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Hydrologic Data From Nation, Kandik, and Yukon Rivers, Yukon–Charley Rivers National Preserve, Alaska

Open-File Report 01–295

Prepared in cooperation with the NATIONAL PARK SERVICE

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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Cover photograph: View of Nation River, looking upstream from near mouth. Photograph by Richard Kemnitz, August 29, 2000.

Hydrologic Data From Nation, Kandik, and Yukon Rivers, Yukon–Charley Rivers National Preserve, Alaska

By Timothy P. Brabets

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2001

U.S. DEPARTMENT OF THE INTERIOR
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CONVERSION FACTORS, ABBREVIATED WATER-QUALITY UNITS, and VERTICAL DATUM

Multiply	by	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic foot per second per square mile ($ft^3/s/mi^2$)	0.02832	cubic meter per second
short ton (ton)	0.9072	metric ton

In this report, temperature is reported in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the equation

$$°F = 1.8\ (°C) + 32$$

Abbreviated water-quality units: Chemical concentration in water, or solute mass per unit volume (liter) of water, is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). (A concentration of 1,000 µg/L is equivalent to a concentration of 1 mg/L. For concentrations less than 7,000 mg/L, the numerical value is about the same as for concentrations in parts per million.) Specific conductance is given in microsiemens per centimeter (µS/cm) at 25°C.

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929, formerly called "Sea-Level Datum of 1929"), which is derived from a general adjustment of the first-order leveling networks of the United States and Canada.

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By Timothy P. Brabets

Abstract

Flow data were collected from two adjacent rivers in Yukon–Charley Rivers National Preserve, Alaska—the Nation River (during 1991–2000) and the Kandik River (1994–2000)—and from the Yukon River (1950–2000) at Eagle, Alaska, upstream from the boundary of the preserve. These flow records indicate that most of the runoff from these rivers occurs from May through September and that the average monthly discharge during this period ranges from 1,172 to 2,210 cubic feet per second for the Nation River, from 1,203 to 2,633 cubic feet per second for the Kandik River, and from 112,000 to 224,000 cubic feet per second for the Yukon River.

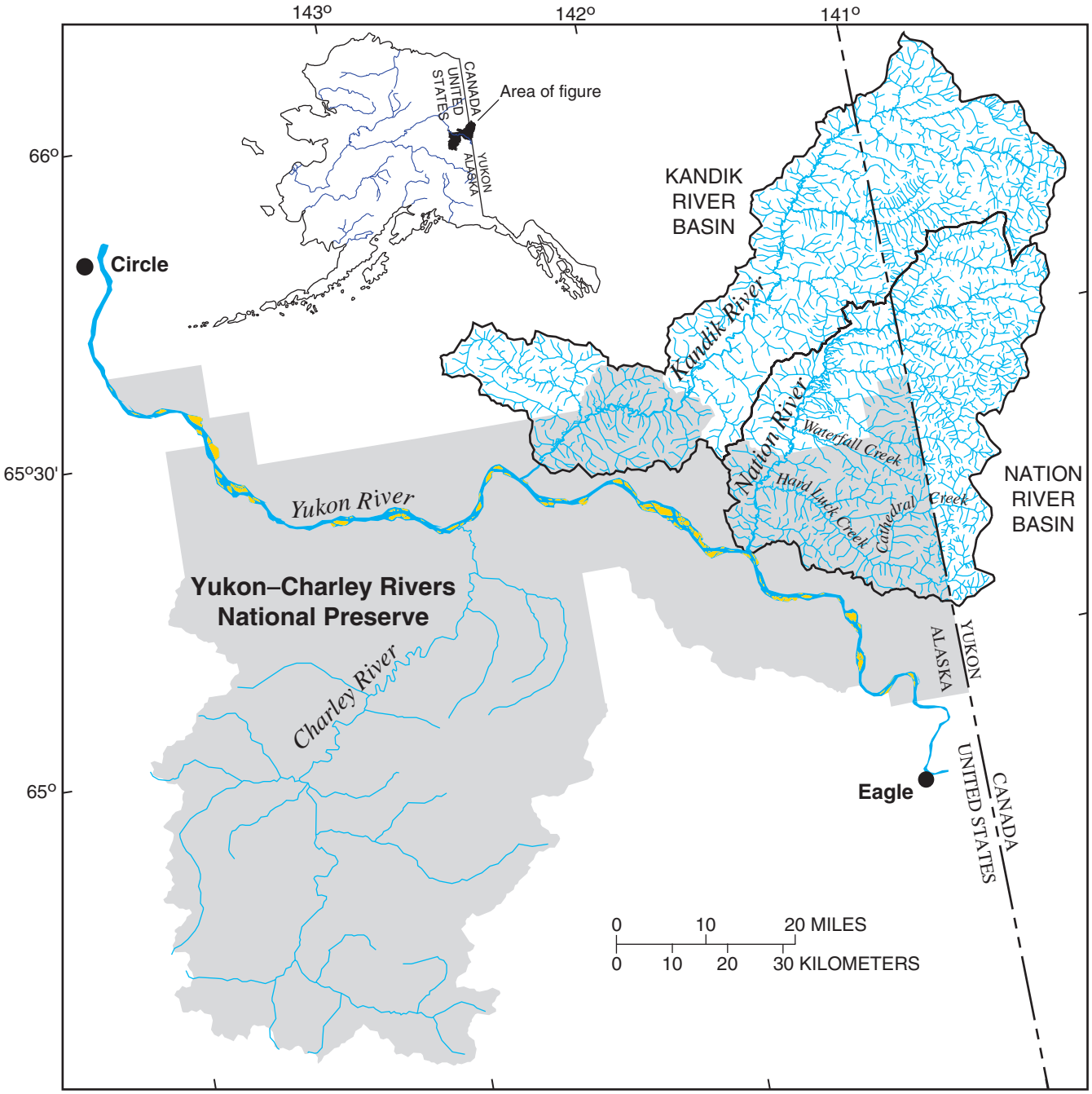
Water-quality data were collected for the Nation River and several of its tributaries from 1991 to 1992 and for the Yukon River at Eagle from 1950 to 1994. Three tributaries to the Nation River (Waterfall Creek, Cathedral Creek, and Hard Luck Creek) have relatively high concentrations of calcium, magnesium, and sulfate. These three watersheds are underlain predominantly by Paleozoic and Precambrian rocks. The Yukon River transports 33,000,000 tons of suspended sediment past Eagle each year. Reflecting the inputs from its major tributaries, the water of the Yukon River at Eagle is dominated by calcium–magnesium bicarbonate.

INTRODUCTION

The Nation and Kandik Rivers are two adjacent rivers located in interior Alaska near the Alaska–Canada border. Both rivers originate in Canada, flow southwestward into the Yukon River, and drain watersheds of approximately 1,000 mi^2. Although the basins are relatively undisturbed, the effects of mining exploration a century ago and modern-day trapping are seen locally. About three-fourths of the land comprising the Nation and Kandik Rivers watersheds is in Alaska, and both rivers flow through the Yukon–Charley Rivers National Preserve (fig. 1).

The main visitor center for the Yukon–Charley Rivers National Preserve is at Eagle, a village just west of the Alaska–Canada border (fig. 1). At Eagle, the Yukon River has drained approximately 114,000 mi^2, about one-third of the entire Yukon River Basin. Downstream from Eagle, the Yukon River flows for about 150 mi through the preserve to Circle. The preserve encompasses parts of the valley on both sides of the Yukon and the entire drainage of the Charley River, a designated National Wild and Scenic River. The Nation and Kandik Rivers, entering from the north, are the other major tributaries between Eagle and Circle.

Under terms of the Alaska Native Claims Settlement Act of 1976, the Doyon Limited Regional Corporation selected approximately 550 mi^2 of land within the preserve. As of 1994, approximately 370 mi^2 had been conveyed to Doyon. Much of this land is within the Nation River and Kandik River Basins and was selected for possible oil and gas extraction.



Base from U.S. Geological Survey digital data, 1: 63,360, 1956
Albers Equal-Area Conic projection
Standard parallels 55°00' and 65°00', central meridian -154°00'

Figure 1. Location and extent of Nation River and Kandik River Basins in Alaska (United States) and Yukon Territory (Canada) and part of Yukon River that is within Yukon–Charley Rivers National Preserve within Alaska.

Also, the State of Alaska owns the beds of the Nation and Kandik Rivers within the preserve because the rivers are deemed navigable. Potential oil and gas exploration and State ownership of the navigable river beds are the most important resources-management issues for the National Park Service in the Nation River and Kandik River Basins. In addition, they are required by law to provide access to private inholdings in the preserve. Thus the National Park Service is concerned about two categories of impacts—from temporary access across lands and potential development on lands within the preserve. To manage development activities effectively, resources information such as water quantity and quality is required. By collecting and assembling data before any development takes place, park managers have a baseline with which to compare future impacts.

Purpose and Scope

As a result of possible oil and gas exploration, the National Park Service, in cooperation with the U.S. Geological Survey (USGS), began to collect hydrologic data on the Nation River in 1991 and on the Kandik River in 1994. Flow and water-quality information were collected by the USGS and Environment Canada on the Yukon River at Eagle from 1950 to 1994. The purpose of this report is to compile and summarize the flow and water-quality data of the Nation and Kandik Rivers that have been collected to date. In addition, flow and water-quality information that has been collected from the Yukon River at Eagle is also summarized. Although the National Park Service does not control upstream activities that might affect the water quality of the Yukon River at Eagle, they need to know the water quality of the Yukon because it is a migration corridor for fish and wildlife in both the United States and Canada. Water quality of the Yukon River can affect changes in those fish species that migrate up tributaries such as the Nation and Kandik Rivers.

Acknowledgments

The author gratefully appreciates the efforts of the National Park Service in providing streamflow and water-quality information for the Nation River. Environment Canada provided access to water-quality data collected on the Yukon River at Eagle through their website (URL: <http://www.ec.gc.ca/water/index.htm>).

PHYSICAL SETTING

The Nation and Kandik Rivers originate in the Ogilvie Mountains in west-central Yukon Territory, Canada. Both rivers then flow southwestward into the Yukon River in Alaska. Average basin elevation for the Nation River Basin is 2,500 ft and ranges from 750 to 5,500 ft; average basin elevation for the Kandik Basin is 2,200 ft and ranges from 720 to 5,600 ft (fig. 2). Both basins receive from 10 to 15 in. of precipitation annually. The Yukon River is believed to originate from the Llewellyn Glacier, near Atlin Lakes, in northwestern British Columbia (Parfit, 1998). From its headwaters, the Yukon generally flows northwestward to the Canada–Alaska border.

Land-cover types for the Kandik River Basin are primarily needleleaf forest, broadleaf forest, and tall and low shrubland (table 1). Land-cover types for the Nation River Basin are primarily needleleaf forest, wet herbaceous, and lichens. Needleleaf forests consist of white and black spruce, broadleaf forests consist primarily of white birch, tall and low shrublands consist of willows and alders, wet herbaceous areas consist of grasses, and lichens consist of low and dwarf shrubs.

The geology of the Nation River Basin consists primarily of Precambrian metamorphic rocks, Paleozoic sedimentary and igneous rocks, and Cenozoic sedimentary rocks (fig. 3). The Precambrian rocks in the Nation River Basin are predominantly limestone and granitic rocks; the Paleozoic rocks are part of the Devonian McCann Hill Chert; and the Cenozoic sedimentary rocks are predominantly sandstone and mudstone (Dover and Miyaoka, 1988). The geology of the Kandik River Basin is dominated by Mesozoic sedimentary rocks. The main geologic formations are the Early Cretaceous Kathul Graywacke (sandstone, conglomerate, and argillite, all having a volcanic-clast component) and the underlying Early Cretaceous Biederman Argillite (interbedded carbonaceous argillite, siltstone, and sandstone) (Brabb and Churkin, 1969; Dover and Miyaoka, 1988). Quaternary unconsolidated surficial and flood-plain deposits are found along the main course of each river.

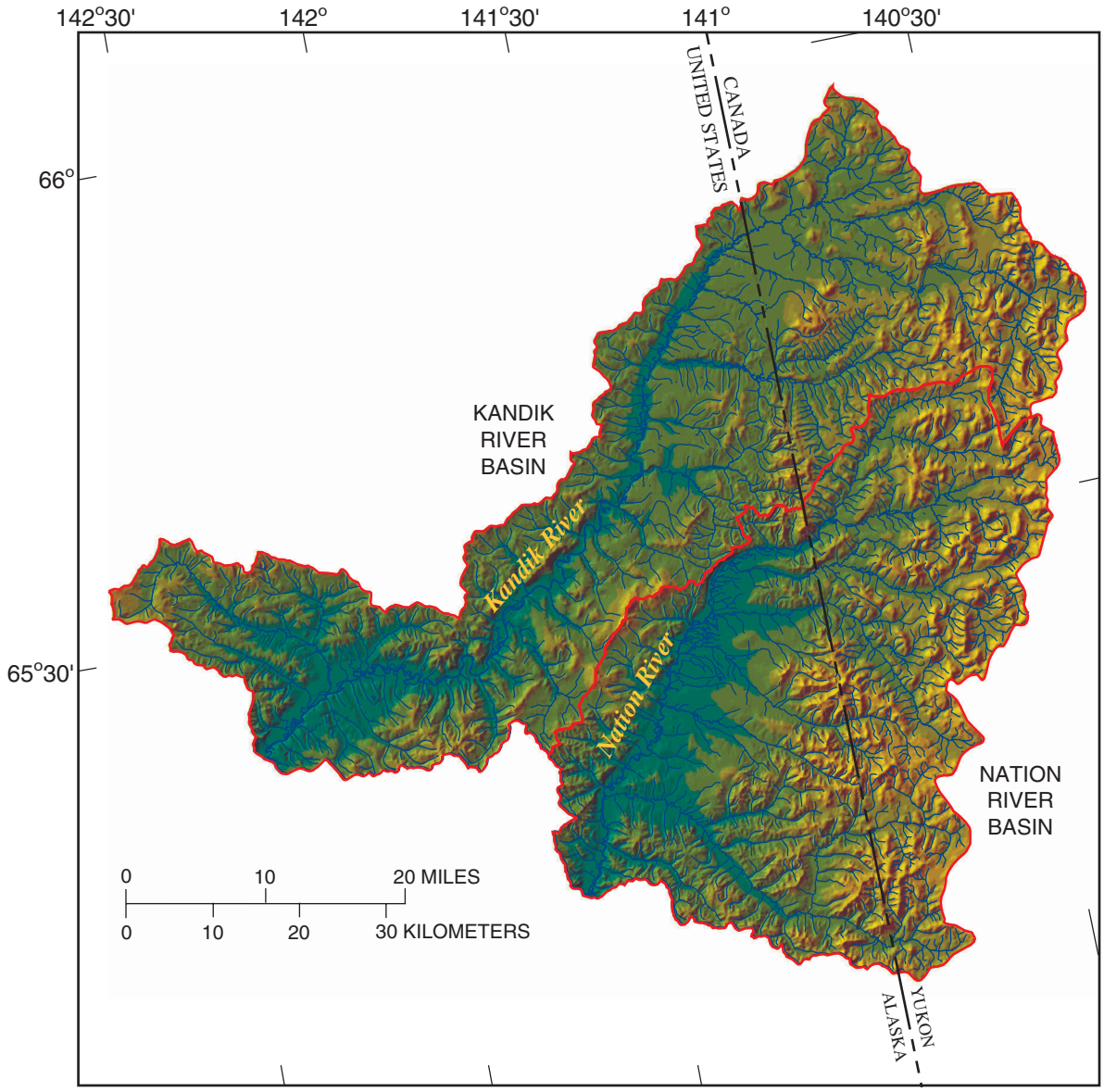


Figure 2. Shaded relief of Nation River and Kandik River Basins. Minimum and maximum elevations in area of map are 718 and 5,557 ft. For base-map information, see figure 1.

SURFACE WATER

Discharge measurements have been made by the National Park Service and the USGS at 13 sites in the Nation River Basin (fig. 4 and table 2). Flow was measured at these sites intermittently in 1991, 1992, and 1993. A streamflow-gaging station was established at site 12 in June 1991 to collect continuous flow records during the open-water season (June–September). Flow records for the entire water year have been collected since October 1997.

Most of the flow in the Nation River occurs from May through September (tables 3 and 4; figs. 5 and 6). Average monthly discharge ranges from 1,172 to 2,210 ft^3/s. Most variability in flows in the Nation River occurs in May. Flows are highest in May, June, and August, reflecting runoff from snowmelt and rain.

Table 1. Types and areal extents of land cover in Nation River and Kandik River Basins

[Data modified from electronic files at Alaska Geospatial Data Clearinghouse, U.S. Geological Survey; accessed September 1998]

Type of land cover	Areal extent (square miles)	Areal extent (percent of basin)
Nation River Basin		
Needleleaf forest	589	50.6
Broadleaf forest	76	6.5
Tall and low shrubland	94	8.2
Dwarf shrubland	24	2.0
Wet herbaceous	176	15
Lichens	184	15.8
Barren	22	1.9
Total.....	1,165	100
Kandik River Basin		
Needleleaf forest	791	59.0
Broadleaf forest	260	19.4
Tall and low shrubland	148	11.0
Dwarf shrubland	4	0.3
Wet herbaceous	46	3.4
Lichens	92	6.9
Barren	0	0
Total.....	1,341	100

Discharge measurements were made at four tributaries to the Nation River: Tinder Creek, Waterfall Creek, Cathedral Creek, and Hard Luck Creek (fig. 4, table 5). Flow measurements made on these streams show the seasonality of flows, with low flows occurring in March and higher flows occurring during the summer runoff season (May–September). Comparing the flows on a unit-discharge basis, runoff from Waterfall Creek is lowest and runoff from Cathedral and Tindir Creeks is highest.

Discharge measurements and flow records since June 1994 are available for the Kandik River near the mouth (site 14; fig. 4, table 5). Kandik River flow records used in this study include daily records for the open-water season (May–September) from June 1994 through September 1999 (table 3) and year-round flow records from October 1997 through 1999.

Average daily flow records for 1998 through 2000 indicate that most of the flow in the Kandik River (as in the Nation River) occurs from May through September (fig. 7). Average monthly discharge ranges from 1,203 to 2,633 ft^3/s (table 3). Flow-duration curves for each of these months for the Kandik River (fig. 8 and table 4) provide a good indication of range and variability in flows. As in the Nation River, flows in May are the most variable, owing to the low flows that occur before ice breakup, and flows are highest in May, June, and August, reflecting runoff from snowmelt and rain. September shows the least variability as flow in the river gradually begins to recede into winter flow.

Daily discharge records are available for the Yukon River at Eagle from June, 1950, through 2000. The average annual discharge for this period is 83,630 ft^3/s (figs. 9 and 10). Analyzing the departure of annual discharge from the long-term average provides a good indication of the trend of streamflow (fig. 11). A prolonged period of below-average flow occurred during the 1950s; shorter periods (3 or 4 years) of above-average and below-average streamflow have occurred since that time.

As in the Nation and Kandik Rivers, high flows in the Yukon River generally occur during June, and the most variability in flow occurs in May (fig. 10). Average monthly discharge ranges from 110,500 to 223,600 ft^3/s (table 3). Flows are highest in June (table 4), after which flow slowly declines and varies only slightly. The lack of variability is characteristic of large rivers.

WATER QUALITY

In addition to water-quality data collected by the USGS, water-quality information was obtained from the National Park Service and Environment Canada. Most of the water-quality data are for the Yukon River at Eagle. No water-quality information is available for the Kandik River and only a limited amount is available for the Nation River and its tributaries. Data for the Nation River and some of its tributaries were collected during 1991–92; the field properties measured were discharge, dissolved oxygen, pH, specific conductance, turbidity, and water temperature (table 5). Nutrient (table 6), trace-element (table 7), and major-ion (table 8) concentrations also were determined from water samples.

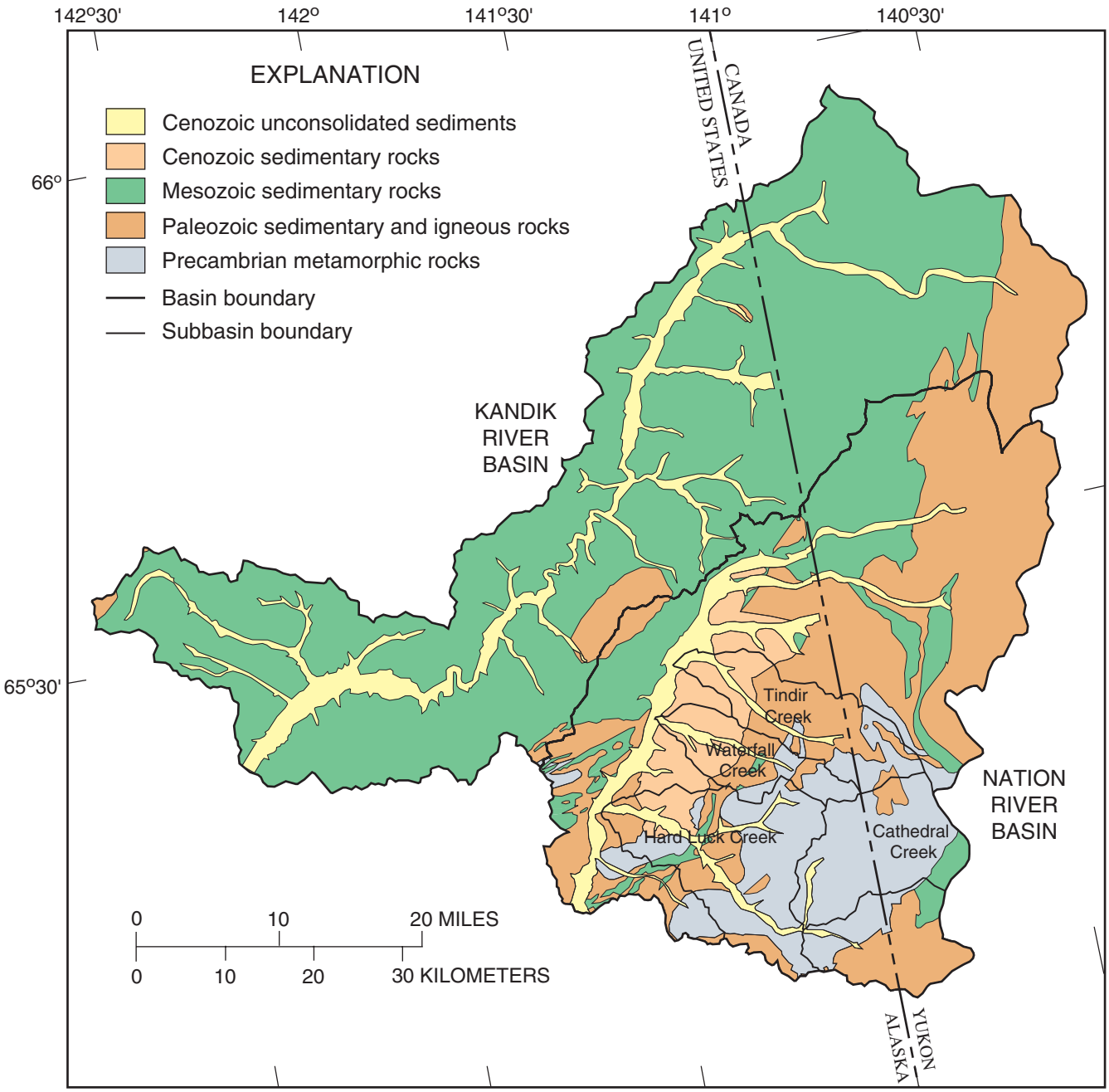


Figure 3. Geology of Nation River and Kandik River Basins (modified after Brabb and Churkin, 1969; Dover and Miyaoka, 1988). Selected subbasins within Nation River Basin are delineated. For base-map information, see figure 1.

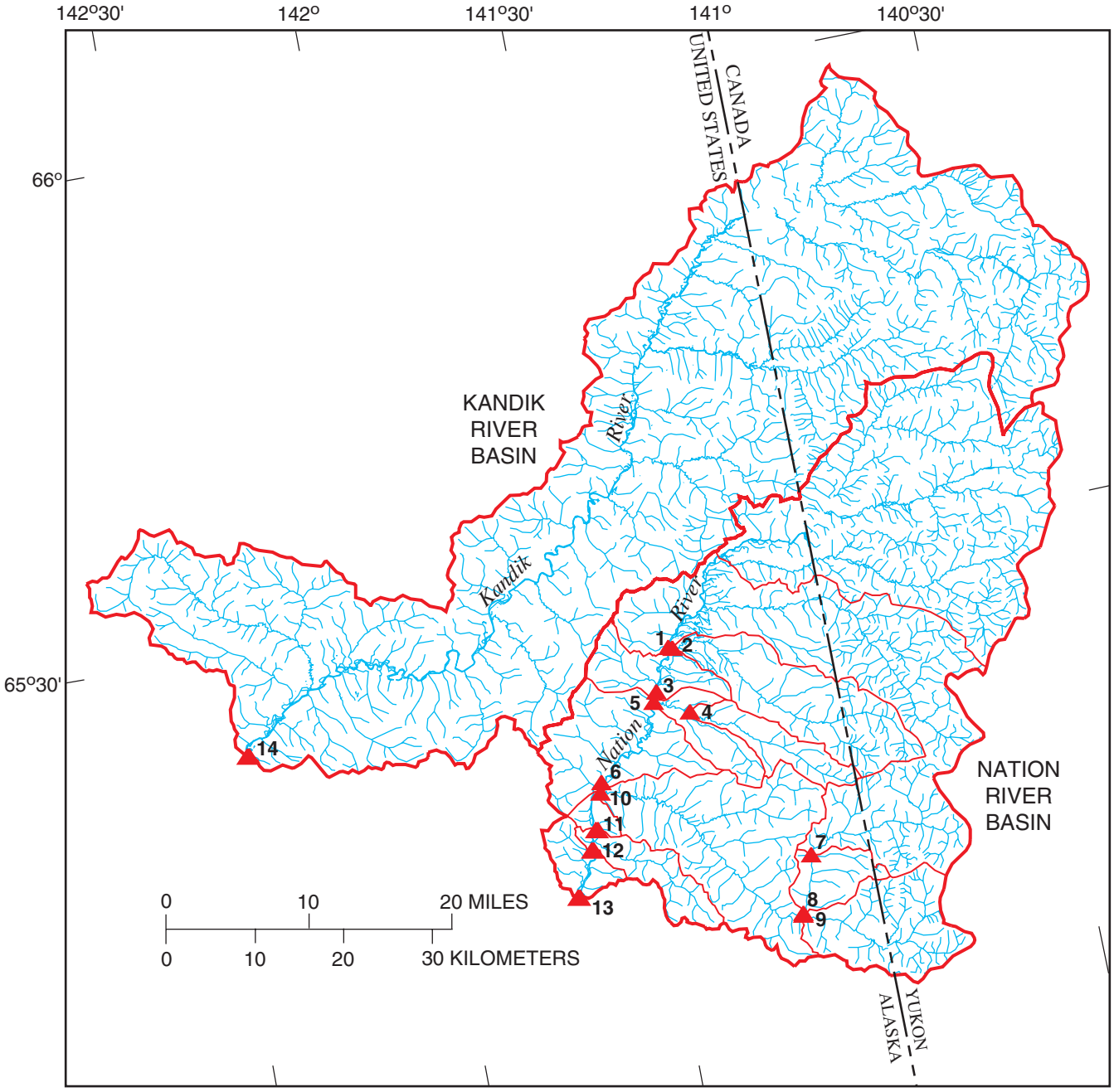


Figure 4. Location of sampling sites in Nation River and Kandik River Basins (table 2). For base-map information, see figure 1..

Table 2. Discharge-measurement and water-quality sampling sites in Nation River and Kandik River Basins

[Site no.: Number used in this report (see fig. 4). —, not applicable]

Site no.	Site name	U.S. Geological Survey identification number	Drainage area (square miles)
	Nation River Basin		
1	Nation River above Tindir Creek	652536141224800	434
2	Tindir Creek above mouth	652532141221500	73
3	Nation River above Waterfall Creek	—	530
4	Waterfall Creek near Nation	652133141213200	24
5	Waterfall Creek above mouth	—	44.3
6	Nation River above Hard Luck Creek	—	638
7	Cathedral Creek near Nation	651140141082000	60.6
8	Cathedral Creek above mouth	—	80.7
9	Hard Luck Creek above Cathedral Creek	—	58.4
10	Hard Luck Creek near Nation	651742141362800	255
11	Nation River below Hard Luck Creek	651535141375800	905
12	Nation River near Nation	15388030	931
13	Nation River at mouth	—	948
	Kandik River Basin		
14	Kandik River near Nation	15388060	1,084

Table 3. Average monthly discharge during May through September for Nation, Kandik, and Yukon Rivers

[—, no data]

Year	Monthly discharge (cubic feet per second)				
	May	June	July	August	September
	Nation River, 1991–2000				
1991	—	—	561	1,673	—
1992	—	—	816	1,325	—
1993	—	1,077	1,084	1,101	1,468
1994	—	—	1,525	800	847
1995	—	1,581	1,816	1,333	1,780
1996	—	759	532	1,241	543
1997	3,143	1,469	792	2,232	1,230
1998	2,243	2,577	1,218	2,428	1,394
1999	912	770	858	923	767
2000	2,541	3,054	2,639	3,103	1,346
Average....	2,210	1,612	1,184	1,616	1,172
	Kandik River, 1994–2000				
1994	—	—	1,312	574	858
1995	—	1,970	1,876	1,543	1,865
1996	—	657	743	1,421	715
1997	2,942	1,754	1,078	2,758	1,292
1998	2,106	3,083	1,014	2,659	1,246
1999	857	872	1,072	1,144	896
2000	4,626	3,684	2,723	3,844	1,546
Average....	2,633	2,003	1,403	1,992	1,203
	Yukon River, 1950–2000				
Average....	124,600	224,000	182,300	144,000	112,000

Table 4. Magnitudes of selected percentiles of flow during May through September for Nation, Kandik, and Yukon Rivers

Month	90th percentile		50th percentile		10th percentile	
	Discharge (cubic feet per second)	Unit discharge (cubic feet per second per square mile)	Discharge (cubic feet per second)	Unit discharge (cubic feet per second per square mile)	Discharge (cubic feet per second)	Unit discharge (cubic feet per second per square mile)
			Nation River, 1991–2000			
May	660	0.71	1,950	2.09	3,904	4.19
June	511	.55	1,092	1.17	3,455	3.71
July	469	.50	877	.94	2,437	2.62
August	678	.73	1,180	1.27	3,146	3.38
September	599	.64	1,058	1.14	1,872	2.01
			Kandik River, 1994–2000			
May	524	0.48	2,129	1.96	5,592	5.16
June	424	.39	1,337	1.23	4,475	4.13
July	479	.44	1,145	1.06	2,618	2.42
August	534	.49	1,435	1.32	3,812	3.52
September	617	.57	994	.92	2,050	1.89
			Yukon River, 1950–2000			
May	23,800	0.21	129,600	1.14	216,700	1.91
June	146,500	1.29	211,800	1.87	320,300	2.82
July	132,200	1.16	176,000	1.55	240,400	2.12
August	109,400	.96	140,800	1.24	183,500	1.62
September	82,400	.72	110,200	.97	143,300	1.26

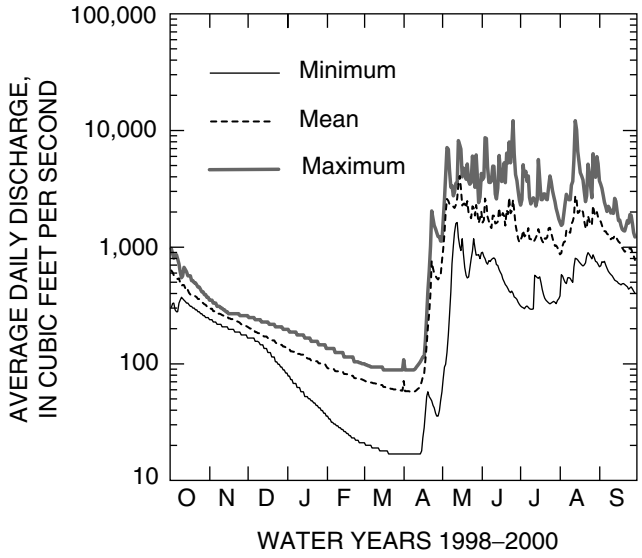


Figure 5. Daily discharge for Nation River near Nation, water years 1998–2000.

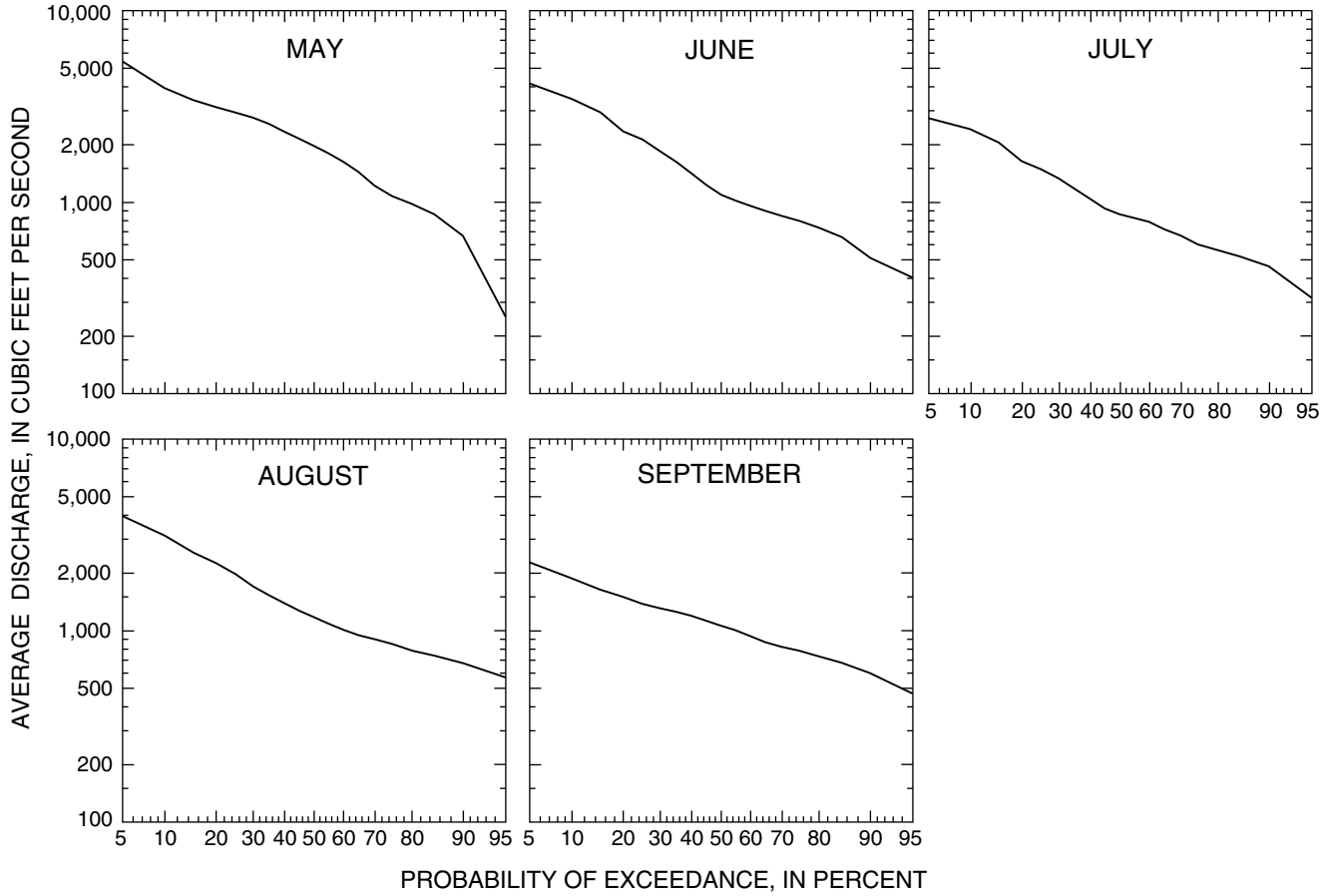


Figure 6. Flow-duration curves for Nation River near Nation, open-water season (May–September), 1991–2000.

Table 5. Discharge and other field properties measured at 13 sites in Nation River Basin

[Site no.: Number used in this report (see figure 4). —, no data]

Site no.	Site name	Date	Discharge (cubic feet per second)	Unit discharge (cubic feet per second per square mile)	Dissolved oxygen (milligrams per liter)	pH (standard units)	Specific conductance (microsiemens per centimeter)	Turbidity (nephelometric units)	Water temperature (degrees Celsius)
1	Nation River above Tindir Creek	7-20-91	321	0.74	9.2	8.2	380	1.0	13.0
		7-22-91	290	.68	9.7	8.1	410	.3	10.0
		3-30-92	85	.20	11.9	7.7	447	.5	.1
		8-24-92	518	1.21	—	—	—	—	—
		6-10-93	604	1.41	—	—	—	—	—
		8-24-93	837	2.00	—	—	—	—	—
2	Tindir Creek above mouth	7-20-91	38.3	.52	10.6	8.1	480	6.0	11.0
		7-22-91	37.9	.52	10.4	8.0	420	.67	8.0
		3-30-92	15	.20	13.0	8.2	398	.5	.2
		8-24-92	83	1.14	—	—	—	—	—
		8-24-93	179	2.45	—	—	—	—	—
3	Nation River above Waterfall Creek	7-23-91	316	.60	10.0	8.1	400	.33	11.0
		7-24-91	313	.59	11.0	8.1	370	.40	12.0
4	Waterfall Creek near Nation	3-31-92	1.1	.04	7.8	7.5	708	.50	.2
5	Waterfall Creek above mouth	7-23-91	7.3	.16	9.0	7.8	540	.32	14.0
		7-24-91	5.8	.13	8.4	7.9	440	.42	12.0
		3-31-92	0	0	—	—	—	—	—
		8-23-92	31	.70	—	—	—	—	—
		6-10-93	18	.41	—	—	—	—	—
6	Nation River above Hard Luck Creek	7-27-91	352	.55	10.2	8.0	470	.72	13.0
		7-28-91	328	.62	9.5	—	480	.74	13.0
7	Cathedral Creek near Nation	7-15-91	48.6	.80	12.3	8.0	540	.3	9.0
		7-17-91	51.9	.86	14.0	8.3	540	.22	7.0
		3-31-92	9.2	.15	12.5	8.3	560	.6	3.4
8	Cathedral Creek above mouth	7-17-91	50.5	.62	11.6	8.5	590	.35	11.0
		7-19-91	55.7	.69	11.0	8.4	590	.99	7.0
		8-24-92	97	1.20	—	—	—	—	—
		6-10-93	148	1.80	—	—	—	—	—
9	Hard Luck Creek above Cathedral Creek	7-17-91	18.5	.32	—	8.3	590	.46	12.0
		7-19-91	16.9	.29	10.1	8.2	660	.53	11.0
		6-10-93	60	1.03	—	—	—	—	—
10	Hard Luck Creek near Nation	6-19-91	233	.92	14.3	8.3	630	.25	13.0
		6-30-91	145	.57	11.7	8.4	620	.40	12.0
		7-27-91	84.4	.33	12.8	7.8	752	.50	.1
		7-28-91	83.4	.33	—	—	—	—	—
		3-31-92	21	.08	—	—	—	—	—
		8-22-92	189	.74	—	—	—	—	—
		6-8-93	455	1.78	—	—	—	—	—
		8-25-93	391	1.53	—	—	—	—	—
11	Nation River below Hard Luck Creek	5-24-91	—	—	10.4	7.6	300	4.8	6.0
		4-1-92	104	.11	11.8	7.8	516	1.6	.1
12	Nation River near Nation	6-19-91	1,060	1.14	14.2	8.0	420	9.0	14.0
		6-27-91	840	.90	11.0	7.9	400	4.2	12.0
		7-2-91	664	.71	16.9	8.3	420	8.0	13.0
		7-30-91	601	.64	—	—	—	—	—
		9-10-91	911	.98	—	—	—	—	—
		6-4-92	6,020	6.47	—	—	186	—	3.2
		8-22-92	946	1.02	—	—	434	—	9.0
		6-8-93	1,200	1.29	—	—	—	—	—
		8-25-93	1,590	1.71	—	—	—	—	—
13	Nation River at mouth	6-13-91	938	.99	9.8	8.2	340	20	12.0

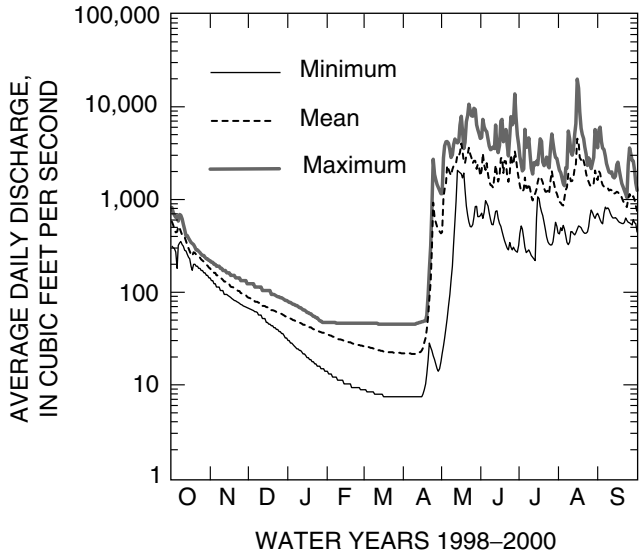


Figure 7. Daily discharge for Kandik River near Nation, water years 1998–2000.

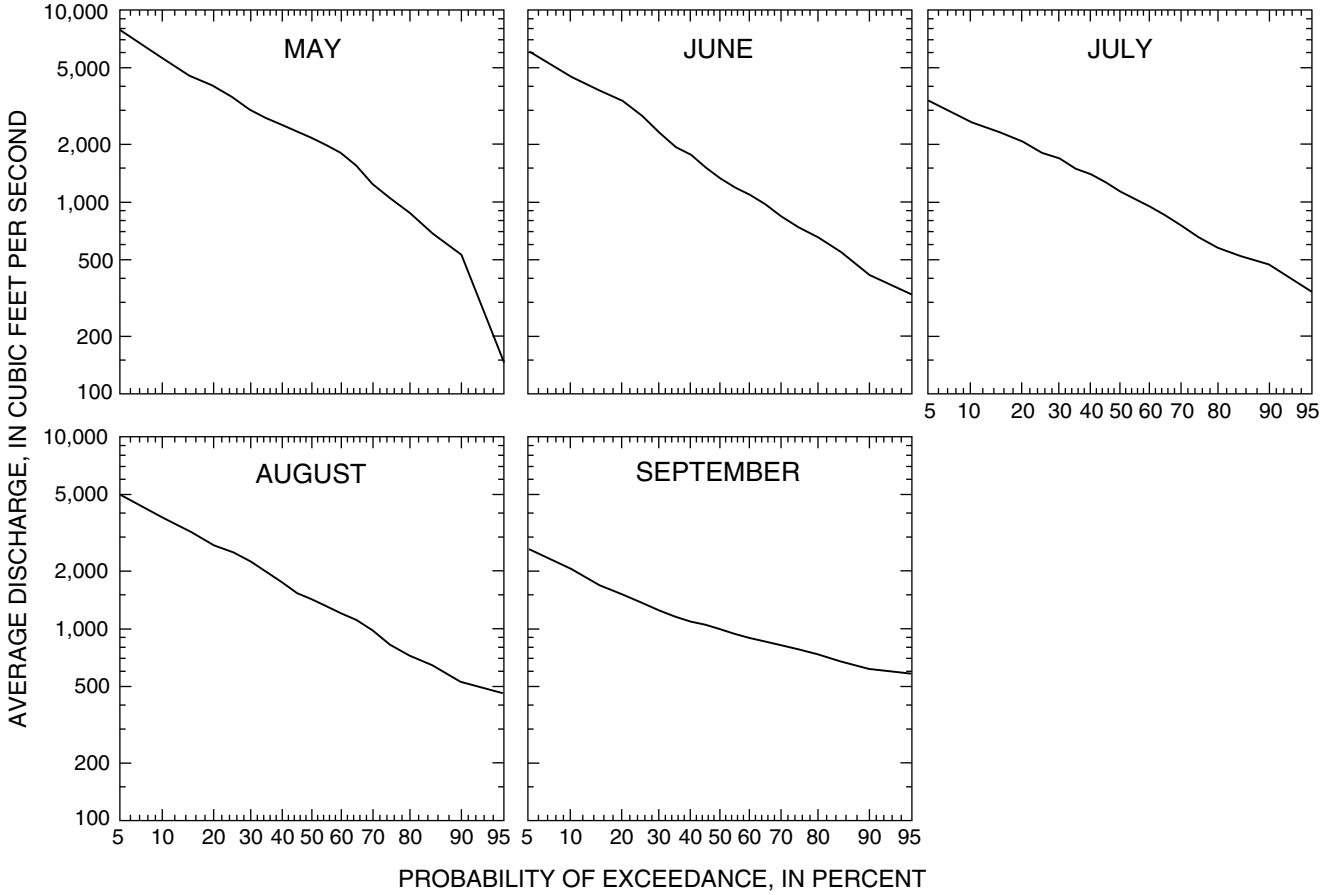


Figure 8. Flow-duration curves for Kandik River near Nation, open-water season (May–September), 1994–2000.

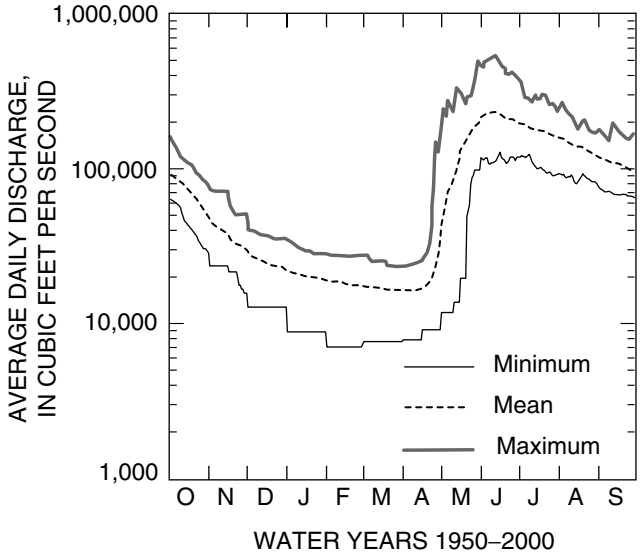


Figure 9. Daily discharge for Yukon River at Eagle, water years 1950–2000.

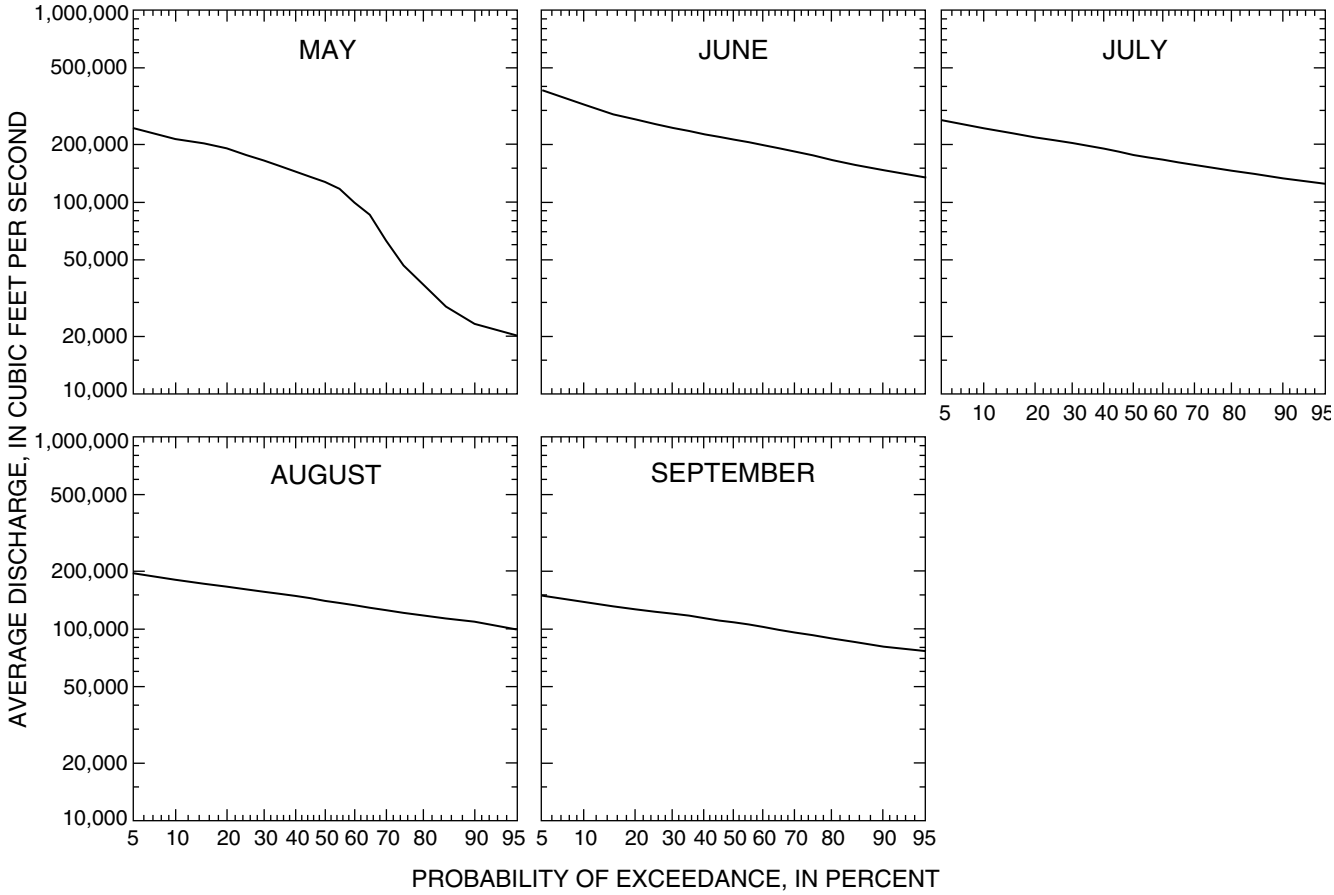


Figure 10. Flow-duration curves for Yukon River at Eagle, open-water season (May–September), 1950–2000.

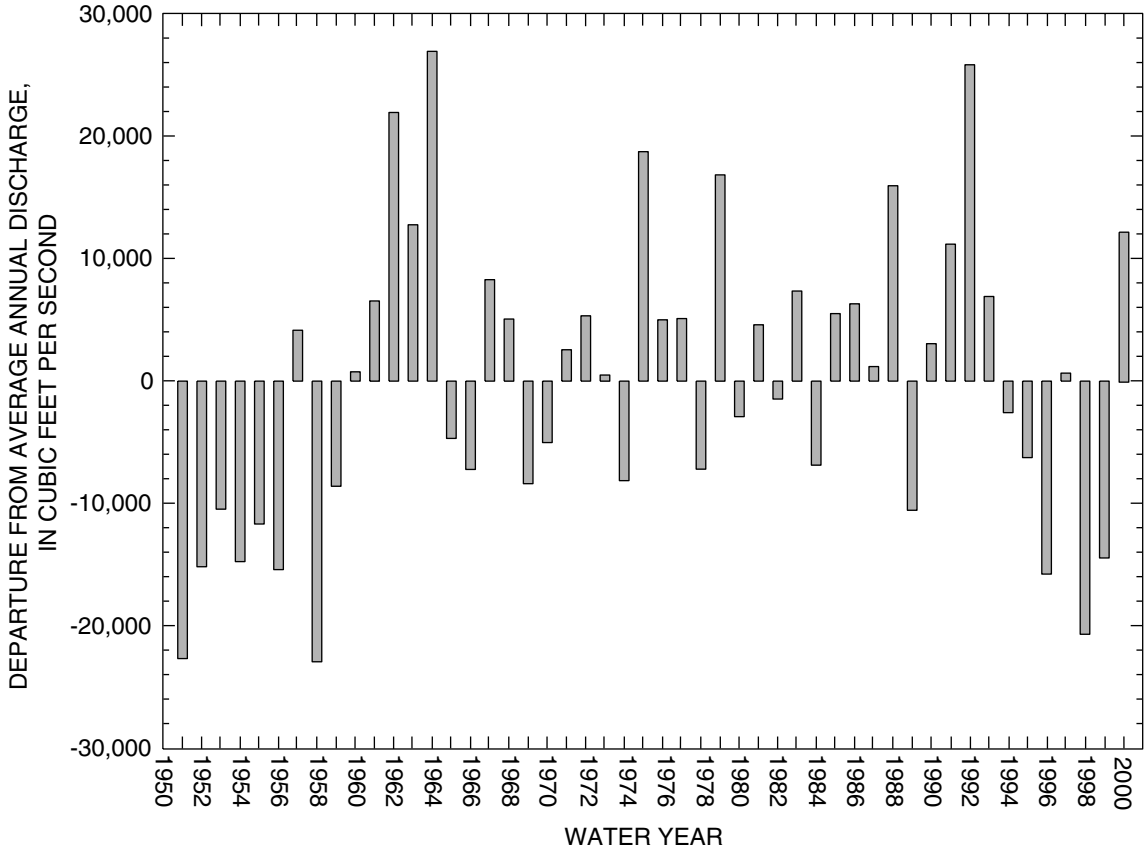


Figure 11. Departure of long-term average annual discharge for Yukon River at Eagle.

Table 6. Nutrient concentrations at six sites in Nation River Basin

[Site no.: Number used in this report (see figure 4). <, less than]

Site no.	Site name	Date	Nutrient (milligrams per liter)			
			Nitrogen, as (NO_2+NO_3)		Phosphorus, as P	
			Total	Dissolved	Total	Dissolved
1	Nation River above Tindir Creek	3-30-92	0.36	0.31	<0.01	<0.01
2	Tindir Creek above mouth	3-30-92	.37	.37	<.01	<.01
4	Waterfall Creek near Nation	3-31-92	.30	.30	<.01	<.01
7	Cathedral Creek near Nation	3-31-92	.39	.40	<.01	<.01
10	Hard Luck Creek near Nation	3-31-92	.43	.43	<.01	<.01
11	Nation River below Hard Luck Creek	4-1-92	.40	.39	<.01	<.01

Inspection of values of field properties for the Nation River Basin (table 5) indicates low turbidity for the tributaries with the exception of one sample at Tindir Creek (site 2). Higher values of turbidity were found at sites along the Nation River (sites 11, 12, and 13, fig. 4). However, these samples were collected during high-flow periods and probably reflect high suspended-sediment concentrations. Water temperature varied with season, and all pH values are considered to be in a normal range (Hem, 1985). Dissolved oxygen was near saturation for most streams.

Concentrations of various forms of nutrients (table 6) were all less than 1.0 mg/L. Of the selected trace elements analyzed (table 7), the notable differences in concentrations were found in aluminum and zinc. The relatively high concentrations of these trace elements may be related to the differences in discharge and the corresponding differences in suspended-sediment concentrations.

Of the water-quality data collected in the Nation River Basin, the most variability among sites is noted in the concentrations of the dissolved ions (table 8).

Table 7. Trace-element concentrations at 12 sites in Nation River Basin

[Site number: Number used in this report (see figure 4). —, no data]

Site number	Site name	Date	Trace element (milligrams per liter)					
			Aluminum	Barium	Cadmium	Lead	Zinc	Mercury
1	Nation River above Tindir Creek	7-20-91	0.86	0.071	—	—	—	0.0002
		7-22-91	—	.068	—	—	—	.0002
2	Tindir Creek above mouth	7-20-91	.087	.040	—	—	0.005	.0003
		7-22-91	.076	.041	—	—	.002	.0003
3	Nation River above Waterfall Creek	7-23-91	—	.076	—	—	—	.0005
		7-24-91	—	.075	—	—	—	—
5	Waterfall Creek above mouth	7-23-91	—	.071	—	—	—	.0009
		7-24-91	—	.067	—	—	—	.0003
6	Nation River above Hard Luck Creek	7-27-91	—	.075	—	—	—	.0002
		7-28-91	.095	.076	—	—	.225	.0003
7	Cathedral Creek near Nation	7-15-91	.059	.043	—	—	—	.0002
		7-17-91	.095	.040	—	—	—	—
8	Cathedral Creek above mouth	7-17-91	.068	.040	—	—	.043	.0002
		7-19-91	.077	.040	—	—	—	.0004
9	Hard Luck Creek above Cathedral Creek	7-17-91	.087	.042	—	—	.005	.0002
		7-19-91	.087	.047	—	—	—	.0004
10	Hard Luck Creek near Nation	7-27-91	—	.047	—	—	.043	.0002
		7-28-91	—	.046	—	—	—	.0003
11	Nation River below Hard Luck Creek	5-24-91	.073	.026	—	—	—	.0006
12	Nation River near Nation	6-19-91	.189	.057	—	—	.010	.0003
		6-27-91	.158	.060	—	0.064	—	.0002
		7-2-91	1.125	.065	0.004	.003	.009	—
13	Nation River at mouth	6-6-91	.085	.041	—	—	—	.0007
		6-13-91	.122	.063	.005	—	.003	.0005

Table 8. Major-ion concentrations at six sites in Nation River Basin

[Site number: Number used in this report (see figure 4). <, less than]

Site number	Site name	Date	Constituent (milligrams per liter)								
			Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Fluoride	Silica	Dissolved solids
1	Nation River above Tindir Creek	3-30-92	76	9.7	4.1	0.4	5.0	55	<0.10	4.3	225
2	Tindir Creek above mouth	3-30-92	52	20	2.3	.5	4.2	49	<.10	4.5	226
4	Waterfall Creek near Nation	3-31-92	100	38	3.5	.9	4.6	180	.10	4.9	465
7	Cathedral Creek near Nation	3-31-92	89	22	2.4	1.1	2.0	140	.20	4.6	379
10	Hard Luck Creek near Nation	3-31-92	110	33	5.3	1.1	4.0	230	.10	5.3	526
11	Nation River below Hard Luck Creek	4-1-92	82	18	4.5	.6	5.8	110	<.10	4.2	335

Water samples from Waterfall Creek near Nation (site 4, fig. 4), Cathedral Creek near Nation (site 7, fig. 4), and Hard Luck Creek near Nation (site 10, fig. 4) had the highest concentrations of calcium, magnesium, sulfate, and dissolved solids. The high concentrations of these ions are most likely due to the dominant rock type (Paleozoic sedimentary and igneous rocks and Precambrian metamorphic rocks) found in Waterfall Creek, Cathedral Creek, and Hard Luck Creek drainage subbasins (fig. 3, table 9).

Water-quality data were collected at the Yukon River at Eagle by the USGS from 1950 to 1979 and by Environment Canada from 1982 to 1994. The water-quality information collected by both the USGS and Environment Canada (table 10) consisted of specific conductance, dissolved solids, pH, water temperature, major-ion concentrations, and suspended sediments; Environment Canada also collected data on nutrients and selected trace elements.

Table 9. Surficial geology at six sites in Nation River Basin

[Site no.: Number used in this report (see figure 4). Surficial geology: modified after Brabb and Churkin (1969) and Dover and Miyaoka (1988). —, none]

Site no.	Site name	Surficial geology (percent of basin area)				
		Cenozoic unconsolidated sediments	Cenozoic sedimentary rocks	Mesozoic rocks	Paleozoic sedimentary and igneous rocks	Precambrian metamorphic rocks
1	Nation River above Tindir Creek	8	4	29	57	2
2	Tindir Creek above mouth	6	14	—	35	17
4	Waterfall Creek near Nation	9	18	2	32	40
7	Cathedral Creek near Nation	—	—	7	66	24
10	Hard Luck Creek near Nation	6	4	6	26	58
11	Nation River below Hard Luck Creek	8	8	19	43	21

Table 10. Summary statistics for selected field properties and constituents for Yukon River at Eagle

[Constituent percentiles were calculated from data collected by listed agency]

Data-collection agency	Number of analyses	Average	25th percentile	50th percentile	75th percentile
Specific conductance, in microsiemens per centimeter at 25°C					
Environment Canada	202	214	188	213	235
U.S. Geological Survey	81	213	187	204	231
Dissolved solids, residue on evaporation at 180°C, in milligrams per liter					
Environment Canada	144	153	133	151	170
U.S. Geological Survey	69	130	113	143	143
pH, in standard units					
Environment Canada	46	7.9	7.8	8.0	8.1
U.S. Geological Survey	75	7.6	7.3	7.6	7.9
Water temperature, in degrees Celsius					
Environment Canada	292	11.9	1	13.8	21.1
U.S. Geological Survey	49	9.6	6.5	11.5	14
Calcium, in milligrams per liter					
Environment Canada	106	31	28	30	33
U.S. Geological Survey	69	31	26	28	34
Magnesium, in milligrams per liter					
Environment Canada	106	7.8	7	8.2	9.3
U.S. Geological Survey	69	8.0	6.5	7.4	8.4
Sodium, in milligrams per liter					
Environment Canada	110	2.6	2.3	2.5	2.7
U.S. Geological Survey	53	2.6	2.2	2.4	2.8
Potassium, in milligrams per liter					
Environment Canada	108	1.3	0.97	1.1	1.3
U.S. Geological Survey	52	1.4	.95	1.2	1.7
Total alkalinity, as calcium carbonate, in milligrams per liter					
Environment Canada	197	93	79	88	102
U.S. Geological Survey	73	89	75	82	99
Sulfate, in milligrams per liter					
Environment Canada	197	25	22	25	28
U.S. Geological Survey	70	26	21	24	29
Chloride, in milligrams per liter					
Environment Canada	197	0.9	0.6	0.7	0.9
U.S. Geological Survey	69	1.1	.5	.8	1.1
Dissolved silica, in milligrams per liter					
Environment Canada	197	3.6	3.3	3.6	4.0
U.S. Geological Survey	69	7.3	6.2	7.2	8.1
Dissolved nitrate plus nitrite, as nitrogen, in milligrams per liter					
Environment Canada	661	0.21	0.046	0.093	0.17
Total phosphorus, as phosphorus, in milligrams per liter					
Environment Canada	596	0.28	0.013	0.092	0.412
Total organic carbon, as carbon, in milligrams per liter					
Environment Canada	154	5.4	2.3	4.2	6.9
Total iron, as iron, in micrograms per liter					
Environment Canada	141	6,812	100	2,200	9,620
Total manganese, as manganese, in micrograms per liter					
Environment Canada	141	155	5	69	240
Total barium, as barium, in micrograms per liter					
Environment Canada	80	104	57	86	133
Total strontium, as strontium, in micrograms per liter					
Environment Canada	141	168	152	167	194
Total arsenic, as arsenic, in micrograms per liter					
Environment Canada	144	2.6	0.4	1.2	3.6
Total aluminum, as aluminum, in micrograms per liter					
Environment Canada	80	4,458	70	199	6,910

Daily suspended-sediment concentration at the Yukon River at Eagle is generally highest from mid-July to mid-August, at least a month after the greatest discharge of water (fig. 12). At this location on the Yukon main stem, the most likely source of large concentrations of suspended sediment is the White River and its tributaries that drain the Wrangell–St. Elias Mountains. The estimated annual suspended-sediment load for the Yukon River at Eagle is 33,000,000 tons (Brabets and others, 2000).

The chemistry of the Yukon River at Eagle reflects the chemical inputs from its major tributaries. The water of the tributaries to the Yukon upstream from Eagle are predominantly calcium-magnesium bicarbonate water having a specific conductance ranging from 54 to 373 µS/cm (Brabets and others, 2000). The water-quality data from the Yukon River at Eagle indicates that calcium, sulfate, and magnesium are the predominant ions (table 10). Ranges in values of total phosphorus and dissolved nitrate plus nitrite are less than 1.0 mg/L. Of the trace-element data collected, total aluminum and total iron have the largest ranges in values. These values are most likely dependent on the amount of suspended sediment present in the river at the time of sampling.

REFERENCES CITED

Brabb, E.E., and Churkin, Michael, Jr., 1969, Geologic map of the Charley River quadrangle, east-central Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I–573.

Brabets, T.P., Wang, Bronwen, and Meade, R.H., 2000, Environmental and hydrologic overview of the Yukon River Basin, Alaska and Canada: U.S. Geological Survey Water-Resources Investigations Report 99–4204, 106 p.

Dover, J.H., and Miyaoka, R.T., 1988, Reinterpreted geologic map and fossil data, Charley River quadrangle, east-central Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF–2004, 2 sheets.

Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 225–A, 263 p., 3 pls.

Parfit, Michael, 1998, The untamed Yukon River: National Geographic Magazine, v. 194, no. 1, July 1998, p. 100–127.

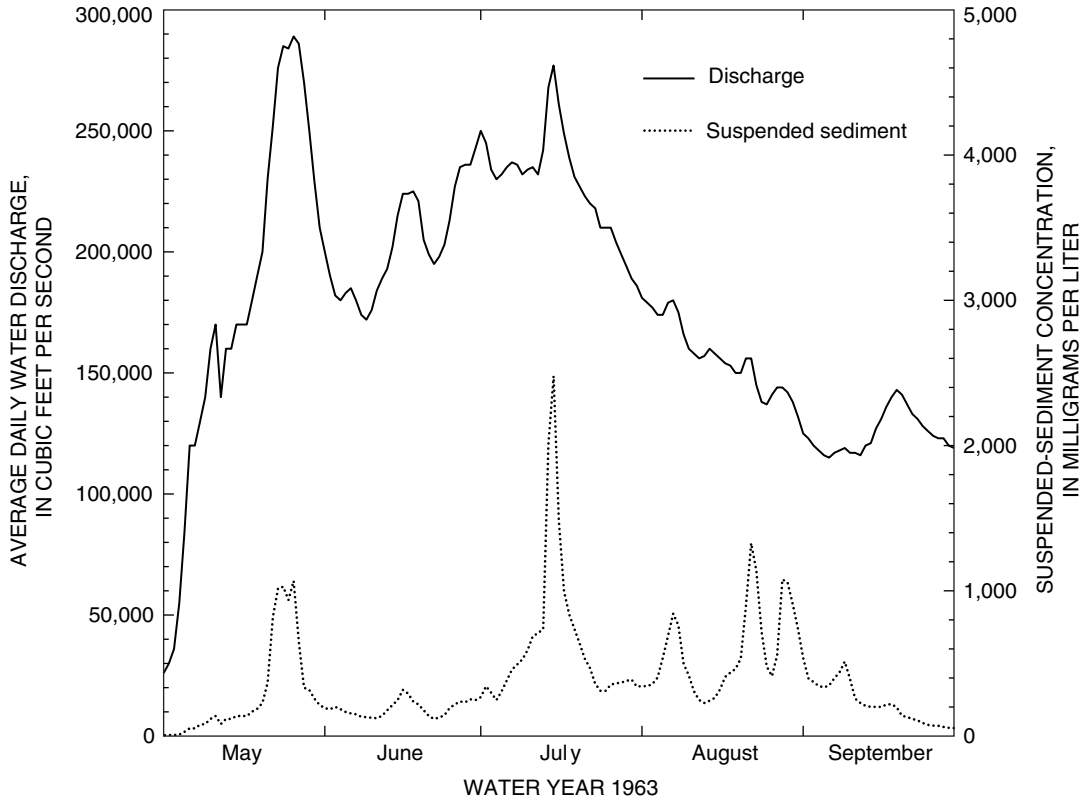


Figure 12. Average daily water discharge and suspended-sediment concentration for Yukon River at Eagle during 1963 runoff season.