TEXAS WATER DEVELOPMENT BOARD

REPORT 83

FLOODS FROM HURRICANE BEULAH IN SOUTH TEXAS AND NORTHEASTERN MEXICO, SEPTEMBER-OCTOBER 1967

By

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FLOODS FROM HURRICANE BEULAH IN SOUTH TEXAS AND NORTHEASTERN MEXICO, SEPTEMBER-OCTOBER 1967

ABSTRACT

Floods produced by Hurricane Beulah during September and October 1967 were outstanding because of the magnitude of the stage and discharge and because of the number of river basins affected. Maximum previously known stages were exceeded, at the downstream station, on five river basins in Texas by amounts ranging from 2.7 feet at Guadalupe River near Tivoli to 9.2 feet at Aransas River near Skidmore. The greatest relative maximum discharge recorded during the storm occurred at Medio Creek near Beeville, where the peak discharge was 4.12 times the previous maximum since 1914 and 6.0 times the magnitude of a regional 50-year flood. The inflow to Lake Corpus Christi was more than 4½ times the volume of the lake at spillway elevation.

Because of the large volume of fresh-water inflow to bays and estuaries along the Texas coast, the salinity of contained water was greatly reduced. Data collected in Nueces-Corpus Christi and Guadalupe-San Antonio Bays show that dilution proceeded rapidly along the line of flow.

Fresh-water inflow to Corpus Christi Bay exceeded 60,000 cfs from September 23 through September 28. The total inflow was about 1½ times the volume of water normally in the bay, but because of its shape and depth, the bay was not entirely flushed of saline water.

Fresh-water inflow to San Antonio Bay exceeded 40,000 cfs from September 21 through September 26. The total inflow was more than three times the volume of water normally in the bay, and most of the saline water was flushed from the bay.

Measurements of water levels in wells indicate that Hurricane Beulah caused significant rises in water levels in shallow wells by percolation of rainfall and ponded waters and by the cascading of floodwaters directly into numerous inundated wells.

Flooding along the Rio Grande and its floodways below Falcon Dam was the greatest since the American floodway system was completed in 1926. At Mission Branch Floodway, south of McAllen, Texas, the peak discharge was 2.15 times the previous maximum in 1932. The peak stage exceeded the previous maximum by 4.14 feet. Flooding along the Mexican floodways destroyed all stream-gaging equipment.

A 4,000-square-mile area of South Texas having no defined drainage system was inundated by ponded water. The ponds blocked highways for several days and hampered ranching and oil-field operations for at least six months after the storm. Rainfall measurements of 25 inches during the period September 19-25, 1967, were common in Texas, and as much as 35 inches was measured in Mexico.

FLOODS FROM HURRICANE BEULAH IN SOUTH TEXAS AND NORTHEASTERN MEXICO, SEPTEMBER-OCTOBER 1967

INTRODUCTION

Torrential rainfall produced by Hurricane Beulah caused floods of record-breaking magnitude on many streams in a 50,000-square-mile area of south Texas and northeastern Mexico in September and October 1967. Beulah made landfall on the Texas coast near Brownsville about daybreak on September 20, 1967, and dissipated in the mountains of northern Mexico on September 22 (Figure 1). Unofficial rainfall measurements during the period September 19-25 ranged up to 34 inches in the Nueces River basin in Texas, and up to 35 inches on the Rio Alamo watershed in Mexico. The highest measurement at a regular U.S. Weather Bureau rainfall station was 25.5 inches near Falls City in Karnes County.

Major flooding occurred on the main and tributary streams in the Guadalupe, San Antonio, Mission, Aransas, Nueces, and many small coastal basins in Texas; on the Rio Grande and its floodways; and on the Rio Alamo and Rio San Juan in Mexico.

In Mexico, the magnitude of the flood was so great that most of the recording gages were either submerged, destroyed, or were unable to record the total discharge because water overflowed the natural divides and bypassed the gaging stations. At several streamflow stations in Texas, the maximum rate of flow was more than three times the magnitude of a 50-year flood. The greatest relative discharge rate recorded was on Medio Creek, where the peak discharge was six times that of a 50-year flood.

In the flood area, stage and discharge data were collected at 55 sites in the network of stream-gaging stations that are maintained by the U.S. Geological Survey in cooperation with various state, local, and federal agencies. Peak stage and discharge data were obtained at nine miscellaneous reservoir sites in the Escondido Creek watershed near Kenedy and at nine other miscellaneous sites throughout the flood area. The International Boundary and Water Commission, United States and Mexico, collected data at 16 regular stations in the Rio Grande basin below Falcon Dam. The Ministry of Hydraulic Resources of Mexico collected data at four stations in the Rio Grande basin below Falcon Dam in Mexico. Rainfall data were collected by the U.S. Weather Bureau in the United States. Rainfall data for Mexico were obtained from the International Boundary and Water Commission.

This report was prepared to present all of the documented flood data in a comprehensive and readily available form. The report includes: a discussion of the storm; tabulations of rainfall data; an isohyetal map; a description of the floods, by basin, in terms of magnitude, frequency, and urban inundation; a damage report; a section on the effect of fresh-water inflow on the quality of water in Nueces, Corpus Christi, and San Antonio Bays; a discussion of the effect of rainfall on ground-water recharge; a discussion of ponded water on the Coastal Plain; and detailed information on stage, discharge, and maximum rates of discharge for the September-October 1967 period.

ACKNOWLEDGMENTS

The aid of the many individuals, corporations, and governmental agencies who furnished data and assistance for the preparation of this report is gratefully acknowledged.

The U.S. Weather Bureau assigned men to make precipitation surveys supplementary to their regular rain-gage network; the U.S. Army Corps of Engineers assigned men to make a summary of flood damages; the International Boundary and Water Commission provided information on flood flows and gaging-station records for the Rio Grande and its tributaries; and the Texas Water Development Board provided information on the effects of the floods on ground-water levels.

Collection of field data, necessary for the computation of peak discharge by indirect methods and calculation of detailed records of discharge, was greatly aided by the work of technical personnel detailed from the U.S. Geological Survey Districts of New Mexico, Colorado, Nebraska, and Wyoming. Personnel of the U.S. Geological Survey from Phoenix, Arizona made aerial photographs of flood crests along many of the rivers. Data furnished by all governmental agencies are specifically acknowledged where they appear in the text.

DESCRIPTION OF THE STORM

The first advisory on Hurricane Beulah was issued on September 7, 1967. The disturbance was classified as a tropical storm, centered 35 miles west of Martinique in the eastern Caribbean. Winds reached hurricane force by noon on September 8.

As Beulah moved westerly across the Caribbean, hurricane winds and rains affected inhabited areas of Martinique, St. Lucia, the Barahona Peninsula of the Dominican Republic, the Tiburon Peninsula of Haiti, and Puerto Rico.

Because part of its circulation was over land, the force of the hurricane diminished, and on September 14, Beulah was downgraded to a tropical storm. By September 16, Beulah regained hurricane force and moved across Cozumel Island and the lowlands of the Yucatan Peninsula. The hurricane entered the Gulf of Mexico on the afternoon of September 17. During the three days required for Beulah to reach the coast of south Texas and northeastern Mexico, she gained considerable energy from the warm waters of the Gulf of Mexico.

When Beulah made landfall on the Texas coast about daybreak on September 20, she was a large and dangerous hurricane, with a central pressure of 27.25 inches and a wind speed of about 136 miles per hour. Hurricane force winds were recorded as far up the coast as Corpus Christi and as far inland as Alice.

Beulah began to lose wind speed as she moved north-northwest toward Alice. The storm center stalled, then took a southwesterly course and dissipated in the Sierra Madre near Monterrey, Mexico.

During recent years, most of the hurricanes reaching Texas have been captured by the continental weather system, causing them to move rapidly to the north and east and dissipate their energy over a large area. Beulah moved in the opposite direction and compounded the intensity of energy-mass dissipation by adding an orographic effect to the already torrential rains. Consequently, the greatest amount of precipitation during the storm period occurred on the Rio Alamo watershed, where a maximum of more than 35 inches was reported.

According to reports of the U.S. Weather Bureau, Beulah was the third largest hurricane of record to strike the North American Continent. On the basis of frequency curves (U.S. Weather Bureau Technical Paper No. 49), the storm produced rainfall in excess of a 100-year recurrence interval for durations of 1 to 7 days at a number of stations. Figures 2 and 3 show the accumulative precipitation for eight stations where the 2-day, 100-year frequency was exceeded. Figure 4 shows accumulative rainfall for five selected stations in Mexico. Although no frequency information is available for Mexico, the recurrence interval is probably at least 100 years.

Beulah's maximum precipitation intensity was less than that for the storm at Hearne, Texas, on June 28, 1899 (24 inches in 24 hours), or for the storm at Thrall, Texas, on September 9-10, 1921 (38.2 inches in 24 hours). However, a comparison of the areas bounded by the 5-inch isohyetal lines (Figure 5) shows that Beulah was greater in areal extent than either of these storms.

Table 1 lists precipitation measurements from regular U.S. Weather Bureau observation stations; Table 2 lists supplemental reports from privately owned gages or other receptacles; Table 3 lists precipitation data for sites in Mexico, obtained by the U.S. Weather Bureau and the U.S. Section of the International Boundary and Water Commission.

A unique feature of Hurricane Beulah was the large number of tornadoes (95 by unofficial count) spun off from the main storm. Sightings were reported as far up the coast as Houston and as far inland as Austin, where several buildings were slightly damaged by one tornado that touched down within the city. The most severe tornado occurred at Palacios on Matagorda Bay, where three persons were killed and five were injured.

DESCRIPTION OF THE FLOODS

By E. E. Schroeder

Flooding varied from minor to "maximum known" during September-October 1967 in south Texas and northeastern Mexico.

From the Lavaca River to the Rio Grande, all streams that discharge into the Gulf of Mexico were affected by the storm. The record-breaking volume of water carried by the Rio Grande and its floodways was runoff from the Rio Alamo and Rio San Juan watersheds in Nuevo Leon and Tamaulipas, Mexico. A summary of flood stages and discharges for selected sites in these basins is shown in Table 13, and location of the sites is shown on Figure 38.

Soil moisture and other factors that influence runoff rate ranged from extremely favorable for a high percentage of runoff in the Rio Alamo and Rio San Juan watersheds to near or below normal in the Lavaca River basin.

Lavaca River Basin

The headwaters of the Lavaca River are on the eastern edge of the heavy precipitation area. In the basin, rainfall ranged from 5 to 15 inches, with the lesser amount occurring in the headwaters area. The weather station at Edna in Jackson County reported a 2-day total rainfall of 11.60 inches on September 20 and 21. Rainfall of this amount has a recurrence interval greater than 25 years.

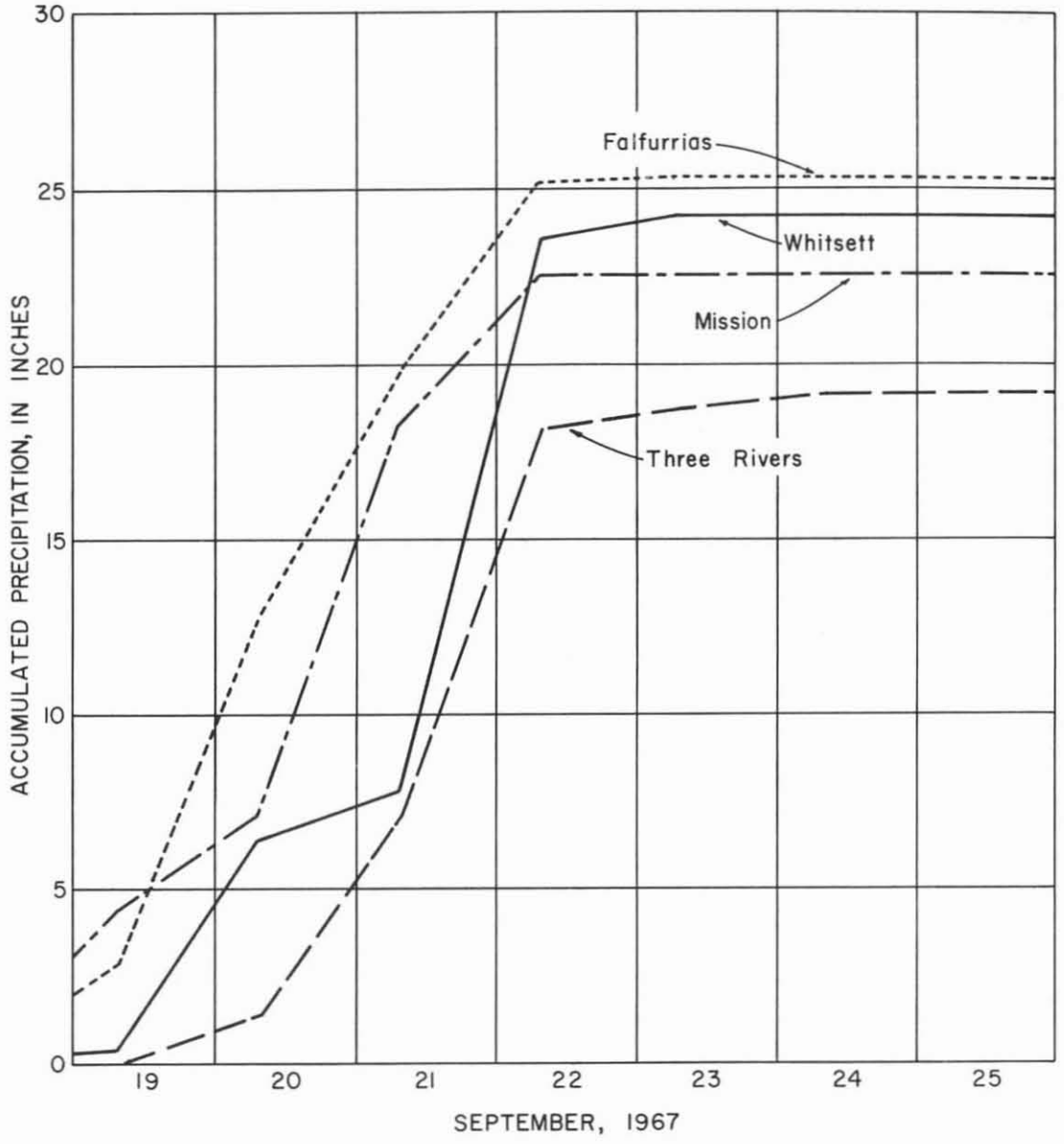


Figure 2

Accumulation of Precipitation at Falfurrias, Whitsett, Mission, and Three Rivers, September 19-25, 1967

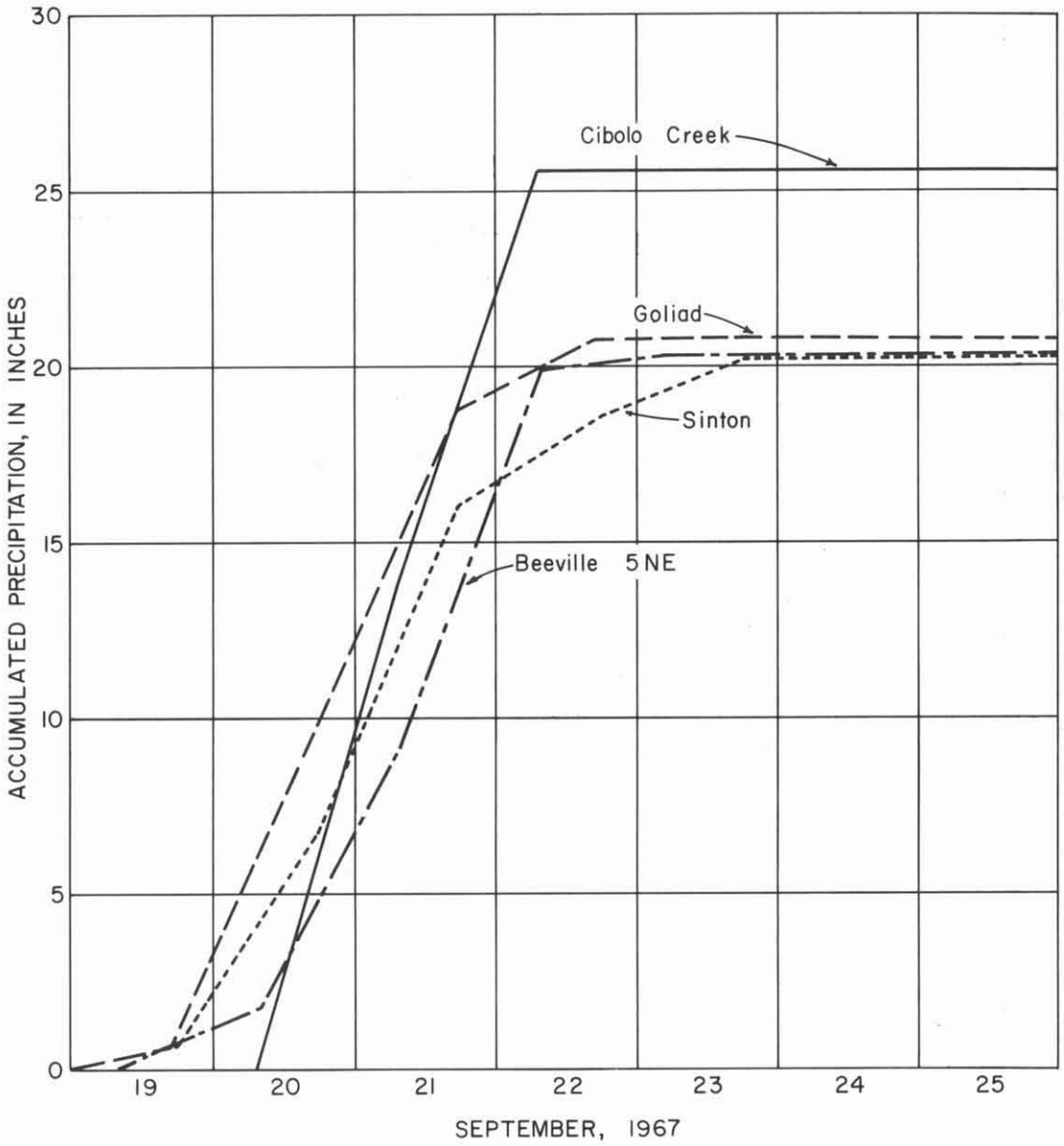


Figure 3

Accumulation of Precipitation at Cibolo Creek, Goliad, Sinton, and Beeville, September 19-25, 1967

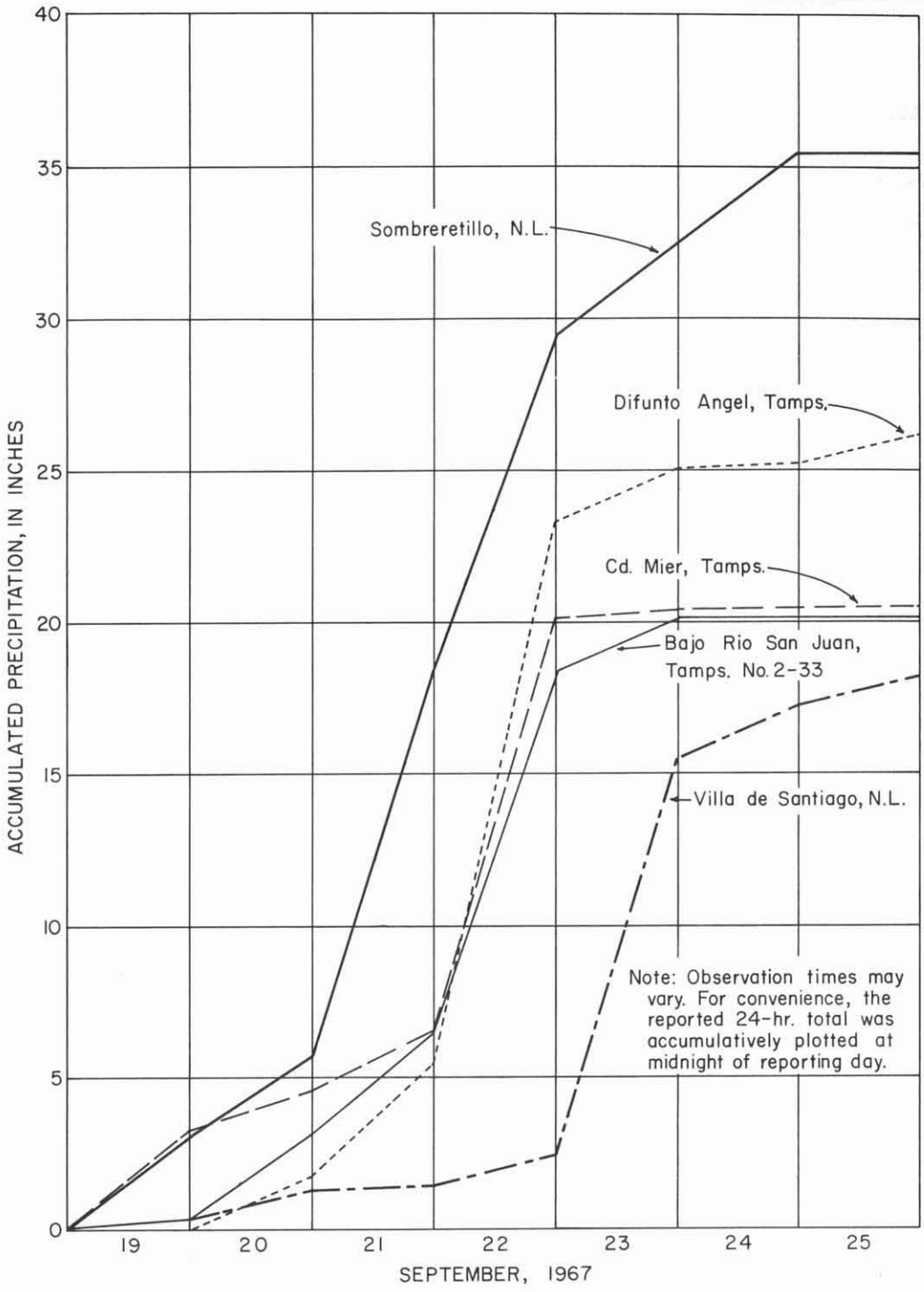


Figure 4

Accumulation of Precipitation at Sombreretillo, Nuevo Leon; Difunto Angel, Tamaulipas; Ciudad Mier, Tamaulipas; Bajo Rio San Juan, Tamaulipas; and Villa de Santiago, Nuevo Leon, Mexico, September 19-25, 1967

International Boundary and Water Commission, United States and Mexico; and U.S. Weather Bureau

Table 1.--Precipitation, in Inches, at U.S. Weather Bureau Gages, Storm Period September 19-25, 1967

COUNTY AND STATION	PRECIPITATION COLLECTED ON--SEPTEMBER 19	20	21	22	23	24	25	TOTAL FOR PERIOD
Aransas County:								
Austwell, National Wildlife Refuge..	1.03	(*)	(*)	13.90	0	0	0	14.93
Rockport.....	1.55	4.50	0	.15	6.10	0	0	12.30
Atascosa County:								
Charlotte, 5 mi NNW.....	.03	2.12	2.50	5.23	.02	0	.65	10.55
Jourdanton.....	.99	4.70	2.95	6.72	0	0	.05	15.41
Poteet.....	.44	3.15	2.60	5.75	0	.50	T	12.44
Bee County:								
Beeville, 5 mi NE.....	0	1.87	7.43	10.61	.47	0	0	20.38
Bexar County:								
Classens Ranch.....	.39	1.91	2.15	1.53	0	0	0	5.98
San Antonio WB Airport.....	.31	2.33	2.45	.46	T	.26	0	5.81
Brooks County:								
Falfurrias.....	2.90	10.00	7.00	5.20	.20	T	T	25.30
Calhoun County:								
Point Comfort.....	1.27	7.60	3.36	.02	0	.18	0	12.43
Port Lavaca No. 2.....	.02	4.36	7.01	.02	0	0	0	11.41
Port O'Connor.....	T	4.85	3.60	.40	T	0	T	8.85
Cameron County:								
Brownsville WB Airport.....	2.17	12.09	1.14	0	.33	.69	0	16.42
Harlingen.....	.45	3.85	4.81	.87	.05	1.40	.06	10.49
Port Isabel.....	(*)	(*)	(*)	16.00	0	0	0	16.00
San Benito.....	.51	3.31	4.35	2.23	.07	.45	0	10.92
De Witt County:								
Cuero, 3 mi S.....	0	1.32	10.90	7.45	.14	0	0	19.81
Yorktown.....	0	2.00	10.62	9.49	.17	0	0	22.28
Duval County:								
Benavides, 3 mi S.....	0	1.15	.60	1.75	.20	0	.40	4.10
Benavides, 7 mi S.....	0	1.75	4.75	5.75	3.85	0	0	16.10
Frio County:								
Dilley.....	0	.21	2.09	3.81	.68	.07	0	6.86
Pearsall.....	0	1.40	2.23	4.03	.19	0	.22	7.85
Goliad County:								
Goliad.....	.78	8.84	9.16	1.96	.05	T	0	20.79
Goliad, 1 mi SE.....0		1.70	6.56	7.20	0	0	0	15.46
Gonzales County:								
Dryer, 1 mi NW.....	.13	4.00	5.79	2.98	0	0	0	12.90
Gonzales.....	.62	1.70	6.56	7.20	0	0	0	16.08
Nixon.....	.15	4.25	7.24	2.55	0	0	0	14.19
Waelder, 7 mi SSW.....	0	2.00	4.09	1.51	0	0	0	7.60
Guadalupe County:								
Seguin.....	.21	2.96	2.95	2.05	0	0	0	8.17
Hidalgo County:								
Engleman Garden.....	.13	4.00	3.00	2.75	.25	.25	0	10.38

See footnotes at end of table.

Table 1.--Precipitation, in Inches, at U.S. Weather Bureau Gages, Storm Period September 19-25, 1967--Continued

COUNTY AND STATION	PRECIPITATION COLLECTED ON--SEPTEMBER 19	20	21	22	23	24	25	TOTAL FOR PERIOD
Hidalgo County--Continued								
McAllen	0.14	3.06	5.52	6.06	0.87	0.29	0.11	16.05
McAllen FAAAP	2.78	5.08	--	--	--	--	--	--
McCook	.09	4.05	6.28	3.76	2.42	.44	.14	17.18
Mercedes, 6 mi SSE	.40	2.44	2.87	2.77	.54	.21	.30	9.53
Mission	4.47	2.66	11.11	4.46	0	0	0	22.70
Weslaco, 2 mi E	1.00	2.75	7.33	.40	.35	.37	0	12.20
Jackson County:								
Edna, 3 mi SW	.62	6.50	5.10	.05	0	0	0	12.27
Jim Hogg County:								
Hebbronville	.02	1.13	4.00	2.60	7.00	.04	.03	14.82
Kaffie Ranch	2.00	5.50	2.80	3.22	.91	0	0	14.43
Jim Wells County:								
Alice	T	1.03	8.05	2.00	3.90	.13	.48	15.59
Karnes County:								
Cibolo Creek	0	13.75	11.75	0	0	0	0	25.50
Falls City, 4 mi WSW	T	1.22	5.32	6.38	.23	T	0	13.15
Karnes City	.18	7.72	3.77	7.95	.10	0	0	19.72
Kenedy	.40	6.62	4.19	6.90	.10	.15	0	18.36
Runge	.56	5.65	6.32	6.15	.02	0	0	18.70
Kenedy County:								
Armstrong	1.20	(*)	11.50	(*)	2.80	(*)	3.00	18.50
Sarita, 7 mi E	1.05	3.65	5.20	2.10	T	0	.76	12.76
Kleberg County:								
Kingsville	.69	3.70	3.55	4.16	.04	0	.06	12.20
Richards	1.00	.70	8.00	2.36	.23	.27	0	12.56
La Salle County:								
Cotulla	0	.43	1.72	2.90	.44	.09	0	5.58
Cotulla FAA Airport	.27	1.78	2.38	1.58	.08	T	0	6.09
Encinal, 3 mi NW	0	.58	1.10	4.20	1.18	.04	0	7.10
Fowlerton	.27	2.20	3.20	4.50	.75	.17	0	11.09
Lavaca County:								
Yoakum	T	4.00	3.27	0	0	0	0	7.27
Live Oak County:								
George West	0	1.02	5.57	9.12	1.30	1.15	0	18.16
Three Rivers	0	1.47	5.70	11.00	.75	.20	.53	19.65
Whitsett, 2 mi SW	.40	6.04	1.49	15.69	.60	0	0	24.22
Matagorda County:								
Bay City Waterworks	0	1.20	4.88	1.25	0	.10	0	7.33
Matagorda No. 2	.52	3.72	6.79	0	0	.06	0	11.09
Palacios FAA Airport	1.66	6.12	3.89	0	T	0	0	11.67
McMullen County:								
Tilden	0	.57	3.56	6.93	1.26	.62	.42	13.36
Nueces County:								
Chapman Ranch	1.00	10.00	1.50	0.50	0.85	0.30	0	14.15
Corpus Christi	.91	6.76	3.68	1.26	.08	0	0	12.69
Corpus Christi WB Airport	.90	3.48	6.38	3.02	.29	0	0	14.07
Robstown	.68	1.68	6.38	3.48	1.76	0	.24	14.22

See footnotes at end of table.

Table 1.--Precipitation, in Inches, at U.S. Weather Bureau Gages, Storm Period September 19-25, 1967--Continued

COUNTY AND STATION	PRECIPITATION COLLECTED ON-- SEPTEMBER							TOTAL FOR PERIOD
	19	20	21	22	23	24	25	
Refugio County:								
Refugio	.48	7.92	4.00	0.31	0.71	0	0	13.42
San Patricio County:								
Aransas Pass 2	1.10	7.38	5.10	1.60	.85	.10	0	16.13
Mathis	0	1.19	8.40	7.65	2.78	.24	0	20.26
Sinton	.82	6.05	9.16	2.60	1.66	.04	.16	20.49
Welder Wildlife Fndtn	.10	1.91	5.97	3.60	0	0	0	11.58
Starr County:								
Rio Grande City, 3 mi W	.02	2.42	4.00	12.51	4.96	T	1.40	25.31
Victoria County:								
Victoria WB Airport	1.07	6.63	5.27	T	0	0	0	12.97
Webb County:								
Laredo No. 2	.71	.55	1.33	3.61	.95	.10	0	7.25
Oilton	0	.38	3.31	2.22	3.52	.16	0	9.59
Willacy County:								
Port Mansfield	.38	(*)	(*)	14.30	0	0	0	14.68
Raymondville	.09	0	8.88	4.87	.64	1.40	.32	16.20
Wilson County:								
Floresville	T	3.30	2.70	9.25	.50	0	0	15.75
Zapata County:								
Zapata	.47	2.24	2.42	3.11	1.62	.58	0	10.44

* Amount included in following measurement, time distribution unknown.
-- No record.
T Trace.

Table 2.--Precipitation, in Inches, at Supplemental Sites,
Storm Period September 19-25, 1967

SITE	LAT.	LONG.	PRECIPITATION COLLECTED ON-- SEPTEMBER							TOTAL FOR PERIOD
			19	20	21	22	23	24	25	
Alice, 3 mi E	27°44'	98°02'	0.64	6.65	2.35	4.79	0.20	0.01	0.01	14.65
Calliham, 5 mi N	28°33'	98°21'	--	--	--	--	--	--	--	16.5
Calliham, 8.5 mi N	28°35'	98°23'	2.25	7.90	9.60	.55	.80	--	--	21.+
Charco, 3 mi W	28°44'	97°40'	--	--	--	--	--	21.5	--	21.5
Cuero, 10 mi NNE	29°13'	97°13'	--	5.0	5.0	2.0	--	--	--	12.0
Falfurrias, 10 mi S	27°04'	98°09'	.18	2.0	6.0+	--	13.0	--	--	21.0+
Fannin	28°42'	97°14'	--	--	16.0	4.0	--	--	--	20.0
Goliad, 10 mi SSE	28°32'	97°21'	--	--	--	--	19.5	--	--	19.5
Hochheim, 4 mi S	29°11'	97°17'	--	2.0	8.0	4.1	--	--	--	14.1
Nursery, 8 mi W	28°55'	97°14'	--	5.0+	10.0	4.0	--	--	--	19.0+
Placedo, 6 mi SE	28°38'	96°45'	--	--	--	16.0	--	--	--	16.0
Premont, 2 mi N	27°24'	98°07'	--	3.0	6.0+	5.0	5.0	.2	--	19.2+
Realitos, SE	27°21'	98°29'	--	--	--	--	--	19.5	--	19.5
San Diego	27°46'	98°14'	--	--	--	--	--	--	15.8	15.8
Stockdale, 1.5 mi SSW	29°13'	97°59'	--	4.5	4.5	4.5+	--	--	--	13.5+
Thomaston	29°00'	97°09'	--	--	--	22.00	--	--	--	22.00
Tilden, 6 mi SE	28°24'	98°27'	--	3.3	3.9	4.1	--	1.1	--	12.4+
Tilden, 8 mi S	28°21'	98°34'	--	--	--	*19.3	--	1.1	--	20.4+
Victoria	28°49'	97°00'	--	--	18.0	--	--	--	--	18.0
Victoria, 10 mi NW	28°56'	97°05'	--	--	--	22.2	--	--	--	22.2
Weesatche	28°51'	97°27'	--	--	--	21.02	--	--	--	21.02
Westhoff	29°11	97°28	--	--	10.00	--	10.9	--	--	20.9
Yorktown, 8 mi SE	28°53'	97°28'	--	--	--	21.0+	--	--	--	21.0+

* Undetermined amount of spill.
Data from bucket survey by U.S. Weather Bureau and Texas Water Development Board.

Table 3.--Precipitation, in Inches, at Weather Stations in Mexico, Storm Period September 19-25, 1967

STATION	LATITUDE	LONGITUDE	PRECIPITATION COLLECTED ON-- SEPTEMBER							TOTAL FOR PERIOD
			19	20	21	22	23	24	25	
Adjuntas, N. L.	25°18'	100°08'	T	1.77	0.12	1.02	12.60	1.57	2.36	19.44
Agua Blanca Canoas, N.L.	25°32'	100°30'	0.43	.55	2.68	4.96	.98	.24	--	9.84
Agualeguas, N.L.	26°19'	99°32'	--	--	--	6.00	6.00	6.00	--	18.00
Anahuac, N.L.	27°15'	100°08'	T	.31	.43	2.52	1.00	T	.85	5.11
Apodaca, N.L.	25°46'	100°11'	--	1.65	.98	.83	5.33	3.62	1.28	13.69
Bajo Rio Bravo, Tamps. No. 1-2	25°56'	97°46'	.39	3.21	4.70	4.90	.39	.30	--	13.89
1-3	25°50'	97°42'	.16	3.15	3.94	2.95	.47	.31	.39	11.37
1-4	25°51'	97°45'	.20	3.31	4.06	3.74	.71	.55	--	12.57
1-12	25°56'	97°38'	.79	2.48	3.23	1.46	.12	--	1.18	9.26
1-13	25°44'	97°40'	--	(*)	7.09	1.77	--	--	--	8.86
2-5	25°48'	97°49'	.16	(*)	(*)	12.60	--	--	.67	13.43
2-6	25°44'	97°53'	.20	1.50	1.65	4.72	1.57	--	--	9.64
2-7	25°39'	97°42'	--	(*)	6.50	.98	.39	--	--	7.87
2-8	25°40'	97°55'	.12	(*)	5.91	4.72	1.57	.16	.24	12.72
2-10	25°36'	97°52'	--	(*)	5.39	5.35	1.50	.35	--	12.59
2-12	25°59'	97°38'	.79	2.48	3.23	1.46	.12	--	1.18	9.26
3-14	25°56'	97°59'	.26	2.05	3.03	1.63	.81	1.56	.06	9.40
3-15	25°46'	98°01'	.24	1.97	2.64	2.95	1.77	.43	.39	10.39
3-17	25°49'	97°58'	.28	(*)	(*)	10.24	.79	.79	.20	12.30
4-16	25°35'	98°00'	.24	3.54	3.15	2.40	2.56	.67	.31	12.87
Bajo Rio San Juan, Tamps. No. 2-29	26°10'	98°38'	--	2.95	3.94	6.50	2.58	.10	1.36	17.43
2-33	26°10'	98°28'	.16	2.95	3.23	12.20	1.57	--	--	20.11
2-38	26°06'	98°34'	--	.30	1.57	3.35	5.53	1.77	--	12.52
3-42	26°04'	98°19'	.13	2.85	5.05	4.79	1.29	--	1.52	15.63
3-47	25°58'	98°07'	--	1.77	4.64	3.87	2.30	.24	.17	12.99
3-55	25°52'	98°12'	--	5.91	3.54	2.13	.20	--	--	11.78
3-58	25°50'	98°11'	--	4.33	5.12	2.95	2.05	.79	.47	15.71
3-60	25°46'	98°10'	--	4.53	5.04	3.27	1.85	.98	.51	16.18
3-63	25°41'	98°06'	--	4.53	4.72	3.74	1.57	.35	.28	15.19
Barranco Azul, Tamps.	24°24'	99°07'	--	1.39	.85	2.18	3.37	1.55	.39	9.73
Brecha Arguelles, Tamps.	26°11'	98°28'	--	2.95	3.23	12.20	1.57	--	--	19.95
Burges, Tamps.	24°57'	98°48'	.31	2.56	.79	4.33	3.27	1.77	.20	13.23
Bustamante, N.L.	26°32'	100°30'	--	2.20	.98	4.53	4.17	.55	.08	12.51
Cabezones, N.L.	24°59'	99°45'	.28	1.54	.14	.48	4.50	1.37	.99	9.30
Cadereyta, N.L.	25°35'	100°00'	--	1.83	.16	3.07	2.96	1.71	--	9.73
Camargo, Tamps.	26°19'	98°50'	.08	1.57	3.54	9.57	1.38	.06	--	16.20
Candela, Coah.	26°51'	100°40'	--	1.02	.83	4.80	5.83	.47	--	12.95
Cd. Mier, Tamps.	26°26'	99°09'	3.15	1.38	1.97	13.58	.31	--	--	20.39
Cerralvo, N.L.	26°05'	99°37'	.04	.94	.58	9.70	2.05	--	--	13.31
Cerritos, N.L.	25°31'	100°12'	.12	1.06	.71	2.99	12.60	1.50	.87	19.85
Cerro Prieto, N.L.	24°56'	99°23'	.35	--	--	.83	--	2.13	1.93	5.24
China, N.L.	25°42'	99°14'	--	1.54	1.38	9.29	1.38	--	.31	13.90

See footnotes at end of table.

Table 3.--Precipitation, in inches, at Weather Stations in Mexico, Storm Period September 19-25, 1967--Continued

STATION	LATITUDE	LONGITUDE	PRECIPITATION COLLECTED ON-- SEPTEMBER							TOTAL FOR PERIOD
			19	20	21	22	23	24	25	
Cienega de Flores, N.L.	25°57'	100°10'	0.20	1.41	0.71	8.07	3.66	0.72	T	14.77
Comales, Tamps.	26°11'	98°55'	--	1.71	3.52	11.89	2.27	.10	--	19.49
Control, Tamps.	25°18'	97°49'	--	(*)	(*)	9.00	.24	.20	.08	9.52
Cruillas, Tamps.	24°45'	98°32'	.31	3.43	.79	1.73	7.32	1.77	1.57	16.92
Difunto Angel, Tamps.	26°23'	99°02'	--	1.94	3.64	17.71	1.78	.18	.88	26.13
Div. de Munic. Y Canal Rode, Tamps.	26°06'	98°34'	--	.30	1.57	3.35	5.51	1.79	--	12.52
Don Martin, Coah.	27°31	100°37	--	.08	.20	1.73	.93	.33	.04	3.31
El Barrote, Tamps.	26°10	98°38'	--	2.95	3.94	6.50	2.58	.10	1.36	17.43
El Cuchillo, N.L.	25°43'	99°16'	.08	.67	.68	9.29	1.36	2.81	.58	15.47
El Manzano, N.L.	25°32'	100°28'	.08	2.72	.12	1.30	13.11	2.76	1.30	21.39
El Ocotillal, Tamps.	24°24'	98°28'	.24	.65	.51	.18	5.91	2.40	.22	10.11
El Pealito, N.L.	25°18'	99°21'	5.16	2.83	.35	7.48	.55	2.05	.39	18.81
Estacion Camacho, N.L.	24°53'	99°35'	.49	.75	.15	.50	2.72	.96	.35	5.92
Garza Ayala, N.L.	26°29'	100°03'	--	2.20	.81	2.36	2.38	1.21	--	8.96
Gral. Bravo, N.L.	25°48'	99°11'	.08	1.73	1.52	11.79	.87	1.42	.41	17.82
Gral. Trevino, N.L.	26°14'	99°29'	.20	.79	--	--	9.84	--	--	10.83
Hedionda Grande, Coah.	25°07'	100°51'	.67	.39	.28	.51	--	--	--	1.85
Hidalgo, Tamps.	24°15'	99°26'	.02	.04	.27	.36	3.84	1.59	.43	6.55
Higueras, N.L.	25°58'	100°01'	1.06	1.42	11.81	2.83	.67	--	--	17.79
Inst. Nac. Invest. Agr., N.L.	25°18'	99°36'	.12	2.20	.16	2.52	1.97	1.77	1.57	10.31
Iturbide, N.L.	24°44'	99°54'	.58	.69	.02	1.02	3.76	.70	.23	7.00
Jimenez, Tamps.	24°13'	98°29'	.09	.59	.41	.17	8.78	4.56	.20	14.80
La Arena, N.L.	25°46'	100°01'	--	.73	.39	10.86	2.23	2.03	.81	17.05
La Cruz, N.L.	25°28'	100°26'	.47	.63	2.99	5.20	.91	.12	--	10.32
La Encarnacion, Tamps.			4.24	1.38	.26	3.98	5.81	7.09	.28	23.04
La Gloria, N.L.	26°53'	99°49'	1.97	2.17	1.57	2.36	--	--	--	8.07
Laguna de Sanchez, N.L.	25°21'	100°17'	.08	1.38	.31	1.83	6.69	1.65	.65	12.59
La Popa, N.L.	26°10'	100°50'	--	1.42	1.38	2.09	1.89	--	--	6.78
Las Comitas, N.L.			.79	--	1.89	.55	3.23	.61	.67	7.74
Las Enramadas, N.L.	25°30'	99°31'	T	2.76	.59	7.30	3.35	1.97	--	15.97
Las Norias, Tamps.	24°37'	98°18'	.79	2.48	.87	1.38	9.31	2.00	.25	17.08
Linares, N.L.	24°52'	99°34'	.49	.75	.15	.50	2.72	.96	.35	5.92
Los Aldamas, N.L.	26°04'	99°12'	--	--	4.13	5.91	--	--	--	10.04
Los Herreras, N.L.	25°54'	99°24'	.30	1.65	.57	10.63	3.15	--	--	16.30
Los Ramones, N.L.	25°42'	99°38'	.16	1.26	.16	6.30	1.89	1.89	.31	11.97
Magueyes, Tamps.	24°34'	99°33'	.36	.33	.09	.65	4.33	1.04	1.00	7.80
Mendez, Tamps.	25°07'	98°35'	T	1.97	.24	3.74	8.46	1.97	1.06	17.44
Miguel Aleman, Tamps. (same as Difunto, Tamps.)	26°24'	99°02'	--	1.94	3.64	17.71	1.78	.18	.88	26.13
Mina, N.L.	26°00'	100°32'	--	.75	.69	4.21	.71	.55	.12	7.03
Monclova, Coah.	26°54'	101.25'	.10	1.20	1.84	4.23	.72	.07	--	8.16
Montemorelos, N.L.	25°12'	99°50'	.04	1.57	.14	1.02	6.89	1.10	.04	10.80
Monterrey, N.L.	25°40'	100°18'	--	1.54	T	2.13	5.63	1.16	.26	10.72

See footnotes at end of table.

Table 3.--Precipitation, in Inches, at Weather Stations in Mexico, Storm Period September 19-25, 1967--Continued

STATION	LATITUDE	LONGITUDE	PRECIPITATION COLLECTED ON-- SEPTEMBER 19	20	21	22	23	24	25	TOTAL FOR PERIOD
Muzquiz, Coah.	27°53'	101°31'	--	0.35	0.51	2.48	1.73	--	0.08	5.15
Nueva Cd. Guerrero, Tamps.	26°34'	99°14'	--	.69	1.69	12.80	2.01	.08	.37	17.64
Nuevo Laredo, Tamps. CILA	27°30'	99°30'	--	.55	1.69	3.27	1.65	.20	.20	7.56
Pajonal, N.L.	25°29'	100°23'	--	1.57	.59	2.56	3.98	.79	.79	10.28
Paso del Aura, Tamps.			1.77	1.91	.91	3.94	5.51	.79	.59	15.42
Potrero Redondo, N.L.	25°16'	100°10'	.04	.59	1.18	2.36	2.76	2.68	3.74	13.35
Progreso, Coah.	27°25'	101°00'	1.18	.43	1.93	2.24	.08	--	--	5.86
Rancho Mercedes, Coah.	28°02'	100°01'	.39	.12	--	.71	.31	--	.63	2.16
Rancho San Juan de la Palma, Tamps.	26°54'	99°20'	--	.83	2.24	3.82	1.57	1.18	--	9.64
Rayones, N.L.	25°01'	100°05'	.39	.83	T	.87	1.18	1.14	1.16	5.57
Reynosa, Tamps.	26°06'	98°17'	.20	3.94	7.48	3.15	1.06	--	--	15.83
Reynosa Km. 40, SW, N.L.	25°57'	98°39'	.94	7.09	5.51	5.12	2.36	.71	--	21.73
Rinconada, N.L.	25°41'	100°43'	.24	.79	.63	4.72	1.10	--	--	7.48
Rio Bravo, Tamps.	25°59'	98°06'	--	7.48	5.91	3.56	.98	.31	.20	18.44
Sabinas Hidalgo, N.L.	26°30'	100°10'	.08	1.61	.79	3.31	4.06	.59	T	10.44
San Carlos, Tamps.	24°35'	98°56'	.37	3.78	1.36	2.99	6.61	1.54	.11	16.76
San Fernando, Tamps.	24°51'	98°14'	.91	2.48	.91	.79	4.98	2.56	2.05	14.68
San Juan, N.L.	25°33'	99°50'	.83	3.17	1.61	.83	1.42	.16	.53	8.55
San Miguel de Camargo, Tamps.	26°14'	98°36'	.12	3.19	2.95	2.30	1.57	--	.43	10.56
San Nicolas, Tamps.	24°42'	98°50'	--	.91	7.09	1.28	1.75	5.61	1.52	18.16
Santa Catarina, N.L.	25°40'	100°28'	--	.87	.12	1.81	6.10	.87	.24	10.01
Santa Teresa, Coah.	26°27'	101°24'	--	.79	.20	1.85	2.13	.24	--	5.21
Sombreretillo, N.L.	26°18'	99°58'	3.15	2.76	12.60	11.02	2.90	3.15	--	35.67
Tenacitas, Tamps.	25°59'	98°02'	2.24	3.25	.51	.33	13.58	6.38	.37	26.66
Topo Chico, N.L.	25°44'	100°20'	--	1.52	.10	2.46	4.76	.79	.28	9.91
Tunel San Francisco, N.L.	25°25'	100°10'	.09	1.33	--	--	8.66	.02	.75	10.85
Valadeces, Tamps.	26°14'	98°40'	.06	3.25	3.56	4.40	2.05	--	1.06	14.38
Vallecillo, N.L.	26°40'	99°59'	1.81	.08	.10	.49	.24	.93	1.46	5.11
Villa Allende, N.L.	25°17'	100°01'	.20	1.81	.20	1.10	9.92	1.06	.71	15.00
Villa de Santiago, N.L.	25°25'	100°09'	.17	1.07	.08	1.20	13.08	1.73	.79	18.12
Villa Hidalgo, Coah.	27°47'	99°52'	.59	.55	4.57	1.18	.24	--	--	7.13

* Amount included in following measurement, time distribution unknown.
T Trace.
Data furnished by International Boundary & Water Commission, United States and Mexico and U.S. Weather Bureau

Runoff was substantial, although less than would be expected from rainfall alone. This result, based on a daily discharge of 3.6 cfs (cubic feet per second) on September 19 at the streamflow station near Edna (station 1), can be partly attributed to fairly low soil-moisture content in the basin. On the 23rd, a peak discharge of 22,500 cfs at a gage height of 26.37 feet was recorded. Flood stage at Edna is 21 feet. A flood of this magnitude has a recurrence interval of about 4½ years.

The Navidad River, a tributary of the Lavaca River, had a peak discharge of 26,600 cfs from 1,116 square miles with a stage of 31.91 feet at the streamflow station near Ganado (station 2). Flood stage at Ganado is 21 feet. A flood of this magnitude has a recurrence interval of about 4½ years.

Flooding did occur in the Lavaca River basin, but flood damage was minor, and the flood did not approach the magnitude of previous floods.

Guadalupe River Basin

The Guadalupe River basin received precipitation ranging from 1.75 inches at Kerrville in Kerr County, near the headwaters, to about 25 inches in the Coleto Creek area upstream from the gaging station at Schroeder in Goliad County. The greatest amount of rainfall recorded during the storm period at a regular weather station was 22.28 inches at Yorktown in DeWitt County, although larger amounts were reported at supplemental sites in this basin. Yorktown received a 2-day total rainfall for September 20 and 21 of 20.11 inches. Cuero, also in DeWitt County, had a 2-day total of 18.35 inches for the same period. These amounts greatly exceed the 2-day, 100-year frequency.

In downstream order, the principal streams tributary to the Guadalupe River are: San Marcos River, Peach Creek, Sandies Creek, and Coleto Creek. Runoff in the basin above the mouth of the San Marcos River was light.

Peach Creek, in a 5 to 10 inch precipitation zone in Gonzales County, had a peak discharge of 10,200 cfs at the streamflow station near Dilworth (station 5). A flood of this magnitude has a recurrence interval of 2½ years.

Sandies Creek watershed, in Guadalupe, Gonzales, Wilson, Karnes, and DeWitt Counties, received rainfall totals during the storm period ranging from less than 10 inches at the headwaters in Guadalupe County to more than 20 inches at the streamflow station near Westhoff in DeWitt County. At a site near Leesville, Sandies Creek (station 6) had a peak discharge of 3,920 cfs from a drainage area of 47.4 square miles. This discharge has a recurrence interval of 3 years. At the streamflow station near Westhoff (station 7), the peak discharge was 79,700 cfs from a drainage area of 560 square miles. The recurrence interval for this discharge is 35 years.

Coleto Creek watershed, in DeWitt, Goliad, and Victoria Counties, received 20 to 25 inches of rainfall during the storm period. These were the greatest amounts reported in the Guadalupe River basin, and the consequent flooding on Coleto Creek was greater than any previously recorded during the period of record dating back to 1872. The peak discharge from the 365-square-mile drainage area above the streamflow station near Schroeder (station 12) was 122,000 cfs, which is 1.73 times the magnitude of a 50-year flood. At the discontinued gaging-station site near Victoria (station 13) in Victoria County, the peak discharge from a drainage area of 514 square miles was 236,000 cfs, which is 2.74 times the magnitude of a 50-year flood and is 2.65 times greater than the previously recorded maximum.

A peak discharge of 70,000 cfs was recorded on the Guadalupe River on September 21 at the gaging station near Victoria (station 10). This runoff was generated primarily in the 284-square-mile area between the Cuero station and the Victoria station. The upstream rise, which had a peak discharge of 61,500 cfs at Cuero (station 8), did not reach the Victoria station until September 24. The peak discharge at Cuero and Victoria has a recurrence interval of 10 and 14 years, respectively.

Flooding also occurred on the many smaller streams in the basin. At the present time, data from this area are not sufficient to define a frequency and magnitude relation for streams having a drainage area of less than 30 square miles, but peak stage and discharge data for four small streams are included in Table 13.

Flood damage in the Guadalupe River basin was most severe along the lower reaches of Sandies Creek, downstream from Westhoff; along the entire Coleto Creek; and along the mainstem below Victoria, especially below the mouth of Coleto Creek. In these areas, inundation damaged railways, highways, and utilities. Figure 6 is a photograph of the Guadalupe Diversion Dam and salt-water barrier during normal low-flow periods. Figure 7 is a photograph of this structure during the Beulah floods.

San Antonio River Basin

In the San Antonio River basin, precipitation during the period ranged from 1.92 inches at Medina in Bandera County, near the headwaters of the Medina River, to 25 inches in the lower Cibolo Creek watershed near the Wilson-Karnes County line. The 2-day, 100-year frequency was exceeded at a number of weather stations. The greatest 2-day total (25.50 inches) at a regular weather station was recorded at the site of the

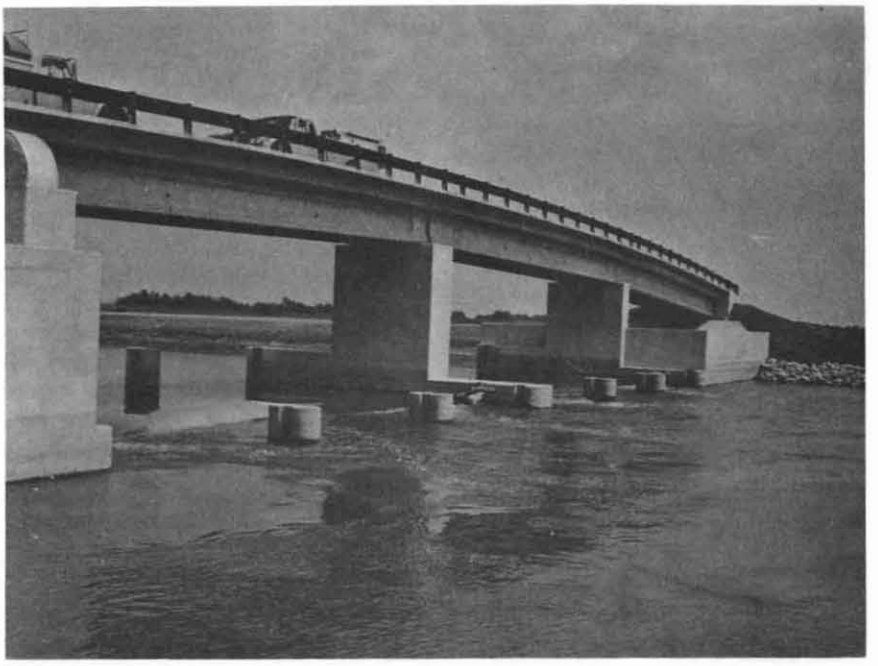


Figure 6--Guadalupe Diversion Dam and Salt-Water Barrier During a Normal Low-Flow Period

Photograph by Guadalupe-Blanco River Authority

Figure 7--Aerial View of Guadalupe Diversion Dam During the Beulah Floods

streamflow station Cibolo Creek near Falls City (station 22) in Karnes County.

In downstream order, the principal streams tributary to the San Antonio River are: Medina River, Calaveras Creek, Cibolo Creek, Ecleto Creek, and Escondido Creek.

Very little over-bank flooding occurred in the San Antonio River basin above the mouth of the Medina River. However, local flooding did occur in the city of San Antonio, where at least two people were drowned while attempting to navigate low-water crossings.

Runoff from the Medina River and Calaveras Creek watersheds was comparatively light. A peak discharge of 5,480 cfs was recorded at Medina River near San Antonio (station 16) and 3,720 cfs was recorded at Calaveras Creek near Elmendorf (station 19) in Bexar County. Medio Creek, a tributary of the Medina River, had a peak discharge of 2,640 cfs from a drainage area of 47.9 square miles at a miscellaneous site near Macdona (station 15) in western Bexar County.

Cibolo Creek, which drains parts of Kendall, Comal, Bexar, Guadalupe, Wilson, and Karnes Counties, had very light runoff upstream from the streamflow station at Selma (station 21) in Bexar County. During this storm a peak discharge of only .89 cfs was recorded. At the downstream station near Falls City (station 22) in Karnes County, a maximum discharge of 25,300 cfs was recorded from 827 square miles. The runoff in the lower part of the watershed, produced by rainfall that ranged from 10 to 25 inches, has a recurrence interval of nine years.

Ecleto Creek watershed in Wilson and Karnes Counties had 10 to 20 inches of rain during the storm period. Runoff was very high in the 239-square-mile area above the streamflow station near Runge (station 23) in Karnes County, where a peak discharge of 58,400 cfs was recorded. This discharge is 2.24 times the magnitude of a 50-year flood.

Escondido Creek, which drains 72.4 square miles above the streamflow station at Kenedy in Karnes County, had very heavy runoff as a result of antecedent conditions in the watershed. Ten floodwater-retarding structures, which partly control the runoff from 36.5 square miles, discharged over the emergency spillways. The weighted mean rainfall in the watershed above the Kenedy station (station 34) was 22.5 inches, and the peak discharge at this station was 37,000 cfs. This discharge is 3.82 times the magnitude of a 50-year flood.

Because the Escondido Creek watershed is a special study area, detailed information was obtained for two subwatersheds above a floodwater-retarding structure. Rainfall and runoff data for these two sites (subwatersheds 1 and 11) are shown in Figures 8 and 9. Figure 10 shows rainfall and runoff for Escondido Creek at Kenedy. Some flooding from Escondido Creek did occur. Water overflowed U.S. Highway 281 at Kenedy and inundated some houses in the northeast part of town.

The San Antonio River was above bank-full stage from Ecleto Creek in Karnes County to the mouth. The volume of runoff being contributed by very small tributaries is illustrated by the discharge from Baugh Creek at Goliad (station 36), where a peak discharge of 1,000 cfs was recorded from a drainage area of 3.02 square miles.

The downstream discharge station, San Antonio River at Goliad (station 37), had a peak discharge of 138,000 cfs from a drainage area of 3,921 square miles. This discharge is 3.22 times the magnitude of a 50-year flood and 4.08 times the previously recorded maximum since 1869. The peak stage exceeded the previous maximum by 8.8 feet. The San Antonio River joins the Guadalupe River near Tivoli (station 14), where the peak stage was 2.7 feet higher than the previous maximum since 1869.

Discharge hydrographs for Guadalupe River at Victoria, Coleto Creek near Schroeder, and San Antonio River at Goliad (stations 10, 12, and 37) are shown on Figure 11.

Flooding was severe in the lower part of the basin. All low areas from Goliad to the Gulf of Mexico were inundated. Figure 12 shows the San Antonio River flooding the southern edge of Goliad in Goliad County. All highways crossing the river from Goliad to the coast were closed.

Mission River Basin

Extreme flooding occurred throughout the Mission River basin in Bee, Goliad, and Refugio Counties. During the storm period, rainfall of 20 to 25 inches was reported over most of the basin upstream from Refugio. Pettus in Bee County reported a supplementary measurement totaling 27.38 inches during the period September 20-24, which is one of the largest amounts reported in Texas. Rainfall in the basin easily exceeded the 2-day, 100-year frequency.

The mainstem of the Mission River is formed a few miles upstream from Refugio by the confluence of Blanco and Medio Creeks. On Blanco Creek, the peak discharge at the miscellaneous site near Berclair (station 38) in Bee County was 38,600 cfs from a drainage area of 70.3 square miles. This is 4.28 times the magnitude of a 50-year flood.

Toro Creek, a tributary of Medio Creek, had a peak discharge of 13,400 cfs from a drainage area of 24.6 square miles at a miscellaneous site near Tuleta (station 39) in Bee County. Medio Creek, which has a

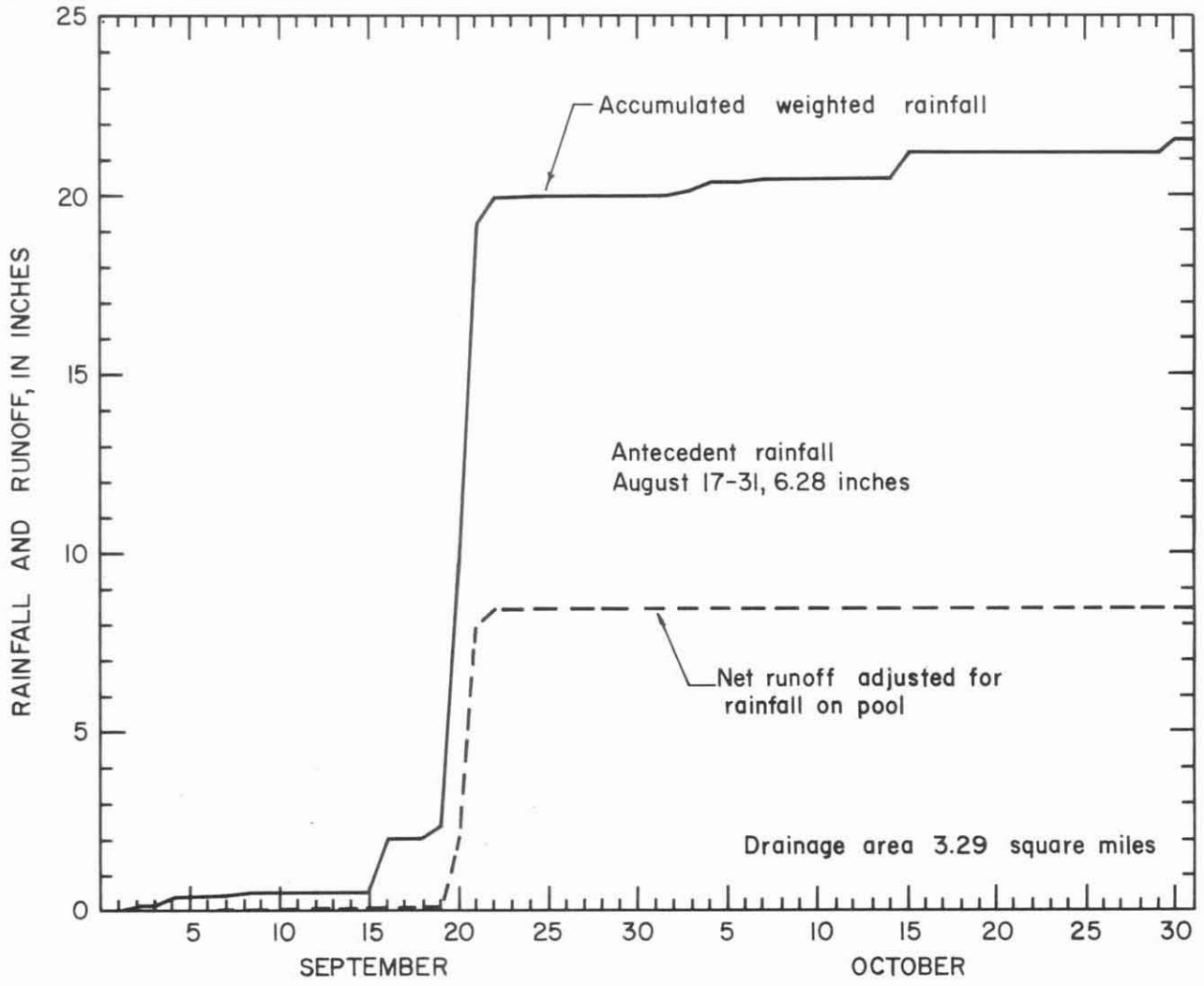


Figure 8

Accumulated Weighted Rainfall and Net Runoff,
Escondido Creek, Subwatershed No. 1

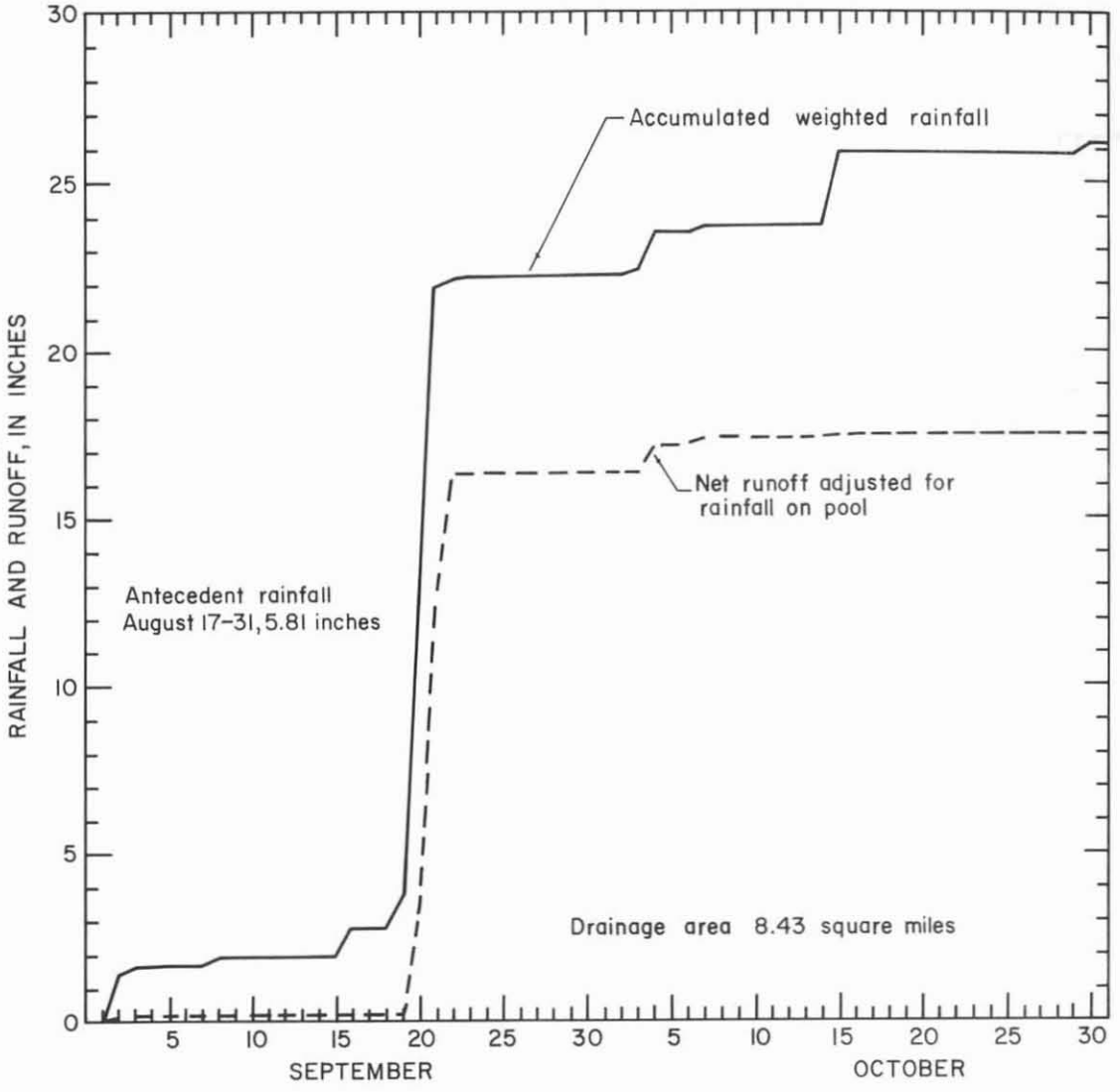


Figure 9

Accumulated Weighted Rainfall and Net Runoff, Escondido Creek, Subwatershed No. 11

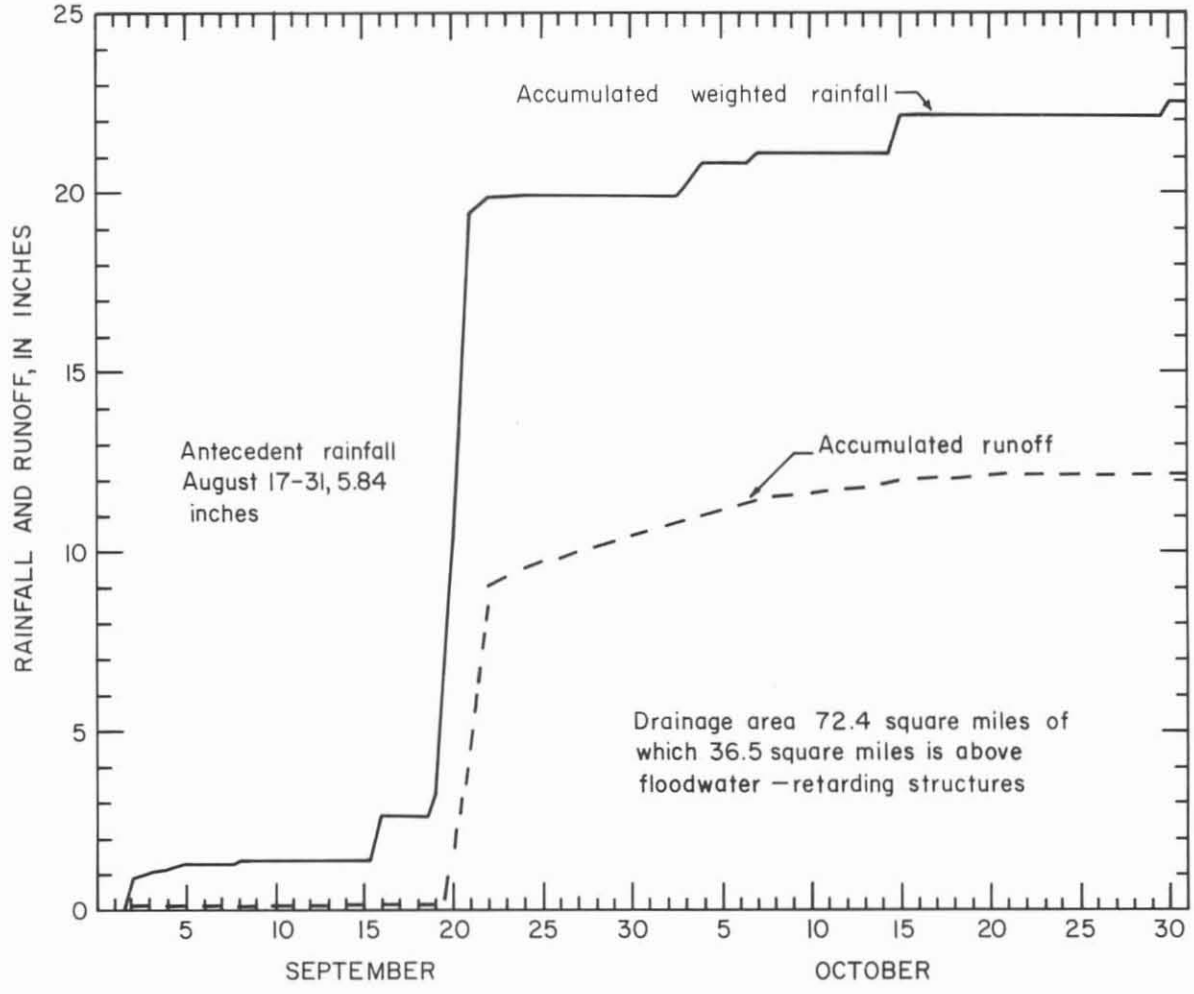


Figure 10

Accumulated Weighted Rainfall and Runoff, Escondido Creek at Kenedy

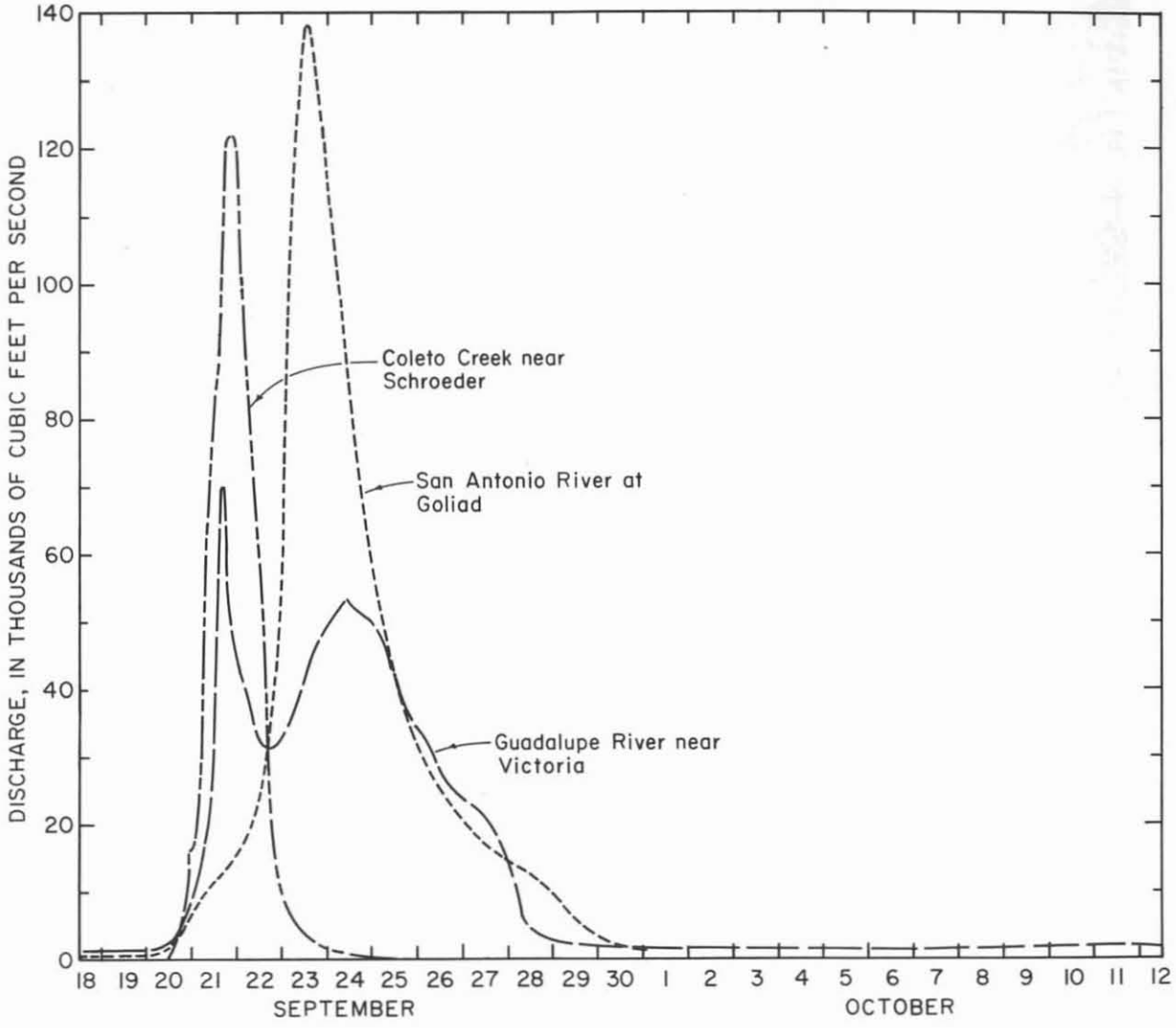


Figure 11

Discharge Hydrographs for Guadalupe River at Victoria, Coleto Creek Near Schroeder, and San Antonio River at Goliad

Figure 12--Aerial View of Flooding on the San Antonio River at Goliad

drainage area of 204 square miles at the streamflow station near Beeville (station 40), had a peak discharge of 105,000 cfs, which is 6.0 times the magnitude of a 50-year flood. The stage for this flood was 7.7 feet higher than the previous maximum in 1919.

At the streamflow station Mission River at Refugio (station 41), a peak discharge of 116,000 cfs from a drainage area of 690 square miles occurred on September 21, the day before Medio Creek crested at the Beeville station. Therefore, the peak at Refugio was principally Blanco Creek water. A secondary peak slightly less in magnitude occurred at Refugio when the upstream rise from Medio Creek reached the Mission River. The peak discharge for this station is 3.17 times the magnitude of a 50-year flood.

Flood damage was widespread throughout the entire basin. Many rural and urban homes were damaged, and transportation was almost nonexistent because of the many submerged highways. One of the most severly damaged places in the basin was the small unincorporated village of Pettus in Bee County, which was completely inundated by 3 to 5 feet of flowing water from Medio Creek. Five people were reported drowned.

Aransas River Basin

The Aransas River basin is a small coastal basin having a drainage area of 247 square miles above the streamflow station near Skidmore in Bee County. Precipitation throughout the basin during the storm period was slightly more than 20 inches. Beeville in Bee County reported 18.04 inches in 48 hours and Sinton in San Patricio County reported 15.21 inches during the same period. These amounts are equal to or greater than a 2-day, 100-year storm.

Flooding in this basin was almost equal to that in the Mission River basin. The streamflow station Aransas River near Skidmore (station 44) had a maximum discharge of 82,800 cfs from a drainage area of 247 square miles. This discharge is 4.23 times the magnitude of a 50-year flood. The stage for this flood was 9.22 feet higher than the previous maximum since 1914.

Poesta Creek (station 42), a tributary in the upper part of the basin, had a peak discharge of 20,800 cfs from a drainage area of 46.5 square miles. This discharge is 3.02 times the magnitude of a 50-year flood.

A very small stream, Olmos Creek tributary near Skidmore (station 43), had a peak discharge of 325 cfs from a drainage area of 0.58 square mile.

A sample of the magnitude of runoff in ungaged areas was obtained at Papalote Creek near Papalote (station 45) in San Patricio County. The peak discharge at this site was 56,400 cfs from a drainage area of 99.2 square miles. This discharge is 5.19 times the magnitude of a 50-year flood.

Flooding was extensive in the Aransas River basin. Most of the principal highways were closed for a time, and considerable inundation occurred in both rural and urban areas.

Poesta Creek inundated part of Beeville (Figure 13). The depth of inundation at any point can be obtained by using the flood profile (Figure 14) to determine the water surface elevation and a topographic map to determine the elevation.

Sinton in San Patricio County was completely inundated by water from Chiltipin Creek. Local residents reported that the water was as much as 4 feet deep but had no discernible velocity, so flood damage was less than would have occurred from flowing water.

A form of sheet flow was prevalent, especially in the lower part of the basin. The boundaries of inundation from any particular creek could not be delineated, in the classical manner of observing deposits of flood debris, because sheet flow extended continuously from one creek to another.

Nueces River Basin

The Nueces River basin, which has a drainage area of 16,660 square miles above the downstream discharge station near Mathis (station 61), had the greatest mainstem flood in the lower basin since records began in 1919. Less than one-half of the total drainage area contributed runoff to the flood. Runoff from the 5,260 square miles above Cotulla (station 46) on the mainstem and from the 3,493 square miles above Derby (station 51) on the Frio River was comparatively low. Furthermore, the Nueces River at Cotulla crested after the large crest had occurred at downstream stations.

Precipitation during the storm period ranged from less than 5 inches at the headwaters to 25 inches in the lower part of the basin. The 2-day, 100-year frequency was exceeded at a number of regular weather stations in the lower basin.

The Atascosa River, which drains parts of Bexar, Wilson, Karnes, and Atascosa Counties, is tributary to the Frio River at a point just a few miles upstream from the mouth of the Frio River, which is tributary to the Nueces River near a town in Live Oak County appropriately named Three Rivers. In the 1,171-square-mile drainage area upstream from the discharge station at Whitsett (station 56) in Live Oak County, rainfall ranged from less than 10 inches to more than 25 inches, with the heavier amounts occurring in the lower part of the watershed. The greatest 24-hour total reported from a regular weather station in Texas was 15.69 inches at Whitsett. This amount greatly exceeds the 100-year frequency.

In the upper part of the watershed, runoff was appreciable but not record breaking. Rutledge Hollow Creek near Poteet (station 54, drainage area 18.3 square miles) and Lucas Creek near Pleasanton (station 55, drainage area 32.8 square miles), both in Atascosa County, had a peak discharge of 1,800 and 2,970 cfs, respectively. For Lucas Creek this discharge has a recurrence interval of 7½ years.

At the gaging station Atascosa River at Whitsett (station 56), the peak discharge was 121,000 cfs. The stage was 0.3 foot higher than the previous maximum since 1881, and the discharge was 1.70 times the magnitude of a 50-year flood.

Flooding along the Atascosa was severe from Pleasanton to the mouth. West of Whitsett, State Highway 99 was severely damaged, and near Campbellton, a 3-mile stretch of U.S. Highway 281 was inundated. The railway between Campbellton and Three Rivers was severely damaged. Many of the smaller streams in the watershed caused other roads to be closed at times.

In the Frio River watershed downstream from Derby in Frio County, precipitation ranged from less than 10 inches at Derby to 19 inches at Three Rivers. The 2-day, 100-year frequency was exceeded only in the lower part of the watershed.

At Derby (station 51), the peak discharge was only 3,880 cfs, which is less than the magnitude of the mean annual flood.

San Miguel Creek near Tilden (station 52) in McMullen County had a peak discharge of 13,700 cfs from a drainage area of 793 square miles. Discharge of this magnitude has a recurrence interval of about four years.

At Calliham (station 53) near the McMullen-Live Oak County line, the Frio River had a peak discharge of 57,000 cfs. This discharge has a recurrence interval of about 34 years. The stage was about three feet less than during the great flood in 1932.

Flooding was substantial but not record breaking in the Frio River watershed. At Farm Road 99, just downstream from the gaging station, the maximum depth over the highway was 7 feet. More than one-half of the total discharge flowed over the left channel bank into Opossum Creek, which for a short distance had more discharge than the Frio River. At this stage, the creek had become an overflow channel of the river.

The drainage area along the mainstem of the Nueces River below Cotulla in La Salle County received rainfall ranging from less than 10 inches at Cotulla to about 25 inches near Mathis in San Patricio County. The 2-day, 100-year frequency was exceeded in the lower part of the basin. Mathis reported a 2-day total for September 21-22 of 16.05 inches.

At Cotulla (station 46), a peak discharge of 7,050 cfs was recorded. This discharge, which is less than the mean annual flood, occurred after the crest had passed the downstream stations.

San Casimiro Creek near Freer (station 47) had a peak discharge of 43,200 cfs from a drainage area of 469 square miles. This was a large flood, but the peak stage was 1.4 feet lower than the previous maximum in 1954. At the streamflow station on State Highway 44, west of Freer in Duval County, the width of flow over the highway was 0.9 mile.

On the mainstem at the gaging station near Tilden (station 48) in McMullen County, the peak discharge was 76,500 cfs. This discharge has a recurrence interval of 45 years. The stage was the greatest known since 1902 and was about 0.1 foot higher than the previous maximum in 1946. In this area, the volume of water contributed by very small streams is indicated by Plant Creek near Tilden (station 49), where a peak discharge of 220 cfs occurred from 0.36 square mile.

The last streamflow station on the mainstem above the mouth of the Frio River is at Simmons (station 50) in Live Oak County. The peak discharge at this station was 72,000 cfs. The peak stage for this flood was about 0.3 foot lower than the previous maximum in 1919.

At Three Rivers (station 57) in Live Oak County the combined flow of the Atascosa and Frio Rivers merged with the Nueces to produce the greatest flood since at least 1875. A peak discharge of 141,000 cfs occurred on September 23, 1967. This discharge is 1.76 times the magnitude of a 50-year flood and is 1.66 times greater than the previous maximum which occurred in 1919. The 1919 stage was exceeded by 3.2 feet.

Flooding in the town of Three Rivers, which has a population of approximately 2,000, was near catastrophic. The entire business section along with most of the residential area was inundated with depths up to 6 feet. The depth of inundation was made vividly evident by an ugly deep ring of oil that adhered to the surface of practically every building in town. This oil ring was later found to be about ¾ of a foot below the peak. All traffic was stopped by flood water. Scouring action sank an internal pier and two spans dropped from a bridge on the northbound lane of U.S. Highway 281, south of town. Flood damage was heavy in all parts of the lower Nueces basin, but the damage at Three Rivers was the most severe.

The flood at Three Rivers would have been greater had the timing of the runoff been such that the water from the Atascosa, Frio, and Nueces Rivers reached the site simultaneously. Actually, the Atascosa water probably reached the site several hours before the flood crest of the Frio arrived. The maximum flood crest on the Nueces did not arrive until about 43 hours later. Flood hydrographs for Nueces River at Simmons, Frio River at

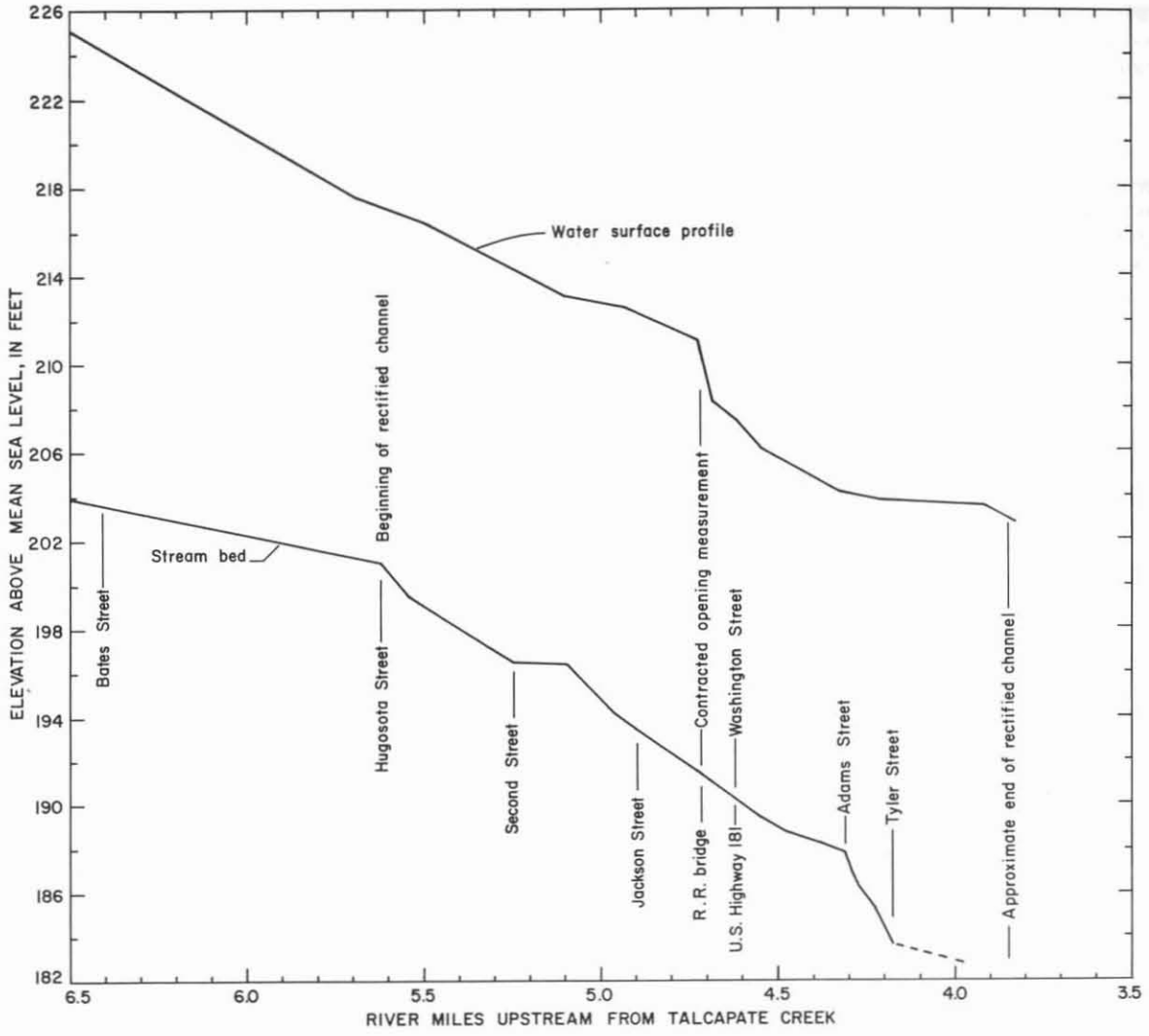


Figure 14

Profile of September 21, 1967, Flood on Poesta Creek at Beeville

Calliham, Atascosa River at Whitsett, and Nueces River near Three Rivers are shown in Figure 15. Figure 16 is an aerial view of the inundation at Three Rivers caused by the Nueces and Frio Rivers on September 25, 1967.

There is an increase of 1,056 square miles in drainage area between the discharge station at Three Rivers and Wesley E. Seale Dam, which forms Lake Corpus Christi. This drainage area had precipitation ranging from more than 15 inches to about 25 inches. A rancher who lives 1 mile south of Dinero, in Live Oak County, reported orally that he had measured 34 inches during the period September 20-23, 1967.

A sample of the peak rate of flow from this ungaged area was obtained at two sites. Sulphur Creek (station 58), which joins the Nueces River on the east bank near Oakville, had a peak discharge of 43,600 cfs from a drainage area of 71.1 square miles at a site east of Three Rivers. Ramirena Creek (station 59), which drains 84.4 square miles of southern Live Oak County, had a peak discharge of 20,500 cfs at a site south of George West. Evidence of a high runoff rate was noted at other creeks in the area, particularly on Gamble Gully and La Parra Creek. Preliminary computations indicate that the peak inflow rate into Lake Corpus Christi was produced by the combined flow of these relatively small creeks and that the peak rate of inflow occurred prior to the arrival of the flood crest of the mainstem Nueces River.

Discharge from Lake Corpus Christi was partly controlled by manipulation of the 60 tainter gates in Wesley E. Seale Dam. These gates (Figure 17) were operated throughout the flood to cause the least damage possible, both from backwater flooding upstream and from release-water flooding downstream. The lake (station 60) had a peak elevation of 94.82 feet (contents 320,000 acre-feet), which is the highest stage since the present dam was completed in 1958. The peak discharge from the lake, at about 6:00 p.m. on September 24, was computed to be 138,000 cfs. At that time, 54 of the gates were open full and the other six were partly open.

The discharge station (station 61), located 0.6 mile downstream from the dam, had a peak stage of 47.7 feet, which is 7.7 feet higher than the previous maximum in 1919. The discharge of 138,000 cfs is 2.38 times the discharge of the 1919 flood. Discharge hydrographs for Nueces River near Three Rivers and Nueces River near Mathis, along with contents for Lake Corpus Christi near Mathis are shown in Figure 18.

State Highway 359 and the Southern Pacific Railroad (Figure 19) were submerged just downstream from the dam for several days. Farther downstream, State Highway 9 and U.S. Highway 77 were also closed. Some homes in Corpus Christi and Calallen suburbs were inundated along Nueces Bay, which had a substantial rise as a result of flood-flow from the Nueces River.

Coastal Area Between the Nueces River and the Rio Grande

The coastal area between the Nueces River and the Rio Grande totals 10,442 square miles, of which 5,179 square miles is probably noncontributing. This area is relatively flat, having a maximum elevation of less than 200 feet above sea level. Total precipitation in the contributing part of the coastal area ranged from 10 to 25 inches during the storm period.

The coastal area between the mouth of the Nueces River at Corpus Christi Bay and the mouth of Los Olmos Creek at Baffin Bay contains 3,576 square miles, of which 273 square miles is probably noncontributing. This 273 square miles consists mainly of many small depressions, known locally as water holes. The rest of the area is drained by a fairly well developed system of streams that ultimately discharge into either Corpus Christi or Baffin Bays. During this flood, some overland flooding occurred as water overflowed from one watershed to another in the lower part of the area.

Oso Creek (station 62), which discharges into Nueces Bay, had a peak discharge of 3,620 cfs at a site near Violet on State Highway 44 in Nueces County from a drainage area of 45.8 square miles. This vicinity was described as a "sea of water," with water overflowing the highway at many places. At one time, State Highway 44 was the only access road to Corpus Christi. Much of the area east of a line from Mathis to Kingsville to Falfurrias, a distance of about 50 miles, was reported to have been covered by sheet flow ranging up to two feet in depth.

San Fernando Creek is one of the principal streams that ultimately discharges into Baffin Bay. A tributary of this creek, San Diego Creek, had a peak discharge of 14,000 cfs from a drainage area of 319 square miles above the discharge station at Alice (station 65) in Jim Wells County. This discharge has a recurrence interval of 44 years. A short distance downstream from the mouth of San Diego Creek, San Fernando Creek (station 67), which has a drainage area of 507 square miles, had a peak discharge of 16,900 cfs. This is slightly greater than the 1962 flood, which was the greatest since 1949. Runoff from 150 square miles of intervening drainage area between the San Diego and San Fernando stations is partly controlled by Lake Alice on Chiltipin Creek (station 66). This reservoir was completed in 1965 and has a capacity of 2,780 acre-feet below the siphon spillway. The peak contents during this flood was 4,150 acre-feet. Flow from 73.4 square miles above Lake Alice is partly controlled by six floodwater-retarding structures having a total combined capacity of 15,690 acre-feet below the flood spillways.

A short distance downstream from the streamflow station San Fernando Creek at Alice, part of the flood discharge overflowed into Pintas Creek, a tributary of

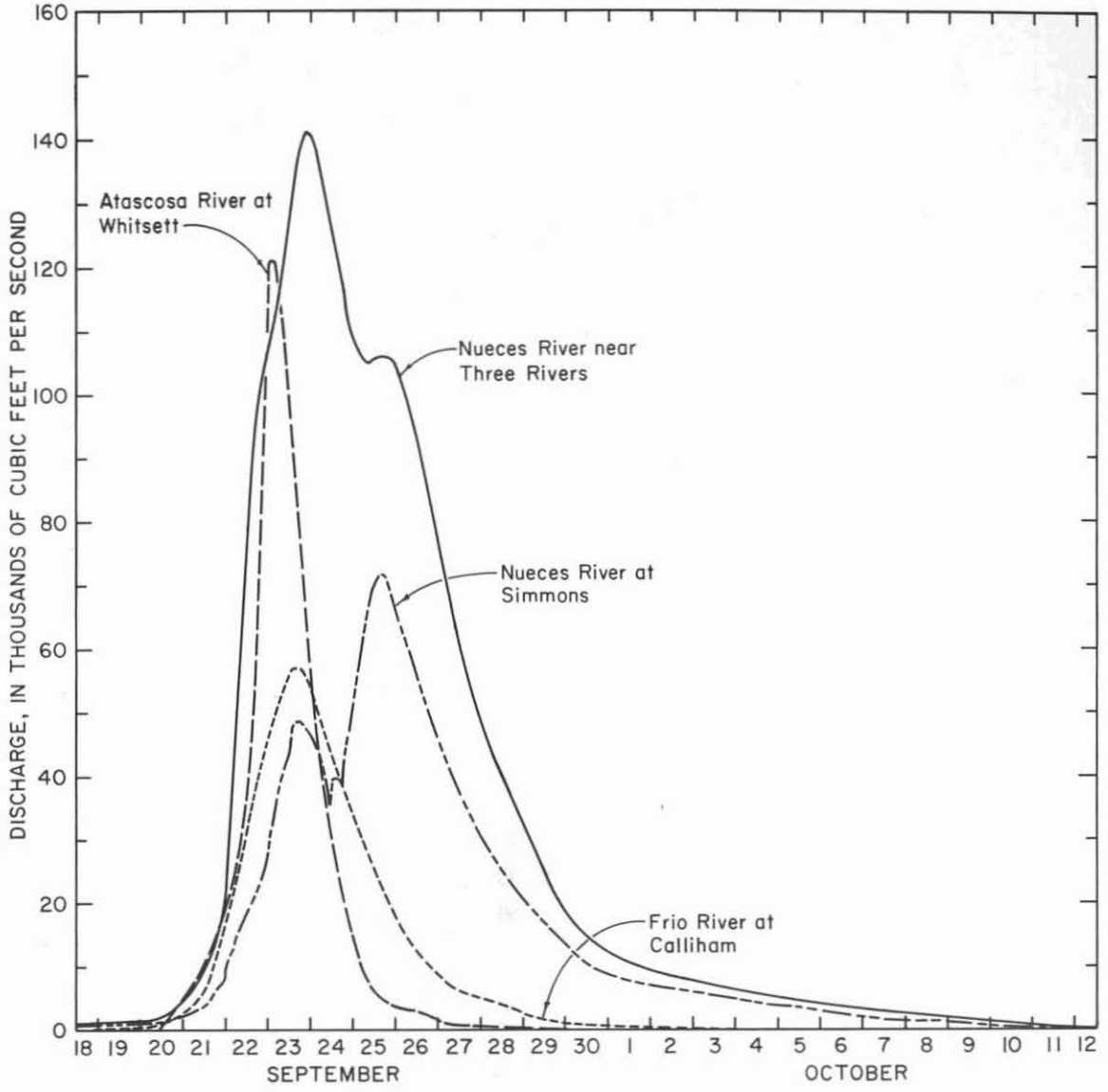


Figure 15

Discharge Hydrographs for Nueces River at Simmons, Frio River at Calliham, Atascosa River at Whitsett, and Nueces River Near Three Rivers

Photograph by Texas Highway Department

Figure 16--Aerial View of the Flooding at Three Rivers Caused by the Nueces and Frio Rivers on September 25, 1967

Photograph by Blackwell Photography, Corpus Christi, Texas

Figure 17--Aerial View of the Spillway at Wesley E. Seale Dam, Lake Corpus Christi. (Discharge 123,000 cfs)

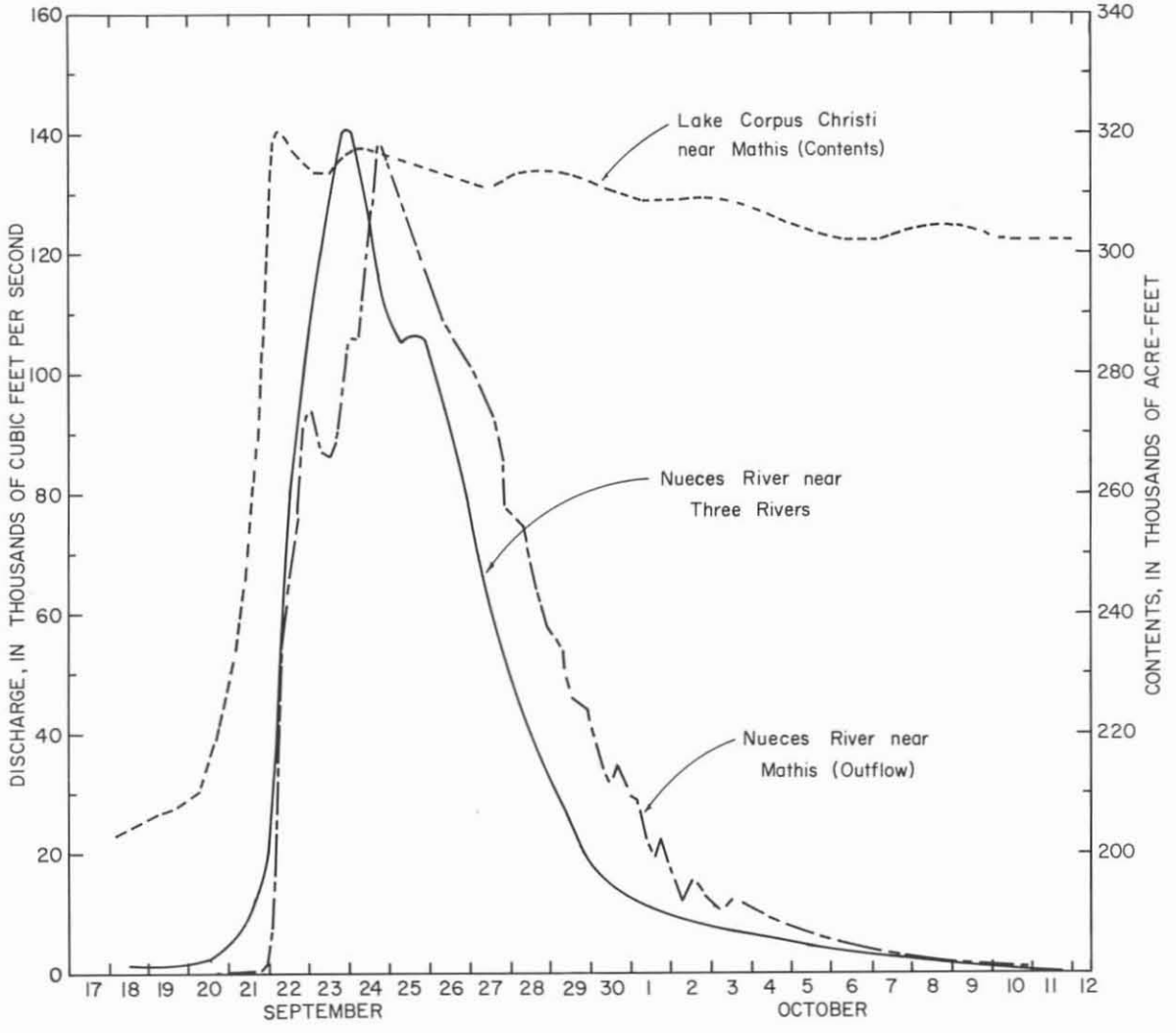


Figure 18

Discharge Hydrographs for Nueces River Near Three Rivers and Nueces River Near Mathis, and Contents of Lake Corpus Christi Near Mathis

Photograph by Blackwell Photography, Corpus Christi, Texas

Figure 19--Aerial View of Railway and Highway 0.6 Mile Downstream From Wesley E. Seale Dam.
(Discharge 123,000 cfs)

Petronila Creek, which also discharges into the Baffin Bay system.

A small dam on Santa Gertrudis Creek broke and part of the water overflowed into Tranquitas Creek above Tranquitas Reservoir. This reservoir overflowed on both sides, with part of the water flowing into San Fernando Creek and part of it flowing back into Santa Gertrudis Creek upstream from the King Ranch Dairy Dam. The Dairy Dam reservoir then overflowed on the right side and flowed over into Escondido Creek.

At the sites where these three creeks cross U.S. Highway 77, near Kingsville, flood marks indicate that only moderate rises had occurred and that the flow was well confined within banks. A field estimate of 8,700 cfs was computed for San Fernando Creek at the U.S. Highway 77 crossing, just north of Kingsville. At this site, San Fernando Creek has a nominal drainage area of 627 square miles; however, because of the watershed overflow and interchange, the drainage area is indefinite.

The southernmost stream that contributes discharge to the Gulf of Mexico is Los Olmos Creek. At the streamflow station just north of Falfurrias (station 69) in northeastern Brooks County, the peak discharge was 3,380 cfs from 480 square miles. Local residents reported that water overflowed the divide upstream from the gage and flowed south into Cibolo Creek, which flows through the northern part of Falfurrias. The recorded peak discharge at Los Olmos Creek is not compatible with the discharge for Cibolo Creek and for Palo Blanco Creek, which flows through the middle of town. Downstream from Falfurrias, Cibolo Creek joins Palo Blanco Creek, and further downstream, Baluarte Creek joins Palo Blanco Creek, which does not reach the Gulf of Mexico.

Floods are such a rare event in these sandy areas that Palo Blanco Creek does not have a defined channel through part of Falfurrias. At a site on State Highway 285 about 16 miles west of Falfurrias, Palo Blanco Creek (station 70) had a peak discharge of 16,600 cfs from a drainage area of 343 square miles. On State Highway 285 at a site about 3½ miles west of the center of Falfurrias, more than 5,000 yards of fill was required to repair the washout created by Palo Blanco Creek.

In Falfurrias, the weather station reported successive daily totals of 2.90, 10.00, 7.00, and 5.20 inches of rain during the storm period. The monthly total exceeded the long-term mean by 28.24 inches.

The city of Falfurrias experienced the worst flood in history. Some residents had to evacuate their homes during the early morning hours of September 22. By that evening, the crest had receded enough for some of them to return home. During the early morning hours of September 23, the town was almost completely inundated by the combined flow of Cibolo and Palo Blanco Creeks. Some residents report that the south part of town also received flood waters from the overflow of Una de Gato, a very small tributary of Baluarte Creek. Water covered U.S. Highway 281 from north of Los Olmos Creek to south of Baluarte Creek, except for a small hill between Los Olmos and Cibolo Creeks and the hill where the Brooks County courthouse is located. Figures 20 and 21 are scenes of flooded areas in Falfurrias. Figure 22 is a profile along U.S. Highway 281 showing the elevation of the water surface. Many business establishments and homes suffered extensive damage, but because of the efforts of the rescue teams, no lives were lost.

Between Baluarte Creek and the Rio Grande, a distance of about 60 miles, there is no defined drainage system. The surface of this noncontributing area of about 4,000 square miles is mostly sandy deposits that can readily absorb normal amounts of rainfall. During this storm, rainfall intensity exceeded the infiltration rate of the sand, and water collected in hundreds of shallow depressions. Ponded water inundated U.S. Highway 77 and U.S. Highway 281 at many places and prevented many of the people who had evacuated the area from returning.

Although many of the ponds disappeared rather quickly, many others were still present as late as January 1968. This remaining water will not infiltrate, and apparently can be removed only through evaporation.

Rainfall decreased west of Encino in Brooks County. Between Encino and La Gloria, in Starr County, there was very little evidence of excessive rainfall. In this area, the sands were apparently able to receive most of the water, although rainfall ranged up to 20 inches.

The area south and east of Encino, which includes parts of Brooks, Kenedy, Willacy, and Starr Counties, was mostly under water. The conditions on the Norias Division of the King Ranch, in Kenedy County, are typical of those in the southeast part of the basin. Ponded water stood at a maximum elevation of about 20 feet near the Norias headquarters. Figure 23 shows the wind sock barely above 17 feet of water at the landing strip, built in the bed of a normally dry lake with a minimum elevation of 3 feet above sea level. At the end of October 1967, all ranch roads were closed and boats were a common means of transportation.

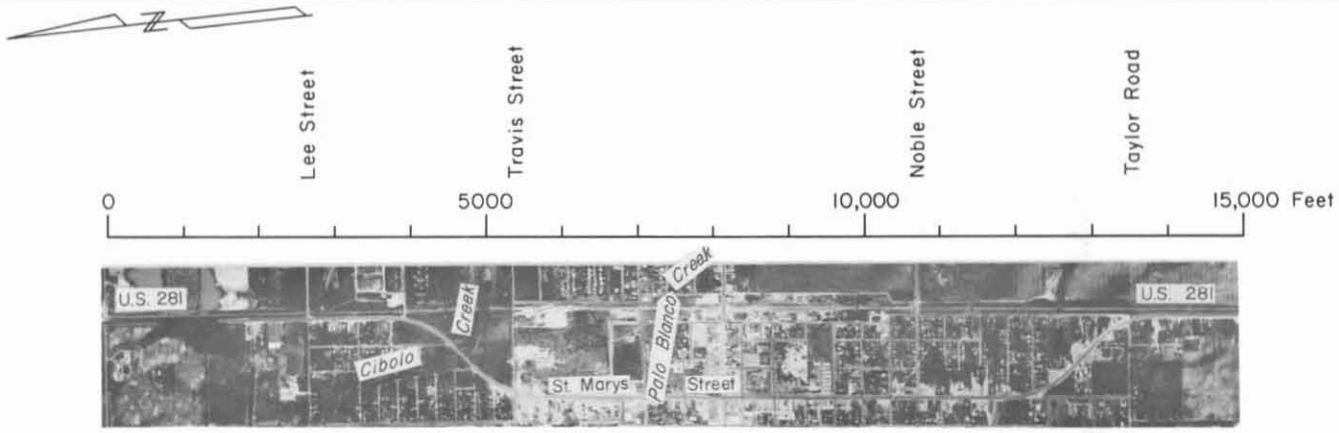
Attempts to drain some of the ponded water into the Gulf of Mexico by ditching and pumping have been futile. Some water was removed, but the water level did not decrease appreciably in the ponds because the underlying sands dewatered immediately. Natural processes may require more than a year to decrease this vast volume of water to the point that the depressions become dry.

Photograph by L. C. Smith, Falfurrias, Texas

Figure 20--Flooded Areas in Falfurrias

Photograph by L. C. Smith, Falfurrias, Texas

Figure 21--U.S. Highway 281 at South Edge of Falfurrias



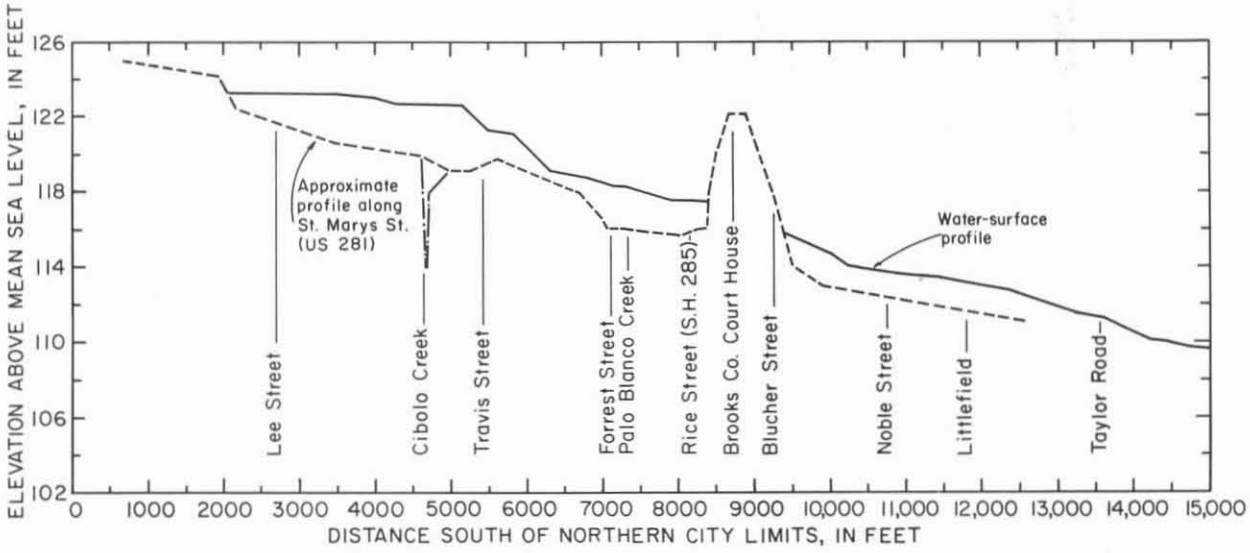
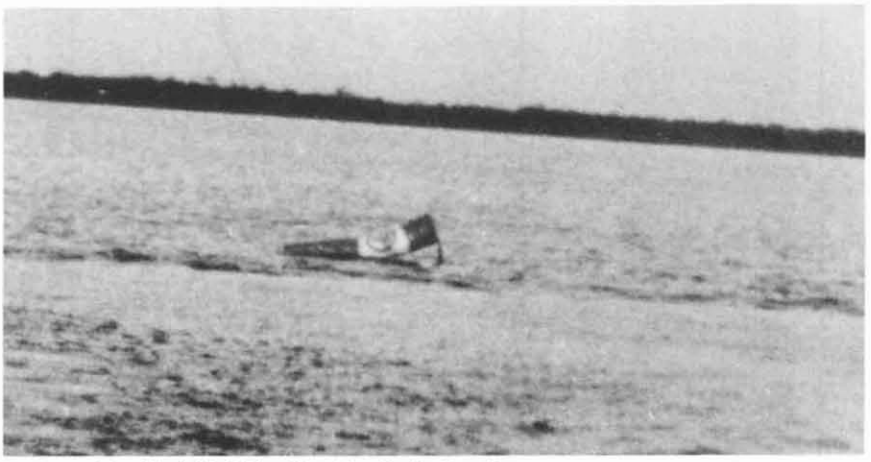


Figure 22

Plan View and Profile of Water-Surface Elevation Along St. Marys Street (U. S. Highway 281) in Falfurrias, September 23, 1967



Photograph by W. J. McBride, King Ranch, Encino, Texas

Figure 23--Private Landing Strip Under 17 Feet of Water at the Norias Division Headquarters of the King Ranch. Wind sock is visible just above water surface.

Rio Grande Basin

Record-breaking floods occurred on the Rio Grande in the reach downstream from Falcon Dam. As a result of the orographic demise of Hurricane Beulah, rainfall in the Rio Alamo watershed was greater than in other areas. Amounts in excess of 35 inches were recorded in this watershed and amounts ranging up to 20 inches were recorded in the adjacent Rio San Juan watershed. These two watersheds constitute more than 85 percent of the approximate 17,700 square miles of contributing drainage area downstream from Falcon Dam. Although there was some runoff in the basin above Falcon Dam, the water was impounded and no releases were made during the flood.

In the Rio Alamo and Rio San Juan watersheds, atecedent conditions were very favorable for a high percentage of runoff. During the last two weeks of August and the first three weeks of September, rainfall had been above normal, with totals ranging up to 25 inches recorded in the San Juan watershed during the period August 18-31. Soil moisture content was high and all reservoirs in the basin were at or near spillway levels, including the large Marte Gomez Reservoir on the Rio San Juan (Figure 24).

International Falcon Reservoir (station 72) gained 990,885 acre-feet in contents during the period September 19-30, 1967. During this period, the peak daily discharge at the station Rio Grande below Falcon Dam (station 73) was only 18 cfs.

Downstream along the mainstem, the first flood water was contributed by the Rio Alamo from a drainage area of approximately 1,700 sqaure miles. A maximum daily mean discharge of 68,900 cfs was recorded at the streamflow station at Cuidad Mier (station 74), Tamaulipas. This discharge alone was sufficient to cause a major flood on the Rio Grande.

The Rio San Juan normally joins the Rio Grande about 23 miles downstream from the mouth of the Rio Alamo. During large floods, the Rio San Juan overflows its right bank and part of the floodwater bypasses the lower streamflow station as well as the streamflow station on the Rio Grande near Rio Grande City. During the storm period, rainfall ranging up to 20 inches was recorded in the 13,601-square-mile drainage area of the Rio San Juan. The resultant flood inundated the streamflow station at Carmargo (station 76), Tamaulipas, and floodwater overflowed the right bank on September 22. The peak discharge at the Marte Gomez Dam (station 75), 9.4 miles upstream from the Carmargo station, was 160,000 cfs on September 25.

On the mainstem Rio Grande, a peak discharge of 220,000 cfs was recorded at the streamflow station Rio Grande at Fort Ringgold near Rio Grande City, Texas (station 77). Under present conditions, this discharge constitutes a great flood with a stage about 10 feet above top of banks. The discharge was only slightly reduced when the crest reached the head of the floodway system near Mission, Texas.

Floodwaters in the Rio Grande are diverted through a series of floodways in both the United States and Mexico. In the United States, part of the excess water is diverted from the river through a system with inlets located approximately 6 miles upstream (Mission Inlet) and 7 miles downstream (Hackney Inlet) from Anzalduas Dam. These channels join at a point 5 miles northeast of Hidalgo to form the main floodway which extends eastward about 19 miles to a point about 3 miles southwest of Mercedes, Texas. At this point, the main floodway branches into two channels. The right hand channel joins the Arroyo Colorado, which discharges into Laguna Madre. The left hand channel extends north and east through Cameron and Willacy Counties before it also discharges into Laguna Madre.

This floodway system was completed in 1926. Since that time the system diverted excess water on nine occasions prior to the Beulah flood. During this storm, the peak discharge through the system was about double the previous maximum in 1932. Figure 25 shows hydrographs of mean daily discharge of the river and the U.S. floodway system below Anzalduas Dam.

The floodway system is designed so that diversions into the Arroyo Colorado can be limited to stay within the capacity of its channel. During this flood, the control structure failed and permitted excessive floodwater to flow into the Arroyo Colorado. As a result, extensive flood damage occurred along the channel.

On the Mexican side of the Rio Grande, there are three principal floodways, which are operated by the Ministry of Hydraulic Resources. These are located about 38 miles (Retamal Heading), 51 miles (San Rafael), and 107 miles (Floodway No. 2) downstream from Anzalduas Dam. To date, no discharge data have been furnished by the Ministry of Hydraulic Resources. However, the effectiveness of the entire floodway system is graphically illustrated by Figure 26, which shows the hydrographs of daily mean discharge at each of the mainstem gaging stations below Falcon Dam. A considerable reduction in rate of flow as well as a reduction in volume of water in the main channel was attained by the system. The maximum daily mean discharge at the lower Brownsville station (station 93) was 15,500 cfs on October 1, 1967.

A factual comparison of the Beulah flood with previous great floods is nearly impossible because of the many man-made changes in the Rio Grande basin, such as the floodway systems, the Marte Gomez Dam on the Rio San Juan, and the Falcon Dam on the Rio Grande. Discharge records for the United States floodway show that the system carried more floodwater during the Beulah flood than at any time since completion in 1926.

U.S. Army Photograph

Figure 24--Aerial View of the Spillway of the Marte Gomez Reservoir on the Rio San Juan Discharging About 150,000 cfs

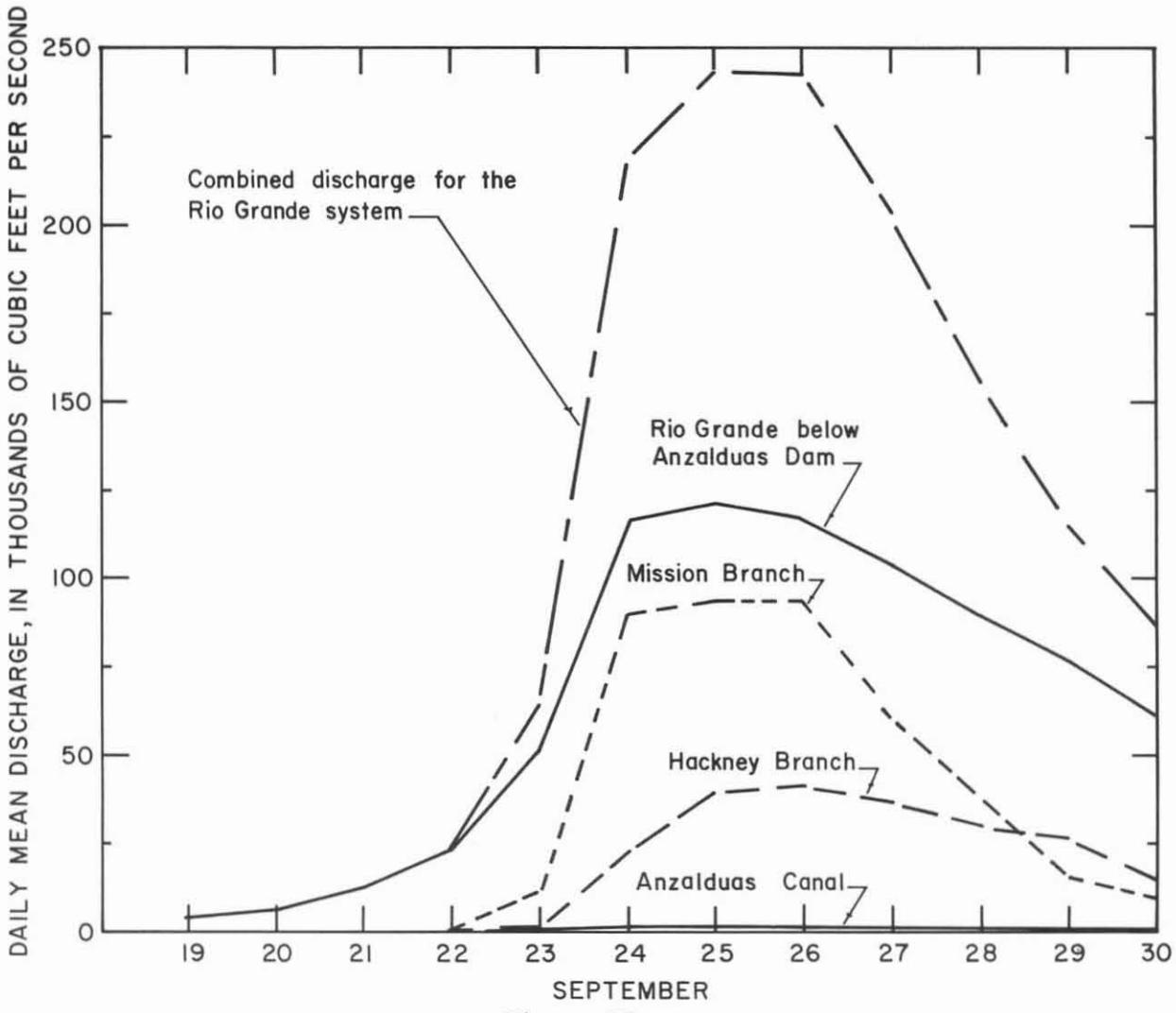


Figure 25

Discharge Hydrographs for the United States Floodways and the Mainstem Rio Grande Below Anzalduas Dam

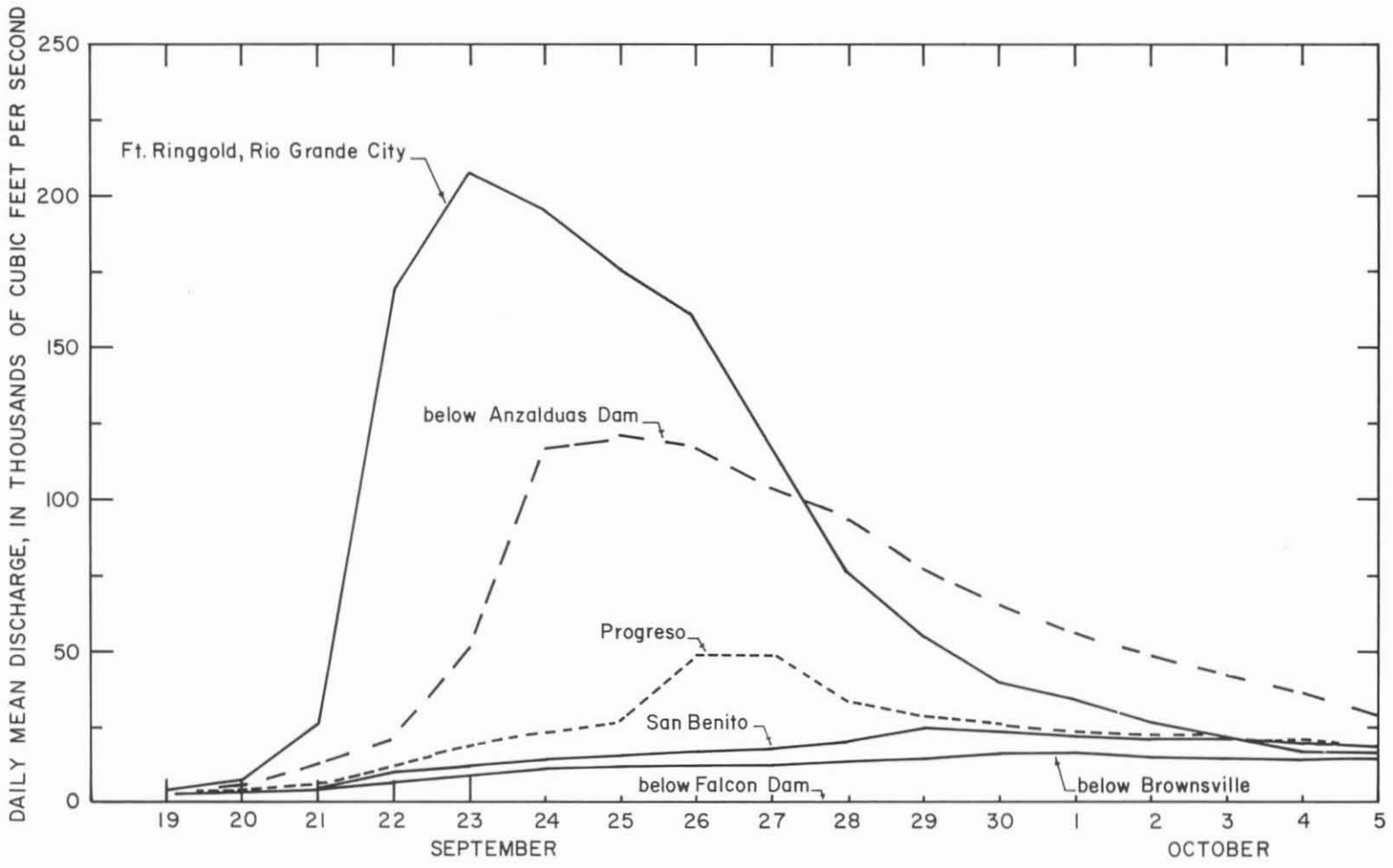


Figure 26
Discharge Hydrographs for Each Mainstem Rio Grande Gaging Station Downstream From Falcon Dam

The Lower Rio Grande Valley area was damaged severely by the Beulah storm. This damage was inflicted by a combination of hurricane-force winds; excessive rainfall, that destroyed fall vegetable crops; and flooding that inundated residential and business areas.

SUMMARY OF FLOOD DAMAGE

A detailed report on the total damage inflicted by Hurricane Beulah is being prepared by the U.S. Army Corps of Engineers, Galveston District. The following assessment, provided by the Corps of Engineers, is for 25 counties in south Texas.

Total damages, by preliminary estimates, were $160,310,000. This amount includes losses resulting from wind, rain, and tides.

Wind damage, including damage from tornadoes, was $52,260,000; damage from rain, including stream flooding, sheet flow, and ponded water, was $98,400,000; and damage from tidal flooding and erosion was $9,650,000.

RESULTS OF FRESH-WATER INFLOW TO BAYS AND ESTUARIES

By D. C. Hahl

The floods caused by Hurricane Beulah presented a unique opportunity to study the effects of a large volume of fresh-water inflow to bays and estuaries along the Texas coast. Nueces-Corpus Christi and Guadalupe-San Antonio Bays were selected for study because of their accessibility and proximity to populated areas and because of their differences in configuration, surface area, and depth.

Data were collected on both bay systems and their tributary streams along traverses. Verticals were selected at points one-half to one mile apart except where changes in water quality indicated that other spacing was more suitable. Channels were sampled wherever crossed by the lines of traverse.

Dissolved oxygen, specific conductance, and temperature measurements were made from the water surface to the bottom at most data-collection points. Samples for laboratory analysis were taken at selected points. In addition to the major chemical constituents determined in the laboratory, strontium (Sr), lithium (Li), nitrate (NO_3), and phosphate (PO_4) were determined for a few samples. The results of field measurements are given in Tables 8, 10, and 12; results of laboratory analyses are given in Tables 7, 9, and 11. The periods of data collection and stages of Corpus Christi and San Antonio Bays are shown in Figure 27.

Figure 28 shows the relation of specific conductance to concentrations of dissolved solids and chloride.

Under the influence of the tremendous influx of fresh water, the salinity of water in the bays was greatly reduced. Because the flood waters moved directly through each bay, dilution proceeded rapidly along the line of flow. The fact that San Antonio Bay is 25 miles from its confluence with the Gulf did not affect the direct movement of water through the bay. The side bays and barge channels of San Antonio Bay, though diluted, were bypassed by the main flood flow. Even a depression in the bay floor was left filled with saline water, while a few feet above, the water was fresh. In Corpus Christi Bay, even though the entire bay was freshened, the flow of dilute water was directly through the bay. After the flooding had ceased and a windstorm moved over the bay, lateral and in-depth dilution increased significantly.

The barge channels in both bays and most of the Corpus Christi ship channel seemed to have little influence on the movements of flood waters. Only that part of the ship channel near Aransas Pass seemed to have an influence on flow of water.

Differences in configuration, depth, and volumes of inflow relative to the size of each bay were largely responsible for a higher concentration of dissolved solids in Corpus Christi Bay.

Nueces-Corpus Christi Bay

Nueces-Corpus Christi Bay is on the Texas Gulf Coast between Nueces and San Patricio Counties (Figure 29). Corpus Christi Bay is roughly an oval about 15 miles by 10 miles, with a uniform depth of 10 to 13 feet. Nueces Bay, which is about 3 miles wide and generally less than 3 feet deep, extends inland about 7 miles from its junction with Corpus Christi Bay. Deep water access to the Gulf of Mexico is maintained by a 45 foot deep channel between Corpus Christi and Port Aransas. The Nueces River, with a total drainage area of approximately 17,000 square miles, discharges into Nueces Bay at Corpus Christi.

Data were collected twice during the investigation on Corpus Christi Bay, once when flow in the Nueces River near Calallen, immediately upstream from Nueces Bay, was about 100,000 cfs and once when the flow was about 26,000 cfs.

During the period September 28-30, 1967, water in the Nueces River near Calallen contained about 122 mg/l (milligrams per liter) dissolved solids, most of which were calcium and bicarbonate ions. By the time the water had flowed through Nueces Bay, it contained 184 mg/l dissolved solids and was a calcium sodium bicarbonate type.

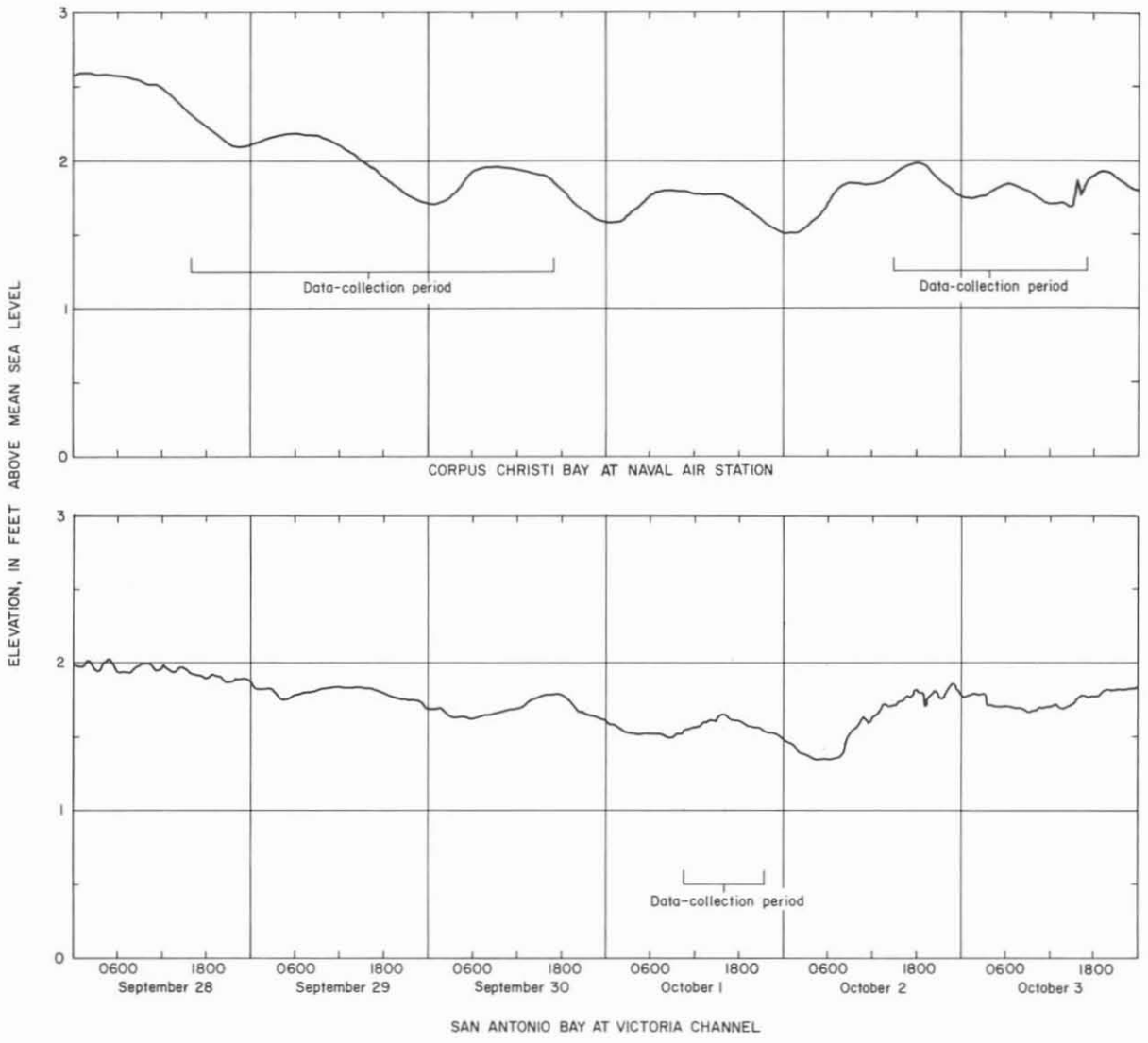


Figure 27

Periods of Data Collection and Stages of Corpus Christi and San Antonio Bays, September 28-October 3, 1967

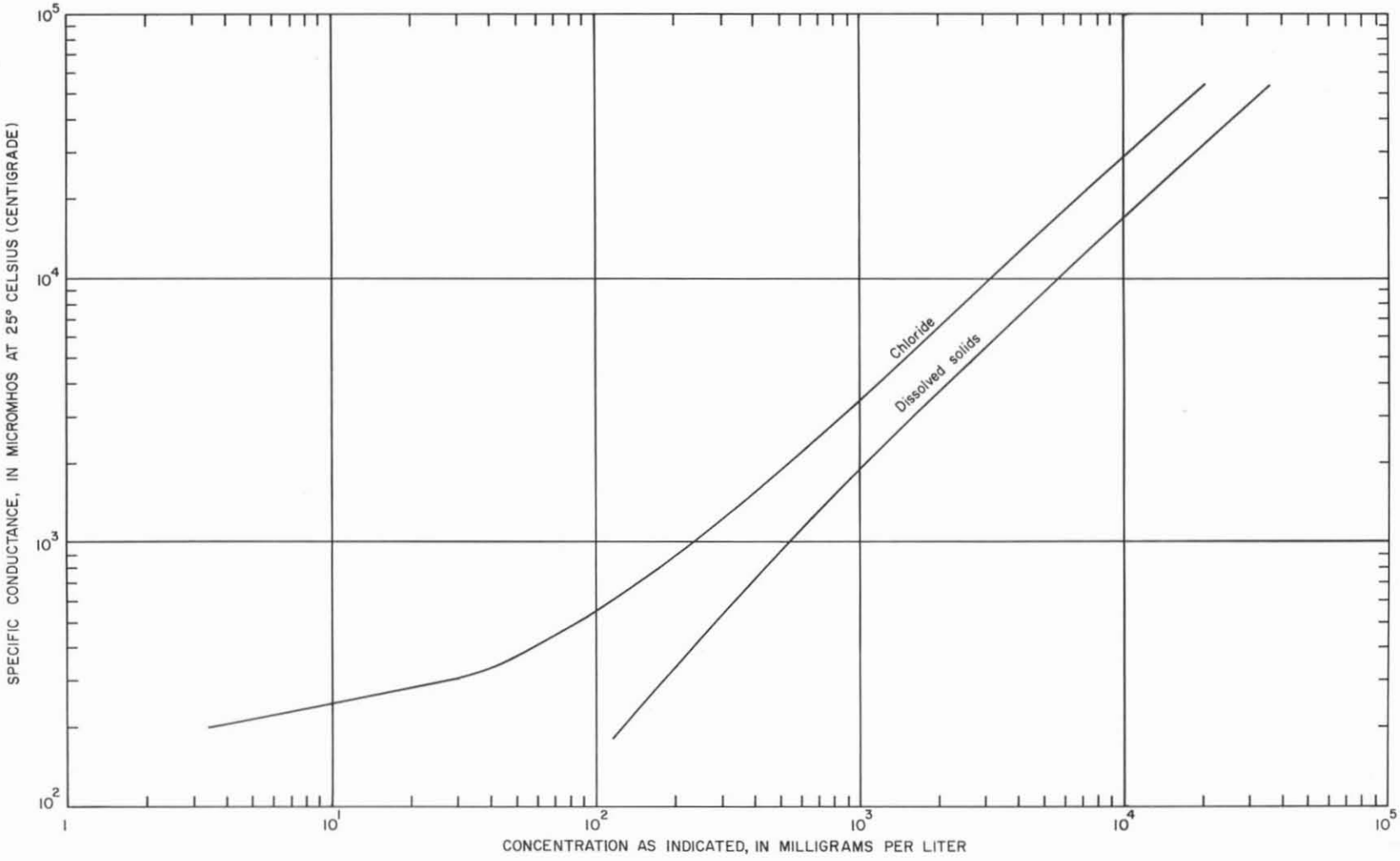


Figure 28

Relationship of Dissolved Solids and Chloride Concentrations to Specific Conductance in Corpus Christi and San Antonio Bays

Inflow to Corpus Christi Bay exceeded 60,000 cfs from September 23 through September 28. The total inflow was about 1½ times the volume of water normally in the bay, but because of its shape and depth, the bay was not entirely flushed of saline water. The stream of dilute water moved generally from the confluence of Nueces and Corpus Christi Bays about one-third of the way to the Naval Air Station, then along the ship channel and out of the bay through Aransas Pass.

As the water moved through Corpus Christi Bay from the bridge at U.S. Highway 181 to the position of traverse line D-D' (Figure 29), it changed from a calcium sodium bicarbonate type with 184 mg/l dissolved solids to a sodium chloride type with 333 mg/l dissolved solids, and magnesium and sulfate became more abundant than calcium and bicarbonate. The water left the bay with a concentration of about 7,000 mg/l dissolved solids. The changes in concentrations as the water moved through the bay are shown in Figure 30.

The concentrations of strontium and lithium (Table 7), determined at a few points in the bay, were generally very low, but increased at about the same rate as chloride and sulfate. The phosphate and nitrate concentrations, probably affected by biologic activity, varied irregularly from point to point. Dissolved-oxygen concentrations in much of the water near the surface of the bay was about 8 mg/l. This was 2 to 3 mg/l greater than at depth. The difference between surface and bottom dissolved-oxygen concentrations reached 6 mg/l in only two instances.

The second set of data were collected in Corpus Christi Bay during the period October 2-3, 1967 (Tables 9 and 10, Figure 31). At this time, flow in the Nueces River was approximately 26,000 cfs or about one-fourth of the flow during the previous data-collection period.

Water in the Mathis-Calallen reach of the Nueces River contained about 145 mg/l dissolved solids. Along the line of contact between Corpus Christi Bay and Nueces Bay, the concentration of dissolved solids ranged from 300 to 1,200 mg/l. At Aransas Pass, the water left the bay as a sodium chloride type with a dissolved-solids concentration of about 10,000 mg/l. Throughout most of the bay, the second most predominant pair of ions were magnesium and sulfate.

As in the first analyses, concentrations of lithium and strontium increased at about the same rate as chloride and sulfate, and nitrate concentrations were irregular.

The dissolved-oxygen content of much of the water near the surface of the bay was about 10 mg/l (Figure 31, Table 10). At depth the dissolved-oxygen content varied markedly and was 8 to 10 mg/l lower than at the surface. In a few places, dissolved oxygen was as low as 0.9 mg/l. This was a complete change from the conditions noted a few days earlier.

Although the stage of Corpus Christi Bay was almost the same during the two data-collection periods (Figure 27), the conditions causing the stage were different. During the September 28-30 period, the bay was receiving a very large volume of fresh-water inflow. During the October 2-3 period, the volume of inflow was much smaller but the stage was maintained by winds.

The September chemical-quality data show that a large volume of dilute water was moving directly through the bay, with little mixing away from the line of flow or at depth. The October data show the combined effects of wind and reduced inflow. Mixing was more uniform throughout the bay and extended to greater depths. Both sets of data indicate little, if any, mixing in the deeper parts of the channels.

Suspended-sediment samples were taken from the Nueces River near Mathis and near Calallen, and from Corpus Christi Bay at its confluence with Nueces Bay (Table 4). Analysis of the samples indicate that after the flood water entered Nueces Bay, the velocity of flow decreased enough to allow most of the suspended sediment to settle out, leaving Corpus Christi Bay relatively free of flood-derived sediment.

Table 4.--Suspended-Sediment Concentrations in the Nueces River and Corpus Christi Bay

	SEPTEMBER 27, 1967	SEPTEMBER 28, 1967	SEPTEMBER 29, 1967
Nueces River near Mathis	--	156 mg/l	--
Nueces River at U.S. Highway 77, near Calallen	374 mg/l	262 mg/l	--
Cross section C-C'—Corpus Christi Bay at U. S. Highway 181, at Corpus Christi	--	--	76 mg/l

The velocity of flow in the middle of Corpus Christi Bay ranged from approximately 1 foot per second at the surface to almost zero at the bottom. At some points, the direction of flow at depth was opposite to the direction at the surface. This reversal can be attributed to either tidal currents or density currents. In Nueces Bay, the velocity of flow was as much as 3 feet per second. Velocities in the ship channel were measured as follows: in the middle of the bay, zero; near Ingleside, from 1 to 2 feet per second; and near Aransas Pass, 1.7 feet per second.

Guadalupe-San Antonio Bay

Guadalupe-San Antonio Bay is on the Texas Gulf Coast between Refugio and Calhoun Counties (Figure 32). The depth of water in San Antonio Bay averages about 5 feet; deep water access to the Gulf is through Victoria Channel and the Intracoastal Waterway via Port O'Conner. The Guadalupe River, with a total drainage area (including the tributary San Antonio River) of approximately 10,000 square miles, discharges into Guadalupe Bay.

Data were collected only once, on October 1, 1967, during the investigation of San Antonio Bay. At this time, the flow of the Guadalupe River near Tivoli (Figure 32) was about 23,000 cfs, and the water was a calcium bicarbonate type with a dissolved-solids concentration of 208 mg/l. Flood waters in other stream channels near Tivoli contained as little as 150 mg/l dissolved solids.

The field data (Table 12) indicate that the dilute water was moving down the center of San Antonio Bay toward Matagorda Island, then generally northeast into the Gulf of Mexico at Pass Cavallo. The water did not flow along either Victoria Channel or the Intracoastal Waterway because the stage of the bay was high enough to inundate the islands that normally restrict the movement of water from San Antonio to Matagorda Bay.

The water at the head of the bay was a calcium bicarbonate type with a dissolved-solids concentration of 152 mg/l (Table 11). Seaward, the concentration increased. The changes in dissolved-solids and chloride concentrations are shown in Figure 33.

The fresh-water inflow to San Antonio Bay exceeded 40,000 cfs from September 21 through September 26, with the total inflow more than three times the volume of water normally in the bay. Most of the saline water was flushed out of the bay.

Dilution of the saline water was most rapid along the line of flow. Water in Victoria Channel and in bay floor depressions was least affected by dilution (Figure 33). Concentrations of strontium and lithium increased in proportion to sodium and chloride, and phosphate and nitrate concentrations were irregular; the concentration of dissolved oxygen varied little with depth but increased along the line of flow from 4 mg/l to more than 7 mg/l, then decreased to about 6 mg/l (Figure 33).

EFFECTS OF THE HURRICANE ON WATER LEVELS IN WELLS

By Texas Water Development Board

Soon after the floodwaters of Hurricane Beulah began to subside personnel of the Texas Water Development Board set out to document the effects, if any, on the ground-water reservoirs.

Seventy-three representative water wells were selected for measurements of depth to water; these were wells, most of them less than 100 feet deep, for which pre-flood data were available. All of the wells, regardless of depth, might be expected to show rises in water levels, but the rises in the deep wells and in some of the shallow wells would probably be caused by cutbacks in pumping rather than by recharge.

Water levels were measured in 59 wells in mid-October, and all 73 wells were measured in mid-November. The October, November, and pre-flood measurements of depth to water are given in Tables 5 and 6. Well locations are shown in Figures 34 and 35.

In the Lower Rio Grande Valley (Figure 35), water-level measurements in the past years have usually been made in late summer, when irrigation pumpage is diminished. In the Alice-Corpus Christi area (Figure 34), where growing seasons are different, minimum pumpage usually occurs during the winter months, and the annual water-level measurements are generally obtained then.

Some of the data in Tables 5 and 6 have been simplified in the tabulation on page 73 by averaging the water-level changes for wells that have similar dates of measurements. These are the wells that were accessible in October and for which earlier measurement dates are close together—February 1967 for the Alice-Corpus Christi area and July 1967 for the Lower Rio Grande Valley. These averages and Tables 5 and 6 show that in each region the water levels generally rose several feet prior to the October measurement and then generally declined slightly from the October to November measurements.

Table 5.--Water Levels in Wells in the Alice-Corpus Christi Area

WELL	DEPTH OF WELL (FEET)	PREVIOUS MEASUREMENT 1/ DATE	PREVIOUS MEASUREMENT 1/ DEPTH TO WATER (FEET)	OCTOBER MEASUREMENT DATE	OCTOBER MEASUREMENT DEPTH TO WATER (FEET)	OCTOBER MEASUREMENT CHANGE FROM PREVIOUS MEASUREMENT (FEET)	NOVEMBER MEASUREMENT DATE	NOVEMBER MEASUREMENT DEPTH TO WATER (FEET)	NOVEMBER MEASUREMENT CHANGE FROM OCTOBER (FEET)	NOVEMBER MEASUREMENT CHANGE FROM PREVIOUS MEASUREMENT (FEET)	REMARKS
DUVAL COUNTY											
84-12-301	503	7/21/67	143.87	10/19/67	171.60	-27.73	11/17/67	142.81	+28.79	+ 1.06	
13-801	40	2/25/67	34.65	10/19/67	31.91	+ 2.74	11/17/67	32.61	- .70	+ 2.04	
15-702	509	7/21/67	260.10	10/19/67	242.90	+17.20	11/17/67	225.80	+17.10	+34.30	
22-901	90	2/25/67	36.20	10/19/67	34.00	+ 2.20	11/17/67	34.63	- .63	+ 1.57	
29-306	40	2/25/67	36.31	10/19/67	34.15	+ 2.16	11/17/67	34.00	+ .15	+ 2.31	
30-301	70	2/25/67	43.69	10/18/67	44.52	- .92	11/17/67	43.74	+ .78	- .14	
501	90	2/25/67	45.56	10/18/67	40.46	+ 5.10	11/17/67	37.54	+ 2.92	+ 8.02	
36-901	69	2/25/67	61.40	10/18/67	59.90	+ 1.50	11/17/67	58.47	+ 1.43	+ 2.93	
38-701	93	2/25/67	48.30	10/18/67	42.52	+ 5.78	11/17/67	44.11	- 1.59	+ 4.19	
44-601	102	2/25/67	47.66	10/17/67	45.70	+ 1.96	11/17/67	45.94	- .24	+ 1.72	
45-304	80	2/25/67	29.10	10/17/67	24.80	+ 4.30	11/17/67	24.48	+ .32	+ 4.62	
46-101	90	2/25/67	62.45	10/17/67	62.44	+ .01	11/17/67	61.96	+ .48	+ .49	
402	80	2/25/67	41.06	10/17/67	33.60	+ 7.46	11/17/67	32.04	+ 1.56	+ 9.02	
JIM WELLS COUNTY											
84-16-701	844	7/22/67	93.45	10/20/67	91.40	+ 2.05	11/18/67	91.51	- .11	+ 1.94	
23-706	40	2/24/67	31.90	10/20/67	20.18	+11.72	11/18/67	21.56	- 1.38	+10.34	
24-104	586	2/24/67	137.40	10/20/67	132.70	+ 4.70	11/18/67	133.15	- .45	+ 4.25	
31-201	75	2/26/67	59.93	10/20/67	54.96	+ 4.97	11/18/67	55.04	- .08	+ 4.89	
502	60	2/26/67	55.52	10/20/67	45.69	+ 9.83	11/18/67	49.97	- 4.28	+ 5.55	
KLEBERG COUNTY											
83-25-601	690	7/21/67	224.16	10/16/67	222.41	+ 1.75	11/13/67	223.04	- .63	+ 1.12	
84-32-501	487	7/21/67	183.60	10/16/67	182.66	+ .94	11/13/67	183.77	- 1.11	- .17	
NUECES COUNTY											
83-02-204	58	2/ 8/67*	53.27	10/20/67	45.39	+ 7.88	11/16/67	45.48	- .09	+ 7.79	Well inundated during flood.
504	40	2/ 9/67*	29.03	10/20/67	16.48	+12.55	11/16/67	18.75	- 2.27	+10.28	Do.
601	32	4/13/65*	29.00	10/20/67	5.49	+23.51	11/16/67	8.39	- 2.90	+20.61	Do.
11-204	82	11/09/65*	71.35	10/20/67	70.22	+ 1.13	11/16/67	70.81	- .59	+ .54	
29-301	63	7/28/60*	10.24	10/17/67	12.20	- 1.96	11/16/67	9.24	+ 2.96	+ 1.00	Well inundated during flood.
30-101	50	11/10/65*	23.74	--	--	--	11/16/67	22.10	--	+ 1.64	Well inundated during flood; roads impassable in October.

See footnotes at end of table.

Table 5.--Water Levels in Wells in the Alice-Corpus Christi Area--Continued

WELL	DEPTH OF WELL (FEET)	PREVIOUS MEASUREMENT[1] DATE	PREVIOUS MEASUREMENT[1] DEPTH TO WATER (FEET)	OCTOBER MEASUREMENT DATE	OCTOBER MEASUREMENT DEPTH TO WATER (FEET)	OCTOBER MEASUREMENT CHANGE FROM PREVIOUS MEASUREMENT (FEET)	NOVEMBER MEASUREMENT DATE	NOVEMBER MEASUREMENT DEPTH TO WATER (FEET)	NOVEMBER MEASUREMENT CHANGE FROM OCTOBER (FEET)	NOVEMBER MEASUREMENT CHANGE FROM PREVIOUS MEASUREMENT (FEET)	REMARKS
					NUECES COUNTY--Continued						
83-30-201	90	11/10/65*	8.74	10/17/67	13.10	-4.36	11/16/67	8.65	+4.45	+ .09	Well inundated during flood.
202	65	11/10/65*	7.53	10/17/67	5.68	+1.85	11/16/67	5.41	+ .27	+2.12	Do.
203	50	11/10/65*	6.85	--	--	--	11/16/67	6.40	--	+ .45	Well inundated during flood; roads impassable in October.
					SAN PATRICIO COUNTY						
79-57-602	205	7/22/67	52.30	10/19/67	43.40	+8.90	11/16/67	44.27	- .87	+8.03	
60-210	60	6/15/65*	53.00	10/16/67	52.10	+ .90	11/16/67	51.44	+ .66	+1.56	
211	50	6/15/65*	51.60	10/16/67	51.36	+ .24	11/16/67	50.86	+ .50	+ .74	
905	45	1/14/65*	20.50	10/16/67	14.90	+5.60	11/16/67	13.10	+1.80	+7.40	Well inundated during flood.
906	40	1/16/65*	22.10	10/16/67	22.70	- .60	11/16/67	16.55	+6.15	+5.55	Do.
907	40	1/16/65*	22.50	10/16/67	17.56	+4.94	11/16/67	18.00	- .44	+4.50	Do.
908	42	1/15/65*	24.10	10/16/67	22.84	+1.26	11/16/67	22.08	+ .76	+2.02	Do.
83-02-604	100	4/14/65*	29.75	10/18/67	20.69	+9.06	11/16/67	20.14	+ .55	+9.61	
07-808	90	2/21/67	13.38	10/16/67	12.18	+1.20	11/16/67	11.74	+ .44	+1.64	
919	40	2/22/67	2.59	10/16/67	2.73	- .14	11/16/67	2.87	- .14	- .28	
15-201	41	2/21/67	8.69	10/16/67	7.97	+ .72	11/16/67	7.69	+ .28	+1.00	

1/Latest measurement before Hurricane Beulah.
* Measurement by U.S. Geological Survey.

Table 6.--Water Levels in Wells in the Lower Rio Grande Valley

WELL	DEPTH OF WELL (FEET)	PREVIOUS MEASUREMENT[1] DATE	PREVIOUS MEASUREMENT[1] DEPTH TO WATER (FEET)	OCTOBER MEASUREMENT DATE	OCTOBER MEASUREMENT DEPTH TO WATER (FEET)	CHANGE FROM PREVIOUS MEASUREMENT (FEET)	NOVEMBER MEASUREMENT DATE	NOVEMBER MEASUREMENT DEPTH TO WATER (FEET)	CHANGE FROM OCTOBER (FEET)	CHANGE FROM PREVIOUS MEASUREMENT (FEET)	REMARKS
					CAMERON COUNTY						
88-58-302	240	7/20/67	19.36	10/19/67	12.96	+ 6.40	11/16/67	14.02	-1.06	+ 5.34	Roads impassable in October.
					HIDALGO COUNTY						
87-31-501	90	7/28/67	40.47	--	--	--	11/13/67	34.72	--	+ 5.75	Roads impassable in October.
503	86	7/28/67	44.17	--	--	--	11/13/67	42.80	--	+ 1.37	Do.
601	80	7/27/66	52.79	10/19/67	45.10	+ 7.69	11/13/67	43.58	+1.52	+ 9.21	
801	95	7/28/67	50.44	--	--	--	11/13/67	47.55	--	+ 2.89	Roads impassable in October.
804	80	7/27/67	44.70	--	--	--	11/13/67	41.84	--	+ 2.86	Do.
903	78	7/28/67	42.40	10/19/67	17.55	+24.85	11/13/67	16.86	+ .69	+25.54	
904	80	7/28/67	40.11	--	--	--	11/13/67	34.02	--	+ 6.09	Roads impassable in October.
906	100	8/10/65	38.78	--	--	--	11/13/67	32.22	--	+ 6.56	Do.
907	90	7/28/67	42.41	10/19/67	30.60	+11.81	11/13/67	32.34	-1.74	+10.07	
911	91	7/21/67	37.36	10/19/67	24.84	+12.52	11/13/67	28.92	-4.08	+ 8.44	
39-301	95	7/28/67	28.77	10/19/67	12.70	+16.07	11/13/67	11.85	+ .85	+16.92	
52-201	75	7/25/67	23.36	--	--	--	11/14/67	18.52	--	+ 4.84	Roads impassable in October.
306	90	7/26/67	20.62	--	--	--	11/14/67	16.62	--	+ 4.00	Do.
53-204	50	7/26/67	4.97	--	--	--	11/14/67	3.48	--	+ 1.49	Do.
503	89	7/25/67	13.81	--	--	--	11/14/67	9.22	--	+ 4.59	Do.
54-101	390	7/25/67	33.30	10/17/67	24.28	+ 9.02	11/14/67	25.98	-1.70	+ 7.32	
201	363	7/25/67	9.55	10/17/67	4.55	+ 5.00	11/14/67	5.49	- .94	+ 4.06	
301	309	7/27/66	22.39	10/17/67	15.64	+ 6.75	11/14/67	16.98	-1.34	+ 5.41	
501	80	7/26/67	9.98	10/18/67	4.12	+ 5.86	11/14/67	5.11	- .99	+ 4.87	
502	355	7/20/67	17.08	10/18/67	12.22	+ 4.86	11/14/67	13.14	- .92	+ 3.94	
514	115	7/20/67	12.53	10/18/67	6.48	+ 6.05	11/14/67	7.96	-1.48	+ 4.57	
701	100	7/27/66	4.40	--	--	--	11/15/67	3.82	--	+ .58	Roads impassable in October.
810	106	7/25/67	8.63	10/18/67	3.68	+ 4.95	11/15/67	4.72	-1.04	+ 3.91	
820	110	7/26/67	20.62	--	--	--	11/15/67	16.04	--	+ 4.58	Roads impassable in October.
921	113	7/26/67	12.61	10/18/67	8.02	+ 4.59	11/15/67	9.60	-1.58	+ 3.01	
55-701	234	7/26/67	27.17	10/18/67	9.52	+17.65	11/15/67	13.18	-3.66	+13.99	
63-102	119	7/26/67	13.34	10/18/67	3.18	+10.16	11/15/67	5.78	-2.60	+ 7.56	
63-301	115	7/25/67	11.76	10/18/67	5.39	+ 6.37	11/15/67	7.08	-1.69	+ 4.68	
88-57-402	180	7/20/67	46.94	10/18/67	36.16	+10.78	11/15/67	37.46	-1.30	+ 9.48	
					STARR COUNTY						
86-40-502	30	7/25/67	8.92	10/17/67	4.08	+ 4.84	11/16/67	4.48	- .40	+ 4.44	
87-42-103	53	7/25/67	25.20	10/17/67	6.90	+18.30	11/16/67	8.26	-1.36	+16.94	Well inundated during flood.
43-909	65	7/25/67	38.01	10/17/67	33.08	+ 4.93	11/16/67	33.98	- .90	+ 4.03	

1/ Latest measurement before Hurricane Beulah.

Average rise (+) or decline (-) of water level, in feet:

ALICE-CORPUS CHRISTI AREA	FEB. TO OCT. 1967	OCT. TO NOV. 1967
18 shallow wells (not more than 100 feet deep)	+ 4.39	-0.16
2 deep wells (more than 100 feet deep)	+ 3.33	- .35
LOWER RIO GRANDE VALLEY	JULY TO OCT. 1967	OCT. TO NOV. 1967
8 shallow wells	+12.40	-0.99
11 deep wells	+ 7.80	-1.63

Because water levels normally change in response to seasonal pumping, not all of the rises in water levels can be attributed to rains from Hurricane Beulah. However, the significance of these rises, particularly in the shallow wells, may be determined by comparing them with water-level changes in previous years. Figures 36 and 37 are hydrographs of water-level fluctuations in selected wells for which earlier records are available.

In the Alice-Corpus Christi area, comparison of water-level fluctuations in well 83-02-504 (40 feet deep) and well 79-57-602 (205 feet deep) with previous trends shows major rises of water levels during the hurricane period. In contrast, well 84-16-701 (844 feet deep) had only a slight rise in water level during the same period (Figure 36). Two other deep wells, 83-25-601 and 84-15-702, exhibit seasonal fluctuations that are large enough to mask any effects of the hurricane.

The hydrographs of wells 87-31-911 (91 feet deep) and 87-54-514 (115 feet deep) in the Lower Rio Grande Valley (Figure 37) show marked rises in water levels during the September 1967 period. Slight rises above the previous trends are shown for well 88-58-302 (240 feet deep) and well 87-54-502 (355 feet deep). The 1965 and 1966 water-level fluctuations in well 88-57-402 (180 feet deep) suggest that the September 1967 rise could be caused by factors other than hurricane-induced recharge.

The evidence indicates that Hurricane Beulah caused significant rises in water levels in shallow wells by percolation of rainfall and ponded waters and by the cascading of floodwaters directly into numerous inundated wells (Tables 5 and 6). Water levels also rose due to cutbacks in pumping.

While considerable economic losses resulted from the hurricane, there were probably some benefits by partial replenishment of the ground-water reservoirs.

WATER-QUALITY DATA FOR CORPUS CHRISTI AND SAN ANTONIO BAYS

WATER-QUALITY DATA FOR

CORPUS CHRISTI AND

SAN ANTONIO BAYS

Table 7.--Chemical Analyses of Water in the Nueces River and in Corpus Christi Bay, September 28-30, 1967

(Results in milligrams per liter except as indicated)

DATE OF COLLECTION	ALTITUDE, IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	SILICA (SiO_2)	CALCIUM (CA)	MAGNESIUM (MG)	STRONTIUM (SR)	SODIUM (NA)	POTASSIUM (K)	LITHIUM (LI)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (CL)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS (CALCULATED)	HARDNESS AS $CaCO_3$ CALCIUM, MAGNESIUM	HARDNESS AS $CaCO_3$ NONCARBONATE	DENSITY (GRAMS PER ML AT 20°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	PH
NUECES RIVER NEAR MATHIS																				
Sept. 28, 1967	(a)	10	29	1.6	0.11	10	5.0	0.01	103	13	5.3	0.3	1.0	0.05	b127	79	0	--	207	7.2
CROSS SECTION A-A'																				
Nueces River at U.S. Highway 77 near Calallen																				
Sept. 27, 1967	(a)	9.9	31	1.6	0.09	8.0	4.6	0.01	104	13	3.8	0.3	0.8	0.06	124	84	0	--	198	7.1
Sept. 28	(a)	11	29	1.4	.06	8.5	4.9	.01	95	13	5.2	.3	1.0	.08	c122	78	0	--	195	7.2
CROSS SECTION C-C'																				
Vertical 6																				
Sept. 28, 1967	+ 2.0	9.6	31	3.4	0.10	27	6.0	0.01	102	18	37	0.3	1.0	0.06	d184	91	8	--	316	7.7
CROSS SECTION D-D'																				
Vertical 8																				
Sept. 30, 1967	+ 1.7	9.9	34	8.2	0.15	73	7.4	0.01	108	28	118	0.3	0.8	0.08	e333	118	30	--	607	7.2
Do.	- 3.1	8.3	--	--	--	--	--	--	100	194	1,340	--	--	--	--	560	478	--	4,450	7.2
Do.	- 7.1	9.0	--	--	--	--	--	--	107	540	3,880	--	--	--	--	1,540	1,450	1.003	10,800	7.3
Do.	- 9.1	7.5	--	--	--	--	--	--	111	1,020	7,400	--	--	--	--	2,600	2,510	1.006	21,500	7.6
Vertical 9																				
Sept. 30, 1967	-17.1	4.7	--	--	--	--	--	--	124	1,830	13,100	--	--	--	--	4,550	4,450	1.014	35,800	7.5
Do.	-27.1	3.8	--	--	--	--	--	--	129	2,190	15,900	--	--	--	--	5,400	5,290	1.017	42,500	7.4
Do.	-42.1	2.5	442	1,230	6.4	10,800	378	0.19	139	2,700	19,100	1.7	0.5	5.2	f34,700	6,170	6,060	1.021	50,300	7.4
CROSS SECTION F-F'																				
Vertical 10																				
Sept. 29, 1967	0.0	9.2	--	--	--	--	--	--	102	384	2,700	--	--	--	--	1,020	936	--	8,420	7.1
Vertical 11																				
Sept. 29, 1967	+ 1.8	9.0	53	63	0.45	539	23	0.01	96	155	980	0.3	1.0	0.24	g1,870	392	313	--	3,370	7.4
Do.	- 8.0	8.3	--	--	--	--	--	--	102	632	4,500	--	--	--	--	1,590	1,510	1.004	13,800	7.1
Do.	-18.0	5.8	--	--	--	--	--	--	120	1,720	12,100	--	--	--	--	4,250	4,150	1.013	33,400	7.4
Do.	-38.0	4.7	392	1,180	6.4	9,880	350	.18	133	2,600	17,900	1.6	2.0	5.3	h32,400	5,840	5,730	1.019	47,800	7.5
CROSS SECTION H-H'																				
Vertical 2																				
Sept. 30, 1967	+ 0.9	7.2	167	415	2.2	3,480	126	0.07	111	901	6,320	0.8	7.2	1.5	i11,500	2,130	2,040	1.004	18,900	7.3
Do.	-19.6	6.4	268	695	4.1	5,940	218	.13	123	1,520	10,700	1.1	.8	2.7	j19,400	3,530	3,430	1.011	29,900	7.3

See footnotes at end of table.

Table 7.--Chemical Analyses of Water in the Nueces River and in Corpus Christi Bay, September 28-30, 1967--Continued

DATE OF COLLECTION	ALTITUDE, IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	SILICA (SiO_2)	CALCIUM (CA)	MAGNESIUM (MG)	STRONTIUM (SR)	SODIUM (NA)	POTASSIUM (K)	LITHIUM (LI)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (CL)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS (CALCULATED)	HARDNESS AS $CaCO_3$ CALCIUM, MAGNESIUM	HARDNESS AS $CaCO_3$ NONCARBONATE	DENSITY (GRAMS PER ML AT 20°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	PH
CROSS SECTION H-H'--Continued																				
Vertical 12																				
Sept. 30, 1967	-18.7	7.3	--	--	--	--	--	--	112	1,060	7,700	--	--	--	--	2,680	2,590	1.006	22,100	7.3
Vertical 13																				
Sept. 30, 1967	+ 0.9	9.1	129	250	1.6	2,100	78	0.04	103	547	3,800	0.6	2.5	0.80	k6,970	1,350	1,270	1.001	11,900	7.1
Do.	-28.1	8.8	--	--	--	--	--	--	104	580	4,150	--	--	--	--	1,480	1,400	1.002	12,800	7.2
Do.	-41.1	8.6	129	265	1.7	2,200	81	.05	104	570	4,020	.6	3.5	1.0	m7,330	1,410	1,330	1.001	12,500	7.1
CROSS SECTION I-I'																				
Vertical 5																				
Sept. 29, 1967	+ 1.1	7.9	268	672	4.2	5,790	214	0.12	90	1,520	10,500	1.1	2.0	2.8	n19,000	3,440	3,360	1.010	29,600	7.1
Do.	-25.6	7.5	278	715	4.4	6,080	222	.13	106	1,610	11,000	1.2	5.2	2.7	f20,000	3,640	3,550	1.010	30,800	7.2

a Data represent entire vertical.
b Includes 0.38 mg/l total phosphate (PO_4).
c Includes 0.32 mg/l total phosphate (PO_4).
d Includes 0.37 mg/l total phosphate (PO_4).
e Includes 0.25 mg/l total phosphate (PO_4).
f Includes 0.10 mg/l total phosphate (PO_4).
g Includes 0.22 mg/l total phosphate (PO_4).
h Includes 0.18 mg/l total phosphate (PO_4).
i Includes 0.15 mg/l total phosphate (PO_4).
j Includes 0.13 mg/l total phosphate (PO_4).
k Includes 0.16 mg/l total phosphate (PO_4).
m Includes 0.18 mg/l total phosphate (PO_4).
n Includes 0.12 mg/l total phosphate (PO_4).

Table 8.--Field Determinations of Water-Quality Data for Corpus Christi Bay, September 28-30, 1967

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section C-C' - September 28, 1967[a]			
Vertical 1 - 1630 hours			
+ 2.0	23.9	800	--
- 1.8	23.9	800	--
Vertical 4 - 1705 hours			
+ 2.0	23.3	350	--
- 2.3	23.3	350	--
Vertical 5 - 1720 hours			
+ 2.0	23.9	350	--
- 2.8	23.9	350	--
Vertical 6 - 1735 hours			
+ 2.0	23.3	330	--
- 3.8	23.3	330	--
Vertical 7 - 1750 hours			
+ 2.0	23.3	650	--
- 2.8	23.3	650	--
Vertical 8 - 1805 hours			
+ 2.0	23.3	1,010	--
- 3.8	23.3	1,010	--
Vertical 10 - 1810 hours			
+ 2.0	23.3	1,300	--
- 2.3	23.3	1,300	--
Vertical 11 - 1820 hours			
+ 2.0	23.3	1,500	--
- .8	23.3	1,500	--
Cross Section D-D' - September 30, 1967[b]			
Vertical 1 - 1050 hours			
+ 1.8	23.5	9,200	6.3
- 5.5	23.5	9,600	6.3
Vertical 2 - 1110 hours			
+ 1.8	24.0	8,300	6.0
- 3.5	24.0	9,600	6.0
- 6.5	24.0	11,600	5.9
- 9.5	24.0	13,000	5.8
-12.5	25.0	37,300	4.0
Vertical 3 - 1130 hours			
+ 1.8	24.0	7,700	5.5
- 1.5	24.0	10,100	5.5
- 3.5	24.0	12,100	5.4
- 5.5	24.0	12,100	5.4
- 7.5	24.0	14,600	5.4
- 9.5	24.3	14,600	5.3
-11.5	25.5	30,500	4.4
-13.5	25.5	39,200	3.9
Vertical 4 - 1200 hours			
+ 1.8	24.0	2,900	5.5
- 3.5	24.0	5,700	5.4
- 5.5	24.0	8,800	5.4
- 7.5	24.0	11,200	5.3
- 9.5	24.0	11,600	5.2
-11.5	25.0	19,500	4.8
-13.5	25.5	35,400	4.2

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section D-D' September 30, 1967[b]--Continued			
Vertical 5 - 1225 hours			
+ 1.8	25.5	3,100	5.6
- 3.0	24.5	5,800	5.9
- 5.0	24.5	9,200	5.8
- 7.0	24.5	11,200	5.8
- 9.0	25.0	15,600	5.6
-11.0	25.5	29,500	5.4
-13.0	26.0	39,200	5.0
Vertical 6 - 1300 hours			
+ 1.7	25.0	2,900	5.4
- 3.1	25.0	5,800	5.4
- 5.1	25.0	8,800	5.4
- 7.1	25.0	11,600	5.4
- 9.1	25.0	17,600	5.4
-11.1	26.0	29,500	5.1
-13.1	27.0	36,300	4.8
Vertical 7 - 1330 hours			
+ 1.7	25.0	1,250	4.9
- 1.1	25.0	1,250	4.9
- 3.6	25.0	7,200	4.9
- 5.6	25.0	9,700	4.9
- 7.6	25.0	13,600	4.9
- 9.6	25.0	17,600	4.8
-11.6	25.0	33,500	4.6
Vertical 8 - 1355 hours			
+ 1.7	26.0	680	4.8
- 1.1	23.5	3,400	5.5
- 3.1	24.0	4,800	5.3
- 5.1	25.0	8,800	5.0
- 7.1	25.0	11,800	5.0
- 9.1	25.5	22,500	4.9
-11.1	26.0	33,500	4.6
Vertical 9 - 1440 hours			
+ 1.7	26.0	1,600	4.9
- 2.1	24.5	3,200	5.2
- 7.1	25.0	12,100	5.0
-12.1	25.5	30,500	4.8
-17.1	26.0	33,500	4.6
-22.1	26.5	39,200	4.2
-27.1	27.0	39,200	3.9
-32.1	27.0	44,100	3.4
-37.1	27.0	48,800	3.0
-42.1	27.0	48,800	3.0
Vertical 10 - 1515 hours			
+ 1.7	26.0	3,500	4.6
- 1.1	25.0	4,500	4.8
- 3.1	25.0	4,500	4.6
- 5.1	24.0	8,300	5.4
- 7.1	24.0	14,600	5.3
- 9.1	24.5	19,500	5.2
-11.1	25.0	27,400	5.0
-13.1	26.0	31,000	4.8

See footnotes at end of table.

Table 8.--Field Determinations of Water-Quality Data for Corpus Christi Bay, September 28-30, 1967--Continued

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section D-D' September 30, 1967[b]/--Continued			
Vertical 11 - 1535 hours			
+ 1.7	26.0	3,000	4.6
- .6	24.5	6,300	5.0
- 2.6	24.5	9,700	5.0
- 4.6	24.5	12,600	5.0
- 6.6	24.5	13,600	5.0
- 8.6	25.0	25,500	4.8
-10.6	26.0	31,400	4.3
-12.6	26.5	44,100	3.7
Vertical 12 - 1600 hours			
+ 1.7	25.5	4,300	4.9
- 2.6	24.5	8,800	5.2
- 4.6	24.5	10,700	5.2
- 6.6	24.5	12,800	5.2
- 8.6	25.0	27,500	5.0
-10.6	26.0	33,500	4.8
-12.6	27.0	44,100	2.6
Vertical 13 - 1625 hours			
+ 1.7	25.0	5,000	5.0
- .1	25.0	5,000	5.0
- 2.1	24.5	5,700	5.0
- 4.1	24.0	8,800	5.1
- 6.1	24.0	10,700	5.1
- 8.1	24.5	19,500	4.8
-10.1	25.0	26,000	4.7
-12.1	26.5	44,100	3.7
Vertical 14 - 1705 hours			
+ 1.6	24.5	4,800	4.3
- 2.2	24.5	4,800	4.3
- 4.2	24.0	4,800	4.8
- 6.2	24.0	4,900	4.8
- 8.2	24.0	12,100	4.6
-10.2	25.5	39,200	4.0
Cross Section E-E' - September 30, 1967[b]/			
East Mouth Oso Bay - 1010 hours			
+ 1.8	23.0	8,200	6.2
- 1.5	23.0	8,300	6.2
- 3.5	23.0	8,600	6.2
- 5.5	23.0	8,600	6.2
West Mouth Oso Bay - 1025 hours			
+ 1.8	23.5	9,300	6.4
- 3.5	23.5	9,300	6.3
Cross Section F-F' - September 29, 1967[c]/			
Vertical 1 - 1040 hours			
+ 1.9	23.0	9,400	8.0
+ .1	23.0	9,700	8.0
- 1.9	23.5	10,700	7.9
- 3.9	23.5	11,200	7.9
- 5.9	23.5	13,600	7.9
- 8.9	23.0	13,600	8.0

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section F-F' September 29, 1967[c]/--Continued			
Vertical 2 - 1105 hours			
+ 1.9	23.5	11,600	7.9
- 2.9	23.5	12,600	7.9
- 7.9	23.5	12,600	7.9
-12.9	23.0	13,400	8.0
Vertical 3 - 1120 hours			
+ 1.9	23.5	11,600	7.9
- 2.9	23.5	11,600	7.5
- 7.9	23.0	13,600	7.6
-13.4	21.5	14,600	6.0
Vertical 4 - 1155 hours			
+ 1.9	23.5	12,100	7.9
- 2.9	23.5	12,100	7.6
- 7.9	22.0	14,600	7.4
-13.9	23.0	19,500	5.9
Vertical 5 - 1220 hours			
+ 1.9	23.5	[d]/13,200	7.9
- 3.4	23.5	--	7.9
- 8.4	24.0	--	7.6
-13.4	25.5	31,400	5.0
Vertical 6 - 1255 hours			
+ 1.9	23.5	8,800	7.9
- 2.9	23.5	9,700	7.8
- 7.9	24.5	20,500	6.7
- 9.9	24.5	26,400	5.8
-12.9	25.5	43,100	2.6
Vertical 7 - 1340 hours			
+ 1.9	24.0	5,600	7.6
- .9	24.0	7,800	7.5
- 2.9	23.5	9,700	7.8
- 7.9	25.0	20,500	6.9
- 9.9	25.5	26,400	6.5
-12.9	26.5	41,900	1.6
Vertical 8 - 1430 hours			
+ 1.8	24.0	4,000	7.2
.0	24.0	10,200	7.1
- 3.0	24.0	14,400	7.1
- 8.0	25.5	20,500	6.2
-12.5	25.5	30,500	5.2
Vertical 9 - 1500 hours			
+ 1.8	25.0	4,000	6.8
- 1.0	24.5	12,100	6.8
- 3.0	24.5	16,100	6.7
- 7.0	25.5	24,500	6.3
-11.0	25.5	27,400	6.2
Vertical 10 - 1540 hours			
+ 1.8	25.0	4,000	6.4
.0	25.0	8,800	6.3
- 3.0	25.0	17,000	6.3
- 7.0	25.0	18,000	6.3
Vertical 11 - 1610 hours			
+ 1.8	24.0	3,400	6.7
- 3.0	24.0	11,600	6.7
- 8.0	24.0	13,600	6.7

See footnotes at end of table.

Table 8.--Field Determinations of Water-Quality Data for Corpus Christi Bay, September 28-30, 1967--Continued

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section F-F' September 29, 1967[c]/--Continued			
Vertical 11 - 1610 hours--Continued			
-13.0	25.0	27,400	6.0
-18.0	26.0	33,500	5.1
-23.0	26.5	39,300	4.2
-28.0	26.5	44,100	3.4
-33.0	26.5	46,900	3.4
-38.0	26.5	46,900	3.2
Cross Section G-G' - September 19, 1967[c]/			
Vertical 1 - 1330 hours			
+ 1.9	21.7	16,700	12.6
- 1.5	21.7	16,700	12.6
Vertical 2 - 1400 hours			
+ 1.9	22.2	14,600	10.7
- 1.5	22.2	14,600	10.7
Vertical 3 - 1500 hours			
+ 1.0	22.2	25,800	12.1
- 8.0	21.7	30,000	10.4
-15.5	22.2	30,000	10.0
Vertical 4 - 1530 hours			
+ 1.0	22.2	29,000	10.8
- 3.5	22.2	29,000	10.8
Cross Section H-H' - September 30, 1967[b]/			
Vertical 2 - 1450 hours			
+ 0.9	24.4	18,800	12.5
- 3.1	22.8	20,900	11.1
- 8.1	22.2	23,100	9.9
-13.1	23.3	26,800	8.5
-19.6	23.9	26,800	7.7
Vertical 3 - 1110 hours			
+ 1.0	23.3	13,400	8.8
- 9.0	23.3	13,900	9.2
Vertical 5 - 1120 hours			
+ 1.0	23.3	13,400	8.7
-11.8	23.3	13,400	8.3
Vertical 6 - 1130 hours			
+ 1.0	23.3	12,400	9.2
- 5.0	23.3	13,400	8.9
Vertical 8 - 1140 hours			
+ 1.0	23.3	15,600	9.1
- 6.3	23.3	15,600	8.9
Vertical 10 - 1150 hours			
+ 1.0	23.9	15,600	8.9
- 4.0	23.3	15,900	9.1
Vertical 11 - 1210 hours			
+ 1.0	23.3	24,200	10.7
- 2.0	23.3	23,600	10.6
Vertical 12 - 1235 hours			
+ 0.9	23.3	11,800	8.5
- 8.1	23.3	12,900	8.2
-13.1	23.3	12,900	8.2
-15.1	23.3	13,400	8.0
-16.1	23.3	13,900	7.8
-18.7	23.9	19,800	7.1
Vertical 13 - 1320 hours			
+ 0.9	23.3	12,400	8.6
- 8.1	23.3	13,400	8.7
-18.1	23.3	18,800	7.6
-28.1	23.9	[d]/12,800	--
-41.1	23.3	[d]/12,500	--
Vertical 14 - 1305 hours			
+ 0.9	23.3	12,900	8.8
- 8.1	23.3	13,900	9.1
-13.6	23.3	13,900	8.9
Cross Section H-H' September 30, 1967[b]/--Continued			
Cross Section I-I' - September 29, 1967[c]/			
Vertical 1 - 1025 hours			
+ 1.2	20.6	28,000	8.1
- 3.8	21.1	32,500	8.4
Vertical 2 - 1035 hours			
+ 1.1	21.1	28,400	8.2
- 2.9	21.1	28,400	8.1
- 7.9	21.1	28,400	7.9
-13.6	21.1	21,900	7.9
Vertical 3 - 1050 hours			
+ 1.1	20.6	28,400	8.6
- 3.9	20.6	26,800	8.6
Vertical 4 - 1140 hours			
+ 1.1	21.1	23,100	8.5
- 2.9	21.1	23,600	8.9
- 7.9	21.1	23,100	8.6
-11.0	21.1	23,600	8.9
Vertical 5 - 1150 hours			
+ 1.1	21.1	27,900	8.2
- 6.0	21.1	28,000	8.6
-13.1	21.1	28,000	8.9
-25.6	--	[d]/30,800	--
Vertical 6 - 1200 hours			
+ 1.1	21.1	24,700	8.9
- 9.4	21.1	28,400	9.0
Vertical 7 - 1300 hours			
+ 1.1	21.1	21,500	10.0
- 7.9	21.1	21,500	10.0

[a]/ Stage of bay fluctuated from +2.3 feet at 1600 hours to +2.2 feet at 1900 hours.
[b]/ Stage of bay fluctuated from +2.0 feet at 1000 hours to +1.8 feet at 1700 hours.
[c]/ Stage of bay fluctuated from +2.2 feet at 1000 hours to +2.0 feet at 1600 hours.
[d]/ Determined in Laboratory.

Table 9.--Chemical Analyses of Water in the Nueces River and in Corpus Christi Bay, October 2-3, 1967

(Results in milligrams per liter except as indicated)

DATE OF COLLECTION	ALTITUDE, IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	SILICA (SiO_2)	CALCIUM (CA)	MAGNESIUM (MG)	STRONTIUM (SR)	SODIUM (NA)	POTASSIUM (K)	LITHIUM (LI)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (CL)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS (CALCULATED)	HARDNESS AS $CaCO_3$ CALCIUM, MAGNESIUM	HARDNESS AS $CaCO_3$ NONCARBONATE	DENSITY (GRAMS PER ML AT 20°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	PH
NUECES RIVER NEAR MATHIS																				
Oct. 2, 1967	(a)	12	32	1.9	0.09	12	5.4	0.01	114	13	7.0	0.3	1.0	0.08	b141	88	0	--	228	7.3
CROSS SECTION A-A'																				
Nueces River at U.S. Highway 77 near Calallen																				
Oct. 2, 1967	(a)	12	34	2.0	0.11	12	5.3	0.01	119	13	7.0	0.3	1.0	0.08	c146	93	0	--	237	7.3
CROSS SECTION C-C'																				
Vertical 5																				
Oct. 2, 1967	+ 1.0	12	36	6.8	0.14	60	7.2	0.01	121	25	92	0.3	1.0	0.13	d301	118	19	--	534	7.3
CROSS SECTION D-D'																				
Vertical 4																				
Oct. 2, 1967	+ 1.7	11	--	--	--	--	--	--	112	68	422	--	--	--	--	228	136	--	1,650	7.2
Do.	-10.6	11	--	--	--	--	--	--	113	138	920	--	--	--	--	392	300	--	3,230	7.2
Do.	-12.6	8.3	--	--	--	--	--	--	130	1,400	10,000	--	--	--	--	3,480	3,370	1.010	28,300	7.3
Vertical 9																				
Oct. 2, 1967	- 6.0	9.0	--	--	--	--	--	--	106	328	2,290	--	--	--	--	880	793	--	7,230	7.4
Do.	-11.0	6.9	--	--	--	--	--	--	126	1,280	9,400	--	--	--	--	3,200	3,100	1.009	26,300	7.3
Do.	-41.0	6.4	407	1,200	6.4	10,100	372	0.19	149	2,490	18,200	1.6	3.2	5.3	e32,900	5,960	5,840	1.020	48,300	7.4
CROSS SECTION F-F'																				
Vertical 3																				
Oct. 3, 1967	+ 1.6	9.6	--	--	--	--	--	--	106	220	1,500	--	--	--	--	580	493	--	4,950	7.3
Vertical 11																				
Oct. 3, 1967	+ 1.5	9.2	--	--	--	--	--	--	106	328	2,350	--	--	--	--	880	793	--	7,350	7.7
Do.	-13.3	7.8	--	--	--	--	--	--	110	1,070	7,700	--	--	--	--	2,680	2,590	1.008	22,200	7.6
Do.	-23.3	7.3	--	--	--	--	--	--	117	1,620	11,200	--	--	--	--	4,000	3,900	1.011	31,300	7.2
Do.	-38.3	5.9	372	1,050	6.4	8,720	318	0.16	141	2,260	16,000	1.4	2.8	3.8	f28,800	5,250	5,140	1.017	42,900	7.3
CROSS SECTION H-H'																				
Vertical 2																				
Oct. 3, 1967	+ 0.7	7.0	--	--	--	--	--	--	116	828	5,980	--	--	--	--	2,080	1,980	1.006	17,900	7.5
Do.	-13.3	7.2	185	458	2.8	3,880	142	0.08	117	998	7,050	0.9	3.8	1.8	g12,800	2,350	2,250	1.005	20,600	7.5
Vertical 12																				
Oct. 3, 1967	+ 1.6	8.2	151	358	2.0	2,950	110	0.06	107	772	5,400	0.7	3.8	1.3	g9,810	1,850	1,760	1.003	16,300	7.3

See footnotes at end of table.

Table 9.--Chemical Analyses of Water in the Nueces River and in Corpus Christi Bay, October 2-3, 1967--Continued

DATE OF COLLECTION	ALTITUDE, IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	SILICA (SiO_2)	CALCIUM (CA)	MAGNESIUM (MG)	STRONTIUM (SR)	SODIUM (NA)	POTASSIUM (K)	LITHIUM (LI)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (CL)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS (CALCULATED)	HARDNESS AS $CaCO_3$ CALCIUM, MAGNESIUM	HARDNESS AS $CaCO_3$ NONCARBONATE	DENSITY (GRAMS PER ML AT 20°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	PH
CROSS SECTION H-H'--Continued																				
Vertical 13																				
Oct. 3, 1967	- 7.2	8.2	--	--	--	--	--	--	108	824	5,800	--	--	--	--	2,030	1,940	1.004	17,500	7.3
Do.	-18.2	5.5	--	--	--	--	--	--	124	1,730	12,500	--	--	--	--	4,800	4,700	1.013	34,200	7.4
Do.	-45.2	2.7	343	965	5.2	8,080	286	0.15	130	2,100	14,700	1.3	3.8	3.5	h26,600	4,830	4,720	1.015	40,200	7.6
CROSS SECTION I-I'																				
Vertical 5																				
Oct. 3, 1967	+ 0.7	8.2	--	--	--	--	--	--	97	888	6,180	--	--	--	--	2,440	2,360	1.005	18,400	7.5
Do.	-28.9	8.0	179	415	2.8	3,500	127	0.07	98	915	6,320	0.8	2.2	1.5	i11,500	2,160	2,080	1.004	18,800	7.3

a Data represent entire vertical.
b Includes 0.40 mg/l total phosphate (PO_4).
c Includes 0.41 mg/l total phosphate (PO_4).
d Includes 0.38 mg/l total phosphate (PO_4).
e Includes 0.32 mg/l total phosphate (PO_4).
f Includes 0.25 mg/l total phosphate (PO_4).
g Includes 0.15 mg/l total phosphate (PO_4).
h Includes 0.05 mg/l total phosphate (PO_4).
i Includes 0.12 mg/l total phosphate (PO_4).

Table 10.--Field Determinations of Water-Quality Data for Corpus Christi Bay, October 2-3, 1967

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section C-C' - October 2, 1967[a]			
Vertical 1 - 1455 hours			
+ 0.9	27.2	2,200	9.1
- 1.6	27.2	2,100	8.9
Vertical 2 - 1540 hours			
+ 1.0	26.7	1,060	7.9
- 1.0	26.7	1,060	7.9
Vertical 3 - 1525 hours			
+ 0.9	26.7	490	7.4
- 2.9	26.7	490	7.4
Vertical 4 - 1515 hours			
+ 0.9	26.7	500	7.4
- 2.6	26.7	500	7.4
Vertical 5 - 1610 hours			
+ 1.0	26.7	440	7.3
- 3.2	26.7	440	7.2
Vertical 6 - 1625 hours			
+ 1.0	26.7	790	7.4
- 6.5	25.6	870	7.7
Vertical 7 - 1640 hours			
+ 1.0	27.8	910	7.6
- 4.1	27.8	1,010	7.4
Vertical 9 - 1650 hours			
+ 1.0	27.8	1,200	7.4
- 5.3	27.2	1,340	7.5
Vertical 12 - 1710 hours			
+ 1.0	27.2	760	7.8
- 3.0	27.2	770	7.6
- 7.7	27.2	810	7.6
Cross Section D-D' - October 2, 1967[a]			
Vertical 1 - 1430 hours			
+ 1.7	27.0	2,800	6.4
- 1.1	27.0	2,800	6.4
- 4.1	27.5	2,800	6.3
Vertical 2 - 1440 hours			
+ 1.7	26.5	2,000	5.7
- 4.1	26.0	2,100	5.7
- 6.1	26.0	2,400	5.7
- 8.1	26.0	2,600	5.6
-10.1	26.0	2,800	5.2
-12.1	26.5	10,800	4.0
Vertical 3 - 1500 hours			
+ 1.7	26.5	1,900	5.5
- 1.1	26.0	2,100	5.6
- 5.1	25.5	2,400	5.6
- 7.1	25.5	2,500	5.4
- 9.1	25.5	2,500	5.3
-11.1	25.5	2,900	5.1
-13.1	26.0	32,400	3.2
Vertical 4 - 1515 hours			
+ 1.7	25.5	1,600	5.6
- 2.6	25.5	1,900	5.6
- 4.6	25.5	1,900	5.3
- 6.6	25.5	1,900	5.2
- 8.6	25.5	2,100	5.1
-10.6	25.5	2,900	4.6
-12.6	25.5	27,700	1.7

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section D-D' October 2, 1967[a]--Continued			
Vertical 5 - 1535 hours			
+ 1.8	27.5	2,100	6.3
0.0	26.0	2,100	6.0
- 2.0	25.5	2,100	6.0
- 4.0	25.0	2,400	6.2
- 6.0	25.0	3,000	6.2
- 8.0	25.0	5,300	6.1
-10.0	25.0	8,300	4.7
-12.0	26.0	40,200	1.4
Vertical 6 - 1600 hours			
+ 1.8	26.5	2,800	6.9
- 2.0	25.5	2,800	6.9
- 4.0	25.0	2,900	7.0
- 6.0	25.0	4,300	7.0
- 8.0	25.0	6,300	7.5
-10.0	25.0	7,000	6.4
-12.0	25.0	29,300	3.5
Vertical 7 - 1620 hours			
+ 1.8	26.5	2,600	7.8
- .5	25.5	2,800	8.2
- 2.5	25.5	5,500	8.3
- 4.5	25.0	6,600	8.5
- 6.5	25.0	6,600	7.5
- 8.5	25.0	6,800	7.0
-10.5	25.0	14,100	5.0
Vertical 8 - 1640 hours			
+ 1.8	26.5	3,100	8.9
0.0	26.0	6,000	9.2
- 2.0	26.0	6,000	9.2
- 4.0	25.5	7,000	9.3
- 6.0	25.0	7,000	8.3
- 8.0	24.5	7,700	7.0
-10.0	25.0	25,700	4.8
Vertical 9 - 1705 hours			
+ 1.8	26.0	7,300	9.3
- 1.0	25.5	7,300	9.5
- 6.0	25.0	7,300	7.7
-11.0	25.0	26,900	3.7
-16.0	25.5	35,300	2.5
-21.0	25.5	37,300	2.3
-26.0	25.5	38,300	2.2
-31.0	26.5	39,200	1.4
-36.0	26.5	46,900	.9
-41.0	26.5	46,900	.9
Vertical 10 - 1730 hours			
+ 1.8	26.0	8,200	9.3
- 2.0	26.0	8,200	9.3
- 4.0	25.0	8,300	9.8
- 6.0	25.0	8,700	8.7
- 8.0	25.0	9,700	7.7
-10.0	25.0	25,500	4.5
-12.0	26.0	42,100	1.6
Vertical 11 - 1750 hours			
+ 1.8	26.5	9,000	9.2
- 2.0	26.0	9,000	9.3
- 4.0	25.0	9,400	9.8
- 6.0	25.0	9,700	9.8

See footnotes at end of table.

Table 10.--Field Determinations of Water-Quality Data for Corpus Christi Bay, October 2-3, 1967--Continued

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section D-D' October 2, 1967[a]/--Continued			
Vertical 11 - 1750 hours--Continued			
- 8.0	25.0	12,600	7.0
-10.0	26.0	33,500	3.9
-12.0	26.0	42,100	.9
Vertical 12 - 1805 hours			
+ 1.8	25.0	8,200	9.8
- 2.0	25.0	8,200	9.8
- 4.0	24.5	8,200	10.1
- 6.0	24.5	8,700	9.3
- 8.0	24.0	21,400	6.3
-10.0	24.0	38,200	5.1
Vertical 13 - 1820 hours			
+ 1.8	25.5	8,100	9.6
- 3.0	25.5	8,100	9.6
- 5.0	25.0	8,100	9.8
- 7.0	25.0	8,100	9.3
- 9.0	24.5	10,200	7.5
-11.0	24.5	32,400	4.7
Vertical 14 - 1830 hours			
+ 1.8	25.5	8,200	9.6
- 3.0	25.5	8,200	9.6
- 5.0	25.5	8,200	9.6
- 7.0	25.0	8,200	9.6
- 9.0	24.5	23,800	4.8
Cross Section F-F' - October 3, 1967[b]/			
Vertical 1 - 0920 hours			
+ 1.6	25.0	9,900	11.1
- 1.2	25.0	10,200	11.1
- 3.2	25.5	10,800	10.9
- 5.2	25.5	11,100	10.9
- 7.2	25.0	12,100	8.6
- 9.2	25.0	14,100	8.6
Vertical 2 - 0935 hours			
+ 1.6	25.0	5,600	10.0
- .7	25.0	5,600	10.0
- 2.7	25.5	7,300	9.5
- 4.7	25.0	11,900	11.0
- 6.7	25.0	14,100	10.2
- 8.7	25.0	16,600	8.9
-10.7	25.0	25,400	4.2
-12.7	25.0	41,100	.5
Vertical 3 - 0955 hours			
+ 1.6	25.0	5,000	9.2
- 1.2	25.0	5,000	9.2
- 3.2	25.5	9,700	10.9
- 5.2	25.0	12,900	11.0
- 7.2	25.0	15,700	10.5
- 9.2	25.0	17,000	9.5
-11.2	25.0	23,500	7.4
-13.2	25.0	38,200	.8
Vertical 4 - 1015 hours			
+ 1.6	26.0	9,300	11.7
- 1.7	26.0	9,300	11.7
- 3.7	26.0	9,700	11.6
- 5.7	26.0	14,600	11.5
- 7.7	26.0	15,600	10.6
- 9.7	26.0	16,800	10.5
-11.7	26.0	23,500	8.2
-13.7	26.5	39,200	.7
Vertical 5 - 1035 hours			
+ 1.5	26.0	9,400	10.9
- 1.3	26.0	9,400	10.9
- 3.3	25.5	11,200	10.9
- 5.3	25.5	12,800	10.8
- 7.3	25.0	14,600	10.8
- 9.3	25.5	16,600	9.8
-11.3	25.0	23,500	7.2
-13.3	25.5	37,300	.6
Vertical 6 - 1055 hours			
+ 1.5	26.0	9,700	10.9
- 2.8	25.5	10,000	11.0
- 4.8	25.5	10,700	10.9
- 6.8	25.5	12,400	10.9
- 8.8	25.5	12,400	10.9
-10.8	25.0	23,500	7.8
-12.8	25.0	28,500	4.4
Vertical 7 - 1115 hours			
+ 1.5	26.5	8,200	9.7
- 2.8	26.5	8,300	10.0
- 4.8	27.0	9,000	9.7
- 6.8	27.0	11,600	10.2
- 8.8	26.0	12,600	10.4
-10.8	26.0	23,500	7.2
-12.8	26.0	26,500	4.7
Vertical 8 - 1130 hours			
+ 1.5	26.5	9,200	9.7
- 2.3	26.5	9,200	9.4
- 4.3	26.5	9,200	9.2
- 6.3	27.0	11,800	10.7
- 8.3	26.5	13,100	9.7
-10.3	26.0	24,500	6.7
-12.3	26.5	27,500	4.2
Vertical 9 - 1145 hours			
+ 1.5	26.0	6,900	10.5
- .8	26.0	7,700	10.8
- 2.8	26.5	11,800	11.1
- 4.8	26.5	11,800	10.6
- 6.8	26.0	14,100	10.0
- 8.8	25.5	25,500	7.3
-10.8	25.5	26,300	5.4
Vertical 10 - 1200 hours			
+ 1.5	26.0	7,700	11.4
- .8	26.0	7,700	11.0
- 2.8	26.0	9,000	9.6
- 4.8	26.0	11,900	9.6
- 6.8	26.0	12,100	9.6
Vertical 11 - 1230 hours			
+ 1.5	26.0	7,400	11.4
- 3.3	25.5	10,700	10.5
- 8.3	25.0	13,100	8.8
-13.3	25.0	21,600	6.5

See footnotes at end of table.

Table 10.--Field Determinations of Water-Quality Data for Corpus Christi Bay, October 2-3, 1967--Continued

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section F-F' October 3, 1967[b]/--Continued			
Vertical 11 - 1230 hours--Continued			
-18.3	25.0	26,500	3.8
-23.3	25.5	30,500	3.5
-28.3	26.0	34,400	2.6
-33.3	26.0	39,200	1.9
-38.3	26.0	41,100	1.8
Cross Section G-G' - October 3, 1967[b]/			
Vertical 1 - 0945 hours			
+ 0.8	26.1	23,600	7.8
- 1.4	25.6	23,600	7.9
Vertical 2 - 0930 hours			
+ 0.8	25.6	21,500	7.8
- 1.0	25.6	22,500	7.4
Vertical 3 - 1035 hours			
+ 0.7	26.1	19,900	7.1
- 8.3	25.6	20,200	7.4
-15.0	26.1	20,400	7.6
Vertical 4 - 1105 hours			
+ 0.7	26.7	16,300	7.2
- 4.3	26.7	16,300	7.3
Cross Section H-H' - October 3, 1967[b]/			
Vertical 1 - 1320 hours			
+ 0.7	27.8	[c]/16,700	9.8
- 3.3	26.7	[c]/17,000	9.0
- 5.3	26.7	[c]/17,200	8.6
- 6.3	26.7	[c]/17,200	7.6
- 7.3	26.7	[c]/17,500	6.7
- 9.3	26.7	[c]/18,000	6.3
Vertical 2 - 1350 hours			
+ 0.7	26.7	18,100	9.9
- 3.3	26.7	18,300	8.9
- 5.3	26.7	18,300	8.7
- 6.3	26.7	18,300	8.0
- 8.3	26.1	19,900	7.2
-13.3	25.6	21,000	6.7
-19.0	25.6	21,000	6.1
Vertical 4 - 1415 hours			
+ 0.7	27.2	15,600	10.7
- 3.3	27.2	15,600	10.5
- 5.3	27.2	15,600	8.8
- 7.8	25.6	15,600	8.4
Vertical 7 - 1530 hours			
+ 1.5	27.0	18,100	9.9
- .3	27.0	18,100	9.4
- 2.3	27.0	18,100	9.7
- 4.3	26.5	18,100	10.2
- 6.3	25.0	24,200	4.8
Vertical 9 - 1545 hours			
+ 1.6	26.5	18,100	10.3
- .2	26.5	18,100	10.3

See footnotes at end of table.

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section H-H' October 3, 1967[b]/--Continued			
Vertical 9 - 1545 hours--Continued			
- 2.2	26.5	18,100	10.0
- 4.2	26.5	18,300	10.0
- 6.2	25.5	23,600	6.0
Vertical 11 - 1615 hours			
- 0.2	27.0	18,300	10.4
Vertical 12 - 1545 hours			
+ 1.6	26.1	16,700	10.8
- 3.2	26.7	17,200	9.2
- 5.2	25.6	18,300	9.4
- 6.2	25.0	18,300	9.4
- 7.2	25.0	18,800	8.4
- 8.2	25.0	23,600	7.9
-13.2	25.0	29,000	5.4
-18.9	24.4	30,000	4.8
Vertical 13 - 1605 hours			
+ 0.8	25.0	17,800	11.4
- 3.2	25.6	17,200	10.3
- 7.2	25.6	19,400	7.7
- 8.2	25.6	29,000	6.7
-13.2	25.6	31,100	5.2
-18.2	25.6	33,300	5.0
-23.2	25.6	35,600	6.3
-28.2	26.1	37,800	7.1
-33.2	26.1	37,800	6.9
-38.2	26.1	37,800	7.3
-43.2	26.1	37,800	7.5
-45.2	26.1	37,800	7.6
Vertical 14 - 1645 hours			
+ 0.8	25.6	17,200	11.3
- 1.2	26.7	17,200	10.3
- 2.2	26.1	17,800	10.1
- 3.2	25.0	19,400	9.9
- 5.2	24.4	21,500	10.0
- 6.2	25.0	23,100	8.6
- 7.2	25.0	18,700	7.6
- 8.2	25.0	26,300	6.7
-12.2	25.0	31,100	5.2
Cross Section I-I' - October 3, 1967[b]/			
Vertical 1 - 0930 hours			
+ 0.8	26.1	[c]/17,400	--
- 3.2	26.1	[c]/18,200	--
Vertical 2 - 0945 hours			
+ 0.8	26.1	[c]/17,100	--
- 8.2	26.1	--	--
-13.2	26.1	[c]/17,400	--
-16.7	26.1	[c]/17,700	--
Vertical 3 - 1000 hours			
+ 0.8	26.1	[c]/17,900	--
- 5.3	26.1	[c]/17,800	--
Vertical 4 - 1020 hours			
+ 0.8	26.1	[c]/18,100	--
- 9.6	26.1	[c]/18,200	--

Table 10.--Field Determinations of Water-Quality Data for Corpus Christi Bay, October 2-3, 1967--Continued

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section I-I' October 3, 1967[b]/--Continued			
Vertical 5 - 1035 hours			
+ 0.7	26.1	[c]/18,400	--
- 8.3	26.1	[c]/18,100	--
-13.3	26.1	[c]/18,200	--
-18.3	25.8	[c]/18,400	--
-23.3	25.8	[c]/18,500	--
-28.9	25.8	[c]/18,800	--
Cross Section I-I' October 3, 1967[b]/--Continued			
Vertical 6 - 1050 hours			
+ 0.7	26.1	[c]/18,100	--
- 9.7	26.1	[c]/18,200	--
Vertical 7 - 1110 hours			
+ 0.7	27.8	[c]/20,400	--
- 7.8	27.2	[c]/20,300	--

[a]/ Stage of bay fluctuated from +1.9 feet at 1400 hours to +2.0 feet at 1700 hours to +1.9 feet at 1900 hours.

[b]/ Stage of bay fluctuated from +1.8 feet at 0900 hours to +1.6 feet at 1500 hours to +1.8 feet at 1700 hours.

[c]/ Determined in laboratory.

Table 11.--Chemical Analyses of Water in the Guadalupe and San Antonio Rivers and in San Antonio Bay, September 27 and October 1, 1967

(Results in milligrams per liter except as indicated)

DATE OF COLLECTION	ALTITUDE, IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	SILICA (SiO_2)	CALCIUM (Ca)	MAGNESIUM (Mg)	STRONTIUM (Sr)	SODIUM (Na)	POTASSIUM (K)	LITHIUM (Li)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS (CALCULATED)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM	HARDNESS AS $CaCO_3$: NONCARBONATE	DENSITY (GRAMS PER ML AT 20°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	PH
GUADALUPE RIVER AT VICTORIA																				
Sept. 27, 1967	(a)	12	44	2.8	0.16	8.0	4.8	0.00	135	22	9.0	0.3	0.5	0.03	170	122	11	--	260	7.3
SAN ANTONIO RIVER NEAR GOLIAD																				
Sept. 27, 1967	(a)	11	44	3.2	0.19	11	6.6	0.01	130	30	11	0.5	3.2	0.06	185	123	17	--	318	7.3
CROSS SECTION A-A'																				
Guadalupe River at State Highway 35 near Tivoli																				
Oct. 1, 1967	(a)	14	48	4.3	0.18	15	7.1	0.01	144	25	18	0.5	2.8	0.09	b208	138	20	--	332	7.4
Schwings Bayou at State Highway 35 near Tivoli																				
Oct. 1, 1967	(a)	12	--	--	--	--	--	--	126	12	13	--	--	--	--	115	12	--	268	7.3
Goffs Bayou at State Highway 35 near Tivoli																				
Oct. 1, 1967	(a)	11	--	--	--	--	--	--	122	11	6.3	--	--	--	--	108	8	--	231	7.5
CROSS SECTION B-B'																				
Vertical 2																				
Oct. 1, 1967	+ 1.3	9.8	--	--	--	--	--	--	124	32	168	--	--	--	--	168	66	--	798	7.3
Do.	- .5	11	--	--	--	--	--	--	130	59	405	--	--	--	--	232	126	--	1,580	7.2
Do.	- 5.5	12	--	--	--	--	--	--	144	106	760	--	--	--	--	350	232	--	2,680	7.3
Vertical 5																				
Oct. 1, 1967	+ 1.3	12	38	2.8	0.09	8.8	4.9	0.00	124	11	12	0.3	0.8	0.05	c152	106	5	--	248	7.6
CROSS SECTION C-C'																				
Vertical 3																				
Oct. 1, 1967	+ 1.4	10	--	--	--	--	--	--	120	12	33	--	--	--	--	110	12	--	318	7.3
Do.	- 9.4	10	--	--	--	--	--	--	120	14	52	--	--	--	--	114	16	--	384	7.2
Do.	-11.4	5.2	283	790	4.1	6,440	238	0.12	117	1,700	11,600	--	4.5	2.5	d21,100	3,960	3,860	1,012	32,500	6.9
CROSS SECTION D-D'																				
Vertical 1																				
Oct. 1, 1967	+ 0.6	9.6	--	--	--	--	--	--	122	182	1,290	--	--	--	--	515	415	--	4,290	7.4
Do.	-11.1	8.5	85	159	0.81	1,370	53	0.03	120	341	2,500	--	0.5	0.61	e4,580	867	768	--	7,730	7.4
Vertical 3																				
Oct. 1, 1967	+ 0.6	9.0	--	--	--	--	--	--	109	60	422	--	--	--	--	218	128	--	1,600	7.4

See footnotes at end of table.

Table 11.--Chemical Analyses of Water in the Guadalupe and San Antonio Rivers and in San Antonio Bay, September 27 and October 1, 1967--Continued

DATE OF COLLECTION	ALTITUDE, IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	SILICA (SiO_2)	CALCIUM (Ca)	MAGNESIUM (Mg)	STRONTIUM (Sr)	SODIUM (Na)	POTASSIUM (K)	LITHIUM (Li)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	BORON (B)	DISSOLVED SOLIDS (CALCULATED)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM	HARDNESS AS $CaCO_3$: NONCARBONATE	DENSITY (GRAMS PER ML AT 20°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	PH
CROSS SECTION D-D'--Continued																				
Vertical 5																				
Oct. 1, 1967	- 5.0	10	35	6.6	0.10	50	6.9	0.00	116	16	83	0.3	2.5	0.10	d268	115	20	--	480	7.5
CROSS SECTION E-E'																				
Vertical 1																				
Oct. 1, 1967	- 4.4	10	--	--	--	--	--	--	110	92	660	--	--	--	--	284	194	--	2,370	7.5
Do.	-13.4	9.6	54	74	0.49	656	29	0.02	118	159	1,170	--	3.0	0.40	f2,210	440	343	--	3,950	7.3
Vertical 2																				
Oct. 1, 1967	- 1.4	9.6	--	--	--	--	--	--	111	67	502	--	--	--	--	242	151	--	1,860	7.5
CROSS SECTION F-F'																				
Vertical 1																				
Oct. 1, 1967	+ 1.4	8.6	--	--	--	--	--	--	110	127	890	--	--	--	--	376	286	--	3,080	7.2
Do.	-16.9	8.3	74	129	0.78	1,120	44	0.02	118	275	2,020	--	5.5	0.65	f3,740	716	620	--	6,390	7.5
Vertical 3																				
Oct. 1, 1967	- 1.8	9.0	--	--	--	--	--	--	103	56	390	--	--	--	--	207	122	--	1,500	7.3

a Sample represents entire vertical.
b Includes 1.8 mg/l total phosphate (PO_4).
c Includes 0.37 mg/l total phosphate (PO_4).
d Includes 0.34 mg/l total phosphate (PO_4).
e Includes 0.20 mg/l total phosphate (PO_4).
f Includes 0.24 mg/l total phosphate (PO_4).

Table 12.--Field Determinations of Water-Quality Data for San Antonio Bay
October 1, 1967

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section B-B' - October 1, 1967[a]/			
Vertical 1 - 1030 hours			
+ 1.3	23.3	1,150	6.0
+ .5	23.3	1,900	4.8
- 1.2	23.9	2,900	3.4
Vertical 2 - 1100 hours			
+ 1.3	23.3	890	6.4
- .5	23.3	1,450	6.1
- 1.5	23.9	1,900	5.5
- 3.5	23.9	2,500	5.0
- 5.5	23.9	2,600	4.2
Vertical 3 - 1410 hours			
+ 1.4	25.6	490	6.2
- .4	25.6	490	6.1
Vertical 4 - 1355 hours			
+ 1.4	24.4	400	5.8
- 1.6	24.4	400	5.8
Vertical 5 - 1130 hours			
+ 1.3	22.8	250	4.5
- 2.5	22.8	250	4.5
- 4.5	22.8	300	4.6
Vertical 6 - 1150 hours			
+ 1.4	23.3	310	4.1
- .4	23.3	280	4.1
- 3.6	23.3	300	4.1
Vertical 7 - 1215 hours			
+ 1.4	23.9	300	4.1
- 3.4	23.3	330	4.1
Vertical 8 - 1230 hours			
+ 1.4	23.9	370	4.6
- 1.4	23.3	410	4.5
- 3.4	22.8	540	5.0
Vertical 9 - 1300 hours			
+ 1.4	23.9	410	6.6
- 1.4	23.3	420	6.8
- 3.6	22.2	470	7.4
Vertical 10 - 1320 hours			
+ 1.4	24.4	510	7.3
- .4	23.9	520	7.5
- 2.4	23.3	580	7.2
Cross Section C-C' - October 1, 1967[a]/			
Vertical 1 - 1140 hours			
+ 1.4	24.0	2,500	5.1
- 5.9	23.5	2,500	5.1
- 7.9	23.5	2,500	5.1
- 9.9	23.5	2,500	5.1
-11.9	23.5	2,500	5.1
Vertical 2 - 1150 hours			
+ 1.4	24.5	470	4.9
- 3.4	24.5	470	4.8
Vertical 3 - 1200 hours			
+ 1.4	24.0	370	4.8
- 3.4	24.0	370	4.8
- 5.4	24.0	390	4.8
- 7.4	24.0	400	4.8
- 9.4	24.0	4,300	4.7
-11.4	25.5	31,500	1.9

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section C-C' October 1, 1967[a]/--Continued			
Vertical 4 - 1220 hours			
+ 1.4	24.5	330	4.9
- 5.9	25.5	330	4.7
Vertical 5 - 1230 hours			
+ 1.4	24.5	550	4.7
- 4.4	24.5	610	4.4
Vertical 6 - 1240 hours			
+ 1.4	24.5	850	4.9
- 2.4	25.0	950	4.8
Cross Section D-D' - October 1, 1967[a]/			
Vertical 1 - 1920 hours			
+ 0.6	25.0	4,300	6.8
- 3.4	23.9	4,600	6.8
- 8.4	25.0	6,000	7.7
-11.1	25.0	6,500	8.7
Vertical 2 - 1545 hours			
+ .6	24.4	1,800	7.5
- 1.4	24.4	1,800	7.5
- 2.9	24.4	2,200	6.9
- 4.4	23.9	4,300	3.8
Vertical 3 - 1605 hours			
+ .6	24.4	1,600	7.7
- 1.4	24.4	1,600	7.7
- 3.4	24.4	1,700	7.7
- 4.4	24.4	2,500	5.1
Vertical 4 - 1630 hours			
+ 0.7	24.4	670	6.7
- 3.3	23.9	700	6.9
- 6.3	23.3	880	7.0
Vertical 5 - 1650 hours			
+ .7	24.4	490	6.7
- 1.3	24.4	490	6.7
- 5.0	22.8	520	7.0
Vertical 6 - 1710 hours			
+ .7	23.3	490	7.5
- 1.3	23.3	490	7.5
- 4.3	22.8	590	7.4
Vertical 7 - 1730 hours			
+ 0.6	23.9	690	7.4
- 3.4	23.3	710	7.5
- 5.1	22.8	920	7.4
Vertical 8 - 1755 hours			
+ .6	24.4	870	7.5
- 3.4	24.4	870	7.5
- 5.1	24.4	1,070	7.0
Vertical 9 - 1815 hours			
+ .6	25.6	1,170	8.0
- 1.8	25.6	1,120	7.9
Cross Section E-E' - October 1, 1967[a]/			
Vertical 1 - 1800 hours			
+ 1.4	25.5	2,300	4.2
- 1.4	25.0	2,300	4.4
- 4.4	24.5	2,300	4.2

See footnote at end of table.

Table 12.--Field Determinations of Water-Quality Data for San Antonio Bay
October 1, 1967--Continued

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section E-E' October 1, 1967[a]/--Continued			
Vertical 1 - 1800 hours--Continued			
- 7.4	24.0	2,600	4.1
-10.4	23.5	2,900	3.9
-13.4	23.5	3,400	3.9
Vertical 2 - 1820 hours			
+ 1.4	25.0	1,800	4.4
- 1.4	25.0	1,800	4.4
Vertical 3 - 1830 hours			
+ 1.4	25.0	2,900	4.6
- 2.6	25.0	2,900	4.6
Vertical 4 - 1835 hours			
+ 1.4	25.0	3,500	4.4
- 2.6	25.0	3,500	4.4
Cross Section F-F' - October 1, 1967[a]/			
Vertical 1 - 1545 hours			
+ 1.4	24.5	2,800	6.4
- 4.9	23.5	2,900	6.8
- 6.9	23.5	2,900	6.8
- 8.9	23.5	2,900	6.8
-10.9	23.5	3,500	6.8
-12.9	24.0	4,500	6.6
-14.9	24.0	5,800	6.6
-16.9	24.5	5,800	6.6

DEPTH IN FEET ABOVE(+) OR BELOW(-) MEAN SEA LEVEL	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	DISSOLVED OXYGEN (MILLIGRAMS PER LITER)
Cross Section F-F' October 1, 1967[a]/--Continued			
Vertical 2 - 1610 hours			
+1.4	27.0	3,000	5.4
-1.4	26.5	3,000	5.6
Vertical 3 - 1620 hours			
+1.5	24.5	1,460	5.7
-1.8	24.0	1,460	6.1
-4.8	24.5	3,800	6.2
Vertical 4 - 1630 hours			
+1.4	24.5	1,530	5.2
-2.9	24.0	1,530	5.3
-5.9	23.5	6,300	5.5
Vertical 5 - 1640 hours			
+1.4	24.5	1,600	4.9
-1.9	24.0	1,600	5.1
-4.9	23.5	7,400	4.8
Vertical 6 - 1650 hours			
+1.4	24.5	2,900	4.7
-2.4	24.5	2,900	4.7
-4.4	23.5	3,400	5.0
-5.4	23.5	5,700	4.8
Vertical 7 - 1705 hours			
+1.4	24.0	3,400	5.0
-2.4	23.5	3,400	4.7
-4.4	23.5	6,300	4.8
-5.4	23.5	7,700	4.4

a/ Stage of bay fluctuated from +1.5 feet at 1000 hours to +1.7 feet at 1700 hours to +1.6 feet at 2000 hours.

STREAMFLOW DATA

Summary of Station Data (Table 13)

Maximum stages and discharges at 93 gaging stations, crest-stage stations, miscellaneous sites, and reservoir stations are summarized in Table 13. The reference numbers in the table correspond to those on the location map (Figure 38) and aid in locating the sites at which peak discharges were determined.

Explanation of data in Table 13 is as follows:

Number.—The number by which each station is identified at references in this report. The numerical order follows the U.S. Geological Survey's standard downstream order of listing stations.

Permanent station number.—The number used in the Geological Survey's Water-Supply Papers, the annual reports of Surface-Water Records of Texas, and in Water Bulletins of the International Boundary and Water Commission, United States and Mexico. Blank spaces in the column indicate that a station is at a miscellaneous site. The number for each station includes the number for the Geological Survey's geographical division of principal river basins. All stations in this report are in Part 8.

Stream and place of determination.—The permanent name adopted for the site to which the listed data apply; each name is unique.

Drainage area.—The gross drainage area, in square miles, above the station site as determined by the topography.

The remaining columns of the table give data for all known floods at this site:

Period.—The period of known floods prior to September 1967. This period does not necessarily correspond to that in which continuous records of discharge were obtained, but for many records it extends back to an earlier date.

Year.—The calendar year, in the period of known floods before September 1967, of the maximum stage or discharge.

Day.—The date of the maximum stage or discharge during the flood of September 1967.

Gage height and discharge.—Data in each pair of columns are associated with the year or date in the preceding column.

Recurrence interval.—The average interval of time in which the peak discharge of September 1967 can be expected to be equaled or exceeded once. Where the recurrence interval is greater than 50 years, the ratio of the peak discharge to the discharge of the 50-year flood is shown.

Table 13.--Summary of Flood Stages and Discharges

NO. ON FIGURE 38	PERMANENT STATION NUMBER	STREAM AND PLACE OF DETERMINATION	DRAINAGE AREA (SQ MI) 1	MAXIMUM PREVIOUSLY KNOWN				MAXIMUM SEPTEMBER 1967			
				PERIOD	YEAR	GAGE HEIGHT (FEET)	DISCHARGE (CFS)	DAY	GAGE HEIGHT (FEET)	DISCHARGE	
										CFS	RECURRENCE INTERVAL (YEARS)
				Lavaca River basin							
1	8-1640	Lavaca River near Edna, Tex.	887	1880-1967	1936	33.8	83,400	23	26.37	22,500	4
2	8-1645	Navidad River near Ganado, Tex.	1,116	1876-1967	1936	39.8	94,000	23	31.91	26,600	4
				Guadalupe River basin							
3	8-1697.5	Walnut Branch at Seguin, Tex.	5.46	--	--	--	--	21	6.08	1,030	--
4	8-1698.5	East Pecan Branch near Gonzales, Tex.	.24	1966-67	1966	6.37	54	22	8.91	165	--
5	8-1746	Peach Creek below Dilworth, Tex.	462	1840-1967	1940	35.3	a	22	28.87	10,200	3
6	--	Sandies Creek near Leesville, Tex.	47.4	--	--	--	--	22	--	3,920	3
7	8-1750	Sandies Creek near Westhoff, Tex.	560	1864-1967	1936	33.1	92,700	22	32.34	79,700	35
8	8-1758	Guadalupe River near Cuero, Tex.	4,877	1900-67	1936	44.33	a	23	36.56	61,500	10
9	8-1762	Irish Creek near Cuero, Tex.	15.5	--	--	--	--	21	7.86	4,650	--
10	8-1765	Guadalupe River at Victoria, Tex.	5,161	1833-1967	1936	31.22	179,000	21	30.67	70,000	14
11	8-1766	Threemile Creek near Cuero, Tex.	.48	--	--	--	--	21	11.71	1,140	--
12	8-1770	Coleto Creek near Schroeder, Tex.	365	1872-1967	1946	26.0	63,700	21	33.47	122,000	b1.73
13	8-1775	Coleto Creek near Victoria, Tex.	514	1875-1967	1946	31.64	89,000	22	37.0	236,000	b2.74
14	8-1888	Guadalupe River near Tivoli, Tex.	10,096	1869-1967	1936	11	a	22	13.7	a	--
				San Antonio River basin							
15	--	Medio Creek near Macdona, Tex.	47.9	--	--	--	--	22	--	2,640	3
16	8-1815	Medina River near San Antonio, Tex.	c1,317	1852-1967	d	55	a	22	23.56	5,480	--
17	8-1818	San Antonio River near Elmendorf, Tex.	1,743	1900-67	1946	61	a	22	35.25	15,000	--
18	8-1824	Calaveras Creek subwatershed No. 6 near Elmendorf, Tex.	7.01	1956-67	1957	--	e3,750	22	--	e1,500	--

See footnotes at end of table.

Table 13.--Summary of Flood Stages and Discharges--Continued

NO. ON FIGURE 38	PERMANENT STATION NUMBER	STREAM AND PLACE OF DETERMINATION	DRAINAGE AREA (SQ MI)	MAXIMUM PREVIOUSLY KNOWN				MAXIMUM SEPTEMBER 1967			
				PERIOD	YEAR	GAGE HEIGHT (FEET)	DISCHARGE (CFS)	DAY	GAGE HEIGHT (FEET)	DISCHARGE CFS	DISCHARGE RECURRENCE INTERVAL (YEARS)
		San Antonio River basin--Continued									
19	8-1825	Calaveras Creek near Elmendorf, Tex.	77.2	1860-1967	1946	35	a	21	19.99	3,720	--
20	8-1835	San Antonio River near Falls City, Tex.	2,113	1875-1967	1946	33.80	47,400	22	25.26	14,600	6
21	8-1850	Cibolo Creek at Selma, Tex.	274	1869-1967	1889	26	a	5	4.56	284	--
22	8-1860	Cibolo Creek near Falls City, Tex.	827	1890-1967	1913	35	35,000	22	33.39	25,300	9
23	8-1865	Ecleto Creek near Runge, Tex.	239	1903-67	1903	34	71,000	22	33.3	58,400	b2.24
24	--	Escondido Creek subwatershed No. 9 near Kenedy, Tex.	6.90	1958-67	1965	19.5	f 28	21	30.44	f 964	--
25	--	Escondido Creek subwatershed No. 8 near Kenedy, Tex.	3.95	1957-67	1957	23.4	f 31	21	31.5	f 3,240	--
26	--	Escondido Creek subwatershed No. 10 near Kenedy, Tex.	2.75	1955-67	1965	22.80	f 25	21	31.6	f 2,780	--
27	--	Escondido Creek subwatershed No. 6 near Kenedy, Tex.	2.29	1955-67	1960	29.80	f 31	21	33.10	f 2,870	--
28	--	Escondido Creek subwatershed No. 7 near Kenedy, Tex.	2.12	1956-67	1960	22.00	f 22	21	29.30	f 1,670	--
29	--	Escondido Creek subwatershed No. 5 near Kenedy, Tex.	1.48	1956-67	1960	27.60	f 26	21	30.70	f 1,490	--
30	--	Escondido Creek subwatershed No. 3 near Kenedy, Tex.	4.78	1956-67	1960	36.46	f 91	21	38.45	f 4,670	--
31	--	Escondido Creek subwatershed No. 4 near Kenedy, Tex.	6.24	1957-67	1960	28.30	f 103	21	32.0	f 6,830	--
32	8-1870	Escondido Creek subwatershed No. 1 near Kenedy, Tex.	3.29	1954-67	1960	--	e5,260	21	--	e 2,910	--
33	--	Escondido Creek subwatershed No. 2 near Kenedy, Tex.	2.69	1955-67	1960	25.40	f 40	21	29.32	f 1,400	--
34	8-1875	Escondido Creek at Kenedy, Tex.	72.4	1887-1967	1946	24.2	a	22	25.48	37,000	b3.82
35	8-1879	Escondido Creek subwatershed No. 11 near Kenedy, Tex.	8.43	1958-67	1965	--	d4,950	21	--	e18,000	--

See footnotes at end of table.

Table 13.--Summary of Flood Stages and Discharges--Continued

NO. ON FIGURE 38	PERMANENT STATION NUMBER	STREAM AND PLACE OF DETERMINATION	DRAINAGE AREA (SQ MI)	MAXIMUM PREVIOUSLY KNOWN				MAXIMUM SEPTEMBER 1967			
				PERIOD	YEAR	GAGE HEIGHT (FEET)	DISCHARGE (CFS)	DAY	GAGE HEIGHT (FEET)	DISCHARGE	
										CFS	RECURRENCE INTERVAL (YEARS)
		San Antonio River basin--Continued									
36	8-1884	Baugh Creek at Goliad, Tex.	3.02	1966-67	1966	5.50	360	21	7.73	1,000	--
37	8-1885	San Antonio River at Goliad, Tex.	3,921	1869-1967	g1942	44.9	33,800	23	53.7	138,000	b3.22
		Mission River basin									
38	--	Blanco Creek near Berclair, Tex.	70.3	--	--	--	--	22	--	38,600	b4.28
39	--	Toro Creek near Tuleta, Tex.	24.6	--	--	--	--	21	--	13,400	--
40	8-1893	Medio Creek near Beeville, Tex.	204	1914-67	1919	31	25,500	22	38.68	105,000	b6.00
41	8-1895	Mission River at Refugio, Tex.	690	1899-1967	1942	33.3	41,700	21	36.5	116,000	b3.17
		Aransas River basin									
42	--	Poesta Creek at Beeville, Tex.	46.5	--	--	--	--	21	--	20,800	b3.02
43	8-1896	Olmos Creek tributary near Skidmore, Tex.	.58	1966-67	1966	8.00	235	22	8.71	325	--
44	8-1897	Aransas River near Skidmore, Tex.	247	1914-67	1954	33	19,600	22	42.22	82,800	b4.23
45	--	Papalote Creek near Papalote, Tex.	99.2	--	--	--	--	22	--	56,400	b5.19
		Nueces River basin									
46	8-1940	Nueces River at Cotulla, Tex.	5,260	1879-1967	1935	32.4	82,600	25	16.61	7,050	--
47	8-1942	San Casimiro Creek near Freer, Tex.	469	1946-67	1954	26	a	23	24.6	43,200	--
48	8-1945	Nueces River near Tilden, Tex.	8,192	1902-67	1946	26.46	70,000	24	26.57	76,500	45
49	8-1945.5	Plant Creek near Tilden, Tex.	.36	1966-67	1967	8.31	60	22	10.06	220	--
50	8-1946	Nueces River at Simmons, Tex.	8,561	1875-1967	1919	43.5	75,800	25	43.21	72,000	--
51	8-2055	Frio River near Derby, Tex.	3,493	1860-1967	1932	29.45	230,000	23	8.72	3,880	--
52	8-2067	San Miguel Creek near Tilden, Tex.	793	1919-67	1942	32.6	a	22	25.99	13,700	4
53	8-2070	Frio River at Calliham, Tex.	5,491	1870-1967	1932	39.2	109,000	23	36.15	57,000	34

See footnotes at end of table.

Table 13.--Summary of Flood Stages and Discharges--Continued

NO. ON FIGURE 38	PERMANENT STATION NUMBER	STREAM AND PLACE OF DETERMINATION	DRAINAGE AREA (SQ MI)	MAXIMUM PREVIOUSLY KNOWN				MAXIMUM SEPTEMBER 1967			
				PERIOD	YEAR	GAGE HEIGHT (FEET)	DISCHARGE (CFS)	DAY	GAGE HEIGHT (FEET)	DISCHARGE CFS	DISCHARGE RECURRENCE INTERVAL (YEARS)
				Nueces River basin--Continued							
54	8-2072	Rutledge Hollow Creek near Poteet, Tex.	18.3	1966-67	1967	3.60	a	22	8.69	1,800	--
55	8-2077	Lucas Creek near Pleasanton, Tex.	32.8	1966-67	1967	8.97	475	22	12.97	2,970	8
56	8-2080	Atascosa River at Whitsett, Tex.	1,171	1881-1967	1919	41	106,000	23	41.3	121,000	b1.70
57	8-2100	Nueces River near Three Rivers, Tex.	15,600	1875-1967	1919	46	85,000	23	49.21	141,000	b1.76
58	--	Sulphur Creek near Three Rivers, Tex.	71.1	--	--	--	--	21	--	43,600	b4.57
59	--	Ramirena Creek near George West, Tex.	84.4	--	--	--	--	22	--	20,500	b2.04
60	8-2105	Lake Corpus Christi near Mathis, Tex.	16,656	1948-67	1964	94.05	h302,100	22	94.82	h320,000	--
61	8-2110	Nueces River near Mathis, Tex.	16,660	1888-1967	1919	40	59,000	24	47.7	138,000	--
				Oso Creek basin							
62	--	Oso Creek at Violet, Tex.	45.8	--	--	--	--	23	--	3,620	--
				Petronila Creek basin							
63	8-2115.5	Pintas Creek tributary near Banquete, Tex.	3.28	--	--	--	--	21	10.40	1,300	--
				San Fernando Creek basin							
64	8-2116	Hamon Creek near Freer, Tex.	.73	1965-67	1965	8.28	225	22	5.20	40	--
65	8-2118	San Diego Creek at Alice, Tex.	319	1928-67	1949	18.2	a	23	16.35	14,000	--
66	8-2118.5	Lake Alice at Alice, Tex.	150	1964-67	1965	196.75	h 3,270	22	198.00	h 4,150	--
67	8-2119	San Fernando Creek at Alice, Tex.	507	1949-67	1962	15.5	14,600	23	15.86	16,900	--
68	8-2123	Tranquitas Creek at Kingsville, Tex.	48.5	1965-67	1965	3.90	a	21	4.51	a	--
				Los Olmos Creek basin							
69	8-2124	Los Olmos Creek near Falfurrias, Tex.	480	1929-67	1951	15.0	a	24	11.79	3,380	--

See footnotes at end of table.

Table 13.--Summary of Flood Stages and Discharges--Continued

NO. ON FIGURE 38	PERMANENT STATION NUMBER	STREAM AND PLACE OF DETERMINATION	DRAINAGE AREA (SQ MI)	MAXIMUM PREVIOUSLY KNOWN				MAXIMUM SEPTEMBER 1967			
				PERIOD	YEAR	GAGE HEIGHT (FEET)	DISCHARGE (CFS)	DAY	GAGE HEIGHT (FEET)	DISCHARGE CFS	DISCHARGE RECURRENCE INTERVAL (YEARS)
				Palo Blanco Creek basin							
70	--	Palo Blanco Creek near Falfurrias, Tex.	343	--	--	--	--	--	--	16,600	--
				Rio Grande basin							
71	8-4596	Arroyo San Bartolo at Zapata, Tex.	.61	1966-67	1967	10.9	570	1	3.73	255	--
72	8-4612	International Falcon Reservoir	164,482	1953-67	1958	--	h3,490,600	i	303.22	h2,948,139	--
73	8-4613	Rio Grande below Falcon Dam, Tex.	164,482	1953-67	1958	308.11	48,900	j	--	k 9,540	--
74	8-4620	Rio Alamo at Ciudad Mier, Tamaulipas, Tex.	1,692	1753-1967	1948	33.56	144,800	22	26.90	86,500	--
75	--	Rio San Juan at Marte R. Gomez Dam, Tamaulipas, Mex.	13,429	--	--	--	--	25	--	k 160,000	--
76	8-4642	Rio San Juan at Camargo, Tamaulipas, Mex.	13,601	1954-67	1958	33.53	49,800	25	42.03	115,000	--
77	8-4647	Rio Grande at Ft. Ringgold, Rio Grande City, Tex.	180,396	1865-1967	1865	--	590,000	23	61.40	220,000	--
78	8-4661	Rio Grande tributary near Rio Grande City, Tex.	3.37	1966-67	1966	4.61	100	22	4.79	125	--
79	8-4662	Rio Grande tributary near Sullivan City, Tex.	2.47	1966-67	1967	7.27	40	3	7.42	47	--
80	8-4680	Mission Branch Floodway south of McAllen, Tex.	--	1926-67	1932	100.82	38,710	26	104.96	83,300	-- --
81	8-4686	Anzalduas Canal near Reynosa, Tamaulipas, Mex.	--	1952-67	1957	16.01	10,950	1	--	k 5,650	--
82	8-4692	Rio Grande below Anzalduas Dam, Tex.	182,138	1952-67	1958	28.87	63,920	24	30.51	131,000	--
83	8-4700	Hackney Branch Floodway south of McAllen, Tex.	--	1926-67	1932	101.81	29,120	26	106.22	43,300	--
84	8-4701	North Floodway west of Mercedes, Tex.	--	1933-67	1958	69.30	37,200	26	72.45	61,200	--
85	8-4702	North Floodway near Sebastian, Tex.	--	1933-67	1958	45.07	39,300	26	46.67	59,200	--

See footnotes at end of table.

Table 13.--Summary of Flood Stages and Discharges--Continued

NO. ON FIGURE 38	PERMANENT STATION NUMBER	STREAM AND PLACE OF DETERMINATION	DRAINAGE AREA (SQ MI)	MAXIMUM PREVIOUSLY KNOWN				MAXIMUM SEPTEMBER 1967			
				PERIOD	YEAR	GAGE HEIGHT (FEET)	DISCHARGE (CFS)	DAY	GAGE HEIGHT (FEET)	DISCHARGE	
										CFS	RECURRENCE INTERVAL (YEARS)
			Rio Grande basin--Continued								
86	8-4703	Arroyo Colorado Floodway, south of Mercedes, Tex.	--	--	--	--	--	26	15.94	60,100	--
87	8-4704	Arroyo Colorado Floodway south of Harlingen, Tex.	--	1933-67	1958	33.68	19,700	26	43.85	55,400	--
88	8-4725	Retamal Canal near Rio Bravo, Tamaulipas, Mex.	--	--	--	--	--	--	--	--	--
89	8-4733	Rio Grande near Progreso, Tex.	182,173	1954-67	1958	23.69	19,900	26	24.84	60,700	--
90	8-4733.5	San Rafael Floodway near Progreso, Tamaulipas, Mex.	--	--	--	--	--	--	--	--	--
91	8-4737	Rio Grande near San Benito, Tex.	182,187	1954-67	1958	60.07	13,600	29	61.05	25,000	--
92	8-4741.7	Floodway No. 2 near Matamoros, Tamaulipas, Mex.	--	--	--	--	--	--	--	--	--
93	8-4750	Rio Grande near Brownsville, Tex.	182,215	1934-67	1945	31.48	31,700	30	m31.08	15,900	--

[a] Discharge not determined.
[b] Ratio of peak discharge to 50-year flood.
[c] Of which 634 square miles is above dam forming Medina Lake.
[d] Probably occurred in July 1869.
[e] Peak inflow computed from outflow and change in reservoir contents adjusted for rainfall on pool surface during time of peak inflow.
[f] Peak outflow from reservoir.
[g] The maximum stage since about 1800 occurred in 1869 and was several feet higher than flood of July 9, 1942.
[h] Contents in acre-feet.
[i] Occurred on October 8.
[j] Occurred on October 19.
[k] Maximum daily.
[m] Occurred at different time than peak discharge.

Station Data (Table 14)

The main purpose of this flood report is to present peak flood discharges and stages and daily discharge data in sufficient detail for the hydrologist who needs preliminary data for design purposes. More detailed information on stages and discharges will be published later in the Water-Supply Paper series of the U.S. Geological Survey. The hydrologist who needs more detailed data may find them in the Austin District office and the San Antonio Subdistrict office of the Geological Survey.

The data in Table 14 consist of a description of the station or site showing the daily discharges at the regular gaging station for September and October 1967 and daily contents for reservoir stations for the same period.

The station description gives information relative to the location of the gage or miscellaneous site, size of the drainage basin above the gage, type of gage-height record obtained during the flood period, datum of gage, definition of the stage-discharge relation, maximum stage and disharge during September 1967 and previous maximum during the period of record, maximum data for floods outside the period of record, effect of regulation and diversion, and other pertinent general information.

The table of daily mean discharge gives data for the 2-month period, September-October 1967, to cover not only the period of major flooding but a sufficient length of time to show discharges during antecedent and recession periods. The monthly figures show the monthly mean discharge, in cubic feet per second, and the volume of monthly runoff, in acre-feet. Monthly figures have not been adjusted for any change in contents of upstream reservoirs.

The operation of a stream-gaging station consists principally of the measurement of stage and discharge and the definition of the stage-discharge relation, from which discharge can be calculated for a given stage. The development of a stage-discharge relation is based upon current-meter measurements throughout the range of stage experienced. Because of the record-breaking magnitude of the floods in September 1967, it was not possible to obtain current-meter measurements at or near the peak stage at many of the gaging stations. In one case, the gage and measuring facility was destroyed; in others, water was so high that gages, bridges, and other measuring facilities were under water to the extent that it was impossible to get to the site to make a current-meter measurement. Because of the advance warning available, field crews were stationed at strategic locations to obtain current-meter measurements when and where possible.

For many of the inaccessible gaging stations and for ungaged sites where peak discharge data were desired, peak discharges were obtained by measurements using slope area methods, contracted openings, flow over highway embankments, flow over spillways, and flow through culverts, or a combination of these methods. These indirect methods are based on channel geometry and high-water profiles obtained by field survey and are computed by established hydraulic principles. They are indirect only in the sense that the data are collected subsequent to the passage of the peak discharge. A complete description of the indirect measurement methods used by the U.S. Geological Survey is given in book 3, chapters A1, A2, A3, A4, and A5 of *Techniques of Water-Resources Investigations of the U.S. Geological Survey.*

LAVACA RIVER BASIN

(1) 8-1640. Lavaca River near Edna, Tex.

Location.--Lat 28°57'35", long 96°41'10", at downstream side near center of upstream bridge of two bridges on U.S. Highway 59, 660 ft upstream from Texas and New Orleans Railroad Co. bridge, and 2.8 miles southwest of Edna, Jackson County.

Drainage area.--887 sq mi.

Gage-height record.--Digital-recorder tape punched at 30-minute intervals except Sept. 13 to Oct. 24, when water-stage recorder graph was used. Datum of gage is 13.88 ft above mean sea level, datum of 1929 (levels by Corps of Engineers).

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 22,500 cfs 0230 hours Sept. 23 (gage height, 26.37 ft).
1938 to August 1967: Discharge, 73,000 cfs July 1, 1940 (gage height, 32.51 ft).
Since at least 1880: Discharge, 83,400 cfs May 25, 1936 (gage height, 33.8 ft).

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	8.0	149	11	6.7	131	21	6,200	263
2	9.0	133	12	5.7	101	22	17,200	218
3	11	122	13	5.1	85	23	19,800	190
4	12	115	14	4.2	85	24	9,320	164
5	15	104	15	4.2	422	25	1,710	148
6	14	93	16	3.8	4,910	26	473	130
7	13	85	17	3.2	9,710	27	343	119
8	10	708	18	3.2	5,780	28	259	110
9	8.8	555	19	3.6	576	29	207	104
10	7.4	202	20	715	346	30	174	104
						31	----------	106

Monthly mean discharge, in cubic feet per second	1,885	841
Runoff, in acre-feet	112,200	51,710

(2) 8-1645. Navidad River near Ganado, Tex.

Location.--Lat 29°01'32", long 96°33'08", at downstream side near center of upstream bridge of two bridges on U.S. Highway 59, 170 ft upstream from Texas and New Orleans Railroad Co. bridge, 0.2 mile downstream from Sandy Creek, and 2.5 miles southwest of Ganado, Jackson County.

Drainage area.--1,116 sq mi.

Gage-height record.--Digital-recorder tape punched at 30-minute intervals except Sept. 1-5, Sept. 9 to Oct. 25, when water-stage recorder graph was used. Datum of gage is 13.62 ft above mean sea level, datum of 1929 (levels by Corps of Engineers).

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 26,600 cfs 0800 hours Sept. 23 (gage height, 31.91 ft).
1938 to August 1967: Discharge, 64,500 cfs July 2, Nov. 26, 1940; gage height, 36.54 ft, from floodmark, July 2, 1940.
Since at least 1876: Discharge, 94,000 cfs May 27, 1936 (gage height, 39.8 ft), from rating curve extended above 57,000 cfs.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	114	398	11	90	251	21	8,790	600
2	76	315	12	86	171	22	18,800	410
3	69	260	13	88	138	23	26,000	310
4	72	221	14	103	117	24	22,500	240
5	70	187	15	93	276	25	16,000	187
6	80	153	16	92	4,060	26	7,720	155
7	99	135	17	113	7,740	27	2,260	133
8	117	282	18	195	7,470	28	1,160	119
9	107	438	19	184	3,950	29	750	108
10	84	357	20	1,040	1,100	30	521	101
						31	----------	99
Monthly mean discharge, in cubic feet per second							3,582	983
Runoff, in acre-feet							213,200	60,460

GUADALUPE RIVER BASIN

(3) 8-1697.5. Walnut Branch at Seguin, Tex.

(Crest-stage station)

Location.--Lat 29°34'47", long 97°58'46", at culvert on U.S. Highway 90 (west Kingsbury Street) at Seguin, Guadalupe County, and 2.5 miles upstream from mouth.

Drainage area.--5.46 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Maximum discharge determined by flow-through-culverts measurement.

Maxima.--September-October 1967: Discharge, 1030 cfs Sept. 21 (gage height, 6.08 ft).
1966 to August 1967: Gage height, 3.53 ft July 14, 1967.

(4) 8-1698.5. East Pecan Branch near Gonzales, Tex.

(Crest-stage station)

Location.--Lat 29°29'58", long 97°31'36", at culvert on U.S. Highway 90-A, 0.6 mile west of Farm Road 2091, and 3.7 miles west of Gonzales, Gonzales County.

Drainage area.--0.24 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder.

Discharge record.--Discharge determined by computed culvert rating.

Maxima.--September-October 1967: Discharge, 165 cfs 1320 hours Sept. 22 (gage height, 8.91 ft).
1965 to August 1967: Discharge, 73 cfs May 4, 1966, (gage height, 6.88 ft).

(5) 8-1746. Peach Creek below Dilworth, Tex.

Location.--Lat 29°28'26", long 97°18'59", on right bank at downstream side of bridge on U.S. Highway 90-A, 1.3 miles downstream from Mitchell Creek, 3.1 miles southwest of Dilworth, Gonzales County, 6.4 miles upstream from mouth, and 8.5 miles southeast of Gonzales.

Drainage area.--462 sq mi.

Gage-height record.--Water-stage recorder graph except Sept. 23-26, for which partly estimated graph was drawn. Datum of gage is 213.53 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 10,200 cfs 1100 hours Sept. 22 (gage height, 28.87 ft).
1959 to August 1967: Discharge, 23,800 cfs Oct. 19, 1960 (gage height, 31.28 ft).
Highest stage since at least 1840, 35.3 ft in June 1940.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0.14	7.8	11	0.68	11	21	3,130	10
2	.16	6.8	12	2.2	7.3	22	7,630	7.7
3	.11	6.1	13	2.0	5.7	23	2,020	6.2
4	.06	5.6	14	.80	4.8	24	160	5.4
5	.04	4.4	15	.65	45	25	70	4.7
6	1.3	4.4	16	1.4	555	26	36	4.3
7	1.0	5.6	17	2.9	348	27	22	4.1
8	.74	22	18	13	66	28	14	3.6
9	.68	49	19	4.4	28	29	11	3.4
10	.68	22	20	403	15	30	8.9	4.1
						31	----------	4.2
Monthly mean discharge, in cubic feet per second							451	41.2
Runoff, in acre-feet							26,850	2,530

(6) Sandies Creek at Leesville, Tex.

(Miscellaneous site)

Location.--Lat 29°23'16", long 97°44'54", just downstream from bridge on State Highway 80, 1.3 miles south of Leesville, Gonzales County.

Drainage area.--47.4 sq mi.

Maximum.--September-October 1967: Discharge, 3,920 cfs Sept. 22, from slope-area measurement.

(7) 8-1750. Sandies Creek near Westhoff, Tex.

Location.--Lat 29°12'54", long 97°26'57", on left bank 100 ft downstream from bridge on county highway, 1.9 miles upstream from Birds Creek, and 2.0 miles northeast of Westhoff, DeWitt County.

Drainage area.--560 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 178.27 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge record defined by current-meter measurements below 21,000 cfs and extended above as explained below.

Maxima.--September-October 1967: Discharge, 79,700 cfs 1600 hours Sept. 22 (gage height, 32.34 ft).
1930-34, 1959 to August 1967: Discharge, 20,700 cfs June 19, 1961 (gage height, 26.64 ft).
Since at least 1864: Discharge, 92,700 cfs July 2, 1936 (gage height, 33.1 ft, from floodmark), on basis of slope-area measurement of peak flow.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	3.8	29	11	9.0	64	21	11,100	39
2	92	26	12	6.6	35	22	67,900	29
3	267	24	13	5.0	24	23	31,800	24
4	366	22	14	4.1	20	24	5,570	21
5	168	21	15	3.6	383	25	1,340	18
6	93	20	16	33	1,770	26	243	17
7	145	25	17	500	2,180	27	95	15
8	41	48	18	599	879	28	57	15
9	26	221	19	215	197	29	42	14
10	16	135	20	1,030	68	30	34	14
						31	----------	14
Monthly mean discharge, in cubic feet per second							4,060	207
Runoff, in acre-feet							241,600	12,720

(8) 8-1758. Guadalupe River at Cuero, Tex.

Location.--Lat 29°03'57", long 97°19'16", on left bank at downstream side of bridge on U.S. Highways 77-A, 87, and 183, 2.1 miles upstream from Gohlke Creek, 2.4 miles southwest of Cuero, DeWitt County, 4.2 miles downstream from Sandies Creek, and 7.1 miles downstream from Central Power and Light Co. powerplant dam.

Drainage area.--4,877 sq mi.

Gage-height record.--Digital-recorder tape punched at 60-minute intervals except Sept. 18-24, Oct. 3, 14, when water-stage recorder graph was used. Datum of gage is 128.64 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 61,500 cfs 1000 hours Sept. 23 (gage height, 36.56 ft).
1902-6, 1916-18, 1920-35, 1964 to August 1967: Discharge, 101,000 cfs May 30, 1929 (gage height, 35.2 ft, at site 5.0 miles downstream and at datum 3.19 ft lower), from rating curve extended above 45,000 cfs.
Highest flood since at least 1900, 44.3 ft July 2, 1936.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	263	1,070	11	642	1,520	21	22,300	1,300
2	312	1,030	12	651	1,170	22	53,400	1,230
3	677	1,060	13	650	1,070	23	59,500	1,150
4	841	1,040	14	659	1,020	24	45,600	1,190
5	805	1,010	15	667	2,690	25	31,900	1,100
6	792	977	16	650	7,870	26	21,100	1,080
7	786	982	17	1,280	6,510	27	5,320	1,060
8	631	1,260	18	1,790	6,330	28	1,720	1,040
9	604	1,390	19	1,570	3,250	29	1,420	1,030
10	618	2,100	20	3,030	1,540	30	1,220	1,020
						31	----------	1,050
Monthly mean discharge, in cubic feet per second							8,713	1,843
Runoff, in acre-feet							518,500	113,300

GUADALUPE RIVER BASIN

(9) 8-1762. Irish Creek near Cuero, Tex.

(Crest-stage station)

Location.--Lat 29°08'02", long 97°12'10", at downstream side of bridge on Farm Road 1447, 6.2 miles northeast of Cuero, DeWitt County, and 8.4 miles upstream from mouth.

Drainage area.--15.5 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Maximum discharge determined by flow-over-road and flow-through-culverts measurements.

Maxima.--September-October 1967: Discharge, 4,650 cfs Sept. 21 (gage height, 7.86 ft).
1966 to August 1967: Gage height, 2.21 ft Aug. 22, 1967.

(10) 8-1765. Guadalupe River at Victoria, Tex.

Location.--Lat 28°47'35", long 97°00'45", on left bank just upstream from pier of upstream bridge of two bridges on U.S. Highway 59 in Victoria, Victoria County, 1,300 ft upstream from Southern Pacific Railroad Co. bridge, and 15 miles upstream from Coleto Creek.

Drainage area.--5,161 sq mi.

Gage-height record.--Digital-recorder tape punched at 60-minute intervals except Oct. 26-30, when water-stage recorder graph was used. Datum of gage is 29.15 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 70,000 cfs 1700 hours Sept. 21 (gage height, 30.67 ft).
1934 to August 1967: Discharge, 179,000 cfs July 3, 1936 (gage height, 31.22 ft).
Highest flood since at least 1833, that of July 3, 1936.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	287	1,600	11	564	1,970	21	34,500	1,660
2	261	1,460	12	584	1,440	22	35,400	1,470
3	315	1,410	13	591	1,260	23	41,400	1,390
4	627	1,350	14	591	1,270	24	51,200	1,320
5	819	1,310	15	600	2,540	25	42,500	1,310
6	718	1,250	16	607	10,500	26	28,300	1,230
7	756	1,220	17	607	8,680	27	20,600	1,210
8	699	1,410	18	1,330	6,480	28	6,090	1,180
9	579	1,430	19	1,660	5,370	29	2,300	1,160
10	559	1,630	20	3,220	2,580	30	1,850	1,160
						31	----------	1,130
Monthly mean discharge, in cubic feet per second							9,337	2,270
Runoff, in acre-feet							555,600	139,600

(11) 8-1766. Three Mile Creek near Cuero, Tex.

(Crest-stage station)

Location.--Lat 29°02'00", long 97°20'52", 23 ft upstream from culvert on Farm Road 2718, and 5.2 miles southwest of Cuero, DeWitt County.

Drainage area.--0.48 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Maximum discharge determined by flow-over-road and flow-through-culvert measurements.

Maxima.--September-October 1967: Discharge, 1,140 cfs Sept. 21 (gage height, 11.71 ft).
1966 to August 1967: Discharge, 24 cfs May 21, 1967 (gage height, 6.72 ft).

(12) 8-1770. Coleto Creek near Schroeder, Tex.

Location.--Lat 28°49'55", long 97°11'09", on downstream side of left abutment of bridge on Farm Road 622 at Goliad-Victoria County line, 2.5 miles northeast of Schroeder, Goliad County, 4.2 miles downstream from confluence of Twelvemile and Fifteenmile Creeks, 9.1 miles upstream from Perdido Creek, and 11.1 miles west of Victoria.

Drainage area.--365 sq mi.

Gage-height record.--Water-stage recorder graph until Sept. 21 when gage destroyed. Gage heights subsequently based on relationship curve between staff gage at recording site and staff gages 0.7 mile downstream. Datum of gage is 87.59 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 28,000 cfs and by slope-area measurement of 122,000 cfs.

Maxima.--September-October 1967: Discharge, 122,000 cfs 2100 hours Sept. 21 (gage height, 33.47 ft).
1930-33, 1952 to August 1967: Discharge, 39,000 cfs Apr. 28, 1957 (gage height, 21.00 ft).
From at least 1872 to August 1967: Gage height, 26.0 ft Oct. 16, 1946, present site and datum.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	1.5	105	11	3.0	85	21	74,800	106
2	.58	92	12	1.4	62	22	56,200	102
3	2.0	93	13	.18	57	23	4,370	96
4	3.0	88	14	.15	56	24	890	92
5	4.2	84	15	.15	12,400	25	324	89
6	9.5	81	16	.15	9,270	26	236	88
7	29	83	17	.15	914	27	217	85
8	18	487	18	.15	280	28	210	73
9	10	330	19	.44	168	29	183	73
10	7.0	86	20	3,060	118	30	109	78
						31	----------	73
Monthly mean discharge, in cubic feet per second							4,690	835
Runoff, in acre-feet							279,100	51,360

GUADALUPE RIVER BASIN

(13) 8-1775. Coleto Creek near Victoria, Tex.

(Gaging station, discontinued 1954)

Location.--Lat 28°43', long 97°08', near left bank on downstream side of bridge on U.S. Highway 59, 100 ft upstream from Texas and New Orleans Railroad bridge, 1.1 miles donwstream from Perdido Creek, and 9.4 miles southwest of Victoria, Victoria County.

Drainage area.--514 sq mi.

Maxima.--September-October 1967: Discharge, 236,000 cfs Sept. 22 (gage height, 37.0 ft), from slope-area measurement.
1939-54: Discharge, 89,000 cfs Oct. 16, 1946 (gage height, 31.64 ft), from rating curve extended above 40,000 cfs on basis of slope-area measurement of 89,000 cfs.
Highest flood from at least 1875 to August 1967, that of Oct. 16, 1946.

(14) 8-1888. Guadalupe River near Tivoli, Tex.

(Stage only)

Location.--Lat 28°30'20", long 96°53'04", on right bank at Diversion Dam and Salt Water Barrier, 550 ft downstream from Calhoun County Irrigation Canal intake, 0.4 mile downstream from San Antonio River, 3.5 miles north of Tivoli, Refugio County, and 10.2 miles upstream from mouth.

Drainage area.--10,096 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 0.04 ft above mean sea level, datum of 1929.

Maxima.--September-October 1967: Gage height, 13.7 ft 1800 hours Sept. 22
1965 to August 1967: Gage height, 8.0 ft May 7, 1966.
Since at least 1936 to 1965: Gage height, 11 ft in July 1936. Levees along the Navigation Canal from San Antonio Bay to Victoria which were built in 1961 decreased the flood plain materially.

Maximum daily gage height, in feet, upstream from Salt Water Barrier, 1967

Day	September	October	Day	September	October	Day	September	October
1	4.0	8.5	11	5.0	7.3	21	9.9	7.6
2	4.0	8.2	12	4.4	7.3	22	13.7	7.4
3	3.9	7.9	13	4.1	7.1	23	13.6	7.1
4	4.0	7.7	14	3.6	7.0	24	12.2	6.9
5	5.3	7.5	15	4.1	7.0	25	12.2	6.8
6	5.4	7.4	16	3.6	7.4	26	11.7	6.6
7	5.4	7.4	17	3.6	7.7	27	10.9	6.5
8	5.6	7.4	18	3.8	7.8	28	10.2	6.4
9	5.5	7.4	19	5.3	7.8	29	9.6	6.4
10	5.0	7.3	20	7.7	7.8	30	9.0	6.5
						31	----------	6.2

SAN ANTONIO RIVER BASIN

(15) Medio Creek near Macdona, Tex.

(Miscellaneous site)

Location.--Lat 29°19'40", long 98°38'19", at bridge on Farm Road 2536, 3.3 miles east of Macdona, Bexar County.

Drainage area.--47.9 sq mi.

Maximum.--September-October 1967: Discharge, 2,640 cfs Sept. 22, from flow-through-culvert measurement.

(16) 8-1815. Medina River near San Antonio, Tex.

Location.--Lat 29°15'15", long 98°28'20", near left bank on downstream side of pier of upstream bridge of two bridges on U.S. Highway 281, 6.8 miles upstream from mouth, and 7 miles south of San Antonio, Bexar County.

Drainage area.--1,317 sq mi (634 sq mi is above dam forming Medina Lake).

Gage-height record.--Digital-recorder tape punched at 30-minute intervals. Datum of gage is 439.0 ft above mean sea level (levels by Corps of Engineers).

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 5,480 cfs 1030 hours Sept. 22 (gage height, 23.56 ft).

1929-30, 1939 to August 1967: Discharge, 31,800 cfs Aug. 29, 1946; maximum gage height, 41.57 ft Sept. 27, 1946 (backwater from San Antonio River).

Maximum stage known, 55 ft sometime prior to construction of Medina Dam in 1913.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	35	118	11	38	76	21	825	73
2	37	101	12	38	76	22	4,670	71
3	109	97	13	36	74	23	2,780	71
4	173	94	14	36	73	24	980	72
5	381	90	15	36	99	25	670	73
6	581	86	16	62	119	26	378	72
7	107	84	17	59	93	27	304	71
8	61	81	18	47	85	28	187	69
9	51	78	19	44	79	29	126	67
10	42	77	20	64	75	30	112	86
						31	----------	81
Monthly mean discharge, in cubic feet per second							436	82.4
Runoff, in acre-feet							25,920	5,070

SAN ANTONIO RIVER BASIN

(17) 8-1818. San Antonio River near Elmendorf, Tex.

Location.--Lat 29°14'15", long 98°21'43", on left bank 270 ft to left of low-water edge, 2,000 ft downstream from Braunig Plant Lake, and 2.2 miles southwest of Elmendorf, Bexar County.

Drainage area.--1,743 sq mi.

Gage-height record.--Water-stage recorder graph Sept. 1-30. Digital-recorder tape punched at 30-minute intervals Oct. 1-31. Datum of gage is 392.50 ft above mean sea level, datum of 1929, San Antonio supplementary adjustment of 1953.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 15,000 cfs 1200 hours Sept. 22 (gage height, 35.25 ft).
1962 to August 1967: Discharge, 15,100 cfs May 18, 1965 (gage height, 35.34 ft).
Since at least 1900: Flood in September 1946 reached a stage of 61 ft.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	286	285	11	196	244	21	3,230	232
2	295	275	12	208	240	22	12,200	219
3	789	276	13	192	238	23	6,200	223
4	633	279	14	180	229	24	2,000	232
5	587	272	15	197	404	25	1,100	221
6	963	264	16	1,230	794	26	700	226
7	334	255	17	375	331	27	540	224
8	264	265	18	282	269	28	410	213
9	235	244	19	258	251	29	320	207
10	208	247	20	419	242	30	300	416
						31	-----	315
Monthly mean discharge, in cubic feet per second							1,171	278
Runoff, in acre-feet							69,680	17,120

(18) 8-1824. Calaveras Creek subwatershed No. 6 near Elmendorf, Tex.

Location.--Lat 29°22'53", long 98°17'34", near center of dam on Chupaderas Creek, tributary to Calaveras Creek, 0.4 mile north of Sayer, 9.1 miles north of Elmendorf, Bexar County, and 9.2 miles upstream from mouth.

Drainage area.--7.01 sq mi.

Gage-height record.--Water-stage recorder graph except Sept. 20-22. Graph drawn on basis of floodmark, staff-gage reading, and rainfall records. Datum of gage is 516.06 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Inflow computed from change in contents, adjusted for outflow. Outflow defined by current-meter measurements.

Maxima.--September-October 1967: Outflow, 40.2 cfs 0630 to 1230 hours Sept. 22; gage height, 24.60 ft 0815 hours Sept. 22. Inflow, 1,500 cfs (average for 5-minute interval) 2050 to 2055 hours Sept. 22. Inflow computed from outflow and change in reservoir contents adjusted for rainfall on pool surface during time of peak inflow. Contents, 386 acre-feet 0700 to 0945 hours Sept. 22.

1956 to August 1967: Outflow, 46.4 cfs Sept. 25, 1957 (gage height, 30.57 ft). Inflow, 3,750 cfs (average for 5-minute interval) Sept. 25, 1957. Inflow computed from outflow and change in reservoir contents, adjusted for rainfall on pool surface during time of peak inflow. Contents, 1,070 acre-ft Sept. 25, 1957.

Remarks.--Records given herein represent daily outflow from pool determined from stage-discharge relation for outlet structure. Pool is formed by earth-fill dam; dam completed Dec. 15, 1956. Outlet structure is a 36-inch square concrete drop inlet connected to a 17-inch concrete outlet pipe. Top of drop inlet is at gage height 18.0 ft; bottom of four 8- by 8-inch uncontrolled openings at 14.80 ft; right emergency spillway at 34.3 ft, left emergency spillway at 34.5 ft. There is a sluice gate at end of an 8-inch pipe which connects to lower end of drop inlet box at gage height 8.52 ft. Pool capacity, 1,650 acre-ft at spillway crest, 98 acre-ft at top of drop inlet, and 8.0 acre-ft at sluice gate. Capacity based on survey made June 26, 1960. There are 2 recording rain gages; 1 at the gaging station and 1 in basin.

Contents, in acre-feet, at 2400 hours, daily computed inflow and outflow, in cubic feet per second, on indicated day, 1967

Day	September			October			Day	September			October		
	Contents	Inflow	Outflow	Contents	Inflow	Outflow		Contents	Inflow	Outflow	Contents	Inflow	Outflow
1	0	0	0	49.6	0	0.10	16	0	0	0	46.9	0.11	0
2	0	0	0	49.2	0	.01	17	0	0	0	46.5	0	0
3	0	0	0	49.0	.01	0	18	0	0	0	46.0	0	0
4	0	0	0	49.4	.31	0	19	0	0	0	45.6	0	0
5	0	0	0	49.2	0	0	20	8.9	3.7	0	45.3	0	0
6	0	0	0	48.8	0	0	21	279	144	8.2	44.9	0	0
7	0	0	0	48.6	.02	0	22	343	73.6	39.9	44.6	0	0
8	0	0	0	48.2	0	0	23	258	0	38.7	44.3	0	0
9	0	0	0	47.8	0	0	24	184	0	36.6	43.9	0	0
10	0	0	0	47.3	0	0	25	119	0	33.3	43.5	0	0
11	0	0	0	47.0	0	0	26	80.6	0	22.0	43.2	0	0
12	0	0	0	46.6	0	0	27	60.3	0	9.9	42.7	0	0
13	0	0	0	46.2	0	0	28	53.3	0	3.7	42.4	0	0
14	0	0	0	45.9	0	0	29	51.2	0	.94	42.2	0	0
15	0	0	0	47.0	.62	0	30	50.2	0	.36	42.3	.19	0
							31	--	--	--	41.9	0	0
Mean, in cubic feet per second								--	7.38	6.45	--	0.041	0.004
Runoff, in acre-feet								--	439	384	--	2.5	0.22
Change in contents								+50.2	--	--	-8.3	--	--

(19) 8-1825. Calaveras Creek near Elmendorf, Tex.

Location.--Lat 29°15'38", long 98°17'34", near center of span at downstream side of upstream bridge of two bridges on U.S. Highway 181, 2.5 miles east of Elmendorf, Bexar County, 5 miles upstream from mouth, and 9 miles southeast from city limits of San Antonio.

Drainage area.--77.2 sq mi.

Gage-height record.--Water-stage recorder graph except Oct. 16-17, when graph was reconstructed on basis of record for part of day, one wire-weight gage reading, and shape of normal recession.
Datum of gage is 406.45 ft above mean sea level, datum of 1929, supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 3,720 cfs 2400 hours Sept. 21 (gage height, 19.99 ft).
1954 to August 1967: Discharge, 5,310 cfs Sept. 25, 1957 (gage height, 21.83 ft).
Highest stage known since at least 1860, 35 ft Sept. 29, 1946, from information by local residents.

Remarks.--Station operated as part of the Calaveras Creek hydrologic program to evaluate rainfall-runoff relation and the effects of floodwater-retarding structures. Flow from 37.1 sq mi above station was partly controlled by 9 floodwater-retarding structures with a total combined capacity of 12,040 acre-ft below the flood-spillway crests, of which 10,670 acre-ft is floodwater-retarding capacity and 1,370 acre-ft is sediment-pool capacity. The capacity in these pools allocated to sediment storage will be used for conservation storage until eliminated by sedimentation. There are 2 recording and 9 nonrecording rain gages in the basin above station.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0	1.0	11	0	0	21	412	0
2	0	0	12	0	0	22	1,370	0
3	0	0	13	0	0	23	212	0
4	0	3.1	14	0	0	24	160	0
5	0	.47	15	.98	6.1	25	108	0
6	0	0	16	.01	22	26	63	0
7	0	.20	17	16	.07	27	27	0
8	0	.51	18	.03	0	28	17	0
9	0	0	19	0	0	29	8.3	0
10	0	0	20	53	0	30	3.0	0
						31	----------	0
Monthly mean discharge, in cubic feet per second							81.7	1.08
Runoff, in acre-feet							4,860	66

(20) 8-1835. San Antonio River near Falls City, Tex.

Location.--Lat 28°57'05", long 98°03'50", on left bank 23 ft downstream from bridge on Farm Road 791, 0.9 mile upstream for Scared Dog Creek, and 3.6 miles southwest of Falls City, Karnes County.

Drainage area.--2,113 sq mi.

Gage-height record.--Water-stage recorder graph Sept. 1 to Oct. 5. Digital-recorder tape punched at 60-minute intervals Oct. 6-31. Datum of gage is 285.49 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 14,600 cfs 0400 hours Sept. 22 (gage height, 25.26 ft).
1925 to August 1967: Discharge, 47,400 cfs Sept. 29, 1946 (gage height, 33.80 ft, from floodmark).
Highest flood since at least 1875, that of Sept. 29, 1946. Flood in October 1913 reached a stage of 28.4 ft, from floodmark.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	160	405	11	198	283	21	6,480	279
2	225	375	12	164	281	22	12,900	270
3	262	350	13	139	276	23	9,450	256
4	487	345	14	124	272	24	9,080	244
5	965	415	15	114	496	25	6,380	252
6	644	354	16	292	353	26	2,970	253
7	1,030	355	17	798	849	27	1,300	241
8	650	451	18	709	582	28	813	244
9	325	316	19	345	339	29	645	224
10	238	294	20	2,400	298	30	478	224
						31	----------	242
Monthly mean discharge, in cubic feet per second							2,026	337
Runoff, in acre-feet							120,500	20,700

(21) 8-1850. Cibolo Creek at Selma, Tex.

Location.--Lat 29°35'38", long 98°18'40", on right bank 0.6 mile downstream from Missouri-Kansas-Texas Railroad Co. bridge, and 0.9 mile upstream from bridge on U.S. Highway 81 at Selma, Bexar County.

Drainage area.--274 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 728.34 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 284 cfs 0800 hours Sept. 5 (gage height, 4.56 ft).
1946 to August 1967: Discharge, 49,200 cfs May 3, 1958 (gage height, 21.7 ft, from floodmark), from rating curve extended above 16,000 cfs on basis of slope-area measurement of 36,400 cfs.
Since at least 1869: Gage height, 26 ft in 1889, stage of 1913 flood unknown.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0	--	11	0	--	21	0.54	--
2	0	--	12	0	--	22	28	--
3	0	--	13	0	--	23	.50	--
4	91	--	14	0	--	24	.10	--
5	90	--	15	0	--	25	.06	--
6	4.2	--	16	0	--	26	.03	--
7	.09	--	17	0	--	27	.01	--
8	0	--	18	0	--	28	0	--
9	0	--	19	0	--	29	0	--
10	0	--	20	0	--	30	0	--
						31	----------	--
Monthly mean discharge, in cubic feet per second							7.15	0
Runoff, in acre-feet							426	0

(22) 8-1860. Cibolo Creek near Falls City, Tex.

Location.--Lat 29°00'50", long 97°55'48", on right bank at downstream side of pier of bridge on State Highway 123, 5.5 miles northeast of Falls City, Karnes County, and 9 miles upstream from mouth.

Drainage area.--827 sq mi.

Gage-height record.--Digital-recorder tape punched at 30-minute intervals. Datum of gage is 264.28 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 25,300 cfs 0500 hours Sept. 22 (gage height, 33.39 ft).
1930 to August 1967: Discharge, 33,600 cfs July 6, 1942 (gage height, 34.45 ft).
Since at least 1890: Gage height, 35 ft in October 1913 (discharge, about 35,000 cfs).

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	6.3	70	11	19	47	21	9,780	37
2	6.6	64	12	15	41	22	19,900	32
3	190	77	13	13	38	23	9,750	30
4	180	73	14	11	36	24	813	29
5	69	66	15	9.9	200	25	267	28
6	42	54	16	17	191	26	167	27
7	23	79	17	31	97	27	127	26
8	17	241	18	57	85	28	102	25
9	13	63	19	41	55	29	87	24
10	16	61	20	1,640	45	30	77	26
						31	----------	27

Monthly mean discharge, in cubic feet per second	1,450	64.3
Runoff, in acre-feet	86,250	3,960

(23) 8-1865. Ecleto Creek near Runge, Tex.

Location.--Lat 28°55'12", long 97°46'19", on left bank 55 ft downstream from Farm Road 81, 215 ft left of left end of bridge, 2.6 miles upstream from Salt Branch, 4.5 miles northwest of Runge, Karnes County, and 5.2 miles upstream from mouth.

Drainage area.--239 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 215.03 ft above mean sea level, Texas Highway Department bridge plans.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 7,300 cfs and by slope-area measurement of 58,400 cfs.

Maxima.--September-October 1967: Discharge, 58,400 cfs 0500 hours Sept. 22 (gage height, 33.13 ft from recorder, 33.3 ft from floodmark).
1962 to August 1967: Discharge, 3,800 cfs Jan. 22, 1965 (gage height, 17.94 ft, from floodmark).
Since at least 1903: Gage height, 34 ft in June 1903. A stage of 32 ft occurred in September 1952.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0	18	11	0.60	11	21	12,200	6.4
2	0	17	12	.07	8.4	22	29,600	5.9
3	2.7	16	13	0	7.2	23	6,640	5.7
4	14	17	14	0	6.4	24	1,140	5.3
5	7.5	16	15	0	158	25	85	5.0
6	4.1	13	16	0	484	26	48	4.8
7	25	13	17	0	53	27	33	4.8
8	8.2	72	18	0	14	28	27	4.5
9	2.8	41	19	0	9.3	29	22	4.5
10	1.2	18	20	349	7.5	30	19	4.8
						31	----------	4.6
Monthly mean discharge, in cubic feet per second							1,674	34.1
Runoff, in acre-feet							99,630	2,090

(24) Escondido Creek subwatershed No. 9 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°51'58", long 97°59'52", at drop inlet above dam on Escondido Creek, 9.6 miles west of Kenedy, Karnes County.

Drainage area.--6.90 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 385.0 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 920 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 964 cfs Sept. 21 (gage height, 30.44 ft, from floodmark); contents, 3,390 acre-ft.
1958 to August 1967: Outflow, 28 cfs Feb. 16, 1965 (gage height, 19.5 ft, from floodmark); contents, 771 acre-ft.

Remarks.--Dam completed Feb. 17, 1957; records collected since June 5, 1958.

SAN ANTONIO RIVER BASIN

(25) Escondido Creek subwatershed No. 8 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°50'22", long 97°57'14", at drop inlet above dam on Olmos Creek, 6.6 miles west of Kenedy, Karnes County.

Drainage area.--3.95 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 338.7 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillways measurement (2 spillways) of 3,190 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 3,240 cfs Sept. 21 (gage height, 31.5 ft, from floodmark); contents, 1,820 acre-ft.
1957 to August 1967: Outflow, 31 cfs Sept. 23, 1957 (gage height, 23.4 ft, from floodmark); contents, 814 acre-ft.

Remarks.--Dam completed Feb. 17, 1957; records collected since Feb. 7, 1957.

(26) Escondido Creek subwatershed No. 10 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°50'32", long 97°54'30", at drop inlet above dam on unnamed tributary of Escondido Creek, 4.0 miles northwest of Kenedy, Karnes County.

Drainage area.--2.75 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 305.2 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 2,750 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 2,780 cfs Sept. 21 (gage height, 31.6 ft, from floodmark); contents, 1,240 acre-ft.
1955 to August 1967: Outflow, 25 cfs May 19, 1965 (gage height, 22.80 ft, from floodmark); contents, 414 acre-ft.

Remarks.--Dam completed Oct. 6, 1954; records collected since Mar. 15, 1955.

SAN ANTONIO RIVER BASIN

(27) Escondido Creek subwatershed No. 6 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°47'43", long 97°57'53", at drop inlet above dam on an unnamed fork of Bucker Creek, 7.2 miles west of Kenedy, Karnes County.

Drainage area.--2.29 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 383.0 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 2,840 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 2,870 cfs Sept. 21 (gage height, 33.10 ft, from floodmark); contents, 1,690 acre-ft.
1955 to August 1967: Outflow, 31 cfs Oct. 26, 1960 (gage height, 28.90 ft, from floodmark); contents, 1,170 acre-ft.

Remarks.--Dam completed Mar. 4, 1955; records begin Mar. 15, 1955.

(28) Escondido Creek subwatershed No. 7 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°48'01", long 97°58'03", at drop inlet above dam on an unnamed fork of Bucker Creek, 7.3 miles west of Kenedy, Karnes County.

Drainage area.--2.12 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 378.7 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--September-October 1967: Outflow, 1,670 cfs Sept. 21 (gage height, 29.30 ft, from floodmarks); contents, 1,060 acre-ft.
1956 to August 1967: Outflow, 22 cfs Oct. 26, 1960 (gage height observed, 22.0 ft); contents, 406 acre-ft.

Remarks.--Dam completed Feb. 18, 1956; records begin July 4, 1956.

SAN ANTONIO RIVER BASIN

(29) Escondido Creek subwatershed No. 5 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°47'54", long 97°57'32", at drop inlet above dam on an unnamed fork of Bucker Creek, 6.8 miles west of Kenedy, Karnes County.

Drainage area.--1.48 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 373.7 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 1,460 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 1,490 cfs Sept. 21 (gage height, 30.70 ft, from floodmark); contents, 746 acre-ft.
1956 to August 1967: Outflow, 26 cfs Oct. 26, 1960 (gage height, 27.60 ft, from floodmark); contents, 510 acre-ft.

Remarks.--Dam completed May 1, 1956; records begin July 5, 1956.

(30) Escondido Creek subwatershed No. 3 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°46'19", long 97°55'41", at drop inlet above dam on Doe Branch, 5.8 miles southwest of Kenedy, Karnes County.

Drainage area.--4.78 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 381.0 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 4,620 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 4,670 cfs Sept. 21 (gage height, 38.45 ft, from floodmark); contents, 2,130 acre-ft.
1956 to August 1967: Outflow, 91 cfs (revised) Oct. 26, 1960 (gage height, 36.46 ft, from floodmark); contents, 1,800 acre-ft.

Remarks.--Dam completed Feb. 18,1956; records begin July 5, 1956.

SAN ANTONIO RIVER BASIN

(31) Escondido Creek subwatershed No. 4 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°48'52", long 97°54'07", at drop inlet above dam on Doe Branch, 1,600 ft upstream from Farm Road 2102, and 3.3 miles west of Kenedy, Karnes County.

Drainage area.--6.24 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 299.1 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 6,720 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 6,830 cfs Sept. 21 (gage height, 32.0 ft, from floodmark); contents, 3,090 acre-ft.
1957 to August 1967: Outflow, 103 cfs Oct. 26, 1960 (gage height, 28.30 ft, from floodmark); contents, 2,100 acre-ft.

Remarks.--Dam completed Nov. 17,1956; records begin Feb. 6, 1957.

(32) 8-1870. Escondido Creek subwatershed No. 1 near Kenedy, Tex.

Location (revised).--Lat 28°46'41", long 97°53'41", near center of dam on unnamed fork of Panther Creek, 900 ft upstream from State Highway 72, and 3.9 miles southwest of Kenedy, Karnes County.

Drainage area.--3.29 sq mi.

Gage-height record.--Water-stage recorder graph except 2110 hours Sept. 21 to 0950 hours Sept. 22 and Oct. 3-9. Graph drawn on basis of floodmarks, rainfall records, and normal recession. Datum of gage is 350.00 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Inflow computed from change in contents adjusted for outflow. Outflow defined by current-meter measurements below 200 cfs and extended above to 2,350 cfs on basis of flow-through-culvert measurement of 2,330 cfs at peak flow plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 2,340 cfs 2240 hours Sept. 21 (gage height, 30.06 ft, at gage, 31.0 ft, from floodmarks at spillway). Inflow, 2,910 cfs (average for 5-minute interval) 2225 to 2230 hours Sept. 21. Inflow computed from outflow and change in reservoir contents, adjusted for rainfall on pool surface during time of peak inflow. Contents, 1,180 acre-ft 2230 to 2245 hours Sept. 21.

1954 to August 1967: Outflow, 183 cfs Oct. 26, 1960 (gage height, 29.08 ft). Inflow, 5,260 cfs (average for 5-minute interval) Oct. 25, 1960. Inflow computed from outflow and change in pool contents, adjusted for rainfall on pool surface during time of peak inflow. Contents, 1,090 acre-ft Oct. 26, 1960.

Remarks.--Dam completed Sept. 21, 1954, but no appreciable storage before July 1955. First outflow began Apr. 27, 1957. Rolled-fill earthen dam is about 2,000 ft long, with earthen spillway at gage height 27.7 ft. Outlet structure is 2½-foot square concrete drop inlet, gage height of crest 18.0 ft, with a 10-inch pipe auxiliary opening in the upstream face of the drop inlet, invert gage height 16.0 ft. Outlet structure is connected to a 12-inch concrete outlet pipe at gage height 9.2 ft. There is an 8-inch controlled emergency outlet to drop inlet at gage height 9.2 ft. Pool capacity, 905 acre-ft at spillway crest, 220 acre-ft at drop inlet crest, 150 acre-ft at 10-inch uncontrolled pipe, and 23.2 acre-ft at 8-inch controlled outlet. Dam built by Soil Conservation Service for flood control. Capacity based on survey made June 21, 1964. Rainfall record from 2 recording gages, 1 at station and 1 in basin above.

Contents, in acre-feet, at 2400 hours, daily computed inflow and outflow, in cubic feet per second, on indicated day, 1967

Day	September			October			Day	September			October		
	Contents	Inflow	Outflow	Contents	Inflow	Outflow		Contents	Inflow	Outflow	Contents	Inflow	Outflow
1	77.5	0	0	596	0	15.4	16	78.2	3.7	0	210	0	2.8
2	90.0	7.1	0	570	0	15.3	17	77.1	0	0	203	0	2.3
3	88.8	0	0	535	0	15.1	18	75.6	0	0	197	0	1.9
4	87.3	0	0	503	1.5	14.9	19	74.9	.21	0	191	0	1.1
5	86.1	0	0	472	.1	14.7	20	428	183	5.1	186	0	.47
6	84.6	0	0	440	0	14.5	21	1,120	557	211	180	0	.10
7	83.0	0	0	410	.8	14.3	22	963	39.5	108	176	0	0
8	81.5	0	0	378	0	14.0	23	918	0	16.6	172	0	0
9	80.0	0	0	347	0	13.7	24	876	0	16.4	170	0	0
10	78.5	0	0	316	0	13.6	25	836	0	16.3	167	0	0
11	77.2	0	0	287	0	13.0	26	795	0	16.2	165	0	0
12	75.6	0	0	258	0	11.2	27	755	0	16.0	162	0	0
13	74.2	0	0	233	0	6.4	28	716	0	15.8	160	0	0
14	72.8	0	0	222	0	4.0	29	677	0	15.6	159	0	0
15	71.6	0	0	218	1.8	3.2	30	640	0	15.5	158	.75	0
							31	--	--	--	157	0	0
Mean, in cubic feet per second								--	26.4	15.1	--	0.160	6.19
Runoff, in acre-feet								--	1,570	898	--	9.8	381
Change in contents								+562	--	--	-483	--	--

SAN ANTONIO RIVER BASIN

(33) Escondido Creek subwatershed No. 2 near Kenedy, Tex.

(Miscellaneous site)

Location.--Lat 28°46'40", long 97°54'18", at drop inlet above dam on an unnamed fork of Panther Creek, 4.4 miles southwest of Kenedy, Karnes County.

Drainage area.--2.69 sq mi.

Gage-height record.--Staff gage read weekly and floodmarks noted. Datum of gage is 352.2 ft above mean sea level, datum of 1929 (levels by Soil Conservation Service).

Discharge record.--Peak outflow computed on basis of flow-over-spillway measurement of 1,350 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 1,400 cfs Sept. 21 (gage height, 29.32 ft, from floodmark); contents, 1,200 acre-ft.
1955 to August 1967: Outflow, 40 cfs Oct. 26, 1960 (gage height, 25.40 ft, from floodmark); contents, 772 acre-ft.

Remarks.--Dam completed June 17, 1955; records begin Sept. 11, 1955.

(34) 8-1875. Escondido Creek at Kenedy, Tex.

Location.--Lat 28°49'11", long 97°51'32", near center of channel at downstream side of bridge on U.S. Highway 181 in northwest edge of Kenedy, Karnes County, 4.6 miles upstream from Dry Escondido Creek, and 9.6 miles upstream from mouth.

Drainage area.--72.4 sq mi.

Gage-height record.--Water-stage recorder graph except Oct. 25-31, when intakes were plugged. Graph reconstructed on basis of wire-weight gage readings on Oct. 30 and Nov. 6. Datum of gage is 246.40 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 4,400 cfs and extended to 37,000 cfs on basis of contracted-opening, flow-over-road and flow-through-culverts measurement.

Maxima.--September-October 1967: Discharge, 37,000 cfs 0100 hours Sept. 22 (gage height, 25.48 ft).
1954 to August 1967: Discharge, 15,900 cfs (revised) Oct. 25, 1960 (gage height, 23.55 ft).
Highest stage known since at least 1887, that of Sept. 22, 1967; second highest 24.2 ft Aug. 29, 1946, from information by local residents.

Remarks.--At end of year, flow from 36.5 sq mi above this station was partly controlled by 10 floodwater-retarding structures with a total combined capacity of 14,060 acre-ft below flood-spillway crests, of which 11,860 acre-ft is floodwater-retarding capacity and 2,200 acre-ft is sediment-pool capacity. The capacity in these pools allocated to sediment storage will be used for conservation storage until eliminated by sedimentation. Eleven rain gages (8 standard and 3 recording) are in operation in the basin above the station. Station operated as part of the Escondido Creek basin hydrologic cooperative program of the Geological Survey and Soil Conservation Service to evaluate rainfall-runoff relation, soil conservation practices, and to assist the Soil Conservation Service in evaluating the effect of floodwater-retarding structures.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0.82	291	11	0.28	104	21	5,340	32
2	195	287	12	.20	94	22	9,040	28
3	15	277	13	.09	78	23	459	19
4	5.6	280	14	.01	65	24	336	12
5	1.8	266	15	0	303	25	327	7.4
6	5.6	230	16	85	124	26	322	4.6
7	1.3	230	17	50	61	27	315	3.4
8	.68	212	18	16	44	28	310	3.0
9	.46	153	19	8.0	37	29	304	2.8
10	.26	113	20	3,030	34	30	298	2.6
						31	----------	2.4
Monthly mean discharge, in cubic feet per second							682	110
Runoff, in acre-feet							40,600	6,740

(35) 8-1879. Escondido Creek subwatershed No. 11 (Dry Escondido Creek) near Kenedy, Tex.

Location.--Lat 28°51'39", long 97°50'39", near center of dam on Dry Escondido Creek, 0.5 mile upstream from bridge on Farm Road 792, 3.0 miles north of Kenedy, Karnes County, and 5.0 miles upstream from Escondido Creek.

Drainage area.--8.43 sq mi.

Gage-height record.--Water-stage recorder graph except 2000 hours Sept. 20 to 0530 hours Sept. 22 and Sept. 24. Graph drawn on basis of floodmarks, rainfall records, and normal recession. Datum of gage is 285.12 ft above mean sea level, datum of 1929.

Discharge record.--Inflow computed from change in contents adjusted for outflow. Outflow defined by current-meter measurements below 100 cfs and extended above to 8,030 cfs on basis of flow-over-spillways measurement (2 spillways) of 7,900 cfs plus flow through drop inlet.

Maxima.--September-October 1967: Outflow, 8,030 cfs 2115 to 2135 hours Sept. 21; gage height, 36.36 ft, from floodmarks, 2125 hours Sept. 21. Inflow, 17,700 cfs (average for 5-minute interval) 1940 to 1950 hours Sept. 21. Inflow computed from outflow and change in reservoir contents and adjusted for rainfall on pool surface during time of peak inflow. Contents, 3,900 acre-ft 2110 to 2135 hours Sept. 21.

1958 to August 1967: Outflow, 87.2 cfs May 19,1965 (gage height, 23.42 ft). Inflow, 4,950 cfs (average for 5-minute interval) May 19, 1965, computed and adjusted as explained above. Contents, 734 acre-ft May 19, 1965.

Remarks.--Dam was completed in 1958; however, the lower drain valve in outlet structure remained open until Sept. 15, 1958, when all finishing work was completed. The first outflow since the lower drain valve was closed began Sept. 22, 1958. Outflow structure is a 3-foot square concrete drop inlet connected to a 28-inch concrete outlet pipe. Four 10-inch square portholes are set in the sides of the drop inlet, two on the upstream side and two on the downstream side, at bottom gage height 15.67 ft. Top of drop inlet is at gage height 18.00 ft. Two emergency spillways are at gage height 32.8 ft. The lower drain valve is an 8-inch diameter cleanout gate at bottom of drop inlet at gage height 9.4 ft. Pool capacity, 2,700 acre-ft at spillway crest, 266 acre-ft at drop inlet crest, 161 acre-ft at bottom of portholes and 35 acre-ft at 8-inch controlled outlet. Structure built by Soil Conservation Service for flood control. Capacity based on survey made July 11, 1960. Rainfall record collected at two recorded gages, one at the station and one in the basin above.

Contents, in acre-feet, at 2400 hours, daily computed inflow and outflow, in cubic feet per second, on indicated day, 1967

Day	September			October			Day	September			October		
	Contents	Inflow	Outflow	Contents	Inflow	Outflow		Contents	Inflow	Outflow	Contents	Inflow	Outflow
1	135	0	0	811	0	95.6	16	133	1.5	0	170	0.64	10.8
2	147	6.3	.21	633	0	91.3	17	134	.15	0	158	0	6.9
3	150	1.3	1.7	467	0	85.5	18	133	0	0	151	0	3.6
4	146	0	1.6	330	.83	77.3	19	135	1.2	0	148	0	2.0
5	144	0	.96	242	0	59.5	20	1,620	797	47.2	145	0	1.2
6	142	0	.56	205	0	19.2	21	3,560	2,170	1,210	143	0	.56
7	140	0	.26	182	1.4	15.0	22	2,780	869	1,260	142	0	.31
8	139	0	.03	163	0	10.2	23	2,530	0	118	141	0	.11
9	138	0	0	154	0	5.0	24	2,280	0	116	140	0	.03
10	137	0	0	149	0	2.6	25	2,050	0	114	139	0	0
11	135	0	0	146	0	1.5	26	1,830	0	111	139	0	0
12	134	0	0	144	0	.84	27	1,610	0	108	138	0	0
13	133	0	0	142	0	.46	28	1,400	0	106	137	0	0
14	132	0	0	141	0	.21	29	1,190	0	102	137	0	0
15	131	0	0	179	19.3	5.1	30	997	0	99.2	137	.46	0
							31	--	--	--	136	0	0
Mean, in cubic feet per second								--	128	113	--	0.730	16.0
Runoff, in acre-feet								--	7,630	6,740	--	48	981
Change in contents								+861	--	--	-861	--	--

(36) 8-1884. Baugh Creek at Goliad, Tex.

(Crest-stage station)

Location.--Lat 28°39'50", long 97°25'05", at culvert on U.S. Highway 59, 0.2 mile west of State Highway 239, and 1.5 miles west of Goliad, Goliad County.

Drainage area.--3.02 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder.

Discharge record.--Maximum discharge determined by flow-through-culverts measurement.

Maxima.--September-October 1967: Discharge, 1,000 cfs 0745 hours Sept. 21 (gage height, 7.73 ft).
1965 to August 1967: Discharge, 360 cfs Aug. 20, 1966 (gage height, 5.50 ft).

SAN ANTONIO RIVER BASIN

(37) 8-1885. San Antonio River at Goliad, Tex.

Location.--Lat 28°38'58", long 97°23'04", on right bank at upstream side of bridge on U.S. Highway 183, 1.2 miles southeast of courthouse in Goliad, Goliad County, and 11.7 miles upstream from Manahuilla Creek.

Drainage area.--3,921 sq mi.

Gage-height record.--Digital-recorder tape punched at 60-minute intervals Sept. 1-21, Sept. 28 to Oct. 31. Digital recorder and water-stage recorder removed Sept. 22 to prevent being overtopped by floodwater. Water-stage recorder reinstalled Sept. 25 and digital recorder Sept. 27. Sept. 22 to Sept. 25 record reproduced on basis of floodmark and elevations of stakes set at water surface at various times. Sept. 26-27 record from water-stage recorder graph. Datum of gage is 91.08 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 34,000 cfs and by slope-area measurement of 138,000 cfs.

Maxima.--September-October 1967: Discharge, 138,000 cfs 1400 hours Sept. 23 (gage height, 53.7 ft, from floodmark).
1924-29, 1939 to August 1967: Discharge, 33,800 cfs July 9, 1942 (gage height, 44.9 ft).
Highest flood since at least 1869, that of Sept. 23, 1967. Maximum stage since about 1800 occurred in 1869 and was several feet higher than the flood of Sept. 23, 1967.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	187	1,390	11	314	838	21	11,200	636
2	197	1,280	12	264	757	22	28,800	559
3	269	1,200	13	239	710	23	121,000	519
4	374	1,140	14	213	694	24	84,200	490
5	543	1,500	15	211	1,510	25	42,900	455
6	678	1,360	16	211	3,920	26	25,300	431
7	779	1,050	17	232	3,250	27	17,100	424
8	653	1,000	18	492	1,500	28	12,300	419
9	853	1,320	19	799	1,100	29	5,960	403
10	500	1,140	20	2,690	827	30	1,940	403
						31	----------	393
Monthly mean discharge, in cubic feet per second							12,050	1,052
Runoff, in acre-feet							716,800	64,700

MISSION RIVER BASIN

(38) Blanco Creek at Berclair, Tex.

(Miscellaneous site)

Location.--Lat 28°31'27", long 97°36'17", at U.S. Highway 59 bridge, 0.9 mile west of Berclair, Goliad County.

Drainage area.--70.3 sq mi.

Maximum.--September-October 1967: Discharge, 38,600 cfs Sept. 22, from contracted-opening measurement.

MISSION RIVER BASIN

(39) Toro Creek near Tuleta, Tex.

(Miscellaneous site)

Location.--Lat 28°34'04", long 97°50'36", at bridge on Farm Road 1465, 2.6 miles west at Tuleta, Bee County.

Drainage area. --24.6 sq mi.

Maximum.--September-October 1967: Discharge, 13,400 cfs Sept. 21, from contracted-opening and flow-over-road measurement.

(40) 8-1893. Medio Creek near Beeville, Tex.

Location.--Lat 28°28'58", long 97°39'23", on left bank at downstream side of bridge on U.S. Highway 59, 8 miles northeast of Beeville, Bee County, and 9 miles upstream from Parker Hollow Creek.

Drainage area.--204 sq mi.

Gage-height record.--Water-stage recorder graph except 0700 hours Sept. 22 to 1230 hours Sept. 23, when manometer was submerged and shorted out. Gage-height graph reproduced on basis of floodmark and wire-weight gage readings. Datum of gage is 163.00 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 30,000 cfs and extended above on basis of slope-area measurement of 105,000 cfs.

Maxima.--September-October 1967: Discharge, 105,000 cfs 0900 hours Sept. 22 (gage height, 38.68 ft, from floodmark).
1962 to August 1967: Discharge, 2,990 cfs Feb. 17, 1965 (gage height, 14.06 ft).
Highest flood since at least 1914, that of Sept. 22, 1967. A stage of about 31 ft occurred in September 1919.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0	27	11	0	14	21	13,000	9.8
2	0	25	12	0	14	22	46,300	9.4
3	25	25	13	0	13	23	2,770	9.1
4	5.9	40	14	0	12	24	273	8.8
5	1.0	24	15	0	318	25	90	8.0
6	.19	19	16	0	93	26	56	8.0
7	.06	33	17	0	18	27	44	8.0
8	.01	41	18	0	12	28	36	7.8
9	0	17	19	0	11	29	33	7.8
10	0	15	20	2,650	10	30	30	8.0
						31	----------	7.2
Monthly mean discharge, in cubic feet per second							2,177	28.2
Runoff, in acre-feet							129,500	1,730

MISSION RIVER BASIN

(41) 8-1895. Mission River at Refugio, Tex.

Location.--Lat 28°17'30", long 97°16'44", on left bank at upstream side of upstream bridge of two bridges on U.S. Highway 77, 560 ft upstream from Missouri-Pacific Railroad Co. bridge, and a quarter of a mile southwest of Refugio, Refugio County.

Drainage area.--690 sq mi.

Gage-height record.--Water-stage recorder graph except Sept. 20-25, when graph was reconstructed on basis of floodmark and information from local residents. Datum of gage is 1.00 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 41,000 cfs and extended to 116,000 cfs on basis of contracted-opening measurement of peak flow.

Maxima.--September-October 1967: Discharge, 116,000 cfs 2200 hours Sept. 21 (gage height, 36.5 ft, from floodmark).
1939 to August 1967: Discharge, 41,700 cfs July 7, 1942 (gage height, 33.3 ft).
Highest stage known since about 1899, that of Sept. 21, 1967; second highest, that of July 7, 1942.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	9.2	182	11	21	170	21	54,100	240
2	17	172	12	15	154	22	78,800	206
3	515	166	13	13	144	23	57,800	184
4	1,230	162	14	11	136	24	24,200	166
5	1,110	244	15	11	296	25	5,500	149
6	1,020	318	16	10	4,660	26	1,150	138
7	351	217	17	10	6,970	27	499	128
8	121	222	18	9.6	2,500	28	352	120
9	56	279	19	9.6	529	29	244	113
10	41	209	20	1,950	303	30	196	109
						31	----------	104
Monthly mean discharge, in cubic feet per second							7,646	635
Runoff, in acre-feet							455,000	39,054

(42) Poesta Creek at Beeville, Tex.

(Miscellaneous site)

Location.--Lat 28°23'55", long 97°44'55", at Texas and New Orleans Railroad Co. Bridge, 0.2 mile south of courthouse in Beeville, Bee County.

Drainage area.--46.5 sq mi.

Maximum.--September-October 1967: Discharge, 20,800 cfs Sept. 21, from contracted-opening measurement.

(43) 8-1896. Olmos Creek Tributary near Skidmore, Tex.

(Crest-stage station)

Location.--Lat 28°15'27", long 97°44'15", at culvert on Farm Road 797, 3.4 miles west of Skidmore, Bee County.

Drainage area.--0.58 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Maximum discharge determined by flow-through-culverts measurements.

Maxima.--September-October 1967: Discharge, 325 cfs Sept. 22 (gage height, 8.71 ft).
1966 to August 1967: Discharge, 235 cfs Apr. 25, 1966 (gage height, 8.00 ft).

(44) 8-1897. Aransas River near Skidmore, Tex.

Location.--Lat 28°16'56", long 97°37'14", on right bank 160 ft downstream from centerline of county road bridge, 3.8 miles downstream from confluence of West Aransas Creek and Poesta Creek, and 4.4 miles northeast of Skidmore, Bee County.

Drainage area.--247 sq mi.

Gage-height record.--Water-stage recorder graph except 2200 hours Sept. 21 to 1800 hours Sept. 22, when graph was reconstructed on basis of floodmark and staff-gage readings. Datum of gage is 72.37 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 14,000 cfs and extended to 82,800 cfs on basis of slope-area measurement of peak flow.

Maxima.--September-October 1967: Discharge, 82,800 cfs 0600 hours Sept. 22 (gage height, 42.22 ft, from floodmark).
1964 to August 1967: Discharge, 5,410 cfs Apr. 25, 1966 (gage height, 19.73 ft).
Highest flood since at least 1914, that of Sept. 22, 1967. A stage of 33 ft occurred in September 1954, from information by local resident.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0.91	17	11	2.6	5.4	21	16,200	11
2	.83	16	12	1.8	5.0	22	49,300	9.9
3	1.6	15	13	1.3	4.8	23	2,940	9.3
4	24	16	14	.83	4.3	24	288	8.7
5	36	14	15	.75	381	25	77	8.0
6	23	18	16	.67	1,760	26	42	7.9
7	9.2	16	17	.75	97	27	29	7.4
8	4.4	31	18	.75	30	28	23	6.8
9	2.4	9.3	19	.91	19	29	19	6.8
10	1.7	6.2	20	1,640	14	30	18	6.5
						31	----------	6.2
Monthly mean discharge, in cubic feet per second							2,356	82.8
Runoff, in acre-feet							140,200	5,090

ARANSAS RIVER BASIN

(45) Papalote Creek at Papalote, Tex.

(Miscellaneous site)

Location.--Lat 28°09'40", long 97°35'30", at bridge on U.S. Highway 181, 1 mile south of Papalote, and 8.3 miles southwest of Skidmore, Bee County.

Drainage area.--99.2 sq mi.

Maximum.--September-October 1967: Discharge, 56,400 cfs Sept. 22, from contracted-opening and flow-over-road measurement.

(46) 8-1940. Nueces River at Cotulla, Tex.

Location.--Lat 28°25'32", long 99°14'26", on left bank at downstream side of bridge on U.S. Highway 81, a third of a mile upstream from Missouri Pacific Railroad Co. bridge, three-quarters of a mile south of Cotulla, La Salle County, and 1.2 miles upstream from Lind Dam.

Drainage area.--5,260 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 368.08 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 7,050 cfs 1330 hours Sept. 25 (gage height, 16.61 ft).

1923 to August 1967: Discharge, 82,600 cfs June 18, 1935 (gage height, 32.4 ft, from floodmark), from rating curve extended above 43,000 cfs on basis of slope-area measurement of peak flow.

Highest flood since at least 1879, that of June 18, 1935. Flood of June 19, 1899, reached a stage of 29.7 ft, from information by local resident.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	184	1,340	11	582	41	21	2,000	1,340
2	251	1,500	12	229	29	22	2,420	1,250
3	1,770	1,480	13	138	23	23	2,430	529
4	2,440	1,000	14	90	19	24	2,960	216
5	2,060	413	15	59	90	25	6,570	129
6	2,120	234	16	520	167	26	4,720	88
7	2,300	149	17	1,260	112	27	2,770	57
8	2,180	105	18	2,000	223	28	1,900	43
9	2,080	76	19	2,100	748	29	1,480	31
10	1,510	57	20	1,960	1,140	30	1,310	27
						31	----------	22
Monthly mean discharge, in cubic feet per second							1,810	409
Runoff, in acre-feet							107,900	25,150

(47) 8-1942. San Casimiro Creek near Freer, Tex.

Location.--Lat 27°57'47", long 98°58'05", at downstream side of bridge on State Highway 44, 11 miles upstream from Nueces River, and 22 miles northwest of Freer, Duval County.

Drainage area.--469 sq mi.

Gage-height record.--Water-stage recorder graph, except 1800 hours Sept. 22 to 1500 hours Sept. 23, for which graph was reconstructed on basis of floodmark. Datum of gage is 298 ft above mean sea level, State Highway Department bridge plans.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 21,000 cfs and extended above by logarithmic plotting.

Maxima.--September-October 1967: Discharge, 43,200 cfs 0200 hours Sept. 23 (gage height, 24.6 ft, from floodmark).
1962 to August 1967: Discharge, 13,400 cfs June 17, 1963 (gage height, 22.35 ft).
Maximum stage since at least 1946, 26 ft in 1954, from information by State Highway Department.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	75	36	11	2.9	4.0	21	654	0.68
2	17	25	12	1.9	3.4	22	22,200	.64
3	169	20	13	1.2	2.9	23	27,500	.56
4	310	17	14	.61	2.5	24	8,280	.49
5	269	15	15	.28	2.1	25	5,960	.43
6	175	36	16	.39	1.6	26	2,550	.37
7	29	11	17	100	1.3	27	690	.31
8	13	10	18	352	1.1	28	599	.25
9	8.3	7.9	19	332	.93	29	473	.19
10	4.8	5.9	20	175	.78	30	79	.13
						31	.....	.07
Monthly mean discharge, in cubic feet per second							2,367	6.73
Runoff, in acre-feet							140,900	414

(48) 8-1945. Nueces River near Tilden, Tex.

Location.--Lat 28°18', long 98°34', on right bank at downstream side of pier of bridge on State Highway 16, 2 miles upstream from Cow Creek, and 10.5 miles south of Tilden, McMullen County.

Drainage area.--8,192 sq mi.

Gage-height record.--Digital-recorder tape punched at 60-minute intervals. Datum of gage is 183.5 ft above mean sea level, datum of 1929 (levels by Topographic Division).

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 76,500 cfs 1200 hours Sept. 24 (gage height, 26.57 ft).
1942 to August 1967: Discharge, 70,000 cfs Oct. 11, 1946 (gage height, 26.46 ft).
Highest stage since about 1902, that of Sept. 24, 1967.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	671	6,490	11	2,470	147	21	3,280	228
2	382	4,520	12	2,320	97	22	28,200	489
3	376	3,370	13	2,200	68	23	33,500	677
4	986	2,770	14	2,100	51	24	70,000	818
5	1,330	2,280	15	2,010	40	25	55,100	923
6	1,590	1,860	16	1,510	35	26	33,200	1,010
7	1,340	1,570	17	677	33	27	21,100	652
8	1,430	1,420	18	1,070	44	28	13,500	187
9	1,880	904	19	1,330	144	29	9,190	106
10	2,450	255	20	1,590	113	30	7,850	69
						31	----------	47
Monthly mean discharge, in cubic feet per second							10,150	1,013
Runoff, in acre-feet							604,200	62,310

(49) 8-1945.5. Plant Creek near Tilden, Tex.

(Crest-stage station)

Location.--Lat 28°24'04", long 98°32'58", at culvert on State Highway 173, 4.0 miles south of Tilden, McMullen County.

Drainage area.--0.36 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder.

Discharge record.--Maximum discharge determined by flow-through-culverts measurement.

Maxima.--September-October 1967: Discharge, 220 cfs 0040 hours Sept. 22 (gage height, 10.06 ft).
1965 to August 1967: Discharge, 60 cfs Aug. 19, 1967 (gage height, 8.31 ft).

(50) 8-1946. Nueces River at Simmons, Tex.

Location.--Lat 28°25'18", long 98°17'06", on right bank 31 ft downstream from bridge on county road, 0.8 mile downstream from Adolph Hollow, 1.2 miles north of Simmons, Live Oak County, and 10 miles upstream from Frio River.

Drainage area.--8,561 sq mi.

Gage-height record.--Water-stage recorder graph except Sept. 1-7, 9-13, when graph was reconstructed from twice-daily wire-weight gage readings. Datum of gage is 119.63 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 72,000 cfs 1600 hours Sept. 25 (gage height, 43.21 ft).
1965 to August 1967: Discharge, 5,420 cfs May 9, 1966 (gage height, 25.84 ft).
Maximum stage since at least 1875, 43.5 ft in September 1919; flood in June 1935 and July 1942 reached a stage of 42.0 ft, from information by local residents.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	1,050	7,940	11	1,970	234	21	4,210	122
2	555	6,670	12	2,310	163	22	18,500	298
3	384	5,200	13	2,380	120	23	42,500	484
4	699	4,090	14	2,330	92	24	42,300	612
5	1,030	3,630	15	2,150	189	25	65,900	704
6	1,280	2,530	16	2,000	130	26	55,700	778
7	1,510	1,760	17	1,560	61	27	37,400	802
8	1,420	1,390	18	844	52	28	25,500	378
9	1,370	1,190	19	1,080	75	29	17,100	160
10	1,580	560	20	1,500	148	30	10,700	107
						31	----------	77
Monthly mean discharge, in cubic feet per second							11,630	1,314
Runoff, in acre-feet							691,900	80,820

NUECES RIVER BASIN

(51) 8-2055. Frio River near Derby, Tex.

Location.--Lat 28°44'10", long 99°08'45", near center of span at downstream side of pier of bridge on U.S. Highway 81, 150 ft upstream from Missouri Pacific Railroad Co. bridge, 750 ft downstream from Leona River, and 2.4 miles south of Derby, Frio County.

Drainage area.--3,493 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 449.11 ft above mean sea level, datum of 1929, supplementary adjustment of 1960.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 3,880 cfs 1500 hours Sept. 23 (gage height, 8.72 ft).

1915 to August 1967: Discharge, 230,000 cfs July 4,1932 (gage height, 29.45 ft), from rating curve extended above 46,000 cfs on basis of slope-area measurement of peak flow.

Highest flood since at least 1860, that of July 4, 1932.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0	18	11	1.8	0.04	21	132	138
2	0	12	12	.60	0	22	816	87
3	0	5.9	13	.15	0	23	3,430	60
4	137	3.4	14	0	0	24	1,760	40
5	178	2.4	15	0	3.7	25	516	27
6	645	2.0	16	216	533	26	448	18
7	180	1.5	17	2,000	3,910	27	255	12
8	48	.71	18	1,410	1,710	28	72	7.0
9	16	.39	19	235	451	29	32	4.4
10	4.4	.15	20	108	267	30	20	3.0
						31	----------	1.5
Monthly mean discharge, in cubic feet per second							422	236
Runoff, in acre-feet							25,110	14,520

(52) 8-2067. San Miguel Creek near Tilden, Tex.

Location.--Lat 28°35'15", long 98°33'00", on left bank 25 ft downstream from State Highway 16, 3 miles upstream from mouth of San Patricio Creek, 7 miles downstream from Clear Creek, 9 miles north of Tilden, McMullen County, and 12 miles upstream from mouth.

Drainage area.--793 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 242.95 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 13,700 cfs 1200 hours Sept. 22 (gage height, 25.99 ft).
1964 to August 1967: Discharge, 5,370 cfs June 19, 1966 (gage height, 18.94 ft, from floodmark).
Highest stage known since 1919, 32.6 ft in 1942, stage of 1919 flood not known, from information by local residents.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0.20	50	11	5.3	39	21	6,040	23
2	.08	42	12	2.6	32	22	12,700	20
3	85	37	13	.90	19	23	8,030	19
4	110	32	14	.33	18	24	5,290	18
5	46	33	15	.10	301	25	1,980	17
6	20	35	16	4.2	685	26	463	16
7	62	66	17	2.0	468	27	716	16
8	58	29	18	8.1	84	28	185	15
9	20	22	19	24	41	29	90	15
10	9.6	21	20	986	29	30	64	15
						31	----------	15
Monthly mean discharge, in cubic feet per second							1,233	73.3
Runoff, in acre-feet							73,390	4,510

(53) 8-2070. Frio River at Calliham, Tex.

Location.--Lat 28°29'30", long 98°20'45", on right bank at upstream side of county bridge, 0.5 mile upstream from bridge on Farm Road 99, 1 mile north of Calliham, McMullen County, and 10.4 miles downstream from San Miguel Creek.

Drainage area.--5,491 sq mi.

Gage-height record.--Water-stage recorder graph except 1300 hours Sept. 22 to 0200 hours Sept. 25, when graph was reconstructed on basis of floodmark and slope of preceding and following period. Datum of gage is 153.47 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation of defined by current-meter measurement below 13,000 cfs and extended to 57,000 cfs on basis of contracted-opening measurement and flow-over-road computation of peak flow.

Maxima.--September-October 1967: Discharge, 57,000 cfs 1600 hours Sept. 23 (gage height, 36.15 ft, from floodmark).
1924-26, 1932 to August 1967: Discharge, 109,000 cfs (revised) July 6, 1932 (39.2 ft, from floodmark).
Highest stage since at least 1870, that of July 6, 1932, from information by local resident.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	87	556	11	194	62	21	7,330	1,420
2	46	303	12	85	87	22	32,000	1,930
3	65	188	13	50	58	23	53,600	1,280
4	605	133	14	35	51	24	43,600	461
5	929	118	15	27	440	25	25,600	202
6	2,280	106	16	61	1,260	26	12,900	150
7	2,280	140	17	54	874	27	6,500	121
8	941	367	18	50	718	28	4,070	97
9	472	99	19	371	369	29	1,900	80
10	485	73	20	1,080	677	30	1,060	69
						31	----------	56
Monthly mean discharge, in cubic feet per second							6,625	405
Runoff, in acre-feet							394,200	24,880

(54) 8-2072. Rutledge Hollow Creek at Poteet, Tex.

(Crest-stage station)

Location.--Lat 29°02'40", long 98°34'20", at culvert on Farm Road 476 in Poteet, Atascosa County.

Drainage area.--18.3 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Maximum discharge determined by flow-through-culverts measurements.

Maxima.--September-October 1967: Discharge, 1,800 cfs Sept. 22 (gage height, 8.69 ft).
1966 to August 1967: Gage height, 3.60 ft Aug. 19, 1967.

NUECES RIVER BASIN

(55) 8-2077. Lucas Creek near Pleasanton, Tex.

(Crest-stage station)

Location.--Lat 29°00'55", long 98°22'30", at downstream side of bridge on State Highway 97, 8 miles northeast of Pleasanton, Atascosa County.

Drainage area.--32.8 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Maximum discharge determined by contracted-opening measurement.

Maxima.--September-October 1967: Discharge, 2,970 cfs Sept. 22 (gage height, 12.97 ft).
1966 to August 1967: Discharge, 475 cfs May 21, 1967 (gage height, 8.97 ft).

(56) 8-2080. Atascosa River at Whitsett, Tex.

Location.--Lat 28°37'20", long 98°17'05", on right bank 1,400 ft upstream from bridge on Farm Road 99, 1.2 miles west of Whitsett, Live Oak County, and 3.8 miles downstream from LaParita Creek.

Drainage area.--1,171 sq mi.

Gage-height record.--Water-stage recorder graph except 1100 hours Sept. 21 to 0500 hours on Sept. 25, when graph reconstructed on basis of floodmark and slope of preceding and following period. Datum of gage is 159.04 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 25,000 cfs and extended to 121,000 cfs on basis of slope-area measurement of peak flow.

Maxima.--September-October 1967: Discharge, 121,000 cfs about 0200 hours Sept. 23 (gage height, 41.3 ft, from floodmark).
1924-26, 1932 to August 1967: Discharge, 39,300 cfs July 7, 1942 (gage height, 38.3 ft, from floodmark).
Highest stage known since at least 1881, that of Sept. 23, 1967, second highest occurred in September 1919 (gage height, 41 ft).

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	7.3	108	11	3.2	56	21	11,400	52
2	18	92	12	2.2	49	22	47,700	44
3	235	85	13	2.0	44	23	92,600	40
4	119	101	14	1.6	40	24	31,900	37
5	34	220	15	1.6	47	25	7,360	34
6	18	289	16	98	146	26	2,560	33
7	9.3	104	17	133	407	27	748	32
8	5.3	74	18	84	262	28	605	30
9	4.3	110	19	53	102	29	218	30
10	5.6	75	20	1,580	67	30	131	29
						31	----------	28
Monthly mean discharge, in cubic feet per second							6,588	92.5
Runoff, in acre-feet							392,000	5,690

(57) 8-2100. Nueces River near Three Rivers, Tex.

Location.--Lat 28°26'10", long 98°11'10", on left bank 100 ft downstream from San Antonio, Uvalde & Gulf (Missouri Pacific) Railroad bridge, half a mile downstream from Frio River, and 2 miles south of Three Rivers, Live Oak County.

Drainage area.--15,600 sq mi.

Gage-height record.--Water-stage recorder graph except 1300 hours Sept. 22 to 1500 hours Sept. 28, for which graph was reconstructed on basis of outside gage readings and inside floodmark. Datum of gage is 101.13 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 141,000 cfs 2100 hours Sept. 23 (gage height, 49.21 ft, from floodmark).
1915 to August 1967: Discharge observed, 85,000 cfs Sept. 18, 1919 (gage height, 46.0 ft), from rating curve extended above 55,000 cfs.
Highest flood since at least 1875, that of Sept. 23,1967.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	1,340	10,800	11	2,170	517	21	9,650	1,150
2	757	8,590	12	2,260	387	22	70,700	2,090
3	502	7,170	13	2,380	345	23	128,000	2,450
4	987	5,790	14	2,320	262	24	124,000	1,680
5	1,690	4,620	15	2,190	427	25	106,000	1,200
6	2,550	3,690	16	2,080	1,670	26	90,100	1,190
7	3,850	2,670	17	2,250	1,560	27	61,300	1,230
8	3,480	2,220	18	1,130	1,360	28	40,000	846
9	2,120	1,820	19	1,270	801	29	25,000	399
10	2,040	1,190	20	2,450	738	30	15,000	295
						31	----------	225
Monthly mean discharge, in cubic feet per second							23,650	2,238
Runoff, in acre-feet							1,407,000	137,600

(58) Sulphur Creek near Three Rivers, Tex.

(Miscellaneous site)

Location.--Lat 28°32'36", long 98°04'10", at bridge on State Highway 72, 8.5 miles northeast of Three Rivers, Live Oak County.

Drainage area.--71.1 sq mi.

Maximum.--September-October 1967: Discharge, 43,600 cfs Sept. 21, from contracted-opening, flow-over-road, and flow-through-culvert measurement.

NUECES RIVER BASIN

(59) Ramirena Creek near George West, Tex.

(Miscellaneous site)

Location.--Lat 28°08'30", long 98°06'12", at bridge on U.S. Highway 281, 13.5 miles south of George West, Live Oak County.

Drainage area.--84.4 sq mi.

Maximum.--September-October 1967: Discharge, 20,500 cfs Sept. 22, from slope-area measurement.

(60) 8-2105. Lake Corpus Christi near Mathis, Tex.

Location.--Lat 28°02'17", long 97°52'15", on right upstream corner of outlet tower at right end of Wesley E. Seale Dam on Nueces River, 0.6 mile upstream from bridge on State Highway 359, and 4½ miles southwest of Mathis, San Patricio County.

Drainage area.--16,656 sq mi.

Gage-height record.--Once-daily wire-weight gage readings at 0600 hours with extra readings Sept. 22. Datum of gage is mean sea level, datum of 1929.

Maxima.--September-October 1967: Contents observed, 320,000 acre-ft 0400 to 0700 hours Sept. 22; elevation observed, 94.82 ft 0500 hours Sept. 22. 1948 to August 1967: Contents observed, 302,100 acre-ft Oct. 5-9, 1064; elevation observed, 94.05 ft Oct. 5, 1964.

Remarks.--Mathis dam completed and storage began July 24, 1934. The original capacity at spillway crest (elevation, 74.5 ft) of 54,000 acre-ft had decreased to 39,400 acre-ft by March 1948. Wesley E. Seale Dam was completed and impoundment began on Apr. 26, 1958, submerging the old Mathis Dam. Wesley E. Seale Dam is a rolled-fill earthen dam, 5,930 ft long, with two spillways. On the 1,320-foot north spillway there are 33 gates which are operated by movable hydraulic lifts. The 27 gates on the 1,080-foot south spillway are electrically operated from the control tower. Gates were repaired and modified in August 1966; each gate is 37.5 ft wide. Water for municipal supply for city of Corpus Christi is released through 5.0-foot diameter cylinder valve and three rectangular openings 2½ by 4 ft and is diverted from river at Calallen 35 miles downstream. Data regarding dam is shown in the following table:

Elevation	Elevation (feet)	Capacity (acre-feet)
Top of gates (when closed) on north spillway	94.5	--
Top of gates (when closed) on south spillway	94.0	302,100
Crest of spillways	88.0	185,900
Invert of three 2½- by 4-foot rectangular openings	55.5	140

Contents, in acre-feet, at 0600 hours, 1967

Day	September	October	Day	September	October	Day	September	October
1	139,700	308,700	11	177,700	302,100	21	236,100	299,900
2	142,500	308,700	12	180,900	302,100	22	320,000	297,800
3	145,400	308,700	13	184,300	302,100	23	313,200	299,900
4	148,300	306,500	14	187,600	302,100	24	317,700	302,100
5	149,700	304,300	15	192,700	302,100	25	315,500	302,100
6	151,200	302,100	16	196,100	308,700	26	313,200	302,100
7	155,700	302,100	17	299,600	302,100	27	311,000	304,300
8	161,800	304,300	18	203,100	304,300	28	313,200	302,100
9	169,600	304,300	19	206,700	304,300	29	313,200	302,100
10	174,400	302,100	20	210,300	302,100	30	311,000	306,500
						31	.....	299,900
Change in contents							+172,700	-11,100

(61) 8-2110. Nueces River near Mathis, Tex.

Location.--Lat 28°02'17", long 97°51'36", on left bank 6 ft downstream from pier of bridge on State Highway 359, 200 ft downstream from Texas and New Orleans Railroad Co. bridge, 0.6 mile downstream from Wesley E. Seale Dam, and 4 miles southwest of Mathis, San Patricio County.

Drainage area.--16,660 sq mi.

Gage-height record.--Digital-recorder tape punched at 15-minute intervals Sept. 1-21, water-stage recorder graph used Sept. 22-23, Sept. 28 to Oct. 6, Oct. 13-14, 26-31, and graph drawn through floodmark and readings obtained by employees of city of Corpus Christi at Wesley E. Seale Dam and USGS personnel for other periods. Datum of gage is 27.53 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 99,000 cfs and extended to 138,000 cfs on basis of computed peak flow through gates at Lake Corpus Christi.

Maxima.--September-October 1967: Discharge, 138,000 cfs 1800 hours Sept. 24 (gage height, 47.7 ft, from floodmark).
1939 to August 1967: Discharge, 49,400 cfs July 12, 1942 (gage height, 37.38 ft).
Highest stage known since 1888, that of Sept. 24, 1967. A stage of about 40 ft occurred Sept. 20, 1919, from information by Texas and New Orleans Railroad Co. and is the second highest known.

Remarks.--Flow regulated by Lake Corpus Christi (see preceding page). Numerous diversions above station for irrigation. Water for municipal and industrial use at Corpus Christi is released from Lake Corpus Christi above gage and is diverted from river at Calallen 34 miles downstream.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	109	22,900	11	101	542	21	679	1,720
2	109	15,500	12	114	91	22	57,900	1,170
3	132	11,700	13	105	67	23	91,200	1,180
4	100	9,300	14	99	61	24	122,000	1,570
5	102	7,350	15	100	456	25	125,000	1,430
6	96	4,740	16	100	6,030	26	107,000	157
7	102	3,240	17	101	1,590	27	91,100	1,110
8	110	2,540	18	105	977	28	67,600	987
9	112	2,130	19	110	1,680	29	49,200	329
10	110	1,830	20	205	1,730	30	34,500	1,520
						31	----------	343
Monthly mean discharge, in cubic feet per second							24,950	3,418
Runoff, in acre-feet							1,484,000	210,200

OSO CREEK BASIN

(62) Oso Creek at Violet, Tex.

(Miscellaneous site)

Location.--Lat 27°47'01", long 97°35'32", at Texas-Mexican Railroad Co. bridge, ½ mile east of Violet, Nueces County.

Drainage area.--45.8 sq mi.

Maximum.--September-October 1967: Discharge, 3,620 cfs Sept. 23, from contracted-opening measurement.

PETRONILLA CREEK BASIN

(63) 8-2115.5. Pintas Creek Tributary near Banquete, Tex.

(Crest-stage station)

Location.--Lat 27°42'36", long 97°49'57", at culvert on Farm Road 666, 0.8 mile north of intersection with Farm Road 665, and 7.0 miles south of Banquete, Nueces County.

Drainage area.--3.28 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder.

Discharge record.--Maximum discharge determined by flow-over-road and flow through culverts computations.

Maxima.--September-October 1967: Discharge, 1,300 cfs Sept. 21 (gage height, 10.40 ft).
1966 to August 1967: Discharge, 84 cfs May 5, 1966 (gage height, 8.43 ft).

SAN FERNANDO CREEK BASIN

(64) 8-2116. Hamon Creek near Freer, Tex.

(Crest-stage station)

Location.--Lat 27°46'30", long 98°34'10", at culvert on State Highway 339, 8.3 miles southeast of Freer, Duval County.

Drainage area.--0.73 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Discharge determined by computed culvert rating.

Maxima.--September-October 1967: Discharge, 40 cfs Sept. 22 (gage height, 5.20 ft, from floodmark).
1965 to August 1967: Discharge, 225 cfs Nov. 11, 1965 (gage height, 8.28 ft).

SAN FERNANDO CREEK BASIN

(65) 8-2118. San Diego Creek at Alice, Tex.

Location.--Lat 27°45'59", long 98°04'31", at bridge on Edith Drive, Alice, Jim Wells County, 540 ft downstream from Texas and New Orleans Railroad Co. bridge, and 3.2 miles upstream from confluence with Chiltipin Creek.

Drainage area.--319 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is 189.60 ft above mean sea level, datum of 1929, Houston supplementary adjustment of 1943.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 14,000 cfs 0600 hours Sept. 23 (gage height, 16.35 ft).

1963 to August 1967: Discharge, 1,130 cfs Mar. 30, 1965, from rating curve extended above 400 cfs by logarithmic plotting; gage height, 6.88 ft Oct. 20, 1965.

Highest stage since at least 1928, 18.2 ft April 1949 (discharge unknown), equivalent gage height in channel rectified in 1955, 17.2 ft.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	0	64	11	0	0	21	1,910	0
2	0	30	12	0	0	22	2,900	0
3	.10	13	13	0	0	23	8,610	0
4	21	4.5	14	0	0	24	1,170	0
5	14	15	15	0	0	25	368	0
6	.31	1.4	16	0	0	26	226	0
7	0	.05	17	0	0	27	170	0
8	0	0	18	0	0	28	136	0
9	0	0	19	0	0	29	103	0
10	0	0	20	118	0	30	74	0
						31	----------	0
Monthly mean discharge, in cubic feet per second							527	4.13
Runoff, in acre-feet							31,380	254

(66) 8-2118.5. Lake Alice at Alice, Tex.

Location.--Lat 27°47'25", long 98°03'39", on right bank just upstream from Alice dam on Chiltipin Creek, 1.8 miles upstream from confluence of Chiltipin and San Diego Creeks, and 2.6 miles northeast of Alice, Jim Wells County.

Drainage area.--150 sq mi.

Gage-height record.--Water-stage recorder graph. Datum of gage is mean sea level, datum of 1929 (levels by city of Alice).

Maxima.--September-October 1967: Contents, 4,150 acre-ft 2100 hours Sept. 22 (elevation, 198.00 ft).
1964 to August 1967: Contents, 3,270 acre-ft May 20, 1965 (elevation, 196.75 ft).

Remarks.--Lake is formed by Alice dam, which has a total length of 11,525 ft including 4,275 ft of west protective levee, a 1,000-foot temporary weir between the main embankment and the west protective levee, rolled earth fill west embankment 3,470 ft long, concrete siphon spillway 22½ ft wide, and concrete main spillway 414 ft wide, and rolled earth fill east embankment 2,343 ft long. Service spillway is a concrete siphon type 22½ ft wide with two 3,200 gallons per minute pumps. Main spillway is concrete, 414 ft wide with 13 30-foot wide slots for gates. Emergency spillway is 50 wood gates 20 ft wide by 3½ ft high, resting on concrete. Rolled earth filled embankments are 15 ft thick on top with varying bottom widths. The levee is a rolled earth fill embankment 8 ft thick on top with varying bottom widths. Dam is property of Alice Water Authority and was built to store water for use by the city of Alice. Storage began Oct. 26, 1964; dam completed Mar. 16, 1965. Capacity table based on data furnished by Lockwood, Andrews, and Newnam, Inc., revised using maps surveyed in 1963. Flow from 73.4 sq mi above this station was partly controlled by 6 floodwater-retarding structures with a total combined capacity of 15,690 acre-ft below the flood-spillway crests, of which 14,780 acre-ft is floodwater-retarding capacity and 912 acre-ft is sediment-pool capacity. All of these structures were built during the period September 1960 to January 1965. The capacity in these pools allocated to sediment storage will be used for conservation storage until eliminated by sedimentation. Data regarding dam and lake are given in the following table:

	Elevation (feet)	Capacity (acre-feet)
Top of dam	205.0	--
Top of west levee	202.0	--
Top of east levee	199.0	4,910
Elevation siphon spillway	196.0	2,780

Contents, in acre-feet, at 2400 hours, 1967

Day	September	October	Day	September	October	Day	September	October
1	91	2,860	11	315	2,770	21	3,640	2,860
2	104	2,850	12	307	2,760	22	4,130	2,850
3	175	2,870	13	300	2,740	23	3,380	2,830
4	338	2,860	14	295	2,750	24	3,280	2,810
5	347	2,880	15	293	2,760	25	3,250	2,780
6	336	2,870	16	295	2,950	26	3,240	2,760
7	333	2,870	17	279	2,940	27	3,180	2,740
8	328	2,830	18	273	2,920	28	3,050	2,710
9	323	2,800	19	279	2,900	29	2,940	2,690
10	320	2,790	20	1,400	2,870	30	2,870	2,630
						31	----------	2,610
Change in contents							+2,784	-260

SAN FERNANDO CREEK BASIN

(67) 8-2119. San Fernando Creek at Alice, Tex.

Location.--Lat 27°46'20", long 98°02'00", on left bank 34 ft downstream from downstream bridge of two bridges on State Highways 44 and 359, 0.5 mile downstream from confluence of San Diego Creek and Chiltipin Creek, 2.3 miles upstream from head of Pintas Creek, and 2.7 miles northeast of Alice, Jim Wells County.

Drainage area. --507 sq mi.

Gage-height record.--Digital-recorder tape punched at 30-minute intervals except 1300 hours Sept. 15 to 1800 hours Sept. 19, 1200 hours Sept. 24 to 1300 hours Sept. 25, and 1000 hours Sept. 30 to 2400 hours Oct. 4. Water-stage recorder graph used Sept. 15-19 and graph drawn on basis of partial record and shape of graph at nearby stations Sept. 24-25, Sept. 30 to Oct. 4. Datum of gage is 161.68 ft above mean sea level, datum of 1929.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 16,900 cfs 0630 hours Sept. 23 (gage height, 15.86 ft).
1964 to August 1967: Discharge, 1,900 cfs May 1, 1966 (gage height, 8.75 ft).
Highest stage since at least 1949, that of Sept. 23, 1967.

Remarks.--San Diego Creek joins Chiltipin Creek below Lake Alice to form San Fernando Creek. Flow regulated by Lake Alice (station 8-2118.5) since Oct. 26, 1964.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	2.1	111	11	1.1	1.5	21	5,040	1.2
2	1.9	50	12	1.2	1.7	22	7,230	1.1
3	4.8	19	13	1.2	2.0	23	12,900	1.4
4	78	10	14	1.3	2.1	24	2,000	1.4
5	121	21	15	1.3	2.6	25	897	1.4
6	16	6.8	16	1.6	23	26	631	1.3
7	4.4	3.7	17	1.4	3.5	27	546	1.2
8	2.2	4.7	18	1.4	2.4	28	385	1.2
9	1.5	2.5	19	1.9	1.8	29	222	1.1
10	1.3	1.6	20	484	1.4	30	124	13
						31	----------	1.6
Monthly mean discharge, in cubic feet per second							1,023	9.62
Runoff, in acre-feet							60,900	591

(68) 8-2123. Tranquitas Creek at Kingsville, Tex.

(Crest-stage station)

Location.--Lat 27°31'33", long 97°52'02", at downstream side of bridge on U.S. Highway 77, Business Route, Kingsville, Kleberg County, and 5.9 miles downstream from Tranquitas Dam.

Drainage area.--48.5 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder. Datum of gage is 50.27 ft above mean sea level, datum of 1929.

Maxima.--September-October 1967: Gage height, 4.51 ft 0115 hours Sept. 21.
1965 to August 1967: Gage height, 3.90 ft May 16, 1965.

LOS OLMOS CREEK BASIN

(69) 8-2124. Los Olmos Creek near Falfurrias, Tex.

Location.--Lat 27°15'51", long 98°08'08", at downstream side of bridge on U.S. Highway 281, 0.2 mile north of Jim Wells-Brooks County line, and 2.6 miles north of Falfurrias, Brooks County.

Drainage area.--480 sq mi, of which 4.5 sq mi is probably noncontributing.

Gage-height record.--Water-stage recorder graph.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 3,380 cfs 0600 hours Sept. 24 (gage height, 11.79 ft).
Highest stage known since at least 1929, 15.0 ft Sept. 13, 1951, from information by Texas Highway Department.

Remarks.--During September 1967 much of the flow may have crossed over into adjacent basins to the south and the flow passing the gage would therefore represent only part of the total flow.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	15	1.8	11	0.41	0.47	21	1,580	0.68
2	3.3	.84	12	.38	.44	22	2,300	.44
3	272	.56	13	.38	.41	23	2,910	.38
4	363	.56	14	.38	.41	24	3,230	.29
5	368	.56	15	.35	.44	25	2,020	.20
6	142	.50	16	.38	4.4	26	1,110	.20
7	22	.47	17	.35	27	27	274	.20
8	5.2	.44	18	.29	32	28	24	.23
9	1.5	.38	19	.38	10	29	11	.26
10	.65	.47	20	57	1.5	30	5.5	.23
						31	----------	.26
Monthly mean discharge, in cubic feet per second							491	2.81
Runoff, in acre-feet							29,190	173

PALO BLANCO CREEK BASIN

(70) Palo Blanco Creek near Falfurrias, Tex.

(Miscellaneous site)

Location.--Lat 27°15'48", long 98°22'48", at culvert on State Highway 285, 0.3 mile downstream from unnamed tributary, and 15½ miles west of Falfurrias, Brooks County.

Drainage area.--343 sq mi.

Maximum.--September-October 1967: Discharge, 16,600 cfs Sept. 23, from flow-through-culvert and flow-over-road measurement.

RIO GRANDE BASIN

(71) 8-4596. Arroyo San Bartolo at Zapata, Tex.

(Crest-stage station)

Location.--Lat 26°55'40", long 99°17'20", at culvert on U.S. Highway 83, 1 mile north of Zapata, Zapata County.

Drainage area.--0.61 sq mi.

Gage-height record.--Crest stages only.

Discharge record.--Discharge determined by computed culvert rating.

Maxima.--September-October 1967: Discharge, 225 cfs Sept. 1, 1967 (gage height, 3.73 ft).
1966 to August 1967: Discharge, 570 cfs May 16, 1967 (gage height, 10.9 ft).

(72) 8-4612. International Falcon Reservoir

(International Boundary and Water Commission gage)

Location.--Lat 26°33'25", long 99°10'05", at Falcon Dam on the Rio Grande, 84.5 river miles downstream from Laredo, Webb County, Tex., and Nuevo Laredo, Tamaulipas, Mex., and at mile 273.8.

Drainage area.--164,482 sq mi (contributing area), of which 87,760 sq mi is in the United States and 76,722 sq mi is in Mexico.

Gage-height record.--Water-stage recorder.

Storage record.--Area and capacity curves based on survey made in 1956.

Maxima.--September-October 1967: Storage, 2,948,139 acre-ft Oct. 8 (gage height, 303.22 ft).
1953 to August 1967: Storage, 3,490,600 acre-ft Oct. 19, 1958.

Remarks.--Records furnished by International Boundary and Water Commission. Capacity at spillway elevation is 3,280,683 acre-ft. No releases were made during the period Sept. 9 to Oct. 8, 1967.

Contents, in acre-feet, at 2400 hours, 1967

Day	September	October	Day	September	October	Day	September	October
1	1,637,959	2,848,572	11	1,731,155	2,941,721	21	1,998,064	2,853,933
2	1,640,405	2,870,062	12	1,736,845	2,938,059	22	2,134,497	2,841,438
3	1,651,436	2,889,876	13	1,741,912	2,930,745	23	2,276,136	2,827,212
4	1,661,278	2,907,076	14	1,747,623	2,920,712	24	2,443,215	2,816,581
5	1,687,902	2,917,981	15	1,757,167	2,912,524	25	2,572,407	2,804,218
6	1,702,247	2,927,094	16	1,765,463	2,900,729	26	2,677,054	2,793,656
7	1,708,507	2,945,387	17	1,798,883	2,896,203	27	2,758,684	2,789,265
8	1,714,152	2,948,139	18	1,839,878	2,888,070	28	2,795,414	2,786,633
9	1,719,809	2,945,387	19	1,874,798	2,878,155	29	2,818,350	2,784,003
10	1,725,476	2,943,553	20	1,910,116	2,867,369	30	2,830,763	2,784,880
						31	----------	2,784,880
Momentary maximum							2,830,763	2,948,139
Momentary minimum							1,632,465	2,784,003

RIO GRANDE BASIN

(73) 8-4613. Rio Grande below Falcon Dam, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°33'25", long 99°10'05", about 7 miles southwest of Falcon, Zapata County, and at mile 273.8.

Drainage area.--164,482 sq mi (contributing area), of which 87,760 sq mi is in the United States and 76,722 sq mi is in Mexico.

Gage-height record.--Water-stage recorder located 2.5 miles downstream to record flow then spillway gages are in operation.

Discharge record.--Discharge computed from daily Simplex meter records of releases through the six turbines, established rating curves for the four hollow-jet-by-pass valves, estimates of gate leakage, and spillway discharge determined from stage-discharge relation defined by current-meter measurements made at the cableway located one mile downstream from the water-stage recorder.

Maxima.--September-October 1967: Discharge, 9,540 cfs (maximum daily) Oct. 19.
1953 to August 1967: Discharge, 48,900 cfs Nov. 9, 1958.

Remarks.--Records furnished by International Boundary and Water Commission. Permanent storage in Falcon Reservoir began Aug. 25, 1953. No releases were made during the period Sept. 9 to Oct. 8, 1967.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	18.0	18.0	11	18.0	5,120	21	18.0	9,530
2	18.0	18.0	12	18.0	6,260	22	18.0	9,500
3	18.0	18.0	13	18.0	6,780	23	18.0	9,160
4	18.0	18.0	14	18.0	7,520	24	18.0	8,510
5	18.0	18.0	15	18.0	8,040	25	18.0	8,520
6	18.0	18.0	16	18.0	8,000	26	18.0	7,540
7	18.0	18.0	17	18.0	8,680	27	18.0	5,800
8	198	18.0	18	18.0	9,320	28	18.0	2,010
9	18.0	4,520	19	18.0	9,540	29	18.0	1,690
10	18.0	4,550	20	18.0	9,490	30	18.0	1,530
						31	----------	1,520
Monthly mean discharge, in cubic feet per second							24.0	4,940
Runoff, in acre-feet							1,428	304,019

(74) 8-4620. Rio Alamo at Ciudad Mier, Tamaulipas, Mex.

(International Boundary and Water Commission gage)

Location.--Lat 26°27'10", long 99°09'20", at a point called "El Paso del Cantaro", 0.5 mile north of Ciudad Mier, Tamaulipas, and about 5 miles upstream from mouth, which is 12.4 river miles downstream from Falcon Dam.

Drainage area.--1,692 sq mi (contributing area) all in Mexico.

Gage-height record.--Water-stage recorder. Datum of gage is 188.35 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation in excess of weir capacity defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 86,500 cfs Sept. 22 (gage height, 26.90 ft).
1924 to August 1967: Discharge, 144,800 cfs Sept. 11, 1948 (gage height, 33.56 ft).
Highest flood since at least 1753, that of Sept. 11, 1948.

Remarks.--Records furnished by International Boundary and Water Commission.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	424	2,160	11	168	911	21	10,800	579
2	367	1,830	12	142	862	22	68,900	579
3	291	1,750	13	120	759	23	59,000	551
4	283	1,720	14	104	699	24	39,600	551
5	291	1,850	15	89.7	671	25	15,300	540
6	284	1,470	16	86.9	710	26	6,530	516
7	277	1,320	17	262	710	27	4,130	516
8	271	1,190	18	102	636	28	4,840	516
9	277	1,100	19	97.8	614	29	2,950	505
10	214	1,010	20	285	600	30	2,630	494
						31	----------	473
Monthly mean discharge, in cubic feet per second							7,310	915
Runoff, in acre-feet							434,387	56,338

RIO GRANDE BASIN

(75) Rio San Juan at Marte R. Gomez Dam, Tamaulipas, Mex.

(Ministry of Hydraulic Resources gage)

Location.--At dam on the Rio San Juan, 9.3 miles upstream from the Rio San Juan gaging station near Camargo, Tamaulipas.

Drainage area.--13,429 sq mi (contributing area) all in Mexico.

Gage-height record.--Water-stage recorder. Datum of gage is 7.64 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation for spillway determined empirically.

Maximum.--September-October 1967: Discharge, 160,000 cfs (maximum daily) Sept. 25.

Remarks.--Records furnished by International Boundary and Water Commission. On Oct. 2, 1946, Azucar Dam was officially named Marte R. Gomez Dam. Capacity at spillway elevation is 898,300 acre-ft.

Mean discharge, in cubic feet per second, 1967

Sept. 18	3,190	Sept. 25	160,000
19	4,780	26	122,000
20	4,830	27	78,000
21	9,230	28	54,100
22	48,900	29	40,400
23	105,000	30	30,300
24	144,000		

(76) 8-4642. Rio San Juan at Camargo, Tamaulipas, Mex.

(International Boundary and Water Commission gage)

Location.--Lat 26°18'50", long 98°50'20", on left bank opposite Camargo, Tamaulipas, 3.1 miles upstream from mouth, which is at river mile 237.8, and 9.3 miles downstream from Marte R. Gomez Dam.

Drainage area.--13,601 sq mi (contributing area) all in Mexico.

Gage-height record.--Water-stage recorder. No record was obtained after Sept. 21, when the gage flooded. Datum of gage is 130.45 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 115,000 cfs Sept. 25, 1967 (gage height, 42.03 ft).
1954 to August 1967: Discharge, 49,800 cfs Oct. 17, 1958 (gage height, 33.53 ft).

Remarks.--Records furnished by International Boundary and Water Commission. The spillway on Marte R. Gomez Dam was completed on July 5, 1946, although varying amounts of water had been impounded beginning in 1943. The gage flooded on Sept. 21, 1967, and considerable water overflowed the right bank above the station.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	16,500	32,500	11	5,090	9,920	21	28,000	1,120
2	12,100	24,400	12	4,730	9,040	22	99,200	424
3	9,460	19,100	13	4,270	8,330	23	106,000	353
4	8,300	16,300	14	3,990	7,770	24	109,000	353
5	7,840	16,200	15	3,670	7,100	25	115,000	283
6	7,630	14,700	16	3,390	6,710	26	108,000	283
7	7,980	13,100	17	3,250	6,530	27	90,000	283
8	7,200	12,000	18	3,140	5,930	28	67,800	353
9	6,290	11,500	19	4,730	4,240	29	51,500	713
10	5,650	10,800	20	7,590	2,780	30	40,200	1,040
						31	----------	1,180
Monthly mean discharge, in cubic feet per second							31,600	7,910
Runoff, in acre-feet							1,878,406	486,864

RIO GRANDE BASIN

(77) 8-4647. Rio Grande at Fort Ringgold, Rio Grande City, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°22'05", long 98°48'20", 1 mile downstream from Rio Grande City, Starr County, 3.9 miles downstream from Rio San Juan, and at mile 233.9.

Drainage area.--180,396 sq mi (contributing area), of which 87,982 sq mi is in the United States and 92,414 sq mi is in Mexico.

Gage-height record.--Water-stage recorders (graphic and digital) and impulse-type transmitter located on the left bank at Fort Ringgold. Datum of gage is 100.00 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 220,000 cfs Sept. 23 (gage height, 61.40 ft).
1955 to August 1967: Discharge, 104,000 cfs Oct. 17, 1958 (gage height, 57.40 ft).
Since 1865: Discharge, 590,000 cfs June 1865.

Remarks.--Records furnished by International Boundary and Water Commission.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	18,800	33,200	11	5,140	15,300	21	26,100	11,300
2	14,500	26,000	12	4,700	15,200	22	168,000	10,600
3	11,400	20,400	13	4,390	15,200	23	207,000	10,500
4	9,540	17,100	14	4,110	15,100	24	195,000	9,830
5	8,610	16,500	15	3,830	15,400	25	176,000	9,680
6	8,280	15,100	16	3,620	15,400	26	159,000	9,330
7	8,610	13,300	17	3,590	15,000	27	118,000	8,410
8	7,790	12,200	18	3,590	14,700	28	76,300	4,520
9	6,910	13,100	19	4,570	14,200	29	55,000	3,150
10	5,890	16,200	20	7,490	12,800	30	41,900	3,110
						31	----------	3,210
Monthly mean discharge, in cubic feet per second							45,600	13,400
Runoff, in acre-feet							2,712,754	823,232

(78) 8-4661. Rio Grande Tributary near Rio Grande City, Tex.

(Crest-stage station)

Location.--Lat 26°18'58", long 98°39'47", at culvert on U.S. Highway 83, 6.0 miles northwest of Hidalgo-Starr County line, and 10.0 miles southeast of Rio Grande City, Starr County.

Drainage area.--3.37 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder.

Discharge record.--Discharge determined by computed culvert rating.

Maxima.--September-October 1967: Discharge, 125 cfs 1340 hours Sept. 22 (gage height, 4.79 ft).
1966 to August 1967: Discharge, 100 cfs June 19, 1966 (gage height, 4.61 ft).

(79) 8-4662. Rio Grande Tributary near Sullivan City, Tex.

(Crest-stage station)

Location.--Lat 26°17'11", long 98°35'18", at culvert on U.S. Highway 83, 0.9 mile northwest of Starr-Hidalgo County line, and 1.6 miles northwest of Sullivan City, Hidalgo County.

Drainage area.--2.47 sq mi.

Gage-height record.--Crest-stages and stage-rainfall recorder.

Discharge record.--Discharge determined by computed culvert rating.

Maxima.--September-October 1967: Discharge, 47 cfs 1300 hours Sept. 3 (gage height, 7.42 ft).
1966 to August 1967: Discharge, 40 cfs May 16, 1967 (gage height, 7.27 ft).

(80) 8-4680. Mission Branch Floodway south of McAllen, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°10'10", long 98°14'10", at Tenth Street bridge on State Highway 336, 2.5 miles south of McAllen, Hidalgo County.

Gage-height record.--Water-stage recorder. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 83,300 cfs Sept. 26 (gage height, 104.96 ft).
1926 to August 1967: Discharge, 38,710 cfs Sept. 7, 1932 (gage height, 100.82 ft, present datum).

Remarks.--Records furnished by International Boundary and Water Commission. This floodway diverts only excess floodwater from the Rio Grande at an inlet 6 miles upstream from Anzalduas Dam. When the stage at Anzalduas Dam reaches approximately 109 ft, the Rio Grande begins to divert into Mission Branch.

Mean discharge, in cubic feet per second, 1967

Sept. 23	12,200	Sept. 29	15,800
24	77,500	30	7,680
25	81,000	Oct. 1	3,660
26	80,800	2	1,540
27	64,000	3	663
28	37,500		

(81) 8-4686. Anzalduas Canal near Reynosa, Tamaulipas, Mex.

(International Boundary and Water Commission gage)

Location.--Lat 26°08'05", long 98°20'10", 0.5 mile from the canal intake, 5 miles northwest of Reynosa, Tamaulipas. The canal intake is immediately upstream from Anzalduas Dam at mile 171.6.

Gage-height record.--Water-stage recorder. Datum of gage is 86.32 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 5,650 cfs (maximum daily) Sept. 1.
1952 to August 1967: Discharge, 10,950 cfs June 2, 1957 (gage height, 16.01 ft).

Remarks.--Records furnished by International Boundary and Water Commission. Diversions by this canal are for irrigation and domestic use in Mexico and for conveying water for storage in Culebron, Villa Cardenas, and Palito Blanco reservoirs about 23 canal miles downstream from this station.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	5,650	35.3	11	14.1	2,640	21	14.1	14.1
2	2,140	35.3	12	14.1	1,770	22	35.3	14.1
3	70.6	35.3	13	14.1	1,760	23	70.6	14.1
4	70.6	35.3	14	14.1	1,390	24	816	14.1
5	53.0	35.3	15	14.1	14.1	25	1,980	14.1
6	53.0	35.3	16	14.1	14.1	26	657	14.1
7	42.4	738	17	14.1	14.1	27	242	14.1
8	42.4	4,450	18	14.1	14.1	28	70.6	42.4
9	42.4	5,160	19	14.1	14.1	29	70.6	42.4
10	35.3	4,060	20	14.1	14.1	30	35.3	42.4
						31	----------	42.4
Monthly mean discharge, in cubic feet per second							410	727
Runoff, in acre-feet							24,470	44,675

(82) 8-4692. Rio Grande below Anzaldaus Dam, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°08'00", long 98°20'05", 0.5 mile downstream from headworks of Anzalduas Canal and Anzalduas Dam, 12.2 miles upstream from International Bridge between Hidalgo County, Tex., and Reynosa, Tamaulipas, Mex., and at mile 171.1.

Drainage area.--182,138 sq mi (contributing area), of which 88,934 sq mi is in United States and 93,204 sq mi is in Mexico.

Gage-height record.--Water-stage recorder. Datum of gage is 82.61 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 131,000 cfs Sept. 24 (gage height, 30.51 ft).
1952 to August 1967: Discharge, 63,920 cfs Oct. 19, 1958 (gage height, 28.87 ft).

Remarks.--Records furnished by International Boundary and Water Commission. During floods a portion of the upstream river flow finds outlet to the Gulf of Mexico through Mission Branch in the United States and through Anzalduas Canal in Mexico.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	15,400	55,800	11	6,110	13,900	21	12,500	13,000
2	15,600	48,700	12	5,330	15,100	22	20,400	12,000
3	15,400	40,300	13	4,870	14,900	23	51,900	11,200
4	14,800	33,000	14	4,450	14,900	24	117,000	10,700
5	12,500	26,300	15	4,170	16,200	25	121,000	10,100
6	10,200	22,100	16	4,060	16,700	26	117,000	9,850
7	9,040	18,800	17	3,960	16,300	27	104,000	9,290
8	8,580	11,700	18	3,850	15,700	28	89,700	6,530
9	8,120	9,110	19	3,850	15,300	29	77,000	5,260
10	7,270	10,700	20	5,720	14,300	30	65,300	4,270
						31	----------	3,710
Monthly mean discharge, in cubic feet per second							31,300	17,000
Runoff, in acre-feet							1,862,856	1,042,905

(83) 8-4700. Hackney Branch Floodway south of McAllen, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°08'30", long 98°14'30", at bridge on State Highway 336, 4.5 miles south of McAllen, Hidalgo County.

Gage-height record.--Water-stage recorder. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 43,300 cfs Sept. 26 (gage height, 106.22 ft).
1926 to August 1967: Discharge, 29,120 cfs Sept. 8, 1932 (gage height, 101.81 ft, present datum).

Remarks.--Records furnished by International Boundary and Water Commission. This floodway diverts only excess floodwater from the Rio Grande at an inlet 7 miles downstream from Anzalduas Dam. When the stage of the Rio Grande at Hidalgo reaches approximately 100 ft, the Rio Grande begins to divert into Hackney Branch.

Mean discharge, in cubic feet per second, 1967

Sept. 23	565	Sept. 29	23,100
24	22,700	30	14,400
25	39,000	Oct. 1	8,550
26	42,700	2	5,040
27	36,400	3	2,310
28	29,800	4	1,020

(84) 8-4701. North Floodway west of Mercedes, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°08'30", long 97°55'50", at bridge on U.S. Highway 83 west of Mercedes, Hidalgo County.

Gage-height record.--Water-stage recorder. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 61,200 cfs Sept. 26 (gage height, 72.45 ft).
1933 to August 1967: Discharge, 37,200 cfs Oct. 20, 1958 (gage height, 69.40 ft).

Remarks.--Records furnished by the International Boundary and Water Commission.

Mean discharge, in cubic feet per second, 1967

Sept. 24	34,900	Sept. 30	19,600
25	57,200	Oct. 1	14,700
26	60,100	2	10,700
27	52,100	3	6,940
28	42,000	4	4,440
29	27,900	5	2,720

(85) 8-4702. North Floodway near Sebastian, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°18'50", long 97°46'35", at bridge on U.S. Highway 77, approximately 2 miles south of Sebastian, Willacy County.

Gage-height record.--Water-stage recorder. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 59,200 cfs Sept. 26 (gage height, 46.67 ft).
1933 to August 1967: Discharge, 39,300 cfs Oct. 20, 1958 (gage height, 45.07 ft).

Remarks.--Records furnished by International Boundary and Water Commission.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	84.0	18,200	11	67.6	1,490	21	2,380	858
2	75.7	14,700	12	65.2	1,370	22	4,950	738
3	73.1	11,500	13	64.7	1,270	23	7,550	673
4	79.6	8,700	14	65.2	1,180	24	14,900	669
5	73.4	6,680	15	64.7	1,090	25	58,300	660
6	74.8	5,050	16	75.6	1,150	26	58,400	617
7	71.3	3,520	17	114	1,210	27	55,200	594
8	67.9	2,780	18	108	1,180	28	45,800	576
9	67.3	2,090	19	108	1,080	29	31,800	533
10	69.1	1,730	20	586	981	30	23,100	496
						31	----------	452
Monthly mean discharge, in cubic feet per second							10,100	3,030
Runoff, in acre-feet							603,847	186,086

(86) 8-4703. Arroyo Colorado Floodway south of Mercedes, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°07'45", long 97°54'45", at El Fuste Siphon, 1.4 miles downstream from the Arroyo Colorado Heading, and 1.5 miles south of Mercedes, Hidalgo County.

Gage-height record.--Water-stage recorder. Datum of gage is 51.97 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maximum.--September-October 1967: Discharge, 60,100 cfs Sept. 26 (gage height, 15.94 ft).

Remarks.--Records furnished by International Boundary and Water Commission. The flow into the Arroyo Colorado is controlled by a concrete and sheet pipe structure at the point of diversion from the main floodway. During the present flood, this structure failed and flow into the Arroyo Colorado was uncontrolled.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	92.3	6,590	11	47.6	594	21	1,250	192
2	112	3,910	12	45.8	512	22	1,570	169
3	173	2,530	13	42.4	428	23	1,420	154
4	222	1,850	14	44.3	358	24	20,200	157
5	235	1,470	15	44.3	334	25	52,800	150
6	201	1,190	16	69.9	334	26	58,200	135
7	135	1,010	17	88.7	315	27	51,300	131
8	90.6	881	18	73.4	287	28	37,300	128
9	66.0	782	19	62.1	255	29	24,000	124
10	54.7	692	20	238	208	30	13,800	100
						31	----------	83.8

Monthly mean discharge, in cubic feet per second	8,800	840
Runoff, in acre-feet	523,601	51,678

(87) 8-4704. Arroyo Colorado Floodway south of Harlingen, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°10'20", long 97°41'55", at bridge on U.S. Highway 83 south of Harlingen, Cameron County.

Gage-height record.--Staff-gage readings. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 55,400 cfs Sept. 26 (gage height, 43.85 ft).
1933 to August 1967: Discharge, 19,700 cfs Oct. 21, 1958 (gage height, 33.68 ft).

Remarks.--Records furnished by International Boundary and Water Commission.

Mean discharge, in cubic feet per second, 1967

Sept. 24	5,860	Sept. 29	31,700
25	45,000	30	17,600
26	54,500	Oct. 1	9,460
27	54,700	2	5,560
28	49,500		

(88) 8-4725. Retamal Canal near Rio Bravo, Tamaulipas, Mex.

(Ministry of Hydraulic Resources gage)

Location.--Lat 26°02'20", long 98°02'25", near Rio Bravo, Tamaulipas, and 38 miles downstream from Anzalduas Dam.

Gage-height record.--No records were obtained.

Discharge record.--No records were obtained. An estimate of the volume of water diverted into this floodway can be obtained by computing the difference between the discharge below the Hackney Inlet and the Progresso station. Based on preliminary data, approximately 700,000 acre-ft were diverted by this floodway during September and October 1967.

Remarks.--Computation of diversion based on records furnished by International Boundary and Water Commission. Part of the excess water from floods entering the Lower Rio Grande Valley is diverted from the river through the Mexican Floodway System, with inlets 38 miles (Retamal Heading), 51 miles (San Rafael), and 107 miles (Floodway No. 2), respectively, downstream from Anzalduas Dam. Retamal Heading is equipped with gates and may divert floodwater at any stage. Floodwater diverted through Retamal Heading flows through Retamal Canal into Culebron and Villa Cardenas Lakes from which it discharges through floodgates into Floodway No. 1 and flows southeastward into the Gulf of Mexico.

RIO GRANDE BASIN

(89) 8-4733. Rio Grande near Progreso, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°03'45", long 97°57'00", at the Progreso International Bridge, 2 miles south of Progreso, Hidalgo County, and at mile 123.8.

Drainage area.--182,173 sq mi (contributing area), of which 88,947 sq mi is in the United States and 93,226 sq mi is in Mexico.

Gage-height record.--Water-stage recorder. Datum of gage is 52.56 ft above mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 60,700 cfs Sept. 26 (gage height, 24.84 ft).
1954 to August 1967: Discharge, 19,900 cfs Oct. 22, 1958 (gage height, 23.69 ft).

Remarks.--Records furnished by International Boundary and Water Commission. During floods a portion of the upstream river flow finds outlet to the Gulf of Mexico through Mission Branch and Hackney Branch in the United States and through Anzalduas Canal and Retamal Canal in Mexico.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	12,600	23,600	11	6,960	10,100	21	6,570	14,000
2	12,400	22,700	12	5,760	13,700	22	12,300	13,000
3	12,700	21,700	13	4,660	13,500	23	18,000	12,000
4	12,600	20,300	14	4,130	14,100	24	22,500	11,200
5	12,300	17,900	15	3,740	15,000	25	27,100	10,700
6	11,300	15,500	16	3,740	15,900	26	48,400	10,300
7	10,100	13,700	17	3,640	16,000	27	47,700	10,000
8	9,110	11,400	18	3,530	15,700	28	33,000	8,650
9	8,550	9,180	19	3,600	15,400	29	27,700	6,430
10	7,950	8,160	20	3,920	14,800	30	25,600	4,700
						31	----------	3,920
Monthly mean discharge, in cubic feet per second							14,100	13,300
Runoff, in acre-feet							837,532	819,671

(90) 8-4733.5. San Rafael Floodway near Progreso, Tamaulipas, Mex.

(Ministry of Hydraulic Resources gage)

Location.--Lat 26°03'05", long 97°54'50", near intake at San Rafael, Tamaulipas, and 51 miles downstream from Anzalduas Dam.

Gage-height record.--No records were obtained.

Discharge record.--No records were obtained. An estimate of the volume of water diverted by this floodway can be obtained by computing the difference in discharge between the Progreso and San Benito stations. Based on preliminary data, approximately 140,000 acre-ft were diverted by this floodway during September and October 1967.

Remarks.--Computation of diversion based on records furnished by International Boundary and Water Commission. Floodwater diverted at San Rafael flows through San Rafael Drain into Culebron and Villa Cardenas Lakes from which it discharges into Floodway No. 1.

RIO GRANDE BASIN

(91) 8-4737. Rio Grande near San Benito, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 26°02'00", long 97°43'40", 5.6 miles downstream from San Benito pumping plant, 9.5 miles southwest of San Benito, Cameron County, and at mile 96.5.

Drainage area.--182,187 sq mi (contributing area), of which 88,954 sq mi is in the United States and 93,233 sq mi is in Mexico.

Gage-height record.--Water-stage recorders (graphic and digital) and impulse-type transmitter. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements below 20,000 cfs and estimated above 20,000 cfs.

Maxima.--September-October 1967: Discharge, 25,000 cfs Sept. 29 (gage height, 61.05 ft).
1954 to August 1967: Discharge, 13,600 cfs Oct. 22, 1958 (gage height, 60.07 ft).

Remarks.--Records furnished by International Boundary and Water Commission. During floods a portion of the upstream river flow finds outlet to the Gulf of Mexico through Mission Branch and Hackney Branch Floodways in the United States and through Anzalduas Canal, Retamal Canal, and San Rafael Floodway in Mexico.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	11,000	21,900	11	7,170	10,700	21	4,880	13,400
2	10,800	21,100	12	6,190	11,800	22	8,280	12,700
3	11,200	20,700	13	5,140	12,300	23	11,600	12,000
4	11,500	20,000	14	4,350	12,500	24	13,300	11,100
5	11,400	19,100	15	3,770	12,800	25	15,000	10,800
6	10,900	18,100	16	3,420	13,300	26	16,300	10,600
7	10,200	17,000	17	3,460	14,200	27	17,300	10,400
8	9,310	15,800	18	3,470	14,300	28	19,600	9,660
9	8,530	13,200	19	3,620	14,500	29	24,800	7,770
10	7,960	11,300	20	3,970	13,900	30	23,900	5,720
						31	----------	4,190
Monthly mean discharge, in cubic feet per second							10,100	13,400
Runoff, in acre-feet							599,652	826,802

(92) 8-4741.7. Floodway No. 2 near Matamoros, Tamaulipas, Mex.

(Ministry of Hydraulic Resources gage)

Location.--Lat 25°54'40", long 97°34'00", west of Matamoros, Tamaulipas, and 107 miles downstream from Anzalduas Dam.

Gage-height record.--No records were obtained.

Discharge record.--No records were obtained. An estimate of the volume of water diverted by this floodway can be obtained by computing the difference in discharge between the San Benito and Lower Brownsville stations. Based on preliminary data, approximately 185,000 acre-ft were diverted by this floodway during September and October 1967.

Remarks.--Computation of diversion based on records furnished by International Boundary and Water Commisssion. Floodwater entering Floodway No. 2 is normally measured at the Matamoros-Reynosa highway crossing and flows south and east into the Gulf of Mexico.

RIO GRANDE BASIN

(93) 8-4750. Rio Grande near Brownsville, Tex.

(International Boundary and Water Commission gage)

Location.--Lat 25°52'35", long 97°27'15", 1,000 ft downstream from El Jardin pumping plant, 6.8 miles downstream from the International Highway bridge (Gateway) between Brownsville, Cameron County, Tex., and Matamoros, Tamaulipas, Mex., and at mile 48.8.

Drainage area.--182,215 sq mi (contributing area), of which 88,968 sq mi is in the United States and 93,247 sq mi is in Mexico.

Gage-height record.--Water-stage recorder. Datum of gage is mean sea level, U.S. Coast and Geodetic Survey datum.

Discharge record.--Stage-discharge relation defined by current-meter measurements.

Maxima.--September-October 1967: Discharge, 15,900 cfs Sept. 30 (gage height, 30.59 ft); maximum gage height, 31.08 ft Sept. 30.
1934 to August 1967: Discharge, 31,700 cfs Oct. 8, 1945 (gage height, 31.48 ft).

Remarks.--Records furnished by International Boundary and Water Commission. During floods a portion of the upstream river flow finds outlet to the Gulf of Mexico through Mission Branch and Hackney Branch floodways in the United States and through Anzalduas Canal, Retamal Canal, San Rafael Floodway, and Floodway No. 2 in Mexico.

Mean discharge, in cubic feet per second, 1967

Day	September	October	Day	September	October	Day	September	October
1	10,500	15,500	11	7,750	9,620	21	4,420	13,400
2	10,800	15,000	12	7,110	10,200	22	5,230	13,100
3	10,900	14,800	13	6,280	11,600	23	8,250	12,500
4	11,200	14,500	14	5,340	12,500	24	11,200	11,600
5	11,300	13,900	15	4,590	12,900	25	11,800	10,900
6	11,100	13,400	16	4,080	13,500	26	12,100	10,400
7	10,500	12,800	17	3,810	13,800	27	12,200	10,100
8	9,790	12,200	18	3,730	13,900	28	12,600	9,560
9	8,930	11,400	19	3,760	13,700	29	13,400	8,810
10	8,240	10,600	20	4,200	13,400	30	15,200	7,200
						31	----------	5,580
Monthly mean discharge, in cubic feet per second							8,680	12,000
Runoff, in acre-feet							516,325	738,596