INTRODUCTION

Record-breaking peak discharges were recorded at eight U.S. Geological Survey (USGS) streamflow-gaging stations in central Texas during December 1991 (fig. 1), and substantial peak discharges also occurred at numerous other stations. Large peak discharges during December are unusual in central Texas. The rainfall causing the flooding began on December 18, with 6-day totals exceeding 10 inches (in.) in the area of heaviest rainfall.

This report documents peak discharges and runoff volumes during December 1991. Recurrence intervals were determined for the peak discharges and runoff volumes for 1-, 3-, and 7-day periods. A recurrence interval references the approximate number of years during which a given peak discharge or runoff volume is expected to be equaled or exceeded only once. A flood of a given recurrence interval is defined on the basis of peak discharge—for example, a 100-year flood is defined as the peak discharge that has a 1-percent chance of being equaled or exceeded in any given year.

DESCRIPTION OF STORMS

Rainfall on a large area of central Texas during December 18–23, 1991, caused extensive flooding in many locations. On December 18, a warm, moist, unstable air mass spread northward from the Gulf of Mexico and overran a cold surface ridge that had settled over Texas. Simultaneously, a deep, cold upper-level trough over the southwestern United States and northern Mexico pumped tropical moisture into central and northern Texas from low latitudes across Mexico. Embedded thunderstorms produced heavy rainfall over south-central Texas and expanded northward late on December 18. This combination of moisture and movement persisted until December 23, with thunderstorms producing heavy rainfall throughout central Texas during the period (National Oceanic and Atmospheric Administration, 1991c). Lines of equal precipitation in figure 1 depict the total rainfall during this 6-day period.

Daily rainfall totals in excess of 4 in. were recorded at numerous National Weather Service rain gages. A maximum 24-hour rainfall total of 8.60 in. and a maximum 12-hour total of 7.30 in. were observed at Evant, about 60 miles (mi) west of Waco (National Oceanic and Atmospheric Administration, 1991b). The recurrence interval for these 24- and 12-hour duration rainfall amounts is 50 years (U.S. Weather Bureau, 1961).

The monthly rainfall departure from the 1951–80 normal for December 1991 was 100 percent or more for stations in some parts of the area shown in figure 1 (National Oceanic and Atmospheric Administration, 1991a). The rainfall during November 1991 generally was 50 percent or more below normal.

PEAK DISCHARGES AND RUNOFF VOLUMES

Peak discharges for floods, some exceeding known historical maximums, occurred during December 20–26, 1991, at streamflow-gaging stations in central Texas. Twenty-two stations on unregulated and regulated streams in central Texas where the December 1991 peak discharges equaled or exceeded the 10-year flood are listed in table 1. The December 1991 peak discharge exceeded the previously known peak discharge at 8 of the 22 streamflow-gaging stations.

Recurrence intervals were determined for peak discharges and runoff volumes for 1-, 3-, and 7-day periods from flow data recorded at each gaging station. Recurrence intervals were rounded to the nearest 5 years (table 1), except for those exceeding 100 years, which are shown as greater than 100 years. Peak discharges in December 1991 exceeded the 100-year flood at 5 of the 22 streamflow-gaging stations.

Peak discharge as a function of drainage area for basins throughout Texas are shown in figure 2. The peak discharges during the December 1991 floods are included to illustrate their relative magnitudes with respect to known maximum peak discharges in Texas.

Runoff volumes were computed from discharge hydrographs for the stations; for example, discharge hydrographs for two stations are shown in figures 3 and 4. Instantaneous discharge and daily mean discharge are shown for December 19–23, 1991. Runoff volumes were computed from the shaded area representing the daily mean discharge.

FLOOD DAMAGES

The flooded area in central Texas was declared a Federal disaster area on December 26, 1991. Ten deaths were attributed to the flooding. The Federal Emergency Management Agency dispensed about $43 million in Federal funds for public assistance, temporary housing, individual and family grants, disaster unemployment, and home and business loans (Graham Nance, Federal Emergency Management Agency, oral commun., 1995). The full value of flood damages could have exceeded the $43 million.

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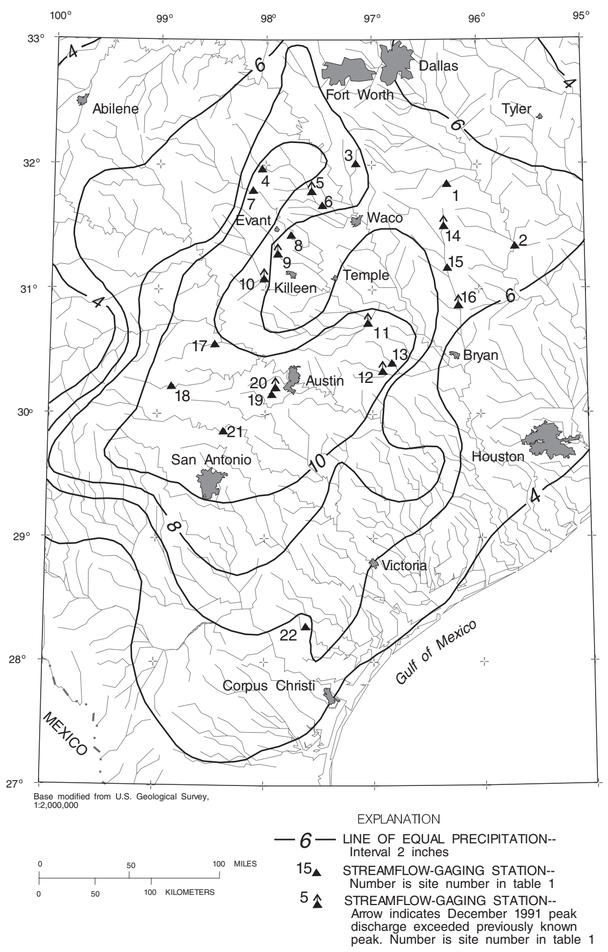
CONVERSION FACTORS

Multiply	By	To obtain
acre-foot (acre-ft)	1,233	cubic meter
foot (ft)	0.3048	meter
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.59	square kilometer



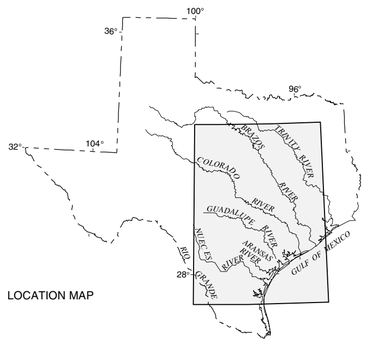


Figure 1. Location of streamflow-gaging stations and lines of equal precipitation for storms in central Texas, December 18–23, 1991. (Data from National Oceanic and Atmospheric Administration 1991a, b, c.)

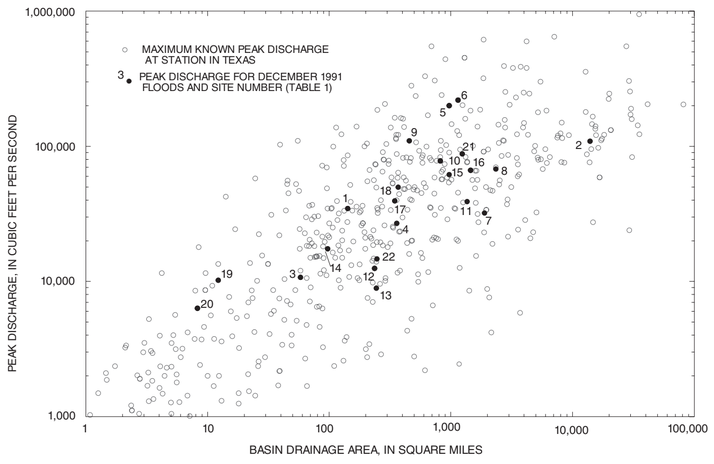


Figure 2. Peak discharges in central Texas, December 1991, and maximum known peak discharges statewide.

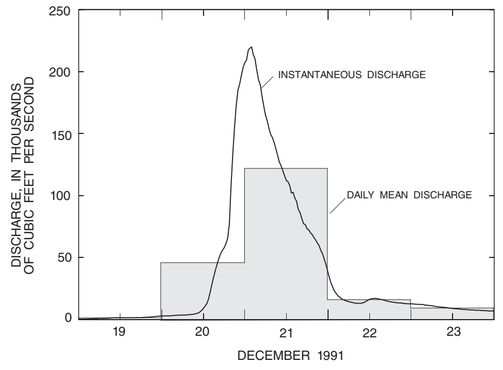


Figure 3. Hydrograph showing discharge for streamflow-gaging station North Bosque River at Valley Mills, Tex.

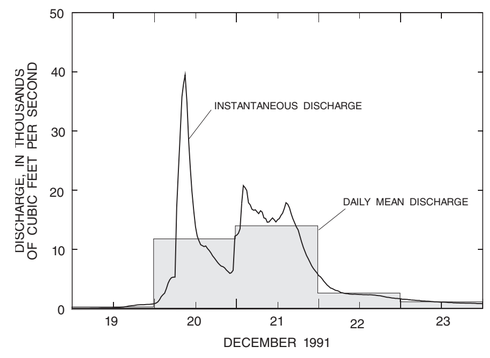


Figure 4. Hydrograph showing discharge for streamflow-gaging station Sandy Creek near Kingsland, Tex.

Table 1. Streamflow-gaging stations in central Texas where floods of December 1991 equaled or exceeded the 10-year flood

[mi^2, square miles; ft, feet; ft^3/s, cubic feet per second; R.I., recurrence interval; acre-ft, acre-feet; --, not determined; >, greater than]

Site number (fig. 1)	USGS station number	Streamflow station name	Contributing drainage area (mi^2)	Maximum gage height and discharge prior to December 1991				Maximum gage height and discharge in December 1991				Maximum runoff volumes in December 1991					
				Period	Year	Gage height (ft)	Discharge (ft^3/s)	Date	Gage height (ft)	Discharge (ft^3/s)	R.I. (years)	1-day		3-day		7-day	
												Volume (acre-ft)	R.I. (years)	Volume (acre-ft)	R.I. (years)	Volume (acre-ft)	R.I. (years)
		TRINITY RIVER BASIN															
1	08064700	Tehuacana Creek near Streetman	142	1932–91	1989	30.2	85,700	Dec. 21	26.4	34,700	45	39,670	50	52,420	40	57,340	45
2	08065350	Trinity River near Crockett	13,911	1964–91	1990	48.54	109,000	Dec. 26	48.5	[1]109,000	40	--	--	--	--	--	--
		BRAZOS RIVER BASIN															
3	08093250	Hackberry Creek at Hillsboro	57.9	1887–1991	1981	18.95	12,050	Dec. 20	18.44	10,700	20	8,130	10	16,010	20	19,020	20
4	08094800	North Bosque River at Hico	359	1880–1991	1952	27.60	[1]87,800	Dec. 20	23.27	[1]27,000	60	26,780	60	44,150	65	62,480	50
5	08095000	North Bosque River near Clifton	968	1854–1991	1959	34.88	[2]92,800	Dec. 20	38.3	[1]200,000	>100	192,000	>100	372,000	>100	413,800	>100
6	08095200	North Bosque River at Valley Mills	1,146	1868–1991	1908	43	--	Dec. 21	44.6	[3]220,000	>100	244,000	>100	366,000	>100	413,800	100
7	08100000	Leon River near Hamilton	1,891	1858–1991	1908	38.4	--	Dec. 20	35.02	[1]32,100	70	--	--	--	--	--	--
8	08100500	Leon River at Gatesville	2,342	1854–1991	1908	35	70,000	Dec. 21	35.00	[1]68,000	>100	--	--	--	--	--	--
9	08101000	Cowhouse Creek at Pidcoke	455	1882–1991	1959	40.1	66,200	Dec. 20	44.3	110,000	>100	50,780	45	97,590	>100	155,100	>100
10	08103800	Lampasas River near Kempner	818	1960–91	1965	32.98	[2]71,000	Dec. 20	35.00	[3]78,000	>100	84,300	100	147,600	100	174,900	85
11	08106310	San Gabriel River near Rockdale	1,359	1979–91	1981	32.11	15,600	Dec. 21	35.74	[1]39,000	15	--	--	--	--	--	--
12	08109700	Middle Yegua Creek near Dime Box	236	1914–91	1975	15.16	11,400	Dec. 22	15.39	12,500	30	18,780	25	30,820	15	39,150	10
13	08109800	East Yegua Creek near Dime Box	244	1958–91	1975	13.91	14,000	Dec. 22	12.94	8,910	10	14,560	20	27,070	20	35,820	15
14	08110430	Big Creek near Freestone	97.2	1980–91	1989	15.37	5,950	Dec. 21	16.33	17,500	65	16,640	45	23,680	45	28,190	75
15	08110500	Navasota River near Easterly	968	1845–1991	1899	24	[2]90,000	Dec. 22	27.22	[1]61,800	65	--	--	--	--	--	--
16	08111000	Navasota River near Bryan	1,454	1951–91	1966	16.57	38,200	Dec. 23	19.97	[1]66,600	60	--	--	--	--	--	--
		COLORADO RIVER BASIN															
17	08152000	Sandy Creek near Kingsland	346	1881–1991	1952	34.2	163,000	Dec. 20	17.62	39,500	25	28,170	>100	56,770	>100	62,480	>100
18	08152900	Pedernales River near Fredericksburg	369	1979–91	1979	34.4	64,000	Dec. 20	32.09	49,900	10	29,360	25	51,770	30	56,790	30
19	08158810	Bear Creek below Farm Road 1826 near Driftwood	12.2	1924–91	1939	16.2	14,200	Dec. 20	14.23	10,200	15	1,980	20	4,240	20	4,960	15
20	08158840	Slaughter Creek at Farm Road 1826 near Austin	8.24	1980–91	1981	10.79	4,080	Dec. 20	10.68	6,330	20	1,490	15	3,310	15	4,120	15
		GUADALUPE RIVER BASIN															
21	08167500	Guadalupe River near Spring Branch	1,315	1923–91	1978	45.25	160,000	Dec. 21	36.00	79,300	20	111,100	25	208,900	40	261,000	45
		ARANSAS RIVER BASIN															
22	08189700	Aransas River near Skidmore	247	1914–91	1967	42.22	82,800	Dec. 22	29.4	14,700	10	16,480	5	19,400	5	19,850	5

[1] Streamflow regulated by reservoirs—recurrence interval computed for regulated period.
[2] Discharge occurred prior to regulation of streamflow by one or more reservoirs.
[3] Streamflow regulated by flood-detention reservoirs—recurrence interval computed for unregulated period.

FLOODS IN CENTRAL TEXAS, DECEMBER 1991

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