PREAUTHORIZATION ASSESSMENT OF ANADROMOUS FISH POPULATIONS OF THE UPPER SUSITNA RIVER WATERSHED IN THE VICINITY OF THE PROPOSED DEVIL CANYON HYDROELECTRIC PROJECT

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF FIGURES

A 1972 Senate Public Works Committee resolution requested the U.S. Corps of Engineers to consider the possibilities of hydroelectric power development along the Upper Susitna River in the area of Devil Canyon. In 1974 the National Marine Fisheries Service (NMFS) contracted the Alaska Department of Fish and Game, Division of Commercial Fisheries, to conduct a preauthorization assessment of the salmon populations (Oncorhynchus sp.) utilizing the Susitna River in the vicinity of the proposed Devil Canyon damsite. The objectives of these studies were to determine the spawning distribution, relative abundance, migrational timing, representative age-length-sex composition by species, and juvenile rearing areas (Barrett, 1974, 1975a, 1975b, 1975c). Investigations were expanded in 1975 to include the lower reaches of the Talkeetna and Chulitna Rivers through funds provided by U.S. Fish and Wildlife Service.

Several sites within the Susitna River drainage have been under consideration for construction of a hydroelectric complex since the early 1950's. The current recommended plan includes the construction of dams and powerplants on the Susitna River at Devil Canyon and Watana and electric transmission facilities to the Alaska Railbelt load centers. Construction is expected to commence in 1981 with Watana Dam followed by Devil Canyon Dam. Proposed construction time for the project is 12 years.

The proposed plan for the Watana site includes the construction of an earthfill dam with a structural height of 810 feet (247 m) at river mile 165 (266 km). The reservoir would have an elevation of 2,200 feet (671 m) and a crest elevation of 2,210 feet (674 m). It would cover a surface area of approximately 43,000 acres and extend about 54 river miles (87 km) upstream from the damsite, i.e., 4 miles (6 km) above the confluence of the Susitna and Oshetna Rivers (personal communication, J. Reid, 1975).

The plans for the Devil Canyon site include the construction of a concrete thin-arch dam with a structural height of 635 feet (194 m) located at river mile 134 (216 km). The reservoir created would have a surface area of about 7,550 acres and would extend upstream approximately 23 river miles (37 km) to the Watana Dam site (personal communication, J. Reid, 1975).

Barrett's studies (1974) provide the only recent information available on the extent of salmon utilizing the Susitna River and its tributaries between Devil Canyon and its confluence with the Chulitna River. Investigations by U.S. Fish and Wildlife Service in 1956 documented the presence of salmonid populations in the Susitna River and four tributary streams between Gold Creek and the Devil Canyon site (Anonymous, 1957). Anadromous species were not found above Devil Canyon.

This study included continued monitoring of spawning distribution, relative abundance and representative age-length-sex composition by species and surveys of juvenile rearing areas. Reconnaissance surveys were initiated on the Talkeetna and Chulitna Rivers in June 1975 and weekly surveys were conducted from July through September 1975. Adult and juvenile fish populations were monitored in the Susitna River and its tributaries between Devil Canyon and its confluence with the Chulitna River from July through September 1975.

Description of Study Area

The Susitna River rises in Alaska Range of southcentral Alaska and drains an area exceeding 19,000 square miles (49,210 sq km). The Susitna River is approximately 275 miles (443 km) long from its source to its point of discharge into Cook Inlet (Figure 1). The major tributaries of lower basin originate in glaciers and carry a heavy load of glacial silt. Most of the tributaries are turbulent in their upper reaches and slow-flowing in the lower regions. Thirty-seven sampling sites were monitored on the Susitna River between Devil Canyon and the confluence of the Chulitna River in 1975 (Figure 2). Twenty-eight of these sites were clearwater slough areas adjunct to the Susitna River. The remaining locations were clearwater creeks and rivers flowing into the Susitna River (Appendix I, Figures 1-27).

The Talkeetna River originates in the Talkeetna Mountains and flows in a westerly direction to its point of discharge into the Susitna River 80 miles (129 km) upstream from its mouth. An aerial reconnaissance of the river was conducted in June 1975. Potential spawning and rearing areas were mapped and later surveys by riverboat established 16 sampling sites from Clear Creek downstream to the confluence of the Talkeetna and Susitna Rivers (Figure 3). Two of these sites are clearwater streams and 14 are slough areas adjunct to the Talkeetna River (Appendix I, Figures 28-40).

The Chulitna River originates in the Alaska Range and flows in a southerly direction, joining the Susitna River opposite the Talkeetna River confluence. The braided nature of this river at its mouth prevents extensive surveying by riverboat. One sampling location was established on the Chulitna River approximately one-half mile (0.8 m) above its confluence with the Susitna River (Appendix I, Figure 41).

METHODS OF INVESTIGATION

Sampling Procedures

Winter Sampling

Winter sampling was conducted from a base camp located at Indian River. Access to slough areas was provided by a single track snow vehicle. Fifteen sloughs and 3 clearwater streams were surveyed from March 11 to March 14, 1975. Sloughs were sampled for temperature, dissolved oxygen, pH, relative water height and flow, ice cover and thickness, and snow depth. Dissolved oxygen was measured with a Edmondson-Wilson D.O. and temperature analyzer (Model #60-620). Fry were sampled from sloughs with minnow traps when water depths permitted. Samples caught were frozen and returned to the Anchorage laboratory for analysis. Standard length (SL) data was obtained for all specimens. Scale samples were taken for age analysis.

A Ryan thermograph was installed at Gold Creek (river mile 119) to monitor daily water temperature fluctuations. Water conditions at Gold Creek and the Anchorage-Fairbanks Highway Bridge crossing below Talkeetna were monitored biweekly. Water conditions at Chase Creek, river mile 91 (146 km), were sampled monthly. Two liter water samples were collected at each site for total dissolved solid analysis. Temperature, dissolved oxygen, pH, water depth, ice cover and snow cover were recorded at each site.

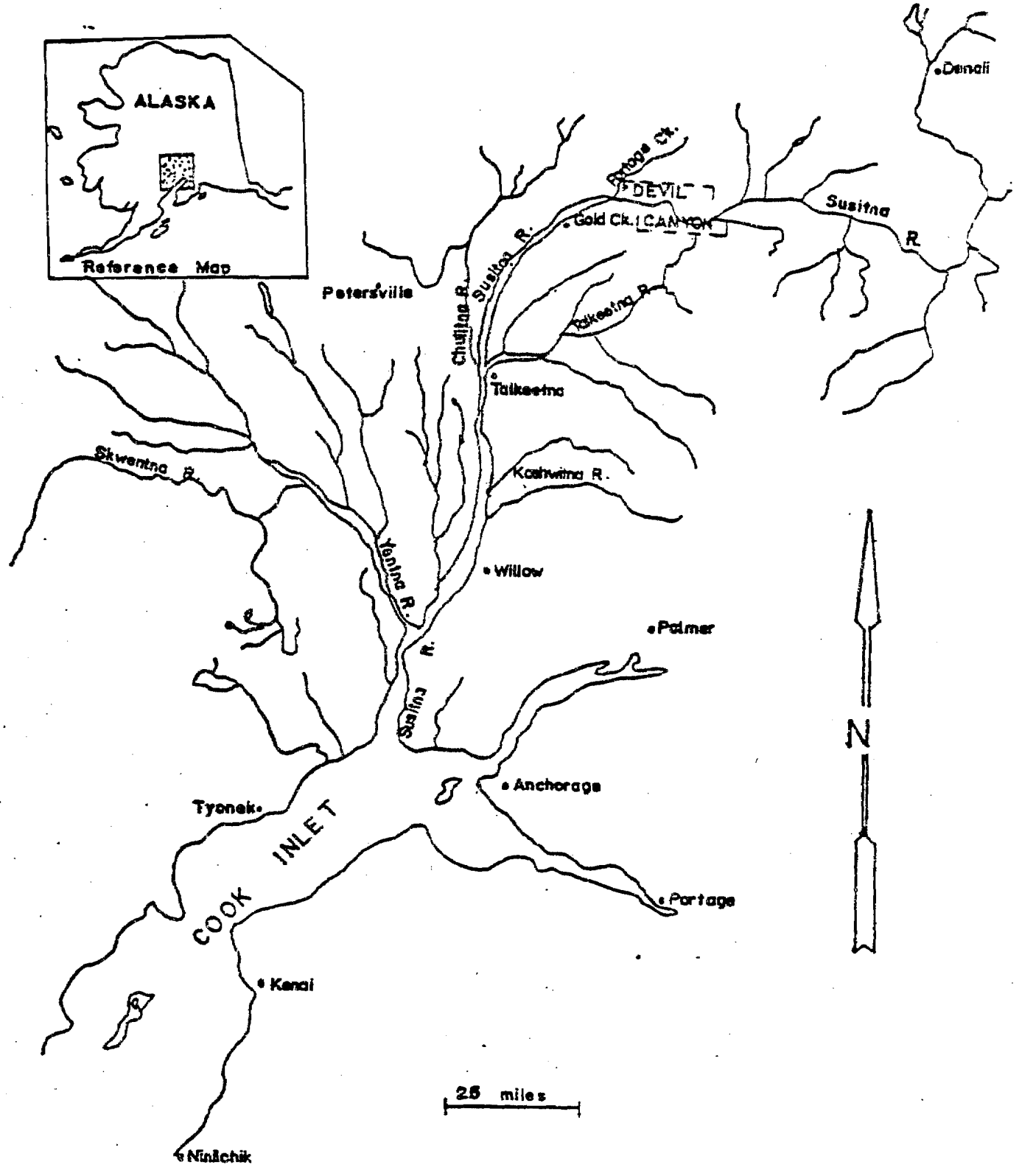

Figure 1. Devil Canyon in reference to the Susitna River watershed and northern Cook Inlet, Devil's Canyon Project, 1975.

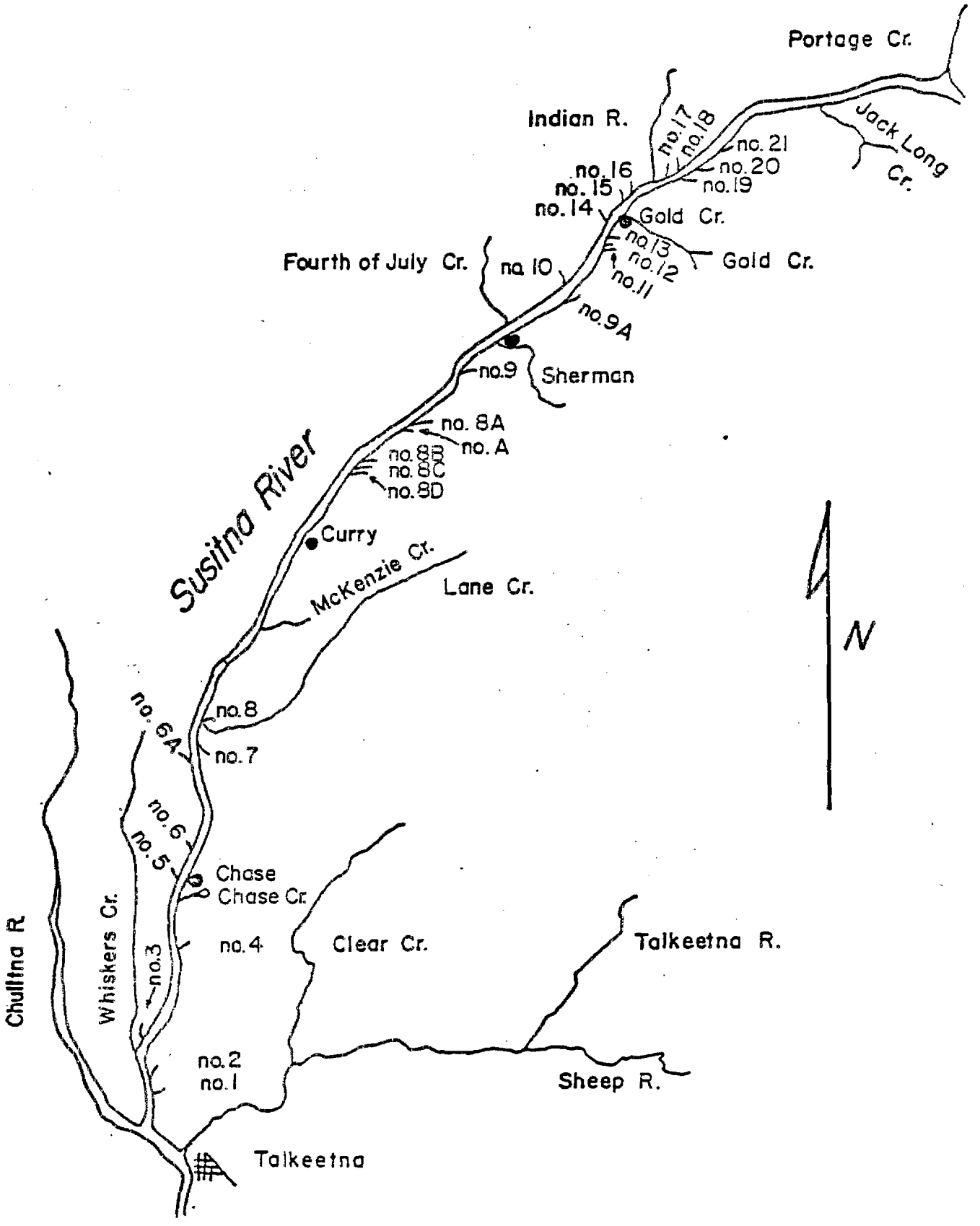

Figure 2. Map of the upper Susitna River study area encompassed in the Devil's Canyon Project, 1975.

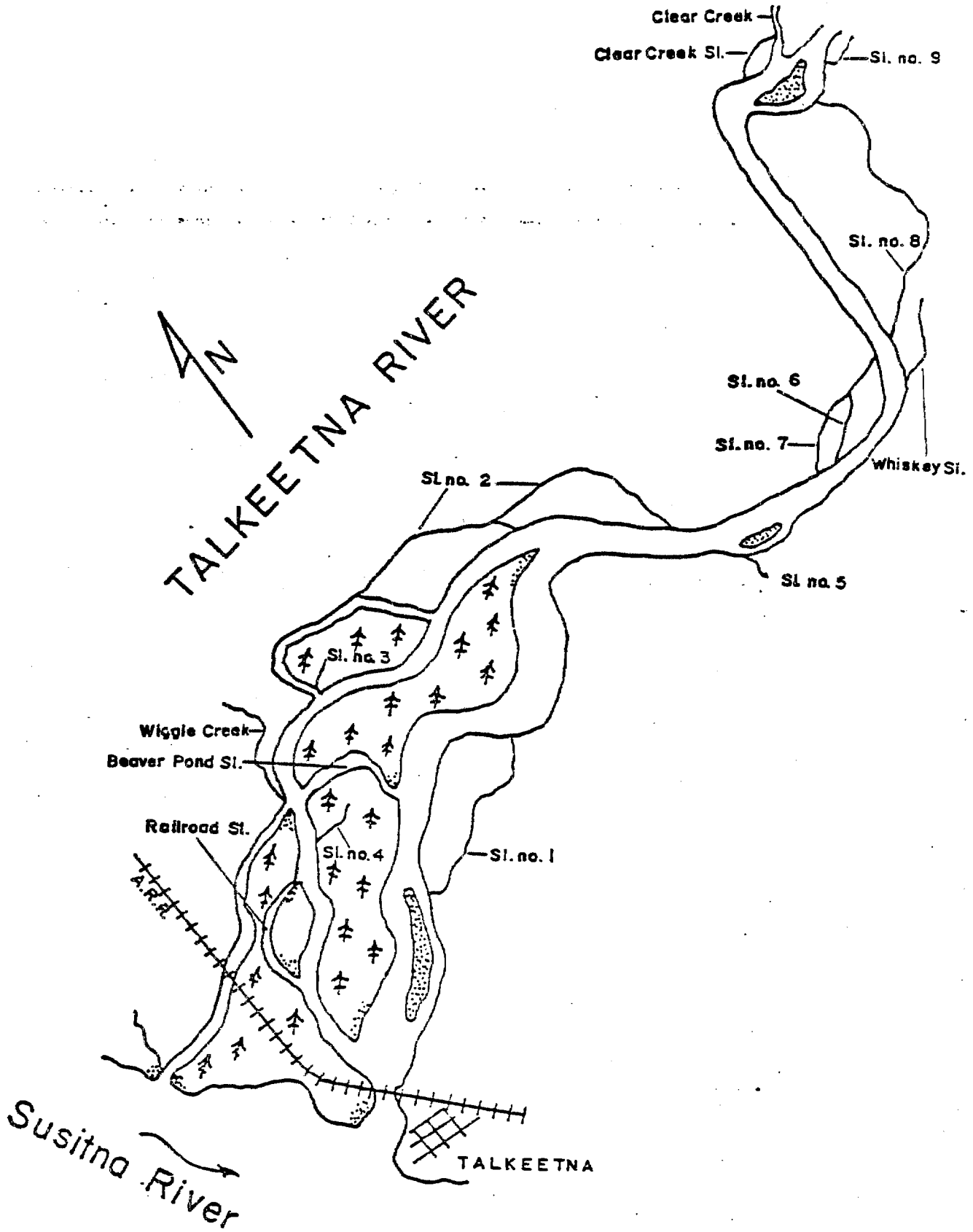

Figure 3. Map of the Talkeetna River study area encompassed in the Devil's Canyon Project, 1975.

Spring Sampling

A base camp was established on Billion Slough at the confluence of the Susitna and Talkeetna Rivers June 2, 1975. Surveys by riverboat were conducted on the Talkeetna, Chulitna, and Susitna (from Talkeetna downstream to the Anchorage-Fairbanks Highway bridge crossing) Rivers to investigate potential adult spawning areas and locate areas utilized by rearing fry. High water conditions during this period made surveying difficult and in some areas impossible. Slough areas were identified and mapped where the mainstem river was not flowing through them. Permanent depth stakes were installed. Fry samples were taken with a dip net or minnow seine and preserved in 10 percent formalin solution.

Two liter water samples were taken in the Talkeetna River at the Alaska Railroad bridge and the Susitna River at the Anchorage-Fairbanks Highway bridge biweekly. Air and water temperature and depth were taken when possible. Samples were processed in the Anchorage laboratory for total dissolved solids.

An aerial survey of the area was conducted June 26, 1975. Additional slough areas were noted.

Summer Sampling

Fishwheels were operated on the Susitna River from July 7 through August 27, 1975 at the same locations as 1974 studies. One wheel was located adjacent to the east bank of the river approximately 5 miles (8 m) upstream from the town of Talkeetna; the second was located adjacent to the west bank of the river approximately 2.3 miles (3.7 m) downstream from the first. Fishwheels were operated on a twenty-four hour a day schedule with exception of occational breakdown periods. The east and west bank fishwheels averaged 2.25 and 2.5 revolutions per minute, respectively, during the season. Fishwheels were normally fished 2 feet (0.6 m) above the river bottom due to daily fluctuation of water levels. Fishwheel design is discussed by Barrett (1974). Complete structural failure of the west bank fishwheel axel occurred on August 1. Fishwheel sampling at this site was discontinued due to the low catch prior to the breakdown. Gill net sets were made on the west bank approximately 100 yards (91 m) above the fishwheel site to continue monitoring salmon migration.

Fishwheel catches were recorded daily by species and all salmon were tagged immediately below their dorsal fin with a color and number coded 1 inch (2.54 cm) diameter Peterson disc. Buffer discs were also applied. Length and sex data were collected on all species of salmon. Scale samples for age analysis were taken on all species with the exception of pink salmon (O. gorbuscha). Fish were measured from mid-eye to fork of tail. Fish were released immediately after sampling.

A stream survey camp was established July 17 and maintained through September 27 at the mouth of Gold Creek. Boat, foot, and aerial surveys monitoring spawning and rearing areas between Devil Canyon and the confluence of the Susitna and Chulitna Rivers and the Talkeetna River were

conducted. All spawning and rearing areas were scheduled to be surveyed weekly, but due to poor weather, substandard survey conditions, and the distance involved in surveying, a strict schedule could not be adhered to. The section of the Susitna River from the community of Chase downstream to the Chulitna River and the one accessible slough on the Chulitna River was surveyed by the crew stationed at the fishwheel camp.

Sloughs were surveyed in their entirety. Streams were surveyed within established index areas, usually located from the mouth upstream 0.5 mile (0.8 km). Limited manpower did not permit surveying the streams in their entirety, although adults do occur above most established index areas. Water and air temperature, survey conditions as determined by the survey crew, and water depth were recorded on each slough survey. Stream flow was taken on limited streams with a flow rod.

A two man crew conducted escapement surveys in streams and sloughs; one person counted live fish while the other individual counted carcasses. Tagged fish observed were recorded by tag color and, when permissable, by tag number. Sampling adult salmon for age and length in the spawning areas was discontinued in 1975 due to the condition of the scales. Most scales sampled were reabsorbed and accurate age determination could not be made.

Rearing fry data was collected in sloughs of the Susitna, Talkeetna and Chulitna Rivers. The total number of fry observed was recorded and species composition noted. A dip net and/or minnow seine was employed to capture fry for positive species identification, age-length composition samples and foregut analysis.

Biweekly water samples were collected from three locations for total dissolved solid content. The Susitna River was sampled at Gold Creek and Anchorage-Fairbanks Highway bridge below Talkeetna. The Talkeetna River was sampled at the Alaska Railroad bridge above the confluence of the Susitna River. Air and water temperatures were recorded.

Benthic invertebrates were collected with artificial substrates. The artificial substrates consisted of a wire vegetable basket lined with nylon cloth with 210 micrometer (μm) mesh and filled with rocks collected from the streambed sampled. Four traps were installed in Indian River and Waterfall Creek. Four types of habitat were sampled in Indian River. These included a deep pool, deep riffle, shallow riffle and quiet water. Two traps were placed in a shallow riffle and two in a shallow pool near the mouth of Waterfall Creek. The substrate was placed in a bucket immediately after retrieval. Specimens were preserved in 70 percent methyl alcohol. Insects were identified to the generic level in most cases with the aid of a Bausch and Lomb dissecting scope.

Juvenile insects are often good indicators of water conditions, i.e., dissolved oxygen and temperature. Many groups are extremely sensitive to even slight changes in temperature. A temperature change of 5°C could result in the elimination of certain insect populations within slough areas, resulting in a complete change in the food chain.

Climatological observations were recorded daily at the fishwheel camp. Conditions monitored included air and water temperature, relative water level and general atmospheric conditions, such as cloud cover and precipitation.

Laboratory Analyses

Total dissolved solids were determined by methods adapted from Standard Methods (APHA, et. al., 1971). The water sample was shaken vigorously for a minimum of 15 seconds and then 1000 milliliters (ml) was poured into a graduated cylinder and allowed to settle for a 24 hour period. After settling, the water was filtered through preweighed 1.2 μ (0.0012 mm) Millipore filters. The first few hundred ml were filtered taking care not to disturb the residue of the sample. The volume of water filtered was recorded. The remainder of the sample was filtered through a second Millipore filter, using distilled water to completely rinse the residue from the graduated cylinder.

Millipore filters were placed in Petri dishes and dried in a drying oven at 103-105°C until constant weights were attained. The settlable and nonfilterable residue weights were computed by determining the difference between the weights of the filters before and after filtration. Total suspended solids (mg/l) are the summation of the settlable and nonfilterable residues.

Age data presented in this report is expressed by the European method. The number of winters spent in freshwater is written to the left of the decimal. The number of winters reared in saltwater appears to the right of the decimal.

RESULTS

Adult Investigations

A total of 618 salmon (Oncorhyncus sp.) were captured in the two fishwheels from July 7 through August 27, 1975. The composition by species was 291 pink (O. gorbuscha), 139 chum (O. keta), 27 coho (O. kisutch), 103 sockeye (O. nerka) and 58 king salmon (O. tshawytscha). The catch of the east bank fishwheel comprised 98.7 percent of the total catch for the season. The west bank fishwheel was removed from the water on August 1. Limited gill netting was initiated on the west bank of the river at that time. Sampling on the west bank indicated only a minor portion of the fish migrate along this bank. Catch of the east and west bank fishwheels by species and date is presented in Tables 1 and 2, respectively. Average hourly catch of pink and chum salmon is presented in Figure 4. The chum salmon fishwheel catches peaked on August 14. Fishwheel catches indicate about 70.5 percent of the chum salmon migration occurred between August 5 and August 15. Approximately 69 percent of the pink salmon migration occurred during the 9 day period between August 1 and August 9. Sockeye salmon catch was significantly higher than that of 1974. About 48.5 percent of the migration occurred between August 2 and August 10 (Figure 5). The accumulative catch of coho salmon shows a marked decline over 1974. About 52 percent of the coho catch occurred from August 12 through August

Table 1. East bank fishwheel catch of salmon by species from July 7 through August 27, Devil's Canyon Project, 1975.

Date	No. Hours Fished	Pink		Chum		Coho		Sockeye		King	
		Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
July											
7	24	0	0	0	0	0	0	0	0	5	5
8	24	0	0	0	0	0	0	0	0	3	8
9	24	0	0	0	0	0	0	0	0	6	14
10	24	0	0	0	0	0	0	0	0	4	18
11	24	0	0	0	0	0	0	0	0	4	22
12	24	0	0	0	0	0	0	0	0	0	22
13	24	0	0	0	0	0	0	0	0	2	24
14	24	0	0	0	0	0	0	0	0	2	26
15	24	0	0	0	0	0	0	0	0	4	30
16	24	0	0	0	0	0	0	0	0	2	32
17	24	0	0	0	0	0	0	0	0	2	34
18	24	0	0	0	0	0	0	0	0	2	36
19	24	0	0	0	0	0	0	0	0	1	37
20	24	0	0	0	0	0	0	0	0	0	37
21	24	0	0	0	0	0	0	1	1	0	37
22	24	0	0	0	0	0	0	1	2	0	37
23	24	1	1	0	0	0	0	3	5	1	38
24	24	4	5	0	0	0	0	1	6	0	38
25	24	6	11	0	0	0	0	1	7	0	38
26	24	13	24	0	0	0	0	4	11	1	39
27	24	9	33	0	0	0	0	1	12	2	41
28	24	7	40	1	1	0	0	6	18	2	43
29	24	14	54	0	1	1	1	5	23	1	44
30	20.0	5	59	0	1	0	1	0	23	0	44
31	0	0	59	0	1	0	1	0	23	0	44
August											
1	2.5	13	72	0	1	0	1	0	23	0	44
2	24	46	118	5	6	1	2	10	33	1	45
3	24	36	154	9	15	0	2	4	37	0	45
4	24	31	185	1	16	0	2	6	43	0	45
5	24	32	217	10	26	2	4	9	52	0	45
6	24	17	234	14	40	0	4	4	56	0	45
7	24	11	245	2	42	2	6	3	59	0	45
8	24	8	253	7	49	3	9	2	61	0	45
9	24	8	261	2	51	0	9	5	66	0	45
10	24	4	265	9	60	0	9	7	73	0	45
11	24	2	267	8	68	0	9	3	76	1	46
12	24	6	273	10	78	0	9	2	78	0	46
13	24	6	279	12	90	3	12	3	81	0	46
14	24	4	283	15	105	0	12	2	83	0	46
15	24	2	285	9	114	3	15	4	87	1	47
16	24	0	285	2	116	2	17	0	87	2	49
17	24	1	286	1	117	1	18	0	87	0	49
18	24	0	286	1	118	1	19	5	92	1	50
19	24	1	287	3	121	0	19	0	92	1	51
20	24	0	287	8	129	3	22	4	96	0	51
21	24	1	288	1	130	1	23	1	97	1	52
22	24	0	288	4	134	1	24	2	99	0	52
23	24	0	288	2	136	1	25	2	101	1	53
24	24	0	288	1	137	1	26	2	103	0	53
25	24	0	288	0	137	0	26	0	103	0	53
26	24	0	288	0	137	0	26	0	103	0	53
27	24	0	288	2	139	1	27	0	103	0	53
Season Total	1198.5		288		139		27		103		53

Table 2. West bank fishwheel catch of salmon from July 9 through July 31, Devil's Canyon Project, 1975.

Date	No. Hours Fished	Pink		Chum		Coho		Sockeye		King	
		Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
July											
9	22	0	0	0	0	0	0	0	0	0	0
10	24	0	0	0	0	0	0	0	0	2	2
11	24	0	0	0	0	0	0	0	0	0	2
12	24	0	0	0	0	0	0	0	0	1	3
13	24	0	0	0	0	0	0	0	0	0	3
14	24	0	0	0	0	0	0	0	0	0	3
15	24	0	0	0	0	0	0	0	0	0	3
16	24	0	0	0	0	0	0	0	0	0	3
17	24	0	0	0	0	0	0	0	0	1	4
18	24	0	0	0	0	0	0	0	0	1	5
19	2	0	0	0	0	0	0	0	0	0	5
20	21	0	0	0	0	0	0	0	0	0	5
21	24	0	0	0	0	0	0	0	0	0	5
22	24	0	0	0	0	0	0	0	0	0	5
23	24	1	1	0	0	0	0	0	0	0	5
24	24	0	1	0	0	0	0	0	0	0	5
25	24	0	1	0	0	0	0	0	0	0	5
26	24	1	2	0	0	0	0	0	0	0	5
27	24	1	3	0	0	0	0	0	0	0	5
28	24	0	3	0	0	0	0	0	0	0	5
29	24	0	3	0	0	0	0	0	0	0	5
30	24	0	3	0	0	0	0	0	0	0	5
31	24	0	3	0	0	0	0	0	0	0	5
Season Total	549	3		0		0		0		5	

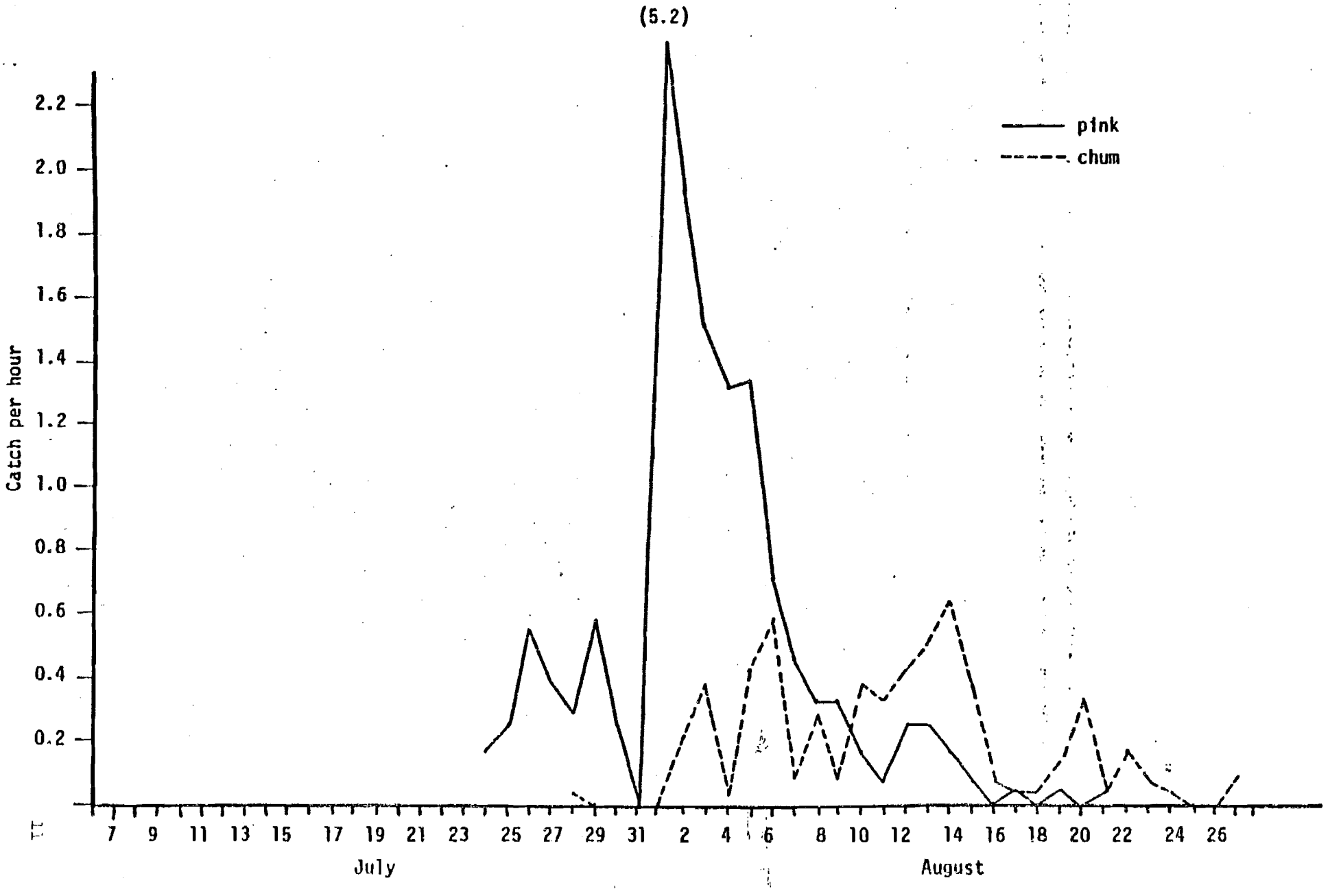

Figure 4. Average hourly catch of pink (Oncorhynchus gorbuscha) and chum (O. keta) salmon per day from the east bank fishwheel, Devil's Canyon Project, 1975.

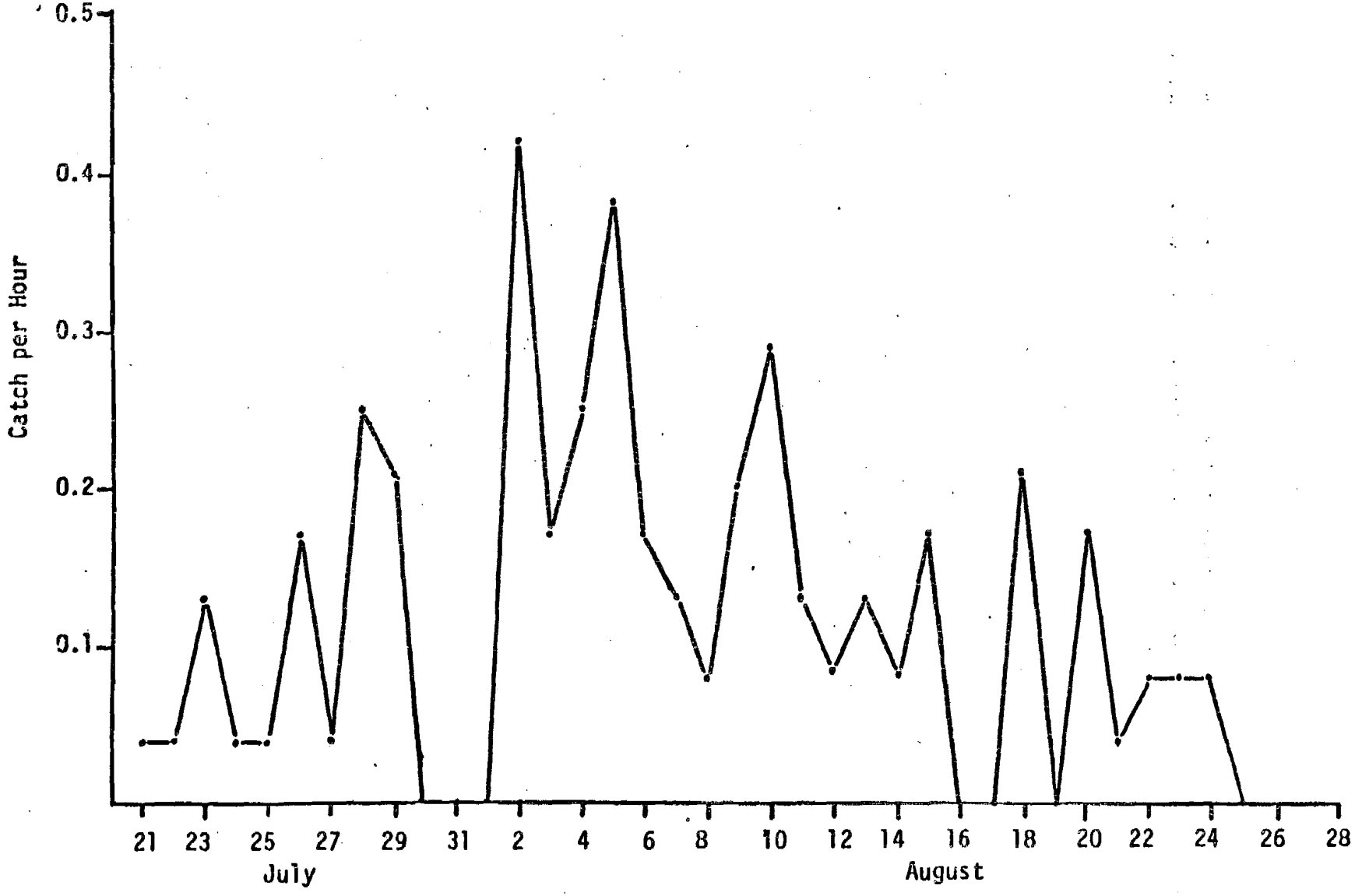

Figure 5. Average hourly catch of sockeye salmon from the east bank fishwheel at the Devil's Canyon fishwheel camp, Devil's Canyon Project, 1975.

24, 1974. The peak in migration may have occurred after removal of the fishwheels in 1975, but escapement surveys of coho salmon were also significantly less in 1975. The peak king salmon migration occurred prior to installation of the fishwheels and a steady decline in catch was observed a few days after operations began. Catch did increase over 1974, but this was due to earlier installation of fishwheels.

Population estimates were obtained for pink, chum and sockeye salmon migrating into the Susitna River and susceptible to capture at the fishwheel sites by the Peterson mark and recapture formula (Table 3). The number of fish tagged in the population (m), number of fish sampled (c), and number of fish sampled (r), were used to calculate the estimated size of the population with 95 percent confidence limits using the following expressions:

$$N = \frac{m\,c}{r} \pm N\sqrt{\frac{(N-m)\,(N-c)}{mc\quad(N-1)}}\,.$$

The population estimates for each species were as follows:

Chum	11,850 ± 4,044
Pink	6,257 ± 261
Sockeye	1,835 ± 337

The population estimates reflect the density of the salmon populations that were susceptible to capture at the fishwheel sites rather than the spawning ground density above the fishwheel sites. The number of live fish sampled were from sloughs and index areas of streams above the fishwheel sites surveyed by the escapement survey crew (Appendix II, Table 1).

Insufficient numbers of coho salmon were observed to obtain population estimates for this species. The peak king salmon migration occurred prior to installation of fishwheels so population estimates based on catch and recovery data could not be determined.

The population estimates would be increased directly proportional to possible tag loss and/or tag induced mortalities. The possibility of either of these having occurred above the fishwheel sites is unlikely since no tag scarred fish were observed on spawning grounds and tags were difficult to remove from carcasses. The population estimates contain some positive bias since these factors are not taken into consideration in the computation.

Sportfishermen provided tag recoveries from below the fishwheel camp (Table 4). This is concurrent with 1974 findings. Two possible implications still exist: (1) a proportion of the tagged fish become disoriented after the capture-tag process and finally migrate downstream spawning in a different location than their homestream, or (2) fish passing the tagging site are not all destined for upstream areas and later migrate downstream to spawn in areas below the site. Further studies are needed to provide an explanation for this phenomenon. Either possibility adds bias to estimates of population size above the fishwheel sites.

Table 3. Number of fish tagged at the fishwheel site and the number of tagged to untagged fish observed on the spawning grounds with the resultant population estimates by species, Devil's Canyon Project, 1975.

Species	No. Fish Tagged (m) (Fishwheel)	No. Fish Sampled (live counts)			Population Estimates (N)
		Untagged	Tagged (r)	Total (c)	
Chum	139	674	8	682	11850 ± 4044
Pink	291	943	46	989	6257 ± 261
Sockeye	103	370	22	392	1835 ± 337

Table 4. Record of tagged salmon recovered below the Devil Canyon fishwheel camp, Devil's Canyon Project, 1975.

Species	Tagging Date	Recovered Date	Location	Activity
Sockeye	8/2-8/3	8/24	Stephan Lake	Spawning
Pink	7/27	8/3	Birch Creek	
	8/3-8/4	8/17	Clear Creek	
Chum	8/12-8/14	8/17	Chunilna Creek	Spawning
	8/9-8/11	8/20	Montana Creek	Spawning
	8/9-8/11		Byers Creek	
	8/12-8/14		Byers Creek	
King	7/7-7/10	7/15	Montana Creek	
Coho	8/2	8/11	Birch Creek	
	8/5-8/7	8/23	Clear Creek	
	8/21-8/23	7/29	Clear Creek	

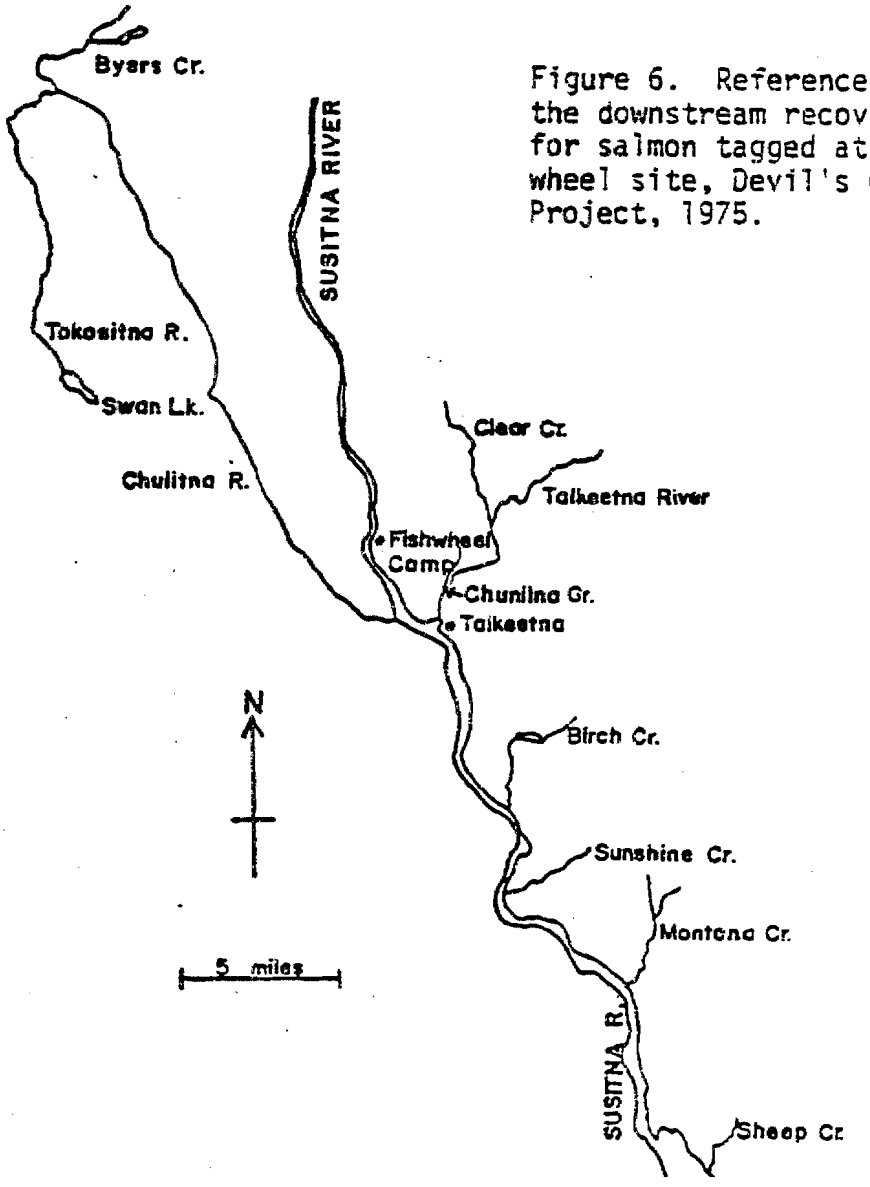

Figure 6. Reference map of the downstream recovery areas for salmon tagged at the fishwheel site, Devil's Canyon Project, 1975.

Analysis of chum salmon age samples revealed the 1975 escapement was composed of primarily three and four-year-old fish produced from the 1971 and 1972 brood year, respectively (Table 5). Eighty-two percent of the samples collected at the fishwheel camp were four-year-old fish. The sex ratio was 1 female to 1.1 males. Length frequency distribution for chum salmon is presented in Figure 8.

Sockeye salmon sampled at the fishwheels were represented by five age classes produced from the 1970 through 1972 parent years (Table 6). The largest percentage of individuals (46.3 percent) spent one year in freshwater and two years in the ocean prior to returning as adults to spawn. The sex ratio was 1.3 females to 1 male. Precocious males (1.1 age) comprised 14.8 percent of the fish sampled. The mean length frequency of sockeye, including precocious males, was 511.7 mm (Figure 9).

Pink salmon were not sampled for age composition. Sex composition and length frequency were recorded. The sex ratio was 2.1 females to 1 male (Table 7). The mean length of pink salmon sampled was 445.8 mm (Figure 10).

Escapement sampling of coho salmon for age was limited due to the small number of fish captured and condition of the scale samples. The prominent age class of the migrants was 2.1 or four-year-old fish from the 1971 brood year: Males comprised 48.3 percent of the samples. The 29 individuals sampled had a mean length of 522.1 mm (Figure 7).

Rearing Fry and Escapement Investigations

Susitna River Winter Sampling

Winter investigations were continued in March 1975 to monitor the distribution of rearing fry and winter conditions of the sloughs and mainstem Susitna River. Studies conducted during December, January and February established that coho fry were wintering in Sloughs Numbers 8-A, 9, 9-A, 11 and 19 (Barrett 1975a, 1975b, 1975c).

All sloughs upstream from Slough Number 8 were monitored for winter conditions and fry distribution during March (Table 8). Sloughs surveyed had ice cover ranging from 25 to 100 percent. Minnow traps were installed in sloughs with sufficient water levels. Rearing fry were found in Sloughs 13, 17 and 21. Dissolved oxygen was below minimum levels required for fish survival at all sampling locations. Data is presented in the report, although the proper functioning of the dissolved oxygen analyzer is in question.

Slough Number 13 was 60 percent ice free and water temperature was 38°F. Minnow traps were fished for a 26 hour period. Seven 0.0 age class coho fry were captured (Table 8).

Slough Number 21 had a 100 percent ice cover and water temperature was 33°F. Minnow traps installed in the slough for a 21.4 hour period captured five 0.0 age coho fry (Table 8).

Table 5. Analysis of chum salmon age and sex data by percent from escapement samples collected at fishwheel camp, Devil's Canyon Project, 1975.

Year of Return		Age Class 0.2	0.3	0.4	Brood Year 1972	1971	1970	Sample Size
1975	percent	16.4	82.0	1.6	16.4	82.0	1.6	100.0
	number	21	105	2	21	105	2	128

	Sex Ratio Male	Female	Sample Size
percent	52.5	47.5	100
number	73	66	139

Table 6. Analysis of sockeye salmon age and sex data by percent from escapement samples collected at fishwheel camp, Devil's Canyon Project, 1975.

Year of Return		Age Class 1.1	1.2	1.3	2.1	2.2	Brood Year 1972	1971	1970	Sample Size
1975	percent	14.8	46.3	25.9	3.7	9.3	14.8	50.0	35.2	100.0
	number	8	25	14	2	5	8	27	19	54

	Sex Ratio Male	Female	Sample Size
percent	43.3	56.7	100.0
number	42	55	97

Table 7. Analysis of pink salmon sex data by percent from escapement samples collected at fishwheel camp, Devil's Canyon Project, 1975.

Year of Return		Sex Ratio Male	Female	Sample Size
	percent	31.8	68.2	100.0
	number	92	197	289

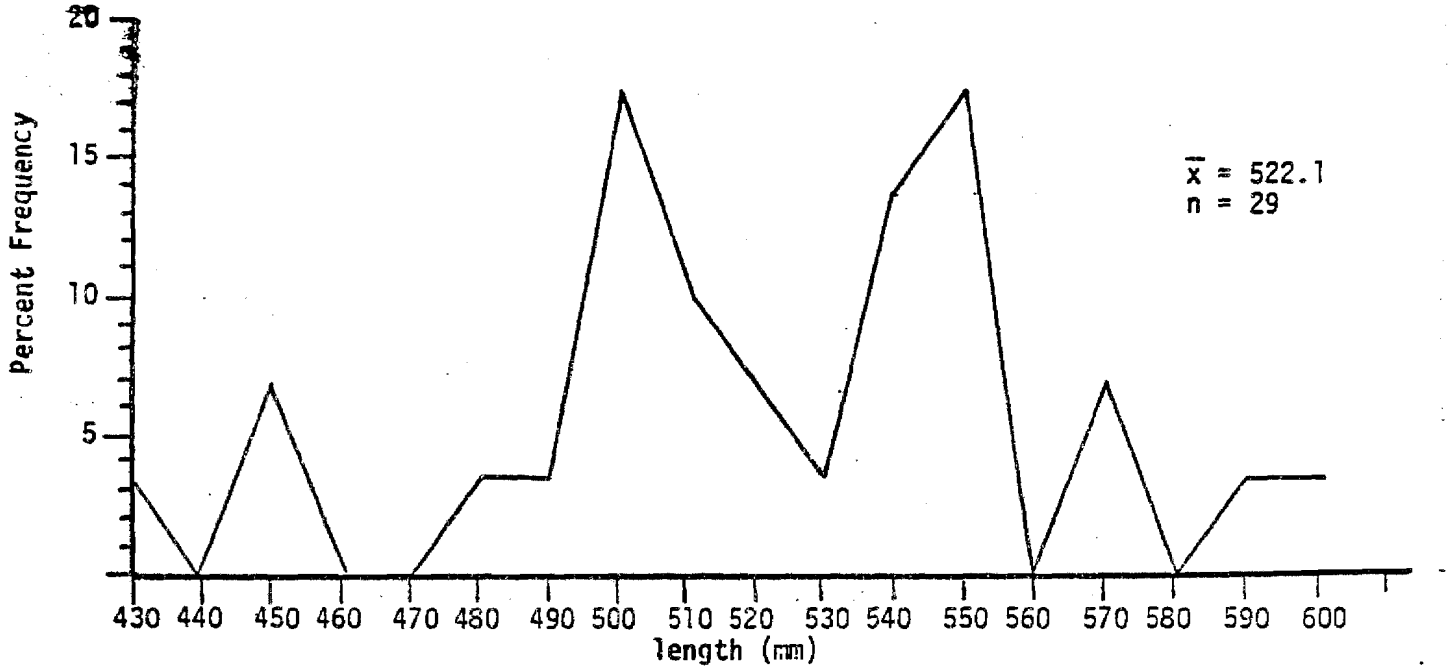

Figure 7. Length frequency of the coho salmon (Oncorhynchus kisutch) catch from the east and west bank fishwheels, Devil's Canyon Project, 1975.

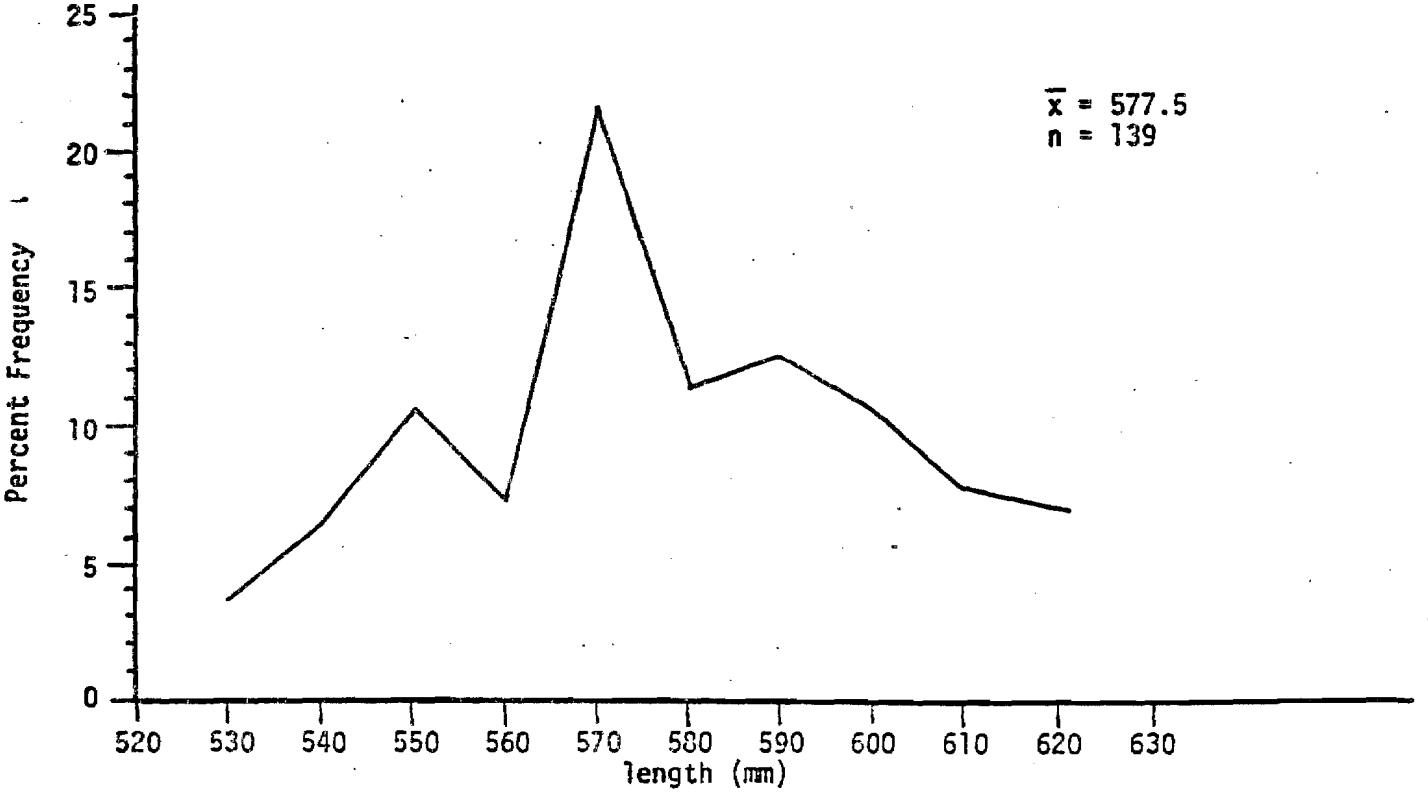

Figure 8. Length frequency of the chum salmon (O. keta) catch from the east and west bank fishwheels, Devil's Canyon Project, 1975.

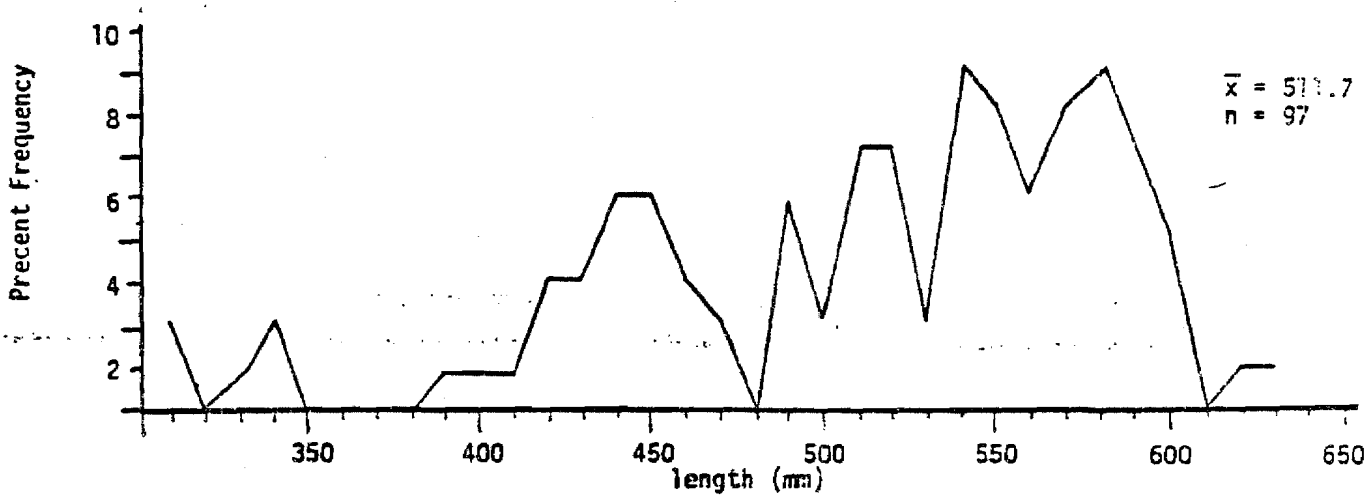

Figure 9. Length frequency of the sockeye salmon catch from the east and west bank fishwheels, Devil's Canyon Project, 1975.

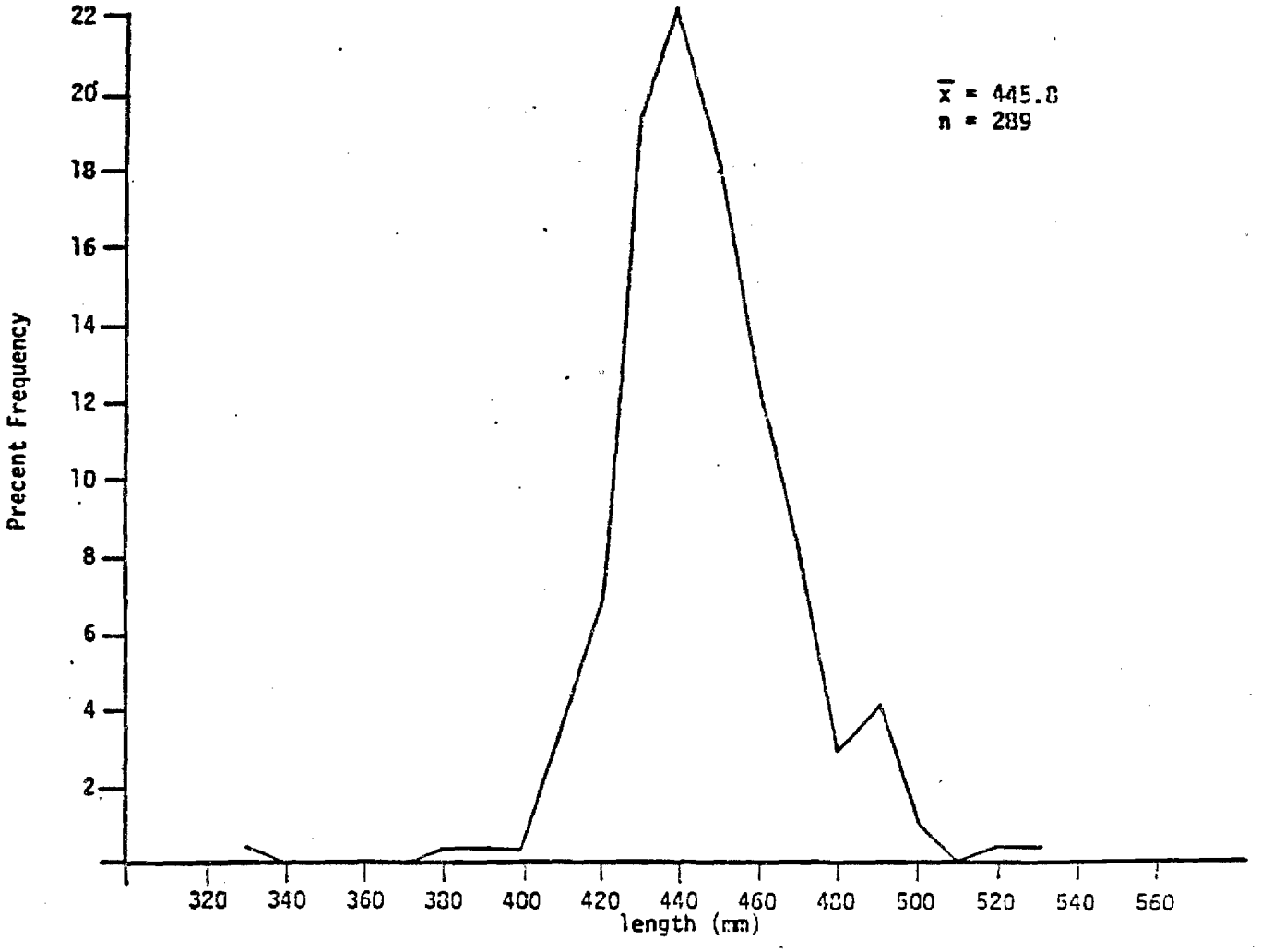

Figure 10. Length frequency of the pink salmon catch from the east and west bank fishwheels, Devil's Canyon Project, 1975.

Table 8. Survey of winter conditions and fry distribution in Slough Numbers 8, 8A, 9, 9A, 10, 11, 12, Devil's Canyon Project, 1974-1975.

Slough No.	Survey Site	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	D.O. (ppm)	pH	Ice Thickness (inches)	Ice Cover (%)	Snow Depth in Ice (inches)	Water Depth (inches)	Water Flow Detectable	Anchor Ice present	Number hours fished	Minnow Trap Catch Fish Species Coho	Grayling	Rainbow	Sculpin
8	A	12/6/74	1530	28	35	13.6	5.1	0.3-0.5	30	5-24	3.0	yes	no	0.0				
		1/13/75	1415	6	34	13.4	5.5	0.1-3	75	0-12	4.5	yes	no	0.0				
		2/18/75	1344	30	36	8.8	5.4	0.1-3	50	4-28	2.0	yes	no	0.0				
		3/14/75	1345	30	36	1.8	5.3	0.0-1	25	0-3	4.0	yes	no	0.0				
8A	A	12/6/74	1200	26	34	12.8	5.4	0.5-1	20	5-24	5.0	yes	no	0.0				
		1/17/75	1210	29	34	----	5.4	0.5-2	80	6-12	4.0	yes	no	68.1	0	0	0	0
		2/17/75	1420	25	33	8.5	5.8	0.5-4	95	2-14	3.0	yes	no	0.0				
		3/12/75	1545	32	36	7.5	5.3	0.3-3	40	0-6	2.5	yes	no	0.0				
8A	B	12/5/75	1215	26	34	11.7	5.5	0.3-1	20	1-24	7.0	yes	no	0.0				
		1/17/75	1225	29	34	----	5.4	0.3-1.8	90	1-10	8.5	yes	no	68.0	2	0	0	3
		2/17/75	1448	24	33	7.2	5.8	0.5-6	99	2-30	4.5	yes	no	21.8	0	0	0	0
		3/12/75	1530	32	34	11.0	5.4	0.0-2	60	2-18	3.5	yes	no	0.0				
9	A	12/5/75	0930	30	34	11.0	5.5	2.0	80	0-36	16.5	yes	no	25.5	4	0	0	0
		1/17/75	1107	25	34	11.4	5.5	0.5-4	95	2-36	13.0	yes	no	66.0	2	0	0	0
		2/17/75	1245	27	33	9.0	5.3	0.8-10	95	1-30	9.5	yes	no	0.0				
		3/13/75	1600	30	36	13.0	5.5	0.5-1	60	0-4	6.5	yes	no	0.0				
9	B	12/5/74	1000	30	34	10.5	5.3	2.8	80	5-2	17.3	yes	no	25.5	6	0	0	0
		1/17/75	1128	25	33	----	5.5	0.2-3	80	5-15	13.0	yes	no	66.5	0	0	0	0
		2/17/75	1315	26	34	7.4	5.3	0.4-10	95	5-16	10.0	yes	no	45.4	7	0	0	0
		3/12/75	1220	30	33	1.9	5.4	4.0	90	0-18	11.0	no	no	0.0				
9A	A	2/17/75	1545	24	35.5	6.1	5.4	0.5-2	65	2-5	9.5	yes	no	20.3	21	0	0	0
		3/13/75	1600	30	36	1.3	5.5	0.5-1	60	0-4	6.5	yes	no	0.0				
9A	B	3/13/75	1600	30	37	1.2	5.6	0.0-1	80	0-1	8.5	yes	no	0.0				
10	A	2/17/75	1615	24	34.5	7.4	5.4	0.1-4	55	3-16	6.0	yes	no	0.0				
11	A	12/4/74	1300	15	34	9.6	5.6	0.5	80	1-2	14.5	yes	no	43.5	2	0	0	0
		1/14/75	1445	4	35	7.0	5.7	0.5-3	95	5-3	12.0	yes	no	24.8	1	0	1	0
		2/13/75	1025	-6	36	8.1	5.8	0.4-9	95	0-0.3	20.0	yes	no	24.5	0	0	0	0
		3/12/75	1420	32	36	9.5	6 0	0.1-3	60	1-2	18.0	yes	no	0.0				
11	B	12/4/74	1320	--	--	----	---	-----	--	-----	----	yes	no	43.2	6	0	0	0
		1/14/75	1430	4	35	8.8	5.7	0.5-2.5	95	1-3	9.0	yes	no	24.8	6	0	0	0
		2/13/75	1100	-2	36	7.4	5.4	0.3-8	95	0-0.3	14.0	yes	no	68.5	2	0	0	0
		3/12/75	1430	31	37	9.5	5.9	0.1-3	80	1-2	11.5	yes	no	0.0				
12	A	12/4/74	1330	15	32.5	5.0	6.0	4.6	95	1	7.8	no	yes	0.0				
12	B	12/4/74	1345	15	32.5	----	---	4.3	95	2-36	5.8	no	yes	0.0				
		1/14/75	1515	4	33	5.8	5.7	6.25	100	3-24	8.0	yes	no	0.0				
		2/13/75	1230	0	34	8.5	5.8	0.5-2	99	8-18	11.5	yes	no	0.0				
		3/12/75	1500	33	34	14.5	5.8	0.0-2	99	0-36	8.5	yes	no	0.0				
12	C	12/4/74	1400	15	34	5.2	5.8	0.1-2	95	1	2.0	yes	no	0.0				
		1/14/75	1506	4	34	6.8	5.6	0.1-3	70	5-36	4.0	yes	no	0.0				
		2/13/75	1155	3	34	9.4	5.2	0.3-9	98	1-24	4.5	no	no	0.0				
		3/12/75	1510	32	36	18.0	5.9	0.0-13	30	0-5	3.5	yes	no	0.0				

Table 8. Survey of winter conditions and fry distribution in Slough Numbers 13, 14, 15, 16, 17, 18, 19, 20, 21, Devil's Canyon Project, 1974-1975. (continuation page 2 of 2).

Slough No.	Survey Site	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	D.O. (ppm)	pH	Ice Thickness (inches)	Ice Cover (%)	Snow Depth in Ice (inches)	Water Depth (inches)	Water Flow Detectable	Anchor Ice present	Number hours fished	Minnow Trap Catch Fish Species Coho	Grayling	Rainbow	Sculpin
13	A	12/4/74	1440	15	33	6.6	5.6	0.8	95	3-48	1.9	yes	no	0.0				
		1/14/75	1531	8	34	7.4	5.5	9.5-2	90	1-12	3.5	yes	no	0.0				
		2/13/75	1355	1	34	9.2	5.7	0.5-2	75	0-10	4.0	yes	no	0.0				
		3/12/75	1520	31	37	16.0	6.2	0.0-1	50	0-24	1.5	yes	no	0.0				
13	B	12/4/74	1500	15	33	5.2	5.6	1.0	95	1	7.6	yes	no	0.0				
		1/14/75	1541	8	34	7.0	5.6	0.5-1.5	90	5-12	8.0	yes	no	0.0				
		2/13/75	1420	0	34	9.2	5.6	0.5-2	75	5-10	7.5	yes	no	0.0				
		3/12/75	1535	32	38	17.0	5.9	0.2	40	0-24	1.5	yes	no	26.0	7	0	0	1
14	A	12/5/74	1530	25	34	11.8	5.4	1.0	50	8-36	3.3	yes	no	0.0				
		1/14/75	1105	6	35	9.1	5.5	0.5-3	98	5-9	5.0	yes	no	0.0				
		2/16/75	1140	16	34	8.8	5.7	0.3-10	90	1-15	3.3	yes	no	0.0				
		3/12/75	1325	31	32.5	13.5	5.3	0.3-1	50	5-6	5.5	yes	no	0.0				
14	B	1/14/75	1035	6	35	8.2	5.5	2.5-5	100	5-12	3.0	yes	no	0.0				
		2/16/75	1210	16	33	9.7	5.7	0.3-3	100	1-14	4.5	yes	no	0.0				
		3/12/75	1310	31	35	1.7	5.3	3.5	100	1-8	4.0	yes	no	0.0				
15	A	12/4/74	1000	10	--	----	---	9.8	100	19	0.0	no	no	0.0				
		3/12/75	1230	28	33	----	5.4	22	100	3-24	4.0	no	no	0.0				
15	B	12/4/74	1015	10	34	12.4	5.2	9.0	100	11	7.3	yes	no	0.0				
		1/15/75	1000	18	32	6.4	5.4	10	100	36-48	14.0	---	no	0.0				
		2/15/75	1205	9	33	8.1	5.5	12	100	7-16	9.0	no	no	0.0				
		3/12/75	1240	32	34	11.8	5.5	0.3-5	90	0-36	2.0	yes	no	0.0				
15	C	1/15/75	0930	18	34	7.4	5.3	0.5-3	95	2-24	3.0	yes	no	0.0				
		2/15/75	1230	8	34	7.4	5.3	0.1-7	100	5-30	5.0	no	no	0.0				
16	A	2/17/75	0942	26	35	6.5	5.2	0.5-2	70	1-18	3.0	yes	no	0.0				
		3/12/75	1210	28	33	12.0	5.3	0.5-12	100	1-12	5.0	no	?	0.0				
17	A	1/16/75	1145	28	35	9.6	5.7	0.5-1	20	5-36	10.5	yes	no	0.0				
		2/13/75	1700	-2	33	8.5	5.3	0.3-3	95	0-12	13.0	yes	no	23.5	0	0	0	0
		3/11/75	1400	26	35	1.4	5.4	0.5-4	35	0-12	6.5	yes	no	20.4	3	0	0	0
17	B	1/16/75	1145	28	34	10.2	5.7	0.2	10	8-24	3.0	yes	no	0.0				
		2/13/75	1700	-3	36	8.3	5.5	0.3-4	50	0-8	4.0	yes	no	0.0				
		3/11/75	1410	27	36	1.4	5.5	0.0-5	40	0-36	2.5	yes	no					
18	A	1/16/75	1225	29	34	9.2	5.5	6.5	100	12-24	6.0	no	no	0.0				
		2/14/75	1035	6	33.5	7.2	5.7	0.5-9	100	0-28	6.5	no	no	0.0				
		3/11/75	1330	28	34.5	1.3	5.4	0.3-5	95	0-24	7.3	yes	no					
19	A	2/16/75	1720	16	34	9.0	5.5	0.5-6	98	14-28	9.5	no	no	16.6	1	0	0	0
		3/11/75	1305	26	34	1.3	5.4	0.3-2	75	0-12	18.0	yes	no	22.1	0	0	0	0
19	B	3/11/75	1300	25	34	1.4	5.6	0.3-2	75	0-20	17.0	yes	no					
20	A	2/16/75	1430	17	32	10.3	5.5	0.6-15	100	23-36	2.0	yes	no	0.0				
		3/11/75	1130	--	--	----	---	0.9-12	100	12-36	0.0	none	yes	0.0				
20	B	2/16/75	1530	16	32	----	5.4	14	100	23-36	9.0	no	no	0.0				
		3/11/75	1115	24	32	----	5.7	24.5	100	12-36	2.5	none	no					
21	A	2/16/75	1620	17	34	9.4	5.7	0.1-12	100	5-10	5.0	yes	no	0.0				
		3/11/75	1200	24	32	1.7	5.5	0.5-5	100	0-24	11.5	yes	no	21.4	4	0	0	1
21	B	2/16/75	1635	15	32.5	9.4	5.4	0.3-10	100	5-16	8.5	no	no	0.0				

The mainstem Susitna River was sampled for rearing fry at three locations. A minnow trap installed in the mainstem river near Slough 17 captured 3 coho fry. There was a 35 percent ice cover at this location. One age 0.0 coho fry was captured in the mainstem Susitna River at Curry. This specimen was 69.0 mm in length, weighed 3.3 gm, and had a condition factor of 1.005 (Table 9).

Twelve coho fry were captured in the mainstem Susitna River, 2.5 river miles south of the Talkeetna River during April. Age analysis revealed all were 0.0 age fish produced from the 1973 brood year. Mean length, weight and condition factor were 64.2 mm, 2.7 gm and 1.020, respectively.

Winter conditions were monitored on Indian River, Lane Creek and Gold Creek (Table 10). Water flow was noted in all three locations. Ice cover was 50 percent in Lane Creek, 95 percent in Gold Creek and 99.5 percent in Indian River. Water samples were taken at Gold Creek, Chase Creek, and the Anchorage-Fairbanks Highway bridge. Total suspended solid content decreased from the previous three months. Total suspended solid levels at Chase Creek were 4.0 mg/l (Table 11). The settleables, that portion of the total suspended solids which settle within a 24 hour period, comprised 50 percent of the sample. Ice cover was 100 percent and anchor ice was present on the stream bottom.

Total dissolved solid levels averaged 6.5 and 3.5 mg/l at Gold Creek and the Anchorage-Fairbanks Highway bridge, respectively (Tables 12 and 13). The settleable portions were approximately 54 percent at Gold Creek and 71 percent at Anchorage-Fairbanks Highway bridge. Dissolved oxygen levels average 5 ppm higher at Gold Creek.

Susitna River summer and fall surveys

Surveys during 1974 located 21 potential spawning and rearing sloughs on the Susitna River between Devil Canyon and the Chulitna River. Seven additional slough areas were located during the winter and summer of 1975 (Figure 2). Rearing fish were observed in 22 of the slough areas. Adult salmon were present in 8 of the 21 backwater areas. Seven clearwater streams along the Susitna River were also surveyed. Adult salmon were observed spawning in all streams and rearing fry were observed in four. The adult salmon and rearing fry densities are summarized in Appendix II, Table 2.

Coho fry populations were the most numerous rearing fry species observed. Coho fry were observed in 19 slough areas and 3 streams (Appendix II, Tables 2-6). The majority of fry sampled for age analysis were 0.0 age fish (Table 14).

Only three 1.0 age fry were collected during the season and these were located above a beaver dam in Fishwheel Slough (located at the east bank fishwheel camp) suggesting a possible migrational barrier to these individuals. Coho fry were found in Whisker's, Chase, Lane and McKenzie Creek (Appendix II, Table 7). All fry sampled were 0.0 age class. The mean length ranged from 49.8 to 61.3 mm (Table 15).

Table 9. Age, length and weight analysis of coho fry collected in the Susitna River and Sloughs Numbers 8A, 9, 9A, 11, 13, 17, 19, 21, Devil's Canyon Winter Project, 1974-1975.

Slough No.	Date	Sample Size	0.0 Age Class							1.0 Age Class						
			Percent Composition	Length (mm)	Standard Deviation	Weight (g)	Standard Deviation	Condition Factor	Brood Year	Percent Composition	Length (mm)	Standard Deviation	Weight (g)	Standard Deviation	Condition Factor	Brood Year
8A	1/17/75	2	50.0	64		3.0		1.144	1973	50	74		4.8		1.185	1972
9	11/6/74	10	100.0	64.3	5.8	3.1	1.1	1.166	1973							
	1/17/75	2	50.0	64		3.0		1.144	1973	50.0	83		5.8		1.014	1972
	2/18/75	7	100.0	70.1	4.3	3.7	0.6	1.074	1973							
9A	2/18/75	8	100.0	73.5	4.5	4.9	0.9	1.234	1973							
11	11/6/74	8	100.0	61.0	6.5	2.8	0.9	1.242	1973							
	1/15/75	6	85.7	62.3	5.0	3.4	0.8	1.406	1973	14.3	83		5.8		1.014	1972
	2/15/75	2	100.0	62.0	2.8	2.8	0.1	1.175	1973							
13	3/12/75	7	100.0	67.4	4.6	3.1	0.8	1.013	1973							
Susitna R.	1/16/75	1	100.0	62.0		2.7		1.133	1973							
at Gold Cr.	2/14-16/75	6	100.0	70.0	4.9	3.9	0.9	1.137	1973							
(Sl. No. 17)	3/12/75	3	100.0	68.0	1.0	2.9	0.7	0.922	1973							
19	2/17/75	1	100.0	67.0		3.4		1.130	1973							
21	3/12/75	5	100.0	65.2	3.8	2.6	0.5	0.938	1973							
Susitna R. at Curry	3/14/75	1	100.0	69.0		3.3		1.005	1973							
Susitna R. 2.5 miles south Talkeetna R.	4/4/75	12	100.0	64.2	4.9	2.7	0.6	1.020	1973							

Table 10. Survey of winter conditions in Indian River, Lane Creek, and Gold Creek, Devil's Canyon Winter Project, 1974-1975.

Stream	Survey Site	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Ice Thickness (inches)	Ice Cover (%)	Snow Depth on ice (inches)	Water Depth (inches)	Water Flow	Anchor Ice Present
Indian River	3.0	12/6/74	0930	21	34	1.5-3.5	50	4-24	12-14	yes	no
	3.0	1/15/75	1155	18	34	3.0-5.0	100	8-36	12	yes	no
	0.2	2/18/75	0934	27	32	7-12	100	14-40	7	yes	no
	0.3	3/11/75	1030	27	32	9.5	99.5	24-35	12	yes	no
Lane Creek	0.1	12/6/74	1500	28	35.5	0.5-1.0	90	6-24	8-12	7.21 1/	no
	0.1	1/13/75	1405	6	33	1.0-12.0	99	2-36	5	yes	no
	0.1	2/18/75	1538	28	33	6.0-14.0	100	5-36	7	yes	no
	0.1	3/14/75	1300	30	33	0.0-1.0	50	0-36	7	yes	no
Gold Creek	0.3	12/6/74	0830	21	32.5	12.0-14.0	98	24-48	6-9	yes	no
	0.3	1/15/75	1006	21	33	2.0-12.0	100	12-48	7	yes	no
	0.3	2/16/75	1100	15	32.5	1.0-7.0	100	28-36	7.2	yes	no
	0.3	3/13/75	1145	30	33	0.0-36.0	95	0-24	15	yes	no

1/ Cubic feet per second

Table 11. Analysis of water conditions at Chase Creek, Devil's Canyon Project, 1974-1975.

Date	Time (military)	Temperature Air(°F)	Temperature Water(°F)	Sample Size (l.)	Settlable (mg/l)	Non-filterable (mg/l)	Suspended (mg/l)	D.O. (ppm)	pH	Water Depth (inches)	Ice Cover (%)	Snow Depth on Ice (inches)	Anchor Ice Present
12/6/74	1700	28	34	2.0	6	6	12	14.8	6.7	>96	95	1.0-24	no
1/13/75	1145	-9	32	2.0	57	1	58	10.4	5.7	48	75	0.5-12	no
2/18/75	1630	27	32	2.0	8	1	9	9.0	5.8	50	100	24-30	no
3/14/75	1430	30	32	2.0	2	2	4	19.0	5.3	20	100	1-24	yes

Table 12. Analysis of water conditions at Gold Creek, Devil's Canyon Project, 1974-1975.

Date	Temperature Air(°F)	Temperature Water(°F)	Sample Size (l)	Suspended Solids Settlable (mg/l)	Suspended Solids Non-filterable (mg/l)	Suspended Solids Total Suspended (mg/l)	D.O. (ppm)	pH	Water Depth (inches)	Ice Cover (%)	Snow Depth (inches)	Anchor Ice Present
12/5/75	30	33.5	2.0	21	4	25	>6.4	5.6	48	30	0.5-6	no
1/14/75	6	32	2.0	57	1	58	10.4	5.7	48	75	0.5-12	no
2/14/75	14	32	2.0	19	1	20	10.1	5.8	47	95	0.0-18	no
3/16/75	25	32	2.0	2	2	4	17.0	5.5	>50	95	0.0-12	no
3/29/75		32	2.0	5	4	9	15.0	5.4	>50	95	0.0-8	no
7/23/75	68	48	2.0	329	52	381						
8/4/75			2.0	189	16	205			>60			
8/14/75	53	42	2.0	113	10	123			>60			
8/27/75	56	45	2.0	147	20	167			>60			
9/2/75	55	44	2.0	33	1	34			>60			

Table 13. Analysis of water conditions at the Anchorage-Fairbanks Highway Bridge crossing, Devil's Canyon Project, 1974-1975.

Date	Temperature		Sample Size (l)	Suspended Solids			D.O. (ppm)	pH	Water Depth (inches)	Ice Cover (%)	Snow Depth (inches)	Anchor Ice Present
	Air(°F)	Water(°F)		Settlable (mg/l)	Non-filterable (mg/l)	Total Suspended (mg/l)						
12/19/74	16	32.5	2.0	2	2	4	14.2	6.8	>96	75	9.7-13	
1/12/75	2	33	2.0	4	224	228	12.8	5.6	42	90	9	no
1/22/75			2.0	2	2	4	12.1	7.8		90		
2/18/75	23	32	2.0	10	2	12	8.8	5.9	50	100	12	no
2/20/75			2.0	6	1	7	9.7					no
3/9/75	25	32	2.0	4	1	5	10.8	5.9	>50	100	1-36	no
3/25/75			2.0	1	1	2	11.0					
4/4/75	22	32.5	2.0	2	1	3	11.0	5.7	>50	99	10.3	no
4/21/75	39	33	2.0	6	4	10	14.5	6.0	>50	99	0-12	no
4/24/75			2.0	3	2	5	13.2	7.8				
5/14/75			2.0	84	2	86						
5/27/75			2.0	264	6	270						
6/9/75	50	45	2.0	155	22	177						
6/20/75			2.0	163	13	177						
7/21/75			2.0	358	74	432						

Table 14. Age and length samples of coho fry collected at Sloughs Numbers 1, 2, 3, 4, 5, 6, 9, 10, 11, 13, 14, 15, 17, 20, 21 and Fishwheel Slough, Susitna River, Devil's Canyon Project, 1975.

Slough No.	Date	Sample Size	0.0 Age Class			1.0 Age Class		
			Percent Composition	Mean Length(mm)	Standard Deviation	Percent Composition	Mean Length(mm)	Standard Deviation
1	8/11	8	100	53.3	6.4			
2	8/5	8	100	58.9	2.3			
	9/24	8	100	60.4	2.0			
3	7/29	4	100	57.3	5.4			
3A	7/29	4	100	55.3	4.4			
	8/5	8	100	55.8	3.1			
3B	8/23	9	100	60.0	6.2			
4	8/2	8	100	49.9	5.1			
6	7/26	8	100	57.9	7.0			
8	9/27	1	100	69.0	---			
9	8/9	8	100	53.5	5.3			
10	8/7	8	100	50.8	7.8			
11	8/7	8	100	55.0	3.2			
13	3/12	7	100	67.4	4.6			
	7/28	7	100	50.1	8.8			
	9/25	2	100	64.0	7.0			
14	7/23	8	100	61.3	4.7			
	9/4	6	100	61.3	1.9			
15	7/29	8	100	59.1	5.7			
	8/14	9	100	52.2	3.0			
17	3/12	3	100	68.0	1.0			
	7/29	8	100	54.9	2.4			
20	8/14	8	100	60.6	3.4			
21	3/12	5	100	65.2	3.8			
Fishwheel	8/2	4	25	65.0		75	99.0	9.5
Fishwheel	8/25	4	100	70.3	6.7			

Table 15. Age and length samples of coho fry collected at Whisker's Creek, Chase, Lane and McKenzie Creeks, Susitna River, Devil's Canyon Project, 1975.

Slough No.	Date	Sample Size	0.0 Age Class			1.0 Age Class		
			Percent Composition	Mean Length(mm)	Standard Deviation	Percent Composition	Mean Length(mm)	Standard Deviation
Whiskers Creek	7/28	8	100	49.8	4.6			
Chase Creek	7/17	8	100	50.0	5.0			
Lane Creek	7/26	8	100	61.3	5.7			
McKenzie Creek	8/6	8	100	51.0	3.9			

Table 16. Age and length samples of king salmon fry in Slough Number 15, Susitna River, Devil's Canyon Project, 1975.

Slough	Date	Sample Size	0.0 Age Class			Mean Weight	Standard Deviation	Condition Factor
			Percent Composition	Mean Length(mm)	Standard Deviation			
15	8/14	6	100	50.7	3.7	1.3	0.23	1.013

King salmon fry (O. tshawytscha) were collected in Slough Number 15. The mean length and mean weight were 50.7 mm and 1.3 gm, respectively (Table 16). No sockeye salmon fry were observed in the sloughs by survey crews in 1975.

Resident fish species were found in sloughs containing salmon fry. Grayling fry (Thymallus arcticus) were observed in Sloughs Numbers 2, 10, 11, 13, 20 and 21. Whitefish fry (Coregonidae) were found in Slough Numbers 8, 10, 13, 20 and 21. Juvenile rainbow trout (Salmo gairdneri) were observed in Slough Number 20. Sculpins (Cottidae) and suckers (Catostomidae) were observed in many slough areas.

Limited artificial substrate sampling was conducted to determine species composition of the insect population in tributary streams of the Susitna River. Foregut analysis of salmon fry provided comparative data on food availability. The most common insects were stoneflies (Plecoptera: Perlodidae: Isoperla sp.) and "no-see-ums" (Diptera: Ceratopogonidae: Dasyhelea sp.). Also present were:

Simuliidae: Diptera (black-flies)

Heptageniidae: Ephemeroptera (mayflies): Cinygma sp.
Ironodes sp.

Rhyacophilidae: Tricoptera (caddis flies): Rhyacophila sp.
Psychomyiidae: Tricoptera (caddis flies): Psychomyia sp.

The low number of insects captured was due to the late dates of substrate installation. No Plecoptera were found in Waterfall Creek samples. Plecoptera adults were, however, very common after late July. No-see-ums adults were also very common accounting for the low number of larvae in the samples. Large numbers of Psychomia sp. larvae (up to 4 per sq ft) were observed in the silt bottoms of some areas (Sloughs Numbers 4, 14 and McKenzie Creek). Substrates should be installed in early June to provide more detailed data on species composition.

Foregut analysis of coho fry demonstrated the importance of insect larvae in the diets of rearing fish (Table 17). Salmon eggs were also an important food source. A larger variety of insects were present in the Talkeetna River stomach samples. This is probably due to the time of year these fry were collected. More detailed studies on insect populations and their importance in salmon fry diets is required.

Escapement Surveys

Chum salmon spawning occurred in Sloughs Numbers 3, 9, 13, 15, 16, 21, Lane Creek and Indian River. Peak spawning occurred during the last week of August and first three weeks of September (Table 18). Sloughs Numbers 9 and 21 contained the largest numbers of spawning adults.

Spawning sockeye salmon were observed in four sloughs and three streams. Sloughs Number 3-B and 21 contained spawning sockeye and chum salmon. The highest density of spawning occurred in Sloughs Numbers 11 and 21. The peak of spawning occurred between August 26 and September 27 (Table 18).

Table 17. Stomach content analysis of coho salmon fry collected at Sloughs Numbers 9, 11 and 15, Susitna River and Slough Number 2, Talkeetna River, Devil's Canyon Project, 1975.

Slough No.	Date	Length (mm)	Weight (g)	Relative Condition	Contents
Susitna River					
15	8/14/75	50	1.6	full	1 egg, 1 Diptera larvae 5 Trichoptera larvae
		50	1.3	empty	
		50	1.4	1/2	Trichoptera larvae, detritus Diptera larvae
		58	1.8	full	1 egg, detritus, Diptera larvae
		55	1.5	1/2	1 egg
		54	1.4	3/4	Diptera larvae, algae, Trichoptera larvae, detritus
		50	1.3	empty	
		50	1.4	empty	
		53	1.5	1/2	Diptera larvae & pupae, algae, Trichoptera larvae, detritus
9	9/6/74	78	6.1	full	2 eggs
		65	3.6	1/2	Diptera nymphs
		61	3.2	full	2 eggs, Diptera nymphs
		60	2.6	1/2	3 Diptera larvae
		69	4.2	full	2 eggs, 1 Trichoptera larvae
		65	3.3	empty	
		68	3.7	1/3	1 egg
		66	3.4	empty	
		63	3.0	empty	
		54	2.3	1/4	detritus
11	9/6/75	67	4.0	full	2 eggs
		63	2.9	empty	
		60	2.7	full	2 eggs, ? Trichoptera
		57	2.4	1/2	? Trichoptera, detritus, algae
		58	2.5	full	2 eggs, detritus
		55	2.0	full	1 egg, 8 Trichoptera (heads)
Talkeetna River					
2	6/5/75	49	1.4	3/4	8 Trichoptera larvae, blue-green algae, ? Diptera larvae
		49	1.5	full	Diptera larvae & pupae, algae, detritus, Trichoptera, Odonata, Plecoptera, Coleoptera
		56	1.8	3/4	Trichoptera larvae, algae, detritus, Plecoptera, Diptera larvae
		48	1.3	empty	
		47	1.3	1/2	Trichoptera larvae, detritus, algae
		45	1.2	full	Trichoptera larvae, Diptera larvae Odonata (?), detritus
		46	1.3	3/4	1 egg, Trichoptera larvae, algae Diptera larvae

Table 18. Peak adult escapement survey counts for chum, pink, sockeye and king salmon, Susitna River, Devil's Canyon Project, 1975.

Chum Salmon Surveys

Location	Date	Density		
		Live	Dead	Total
Slough No. 3B	9/3	50	0	50
Lane Creek	8/17	3	0	3
Slough No. 9	9/27	54	127	181
Slough No. 13	9/25	1	0	1
Slough No. 15	9/6	1	0	1
Slough No. 16	8/26	12	0	12
Indian River	8/12	70	0	70
Slough No. 21	9/6	246	4	250
Total		437	131	568

Sockeye Salmon Surveys

Location	Date	Density		
		Live	Dead	Total
Slough 3B	9/3	14	1	15
4th July Creek	8/17	1	0	1
Slough No. 11	9/4	84	0	84
Slough No. 19	8/25	16	4	20
Slough No. 21	9/25	74	1	75
McKenzie Creek	9/27	45	1	46
Indian River	9/26	1	0	1
Total		235	7	242

Pink Salmon Surveys

Location	Date	Density		
		Live	Dead	Total
4th July Creek	8/17	143	5	148
Indian River	8/12	312	9	321
Lane Creek	8/17	96	10	106
Total		551	24	575

King Salmon Surveys

Location	Date	Density		
		Live	Dead	Total
Whisker's Cr.	8/4	19	3	22
4th July Creek	8/9	1	0	1
Indian River	8/12	10	0	10
Portage Creek	7/29	29	0	29
Total		59	3	62

Pink and king salmon were observed spawning only in clearwater streams. The peak in pink spawning was from August 12 through August 17 and the peak of king spawning from July 29 to August 12 (Table 18). The survey counts of the clearwater tributary streams do not reflect the total number of spawning salmon, but only the density within the index areas (Appendix II, Table 7).

Talkeetna and Chulitna River Investigations

Investigations were initiated on the Talkeetna and Chulitna Rivers in June 1975. Surveys located 13 potential spawning and rearing sloughs and two clearwater tributary streams in the Talkeetna River from the confluence with the Susitna River upstream about 16 miles (26 km) to Clear Creek (Figure 3). The mainstem Talkeetna River flowed through some of the potential slough areas making fry counts impossible due to silty water conditions. Only one slough area was accessible by boat on the Chulitna River due to the braided nature of the mouth. One slough was identified on the mainstem Susitna River from the Talkeetna River downstream to the Anchorage-Fairbanks Highway bridge (Appendix I, Figure 41). No fry were observed in this slough.

Rearing coho and chum salmon fry were observed in the Talkeetna River sloughs during June surveys. Chum salmon were collected from Sloughs Numbers 1, 4 and Beaver Pond Slough. Seventeen samples were collected from Slough Number 1 (Table 19). The mean lengths of chum salmon fry from Beaver Pond Slough and Slough Number 4 were 38.4 and 37.6 mm, respectively. No chum salmon fry were observed in the sloughs after the first week of June.

Coho salmon fry were observed in Sloughs Numbers 1, 2, 9 and Beaver Pond Slough during June surveys. The mean lengths ranged from 42.9 mm in Slough Number 2 to 73.6 mm in Slough Number 9. All were 0.0 age fish produced from the 1973 brood year (Table 20). The largest numbers of fry were observed in Slough Number 2. High water conditions in mid-June prevented further boat surveys. An aerial reconnaissance was conducted to observe conditions of the river and note the presence of king salmon adults migrating to spawning areas. No adults were observed. Further sampling was postponed until conditions of the river permitted.

Escapement surveys were initiated the third week of July and continued through mid-September. Rearing coho fry were observed in 8 slough areas and one clearwater tributary stream (Appendix II, Tables 8 and 9). Only one representative of the 1.0 age class coho fry was collected in a Talkeetna River slough. No other salmon fry species were observed. Grayling and whitefish, resident species, were observed in Clear Creek slough on August 19.

Chum salmon were the only adult species observed spawning in the slough areas of the Talkeetna River by the escapement survey crew. Reports from sportfishermen and other department biologists did, however, document sockeye, pink and chum salmon spawning in clearwater tributaries. Tags were recovered from Chunilna Creek, Clear Creek and Stephan Lake (Table 4). Aerial surveys of sloughs upstream from Clear Creek revealed high densities of spawning chum salmon.

Table 19. Age and length samples of chum salmon fry from Slough Number 1, Beaver Pond Slough, and Slough Number 4, Talkeetna River, Devil's Canyon Project, 1975.

Slough Number	Date	Sample Size	0.0 Age Class	
			Mean Length (mm)	Standard Deviation
1	6/5	17	35.7	2.2
Beaver Pond	6/5	10	38.4	3.4
4	6/5	20	37.6	3.0

Table 20. Age and length of coho salmon fry from Sloughs Numbers 1, 2, Beaver Pond, Billion, 3A, 5, 6, 7, Whiskey and 9, Talkeetna River, Devil's Canyon Project, 1975.

Slough No.	Date	Sample Size	0.0 Age Class			1.0 Age Class		
			Percent Composition	Mean Length (mm)	Standard Deviation	Percent Composition	Mean Length (mm)	Standard Deviation
1	6/5	5	100	48.6	8.1	0		
	7/25	8	100	54.8	3.0	0		
	9/2	8	100	62.6	5.1	0		
2	6/5	19	100	42.9	7.6	0		
	8/5	8	100	58.9	2.3	0		
Beaver Pond	6/5	2	100	44.5	2.12	0		
Billion	8/11	8	90	65.4	4.7	10	91.0	
3A	8/5	8	100	55.8	3.1	0		
5	7/25	4	100	42.5	5.2	0		
6 & 7	7/25	8	100	54.5	5.0	0		
	9/9	8	100	60.9	8.5	0		
Whiskey	8/5	8	100	58.1	6.5	0		
9	6/7	8	100	73.6	3.7	0		

Three sloughs (Numbers 4, 8 and 9) originally identified in June were flooded by the mainstem Talkeetna River on August 5. These 3 sloughs were flowing through for the remainder of the surveys.

The mouth of Slough Number 6 dried up between August 19 and September 2. Approximately 1,000 coho fry were trapped in the slough. Water levels were sufficient to support the population, but it is not known if this area will freeze completely and result in mortalities during winter months.

Water conditions of the Talkeetna River were monitored monthly at the Alaska Railroad bridge (Table 21). Total suspended solid levels ranged from 4 mg/l in March to a peak of 185 mg/l on July 25. The settleable suspended solids were normally greater than 9 percent of the total dissolved solids. Water temperatures ranged from 33°F in March to 48°F in mid-August. Dissolved oxygen levels were not a limiting factor at this location, being greater than 12 ppm.

The Chulitna River was surveyed weekly from July 22 to August 25. No fry or adults were observed in Slough Number 1, Chulitna River, throughout the season. June surveys noted the presence of unidentifiable adult salmon carcasses, from the 1974 season, in the clearwater stream below the beaver dam (Appendix I, Figure 40).

Climatological Observations

Climatological data was collected daily, at approximately 2000 hours, at the fishwheel camp from July 7 through August 26 (Table 22). The maximum air temperature during this period was 76°F and the minimum was 52°F. The maximum and minimum water temperatures were 62°F and 50°F, respectively. The Susitna River level fluctuated a maximum of 3.1 feet (0.9 m) from July 7 through August 26. The maximum twenty-four hour fluctuation in the river level was an increase of 0.9 feet (0.3 m) which occurred between July 27 and July 28. Atmospheric observations during the 51 day period indicated that 3 days had a cloud cover less than 5 percent of the sky and 13 days were completely overcast.

Water temperature profiles, recorded 24 hours a day with a Ryan thermograph, demonstrate relatively low fluctuations in water temperatures at Gold Creek during winter months (Figure 11). Profiles of water and air temperatures at the fishwheel site suggests a significant daily warming and cooling of water temperatures (Figure 12).

DISCUSSION AND SUMMARY

Gross indications of migrational timing, abundance by species and age-length-sex data was obtained from fishwheel operation in the lower study area. The total catch of salmon during the 1975 season was less than 1974. Chum and pink salmon dominated the fishwheel catches. Population estimates were determined by the Peterson mark and recapture method. The population estimates for 1974 and 1975 were:

Table 21. Analysis of water conditions of the Talkeetna River at the Alaska Railroad bridge, Devil's Canyon Project, 1975.

Date	Temperature		Sample Size (l)	Suspended Solids			D.O. (ppm)	pH	Water Depth (inches)	Ice Cover (%)	Snow Depth on Ice (inches)	Anchor Ice Present
	Air(°F)	Water(°F)		Settlable (mg/l)	Non-filterable (mg/l)	Total Suspended (mg/l)						
3/16/75	30	33	3	3	1	4	18	5.6	>50	100	6-12	no
4/3/75	29	33	3	36	1	37	17.9	5.5	32.5	95	10.8	no
4/21/75	40	34	2	23	1	24	18.5	5.6	>60			
6/5/75	50	42	2	69	2	71			>72			
7/25/75	57	48	2	168	17	185						
8/19/75	55	48	2	171	8	179						
9/1/75	56	45	2	24	1	25						

Table 22. Climatological observations at the fishwheel camp, Devil Canyon Project, 1975.

Date	(military)	Air Temp (°F)	Water Temp (°F)	Water Guage (feet)	Cloud Cover (percent)
July					
7	2100	67	58	2.1	10
8	2000	76	62	2.2	5
9	2000	76	62	2.3	80
10	2020	76	62	---	5
11	2200	65	62	2.2	90
12	2000	55	58	2.6	100
13	2000	53	54	3.2	100
14	2000	65	54	3.0	60
15	2000	52	51	2.4	100
16	2000	58	54	2.6	30
17	1945	64	55	2.1	90
18	2000	59	55	1.8	40
19	2000	54	52	2.0	100
20	2000	53	51	2.3	100
21	2000	53	50	2.6	100
22	2000	57	51	2.5	5
23	2000	60	52	1.8	90
24	2000	57	53	1.5	100
25	2130	54	53	1.7	100
26	2000	55	52	1.7	90
27	2000	59	53	1.5	60
28	2020	58	53	2.4	60
29	2000	53	51	2.2	100
30	2000	54	53	1.7	100
31	2000	54	51	1.6	95
August					
1	2130	54	51	1.6	90
2	2000	60	56	1.5	50
3	2000	58	54	1.3	100
4	2000	56	54	1.2	60
5	2000	58	56	0.8	10
6	2000	58	55	0.8	70
7	2000	58	54	1.0	95
8	2000	60	54	0.9	50
9	2000	60	54	1.0	80
10	2000	58	53	0.8	100
11	2000	59	53	0.8	60
12	2000	62	54	0.7	90
13	2000	58	56	0.5	95
14	2000	63	57	0.5	90
15	2000	55	56	0.5	100
16	2000	58	55	0.8	50
17	2000	61	53	1.3	50
18	2000	56	53	0.9	60
19	2000	57	52	0.9	20
20	2000	57	53	0.5	50
21	2000	56	53	0.3	10
22	2000	54	55	0.3	70
23	2000	57	55	0.1	10
24	2000	53	52	0.1	99
25	2000	55	53	0.1	99
26	2000	53	52	0.1	50

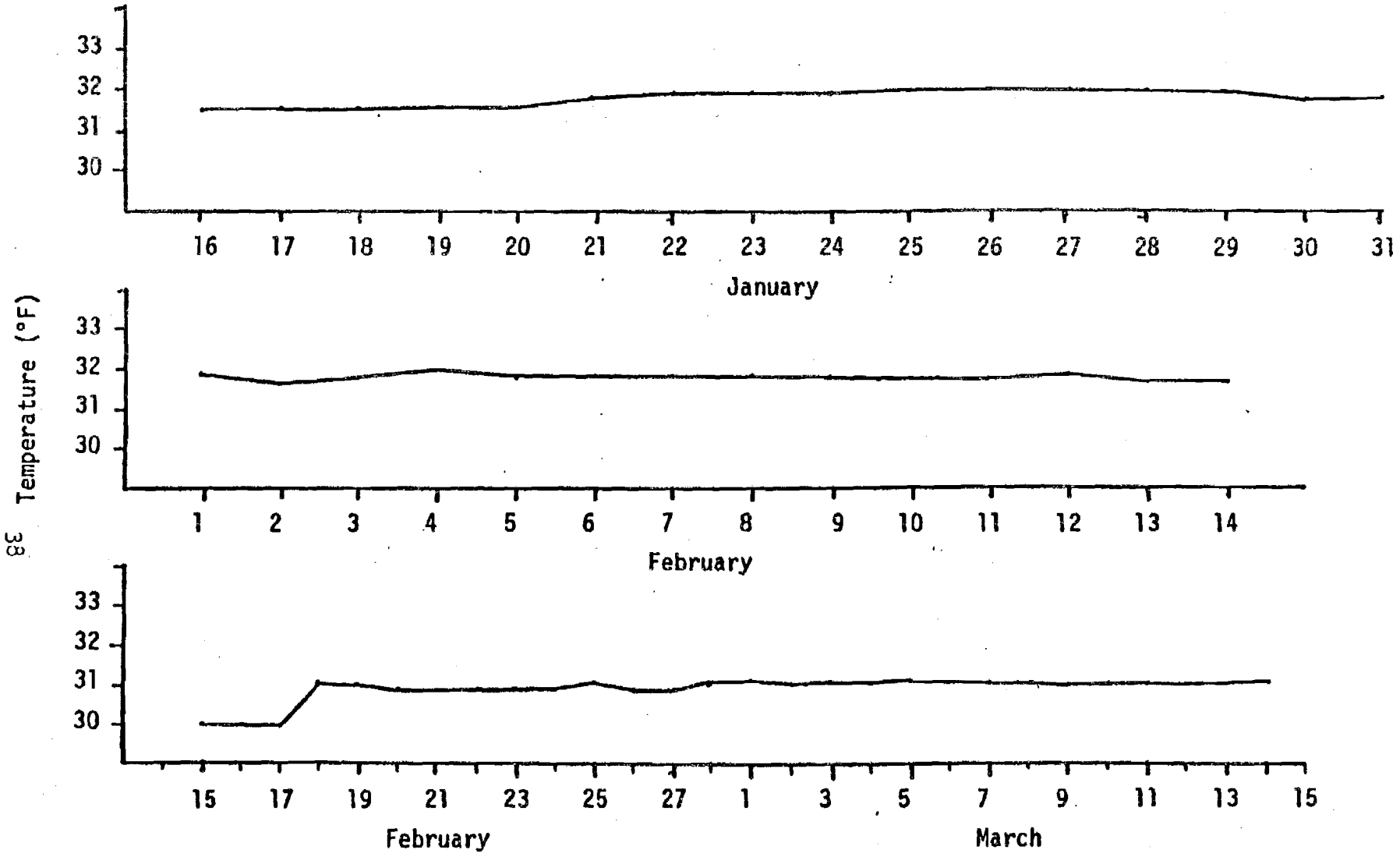

Figure 11. Water temperature profiles recorded daily in the Susitna River at Gold Creek, Devil's Canyon Winter Project, 1975.

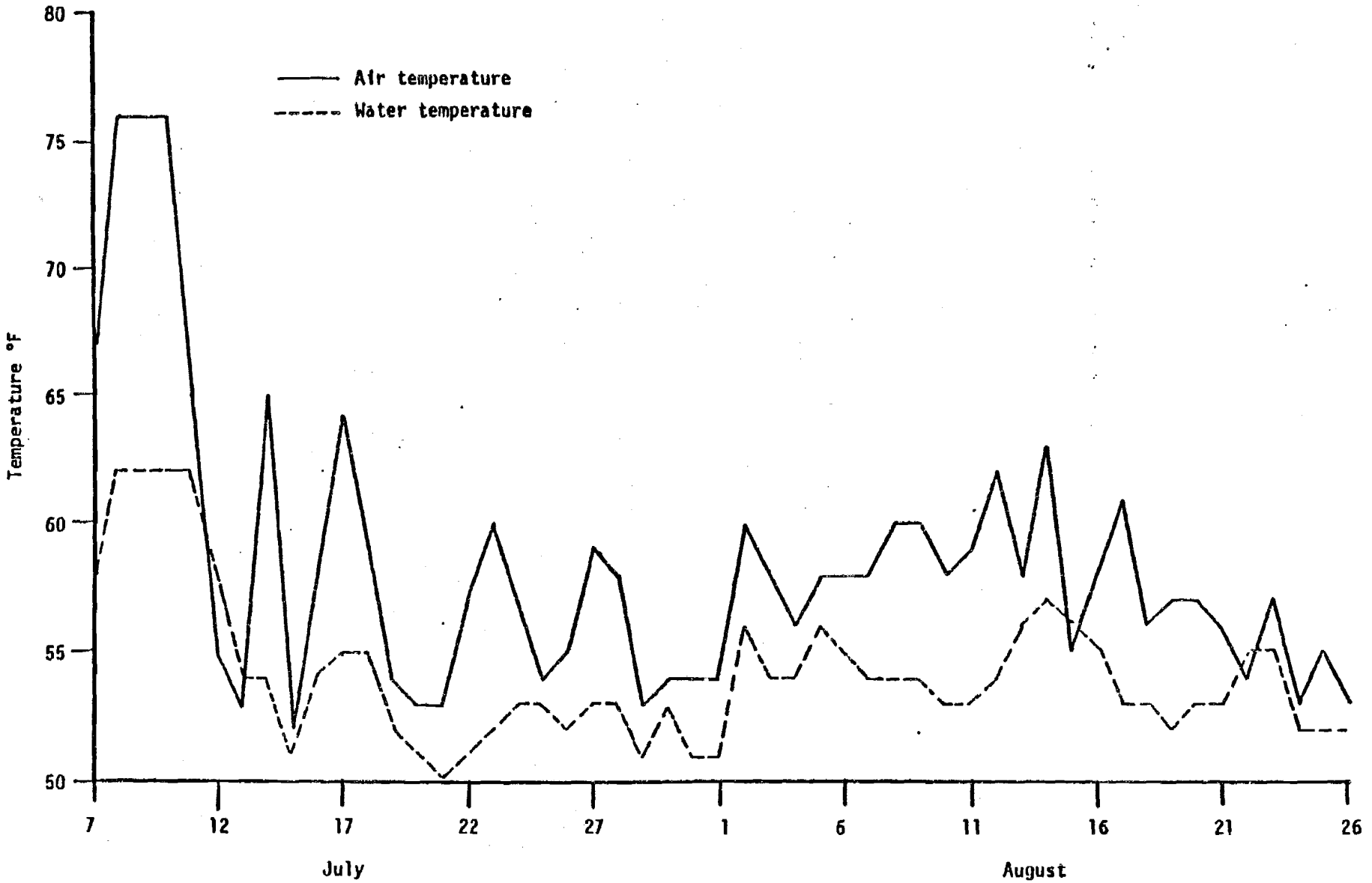

Figure 12. Profile of water and air temperatures recorded daily (2000 hours) at the east bank fishwheel camp, Devil's Canyon Project, 1975.

	1974	1975
chum	24,386 ± 2,602	11,850 ± 4,044
pink	5,252 ± 998	6,257 ± 261
sockeye	1,008 ± 224	1,835 ± 337

Comparative data is not available for king and coho salmon. Tag recoveries from chum, pink, sockeye and coho salmon below the fishwheel sites indicate a significant, but unknown, proportion of the salmon captured were possibly milling and not migrating to spawning grounds above the tagging project.

Twenty-one sloughs were identified and surveyed on the Susitna River during 1974. An additional 7 sloughs were identified during winter and summer 1975. Rearing fry were observed in 22 of the slough areas. Adult salmon were found spawning in 8 of the sloughs. Adult sockeye salmon were observed in 4 sloughs and adult chum salmon were observed in 6 slough areas. Pink, king and coho salmon adults were found exclusively in clearwater tributaries. Chum salmon were observed spawning in Lane Creek and Indian River and sockeye spawned in Fourth of July Creek, McKenzie Creek and Indian River, clearwater tributaries of the Susitna River.

A minimum of 575 pink, 568 chum, 242 sockeye and 62 king salmon spawned in the streams and sloughs of the Susitna River between the confluence of the Chulitna River and Portage Creek as determined from peak slough and stream index escapement counts.

Thirteen sloughs and 2 clearwater streams were identified and surveyed on the Talkeetna River between its confluence with the Susitna River and Clear Creek in 1975. Coho fry were rearing in 8 sloughs and one clearwater stream. Rearing chum salmon fry were observed in 3 sloughs in June. Chum salmon were the only salmon species observed spawning in the slough areas of the Talkeetna River. Pink salmon were, however, observed in Clear Creek by the escapement survey crew. The presence of spawning sockeye, coho and pink salmon was confirmed by sportfishermen's tag returns in Chunilna Creek, Clear Creek and Stephan Lake.

Winter surveys of the slough and mainstem Susitna River established the presence of rearing coho fry (O. kisutch) in both areas. Suspended solid levels of the mainstem river were extremely low during fall and winter months resulting in clear water conditions. The combination of partial slough dewatering and clear water conditions were contributing factors of fry emigration into the mainstem river for rearing.

Artificial substrate sampling and fry foregut analysis was conducted to determine species composition of invertebrates within the study area and the importance of benthic invertebrates as food items to rearing fry. Insects comprised 100 percent of the benthic organisms found in the substrate samples. The number of species of benthic organisms identified was extremely low. The contributing factors are the time of year they were installed and the length of time they remained in the sampling locations. The Plecoptera (stoneflies) and Diptera ("no-see-ums") represented the dominant orders. Simuliidae (black flies), Ephemeroptera (mayflies)

and Tricoptera (caddis flies) were also present.

Various environmental changes will occur as a result of dam construction on the Susitna River. The most obvious change produced will be the flooding of about 82 miles (132 km) of river above the Devil Canyon Damsite. Anadromous fishes are not found in this section of the river. Environmental changes will, however, occur downstream as a result of river impoundment. The effects will occur not only on the mainstem Susitna River but also on the Talkeetna and Chulitna Rivers.

Deposition of the Susitna, Talkeetna and Chulitna Rivers will be altered by dam construction. The Chulitna River carries a large bed load and suspended load to its confluence with the Susitna River. The braided nature of the Chulitna at its mouth and the extension of this condition several miles up the Susitna, indicate that this portion of the two rivers has a sediment transporting regime that could readily become depositional. The loss of peak flows in the Susitna River will favor deposition and related flooding in the flats of the Chulitna River above its confluence (Bishop, 1974).

The Talkeetna River does not carry the sediment load of the Chulitna River, but it may also be affected by regulation of the Susitna. The effect would most likely be in response to the Chulitna's deposition of sediments acting to backwater the Talkeetna River. Flooding conditions in the Talkeetna River would most likely be enhanced (Bishop, 1974).

Temperature regimes and velocities in the Talkeetna and Chulitna Rivers are also expected to be altered. Potential changes such as these warrant continued studies of the fish populations in these tributaries.

Descriptions of potential impacts and suggestions for further studies have been compiled by Department of Fish and Game, Sport and Commercial Fisheries biologists. These were compiled jointly, since many areas overlap and would result in unnecessary repetition. These are included in the next section of the report.

There are no present methods of affixing a value on the Susitna River salmon production. Total escapement data by species by year is not available for the Susitna River drainage due to the glacial water conditions of this system which prohibits visual observation and total escapement counts. Test fishing and fishwheel tag-recovery programs have been and are still being conducted in the lower Susitna River and its tributaries (Yentna and Talachulitna Rivers and Susitna River at Susitna Station), but have been unsuccessful in providing total escapement figures to date. The utilization of sonar to provide escapement data for the Susitna River has not been explored fully. An experimental program may be initiated by Department of Fish and Game in 1976. We can only estimate the monetary values of the Susitna River salmon stocks at this time. Department of Fish and Game Commercial Fisheries biologists have derived a method of determining the monetary values, but it must be emphasized that these figures are at best "guesstimates" (Appendix IV).

POTENTIAL IMPACTS AND RECOMMENDATIONS

Impoundment of the Susitna River, from Devil Canyon upstream 84 miles, by the Devil Canyon and Watana Dams will inundate some 50,500 acres of land. Environmental impacts will occur both up and downstream from the dams. Two phases of development of the hydroelectric facilities will occur:

(1) the construction period projected to extend over a 12-year period and

(2) the operation of the facilities which will provide hydroelectric power to the Southcentral Railbelt area. Environmental impacts of this project can be divided into two phases: (1) those occurring during the construction period and; (2) those occurring during the post-construction period which will encompass the entire life of the project.

Construction Period Impacts

Construction of the dams will necessitate the diversion of the Susitna River from its natural course. The major effect during this period is expected to be an increase in silt load due to construction activities. This decrease in water quality may cause the following impacts:

1. Disorientation of adult salmon returning to their home streams, resulting in a decrease or lack of production in the upper areas of the river.

2. Change in substrate composition in sloughs resulting in decreased spawning area. Chum (*Oncorhynchus keta*) and sockeye salmon (*O. nerka*) are known to utilize these areas for spawning.

3. Lack of clearwater conditions during fall and winter months preventing fry from utilizing the mainstem Susitna River for rearing.

4. Degradation of water quality resulting in possible alterations in the aquatic food chain. Some orders of insects, important food items for salmon fry, may be unable to adapt to the changed water quality and the entire food chain will be altered.

5. Reduction of flow during construction years and initial filling of dam would remove much spawning habitat and could eventually change fish distribution below dam. During the low flow construction period a substantial risk of water pollution from concrete pouring, oil spillage, etc., could occur.

6. Reduction in run of salmon would follow reduction of flow (Penn, 1975). Reducing flows could result in access restrictions to salmon utilizing the upper regions.

Post-Construction Impacts

1. Turbidity

The Susitna River currently carries a heavy load of glacial silt in spring and summer. The rivers water is clear during fall and winter months. Impoundment will result in a milky color of the water year-round. Turbidity may also be increased if there is permafrost in the area (Afton, 1975). This condition may result in:

a. Inability of fry to utilize the mainstem for rearing.

b. Erosion of gills of adults and fry due to the silty condition of the mainstem Susitna River.

c. Increased light penetration due to decreased summer turbidity would encourage more primary production. Rate of zooplankton development may not necessarily be increased due to possible lower temperature in the April-May period. Rearing salmon depend on zooplankton stock at this time.

d. Influence of bedrock on impoundment water quality may affect fisheries. (Duthie and Ostrofsky, 1975).

e. Increased mortality due to decreased summer turbidity and increased predation success might occur (Geen, 1975).

f. Decreased spring and summer turbidity would likely limit downstream migration to the darker hours, thereby extending the downstream migration periods even further than at present since some migration occurs in the turbid water during daylight. There is evidence suggesting that increased time to migrate would increase young salmon mortality (Geen, 1975).

2. Temperature

Normal temperature regimes will be altered by impoundment. Various effects may be seen.

a. Any increases in downstream fall temperatures could affect spawning success of salmon. There is evidence that relatively high temperatures are associated with poor returning runs (Geen, 1975).

b. Increases in temperatures could result in change in the incubation period of salmon eggs and incubation conditions.

c. Increases in temperature could result in premature fry emergence and seaward migration due to increased rate of development. Increased mortality could occur because the migration may occur prior to development of estuarine and marine zooplankton.

d. Alteration of the normal thermal regime would change the overall productivity of the river, which could add extreme stress to fry populations.

e. A decrease in summer temperature could effect upstream migrational time for adult salmon, but its critical nature is unknown.

f. Changes in the aquatic food chain would be expected due to the inability of some organisms to adapt to even slight thermal alterations. The elimination of even one invertebrate species could affect the remainder of the food chain.

3. Chemical and Physical Parameters

a. Reservoir supersaturation of both dissolved oxygen and nitrogen resulting from stratification and spillage can be expected, impacting downstream fishes for an unknown distance (Geen, 1975).

b. Increases in dissolved nitrogen gas could also result from air vented into turbines to reduce negative pressures during weekend periods of sustained low generating levels (Ruggles and Watt, 1975).

c. Dams slow down water transport which gives more time for the biochemical oxygen demand to consume available oxygen, thus reducing dissolved oxygen content.

d. Conductivity, alkalinity, and pH can increase after impoundment construction (Geen, 1975).

e. Dissolved oxygen levels will probably be altered due to changes in river conditions. Levels below 5 ppm would preclude the survival of fish in slough areas.

4. Organic Debris

a. Debris has a time frame of 100-200 years. This time frame would be reduced with time as a result of forest drowning.

b. Population explosions of fish, benthos, and plankton may result from the addition of organic nutrients.

5. Water Flow

a. Altered lake levels may result in flooding, slumping, erosion and general shoreline degradation. Littoral zone changes affect fisheries.

b. Changed ice regimes can also affect river and lake shorelines. A change in water quality can be expected due to erosion and sediment processes from altered water levels, flows and ice regimes (Dickson, 1975).

c. Changes in substrate composition of spawning areas due to lack of natural scouring could affect winter survival of eggs.

d. Decreases in water levels during June and July could affect adult access to spawning areas.

e. Reduced discharge during summer could delay the migration of adult salmon upstream.

f. Reduction of discharge could affect survival of young salmonids moving to saline water during April-May. Seaward migration is directly related to river velocity and therefore could extend this period (Geen, 1975).

g. Reduction of normal spring and summer flows could result in a decrease of fry rearing habitat.

Recommendations

Before the full effects of this project are identified as related to fish and wildlife, considerable studies are necessary which are going to be both lengthy in time and costly in money. A brief resume of biological studies and investigational goals required prior to final definition of fish losses and/or gains resulting from impoundment of the Susitna River at Devil Canyon and Watana are:

I A thorough literature review of hydroelectric facilities is needed. This would provide information on pre and post-construction studies and indicate areas of potential concern.

II A thorough hydrologic study is essential. This study may have to be conducted in close coordination with a private engineering firm. The following is a partial list of necessary information.

1. Current unregulated flows and projected regulated flows.

2. Temperature regimes.

3. Turbidity and sediment data.

4. Anticipated physical changes to the natural stream course as a result of flow alterations.

III A comprehensive fishery study to address adult and juvenile salmonid abundance, distribution, migrational patterns, and age composition by species for areas both upstream and downstream of the proposed Devil Canyon Dam.

The Cook Inlet fishery is of mixed stock and presents many problems for its proper management. Total escapement data by species is not available for the Susitna River drainage. Until we are able to determine total escapement into the drainage we will not be able to

determine the value of the salmon stocks in the upper Susitna River. Spawning ground surveys do, however, demonstrate the importance of this area to chum and pink salmon.

Data collected since July 1974 provides us with baseline information only. Generalizations may be made, but sufficient information is not available to determine exact impacts of dam construction and operation upon the fishery. Intense investigational projects should be initiated in the study area to provide pre-construction data to adequately evaluate possible impacts.

IV A study of affected habitat areas will be conducted in conjunction with the fisheries program. Productivity and limiting factors can be defined by a thorough limnological study. Physical, chemical and biological conditions of the Susitna River and its tributaries should be examined. A few specific concerns are:

1. Changes in quality and quantity of spawning habitat both upstream and downstream of the proposed dam sites as a result of a) flow and releases, b) innundation of upstream areas and c) effects of periodic pool fill and drawdown.

2. Effects upon the habitat and fisheries resource directly as a result of construction activities.

3. Effects of increased human use resulting from improved air and road access upon both the Susitna River drainage and adjacent fisheries.

These studies can be conducted in conjunction with the fisheries studies. Before ADF&G can completely outline the objectives of hydrological biological and environmental studies, the Corps of Engineers will also need to supply the following data:

1. Finalized plans on locations, design criteria, and features of dams.

2. Year-around data on current projections of regulated flows. The flow regimes are of utmost importance in determining what is required to protect fishery values.

3. Frequency and timing regarding spilling of excess water. Seasonal time and amount of reservoir drawdown is also required.

4. Description of access routes and distances and their status, i.e., private or public.

A means for advising this department of design or operational changes which may necessitate alterations in investigational programs is critical.

Project Time Span & Costs

Estimates from private engineer consultants indicate adequate and comprehensive hydrologic studies will require a minimum of one year to complete, but ideally should continue for a three year period.

Including the required personal services, equipment, and operational costs, etc., a total figure of $4-500,000 will be required annually.

The fisheries investigations required for both the upstream (above Devil Canyon) and the downstream area will require four to five years to complete due to the life cycles of the salmon species involved and the length of time required to assess habitat and environmental changes.

Costs for all fisheries studies, including resident and anadromous, for areas both upstream and downstream of Devil Canyon Dam are estimated at $300-350,000 annually. These figures include necessary personal services, operational costs, equipment, materials, etc. Included in this sum are monies for fulltime professional biologists to act as project leaders and direct the investigational programs. It can be anticipated that as the above mentioned projects are conducted the estimated budget figures stated may require modification.

ACKNOWLEDGEMENTS

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Ward Knous, Project Leader
Mike Stratton

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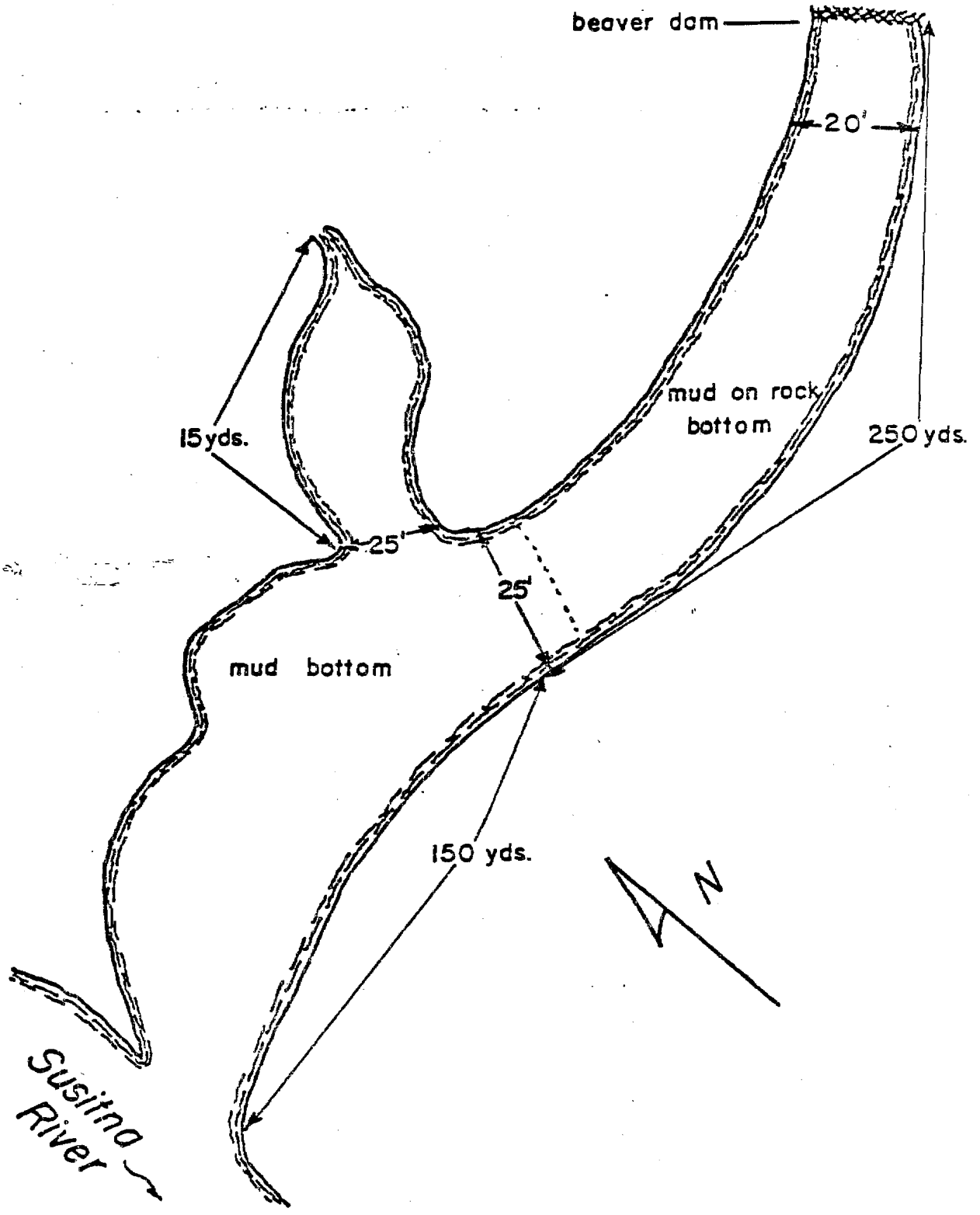
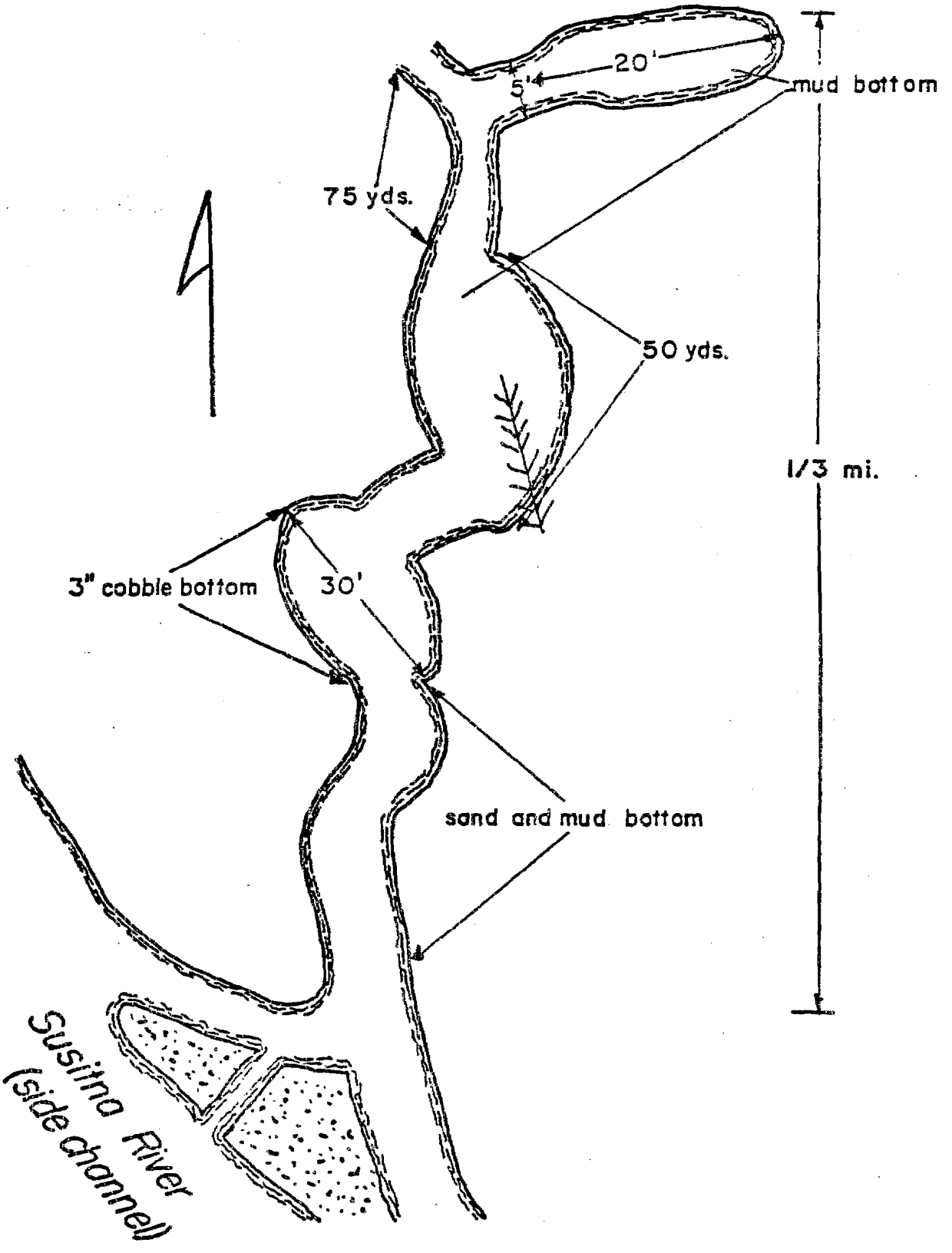
APPENDIX I

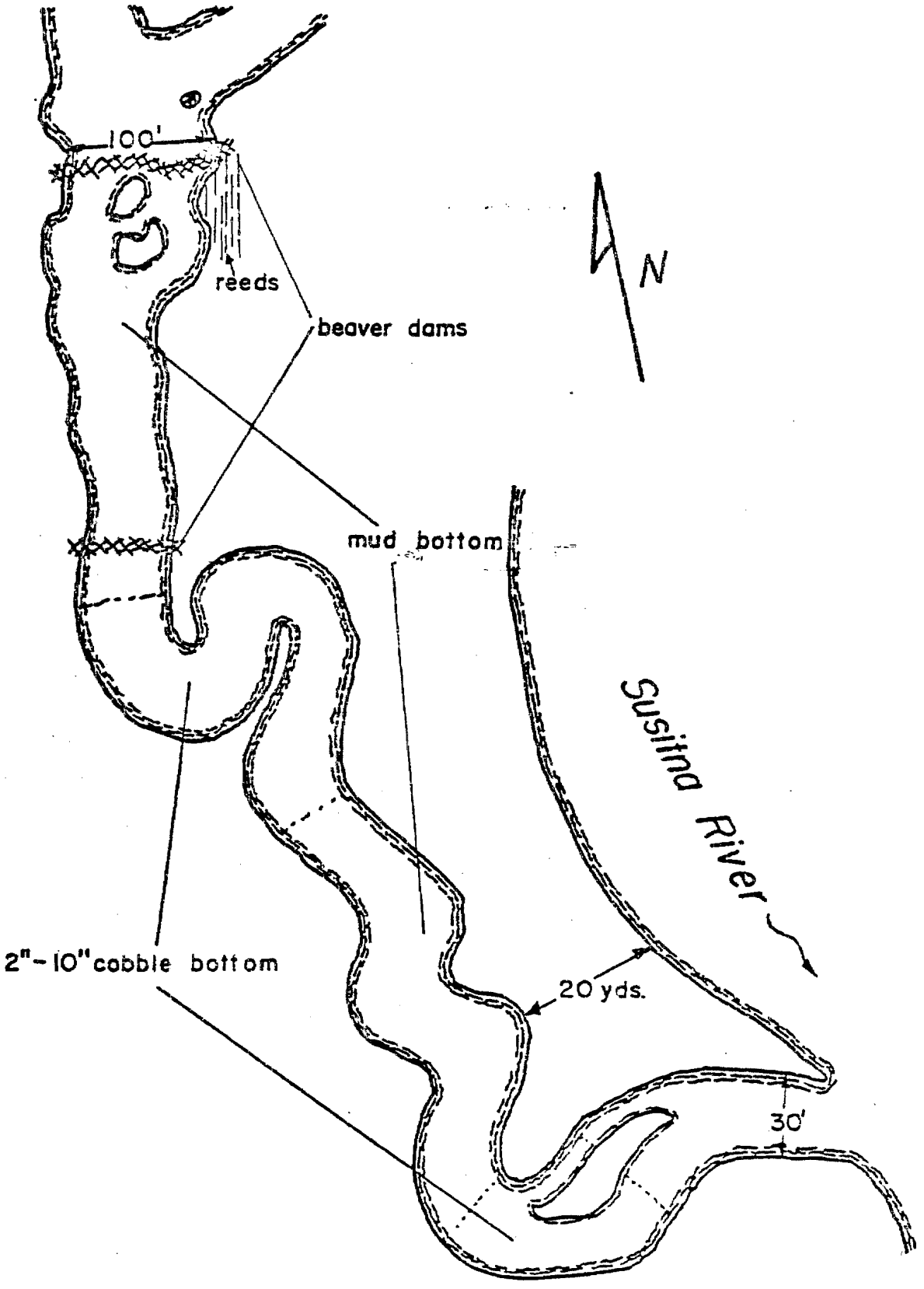
The slough areas of the Susitna, Talkeetna, and Chulitna Rivers have been referred to throughout the text. A diagrammatic sketch of each slough and some clearwater streams follows. The drawings are not to scale and are intended to define the slough area, its relative size, substrate composition, and sampling sites.



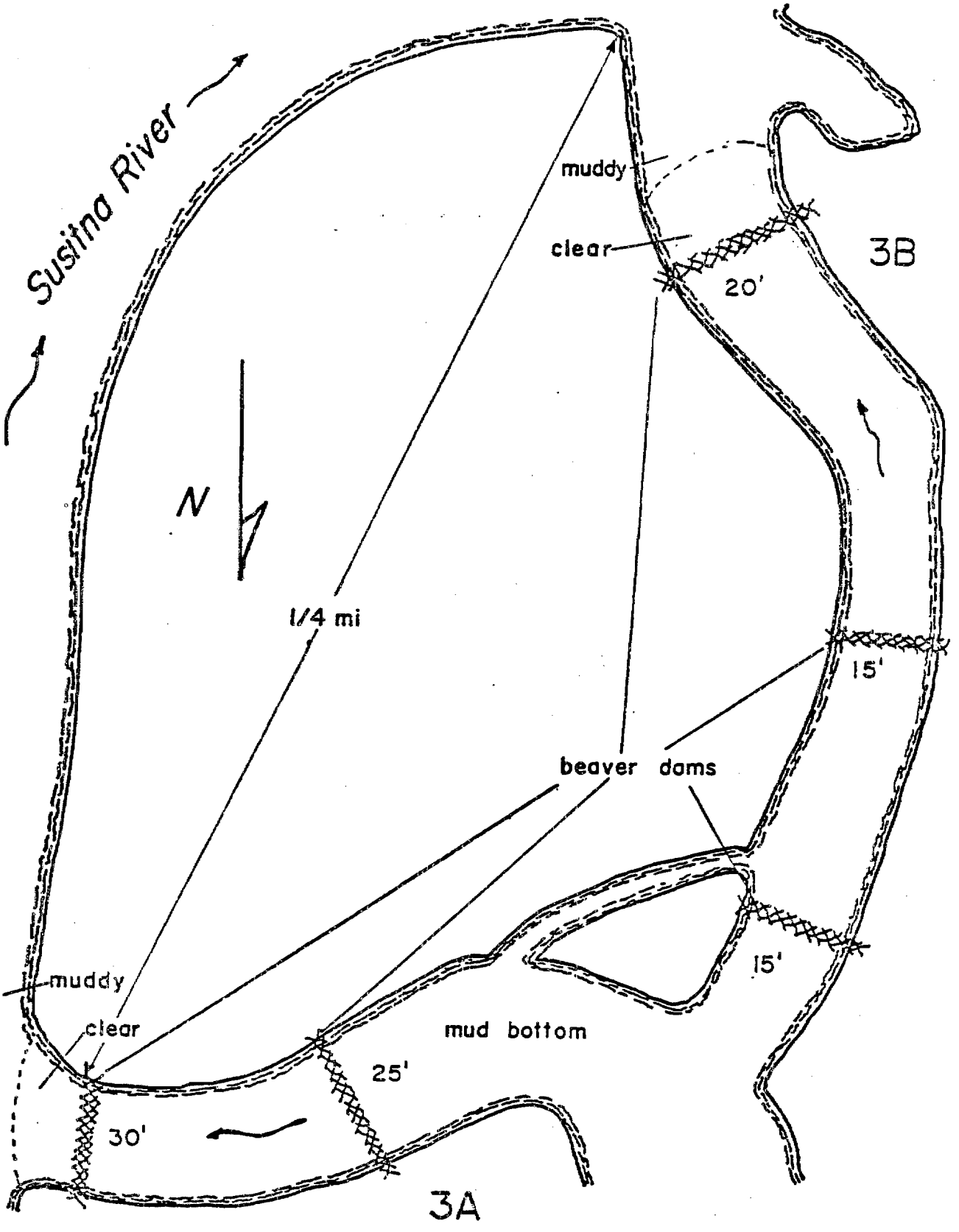
Appendix Figure 1. Map of Slough Number 1, Susitna River, as composed on September 3, Devil's Canyon Project, 1975.



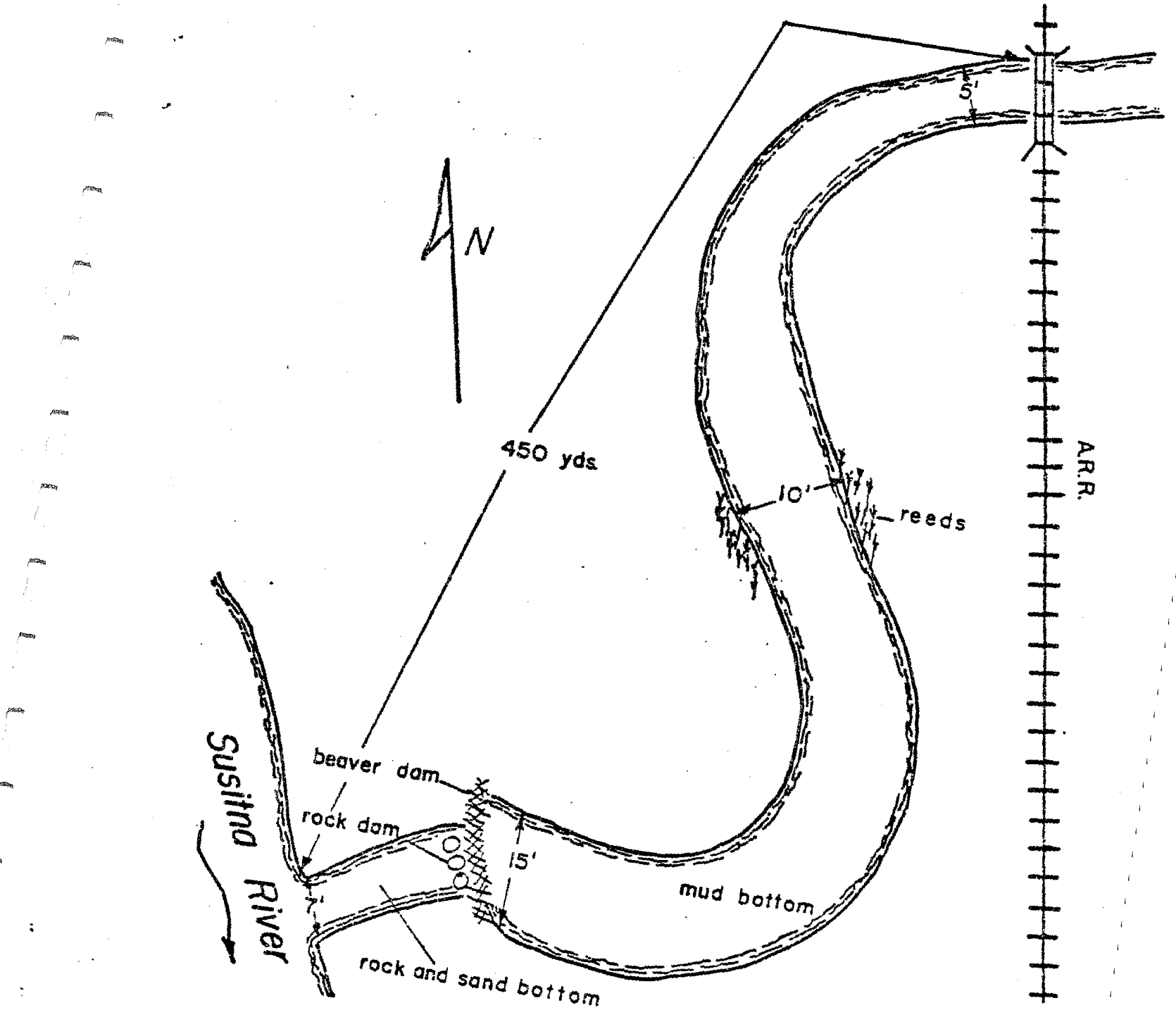
Appendix Figure 2. Map of Slough Number 2, Susitna River, as composed on September 3, Devil's Canyon Project, 1975.



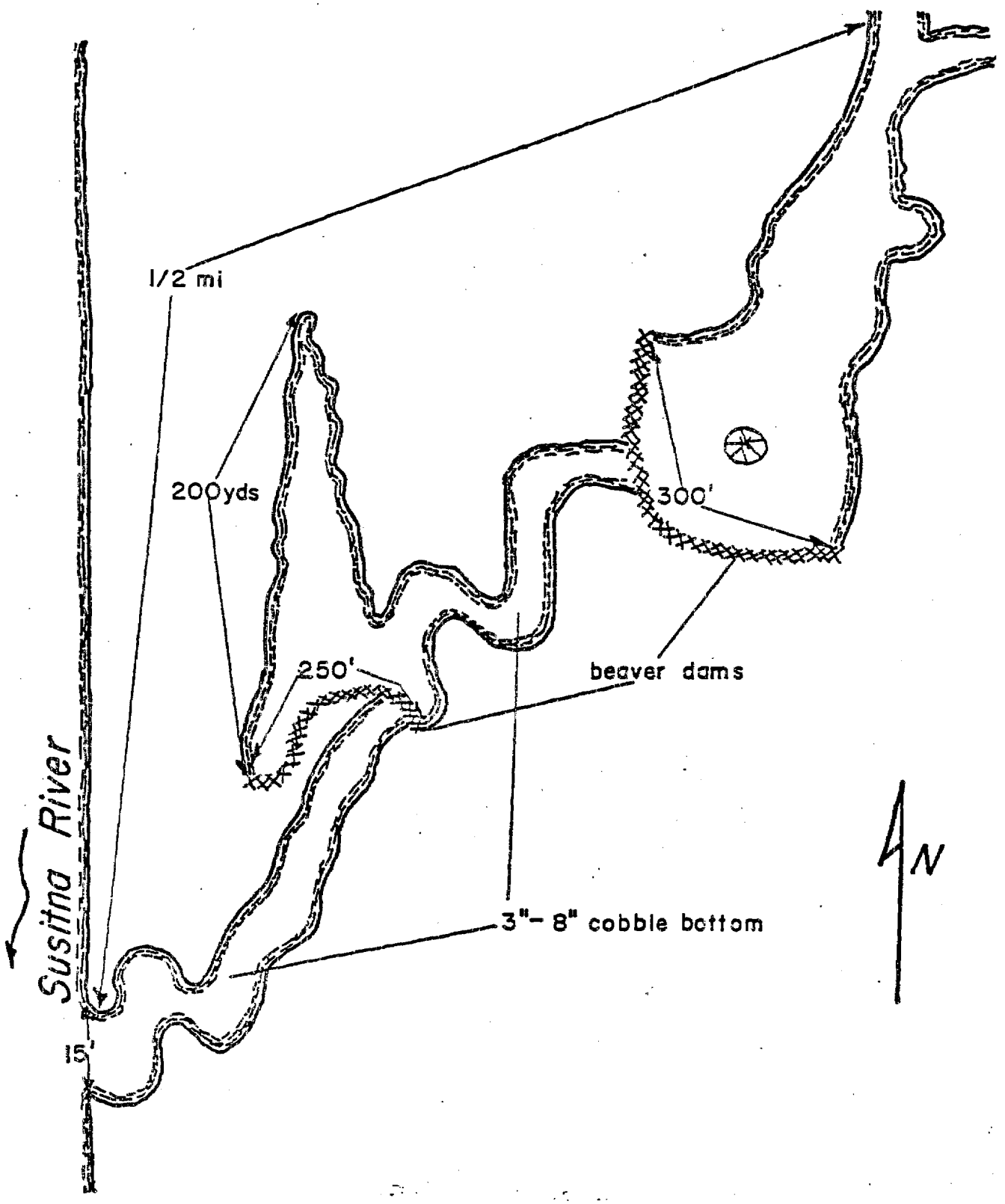
Appendix Figure 3. Map of Whiskers Creek, Susitna River, as composed on September 3, Devil's Canyon Project, 1975.



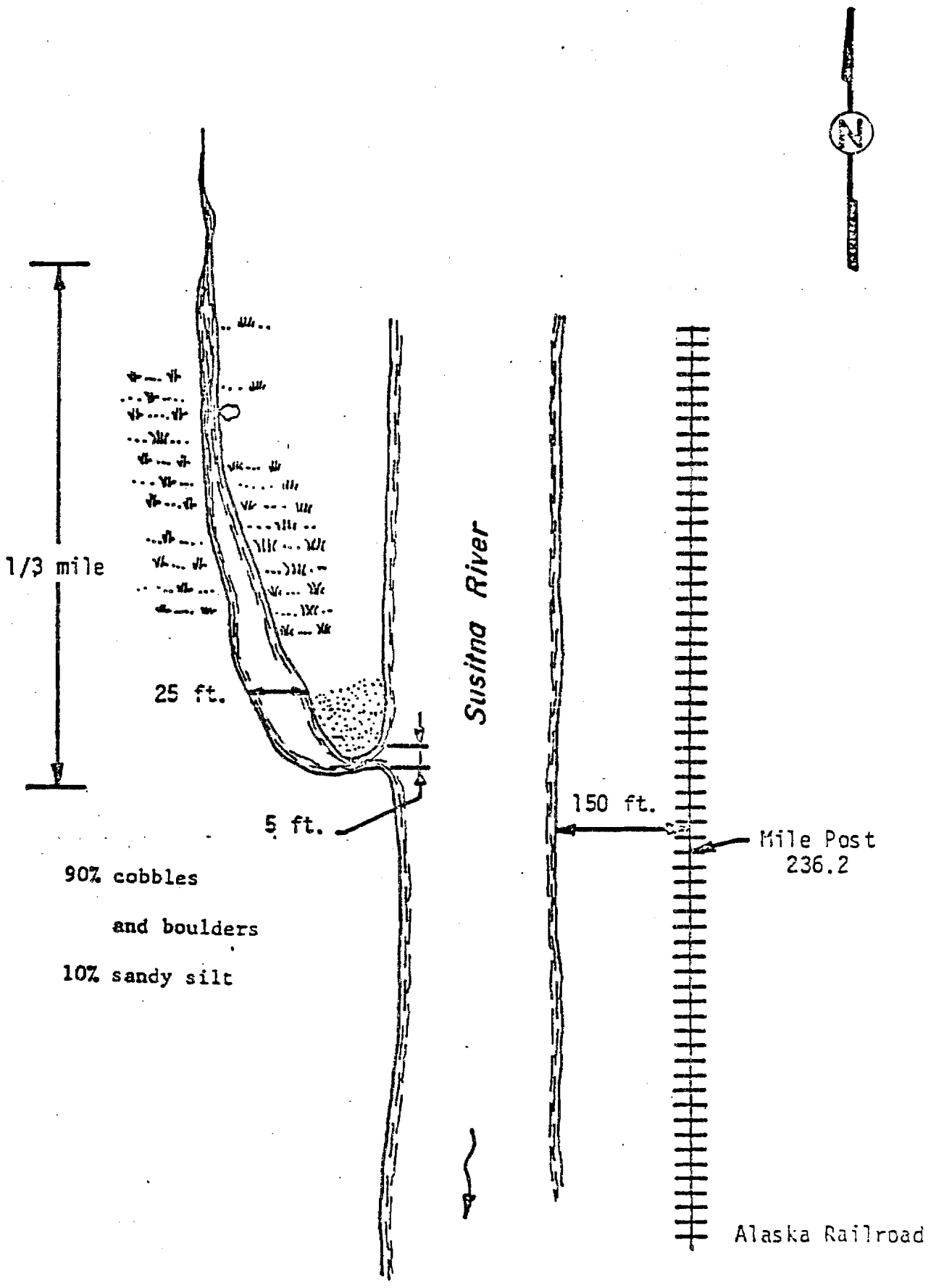
Appendix Figure 4. Map of Slough Number 3-A and Number 3-B, Susitna River, as composed on September 4, Devil's Canyon Project, 1975.



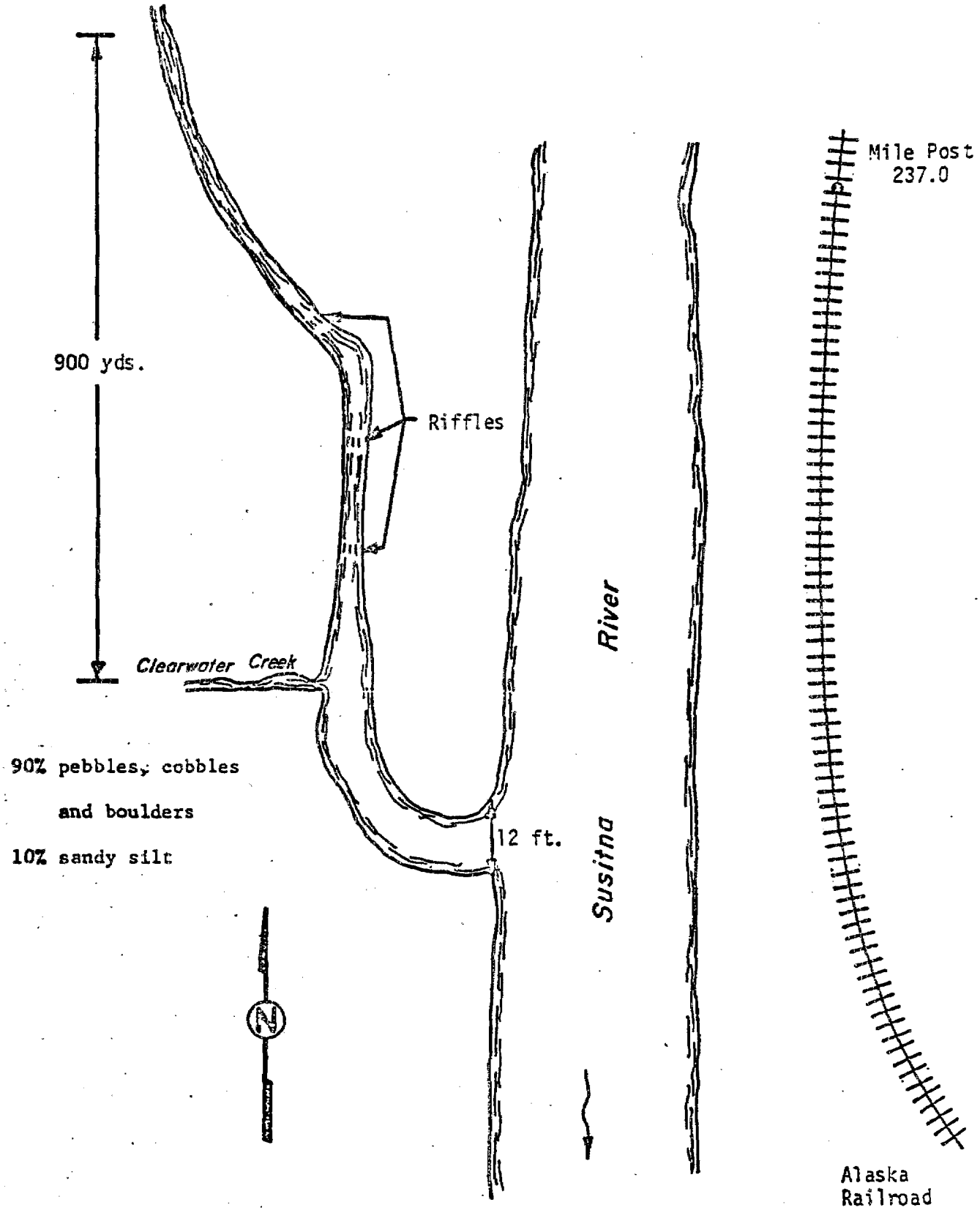
Appendix Figure 5. Map of Slough Number 4, Susitna River, as composed on September 4, Devil's Canyon Project, 1975.



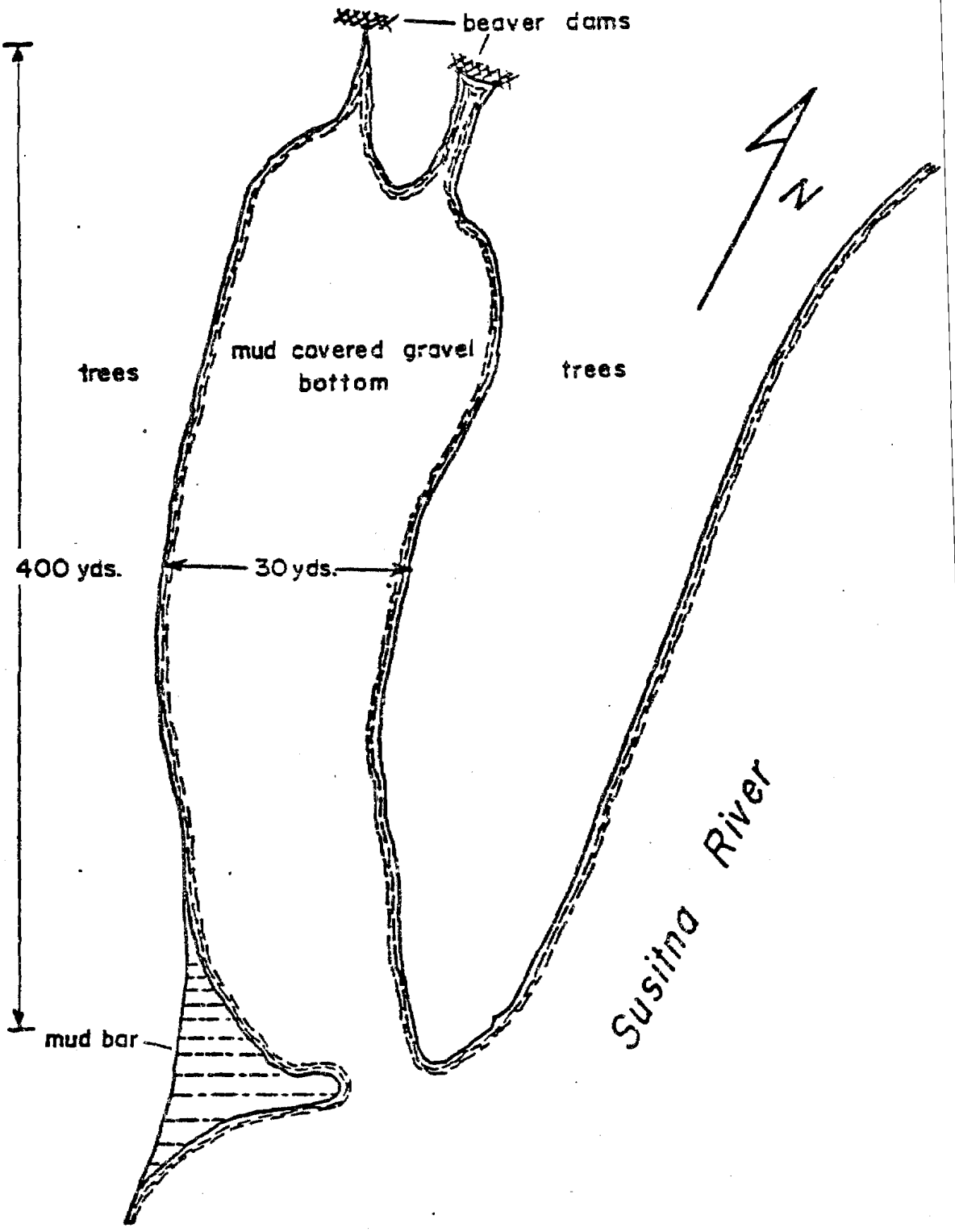
Appendix Figure 6. Map of Chase Creek, Susitna River, as composed on September 4, Devil's Canyon Project, 1975.



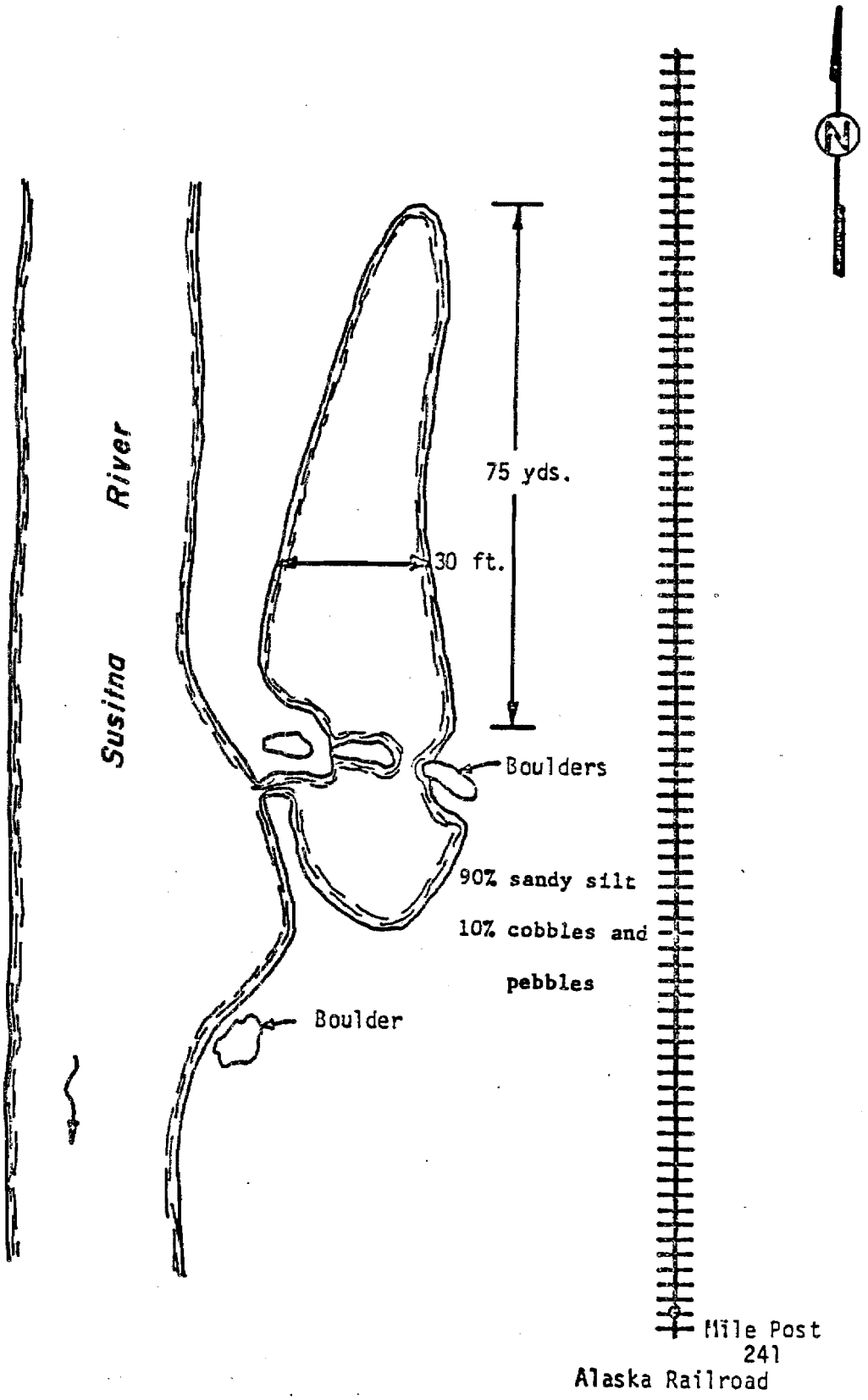
Appendix Figure 7. Map of Slough Number 5, Susitna River, as composed on August 16, Devil's Canyon Project, 1974.



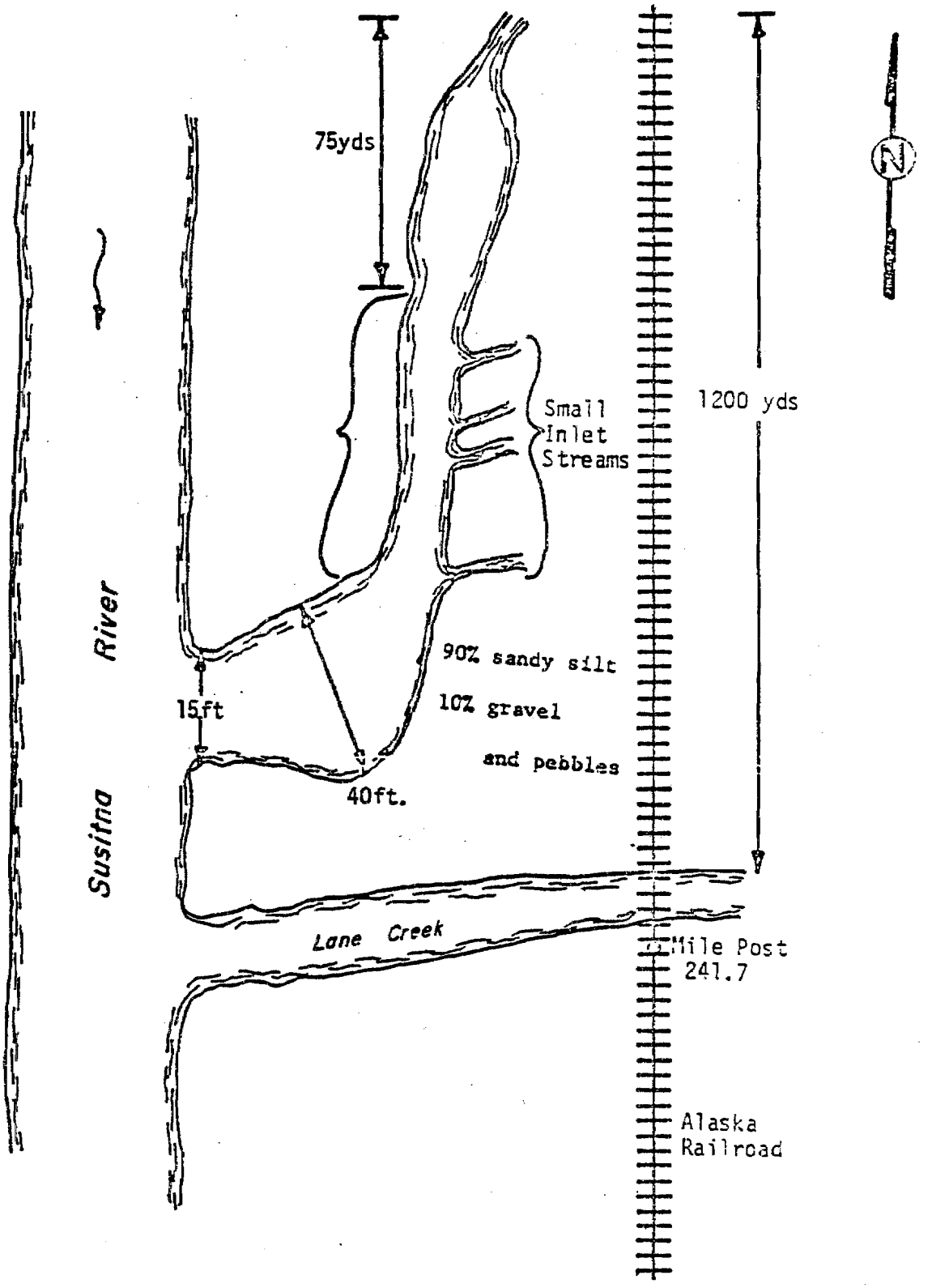
Appendix Figure 8. Map of Slough Number 6, Susitna River, as composed on August 16, Devil's Canyon Project, 1974.



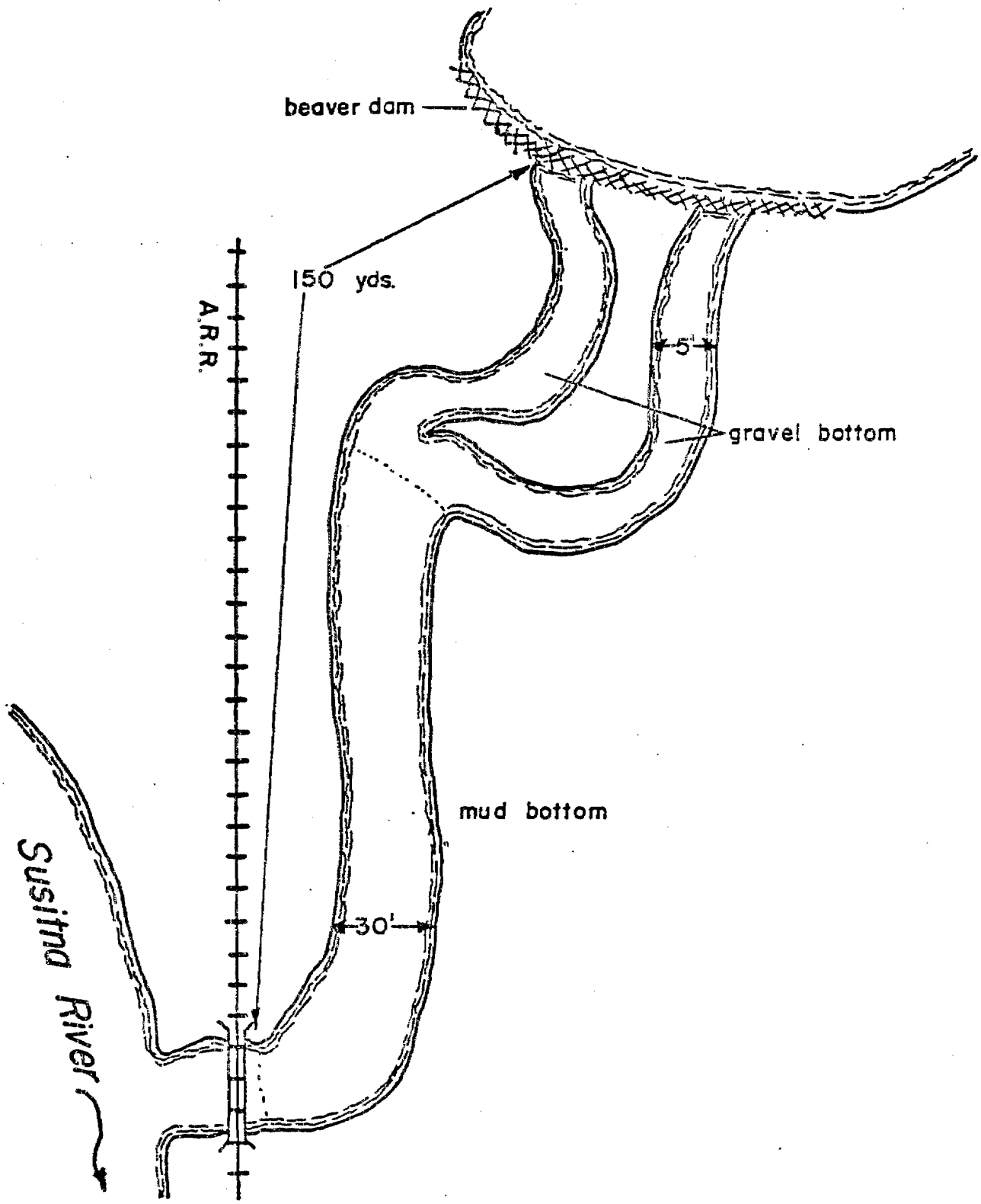
Appendix Figure 9. Map of Slough Number 6-A, Susitna River, as composed on September 5, Devil's Canyon Project, 1975.



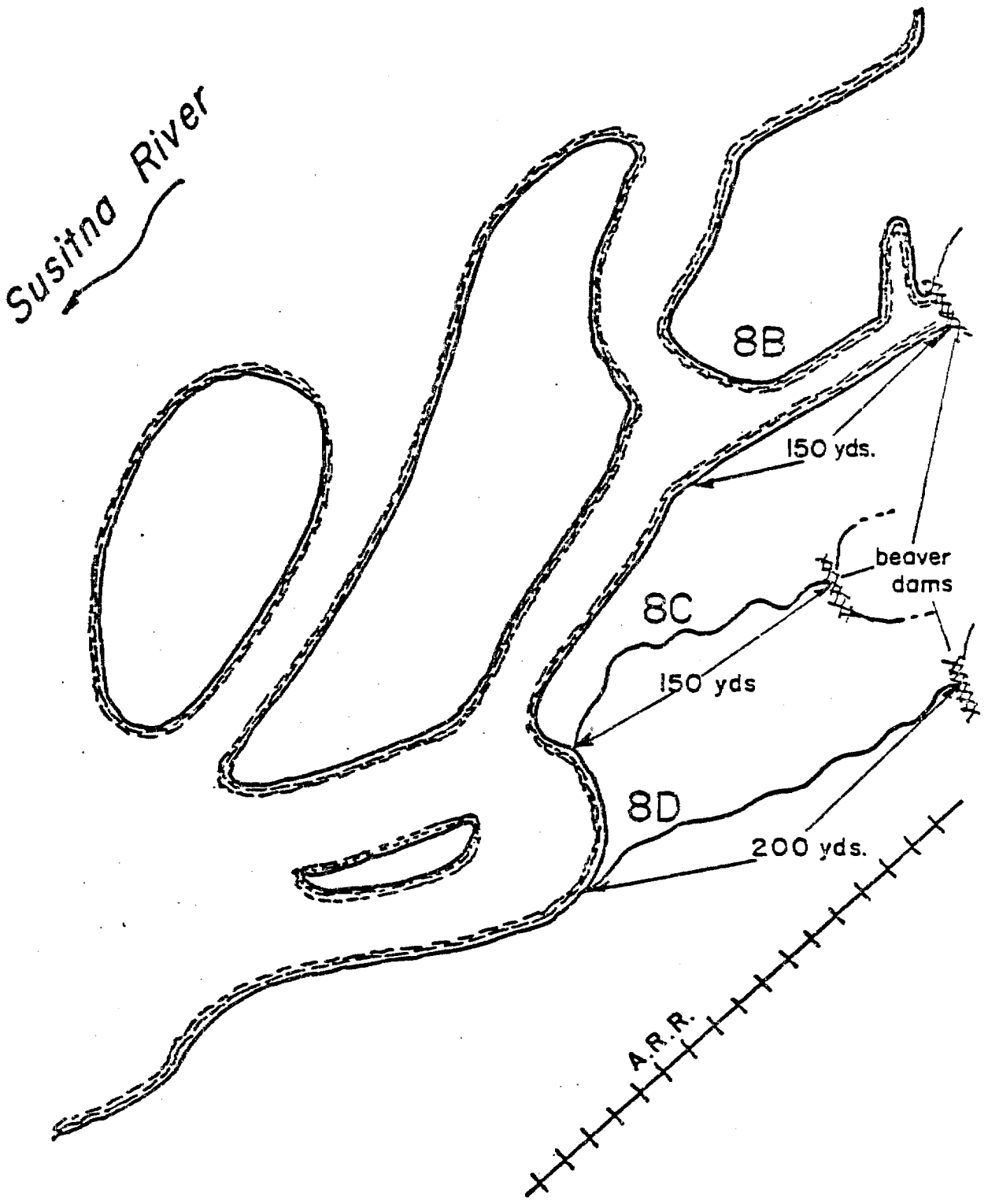
Appendix Figure 10. Map of Slough Number 7, Susitna River, as composed on August 16, Devil's Canyon Project, 1974.



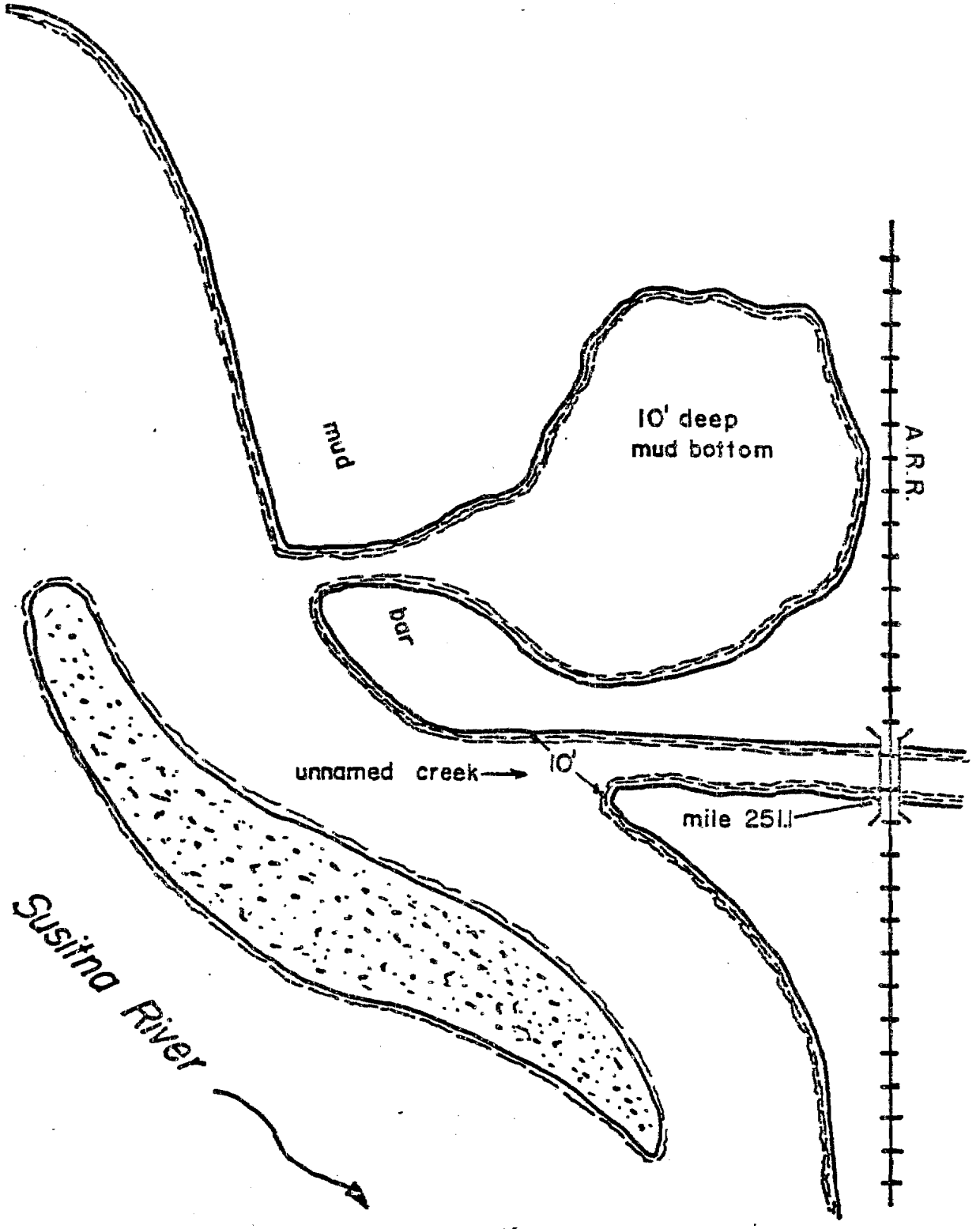
Appendix Figure 11. Map of Slough Number 8, Susitna River, as composed on August 28, Devil's Canyon Project, 1974.



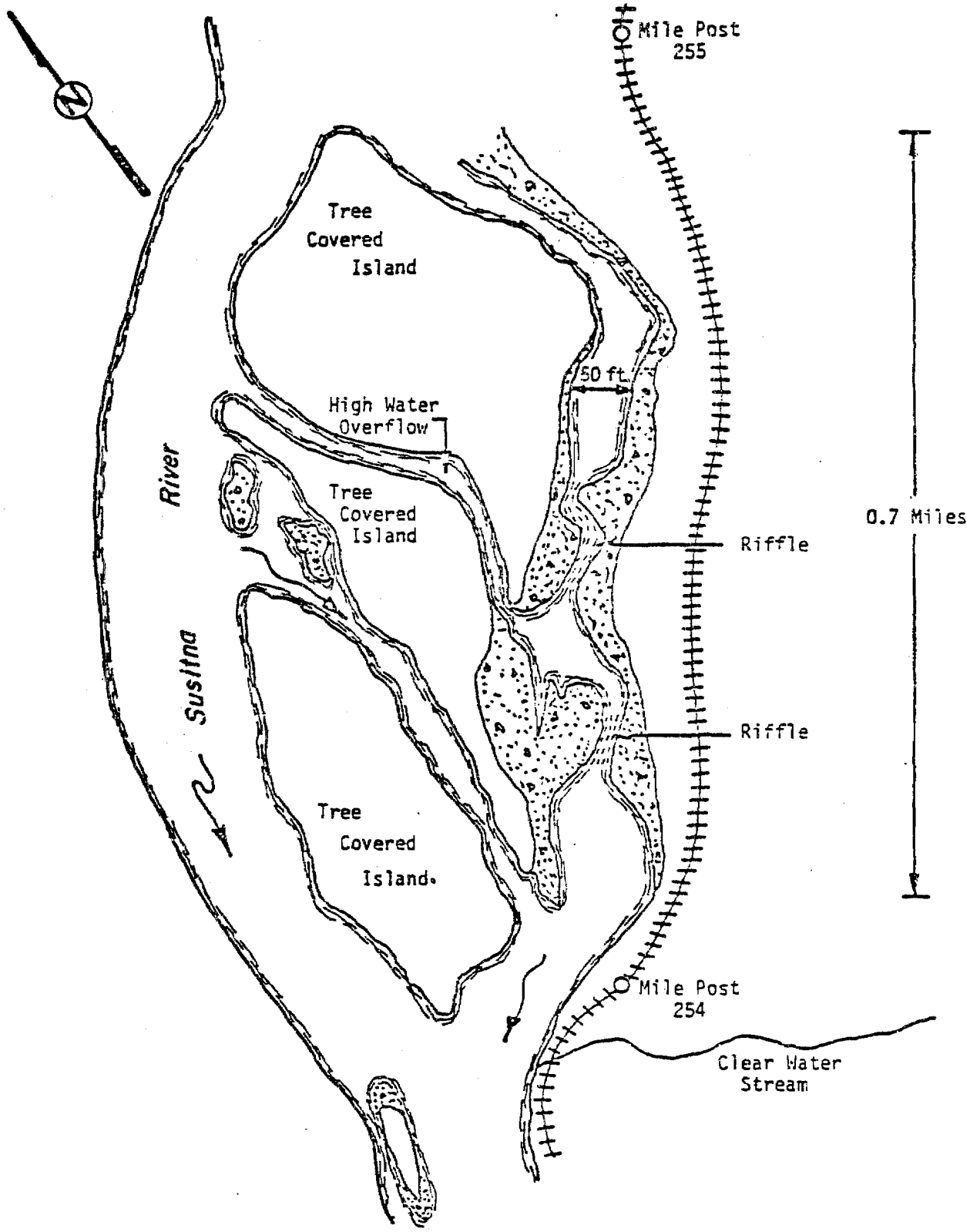
Appendix Figure 12. Map of McKenzie Creek, Susitna River, as composed on September 26, Devil's Canyon Project, 1975.



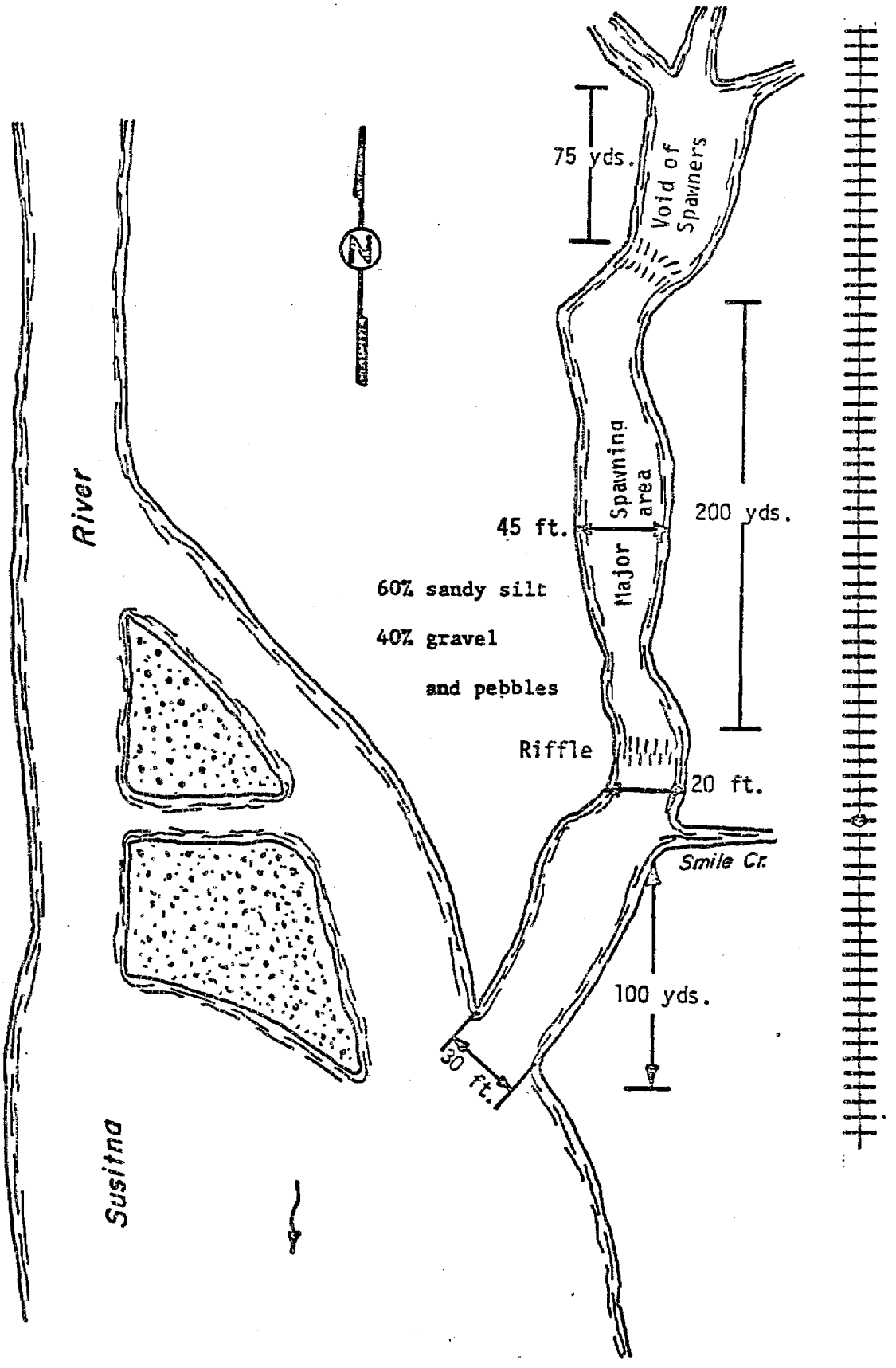
Appendix Figure 13. Map of Slough Number 8B, 8C, and 8D, Susitna River, as composed on September 8, Devil's Canyon Project, 1975.



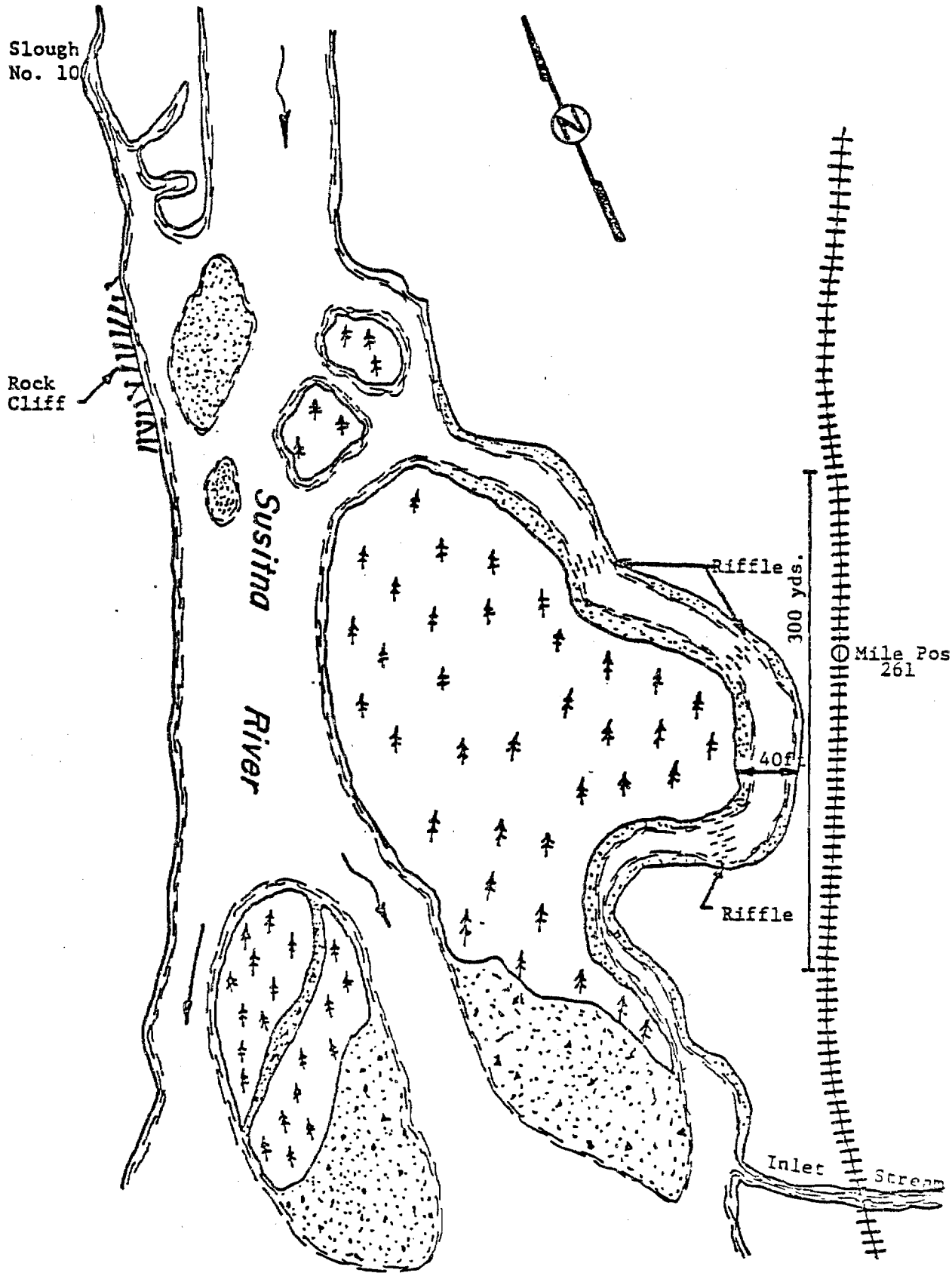
Appendix Figure 14. Map of Slough Number "A", Susitna River, as composed on Septmeber 26, Devil's Canyon Project, 1975.



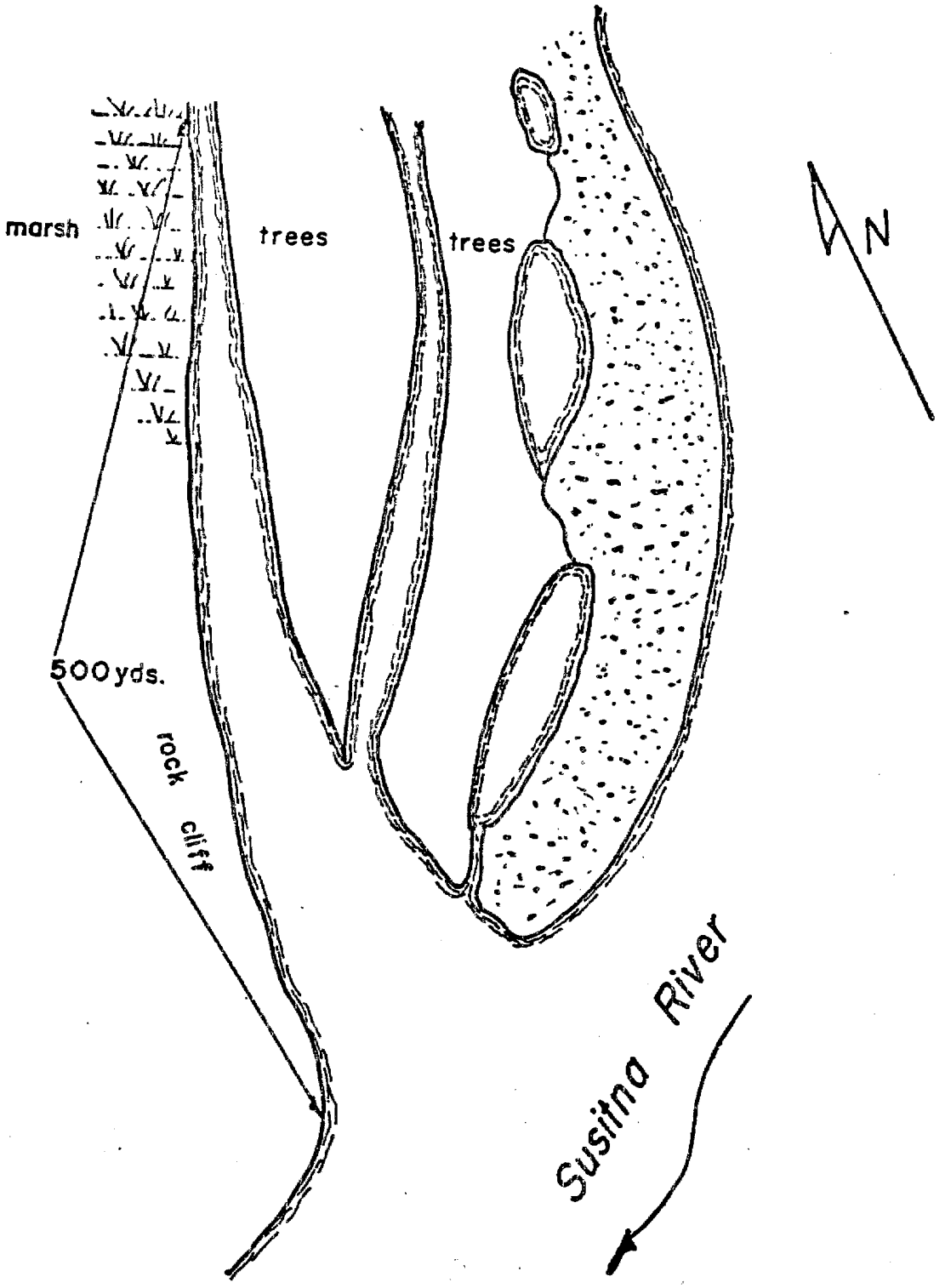
Appendix Figure 15. Map of Slough, Number 8A, Susitna River, as composed on December 6, Devil's Canyon Winter Project, 1974.



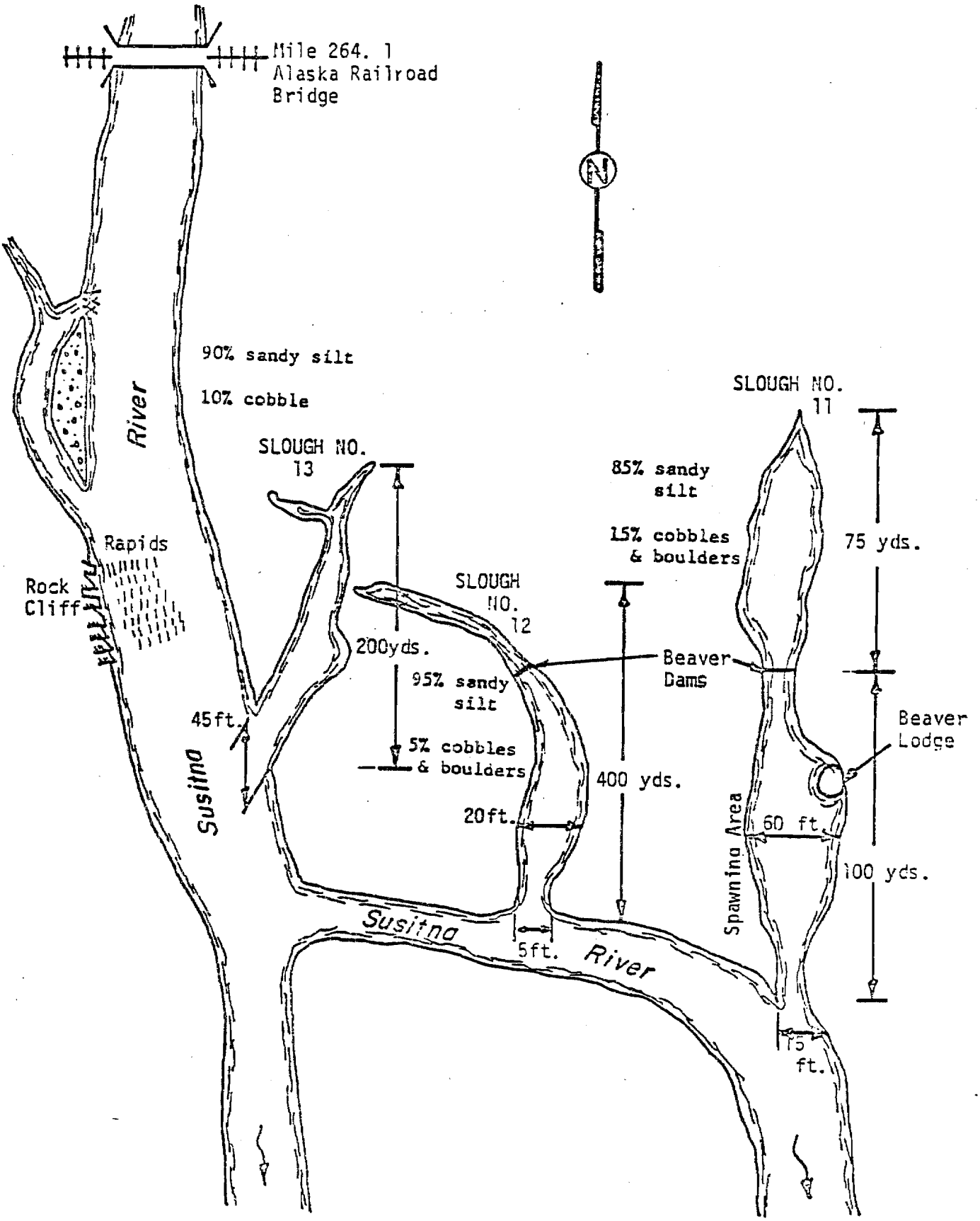
Appendix Figure 16. Map of Slough Number 9, Susitna River, as composed on August 16, Devil's Canyon Project, 1974.



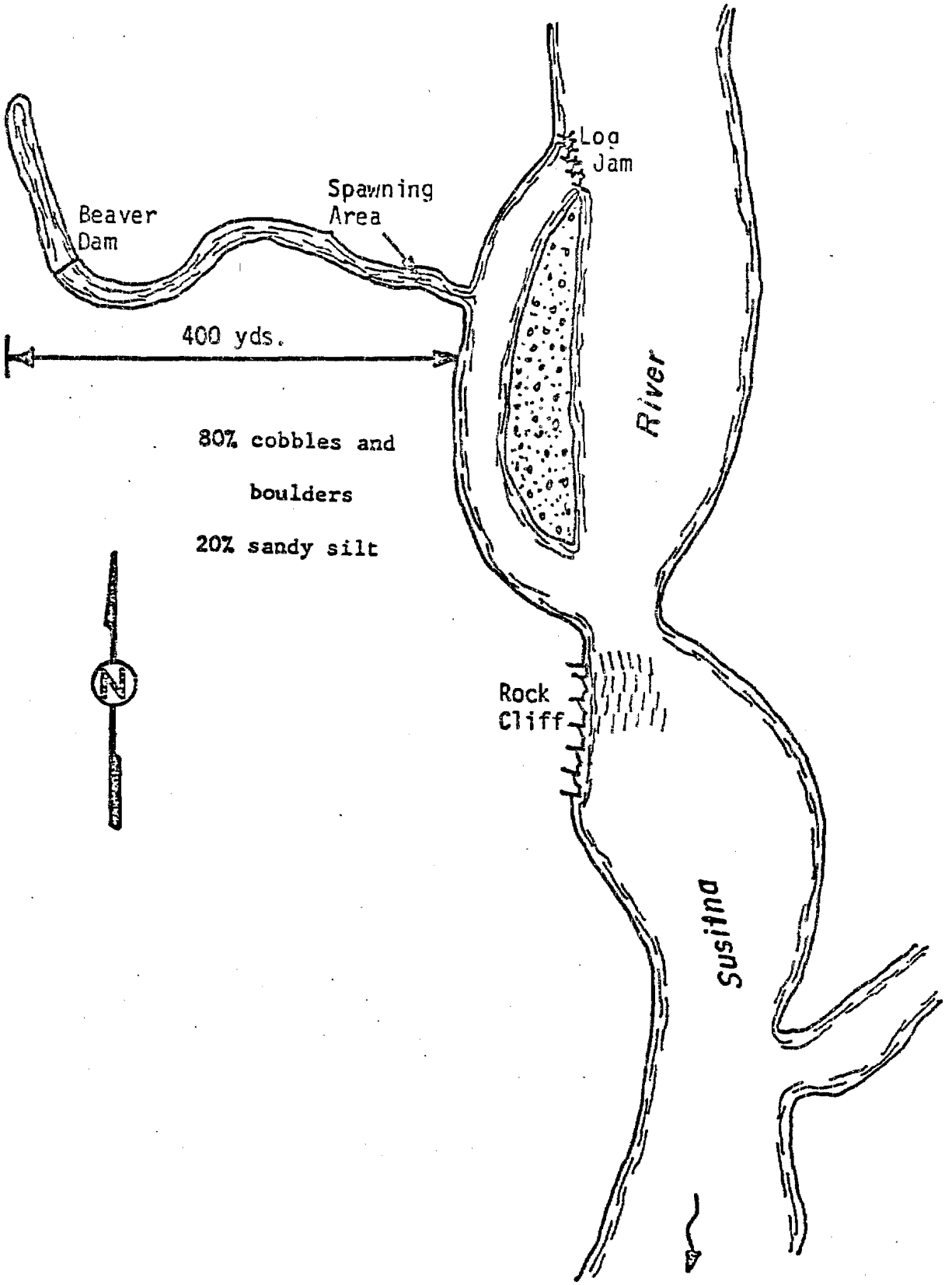
Appendix Figure 17. Map of Slough Number 9A, Susitna River, as composed on February 17, Devil's Canyon Winter Project, 1975.



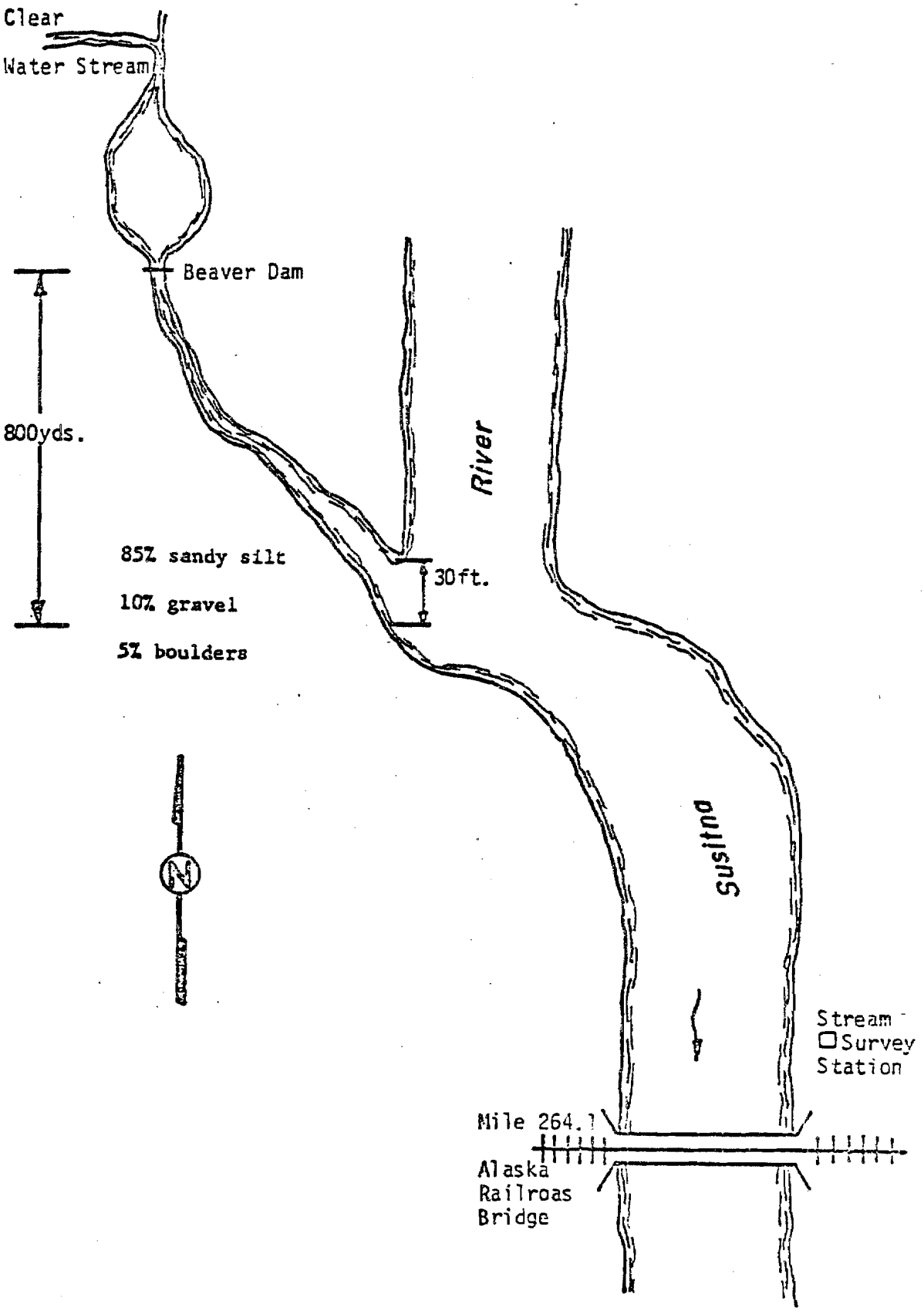
Appendix Figure 18. Map of Slough Number 10, Susitna River, as composed on September 8, Devil's Canyon Project, 1975.



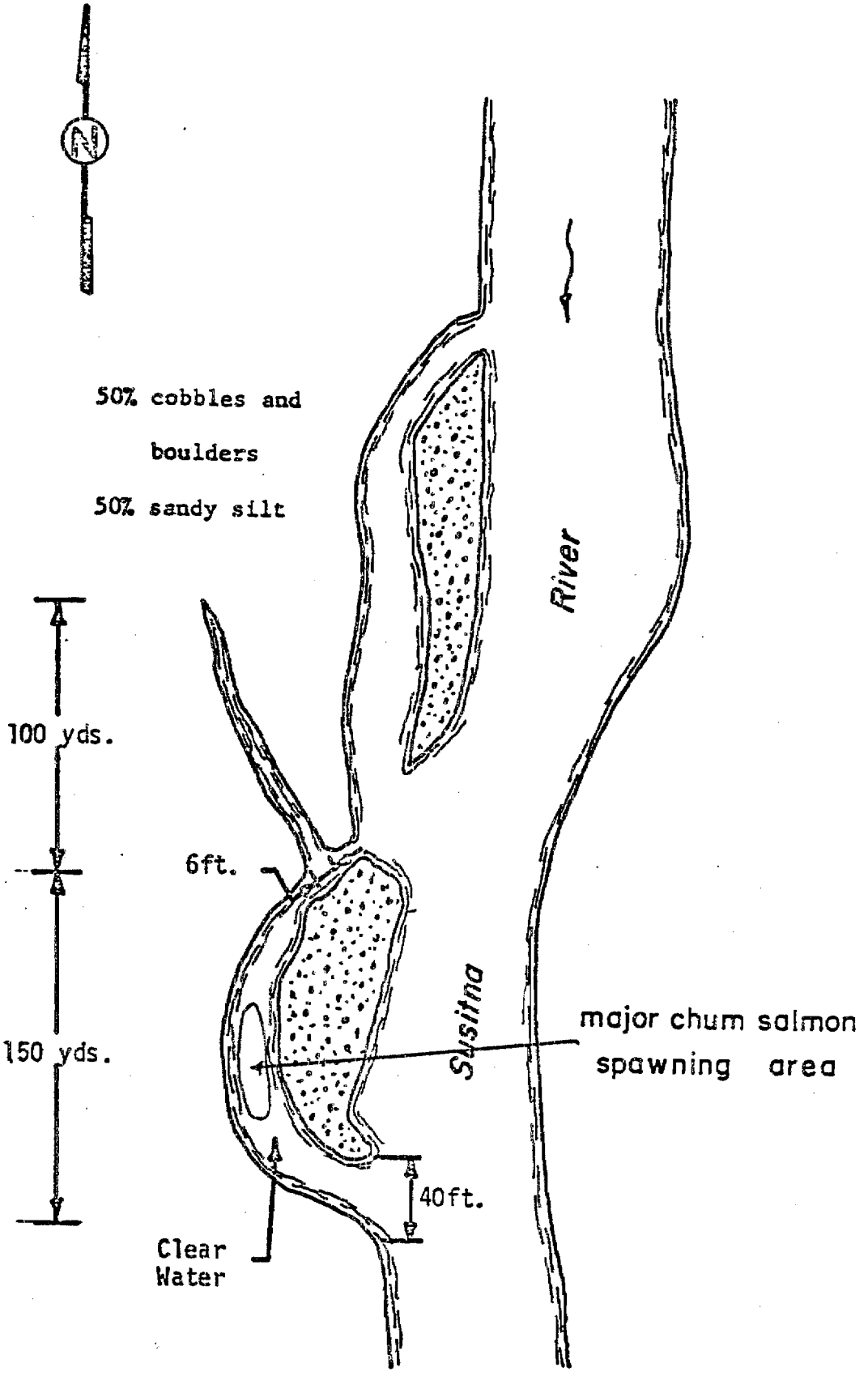
Appendix Figure 19. Map of Sloughs Numbers 11, 12, and 13, Susitna River as composed on August 9, Devil Canyon Project, 1974.



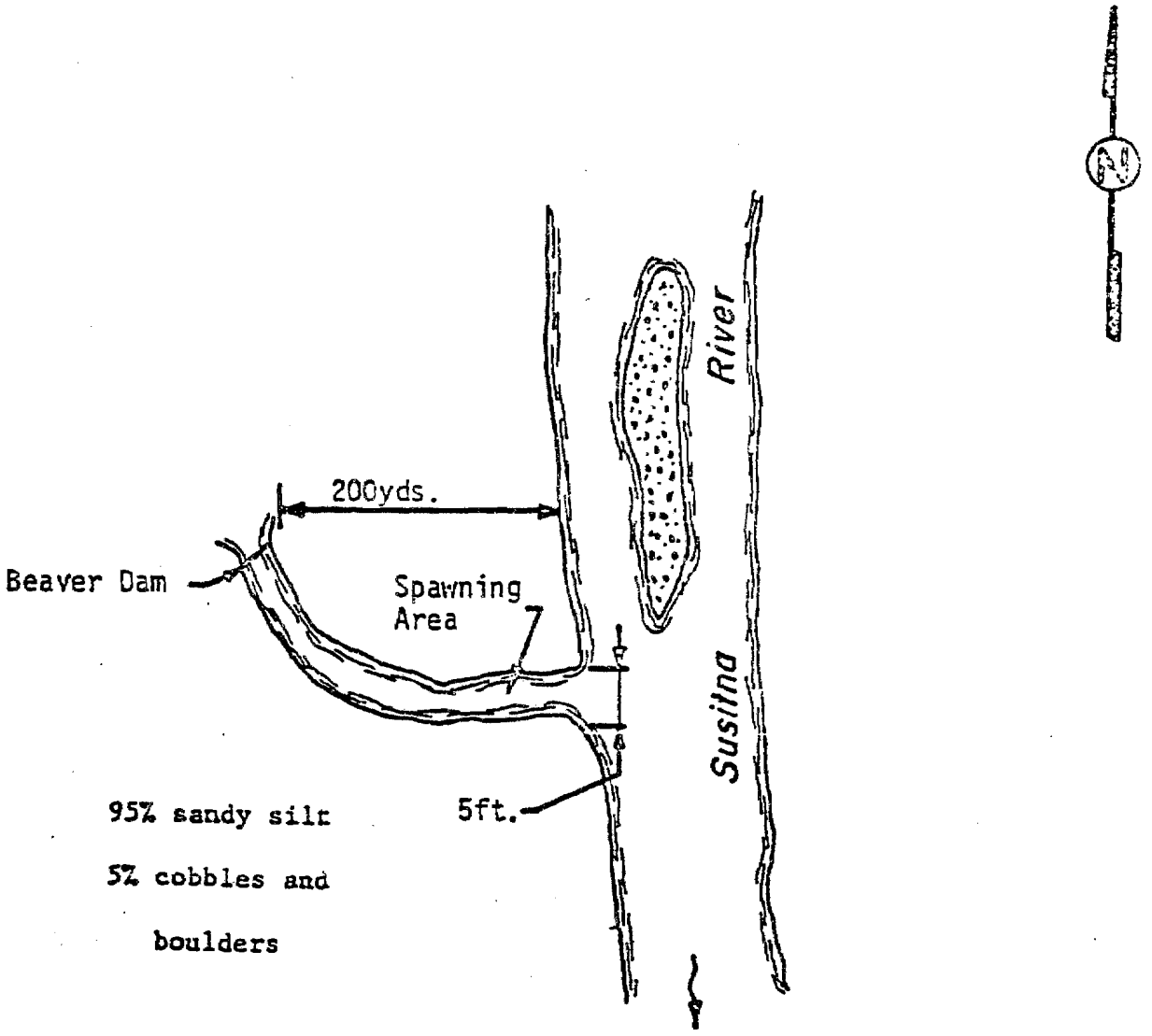
Appendix Figure 20. Map of Slough Number 14, Susitna River, as composed on August 30, Devil's Canyon Project, 1974.



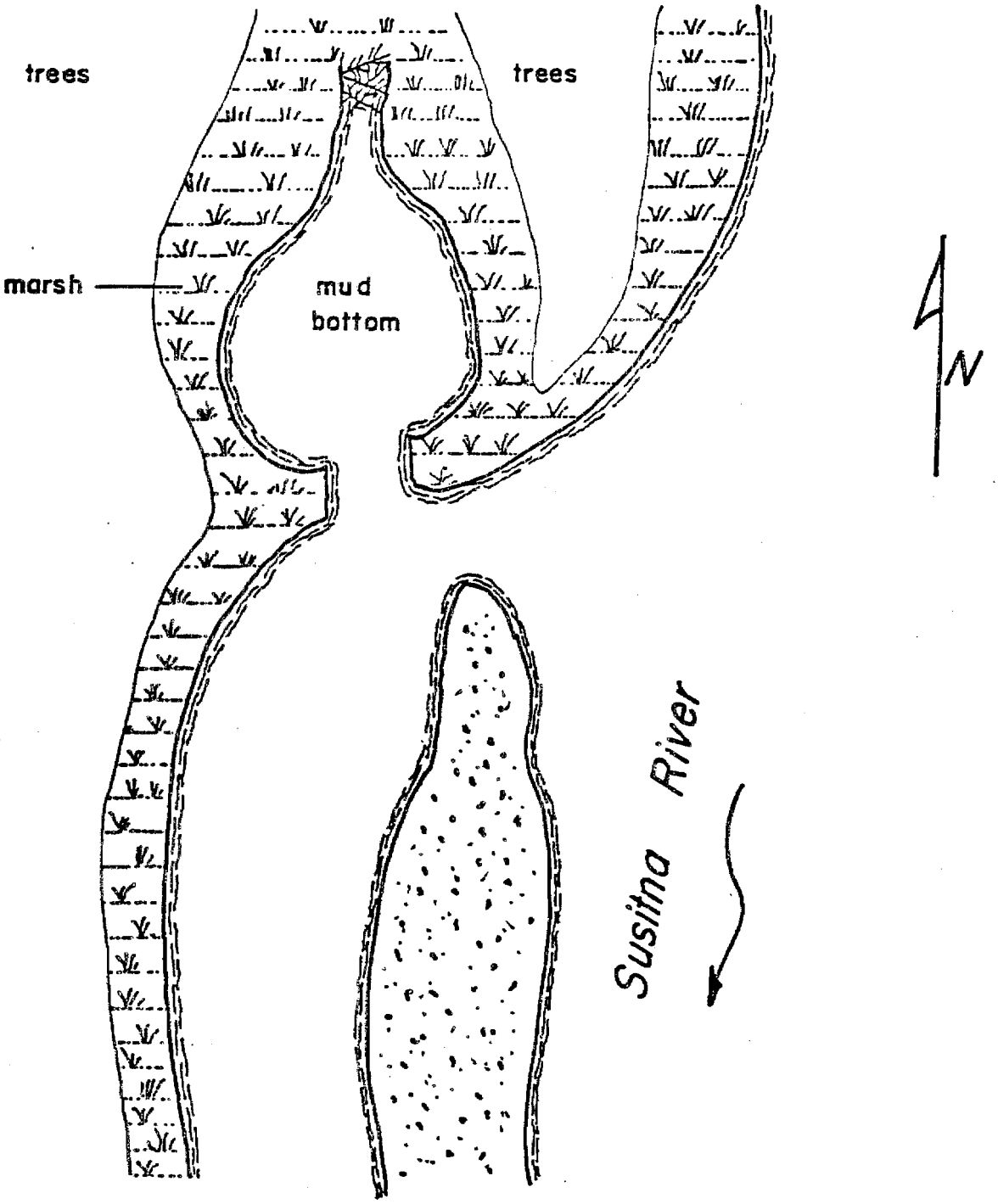
Appendix Figure 21. Map of Slough Number 15, Susitna River, as composed on August 5, Devil's Canyon Project, 1974.



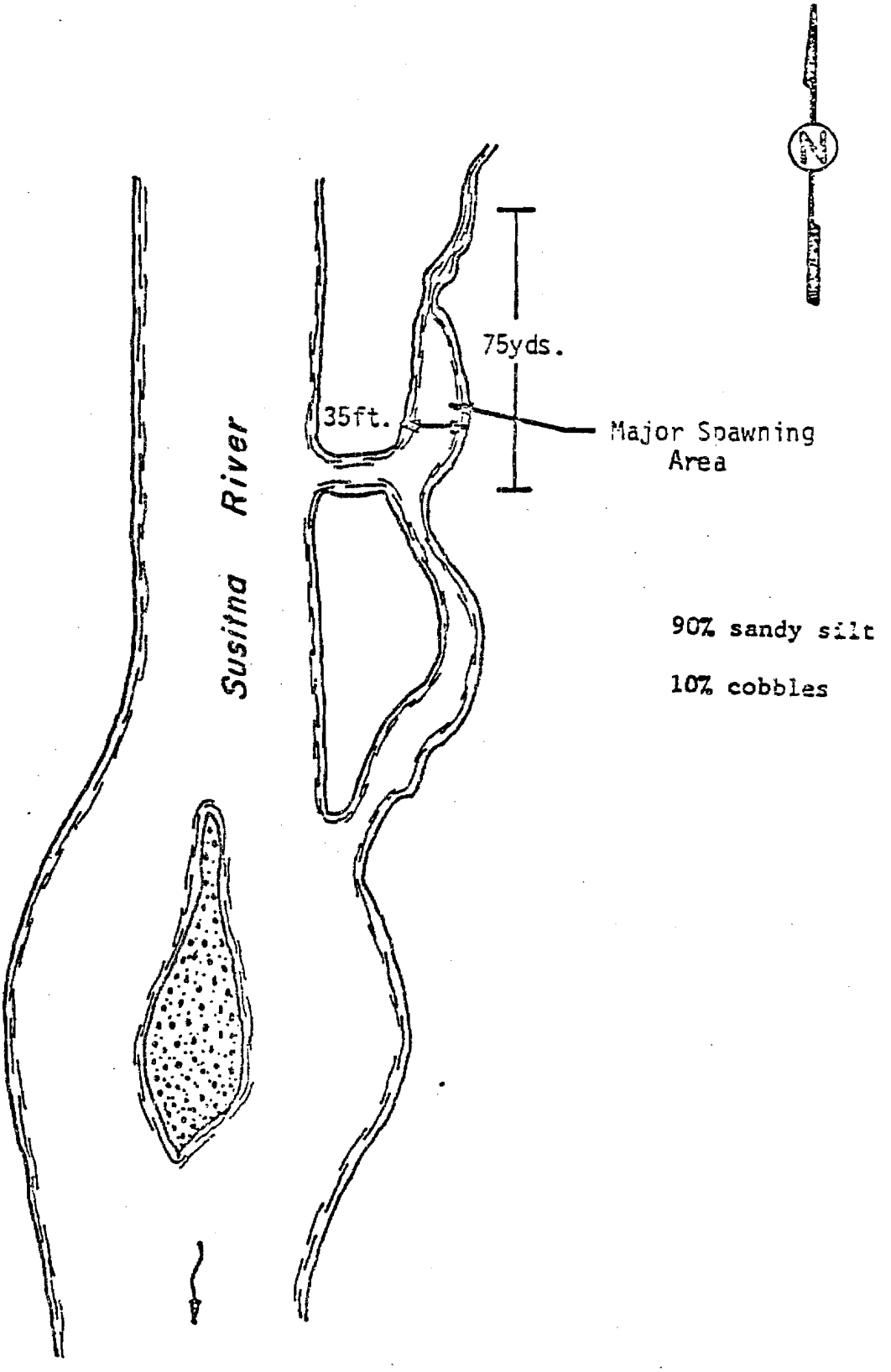
Appendix Figure 22. Map of Slough Number 16, Susitna River, as composed on August 3, Devil's Canyon Project, 1974.



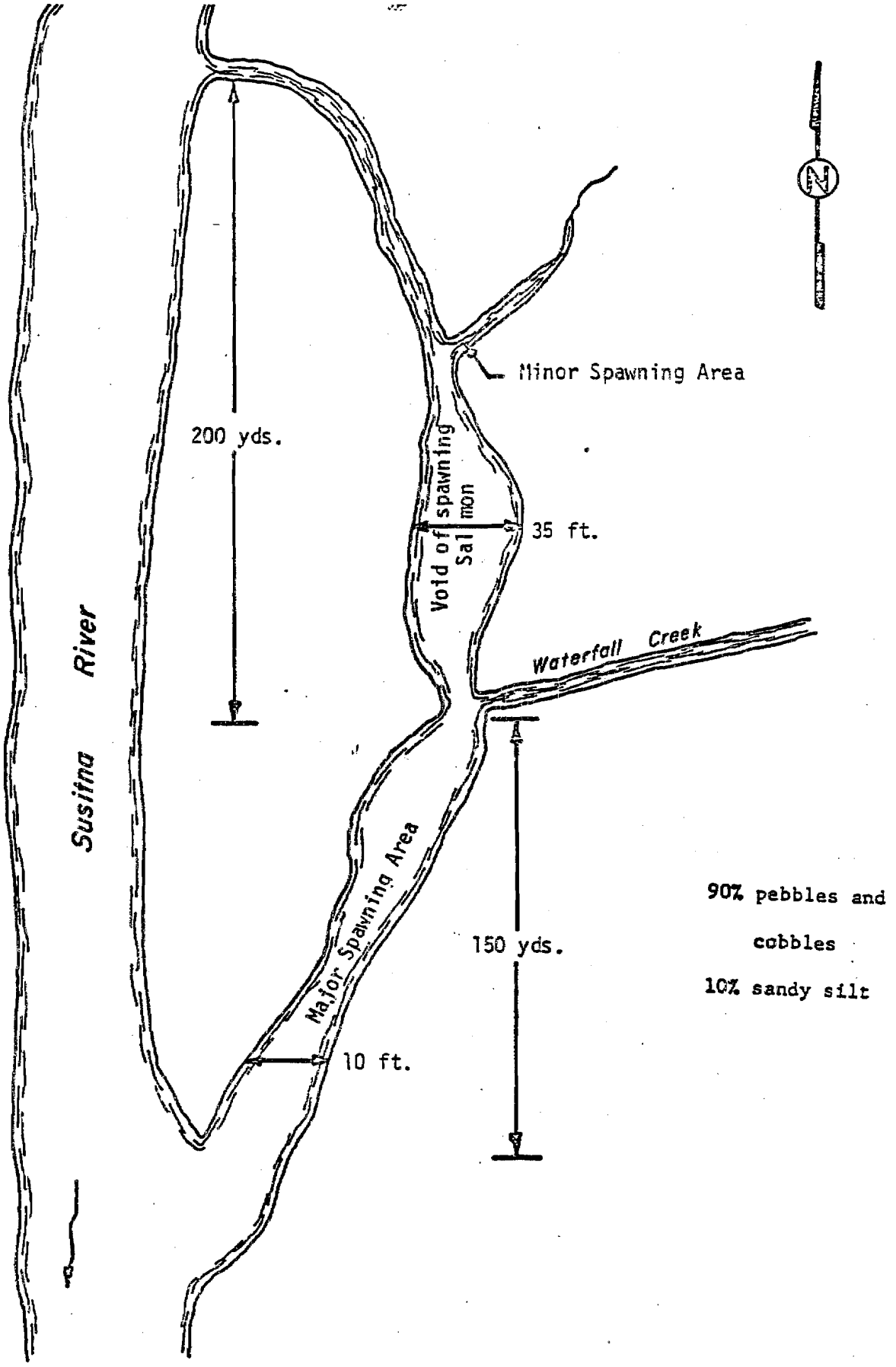
Appendix Figure 23. Map of Slough Number 17, Susitna River, as composed on August 3, Devil's Canyon Project, 1974.



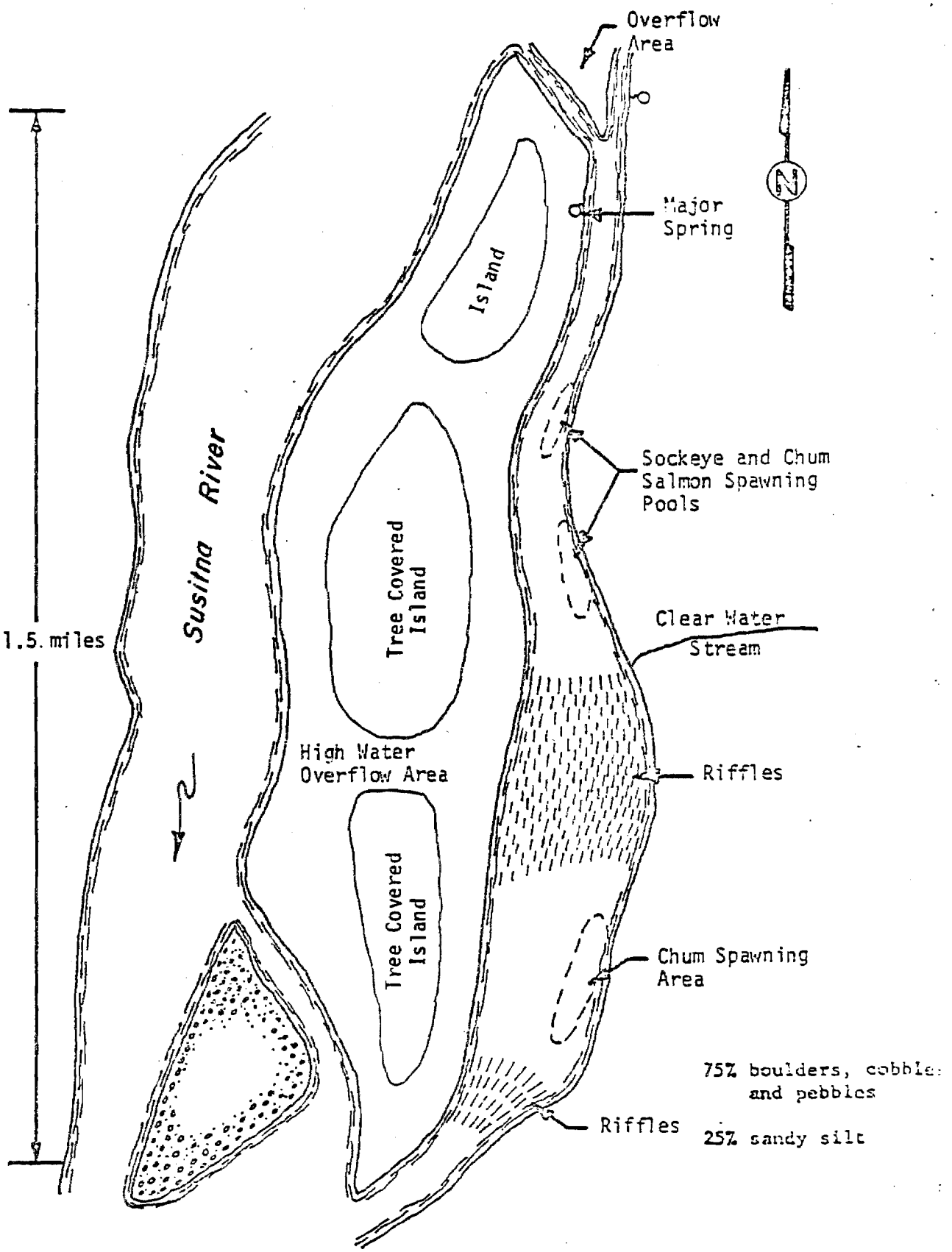
Appendix Figure 24. Map of Slough Number 18, Susitna River as composed on September 8, Devil's Canyon Project, 1975.



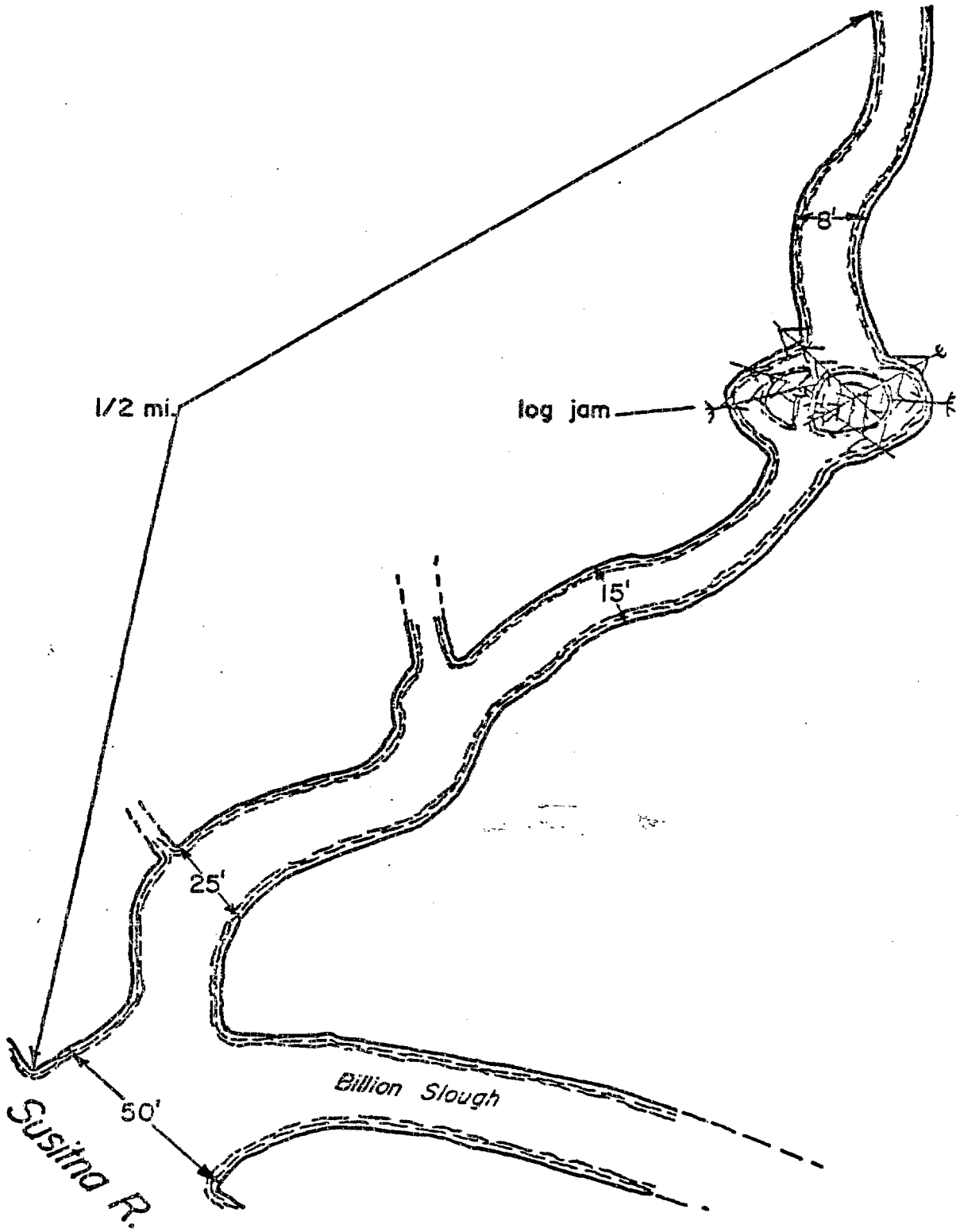
Appendix Figure 25. Map of Slough Number 19, Susitna River, as composed on August 21, Devil's Canyon Project, 1974.



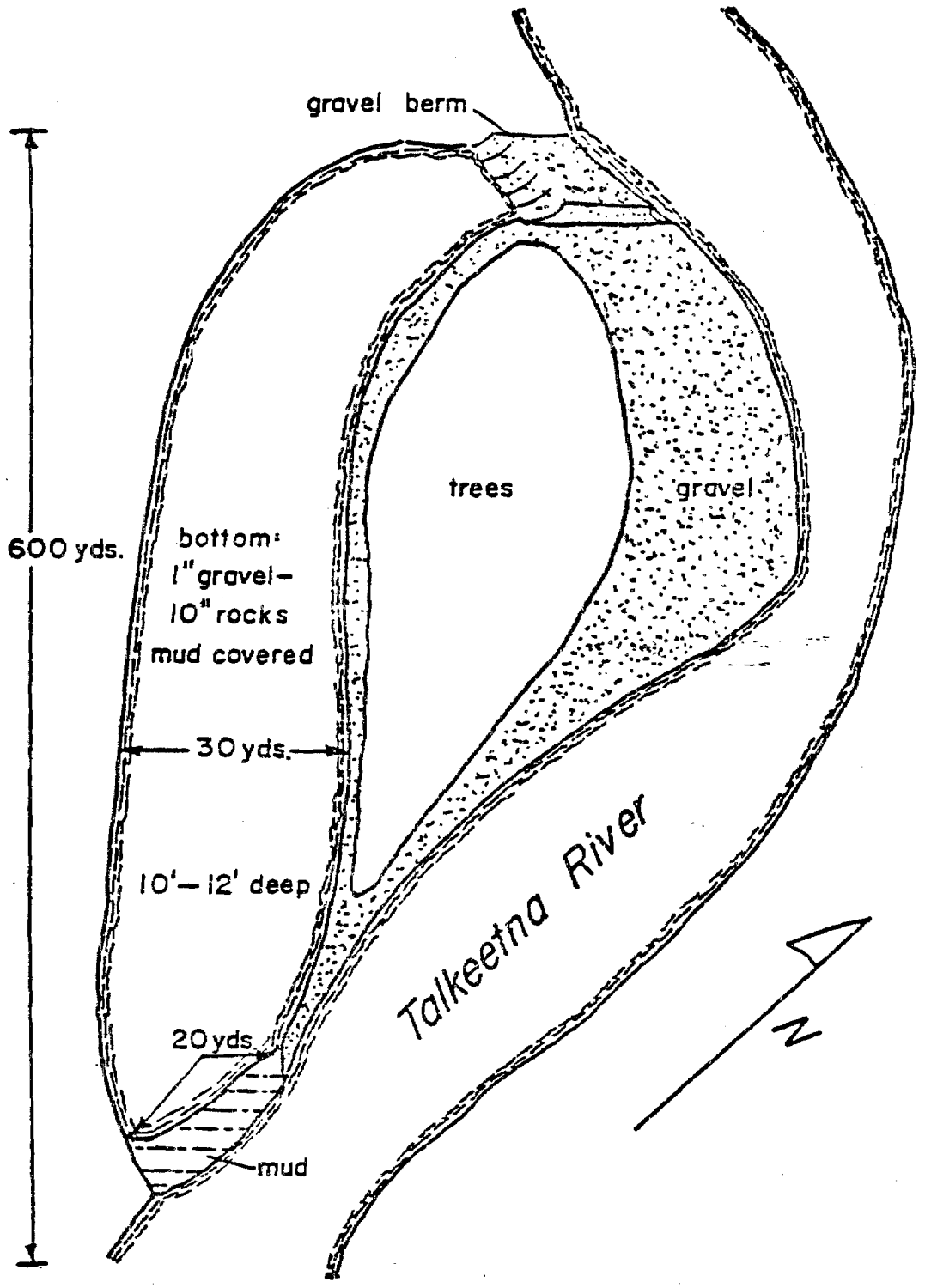
Appendix Figure 26. Map of Slough Number 20, Susitna River, as composed on August 16, Devil's Canyon Project, 1974.



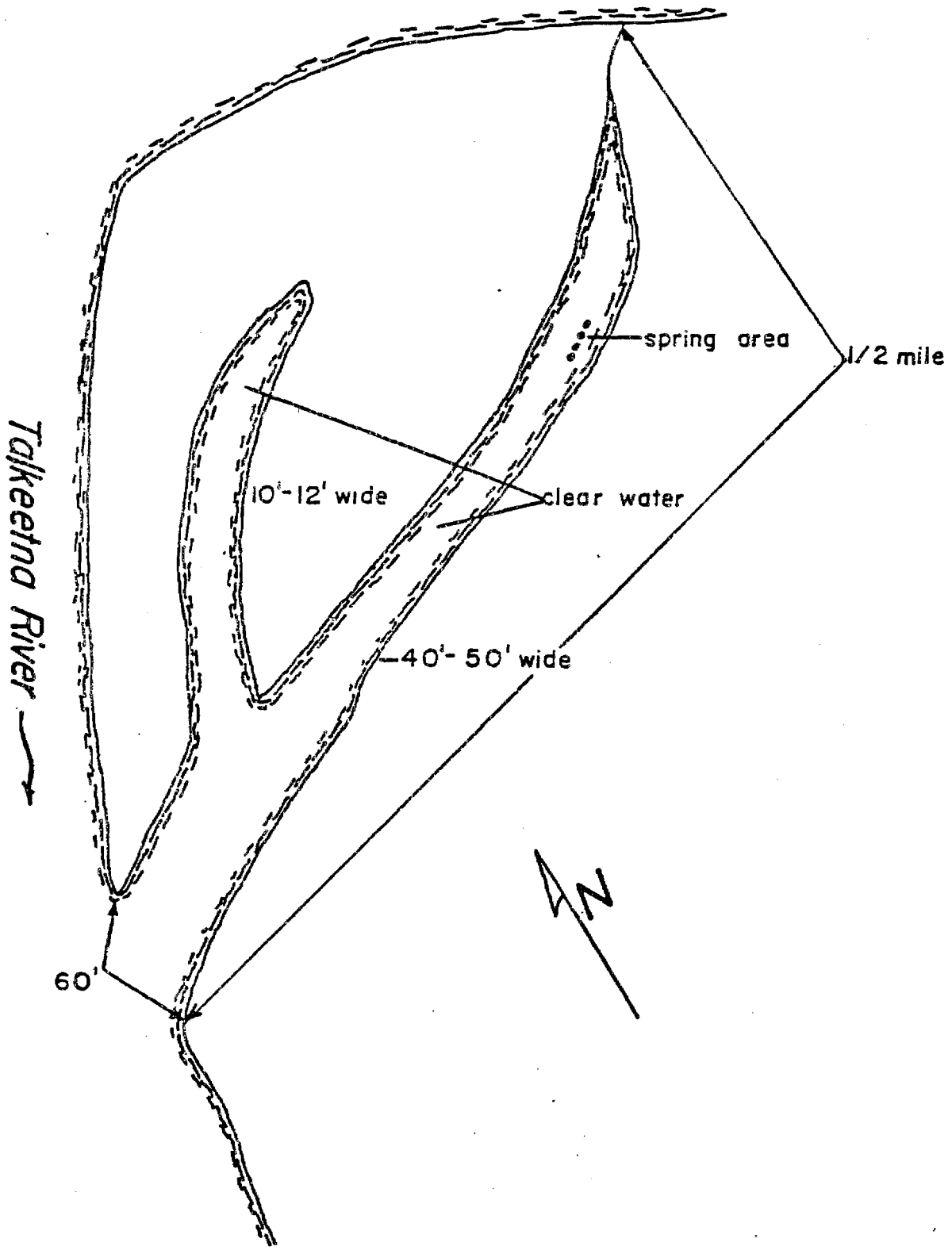
Appendix Figure 27. Map of Slough Number 21, Susitna River, as composed on September 24, Devil's Canyon Project, 1974.



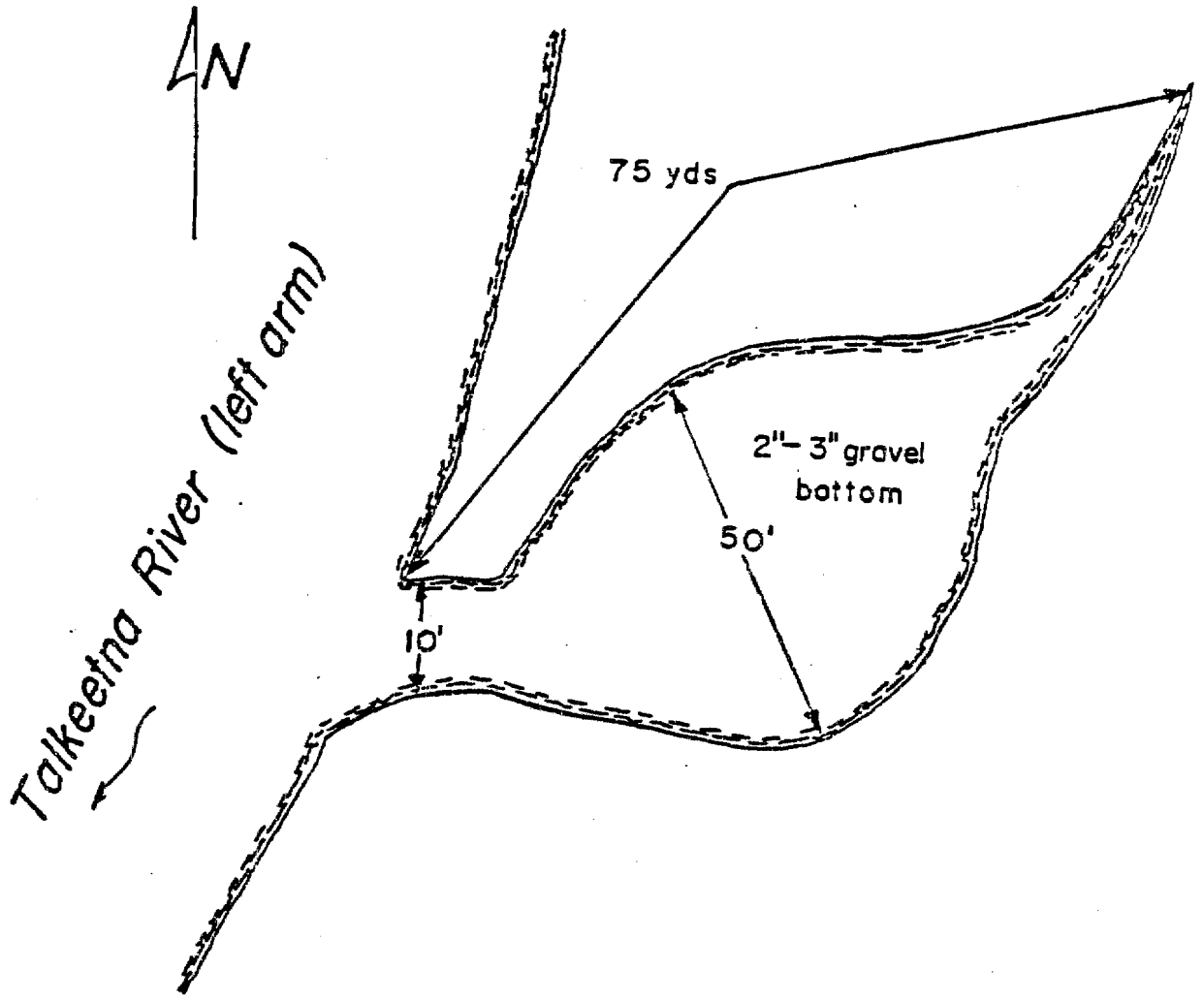
Appendix Figure 28. Map of Billion Slough, Susitna River, as composed on June 9, Devil's Canyon Project, 1975.



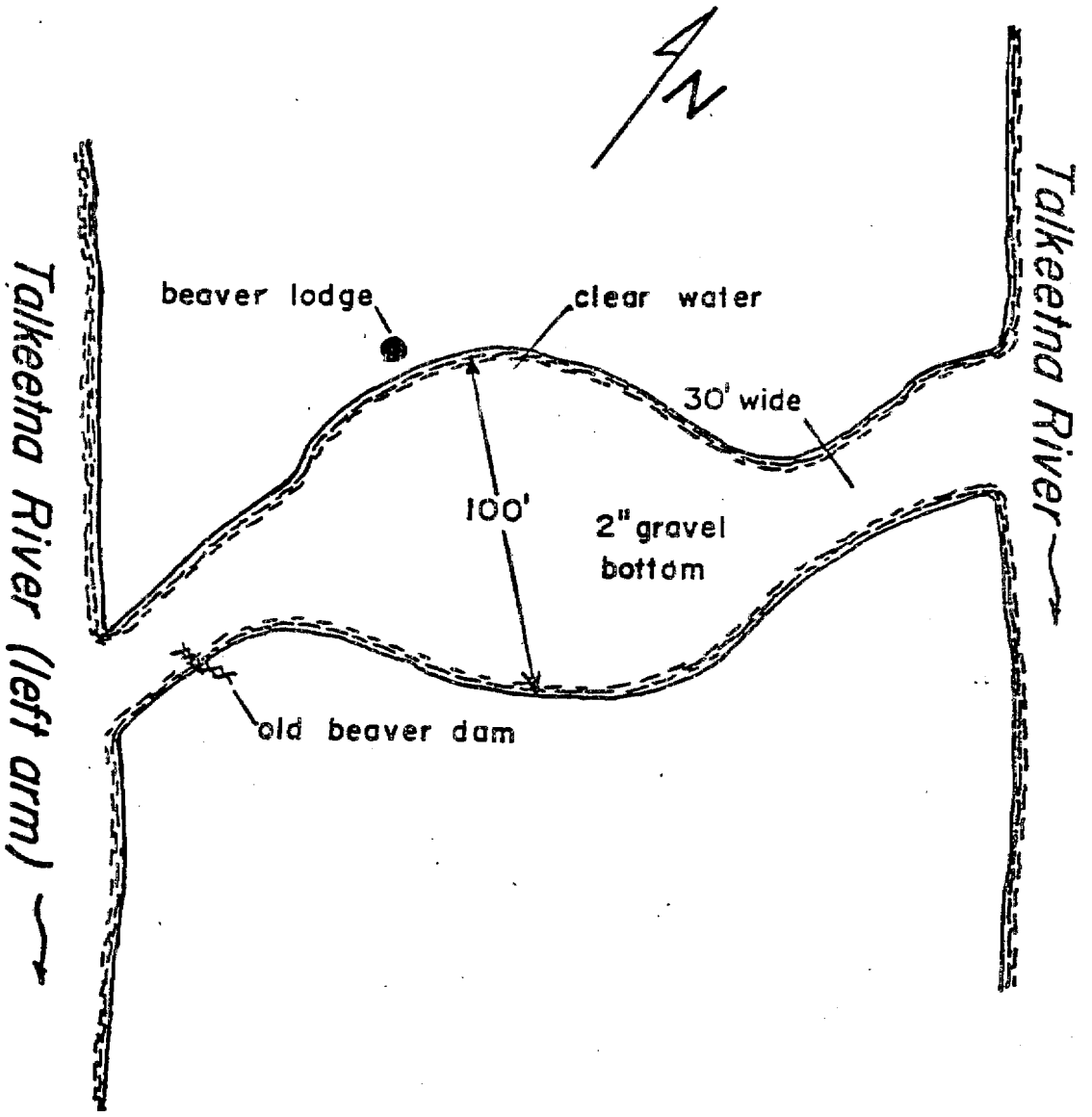
Appendix Figure 29. Map of Railroad Slough, Talkeetna River, as composed June 9, Devil's Canyon Project, 1975.



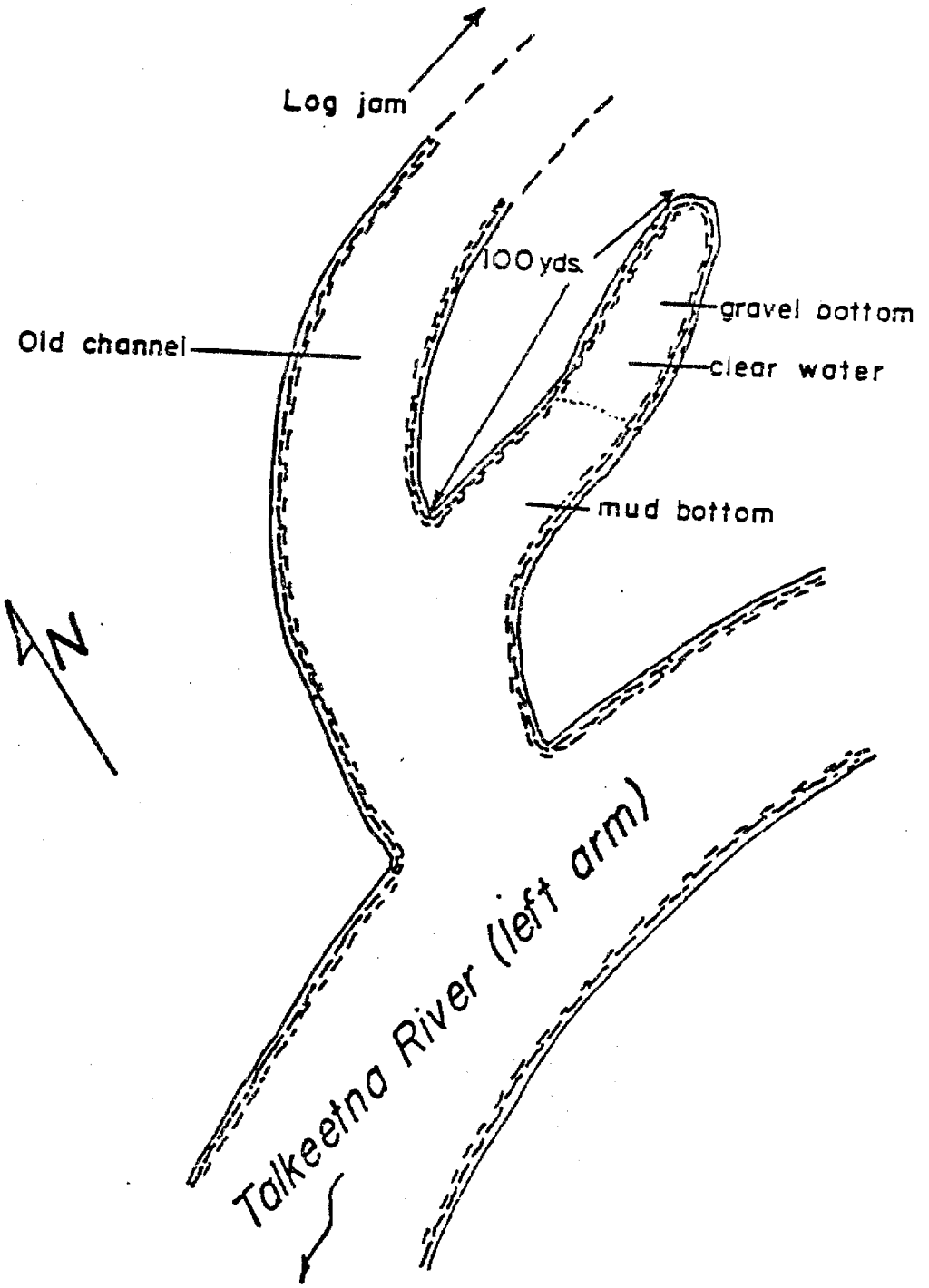
Appendix Figure 30. Map of Slough Number 1, Talkeetna River as composed on June 9, 1975.



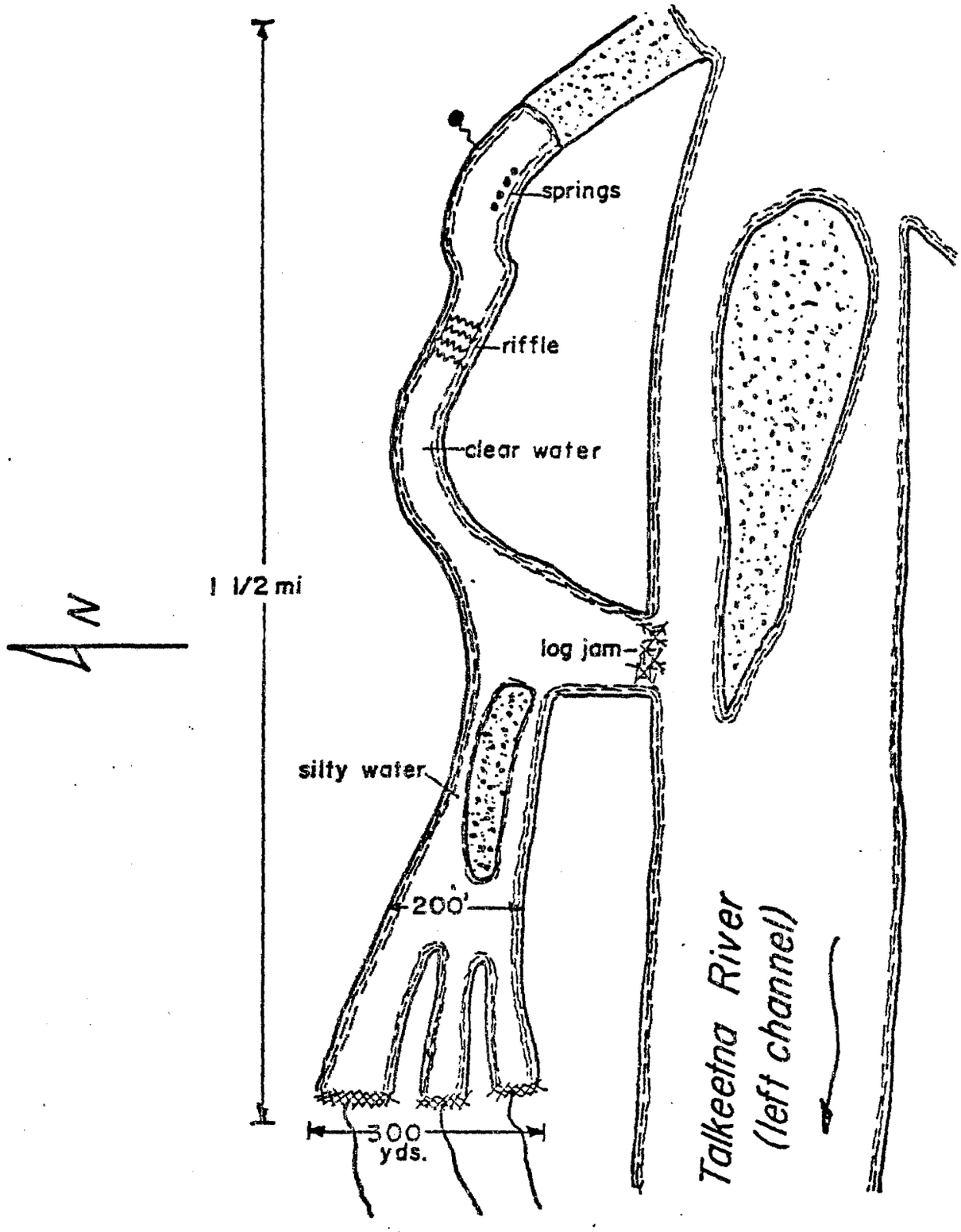
Appendix Figure 31. Map of Slough Number 4, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



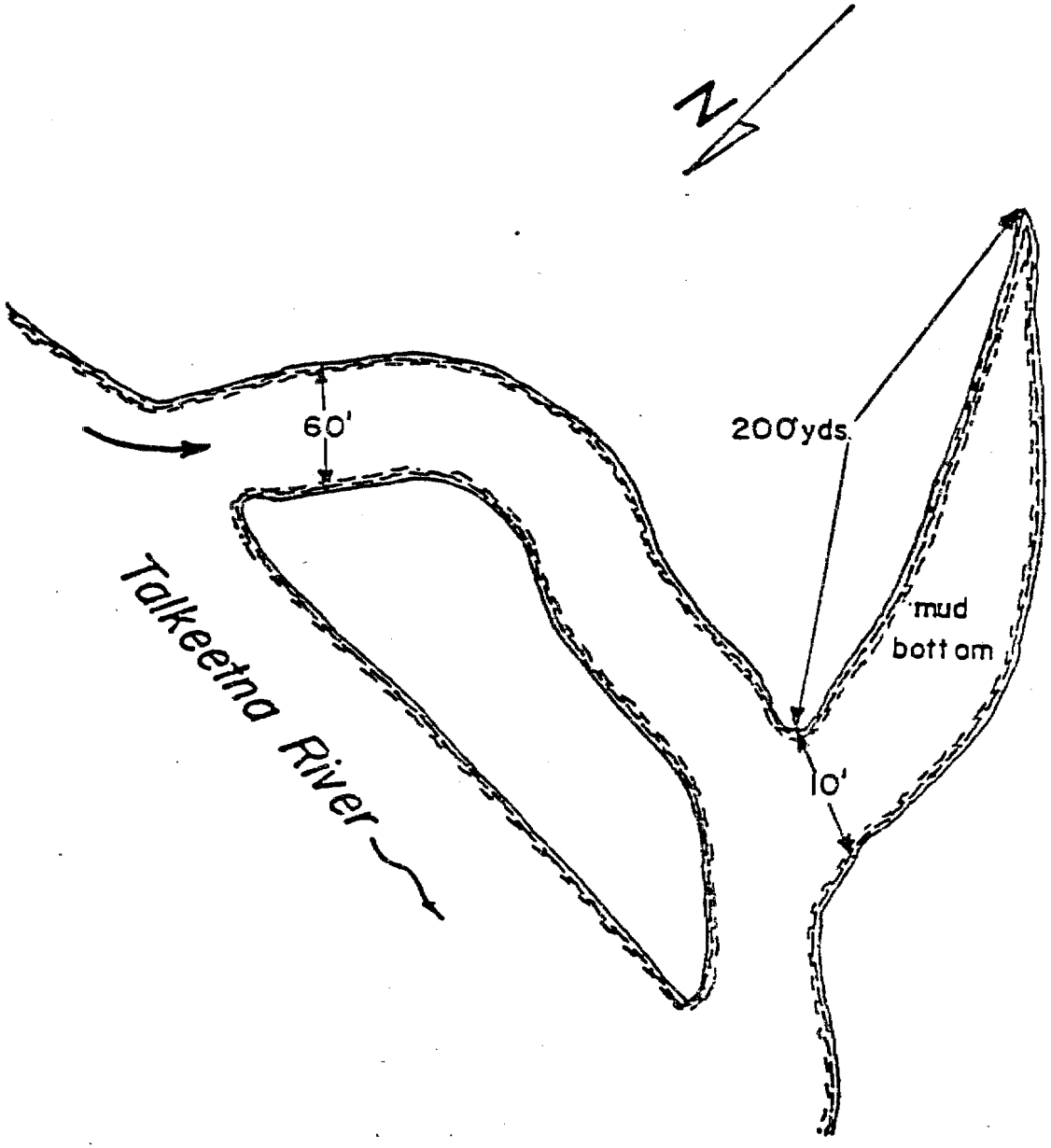
Appendix Figure 32. Map of Beaver Pond Slough, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



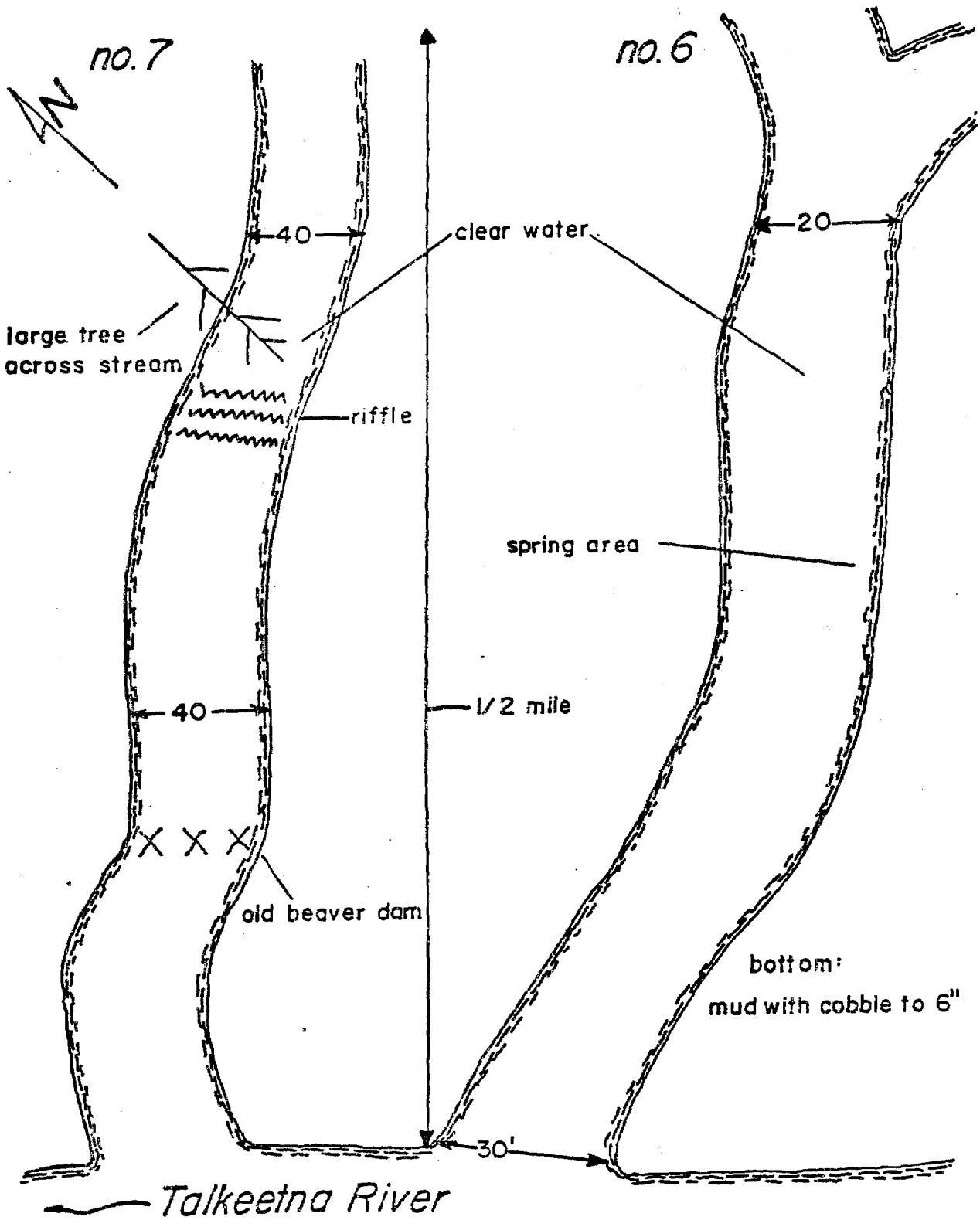
Appendix Figure 33. Map of Slough Number 3, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



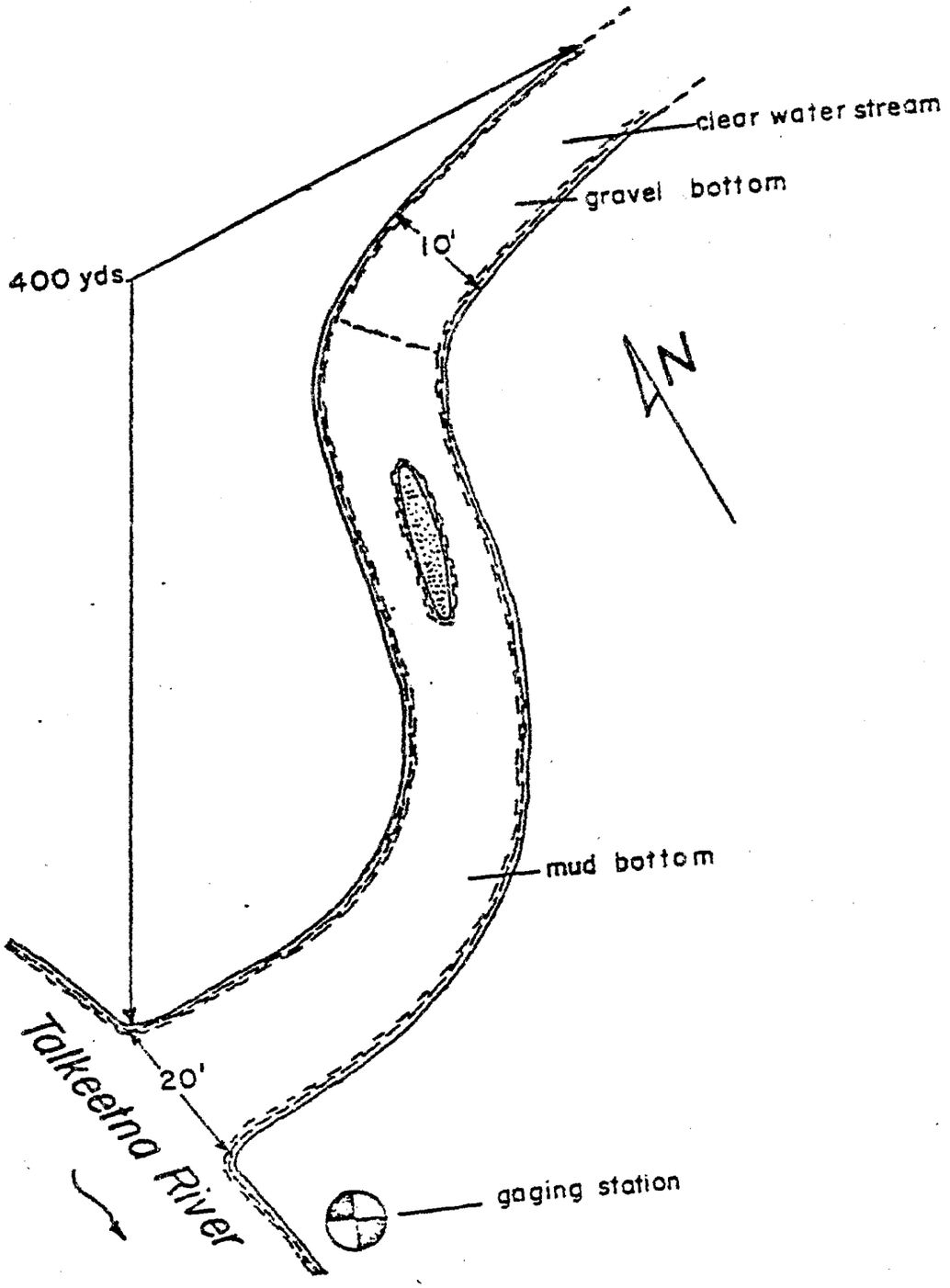
Appendix Figure 34. Map of Slough Number 2, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



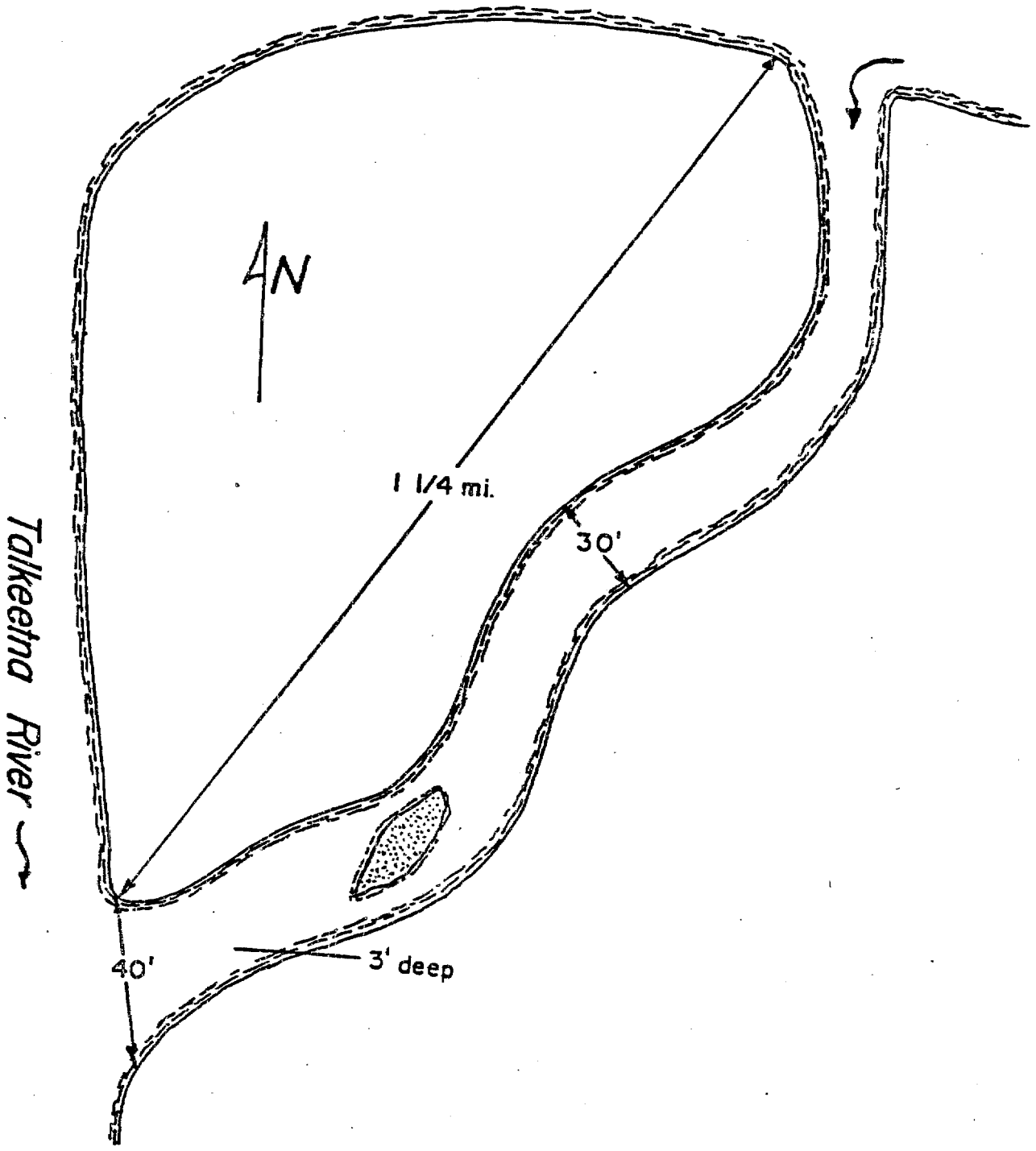
Appendix Figure 35. Map of Slough Number 5, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



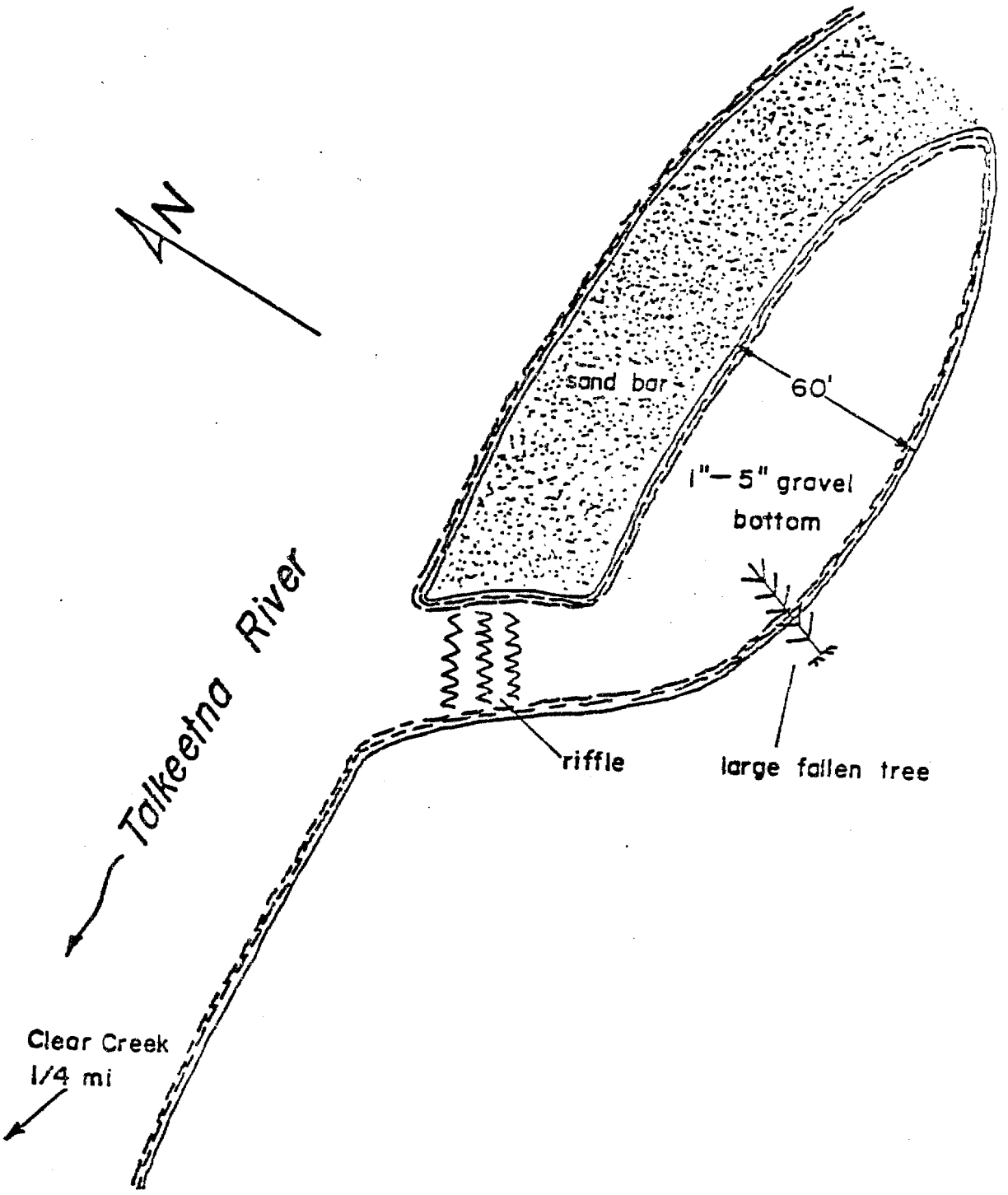
Appendix Figure 36. Map of Sloughs Numbers 6 and 7, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



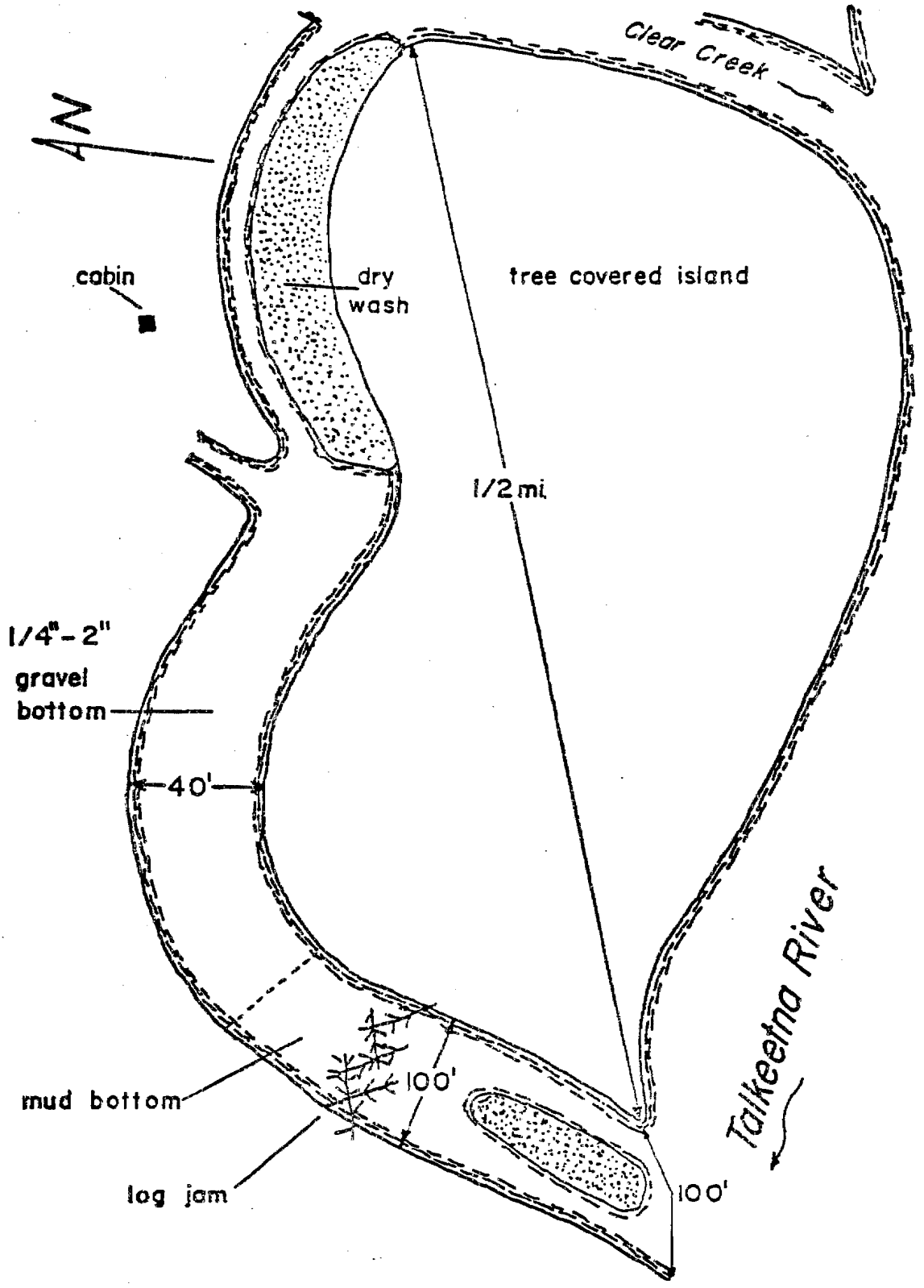
Appendix Figure 37. Map of Whiskey Slough, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



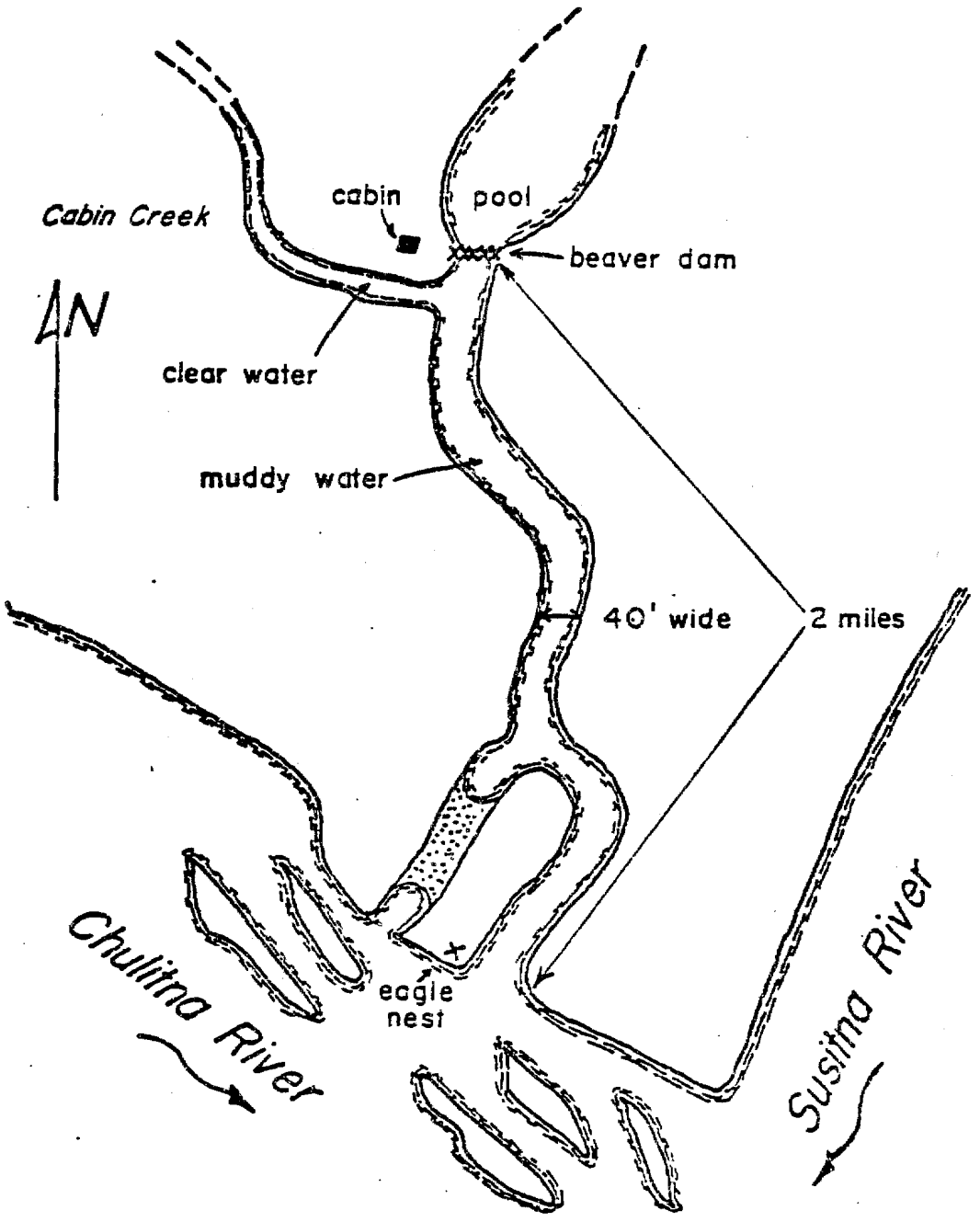
Appendix Figure 38. Map of Slough Number 8, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



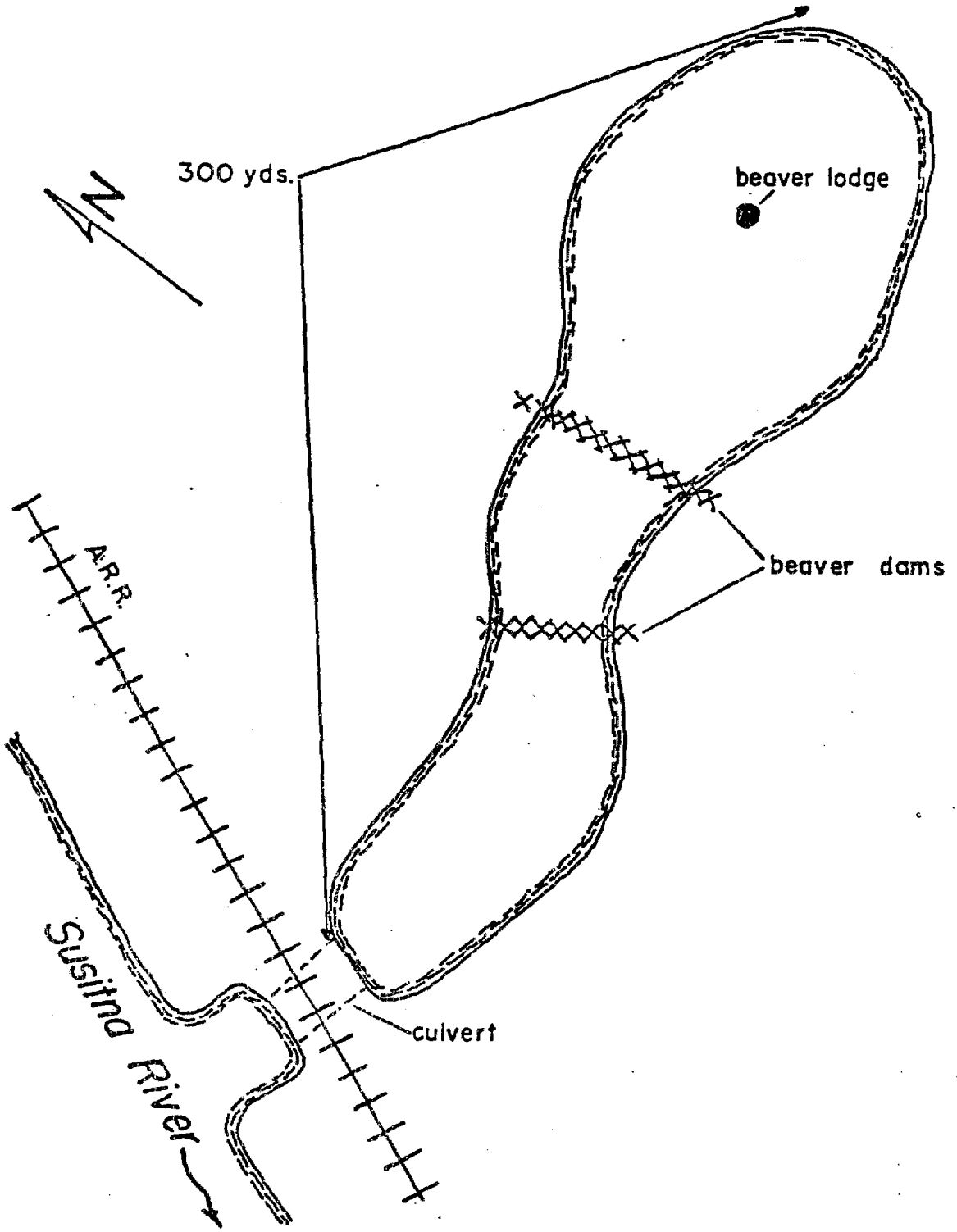
Appendix Figure 39. Map of Slough Number 9, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



Appendix Figure 40. Map of Clear Creek Slough, Talkeetna River, as composed on June 9, Devil's Canyon Project, 1975.



Appendix Figure 41. Map of Slough Number 1, Chulitna River, as composed June 9, Devil Canyon Project, 1975.



Appendix Figure 42. Map of Slough No. 1, Susitna River below the Talkeetna River confluence, as composed on June 6, Devil's Canyon Project, 1975.

APPENDIX II

Escapement surveys of sloughs and tributary streams of the Susitna and Talkeetna Rivers are presented in this Appendix. Included are counts of live tagged and untagged adult salmon in the Susitna River.

Appendix Table 1. Number of live tagged and untagged salmon by species observed during adult escapement surveys, Susitna River, Devil's Canyon Project, 1975.

Chum Salmon Surveys

Location	Date	Survey Conditions	Number Fish Sampled (live) Untagged	Tagged (r)	Total (c)	Ratio (c/r)
Slough 3B	8/27	good	1	1	2	2.0
	9/3	good	50	0	50	0.0
Lane Creek	8/17	excellent	3	0	3	0.0
	8/27	excellent	1	0	1	0.0
Slough 9	8/17	excellent	15	0	15	0.0
	8/25	good	64	0	64	0.0
	9/8	good	63	0	63	0.0
	9/27	excellent	54	0	54	0.0
Slough 13	9/25	good	1	0	1	0.0
Slough 15	9/6	good	1	0	1	0.0
Slough 16	8/26	good	12	0	12	0.0
Indian River	8/8	good	0	2	2	1.0
	8/9	good	0	1	1	1.0
	8/12	excellent	70	0	70	0.0
	9/26	fair	1	0	1	0.0
Slough 21	9/6	good	246	4	250	52.5
	9/25	excellent	92	0	92	0.0
Total			674	8	682	85.3

Pink Salmon Surveys

Location	Date	Survey Conditions	Number Fish Sampled (live) Untagged	Tagged (r)	Total (c)	Ratio (c/r)
4th July Creek	7/28	excellent	40	0	40	0.0
	8/9	excellent	85	2	87	43.5
	8/13	excellent	50	3	53	17.7
	8/17	excellent	143	5	148	29.6
	8/25	excellent	95	6	101	16.8
	9/8	poor	---	---	---	----
Indian River	8/7	-----	0	1	1	1.0
	8/9	-----	0	4	4	1.0
	8/12	-----	312	9	321	35.7
Lane Creek	7/26	excellent	20	0	20	0.0
	8/6	excellent	78	3	81	27.0
	8/17	excellent	96	10	106	10.6
	8/27	excellent	22	3	25	8.3
	9/3	excellent	2	0	2	0.0
Total			943	46	989	21.5

Appendix Table 1. Number of live tagged and untagged salmon by species observed during adult escapement surveys, Susitna River, Devil's Canyon Project, 1975.

Sockeye Salmon Surveys

Location	Date	Survey Conditions	Number Fish Sampled (live) Untagged	Tagged (r)	Total (c)	Ratio (c/r)
Slough 3B	8/23	excellent	12	1	13	13.0
	9/3	good	14	1	15	15.0
4th July	8/17	excellent	1	0	1	0.0
Slough 11	8/25	excellent	24	1	25	25.0
	9/4	good	78	6	84	14.0
	9/25	good	72	5	77	15.4
Slough 19	8/10	fair	0	1	1	1.0
	8/26	excellent	18	2	20	10.0
	9/6	good	10	2	12	6.0
	9/24	good	10	0	10	0.0
Slough 21	9/6	good	34	2	36	18.0
	9/25	excellent	48	1	49	49.0
McKenzie Creek	9/8	good	3	0	3	0.0
	9/27	excellent	45	0	45	0.0
Indian River	9/26	fair	1	0	1	0.0
Total			370	22	392	17.8

King Salmon Surveys

Location	Date	Survey Conditions	Number Fish Sampled (live) Untagged	Tagged (r)	Total (c)	Ratio (c/r)
Whiskers Creek	7/23	poor	2	1	3	3.0
	7/28	poor	1	0	1	0.0
	8/4	poor	19	3	22	7.3
	8/14		3	0	3	0.0
4th July Creek	8/9	excellent	1	0	1	0.0
Indian River	8/12	excellent	10	0	10	0.0
Portage Creek	7/23	excellent	2	0	2	0.0
	7/29	excellent	29	0	29	0.0
	8/10	excellent	3	0	3	0.0
Total			70	4	74	18.5

Appendix

Table 2. Escapement survey counts conducted on the Susitna River in Sloughs Numbers 1, 2, 3A, 4, Devil's Canyon Project, 1975.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
1	7/22	1320	54	58	poor	0						0	0	0	0	0	0
	7/27	1420	61	55	poor	0						0	0	0	0	0	0
	8/4	1810	66	54	poor	0						0	0	0	0	0	0
	8/11	1510	59	51	good	200		X				0	0	0	0	0	0
	8/22	1555	58	48	good	200		X				0	0	0	0	0	0
	9/3	1030	54	48	good	0						0	0	0	0	0	0
	9/23	1110	54	45	good	2		X				0	0	0	0	0	0
2	7/22	1440	59	50	poor	0						0	0	0	0	0	0
	7/28	1205	57	45	poor	0						0	0	0	0	0	0
	8/4	1740	67	48	excellent	0						0	0	0	0	0	0
	8/11	1545	61	55	excellent	0						0	0	0	0	0	0
	8/25	1235	57	45	excellent	0						0	0	0	0	0	0
	9/23	1200	54	45	excellent	100		X		X		0	0	0	0	0	0
3A	7/15	1245	52	44	excellent	0						0	0	0	0	0	0
3B		1310	51	44	poor	0						0	0	0	0	0	0
A	7/23	1640	66	47	excellent	0						0	0	0	0	0	0
B		1610	64	49	excellent	0						0	0	0	0	0	0
A	7/28	1410	58	45	excellent	40		X				0	0	0	0	0	0
B		1435	57	50	excellent	200		X				0	0	0	0	0	0
A	8/4	1435	65	53	excellent	40		X				0	0	0	0	0	0
B		1510	68	53	excellent	200		X				0	0	0	0	0	0
A	8/14	1220	65	53	excellent	30		X				0	0	0	0	0	0
B		1245	68	44	excellent	150		X				0	0	0	0	0	0
A	8/23	1400	62	49	excellent	150		X				0	0	0	1	0	1
B		1420	58	45	excellent	50		X				0	0	0	12	0	12
B	8/27	1315	--	--	excellent	0						2	0	2	0	0	0
A	9/2	1210	55	45	poor	0						0	0	0	0	0	0
B		1130	52	45	good	0						50	0	50	15	0	15
4	7/25	1355	59	56	poor	0						0	0	0	0	0	0
	8/2	1240	59	57	poor	50		X				0	0	0	0	0	0
	8/9	1255	60	55	poor	0						0	0	0	0	0	0
	8/21	1400	58	55	poor	0						0	0	0	0	0	0

Appendix
Table 3. Escapement survey counts conducted on the Susitna River in Sloughs Numbers 5, 6, 7, 8, 8A, 8B, Devil's Canyon Project, 1975.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
5	7/21	1200	70	56	poor	0						0	0	0	0	0	0
	7/26	1405	58	54	fair	200		X				0	0	0	0	0	0
	8/6	1045	56	54	good	0						0	0	0	0	0	0
	8/21	1215	56	55	fair	0						0	0	0	0	0	0
	9/3	1230	--	--	poor 1/	0						0	0	0	0	0	0
6	7/21	1220	70	56	fair	+		X				0	0	0	0	0	0
	7/26	1405	58	53	fair	200		X				0	0	0	0	0	0
	8/6	1100	56	56	good	0						0	0	0	0	0	0
	8/21	1230	56	57	fair	0						0	0	0	0	0	0
	9/3	----	--	--	poor	0						0	0	0	0	0	0
	9/27	1445	--	47	good	0						0	0	0	0	0	0
7	7/21	----	--	--	---------	---						-	-	-	-	-	-
	7/26	1450	59	48	excellent	0						0	0	0	0	0	0
	8/6	1220	56	53	excellent	0						0	0	0	0	0	0
	8/21	----	--	--	poor 1/	---						-	-	-	-	-	-
	9/3	----	--	--	poor 1/	---						-	-	-	-	-	-
8	7/21	1315	70	50	poor	0						0	0	0	0	0	0
	7/26	1530	56	49	excellent	500		X				0	0	0	0	0	0
	8/6	1230	55	47	excellent	400		X				0	0	0	0	0	0
	8/17	1745	59	54	excellent	350		X				0	0	0	0	0	0
	8/27	1315	60	47	good	500		X				0	0	0	0	0	0
	9/3	1750	55	45	excellent	1000		X				0	0	0	0	0	0
	9/27	1400	55	48	excellent	60		X			X	0	0	0	0	0	0
8A	7/26	1800	59	48	excellent	2						0	0	0	0	0	0
	8/9	1500	59	54	good	0						0	0	0	0	0	0
8B	8/6	1600	55	48	excellent	300		X				0	0	0	0	0	0
	9/8	1310	51	44	good	0						0	0	0	0	0	0

1/ Slough area dried up.

Appendix

Table 4. Escapement survey counts conducted on the Susitna River in Sloughs Numbers A, 9, 9A, 10, 11, 12, Devil's Canyon Project, 1975.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
A	7/21	1520	65	45	excellent	0						0	0	0	0	0	0
	8/6	1700	64	51	excellent	0						0	0	0	0	0	0
	8/17	1430	60	50	excellent	0						0	0	0	0	0	0
9	7/21	1545	65	50	poor	0						0	0	0	0	0	0
	7/26	1930	60	48	fair	200		X				0	0	0	0	0	0
	8/9	1300	56	49	excellent	400		X				0	0	0	0	0	0
	8/17	1400	65	52	excellent	0						15	0	15	0	0	0
	8/25	1600	56	51	good	0						64	2	66	0	0	0
	9/8	1200	48	49	good	0						63	14	77	0	0	0
	9/27	1100	50	45	excellent	0						54	127	181	0	0	0
9A	8/7	----	--	--	poor 1/	---						-	-	-	-	-	-
10	7/28	1400	55	46	poor	0						0	0	0	0	0	0
	8/7	1050	63	43	excellent	1500		X		X	X	0	0	0	0	0	0
	8/25	1300	57	44	excellent	600				X		0	0	0	0	0	0
	9/4	1915	50	41	good	1000				X		0	0	0	0	0	0
	9/25	1705	59	43	good	10		X				0	0	0	0	0	0
11	7/22	1000	75	44	good	0						0	0	0	0	0	0
	7/28	1325	55	44	excellent	30		X				0	0	0	0	0	0
	8/7	1020	60	47	excellent	4000		X		X		0	0	0	0	0	0
	8/13	1710	59	47	excellent	4500		X				0	0	0	0	0	0
	8/25	1200	54	44	excellent	3000		X				0	0	0	25	0	25
	9/4	1800	50	44	good	300		X				0	0	0	84	0	84
	9/25	1640	51	45	good	0						0	0	0	77	5	82
12	7/28	1300	53	42	good	0						0	0	0	0	0	0
	8/7	0940	57	43	excellent	0						0	0	0	0	0	0
	8/13	1650	58	43	excellent	0						0	0	0	0	0	0
	8/25	1145	52	47	good	0						0	0	0	0	0	0
	9/4	1740	57	45	good	0						0	0	0	0	0	0
	9/25	1620	55	45	good	30						0	0	0	0	0	0

1/ Slough area dried up.

Appendix
Table 5. Escapement survey counts conducted on the Susitna River in Sloughs Numbers 13, 14, 15, 16, 17, Devil's Canyon Project, 1975.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
13	7/23	1750	62	50	poor	0						0	0	0	0	0	0
	7/28	1215	54	49	poor	100		X				0	0	0	0	0	0
	8/13	1620	63	58	excellent	200		X		X		0	0	0	0	0	0
	8/25	1115	52	44	good	300		X				0	0	0	0	0	0
	9/4	1715	53	44	good	50				X		0	0	0	0	0	0
	9/25	1600	55	48	good	100				X	X	1	0	1	0	0	0
14	7/23	1735	68	51	excellent	100		X				0	0	0	0	0	0
	7/30	1600	63	51	excellent	600		X				0	0	0	0	0	0
	8/7	1230	62	49	excellent	1000		X				0	0	0	0	0	0
	8/13	1600	59	47	excellent	500		X				0	0	0	0	0	0
	8/25	1100	55	45	good	200		X				0	0	0	0	0	0
	9/4	1630	60	47	good	1000		X				0	0	0	0	0	0
	9/25	1530	57	46	excellent	200		X				0	0	0	0	0	0
15	7/23	1700	68	51	excellent	0						0	0	0	0	0	0
	7/29	1300	66	52	excellent	3500		X				0	0	0	0	0	0
	8/8	1205	62	56	excellent	3000		X				0	0	0	0	0	0
	8/14	0745	50	47	good	500	X					0	0	0	0	0	0
	9/6	1030	44	45	good	0						1	0	1	0	0	0
	9/24	1030	48	46	good	7		X				0	0	0	0	0	0
16	7/23	1645	68	56	fair	0						0	0	0	0	0	0
	7/29	1330	66	49	poor	0						0	0	0	0	0	0
	8/8	1320	61	45	excellent	10		X				0	0	0	0	0	0
	8/14	0815	53	43	good	10		X				0	0	0	0	0	0
	8/26	1615	54	48	good	0						12	0	12	0	0	0
	9/6	1110	47	47	good	0						0	0	0	0	0	0
	9/24	1110	52	45	good	1						0	0	0	0	0	0
17	7/23	1630	76	52	excellent	0						0	0	0	0	0	0
	7/29	1340	64	57	good	1500		X				0	0	0	0	0	0
	8/14	0845	53	40	good	0						0	0	0	0	0	0
	8/26	1630	56	43	good	0						0	0	0	0	0	0
	9/6	----	--	--	poor[1/]	0						-	-	-	-	-	-
	9/24	1115	50	46	good	25						0	0	0	0	0	0

Appendix
Table 6. Escapement survey counts conducted on the Susitna River in Sloughs Numbers 18, 19, 20, 21, Devil's Canyon Project 1975.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
18	7/29	1400	62	53	poor	0						0	0	0	0	0	0
	8/14	0920	56	46	good	0						0	0	0	0	0	0
	8/26	1645	56	47	good	0						0	0	0	0	0	0
	9/6	----	--	--	poor 1/	---						-	-	-	-	-	-
	9/24	1145	54	45	good	10						0	0	0	0	0	0
19	7/23	0900	59	44	poor	0						0	0	0	0	0	0
	7/29	1415	62	48	poor	0						0	0	0	0	0	0
	8/10	1125	56	49	fair	0						0	0	0	1	0	1
	8/14	0950	58	42	excellent	0						0	0	0	0	0	0
	8/26	1700	54	43	good	0						0	0	0	20	0	20
	9/6	1135	45	42	good	0						0	0	0	12	0	12
	9/24	1200	52	45	good	20						0	0	0	10	3	13
20	7/23	0915	59	44	poor	0						0	0	0	0	0	0
	7/29	1425	62	49	poor	0						0	0	0	0	0	0
	8/10	1220	54	43	excellent	500		X		X	X	0	0	0	0	0	0
	8/14	1020	60	43	excellent	300		X		X		0	0	0	0	0	0
	8/26	1800	54	44	excellent	200		X		X		0	0	0	0	0	0
	9/6	1220	47	44	good	200		X		X		0	0	0	0	0	0
21	7/23	0940	62	50	poor	0						0	0	0	0	0	0
	7/29	1440	62	48	poor	0						0	0	0	0	0	0
	8/10	1330	61	44	fair	500				X	X	0	0	0	0	0	0
	8/14	1120	60	48	good	500				X	X	0	0	0	0	0	0
	8/26	1830	54	46	poor	150				X		0	0	0	0	0	0
	9/6	1300	46	45	good	300				X		250	146	396	36	0	36
	9/25	1400	54	48	excellent	0						92	34	126	49	26	75

1/ Slough area dried up.

Appendix Table 7. Escapement survey counts conducted on the Susitna River in Whisker's Creek, Chase Creek, Lane Creek, McKenzie Creek, Fourth of July Creek, Indian River and Portage Creek, Devil's Canyon Project, 1975.

Location	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed 1/	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total	King Live	King Dead	King Total	Pink Live	Pink Dead	Pink Total
Whisker's Creek	7/23	1430	65	55	poor	1500	0	0	0	0	0	0	3	2	5	0	0	0
	7/28	1245	60	50	poor	1500	0	0	0	0	0	0	1	0	1	0	0	0
	8/4	1710	68	56	poor	1500	0	0	0	0	0	0	22	1	23	0	0	0
	8/14	1320	66	55	poor	1500	0	0	0	0	0	0	3	1	4	0	0	0
	8/23	1650	60	54	poor	1500	0	0	0	0	0	0	0	0	0	0	0	0
	9/3	1230	56	49	good	0	0	0	0	0	0	0	0	0	0	0	0	0
Chase Creek	7/17	1235	59	58	poor	1500	0	0	0	0	0	0	0	0	0	0	0	0
	7/25	1445	58	57	poor	1500	0	0	0	0	0	0	0	0	0	0	0	0
	8/2	1310	60	58	poor	1500	0	0	0	0	0	0	0	0	0	0	0	0
	8/9	1315	58	57	poor	1500	0	0	0	0	0	0	0	0	0	0	0	0
	8/22	1725	61	57	poor	1500	0	0	0	0	0	0	0	0	0	0	0	0
	9/3	1515	60	54	good	0	1	1	0	0	0	0	0	0	0	0	0	0
Lane Creek	7/21	1330	70	47	excellent	0	0	0	0	0	0	0	0	0	0	0	0	0
	7/26	1545	56	49	excellent	0	0	0	0	0	0	0	0	0	0	20	0	20
	8/6	1245	55	47	excellent	100	0	0	0	0	0	0	1	0	1	81	0	81
	8/17	1700	59	49	excellent	0	3	0	3	0	0	0	0	0	0	106	2	108
	8/27	1220	57	48	excellent	0	1	0	1	0	0	0	0	0	0	25	21	46
	9/3	1700	55	46	excellent	0	0	0	0	0	0	0	0	0	0	2	41	43
	9/27	1415	55	45	poor	0	0	0	0	0	0	0	0	0	0	0	0	0
McKenzie Creek	8/6	1410	60	49	excellent	250	0	0	0	0	0	0	0	0	0	0	0	0
	8/17	1630	59	53	excellent	250	0	0	0	0	0	0	0	0	0	0	0	0
	8/27	1200	54	49	excellent	0	0	0	0	0	0	0	0	0	0	0	0	0
	9/8	1400	51	48	good	200	0	0	0	3	0	3	0	0	0	0	0	0
	9/27	1300	54	46	excellent	0	0	0	0	45	1	46	0	0	0	0	0	0
Fourth of July Creek	7/28	1620	63	46	excellent	0	0	0	0	0	0	0	0	0	0	40	0	40
	8/9	1600	66	56	excellent	0	0	0	0	0	0	0	1	0	1	87	0	87
	8/17	1130	65	53	excellent	0	0	0	0	1	0	1	0	0	0	148	3	151
	8/25	1500	60	55	excellent	0	0	0	0	0	0	0	0	0	0	101	70	171
	9/8	0945	43	45	poor 2/	----	-	-	-	-	-	-	-	-	-	-	-	-
	9/27	1030	50	46	fair	0	0	0	0	0	0	0	0	0	0	0	0	0
Indian River	8/9	1800	--	--	good	0	1	0	1	0	0	0	0	0	0	4	0	4
	8/12	1415	76	57	excellent	0	70	0	70	0	0	0	10	8	18	321	0	321
	9/6	1400	--	--	poor 2/	-	-	-	-	-	-	-	-	-	-	-	-	-
	9/26	1030	57	45	fair	0	1	6	7	1	0	1	0	0	0	0	0	0
Portage Creek	7/23	1030	78	48	excellent	0	0	0	0	0	0	0	2	0	2	0	0	0
	7/29	1700	54	47	excellent	0	0	0	0	0	0	0	25	0	25	0	0	0
	8/10	1400	58	50	good	0	0	0	0	0	0	0	3	0	3	0	0	0
	8/24	1200	52	47	excellent	0	0	0	0	0	0	0	0	0	0	0	0	0
	9/6	1330	--	--	poor 2/	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ All fry present were coho salmon.

2/ White water conditions prevented surveys.

Appendix Table 8. Escapement survey counts conducted on the Talkeetna River in Sloughs Numbers 1, 2, 3, 4, 5, and 6, Devil's Canyon Project, 1975.

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
1	7/25	1300	63	49	excellent	3500		X				0	0	0	0	0	0
	8/5	1030	69	47	excellent	1500		X				0	0	0	0	0	0
	8/19	1015	55	49	excellent	3000		X				0	0	0	0	0	0
	9/2	0945	54	46	good	3000		X				0	0	0	0	0	0
	9/9	1200	50	45	good	2000		X				0	0	0	0	0	0
2	7/25	1735	57	48	excellent	300		X				0	0	0	0	0	0
	8/5	1400	77	55	excellent	1500		X				0	0	0	0	0	0
	8/19	1350	64	55	excellent	0						0	0	0	0	0	0
	9/2	1205	58	47	good	4		X				15	0	15	0	0	0
3	7/25	1750	57	52	poor	0						0	0	0	0	0	0
	8/5	1505	75	50	excellent	1400		X				0	0	0	0	0	0
	8/19	1530	63	54	poor	0						0	0	0	0	0	0
	9/2	1235	54	49	excellent	0						6	0	6	0	0	0
4	7/25	1830	60	48	poor[1/]	0						0	0	0	0	0	0
	8/5	1550	--	--	poor[1/]	0						0	0	0	0	0	0
5	7/25	1410	58	49	excellent	300		X				0	0	0	0	0	0
	8/5	1715	59	54	excellent	20						0	0	0	0	0	0
	8/19	1050	57	55	good[2/]	0						0	0	0	0	0	0
	9/2	1020	--	--	poor[2/]	-						-	-	-	-	-	-
6	7/25	1500	57	46	excellent	3000		X				0	0	0	0	0	0
	8/5	1730	69	48	excellent	500		X				0	0	0	0	0	0
	8/19	1105	59	47	good[3/]	1500		X				0	0	0	0	0	0
	9/2	1040	56	46	good[3/]	300		X				0	0	0	0	0	0
	9/9	1225	48	47	good[3/]	1000		X				0	0	0	0	0	0

Appendix Table 8. Escapement survey counts conducted on the Talkeetna River in Sloughs Numbers 7, 8, and 9, Devil's Canyon Project, 1975 (cont.).

Slough No.	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
7	7/25	1500	57	46	excellent	1000		X				0	0	0	0	0	0
	8/5	1745	69	47	excellent	50		X				0	0	0	0	0	0
	8/19	1130	57	48	good	2000		X				0	0	0	0	0	0
	9/2	1145	57	49	good 3/	400		X				0	0	0	0	0	0
	9/9	1325	48	47	good 3/	500		X				0	0	0	0	0	0
8	8/5	1220	--	--	poor 1/	----						-	-	-	-	-	-
9	7/25	1700	58	49	poor 1/	----						-	-	-	-	-	-
	8/5	1240	--	--	poor 1/	----						-	-	-	-	-	-

1/ The mainstem Talkeetna River flowing through the slough area.

2/ The slough area completely dried up.

3/ The mouth and sections of the slough area dried up.

Appendix Table 9. Escapement survey counts conducted on the Talkeetna River in Beaver Pond, Railroad, Old Channel, Whiskey, Clear Creek Sloughs, and Wiggle Creek, Devil's Canyon Project, 1975.

Slough	Date	Time (military)	Temperature (°F) Air	Temperature (°F) Water	Survey Conditions	No. Fry Observed	Fry Species Identified: King	Coho	Chum	Grayling	Whitefish	Adult Salmon Density: Chum Live	Chum Dead	Chum Total	Sockeye Live	Sockeye Dead	Sockeye Total
Wiggle Creek	7/25	1800	59	57	excellent	0						0	0	0	0	0	0
	8/5	1530	76	59	excellent	1000		X				0	0	0	0	0	0
	8/19	1535	66	57	good	1500		X				0	0	0	0	0	0
	9/2	1300	55	49	good	0						0	0	0	0	0	0
Beaver Pond Slough	7/25	1820	60	48	poor 1/	----						-	-	-	-	-	-
	8/5	1540	75	48	poor 1/	----						-	-	-	-	-	-
	9/2	1350	57	49	good	0						0	0	0	0	0	0
Railroad Slough	8/19	1545	65	58	poor	0						0	0	0	0	0	0
	9/2	1330	55	55	good	0						0	0	0	0	0	0
Old Channel	8/5	1600	72	59	fair	0						0	0	0	0	0	0
Whiskey Slough	7/25	1600	57	52	excellent	3000		X				0	0	0	0	0	0
	8/5	1200	64	52	excellent	3000		X				0	0	0	0	0	0
	8/19	1220	65	55	good	4000		X				50	0	50	0	0	0
	9/2	1100	57	51	good	2000		X				0	0	0	0	0	0
	9/9	1415	50	48	good	200		X				8	0	8	3	0	3
Clear Creek Slough	8/5	1300	75	54	excellent	600						0	0	0	0	0	0
	8/19	1245	63	52	excellent	2000		X		X	X	0	0	0	0	0	0
	9/2	1130	54	47	good	0						-	-	-	-	-	-
	9/9	1500	48	45	good	0						139	21	160	0	0	0

1/ The mainstem Talkeetna River flowing through the slough area.

APPENDIX III

NOTES ON THE MORE COMMON BENTHIC INVERTEBRATES FOUND IN THE SUSITNA RIVER TRIBUTARIES

Insecta

All of the insects collected in the Susitna River sampling sites were larval or pupal forms of insects that are terrestrial in the adult stage. The major portion of the life history usually occurs in the aquatic environment. The adult stages often emerge and live as a terrestrial insect for only a few days. In some instances the adult has no mouth parts (Ephemeroptera). It emerges, carries out the reproductive functions, and dies in two or three days. The juveniles stages of an aquatic insect may last from several months to three years, as with Plecoptera. It is during this developmental stage that all growth or increase in biomass occurs.

Plecoptera (stoneflies)

Stonefly nymphs are strictly aquatic and are found in debris, masses of leaves and algae, and under stones in every kind of lotic environment where there is an abundance of dissolved oxygen. They form an important portion of the diet of fish, especially for members of the trout family, and are commonly found in clear, cool, streams where little organic enrichment occurs (Reid, 1961; Pennak, 1953).

Ephemeroptera (mayflies)

This order of insects is found in all types of fresh water where there is an abundance of dissolved oxygen. The nature of the substrate and the rate of water movements largely determines the species composition. They are all herbivores, very sensitive to temperature changes, and one of the most important sources of fish food (Pennak, 1953). They will not survive even a short-term oxygen depletion (Beeton, 1961).

Tricoptera (caddis flies)

Larval and pupal forms of caddis flies are aquatic and are found in all types of freshwater habitats. Most species of this order build a case of rocks or organic debris. These cases may or may not be attached to the substrate. The larvae and pupa are an important source of fish food and require an adequate supply of dissolved oxygen. The species composition is affected by rate of flow and the nature of the substrate (Pennak, 1953). In swift flowing streams most large concentrations of caddis fly larvae are associated with gravel or cobble bottoms (Hickin, 1968).

Diptera

The Diptera are highly specialized two-winged flies and include common insects such as the horsefly, mosquitoes and midges. Many families have aquatic immature stages, although adults are never found in the aquatic

environment. Representatives of two families, Simuliidae and Ceratopoqonidae, were identified in the Susitna River tributary streams.

Simuliidae (black flies)

Black fly larvae are usually abundant in shallow, swift streams where an abundance of oxygen occurs. They are always attached and feed on plankton and detritus (Pennak, 1953).

Ceratopogonidae (biting midges)

This family of insects is commonly referred to as "no-see-ums." The larvae are most commonly found in floating masses of algae, but also occur in springs, streams, and wet mud along shores (Pennak, 1953).

APPENDIX IV

The Alaska Department of Fish and Game has been requested to assign monetary values to the Susitna River salmon stocks by the Corps of Engineers. These figures will provide a basis for mitigation actions. Total escapement figures are not available for this system and it is therefore difficult to assign a value to the salmon populations. The following has been compiled by Commercial Fisheries staff biologists to partially fulfill the request. It must be emphasized that final figures are only estimates based on feelings of biologists familiar with the Susitna Basin area and do not represent fact.

The estimated maximum sustained yields (MSY) for salmon produced in the Cook Inlet gill net districts, i.e., that area north of the latitude of Anchor Point, based on historical catch trends are:

sockeye	1,700,000
king	66,000
pink	1,800,000
chum	700,000
coho	300,000

The percentage of salmon produced from the Susitna River basin is estimated to be:

sockeye	.50	x	1,700,000	= 850,000
king	.90	x	66,000	= 59,400
pink	.85	x	1,800,000	= 1,530,000
chum	.90	x	700,000	= 630,000
coho	.70	x	300,000	= 210,000

If we assume the above is relatively correct and we relate this to:

1. The average weights of adult salmon by species, i.e., sockeye 6.1 lbs.; king 25.0 lbs.; pink 3.5 lbs.; chum 7.4 lbs.; and coho 6.1 lbs.

2. The average 1975 prices paid to fishermen per pound by species, i.e., sockeye $0.63, king .62, pink .36, chum .43, and coho .47.

Then:

	Susitna Production	x	Average Weight	x	Average Price/lb.	Value to Fishermen
Sockeye	850,000		6.1		.63	$3,266,550
King	59,400		25.0		.62	920,700
Pink	1,530,000		3.5		.36	1,927,800
Chum	630,000		7.4		.43	2,004,660
Coho	210,000		6.1		.47	602,070

The estimated average annual value to fishermen is therefore approximately $8,721,780.

This value does not include the value of salmon it takes to produce the estimated catch produced in the Susitna basin. This may be calculated by using estimated return by spawner by species using the 1975 price per pound paid to fishermen:

Species	Return/Spawner	Spawners/MSY
Sockeye	3.0:1	283,333
King	1.0:1	59,400
Pink	3.8:1	402,632
Chum	2.2:1	286,364
Coho	2.2:1	95,455

Value of Spawners

Species	Average Weight	Average Price	Spawners	Value
Sockeye	6.1	.63	283,333	$1,088,849
King	25.0	.62	59,400	920,700
Pink	3.5	.36	402,632	507,316
Chum	7.4	.43	286,364	911,210
Coho	6.1	.47	95,455	273,670
Average annual value of spawners				$3,701,745

The 1973 average estimated market values of drift gill net vessels and gear were $12,843 and $2,411, respectively. The maximum number of drift gill net units participating in the Cook Inlet fisheries is 625. With a potential loss of a portion or all of the above Susitna River production this investment will constitute a potential loss.

Based on the same 1973 estimates, set gill net gear and sites were valued at $8,223 and $21,563 respectively, or a total of $29,786 per set net fisherman. The maximum number of set gill net units participating in the fishery is 525. As with the drift gill net fishery a portion or all of this investment represents a potential loss.

Other areas of interest would obviously be affected should a drastic decline in salmon production occur. These include, but are not limited to: (1) sport fishermen and supporting services; (2) salmon processing facilities and seasonal employment; (3) State tax of the commercial cannery salmon pack of Cook Inlet; (4) licensing revenues; (5) a variety of commercial fishermen and industry supporting services; and (6) cutback in the numbers of fishermen participating in the fishery by the Commercial Fisheries Entry Commission accomplished through the "buy-back program" costing the State funds.