GTA Aquifer Assessment 08-08

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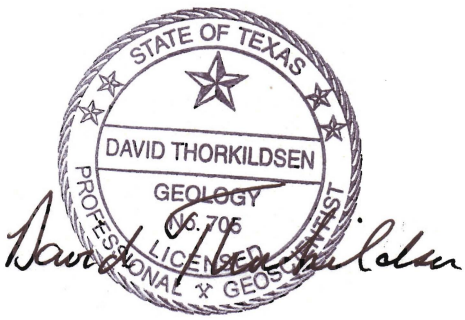

August 31, 2010

REQUESTOR:

Caroline Runge, of the Menard County Underground Water District acting on behalf of the member groundwater conservation districts of Groundwater Management Area 7.

DESCRIPTION OF REQUEST:

In a letter dated July 8, 2008, Ms. Caroline Runge provided the Texas Water Development Board (TWDB) with draft desired future conditions for the Hickory and Ellenburger-San Saba aquifers in Groundwater Management Area 7 and requested that TWDB evaluate the draft desired future condition scenarios for each of those areas. This aquifer assessment estimates the annual total pumping to achieve the draft desired future condition scenarios for the Ellenburger-San Saba Aquifer in Groundwater Management Area 7.

DRAFT DESIRED FUTURE CONDITIONS:

- Ellenburger-San Saba Aquifer – Four scenarios that allow water-level declines of 5, 10, 15, and 20 feet after 50 years, respectively.

METHODS:

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

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, or:

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

County, regional water planning area, river basin, subcrop/outcrop, and groundwater conservation district boundaries subdivided the aquifer into map areas (Figure 1). The areal extent of each aquifer map area was calculated. These areas were used to calculate estimated annual effective recharge and change in aquifer storage.

These map areas were multiplied by the estimated aquifer storativity, and then by uniform water level declines of 5, 10, 15, and 20 feet. These volumes were then divided by 50 years to obtain a yearly volume. In cases where unconfined and confined conditions existed, those were calculated separately.

Annual effective recharge to the aquifer was calculated by multiplying each outcrop area by the average precipitation (1971 to 2000) and an estimated effective recharge rate. In Gillespie County the recharge area was increased based on additional aquifer data provided by the Hill Country Underground Water Conservation District (HCUWCD) and a groundwater availability model of the Ellenburger Aquifer in Southeast Gillespie County (LBG-Guyton Associates, 2007).

The calculations were completed in a Microsoft Excel worksheet.

PARAMETERS AND ASSUMPTIONS:

- Water level declines of 5, 10, 15, and 20 feet, respectively, were estimated to be uniform across the aquifer.
- The areas for each area were calculated from the Texas Water Development Board (TWDB) shapefile for the Ellenburger-San Saba Aquifer, projected into the groundwater availably modeling (GAM) projection (Anaya, 2001).
- Areas, in acres, were calculated within ArcGIS 9.2.

- Average annual precipitation was used to calculate annual average effective recharge volumes.
- The average annual precipitation (1971-2000) for the aquifer map area (Table 1) was determined from the Texas Climatic Atlas (Narasimhan and others, 2008).
- Annual effective recharge from precipitation is estimated to be 2 percent of annual precipitation (Muller and Price, 1979) and is applied to outcrop areas and the additional recharge area delineated in Gillespie County
- 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 are calculated by dividing the total volume by 50 years.
- Specific yield of the aquifer is estimated as 0.03 (LBG-Guyton Associates, 2003) and the storage coefficient is estimated as 0.002 (Bluntzer, 1992; LBG-Guyton Associates, 2003).
- Outcrop areas are calculated as unconfined areas of the aquifer and subcrop areas are calculated as confined areas of the aquifer.
- Conditions were assumed to be physically possible across the groundwater management area.

Table 1. Estimated total annual effective recharge volume for the Ellenburger-San Saba Aquifer by map area subdivisions (See Figure 1).

GMA	Aquifer	County	GCD	Map Area	Areal extent (acres)	Estimated average annual precipitation (inches)	Estimated average annual precipitation (feet)	Effective recharge rate (percent)	Estimated annual effective recharge (ac-ft/yr)
7	Ellenburger-San Saba	Llano	None	1	40,012	29	2.42	2	1,937
		San Saba	None	2	67,338	29	2.42	2	3,259
			Hickory UWCD No.1	4	211,426	29	2.42	2	10,233
		McCulloch	Hickory UWCD No.1	6	110,411	27	2.25	2	4,968
		Mason	Hickory UWCD No.1	12	120,577	27	2.25	2	5,426
		Menard	Hickory UWCD No.1	14	902	26	2.17	2	39
		Kimble	Hickory UWCD No.1	17	4,340	26	2.17	2	188
			Kimble County GCD	19	1,323	27	2.25	2	60
		Gillespie	Hill Country UWCD	21	162,789*	31	2.58	2	8,400
								Total	34,510

GMA = groundwater management area
GCD = groundwater conservation district
UWCD = underground water conservation district
ac-ft/yr = acre-feet per year
*The areal extent used to calculate recharge for Map Area 21 is a combination of 11,175 acres of the Ellenberger-San Saba Aquifer outcrop and 151,614 acres of Hensell Sand outcrop, alluvium, and colluvium.
The formula for this table is: areal extent (acres) * estimated average annual precipitation (feet) * effective recharge rate = estimated annual effective recharge (ac-ft/yr).

RESULTS:

The annual effective recharge estimate for the Ellenburger-San Saba Aquifer in Groundwater Management Area 7 is 34,510 acre-feet per year.

The results (Tables 3-7) show the draft annual total pumping estimates for the Ellenburger-San Saba Aquifer in Groundwater Management Area (GMA) 7. A 5-foot decline results in an estimated annual total pumping of 36,576 acre-feet per year, a 10-foot decline results in an estimated annual total pumping of 38,644 acre-feet per year, a 15-foot decline results in an estimated annual total pumping of 40,710 acre-feet per year, and a 20-foot decline results in an estimated annual total pumping of 42,775 acre-feet per year.

The following table summarizes the draft annual total pumping for the groundwater conservation districts based on the requested conditions for the Ellenburger-San Saba Aquifer in GMA 7.

Table 2. Summary draft annual total pumping for the Ellenburger-San Saba Aquifer in GMA 7 by groundwater conservation district.

Groundwater Conservation District	**5 ft. decline**	**10 ft. decline**	**15 ft. decline**	**20 ft. decline**
Hickory UWCD No. 1	22,315	23,777	25,239	26,701
Hill Country UWCD	8,544	8,688	8,831	8,974
Kimble County GCD	100	141	181	221
Lipan-Kickapoo WCD	1	1	2	2
Menard County UWD	13	26	38	51
Total (ac-ft/yr)	**30,973**	**32,633**	**34,291**	**35,949**

UWCD = underground water conservation district
WCD = water conservation district
UWD = underground water district
ac-ft/yr = acre-feet per year

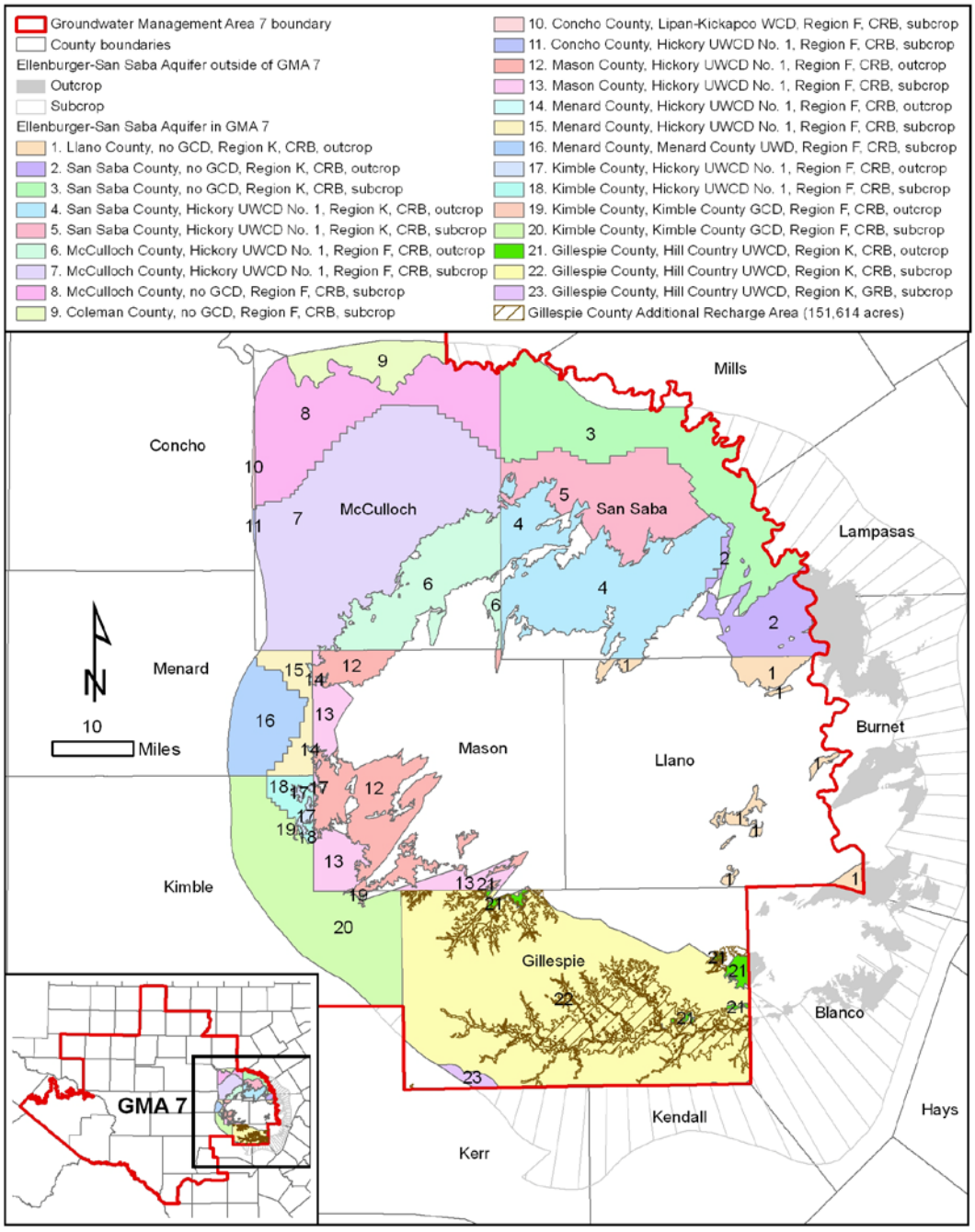

Figure 1. Geographic subdivisions for analyzing draft total pumping for the Ellenburger-San Saba Aquifer in Groundwater Management Area 7. GMA = groundwater management area, GCD = groundwater conservation district, UWCD = underground water conservation district, UWD = underground water district, WCD = water conservation district,
CRB = Colorado River Basin, GRB = Guadalupe River Basin

Table 3. Estimates of draft annual total pumping for the Ellenburger-San Saba Aquifer summarized by map areas (see Figure 1).

GMA	Aquifer	County	GCD	Map Area	Estimated storage coefficient	Areal extent (acres)	Desired total aquifer water level decline (feet)	Estimated total volume from water level decline (acre-feet)	Estimated annual volume from water level decline (acre-feet)	Estimated annual effective recharge[1] (ac-ft/yr)	Estimated annual total volume (ac-ft/yr)
7	Ellenburger-San Saba	Llano	None	1	0.03	40,012	5	6,002	120	1,937	2,057
					0.03	40,012	10	12,004	240	1,937	2,177
					0.03	40,012	15	18,005	360	1,937	2,297
					0.03	40,012	20	24,007	480	1,937	2,417
		San Saba	None	2	0.03	67,338	5	10,101	202	3,259	3,461
					0.03	67,338	10	20,201	404	3,259	3,663
					0.03	67,338	15	30,302	606	3,259	3,865
					0.03	67,338	20	40,403	808	3,259	4,067
				3	0.002	210,875	5	2,109	42	0	42
					0.002	210,875	10	4,218	84	0	84
					0.002	210,875	15	6,326	127	0	127
					0.002	210,875	20	8,435	169	0	169
			Hickory UWCD No.1	4	0.03	211,426	5	31,714	634	10,233	10,867
					0.03	211,426	10	63,428	1,269	10,233	11,502
					0.03	211,426	15	95,142	1,903	10,233	12,136
					0.03	211,426	20	126,856	2,537	10,233	12,770
				5	0.002	128,770	5	1,288	26	0	26
					0.002	128,770	10	2,575	52	0	52
					0.002	128,770	15	3,863	77	0	77
					0.002	128,770	20	5,151	103	0	103
		McCulloch	Hickory UWCD No.1	6	0.03	110,411	5	16,562	331	4,968	5,299
					0.03	110,411	10	33,123	662	4,968	5,630
					0.03	110,411	15	49,685	994	4,968	5,962
					0.03	110,411	20	66,247	1,325	4,968	6,293
				7	0.002	348,790	5	3,488	70	0	70
					0.002	348,790	10	6,976	140	0	140
					0.002	348,790	15	10,464	209	0	209
					0.002	348,790	20	13,952	279	0	279
			None	8	0.002	170,551	5	1,706	34	0	34
					0.002	170,551	10	3,411	68	0	68
					0.002	170,551	15	5,117	102	0	102
					0.002	170,551	20	6,822	136	0	136
		Coleman	None	9	0.002	46,525	5	465	9	0	9
					0.002	46,525	10	931	19	0	19
					0.002	46,525	15	1,396	28	0	28
					0.002	46,525	20	1,861	37	0	37
		Concho	Lipan-Kickapoo WCD	10	0.002	2,608	5	26	1	0	1
					0.002	2,608	10	52	1	0	1
					0.002	2,608	15	78	2	0	2
					0.002	2,608	20	104	2	0	2
			Hickory UWCD No.1	11	0.002	902	5	9	0	0	0
					0.002	902	10	18	0	0	0
					0.002	902	15	27	1	0	1
					0.002	902	20	36	1	0	1
		Mason	Hickory UWCD No.1	12	0.03	120,577	5	18,087	362	5,426	5,788
					0.03	120,577	10	36,173	723	5,426	6,149
					0.03	120,577	15	54,260	1,085	5,426	6,511
					0.03	120,577	20	72,346	1,447	5,426	6,873
				13	0.002	66,362	5	664	13	0	13
					0.002	66,362	10	1,327	27	0	27
					0.002	66,362	15	1,991	40	0	40
					0.002	66,362	20	2,654	53	0	53

Table 3 continued.

7	Ellenburger-San Saba	Menard	Hickory UWCD No.1	14	0.03	902	5	135	3	39	42
					0.03	902	10	271	5	39	44
					0.03	902	15	406	8	39	47
					0.03	902	20	541	11	39	50
				15	0.002	32,171	5	322	6	0	6
					0.002	32,171	10	643	13	0	13
					0.002	32,171	15	965	19	0	19
					0.002	32,171	20	1,287	26	0	26
			Menard County UWD	16	0.002	63,810	5	638	13	0	13
					0.002	63,810	10	1,276	26	0	26
					0.002	63,810	15	1,914	38	0	38
					0.002	63,810	20	2,552	51	0	51
		Kimble	Hickory UWCD No.1	17	0.03	4,340	5	651	13	188	201
					0.03	4,340	10	1,302	26	188	214
					0.03	4,340	15	1,953	39	188	227
					0.03	4,340	20	2,604	52	188	240
				18	0.002	16,083	5	161	3	0	3
					0.002	16,083	10	322	6	0	6
					0.002	16,083	15	482	10	0	10
					0.002	16,083	20	643	13	0	13
			Kimble County GCD	19	0.03	1,323	5	198	4	60	64
					0.03	1,323	10	397	8	60	68
					0.03	1,323	15	595	12	60	72
					0.03	1,323	20	794	16	60	76
				20	0.002	181,295	5	1,813	36	0	36
					0.002	181,295	10	3,626	73	0	73
					0.002	181,295	15	5,439	109	0	109
					0.002	181,295	20	7,252	145	0	145
		Gillespie	Hill Country UWCD	21	0.03	11,175	5	1,676	34	8,400	8,434
					0.03	11,175	10	3,353	67	8,400	8,467
					0.03	11,175	15	5,029	101	8,400	8,501
					0.03	11,175	20	6,705	134	8,400	8,534
				22	0.002	543,935	5	5,439	109	0	109
					0.002	543,935	10	10,879	218	0	218
					0.002	543,935	15	16,318	326	0	326
					0.002	543,935	20	21,757	435	0	435
				23	0.002	6,324	5	63	1	0	1
					0.002	6,324	10	126	3	0	3
					0.002	6,324	15	190	4	0	4
					0.002	6,324	20	253	5	0	5
		Total					5				36,576
						2,386,505	10			34,510	38,644
							15				40,710
							20				42,775

GMA = groundwater management area
GCD = groundwater conservation district
UWCD = underground water conservation district
ac-ft/yr = acre-feet per year
WCD = water conservation district
UWD = underground water district

1 - This is the estimated total annual effective recharge volume for the Ellenburger-San Saba Aquifer by map areas as shown in Table 1.
The formulas for this table are: storage coefficient * areal extent * desired total aquifer water level decline = estimated total volume from water level decline. Estimated total volume from water level decline/50 = estimated annual volume from water level decline. Then estimated annual volume from water level decline + estimated annual effective recharge = estimated annual total volume.

Table 4. Estimates of draft annual total pumping for water level declines of 5 feet in the Ellenburger-San Saba Aquifer (see Figure 1).

Map Key	Aquifer	County	RWPA	River Basin	GCD	GMA	GeoArea	Year	Outcrop/ Subcrop	Total Pumping (acre-feet per year)
1	Ellenburger-San Saba	Llano	K	Colorado	n/a	7	n/a	n/a	outcrop	2,057
2	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	outcrop	3,461
3	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	subcrop	42
4	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	10,867
5	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	26
6	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	5,299
7	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	70
8	Ellenburger-San Saba	McCulloch	F	Colorado	n/a	7	n/a	n/a	subcrop	34
9	Ellenburger-San Saba	Coleman	F	Colorado	n/a	7	n/a	n/a	subcrop	9
10	Ellenburger-San Saba	Concho	F	Colorado	Lipan-Kickapoo WCD	7	n/a	n/a	subcrop	1
11	Ellenburger-San Saba	Concho	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	0
12	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	5,788
13	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	13
14	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	42
15	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	6
16	Ellenburger-San Saba	Menard	F	Colorado	Menard County UWD	7	n/a	n/a	subcrop	13
17	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	201
18	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	3
19	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	outcrop	64
20	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	subcrop	36
21	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	outcrop	8,434
22	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	subcrop	109
23	Ellenburger-San Saba	Gillespie	K	Guadalupe	Hill Country UWCD	7	n/a	n/a	subcrop	1

RWPA = regional water planning area
GMA = groundwater management area
GCD = groundwater conservation district
WCD = water conservation district
UWCD = underground water conservation district
UWD = underground water district
GeoArea = Geographic areas defined by unique desired future conditions as specified by a groundwater management area.

Table 5. Estimates of draft annual total pumping for water level declines of 10 feet in the Ellenburger-San Saba Aquifer (see Figure 1).

Map Key	Aquifer	County	RWPA	River Basin	GCD	GMA	GeoArea	Year	Outcrop/ Subcrop	Total Pumping (acre-feet per year)
1	Ellenburger-San Saba	Llano	K	Colorado	n/a	7	n/a	n/a	outcrop	2,177
2	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	outcrop	3,663
3	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	subcrop	84
4	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	11,502
5	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	52
6	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	5,630
7	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	140
8	Ellenburger-San Saba	McCulloch	F	Colorado	n/a	7	n/a	n/a	subcrop	68
9	Ellenburger-San Saba	Coleman	F	Colorado	n/a	7	n/a	n/a	subcrop	19
10	Ellenburger-San Saba	Concho	F	Colorado	Lipan-Kickapoo WCD	7	n/a	n/a	subcrop	1
11	Ellenburger-San Saba	Concho	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	0
12	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	6,149
13	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	27
14	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	44
15	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	13
16	Ellenburger-San Saba	Menard	F	Colorado	Menard County UWD	7	n/a	n/a	subcrop	26
17	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	214
18	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	6
19	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	outcrop	68
20	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	subcrop	73
21	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	outcrop	8,467
22	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	subcrop	218
23	Ellenburger-San Saba	Gillespie	K	Guadalupe	Hill Country UWCD	7	n/a	n/a	subcrop	3

RWPA = regional water planning area
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GMA = groundwater management area
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GeoArea = Geographic areas defined by unique desired future conditions as specified by a groundwater management area.

Table 6. Estimates of draft annual total pumping for water level declines of 15 feet in the Ellenburger-San Saba Aquifer (see Figure 1).

Map Key	Aquifer	County	RWPA	River Basin	GCD	GMA	GeoArea	Year	Outcrop/ Subcrop	Total Pumping (acre-feet per year)
1	Ellenburger-San Saba	Llano	K	Colorado	n/a	7	n/a	n/a	outcrop	2,297
2	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	outcrop	3,865
3	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	subcrop	127
4	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	12,136
5	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	77
6	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	5,962
7	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	209
8	Ellenburger-San Saba	McCulloch	F	Colorado	n/a	7	n/a	n/a	subcrop	102
9	Ellenburger-San Saba	Coleman	F	Colorado	n/a	7	n/a	n/a	subcrop	28
10	Ellenburger-San Saba	Concho	F	Colorado	Lipan-Kickapoo WCD	7	n/a	n/a	subcrop	2
11	Ellenburger-San Saba	Concho	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	1
12	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	6,511
13	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	40
14	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	47
15	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	19
16	Ellenburger-San Saba	Menard	F	Colorado	Menard County UWD	7	n/a	n/a	subcrop	38
17	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	227
18	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	10
19	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	outcrop	72
20	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	subcrop	109
21	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	outcrop	8,501
22	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	subcrop	326
23	Ellenburger-San Saba	Gillespie	K	Guadalupe	Hill Country UWCD	7	n/a	n/a	subcrop	4

RWPA = regional water planning area
GCD = groundwater conservation district
UWCD = underground water conservation district
GMA = groundwater management area
WCD = water conservation district
UWD = underground water district
GeoArea = Geographic areas defined by unique desired future conditions as specified by a groundwater management area.

Table 7. Estimates of draft annual total pumping for water level declines of 20 feet in the Ellenburger-San Saba Aquifer (see Figure 1).

Map Key	Aquifer	County	RWPA	River Basin	GCD	GMA	GeoArea	Year	Outcrop/ Subcrop	Total Pumping (acre-feet per year)
1	Ellenburger-San Saba	Llano	K	Colorado	n/a	7	n/a	n/a	outcrop	2,417
2	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	outcrop	4,067
3	Ellenburger-San Saba	San Saba	K	Colorado	n/a	7	n/a	n/a	subcrop	169
4	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	12,770
5	Ellenburger-San Saba	San Saba	K	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	103
6	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	6,293
7	Ellenburger-San Saba	McCulloch	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	279
8	Ellenburger-San Saba	McCulloch	F	Colorado	n/a	7	n/a	n/a	subcrop	136
9	Ellenburger-San Saba	Coleman	F	Colorado	n/a	7	n/a	n/a	subcrop	37
10	Ellenburger-San Saba	Concho	F	Colorado	Lipan-Kickapoo WCD	7	n/a	n/a	subcrop	2
11	Ellenburger-San Saba	Concho	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	1
12	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	6,873
13	Ellenburger-San Saba	Mason	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	53
14	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	50
15	Ellenburger-San Saba	Menard	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	26
16	Ellenburger-San Saba	Menard	F	Colorado	Menard County UWD	7	n/a	n/a	subcrop	51
17	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	outcrop	240
18	Ellenburger-San Saba	Kimble	F	Colorado	Hickory UWCD No. 1	7	n/a	n/a	subcrop	13
19	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	outcrop	76
20	Ellenburger-San Saba	Kimble	F	Colorado	Kimble County GCD	7	n/a	n/a	subcrop	145
21	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	outcrop	8,534
22	Ellenburger-San Saba	Gillespie	K	Colorado	Hill Country UWCD	7	n/a	n/a	subcrop	435
23	Ellenburger-San Saba	Gillespie	K	Guadalupe	Hill Country UWCD	7	n/a	n/a	subcrop	5

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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 Ellenburger-San Saba Aquifer may not behave in a uniform manner. 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.

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