GTA Aquifer Assessment 10-21 MAG

by David Wuerch, P.G. and Sarah Backhouse
Texas Water Development Board
Groundwater Technical Assistance Section
(512) 936-0870

Robert G. Bradley is a Senior Geoscientist in the Groundwater Technical Assistance Section and is responsible for technical oversight of work performed by Groundwater Technical Assistance Section employees working on Texas Water Development Board Aquifer Assessments. Co-author, David Wuerch, P.G. 484, was responsible for work on this assessment until June 28, 2011. Robert G. Bradley, P.G. 707 on August 19, 2011, authorized the seal appearing on this document.

This page is intentionally blank.

EXECUTIVE SUMMARY:

The estimated total pumping from the Capitan Reef Complex Aquifer that achieves the desired future condition adopted by members of Groundwater Management Area 4 is approximately 9,680 acre-feet per year and is divided by county, regional water planning area, and river basin as shown in Table 2. The estimated managed available groundwater for the groundwater conservation districts in Groundwater Management Area 4 for the aquifer decreases from approximately 9,647 acre-feet per year to 9,644 acre-feet per year between 2010 and 2060 and is shown in Table 5. Total pumping estimates, as well as parameters and assumptions to determine additional total pumping estimates were extracted from GTA Aquifer Assessment 09-08, which Groundwater Management Area 4 used as the basis for developing a desired future condition stating "for Brewster County GCD 0 foot drawdown for the Capitan Reef [Complex Aquifer]," and "for Culberson County GCD 50 foot drawdown for the Capitan Reef [Complex Aquifer]."

REQUESTOR:

Ms. Janet Adams of the Jeff Davis County Underground Water Conservation District acting on behalf of the member groundwater conservation districts of Groundwater Management Area 4.

DESCRIPTION OF REQUEST:

In a letter received August 18, 2010, Ms. Janet Adams provided the Texas Water Development Board (TWDB) with the desired future condition of the Capitan Reef Complex Aquifer adopted by the members of Groundwater Management Area 4. The desired future condition for the Capitan Reef Complex Aquifer, as described in Resolution No. R 2010-01 and adopted August 13, 2010 by the groundwater conservation districts in Groundwater Management Area 4 is described below:

1) *for Brewster County GCD 0 foot drawdown for the Capitan Reef [Complex Aquifer],*
2) *for Culberson County GCD 50 foot drawdown for the Capitan Reef [Complex Aquifer]*

In response to receiving the adopted desired future condition, TWDB has estimated the managed available groundwater that achieves the above desired future condition for Groundwater Management Area 4.

METHODS:

Groundwater Management Area 4, located in West Texas, includes part of the Capitan Reef Complex Aquifer (Figure 1). At the request of Groundwater Management Area 4 the TWDB previously analyzed several water level decline scenarios for the Capitan Reef Complex Aquifer, documented in GTA Aquifer Assessment 09-08.

One of the scenarios included the desired future condition of 50 feet of drawdown for Culberson County Groundwater Conservation District (GCD). For this scenario the total pumping results presented here for Groundwater Management Area 4 are taken directly from GTA Aquifer Assessment 09-08. The assessment did not include a 0 foot drawdown scenario, therefore new calculations to determine the total pumping for Brewster County GCD were completed for this area (Table 1).

To calculate the total pumping for the desired future condition of 0 feet of drawdown for Brewster County GCD parameters and assumptions for the volumetric storage, recharge, map areas, and areal extent were obtained from GTA Aquifer Assessment 09-08 (Wuerch and Davidson, 2010).

To calculate change in aquifer storage for the Brewster County GCD based on the desired future condition, map areas were multiplied by the estimated aquifer storativity or specific yield and then by a uniform water level decline of 0 feet. These volumes were then divided by 50 years to obtain a yearly volume.

Within the boundary of Groundwater Management Area 4, the Capitan Reef Complex Aquifer is located entirely within Regional Water Planning Area E and the Rio Grande River Basin. These areas are shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

- Parameters, assumptions, volumetric calculations, and areas were obtained from GTA Aquifer Assessment 09-08 (Wuerch and Davidson, 2010).
- Water-level declines were estimated to be uniform across the aquifer.

DETERMINING MANAGED AVAILABLE GROUNDWATER:

As defined in Chapter 36 of the Texas Water Code, “managed available groundwater” is the amount of water that may be permitted by a groundwater conservation district. The estimated total annual volume of groundwater calculated, however, represents the total amount of pumping from the aquifer. The total pumping includes uses of water both subject to permitting and exempt

from permitting. Examples of exempt uses include domestic, livestock, and oil and gas exploration. Each district may also exempt additional uses as defined by its rules or enabling legislation.

Since exempt uses are not available for permitting, it is necessary to account for them when determining managed available groundwater. To do this the Texas Water Development Board 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 Texas Water Development Board for consideration. Once established, the estimates of exempt pumping are subtracted from the total pumping calculation to yield the estimated managed available groundwater for permitting purposes.

RESULTS:

The estimated total pumping from the Capitan Reef Complex Aquifer in Groundwater Management Area 4 that achieves the adopted desired future condition is approximately 9,680 acre-feet per year. This pumping has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 2). The total pumping estimate is also summarized by groundwater conservation district as shown in Table 3.

Table 4 contains the estimates of exempt pumping within Groundwater Management Area 4 for domestic and livestock uses. The managed available groundwater for the groundwater conservation districts is the difference between the total pumping (Table 3) and the estimated exempt use (Table 4) and is shown in Table 5.

Table 1. Volumetric calculations estimating the annual total pumping for the Capitan Reef Complex Aquifer in Brewster County GCD. Map areas and parameters were obtained from GTA Aquifer Assessment 09-08 (Wuerch and Davidson, 2010).

GMA	Aquifer	County	GCD	Map Area	Storage coefficient	Areal extent (acres)	Desired total aquifer drawdown (feet)	Estimated total volume from storage (acre-feet)	Estimated annual volume from storage (acre-feet)	Estimated annual effective recharge (ac-ft/yr)	Estimated annual total volume (ac-ft/yr)
4	Capitan Reef Complex	Brewster	Brewster County GCD	1	0.001	72,731	0	0	0	2,100	2,100

GMA = groundwater management area GCD = groundwater conservation district ac-ft/yr = acre-feet per year

The formulas for this table are: storage coefficient * areal extent * desired total aquifer drawdown = estimated total volume from storage. Estimated total volume from storage/50 = estimated annual volume from storage. Then estimated annual volume from storage + estimated annual effective recharge = estimated annual total volume.

Table 2. Estimated total pumping by decade for the Capitan Reef Complex Aquifer in Groundwater Management Area 4. Results are in acre-feet per year and are shown by county, regional water planning area, and river basin.

County	Regional Water Planning Area	River Basin	Year					
			2010	2020	2030	2040	2050	2060
Brewster	E	Rio Grande	2,100	2,100	2,100	2,100	2,100	2,100
Culberson			7,580	7,580	7,580	7,580	7,580	7,580
Total			**9,680**	**9,680**	**9,680**	**9,680**	**9,680**	**9,680**

Table 3. Estimated total pumping for the Capitan Reef Complex Aquifer summarized by groundwater conservation district in Groundwater Management Area 4 for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District (GCD)	Year					
	2010	2020	2030	2040	2050	2060
Brewster County GCD	2,100	2,100	2,100	2,100	2,100	2,100
Culberson County GCD	7,580	7,580	7,580	7,580	7,580	7,580
Total	**9,680**	**9,680**	**9,680**	**9,680**	**9,680**	**9,680**

Table 4. Estimates of exempt use for the Capitan Reef Complex Aquifer by groundwater conservation district for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District (GCD)	Source	Year					
		2010	2020	2030	2040	2050	2060
Brewster County GCD	TA	17	17	18	18	18	18
Culberson County GCD	TA	16	17	17	18	18	18
Total		**33**	**34**	**35**	**36**	**36**	**36**

TA = Estimated exempt use calculated by TWDB and accepted by the district

Table 5. Estimates of managed available groundwater for the Capitan Reef Complex Aquifer in Groundwater Management Area 4 by groundwater conservation district for each decade between 2010 and 2060. Results are in acre-feet per year.

Groundwater Conservation District (GCD)	Year					
	2010	2020	2030	2040	2050	2060
Brewster County GCD	2,083	2,083	2,082	2,082	2,082	2,082
Culberson County GCD	7,564	7,563	7,563	7,562	7,562	7,562
Total	**9,647**	**9,646**	**9,645**	**9,644**	**9,644**	**9,644**

LIMITATIONS:

Managed available groundwater numbers included in this report are the result of subtracting the estimated future exempt use from the estimated total pumping that would achieve the desired future condition adopted by the groundwater conservation districts in the groundwater management area. These numbers, therefore, are the result of (1) using a simplified water budget to estimate the total pumping which achieves the desired future condition and (2) estimating the future exempt use in the area.

The water budget in this analysis was determined to be the best method to calculate a total pumping estimate, however this method has limitations and should be replaced with better tools, including groundwater models and additional data that are not currently available, whenever possible. This analysis assumes homogeneous and isotropic aquifers; however, aquifer conditions may not be uniform. The analysis further assumes that precipitation is the only source of aquifer recharge that lateral inflow to the aquifer is equal to lateral outflow from the aquifer, and that future pumping will not alter this balance. In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing these total pumping estimates. Those assumptions also

need to be considered and compared to actual future data when evaluating achievement of the desired future condition.

In the case of TWDB's estimates of future exempt use, key assumptions were made as to the pattern of population growth relative to the need for domestic wells or supplied water, per capita use from domestic wells, and livestock use of water. In the case of district estimates of future exempt use, including exempt use associated with the exploration of oil and gas, the assumptions are specific to that district. In any case, these assumptions will need to be considered when reviewing future data related to exempt use.

Given these limitations, users of this information are cautioned that the total pumping numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor future groundwater pumping and water levels to know if they are achieving their desired future conditions. Because of the limitations of using a water budget and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine these managed available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES:

Wuerch D. and Davidson, S., 2010, GTA Aquifer Assessment 09-08: Texas Water Development Board, GTA Aquifer Assessment 09-08 Report, 9 p.

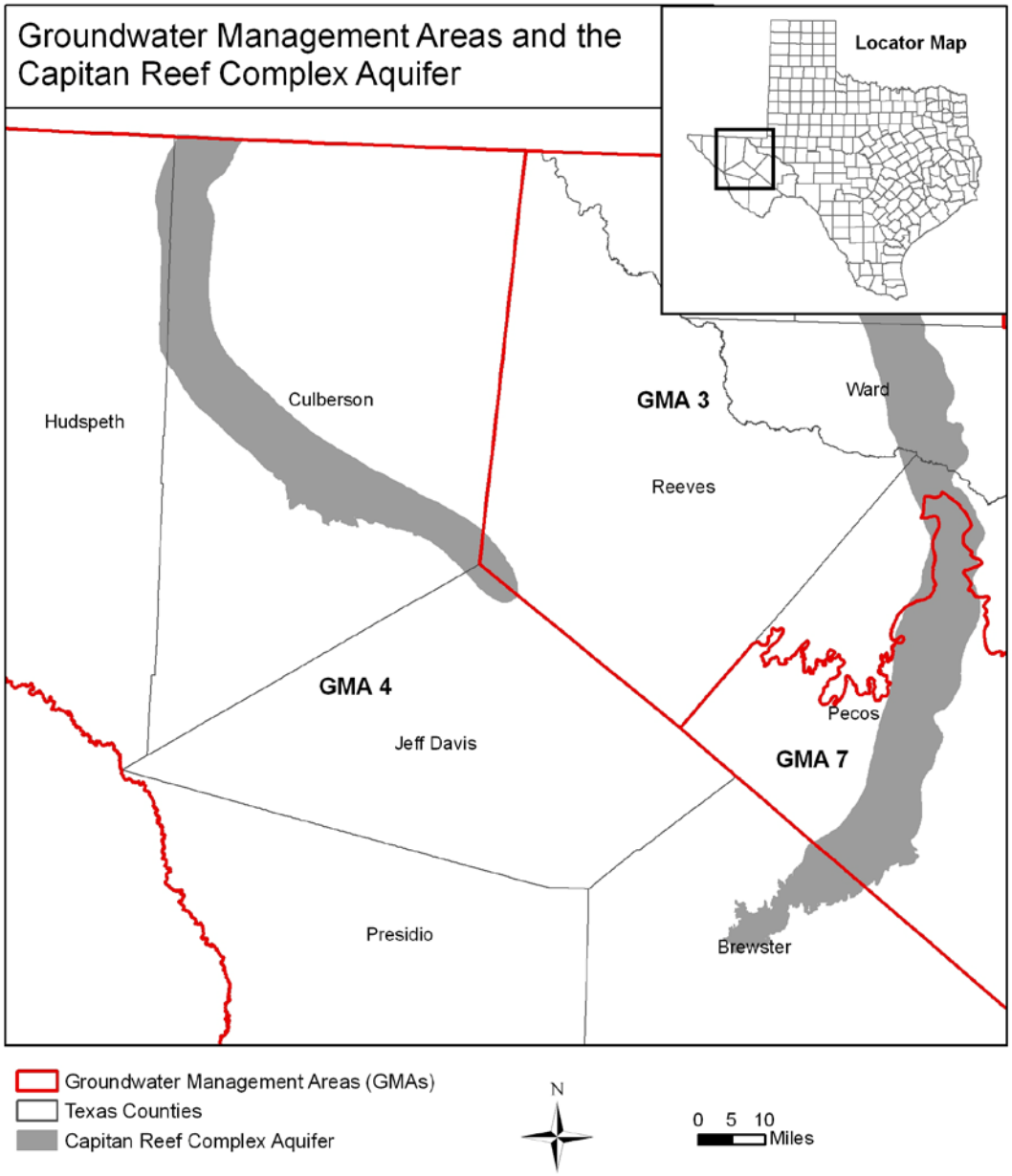

Figure 1. Map showing the area covered by the Capitan Reef Complex Aquifer.

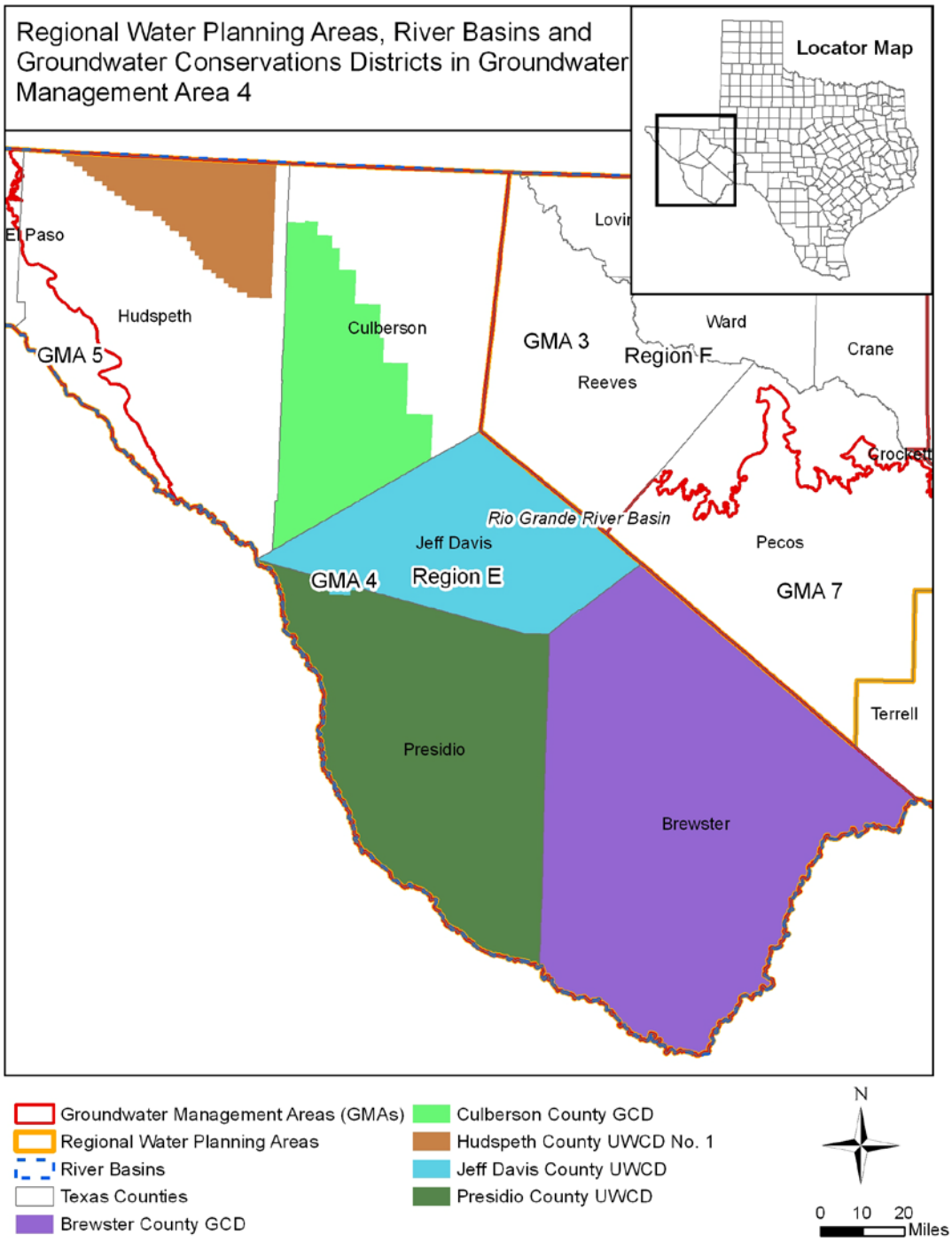

Figure 2. Map showing regional water planning areas, river basins, groundwater conservation districts and counties in Groundwater Management Area 4. GCD = Groundwater Conservation District, UWCD = Underground Water Conservation District