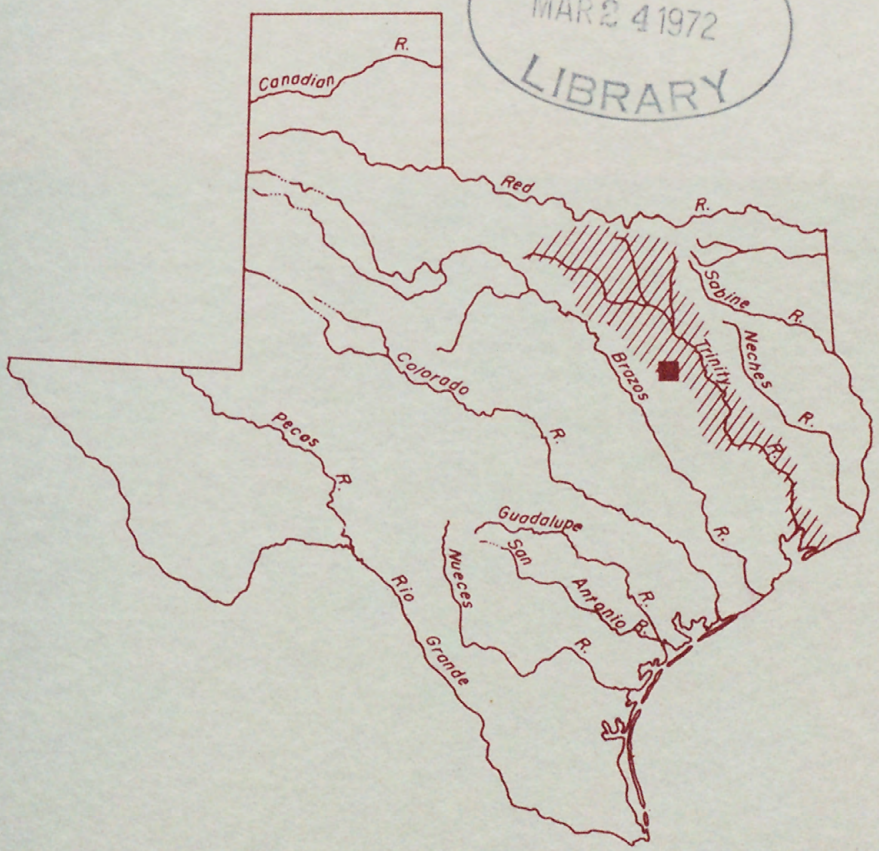
Annual Compilation and Analysis of Hydrologic Data for Pin Oak Creek, Trinity River Basin Texas, 1970

U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION



Prepared in cooperation with the Texas Water Development Board

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By D. R. Myers and B. B. Hampton

U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
Texas District Open-File Report
I. D. Yost, District Chief

Prepared in cooperation with the Texas Water Development Board

January 1972

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ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR PIN OAK CREEK, TRINITY RIVER BASIN, TEXAS 1970

By

D. R. Myers and B. B. Hampton

INTRODUCTION

History of Small Watershed Projects in Texas

The U.S. Soil Conservation Service is actively engaged in the installation of flood- and soil-erosion reducing measures in Texas under the authority of "The Flood Control Act of 1936 and 1944" and "Watershed Protection and Flood Prevention Act" (Public Law 566), as amended. The Soil Conservation Service has found a total of approximately 3,500 floodwater-retarding structures to be physically and economically feasible in Texas. As of September 30, 1970, 1,439 of these structures had been built.

This watershed-development program will have varying but important effects on the surface- and ground-water resources of river basins, especially where a large number of the floodwater-retarding structures are built. Basic hydrologic data under natural and developed conditions are needed to appraise the effects of the structures on the yield and mode of occurrence of runoff.

Hydrologic investigations of these small watershed study areas were begun by the U.S. Geological Survey in 1951 and are now being made in 12 areas (fig. 1). These investigations are being made in cooperation with the Texas Water Development Board, the Soil Conservation Service, the San Antonio River Authority, the city of Dallas, and the Tarrant County Water Control and Improvement District No. 1. The 12 study areas were chosen to sample watersheds having different rainfall, topography, geology, and soils. In five of the study areas (North, Little Elm, Mukewater, Little Pond-North Elm, and Pin Oak Creeks), streamflow and rainfall records were collected prior to construction of the floodwater-retarding structures, thus affording the opportunity for analyses of the conditions "before and after" development. Structures have now been built in four of these study areas. A summary of the development of the floodwater-retarding structures in each study area as of September 30, 1970, is shown in table 1.

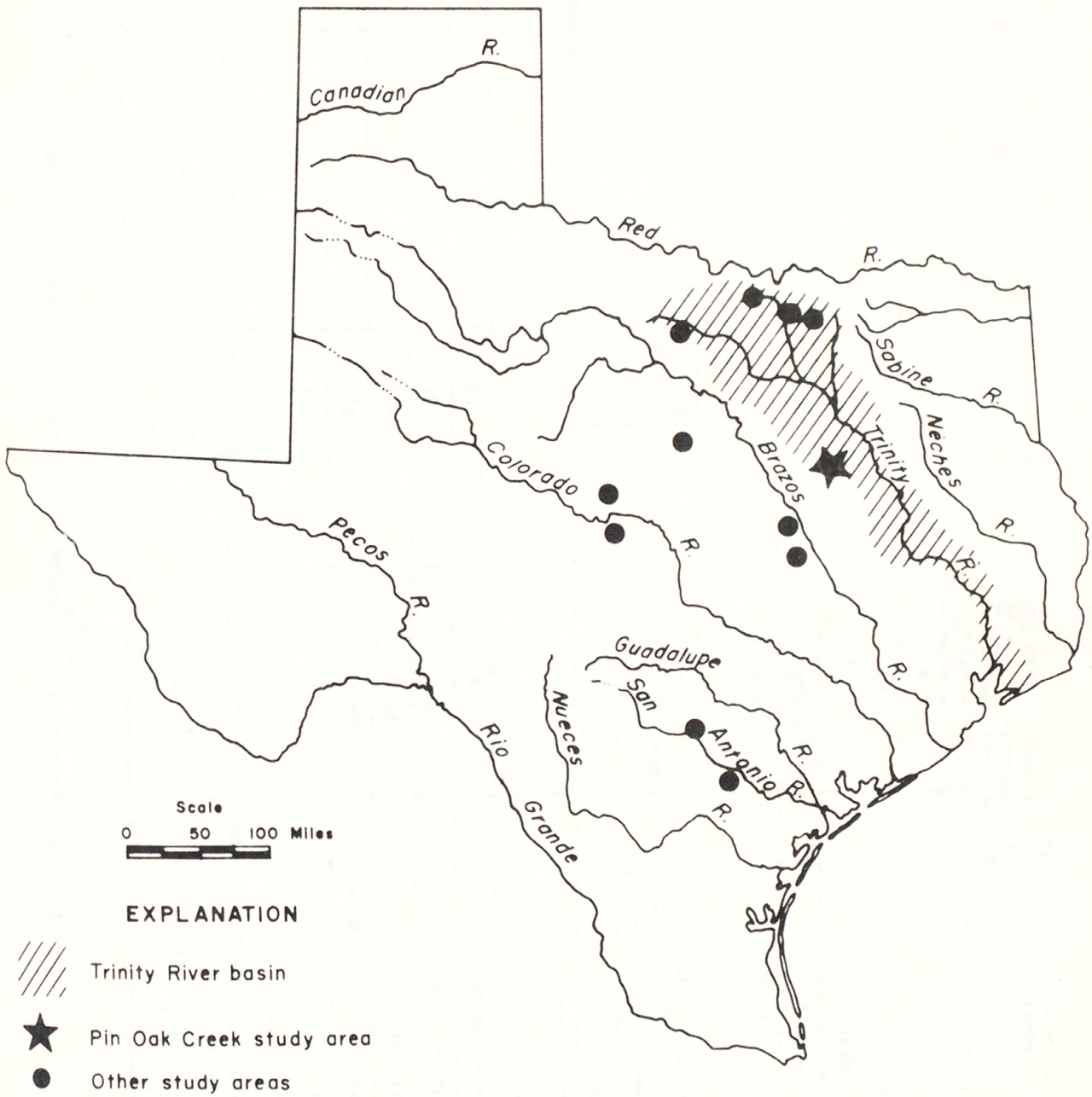


FIGURE 1.–Location of the Pin Oak Creek study area

Table 1.--Small watershed study areas in Texas as of September 30, 1970

Watershed	Drainage area above stream-gaging station (sq mi)	Hydrologic data collection began	Floodwater-retarding structures above stream-gaging station	Period the structures were built
Trinity River basin:				
North Creek near Jacksboro	21.6	Aug. 1956	1	1970
Elm Fork Trinity River near Muenster	46.0	July 1956	14	1954-57, 63
Little Elm Creek near Aubrey	75.5	June 1956	11	1966, 70
Honey Creek near McKinney	39.0	July 1951	13	1951-57, 69
Pin Oak Creek near Hubbard	17.6	Sept. 1956	6	1962-63, 65
Brazos River basin:				
Green Creek near Alexander	46.1	Oct. 1954	8	1954-56
Cow Bayou at Mooreville	85.0	Sept. 1954	26	1955-58, 64-65
1/Little Pond Creek at Burlington	22.2	Oct. 1962	None	-
1/North Elm Creek near Cameron	48.6	Oct. 1962	None	-
Colorado River basin:				
Mukewater Creek at Trickham	70.0	Aug. 1951	6	1961-62, 65
Deep Creek near Mercury	a/43.9	June 1951	5	1951-53
San Antonio River basin:				
Calaveras Creek near Elmendorf	77.2	Aug. 1954	c/ 7	1954-58
Escondido Creek at Kenedy	b/72.4	July 1954	10	1954-58

1/ Adjacent watersheds; considered as one study area.
a/ 8.31 sq mi above Dry Prong Deep Creek near Mercury not included in this total.
b/ 8.43 sq mi above Escondido Creek subwatershed No. 11 (Dry Escondido Creek) near Kenedy not included in this total.
c/ Six of the floodwater-retarding structures above Calaveras Creek near Elmendorf are in part of a 65.0 sq mi area controlled by Calaveras Creek Dam.

Objectives of the Texas Small Watershed Projects

The purpose of these investigations is to collect sufficient data to meet the following objectives:

1. To determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points.

2. To determine the effectiveness of the structures as ground-water recharge facilities.

3. To determine the effect of the structures on the sediment yield at downstream points.

4. To develop relationships between maximum rates and/or volumes of runoff with rainfall in small natural watersheds.

5. To develop a stream-system model for basins with floodwater-retarding structures.

6. To determine the minimum instrumentation necessary for estimating the flood hydrographs below a system of structures, as needed for downstream water-management operation.

Purpose and Scope of this Basic-Data Report

This report, which is the twelfth in a series of basic-data reports published annually for the Pin Oak Creek study area, contains the rainfall and runoff data collected during the 1970 water year for the 17.6-square-mile area above the stream-gaging station Pin Oak Creek near Hubbard, Texas. The locations of floodwater-retarding structures (ungaged) and hydrologic-instrument installations in the Pin Oak Creek study area are shown on figure 2.

The investigation is scheduled to continue through a period of both above- and below-normal precipitation to define the various factors used in the analyses of rainfall-runoff relationships before and after floodwater-retarding structures were built.

To facilitate the publication and distribution of this report at the earliest feasible time, certain material contained herein does not conform to the formal publication standards of the U.S. Geological Survey.

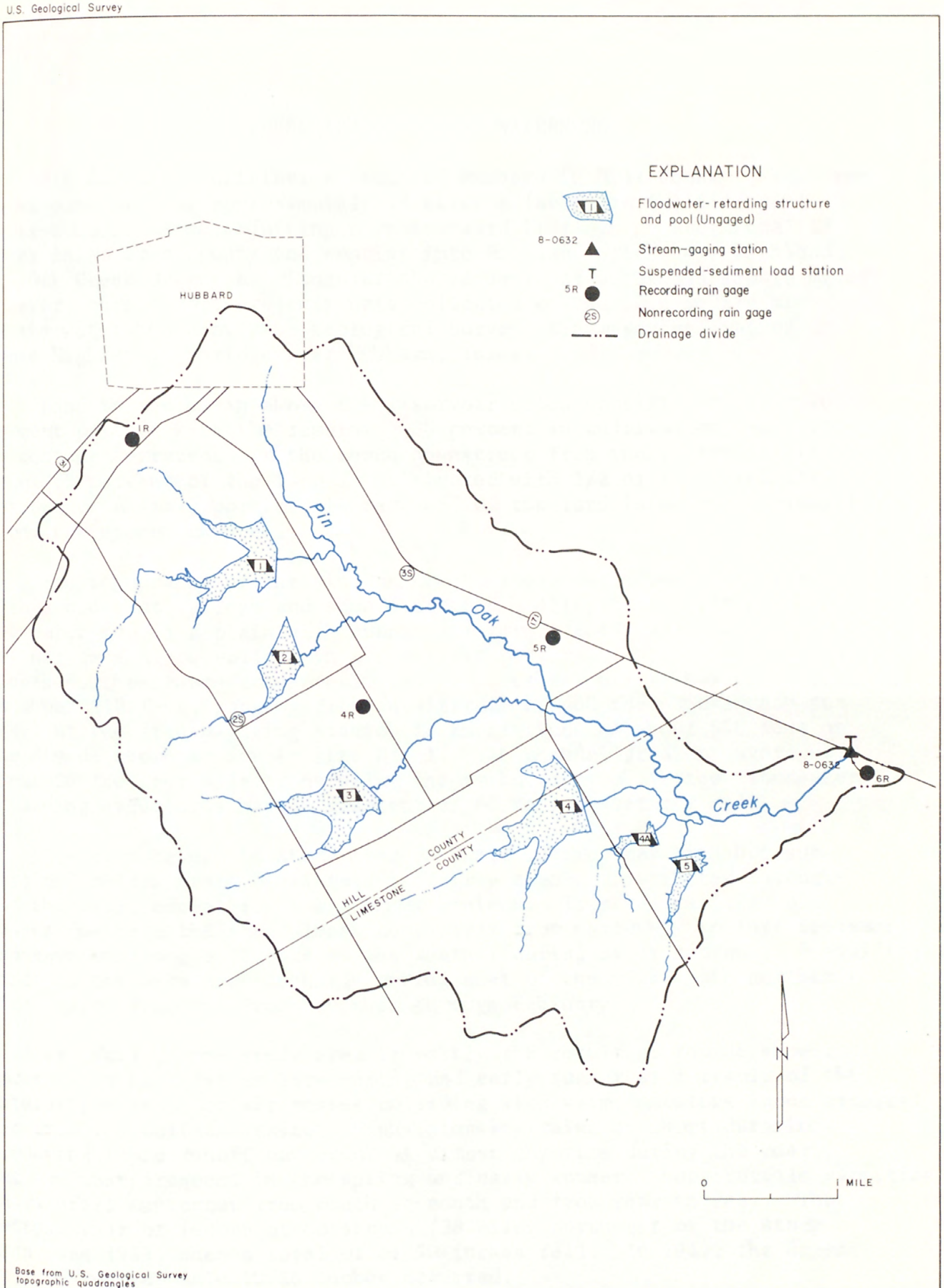


FIGURE 2.– Locations of floodwater-retarding structures and hydrologic-instrument installations in the Pin Oak Creek study area

DESCRIPTION OF THE WATERSHED

Pin Oak Creek originates south of Hubbard in Hill County. The creek flows eastward for approximately 14 miles adjacent to the Limestone-Navarro County line. Turning northeastward it flows an additional 14 miles in Navarro County and empties into Richland Creek near Richland. Pin Oak Creek drains a triangular-shaped basin of about 171 square miles. However, this report presents data collected on the 17.6 square miles of the watershed above the Geological Survey stream-gaging station at State Highway 171 bridge near Hubbard, Texas.

Land in the basin above the reservoir sites consists of about 70 percent pasture with the remaining 30 percent in cultivation, much of it contour terraced. In the reach downstream from the reservoir sites, about 80 percent of the land is cultivated with 1/2 of the cultivation terraced. A small portion, 15 percent, of the land is wooded, primarily along the stream channel.

The topography of the Pin Oak Creek watershed is gently rolling with broad flat valleys and some flattened hilltop areas. Primarily the watershed is a plain with numerous intermittent streams which have cut narrow shallow valleys in a dendritic pattern. The topographic plain slopes southeastward at approximately 17 feet per mile. Maximum relief is about 210 feet, ranging from an altitude of 460 feet above mean sea level at the stream-gaging station to an altitude of about 670 feet on the divide above reservoir site No. 1. The channel gradient averages about 20 feet per mile; generally, the tributaries above the floodwater-retarding structures have a gradient of 60 to 100 feet per mile.

The climate of the study area is humid subtropical with hot summers and mild winters. Rainfall is fairly evenly distributed throughout the year, except for a midsummer minimum. Tropical maritime air masses dominate the area almost completely from early May to late September and have a strong influence on the weather during other seasons. Prevailing winds in the area are southerly during most of the year, with northerly winds quite frequent from November through February.

Rainfall in the study area is mostly the result of thundershowers. Amounts are heaviest in late spring and early summer as a result of the interaction of polar air masses colliding with warm, moisture laden tropical air from the Gulf of Mexico. High-intensity rains of short duration, producing rapid runoff may occur at almost any time during the year, but are most frequent in the spring and early summer. Considerable variation in rainfall may occur from month to month and from year to year. The wettest year of record at Corsicana (28 miles northeast of the study area) was 1957, when a total of 61.50 inches fell. In 1917, the dryest year of record, only 19.36 inches occurred.

FLOODWATER-RETARDING STRUCTURES

Five floodwater-retarding structures in the study area were built during the 1963 water year, and one was completed in the 1965 water year. These six structures (sites 1, 2, 3, 4, 4A, and 5) have a combined total capacity of 3,480 acre-feet at the emergency spillway crests and partly control runoff from 9.68 square miles of the 17.6-square-mile area above the stream-gaging station. Pertinent information relating to each structure is given in table 2.

HYDROLOGIC INSTRUMENTS

Instruments to collect rainfall, runoff, and sediment data in the Pin Oak Creek study area consist of a network of rain gages and a stream-gaging station downstream from the floodwater-retarding structures. No instrumentation has been installed on the pool sites, and none is anticipated. Location of instruments presently in operation is shown on figure 2.

Four recording and two nonrecording rain gages are located in the study area to determine the amount and intensity of rainfall. The rain gages were located to give the best geometric coverage of the study area. Basin rainfall is computed as the arithmetic average of the six gages. Daily rainfall observed at the nonrecording gages is distributed to storm periods on the basis of the recorded rainfall.

The stream-gaging station, Pin Oak Creek near Hubbard, continuously records the stage, which together with measurements of streamflow are used to compute runoff from the study area. Streamflow records at this gage began September 1, 1956.

Suspended-sediment load is computed from daily or more frequent sediment samples collected at the gaging station. The collection of sediment data began in October 1956 and continued until September 1960 when the sediment station was discontinued. The sediment station was reestablished in September 1962, and data have been collected to the present time.

Table 2.--Floodwater-retarding structures in Pin Oak Creek study area, 1970 water year

Site number	Drainage area (sq mi)	Date dam completed	Capacity, in acre-feet		
			Total	Floodwater-retarding pool	Sediment pool
1	2.66	April 1963	836	769	67
2	0.99	April 1963	354	303	51
3	2.13	April 1963	791	641	150
4	2.39	November 1964	943	744	199
4A	0.51	December 1962	165	111	54
5	1.00	December 1962	391	283	108

SUMMARY OF DATA FOR 1970 WATER YEAR

Rainfall and Runoff

Average rainfall over the study area for the 1970 water year was 39.02 inches, or 105 percent of the long-term normal (1931-60) rainfall of 37.06 inches recorded by the U.S. Weather Bureau at Corsicana (28 miles northeast). Rainfall was scattered throughout the year with every month receiving some rainfall. The monthly rainfall totals ranged from 0.20 inch in June to 10.53 inches in September. The yearly mean discharge at the stream-gaging station Pin Oak Creek near Hubbard was 9.50 cfs (cubic feet per second), compared with the 14-year (1957-70) average of 11.6 cfs. The annual runoff at the stream-gaging station was 6,880 acre-feet, or 7.33 inches, which represents 19 percent of the total rainfall.

A storm event is defined as a period of rainfall separated by at least 6 hours from other rainfall. Storms are selected for detailed rainfall-runoff computations on the basis of rainfall totals and distribution, the peak discharge produced from the rainfall at the stream-gaging station, and the assurance of good rainfall and runoff records for the storm periods selected.

During the 1970 water year, four storm periods were selected for detailed computations and analyses. These computations include detailed time breakdown of rainfall and discharge, hydrograph, and mass curves. The storms selected occurred on February 24-25, March 1-3, March 6-7, and September 16-17, 1970. A summary of rainfall-runoff data for these storms is given in table 3. Computations along with hydrograph and mass curves for each storm are shown in the section "Compilation and Analysis of Data".

Water Quality

No chemical quality water samples were obtained during the 1970 water year at the stream-gaging station or at the reservoir sites.

Because suspended-sediment data for the 1969 water year were unavailable for inclusion in the previous annual report, the data are presented herein along with the 1970 water year data.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY-TEXAS DISTRICT

ANNUAL STORM RAINFALL-RUNOFF SUMMARY DATA

Table 3.--Storm rainfall-runoff data, 1970 water year.

Date of Storm	Rainfall (inches)					Runoff (inches)	Ratio runoff to rainfall	Maximum discharge (cfs)
	Duration (hours)	Total	Maximum increment					
			15-minute	30-minute	60-minute			
Pin Oak Creek near Hubbard, Tex. (Drainage area 17.6 sq mi, of which 9.68 sq mi is above floodwater-retarding structures)								
Feb. 24-25, 1970	30	2.09	0.12	0.24	0.36	0.90	0.43	525
Mar. 1- 3, 1970	49	1.87	.22	.33	.43	1.36	.73	428
Mar. 6- 7, 1970	25	1.12	.08	.16	.30	.70	.62	272
Sept. 16-17, 1970	35	6.14	.52	.71	1.09	1.03	.17	896

Suspended Sediment for the 1969 Water Year

The annual total sediment discharge for the 1969 water year at the stream-gaging station near Hubbard was 2,750 tons. The maximum daily sediment concentration of 1,080 mg/l (milligrams per liter) occurred on May 5, 1969, and the maximum daily sediment load of 1,210 tons also occurred on this date. There was no flow for many days during the year. Daily suspended-sediment loads for the 1969 water year are given in table 4.

Three suspended-sediment samples collected during 1969 at the stream-gaging station were analyzed for size distribution; the results are given in table 5 and indicate that the suspended sediment is composed mostly of silt and clay.

Suspended Sediment for the 1970 Water Year

The annual total sediment discharge for the 1970 water year at the stream-gaging station near Hubbard was 3,467.06 tons. The maximum daily sediment concentration of 994 mg/l occurred on February 24, 1970, and the maximum daily sediment load of 928 tons also occurred on this date. There was no flow for many days during the year. Daily suspended-sediment loads for the 1970 water year are given in table 6.

Seven suspended-sediment samples collected during 1970 at the stream-gaging station were analyzed for size distribution; the results are given in table 7 and indicate that the suspended sediment is composed mostly of silt and clay.

Table 4.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1969 water year.

DAILY SUSPENDED SEDIMENT, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

	OCTOBER			NOVEMBER			DECEMBER		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)
1	0	0	0	0	0	0	38	323	86
2	0	0	0	0	0	0	1.2	35	.11
3	0	0	0	0	0	0	.13	75	.03
4	0	0	0	0	0	0	.04	115	.01
5	0	0	0	0	0	0	.01	92	0
6	0	0	0	0	0	0	0	48	0
7	0	0	0	0	0	0	0	23	0
8	0	0	0	0	0	0	0	25	0
9	0	0	0	0	0	0	0	25	0
10	0	0	0	0	0	0	0	25	0
11	0	0	0	0	0	0	0	27	0
12	0	0	0	0	0	0	0	60	0
13	0	0	0	0	0	0	0	68	0
14	0	0	0	0	0	0	0	62	0
15	0	0	0	0	0	0	0	30	0
16	0	0	0	0	0	0	0	47	0
17	0	0	0	0	0	0	0	65	0
18	0	0	0	0	0	0	0	63	0
19	0	0	0	0	0	0	0	42	0
20	0	0	0	0	0	0	0	15	0
21	0	0	0	0	0	0	0	20	0
22	0	0	0	0	0	0	0	45	0
23	0	0	0	0	0	0	0	30	0
24	0	0	0	0	0	0	0	20	0
25	0	0	0	0	0	0	0	30	0
26	0	0	0	0	0	0	0	40	0
27	0	0	0	.10	57	.02	0	36	0
28	0	0	0	3.8	65	.67	0	35	0
29	0	0	0	.13	128	.04	0	30	0
30	0	0	0	23	599	126	0	35	0
31	0	0	0	--	--	--	0	25	0
TOTAL	0	--	0	27.03	--	126.73	39.38	--	86.15

Table 4.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1969 water year.--Continued

DAILY SUSPENDED SEDIMENT, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

	JANUARY			FEBRUARY			MARCH		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)
1	0	33	0	.10	40	.01	.27	105	.08
2	0	20	0	.08	32	.01	.33	83	.07
3	0	12	0	.06	30	0	1.3	140	.49
4	0	20	0	.02	43	0	.47	143	.18
5	0	20	0	.01	33	0	3.1	144	2.4
6	0	37	0	.01	20	0	16	138	7.2
7	0	40	0	.01	27	0	5.4	82	1.2
8	0	33	0	.01	40	0	9.6	110	2.9
9	0	20	0	.01	28	0	4.0	60	.65
10	0	32	0	.01	30	0	2.0	48	.26
11	0	36	0	.01	42	0	.94	45	.11
12	0	35	0	.01	46	0	.55	35	.05
13	0	32	0	.01	52	0	.27	35	.03
14	0	20	0	28	428	50	.17	32	.01
15	0	26	0	23	229	18	58	505	133
16	.04	55	.01	4.2	75	.85	43	168	24
17	.94	55	.14	1.1	32	.10	19	63	3.2
18	.13	35	.01	.33	45	.04	43	190	24
19	.03	43	0	.08	50	.01	16	125	5.4
20	.01	60	0	.08	33	.01	6.6	40	.71
21	.01	35	0	59	614	228	3.1	35	.29
22	.01	32	0	40	226	31	1.8	120	.58
23	.02	50	0	17	80	3.7	142	984	598
24	.02	37	0	6.9	83	1.5	54	270	39
25	.01	30	0	2.9	125	.98	35	150	14
26	.01	45	0	1.7	148	.68	18	120	5.8
27	.01	65	0	.94	162	.41	9.9	110	2.9
28	.01	82	0	.47	205	.26	4.4	120	1.4
29	.03	78	.01	--	--	--	2.4	140	.91
30	.06	55	.01	--	--	--	1.4	160	.60
31	.13	40	.01	--	--	--	.94	110	.28
TOTAL	1.47	--	.19	186.05	--	335.56	502.94	--	869.70

Table 4.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1969 water year.--Continued

DAILY SUSPENDED SEDIMENT, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

	APRIL			MAY			JUNE		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)
1	.79	100	.21	2.0	93	.50	.17	22	.01
2	2.9	90	.70	1.5	113	.58	.10	30	.01
3	8.4	80	1.8	4.6	96	1.3	.06	65	.01
4	193	689	882	3.8	89	.93	.17	40	.02
5	107	237	79	258	1080	1210	.27	25	.02
6	70	130	25	93	418	105	.08	25	.01
7	50	140	19	247	899	671	.03	27	0
8	32	150	13	96	250	65	.02	25	0
9	21	120	6.8	70	210	40	.02	25	0
10	12	110	3.6	59	220	35	.01	25	0
11	6.3	100	1.7	37	200	20	.01	20	0
12	161	621	485	25	150	10	.01	20	0
13	97	284	91	15	200	8.1	.01	20	0
14	49	128	17	7.5	200	4.1	.01	20	0
15	32	123	11	5.4	250	3.6	0	0	0
16	20	100	5.4	3.5	250	2.4	0	0	0
17	16	82	3.5	3.1	250	2.1	0	0	0
18	12	82	2.7	1.5	290	1.2	0	0	0
19	8.1	40	.87	.79	150	.32	0	0	0
20	6.3	42	.71	.68	130	.24	0	0	0
21	8.4	91	2.5	.68	92	.17	0	0	0
22	11	95	2.8	.40	45	.05	0	0	0
23	9.0	148	4.0	.40	41	.04	0	0	0
24	24	137	8.7	.33	36	.03	0	0	0
25	19	102	5.2	.13	30	.01	0	0	0
26	12	95	3.1	.13	27	.01	0	0	0
27	36	546	81	.13	50	.02	0	0	0
28	19	293	16	.13	55	.02	0	0	0
29	7.5	80	1.6	.17	34	.02	0	0	0
30	4.2	87	.99	.17	25	.01	0	0	0
31	--	--	--	.27	30	.02	--	--	--
TOTAL	1054.89	--	1775.88	937.31	--	2181.77	.97	--	.08

Table 4.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1969 water year.--Continued

DAILY SUSPENDED SEDIMENT, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969

	JULY			AUGUST			SEPTEMBER		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	LOAD (TONS)
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	--	--	--
TOTAL	0	--	0	0	--	0	0	--	0

TOTAL DISCHARGE FOR YEAR (CFS-DAYS) 2750.04
TOTAL LOAD FOR YEAR (TONS) 5376.06

TABLE 5.--PARTICLE-SIZE ANALYSES OF SUSPENDED SEDIMENT, PIN OAK CREEK NEAR HUBBARD, 1969 WATER YEAR.

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1968 TO SEPTEMBER 1969.
(METHODS OF ANALYSIS: B, BOTTOM WITHDRAWAL TUBE; C, CHEMICALLY DISPERSED; N, IN NATIVE WATER; P, PIPET; S, SIEVE; V, VISUAL ACCUMULATION TUBE; W, IN DISTILLED WATER)

DATE	TIME	WATER TEMPERATURE (C)	DISCHARGE (CFS)	CONCENTRATION (MG/L)	SUSPENDED SEDIMENT DISCHARGE (TONS/DAY)	PARTICLE SIZE PERCENT FINER THAN THE SIZE (IN MILLIMETERS) INDICATED											METHOD OF ANALYSIS
						.002	.004	.008	.016	.031	.062	.125	.250	.500	1.00	2.00	
FEB 21, 1969	2130	11.0	163	1170	515	54	61	69	77	88	95	99	100	--	--	--	SPWC
MAR 23.....	1030	15.0	355	987	946	89	95	96	97	98	100	--	--	--	--	--	SPWC
MAY 5.....	1000	20.5	750	4380	8870	47	57	59	74	77	94	100	--	--	--	--	SPWC

Table 6.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1970 water year.

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

	OCTOBER			NOVEMBER			DECEMBER		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
1	0	0	0	.05	50	.01	.09	23	.01
2	0	0	0	.01	30	0	.03	26	0
3	0	0	0	0	0	0	.01	44	0
4	0	0	0	0	0	0	.01	25	0
5	0	0	0	0	0	0	64	931	407
6	0	0	0	0	0	0	173	991	575
7	0	0	0	0	0	0	64	171	31
8	0	0	0	0	0	0	29	54	4.2
9	0	0	0	0	0	0	15	39	1.6
10	0	0	0	0	0	0	7.0	42	.79
11	0	0	0	0	0	0	3.6	48	.47
12	0	0	0	0	0	0	2.1	41	.23
13	0	0	0	0	0	0	1.4	46	.17
14	0	0	0	0	0	0	.89	35	.08
15	0	0	0	0	0	0	.63	14	.02
16	0	0	0	0	0	0	.42	16	.02
17	0	0	0	2.1	494	7.5	.36	17	.02
18	0	0	0	7.7	779	19	.40	11	.01
19	0	0	0	2.5	161	1.2	.33	10	.01
20	0	0	0	.53	50	.07	.32	30	.03
21	0	0	0	.17	34	.02	.31	30	.03
22	0	0	0	.04	41	0	.24	13	.01
23	0	0	0	.01	51	0	.23	20	.01
24	0	0	0	.01	37	0	.15	17	.01
25	0	0	0	.01	44	0	.10	16	0
26	0	0	0	.01	60	0	.04	16	0
27	0	0	0	.03	78	.01	.02	10	0
28	0	0	0	.68	59	.11	.50	57	.35
29	0	0	0	.62	48	.08	23	291	28
30	54	918	296	.22	28	.02	35	74	7.0
31	1.0	70	.19	--	--	--	13	25	.88
TOTAL	55.0	--	296.19	14.69	--	28.02	435.18	--	1056.95

Table 6.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1970 water year.--Continued

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

	JANUARY			FEBRUARY			MARCH		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
1	6.1	17	.28	47	736	142	74	384	124
2	3.5	15	.14	25	85	6.3	179	1050	792
3	2.8	11	.08	9.9	45	1.2	208	740	457
4	1.7	10	.05	5.1	42	.58	105	313	89
5	40	350	52	3.1	37	.31	78	240	50
6	41	58	6.4	2.3	42	.26	67	366	77
7	14	33	1.2	2.0	35	.19	173	532	266
8	8.9	32	.77	1.5	26	.11	90	184	48
9	4.8	44	.57	1.1	24	.07	58	140	22
10	2.8	27	.20	.68	21	.04	39	120	13
11	2.2	13	.08	.40	18	.02	73	345	86
12	1.6	23	.10	.40	28	.03	38	130	13
13	.85	44	.10	.33	15	.01	17	122	5.6
14	.74	22	.04	.22	16	.01	9.0	96	2.3
15	.55	57	.08	1.0	25	.07	5.5	88	1.3
16	.45	27	.03	2.6	44	.31	4.1	100	1.1
17	.40	22	.02	.94	37	.09	30	296	30
18	.42	25	.03	1.3	27	.09	12	80	2.6
19	.47	35	.04	.94	42	.11	7.3	82	1.6
20	.40	25	.03	.27	23	.02	4.9	94	1.2
21	.33	46	.04	.17	28	.01	29	154	13
22	.27	35	.03	.10	15	0	16	82	3.5
23	.22	29	.02	.17	19	.01	8.5	49	1.1
24	.22	19	.01	168	994	928	5.4	56	.82
25	.33	36	.03	169	607	298	3.9	33	.35
26	.40	27	.03	88	286	70	2.9	57	.45
27	.40	34	.04	65	175	31	2.5	58	.39
28	.33	20	.02	78	218	48	2.4	52	.34
29	.40	29	.03	--	--	--	2.3	38	.24
30	.33	42	.04	--	--	--	2.3	32	.20
31	.22	18	.01	--	--	--	2.1	26	.15
TOTAL	137.13	--	62.54	674.52	--	1526.84	1349.1	--	2103.24

Table 6.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1970 water year.--Continued

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

	APRIL			MAY			JUNE		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
1	2.1	30	.17	1.7	115	.53	.20	90	.05
2	1.9	22	.11	.40	118	.13	.09	70	.02
3	1.8	28	.14	.27	108	.08	.04	50	.01
4	1.8	26	.13	.22	125	.07	.04	30	0
5	1.6	28	.12	.22	114	.07	.02	15	0
6	1.5	30	.12	.22	111	.07	.01	10	0
7	1.5	30	.12	.22	92	.05	.01	10	0
8	1.4	30	.11	.13	106	.04	0	0	0
9	1.5	26	.11	.13	138	.05	0	0	0
10	4.8	44	.57	.13	120	.04	0	0	0
11	2.3	44	.27	.14	75	.03	0	0	0
12	1.6	44	.19	.10	65	.02	0	0	0
13	1.3	63	.22	.06	74	.01	0	0	0
14	1.1	61	.18	.04	75	.01	0	0	0
15	1.1	63	.19	.03	110	.01	0	0	0
16	1.0	80	.22	.02	122	.01	0	0	0
17	.92	75	.19	.01	109	0	0	0	0
18	.97	72	.19	.01	91	0	0	0	0
19	2.0	76	.41	0	108	0	0	0	0
20	1.4	90	.34	0	37	0	0	0	0
21	.80	74	.16	0	30	0	0	0	0
22	.68	86	.16	0	34	0	0	0	0
23	.54	111	.16	.02	37	0	0	0	0
24	.56	101	.15	.02	98	.01	0	0	0
25	.64	132	.23	.03	53	0	0	0	0
26	.63	75	.13	.05	65	.01	0	0	0
27	.68	112	.21	.03	67	.01	0	0	0
28	.61	102	.17	.07	94	.02	0	0	0
29	.50	101	.14	.32	140	.12	0	0	0
30	2.3	100	.62	.71	140	.37	0	0	0
31	--	--	--	1.1	150	.45	--	--	--
TOTAL	41.53	--	6.23	6.40	--	2.21	.41	--	.08

Table 6.--Daily, monthly, and yearly summary of water and suspended-sediment discharge, Pin Oak Creek near Hubbard, 1970 water year.--Continued

SUSPENDED-SEDIMENT DISCHARGE, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

	JULY			AUGUST			SEPTEMBER		
DAY	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)	MEAN DISCHARGE (CFS)	MEAN CONCEN-TRATION (MG/L)	SEDIMENT DISCHARGE (TONS/DAY)
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	5.0	155	7.6
17	0	0	0	0	0	0	369	2020	2220
18	0	0	0	0	0	0	116	621	219
19	0	0	0	0	0	0	74	210	42
20	0	0	0	0	0	0	48	140	18
21	0	0	0	0	0	0	28	61	4.6
22	0	0	0	0	0	0	18	82	4.0
23	0	0	0	0	0	0	8.4	68	1.5
24	0	0	0	0	0	0	2.9	65	.51
25	0	0	0	0	0	0	3.0	92	2.1
26	0	0	0	0	0	0	44	617	95
27	0	0	0	0	0	0	20	125	6.8
28	0	0	0	0	0	0	9.6	100	2.6
29	0	0	0	0	0	0	4.6	83	1.0
30	0	0	0	0	0	0	2.6	85	.60
31	0	0	0	0	0	0	--	--	--
TOTAL	0	--	0	0	--	0	753.1	--	2625.31

TOTAL DISCHARGE FOR YEAR (CFS-DAYS) 3467.06
TOTAL SUSPENDED-SEDIMENT DISCHARGE FOR YEAR (TONS) 7695.16

TABLE 7.--PARTICLE-SIZE ANALYSES OF SUSPENDED SEDIMENT, PIN OAK CREEK NEAR HUBBARD, 1970 WATER YEAR.

INSTANTANEOUS SUSPENDED SEDIMENT AND PARTICLE SIZE, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970
(METHODS OF ANALYSIS: B, BOTTOM WITHDRAWAL TUBE; C, CHEMICALLY DISPERSED; N, IN NATIVE WATER; P, PIPET; S, SIEVE; V, VISUAL ACCUMULATION TUBE; W, IN DISTILLED WATER)

DATE	TIME	WATER TEMPERATURE (C)	DISCHARGE (CFS)	CONCENTRATION (MG/L)	SUSPENDED SEDIMENT DISCHARGE (TONS/DAY)	PARTICLE SIZE PERCENT FINER THAN THE SIZE (IN MILLIMETERS) INDICATED											METHOD OF ANALYSIS
						.002	.004	.008	.016	.031	.062	.125	.250	.500	1.00	2.00	
OCT 30, 1969	1030	14.0	204	1670	920	61	72	81	86	92	96	100	--	--	--	--	SBWC
DEC 5.....	2000	11.0	222	1770	1060	49	57	64	71	78	87	99	100	--	--	--	SBWC
DEC 6.....	1030	09.0	258	2220	1550	50	56	61	67	74	79	98	100	--	--	--	SBWC
JAN 5, L970	1700	09.0	98	626	166	61	67	74	79	86	93	99	100	--	--	--	SBWC
FEB 1.....	1300	09.0	112	1970	596	41	49	53	65	79	87	99	100	--	--	--	SBWC
FEB 24.....	2030	13.0	525	2470	3500	46	49	53	61	70	82	98	100	--	--	--	SBWC
MAR 2.....	2000	18.0	424	1690	1930	43	47	54	59	68	82	96	100	--	--	--	SBWC

COMPILATION AND ANALYSIS OF DATA

TRINITY RIVER BASIN

08063200 Pin Oak Creek near Hubbard, Tex.

LOCATION.--Lat 31°48'01", long 96°43'02", Hill County, on right bank 85 ft downstream from bridge on State Highway 171, 5.8 miles southeast of Hubbard, and 11 miles upstream from Elm Creek.

DRAINAGE AREA.--17.6 sq mi.

PERIOD OF RECORD.--September 1956 to current year.

GAGE.--Water-stage recorder. Datum of gage is 463.08 ft above mean sea level.

AVERAGE DISCHARGE.--14 years, 11.6 cfs (8.95 inches per year, 8,400 acre-ft per year).

EXTREMES.--Current year: Maximum discharge, 896 cfs Sept. 17 (gage height, 10.48 ft); no flow for many days.
Period of record: Maximum discharge, 4,340 cfs Aug. 24, 1958 (gage height, 13.86 ft); no flow at times each year.
Maximum stage since at least 1900, about 17 ft in August 1919, from information by local resident.

REMARKS.--Records good. Since 1966, flow from 9.68 sq mi above this station has been partly controlled by 6 floodwater-retarding structures with a total combined capacity of 3,480 acre-ft below the flood-spillway crests, of which 2,850 acre-ft is floodwater-retarding capacity and 630 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. Three recording and two standard rain gages are located in the basin above the station, and one recording rain gage is located at the station. Records of suspended-sediment loads and water temperatures for the water year 1970 are published in Part 2 of this report.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1969 TO SEPTEMBER 1970

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0	.05	.09	6.1	47	74	2.1	1.7	.20	0	0	0
2	0	.01	.03	3.5	25	179	1.9	.40	.09	0	0	0
3	0	0	.01	2.8	9.9	208	1.8	.27	.04	0	0	0
4	0	0	.01	1.7	5.1	105	1.8	.22	.04	0	0	0
5	0	0	64	40	3.1	78	1.6	.22	.02	0	0	0
6	0	0	173	41	2.3	67	1.5	.22	.01	0	0	0
7	0	0	64	14	2.0	173	1.5	.22	.01	0	0	0
8	0	0	29	8.9	1.5	90	1.4	.13	0	0	0	0
9	0	0	15	4.8	1.1	58	1.5	.13	0	0	0	0
10	0	0	7.0	2.8	.68	39	4.8	.13	0	0	0	0
11	0	0	3.6	2.2	.40	73	2.3	.14	0	0	0	0
12	0	0	2.1	1.6	.40	38	1.6	.10	0	0	0	0
13	0	0	1.4	.85	.33	17	1.3	.06	0	0	0	0
14	0	0	.89	.74	.22	9.0	1.1	.04	0	0	0	0
15	0	0	.63	.55	1.0	5.5	1.1	.03	0	0	0	0
16	0	0	.42	.45	2.6	4.1	1.0	.02	0	0	0	5.0
17	0	2.1	.36	.40	.94	30	.92	.01	0	0	0	369
18	0	7.7	.40	.42	1.3	12	.97	.01	0	0	0	116
19	0	2.5	.33	.47	.94	7.3	2.0	0	0	0	0	74
20	0	.53	.32	.40	.27	4.9	1.4	0	0	0	0	48
21	0	.17	.31	.33	.17	29	.80	0	0	0	0	28
22	0	.04	.24	.27	.10	16	.68	0	0	0	0	18
23	0	.01	.23	.22	.17	8.5	.54	.02	0	0	0	8.4
24	0	.01	.15	.22	168	5.4	.56	.02	0	0	0	2.9
25	0	.01	.10	.33	169	3.9	.64	.03	0	0	0	3.0
26	0	.01	.04	.40	88	2.9	.63	.05	0	0	0	44
27	0	.03	.02	.40	65	2.5	.68	.03	0	0	0	20
28	0	.68	.50	.33	78	2.4	.61	.07	0	0	0	9.6
29	0	.62	23	.40	------	2.3	.50	.32	0	0	0	4.6
30	54	.22	35	.33	------	2.3	2.3	.71	0	0	0	2.6
31	1.0	------	13	.22	------	2.1	------	1.1	------	0	0	------
TOTAL	55.0	14.69	435.18	137.13	674.52	1,349.1	41.53	6.40	0.41	0	0	753.1
MEAN	1.77	.49	14.0	4.42	24.1	43.5	1.38	.21	.014	0	0	25.1
MAX	54	7.7	173	41	169	208	4.8	1.7	.20	0	0	369
MIN	0	0	.01	.22	.10	2.1	.50	0	0	0	0	0
CFSM	.10	.03	.80	.25	1.37	2.47	.08	.01	.0007	0	0	1.43
IN.	.12	.03	.92	.29	1.43	2.85	.09	.01	.0008	0	0	1.59
AC-FT	109	29	863	272	1,340	2,680	82	13	.8	0	0	1,490

CAL YR 1969 TOTAL 3,188.50 MEAN 8.74 MAX 258 MIN 0 CFSM .50 IN 6.74 AC-FT 6,320
WTR YR 1970: TOTAL 3,467.06 MEAN 9.50 MAX 369 MIN 0 CFSM .54 IN 7.33 AC-FT 6,880

9-220 c
(Oct. 1951)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

Sheet 1 of _____ Sheets

08-0632.00

Monthly and ~~annual discharge~~ yearly average rainfall, in inches, of Pin Oak Creek ~~River~~ at near Hubbard, Texas

[Drainage area, 17.6 square miles]

16—26489-5 U. S. GOVERNMENT PRINTING OFFICE

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	ANNUAL
			Station established September 1, 1956										
1956	-	-	-	-	-	-	-	-	-	-	-	0	-
1957	-	-	-	1.76	2.55	4.26	16.09	8.53	3.39	0.03	0.66	5.59	-
1958	5.36	4.02	0.83	2.36	1.95	1.70	3.97	3.66	2.11	1.16	9.16	4.67	40.95
1959	2.60	2.10	1.20	.37	2.90	1.23	4.66	5.98	9.01	3.12	1.24	1.11	35.52
1960	8.41	1.51	4.76	2.23	1.96	1.58	3.01	2.45	4.46	.20	5.95	1.35	37.87
1961	6.48	1.90	7.87	6.07	4.65	3.17	1.94	2.02	9.69	1.49	.45	4.24	49.97
1962	3.02	5.62	2.90	.86	2.94	1.07	5.54	2.80	5.96	.14	.10	3.78	34.73
1963	1.06	2.22	.98	.58	.71	.41	3.71	2.29	1.71	.12	1.65	1.27	16.71
1964	.31	3.36	1.21	2.76	1.68	2.13	1.37	1.42	1.31	.22	2.10	3.56	21.43
1965	.72	2.27	1.00	2.86	3.97	3.29	.97	13.10	1.07	.11	1.84	4.36	35.56
1966	1.97	3.24	1.88	1.66	3.00	1.79	14.80	1.62	.81	1.31	5.64	4.92	42.64
1967	.19	.08	1.22	.47	.75	1.44	5.31	3.46	4.38	1.70	1.38	7.52	27.90
1968	6.17	4.10	4.10	3.72	2.74	3.06	6.98	8.72	7.48	1.34	.28	3.26	51.95
1969	1.23	5.21	.74	1.21	2.55	3.90	5.46	3.94	.33	.09	2.72	1.04	28.42
1970	5.66	2.54	4.07	.91	4.43	4.59	2.40	1.83	.20	1.07	.79	10.53	39.02

9-220 c
(Oct. 1951)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

Sheet 1 of _____ Sheets

08-0632.00

yearly mean

Monthly and ~~annual~~ discharge, in cfs, of Pin Oak Creek ~~River~~ at or near Hubbard, Texas

[Drainage area, 17.6 square miles]

16—26489-5 U. S. GOVERNMENT PRINTING OFFICE

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	ANNUAL
			Station established September 1, 1956										
1956												0	-
1957	0	29.2	0.21	0.74	7.11	12.7	166	57.9	23.2	0	0	0.19	24.6
1958	10.5	5.69	0	.93	1.09	.14	4.09	19.4	0	0	37.5	10.9	7.59
1959	1.60	.71	.61	.19	13.4	.69	18.4	26.3	72.7	1.30	0	0	11.2
1960	30.8	1.41	25.4	16.2	3.03	2.11	3.70	2.27	4.36	0	4.43	0	7.89
1961	16.1	1.75	72.4	75.1	43.2	10.5	3.70	.35	52.6	.29	0	1.94	23.1
1962	.18	31.8	12.3	.41	9.60	1.84	25.6	2.72	13.3	.003	0	.87	8.09
1963	0	0	0	0	0	0	.74	.07	.05	0	0	0	.07
1964	0	0	0	.003	0	.17	0	0	0	0	0	1.30	.12
1965	0	0	0	1.84	6.14	12.3	8.10	99.3	4.18	0	0	.30	11.1
1966	.001	2.59	.40	.27	7.21	.62	114	37.8	.04	0	1.42	9.54	14.3
1967	.22	0	0	0	0	.003	11.5	2.02	26.2	0	0	11.1	4.20
1968	27.4	45.3	28.3	30.3	17.3	26.3	55.1	98.3	68.1	7.17	.28	0	33.6
1969	0	.90	1.27	.047	6.64	16.2	35.2	30.2	.032	0	0	0	7.53
1970	1.77	.49	14.0	4.42	24.1	43.5	1.38	.21	.014	0	0	25.1	9.50

Form A-88
Rev. 1-63

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey - Water Resources Division

RAINFALL DATA SUMMARY

STUDY AREA Pin Oak Creek — 1970 WATER YEAR

Date of Storm	RAIN GAGES 1-R	2-S	3-S	4-R	5-R	6-R	Average
Oct. 12, 1969	1.46	1.60	1.51	1.70	1.00	0.90	
27	1.15	1.20	1.34	1.10	1.00	.90	
28-30	3.05	3.47	3.84	3.40	3.05	2.30	
October Totals	5.66	6.27	6.69	6.20	5.05	4.10	5.66
Nov. 2, 1969	.20	0	.21	.22	.16	.17	
17	1.20	.70	.79	.85	.92	.56	
17-18	.90	.61	.70	.90	.75	.55	
24	.35	.35	.36	.35	.36	.32	
26-27	.45	.38	.55	.44	.48	.45	
November Totals	3.10	2.04	2.61	2.76	2.67	2.05	2.54
Dec. 5-6, 1969	2.75	2.95	2.65	2.90	2.62	2.74	
28	.65	.48	.62	.50	.65	.33	
29	.23	.33	.39	.50	.42	.47	
30	.45	.24	.35	.20	.20	.20	
31	.20	.07	.16	.03	.08	.04	
December Totals	4.28	4.07	4.17	4.13	3.97	3.78	4.07
1969 Calendar Year Total							33.51

Form A-88
Rev. 1-63

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey - Water Resources Division

RAINFALL DATA SUMMARY

STUDY AREA Pin Oak Creek — 1970 WATER YEAR

Date of Storm	RAIN GAGES 1-R	2-S	3-S	4-R	5-R	6-R	Average
Jan. 2, 1970	0.14	0.13	0.20	0.14	0.16	0.16	
5	.65	.75	.76	.70	.70	.97	
January Totals	.79	.88	.96	.84	.86	1.13	.91
Feb. 1, 1970	1.12	1.16	1.11	1.10	1.18	1.24	
6	.18	0	.11	.12	.08	.19	
15	.30	.46	.55	.50	.36	.40	
22	.05	.02	.05	.06	.05	0	
23	.14	.23	.16	.19	.21	.22	
24-25	1.96	2.04	2.19	2.10	2.19	2.04	
27-28	.45	.40	.42	.40	.44	.42	
February Totals	4.20	4.31	4.59	4.47	4.51	4.51	4.43
Mar. 1, 1970	.42	.42	.38	.48	.47	.30	
2	1.66	.92	1.00	.70	.80	.68	
3	.40	.46	.40	.55	.56	.62	
6-7	1.25	1.25	1.22	1.02	1.00	.95	
11	.65	.90	.58	.68	.65	.57	
16-17	.48	.54	.50	.48	.50	.42	
20-21	.48	.45	.50	.45	.40	.41	
March Totals	5.34	4.94	4.58	4.36	4.38	3.95	4.59

Form A-88
Rev. 1-63

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey - Water Resources Division

RAINFALL DATA SUMMARY

STUDY AREA Pin Oak Creek — 1970 WATER YEAR

Date of Storm	RAIN GAGES 1-R	2-S	3-S	4-R	5-R	6-R	Average
Apr. 9-10, 1970	0.88	1.06	0.58	1.10	1.02	1.00	
18-19	.48	.56	.62	.50	.65	.44	
24	.14	.15	.19	.10	.05	0	
30	.60	.90	.79	.77	.84	1.00	
April Totals	2.10	2.67	2.18	2.47	2.56	2.44	2.40
May 15, 1970	Trace	0	.03	.05	.05	.03	
21	.25	.23	.13	.18	.18	.06	
22	.05	.03	.03	0	0	.03	
26	.04	0	Trace	.06	.10	.32	
28	.78	.87	.90	.68	.68	.73	
30	.68	.74	.58	.77	.64	1.07	
May Totals	1.80	1.87	1.67	1.74	1.65	2.24	1.83
June 1, 1970	.16	.16	.10	.16	.10	.07	
22	0	0	0	.20	0	.17	
23	0	0	0	.11	0	0	
June Totals	.16	.16	.10	.47	.10	.24	.20

Form A-88
Rev. 1-63

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey - Water Resources Division

RAINFALL DATA SUMMARY

STUDY AREA Pin Oak Creek — 1970 WATER YEAR

Date of Storm	RAIN GAGES 1-R	2-S	3-S	4-R	5-R	6-R	Average
July 12, 1970	0.05	0	0.07	0.06	0.06	0.12	
15	0	0	0	0	0	.10	
21	.35	.20	.35	.40	.35	.21	
25	1.60	.60	.93	.25	.30	.40	
July Totals	2.00	.80	1.35	.71	.71	.83	1.07
Aug. 3, 1970	.12	.09	.22	.20	.28	.22	
21	0	.42	.11	0	0	0	
23	.20	.24	0	.15	.22	.14	
29	0	.32	.27	.25	0	0	
31	.25	.21	.23	.20	.10	.30	
August Totals	.57	1.28	.83	.80	.60	.66	.79
Sept. 1-2, 1970	2.30	2.17	2.36	2.30	2.55	2.40	
13	.20	.30	.22	.30	.16	.20	
16-17	6.08	7.33	5.71	6.25	6.25	5.20	
20	.12	.21	.05	.20	.05	.16	
23	.12	.23	.18	.20	.38	.33	
25-26	1.10	1.90	1.68	1.86	.98	1.15	
September Totals	9.92	12.14	10.20	11.11	10.37	9.44	10.53
Water Year Total							39.02

TX.-65 (Rev. 7-69)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - TEXAS DISTRICT

RUNOFF COMPUTATIONS

Station Pin Oak Creek near Hubbard, Tex.

Period of Record February 24-26, 1970 Drainage Area 17.6 sq. mi.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Inc.	In/Hr.	Runoff Inches	Acc. In.
	Feb. 24, 1970						
0000	1.60	0	.22	3.5	.0000	.0000	.0000
0700	1.70		1.2	4.5	.0001	.0004	.0004
0900	1.82		3.1	1.5	.0003	.0004	.0008
1000	1.90		4.8	1	.0004	.0004	.0012
1100	2.02		8.4	1	.0007	.0007	.0019
1200	2.13		12	1	.0011	.0011	.0030
1300	2.42		23	.75	.0020	.0015	.0045
1330	2.92		52	.5	.0046	.0023	.0068
1400	3.58		97	.5	.0085	.0042	.0110
1430	4.45		146	.5	.0128	.0064	.0174
1500	5.53		187	.75	.0164	.0123	.0297
1600	7.10		255	.75	.0224	.0168	.0465
1630	7.93		299	.5	.0263	.0132	.0597
1700	8.59		359	.75	.0316	.0237	.0834
1800	9.30		465	1.5	.0409	.0614	.1448
2000	9.52		516	1.5	.0454	.0681	.2129
2100	9.55		525	1	.0462	.0462	.2591
2200	9.37		479	1.5	.0421	.0632	.3223
2400	8.66	0	369	1	.0324	.0324	.3547
			4,035.02	24			
			168				

Time	G. Ht. Feet	Sh. Adj.	Discharge C.f.s.	Inc.	In/Hr.	Runoff Inches	Acc. In
	Feb. 25, 1970						
0000	8.66	0	369	1	.0324	.0324	.3871
0200	7.90		297	2.5	.0261	.0652	.4523
0500	6.50		226	2.5	.0199	.0498	.5021
0700	5.44		184	2	.0162	.0324	.5345
0900	4.75		161	3	.0142	.0426	.5771
1300	4.09		127	3	.0112	.0336	.6107
1500	3.96		120	5.5	.0106	.0583	.6690
2400	3.65	0	101	4.5	.0089	.0400	.7090
			4,023	24			
			169				
	Feb. 26, 1970						
0000	3.65	0	101	6	.0089	.0534	.7624
1200	3.42		86	12	.0076	.0912	.8536
2400	3.31	0	79	6	.0069	.0414	.8950
			2,112	24			
			88				

Total Storm Runoff = 840 ac-ft

Computed by BBH Date 1-7-71 Checked by J.D.B DRM Date 1-11-71

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

Sheet 1 of 2
Comp. by: DRM
Date: 5-3-71
Check by: G M W
Date: 5-6-71

Study Area: Pin Oak Creek near Hubbard, Tex. Date of Storm: February 24-25 1970

Date & Time	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
Feb. 24, 1970														
0000	0.00		0.00		0.00		0.00						0.00	0.00
0100	.02		.02		.01		0						.01	.01
30	.04		.05		.03		0						.03	.03
0200	.06		.08		.05		.04						.05	.05
30	.13		.14		.07		.08						.10	.10
0300	.20		.18		.12		.16						.16	.16
30	.24		.21		.17		.20						.20	.20
0400	.27		.24		.22		.22						.24	.24
0500	.29		.28		.25		.25						.27	.27
0600	.32		.34		.27		.27						.30	.30
30	.37		.38		.30		.38						.36	.36
0700	.42		.42		.37		.39						.40	.40
0900	.50		.52		.53		.47						.50	.50
1000	.53		.56		.54		.50						.53	.54
1100	.57		.64		.60		.58						.60	.61
1200	.64		.70		.65		.66						.66	.67
30	.67		.76		.67		.76						.72	.73
45	.69		.85		.73		.80						.77	.78
1300	.74		.95		.81		.82						.83	.84
15	.82		1.06		.84		.84						.89	.90
30	.94		1.26		.92		.92						1.01	1.02
45	1.03		1.31		1.02		1.15						1.13	1.14
1400	1.08		1.36		1.13		1.18						1.19	1.20
30	1.17		1.42		1.35		1.25						1.30	1.31
1500	1.24		1.51		1.47		1.36						1.40	1.41
30	1.33		1.66		1.55		1.44						1.50	1.52
1600	1.46		1.74		1.62		1.58						1.60	1.62

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
										Avg. Rainfall:	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

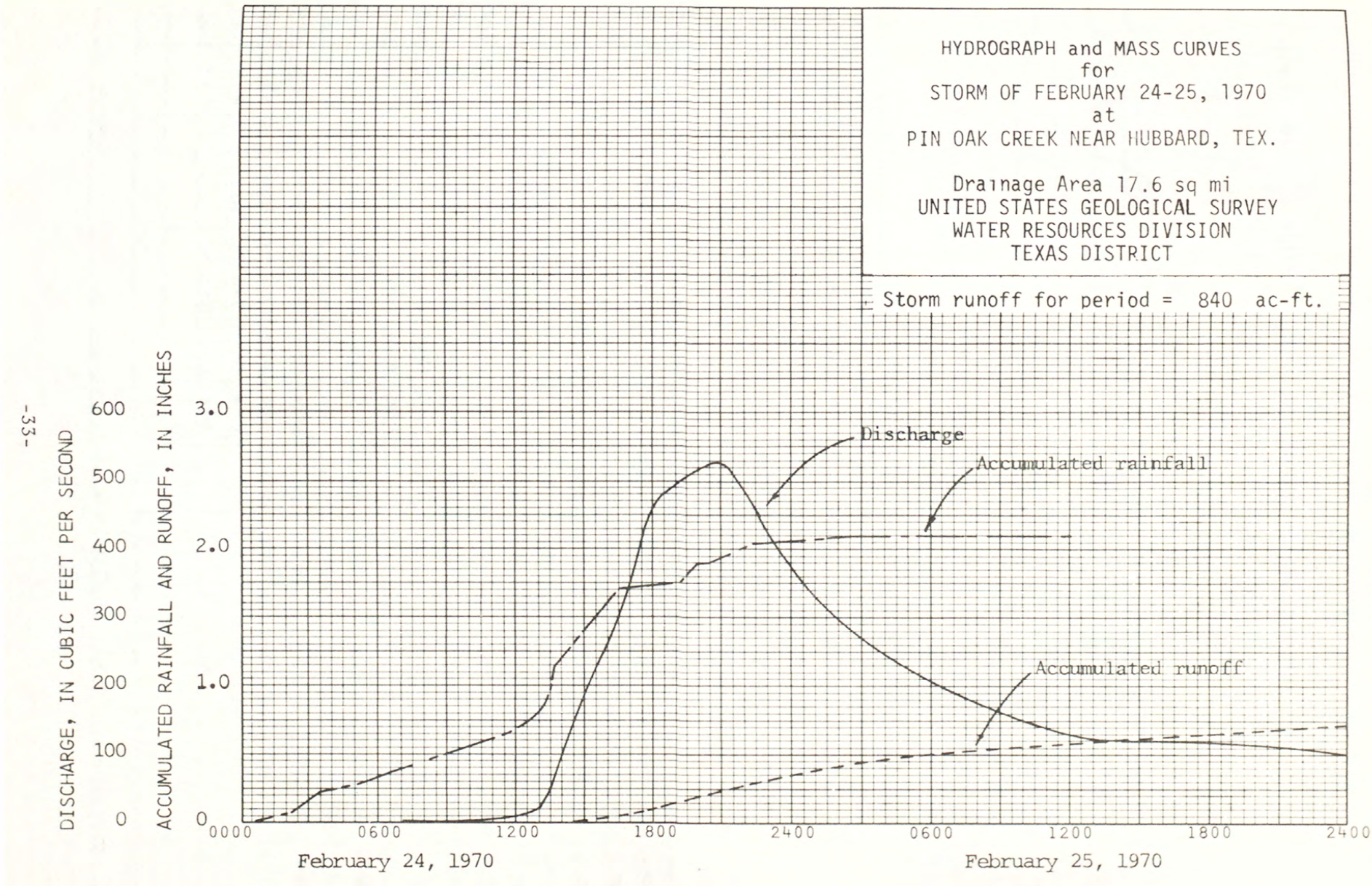
Comp. by: DRM
Date: 5-3-71
Check by: CMW
Date: 5-6-71

Study Area: Pin Oak Creek near Hubbard, Tex. Date of Storm: February 24-25, 1970

	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
Date & Time	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
Feb 24, 1970 (cont.)														
1630	1.54		1.78		1.75		1.62						1.67	1.69
1700	1.56		1.78		1.80		1.63						1.69	1.71
1900	1.60		1.82		1.83		1.64						1.72	1.74
30	1.66		1.89		1.88		1.70						1.78	1.80
45	1.76		1.94		1.90		1.78						1.84	1.86
2000	1.77		1.94		1.92		1.82						1.86	1.88
2100	1.80		(1.97)		2.03		1.86						1.92	1.94
2200	1.90		(2.01)		2.08		1.98						1.99	2.01
2400	1.90		(2.08)		2.16		2.02						2.04	2.06
Feb. 25, 1970			(2.09)		2.17		2.03						2.06	2.08
0300	1.93		2.10		2.19		2.04						2.07	2.09
0600	1.96		2.10		2.19		2.04						2.07	2.09
1200	1.96													

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
1-R	1.96	5-R	2.19								
2-S	2.04	6-R	2.04								
3-S	2.19										
4-R	2.10	Average = 2.09								Avg. Rainfall:	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages = 2.09 / 2.07 = 1.009


HYDROGRAPH and MASS CURVES
for
STORM OF FEBRUARY 24-25, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEX.
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 840 ac-ft.
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
600
500
400
300
200
100
0
3.0
2.0
1.0
0
Discharge
Accumulated rainfall
Accumulated runoff
0000
0600
1200
1800
2400
0600
1200
1800
2400
February 24, 1970
February 25, 1970

TX.-65 (Rev. 7 - 69)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - TEXAS DISTRICT

RUNOFF COMPUTATIONS

Station Pin Oak Creek near Hubbard, Tex.

Period of Record March 1-5, 1970 Drainage Area 17.6 Sq. mi.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Inc.	In/Hr	Runoff Inches	Acc. In.
			March 1, 1970				
0000	2.96	0	55	7	.0048	.0336	0.0336
1400	2.68		36	8	.0032	.0256	.0592
1600	2.88		49	2	.0043	.0086	.0678
1800	3.27		76	1.5	.0067	.0101	.0779
1900	3.78		109	1	.0096	.0096	.0875
2000	4.79		163	1	.0143	.0143	.1018
2100	5.30		179	1	.0157	.0157	.1175
2200	5.40		182	1	.0160	.0160	.1335
2300	5.20		176	1	.0155	.0155	.1490
2400	4.78	0	162	.5	.0142	.0071	.1561
			1,775				
			74				
			March 2, 1970				
0000	4.78	0	162	1.5	.0142	.0213	.1774
0300	3.82		111	4	.0098	.0392	.2166
0800	3.34		81	5	.0071	.0355	.2521
1300	3.18		70	4	.0062	.0248	.2769
1600	3.57		96	2	.0084	.0168	.2937
1700	5.00		170	.75	.0149	.0112	.3049
30	7.05		252	.5	.0222	.0111	.3160
1800	8.52		352	.75	.0309	.0232	.3392
1900	8.92		408	.75	.0359	.0269	.3661
30	9.05		428	.5	.0376	.0188	.3849
2000	9.03	0	424	1.25	.0373	.0466	.4315

Time	G. Ht. Feet	Sh. Adj.	Discharge C.f.s.	Inc.	In/Hr.	Runoff Inches	Acc. In
			March 2, 1970 cont.				
2200	8.97	0	416	2	.0366	.0732	.5047
2400	8.32	0	332	1	.0292	.0292	.5339
			4295.50	24			
			179				
			March 3, 1970				
0000	8.32	0	332	1	.0292	.0292	.5631
0200	6.60		230	1.5	.0202	.0303	.5934
0300	5.75		196	1.5	.0172	.0258	.6192
0500	4.77		162	1.5	.0142	.0213	.6405
0600	4.58		153	.75	.0135	.0101	.6506
30	5.43		183	.5	.0161	.0080	.6586
0700	6.52		227	.5	.0200	.0100	.6686
30	6.97		248	.75	.0218	.0164	.6850
0830	6.90		245	1.25	.0215	.0269	.7119
1000	7.60		280	1.25	.0246	.0308	.7427
1100	7.88		296	1	.0260	.0260	.7687
1200	7.72		287	1	.0252	.0252	.7939
1300	7.27		264	1	.0232	.0232	.8171
1400	6.68		234	1.5	.0206	.0309	.8480
1600	5.80		198	2.5	.0174	.0435	.8915
1900	4.58		153	4	.0135	.0540	.9455
2400	3.99	0	121	2.5	.0106	.0265	.9720
			4,983.50	24			
			208				

Computed by B.B.H Date 1-11-71 Checked by J.D.B. DRM Date 1-11-71

TX-65 (Rev. 7-69)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - TEXAS DISTRICT

RUNOFF COMPUTATIONS

Station Pin Oak Creek near Hubbard, Tex.

Period of Record March 1-5, 1970 Drainage Area 17.6 sq. mi.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Discharge Inc.	Discharge In/Hr.	Runoff Inches	Runoff Acc. In.
			March 4, 1970				
0000	3.99	0	121	6	.0106	.0636	1.0356
1200	3.65		101	12	.0089	.1068	1.1424
2400	3.49	0	97	6	.0085	.0510	1.1934
			2,520	24			
			105				
			March 5, 1970				
0000	3.49	0	97	6	.0085	.0510	1.2444
1200	3.25		74	12	.0065	.0780	1.3224
2400	3.13	0	66	6	.0058	.0348	1.3572
			1,866	24			
			78				

Total Storm Runoff = 1,270 ac-ft

Time	G. Ht. Feet	Sh. Adj.	Discharge C.f.s.	Discharge Inc.	Discharge In/Hr.	Runoff Inches	Runoff Acc. In

Computed by BBH Date 1-11-71 Checked by J.D.B. DRM Date 1-11-71

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

Sheet 1 of 2
Comp. by: DRM
Date: 5-4-71
Check by: CMW
Date: 5-6-71

Study Area: Pin Oak Creek near Hubbard, Tex. Date of Storm: March 1-3, 1970

Date & Time	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
March 1, 1970														
1100	0.00		0.00		0.00		0.00						0.00	0.00
1200	.02		.12		.10		0						.06	.06
1400	.04		.12		.10		0						.06	.06
15	.04		.17		.10		.02						.08	.08
30	.13		.20		.15		.10						.14	.14
45	.16		.28		.17		.20						.20	.20
1500	.18		.37		.25		.22						.26	.25
15	.25		.38		.37		.22						.30	.29
30	.29		.44		.39		.24						.34	.33
45	.30		.47		.43		.28						.37	.36
1600	.35		.48		.45		.30						.40	.39
2000	.38		.49		.46		.30						.41	.40
2400	.42		.50		.47		.30						.42	.41
March 2, 1970														
0500	.42		.52		.47		.30						.43	.42
1000	.42		.53		.47		.30						.43	.42
30	.42		.53		.51		.30						.44	.43
1100	.42		.60		.51		.30						.46	.45
15	.54		.62		.55		.32						.51	.50
30	.64		.68		.57		.34						.56	.55
45	.85		.69		.61		.34						.62	.61
1200	1.10		.70		.63		.34						.69	.68
30	1.46		.70		.66		.34						.79	.77
1300	1.48		.70		.66		.36						.80	.78

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
										Avg. Rainfall:	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

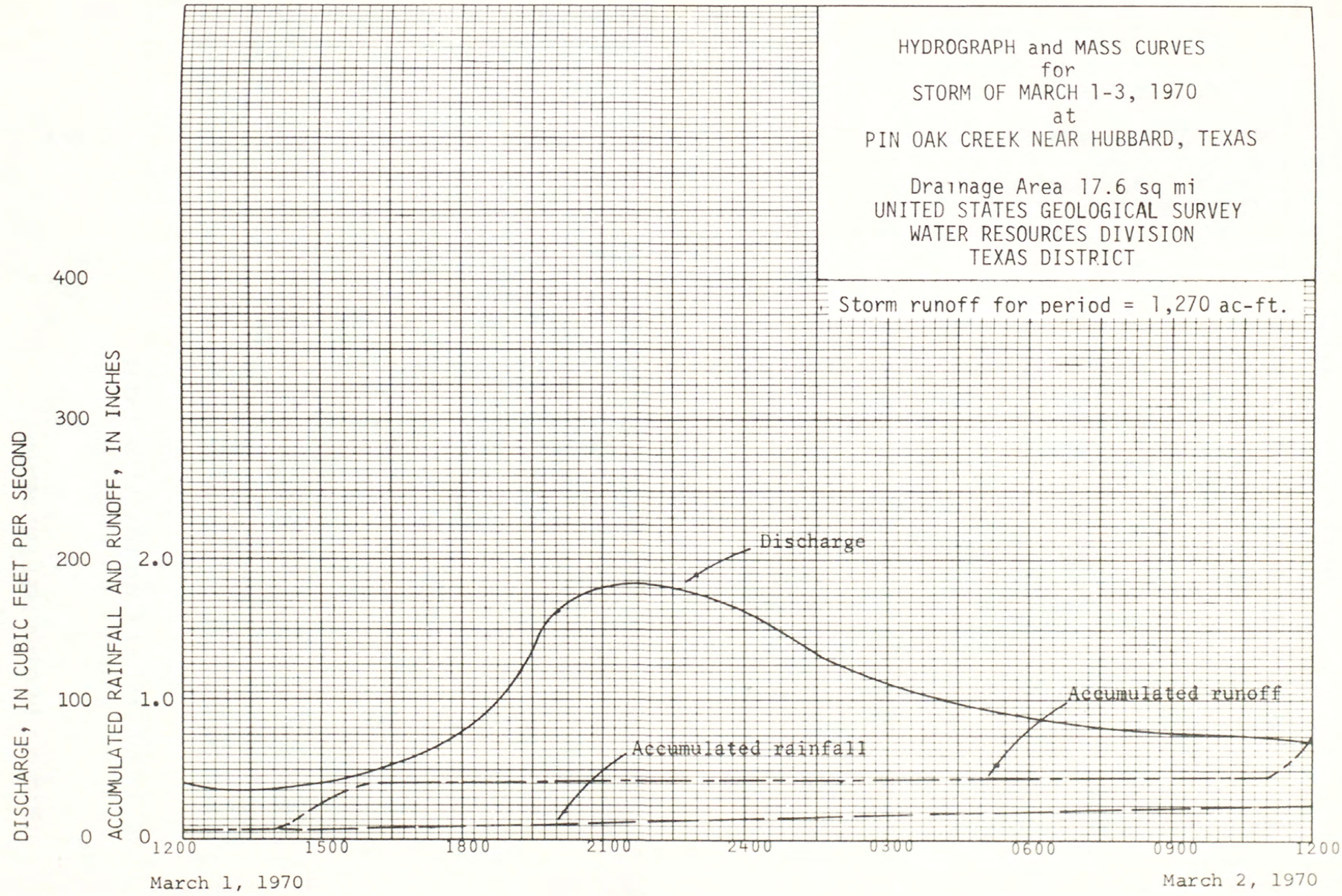
Comp. by: DRM
Date: 5-4-71
Check by: CMW
Date: 5-6-71

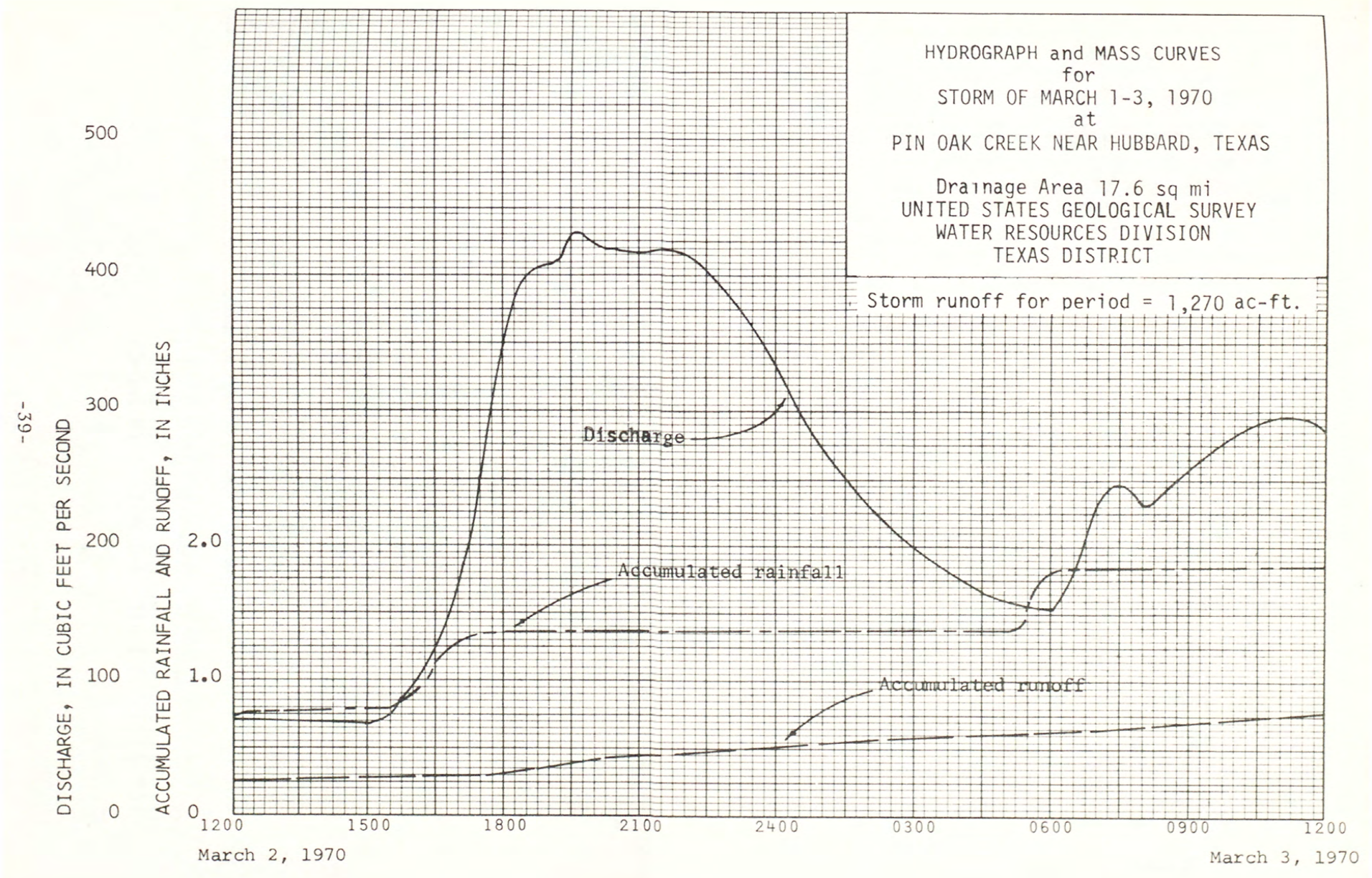
Study Area: Din Oak Creek near Hubbard, Tex. Date of Storm: March 1-3, 1970

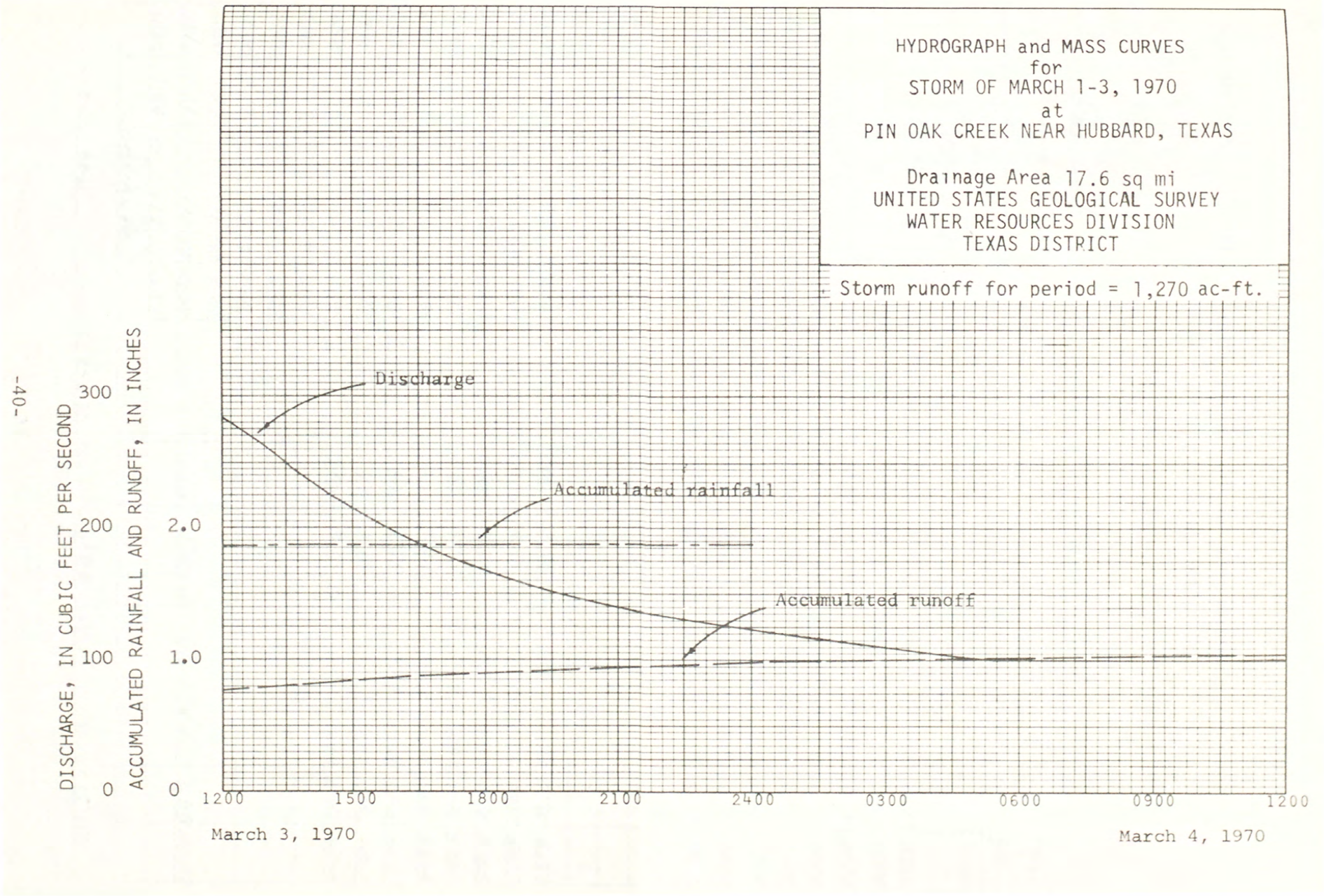
Date & Time	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
March 2, 1970 (continued)														
1545	1.50		.70		.66		.38						.81	.79
1600	1.50		.88		.66		.38						.86	.84
15	1.64		.95		.72		.48						.95	.93
30	1.72		1.06		.87		.60						1.06	1.04
45	1.83		1.18		1.05		.90						1.24	1.22
1700	1.90		1.18		1.20		.94						1.30	1.27
15	1.97		1.18		1.22		.94						1.33	1.30
30	2.00		1.18		1.23		.95						1.34	1.31
45	2.02		1.19		1.23		.97						1.35	1.32
1800	2.08		1.22		1.24		1.00						1.38	1.35
1900	2.11		1.22		1.26		1.02						1.40	1.37
2400	2.12		1.22		1.27		1.02						1.41	1.38
March 3, 1970														
0500	2.12		1.22		1.28		1.02						1.41	1.38
15	2.12		1.25		1.28		1.02						1.42	1.39
30	2.18		1.53		1.32		1.10						1.53	1.50
45	2.33		1.67		1.60		1.42						1.76	1.72
0600	2.44		1.73		1.74		1.50						1.85	1.81
30	2.48		1.73		1.75		1.52						1.87	1.83
0700	2.48		1.73		1.78		1.54						1.88	1.84
30	2.48		1.73		1.78		1.54						1.88	1.84
0800	2.48		1.73		1.78		1.54						1.88	1.84
1200	2.48		1.73		1.83		1.60						1.91	1.87
2400	2.48		1.73		1.83		1.60						1.91	1.87

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
1-R	2.48	5-R	1.83								
2-S	1.80	6-R	1.60								
3-S	1.78										
4-R	1.73	Average = 1.87								Avg. Rainfall:	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages = 1.87 / 1.91 = 0.979


HYDROGRAPH and MASS CURVES
for
STORM OF MARCH 1-3, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEXAS
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 1,270 ac-ft.
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
400
300
200
100
0
2.0
1.0
0
Discharge
Accumulated runoff
Accumulated rainfall
1200
1500
1800
2100
2400
0300
0600
0900
1200
March 1, 1970
March 2, 1970


HYDROGRAPH and MASS CURVES
for
STORM OF MARCH 1-3, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEXAS
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 1,270 ac-ft.
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
500
400
300
200
100
0
2.0
1.0
0
Discharge
Accumulated rainfall
Accumulated runoff
1200
1500
1800
2100
2400
0300
0600
0900
1200
March 2, 1970
March 3, 1970


HYDROGRAPH and MASS CURVES
for
STORM OF MARCH 1-3, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEXAS
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 1,270 ac-ft.
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
300
200
100
0
2.0
1.0
0
Discharge
Accumulated rainfall
Accumulated runoff
1200
1500
1800
2100
2400
0300
0600
0900
1200
March 3, 1970
March 4, 1970

TX.-65 (Rev. 7-69)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - TEXAS DISTRICT

RUNOFF COMPUTATIONS

Station Pin Oak Creek near Hubbard, Tex.

Period of Record March 6-8, 1970 Drainage Area 17.6 sq. mi.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Inc.	In/Hr	Runoff Inches	Acc. In.
	March 6, 1970						
0000	3.25	0	74	9	.0065	.0585	0.0585
1800	2.97		56	10	.0049	.0490	.1075
2000	2.96		55	1.75	.0048	.0084	.1159
2130	2.99		57	1	.0050	.0050	.1209
2200	3.02		59	.5	.0052	.0026	.1235
2230	3.22		72	.5	.0063	.0032	.1267
2300	3.65		101	.75	.0089	.0067	.1334
2400	4.90	0	167	.5	.0147	.0074	.1408
			16,040	24			
			67				
	March 7, 1970						
0000	4.90	0	167	.5	.0147		
0100	5.50		186	1.25	.0164		
0230	6.83		242	1	.0213		
0300	7.15		258	.5	.0227		
0330	7.36		268	.5	.0236		
0400	7.43		272	.5	.0239		
0430	7.38		269	.75	.0237		
0530	6.98		249	1.75	.0219		
0800	5.17		175	2	.0154		
0930	4.45		146	1.25	.0128		
1030	4.17		132	1.25	.0116		
1200	3.93		118	1.25	.0104		
1300	3.85		113	.75	.0099		
1330	3.84	0	112	.5	.0098		
	Continued						

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Inc.	In/Hr.	Runoff Inches	Acc. In
	March 7, 1970 (cont.)						
1400	3.92	0	117	.75	.0103	.0077	.3756
1500	4.32		140	.75	.0123	.0092	.3848
1530	4.44		146	.75	.0128	.0096	.3944
1630	4.50		149	.75	.0131	.0098	.4042
1700	4.56		152	1.5	.0134	.0201	.4243
1930	5.11		173	1.75	.0152	.0266	.4509
2030	5.02		171	2.25	.0150	.0338	.4847
2400	4.24	0	136	1.75	.0120	.0210	.5057
			4,147.75	24			
			173				
	March 8, 1970						
0000	4.24	0	136	1	.0120	.0120	.5177
0200	3.92		117	2.5	.0103	.0258	.5435
0500	3.66		102	3	.0090	.0270	.5705
0800	3.53		94	3.5	.0083	.0290	.5995
1200	3.41		86	5	.0076	.0380	.6375
1800	3.29		77	4.5	.0068	.0306	.6681
2100	3.18		70	3	.0062	.0186	.6867
2400	3.13	0	66	1.5	.0058	.0087	.6954
			2,149	24			
			90				

Total Storm Runoff = 653 ac-ft.

Computed by EEL BBH Date 5-25-70 Checked by JDB DRM Date 1-11-71

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

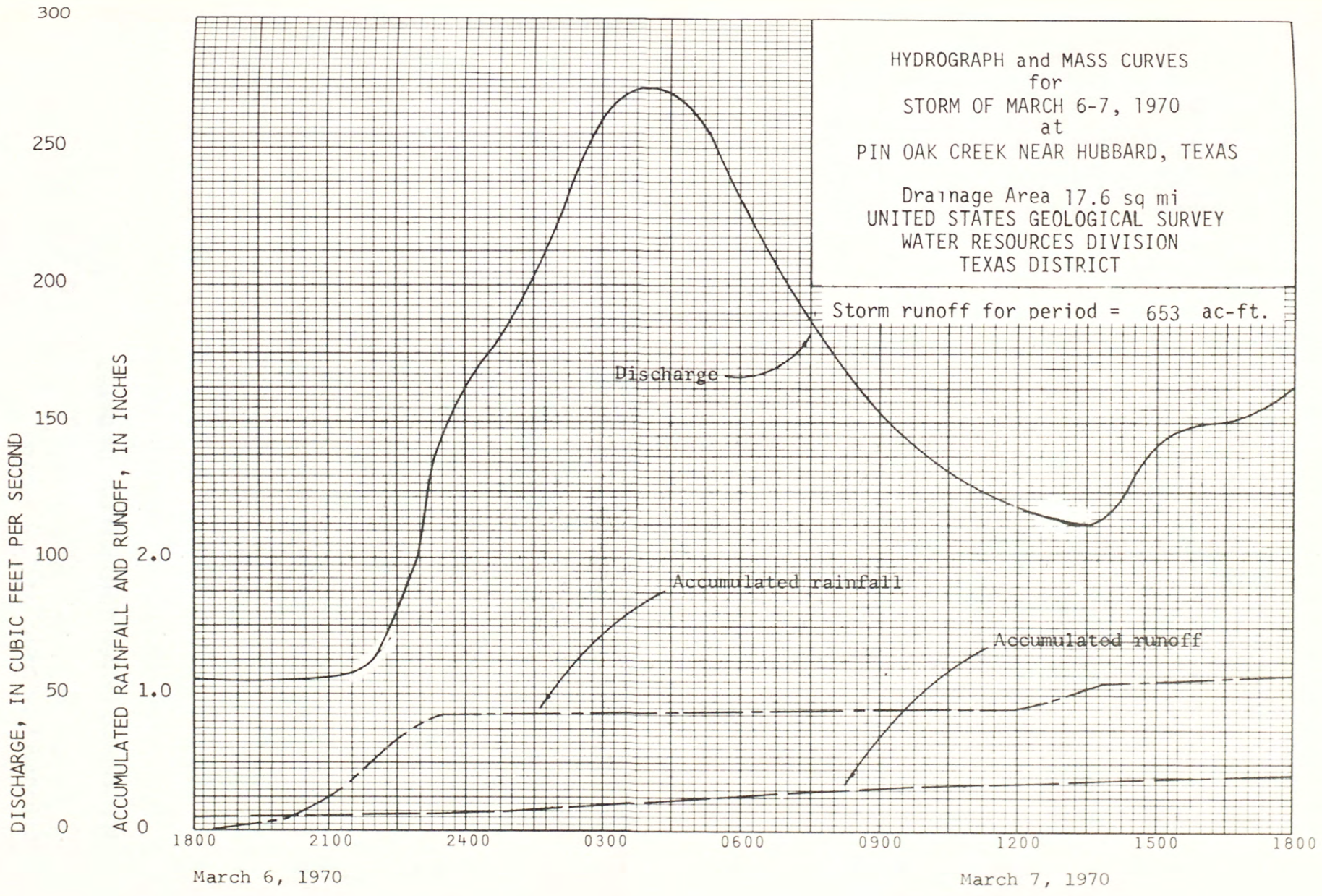
Sheet 1 of 1
Comp. by: DRM
Date: 5-4-71
Check by: CMW
Date: 5-6-71

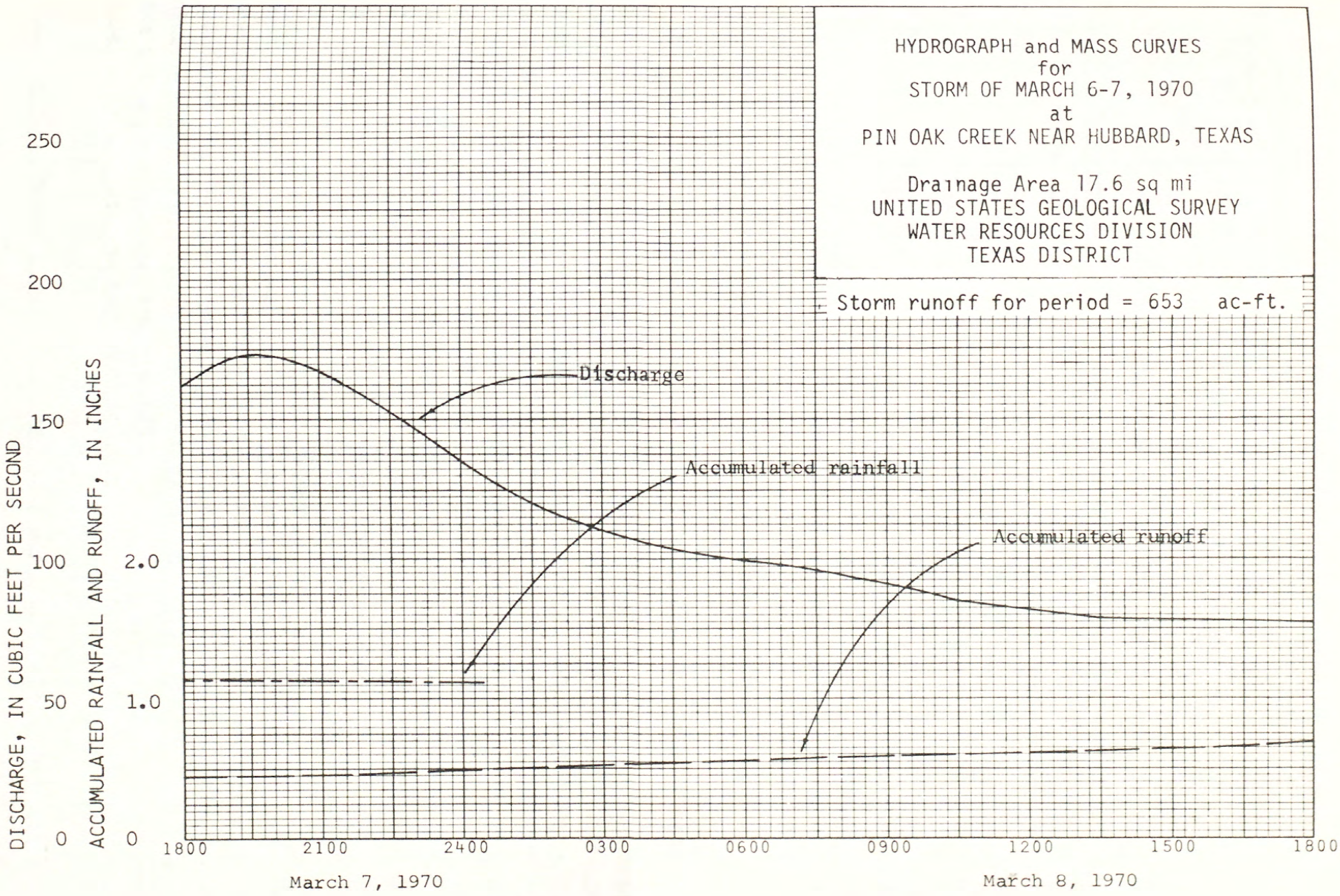
Study Area: Pin Oak Creek near Hubbard, Tex. Date of Storm: March 6-7, 1970

Date & Time	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
Mar. 6, 1970														
1700	0.00		0.00		0.00		0.00						0.00	0.00
1800	.02		.02		.04		0						.02	.02
1900	.04		.03		.06		0						.03	.03
30	.06		.08		.07		0						.05	.05
2000	.12		.12		.08		0						.08	.08
30	.16		.22		.12		.02						.13	.14
2100	.24		.35		.18		.15						.23	.24
15	.32		.40		.23		.20						.29	.31
30	.40		.47		.29		.24						.35	.37
45	.46		.54		.35		.35						.42	.45
2200	.56		.62		.42		.39						.50	.53
15	.62		.70		.48		.46						.56	.59
30	.70		.74		.53		.54						.63	.67
45	.77		.76		.61		.62						.69	.73
2300	.84		.76		.68		.64						.73	.77
30	.88		.81		.73		.68						.78	.83
2400	.95		.82		.75		.69						.80	.85
March 7, 1970														
1100	1.00		.85		.76		.73						.84	.89
1200	1.02		.88		.82		.75						.87	.92
30	1.04		.90		.83		.76						.88	.93
1300	1.07		.98		.85		.82						.93	.99
30	1.13		1.00		.90		.90						.98	1.04
1400	1.22		1.00		.98		.92						1.03	1.09
1600	1.23		1.02		1.00		.95						1.05	1.11
1800	1.25		1.02		1.00		.95						1.06	1.12

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
1-R	1.25	5-R	1.00								
2-S	1.25	6-R	.95								
3-S	1.22										
4-R	1.02	Average = 1.12								Avg. Rainfall:	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages 1.12 / 1.06 = 1.057


HYDROGRAPH and MASS CURVES
for
STORM OF MARCH 6-7, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEXAS
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 653 ac-ft.
Discharge
Accumulated rainfall
Accumulated runoff
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
300
250
200
150
100
50
0
2.0
1.0
0
1800
2100
2400
0300
0600
0900
1200
1500
1800
March 6, 1970
March 7, 1970


HYDROGRAPH and MASS CURVES
for
STORM OF MARCH 6-7, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEXAS
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 653 ac-ft.
Discharge
Accumulated rainfall
Accumulated runoff
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
250
200
150
100
50
0
2.0
1.0
0
1800
2100
2400
0300
0600
0900
1200
1500
1800
March 7, 1970
March 8, 1970

TX.-65 (Rev. 7-69)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - TEXAS DISTRICT

RUNOFF COMPUTATIONS

Station Pin Oak Creek near Hubbard, Tex.

Period of Record September 16-18, 1970 Drainage Area 17.6 sq. mi.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Discharge Inc.	Discharge In/Hr	Runoff Inches	Runoff Acc. In.
			Sept. 16, 1970				
0000	0.47		0	6.5	.0000	.0000	0.0000
1300	.49		0	7.875	.0000	.0000	.0000
1545	.57		0	1.5	.0000	.0000	.0000
1600	1.75	O	2.0	.25	.0002	.0001	.0001
15	2.25		16	.25	.0014	.0004	.0005
30	2.35		20	.5	.0018	.0009	.0014
1715	2.49		26	.875	.0023	.0020	.0034
1815	2.30		18	.875	.0016	.0014	.0048
1900	2.17		13	1.125	.0011	.0012	.0060
2030	2.05		9.3	1.875	.0008	.0015	.0075
2245	1.95		6.3	1.25	.0006	.0008	.0083
2300	2.02		8.4	.25	.0007	.0002	.0085
15	2.15		12	.25	.0011	.0003	.0088
30	2.35		20	.25	.0018	.0004	.0092
45	2.70		37	.25	.0033	.0008	.0100
2400	3.05	O	61	.125	.0054	.0007	.0107
			119.9125	24			
			5.0				
			Sept. 17, 1970				
0000	3.05	O	61	.375	.0054	.0020	.0127
0045	4.10		128	.75	.0113	.0085	.0212
0130	4.94		168	.75	.0148	.0111	.0323
0215	6.60		230	1	.0202	.0202	.0525
0330	8.50		350	1.125	.0308	.0346	.0871
0430	9.09	O	434	.875	.0382	.0334	.1205

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Discharge Inc.	Discharge In/Hr.	Runoff Inches	Runoff Acc. In
			Sept. 17, 1970 cont.				
0515	9.17	O	445	.5	.0391	.0196	.1401
30	9.14		441	.375	.0388	.0146	.1547
0600	8.90		405	1	.0356	.0356	.1903
0730	6.95		248	1	.0218	.0218	.2121
0800	6.46		224	.375	.0197	.0074	.2195
15	6.39		222	.25	.0195	.0049	.2244
30	6.55		228	.625	.0200	.0125	.2369
0930	8.10		312	.75	.0274	.0206	.2575
1000	9.10		435	.625	.0382	.0239	.2814
45	9.90		650	.75	.0571	.0428	.3242
1130	10.32		824	.625	.0724	.0452	.3694
1200	10.44		878	.5	.0772	.0386	.4080
30	10.48		896	.5	.0788	.0394	.4474
1300	10.46		887	.5	.0780	.0390	.4864
30	10.36		842	.875	.0740	.0648	.5512
1445	9.55		525	1	.0462	.0462	.5974
1530	8.55		355	1	.0312	.0312	.6286
1645	6.70		235	1.5	.0207	.0310	.6596
1830	4.72		160	1.875	.0141	.0264	.6860
2030	6.55		228	1.75	.0200	.0350	.7210
2200	7.76		290	1.125	.0255	.0287	.7497
45	7.92		298	.625	.0262	.0164	.7661
2315	7.80		292	.625	.0257	.0161	.7822
2400	7.36	O	268	.375	.0236	.0088	.7910
			8,873.875	24			
			369				

Computed by E.E.L. BBH Date 9-25-70 Checked by J.D.B. DRM Date 1-11-71

TX.-65 (Rev. 7-69)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY - TEXAS DISTRICT

RUNOFF COMPUTATIONS

Station Pin Oak Creek near Hubbard, Tex.

Period of Record September 16-18, 1970 Drainage Area 17.6 Sq. mi.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Discharge Inc.	Discharge In/Hr.	Runoff Inches	Runoff Acc. In.
	Sept. 18, 1970						
0000	7.36	0	268	1	.0236	.0236	.8146
0200	5.36		181	1.75	.0159	.0278	.8424
0330	4.45		146	1.25	.0128	.0160	.8584
0430	4.17		132	1.25	.0116	.0145	.8729
0600	3.96		120	2.25	.0106	.0238	.8967
0900	3.74		106	6.75	.0093	.0628	.9595
1930	3.46		89	7.50	.0078	.0585	1.0180
2400	3.39	0	84	2.25	.0074	.0166	1.0346
			2,773	24			
			116				

Total Storm Runoff = 971 ac-ft.

Time	G. Ht. Feet	Sh. Adj.	Discharge C. f. s.	Discharge Inc.	Discharge In/Hr.	Runoff Inches	Runoff Acc. In

Computed by E.E.L. B.B.H. Date 9-25-70 Checked by J.D.B. DRM Date 1-11-71

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

Sheet 1 of 2
Comp. by: D.R.M.
Date: 5-4-71
Check by: C.W.W.
Date: 5-6-71

Study Area: Pin Oak Creek near Hubbard, Tex. Date of Storm: September 16-17, 1970

Date & Time	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
Sept. 16, 1970														
0900			0.00		0.00		0.00						0.00	0.00
1000			.05		.02		0						.02	.02
1100			.07		.04		.01						.04	.04
1200			.11		.14		.20						.15	.16
15			.15		.20		.24						.20	.21
30			.26		.27		.28						.27	.28
45			.35		.35		.32						.34	.35
1300			.47		.47		.86						.60	.62
15			.70		.74		1.10						.85	.88
30			.83		.97		1.28						1.03	1.07
45			1.00		1.15		1.38						1.18	1.23
1400			1.18		1.32		1.40						1.30	1.35
15			1.20		1.32		1.44						1.32	1.37
30			1.30		1.55		1.74						1.53	1.59
45			1.46		1.73		1.92						1.70	1.77
1500			1.63		1.86		2.04						1.84	1.91
15			1.65		2.03		2.12						1.93	2.01
30			1.74		2.15		2.15						2.01	2.09
1600			1.80		2.18		2.16						2.05	2.13
1900			1.80		2.20		2.23						2.08	2.16
2000			1.85		2.29		2.24						2.13	2.22
30			1.85		2.29		2.24						2.13	2.22
2100			1.98		2.46		2.25						2.23	2.32
30			2.07		2.52		2.30						2.30	2.39
2200			2.18		2.58		2.38						2.38	2.48
30			2.29		2.70		2.48						2.49	2.59
45			2.30		2.81		2.80						2.64	2.75

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
										Avg. Rainfall	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages

TX-78a July 1969

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION
TEXAS DISTRICT
AVERAGE PRECIPITATION RECORD

Sheet 2 of 2
Comp. by: DRM
Date: 5-4-71
Check by: CMW
Date: 5-6-71

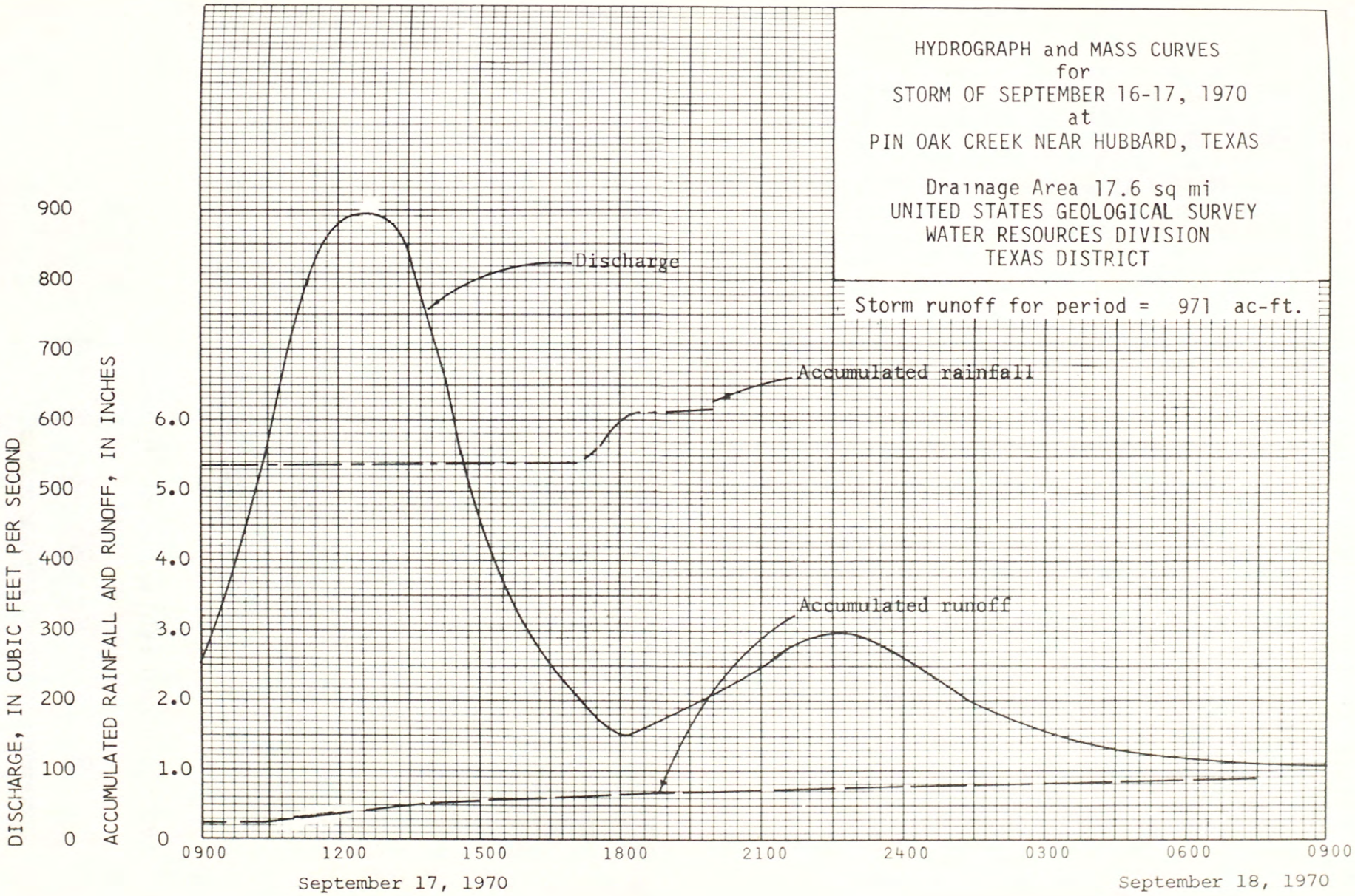
Study Area:

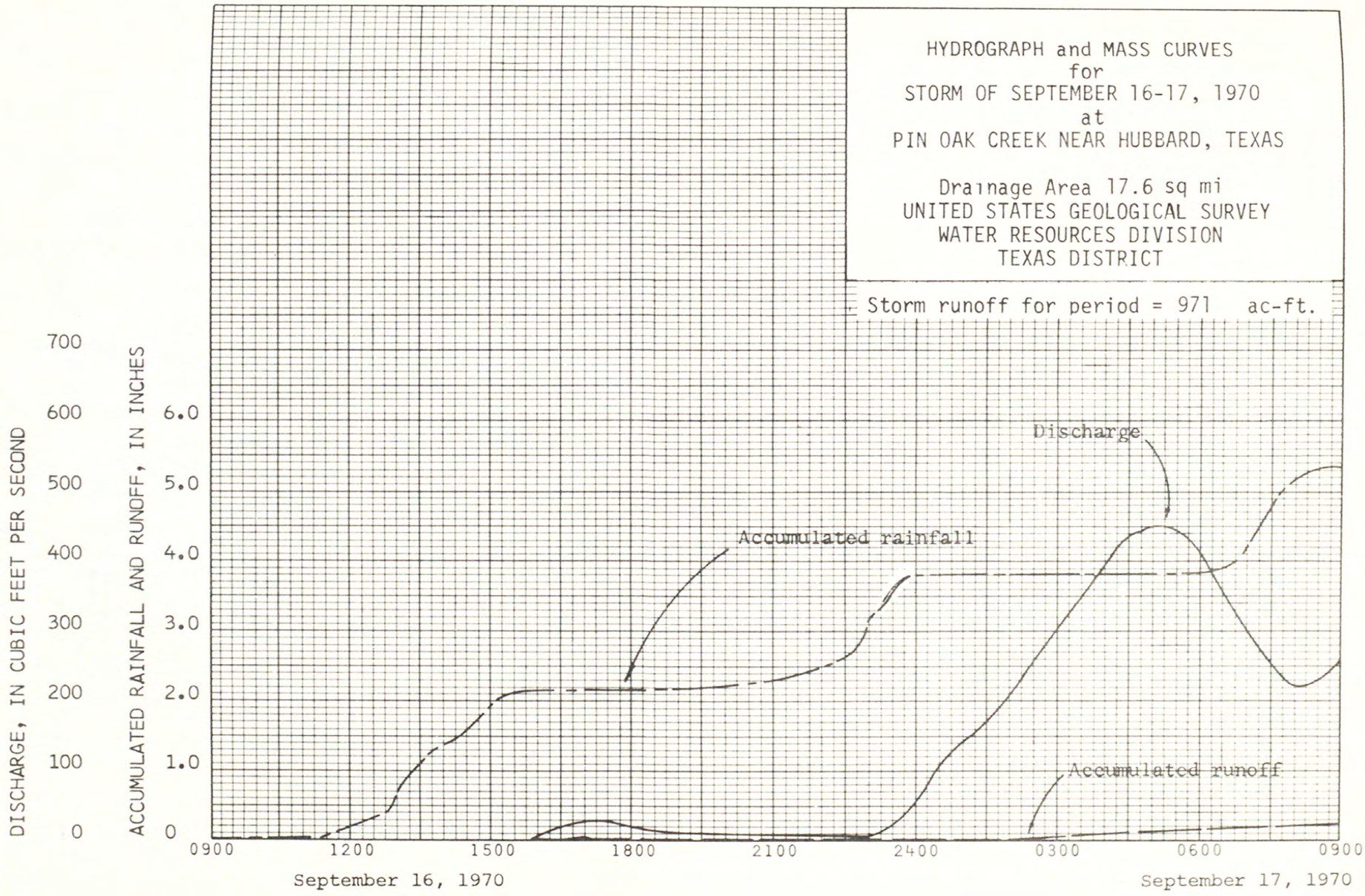
Date of Storm:

Date & Time	Accumulated Precipitation in Inches for Recording Rain Gages												Accumulated Average Precipitation	
	Gage 1-R Recorded	Gage Recorded	Gage 4-R Recorded	Gage Recorded	Gage 5-R Recorded	Gage Recorded	Gage 6-R Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Gage Recorded	Avg. Recording Gages	Recording Gages x K
Sept. 16, 1970 (continued)														
2300			2.72		3.16		3.10						2.99	3.11
15			2.85		3.38		3.22						3.15	3.28
30			3.16		3.82		3.35						3.44	3.58
45			3.46		3.93		3.37						3.59	3.73
2400			3.51		3.95		3.38						3.61	3.75
Sept. 17, 1970														
0300			3.51		3.96		3.40						3.62	3.77
0600			3.51		4.00		3.47						3.66	3.81
30			3.52		4.05		3.48						3.68	3.83
45			3.60		4.15		3.50						3.75	3.90
0700			4.21		4.73		3.80						4.25	4.42
15			4.56		4.90		3.84						4.43	4.61
30			4.80		5.05		3.88						4.58	4.76
45			5.00		5.32		4.10						4.80	4.99
0800			5.20		5.46		4.24						4.97	5.17
30			5.32		5.51		4.42						5.08	5.28
0900			5.36		5.56		4.44						5.12	5.32
1000			5.38		5.58		4.48						5.15	5.36
1200			5.40		5.60		4.48						5.16	5.37
1400			5.43		5.60		4.48						5.17	5.38
1730			5.46		5.80		4.86						5.37	5.58
45			5.65		6.00		4.86						5.50	5.72
1800			6.05		6.20		4.96						5.74	5.97
15			6.20		6.23		5.10						5.84	6.07
30			6.22		6.24		5.16						5.87	6.10
1900			6.23		6.25		5.20						5.89	6.13
2000			6.25		6.25		5.20						5.90	6.14

Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation	Rain Gage	Precipitation
1-R	6.08	5-R	6.25								
2-S	7.33	6-R	5.20								
3-S	5.71										
4-R	6.25	Average = 6.14								Avg. Rainfall:	

Average = Sum of Precipitation ÷ Total Number Rain Gages K = Average of all Rain Gages / Average of all Recording Rain Gages = 6.14 / 5.90 = 1.041


HYDROGRAPH and MASS CURVES
for
STORM OF SEPTEMBER 16-17, 1970
at
PIN OAK CREEK NEAR HUBBARD, TEXAS
Drainage Area 17.6 sq mi
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 971 ac-ft.
Discharge
Accumulated rainfall
Accumulated runoff
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
900
800
700
600
500
400
300
200
100
0
6.0
5.0
4.0
3.0
2.0
1.0
0
0900
1200
1500
1800
2100
2400
0300
0600
0900
September 17, 1970
September 18, 1970


HYDROGRAPH and MASS CURVES
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WATER RESOURCES DIVISION
TEXAS DISTRICT
Storm runoff for period = 971 ac-ft.
DISCHARGE, IN CUBIC FEET PER SECOND
ACCUMULATED RAINFALL AND RUNOFF, IN INCHES
700
600
500
400
300
200
100
0
6.0
5.0
4.0
3.0
2.0
1.0
0
Discharge
Accumulated rainfall
Accumulated runoff
0900
1200
1500
1800
2100
2400
0300
0600
0900
September 16, 1970
September 17, 1970