

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

FLOODS OF JUNE 24-25, 1966
IN SOUTHWEST-CENTRAL NORTH DAKOTA

By
Orlo A. Crosby

Prepared in cooperation with
North Dakota State Highway Department
North Dakota State Water Commission
Oliver County and with other Federal Agencies

Open-file report

Bismarck, North Dakota
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A severe thunderstorm accompanied by much hail swept through southwest-central North Dakota on the afternoon of June 24. Rainfall of up to 13 inches caused floods higher than any previously known in the area. The isohyetal map (fig. 1) indicates the extent and magnitude of the storm. This map was derived from rainfall data at 20 U.S. Weather Bureau gages (4 recording), 26 Geological Survey gages (5 recording) and 124 sites located in a bucket survey made by the Geological Survey (table 1).

The storm traveled in a northeasterly direction with most of the rain occurring in about 2 hours in any one location. The severity and rarity of the storm are indicated by comparing it with charts in U.S. Weather Bureau Technical Paper No. 40 which shows the 100-year 2-hour precipitation to be about 3 inches in the storm area. Most of the hail occurred in the areas of heaviest rainfall. At the town of Stanton, one-third of the windows were reported as being shattered and buildings were severely damaged. Crops over a large area were completely destroyed and trees were defoliated.

The flood area includes parts of the Knife River, Square Butte Creek and Heart River basins and some unnamed small tributaries to the Missouri River. As far as can be ascertained, a flood of this magnitude and areal coverage (caused by a thunderstorm-type rain) has

not been previously recorded in the state. In 1962 a record flood on Bonnes Coulee near Valva resulted in a peak discharge of 26,300 cfs from an area of 52.5 square miles but the areal coverage of that storm was much less than this one. The peak discharge for the Knife River at Hazen was the greatest known since 1884 with less than half the total drainage area contributing to the flood runoff. A summary of peak stages and discharges is given in table 2. The peak discharge was determined by indirect measurement at 13 sites. Many of the peak flows substantially exceeded the 50-year flood^{a/}; hence, a ratio of this flood to the 50-year flood rather than the recurrence interval is given. The maximum ratio thus computed is 22.2 for Otter Creek near Hannover (station 4, fig. 1). The ratio is not computed for the smaller streams because the flood frequency relation is not defined below 10 square miles. The maximum discharge rate per square mile determined was that of Kineman Creek tributary (station 7, fig. 1) with 3,040 cubic feet per second per square mile from a 2.45 square mile drainage area. This peak discharge is 8.7 times the 50-year flood from a 10 square mile drainage area. Square Butte Creek tributary No. 2 (station 11, fig. 1) shows only moderately high runoff although it is in the area of heaviest rainfall. This is probably due to storage at the highway fill.

Figure 2 shows the accumulated rainfall and discharge hydrographs for Otter Creek near Hannover, which are probably quite typical for basins of similar size in the flood area. The peaks were very sharp

^{a/} Patterson, J. L., 1966, Magnitude and frequency of floods in the United States, Part 6-A, Missouri River basin above Sioux City, Iowa: U.S. Geol. Survey Water-Supply Paper 1679 (in press).

and recessions were rapid.

The damage caused by the flood was extensive. Flood water from Big Muddy Creek covered a part of Glen Ullin and all of Almont to a depth of 3 to 4 feet. The populace had been evacuated to higher ground by the time the flood wave struck. About one-third of the population of Center had to be evacuated as a large part of the town was inundated.

Highway damage was estimated to be in excess of one million dollars in a six-county area; about one-quarter of this was in Oliver County. Virtually no bridges or culverts remained in place in the area of severe flooding. Newly opened Interstate 94 was considerably damaged at the bridge over Wilson Creek. The Northern Pacific main line railroad tracks west of Glen Ullin and the branch line tracks near Stanton were washed out. Power and telephone service was disrupted in much of the area. Municipal and residential water supplies were contaminated. Farm machinery was overturned and ruined by water and large numbers of livestock and poultry were washed away or drowned. Many farm buildings located on the flood plains were destroyed or washed away.

There was no loss of human life attributable to the floods although many rural residents had little or no warning.

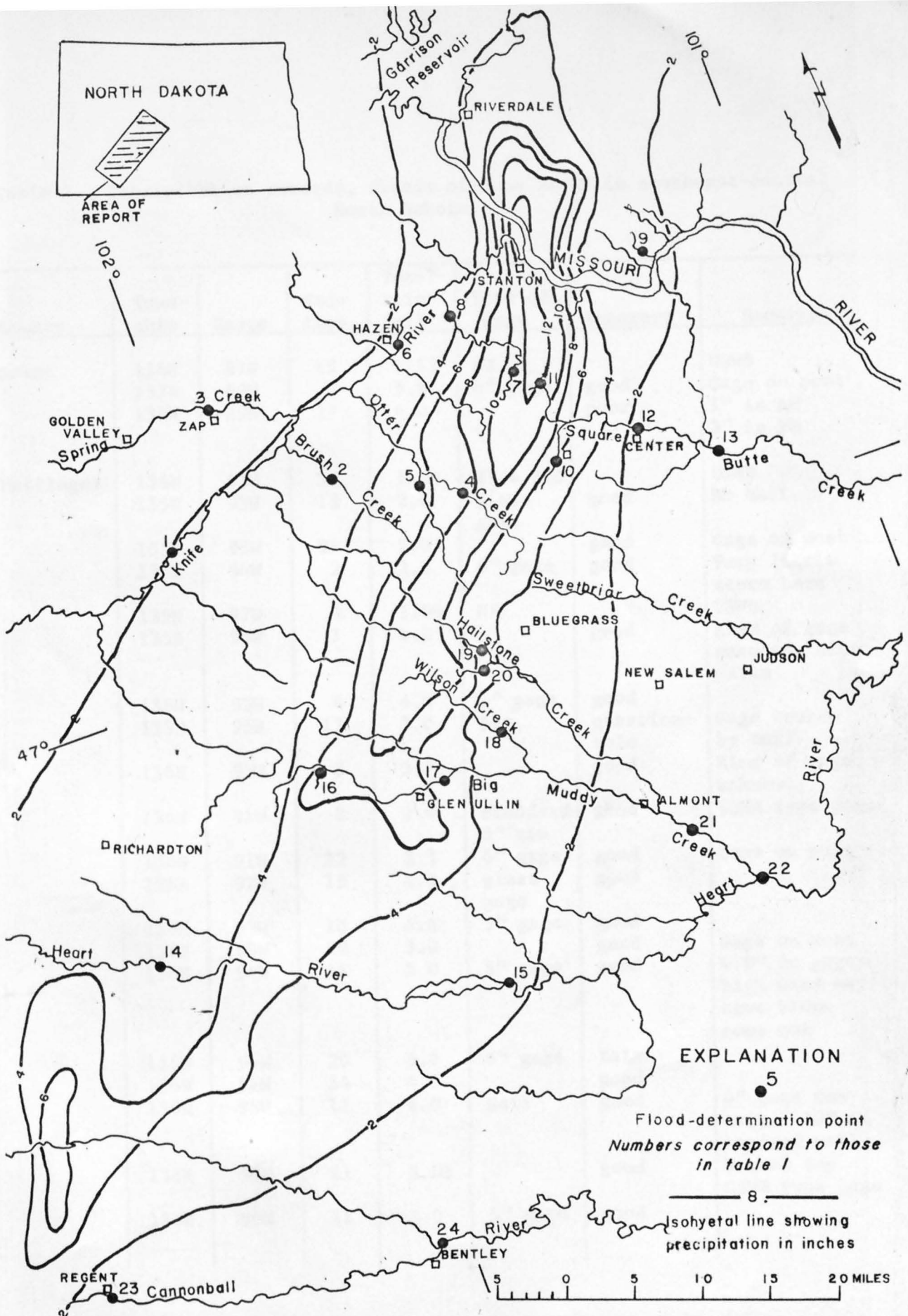


Figure 1.--Location of flood determination points and isohyets for June 24-25 floods in southwest-central North Dakota.

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota.

County	Town-ship	Range	Sec-tion	Total rain-fall	Type of gage	Accuracy	Remarks
Grant	134N	87W	13	1.15	NR		USWB
	137N	89W	2	3.8	6" gage	good	Gage on post
	137N	89W	17	4.0		poor	1" in AM 3" in PM
Hettinger	134N	93W	35	1.14	NR & REC		USWB
	135N	93W	12	2.6	glass gage	good	No hail
	135N	93W	24	2.0		good	Gage on post
	135N	94W	2	2.5	4" gage	good	Very little storm here
	135N	97W	3	1.98	NR		USWB
	135N	95W	1	4.8		good	Kind of gage unknown, also pails
	135N	95W	4	4.0	5" gage	good	
	135N	95W	17	5.0	est.	question-able	Gage broken by hail
	136N	91W	8	3.7		good	Kind of gage unknown
	136N	91W	8	2.9	standard 8" can	good	USWB type gage
	136N	91W	32	2.3	6" gage	good	Gage on post
	136N	92W	15	4.0	glass gage	good	
	136N	93W	10	4.2	5" gage	good	
	136N	93W	22	3.0		good	Gage on post
	136N	94W	11	5.0	5" gage	good	4.8" in gage-high wind may have blown some out
	136N	94W	20	5.0	6" gage	fair	
	136N	94W	34	4.0		good	
	136N	95W	11	8.0	pail	good	4" gage ran over. 10" in tapered pail
	136N	95W	21	3.05		good	Funnel top - USWB type gage
	136N	96W	11	3.0	5" gage	good	

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota--Continued.

County	Town- ship	Range	Sec- tion	Total rain- fall	Type of gage	Accuracy	Remarks
Hettinger (Cont.)	136N	96W	28	3.1	6" gage	fair	No hail
	138N	94W	23	4.5	6" gage	good	Gage on post
	139N	94W	6	6.0	Can & pail	good	5" can ran over-5 gal. pail about 6.5"
McLean	144N	82W	14	1.00	NR		USWB
	144N	83W	15	2.50	6" gage	good	Glass gage
	144N	84W	2	3.50	4" gage	good	Glass gage
	145N	83W	3	4.0	6" gage	good	
	145N	83W	9	10.0	Est.	fair	Hail broke gage
	145N	83W	11	3.8	4" gage	good	Glass gage
	145N	83W	29	7.0	Est.	fair	Est. - hail
	145N	84W	14	12.0	Est.	fair	Est. - no way to measure
	145N	84W	14	12.0+	water tank	fair	Estimated
	146N	82W	13	3.0		good	
	146N	82W	21	2.67	NR		USWB
	146N	83W	10	3.2	kettle	good	Hail broke gage. Meas. 4.0" in tapered kettle
	146N	83W	17	5.0	none	good	Est. on basis of rain neigh- bors had
	146N	83W	32	4.0	tin can	good	
	146N	84W	3	4.15	NR		USWB
	146N	84W	26	10.0	est.	fair	Gage broken by hail
	147N	80W	29	1.90	NR		USWB
	147N	83W	9	4.0		good	Rain gage on post in open area
	147N	83W	30	5.0	6" gage	good	Gage on post in yard
	148N	84W	8	2.99	NR		USWB
	150N	78W	4	0.88	NR		USWB
	150N	83W	10	1.28	NR		USWB
Mercer	141N	88W	20	5.5	5" gage	fair	5" gage ran over. Est. 5-6 inches

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota--Continued.

County	Town-ship	Range	Sec-tion	Total rain-fall	Type of gage	Accuracy	Remarks
Mercer (Cont.)	141N	88W	26	8.0	5" gage	fair	5" gage ran over. Est 8 inches
	141N	89W	22	3.0	4" gage	good	4.0" 2 mi S and 2 mi E
	141N	89W	28	3.7		good	3.5" one mi N 4.0" 3.5 mi E
	141N	90W	26	3.5	5" gage	fair	Gage on post
	142N	88W	11	3.9	glass gage	good	Gage on post in yard
	142N	88W	26	4.1		good	1.0" in morning 3.1" in afternoon
	142N	88W	29	2.0	est.	poor	Gage broken. Estimated rain
	142N	88W	32	2.0	est.	fair	Gage broken. Estimated rain
	142N	88W	36	5.1	5" gage	good	Meas. 4.0" then emptied and got 1.1" more
	144N	84W	35	3.5		good	
	144N	85W	14	9.0	none	fair	Estimate
	144N	85W	33	9.0	pails & cans	fair	Gage broken by hail
	144N	86W	30	3.0		fair	
	144N	88W	25	2.18	NR		USWB
	144N	90W	15	2.34	NR		USWB
	145N	84W	28	13.0	5 gal.	good	10 qt. pail 12" deep ran over
	145N	85W	4	2.8		very good	Gage on post
	145N	85W	24	3.0	coffee can	fair	can setting in yard-meas. 3.0"
	145N	85W	36	3.9	4" gage	good	
	146N	85W	4	1.9		good	Good gage
	147N	89W	36	3.5		good	Steady rain. Very little runoff
Morton	134N	84W	3	0.85	NR		USWB
	138N	86W	14	0.2		good	
	138N	86W	35	1.13	NR		USWB
	138N	87W	4	3.5	glass gage	good	On post in yard

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota--Continued.

County	Town-ship	Range	Sec-tion	Total rain-fall	Type of gage	Accuracy	Remarks
Morton (Cont.)	138N	87W	18	2.5		good	
	138N	87W	20	0.7		good	
	138N	88W	27	3.0		ood	
	138N	89W	9	6.0	6" gage	good	1.0" in AM 5.0" in PM
	138N	89W	13	5.5	5" gage	good	Gage on post.
					6" gage	good	Gage on post. Neighbor re- corded 5" 1 mi N
	138N	90W	10	4.5		good	
	138N	90W	22	6.1	6" gage	good	Gage on post
	138N	90W	24	4.5	6" gage	good	Gage on post in yard
	139N	81W	33	1.12	NR & REC		USWB
	139N	84W	20	0.8		good	>1.0" rain and no hail at Judson
	139N	85W	21	1.02	NR		USWB
	139N	86W	13	1.0	pail	good	Hail broke gage
	139N	86W	20	1.35		good	Gage on post in yard
	139N	87W	6	3.50	12"	good	USGS 3" dia.
	139N	87W	13	3.0		good	Gage on post in yard
	139N	87W	18	3.50	12" gage	good	USGS 3" dia.
	139N	87W	19	3.25	4" gage	good	Glass gage on post
	139N	87W	27	2.8	REC	good	USBS tipping bucket
	139N	88W	6	8.0	pails	fair	Pail in yard ran over - estimate 8.0"
	139N	88W	17	6.0	5 gal pail	good	Glass gage had 5.25" before being blown down
	139N	88W	34	5.5	6" gage	good	On post in yard
	139N	89W	9	7.0	5" gage	good	Gage full then emptied but was broken after that-est. 7.0"
	139N	89W	30	3.5		good	Small gage in yard
	139N	89W	31	6.5	REC		USWB

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota--Continued.

County	Town-ship	Range	Sec-tion	Total rain-fall	Type of gage	Accuracy	Remarks
Morton (Cont.)	139N	89W	33	5.0		good	
	139N	90W	2	4.0		fair	3.5" before gage broke
	139N	90W	14	7.0	Washtub	good	4" gage ran over for unknown time
	139N	90W	20	3.0	None Est.	fair	14 mile north-relative had 3.0" rain
	139N	90W	23	4.3	4" gage	good	Gage ran over-est. .25 to .5"
	140N	86W	7	3.0	12" gage	good	USGS 3" dia.
	140N	87W	2	3.7	12" gage	good	USGS 3" dia.
	140N	87W	8	5.15	12" gage	good	USGS 3" dia.
	140N	87W	20	8.0	12" gage	good	USGS 3" dia.
	140N	88W	8	8.5	12" gage	good	USGS 3" dia.
	140N	88W	22	9.0	12" gage	good	USGS 3" dia.
	140N	88W	27	7.50	12" gage	good	USGS 3" dia.
	140N	89W	14	5.0	4" gage	good	Gage ran over
	140N	89W	24	7.0	6" gage	fair	Gage ran over
	140N	89W	26	7.0	6" gage	fair	Gage ran over Estimate 1"
	140N	89W	32	6.0	5" gage	fair-good	Gage ran over Estimate 1"
	140N	90W	25	4.4	6" gage	good	.70" in AM
							3.70" in PM
	140N	90W	26	3.25		good	Gage on post
Oliver	141N	85W	18	2.2	REC	good	USGS float-type
	141N	86W	1	5.00	12" gage	good	USGS 3" dia.
	141N	86W	10	6.00	12" gage	good	USGS 3" dia.
	141N	86W	30	4.60	12" gage	good	USGS 3" dia.
	141N	86W	34	2.90	12" gage	good	USGS 3" dia.
	141N	87W	4	7.30	12" gage	good	USGS 3" dia.
	141N	87W	12	9.00	12" gage	good	USGS 3" dia.
	141N	87W	22	7.50	12" gage	good	USGS 3" dia.
	141N	87W	32	9.70	12" gage	good	USGS 3" dia.
	141N	87W	32	7.2	REC	good	USGS float-type
	142N	84W	14	1.68	NR		USWB
	142N	86W	8	8.50	12" gage	good	USGS 3" dia.
	142N	86W	14	10.20	12" gage	good	USGS 3" dia.
	142N	86W	20	7.0	REC	good	USGS & tipping bucket

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota--Continued.

County	Town- ship	Range	Sec- tion	Total rain- fall	Type of gage	Accuracy	Remarks
Oliver (cont.)	142N	87W	11	5.1	REC	good	USGS tipping bucket
	142N	87W	15	4.50	12" gage	good	USGS 3" dia.
	142N	87W	35	7.10	12" gage	good	USGS 3" dia.
	143N	84N	34	3.0		good	
	143N	85W	23	12.0	Est.	poor	No gage
	143N	86W	17	5.5	6" gage	good	
	143N	86W	20	7.0	6" gage	question- able	Gage ran over, had 2.6" 2 days before
	143N	87W	13	3.5		good	Not much runoff
	143N	87W	29	3.0	4" gage	fair	1" in morning 2" in afternoon
Stark	137N	91W	9	4.2		good	Gage on post in yard
	137N	91W	22	4.0	None	good	Estimate
	137N	91W	28	3.6	5" gage		Gage on post
	137N	92W	5	3.0		good	Had gage but kind unknown
	137N	93W	10	2.8		good	.8" in morning 2.0" in afternoon
	137N	93W	36	2.45		good	Old USWB gage
	137N	94W	4	4.5		good	Gage on post in yard
	137N	94W	13	5.5	Est.	fair	
	137N	94W	17	4.5		good	Had gage but kind unknown
	137N	94W	31	3.5	glass gage	fair	
	137N	94W	34	6.5	12 qt pail	fair	Pail ran over
	138N	91W	6	3.0		good	
	138N	91W	24	3.0		good	Kind of gage unknown
	138N	91W	28	4.5	4½" gage	good	May have run over a little
	138N	92W	4	3.5		good	Gage on post
	138N	92W	16	3.2	5" gage	good	Rained from 1130 to 1430
	138N	93W	9	3.5	5½" gage	good	
	138N	93W	28	5.0	4" gage	good	Gage ran over an estimated 1.0"
	139N	89W	5	.68	NR		USWB
	139N	91W	9	3.0		good	

Table 1. Precipitation records, floods of June 24-25 in southwest-central North Dakota--Continued.

County	Town-ship	Range	Sec-tion	Total rain-fall	Type of gage	Accuracy	Remarks
Stark (Cont.)	139N	91W	10	4.3		good	Kind of gage unknown
	139N	92W	5	3.15	NR & REC		USWB
	139N	92W	13	3.1		fair	Kind of gage unknown
	139N	93W	9	3.5		good	Gage on post in yard
	139N	93W	28	3.0	5" gage	good	
	139N	94W	17	2.0	various	fair	Survey of several people
	140N	92W	7	3.0	5" gage	good	
	140N	93W	33	3.0		good	Survey of several people
	140N	96W	33	1.19	NR		

NR - Non-recording U. S. Weather Bureau gage.

REC - Recording rain gage.

Table 2. Flood stages and discharges, June 24-25 in southwest-central North Dakota

No.	Stream and place of determination	Drainage area (sq mi)	Maximum floods					
			Prior to June 1966		June 1966	Gage height (ft)	Discharge	
			Period	Year			Cfs	Ratio to 50-year flood
Knife River basin								
1	Knife River near Golden Valley	1,230	1903-66 --	1943 --	-- 26	26.7 14.84	11,500 2,070	0.72 .12
2	Brush Creek near Beulah	23.3	--	--	24	--	6,000	4.24
3	Spring Creek at Zap	549	1924, 1947-66 --	1952 --	-- 25	20.03 4.78	6,130 169	.64 a
4	Otter Creek near Hannover	42.9	--	--	24	12.48	45,300	22.2
5	West Branch Otter Creek near Beulah	26.5	--	--	24	17.2	23,700	15.6
6	Knife River at Hazen	2,240	1884-1966 --	1943 --	-- 24	26.3 26.99	26,500 26,600	1.17 1.17
7	Kineman Creek tributary near Hannover	2.45	--	--	24	--	7,450	b
8	Kineman Creek near Hazen	31.3	--	--	24	--	29,600	17.4
Missouri River basin								
9	Missouri River tributary near Hensler	.65	--	--	24	--	167	b

See footnotes at end of table

Table 2. Flood stages and discharges, June 24-25 in southwest-central North Dakota
(Continued)

No.	Stream and place of determination	Drainage area (sq mi)	Maximum floods					
			Prior to June 1966		June 1966	Gage height (ft)	Discharge	
			Period	Year			Cfs	Ratio to 50-year flood
Square Butte Creek basin								
10	Square Butte Creek tributary near Hannover	1.45	--	--	24	--	473	b
11	Square Butte Creek tributary No. 2 near Hannover	.14	--	--	24	--	80.2	b
12	Square Butte Creek at Center	56.8	1955-66 --	1960 --	-- 24	7.00 10.96	1,000 8,000	.25 2.00
13	Square Butte Creek below Center	146	1965-66 --	1965 --	-- 24	2.55 14.35	30 9,700	a 1.36
Heart River basin								
14	Heart River near Richardton	1,240	1903-22, 1938, 1943-66	1950 --	-- 24	28.05 23.64	23,400 10,700	1.03 .47
15	Heart River below Heart Butte Dam near Glen Ullin	1,710	1904-66 --	1947 --	-- 25	21.5 6.10	25,000 2,830	c c
16	Big Muddy Creek tributary near Eagles Nest	0.8	--	--	24	--	1,300	b

See footnotes at end of table.

Table 2. Flood stages and discharges, June 24-25 in southwest-central North Dakota
(Continued)

No.	Stream and place of determination	Drainage area (sq mi)	Maximum floods					
			Prior to June 1966		June 1966	Gage height (ft)	Discharge	
			Period	Year			Cfs	Ratio to 50-year flood
Heart River basin--Continued								
17	Big Muddy Creek near Glen Ullin	86.8	--	--	24	--	10,400	2.00
18	Wilson Creek near Glen Ullin	30.7	--	--	24	22.9	20,800	7.64
19	Hailstone Creek near Bluegrass	34.7	--	--	24	--	12,000	4.07
20	Hailstone Creek tributary near Bluegrass	3.26	--	--	24	--	1,860	b
21	Big Muddy near Almont	456	1945-66	1950	--	30.7	20,200	1.42
			--	--	25	29.37	8,800	.62
22	Heart River near Lark	2,750	1947-66	1950	--	20.70	29,200	d
			--	--	25	16.54	13,900	d
Cannonball River basin								
23	Cannonball River at Regent	580	1950-66	1950	--	26.1	20,300	1.24
			--	--	25	14.63	4,620	.28
24	Cannonball River below Bentley	1,140	1943-66	1950	--	34.0	51,800	2.07
			--	--	26	16.12	5,000	.20

a Less than the mean annual flood.

b Frequency not determined.

c Flow regulated by Lake Tschida.

d Flow partly regulated by Lake Tschida.

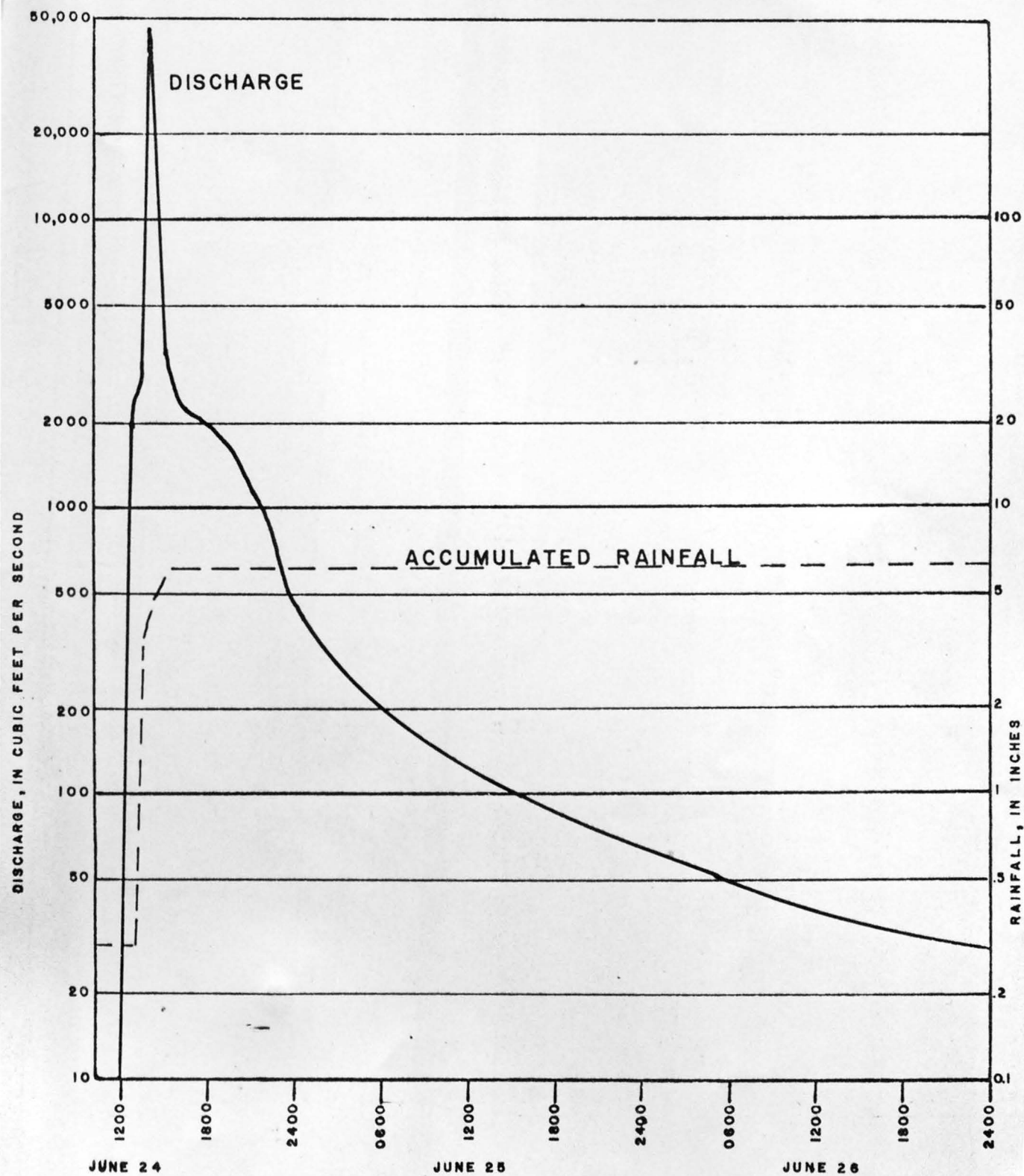


Figure 2.--Rainfall and discharge hydrographs for Otter Creek near Hannover, floods of June 24-25 in southwest-central North Dakota.

