		388	**556**	**791**	**928**	**1,187**	**1,449**
Green Valley SUD, Guadalupe (L)							
ARWA - Phase 2	Carrizo-Wilcox Aquifer [Caldwell]	0	0	25	25	24	24
ARWA - Phase 3	Direct Reuse [Hays]	0	0	0	0	7	6
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	18	17	18	18	17	17
		18	**17**	**43**	**43**	**48**	**47**
Guadalupe-Blanco River Authority, San Antonio (L)							
FE - GBRA Western Canyon Expansion	Canyon Lake/Reservoir [Reservoir]	0	0	0	0	236	214
FE - Hays County Pipeline Project	Canyon Lake/Reservoir [Reservoir]	0	299	704	595	0	0
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	2,542	2,488	2,390	2,013	1,169
GBRA Lower Basin Storage Project	GBRA Lower Basin Off-Channel Lake/Reservoir [Reservoir]	8,160	8,067	8,103	8,048	8,022	7,999
		8,160	**10,908**	**11,295**	**11,033**	**10,271**	**9,382**
KT Water Development, Guadalupe (L)							
Drought Management - KT Water Development	DEMAND REDUCTION [Comal]	7	0	0	0	0	0
Local Trinity Aquifer Development	Trinity Aquifer [Comal]	161	161	322	483	483	644
Municipal Water Conservation	DEMAND REDUCTION [Comal]	28	78	146	228	321	421
		196	**239**	**468**	**711**	**804**	**1,065**
Manufacturing, Comal, Guadalupe (L)							
ARWA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	2,786	0	0	0	0	0

GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	3,783	3,783	3,783	3,783	3,783
		2,786	**3,783**	**3,783**	**3,783**	**3,783**	**3,783**

Mining, Comal, Guadalupe (L)

Local Trinity Aquifer Development	Trinity Aquifer [Comal]	3,866	5,210	6,496	7,623	8,849	8,849
		3,866	**5,210**	**6,496**	**7,623**	**8,849**	**8,849**

Mining, Comal, San Antonio (L)

Local Trinity Aquifer Development	Trinity Aquifer [Comal]	250	356	522	605	357	336
		250	**356**	**522**	**605**	**357**	**336**

New Braunfels, Guadalupe (L)

FE - NBU Seguin Interconnect	Carrizo-Wilcox Aquifer [Gonzales]	2,154	2,178	2,180	2,188	2,193	2,196
FE - NBU South WTP Expansion	Guadalupe Run-of-River [Comal]	0	1	1	1	1	1
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Caldwell]	3,420	3,457	3,461	3,475	3,481	3,486
GBRA Shared Project (Phase 1)	Carrizo-Wilcox Aquifer [Gonzales]	3,474	3,511	3,515	3,528	3,535	3,540
Municipal Water Conservation	DEMAND REDUCTION [Comal]	571	1,951	3,820	5,089	6,287	7,581
NBU - ASR	Trinity and/or Brackish Edwards Aquifer ASR [Comal]	9,323	9,423	9,433	9,469	9,488	9,501
NBU - Trinity Development	Trinity Aquifer [Comal]	0	2,927	2,930	2,941	2,947	2,951
		18,942	**23,448**	**25,340**	**26,691**	**27,932**	**29,256**

San Antonio Water System, Guadalupe (L)

Drought Management - SAWS	DEMAND REDUCTION [Comal]	6	17	24	26	28	30
FE - SAWS ASR Treatment Plant Expansion	Carrizo-Aquifer ASR [Bexar]	0	18	18	18	18	18
FE - SAWS Western Integration Pipeline	Canyon Lake/Reservoir [Reservoir]	0	2	2	2	2	2
Municipal Water Conservation	DEMAND REDUCTION [Comal]	13	28	40	49	55	62
Reuse - SAWS - Reuse Water Programs	Direct Reuse [Bexar]	0	3	3	8	13	21
SAWS - Expanded Brackish Wilcox Project	Carrizo-Wilcox Aquifer [Wilson]	0	0	11	11	33	33
SAWS - Expanded Brackish Wilcox Project (GW Conversion)	Carrizo-Wilcox Aquifer [Wilson]	0	0	0	0	5	5
SAWS - Expanded Local Carrizo	Carrizo-Wilcox Aquifer [Bexar]	0	0	11	11	11	11
SAWS Advanced Meter Infrastructure	DEMAND REDUCTION [Comal]	0	0	0	0	0	0
		19	**68**	**109**	**125**	**165**	**182**

San Antonio Water System, San Antonio (L)

Drought Management - SAWS	DEMAND REDUCTION [Comal]	7	20	28	31	33	35
FE - SAWS ASR Treatment Plant Expansion	Carrizo-Aquifer ASR [Bexar]	0	21	21	21	21	21
FE - SAWS Western Integration Pipeline	Canyon Lake/Reservoir [Reservoir]	0	2	2	2	2	2

Municipal Water Conservation	DEMAND REDUCTION [Comal]	15	32	46	56	64	72
Reuse - SAWS - Reuse Water Programs	Direct Reuse [Bexar]	0	3	3	9	16	25
SAWS - Expanded Brackish Wilcox Project	Carrizo-Wilcox Aquifer [Wilson]	0	0	13	13	39	39
SAWS - Expanded Brackish Wilcox Project (GW Conversion)	Carrizo-Wilcox Aquifer [Wilson]	0	0	0	0	5	5
SAWS - Expanded Local Carrizo	Carrizo-Wilcox Aquifer [Bexar]	0	0	13	13	13	13
SAWS Advanced Meter Infrastructure	DEMAND REDUCTION [Comal]	0	0	0	0	0	0
		22	**78**	**126**	**145**	**193**	**212**
Schertz, Guadalupe (L)							
CVLGC Carrizo Project	Carrizo-Wilcox Aquifer [Gonzales]	0	86	108	129	152	170
CVLGC Carrizo Project	Carrizo-Wilcox Aquifer [Wilson]	0	129	162	194	207	232
CVLGC Carrizo Project (GW Conversion)	Carrizo-Wilcox Aquifer [Wilson]	0	0	0	0	21	23
Municipal Water Conservation	DEMAND REDUCTION [Comal]	9	16	34	63	108	168
SSLGC Expanded Brackish Wilcox Groundwater	Carrizo-Wilcox Aquifer [Gonzales]	0	0	135	162	190	213
SSLGC Expanded Carrizo Project	Carrizo-Wilcox Aquifer [Guadalupe]	107	129	162	194	228	255
		116	**360**	**601**	**742**	**906**	**1,061**
Schertz, San Antonio (L)							
CVLGC Carrizo Project	Carrizo-Wilcox Aquifer [Gonzales]	0	2	3	3	4	4
CVLGC Carrizo Project	Carrizo-Wilcox Aquifer [Wilson]	0	3	4	5	5	6
CVLGC Carrizo Project (GW Conversion)	Carrizo-Wilcox Aquifer [Wilson]	0	0	0	0	1	1
Municipal Water Conservation	DEMAND REDUCTION [Comal]	0	0	1	2	3	4
SSLGC Expanded Brackish Wilcox Groundwater	Carrizo-Wilcox Aquifer [Gonzales]	0	0	3	4	5	5
SSLGC Expanded Carrizo Project	Carrizo-Wilcox Aquifer [Guadalupe]	3	3	4	5	6	6
		3	**8**	**15**	**19**	**24**	**26**
Selma, San Antonio (L)							
Municipal Water Conservation	DEMAND REDUCTION [Comal]	0	0	0	1	1	1
		0	**0**	**0**	**1**	**1**	**1**
Water Services, San Antonio (L)							
Local Trinity Aquifer Development	Trinity Aquifer [Bexar]	0	218	217	218	320	403
Municipal Water Conservation	DEMAND REDUCTION [Comal]	10	11	13	25	42	61
		10	**229**	**230**	**243**	**362**	**464**
Wingert Water Systems, Guadalupe (L)							
Drought Management - Wingert Water Systems	DEMAND REDUCTION [Comal]	10	0	0	0	0	0
Local Trinity Aquifer Development	Trinity Aquifer [Comal]	296	296	296	296	296	296

Municipal Water Conservation	DEMAND REDUCTION [Comal]	5	40	86	102	111	119
		311	**336**	**382**	**398**	**407**	**415**
Sum of Projected Water Management Strategies (acre-feet)		**36,887**	**48,133**	**53,873**	**57,496**	**61,001**	**63,748**

KENDALL COUNTY

WUG, Basin (RWPG)

All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
Boerne, San Antonio (L)							
Municipal Water Conservation	DEMAND REDUCTION [Kendall]	139	496	1,009	1,551	1,936	2,352
Reuse - Boerne Non-Potable Reuse	Direct Reuse [Kendall]	750	1,500	1,500	1,500	1,500	1,500
		889	**1,996**	**2,509**	**3,051**	**3,436**	**3,852**
County-Other, Kendall, Guadalupe (L)							
Municipal Water Conservation	DEMAND REDUCTION [Kendall]	0	0	0	0	0	4
		0	**0**	**0**	**0**	**0**	**4**
County-Other, Kendall, San Antonio (L)							
Municipal Water Conservation	DEMAND REDUCTION [Kendall]	0	0	0	0	0	2
		0	**0**	**0**	**0**	**0**	**2**
Fair Oaks Ranch, San Antonio (L)							
Municipal Water Conservation	DEMAND REDUCTION [Kendall]	37	125	246	377	552	723
Reuse - Fair Oaks Ranch Non-Potable Reuse	Direct Reuse [Bexar]	0	251	282	305	325	342
		37	**376**	**528**	**682**	**877**	**1,065**
Guadalupe-Blanco River Authority, Guadalupe (L)							
FE - GBRA Western Canyon Expansion	Canyon Lake/Reservoir [Reservoir]	0	0	0	0	219	200
FE - Hays County Pipeline Project	Canyon Lake/Reservoir [Reservoir]	0	273	647	550	0	0
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	2,326	2,289	2,209	1,872	1,092
GBRA Lower Basin Storage Project	GBRA Lower Basin Off-Channel Lake/Reservoir [Reservoir]	7,435	7,381	7,455	7,441	7,459	7,474
		7,435	**9,980**	**10,391**	**10,200**	**9,550**	**8,766**
Guadalupe-Blanco River Authority, San Antonio (L)							
FE - GBRA Western Canyon Expansion	Canyon Lake/Reservoir [Reservoir]	0	0	0	0	4	4
FE - Hays County Pipeline Project	Canyon Lake/Reservoir [Reservoir]	0	6	14	11	0	0
GBRA - MBWSP - Surface Water w/ASR	Carrizo-Wilcox Aquifer ASR [Gonzales]	0	54	50	45	35	19
GBRA Lower Basin Storage Project	GBRA Lower Basin Off-Channel Lake/Reservoir [Reservoir]	181	172	162	152	141	131
		181	**232**	**226**	**208**	**180**	**154**

Kendall County WCID 1, Guadalupe (L)

Reuse - Kendall County WCID Non-Potable	Direct Reuse [Kendall]	180	180	180	180	180	180
		180	**180**	**180**	**180**	**180**	**180**

Kendall West Utility, San Antonio (L)

Local Trinity Aquifer Development	Trinity Aquifer [Kendall]	0	282	561	902	1,365	1,596
Municipal Water Conservation	DEMAND REDUCTION [Kendall]	0	0	0	0	0	9
		0	**282**	**561**	**902**	**1,365**	**1,605**
Sum of Projected Water Management Strategies (acre-feet)		**8,722**	**13,046**	**14,395**	**15,223**	**15,588**	**15,628**

APPENDIX B – GAM RUN 21-014 MAG

GAM RUN 21-014 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 9

Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-475-1552
December 8, 2022

STATE OF TEXAS
R. GRAYSON DOWLEARN
GEOLOGY
No. 15293
LICENSED
PROFESSIONAL GEOSCIENTIST

12/8/2022

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GAM RUN 21-014 MAG: MODELED AVAILABLE GROUNDWATER FOR THE AQUIFERS IN GROUNDWATER MANAGEMENT AREA 9

Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Section
512-475-1552
December 8, 2022

EXECUTIVE SUMMARY:

Groundwater Management Area (GMA) 9 adopted the desired future conditions for the Hickory and Ellenburger-San Saba aquifers, for the combined Trinity Aquifer and Trinity Group of the Edwards-Trinity (Plateau) Aquifer, and for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer on November 15, 2021. Groundwater Management Area 9 submitted a Desired Future Conditions Explanatory Report (GMA 9 and others, 2021) and other supporting documents to the Texas Water Development Board (TWDB) on December 9, 2021. The TWDB determined that the explanatory report and other materials submitted by the district representatives were administratively complete on November 8, 2022.

Modeled available groundwater estimates are approximately 140 acre-feet per year for the Hickory Aquifer and approximately 60 acre-feet per year for the Ellenburger-San Saba Aquifer for the period between 2020 and 2080. Modeled available groundwater estimates range between a maximum of 90,264 acre-feet per year in 2020 and a minimum of 89,491 acre-feet per year in 2060 for the combination of Trinity Aquifer and Trinity group of the Edwards-Trinity (Plateau) Aquifer within Groundwater Management Area 9. Modeled available groundwater estimates are approximately 2,210 acre-feet per year for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer for the period between 2020 and 2080. Modeled available groundwater estimates are provided in Tables 2 through 10.

Figure 1 provides the groundwater conservation district and county boundaries within Groundwater Management Area 9. Figure 2 provides the county, regional water planning area, and river basin boundaries within Groundwater Management Area 9.

REQUESTOR:

Mr. Ronald Fieseler, General Manager of Blanco Pedernales Groundwater Conservation District and Administrator of Groundwater Management Area 9.

DESCRIPTION OF REQUEST:

Mr. Ronald Fieseler provided the TWDB with the desired future conditions of the aquifers within Groundwater Management Area 9 on behalf of Groundwater Management Area (GMA) 9 in a letter dated December 9, 2021. Groundwater conservation district representatives in Groundwater Management Area 9 adopted desired future conditions for the aquifers within Groundwater Management Area 9 on November 15, 2021, as described in Resolution No. 111521-01 (Appendix D in GMA 9 and others, 2021). Desired future conditions are listed in Table 1 and represent average water level drawdowns across the specified area until the specified ending year.

TABLE 1. DESIRED FUTURE CONDITIONS FOR GROUNDWATER MANAGEMENT AREA 9 EXPRESSED AS AVERAGE DRAWDOWN (ADAPTED FROM SUBMITTED RESOLUTION).

Major or minor aquifer	Desired future condition
Trinity Aquifer and Trinity Group of the Edwards-Trinity (Plateau) Aquifer	Allow for an increase in average drawdown of approximately 30 feet through 2060 (throughout GMA 9) consistent with “Scenario 6” in TWDB GAM Task 10-005
Edwards Group of Edwards-Trinity (Plateau)	Allow for no net increase in average drawdown in Bandera and Kendall counties through 2080
Ellenburger-San Saba	Allow for an increase in average drawdown of no more than 7 feet in Kendall County through 2080
Hickory	Allow for an increase in average drawdown of no more than 7 feet in Kendall County through 2080

Additionally, Groundwater Management Area 9 voted to declare certain aquifers and/or portions of aquifers to be non-relevant for the purposes of joint planning, as shown in Table 2.

TABLE 2. AQUIFERS AND PORTIONS OF AQUIFERS WHICH WERE DECLARED NON-RELEVANT FOR THE PURPOSES OF JOINT PLANNING WITHIN GROUNDWATER MANAGEMENT AREA 9.

Major or minor aquifer	Non-relevant area
Edwards (Balcones Fault Zone) Aquifer	Entire aquifer (Bexar, Comal, Hays, and Travis counties)
Edwards Group of Edwards-Trinity (Plateau) Aquifer	Portion in Blanco and Kerr counties
Ellenburger-San Saba Aquifer	Portion in Blanco and Kerr counties
Hickory Aquifer	Portion in Blanco, Hays, Kerr, and Travis counties
Marble Falls Aquifer	Entire aquifer (Blanco County)

After reviewing the submitted documents, TWDB staff requested clarifications regarding the methodology and assumptions used in the definitions of desired future conditions. Appendix A includes the responses to these clarifications that Groundwater Management Area 9 provided to the TWDB on October 17, 2022.

METHODS:

Hickory and Ellenburger-San Saba Aquifers

The groundwater availability model for the minor aquifers of the Llano Uplift Region of Texas (Version 1.01; Shi and others, 2016a, 2016b) was used to calculate the drawdown and modeled available groundwater for the Hickory and Ellenburger-San Saba aquifers (Llano Uplift aquifers) within Groundwater Management Area 9. The predictive model files used in the evaluation were originally developed by the TWDB in the previous joint planning cycle for GAM Run 16-023 (Jones, 2017). The evaluation in GAM Run 16-023 only went to 2070, so the TWDB extended the model files to 2080 for this evaluation.

Pumping was distributed evenly across the Kendall County portion of the Llano Uplift aquifers and then varied until the desired future condition was achieved within the accepted tolerance defined by Groundwater Management Area 9. Modeled water levels were extracted for December 2010 (initial water levels equivalent to the final stress period of the historically calibrated model) and December 2080 (stress period 70). Drawdown was calculated as the difference in water levels between those two endpoints. Drawdown averages were calculated by aquifer for each area specified in the desired future conditions. The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET USG Version 1.00 (Panday and others, 2013).

Trinity Aquifer and Trinity Group of the Edwards-Trinity (Plateau) Aquifer

The groundwater availability model for the Hill Country Portion of the Trinity Aquifer (Version 2.01; Jones and others, 2011) was used to calculate the drawdown and modeled available groundwater values for the combination of Trinity Aquifer and Trinity Group of the Edwards-Trinity (Plateau) Aquifer within Groundwater Management Area 9. Predictive model files from TWDB GAM Task 10-005 (Hutchison, 2010) were used, as specified by Resolution No. 111521-01 (Appendix D in GMA 9 and others, 2021). GAM Task 10-005 (Hutchison, 2010) ran a predictive pumping scenario ("Scenario 6") under 387 different recharge conditions. For every model run, modeled water levels were extracted for December 2008 (initial water levels) and December 2060 (stress period 50), and drawdown was calculated as the difference in water level between those two endpoints. The drawdown average across Groundwater Management Area 9 was calculated as the average of the 387 scenarios. The TWDB confirmed that the desired future conditions adopted by Groundwater Management Area 9 are achievable using this methodology. The modeled available groundwater values were determined by extracting pumping rates by decade from each model run's results and then averaging the modeled pumping rates from the 387 scenarios using custom Fortran scripts developed by the TWDB for Task 10-005 (Hutchison, 2010).

Edwards Group of the Edwards-Trinity (Plateau) Aquifer

The groundwater availability model for the Hill Country Portion of the Trinity Aquifer (Version 2.01; Jones and others, 2011) was also used to calculate the drawdown and modeled available groundwater for the Edwards Group of the Edwards-Trinity (Plateau) Aquifer within Groundwater Management Area 9. The predictive model files used in the evaluation were originally developed by the TWDB in the previous joint planning cycle for GAM Run 16-023 (Jones, 2017). The evaluation in GAM Run 16-023 only went to 2070, so the TWDB extended these model files to 2080 for this evaluation.

The TWDB created a predictive pumping scenario by copying "Scenario 6" from TWDB Task 10-005 and then varying Edwards Group pumping by a constant multiplier across Bandera and Kendall counties until the desired future condition was achieved within the accepted tolerance defined by Groundwater Management Area 9. The TWDB used these predictive model files to extract modeled water levels from December 1997 (initial water levels equivalent to the final stress period of the historically calibrated model) and December 2080 (stress period 83) and drawdown was calculated as the difference in water level between those two endpoints. The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009).

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:

Hickory and Ellenburger-San Saba aquifers

- Version 1.01 of the groundwater availability model for the minor aquifers of the Llano Uplift Region of Texas was the base model for this analysis. See Shi and others (2016a, 2016b) for assumptions and limitations of the historical calibrated model.
- In the previous joint planning cycle, the TWDB created predictive model files to extend the base model to 2070 for planning purposes. For the current analysis, these model files were extended an additional ten years to 2080 using the same assumptions used in the previous cycle. See GAM Run 16-023 (Jones, 2017) for assumptions and limitations of this predictive model simulation.
- The model has eight layers, which represent the Cretaceous age and younger water-bearing units (Layer 1), Permian and Pennsylvanian age confining units (Layer 2), the Marble Falls Aquifer and equivalent (Layer 3), Mississippian age confining units (Layer 4), the Ellenburger-San Saba Aquifer and equivalent (Layer 5), Cambrian age confining units (Layer 6), the Hickory Aquifer and equivalent (Layer 7), and Precambrian age confining units (Layer 8).
- To be consistent with assumptions made by Groundwater Management Area 9 (see GMA 9 and others, 2021), the TWDB assumed a tolerance of five percent of the drawdown when comparing desired future conditions to modeled drawdown results.

- The model was run with MODFLOW-USG (Panday and others, 2013).
- Drawdown averages and modeled available groundwater volumes were calculated based on the extent of the official TWDB aquifer boundary (Figures 3 and 4). The most recent TWDB model grid file dated August 23, 2022 (*lnup_grid_poly082322.csv*) was used to determine model cell entity assignment (county, groundwater management area, groundwater conservation district, river basin, regional water planning area).
- Drawdowns for cells that became dry during the simulation were excluded from the drawdown averages. Pumping in dry cells was excluded from the modeled available groundwater calculations.
- Estimates of modeled available groundwater from the model simulation were rounded to the nearest whole number.

Trinity Aquifer and Edwards-Trinity (Plateau) Aquifer

- Version 2.01 of the groundwater availability model for the Hill Country Portion of the Trinity Aquifer was the base model for this analysis. See Jones and others (2011) for assumptions and limitations of the historical calibrated model.
- The model has four layers which represent the Edwards Group of the Edwards-Trinity (Plateau) Aquifer (Layer 1), the Upper Trinity hydrostratigraphic unit (Layer 2), the Middle Trinity hydrostratigraphic unit (Layer 3), and the Lower Trinity hydrostratigraphic unit (Layer 4).
- The evaluation of the Trinity Aquifer and the Trinity Group of the Edwards-Trinity (Plateau) Aquifer used predictive model files created by the TWDB that extended the base model to 2060 for planning purposes and represented 387 different potential recharge scenarios. See GAM Task 10-005 (Hutchison, 2010) for the assumptions and limitations of these predictive model simulations.
- The evaluation of the Edwards Group of the Edwards-Trinity (Plateau) Aquifer used predictive model files created by the TWDB during the previous joint planning cycle that extended the base model to 2070 for planning purposes. For the current analysis, the TWDB extended these model files an additional ten years to 2080 using the same assumptions used in the previous cycle. See GAM Run 16-023 (Jones, 2017) for assumptions and limitations of this predictive model simulation.
- Although the base model (Jones and others, 2011) was only calibrated to 1997, the TWDB developed a subsequent steady-state version of the model representing observed conditions in the Trinity Aquifer as of 2008 (Chowdhury, 2010). Since that model provided the initial water levels for the GAM Task 10-005 (Hutchison, 2010) predictive model files, the reference year of 2008 can be used for drawdown calculations for the Trinity Aquifer and the Trinity Group of Edwards-Trinity (Plateau) Aquifer. Since this verification did not apply to the Edwards Group of the Edwards-Trinity (Plateau) Aquifer, the original reference year of 1997 from the base model was used for drawdown calculations in that unit.
- Drawdowns for cells that became dry during the simulation were excluded from the drawdown averages. Pumping volumes are reduced to zero if a cell becomes dry during the predictive model run. The modeled available groundwater values do not include dry cells for decades after the cell becomes dry.

- Drawdown averages and modeled available groundwater volumes were calculated based on the extent of active model cells, not the official TWDB aquifer boundary (Figures 5 and 6). The most recent TWDB model grid file dated August 15, 2022 (*trnt_h_grid_poly081522.csv*) was used to determine model cell entity assignment (county, groundwater management area, groundwater conservation district, river basin, regional water planning area).
- To be consistent with Groundwater Management Area 9's assumptions (see GMA 9 and others, 2021), a tolerance of five percent of the desired future condition drawdown was assumed when comparing desired future conditions to modeled drawdown results.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996)
- Estimates of modeled available groundwater from the model simulation were rounded to the nearest whole number.

RESULTS:

The modeled available groundwater estimates that achieve the desired future conditions adopted by Groundwater Management Area 9 are as follows:

- Hickory Aquifer: 140 acre-feet per year (summarized by county and groundwater conservation district in Table 3 and by county, regional water planning area, and river basin in Table 4).
- Ellenburger-San Saba Aquifer: Approximately 60 acre-feet per year for the that (summarized by county and groundwater conservation district in Table 5 and by county, regional water planning area, and river basin in Table 6).
- Combined Trinity Aquifer and Trinity Group of the Edwards-Trinity (Plateau) Aquifer: Ranges from a maximum of 90,264 acre-feet per year in 2020 and a minimum of 89,491 acre-feet per year in 2060 (summarized by county and groundwater conservation district in Table 7 and by county, regional water planning area, and river basin in Table 8).
- Edwards Group of the Edwards-Trinity (Plateau) Aquifer: 2,210 acre-feet per year (summarized by county and groundwater conservation district in Table 9 and by county, regional water planning area, and river basin in Table 10).

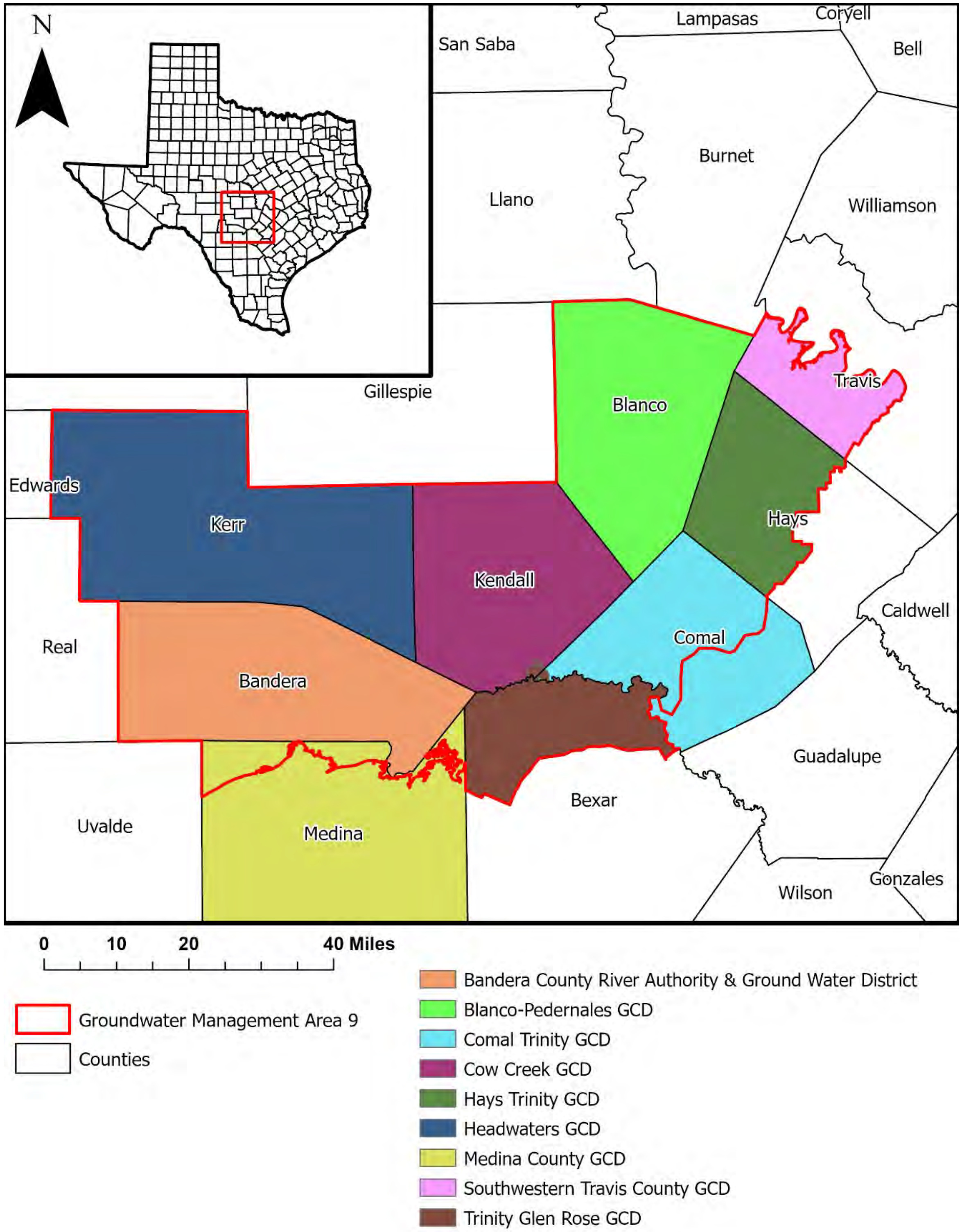

FIGURE 1. MAP SHOWING GROUNDWATER MANAGEMENT AREA 9, GROUNDWATER CONSERVATION DISTRICTS (GCD), AND COUNTY BOUNDARIES.

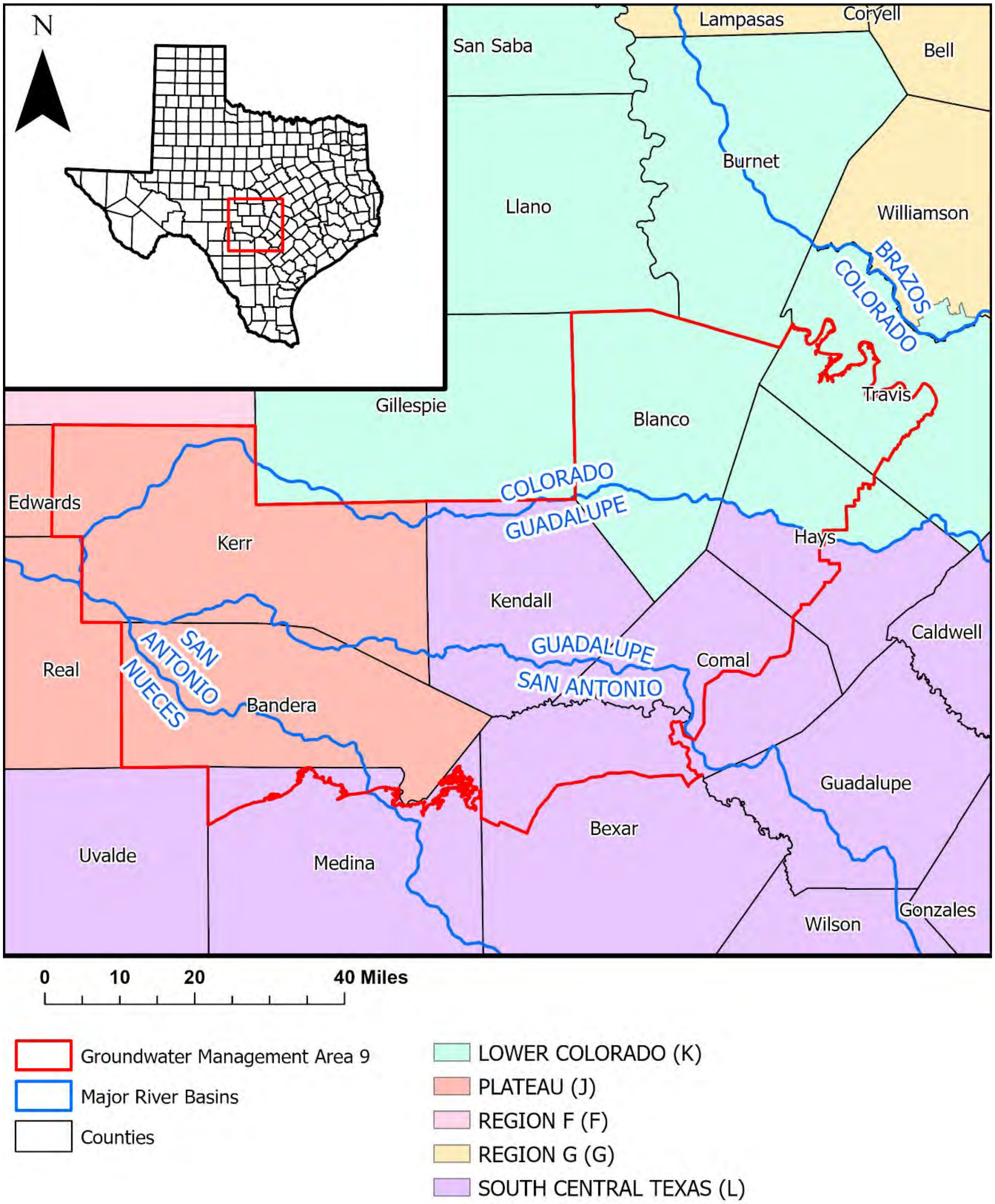

FIGURE 2. MAP SHOWING GROUNDWATER MANAGEMENT AREA 9, REGIONAL WATER PLANNING AREAS, RIVER BASINS, AND COUNTY BOUNDARIES.

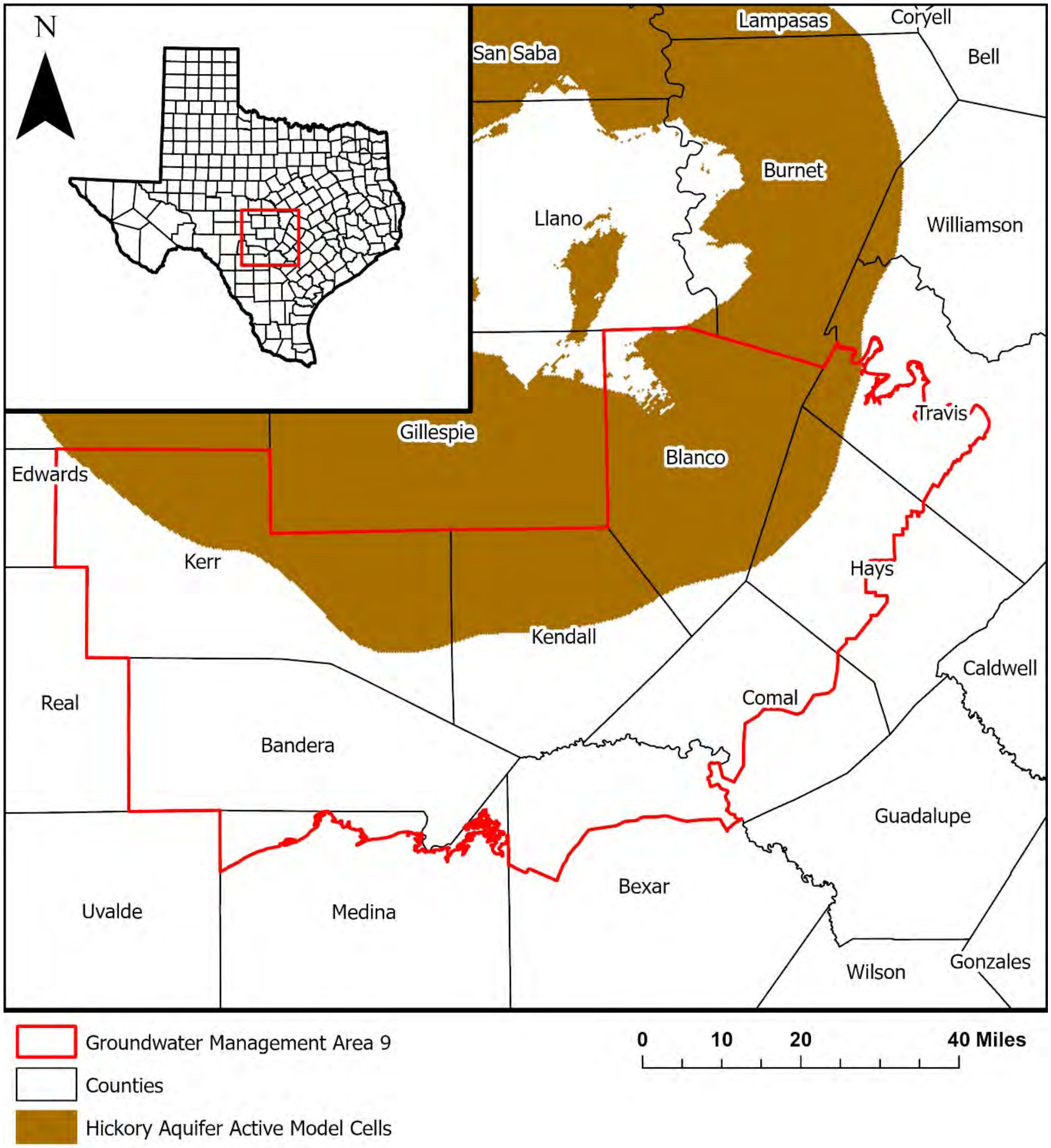

FIGURE 3. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE HICKORY AQUIFER (LAYER 7) IN THE MINOR AQUIFERS OF THE LLANO UPLIFT REGION OF TEXAS GROUNDWATER AVAILABILITY MODEL IN RELATION TO GROUNDWATER MANAGEMENT AREA 9.

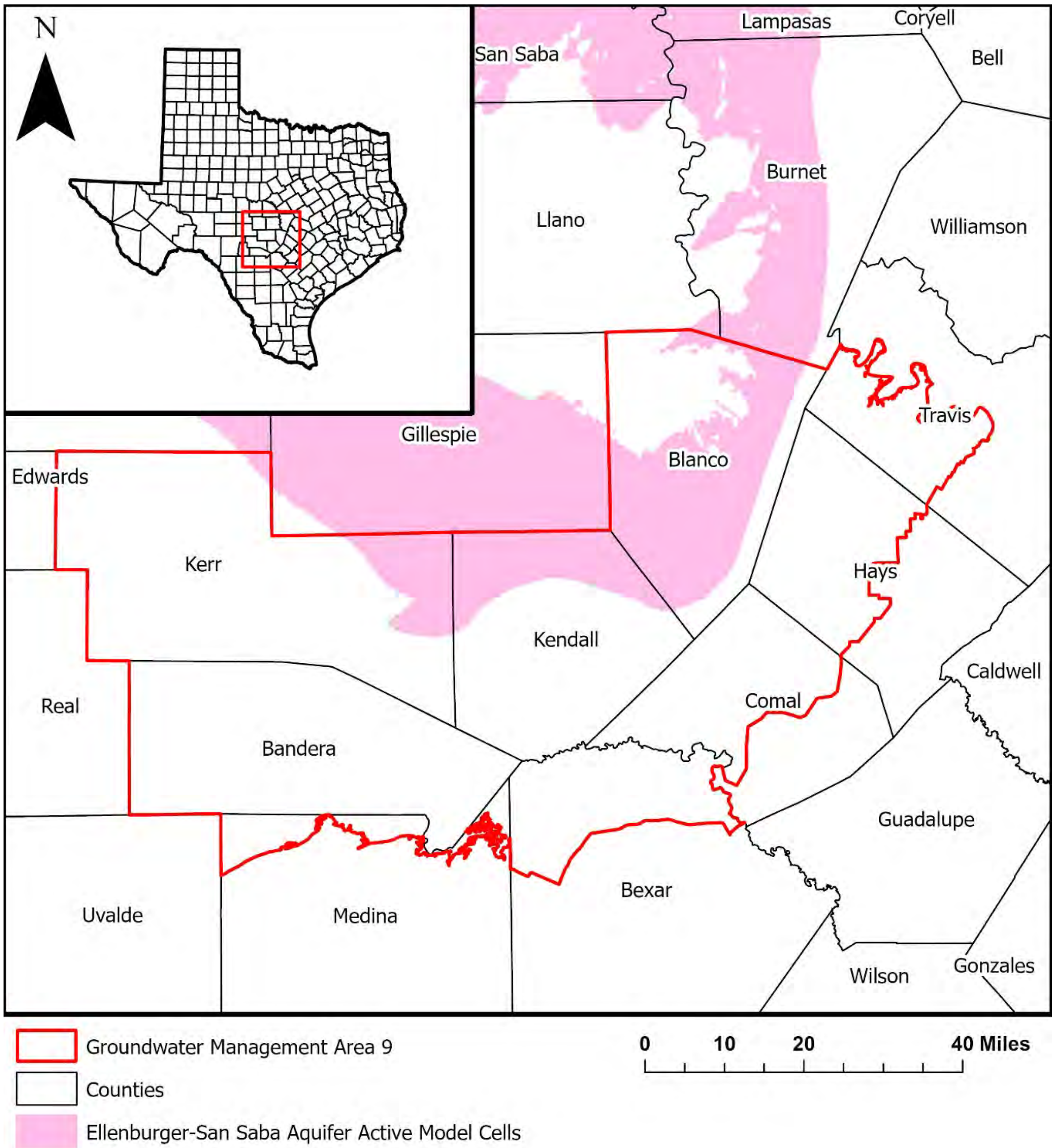

FIGURE 4. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE ELLENBURGER-SAN SABA AQUIFER (LAYER 5) IN THE MINOR AQUIFERS OF THE LLANO UPLIFT REGION OF TEXAS GROUNDWATER AVAILABILITY MODEL IN RELATION TO GROUNDWATER MANAGEMENT AREA 9.

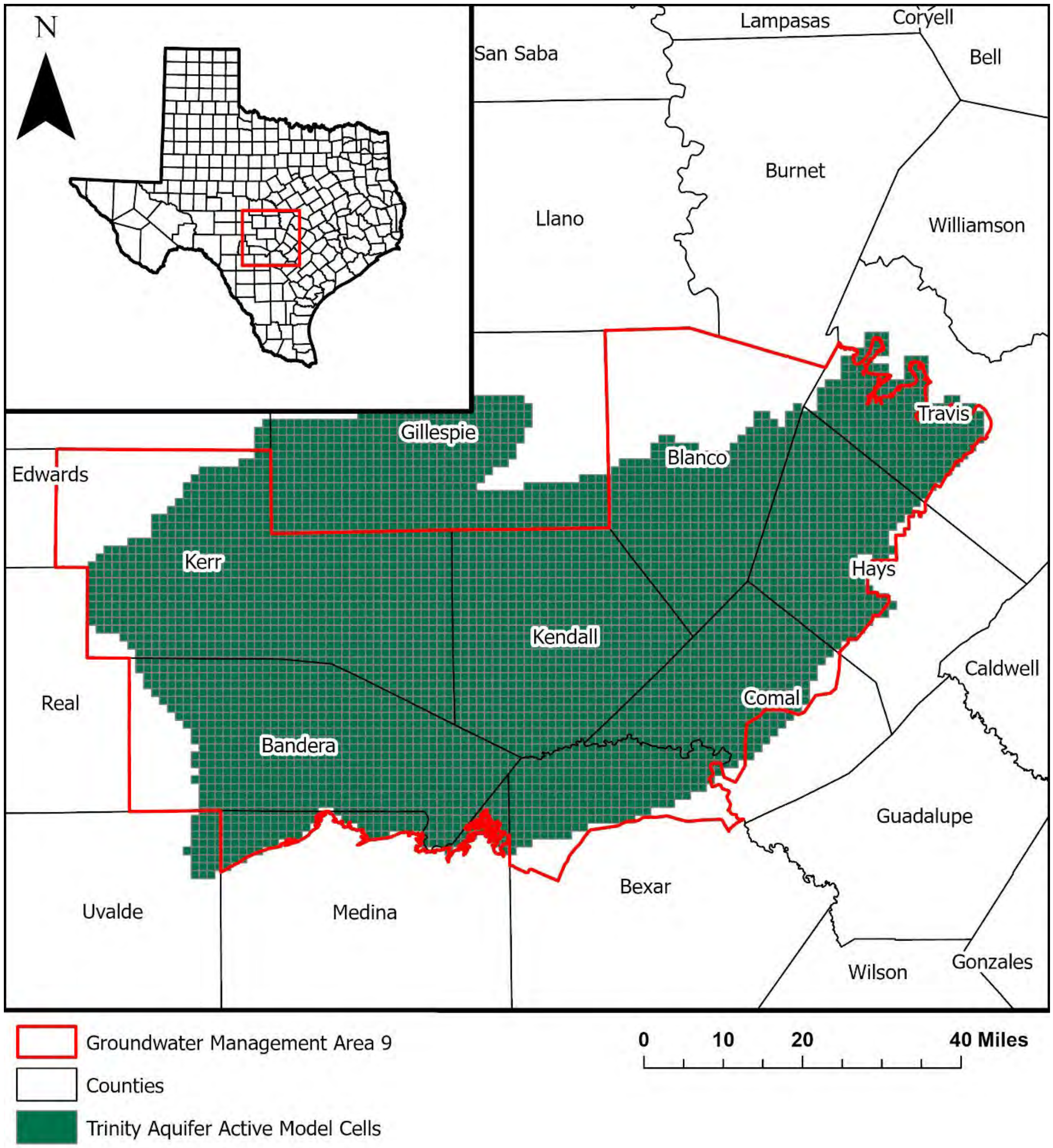

FIGURE 5. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE TRINITY AQUIFER AND TRINITY GROUP OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER (LAYERS 2, 3, AND 4) IN THE HILL COUNTRY PORTION OF THE TRINITY AQUIFER GROUNDWATER AVAILABILITY MODEL IN RELATION TO GROUNDWATER MANAGEMENT AREA 9.

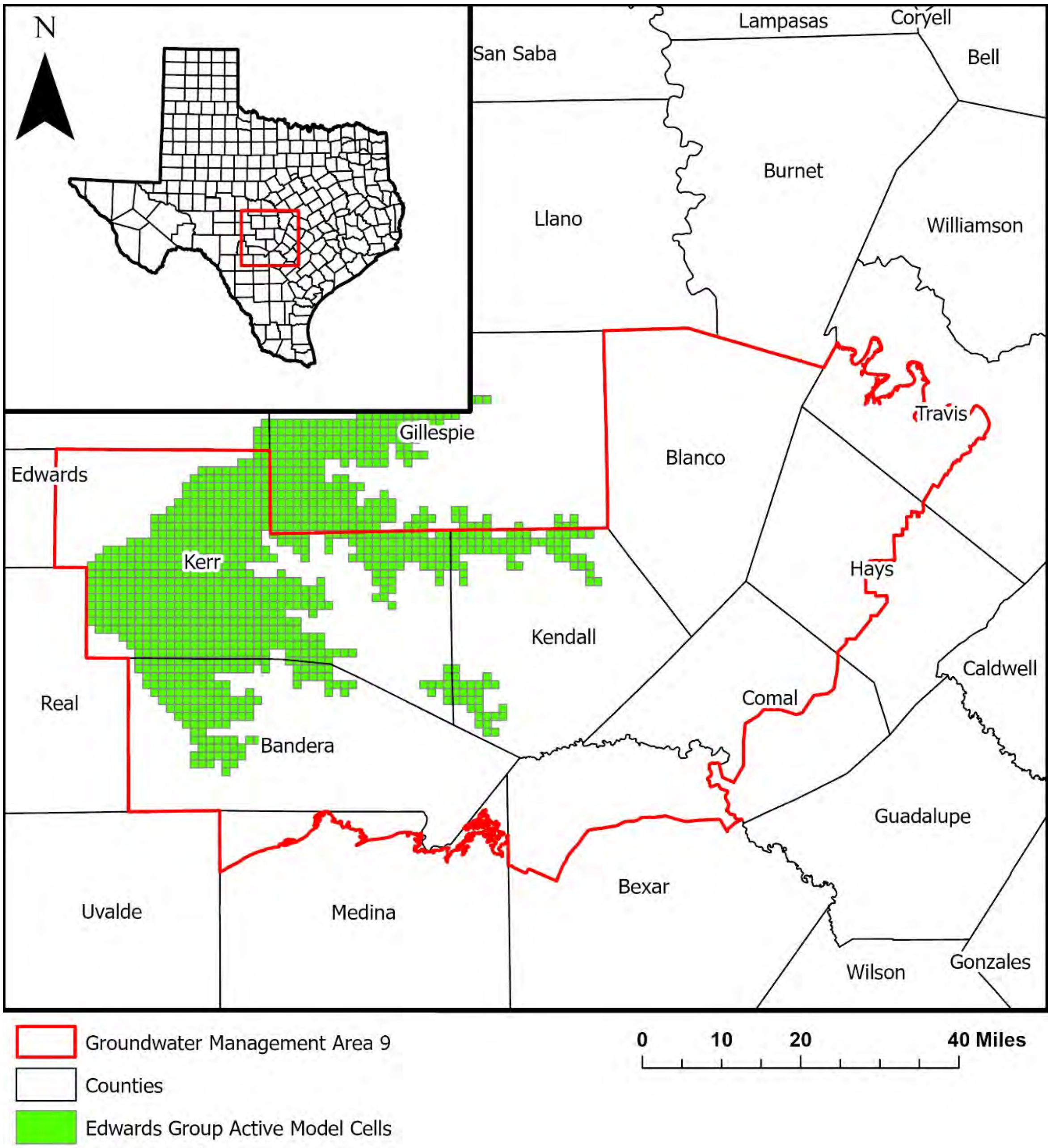

FIGURE 6. MAP SHOWING THE ACTIVE MODEL CELLS REPRESENTING THE EDWARDS GROUP OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER (LAYER 1) IN THE HILL COUNTRY PORTION OF THE TRINITY AQUIFER GROUNDWATER AVAILABILITY MODEL IN RELATION TO GROUNDWATER MANAGEMENT AREA 9.

TABLE 3. **MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 9 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

Groundwater Conservation District (GCD)	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Cow Creek GCD	Kendall	Hickory	141	140	141	140	141	140	141

TABLE 4. **MODELED AVAILABLE GROUNDWATER FOR THE HICKORY AQUIFER IN GROUNDWATER MANAGEMENT AREA 9. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

County	RWPA	Basin	Aquifer	2030	2040	2050	2060	2070	2080
Kendall	L	Colorado	Hickory	12	12	12	12	12	12
Kendall	L	Guadalupe	Hickory	128	128	128	128	128	128
Groundwater Management Area 9 Total			**Hickory**	**140**	**140**	**140**	**140**	**140**	**140**

TABLE 5. **MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 9 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

Groundwater Conservation District (GCD)	County	Aquifer	2020	2030	2040	2050	2060	2070	2080
Cow Creek GCD	Kendall	Ellenberger-San Saba	62	62	62	62	62	62	62

TABLE 6. **MODELED AVAILABLE GROUNDWATER FOR THE ELLENBURGER-SAN SABA AQUIFER IN GROUNDWATER MANAGEMENT AREA 9. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2080. VALUES ARE IN ACRE-FEET PER YEAR.**

County	RWPA	Basin	Aquifer	2030	2040	2050	2060	2070	2080
Kendall	L	Colorado	Ellenberger-San Saba	9	9	9	9	9	9
Kendall	L	Guadalupe	Ellenberger-San Saba	53	54	53	54	53	54
Groundwater Management Area 9 Total			**Ellenberger-San Saba**	**62**	**63**	**62**	**63**	**62**	**63**

TABLE 7. MODELED AVAILABLE GROUNDWATER FOR THE TRINITY AQUIFER AND TRINITY GROUP OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 9 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2020 AND 2060. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2020	2030	2040	2050	2060
Bandera County River Authority & Ground Water District	Bandera	Trinity	7,284	7,284	7,284	7,284	7,284
Blanco-Pedernales GCD	Blanco	Trinity	2,573	2,573	2,573	2,573	2,573
Comal Trinity GCD	Comal	Trinity	9,383	9,383	9,383	9,383	9,383
Cow Creek GCD	Kendall	Trinity	10,622	10,622	10,622	10,622	10,622
Hays Trinity GCD	Hays	Trinity	9,074	9,071	9,070	9,070	9,070
Headwaters GCD	Kerr	Trinity	14,918	14,845	14,556	14,239	14,223
Medina County GCD	Medina	Trinity	2,340	2,340	2,340	2,340	2,340
Southwestern Travis County GCD	Travis	Trinity	8,559	8,542	8,530	8,515	8,485
Trinity Glen Rose GCD	Bexar	Trinity	24,856	24,856	24,856	24,856	24,856
	Comal	Trinity	138	138	138	138	138
	Kendall	Trinity	517	517	517	517	517
Trinity Glen Rose GCD Total		**Trinity**	**25,511**	**25,511**	**25,511**	**25,511**	**25,511**
Groundwater Management Area 9 Total		**Trinity**	**90,264**	**90,171**	**89,869**	**89,537**	**89,491**

TABLE 8 MODELED AVAILABLE GROUNDWATER FOR THE TRINTY AQUIFER AND TRINITY GROUP OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 9. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2060. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	Basin	Aquifer	2030	2040	2050	2060
Bandera	J	Guadalupe	Trinity	76	76	76	76
Bandera	J	Nueces	Trinity	903	903	903	903
Bandera	J	San Antonio	Trinity	6,305	6,305	6,305	6,305
Bexar	L	San Antonio	Trinity	24,856	24,856	24,856	24,856
Blanco	K	Colorado	Trinity	1,322	1,322	1,322	1,322
Blanco	K	Guadalupe	Trinity	1,251	1,251	1,251	1,251
Comal	L	Guadalupe	Trinity	6,252	6,252	6,252	6,252
Comal	L	San Antonio	Trinity	3,269	3,269	3,269	3,269
Hays	K	Colorado	Trinity	4,707	4,706	4,706	4,706
Hays	L	Guadalupe	Trinity	4,364	4,364	4,364	4,364
Kendall	L	Colorado	Trinity	135	135	135	135
Kendall	L	Guadalupe	Trinity	6,028	6,028	6,028	6,028
Kendall	L	San Antonio	Trinity	4,976	4,976	4,976	4,976
Kerr	J	Colorado	Trinity	318	318	318	318
Kerr	J	Guadalupe	Trinity	14,056	13,767	13,450	13,434
Kerr	J	Nueces	Trinity	0	0	0	0
Kerr	J	San Antonio	Trinity	471	471	471	471
Medina	L	Nueces	Trinity	1,575	1,575	1,575	1,575
Medina	L	San Antonio	Trinity	765	765	765	765
Travis	K	Colorado	Trinity	8,542	8,530	8,515	8,485
Groundwater Management Area 9 Total			**Trinity**	**90,171**	**89,869**	**89,537**	**89,491**

TABLE 9 MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS GROUP OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 9 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
Bandera County River Authority & Ground Water District	Bandera	Edwards	2,009	2,009	2,009	2,009	2,009	2,009	2,009
Cow Creek GCD	Kendall	Edwards	200	200	200	200	200	200	200
Groundwater Management Area 9 Total		**Edwards**	**2,209**	**2,209**	**2,209**	**2,209**	**2,209**	**2,209**	**2,209**

TABLE 10 MODELED AVAILABLE GROUNDWATER FOR THE EDWARDS GROUP OF THE EDWARDS-TRINITY (PLATEAU) AQUIFER IN GROUNDWATER MANAGEMENT AREA 9. RESULTS ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), AND RIVER BASIN FOR EACH DECADE FROM 2030 TO 2080. VALUES ARE IN ACRE-FEET PER YEAR.

County	RWPA	Basin	Aquifer	2030	2040	2050	2060	2070	2080
Bandera	J	Guadalupe	Edwards	81	81	81	81	81	81
Bandera	J	Nueces	Edwards	38	38	38	38	38	38
Bandera	J	San Antonio	Edwards	1,890	1,890	1,890	1,890	1,890	1,890
Kendall	L	Colorado	Edwards	69	69	69	69	69	69
Kendall	L	Guadalupe	Edwards	130	130	130	130	130	130
Groundwater Management Area 9 Total			**Edwards**	**2,208**	**2,208**	**2,208**	**2,208**	**2,208**	**2,208**

LIMITATIONS:

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

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

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

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

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

REFERENCES:

Chowdhury, A., 2010, GAM Runs 09-011, 09-012, and 09-24, Predictive simulations for the Edwards-Trinity (Plateau) and Trinity aquifers in Groundwater Management Area 9, 25 p. http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR09-11_09-12_09-24.pdf

Groundwater Management Area 9 Joint Planning Committee, Blanton and Associates, Inc., and Advanced Groundwater Solutions, LLC., 2021, Groundwater Management Area 9 2021 Explanatory Report for Desired Future Conditions for Major and Minor Aquifers, 710 p.

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

Harbaugh, A. W., and McDonald, M. G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference groundwater-water flow model: U.S. Geological Survey Open-File Report 96-485, 56 p.

Hutchison, W.R., 2010, GAM Task 10-005, 27 p. http://www.twdb.texas.gov/groundwater/docs/GAMruns/Task10-005.pdf

Jones, I., 2017, GAM Run 16-023 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9, 26 p. http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR16-023_MAG.pdf

Jones, I., Anaya, R., and Wade, S.C., 2011, Groundwater Availability Model: Hill County Portion of the Trinity Aquifer of Texas. Texas Water Development Board Report 377, 175 p. http://www.twdb.texas.gov/groundwater/models/gam/trnt_h/R377_HillCountryGAM.pdf

National Research Council, 2007, Models in Environmental Regulatory Decision Making Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p., http://www.nap.edu/catalog.php?record_id=11972.

Panday, S., Langevin, C.D., Niswonger, R.G., Ibaraki, M., and Hughes, J.D., 2013, MODFLOW-USG version 1: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation: U.S. Geological Survey Techniques and Methods, book 6, chap. A45, 66p., https://pubs.usgs.gov/tm/06/a45/

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

Shi, J., Boghici, R., Kohlrenken, W., and Hutchison, W.R., 2016a, Conceptual Model Report: Minor Aquifers of the Llano Uplift Region of Texas. Texas Water Development Board Report, 306 p., http://www.twdb.texas.gov/groundwater/models/gam/llano/Llano_Uplift_Conceptual_Model_Report_Final.pdf.

Shi, J., Boghici, R., Kohlrenken, W., and Hutchison, W.R., 2016b, Numerical Model Report: Minor Aquifers of the Llano Uplift Region of Texas (Marble Falls, Ellenburger-San Saba, and Hickory). Texas Water Development Board Report, 435 p., http://www.twdb.texas.gov/groundwater/models/gam/llano/Llano_Uplift_Numerical_Model_Report_Final.pdf.

APPENDIX A: CLARIFICATIONS

Groundwater Management Area 9 Joint Planning Committee

Bandera County River Authority and Groundwater District
Blanco-Pedernales Groundwater Conservation District
Comal Trinity Groundwater Conservation District
Cow Creek Groundwater Conservation District
Hays-Trinity Groundwater Conservation District
Headwaters Groundwater Conservation District
Medina County Groundwater Conservation District
Trinity Glen Rose Groundwater Conservation District
Southwestern Travis County Groundwater Conservation District

Mr. Micah Voulgaris, GMA 9 Planning Committee Chairman P.O. Box 1557 Boerne, Texas 78006

October 17, 2022

Stephen Allen, P.G., Geoscientist
Groundwater Technical Assistance Team
Groundwater Resources
Texas Water Development Board
P. O. Box 13231
1700 North Congress Avenue
Austin, Texas 78711-3231

Re: Acknowledgement of clarifications needed for the Texas Water Development Board to declare the Groundwater Management Area 9 Desired Future Conditions submittal administratively complete

Mr. Allen,

This letter is in response to your email sent to me on Tuesday, October the 11th.

It was the intent of the Groundwater Management Area 9 Joint Planning Committee to adopt Desired Future Conditions that produced drawdown values consistent with the previous two planning cycles.

GMA 9 acknowledges and accepts all ten of the "other clarifications" and the two "optional clarifications" as outlined in the attached document sent by the TWDB.

Please let us know if you need additional information or if further action is required.

Thank you,
Groundwater Management Area 9

Micah Voulgaris
GMA 9 Chairman

Enclosure: *GMA09_Clarifications_v1*

FIGURE A1: PAGE 1 OF CORRESPONDENCE BETWEEN GROUNDWATER MANAGEMENT AREA 9 AND THE TWDB RELATED TO CLARIFIACTIONS (LETTER FROM GROUNDWATER MANAGEMENT AREA 9 ACKNOWLEDGING AND ACCEPTING CLARIFICATIONS)

Critical Clarifications *(need additional files or an update to Legal DFC Resolution)***:**

- None, unless the GMA disagrees with clarifications and assumptions below.

Other Clarifications (*TWDB will only need acknowledgement for administratively complete*)**:**

Trinity Aquifer:

1. Please confirm that the phrase *"average drawdown of approximately 30 feet through 2060 consistent with Scenario 6 in TWDB GAM Task 10-005"* in the DFC Resolution means *"no more than 30 feet of average water level decline in 2060, as compared to 2008 water levels, averaged over all TWDB GAM Task 10-005 Scenario 6 model iterations."*[1] This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and is consistent with the methodology used in the previous planning cycle.
2. Please confirm that the GMA accepts the following assumptions for calculating modeled drawdown: 1) exclude all cells that become dry and 2) use all active model cells even if they do not fall within the official TWDB aquifer boundary. This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and is consistent with the methodology used in the previous planning cycle.
3. As in the previous planning cycle, we will only provide MAG values calculated within the extent of the TWDB Trinity (Hill Country) Aquifer GAM. Since this model does not extend across the entire GMA, these MAG values will not include any pumping that might occur outside the model extent. Please confirm that this methodology is acceptable to the GMA. Otherwise, please contact TWDB to request additional MAG value calculations.

Edwards Group of the Edwards-Trinity (Plateau) Aquifer:

4. Please confirm that the phrase *"no net increase in average drawdown through 2080"* in the DFC Resolution means *"no average water level decline in 2080, as compared to 1997 water levels."*[2] This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and is consistent with the methodology used in the previous planning cycle.
5. Since the GMA did not provide predictive model files, TWDB used the predictive model files *[based on Trinity (Hill Country) Aquifer GAM]* developed by TWDB during the previous planning cycle (see GAM Run 16-023) and extended them to 2080 by assuming the same recharge rates and the same percentage increase in pumping rates as was used in the previous planning cycle. Please confirm that this methodology is acceptable to the GMA.
6. Please confirm that the GMA accepts the following assumptions for calculating modeled drawdown: 1) exclude all cells that become dry and 2) include all active model cells even if they do not fall within the official TWDB aquifer boundary. This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and is consistent with the methodology used in the previous planning cycle.
7. As in the previous planning cycle, we will only provide MAG values calculated within the extent of the TWDB Trinity (Hill Country) Aquifer GAM. Since this model does not extend across the entire GMA, these MAG values will not include any pumping that might occur outside the model extent.

[1] 2008 is the last calibrated water level available from the TWDB GAM Task 10-005 model
[2] 1997 is the last calibrated water level available from the TWDB Trinity (Hill Country) Aquifer GAM

FIGURE A2: PAGE 2 OF CORRESPONDENCE BETWEEN GROUNDWATER MANAGEMENT AREA 9 AND THE TWDB RELATED TO CLARIFIACTIONS (OTHER CLARIFICATIONS NUMBERS 1 TO 7)

Please confirm that this methodology is acceptable to the GMA. Otherwise, please contact TWDB to request additional MAG value calculations.

Ellenburger-San Saba & Hickory Aquifers:

8. Please confirm that the phrase "*average drawdown of no more than 7 feet in Kendall County through 2080*" in the DFC Resolution means "*average water level decline of no more than 7 feet in 2080, as compared to 2010 water levels.*"[3] This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and is consistent with the methodology used in the previous planning cycle.
9. Since the GMA did not provide predictive model files, TWDB used the predictive model files *[based on Llano Uplift GAM]* developed by TWDB during the previous planning cycle (see GAM Run 16-023) and extended them to 2080 by assuming the same recharge rates and the same pumping rates and distribution as was used in the previous planning cycle. Please confirm that this methodology is acceptable to the GMA.
10. Please confirm that the GMA accepts the following assumptions for calculating modeled drawdown: 1) only include active model cells within the official TWDB aquifer boundary. This method produces drawdown values consistent with the DFC values provided in the Explanatory Report and is consistent with the methodology used in the previous planning cycle.

Optional Clarifications *(Clerical corrections to Explanatory Report)*[4]:

Edwards Group of the Edwards-Trinity (Plateau) Aquifer:

– baseline year for DFC incorrectly listed as 2008 rather than 1997 *(see Clarification #4)*

Ellenburger-San Saba & Hickory Aquifers:

– baseline year for DFC incorrectly listed as 2008 rather than 2010 *(see Clarification #8)*

[3] 2010 is the last calibrated water level available from the TWDB Llano Uplift GAM.

[4] Since TWDB considers the legal DFC Resolution documents, rather than the Explanatory Report, as the official definition of DFCs, TWDB does not officially require corrections to the Explanatory Report. However, because the Explanatory Report is often used as a simplified, more-readable summary of the legal DFC Resolution documents, we recommend correcting the Explanatory Report to match the DFC Resolutions to avoid confusion.

FIGURE A3: PAGE 3 OF CORRESPONDENCE BETWEEN GROUNDWATER MANAGEMENT AREA 9 AND THE TWDB RELATED TO CLARIFIACTIONS (OTHER CLARIFICATIONS NUMBERS 8 TO 10 AND OPTIONAL CLARIFICATIONS)

APPENDIX C – GAM RUN 19-025

GAM RUN 19-025: TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Stephen Bond, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-475-1520
October 31, 2019

STATE OF TEXAS
STEPHEN BOND
GEOLOGY
11208
LICENSED
PROFESSIONAL GEOSCIENTIST

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GAM RUN 19-025: TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT GROUNDWATER MANAGEMENT PLAN

Stephen Bond, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-463-5076
October 30, 2019

EXECUTIVE SUMMARY:

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

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

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers; and
3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Trinity Glen Rose Groundwater Conservation District should be adopted by the district on or before October 16, 2020 and submitted to the Executive Administrator of the TWDB on or before November 15, 2020. The current management plan for the Trinity Glen Rose Groundwater Conservation District expires on January 14, 2021.

This report discusses the methods, assumptions, and results from a model run using the groundwater availability model for the Hill Country portion of the Trinity Aquifer System (Jones and others, 2011). This report replaces the results of GAM Run 15-001 (Wade, 2015), as the approach used for analyzing model results has been since refined.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the groundwater availability model mentioned above was used to estimate information for the Trinity Glen Rose Groundwater Conservation District management plan. Water budgets were extracted for the historical model period for the (1981 through 1997) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and net inter-aquifer flow (lower) for the portion of the aquifer located within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Hill Country portion of the Trinity Aquifer System

- We used version 2.01 of the groundwater availability model for the Hill Country portion of the Trinity Aquifer System. See Jones and others (2011) for assumptions and limitations of the groundwater availability model.

- The groundwater availability model includes four layers, representing (from top to bottom):

    1. the Edwards Group of the Edwards-Trinity (Plateau) Aquifer,

    2. the Upper Trinity Aquifer,

    3. the Middle Trinity Aquifer, and

    4. the Lower Trinity Aquifer.

- Layer 1 is not present in the district. An individual water budget for the district was determined for the remaining layers of the Hill Country portion of the Trinity Aquifer System (Layer 2 to Layer 4, collectively).
- The General-Head Boundary (GHB) package of MODFLOW was used to represent flow out of the study area between the Hill Country portion of the Trinity Aquifer and the Edwards (Balcones Fault Zone) Aquifer or the confined parts of the Trinity Aquifer underlying the Edwards (Balcones Fault Zone) Aquifer.
- The groundwater availability model includes some portions of the Edwards Group outside the official boundary of the Edwards-Trinity (Plateau) Aquifer. Though flow for these areas is not explicitly reported, the interaction between the Edwards Group (outside the Edwards-Trinity Plateau Aquifer) and the underlying Trinity Aquifer would be shown in the "flow between aquifers" segment of Table 1, if Layer 1 was present in the district.
- Only the outcrop area of the Hill County portion of the Trinity Aquifer was modeled, and the down-dip extent that underlies the Edwards (Balcones Fault Zone) Aquifer is not included.
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Hill Country potion of the Trinity Aquifer System located within the Trinity Glen Rose Groundwater Conservation District and averaged over the historical calibration periods, as shown in Table 1.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.

4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

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

TABLE 1. SUMMARIZED INFORMATION FOR THE HILL COUNTRY PORTION OF THE TRINITY AQUIFER SYSTEM FOR TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Trinity Aquifer	44,992
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Trinity Aquifer	10,347
Estimated annual volume of flow into the district within each aquifer in the district	Trinity Aquifer	36,079
Estimated annual volume of flow out of the district within each aquifer in the district	Trinity Aquifer	26,417
Estimated net annual volume of flow between each aquifer in the district	From the Trinity Aquifer to the Edwards (Balcones Fault Zone) Aquifer.	39,006

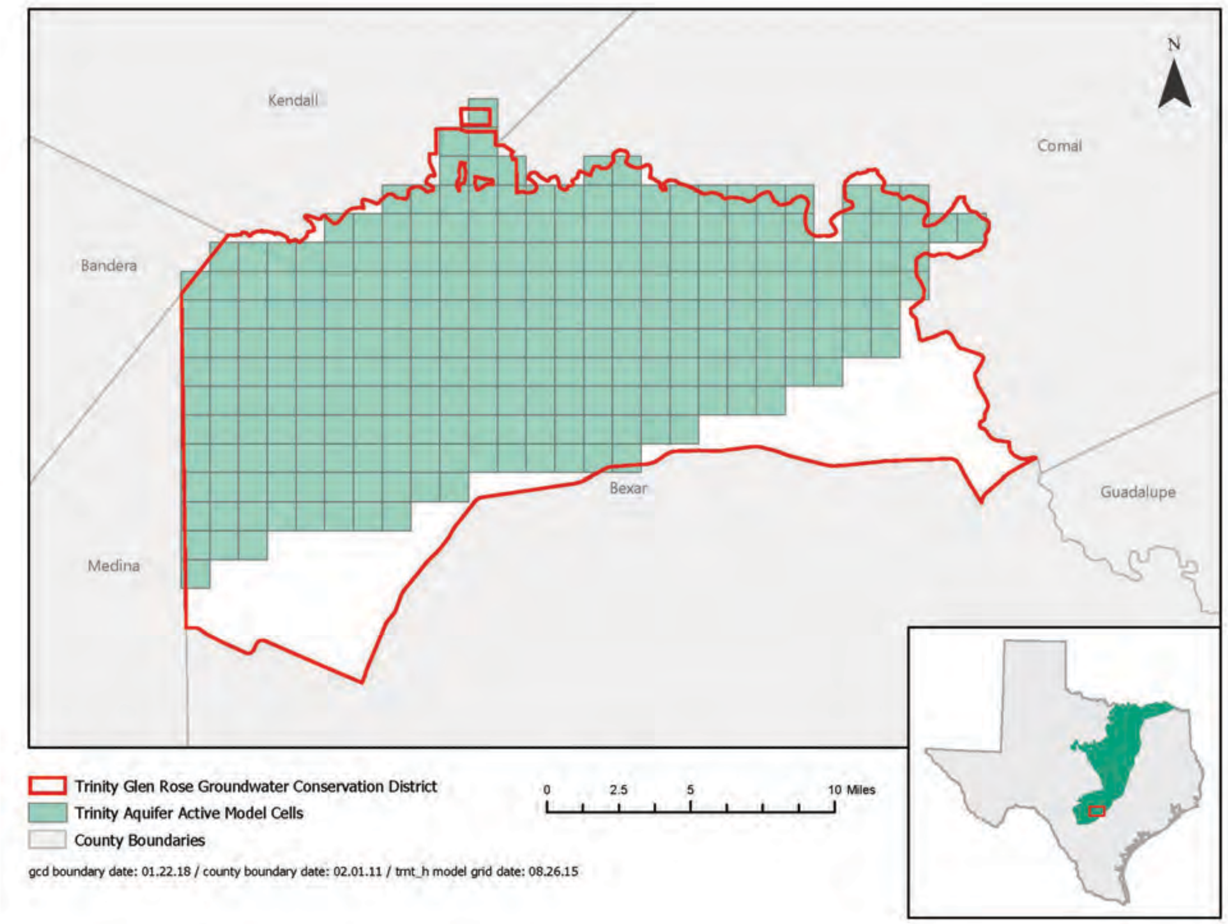

FIGURE 1 AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE HILL COUNTRY PORTION OF THE TRINITY AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE TRINITY AQUIFER EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

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

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

A key aspect of using the groundwater model to evaluate historical groundwater flow conditions includes the assumptions about the location in the aquifer where historical pumping was placed. Understanding the amount and location of historical pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historical 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. Historical precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

REFERENCES:

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

Harbaugh, A. W., and McDonald, M. G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference groundwater-water flow model: U.S. Geological Survey Open-File Report 96-485, 56 p.

Jones, I. C., Anaya, R., and Wade, S. C., 2011, Groundwater availability model: Hill Country portion of the Trinity Aquifer of Texas: Texas Water Development Board Report 377, 165 p.

National Research Council, 2007, Models in Environmental Regulatory Decision Making Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p., http://www.nap.edu/catalog.php?record_id=11972.

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

Wade, S. C., 2015, GAM Run 15-001: Texas Water Development Board, GAM Run 15-001 Report, 9 p., http://www.twdb.texas.gov/groundwater/docs/GAMruns/GR15-001.pdf.

APPENDIX D – ADOPTED GMA 9 DFCS

Groundwater Management Area (GMA) 9
Desired Future Conditions
2021 Joint Planning

Adopted Desired Future Conditions for Relevant Aquifers		
Aquifer	**Desired Future Condition (DFC)**	**Date DFC Adopted**
Edwards Group of the Edwards-Trinity (Plateau)	No net increase in average drawdown in Kendall and Bandera counties through 2080 [no average water level decline in 2080, as compared to 1997 water levels]	11/15/2021
Ellenburger-San Saba	Increase in average drawdown of no more than 7 feet in Kendall County through 2080 [average water level decline of no more than 7 feet in 2080, as compared to 2010 water levels]	11/15/2021
Hickory	Increase in average drawdown of no more than 7 feet in Kendall County through 2080 [average water level decline of no more than 7 feet in 2080, as compared to 2010 water levels]	11/15/2021
Trinity	Increase in average drawdown of approximately 30 feet through 2060 [no more than 30 feet of average water level decline in 2060, as compared to 2008 water levels]	11/15/2021

Non-Relevant Aquifers *		
Aquifer	**Location**	**Justification**
Edwards Group of the Edwards-Trinity (Plateau)	Blanco and Kerr counties	No significant pumping
Ellenburger-San Saba	Blanco and Kerr counties	Minimal current pumping and geological/hydrogeological characteristics limiting pumping impacts on surrounding areas
Hickory	Blanco, Hays, Kerr, and Travis counties	Minimal pumping and geological/hydrogeological characteristics limiting pumping impacts on surrounding areas
Marble Falls	Blanco County	Limited areal extent, minimal pumping, and geological/hydrogeological characteristics limiting pumping impacts on surrounding areas

* Districts in a groundwater management area may, as part of the process for adopting and submitting desired future conditions, propose classification of a portion or portions of a relevant aquifer as non-relevant if the districts determine that aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition (Texas Administrative Code § 356.31(b)). Declaring an aquifer as non-relevant for the purposes of joint planning does not necessarily mean that the aquifer will not be managed by a local groundwater conservation district.

Non-Relevant Aquifers *		
Aquifer	**Location**	**Justification**
Edwards Aquifer (BFZ)	Bexar, Comal, Hays, and Travis counties	Regulatory and management jurisdiction of the Edwards Aquifer Authority and Barton Springs/Edwards Aquifer Conservation District

APPENDIX E –GMA 9 MAGS BY GCD

Groundwater Management Area (GMA) 9
Modeled Available Groundwater for Relevant Aquifers by Groundwater Conservation District (GCD)
2021 Joint Planning

Bandera County River Authority & Ground Water District									
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)						
			2020	2030	2040	2050	2060	2070	2080
Bandera County River Authority & Ground Water District	Trinity	Bandera	7,284	7,284	7,284	7,284	7,284	n/a	n/a
Bandera County River Authority & Ground Water District	Edwards Group of the Edwards-Trinity (Plateau)	Bandera	2,009	2,009	2,009	2,009	2,009	2,009	2,009

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Groundwater Management Area (GMA) 9
Modeled Available Groundwater for Relevant Aquifers by Groundwater Conservation District (GCD)
2021 Joint Planning

Blanco-Pedernales GCD									
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)						
			2020	2030	2040	2050	2060	2070	2080
Blanco-Pedernales GCD	Trinity	Blanco	2,573	2,573	2,573	2,573	2,573	n/a	n/a

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Groundwater Management Area (GMA) 9
Modeled Available Groundwater for Relevant Aquifers by Groundwater Conservation District (GCD)
2021 Joint Planning

Comal Trinity GCD									
GCD	**Aquifer**	**County**	**Modeled Available Groundwater (acre-feet per year)**						
			2020	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Comal Trinity GCD	Trinity	Comal	9,383	9,383	9,383	9,383	9,383	n/a	n/a

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Cow Creek GCD									
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)						
			2020	2030	2040	2050	2060	2070	2080
Cow Creek GCD	Hickory	Kendall	141	140	141	140	141	140	141
Cow Creek GCD	Ellenberger-San Saba	Kendall	62	62	62	62	62	62	62
Cow Creek GCD	Trinity	Kendall	10,622	10,622	10,622	10,622	10,622	n/a	n/a
Cow Creek GCD	Edwards Group of the Edwards-Trinity (Plateau)	Kendall	200	200	200	200	200	200	200

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Hays Trinity GCD									
GCD	**Aquifer**	**County**	**Modeled Available Groundwater (acre-feet per year)**						
			2020	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Hays Trinity GCD	Trinity	Hays	9,074	9,071	9,070	9,070	9,070	n/a	n/a

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Groundwater Management Area (GMA) 9
Modeled Available Groundwater for Relevant Aquifers by Groundwater Conservation District (GCD)
2021 Joint Planning

Headwaters GCD									
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)						
			2020	2030	2040	2050	2060	2070	2080
Headwaters GCD	Trinity	Kerr	14,918	14,845	14,556	14,239	14,223	n/a	n/a

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Medina County GCD									
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)						
			2020	2030	2040	2050	2060	2070	2080
Medina County GCD	Trinity	Medina	2,340	2,340	2,340	2,340	2,340	n/a	n/a

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Southwestern Travis County GCD									
GCD	Aquifer	County	Modeled Available Groundwater (acre-feet per year)						
			2020	2030	2040	2050	2060	2070	2080
Southwestern Travis County GCD	Trinity	Travis	8,559	8,542	8,530	8,515	8,485	n/a	n/a

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

Trinity Glen Rose GCD									
GCD	**Aquifer**	**County**	**Modeled Available Groundwater (acre-feet per year)**						
			2020	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Trinity Glen Rose GCD	Trinity	Bexar	24,856	24,856	24,856	24,856	24,856	n/a	n/a
Trinity Glen Rose GCD	Trinity	Comal	138	138	138	138	138	n/a	n/a
Trinity Glen Rose GCD	Trinity	Kendall	517	517	517	517	517	n/a	n/a
Trinity Glen Rose GCD Totals									
		Trinity Aquifer	**25,511**	**25,511**	**25,511**	**25,511**	**25,511**	**n/a**	**n/a**

Values from GAM Run 21-014 MAG: Modeled Available Groundwater for the Aquifers in Groundwater Management Area 9.

APPENDIX F – ABBREVIATIONS & ACRONYMS

- **District or TGR**– Trinity Glen Rose Groundwater Conservation District
- **DFC** – desired future conditions
- **GAM** – groundwater availability model
- **GBRA** – Guadalupe Blanco River Authority
- **GCD** – groundwater conservation district
- **GMA** – groundwater management area
- **MAG** – modeled available groundwater
- **PGMA** – priority groundwater management area
- **Region L** – South Central Texas Regional Water Planning Group
- **RWPG** – regional water planning group
- **SAWS** – San Antonio Water Systems
- **TCEQ** – Texas Commission on Environmental Quality
- **TWDB** – Texas Water Development Board
- **WUG** – water user group

APPENDIX G – CERTIFIED COPY OF ADOPTED RESOLUTION

STATE OF TEXAS §
§ **RESOLUTION #110625-01**
COUNTY OF BEXAR §

**A RESOLUTION OF THE
TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT
ADOPTING ITS UPDATED MANAGEMENT PLAN FOR SUBMITTAL
TO THE TEXAS WATER DEVOLOPMENT BOARD**

WHEREAS, the Trinity Glen Rose Groundwater Conservation District ("District") is charged by the Texas Legislature with providing for the conservation, preservation, protection, and prevention of waste of groundwater, and of groundwater resources in parts of Bexar, Kendall, and Comal counties, Texas, under §36.0015, Texas Water Code and Chapter 8870 of the Texas Special District Local Laws Code;

WHEREAS, the District is authorized to make and enforce fair and impartial rules to manage groundwater resources as scientifically necessary to conserve and protect groundwater resources in the area under §36.101, Tex. Water Code; and

WHEREAS, pursuant to §§36.1071 and 36.1072, Tex. Water Code, following notice and hearing, the District developed a comprehensive management plan that addresses the required management goals, as applicable, and shall submit the updated Management Plan to the Texas Water Development Board as provided under §§36.1071, 36.1072, and 36.1073 Tex. Water Code.

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT THAT

> the District readopts the Trinity Glen Rose Groundwater Conservation District's updated Management Plan and submits it to the Texas Water Development Board for review and approval. The Board delegates authority to the District's General Manager to make revisions to the readopted Management Plan, for non-substantive revisions and as requested by the Texas Water Development Board for its approval.

PASSED AND APPROVED, with 5 ayes, and 0 nayes, this the 6TH day of NOVEMBER, 2025

TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT

SIGNED AND SEALED the 6TH day of November, 2025.

Joseph duMenil, President

ATTESTED BY:

Stuart Birnbaum, Vice President

TRINITY GLEN ROSE GROUNDWATER CONSERVATION DISTRICT