



2018

PRECIPITATION IN THE EDWARDS AQUIFER REGION



August 2019

The Edwards Aquifer Authority (EAA) monitors precipitation throughout the region using a network of 74 real-time rain gauges. Rainfall data is used as input for watershed computer models that can provide estimates of monthly recharge to the aquifer. Collected over several years or decades, the extensive database of rainfall information can also be useful for monitoring climate trends, evaluating relationships between rainfall and aquifer levels, or for understanding how global-scale phenomena such as “El Nino” (which refers to above-average sea surface temperatures in the equatorial region of the Pacific Ocean) may affect rainfall in Central Texas.

The locations of the EAA rain gauges are shown in Figure 1. In general, rain gauges are not always reliable indicators of total rainfall over a region. Rainfall can vary greatly over relatively short distances and a gauge only reflects rainfall at a specific point. Additionally, gauges are susceptible to occasional malfunctions such as clogging, battery or electronic failure, or physical damage. NEXRAD (Next-Generation Radar) data from the National Weather Service (NWS) provides a potential solution to the limitations of individual rain gauges because it provides continuous coverage of the entire region based on overlapping coverage from NEXRAD Doppler radar stations in Brackettville, Corpus Christi, New Braunfels, and Granger, Texas. However, NEXRAD measures reflectivity of precipitation near ground level and not the actual amount of precipitation as measured by rain gauges. For this reason, EAA takes a two-step approach by performing a quality review of the rain gauge data each month and using the operational rain-gauge data as a “ground-truth” to calibrate the NWS NEXRAD data. The resulting product is a dataset of hourly rainfall totals for a grid of 4 km × 4 km pixels over the entire region of interest that extends back to January 1, 2003.

Figure 2 shows the calibrated NEXRAD coverage area with a color map indicating total 2018 rainfall for each 16-km² pixel. The high degree of spatial variability in rainfall totals can be seen, with the highest rainfall total of 50.2 inches in southeastern Bandera County near Lake Medina and the lowest total of 18.6 inches in Val Verde County near the border with Edwards County. A pattern of higher rainfall totals to the east and lower totals to the west is typical of most years in the South-Central

Texas region. The average rainfall over the entire coverage area was 31.3 inches.

Figure 2 also shows delineations of the nine watershed catchment areas that contain streams that cross the Edwards Aquifer recharge zone. The rainfall over these watersheds is of interest because their catchment areas convey water to the Edwards Aquifer recharge zone and the data can be used as input to the EAA’s HSPF (Hydrologic Simulation Program—Fortran) models to estimate recharge. Table 1 provides the 2018 area-averaged rainfall totals for the nine watersheds obtained from the calibrated NEXRAD data.

Because the timeframe covered by EAA’s calibrated NEXRAD rainfall data does not begin until year 2003, it is not yet suited for evaluating long term historical trends in annual rainfall. For this type of analysis, we rely on data at individual rain gauges that have been in place for many decades. Table 2 shows how the 2018 annual rainfall for several selected gauges across the region compares to the long-term average rainfall. Rainfall varied from above average to below average at these locations with no particular spatial trend. Generally, the calibrated NEXRAD rainfall totals should be considered the best available representation of the annual rainfall total.

Table 3 lists the annual rainfall totals for several gauge locations going back to 1934. These records indicate how variable rainfall can be at any location from year to year. For example, the lowest annual rainfall total observed at San Antonio Airport rain gauge was 13.7 inches in 1954, while the highest was 52.3 inches in 1973. Although these records show extended periods of above-average or below-average rainfall, there does not appear to be any significant trend of increasing or decreasing annual rainfall totals in the region over the long term.

The long-term records for these rain gauges and many other weather stations throughout the region can be obtained online from the National Centers for Environmental Information (formerly the National Climatic Data Center) at <http://www.ncdc.noaa.gov/cdo-web/search>. Data from the EAA’s rain gauge network or calibrated NEXRAD database may be obtained from EAA upon request.

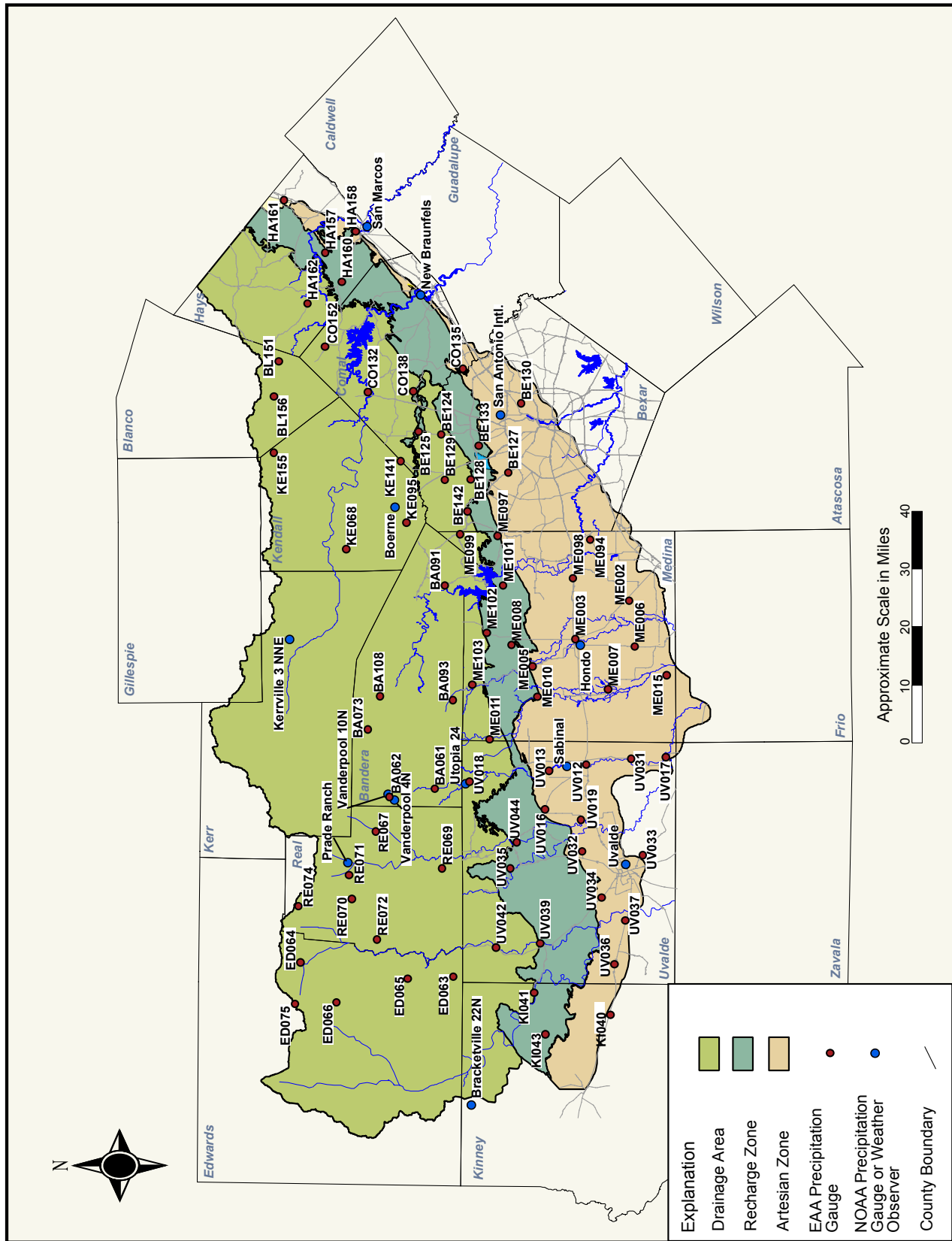


Figure 1. Locations of Precipitation Gauging Stations.

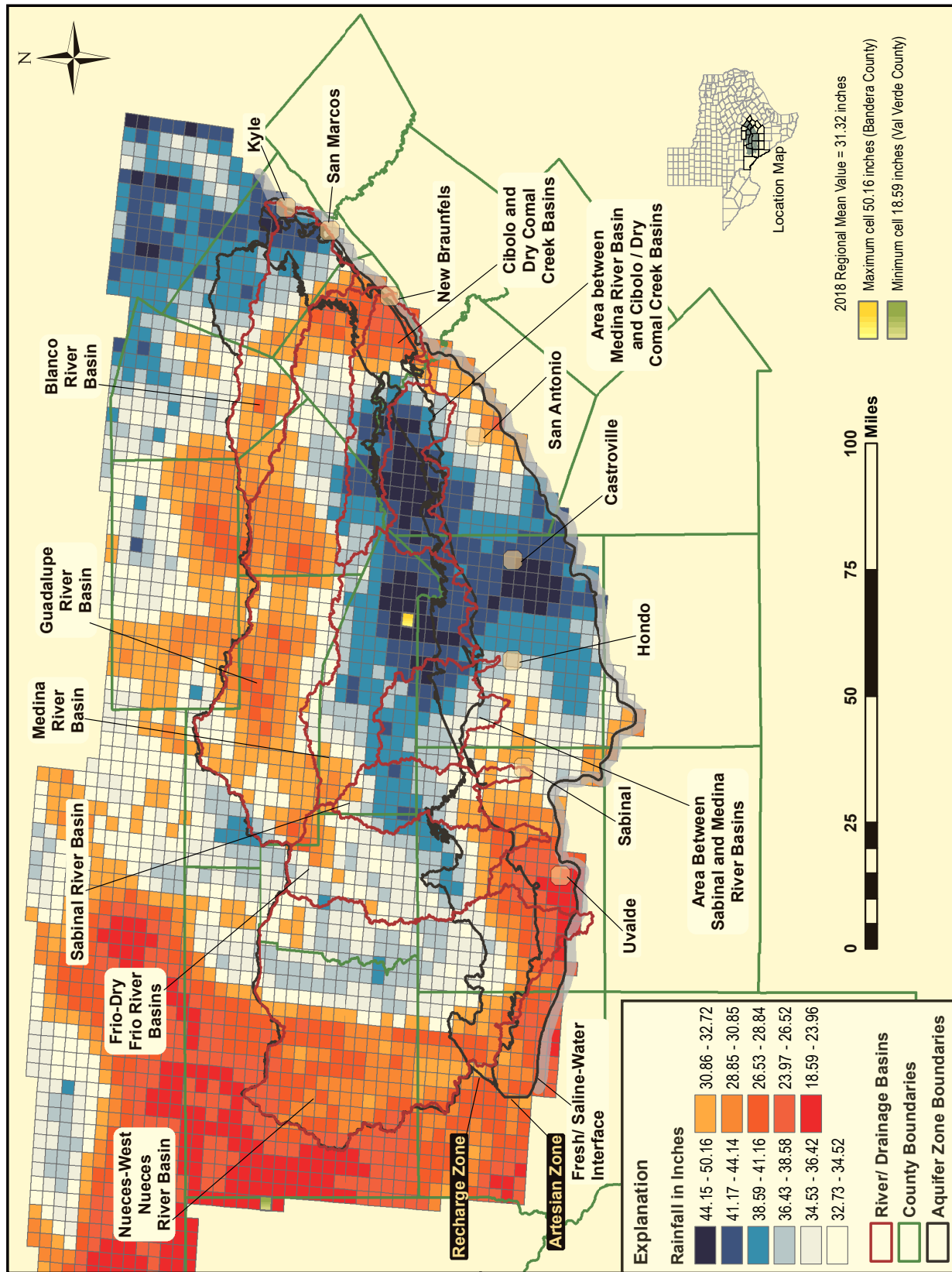


Figure 2. Gauge-Calibrated NEXRAD Rainfall Distribution for 2016

Table 1. 2018 Rainfall Totals for Nine Delineated Contributing Zone Watershed Areas.

Gauge	2018 Area Average Rainfall (inches)
Nueces-West Nueces River Basins	31.6
Frio-Dry Frio River Basins	34.6
Sabinal River Basin	36.3
Area Between Sabinal and Medina River Basins	38.9
Medina River Basin	39.7
Area Between Medina and Cibolo River Basins	43.1
Cibolo and Dry Comal Creek Basins	35.7
Guadalupe River Basin	31.4
Blanco River Basin	34.2

Table 2. Deviation from Mean Rainfall Values, 2018. Rainfall amounts are in inches.

Station Name	County	Long-Term Average	2018 Total	Deviation from Average
San Antonio Intl. Airport	Bexar	30.61	41.24	+10.63
San Marcos	Hays	34.36	39.13	+4.77
Hondo	Medina	28.62	46.37	+17.75
Sabinal	Uvalde	24.16	39.06	+14.90
Boerne	Kendall	34.14	43.00	+8.86
Brackettville 22N	Kinney	22.20	39.31	+17.11

Table 3. Annual Precipitation for Selected Precipitation Stations in the Edwards Aquifer Region, 1934–2018 (in inches).

Year	Brackettville 22N	Uvalde	Sabinal	Hondo	San Antonio Intl. Airpt.	Boerne	New Braunfels	San Marcos
1934	---	16.70	18.07	23.97	27.65	26.78	30.80	35.67
1935	---	41.17	48.21	58.73	42.93	52.93	41.67	41.09
1936	22.34	24.53	26.53	35.27	34.11	47.59	30.41	33.48
1937	16.85	17.88	9.57 ^a	22.93	26.07	32.81	29.19	26.03 ^a
1938	19.97	13.12	15.39	27.56	23.26	24.14	28.32	28.17
1939	18.38	25.30	13.98 ^b	23.14	18.83	26.20	13.35	18.59
1940	22.43	27.66	27.51	28.13	30.79	32.29	38.11	43.57
1941	21.52	31.79	33.74 ^a	44.07	26.34	41.60	42.99	48.41
1942	21.01	19.01	11.37 ^a	34.83	38.46	31.12	42.08	44.65
1943	23.39 ^b	20.63	17.21	31.43	20.51	26.33	29.93	25.45
1944	24.76	32.76	27.62 ^a	32.46	33.19	42.98	43.14	47.42
1945	15.69	22.37	26.60	29.57	30.46	33.50	39.38	31.74 ^b
1946	19.10	26.41	14.16 ^a	29.65	45.17	45.62	61.60	52.24
1947	22.92 ^b	22.67	---	18.98	17.32	21.89	27.52	27.53
1948	20.02 ^a	18.31	---	28.82	23.64	23.77	19.88 ^b	21.27 ^a
1949	31.32	34.41	---	39.90	40.81	41.15	43.21	36.22
1950	17.70	18.27	15.28 ^a	24.91	19.86	24.94	21.13	21.10
1951	14.71	16.07	15.63	24.05 ^a	24.44	18.76	24.84	30.88
1952	12.26	18.24	23.16	25.56	26.24	37.54	33.87	39.91
1953	10.12	18.34	21.44	20.61	17.56	21.42	30.06	33.39
1954	19.38	15.60	14.72	11.92	13.70	10.29	10.12	13.42
1955	26.55	18.36	20.87	21.21	18.18	19.27	23.12	26.44
1956	7.58	9.29	11.29	15.54	14.31	12.05	18.41	18.37
1957	34.21	39.30	40.03	35.09	48.83	52.55	51.88	46.51
1958	45.37	39.03	41.18	41.60	39.69	40.94	36.40	39.08
1959	27.51	31.51	27.02	30.68	24.50	35.64	40.45	43.47
1960	19.12	23.98	26.24	32.37	29.76	32.55	34.28	45.48
1961	17.91	26.26	27.24	27.36	26.47	25.45	15.70 ^a	30.02
1962	10.87	14.12	13.58	17.85	23.90	25.26	27.40	28.47
1963	15.07	16.70	18.99	18.90	18.65	20.66	23.41	19.90
1964	20.75	22.30	23.78	28.29	31.88	27.36	30.65	30.27
1965	21.48	26.21	29.41	30.80	36.65	42.41	45.16	45.00
1966	21.63	20.87	21.54	29.46	21.44	29.05	25.98	27.12
1967	21.95	20.10	23.89	30.33	29.26	26.75	31.74	26.41
1968	17.26	25.20	29.88 ^b	31.91	30.40	35.14	35.97	37.13
1969	28.53	33.38	33.05	32.30	31.42	38.07	33.01	36.59
1970	16.50	13.59	22.13	30.96	22.74	27.79	35.23	32.30
1971	29.46	31.01	31.00	32.96	31.80	45.24	29.43	31.10
1972	21.21	15.49	21.10	25.43	31.49	35.09	42.02	31.90
1973	30.61	30.85	35.14 ^b	47.82	52.28	50.93	51.66	47.91
1974	18.25	30.94	20.93 ^b	36.41 ^b	37.00	41.80	42.85	37.28 ^a
1975	26.62	24.92	23.65	25.84 ^a	25.67	33.49	35.82	48.64
1976	34.40	46.04	40.82	45.21	39.13	45.24	49.06	47.46
1977	15.06	19.90	17.06	19.40	29.64	32.43	24.83	29.69
1978	19.04	18.48	21.28	24.64	35.99	35.17	36.35 ^b	33.08
1979	16.34	32.35	31.44	28.83	36.64	39.97	36.72	38.74
1980	18.33	23.05	22.67	21.27	24.23	39.02	33.69	29.56
1981	28.73	26.24	30.19	27.40	36.37	41.05	43.23	49.62
1982	19.10	23.35	18.44	21.99	22.96	27.64	21.04	22.47 ^b
1983	19.35	24.45 ^a	23.33	20.92 ^b	26.11	34.60	34.13	36.95
1984	16.24	15.33 ^b	20.67	21.19 ^a	25.95	26.97	20.90	8.26 ^b
1985	18.93	5.76 ^a	23.67	21.94	41.43	37.77	37.26	33.54
1986	27.44	29.86 ^b	29.62 ^b	36.01 ^b	42.73	43.52	47.14	42.20
1987	39.45	36.39	38.36	40.09	37.96	39.86	37.33 ^a	37.94
1988	12.08	15.20	13.52	9.81 ^b	19.01	19.49	16.27 ^b	21.50
1989	16.98	18.65	17.26	16.10	22.14	25.14	20.99	25.46
1990	38.24 ^b	24.73	30.06	27.01	38.31	42.51	24.58 ^a	35.14 ^b
1991	23.11	21.77	31.12	34.55	42.76	48.22	56.55	51.07
1992	22.22	27.85 ^a	37.73	45.34	46.49	64.17	38.84 ^b	40.33 ^b
1993	15.18	9.32 ^c	13.20	16.60	32.00	24.02	19.54 ^b	24.01 ^b
1994	22.85 ^a	39.61	29.32	22.38 ^b	40.42	40.98	35.76 ^a	40.85
1995	25.87	19.47	27.55	24.55	23.20	30.29	23.29	32.57
1996	20.32 ^b	16.20	14.20	15.50	17.80	24.57	19.00	28.20
1997	---	27.77	35.74	37.54	33.94	---	41.65	43.56

Table 3. (Continued) Annual Precipitation for Selected Precipitation Stations in the Edwards Aquifer Region, 1934–2018 (in inches).

	Brackettville				San Antonio		New	San
Year	22N	Uvalde	Sabinal	Hondo	Intl. Airt.	Boerne	Braunfels	Marcos
1998	24.15	27.40 ^b	20.66 ^b	30.44 ^a	42.10	45.74	52.98	58.51
1999	19.88	19.08	2.55 ^b	16.94	16.63	18.67	21.07	19.38
2000	18.11 ^b	23.84	22.87	32.49	35.86	46.30 ^a	36.34 ^b	40.56
2001	18.40	26.02	25.87	30.59	36.72	53.91	37.91	42.41
2002	---	36.79	35.75	44.70	46.27	63.20	43.60	46.16
2003	25.19 ^c	23.39	24.86	34.70	28.45	28.55	23.42	25.74
2004	40.23	27.76	37.99	44.76	45.32	60.50	50.55	52.68
2005	25.13	16.48	20.24	28.90	16.54	25.31	21.01	22.42
2006	14.62	7.85	11.06	12.15	21.34	24.24	28.51	26.36
2007	39.93	28.89	37.55	57.58	47.25	59.00	45.40	41.59
2008	12.59	11.23	14.66	16.18	13.76	14.74	16.70	15.79
2009	14.26	16.19	20.86	25.00	30.69	32.65	28.10	33.10
2010	23.78	18.86	27.13	27.32	37.39	42.06	37.03	27.58 ^b
2011	12.98	9.91	13.81	15.27	17.58	17.76	19.25 ^a	19.39 ^b
2012	20.35 ^a	13.97	18.70	25.96	39.30	29.78	35.49	34.26
2013	21.18 ^a	22.75	22.87	19.48 ^a	31.99	28.95	32.88	31.30
2014	18.92 ^a	21.09	20.62	17.84 ^a	28.20	29.00	23.17	23.84
2015	26.20 ^a	---	41.62	32.90 ^a	42.22	50.09	43.45	52.29
2016	43.34 ^a	---	32.04	38.94 ^a	43.92	39.70	---	49.91 ^a
2017	20.03	---	27.14	24.32	27.33	28.84	---	42.56
2018	39.31	---	39.06	46.37	41.24	43.00	---	39.13
Years of Record	81	81	82	85	85	84	83	85
Mean	21.77	23.06	25.10	28.96	30.74	34.25	33.52	35.37
Median	20.35	22.67	23.33	28.13	30.46	32.81	33.78	33.48

Data sources: U.S. Department of Commerce; Uvalde data: Texas A&M AgriLIFE Extension Service.

a = Partial record not included in long-term mean or median; missing one month.

b = Partial record not included in long-term mean or median; missing more than one month.

c = Change in gauge location from previous years.

--- = No data available.

Mean and median values calculated using only years with full records. Years with partial or missing records discarded from data set.