Adopted Desired Future Conditions Explanatory Report

Austin Chalk and Buda Limestone Aquifers

Groundwater Management Area 10

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Abbreviations

DFC	Desired Future Conditions
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
MAG	Modeled Available Groundwater
TWDB	Texas Water Development Board

1. Groundwater Management Area 10

Groundwater Management Areas (GMA) were created by the Texas Legislature to provide for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions. Each GMA is charged with facilitating joint planning efforts in the GMAs within its jurisdiction.

GMA 10 was created to oversee the Edwards (Balcones Fault Zone) and Trinity aquifers. Other aquifers include the Leona Gravel, Buda Limestone, Austin Chalk, and the saline Edwards (Balcones Fault Zone) aquifers. The jurisdiction of GMA 10 includes all or parts of Bexar, Caldwell, Comal, Guadalupe, Hays, Kinney, Medina, Travis, and Uvalde counties (Figure 1). Groundwater Conservation Districts (GCD) in GMA 10 include Barton Springs/Edwards Aquifer Conservation District, Comal Trinity GCD, Edwards Aquifer Authority, Kinney County GCD, Medina County GCD, Plum Creek Conservation District, and Uvalde County Underground Water Conservation District (UWCD).

As mandated in Texas Water Code § 36.108, districts are required to submit DFCs of the groundwater resources in their GMA to the executive administrator of the Texas Water Development Board (TWDB), unless that aquifer is deemed to be non-relevant. According to Texas Water Code § 36.108 (d-3), the district representatives shall produce a DFCs Explanatory Report for the management area and submit to the TWDB a copy of the Explanatory Report.

The Austin Chalk and Buda Limestone aquifers are neither major nor minor aquifers, but have been determined to be locally relevant in Uvalde County for joint planning purposes. The Austin Chalk and Buda Limestone aquifers have been determined to be non-relevant in Medina County for joint planning purposes. This document is the Explanatory Report for the Austin Chalk and Buda Limestone aquifers where they is determined to be relevant within GMA 10.

2. Aquifer Description

For jurisdictional purposes, the Austin Chalk and Buda Limestone aquifers are defined as the Austin Chalk and Buda Limestone aquifers within Uvalde County. The boundaries of the Austin Chalk Aquifer and Buda Limestone Aquifer were determined using the Digital Geologic Atlas of Texas (U.S. Geological Survey and Texas Water Development Board, 2006), the Uvalde County boundary, and the GMA 10 boundary. The Buda Limestone Aquifer in Uvalde County is located entirely within the Regional Water Planning Area L, the Nueces River Basin, and the Uvalde County Underground Water Conservation District. The geographic extents of the Austin Chalk and Buda Limestone aquifers are presented in Figures 2 (Thorkildsen and Backhouse, 2011a) and 3 (Thorkildsen and Backhouse, 2011b), respectively. As illustrated, the jurisdiction is limited to Uvalde County.

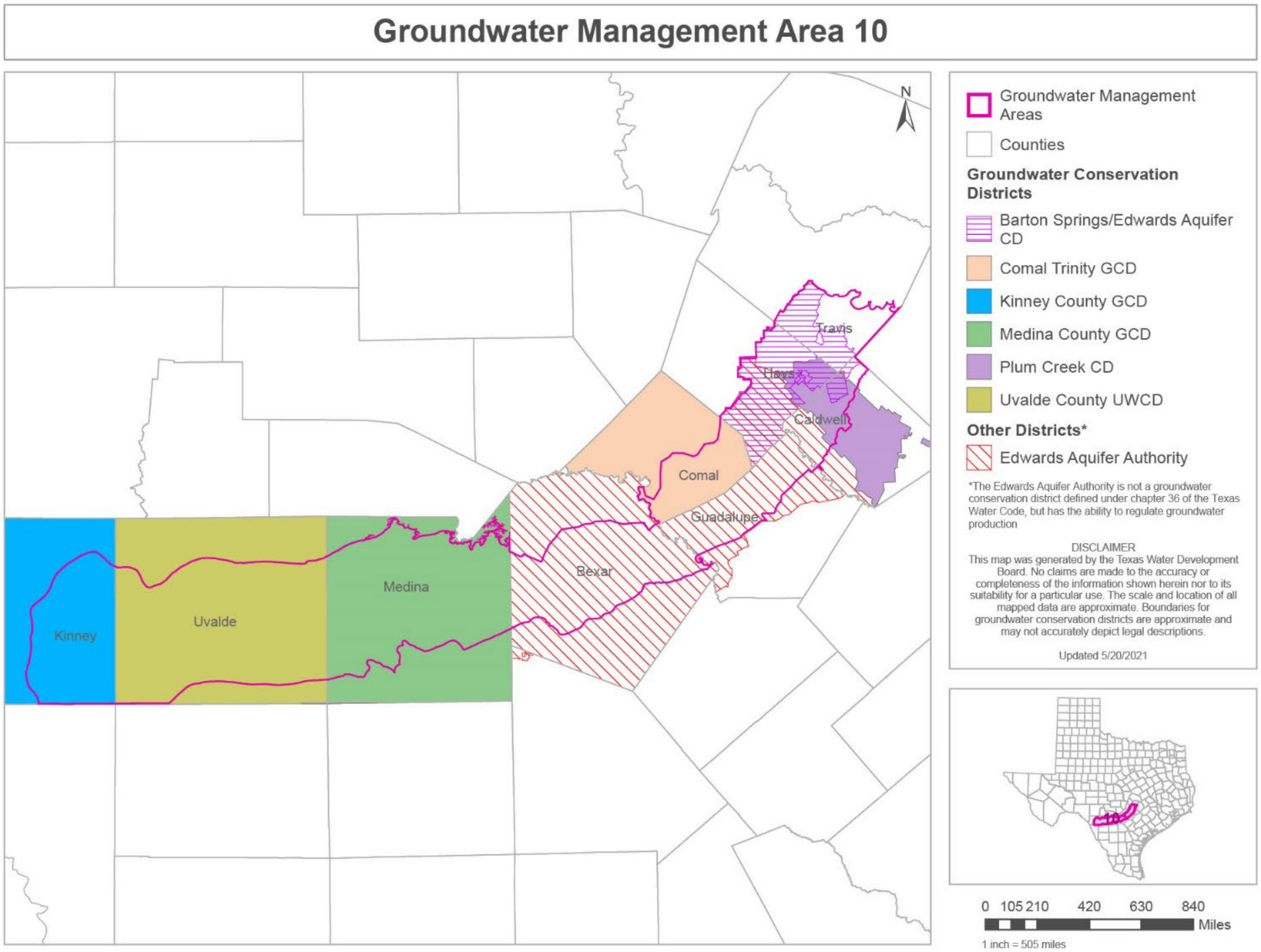


Figure 1. GCDs in GMA 10 (TWDB website)

3. Desired Future Conditions

The DFCs for the Austin Chalk and Buda Limestone aquifers in the Uvalde County part of GMA 10, as described in Resolution No. 2010-11 and adopted August 23, 2010 by the GCDs in GMA 10, are a regional average well drawdown of zero (0) feet (including exempt and non-exempt use) (Table 1). The second round DFCs were adopted at the GMA 10 meeting on March 14, 2016. The third round DFCs were adopted at the GMA 10 Meeting on October 26, 2021.

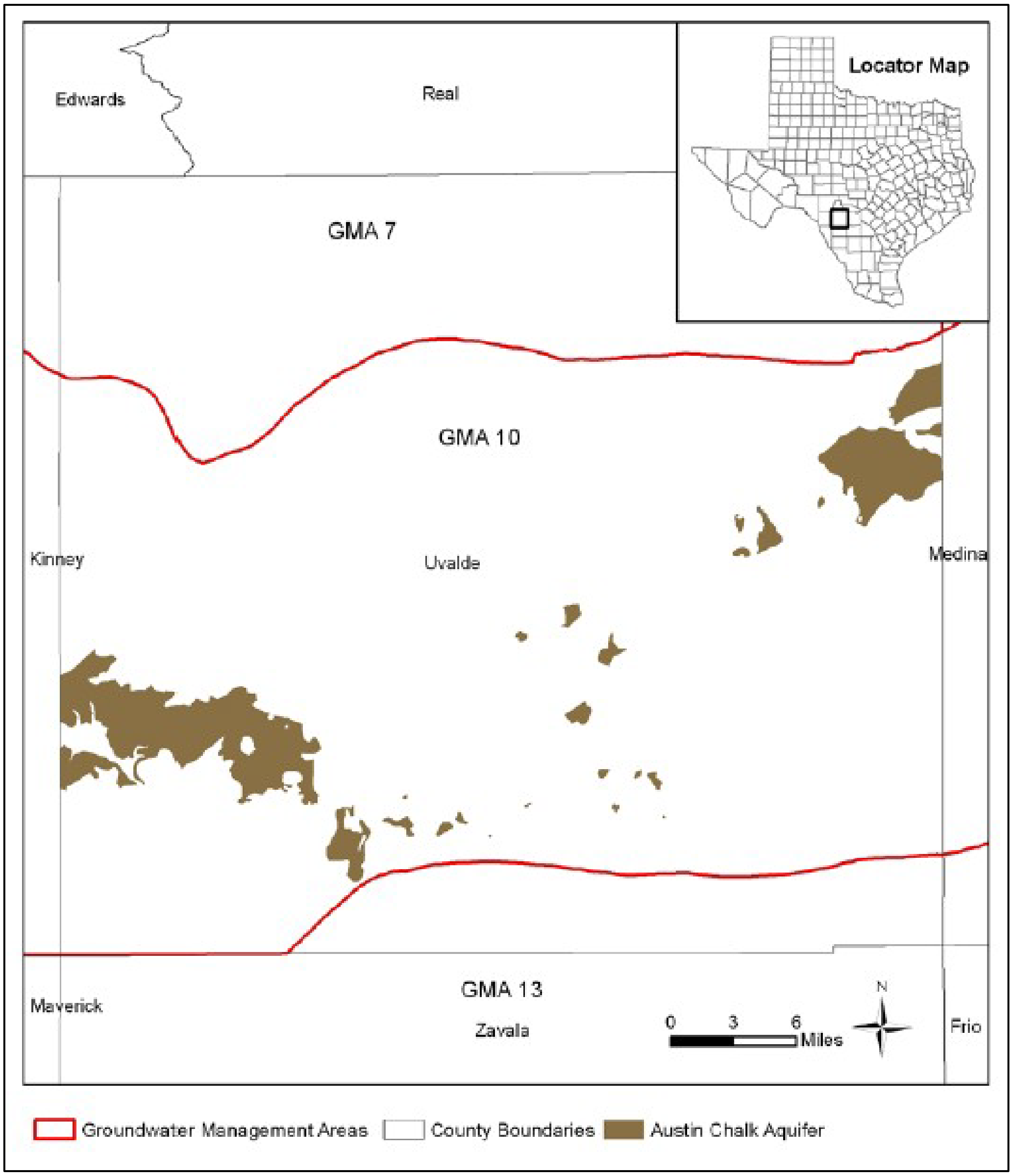


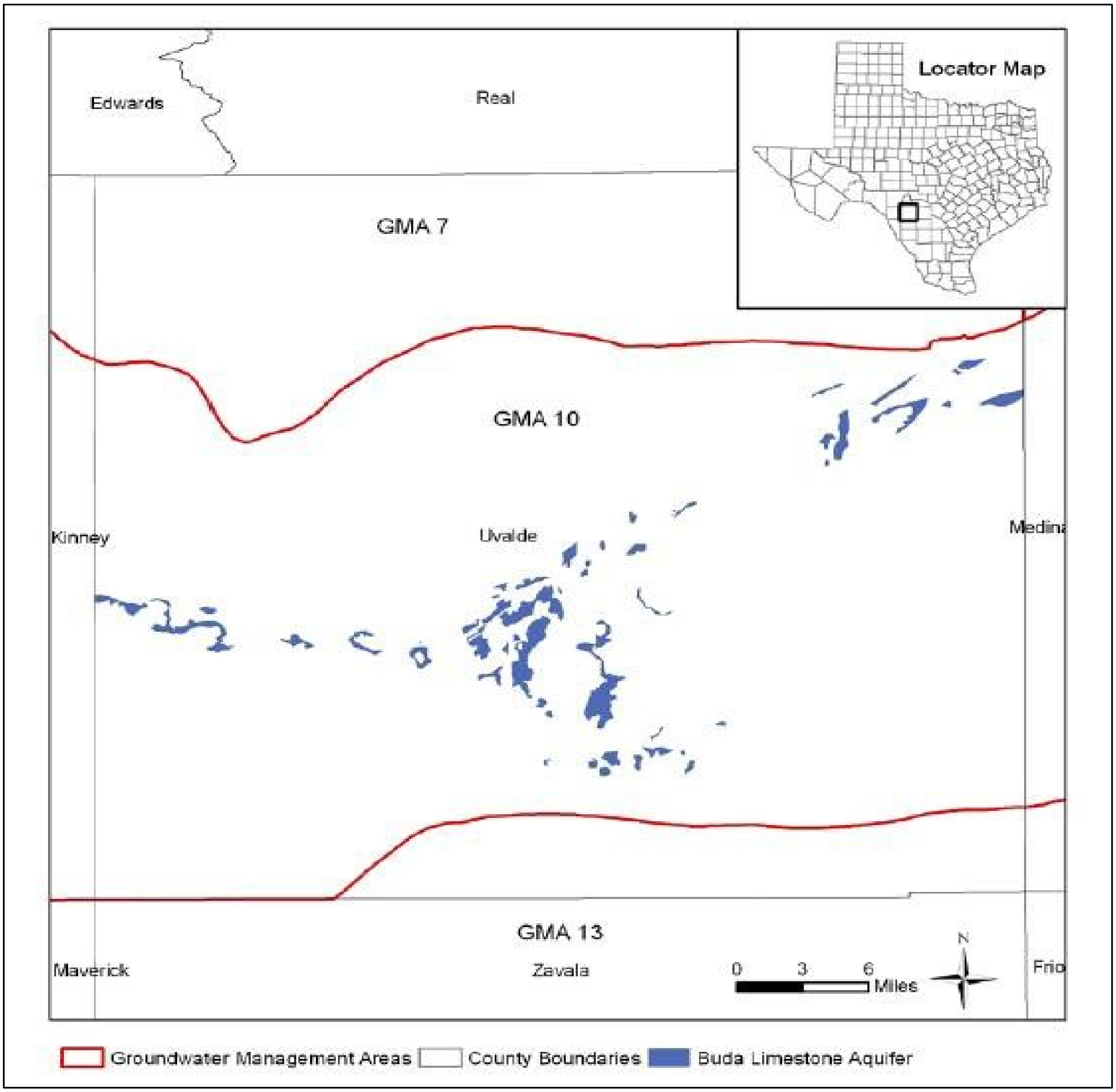
Figure 2. Map showing the outcrop extent of the Austin Chalk in Uvalde County in GMA 10 (from Thorkildsen and Blackhouse, 2011a)

Table 1. DFCs for the Austin Chalk and Buda Limestone aquifers within Uvalde County in GMA 10.

Aquifer	DFC Summary	Date DFC Adopted
Austin Chalk	No drawdown (including exempt and non-exempt use)	8/23/2010
Austin Chalk	No drawdown (including exempt and non-exempt use)	4/10/2016

Austin Chalk	No drawdown (including exempt and non-exempt use)	10/26/2021
Buda Limestone	No drawdown (including exempt and non-exempt use)	8/23/2010
Buda Limestone	No drawdown (including exempt and non-exempt use)	4/10/2016
Buda Limestone	No drawdown (including exempt and non-exempt use)	10/26/2021

Figure 3. Map showing the outcrop extent of the Buda Limestone in Uvalde County in GMA 10 Aquifers (From Thorkildsen and Blackhouse, 2011b).



4. Policy Justification

The DFCs for the Austin Chalk and Buda Limestone aquifers in Uvalde County were adopted after considering the following factors specified in Texas Water Code §36.108 (d):

A. Aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another;

   i. for each aquifer, subdivision of an aquifer, or geologic strata; and
   ii. for each geographic area overlying an aquifer

B. The water supply needs and water management strategies included in the state water plan;

C. Hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge;

D. Other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water;

E. The impact on subsidence;

F. Socioeconomic impacts reasonably expected to occur;

G. The impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002;

H. The feasibility of achieving the DFC; and

I. Any other information relevant to the specific DFCs.

These factors are discussed in detail in appropriate sections in this Explanatory Report.

5. Technical Justification

There is no Groundwater Availability Model for either the Austin Chalk Aquifer or the Buda Limestone Aquifer in Uvalde County. Technical justification for selection of the DFCs for the Austin Chalk and Buda Limestone aquifers in Uvalde County was provided using alternative analyses.

Thorkildsen and Backhouse (2011a,b) noted that there are limited hydrogeologic data available for either the Austin Chalk Aquifer or the Buda Limestone Aquifer in Uvalde County, but that historical water-level data show significant variation in aquifer storage over time. Thorkildsen and Backhouse (2011a,b) cite measurements (2005-2006) for several Austin Chalk Aquifer wells and one Buda Limestone Aquifer well that show a degree of stabilization during that time period. Hydrographs of the Austin Chalk Aquifer wells and the Buda Limestone well are shown in Figures 4 and 5 (Thorkildsen and Backhouse (2011a,b).

Green et al, (2009b) estimated 2008 pumpage for the Austin Chalk Aquifer in Uvalde County was 2,935 acre-feet. For the Managed {modeled} Available Groundwater analysis of the Austin Chalk Aquifer in Uvalde County, Thorkildsen and Backhouse (2011a) assumed that the Austin Chalk Aquifer was under a state of dynamic equilibrium and the estimated pumpage of 2,935 acre-feet/year would achieve the adopted DFC for the Austin Chalk Aquifer in Uvalde County. Similarly, Thorkildsen and Backhouse (2011b) used the estimated 2008 pumpage for the Buda Limestone Aquifer in Uvalde County of 758 acre-feet (Green et al. 2009b) and with the same assumption of dynamic equilibrium, estimated that a Managed {modeled} Available Groundwater equivalent to the estimated 2008 pumpage of 758 acre-feet would achieve the adopted DFC for the Buda Limestone Aquifer in Uvalde County.

Since exempt uses are not available for permitting, it is necessary to account for them when determining the Modeled Available Groundwater (MAG). To do this, the TWDB developed a standardized method for estimating exempt use for domestic and livestock purposes based on projected changes in population and the ratio of domestic and livestock wells in an area to the total number of wells. Because other exempt uses can vary significantly from district to district and there is much higher uncertainty associated with estimating use due to oil and gas exploration, estimates of exempt pumping outside domestic and livestock uses have not been included. If a district believes it has a more appropriate estimate of exempt pumping, they may submit it, along with a description of how it was developed, to the TWDB for consideration. Once established, the estimates of exempt pumping are subtracted from the total pumping calculation to yield the estimated MAG for permitting purposes.

Exempt use in the Uvalde County Underground Water Conservation District was estimated for the period 2020 to 2070 by TWDB and accepted by the district (TWDB Projected Exempt Use Estimates, 2020). Table 2 contains the estimates of exempt pumping from the Austin Chalk Aquifer in the Uvalde County Underground Water Conservation District for domestic and livestock uses (TWDB Projected Exempt Use Estimates, 2020). There is negligible exempt use due to oil and gas exploration in Uvalde County.

Estimated total pumping from the Austin Chalk Aquifer within Uvalde County in GMA 10 that achieves the adopted DFC is approximately 2,935 acre-feet per year (Thorkildsen and Backhouse, 2011a). Table 3 shows the total pumping estimates by the lone river basin (i.e., Nueces River) for each decade between 2010 and 2060 for use in the regional water planning process. The MAG for the Uvalde County Underground Water Conservation District is equal to the total pumping and is shown in Table 4 (Thorkildsen and Backhouse, 2011a). Tables 5-7 contain the same information as Tables 2-4 for the Buda Limestone Aquifer in Uvalde County.

Table 2. Estimates of exempt use for the Austin Chalk Aquifer in the Uvalde County Underground Water Conservation District for each decade between 2020 and 2080. Results are in acre-ft/yr. Estimated exempt use calculated by TWDB and accepted by the district (TWDB Projected Exempt Use Estimates, 2020).

Year	2020	2030	2040	2050	2060	2070	2080
Acre-ft	232	239	245	256	271	286	288

Table 3. Estimated total pumping for the Austin Chalk Aquifer in the Uvalde County Underground Water Conservation District for each decade between 2010 and 2060. Results are in acre-ft/yr (Thorkildsen and Backhouse, 2011a).

Year	2010	2020	2030	2040	2050	2060
Acre-ft	2,935	2,935	2,935	2,935	2,935	2,935

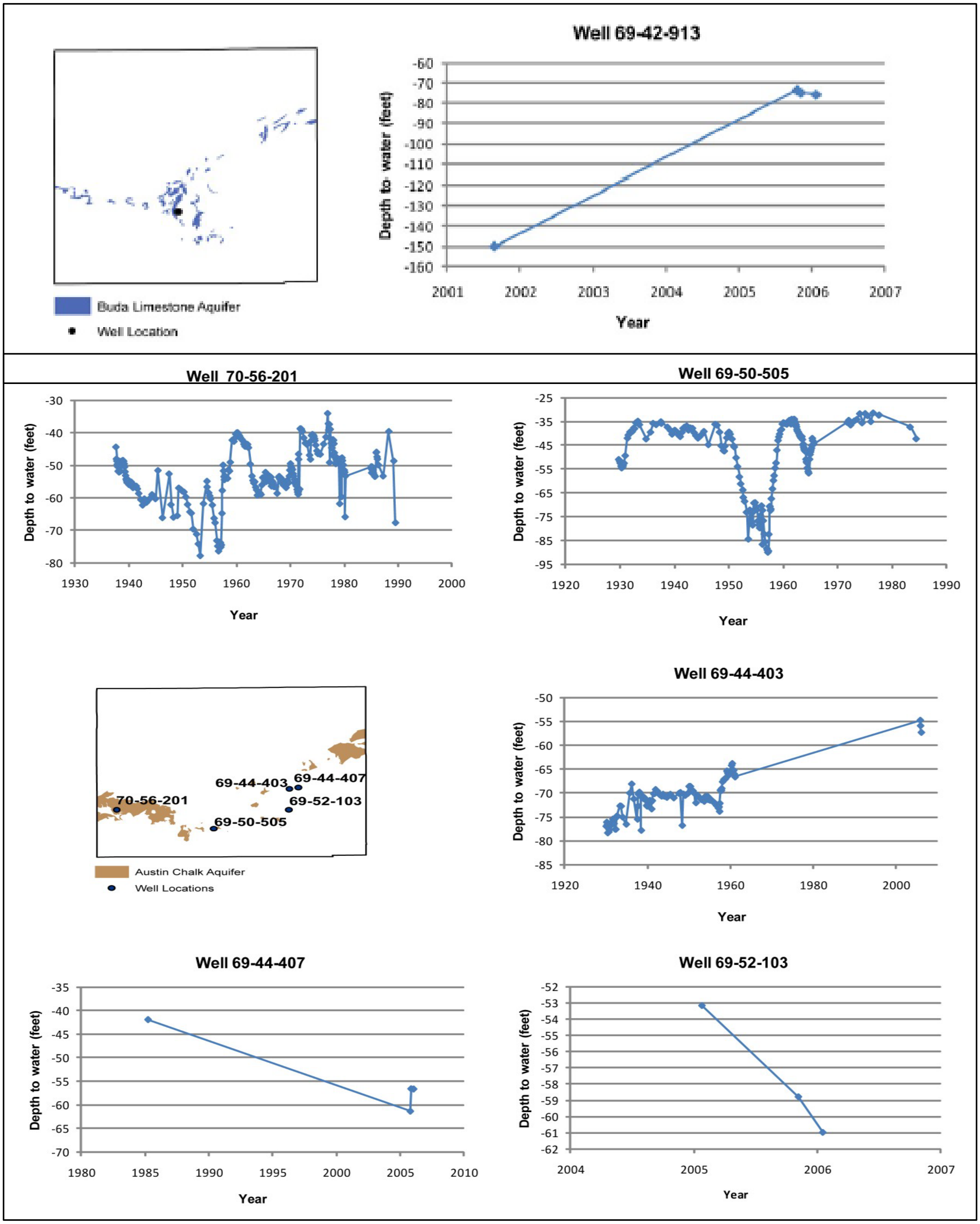


Figure 4. Water-level measurements for selected Austin Chalk wells in Uvalde County, Texas (Thorkildsen and Backhouse (2011a).

Figure 5. Water-level measurements for a selected Buda Limestone well in Uvalde County, Texas (Thorkildsen and Backhouse (2011b)

Table 4. Estimates of MAG for the Austin Chalk Aquifer in the Uvalde County Underground Water Conservation District for each decade between 2020 and 2070. Results are in acre-ft/yr (Robert G. Bradley, P.G. and Radu Boghici, P.G. 2018.).

Year	2020	2030	2040	2050	2060	2070
Acre-ft	2,935	2,935	2,935	2,935	2,935	2,935

Table 5. Estimates of exempt use for the Buda Limestone Aquifer in the Uvalde County Underground Water Conservation District for each decade between 2020 and 2080. Results are in acre-ft/yr. Estimated exempt use calculated by TWDB and accepted by the district (Thorkildsen and Backhouse, 2011b).

Year	2020	2030	2040	2050	2060	2070	2080
Acre-ft	232	239	245	256	271	286	288

Table 6. Estimated total pumping for the Buda Limestone Aquifer in the Uvalde County Underground Water Conservation District for each decade between 2010 and 2060. Results are in acre-ft/yr (Thorkildsen and Backhouse, 2011b).

Year	2010	2020	2030	2040	2050	2060
Acre-ft	758	758	758	758	758	758

Table 7. Estimates of MAG for the Buda Limestone Aquifer in the Uvalde County Underground Water Conservation District for each decade between 2010 and 2060. Results are in acre-ft/yr (Robert G. Bradley, P.G. and Radu Boghici, P.G. 2018).

Year	2020	2030	2040	2050	2060	2070
Acre-ft	758	758	758	758	758	758

6. Consideration of Designated Factors

In accordance with Texas Water Code § 36.108 (d-3), the district representatives shall produce a Desired Future Condition Explanatory Report. The report must include documentation of how factors identified in Texas Water Code §36.108 (d) were considered prior to proposing a DFC, and how the proposed DFC impacts each factor. The following sections of the Explanatory Report summarizes the information that the GCDs used in its deliberations and discussions.

6.1 Aquifer Uses or Conditions

6.1.1 Description of Factors in the Austin Chalk and Buda Limestone Aquifers in Uvalde County

GMA 10 incorporated information from the Uvalde County Underground Water Conservation District Groundwater Management Plan and analyses from the TWDB during development of the proposed DFCs.

Surface water in Uvalde County comes primarily from the Nueces River and its tributaries. Groundwater is found in both major and local aquifers in Uvalde County. Although other rivers traverse Uvalde County, only reaches in the Nueces River exhibit significant baseflow. Major aquifers include the Edwards (Balcones Fault Zone), Edwards-Trinity (Plateau), Carrizo-Wilcox and Trinity aquifers. Minor or local aquifers include the Leona Gravel, Buda Limestone, Anacacho, Austin Chalk, and Glen Rose Formations. There is significant production from the Buda Limestone, Austin Chalk and Leona Formation aquifers in areas of Uvalde County west of the Knippa Gap (Green et al., 2006; 2009a.b). A report completed for the Uvalde County Underground Water Conservation District in 2009 concludes that the Edwards (Balcones Fault Zone) Aquifer is in hydraulic communication with these local aquifers, and that index well J-27, although completed in the Edwards (Balcones Fault Zone) Aquifer, can indicate declines in groundwater levels in the Buda Limestone, Austin Chalk and Leona Formation aquifers that adversely impact the water resource (Green et al., 2009b). When the level in index well J-27 drops below 860 feet msl, recharge to the Leona Gravel Aquifer and discharge to Soldiers Camp Springs and other related un-named springs in the Nueces River decline measurably (Green et al., 2009a.b).

Aquifer use in Uvalde County divided between surface water and groundwater and among industry sector for the years 2000–2019 is summarized in Table 8.

6.1.2 DFC Considerations

The dominant use of the Austin Chalk and Buda Limestone aquifers in Uvalde County by pumping is domestic use and irrigation, and the sustainability of that supply, especially for users who have no alternative supply physically or economically available and/or who are in vulnerable locations, must be protected to the extent feasible (Texas Water Code §36). The primary concern with sustainability of these karst aquifer groundwater supplies is drought, notably extreme drought that stresses both aquifers. The DFCs support and are, in fact, the primary concern with sustainability of these karst aquifer groundwater supplies is drought, notably extreme drought that stresses both aquifers. The DFCs support and are, in fact, the linchpin of a drought management program to promote long-term sustainability of water supplies.

Table 8. Uvalde County use divided between surface water (SW) and groundwater (GW) among industry sectors (Texas Water Development Board Historical Water Use TWDB) (acre-ft).

Year	Source	Municipal	Manufac turing	Steam Electric	Irriga tion	Mining	Livestock	Total
2000	GW	7,846	378	0	56,967	250	642	66,083
	SW	0	0	0	1,094	0	642	1,736
Total		7,846	378	0	58,061	250	1,284	67,819
2001	GW	5,472	1,110	0	83,276	250	592	90,700
	SW	67	13	0	1,700	0	592	2,372
Total		5,539	1,123	0	84,976	250	1,184	93,072
2002	GW	4,777	751	0	88,392	717	579	95,216
	SW	59	9	0	1,804	0	579	2,451
Total		4,836	760	0	90,196	717	1,158	97,667
2003	GW	5,207	152	0	67,820	239	557	73,975
	SW	64	2	0	425	0	557	1,048
Total		5,271	154	0	68,245	239	1,114	75,023
2004	GW	4,083	3	0	66,399	239	522	71,246
	SW	50	0	0	377	0	522	949
Total		4,133	3	0	66,776	239	1,044	72,195
2005	GW	5,121	3	0	58,087	147	1,837	65,195
	SW	0	0	0	400	0	339	739
Total		5,121	3	0	58,487	147	2,176	65,934
2006	GW	6,114	3	0	72,872	147	0	79,136
	SW	0	0	0	0	0	950	950
Total		6,114	3	0	72,872	147	950	80,086
2007	GW	4,425	3	0	36,649	112	2,727	43,916
	SW	0	0	0	358	0	336	694
Total		4,425	3	0	37,007	112	3,063	44,610
2008	GW	5,339	0	0	75,016	1,125	2,282	83,762
	SW	0	0	0	1,103	1,051	294	2,448
Total		5,339	0	0	76,119	2,176	2,576	86,210
2009	GW	5,578	3	0	96,802	1,092	2,207	105,682
	SW	0	0	0	698	1,090	248	2,036
Total		5,578	3	0	97,500	2,182	2,455	107,718
2010	GW	5,162	0	0	52,156	1,146	2,141	60,605
	SW	0	3	0	390	1,129	261	1,783
Total		5,162	3	0	52,546	2,275	2,402	62,388
2011	GW	6,112	0	0	82,968	74	2,205	91,359
	SW	0	3	0	491	0	270	764
Total		6,112	3	0	83,459	74	2,475	92,123
2012	GW	5,380	3	0	72,263	86	2,007	79,739
	SW	0	0	0	368	0	236	604
Total		5,380	3	0	72,631	86	2,243	80,343
2013	GW	4,901	3	0	49,494	49	1,728	56,175
	SW	0	0	0	462	0	245	707
Total		4,901	3	0	49,956	49	1,973	56,882

2014	GW	4,742	0	0	52,877	49	1,624	59,292
	SW	0	0	0	572	0	273	845
Total		4,742	0	0	53,449	49	1,897	60,137
2015	GW	4,472	0	0	36,243	0	1,478	42,193
	SW	0	0	0	357	49	247	653
Total		4,472	0	0	36,600	49	1,725	43,499
2016	GW	4,477	0	0	47,886	44	1,726	54,133
	SW	0	0	0	150	0	251	401
Total		4,477	0	0	48,036	44	1,977	54,534
2017	GW	4,337	0	0	33,387	44	1,712	39,480
	SW	0	0	0	441	0	226	667
Total		4,337	0	0	33,828	44	1,938	40,147
2018	GW	4,118	0	0	42,829	61	1,648	48,656
	SW	0	0	0	514	0	234	748
Total		4,118	0	0	43,343	0	1,882	49,404
2019	GW	4,157	0	0	52,735	54	1631	58,577
	SW	0	0	0	110	0	239	349
Total		4,157	0	0	52,845	54	1,870	58,926
GW = groundwater; SW = surface water								
Source: TWDB Water Use Survey Database 1/5/2010								

6.2 Water-Supply Needs

6.2.1 Description of Factors in the Austin Chalk and Buda Limestone Aquifers in Uvalde County

Water use in Uvalde County is divided between surface water and groundwater and among industry sector (Table 9) (Uvalde County Underground Water Conservation District Groundwater Management Plan). Water use is not delineated by aquifer; thus, water use of the Austin Chalk and Buda Limestone aquifers is not known.

6.2.2 DFC Considerations

The population growth of Uvalde County is projected by the Office of the State Demographer for State of Texas, Texas State Data Center Texas A&M University System to grow from 26,260 in 2020 to 35,650 in 2040, an increase of 26.33 percent (https://demographics.texas.gov/data/TPEPP/Estimates/). The DFCs maximize the amount of water that can be provided during non-drought periods that is consistent with the implementation of a drought management program that protects the supply for existing uses during drought, especially extreme drought. The drought program response to the DFCs indexes the amount of aquifer water available to meet the needs with the severity of drought.

6.3 Water-Management Strategies

6.3.1 Description of Factors in the Austin Chalk and Buda Limestone Aquifers in Uvalde County

The following information is from the South Central Texas Region Water Plan (South Central Texas Region Water Planning Group, 2021). A major component of the South Central Texas Region Initially Prepared Water Plan is to identify municipalities and water-use categories that may, in times of severe drought, be unable to meet expected water-supply needs based on today's ability to access, treat, and distribute the supply. A goal of the South Central Texas Region Water Plan is to provide for the health, safety, and welfare of the human community, with as little detrimental effect to the environment as possible. Recreation activities involve human interaction with the outdoor environment and are often directly dependent on water resources. It is recognized that the maintenance of the regional environmental community's water supply needs serves to enhance the lives of citizens of the South Central Texas Region as well as the tens of thousands of annual visitors to this Region. The implementation of water-management strategies recommended in the South Central Texas Region Water Plan is not expected to have any impact on native-water quality. In particular, primary and secondary safe drinking water standards, which are the key parameters of water quality identified by the South Central Texas Region Water Planning Group as important to the use of the water resource, are not compromised by the implementation of the strategies. Also, no recommended strategies involve moving water from a rural location for use in an urban area.

The data presented in this section are provided by the South Central Texas Region Water Planning Group Plan (South Central Texas Region Water Planning Group, 2021). Recommended alternatives, or water-management strategies, to meet anticipated drought-induced shortages are presented in the South Central Texas Region Water Plan for consideration. The projected water supply and demand estimates for Uvalde County indicate that projected demands exceed projected supplies within the City of Sabinal, City of Uvalde, and Irrigation (Table 9). Source water available after known demands are subtracted are presented in Table 10. Table 11 identifies water-use categories where no water supply is available to meet its total need. As noted, these data are not currently available in the South Central Texas Region Water Planning Group Plan (South Central Region Water Planning Group, 2021).

To meet the needs of water-user groups in the Uvalde County Underground Water Conservation District, Region L recommended water-management strategies to address the identified shortages. Water-management strategies are projects or procedures that if implemented will produce additional water to meet the identified needs of water-user groups. The total amount of groundwater and surface water resulting from implementation of the water-management strategies recommended for Uvalde County in the 2022 State Water Plan is anticipated to provide 2,771 acre-feet in 2020, increasing to 4,738 acre-feet in 2070. Transfers from the Edwards (Balcones Fault Zone) Aquifer and municipal water conservation are the primary strategies identified (Table 12).

Table 9. Projected water-supply and demand estimates for Uvalde County in the 2022 State Water Plan

Water User Group	Supply/Shortage 2020 (acft/yr)	Supply/Shortage 2070 (acft/yr)	Comment
City of Sabinal	151	-4	Projected shortage 2070
City of Uvalde	-483	-2021	Projected shortage (2020 through 2070)
Rural Area Residential and Commercial	858	1,146	No projected shortage
Manufacturing	111	111	No projected shortage
Steam-Electric Power	0	0	No projected shortage
Mining	2,457	3,670	No projected shortage
Irrigation	-18,573	-20,999	Projected shortage (2020 through 2070)
Livestock	2,198	2,198	No projected shortage

Table 10. Source water available after known demands are subtracted (South Central Texas Initially Prepared Plan, 2021) (acre-ft/yr).

Groundwater	Basin	Salinity	2020	2030	2040	2050	2060	2070
Buda Limestone Aquifer	Nueces	Fresh	233	233	233	233	233	233
Carrizo-Wilcox Aquifer	Nueces	Fresh	0	0	0	0	0	0
Edwards-Trinity Aquifer	Nueces	Fresh	0	0	0	0	0	0
Leona Gravel Aquifer	Nueces	Fresh	256	262	283	78	0	0
Trinity Aquifer	Nueces	Fresh	0	0	0	0	0	0

Table 11. Water-use categories where no water supply is available to meet its total need. These data are not currently available in the South Central Texas Region Water Planning Group Plan (South Central Region Water Planning Group, 2021) (acre-ft/yr).

WUG/WWP	Basin	2020	2030	2040	2050	2060	2070
-	-	-	-	-	-	-	-

Water-management strategies for Uvalde County that are identified in the 2022 State Water Plan are summarized in Table 12. Water-management strategies that involve aquifer storage and recovery (ASR) comprise approximately 9 percent of recommended new supplies and include an Uvalde aquifer storage and recovery project (1,155 acre-ft/yr @ $2,803/acre-ft/yr) (South Central Region Water Planning Group, 2021).

Table 12. Water-management strategies in Uvalde County in the 2022 State Water Plan (acre-ft/yr).

WUG	River Basin	Water Management Strategy	Source Name	2020	2030	2040	2050	2060	2070
Sabinal	Nueces	Edwards Transfers	Edwards (Balcones Fault Zone) Aquifer	150	150	150	125	125	125
Sabinal	Nueces	Municipal Water Conservation	Conservation	20	57	96	141	182	203
Uvalde	Nueces	Edwards Transfers	Edwards (Balcones Fault Zone) Aquifer	2,138	2,195	2,074	1,947	1,911	2,030
County Other	Nueces	Municipal Water Conservation	Conservation	0	0	0	0	0	1
Uvalde	Nueces	Municipal Water Conservation	Conservation	193	552	945	1,384	1,744	1,942
TOTAL				**2,501**	**2,954**	**3,265**	**3,597**	**3,962**	**4,301**

6.3.2 DFC Considerations

The DFCs under consideration here are specific to the Austin Chalk and Buda Limestone Aquifers in Uvalde County. The Edwards Aquifer in Uvalde County has a different DFC and is the subject of a separate groundwater management zone, designed to promote protection of the downgradient springs in the Edwards Aquifer and the endangered species impacted by spring discharge. The DFCs for the Austin Chalk and Buda Limestone Aquifers, as described above, underpin an aquifer-responsive drought management program that encourages both full-time water conservation and further temporary curtailments in pumping during drought periods that increase with drought severity.

6.4 Hydrological Conditions

6.4.1 Description of Factors in the Austin Chalk and Buda Limestone Aquifers in Uvalde County

6.4.1.1 Total Estimated Recoverable Storage

Texas statute requires that the total estimated recoverable storage of relevant aquifers be determined. Total estimated recoverable storage is a calculation provided by the TWDB. Texas Administrative Code Rule §356.10 (Texas Administrative Code, 2011) defines the total estimated recoverable storage as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume. As described in Aquifer Assessment 16-01 (Bradley, 2016), the total recoverable storage was estimated for the portion of the Austin Chalk Aquifer and the Buda

Limestone Aquifer within GMA 10 (Tables 13 and 14). The official lateral aquifer boundaries were delineated in Bradley (2016).Total estimated recoverable storage values may include a mixture of water quality types, including fresh, brackish, and saline groundwater, because the available data and the existing Groundwater Availability Models do not permit the differentiation between different water quality types. The total estimated recoverable storage values do not take into account the effects of land surface subsidence, degradation of water quality, or any changes to surface water-groundwater interaction that may occur due to pumping.

Table 13. Total estimated recoverable storage for the Austin Chalk Aquifer within Uvalde County Underground Water Conservation District in GMA 10. Estimates are rounded within two significant numbers (Bradley, 2016).

Total Storage (acre-ft)	25 percent of Total Storage (acre-ft)	75 percent of Total Storage (acre-ft)
280,000	70,000	210,000

Table 14. Total estimated recoverable storage for the Buda Limestone Aquifer within Uvalde County Underground Water Conservation District in GMA 10. Estimates are rounded within two significant numbers (Bradley, 2016).

Total Storage (acre-ft)	25 percent of Total Storage (acre-ft)	75 percent of Total Storage (acre-ft)
76,000	19,000	57,000

6.4.1.2 Average Annual Recharge

Using results from TWDB GAM Run 15-006 (Bahaya, 2015), the estimated recharge from the Carrizo-Wilcox Aquifer in Uvalde County is 3,003 acre-ft/yr and the estimated recharge from the Edwards-Trinity Aquifer in Uvalde County is 8,436 acre-ft/yr (Uvalde County Underground Water Conservation District Groundwater Management Plan). The Uvalde County Underground Water Conservation District Groundwater Management Plan does not include an estimate for average annual recharge from the Austin Chalk Aquifer and the Buda Limestone Aquifer.

6.4.1.3 Inflows

The Austin Chalk and Buda Limestone aquifers are recharged by distributed recharge where they crop out. In addition, the intense faulting and significant offset inherent to the Balcones Fault Zone within the confines of the Uvalde pool has sufficiently juxtaposed the Edwards, Austin Chalk, and Buda Limestone aquifers that all three aquifers are in hydraulic communication. Because of this hydraulic communication, the Austin Chalk and the Buda Limestone aquifers are readily recharged by the Edwards (Balcones Fault Zone) Aquifer, however, the Austin Chalk and the Buda Limestone can just as easily discharge to the Edwards (Balcones Fault Zone) Aquifer. The direction of flow is a function of local hydraulic gradient. Whether recharge to the Austin Chalk and Buda Limestone aquifers is from autogenic recharge or by discharge from the Edwards (Balcones Fault Zone) Aquifer is complex due to the structure and not easily quantified.

6.4.1.4 Discharge

The Uvalde County Underground Water Conservation District has only partial estimation of discharge from the Austin Chalk Aquifer and the Buda Limestone Aquifer in Uvalde County. The source for the Soldiers Camp Spring and related un-named springs on the Nueces River appears to be the Austin Chalk Aquifer where it crops out at the Nueces River. These springs are at the downdip boundary of where the Austin Chalk crops out in Uvalde County. The U.S. Geological Survey gage on the Nueces River downstream from Soldier Camp Springs and the other unnamed springs provides a measure of the discharge from all the springs in addition to surface runoff flow in the Nueces River. The baseflow component to flow measured at this gage could be separated out from total flow to provide the quantity of discharge from the Austin Chalk Aquifer. This separation has not yet been performed.

Similarly, the Buda Limestone Aquifer and possibly the Austin Chalk Aquifer crop out in the bed of the Leona River north of Ft Inge and south of the City of Uvalde. The Buda Limestone Aquifer and possibly the Austin Chalk Aquifer discharge to the Leona River and possibly to the Leona Gravel Aquifer near this location.

Analysis by Green et al. (2008) indicates that as much as 74,000 acre-ft/yr is recharged to the Leona Gravel Aquifer as inflow where the gravels abut with down gradient boundary of the Austin Chalk, Buda Limestone, and possibly the Edwards (Balcones Fault Zone) Aquifer in the Leona River floodplain in the reach from Highway 90 in the north to Ft. Inge in the south. The quantity of recharge to the Leona Gravel Aquifer is highly variable and is greatly affected by aquifer stage as measured at monitoring well J-27. This volume of water discharge by the Austin Chalk and Buda Limestone aquifers to the Leona Gravel Aquifer has not been quantified.

6.4.1.5 Other Environmental Impacts Including Springflow and Groundwater/Surface Water Interaction

Significant springs in Uvalde County include Soldiers Camp Spring and related un-named springs on the Nueces River and Leona Springs on the Leona River. Soldiers Camp Spring and related un-named springs on the Nueces River contribute to surface flow in the Nueces River Green et al., 2009a,b). The source for the Soldiers Camp Spring and related un-named springs on the Nueces River appears to be the Austin Chalk Aquifer where it crops out at the Nueces River. Baseflow in the Nueces River downstream from Soldiers Camp Spring and the related un- named springs is wholly derived from the Austin Chalk Aquifer. Storm surge and surface runoff are the only contribution to the Nueces River that flows from the north.

6.4.2 DFC Considerations

The DFCs are proposed on the basis that the Austin Chalk Aquifer and the Buda Limestone Aquifer in Uvalde County are in direct hydrologic communication with each other and with the Edwards Aquifer. The three aquifers are well-integrated hydrologically and have a common potentiometric surface throughout the subdivision. This hydrologic condition denotes that all three aquifers are jointly vulnerable to drought. The Austin Chalk Aquifer and the Buda Limestone Aquifer in Uvalde County are more vulnerable to drought than the Edwards Aquifer because they are above and have less saturated thickness that the Edwards Aquifer.

7. Subsidence Impacts

Subsidence has historically not been an issue with the Austin/Buda Aquifer in GMA 10. The aquifer matrix in the northern subdivision is well-indurated and the amount of pumping does not create compaction of the host rock and/or subsidence of the land surface. Hence, the proposed DFCs are not affected by and do not affect land-surface subsidence or compaction of the aquifer. Additionally, LRE Water LLC hydrologists have built a Subsidence Prediction Tool (SPT) that takes individual well characteristics and calculates a potential subsidence risk in a localized area. GMA 10 recognizes that the general reports from the SPT indicate that subsidence is not a concern for GMA 10 at this time.

8. Socioeconomic Impacts Reasonably Expected to Occur

8.1 Description of Factors in the Austin Chalk and Buda Limestone Aquifers in Uvalde County

Administrative rules require that regional water planning groups evaluate the impacts of not meeting water needs as part of the regional water planning process, and rules direct TWDB staff to provide technical assistance [§357.7 (4)(A)]. Staff of the TWDB's Water Resources Planning Division designed and conducted a report in support of the South Central Texas Regional Water Planning Group (Region L). The report "Socioeconomic Impacts of Projected Water Shortages for the South Central Texas Regional Water Planning Area (Region L)" was prepared by the TWDB in support of the 2021 South Central Texas Regional Water Plan.

The report on socioeconomic impacts summarizes the results of the TWDB analysis and discusses the methodology used to generate the results for Region L. The report does not include the socioeconomic impact associated with only the Austin Chalk and Buda Limestone aquifers. The socioeconomic impact report for Water Planning Group L is included in Appendix A.

8.2 DFC Considerations

Because none of the water management strategies involve changes in the current use of the Austin Chalk and Buda Limestone aquifers in Uvalde County, as described in Section 6.3, the proposed DFCs do not have a differential socioeconomic impact. They are supportive of the status quo in this regard, which is considered positive.

9. Private Property Impacts

9.1 Description of Factors in the Austin Chalk and Buda Limestone Aquifers in Uvalde County

The impact on the interests and rights in private property, including ownership and the rights of GMA landowners and their lessees and assigns in groundwater is recognized under Texas Water Code Section 36.002. The legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property. Nothing in this code shall be construed as granting the authority to deprive or divest a landowner, including a landowner's lessees, heirs, or assigns, of the groundwater ownership and rights described by this section.

Texas Water Code Section 36.002 does not: (1) prohibit a district from limiting or prohibiting the drilling of a well by a landowner for failure or inability to comply with minimum well spacing or tract size requirements adopted by the district; (2) affect the ability of a district to regulate groundwater production as authorized under Section 36.113, 36.116, or 36.122 or otherwise under this chapter or a special law governing a district; or (3) require that a rule adopted by a district allocate to each landowner a proportionate share of available groundwater for production from the aquifer based on the number of acres owned by the landowner.

9.2 DFC Considerations

The DFCs are designed to protect the sustained use of the aquifer as a water supply for all users in aggregate. The DFCs do not prevent use of the groundwater by landowners either now or in the future, although ultimately total use of the groundwater in the aquifer is restricted by the aquifer condition, and that may affect the amount of water that any one landowner could use, either at particular times or all of the time.

10. Feasibility of Achieving the DFCs

The feasibility of achieving a DFC directly relates to the ability of the Uvalde County Underground Water Conservation District to manage the Austin Chalk and Buda Limestone aquifers toward that goal. The Uvalde County Underground Water Conservation District is limited by the hydrogeology of the resource (e.g. how it responds to drought) and the authority of the Uvalde County Underground Water Conservation District to regulate pumping (e.g. uses exempt from permitting and by virtue of the fact that the Edwards (Balcones Fault Zone) Aquifer, the principal aquifer within its jurisdictional boundaries, is regulated by the Edwards Aquifer Authority, not the Uvalde County Underground Water Conservation District. Because the Edwards (Balcones Fault Zone) Aquifer is the principal source of recharge to Austin Chalk and Buda Limestone aquifers, the feasibility of achieving the DFC of the Austin Chalk and Buda Limestone aquifers is dependent on the management and hydraulic condition of the Edwards (Balcones Fault Zone) Aquifer.

11. Discussion of Other DFCs Considered

No other DFC of the Austin Chalk and Buda Limestone aquifers in Uvalde County was considered.

12. Discussion of Other Recommendations

12.1 Advisory Committees

An Advisory Committee for GMA 10 has not been established.

12.2 Public Comments

GMA 10 approved its proposed DFCs on April 20, 2021. In accordance with requirements in Chapter 36.108(d-2), each GCD then had 90 days to hold a public meeting at which stakeholder input was documented. This input was submitted by the GCD to the GMA within this 90-day period. The dates on which each GCD held its public meeting is summarized in Table 16. Public comments for GMA 10 are included in Appendix B.

Table 15. Dates on which each GCD held a public meeting allowing for stakeholder input on the DFCs.

GCD	Date
Barton Springs/Edwards Aquifer Conservation District	June 10,2021
Comal Trinity GCD	May 17, 2021
Kinney County GCD	June 10, 2021
Medina County GCD	June 16, 2021
Plum Creek Conservation District	June 30, 2021
Uvalde County UWCD	May 19, 2021

Under Texas Water Code, Ch. 36.108(d-3)(5), GMA 10 is required to "discuss reasons why recommendations made by advisory committees and relevant public comments were or were not incorporated into the desired future conditions" in each DFC Explanatory Report.

Numerous comments on the GMA 10's proposed DFCs were received from stakeholders. All individual public comments and the detailed GMA 10 responses to each are included in Appendix B of this Explanatory Report and are incorporated into the discussion herein by reference. Some comments did not designate which aquifer's DFC was being addressed but were considered by the GMA, where possible and pertinent, to be applicable to all DFCs. And some comments were not DFC recommendations *per se*, rather general observations on joint groundwater planning.

However, there were no comments specifically addressing the Austin Chalk and Buda Limestone Aquifer DFC.

13. Any Other Information Relevant to the Specific DFCs

No additional information relevant to the specific DFCs has been identified.

14. Provide a Balance Between the Highest Practicable Level of Groundwater Production and the Conservation, Preservation, Protection, Recharging, and Prevention of Waste of Groundwater and Control of Subsidence in the Management Area

This DFC is designed to balance the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area. This balance is demonstrated in (a) how GMA 10 has assessed and incorporated each of the nine factors used to establish the DFC, as described in Chapter 6 of this Explanatory Report, and (b) how GMA 10 responded to certain public comments and concerns expressed in timely public meetings that followed proposing the DFC, as described more specifically in Appendix B of this Explanatory Report. Further, this approved DFC will enable current and future Management Plans and regulations of those GMA 10 GCDs charged with achieving this DFC to balance specific local risks arising from protecting the aquifer while maximizing groundwater production.

15. References

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