HYDROLOGIC RECONNAISSANCE OF WESTERN ARCTIC ALASKA, 1976 AND 1977

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GEOLOGICAL SURVEY

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OF

WESTERN ARCTIC ALASKA, 1976 and 1977

By

Joseph M. Childers, Donald R. Kernodle, and Robert M. Loeffler

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UNITED STATES DEPARTMENT OF THE INTERIOR

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CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS--Continued

TABLES

INCH-POUND UNITS AND SI UNIT EQUIVALENTS

Multiply Inch-pound unit	by	to obtain SI unit equivalent
inch (in.)	25.40	millimeter (mm)
foot (ft)	.3058	meter (m)
mile (mi)	1.609	kilometer (km)
cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)
cubic feet per second per square mile [$(ft^3/s)/mi^2$]	1.093×10^{-2}	cubic meter per second per square kilometer [$(m^3/s)/km^2$]

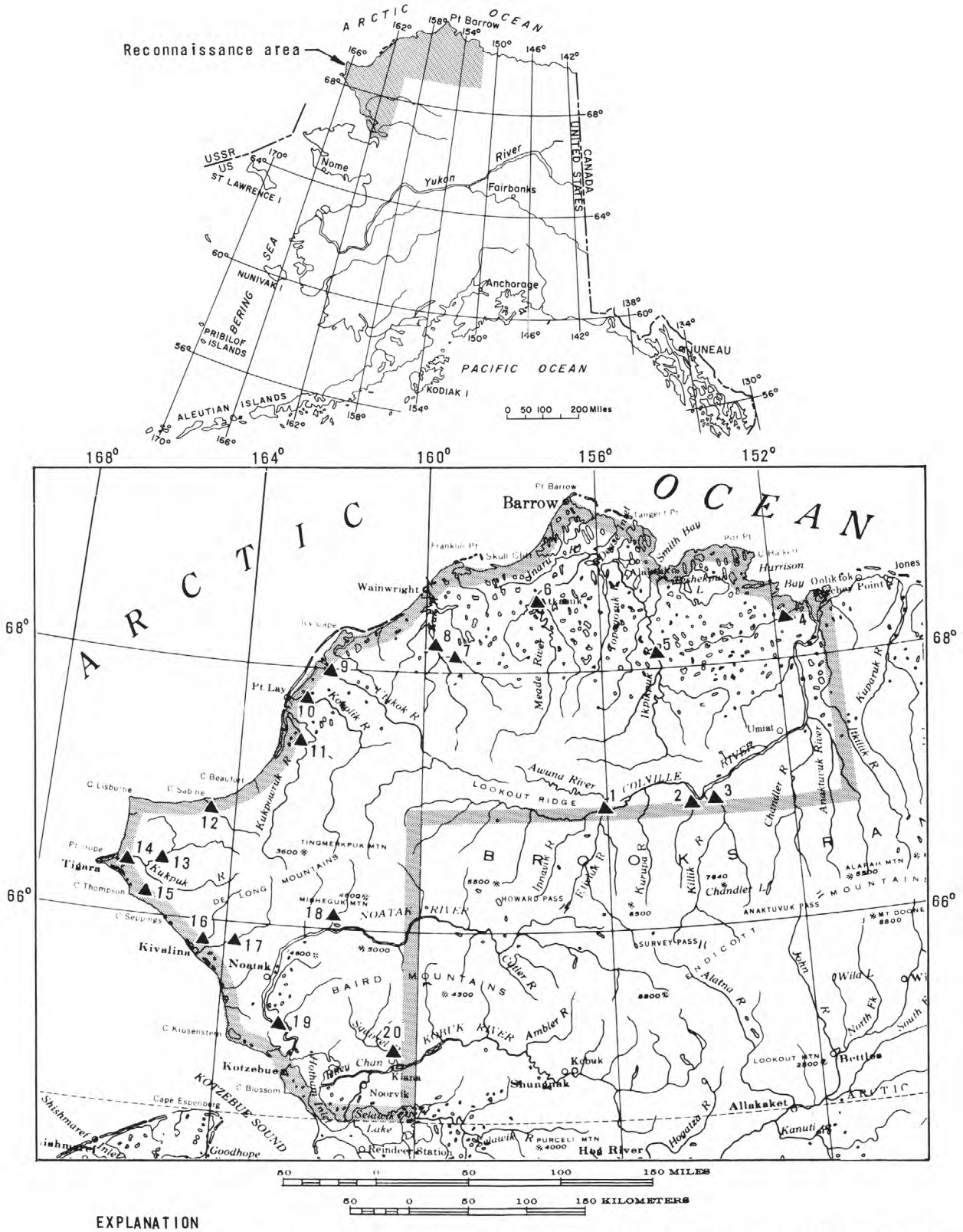

Figure 1.--Reconnaissance area of Western Arctic Alaska showing location of flood survey sites, August 1977.

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ABSTRACT

A reconnaissance of the water resources of the western Arctic was conducted during April 1976 and August 1977. Data were collected at 9 springs, 9 lakes and 22 stream sites.

Using slope-conveyance methods based on field evidence, estimates of bankfull and maximum evident flood-peak discharges were made for 20 selected streams. Maximum evident flood peak discharges ranged from 7.0 to 80.8 $(ft^3/s)/mi^2$ and averaged 30.1 $(ft^3/s)/mi^2$. These estimates bore no obvious relation to either drainage basin physiography or climatological characteristics. Both the bankfull and maximum evident flood-peak discharges were generally less than the 50-year flood and greater than the 2-year flood estimates made using regression relations developed from Alaska stream gaging records and drainage basin characteristics.

Springs were found only in the foothills of the Brooks Range. Their discharge ranged from 1.42 ft^3/s at the Eli River spring to 13.0 ft^3/s at North Fork Squirrel River spring. Water temperatures of springs sampled ranged from 0.0°C at the Omikviorok spring to 3.5°C at the Kavrorak Springs near Kivalina. The nine springs were found by noting the locations of the associated icings on Landsat imagery of the previous year.

Eleven stream sites were sampled under winter conditions; all were on the Arctic Slope. No winter streamflow was found at any of the streams. It appears that the streamflow on the Arctic Slope ceases in late winter except for limited local zones of ground-water discharge that form icings.

Ice thickness on most lakes was 6 ft except at Teshekpuk Lake where the ice was 8 ft thick. Three of the nine lakes examined were frozen to the bottom.

Winter water quality of the lakes and of standing water at stream sites was characterized by higher specific conductivity values than in summer. At three of the five lakes where specific conductance was measured, it was equal to or greater than 700 micromhos per centimeter at 25°C; at four of the five rivers where standing water was found, it

was more than 400 micromhos per centimeter at 25°C.

Biological sampling was done to identify the widest range of benthic invertebrates likely to be present in a representative reach of a stream. A total of nine spring sites was sampled using drift nets in April 1976. Twenty-one stream sites and one spring were sampled in August 1977 by dip nets. Total numbers of organisms collected using drift net sampling in April 1976 ranged from 0 to 480. Total numbers of organisms collected by dip net sampling in August 1977 ranged from 0 to 776.

A hydrologic reconnaissance of the eastern Alaskan Arctic Slope was completed in 1975. The work covered in this report and in the 1975 companion report represents a preliminary hydrologic reconnaissance for the entire Alaskan Arctic Slope and western foothills regions of the Brooks Range.

INTRODUCTION

Reconnaissance water-resource investigations were conducted on the western Alaskan Arctic Slope during April 1976 and August 1977; these months are times of winter and summer low flow. The information gathered is important for coordinated development in the area. Such development has been spurred by oil and gas discoveries on the North Slope, most notably at Prudhoe Bay. Little water resources information is currently available.

The study area for this report extended from the Colville River to the vicinity of Kotzebue (fig. 1). It included the western Arctic Slope and the western foothills of the Brooks Range. This report is a companion to that completed for the eastern Arctic slope in 1975 (Childers and others, 1977). When taken together, reconnaissance coverage includes the entire Alaska Arctic Slope and western foothills region of the Brooks Range, from Kotzebue to the Canadian border.

Nine springs, nine lakes and eleven rivers were sampled during the April 1976 reconnaissance trip. Its purpose was to locate winter flow and describe its quantity and quality. Field water-quality measurements made at these sites were: ice thickness, water depth, discharge (spring and streams), specific conductance, water temperature, dissolved oxygen, alkalinity (bicarbonate, HOC_3), and pH (tables 2, 3, and 4). A followup summer trip was made in August 1977 to determine flood characteristics of twenty selected streams. Bankfull and miximum evident flood-peak discharges were determined by measuring channel geometry and estimating channel roughness.

Aquatic invertebrate samples were collected at springs and flood survey sites visited during both reconnaissance trips. No attempt has been made to determine unit area production values or account for differences between samples collected with dip nets or drift nets.

This report completes the first phase of water resources studies in the Arctic. It attempts to provide preliminary data for an area for which information was previously unavailable. More detailed studies will be necessary for adequate understanding of the data crucial to development and planning purposes. The U.S. Geological Survey is currently (1978) conducting more intensive work in the Noatak basin.

FLOOD SURVEYS

The 20 flood survey sites were preselected on topographic maps to provide an array of streams and drainage areas representative of the western Arctic (fig. 1). Prior to the ground surveys, the sites were studied from the air to insure that reasonably uniform channel reaches were selected. The party then surveyed channel cross sections and longitudinal profiles of the water surface, the bank tops, and the maximum evident flood high-water marks upstream and downstream from the cross sections. At each site, a photograph was made of an area of the streambed covered with deposits that were considered to be representative of the size of streambed material transported during floodflow conditions. In addition, an oblique aerial photograph of each site was made (figs. 2-21).

In the photographs of the flood survey sites (figs. 2-21) on the pages which follow, the upper photo shows the maximum evident flood channel width as measured in feet at the surveyed cross section. The + symbol indicates sites where bed material was photographed. The lower photograph shows typical streambed material; the scale is given in centimeters.

The results of the stream-site studies are shown in table 1. The dominant streambed material was visually classified into standard American Geophysical Union size categories (Lane, 1947, p. 937). Bankfull stage was determined at the observed surface of the flood plain (Leopold and Skibitske, 1967). Discharge was estimated by slope-conveyance methods (Dalrymple and Benson, 1967), and veolocity was calculated from the discharge estimate.

The basin characteristics displayed in table 1 include:

Drainage area, in square miles -- The total drainage area upstream from the stream site.

Precipitation, in inches -- Mean annual precipitation in inches as determined from the National Weather Service (1972) isohyetal map.

Temperature, in ^{o}F -- Mean minimum January temperature in ^{o}F from the isothermal map of Johnson and Hartman (1969).

Area of forests -- The percentage of the drainage area shown as forested on USGS 1:250,000 topographic maps.

Area of lakes and ponds -- The percentage of the drainage area occupied by lakes and ponds.

Table 1 displays flood discharge figures for 2-year (Q_2) and 50-year (Q_{50}) average recurrence intervals. As no streamflow records are available for the streams, the flood discharges were estimated from multiple-regression equations developed for other parts of Alaska that relate flood discharge to the aforementioned basin characteristics (Lamke, 1979).

The calculated bankfull and maximum evident flood discharges generally exceed the estimates of Q_2 but are less than Q_{50}. On the Arctic Slope, drainage basin characteristics such as the presence of continuous permafrost and the amounts and rates of precipitation and snowmelt are important, but their effects on flooding have not been evaluated.

The unit runoff rates for the maximum evident flood shown in table 1 averaged 30.1 cubic feet per second per square mile [$(ft^3/s)/mi^2$] and ranged from 7.0 to 80.8 $(ft^3/s)/mi^2$. These estimates bore no clear relation to drainage basin physiography. The bankfull discharges for Fish Creek and the Avalik River are shown to be greater than the maximum evident flood. This may be due to the fact that part of the channel may be formed in snowbanks; therefore, large floods that occurred then would leave little or no flood debris.

A gaging station was operated on Ogotoruk Creek from August 1958 to September 1961. The maximum discharge recorded during that time was 1,450 cubic feet per second (ft^3/s), significantly greater than the 850 ft^3/s maximum evident flood measurement of this study. There is no means of reconciling the difference between these two measurements other than to note that "the record and the gage location were poor... Because the stream-control section for the station was unstable gravel riffle, there was an uncertain stage-discharge relation" (Likes, 1966, p. 126).

SPRINGS

On the Arctic Slope, streamflow virtually ceases in the winter except in zones of ground-water discharge (springs) and the channel reaches immediately downstream from these areas. During the winter, water that discharges from springs freezes downstream from its source to form icings. The location, thickness, and total area of the icing depends primarily on the volume of water supplied and to a lesser extent on the water temperature, air temperature and topography in the area of ice accumulation.

Satellite imagery taken in the late winter of 1975 was used to locate springs and icings to be visited during the reconnaissance trips. Nine springs were examined in April 1976. The locations of those springs are shown on figure 22. At each spring, discharge was measured, and field measurements were made of water temperature, specific conductance,

pH, alkalinity and dissolved oxygen concentration. Samples were collected for laboratory analysis of selected dissolved chemical constituents (table 2). The discharge measurements were made far enough downstream to include the flow of different orifices, yet as close to the source as practical. Water-quality measurements were made and samples were taken near the discharge measurement site. A photograph was also taken of each site (figs. 23-31).

The water quality of these springs was generally similar to the quality of surface waters of the area, low in dissolved constituents and soft. Dissolved oxygen values ranged from 3.8 milligrams per liter (mg/L) to 14.0 mg/L. This difference in values could be due in part to location of sample points with respect to spring orifices. All spring waters sampled were clear with no discernable turbidity. The pH values ranged from 6.9 to 7.8. These spring waters are of the calcium bicarbonate type except for Kavrorak Springs which is a sodium chloride type. Dissolved solids ranged from 115 mg/L to Kivalina River tributary spring to 936 mg/L at Kavrorak Springs.

Kavrorak Springs had the highest specific conductance values of any spring sampled in April 1976 [1,460 micromhos (µmhos) per cm at 25°C]. This spring was also visited in August 1977 when a value of 2,500 µmhos was measured. Specific conductance for the nine springs sampled during April 1976 ranged from 155 to 1,460 µmhos. Sodium and chloride concentrations were also highest at Kavrorak Springs (240 and 420 mg/L respectively). The relationships, if any, of these values to the nearby ocean are not understood.

Because springs are the major source of flowing water during the long winter season, they support a varied and abundant flora and fauna, and often provide an important overwintering habitat for fish.

LAKES

Winter water-quality investigations were conducted on eight lakes in the western Arctic coastal plain and Narvakrak Lake in the Noatak drainage (fig. 22). The coastal plain is very poorly drained and abounds in shallow thermokarst lakes. Many are elongated and oriented approximately N 15° W. The maximum lake length is approximately 30 miles (mi) at Teshekpuk Lake, and many lakes are known to exceed 20 feet (ft) in depth, although most are probably shallower.

During the winter, the shallower lakes (those less than 6 ft deep) freeze solid and deeper ones have a significant portion of their water stored as ice. This winter freezing process concentrates dissolved constituents, causing the remaining water to become brackish. Specific conductance ranged from 360 to 1,350 µmhos. Hardness ranged from 100 to 406 mg/L (table 3).

With the exception of Teshekpuk Lake where ice was 8 ft thick, ice

thickness at the nine sites was found to be fairly uniform, approximately 6 ft. Three lakes were frozen to bottom at the sampling point; of the remaining six, only Teshekpuk Lake had an effective depth of water greater than one foot. All of the lakes on the coastal plain had relatively high concentrations of dissolved sodium and chloride which ranged from 25 to 130 and from 50 to 370 mg/L respectively. These concentration levels are probably influenced by occasional wind storms which blow ocean water or spray into these lakes.

STREAMS

There is little or no winter streamflow on the western Arctic Slope. Where flow does exist, it is generally close to a spring and does not proceed far downstream before becoming frozen in an icing. Where the stream is shallow, it is likely to freeze solid; where it is deeper, pools may remain. The water of these pools is subject to the same freeze-concentration mechanisms which work on lakes. Consequently, they have relatively high winter concentrations of dissolved constituents.

All eleven stream sites visited during April 1976 were on the Arctic Slope (fig. 32). At five sites streams were frozen solid, and no flow was detected in the remaining six. Where standing water was found, a field determination was made for specific conductance, pH, water temperature, alkalinity and dissolved oxygen, and samples were obtained for laboratory analysis of the dissolved chemical constituents and total organic carbon (table 4). Specific conductance ranged from 295 to 850 µmhos; hardness ranged from 130 to 456 mg/L, and pH values were quite consistent, ranging from 7.3 to 7.6. Water temperatures ranged from 0.1 to -2.0°C. The negative value was measured at the Kuk River and is probably due to saltwater influence.

During August 1977 low flow conditions were usually encountered. Most streams were clear and shallow, usually less than 3 ft deep. Field measurements of water temperature and specific conductance were made at each of the 20 flood survey sites and at two sites where flood surveys were not made. Samples were also taken for laboratory analysis of turbidity and color. Specific conductance ranged from 70 to 375 µmhos per cm at 25°C (excluding an estuarine site in the Kuk River, and Kavrorak Springs). Turbidity values ranged from 1.5 to 3.9 Ntu, and color ranged from 0 to 15 platinum-cobalt units.

AQUATIC INVERTEBRATES

Biological surveys were conducted during April 5-7, 1976, and in conjunction with flood surveys during August 11-20, 1977. The sites selected were considered to be representative of a given spring or stream aquatic habitat and would indicate in a general way the presence and relative abundance of the various aquatic invertebrates. Tables 5 and 6 list aquatic invertebrates as percent of total numbers collected, the total number of identifiable groups having similar characteristics

(taxa), and total number of organisms collected per sample.

During the April trip, drift net sampling was used at nine collection sites (table 5). These nine spring sites were sampled where little or no ice cover was present. April was chosen for the sampling time because late winter, minimum stream-flow conditions would normally be expected. Drift net sampling was carried out using a Surber stream bottom sampler fitted with nylon netting have 0.210-millimeter (mm) mesh openings. This sampler was set as a drift net by anchoring it in place with rods driven into the stream bed. Total numbers of organisms collected ranged from none at Kelly River spring to 480 individuals at Kivalina River tributary spring where the sample was composed almost entirely of ephemeroptera nymphs. The number of taxa ranged from 0 to 5 (table 5).

The second collection period was in August 1977 when conditions were representative of late summer flow. Sampling during this trip was done using a dip net fitted with nylon netting having 0.210-mm mesh opening. (Slack and others, 1973). This sampling was performed for approximately 15 minutes each at 21 stream sites and one spring (table 6 and fig. 32). Sites in table 6 are the same as those on table 4 which lists physical parameters and dissolved chemical constituents. Total numbers of organisms collected ranged from 0 on the Noatak River to 728 on the Pitmegea River.

Dip net sampling was limited to areas of a stream which could be reached by a person wearing chest waders. Where high-water conditions were present, as at the Wulik River site (table 6, map number 22), sampling of representative aquatic habitats was not possible, and consequent findings can not be considered as truly representative of the aquatic community. Samples from sites whose channels had sandy substrates (Fish Creek, Ikpikpuk River, Avalik River, Kuk River, Squirrel River and Kobuk River, table 6) yielded fewer specimens and taxa than samples from those sites having substrates composed primarily of gravel and cobbles.

Recommendations

Arctic Alaska encompasses over 150,000 square miles, yet its water resources are for the most part unknown. Factors such as climate, permafrost, and large expanses of pristine land make this region unique. Exploration and development here will require planning for water supplies, flood control, erosion control, and other activities.

The need for estimating streamflow characteristics may develop at any site on any stream. For large water development projects such as hydroelectric generation, flood control or water-supply storage, long-term station records are indispensible. The accuracy of estimates based on gaging site records depends primarily on the length of record, and there is a considerable gain in accuracy for additional years of record up to about 25 years (Childers, 1970). Consequently, adequate planning

requires a long lead time.

The need for different types of information tends to govern the design of data-collection programs. In arctic Alaska, data-collection has scarcely begun. It is imperative that planners express their priorities for water information early, to allow the data collection to be tailored to the needs.

Estimates of streamflow characteristics for ungaged sites may be based on records of adequate lengths at hydrologically similar sites. Selection of representative gaging station sites to sample the range of hydrologic conditions which exist in arctic Alaska requires consideration of factors such as topographic relief, precipitation, geology and drainage basin size. The harsh weather conditions, increased construction requirements and transportation, usually requiring aircraft, all contribute to the tremendous cost of data collection in the Arctic. Improved techniques and instrumentation which can decrease the complexity and costs of the data collection in the Arctic are needed.

Satisfactory streamgaging stations could be established at several of the flood survey sites visited during this reconnaissance. The Kugururok River (fig. 32, map number 24) is a perennial stream and a principal tributary of the Noatak River. A gage site could be located downstream from the flood survey site (fig. 20). A suitable site to gage the Noatak River could be located in either the Noatak Canyon or the Grand Canyon of the Noatak.

A gaging station was operated during the period 1965-71 (no winter records) on the Noatak River in the Lower Noatak Canyon. Tidal action in Kotzebue Sound causes variable and indefinite flow conditions at the gage and probably throughout the Lower Noatak Canyon. This caused the poor discharge records for the gaging station.

Gaging stations could also be located near flood survey sites on the Kukpuk River (fig. 15), Kukpowruk River (fig. 12), and Meade River (fig. 7).

The information in this and its companion report (Childers and others, 1977) provides 'broad brush' basic data on flooding, channel geometry and low-flow conditions for major streams, and basic water-quality data for springs, lakes and streams. Further work should be concentrated in selected watersheds. Water-resource surveys of entire drainage basins could give in-depth information to complement the present 'broad-brush' studies. Such a study of the Noatak River basin has already begun. During 1979 the Geological Survey investigated late winter conditions, identifying sources of water, their quantity and quality within the Noatak basin. Surveys of flood and channel erosion conditions, as well as late summer flow conditions, were also done in 1978 along the mainstem of the Noatak River and the mouths of major tributaries.

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Table 1.--*Flood characteristics and channel geometry at the flood survey sites. Locations are shown on figure 1.*

Map No.	Stream site (lat and long)	Bankfull Channel							Maximum Evident Flood			Basin Characteristics					Flood Characteristics	
		Streambed material	Slope (ft/ft)	Width (ft)	Mean depth (ft)	Max. depth (ft)	Ave. vel. (ft/s)	Discharge (ft^3/s) (computed)	Width (ft)	Discharge (ft^3/s) (computed)	Unit runoff [$(ft^3/s)/mi^2$]	Drainage area (mi^2)	Mean annual precip. (in.)	Mean minimum Jan. temp. (°F)	Area forests (percent)	Area lakes and ponds (percent)	Q_2 (2-yr flood) (computed)	Q_{50} (50-yr flood) (computed)
1	Etivluk R. 68°56'42" 155°57'42"	Coarse gravel	0.0031	1,490	5.0	12.0	6.4	45,100	1,530	49,400	21.6	2,264	15	-18	0	0.83	34,000	84,000
2	Colville R. 69°00'12" 153°54'36"	Medium gravel	.00092	1,460	12.8	23.0	10.7	200,000	1,460	236,000	29.2	8,070	15	-18	0	.41	117,000	238,000
3	Killik R. 68°58'00" 153°47'00"	Coarse gravel	.0015	490	6.3	12.0	6.8	21,000	490	29,700	10.8	2,771	20	-18	0	.72	52,000	121,000
4	Fish Cr. 70°19'00" 151°28'36"	Medium sand	.0012	380	6.6	12.0	5.3	18,200	350	11,700	7.0	1,699	5	-20	0	24.9	7,000	18,000
5	Ikpikpuk R. 70°08'12" 154°38'30"	Medium sand	.00027	1,120	8.1	15.0	4.9	45,000	1,260	76,900	19.3	3,980	9	-20	0	4.66	32,000	74,000
6	Meade R. 70°29'20" 157°24'40"	Coarse gravel	.0016	470	3.8	9.0	4.8	8,700	700	105,300	58.6	1,798	8	-20	0	2.85	15,000	38,000
7	Avalik R. 70°07'30" 159°25'12"	Fine gravel	.0007	840	11.3	17.0	9.8	93,300	840	91,300	80.8	1,130	10	-20	0	2.02	12,000	33,000
8	Kuk R. 70°08'06" 159°40'42"	Medium sand	.00018	870	10.3	17.0	6.3	56,600	870	61,100	16.6	3,688	10	-20	0	.24	43,000	101,000
9	Utukok R. 69°57'48 162°03'12"	Small cobbles	.0012	1,580	6.3	13.0	6.3	62,000	1,580	62,000	22.4	2,765	10	-20	0	.60	31,000	76,000
10	Kokolik R. 69°45'39" 162°31'00"	Medium gravel	.0017	570	7.0	10.0	7.3	29,200	630	43,800	19.3	2,271	15	-16	0	1.46	32,000	73,000
11	Kukpowruk R. 69°29'50" 162°43'30"	Coarse gravel	.0017	400	6.4	8.0	7.0	18,200	410	33,000	19.5	1,694	18	-16	0	.10	38,000	78,000

Table 1.--*Flood characteristics and channel geometry at the flood survey sites. Locations are shown on figure 1*--Continued.

Map No.	Stream Site (lat and long)	Bankfull Channel							Maximum Evident Flood			Basin Characteristics					Flood Characteristics	
		Streambed material	Slope (ft/ft)	Width (ft)	Mean depth (ft)	Max. depth (ft)	Ave. vel. (ft/s)	Discharge (ft^3/s) (computed)	Width (ft)	Discharge (ft^3/s) (computed)	Unit runoff [$(ft^3/s)/mi^2$)]	Drainage area (mi^2)	Mean annual precip. (in.)	Mean minimum Jan. temp. (°F)	Area forests (percent)	Area lakes and ponds (percent)	Q_2 (2-yr flood) (computed)	Q_{50} (50-yr flood) (computed)
12	Pitmegea R. 68°51'15" 164°25'36"	Medium gravel	0.0089	320	4.1	7.0	9.1	11,900	380	25,000	52.1	480	20	-16	0	0.21	11,000	30,000
13	Ipewik R. 68°25'30" 165°29'00"	Coarse gravel	.0018	380	9.7	12.0	9.5	35,000	400	46,800	43.9	1,067	18	-16	0	.14	21,000	53,600
14	Kukpuk R. 68°24'24" 165°56'40"	Medium gravel	.0031	1,028	6.3	12.0	9.4	62,100	1,120	83,500	38.3	2,178	15	-16	.02	.16	36,000	82,000
15	Ogotoruk Cr. 68°06'40" 165°45'10"	Medium gravel	.0051	150	0.5	1.0	1.6	110	320	850	23.0	36.9	15	-16	0	.08	790	3,200
16	Kivalina R. 67°48'42" 164°30'42"	Fine gravel	.0005	514	4.7	8.0	2.8	6,800	520	11,300	15.3	740	17	-16	1.33	.292	12,000	33,000
17	Wulik R. 67°49'54" 163°58'00"	Medium gravel	.0053	750	5.3	11.0	9.9	39,000	750	39,000	47.5	822	20	-16	.42	.29	17,000	44,000
18	Kugururok R. 68°01'24" 161°50'08"	Coarse gravel	.0019	484	3.5	6.0	4.1	6,900	630	11,600	12.9	901	10	-16	1.06	.31	10,000	38,000
19	Noatak R. 67°15'24" 162°35'09"	Small cobbles	.00064	1,320	26.2	47.0	13.3	461,300	1,320	461,300	37.2	12,400	20	-16	2.42	.90	172,000	312,000
20	Squirrel R. 67°02'00" 169°24'00"	Coarse silt	.00013	560	17.6	26.0	4.5	44,500	570	46,200	26.8	1,725	10	-16	24.6	.48	13,000	29,000

Table 2.--*Physical parameters and dissolved chemical constituents of springs. Locations are shown in figure 22.*

Map No.	1	2	3	4 & 27		5
Station Name	Kelly River spring	Kivalina River tributary spring	Wulik River spring	Kavrokak Springs		Omikviorok Spring
Latitude	68°12'06"	68°08'24"	67°55'30"	67°52'26"		67°41'50"
Longitude	162°12'45"	163°57'18"	163°34'20"	164°52'37"		164°02'30"
Date	04-06-76	04-07-76	04-06-76	04-07-76	08-16-77	04-06-76
Ice thickness (ft)	0	0	0	0	0	0
Water depth	1.0	2.0	1.0	2.0	--	1.0
Discharge (ft^3/s)	5.9	7.0	9.6	5.3	15 est	3.3
Specific conductance (μmhos/cm at 25°C)	280	190	270	1,460	2,500	195
Water temperature (°C)	0.5	2.5	0.5	3.5	4.0	0.0
Dissolved oxygen (mg/L)	3.8	7.8	7.0	10.5	--	8.4
Turbidity (Ntu)*	--	--	--	--	--	--
Color (platinum-cobalt units)	--	--	--	--	--	--
Bicarbonate (HCO_3) (mg/L)	150	124	148	164	--	124
Hardness ($CaCO_3$) (mg/L)	158	106	150	260	--	104
pH (units)	7.3	7.6	7.2	7.8	--	7.2
Dissolved potassium (K) (mg/L)	.3	.2	.3	10	--	.3
Dissolved sodium (Na) (mg/L)	1.4	1.4	1.5	240	--	1.5
Carbon dioxide (CO_2) (mg/L)	12	5.0	15	4.2	--	13
Dissolved sulfate (SO_4) (mg/L)	32	6.1	19	48	--	4.3
Dissolved chloride (Cl) (mg/L)	.9	.0	.0	420	--	2.7
Dissolved fluoride (F) (mg/L)	.0	.2	.0	.1	--	.0
Dissolved silica (SiO_2) (mg/L)	2.6	4.0	2.7	3.1	--	3.3

*Turbidity was determined using a Hach 2100A Nephelometric Turbidity Meter calibrated against standard formazin solution. Turbidity values are reported as Ntu (nephelometric turbidity units). Recent study by the USGS and others has revealed inconsistent values for turbidity depending upon instruments used and fluids measured. More information on turbidity studies may be obtained by reading U.S. Geological Survey Open-file Report 76-153,Measurement of Turbidity and Related Characteristics of Natural Waters,by R. J. Pickering, Chief of USGS Quality of Water Branch.

The use of named products in this report is for identification only and does not imply endorsement by the U.S. Geological Survey.

Table 2.--*Physical parameters and dissolved chemical constituents of springs. Locations are shown in figure 22*--Continued.

Map No.	1	2	3	4 & 27		5
Station Name	Kelly River spring	Kivalina River tributary spring	Wulik River spring	Kavrokak Springs		Omikvirok Spring
Latitude	68°12'06"	68°08'24"	67°55'30"	67°52'26"		67°41'50
Longitude	162°12'45"	163°57'18"	163°34'20"	164°52'37"		164°02'30"
Dissolved nitrite plus nitrate (N) (mg/L)	.18	.17	.12	.24	--	.37
Dissolved ortho-phosphorus (P) (mg/L)	.00	.00	.00	.00	--	.01
Dissolved lithium (Li) (µg/L)	0	0	0	30	--	0
Dissolved vandium (V) (µg/L)	.1	.5	.0	5.1	--	.1
Total organic carbon (C) (mg/L)	--	4.8	7.0	.8	--	--
Total barium (Ba) (µg/L)	--	--	--	--	--	--
Total cadmium (Cd) (µg/L)	--	--	--	--	--	--
Total lead (Pb) (µg/L)	--	3	3	2	--	--
Total copper (Cu) (µg/L)	--	1	1	1	--	--
Dissolved solids (residue at 180°C) (mg/L)	--	115	165	936	--	--
Dissolved cobalt (Co) (µg/L)	--	2	2	2	--	--
Dissolved iron (Fe) (µg/L)	--	20	30	120	--	--
Dissolved manganese (Mn) (µg/L)	--	0	0	0	--	--
Dissolved nickel (Ni) (µg/L)	--	2	1	2	--	--
Dissolved silver (Ag) (µg/L)	--	0	0	0	--	--
Dissolved zinc (Zn) (µg/L)	--	10	7.0	.80	--	--

Table 2.--*Physical parameters and dissolved chemical constituents of springs. Locations are shown in figure 22*--Continued.

Map No.	6	7	8	9
Station Name	Eli River spring	Rabbit Creek spring	North Fork Squirrel River spring	Amaouk Creek spring
Latitude	67°42'51"	67°28'20"	67°18'18"	66°58'48"
Longitude	162°19'36"	163°46'00"	161°08'55"	161°19'00"
Date	04-06-76	04-07-76	04-05-76	04-05-76
Ice thickness (ft)	0	0	0	0
Water depth	0.5	1.0	2.0	1.0
Discharge (ft^3/s)	1.4	11	13	3.1
Specific conductance (μmhos/cm at 25°C)	280	155	260	320
Water temperature (°C)	1.0	1.0	2.0	1.0
Dissolved oxygen (mg/L)	9.0	11.5	14.0	10.1
Turbidity (Ntu)	--	--	--	--
Color (platinum-cobalt units)	--	--	--	--
Bicarbonate (HCO_3) (mg/L)	166	96	176	160
Hardness (total Ca, Mg) (mg/L)	162	80	152	130
pH (units)	--	7.1	--	6.9
Dissolved potassium (K) (mg/L)	.4	.3	.2	.4
Dissolved sodium (Na) (mg/L)	1.8	1.6	.6	3.6
Carbon dioxide (CO_2) (mg/L)	--	12	--	32
Dissolved sulfate (SO_4) (mg/L)	25	3.3	4.0	1.3
Dissolved chloride (Cl) (mg/L)	.7	2.4	.0	2.4
Dissolved fluoride (F) (mg/L)	.1	.0	.0	.1
Dissolved silica (SiO_2) (mg/L)	5.4	4.0	2.0	4.3

Table 2.--*Physical parameters and dissolved chemical constituents of springs. Locations are shown in figure 22*--Continued.

Map No.	6	7	8	9
Station Name	Eli River spring	Rabbit Creek spring	North Fork Squirrel River spring	Amaouk Creek spring
Latitude	67°42'51"	67°28'20"	67°18'18"	66°58'48"
Longitude	162°19'36"	163°46'00"	161°08'55"	161°19'00"
Dissolved nitrite plus nitrate (N) (mg/L)	.15	.29	.24	.30
Dissolved ortho-phosphorus (P) (mg/L)	.00	.00	.00	.00
Dissolved lithium (Li) (µg/L)	0	0	0	0
Dissolved vanadium (V) (µg/L)	.0	.0	.2	.0
Total organic carbon (C) (mg/L)	--	--	.1	.7
Total barium (Ba) (µg/L)	--	--	--	--
Total cadmium (Cd) (µg/L)	--	--	--	--
Total lead (Pb) (µg/L)	1	--	3	0
Total copper (Cu) (µg/L)	0	--	1	0
Dissolved solids (residue at 180°C) (mg/L)	182	--	167	195
Dissolved cobalt (Co) (µg/L)	2	--	2	0
Dissolved iron (Fe) (µg/L)	40	--	80	40
Dissolved manganese (Mn) (µg/L)	0	--	0	0
Dissolved nickel (Ni) (µg/L)	0	--	1	2
Dissolved silver (Ag) (µg/L)	0	--	0	0
Dissolved zinc (Zn) (µg/L)	0	--	0	0

Table 3.--*Physical parameters and dissolved chemical constituents of lakes. Locations shown in figure 22.*

Map No.	1	2	3	4	5
Station Name	Teshekpuk Lake near Three Ranch	Itinik Lake near Nalimiut Point	Unnamed lake near Atanik near Wainwright	Winter Water Supply Lake near Wainwright	Sikolik Lake near Wainwright
Latitude	70°36'06"	70°39'55"	70°49'50"	70°37'10"	70°09'55"
Longitude	153°30'00"	158°34'30"	159°20'24"	159°45'25"	161°27'18"
Date	04-19-76	04-17-76	04-17-76	04-16-76	04-16-76
Ice thickness (ft)	8.0	6.5	6.0	6.0	6.0
Water depth	12.0	1.0	0.0	1.0	0.0
Specific conductance (μmhos at 25°C)	360	1,350	--	375	--
Water temperature (°C)	.5	.0	--	.0	--
Dissolved oxygen (mg/L)	19.0	--	--	3.2	--
Turbidity (Ntu)	--	--	--	--	--
Color (platinum-cobalt units)	--	--	--	--	--
Bicarbonate (HCO_3) (mg/L)	150	244	--	50	--
Hardness (total Ca, Mg) (mg/L)	136	406	--	100	--
pH (units)	7.6	6.6	--	6.0	--
Dissolved potassium (K) (mg/L)	1.8	4.3	--	2.7	--
Dissolved sodium (Na) (mg/L)	25	130	--	32	--
Carbon dioxide (CO_2) (mg/L)	6.0	98	--	80	--
Dissolved sulfate (SO_4) (mg/L)	4.0	4.5	--	5.2	--
Dissolved chloride (Cl) (mg/L)	50	370	--	94	--
Dissolved fluoride (F) (mg/L)	.0	.1	--	.1	--
Dissolved silica (SiO_2) (mg/L)	.4	1.4	--	.9	--

Table 3.--*Physical parameters and dissolved chemical constituents of lakes. Locations shown in figure 22*--Continued.

Map No.	1	2	3	4	5
Station Name	Teshekpuk Lake near Three Ranch	Itinik Lake near Nalimiut Point	Unnamed lake near Atanki near Wainwright	Winter Water Supply Lake near Wainwright	Sikolik Lake near Wainwright
Latitude	70°36'06"	70°39'55"	70°49'50"	70°37'10"	70°09'55"
Longitude	153°30'00"	158°34'30"	159°20'24"	159°45'25"	161°27'18"
Dissolved nitrite plus nitrate (N) (mg/L)	.11	.10	--	.31	--
Dissolved ortho-phosphorus (P) (mg/L)	.00	.00	--	.00	--
Dissolved lithium (Li) (µg/L)	0	0	--	0	--
Dissolved vanadium (V) (µg/L)	.0	5.3	--	.8	--
Total organic carbon (C) (mg/L)	--	--	--	--	--
Total barium (Ba) (µg/L)	--	--	--	--	--
Total cadmium (Cd) (µg/L)	--	--	--	--	--
Total lead (Pb) (µg/L)	--	--	--	--	--
Total copper (Cu) (µg/L)	--	--	--	--	--
Dissolved solids (residue at 180°C) (mg/L)	--	--	--	--	--
Dissolved cobalt (Co) (µg/L)	--	--	--	--	--
Dissolved iron (Fe) (µg/L)	--	--	--	--	--
Dissolved manganese (Mn) (µg/L)	--	--	--	--	--
Dissolved nickel (Ni) (µg/L)	--	--	--	--	--
Dissolved silver (Ag) (µg/L)	--	--	--	--	--
Dissolved zinc (Zn) (µg/L)	--	--	--	--	--

Table 3.--*Physical parameters and dissolved chemical constituents of lakes. Locations shown in figure 22*--Continued.

Map No.	6	7	8	9
Station Name	Unnamed lake tributary to Kokolik River near Point Lay	Kuvirok Lake near Point Lay	Winter Water Supply Lake near Point Lay	Narvakrak Lake near Noatak
Latitude	69°43'35"	69°30'38"	69°44'25"	68°00'00"
Longitude	161°48'37"	162°20'30"	162°56'30"	161°43'12"
Date	04-14-76	04-14-76	04-15-76	04-06-76
Ice thickness (ft)	6.0	6.0	6.0	5.5
Water depth	0.0	1.0	1.0	1.0
Specific conductance (µmhos at 25°C)	--	730	700	--
Water temperature (°C)	--	0.0	0.0	0.5
Dissolved oxygen (mg/L)	--	--	--	--
Turbidity (Ntu)	--	--	--	--
Color (platinum-cobalt units)	--	--	--	--
Bicarbonate (HCO_3) (mg/L)	--	348	264	134
Hardness (total Ca, Mg) (mg/L)	--	314	270	150
pH (units)	--	7.1	6.8	6.7
Dissolved potassium (K) (mg/L)	--	3.3	3.4	1.5
Dissolved sodium (Na) (mg/L)	--	43	57	3.2
Carbon dioxide (CO_2) (mg/L)	--	44	67	43
Dissolved sulfate (SO_4) (mg/L)	--	3.7	1.7	5.8
Dissolved chloride (Cl) (mg/L)	--	94	110	4.9
Dissolved fluoride (F) (mg/L)	--	.1	.1	.1
Dissolved silica (SiO_2) (mg/L)	--	.4	.7	2.5

Table 3.--*Physical parameters and dissolved chemical constituents of lakes. Locations shown in figure 22*--Continued.

Map No.	6	7	8	9
Station Name	Unnamed lake tributary to Kokolik River near Point Lay	Kuvirok Lake near Point Lay	Winter Water Supply Lake near Point Lay	Narvakrak Lake near Noatak
Latitude	69°43'35"	69°30'38"	69°44'25"	68°00'00"
Longitude	161°48'37"	162°20'30"	162°56'30"	161°43'12"
Dissolved nitrite plus nitrate (N) (mg/L)	--	.15	.17	.07
Dissolved ortho-phosphorus (P) (mg/L)	--	.00	.00	.00
Dissolved lithium (Li) (µg/L)	--	10	0	0
Dissolved vanadium (V) (µg/L)	--	.5	1.1	.9
Total organic carbon (C) (mg/L)	--	--	--	21
Total barium (Ba) (µg/L)	--	--	--	300
Total cadmium (Cd) (µg/L)	--	--	--	10
Total lead (Pb) (µg/L)	--	--	--	200
Total copper (Cu) (µg/L)	--	--	--	370
Dissolved solids (residue at 180°C) (mg/L)	--	--	--	--
Dissolved cobalt (Co) (µg/L)	--	--	--	--
Dissolved iron (Fe) (µg/L)	--	--	--	--
Dissolved manganese (Mn) (µg/L)	--	--	--	--
Dissolved nickel (Ni) (µg/L)	--	--	--	--
Dissolved silver (Ag) (µg/L)	--	--	--	--
Dissolved zinc (Zn) (µg/L)	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32.*

Map No.	1	2	3	4
Station Name	Etivluk River near Umiat	Colville River at Killik River near Umiat	Killik River near Umiat	Fish Creek above Tigmeachsiovik River near Nuiqsut
Latitude	68°56'42"	69°00'12"	68°58'00"	70°19'00"
Longitude	155°57'42"	153°54'36"	153°47'00"	151°28'36"
Date	08-11-77	08-12-77	08-11-77	08-12-77
Ice thickness (ft)	--	--	--	--
Water depth	--	--	--	--
Discharge (ft^3/s)	--	--	--	--
Specific conductance (µmhos at 25°C)	110	150	150	140
Water temperature (°C)	14.0	17.0	12.0	9.5
Dissolved oxygen (mg/L)	--	--	--	--
Turbidity (Ntu)	2	3	3	2
Color (platinum-cobalt units)	5	5	5	5
Bicarbonate (HCO_3) (mg/L)	--	--	--	--
Hardness (total Ca, Mg) (mg/L)	--	--	--	--
pH (units)	--	--	--	--
Dissolved potassium (K) (mg/L)	--	--	--	--
Dissolved sodium (Na) (mg/L)	--	--	--	--
Carbon dioxide (CO_2) (mg/L)	--	--	--	--
Dissolved sulfate (SO_4) (mg/L)	--	--	--	--
Dissolved chloride (Cl) (mg/L)	--	--	--	--
Dissolved fluoride (F) (mg/L)	--	--	--	--
Dissolved silica (SiO_2) (mg/L)	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	5	6	7		8
Station Name	Ikpikpuk River near Lonely	Chipp River near Barrow	Meade River at Atkasuk		Avalik River near Wainwright
Latitude	70°08'12"	70°41'35"	70°29'20"		70°04'40"
Longitude	154°38'30"	155°27'00"	155°24'40"		159°02'40"
Date	08-13-77	04-18-76	04-18-76	08-13-77	04-17-76
Ice thickness (ft)	--	7.8	5.0	--	5.9
Water depth	--	7.7	5.7	--	1.7
Discharge (ft^3/s)	--	0	0	--	0
Specific conductance (µmhos at 25°C)	150	425	450	165	420
Water temperature (°C)	12.0	.5	.0	11.0	.0
Dissolved oxygen (mg/L)	--	12.6	9.6	--	9.0
Turbidity (Ntu)	4	--	--	3	--
Color (platinum-cobalt units)	10	--	--	5	--
Bicarbonate (HCO_3) (mg/L)	--	242	226	--	234
Hardness (Total Ca, Mg) (mg/L)	--	212	222	--	252
pH (units)	--	7.6	7.3	--	7.3
Dissolved potassium (K) (mg/L)	--	1.8	1.9	--	1.5
Dissolved sodium (Na) (mg/L)	--	6.5	6.8	--	17
Carbon dioxide (CO_2) (mg/L)	--	9.7	18	--	19
Dissolved sulfate (SO_4) (mg/L)	--	4.8	1.7	--	8.2
Dissolved chloride (Cl) (mg/L)	--	12	9.8	--	35
Dissolved fluoride (F) (mg/L)	--	.1	.1	--	.1
Dissolved silica (SiO_2) (mg/L)	--	2.3	5.5	--	9.0

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	5	6	7	8
Station Name	Ikpikpuk River near Lonely	Chipp River near Barrow	Meade River at Atkasuk	Avalik River near Wainwright
Latitude	70°08'12"	70°41'35"	70°29'20"	70°04'40"
Longitude	154°38'30"	155°27'00"	157°24'40"	159°02'40"
Dissolved nitrite plus nitrate (N) (mg/L)	--	.31	.53 --	.49
Dissolved ortho-phosphorus (P) (mg/L)	--	.00	.00 --	.01
Dissolved lithium (Li) (µg/L)	--	0	0 --	10
Dissolved vanadium (V) (µg/L)	--	.8	1.8 --	5.0
Total organic carbon (C) (mg/L)	--	--	37 --	80
Total barium (Ba) (µg/L)	--	--	-- --	--
Total cadmium (Cd) (µg/L)	--	--	-- --	--
Total lead (Pb) (µg/L)	--	--	-- --	--
Total copper (Cu) (µg/L)	--	--	-- --	--
Dissolved solids (residue at 180°C) (mg/L)	--	--	-- --	--
Dissolved cobalt (Co) (µg/L)	--	--	-- --	--
Dissolved iron (Fe) (µg/L)	--	--	-- --	--
Dissolved manganese (Mn) (µg/L)	--	--	-- --	--
Dissolved nickel (Ni) (µg/L)	--	--	-- --	--
Dissolved silver (Ag) (µg/L)	--	--	-- --	--
Dissolved zinc (Zn) (µg/L)	--	--	-- --	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	9		10		11
Station Name	Avalik River below Oyagaruk Creek near Wainwright		Kuk River near Wainwright		Utukok River near Point Lay
Latitude	70°07'30"		70°08'06"		69°57'48"
Longitude	159°25'12"		159°40'42"		162°03'12"
Date	04-16-76	08-14-77	04-16-76	08-14-77	08-14-77
Ice thickness (ft)	2	--	4.5	--	--
Water depth	0	--	5	--	--
Discharge (ft^3/s)	--	--	0	--	--
Specific conductance (μmhos at 25°C)	--	135	--	1,350	240
Water temperature (°C)	--	15.0	-2.0	15.5	16.0
Dissolved oxygen (mg/L)	--	--	--	--	--
Turbidity (Ntu)	--	2	--	3	4
Color (platinum-cobalt units)	--	10	--	15	15
Bicarbonate (HCO_3) (mg/L)	--	--	--	--	--
Hardness (total Ca, Mg) (mg/L)	--	--	--	--	--
pH (units)	--	--	--	--	--
Dissolved potassium (K) (mg/L)	--	--	--	--	--
Dissolved sodium (Na) (mg/L)	--	--	--	--	--
Carbon dioxide (CO_2) (mg/L)	--	--	--	--	--
Dissolved sulfate (SO_4) (mg/L)	--	--	--	--	--
Dissolved chloride (Cl) (mg/L)	--	--	--	--	--
Dissolved fluoride (F) (mg/L)	--	--	--	--	--
Dissolved silica (SiO_2) (mg/L)	--	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	12	13		14
Station Name	Utukok River at mouth near Point Lay	Kokolik River near Point lay		Kokolik River at mouth near Point Lay
Latitude	70°02'39"	69°45'39"		69°45'14"
Longitude	162°16'42"	162°31'00"		162°57'08"
Date	04-15-76	04-15-76	08-15-77	04-15-76
Ice thickness (ft)	2	2	--	2
Water depth	0	0	--	0
Discharge (ft^3/s)	--	--	--	--
Specific conductance (μmhos at 25°C)	--	--	320	--
Water temperature (°C)	--	--	17.0	--
Dissolved oxygen (mg/L)	--	--	--	--
Turbidity (Ntu)	--	--	2	--
Color (platinum-cobalt units)	--	--	5	--
Bicarbonate (HCO_3) (mg/L)	--	--	--	--
Hardness (total Ca, Mg) (mg/L)	--	--	--	--
pH (units)	--	--	--	--
Dissolved potassium (K) (mg/L)	--	--	--	--
Dissolved sodium (Na) (mg/L)	--	--	--	--
Carbon dioxide (CO_2) (mg/L)	--	--	--	--
Dissolved sulfate (SO_4) (mg/L)	--	--	--	--
Dissolved chloride (Cl) (mg/L)	--	--	--	--
Dissolved fluoride (F) (mg/L)	--	--	--	--
Dissolved silica (SiO_2) (mg/L)	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	15		16	17
Station Name	Kukpowruk River near Point Lay		Kukpowruk River below Deadfall Creek near Point Lay	Pitmegea River near Cape Lisburne
Latitude	69°29'50"		69°16'58"	68°51'15"
Longitude	162°43'30"		162°43'13"	164°25'36"
Date	04-15-76	08-15-77	04-15-76	08-15-77
Ice thickness (ft)	7.0	--	4	--
Water depth	6.0	--	0	--
Discharge (ft^3/s)	0	--	--	--
Specific conductance (µmhos at 25°C)	--	340	--	375
Water temperature (°C)	0.0	19.5	--	16.5
Dissolved oxygen (mg/L)	--	--	--	--
Turbidity (Ntu)	--	2	--	2
Color (platinum-cobalt units)	--	5	--	5
Bicarbonate (HCO_3) (mg/L)	384	--	--	--
Hardness (total Ca, Mg) (mg/L)	--	--	--	--
pH (units)	--	--	--	--
Dissolved potassium (K) (mg/L)	--	--	--	--
Dissolved sodium (Na) (mg/L)	--	--	--	--
Carbon dioxide (CO_2) (mg/L)	--	--	--	--
Dissolved sulfate (SO_4) (mg/L)	--	--	--	--
Dissolved chloride (Cl) (mg/L)	--	--	--	--
Dissolved fluoride (F) (mg/L)	--	--	--	--
Dissolved silica (SiO_2) (mg/L)	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	18	19		20
Station Name	Ipewik River near Kukpuk	Kukpuk River at Kukpuk		Ogotoruk Creek near Point Hope
Latitude	68°25'30"	68°24'24"		68°06'40"
Longitude	165°29'00"	165°56'40"		165°45'10"
Date	08-16-77	04-08-76	08-16-77	08-16-77
Ice thickness (ft)	--	5.4	--	--
Water depth	--	1.8	--	--
Discharge (ft^3/s)	--	0	--	--
Specific conductance (μmhos at 25°C)	160	295	275	70
Temperature (°C)	14.5	0.5	13.5	14.0
Dissolved oxygen (mg/L)	--	3.4	--	--
Turbidity (Ntu)	4	--	2	3
Color (platinum-cobalt units)	10	--	5	0
Bicarbonate (HCO_3) (mg/L)	--	142	--	--
Hardness (total Ca, Mg) (mg/L)	--	130	--	--
pH (units)	--	7.5	--	--
Dissolved potassium (K) (mg/L)	--	.6	--	--
Dissolved sodium (Na) (mg/L)	--	14	--	--
Carbon dioxide (CO_2) (mg/L)	--	7.2	--	--
Dissolved sulfate (SO_4) (mg/L)	--	4.8	--	--
Dissolved chloride (Cl) (mg/L)	--	27	--	--
Dissolved fluoride (F) (mg/L)	--	.0	--	--
Dissolved silica (SiO_2) (mg/L)	--	2.9	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	18	19		20
Station Name	Ipewik River near Kukpuk	Kukpuk River at Kukpuk		Ogotogruk Creek near Point Hope
Latitude	68°25'30"	68°24'24"		68°06'40"
Longitude	165°29'00"	165°56'40"		165°45'10"
Dissolved nitrite plus nitrate (N) (mg/L)	--	.18	--	--
Dissolved ortho-phosphorus (P) (mg/L)	--	.00	--	--
Dissolved lithium (Li) (µg/L)	--	0	--	--
Dissolved vanadium (V) (µg/L)	--	.0	--	--
Total organic carbon (C) (mg/L)	--	--	--	--
Total barium (Ba) (µg/L)	--	--	--	--
Total cadium (Cd) (µg/L)	--	--	--	--
Total lead (Pb) (µg/L)	--	--	--	--
Total copper (Cu) (µg/L)	--	--	--	--
Dissolved solids (residue at 180°C) (mg/L)	--	--	--	--
Dissolved cobalt (CO) (µg/L)	--	--	--	--
Dissolved iron (Fe) (µg/L)	--	--	--	--
Dissolved manganese (Mn) (µg/L)	--	--	--	--
Dissolved nickel (Ni) (µg/L)	--	--	--	--
Dissolved silver (Ag) (µg/L)	--	--	--	--
Dissolved zinc (Zn) (µg/L)	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	21	22	23	24	25
Station Name	Kivalina River near Kivalina	Wulik River near Kivalina	Noatak River near Noatak	Kugururok River near Noatak	Squirrel River near Kiana
Latitude	67°48'42"	67°49'54"	67°15'24"	68°01'24"	67°02'00"
Longitude	164°30'42"	163°58'00"	162°35'09"	161°50'08"	160°24'00"
Date	08-18-77	08-20-77	08-20-77	08-18-77	08-20-77
Ice thickness (ft)	--	--	--	--	--
Water depth	--	--	--	--	--
Discharge (ft^3/s)	--	--	--	--	--
Specific conductance (µmhos at 25°C)	287	225	250	250	260
Water temperature (°C)	13.5	14.0	15.0	13.0	13.5
Dissolved oxygen (mg/L)	--	--	--	--	--
Turbidity (Ntu)	2	3	2	2	2
Color (platinum-cobalt units)	5	0	0	0	5
Bicarbonate (HCO_3) (mg/L)	--	--	--	--	--
Hardness (total Ca, Mg) (mg/L)	--	--	--	--	--
pH (units)	--	--	--	--	--
Dissolved potassium (K) (mg/L)	--	--	--	--	--
Dissolved sodium (Na) (mg/L)	--	--	--	--	--
Carbon dioxide (CO_2) (mg/L)	--	--	--	--	--
Dissolved sulfate (SO_4) (mg/L)	--	--	--	--	--
Dissolved chloride (Cl) (mg/L)	--	--	--	--	--
Dissolved fluoride (F) (mg/L)	--	--	--	--	--
Dissolved silica (SiO_2) (mg/L)	--	--	--	--	--

Table 4.--*Physical parameters and dissolved chemical constituents of streams. Locations are shown in figure 32*--Continued.

Map No.	26
Station Name	Kobuk River at Ambler
Latitude	67°05'13"
Longitude	157°50'51"
Date	08-20-77
Ice thickness (ft)	--
Water depth	--
Discharge (ft^3/s)	--
Specific conductance (µmhos at 25°C)	162
Water temperature (°C)	15.5
Dissolved oxygen (mg/L)	--
Turbidity (Ntu)	1.8
Color (platinum-cobalt units)	5
Bicarbonate (HCO_3) (mg/L)	--
pH (units)	--
Dissolved potassium (K) (mg/L)	--
Dissolved sodium (Na) (mg/L)	--
Carbon dioxide (CO_2) (mg/L)	--
Dissolved sulfate (SO_4) (mg/L)	--
Dissolved chloride (Cl) (mg/L)	--
Dissolved fluoride (F) (mg/L)	--
Dissolved silica (SiO_2) (mg/L)	--

Table 5.--*Occurrence of aquatic invertebrates in percent of sample using drift net, April 5-7 1976.*

Map No. (refer to figure 22 and table 2)	1	2	3	4
Station Name	Kelly River spring	Kivalina River tributary spring	Wulik River spring	Kavrorak Springs
Collection date	4-06-76	4-06-76	4-06-76	4-06-76
Collection time	14:45-15:35	13:20-14:00	16:25-17:00	14:40-15:15
Worms:				
Oligochaeta - aquatic worms	--	--	--	--
Immature Insecta:				
Diptera - true flies	--	--	--	--
Chironomidae - midges	--	1	64	--
Ceratopogonidae - biting midges	--	--	--	--
Tipulidae - crane flies	--	--	--	20
Ephemeroptera - may flies	--	99	10	80
Plecoptera - stone flies	--	--	26	--
Miscellaneous organisms:				
Acarina - water mites	--	--	--	--
Total number of taxa collected per sample	0	2	3	2
Total number of organisms collected per sample	0	480	50	5

Table 5.--*Occurrence of aquatic invertebrates in percent of sample using drift net, April 5-7 1976*--Continued.

Map No. (refer to figure 22 and table 2)	5	6	7	8	9
Station Name	Omikvirok River spring	Eli River spring	Rabbit Creek spring	North Fork Squirrel River spring	Amaouk Creek spring
Collection date	4-06-76	4-06-76	4-06-76	4-06-76	4-06-76
Collection time	17:35-18:05	11:30-12:05	11:25-12:05	18:20-19:05	15:35-16:35
Worms:					
Oligochaeta - aquatic worms	--	53	--	1	--
Immature Insecta:					
Dipteria - true flies:	--	--	--	--	19
Chironomidae - midges	88	37	67	42	--
Ceratopogonidae - biting midges	--	5	--	--	--
Tipulidae - crane flies	--	--	--	--	--
Ephemeroptera - may flies	--	5	17	50	30
Plecoptera - stone flies	13	--	17	3	51
Miscellaneous organisms:					
Acarina - water mites	--	--	--	4	--
Total number of taxa collected per sample	2	4	3	5	3
Total number of organisms collected per sample	8	19	6	74	98

Table 6.--*Occurrence of aquatic invertebrates in percent of sample (collected using dip net) August 1977.*

Map No. (refer to figure 32 and tables 2 and 4)	1	2	3	4
Station Name	Etivluk River	Colville River	Killik River	Fish Creek
Collection date	8-11-77	8-12-77	8-11-77	8-12-77
Bottom type	gravel, cobble	gravel, cobble	gravel, cobble	sand
Worms:				
Nematoda	2	--	--	--
Oligochaeta - aquatic worms	--	--	--	--
Hirudinea - leeches	--	--	1	--
Turbellaria - flat worms	--	--	--	--
Crustacea:				
Cladocera - water fleas	--	--	--	--
Cyclopodia - freshwater copepods	--	--	--	--
Decapoda - shrimp	--	--	--	--
Immature Insecta:				
Diptera - true flies	--	--	--	--
Chironomidae - midges	65	75	32	--
Ceratopogonidae - biting midges	2	--	--	--
Dolichopodidae - long-legged flies	--	--	1	--
Empididae - dance flies	2	--	1	--
Tipulidae - crane flies	--	13	1	--
Simuliidae - black flies	--	--	4	--
Ephemeroptera - may flies	25	13	56	--
Plecoptera - stone flies	2	--	6	--
Trichoptera - caddis flies	--	--	--	--
Miscellaneous organisms:				
Coleoptera - beetles	--	--	--	--
Acarina - water mites	4	--	1	--
Total number of taxa collected per sample	7	3	9	0
Total number of organisms collected per sample	228	32	190	0

Table 6.--*Occurrence of aquatic invertebrates in percent of sample (collected using dip net) August 1977*--Continued.

Map No. (refer to figure 32 and tables 2 and 4)	5	7	9	10
Station Name	Ikpikpuk River	Meade River	Avalik River	Kuk River
Collection date	8-13-77	8-17-77	8-14-77	8-14-77
Bottom type	sand	sand, gravel	sand, gravel	sand, silt
Worms:				
Nematoda	--	55	2	--
Oligochaeta - aquatic worms	--	9	--	--
Hirudinea - leeches	--	--	--	--
Turbellaria - flat worms	--	--	--	--
Crustacea:				
Cladocera - water fleas	--	--	--	--
Cyclopodia - freshwater copepods	--	--	--	--
Decapoda - shrimps	--	--	--	100
Immature Insecta:				
Diptera - true flies	--	--	--	--
Chironomidae - midges	100	36	95	--
Ceratopogonidae - biting midges	--	--	--	--
Dolichopodidae - long-legged flies	--	--	--	--
Empididae - dance flies	--	--	--	--
Tipulidae - crane flies	--	--	--	--
Simuliidae - black flies	--	--	--	--
Ephemeroptera - may flies	--	--	--	--
Plecoptera - stone flies	--	--	--	--
Trichoptera - caddis flies	--	--	2	--
Miscellaneous organisms:				
Coleoptera - beetles	--	--	--	--
Acarina - water mites	--	--	--	--
Total number of taxa collected per sample	1	3	3	1
Total number of organisms collected per sample	36	44	43	2

Table 6.--*Occurrence of aquatic invertebrates in percent of sample (collected using dip net) August 1977*--Continued.

Map No. (refer to figure 32 and tables 2 and 4)	11	13	15	17
Station Name	Utukok River	Kokolik River	Kukpowruk River	Pitmegea River
Collection date	8-14-77	8-15-77	8-15-77	8-15-77
Bottom type	gravel	gravel	gravel, cobble	gravel, cobble
Worms:				
Nematoda	--	--	--	--
Oligochaeta - aquatic worms	22	--	--	2
Hirudinea - leeches	--	--	5	--
Turbellaria - flat worms	--	--	--	--
Crustacea:				
Cladocera - water fleas	17	--	--	9
Cyclopodia - freshwater copepods	28	--	--	2
Decapoda - shrimps	--	--	--	5
Immature Insecta:				
Diptera - true flies	--	--	--	--
Chironomidae - midges	28	58	78	60
Ceratopogonidae - biting midges	--	--	--	--
Dolichopodidae - long-legged flies	--	--	--	1
Empididae - dance flies	--	--	--	1
Tipulidae - crane flies	--	33	1	1
Simuliidae - black flies	--	--	--	--
Ephemeroptera - may flies	--	8	16	1
Plecoptera - stone flies	--	--	--	16
Trichoptera - caddis flies	--	--	--	2
Miscellaneous organisms:				
Coleoptera - beetles	--	--	--	--
Acarina - water mites	6	--	--	--
Total number of taxa collected per sample	5	3	4	11
Total number of organisms collected per sample	72	12	245	728

Table 6.--*Occurrence of aquatic invertebrates in percent of sample (collected using dip net) August 1977*--Continued.

Map No. (refer figure 32 and tables 2 and 4)	18	19	20	21
Station Name	Ipewik River	Kukpuk River	Ogotoruk Creek	Kivalina River
Collection date	8-16-77	8-16-77	8-16-77	8-18-77
Bottom type	gravel, cobble	gravel, cobble	gravel, cobble	gravel, cobble
Worms:				
Nematoda	7	--	--	--
Oligochaeta - aquatic worms	79	--	--	--
Hirudinea - leeches	--	--	--	--
Turbellaria - flat worms	--	--	--	--
Crustacea:				
Cladocera - water fleas	--	--	--	--
Cyclopodia - freshwater copepods	--	--	--	--
Decapoda - shrimps	--	--	--	--
Immature Insecta:				
Diptera - true flies	--	--	--	
Chironomidae - midges	7	98	9	100
Ceratopogonidae - biting midges	--	--	--	--
Dolichopodidae - long legged flies	--	--	--	--
Empididae - dance flies	--	--	--	--
Tipulidae - crane flies	--	--	10	--
Simuliidae - black flies	--	--	--	--
Ephemeroptera - may flies	3	--	32	--
Plecoptera - stone flies	--	1	48	--
Trichoptera - caddis flies	3	--	1	--
Miscellaneous organisms:				
Coleoptera - beetles	--	1	--	--
Acarina - water mites	--	--	1	--
Total number of taxa collected per sample	5	3	6	1
Total number of orgamisms collected per sample	116	412	293	5

Table 6.--*Occurrence of aquatic invertebrates in percent of sample (collected using dip net) August 1977*--Continued.

Map No. (refer to figure 32 and tables 2 and 4)	22	23	24	25
Station Name	Wulik River	Noatak River	Kugururok River	Squirrel River
Collection date	8-20-77	8-18-77	8-18-77	8-20-77
Bottom type	gravel, cobble	gravel, cobble	cobble, boulders	sand, gravel
Worms:				
Nematoda	--	--	--	--
Oligochaeta - aquatic worms	20	--	--	50
Hirudinea - leeches	--	--	7	--
Turbellaria - flat worms	--	--	--	--
Crustacea:				
Cladocera - water fleas	--	--	--	--
Cyclopodia - freshwater copepods	--	--	--	--
Decapoda- shrimps	--	--	--	--
Immature Insecta:				
Diptera - true flies	--	--	--	--
Chironomidae - midges	60	--	40	50
Ceratopogonidae - biting midges	--	--	--	--
Dolichopodidae - long-legged flies	--	--	--	--
Empididae - dance flies	20	--	7	--
Tipulidae - crane flies	--	--	--	--
Simuliidae - black flies	--	--	--	--
Ephemeroptera - may flies	--	--	20	--
Plecoptera - stone flies	--	--	27	--
Trichoptera - caddis flies	--	--	--	--
Miscellaneous organisms:				
Coleoptera - beetles	--	--	--	--
Acarina - water mites	--	--	--	--
Total number of taxa collected per sample	3	0	5	2
Total number of organisms collected per sample	20	0	150	8

Table 6.--*Occurrence of aquatic invertebrates in percent of sample (collected using dip net) August 1977*--Continued.

Map No. (refer to figure 32 and tables 2 and 4)	26	27
Station Name	Kobuk River	Kavrorak Spring
Collection date	8-20-77	8-16-77
Bottom type	sand	gravel
Worms:		
Nematoda	--	--
Oligochaeta - aquatic worms	--	--
Hirudinea - leeches	--	--
Turbellaria - flat worms	--	1
Crustacea:		
Cladocera - water fleas	--	--
Cyclopodia - freshwater copepods	--	--
Decapoda - shrimps	--	--
Immature Insecta:		
Diptera - true flies	--	--
Chironomidae - midges	84	99
Ceratopogonidae - biting midges	16	--
Dolichopodidae - long-legged flies	--	--
Empididae - dance flies	--	--
Tipulidae - crane flies	--	--
Simuliidae - black flies	--	--
Ephemeroptera - may flies	--	--
Plecoptera - stone flies	--	--
Trichoptera - caddis flies	--	--
Miscellaneous organisms	--	--
Coleoptera - beetles	--	--
Acarina - water mites	--	--
Total number of taxa collected per sample	2	2
Total number of organisms collected per sample	25	776

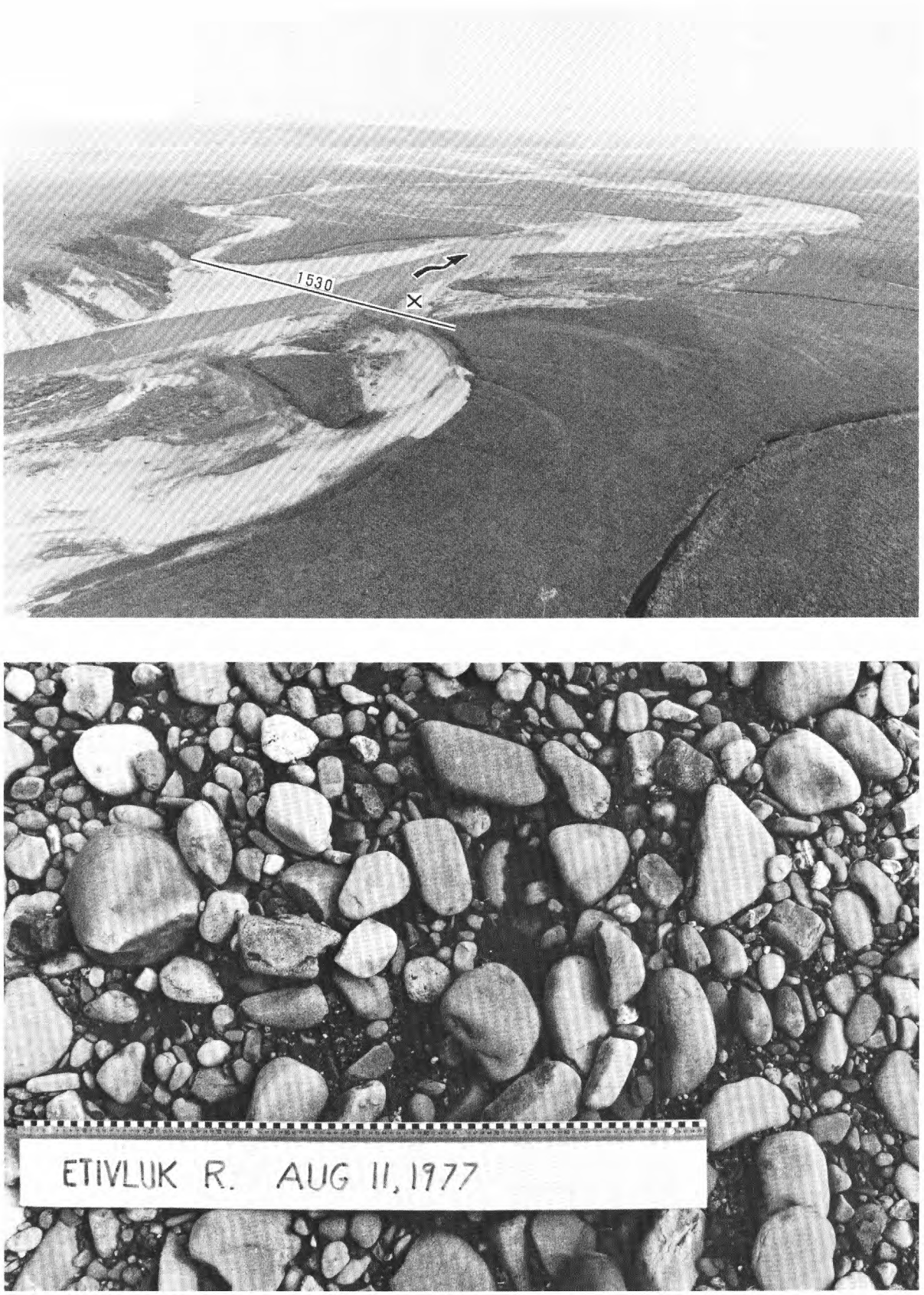
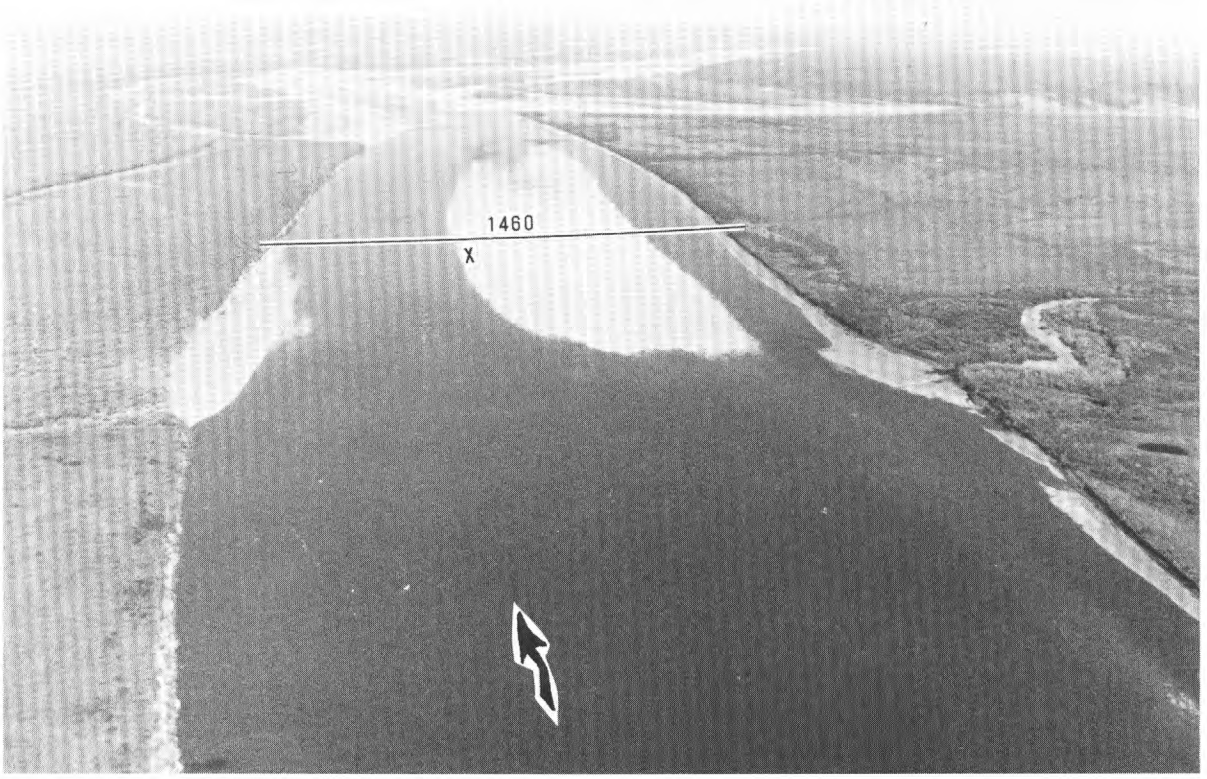


Figure 2.--Site 1, Etivluk River near Umiat, August 11, 1977.



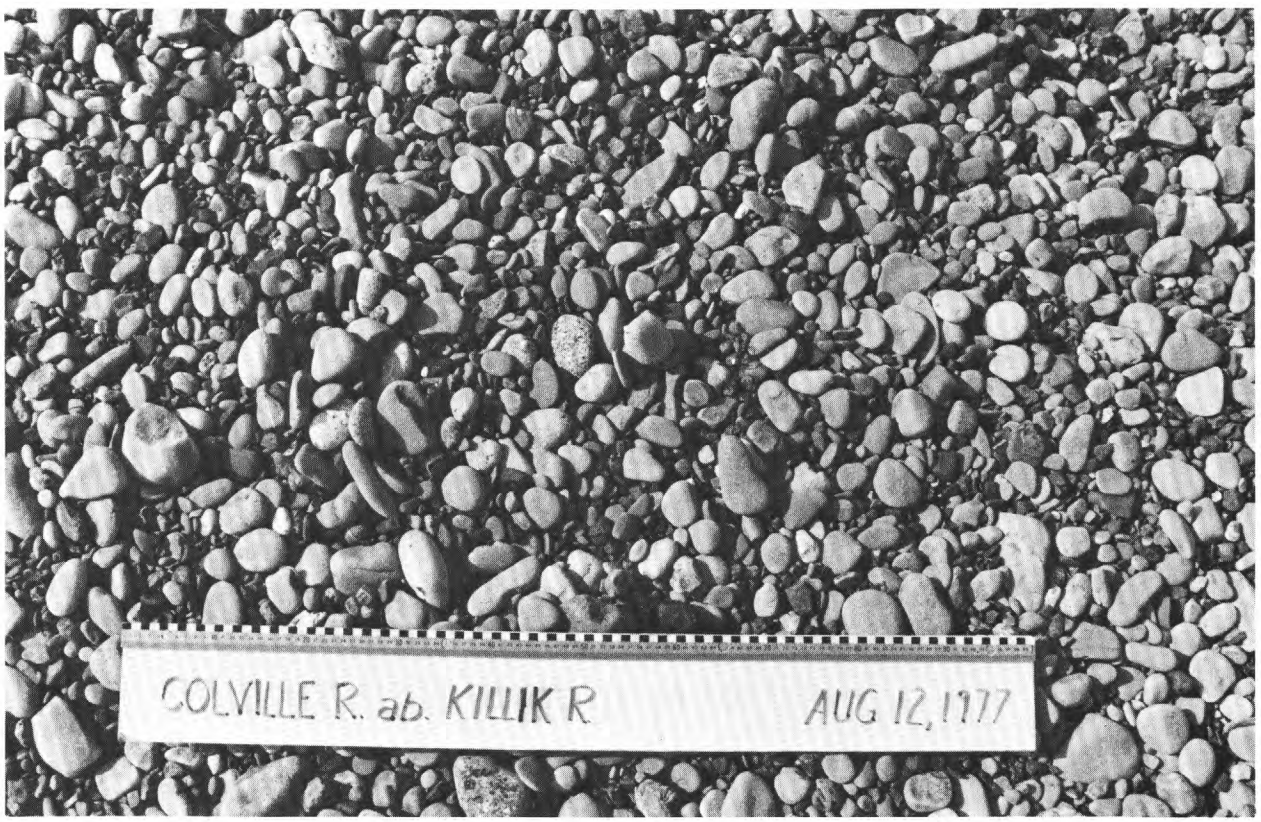


Figure 3.--Site 2, Colville River above Killik River near Umiat, August 12, 197

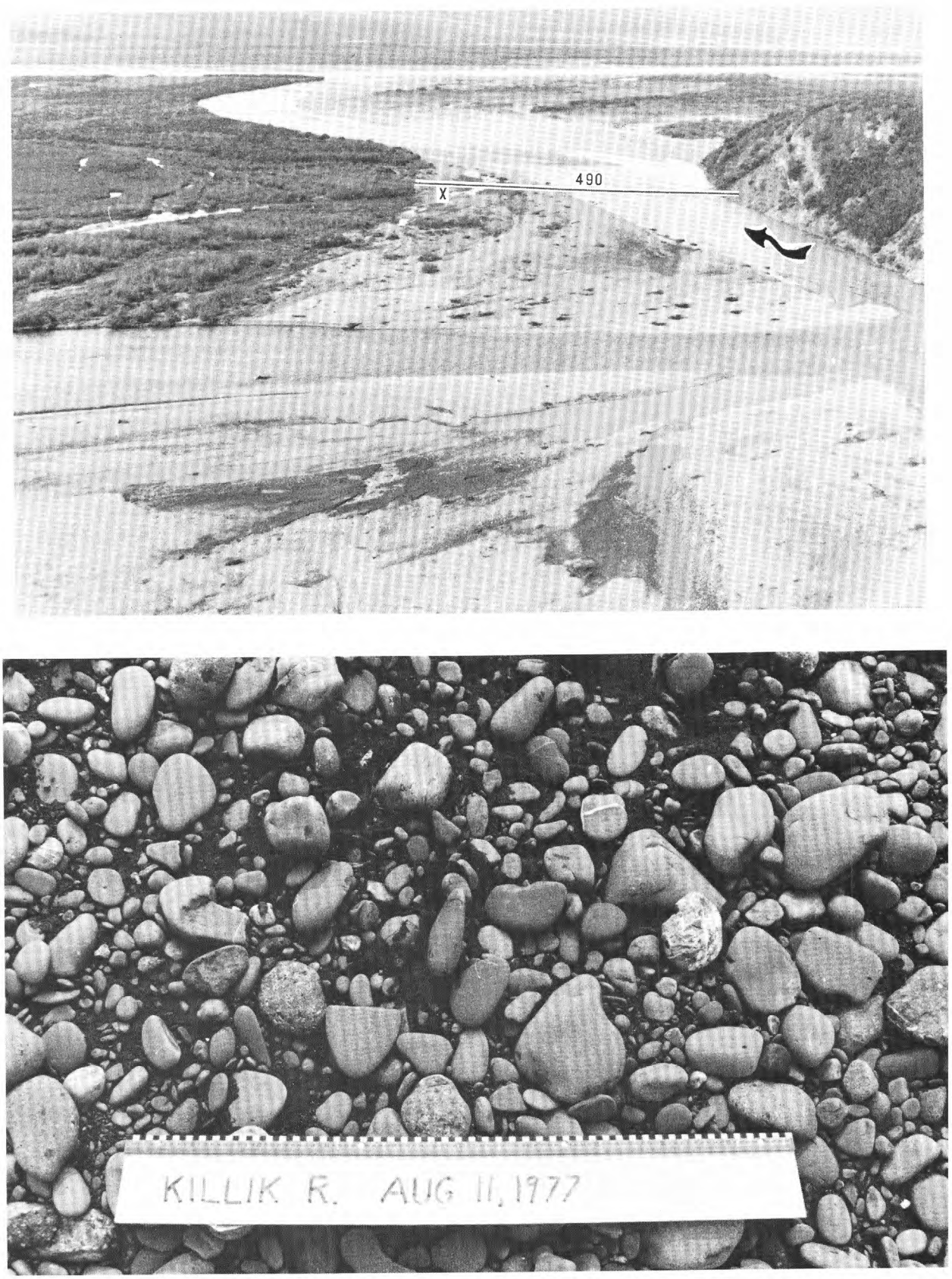


Figure 4.--Site 3, Killik River near Umiat, August 11, 1977.

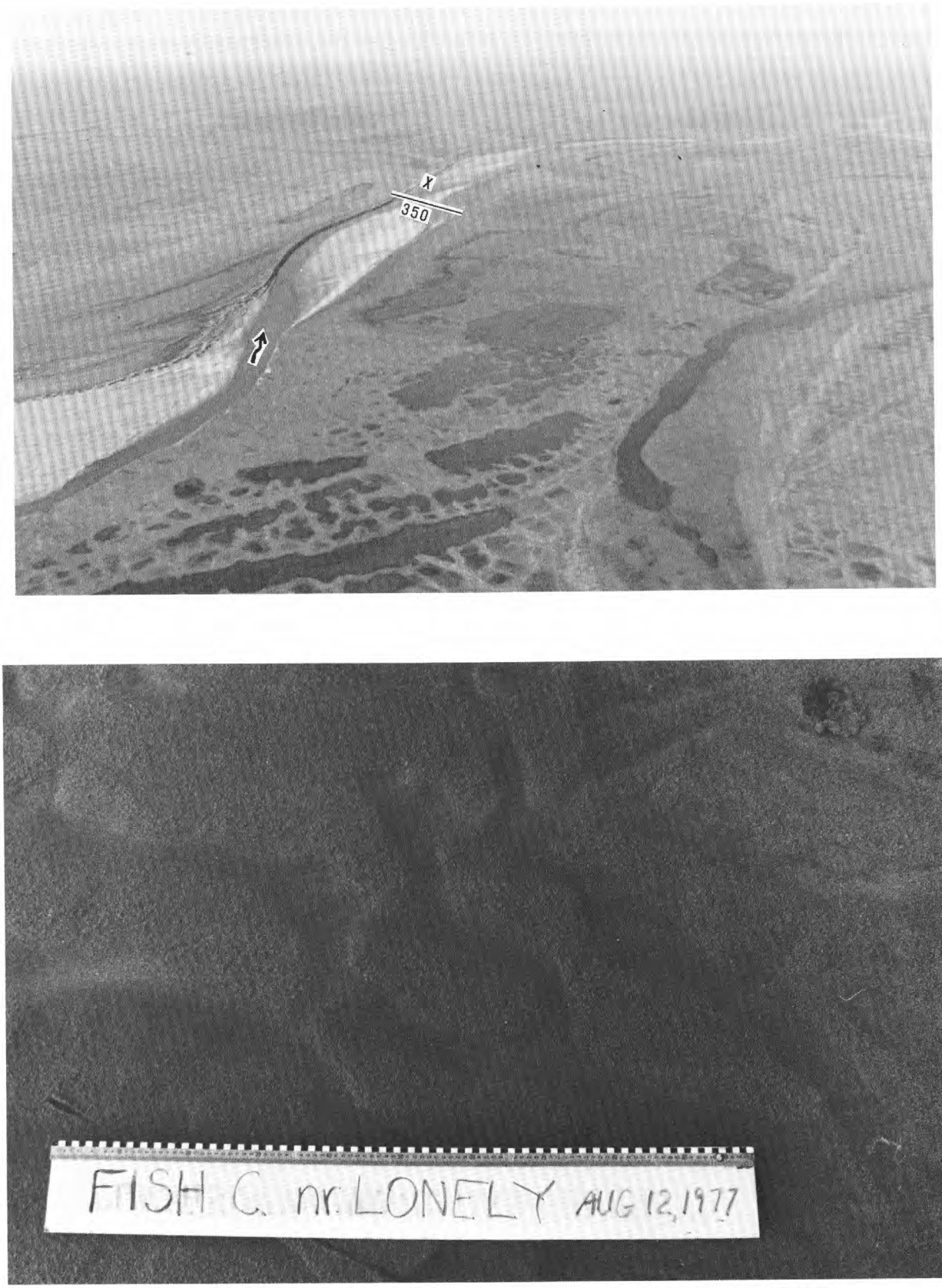


Figure 5.--Site 4, Fish Creek near Lonely, August 12, 1977.

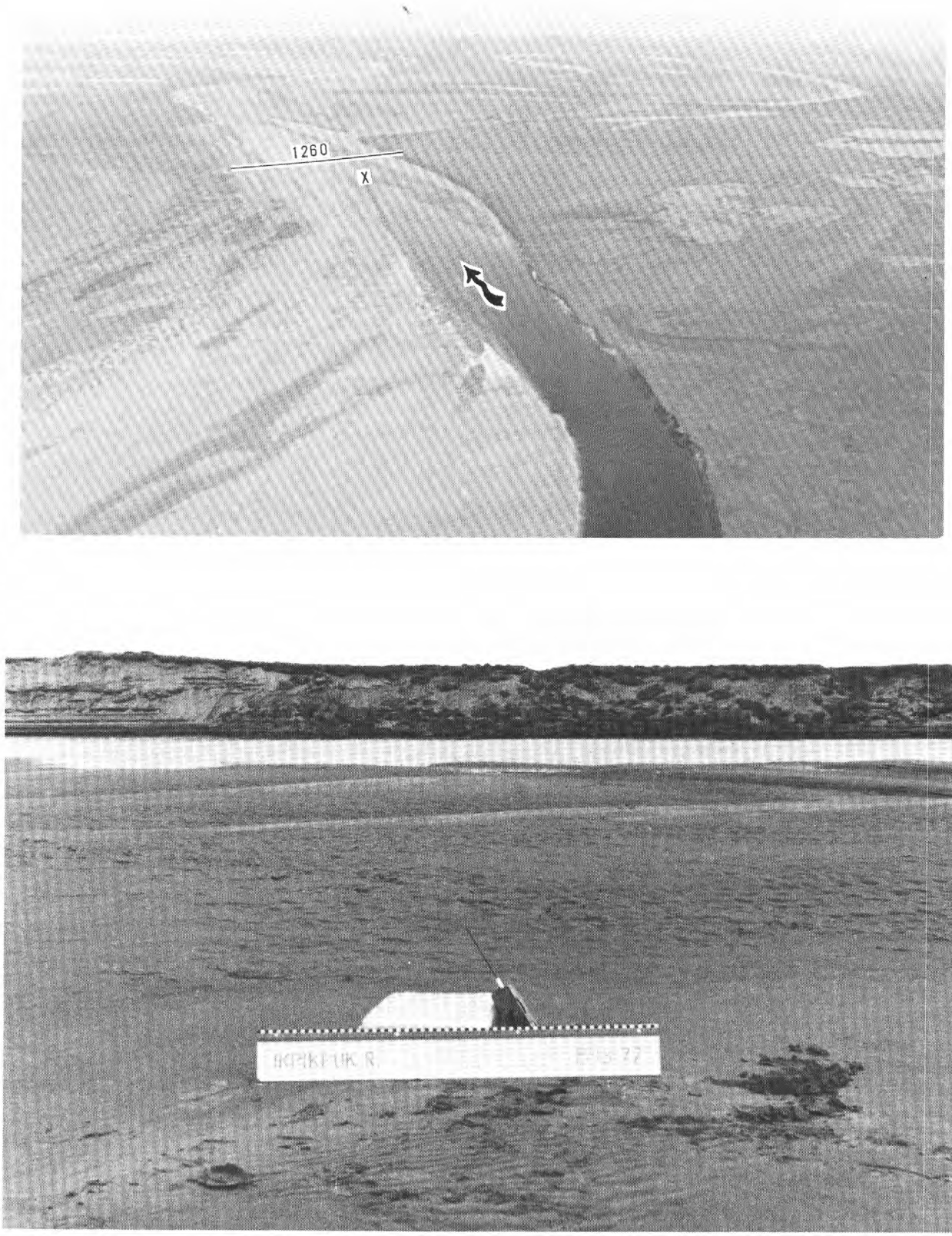


Figure 6.--Site 5, Ikpikpuk River near Lonely, August 13, 1977.

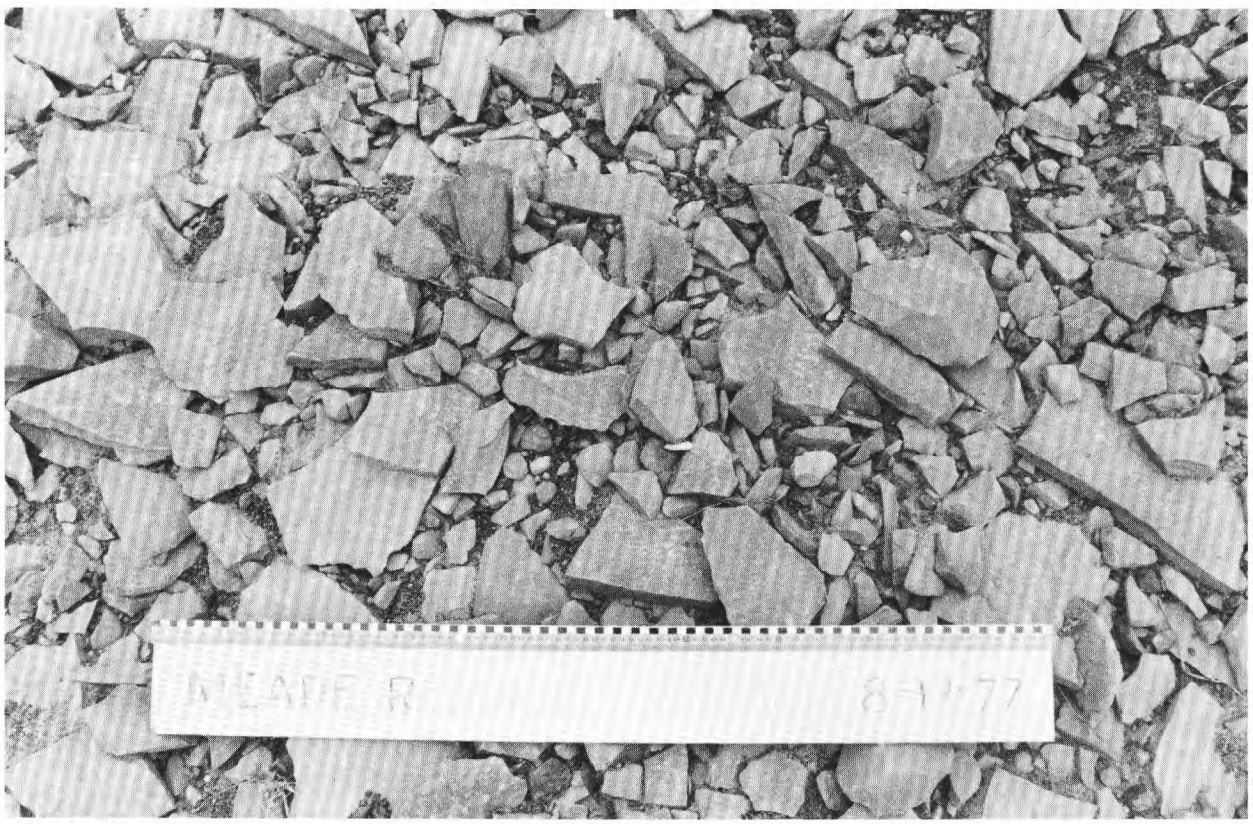


Figure 7.--Site 6, Meade River near Atkasuk, August 13, 1977.

Figure 8.--Site 7, Avalik River near Wainwright, August 14, 1977.

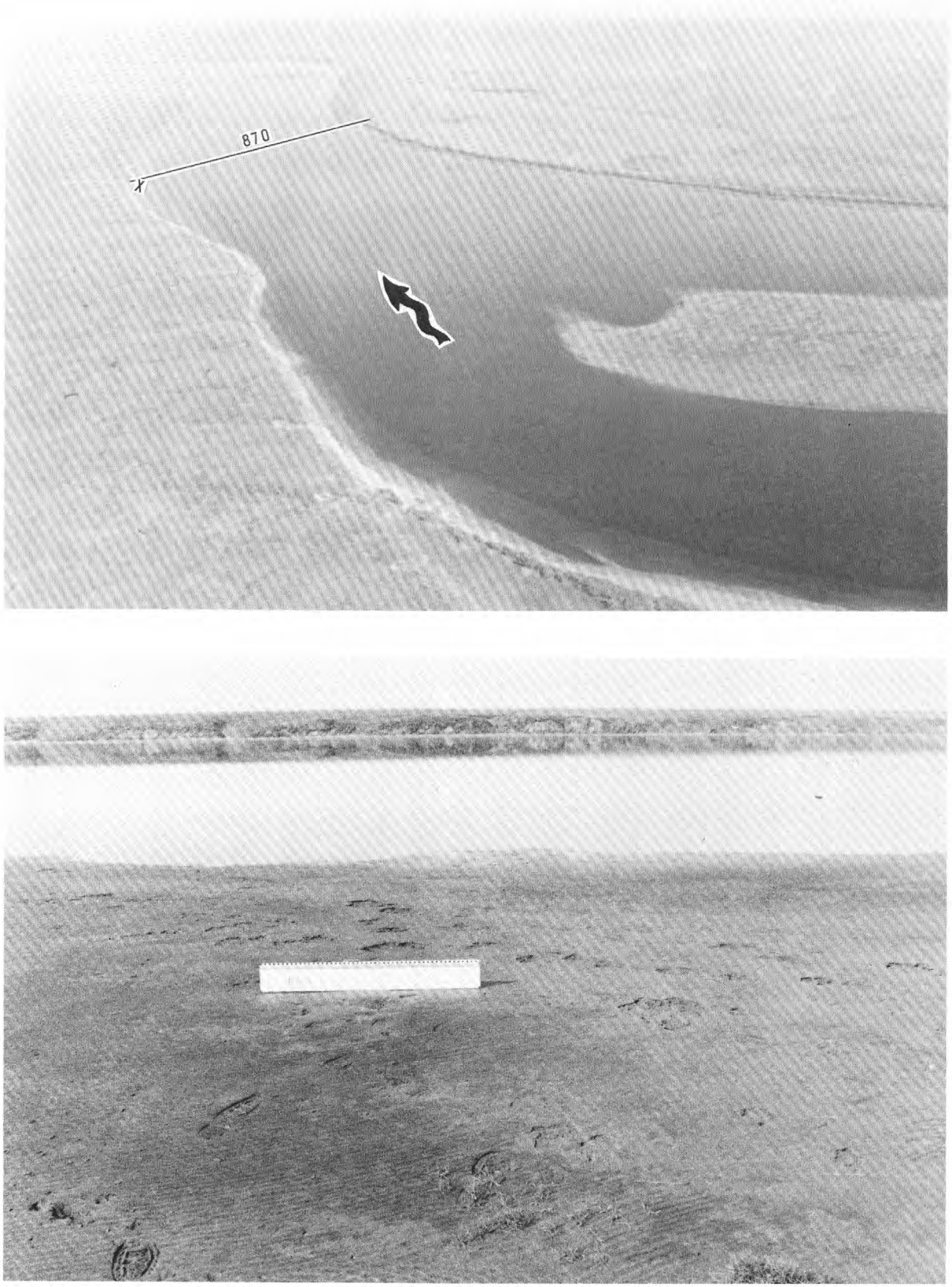
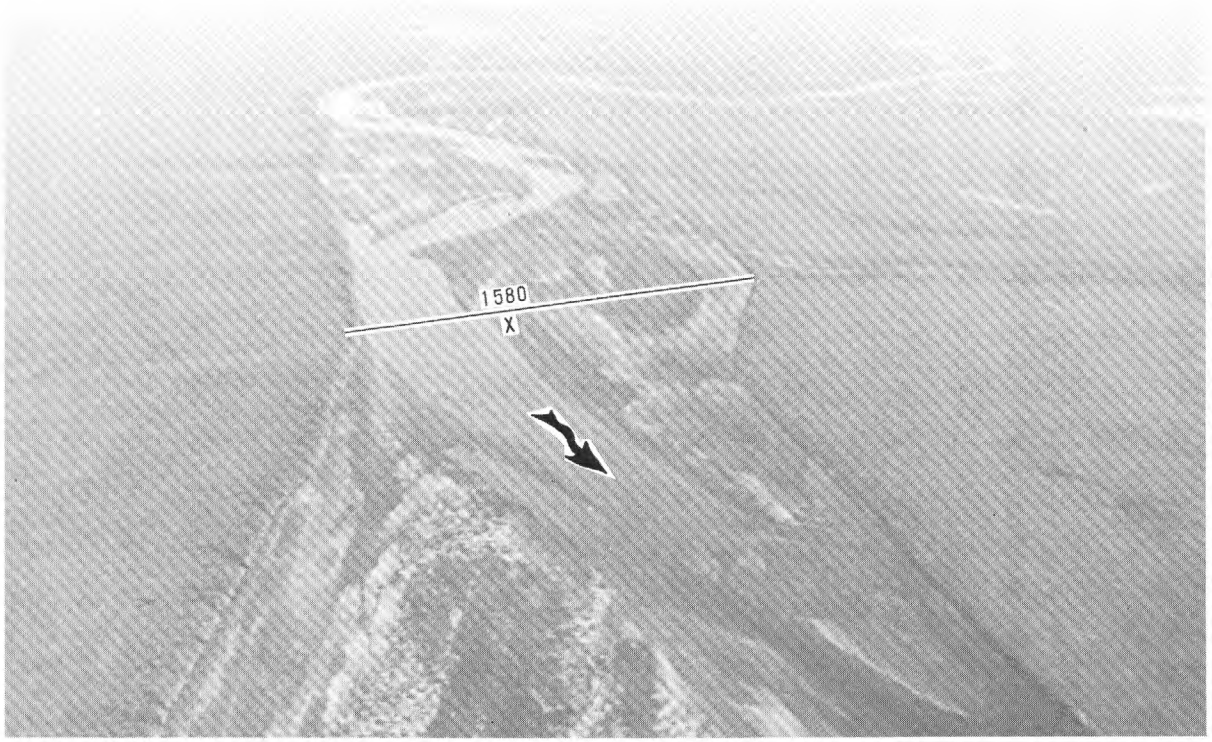


Figure 9.--Site 8, Kuk River near Wainwright, August 14, 1977.



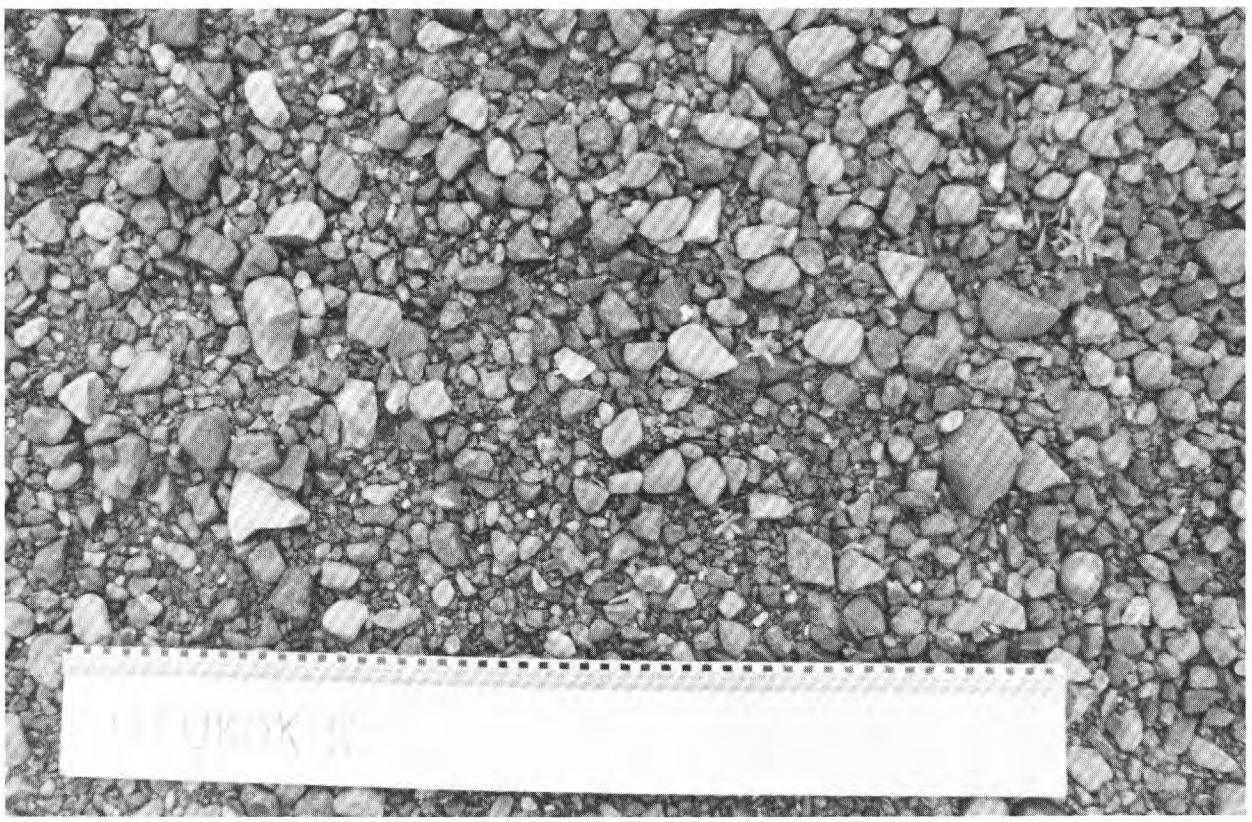


Figure 10.--Site 9, Utukok River near Point Lay, August 14, 1977.

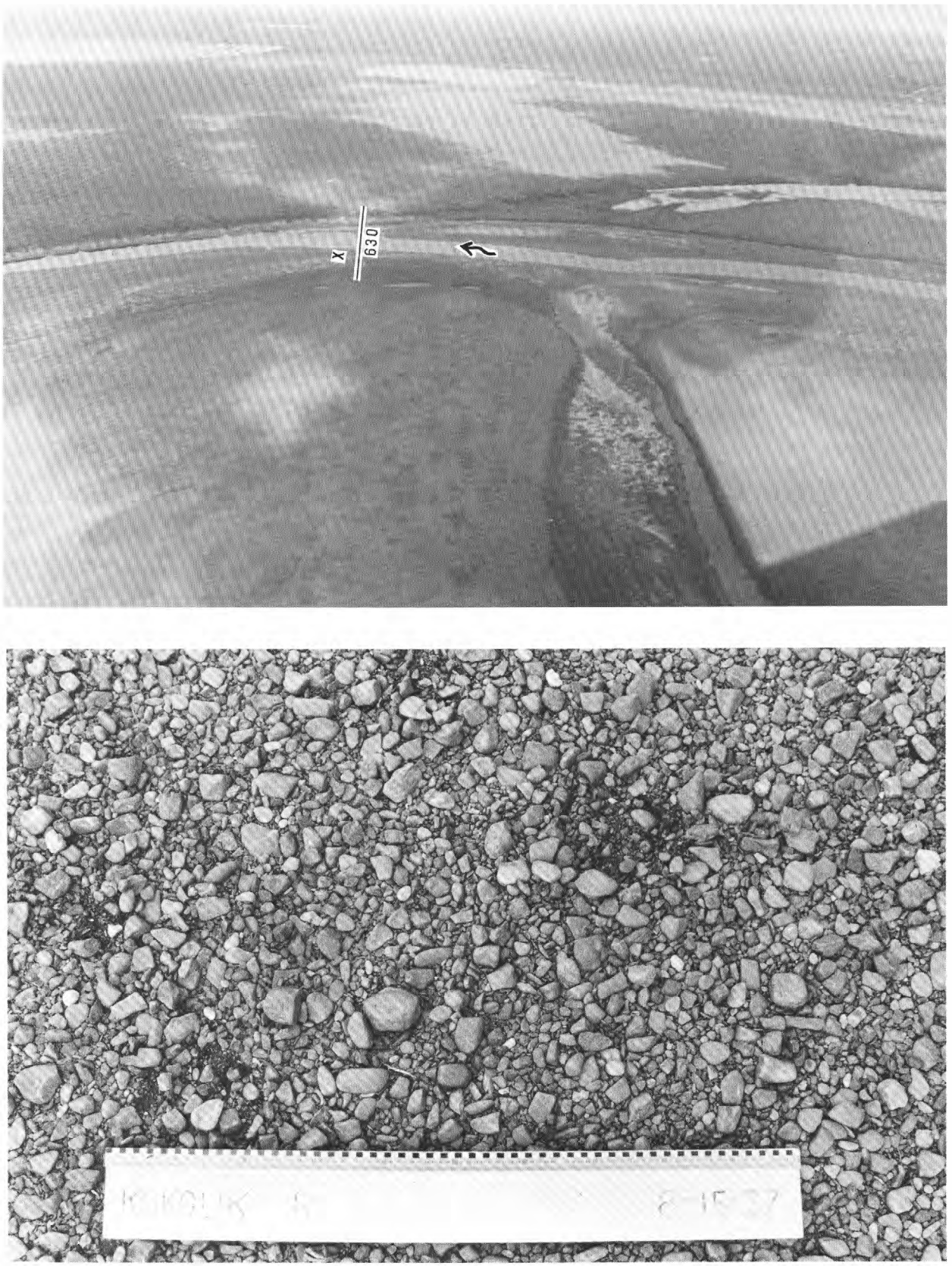
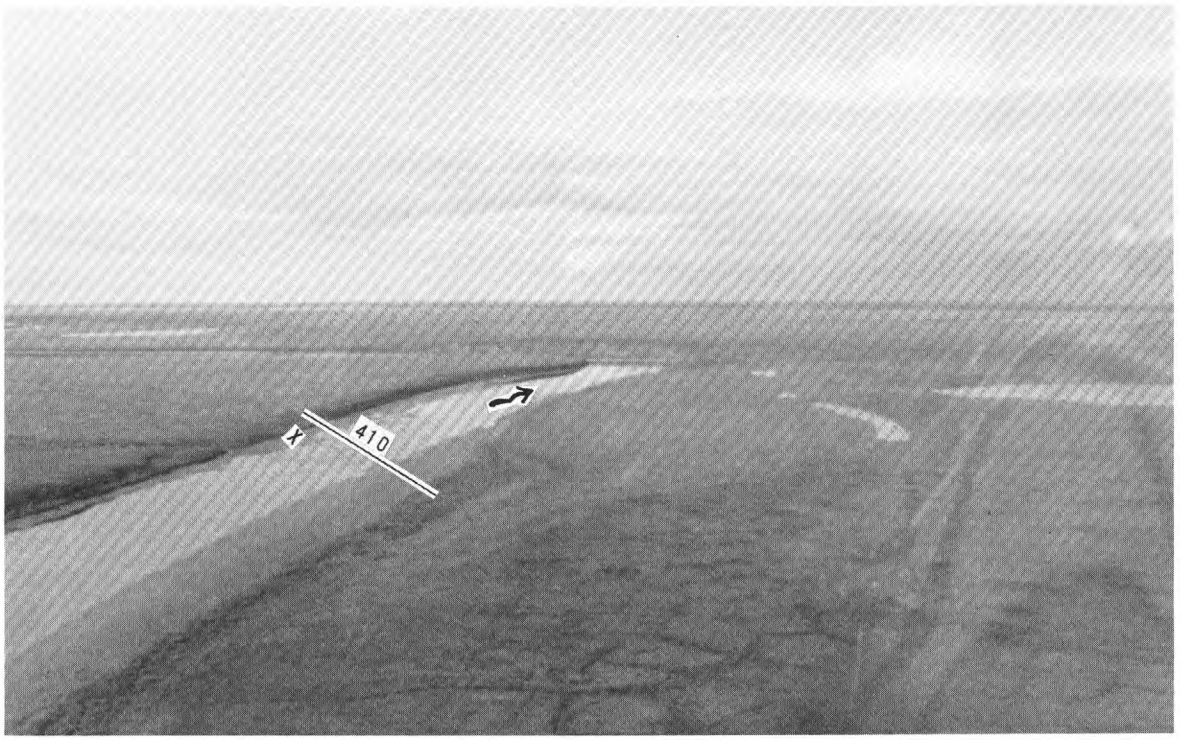


Figure 11.--Site 10, Kokolik River near Point Lay, August 15, 1977.



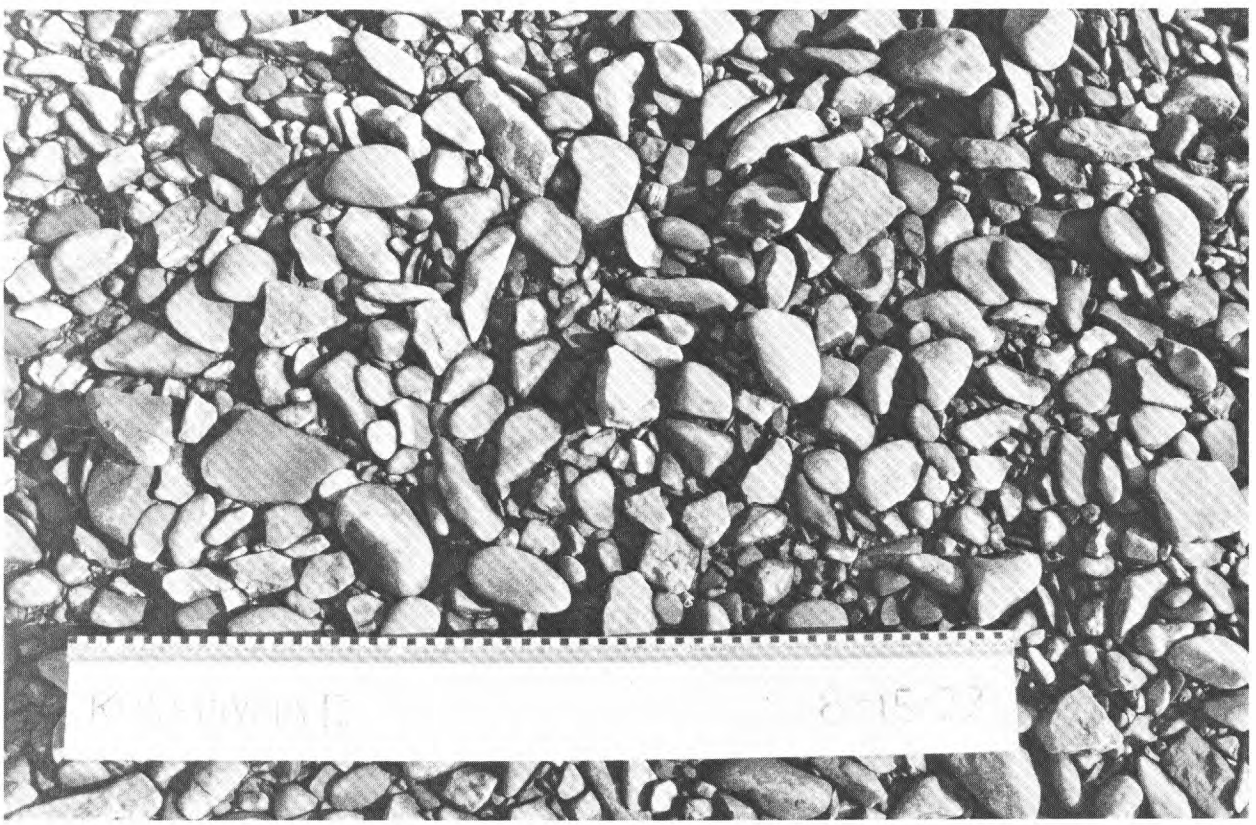


Figure 12.--Site 11, Kukpowruk River near Point Lay, August 15, 1977.

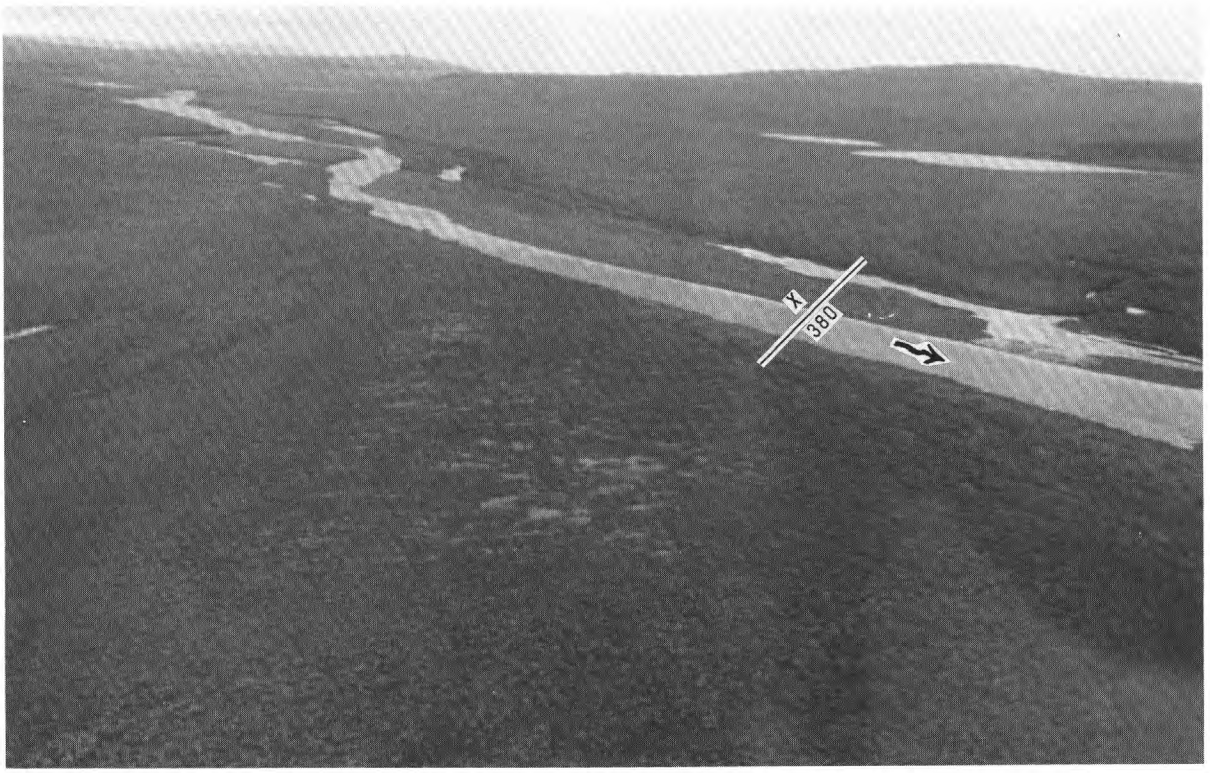


Figure 13.--Site 12, Pitmegea River near Cape Lisburne, August 15, 1977.

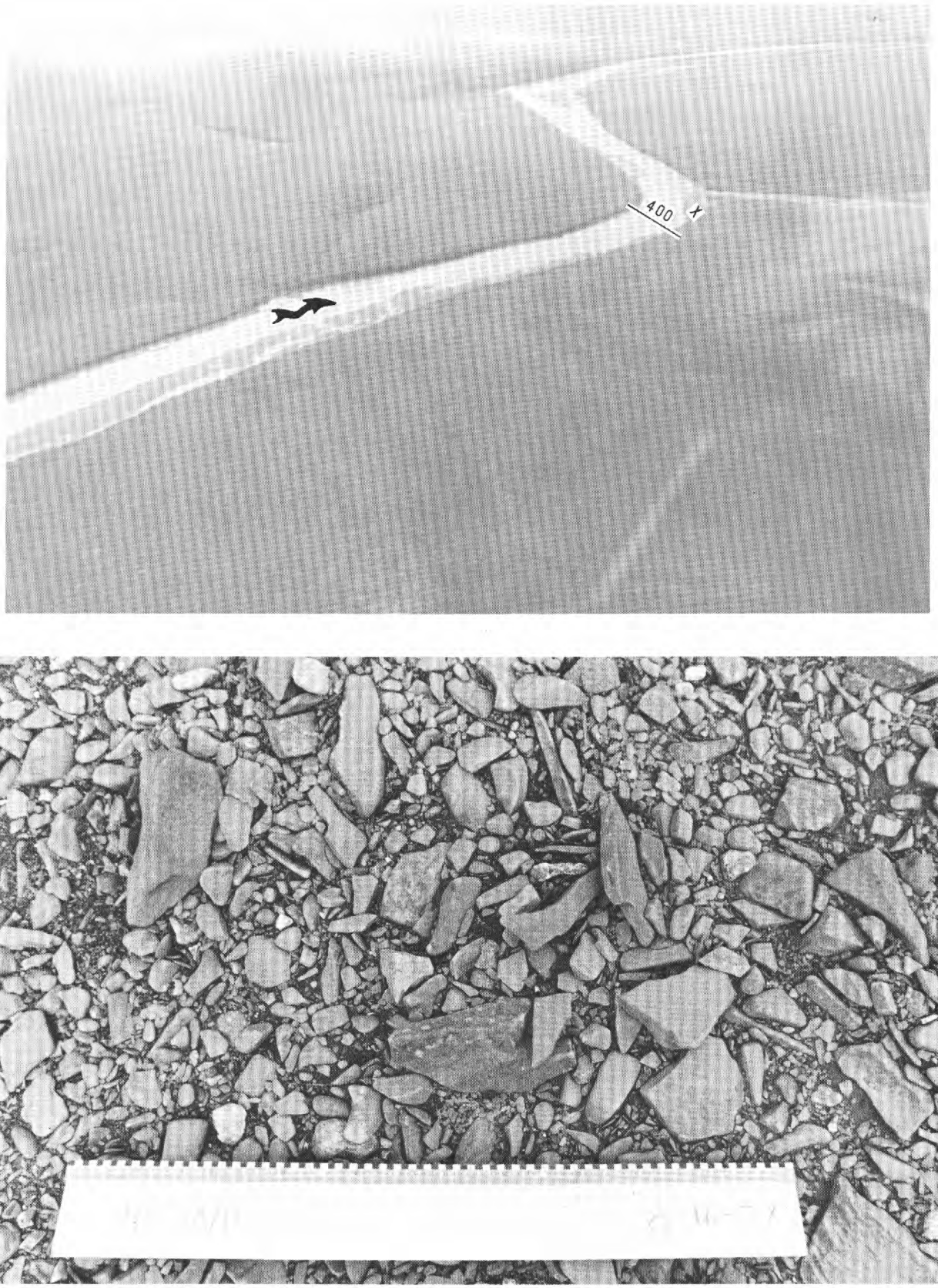


Figure 14.--Site 13, Ipewik River near Kukpuk, August 16, 1977.

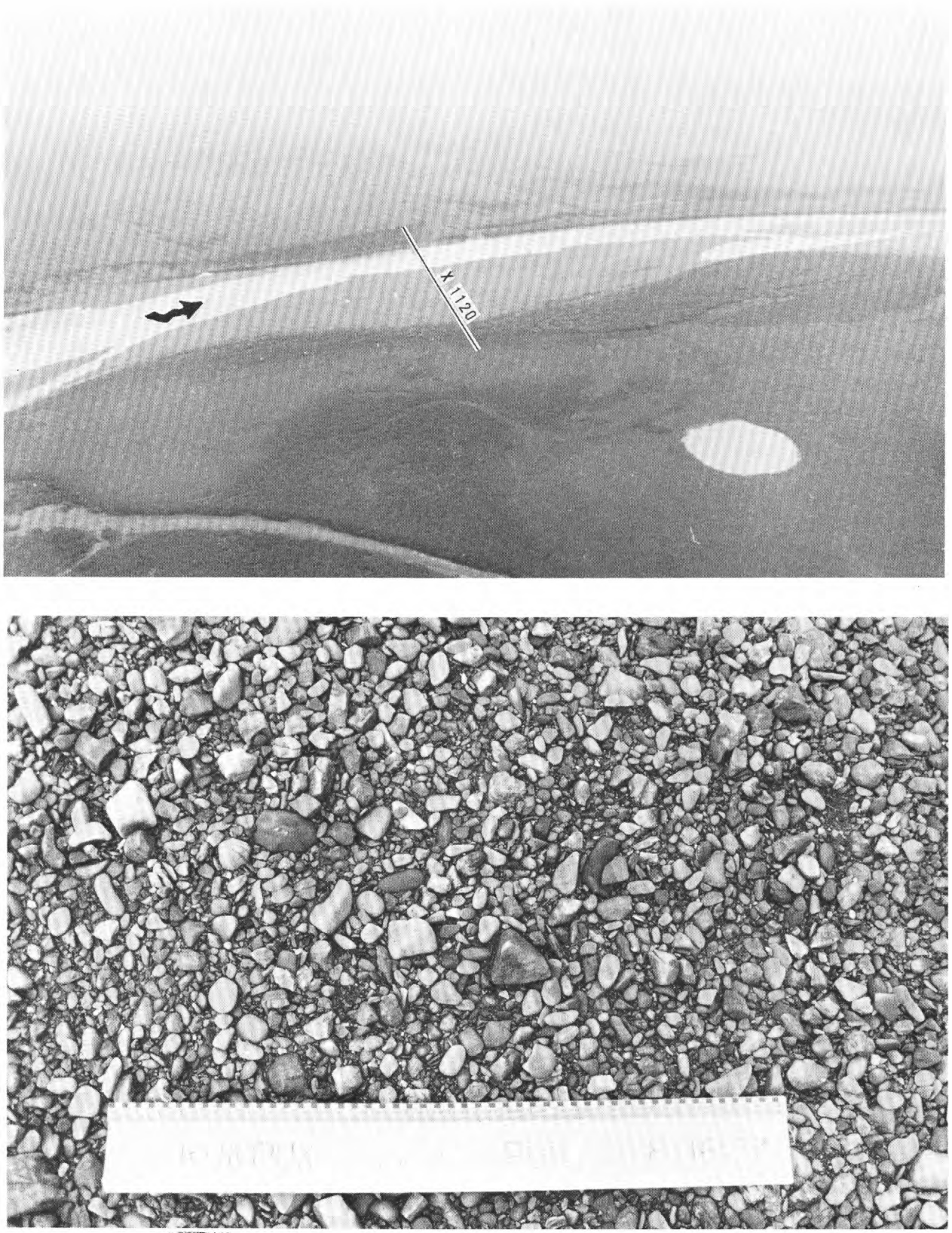


Figure 15.--Site 14, Kukpuk River near Kukpuk, August 16, 1977.

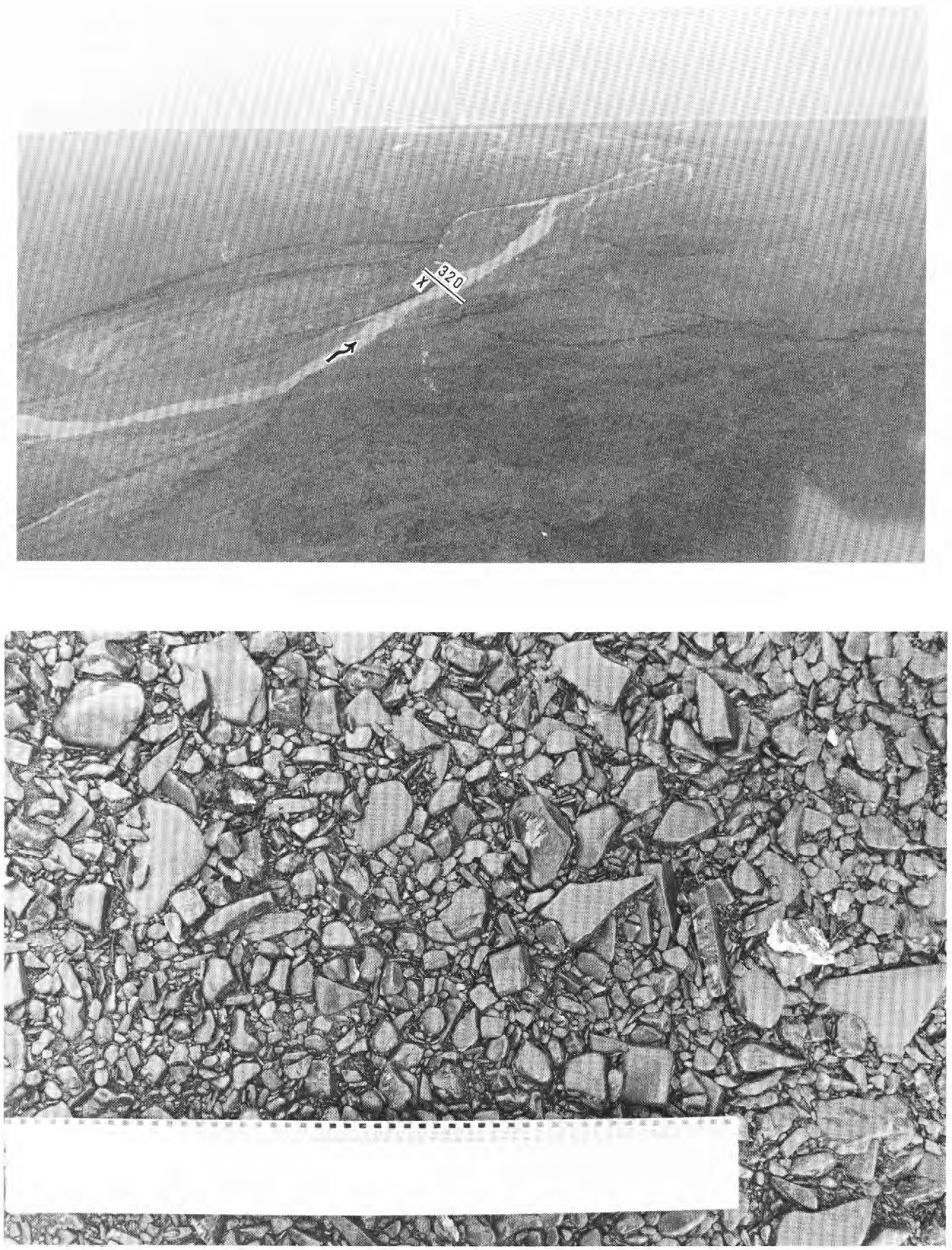


Figure 16.--Site 15, Ogotoruk Creek near Point Hope, August 16, 1977.

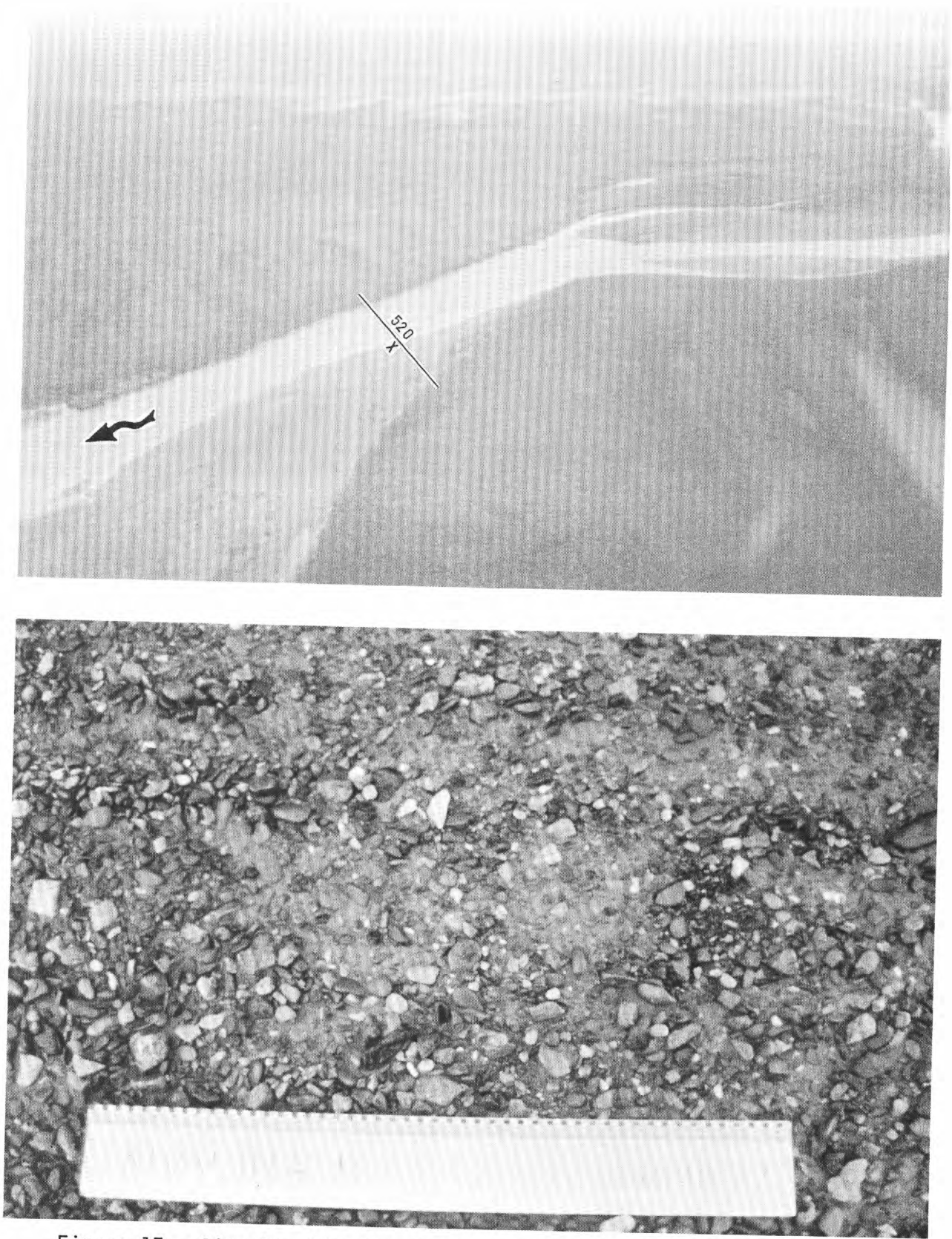


Figure 17.--Site 16, Kivalina River near Kivalina, August 18, 1977.

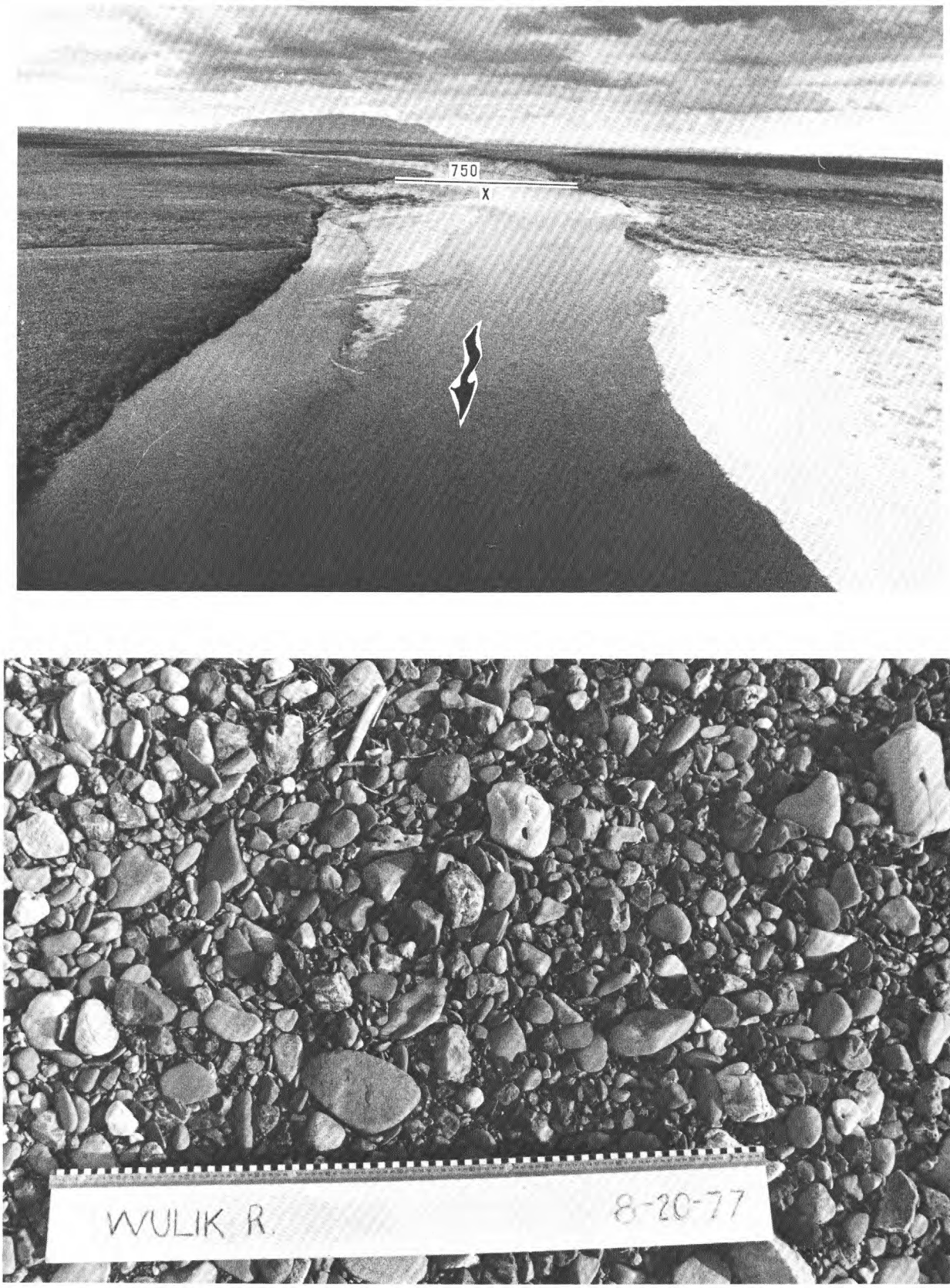
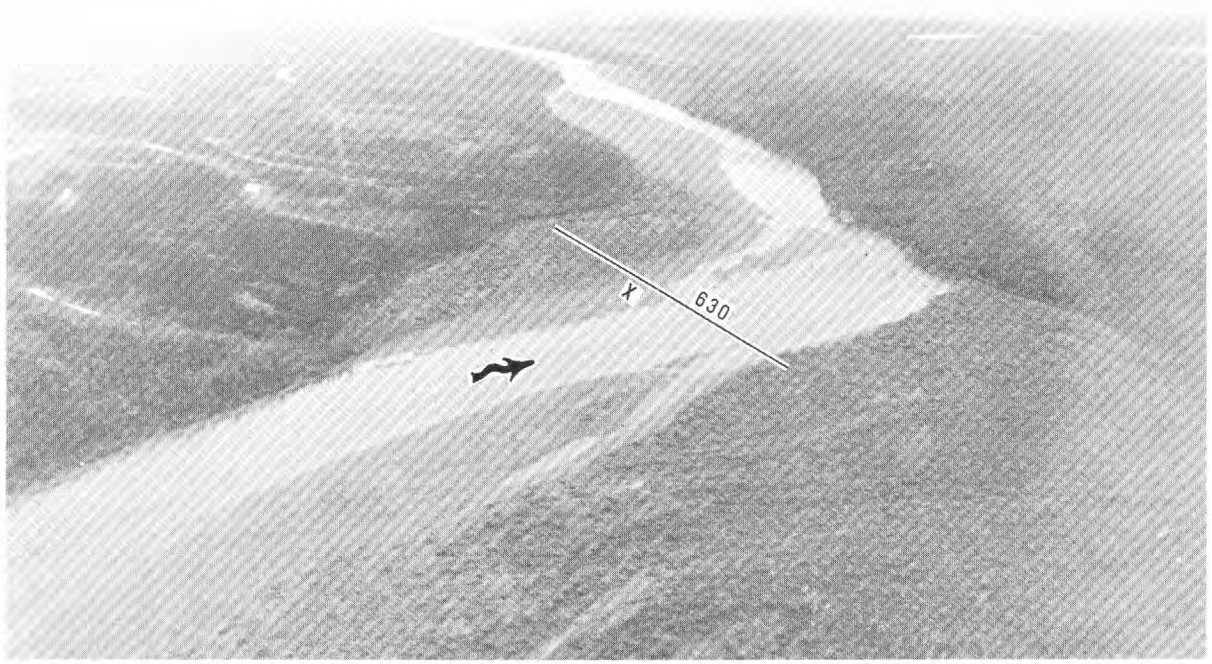


Figure 18.--Site 17, Wulik River near Kivalina, August 20, 1977.

Figure 19.--Site 18, Noatak River near Noatak, August 18, 1977.



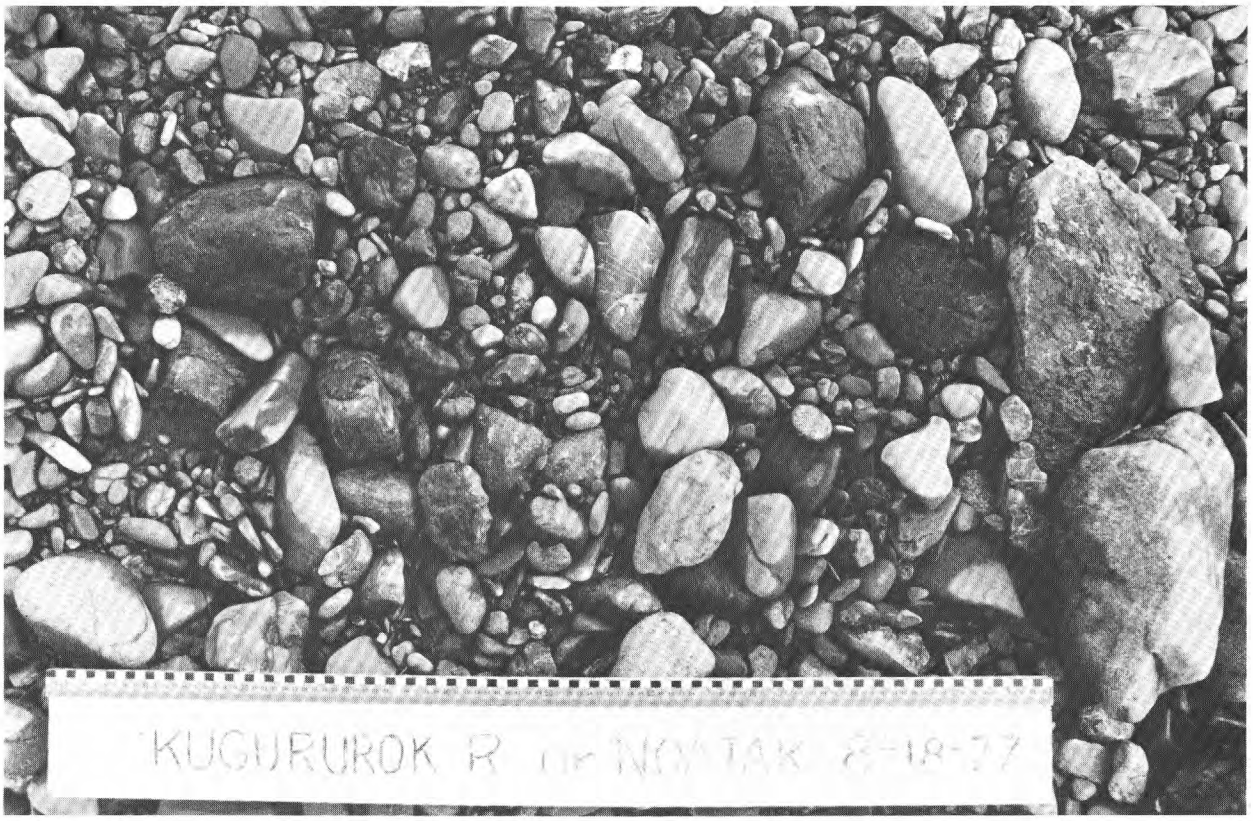


Figure 20.--Site 19, Kugururok River near Noatak, August 18, 1977.

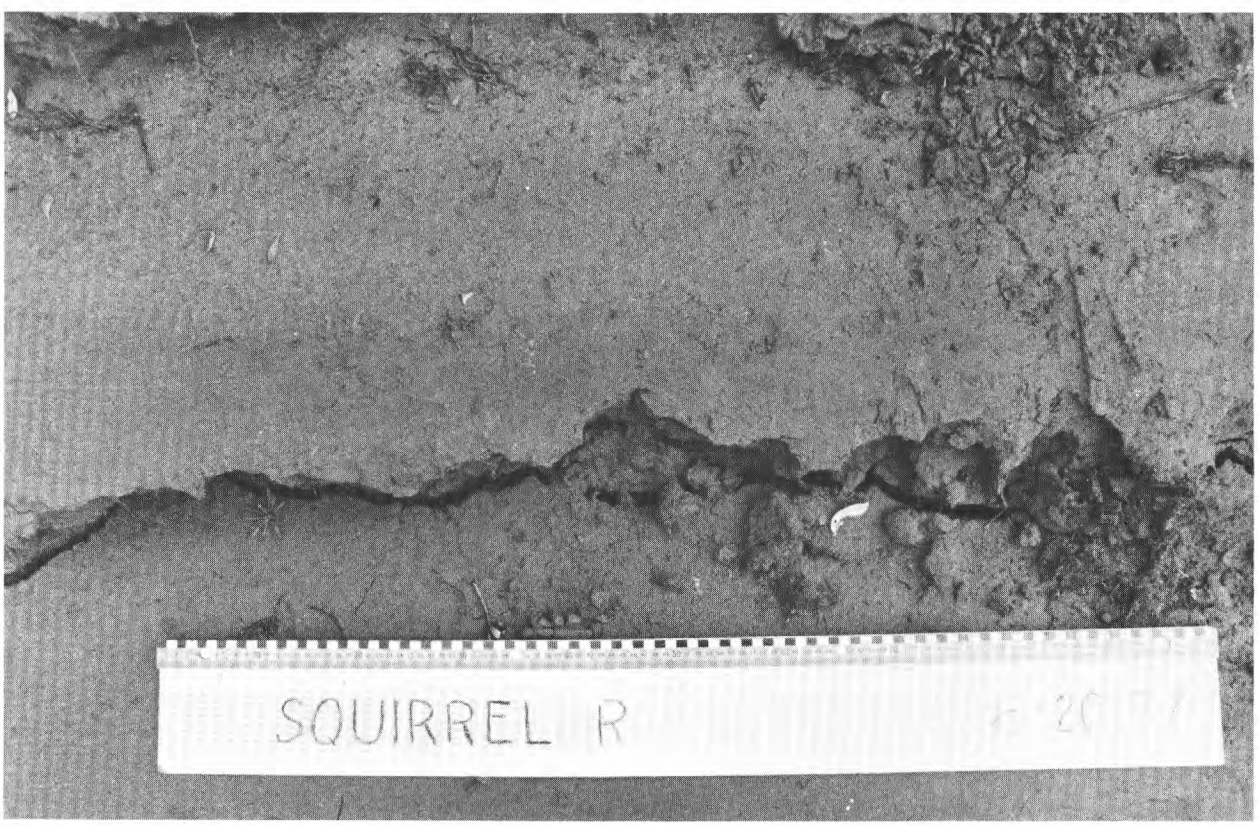


Figure 21.--Site 20, Squirrel River near Kiana, August 20, 1977.

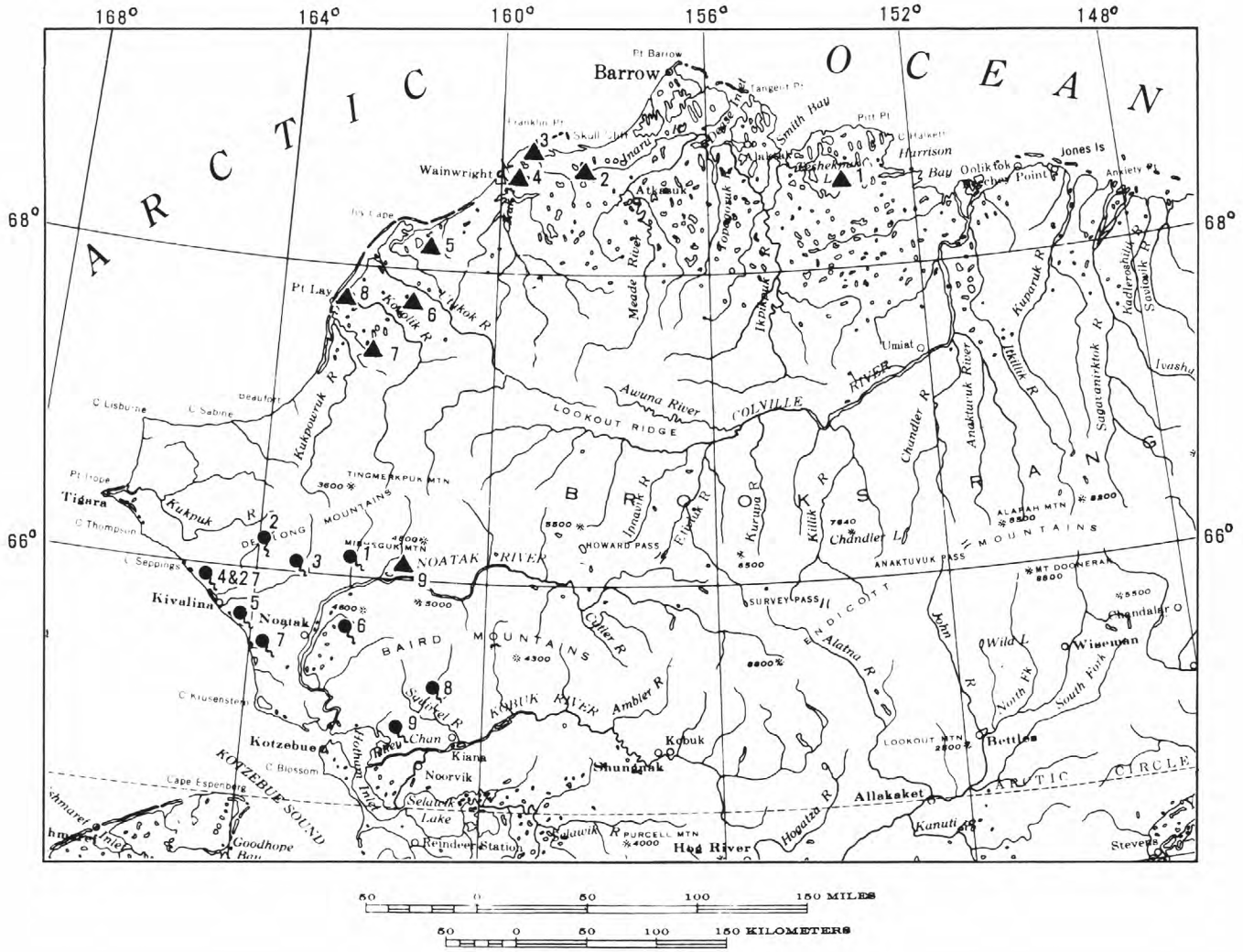


Figure 22.--Location of spring and lake sites, April 1976 and August 1977.

Figure 23.--Members of the Survey party are measuring water discharge and quality. Kelly River spring near Noatak, April 6, 1976.

Figure 24.--Kivalina River tributary spring near Kivalina, April 7, 1976.

Figure 25.--Wulik River spring near Kivalina, April 6, 1976.

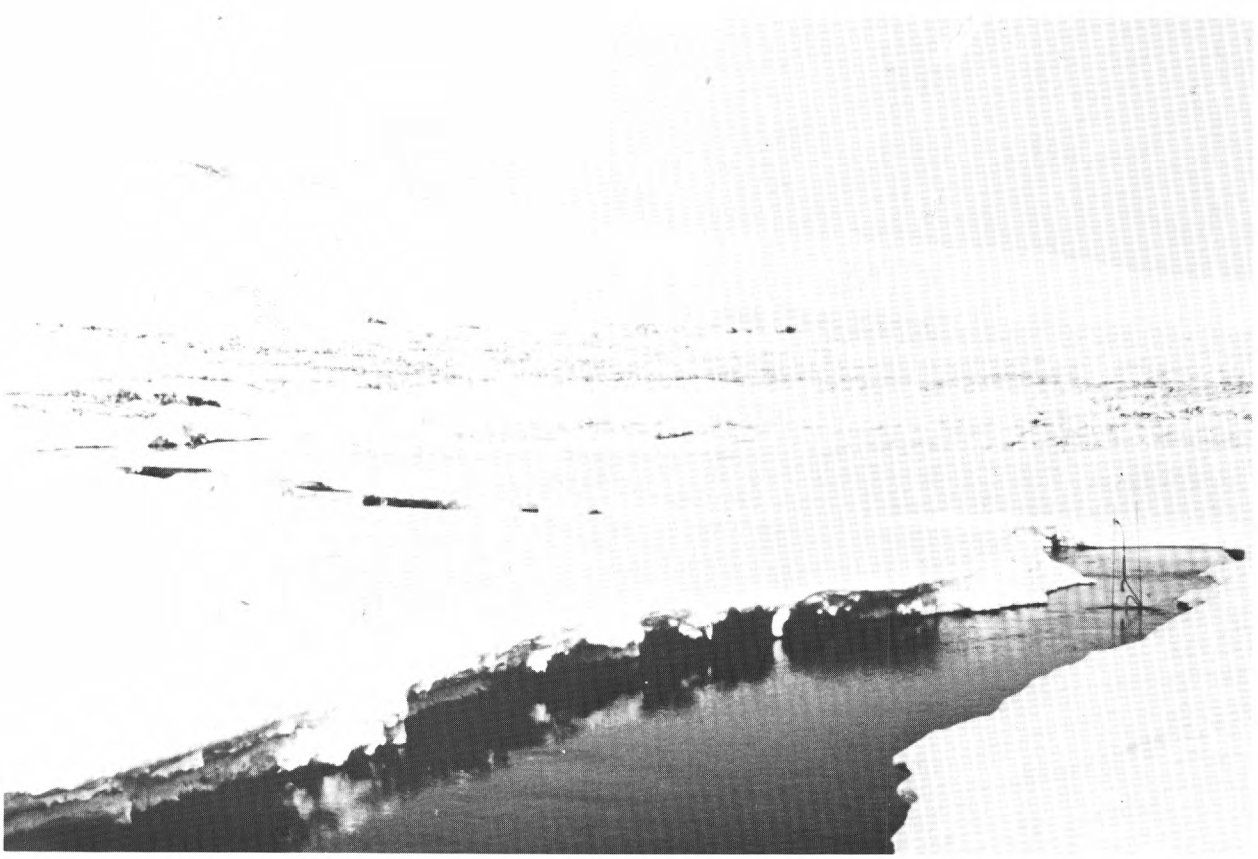


Figure 26.--Kavrorak Springs near Kivalina, April 7, 1976.

Figure 27.--Omikviorok Spring near Kivalina, April 6, 1976.

Figure 28.--Eli River spring near Noatak, April 6, 1976.

Figure 29.--Survey party member is measuring water quality Rabbit Creek spring near Noatak, April 7, 1976.

Figure 30.--North Fork Squirrel River spring near Kiana, April 5, 1976.

Figure 31.--Amaouk Creek spring near Noorvik, April 5, 1976.

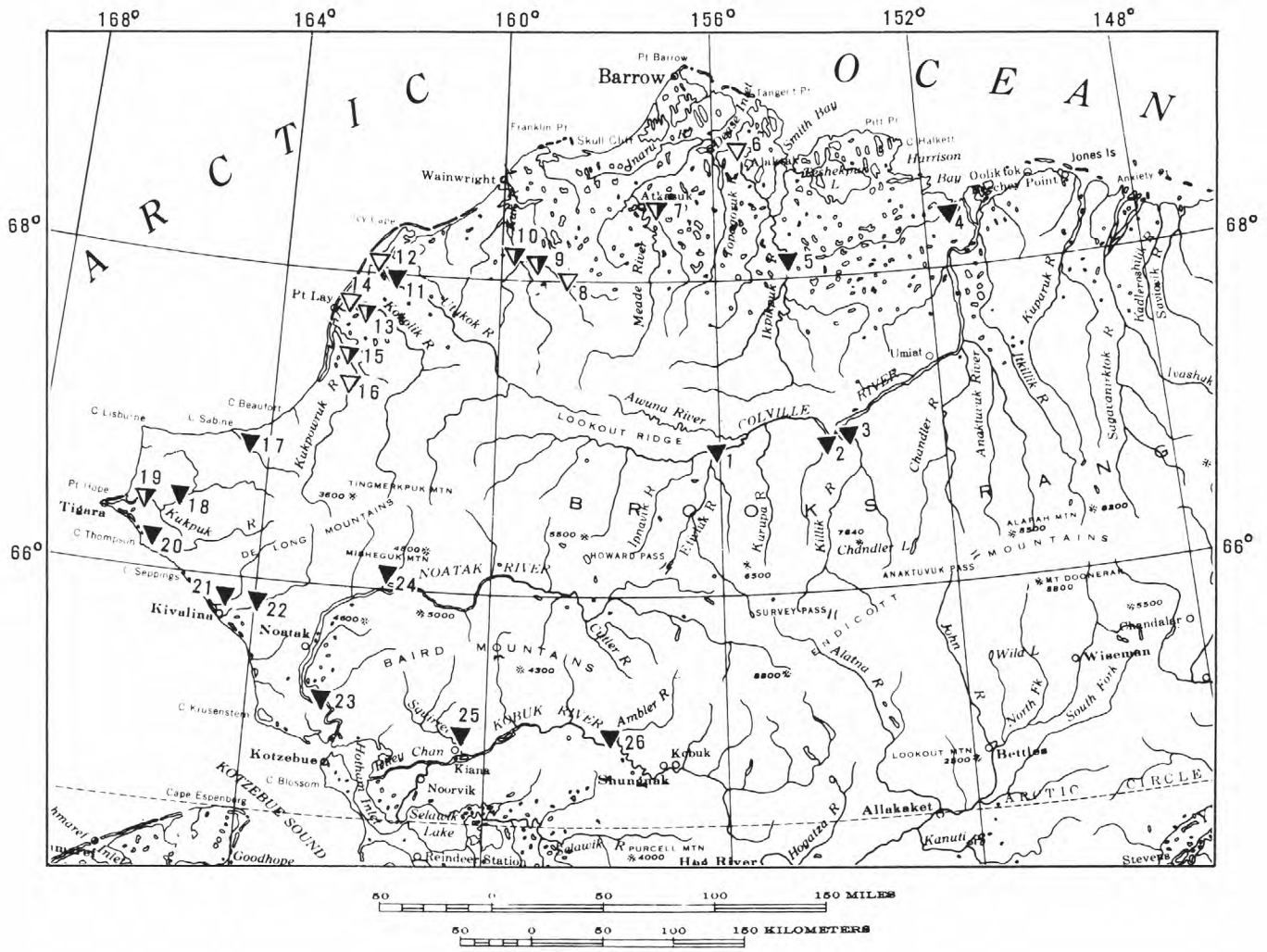


Figure 32.--Location of stream sites, April 1976 and August 1977.

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