Brazos Valley Groundwater Conservation District

Groundwater Management Plan

Adopted May 6, 2004
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Draft

BRAZOS VALLEY GROUNDWATER CONSERVATION DISTRICT

GROUNDWATER MANAGEMENT PLAN

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I. MISSION STATEMENT:

The Brazos Valley Groundwater Conservation District was created by the Texas Legislature to protect and conserve the groundwater resources of Robertson and Brazos counties through local management in concert with Groundwater Management Areas 12 and 14. The District will direct its efforts toward preventing waste, collecting data, promoting water conservation, protecting existing users and preventing irreparable harm to the aquifer. The District's rules and management plan will be based on the best available science, the laws and rules in effect, and the area's beneficial needs.

II. TIME PERIOD FOR THIS PLAN:

This plan becomes effective upon adoption by the BVGCD Board of Directors and subsequent certification by the Texas Water Development Board (TWDB). The management plan is based on a ten-year planning period, however, the plan shall be reviewed annually and may be revised at anytime to insure that it is consistent with the applicable Regional Water Plans, the State Water Plan, and additional science which may be developed. The District's Board of Directors shall re-adopt the management plan, with or without, revisions at least every five years.

III. STATEMENT OF GUIDING PRINCIPLES:

A vast majority ofthe residents of Brazos and Robertson counties rely solely on the local groundwater supplies to meet their drinking water needs and the majority of their agricultural and livestock needs. Therefore, the local groundwater resources are vital to the Brazos Valley's growth, health, economy, and environment. The District

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believes that this valuable resource can be managed in a prudent and cost effective manner through conservation, education, and regulation. The overall management goal will be to ensure a sustainable supply of water from the local groundwater resources while recognizing the need to balance the protection of rights of private landowners with the responsibility of managing the area's groundwater resources for future generations. A basic understanding of the local aquifers and their hydro-geologic properties, as well as the quantification of available water supplies, is the foundation for development of prudent management strategies. The Carrizo-Wilcox aquifer as well as the minor aquifers in the area, must be conserved and preserved for future generations, to the extent allowed by law and made possible through the development of scientific data. This management document is intended as a tool for the District to provide continuity and develop an understanding of local aquifer conditions and subsequently implement proper groundwater management policies.

The District has a responsibility to continually monitor aquifer conditions. As conditions warrant, this document may be modified to best serve the district in meeting its goals. At a minimum, the Board will review and re-adopt this plan every five years.

IV. DISTRICT INFORMATION -31 TAC 356.5(a)(5)(A)(B)(C)(D)

A. Creation

The Brazos Valley Groundwater Conservation District was originally created as a temporary District by the 76th Legislature through Senate Bill 1911. The District then operated with all of the powers granted to groundwater conservation districts by Chapter 36 of the Texas Water Code, except the authority to adopt a management plan or levy an

ad-valorem tax. The District was ratified by House Bill 1784 in the 77th Legislative Session in 2001, and was subsequently confirmed by the voters of both Brazos and Robertson counties in a general election held on November 5, 2002 and was granted full authorities afforded groundwater conservation districts by Chapter 36 of the Texas Water Code, limited only by provisions of the District's enabling legislation.

The District was created to implement proper management techniques, at the local level to address local groundwater needs that are vital to the Brazos and Robertson counties. The District will direct its efforts toward preventing waste, collecting data, providing education about water conservation, and preventing irreparable harm to the aquifer. This plan provides a template for the District to follow that will help develop an understanding of local aquifer conditions and subsequently implement proper groundwater management policies.

B. Location and Extent

The District encompasses Brazos and Robertson counties in Central Texas. The boundaries of the District are coterminous with the counties' boundaries. The District is bordered by Falls and Limestone counties to the North; Grimes and Washington counties to the South; Madison, Leon and Grimes counties to the East; and Milam and Burleson Counties to the West. The District comprises an area of approximately 1,456 square miles or 932,000 acres.

C. Background

The District's Board of Directors consists of eight (8) members who are appointed by their respective County Commissioners Courts. Four (4) members represent

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Robertson County and four (4) members represent Brazos County. The Board of Directors are appointed to represent the following interests:

Robertson County

1. One must represent municipal interests in the county.
2. One must be a bona fide agricultural producer who derives a substantial portion of his or her income from agriculture in the county.
3. One must be an employee or director of a rural water supply corporation in the county.
4. One must represent active industrial interests in the county.

Brazos County

1. One must be an employee or director of a rural water supply corporation in the county.
2. One must be a bona fide agricultural producer who derives a substantial portion of his or her income from agriculture in the county.
3. The governing body of the City of Bryan, with the approval of the Brazos County Commissioners Court, shall appoint one Director.
4. The governing body of the City of College Station, with the approval of the Brazos County Commissioners Court, shall appoint one Director.

D. Authority / Regulatory Framework

In the preparation of its management plan, the District followed all procedures and satisfied all requirements of Chapter 36 of the Texas Water Code and Chapter 356 of the Texas Water Development Board's rules contained in Title 30 of the Texas

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Administrative Code. The District exercises the powers that it was granted and authorized to use by and through the special and general laws that govern it, including Chapter 1307, Acts of the 77th Legislature, Regular Session, 2001, and Chapter 36 of the Texas Water Code.

E. Groundwater Resources of the Brazos Valley Groundwater Conservation District

The five significant aquifers within the District's boundaries are the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Brazos River Alluvium. The Simsboro Sand is the most prolific water-yielding unit and is part of the Carrizo-Wilcox aquifer. The Brazos River Alluvium located near the Brazos River is the next most prolific aquifer in the District. The Queen City, Sparta, and Yegua-Jackson aquifers provide small to large pumping rates of useable groundwater to wells, as noted in Groundwater Resources of Brazos and Burleson Counties, Texas, Report 185 (Follett, 1974). A large pumping rate is defined as 200 gallons per minute or more. The vertical sequence of the geologic units in descending order is listed in Figure 1. The Carrizo-Wilcox (Simsboro Sand) and Sparta aquifers provide water for large capacity public supply wells. Water from the Yegua-Jackson aquifer is used for domestic, stock, small irrigation, limited industrial pumping and some minor retail public water supply use. Brazos River Alluvium wells are used mostly for irrigation purposes. The outcrop of the Gulf Coast aquifer occurs in the very southern part of the District and the aquifer provides a small amount of water to wells.

The principle fresh-water aquifers consist of sandy fluvial and deltaic sediments, while marine silts and clays act as aquitards and separate the water-yielding zones. The

Wilcox Group, from the shallowest to the deepest, consists of the Calvert Bluff Formation, Simsboro Sand, and Hooper Formation. No fresh water aquifers are located below the Midway, which is a thick impermeable clay located at the base of the Hooper Formation. The Calvert Bluff Formation is comprised of clay, sandy clay, shale, silt, and sand. The Simsboro Sand is generally composed of sand while the Hooper Formation is made up of sand, silt, clay, and shale. The Simsboro Sand is older in age than the Carrizo, Queen City, Sparta, and Yegua-Jackson formations. The Carrizo Sand and Queen City Sand are separated by the Reklaw Formation, which is a clay zone. The Cook Mountain Formation is composed of mostly clay and separates the Sparta Sand and Yegua-Jackson formations. The Catahoula Sandstone or Catahoula Formation of the Gulf Coast aquifer is composed of clay and sand in cross-bedded lenses. The Brazos River Alluvium can be found in a two to six mile wide zone of floodplain alluvial deposits located along the Brazos River on the western boundary of the District. Sand, small gravel, and clay compose the relatively thin Brazos River Alluvium. Figure 2 illustrates a geologic cross section through Brazos and Robertson Counties and depicts the position, depth, thickness and dip of the aquifers and confining units.

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System	Series	Geologic Unit	Hydrogeologic Unit
Quaternary	Holocene	Flood-plain alluvium	Brazos River alluvium
	Pleistocene	Terrace deposites	
Tertiary	Miocene	Catahoula Sandstone	
	Eocene	Jackson Group Whitsett Formation Manning Formation Wellborn Formation Caddell Formation	
		Yegua Formation	Yegua aquifer
		Cook Mountain Formation	
		Sparta Sand	Sparta aquifer
		Weches Formation	
		Queen City Sand	Queen City aquifer
		Reklaw Formation	
		Carrizo Sand	Carrizo-Wilcox aquifer
		Wilcox Group Calvert Bluff Simsboro Hooper	

Figure 1: Geologic Units

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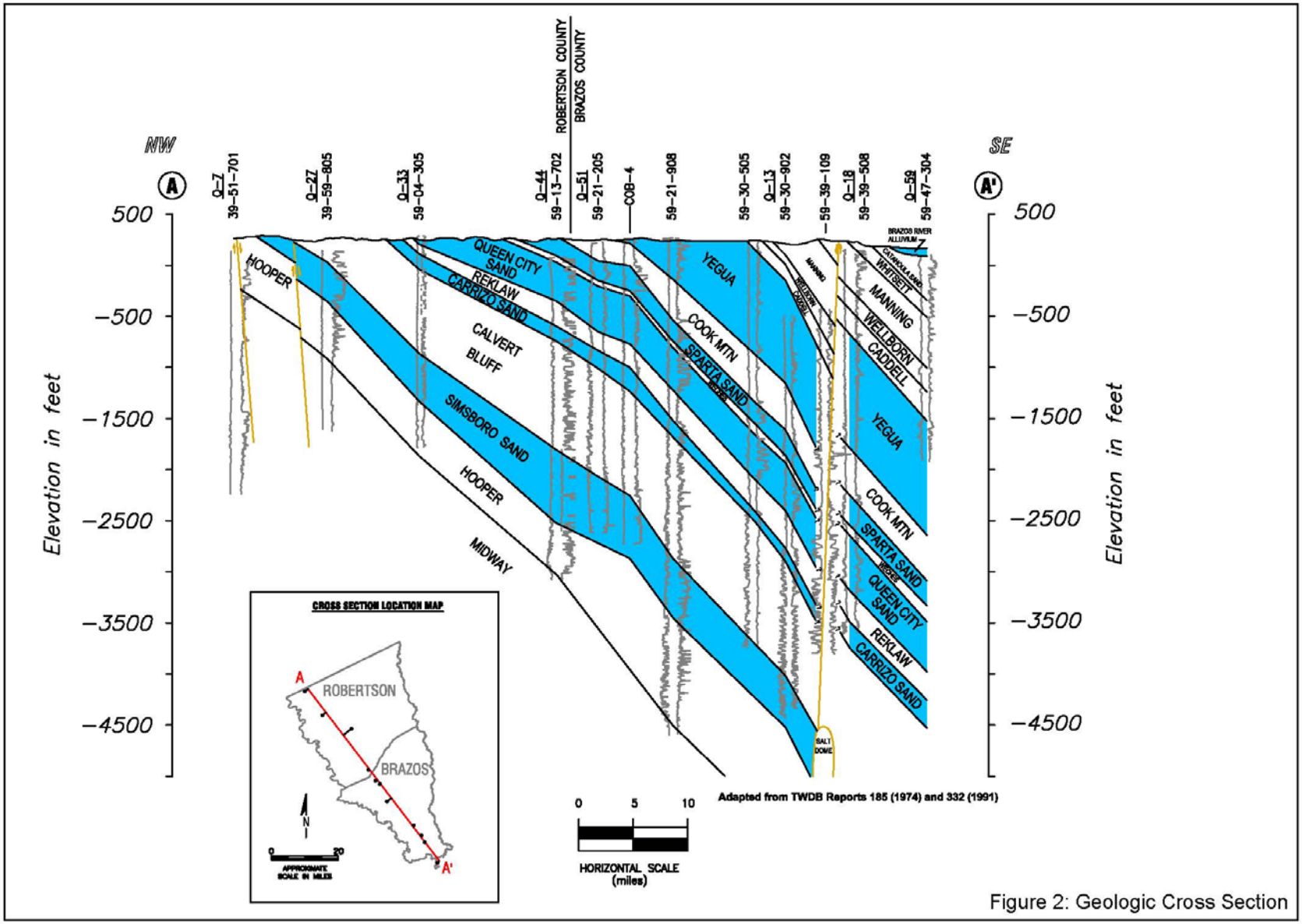
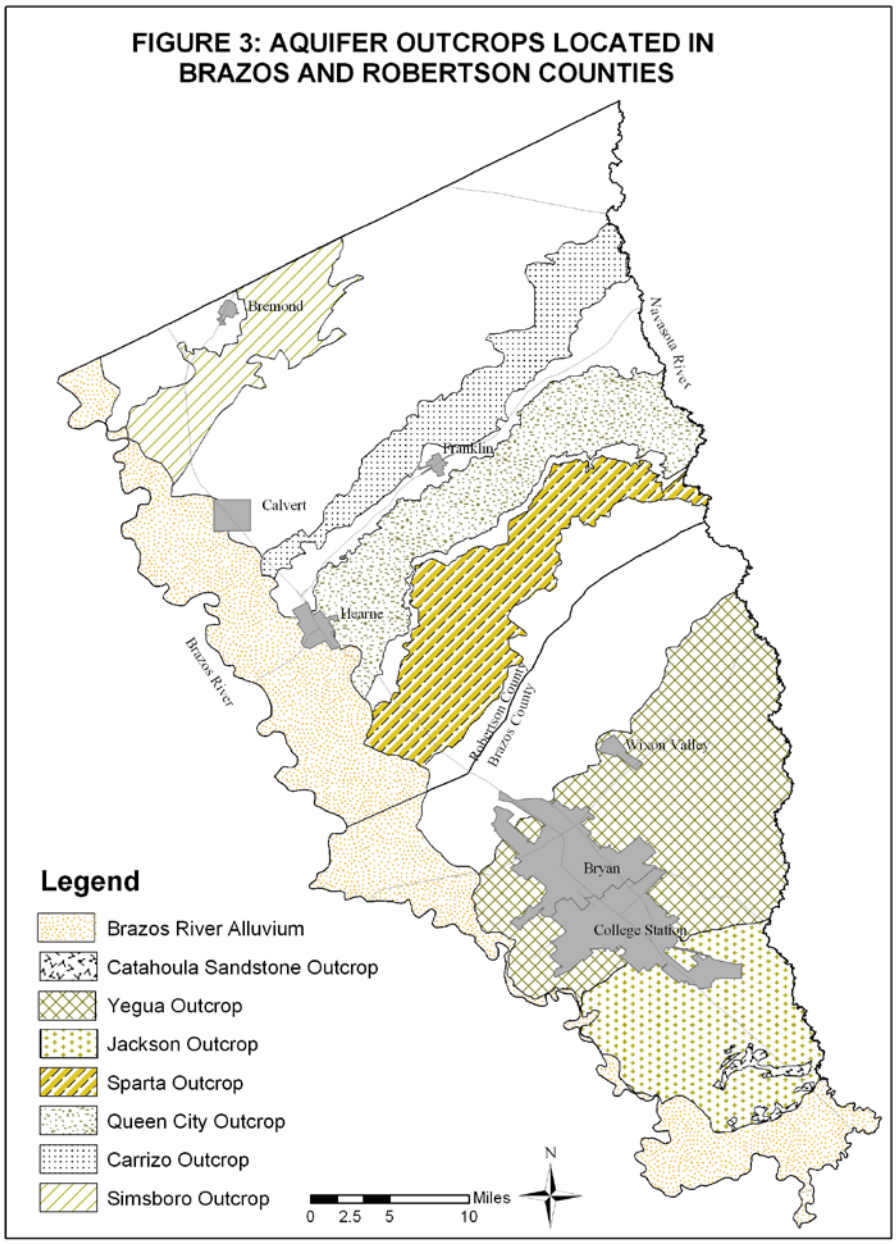


Figure 2: Geologic Cross Section

The Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers outcrop within the District's boundaries in northeast to southwest trending belts that parallel the Gulf coastline. An aquifer outcrop map is included for Brazos and Robertson Counties in Figure 3. The aquifer outcrops extend outside of the two counties shown on the map.



Younger formations outcrop closest to the coast and older formations outcrop progressively further inland with increased age of the formations. The Catahoula Sandstone, which is the basal sand of the Gulf Coast aquifer, occurs in a very limited area in the southern tip of Brazos County.

The general trend of the aquifers, with exception of the Brazos River Alluvium, is to dip underground southeastward towards the Gulf Coast from their surface exposure. The formations dip at a maximum rate of about 110 feet per mile. Each formation underlies younger formations that have a similar dip toward the coast. A salt dome occurs in the southern part of Brazos County. The top of the salt dome has an elevation of about - 4,600 feet relative to sea level. The thickness and position of the Simsboro Sand is influenced by the salt dome, but the dome occurs significantly down dip of the area where the Simsboro Sand contains usable quality groundwater.

Topography and Drainage

Natural topography in Brazos and Robertson counties range from gently hilly terrain in the center of the counties to relatively flat terrain along the Brazos and Navasota River corridors. The southwest border of the counties is the Brazos River and the eastern border is the Navasota River. The land surface elevation above sea level for Brazos and Robertson counties is shown on Figure 4. Altitudes in the District range from about 140 feet to 550 feet above mean sea level, with higher elevations in the center of the counties.

Numerous creeks drain runoff into the Brazos River west of the surface water drainage divide and into the Navasota River to the east of the surface water drainage divide. At the southern most tip of Brazos County, the Navasota River merges with the Brazos River. Drainages include Carters Creek, Cedar Creek, Duck Creek, Mud Creek,

Peach Creek, Pin Oak Creek, Spring Creek, Thompson Creek, Walnut Creek, Wickson Creek, and the Little Brazos River. The Little Brazos River drains Walnut Creek, Mud Creek, Pin Oak Creek, and Spring Creek into the Brazos River.

Carters Creek has a stream gradient of about 10 feet per mile towards the Navasota River from its origin in central Brazos County. Cedar Creek drains from central Robertson County through Brazos County to the Navasota River and has a stream gradient of about 9 feet per mile. Duck Creek has a stream gradient of about 7 feet per mile and drains northeast Robertson County into the Navasota River. Mud Creek drains central Robertson County into the Little Brazos River and has a stream gradient of about 10 feet per mile. Peach Creek has a stream gradient of about 12 feet per mile and drains southern Brazos County into the Navasota River. Pin Oak Creek drains southern Robertson County into the Little Brazos River and has a stream gradient of about 22 feet per mile. Spring Creek has a stream gradient of about 17 feet per mile and drains southern Robertson County into the Little Brazos River. Thompson Creek drains northwest Brazos County into the Brazos River and has a stream gradient of about 11 feet per mile. Walnut Creek has a stream gradient of about 7 feet per mile and drains northwestern Robertson County into the Little Brazos River. Wickson Creek drains central Brazos County into the Navasota River and has a stream gradient of about 8 feet per mile.

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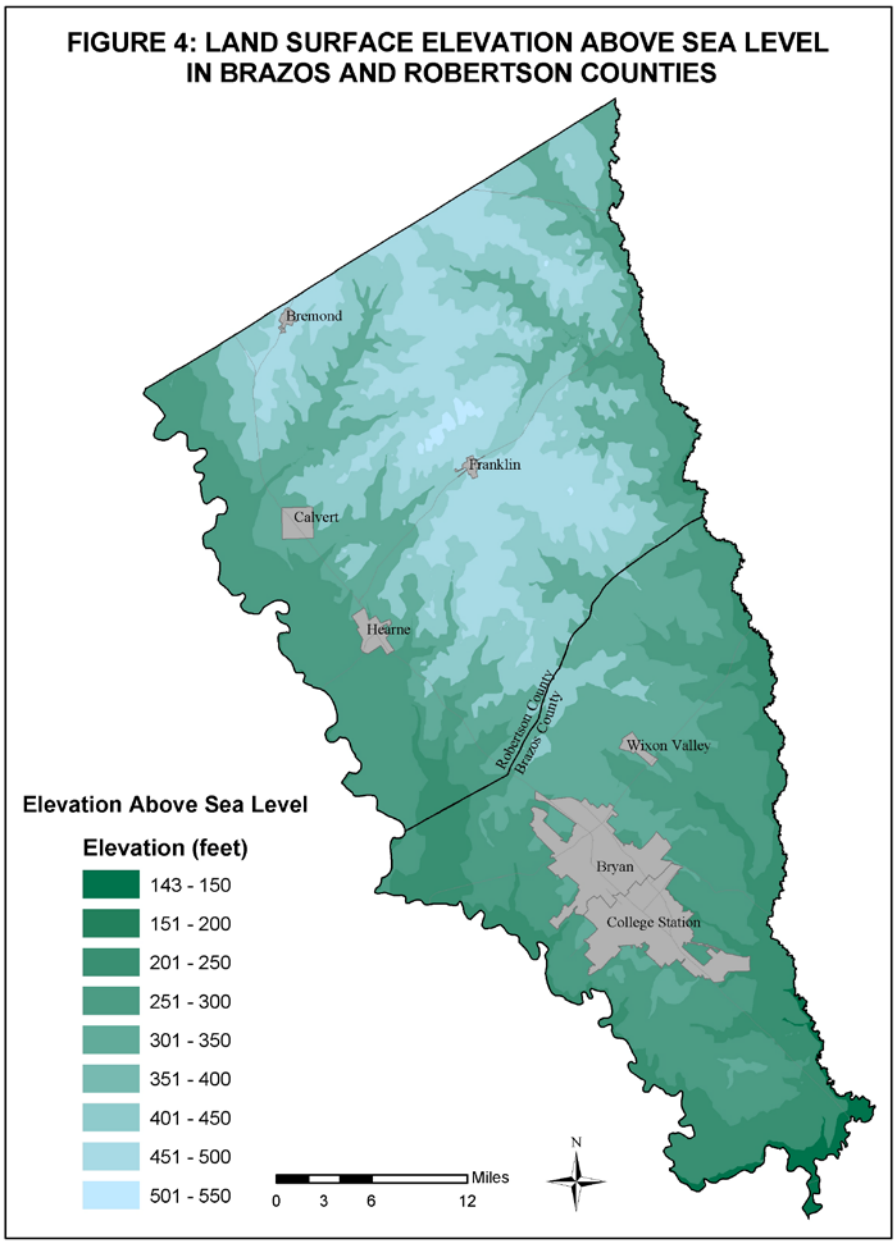
FIGURE 4: LAND SURFACE ELEVATION ABOVE SEA LEVEL
IN BRAZOS AND ROBERTSON COUNTIES
Bremond
Franklin
Calvert
Hearne
Robertson County
Brazos County
Wixon Valley
Bryan
College Station
Elevation Above Sea Level
Elevation (feet)
143 - 150
151 - 200
201 - 250
251 - 300
301 - 350
351 - 400
401 - 450
451 - 500
501 - 550
Miles
0
3
6
12
N

F. Surface Water Resources of Brazos and Robertson Counties

Surface water is currently allocated by the TCEQ for the use and benefit of all people of the state. Anyone seeking a new water right must submit an application to the TCEQ. The TCEQ then determines whether or not the permit will be issued and the permit conditions. The water right grants a certain quantity of water to be diverted and/or stored, a priority date, and other conditions, which may include a maximum diversion rate and instream flow restrictions to protect existing water rights and environmental concerns.

The Brazos River Authority (BRA) is the largest water right holder within the District, holding most of the rights to the water within the Brazos River Basin, including the water in Lake Limestone in Northeast Robertson County. There are several smaller water rights within the District consisting primarily of small irrigation rights along the rivers and one right for water for public supply. The BRA contracts raw water to various entities for long and short-term supplies for municipal, industrial, and irrigation uses.

Surface water supplies within the District's boundaries are limited and include the Brazos River, comprising the Western boundary of the District and the Navasota River along the Eastern boundary of the District. The majority of the water in these two rivers is permitted to the Brazos River Authority (BRA) and is available only through contract with the BRA. Currently, only a small portion of the water flowing in these rivers is available to new users.

Wellborn Special Utility District (Wellborn) is currently the only retail water supply within the District that is utilizing surface water in addition to some groundwater.

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G. Estimate of Total Managed Available Groundwater in the District

The District currently does not have a managed available groundwater amount based on the desired future condition of the aquifers, as required by 31 Tex. Admin. Code §356.5(a)(5)(A) and Tex. Water Code §36.1071(e)(3)(A), as GMA 12 has not officially submitted its desired future conditions to the TWDB yet. The District will amend its management plan when it receives a managed available groundwater amount from the Texas Water Development Board.

There are two major aquifers within the District, based on Texas Water Development Board (TWDB) data, which include the Carrizo-Wilcox and the Gulf Coast aquifers. There also are four minor aquifers that include the Brazos River Alluvium, Queen City, Sparta and Yegua-Jackson. The Carrizo-Wilcox aquifer exists in the subsurface over a large part of the District and the Gulf Coast aquifer occurs at shallow depths only over the very southern end of the District. In that area, the Catahoula Sandstone of the Gulf Coast aquifer outcrops and is in the subsurface and is a minor source of water.

Table 1 below shows the current estimated amounts of usable water available from the aquifers in the District. The amount shown for each county is an estimate only per the current State Water Plan. The groundwater resources are managed on a District wide basis and not on individual county availability. This data was developed as part of the GMA 12 process for developing the desired future conditions of the aquifers and the Region G proposed 2011 regional water plan.

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2009 Groundwater Availability Estimates for BVGCD

Aquifer	BVGCD Amount, ac-ft/yr	Brazos County Amount, ac-ft/yr	Robertson County Amount, ac-ft/yr
Brazos River Alluvium	N/A	N/A	N/A
Carrizo-Wilcox	103,400	57,200	46,200
Queen City	1,100	650	450
Sparta	9000	7800	1200
Yegua-Jackson	6,100	6,100	0
Gulf Coast	1,200	1,200	0

Brazos River Alluvium

The Brazos River alluvium has provided water for decades, principally to irrigation wells located in the flood plain of the Brazos River. Groundwater pumping from the Brazos River alluvium in Robertson County has ranged from about 6,300 ac-ft/yr in 1993 to about 18,000 ac-ft/yr in 1996, a year with significantly below normal precipitation. Pumpage from the Brazos River alluvium in Robertson County over the past approximately 20 years, based on data available from the TWDB has averaged about 13,000 ac-ft/yr. Static water-level decline in wells screening the Brazos River alluvium have been small during that time period. Groundwater availability amounts are not currently applicable to the Brazos River Alluvium. Regulation and permitting of the Brazos River Alluvium is not based on groundwater availability, but is based on the criteria set forth in Chapter 36 of the Texas Water Code, including §36.113, and the related District Rules.

Carrizo-Wilcox Aquifer

The estimate of the combined quantity of water available from the Carrizo-Wilcox aquifer is from the Region G planning study of 2009 and represents current work performed for the GMA-12 planning effort of overall availability in Brazos and

Robertson counties. The Simsboro Sand of the Wilcox aquifer provides the vast majority of water available from the Wilcox aquifer. In Brazos County, the Carrizo aquifer is utilized to a limited degree because somewhat limited productivity and the water increases in mineralization in areas somewhat south of the boundary between Brazos and Robertson counties. Additional data and study are needed to improve the estimate of the amount of ground water available from the Carrizo aquifer. It is estimated that there could be about 5,000 acre-feet per year (ac-ft/yr) of water available from the Carrizo aquifer in Robertson County in the area down dip of the aquifer outcrop shown on Figure 3.

Queen City Aquifer

The Queen City aquifer crops out at land surface in the central part of Robertson County as shown in Figure 3. It is a potential source of water in the areas down dip from outcrop. It is estimated that the quantity of water available from the aquifer is about 645 ac-ft/yr in Brazos County and about 440 ac-ft/yr in Robertson County. The Texas Water Development Board has funded a project to develop a groundwater availability model (GAM) for the Queen City and Sparta aquifers and the model was released and the model report published in October 2004. Queen City aquifer utilization is limited as the productivity of the aquifer is not as high as some other aquifers.

Sparta Aquifer

The amount of usable groundwater from the Sparta aquifer is estimated at about 7,800 ac-ft/yr in Brazos County. For approximately the past 4 years, pumping from the aquifer has averaged about 3,100 ac-ft/yr with groundwater quality remaining good, the yields of wells being sustained, and available drawdown remaining in wells through the years. The estimate of availability of usable quality water for the Sparta aquifer in

Robertson County is about 1,200 ac-ft/yr, based on work performed by the District and the GMA-12 planning. Additional data will be collected to refine the estimate of availability as the District expands its aquifer monitoring program. The Queen City and Sparta aquifer GAM will be another tool used by the District as it continues to evaluate the groundwater availability in the area.

Yegua-Jackson Aquifer

This minor aquifer is an important source of water in Brazos County in the area essentially south and southeast of State Highway 21. The aquifer is utilized mainly by domestic and stock wells and also provides some water for irrigation and industrial use. The estimated amount of usable groundwater available from the Yegua-Jackson aquifer is approximately 6,100 ac-ft/yr. The estimate of availability will be revised as additional data are collected regarding pumpage and aquifer response to pumpage.

Gulf Coast Aquifer

The Gulf Coast aquifer outcrop occurs in the very south part of Brazos County. The estimate of availability of about 1,200 ac-ft/yr is from the Region G Planning Study of 2009 and from estimates developed previously by the TWDB. The aquifer in the very south part of the District is capable of providing small quantities of water to wells.

In summary, the estimates of the amount of usable groundwater available are based on previous studies, Queen City-Sparta GAM runs, and on the past response of the aquifers to pumpage. as required by 31 Tex. Admin. Code §356.5(a)(5)(A) and Tex. Water Code §36.1071(e)(3)(A)the District will continue to work with the other Districts in the GMA 12 to determine the desired future condition of each aquifer in the District ultimately resulting in the required managed available groundwater.

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H. Annual Volume of Water Discharging to Surface Water

Scope: This includes groundwater discharging from each aquifer within the District to springs and to surface water bodies including lakes, steams and rivers.

Methodology: Using the data from the TWDB Central Queen City and Sparta GAM for the model calibration base simulation from 1980 to 1999, Table 1 summarizes the flow from each aquifer to surface water springs, lakes streams and rivers.

I. Annual Recharge from Precipitation

Scope: This is the recharge from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the District. Additional recharge to aquifers occurs in the areas outside the District.

Methodology: Using data from the TWDB Central Queen City and Sparta GAM for the model calibration base simulation from 1980 to 1999, the annual estimated recharge is given in acre feet per year (ac-ft/yr) in Table 1.

Table 1

Management Plan Requirements	**Aquifer**	**Results** ac-ft/yr
Estimated annual amount of recharge from precipitation in the District	Sparta	10,142
	Queen City	6,169
	Carrizo	9,651
	Wilcox (upper)	10,374
	Wilcox (middle)	6,220
	Wilcox (lower)	693
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams and rivers	Sparta	1,591
	Queen City	6,271
	Carrizo	929
	Wilcox (upper)	5,105
	Wilcox (middle)	6,126
	Wilcox (lower)	641

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J. Annual Flow Into/Out and Between Aquifers

Scope: Flow into and out of the District is described as lateral flow within the aquifers between the District and adjacent counties. Flow between aquifers describes the vertical flow, or leakage, between aquifers. Flow into the District from each aquifer also is provided in the table.

Methodology: Summaries of water budgets derived from the Flow Components of the model simulation described in I. were extracted from the groundwater budget for the aquifers located within the District and averaged over the duration of the calibrated portion of the model run (1980 to 1999).

Groundwater flow results are provided in Table 2.

Table 2

Management Plan Requirements	**Aquifer**	**Results** ac-ft/yr
Estimated annual amount of flow into the District within each aquifer in the District	Sparta	720
	Queen City	1,930
	Carrizo	2,215
	Wilcox (upper)	2,684
	Wilcox (middle)	21,458
	Wilcox (lower)	5,138
Estimated annual volume of flow out of the District within each aquifer in the District	Sparta	483
	Queen City	831
	Carrizo	4,335
	Wilcox (upper)	2,010
	Wilcox (middle)	5,581
	Wilcox (lower)	2,431
Estimated net annual volume of flow between each aquifer in the District	Wilcox (upper) into Carrizo	55
	Carrizo into Wilcox (upper)	929
	Wilcox (middle) into Wilcox (upper)	315
	Wilcox (lower) into Wilcox (middle)	3,335
	Wilcox (upper) into Wilcox (middle)	5,706
	Wilcox (middle) into Wilcox (lower)	80

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K. Current Annual Water Use

The annual groundwater use within the District is currently estimated at 90,037 acre-feet. This data was developed as part of the Brazos G Regional Planning Study, 2006 and District Records. The estimated usage for each water user group is shown in Table 2 below.

Table 2 – Current Annual Groundwater Use

Water User Group	Use in Acre-feet per year	Source Aquifer
Retail Public Supplies	38,304	Carrizo-Wilcox/Sparta/ Yegua-Jackson
Manufacturing	2,034	Carrizo-Wilcox / Sparta
Steam-Electric	4,712	Carrizo-Wilcox
Mining	7,216	Carrizo-Wilcox
Irrigation	35,231	Carrizo-Wilcox / Brazos Alluvium
Livestock	2,540	Carrizo-Wilcox / Sparta / Yegua-Jackson / Brazos Alluvium

Data developed as part of the Region G 2006 Plan and District Records

L. Projected Water Demand within the District

The Brazos G Regional Water Planning Group (BGRWPG) and local water use data indicate that the total water demands for the District will be 120,082 acre-feet, by the year 2060. This number includes use from all of the available groundwater sources within the District.

Table 3 below shows the current and projected water demands by user group within each county in the District through the year 2060as estimated in the current 2007 State Water Plan. However, the District has concerns that these numbers are low and do not appropriately reflect the actual growth within the district. It is expected that actual demands will be considerably higher than shown. The District will continue to work to

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develop better estimates of current production as well as projected demands and present this data to the Region G Planning Group for inclusion in future state water plans. As indicated in the Regional water plan, these projections take into account population growth, rainfall, and conservation measures to be taken by each user group.

Table 3 – Projected Water Demand

Robertson County **Current and Projected Water Demand (acre-feet/year)**							
Water User Group	**Year**						
	2000	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Manufacturing	65	85	101	117	134	150	163
Steam-Electric	15,000	28,000	30,000	30,000	35,000	40,000	40,000
Mining	91	82	80	79	78	77	76
Irrigation	16,572	16,175	16,019	15,561	15,115	14,682	14,261
Livestock	1,508	1,508	1,508	1,508	1,508	1,508	1,508
Retail Public Water Supplies							
Bremond	160	157	154	151	148	146	146
Calvert	332	327	323	318	313	310	310
Franklin	324	344	373	389	397	396	395
Hearne	1,145	1,124	1,108	1,093	1,077	1,066	1,066
Robertson County WSC	218	258	315	348	370	368	365
Tri-County WSC	75	77	82	83	84	83	83
Wickson Creek SUD	10	20	30	35	39	39	39
County-Other	548	567	594	609	616	613	611
County Total	**36,048**	**48,724**	**50,687**	**50,291**	**54,879**	**59,438**	**59,023**

[1] Estimate from 2007 State Water Plan

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Brazos County Current and Projected Water Demand (acre-feet/year)							
Water User Group	**Year**						
	2000	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Manufacturing	244	316	365	413	462	506	549
Steam-Electric	545	453	361	422	497	588	698
Mining	25	27	28	29	30	31	31
Irrigation	6,918	6,584	6,267	5,964	5,676	5,403	5,142
Livestock	1,032	1,032	1,032	1,032	1,032	1,032	1,032
Retail Public Water Supplies Bryan	10,812	11,957	13,179	14,221	15,022	16,096	16,493
College Station	17,110	20,032	22,997	25,779	27,844	30,432	31,342
Wellborn SUD	858	1,069	1,285	1,482	1,637	1,820	1,886
Wickson Creek SUD	624	1,126	1,451	1,701	1,924	2,206	2,301
County-Other	913	808	695	593	510	422	395
County Total	**30,317**	**34,992**	**39,587**	**43,776**	**46,937**	**50,976**	**52,417**

1 Estimate from 2007 State Water Plan

M. Projected Water Management Strategies to Meet Future Supply Needs

The demand and supply data developed as part of the Region G planning process in 2006 and the GMA-12 planning efforts indicate that the groundwater and surface water supplies should be adequate to meet projected demands. There will be a need for infrastructure improvements to provide water at higher rates as water demands increase. While there seems to be sufficient water resources today to meet the 50-year planning horizon, large scale water development projects, both within the District and in neighboring Districts could alter the available water supplies. Hydro-geological studies indicate that as groundwater production approaches the estimates of water demands being developed as part of the GMA-12 process, some older production wells in the Simsboro aquifer may need to be replaced due to declining water levels and limited available drawdown. As part of its long-range management strategy, the District will review changes in aquifer utilization and well water level changes to help estimate appropriate

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future well construction and if there is a need for a change in the water management strategy.

N. Natural or Artificial Recharge of Groundwater Resources

1. Estimate of Average Recharge to the Groundwater Resources within the District.

The aquifers within the District receive recharge from the infiltration of precipitation and from the infiltration of water from streams that cross the aquifer outcrops. The estimated locations of aquifer outcrops within the District are shown on Figure 3. Recharge to the aquifers within the District can occur outside the District boundaries as an aquifer outcrop extends to the north into an adjoining county or to the east and west of the District.

Estimates of recharge for the Carrizo and Simsboro (Wilcox Upper Unit) aquifers have been in the range of 3 to possible 5 inches per year based on groundwater flow modeling work performed. The Queen City-Sparta aquifer GAM project funded by the Texas Water Development Board (TWDB) also provided estimates of recharge to the Carrizo and the Simsboro aquifers. Based on the areas of the aquifer outcrops within Robertson County and the resulting estimate of recharge to the Simsboro aquifer is about 6,220 acre-feet per year (ac-ft/yr) and to the Carrizo aquifer about 9,651 ac-ft/yr. Additional recharge occurs to the Lower and Upper Units of the Wilcox within the District with those amounts estimated to average about 10,374 and 693 ac-ft/yr, respectively, based on the 1980 to 1999 base simulation with the Queen City-Sparta aquifer GAM. Additional recharge occurs outside the District that contributes to the total recharge to the aquifer system.

The Queen City aquifer is composed of fine-grained sands with interbedded clay. The outcrop area also can contain alternating areas of sands and other areas of lower permeability silt or clay. The 1980 to 1999 base simulation with the Queen City-Sparta GAM estimates the recharge to the Queen City aquifer within the District is about 6,200 ac-ft/yr. The Queen City aquifer crops out at land surface over about 105 square miles in Robertson County.

The Sparta aquifer is composed of quartz sand with a small amount of interbedded clay within the aquifer thickness. Recharge to the aquifer via infiltrated precipitation and stream flow is estimated at about 10,100 ac-ft/yr in the 1980 to 1999 base simulation with the Queen City-Sparta GAM. The estimated outcrop of the aquifer encompasses about 100 square miles within the District.

The Yegua-Jackson aquifer is composed of sandstone, clay, and lignite beds in some areas. The outcrop area is extensive in Brazos County as shown on Figure 3. Estimated recharge to the Yegua-Jackson aquifer is about 6,100 ac-ft/yr, based on work performed by the BVGCD and Region G planning effort. The aquifer or overlying fluviatile terrace deposits crop out at land surface over about 350 square miles in Brazos County.

The outcrop for the Catahoula sandstone of the Gulf Coast aquifer occurs in the very southern part of the District. In part of the outcrop area, either the Navasota River or Brazos River alluvium has covered or washed away. Most likely, some recharge to the Gulf Coast aquifer occurs via leakage from the Brazos River alluvium to the Catahoula sandstone. It is estimated that recharge to the Gulf Coast aquifer is at least as high as the estimate of availability of 1,200 ac-ft/yr.

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The Brazos River alluvium, located in the area of the Brazos River flood plain encompasses about 140 square miles within Brazos and Robertson Counties. Recharge to the Brazos River alluvium is estimated to occur via infiltration of precipitation and stream flow. Recharge to the Brazos River alluvium is estimated to be at least 26,500 ac-ft/yr. Pumping from the alluvium for the past 20 years has not significantly lowered the water levels in wells screening the alluvium, an indication that pumpage is not exceeding the rate that water is being replenished to the aquifer.

2. How Natural or Artificial Recharge of Groundwater Within The District Might Be Increased.

Recharge enhancement may increase the amount of groundwater available from the aquifers within the District. Increasing recharge can be difficult in geologic environments that occur within the District because a large percentage of the potential recharge is rejected due to shallow water levels in the sediments of the aquifer outcrops or to the low permeability of some of the sediments in some of the aquifer outcrops. Recharge might be enhanced by the construction of rainfall runoff retention structures on ephemeral streams. Further study of the surface geology and soil characteristics in the District may result in the identification of areas with porous soils that could provide sites for enhanced recharge or test sites for recharge investigations.

V. MANAGEMENT OF GROUNDWATER SUPPLIES – 31 TAC 356.5(A)(6)

Groundwater conservation districts have statutorily been designated as Texas' preferred method of groundwater management, through the rules developed, adopted, and promulgated by individual groundwater district's, as authorized by Chapter 36 of the Texas Water Code and the individual district's enabling act. Texas Water Code §36.0015.

The Brazos Valley Groundwater Conservation District may manage groundwater supplies, in part, by regulating the spacing and production of wells, in order to minimize the drawdown of the water table or the reduction of artesian pressure, to control subsidence, to prevent interference between wells, to prevent degradation of water quality, or to prevent waste. Texas Water Code § 36.116. The method of groundwater production regulation must be based on the hydrogeological conditions of the aquifers in the District. However, the District may preserve historic use. Texas Water Code §36.116(b).

The Brazos Valley Groundwater Conservation District, as authorized by law, has adopted the following groundwater management strategy:

1 Availability Goal

The District, in concert with the GMA-12 District's adopted an Availability Goal for the aquifers within the District utilizing information from hydrogeological studies of the Region G Water Planning Group, the Groundwater Management Area 12 efforts, the Texas Water Development Board, and the District's hydrologist.

2 Historic Use

The District shall preserve historic use of groundwater produced prior to the effective date of the District's Rules by issuing historic use permits for those wells in operation at the time the Districts Rules were adopted.

3 Pumping Rate Limit

The District will regulate groundwater withdrawal through permitting efforts and by setting a maximum pumping rate limit of 3000gpm / well. Wells producing water from the Simsboro aquifer will be

required to have land legally assigned to the well in an amount to be determined in relationship to the pumping capacity of the well.

4 Beneficial Use

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

5 Well Spacing

The District will require well spacing on new water wells as follows:

a. A new well may not be drilled within 50 feet from the property line of any adjoining landowners:

b. Spacing of new wells completed in the Simsboro formation shall be spaced one foot per one gallon per minute of production capacity from existing wells; and

c. Spacing of new wells completed in other formations (other than the Brazos River Alluvium) shall be spaced two feet per one gallon per minute production capacity from existing wells.

The District will incorporate these management strategies into its Rules and will permit wells accordingly.

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VI. METHODOLOGY TO TRACK DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS 31 TAC 356.5 (a)(6)

An annual report will be developed by the general manager and District staff and provided to the members of the Board of the District. The Annual Report will cover the activities of the District including information on the District's performance regarding achieving the District's management goals and objectives. The annual Report will be delivered to the Board within 60 days following the completion of the District's fiscal year, beginning with the fiscal year that starts on January 1, 2005. A copy of the Annual Report will be kept on file and available for public inspection at the District's offices upon adoption.

VII. ACTIONS, PROCEDURES, PERFORMANCE, AND AVOIDANCE FOR DISTRICT IMPLEMENTATION OF MANAGEMENT PLAN 31 TAC 356.5 (a)(4)

The District will act on the goals and directives established in this management plan. The District will use the objectives and provisions of the management plan as a guideline in its policy implementation and decision-making. In both its daily operations and long term planning efforts, the District will continuously strive to comply with the initiatives and standards created by the management plan for the District.

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

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The District will encourage public cooperation and coordination in the implementation of the management plan for the District. All operations and activities of the District will be performed in a manner that best encourages cooperation with the appropriate state, regional or local water entity. The meetings of the Board of the District will be noticed and conducted in accordance with the Texas Open Meetings Act. The District will also make available for public inspection all official documents, reports, records and minutes of the District pursuant with the Texas Public Information Act.

VIII. MANAGEMENT GOALS AND OBJECTIVES 31 TAC 356.5(A)(1)

Unless indicated otherwise, performance on goals will be measured annually. The plan will be subject to review at least every five years and modification will be made as appropriate Information describing the programs, policies, and actions taken by the District to meet the goals and objectives established by the District will be included in the annual report prepared by the General Manager and presented to the Board of Directors.

A. Management Goals:

1. Implement Strategies Providing For the Most Efficient Use of Groundwater:

1a. Objective – Require all existing and new non-exempt wells constructed within the boundaries of the District to be permitted by the District and operated in accordance with District Rules. In addition, the District will encourage all exempt wells constructed within the District boundaries to be registered with the District.

- **Performance Standard** – The number of exempt and permitted wells registered within the District will be reported annually in the District's Annual Report submitted to the Board of Directors of the District.

1b. Objective – Regulate the production of groundwater by permitting wells within the District's boundaries based on beneficial use and in accordance with District Rules.

- **Performance Standard –** Each year the District will accept and process applications for the permitted use of groundwater in the District, in accordance with the permitting process established by District Rules. The number and type of applications made for the permitted use of groundwater in the District, the number and type of permits issued by the District, and the amount of groundwater permitted, will be included in the Annual Report given to the Board of Directors.
- **Performance Standard –** The actual annual pumpage from each metered well within the District will be reported annually and compared to the amount permitted for that well. This information will be included in the District's Annual Report submitted to the Board of Directors of the District.

1c. Objective – Conduct ongoing monitoring of the aquifers underlying the District and the current groundwater production within the District, and then assess the available groundwater that can be produced from each aquifer within the District after sufficient data are collected and evaluated. Using this data and

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information developed for GMA-12 the District will re-evaluate availability goals as necessary and will permit wells in accordance with the appropriate production goals.

- **Performance Standard –** The District will conduct the appropriate studies to identify the issues and criteria needed to address groundwater management needs within the District's boundaries. Groundwater availability goals will take into consideration the GMA-12 Planning and research of the hydro-geologic and geologic characteristics of the aquifers, which may include, but not necessarily be limited to, the amount of water use, water quality, and water level declines.
- **Performance Standard –** A progress report on the work of the District regarding the groundwater availability will be written periodically, as substantial additional data are developed.

2. <u>Implement Strategies to Control and Prevent Waste of Groundwater</u>:

2.a Objective – Apply a water use fee to the permitted use of groundwater in the District to encourage conservation-oriented use of the groundwater resources to eliminate or reduce waste.

- **Performance Standard –** Each year the District will apply a water use fee to the non-exempt permitted use of groundwater produced within the District pursuant to District rules. The amount of fees generated and the amount of water produced for each type of permitted use will be a part of the Annual Report presented to the District Board of Directors.

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2b. **Objective –** Evaluate District rules annually to determine whether any amendments are necessary to decrease the amount of waste within the District.

- **Performance Standard –** The District will include a discussion of the annual evaluation of the District rules, and the determination of whether any amendments to the rules are necessary to prevent the waste of groundwater in the Annual Report of the District provided to the Board of Directors.

2c. **Objective** – Provide information to the public and the schools within the District on the wise use of water to eliminate and reduce wasteful practices.

- **Performance Standard** – The District will include a page on the Districts web-site devoted to the wise use of water and providing tips to help eliminate and reduce wasteful use of groundwater. The District will provide information to local school Districts including providing book covers to encourage wise use of water.

3. **<u>Implement Strategies to Address Conjunctive Surface Water Management Issues:</u>**

3a. **Objective** – Encourage the use of surface water supplies where available, to meet the needs of specific user groups within the District.

- **Performance Standard** – The District will participate in the Region G - Regional Water Planning process and encourage the development of

surface water supplies where appropriate. This activity will be noted in the Annual Report presented to the District Board of Directors.

4. <u>Implement Strategies to Address natural resource issues which impact the use and availability of groundwater, and which are impacted by the use of groundwater</u>

4a. Objective – Determine if there are any natural spring flows within the District that may be impacted by increased groundwater pumping.

- **Performance Standard -** Monitor water levels in wells near natural spring flows if found for potential impact from groundwater production. Prepare an annual assessment statement and include in annual report to the District Board of Directors.

5. <u>Implement Strategies to Address Drought Conditions:</u>

5a. Objective – Use the Palmer Drought Severity Index (PDSI) map to monitor drought conditions and notify permit holders of severe drought conditions.

- **Performance Standard** –The District will make an assessment of drought conditions in the District and will prepare an annual briefing to the Board of Directors.

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5b. **Objective** – Require all water producers, that are required by the state of Texas to have drought contingency plans, to submit those plans to the District when applying for a permit for well production from the District.

- **Performance Standard** – Review all drought contingency plans submitted as a result of permit requirements whenever a severe drought condition is reached as determined by the PDSI.

5c. **Objective** – Develop a District drought contingency plan.

- **Performance Standard –** Develop the District drought contingency plan. The target goal for developing the plan is April 2010.

6. <u>Implement Strategies to Promote Water Conservation:</u>

6a. **Objective -** Require all water producers requesting a permit for water production within the District to submit a water conservation plan at the time of permit application.

- **Performance Standard** – Review all water conservation plans submitted as a result of permit requirements to ensure compliance with permit conditions.

6b. **Objective** – Develop a system for measurement and evaluation of groundwater supplies.

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- **Performance Standard** – Water level monitoring wells will be identified for each aquifer and will be monitored on an annualor semi-annual basis to track changes in static water levels.

6c. Objective – Assist in obtaining grant funds for the implementation of water conservation methods.

- **Performance Standard** – Work with the appropriate state and federal agencies to facilitate bringing grant funds to various groups within the District boundaries to develop and implement water conservation methods.

7. Implement Strategies to Protect Water Quality:

7a. Objective - Develop baseline water quality data and a system for continued evaluation of groundwater quality.

- **Performance Standard** –. Develop general understanding of water quality within aquifers in the District based on TCEQ and TWDB data. Develop response plan for potential water quality issues.

7b. Objective – Require all water producers that are required by the Texas Commission on Environmental Quality to have well vulnerability studies prior to constructing a well, to provide evidence of the study to the District prior to construction of a well within the District.

- **Performance Standard** – Review all vulnerability studies submitted as a result of permit requirements to help ensure water quality protection.

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7c. **Objective** – Provide information to the public and the schools within the District on the importance of protecting water quality.

- **Performance Standard** – The District will include a page on the Districts web-site devoted to water quality issues and will provide information to water producers on wellhead protection programs.

B. <u>Management Goals determined not to be applicable to the Brazos Valley Groundwater Conservation District.</u>

1. Controlling and preventing Subsidence:

The geologic formation of the aquifers within the District precludes significant subsidence from occurring due to groundwater pumping.

2. Rainwater Harvesting:

With average annual precipitation in the District about 39 inches, a goal of rainwater harvesting is not applicable at this time.

3. Recharge Enhancement:

With an average annual precipitation of about 39 inches and with the outcrop area of the Carrizo-Wilcox aquifer limited to the north part of Robertson County, this goal is not applicable at this time.

4. Precipitation Enhancement:

With the high amount of rainfall in the District, precipitation enhancement does not appear needed. Therefore, this goal is not applicable at this time.

5. Brush Control:

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A significant amount of the area of the District is heavily forested with other areas in improved pasture or cultivated land. Brush control as a goal, is not applicable at this time.

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