# GTA Aquifer Assessment 09-10

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Texas Water Development Board Groundwater Technical Assistance Section (512) 936-2245



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## **REQUESTOR:**

Janet Adams, General Manager of the Jeff Davis County and Presidio County underground water conservation districts, acting on behalf of Groundwater Management Area 4.

#### **DESCRIPTION OF REQUEST:**

Ms. Janet Adams provided the Texas Water Development Board (TWDB) with draft desired future conditions for the aquifers in Groundwater Management Area 4 and requested that TWDB evaluate the draft desired future conditions. This aquifer analysis estimates the annual total pumping to achieve the draft desired future conditions for the Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers in Groundwater Management Area 4.

## DRAFT DESIRED FUTURE CONDITIONS:

For the Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers,

- Culberson County GCD—on average a 50-foot drawdown over 50 years
- Jeff Davis County Underground Water Conservation District (UWCD)—on average a 10-foot drawdown over 50 years
- Presidio County UWCD—on average a 5-foot drawdown over 50 years
- areas outside conservation district boundaries—on average a 20-foot drawdown over 50 years

#### **METHODS:**

Due to limited data on these aquifers, a simple method of determining groundwater volume based on a uniform water-level decline was used. A transient hydrologic budget for the saturated portion of an aquifer is described by Freeze and Cherry (1979, p. 365):

$$Q(t) = R(t) - D(t) + \frac{dS}{dt}$$

where

Q(t)= total rate of groundwater withdrawal R(t)= total rate of groundwater recharge to the basin D(t)= total rate of groundwater discharge from the basin  $\frac{dS}{dt}$  = rate of change of storage in the saturated zone of the basin

For this analysis, it is assumed that

$$R(t) = R(r) + R(e)$$

where R(r) = rejected recharge for the basin R(e) = effective recharge

Effective recharge is the amount of water that enters an aquifer and is available for development (Muller and Price, 1979, p. 5). Rejected recharge is the amount of total (or potential) recharge that discharges from an aquifer because it is overfull and cannot accept more water (Theis, 1940, p. 1).

In addition, it is assumed that

$$R(r) \cong D(t)$$

Therefore, the total rate of groundwater pumping equals effective recharge plus the change in storage of the aquifer:

$$Q(t) = R(e) + \frac{dS}{dt}$$

The Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers are located entirely within the Rio Grande River Basin and the Far West Regional Water Planning Area (Region E). To calculate the total pumping, the aquifers were divided into map areas by county and groundwater conservation district (Figure 1). The areal extent of each aquifer map area was calculated. These areas were used to calculate estimated annual effective recharge.

To determine the volume from storage used to reach the desired water-level drawdown, the areas were multiplied by the estimated aquifer storage coefficient and by the drained saturated thickness necessary to maintain the draft desired future condition. This volume was then divided by 50 years to obtain a yearly volume.

The calculations were completed in a Microsoft Excel worksheet.

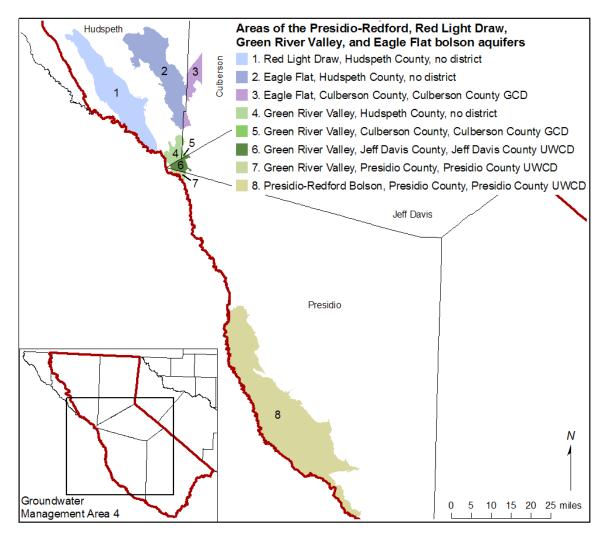


Figure 1. Map areas for estimating total pumping for the Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers in Groundwater Management Area 4.

#### PARAMETERS AND ASSUMPTIONS:

- The areas, in acres, for each map area were calculated using the shapefile used for the steady-state groundwater availability model for the Presidio-Redford, Red Light Draw, Green River Valley, and Eagle Flat bolson aquifers, projected into the groundwater availability modeling (GAM) projection (Anaya, 2001), within ArcGIS 9.3.
- Recharge to the Red Light Draw, Green River Valley, and Eagle Flat aquifers is estimated to be 1,631, 248, and 2,869 acre-feet per year,

respectively, based on a runoff-redistribution method (Beach and others, 2008).

- Recharge to the Presidio-Redford Bolson Aquifer is estimated at 3,630 acre-feet per year, calculated as 1 percent of average annual rainfall over the recharge area of the bolson (FWTRWPG, 2001).
- Specific yield of the Red Light Draw, Green River Valley, and Eagle Flat aquifers is estimated to be 0.035, based on estimates from the calibrated steady-state groundwater availability model for these aquifers (Beach and others, 2008).
- Specific yield of the Presidio-Redford Bolson Aquifer is estimated to be 0.075 for the Alamito Creek area of the Presidio Bolson and 0.10 for the Redford Bolson (Gates and others, 1980). The average of these estimates, 0.0875, was used in this assessment.
- All of the aquifers are assumed to be unconfined.
- The draft annual total pumping estimates are the sum of the annual effective recharge amount and the annual volume of water depleted from the aquifer based on the draft desired future condition.
- Annual volumes of water taken from storage are calculated by dividing the total volume of depletion, based on the draft desired future condition, by 50 years.
- Water-level declines are estimated to be uniform across the aquifer within map areas.
- It is assumed that the water-level declines do not exceed aquifer thickness.
- Conditions were assumed to be physically possible across the groundwater management area.

## **RESULTS**:

The total annual effective recharge estimate for the Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers in Groundwater Management Area 4 is 8,378 acre-feet per year (Table 1).

Tables 1 and 2 show the draft annual total pumping estimates for the Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers in Groundwater Management Area 4. Based on the draft desired future conditions provided, the estimated total pumping volume for these aquifers in Groundwater Management Area 4 is 15,064 acre-feet per year. Specifically,

• Culberson County GCD has a total of 1,205 acre-feet per year of total pumping in the Eagle Flat Aquifer and 69 acre-feet per year of total pumping in the Green River Valley Aquifer;

- the area of Hudspeth County outside the Hudspeth County UWCD No. 1 has a total of 3,741 acre-feet per year of total pumping in the Eagle Flat Aquifer, 306 acre-feet per year total pumping in the Green River Valley Aquifer, and 3,285 acre-feet per year of total pumping in the Red Light Draw Aquifer;
- Jeff Davis County UWCD has a total of 128 acre-feet per year of total pumping in the Green River Valley Aquifer; and
- Presidio County UWCD has a total of 6,282 acre-feet per year of total pumping in the Presidio-Redford Bolson Aquifer and 48 acre-feet per year of total pumping in the Green River Valley Aquifer.

Table 1. Estimates of annual total pumping for the Presidio-Redford, Red Light Draw, Green River Valley, and Eagle Flat bolson aquifers in Groundwater Management Area 4, summarized by map areas (see Figure 1).

(feet)         (acre-feet)         (ac-ft/yr)         (ac-ft/yr					Map	Specific	Areal extent	Desired total aquifer drawdown	Estimated total volume from storage	Estimated annual volume from storage	Estimated annual effective recharge	Estimated annual total volume
Red Light         Hudspeth         none         1         0.035         118,127         20         82,689         1,654         1,631         1           Hudspeth         none         2         0.035         97,541         20         68,279         1,654         1,631           Hudspeth         county         3         0.035         20,309         50         35,541         711         494           Hudspeth         none         4         0.035         1,537         36,541         711         494           Hudspeth         none         4         0.035         1,537         50         3,541         711         494           Hudspeth         none         4         0.035         1,537         50         3,070         167         124           Hudspeth         none         0.035         1,537         50         2,719         714         16         16           Valley         Jeff Davis         UWCD         6         0.035         3,700         50         54         15         16           Presidio         Presidio         NWCD         1         0.035         3,700         56         3,530         15         56	GMA		County	GCD	area	yield	(acres)	(feet)	(acre-feet)	(ac-ft/yr)	(ac-ft/yr)	(ac-ft/yr)
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Eagle Flat         Culberson GCD         Culberson GCD         0.035         20,309         50         35,541         711         494           Hudspeth         none         4         0.035         13,010         20         9,107         182         124           Hudspeth         none         4         0.035         1,537         50         3,541         711         494           Rene         Culberson         County         5         0.035         1,537         50         2,690         54         15           Valley         Jeff Davis         Londor         7,769         10         2,719         54         74           Valley         Jeff Davis         Londor         7,769         10         2,719         54         74           Valley         Defension         UWCD         0.035         3,700         5         648         13         35           Presidio         Presidio         County         8         0.035         3,700         548         74         74           Presidio         Presidio         County         8         0.035         3,700         548         74         74           Presidio         Presidio			Hudspeth		2	0.035	97,541	20	68,279	1,366		3,741
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specific yield \* areal extent \* desired total aquifer drawdown = estimated total volume from storage

estimated total volume from storage/50 = estimated annual volume from storage

Table 2. Summary of estimated annual total pumping for the Presidio-Redford, Red Light Draw, Green River Valley, and Eagle Flat bolson aquifers in Groundwater Management Area 4.

Мар				River					Total Pumping
key	Aquifer	County	RWPA	basin	GCD	GMA	GeoArea	Year	(ac-ft/yr)
1	Red Light Draw	Hudspeth	Е	Rio Grande	none	4	n/a	n/a	3,285
2	Eagle Flat	Hudspeth	Е	Rio Grande	none	4	n/a	n/a	3,741
3	Eagle Flat	Culberson	Е	Rio Grande	Culberson County GCD	4	n/a	n/a	1,205
4	Green River Valley	Hudspeth	Е	Rio Grande	none	4	n/a	n/a	306
5	Green River Valley	Culberson	Е	Rio Grande	Culberson County GCD	4	n/a	n/a	69
6	Green River Valley	Jeff Davis	Е	Rio Grande	Jeff Davis County UWCD	4	n/a	n/a	128
7	Green River Valley	Presidio	Е	Rio Grande	Presidio County UWCD	4	n/a	n/a	48
8	Presidio-Redford Bolson	Presidio	Е	Rio Grande	Presidio County UWCD	4	n/a	n/a	6,282

RWPA = regional water planning area, GCD = groundwater conservation district, UWCD = underground water conservation district, GMA = groundwater management area, GeoArea = geographic areas defined by unique desired future conditions as specified by a groundwater management area, ac-ft/yr = acre-feet per year.

## LIMITATIONS:

Additional data are needed to create improved estimates; these estimates are a fundamental interpretation of the requested conditions. This analysis assumes homogeneous and isotropic aquifers; however, conditions for the Presidio-Redford Bolson, Red Light Draw, Green River Valley, and Eagle Flat aquifers may not behave in a uniform manner. The analysis further assumes that lateral inflow to the aquifer is equal to lateral outflow from the aquifer and that future pumping will not alter this balance.

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