Coastal Bend
Groundwater Conservation District
Groundwater Management Plan

CBGCD Board Adoption: 10-30-03

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Coastal Bend Groundwater Conservation District

Groundwater Management Plan

November 2014, Amended April 10, 2018

I. District Mission

The Coastal Bend Groundwater Conservation District (the District) is committed to manage and protect the groundwater resources of the District. The District is committed to maintaining a sustainable, adequate, reliable, cost effective and high quality source of groundwater to promote the vitality, economy and environment of the District. The District will work with and for the citizens of the District and cooperate with other local, regional and state agencies involved in the study and management of groundwater resources. The District shall take no action without a full consideration of the groundwater needs of the citizens of the District.

II. Purpose of Management Plan

In 1997 the 75th Texas Legislature established a statewide comprehensive regional water planning initiative with the enactment of Senate Bill 1 (SB1). Among the provisions of SB1 were amendments to Chapter 36 of the Texas Water Code requiring groundwater conservation districts to develop a groundwater management plan that shall be submitted to the Texas Water Development Board for certification as administratively complete. The groundwater management plan is specified to contain estimates on the availability of groundwater in the District, details of how the District would manage groundwater and management goals for the District. In 2001 the 77th Texas Legislature further clarified the water planning and management provisions of SB1 with the enactment of Senate Bill 2 (SB2).

In addition, the 79th Texas Legislature enacted HB 1763 in 2005 that requires joint planning among districts that are in the same Groundwater Management Area (GMA). These districts must jointly agree upon and establish the desired future conditions of the aquifers within their respective GMAs. Through this process, the districts will submit the desired future conditions (DFC) to the Executive Administrator of the Texas Water Development Board (TWDB) who, in turn, will provide each district within the GMA with the amount of Modeled Available Groundwater (MAG) within each district. The MAG will be based on the desired future conditions jointly established for each aquifer within the GMA.

The administrative requirements of the Chapter 36 Texas Water Code provisions for groundwater management plan development are specified in 31 Texas Administrative Code Chapter 356 of the Texas Water Development Board Rules. This plan fulfills all requirements for groundwater management plans in SB1, SB2, Chapter 36 Texas Water Code and administrative rules of the Texas Water Development Board.

III. Time Period of Management Plan

This plan shall be in effect for a period of five years from the date of TWDB approval, unless a new or amended management plan is adopted by the District Board of Directors and approved by TWDB. This plan will be reviewed within five years as required by §36.1072(e), Water Code. The District will consider the necessity to amend the plan and re-adopt the plan with or without amendments as required by §36.1072(e), Water Code.

IV. Coastal Bend Groundwater Conservation District

The District was created in 2001 by the 77th Texas Legislature enacting HB 1038. This act is recorded in Chapter 1294 of the Acts of the 77th Texas Legislature. The District was confirmed by local election held in Wharton County on November 6, 2001 with 57.6 percent of the voters in favor of the District.

The District is located in Wharton County, Texas. The District boundaries are the same as the area and extent of Wharton County, Texas with the exception of approximately 800 acres of Colorado County annexed into the District in 2006. The District is bounded by Jackson, Colorado, Austin, Fort Bend, Brazoria and Matagorda Counties. As of the plan date, confirmed groundwater conservation districts (GCDs) exist in Austin, Colorado, Matagorda, Brazoria and Jackson Counties. The GCDs neighboring the District are: Bluebonnet GCD (Austin), Colorado County GCD (Colorado), Brazoria County GCD (Brazoria), Coastal Plains GCD (Matagorda) and Texana GCD (Jackson). The Fort Bend Subsidence District is located in Fort Bend County. Figure.1

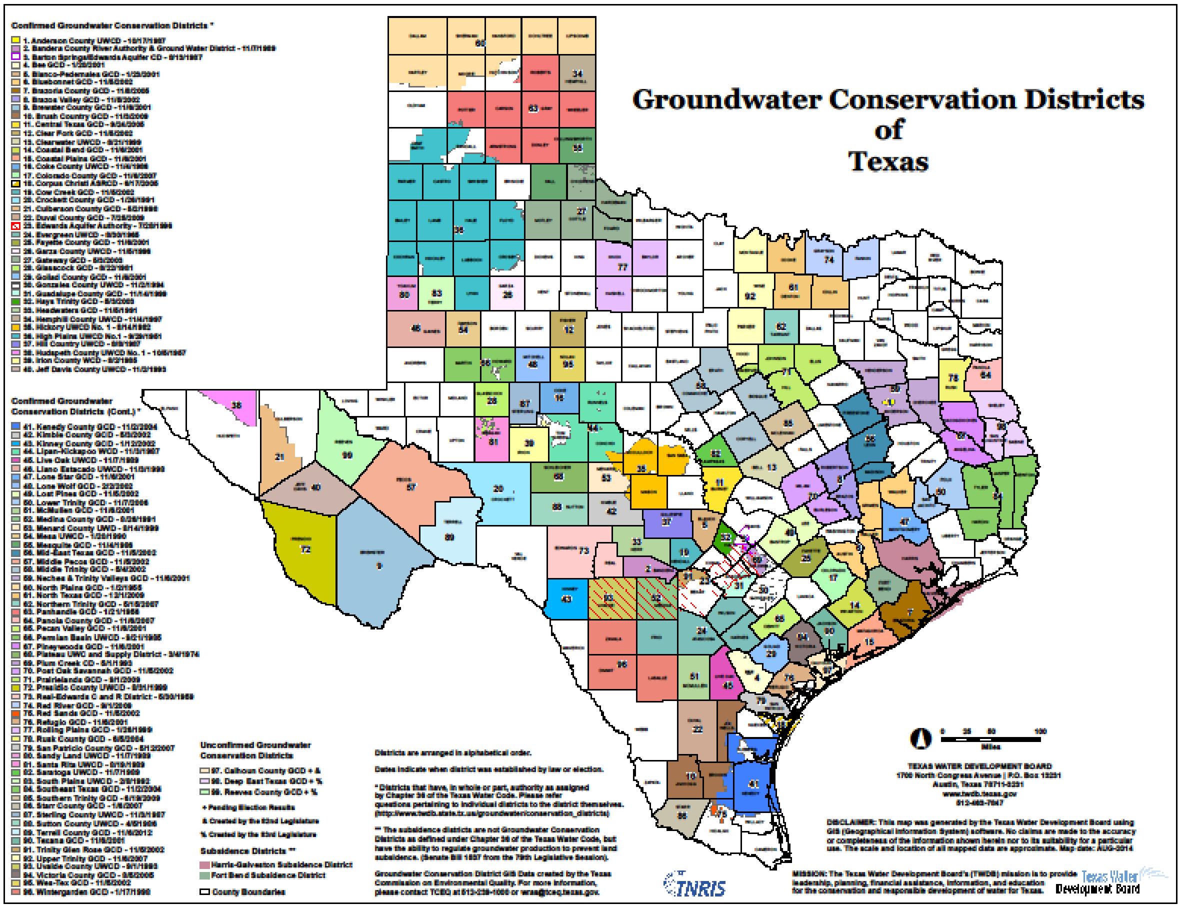

Figure 1. Neighboring Districts to Coastal Bend Groundwater Conservation District

The District is located in Groundwater Management Area (GMA) 15. Chapter 36 Texas Water Code authorizes the District to coordinate its management of groundwater with other GCDs in GMA 15. The other confirmed GCDs that are located in GMA 15 are: Fayette County GCD (Fayette), Pecan Valley GCD (DeWitt), Texana GCD (Jackson), Calhoun County GCD (Calhoun), Coastal Plains GCD (Matagorda), Colorado County GCD (Colorado), Victoria County GCD (Victoria), Evergreen UWCD (Karnes), Goliad County GCD (Goliad), Refugio County GCD (Refugio), Bee GCD (Bee), and Corpus Christi ASR Conservation District.

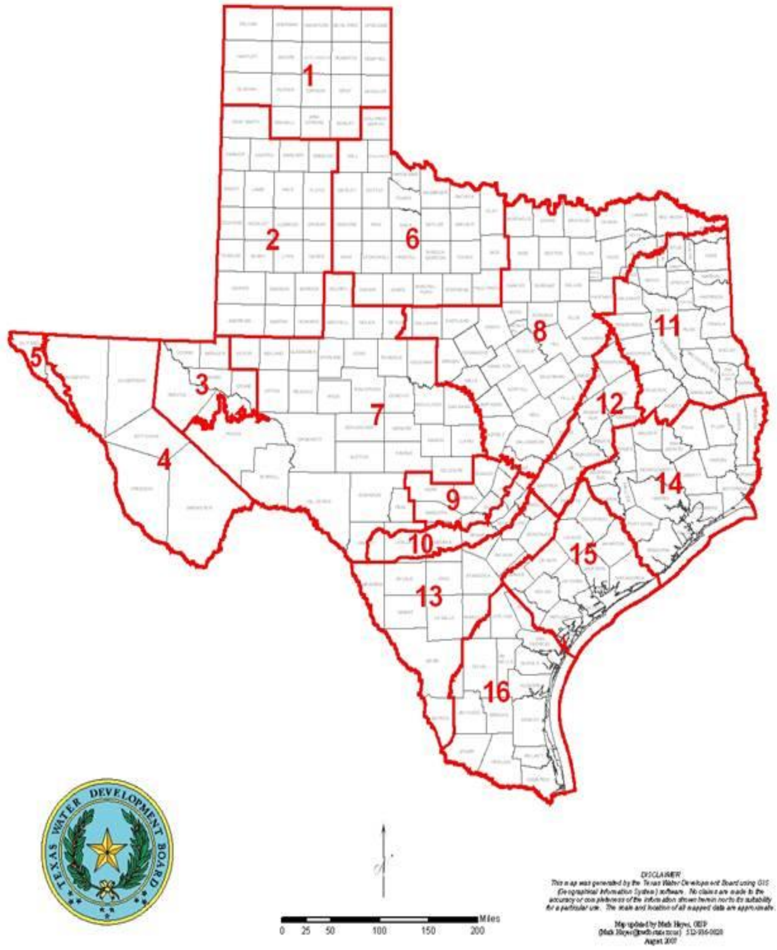

Figure 2. Groundwater Management Areas in Texas

The District Board of Directors is composed of five members elected to staggered four-year terms. Four directors are elected from county precincts and one director is elected at-large. The Board of Directors holds regular meetings at the District offices at 109 E. Milam in Wharton, Texas on the second Tuesday of each month unless otherwise posted. All meetings of the Board of Directors are public meetings noticed and held in accordance with all public meeting requirements. The Board of Directors meetings are announced on the District website www.cbgcd.com along with other items of interest posted by the District.

V. Authority of the District

The District derives its authority to manage groundwater within the District by virtue of the powers granted and authorized in the District's enabling act, HB 1038 of the 77th Texas Legislature. (Appendix A). The District, acting under authority of the enabling legislation, assumes all the rights and responsibilities of a groundwater conservation district specified in Chapter 36 of the Texas Water Code. Upon adoption of the District Rules (Appendix B) by the Board of Directors in a public meeting, the authority to manage the use of groundwater in the District will be governed at all times by the due process specified in the District Rules. (Appendix B).

VI. Geological Formations and Aquifers

All groundwater pumped in Wharton County originates from the Gulf Coast Aquifer System. The Gulf Coast Aquifer is a major aquifer paralleling the Gulf of Mexico coastline from the Louisiana border to the border of Mexico (George and others, 2011). The Gulf Coast Aquifer System is comprised of, from shallowest to deepest, the Chicot Aquifer, the Evangeline Aquifer, the Burkeville Confining Unit, and the Jasper Aquifer, with parts of the Catahoula Formation acting as the Catahoula Confining System.

The most recent studies funded by the TWDB that delineate the structure and stratigraphy of the Gulf Coast Aquifer System are by Young and others (2010, 2012). These studies subdivided the aquifer units into geological formations based on chronostratigraphic correlations. Figure 3 shows the relationships between geological formations and aquifers as defined by Young and others (2010, 2012) and study of the Catahoula Aquifer (LGB Guyton and INTERA, 2013). Figure 4 is a vertical cross-section through the Gulf Coast Aquifer System that crosses through Wharton County.

ERA	Epoch		Est. Age (M.Y)	Geologic Unit	Hydrogeologic Unit
Cenozoic	Pleistocene		0.7	Beaumont	CHICOT AQUIFER
			1.6	Lissie	
	Pliocene		3.8	Willis	
	Miocene	Late	11.2	Upper Goliad	EVANGELINE AQUIFER
			14.5	Lower Goliad	
		Middle	17.8	Upper Lagarto	
				Middle Lagarto	BURKEVILLE
		Early		Lower Lagarto	JASPER AQUIFER
			24.2	Oakville	
	Oligocene		32	Frio	CATAHOULA
			34	Vicksburg	

Figure 3. Geologic and Hydrologic Units of the Gulf Coast Aquifer System in Matagorda County, Modified from (based on Young and others (2010; 2012) and LGB Guyton and INTERA (2012)).

All of the District's registered wells are located in either the Chicot Aquifer or the Evangeline Aquifer. As shown in Figure 4, these two aquifers comprise the majority of the upper 1,500 feet of the Gulf Coast Aquifer System in Wharton. These two aquifers are described below.

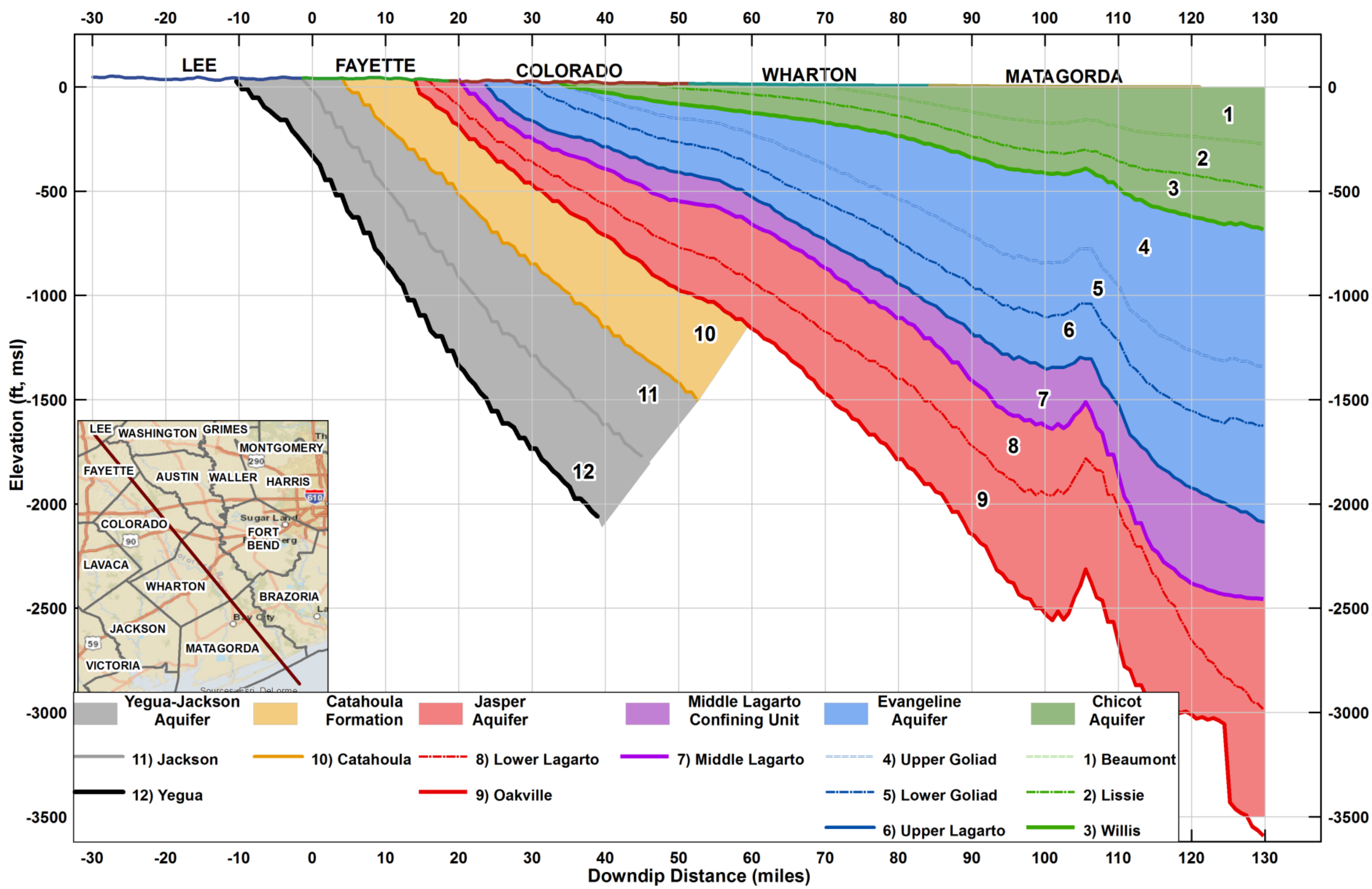

Figure 4. Vertical Cross-Section of the Geological Units through the middle of Wharton County (Steve Young, Intera)

Chicot Aquifer - The Chicot Aquifer includes, from the shallowest to deepest, the Beaumont and Lissie Formations of Pleistocene Epoch and the Pliocene Epoch Willis Formation. The Beaumont outcrop covers a large part of the lower coastal plain except where cut by modern river valleys or covered by Holocene wind-blown sand in south Texas. The Beaumont is often composed of clay-rich sediments transected by sandy fluvial and deltaic-distributary channels. Much of the original depositional morphology of Beaumont fluvial, deltaic, and marginal-marine systems, such as abandoned channels and relict beach ridges, can be seen at the surface in aerial photographs. At outcrop the Lissie is composed of fine-grained sand and sandy clay and unconformably overlies and onlaps the Willis (Morton and others, 1991). The Lissie is dominated by nonmarine depositional systems in the onshore part across most of the Texas Gulf Coast, although some shore-zone facies occur in Matagorda County as well as other coastal counties. At outcrop, the Willis is composed of gravelly coarse sand in several upward-fining successions that are interpreted as incised valley fills overlain by transgressive deposits (Morton and Galloway, 1991). Near the modern shoreline and offshore, Willis deltaic and marine systems record four cyclic depositional episodes bounded by transgressive shales (Galloway and others, 2000). Willis fluvial systems include dip-oriented sand-rich channel-fill facies and sand-poor interchannel areas, which grade toward the coast into shore-parallel deltaic and shore-zone sands and interdeltaic muddy bay deposits. Individual Willis sands vary widely in thickness from about 20 to 200 feet and are separated by muds of similar thickness (Knox and others, 2006).

Evangeline Aquifer - The Evangeline Aquifer includes the upper Goliad Formation of earliest Pliocene Epoch and late Miocene Epoch, the lower Goliad Formation of middle Miocene Epoch, and the upper unit of the Lagarto Formation (a member of the Fleming Group) of middle Miocene Epoch. The Goliad Formation in Matagorda County was formed as part of the Eagle Lake Extrabasinal fluvial system. In this system the Goliad fluvial depositional systems comprise channel-fill and interchannel deposits (Young and others, 2012). Channel belts typically are 10 to 20 miles wide with about 50% sands and the interchannel deposits having less than 20% sand. The Upper Lagarto is comprised of deposits from the Fleming Group. The Fleming Group comprises several large fluvial systems that grade downdip into equally large delta and shore-zone systems (Rainwater, 1964; Doyle, 1979; Spradlin, 1980; DuBar, 1983; Galloway and others, 1982, 1986). In Matagorda, the Fleming sands tend to be align parallel to the shoreline and to have sand contents between 10 and 40% (Young and others, 2012).

Burkeville - The Burkeville Confining Unit is represented by the middle unit of the Lagarto Formation of middle and early Miocene Epoch, which is the chronostratigraphic layer with the most widespread clayey interval between the Evangeline and Jasper Aquifers.

- the Jasper Aquifer includes the lower Lagarto unit of early Miocene Epoch, the early Miocene Oakville sandstone member of the Fleming Group, and the sandy intervals of the Oligocene Epoch Catahoula Formation.

VII. Geography of the District

The District is located within the Gulf Coastal Plains region of Texas. The topography of the District ranges from gently rolling terrain in the northern part of the District to very gently rolling in the south. There are three major drainages in the District; Tres Palacios Creek in the western part, the Colorado River in the central part and the San Bernard River in the eastern part. The principal cross-roads of the District are State Highway 71 and U.S. Highway 59.

The major population centers in the district are the Cities of Wharton and El Campo. Other population centers of the District are Boling-Iago, Danevang, East Bernard, Egypt, Glen Flora, Hungerford, Lane City, Lissie, Louise and Pierce. (Texas Almanac, 2000)

Agriculture is one of the principal economic activities in the District. The District incorporates the leading rice producing region in Texas. However, the production of cotton, corn, grain sorghum, soybeans, turf grass, eggs and beef cattle production are also significant agricultural activities. Other principal economic activities in the District include production of oil and gas, mining of sulfur and gravels, waterfowl and big-game hunting and varied type of manufacturing. (Texas Almanac, 2000)

VIII. Management of Groundwater Supplies

The District will evaluate and monitor groundwater conditions and regulate production consistent with this plan and the District Rules (Appendix B). Production will be regulated as needed to conserve groundwater, and protect groundwater users, in a manner not to unnecessarily and adversely limit production or impact the economic viability of the public, landowners and private groundwater users and achieve the Desired Future Conditions. In consideration of the importance of groundwater to the economy and culture of the District, the District will identify and engage in activities and practices that will permit groundwater production and, as appropriate, protect the aquifer and groundwater in accordance with this Management Plan and the District's rules (Appendix B). A monitoring well network will be maintained to monitor aquifer conditions within the District. The District will make a regular assessment of water supply and groundwater storage conditions and will report those conditions as appropriate in public meetings of the Board or public announcements. The District will undertake investigations, and co-operate with third-party investigations, of the groundwater resources within the District, and the results of the investigations will be made available to the public upon being presented at a meeting of the Board.

The District will amend the current rules to implement this plan to regulate groundwater withdrawals by means of well spacing and production limits as appropriate to implement this Plan. In making a determination to grant a permit or limit groundwater withdrawals, the District will consider the available evidence and, as appropriate and applicable, weigh the public benefit against the individual needs and hardship.

To accomplish the purposes of Texas Water Code Chapter 36, and to achieve the stated purposes and goals of the District, including managing the sustainability of the aquifers and preventing significant, sustained water-level declines within the aquifers, the District shall manage total groundwater production on a long-term basis to achieve the applicable desired future condition. The District may establish production limits on new regular permits or existing permits. All permits are issued subject to any future production limits adopted by the District.

The factors that the District may consider in making a determination to grant a drilling and operating or operating permit or limit groundwater withdrawals will include:

1. The purpose of the rules of the District;
2. The equitable distribution of the resource;
3. The economic hardship resulting from grant or denial of a permit, or the terms prescribed by the permit;
4. This Management Plan and Desired Future Conditions of the District as adopted in Joint Planning under §36.108, Water Code; and
5. The potential effect the permit may have on the aquifer, and groundwater users.

The transport of groundwater out of the District will be regulated by the District according to the Rules of the District (Appendix B).

In pursuit of the District’s mission of protecting the groundwater resources and achieving the Desired Future Conditions, the District may require adjustment of groundwater withdrawals in accordance with the Rules (Appendix B) and Management Plan. To achieve this purpose, the District may, at the Board’s discretion after notice and hearing, amend or revoke any permit for non-compliance, or reduce the production authorized by permit for the purpose of protecting the aquifer and groundwater availability. The determination to seek the amendment of a permit will be based on aquifer conditions observed by the District as stated in the District’s rules. The determination to seek revocation of a permit will be based on compliance and non-compliance with the District's rules and regulations. The District will enforce the terms and conditions of permits and the rules of the District, as necessary, by fine and enjoining the permit holder in a court of competent jurisdiction as provided for in Chapter 36, Water Code.

As allowed under §36.116(b), Water Code, in promulgating rules, the district may preserve historic or existing use to the maximum extent practicable. If production limitations are necessary, historic user permits and regular permits will be required to reduce permits based on aquifer levels. The Board will determine if permit limits are necessary, and will consider:

1. the modeled available groundwater determined by the executive administrator;
2. the executive administrator's estimate of the current and projected amount of groundwater produced under exemptions granted by District Rules (Appendix B) and §36.117, Water Code;
3. the amount of groundwater authorized under permits previously issued by the District;
4. a reasonable estimate of the amount of groundwater that is actually produced under permits issued by the District; and
5. yearly precipitation and production patterns.

Permit limitations will be triggered if average aquifer levels decline below the Desired Future Condition. The first permit limitations will be triggered when aquifer levels drop at least one foot below the Desired Future Condition level; the second permit limitations will be triggered when aquifer levels drop at least two feet below the Desired Future Condition level; the third permit limitations will be triggered when aquifer levels drop at least four feet below the Desired Future Condition level. The percentage reduction will be based on hydrogeologic calculations of that amount of production that must be reduced to restore aquifer levels above the Desired Future Condition level. The exact amount of percentage reduction for each type of permit will be established by rule.

The District will employ reasonable and necessary technical resources at its disposal to evaluate the groundwater resources available within the District and to determine the effectiveness of regulatory or conservation measures. A public or private user may appeal to the Board for discretion in enforcement of the provisions of the water supply deficit contingency plan on grounds of adverse economic hardship or unique local conditions. The exercise of discretion by the Board shall not be construed as limiting the power of the Board.

IX. Desired Future Conditions - (§36.108, Water Code, and 31 TAC 356.5 (a)(5)(A))

Per §36.001, Water Code, "Desired future condition" means a quantitative description, adopted in accordance with §36.108, Water Code, of the desired condition of the groundwater resources in a management area at one or more specified future times. To establish a Desired future condition, the District shall participate in the joint planning process in GMA 15 as defined per §36.108, Water Code, including establishment of Desired Future Conditions (DFCs) for management areas within the District.

Based on the GMA 15 joint planning resolution dated 29 April 2018 (Appendix B, Desired Future Condition Explanatory Report for Groundwater Management Area 15, 2016), the District agreed to adopt the following Desired Future Condition:

> “The Desired Future Condition for the counties in the groundwater management area shall not exceed an average drawdown of 13 feet for the Gulf Coast Aquifer System at December 2069. Desired Future Conditions for each county within the groundwater management area (county-specific DFCs) shall not exceed the values specified in Table A-1 at December 2069.”

Aransas County	0 feet of drawdown of the Gulf Coast Aquifer System
Bee County	7 feet of drawdown of the Gulf Coast Aquifer System
Calhoun County	5 feet of drawdown of the Gulf Coast Aquifer System
Colorado County	17 feet of drawdown of the Chicot and Evangeline Aquifers 23 feet of drawdown of the Jasper Aquifer
Dewitt County	17 feet of drawdown of the Gulf Coast Aquifer System
Fayette County	16 feet of drawdown of the Gulf Coast Aquifer System
Goliad County	10 feet of drawdown of the Gulf Coast Aquifer System
Jackson County	15 feet of drawdown of the Gulf Coast Aquifer System
Karnes County	22 feet of drawdown of the Gulf Coast Aquifer System
Lavaca County	18 feet of drawdown of the Gulf Coast Aquifer System
Matagorda County	11 feet of drawdown of the Chicot and Evangeline Aquifers
Refugio County	5 feet of drawdown of the Gulf Coast Aquifer System
Victoria County	5 feet of drawdown of the Gulf Coast Aquifer System
Wharton County	15 feet of drawdown of the Chicot and Evangeline Aquifers

Figure 5. Table A-1 from Appendix B, Desired Future Condition Explanatory Report for Groundwater Management Area 15, 2016For the purpose of joint planning in GMA 15, the District considers the Burkeville Formation and Jasper Aquifer as non-relevant aquifers. Thus, the District will not have a DFC for the Burkeville and the Jasper Aquifer. For the Chicot and the Evangeline Aquifers, the District will manage groundwater supplies to achieve a DFC of not more than 15 ft of average drawdown in the Chicot and Evangeline Aquifers over the period from January 2000 to December 2069. To manage the Chicot and Evangeline Aquifers so that 15 ft DFC will not be violated, the District will adopt rules to regulate groundwater withdrawals by means of well spacing and production limits as appropriate. If the Board finds it is necessary to reduce the maximum allowable production or the permitted production within the District or for any management zone to accomplish the desired future conditions, preserve and conserve groundwater or protect groundwater users within the District or a management zone, the Board shall establish a schedule for reducing the maximum allowable production or permitted production for the District or a management zone.

X. Modeled Available Groundwater - (§36.1071(e)(3)(A), Water Code and 31 TAC 356.5(a)(5)(A))

Modeled available groundwater is defined in §36.001, Water Code, as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under §36.108, Water Code. Table X.1 provides the MAG values for Wharton County as determined by the GAM Run 16-025 MAG (Goswami, 2017) (Table 1). These MAG values are based on the DFC established by GMA 15 (Appendix B, Desired Future Condition Explanatory Report for Groundwater Management Area 15, 2016).

Table X.1 Modeled Available Groundwater (acre-feet/yr) for the Gulf Coast Aquifer in Wharton County as Determined by GAM Run 16-025 MAG (Goswami, 2017) (Table 1)

Year	Modeled Available Groundwater (MAG) (acre-feet/yr)
2010	181,168
2020	181,168
2030	181,168
2040	181,168
2050	181,168
2069	181,168

The MAGs listed in Table X.1 were developed through the application of Version 1.01 of the groundwater availability model for the central portion of the Gulf Coast Aquifer System (Chowdhury and others, 2004). This model includes four layers represent the Chicot Aquifer (layer 1), the Evangeline Aquifer (layer 2), the Burkeville Unit (layer 3), and the Jasper Aquifer including portions of the Catahoula Unit (layer 4). Wade (2010) provides the description of the methods, assumptions, and results of the groundwater availability model simulations.

The District will consider the MAGs in Table X.1 along with other factors, when issuing permits. Implicit in this consideration is recognition of the TWDB disclaimer associated with MAG report (Goswami, 2017) that:

> "The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results…..
>
> Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time."

XI. Groundwater Monitoring

The District will maintain a monitoring well network that will be used by the District to obtain measured water levels, and will also utilize any data from wells monitored by TWDB. Groundwater monitoring will be designed to monitor changes in groundwater conditions over time. The District encourages well owners to volunteer wells to be used as part of the monitoring network. The District will accept wells into, or replace an existing well in, the monitoring network. The selection process will consider the well proximity to other monitoring wells, to permitted and exempt wells, to streams, and to geographic and political boundaries. If no suitable well locations can be found to meet the monitoring objectives in a specific aquifer or management zone, the District may evaluate the benefits of converting an oil and gas well to a water well, drilling and installing a new well, or using modeled water levels for that area until such time as a suitable well can be obtained for monitoring.

XII. Estimate of the Amount of Groundwater Used in the District on Annual Basis - (§36.1071(e)(3)(B), Water Code, and 31 TAC 356.52 (a)(5)(B))

The estimated historical water use in the district, according to the most recently adopted state water plan, is provided in Appendix C, in the Table titled, "Estimated Historical Water Use: TWDB Historical Water Use Survey (WUS) Data

The Coastal Bend GCD began permitting non-exempt wells in 2005. Since that time, annual water use reports were collected from each permitted user in the District at the end of each calendar year. Exempt uses (*) were calculated based on the initial well registration of a well owner. The actual reported data for groundwater use within the District for years 2005-2018 is shown below in Table XII.2.

Table XII.2 Coastal Bend Groundwater Conservation Total Groundwater Use
Source: CBGCD database – August 2019

Type of Use	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aquaculture	5939	10,068	6,604	9,643	12,460	9,075	8,712	10,174	8,142	11,152	11,192	6,910	8,154	8,948
Com./Ind.	614	631	1,175	1,202	1,736	4,872	2,226	567	2,466	2,861	2,652	3,140	2,697	2,282
1st Crop Rice	77,112	52,568	33,924	47,190	72,716	54,336	79,996	69,012	75,363	72,145	54,336	48,128	44,509	59,375
2nd Crop Rice	24,169	18,683	8,586	11,247	14.034	12,961	16,122	18,185	17,586	18,008	19,702	15,092	14,573	14,797
Corn	2,912	6,130	4,218	13,464	13,603	5,212	14,694	9,773	11,947	7,948	737	1,779	6,845	10,778
Cotton	5,417	1,791	599	3,816	4,690	2,533	7,300	2,783	3,686	6,880	5,183	5,211	5,232	8,207
Municipal	4,139	4,114	3,803	4,157	4,477	3,760	3,338	4,212	4,055	5,632	3,879	4,989	3,907	3,767
Nursery	2,259	2,790	2,965	2,301	3,257	3,387	4,486	4,600	4,116	3,734	3,526	4,149	3,722	3,234
Turfgrass	24,156	23,913	14,678	22,859	21,390	19,044	20,067	12,843	13,992	11,986	8,349	8,468	8,323	8,487
Soybeans	1,737	1,181	293	3,646	3,608	1,506	2,308	762	2,870	2,144	1,908	1,488	2,920	3,699
Milo	199	1,420	66	1,449	992	159	863	611	1,667	321	275	59	278	820
Waterfowl	3,422	4,683	4,807	6,628	5,452	6,346	6,664	8,763	8,620	8,818	6,978	5,845	5,323	5,742
Pasture/Hay/ Livestock	4,861	7,390	2,044	7,599	15,088	4,266	20,169	6,436	6,863	4,418	2,668	1,418	1,022	3,568
Recreational	0	0	227	414	385	453	0	0	199	519	292	385	406	391
*Exempt/Other Use (TWDB est.)	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	3,814	4,024	4,185	4,082	3,908	3,892
Total GW (ac-ft)	**158,869**	**137,305**	**85,932**	**137,624**	**175,920**	**129,942**	**190,759**	**153,313**	**161,981**	**156,806**	**121,443**	**111,143**	**111,819**	**138,047**

On average, agricultural irrigation accounts for approximately 95% of Coastal Bend GCD's total groundwater use. Municipalities use 3-4% with the remainder of use being exempt use.

XIII. Estimate of the Annual Recharge from Precipitation to the Groundwater Resources within the District - (§36.1071(e)(3)(C), Water Code, and 31 TAC 356.52 (a)(5)(C))

The average amount of groundwater recharge from precipitation was estimated using Groundwater budget studies that employed the Central Gulf Coast Aquifer Model (Chowdhury and others, 2004) and the Lower Colorado River Basin Model (Young and others, 2010). The GAM runs were carried out by the Texas Water Development Board and the results were described in the report (GAM Run 13-025, Goswami, 2013) (Appendix F). The LCRB Model Runs were performed by INTERA. The annual recharge estimate represents the average recharge from 1981-1999. The average annual recharge estimates in Table XIII.1 are 20,109 ~100,000 AF/yr based on the Central Gulf Coast Aquifer Model and the Lower Colorado Aquifer Model, respectively. As shown in Table XIII.1, all recharge from precipitation occurs in the Chicot Aquifer. One of the reasons for the large difference between the recharge values is the different numerical construction in the two models. The LCRB model has significantly smaller grid spacing and model layers than the GAM so that it can better represent the shallow flow zone (Toth, 1963, 1966, 1970). The shallow flow zone is the upper portion of a groundwater flow system that is primarily responsible for baseflow into the rivers and streams and has hydraulic head gradients, which control flow directions that largely mimic the topographic gradients. In addition, the LCRB model accounts for the recharge that results from irrigation/flooding of rice fields.

Table XIII.1 Estimate of the Annual Recharge from Precipitation to the Groundwater Resources within the District rounded to nearest 1 acre-foot.

Aquifer	Recharge from Precipitation	
	Central Gulf Coast GAM	Lower Colorado Basin Model
Gulf Coast Aquifer System	20,109	229,593

XIV. Estimate of the Annual Volume of Water That Discharges From the Aquifer to Springs and Any Surface Water Bodies, Including Lakes, Streams, and Rivers - (§36.1071(e)(3)(D), Water Code, and 31 TAC 356.5 (a)(5)(D))

The surface water-groundwater exchanges between various components average over the 1981-1999 time-frame is present in Table XIV.1. The Central Gulf Coast Aquifer Model (Chowdhury and others, 2004) and the Lower Colorado River Basin Model (Young and others, 2010). The GAM runs were carried out by the Texas Water Development Board and the results were described in the report (GAM Run 13-025, Goswami, 2013) (Appendix F). The LCRB Model Runs were performed by INTERA. Negative values indicate discharge out of aquifer. The results indicated that over the 1981-1999 time frame, there is a net loss of water from the Chicot Aquifer to surface water bodies. One of the reasons for the large difference between the water exchange values that the two models have very different numerical grids and construction. The LCRB model has significantly smaller grid spacing and model layers than does the GAM so that it can better represent the shallow flow zone (Toth, 1963, 1966, 1970). The shallow flow zone is the upper portion of a groundwater flow system that is primarily responsible for baseflow into the rivers and streams and has hydraulic head gradients, which control flow directions that largely mimic the topographic gradients.

Table XIV.1. Estimate of the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers rounded to nearest 1 acre-foot.

Aquifer	Net Surface Water-Groundwater Water Exchange (AF/yr)	
	Central Gulf Coast GAM	Lower Colorado Basin Model
Gulf Coast Aquifer System	14,614[1]	65,888

[1]This total includes 146 acre-feet per year spring discharge and 14,468 acre-feet per year leakage to streams.

Note: negative values indicate a net loss of groundwater to surface water

XV. Estimate of Annual Volume of Flow Into and Out of the District Within Each Aquifer and Between Aquifers in the District, If a Groundwater Availability Model is Available - (§36.1071(e)(3)(E), Water Code and 31 TAC 356.52(a)(5)(E))

The lateral movement of water (inflow into and out of the district) across the district boundaries is referred to as horizontal exchanges. Water budget calculations were made by TWDB for each year during the 1980-1999 time frame over the entire Coastal Bend GCD. Vertical exchanges represent the cross-formational flows within the District boundaries among various aquifer formations. Table XV.1 shows water budget calculations based on results from the Central Gulf Coast (GAM Run 13-025, Goswami, 2013) (Appendix F). Table XV.2 shows water budget calculations based on results from the Lower Colorado River Basin Model (INTERA, 2013).

Table XV.1. Estimate of annual volume of flow into and out of District rounded to nearest 1 acre-foot based on results from the Gulf Coast Central GAM

Aquifer	Lateral Flow Into the District (acre-ft/yr)	Lateral Flow Out of the District (acre-ft/yr)	Flow Between Aquifer and Overlying Geologic Unit [1] (acre-ft/yr)
Gulf Coast Aquifer System	55,548	25,453	NA

Note: NA – not applicable

[1] positive values indicate flow into the aquifer; negative numbers indicate flow out of the aquifer

Table XV.2. Estimate of annual volume of flow between each aquifer in the District rounded to nearest 1 acre-foot based on results from the Lower Colorado River Basin Model

Aquifer	Flow Into the District (acre-ft/yr)	Flow Out of the District t(acre-ft/yr)	Flow Between Aquifer and Overlying Geologic Unit [1] (acre-ft/yr)
Gulf Coast Aquifer System	63,190	43,450	NA

Note: NA – not applicable

[1] positive values indicate flow into the aquifer; negative numbers indicate flow out of the aquifer

XVI. Projected Surface Water Supply in the District, According to the Most Recently Adopted State Water Plan - (§36.1071(e)(3)(F), Water Code, and 31 TAC 356.52(a)(5)(F))

The projected surface water supply in the district, according to the most recently adopted state water plan, is provided in Appendix C, in the Table titled, "Projected Surface Water Supplies- TWDB 2017 State Water Plan."

XVII. Projected Total Demand For Water in the District According to the Most Recent Adopted State Water Plan - (§36.1071(e)(3)(G), Water Code, and 31 TAC 356.52(a)(5)(G))

The projected total demand for water in the district, according to the most recently adopted state water plan, is provided in Appendix C, in the Table titled, "Projected Water Demands: TWDB 2017 State Water Plan Data."

XVIII. Water Supply Needs and Water Management Strategies Included in the Adopted State Water Plan - (§36.107(e)(4), Water Code, and 31 TAC 356.5(a)(7))

The water supply needs for the district, according to the most recently adopted state water plan, is provided in Appendix C, in the Table titled, "Projected Water Supply Needs: TWDB 2017 State Water Plan Data."

Appendix C shows a listing of the projected water supply needs for Wharton County for each water user group. Only 5 of the water user groups show a negative number which indicates a projected need during a drought. These deficits are related to agricultural irrigation.

The water management strategies for the district, according to the most recently adopted state water plan, is provided in Appendix C, in the Table titled, "Projected Water Management Strategies: TWDB 2017 State Water Plan Date."

A projected water management strategy is a specific project or action to increase water supply or maximize existing supply to meet a specific need. Each water need identified in the previous section is required to have at least one identified water management strategy that will provide the additional water to fully serve the projected needs. The more significant strategies for Wharton County deal with irrigated agriculture through drought management, on-farm conservation, and conveyance improvements.

XIX. Actions, Procedures, Performance and Avoidance Necessary to Effectuate the Plan

The District will implement the provisions of this management plan and will utilize the objectives of the plan as a guide for District actions, operations and decision-making. The District will ensure that its planning efforts, activities and operations are consistent with the provisions of this plan.

The District will amend the current rules to implement this plan in accordance with Chapter 36 of the Texas Water Code and all rules will be followed and enforced. The development of rules will be based on the best scientific information and technical evidence available to the District.

https://cbgcd.com/rulesmanagement-plan/

The District will encourage cooperation and coordination in the implementation of this plan. All operations and activities will be performed in a manner that encourages the cooperation of the citizens of the District and with the appropriate water management entities at the state, regional and local level.

XX. Methodology for Tracking the District's Progress in Achieving Management Goals

The general manager of the District will prepare and submit an annual report (Annual Report) to the District Board of Directors. The Annual Report will include an update on the District's performance in achieving the management goals contained in this plan. The general manager will present the Annual Report to the Board of Directors Within ninety (90) days following the completion of the District's Fiscal Year, beginning in the fiscal year starting on October 1, 2020. A copy of the annual audit of District financial records will be included in the Annual Report. The District will maintain a copy of the Annual Report on file for public inspection at the District offices, upon adoption by the Board of Directors.

XXI. Management Goals

1) Providing for the Most Efficient Use of Groundwater in the District.

1.1 Objective – Each year, the District will require 100 percent of new exempt or permitted wells that are constructed within the boundaries of the District to be registered with the District in accordance with the District Rules (Appendix B).

1.1 Performance Standard – The number of exempt and permitted wells registered by the District for the year will be incorporated into the Annual Report submitted to the Board of Directors of the District.

1.2 Objective – Each year, the District will regulate the production of groundwater by maintaining a system of permitting the use of groundwater within the boundaries of the District in accordance with the District Rules (Appendix B).

1.2 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 (Appendix B). The number and type of applications made for the permitted use of groundwater in the District and, the number and type of permits issued by the District will be included in the Annual Report given to the Board of Directors.

1.3 Objective – The District will conduct an investigation to evaluate the aquifers of the district and the production of groundwater within the district in preparation of establishing a monitor well network within the boundaries of the District.

1.3. Performance Standard – Each year the District will utilize the monitor well network to take samples of water quality and to conduct regular measurements of the changing water-levels in the aquifers of the District. The District will monitor the water levels in at least 10 wells monthly throughout the District. The District will also annually test the water quality in at least one well for each county precinct in Wharton County. A progress report on the work of the District regarding monitoring the water quality and water-levels of aquifers within the District will be included in the Annual Report of the District each year.

2) Controlling and Preventing the Waste of Groundwater in the District.

2.1 Objective – Each year, the District will make an evaluation of the District Rules (Appendix B) to determine whether any amendments are recommended to decrease the amount of waste of groundwater within the District.

2.1 Performance Standard – The District will include a discussion of the annual evaluation of the District Rules (Appendix B) and the determination of whether any amendments to the rules are recommended to prevent the waste of groundwater in the Annual Report of the District provided to the Board of Directors.

2.2 Objective – Each year, the District will provide at least one article annually on the District's website on eliminating and reducing wasteful practices in the use of groundwater.

2.2 Performance Standard – Each year, a copy of the information provided on the District's website regarding groundwater waste reduction will be included in the District's Annual Report to be given to the District Board of Directors.

3) Controlling and Preventing Subsidence.

3.1 Objective – Each year, the District will hold a joint meeting with neighboring Groundwater Conservation Districts focused on sharing information regarding subsidence and the control and prevention of subsidence through the regulation of groundwater use.

3.1 Performance Standard – Each year, a summary of the joint meeting on subsidence issues will be included in the Annual Report submitted to the Board of Directors of the District.

3.2 Objective – Each year, the District will provide one article annually on the District's website to educate the public on the subject of subsidence.

3.2 Performance Standard – The Annual Report submitted to the Board of Directors will include a copy of the article posted on the District's website.

4) Natural Resource Issues That Affect the Use and Availability of Groundwater or are affected by the Use of Groundwater.

4.1 Objective – Each year the District will inquire to the Railroad Commission of Texas asking whether any new salt water or waste disposal injection wells have been permitted by the Railroad Commission of Texas to operate within the District.

4.1 Performance Standard – Each year a copy of the letter to the Railroad Commission of Texas asking for the location of any new salt water or waste disposal wells permitted to operate within the District will be included in the Annual Report submitted to the Board of Directors of the District along with any information received from the Railroad Commission of Texas.

4.2 Objective – Each year the District will request the Railroad Commission of Texas to provide a copy of the results of integrity tests performed on salt water or waste disposal injection wells permitted by the Railroad Commission of Texas to operate within the District.

4.2 Performance Standard – Each year a copy of the letter to the Railroad Commission of Texas requesting the results of the integrity testing performed on salt water or waste disposal injection wells permitted by the Railroad Commission of Texas to operate within the District will be included in the Annual Report submitted to the Board of Directors of the District along with any information received from the Railroad Commission of Texas.

5) Conjunctive Surface Water Management Issues.

5.1 Objective – Each year, the District will participate in the regional planning process by attending 50% of the Region K and Region P Regional Water Planning Group meetings to encourage the development of surface water supplies to meet the needs of water user groups in the District.

5.1 Performance Standard – The percentage of meetings attended by a District representative at the Region K and Region P Regional Water Planning Group meetings will be noted in the Annual Report presented to the District Board of Directors.

6) Addressing Drought Conditions.

6.1 Objective – Each month, the District will download the updated Palmer Drought Severity Index (PDSI) map and other related information from the National Weather Service – Climate Prediction Center website. Additional information is available from TWDB at the following website:

http://waterdatafortexas.org/drought/

6.1 Performance Standard – Quarterly, the District will make an assessment of the status of drought in the District and prepare a quarterly briefing to the Board of Directors. The downloaded PDSI maps and other related information will be included with copies of the quarterly briefing in the District Annual Report to the Board of Directors.

7) Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, or Brush Control, where appropriate and cost-effective.

Conservation
7.1 Objective – The District will annually submit an article regarding water conservation for publication to at least one newspaper of general circulation in the District.

7.1 Performance Standard – A copy of the article submitted by the District for publication to a newspaper of general circulation in the District regarding water conservation will be included in the Annual Report to the Board of Directors.

7.2 Objective – The District will develop or implement a pre-existing educational program for use in public or private schools located in the District to educate students on the importance of water conservation.

7.2 Performance Standard – A summary of the educational program developed or implemented by the District for use in public or private schools located in the District will be included in the Annual Report to the Board of Directors for every year this plan is active.

7.3 Objective – Each year, the District will include an informative flier on water conservation with at least one mail out to groundwater use permit holders distributed in the normal course of business for the District.

7.3 Performance Standard – The District's Annual Report will include a copy of the informative flier distributed to groundwater use permit holders regarding water conservation and the number of fliers distributed.

Recharge Enhancement
7.4 Objective – Each year, the District will provide one article relating to recharge enhancement on the District web site.

7.4 Performance Standard – Each year, the District annual report will include a copy of the information that has been provided on the District web site relating to recharge enhancement.

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

Brush Control

7.5 Objective – Each year, the District will provide one article relating to Brush Control on the District web site.

7.5 Performance Standard – Each year, the District annual report will include a copy of the information that has been provided on the District web site relating to Brush Control.

Rainwater Harvesting

7.6 Objective – Each year, the District will provide one article relating to Rainwater Harvesting on the District web site.

7.6 Performance Standard – Each year, the District annual report will include a copy of the information that has been provided on the District web site relating to Rainwater Harvesting.

8) Addressing Desired Future Conditions (DFCs)

8.1 Management Objective:

At least once every three years, the District will monitor water levels and evaluate whether the change in water levels is in conformance with the DFCs adopted by the District. The District will estimate total annual groundwater production for each aquifer based on the water use reports, estimated exempted use, and other relevant information, and compare these production estimates to the MAGs listed in Table X.1.

8.1 Performance Standard:

1. At least once every three years, the general manager will report to the Board the measured water levels obtained from the monitoring wells within each Management Zone, the average measured drawdown for each Management Zone calculated from the measured water levels of the monitoring wells within the Management Zone, a comparison of the average measured drawdowns for each Management Zone with the DFCs for each Management Zone, and the District's progress in conforming with the DFCs.

2. At least once every three years, the general manager will report to the Board the total permitted production and the estimated total annual production for each aquifer and compare these amounts to the MAGs listed in Figure 5 for each aquifer that is declared by the district to be relevant.

XXII. REFERENCES

Chowdhury, A. Wade, S., Mace, R.E., and Ridgeway, C., 2004, Groundwater Availability of the Central Gulf Coast Aquifer System: Numerical Simulations through 1999: Texas Water Development Board, unpublished report.

Doyle, J.D., 1979, Depositional patterns of Miocene facies, middle Texas Coastal Plain: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 99, 28 p.

DuBar, J.R., 1983, Miocene depositional systems and hydrocarbon resources: the Texas Coastal Plain: The University of Texas at Austin, Bureau of Economic Geology, report prepared for U.S. Geological Survey under contract no. 14-08-0001-G-707, 99 p.

Galloway, W.E., 1982. Depositional architecture of Cenozoic Gulf Coastal Plain fluvial systems: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 82-5, 29 p.

Galloway, W.E., D.G. Bebout, W.L. Fisher, R. Cabrera-Castro, J.E. Lugo-Rivera, and T.M. Scott, 1991, Cenozoic, in A. Salvador, ed., The geology of North America: the Gulf of Mexico basin, v. J: Boulder, Colorado, Geological Society of America, p. 245–324.

Galloway, W.E. P. Ganey-Curry, X. Li, and R.T. Buffler, 2000. "Cenozoic depositional evolution of the Gulf of Mexico Basin," AAPG Bulletin, *v. 84*, p. 1743-1774.

George, P.G., Mace, R E., and Petrossian, R., 2011, Aquifers of Texas, Report 380, Texas Water Development Board, Austin, TX.

Goswami, R.R., 2013. GAM Run 13-025: Coastal Bend Groundwater Conservation District Management Plan, Texas Water Development Board, Austin, TX. (Appendix F).

Hudgins, N., 2011. Letter to Kevin Ward referencing "Desired Future Condition Submittal for GMA 15.," dated July 15, 2010. Prepared by Coastal Bend Groundwater Conservation District.

Knox, P.R., S.C. Young, W.E. Galloway, E.T. Baker Jr., and Trevor Budge, 2006. "A stratigraphic approach to Chicot and Evangeline Aquifer boundaries, Central Texas Gulf Coast, Gulf Coast Association of Geological Societies," Transactions Volume.

LBG Guyton and INTERA. 2012, Catahoula Aquifer Characterization and Modeling Evaluation in Montgomery County: prepared for the Lone Star Groundwater Conservation District, September 2012.

Morton, R.A., and Galloway, W.E., 1991, Depositional, tectonic and eustatic controls on hydrocarbon distribution in divergent margin basins: Cenozoic Gulf of Mexico case history: Marine Geology, v. 102, p 239–263.

Rainwater, E.H., 1964, Regional stratigraphy of the Gulf Coast Miocene: Gulf Coast Association of Geological Societies Transactions, v. 14, p. 81–124.

Spradlin, S.D., 1980, Miocene fluvial systems: southeast Texas: The University of Texas at Austin, Master's thesis, 139 p.

Texas Almanac, 2000. Published by the Dallas Morning News, Dallas, Texas.

Toth, J., 1963, "A theoretical analysis of groundwater flow in small drainage basins": *Journal of Geophysical Research*, Vol. 68, No. 16, p. 475-4812.

Toth, J., 1966, Mapping and interpretation of of field phenomena for groundwater reconnaissance in a prairie environment, Alberta Canada: Bull. International Association of Sciance and Hydrology, 11, no. 2, p. 1-49.

Toth, J., 1970, A conceptual model of groundwater regime and the hydrogeologic environment: Journal of Hydrology, vol. 10, no. 2, p. 164-176.

Wade, S., 2010, GAM Run 10-008 Addendum: Texas Water Development Board. (Appendix D).

Young, S.C., Knox, P.R., Baker, E., Budge, T., Hamlin, S., Galloway, B., Kalbouss, R., and Deeds, N., 2010, Hydrostratigraphic of the Gulf Coast Aquifer from the Brazos River to the Rio Grande: Texas Water Development Board Report, 203 p.

Young, S.C., Ewing, T. Hamlin, S., Baker, E., and Lupton, D., 2012, Updating the Hydrogeologic Framework for the Northern Portion of the Gulf Coast Aquifer, Unnumbered Report: Texas Water Development Board.

Appendix A

Enabling Act

Chapter 8829, Special District Local Laws Code

Appendix B
District Rules

Appendix C
Estimated Historical Water Use
and
2017 State Water Plan Datasets

Appendix D
GAM Run Addendum 10-008

Appendix E
GAM Run 16-025 MAG

Appendix F

GAM Run 13-025