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Ice breakup on the Chena River 1975 and 1976

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Cover: Breakup of Chena River at checkpoint 12, 3 May 1975. (Photograph by Terry McFadden.)

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Terry T. McFadden and Charles M. Collins

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The breakup of the Chena River was observed and documented during the spring of 1975 and 1976. This study attempted to determine the potential for damage to the proposed Chena River flood control dam from ice and debris during breakup. Results of this study were compared to those of a 1974 companion study. In 1975, ice thicknesses were determined to be 15% thinner than in 1974 and ice volume was 33% smaller. No major ice floes were observed in 1975 and no significant flooding occurred, although the approaches to a bridge at the damsite were eroded by debris and high water immediately after breakup. The 1976 breakup was milder than that of 1975. Minor flooding in the lower river was caused by jamming of a few large ice pieces, but no property damage resulted.

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PREFACE

This report was prepared by Dr. Terry T. McFadden, Chief, Alaskan Projects Office, U.S. Army Cold Regions Research and Engineering Laboratory, and by Charles M. Collins, Physical Scientist, also of the Alaskan Projects Office. The study described in this report was conducted in response to a request from the District Engineer, U.S. Army Engineer District, Alaska.

The manuscript was technically reviewed by Dr. Charles Slaughter, formerly of CRREL, but now with the Northern Forestry Research Laboratory, U.S. Forest Service.

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CONTENTS

ILLUSTRATIONS

TABLES

SUMMARY

During the spring of 1975 and 1976 the breakup of the Chena River was observed and documented. This study, a companion to that of the 1974 breakup, determined the potential for damage to the proposed Chena River flood control dam from ice and debris during and shortly after the breakup and compared this to the 1974 and earlier breakups.

In 1975 ice thicknesses were measured at specific locations and found to average 15% thinner than in 1974. Likewise the total ice volume was 33% smaller than in the previous year. Compared to the mild 1974 breakup, 1975's was extremely mild. No ice floes of any consequence were observed in the river.

After all the ice had left the river, a period of high water was observed. Water rose to within 1.47 ft (0.45 m) of flood stage before it crested on 15 May 1975. Debris and water were responsible for the loss by washout of both approaches to a bridge at the Chena River damsite. A large number of man and equipment hours were spent in clearing logs and debris in front of this bridge.

The mildness of the 1975 breakup was exceeded by that of 1976. Actually no breakup as such occurred in 1976; rather a progressive melting of the ice from the channel of the river preceded the high water of spring runoff. A few large pieces of ice remained during the runoff, and caused some minor flooding by jamming on the lower portions of the river, but no damage to property resulted.

Documentation and photographs of earlier breakup periods were found in the archives at the University of Alaska and are included in this report.

ICE BREAKUP ON THE CHENA RIVER – 1975 AND 1976

Terry T. McFadden and Charles M. Collins

INTRODUCTION

The purpose of this study was to observe the 1975 and 1976 breakups on the Chena River. Ice conditions and potential problems at the Chena River flood control dam outlet structure were to be observed and compared to the companion study of 1974 (McFadden and Stallion 1975).

The work covered in this report includes the measurement of ice thicknesses on the Chena River, calculations of average ice thickness, and a detailed photographic record of the ice breakup made from the air during the spring of 1975 and 1976. In addition, results from observation of a post-breakup high water incident in 1975 and some information on breakup in previous years are included.

ICE THICKNESS AND QUANTITY

Ice thickness measurements were taken from 8 March to 27 March 1975 at locations numbered on Figure 1. Special emphasis was given to the 25.4-km (15.8-mile) stretch of the river above the Chena damsite.

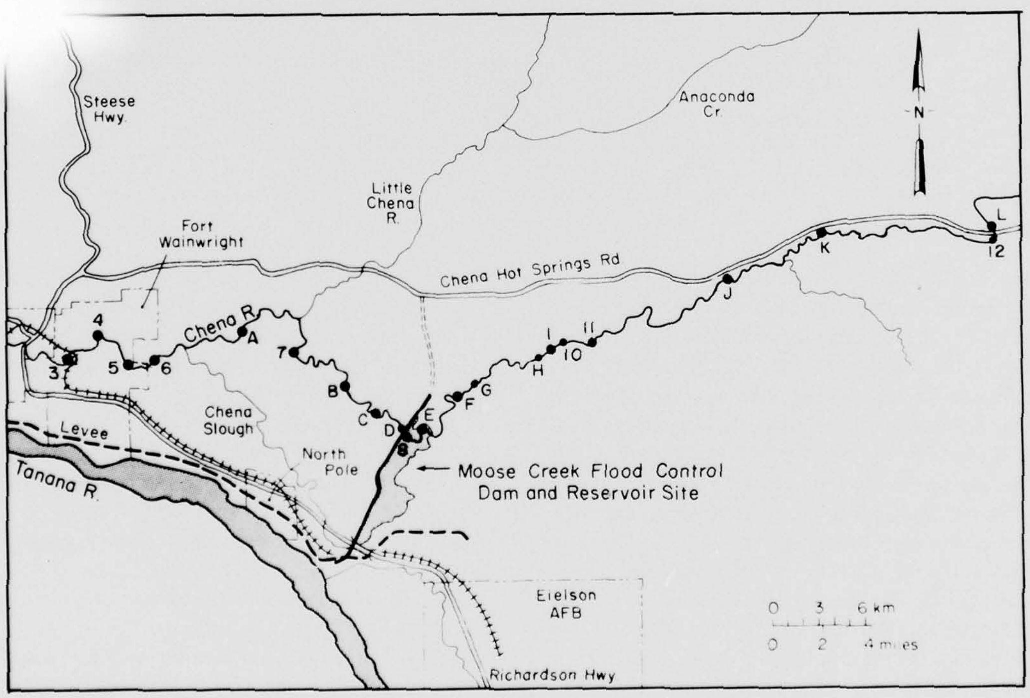

Figure 1. Chena River breakup study area.

Table I. Ice thicknesses, 1975.

Date	Location	Fig. 1 ref. no.	Ice thickness (cm)	River depth (cm)	Snow depth (cm)	Ice type*
6 Mar 75	Engineer Bridge,	3	58.4	241	33	w
6 Mar 75	Fort Wainwright	3	61.0	236	30	w
6 Mar 75		3	47.0	175	24	w
10 Mar 75	Golf Course Bridge,	5	50.8	221	25, snow and slush	w
10 Mar 75	Fort Wainwright	5	76.2	239	3	w
14 Mar 75	Peede Road	B	53.3	180	43	w
18 Mar 75	Damsite bridge	D	58.4	155	25	w
18 Mar 75	Damsite	8	15.2	91	5	w
18 Mar 75		8	15.2	160	5	w
18 Mar 75		8	2.5	135	2.5	w
18 Mar 75	0.25 km upstream of damsite	E	1.3	61		w
18 Mar 75	9.2 km upstream of damsite	F	78.7	213	15	w
18 Mar 75	11.1 km upstream of damsite	G	63.5	140	33, snow and slush	w
27 Mar 75	20.9 km upstream of	H	44.5	244	20	w
27 Mar 75	damsite	H	58.4	157	20	w
27 Mar 75	22.1 km upstream of	I	40.6	122	5, slush	w
27 Mar 75	damsite	I	20.3	122	5, slush	w
27 Mar 75	Air Force Transmitter Site Road	10	open water			
17 Mar 75	29.0 mile Chena Hot Springs Road	J	open water			
17 Mar 75	First bridge, Chena	L	43.2	43	46, frozen to bottom	w
17 Mar 75	Hot Springs Road	L	30.5	48	46	w
17 Mar 75		12	61.0	135	30	w
17 Mar 75		12	40.6	168	30	w

* w – white, overflow ice.
b – clear, "black ice."

This was a difficult area in which to obtain measurements, since snowshoe travel was usually required. When a site was selected, measurements were taken with a CRREL ice thickness kit and a 6-in. Snabb Mora-Borren ice auger. This auger was found to be faster and lighter than the 1.5-in. drill and bit from a CRREL ice thickness kit used in previous years. Both the thickness of ice and the depth to the bottom of the stream bed were measured. The type of ice present (either clear "black ice" or white overflow ice) was also noted along with depth of snow cover. Results of the measurements are shown in Table I.

The mean ice thickness on the Chena River in March 1975 was found to be 43.8 cm (17.3 in.) with a standard deviation of 22.3 cm (8.77 in.), less than the mean ice thickness from the previous year of 59.1 cm (23.3 in.). This difference may be due to early heavy snowfalls in the fall of 1974 which insulated the ice and reduced the heat loss necessary to ice formation. Overflow ice was much more prevalent in 1975 than in the winter of 1973-74. This may also be due to the early heavy snow which weighed down the ice sheet causing overflows.

On 18 April 1974 the 25.4 km (15.8 miles) of river channel upstream of the damsite contained an estimated 5.4×10^4 m^3 (1.9×10^6 ft^3) of ice or 2.1×10^3 m^3/km (1.25×10^5 ft^3/mile). If the same ice surface area is assumed for 1975,* the 25.3 km (15.8 miles) of channel contained 3.7×10^4 m^3 (1.3×10^6 ft^3) of

* In 1974 a composite aerial photo of the entire study area was available from which the ice cover could be measured. No such photo was available in 1975, so an estimate must be made as to size of the ice cover. Assuming the cover area to be the same in both years should be reasonably accurate.

Table II. Ice thicknesses, 1976.

Date	Location	Fig. 1 ref. no.	Ice thickness (cm)	River depth (cm)	Snow depth (cm)	Ice type*
10 Mar 76	Engineer Bridge,	3	68.6	203	30.5	w
10 Mar 76	Fort Wainwright	3	63.5	244	30	w
10 Mar 76		3	61.0	150	30	w
10 Mar 76	Golf Course Bridge	5	40.6	234	7, water above ice	w
10 Mar 76	Fort Wainwright	5	63.5	315	7, water above ice	w
1 Apr 76	Peede Road	B	66.0	203	38	w
31 Mar 76	Damsite bridge	D	38.1	76	5	w
31 Mar 76	Damsite	8	76.2	52	28	w
31 Mar 76		8	45.7	165	25, slush and water	
31 Mar 76	0.25 km upstream of damsite	E	patches of open water			
31 Mar 76	9.2 km upstream of	F	83.8	188	36	w
31 Mar 76	damsite	F	84.0	274	38	b
31 Mar 76	11.1 km upstream of damsite	6	119.38	193	10	w
10 Mar 76	20.9 km upstream of damsite	H	50.8	193	20	w
10 Mar 76	22.1 km upstream of	I	35.6	66	8	w
10 Mar 76	damsite	I	30.5	46	10	w
10 Mar 76	Air Force Transmitter Site Road	10	open water			
30 Mar 76	29.0 Mile, Chena Hot	K	53.3	122	23	w
30 Mar 76	Springs Road	K	71.1	86	41	w
30 Mar 76	First bridge, Chena	L	25.4	25.4	46, frozen to bottom	b
30 Mar 76	Hot Springs Road	L	50.8	50.8	46, frozen to bottom	w
30 Mar 76		L	63.5	76	30	w
30 Mar 76		12	55.9	262	33, slush and snow	w
30 Mar 76		12	68.6	770	30, slush and snow	

* w – white, overflow ice.
b – clear, "black ice."

ice or 1.5×10^3 m^3/km (8.2×10^4 $ft^3/mile$). This is a decrease of 33% compared to 1974.

In March 1976 the mean ice thickness was 59.8 cm (23.5 in.) with a standard deviation of 21.0 cm (8.3 in.) greater than the mean ice thickness in 1975 and nearly equal to the ice thicknesses in 1974. White overflow ice was again very prevalent. Results of the 1976 measurements are shown in Table II.

CHRONOLOGY OF THE 1975 CHENA RIVER BREAKUP

The Chena River breakup was monitored by aerial observation at 12 checkpoints, starting on Fort Wainwright and extending upstream approximately 71 km (44 miles) above the flood control damsite to the first bridge of the Chena Hot Springs Road. These points are identified in Table III. Reconnaissance flights started at the beginning of April and were made with increasing frequency as the breakup approached.

No large ice jams were observed at any time during breakup.

Checkpoint 3*

The first checkpoint was Engineer Bridge at Fort Wainwright (Fig. A1-A4). This bridge is significant in

* Checkpoint numbers were chosen to correspond to the 1974 Chena River breakup study, CRREL Special Report 241. Some of the 1974 checkpoints were not monitored in 1975 and 1976. New checkpoints were designated with a letter instead of a number.

Table III. Breakup reconnaissance checkpoints.

Checkpoint no., Fig. 1	*Location*	*Distance from damsite*
3*	Engineer Bridge, Fort Wainwright	53.9 km (33.5 mi) downstream
4	Ice bridge, Fort Wainwright	46.7 km (29.0 mi) downstream
5	Bailey bridge, Fort Wainwright	43.9 km (27.3 mi) downstream
6	Badger Road Trailer Court	41.8 km (26.0 mi) downstream
A†	Bridge on Nordale Road	33.8 km (21.0 mi) downstream
7	End of Freeman Road (Steamboat Bend)	20.9 km (13.0 mi) downstream
C	Mouth of diversion channel	9.7 km (6.0 mi) downstream
D	Temporary bridge at damsite	0.8 km (0.5 mi) downstream
8	Centerline of dam	
10	Air Force Transmitter Site Road (Chena Park Campground)	23.3 km (14.5 mi) upstream
11	Log jam	25.7 km (16.0 mi) upstream
12	First Chena Hot Springs Road bridge	70.8 km (44.0 mi) upstream

* Numbers are the same as 1974 breakup checkpoints (McFadden and Stallion 1974).
† Letters refer to checkpoints and sampling points established in 1975 and 1976.

that it has five trash racks protecting the piers of the bridge. This checkpoint underwent a typical sequence of breakup events. The first reconnaissance flight, on 1 April 1975 (Fig. A1) showed that the river was almost completely covered with ice. The area in front of the bridge and immediately downstream of the bridge was ice-covered, while a small area of open water existed approximately 50 m downstream of the bridge, where water from the Fort Wainwright power plant is dumped. The ice appeared to be intact in the immediate area of the bridge and no sign of melting or breakup existed. Snow cover was present both upstream and immediately downstream of the bridge.

By 16 April, small areas of open water were evident upstream of the bridge, and the open area by the cooling water dump, downstream of the bridge, had extended upstream to within 25 m of the bridge. By 21 April, the weather had cooled and the areas of open water above the bridge had once again frozen, with fresh snow covering them. The ice appeared solid and intact with no sign of melting. On 23 April, signs of rotting and melting were apparent. Very little change was noted between the 24th and the 26th. By the 29th, however, definite areas of open water above the bridge were evident (Fig. A2). There appeared to be little ice in the immediate vicinity of the bridge, only a small patch downstream, and some ice extending from the upstream side of the bridge to the trash racks. On 30 April, the ice areas around the bridge downstream and upstream had continued to recede and the bridge was essentially ice-free; however, the shaded area under the bridge still contained ice. By 1 May, further deterioration of the ice was noted (Fig. A3). The stage of the river had just started to rise slightly. Up to this time a sand bar below the bridge was evident, although it was a bit smaller on this date. The amount of ice below the bridge had decreased and the open water area above the bridge was considerably larger. A few small ice floes were noticed approximately 150 m upstream from the bridge as they jammed against the winter ice that had not yet moved out of this area. By 3 May, all the ice for 200 m upstream of the bridge had moved out. A few pieces of floating ice were jammed up on the trash racks. The river had continued to rise and the sand bar was almost covered. By the 5th (Fig. A4), the sand bar was completely covered as the river continued to rise. Several pieces of ice were jammed in front of the bridge on the trash racks. Two of these pieces appeared to be over 30 m long and approximately 10 to 15 m wide. No water was backed up by the ice and the jam was not causing any flooding. On 7 May the river was free of ice from its mouth to well above the bridge.

Checkpoint 4

Breakup at the Fort Wainwright ice bridge, constructed by Alyeska, showed much the same pattern (Fig. A5-A8). On 10 April the ice bridge appeared to be completely usable – its snow cover showed no signs of melting. By 16 April, however, the area of the bridge itself appeared to have water standing on it, and it probably was not safe for traffic. By 3 May, the bridge was practically gone (Fig. A7). A little ice in its center area was noted; however, open water was extensive both upstream and downstream. By 5 May (Fig. A8), ice had completely moved out of the area of the bridge, jamming up 150 to 200 m downstream. It is interesting to note that extra thickness of ice at the bridge did not significantly prolong its usable life, nor did it cause any jams to form at that point. Instead, it broke up much the same as the rest of the river.

Checkpoint 5

The Bailey bridge at the Fort Wainwright golf course is protected by two trash racks, compared to five at the Engineer Bridge (Fig. A9-A12). The breakup chronology of this bridge, however, is very similar to that of the Engineer Bridge, with first signs of water appearing at the same time and all ice moving out by 7 May.

Checkpoint 6

Checkpoint 6 was approximately 3.2 km (2 miles) upstream from the Golf Course Bridge, and is directly adjacent to the Badger Road Trailer Court (Fig. A13-A16). This checkpoint, located on a large sweeping bend, is typical of the lower river in general. The ice appeared to be completely intact at this checkpoint until 23 April. At this time, a dump of black material (ashes or gravel) was established on the ice near the trailer court site (Fig. A14). Immediately downstream of the dump, approximately 50 m, a very small area of wet ice about 25 m long and 5 m wide was noted. By the 24th, this area had increased in size noticeably, extending approximately 100 m downstream and starting within 5 m of the dump area, which had also increased in size (Fig. A14). Very little change occurred between the 24th and the 26th (as at the other checkpoints), primarily due to the colder weather. However, by 29 April the area of water on the ice had increased dramatically, extending 200 to 250 m downstream and covering at least half the channel portion of the river. Open water was evident in the area immediately downstream of the dump. On this date some open water also began to appear upstream of this area. By 3 May, the area around the dump was entirely open. On 5 May, the ice moved from the area, forming a moderate sized jam immediately downstream of this checkpoint (Fig. A16). The jammed area was approximately 200 m in length, covering the entire width of the river and containing many small pieces of floating ice that had come from upstream. By 7 May the jam had moved out and the river was clear of ice.

Checkpoint A

Checkpoint A was near a new bridge under construction on Nordale Road (Fig. A17-A20), approximately 8 km (5 miles) upstream from the Badger Road Trailer Court. Little difference in the method of ice breakup was noted in this checkpoint as compared to the other bridges, with the exception that the ice remained in this area of the river longer and was the last on the river (along with the ice at checkpoint 7) to move out. On 7 May there were still several jams between this checkpoint and the next.

Checkpoint 7

Checkpoint 7 was named Steamboat Bend by early settlers of Fairbanks. It is a sharp bend in the river formed by the cutting off of a large oxbow (Fig. A21-A24). No sign of open water was seen at this point until 29 April (Fig. A22). Breakup and melting did not progress as fast in this area as at checkpoints further downstream, and by 3 May the area still had ice over the majority of the river channel in the area of the bend. By 5 May, shorefast ice was still in the vicinity and had not moved out, although considerable open water was present. Significantly, ice had receded from all previous checkpoints by this day, with only some jamming occurring in the vicinity of the bridges, but at this checkpoint, approximately 25 km upriver from the first, ice was still in the channel. This particular reach of river meanders through the middle of a valley, and the channel is somewhat protected from the sun by large spruce trees on the banks. The slow-moving waters of the river probably do not erode the ice as fast as in areas farther downstream, such as checkpoints 3 and 5, where more man-made disturbances and less protection are encountered. On 7 May, an ice jam several hundred meters long was observed in this area (Fig. A23). The jam was largely made up of smaller pieces of floating ice that had come down from upstream. The area of the bend was about 50% ice-covered with shorefast winter ice that had not moved out. This portion of the river was not clear of ice until 12 May (Fig. A24).

Checkpoint C

Checkpoint C was at the confluence of the river and the diversion channel from the flood control dam gravel pit (Fig. A25-A28). It is of interest only in that it shows open water and melting somewhat sooner than the checkpoint 12 km (7.5 miles) downstream at Steamboat Bend.

Checkpoint D

Checkpoint D was at the bridge at the damsite, approximately $^1/_2$ km ($^1/_3$ mile) downstream from the center line of the dam (Fig. A29-A32). Open water first appeared on 16 April approximately 50 to 100 m downstream of the bridge, somewhat earlier than open water appeared around the two bridges at Fort Wainwright. By 26 April a large channel of open water was visible on the upstream side of the bridge, although ice was still present across the entire river in the area under the bridge. By the 29th the open water channel extended through the entire area, but ice was still visible under the bridge where it was shaded from the sun. Ice between the center piers underneath the bridge remained on 30 April but was gone on 1 May (Fig. A31). A low water level in the river was evident in this area until 3 May when a small rise in river stage was observed; by 5 May the river had risen considerably and the width of the open water channel was doubled (Fig. A32). Ice that was previously grounded on the shore finally moved out.

Checkpoint 8

The area in the vicinity of the centerline of the damsite was monitored, since ice measurements showed very thin ice cover, and open water was evident just downstream of the dam centerline as early as 1 April (Fig. A33-A36). Ice measurements (Table I) show that this area had only 2.5 to 15.3 cm (1 to 6 in.) of ice on 18 March. The ice appeared to be quite "rotten" as early as 10 April (Fig. A33), and a channel of open water had completely eaten through the area of the dam centerline as early as 16 April.

Thin and discontinuous ice growth was also typical of the river upstream from the damsite to the vicinity of the large bluffs which will form the north abutment of the dam. In the vicinity where the river passed close to these bluffs, ice cover was more stable and deteriorated considerably later.

Upstream from the bluffs, the character of Chena River changes as it flows through a somewhat narrower valley. In this area the slope of the river is greater (Frey et al. 1970), and since major tributaries enter in this reach, the discharge becomes progressively smaller. The narrow canyon offers more protection from solar input, and breakup (but not necessarily open water) occurs progressively later as one continues upstream toward the headwaters.

Checkpoint 10

From immediately above the bluffs upstream to checkpoint 10 at Chena Park campground (Fig. A37-A40), the river was open as early as 12 March (Fig. A37). By 1 April a clear channel of open water was visible along the entire bend which nearly encircled the campground. The open channel continued to enlarge by melting throughout the period of observation, and virtually no ice was seen flowing in the river between this point and the damsite.

Checkpoint 11

Checkpoint 11, 2 km (3.2 miles) upstream from the campground, was located at a large log jam (Fig. A41-A44). Open water was prevalent through much of the area both upstream and downstream of the log jam as early as 16 April (Fig. A42). The melting of the ice in this area was typical of this portion of the river and may be due to large amounts of ground water entering the river throughout this section.

Checkpoint 12

Checkpoint 12, at the first bridge on the Chena Hot Springs Road, was about 70 km upstream of the damsite (Fig. A45-A47 and cover photograph). Channels of open water were apparent by 29 April (Fig. A46). By 3 May most of the ice in the main channel had melted out with the river almost free of ice by 7 May (Fig. A47). Notice the snow still on the ground at this time.

Judging from the breakup, or perhaps more accurately, "melt-out," in 1975 the river from checkpoint 11 to the damsite would have no ice problems. However, even the mild breakup of 1974 generated large ice floes that originated and accumulated throughout this area.

SPRING FLOODING AND DEBRIS

Subsequent to the melt-out of the ice, the river discharge continued to increase until it reached 16,800 ft^3/s on 12 May, at the USGS Two Rivers station 40 river miles above the damsite. The discharge of the river at Fairbanks rose to 12,100 ft^3/s (flood stage being 15,000 ft^3/s) on 15 May (Table IV). This volume was sufficient to dislodge large quantities of debris, and the bridge at the Chena River damsite (checkpoint 8) accumulated a large number of logs (Fig. 2). Concern for the bridge mounted as both approaches washed out (Fig. 3) and debris continued to accumulate until it was feared that the bridge would be lost.

A sizeable effort was expended at the bridge to remove logs from in front of its pilings. The south approach eroded 5 m back from the bridge, although the

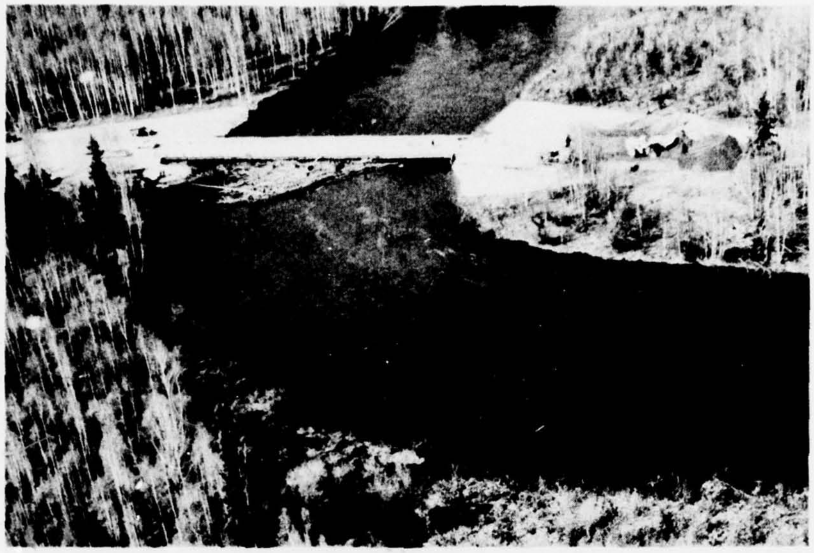

Figure 2. Debris accumulation behind the bridge at the damsite (12 May 1975).

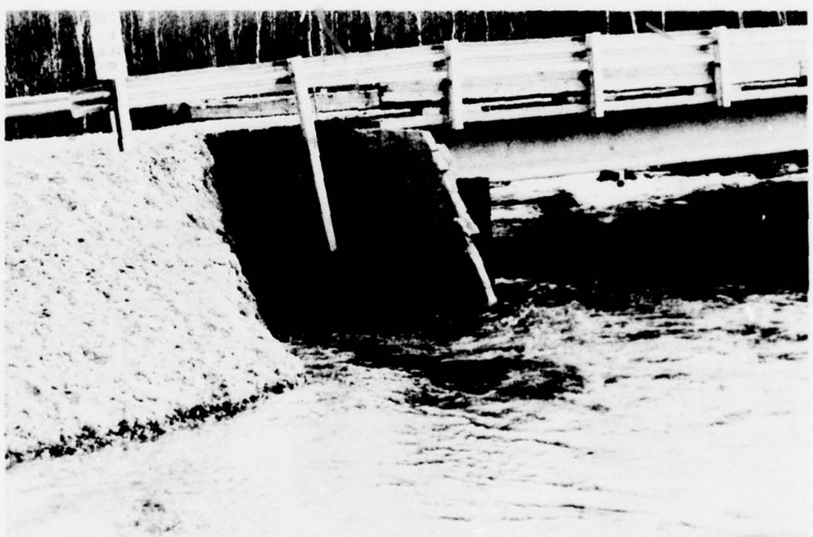

Figure 3. Early stages of damsite bridge approach washout (12 May 1975).

Figure 4. Debris accumulation behind bridge at damsite (12 May 1975). Note trash hook in foreground.

Figure 5. Debris accumulation on trash racks at Engineer Bridge, Fort Wainwright (12 May 1975). Note that debris did not accumulate against the bridge pilings.

Table IV. Chena River average daily discharge (ft³/s) during the May 1975 breakup.*
Data courtesy of U.S. Geological Survey, Water Resources Division, Fairbanks, Alaska.

		USGS site locations	
Date	*Fairbanks†* *(ft³/s)*	*North Pole (0.8 km downstream of damsite) (ft³/s)*	*Two Rivers (64 km upstream of damsite) (ft³/s)*
1	500	350	350
2	610	500	460
3	700	800	600
4	814	1,200	800
5	1,630	1,700	900
6	2,940	2,100	1,100
7	3,260	2,120	1,500
8	3,730	2,220	2,200
9	3,760	2,570	2,760
10	4,160	3,420	3,240
11	5,990	6,350	6,370
12	9,460	10,000	14,200
			16,800 (peak at 1030 hours)
13	11,000	11,800	12,000
14	11,800	12,000	6,430
		12,300 (peak at 1030 hours)	
15	11,900	8,180	3,800
	12,100 (peak at 0130 hours)		
16	8,710	4,780	3,150
17	5,890	4,250	4,160
18	5,830	5,270	4,980
19	6,390	4,800	2,750
20	4,710	3,210	1,920
21	3,750	2,500	1,610
22	3,260	2,220	1,860
23	3,260	2,220	1,8[illegible]0
24	3,050	2,130	1,720
	2,900	2,000	1,600
Total monthly discharge	135,404	109,300	91,510

* To convert from ft³/s to m³/s, multiply by 0.0283.
† Flood stage in Fairbanks is 15,000 ft³/s.

bridge remained with no apparent damage when the high water subsided. Debris accumulation was also a problem at Engineer Bridge on Fort Wainwright. However, the trash racks in front of this bridge protected the bridge pilings. Figures 4 and 5 show the debris accumulation at the two bridges and the advantages of the trash tracks.

Above the damsite, minor flooding was observed along the river for several miles. At the Chena Park campground, a car parked on what is normally a dry gravel bar beside the river was submerged with only its roof remaining above water (Fig. A40).

Several sloughs were observed to be running full and low-lying areas around the river were inundated with water. Engineer Bridge (checkpoint 3) at Fort Wainwright was closed for several days while logs were removed from its trash racks (Fig. 5).

THE 1976 CHENA RIVER BREAKUP

The Chena River breakup in 1976 was even milder than the mild 1975 breakup. Much of the ice in the main channel of the Chena River from Fairbanks to above the damsite melted in place, with large sections of the channel open by 27 April. At that time some ice floes started appearing in the river.

As the river level rose on 29 April, more ice floes were apparent as shorefast ice broke up. A number of small jams were noted in the river between

Ft. Wainwright and the damsite with some shorefast ice still present. The river above the damsite for 40 km appeared almost completely clear of ice.

On 2 May several small ice floes were moving in the lower Chena, below Fairbanks. There were several jams in the Steamboat Bend area (checkpoint 7). The rest of the river appeared nearly clear of ice. The river crested on 5 May at 7,400 ft^3/s, well below flood stage (Table V). Some minor flooding occurred on Freeman road, and a house at Steamboat Bend, although itself not flooded, was cut off by flood waters for several hours. No damage, washout, or property loss of any consequence was noted during the breakup.

Table V. Chena River average daily discharge (ft^3/s) during the 1976 breakup.*

	USGS site locations	
Date	*Fairbanks†* *(ft^3/s)*	*North Pole (0.8 km downstream of damsite)* *(ft^3/s)*
April		
26	432	350
27	526	500
28	675	800
29	916	1,300
30	1,440	2,000
May		
1	2,800	3,000
2	5,960	4,000
3	7,140	5,000
4	7,290	5,200
5	7,120	4,800
	7,400 (peak at 0300 hours)	
6	5,980	3,980
7	4,600	3,260
8	3,800	2,610
9	3,290	2,280
10	3,090	2,280
11	2,980	2,110
12	2,720	2,040
13	2,760	2,120
14	2,760	2,040
15	2,600	1,800

* Data is provisional and is subject to revision by the U.S. Geological Survey.

† Flood stage in Fairbanks is 15,000 ft^3/s.

BREAKUP IN OTHER YEARS

The 1975 and 1976 ice breakups were mild compared to some past years (Table VI). Except for the high discharge of the river (12,100 ft^3/s) which followed after the ice had gone out in 1975, very little concern or inconvenience accompanied either breakup. Most of the ice melted in place, and over much of the river there was little ice left for breakup.

The 1974 breakup was also mild. The maximum river discharge of 4,390 ft^3/s on 20 May was much lower than in 1975. Again the peak arrived after the ice had gone out, yet there was much more ice in the river during the breakup process.

Comparison with other years is difficult since no other quantitative reports of breakup on the Chena could be found. However, accounts of previous major breakups published in the *Fairbanks Daily News Miner* give some insight into conditions of other years.

In 1966 the river reached a stage of 12,900 ft^3/s on 11 May. There was minor flooding on Broadway, Nordale and Freeman Roads on the east side of Fairbanks. An ice jam on the Tanana River caused some flooding at Twelve Mile Village on 9 May. 1966 was the first year that aerial dusting of the mouth of the Chena River and the Tanana River below the Chena was attempted by the Alaska District, Corps of Engineers. Aerial dusting involves the use of aircraft to spread coal dust or other dark material on the ice to induce melting by radiation. The dusting of the rivers was a success as the ice on the Tanana melted and allowed ice from the Chena to flow into the Tanana without the jamming that had occurred several times previously.

On 6 May 1963 an ice jam formed in the Chena one mile above its mouth which caused water to back up and flood low-lying areas. Ice was still frozen in the Chena near the mouth and in the Tanana. At the height of flooding, Chena Pump Road and Dale Road on the west side of Fairbanks and parts of the airport area were flooded. University Avenue was underwater for ¾ of its length; Noyes Slough was backed up and flooded. The ice jam broke at the Chena mouth, and water levels dropped more than a foot between midnight and 0900 hours on 8 May. Seventy or more families suffered flood damage from the Chena River jam. Many more would be affected today due to much denser population in the flooded area.

In 1960 high water and ice jams caused minor flooding at Fort Wainwright and in low-lying areas of Fairbanks. The river peaked above flood stage on 3 May at 19,900 ft^3/s. Twelve Mile Village was flooded from the Tanana River and was declared a disaster area. Many parts of the Richardson Highway were under water. Figures 6-9 show parts of downtown Fairbanks and Fort Wainwright.

In May 1948 heavy runoff from rainfall and snowmelt caused large-scale flooding in Fairbanks. Approximately 30% of the Fairbanks area was flooded. Much

Table VI. Peak daily discharges (ft³/s) of the Chena River in previous years.*

Fairbanks†		North Pole		Two Rivers	
Date	Discharge (ft³/s)	Date	Discharge (ft³/s)	Date	Discharge (ft³/s)
4 May 76	7,290	4 May 76	5,200		
15 May 75	11,800	14 May 75	12,000	12 May 75	14,200
20 May 74	4,390	20 May 74	2,600	17 May 74	2,710
16 May 73	5,590	16 May 73	4,420	15 May 73	4,080
11 May 72	12,200	10 May 72	9,000	10 May 72	5,850
21 May 71	11,300			27 May 71	7,940
14 May 70	2,430			13 May 70	1,920
16 May 69	2,930			14 May 69	2,120
13 May 68	7,330			20 May 68	5,450
28 May 67	9,700				
15 Aug 67	64,600				
11 May 66	12,900				
23 May 65	5,380				
18 May 61	6,760				
3 May 60	19,900				
21 May 48	24,200				

* Discharge values are taken from USGS surface water records and do not necessarily reflect discharges at time of breakup.

† Flood stage in Fairbanks is 15,000 ft³/s.

Figure 6. Ice and high water in downtown Fairbanks, 3 May 1960 (from Fairbanks News Miner*).*

Figure 7. Ice and high water in downtown Fairbanks, 3 May 1960 (from Fairbanks News Miner*).*

Figure 8. Cushman Street Bridge, 3 May 1960 (from Fairbanks News Miner*).*

Figure 9. Water over road at eastern end of Ladd AFB runway, 3 May 1960 (from Fairbanks News Miner*).*

Figure 10. Fairbanks business area after breakup, circa 1915 (University of Alaska Archives, Charles Bunnell Collection).

Figure 11. Grounded ice left by early day breakup, circa 1915 (University of Alaska Archives, Charles Bunnell Collection).

Figure 12. Ice damage from an early breakup, circa 1915 (University of Alaska Archives, Charles Bunnell Collection).

of the downtown area was under water along with the Graehl and present University Avenue areas. Large stretches of the Richardson Highway were also under water because of flooding from ice jams on the Tanana River. Eielson AFB was cut off from Fairbanks for a number of days, and an air taxi service was started. Nenana was inundated from flood waters of the Tanana. The Chena River crested at Fairbanks on 21 May at 24,200 ft^3/s. Damage from the flood waters in Fairbanks was estimated at around $3,000,000.

During the late 1930's and mid 1940's a dike was built by the Alaska District, Corps of Engineers along the northern bank of the Tanana River, cutting off the sloughs which connected the Tanana with the Chena River above Fairbanks. The dike, Moose Creek Dike, prevented high water from the Tanana from entering the Chena above Fairbanks, lowered the average level of the Chena River, and was a major factor in lowering the damage from spring flooding of the Chena.

On 13 May 1937 an ice jam formed in the Chena River below Fairbanks two days after breakup. Water backed up and flooded the town, covering First, Third and Fourth Avenues from Lacy to Cowles Streets and the Graehl area north of the Chena River. The river level reached an estimated 15.9 ft, using the present standard. The discharge is uncertain, since the water was backed up from the jam. Damage estimates of the flood were approximately $150,000.

Photos of breakup from early in this century (Fig. 10, 11, 12) were obtained from the University of Alaska archives. Dates are unknown; however, they appear to be around 1915, based on dress and on the beginning of the phone system in Fairbanks. The severity of this breakup is obvious from the large grounded ice pieces far from the river. No account of this particular breakup flood was available.

SUMMARY AND CONCLUSIONS

The mildness of the 1975 and 1976 breakups on the Chena River surpassed even that of the 1974 breakup. In 1975 no ice problems of any extent were observed, and the rapid rise in river stage after breakup caused more concern and problems than did breakup itself. Minor flooding resulted, some homes were isolated, and the approaches to the bridge at the flood control damsite were washed out. A large amount of debris was carried downstream which contributed heavily to the washout problem at the bridge. This emphasized the need for adequate debris handling equipment at the damsite during the breakup or other high water periods. Equipment recommendations were outlined in the 1974 breakup report (McFadden and Stallion 1975).

A literature search of past flooding problems indicates that a considerable advantage was gained from the installation of the Tanana River dike. In addition, the ice dusting procedures which have been routinely used in later years appear to have eliminated ice jams and flooding of the lower Chena in West Fairbanks. This practice should be continued since the areas flooded in the past are now more densely populated and there is now a much higher potential for damage and possible loss of life.

When river discharge is plotted on the same abscissa as degree days of melting based on air temperature at Fairbanks Weather Bureau (Fig. 13 and 14), an interesting parallel exists. The similarity in shape of the two traces suggests that forecasting of the breakup high water may be possible after further research. Unfortunately, further discussion of this possibility is beyond the scope of this report.

It is difficult to determine if the current mild breakups are part of an overall warming trend in the weather or the result of unfortunately timed research studies. However, past breakup reports, although lacking in quantitative observation, generally show a picture of much more severe problems than any seen in either this study or the companion study of 1974, and photographs from the local newspaper clearly support this contention. Although future weather trends are difficult to forecast with any confidence, some scientists predict that the future climate will get progressively colder (Hays et al. 1976). Since such forecasting of weather patterns is not yet precise, the outlet structure must be adequate to handle ice and debris conditions equal to the extremes observed over the last 50 or more years. These design considerations are outlined in detail in the companion report of this study (McFadden and Stallion 1975). To do less invites disaster and saves very little, particularly when costs are studied in the light of the present inflationary economy.

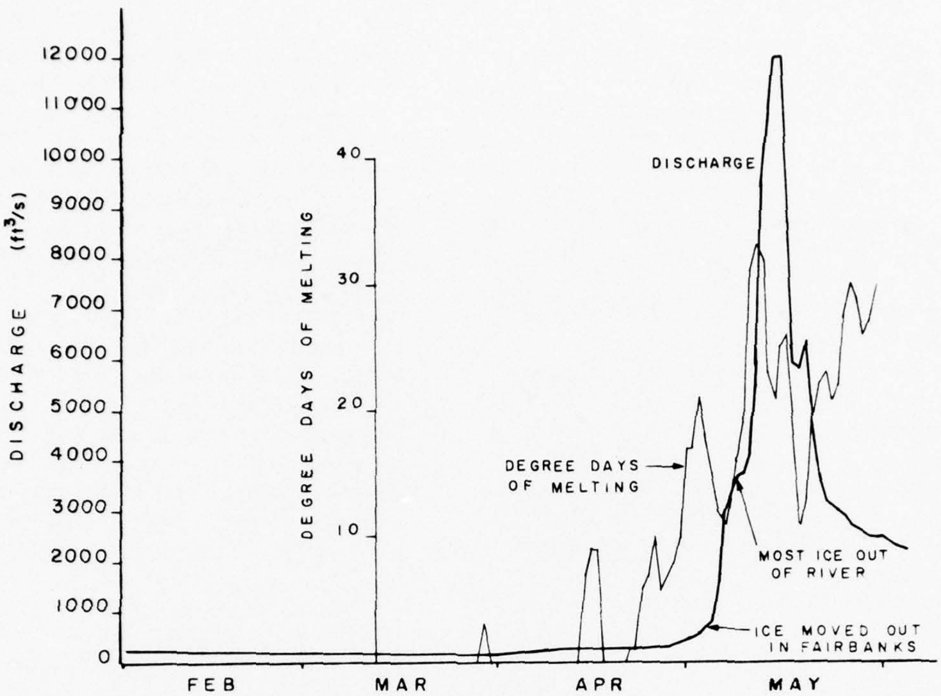

Figure 13. 1975 Chena River breakup.

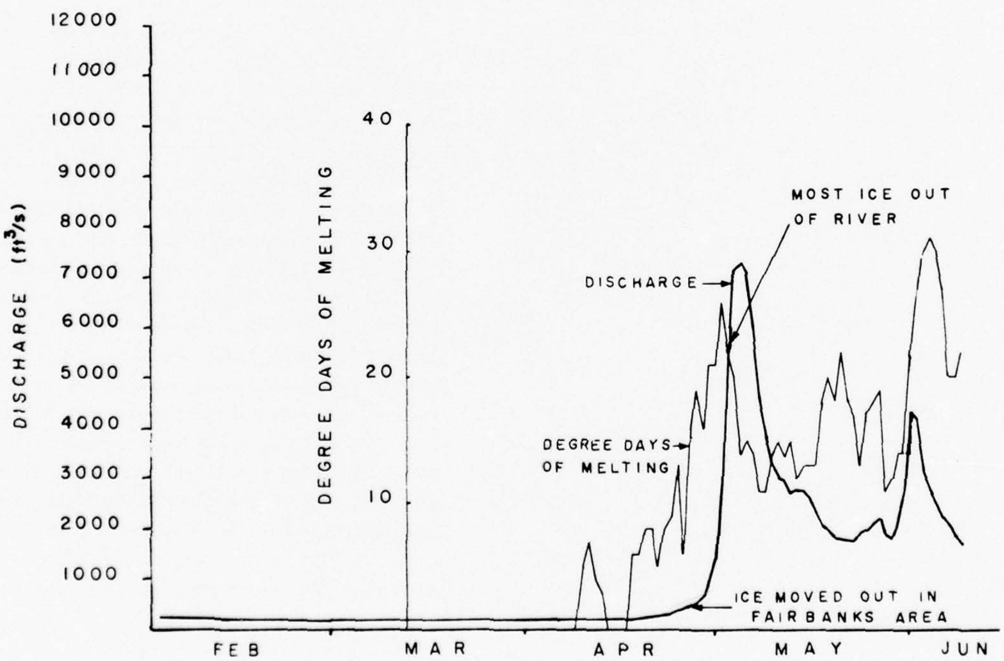

Figure 14. 1976 Chena River breakup.

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APPENDIX A. SEQUENTIAL PHOTOGRAPHS OF 1975 BREAKUP AT CHECKPOINTS 3-12

Figure A1. Checkpoint 3 at Engineer Bridge, 21 April 1975.

Figure A2. Checkpoint 3, 29 April 1975.

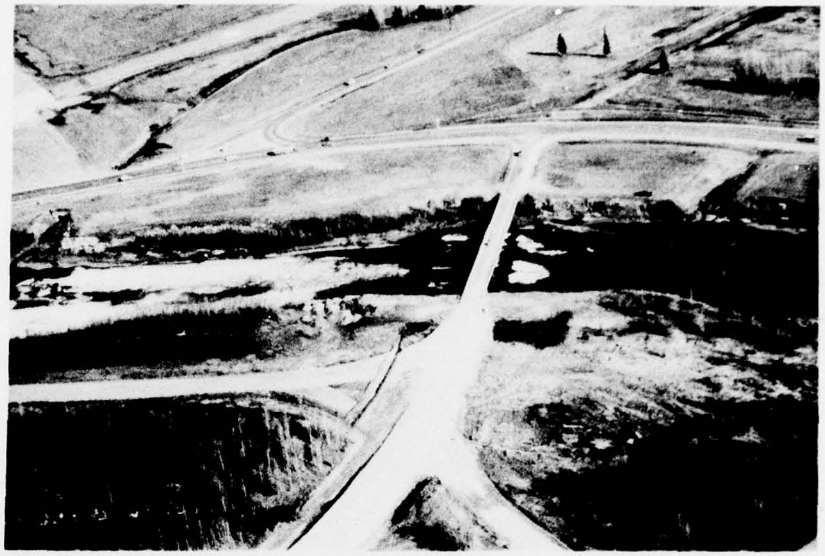

Figure A3. Checkpoint 3, 1 May 1975.

Figure A4. Checkpoint 3, 5 May 1975.

Figure A5. Checkpoint 4 at Fort Wainwright ice bridge, 24 April 1975.

Figure A6. Checkpoint 4, 30 April 1975.

Figure A7. Checkpoint 4, 3 May 1975.

Figure A8. Checkpoint 4, 5 May 1975.

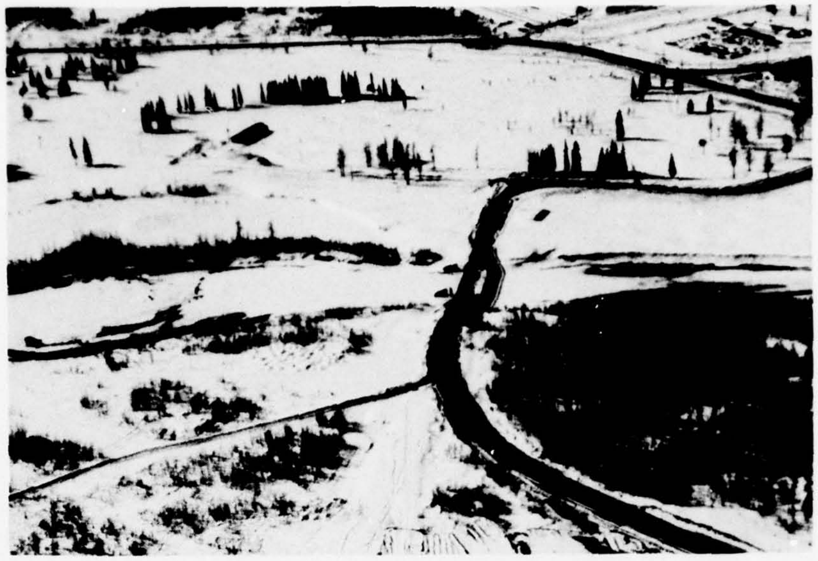

Figure A9. Checkpoint 5 at Bailey bridge, Fort Wainwright, 21 April 1975.

Figure A10. Checkpoint 5, 26 April 1975.

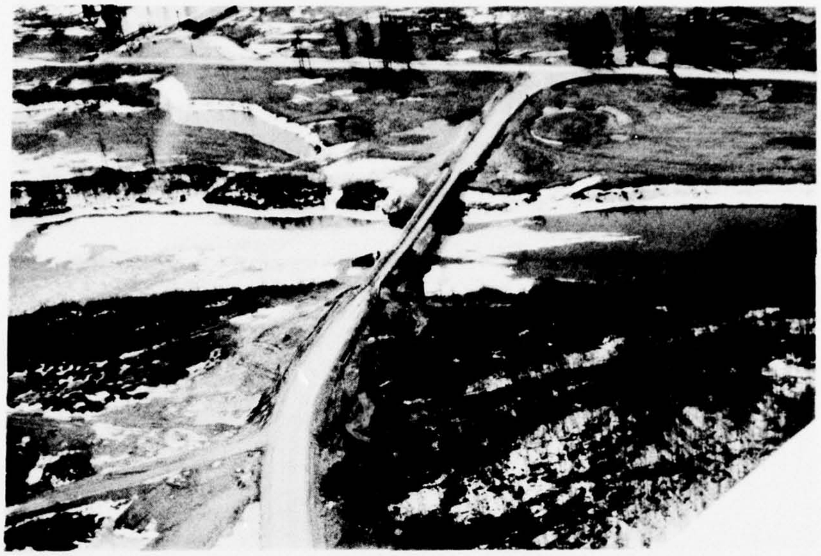

Figure A11. Checkpoint 5, 3 May 1975.

Figure A12. Checkpoint 5, 5 May 1975.

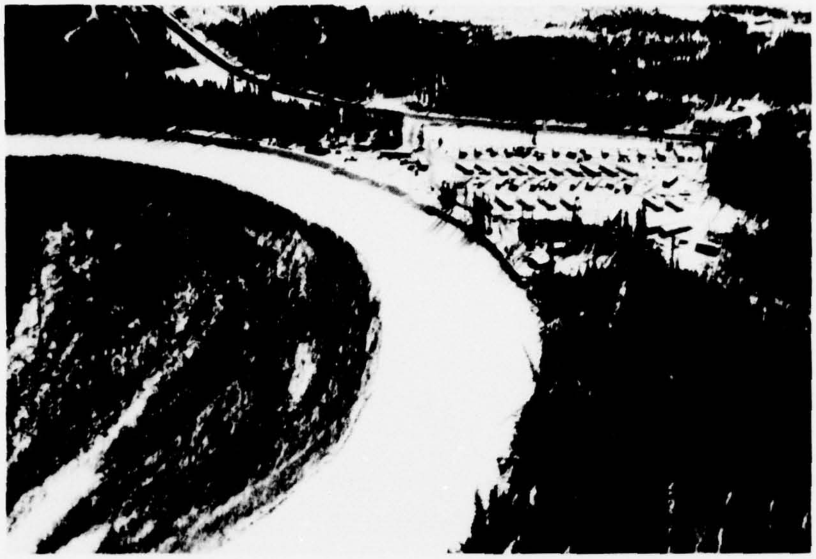

Figure A13. Checkpoint 6 at Badger Road Trailer Court, 21 April 1975.

Figure A14. Checkpoint 6, 24 April 1975.

Figure A15. Checkpoint 6, 3 May 1975

Figure A16. Checkpoint 6, 5 May 1975.

Figure A17. Checkpoint A at bridge on Nordale Road, 16 April 1975.

Figure A18. Checkpoint A, 26 April 1975.

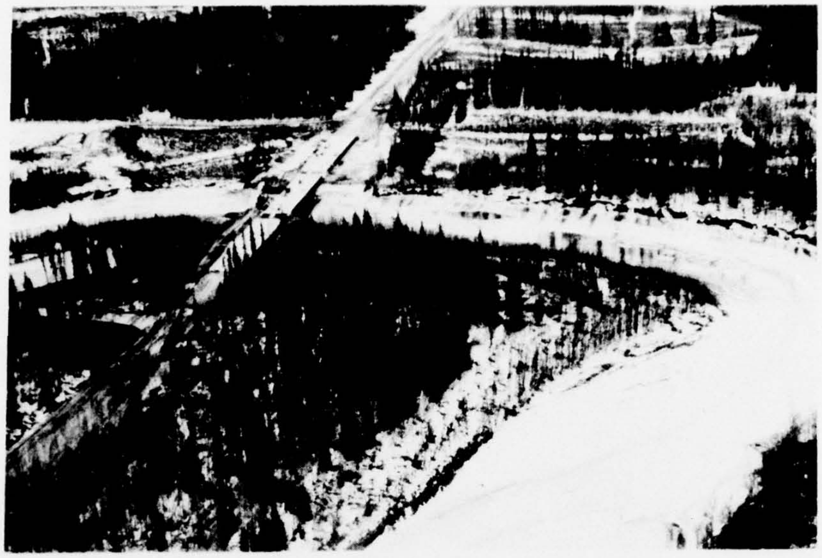

Figure A19. Checkpoint A, 3 May 1975.

Figure A20. Checkpoint A, 7 May 1975.

Figure A21. Checkpoint 7 at end of Freeman Road, 26 April 1975.

Figure A22. Checkpoint 7, 29 April 1975.

Figure A23. Checkpoint 7, 7 May 1975.

Figure A24. Checkpoint 7, 12 May 1975.

Figure A25. Checkpoint C at mouth of diversion channel, 30 April 1975.

Figure A26. Checkpoint C, 3 May 1975.

Figure A27. Checkpoint C, 5 May 1975.

Figure A28. Checkpoint C, 12 May 1975.

Figure A29. Checkpoint D at temporary damsite bridge, 10 April 1975.

Figure A30. Checkpoint D, 23 April 1975.

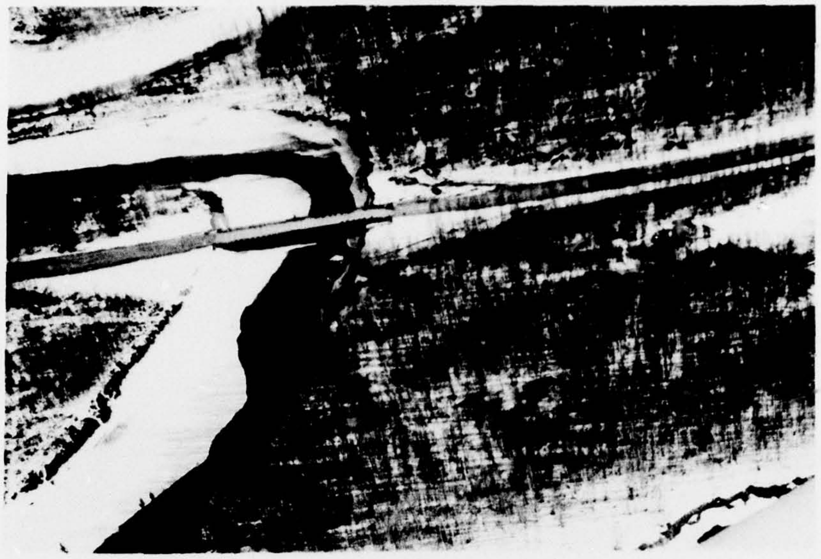

Figure A31. Checkpoint D, 1 May 1975.

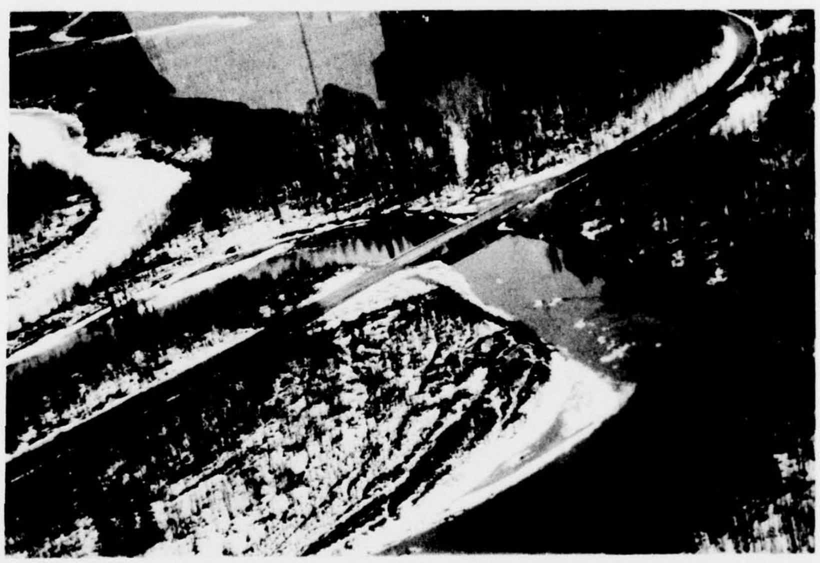

Figure A32. Checkpoint D, 5 May 1975.

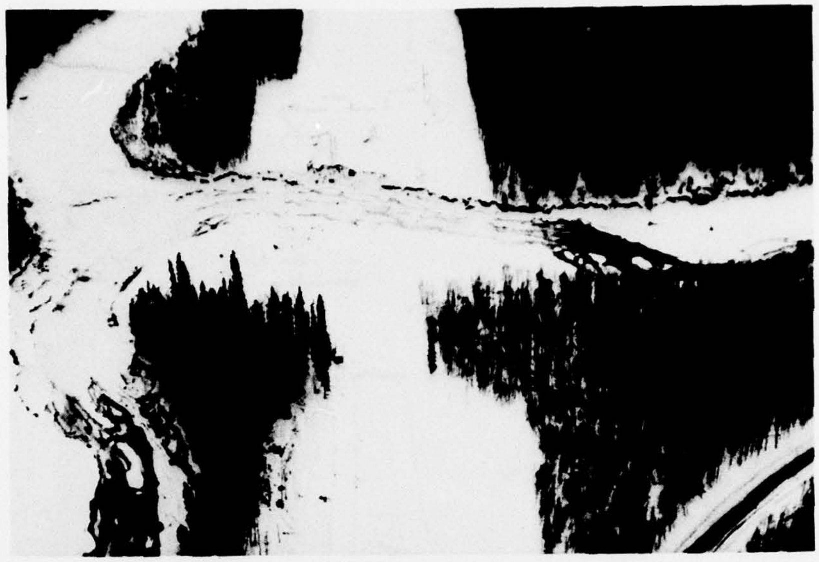

Figure A33. Checkpoint 8 at dam centerline, 10 April 1975.

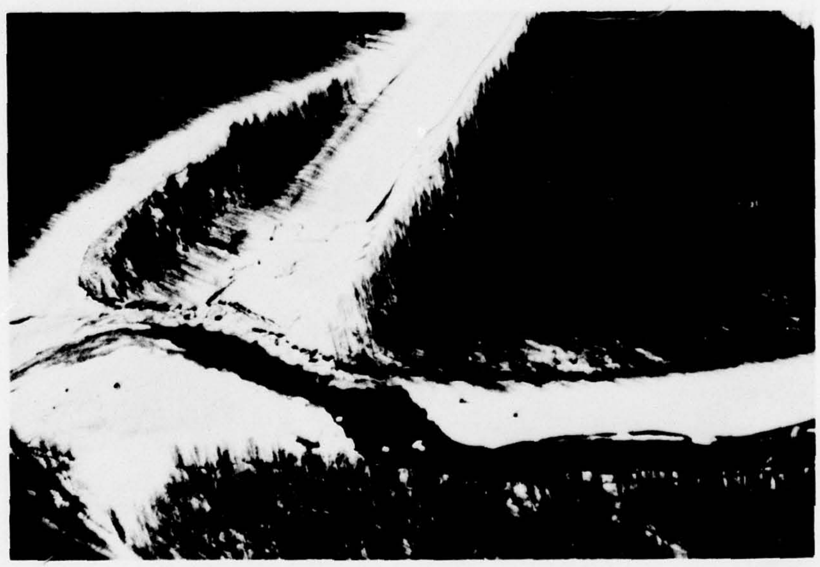

Figure A34. Checkpoint 8, 21 April 1975.

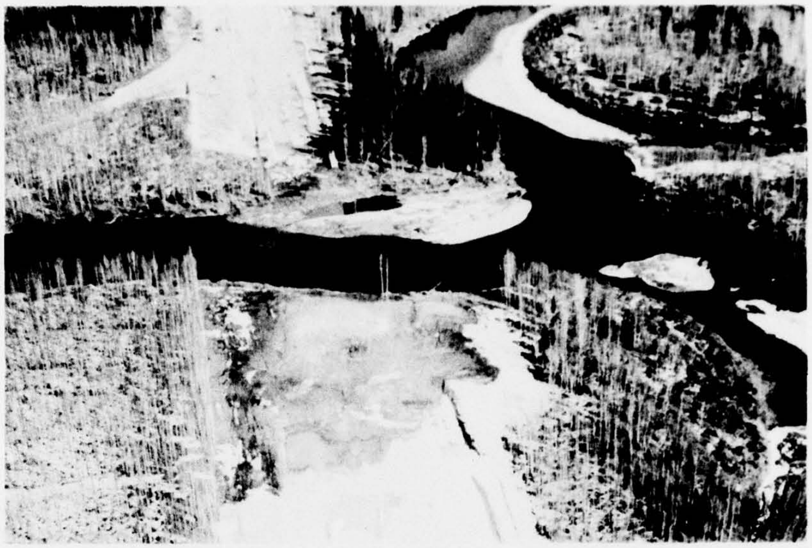

Figure A35. Checkpoint 8, 7 May 1975.

Figure A36. Checkpoint 8, 12 May 1975.

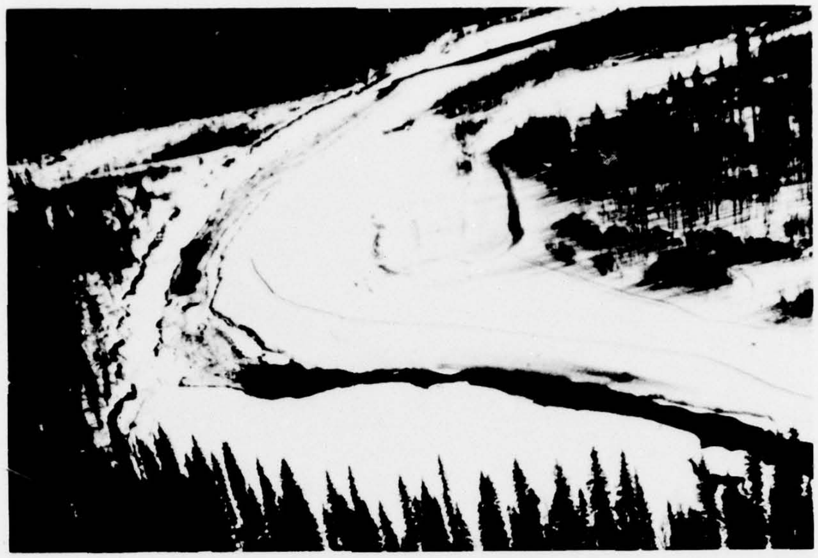

Figure A37. Checkpoint 10, at Air Force Transmitter Site Road, 12 March 1975.

Figure A38. Checkpoint 10, 23 April 1975.

Figure A39. Checkpoint 10, 7 May 1975.

Figure A40. Checkpoint 10, 12 May 1975.

Figure A41. Checkpoint 11, at log jam 16 miles above damsite, 18 March 1975.

Figure A42. Checkpoint 11, 16 April 1975.

Figure A43. Checkpoint 11, 30 April 1975.

Figure A44. Checkpoint 11, 6 May 1975.

Figure A45. Checkpoint 12, at first bridge on Chena Hot Springs Road, 23 April 1975.

Figure A46. Checkpoint 12, 29 April 1975.

Figure A47. Checkpoint 12, 7 May 1975.

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