Texas Water Development Board

Technical Note 15-05

Groundwater Availability in Texas: Comparing Estimates from the 2012 State Water Plan and Desired Future Conditions

by

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Glossary

Acre-foot

Volume of water needed to cover one acre to a depth of one foot. It equals 325,851 gallons (TWDB, 2012).

Aquifer

Geologic formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs. The formation could be sand, gravel, limestone, sandstone, or fractured igneous rocks (TWDB, 2012).

Brackish water

Water with total dissolved solids between 1,000 and 10,000 milligrams per liter (TWDB, 2012).

Demand

Quantity of water projected to meet the overall necessities of a water user group in a specific future year (TWDB, 2012).

Desired future condition

A policy goal, or target, for the condition of a groundwater resource in approximately 50 years.

Existing groundwater supply

Maximum amount of groundwater available from existing sources for use during drought of record conditions that is physically, through existing infrastructure, and legally available for use (TWDB, 2012).

Groundwater availability

Amount of water from an aquifer that is available for use, as defined by groundwater management goals, rules, and policies (Mace and Davidson, 2007).

Groundwater availability model

Numerical groundwater flow models used by the Texas Water Development Board to determine groundwater availability of the major and minor aquifers in Texas (TWDB, 2012).

Groundwater conservation district

Local entity with the authority to manage groundwater. Districts are authorized by Chapter 36 of the Texas Water Code to conserve, preserve, protect, recharge, and prevent the waste of groundwater and to control subsidence caused by withdrawal of groundwater.

Groundwater management area

Area designated and delineated by the Texas Water Development Board as an area suitable for management of groundwater resources (TWDB, 2012). Senate Bill 2, passed in 2001, required TWDB to designate groundwater management areas covering all of the major and minor aquifers of the state. The TWDB has delineated 16 such areas based on major aquifer and political boundaries, typically county lines.

Groundwater strategy supply

Water volumes produced by implementation of water plan strategies as well as predicted volumes associated with future implementation of plan strategies (TWDB, 2012).

Groundwater use

Total amount of groundwater used within a geographic area in a given year as reported by municipal water systems and industrial facilities as part of the Texas Water Development Board's annual water use survey and as estimated through water-related metrics for livestock, irrigation, and some mining uses. Groundwater used within a geographic area may have been pumped outside of the area.

Infrastructure

Physical means for meeting water and wastewater needs, such as dams, wells, conveyance systems, and water treatment plants (TWDB, 2012).

Modeled available groundwater

The total amount of groundwater, including both permitted and exempt uses, that can be produced from the aquifer in an average year that achieves the desired future condition for the aquifer (TWDB, 2012).

Needs

Projected water demands in excess of existing water supplies for a water user group or a wholesale water provider (TWDB, 2012).

Planning group

Team of regional and local leaders of different backgrounds and various social, environmental, and economic interests responsible for developing and adopting a regional water plan for the planning area at five-year intervals (TWDB, 2012).

Recommended groundwater management strategy

Specific project or action to increase groundwater supply or maximize existing supply to meet a specific need (TWDB, 2012).

Total groundwater supply

The combination of existing groundwater supply volumes and groundwater supply volumes generated through the implementation of recommended groundwater management strategies from the 2012 State Water Plan. These quantities represent the total groundwater supply volumes that will be available if the 2012 State Water Plan is fully implemented.

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Executive Summary

Groundwater availability is the amount of groundwater available for use as defined by policy decisions on how to manage groundwater production and the physical ability of an aquifer to give up water. Before the 79th Texas Legislature passed House Bill 1763 in 2005, groundwater availability defined by groundwater conservation districts (termed “total usable amount of groundwater” at that time) could not disallow the implementation of the state water plan. In other words, groundwater availability defined by groundwater conservation districts had to be at least the current use of the aquifer plus the planned future use of the aquifer as reflected in the state water plan.

House Bill 1763 introduced the terms “desired future conditions” (the policy decision by groundwater conservation districts in groundwater management areas that governs groundwater availability) and “managed available groundwater” (now “modeled available groundwater”: the amount of groundwater that the executive administrator of the Texas Water Development Board determines may be produced on an average annual basis to achieve a desired future condition) and required regional water planning groups, and thus the state water plan, to use the district-derived numbers. In other words, after the passage of House Bill 1763 in 2005, when desired future conditions were adopted regional water planning groups had to use groundwater availability defined by groundwater conservation districts, and districts no longer had to honor the implementation of the state water plan.

Groundwater conservation districts only defined a few desired future conditions in time for those conditions to be included in the 2012 State Water Plan. Therefore, regional water planning groups continued to define most groundwater availabilities for the state’s aquifers on their own. However, with all desired future conditions now adopted, the current round of regional water planning is using groundwater availability numbers based on the districts’ desired future conditions.

This report will compare district-defined groundwater availability with the previous, regional water planning group-defined groundwater availability. A key aim of this report is to determine

the extent of differences between groundwater availability and total existing and future groundwater supply volumes from the 2011 regional water plans and the modeled available groundwater volumes generated through the desired future conditions process. Our comparison is restricted to those aquifers or parts of aquifers where regional water planning groups and groundwater conservation districts independently defined groundwater availability.

In 2020 statewide, the groundwater availability defined by regional water planning groups is 11.68 million acre-feet per year while the groundwater availability defined by groundwater conservation districts is 11.18 million acre-feet per year, about 4.4 percent lower (all percent differences compare district-defined availability to regional water planning group-defined availability). By 2060, groundwater availability defined by regional water planning groups is 9.43 million acre-feet per year while the groundwater availability defined by groundwater conservation districts is 9.15 million acre-feet per year, about three percent lower.

When comparing only the state's major aquifers for 2020,[1] groundwater availability defined by regional water planning groups is 9.61 million acre-feet per year while the groundwater availability defined by groundwater conservation districts is 9.59 million acre-feet per year, a difference of less than one percent. The only aquifers with differences in volumes of greater than 100,000 acre-feet are the combined Pecos Valley and Edwards-Trinity (Plateau)[2] and the Carrizo-Wilcox Aquifer. For the Pecos Valley and Edwards-Trinity (Plateau) aquifer combination, groundwater availability defined by the groundwater conservation districts is higher by 170,373 acre-feet. In the case of the Carrizo-Wilcox Aquifer, groundwater availability defined by the regional water planning group is higher by 125,654 acre-feet.

When compared by county for 2020, groundwater availabilities defined by the groundwater conservation districts were lower than those defined by the regional water planning groups in 97 of the 240 counties where we could make comparisons (we considered any difference less than 1,000 acre-feet as negligible; 69 counties fell into this category). The combined volume by which groundwater availabilities defined by groundwater conservation districts fell short of availabilities defined by regional water planning groups in these counties is 2,036,528 acre-feet. In 74 counties, mostly located in the northern Panhandle, Far West Texas, and near the Gulf Coast, groundwater availabilities defined by the groundwater conservation districts were higher

[1] The Edwards (Balcones Fault Zone) Aquifer is not included within the groundwater availability analysis of the state's major aquifers because multiple sections of the aquifer contain different groundwater conservation district-defined groundwater availability volumes depending on drought conditions. The Edwards (Balcones Fault Zone) Aquifer is analyzed separately in the *Groundwater Availability* section of this report.

[2] At the time that we conducted this analysis, volumes for these two aquifers were combined in the state water planning database in some cases and therefore unique volumes could not be calculated for each aquifer. As a result, combined volumes for the two aquifers are presented throughout this paper. However, volumes associated with the individual aquifers are available in the modeled available groundwater reports.

than those defined by the regional water planning groups by a total volume of 1,536,094 acre-feet.

Although groundwater availability defined by groundwater conservation districts is lower than groundwater availability defined by regional water planning groups, district-defined availability will not necessarily impact the implementation of the 2012 State Water Plan projects. For that to occur, district-defined groundwater availability has to be lower than the sum of existing and new supplies of groundwater as defined in the plan, what we refer to here as *total groundwater supplies*. On a statewide basis in 2020,[3] groundwater availability defined by groundwater conservation districts (11.18 million acre-feet per year) is 55 percent higher than total groundwater supplies in the regional water plans (7.19 million acre-feet per year). In 2060, groundwater availability defined by groundwater conservation districts (9.15 million acre-feet per year) is 52 percent higher than total groundwater supplies in the regional water plans (6.01 million acre-feet per year).

When comparing only the state's major aquifers for 2020, the groundwater availability defined by groundwater conservation districts is 9.94 million acre-feet per year while total groundwater supplies in the regional water plans are 6.75 million acre-feet per year, about 47 percent lower. For all major aquifers, groundwater availability defined by groundwater conservation districts exceeds total groundwater supplies. The smallest differential occurs in the Edwards (Balcones Fault Zone) Aquifer (roughly 500 acre-feet per year) while the largest occurs in the Ogallala and Rita Blanca aquifer combination (just more than 2 million acre-feet per year).

When compared by county for 2020, groundwater availabilities defined by the groundwater conservation districts were lower than total groundwater supplies in 36 of the 240 counties where we could make comparisons, most of which are located in western Texas or along the Gulf Coast (we considered any difference less than 1,000 acre-feet as negligible; 41 counties fell into this category). The combined volume by which groundwater availabilities defined by groundwater conservation districts fell short of total groundwater supplies defined by regional water planning groups in these counties is 892,031 acre-feet. This volume represents the statewide total amount by which groundwater availabilities defined by groundwater conservation districts limit the implementation of the 2012 State Water Plan. In 163 counties, groundwater availabilities defined by the groundwater conservation districts were higher than total groundwater supplies defined by the regional water planning groups by a total volume of 5,009,337 acre-feet.

[3] Note that aggregating volumes to the statewide level may obscure both positive and negative local variations such as differences by county. These localized differences can be observed using the maps provided in Appendix A.

Regional water planning groups are required to use groundwater availability where and when defined by groundwater conservation districts, thus minimizing future differences. However, groundwater availability (desired future conditions and modeled available groundwater) has to be revisited and may be updated at least every five years. Updates may include changes in policy goals, improvements to the groundwater availability models, or both. Therefore, there may be times when the state water plan is out of sync with more recent decisions by groundwater conservation districts on groundwater availability. Ultimately, it's the local rules and regulations and how they reflect the desired future condition and modeled available groundwater that control whether or not a project receives a permit or whether the water volume of a permit may be pumped, regardless of what is in the state water plan.

Introduction

The population of Texas is expected to increase between 2010 and 2060, growing roughly 82 percent from 25.4 million to 46.3 million people (TWDB, 2012). As the state's population grows, so does its demand for water. However, Texas' water resources and current water supply infrastructure are limited, especially during times of drought. The drought of the 1950s, the most significant in the state's recorded history, led Texas to begin planning for its future water needs by creating the Texas Water Development Board (TWDB) in 1957. Since that time, the TWDB and its predecessor agency, The Texas Board of Water Engineers, have adopted and published nine state water plans (1961, 1968, 1984, 1990, 1992, 1997, 2002, 2007, and 2012).

Prior to 1997, the TWDB developed water plans at the statewide level. However, in 1997, the 75th Texas Legislature passed Senate Bill 1,[4] which instituted regional water planning as the new structure for assessing and planning for the state's water needs. The TWDB was charged with designating 16 regional water planning areas (Figure 1), which are now responsible for assessing water supply and demand over a 50-year planning period and for recommending strategies to meet projected needs.[5] As part of this assessment, the regional water planning groups are required to consider groundwater availability for aquifers.

[4] Senate Bill 1 (1997) is codified in sections 44 and 201 of the Texas Agricultural Code; sections 791 and 2155 of the Texas Government Code; Section 341 of the Texas Health and Safety Code; Section 401 of the Texas Local Government Code; sections 11 and 151 of the Texas Tax Code; and sections 5, 11, 13, 15, 16, 17, 26, 35, 36, 49, and 51 of the Texas Water Code.

[5] Water supply is based on a repeat of the drought of record. Demand projections are based on dry year demands.

Under Senate Bill 1, regional water planning groups used a variety of methods, data, and tools to define and estimate groundwater availability. Groundwater conservation districts[6] were able to define and report their own groundwater availability estimates in their management plans so long as these volumes allowed for the implementation of the state water plan. Thus, as long as groundwater conservation district estimates of groundwater availability did not conflict with those of the associated regional water planning groups, either entity could use reasonable methodology to arrive at its estimate of groundwater availability.

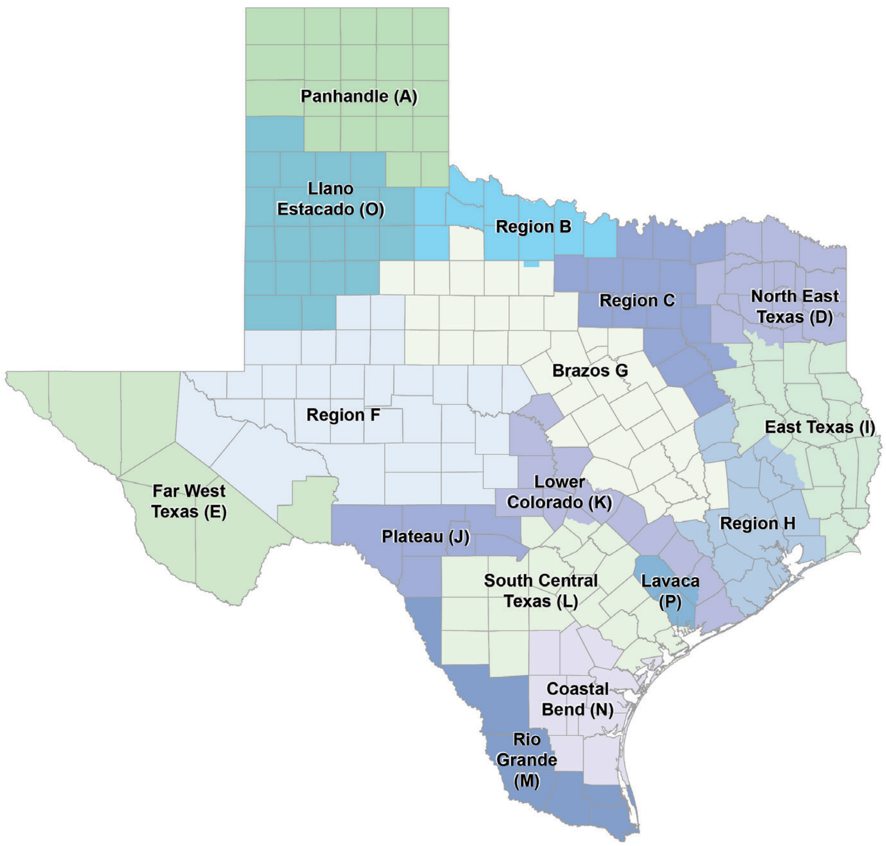

Figure 1: Location of the 16 regional water planning areas in Texas (TWDB, 2012).

[6] A groundwater conservation district is a local entity with the authority to manage groundwater by regulating the spacing of water wells, production of water wells, or both. Districts are subject to powers and duties granted by Chapter 36 of the Texas Water Code and their enabling legislation, as well as any subsequent modifications (if applicable), in order to conserve, preserve, protect, recharge, and prevent the waste of groundwater, and control subsidence caused by withdrawal of groundwater. The Texas Legislature first authorized the creation of groundwater conservation districts through the Groundwater Conservation District Act of 1949, and the first district was created through a petition in 1951. Current methods of district creation include petitions by landowners to the Texas Commission on Environmental Quality, Texas Commission on Environmental Quality initiated districts within Priority Groundwater Management Areas, Special Law, or annexation of territory to an existing district. Today, the majority of districts are created by Special Law.

Due to the passage of House Bill 1763 in 2005 by the 79th Texas Legislature,[7] groundwater conservation districts (Figure 2) now have the responsibility of defining groundwater availability used in regional and state water plans. House Bill 1763 requires all groundwater conservation districts located within the same groundwater management area to conduct joint planning. The joint groundwater planning process stipulates that these districts must, amongst other responsibilities, adopt new or amend existing desired future conditions for each relevant aquifer in the area. These desired future conditions are statements articulating a policy goal for the condition of a groundwater resource in approximately 50 years. Groundwater management areas submit the desired future conditions voted upon through the joint planning process to the TWDB, and the TWDB uses groundwater availability models, water budget calculations, and/or district-provided data to determine modeled available groundwater volumes for each aquifer. The modeled available groundwater volume is the total amount of groundwater, including both permitted and exempt uses, that can be produced from the aquifer in an average year that will achieve the desired future condition specified for that aquifer. Thus, in essence, the groundwater conservation districts work together to determine and meet goals for the future condition of aquifers or segments of aquifers within their groundwater management areas, and the TWDB estimates how much groundwater is available for use in an average year based on those goals.

The TWDB provides the modeled available groundwater volumes estimated via the joint planning process to the groundwater conservation districts and regional water planning groups. The districts are required to include these estimates in their management plans, and the regional water planning groups in turn incorporate these estimates into their regional water plans as groundwater availability volumes. The 16 regional water planning groups then submit their plans to the TWDB and the TWDB compiles them into a state water plan. These regional and state plans are updated every five years, with the most recent state water plan published in 2012.

[7] House Bill 1763 (2005) is codified in sections 16 and 36 of the Texas Water Code.

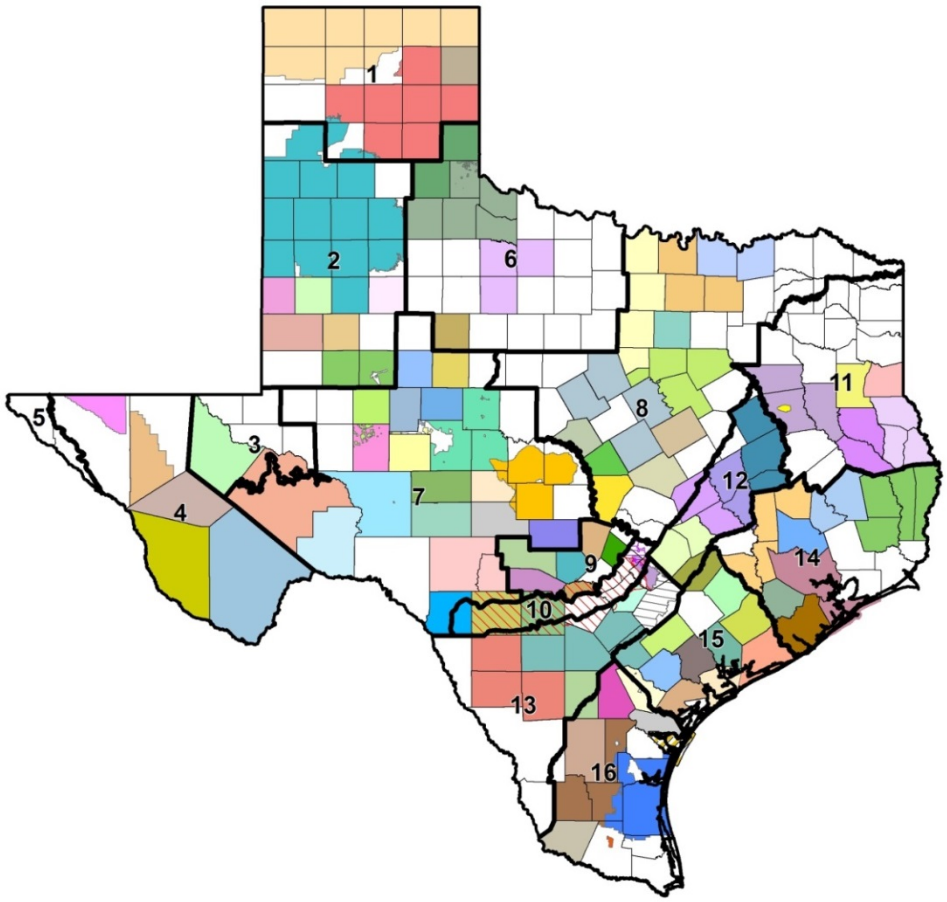

Figure 2: Location of the 16 groundwater management areas, 100 groundwater conservation districts, and two subsidence districts[8] in Texas.

The purpose of this report is to present the groundwater availabilities and supplies that the regional water planning groups provided for the 2012 State Water Plan, to describe how the numbers were estimated, and to compare the 2011 regional water planning numbers to modeled available groundwater volumes determined from desired future conditions. This paper is an update of previous papers published in 2002 and 2007 by the Gulf Coast Association of Geological Societies and Gulf Coast Section of the Society for Sedimentary Geology (Mace and others, 2002; Mace and Davidson, 2007).

[8] The Harris-Galveston Subsidence District and the Fort Bend Subsidence District, covering Harris, Galveston, and Fort Bend counties, are special purpose districts created by the Texas Legislature in 1975 and 1989, respectively, in order to regulate groundwater withdrawals to prevent land subsidence. While the subsidence districts are not subject to Texas Water Code Chapter 36, and therefore the joint planning process, they do regulate groundwater within their counties and they have actively participated in joint planning efforts along with groundwater conservation districts within Groundwater Management Area 14.

Where is the Water?

The TWDB recognizes 30 major and minor aquifers in Texas based on the quantity of water supplied by each aquifer (George and others, 2011; TWDB, 2002, 2007, 2012). Major aquifers cover large geographic areas and produce large amounts of water (Figure 3). Minor aquifers are either aquifers that cover large geographic areas and produce small amounts of water or aquifers that cover small geographic areas and produce large amounts of water (Figure 4). Concise summaries for each of the 30 aquifers, including location maps and lists of aquifer properties and characteristics, are provided in the 2007 State Water Plan. For more detailed information regarding the state's aquifers, refer to TWDB Report 380: Aquifers of Texas.

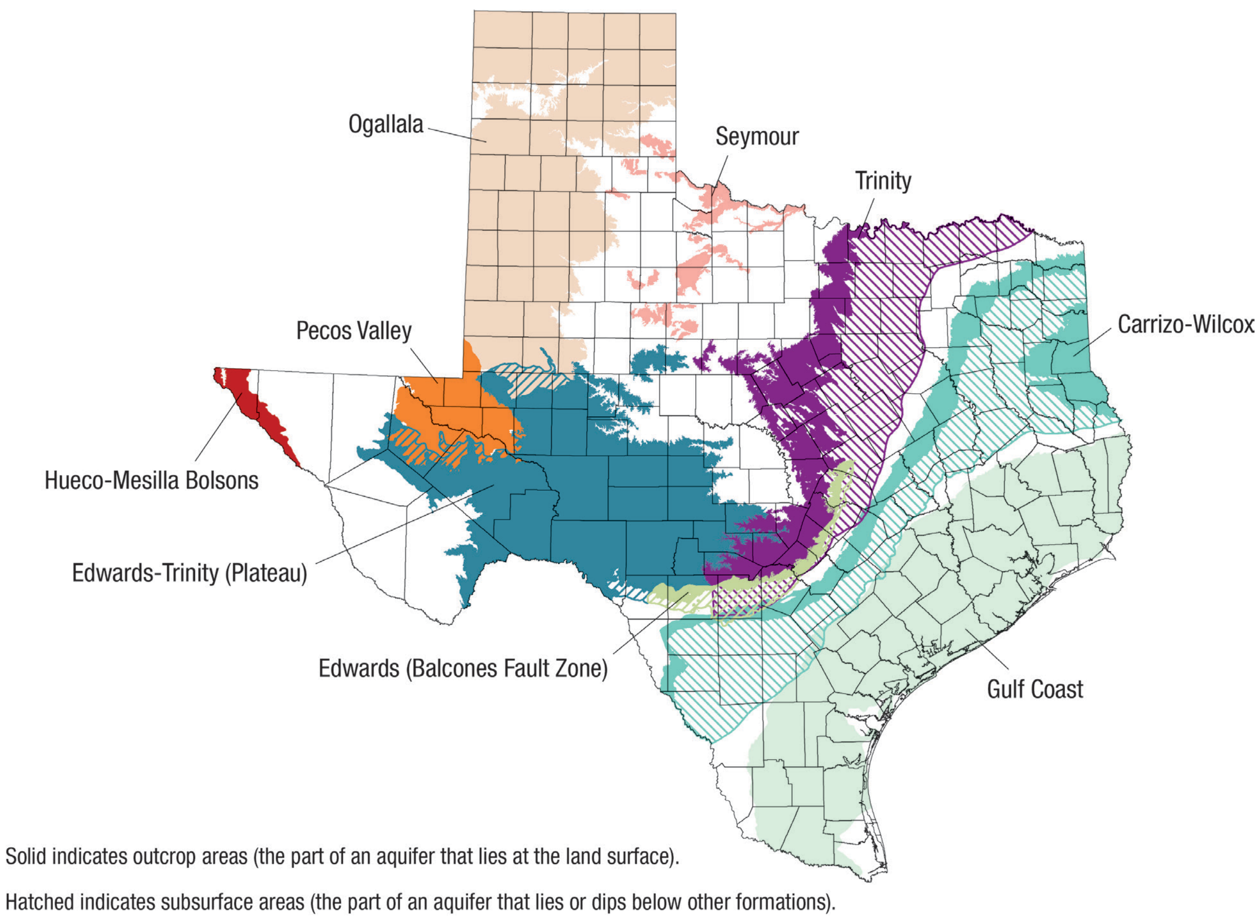

Figure 3: The major aquifers of Texas (TWDB, 2012); the Edwards (Balcones Fault Zone) is shown on top of the subsurface Trinity.

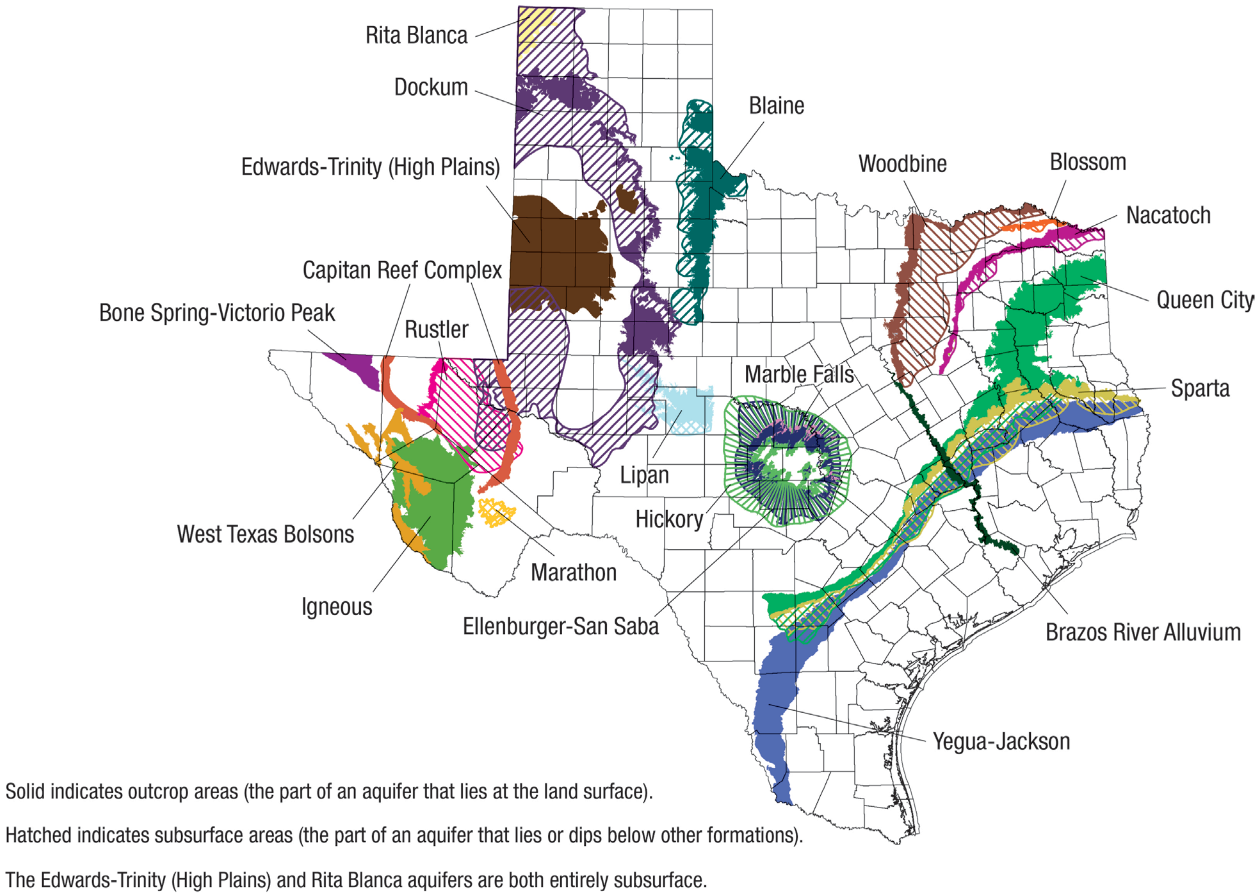

Figure 4: The minor aquifers of Texas (TWDB, 2012).

According to the TWDB's annual Water Use Survey, groundwater supplied 58 percent of the 18.1 million acre-feet of water used in Texas in 2011. About 77 percent of the 10.5 million acre-feet of water produced from aquifers was used for irrigation, with most of this pumped from the Ogallala Aquifer. Approximately 38 percent of water used for municipal needs was from groundwater sources because most large cities in Texas rely primarily on surface-water sources to meet their demands. Most of the western half of the state and a much lesser portion of the eastern half of the state rely primarily on groundwater resources (Figure 5).

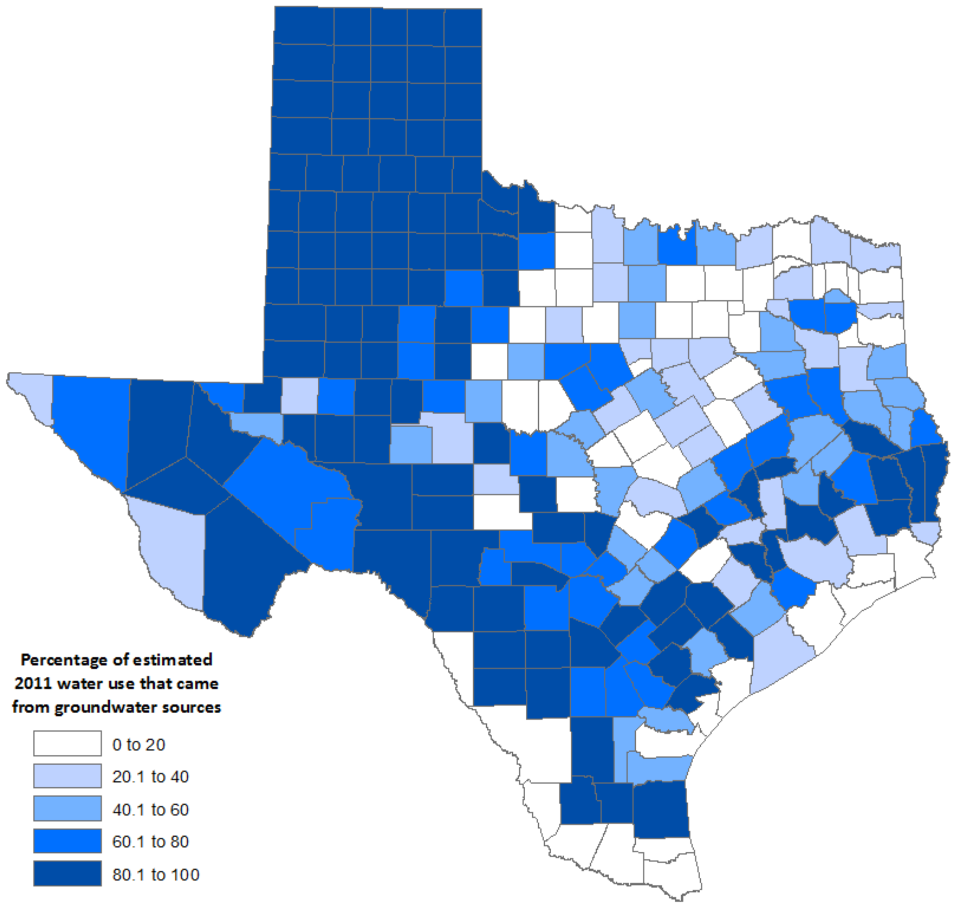

Figure 5: The percentage of water used in 2011 that came from groundwater sources (all other water use came from surface water; data from TWDB Water Use Survey and estimates, accessed on August 6, 2013).

How Much Water Is Available for Use?

Groundwater availability is the amount of groundwater that is available for use from an aquifer (Mace and others, 2001). How much water is available for use depends on policy (such as rules, regulations, and management goals) and the characteristics of the aquifer (such as recharge rate, volume of water in storage, and transmissivity). Prior to the start of regional water planning in 1997, the TWDB used a number of different techniques to estimate groundwater availability for the aquifers of Texas including average recharge; recharge with changes in storage; the above two approaches with limitations to prevent water-quality deterioration, land-subsidence, or other undesired effects; and systematic depletion (Muller and Price, 1979).

Average recharge was estimated using base-flow and spring-flow measurements, low-flow and flow-net analysis, the trough method, comparing pumping and water-level trends, or a percentage of the mean annual precipitation (Walton, 1962; Peckham and others, 1963; Klemt and others, 1975; Keech and Dreeszen, 1959; Shamburger, 1967). Recharge with changes in storage was estimated using water-budget studies (Meyer and Gordon, 1972). Results from numerical models for the Ogallala, Edwards (Balcones Fault Zone), Carrizo-Wilcox, and Hueco-Mesilla Bolsons[9] aquifers were also used (Knowles and others, 1984; Klemt and others, 1979; Thorkildsen and others, 1989; Meyer, 1976).

When the water planning process shifted from the TWDB to regional planning groups in 1997, the regional water planning groups began employing a variety of methods, data, and tools to define and estimate groundwater availability. For each region, these estimates result in a county-level volume of water available in each aquifer for every decade in the planning period. The regions incorporate these volumes into their water plans, and the TWDB subsequently incorporates the 16 regional plans into a single state water plan. Additionally, Senate Bill 2, passed in 2001, required the TWDB to designate groundwater management areas covering all of the major and minor aquifers in the state. The TWDB has delineated 16 such areas based on major aquifer and political boundaries, typically county lines.

Following the passage of House Bill 1763 in 2005, the process for determining groundwater availability in Texas underwent a second major transition. Prior to this legislation, regional water planning groups determined groundwater availability via a wide variety of methods. Under this structure, groundwater conservation districts were able to define and report their own groundwater availability estimates in their management plans, as long as these volumes allowed for the implementation of the state water plan. However, since the passage of House Bill 1763, groundwater conservation districts now determine groundwater availability through a joint planning process. Joint planning requires groundwater conservation districts located within the same groundwater management area to meet at least annually and to review district management plans, accomplishments of the management area, and proposals to adopt new or amend existing desired future conditions. Desired future conditions voted upon through this process are used to determine modeled available groundwater, which is subsequently incorporated into the regional planning process.

Groundwater conservation districts within each groundwater management area adopt desired future conditions by resolution at a joint planning meeting and then submit them to the TWDB. The TWDB then uses groundwater availability models, water budget calculations, and/or district-provided data to estimate the modeled available groundwater. Regional water planning groups, in turn, must use these modeled available groundwater numbers as the groundwater availability volumes in their regional plans. Senate Bill 660, passed in 2011, mandates that the volumes used are based on the desired future conditions that were in place as of the date of

[9] At the time these reports were published, what is now referred to as the Hueco-Mesilla Bolsons Aquifer was known as the Hueco Bolson Aquifer.

adoption of the most recent state water plan. However, this legislation also gives planning groups the discretion to use modeled available groundwater volumes based on desired future conditions established after the adoption of the most recent plan should they desire to do so.

Groundwater conservation districts are responsible for establishing desired future conditions for the relevant aquifers within the entire management area, including district and non-district areas. Relevant aquifers include official major and minor aquifers. The groundwater conservation districts in a groundwater management area have the option to declare an aquifer or portion of an aquifer as non-relevant, therefore choosing not to establish a desired future condition for that particular aquifer or portion thereof. Modeled available groundwater is only calculated for aquifers or portions of aquifers that have a desired future condition. Therefore, in areas where an aquifer has been declared non-relevant, there is no desired future condition established or modeled available groundwater value estimated. In these cases, regional water planning groups have the option to set groundwater availability.

The first deadline to adopt desired future conditions, which all groundwater management areas met, was September 1, 2010. During the first round of joint planning, however, TWDB rules stipulated that if a groundwater management area submitted desired future conditions before January 1, 2008, regional water planning groups would be required to include the resulting groundwater availability volumes in their plans. The districts in Groundwater Management Area 8 met this deadline for some of its aquifers. For the remaining groundwater management areas, whether to include groundwater availability from the first round of desired future conditions was at the discretion of the regional water planning groups. The 2016 regional water plans will be the first time that all estimates of modeled available groundwater determined through the desired future condition process are the basis of groundwater availability.

The 2011 regional water plans were compiled prior to the full implementation of the desired future conditions process, allowing regional water planning groups to employ a variety of methods to determine groundwater availability. These methods include (Table 1): groundwater availability for one or more aquifers is equal to average recharge (regions A, G, J, and K); the volume that can be withdrawn without exceeding a given acceptable amount of drawdown or decrease in spring flow, typically based on a groundwater availability model (regions B, D, E, G, H, J, K, M, N, and O) or a desired future condition (regions A, B, C, D, F, G, K, and L); historical water use (regions A, B, E, and M); projected water use (regions H and O); availability volumes from groundwater conservation district management plans (regions H, K, and L); and availability volumes from the 2000 (Region K) and 2006 regional water plans (regions A, B, C, D, F, G, I, K, L, N, and P).

Once derived, availability numbers are used in the regional water planning process as a maximum amount of groundwater that can be produced to meet projected demands. However, regions D, I, J, L, and M noted that, in places where there is no groundwater conservation district to manage groundwater use, there are no regulatory mechanisms to prevent actual groundwater withdrawals in excess of availability. Thus, if users can afford to increase their infrastructure and groundwater use, actual groundwater production may be equal to or exceed projections. Some regions chose availability numbers based on historical or projected groundwater use for this reason. Other regions based their availability numbers in areas without groundwater conservation districts on assumed drawdown levels but acknowledged that these drawdown levels cannot be enforced. Though subsequent regional plans will include availability numbers determined by groundwater conservation districts for district and non-district areas, groundwater use continues to be unregulated in non-district areas.

Though the use of groundwater is generally not regulated in non-district areas, projects proposed for inclusion in the state water plan by regional water planning groups must be in line with modeled available groundwater volumes for these parts of the state. Any proposed groundwater project that would exceed modeled available groundwater volumes could not be included in the state water plan, which could impact the ability of that project to receive financing from the state.

Table 1: Methods used by regional water planning groups in Texas for determining the availability of groundwater in aquifers for the 2011 regional water plans.

REGION and AQUIFER	METHODOLOGY
REGION A	
Blaine	2006 Regional Water Plan, recharge
Dockum	Estimates of saturated thickness, specific yield, and recharge rates from historical studies and published reports
Ogallala*	Desired future conditions, 2006 Regional Water Plan
Rita Blanca*	Desired future conditions
Seymour	2006 Regional Water Plan, recharge
REGION B	
Blaine	2006 Regional Water Plan
Other	Reported historical use
Seymour	Groundwater availability model, historical studies
Trinity*	Desired future conditions
REGION C	
Carrizo-Wilcox	2006 Regional Water Plan
Nacatoch	2006 Regional Water Plan
Other	2006 Regional Water Plan
Queen City	2006 Regional Water Plan
Trinity*	Desired future conditions

REGION and AQUIFER	METHODOLOGY
Woodbine*	Desired future conditions
REGION D	
Blossom*	Desired future conditions
Carrizo-Wilcox	Groundwater availability model
Nacatoch*	Desired future conditions, 2006 Regional Water Plan
Queen City	Groundwater availability model
Trinity*	Desired future conditions
Woodbine*	Desired future conditions
Other	2006 Regional Water Plan
REGION E*	
Bone Spring-Victorio Peak	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
Capitan Reef Complex	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
Edwards-Trinity (Plateau)	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
Hueco-Mesilla Bolsons	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
Igneous	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
Marathon	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
Rustler	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
West Texas Bolsons	Hydrogeologic studies, groundwater data including historical use, and/or groundwater availability models
REGION F	
Capitan Reef Complex	2006 Regional Water Plan
Pecos Valley	2006 Regional Water Plan
Dockum	2006 Regional Water Plan
Edwards-Trinity (Plateau)	2006 Regional Water Plan
Ellenburger-San Saba	2006 Regional Water Plan
Hickory	2006 Regional Water Plan
Lipan	2006 Regional Water Plan
Ogallala	2006 Regional Water Plan
Rustler	2006 Regional Water Plan
Trinity*	Desired future conditions
REGION G	
Blaine	Net recharge rates based on information from the TWDB, groundwater availability model, and literature
Brazos River Alluvium*	Desired future conditions, 2006 Regional Water Plan

REGION and AQUIFER	METHODOLOGY
Carrizo-Wilcox*	Desired future conditions, 2006 Regional Water Plan
Dockum*	Desired future conditions, 2006 Regional Water Plan
Edwards-Trinity (Plateau)	2006 Regional Water Plan
Edwards (Balcones Fault Zone)*	Desired future conditions
Ellenburger-San Saba*	Desired future conditions
Gulf Coast	2006 Regional Water Plan
Hickory*	Desired future conditions
Marble Falls*	Desired future conditions
Other	2006 Regional Water Plan
Queen City*	Desired future conditions, 2006 Regional Water Plan
Seymour	2006 Regional Water Plan
Sparta*	Desired future conditions, 2006 Regional Water Plan
Trinity*	Desired future conditions
Woodbine*	Desired future conditions
Yegua-Jackson	Net recharge rates based on information from the TWDB, groundwater availability model, and literature
REGION H	
Brazos River Alluvium	TWDB estimates
Carrizo-Wilcox	Groundwater availability model, groundwater conservation district management plan
Gulf Coast	TWDB groundwater flow model, groundwater conservation district management plan
Queen City	Groundwater availability model, TWDB groundwater supply data
Sparta	Groundwater availability model, TWDB groundwater supply data
Yegua-Jackson	No data available
REGION I	
Carrizo-Wilcox	2006 Regional Water Plan
Gulf Coast	2006 Regional Water Plan
Other	2006 Regional Water Plan
Queen City	2006 Regional Water Plan
Sparta	2006 Regional Water Plan
Yegua-Jackson	2006 Regional Water Plan
REGION J	
Edwards-Trinity (Plateau)	Groundwater availability model
Edwards (Balcones Fault Zone)	Recharge
Trinity	Groundwater availability model

REGION and AQUIFER	METHODOLOGY
Other	Recharge
REGION K	
Carrizo-Wilcox	Groundwater conservation district management plans
Edwards-Trinity (Plateau)	Groundwater conservation district management plans, information from groundwater conservation district
Edwards (Balcones Fault Zone)*	Groundwater availability models, desired future conditions
Ellenburger-San Saba*	Groundwater conservation district management plans, 2000 Regional Water Plan, desired future conditions
Gulf Coast	Groundwater conservation district management plans, 2006 Regional Water Plan
Hickory	Groundwater conservation district management plans, 2000 Regional Water Plan
Marble Falls*	Groundwater conservation district management plans, desired future conditions
Other	Recharge
Queen City	Groundwater conservation district management plan, 2000 Regional Water Plan
Sparta	Groundwater conservation district management plan, 2000 Regional Water Plan
Trinity*	Groundwater availability models, desired future conditions
Yegua-Jackson	Information from groundwater conservation district
REGION L*	
Carrizo-Wilcox	Groundwater conservation district management plans, 2006 Regional Water Plan
Edwards-Trinity (Plateau)*	Desired future conditions, groundwater conservation district management plans, 2006 Regional Water Plan
Edwards (Balcones Fault Zone)	Senate Bill 3 of the 80th Texas Legislature
Gulf Coast	Groundwater conservation district management plans, 2006 Regional Water Plan
Queen City	Groundwater conservation district management plans, 2006 Regional Water Plan
Sparta	Groundwater conservation district management plans, 2006 Regional Water Plan
Trinity	Groundwater conservation district management plans, 2006 Regional Water Plan
Yegua-Jackson	Groundwater conservation district management plans, 2006 Regional Water Plan
REGION M	
Carrizo-Wilcox	Groundwater availability model

REGION and AQUIFER	METHODOLOGY
Gulf Coast	Groundwater availability model
Yegua-Jackson	Published information, TWDB historical water use data, well and water level records
Other	Published information, TWDB historical water use data, well and water level records
REGION N	
Carrizo-Wilcox	2006 Regional Water Plan
Gulf Coast	Groundwater availability model
Queen City	2006 Regional Water Plan
Sparta	2006 Regional Water Plan
REGION O****	
Dockum	TWDB data
Edwards-Trinity (High Plains)	TWDB data
Ogallala	Groundwater availability model
Seymour	TWDB data
REGION P	
Gulf Coast	2006 Regional Water Plan
Yegua-Jackson	Unspecified

* Desired future conditions, either draft or final, were used as the basis for generating groundwater availability volumes used in the regional water plan.
** Region E listed all methodologies used but did not specify the methods used to determine groundwater availability by aquifer.
***Region L listed methodologies used for assessing groundwater availability by aquifer but did not specify the methodologies used to evaluate minor aquifers within the region.
**** For all aquifers other than the Ogallala, Region O indicated that groundwater availability figures were “obtained from the TWDB” but did not provide further specifics.

There are two exceptions to the desired future conditions process described above. The Hueco-Mesilla Bolsons Aquifer is excluded from the desired future conditions process because no groundwater conservation districts exist within the groundwater management area. Without a groundwater conservation district, the joint planning process and establishment of desired future conditions are not applicable, and House Bill 1763 cannot be applied here. The Region E Regional Water Planning Group (Far West Texas) currently estimates groundwater availability for this aquifer, located in Groundwater Management Area 5.

Additionally, for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority, the 73rd Texas Legislature defined its groundwater availability through statute in 1993 with the passage of Senate Bill 1477 (known as the Edwards Aquifer Authority Act). This act was subsequently amended in 2007 by the 80th Texas Legislature via Senate Bill 3, and as a result of this update, the Edwards Aquifer Authority

Act now stipulates that permitted groundwater withdrawals may not exceed or be less than 572,000 acre-feet per year. Thus, the Edwards Aquifer Authority Act specifies the exact volume of groundwater to be permitted for withdrawal annually, and the TWDB has accepted this value as the modeled available groundwater volume for this segment of the Edwards (Balcones Fault Zone) Aquifer under non-drought-of-record conditions.[10,11]

During times of drought, groundwater volumes available for use in the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority are reduced. Section 1.26 of the Edwards Aquifer Act and Chapter 715, Subchapter E, of the Edwards Aquifer Authority Rules require the Edwards Aquifer Authority to implement a critical period management plan that is designed to minimize the decline of aquifer levels and associated springflow. This plan requires permit holders of greater than three acre-feet per year to file monthly groundwater withdrawal reports and to curtail their annual withdrawals as water levels in the aquifer and springflow decline. Curtailments are percent reductions in volume of groundwater pumped, and required reductions increase as aquifer levels and springflows drop. Triggers for implementation of the critical period management plan, the stages of the plan, and the associated required reductions in withdrawal vary depending on the particular section of the aquifer. In all cases, there are five critical period stages,[12] and the greatest reduction of groundwater withdrawal is 44 percent (M. Friberg, and N. Pence, email commun(s)., 2014). Thus, through the institution of these thresholds, the Edwards Aquifer Authority Act and the Edwards Aquifer Authority's rules result in 320,000 acre-feet per year of pumping during a severe drought such as a repeat of the drought of record. Although the Authority considers the full amount that can be permitted (572,000 acre-feet per year) as its modeled available groundwater, 320,000 acre-feet amounts to a modeled available groundwater for drought-of-record conditions. Since groundwater availability in the regional and state water plan is supposed to reflect drought-of-record conditions, we used 320,000 acre-feet per year as the modeled available groundwater for comparisons to water plan numbers unless otherwise specified.

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[10] The 572,000 acre-feet of groundwater that is permitted for withdrawal does not include Edwards Aquifer exempt well withdrawals, some federal facility withdrawals, and a new "limited production well" withdrawal amount. All of these volumes are all considered small, de minimis amounts and are not included in the permitted total.

[11] This paragraph provides a synopsis of the desired future conditions process as it relates to this portion of the Edwards (Balcones Fault Zone) Aquifer. Sections 1.14(a), (f), (h), and 1.26 of the Edwards Aquifer Authority Act also inform the Edwards Aquifer Authority's desired future condition.

[12] The fifth stage of the critical period management plan is a result of the approval of the Edwards Aquifer Authority Habitat Conservation Plan. Stage five was codified in Chapter 715 of the Edwards Aquifer Authority rules following approval of the plan and is not part of the Edwards Aquifer Authority Act.

The two cases previously described represent the only departures from the typical joint planning process established under House Bill 1763. However, there is one additional scenario under which an aquifer segment has unique desired future conditions depending on drought conditions. The Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer has different modeled available groundwater volumes depending on whether or not the area is in extreme drought conditions. In this case, the districts established one desired future condition statement for this area of the aquifer during extreme drought conditions and a separate desired future condition statement for use at all other times. Accordingly, there are different modeled available groundwater volumes for each of these two statements. Given that a central aim of this report is to compare modeled available groundwater volumes with regional water planning groundwater availability volumes, and given that regional water planning groundwater availability volumes are based on drought-of-record conditions, we have used the modeled available groundwater volumes for the Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer that are based on extreme drought conditions for analysis in this report unless otherwise specified.

Initial Desired Future Conditions

Though desired future conditions were not set for all aquifers in all regions in time for inclusion in the 2012 State Water Plan, the first round of joint planning is now complete for all areas of Texas. Groundwater conservation districts in each groundwater management area determined whether different conditions were set for aquifer subdivisions or geographic areas. This resulted in a variety of different formats for desired future conditions. For example, some districts set their conditions as an average water-level decline for the entire management area, while others established conditions on a county-by-county or district-by-district basis. Some districts determined conditions for each aquifer subdivision, while others were lumped together.

Thus, desired future conditions adopted in the first planning cycle varied across groundwater management areas. Statements of desired future conditions established include: percent of volume remaining in storage (groundwater management areas 1 and 6); average, total net, average total net, or total decline in water levels (groundwater management areas 1, 2, 3, 6, 7, and 10); percent of saturated thickness remaining (groundwater management areas 2, 8, 12, and 14); total, net, or average drawdown (groundwater management areas 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16); and stream/spring flow level maintenance (groundwater management areas 8, 10, and 13).

Desired future conditions are also specified by legislation for the Edwards Aquifer Authority, whose jurisdictional boundary covers parts of groundwater management areas 7, 9, 10, and 13. In many cases, more than one desired future condition was applied to an aquifer (see Table 2 for statements of desired future conditions used for major aquifers). Appendix D provides summary descriptions of the most current desired future conditions for both major and minor aquifers in Texas, excluding the Hueco-Mesilla Bolsons Aquifer as desired future conditions were not established using the joint planning process in this area. Appendix E provides a description of the desired future condition for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority as established in the Edwards Aquifer Authority Act.

Table 2: Desired future conditions applied to major Texas aquifers.

Aquifer	Statements of desired future conditions	Groundwater management areas
Carrizo-Wilcox	Average drawdown	11, 12, 13, 14
Edwards (Balcones Fault Zone)	Stream/spring flow level maintenance, total and average drawdown, total decline in water levels, specified by legislation*	8, 9, 10, 13
Edwards-Trinity (Plateau)	Average total net decline in water levels, total and average drawdown, stream/spring flow level maintenance	3, 4, 7, 9
Gulf Coast	Average drawdown	14, 15, 16
Hueco-Mesilla Bolsons	Not applicable	5
Ogallala	Percent of volume remaining in storage, percent of saturated thickness remaining, average decline in water levels	1, 2, 6, 7
Pecos Valley	Average total net decline in water levels, average drawdown	3, 7
Seymour	Percent of volume remaining in storage, total decline in water levels	6
Trinity	Average drawdown	7, 8, 9, 10

* The desired future condition for the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority is established in legislation via the Edwards Aquifer Authority Act.

Groundwater Availability

When assessing groundwater availability using the complete set of data available for Texas, the regional water planning groups estimate that total current (2010) groundwater availability during drought conditions is roughly 13.3 million acre-feet per year. This availability decreases to 10.1 million acre-feet per year by 2060, primarily because of projected decreases in availability in the Dockum, Edwards-Trinity (High Plains), Gulf Coast, Ogallala, Rita Blanca, and

Seymour aquifers (Figure 6). This change represents a 24 percent decline in groundwater availability under drought of record conditions over the period from 2010 through 2060.

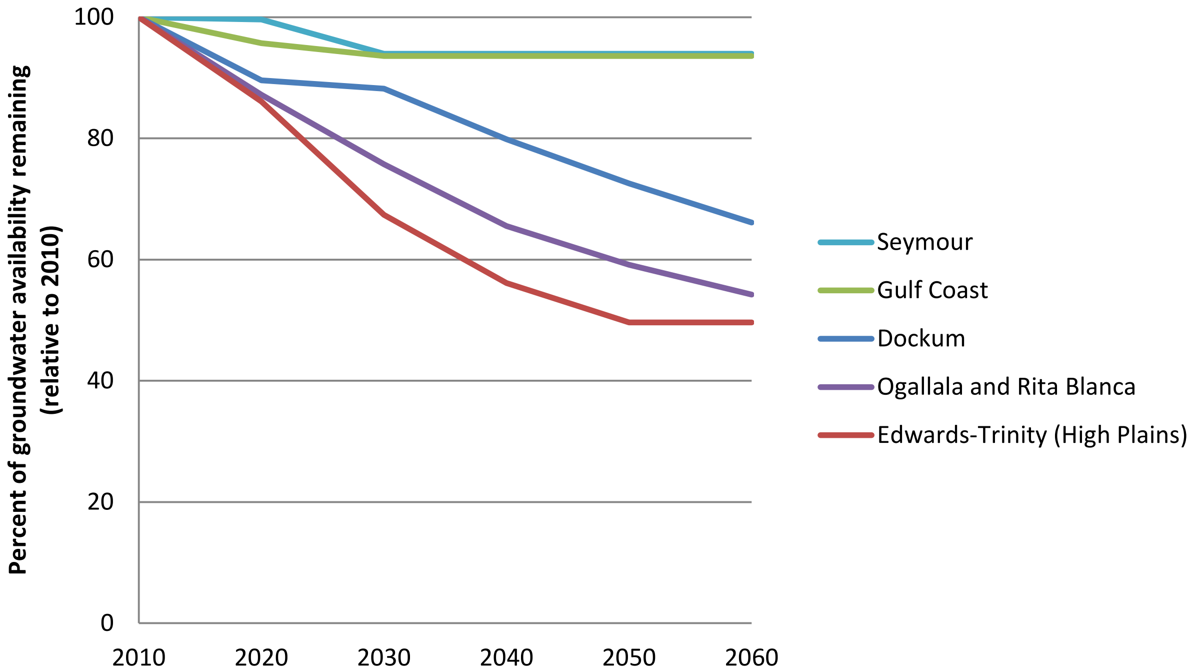

Figure 6: Percentage declines in groundwater availability for selected aquifers under drought of record conditions (TWDB, 2012).

These groundwater availability volumes, developed through the regional water planning process, are different than modeled available groundwater volumes in many cases. A key aim of this report is to compare groundwater availability and total groundwater supply volumes from the 2011 regional water plans with the modeled available groundwater volumes generated through the desired future conditions process to determine the extent of these differences. Given that the desired future conditions process only takes place in groundwater management areas where groundwater conservation districts are present and does not include areas of aquifers that are determined to be non-relevant by the districts or areas where no aquifers are delineated, modeled available groundwater volumes are not available for all areas of the state. Thus, we tailored the available data to ensure comparability. To be included in this analysis, the record for an aquifer for a given county had to include:

1. A groundwater availability volume from the 2012 State Water Plan
2. An existing supply volume and/or a strategy supply volume from the 2012 State Water Plan
3. A modeled available groundwater volume generated through the desired future conditions process

If the record for an aquifer in a particular county did not include a volume in all three categories, we excluded it from our analysis. Thus, unless otherwise noted, the volumes compared in this report represent the subset of all available volumes. For a complete discussion of the methodology used to determine inclusion in this project, refer to Appendix A.

Using only the data that met our criteria for inclusion, the total volume of groundwater available in 2020 for all Texas aquifers as estimated during the most recent round of regional water planning exceeds total 2020 estimates of modeled available groundwater by approximately 4.5 percent. The 2011 regional water plans estimate that Texas will have roughly 11.68 million acre-feet of groundwater available in 2020, whereas modeled available groundwater estimates for the year 2020 indicate that 11.18 million acre-feet will be available. Thus, regional water plan estimates of groundwater availability exceed modeled available groundwater figures for the year 2020 by roughly four and a half percent.

By 2060, the aggregate statewide difference between planning group estimates of groundwater availability and estimates of modeled available groundwater decreases by approximately three percent.[13] Estimates of groundwater availability from the 2011 regional water plans indicate that 9.43 million acre-feet of water will be available in 2060, while modeled available groundwater estimates show that 9.15 million acre-feet are available that same year.

Analysis by Aquifer

To analyze groundwater availability for aquifers in Texas, we compare estimates of modeled available groundwater volumes with estimates of groundwater availability volumes from the 2011 regional water plans. We also compare modeled available groundwater volumes with 2011 groundwater pumpage volumes[14] reported through the TWDB's annual Water Use Survey for each aquifer in Texas.[15] Looking at all three measures offers an indication of how current use compares to both approaches for estimating groundwater availability.

[13] Note that aggregating volumes to the statewide level may obscure both positive and negative local variations such as differences by county. These localized differences can be observed using the maps provided in Appendix A.

[14] Groundwater pumpage data has also been tailored to match the dataset developed for this project.

[15] We included 27 of the state's 30 major and minor aquifers in this comparison. We omitted the Hueco-Mesilla Bolsons Aquifer as there are no modeled available groundwater volumes for this aquifer. No records for the Lipan Aquifer met our criteria for inclusion in this report, so we omitted this aquifer as well. The Edwards (Balcones Fault Zone) Aquifer is not included within the groundwater availability analysis of the state's aquifers because multiple sections of the aquifer contain different modeled available groundwater volumes depending on drought conditions. The Edwards (Balcones Fault Zone) Aquifer is analyzed separately following the analysis of major aquifers. Values are lumped for the Ogallala and the Rita Blanca aquifers, and we combined values for the Pecos Valley and the Edwards Trinity (Plateau) aquifers. In the case of the Pecos Valley and Edwards Trinity (Plateau) aquifers, at the time that we conducted this analysis, there were volumes associated with lumped representations for the aquifer combination as well as for the individual aquifers.

When we compare our subset of 2020 groundwater availability volumes from the 2011 regional water plans with the report subset of 2020 modeled available groundwater volumes determined through the desired future conditions process, regional water planning volumes exceed modeled available groundwater volumes for 13 aquifers or aquifer combinations (Capitan Reef Complex, Carrizo-Wilcox, Dockum, Edwards-Trinity [High Plains], Gulf Coast, Hickory, Igneous, Marble Falls, Ogallala and Rita Blanca, Queen City, Seymour, Sparta, and West Texas Bolsons). These cases represent situations in which groundwater availability volumes generated using the array of methodologies employed during the 2011 round of regional water planning (Table 1) yielded higher volumes than were generated when the desired future conditions process was employed. For 10 aquifers or aquifer combinations, 2020 modeled available groundwater volumes are higher than regional water planning group estimates of 2020 groundwater availability (Blaine, Bone Spring-Victorio Peak, Brazos River Alluvium, Ellenburger-San Saba, Marathon, Nacatoch, Pecos Valley and Edwards-Trinity [Plateau],[16] Rustler, Trinity, and Yegua-Jackson). In these cases, volumes generated using the desired future conditions process exceed previous planning group estimates of availability. For two aquifers (Blossom and Woodbine), modeled available groundwater volumes are identical to estimates of groundwater availability from the 2011 regional water plans.

When we compare our subset of 2020 modeled available groundwater volumes determined through the desired future conditions process with 2011 groundwater pumpage volumes reported through the TWDB's annual Water Use Survey for each aquifer in Texas, modeled available groundwater volumes exceed pumpage volumes for 20 aquifers or aquifer combinations (Blaine, Bone Spring-Victorio Peak, Capitan Reef Complex, Carrizo-Wilcox, Dockum, Ellenburger-San Saba, Gulf Coast, Hickory, Igneous, Marathon, Marble Falls, Nacatoch, Pecos Valley and Edwards-Trinity [Plateau],[17] Queen City, Rustler, Sparta, Trinity, West Texas Bolsons, Woodbine, and Yegua-Jackson). In five aquifers or aquifer combinations, 2011 groundwater pumpage exceeds 2020 modeled available groundwater volumes (Blossom, Brazos River Alluvium, Edwards –Trinity [High Plains], Ogallala and Rita Blanca, and Seymour). These scenarios represent situations in which the amount of groundwater being pumped exceeds modeled available groundwater estimates of available groundwater volumes.

[16] The Pecos Valley and Edwards-Trinity (Plateau) combination is not a unique aquifer. Due to the use of a lumped representation of the Pecos Valley and Edwards-Trinity (Plateau) aquifers in some portions of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers at the time that we conducted this analysis, we have combined volumes for the individual aquifers as well as the lumped volumes.

[17] Refer to Footnote 16.

Major Aquifers

When we compare estimates of groundwater availability for only the state's major aquifers,[18] volumes are similar (Figure 7). The 2011 regional water plans estimate that approximately 9.61 million acre-feet of groundwater will be available from the state's major aquifers in 2020, while modeled available groundwater estimates show that 9.59 million acre-feet will be available that same year (Table 3). Thus, when comparing totals for the major aquifers in Texas, the results of these two approaches to estimating groundwater availability yield essentially the same results when aggregated.[19] The aquifers with the largest differences[20] in these estimates are the Pecos Valley and Edwards-Trinity (Plateau) aquifer combination [21] and the Carrizo-Wilcox aquifers. For the Pecos Valley and Edwards-Trinity (Plateau) aquifer combination, modeled available groundwater volumes are higher by 170,373 acre-feet. In the case of the Carrizo-Wilcox Aquifer, regional water plan estimates of groundwater availability are higher by 125,654 acre-feet.

[18] The Edwards (Balcones Fault Zone) Aquifer is not included within the groundwater availability analysis of the state's major aquifers because multiple sections of the aquifer contain different modeled available groundwater volumes depending on drought conditions. The Edwards (Balcones Fault Zone) Aquifer is analyzed separately in the *Edwards (Balcones Fault Zone)* section which starts on page 33.

[19] Note that aggregating volumes to the aquifer-wide level may obscure both positive and negative local variations such as differences by county. These localized differences for major aquifers can be observed using the maps provided in Appendix B.

[20] These are the only major aquifers with 2020 differences in volumes between approaches of greater than 100,000 acre-feet.

[21] The Pecos Valley and Edwards-Trinity (Plateau) combination is not a unique aquifer. See Footnote 16 on page 29 for a detailed explanation.

Table 3: Number of counties that have modeled available groundwater volumes greater or less than regional water planning groundwater availability volumes for major aquifers in the year 2020 (acre-feet).

Aquifer	< -200,000	-199,999 to -150,000	-149,999 to -100,000	-99,999 to -50,000	-49,999 to -1,000	-999 to 1,000	1,001 to 50,000	50,001 to 100,000	100,001 to 150,000	150,001 to 200,000	> 200,000
Carrizo-Wilcox	0	0	0	1	20	25	11	0	0	0	0
Gulf Coast	0	0	0	2	13	17	18	0	0	0	0
Ogallala	0	2	0	3	15	2	20	2	1	1	0
Pecos Valley and Edwards-Trinity (Plateau)	0	0	0	0	14	4	10	2	0	0	0
Seymour	0	0	0	0	13	1	2	0	0	0	0
Trinity	0	0	0	0	2	40	7	0	0	0	0
All Major Aquifers	0	2	0	6	77	89	68	4	1	1	0

Note: Negative numbers indicate that regional water planning groundwater availability volumes exceed modeled available groundwater volumes for a county, whereas positive numbers indicate that modeled available groundwater volumes are higher.

When comparing 2011 groundwater pumpage volumes and 2020 modeled available groundwater volumes for only the state's major aquifers, modeled available groundwater volumes exceed pumpage volumes for four of the six aquifers or aquifer combinations evaluated. Groundwater pumpage figures for 2011 reflect 8.63 million acre-feet of groundwater pumpage, while 2020 modeled available groundwater estimates show 9.59 million acre-feet of groundwater, a difference of approximately 11.5 percent. The two aquifers or aquifer combinations with 2011 pumpage volumes higher than 2020 modeled available groundwater volumes are the Ogallala and Rita Blanca and the Seymour aquifers. Pumpage volumes for these aquifers exceeded modeled available groundwater volumes by 800,232 acre-feet and 59,732 acre-feet, respectively.

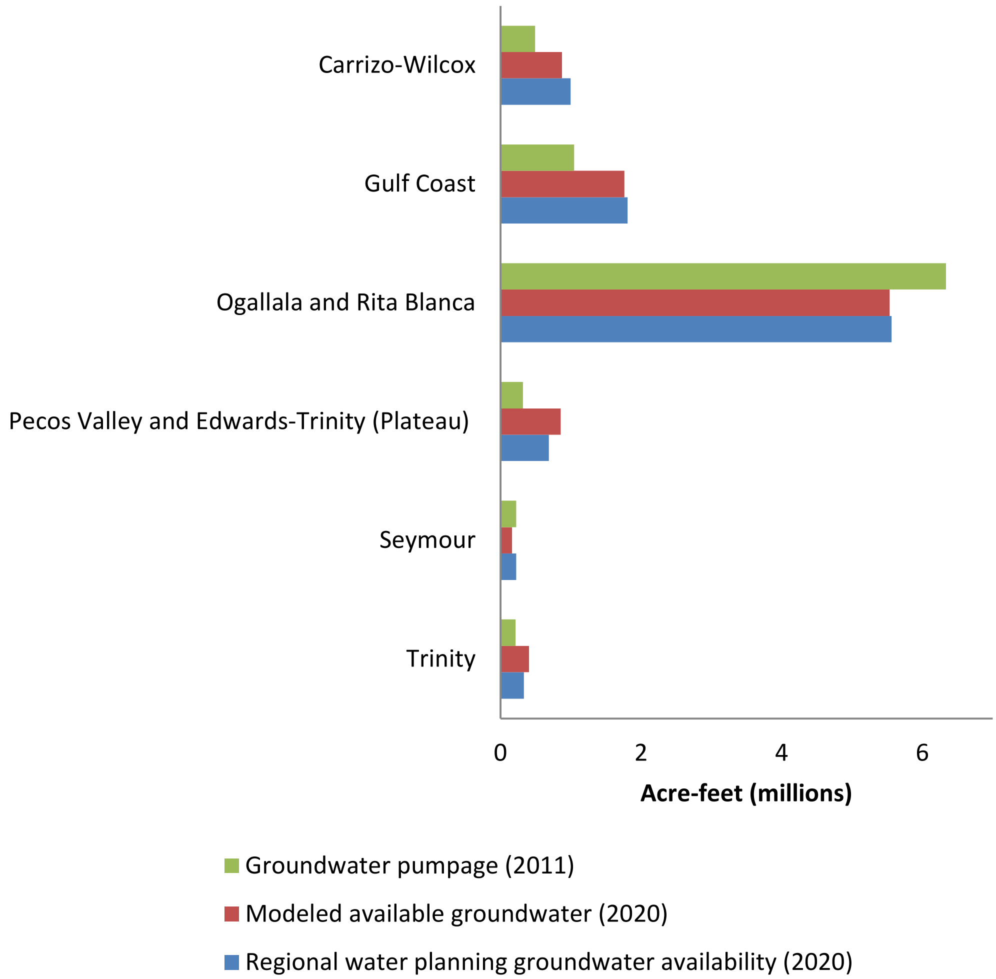

Figure 7: Comparison of groundwater pumpage (2011) volumes, modeled available groundwater (2020) volumes, and regional water planning groundwater availability (2020) volumes for major aquifers. Values for the Ogallala and Rita Blanca aquifers, as well as for the Pecos Valley and Edwards-Trinity (Plateau) aquifers, are combined. In the case of the Pecos Valley and Edwards Trinity (Plateau) aquifers, at the time that we conducted this analysis there were volumes for the individual aquifers as well as combined volumes for the aquifers. We have combined volumes for the individual aquifers as well as the lumped volumes. Additionally, this graphic was generated using our subset of the data. For a complete description of the process used to generate this subset, refer to Appendix A.

When evaluating 2060 estimates of groundwater volumes for the state's major aquifers,[22] modeled available groundwater volumes again exceed regional water plan estimates of groundwater availability, though in this case the difference between volume estimates is slightly greater (Table 4). Modeled available groundwater volumes for 2060 indicate that 7.57 million acre-feet will be available, whereas the 2011 regional water plans show groundwater availability of 7.45 million acre-feet, a difference of approximately 1.5 percent. Nonetheless,

[22] Refer to Footnote 18 on page 30.

only the Pecos Valley and Edwards-Trinity (Plateau) aquifer combination[23] has a difference in availability between the two approaches of greater than 100,000 acre-feet. In this case, the modeled available groundwater volume estimate exceeds the groundwater availability estimate made by the regional water planning group by 170,373 acre-feet.

Table 4: Number of counties that have modeled available groundwater volumes greater or less than regional water planning groundwater availability volumes for major aquifers in the year 2060 (acre-feet).

Aquifer	< -200,000	-199,999 to -150,000	-149,999 to -100,000	-99,999 to -50,000	-49,999 to -1,000	-999 to 1,000	1,001 to 50,000	50,001 to 100,000	100,001 to 150,000	150,001 to 200,000	> 200,000
Carrizo-Wilcox	0	0	0	1	16	27	13	0	0	0	0
Gulf Coast	0	0	0	3	12	17	18	0	0	0	0
Ogallala	0	0	0	3	12	7	20	4	0	0	0
Pecos Valley and Edwards-Trinity (Plateau)	0	0	0	0	14	4	10	2	0	0	0
Seymour	0	0	0	0	14	0	2	0	0	0	0
Trinity	0	0	0	0	2	39	8	0	0	0	0
All Major Aquifers	0	0	0	7	70	94	71	6	0	0	0

Note: Negative numbers indicate that regional water planning groundwater availability volumes exceed modeled available groundwater volumes for a county, whereas positive numbers indicate that modeled available groundwater volumes are higher.

Edwards (Balcones Fault Zone) Aquifer

To analyze groundwater availability for the Edwards (Balcones Fault Zone) Aquifer, we use modeled available groundwater volumes designed for drought of record conditions as well as modeled available groundwater volumes designed for non-drought of record conditions as two segments of the aquifer (the San Antonio Segment within the jurisdiction of the Edwards Aquifer Authority and the Barton Springs Segment) have unique modeled available groundwater volumes dependent upon drought conditions (Figure 8). We compare the modeled available groundwater volume designed for drought of record conditions with the groundwater availability volume from the 2011 regional water plan because availability

[23] The Pecos Valley and Edwards-Trinity (Plateau) combination is not a unique aquifer. See Footnote 16 on page 29 for a detailed explanation.

estimates generated through the regional water planning process are developed for drought of record conditions. We also compare the modeled available groundwater volume designed for non-drought of record conditions[24] with 2011 groundwater pumpage volumes reported through the TWDB's annual Water Use Survey[25] for the aquifer.[26]

For the year 2020, modeled available groundwater volumes designed for drought of record conditions for the Edwards (Balcones Fault Zone) Aquifer total 346,236 acre-feet, whereas regional water planning estimates of groundwater availability for the same decade total 356,121 acre-feet, a difference of just less than 10,000 acre-feet. When comparing 2020 modeled available groundwater volumes designed for non-drought of record conditions with 2011 groundwater pumpage volumes, the non-drought availability estimate (606,028 acre-feet) exceeds pumpage (465,893 acre-feet) by 140,135 acre-feet.

[24] This volume includes 572,000 acre-feet of modeled available groundwater for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority as well as the higher, non-drought modeled available groundwater volume for the Barton Springs Segment of the Edwards (Balcones Fault Zone) Aquifer.

[25] Groundwater pumpage data has also been tailored to match the dataset developed for this project. Records for counties within the jurisdiction of the Edwards Aquifer Authority for the Edwards (Balcones Fault Zone) Aquifer have been included.

[26] Though 2011 was the driest year in Texas's recorded history, conditions did not approach those of the drought of record of the 1950s. Thus, 2011 pumpage volumes are most appropriately compared with non-drought of record conditions.

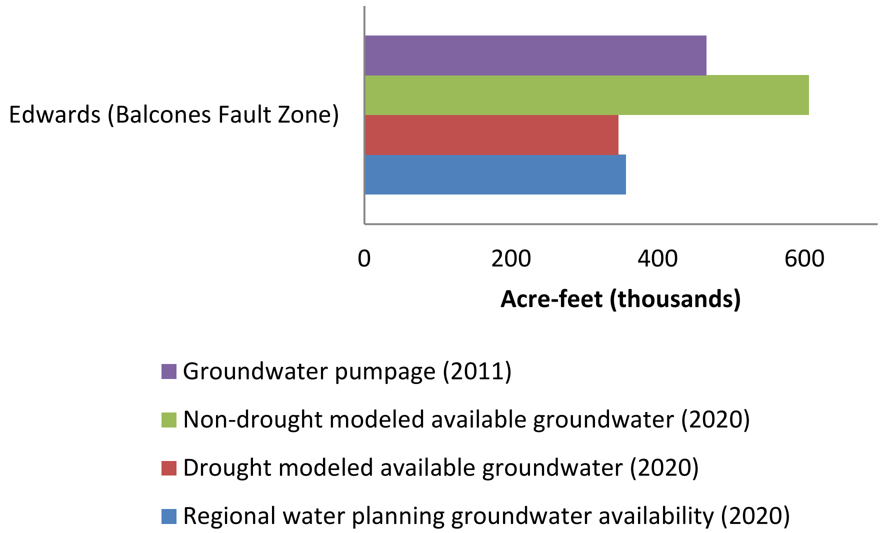

Figure 8: Comparison of groundwater pumpage volumes (2011), non-drought modeled available groundwater volumes (2020), drought modeled available groundwater volumes (2020), and regional water planning groundwater availability volumes for the Edwards (Balcones Fault Zone) Aquifer (2020). This graphic was generated using our subset of the data. For a complete description of the process used to generate this subset, refer to Appendix A.

For the year 2060, estimates of modeled available groundwater volumes designed for drought of record conditions remain the same at 346,236 acre-feet while the regional water planning estimate of groundwater availability climbs slightly to 362,971 acre-feet, increasing the extent to which the planning estimate exceeds the drought modeled available groundwater estimate to 16,735 acre-feet. Non-drought modeled available groundwater volume estimates for 2060 also remain the same at 606,028 acre-feet.

Minor Aquifers

When we take only the state's minor aquifers into consideration, the statewide trends seen in the 2020 comparison of all aquifers remain consistent, though they are more pronounced (Figure 9). The 2011 regional water plans estimate that Texas will have roughly 1.71 million acre-feet of groundwater available from the state's minor aquifers in 2020, whereas modeled available groundwater estimates for the year 2020 indicate that 1.24 million acre-feet will be available. In 2011, Texans pumped roughly 350,000 acre-feet of groundwater from the state's minor aquifers, a volume significantly lower than planning group estimates of groundwater availability and modeled available groundwater volumes for the year 2020. As a result of this difference, 2020 groundwater availability planning group estimates for the state's minor aquifers exceed 2011 groundwater pumpage volumes by roughly 376 percent and 2020 modeled available groundwater volumes exceed 2011 pumpage figures by approximately 246 percent.

Additionally, regional water plan groundwater availability volumes exceed modeled available groundwater volumes by nearly 38 percent for the year 2020. For most of the state's minor aquifers, differences between estimates of groundwater availability using these two approaches are less than 50,000 acre-feet. However, there are three cases in which differences in volumes exceed this figure. Planning estimates of groundwater availability exceed those of modeled available groundwater for the Capitan Reef Complex, Dockum, and Hickory aquifers by 58,136; 242,923; and 231,825 acre-feet, respectively.

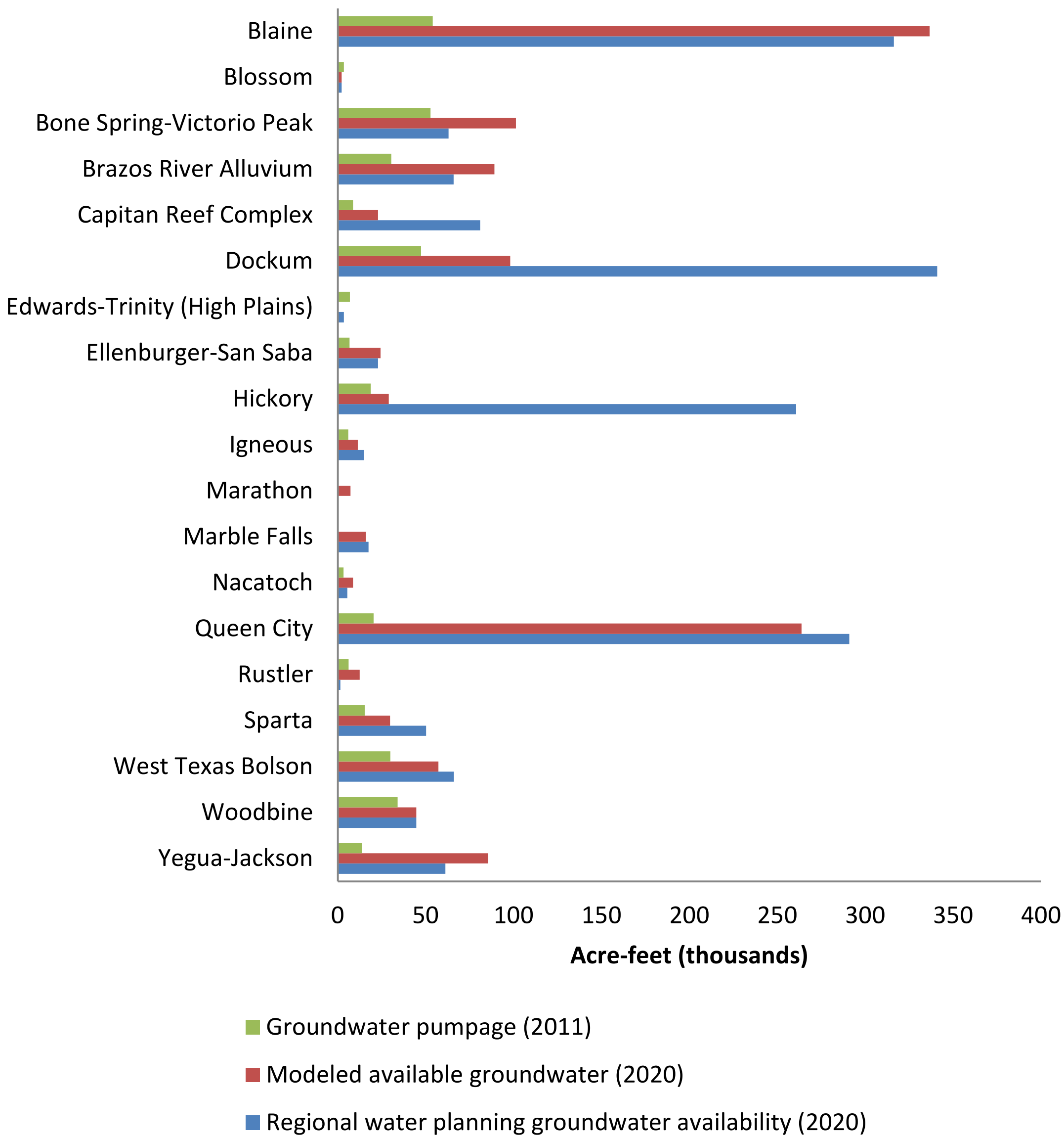

Figure 9: Comparison of modeled available groundwater volumes (2020), regional water planning groundwater availability volumes (2020), and groundwater pumpage volumes (2011) for minor aquifers. This graphic was generated using our subset of the data. For a complete description of the process used to generate this subset, refer to Appendix A.

There is little change in estimated groundwater volumes for the state's minor aquifers from the year 2020 to the year 2060. In 2060, modeled available groundwater estimates show 1.24 million acre-feet of groundwater available while volumes from the 2011 regional water plans reflect groundwater availability of 1.62 million acre-feet. These figures represent a slight reduction in the gap between the two approaches, as the difference is now just over 30 percent. Also, in 2060 the same three aquifers again show groundwater availability estimates developed through the regional water planning process that are more than 50,000 acre-feet greater than modeled available groundwater estimates. For the Capitan Reef Complex and Hickory aquifers, the differences in volumes are again 58,136 acre-feet and 231,825 acre-feet, respectively. For the Dockum Aquifer, the difference in volumes is reduced to 153,227 acre-feet.

Analysis by County

Differences between 2011 regional water plan groundwater availability estimates and modeled available groundwater volumes developed through the desired future conditions process vary by county in the year 2020.[27] In the northern Panhandle, Far West Texas, and in numerous counties near the Gulf Coast, modeled available groundwater volumes exceed planning group groundwater availability volumes. In total, 74 of the 240 counties evaluated in this study are in this category, and for these counties modeled available groundwater volumes exceed planning group groundwater availability volumes by a total of 1,536,094 acre-feet. In northern Central Texas and the Dallas metroplex region, planning group groundwater availability volumes and modeled available groundwater volumes for 69 counties are equal.[28] For an additional 97 counties spread across much of the rest of the state, planning group groundwater availability volumes exceed modeled available groundwater volumes (Figure 10) by a combined total volume of 2,036,528 acre-feet. In general, the differences in estimates of groundwater volumes are less than 50,000 acre-feet per county. However, there are 18 counties in which these differences are greater than 50,000 acre-feet in the year 2020, including five counties (Castro, Dawson, Hale, McCulloch, and Terry) in which differences are greater than 100,000 acre-feet.

[27] We only used volumes in this comparison that met our criteria for inclusion in the project. For a full description of these conditions, refer to Appendix A. Volumes for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority are not included in these county-level analyses. Modeled available groundwater volumes for the Barton Springs Segment of the San Antonio (Balcones Fault Zone) Aquifer are the lower, extreme drought volumes.

[28] We consider differences of less than 1,000 acre-feet to be negligible. Thus, volumes that fall into this category are treated as equivalent for the purposes of the analysis by county.

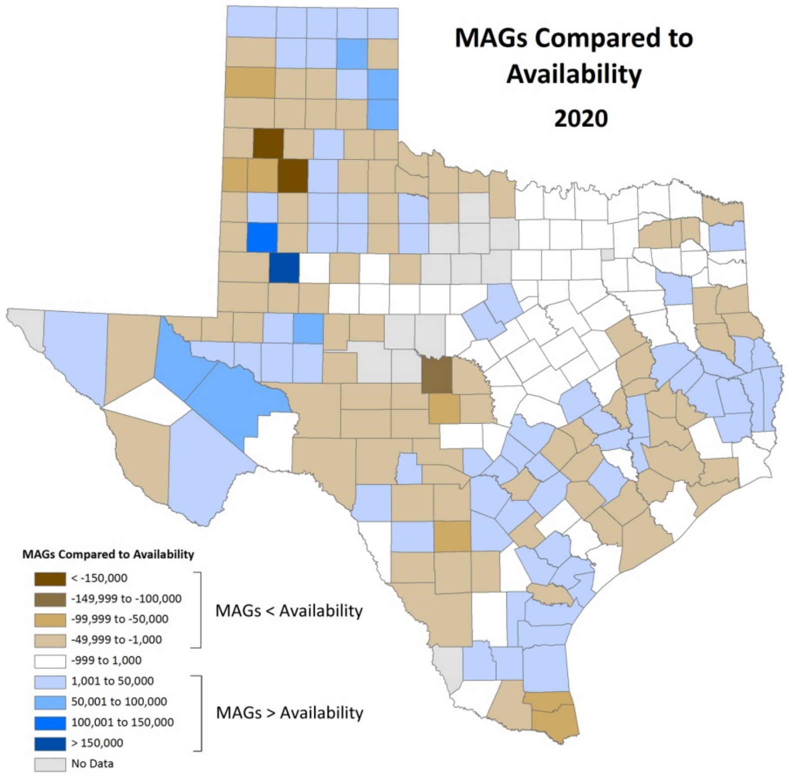

Figure 10: Modeled available groundwater (MAG) volumes compared to regional water planning groundwater availability volumes by county for the year 2020 (acre-feet).

The general trends in spatial distribution regarding 2020 volumes largely hold true when evaluating 2060 volumes (Figure 11), though there are fewer counties in which 2011 regional water plan estimates of groundwater availability exceed those of modeled available groundwater volumes developed through the desired future conditions process. Planning group groundwater availability volumes continue to exceed modeled available groundwater volumes in the majority of Texas counties evaluated, though the number of counties falling into this category drops from 97 to 89. In 73 counties, differences between estimates of groundwater volumes are less than 1,000 acre-feet and can be considered equivalent. For the remaining 78 counties analyzed, estimates of modeled available groundwater exceed planning estimates of groundwater availability. Also, by the year 2060, the number of counties in which differences between estimates of groundwater availability exceed 100,000 acre-feet falls from five to one (McCulloch). Additional maps illustrating differences between planning group groundwater availability volumes and modeled available groundwater volumes at the county level are available in Appendix A. Maps for the same comparison by major aquifer are available in Appendix B. A complete explanation of the methodology used to generate the volumes used for comparison in the map analysis is also included in Appendix A.

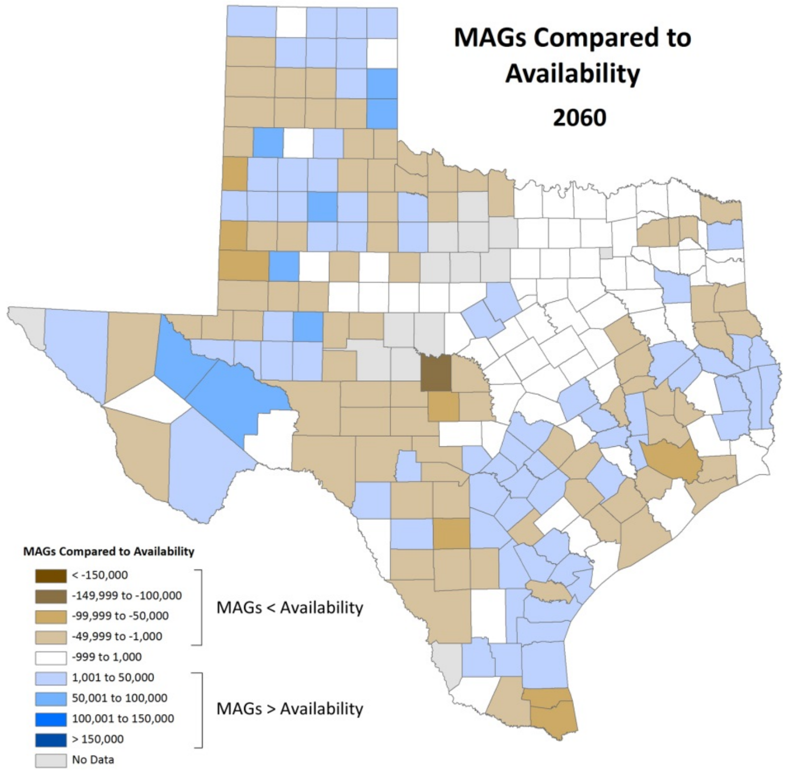

Figure 11: Modeled available groundwater (MAG) volumes compared to regional water planning groundwater availability volumes by county for the year 2060 (measured in acre-feet).

Groundwater Strategies

In addition to assessing water supply, availability, and demand, the regional water planning groups recommended water management strategies to address needs during the planning period. Strategies can involve water conservation, water reuse, surface water or groundwater supply development, desalination, and the conjunctive use of multiple sources. Several types of groundwater management strategies are recommended in the plans, including more groundwater pumping and infrastructure development, conjunctive use of groundwater and surface water supplies, overdrafts, supply redistributions, brackish groundwater desalination, and reallocation of existing supplies, among others. If implemented, groundwater management strategies recommended by the regional water planning groups would result in approximately 800,795 acre-feet per year of additional groundwater supply by 2060, and recommended brackish groundwater desalination strategies would result in an additional 181,568 acre-feet of supply over the same time frame. Thus, full implementation of the 2012 State Water Plan would yield an additional 982,363 acre-feet of groundwater supply by 2060.[29]

[29] These data are inclusive of all groundwater management strategies and are not specific to the data subset analyzed in other sections of this report.

The majority of the planning groups recommended new groundwater infrastructure including wells, treatment plants, and pipelines to meet some of the needs in their regions. New or supplemental wells were recommended in the Carrizo-Wilcox (regions C, D, and I), Dockum (Region A), Edwards-Trinity (Plateau) (Region J), Gulf Coast (regions H and I), Hickory (Region F) Hueco-Mesilla Bolsons (Region E), Igneous (Region E), Nacatoch (regions C and D), Ogallala (regions A and O), Queen City (regions C and I), Trinity (regions C and J), Woodbine (regions C and D), Yegua-Jackson (Region I), and other local aquifers (regions C, E, and J). New or expanded well fields were recommended in the Carrizo-Wilcox (Region L), Dockum (Region G), Gulf Coast (Region M), Ogallala (Region A), Yegua-Jackson (Region M), and other local aquifers (Region M). New or expanded treatment plants were recommended for water from parts of the Carrizo-Wilcox (Region L) Gulf Coast (Region H), Hueco-Mesilla Bolsons (Region E), and Seymour (regions G and B) aquifers to make groundwater supplies meet water quality standards. In addition, five planning groups (regions A, E, F, G, and L) recommended water management strategies involving conveyance or transfer of groundwater supplies through pipelines to meet the needs of urban areas.

Regions E, F, L, M, and O have recommended the construction and operation or expansion of desalination plants to make brackish groundwater supplies usable, primarily for municipal supplies. These planning groups recommend groundwater desalination using the Bone Spring-Victorio Peak, Capitan Reef Complex, Carrizo-Wilcox, Dockum, Edwards-Trinity (High Plains), Gulf Coast, and Yegua-Jackson aquifers, as well as other local aquifers.

Several planning groups recommended various types of conjunctive use projects to meet needs during the planning period. Conjunctive use is the coordinated use of different sources of water—often a surface water source and a groundwater source—to optimize water use and minimize the adverse effects that can come from relying on a single source. A common type of conjunctive use project uses a surface-water supply as the main water source but has groundwater supplies available for use during droughts, peak demand periods, or other times when adequate surface water supplies are not available. Other projects, often referred to as aquifer storage and recovery or groundwater banking projects, use injection wells to put treated surface water into aquifers when additional surface water is available to provide supplies for later use. Some entities in the state, including El Paso Water Utilities and the City of Kerrville, have adopted conjunctive use management policies for all of their water resources. In the 2012 State Water Plan, conjunctive use projects are recommended for the Carrizo-Wilcox (regions G and K), Edwards (Balcones Fault Zone) (Region L), Gulf Coast (regions H, K, and P), Hueco-Mesilla Bolsons (Region E), and Trinity (Region G) aquifers.

Regions B, C, E, G, H, I, K, L, O, and P recommended that some users overdraft their aquifers[30,31]—that is, pump in excess of groundwater availability. Plans recommended overdrafting in parts of the Capitan Reef Complex, Carrizo-Wilcox, Dockum, Edwards (Balcones Fault Zone), Edwards-Trinity (Plateau), Gulf Coast, Ogallala, Queen City, and Trinity aquifers. In more than two-thirds of all cases, this strategy is recommended to meet relatively small needs (less than 5,000 acre-feet per year) for the given decade of the planning period. However, in 2060, three out of eight water planning regions that recommend using water management strategies involving overdrafting plan to use more than 50,000 acre-feet of supply per year from these strategies (68,619 acre-feet per year in Region K; 76,519 acre-feet per year in Region L; and 67,739 acre-feet per year in Region P). In each of these cases, a single county accounts for more than 40 percent of the planned overdrafting volume. In Region K, Bastrop County plans to overdraft 29,977 acre-feet in the year 2060, accounting for nearly 44 percent of all planned overdrafts. In Region L, Gonzales County plans to overdraft 36,400 acre-feet in the year 2060, accounting for nearly 48 percent of planned overdrafts. In Region P, Wharton County plans to overdraft 67,739 acre-feet, accounting for all planned overdrafting volumes for the region.[32] For the next round of planning, regions will no longer be able to recommend overdrafting as a water management strategy.

Some additional recommended strategies do not involve any new physical infrastructure. In several regions, planning groups met user needs by reallocating supplies or transferring pumping rights from water user groups with projected surpluses to water user groups with projected needs. Additionally, several user groups met their needs by purchasing or contracting for additional groundwater supplies from local or regional water suppliers.

[30] Overdrafting data used for this report were shared with the consultants for water planning regions that were identified as having potential overdraft volumes. In each case, the consultants approved the data as accurate.

[31] Overdraft volumes were calculated by subtracting existing supplies for a source and strategy supplies for the source from total availability for that source. Only strategy supplies coded as "Using Water Not Being Used From Current Availability" were included. Negative balances associated with this calculation are attributed to overdrafting.

[32] In 2060, Wharton County also plans to overdraft 12,594 acre-feet in Region K, accounting for more than 18 percent of planned overdrafting in the region.

Groundwater Supplies

Existing groundwater supplies represent the amount of groundwater that can be physically and legally accessed during periods of drought with existing infrastructure, such as wells and pipelines. When considering the complete set of data available for Texas, planning groups estimate that existing groundwater supplies during drought will be about 8 million acre-feet in the year 2010 and could decline by 30 percent to about 5.69 million acre-feet per year by 2060 (Figure 12).

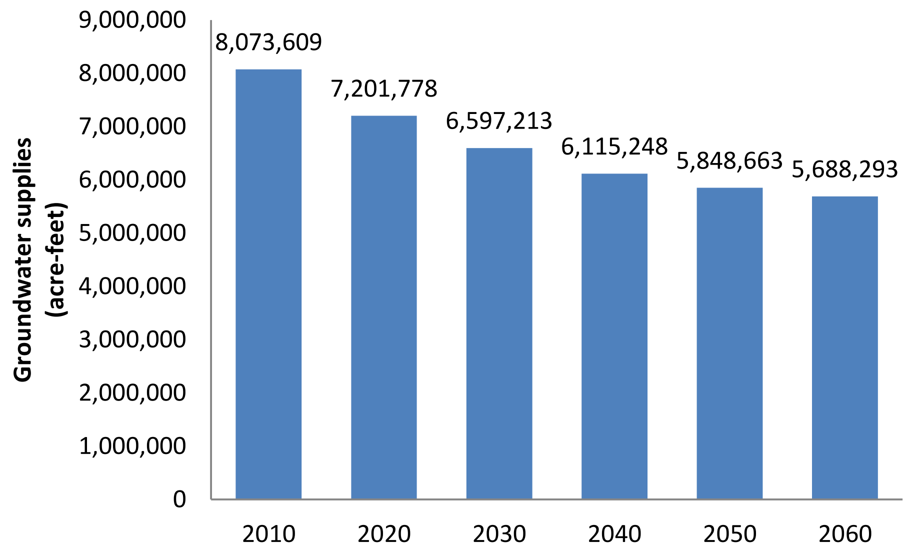

Figure 12: Projected existing groundwater supplies in Texas under drought of record conditions (TWDB, 2012).

This decline in existing supply is due primarily to a reduction in supply from the Ogallala Aquifer as a result of depletion (about 2.1 million acre-feet per year, or 51 percent of total supplies, will be gone by 2060) and a reduction in supply from the Gulf Coast Aquifer as a result of mandatory pumping reductions designed to prevent land subsidence (about 210,000 acre-feet per year less supply by 2060) (Table 5). Between 2010 and 2060, 10 additional aquifers show a decline in existing water supplies. Of the remaining 18 aquifers, supplies for 14 do not change while 4 show an increase in existing supplies. These increases in existing groundwater supplies are likely due to increased pumping of existing well infrastructure and probably represent cases where the planning groups felt that existing infrastructure could support additional pumping.

Table 5: Existing groundwater supplies measured in acre-feet per year (TWDB, 2012).

Aquifer	2010	2020	2030	2040	2050	2060	Percent Change*
Blaine	32,267	28,170	27,702	27,122	25,759	24,496	-24
Blossom	815	815	815	815	815	815	0
Bone Spring-Victorio Peak	63,000	63,000	63,000	63,000	63,000	63,000	0
Brazos River Alluvium	39,198	38,991	38,783	38,783	38,783	38,783	-1
Capitan Reef Complex	23,144	24,669	25,743	26,522	27,017	27,327	18
Carrizo-Wilcox	622,443	627,813	628,534	619,586	614,425	616,855	-1
Dockum	55,585	55,423	61,510	59,837	58,429	57,086	3
Edwards (Balcones Fault Zone)	338,778	338,702	338,828	338,794	338,775	338,763	0
Edwards-Trinity (High Plains)	4,160	3,580	2,802	2,335	2,065	2,065	-50
Edwards-Trinity (Plateau)	225,409	225,450	225,468	225,467	225,467	225,472	0
Ellenburger-San Saba	21,786	21,778	21,776	21,776	21,831	21,886	0
Gulf Coast	1,378,663	1,242,949	1,191,798	1,186,142	1,176,918	1,166,310	-15
Hickory	49,037	49,126	49,205	49,279	49,344	49,443	1
Hueco-Mesilla Bolson	131,826	131,826	131,826	131,826	131,826	131,826	0
Igneous	13,946	13,946	13,946	13,946	13,946	13,946	0
Lipan	42,523	42,523	42,523	42,523	42,523	42,523	0
Marathon	148	148	148	148	148	148	0
Marble Falls	13,498	13,498	13,498	13,498	13,498	13,522	0
Nacatoch	3,733	3,822	3,854	3,847	3,808	3,776	1
Ogallala and Rita Blanca	4,187,892	3,468,454	2,911,789	2,448,437	2,202,499	2,055,245	-51
Other	159,688	159,789	159,820	159,822	159,827	159,896	0
Pecos Valley	120,029	114,937	114,991	115,025	115,071	115,125	-4
Queen City	26,441	26,507	26,574	26,438	26,507	26,556	0
Rustler	2,469	2,469	2,469	2,469	2,469	2,469	0
Seymour	142,021	132,045	128,882	127,530	124,863	122,205	-14
Sparta	25,395	25,373	25,359	24,919	24,924	24,933	-2
Trinity	254,384	250,837	250,544	250,392	249,291	249,040	-2
West Texas Bolsons	52,804	52,804	52,804	52,804	52,804	52,804	0
Woodbine	34,173	34,036	33,932	33,876	33,741	33,688	-1
Yegua-Jackson	8,354	8,298	8,290	8,290	8,290	8,290	-1
Total	**8,073,609**	**7,201,778**	**6,597,213**	**6,115,248**	**5,848,663**	**5,688,293**	**-30**

*Percent represents the percent change from 2010 through 2060.

In addition to estimating existing groundwater supplies, regional water planning groups also estimate how much the implementation of recommended water management strategies will increase future groundwater supplies. When combined, these volumes represent the total groundwater supply volume, referred to in this report as *total groundwater supply*, that will be available if the 2012 State Water Plan is fully implemented.

When estimates of total groundwater supply volumes and of modeled available groundwater volumes are aggregated to the state level using the data that met our criteria for inclusion,[33] modeled available groundwater volumes exceed total groundwater supply volumes by approximately 55 percent in the year 2020.[34] Estimates from the 2011 regional water plans

[33] For the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority, we have assumed that total supplies and modeled available groundwater volumes are equal.

[34] Note that aggregating volumes to the statewide level may obscure both positive and negative local variations such as differences by county. These localized differences can be observed using the maps provided in Appendix A.

reflect a total groundwater supply of approximately 7.19 million acre-feet in the year 2020, based on the combination of existing supplies as well as additional supplies made available through the implementation of the recommended groundwater management strategies included in the state water plan. For the same year, modeled available groundwater estimates for our data subset indicate the availability of 11.18 million acre-feet of groundwater. Thus, on a statewide basis, the volume of groundwater available for use is significantly greater than the volume of water that can be accessed, even under full implementation of the state water plan.

Differences between total groundwater supply volumes and modeled available groundwater volumes estimated for the year 2060 are similar to those estimated for the year 2020. By 2060, our data subset of 2011 regional water planning estimates of total groundwater supply volumes drops to 6.01 million acre-feet, and modeled available groundwater estimates decline to 9.15 million acre-feet. Though both estimates of groundwater volumes decline significantly over this time frame, those declines in volume are comparable as modeled available groundwater volumes continue to exceed total groundwater supply volumes by nearly the same amount. By 2060, estimates of modeled available groundwater volumes exceed those of total groundwater supply volumes by approximately 52 percent when aggregated statewide.

Analysis by Aquifer

When evaluating our data subset for only the state's major aquifers, estimates of modeled available groundwater exceed 2011 regional water planning estimates of total groundwater supply volumes in all cases in the year 2020. The degree to which these modeled available groundwater volumes exceed those of regional planning total groundwater supply varies by aquifer (Table 6). The smallest differential occurs in the Edwards (Balcones Fault Zone) Aquifer (roughly 500 acre-feet) and the largest occurs in the Ogallala and Rita Blanca Aquifer combination (more than 2 million acre-feet). When the state's major aquifers are analyzed collectively, modeled available groundwater volumes (9.94 million acre-feet) exceed total groundwater supply volumes (6.75 million acre-feet) by 47 percent in the year 2020.[35]

[35] Note that aggregating volumes to the aquifer-wide level may obscure both positive and negative local variations such as differences by county. These localized differences for major aquifers can be observed using the maps provided in Appendix C.

Table 6: Number of counties that have modeled available groundwater volumes greater or less than regional water planning total supply volumes for major aquifers in the year 2020 (acre-feet).

Aquifer	< -200,000	-199,999 to -150,000	-149,999 to -100,000	-99,999 to -50,000	-49,999 to -1,000	-999 to 1,000	1,001 to 50,000	50,001 to 100,000	100,001 to 150,000	150,001 to 200,000	> 200,000
Carrizo-Wilcox	0	0	0	0	9	11	37	0	0	0	0
Edwards (Balcones Fault Zone)	0	0	0	0	1	2	2	0	0	0	0
Gulf Coast	0	0	0	0	8	5	36	1	0	0	0
Ogallala	0	2	0	3	9	2	15	2	6	3	4
Pecos Valley and Edwards-Trinity (Plateau)	0	0	0	0	1	7	20	0	1	1	0
Seymour	0	0	0	0	3	10	3	0	0	0	0
Trinity	0	0	0	0	1	28	20	0	0	0	0
All Major Aquifers	0	2	0	3	32	65	133	3	7	4	4

Note: Negative numbers indicate that regional water planning total groundwater supply volumes exceed modeled available groundwater volumes for a county, whereas positive numbers indicate that modeled available groundwater volumes are higher.

By the year 2060, the degree to which estimates of modeled available groundwater volumes (7.91 million acre-feet) for the state's major aquifers exceed planning estimates of total groundwater supply (5.55 million acre-feet) declines slightly from 47 to 42 percent. The degree to which these modeled available groundwater volumes exceed those of regional planning total groundwater supply varies by aquifer (Table 7). Modeled available groundwater volumes exceed those of total groundwater supply estimates for all but one major aquifer, the Edwards (Balcones Fault Zone). In this case, estimates of total supply volumes for 2060 exceed estimates of modeled available groundwater volumes by 6,266 acre-feet. For aquifers with higher estimates of modeled available groundwater than of total supplies, the largest differential occurs for the Ogallala and Rita Blanca Aquifer combination (1.38 million acre-feet).

Table 7: Number of counties that have modeled available groundwater volumes greater or less than regional water planning total supply volumes for major aquifers in the year 2060 (acre-feet).

Aquifer	< -200,000	-199,999 to -150,000	-149,999 to -100,000	-99,999 to -50,000	-49,999 to -1,000	-999 to 1,000	1,001 to 50,000	50,001 to 100,000	100,001 to 150,000	150,001 to 200,000	> 200,000
Carrizo-Wilcox	0	0	0	1	5	17	34	0	0	0	0
Edwards (Balcones Fault Zone)	0	0	0	0	2	2	1	0	0	0	0
Gulf Coast	0	0	0	1	9	6	33	1	0	0	0
Ogallala	0	0	0	3	8	3	19	8	3	1	1
Pecos Valley and Edwards-Trinity (Plateau)	0	0	0	0	1	7	20	0	1	1	0
Seymour	0	0	0	0	3	10	3	0	0	0	0
Trinity	0	0	0	0	1	28	20	0	0	0	0
All Major Aquifers	0	0	0	5	29	73	130	9	4	2	1

Note: Negative numbers indicate that regional water planning total groundwater supply volumes exceed modeled available groundwater volumes for a county, whereas positive numbers indicate that modeled available groundwater volumes are higher.

For the state's minor aquifers, estimates of modeled available groundwater volumes (1.24 million acre-feet) exceed 2011 regional water planning total groundwater supply volumes (0.44 million acre-feet) for the year 2020 by 182 percent when aggregated statewide. However, unlike with the state's major aquifers, regional water planning estimates of total groundwater supply volumes exceed those of modeled available groundwater estimates in some but not all cases. For the Igneous Aquifer and Edwards-Trinity (High Plains) Aquifer, planning estimates of total groundwater supply volumes exceed those of modeled available groundwater by 3,113 and 3,350 acre-feet, respectively. In the case of the Hickory Aquifer, total groundwater supply volumes are higher by approximately 27,000 acre-feet. For the remaining minor aquifers, estimates of modeled available groundwater exceed those of total groundwater supply. This difference in volumes is greatest for the Queen City Aquifer and the Blaine Aquifer, with differences in volumes of approximately 0.24 and 0.31 million acre-feet, respectively.

From 2020 to 2060, the extent to which estimates of modeled available groundwater exceed those of total groundwater supply volumes for the state's minor aquifers also declines slightly, dropping from 182 to 170 percent. The 2011 regional water plans indicate that 0.46 million acre-feet of total groundwater supply will be available, whereas modeled available groundwater estimates show 1.24 million acre-feet of groundwater availability. Modeled available groundwater estimates for the Queen City Aquifer and Blaine Aquifer are again much higher than regional planning estimates of total groundwater supply for these aquifers, with differences of roughly 0.23 million acre-feet and 0.31 million acre-feet, respectively.

By 2060, there are four aquifers for which 2011 regional water planning estimates of total groundwater supply exceed estimates of modeled available groundwater: the Capitan Reef Complex Aquifer (7,401 acre-feet), Edwards-Trinity (High Plains) Aquifer (1,835 acre-feet), Hickory Aquifer (32,306 acre-feet), and the Igneous Aquifer (3,119 acre-feet).

Analysis by County

Using only the data that met our criteria for inclusion in this project, estimates of modeled available groundwater volumes exceed regional planning estimates of total groundwater supply volumes for the year 2020 in 163 of the 240 Texas counties evaluated by 5,009,337 acre-feet (Figure 13). However, in 36 counties, particularly in western Texas, total groundwater supply volumes are higher than modeled available groundwater volumes by 892,031 acre-feet. This volume represents the statewide total amount by which groundwater availabilities defined by groundwater conservation districts limit the implementation of the 2012 State Water Plan. For the remaining 41 counties evaluated, differences between modeled available groundwater volumes and regional planning total groundwater supply volumes were negligible at less than 1,000 acre-feet.

In general, differences between estimates of modeled available groundwater developed through the desired future conditions process and total groundwater supply volumes developed through the 2011 regional water planning process are typically less than 50,000 acre-feet. However, for 25 of the 240 counties evaluated, these differences exceed 50,000 acre-feet. For 12 of these Texas counties (Castro, Collingsworth, Dallam, Dawson, Hale, Hartley, Lipscomb, Ochiltree, Pecos, Roberts, Sherman, and Wheeler), the difference between estimates, either positive or negative, exceeds 150,000 acre-feet.

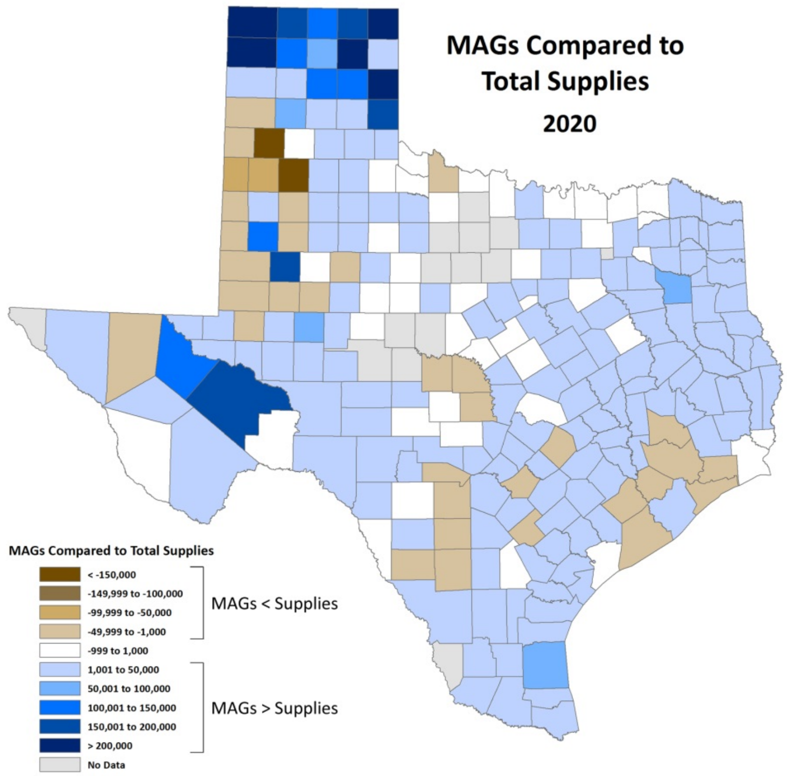

Figure 13: Modeled available groundwater (MAG) volumes compared to total groundwater supply volumes by county for the year 2020 (measured in acre-feet).

By 2060 there are 34 counties for which regional planning total groundwater supply volumes exceed modeled available groundwater volumes, and there are 23 counties for which the difference exceeds 50,000 acre-feet (Figure 14). Also, by 2060 the number of counties for which the difference between modeled available groundwater estimates and 2011 regional water planning total groundwater supply volume estimates exceeds 150,000 acre-feet drops from 12 to 6 (Collingsworth, Hartley, Lipscomb, Pecos, Roberts, and Wheeler). Between 2020 and 2060, the number of counties with total groundwater supply volumes and modeled available groundwater volumes that are essentially equivalent (less than 1,000 acre-feet of difference between volumes) remains unchanged at a total of 41, and the number of counties in which modeled available groundwater estimates exceed regional planning estimates of total groundwater supply grows to 165.

Additional maps illustrating differences between total groundwater supply volumes and modeled available groundwater volumes at the county level are available in Appendix A. Maps for the same comparison by major aquifer are available in Appendix C. A complete explanation of the methodology used to generate the volumes used for comparison in the map analysis is also included in Appendix A.

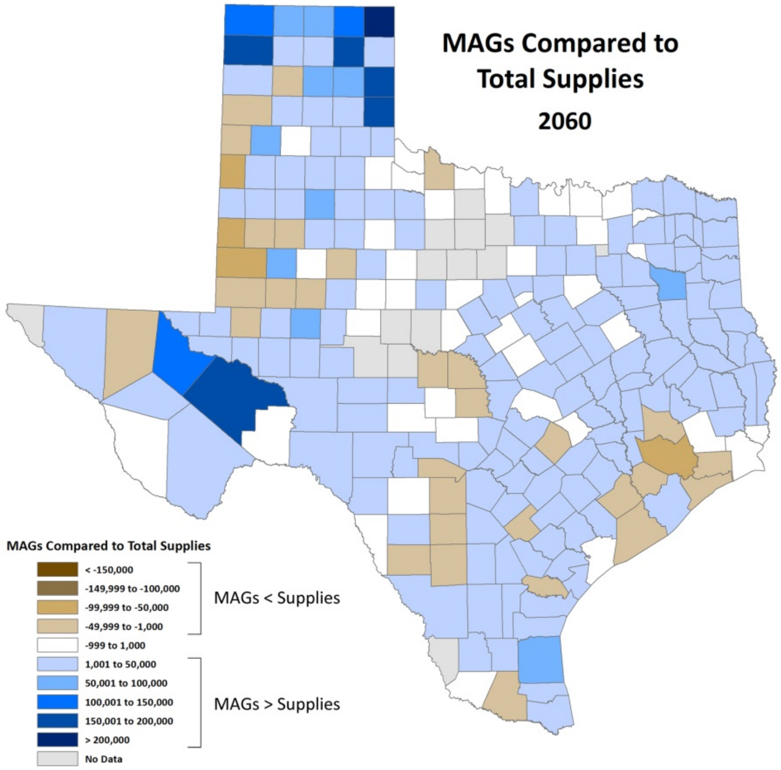

Figure 14: Modeled available groundwater (MAG) volumes compared to total groundwater supply volumes by county for the year 2060 (measured in acre-feet).

The Future

As Texas' population continues to grow, the need to quantify and evaluate the state's groundwater resources intensifies. Through a handful of bills, the Texas Legislature has developed a process, known as the desired future conditions process, for making assessments of groundwater resources more uniform. This process now guides groundwater assessment in the state. Additionally, efforts to expand knowledge of the state's brackish groundwater resources and to determine how to best utilize them are underway.

Planning with Desired Future Conditions

Texas has almost completed its shift toward determining groundwater availability through the desired future conditions process. All groundwater management areas met the first deadline for establishing desired future conditions, and the 2016 regional plans will be the first time estimates of modeled available groundwater determined through the desired future conditions process are the basis of all groundwater availability estimates.[36] Senate Bill 660, passed in 2011 by the 82nd Texas Legislature, aims to facilitate the process by increasing communication

[36] This excludes groundwater availability estimates for the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer, the Hueco-Mesilla Bolsons Aquifer, and any aquifers or portions of aquifers designated by groundwater conservation districts as non-relevant to the joint planning process.

between regional planning groups and groundwater management areas. This legislation requires that a district representative from each groundwater management area overlapping a regional planning group serve as a voting member on that regional planning group.

Additional charges stemming from Senate Bill 660 have made the process for establishing desired future conditions more involved than the first round. Groundwater conservation districts are now required to consider a list of factors set forth in statute when developing desired future conditions, to propose these conditions for adoption, and to hold a public comment period with public hearings prior to adopting the final conditions. Desired future conditions are required to be re-adopted every five years. However, Senate Bill 1282 passed in 2013 by the 83rd Texas Legislature extended the deadline to propose desired future conditions for adoption until May 1, 2016. This bill helps to better align the desired future condition process with the regional water planning process. Despite this extension, many groundwater management areas are already in the process of developing their second round of desired future conditions.

Brackish Groundwater Resources

Though many groundwater users across the state, particularly agricultural and irrigation users in West Texas, have used lower quality groundwater resources for years, the importance of brackish groundwater as an important new water supply in Texas is increasing as municipal and industrial sectors increasingly look for new sources of supply. Aquifers in the state contain more than 2.7 billion acre-feet of brackish water (LBG-Guyton, 2003), making this resource's potential impact on the state's future water supply significant.

When used for potable purposes, brackish groundwater has to be treated (desalinated) or blended with other waters to reduce the concentrations of dissolved solids and other chemicals. In the 2012 State Water Plan, five regional water planning groups (regions E, F, L, M, and O) recommended brackish groundwater desalination as a water management strategy to meet at least some of their projected water needs. In total, the regional water planning groups project that desalting brackish groundwater can create roughly 181,568 acre-feet of new water per year by 2060. This volume accounts for two percent of all recommended water management strategies included in the most recent state water plan (TWDB, 2012).

Though we have known about Texas' brackish groundwater resources for many years, the information required to develop and use these supplies is not yet fully developed (Figure 15). In 2009 the Texas Legislature funded a statewide program—the Brackish Resources Aquifer Characterization System—to map and characterize brackish groundwater resources in the state and to facilitate the planning of desalination projects. The primary goal of the program is to map and characterize the 26 designated major and minor aquifers that are known to contain brackish groundwater so that water resource managers will be able to target areas of high potential for test-well fields. To date, the TWDB has completed three studies (Pecos Valley Aquifer in West Texas; Queen City and Sparta aquifers in Atascosa and McMullen counties; and Gulf Coast Aquifer in the Lower Rio Grande Valley), and two more studies are expected to be finalized in December 2015 (Carrizo-Wilcox Aquifers in Central Texas and Permian-Pennsylvanian formations in and around Wichita Falls).

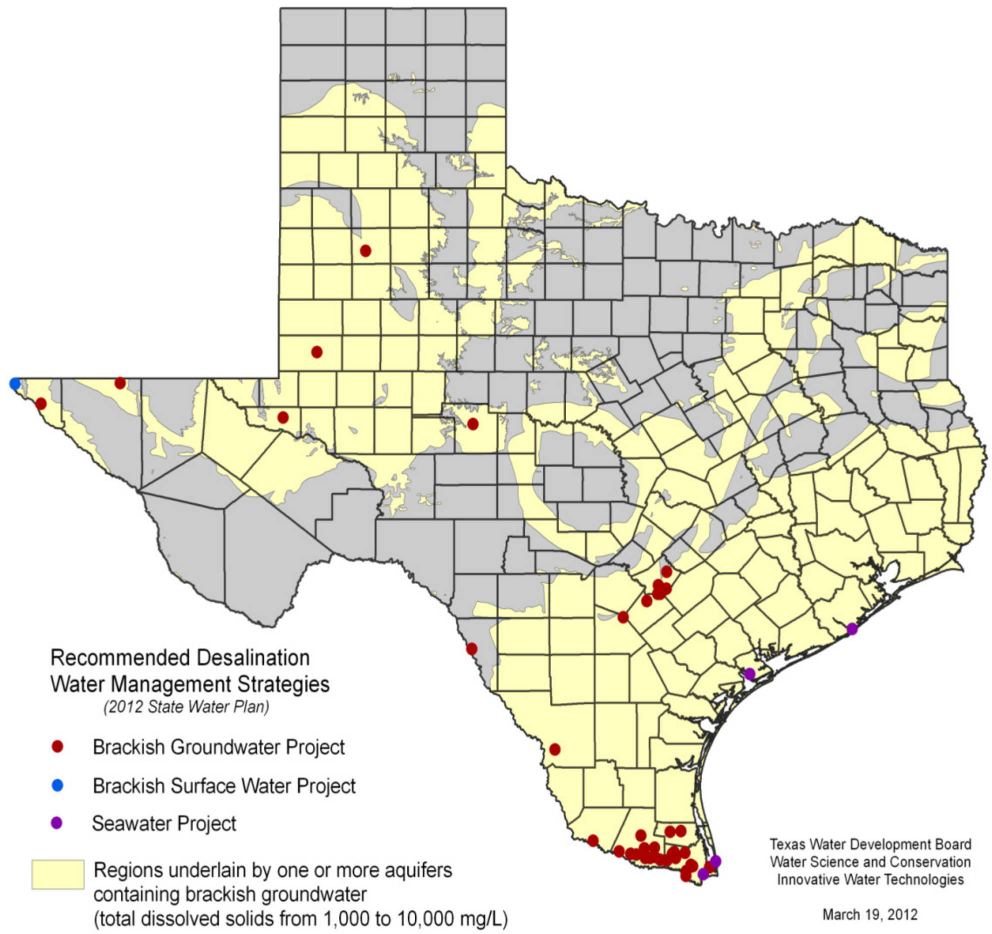

Figure 15: Distribution of brackish groundwater in the major and minor aquifers of Texas and location of recommended brackish and seawater desalination plants (TWDB, 2012).

As the importance of brackish groundwater grows, groundwater conservation districts are starting to take steps to manage the resource. One such step is the development of desired future conditions for brackish groundwater resources. At present, only the saline Edwards Aquifer in the northern subdivision of Groundwater Management Area 10 and the Yegua-Jackson Aquifer in Grimes and Walker counties within Groundwater Management Area 14 have specific desired future conditions statements for brackish groundwater resources. The statement for the saline Edwards Aquifer requires well drawdown at the saline-freshwater interface to average no more than 5 feet and to not exceed a maximum of 25 feet at any one point on the interface. This translates to a modeled available groundwater volume of approximately 1,180 acre-feet per year (Bradley, 2011).

The desired future condition statement for the Yegua-Jackson Aquifer is an average aquifer drawdown of 20 feet in the brackish-confined Yegua and 20 feet in the brackish-confined Jackson. This translates to a modeled available groundwater volume of approximately 870 acre-feet per year (Oliver, 2012). While these are the only desired future conditions statements specifically mentioning brackish groundwater, many other desired future conditions statements include brackish groundwater because most, if not all, of Texas' aquifers contain brackish groundwater. Thus, desired future conditions statements for an aquifer inherently incorporate some amount of brackish groundwater. Some aquifers, such as the Bone Spring-Victorio Peak Aquifer, contain nothing but brackish groundwater, so their desired future condition is, by default, a desired future condition for brackish groundwater. In the future, it is likely that more groundwater conservation districts will develop desired future conditions specific to brackish groundwater resources in response to growing demand.

Conclusion

Groundwater is an important existing and future source of supply for the state of Texas and represented 58 percent of all water used statewide in 2011. Groundwater in Texas is primarily located in 30 recognized aquifers, although groundwater also exists in smaller amounts around the state. Though the 16 regional water planning groups have historically used a variety of methods to determine the groundwater availability volumes to plan for this resource, House Bill 1763 (2005) established a new approach that calls for the establishment of desired future conditions. However, the 2011 regional water plans were completed prior to the full implementation of this new process, and the resulting 2012 State Water Plan incorporates this and other methodologies to determine groundwater availability. The 2016 regional plans and 2017 State Water Plan will be the first time that all estimates of modeled available groundwater determined through the desired future condition process are the basis of groundwater availability for the 16 regional water plans.

When aggregating data to the statewide level, regional planning groups estimated that, during drought conditions, 11.68 million acre-feet of groundwater will be available in 2020, and will decrease to 9.43 million acre-feet by 2060. Modeled available groundwater estimates indicate that 11.18 million acre-feet will be available in 2020 and 9.15 million acre-feet will be available per year by 2060. Regional planning group estimates of total groundwater supply volumes indicate that, if the State Water Plan is fully implemented, 7.19 million acre-feet of groundwater will be accessible in 2020 and 6.01 million acre-feet will be accessible by 2060. Decreases in groundwater volumes over this time frame are the result of projected declines in the Dockum, Edwards-Trinity (High Plains), Gulf Coast, Ogallala, Rita Blanca, and Seymour aquifers.

With the population of Texas expected to increase by 82 percent from 2010 to 2060, comprehensive water resource planning can help meet the state's changing needs. Full implementation of the joint planning process, advances in brackish groundwater technology, future studies, and changes in policy may impact current estimates of the groundwater resources that will be available in the decades to come. The more we know about groundwater, the easier it will be to prepare for Texas' water future.

Acknowledgements

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References

Bradley, R. G., 2011, GTA Aquifer Assessment 10-35 MAG-Groundwater Management Area 10, Northern Saline Edwards Aquifer: TWDB Report, 13 p.

George, P.G., R. E. Mace, and R. Petrossian, 2011, Aquifers of Texas: Texas Water Development Board Report 380, 172 p.

Keech, C. F., and V. H. Dreeszen, 1959, Geology and ground-water resources of Clay County, Nebraska (with a section on chemical quality of the water by F. H. Rainwater): U.S. Geological Survey Water-Supply Paper 1468, 157 p.

Klemt, W. B., T. R. Knowles, G. Elder, and T. Sieh, 1979, Ground-water resources and model applications for the Edwards (Balcones Fault Zone) Aquifer in the San Antonio region, Texas: Texas Department of Water Resources Report 239, 88 p.

Klemt, W. B., R. D. Perkins, and H. J. Alvarez, 1975, Ground-water resources of part of central Texas with emphasis on the Antlers and Travis Peak formations: Texas Water Development Board Report 195, v. 1 and 2, 594 p.

Knowles, T. R., P. Nordstrom, and W. B. Klemt, 1984, Evaluating the ground-water resources of the High Plains of Texas: Texas Department of Water Resources Report 288, v. 1, 119 p.

LBG-Guyton, 2003, Brackish groundwater manual for Texas Regional Planning Groups: LBG-Guyton and Associates, contract report by LBG-Guyton and Associates, Inc., to the Texas Water Development Board, 188 p.

Mace, R. E., and S. C. Davidson, 2007, Groundwater Supplies and Availability in Texas: Results from the 2006 Regional Water Plans and the 2007 State Water Plan: Gulf Coast Association of Geological Societies Transactions, v. 57, p. 523-541.

Mace, R. E., W. F. Mullican, III, and C. R. Williams, 2002, Groundwater supply and availability in Texas—Results from regional water planning: Gulf Coast Association of Geological Societies Transactions, v. 52, p. 681-694.

Mace, R. E., W. F. Mullican, III, and T. (S.-C.) Way, 2001, Estimating groundwater availability in Texas, in the proceedings of the 1st annual Texas Rural Water Association and Texas Water Conservation Association Water Law Seminar: Water Allocation in Texas: The Legal Issues: Austin, Texas, January 25-26, 2001, Section 1, 16 p.

Meyer, W. R., and J. D. Gordon, 1972, Development of ground water in the El Paso district, Texas: Texas Water Development Board 153, 50 p.

Meyer, W. R., 1976, Digital model for simulated effects of ground-water pumping in the Hueco Bolson, El Paso area, Texas, New Mexico, and Mexico: U.S. Geological Survey Water-Resources Investigations 58-75, 31 p.

Muller, D. A., and R. D. Price, 1979, Ground-water availability in Texas, estimates and projections through 2030: Texas Department of Water Resources Report 238, 77 p.

Oliver, W., 2012, GAM Run 10-55 MAG Version 2: Modeled Available Groundwater for the Yegua-Jackson Aquifer in Groundwater Management Area 14: TWDB Report, 17 p.

Peckham, R. C., V. L. Souders, J. W. Dillard, and B. B. Baker, 1963, Reconnaissance investigation of the ground-water resources of the Trinity River basin, Texas: Texas Water Commission Bulletin 6309, 120 p.

Shamburger, V. M., Jr., 1967, Ground-water resources of Mitchell and western Nolan counties, Texas: Texas Water Development Board Report 50, 184 p.

Thorkildsen, D., R. Quincy, and R. Preston, 1989, A digital model of the Carrizo-Wilcox Aquifer within the Colorado River Basin of Texas: Texas Water Development Board, LP-208, 59 p.

TWDB, 2002, Water for Texas—2002: Texas Water Development Board, Austin, Texas, 155 p.

TWDB, 2007, Water for Texas—2007: Texas Water Development Board, Austin, Texas, 392 p.

TWDB, 2012, Water for Texas—2012: Texas Water Development Board, Austin, Texas. 299 p.

Walton, W. C., 1962, Selected analytical methods for well and aquifer evaluation; Illinois State Water Survey Bulletin 49, 81 p.

Appendix A: Statewide Maps

Maps contained in this appendix compare 2011 regional water planning groundwater availability volumes and 2011 regional water planning total supply volumes with modeled available groundwater volumes (MAG), measured in acre-feet per year, at the county level. In our analysis, we compared volumes by decade from 2020 through 2060. However, we only included maps for 2020, 2040, and 2060 as this subset adequately reflects the changes that occur during this time frame.

We used the 2012 Texas State Water Plan and the Texas Water Development Board's water planning database to generate the following map series. The first series of three maps compares 2012 State Water Plan groundwater availability volumes, compiled from the 2011 regional water plans, with modeled available groundwater volumes based on the desired future conditions listed in Appendix D. The second series of three maps compares regional planning total groundwater supply volumes, a combination of existing water supply volumes and supply volumes generated through the implementation of the state water plan, with modeled available groundwater volumes.

Before generating the maps included in this project, we refined the data to ensure comparability. If a county did not have a record for groundwater availability from the 2011 regional water plans, a record for modeled available groundwater based on a desired future condition statement, and either a 2011 regional water planning value for existing supply and/or a value for supply based on a recommended water strategy from the 2011 regional water plans, we excluded it. We also excluded records for aquifers that are not considered either a major or minor aquifer, as well as records for an aquifer in a given county if there was not both a groundwater availability volume and a modeled available groundwater volume specific to that county.

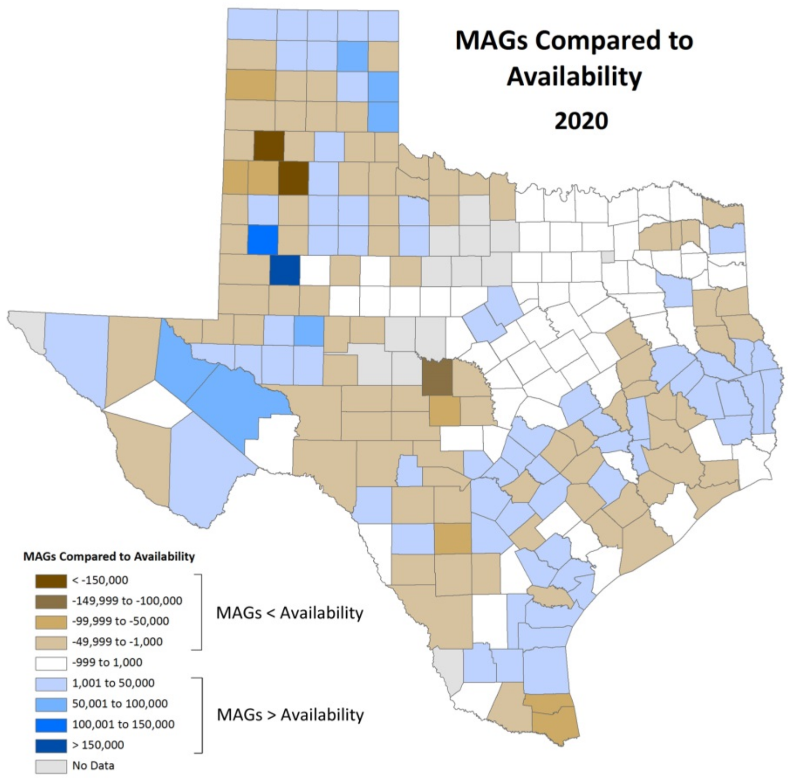
Additionally, we omitted records for aquifers in a given county if the aquifer was declared non-relevant in that county. In some cases, only a portion of an aquifer within a particular county was declared non-relevant. In the majority of these situations, we excluded the entire record for the aquifer in that county as assessing modeled available groundwater, availability, and supply volumes at the sub county level is beyond the scope of this project. However, in cases where the portion of the aquifer within a county that was declared non-relevant constitutes less than 10 percent of the total area of that aquifer within the county, we have maintained these records for comparison. We included eight county/aquifer combinations based on this criterion.[37] We then matched aquifer names used in the 2011 regional water plans with the

[37] The non-relevant portion of the aquifer is less than 10 percent of the total area of the aquifer for that county in the following cases: Bexar (Trinity), Bowie (Carrizo-Wilcox), Fayette (Queen City, Yegua-Jackson), Kimble (Edwards-Trinity [Plateau]), McMullen (Carrizo-Wilcox), Red River (Nacatoch), and Runnels (Lipan).

aquifer names that are being used by the TWDB to ensure that no records were omitted based on changes in nomenclature used in the TWDB database.[38] Lastly, we eliminated values for supply based on recommended water strategies from the 2011 regional water plans if they did not directly involve groundwater pumping.

All maps in this appendix use the same legend format. Counties shaded brown represent areas where availability/supply volumes exceed modeled available groundwater volumes, and counties shaded blue indicate areas where modeled available groundwater volumes are higher. White represents counties for which the difference between volumes is less than 1,000 acre-feet, an amount that we consider negligible. Counties colored gray did not have adequate data for inclusion.

[38] The TWDB periodically updates the nomenclature used in its database to accurately reflect updated groupings and delineations of the state's aquifers.


MAGs Compared to Availability
2020
MAGs Compared to Availability
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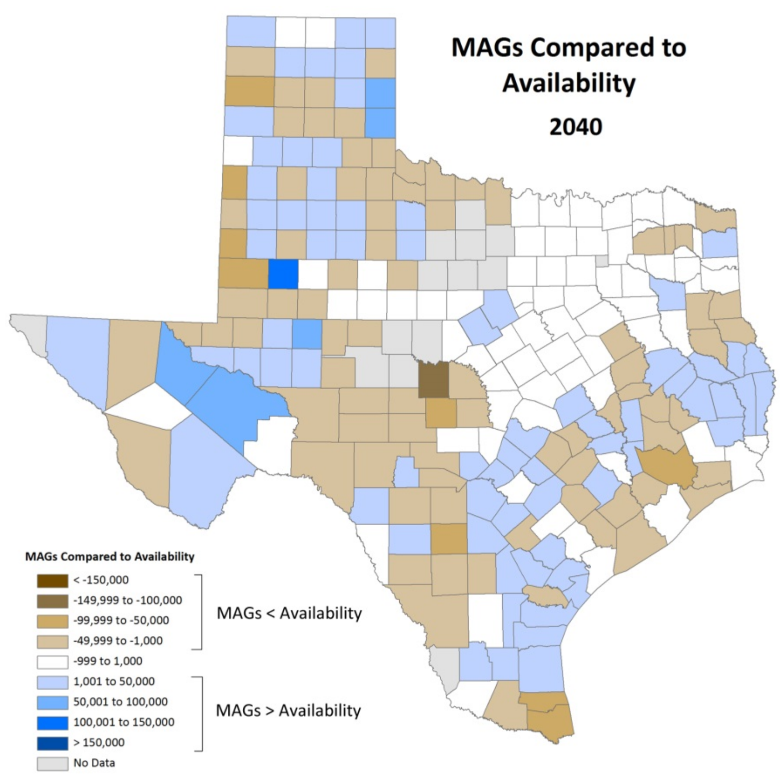
-149,999 to -100,000
-99,999 to -50,000
-49,999 to -1,000
-999 to 1,000
1,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


MAGs Compared to Availability
2040
MAGs Compared to Availability
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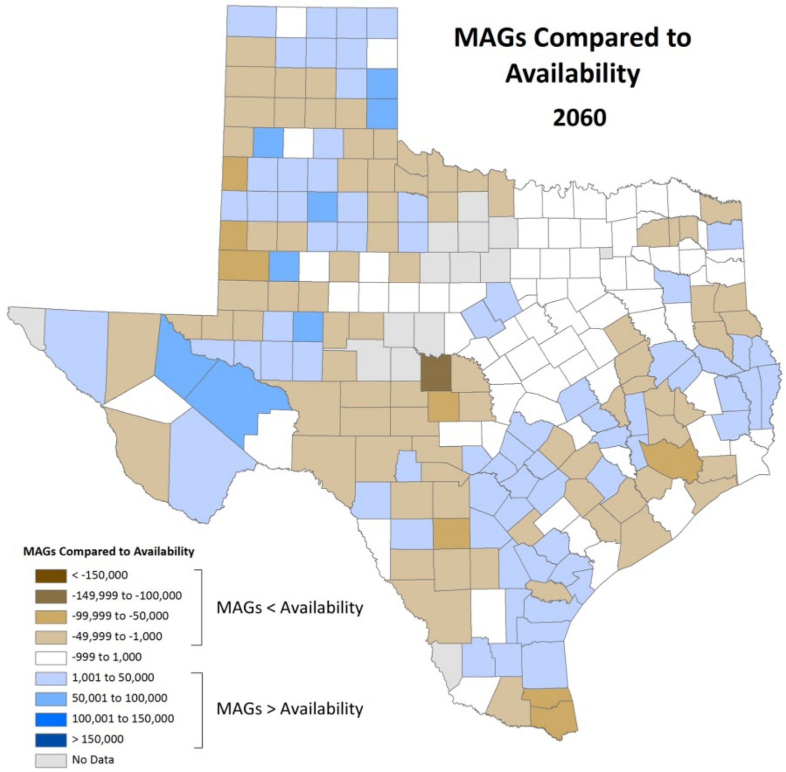
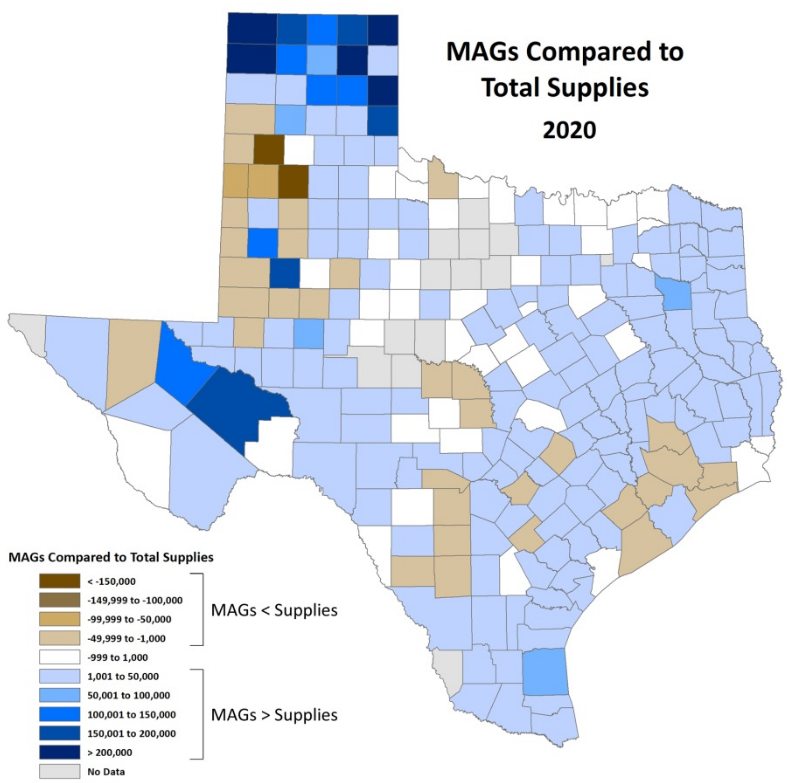
-149,999 to -100,000
-99,999 to -50,000
-49,999 to -1,000
-999 to 1,000
1,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


MAGs Compared to Availability
2060
MAGs Compared to Availability
< -150,000
-149,999 to -100,000
-99,999 to -50,000
-49,999 to -1,000
-999 to 1,000
1,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


MAGs Compared to Total Supplies
2020
MAGs Compared to Total Supplies
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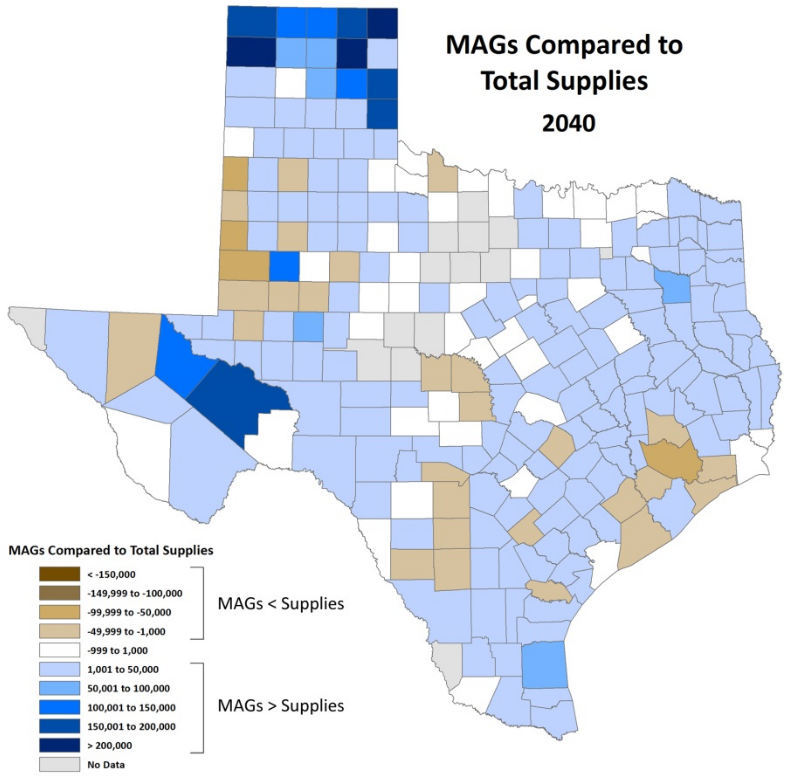
-149,999 to -100,000
-99,999 to -50,000
-49,999 to -1,000
-999 to 1,000
1,001 to 50,000
50,001 to 100,000
100,001 to 150,000
150,001 to 200,000
> 200,000
No Data
MAGs < Supplies
MAGs > Supplies


MAGs Compared to Total Supplies
2040
MAGs Compared to Total Supplies
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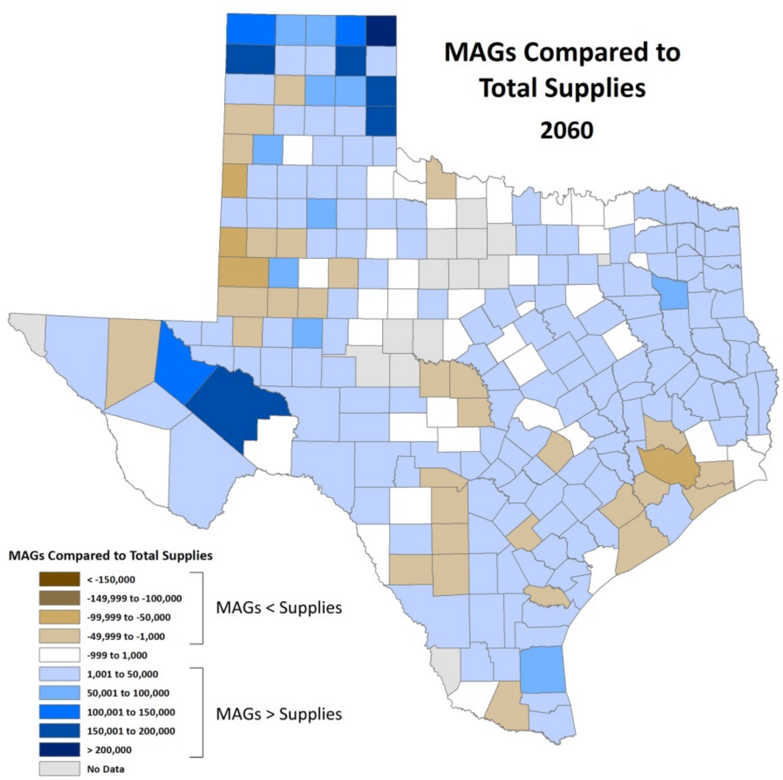
-149,999 to -100,000
-99,999 to -50,000
-49,999 to -1,000
-999 to 1,000
1,001 to 50,000
50,001 to 100,000
100,001 to 150,000
150,001 to 200,000
> 200,000
No Data
MAGs < Supplies
MAGs > Supplies


MAGs Compared to Total Supplies
2060
MAGs Compared to Total Supplies
< -150,000
-149,999 to -100,000
-99,999 to -50,000
-49,999 to -1,000
-999 to 1,000
1,001 to 50,000
50,001 to 100,000
100,001 to 150,000
150,001 to 200,000
> 200,000
No Data
MAGs < Supplies
MAGs > Supplies

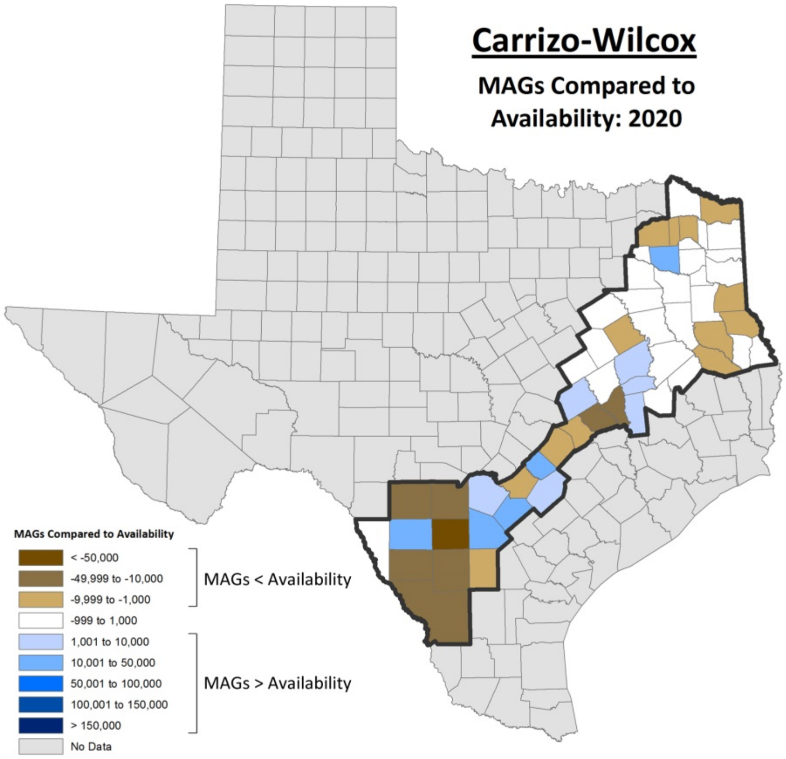
Appendix B: Aquifer Maps – Availability

Maps contained in this appendix compare 2011 regional water planning groundwater availability volumes to modeled available groundwater volumes (MAG) developed through the desired future conditions process. All volumes are measured in acre-feet per year by major aquifer. Though Texas contains nine such aquifers, we only consider eight here. We omitted the Hueco-Mesilla Bolsons aquifers as there are no modeled available groundwater volumes within their extent. We also combined and analyzed jointly data for the Pecos Valley and Edwards-Trinity (Plateau) aquifers[39] as some values associated with these aquifers were represented concurrently and could not be separated. Additionally, we omitted the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer under the jurisdiction of the Edwards Aquifer Authority as its availability volumes are established through legislation rather than the joint planning process. Though we compared volumes by decade for the period from 2020 through 2060, we only included maps for 2020, 2040, and 2060 as this subset adequately reflects the changes that occur during this time frame.

The 2012 Texas State Water Plan and the Texas Water Development Board's water planning database are the data sources used to generate the following series of maps. Maps included in this appendix compare 2011 regional water planning groundwater availability volumes, which are compiled in the 2012 State Water Plan, with modeled available groundwater volumes based on the desired future conditions listed in Appendix D. For a more complete description of the methodology used to generate these maps, see Appendix A.

All maps use the same legend format. Counties shaded brown represent areas where availability volumes exceed modeled available groundwater volumes, and counties shaded blue indicate areas where modeled available groundwater volumes are higher. White represents counties for which the difference between volumes is less than 1,000 acre-feet, an amount that we consider negligible. Counties colored gray did not have adequate data for inclusion, either because the county does not overlay the aquifer in question or because data for the aquifer in that county were inadequate.

[39] The Pecos Valley and Edwards-Trinity (Plateau) combination is not a unique aquifer. Due to there being a lumped representation of the Pecos Valley and Edwards-Trinity (Plateau) aquifers in some portions of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers at the time that we conducted this analysis, we have combined volumes for the individual aquifers as well as the lumped volumes.


Carrizo-Wilcox
MAGs Compared to Availability: 2020
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
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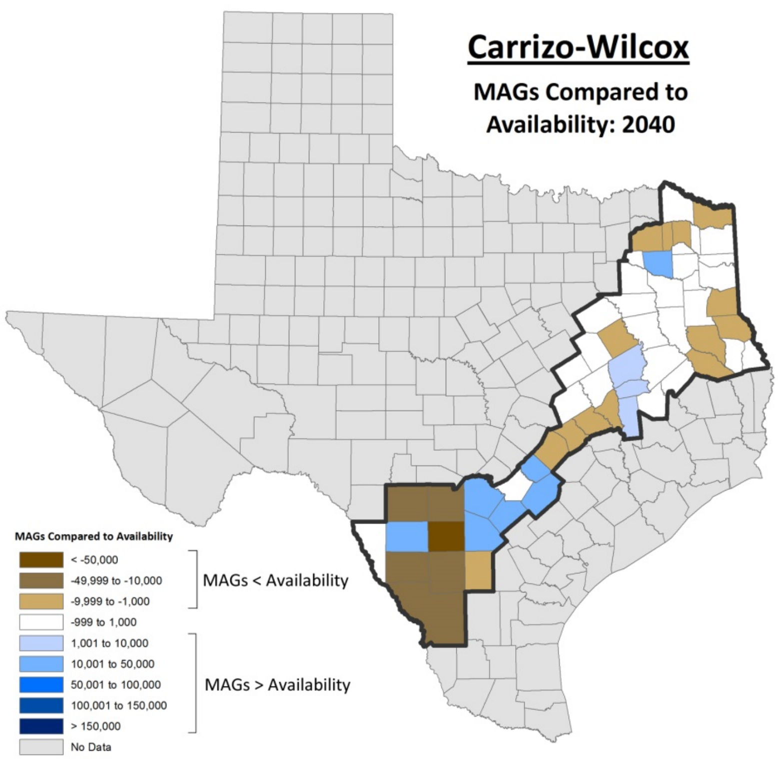
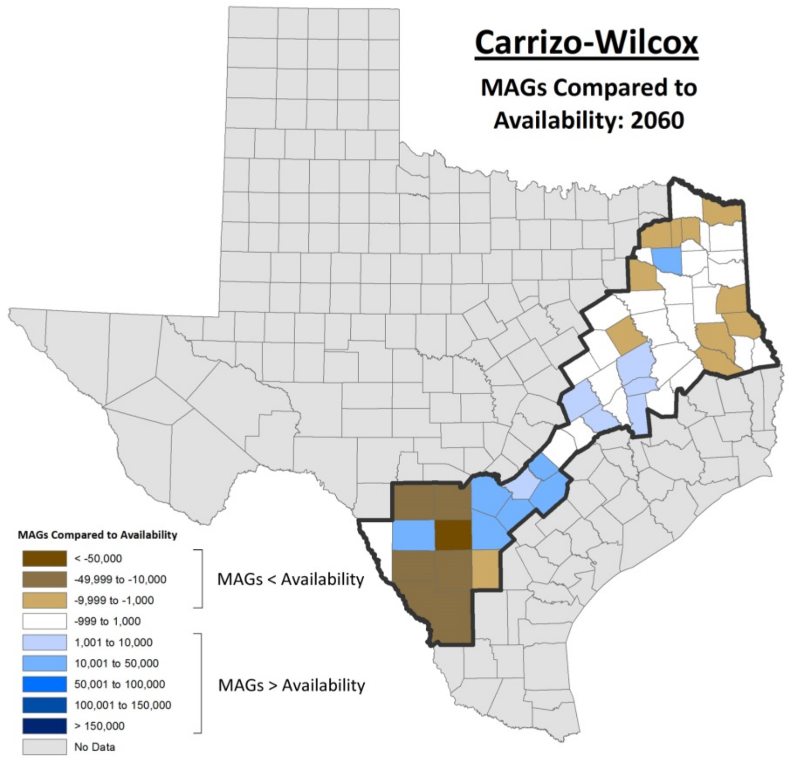
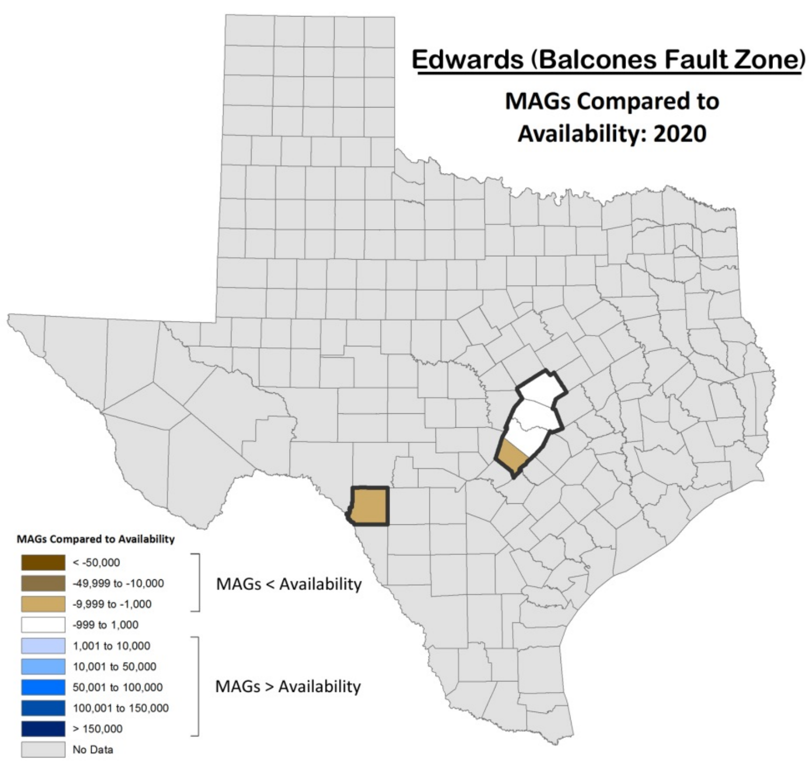
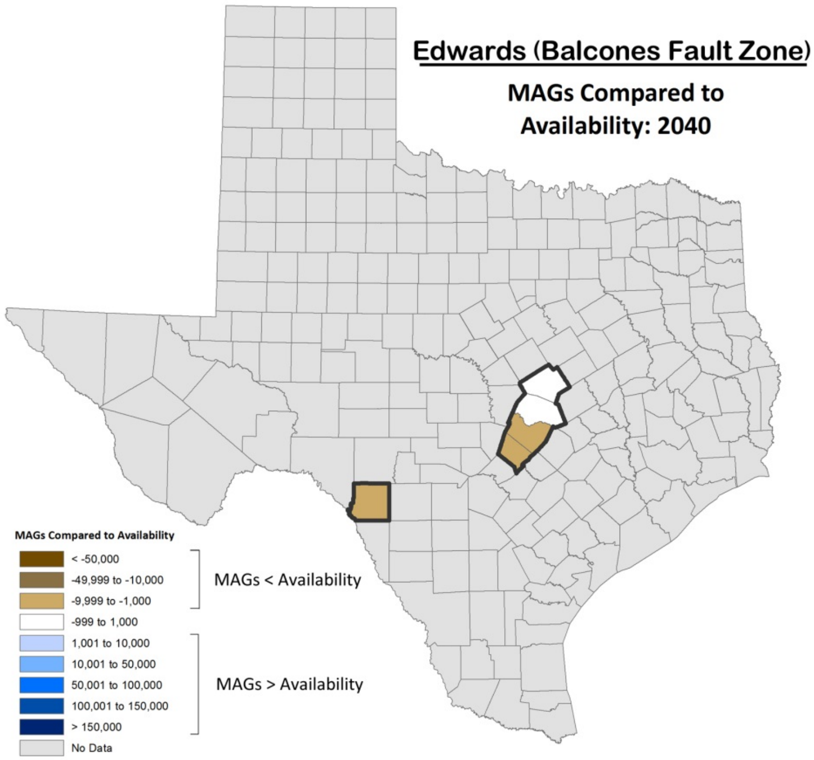
MAGs < Availability
MAGs > Availability


Carrizo-Wilcox
MAGs Compared to Availability: 2040
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Carrizo-Wilcox
MAGs Compared to Availability: 2060
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Edwards (Balcones Fault Zone)
MAGs Compared to Availability: 2020
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Edwards (Balcones Fault Zone)
MAGs Compared to Availability: 2040
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
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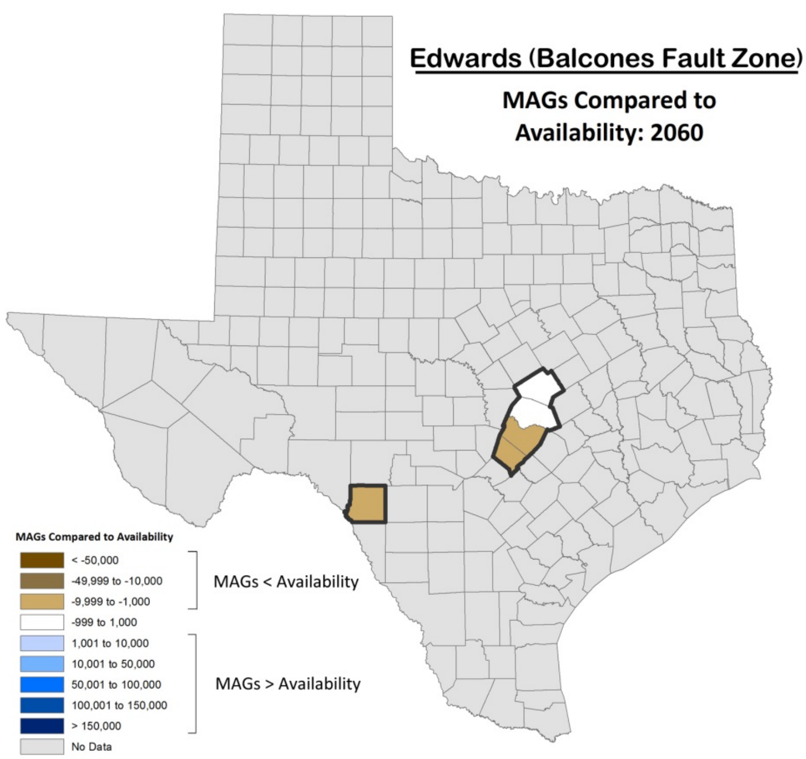
No Data
MAGs < Availability
MAGs > Availability


Edwards (Balcones Fault Zone)
MAGs Compared to Availability: 2060
MAGs Compared to Availability
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-49,999 to -10,000
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-999 to 1,000
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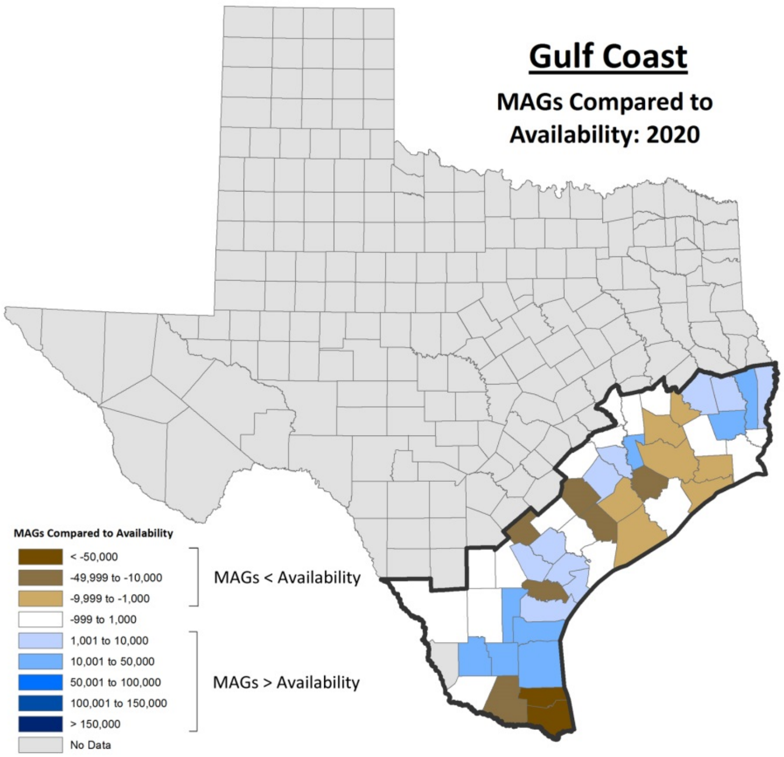
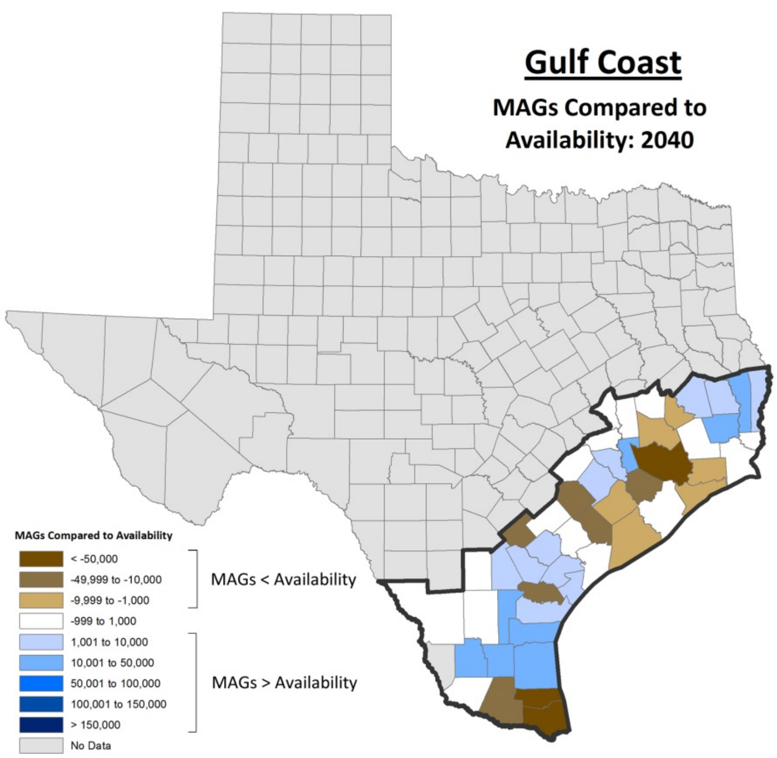
MAGs < Availability
MAGs > Availability


Gulf Coast
MAGs Compared to Availability: 2020
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Gulf Coast
MAGs Compared to Availability: 2040
MAGs Compared to Availability
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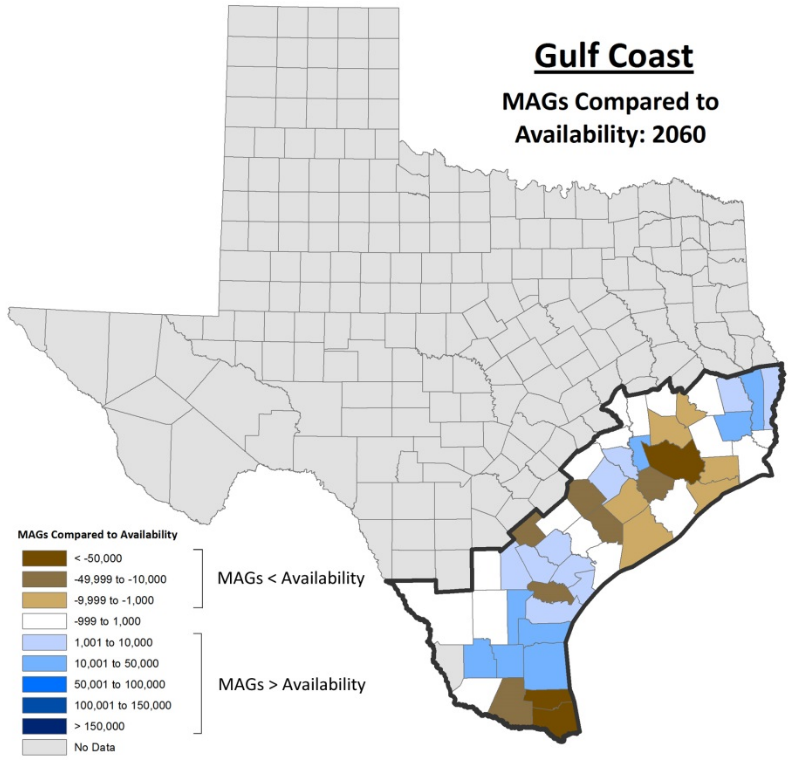
MAGs < Availability
MAGs > Availability


Gulf Coast
MAGs Compared to Availability: 2060
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
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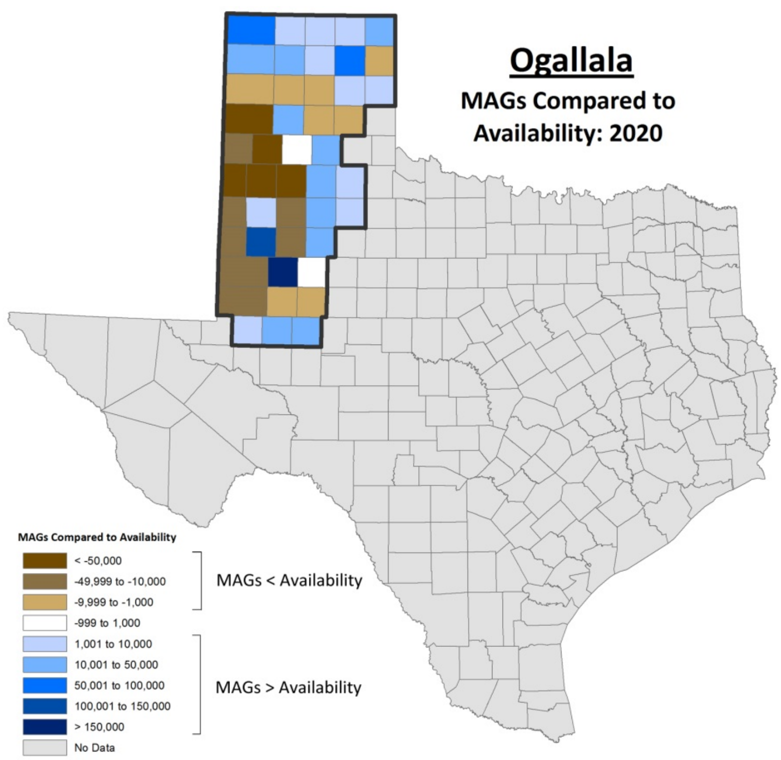
MAGs < Availability
MAGs > Availability


Ogallala
MAGs Compared to Availability: 2020
MAGs Compared to Availability
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-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
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50,001 to 100,000
100,001 to 150,000
> 150,000
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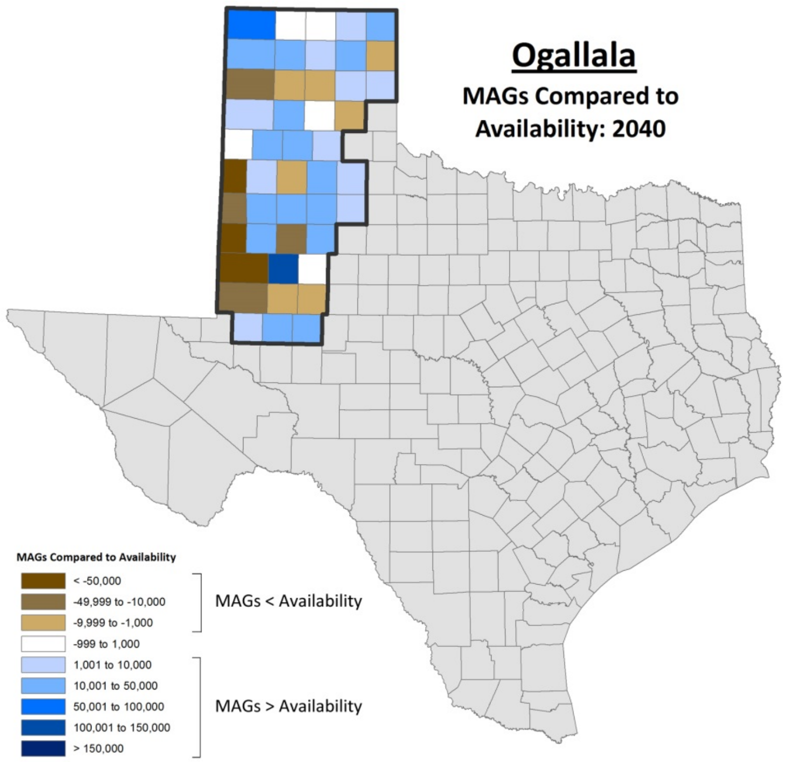
MAGs < Availability
MAGs > Availability


Ogallala
MAGs Compared to Availability: 2040
MAGs Compared to Availability
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-9,999 to -1,000
-999 to 1,000
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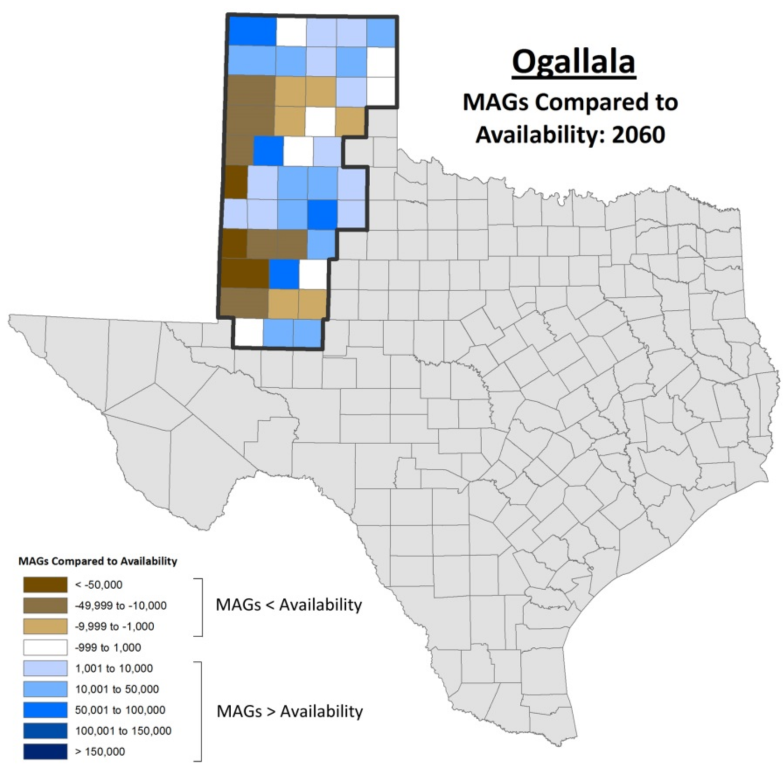
MAGs < Availability
MAGs > Availability


Ogallala
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MAGs < Availability
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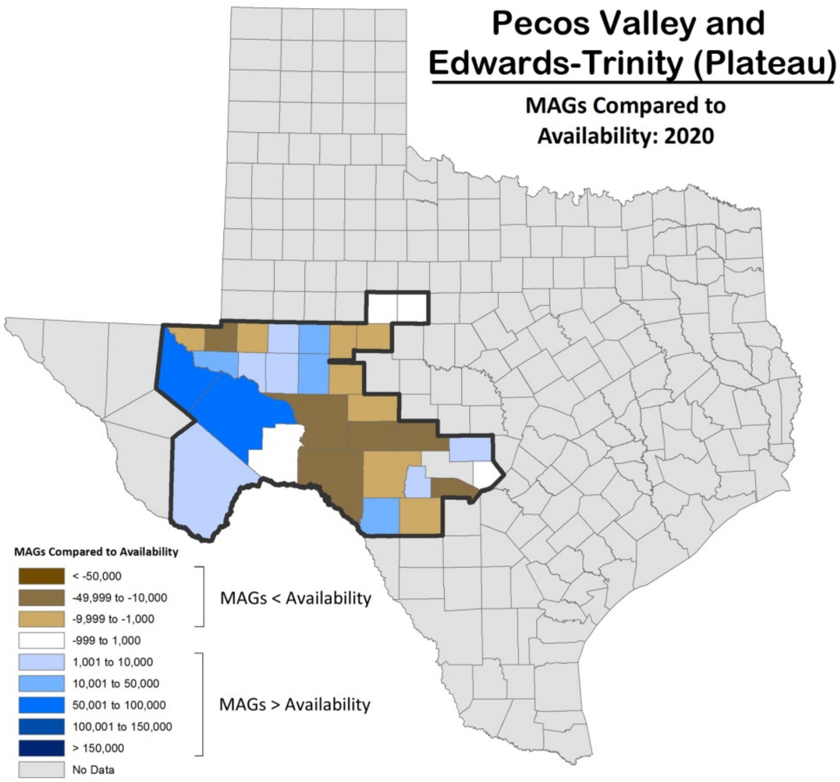
Pecos Valley and
Edwards-Trinity (Plateau)
MAGs Compared to
Availability: 2020
MAGs Compared to Availability
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-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
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100,001 to 150,000
> 150,000
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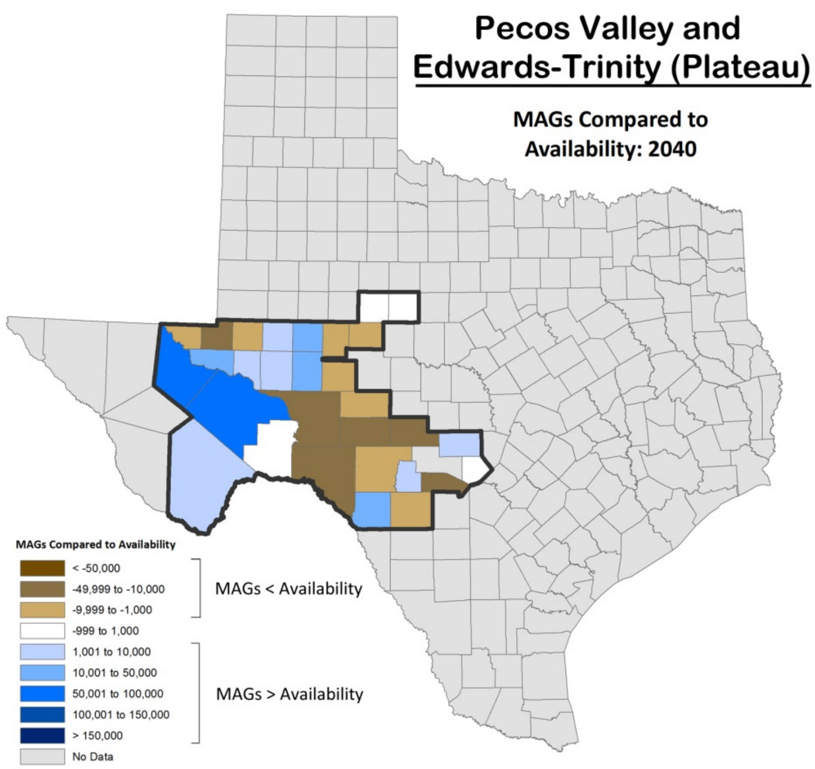
MAGs < Availability
MAGs > Availability


Pecos Valley and
Edwards-Trinity (Plateau)
MAGs Compared to
Availability: 2040
MAGs Compared to Availability
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-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
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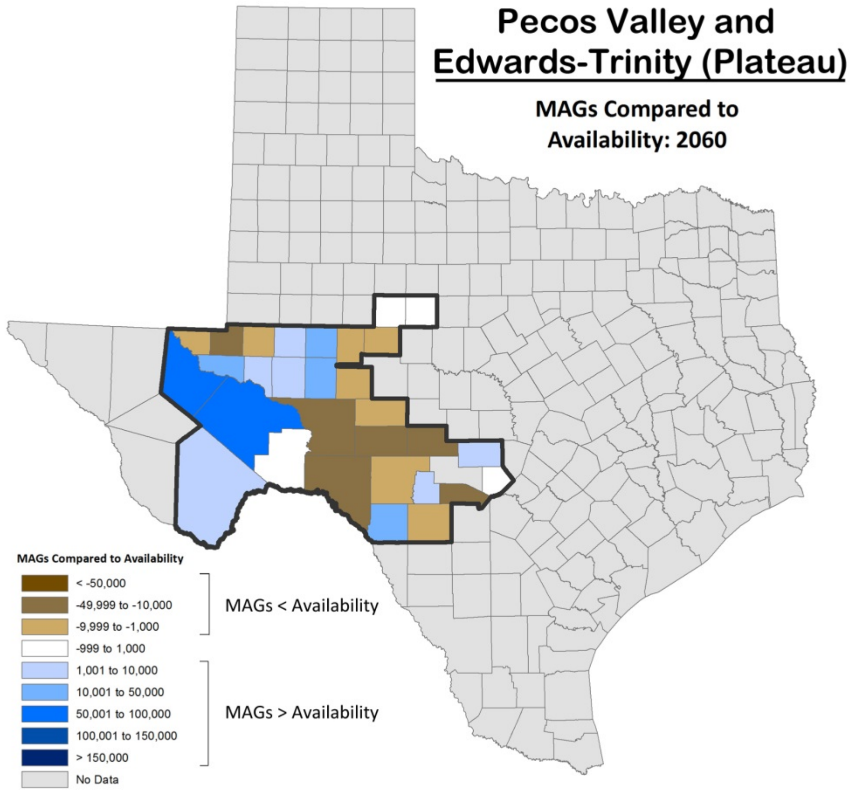
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Pecos Valley and Edwards-Trinity (Plateau)
MAGs Compared to Availability: 2060
MAGs Compared to Availability
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> 150,000
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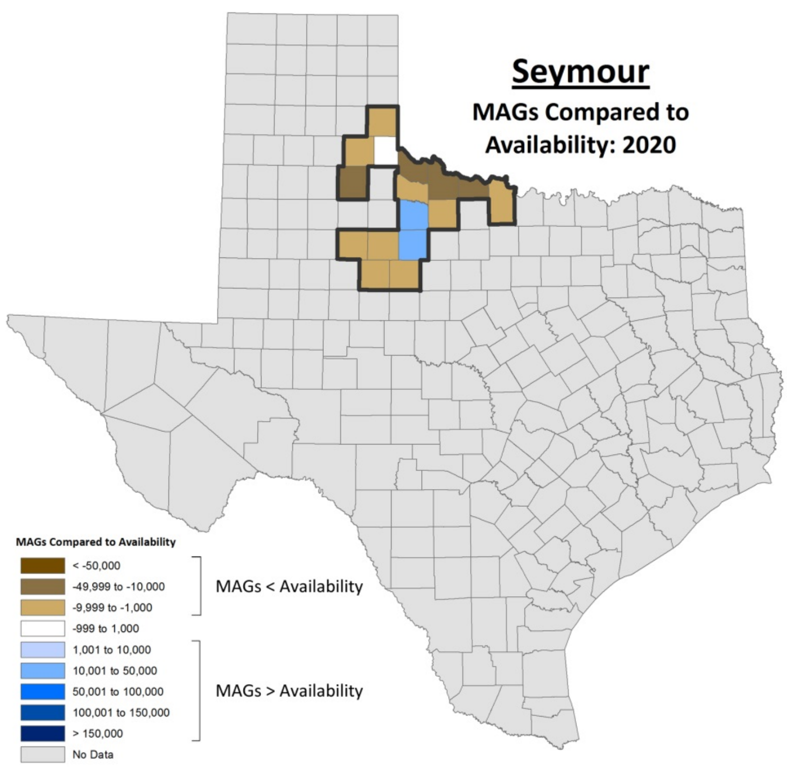
MAGs < Availability
MAGs > Availability


Seymour
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MAGs Compared to Availability
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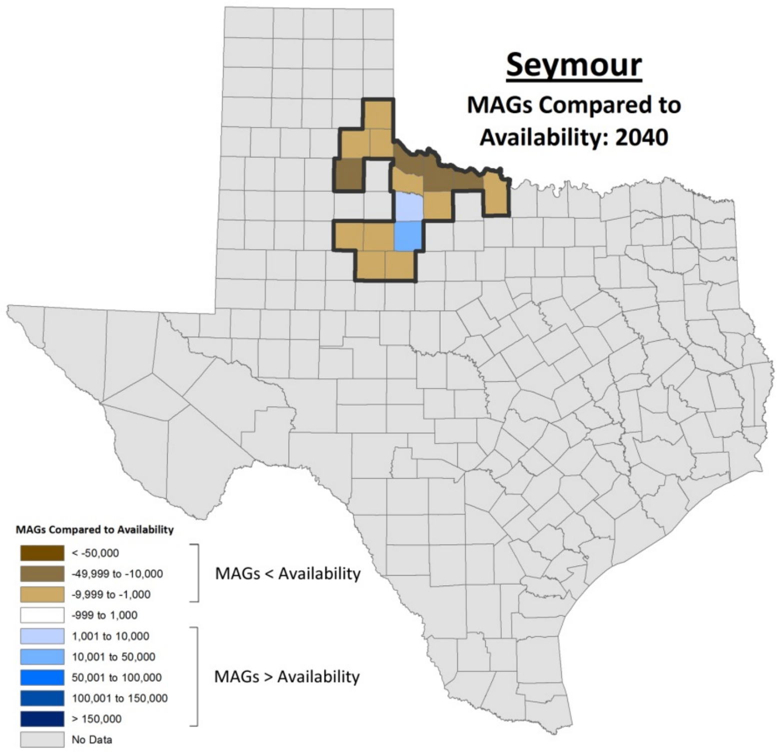
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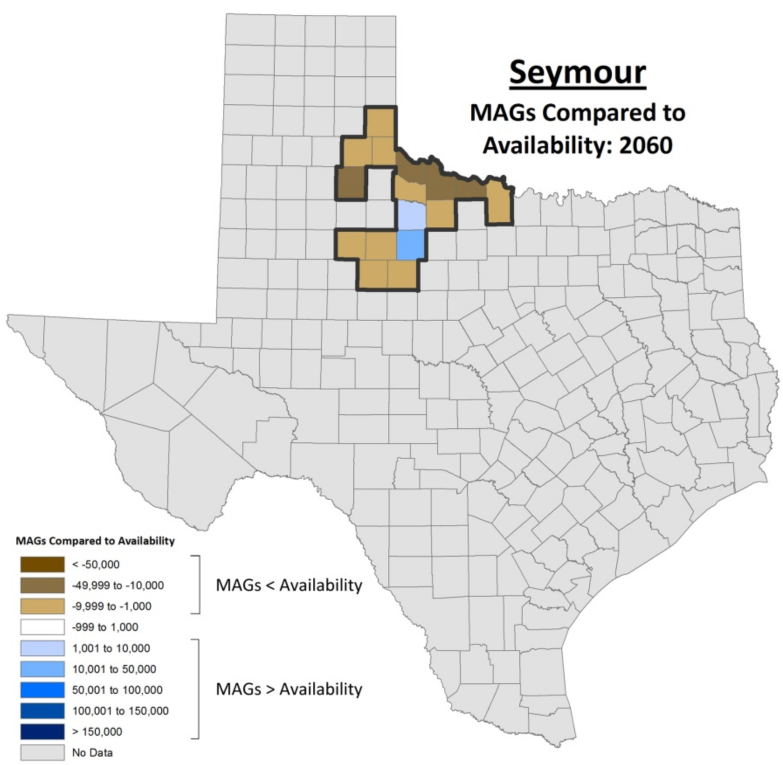
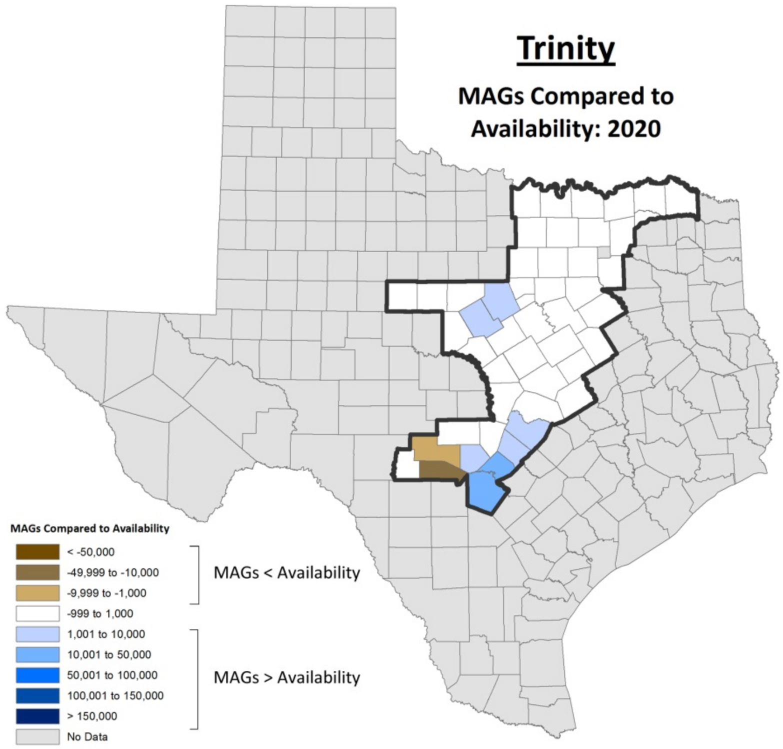
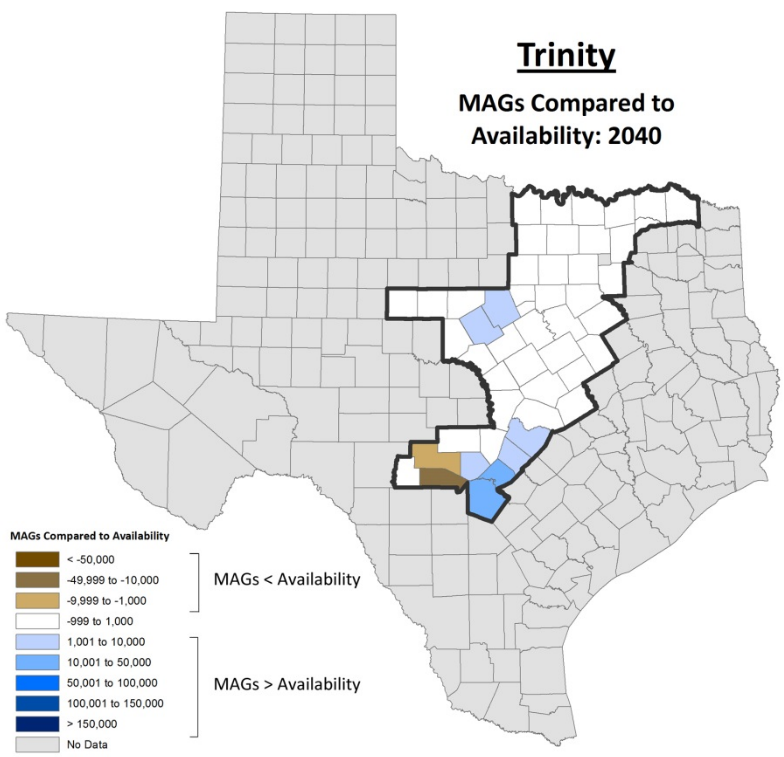
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Seymour
MAGs Compared to Availability: 2060
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Trinity
MAGs Compared to Availability: 2020
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Trinity
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MAGs Compared to Availability
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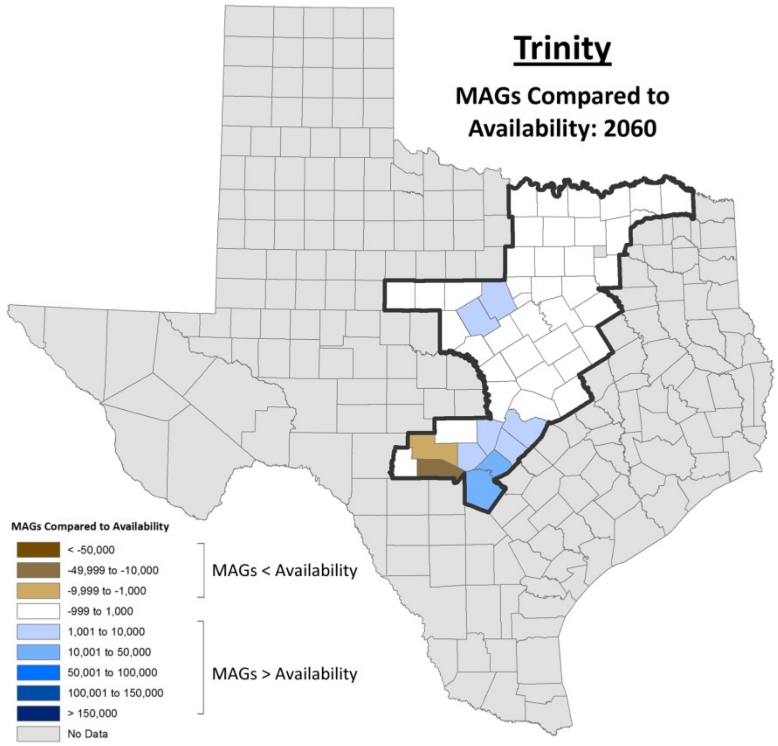
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability


Trinity
MAGs Compared to Availability: 2060
MAGs Compared to Availability
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Availability
MAGs > Availability

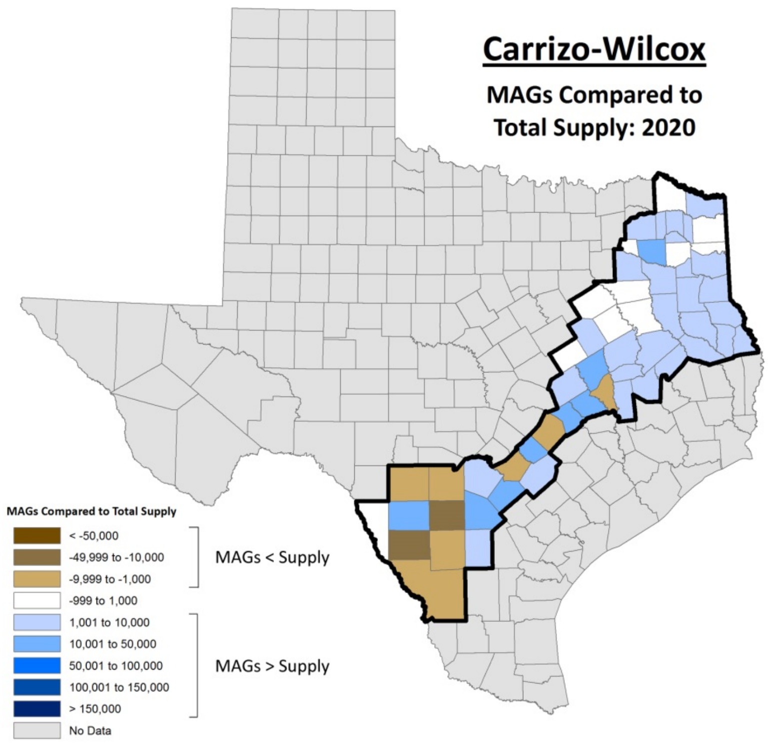
Appendix C: Aquifer Maps – Total Supply

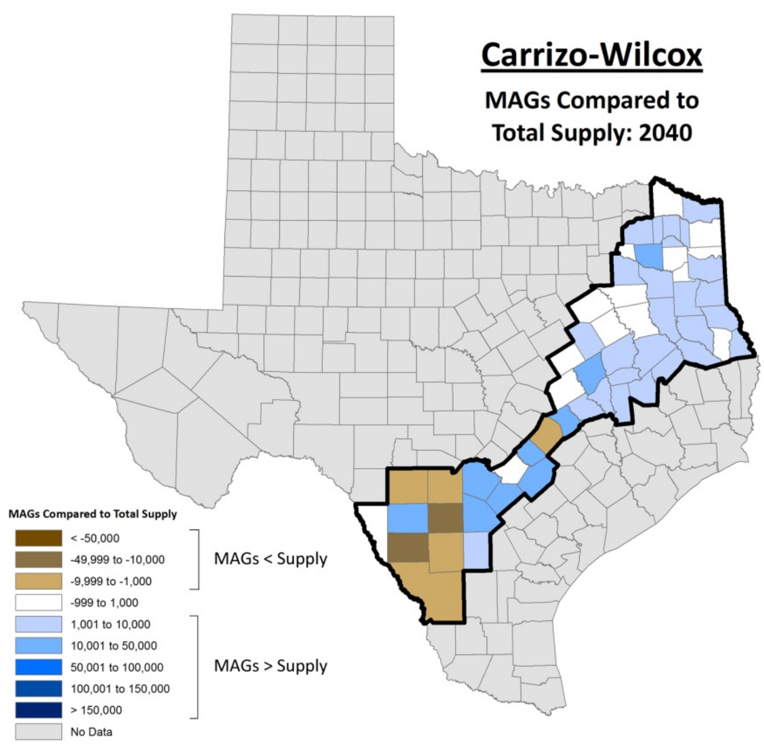
Maps contained in this appendix compare 2011 regional water planning existing groundwater supply volumes combined with supply volumes generated through the implementation of the 2012 State Water Plan to modeled available groundwater volumes (MAG) developed through the joint planning process. All volumes are measured in acre-feet per year by major aquifer. Though Texas contains nine such aquifers, we only consider eight here. We omitted the Hueco-Mesilla Bolsons aquifers as there are no modeled available groundwater volumes within their extent. We also combined and analyzed jointly data for the Pecos Valley and Edwards-Trinity (Plateau) aquifers[40] as some values associated with these aquifers were represented concurrently and could not be separated. Additionally, we omitted the San Antonio segment of the Edwards (Balcones Fault Zone) Aquifer under the jurisdiction of the Edwards Aquifer Authority as its availability volumes are established through legislation rather than the joint planning process. Though we compared volumes by decade for the period from 2020 through 2060, we only included maps for 2020, 2040, and 2060 as this subset adequately reflects the changes that occur during this time frame.

The 2012 Texas State Water Plan and the Texas Water Development Board's water planning database are the data sources used to generate the following series of maps. Maps included in this appendix compare 2011 regional water planning total groundwater supply volumes – which are a combination of existing water supply volumes and supply volumes generated through the implementation of the 2012 State Water Plan – with modeled available groundwater volumes based on the desired future conditions listed in Appendix D. For a more complete description of the methodology used to generate these maps, see Appendix A.

All maps use the same legend format. Counties shaded brown represent areas where supply volumes exceed modeled available groundwater volumes, and counties shaded blue indicate areas where modeled available groundwater volumes are higher. White represents counties for which the difference between volumes is less than 1,000 acre-feet, an amount that we consider negligible. Counties colored gray did not have adequate data for inclusion, either because the county does not overlay the aquifer in question or because data for the aquifer in that county were inadequate.

[40] The Pecos Valley and Edwards-Trinity (Plateau) combination is not a unique aquifer. Due to there being a lumped representation of the Pecos Valley and Edwards-Trinity (Plateau) aquifers in some portions of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers at the time that we conducted this analysis, we have combined volumes for the individual aquifers as well as the lumped volumes.


Carrizo-Wilcox
MAGs Compared to Total Supply: 2020
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Carrizo-Wilcox
MAGs Compared to Total Supply: 2040
MAGs Compared to Total Supply
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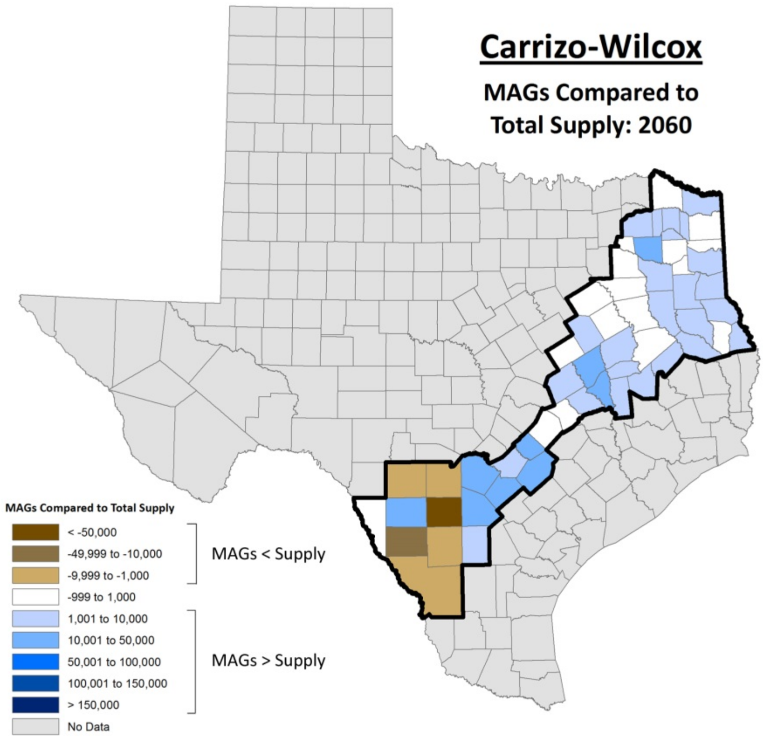
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Carrizo-Wilcox
MAGs Compared to
Total Supply: 2060
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
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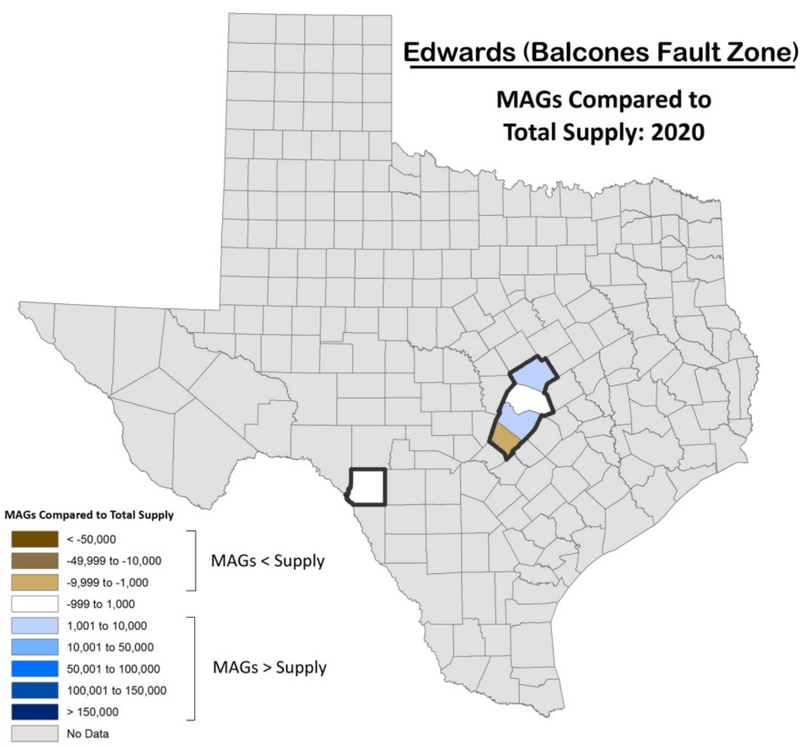
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Edwards (Balcones Fault Zone)
MAGs Compared to
Total Supply: 2020
MAGs Compared to Total Supply
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-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
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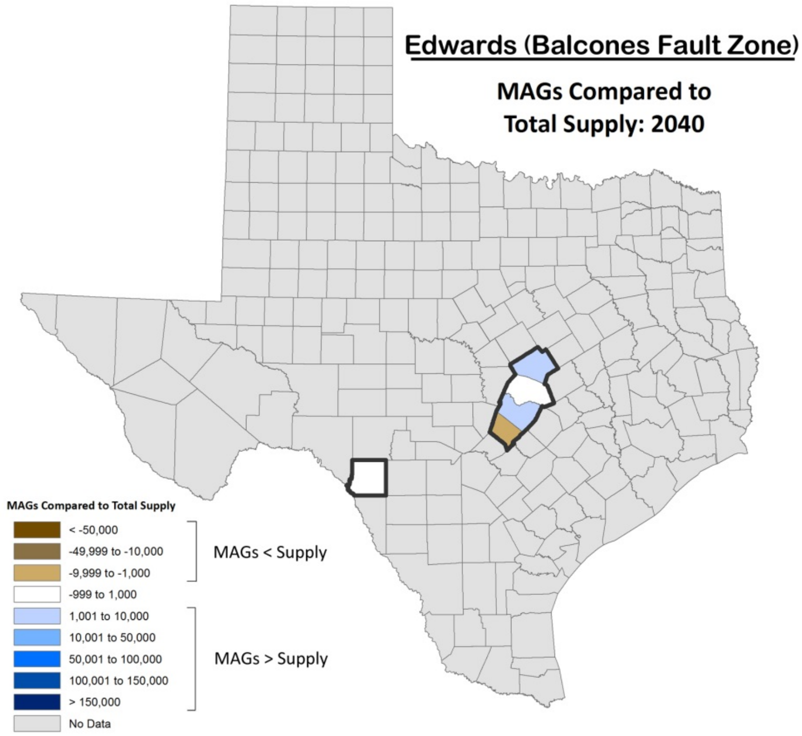
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Edwards (Balcones Fault Zone)
MAGs Compared to
Total Supply: 2040
MAGs Compared to Total Supply
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-999 to 1,000
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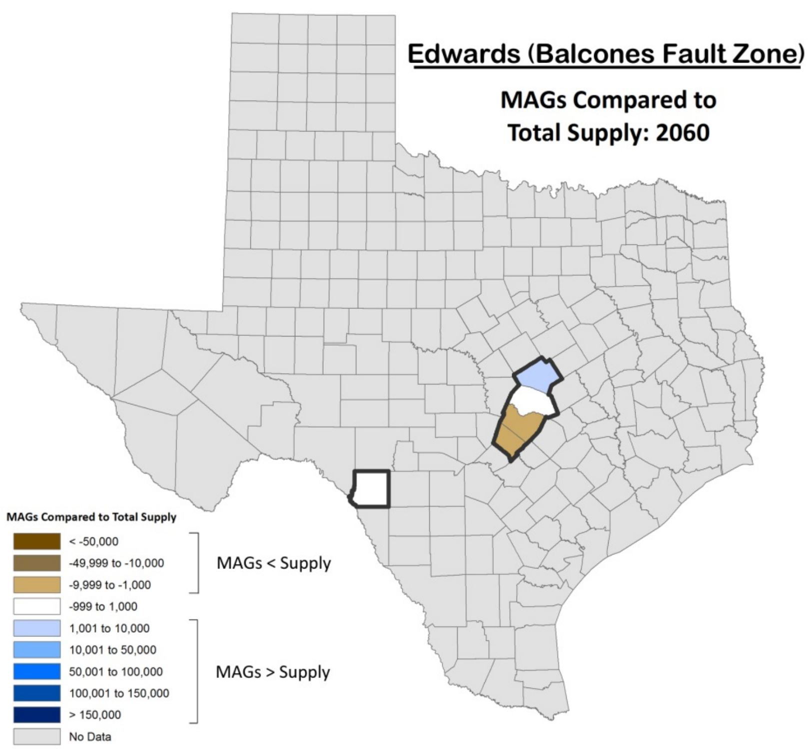
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Edwards (Balcones Fault Zone)
MAGs Compared to
Total Supply: 2060
MAGs Compared to Total Supply
< -50,000
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-9,999 to -1,000
-999 to 1,000
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10,001 to 50,000
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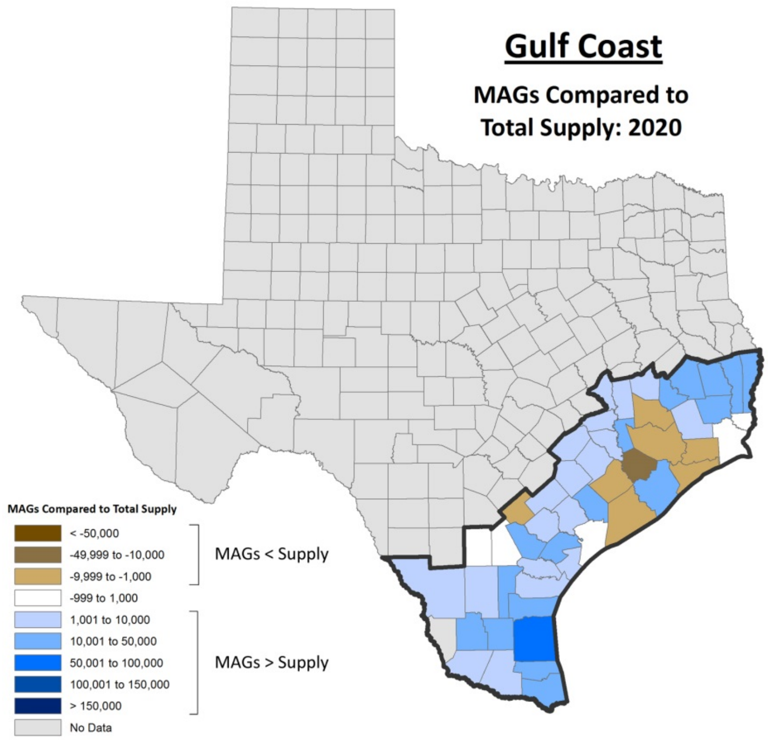
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Gulf Coast
MAGs Compared to Total Supply: 2020
MAGs Compared to Total Supply
< -50,000
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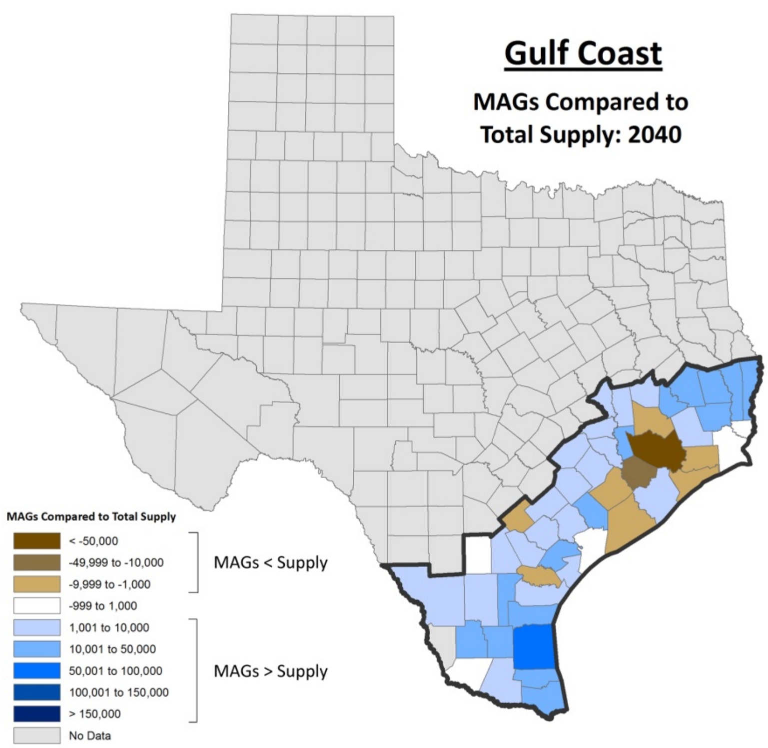
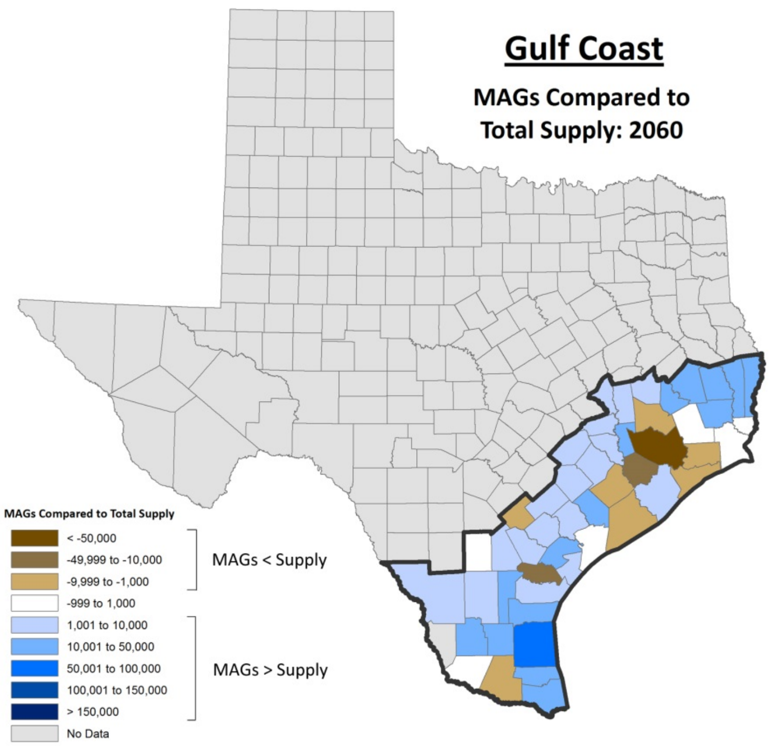
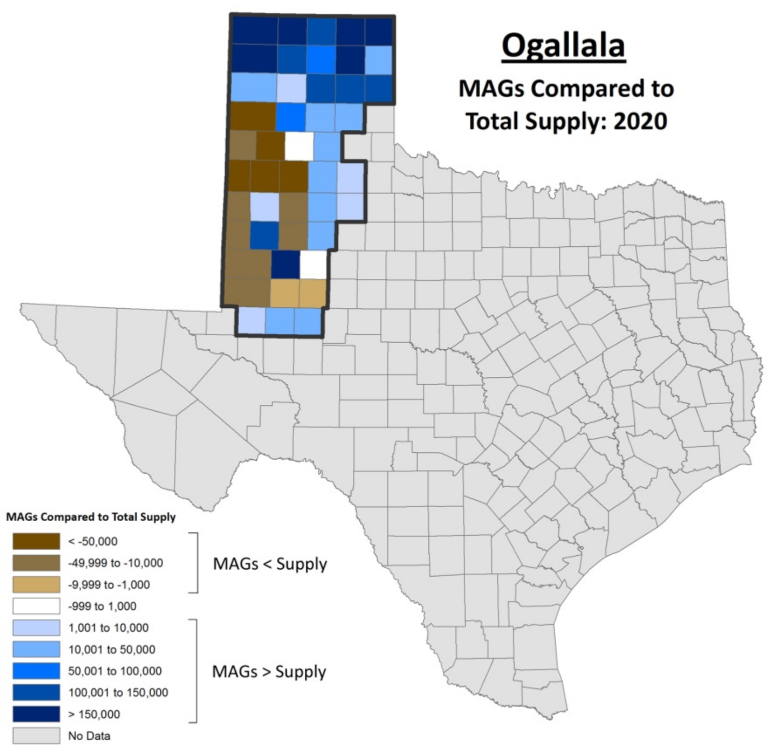
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Gulf Coast
MAGs Compared to Total Supply: 2040
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Gulf Coast
MAGs Compared to
Total Supply: 2060
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Ogallala
MAGs Compared to
Total Supply: 2020
MAGs Compared to Total Supply
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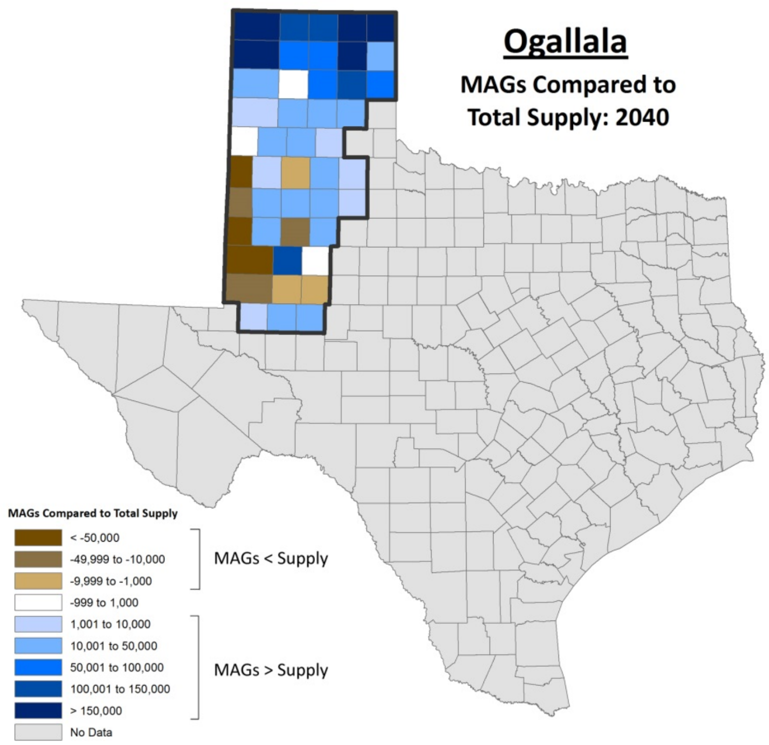
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Ogallala
MAGs Compared to
Total Supply: 2040
MAGs Compared to Total Supply
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-999 to 1,000
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10,001 to 50,000
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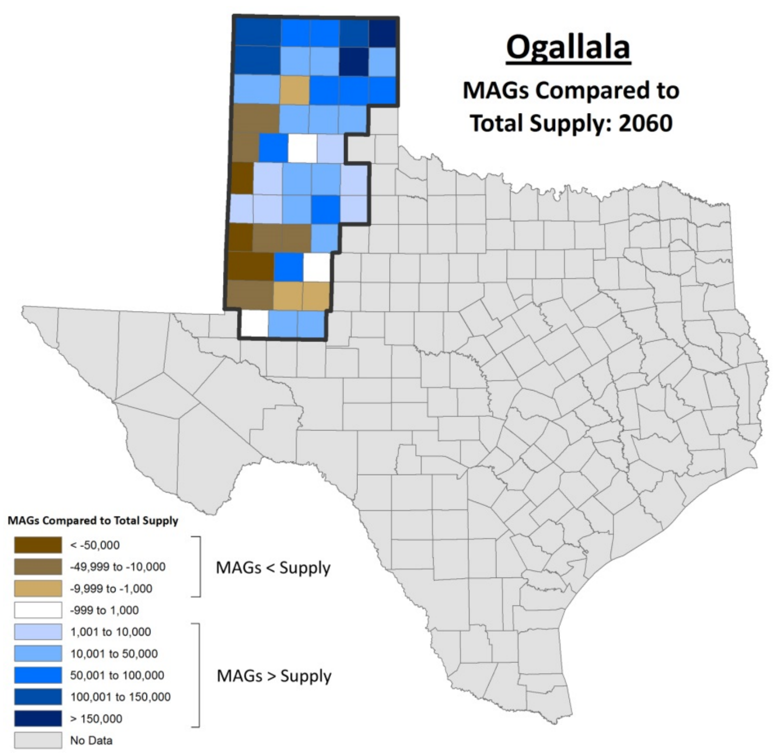
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Ogallala
MAGs Compared to
Total Supply: 2060
MAGs Compared to Total Supply
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-999 to 1,000
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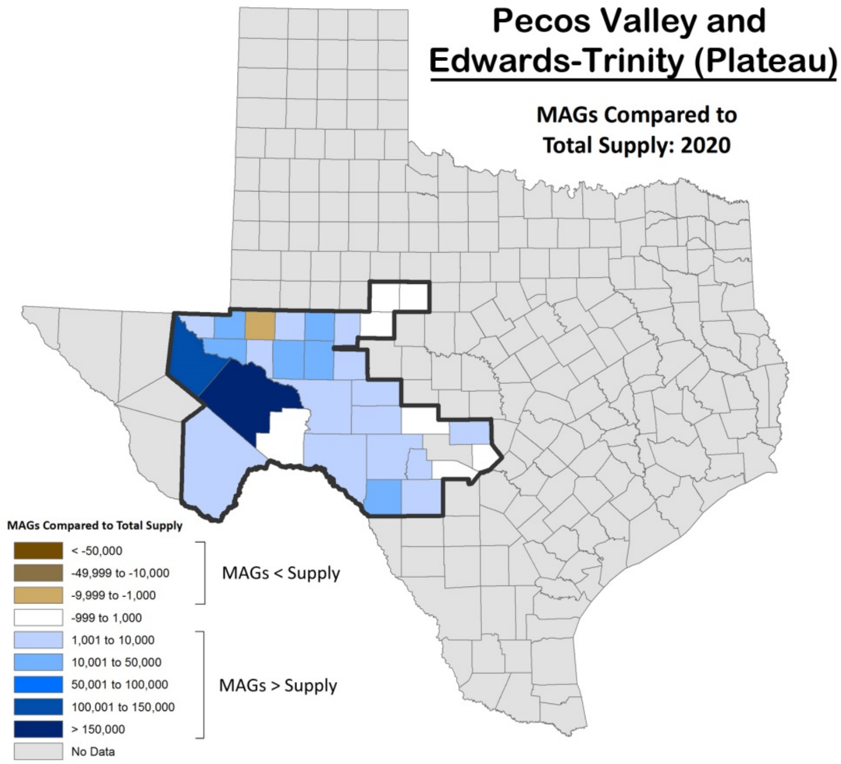
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Pecos Valley and
Edwards-Trinity (Plateau)
MAGs Compared to
Total Supply: 2020
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
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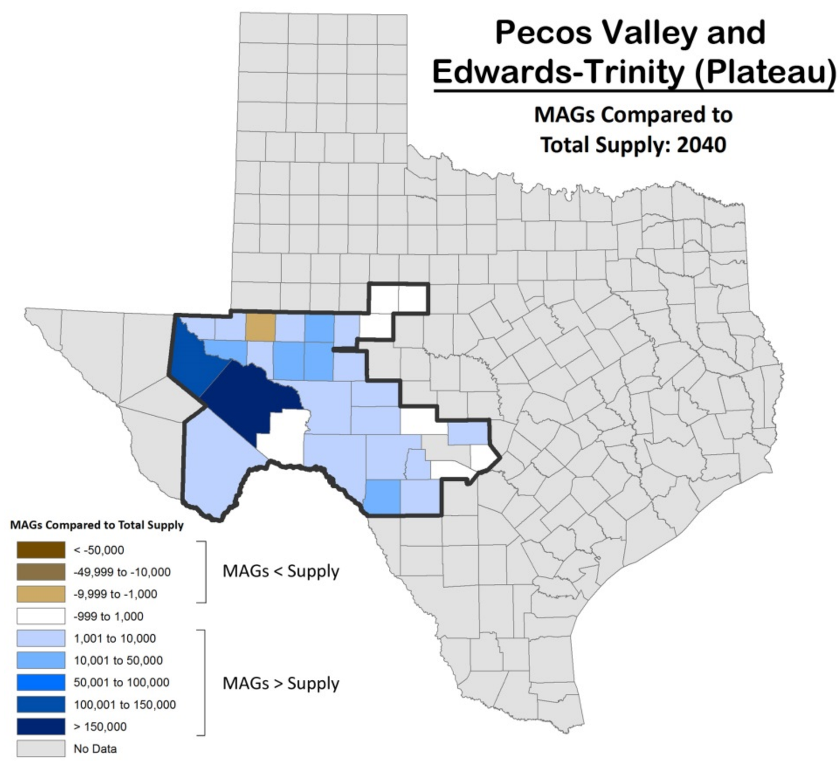
MAGs < Supply
MAGs > Supply


Pecos Valley and
Edwards-Trinity (Plateau)
MAGs Compared to
Total Supply: 2040
MAGs Compared to Total Supply
< -50,000
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-9,999 to -1,000
-999 to 1,000
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10,001 to 50,000
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100,001 to 150,000
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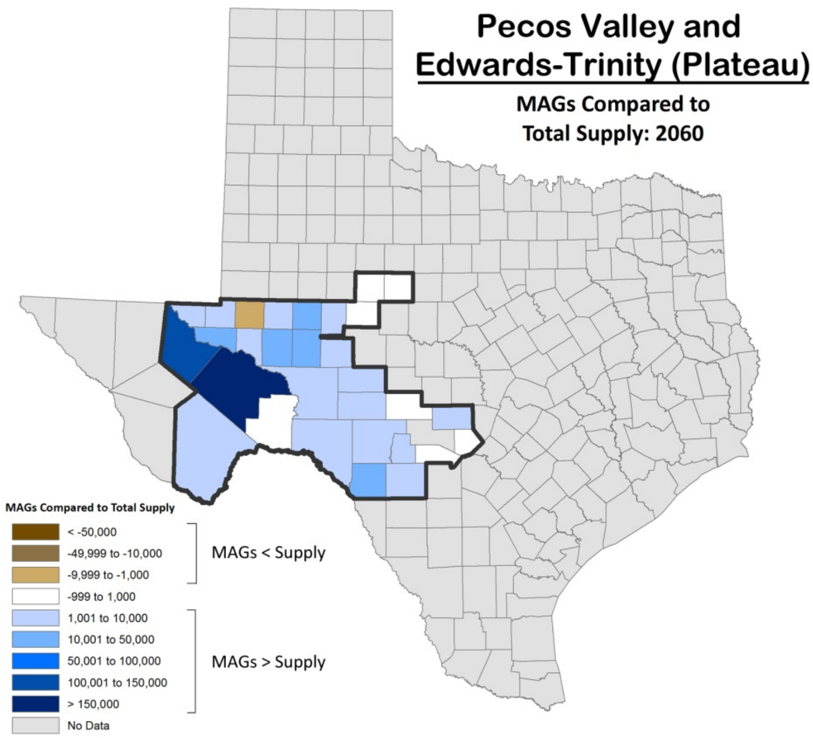
MAGs < Supply
MAGs > Supply


Pecos Valley and
Edwards-Trinity (Plateau)
MAGs Compared to
Total Supply: 2060
MAGs Compared to Total Supply
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-9,999 to -1,000
-999 to 1,000
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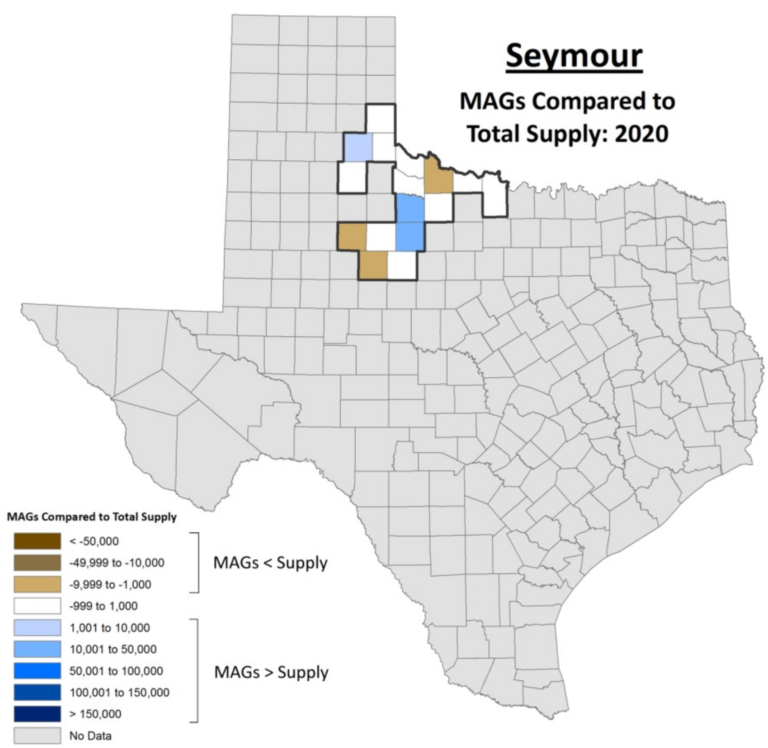
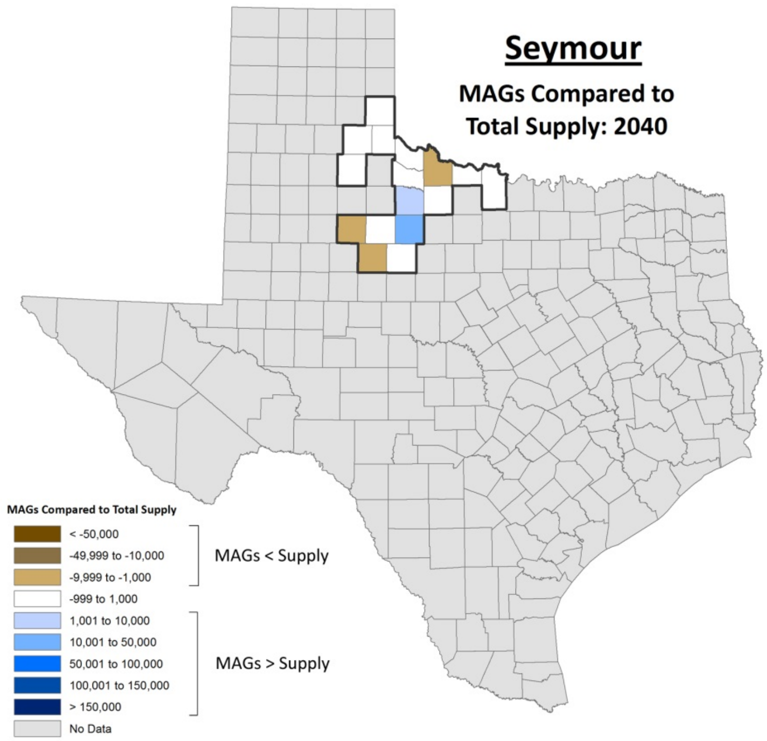
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Seymour
MAGs Compared to
Total Supply: 2020
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Seymour
MAGs Compared to Total Supply: 2040
MAGs Compared to Total Supply
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-9,999 to -1,000
-999 to 1,000
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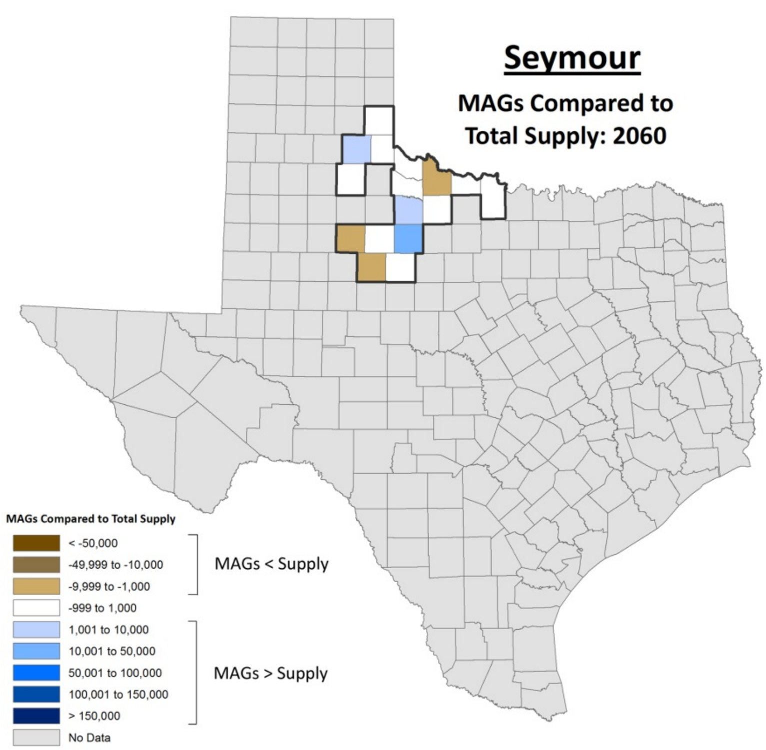
No Data
MAGs < Supply
MAGs > Supply


Seymour
MAGs Compared to Total Supply: 2060
MAGs Compared to Total Supply
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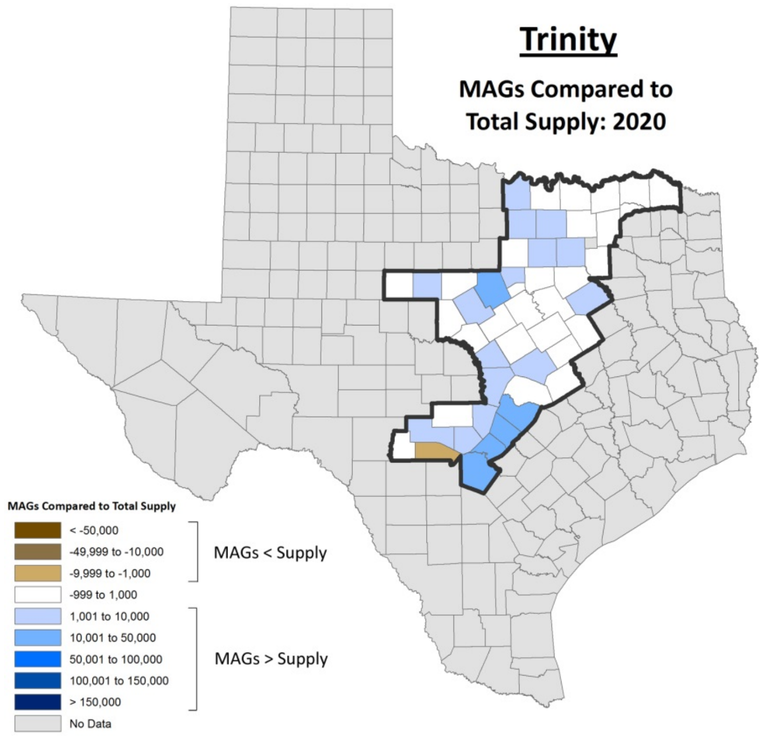
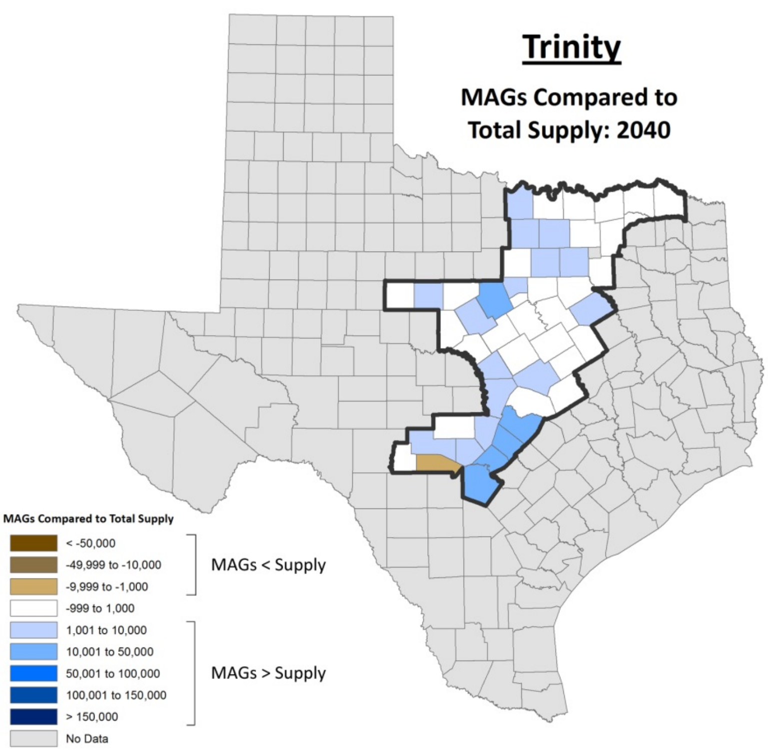
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Trinity
MAGs Compared to Total Supply: 2020
MAGs Compared to Total Supply
< -50,000
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Trinity
MAGs Compared to Total Supply: 2040
MAGs Compared to Total Supply
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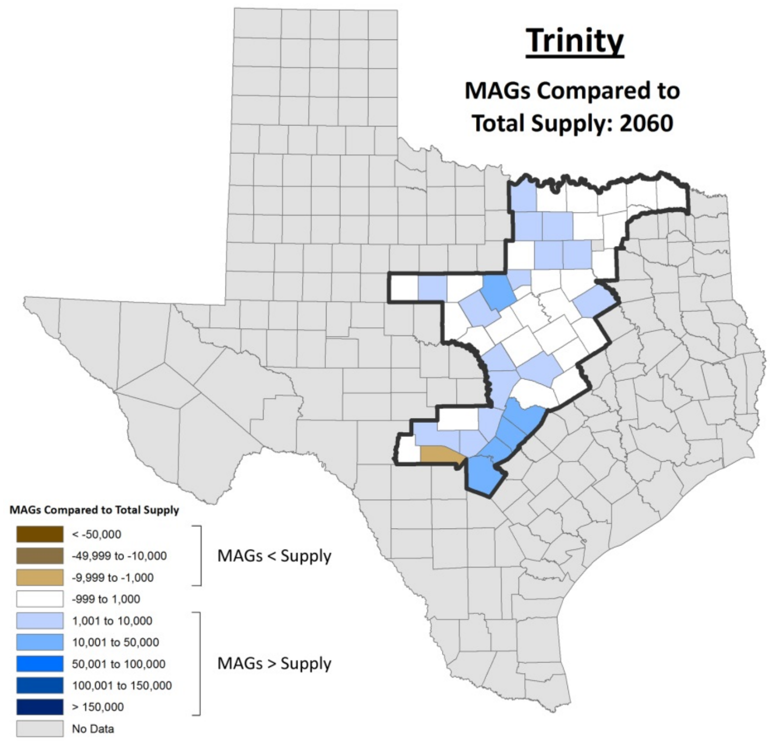
-49,999 to -10,000
-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply


Trinity
MAGs Compared to Total Supply: 2060
MAGs Compared to Total Supply
< -50,000
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-9,999 to -1,000
-999 to 1,000
1,001 to 10,000
10,001 to 50,000
50,001 to 100,000
100,001 to 150,000
> 150,000
No Data
MAGs < Supply
MAGs > Supply

Appendix D: Desired Future Conditions

Tables contained in this appendix include desired future conditions adopted or related to the first round of joint planning for aquifers in each groundwater management area.[41] The conditions, listed by groundwater management area and aquifer, are summarized based on the desired future condition packages submitted to the TWDB. Full desired future condition submittals can be accessed at http://www.twdb.texas.gov/groundwater/management_areas/DFC.asp.

Table 1: Summary of adopted desired future conditions.[42]

Aquifer	Desired Future Condition Summary	Date Desired Future Condition Adopted
	Groundwater Management Area 1	
Blaine	50 percent of the volume in storage remaining in 50 years in Wheeler County.	6/3/2010
Dockum	Average decline in water levels will decline no more than 30 feet over the next 50 years.	6/3/2010
Ogallala and Rita Blanca	40 percent of volume in storage remaining in 50 years in Dallam, Hartley, Moore, and Sherman counties; 50 percent of volume remaining in 50 years in Armstrong, Potter, Randall, Hansford, Hutchinson, Lipscomb, Ochiltree, Carson, Donley, Gray, Roberts, Wheeler, and Oldham counties; and 80 percent of volume in storage remaining in 50 years in Hemphill County.	7/7/2009
	Groundwater Management Area 2	
Dockum	Average water-level decline of no more than 40 feet between 2010 and 2060. Not relevant for Dawson, Garza, Howard, Martin, Terry, and Yoakum counties.	8/5/2010
Ogallala and Edwards-Trinity (High Plains)	50 percent of saturated thickness remaining after 50 years for the Northern portion of Groundwater Management Area 2 (Bailey, Briscoe, Castro, Cochran, Crosby, Deaf Smith, Floyd, Hale, Hockley, Lamb, Lubbock, Lynn, Parmer, and Swisher counties); average water-level decline for the Southern portion of	8/5/2010

[41] The full desired future condition statements for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority are listed separately in Appendix E.

[42] Desired future conditions for the Trinity Aquifer in Groundwater Management Area 8 and for the Gulf Coast Aquifer in Groundwater Management Area 14 are listed in separate tables within this appendix due to their complexity.

	Groundwater Management Area 2 over 50 years by county, Andrews: 6 feet, Bordon: 3 feet, Dawson: 74 feet, Gaines: 70 feet, Garza: 40 feet, Howard: 1 foot, Martin: 8 feet, Terry: 42 feet, and Yoakum: 18 feet.	
	Groundwater Management Area 3	
Capitan Reef Complex	Total net decline in water levels over 50 years shall not exceed 200 feet below water levels in the aquifer in the year 2010. Not relevant in Crane and Loving counties.	8/9/2010
Dockum	Average total net decline in water levels over 50 years shall not exceed 27 feet below water levels in the aquifer in the year 2010.	8/9/2010
Edwards-Trinity (Plateau) and Pecos Valley	Average total net decline in water levels over 50 years shall not exceed 28 feet below water levels in the aquifers in 2010.	8/9/2010
Rustler	Average total net decline in water levels within the unconfined portion in Reeves County over 50 years shall not exceed 15 feet below water levels in the aquifer in 2010; and the average total net decline in water levels within the confined portion in Pecos, Loving, Reeves and Ward counties over 50 years shall not exceed 300 feet below water levels in the aquifer in the year 2010. Not relevant in Crane and Winkler counties.	8/9/2010
	Groundwater Management Area 4	
Bone Spring-Victorio Peak	Hudspeth County Underground Water Conservation District No 1: 0 foot drawdown.	8/13/2010
Capitan Reef Complex	Brewster County Groundwater Conservation District: 0 foot drawdown, Culberson County Groundwater Conservation District: 50 feet of drawdown. Not relevant in Jeff Davis and Hudspeth counties.	8/13/2010
Edwards-Trinity (Plateau)	Brewster County Groundwater Conservation District: 3 feet of drawdown, Culberson County Groundwater Conservation District: 50 feet of drawdown. Not relevant in Jeff Davis County.	8/13/2010, amended 5/19/11
Igneous	Brewster County Groundwater Conservation District: 10 feet of drawdown, Culberson County Groundwater Conservation District: 66 feet of drawdown, Jeff Davis County Groundwater Conservation District: 20 feet of drawdown, Presidio County Groundwater Conservation District: 14 feet of drawdown.	8/13/2010
Marathon	Brewster County Groundwater Conservation District: 0 foot drawdown. Not relevant in Culberson and Jeff Davis counties.	8/13/2010

Presidio-Redford Bolsons	Presidio County Groundwater Conservation District: 5 feet of drawdown.	8/13/2010
Rustler	Brewster County Groundwater Conservation District: 0 foot drawdown. Not relevant in Culberson and Jeff Davis counties.	8/13/2010
West Texas Bolsons	Culberson County Groundwater Conservation District: 78 feet of drawdown, Jeff Davis County Groundwater Conservation District: 72 feet of drawdown, Presidio County Groundwater Conservation District: 72 feet of drawdown. Not relevant in Hudspeth County.	8/13/2010
Upper Salt Basin	Culberson County Groundwater Conservation District: 50 feet of drawdown.	8/13/2010
	Groundwater Management Area 5	
	N/A	
	Groundwater Management Area 6	
Blaine	Clear Fork Groundwater Conservation District (Fisher County): total decline in water levels will be no more than 4 feet over the next 50 years; Gateway Groundwater Conservation District (Childress, Cottle, Foard, and Hardeman counties): total decline in water levels will be no more than 2 feet over the next 50 years; Mesquite Groundwater Conservation District (Childress, Collingsworth and Hall counties): 80 percent of current volume of storage remaining in 50 years; and King County: total decline in water levels will be no more than 7 feet over the next 50 years. Not relevant in Dickens, Knox, Motley, Stonewall, and Wilbarger counties.	7/22/10, amended 7/19/2011
Dockum	Clear Fork Groundwater Conservation District (Fisher County): total decline in water levels will be no more than 25 feet over the next 50 years; Gateway Groundwater Conservation District (Motley County), Dickens and Kent counties: total decline in water levels will be no more than 40 feet over the next 50 years.	7/22/2010
Ogallala	Motley (Gateway Groundwater Conservation District) and Dickens counties: 50 percent of volume in storage remaining in 50 years.	7/22/2010

Seymour	"Pods 1, 2, and 3" in Mesquite Groundwater Conservation District (Collingsworth, Childress, and Hall counties): 50 percent of current volume in storage remaining in 50 years; "Pods 3 and 4" in Gateway Groundwater Conservation District (Motley, Childress, Foard, Hardeman counties): total decline in water levels will be no more than 1 foot over 50 years; "Pod 4" in Wichita and Wilbarger counties: total decline in water levels will be no more than 1 foot over 50 years; "Pod 5" in Archer, Clay, Wichita, and Wilbarger counties: total decline in water levels will be no more than 2 feet over 50 years; "Pods 6, 7, and 8" in Rolling Plains Groundwater Conservation District (Baylor, Knox, and Haskell counties): total decline in water levels will be no more than 18 feet over 50 years; "Pod 7" in Stonewall County: total decline in water levels will be no more than 24 feet over 50 years; "Pod 8" in Throckmorton and Young counties: total decline in water levels will be no more than 3 feet over 50 years; "Pods 9 and 10" in Kent and Stonewall counties: total decline in water levels will be no more than 4 feet over 50 years; "Pod 11" in Clear Fork Groundwater Conservation District (Fisher County): total decline in water levels will be no more than 1 foot over 50 years; and "Pods 11 through 15" in Jones and Stonewall counties: total decline in water levels will be no more than 1 foot over 50 years. "Pod 1" in Gateway Groundwater Conservation District (Childress County) is not relevant.	7/22/10, amended 7/19/2011
	Groundwater Management Area 7	
Capitan Reef Complex	Total net decline in water levels within the Middle Pecos Groundwater Conservation District over 50 years shall not exceed 15 feet below water levels in the unconfined portion of the aquifer in the year 2010; total net decline in water levels over 50 years shall not exceed 200 feet below water levels in the confined portion in the aquifer in year 2010. Not relevant outside of district boundaries.	7/29/2010
Dockum	Upper Dockum: net total drawdown not to exceed 29 feet in Midland County; Lower Dockum: net total drawdown not to exceed 4 feet in Ector, Mitchell, Pecos, Scurry, and Upton counties (Lone Wolf Groundwater Conservation District, Middle Pecos Groundwater Conservation District); and drawdown not to exceed a net total of 39 feet in Nolan County (West-Tex Groundwater Conservation District).	7/29/2010

	Not relevant in all other areas of Groundwater Management Area 7.	
Edwards-Trinity (Plateau), [Trinity, and Pecos Valley]	Average drawdown of 7 feet except within Kinney County Groundwater Conservation District; Kinney County drawdown consistent with maintaining annual average flow of 23.9 cubic feet per second and median flow of 24.4 cubic feet per second at Los Moras Springs. The Edwards-Trinity (Plateau) Aquifer is not relevant within Lipan-Kickapoo Water Conservation District, Lone Wolf Groundwater Conservation District, and the Hickory Underground Water Conservation District No. 1. The Trinity Aquifer is not relevant in Uvalde Underground Water Conservation District.	7/29/2010
Ellenburger-San Saba	Total net decline in water levels within Hickory Underground Water Conservation District No. 1, Hill Country Underground Water Conservation District, Kimble County Groundwater Conservation District, and Menard County Underground Water District over 50 years shall not exceed 5 feet below 2010 levels. Not relevant in all other areas of Groundwater Management Area 7.	7/29/2010
Hickory	Total net decline in water levels within Hickory Underground Water Conservation District No. 1, Hill Country Underground Water Conservation District, Kimble County Groundwater Conservation District, Menard County Underground Water District, and Llano County and non-district areas in McCulloch and San Saba counties over 50 years shall not exceed 7 feet below 2010 levels. Not relevant in all other areas of Groundwater Management Area 7.	7/29/2010
Lipan	Within Lipan-Kickapoo Water Conservation District in Concho, Runnels, and Tom Green counties: continue to use 100 percent of all available groundwater annually with annual fluctuations of water levels and zero net drawdown in water levels over the next 50 years. Not relevant outside of district boundaries.	7/29/2010
Marble Falls	Total net decline in water levels in San Saba County over 50 years shall not exceed 7 feet below 2010 water levels in the aquifer. Not relevant in all other areas of Groundwater Management Area 7.	7/29/2010
Ogallala	Total decline in volume of water within Ector, Glasscock, and Midland counties over 50 years shall not exceed 50 percent of volume in the aquifer in the year 2010. Not relevant in all other areas of Groundwater Management Area 7.	7/29/2010
Rustler	Total net decline in water levels within the Middle Pecos Groundwater Conservation District over 50 years shall not exceed 300 feet below water levels in the aquifer in year 2010. Not relevant outside of district boundaries.	7/29/2010

Groundwater Management Area 8		
Blossom	From estimated year 2009 conditions, Bowie County: average drawdown of the unconfined zone should not exceed approximately 5.4 feet after 50 years; Lamar County: average drawdown of the unconfined zone should not exceed approximately 2.4 feet after 50 years; Red River County: average drawdown of the unconfined zone should not exceed approximately 6.5 feet after 50 years; Bowie, Lamar, and Red River counties: drawdown of the confined zone should not exceed approximately 20 feet after 50 years.	4/27/2011
Brazos River Alluvium	Maintain approximately 100 percent of the saturated thickness after 50 years in Falls County; maintain approximately 82 percent of estimated saturated thickness after 50 years in McLennan County; and maintain approximately 90 percent of the estimated saturated thickness after 50 years in Hill and Bosque counties. Not relevant in Milan County.	4/27/2011,amended 6/23/2011
Edwards (Balcones Fault Zone)	Maintain at least 100 acre-feet per month of stream/spring flow in Salado Creek during a repeat of the drought of record in Bell County; maintain at least 42 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record in Travis County; and maintain at least 60 acre-feet per month of aggregated stream/spring flow during a repeat of the drought of record in Williamson County.	4/27/2011
Ellenburger-San Saba	Burnet County: maintain approximately 100 percent of the saturated thickness after 50 years by using approximately 80 percent of the estimated recharge; Lampasas County: maintain approximately 90 percent of the saturated thickness after 50 years; and Brown and Mills counties: maintain approximately 90 percent of the available drawdown after 50 years.	4/27/2011
Hickory	Burnet County: maintain approximately 100 percent of the saturated thickness after 50 years by using approximately 80 percent of the estimated recharge; Brown, Lampasas, Mills, Travis, and Williamson counties: maintain approximately 90 percent of the available drawdown [saturated thickness] after 50 years.	4/27/2011
Marble Falls	Burnet County: maintain approximately 100 percent of the saturated thickness after 50 years by using approximately 80 percent of the estimated recharge; Lampasas County: maintain approximately 90 percent of the	4/27/2011

	saturated thickness after 50 years.	
Nacatoch	Drawdown by county: Bowie County: 10 feet in the Red River Basin, 17 feet in the Sulphur River Basin; Delta County: 5 feet; Ellis County: 4 feet; Franklin County: 6 feet; Hopkins County: 10 feet in the Sabine River Basin, 12 feet in the Sulphur River Basin; Hunt County: 10 feet in the Sabine River Basin, 6 feet in the Sulphur River Basin; Kaufman County: 7 feet in the Sabine River Basin, 4 feet in the Trinity River Basin; Lamar County: 5 feet; Navarro County: 4 feet; Rains County: 13 feet; Red River County: 10 feet in the Red River Basin, 8 feet in the Sulphur River Basin; and Rockwall County: 5 feet.	6/23/2011
Trinity	Listed desired future conditions of average drawdown (not to exceed approximately) by county and aquifer layer (Paluxy, Glen Rose, Hensell, Houston). See Table 2.	4/27/2011
Woodbine	From estimated year 2000 conditions, the average drawdown after 50 years should not exceed approximately: Colin County: 154 feet, Cooke County: 0 feet, Dallas County: 112 feet, Denton County: 16 feet, Ellis County: 102 feet, Fannin County: 186 feet, Grayson County: 28 feet, Hill County: 87 feet, Hunt County: 353 feet, Johnson County: 4 feet, Kaufman County: 211 feet, Lamar County: 297 feet, Navarro County: 177 feet, Red River County: 202 feet, Rockwall County: 241 feet, Tarrant County: 2 feet. Non-relevant in McLennan County.	4/27/2011, amended 6/23/2011
	Groundwater Management Area 9	
Edwards (Balcones Fault Zone), San Antonio Segment	Desired future conditions for the Edwards (Balcones Fault Zone) Aquifer within jurisdiction of the Edwards Aquifer Authority are set by the Texas Legislature. See Appendix E.	5/28/2007
Edwards Group of Edwards-Trinity (Plateau)	No net increase in average drawdown in Kendall and Bandera counties. Not relevant in Kerr and Blanco counties.	7/26/2010
Ellenburger-San Saba	Allow for an increase in average drawdown of no more than 2 feet (in Blanco County).	8/29/2008
Hickory	Allow for an increase in average drawdown of no more than 7 feet (in Blanco County).	8/29/2008

Marble Falls	Allow for no net increase in average drawdown (in Blanco County).	8/29/2008
Trinity	Allow for an increase in average drawdown of approximately 30 feet through 2060.	7/26/2010
	Groundwater Management Area 10	
Austin Chalk, Uvalde County	No drawdown (including exempt and non-exempt use).	8/23/2010
Buda Limestone, Uvalde County	No drawdown (including exempt and non-exempt use).	8/23/2010
Edwards (Balcones Fault Zone), Northern Subdivision	Springflow at Barton Springs during average recharge conditions shall be no less than 49.7 cubic feet per second averaged over an 84 month (7-year) period; and during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, springflow of Barton Springs shall be no less than 6.5 cubic feet per second averaged on a monthly basis.	8/4/2010
Edwards (Balcones Fault Zone), Northern Subdivision Saline Zone	Well drawdown at the saline-freshwater interface (the so-called Edwards Bad Water Line) averages no more than 5 feet and does not exceed a maximum of 25 feet at any one point on the interface.	8/4/2010
Edwards (Balcones Fault Zone), Kinney County	Water level in well number 70-38-902 shall not fall below 1184 feet mean sea level.	8/4/2010
Edwards (Balcones Fault Zone), San Antonio Segment	Desired future conditions for the Edwards (Balcones Fault Zone) Aquifer within jurisdiction of the Edwards Aquifer Authority are set by the Texas Legislature. See Appendix E.	5/28/2007
Leona Gravel, Medina County	Average drawdown of 15 feet.	5/17/2010
Leona Gravel, Uvalde County	No drawdown (including exempt and non-exempt use).	8/23/2010

Trinity	Average regional well drawdown not exceeding 25 feet during average recharge conditions (including exempt and non-exempt use); within Hays-Trinity Groundwater Conservation District: no drawdown; and within Uvalde County: 20 feet. Not relevant in Trinity-Glen Rose Groundwater Conservation District. Note: Hays-Trinity Groundwater Conservation District and Trinity-Glen Rose Groundwater Conservation District are no longer within the Groundwater Management Area 10 boundary.	8/23/2010
	Groundwater Management Area 11	
Yegua-Jackson, Sparta, Weches, Queen City, Reklaw and Carrizo-Wilcox	Allowing up to an average drawdown of 17 feet.	4/13/2010
	Groundwater Management Area 12	
Brazos River Alluvium	Milan County: a decrease of 5 feet in average saturated thickness from 2010 to 2060, the baseline thickness for 2010 is estimated at 24.5 feet; Burleson County: a decrease of 6 feet in average saturated thickness from 2010 to 2060, the baseline thickness for 2010 is estimated at 38.5 feet. Not relevant in Brazos Valley Groundwater Conservation District.	8/11/2010
Calvert Bluff (Upper Wilcox)	Average drawdown between January 2000 and December 2059: Brazos Valley Groundwater Conservation District: 106 feet, Lost Pines Groundwater Conservation District: 99 feet, Mid-East Texas Groundwater Conservation District: 70 feet, Post Oak Savannah Groundwater Conservation District: 140 feet, Limestone County: 9 feet, Navarro County: 0 feet, Williamson County: 10 foot water-level rise.	8/11/2010
Carrizo	Average drawdown between January 2000 and December 2059: Brazos Valley Groundwater Conservation District: 47 feet, Fayette County Groundwater Conservation District: 60 feet, Lost Pines Groundwater Conservation District: 47 feet, Mid-East Texas Groundwater Conservation District: 55 feet, Post Oak Savannah Groundwater Conservation District: 65 feet.	8/11/2010

Hooper (Lower Wilcox)	Average drawdown between January 2000 and December 2059: Brazos Valley Groundwater Conservation District: 170 feet, Lost Pines Groundwater Conservation District: 129 feet, Mid-East Texas Groundwater Conservation District: 95 feet, Post Oak Savannah Groundwater Conservation District: 180 feet, Falls County: 20 feet, Limestone County: 40 feet, Navarro County: 1 foot, Williamson County: 50 feet.	8/11/2010
Queen City	Average drawdown between January 2000 and December 2059: Brazos Valley Groundwater Conservation District: 12 feet, Fayette County Groundwater Conservation District: 60 feet, Lost Pines Groundwater Conservation District: 13 feet, Mid-East Texas Groundwater Conservation District: 0 feet, Post Oak Savannah Groundwater Conservation District: 30 feet.	8/11/2010
Simsboro (Middle Wilcox)	Average drawdown between January 2000 and December 2059: Brazos Valley Groundwater Conservation District: 270 feet, Lost Pines Groundwater Conservation District: 237 feet, Mid-East Texas Groundwater Conservation District: 115 feet, Post Oak Savannah Groundwater Conservation District: 300 feet, Falls County: 0 feet, Limestone County: 43 feet, Navarro County: 1 foot, Williamson County: 55 feet.	8/11/2010
Sparta	Average drawdown between January 2000 and December 2059: Brazos Valley Groundwater Conservation District: 15 feet, Fayette County Groundwater Conservation District: 60 feet, Lost Pines Groundwater Conservation District: 7 feet, Mid-East Texas Groundwater Conservation District: 0 feet, Post Oak Savannah Groundwater Conservation District: 30 feet.	8/11/2010
Yegua-Jackson	Average drawdown from January 2010 to January 2060: Brazos Valley Groundwater Conservation District: 70 feet for the Yegua, 110 feet for the Jackson; Fayette County Groundwater Conservation District: 75 feet for the Yegua-Jackson; Post Oak Savannah Groundwater Conservation District: 100 feet for the Yegua-Jackson; and Mid-East Texas Groundwater Conservation District: from January 2000 to January 2060, 5 feet for the Yegua-Jackson. Not relevant in Lost Pines Groundwater Conservation District.	6/30/2011
	Groundwater Management Area 13	
Edwards (Balcones Fault Zone), Frio County	Maintain a minimum artesian flow of 500 gallons per minute from wells producing from the Edwards Aquifer in Frio County.	8/12/2010

Edwards (Balcones Fault Zone), San Antonio Segment	Desired future conditions for the Edwards (Balcones Fault Zone) Aquifer within jurisdiction of the Edwards Aquifer Authority are set by the Texas Legislature. See Appendix E.	5/28/2007
Leona Gravel	Average drawdown of 15 feet in Medina County.	7/13/2011
Sparta, Weches, Queen City, Reklaw, and Carrizo-Wilcox	Average drawdown of 23 feet.	4/9/2010
Yegua-Jackson	Average drawdown of 2 feet.	8/12/2010
	Groundwater Management Area 14	
Brazos River Alluvium	Austin, Grimes, Waller, and Washington counties: from estimated 2010 conditions, the saturated thickness should be maintained at 90 percent. Not relevant in Brazos County.	8/25/2010
Carrizo Sand	Grimes County: from estimated 2010 conditions, the average drawdown should not exceed approximately 52.8 feet; Walker County: from estimated 2010 conditions, the average drawdown should not exceed approximately 45.7 feet.	8/25/2010
Gulf Coast	Listed desired future conditions of average drawdown (not to exceed approximately) by county and aquifer layer (Chicot, Evangeline, Burkeville, Jasper). See table 3.	8/25/2010
Navasota River Alluvium	Grimes County: from estimated 2010 conditions, the saturated thickness should be maintained at 90 percent.	8/25/2010
Queen City	Grimes County: from estimated 2010 conditions, the average drawdown should not exceed approximately 16.8 feet; Walker County: from estimated 2010 conditions, the average drawdown should not exceed approximately 21 feet.	8/25/2010
San Bernard River Alluvium	Austin County: from estimated 2010 conditions, the saturated thickness should be maintained at 90 percent.	8/25/2010
San Jacinto River Alluvium	Walker County: from estimated 2010 conditions, the saturated thickness should be maintained at 90 percent.	8/25/2010

Sparta	Grimes County: from estimated 2010 conditions, the average drawdown should not exceed approximately 14 feet; Walker County: from estimated 2010 conditions, the average drawdown should not exceed approximately 19.5 feet.	8/25/2010
Trinity River Alluvium	Walker County: from estimated 2010 conditions, the saturated thickness should be maintained at 90 percent.	8/25/2010
Yegua-Jackson	Average drawdown from estimated 2010 conditions should not exceed, in Grimes and Walker counties: 10 feet in the unconfined Yegua, 15 feet in the confined Yegua, 20 feet in the brackish Yegua, 10 feet in the unconfined Jackson, 15 feet in the confined Jackson, 20 feet in the brackish Jackson; Polk County: 2 feet in the Yegua-Jackson; Washington County: 0 feet in the Yegua-Jackson. Not relevant in Jasper, Newton, and Tyler counties.	8/25/2010
Groundwater Management Area 15		
Gulf Coast	No more than 12 feet of average drawdown by 2060 relative to year 1999 conditions.	7/14/2010
Groundwater Management Area 16		
Gulf Coast	Average drawdown of approximately 94 feet through 2060.	8/30/2010

Table 2: Desired future conditions for each unit of the Trinity Aquifer in Groundwater Management Area 8.

County	Base year	Duration (years)	Average drawdown (feet)			
			Paluxy	Glen Rose	Hensell	Hosston
Bell	2000	50	134	155	286	319
Bosque	2000	50	26	33	201	220
Brown	2000	50	0	0	1	1
Burnet	2000	50	1	1	11	29
Callahan	2000	50	n/a	n/a	0	2
Collin	2000	50	298	247	224	236
Comanche	2000	50	0	0	2	11
Cooke	2000	50	26	42	60	78
Coryell	2000	50	15	15	156	179
Dallas	2000	50	240	224	263	290
Delta	2000	50	175	162	162	159
Denton	2000	50	98	134	180	214
Eastland	2000	50	0	0	0	0
Ellis	2000	50	265	283	336	362
Erath	2000	50	1	1	11	27
Falls	2000	50	279	354	459	480
Fannin	2000	50	212	196	182	181
Grayson	2000	50	175	161	160	165
Hamilton	2000	50	0	2	39	51
Hill	2000	50	209	253	381	406
Hood	2000	50	1	2	16	56
Hunt	2000	50	286	245	215	223
Johnson	2000	50	37	83	208	234
Kaufman	2000	50	303	286	295	312
Lamar	2000	50	132	130	136	134
Lampasas	2000	50	0	1	12	23
Limestone	2000	50	328	392	475	492
McLennan	2000	50	251	291	489	527
Milam	2000	50	252	294	337	344
Mills	2000	50	0	0	3	12
Montague	2000	50	0	1	3	12
Navarro	2000	50	344	353	399	413
Parker	2000	50	5	6	16	40
Red River	2000	50	82	77	78	78
Rockwall	2000	50	346	272	248	265
Somervell	2000	50	1	4	53	113
Tarrant	2000	50	33	75	160	173
Taylor	2000	50	n/a	n/a	n/a	3
Travis	2000	50	124	61	98	116
Williamson	2000	50	108	88	142	166
Wise	2000	50	4	14	23	53

Table 3: Desired future conditions for each unit of the Gulf Coast Aquifer in Groundwater Management Area 14.[43]

County	Base year	Duration (years)	Average drawdown (feet)			
			Chicot Aquifer	Evangeline Aquifer	Burkeville Confining Unit	Jasper Aquifer
Austin	2008	52	17	10	11	20
Brazoria	2008	52	45	40	-	-
Brazos	2008	52	-	-	-	7
Chambers	2008	52	43	36	-	-
Grimes	2008	52	0	5	10	28
Hardin	2008	52	17	27	23	37
Jasper	2008	52	10	23	24	21
Jefferson	2008	52	25	26	-	-
Liberty	2008	52	32	37	28	64
Montgomery	2008	8	3	13	10	61
	2016	44	6	25	23	-38
Newtown	2008	52	9	20	22	18
Orange	2008	52	14	19	-	-
Polk	2008	52	4	4	20	41
San Jacinto	2008	52	5	7	18	72
Tyler	2008	52	3	16	19	33
Walker	2008	52	-	10	5	33
Waller	2008	52	7	8	9	25
Washington	2008	52	-	1	17	20

[43] Negative values indicate a water level rise.

Appendix E: Desired Future Conditions for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer within the jurisdiction of the Edwards Aquifer Authority.

Desired future conditions for the Edwards (Balcones Fault Zone) Aquifer within jurisdiction of the Edwards Aquifer Authority are set by the Texas Legislature (Act of May 28, 2007, 80th Leg., R.S., ch. 1351, § § 2.02 and 2.06, 2007 Tex. Gen. Laws, 4612, 4627, and 4627; Act of May 28, 2007, 80th Leg., R.S. ch. 1430, § § 12.02 and 12.06, 2007 Tex. Gen. Laws 5848, 5901, and 5903). They are specified in Sections 1.14(a), (f), (h), and 1.26 of the Edwards Aquifer Authority Act and are excerpted from the act below.

The Edwards Aquifer Authority's boundaries are partially within groundwater management areas 7, 9, 10, and 13. The San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer is within groundwater management areas 9, 10, and 13.

SECTION 1.14 WITHDRAWALS.
(a) Authorizations to withdraw water from the aquifer and all authorizations and rights to make a withdrawal under this Act shall be limited in accordance with this section to:

(1) protect the water quality of the aquifer;
(2) protect the water quality of the surface streams to which the aquifer provides springflow;
(3) achieve water conservation;
(4) maximize the beneficial use of water available for withdrawal from the aquifer;
(5) recognize the extent of the hydro-geologic connection and interaction between surface water and groundwater;
(6) protect aquatic and wildlife habitat;
(7) protect species that are designated as threatened or endangered under applicable federal or state law; and
(8) provide for instream uses, bays, and estuaries.

(f) If the level of the aquifer is equal to or greater than 660 feet above mean sea level as measured at Well J-17, the authority may authorize withdrawal from the San Antonio pool, on an uninterruptible basis, of permitted amounts. If the level of the aquifer is equal to or greater than 845 feet at Well J-27, the authority may authorize withdrawal from the Uvalde pool, on an uninterruptible basis, of permitted amounts.

(h) To accomplish the purposes of this article, the authority, through a program, shall implement and enforce water management practices, procedures, and methods to ensure that, not later than December 31, 2012, the continuous minimum springflows of the Comal Springs and the San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law and to achieve other purposes provided by Subsection (a) of this section and Section 1.26 of this article. The authority from time to time as appropriate may revise the practices, procedures, and methods. To meet this requirement, the authority shall require:

(1) phased adjustments to the amount of water that may be used or withdrawn by existing users or categories of other users, including adjustments in accordance with the authority's critical period management plan established under Section 1.26 of this article; or
(2) implementation of alternative management practices, procedures, and methods.

Act of May 30, 1993, 73rd Leg., R.S., ch. 626, § 1.14, 1993 Tex. Gen. Laws 2350, 2360; as amended by Act of May 28, 2007, 80th Leg., R.S., ch. 1351, § 2.02, 2007 Tex. Gen. Laws 4612, 4627; Act of May 28, 2007, 80th Leg., R.S., ch. 1430, § 12.02, 2007 Tex. Gen. Laws 5848, 5901.

SECTION 1.26 CRITICAL PERIOD MANAGEMENT PLAN.
(a) After review of the recommendations received in the program document, as prescribed by Section 1.26A of this article, the authority by rule shall adopt a critical period management plan consistent with Sections 1.14(a), (f), and (h) of this article. The critical period management plan shall be adopted by the authority no later than six months after the authority's receipt of the program document. On adoption of the critical period management plan, the authority shall provide a written report to the governor, lieutenant governor, and speaker of the house of representatives describing the actions taken in response to each recommendation and, for each recommendation not implemented, the reason it was not implemented. The plan must:
(1) distinguish between discretionary use and nondiscretionary use;
(2) require reductions of all discretionary use to the maximum extent feasible;
(3) require utility pricing, to the maximum extent feasible, to limit discretionary use by the customers of water utilities;
(4) require reduction of nondiscretionary use by permitted or contractual users, to the extent further reductions are necessary, in the reverse order of the following water use preferences:
(A) municipal, domestic, and livestock;
(B) industrial and crop irrigation;
(C) residential landscape irrigation;
(D) recreational and pleasure; and
(E) other uses that are authorized by law; and
(5) allow irrigation use to continue in order to permit the user to complete the irrigation of a crop in progress.

(b) In this section, "MSL" means the elevation above mean sea level, measured in feet, of the surface of the water in a well, and "CFS" means cubic feet per second. Not later than January 1, 2008, the authority shall, by rule, adopt and enforce a critical period management plan with withdrawal reduction percentages in the amounts indicated in Tables 1 and 2 whether according to the index well levels or the Comal or San Marcos Springs flow as applicable, for a total in critical period Stage IV of 40 percent of the permitted withdrawals under Table 1 and 35 percent under Table 2:

TABLE 1 – CRITICAL PERIOD WITHDRAWAL REDUCTION STAGES FOR THE SAN ANTONIO POOL				
COMAL SPRINGS FLOW CFS	**SAN MARCOS SPRINGS FLOW CFS**	**INDEX WELL J-17 LEVEL MSL**	**CRITICAL PERIOD STAGE**	**WITHDRAWAL REDUCTION – SAN ANTONIO POOL**
<225	<96	<660	I	20%
<200	<80	<650	II	30%
<150	N/A	<640	III	35%
<100	N/A	<630	IV	40%

TABLE 2 – CRITICAL PERIOD WITHDRAWAL REDUCTION STAGES FOR THE UVALDE POOL		
WITHDRAWAL REDUCTION-UVALDE POOL	**INDEX WELL J-27 LEVEL MSL**	**CRITICAL PERIOD STAGE**
N/A	N/A	I
5%	<850	II
20%	<845	III
35%	<842	IV

(c) A change to a critical period stage with higher withdrawal reduction percentages is triggered if the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs or the 10-day average of daily aquifer levels at the J-17 Index Well drops below the lowest number of any of the trigger levels indicated in Table 1. A change to a critical period stage with lower withdrawal reduction percentages is triggered only when the 10-day average of daily springflows at the Comal Springs and the San Marcos Springs and the 10-day average of daily aquifer levels at the J-17 Index Well are all above the same stage trigger level. The authority may adjust the withdrawal percentages for Stage IV in Tables 1 and 2 if necessary in order to comply with Subsection (d) or (e) of this section.

(d) Beginning September 1, 2007, the authority may not require the volume of permitted withdrawals to be less than an annualized rate of 340,000 acre-feet, under critical period Stage IV.

(e) After January 1, 2013, the authority may not require the volume of permitted withdrawals to be less than an annualized rate of 320,000 acre-feet, under critical period Stage IV unless, after review and consideration of the recommendations provided under Section 1.26A of this article, the authority determines that a different volume of withdrawals is consistent with

Sections 1.14(a), (f), and (h) of this article in maintaining protection for federally listed threatened and endangered species associated with the aquifer to the extent required by federal law.

(f) Notwithstanding Subsections (d) and (e) of this section, the authority may require further withdrawal reductions before reviewing and considering the recommendations provided under Section 1.26A of this article if the discharge of Comal Springs or San Marcos Springs declines an additional 15 percent after Stage IV withdrawal reductions are imposed under Subsection (b) of this section. This subsection expires on the date that critical period management plan rules adopted by the authority based on the recommendations provided under Section 1.26A of this article take effect.

(g) Notwithstanding the existence of any stage of an interim or final critical period adopted by the authority under this section, a person authorized to withdraw groundwater from the aquifer for irrigation purposes shall, without regard to the withdrawal reductions prescribed for that stage, be allowed to finish a crop already planted in the calendar year during which the critical period is in effect.

Act of May 30, 1993, 73rd Leg., R.S., ch. 626, § 1.26, 1993 Tex. Gen. Laws 2350, 2363; as amended by Act of May 28, 2007, 80th Leg., R.S., ch. 1351, § 2.06, 2007 Tex. Gen. Laws 4612, 4628; Act of May 28, 2007, 80th Leg., R.S., ch. 1430, § 12.06, 2007 Tex. Gen. Laws 5848, 5903.