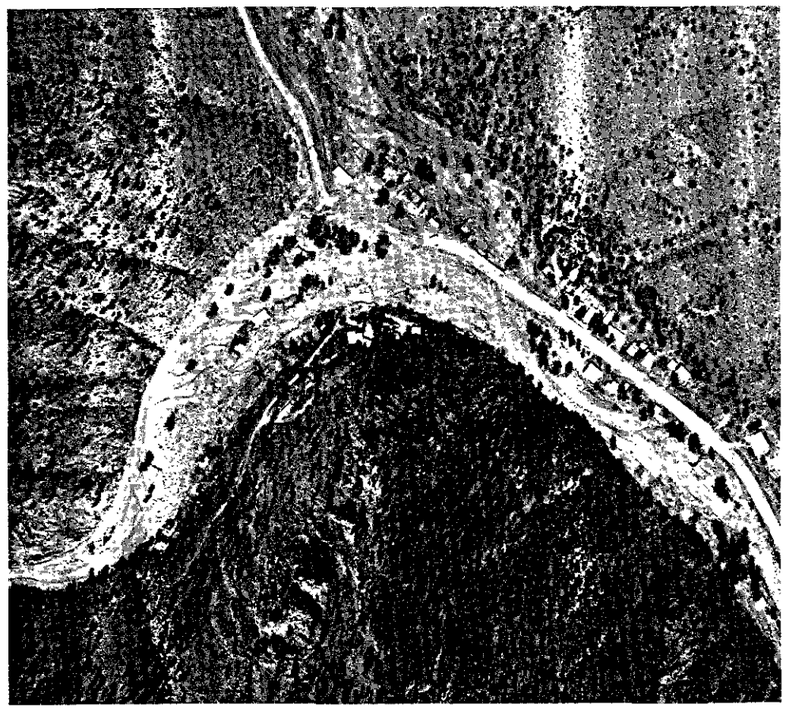
THE BIG THOMPSON RIVER FLOOD

of

JULY 31-AUGUST 1, 1976, LARIMER COUNTY, COLORADO



FLOOD INFORMATION REPORT

OCTOBER, 1976

Colorado Water Conservation Board
Colorado Department of Natural Resources
1313 Sherman Street
Denver, Colorado 80203

Prepared by the
U. S. GEOLOGICAL SURVEY
and the
COLORADO WATER CONSERVATION BOARD

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By

Richard U. Grozier and Jerald F. McCain
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in cooperation with the

COLORADO DEPARTMENT OF NATURAL RESOURCES, OFFICE OF THE STATE ENGINEER

NATIONAL WEATHER SERVICE

U. S. BUREAU OF RECLAMATION

and the

U. S. ARMY, CORPS OF ENGINEERS

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1313 Sherman Street
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1976

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English units in this report may be expressed as metric units by use of the following conversion factors:

To convert English units	Multiply by	To obtain metric units
inches (in)	25.4	millimeters (mm)
square miles (mi^2)	2.590	square kilometers (km^2)
miles (mi)	1.609	kilometers (km)
feet (ft)	.305	meters (m)
cubic feet per second (ft^3/s)	.0283	cubic meters per second (m^3/s)

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ABSTRACT

As much as 12 inches (305 millimeters) of rain fell on the Big Thompson River basin, a favorite summer-home and vacation area in Colorado, during the evening of July 31, 1976, causing a devastating flood on the Big Thompson River and its tributaries between Estes Park and Loveland, Colo. At the latest count (October, 1976), Larimer County officials reported 139 persons lost their lives, with 5 still reported missing, and property damage of $16.5 million.

Descriptions of the storm and flood, peak discharges, flood elevations, photographs of flooded areas, and aerial photographs of the Big Thompson and the North Fork Big Thompson Rivers, outlining inundated areas, are included in this report to assist public officials and private citizens in planning for reconstruction of the roads, homes, and vacation areas in the Big Thompson River basin.

INTRODUCTION

Throughout Colorado, August 1, 1976, was planned as a day of celebration to commemorate 100 years of statehood. In spite of the elaborate plans for "Centennial Sunday" in Big Thompson Canyon, the celebration was not to be, for the dawn of that day revealed a scene of tragedy never before experienced during the State's history. During the evening hours of July 31, a series of violent thunderstorms released large volumes of rain along a path several miles wide from Estes Park to the Wyoming border. The Big Thompson River basin (fig. 1) west of Drake was especially hard hit by the storm; devastating flooding occurred along the Big Thompson River between Estes Park and Loveland, and along the North Fork Big Thompson River from Glen Haven to its mouth at Drake. The flood lasted only a few hours but during this time an appalling amount of death and destruction occurred along the Big Thompson River and its tributaries. The area is a favorite summer-home and vacation area in Colorado and many people had permanent homes along the streams. Based on the latest figures available from Larimer County officials (October, 1976), 139 deaths have been confirmed, 5 names remain on the list of missing persons, and about $16.5 million of property damage has been reported.

This report, a joint effort of the U. S. Geological Survey and the Colorado Water Conservation Board, was prepared to assist public officials and private citizens in planning for reconstruction of the flooded area in the Big Thompson River basin. The report contains the following:

1. A map showing precipitation volumes and a discussion of the conditions associated with the storm.
2. Photographs of pre- and post-flood conditions at two locations that vividly portray the vast amount of destruction that occurred.
3. Photographs that illustrate the enormous damage caused by the flood.
4. A table of peak discharges and drainage areas at selected locations in the flood area.
5. A table of high-water elevations and cross-section data at selected locations in the Big Thompson River basin.
6. Aerial photographs showing flood boundaries along the Big Thompson River and the North Fork Big Thompson River.

The information contained in this report is limited to the Big Thompson River basin except for precipitation amounts and peak discharges at several other locations in Larimer County.

ACKNOWLEDGMENTS

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

The Colorado Department of Natural Resources, State Engineer's Office furnished funds and assistance to the U. S. Geological Survey and the Colorado Water Conservation Board in the collection of data and outlining the flooded areas.

The National Weather Service made precipitation surveys to supplement their regular rain-gage network.

The U. S. Bureau of Reclamation furnished assistance to the National Weather Service in the collection of rainfall data and furnished funds to the Geological Survey for the collection of streamflow data.

The U. S. Army, Corps of Engineers developed a flood profile in parts of the canyon and summarized flood damages. They also furnished funds to assist the Geological Survey in collecting the field data and preparation of this report.

Collection of field data, necessary for the computation of peak discharges by indirect methods, was greatly aided by personnel detailed from the South Dakota, Arkansas, and Wyoming offices of the Geological Survey.

GENERAL METEOROLOGICAL CONDITIONS

The National Weather Service prepared an isohyetal map (fig. 1) of the total precipitation from July 31 to August 2, 1976. They also provided the following statement on the general meteorological conditions existing in the area that contributed to the extreme rainfall and runoff in the Big Thompson River basin.

> **"Eastern Colorado was under conditions favorable for heavy rain on July 31, 1976 for a number of reasons. The surface map of that morning showed a slowly moving cold front in the State. Such fronts are lines of convergence that lift air to form thunderstorms. Also favorable was the east wind just north of the front, moving air upslope and aiding the frontal lifting.**
>
> **"The low-level air was very moist, well above the seasonal normals, and the moisture aloft was also unusually high. These factors combined to give stability conditions unusually favorable for thunderstorms.**
>
> **"That these are valid conditions for thunderstorms was soon borne out by radar and satellite data when a line of thunderstorms developed in extreme east-central Colorado and quickly extended eastward paralleling and just north of the cold front. The thunderstorms extended westward less rapidly until early in the evening when a sudden explosive thunderstorm developed on or just west of the front range of the mountains southeast of Estes Park. The cause of such a strong development at this place and this time is not yet fully understood.**
>
> **"Thunderstorms move with the speed and direction of the winds aloft, and the 500-mb (millibar) level is usually adequate for judging such movement. The 500-mb wind was only about 5 knots and was not expected to change much during the day. This was the case with the thunderstorms near Estes Park. They moved very slowly while putting out large amounts of water over a period of several hours."**

Rainfall began about 6:30 p.m. on July 31, 1976, and ended about 11:30 p.m. that evening. Additional rainfall fell on August 1 and 2. Precipitation totals were as much as 10 inches (254 mm) between Estes Park and Drake and more than 12 inches (305 mm) in the Glen Haven area. Very little rainfall contributing to the flood occurred east of Drake and west of Estes Park.

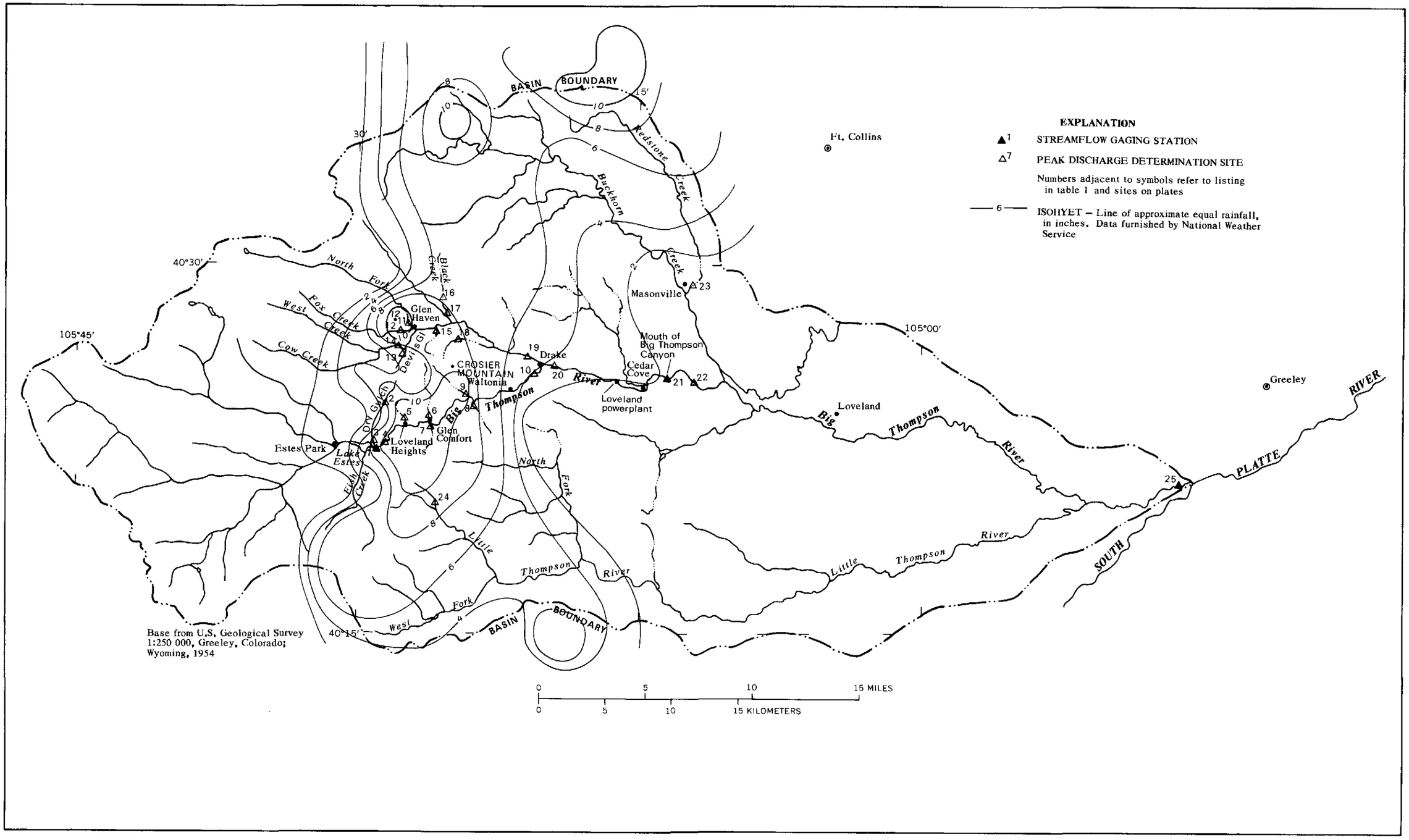


Figure 1.—Flood area, flood-data sites, and total precipitation.

THE FLOOD

Flood runoff in the Big Thompson basin derived from an area of approximately 60 square miles (155 km^2) centered on the Big Thompson River from Lake Estes to Drake. The topography of the area is characterized by steep north-and south-facing slopes with rugged rock faces along the ridges and a thin soil mantle at lower elevations which supports a moderate stand of coniferous trees. Because of the steep slopes and small storage capacity of the soils, storm runoff quickly reached nearby surface channels. Based on records at stream-gaging stations in the area and on information from individuals who observed the flood, most streams in the area started to rise about 7 p.m. The first reported damage occurred about 7:30 p.m. along U. S. Highway 34, 7.5 miles (12.1 km) east of Estes Park where the highway was blocked by rocks and trees deposited by water cascading down the canyon walls and small gulches along the north side of the Big Thompson River. This area approximately corresponds to the areas of maximum rainfall as shown on figure 1.

The normally placid Big Thompson River quickly responded to the large volumes of water entering from several small tributaries between Lake Estes and Waltonia and became a raging torrent of water, trees, debris, and boulders moving downstream with a indescribable force. The reported peak stages on the Big Thompson River occurred as follows: 8:00 p.m. at Glen Comfort, 8:30 p.m. at Waltonia, 9:00 p.m. at Drake, 9:30 p.m. at Loveland powerplant, and about 11:00 p.m. at the mouth of the canyon about 8 miles (13 km) west of Loveland. Because the river reportedly remained extremely high from the first peak stage until after midnight, it is apparent that several other periods of intense rainfall produced secondary rises on streams in the area during the night. A gaging station on Fish Creek, southeast of Estes Park and upstream from Lake Estes, recorded a rise which peaked at 10:00 p.m. and a smaller rise which peaked at 4:00 a.m. Dry Gulch which flows into the Big Thompson River from the north just downstream from Lake Estes peaked at 10:30 p.m., as recorded by the gaging station on the Big Thompson River near Estes Park.

The flood on the North Fork Big Thompson River resulted from extremely heavy rainfall within a few miles of Glen Haven. The western limit of significant flood runoff was about 2 miles (3.2 km) west of Glen Haven while the eastern limit was about 3 miles (4.8 km) east of Glen Haven. Extreme flood runoff occurred from the basin divide on the south to about 4 miles (6.4 km) northeast of Glen Haven.

Although heavy rainfall was reported to begin at Glen Haven about 7:30 p.m., the first report of extreme flooding in that area was on Fox Creek which reached the peak stage at 9:00 p.m. at Glen Haven. Another rise almost as high as the first one occurred at about 11:00 p.m. North of Glen Haven, both Miller Fork and Black Creek reached peak stages about 11:00 p.m., with local residents reporting no flood runoff in the streams prior to that rise. A stream-gaging station operated by the Colorado State Engineer's Office on the North Fork Big Thompson River at the mouth at Drake operated satisfactorily until about 11:00 p.m. when the intakes were covered by deposited bed material. The record from this station indicates one peak at 9:15 p.m. (possibly backwater from the Big Thompson River), a recession of about 0.3 foot (0.09 m) until 9:30 p.m., then an additional rise of about 0.8 foot (0.24 m) which peaked at 9:40 p.m. Flood water from Miller Fork and Black Creek reached the Drake area shortly after 11:00 p.m. but the peak from this rise was lower than the 9:40 p.m. peak.

The major part of flood damage in the North Fork Big Thompson River basin occurred in the vicinity of Glen Haven, caused mainly by the combined flow of Devil's Gulch and West Creek which entered the town from the southwest. The basin between Glen Haven and Drake is sparsely developed; thus, the main damage in this reach was to the county highway which generally follows the river.

The relative timing of the peak stages was such that the peak on the Big Thompson River just downstream from Drake occurred before the peak from the North Fork arrived at Drake. The flood peak moved through the 7.3-mile (11.7-km) length of channel between Drake and the canyon mouth in about 2 hours with no apparent reduction in discharge as indicated by the computed peak discharges. East of the canyon mouth, the Big Thompson River valley widens rapidly and the flood discharge was quickly reduced by valley storage and overflow to numerous reservoirs. The peak discharge at the Big Thompson River at the mouth near La Salle was about 2,500 cubic feet per second (70.8 m^3/s) occurring at 12:00 p.m. on August 1, as compared to 31,200 cfs about 35 miles (56 km) upstream at the "mouth of the canyon."

Aerial photographs of "before" and "after" the flood at Waltonia and Glen Cove are shown in figures 2 and 3, respectively. Photographs of some of the destruction caused by the flood are shown in figures 4 through 10.

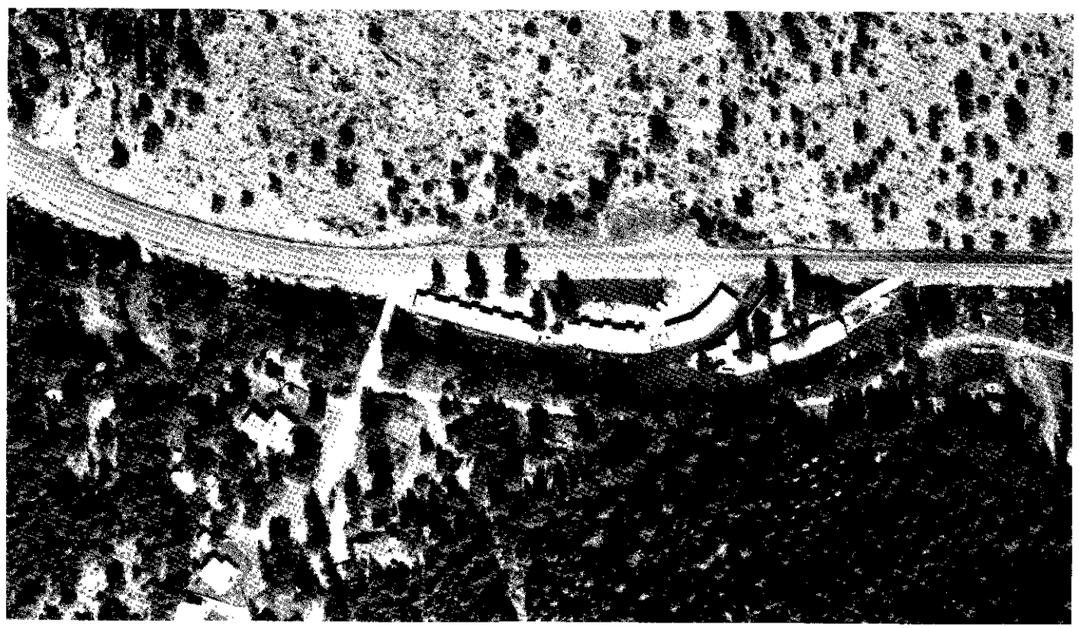


Figure 2.—Aerial views of "before" and "after" the flood at Waltonia, Colo.

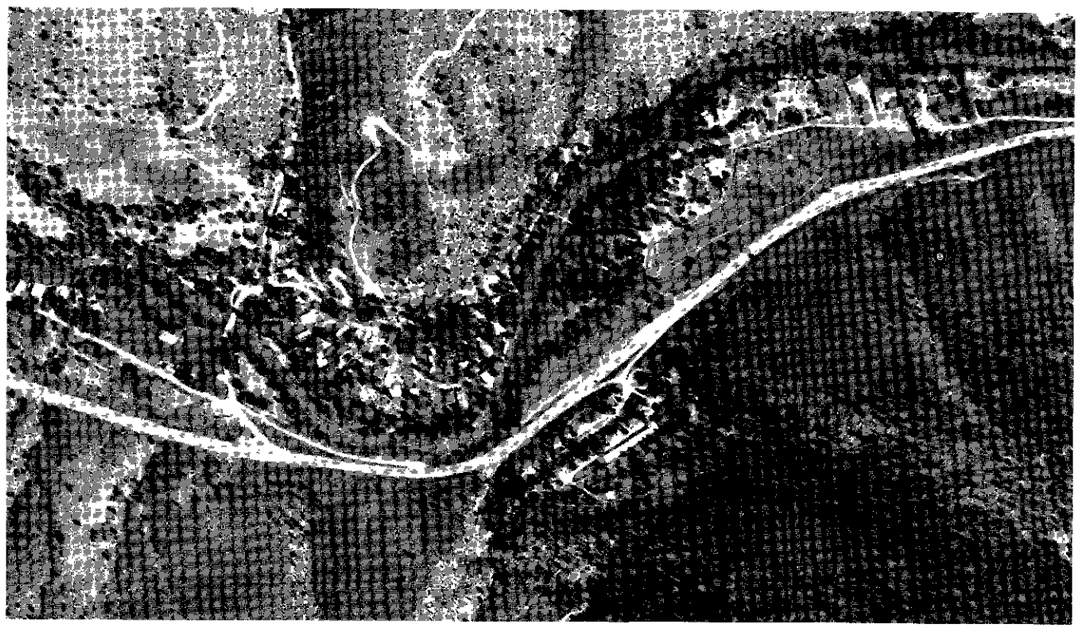


Figure 3.—Aerial views of "before" and "after" the flood at Cedar Cove, Colo.

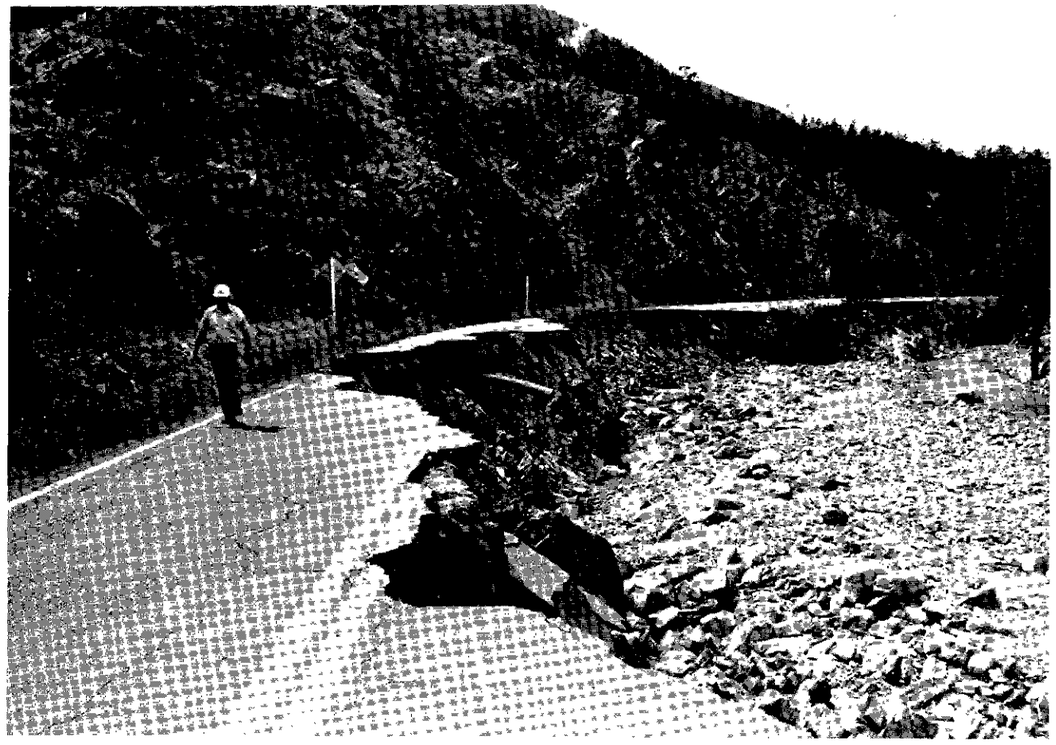


Figure 4.—Destruction of U. S. Highway 34 in Big Thompson Canyon. Photograph courtesy of the Loveland Daily Reporter-Herald.

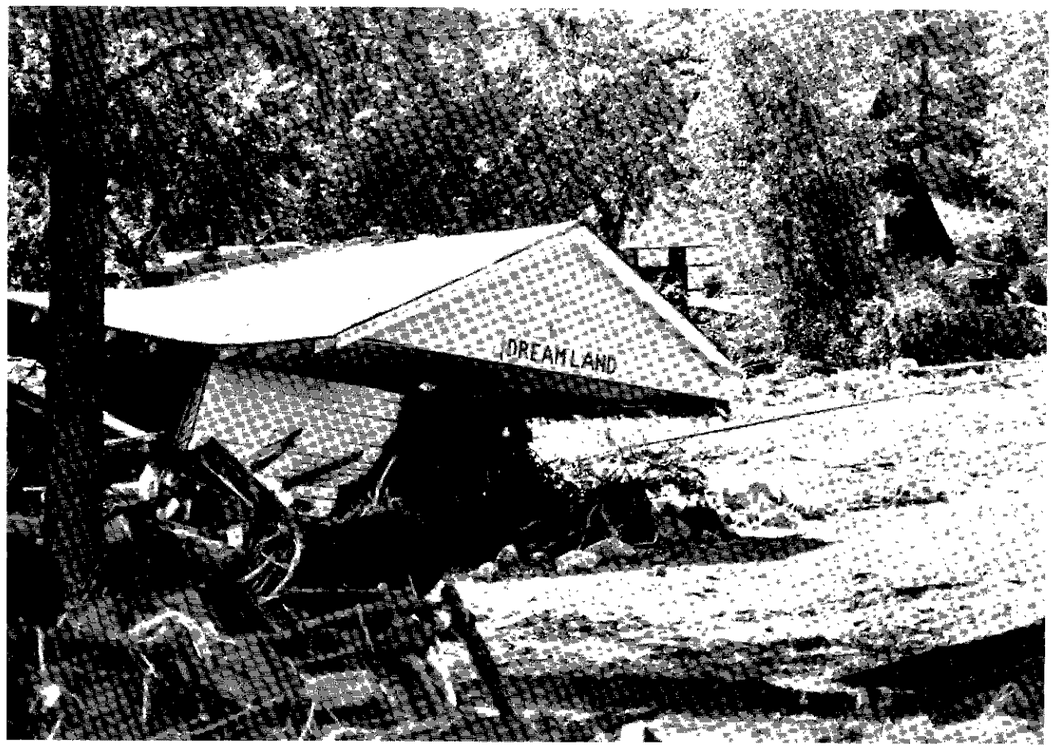


Figure 5.—Destruction of homes and vehicles at Drake, Colo. Photograph courtesy of the Loveland Daily Reporter-Herald.

Figure 6.—Debris from the Big Thompson Canyon piled up against a railroad bridge at Loveland, Colo. Photograph courtesy of the Loveland Daily Reporter-Herald.

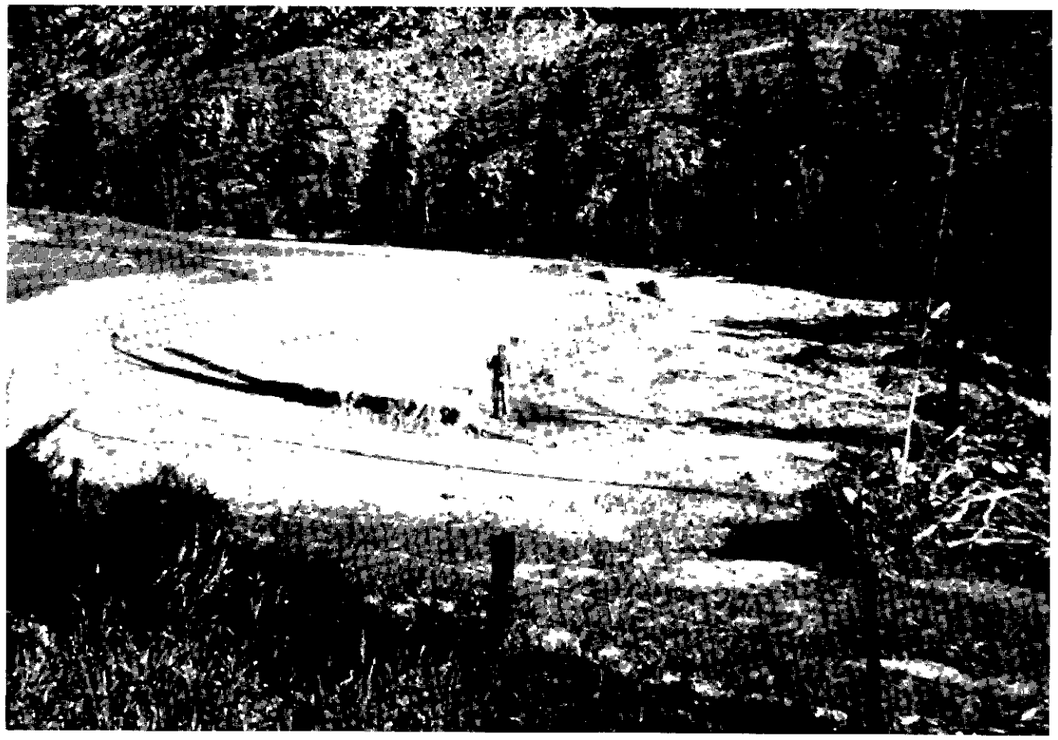


Figure 7.—Silt deposited on inside of bend, North Fork Big Thompson River near Drake, Colo.

Figure 8.—Remains of Loveland powerplant near Cedar Cove, Colo. Photograph courtesy of the Loveland Daily Reporter-Herald.

Figure 9.—Big Thompson River near mouth of canyon, near Loveland, Colo.

Figure 10.—Big Thompson River at mouth of canyon, near Loveland, Colo. Note irrigation siphon washed out and end of U. S. Highway 34.

FLOOD STAGES, DISCHARGES, AND FLOODED AREAS

Discharge is the rate of flow of a stream, usually expressed in cubic feet per second. Peak discharges were determined at 3 streamflow-gaging stations and 22 miscellaneous sites in the Big Thompson River basin area, and 2 streamflow-gaging stations and 6 miscellaneous sites in the other flooded parts of Larimer County. The peak discharges and drainage areas are listed in table 1. The site numbers in the table correspond to those on figure 1 and on the plates to aid in locating the sites at which peak discharges were determined.

Soon after the flood, high-water marks were established and cross-section data were obtained at numerous locations along the Big Thompson River and the North Fork Big Thompson River. These data are shown in table 2 for the Big Thompson River and in table 3 for the North Fork Big Thompson River.

The area flooded on the Big Thompson River from Estes Park to east of Loveland and on the North Fork Big Thompson River from the Glen Haven area to Drake were outlined on aerial photographs, scale 1 inch – 200 feet (25.4 mm – 61 m) in the canyon area and 1 inch – 400 feet (25.4 mm – 122 m) in the Loveland area. These are reproduced as plates 1-51 for the Big Thompson River and plates NF1-NF15 for the North Fork Big Thompson River. The location of the individual plates are indicated on figure 11. The numbers in boxes, 57, shown on some plates indicate the site of the peak discharge in table 1. The number on the plate corresponds to the site number on table 1. The numbers ⑦————⑦ shown on some of the plates indicate the location of high-water elevations and cross-section data shown in tables 2 and 3. The numbers in circles correspond to the site numbers in the tables.

TABLE 1. — Peak discharges, Larimer County, Colo., July 31-August 1, 1976
(Preliminary data — Subject to revision)

Site no.	Station Number	Station Name	Drainage area (square miles)	Date	Discharge (cubic feet per second)
1	06735500	Big Thompson River near Estes Park (lat 40° 22′ 35″, long 105° 29′ 06″)	155	7-31-76	(a)
2	.....	Dry Gulch near Estes Park (lat 40° 24′ 22″, long 105° 28′ 37″)	2.00	7-31-76	3,210
3	.....	Dry Gulch at Estes Park (lat 40° 22′ 42″, long 105° 29′ 15″)	6.12	7-31-76	4,460
4	.....	Big Thompson River below Estes Park (lat 40° 22′ 59″, long 105° 28′ 11″)	164	7-31-76	4,330
5	.....	Big Thompson River tributary below Loveland Heights (lat 40° 23′ 44″, long 105° 27′ 34″)	1.37	7-31-76	8,700
6	.....	Dark Gulch at Glen Comfort (lat 40° 23′ 44″, long 105° 26′ 17″)	1.00	7-31-76	7,210
7	.....	Noels Draw at Glen Comfort (lat 40° 23′ 25″, long 105° 26′ 00″)	3.37	7-31-76	6,910
8	.....	Rabbit Gulch near Drake (lat 40° 24′ 23″, long 105° 24′ 17″)	3.41	7-31-76	3,540
9	.....	Long Gulch near Drake (lat 40° 23′ 46″, long 105° 24′ 04″)	1.99	7-31-76	5,500
10	.....	Big Thompson River above Drake (lat 40° 25′ 39″, long 105° 20′ 37″)	189	7-31-76	28,200
11	.....	North Fork Big Thompson River at Glen Haven (lat 40° 27′ 17″, long 105° 27′ 05″)	18.5	7-31-76	888
12	.....	Fox Creek at Glen Haven (lat 40° 27′ 17″, long 105° 27′ 13″)	7.18	7-31-76	1,300
13	.....	Devils Gulch near Glen Haven (lat 40° 26′ 24″, long 105° 27′ 31″)	.91	7-31-76	2,810
14	.....	West Creek near Glen Haven (lat 40° 26′ 32″, long 105° 27′ 40″)	23.1	7-31-76	2,320
15	.....	North Fork Big Thompson River tributary near Glen Haven (lat 40° 27′ 14″, long 105° 26′ 04″)	1.38	7-31-76	9,670
16	.....	Black Creek near Glen Haven (lat 40° 27′ 04″, long 105° 25′ 28″)	3.17	7-31-76	1,790
17	.....	Miller Fork near Glen Haven (lat 40° 27′ 47″, long 105° 25′ 13″)	13.9	7-31-76	2,060
18	.....	North Fork Big Thompson River tributary near Drake (lat 40° 26′ 55″, long 105° 24′ 11″)	1.26	7-31-76	3,240
19	.....	North Fork Big Thompson River above Drake (lat 40° 26′ 20″, long 105° 21′ 52″)	80.2	7-31-76	8,710
20	.....	Big Thompson River below Drake (lat 40° 25′ 52″, long 105° 19′ 37″)	276	7-31-76	30,100
21	06738000	Big Thompson River at mouth of canyon, near Drake (lat 40° 25′ 18″, long 105° 13′ 34″)	305	7-31-76	31,200
22	.....	Big Thompson River below Green Ridge Glade (lat 40° 25′ 05″, long 105° 12′ 02″)	311	7-31-76	27,000
23	.....	Redstone Creek near Masonville (lat 40° 30′ 19″, long 105° 11′ 49″)	29.1	7-31-76	2,640
24	.....	Little Thompson River near Estes Park (lat 40° 20′ 06″, long 105° 25′ 48″)	2.77	7-31-76	1,940
25	06744000	Big Thompson River at mouth, near LaSalle (lat 40° 21′ 00″, long 104° 47′ 04″)	828	8-1-76	2,500
*26	.....	Dale Creek tributary at Virginia Dale (lat 40° 57′ 36″, long 105° 21′ 39″)	.68	7-31-76	727
*27	.....	Deadman Creek near Virginia Dale (lat 40° 55′ 50″, long 105° 20′ 57″)	23.7	7-31-76	7,400
*28	.....	Stonewall Creek near Livermore (lat 40° 48′ 37″, long 105° 15′ 01″)	31.9	7-31-76	3,470
*29	.....	Lone Pine Creek near Livermore (lat 40° 47′ 44″, long 105° 17′ 24″)	86.3	7-31-76	2,590
*30	.....	North Fork Cache la Poudre River at Livermore (lat 40° 47′ 15″, long 105° 15′ 08″)	539	7-31-76	9,460
*31	06752000	Cache la Poudre River at mouth of canyon, near Ft. Collins (lat 40° 39′ 52″, long 105° 13′ 26″)	1,056	7-31-76	7,340
*32	.....	Rist Canyon near Bellvue (lat 40° 37′ 43″, long 105° 12′ 44″)	5.27	7-31-76	2,710
*33	06752260	Cache la Poudre River at Ft. Collins (lat 40° 35′ 17″, long 105° 04′ 08″)	1,129	7-31-76	5,700

(a)No flow out of Lake Estes.
*Not shown on figure 1.

TABLE 2. — High-water elevations and cross-section data at selected sites on the Big Thompson River

Cross-section number	Approximate distance between cross sections (feet)	Left high water	Left bank	Stream bed	Right bank	Right high water
		Elevations, in feet, above mean sea level				
1		7422.2	7419.7	7415.6	7419.1	7423.3
	70					
2		7420.9	7418.9	7415.0	7418.4	7420.7
	1540					
3		7410.7	7411.9	7407.5	7415.0	7411.9
	3100					
4		7381.7	7382.0	7372.6	7379.6	7381.7
	610					
5		7372.8	7369.1	7365.8	7369.9	7371.4
	2280					
6		7356.8	7354.0	7349.6	7357.5	7356.4
	1850					
7		7328.5	7326.9	7321.7	7328.0	7328.9
	720					
8		7324.0	7320.9	7316.4	7323.8	7324.3
	2070					
9		7310.2	7304.8	7299.8	7303.8	7308.7
	1160					
10		7299.2	7300.5	7289.5	7296.0	7297.8
	1900					
11		7274.7	7271.8	7264.8	7271.4	7273.1
	1420					
12		7248.6	7256.2	7245.6	7252.4	7249.9
	980					
13		7241.2	7237.1	7233.5	7241.0	7241.2
	2950					
14		7207.7	7205.4	7199.5	7201.5	7209.1
	1390					
15		7181.0	7180.8	7172.8	7175.8	7183.4
	1090					
16		7160.2	7158.8	7150.5	7156.0	7159.6
	2090					
17		7130.8	7132.8	7122.3	7125.2	7129.8
	2210					
18		7103.1	7103.1	7087.6	7100.6	7105.4
	1870					
19		7055.0	7053.8	7045.1	7055.0	7059.8
	150					
20		7048.6	7048.6	7041.8	7049.8	7053.3
	2100					
21		7015.3	7007.4	7004.4	7014.3	7015.5
	1320					
22		7003.6	6997.1	6993.7	6996.4	7003.3
	1780					
23		6982.3	6979.6	6972.0	6983.6	---
	1340					
24		6970.8	6962.3	6960.3	6961.3	6970.4
	1500					
25		6961.2	6951.2	6950.2	6951.3	6962.8
	100					
26		6958.5	6951.0	6949.5	6951.0	6960.3
	1610					
27		6942.9	6933.9	6931.9	6932.9	6946.2
	3020					
28		6912.9	6918.0	6901.4	6906.4	6914.9
	2800					
29		6866.5	6857.8	6855.8	6858.1	6868.1
	2270					
30		6845.3	6839.6	6827.8	6837.8	6843.1
	1420					
31		---	6818.4	6810.9	6819.8	6822.3
	1950					
32		6721.0	---	6703.5	---	6719.6
	2810					
33		6588.4	6581.4	6577.9	6580.8	6586.4
	1040					
34		---	6530.5	6520.8	6529.5	6532.5
	1870					
35		6478.4	6477.6	6470.8	6479.8	6479.8
	1120					
36		6457.8	6454.3	6443.3	6451.4	6459.5
	2420					
37		6388.6	6381.2	6378.0	6384.2	6390.1
	3540					
38		6273.5	6269.2	6255.0	6262.0	6267.7

TABLE 2. — continued

Cross-section number	Approximate distance between cross sections (feet)	Left high water	Left bank	Stream bed	Right bank	Right high water
		Elevations, in feet, above mean sea level				
	3710					
39		6163.4	6157.2	6153.2	6158.3	6164.9
	790					
40		6155.9	6148.9	6143.1	6144.9	6154.4
	770					
41		6149.0	6149.5	6136.3	6138.3	6147.2
	1750					
42		6130.3	6123.0	6112.6	6115.6	6129.2
	2530					
43		6090.4	6079.4	6071.4	6082.4	6087.2
	240					
44		6084.2	6080.0	6070.2	6080.2	6084.7
	1600					
45		6042.4	6042.2	6029.0	---	6040.9
	2770					
46		5984.3	5975.3	5964.2	5970.8	5977.4
	1230					
47		5936.8	5933.2	5924.7	5933.1	5939.2
	1160					
48		---	5902.7	5886.7	5901.5	5905.5
	2350					
49		5857.3	5853.1	5836.3	5841.3	5844.4
	3130					
50		---	---	5757.5	---	5772.4
	2000					
51		5713.3	5705.2	5703.4	5705.4	5715.4
	1300					
52		5688.0	5683.7	5676.6	5680.2	5689.3
	640					
53		---	---	5662.1	5680.1	5684.9
	4250					
54		5597.9	5594.6	5590.3	5594.0	5600.0
	290					
55		5598.0	5590.5	5586.2	5592.9	5595.8
	2980					
56		5552.4	5541.5	5539.5	5547.4	5553.3
	1740					
57		5544.1	5538.4	5533.9	5541.0	5546.1
	590					
58		5541.0	5542.0	5526.1	5532.8	5540.5
	1210					
59		5525.6	5519.1	5507.2	5518.7	5524.0
	1300					
60		---	---	5548.3	---	5501.7
	1860					
61		---	---	5433.4	---	5456.9
	5990					
62		5316.9	---	5303.7	---	---
	700					
63		5292.6	5286.5	5274.8	5286.5	---
	2720					
64		5261.6	5254.7	5244.0	5255.5	5259.0
	2730					
65		5246.6	5238.7	5235.7	5249.6	5246.6
	2490					
66		5180.4	5173.1	5168.2	5174.1	5178.4
	590					
67		5163.3	5158.0	5153.2	---	---
	2710					
68		5156.2	5145.4	5137.9	5144.9	5157.1
	2960					
69		5126.1	5118.7	5116.2	5124.8	5125.5
	2630					
70		5108.2	5101.1	5094.2	5101.7	5107.5
	1930					
71		5092.6	5089.1	5083.9	5087.9	5091.9
	3640					
72		5078.1	5071.6	5065.6	5072.5	5078.5
	1270					
73		5070.1	5065.4	5058.1	5069.2	5071.8
	4840					
74		5049.4	5045.1	5036.7	5042.6	5046.3
	5220					
75		5033.7	5030.1	5021.3	5029.0	5030.2

TABLE 3. — High-water elevations and cross-section data at selected sites on the North Fork Big Thompson River

Cross-section number	Approximate distance between cross sections (feet)	Left high water	Left bank	Stream bed	Right bank	Right high water
		Elevations, in feet, above mean sea level				
NF 1		7429.6	7427.4	7419.4	7430.3	7429.5
	940					
NF 2		7381.1	7378.6	7375.4	7378.8	7380.7
	670					
NF 3		7344.7	7340.4	7337.5	7341.9	7344.2
	670					
NF 4		7323.9	7320.5	7315.5	7320.2	7323.9
	1020					
NF 5		7303.5	7300.4	7297.6	7300.5	7304.0
	2180					
NF 6		7272.3	7270.6	7262.4	7267.0	7272.1
	320					
NF 7		7266.8	7263.0	7259.4	7262.2	7267.6
	1220					
NF 8		7244.0	7241.0	7239.8	7245.1	7245.1
	390					
NF 9		7239.6	7235.7	7230.7	7236.9	7241.1
	230					
NF 10		7233.4	7231.2	7228.8	7231.3	7235.5
	380					
NF 11		7227.7	7223.5	7221.7	7224.3	7227.9
	460					
NF 12		7220.4	7219.3	7211.0	7214.5	7219.5
	1310					
NF 13		7190.2	7185.5	7181.4	7187.1	7189.3
	720					
NF 14		7175.2	7170.5	7167.6	7170.8	7173.2
	910					
NF 15		---	---	7145.0	7148.4	7153.0
	1540					
NF 16		7095.9	7090.3	7083.0	---	7094.6
	1160					
NF 17		7068.1	7065.4	7059.2	---	---
	980					
NF 18		7035.9	7031.2	7028.5	7031.0	7037.0
	350					
NF 19		7021.8	7018.0	7016.1	---	7022.7
	480					
NF 20		7013.6	7010.9	7005.5	7010.8	7016.1
	820					
NF 21		6994.6	6992.1	6988.4	6991.6	6997.0
	900					
NF 22		6977.6	6971.3	6966.6	6975.3	6976.3
	1340					
NF 23		6951.4	6947.1	6941.3	6945.1	6950.8
	1480					
NF 24		6928.2	6926.1	6921.8	6924.4	6927.9
	500					
NF 25		6920.6	6915.8	6910.7	6915.8	6920.1
	1430					
NF 26		6900.6	6898.1	6891.9	6895.1	6898.8
	1280					
NF 27		6872.6	6868.7	6859.1	6872.9	6871.4
	290					
NF 28		6865.6	6862.6	6856.3	6864.5	6865.0

TABLE 3. — continued

Cross-section number	Approximate distance between cross sections (feet)	Left high water	Left bank	Stream bed	Right bank	Right high water
		Elevations, in feet, above mean sea level				
	470					
NF 29		---	6852.4	6847.1	6852.5	6856.6
	340					
NF 30		6848.6	6843.7	6838.7	6846.4	6851.7
	360					
NF 31		6835.0	6830.6	6825.6	6835.8	6839.9
	250					
NF 32		6807.1	6801.8	6798.0	6810.9	6808.3
	1570					
NF 33		6757.8	6754.1	6747.3	6751.4	6758.2
	1980					
NF 34		---	6659.2	6653.8	6657.8	6665.1
	240					
NF 35		---	---	6647.7	6653.6	6660.4
	1700					
NF 36		---	6593.9	6588.5	6604.0	6601.2
	380					
NF 37		6585.9	6582.8	6577.3	6588.0	6586.1
	840					
NF 38		6566.8	6561.1	6562.2	---	---
	230					
NF 39		6563.5	6562.4	6552.0	6561.2	6562.4
	1740					
NF 40		6506.9	6500.6	6491.9	---	---
	440					
NF 41		---	6489.4	6477.9	6485.4	6491.9
	1630					
NF 42		6452.3	6448.9	6445.8	6450.8	6451.3
	2070					
NF 43		6406.6	6402.8	6396.8	6400.6	6406.8
	1640					
NF 44		6378.9	6378.6	6369.2	6371.1	6375.7
	280					
NF 45		6371.0	6367.7	6364.8	6372.5	6375.6
	2180					
NF 46		6336.7	6331.3	6325.3	6333.2	6338.8
	1480					
NF 47		6306.6	6304.6	6298.5	6304.7	6306.8
	220					
NF 48		6302.5	6300.0	6295.8	6301.5	6303.7
	1990					
NF 49		6270.6	6266.3	6261.7	6268.1	6272.2
	2270					
NF 50		6241.0	6236.2	6232.5	6236.0	6241.3
	450					
NF 51		6232.8	6228.8	6223.8	6229.3	6231.5
	1280					
NF 52		6217.8	6209.1	6204.4	6212.1	---
	1830					
NF 53		6168.3	6166.2	6165.2	6166.2	6167.9
	430					
NF 54		6159.5	6158.3	6155.8	6157.3	6159.4
						* 6160.4

* High-water mark Big Thompson River.

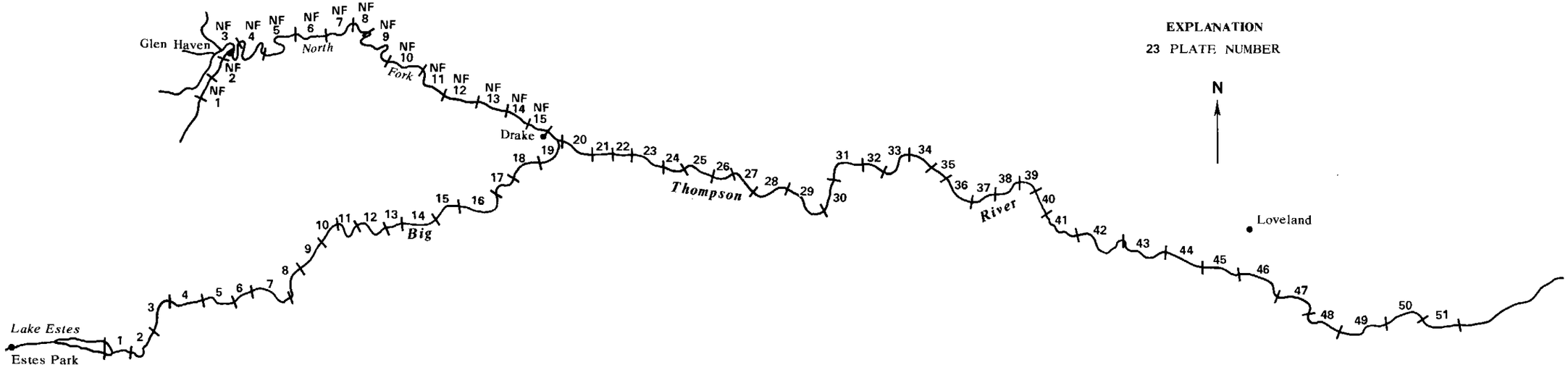
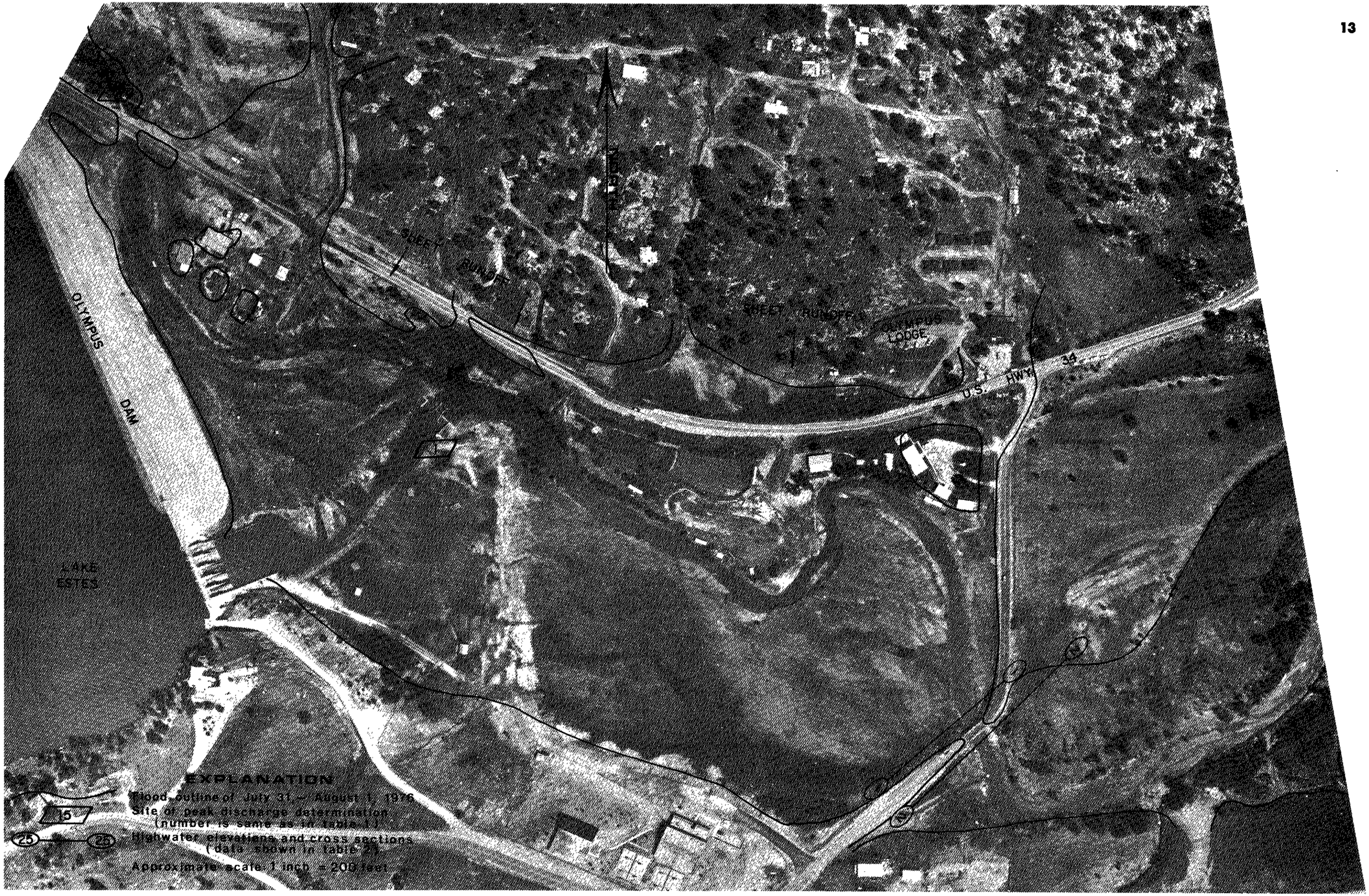


Figure 11.--Index to plates of aerial photographs showing flood outlines for flood of July 31–August 1,1976.
Aerial photographs by Hogan/Olhausen, P.C., Loveland, Colo., August 3, 1976.



BIG THOMPSON RIVER FLOOD of JULY 31, ~ AUGUST 1, 1976 **PLATE NO. 1**

EXPLANATION

15

25 — 25

Flood outline of July 31,– August 1, 1976

Site of peak discharge determination (number is same as in table 1)

Highwater elevations and cross sections (data shown in table 2)

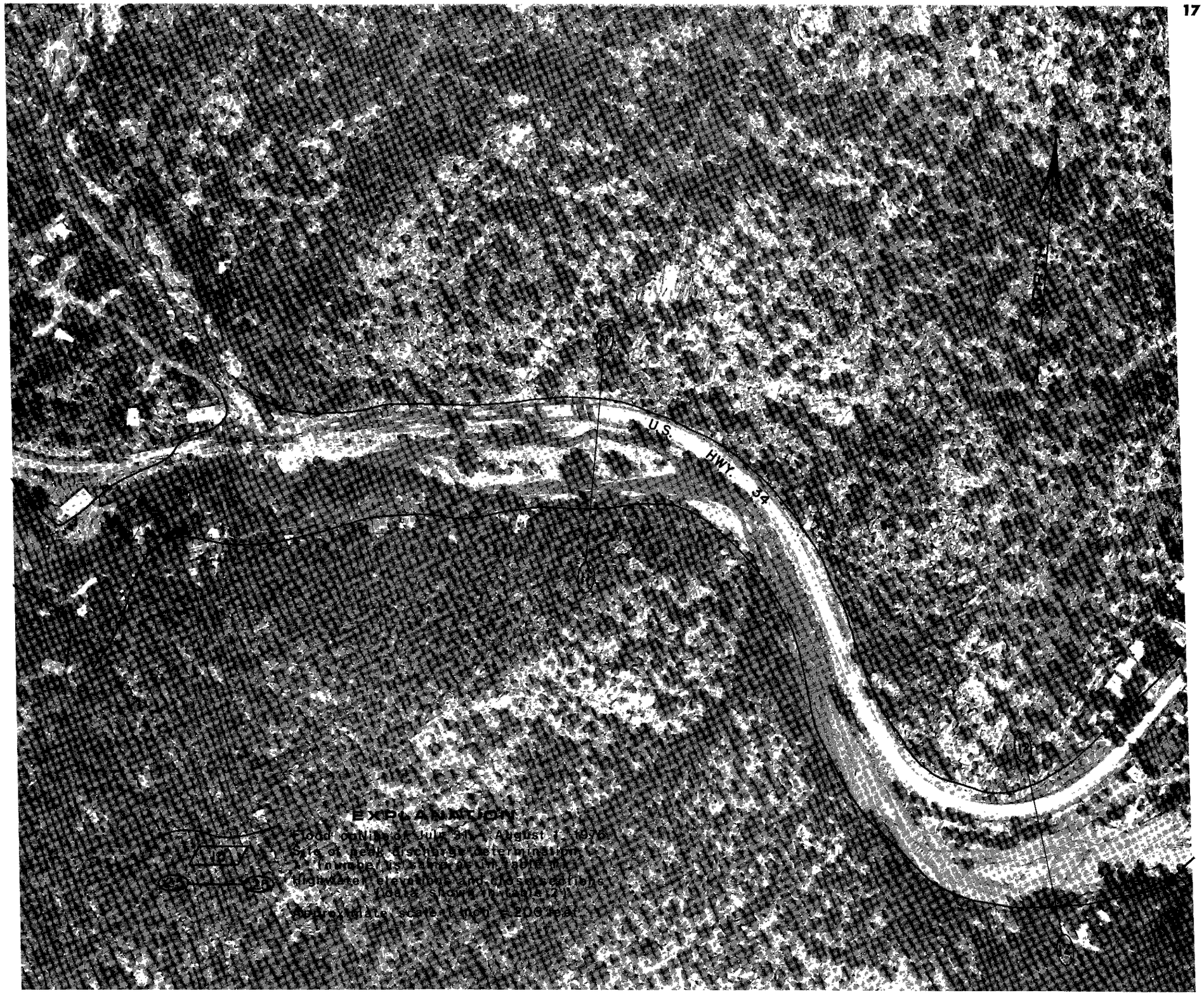
Approximate scale: 1 inch = 200 feet

BIG THOMPSON RIVER FLOOD of JULY 31.--AUGUST 1, 1976 PLATE NO. 2

BIG THOMPSON RIVER FLOOD of JULY 31.--AUGUST 1, 1976 **PLATE NO. 3**

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

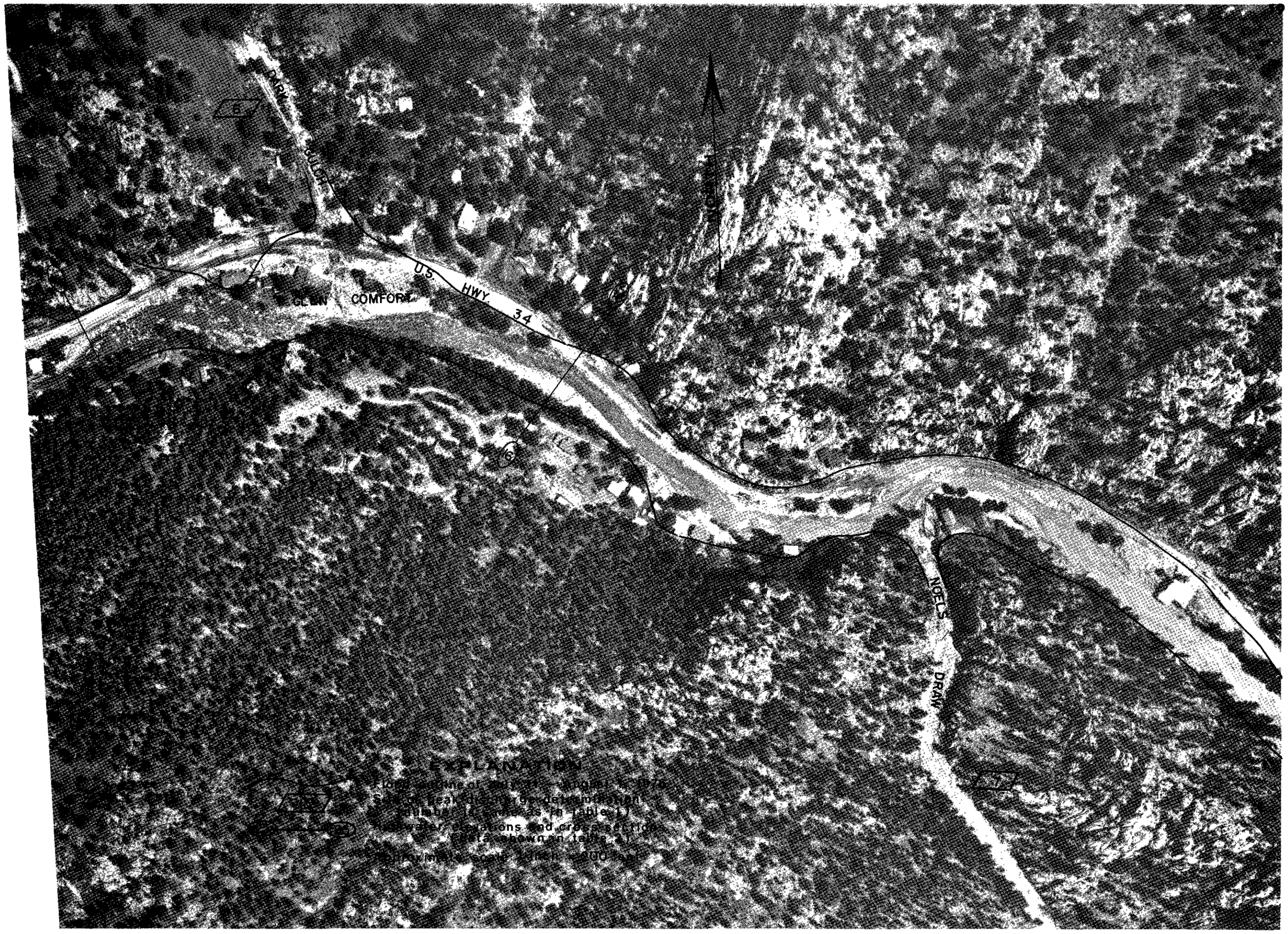
PLATE NO. 4



BIG THOMPSON RIVER FLOOD of JULY 31 - - AUGUST 1, 1976 **PLATE NO. 5**

BIG THOMPSON RIVER FLOOD of JULY 31 - AUGUST 1, 1976

PLATE NO. 6



BIG THOMPSON RIVER FLOOD of JULY 31--AUGUST 1, 1976 **PLATE NO. 7**

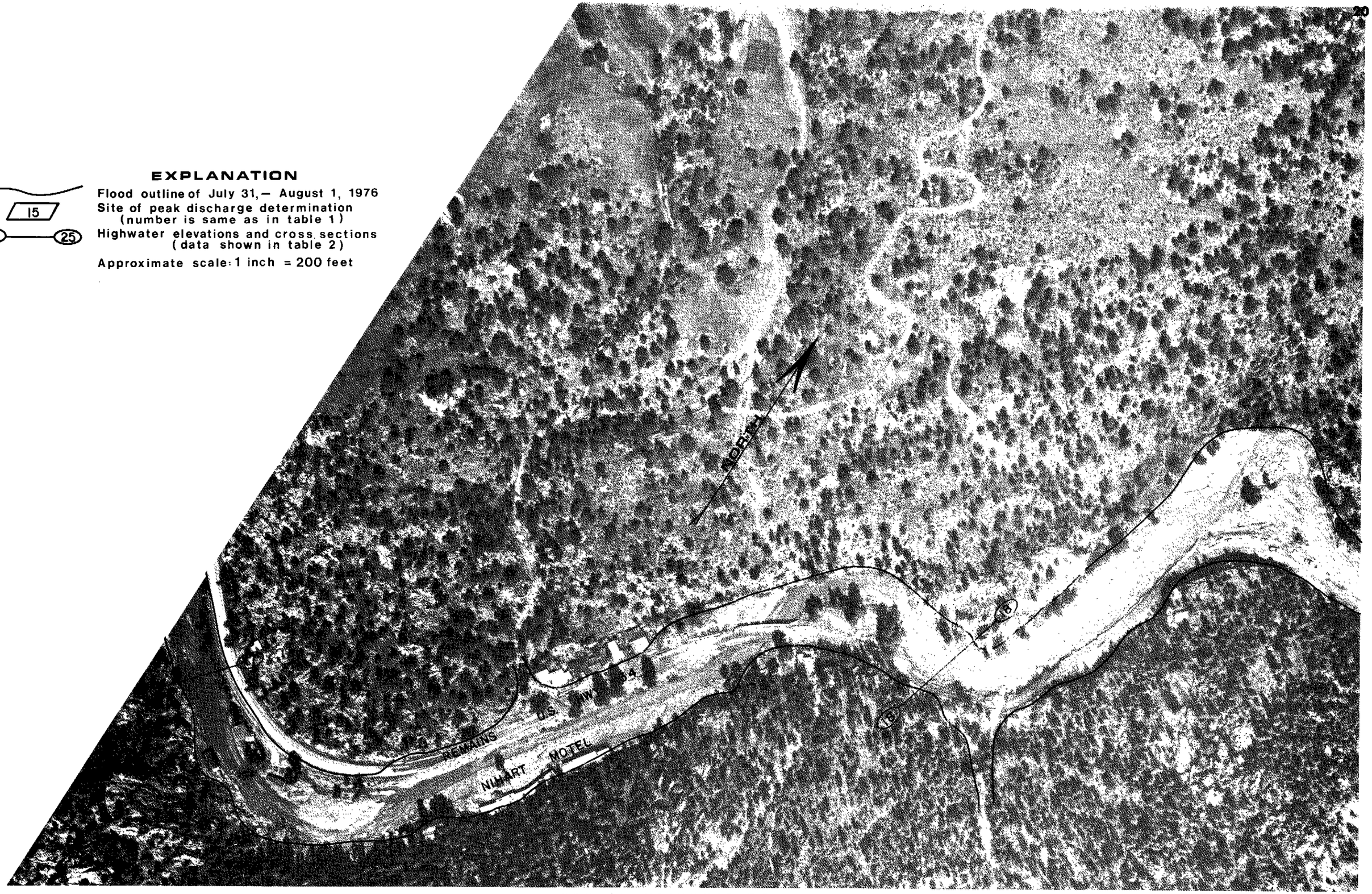
EXPLANATION

Flood outline of July 31,— August 1, 1976

Site of peak discharge determination (number is same as in table 1)

Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 200 feet



BIG THOMPSON RIVER FLOOD of JULY 31,— AUGUST 1, 1976

PLATE NO. 8

EXPLANATION

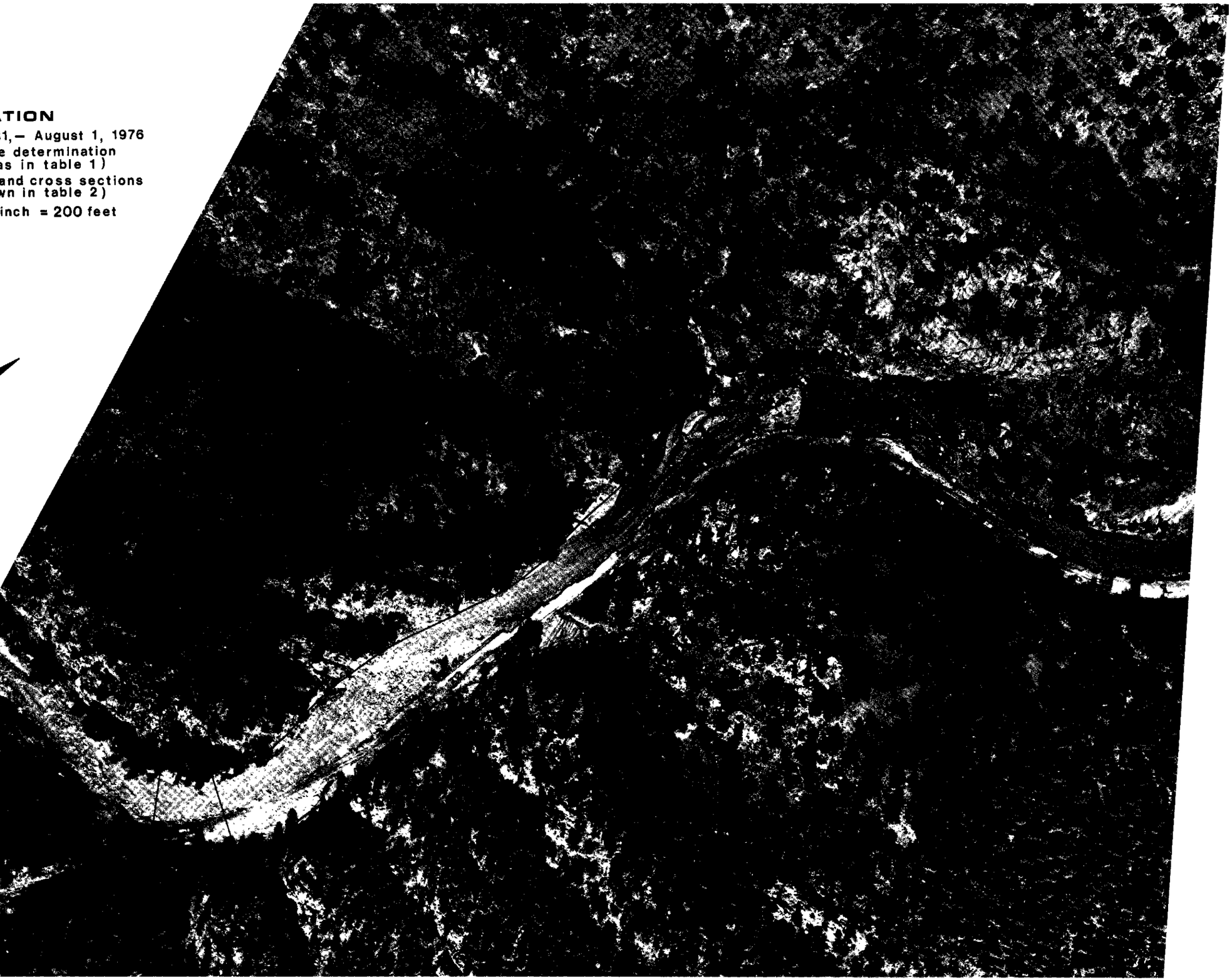
Flood outline of July 31,– August 1, 1976

15 — Site of peak discharge determination (number is same as in table 1)

25 — 25 — Highwater elevations and cross sections (data shown in table 2)

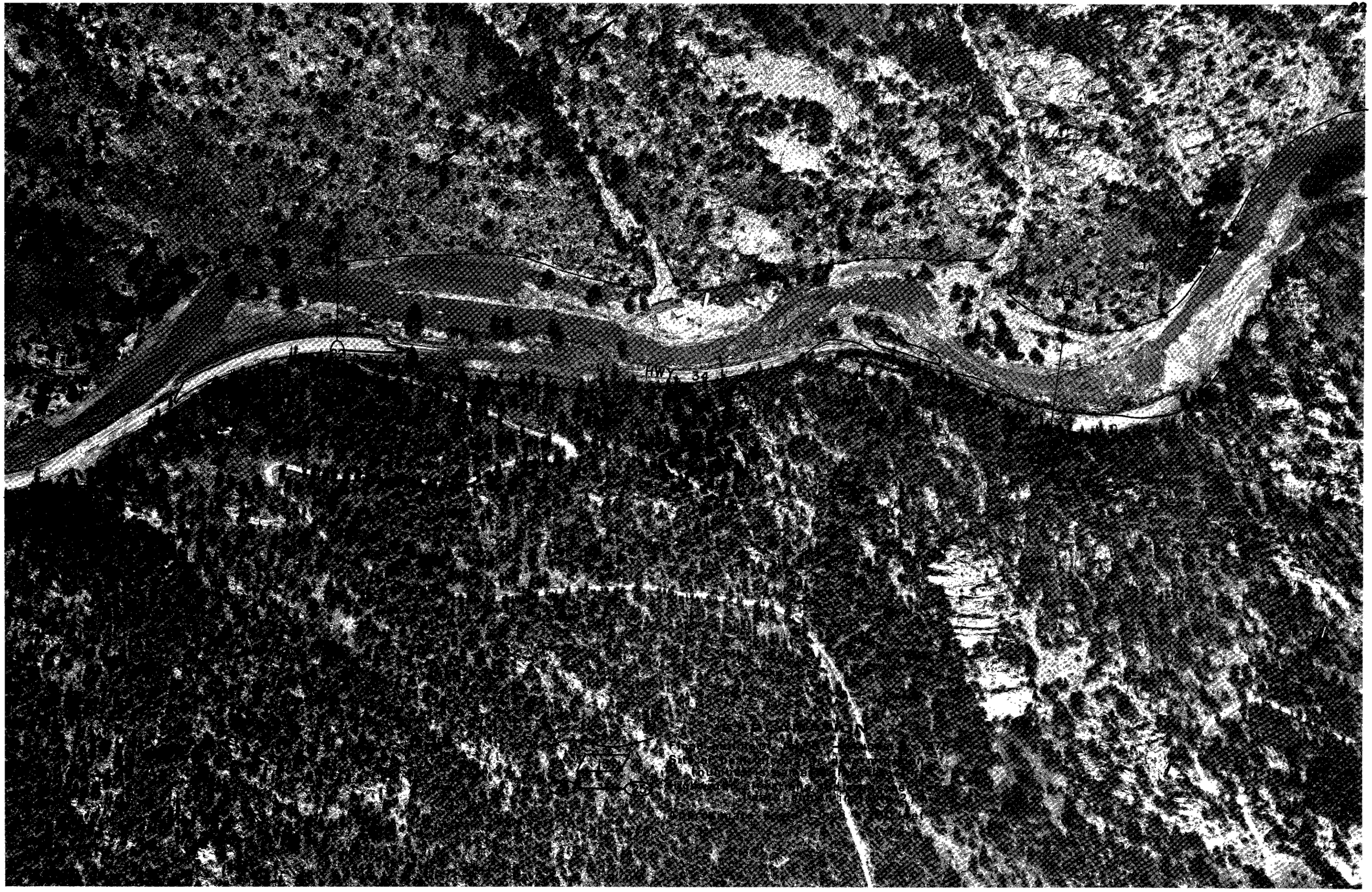
Approximate scale: 1 inch = 200 feet

NORTH

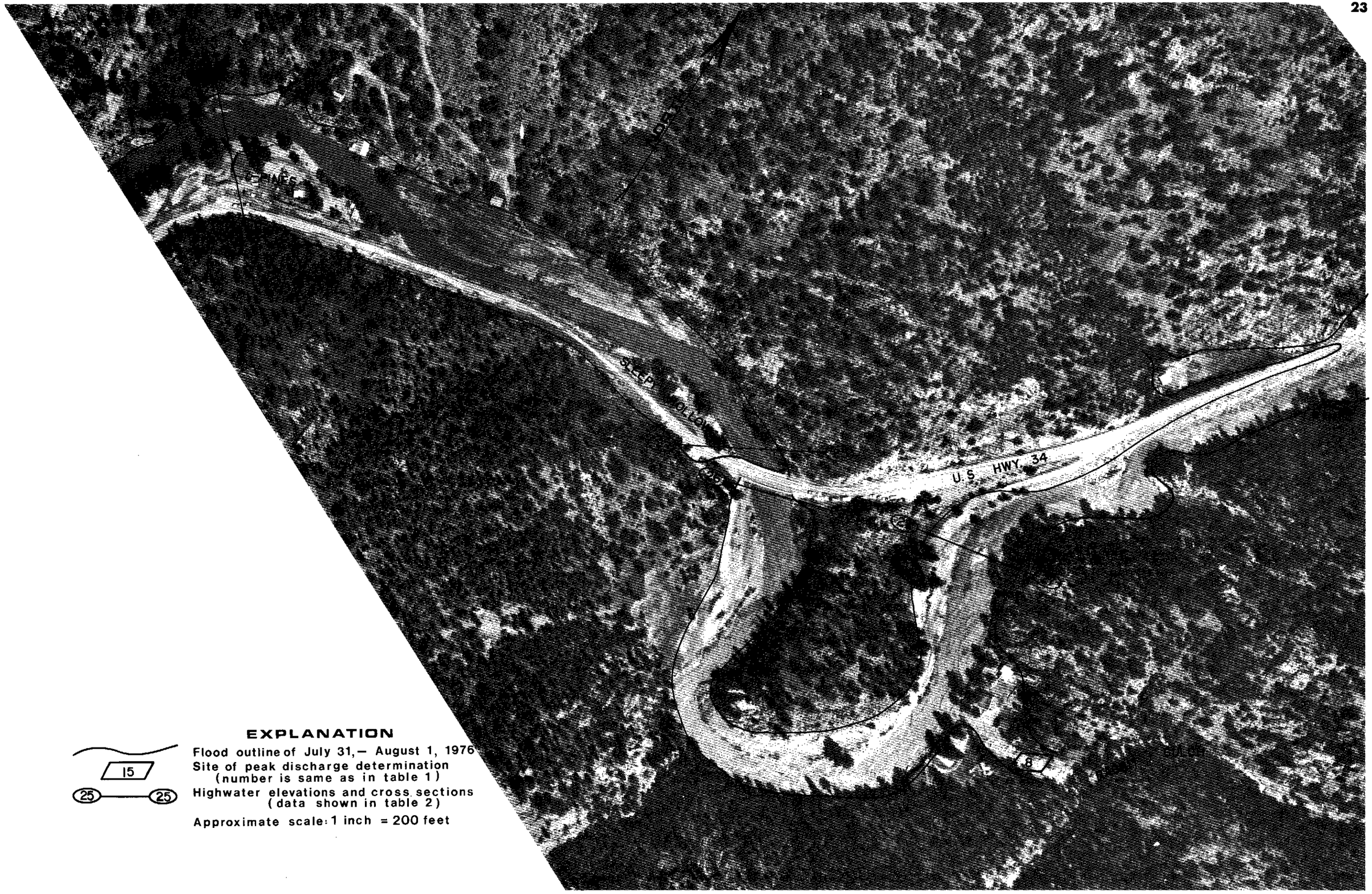


BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 9



BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 PLATE NO. 10



EXPLANATION

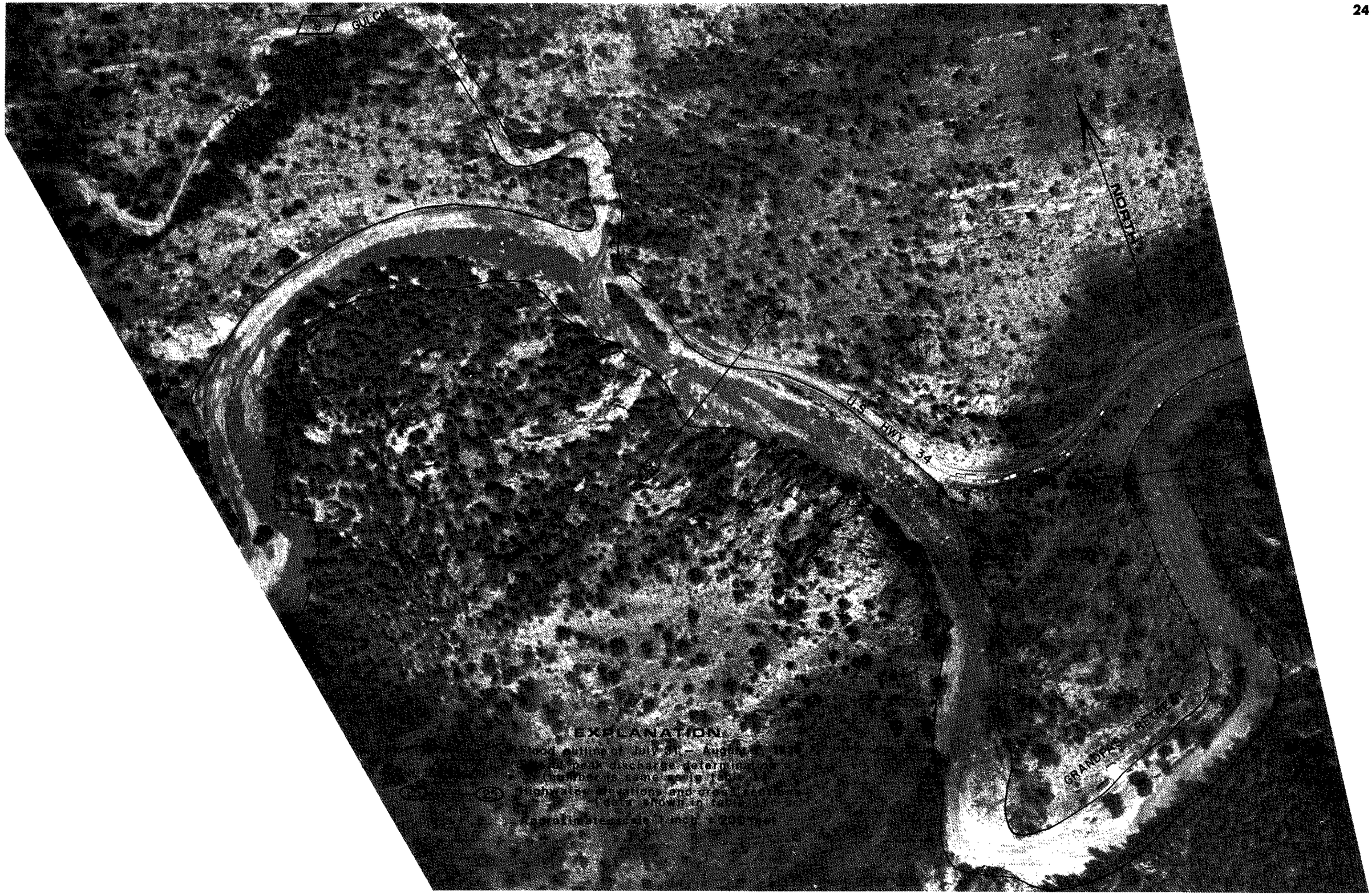
Flood outline of July 31,– August 1, 1976

15 — Site of peak discharge determination (number is same as in table 1)

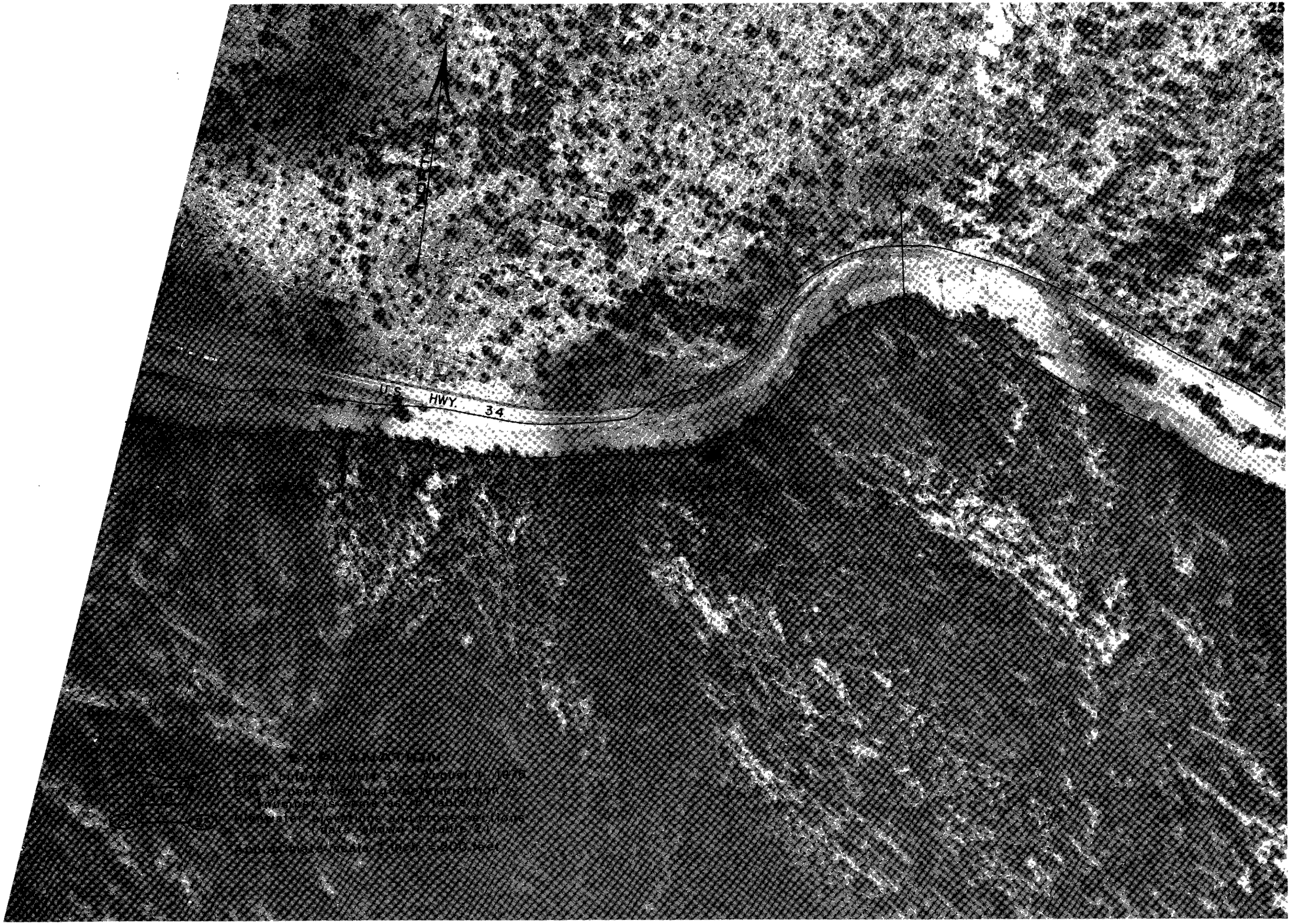
25 — 25 — Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 200 feet

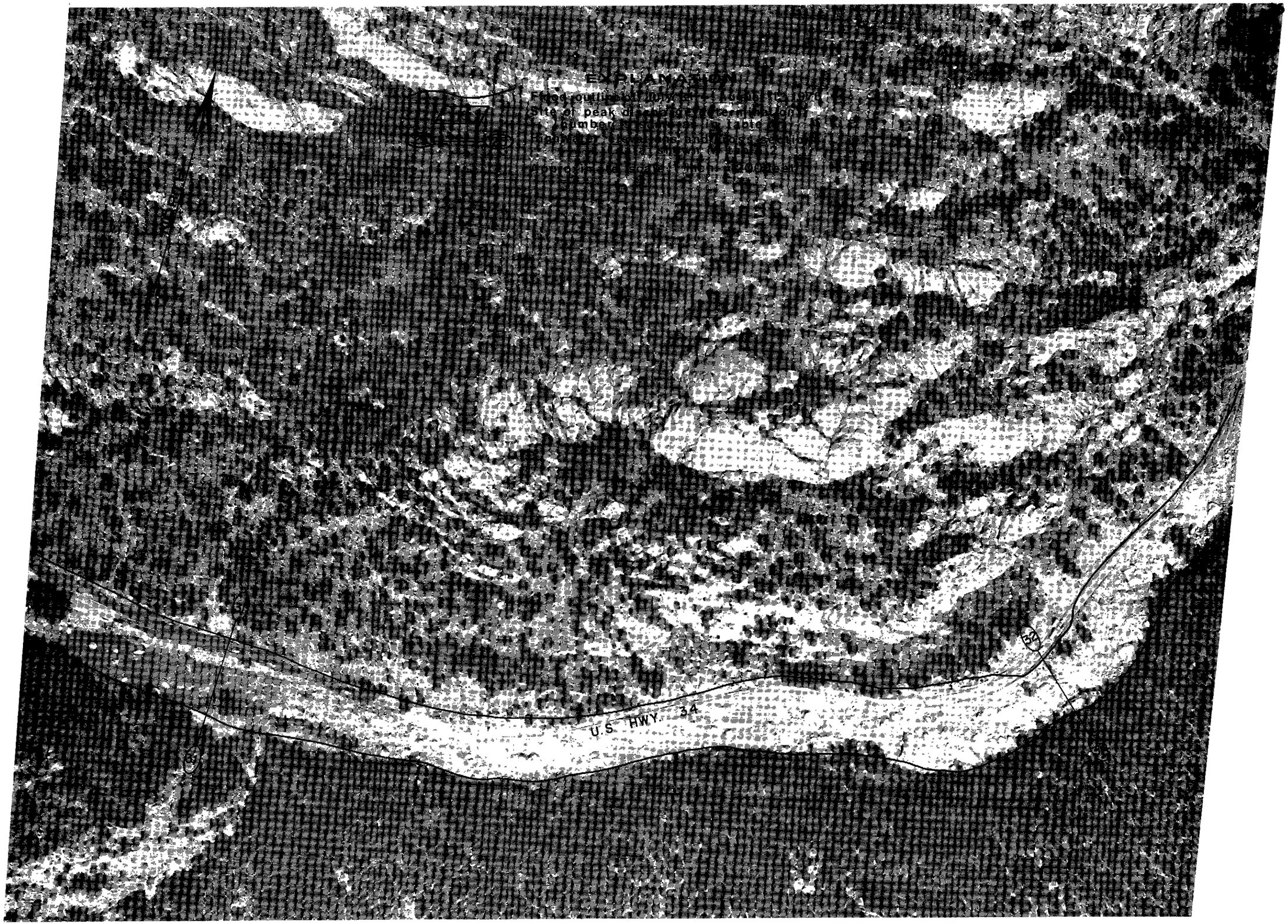
BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 11**



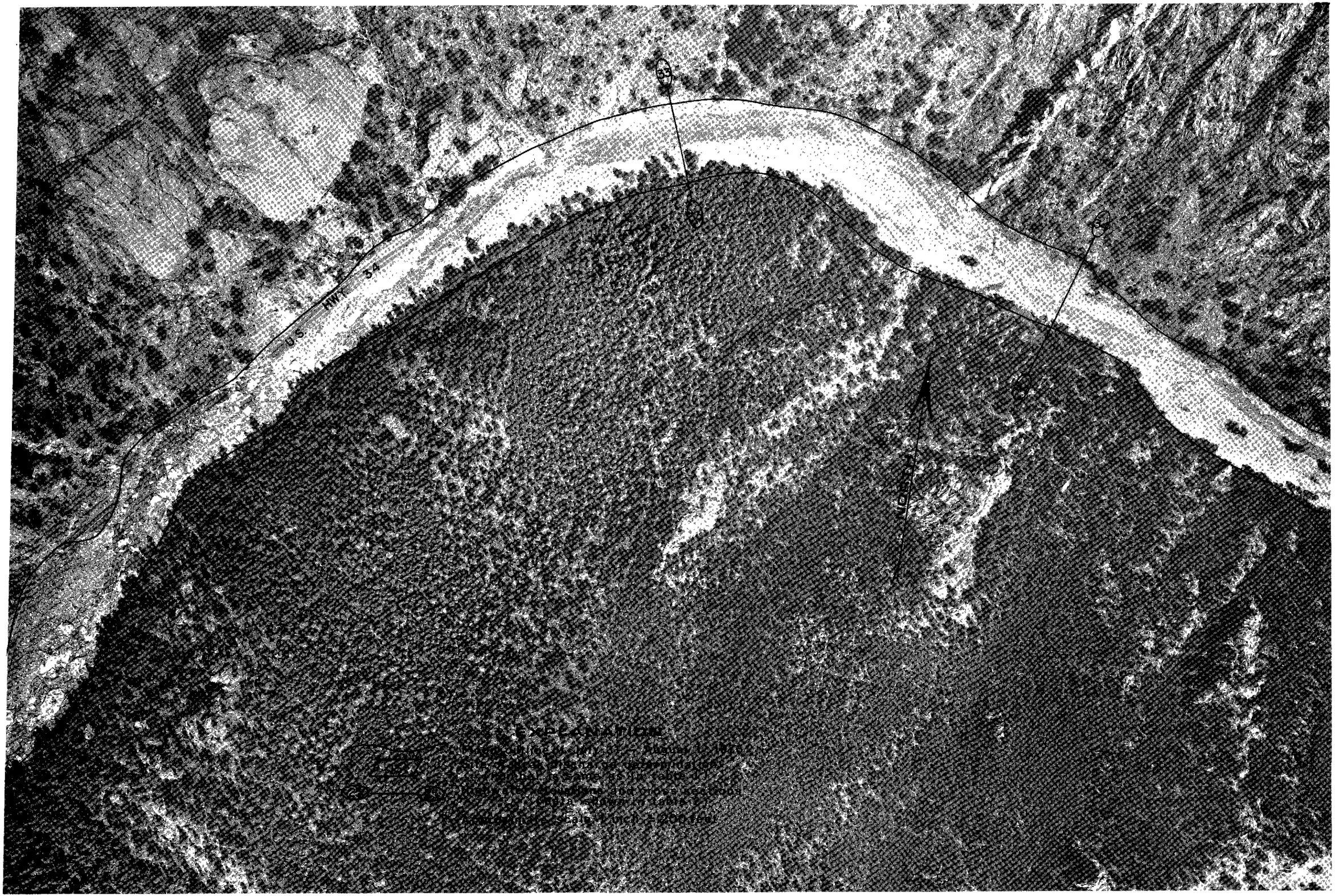
BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 12**



BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 PLATE NO. 13

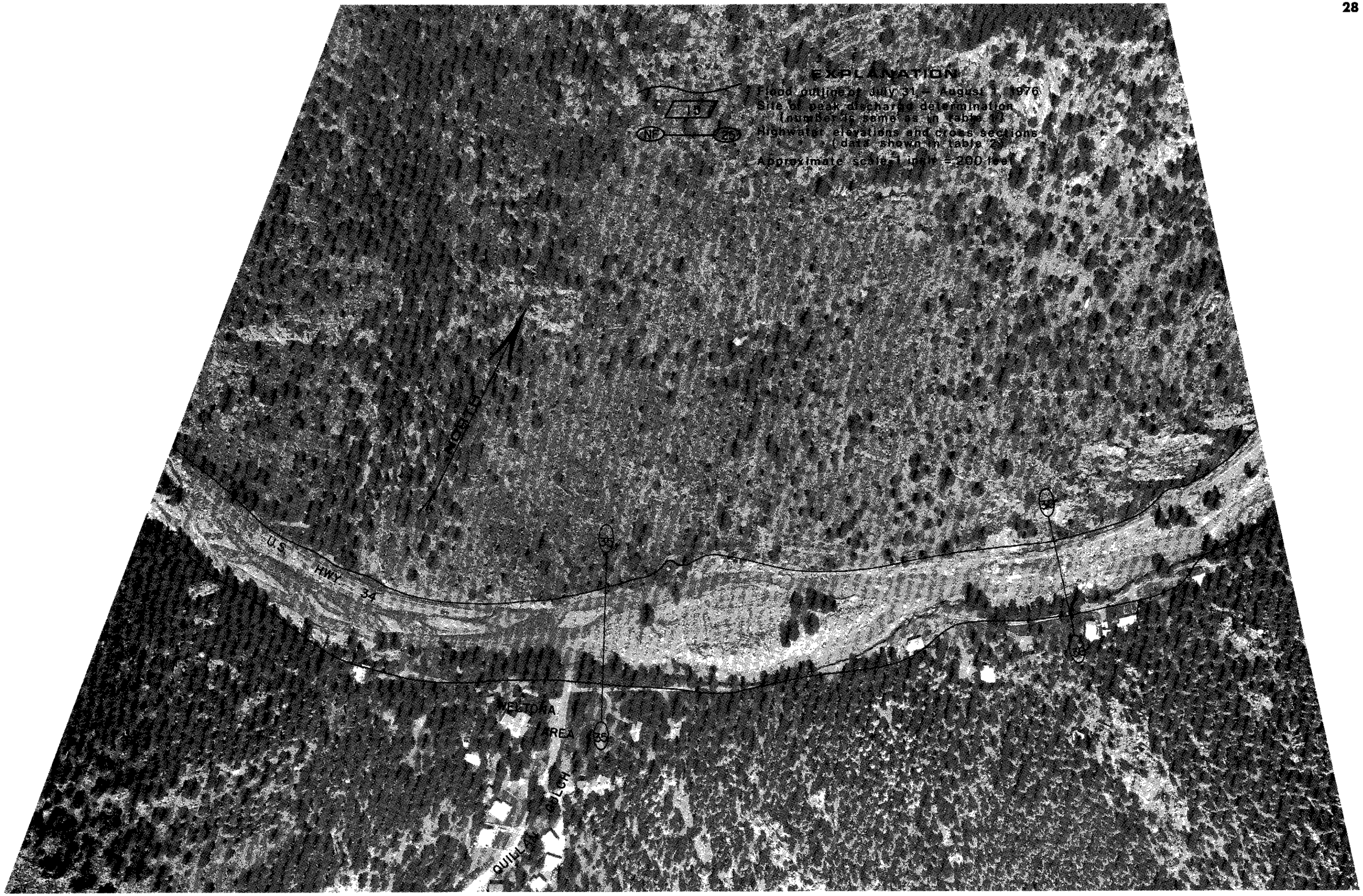


BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 PLATE NO. 14

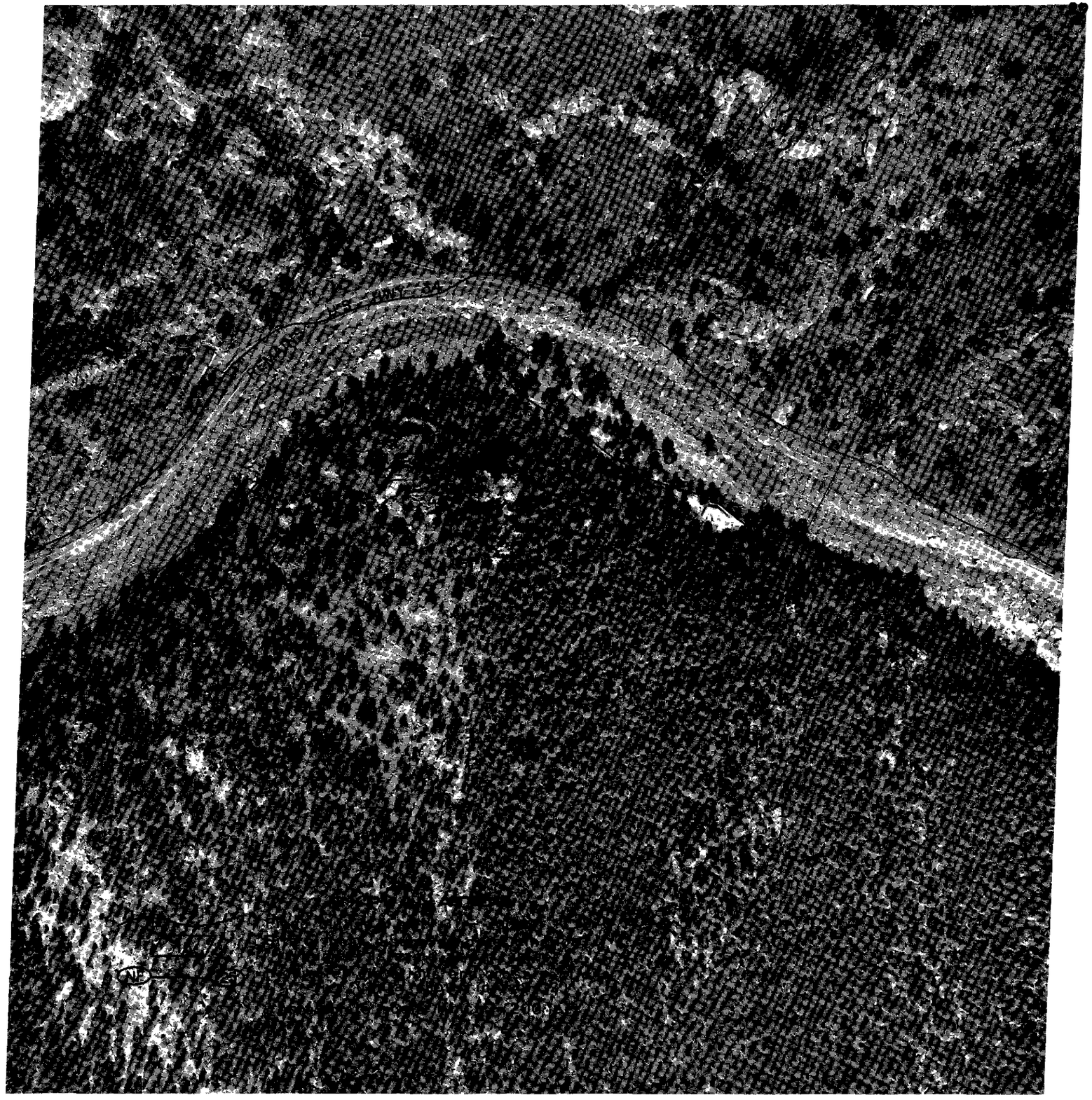


BIG THOMPSON RIVER FLOOD of JULY 31. - - AUGUST 1, 1976

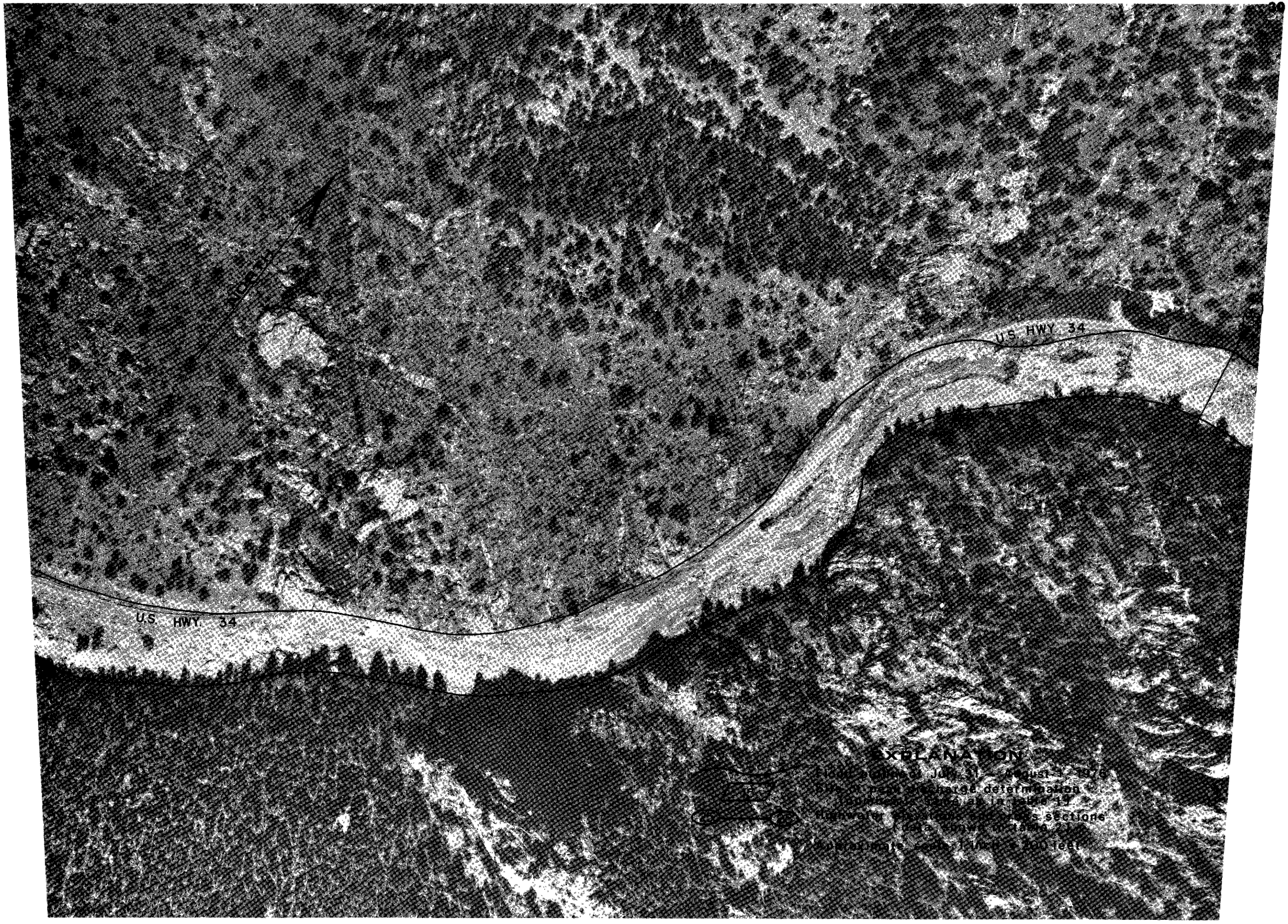
PLATE NO. 15



BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 **PLATE NO. 16**

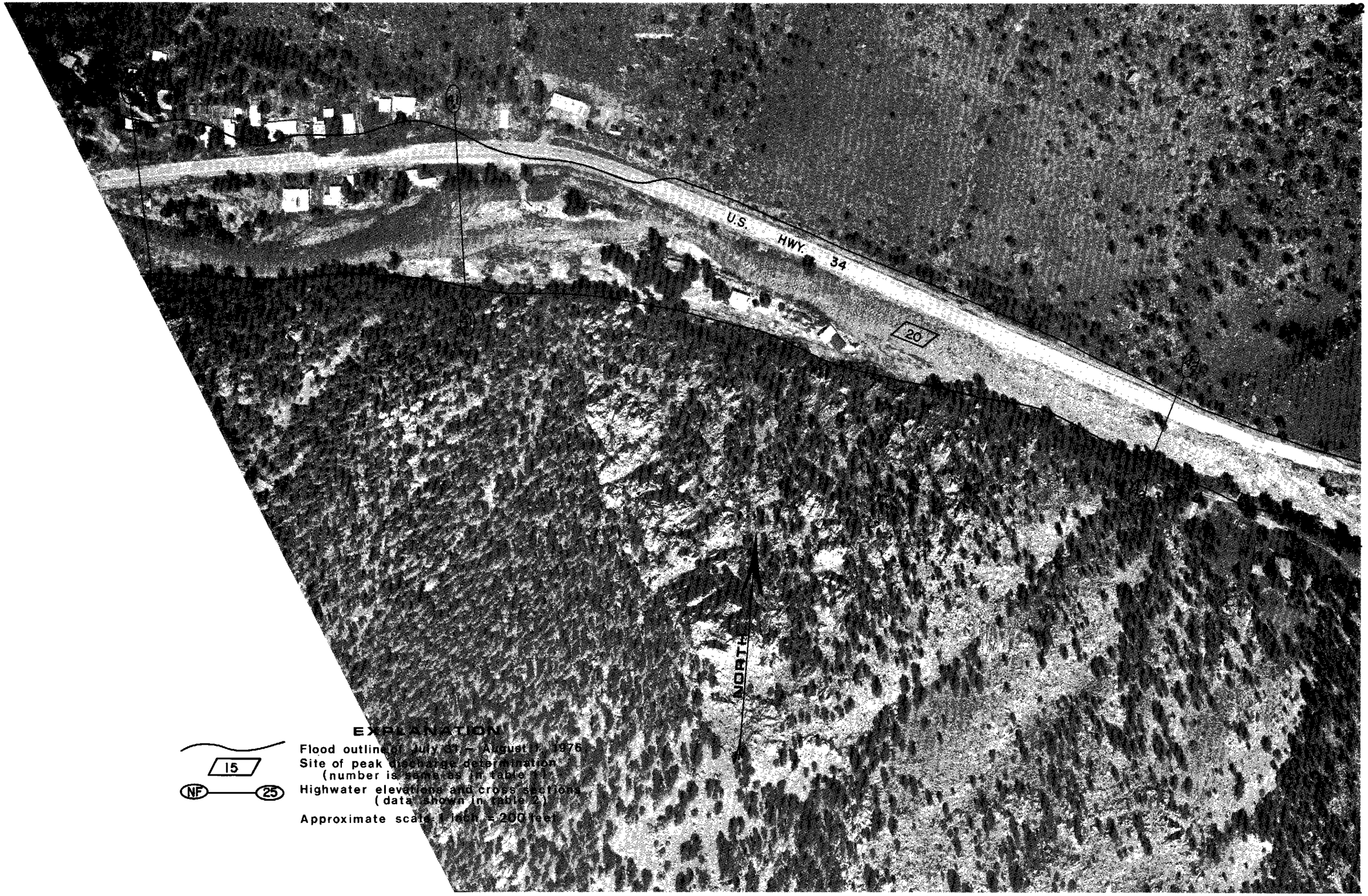


BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 PLATE NO. 17



BIG THOMPSON RIVER FLOOD of JULY 31.--AUGUST 1, 1976 **PLATE NO. 18**

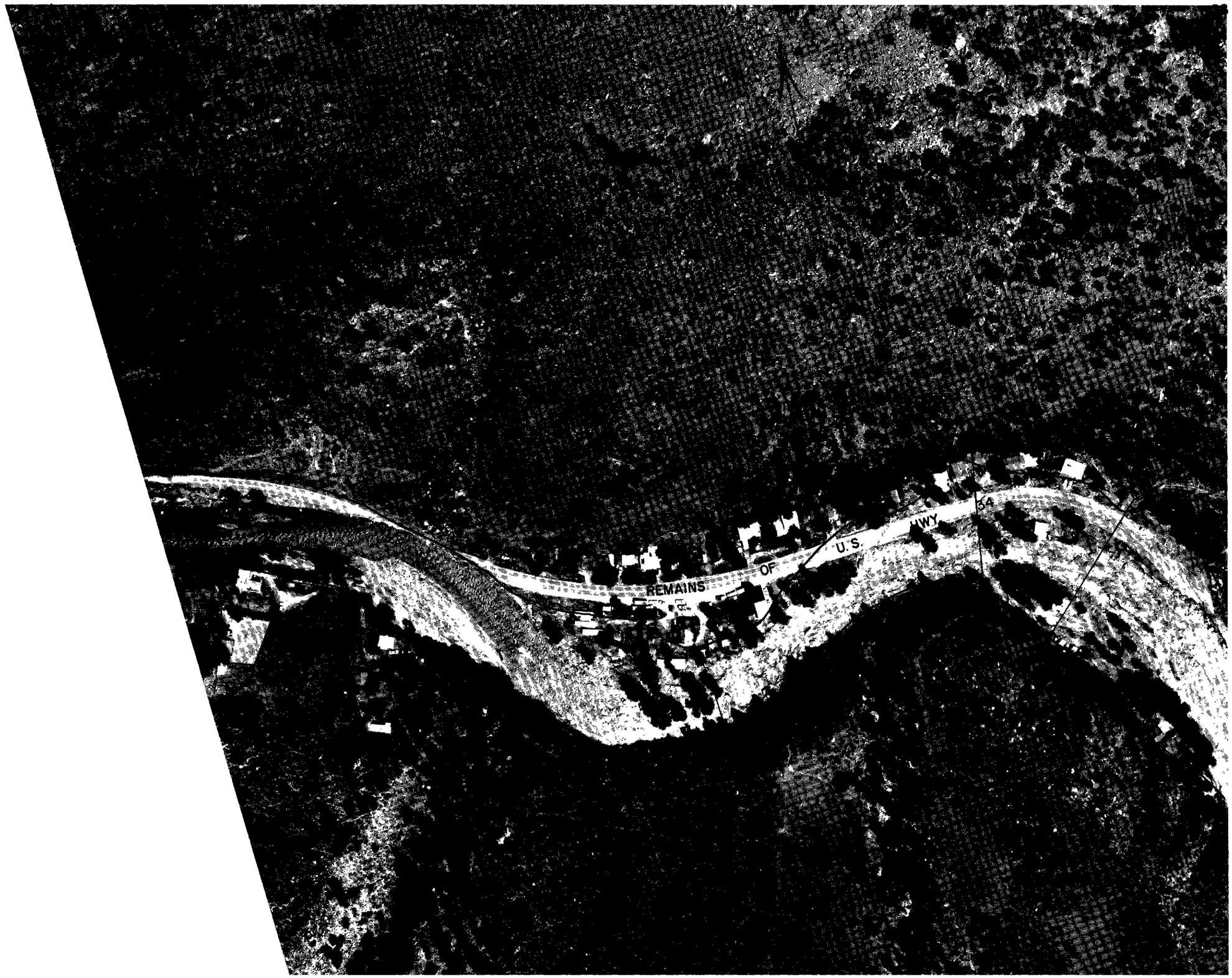
BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 19**



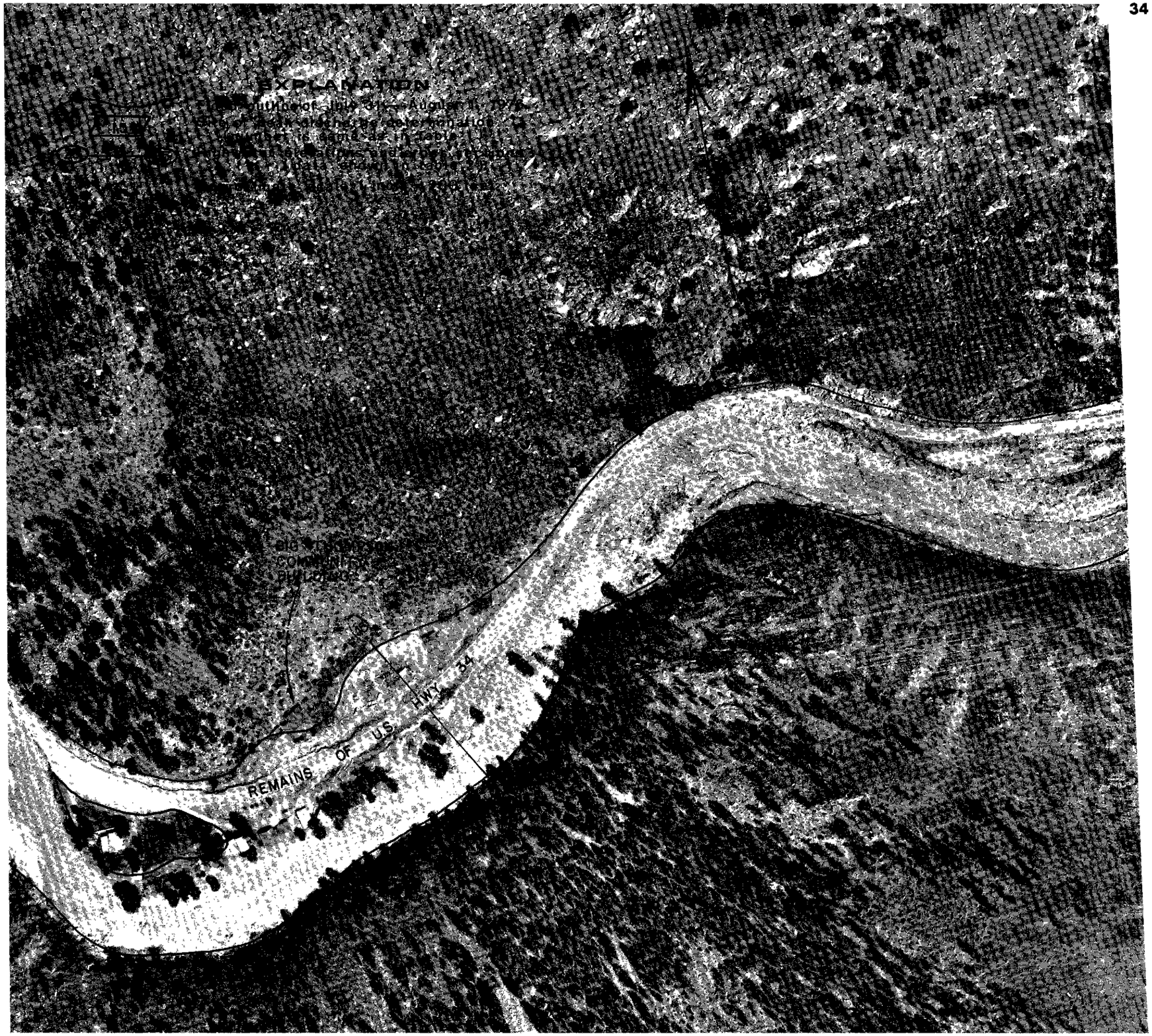
EXPLANATION

- Flood outline of July 31 – August 1, 1976
- 15 — Site of peak discharge determination (number is same as in table 1)
- NF — 25 — Highwater elevations and cross sections (data shown in table 2)
- Approximate scale 1 inch = 200 feet

BIG THOMPSON RIVER FLOOD of JULY 31, ~~ AUGUST 1, 1976 **PLATE NO. 20**

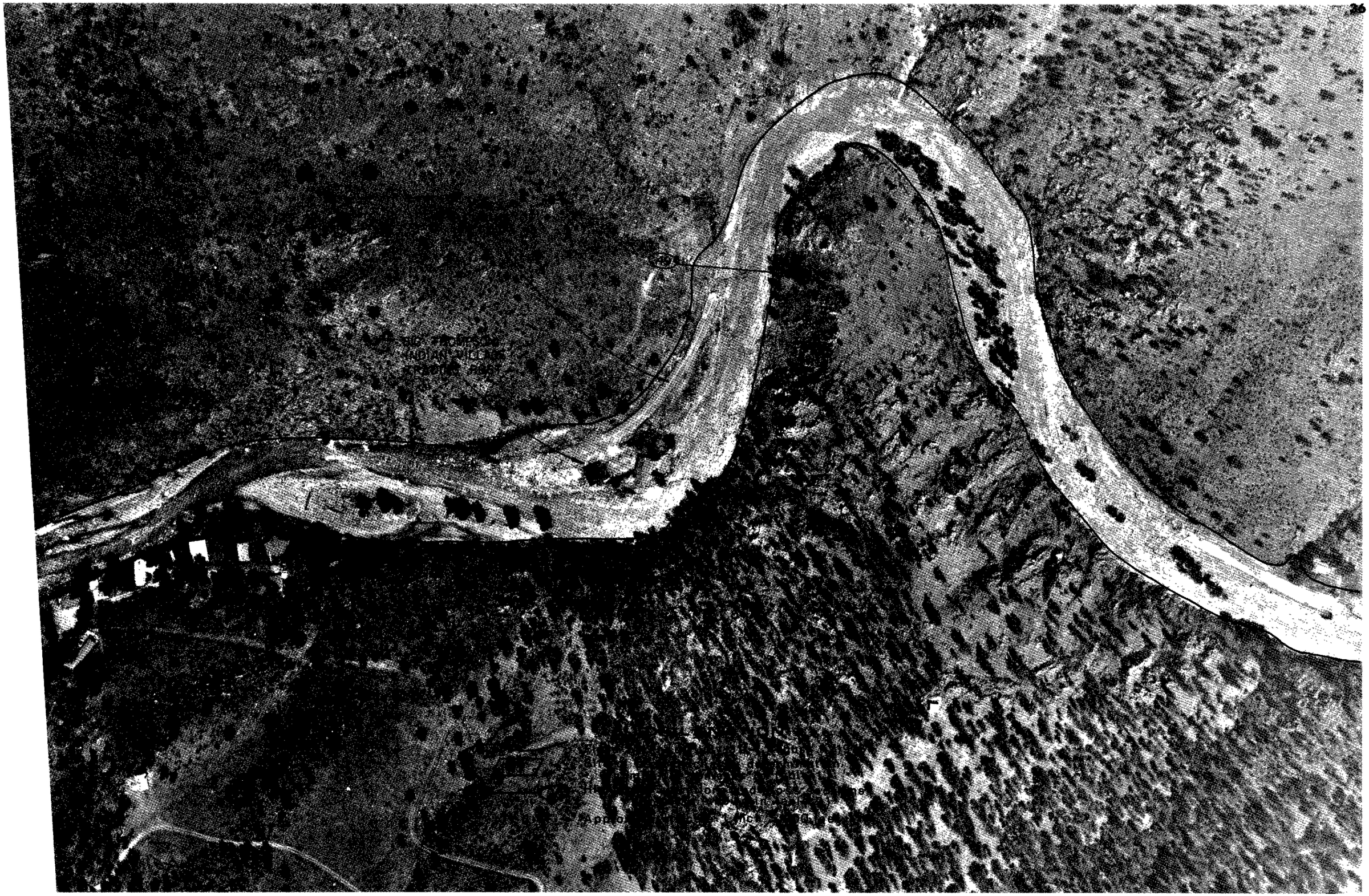


BIG THOMPSON RIVER FLOOD of JULY 31, ~ ~ AUGUST 1, 1976 PLATE NO. 21

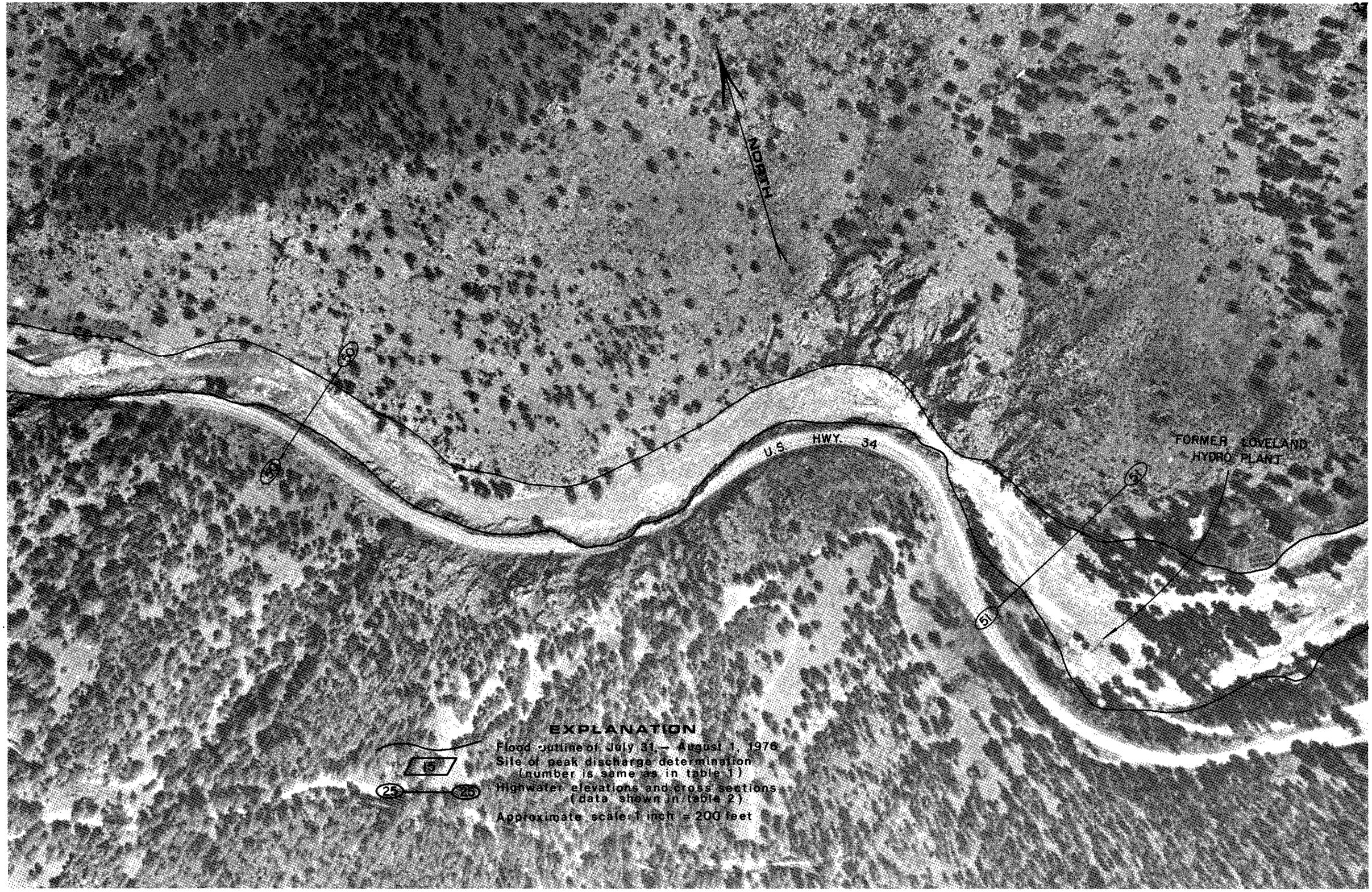


BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 **PLATE NO. 22**

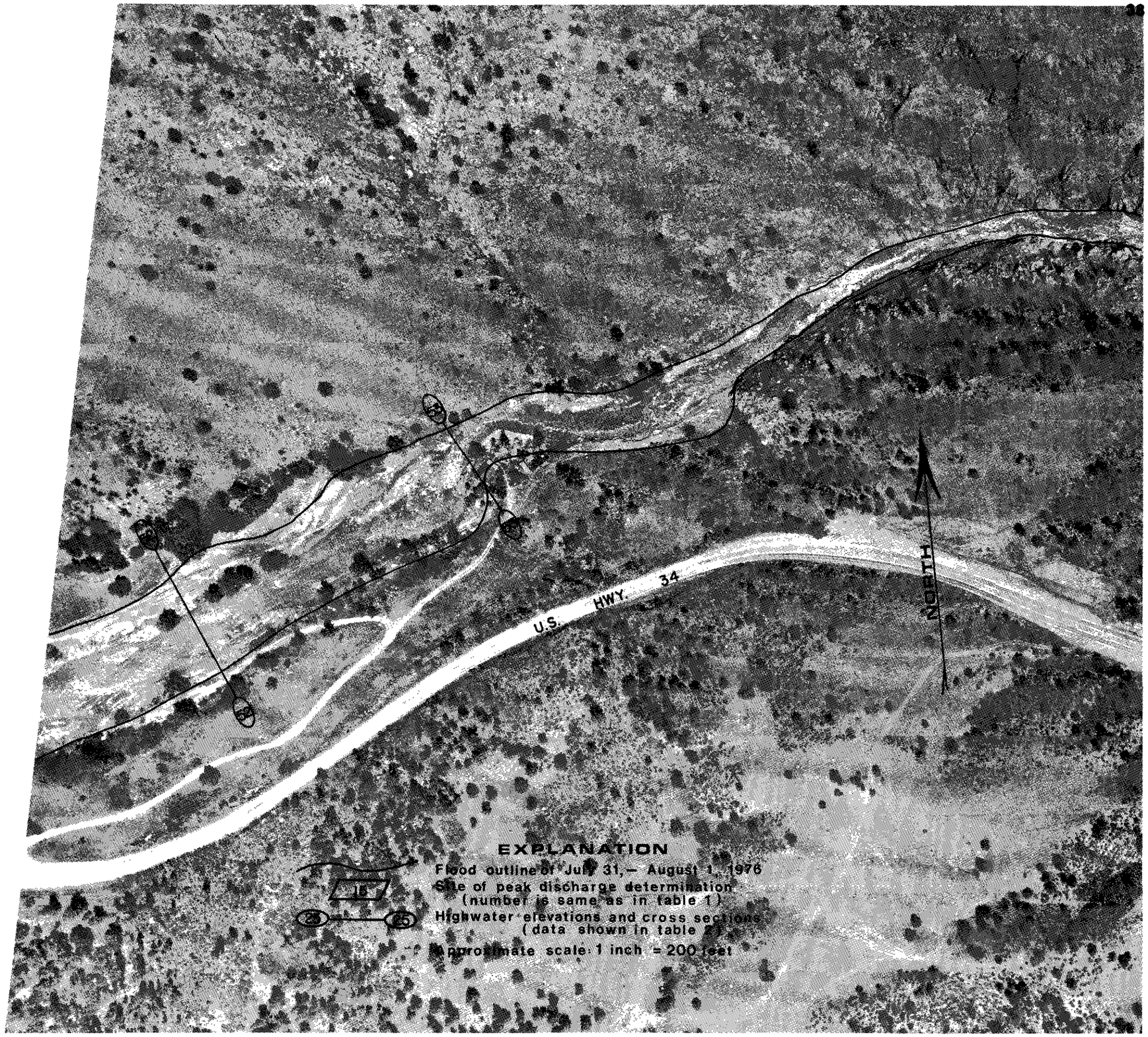
BIG THOMPSON RIVER FLOOD of JULY 31, ~ ~ AUGUST 1, 1976 **PLATE NO. 23**



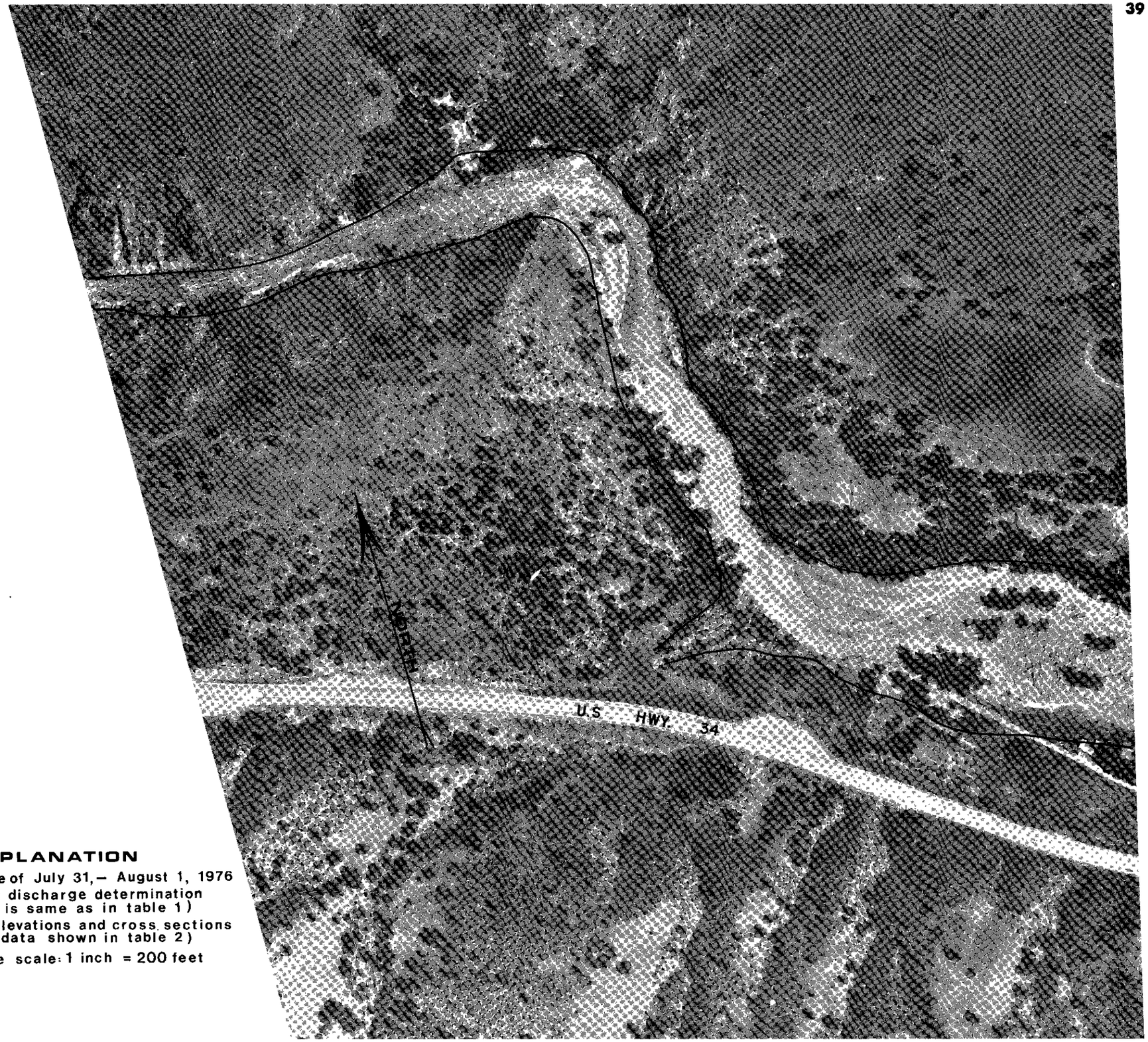
BIG THOMPSON RIVER FLOOD of JULY 31, ~~ AUGUST 1, 1976 PLATE NO. 24



BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 25**



BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 PLATE NO. 26



EXPLANATION

15

25 — 25

Flood outline of July 31,– August 1, 1976

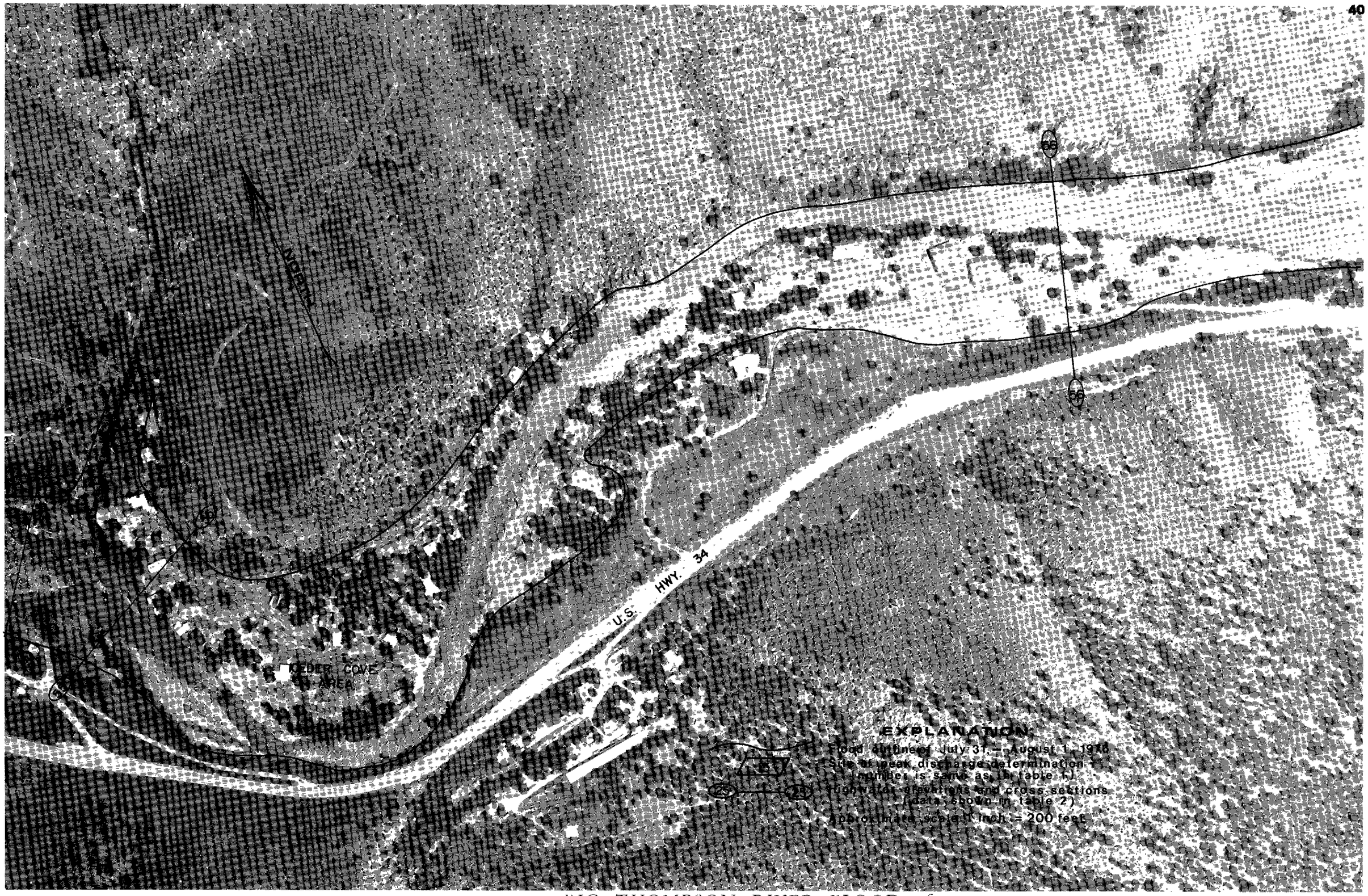
Site of peak discharge determination (number is same as in table 1)

Highwater elevations and cross sections (data shown in table 2)

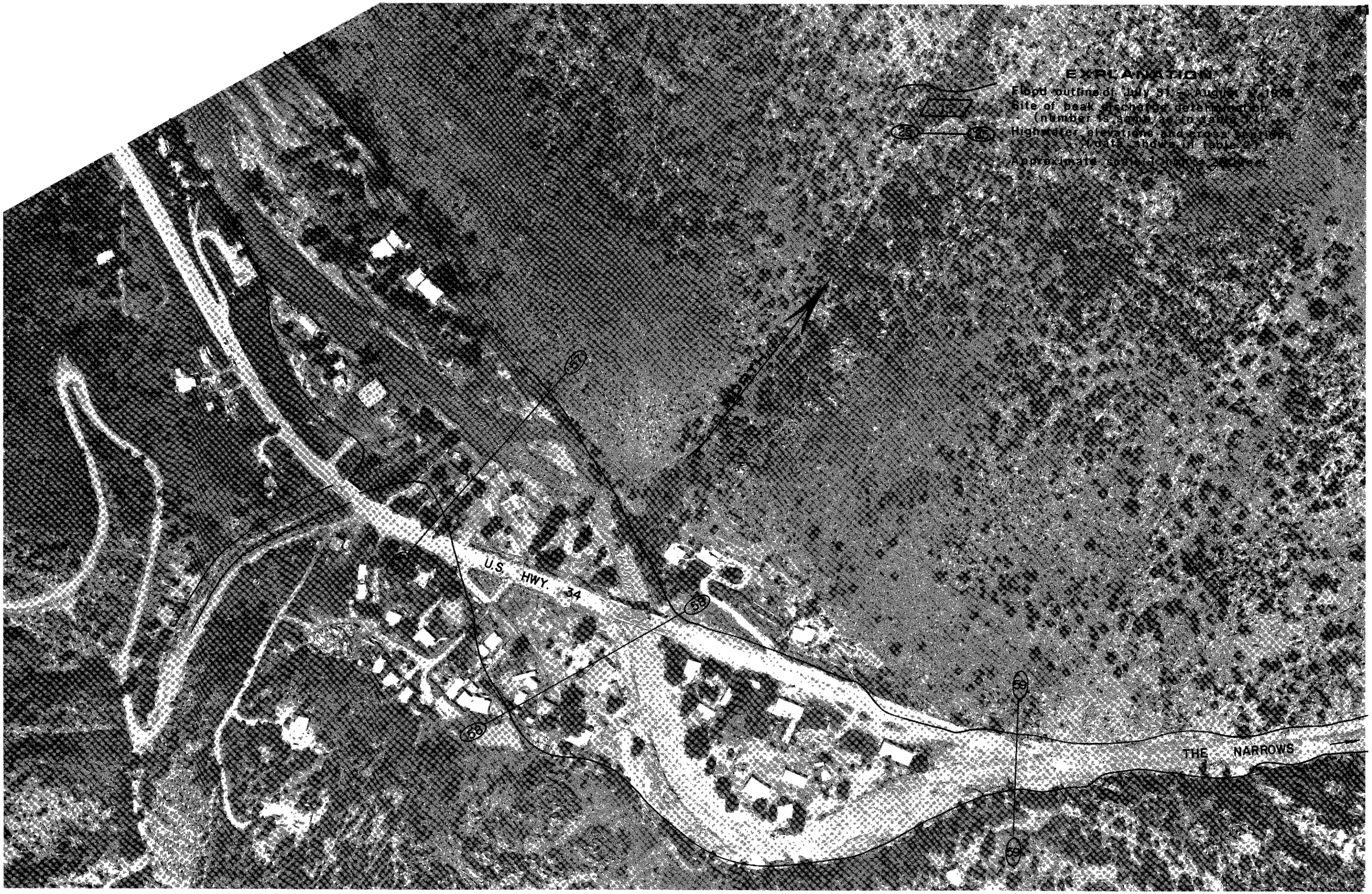
Approximate scale: 1 inch = 200 feet

BIG THOMPSON RIVER FLOOD of JULY 31.--AUGUST 1, 1976

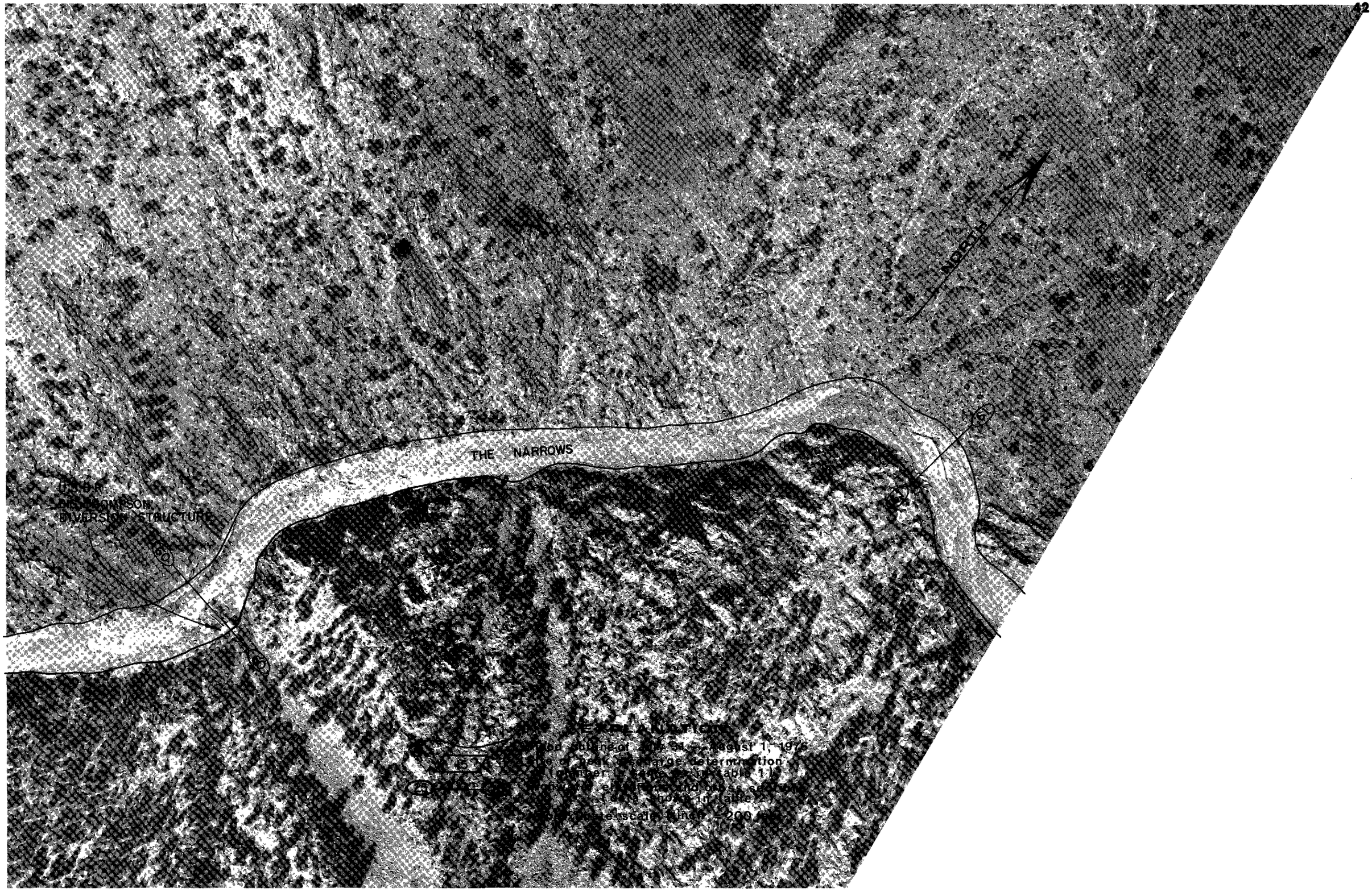
PLATE NO. 27



BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 **PLATE NO. 28**



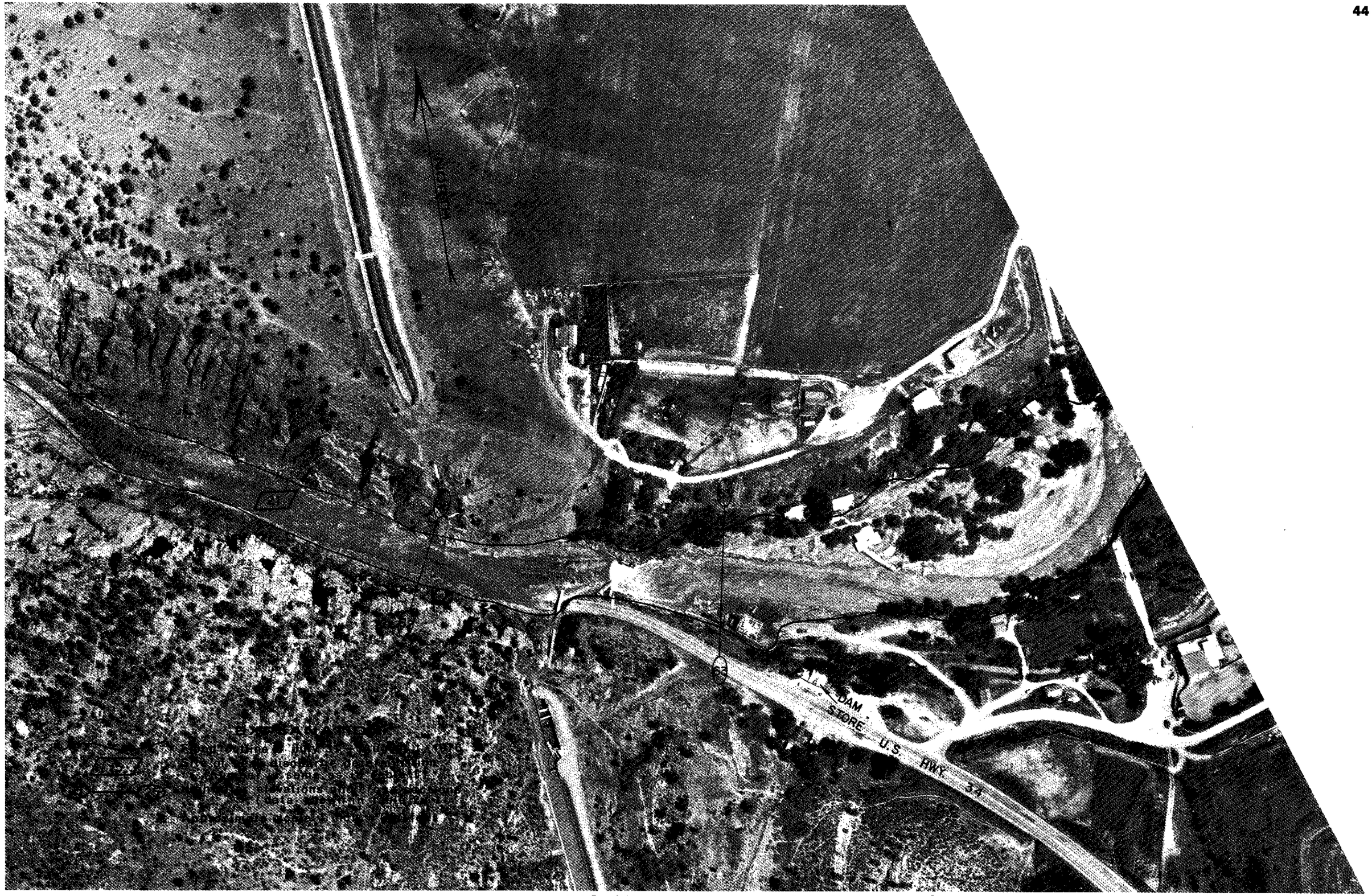
BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 **PLATE NO. 29**



BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 PLATE NO. 30

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

PLATE NO. 31



BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976

PLATE NO. 32

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 PLATE NO. 33

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 34**

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 PLATE NO. 35

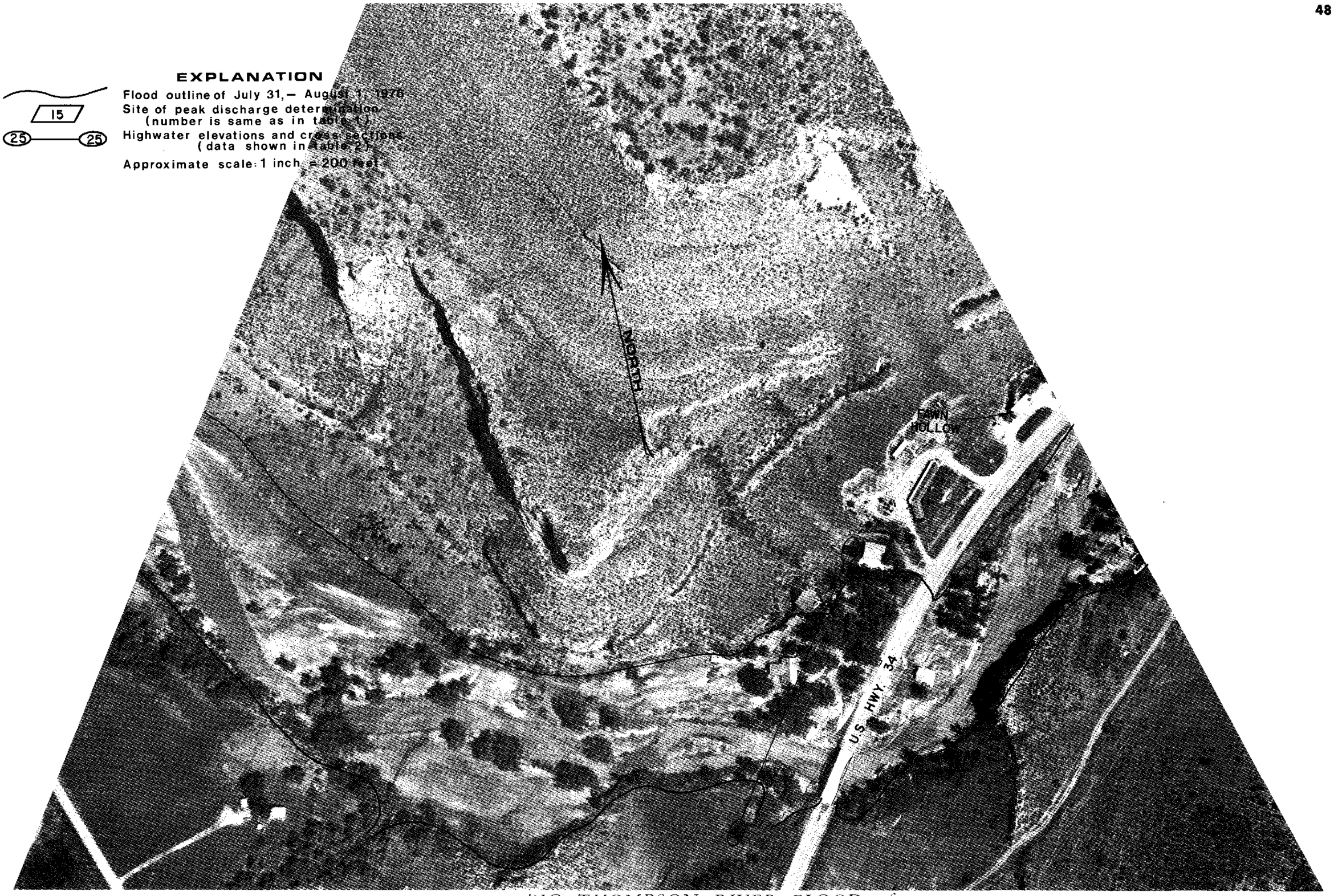
EXPLANATION

Flood outline of July 31,— August 1, 1976

15 Site of peak discharge determination (number is same as in table 1)

25—25 Highwater elevations and cross sections (data shown in table 2)

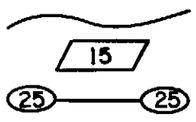
Approximate scale: 1 inch = 200 feet



BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 36

EXPLANATION



Flood outline of July 31,– August 1, 1976

Site of peak discharge determination (number is same as in table 1)

Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 200 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 37**

EXPLANATION

Flood outline of July 31,– August 1, 1976

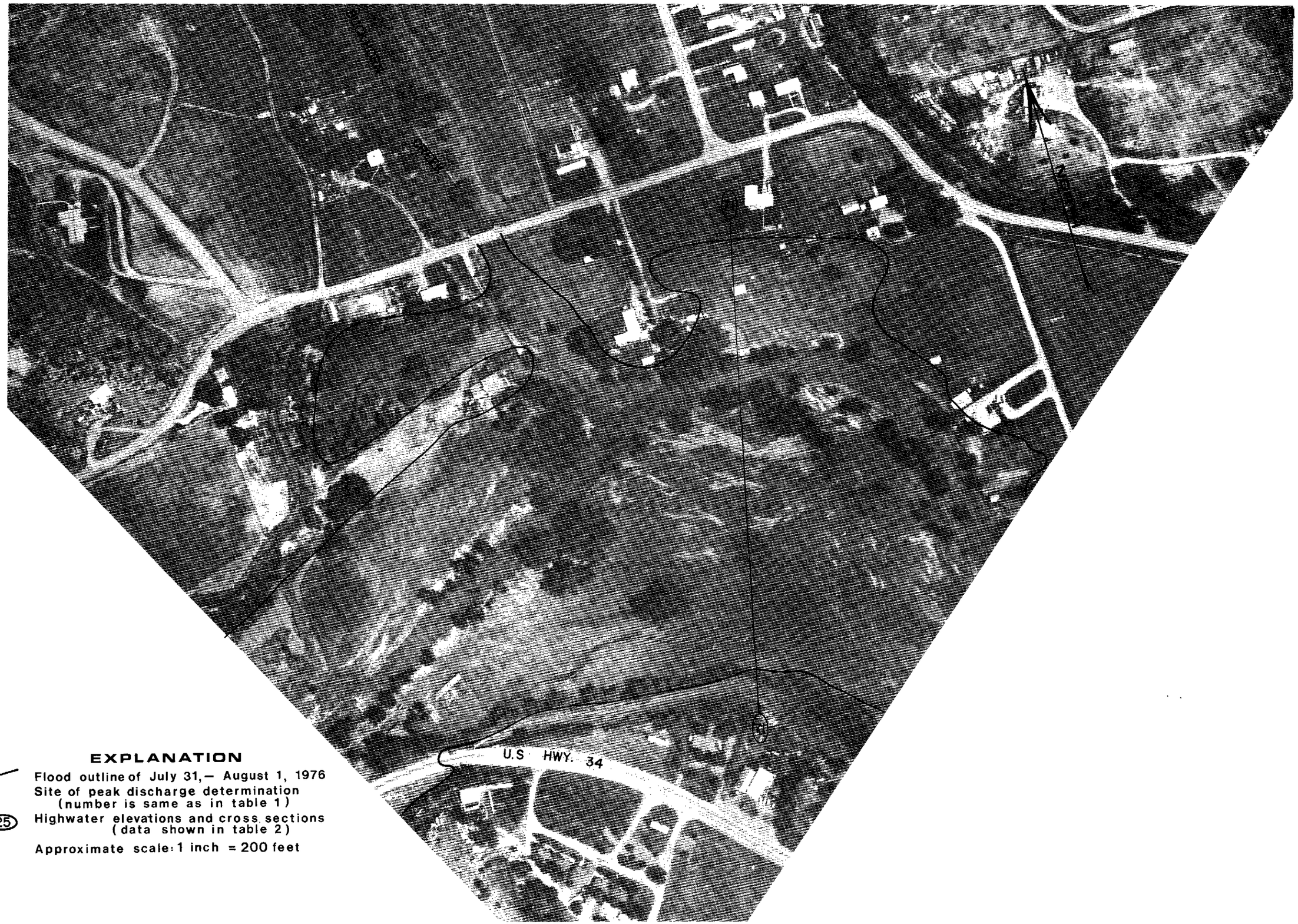
Site of peak discharge determination (number is same as in table 1)

Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 200 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 38



EXPLANATION

15

25 — 25

Flood outline of July 31,– August 1, 1976

Site of peak discharge determination (number is same as in table 1)

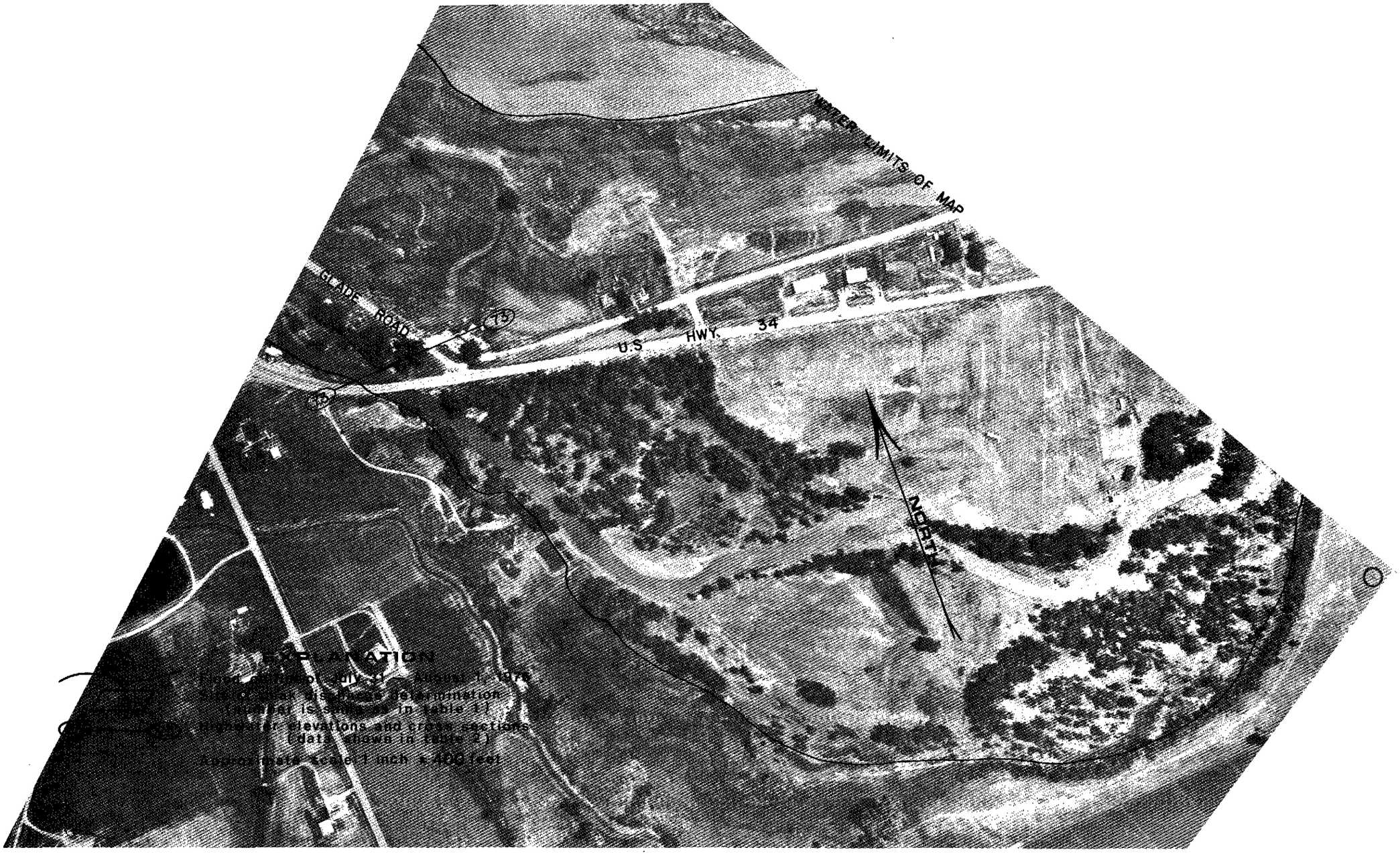
Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 200 feet

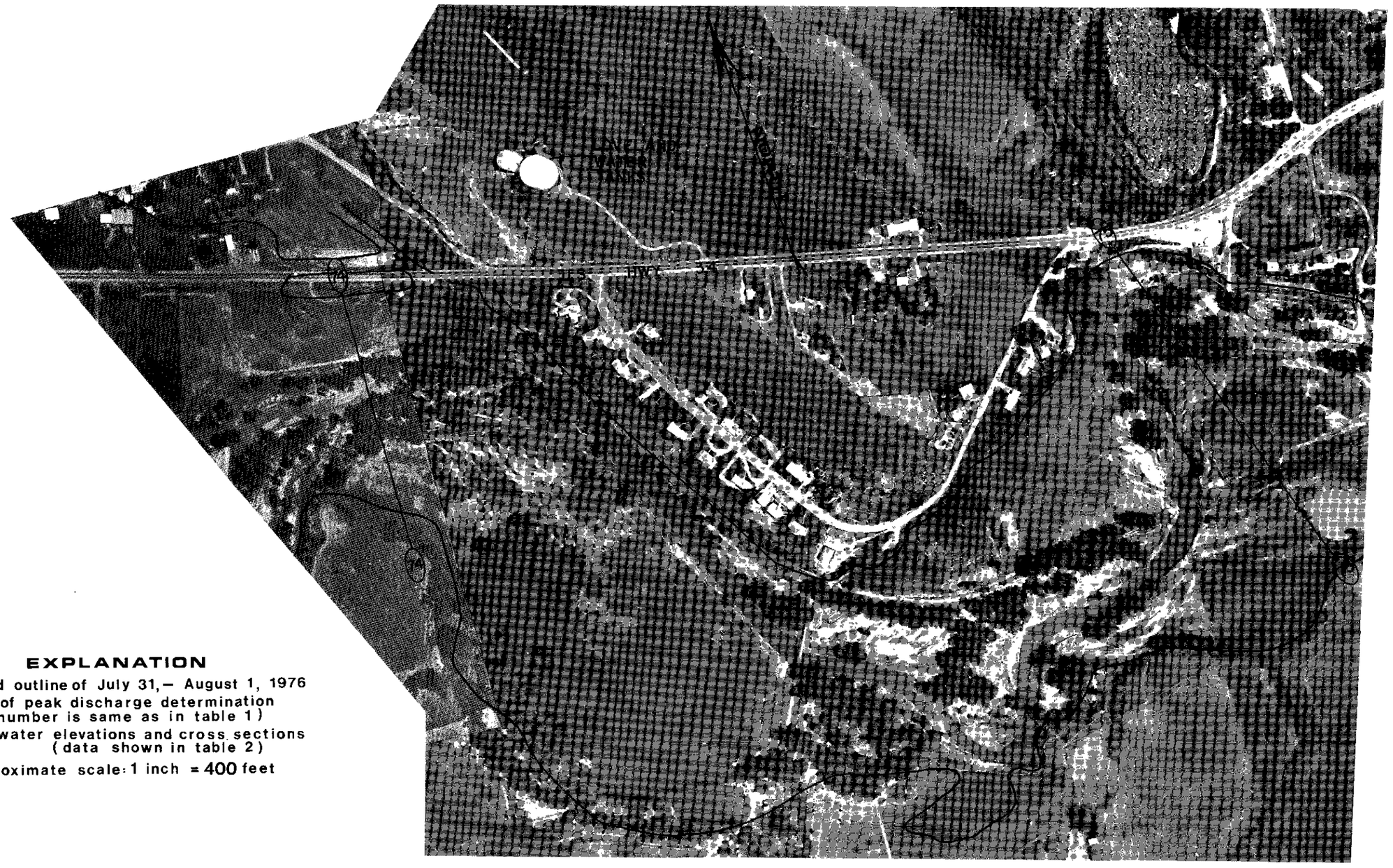
BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 39

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 **PLATE NO. 40**



BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 **PLATE NO. 41**



EXPLANATION

Flood outline of July 31,– August 1, 1976

15 — Site of peak discharge determination (number is same as in table 1)

25 — 25 — Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 400 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 42

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 43**

EXPLANATION

Flood outline of July 31,— August 1, 1976

15 Site of peak discharge determination (number is same as in table 1)

25—25 Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 1000 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 44

EXPLANATION

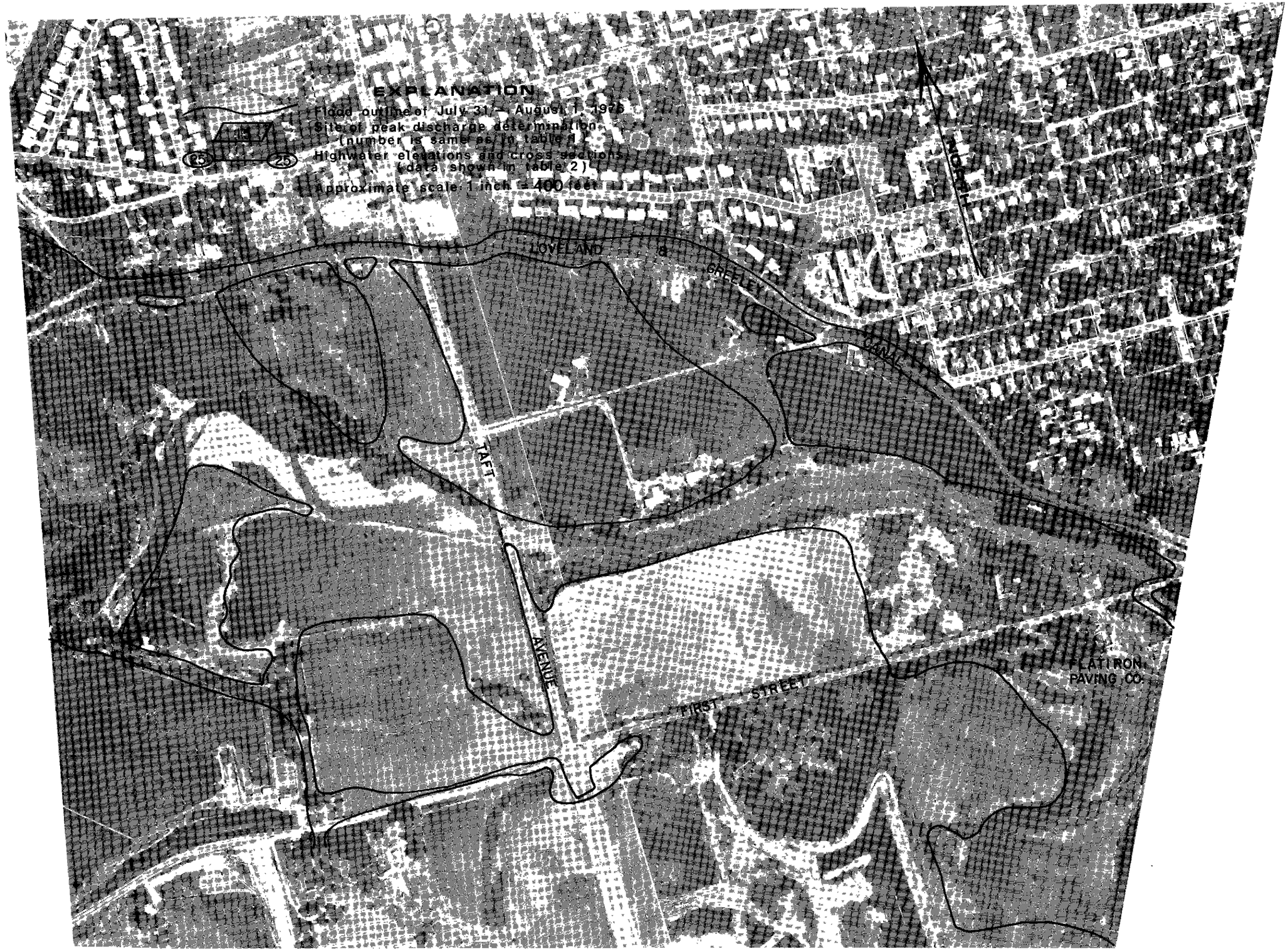
Flood outline of July 31,— Aug

Site of peak discharge determ
(number is same as in ta

Highwater elevations and cros
(data shown in ta

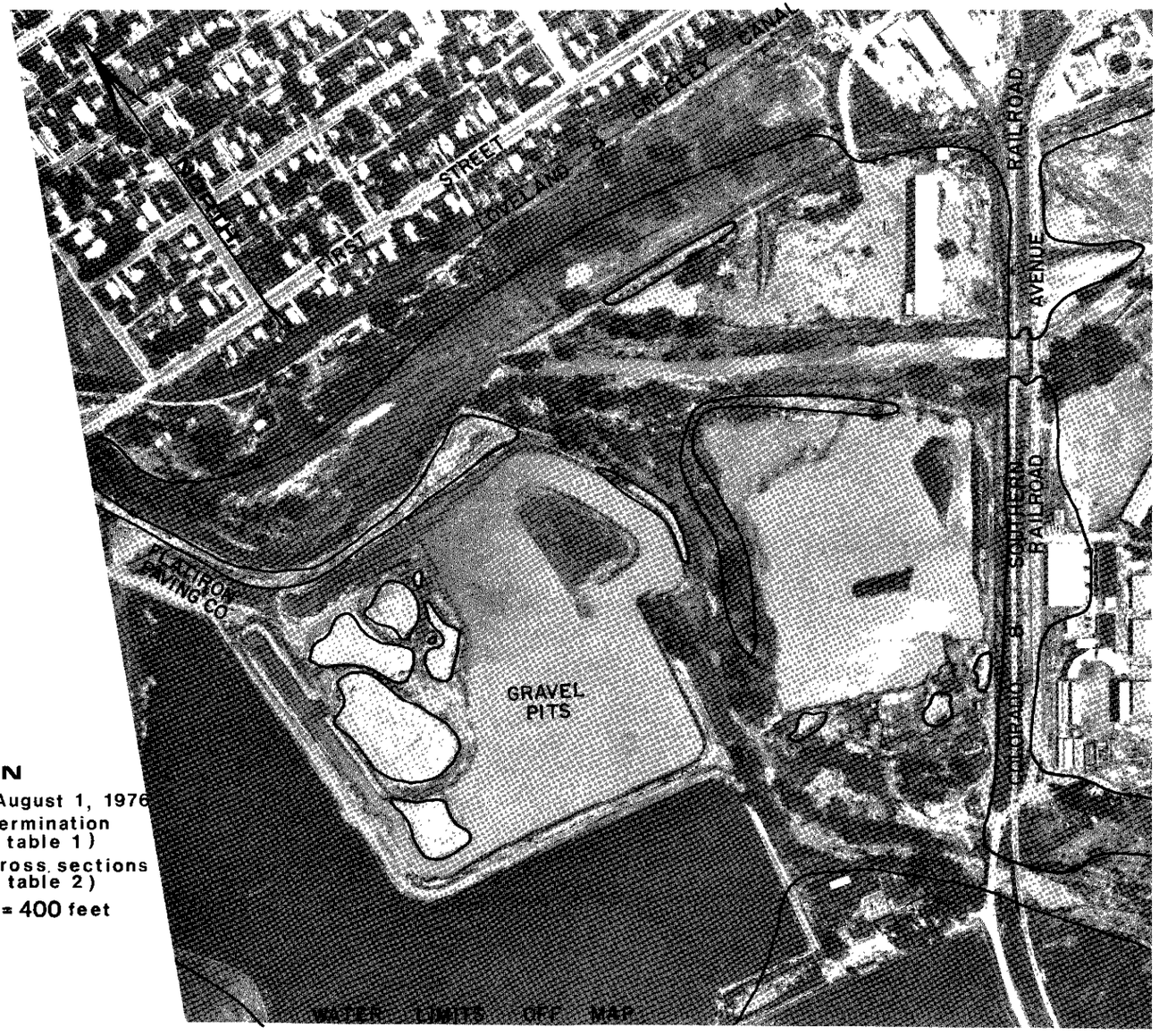
Approximate scale: 1 inch = 4

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 45**



BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

PLATE NO. 46



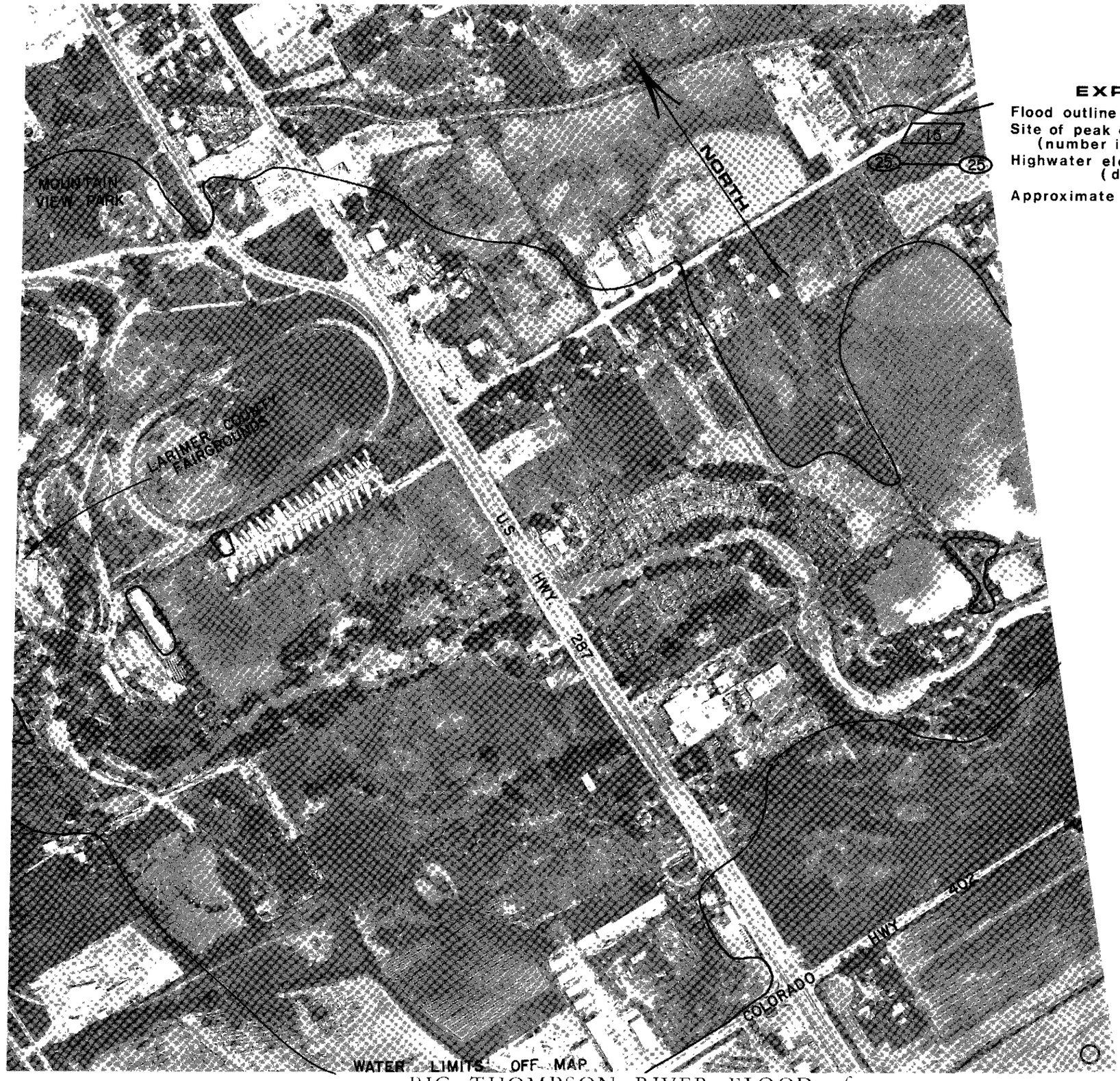
EXPLANATION

Flood outline of July 31,– August 1, 1976

15 Site of peak discharge determination (number is same as in table 1)

25–25 Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 400 feet



EXPLANATION

Flood outline of July 31,– August 1, 1976

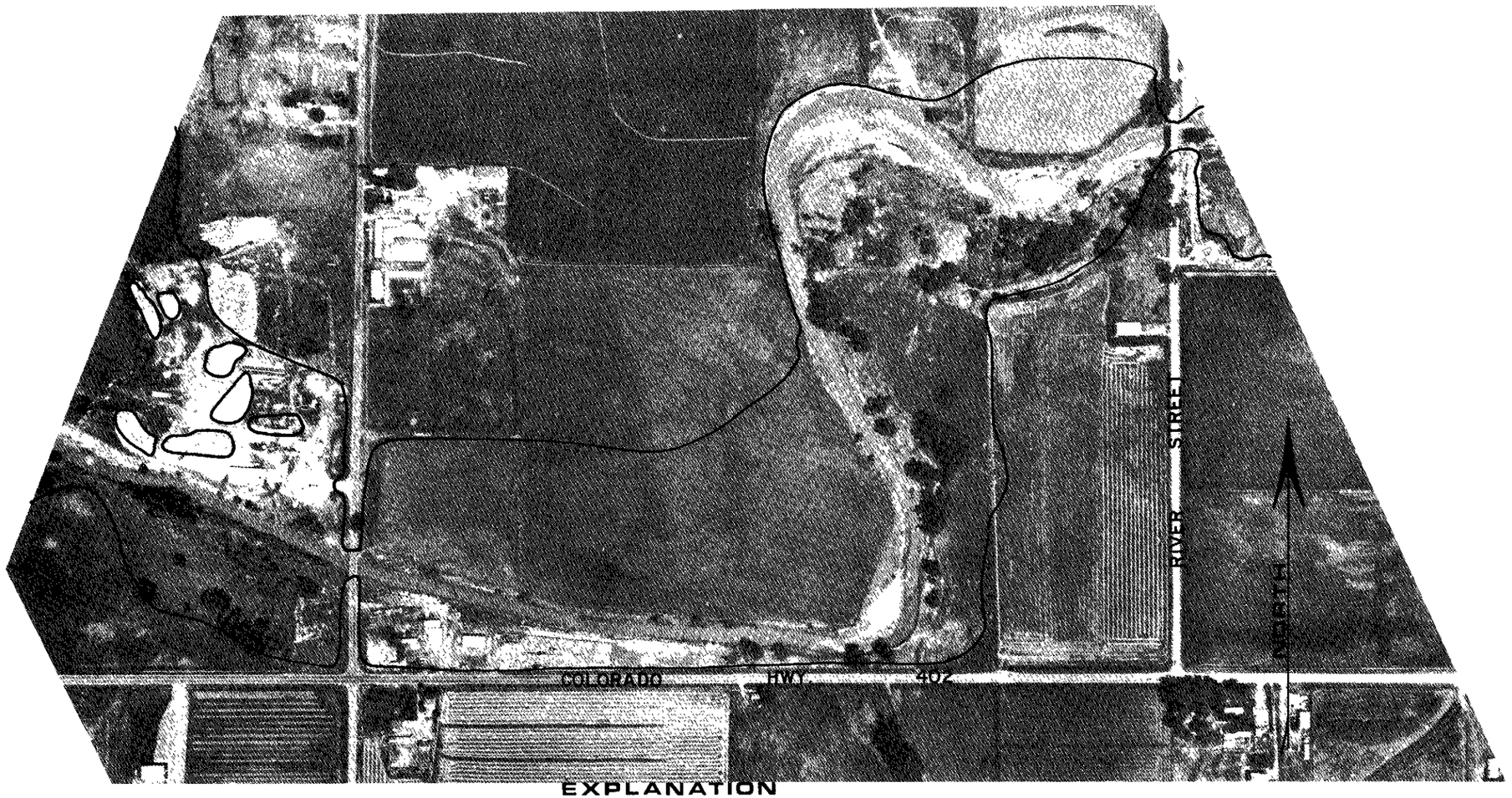
Site of peak discharge determination (number is same as in table 1)

Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 400 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 48



EXPLANATION

Flood outline of July 31,– August 1, 1976

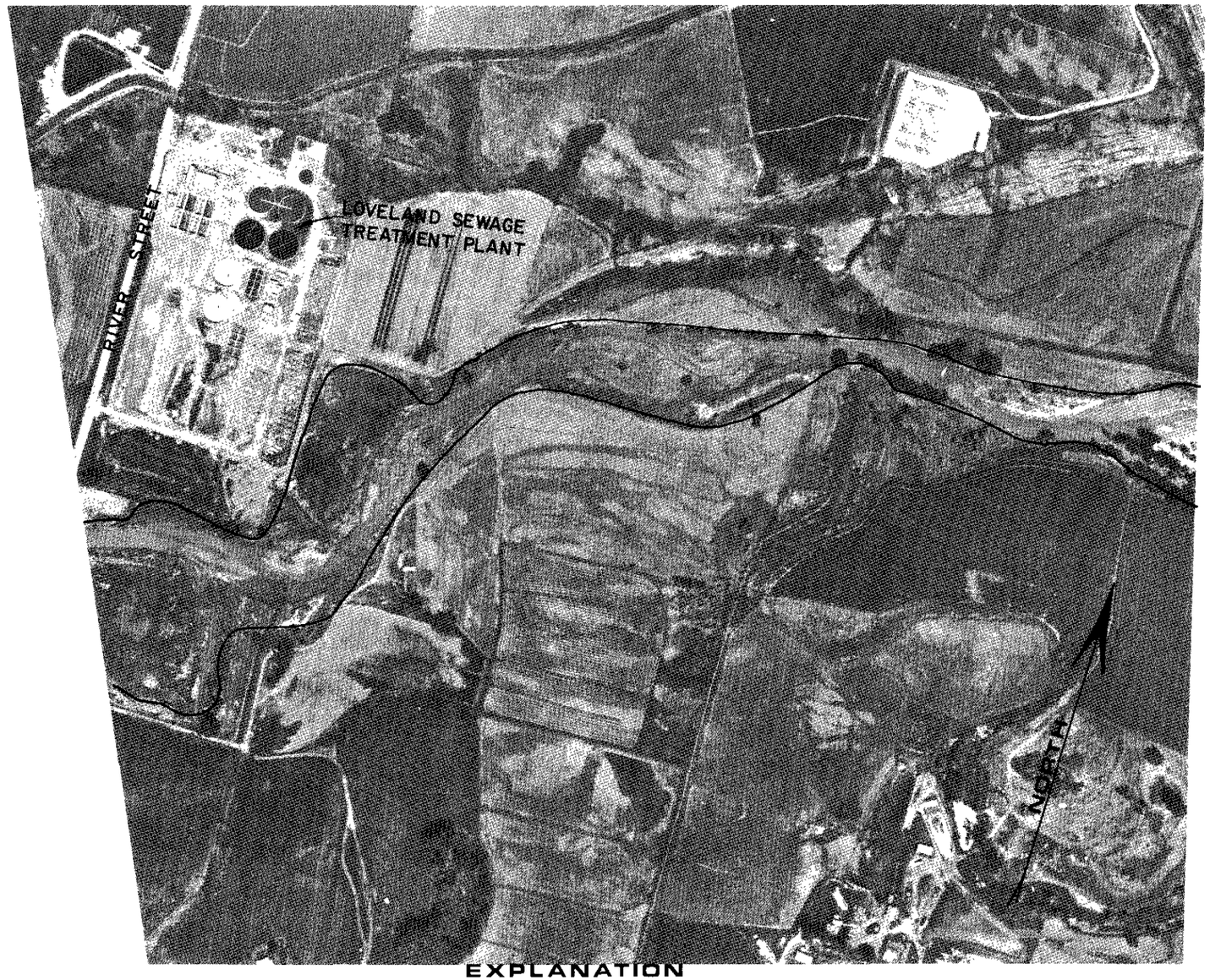
15 — Site of peak discharge determination (number is same as in table 1)

25 — 25 — Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 400 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976

PLATE NO. 49



EXPLANATION

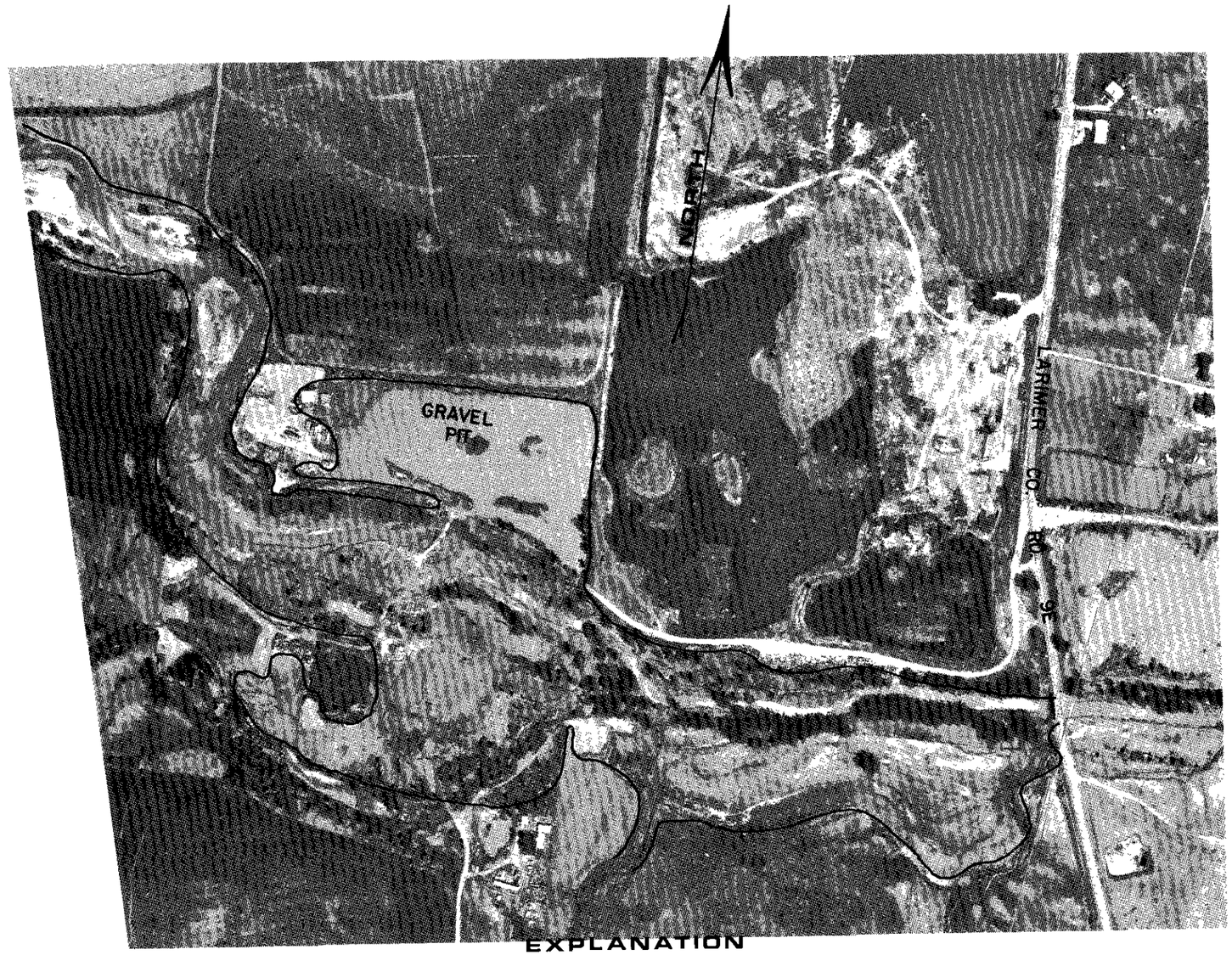
Flood outline of July 31,– August 1, 1976

15 — Site of peak discharge determination (number is same as in table 1)

25 — 25 — Highwater elevations and cross sections (data shown in table 2)

Approximate scale: 1 inch = 400 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. 50**



EXPLANATION

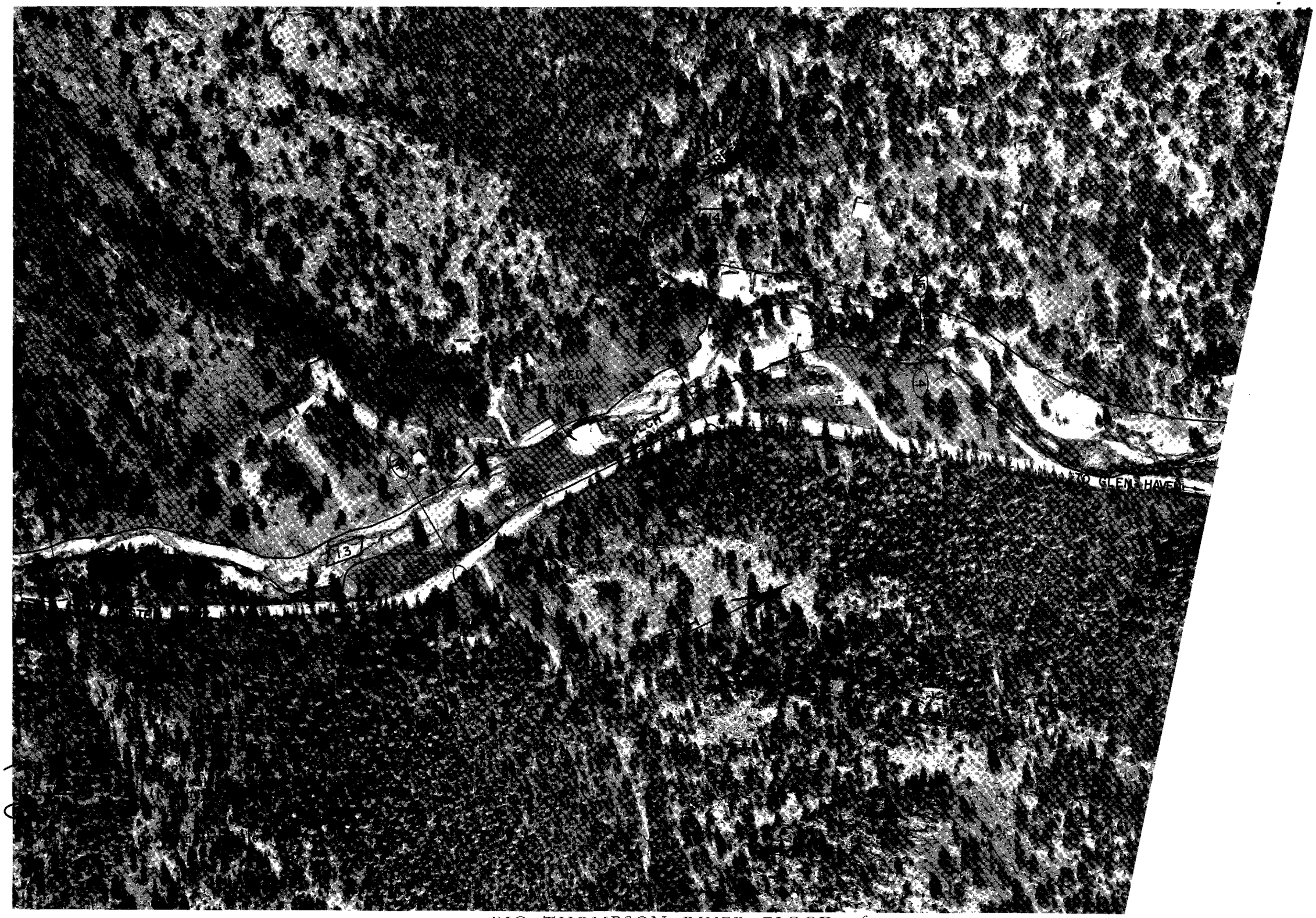
Flood outline of July 31,– August 1, 1976

15 Site of peak discharge determination (number is same as in table 1)

25–25 Highwater elevations and cross sections (data shown in table 2)

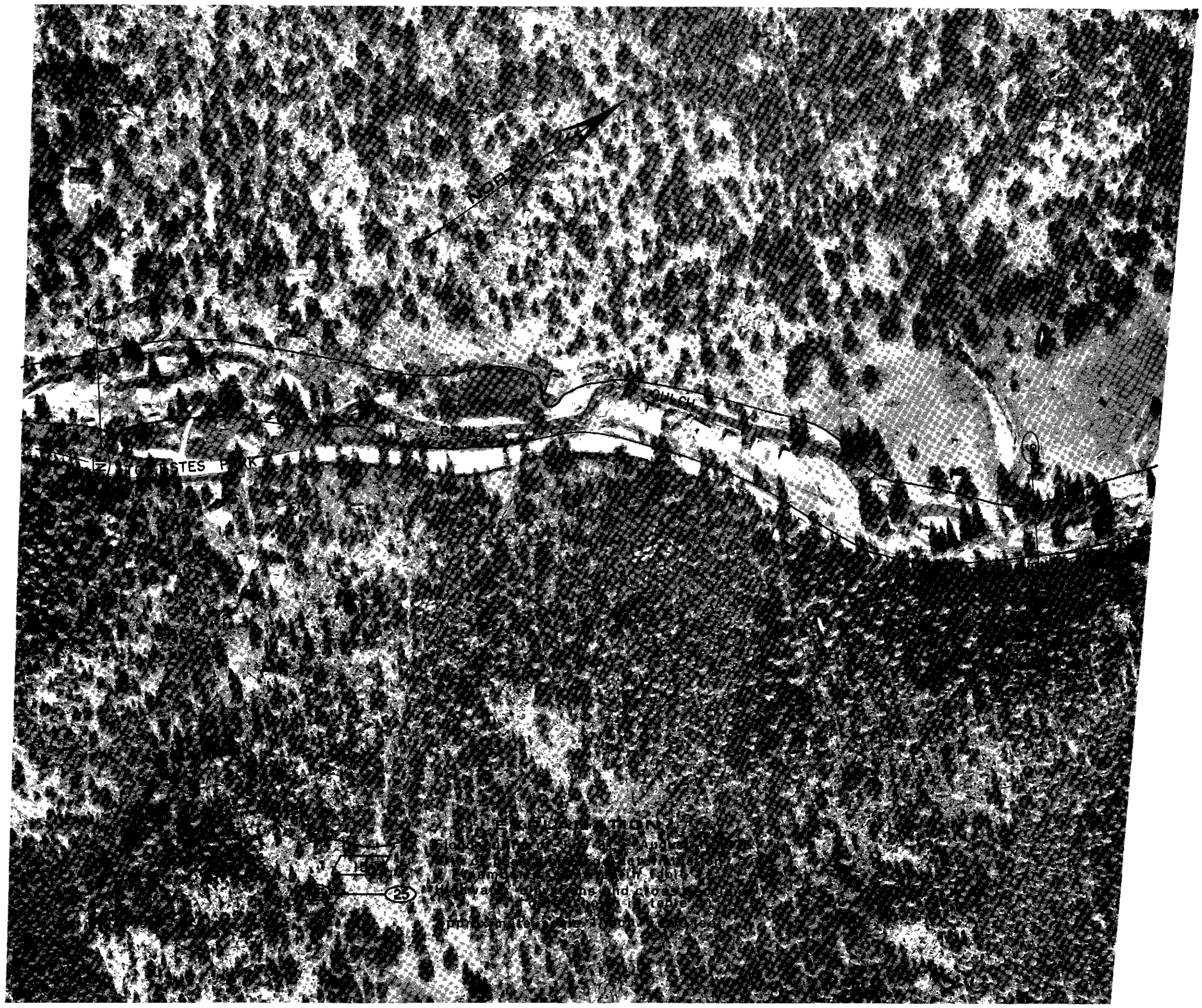
Approximate scale: 1 inch = 400 feet

BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 PLATE NO. 51



BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

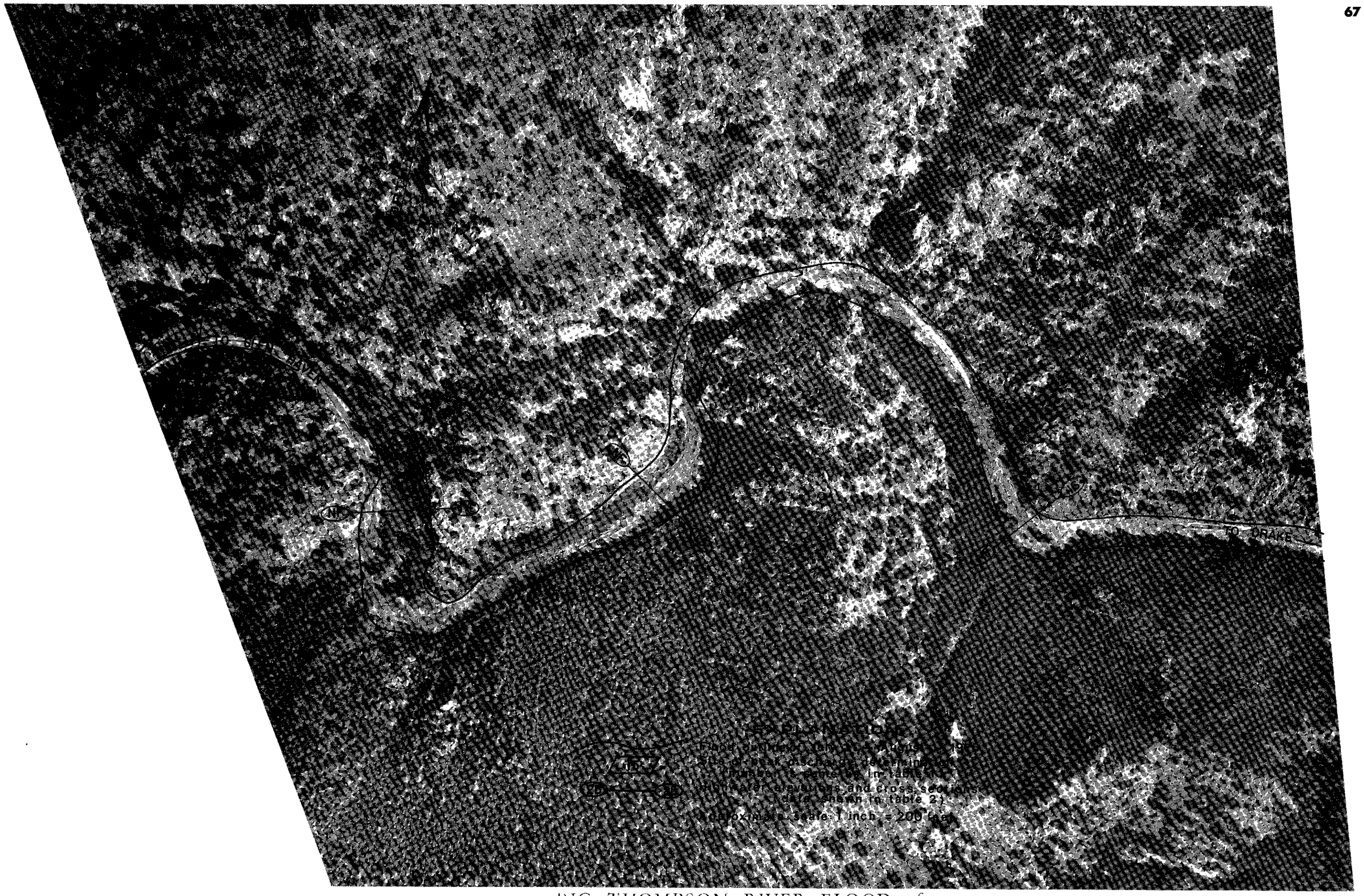
PLATE NO. NF-1



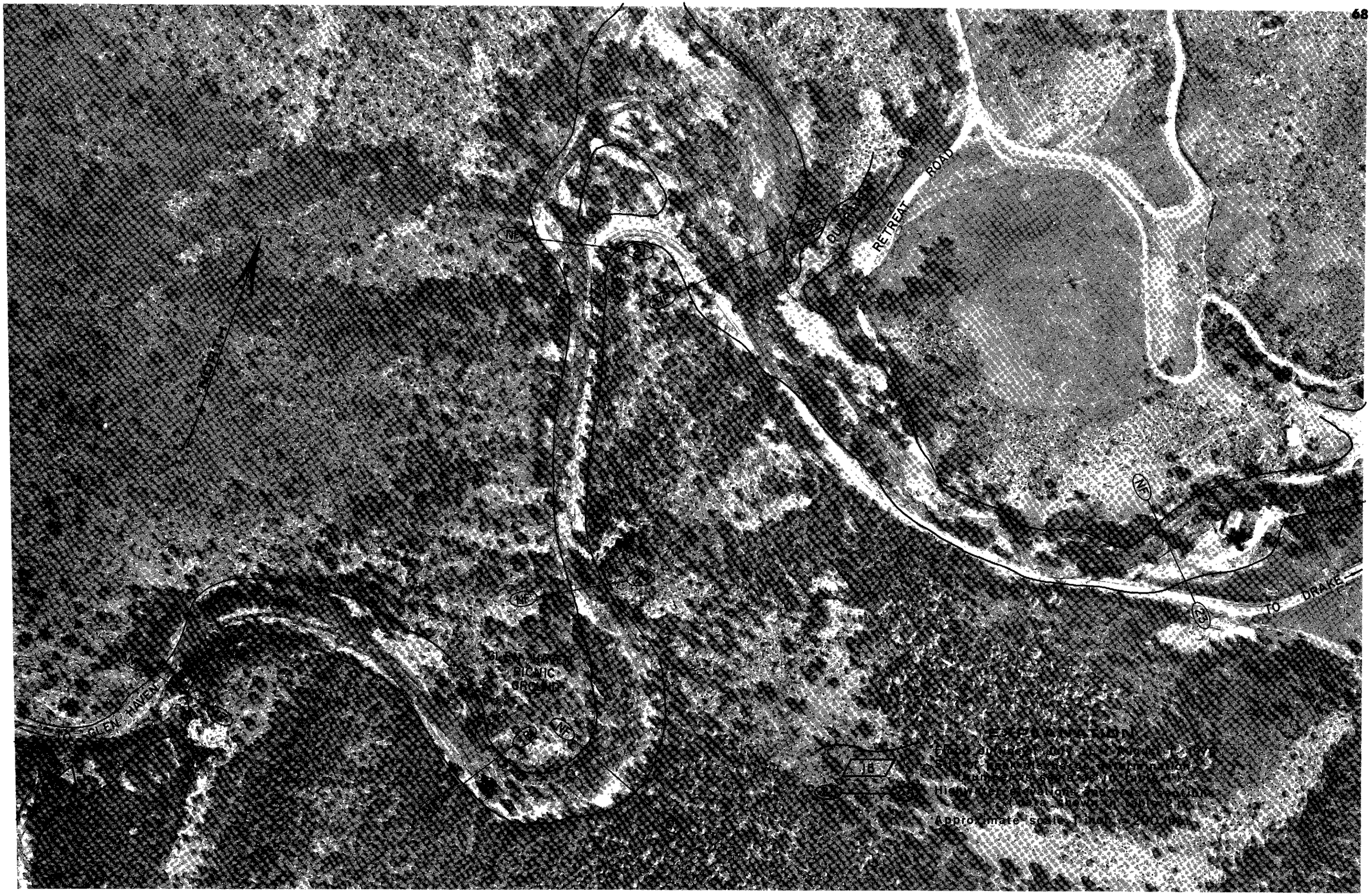
BIG THOMPSON RIVER FLOOD of JULY 31,--AUGUST 1, 1976 **PLATE NO. NF-2**

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

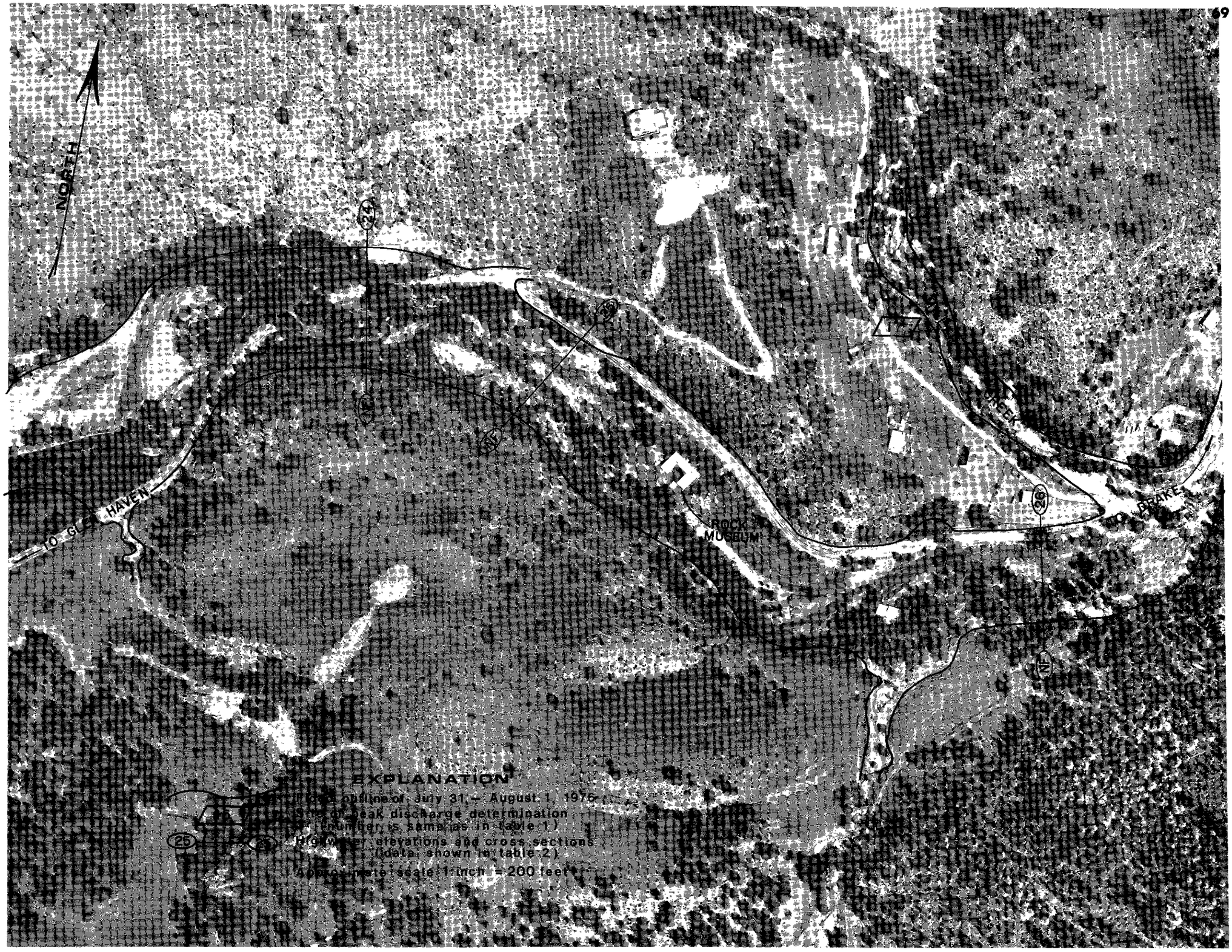
PLATE NO. NF-3



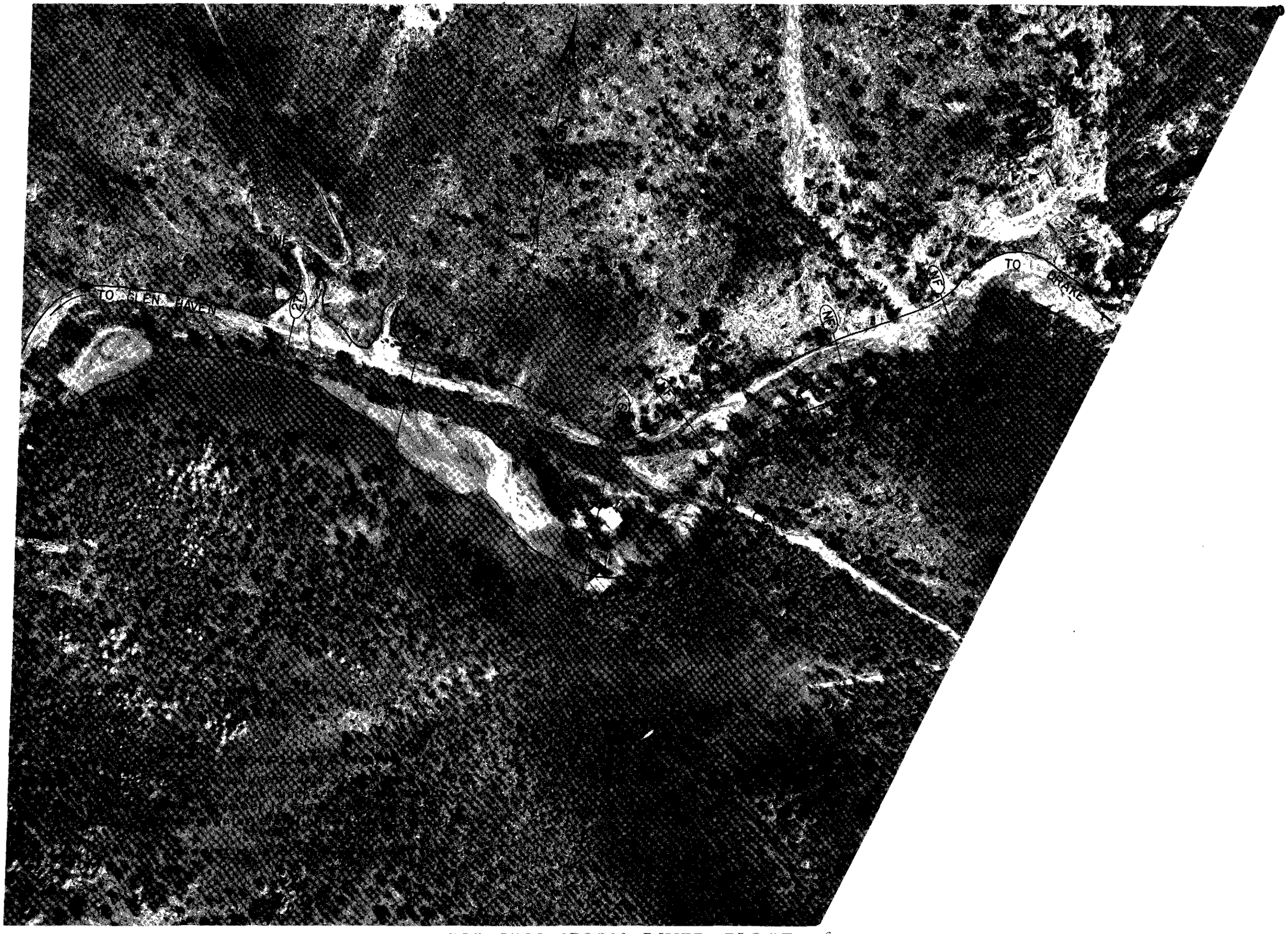
BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 **PLATE NO. NF-4**



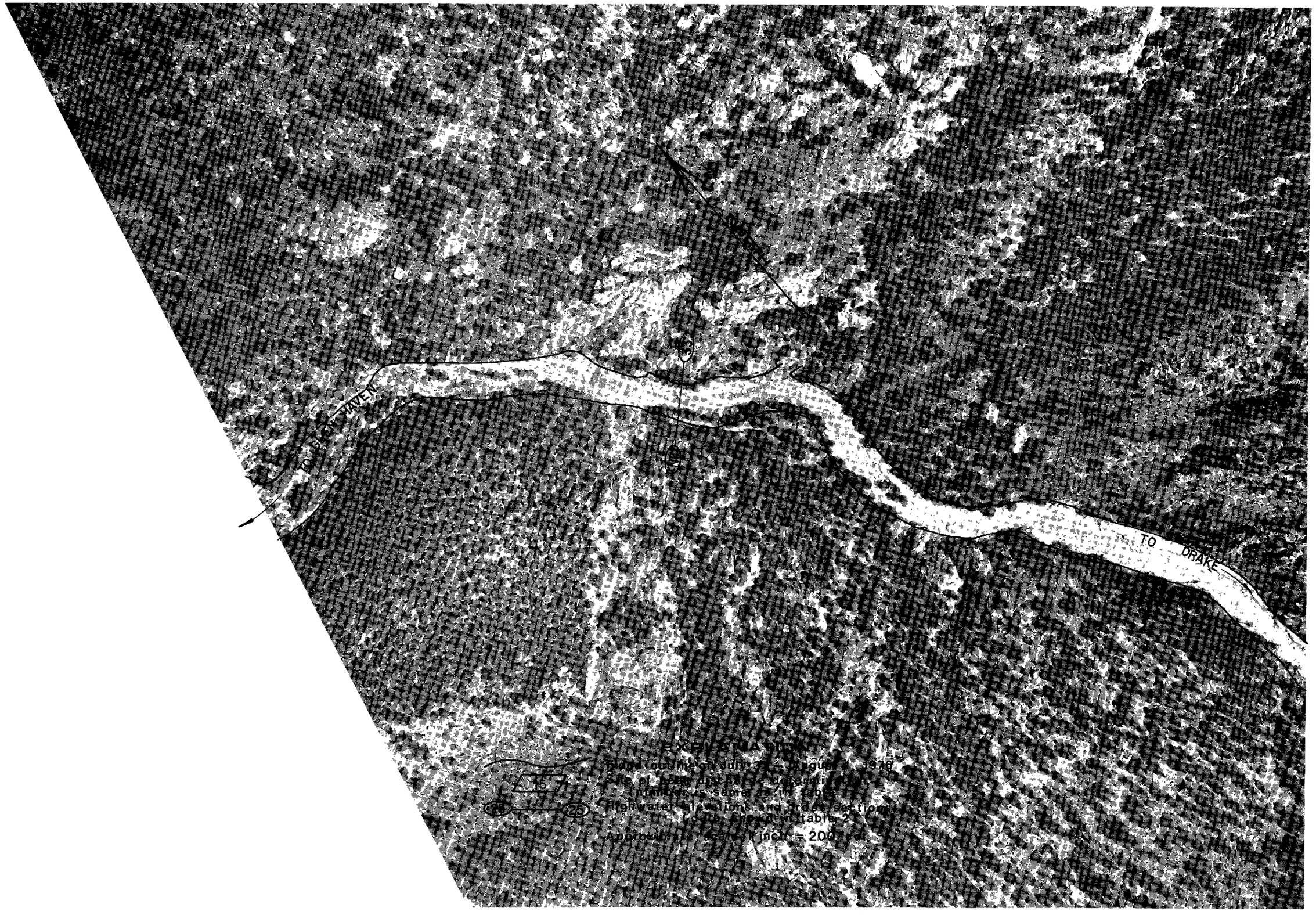
BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 **PLATE NO. NF-5**



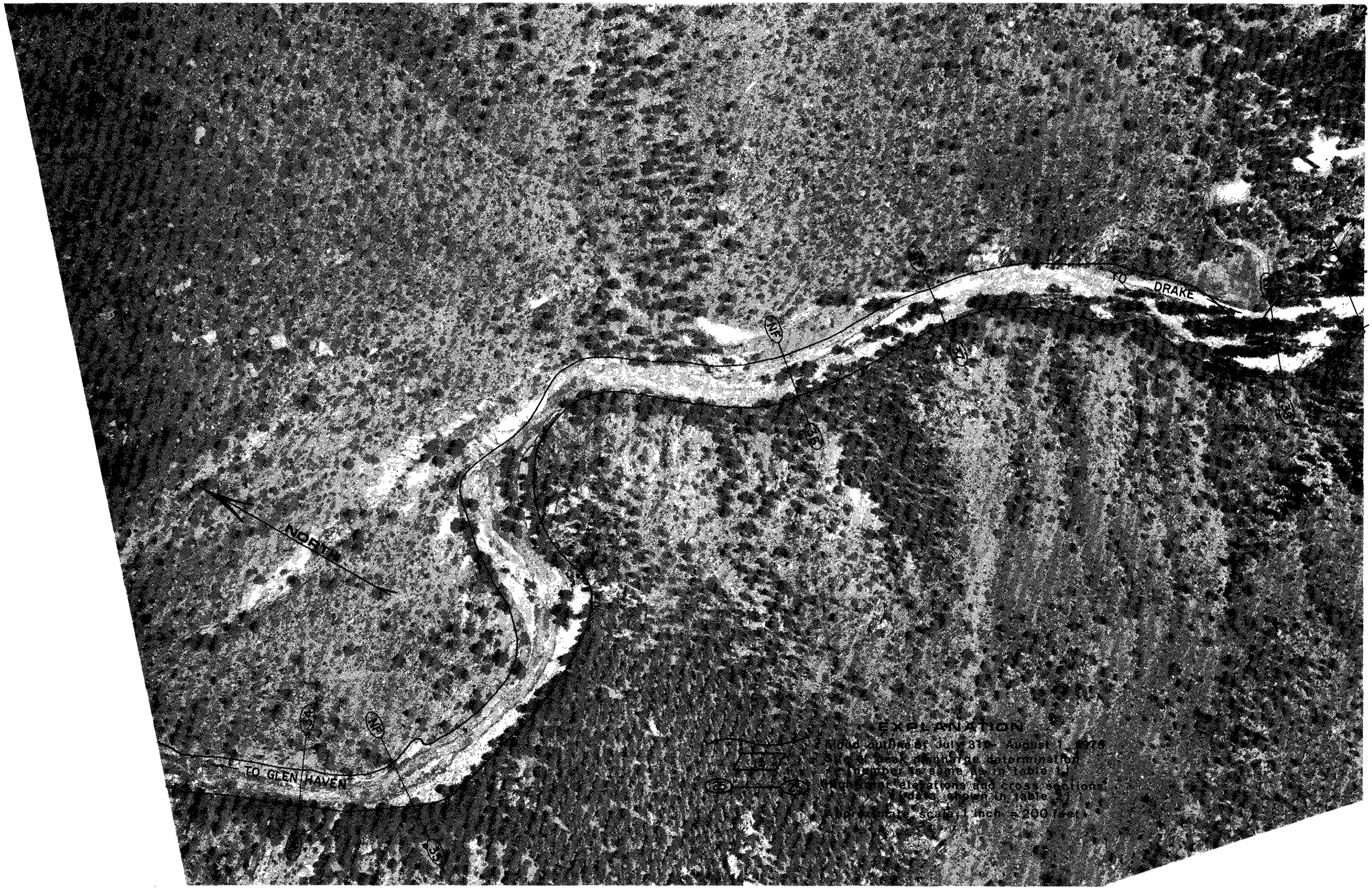
BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 **PLATE NO.** NF-6



BIG THOMPSON RIVER FLOOD of JULY 31, ~ AUGUST 1, 1976 PLATE NO. NF-7

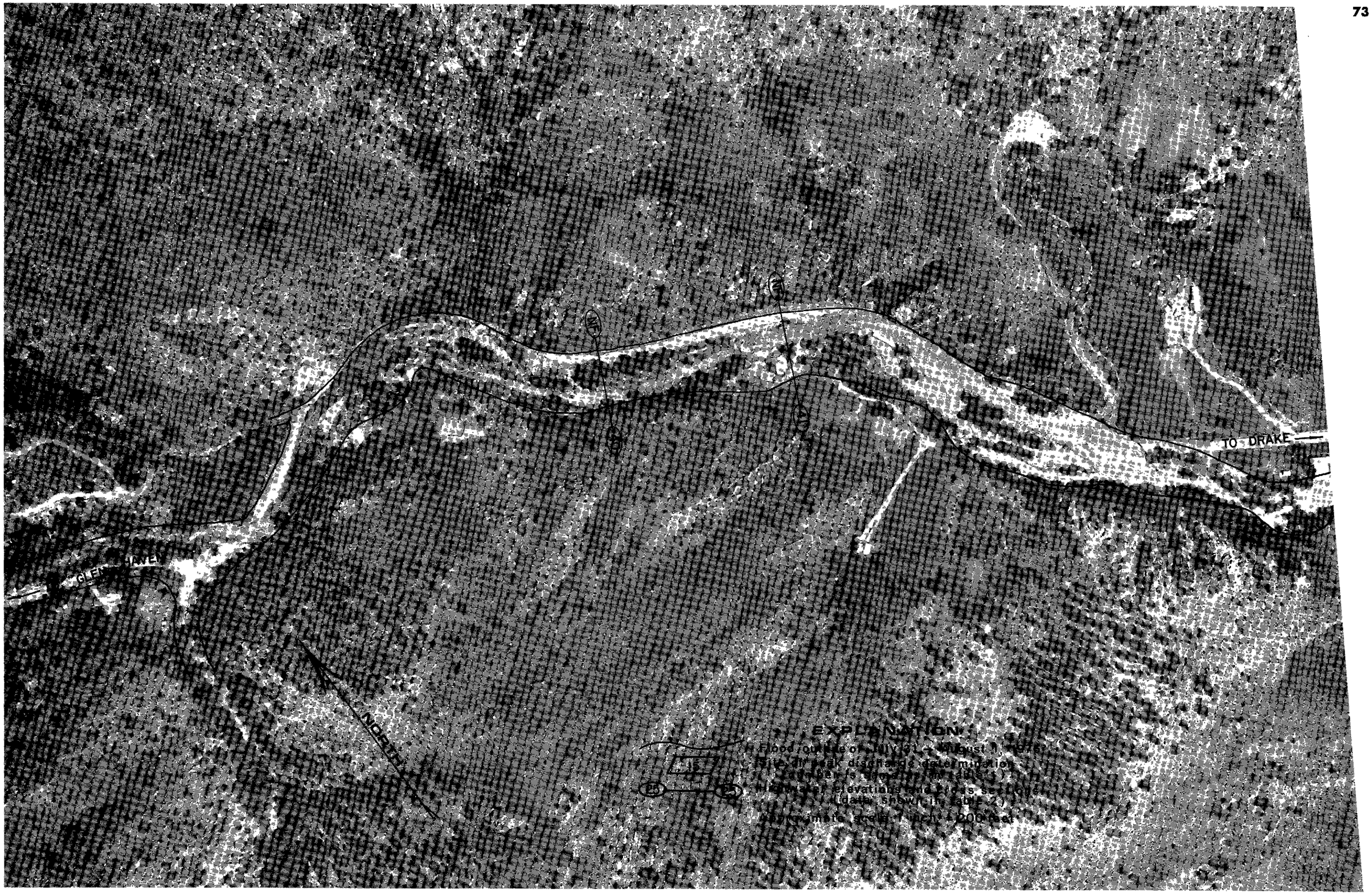


BIG THOMPSON RIVER FLOOD of JULY 31. - - AUGUST 1, 1976 **PLATE NO.** NF-8

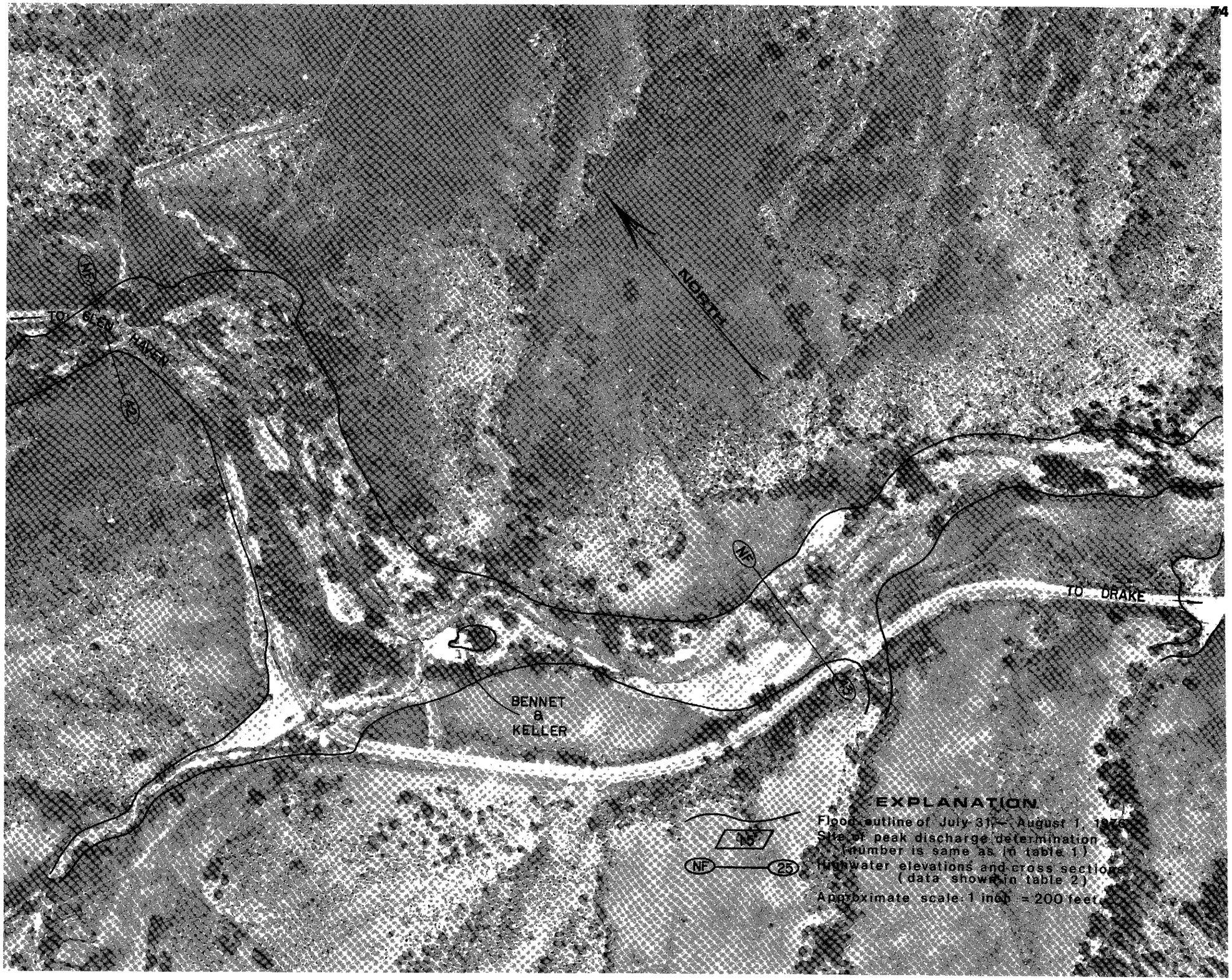


BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

PLATE NO. NF-9



BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976 **PLATE NO.** NF-10

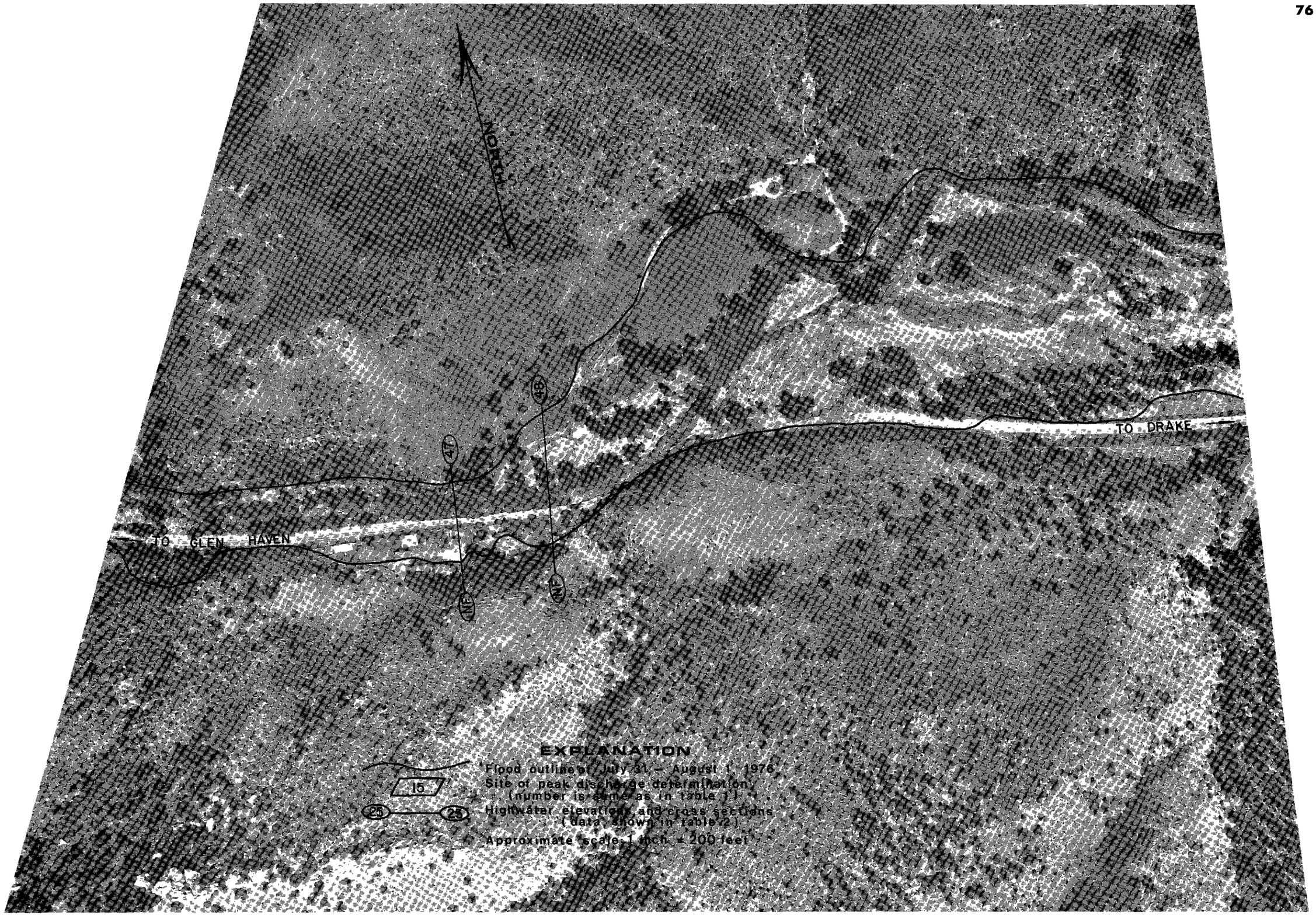


BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

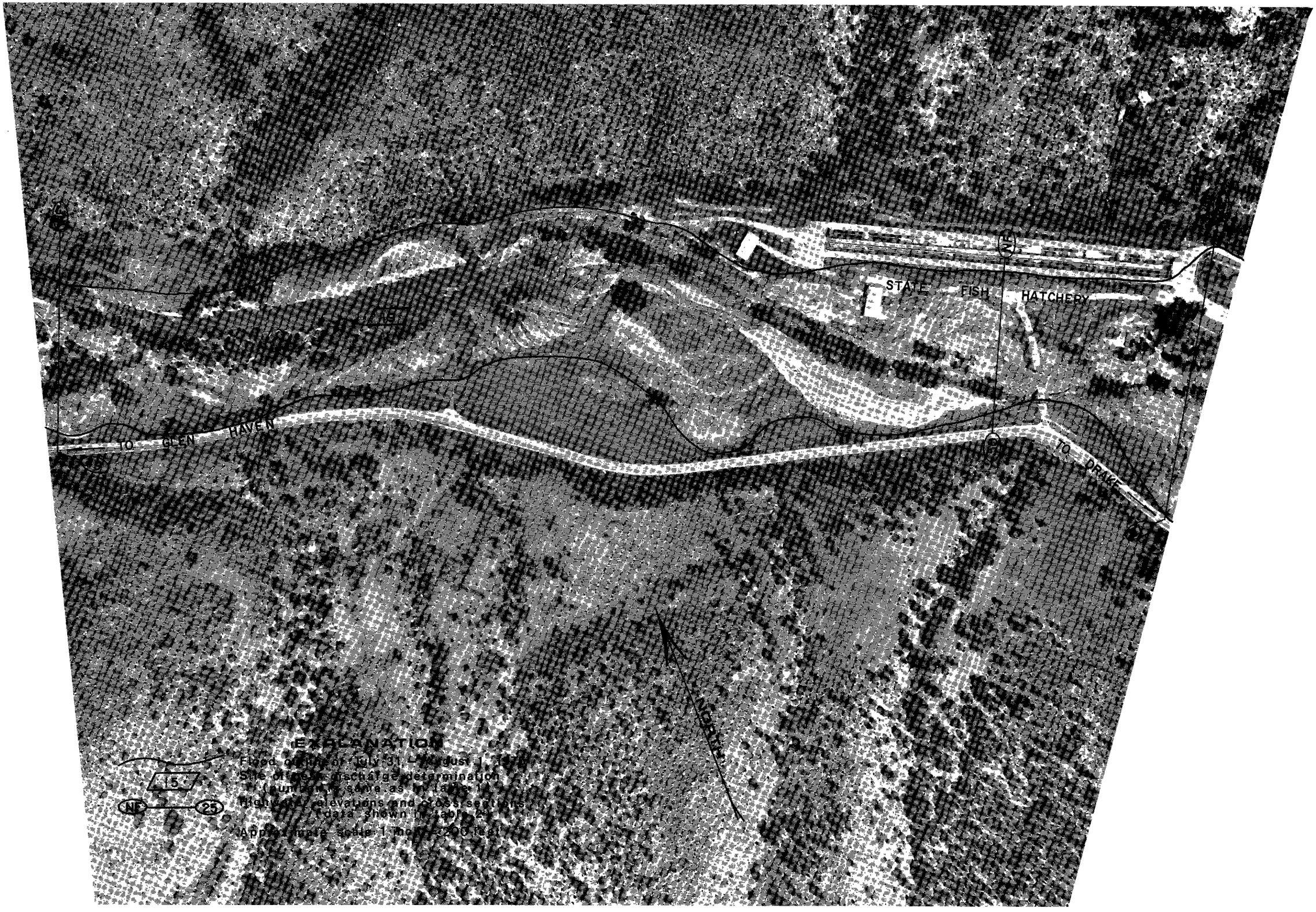
PLATE NO. NF-II

BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

PLATE NO. NF-12

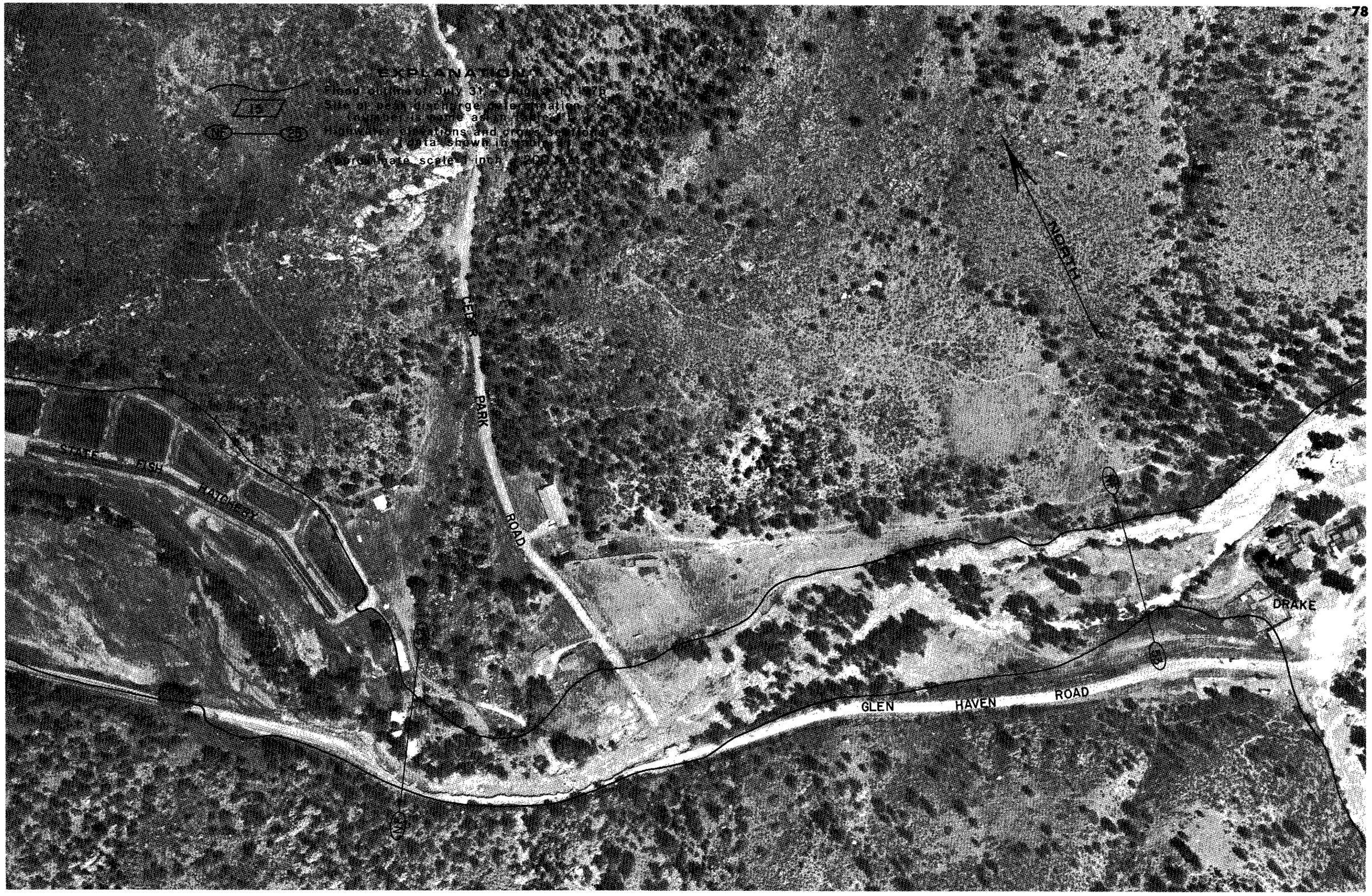


BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976 PLATE NO. NF-13



BIG THOMPSON RIVER FLOOD of JULY 31, - - AUGUST 1, 1976

PLATE NO. NF-14



BIG THOMPSON RIVER FLOOD of JULY 31, -- AUGUST 1, 1976

PLATE NO. NF-15