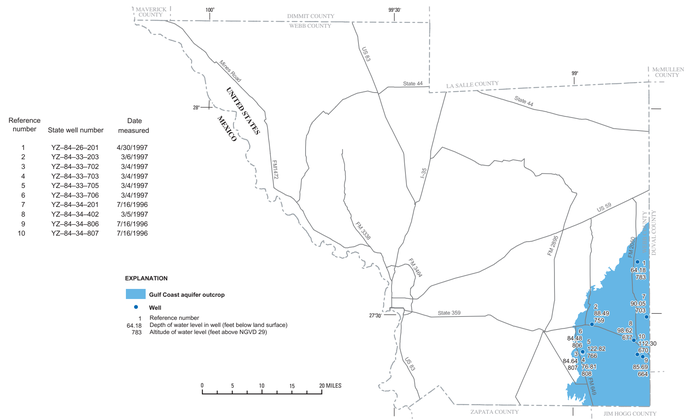
Gulf Coast Aquifer

The Gulf Coast aquifer in Webb County comprises the Catahoula Tuff (Fant member) and the Goliad Sand (table 1). The Gulf Coast aquifer crops out in southeastern Webb County in a band that trends northeast-southwest (fig. 11). The Goliad Sand consists of interbedded sand, caliche, and conglomerate; the Catahoula Tuff is composed primarily of pyroclastic rocks, thinly interbedded bentonitic clays, shaley sandstones, and tuffaceous sandstones (table 1) (Lonsdale and Day, 1937). The outcrop of the Gulf Coast aquifer covers an area of about 290 square miles (mi^2) and dips about 66 ft/mi to the southeast toward the Gulf of Mexico. The top (outcrop) of the Gulf Coast aquifer in southeastern Webb County ranges in altitude from about 940 to 550 feet (ft) above NGVD 29 (fig. 12). Most of the Gulf Coast aquifer in the county ranges in thickness from less than 1 ft along the western edge of the outcrop to about 1,300 ft in the subsurface in the eastern part of the county (fig. 13). The thickest section of the aquifer is along the eastern county line. Although the Goliad Sand outcrops throughout most of southeastern Webb County (fig. 4), the greatest thickness of the Gulf Coast aquifer is composed of the Fant member of the Catahoula Tuff. The greatest thickness of sand in the Gulf Coast aquifer (about 360 to about 450 ft) is along the eastern county line (fig. 14).

Recharge to the Gulf Coast aquifer occurs primarily through the direct infiltration of precipitation on the outcrop. The Gulf Coast aquifer in Webb County receives an estimated 15,500 acre-feet per year (acre-ft/yr) of recharge on the outcrop (assuming an effective recharge rate of 5 percent of the average annual rainfall [20.1 in.]). The regional groundwater-flow direction in the Gulf Coast aquifer is downdip to the east and southeast toward the Gulf of Mexico (Adidas, 1991). The depth to water in the aquifer obtained from measurements in inventoried wells ranged from about 64 to 123 ft below land surface (fig. 11). The depth to water is deeper in the area close to the town of Bruni (fig. 1) and a commercial uranium mine where withdrawals for municipal and industrial uses have created a small cone of depression (Adidas, 1991). In general, ground-water flow through much of the Gulf Coast aquifer is slow (Adidas, 1991). Specific capacity for wells open to or completed in the Gulf Coast aquifer ranged from 12 to 180 ft^2/d (fig. 15, table 2). Transmissivities estimated from specific capacities ranged from 180 to 1,090 ft^2/d (fig. 15, table 2). The specific capacity and estimated transmissivity from well YZ–84–33–102 were not computed because the drawdown was not determined. Because of the relatively small amount of recharge (assumed to be about 1 in. per year) and the low transmissivity, the Gulf Coast aquifer generally yields between 15 and 30 gal/min, with some wells yielding up to 150 gal/min.



Reference number	State well number	Date measured
1	YZ–84–26–201	4/30/1997
2	YZ–84–33–203	3/6/1997
3	YZ–84–33–702	3/4/1997
4	YZ–84–33–703	3/4/1997
5	YZ–84–33–705	3/4/1997
6	YZ–84–33–706	3/4/1997
7	YZ–84–34–201	7/16/1996
8	YZ–84–34–402	3/5/1997
9	YZ–84–34–806	7/16/1996
10	YZ–84–34–807	7/16/1996

Figure 11. Extent of the Gulf Coast aquifer outcrop and depth of water level in wells, 1996–97.

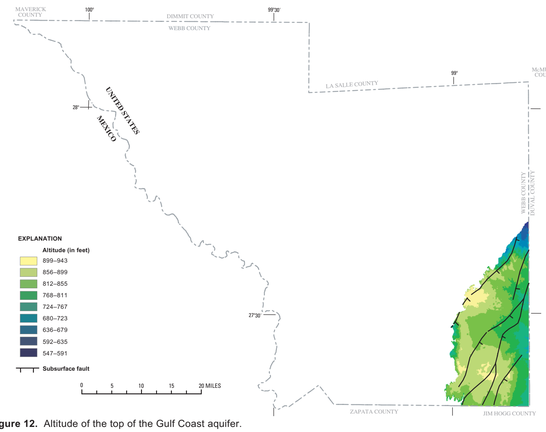


Figure 12. Altitude of the top of the Gulf Coast aquifer.

Table 3. Water quality of the Gulf Coast aquifer

[ft, feet; gal/min; gallons per minute; µS/cm, microsiemens per centimeter at 25 ˚C; ˚C, degrees Celsius; mg/L, milligrams per liter; NTU, nephelometric turbidity units; µg/L, micrograms per liter; <, less than; --, not available]

Sampled well number (fig. 2)	USGS station number	State well number	Aquifer	Sample date	Depth of well (ft)	Flow rate (gal/min)	Specific conductance (field) (µS/cm)	pH (field) (standard units)	Water temperature (˚C)	Dissolved solids, residue at 180 ˚C (mg/L)	Turbidity (NTU)	Hardness, total (mg/L as $CaCO_3$)
33	272352098585101	YZ–84–33–707	Gulf Coast	09/10/1997	198	23	1,461	7.1	27	919	1.4	280
34	272636098531601	YZ–84–33–402	Gulf Coast	10/30/1997	360	15	1,750	8.5	28	1,090	.10	13
35	272550098501601	YZ–84–34–406	Gulf Coast	10/29/1997	340	20	1,524	8.3	30	872	.10	20
36	272323098490301	YZ–84–26–501	Gulf Coast	03/03/1998	440	15	1,588	8.3	30	972	.15	19

Sampled well number (fig. 2)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Sodium adsorption-ratio	Sodium percentage	Potassium, dissolved (mg/L as K)	Alkalinity (field, total) (mg/L as $CaCO_3$)	Bicarbonate, dissolved (mg/L as HCO_3)	Sulfate, dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)
33	75	23	197	5	60	9.4	237	289	121	248	0.88
34	2.8	1.3	379	47	98	5.7	319	389	91	335	1.3
35	4.9	1.8	291	29	96	5.4	314	383	93	210	.89
36	5.2	1.5	337	33	97	5.7	296	361	149	217	.64

Sampled well number (fig. 2)	Silica, dissolved (mg/L as Si)	Nitrogen, nitrite, dissolved (mg/L as N)	Nitrogen, nitrite + nitrate, dissolved (mg/L as N)	Nitrogen, ammonia, dissolved (mg/L as NH_3)	Nitrogen, ammonia, dissolved (mg/L as N)	Nitrogen, ammonia + organic, dissolved (mg/L as N)	Nitrogen, organic, dissolved (mg/L as N)	Phosphorus, dissolved (mg/L as P)	Phosphorus, ortho, dissolved (mg/L as P)	Phosphate, ortho, dissolved (mg/L as PO_4)	Aluminum, dissolved (µg/L as Al)
33	81	<0.01	5.9	--	<0.01	<0.2	--	<0.01	<0.01	--	3.7
34	32	<.01	<.05	0.03	.02	<.1	--	.03	.03	0.09	7.1
35	43	.01	1.5	--	<.01	<.2	--	.03	.04	.11	4.4
36	31	<.01	<.05	.04	.03	<.1	--	<.01	.03	.10	4.1

Sampled well number (fig. 2)	Antimony, dissolved (µg/L as Sb)	Arsenic, dissolved (µg/L as As)	Barium, dissolved (µg/L as Ba)	Beryllium, dissolved (µg/L as Be)	Boron, dissolved (µg/L as B)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Cobalt, dissolved (µg/L as Co)	Copper, dissolved (µg/L as Cu)	Iron, dissolved (µg/L as Fe)	Lead, dissolved (µg/L as Pb)
33	<1	7.5	55	<1	1,234	<1	2.5	<1	1.3	99	<1
34	<1	<1	54	<1	2,538	<1	4.2	<1	<1	<3	<1
35	<1	77	51	<1	1,709	<1	3.0	<1	1.3	<3	<1
36	<1	1	22	<1	1,702	<1	5.3	<1	<1	<10	<1

Sampled well number (fig. 2)	Lithium, dissolved (µg/L as Li)	Manganese, dissolved (µg/L as Mn)	Mercury, dissolved (µg/L as Hg)	Molybdenum, dissolved (µg/L as Mo)	Nickel, dissolved (µg/L as Ni)	Selenium, dissolved (µg/L as Se)	Silver, dissolved (µg/L as Ag)	Strontium, dissolved (µg/L as Sr)	Uranium, dissolved (µg/L as U)	Vanadium, dissolved (µg/L as V)	Zinc, dissolved (µg/L as Zn)
33	27	11	<0.1	2.0	<1	3.6	<1	813	2.8	59	1.1
34	42	<1	<.1	33	<1	<1	<1	159	<1	<6	1.1
35	40	2.4	.15	25	<1	10	<1	191	30	7.1	<1
36	56	1.7	<.1	26	<1	<1	<1	131	<1	<10	3.9

Water withdrawn from the Gulf Coast aquifer in Webb County is fresh to slightly saline and is withdrawn for domestic, stock, irrigation, industrial, and public-supply uses. Four wells completed in the Gulf Coast aquifer (fig. 2, nos. 33–36) were sampled for this report. The concentration of dissolved solids ranged from 872 to 1,090 mg/L (table 3), which is greater than the U.S. Environmental Protection Agency (USEPA) secondary drinking water regulation[1] (SDWR) concentration of 500 mg/L (U.S. Environmental Protection Agency, 2002). Graphical plots (Stiff diagrams) showing the relative proportion of cation and anion species in water samples indicate that water from the Gulf Coast aquifer is similar throughout the area and is dominated by sodium-chloride ions with a smaller proportion of bicarbonates and sulfates (fig. 16). The sodium percentage (percentage of total cations [in milliequivalents per liter] accounted for by sodium) ranges from 60 to 98. The chloride concentration in well 34 (335 mg/L) exceeded the USEPA SDWR of 250 mg/L.

Analysis of the water samples also indicates the presence of several trace elements including aluminum, arsenic, chromium, copper, manganese, selenium, uranium, vanadium, and zinc. The arsenic concentration in water from well 35 (77 micrograms per liter [µg/L], table 3) was nearly eight times the USEPA maximum contaminant level[2] (MCL) of 10 µg/L. The uranium concentration in water from the same well (30 µg/L) exceeded the USEPA MCL of 20 µg/L. Uranium is being mined by injection leaching near Bruni (Adidas, 1991) where the well is located. The leaching agent in such operations can mobilize constituents other than uranium, including molybdenum, vanadium, selenium, iron, lead, and arsenic (Diehl, 2001). In one of the four well-water samples (well 33), the strontium concentration (813 µg/L) was about twice the USEPA lifetime health advisory[3] (HA) concentration of 400 µg/L. Concentrations of the minor constituent boron in water from all four Gulf Coast aquifer wells were about two to four times greater than the USEPA lifetime HA of 600 µg/L.

[1] An SDWR concentration of a constituent is a non-enforceable Federal guideline regarding cosmetic effects (such as tooth or skin discoloration) or esthetic effects (such as taste, odor, or color) in drinking water.

[2] An MCL is the largest concentration of a contaminant that is allowed in drinking water and is an enforceable Federal standard.

[3] A lifetime HA is a non-enforceable estimate of an acceptable concentration of a chemical substance in drinking water for a lifetime of exposure.

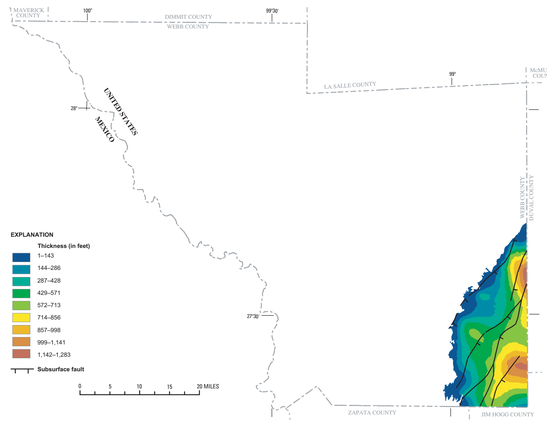


Figure 13. Thickness of the Gulf Coast aquifer.

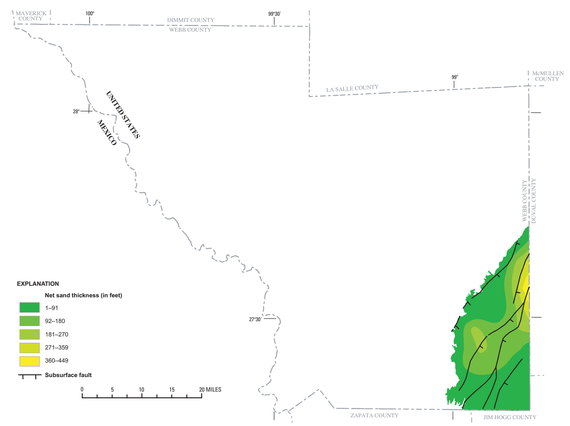


Figure 14. Net sand thickness of the Gulf Coast aquifer.

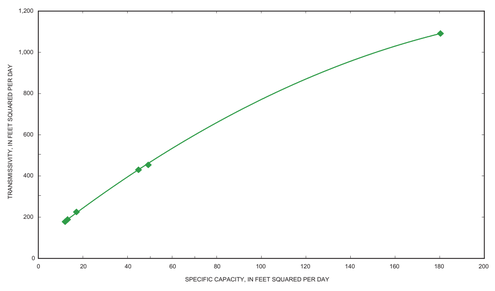
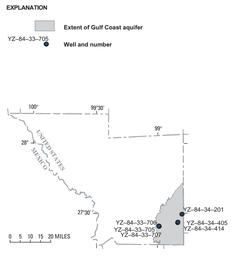


Figure 15. Specific capacity and estimated transmissivity of the Gulf Coast aquifer.



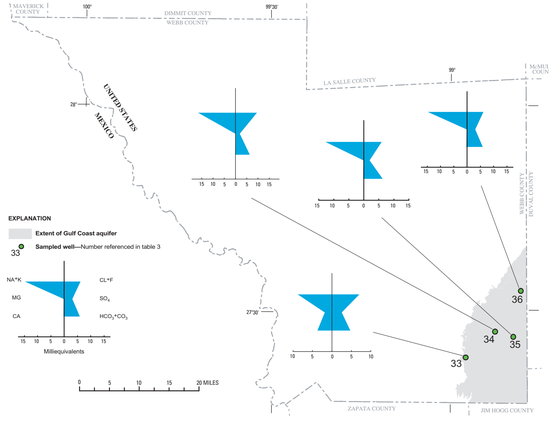


Figure 16. Chemical characteristics of water from the Gulf Coast aquifer.

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