Explanatory Report for the Adopted Desired Future Conditions of the Leona Gravel Aquifer 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
UWCD	Underground Water Conservation District

1. Groundwater Management Area 10 and the Leona Gravel Aquifer

Groundwater Management Areas (GMAs) 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) (Figure 1).

As mandated in Texas Water Code §36.108, districts are required to submit Desired Future Conditions (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 DFC Explanatory Report for the management area and submit to the TWDB a copy of the Explanatory Report.

The Leona Gravel Aquifer is neither a major nor minor aquifer, but has been determined to be locally relevant in Uvalde County for joint planning purposes. The Leona Gravel Aquifer has been determined to be not relevant in Medina County for joint planning purposes. This document is the Explanatory Report for the Leona Gravel Aquifer where it is determined to be relevant within GMA 10.

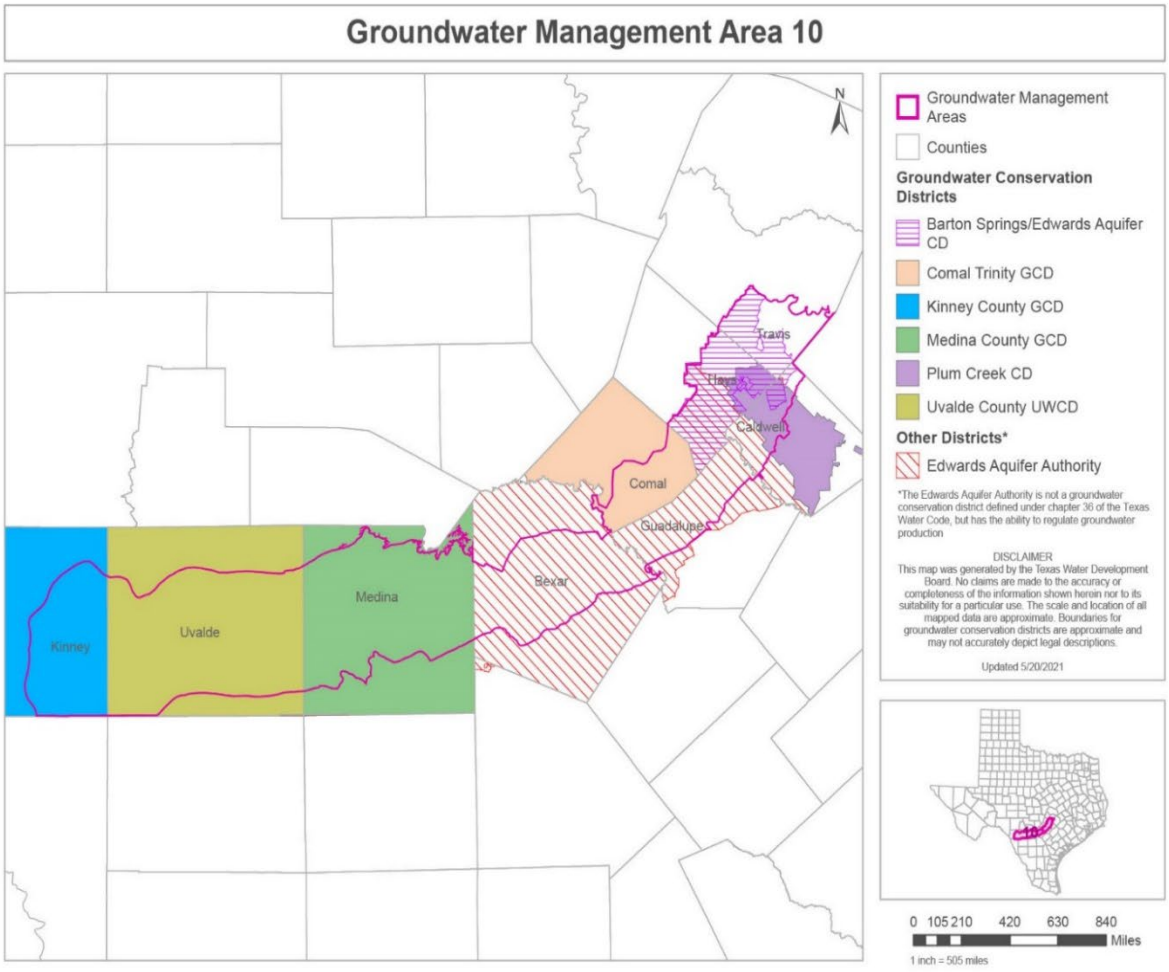

Figure 1. GCDs in GMA 10 (TWDB website)

2. Aquifer Description

For jurisdictional purposes, the Leona Gravel Aquifer is defined as Leona Gravels within Uvalde County. The geographic extent of the Leona Gravel Aquifer is presented in Figure 2 (Bradley, 2012). As illustrated, the jurisdiction is limited to Uvalde County. The Medina County GCD declared the Leona Gravel Aquifer to be non-relevant in Medina County.

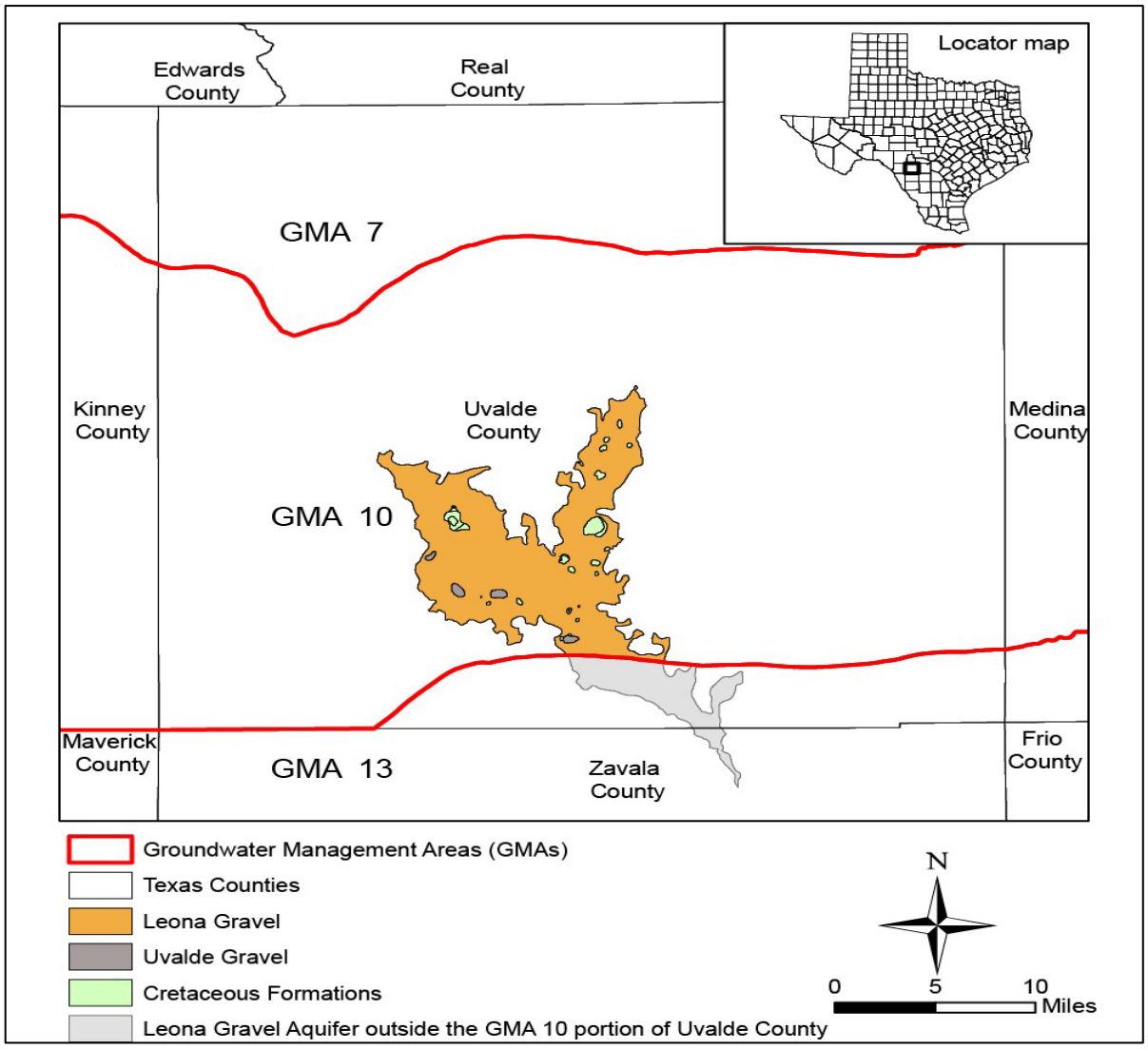

Figure 2. Map of Uvalde County showing the delineated Leona Grave Aquifer and the previously delineated extent of the aquifer, GMAs, and rivers (From Bradley, 2016)

3. Desired Future Conditions

The DFC for the Leona Gravel Aquifer 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, is a regional average well drawdown of zero (0) feet (including exempt and non-exempt use) (Table 1). The second round DFC was adopted at the GMA 10 meeting on March 14, 2016. The third round DFC was adopted at the GMA 10 meeting on October 26, 2021.

Table 1. DFCs for the Leona Gravel Aquifer within Uvalde County in GMA 10

Aquifer	DFC Summary	Date DFC Adopted
Leona Gravel	No drawdown (including exempt and non-exempt use)	8/23/2010
Leona Gravel	No drawdown (including exempt and non-exempt use)	4/10/2016
Leona Gravel	No drawdown (including exempt and non-exempt use)	10/26/2021

4. Policy Justification

The DFC for the Leona Gravel Aquifer in Uvalde County was 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 aquifers.

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

Technical justification for selection of the DFC for the Leona Gravel Aquifer in Uvalde County was provided using a Groundwater Availability Model simulation and alternative analyses. The only Groundwater Availability Model simulation was an aquifer assessment to determine the effects of various levels of pumping in the Edwards (Balcones Fault Zone) Aquifer on discharge to the Leona Gravel Aquifer (Wade, 2008). Subsequent aquifer assessments were alternative analyses to estimate the Managed {modeled} Available Groundwater (MAG) (George, 2010; Wuerch and Backhouse, 2011; Bradley, 2012). The methodology used to estimate the MAG in analyses by George (2010) and Wuerch and Backhouse (2011) was distinct from the methodology used by Bradley (2013).

Wade (2008) used the GWSWIM-IV (Klemt et al., 1979; Thorkildsen and McElhaney, 1992) version of the Groundwater Availability Model for the San Antonio Segment of the Edwards (Balcones Fault Zone) Aquifer to assess the effects of permitted pumping in the Edwards

(Balcones Fault Zone) Aquifer on discharge from the Edwards (Balcones Fault Zone) Aquifer to the Leona Gravel Aquifer. Wade (2008) noted that Leona Springs was poorly understood and not well quantified; thus, model estimates of discharge to Leona Springs include uncertainty due to model estimation and uncertainty about the hydrogeology.

Wuerch and Backhouse (2011) used the approach by George (2010) to evaluate the MAG associated with a DFC that specifies a regional average well drawdown in the Leona Gravel Aquifer of zero (0) ft. Wuerch and Backhouse (2011) defined effective recharge as the amount of water that enters an aquifer and is available for development (Muller and Price, 1979).

Because the DFC is zero, no water can be taken out of storage. Thus, the Managed MAG can be no greater than the effective recharge. Wuerch and Backhouse (2011) used the Atlas of Texas (US Geological Survey and Texas Water Development Board, 2006) to determine the boundary of the Leona Gravel Aquifer.

The Leona Gravel Aquifer is defined as having three hydrostratigraphic units, the Leona Formation (Qle), Quaternary alluvium (Qal), and terrace deposits (Qt) (Figure 2). Wuerch and Blackhouse (2011) calculated recharge by multiplying the outcrop area of each of the three units by the average precipitation (1971-2000) and an effective recharge rate of 5.5 percent. Wuerch and Blackhouse (2011) relied on an assessment by Lowry and Couch (2002) that included Qal and Qt with the Leona Gravel Aquifer when determining aquifer area. Using this methodology for the Leona Gravel Aquifer in Uvalde County, Wuerch and Blackhouse (2011) calculated the annual effective recharge at 30,772 acre-ft/yr, total pumping at 17,646 acre-ft/yr, and MAG at rates that vary from 17,485 to 17,552 acre-ft/yr.

Managed MAG in analyses performed by Bradley (2013) are the most current analyses available and are used as the basis for the Technical Justification. The following information is taken from the aquifer assessment for the Leona Gravel Aquifer within Uvalde County (Bradley, 2012). Limited data for both historic water levels and pumpage estimates hinder an estimate of the MAG. However, there are four wells within Uvalde County that have short to long-term measurements taken from the 1945s to 2001 (Figure 3). Based on historical water levels, the Leona Gravel Aquifer recharges in response to inflows from the Edwards (Balcones Fault Zone) Aquifer (Green et al., 2008) and behaves in a similar manner as the Edwards (Balcones Fault Zone) Aquifer. The hydrograph of Well 69-51-406 shows a highly variable water level trend that mimics changes in the Edwards (Balcones Fault Zone) Aquifer J-27 Index Well (Bradley, 2012), especially high and low water conditions. During the drought of the 1950s, extreme water-level declines showed up in the other historic well measurements (69-51-801, 69-51-701) that also mimic the J-27 water levels (Figure 3). Figure 4 shows annual minimum and maximum measurements for the same wells to highlight that the Leona Gravel Aquifer reflects water levels in the Edwards (Balcones Fault Zone) Aquifer.

Since exempt uses are not available for permitting, it is necessary to account for them when determining the 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. The Uvalde County UWCD receives pumpage data from landowners that's is used to estimate exempt pumping from local wells. Once established, the estimates of exempt pumping are subtracted from the total pumping calculation to yield the estimated MAG for permitting purposes. Exempt use of the Leona Gravel Aquifer in the Uvalde County UWCD has not yet been independently estimated by the TWDB. Estimates for total, domestic, and livestock use by aquifers other than the Trinity and Edwards Aquifers in Uvalde County are presented in Tables 2–4 (TWDB, 2020). There is negligible exempt use due to oil and gas exploration in Uvalde County.

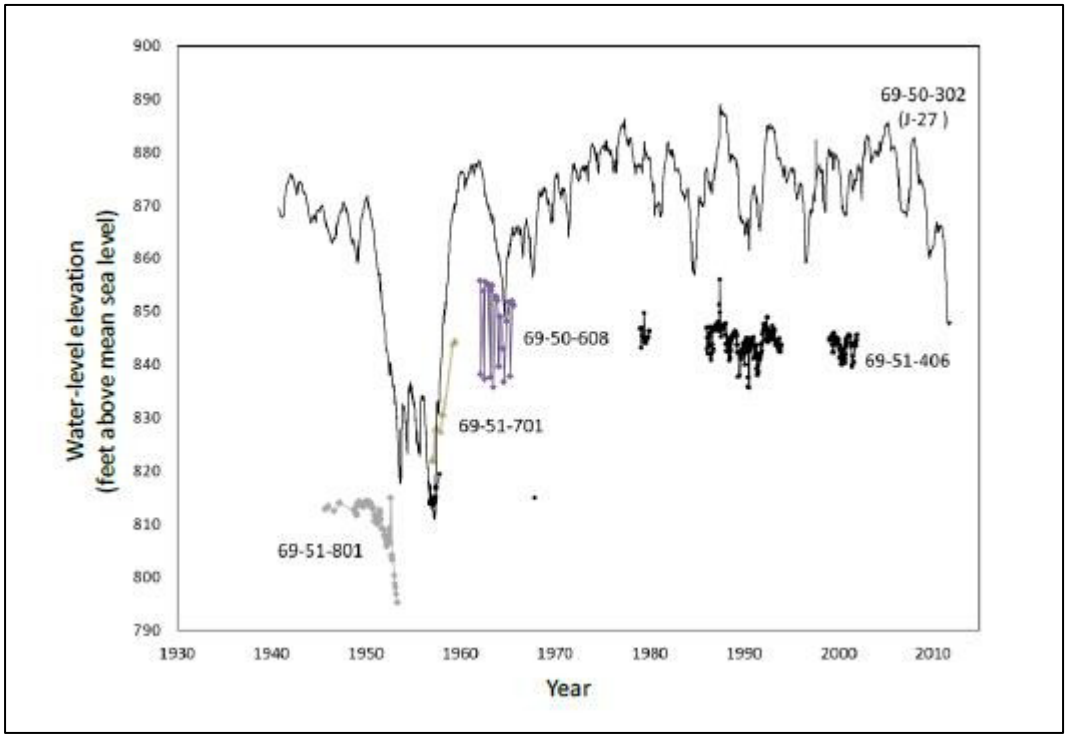

Figure 3. Hydrographs of the J-27 Edwards (Balcones Fault Zone) Aquifer index well and Leona Gravel Aquifer wells in Uvalde County (Bradley, 2012).

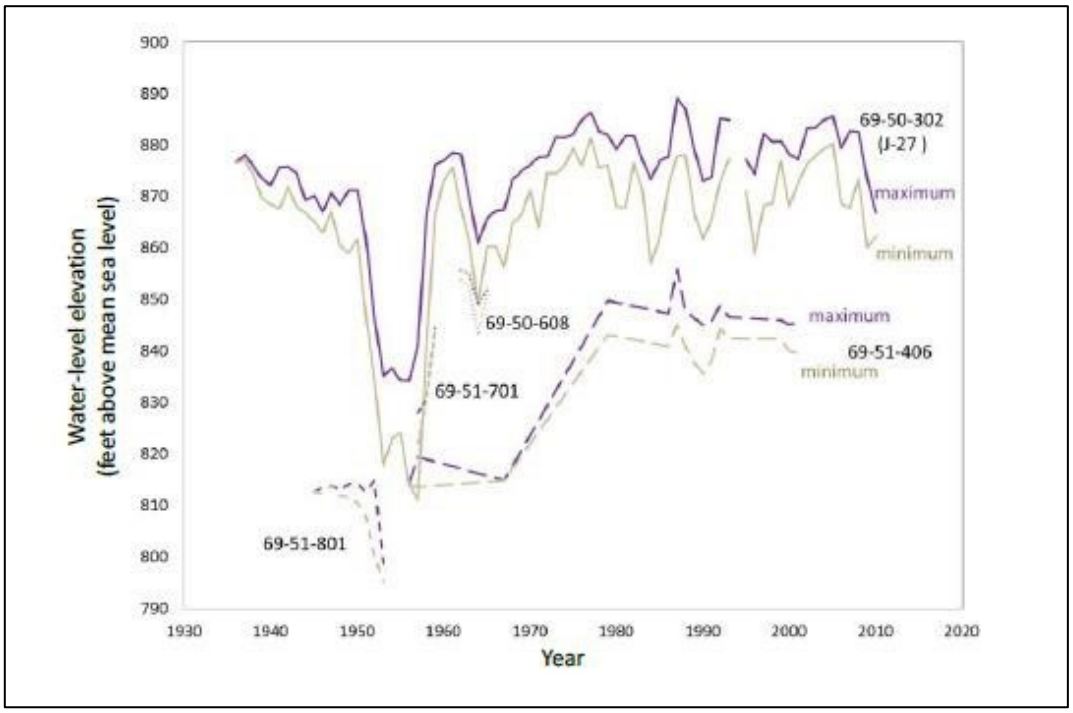

Figure 4. Hydrographs showing maximum and minimum annual water levels for the J-27 Edwards (Balcones Fault Zone) Aquifer index well and Leona Gravel Aquifer wells in Uvalde County (Bradley, 2012).

Table 2. Total estimated exempt use for the other aquifers in the Uvalde County UWCD for decades from 2020 to 2080. Results are in acre-ft /yr. Estimated exempt use calculated by TWDB. (TWDB Projected Exempt Use Estimates, 2020).

Year	2020	2030	2040	2050	2060	2070	2080
Acre-ft	1,489	1,489	1,489	1,489	1,489	1,489	1,489

Table 3. Estimated domestic exempt use for the other aquifers in the Uvalde County UWCD for decades from 2020 to 2080. Results are in acre-ft /yr. Estimated exempt use calculated by TWDB.(TWDB Projected Exempt Use Estimates, 2020).

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

Table 4. Estimated livestock exempt use for the other aquifers in the Uvalde County UWCD for decades from 2020 to 2080. Results are in acre-ft /yr. Estimated exempt use calculated by TWDB. (TWDB Projected Exempt Use Estimates, 2020).

Year	2020	2030	2040	2050	2060	2070	2080
Acre-ft	1,489	1,489	1,489	1,489	1,489	1,489	1,489

Without current water-level data to match with current groundwater pumpage estimates from the Uvalde County UWCD, it is difficult to ascertain the MAG. However, J-27 hydrograph does indicate a possible correlation between water-level conditions in the Edwards (Balcones Fault Zone) Aquifer and water levels within the Leona Gravel Aquifer.

Analyses by Bradley (2013) relied on historical pumping to establish the MAG in response to a DFC of zero drawdown. In response to requests by the Uvalde County UWCD, the TWDB first reduced the extent of the Leona Gravel Aquifer to only include the Leona Formation. Secondly, the TWDB restricted the extent of the Leona Formation to only the Leona River floodplain and the Cooks Slough area. Bradley (2013) calculated that 84 percent of this area is in GMA 10 and that 16 percent of the area is in GMA 13. Thus 57,474 acres of the total Leona Gravel Aquifer acreage of 68,458 acres are in GMA 10. Bradley (2013) noted that if this restricted area were used in the George (2010) calculation, the MAG would be about 6,600 acre-ft/yr.

Bradley (2013) assumed that the Edwards (Balcones Fault Zone) Aquifer index well in Uvalde County, J-27, is an acceptable surrogate monitoring well for the Leona Gravel Aquifer. Using2008 as a year in which no water was taken from storage, Bradley (2013) observed that 11,173 acre-ft were pumped from the Leona Gravel Aquifer without lowering the water table measured by J-27. Eighty-four percent of this is assumed to have been pumped from the Leona Gravel Aquifer in GMA 10. Using this reasoning, Bradley (2013) calculated the MAG from the Leona Gravel Aquifer in Uvalde County to be constant at 9,385 acre-ft/yr.

6. Consideration of Designated Factors

In accordance with Texas Water Code § 36.108 (d-3), the district representatives shall produce a DFC Explanatory Report. The report must include documentation of how nine 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 summarize the information that the GCDs used in its deliberations and discussions.

6.1 Aquifer Uses or Conditions

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

6.1.1 Description of Factors in the Leona Gravel Aquifer in Uvalde County

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. 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. A report completed for the Uvalde County UWCD in 2009 concludes that the Edwards (Balcones Fault Zone) Aquifer is in hydraulic communication with these minor 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., 2009). When the level in index well J-27 drops

below 860 feet msl, recharge to the Leona Formation gravels and discharge to Soldiers Camp Springs to the Nueces River decline measurably.

Aquifer use in Uvalde County divided between surface water and groundwater and among industry sector for the years 2000–2019 is summarized in Table 5 (Texas Water Development Board Historical Water Use TWDB).

Table 5. Aquifer use in Uvalde County divided by surface water and groundwater and among industry sector (Texas Water Development Board Historical Water Use TWDB) (acre-ft).

Year	Source	Municipal	Manufacturing	Steam Electric	Irrigation	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								

6.1.2 DFC Considerations

The dominant use of the Leona Gravel Aquifer 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 this groundwater supply is drought, notably extreme drought that stresses the aquifer. The DFC supports and is, in fact, the linchpin of a drought management program to promote long-term sustainability of water supplies.

6.2 Water-Supply Needs

6.2.1 Description of Factors in the Leona Gravel Aquifer in Uvalde County

Water use in Uvalde County is divided between surface water and groundwater and among industry sector (Uvalde County UWCD Groundwater Management Plan).

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 28,616 in 2010 to 35,650 in 2040, an increase of 24.6 percent (http://txsdc.tamu.edu/tpepp/2001_txpopprj_method.php). The DFC maximizes 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 DFC 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 Leona Gravel Aquifer in Uvalde County

The following is from the 2021 Region L Water Planning Group Plan and the 2022 State Water Plan, which relies on the Water Planning Group Plans. The projected water supply and demand estimates for Uvalde County in the 2022 State Water Plan indicate that projected demands exceed projected supplies (Table 6). To meet the needs of water-user groups in the Uvalde County UWCD, 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 2,501 acre-feet in 2020, increasing to 4,301 acre-feet in 2070. Transfers from the Edwards (Balcones Fault Zone) Aquifer and municipal water conservation are the primary strategies identified (Table 7). The Leona Gravel Aquifer is not identified as part of the water mitigation strategy.

Table 6. Supply vs Shortage

Water User Group	Supply/Shortage		Comment
	2020 (acft/yr)	2070 (acft/yr)	
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 7. 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 DFC under consideration here is specific to the Leona Gravel Aquifer 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 DFC for the Leona Gravel Aquifer, 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 Leona Gravel Aquifer 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 Leona Gravel Aquifer within Table 8.

Table 8. Total estimated recoverable storage for the Leona Gravel Aquifer within Uvalde County UWCD 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)
51,000	12,750	38,250

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.

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

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 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 J-27.

6.4.1.4 Discharge

The Uvalde County UWCD has no estimate of discharge from the Leona Gravel Aquifer. Discharge from the Leona Gravel Aquifer where it exits Uvalde County can be estimated by subtracting the pumpage from the Leona Gravel Aquifer from the inflow to the Leona Gravel Aquifer. The estimated inflow [74,000 acre-ft/yr] less the pumpage [7,176 acre-ft/yr reported in 2010 by permittees] is estimated to be 66,824 acre-ft/yr if exempt pumping is not taken under consideration. Discharge would be less than 66,824 acre-ft/yr if exempt pumping is included in the calculation.

Interaction

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

Named springs in Uvalde County include Soldiers Camp Spring on the Nueces River and Leona Springs on the Leona River. Leona Springs contributes to surface flow in the Leona River, but not to the Leona Gravel Aquifer (Green et al., 2008). The source for the Leona Springs appears to be the Uvalde Gravel and not the Leona Gravel Aquifer, thus discharge at the Leona Springs should not be impacted by the conditions of or impact to the Leona Gravel Aquifer.

An aquifer pump test conducted on the Leona Gravel Aquifer approximately 6 miles south of Highway 90 in the City of Uvalde indicated that the Leona Gravel Aquifer is not in hydraulic communication with the Leona River at that location (Green et al., 2008). The Leona Gravel Aquifer may be in hydraulic communication with the Leona River at other locations; however, this communication has not been established.

6.4.2 DFC Considerations

The DFC is proposed on the basis that the Leona Gravel Aquifer in Uvalde County is in direct hydrologic communication with the Edwards, Austin Chalk, and the Buda Limestone aquifers in the vicinity of the headwaters of the Leona Gravel Aquifer. This hydraulic communication is thought to occur along a reach of the paleo-stream channel that encompasses the Leona Gravel Aquifer starting from a point near Highway 90 in the City of Uvalde and continuing south to near Ft Inge. The four aquifers are well-integrated hydrologically along this reach and have a common potentiometric surface throughout this area. This hydrologic condition denotes that all four aquifers are jointly vulnerable to drought. The Leona Gravel Aquifer in Uvalde County is more vulnerable to drought than the Edwards Aquifer because it is above and has less saturated thickness than the Edwards Aquifer.

7. Subsidence Impacts

Subsidence has historically not been an issue with the Leona 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 Predition 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 Leona Gravel Aquifer 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 Leona Gravel Aquifer. 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 Leona Gravel Aquifer in Uvalde County, as described in Section 6.3, the proposed DFC does 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 Leona Gravel Aquifer 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 Sections 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 DFC is designed to protect the sustained use of the aquifer as a water supply for all users in aggregate. The DFC does 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 UWCD to manage the Leona Gravel Aquifer toward that goal. The Uvalde County UWCD is limited by the hydrogeology of the resource (e.g. how it responds to drought) and the authority of the Uvalde County UWCD 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 UWCD). Because the Edwards (Balcones Fault Zone) Aquifer is the ultimate source of recharge to the Leona Gravel Aquifer, the feasibility of achieving the DFC of the Leona Gravel Aquifer 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 Leona Gravel Aquifer 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 October 26, 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 10. 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 Leona Gravel 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.

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