

CHAPTER 1 DESCRIPTION OF THE PLANNING AREA

1.1 Background

Senate Bill 1 (SB1), which was passed into law in June 1997 and enacted by the 75th Texas Legislature, stemmed from increased awareness of Texas' vulnerability to drought and of the limitations of existing water supplies to meet the needs of the state's growing population. Senate Bill 2 (SB2), enacted in September 2001, expanded on the regional water planning process as created by SB1, and provided for further analysis and planning for water resources in the state. With rapidly growing populations, the need to adequately plan for existing and future water needs is vital to the economic health of the region and State. Some areas of the State are already facing near-term water shortages, and the projected population is expected to double by 2060. The purpose of SB1 and SB2 is to ensure that the water needs of all Texans are met in the 21st century.

The SB1/SB2 legislation calls for a "bottom up" water planning process wherein Regional Water Planning Groups (RWPGs) are formed with members representing a minimum of 11 different interests, including the environment, industry, municipalities, water authorities, and the public. The Texas Water Development Board (TWDB) has established 16 regional water planning ~~areas~~areas; each with its own RWPG. Each RWPG is tasked with preparing a regional water plan for its area that assesses the available water supplies, the projected demands on these supplies and identifies a means to meet future water needs while maintaining long-term protection of the State's resources.

In accordance with SB2 (as amended), ~~all of~~all the regional water plans must be completed, adopted and submitted to the TWDB by ~~October 20, 2025~~November 5, 2020. The TWDB will approve and compile the 16 regional plans into the ~~2021 State 2027~~2021 State 2027 State Water Plan. The regional and state water plans will continue to be updated every 5 years.

1.1.1 Brazos G Regional Water Planning Area

The Brazos G Regional Water Planning Area (BGRWPA), shown in Figure 1.1, comprises all or portions of 37 central Texas counties. The Brazos G Area is about 31,600 square miles in area, or 12 percent of the State's total area. About 90 percent of the region lies in the Brazos River Basin. Figure 1.2 shows the major features of the BGRWPA, such as major cities, reservoirs, and highways. This figure also shows that parts of several counties extend into the Red, Trinity, Colorado, and San Jacinto River Basins. Cities in the region with current populations greater than 50,000 are Abilene, Bryan, Cedar Park, College Station, Georgetown, Killeen, Leander, Round Rock, Temple, and Waco.¹

The region's geography varies from the rugged, uneven terrain and sandy soils of Kent and Knox Counties in the northwest to the hilly, forested areas and rich soils in Grimes and Washington Counties in the southeast. In the central part of the region are the Blackland Prairies in Hill and McLennan Counties.²

¹ U.S. Census Bureau, *2020 Census*, <https://www.census.gov/programs-surveys/decennial-census/decade/2020/2020-census-results.html><http://www.census.gov/2010census/>.

² The Dallas Morning News, *1997-1998 Texas Almanac*, 1998.

Members of the Brazos G RWPG who contributed to the development of the 2026 Brazos G Regional Water Plan are listed in Table 1.1. These members represent 12 interests: the public, counties, municipalities, industries, agriculture, the environment, small businesses, electric-generating utilities, river authorities, water districts, groundwater districts and water utilities. The Brazos G RWPG has retained the services of engineering firms and other specialists to assist the RWPG with the preparation of the regional plan, and it has designated the Brazos River Authority (BRA) as its administrative contracting agency.

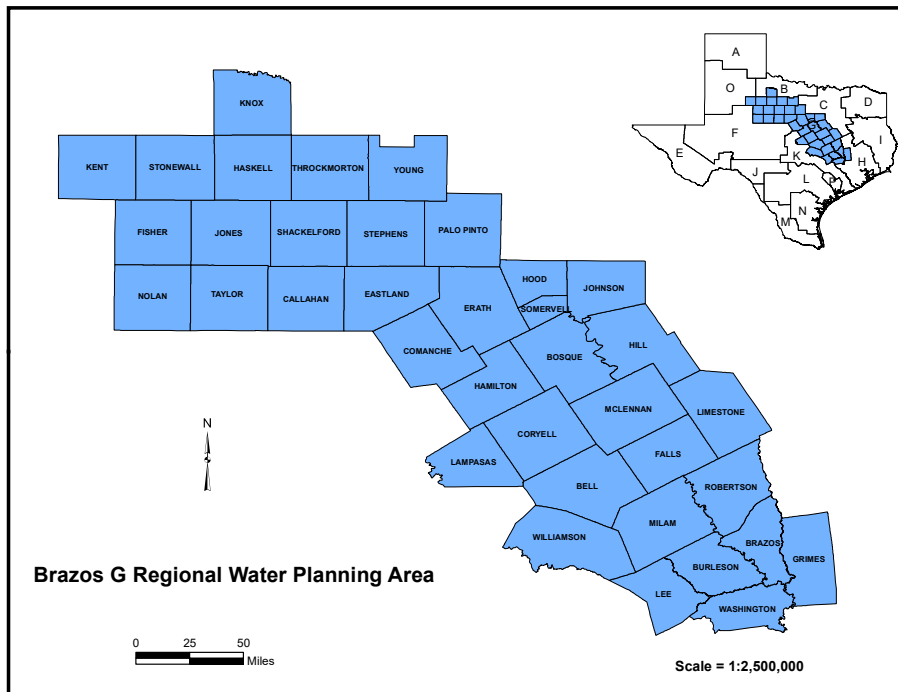


Figure 1.1 Location Map

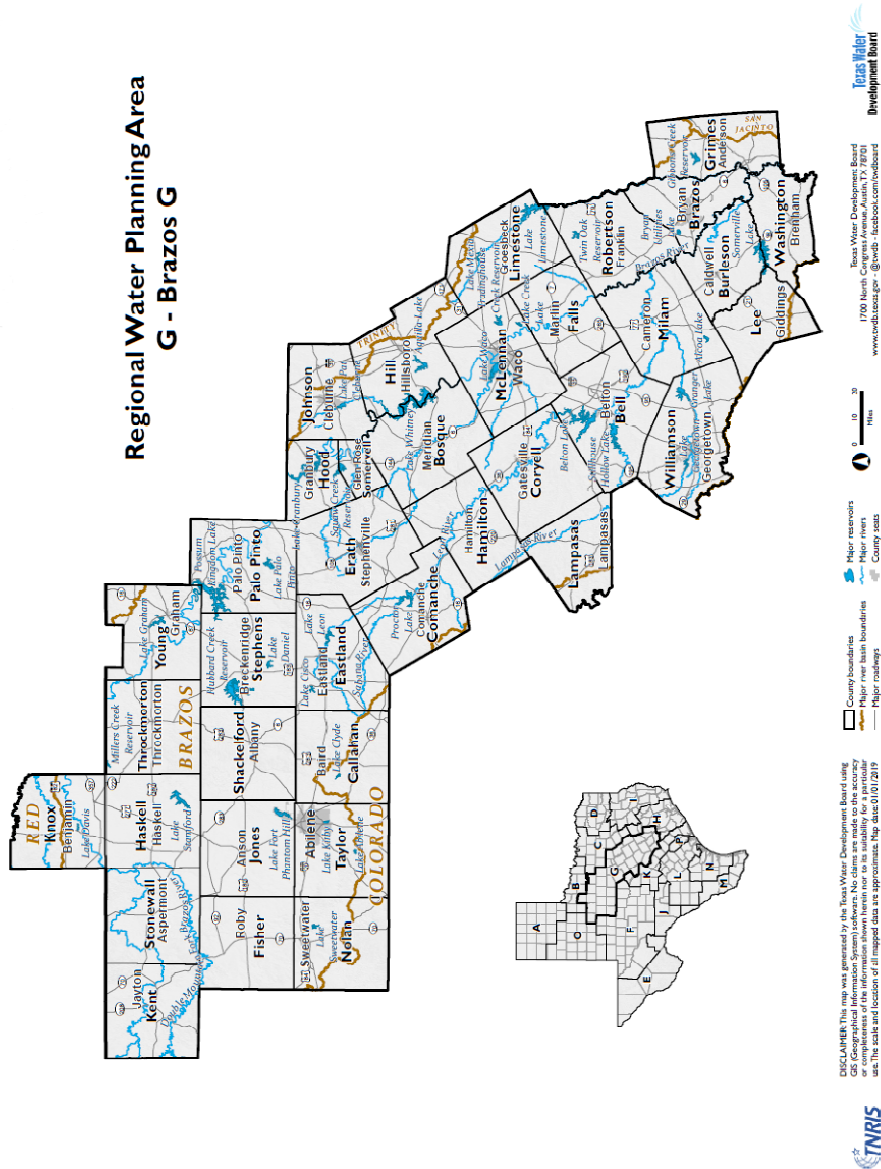


Figure 1.2 Major Features of the Brazos G Area

Table 1.1 Current and Recent Brazos G RWPG Members

Interest Group	Name
Voting Members	
Agricultural	Judge Dale Spurgin Wayne Wilson (Chairman)
Counties	Judge David Blackburn Judge Scott M. Felton Commissioner Gary Myers
Electric Generating Utilities	Ryan Bayle
Environmental	Luci Dunn
Industry	Alan Gardenhire
Municipalities	Jim Briggs Jennifer Nations Lisa Tyer Jerry K. "Kenny" Weldon
Public	Gary Newman
River Authorities	David Collinworth
Small Business	Gail L. Peek
Water Districts	Patrick Wagner Kathy Turner
Groundwater Management Areas	Dirk Aaron Dale Adams Zach Holland Lynn Smith Gary Westbrook
Water Utilities	Charles Beseda
Non-Voting Members	
Texas Water Development Board	John Maurer Jean Devlin (former)
Texas Parks and Wildlife Department	Jennifer Bronson-Wilson
Texas Department of Agriculture	Lauren Moore
Texas State Soil and Water Conservation Board	Allen Nash

1.2 Population

1.2.1 Regional Trends

Figure 1.3 illustrates population growth in the entire BGRWPA for 1900 to 2024 and projected growth for 2030 to 2080. Table A.1 in Appendix A gives historical population data for each county in the BGRWPA, as well as regional and State population totals, for 1990 to 2024.

From 1900 to 1970, the population in the Brazos G Area grew slowly at an average rate of 0.4 percent per year from 680,093 people to 895,682. During the same period, the total population of Texas grew at an average rate of 1.9 percent annually, from 3,048,710 to 11,196,730. Beginning in the 1970s, however, both the State's and the region's population began to increase at faster rates. Growth in the region was about 2 percent annually, which approximates the State's total growth rate of 2 percent. Population in the BGRWPA is expected to increase by an average of 1.63 percent annually, reaching 5,664,35 million by 2080. This is roughly double the census population in 2024.

Population trends may be further understood by dividing the BGRWPA into three subregions: the northwestern Rolling Plains, the central IH-35 Corridor, and the southeastern Lower Basin. Table A.2 in Appendix A provides historical population data for all counties in each subregion from 1900 to 2024.

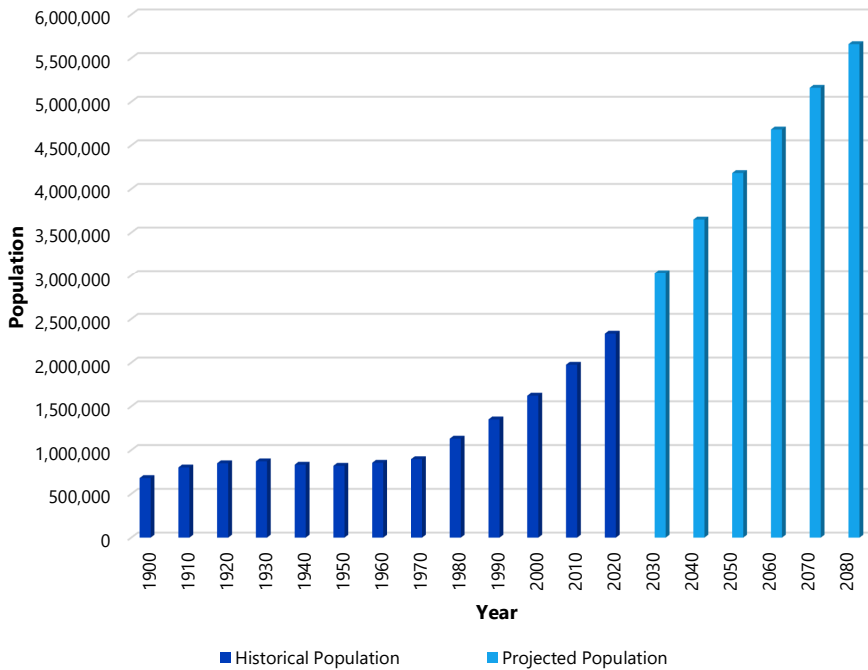


Figure 1.3 Historical and Projected BGRWPA Population

Figure 1.4 illustrates historical population growth in the three subregions from 1900 to 2024 and projected growth from 2030 to 2087. Figure 1.5 and Figure 1.6 illustrate population distribution by county for years 2030 and 2087, respectively. The greatest growth is projected to occur along the IH-35 corridor, which connects some of the larger cities in the region and the state. Table 1.2 presents 2024 populations and projected populations for 2030 and 2087 for the major cities in each subregion. Major cities are defined as those having at least 10,000 people in 2024. This table also presents the percent change in populations from 2030 to 2087 in each city. The overall division of the population between large cities and rural areas is expected to increase from 61.056.6 percent in 2024 to 65.0-61.2 percent by 2087.

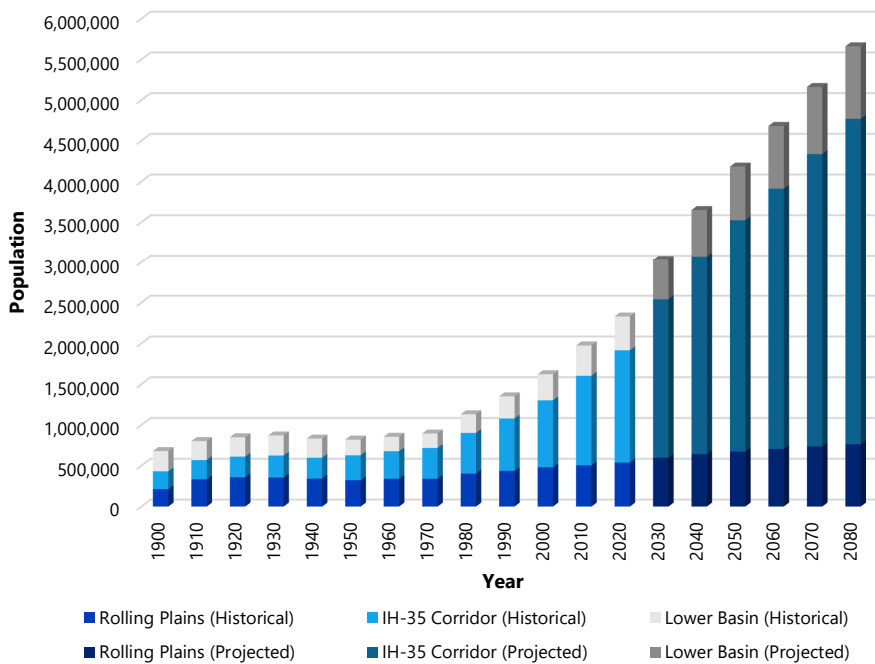


Figure 1.4 Historical and Projected Population by Subregion

1.2.2 Rolling Plains

The counties in the Rolling Plains subregion are Knox, Kent, Stonewall, Haskell, Throckmorton, Young, Fisher, Jones, Shackelford, Stephens, Palo Pinto, Nolan, Taylor, Callahan, Eastland, Erath, Hood, Somervell, Comanche, Hamilton, Bosque, Coryell, and Lampasas. These counties, with about 23.5 percent of the BGRWPA’s population in 2024, have grown moderately since 1970 at an average rate of 1.00.8 percent

per year. Major cities in this subregion include Abilene, Copperas Cove, Gatesville, [Granbury](#), Mineral Wells, Stephenville, and Sweetwater.

1.2.3 IH-35 Corridor

The counties in the IH-35 Corridor are Johnson, Hill, McLennan, Bell, and Williamson. Population growth in these counties has been rapid since 1970, averaging [3.02.4](#) percent annually. In this subregion, cities with a current population greater than 10,000 include [Bellmead](#), Belton, Burleson, Cedar Park, Cleburne, Fort Hood, Georgetown, Harker Heights, Hewitt, Hutto, Killeen, Leander, Robinson, Round Rock, Taylor, Temple, and Waco.³ Total population in the IH-35 Corridor was about [596](#) percent of the region's total in year [20240](#), and it is expected to keep growing rapidly.

1.2.4 Lower Basin

Counties in the Lower Basin are Limestone, Falls, Milam, Robertson, Lee, Burleson, Brazos, Washington, and Grimes. This subregion also has seen a relatively high growth rate averaging [1.95](#) percent annually since 1970. Major cities include Brenham, Bryan, and College Station. The Lower Basin had [189](#) percent of the population of the BGRWPA in [20240](#).

³ U.S. Census Bureau, *20210 Census*, <https://www.census.gov/programs-surveys/decennial-census/decade/2020/2020-census-results.html><http://www.census.gov/2010census/>

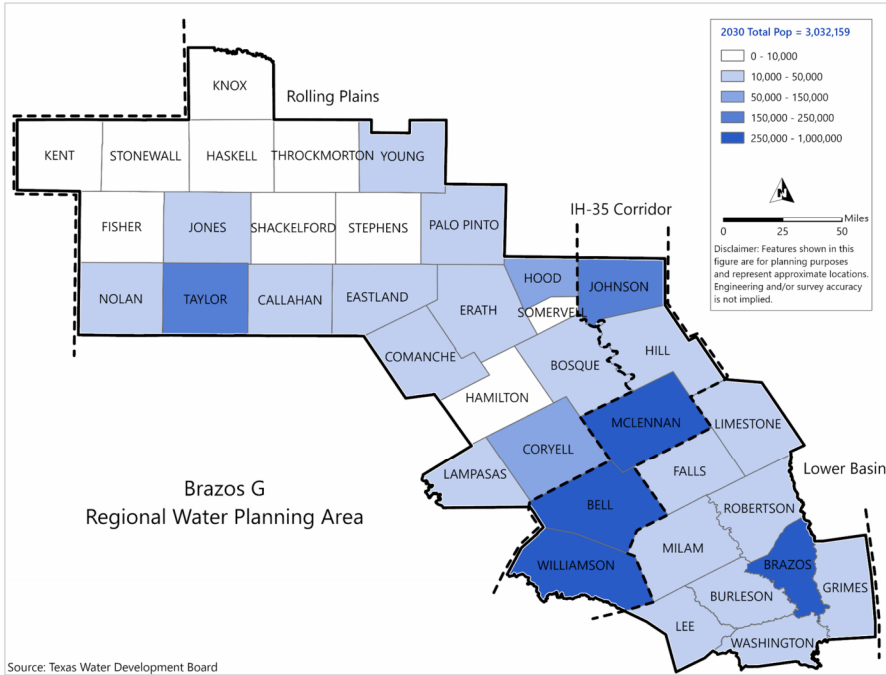


Figure 1.5 2030 Population Distribution by County

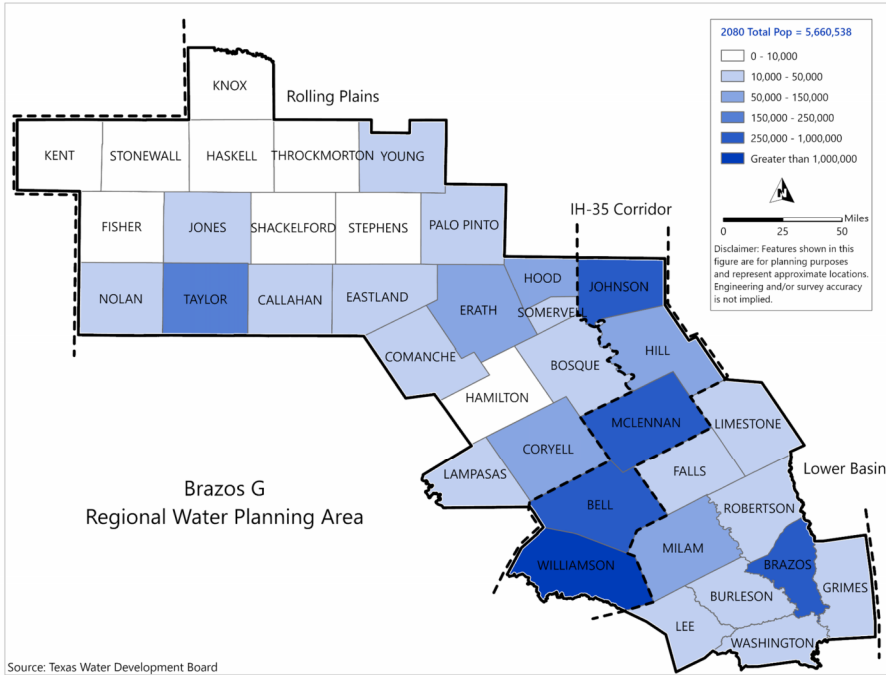


Figure 1.6 2080 Population Distribution by County

Table 1.2 Population of Major Cities in the BGRWPA (Greater than 10,000 People in 2024)

City	County	Population Data ⁽¹⁾			% Change (2030 to 2080)
		2020	2030	2080	
Rolling Plains					
Abilene	Jones, Taylor	120,609	134,466	184,001	36.8
Copperas Cove	Coryell	33,519	48,375	78,916	63.1
Gatesville	Coryell	14,984	15,649	16,353	4.5
Granbury	Hood	14,124	16,684	29,871	79.0
Mineral Wells ⁽²⁾	Palo Pinto	14,626	16,926	19,737	16.6
Stephenville	Erath	20,372	26,797	46,758	74.5
Sweetwater	Nolan	11,457	11,590	10,768	-7.1
IH-35 Corridor					
Bellmead	McLennan	10,471	11,152	12,735	14.2

City	County	Population Data ⁽¹⁾			% Change
		2020	2030	2080	(2030 to 2080)
Belton	Bell	23,310	28,600	53,719	87.8
Burleson ⁽²⁾	Johnson	43,515	42,810	81,047	89.3
Cedar Park	Williamson	83,703	92,024	92,024	0.0
Cleburne	Johnson	27,492	36,047	59,118	64.0
Fort Hood	Bell, Coryell	27,811	36,200	43,451	20.0
Georgetown	Williamson	123,177	247,802	1,041,920	320.5
Harker Heights	Bell	33,013	36,879	50,000	35.6
Hewitt	McLennan	15,779	17,127	17,127	0.0
Hutto	Williamson	16,813	23,452	120,937	415.7
Killeen	Bell	152,631	173,431	297,387	71.5
Leander	Williamson	66,009	137,045	190,010	38.6
Robinson	McLennan	11,340	13,570	26,268	93.6
Round Rock ⁽²⁾	Williamson	123,672	145,880	233,092	59.8
Taylor	Williamson	15,767	27,500	95,847	248.5
Temple	Bell	85,214	115,562	164,252	42.1
Waco	McLennan	137,862	156,758	230,264	46.9
Lower Basin					
Brenham	Washington	16,490	17,003	17,232	1.3
Bryan	Brazos	81,200	103,527	273,294	164.0
College Station	Brazos	96,208	124,105	187,998	51.5
Total, Major Cities	—	1,410,697	1,845,809	3,661,391	98.4
% of Region Total	—	60.5%	60.9%	64.7%	
Total, Rural Areas	—	920,202	1,186,350	1,999,147	68.5
% of Region Total	—	39.5%	39.1%	35.3%	
Region Total	—	2,330,899	3,032,159	5,660,538	86.7

Notes:

- (1) 2020 population data obtained from U.S. Census. 2030 and 2080 projections are based on TWDB.
(2) Represents only the portion of the city located in Region G.

1.3 Economic Activities

The BGRWPA includes all or part of the following metropolitan statistical areas as defined by the Texas State Data Center: Abilene, [Austin-Round Rock-San Marcos, College Station-Bryan, Waco](#), Dallas-Fort Worth-Arlington, Killeen-Temple-Fort Hood, [Austin-Round Rock, and College Station – Bryan and Waco](#). The economy of the region can be divided into the following general sectors: agriculture, agribusiness, mineral production, wholesale and retail trade, and varied manufacturing. Table 1.3 lists 2016 payrolls and employment in the BGRWPA by subregion and economic sector.⁴ As of this writing, 2016 was the most recent year for which such data were available. Payroll and employment in the Brazos G Area were concentrated along the IH-35 Corridor, which in 2016 had a total payroll of about \$16.4 billion and employment of approximately 440,000 people. Primary economic activities were manufacturing, retail trade, and services, accounting for about 64 percent of the region’s total payroll in 2016.

Table 1.3 2016 Economic Data (x\$1,000)

Economic Sector ⁽¹⁾	Rolling Plains	IH-35 Corridor	Lower Basin	Region Total
Agricultural, Forestry, Fishing	\$9,970	\$795	\$2,032	\$12,797
Mining	\$205,657	\$198,476	\$138,260	\$542,393
Construction	\$442,424	\$1,269,836	\$457,709	\$2,169,969
Manufacturing	\$496,570	\$1,751,183	\$510,386	\$2,758,139
Transportation, Public Utilities	\$377,470	\$595,876	\$159,640	\$1,132,986
Wholesale Trade	\$235,224	\$796,502	\$200,670	\$1,232,396
Retail Trade	\$590,413	\$1,625,922	\$437,986	\$2,654,321
Finance, Insurance, Real Estate	\$324,404	\$1,370,931	\$271,515	\$1,966,850
Services	\$1,687,746	\$7,674,877	\$1,390,313	\$10,752,936
Unclassified	\$174,430	\$522,329	\$137,545	\$834,304
Not Categorized	\$81,829	\$494,275	\$105,931	\$682,035
Total Payroll	\$4,788,661	\$16,403,984	\$3,907,547	\$25,100,192
Total Employed ⁽²⁾	169,336	440,058	153,010	762,404

Notes:

- (1) Data from U.S. Census Bureau.
- (2) Data from Bureau of Labor Statistics.

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1.4 Climate

Average temperatures from 1981 to 2023⁵ in the Brazos G area range from an average lows of 28.28° F to 40.41° F to an average highs of 55.55° F to 62.62° F in January. For July, average temperatures across the planning area range from an average lows of 70.69° F to 75.74° F to an average highs of 94.93° F to 97.97° F.

⁴ U.S. Census Bureau, "2016 Economic Data," Online, available URL: https://data.census.gov/https://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

⁵ PRISM Climate Group - Northwest Alliance for Computation Science and Engineering, 2024: Historical Past and Recent Years Datasets for Precipitation and Temperature, <http://www.prism.oregonstate.edu/>

Average annual precipitation^{5,6} ranges from 22 to 26 inches in the northwestern most counties of the region to 38 to 50 inches in the southeastern most counties. Figure 1.7 depicts average annual precipitation for the entire region.

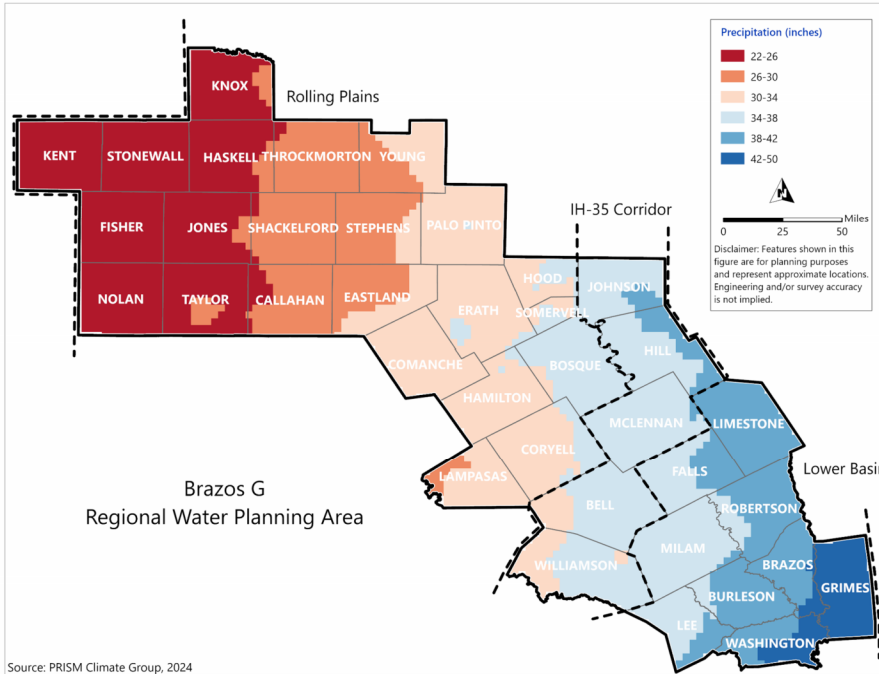


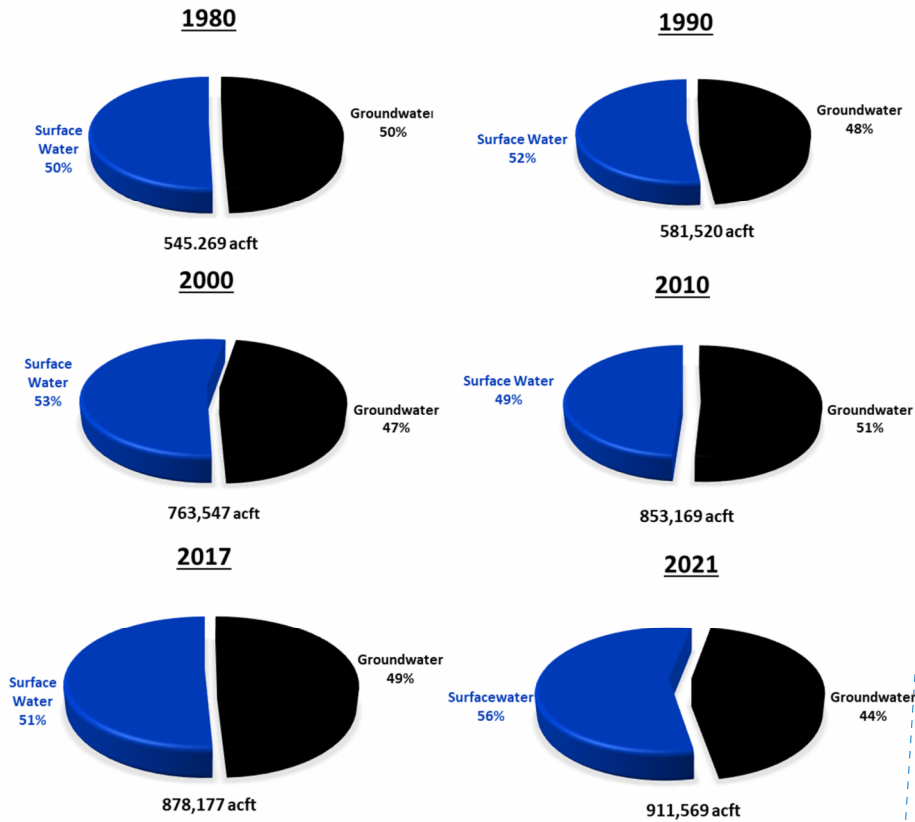
Figure 1.7 Average Annual Precipitation (1981 to 2024)

1.5 Sources of Water

Table A.3 in Appendix A provides historical data on use of groundwater and surface water within the BGRWPA from 1980 to 2021⁷. These data suggest that the planning area depended slightly more on surface water than on groundwater. Figure 1.8 shows the proportion of surface water use to groundwater use in 1980, 1990, 2000, 2010 and 2021. While the proportions were equal in 1980, surface water use was greater by 2 percent in 1990, and 3 percent in 2000. In 2010, the surface water use was 2 percent less than groundwater. In 2017, surface water use was 2 percent more than groundwater and in 2021 surface water was 12% greater.

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⁶ Texas Water Development Board (TWDB), Water Data for Texas – Lake Evaporation and Precipitation Dataset. Accessed at: <https://waterdatafortexas.org/lake-evaporation-rainfall>



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Figure 1.8 BGRWPA Historical Water Use by Source (1981 to 2021⁷)

1.5.1 Groundwater

1.5.1.1 Aquifers⁷⁸⁹

Portions of six major and eleven minor aquifers extend into the Brazos G Area (Figure 1.9 and Figure 1.10). Major aquifers are defined generally as those aquifers that supply large amounts of water to large areas of the State. Minor aquifers are defined as those that supply large amounts of water to small areas of the

⁷ Texas Water Commission, *Groundwater Quality in Texas - An Overview of Natural and Man-Affected Conditions*, TWC Report No. 89-01, 1989.

⁸ Texas Water Development Board (TWDB), *Water for Texas*, 1997.

⁹ TWDB, *Estimated Groundwater Pumpage by County and Aquifer*, 2010.

State or provide small supplies to wide areas. Figure 1.11 shows historical water pumpage for each aquifer in the BGRWPA in 1980, 1990, 2000, 2010, ~~and 2017~~ **and 2021**. In ~~2021~~ **2021**, about ~~74 percent~~ **74 percent** of the groundwater pumped came from four aquifers: Brazos Valley Alluvium, Carrizo-Wilcox, Seymour, and Trinity. Table 1.4 presents historical pumpage in ~~2010~~ **2020** and projected availability in ~~2030~~ **2030** of groundwater in each aquifer in the BGRWPA.

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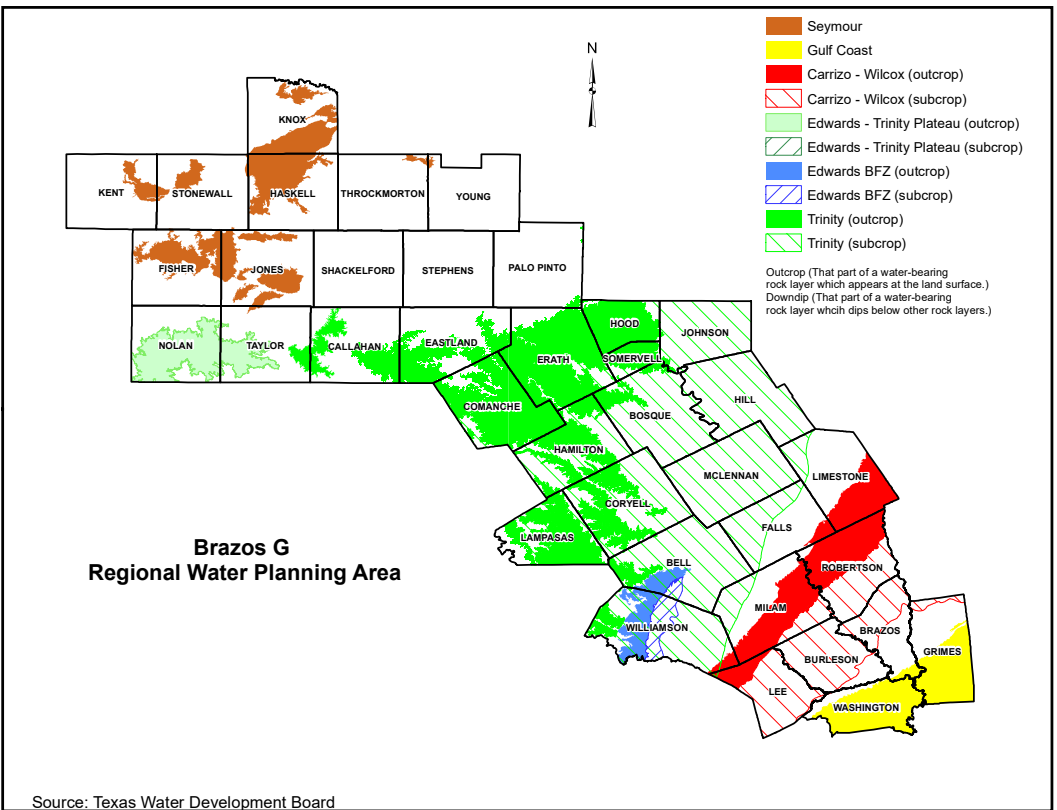


Figure 1.9 Major Aquifers

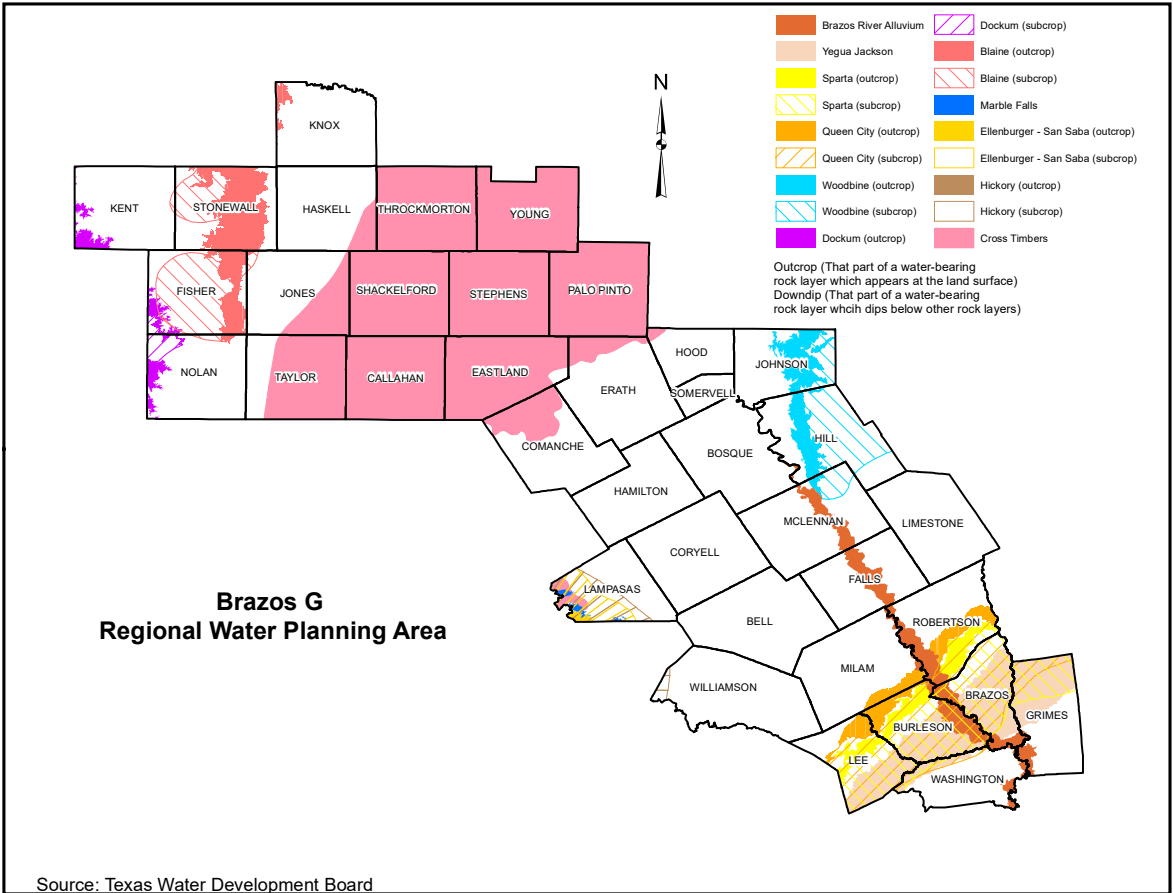


Figure 1.10 Minor Aquifers

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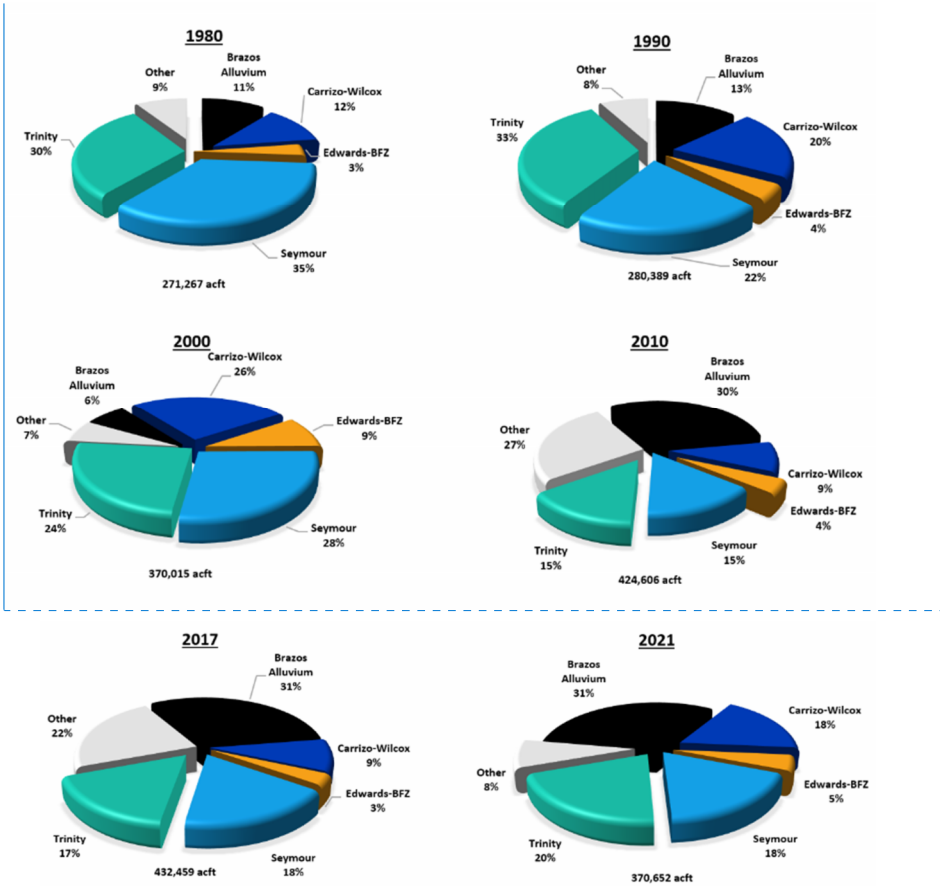


Figure 1.11 Brazos G Area Historical Water Pumpage by Aquifer

Fewer than half of the aquifers in the BGRWPA have potential for further development. Seven of them extend only slightly into the planning area. The aquifers that do offer potential for further development are all in the southeastern part of the region.

In the western part of the region, the Seymour Aquifer is the most significant in terms of usage and yield. The Seymour Aquifer has an uneven distribution, is highly developed, and most of its water is used for irrigation. The Seymour Aquifer is prone to depletion if subjected to a combination of prolonged drought and heavy use, but groundwater supply in the aquifer has remained mostly constant. Along with the Seymour, the fringes of three aquifers, the Dockum, Blaine, and Edwards-Trinity (Plateau), extend into the west end of the planning area, but these offer little room for further development. In the northeastern part of the region, there is a wide area with no major or minor aquifers, including Throckmorton, Young,

Shackelford, Stephens, and Palo Pinto Counties. In these areas, locally occurring groundwater is not associated with a defined major or minor aquifer system and is primarily used for domestic and livestock purposes.

Table 1.4 Historical Pumpage and Future Availability in Brazos G Area Aquifer

Aquifer	2021 Pumpage (acft)	2080 Availability (acft/yr)	Remarks
Western Area			
Seymour	67,171	79,182	Fully developed
Dockum	15,700	2,653	Limited extent within region
Blaine	383	12,920	Limited extent within region
Edwards-Trinity (Plateau)	318	ND ⁽¹⁾	Limited extent within region
Cross Timbers	66	2,714	Recently named minor aquifer
Subtotal:	83,638	97,469	
Central Area			
Trinity	75,366	125,328	Overdeveloped in some areas
Edwards (BFZ)	16,958	9,921	Overdeveloped in drought
Woodbine	385	2,567	Limited extent within region
Marble Falls	13	2,839	Limited extent within region
Ellenburger-San Saba	22	2,595	Limited extent within region
Hickory	ND ⁽¹⁾	113	Limited extent within region
Subtotal:	92,744	143,363	
Southeastern Area			
Brazos River Alluvium	115,112	221,588	Added potential, water quality variable
Carrizo-Wilcox	65,216	299,958	Large added potential
Queen City	2,362	10,108	
Sparta	4,487	19,016	Added potential
Gulf Coast	3,500	93,073	Added potential
Navasota River Alluvium	ND ⁽¹⁾	2,216	
Yegua-Jackson	2,665	14,755	
Subtotal:	193,342	660,714	
Other and Undifferentiated	994	848	Many widely scattered sources
Total:	370,718	902,394	

Commented [CB6]: 2021 PUMPAGE DATA TO BE UPDATED

Notes:

(1) ND indicates no data available.

The Trinity Aquifer is the most significant groundwater source in the central part of the BGRWPA. It is widespread and furnishes small to moderate amounts of groundwater in 17 counties. In the confined portions of the aquifer, however, development has resulted in significant declines in water levels.

In the southeastern part of the area, groundwater supplies are dominated by the Carrizo-Wilcox System and the Gulf Coast Aquifer. The Carrizo-Wilcox has significant potential for further development, but the Gulf Coast Aquifer in this area has low to moderate potential. Several minor aquifers also have potential for further development over wide areas in this sector. The Brazos Alluvium, which lies along the Brazos

River, also extends into the central portion of the area and has some potential for additional development, but most of the BGRWPA's undeveloped groundwater lies in the southeastern sector.

The Trinity Aquifer and all other aquifers to the southeast have outcrop areas under water-table conditions and downdip areas with overlying confining layers where artesian conditions may occur. Most of these aquifers contain fresh water to considerable depths, and all contain slightly saline water just downdip (commonly to the southeast) of the fresh water. Maps in Appendix B show the locations of fresh water, defined as containing less than 1,000 milligrams per liter (mg/L) total dissolved solids (TDS), and slightly saline water, defined as having 1,000 to 3,000 mg/L TDS, within various aquifers. Maps are included for all aquifers within the BGRWPA that have availability estimated to exceed 5,000 acre-feet per year (acft/yr). The use of aquifers with groundwater containing more than 1,000 mg/L TDS is an option only where consumers can use the saline water or where special treatment (desalination or blending) is available. More detailed descriptions and availability of water from each aquifer in the BGRWPA are in Appendix B.

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1.5.1.2 Major Springs

The BGRWPA contains few major springs, defined as springs with discharges commonly greater than 1 cubic foot per second (cfs). The majority of these issue from the Edwards-Balcones Fault Zone (BFZ) Aquifer in Bell and Williamson Counties and from the Marble Falls Aquifer in Lampasas County. Of the Edwards Aquifer springs, all but one are intermittent. The three largest Edwards springs are:

1. Salado Springs at Salado in Bell County along the Lampasas River with discharges ranging from 5 to 60 cfs.
2. Berry Springs, which is located 5 miles north of Georgetown in Williamson County, with discharges ranging from 0 to 50 cfs.
3. San Gabriel Springs at Georgetown in Williamson Co. with discharges ranging from 0 to 25 cfs.

Springs from the Marble Falls Aquifer include Hancock Park Springs along the Sulfur River, which is a tributary to the Lampasas River, with discharges reportedly ranging from 6 to 12 cfs, and Swimming Pool Springs at Hancock Park with a reported discharge of 1.3 to 1.6 cfs. Both springs are in the City of Lampasas in Lampasas County.

Some springs in the region significantly affect the quality of the water in the Brazos River. These are primarily the salt springs and seeps, such as those along Salt Croton and Croton Creeks, in the upper Brazos River Basin in Dickens, Kent, and Stonewall Counties. These natural saltwater sources cause the water in the main stem of the Brazos River above Possum Kingdom Lake to be too saline for most uses during low flow periods. For example, from 1963 to 1986, TDS and chloride concentrations in Croton Creek near Jayton averaged 7,933 mg/L and 3,169 mg/L, respectively. The mean values for TDS and chlorides in the Salt Croton Creek near Aspermont from 1969 to 1977 were 71,237 mg/L and 41,516 mg/L, respectively. Water in Possum Kingdom Lake usually contains more than 400 mg/L chloride and 1,200 mg/L TDS. The natural chloride pollution in the upper Brazos River affects water quality in the lower basin. In the Brazos River at Richmond, it has been estimated that 85 percent (or about 95 mg/L for the years 1946 to 1986)¹⁰ of the chloride is from the upper basin.

¹⁰ Ganze, C. Keith and Ralph A. Wurbs, "Compilation and Analysis of Monthly Salt Loads and Concentrations in the Brazos River Basin," U.S. Army Corps of Engineers, Contract No. DACW63-88-M-0793, January 1989.

There are many smaller springs in the Brazos G Area, but cataloging is inconsistent and incomplete. Only a few small springs have been cataloged in just nine of the 37 counties in the BGRWPA.¹¹ These springs flow substantially less than 1 cfs, and most flow only a few gallons per minute (1 cfs = 448.8 gpm).

1.5.2 Surface Water

The BGRWPA lies within the Brazos River Basin, the boundaries of which are the Red River Basin to the north, the Colorado River Basin to the west, the Trinity and San Jacinto River Basins to the east, and the counties of Fayette, Austin, Waller, and Montgomery to the south. The total drainage area for the Brazos River Basin is about 45,400 square miles, and of this about 28,400 square miles are in the BGRWPA.

The Brazos River is the third-largest river in Texas and the largest river between the Rio Grande River and the Red River in terms of total watershed area.¹² The Brazos River rises in three upper forks: the Double Mountain Fork, Salt Fork, and Clear Fork. Twenty-nine major reservoirs provide surface water to the BGRWPA. Major reservoirs, listed in Table 1.5, are defined as having an authorized conservation capacity greater than 10,000 acft. This table shows amounts of storage and annual use that the Texas Commission on Environmental Quality (TCEQ) authorizes for each reservoir. Figure 1.2 shows locations of some of the reservoirs in the BGRWPA, and Table A.5 in Appendix A provides more detailed information about all reservoirs in the BGRWPA with a permitted capacity greater than [or equal to](#) 2,500 acft. Diversions permitted for municipal, industrial, irrigation, and mining uses for each BGRWPA subregion are listed in Table 1.6. Total diversions permitted by use in each BGRWPA county are given in Table A.6 in Appendix A.

Table 1.5 Major Reservoirs in BGRWPA (Authorized Capacity Greater than 10,000 acft)

Reservoir	Stream	County	Authorized Storage (acft)	Authorized Use (acft/yr)	Owner
Abilene	Elm Creek	Taylor	11,868	1,675	City of Abilene
Alcoa Lake	Sandy Creek	Milam	15,650	14,000	Aluminum Co. of America
Aquilla	Aquilla Creek	Hill	52,400	13,896	U.S. Army Corps of Engineers ⁽¹⁾
Belton	Leon River	Bell	469,600	130,257	U.S. Army Corps of Engineers ⁽²⁾
Brushy Creek		Falls	45,000	2,027	Cisco
Cisco	Sandy Creek	Eastland	45,000	2,027	City of Cisco
Cleburne	Nolan Creek	Johnson	25,600	6,000	City of Cleburne
Daniel	Gonzales Creek	Stephens	11,400	2100	City of Breckenridge
Dansby Power Plant	Unnamed Trib. Brazos River	Brazos	15,227	850	City of Bryan
Fort Phantom Hill	Elm Creek	Jones	73,960	38,662	City of Abilene
Georgetown	North Fork San Gabriel River	Williamson	37,100	13,610	U.S. Army Corps of Engineers ⁽¹⁾

¹¹ Brune, Gunnar, *Major and Historical Springs of Texas: TWDB Report 189*, 1970.

¹² The Dallas Morning News, *2004-2005 Texas Almanac*, 2004.

Reservoir	Stream	County	Authorized Storage (acft)	Authorized Use (acft/yr)	Owner
Gibbons Creek	Gibbons Creek	Grimes	32,084	9,740	Texas Municipal Power Agency
Graham/Eddleman	Flint Creek	Young	52,386	11,000	City of Graham
Granbury	Brazos River	Hood	155,000	64,712	Brazos River Authority
Granger	San Gabriel River	Williamson	65,500	19,840	U.S. Army Corps of Engineers ⁽¹⁾
Hubbard Creek	Hubbard Creek	Stephens	317,750	56,000	West Central Texas MWD
Leon	Leon River	Eastland	28,000	6,300	Eastland Co. WSD
Limestone	Navasota River	Robertson	225,400	65,074	Brazos River Authority
Millers Creek Lake	Millers Creek	Baylor	30,696	5,000	North Central Texas MWA
Palo Pinto	Palo Pinto Creek	Palo Pinto	44,100	13,480	Palo Pinto MWD
Possum Kingdom	Brazos River	Palo Pinto	724,739	230,750	Brazos River Authority
Proctor	Leon River	Comanche	59,400	19,658	U.S. Army Corps of Engineers ⁽¹⁾
Somerville	Yegua Creek	Washington	160,110	48,000	U.S. Army Corps of Engineers ⁽¹⁾
Squaw Creek	Squaw Creek	Somervell	151,500	23,180	Texas Utilities Electric Co.
Stamford	Paint Creek	Haskell	60,000	10,000	City of Stamford
Stillhouse Hollow	Lampasas River	Bell	235,700	67,768	U.S. Army Corps of Engineers ⁽¹⁾
Tradinghouse	Tradinghouse Creek	McLennan	37,800	27,000	Texas Utilities Electric Co.
Truscott Brine	Bluff Creek	Knox	107,000	N/A	Red River Authority of Texas
Twin Oak	Duck Creek	Robertson	30,319	13,200	Texas Utilities Electric Co.
Waco	Bosque River	McLennan	176,124	79,870	U.S. Army Corps of Engineers ⁽⁵⁾
Whitney	Brazos River	Hill	50,000	18,336	U.S. Army Corps of Engineers ⁽¹⁾
Totals	—	—	3,546,413	1,014,012	—

Notes:

- (1) Water rights held by the Brazos River Authority.
- (2) Water rights held by the Brazos River Authority and the Department of the Army (Fort Hood).
- (3) Millers Creek Lake is listed in Baylor County in Region B, but is used exclusively in the Brazos G Area.
- (4) Storage authorization includes both Lake Stamford and College Lake.
- (5) Water rights held by the City of Waco.

Table 1.6 Permitted Surface Water Diversions by Subregion

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Subregion	Permitted Diversion (acft/yr) ⁽¹⁾					Total
	Municipal	Industrial	Irrigation	Mining	Other ⁽²⁾	
Rolling Plains	505,047	46,058	62,023	9,249	75	622,451
IH-35 Corridor	467,025	109,181	21,286	1,121	5	598,618
Lower Basin	204,415	170,977	97,179	2,385	1,480	476,436
Region Total	1,176,487	326,216	180,488	12,755	1,560	1,697,506

Notes:

- (1) Available supply may be less than the permitted diversion based on hydrologic conditions and priority of individual water rights.
- (2) Category includes consumptive amounts for recreation and other uses as classified by the TCEQ.

1.6 Wholesale Water Providers

Commented [TS10]: Information in this section is to be updated as DB27 is updated.

Wholesale water providers are defined in 31 TAC §357 as any person or entity that sells wholesale water to water user groups or other wholesale water providers, or that the RWPG expects or recommends to deliver or sell water to water user groups or other wholesale water providers during the period covered by the regional water plan. It is the responsibility of the RWPG to identify wholesale water providers within the region to be evaluated for plan development. There are 12 identified wholesale water providers located primarily in the BGRWPA. These providers are listed in Table 1.7 and described below.

1.6.1 Brazos River Authority

The largest provider of water in the BGRWPA is the BRA. The BRA also operates water and wastewater treatment systems, has programs to assess and protect water quality, does water supply planning, and supports water conservation efforts in the Brazos River Basin. The BRA provides water from three wholly owned and operated reservoirs: Lake Granbury, Possum Kingdom Lake, and Lake Limestone. The BRA also owns water rights for the proposed Allens Creek Reservoir in Region H. In addition to these sources, the BRA contracts for conservation storage space in the eight U.S. Army Corps of Engineers reservoirs in the region: Lakes Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Somerville, Whitney, and Aquilla. The total permitted capacity of the 12 constructed reservoirs in the BRA system is approximately 2.3 million acft. The BRA holds rights for diversion in the region totaling 661,901 acft, and contracts to supply water to municipal, industrial, and agricultural water customers in the BGRWPA and other regions. The BRA's largest current municipal customers, based on contracted supply, include Bell County Water Control and Improvement District No. 1, the City of Georgetown, and the City of Temple.

In 2016 the Brazos River Authority (BRA) obtained Water Use Permit No. 5851 (System Operations Permit) from the Texas Commission on Environmental Quality (TCEQ) for the diversion, impoundment, and use of (1) previously unappropriated state water in the Brazos River Basin, and (2) BRA owned return flows discharged into state watercourses not already authorized for use by other entities. The water right currently authorizes a maximum combined diversion of up to ~~434,703~~ 334,345 acft/yr. Diversions are authorized in 40 individual stream segments basin-wide, with each stream segment assigned a specific maximum annual diversion amount.

Table 1.7 Wholesale Water Providers in the Brazos G Area

Entity	Current Contracts (acft/yr)	Water Source
Brazos G WWP's		
Aquilla WSD	5,952	Lake Aquilla
Bell County WCID #1	44,134	Lake Belton
Bluebonnet WSC	7,125	Lake Belton
Brazos River Authority	733,297 ^(1,2,3)	Lakes Aquilla, Belton, Georgetown, Granbury, Granger, Limestone, Possum Kingdom, Proctor, Somerville, Stillhouse Hollow, Whitney, BRA System Operations Permit, Highland Lakes Supply and Colorado Basin
Central Texas WSC	10,537	Lake Stillhouse Hollow
Eastland County WSD	5,395	Lake Leon
FHLM WSC	1,934 ⁽⁴⁾	BRA System Operations Permit
North Central Texas MWA	1,797	Millers Creek Lake
Palo Pinto County MWD No. 1	9,551	Lake Palo Pinto
Upper Leon MWD	4,572	Lake Proctor
Salt Fork Water Quality Corporation	-	Local saline groundwater
West Central Texas MWD	15,620	Hubbard Creek Reservoir

Commented [CB11]: TO BE UPDATED AS DB27 IS UPDATED

Notes:

- (1) Includes 11,403 acft/yr in the Lake Aquilla System, 251,643 acft/yr in the Little River System, 379,515 acft/yr in the Main Stem/Lower Basin System, and 94,999 of System Operations Permit supply contracts (pending) (does not include GM Reserve or TPWD Trust) (based on contractual commitment list provided by BRA, dated 1/28/2020).
- (2) Includes contracts in other regions.
- (3) House Bill 1437 supplies from the Lower Colorado River Authority (based on contractual commitment list provided by BRA, dated 1/28/2020). 25,000 acft/yr is available, but not currently committed.
- (4) Contract pending with BRA.

1.6.2 Aquilla Water Supply District

Aquilla Water Supply District is located in Hill County and obtains raw water from Lake Aquilla through a contract with the BRA. The district supplies treated water to five wholesale customers. The City of Hillsboro is the district's largest customer with a contract for 3,640 acft/yr. Total existing contracted sales for Aquilla Water Supply District are in the amount of 5,952 acft/yr.

1.6.3 Bell County WCID No. 1

Bell County WCID No. 1 currently obtains raw water from Lake Belton for distribution to its customers and will soon also obtain water through new facilities at Lake Stillhouse Hollow. Major customers include and the U.S. Department of the Army (Fort Hood) and the Cities of Belton, Copperas Cove, Harker Heights, and Killeen. Bell County WCID No. 1 is currently contracted for a total treated water supply volume of ~~23,795~~44,134 acft/yr, plus an additional supply to meet demands for Bell County WCID No. 3.

1.6.4 Bluebonnet Water Supply Corporation

The Bluebonnet Water Supply Corporation (WSC) is located in Bell County. The WSC obtains raw water from Lake Belton, and sells treated water to nine entities in the BGRWPA. The largest customer is the City of McGregor, which holds a contract for 2,139 acft/yr. The total annual contracted supply to be provided by Bluebonnet WSC is 7,125 acft.

1.6.5 Central Texas Water Supply Corporation

Central Texas WSC contracts with the BRA to obtain raw water from Lake Stillhouse Hollow and sells treated water under contract to 19 municipal water user groups; the largest of these contracts is with the Bell-Milam-Falls WSC for 2,327 acft/yr. Supply contracts by the Central Texas WSC total 10,537 acft/yr.

1.6.6 Eastland County Water Supply District

The Eastland County Water Supply District owns and operates Lake Leon and has a water right to divert 5,800 acft for municipal and industrial purposes and 500 acft for irrigation. The district currently provides treated water to entities in Eastland County through the Cities of Eastland and Ranger. Current supply contracts by the Eastland County WSD total ~~5,395,339~~ acft/yr plus an additional treated supply volume to meet demands for Eastland County-Manufacturing.

1.6.7 FHLM Water Supply Corporation

Several Public Water Supply entities in Falls, Hill, Limestone, and McLennan Counties formed the FHLM Water Supply Corporation to address the elevated arsenic levels, groundwater compliance issues, Trinity Aquifer depletion, and exchange information concerning treatment technologies and operations and maintenance considerations among the member entities. The main purpose of creating the FHLM WSC was to serve as the financing vehicle to obtain funding to support regional water projects for the area. The FHLM WSC has contracted with the BRA for 1,934 acft/yr of surface water supplies to be used by member utilities for blending and/or replacing existing groundwater supply, and is currently pursuing an additional water supply contract with the City of Waco.

1.6.8 North Central Texas Municipal Water Authority

North Central Texas Municipal Water Authority supplies treated water to entities in Knox, Haskell and Stonewall Counties. The district has water rights to divert 5,000 acft/yr of raw water from Millers Creek Reservoir for municipal, industrial, and mining purposes. Current supply contracts from the North Central Texas Municipal Water Authority, including contracts for out of region sales, total 1,797 acft/yr.

1.6.9 Palo Pinto County Municipal Water District No. 1

Palo Pinto County Municipal Water District No. 1 owns and operates Lake Palo Pinto, which is used to supply water to entities in Palo Pinto and Parker Counties. The district has rights to 18,500 acft a year for municipal and steam electric power uses. Treated water is supplied to the City of Mineral Wells (and its customers), Lake Palo Pinto Water Supply Corporation, and steam-electric entities in Palo Pinto County. Current supply contracts from the Palo Pinto County MWD No. 1 total ~~4,250,551~~ acft/yr ~~plus an~~ including the additional treated water volume to meet demands for the City of Mineral Wells.

1.6.10 Salt Fork Water Quality Corporation

The Salt Fork Water Quality Corporation (SFWQC) was formed to develop a project for reducing surface water salinity in the Brazos River Basin. The project concept involves constructing a series of wells to be used for intercepting highly saline water currently being discharged to waterways from a series of seeps and springs in the Upper Brazos Basin. Captured water would be treated and processed to remove the salt which could then be used for commercial application, while the resulting freshwater would be available to for use by local municipal utilities. This project has yet to be developed, and the SFWQC does not currently hold any supply contracts.

1.6.11 Upper Leon Municipal Water District

The Upper Leon Municipal Water District obtains water from Lake Proctor through contracts with the BRA. The MWD provides treated water to the Cities of Comanche, De Leon, Dublin, Gorman, Hamilton, Stephenville, and the Comanche County WSC. Current supply contracts from the Upper Leon MWD total 4,572 acft/yr.

1.6.12 West Central Texas Municipal Water District

The West Central Texas Municipal Water District diverts raw water from Hubbard Creek Reservoir, which it owns and operates, for distribution to the Cities of Abilene, Albany, Anson, and Breckenridge. This district has rights to 56,000 acft/yr of water for municipal, industrial, irrigation, and mining uses. Current supply contracts from the West Central Texas MWD total ~~17,900~~15,620 acft/yr.

1.7 Major Water Providers

The Brazos G RWPG defines Major Water Providers (MWP) to be:

- 1) Any WWP that is not also a municipal WUG, or
- 2) Any WUG with a total municipal demand in the Brazos G Area of at least 1,000 acft/yr, including contractual sales to other municipal utilities.

Based on the above definition, the Brazos G RWPG has identified 105 WUGs and WWPs as Major Water Providers for the 2026+ Brazos G Plan, listed in Table 1.8. This 2026+ Brazos G Plan includes data summaries specific to these MWPs.

Table 1.8 Major Water Providers in the Brazos G Area

Major Water Providers					
439 WSC	Brushy Creek MUD	Eastland County WSD	Hutto	Morgans Point Resort	Sweetwater
Abilene	Bryan	Fern Bluff MUD	Jarrell-Schwertner	Mountain Peak SUD	Tarrant Regional Water District - via other WWPs
Acton MUD	Burleson	FHLM WSC	Johnson County SUD	Navasota	Taylor
Alvarado	Cameron	Files Valley WSC	Jonah Water SUD	North Bosque WSC	Temple

Major Water Providers					
Anson	Cedar Park	Fort Cavazos ⁽¹⁾	Keene	North Central Texas Municipal Water Authority	Texas A and M University
Aquilla WSD	Central Texas WSC	Fort Worth	Kempner WSC	Palo Pinto County MUD No.1	Texas State Technical College
Arlington	Cisco	Gatesville	Killeen	Potosi WSC	Upper Leon Municipal Water District
Bell County WCID 1	Cleburne	Georgetown	Lacy Lakeview	Robinson	Venus
Bell County WCID 3	Clifton	Gholson WSC	Lampasas	Rockdale	Waco
Bellmead	College Station	Giddings	Leander	Round Rock	Wellborn SUD
Belton	Colorado River Municipal Water District	Gordon	Liberty Hill	Salado WSC	West Central Texas MWD
Bethesda WSC	Copperas Cove	Graham	Lower Colorado River Authority	Salt Fork Water Quality Corporation (SFWQC)	Wickson Creek SUD
Bistone Municipal Water Supply District	Corix Utilities Texas Inc	Granbury	Mansfield	Somervell County Water District	Williamson County MUD 11
Bluebonnet WSC	Coryell City Water Supply District	Harker Heights	Manville WSC	Sonterra MUD	Williamson County WSID 3
BRA	Cross Country WSC	Hewitt	Marlin	Southwest Milam WSC	Woodway
Brandon Irene WSC	Dog Ridge WSC	Hilco United Services	McGregor	Stamford	
Brenham	Double Diamond Utilities	Hillsboro	Mexia	Steamboat Mountain WSC	
Bruceville Eddy	Dublin	Huntsville	Mineral Wells	Stephenville	

Notes:

(1) [Fort Cavazos formerly Fort Hood, all references herein should be assumed to be same.](#)

1.8 Current Water Users and Demand Centers

1.8.1 Regional Water Use

Total water use by each county in the BGRWPA is summarized in Figure 1.12 for 2021~~17~~. Water use can be classified into four general types of use: municipal, industrial, agricultural, and non-consumptive. Figure 1.13 shows historical water use by municipalities, industries, and agriculture in the BGRWPA. Industrial use can be further broken down into three sub-categories: manufacturing, steam-electric cooling, and mining. Agricultural use consists of the subcategories of water used for irrigation and livestock. Historical water use in the planning area for six categories is summarized in Table 1.9.

In Appendix A, Table A.7 gives historical water-use data for all counties in the BGRWPA, and Table A.8 gives historical water-use data by category of use. Historical surface water use greater than or equal to 1,000 acft is given in [Appendix D](#) by each water-right holder.

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1.8.2 Municipal Use

Municipal water use includes water consumed for residential and commercial enterprises and institutions. Residential and commercial uses are categorized together because they are similar types of uses (i.e., they both use water primarily for drinking, cleaning, sanitation, air-conditioning, and landscape watering). Generally, municipal use does not include water use by large industries. Projections for future municipal use account for population growth and anticipated efforts at water conservation. Municipal use of ~~387,752,62,506~~ acft accounted for about 410 percent of the region's total water use in 2021~~17~~. Figure 1.14 shows municipal water use in each BGRWPA county in 2017.

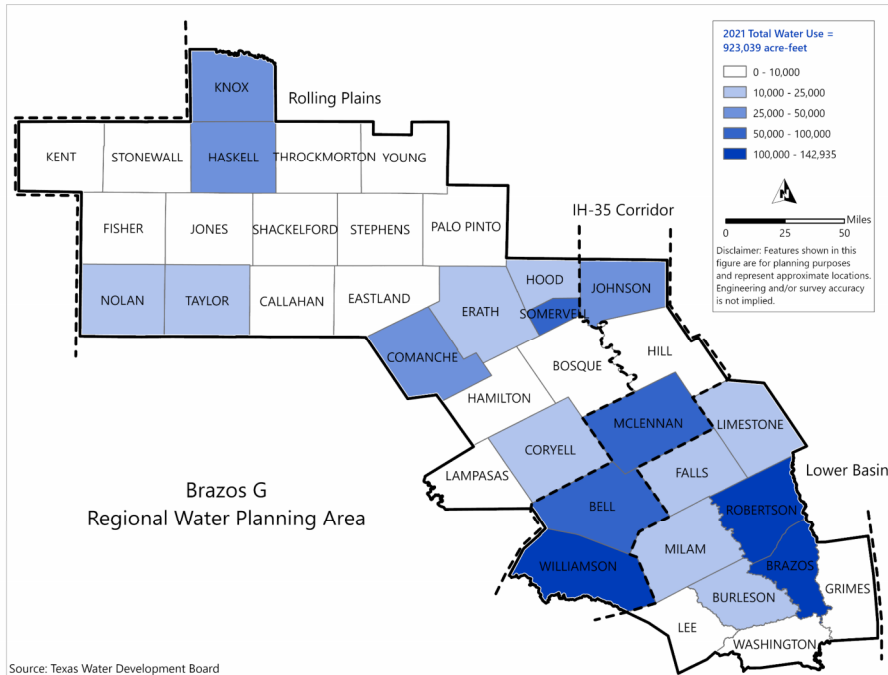


Figure 1.12 2021~~17~~ Total Water Use by County

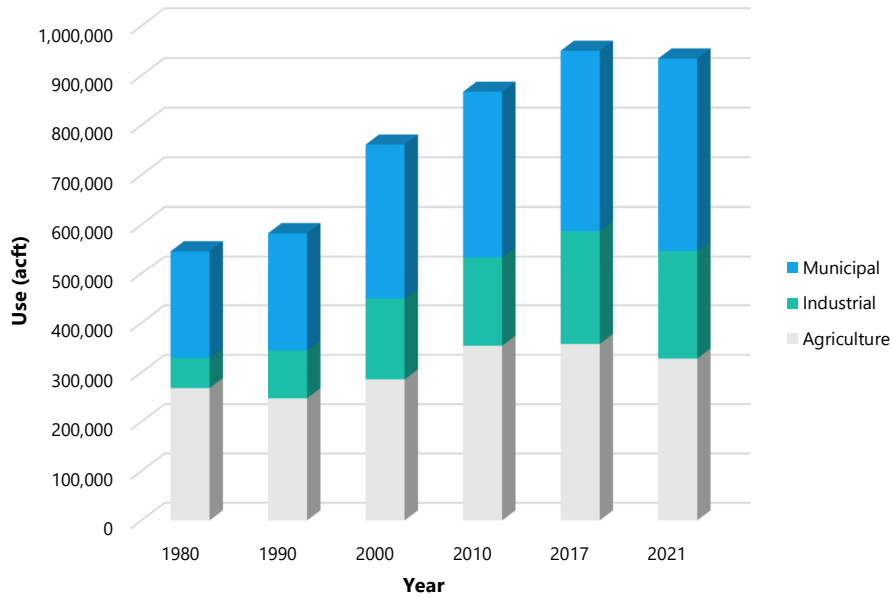


Figure 1.13 Historical Water Use by Type

Table 1.9 Historical Water Use⁽¹⁾ (acft/yr)

Category	1980	1990	2000	2010	2017	2021
Municipal Use	216,782	238,260	312,169	333,404	362,937	387,752
Manufacturing Use	21,124	32,240	60,522	9,006	10,582	10,081
Steam-Electric Use	28,686	57,657	97,921	113,553	205,181	199,296
Mining Use	11,413	6,944	4,382	57,644	13,730	9,246
Irrigation Use	229,387	200,954	232,911	298,754	315,648	284,769
Livestock Use	38,916	46,771	53,222	55,208	41,987	43,303
Total Use	546,308	582,826	761,127	867,569	950,065	934,447
Percent of State Total	3.06%	3.71%	4.69%	6.28%	6.79%	6.50%

Notes:

(1) Historical data obtained from TWDB.

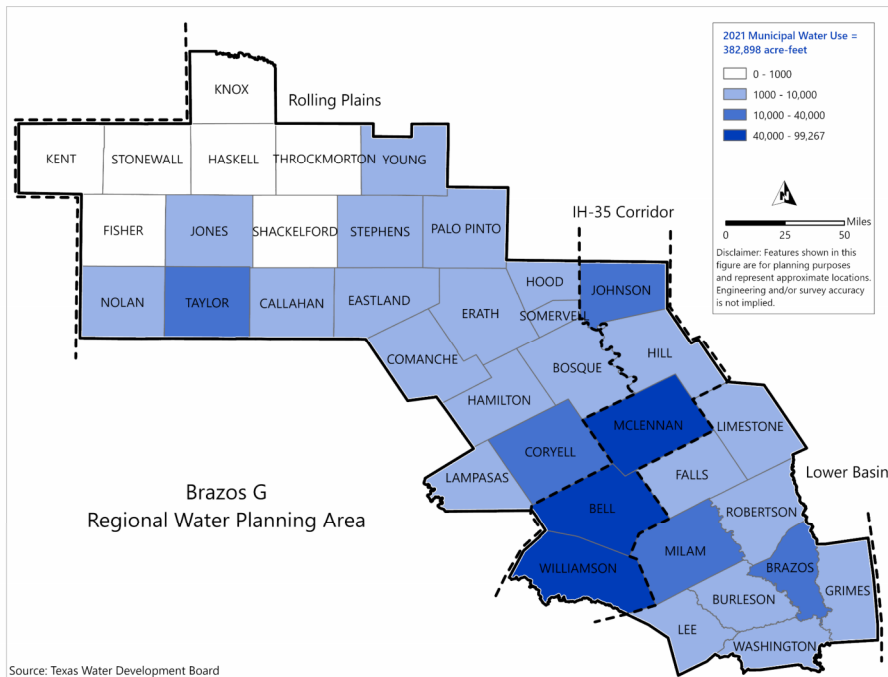


Figure 1.14 2021¹⁷ Municipal Water Use

1.8.3 Industrial Use

Industrial use consists of water used for manufacturing, for steam-electric cooling during power generation, and for mining operations. Projections for industrial use account for expected growth of industries, population changes, available mineral reserves, and production rates. In 2021¹⁷, industrial use was 218,623^{177,780} acft, or about 239 percent of the total water used in the BGRWPA. Refer to Figure 1.15 for 2021¹⁷ industrial water use by county.

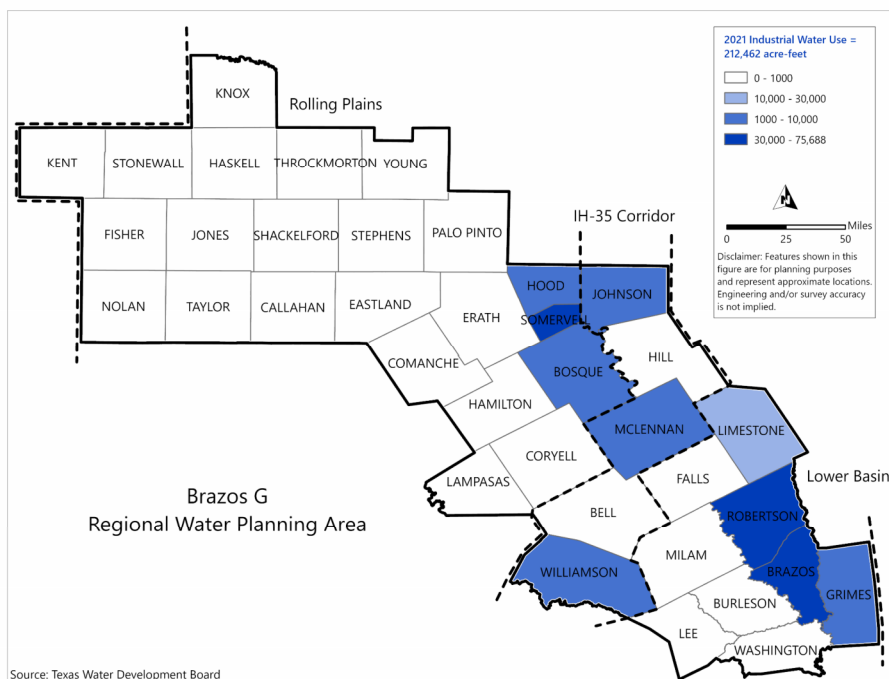


Figure 1.15 2021¹⁷ Industrial Water Use (Manufacturing, Steam-Electric Cooling, and Mining)

1.8.3.1 Manufacturing

Manufacturing use is water used for producing finished goods. Manufacturing use was 10,081,821 acft in 2021¹⁷, or 56 percent of total industrial water usage that year.

1.8.3.2 Steam-Electric Cooling

This category is water used during the power-generation process and is typically losses due to forced evaporation during cooling. Water that is diverted and not consumed (i.e., return flow) is not included in the power-generation total. Water use for steam-electric cooling in 2021¹⁷ was 199,296,153,229 acft, or 9186 percent of total industrial water use.

1.8.3.3 Mining

Mining use is water consumed for exploration and production of oil and gas, and for mining of lignite, sand, gravel, and such. Mining use in 2021¹⁷ was 9,246,13,730 acft, or 48 percent of the total industrial water use.

1.8.4 Agricultural Use

Agricultural use is water used for irrigation and for watering livestock. Agricultural use was ~~328,072,359,683~~ acft in 2021~~17~~ or ~~3540~~ percent of the BGRWPA's total water use. Agricultural water use by each county in the planning area in ~~2017-2021~~ is summarized in Figure 1.16.

1.8.4.1 Irrigation

Irrigation use in 2021~~17~~ totaled ~~284,769,315,648~~ acft, or about ~~878~~ percent of the total agricultural water use. Refer to Appendix F for more detailed information about irrigation use in the BGRWPA.

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1.8.4.2 Livestock Watering

The estimate of use for livestock watering is based on a determination of the total number of livestock in the region. A uniform water-consumption rate for each type of animal is applied to this total number. The categories of livestock considered are cattle and calves, poultry, sheep and lambs, and hogs and pigs. Livestock watering totaled ~~43,303,4035~~ acft, or ~~132~~ percent of agricultural use in 2021~~17~~. Refer to Appendix F for more detailed information on water used for livestock.

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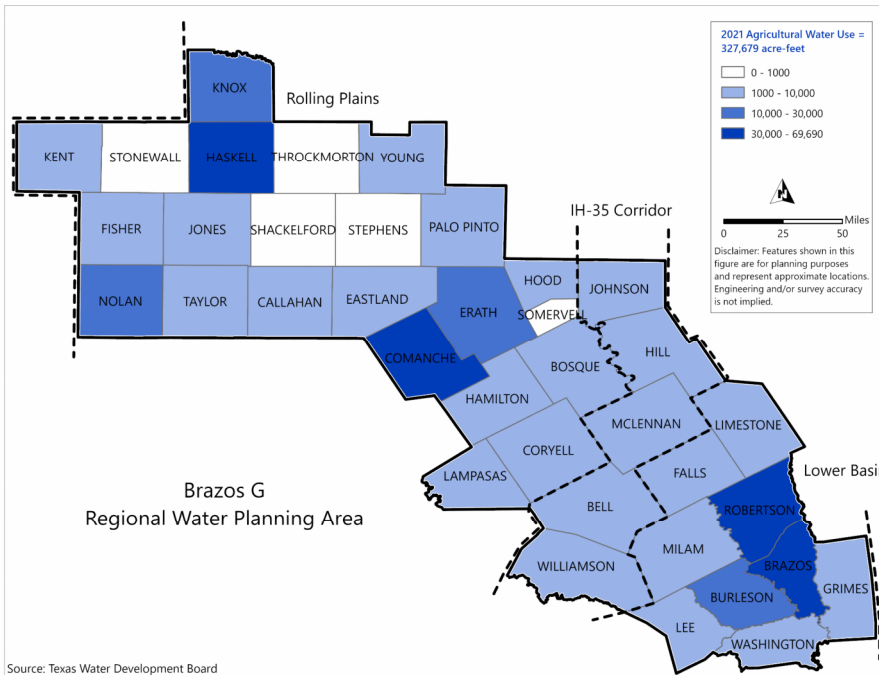


Figure 1.16 2021~~17~~ Agricultural Water Use (Livestock and Irrigation)

1.8.5 Non-Consumptive Use

Non-consumptive use is water that is diverted and then returned to the river basin with minimal change in volume and ~~temperature, or temperature or~~ is used but never leaves the river system. The majority of non-consumptive water use in the BGRWPA is associated with recreational use and the return flow from power generation. Water-related recreational activities include boating, camping, fishing, and swimming. Recreational use in the BGRWPA is supported by numerous state parks and by public facilities for boating and camping at various lakes and reservoirs.

Navigation is another form of non-consumptive use. Other than small watercraft used primarily for recreation on lakes and rivers, the BGRWPA includes no use of water for navigation. No water management strategy considered by the BGRWPG will affect navigation, either in the BGRWPA or in adjacent regions.

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Power generation demands large amounts of water for cooling equipment. Twenty-Fifteen steam-electric power-generating facilities were operating in the BGRWPA in 201908 (BEGTWDB WUS, 2008). Most of the diverted water was returned to the Brazos River Basin. Water that is lost to evaporation during the cooling process is considered industrial use and is discussed in Section 1.5.3.

1.9 Natural Resources

1.9.1 Regional Vegetation

The BGRWPA lies within several different vegetational areas, or ecoregions.¹³

Figure 1.17 shows the locations of these ecoregions, which are relatively homogenous areas in terms of geography, hydrology, and land use. The five ecoregions in the BGRWPA are the Rolling Plains, Blackland Prairies, Post Oak Savannah, Cross Timbers and Prairies, and Edwards Plateau. A general description for each ecoregion is provided below. More detailed information is provided in Appendix E.

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1.9.1.1 Rolling Plains

The Rolling Plains are part of the Great Plains of the central United States. The Rolling Plains region covers about 24 million acres of gently rolling to moderately rough terrain. The region is bordered on the west by the Caprock Escarpment, on the south by the Edwards Plateau, and on the east by the Cross Timbers and Prairies region. Annual precipitation averages about 22 to 30 inches, and elevations range from 800 to 3,000 feet above sea level. The eastern part of the Rolling Plains is called the Reddish Prairie. Soils vary from coarse sands in outwash terraces near streams to tight clays or red-bed clays and shales.

1.9.1.2 Blackland Prairies

The Blackland Prairies region consists of nearly level to gently rolling topography. It covers about 11.5 million acres from Grayson and Red River Counties in northeast Texas to Bexar County in the south-central part of the State where it merges with the brush land of the Rio Grande Plains. Annual precipitation is 30 to 45 inches, and elevations range from 300 to 800 feet above sea level. The term Blackland comes from the uniformly dark-colored, calcareous clays in the Alfisols (fertile mineral soils).

¹³ Gould, F.W., *The Grasses of Texas*, Texas A&M University Press, College Station, Texas, 1975.

Soils in the Blackland Prairies are interspersed with gray-colored, acidic sandy loams. This highly fertile region has widely been used for agriculture, but it is increasingly used for ranching.¹⁴ Experts estimate that less than one percent of the Blackland Prairies remain in a near-natural condition.¹⁵

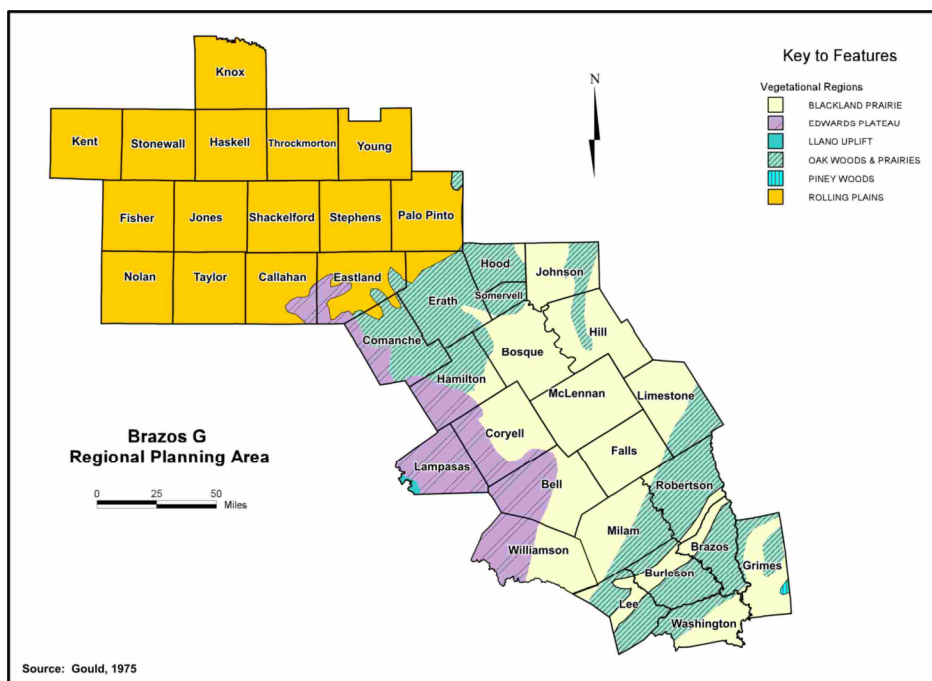


Figure 1.17 Vegetational Areas of the Brazos G Area

1.9.1.3 Post Oak Savannah

The Post Oak Savannah covers about 8.5 million acres in east-central Texas and consists of closely associated and intermingled prairies and woodlands on slightly acidic sandy or clay loams. Topography in this region is gently rolling to hilly, with moderate to deeply dissected drainage paths. Soils in uplands are generally light-colored, acidic sandy loams or sands, and soils in bottomlands are light-brown to dark-gray acidic sandy loams or clays. Much of this vegetational area is used for crops and grazing.

¹⁴ Gould, F.W. and Schuster, J.L. and Hatch, S.L., *Texas Plants B, An Ecological Summary*, Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, 1990.

¹⁵ Smeins and Diamond, 1986.

1.9.1.4 Cross Timbers and Prairies

The Cross Timbers and Prairies vegetational area covers about 17 million acres in north-central Texas. Geology in this area is diverse, and the topography varies from gently rolling to hilly to deeply dissected. Rapid surface drainage is typical throughout the region. Soils are typically brown, neutral-to-slightly acidic, sandy or clay loams.

1.9.1.5 Edwards Plateau

The Edwards Plateau area covers about 24 million acres. This includes a large portion of the Hill Country in west-central Texas, the Llano Uplift, and the Stockton Plateau. Average annual precipitation increases from west to east across this region. Limestone or caliche typically underlie the shallow, variably textured soils, although granitic rock underlies soil in the Llano Uplift. Land use in this vegetational area is dominated by the ranching of cattle, sheep, and goats. This region reportedly once was dominated by a grassland or an open savannah climax community, except in steep canyons and slopes where junipers and oaks were dominant. The widespread disturbance associated with grazing livestock eventually allowed brush and tree species to spread widely throughout the original grasslands and savannahs.

1.9.2 Regional Geology

Figure 1.18 shows the varied geology of the planning area. Generally, the formations in the northwest part of the planning area are the older Blaine and San Angelo Formations of the Paleozoic era. The central part of the planning area is typically dominated by younger formations from the Cretaceous era, such as the Trinity Group; the Navarro and Taylor Groups; and the Austin, Eagle Ford, Woodbine, and U. Washita Groups. The youngest formations are in the southern part of the planning area. These formations include the Cook Mountain, Weches, Sparta, and Yegua, among others. Many areas near streams and rivers are dominated by alluvial deposits.

1.9.3 Soils

The soils of the upper Brazos River Basin are agriculturally and ecologically important. Throughout the Brazos G Area, soils are varied and are influenced by both geology and surface drainage. Figure 1.19 shows the locations of different orders of soil in the BGRWPA. These soil types are briefly described in the following subsections.

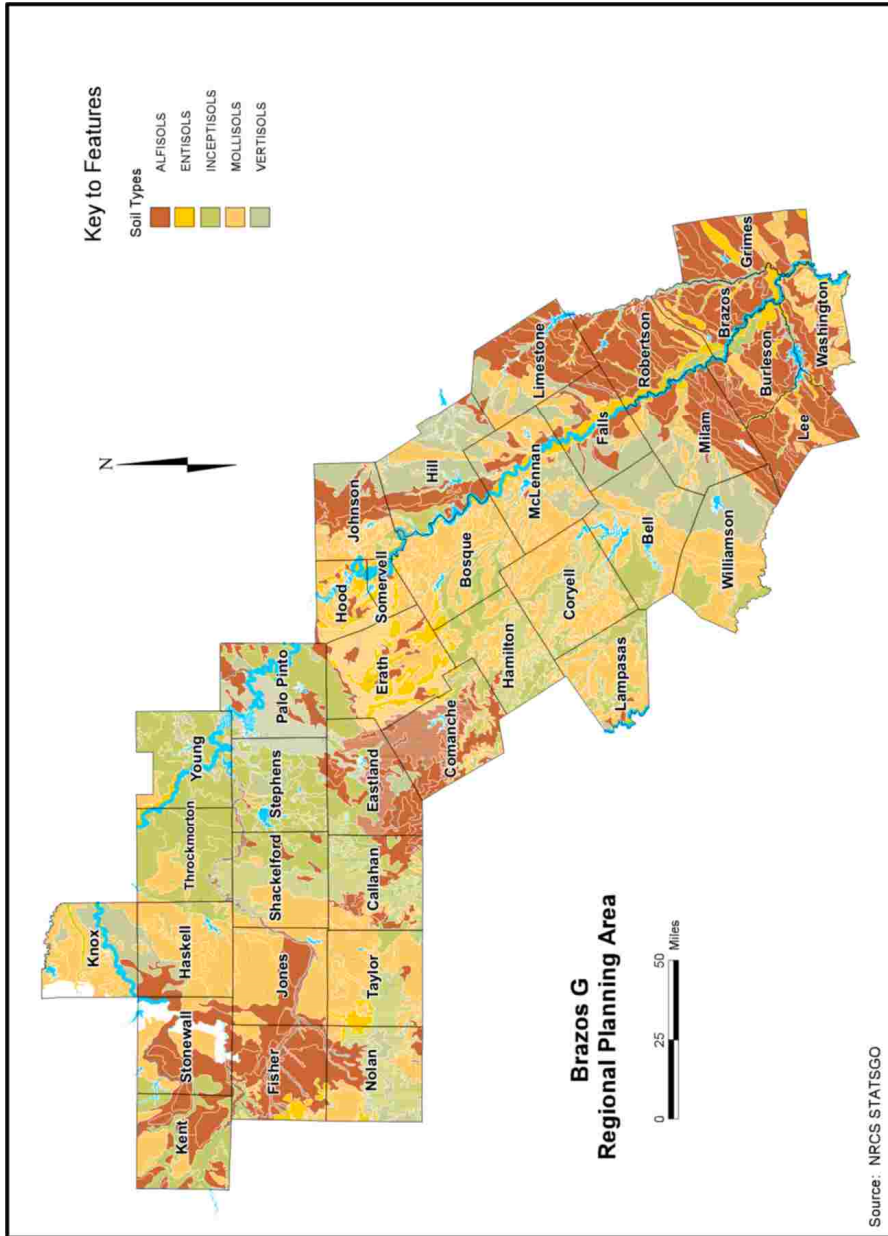


Figure 1.19 Soils of the Brazos G Area

1.9.3.1 Alfisols

Alfisols are mineral soils with a gray-to-brown surface horizon. These soils form under humid, cool-to-hot areas of native grasslands. They are productive and favor good crop yields.

1.9.3.2 Entisols

Entisols are typical of rangeland in west and southwest Texas. In this order, soils range from infertile sands and bedrock to highly productive soils on recent alluvium. A characteristic common to all Entisols is the lack of significant profile development.

1.9.3.3 Inceptisols

Inceptisols are thought to form relatively quickly from the alteration of parent material. Productivity varies among soils in this order, and it is affected by factors such as levels of organic matter and drainage. Typically, Inceptisols have slightly higher profile development than Entisols.

1.9.3.4 Mollisols

Mollisols are considered important agriculturally and are characterized by a thick, dark surface horizon. These soils develop under grassland-prairie vegetation typical of the central United States. Mollisols cover more land area in the United States than any other soil order.

1.9.3.5 Vertisols

Vertisols have a high clay content and therefore may develop deep cracks from shrinking during dry periods. The fine texture of Vertisols and their tendency to shrink excessively makes them generally unstable for building foundations and even for some agricultural uses.

1.9.4 Wetlands

Wetlands are defined by the U.S. Army Corps of Engineers as areas that, due to a combination of hydrologic and soil conditions, are capable of supporting hydrophytic vegetation. In the Brazos G Area, wetlands are found primarily in narrow strips along rivers and streams.

As a natural resource, wetlands are especially valued because of their location on the landscape, the wide variety of ecological functions they perform, and the uniqueness of their plant and animal communities. Many wetlands are also valued for their aesthetic qualities, as sites for educational research, as sites of historic and archaeological importance, and as locations for storing or conveying floodwaters. Wetlands provide high-quality habitats for wildlife, including foraging and nesting areas for birds and spawning and nursery areas for fish.

1.9.5 Water Resources

Rivers and reservoirs are important ecological resources for the Brazos G Area. These support diverse aquatic plants and animals as well as terrestrial wildlife living along the banks. Important rivers and creeks in the planning area include the Brazos, Leon, Bosque, Lampasas, San Gabriel, South Wichita, Little, Clear Fork of the Brazos, and Yegua Creek. These rivers contribute to unique vegetational communities that provide habitat for wildlife. There are more than 40 species of aquatic amphibians, reptiles, and mammals

in the planning area. Waterfowl heavily use the mature, hardwood, bottomland forests and forested wetlands often associated with rivers. Aquatic habitats include riffles and pools, which support both invertebrates and fish.

Reservoirs (Figure 1.20) provide habitat for inland fish stocks and waterfowl. Many reservoirs in the planning area provide habitat for fish stocks and waterfowl including Lake Stamford, Hubbard Creek Reservoir, Possum Kingdom Lake, Lake Leon, Lake Proctor, Lake Whitney, Lake Stillhouse Hollow, Lake Belton, Lake Waco, and Lake Somerville.

Although few in number, the major springs and seeps in the planning area that produce frequent flows are often rich in wildlife habitat and ecological diversity. Springs represent a transition from groundwater to surface water. Where frequent springflow occurs, an abundance of moisture is provided, resulting in diverse vegetational communities unique to such areas. Typical vegetation includes willows, cottonwoods, hackberry, elms, rushes, sedges, and smartweed. These vegetational communities often provide optimal habitat for native wildlife.

1.9.6 Wildlife Resources

1.9.6.1 Biotic Provinces

Just as Texas has been divided into major plant zones,¹⁶ the State has also been classified into biotic provinces based on the distribution of topographic features, climate, vegetation types, and terrestrial vertebrates¹⁷ (Figure 1.21). The BGRWPA includes the Kansan, Austroriparian, Balconian, and Texan biotic provinces.

¹⁶ Gould, Op. Cit., 1975.

¹⁷ Blair, 1950.

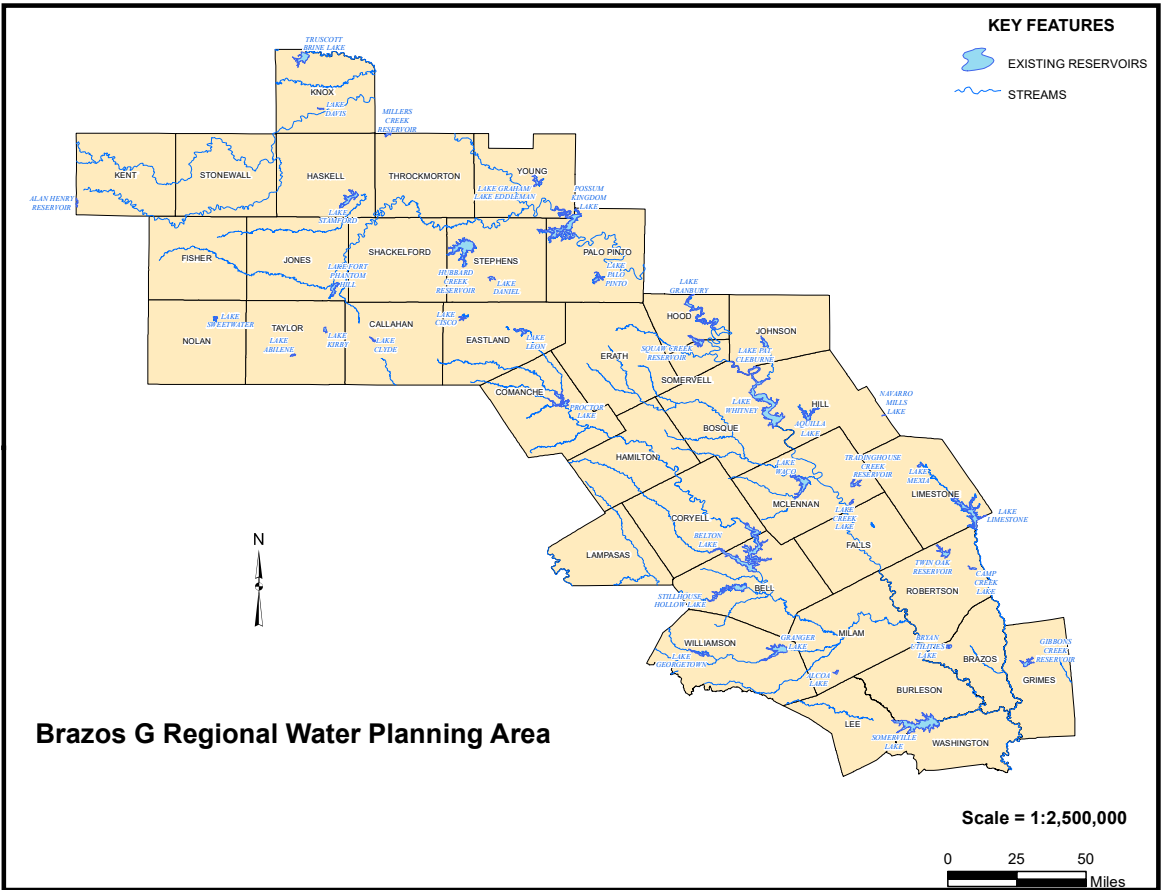


Figure 1.20 Water Resources of the Brazos G Area

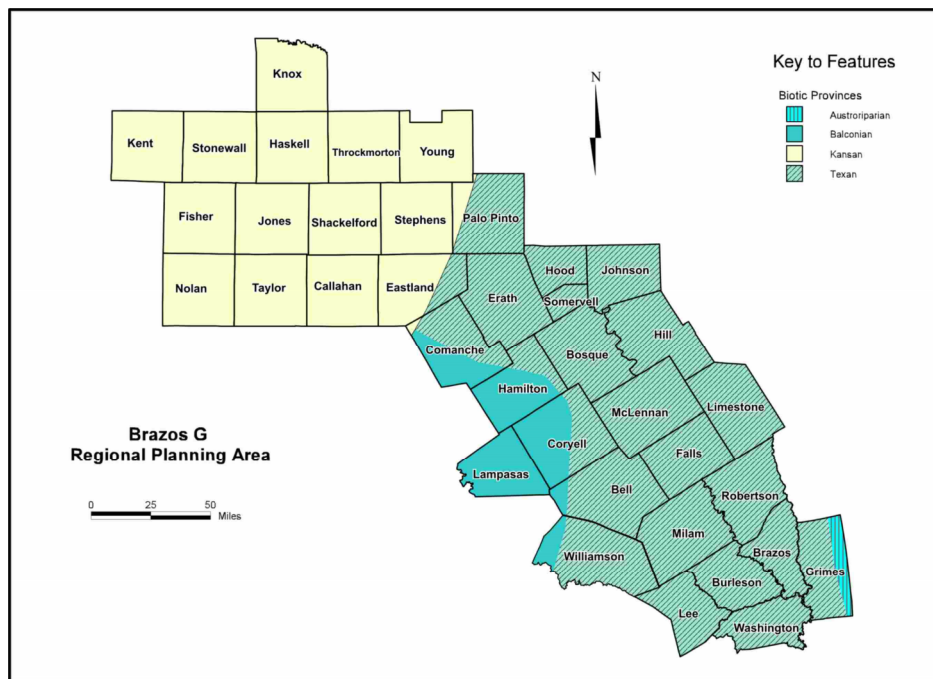


Figure 1.21 Biotic Provinces of the Brazos G Area

1.9.6.2 Kansan

The Kansan province runs southward from the Texas panhandle and across the Rolling Plains area of the Brazos G Area. It meets the Texan biotic province at the western boundary of the Cross Timbers and Prairies vegetational area. There is little available moisture in the province, and moisture that is available decreases from east to west. The plant associations vary. However, they fall into three general categories of associations: the mixed-grass plains, the mesquite-grass association, and the short-grass plains.

1.9.6.3 Austroriparian

The western fringe of the Austroriparian province extends into the southeastern rim of the Brazos G Area. This province comprises the pine and hardwood forests of the eastern Gulf Coastal plain. The province is limited to the west due to low moisture. However, vegetational communities found in the westward extensions of the province occur along drainageways where environmental conditions allow.

1.9.6.4 Balconian

The Balconian province includes most of the Edwards Plateau excluding the region west of the Pecos River. The Edwards Plateau is a physio-graphically discrete unit. It has a variety of wildlife, and its

vegetation is different from that found in adjacent provinces. The abundant vertebrate species are a mixture of Austroriparian, Tamaulipan, Chihuahuan, and Kansan.

Most of the Balconian province lies on Cretaceous limestone, but igneous intrusives and sediments of Precambrian age are exposed in the Llano Uplift. Limestone caverns and springs are common features of this province. Massive outcrops of limestone are characteristic of the stream canyons, and limestone fragments occur at the surface over almost the entire area.

Rainfall amounts typically decrease from east to west. The most characteristic plant association is the juniper-oak scrub. Mesquite is also distributed throughout the province.

1.9.6.5 Texan

The Texan biotic province has no true endemic species of vertebrates. In this area, western species tend to encroach into open habitats, and eastern species encroach along the many wooded drainageways extending through the landscape. The Texan province has supported 49 species of mammals, 39 species of snakes, 16 species of lizards, 2 types of land turtles, 18 types of toads and frogs (anurans), and 5 species of salamander (urodeles).

1.9.6.6 Threatened and Endangered Species

In planning water-management strategies, one major consideration is the potential impact on threatened and endangered species. Table E-1 in Appendix E gives a complete list of threatened and endangered species in each county in the BGRWPA. Some of the more widely seen of these are the golden-cheeked warbler (*Dendroica chrysoparia*), the black-capped vireo (*Vireo atricapillus*), and the bald eagle (*Haliaeetus leucocephalus*).

Commented [CB17]: TO BE UPDATED

1.9.7 Agricultural Resources

Agriculture is a mainstay of the BGRWPA rural economy. Among livestock, cattle were the most significant component, approaching 1,962,041 million head with an additional 961,108,000 dairy cows in 2019. Over 17 million acres, or about 85 percent of BGRWPA's total area, were classified as farmland in 2017. Of the 17 million acres of farmland, about 4.6 million acres were classified as cropland, of which about 2.8 million acres were harvested. Refer to Appendix F for detailed listings of agricultural information for the BGRWPA.

Commented [TS18]: TO BE UPDATED

The Texas Department of Agriculture has specified several Agricultural Statistics Districts for the purpose of keeping records. The districts within the BGRWPA are 2N and 2S (Rolling Plains), 3 (Cross Timbers), 4 (Blacklands), 5S (South East), 7 (Lampasas County), and 8N (South Central).

1.9.7.1 Rolling Plains

Counties in the Rolling Plains (Districts 2N and 2S) are Fisher, Haskell, Jones, Kent, Knox, Nolan, Stonewall, and Taylor. The major dryland products are extensive row-crops, such as cotton, and wheat. Irrigation comes from the Seymour Aquifer where available. Major crops include wheat and cotton. Hay and silage are also produced, but because of low rainfall, their acreage is much less than in other districts in the BGRWPA.

1.9.7.2 Cross Timbers

The Cross Timbers counties (District 3) are Callahan, Comanche, Eastland, Erath, Hood, Palo Pinto, Shackelford, Somervell, Stephens, Throckmorton, and Young. Combined, these counties lead the State in dairy production. This is due to several factors such as available groundwater from the Trinity Aquifer, soils suitable for forage production, topography conducive to dairy operation, and an existing infrastructure. The major crops produced in the Cross Timbers are hay and silage, with smaller amounts of peanuts, pecans, and vegetables irrigated from the Trinity Aquifer.

1.9.7.3 Blacklands

The Blacklands counties (District 4) are Bell, Bosque, Coryell, Falls, Hamilton, Hill, Johnson, Limestone, McLennan, Milam, and Williamson. Lampasas County (District 7) is included for the purposes of this analysis. The Blacklands is noted for dryland production of corn for grain, grain sorghum, wheat for grazing and grain, cotton, and hay. Irrigation in the Blacklands is limited by lack of sufficient groundwater supply.

1.9.7.4 South East and South Central Texas

South East and South Central Texas counties (District 5S and 8N) are Brazos, Burleson, Grimes, Lee, Robertson, and Washington. This subregion has limited row-crop agriculture because suitable topography and soils are limited. Hay and silage are the major agricultural products. The Brazos River Bottoms counties (Brazos, Burleson, and Robertson) produce most of the crops in the subregion, including corn for grain, grain sorghum, and cotton. The Brazos River Alluvium is the major source of groundwater for the Brazos River Bottoms.

1.10 Threats and Constraints to Water Supply

Projected population growth in the region, particularly along the IH-35 Corridor, will strain existing municipal supplies. The population of Williamson County within Region G, for example, is projected to increase more than 4150% between 2020 and 2070 to about 2,426,093~~1,490,951~~ people. Water will become even more valuable, especially in the western and central parts of the BGRWPA, due to limited options for new reservoirs and because the aquifers in these areas have limited potential for further development.

Other concerns include the high content of chloride in surface-water runoff from the upper Brazos River Basin. Water with high chloride content is more expensive to treat and therefore places capital constraints on suppliers who obtain surface water from affected streams and reservoirs.

Zebra mussels are an invasive species impacting water quality in reservoirs and impairing the operation of water supply infrastructure. The Texas Parks and Wildlife Department maintains an up-to-date list of the occurrences of zebra mussels at the following web site:

<https://tpwd.texas.gov/huntwild/wild/species/exotic/zebramusselmap.phtml>

According to the website, as of ~~September 1, 2020~~ July 2023, the following reservoirs in the Brazos G Area are either "infested", i.e., established reproducing populations, or "positive", i.e., zebra mussels or their larvae have been detected: Lake Belton, Lake Georgetown, Lake Granger, ~~and~~ Lake Stillhouse Hollow, ~~and~~ Lake Waco. The Little River, downstream of Lakes Belton, Stillhouse Hollow, Georgetown and Granger is

also positive for zebra mussels. Several reservoirs in the adjacent Trinity and Colorado River Basins are also infested or positive.

1.10.1 Susceptibility of Water Supplies to Drought

1.10.1.1 Groundwater

The 16 aquifers within the BGRWPA vary in drought resistance, but all tend to have more resistance than most surface-water reservoirs. Most of the thick, deep, and extensive sand aquifers with moderate to high transmissivity react very slowly to droughts. Their supplies are virtually drought-proof even during long droughts. These aquifers, such as the Carrizo-Wilcox and Gulf Coast Aquifers, store enormous amounts of water. Somewhat thinner, yet still extensive, sand aquifers with low to moderate transmissivity commonly are only slightly less drought resistant. These aquifers include the Trinity, Woodbine, Queen City, Sparta, and Hickory.

During long droughts, shallow alluvial aquifers from which large withdrawals are made experience water level declines that are relatively large in comparison to total saturated thickness. Supplies from these aquifers, such as the Seymour and Brazos River Alluvium Aquifers, can be affected by drought but generally only by extended droughts. In extended droughts, available well yields are typically reduced, and pumps must run longer for a given level of supply.

In thin aquifers with shallow supplies, drought resistance may not be adequate. Such aquifers in the BGRWPA include the Dockum, Blaine, and Edwards-Trinity (Plateau). Also, shallow supplies in or near outcrop areas of aquifers, even of major aquifers, may have limited drought resistance.

Aquifers composed of limestone and/or dolomite are commonly the least drought-resistant. This is because these aquifers typically have only about one-tenth as much storage per cubic foot as sand aquifers. For limestone aquifers, the amount of well development is also an important factor in drought resistance. Thus, the Edwards (BFZ) Aquifer, with more developed well capacity than is available in extended droughts, is the least drought-resistant of all the aquifers in the BGRWPA. Depending on location and exact local conditions, springflows and some Edwards (BFZ) well supplies are substantially reduced in only moderate droughts. In contrast, the Marble Falls and Ellenburger-San Saba Aquifers, which are relatively undeveloped by wells, can more slowly discharge a part of their stored water during long droughts.

In the Brazos G Area, for supplies drawing from the Edwards (BFZ) Aquifer, drought planning is critical. All of the other aquifers in the region are drought resistant due to their inherent characteristics.

1.10.1.2 Surface Water

Surface water supplies in the region vary greatly, as annual rainfall ranges from 20 to 24 inches in Kent County in the northwest, to 40 to 48 inches in Grimes County in the southeast. Evaporation rates show a similarly wide variation, with the highest rates occurring in the northwestern part of the region.

Drought originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration). It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to

principal crop growth stages) and the effectiveness of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with drought and can significantly aggravate its severity.

Hydrological drought is associated with the effects of periods of precipitation shortfalls on surface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency affects the water supply. Firm yields of reservoirs are estimated based on water that would be available through a repeat of the historic drought of record, which includes the effects of reduced runoff and high evaporation rates during the drought period. Water supply from run-of-the-river diversions are estimated based on water that would be available¹⁸ through a repeat of the drought of record as well, but without the benefit of using stored water. The water supply estimates throughout this water plan are reliable through a repeat of the drought of record and are therefore not particularly susceptible to drought-induced shortages. However, the northwestern counties of the Brazos G Area are currently suffering through a particularly dry spell and data indicate new record drought conditions.

In 2009, 2011, 2012, and 2013 priority calls were made in the Brazos Basin. In July 2013 TCEQ issued an Order for the Brazos Basin including Possum Kingdom Lake and below Possum Kingdom Lake. The Order suspended or modified approximately 900 water rights in the Brazos Basin in 21 counties. The Order required the owners of larger reservoirs affected by the Order to submit pass-through plans, detailing their response to the priority call. The priority call was rescinded on October 10, 2013.

On April 9, 2014 the TCEQ directed that a new Watermaster be appointed for the Brazos River Basin including Possum Kingdom Lake and the watershed below the lake. The purpose of the Watermaster is to maintain compliance with water rights by monitoring stream flows, reservoir levels and water use. It is also the responsibility of the Watermaster to mediate the curtailment of water use if a priority call is initiated.

1.10.2 Identified Water Quality Problems

Water quality varies throughout the upper, middle and lower portions of the BGRWPA. Water quality is generally good in aquifers and in the tributaries of the Brazos River. However, high concentrations of chloride are found in the main stem of the Brazos River. Three factors affecting water quality in the Brazos G Area are wastewater disposal, high-density agricultural activities, and natural saline contamination.¹⁹ Except for the third factor, these threats are associated with the growth of both population and the economy, which are expected to continue in the future.

Water quality data collection and assessment studies have been conducted since 1991 through the Texas Clean Rivers Program (CRP). Through collaborative efforts with other agencies and basin residents, the BRA identifies and evaluates water quality and watershed management issues, establishes priorities for corrective actions, and implements activities to improve and protect the Brazos River basin. Identified surface water quality problems within the BGRWPA are summarized according to specific regions in the

¹⁸ Estimates of municipal and industrial run-of-river diversions are for 100 percent reliability. For irrigation uses, run-of-river reliability less than 100 percent is often acceptable.

¹⁹ Texas Natural Resource Conservation Commission (TNRCC), *Summary Report: Regional Assessments of Water Quality Pursuant to the Texas Clean Rivers Act (Senate Bill 818)*, 1992.

[basin, and basin and](#) are based on information from the Texas Clean Rivers Program [2022 Basin Summary Report](#) [2004 Basin Highlights Report](#).²⁰

1.10.2.1 Upper Basin Region

The Upper Basin Region includes the Salt and Double Mountain Forks and the Clear Fork of the Brazos River. Water quality data reveal water quality impacts represented by high conductivity levels, along with high total dissolved solids and chloride concentrations. [Impairments have been identified in the Salt Fork and Double Mountain Forks of the Brazos River for chloride, bacteria, and mercury in edible tissue \(Lake Alan Henry\). Concerns have been identified for bacteria, chlorophyll a/nutrients, dissolved oxygen, and selenium.](#)

[Within the Clear Fork watershed, land use is predominantly agricultural, with Abilene representing the only urban area. All but one classified segment meet water quality standards to support their designated uses. The Clear Fork Brazos River segment was listed in 2018 as impaired for bacteria. In addition, the Clear Fork of the Brazos has concerns for nitrate and chlorophyll a, along with an increasing trend in chloride concentrations. Chloride concentrations in this region are noted to be a natural feature and dependent upon weather conditions. There are also reported increasing concerns for nutrient levels in this segment.](#)

While this [region-area](#) contributes only 14 to 18 percent of the total Brazos River flow, the area contributes 45 to 55 percent of the total dissolved minerals and about 75 to 85 percent of the dissolved salts. [Special studies in the area include:](#)

- [Biological Assessments of California Creek.](#)

1.10.2.2 Upper Central Basin Activity Region

The Upper Central Basin of the Brazos River includes eight lakes, five watersheds, and a variety of land uses interconnected throughout the watersheds. The Upper Central Basin Region generally covers from Bell County north to Hood County. Numerous watershed protection and management projects are being conducted in this region to address declining water quality due to impacts from industrial, agricultural, municipal, and natural causes.

[Impairments have been identified in the Upper Watershed of the Brazos River for bacteria and sulfate/Total Dissolved Solids. Concerns have been identified for nutrient/Chlorophyll a. Salt Fork and Double Mountain Forks of the Brazos River for chloride, bacteria, and mercury in edible tissue \(Lake Alan Henry\). Concerns have been identified for bacteria, chlorophyll a/nutrients, dissolved oxygen, and selenium.](#)

[Concerns in the Aquilla Watershed have been identified for nutrient/Chlorophyll a, dissolved oxygen, and arsenic in sediment, each within Hackberry Creek.](#)

[The Bosque River Watershed drains approximately 1,652 square miles and discharges into Lake Waco. Impairments have been identified for depressed dissolved oxygen and bacteria. Concerns have been](#)

²⁰ Brazos River Authority (BRA), Texas Clean Rivers Program [2022 Basin Summary Report](#) [2004 Highlights Report](#), available online at http://www.brazos.org/CleanRiversProgram/BasinReport/Executive_Summary.pdf, 2004.

identified for chlorophyll a/nutrients, bacteria, dissolved oxygen, and the microbenthic community in the North Bosque River.

Impairments identified in the Leon River Watershed include bacteria and dissolved oxygen. Concerns have been identified for specific segments in the watershed for dissolved oxygen, bacteria, and chlorophyll a/nutrients.

The Lampasas Watershed includes Stillhouse Hollow Lake and Salado Creek. Water quality issues include identified impairments for dissolved oxygen, and concerns for chlorophyll a/nutrients, dissolved oxygen, and bacteria.

Numerous on-going activities and water quality issues and special studies have been performed in this area to study and improve water quality conditions, including:

- Reservoir Fisheries Habitat Improvement Project, a partnership initiated in 2016 between BRA and the Texas Parks and Wildlife Department (TPWD) to perform habitat improvement projects on Possum Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone, and Lake Somerville.
- Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards, initiated by the BRA in 2012 to perform extensive environmental studies at select locations in the Brazos River basin to gather data related to the Texas Commission on Environmental Quality's adopted Senate Bill 3 environmental flow baseline.
- A Total Maximum Daily Load for Atrazine in Aquilla Reservoir.
- Two Total Maximum Daily Loads for Phosphorus in the North Bosque River.
- Biological Assessments initiated by BRA for long-term aquatic life monitoring on the North Bosque River at Cooper's Crossing in 2008.
- A Watershed Protection Plan for the Leon River developed by stakeholders and approved by the Environmental Protection Agency (EPA) in early 2015 and presently in the implementation phase.
- A Watershed Protection Plan for Nolan Creek/South Nolan Creek developed by the Nolan Creek Watershed Partnership and accepted by the EPA in February 2019.
- Belton Lake, Proctor Lake, and Stillhouse Hollow Lake are part of a Reservoir Fisheries Habitat Improvement project.
- Biological Assessments in Resley Creek (an unclassified tributary of the Leon River) and the Leon River above Belton Lake.
- The Lampasas River Watershed Protection Plan to address bacteria issues in the watershed was approved by the EPA in May 2013 and by a Steering Committee in September 2013 and is in the implementation phase.

In 2002, the BRA began a special study on Lake Granbury to assess impacts from septic systems in the coves throughout the lake.

The BRA currently monitors Aquilla Creek at FM 933 in this watershed. TCEQ has been monitoring Lake Aquilla as a result of its placement on the State's 303 (d) list for impairments due to high concentrations of atrazine.

The Bosque River Watershed drains approximately 1,652 square miles and discharges into Lake Waco. Elevated bacteria, nutrient and algal growth are concerns for this watershed, due to high non-point source pollution activity generally attributed to confined animal feeding operations. There are several on-going

activities undertaken by the State, BRA, City of Waco, and local entities to monitor and reduce pollution in this watershed.

A number of sites in the Leon River watershed show concerns for elevated bacteria and nutrient concentrations, as well as depressed dissolved oxygen.

Lake Stillhouse Hollow experiences above average water quality conditions and remains primarily undeveloped. Discharging into the Lampasas river downstream of the lake, Salado Creek is experiencing concerns from elevated nutrient concentrations.

1.10.2.3 Lower Central Basin Activity Region

Portions of the Lower Central Basin includes the Little River Watershed (Lake Georgetown and Lake Granger), the Central Watershed (Lake Brazos Dam), and the Navasota River Watershed (Lake Mexia, Lake Springfield, and Lake Limestone). Portions of the area are subject to non-point source discharges and nutrient loading from agricultural activities.

The western portion of the Little River watershed is rapidly developing while the eastern portion of the watershed remains rural. It is reported that recent major industrial manufacturing movements will see urbanization spread even more rapidly eastward, potentially leading to additional land application of fertilizers, pesticides, pet waste, septic systems, and new sewage outfalls which can result in increased concentrations of nutrients, bacteria, and organic constituents. Data collected to-date-recently show that current water quality in the watershed overall is good and that most segments support their designated use classifications. Impairments have been identified for bacteria in the watershed, while concerns have been identified for chlorophyll a/nutrients, dissolved oxygen, and bacteria.

The Central Watershed of the Brazos River has primarily agricultural land usage, with two rapidly growing urban areas (Waco and Bryan/College Station). Impairments in portions of the watershed have been identified for bacteria and dissolved oxygen, and concerns have been identified for bacteria, dissolved oxygen, chlorophyll a/nutrients, microbenthic and fish communities, and fish kills in Tradinghouse Reservoir and Tehuacana Creek.

The Navasota Watershed covers approximately 2,235 square miles, with primarily agricultural land uses and one growing urban area (Bryan/College Station). Most of the water quality in the area is good, although there are segments of the watershed that are reported to exceed state standards for E. coli and dissolved oxygen. Impairments have been identified within the watershed for bacteria, dissolved oxygen, and pH, while concerns have been identified for chlorophyll a/nutrients, dissolved oxygen, bacteria, and toxic substances in sediment.

Cottonwood Branch in Brazos County near Bryan has very high concentrations of nutrients and elevated bacteria levels. Lakes Limestone and Granger also show concerns for nutrient loading that is contributing to increased aquatic plant growth. Special studies in the area include:

- Big Elm Watershed Protection Plan.
- Candidate Conservation Agreement with Assurances for the Balcones Spike and Texas Fawnsfoot in the Brazos River Basin.
- The U.S. Army Corps of Engineers (USACE) Sustainable Rivers Program presently underway to bring projects to the Little River System which will evaluate reservoir release strategies using the lower fraction of the USACE controlled reservoir flood pools, including Lake Georgetown, Lake Granger, Stillhouse Hollow Lake, and Lake Belton.

- [Reservoir Fisheries Habitat Improvement Project](#)
- [Characterization of Middle Yegua, Davidson, and Deer Creeks project](#)
- [Watershed Characterization of the Thompsons Creek Watershed](#)
- [TPWD Tehuacana Creek water quality reporting](#)
- [Navasota River Below Lake Limestone Watershed Protection Plan](#)
- [Three Total Maximum Daily Loads for Indicator Bacteria in the Carters Creek Watershed](#)
- [Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards](#)
- [Biological Assessments on Duck Creek](#)

Additionally, elevated naturally occurring arsenic levels have been experienced in Trinity Aquifer groundwater produced from certain areas of Falls, Hill, Limestone, and Milam Counties which has created compliance issues with USEPA drinking water standards.

1.10.2.4 Lower Basin Activity Region

[The Lower Basin area includes the Yegua Creek Watershed, including Lake Somerville. Land use is mainly rural and cattle production with small urban areas and limited crop production areas. Water quality issues in portions of the area include identified impairments to bacteria, depressed dissolved oxygen, and pH, while concerns have been identified for bacteria, chlorophyll a, and dissolved oxygen.](#)

[Special studies in the area include:](#)

- [Characterization of Middle Yegua, Davidson, and Deer Creeks](#)
- [Reservoir Fisheries Habitat Improvement](#)

[The BRA monitors eight sites in Yegua Creek watershed, including two sites on Lake Somerville. The lake, which spans 11,460 acres, has experienced several fish kills. Lake Somerville has experienced both elevated and depressed pH levels, which may be attributed to fluctuations in blue-green algae populations.](#)

1.10.3 Identified Threats to Agricultural and Natural Resources

Drought and water quality are the two primary threats to agricultural and natural resources in the Brazos G Area.

1.10.3.1 Threats to Agricultural Resources

Drought is the primary threat to agricultural resources in the Brazos G Area. During long droughts, surface water supplies for unconfined livestock are diminished. If the drought extends through the season for growing forages, production is reduced due to the lack of forageable food. Additional threats to livestock arise from the reduced water supply for rural water systems that are not interconnected or that are not supplied by a reliable source. This is especially true in the northwest part of the region. Water for confined livestock (e.g., dairy cattle and poultry) and for crop irrigation typically comes from groundwater.

Water quality can also pose a threat to agricultural resources. Increased levels of salts and total dissolved solids may damage certain crops and require additional water for irrigation. High levels of salts can accumulate on the surface soils, creating a hardpan effect that impedes percolation of irrigated water. As water quality degrades, crop selection and production may be limited. An additional threat to crop production is the migration into agricultural land of municipal well fields to supply groundwater to

growing cities. Groundwater Conservation Districts and Underground Water Conservation Districts have been created in part to manage groundwater supplies that may have competing interests.

1.10.3.2 Threats to Natural Resources

The Brazos River Basin within the BGRWPA is a freshwater eco-region that is defined as primarily temperate coastal rivers and lakes habitat, with high ranking habitats for fish, reptiles and amphibian species.²¹ Identified threats to these biological resources stem from the combined effects of land use disturbance, reduced stream flow from prolonged droughts as well as current and future water diversions from water supply projects, lower lake levels, and impacted quality of surface and groundwater. Declining flows can affect the availability and quality of aquatic habitats and streamside vegetation and also contribute to changes in water temperature and chemistry. As discussed in Section 1.7.2, water quality in the Brazos River Basin has been degraded by increased concentrations of chlorides, dissolved metals, ammonia, nitrates, and phosphates, pesticides, algae, and fecal coliform bacteria. Under lower flow conditions, greater effects from pesticide contamination could occur through higher concentrations of chlorinated hydrocarbons and organic phosphates. A summary of potential effects that identified threats would have on biological resources is presented in Table 1.10. The water resources impacted by water quality concerns identified in Section 1.7.2 within the Brazos River Basin are presented in Table 1.11.

Reduced stream flows and reservoir levels, which are brought on by drought and increases in water use, pose the greatest potential threat to aquatic species in the region. Lower stream flows would alter the proportion of stream runs, riffles, pools, and backwater sloughs and decrease the wetted perimeter (total available habitat). These changes in habitat may benefit some species, primarily hardy, generalist species, but would negatively impact most species and result in reduced species richness. Riparian vegetation is also threatened by less over bank flooding and a shift to more mesic (drier) conditions with a decline in those species that are dependent on flooding processes (cottonwood, willow, and pecan) and an increase in species tolerating drier conditions (hackberry and mesquite).

Table 1.10 Summary of Regional Threats to Biological Resources in the Brazos River Basin

Threat	Potential Effects to Aquatic Organisms	Potential Effect to Riparian Vegetation
Rivers & Streams		
Lower Streamflows	Decreased stream runs, riffles, pools, and backwater sloughs resulting in lower habitat diversity and species richness.	Less overbank flooding and shift to more mesic (drier) conditions with decline in species dependent on flooding processes and increase in species tolerating drier conditions.
Lower Water Quality	Lower habitat suitability; lower habitat diversity, species richness, and abundance; possible direct and indirect adverse effects from point and non-point source contaminants.	Potentially enhanced growth from higher concentrations of phosphorus, nitrates, and other nutrients; but increased growth could be suppressed by lower water tables from declining flows, increased salinities or exposure to contaminants.
Reservoirs		

²¹ Abell, R.A, D.M. Olson, E. Dinerstein, P.T. Hurlley, J.T. Diggs, W. Eichbaum, S. Walters, W. Wettengel, T. Allnutt, C.J. Loucks, and P. Hedao. 2000. Freshwater Eco-regions of North America – A Conservation Assessment. World Wildlife Fund. Island Press. Washington D.C. 320 pp.

Threat	Potential Effects to Aquatic Organisms	Potential Effect to Riparian Vegetation
Lower Reservoir Levels	If prolonged, less available habitat resulting in lower species diversity & species abundance. If seasonal, potential positive effects through enhanced fishery production, depending on timing and duration of subsequent rising lake levels.	Increase in growth of shoreline herbaceous and woody vegetation during lower lake levels, but growth suppressed or reversed by rising lake levels and seasonal inundation.
Bays & Estuaries		
Reduced freshwater inflows	Possible change in hydrological dynamics of estuary. Projected effects would be minimal due to limited coastal marsh habitats associated with the Brazos River Estuary.	Effects considered minimal due to limited coverage resulting from previous levee construction and river channelization.

Table 1.11 Location of Threats to Biological Resources Related to Water Quality in the Brazos River

Identified Threats	Upper Basin	Upper Central Basin	Lower Central Basin	Lower Basin
Increased Chlorides	Salt and Double Mountain Forks, Clear Fork Brazos River segment, White River Lake	Upper Brazos River		
Bacteria	Salt Fork and Double Mountain Forks, Clear Fork Brazos River segment. Miller's Creek Reservoir	Upper Brazos River, Aquilla Watershed, Lake Waco, Leon River, Bosque River, Stillhouse Hollow Lake and Salado Creek	Lake Georgetown, Lake Granger, Lake Brazos Dam, Lake Mexia, Lake Springfield, and Lake Limestone	Yegua Creek Watershed, Lower Brazos River Watershed, Upper and Middle Oyster Creek Watersheds
Dissolved Oxygen	Salt Fork and Double Mountain Forks	Upper Brazos River. Aquilla Watershed, Bosque River, Lake Waco, Leon River, Stillhouse Hollow Lake and Salado Creek	Lake Georgetown, Lake Granger, Lake Brazos Dam, Lake Mexia, Lake Springfield, and Lake Limestone	Yegua Creek Watershed, Lower Brazos River Watershed
Increased Nutrients ⁽¹⁾	Salt and Double Mountain Forks, Clear Fork Brazos River segment,	Upper Brazos River, Aquilla Watershed, Bosque River, Lake Waco, Leon River, Stillhouse Hollow Lake and Salado Creek	Lake Georgetown, Lake Granger, Lake Mexia, Lake Springfield, and Lake Limestone, Lake Brazos Dam	Yegua Creek Watershed, Lower Brazos River Watershed, Upper and Middle Oyster Creek Watersheds

Identified Threats	Upper Basin	Upper Central Basin	Lower Central Basin	Lower Basin
	California Creek			
Algae		North Bosque River, Lake Waco	Lake Brazos Dam	
Pesticides & Heavy Metals	Salt Fork and Double Mountain Forks	Aquilla Watershed, Upper Brazos River	Trinity Aquifer groundwater, Lake Brazos Dam	

Notes:

(1) Includes: Ammonia, Phosphorus, Nitrogen, Nitrate-Nitrogen.

1.11 Drought Preparations

With the significant historical growth across the state and considering the current projections for future growth in the Brazos G area, the demand for water is expected to continue increasing. Preparation and planning for potential future drought(s) is critical to ensuring a sufficient water supply is available to meet user demands. Refer to Chapter 7 of this plan for detailed information concerning the drought of record in the Brazos G area, current drought preparation and considerations, and recommendations for additional regional level drought response planning tools.

Drought contingency plans are required by the State for wholesale water suppliers, irrigation districts, and retail water suppliers. For surface water right-holders that supply 1,000 acft/yr or more for non-irrigation use and 10,000 acft/yr for irrigation use, SB1 requires a water conservation plan. To aid entities in the region with the development of these plans, example water conservation and drought management plans are provided in Appendices J and K.

In addition, conservation plans are commonly included in the management plans of Groundwater Conservation Districts or Underground Water Conservation Districts.

1.12 Existing Programs and Goals

1.12.1 Groundwater Regulation

1.12.1.1 Priority Groundwater Management Areas (PGMAs)

The Texas Legislature authorized the TCEQ to identify and delineate priority groundwater management areas (PGMAs) as “those areas of the state that are experiencing or that are expected to experience, within the immediately following 25-year period, critical groundwater problems, including shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, and contamination of groundwater supplies” (§Section 35.007, Chapter 35, Title 2, Texas Water Code).

Following a PGMA designation, [the](#) TCEQ may recommend creating a groundwater conservation district. Citizens in the PGMA have two years to establish a Groundwater Conservation District (GCD). If a GCD is not established in the required timeframe, a GCD will be established that is consistent with the original TCEQ recommendation, which will be governed by a locally elected board of directors.

TCEQ designated two PGMA areas in the BGRWPA, the Central Texas-Trinity Aquifer PGMA and the Northern Trinity and Woodbine Aquifers PGMA, shown on Figure 1.22. The TCEQ designated the Central Texas-Trinity Aquifer PGMA on October 31, 2008. Counties in this PGMA include Bosque, Coryell, Hill, McLennan, and Somervell. The Northern Trinity and Woodbine Aquifers PGMA was designated on February 11, 2009. This PGMA includes Collin, Cooke, Dallas, Denton, Ellis, Fannin, Grayson, Hood, Johnson, Montague, Parker, Tarrant, and Wise counties. Only Hood and Johnson counties are in the Brazos G Area.

At the time of this plan, all affected counties in the PGMA areas are part of GCDs. In 2007 the Upper Trinity GCD was formed, which includes Hood County. In May 2009, Bosque County joined the Middle Trinity GCD. The Tablerock GCD, which included Coryell County, was dissolved by the Legislature; Coryell County joined the Middle Trinity GCD in 2009. In 2009, the Texas Legislature created the Prairielands GCD and the Southern Trinity GCD. The Prairieland GCD includes Johnson, Hill and Somervell counties. At this time, only McLennan County is part of the Southern Trinity GCD. A map of groundwater conservation districts is presented in Figure 1.23.

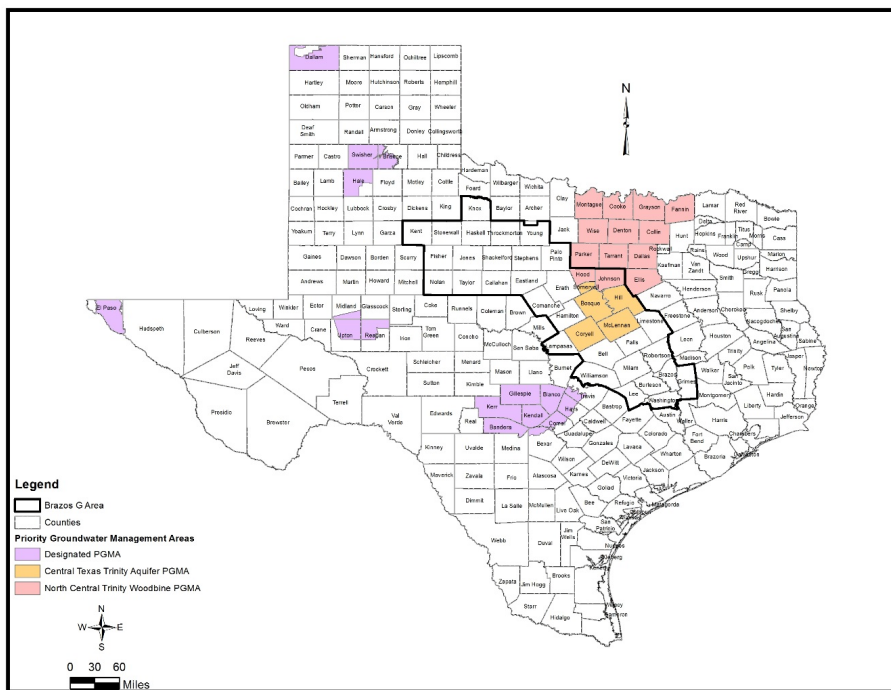


Figure 1.22 Priority Groundwater Management Areas

1.12.1.2 Groundwater Conservation Districts and Groundwater Management Areas

There are thirteen GCDs in the BGRPA, as shown on Figure 1.23 and listed in Table 1.12. All GCDs are required to develop and implement a management plan to manage groundwater resources. A list of the GCDs' management plan approval dates are shown on Table 1.12 and are available through the TWDB website.

In 2001, Senate Bill 2 of the 77th Texas Legislature authorized the TWDB to designate Groundwater Management Areas (GMAs) that would include all major and minor aquifers of the state. Sixteen GMAs were delineated and adopted by the TWDB in 2002 and cover all major and minor aquifers in Texas. The BGRWPA intersects GMA 6, 7, 8, 12, and 14. These GMAs are shown on Figure 1.23 and are listed in Table 1.13.

In 2005, House Bill 1763 of the 79th Texas Legislature required GCDs in groundwater management areas to meet and define the Desired Future Conditions (DFCs) of the groundwater resources within the groundwater management area. The legislation requires that the DFCs be defined by September 1, 2010 and every 5 years thereafter. This requires joint planning among the GCDs in each GMA to determine Desired Future Conditions.

Desired Future Conditions are defined by statute to be "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint groundwater planning process." The most common DFCs are based on the volume of groundwater in storage over time, water levels (limiting decline within the aquifer), water quality (limiting deterioration of quality) or spring flow (defining a minimum flow to sustain).

After the DFCs are determined by the GMAs, the TWDB performs quantitative analysis to determine the amount of groundwater available for production that does not exceed the DFC. For aquifers where a Groundwater Availability Model (GAM) exists, the GAM is used to develop the MAG (Available Groundwater). The MAG estimated through this process is then used by RWPGs as the available groundwater for the planning period. For aquifers or local groundwater that are not listed as a minor or major aquifer, the water availability is based on historical use and available hydrogeological records. Table 1.13 shows the status of the Desired Future Conditions development, and the status of the determination of Modeled Available Groundwater (MAG) for each GMA in the BGRWPA.

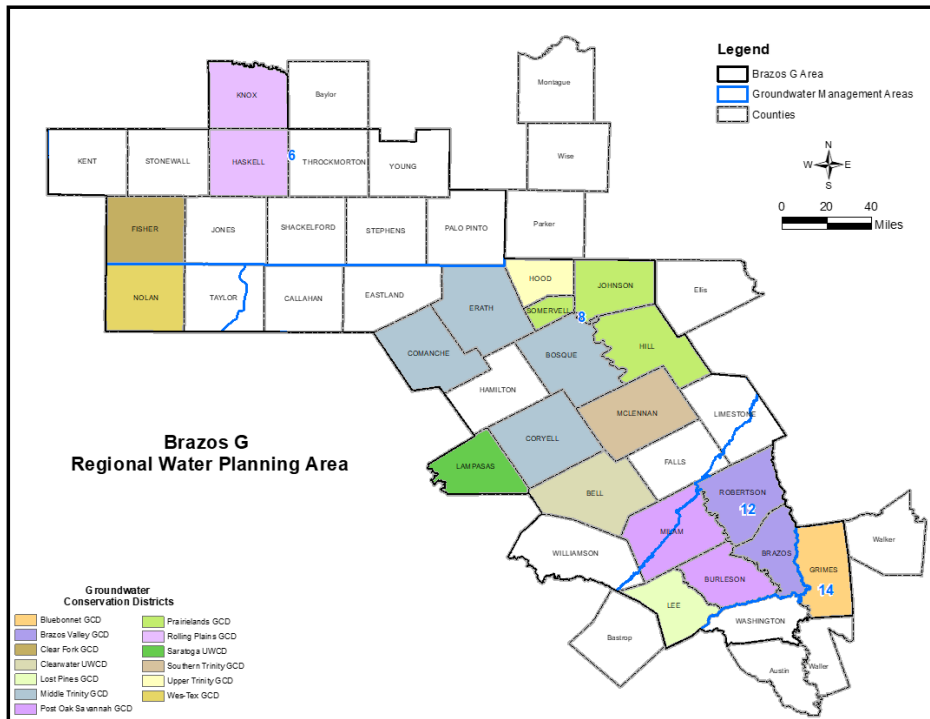


Figure 1.23 Groundwater Conservation Districts and Groundwater Management Areas Located Wholly or Partially within the Brazos G Area

Table 1.12 Groundwater Conservation District Management Plan Approval Dates

Name of District	Date Plan Approved
Bluebonnet Groundwater Conservation District	1/27/2022
Brazos Valley Groundwater Conservation District	5/13/2019
Clear Fork Groundwater Conservation District	2/25/2022
Clearwater Groundwater Conservation District	12/20/2020
Lost Pines Groundwater Conservation District	9/21/2022
Middle Trinity Groundwater Conservation District	7/27/2022

Name of District	Date Plan Approved
Post Oak Savannah Groundwater Conservation District	11/15/2022
Prairielands Groundwater Conservation District	5/31/2019
Rolling Plains Groundwater Conservation District	8/25/2020
Saratoga Groundwater Conservation District	8/31/2020
Southern Trinity Groundwater Conservation District	9/9/2021
Upper Trinity Groundwater Conservation District	7/6/2020
Wes-Tex Groundwater Conservation District	3/18/2020

Table 1.13 Groundwater Conservation Districts, Aquifers, Desired Future Conditions (DFCs), and Modeled Available Groundwater (MAG) Status by GMA for the Brazos G Area

Groundwater Management Areas			
Groundwater Management Area 6			
Clear Fork GCD, Rolling Plains GCD			
Aquifer	Major or Minor Aquifer?	Desired Future Conditions Status	Modeled Available Groundwater Status
Seymour	Major	11/18/2021	Submitted 11/14/2022, GR 21-011 MAG
Dockum	Minor	11/18/2021	Submitted 11/14/2022, GR 21-011 MAG
Blaine	Minor	11/18/2021	Submitted 11/14/2022, GR 21-011 MAG
Cross Timbers	Minor	No DFC adopted ¹	-
Groundwater Management Area 7			
Wes-Tex GCD			
Aquifer	Major or Minor Aquifer?	Desired Future Conditions Status	Modeled Available Groundwater Status
Edwards-Trinity (Plateau)	Major	8/19/2021	Submitted 8/12/2022, GR 21-012 MAG
Dockum	Minor	No DFC adopted ¹	-
Groundwater Management Area 8			
Clearwater UWCD, Middle Trinity GCD, Post Oak Savannah GCD², Prairielands GCD, Saratoga UWCD, Southern Trinity GCD, Upper Trinity GCD			
Aquifer	Major or Minor Aquifer?	Desired Future Conditions Status	Modeled Available Groundwater Status
Trinity	Major	11/4/2021	Submitted 11/1/2022, GR 21-013 MAG
Edwards (BFZ)	Major	11/4/2021	Submitted 11/1/2022, GR 21-013 MAG

Groundwater Management Areas			
Brazos River Alluvium	Minor	No DFC adopted ¹	-
Ellenburger - San Saba	Minor	11/4/2021	Submitted 11/1/2022, GR 21-013 MAG
Hickory	Minor	11/4/2021	Submitted 11/1/2022, GR 21-013 MAG
Marble Falls	Minor	11/4/2021	Submitted 11/1/2022, GR 21-013 MAG
Woodbine	Minor	11/4/2021	Submitted 11/1/2022, GR 21-013 MAG
Groundwater Management Area 12			
Brazos Valley GCD, Post Oak Savannah GCD ² , Lost Pines GCD			
Aquifer	Major or Minor Aquifer?	Desired Future Conditions Status	Modeled Available Groundwater Status
Carrizo-Wilcox	Major	11/30/2021	Submitted 11/1/2022, GR 21-017 MAG
Brazos River Alluvium	Minor	11/30/2021	Submitted 11/1/2022, GR 21-017 MAG
Queen City	Minor	11/30/2021	Submitted 11/1/2022, GR 21-017 MAG
Sparta	Minor	11/30/2021	Submitted 11/1/2022, GR 21-017 MAG
Yegua-Jackson	Minor	11/30/2021	Submitted 11/1/2022, GR 21-017 MAG
Groundwater Management Area 14			
Bluebonnet GCD			
Aquifer	Major or Minor Aquifer?	Desired Future Conditions Status	Modeled Available Groundwater Status
Gulf Coast	Major	1/5/2022	Submitted 9/8/2022, GR 21-019 MAG

Notes:

- (2) No DFC is currently adopted by GMA for this aquifer and no corresponding MAG has been published by the GMA. Availability estimates presented elsewhere in this plan are based on historic modeling and/or modeling during MAG development for other aquifers. 2 Post Oak Savannah GCD is in GMA 8 and GMA 12.

1.12.1.3 Texas Clean Rivers Act

In 1991, the 72nd Legislature passed the Texas Clean Rivers Act²² to establish for the first time a watershed basis for water quality planning in Texas.^{23,24} The Act requires each river basin in the State to be assessed for water quality and management strategies on an on-going basis. It also requires reports to be provided to the TCEQ every even-numbered year.²⁵ The Act provides specific guidelines for accomplishing the water quality assessments, including: (1) comprehensive assessments on a watershed basis with emphasis on non-point sources, nutrients, and toxic materials; (2) delegation of responsibility for assessments to river authorities; (3) formation of river basin steering committees; (4) discharge permitting on a basin-wide basis; and (5) assessment fees charged to wastewater- and water-rights permittees.

²² Senate Bill 818, amending the Texas Water Code, Sections 5.103, 5.105, 26.011; T.A.C. Sections 320.1-320.9

²³ TNRCC, Op. Cit., 1992.

²⁴ TNRCC, Op. Cit., 1999.

²⁵ BRA, "Planning and Environmental Division", [Online] Available URL: <http://www.brazos.org/home.htm>, 1999.

The BRA is a partner with the TCEQ in the Clean Rivers Program for the BGRWPA. The program provides funding for BRA staff to assess water quality in the Brazos River Basin and to document local problems. Also, the program provides fee payers with site-specific information on water quality such as receiving water assessments and flow data. The [Basin Summary 2022-2004 Report](#)²⁶ for the Brazos River Basin provides an assessment of water quality for the basin, drawing attention in part to: (1) [the exceedance of state standards raising concerns for recreation due to elevated bacteria levels, dissolved oxygen depletion, and natural salt impacts to the usability of water](#), (2) the need for more long-term data on water quality, (3) [non-point source pollution](#), (4) [wastewater and watershed management issues](#), (5) [impacts to ecosystems](#), and (6) [the needs for funding and public education](#), a continued emphasis on the Basin Steering Committee for direction and comment on the water quality assessment program, (3) continued assistance in water quality monitoring from local partners in the Basin Monitoring Program, (4) emphasis on assessing and maintaining data, and (5) development of a geographical information system for the basin. The [2004-2022 Basin Summary Report](#) provides detailed findings about water quality and related items for selected sub-watersheds of the basin. The findings most relevant to the BGRWPA were summarized in Section 1.7.2.

1.12.2 Clean Water Act

The 1972 Federal Water Pollution Control Act, which as amended is called the Clean Water Act, is the federal law with the most impact on water quality protection in the BGRWPA. As amended in 1977 and again in 1987, the Clean Water Act: (1) establishes the framework for monitoring and controlling industrial and municipal point-source discharges through the National Pollutant Discharge Elimination System (NPDES), (2) authorizes federal assistance for the construction of municipal wastewater treatment facilities, and (3) requires cities to obtain permits for stormwater or non-point-source discharges.²⁷ The Clean Water Act also includes provisions to protect specific aquatic resources. Section 303 establishes a non-degradation policy for high quality waters and provides for establishment of state standards for receiving water quality. Section 401 allows states to enforce water quality requirements for federal projects such as dams. Section 404 provides safeguards for wetlands and other waters from the discharge of dredged or fill material. Section 305 calls for the TCEQ to prepare and submit a water quality inventory to the U.S. Environmental Protection Agency.²⁸ Other provisions protect particular types of ecosystems such as lakes (Section 314), estuaries (Section 320), and oceans (Section 403).²⁹ Several of these provisions are relevant to specific water quality concerns in the BGRWPA.

1.12.3 Safe Drinking Water Act

The Safe Drinking Water Act, passed in 1974 and amended in 1986 and 1996, allows the U.S. Environmental Protection Agency to set standards for drinking water quality. These standards are divided into two categories: National Primary Drinking Water Regulations (primary standards that must be met by all public water suppliers) and National Secondary Water Regulations (secondary standards that are not enforceable, but are recommended). Primary standards protect water quality by limiting levels of

²⁶ BRA, Op. Cit., 202204.

²⁷ 33 USCA, Sections 1251 through 1387.

²⁸ TWDB, 1997.

²⁹ Adler, R.W., Landman, J. and Cameron, D., *The Clean Water Act: Twenty Years Later*, Island Press, Washington D.C., 1993.

contaminants that are known to adversely affect public health and that are anticipated to occur in water. Secondary standards have been set for contaminants that may affect cosmetic or aesthetic qualities of water (e.g., taste, odor, or color). For some constituents, the State of Texas has secondary standards that differ from the National standards.

1.12.4 Source Water Assessment and Protection Program

The TCEQ's Source Water Assessment and Protection (SWAP) Program can be an important part of water resource management. The SWAP Program, authorized by the Safe Drinking Water Act, assists local jurisdictions in preventing contamination of drinking water supplies. It identifies sources of public drinking water, determines potential contaminants, assesses water systems' susceptibility to contamination, and informs the public of the results. It is part of a comprehensive, integrated approach to clean ground and surface water undertaken by the TCEQ.

The centerpiece of the SWAP Program is a focus on prevention. Water can be easily contaminated, but it is difficult and expensive to clean up. Through the SWAP Program, by preventing contamination, jurisdictions are able to avoid the cost of removing contamination and maintain clean, reliable sources for drinking water.

The SWAP Program is designed to assist Texas communities in protecting their drinking water sources. Its goal is to increase public awareness of the importance of protecting drinking water sources and actions that can be taken to protect those sources. The SWAP Process involves seven steps:

1. Delineation (or mapping) of source water protection areas, any areas surrounding a drinking water source, whether from ground or surface water;
2. Conducting an inventory of actual or potential sources of contamination in the delineated area;
3. Conducting an analysis of the relative susceptibility of the water supply to those contamination sources and presenting the results to the public water supply in the form of a Source Water Susceptibility Assessment Report. These results provide insights into activities near your water sources and serve as the starting point for implementing source water protection.
4. Working with selected local communities to make information available to the public;
5. Voluntary application of best management practices to prevent contamination, such as land use practices, regulations and permits, structural measures, good housekeeping practices, public education and emergency response planning;
6. Monitoring and continually assessing source water supplies; and,
7. Conducting triennial sampling and continually monitoring, assessing and conducting protection activities.

By conducting continual monitoring, assessment and protection activities, communities can minimize potential sources of contamination and protect source water supplies over the long-term.

1.12.5 State Water Availability Modeling Initiatives

1.12.5.1 TCEQ Water Availability Models (WAMs)

Water Availability Models (WAMs) are computer-based simulation models used to determine water availability for surface water rights under Texas' priority system. These models are used to evaluate water availability for newly requested water rights or water right amendments. The models are also used for

regional water planning. There are twenty individual WAMs that cover the twenty-three river basins in Texas, including coastal basins. The original hydrologic period of record within most WAMs is was approximately 1940 to 1997; however, the TCEQ has been working in coordination with stakeholders throughout the state to extend this period with more recent hydrologic data, although the hydrology has been extended for the Colorado WAM through 2016. The TCEQ has initiated an update of the An updated Brazos WAM has been developed that to extends the hydrologic data in the model through 2018.

There are two WAM scenarios used and maintained by TCEQ staff:

1. Full Authorization (Run3) – In the Full Authorization scenario all water rights utilize their full authorized amounts. This scenario is used to evaluate perpetual water rights and amendments.
2. Current Conditions (Run 8) – The Current Conditions scenario Includes return flows, current reservoir conditions and has water rights diversions based on historical use. This scenario is used to evaluate term water rights.

Most of the Brazos G Planning Area falls within the area covered by the Brazos WAM. Existing supplies and future water management strategies were evaluated using a modified WAM Run 3. The modified WAM Run3 includes existing and future sediment conditions for reservoirs.

1.12.5.2 TWDB Groundwater Availability Models (GAMs)

Groundwater Availability Models (GAMs) were developed under the direction of the TWDB. The GAMs cover most of the major and minor aquifers within Texas. The GAMs are used in the regional planning process as discussed in 1.11.1. Based on the agreed upon Desired Future Condition (DFC) the GAMs are run to develop the MAG for each aquifer to be used in the Regional Planning Process.

1.13 Previous Water Supply Planning in the Brazos G Area

As discussed in previous sections, the Brazos G Area is a large and diverse with varying needs of water users in the different parts of the region. In response to these different needs, the region has a history of successful local water supply planning and development. These studies are too numerous to identify and list in entirety here. Some of the more recent studies include:

1. Bosque County water treatment and distribution study to address water needs in Bosque County in the central Brazos River Basin. The study was completed in March 2004.³⁰
2. The Brazos River Authority and Tarrant Regional Water District sponsored a water supply study for Parker and Johnson Counties in the central Brazos River Basin to meet the growing needs of this area. Phase 1 of the study was completed in April 2004.³¹
3. The West Central Brazos River Basin Regional Water Treatment and Distribution Facility Study evaluated water needs in the upper Brazos River Basin. This study was completed in August 2004.³²

³⁰ Carter-Burgess, March 2004, Bosque County Regional Water Treatment and Distribution Facilities Plan, Final Report to the Brazos River Authority.

³¹ Freese and Nichols, April 2004, Regional Water Supply and Wastewater Service Study for Johnson and Parker Counties, Phase I.

³² Freese and Nichols, August 2004, West Central Brazos River Basin Regional Water Treatment and Distribution Facility Plan.

4. Bell/Williamson Regional Water Supply Facility Plan – Included eight participants in southern Bell County and Northern Williamson County. The study recommended the cooperation of these eight participants in development of infrastructure and water supply projects.
5. The City of Abilene and the Cities of Midland and San Angelo (Region F) have formed the West Texas Water Partnership (WTWP) to identify and secure long-range water supplies for the three cities and the surrounding region. Results from ongoing studies will be reflected in future regional water plans.
6. The Falls, Hill, Limestone, and McLennan Counties (FHLM)-TWDB Regional Water Facility Planning Study evaluated the feasibility of a regional water system to replace and/or supplement multiple smaller water systems currently providing service within the FHLM area. The study addresses elevated arsenic concentrations experienced by study participants and also evaluates water treatment and transmission alternatives to meet the arsenic Maximum Contaminant Level (MCL).³³

Brief summaries of the Brazos G Regional and State Water Plans and several studies completed recently are presented in the following sections.

1.13.1 Brazos G Regional and State Water Plans

Since SB1 was passed in 1997, the Brazos G Regional Planning Group has completed four rounds of planning, with regional plans adopted in 2001, 2006, 2011, ~~and 2016~~, and 2021. These regional plans have been rolled up with 15 other regional plans into the State Water Plan in 2002, 2007, 2012, ~~and 2017~~, and 2022, respectively. Each successive plan has been updated to reflect the most relevant information at the time. This section provides a brief summary of each of the Brazos G Regional water Plans and the State Water Plans.

1.13.1.1 2001 Brazos G Regional Water Plan³⁴

The 2001 Brazos G Regional Water Plan found that on a regional basis, there are sufficient water supplies to meet the projected demands. In ~~year~~the year 2050, the region was projected to have a surplus of about 500,000 acre-feet per year, yet there were some entities that did not have enough water to meet projected needs. The highest growth areas were identified along the I-35 corridor in the central part of the region, straining existing groundwater supplies. Slower economic growth and implementation of previous long-term planning in the upper Brazos G Area resulted in fewer municipal needs in this part of the region. However, water quality concerns in the upper Brazos River Basin can limit water supplies.

The major recommended strategies in the 2001 plan included four new major reservoirs, reallocation of hydropower storage in Lake Whitney, coordinated operation of reservoir systems for the Brazos River Authority and the City of Abilene, chloride control in the upper Brazos River Basin, and further development of groundwater from the Carrizo-Wilcox aquifer. Since the plan was completed, the California Creek Diversion Project, a recommended strategy in the 2001 plan for the City of Stamford to supplement supplies from Lake Stamford, has been constructed and is operational. Other smaller projects also have been completed or are in the design phase.

The recommended new major reservoirs include:

³³ Susan Roth, 2015, Final Draft Report – FHLM Regional Water Facility Planning Study.

³⁴ Brazos G Regional Planning Group, January 2001, Regional Water Plan.

1. Millican Reservoir (Bundic Dam Site):
2. Little River Reservoir:
3. South Bend Reservoir (long-term strategy):
4. Breckenridge Reservoir (long-term strategy):

1.13.1.2 2006 Brazos G Regional Water Plan³⁵

In the 2006 plan, a comparison of total supplies available in the region with demand for all use categories in the region shows a surplus past the year 2050. These mask shortages that are projected to occur to individual water supply entities and water user groups. Shortages were shown for entities in 32 of the 37 counties in the Brazos G Area. The recommended water strategies included advanced water conservation, wastewater reuse, system operation of Brazos River Authority Reservoirs, conjunctive use, desalination, aquifer storage and recovery, brush management, weather modification, six new on-channel and five new off-channel reservoirs, regional interconnection, Carrizo-Wilcox aquifer development and voluntary redistribution. The total supply from these recommended water supplies is over 590,000 acre-feet per year at an estimated cost of over \$1 billion.

1.13.1.3 2011 Brazos G Regional Water Plan³⁶

In the 2011 plan, a comparison of total supplies available in the region (developed groundwater supplies and firm surface water) with demand for all use categories in the region shows a surplus past the year 2040. These mask shortages that are projected to occur to individual water supply entities and water user groups. Shortages are projected for Williamson County starting at about the year 2020, while overall regional supplies are projected to exceed regional demands until past the year 2040. Even within most counties that have projected overall surpluses, there are individual entities that do not have sufficient supply to meet projected needs. Shortages were shown for entities in 31 of the 37 counties in the Brazos G Area. The recommended water strategies included advanced water conservation, wastewater reuse, system operation of Brazos River Authority Reservoirs, conjunctive use, desalination, aquifer storage and recovery, brush management, weather modification, nine new on-channel and six new off-channel reservoirs, regional interconnection, Carrizo-Wilcox aquifer development, voluntary redistribution, storage reallocation of federal reservoirs and reservoir connections. The total supply from these recommended water supplies is over 587,000 acre-feet per year at an estimated cost of over \$3 billion.

1.13.1.4 2016 Brazos G Regional Water Plan³⁷

Municipal demands are developed assuming a hot, dry year, with 2011 typically selected as the basis for estimating daily per capita use values (GPCD) for each WUG. Conservation is considered first as a water management.

The 2016 Brazos G Regional Water Plan includes recommendations for 99,573 acft/yr of municipal conservation savings and another 46,662 acft/yr for wastewater reuse. The conservation savings are in excess of those already included in the TWDB demand projections. Conservation recommendations for

³⁵ Brazos G Regional Planning Group, January 2006, Regional Water Plan.

³⁶ Brazos G Regional Planning Group, January 2011, Regional Water Plan.

³⁷ Brazos G Regional Planning Group, January 2016, Regional Water Plan.

several entities in Williamson County go beyond this and call for a reduction to a target of 120 GPCD by 2070.

Total new supplies of water into the Brazos G Area total 397,655 acft/yr, comprised of newly developed groundwater, supply transferred from other regions, newly developed surface water supplies, or supplies made available through conservation or augmentation of existing facilities. Total project costs for these new supplies exceed \$2.5 billion.

System operation of the Brazos River Authority's reservoirs can increase supplies in the Brazos G Area by nearly 167,000 acft/yr (assuming interruptible supplies can be firmed up through conjunctive operation with other sources), with additional supplies available to the Region H Area in the lower basin. This strategy would more efficiently utilize the existing resources of the BRA by expanding the supply that can be developed from the BRA's existing reservoirs, thus delaying the need for new reservoirs to meet growing needs in the basin. Related to this, overdrafting of Lake Granger when the reservoir is nearly full and injecting part of this supply into the Trinity Aquifer through an Aquifer Storage and Recovery (ASR) project can yield an additional 9,050 acft/yr of supply when the ASR well field is operated in conjunction with Lake Granger to meet demands.

During the Brazos G regional water planning process, water management strategies such as additional development of Carrizo-Wilcox Aquifer groundwater and the Lake Granger Augmentation Project were preferred options to include in the 2016 Brazos G Regional Water Plan. When confronted by the Modeled Available Groundwater (MAG) limitations of these two options, the BGRWPG had little alternative [at that time](#) but to make the Little River Off-Channel Reservoir a recommended strategy.

[1.13.1.5 2021 Brazos G Regional Water Plan³⁸](#)

[In the 2021 Brazos G Regional Water Plan, it was determined that the annual total water usage in the region was projected to significantly increase from 853,170 acre-feet in 2010 to 1,408,066 acre-feet in 2070, marking a 65 percent rise. Over this period, municipal and steam-electric water usage were expected to increase, while mining, irrigation, and livestock water usage were anticipated to decline as proportions of the total.](#)

[The analysis utilized the drought as the basis for water supply determinations in the region, with hydrologic data extended to consider more recently observed drought conditions in the Brazos River basin. Fifteen aquifers underlying parts of the Brazos G Area were identified, with a combined reliable supply of approximately 500,100 acre-feet per year by the 2070 decade. Along with surface water supplies, the significance of groundwater supplies were highlighted, such as the Seymour Aquifer in the western part of the region, alongside the Dockum and Edwards-Trinity aquifers. In the eastern part, the Carrizo-Wilcox aquifer was identified as a prolific water supply, supplemented by lesser amounts from the Queen City, Sparta, and Brazos River Alluvium.](#)

[Strategies recommended in the 2021 Brazos G Plan included various approaches such as water conservation, wastewater reuse, construction of new reservoirs, groundwater development, augmentation of existing reservoir supplies, brush control, desalination, aquifer storage and recovery, and regional water supply projects. The total new supplies of water into the Brazos G Area were estimated at 424,436 acre-feet per year, with associated project costs exceeding \\$9 billion.](#)

³⁸ [Brazos G Regional Planning Group, January 2021, Regional Water Plan.](#)

[The plan also provided recommendations for municipal conservation savings and wastewater reuse, totaling 103,439 acre-feet per year and 38,315 acre-feet per year, respectively. Furthermore, guidance on drought management and emergency supply measures was offered to assist water managers in managing their systems. Recommendations were made to the Texas Water Development Board and the Texas Legislature regarding key water policy issues and the direction of water supply management in Texas.](#)

~~1.13.1.5~~1.13.1.6 Water for Texas 2002³⁹

This was the first State Water Plan to be adopted by the TWDB after the passage of SB1 in 1997. It was estimated that by 2050, almost 900 cities statewide (representing 38 percent of the projected population) and other water users will need either to reduce demand (through conservation and/or drought management) or develop additional sources of water beyond those currently available to meet their needs during droughts. The proposed water management strategies had an estimated cost of \$17.9 billion.

~~1.13.1.6~~1.13.1.7 Water for Texas 2007⁴⁰

The state was projected to grow from 21 million people in 2000 to approximately 46 million people in 2060. It was estimated that Texas would need 8.8 million acre-feet of water by 2060 to meet this growth. The 16 Regional Water Planning Groups identified 4,500 water management strategies to provide an additional 9.0 million acre-feet of water. The estimated cost of these strategies was approximately \$30.7 billion. Without this investment there would be a potential \$9.1 billion impact to businesses and workers by 2020 with increased impact of \$98.4 billion by 2060.

~~1.13.1.7~~1.13.1.8 Water for Texas 2012⁴¹

The 16 Regional Water Planning Groups (Planning Groups) identified a total of 2,569 water user groups. Of those groups, 895 (35 percent) in 2020 would have water supply needs if the state were facing drought conditions, increasing to 1,085 (42 percent) in 2060. The Water Planning groups recommended feasible water management strategies to meet most of those needs. Solutions proposed by the Planning Groups include strategies such as the use of currently developed surface water and groundwater sources, conservation, reuse, new interbasin transfers, and development of additional groundwater and surface water resources. 26 new reservoirs were recommended by the Planning Groups to meet identified needs of the water user groups. The Planning Groups estimated total capital costs over the next 50 years to meet needs for additional water supplies at \$53 billion, including \$27 billion to implement strategies for municipal water user groups. Meeting these costs will require a long-term financial commitment from local political subdivisions, regional authorities, and the State of Texas.

~~1.13.1.8~~1.13.1.9 Water for Texas 2017⁴²

The 16 Regional Water Planning Groups (~~Planning Groups~~) identified a total of 4.76 million acre-feet per year of water needs in 2020, increasing to 8.89 million acre-feet/year by 2070. These needs include

³⁹ Texas Water Development Board, January 2002, Texas State Water Plan.

⁴⁰ Texas Water Development Board, January 2007, Texas State Water Plan.

⁴¹ Texas Water Development Board, January 2012, Texas State Water Plan.

⁴² Texas Water Development Board, January 2017, Texas State Water Plan.

511,000 acre-feet/year of municipal needs in 2020 and 3.41 million acre-feet/year in 2070, a 568⁷ percent increase. The 16 regional water planning groups recommended about 5,500 water management strategies. The principal strategies to address those needs include demand management (mostly in the form of conservation) (30 percent of the supply recommended), reuse of wastewater (14 percent), additional groundwater development (10 percent), and surface water strategies (45 percent). Planning groups recommended 26 new major reservoir that would provide about 1.1 million acre-feet per year of new supplies. About 2,500 individual projects are associated with the recommended water management strategies, with an estimated implementation cost of \$63 billion.

1.13.1.10 Water for Texas 2022⁴³

The 16 Regional Water Planning Groups projected an increase in water needs from 3.1 million acre-feet per year in 2020 to 6.9 million acre-feet per year by 2070. These needs consist of 5.2 million acre-feet per year for municipal purposes in 2020, surging to 8.5 million acre-feet per year by 2070, marking a 63 percent rise. The Planning Groups have suggested around 5,800 water management strategies to tackle these demands. The primary strategies proposed include demand management, mainly through conservation (representing 31 percent of the recommended supply), wastewater reuse (15 percent), additional groundwater development (12 percent), aquifer storage and recovery resources (3 percent), seawater desalination (3 percent), and surface water strategies (37 percent). These strategies are tied to approximately 2,400 individual projects. If executed, these strategies could yield an additional 7.7 million acre-feet per year in water supplies to user groups by 2070, with an estimated implementation cost of \$80 billion in 2018 dollars, not adjusting for future inflation.

1.13.2 Bosque County Regional Water Treatment and Distribution Facilities Plan

The 2001 Brazos G Regional Water Plan identified several water users in Bosque County with shortages over the planning period. In an attempt to address this widely known shortage, the Brazos River Authority, Texas Water Development Board, and the Cities of Clifton and Meridian jointly sponsored a study to determine the regional water needs and to evaluate existing and proposed water facilities.

The study evaluated four alternatives to supply water to the different users, including individual treatment and delivery systems to a regional facility that would serve all participants. The study recommended the regional facility, which would include expansion of the City of Clifton's water treatment plant and interconnections to the other participants, including Clifton, Childress WSC, Meridian, Valley Mills and Walnut Springs.

1.13.3 Falls, Hill, Limestone, and McLennan Counties (FHLM) – TWDB Regional Water Facility Planning Study

FHLM WSC, in conjunction with 26 other entities, commissioned this study to evaluate the feasibility of developing a regional water infrastructure plan to serve existing and future populations through 2040 in the study area within Falls, Hill, Limestone, and McLennan Counties. Changes to the Maximum Contaminant Level (MCL) for arsenic published by the United States Environmental Protection Agency

⁴³ Texas Water Development Board, January 2022, Texas State Water Plan.

(USEPA) in 2001 caused a number of water systems to be non-compliant ~~uedue~~ to naturally-occurring and elevated arsenic levels in local groundwater supplies. Additionally, regional declines in the Trinity Aquifer also created supply concerns beyond that of just the arsenic concentrations.

The study evaluated different alternatives for meeting the projects goals including blending of water with elevated arsenic concentrations, individual treatment systems violating the arsenic MCL, a new regional surface water treatment plant, and Carrizo-Aquifer development. The study recommended that the Carrizo-Wilcox Aquifer development project be implemented since it diversifies the water supply portfolio in a cost-effective manner for the member utilities while also securing long term water supplies. The study noted that individual treatment by affected utilities would provide the shortest development time period, and if a negotiated Agreed Order with the USEPA couldn't not be obtained for implementing the recommended Carrizo-Wilcox Regional Groundwater Project, individual treatment or blending should be pursued to satisfy USEPA requirements related to the arsenic MCL.

1.13.4 Regional Water Supply and Wastewater Service Study for Johnson and Parker Counties, Phase I

The Brazos River Authority and Tarrant Regional Water District (TRWD) jointly commissioned a study to investigate the feasibility of developing regional water supply and wastewater treatment facilities to serve the unmet needs of the two counties. The first phase of ~~anthe~~ anticipated two-phase study was completed in April 2004. The primary objective of the first phase was to identify and evaluate raw water supply and water and wastewater treatment concepts of mutual interest to the Authority, TRWD and their primary wholesale customers. Subject to the Phase I identification of concepts deemed worthy of additional study, a Phase II study may further study those options that show promise from an engineering, economic, water quality and institutional standpoint.

Phase I of the study identified several water supply scenarios to serve water user groups with projected shortages in each county. ~~—~~The study focused on concepts that would blend the higher TDS water from the Brazos Basin with lower TDS water from the Trinity River Basin to reduce the need to desalinate the Brazos Basin water. ~~—~~The study concluded that a regional water treatment plant in northwest Johnson County treating a blend of BRA and TRWD water could economically serve a large area of northwest Johnson, southwest ~~Tarrant~~Tarrant, and southeast Parker counties, including the new growth in Fort Worth's extraterritorial jurisdiction. A second option involved a plant in northeast Johnson County which could supply a large area with unmet needs including the rapidly growing areas around Mansfield and Burleson. Phase II of the study is intended to provide more detailed information required by stakeholders to allow them to further evaluate these concepts in relation to their own interests and potential participation in a regional system. Phase II has not been initiated to date.

~~A more recent planning study of the area has been performed by the Upper Trinity Groundwater Conservation District~~The Upper Trinity Groundwater Conservation District has performed a more recent planning study of the area. This study evaluated projected growth in population and water demands, and identified potential water management strategies.

1.13.5 West Central Brazos River Basin Regional Water Treatment and Distribution Facility Study

The Brazos River Authority, Texas Water Development Board, and the U.S. Economic Development Administration sponsored a water treatment and distribution study for water users in the upper Brazos River Basin. This study was initiated in response to the significant drought that occurred in the late 1990s and subsequent years, and years and developed a plan to meet demands 25 percent greater than projected needs in order to account for the future uncertainties of droughts.

The West Central Brazos River Basin Regional Water Treatment and Distribution Facility Plan evaluated the water needs in an 18-county area, assessed the economic impacts of water shortages, and identified a plan to develop and efficiently utilize the water resources in the area. Specific concerns identified in the study included water quality of surface water sources, limited groundwater sources, and limited existing infrastructure to move water from areas with supply to areas with needs.

Recognizing the vulnerability of small surface lakes and the uncertainty of groundwater, this study focused on interconnecting existing supply sources and developing new supplies to provide a safe level of supply to water users and increase the reliability of existing sources to promote economic growth in the region. Collectively, over 25 potential water management strategies were evaluated to meet specific needs in the region. In addition, three general strategies (brush control, weather modification and saltwater control) were reviewed as potential means to improve water quality and quantity in the region.

The study conducted numerous hydraulic analyses to evaluate the possibility of moving water through existing and improved infrastructure, including the West Central Brazos Distribution System in Stephens County (formerly the Kerr-McKee pipeline). Two scenarios demonstrated the greatest potential impact to the region:

1. Interconnection between Abilene and North Central Texas MWA.
2. Interconnections among Shackelford WSC, Stephens County Rural WSC and the City of Throckmorton using the West Central Brazos Distribution System.

Other major strategies recommended in this study include:

- Regional water treatment plant to treat water from Possum Kingdom Lake.
- Connection from Lake Stamford to Throckmorton.
- Turkey Peak Reservoir in Palo Pinto County.
- Diverting water from the Clear Fork of the Brazos River to Hubbard Creek Lake and increasing the capacity to transport water to Abilene.

1.14 Summary of Water Loss Audits in Brazos G Area

Retail public water utilities are required to complete and submit a water loss audit form to the Texas Water Development Board. The first water loss audit reports were submitted to the TWDB by March 31, 2006. Entities with greater than 3,300 connections are required to submit their water loss audit to TWDB on an annual basis. In addition, all other retail public suppliers are required to submit a water loss audit once every five years with the next scheduled audit due May 1, 2024. [Recently passed legislation State law](#) requires that water loss audits be completed by a person trained to conduct water loss auditing. The TWDB offers in-person training across the State and also offers the training through an online Water Loss

Auditor Training Video. The water audit reporting requirements follow the International Water Association (IWA) and American Water Works Association (AWWA) Water Loss Control Committee methodology.

The primary purposes of a water loss audit are to account for all of the water being used and to identify potential areas where water can be saved. Water losses are classified as either apparent loss or real loss. Apparent loss is the water that has been used but has not been tracked. It includes losses associated with inaccurate meters, billing adjustment and waivers, and unauthorized consumption. Real loss is the actual water loss of water from the system, and includes main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility.

In the Brazos G Area in ~~2017~~2022, ~~sixty~~-109 public water suppliers submitted a water loss audit to TWDB. Table 1.14 summarizes the water loss audit information that was collected by the TWDB for the ~~2017-2022~~ calendar year. The average total water loss was nearly ~~24~~19%, which is higher than the 2017 statewide average of 14.56%. The region encourages the reduction in water loss where feasible.

Table 1.14 Summary of Water Loss Audits in the Brazos G Area

Statistic	Real Loss for WUGs with Less than 32 Connections per Mile (gal/mi/day)	Real Loss for WUGs with 32 or More Connections per Mile (gal/connection/day)	Apparent Daily Loss (gal/connection/day) Apparent Daily Loss	Total Water Use (GPCD)	Water Loss (GPCD)	Total Water Loss (%)
Median	570.30	34.80	5.61	106.00	18.00	16.98
Average	724.13	57.55	7.33	113.56	26.92	23.71