Sediment Transport IN THE TANANA RIVER NEAR FAIRBANKS, ALASKA 1982

U.S. GEOLOGICAL SURVEY WATER-RESOURCES INVESTIGATIONS REPORT 83-4213
PREPARED IN COOPERATION WITH U.S. ARMY CORPS OF ENGINEERS, ALASKA DISTRICT

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GEOLOGICAL SURVEY

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By Philip E. Harrold and Robert L. Burrows

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CONVERSION TABLE

The following factors may be used to convert the International System of Units (SI) used herein to the inch-pound system of units.

Multiply SI units	by	to obtain inch-pound units
millimeter (mm)	0.0394	inch (in.)
meter (m)	3.281	foot (ft)
square meter (m^2)	10.76	square foot (ft^2)
kilometer (km)	0.621	mile (mi)
megagram (Mg) or metric ton (t)	1.102	ton, short
cubic meter per second (m^3/s)	35.311	cubic foot per second (ft^3/s)
kilogram per meter per second [(kg/m)/s]	0.672	pound per foot per second [(lb/ft)/s]

Suspended-sediment concentrations are given only in milligrams per liter (mg/L) because these values are (within the range of values presented) numerically equal to equivalent values expressed in parts per million.

LIST OF SYMBOLS

A - Cross-section area of flow (m^2)
D - Mean depth of flow (m)
GH - Gage height (m)
Q - Discharge or flow rate (m^3/s)
V - Mean velocity of flow (m/s)
W - Surface width of flow (m)
d - Particle size (mm)
G_B - Bedload-transport rate (Mg/d)
G_S - Suspended-sediment transport rate (Mg/d)
r^2 - Coefficient of determination

National Geodetic Vertical Datum of 1929 (NGVD of 1929): The reference surface to which relief features and altitude data are related; formerly called mean sea level.

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ABSTRACT

Suspended-sediment and bedload-transport rates for the Tanana River near Fairbanks can be related to water discharge and annual sediment loads can be computed using these relations. For a site at Fairbanks the annual loads in 1982 were 26.1 million metric tons of suspended sediment and 227,000 metric tons of bedload. Data collected at five other sites within a 40-kilometer reach of the river indicate very similar suspended-sediment-transport relations but bedload-transport relations varied from site to site. For all sites bedload is on the order of 1 percent of suspended-sediment load.

Particle-size distribution for suspended sediment is similar at all six sites. Median particle size is generally in the silt range; only occasionally is it in the very fine sand range.

Median particle size of bedload varied from the gravel range to the medium sand range at four of the six sampling sites. At the farthest downstream location, Byers Island, and the farthest upstream location, above Chena River Floodway, median particle size of bedload was always in the sand range.

Water-surface profiles show that at all discharges, the water surface slope was steeper at the upstream sites than at the downstream sites.

INTRODUCTION

To facilitate design and operation of engineering structures and the regulation of gravel extraction along the Tanana River near Fairbanks, the U.S. Geological Survey in cooperation with the U.S. Army Corps of Engineers, Alaska District, collected and evaluated sediment-transport and river hydraulic data during periods of principal runoff, beginning in 1977. In 1977, data-collection sites were established at the Geological Survey gaging station Tanana River at Fairbanks (station 15485500), and at a site, Tanana River near North Pole, approximately 24 km upstream from the Fairbanks station. In 1980 four additional sampling sites were established: Tanana River at Byers Island, 6 km downstream of the Fairbanks station; Tanana River at the lower and upper ends Goose Island, 5.4 km and 6.6 km upstream of the Fairbanks site; and Tanana River above Chena River Floodway, 3.5 km upstream of the North Pole site (fig. 1). Aerial photographs of the sampling sites are shown in figures 2, 3, and 4. Eleven staff gage sites, originally established in 1971, were rehabilitated in 1980 to define water-surface profile data throughout the study area (fig. 1).

The four additional sampling sites, combined with the original two sites, were chosen to place data-collection locations above and below major in-river disturbances. The Byers Island and Fairbanks sites are downstream and upstream respectively of the lower end of the Tanana River Levee System, part of a Corps of Engineers' flood protection project for Fairbanks. This part of the levee, completed in 1981, cuts across a bend of the river and the flow is redirected into a pilot channel (fig. 2). The two sites at Goose Island are downstream and upstream of the most active area of gravel mining from the Tanana (fig. 3).

The above Chena River Floodway site and the North Pole site, downstream of the floodway, are another part of the flood protection project completed in 1979. This includes an L-shaped dike extending into the Tanana River (fig. 4).

Streamflow data for the Fairbanks station are published annually in the U.S. Geological Survey's "Water Resources Data for Alaska" (U.S. Geological Survey, 1983). Previous reports by Burrows and others (1981) and Burrows and Harrold (1983) presented results of data collected in 1977-79 and 1980-1981, respectively. This report contains data collected during 1982. The data, reported in the International System of Units, are presented in tables and graphs and most of the text is devoted to explaining them; the format is consistent with the previous report to make comparison easy. The primary purpose of this report is to provide the Corps of Engineers information pertinent to their design computations and regulation of gravel extraction.

The study program is funded by the Corps of Engineers through their Cold Regions Research and Engineering Laboratory, Alaska Projects Office, in a cooperative agreement with the U.S. Geological Survey. All fieldwork and compilation of data are done by the Geological Survey.

INSTRUMENTATION AND DATA COLLECTION

A continuous record of river stage was collected during the open-water season at the Fairbanks station. This record was analyzed to determine daily mean gage heights and corresponding daily mean discharges. During the winter-flow period, values of daily mean discharges were estimated using periodic discharge measurements and climatological data, and by correlation with data available from the gaging station Tanana River at Nenana.

Measurements of width, depth, and velocity were made and samples of sediment were collected from a boat. Stationing on the section was determined using sextant readings on a base line or by using an electronic distance measuring unit, while the boat's position was maintained by visual reference to the cross-section end markers.

Water-surface profiles were obtained by determining water-surface elevations at 10 staff gage sites (GS-1 to T-9) along the study reach over the several hours taken to travel the river (T-10; the eleventh staff gage was lost to bank erosion in 1981). Distances between sites were measured from topographic maps along a base line drawn to follow the general path of the river's main channels.

Suspended-sediment and bedload samples were collected at all six sites. Bed material was not sampled in 1982.

A P-61 or a D-49 suspended-sediment sampler (Guy and Norman, 1970) was used to collect depth-integrated water samples for concentration and particle-size distribution analysis of the suspended sediment. A Helley-Smith type bedload sampler with a 76.2-mm by 76.2-mm orifice (Helley and Smith, 1971) was used to collect bedload samples for particle-size distribution analysis and determination of transport rate.

The Helley-Smith bedload sampler has not been adopted by the U.S. Geological Survey as standard equipment; therefore, results obtained through its use cannot be certified for accuracy. However, the Geological Survey has described provisional methods for the use of the Helley-Smith sampler pending further research and testing. A field calibration of the sediment trapping characteristics of the Helley-Smith bedload sampler (Emmett, 1980) indicated that no correction factor need be applied to the bedload data collected. The sampler has been used with apparent success in other rivers that have bedload-transport rates and bedload particle-size characteristics similar to those of the Tanana River (Emmett, 1976; Emmett and Thomas, 1978).

Most of the bedload samples were obtained at 15-m increments across the part of the stream width where bedload transport occurs. Generally, this resulted in collection of 18 to 20 samples across the stream width. Sampling duration was usually 30 seconds at each location. For most traverses of the stream, each individual bedload sample was given equal consideration in the determination of average stream-wide transport rate. When duplicate samples were obtained at a given location, these sample data were averaged, and the average value used in the same manner as individual values. Samples collected at each end of the traverses were given the same consideration as other individual samples, regardless of the incremental width of channel associated with the samples collected near each bank.

RIVER HYDRAULICS AND SEDIMENT TRANSPORT DATA

To facilitate empirical evaluation and interpretation of the sediment data in this report, appropriate streamflow, hydraulic and channel geometry, and slope data are provided.

Streamflow

Table 1 presents a summary of discharge measurements made during the period of sediment sampling in 1982 on the Tanana River at Fairbanks. Values of daily mean discharge for the Fairbanks site are presented in table 2 for the 1982 water year. Because a continuous record of the stage is not obtained for the other five sites, daily mean discharges are not determined for those stations. However, except for a travel-time difference of less than a day, values of daily mean discharge are approximately the same for any of the sites, except Byers Island which is below the mouth of the Chena River. For the purposes of this report the Byers Island site was considered to have the same flow as the other sites, that is, contributing flow from the Chena River was not included. Daily mean flow of the Chena ranged from 2 to 15 percent of that of the Tanana River at Fairbanks; the mean annual flow was 6.5 percent. This approximation does not greatly affect later computations.

Hydraulic Geometry

Data from the discharge measurements at the Fairbanks site in table 1 are plotted in figure 5 as at-a-station values of hydraulic geometry (Leopold and Maddock, 1953). Relations shown for gage height, velocity, depth, width, and flow area, as functions of discharge were determined by log-transformed, least-squares linear regression of the data. Sufficient discharge measurements to determine-at-a-station relations of hydraulic geometry for the other five sites are not available.

Channel Geometry

Cross-section data plotted in figures 6-11 show channel geometry before, near, and after the peak runoff in 1982 at the six sampling sites. These data were collected while sampling bedload, so only those channels with significant flow and bedload transport are shown. The tops of exposed bars are shown as straight lines between channels.

At Byers Island (fig. 6), a sand and gravel bar near station 200 m increased considerably in size in 1982. No great lateral shifting of the thalweg (thread of maximum depth) occurred, however, and the overall channel configuration changed only slightly.

At the Fairbanks site (fig. 7) only moderate seasonal variations in the position of the thalweg occurred in 1982.

At the lower end Goose Island (fig. 8) the main channel scoured nearly 3 m during the peak runoff period in 1982. A smaller north channel, visible in the aerial photo in figure 3, increased in size during the peak runoff period in 1982. The overall shape of this channel varied considerably during the year, changing from a single uniform shape to two narrower, deeper channels, separated by about 100 m of bar.

Figure 9 shows the cross section at the upper end Goose Island. The sand and gravel bar centered at station 200 m changed only slightly during 1982. The smaller channel from stations 120 m to 180 m scoured 2 m during June and July. The position of the thalweg and the overall shape of the main channel remained about the same.

At Tanana River near North Pole (fig. 10) no significant change occurred in the overall size and shape of the south channel. However, large changes took place in the north channels. The channel from stations 0 m to 100 m carried significant flow only during the peak runoff period. The channel from about station 200 m to 500 m varied in size and shape and the thalweg shifted back and forth over about 100 m. The channel from stations 550 m to 650 m widened 50 m and was scoured about 2 m.

The south and north channels remained relatively unchanged at the sampling site above Chena River Floodway, shown in figure 11.

Water-Surface Profile

Table 3 gives water-surface elevations at staff gage sites along the study reach. The sites are listed in upstream order and labeled GS-1, and T-1 through T-9. Distance in kilometers from the abandoned T-10 site is shown. Profiles of the water surface along the right or north bank in June, July, and August 1982, shown in table 3, are plotted in figure 12. The profiles show a general reduction in gradient from upstream (T-9) to downstream, (GS-1).

Slopes may be determined for reaches near Byers Island, Fairbanks, Goose Island, and North Pole and above Chena River Floodway data-collection sites. For Byers Island, the slope was computed using the fall from T-1 to GS-1; for Fairbanks from T-2 to T-1; for both Goose Island sites, from T-3 to T-2; and for the North Pole and above Chena River Floodway sites the slope was computed by averaging the fall from T-9 to T-8 and T-8 to T-7. Average slope (m/m) for each of the reaches was obtained from three determinations of slope computed from the data in table 3 and are listed below:

Byers Island	0.00042
Fairbanks	.00051
Goose Island	.00047
North Pole and Chena River Floodway	.00118

Suspended Sediment

Tables 4-9 list values of instantaneous water discharge, suspended-sediment concentration, transport rate, and median particle size for the sites at Byers Island, Fairbanks, the lower and upper ends Goose Island, North Pole, and above Chena River Floodway respectively. The suspended-sediment transport rate (G_S) in megagrams (metric tons) per day is computed as:

$$G_S = 0.0864 \times \text{concentration (mg/L)} \times \text{water discharge } (m^3/s).$$

Suspended-sediment samples were collected at all sites and analyzed for concentration and partial or complete particle-size distribution.

Bedload

Tables 10-15 list values of river hydraulics and bedload transport rate for the six sites. Where two or more channels were sampled, the combined bedload totals are given rather than for separate channels. The total bedload-transport rate, in megagrams per day, was computed by applying the measured unit transport rate over the width of the channel. Widths shown are those measured in the field.

Sediment-Transport Relations

The relations of sediment-transport rate to discharge are illustrated in figures 13-18. The log-transformed, least-squares linear regression describing the relations are given below.

SUSPENDED SEDIMENT
(megagrams per day)

Byers Island

$$G_S = 1.214 \times 10^{-3} Q^{2.641}$$
$(r^2 = 0.960)$

Fairbanks

$$G_S = 1.348 \times 10^{-2} Q^{2.307}$$
$(r^2 = 0.985)$

Lower end Goose Island

$$G_S = 6.676 \times 10^{-4} Q^{2.729}$$
$(r^2 = 0.854)$

Upper end Goose Island

$$G_S = 7.352 \times 10^{-4} Q^{2.695}$$
$(r^2 = 0.931)$

North Pole

$$G_S = 2.493 \times 10^{-3} Q^{2.532}$$
$(r^2 = 0.935)$

Chena River Floodway

$$G_S = 3.015 \times 10^{-4} Q^{2.838}$$
$(r^2 = 0.847)$

BEDLOAD
(megagrams per day)

Byers Island

$$G_B = 29.56\ Q^{0.4585}$$
$(r^2 = 0.112)$

Fairbanks

$$G_B = 5.186\ Q^{0.7646}$$
$(r^2 = 0.148)$

Lower end Goose Island

$$G_B = 2.184\ Q^{0.9380}$$
$(r^2 = 0.791)$

Upper end Goose Island

$$G_B = 42.34\ Q^{0.4778}$$
$(r^2 = 0.420)$

North Pole

$$G_B = 0.2710\ Q^{1.244}$$
$(r^2 = 0.675)$

Chena River Floodway

$$G_B = 4.007 \times 10^{-3} Q^{1.760}$$
$(r^2 = 0.939)$

Bedload-transport rates vary from site to site, but are generally two orders of magnitude less than that of the suspended sediment. The highest measured transport rate for flows greater than 1,000 m^3/s was at the Fairbanks site; the lowest measured rate was at Byers Island. For flows less than 1,000 m^3/s the highest measured rate occurred at the North Pole site; the lowest above Chena River Floodway.

There is a considerable consistency to the measured bedload data. More than 80 percent of the bedload transport rates fall in the tenfold range 0.5 to 5 percent of the corresponding suspended-sediment transport rate.

Particle-Size Data for Suspended Sediment and Bedload

Tables 16-21 list suspended-sediment particle-size data for the six sampling sites. Size determination was made by sieve or visual-accumulation tube analysis for particles larger than silt (>0.062 mm), and by pipet analysis for particles of silt size and smaller. All data are expressed in percentage by weight finer than indicated particle size. Values of median particle size were determined where possible and are included as part of the suspended-sediment data in tables 4-9.

Median particle size of suspended sediment is nearly always in the silt range (<0.062 mm, >0.004 mm), and only occasionally in the very fine sand range (>0.062 mm, <0.125mm).

Tables 22-27 present particle-size distribution data for bedload as determined by dry-sieve analysis for the sites by Byers Island, Fairbanks, and lower and upper ends Goose Island, near North Pole, and above Chena River Floodway, respectively. Statistics of the particle-size determinations are presented in tables 28-33. This compilation is especially useful in visualizing bedload-particle sizes as functions of discharge or bedload-transport rate. The median particle size, d_{50}, from this compilation is included in tables 10-15 as part of the bedload data.

Median particle size of bedload at Byers Island and above Chena River Floodway was always less than 1 mm. For all other sites the median particle size of bedload was sometimes in the gravel range (>2.0 mm, <64 mm), but at other times in the medium sand range. This large variability in median particle size has been observed previously (Emmett, 1976) and is apparently related to the availability and mobility of particles composing the bed material.

The transport-rate weighted, yearly-composite size distributions are presented in table 34 and illustrated in figures 19-21. These size distributions are computed by using the actual weights of samples collected at nearly uniform increments of time throughout the runoff period. Thus, samples collected at higher transport rates carry more "weight" because their actual weights are greater.

For all sites, except Byers Island, 35 to 45 percent of the bedload was gravel and while median particle size varied between 0.26 mm and 0.50 mm from site to site most distributions were very similar. At Byers Island the bedload was much finer than at any other site. Only 14 percent of the bedload was gravel and the median particle size was 0.26 mm.

Annual Sediment Loads

Daily mean discharges from table 2 can be arranged in order of magnitude to indicate the number of days during which each discharge is equaled or exceeded. The number of days can then be multiplied by the corresponding sediment-transport rate to provide estimates of the annual sediment load. Computations for sediment loads are provided in table 35 for the location at Fairbanks, for 1982 water year.

Suspended-sediment loads of 26.1 million Mg and 227,000 Mg of bedload passed the Fairbanks site. While not shown, the same type of computations may be made using the same discharge data and transport functions for each site. The regressed transport functions in figures 13-18 are of limited reliability due to paucity of data. However, it can be seen that there should be only slight differences in computed annual suspended-sediment loads from site to site, but computed bedload would vary widely.

In 1982 bedload was about 0.9 percent of the suspended-sediment load. The average bedload-transport rate expressed as a percentage of average suspended-sediment-transport rate, ranges from 0.3 percent at highest flows to about 7 percent at low flows (column 8 in table 35). The bedload-transport functions are extrapolated to define the transport rates at much lower flows than those for which bedload data have been collected; therefore, no percentage is shown for flows less than 200 m^3/s. High ratios of bedload-to-suspended-sediment-transport rate at very low flows, as indicated by the transport functions, may not actually occur. This does not greatly affect the annual load computations, because most of the transport occurs at higher flows.

Approximately 60 percent of the bedload is transported during 30 percent of the year at flows exceeding 1,000 m^3/s. Nearly half of the suspended-sediment load is transported in about 10 percent of the year at flows greater than 1,300 m^3/s.

Comparison of Data with Previous Years

Comparison of 1982 data herein with data of 1977-81 (Burrows and others, 1981; Burrows and Harrold, 1983) shows some significant similarities and differences. The earlier data show there is some annual shifting of the hydraulic geometry relations, specifically those of gage height, velocity, depth, and width as functions of discharge. The flow area-discharge relation, however, remained fairly constant until 1982. The flow area-discharge relation shown in figure 5 differs primarily at lower discharges where flow area values are as much as 80 percent higher than values in previous years.

Significant changes in channel geometry occurred between 1981 and 1982 at Byers Island, the lower end Goose Island, and near North Pole. At Byers Island (fig. 6), the middle and south channels, shown in the previous report, had insignificant flow and bedload transport in 1982. For comparison with 1980-81 data, stationing at the Goose Island sites (figs. 8 and 9) and the south channel near North Pole (fig. 10) must be offset by (-)100 m. Taking this adjustment into account, the thalweg of the main channel at the lower end Goose Island shifted approximately 80 m toward the left bank between the end of the open-water seasons of 1981 and 1982. The north channel has steadily increased in size since it opened in August 1981. The changes near North Pole occurred primarily in the north channels (fig. 10). The channels from stations 0 m to 100 m decreased in width by about 70 m and the channel from stations 550 m to 650 m nearly doubled in size from October 1981 to October 1982.

Comparison of water-surface elevations and computed slopes for 1982 with those in 1980 and 1981 indicate that 1982 slope values are similar to those of 1981, but that 1981 and 1982 values are different from those in 1980.

For the nine complete years of record, annual mean discharge of the Tanana River ranged from 475 m^3/s to 613 m^3/s and averaged 535 m^3/s. In 1982 the annual mean discharge was 567 m^3/s. The suspended-sediment transport rates defined by the 1982 sediment data are very similar to those defined by the earlier data. The computed annual total for suspended-sediment load (table 35) fell within the previously estimated range of 18-30 million Mg of suspended sediment (Burrows and others, 1981). The computed annual total for bedload fell somewhat below the previously estimated range of 250,000-450,000 Mg. This may be due to the poorly defined bedload transport function or to the fact that the flow duration curve for 1982 is significantly different from the average curve for previous years. In 1982 the computed bedload transport rate is lower for moderate to high flows and the flow duration curve has more days of moderate flow than the average duration curve computed from 9 years of record.

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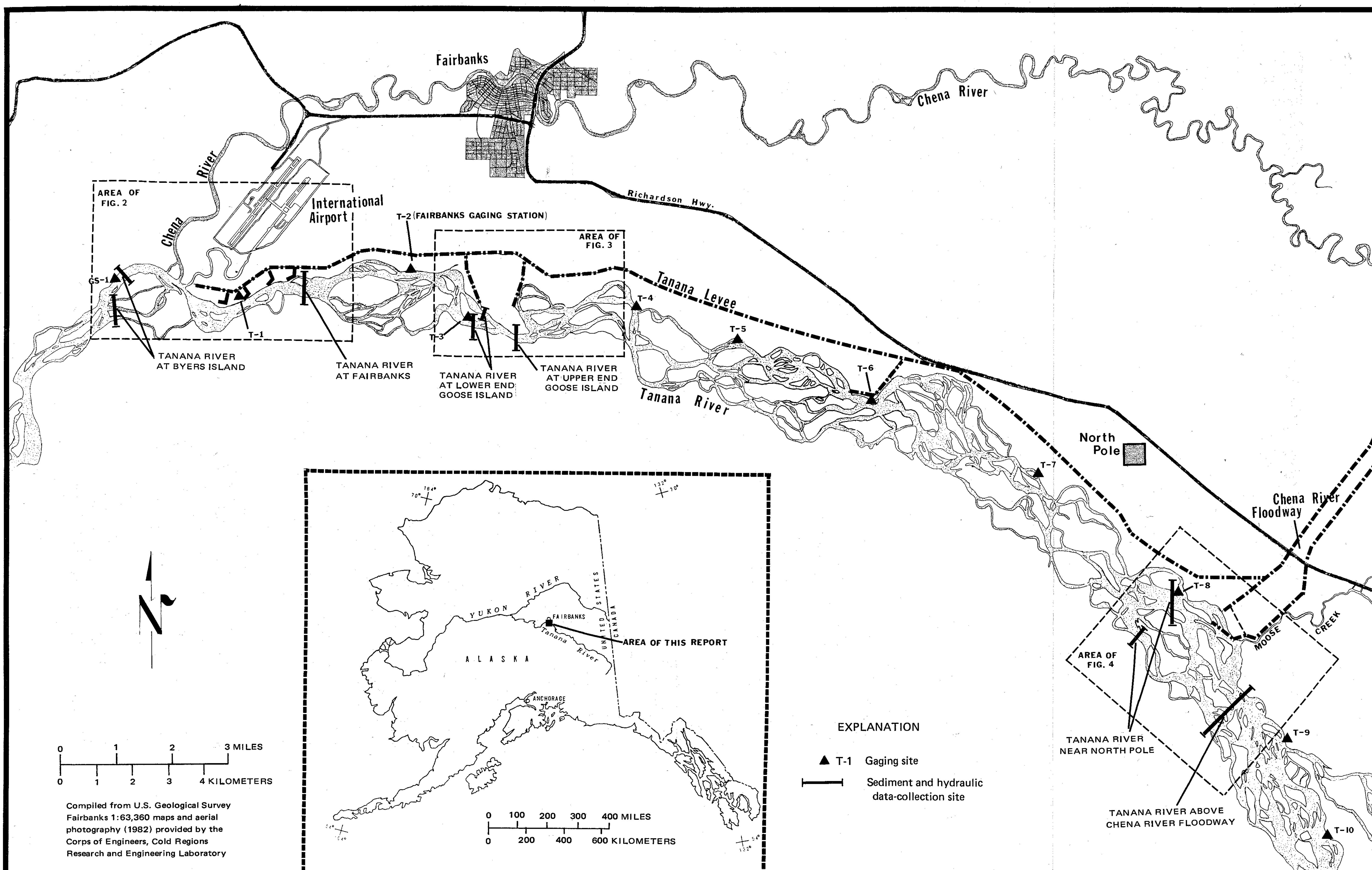
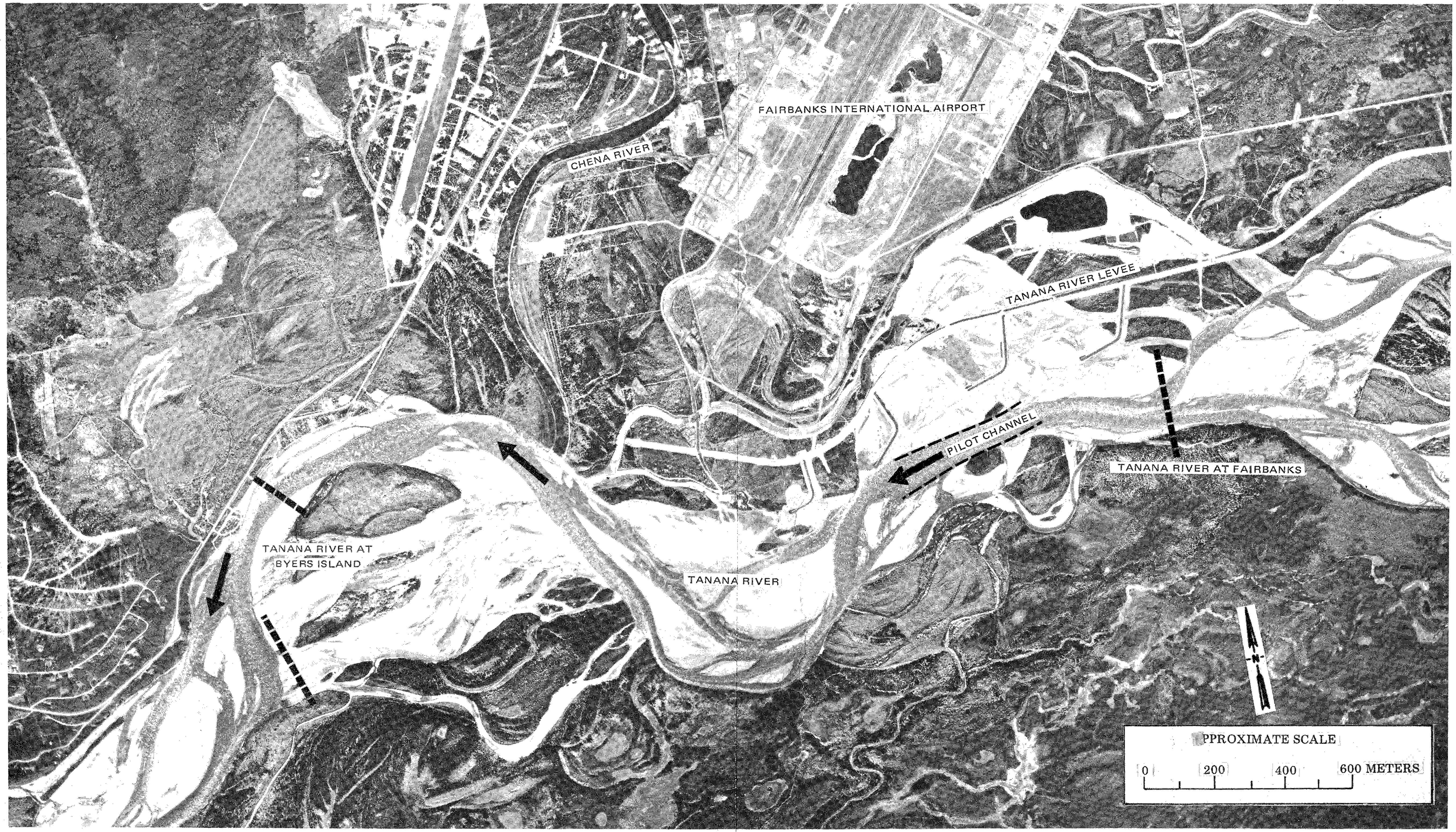


Figure 1.--Location of Tanana River and data-collection stations.



North Pacific Aerial Photos, Inc. October 20, 1981

Figure 2. -- Data-collection sites near Fairbanks.

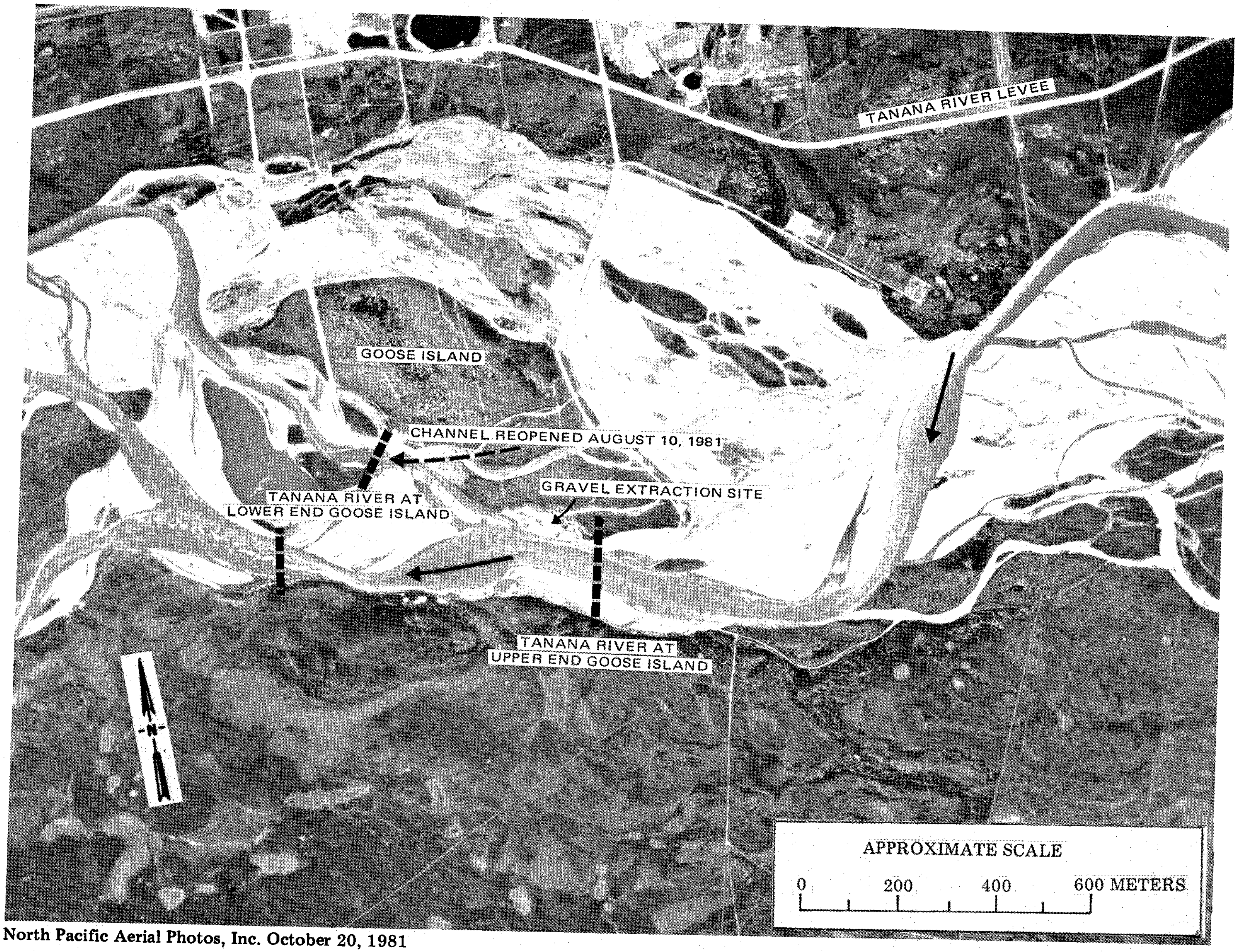


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Figure 3.--Data-collection sites at Goose Island.

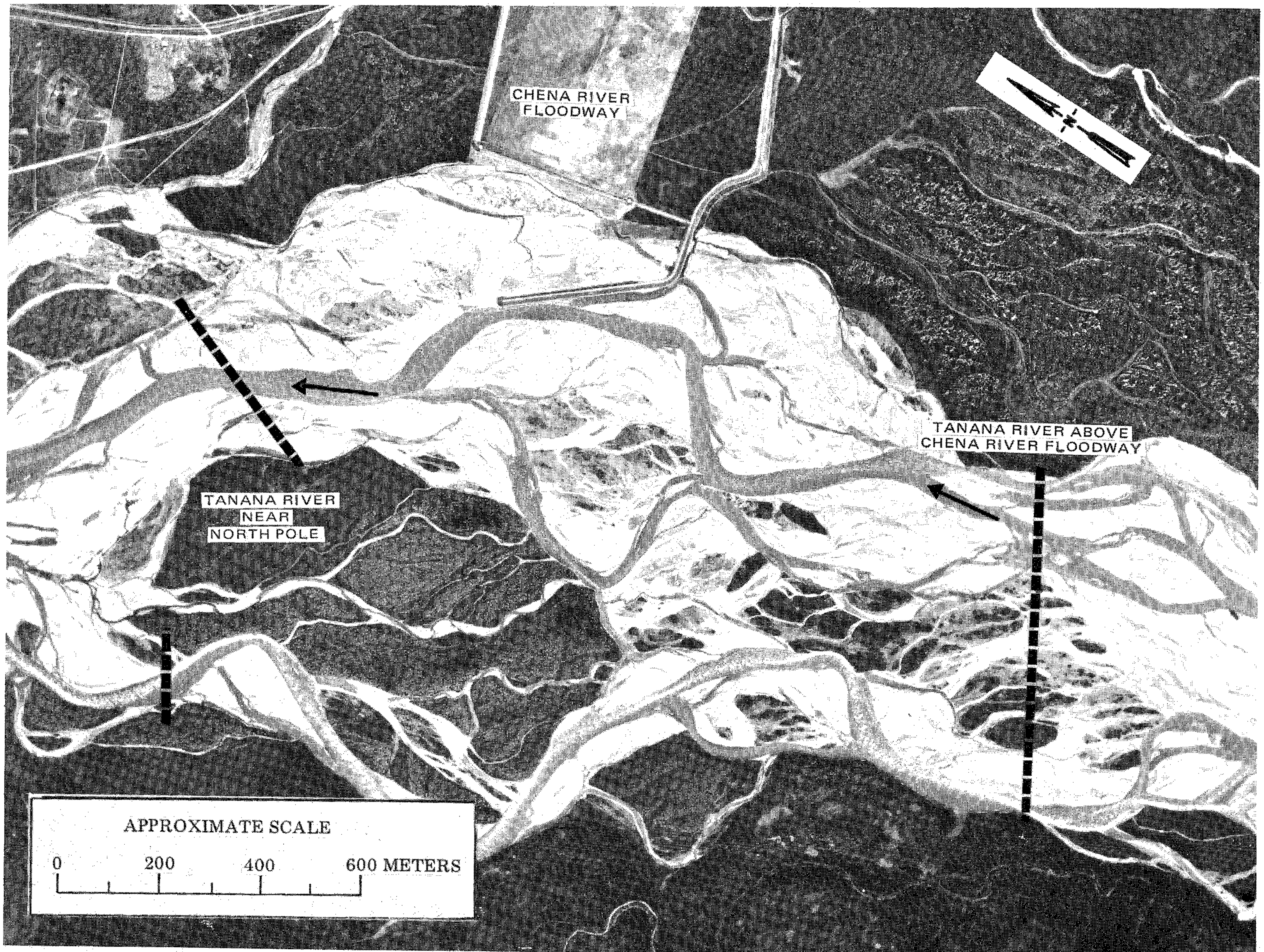

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Figure 4.--Data-collection sites near North Pole.

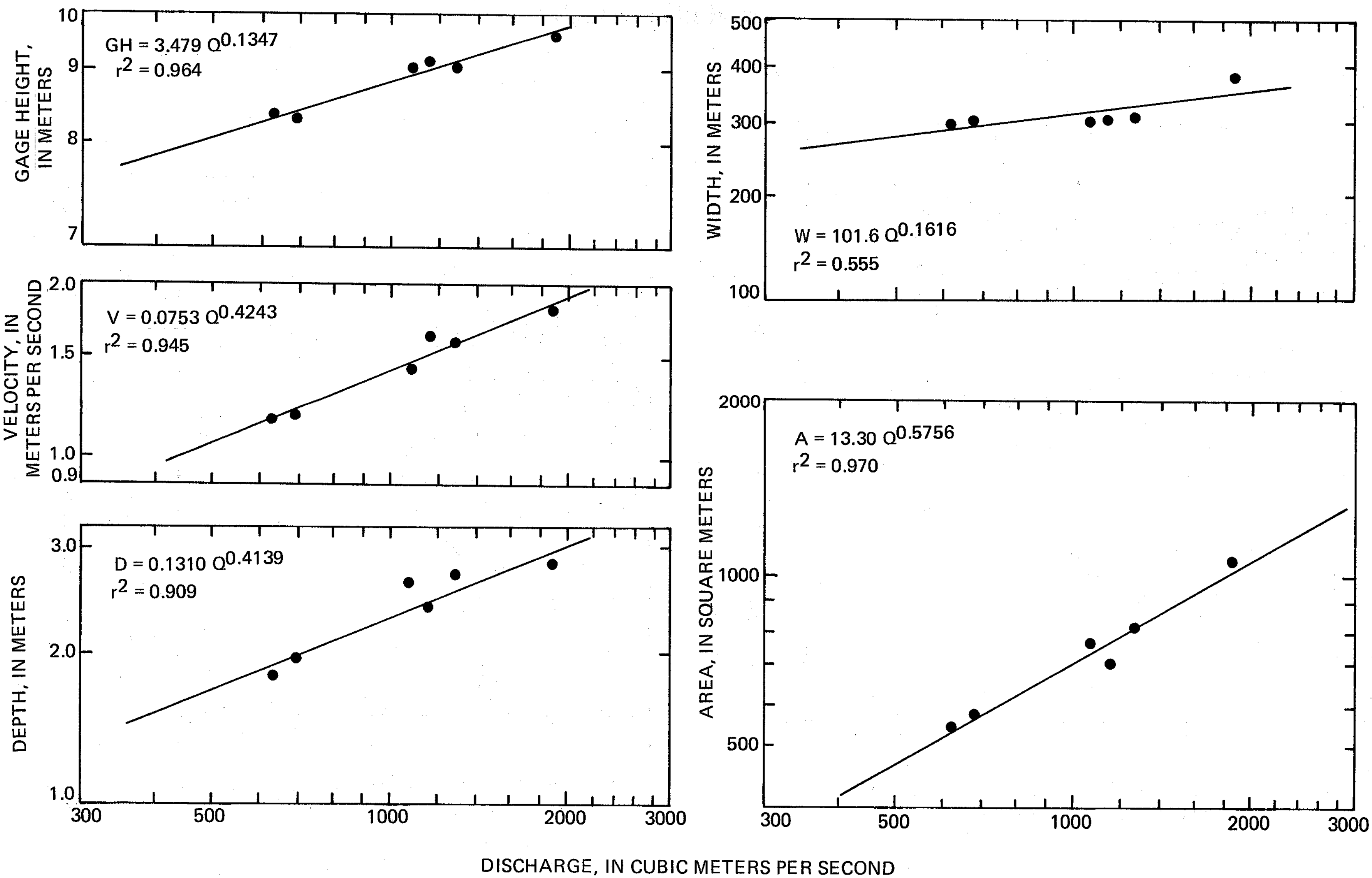

Figure 5.--At-a-station relations of hydraulics and channel geometry, Tanana River at Fairbanks, 1982.

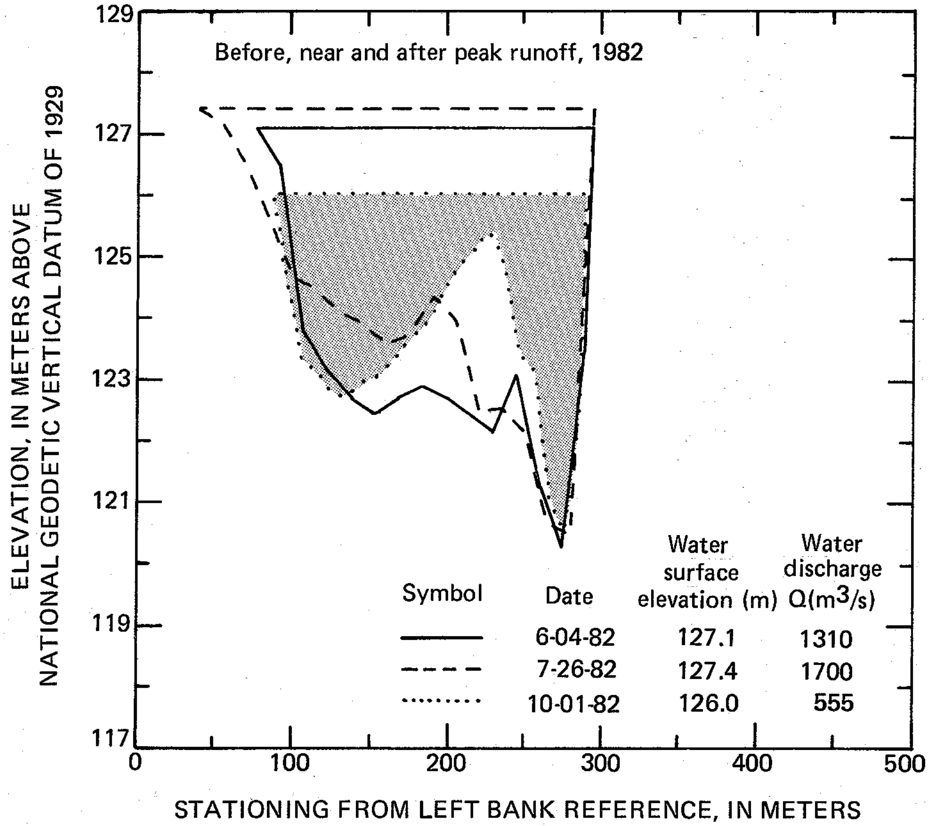

Figure 6.--Cross section of the Tanana River at Byers Island.

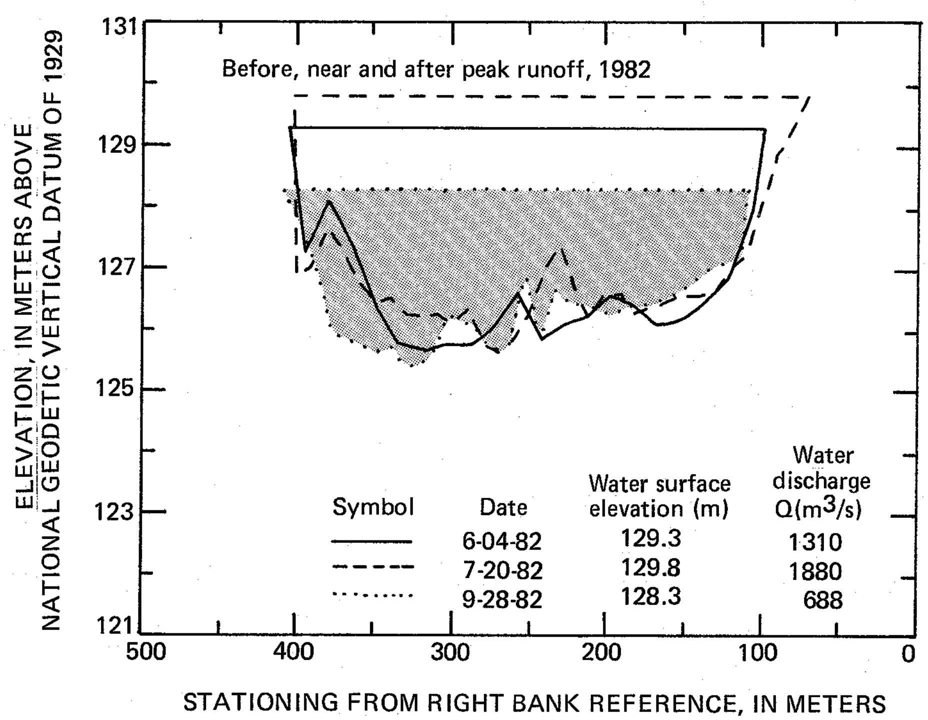

Figure 7.--Cross section of the Tanana River at Fairbanks.

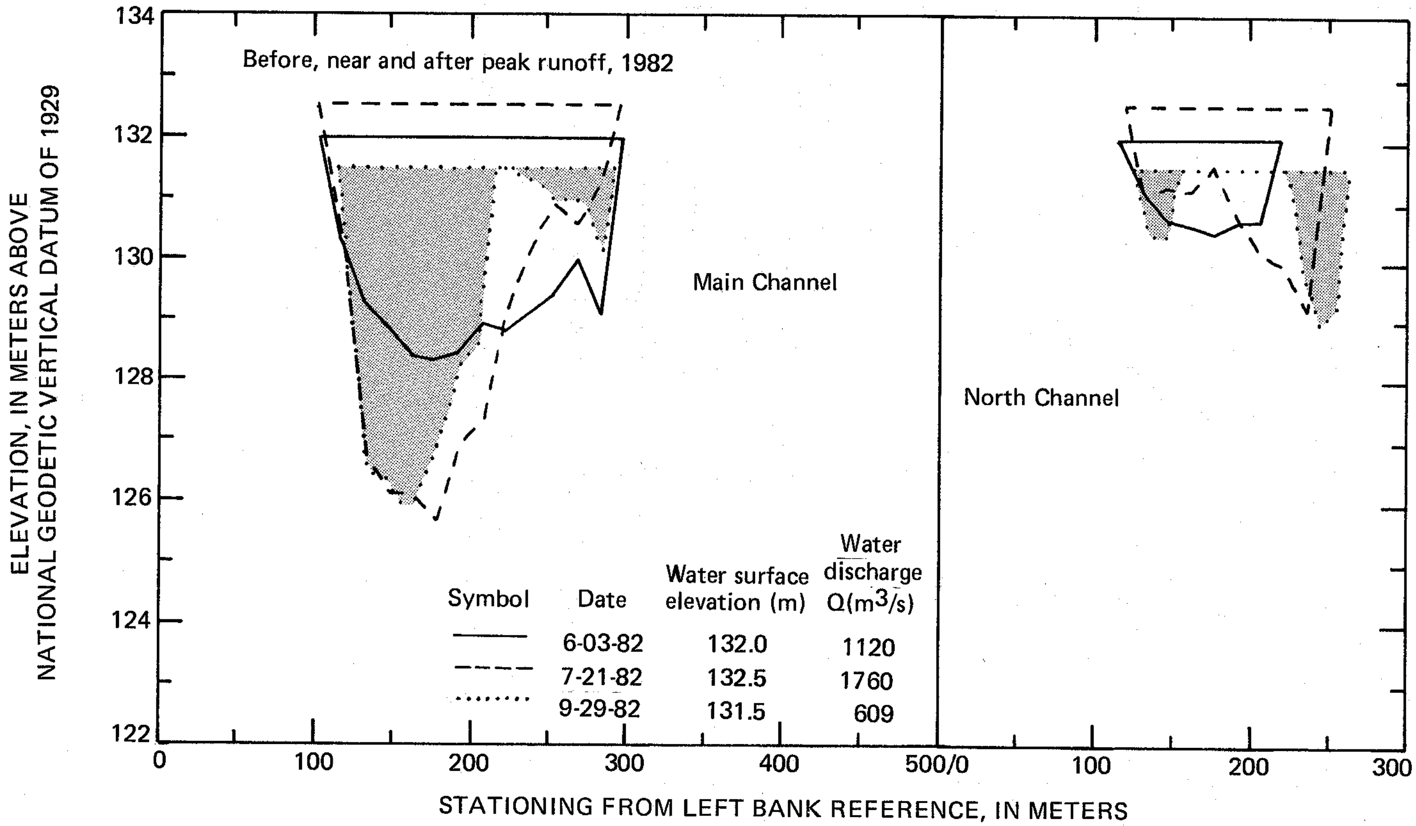

Figure 8.--Cross section of the Tanana River at lower end Goose Island.

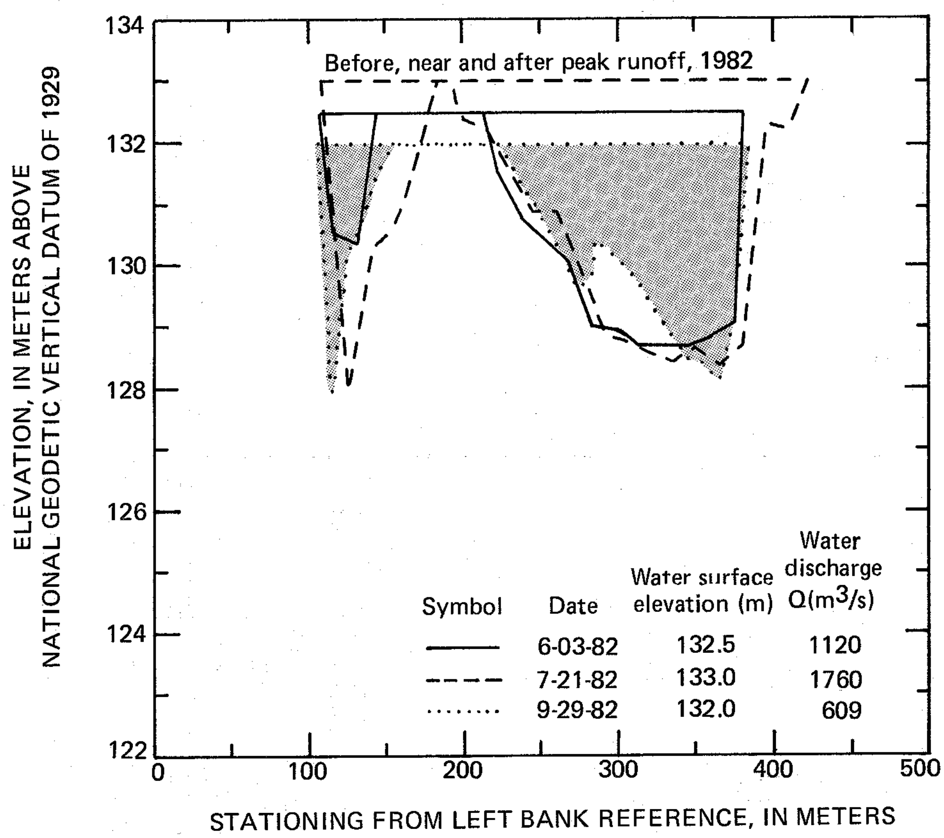

Figure 9.--Cross section of the Tanana River at upper end Goose Island.

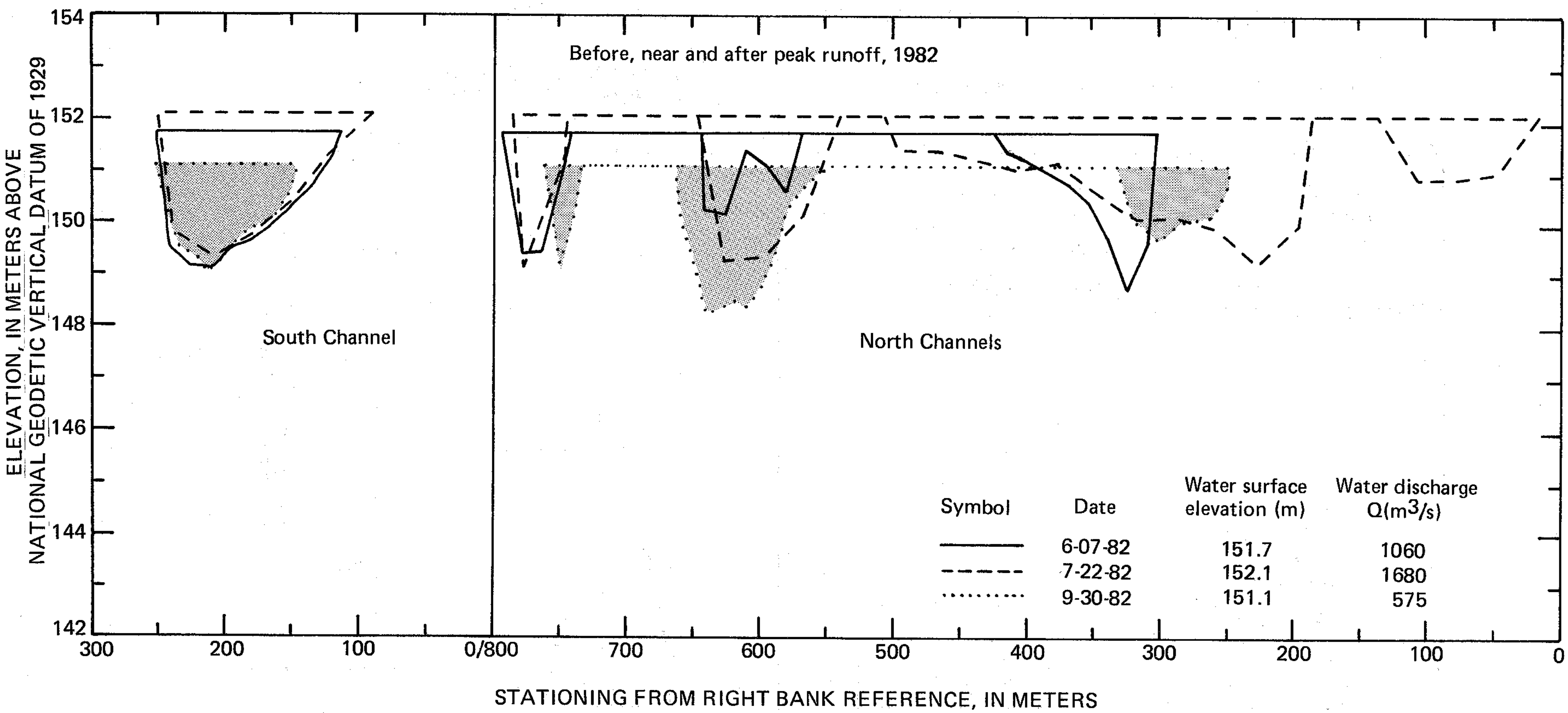

Figure 10.--Cross section of the Tanana River near North Pole.

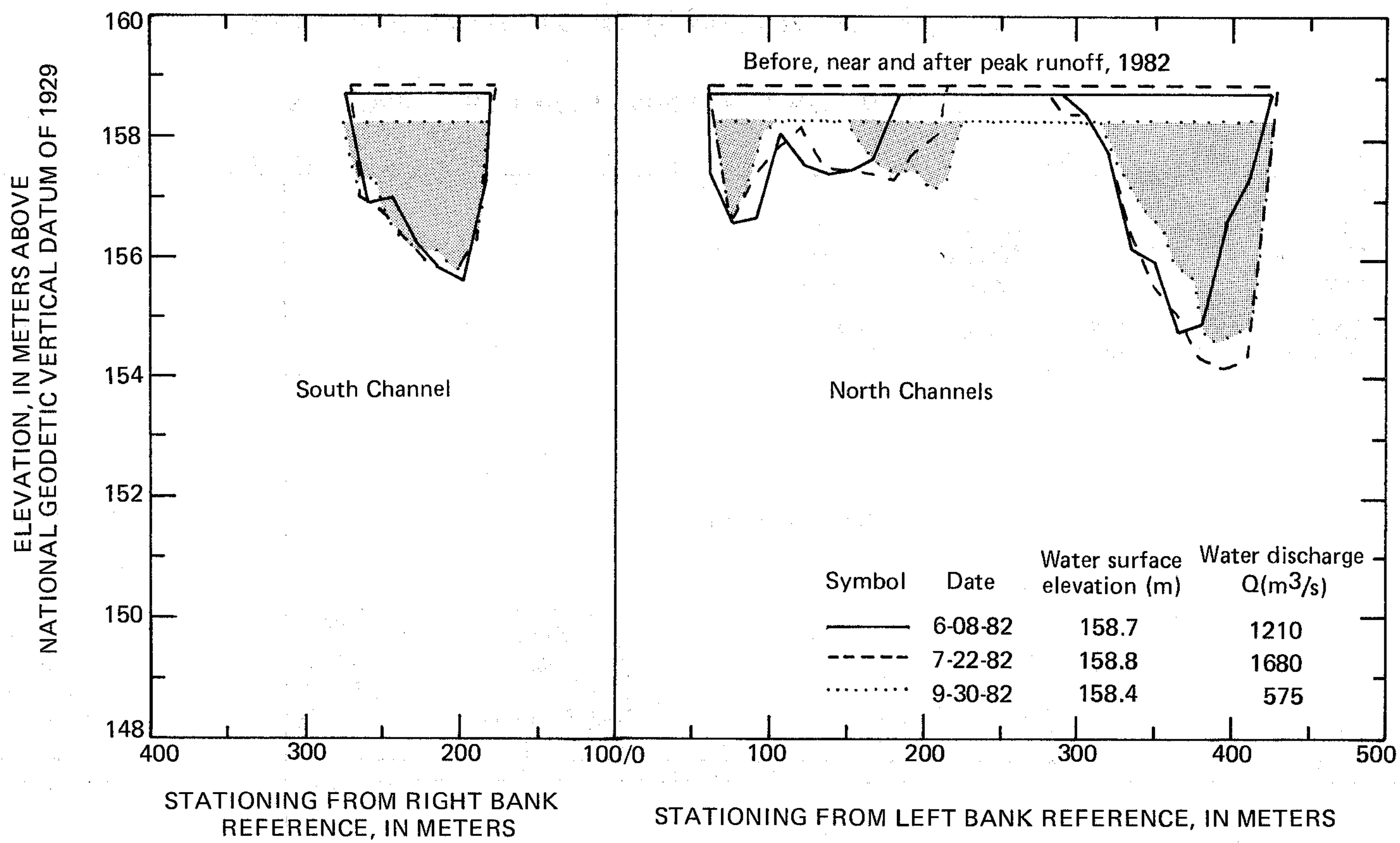

Figure 11.--Cross section of the Tanana River above Chena River Floodway.

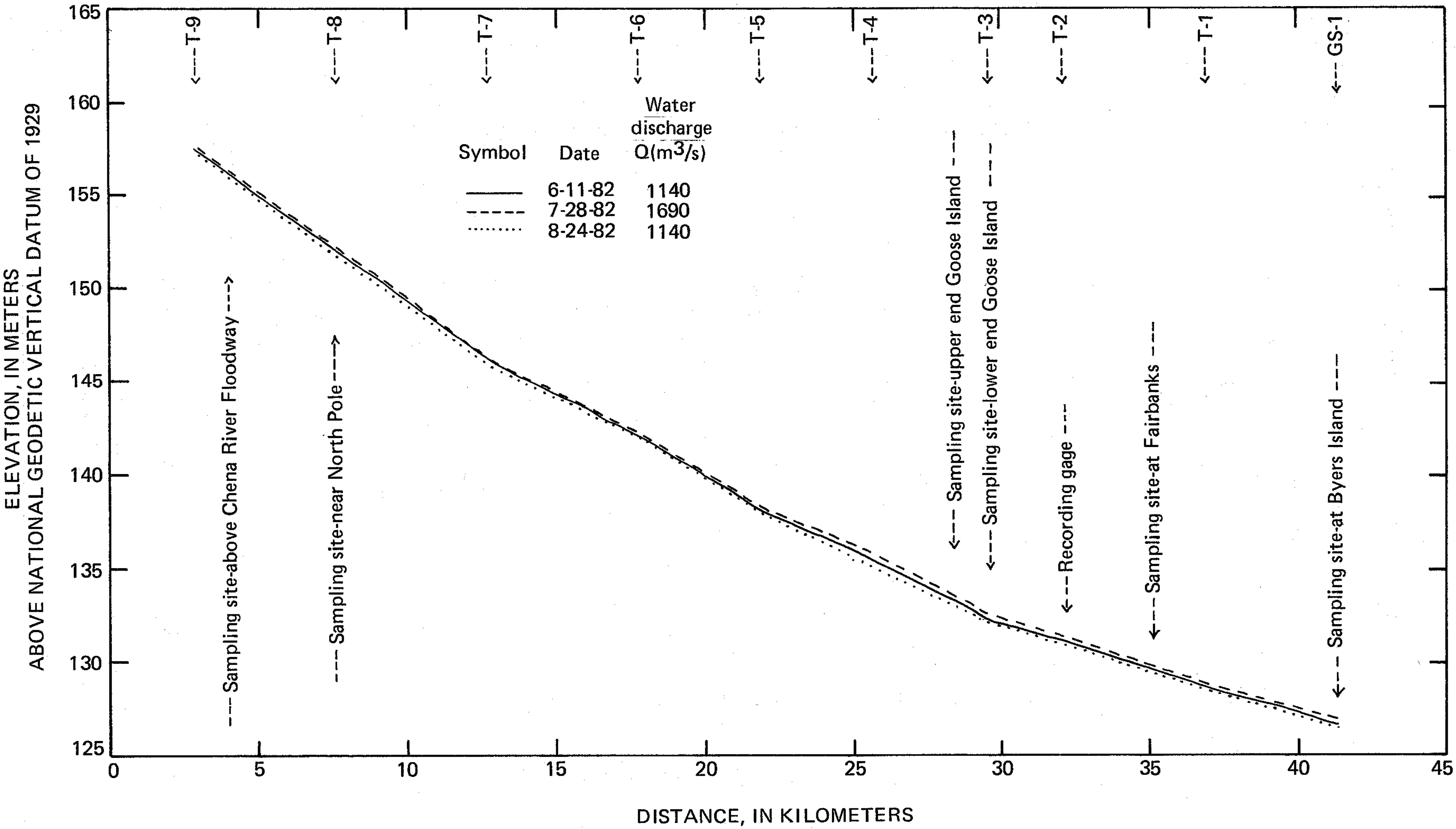

Figure 12.--Water-surface profiles, Tanana River near Fairbanks, 1982.

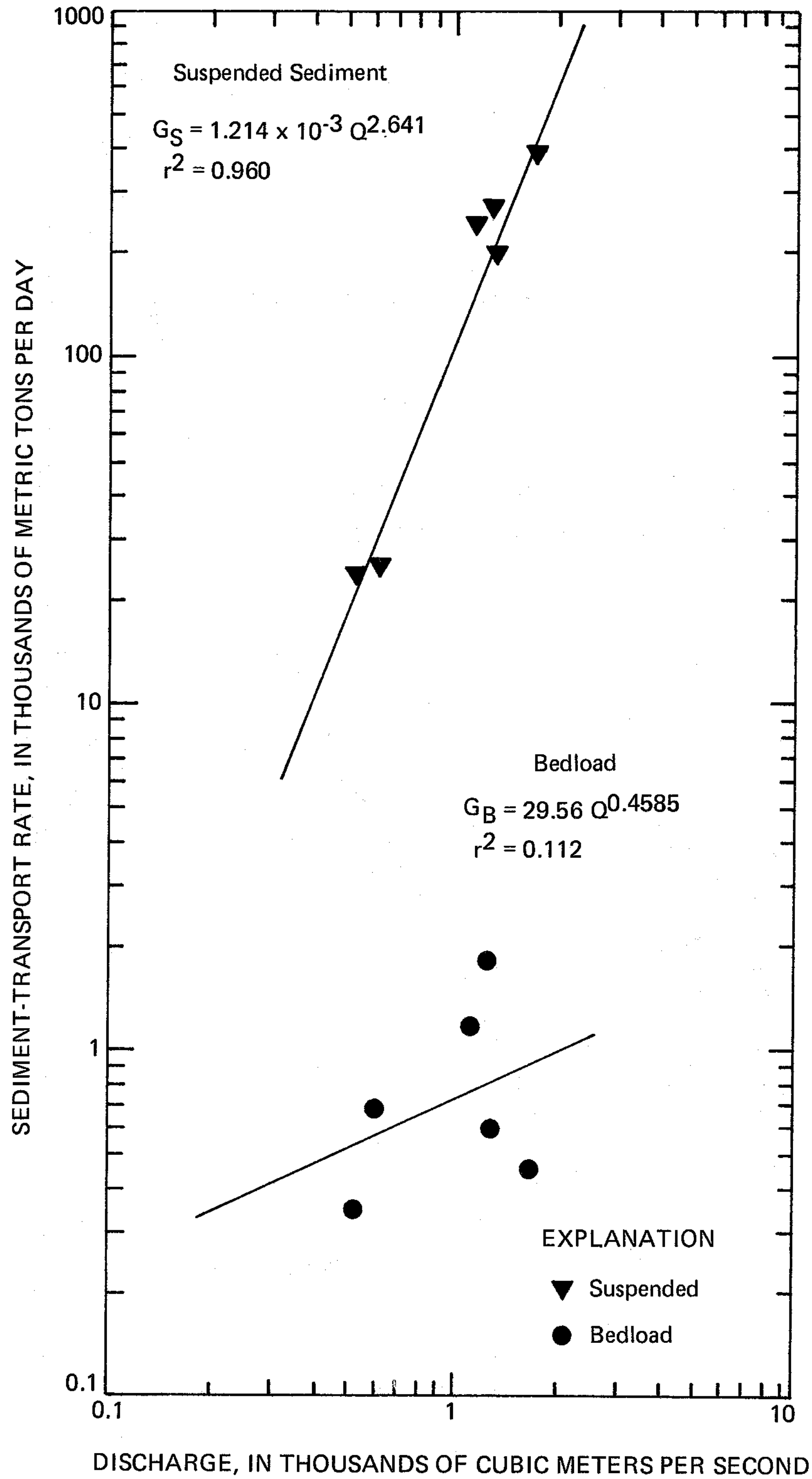

Figure 13.--Sediment-transport rate as a function of discharge, Tanana River at Byers Island.

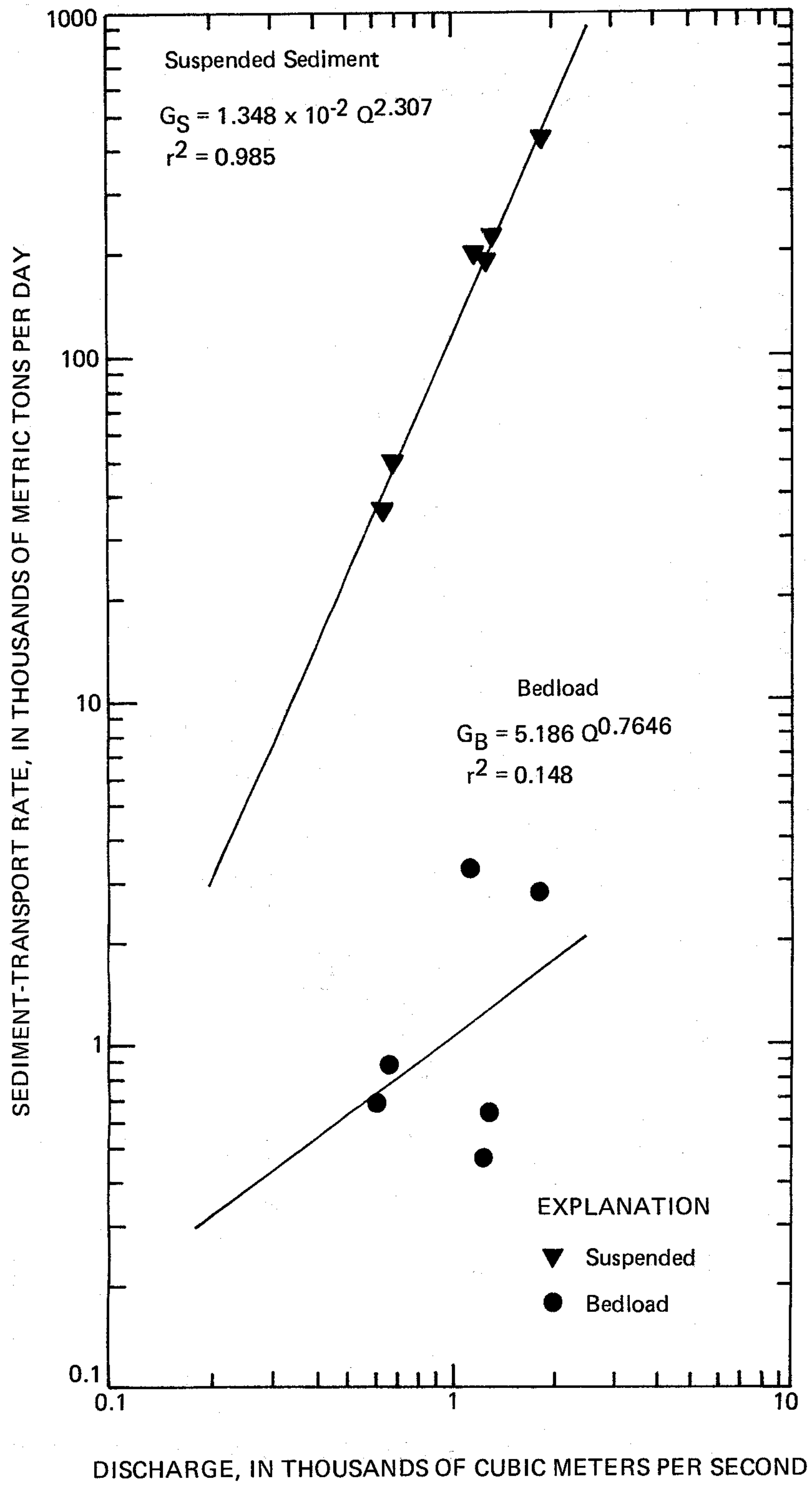

Figure 14.--Sediment-transport rate as a function of discharge, Tanana River at Fairbanks.

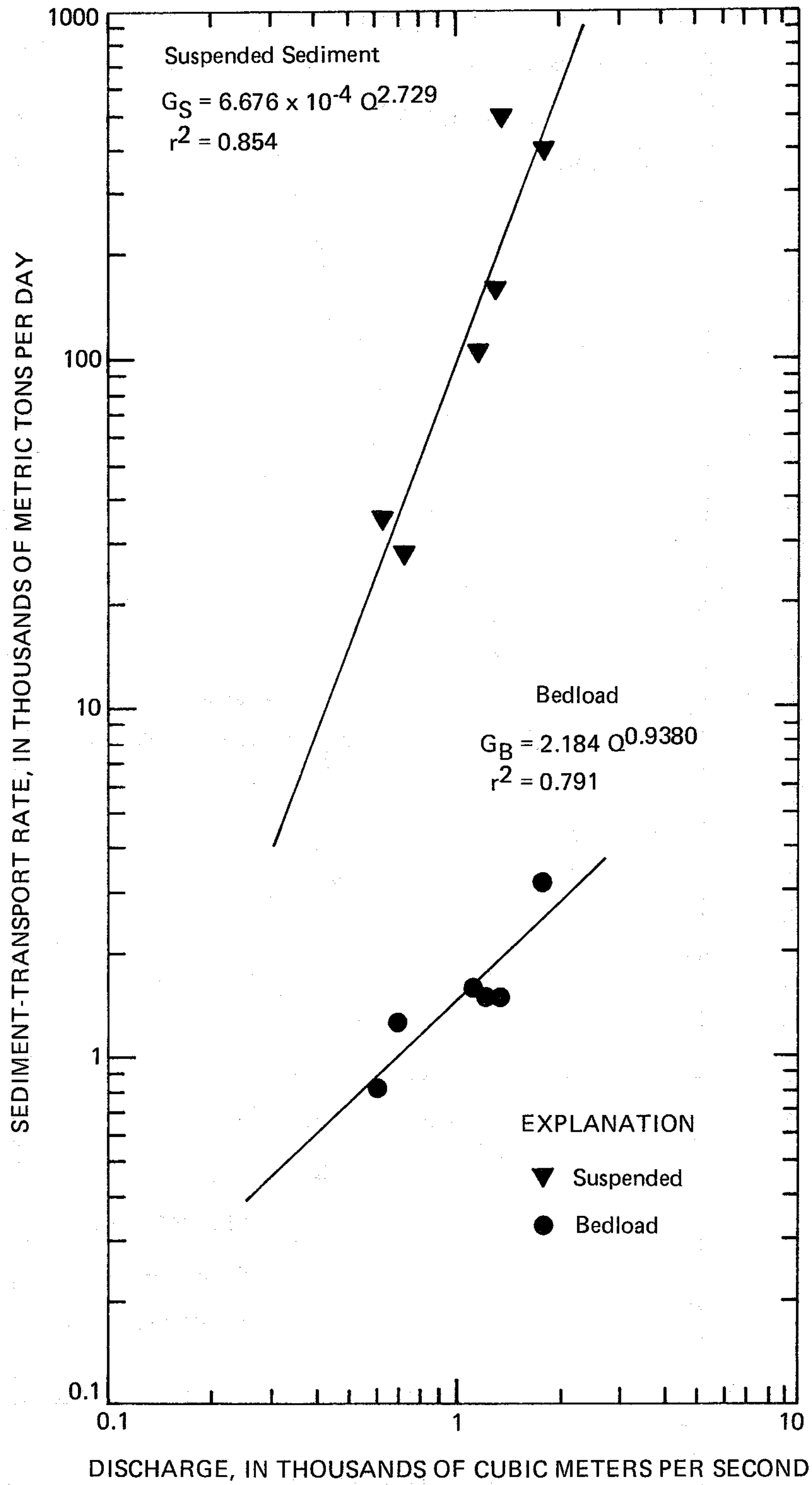

Figure 15.--Sediment-transport rate as a function of discharge, Tanana River at lower end Goose Island.

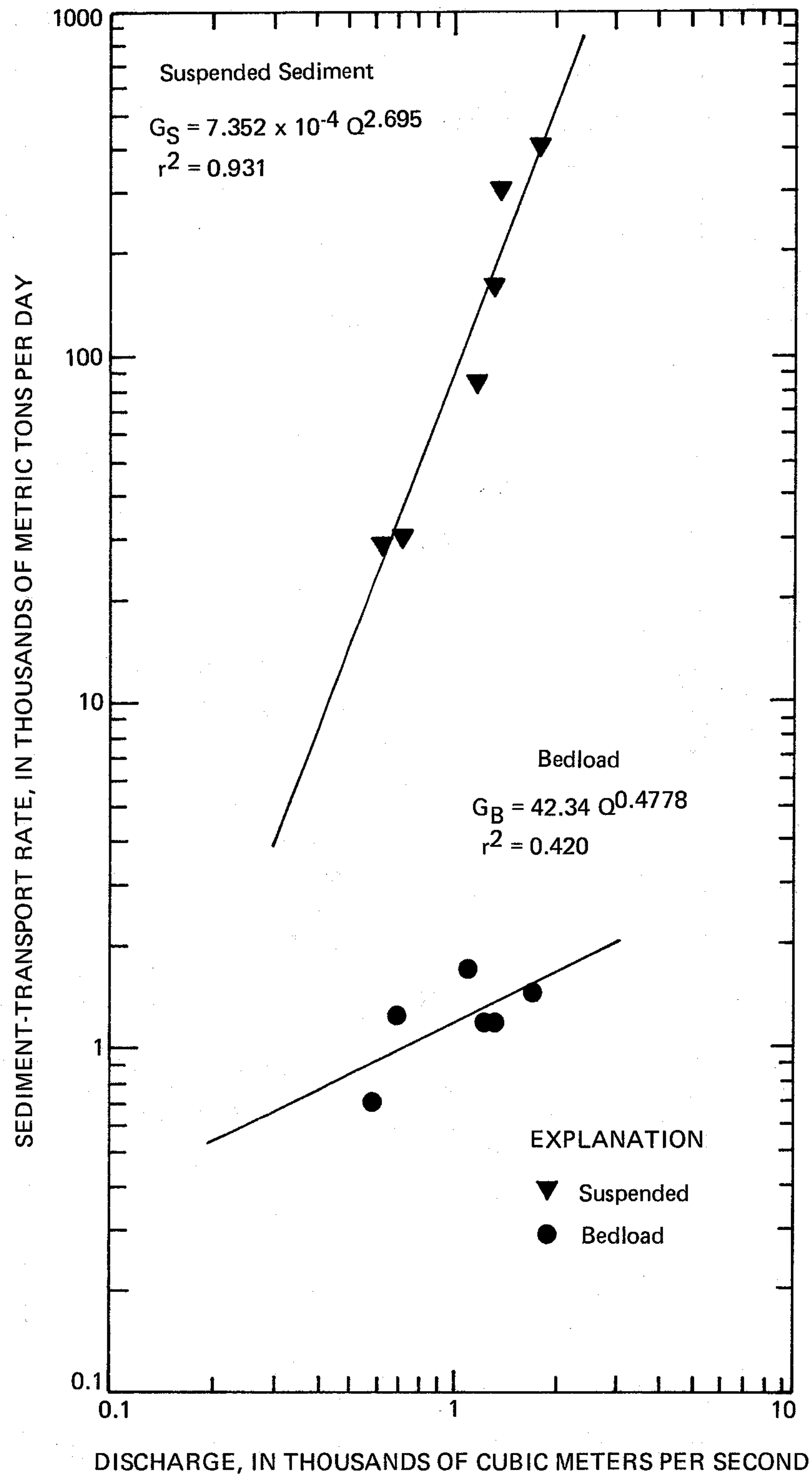

Figure 16.--Sediment-transport rate as a function of discharge, Tanana River at upper end Goose Island.

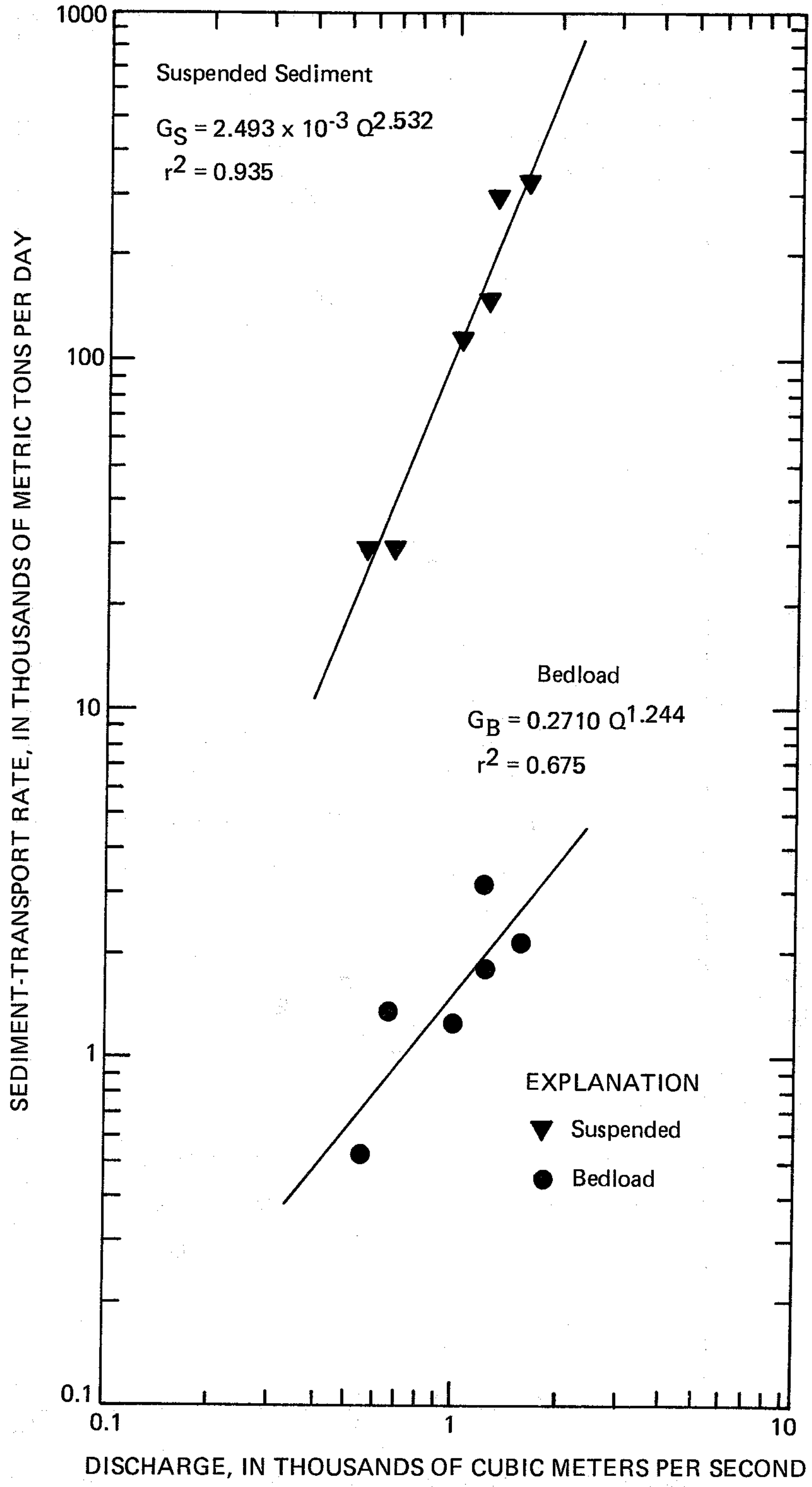

Figure 17.--Sediment-transport rate as a function of discharge, Tanana River near North Pole.

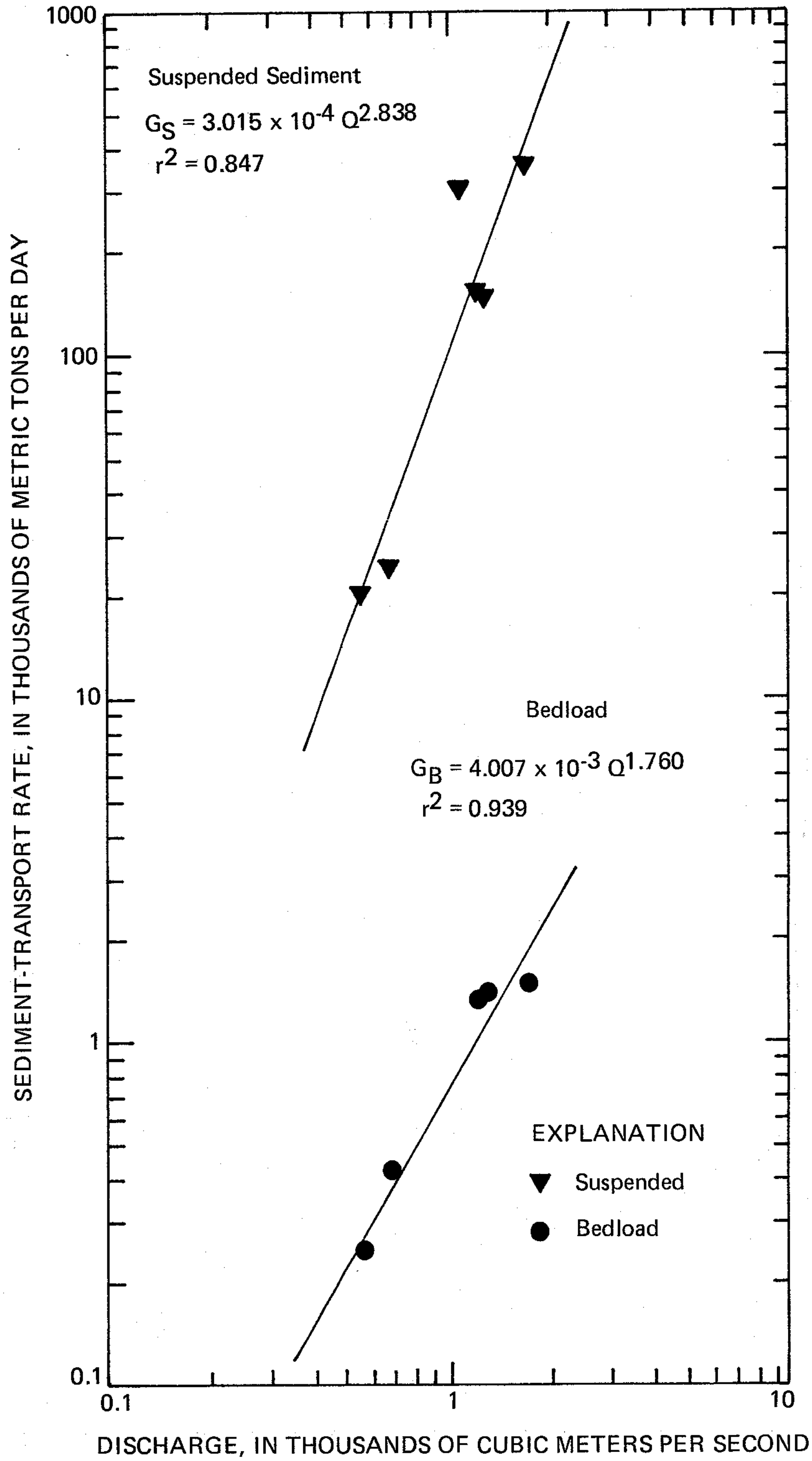

Figure 18.--Sediment-transport rate as a function of discharge, Tanana River above Chena River Floodway.

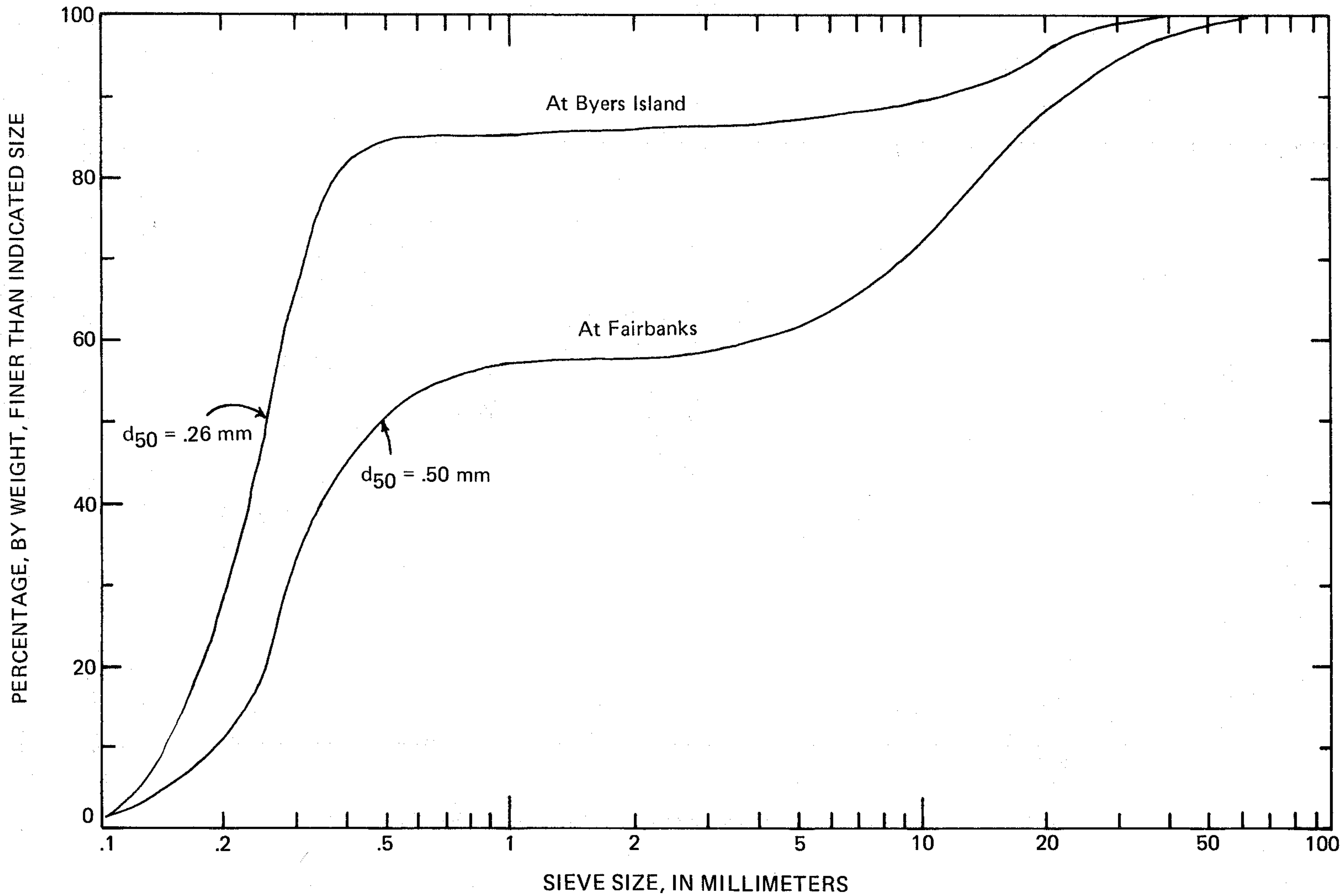

Figure 19.--Particle-size distribution of bedload, comparison of Tanana River at Byers Island and at Fairbanks.

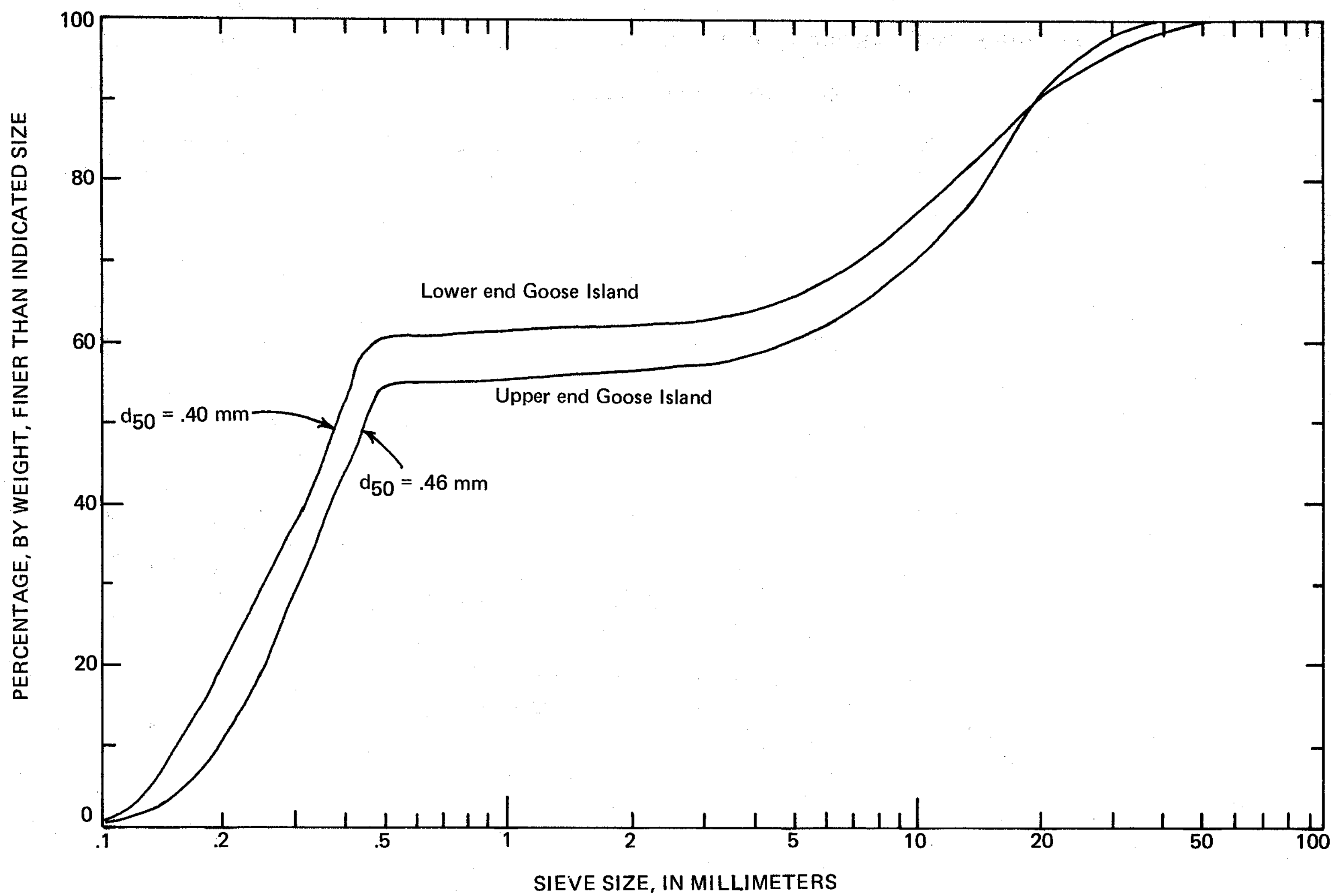

Figure 20.--Particle-size distribution of bedload, comparison of Tanana River at lower and upper ends Goose Island.

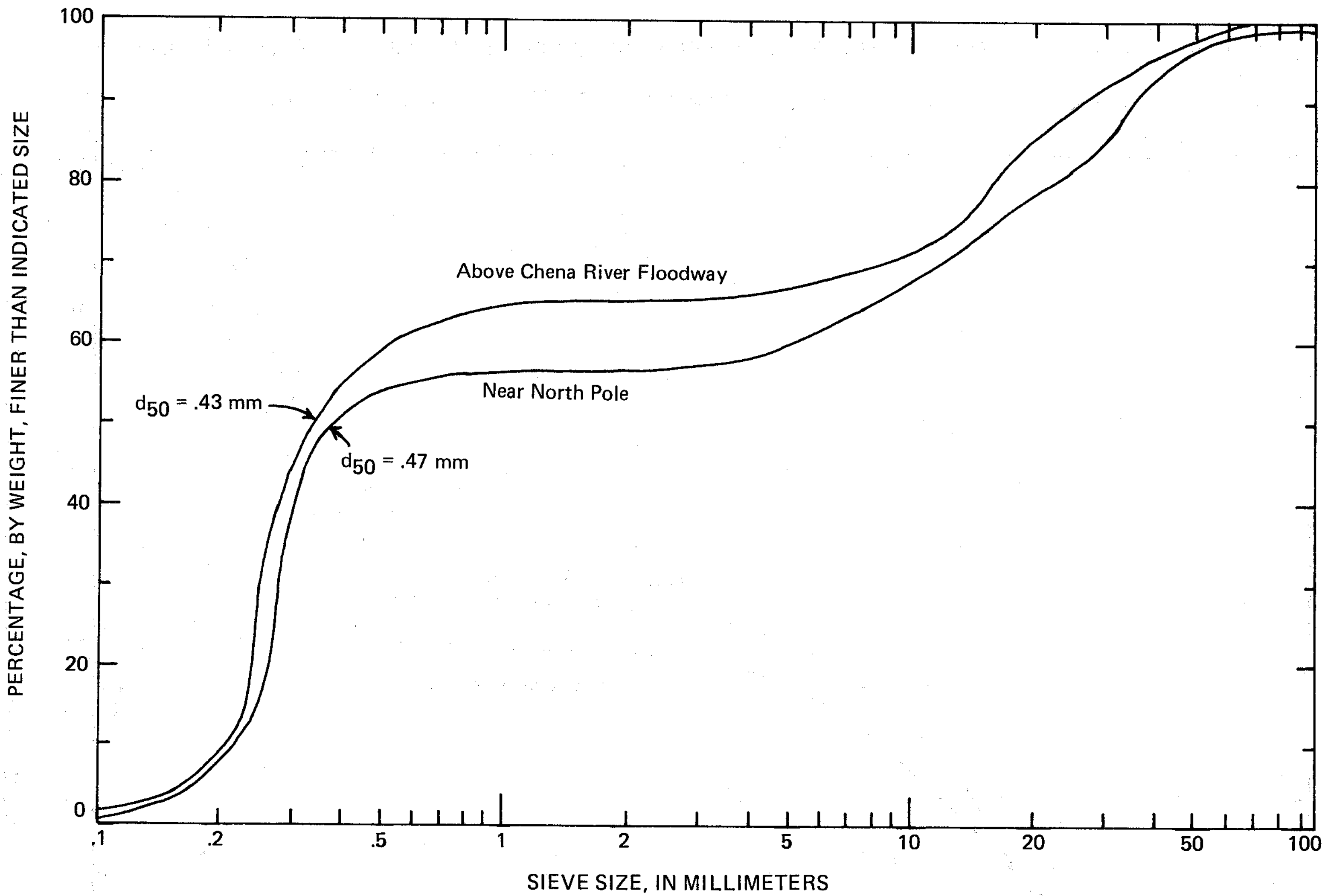

Figure 21.--Particle-size distribution of bedload; comparison of Tanana River near North Pole and above Chena River Floodway.

Table 1.--Summary of discharge measurements made during period of sediment sampling, Tanana River at Fairbanks, 1982 water year

Date	Gage height (m)	Discharge (m^3/s)	Flow area (m^2)	Surface width (m)	Mean velocity (m/s)	Mean depth (m)
6-02-82	9.016	1,090	770	300	1.416	2.567
6-28-82	9.107	1,160	713	302	1.627	2.361
7-20-82	9.568	1,880	1,050	374	1.790	2.807
8-09-82	9.031	1,290	817	306	1.579	2.670
9-08-82	8.336	634	549	299	1.155	1.836
9-28-82	8.284	688	580	301	1.186	1.927

Table 2.--Values of daily mean discharge, Tanana River at Fairbanks, 1982 water year

[Winter flow period, November through April, estimated based on periodic discharge measurements, climatological records, and correlation with data obtained for Tanana River at Nenana.]

Daily mean discharge, in cubic meters per second, October 1981 to September 1982												
Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	413	331	173	159	142	127	127	198	1,060	1,200	1,740	909
2	408	340	173	159	142	127	127	204	1,090	1,170	1,680	855
3	405	312	173	156	142	127	127	210	1,120	1,130	1,610	793
4	396	312	173	156	139	127	127	218	1,270	1,040	1,580	748
5	368	283	173	156	139	127	127	227	1,160	1,040	1,520	728
6	368	278	170	153	139	127	130	241	1,020	1,030	1,430	700
7	368	266	170	153	139	127	133	258	1,040	983	1,360	683
8	340	258	170	153	139	127	133	280	1,190	974	1,310	683
9	340	246	170	153	139	127	136	312	1,250	1,050	1,290	697
10	340	241	167	153	136	127	136	368	1,200	1,010	1,280	702
11	340	235	167	153	136	127	139	510	1,140	1,310	1,290	685
12	343	224	167	153	136	127	142	765	1,180	1,460	1,270	671
13	340	221	167	150	136	127	144	963	1,170	1,580	1,230	651
14	351	215	167	150	136	127	147	1,070	1,060	1,770	1,210	640
15	365	212	164	150	136	127	150	1,120	957	1,900	1,200	705
16	379	210	164	150	133	127	153	1,130	1,130	1,710	1,180	770
17	391	204	164	150	133	127	156	1,130	1,440	1,620	1,170	1,000
18	388	201	164	147	133	127	159	1,070	1,520	1,660	1,160	1,090
19	391	195	164	147	130	127	159	1,060	1,400	1,870	1,140	909
20	388	193	164	147	130	127	161	1,120	1,320	1,890	1,170	878
21	360	190	164	147	130	127	164	1,170	1,380	1,760	1,180	1,010
22	351	187	161	147	130	127	164	1,130	1,490	1,680	1,200	1,030
23	351	184	161	147	130	127	167	1,110	1,330	1,670	1,180	898
24	368	181	161	144	127	127	170	1,060	1,160	1,610	1,140	799
25	379	181	161	144	127	127	173	1,030	1,120	1,530	1,140	742
26	391	178	161	144	127	127	176	1,050	1,110	1,700	1,140	705
27	388	176	159	144	127	127	178	1,130	1,140	1,740	1,110	680
28	377	176	159	142	127	127	184	1,180	1,200	1,690	1,100	643
29	368	176	159	142	127	127	187	1,210	1,310	1,710	1,040	609
30	354	173	159	142	---	127	193	1,120	1,310	1,740	977	575
31	348	---	159	142	---	127	---	1,020	---	1,780	963	---

Table 3.--Water-surface elevations along a reach of the Tanana River near Fairbanks

[Elevation, in meters above NGVD of 1929]

	Gage sites										
	GS-1	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	Water discharge (m^3/s)
	Distance in kilometers from former T-10										
Date	41.3	36.9	32.1	29.6	25.7	21.9	17.8	12.7	7.6	2.9	
6-11-82	126.69	128.58	130.97	132.11	135.32	137.88	141.86	146.09	151.81	157.53	1,140
7-28-82	127.03	128.79	131.31	132.48	135.72	138.10	142.06	146.18	152.10	157.74	1,690
8-24-82	126.53	128.43	130.80	131.99	---	137.73	141.76	145.77	151.55	157.38	1,140

Table 4.--Summary of suspended-sediment data, Tanana River at Byers Island

Date	Discharge (m^3/s)	Suspended sediment: Concentration (mg/L)	Suspended sediment: Transport rate (Mg/d)	Median particle size (mm)
6-04-82	1,310	1,750	198,000	0.0406
6-28-82	1,160	2,330	234,000	.0187
7-26-82	1,700	2,580	379,000	.0168
8-09-82	1,290	1,490	166,000	.0203
9-08-82	634	454	24,900	---
10-01-82	555	491	23,500	---

Table 5.--Summary of suspended-sediment data, Tanana River at Fairbanks

Date	Discharge (m^3/s)	Suspended sediment: Concentration (mg/L)	Suspended sediment: Transport rate (Mg/d)	Median particle size (mm)
6-04-82	1,310	1,940	220,000	0.0462
6-28-82	1,160	1,940	194,000	.0263
7-20-82	1,880	2,660	432,000	.0317
8-09-82	1,290	1,700	189,000	.0232
9-08-82	634	644	35,300	---
9-28-82	688	812	48,300	.0310

Table 6.--Summary of suspended-sediment data, Tanana River at lower end Goose Island

Date	Discharge (m^3/s)	Suspended sediment: Concentration (mg/L)	Suspended sediment: Transport rate (Mg/d)	Median particle size (mm)
6-03-82	1,120	1,070	104,000	0.0876
6-29-82	1,310	4,260	482,000	.0369
7-21-82	1,760	2,570	391,000	.0367
8-10-82	1,281	1,430	158,000	.0209
9-10-82	702	455	27,600	---
9-29-82	609	659	34,700	---

Table 7.--Summary of suspended-sediment data, Tanana River at upper end Goose Island

Date	Discharge (m^3/s)	Suspended sediment: Concentration (mg/L)	Suspended sediment: Transport rate (Mg/d)	Median particle size (mm)
6-03-82	1,120	839	81,200	---
6-29-82	1,310	2,600	294,000	0.0155
7-21-82	1,760	2,620	398,000	.0390
8-10-82	1,280	1,440	159,000	.0209
9-10-82	702	490	29,700	---
9-29-82	609	540	28,400	.0083

Table 8.--Summary of suspended-sediment data, Tanana River near North Pole

Date	Discharge (m^3/s)	Suspended sediment: Concentration (mg/L)	Suspended sediment: Transport rate (Mg/d)	Median particle size (mm)
6-07-82	1,060	1,230	113,000	0.0357
6-30-82	1,310	2,630	298,000	.0195
7-22-82	1,680	2,290	332,000	.0358
8-11-82	1,290	1,320	147,000	.0170
9-09-82	697	489	29,400	---
9-30-82	575	593	29,500	---

Table 9.--Summary of suspended-sediment data, Tanana River above Chena River Floodway

Date	Discharge (m^3/s)	Suspended sediment: Concentration (mg/L)	Suspended sediment: Transport rate (Mg/d)	Median particle size (mm)
6-08-82	1,210	1,450	152,000	0.0415
7-09-82	1,070	3,310	306,000	.0178
7-22-82	1,680	2,420	351,000	.0361
8-12-82	1,270	1,330	146,000	.0155
9-09-82	697	399	24,000	---
9-30-82	575	420	20,900	---

Table 10.--Summary of bedload data, Tanana River at Byers Island

Date	Discharge (m^3/s)	Width (m)	Bedload-transport rate: Unit [(kg/m)/s]	Bedload-transport rate: Total (Mg/d)	Median particle size (mm)
6-04-82	1,310	218	0.03165	596	0.46
6-28-82	1,160	223	.06153	1,190	.27
7-26-82	1,700	255	.01999	440	.22
8-09-82	1,290	217	.09440	1,770	.22
9-08-82	634	200	.03862	667	.27
10-01-82	555	203	.01991	349	.28

Table 11.--Summary of bedload data, Tanana River at Fairbanks

Date	Discharge (m^3/s)	Width (m)	Bedload-transport rate: Unit [(kg/m)/s]	Bedload-transport rate: Total (Mg/d)	Median particle size (mm)
6-04-82	1,310	308	0.02305	613	0.26
6-28-82	1,160	302	.12848	3,350	4.8
7-20-82	1,880	374	.08546	2,760	8.2
8-09-82	1,290	306	.01749	462	.25
9-08-82	634	299	.02667	689	.27
9-28-82	688	301	.03449	897	.30

Table 12.--Summary of bedload data, Tanana River at lower end Goose Island

Date	Discharge (m^3/s)	Width (m)	Bedload-transport rate: Unit [(kg/m)/s]	Bedload-transport rate: Total (Mg/d)	Median particle size (mm)
6-03-82	1,120	298	0.06172	1,590	0.43
6-29-82	1,310	285	.06043	1,490	8.5
7-21-82	1,760	326	.11049	3,110	4.8
8-10-82	1,280	254	.06767	1,490	.31
9-10-82	702	227	.06404	1,260	.28
9-29-82	609	246	.03933	836	.30

Table 13.--Summary of bedload data, Tanana River at upper end Goose Island

Date	Discharge (m^3/s)	Width (m)	Bedload-transport rate Unit [(kg/m)/s]	Bedload-transport rate Total (Mg/d)	Median particle size (mm)
6-03-82	1,120	205	0.09542	1,690	0.43
6-29-82	1,310	306	.04373	1,160	13.0
7-21-82	1,760	305	.05476	1,440	.31
8-10-82	1,280	268	.05026	1,160	13.0
9-10-82	702	216	.06529	1,220	.35
9-29-82	609	211	.03829	698	.42

Table 14.--Summary of bedload data, Tanana River near North Pole

Date	Discharge (m^3/s)	Width (m)	Bedload-transport rate Unit [(kg/m)/s]	Bedload-transport rate Total (Mg/d)	Median particle size (mm)
6-07-82	1,060	389	0.03856	1,300	8.1
6-30-82	1,310	586	.03607	1,830	.34
7-22-82	1,680	752	.03368	2,190	.31
8-11-82	1,290	760	.04980	3,270	6.0
9-09-82	697	428	.03772	1,400	.49
9-30-82	575	333	.01814	522	.46

Table 15.--Summary of bedload data, Tanana River above Chena River Floodway

Date	Discharge (m^3/s)	Width (m)	Bedload-transport rate Unit [(kg/m)/s]	Bedload-transport rate Total (Mg/d)	Median particle size (mm)
6-08-82	1,210	354	0.04267	1,310	0.45
7-22-82	1,680	402	.04195	1,460	.44
8-12-82	1,270	345	.04599	1,370	.54
9-09-82	697	283	.01738	425	.34
9-30-82	575	324	.00893	250	.31

Table 16.--Particle-size distribution of suspended sediment, Tanana River at Byers Island

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-04-82	06-28-82	07-26-82	08-09-82	09-08-82	10-01-82
1.000	---	---	---	---	---	---
.500	---	---	100	---	100	100
.250	100	100	98	100	99	98
.125	85	92	89	88	64	74
.062	64	76	76	67	49	59
.031	---	56	62	57	---	---
.016	22	48	49	46	---	---
.008	---	30	33	38	---	---
.004	11	21	27	31	---	---
.002	9	13	19	22	---	---

Table 17.--Particle-size distribution of suspended sediment, Tanana River at Fairbanks

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-04-82	06-28-82	07-20-82	08-09-82	09-08-82	09-28-82
1.000	---	---	---	---	---	---
.500	100	100	100	100	100	100
.250	97	95	99	99	97	97
.125	81	80	92	78	54	69
.062	59	65	72	64	36	57
.031	38	53	50	54	---	---
.016	23	41	32	45	---	43
.008	21	28	21	38	---	---
.004	18	19	16	32	---	34
.002	16	15	12	28	---	29

Table 18.--Particle-size distribution of suspended sediment, Tanana River at lower end Goose Island

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
1.000	---	---	---	---	---	---
.500	100	100	100	100	100	100
.250	97	99	98	99	99	98
.125	59	78	88	81	58	64
.062	42	61	64	68	45	52
.031	---	47	46	56	---	---
.016	25	37	31	45	---	---
.008	---	27	24	37	---	---
.004	15	20	19	33	---	---
.002	12	17	15	28	---	---

Table 19.--Particle-size distribution of suspended sediment Tanana River at upper end Goose Island

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
1.000	---	---	---	---	---	---
.500	---	---	---	100	100	100
.250	100	100	100	96	94	99
.125	76	95	83	80	60	80
.062	54	81	62	66	45	71
.031	---	67	44	55	---	---
.016	---	50	31	46	---	55
.008	---	36	24	37	---	---
.004	---	28	19	30	---	43
.002	---	20	15	21	---	38

Table 20.--Particle-size distribution of suspended sediment, Tanana River near North Pole

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
1.000	---	---	---	---	---	---
.500	100	100	100	100	100	100
.250	98	99	99	97	99	94
.125	78	86	79	78	75	63
.062	61	75	60	66	59	53
.031	---	56	48	59	---	---
.016	34	47	36	49	---	---
.008	---	32	27	41	---	---
.004	20	24	23	34	---	---
.002	15	15	19	28	---	---

Table 21.--Particle-size distribution of suspended sediment, Tanana River above Chena River Floodway

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-08-82	07-09-82	07-22-82	08-12-82	09-09-82	09-30-82
1.000	---	---	---	---	---	---
.500	100	---	100	100	---	100
.250	96	100	99	97	100	98
.125	79	87	80	81	73	74
.062	60	70	62	70	58	62
.031	43	63	47	60	---	---
.016	31	47	35	50	---	---
.008	20	35	28	41	---	---
.004	18	27	23	35	---	---
.002	15	23	19	25	---	---

Table 22.--Particle-size distribution of bedload sediment, Tanana River at Byers Island

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-04-82	06-28-82	07-26-82	08-09-82	09-08-82	10-01-82
128	---	---	---	---	---	---
64	100	---	---	---	---	---
32	94.2	100	100	100	100	100
16	72.1	91.2	94.0	95.6	99.1	95.4
8	61.2	87.9	89.5	92.4	96.5	95.2
4	57.4	84.1	88.7	91.7	94.5	95.1
2	56.4	82.2	88.5	91.5	94.4	95.0
1	55.7	80.9	88.3	91.3	94.2	94.8
.5	55.0	78.6	87.6	91.1	93.7	94.0
.25	26.8	47.1	59.1	61.0	42.1	36.2
.125	4.0	8.0	10.6	6.9	3.0	2.2
.062	.8	.9	1.4	.8	.3	.3

Table 23.--Particle-size distribution of bedload sediment, Tanana River at Fairbanks

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	06-04-82	06-28-82	07-20-82	08-09-82	09-08-82	09-28-82
128	---	---	---	---	---	---
64	---	100	100	---	100	---
32	---	92.3	96.1	100	91.6	100
16	100	79.0	74.8	93.2	91.6	99.5
8	99.8	59.4	48.8	87.5	91.5	93.9
4	99.6	46.7	39.2	84.4	91.4	93.0
2	99.1	42.1	36.7	83.8	91.3	93.0
1	98.8	40.4	35.9	83.3	91.2	92.7
.5	98.2	38.2	18.7	82.2	91.0	92.2
.25	45.2	11.4	2.8	49.8	44.6	31.9
.125	4.8	1.0	.6	31.4	3.2	2.5
.062	.9	.2	.1	13.2	.3	.3

Table 24.--Particle-size distribution of bedload, sediment Tanana River at lower end Goose Island

[Percentage, by weight, finer than particle size]

Particle size (mm)	Main channel					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
128	---	---	---	---	---	---
64	100	100	---	---	---	---
32	87.2	88.7	100	100	---	100
16	81.5	57.9	81.0	91.4	100	99.6
8	65.1	30.8	64.8	86.9	99.5	99.2
4	56.7	23.2	56.1	84.4	99.3	98.8
2	54.4	21.0	54.8	83.7	99.2	98.8
1	53.8	20.6	54.5	82.6	99.0	98.7
.5	52.8	20.4	54.3	79.7	98.3	97.8
.25	17.3	11.3	35.8	39.2	36.1	28.4
.125	1.7	1.3	6.4	4.5	1.7	2.0
.062	.2	.2	1.3	.6	1.0	.2

Particle size (mm)	North channel					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
128	---	---	---	---	---	---
64	---	---	100	---	---	---
32	100	---	97.8	100	---	---
16	85.1	100	83.1	75.5	100	100
8	76.8	98.0	60.5	59.4	99.9	96.8
4	71.1	95.2	41.6	46.5	99.5	95.7
2	69.8	93.9	35.7	44.0	99.5	95.6
1	69.4	93.3	35.0	41.9	99.2	94.6
.5	68.9	92.7	34.8	41.1	98.6	92.9
.25	29.6	66.5	29.2	20.4	28.3	23.8
.125	2.4	9.8	4.7	.7	1.9	1.3
.062	.4	1.4	.8	.2	.4	.2

Particle size (mm)	Composite channels					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
128	---	---	---	---	---	---
64	100	100	100	---	---	---
32	91.7	91.6	98.4	100	---	100
16	82.7	68.8	82.5	89.7	100	99.7
8	69.2	48.2	61.7	83.9	99.6	98.6
4	61.7	41.8	45.6	80.2	99.4	98.0
2	59.8	39.8	41.0	79.3	99.3	98.0
1	59.2	39.3	40.4	78.1	99.0	97.6
.5	58.4	39.0	40.2	75.5	98.4	96.6
.25	21.6	25.6	31.1	37.1	33.8	27.2
.125	1.9	3.5	5.2	4.1	1.8	1.8
.062	.3	.5	.9	.6	.8	.2

Table 25.--Particle-size distribution of bedload sediment, Tanana River at upper end Goose Island

[Percentage, by weight, finer than particle size]

Particle size (mm)	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
128	---	---	---	---	---	---
64	---	---	100	100	---	---
32	100	100	95.6	96.5	100	100
16	94.3	57.8	87.3	58.2	94.3	89.4
8	78.9	34.5	78.9	35.2	87.3	69.7
4	66.9	24.0	74.9	25.1	83.1	65.9
2	64.2	20.6	73.9	22.5	82.3	65.6
1	63.5	19.3	73.3	21.3	80.8	64.9
.5	62.7	18.2	71.6	20.9	77.6	63.7
.25	14.0	6.3	39.8	10.5	23.9	16.2
.125	1.1	.9	4.2	1.1	1.5	1.2
.062	.2	.1	.6	.2	.2	.2

Table 26.--Particle-size distribution of bedload sediment, Tanana River near North Pole

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	Main channel					
	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
128	---	---	---	100	---	---
64	100	100	100	95.1	100	100
32	73.0	95.3	93.3	76.7	97.0	78.0
16	51.1	92.4	87.2	65.8	73.0	78.0
8	37.1	89.8	85.2	57.3	58.3	72.2
4	30.4	88.2	84.1	50.8	50.8	66.0
2	28.2	87.7	83.7	49.8	48.7	65.0
1	27.3	87.5	83.4	48.5	46.1	59.4
.5	25.8	86.8	82.9	46.3	42.9	56.0
.25	8.7	22.8	41.4	8.4	2.9	7.4
.125	.9	1.8	3.2	1.0	.2	.6
.062	.1	.3	.5	.2	.0	.0

Table 26.--Continued

Particle size (mm)	South channel					
	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
128	---	---	---	---	---	---
64	---	---	---	100	---	100
32	100	100	100	94.7	100	82.4
16	84.5	84.1	91.0	69.2	95.3	73.5
8	77.9	59.5	59.2	44.7	93.4	70.9
4	76.9	40.8	49.7	29.3	91.9	69.3
2	76.5	35.7	48.2	26.0	91.5	69.0
1	76.2	33.7	48.0	23.5	90.8	68.2
.5	74.9	32.9	47.6	22.5	88.5	66.2
.25	23.3	16.6	35.2	10.0	11.3	5.3
.125	2.6	.4	6.1	.7	.7	.4
.062	.6	.1	1.1	.1	.2	.1

Particle size (mm)	Composite channels					
	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
128	---	---	---	100	---	---
64	100	100	100	96.5	100	100
32	81.3	95.5	95.6	81.9	97.6	79.4
16	61.4	91.9	88.5	66.8	77.2	76.6
8	49.7	87.9	76.4	53.7	65.0	71.8
4	44.7	85.2	72.5	44.6	58.6	67.1
2	43.1	84.4	71.7	42.9	56.9	66.3
1	42.4	84.1	71.4	41.3	54.6	62.3
.5	41.0	83.4	71.0	39.4	51.6	59.3
.25	13.2	22.4	39.3	8.8	4.5	6.7
.125	1.5	1.7	4.2	.9	.3	.5
.062	.3	.3	.7	.2	.1	.0

Table 27.--Particle-size distribution of bedload sediment, Tanana River above Chena River Floodway

[Percentage, by weight, finer than particle size indicated]

Particle size (mm)	North channel					
	06-08-82	07-09-82	07-22-82	08-12-82	09-09-82	09-30-82
128	---	---	---	---	---	---
64	100	---	100	100	---	---
32	88.2	---	85.2	94.5	100	---
16	74.0	100	63.9	70.3	94.5	100
8	56.3	99.7	57.5	51.7	94.2	98.1
4	50.2	99.7	54.8	46.2	94.1	97.3
2	48.0	99.7	54.1	45.4	94.0	97.2
1	47.6	99.5	53.9	44.7	93.8	96.9
.5	47.0	99.3	53.3	44.0	92.2	94.6
.25	16.4	53.9	22.4	14.4	15.9	10.6
.125	2.2	3.3	3.5	1.5	1.0	.5
.062	.4	.6	.6	.2	.2	.1

Particle size (mm)	South channel				
	06-08-82	07-22-82	08-12-82	09-09-82	09-30-82
128	---	---	---	---	---
64	---	---	---	---	---
32	100	100	100	100	100
16	98.3	94.9	86.9	95.6	92.3
8	94.6	74.7	83.9	94.9	92.3
4	92.9	62.9	82.9	94.8	92.0
2	91.9	61.1	82.7	94.6	92.0
1	91.5	60.7	82.5	93.9	92.0
.5	90.5	60.1	52.0	91.7	91.6
.25	46.4	41.3	3.3	12.9	58.8
.125	3.7	4.8	.3	1.0	2.2
.062	.5	.7	.0	.1	.2

Table 27.--Continued

Particle size (mm)	Composite channels				
	06-08-82	07-22-82	08-12-82	09-09-82	09-30-82
128	---	---	---	---	---
64	100	100	100	---	---
32	90.4	89.7	97.3	100	100
16	78.5	73.4	78.7	94.9	97.6
8	63.5	62.9	68.0	94.4	96.3
4	58.3	57.3	64.7	94.4	95.7
2	56.3	56.3	64.2	94.2	95.6
1	55.9	56.0	63.8	93.9	95.4
.5	55.2	55.4	48.0	92.0	93.7
.25	22.0	28.2	8.8	14.8	25.5
.125	2.5	3.9	.9	1.0	1.0
.062	.4	.6	.1	.2	.1

Table 28.--Statistical data for particle-size distribution of bedload sediment, Tanana River at Byers Island

[Particle diameter (mm) at given percent-finer parameter]

Percent finer parameter	06-04-82	06-28-82	07-26-82	08-09-82	09-08-82	10-01-82
d_5	0.13	0.11	0.09	0.11	0.14	0.15
d_{16}	.20	.15	.14	.15	.18	.19
d_{35}	.31	.21	.19	.19	.23	.25
d_{50}	.46	.27	.22	.22	.27	.28
d_{65}	10	.36	.28	.27	.32	.33
d_{84}	21	4.0	.45	.40	.40	.41
d_{90}	26	12	8.5	.48	.45	.45
d_{95}	33	18	17	14	4.6	2.0

Table 29.--Statistical data for particle-size distribution of bedload sediment, Tanana River at Fairbanks

[Particle diameter (mm) at a given percent-finer parameter]

Percent finer parameter	06-04-82	06-28-82	07-20-82	08-09-82	09-08-82	09-28-82
d_{5}	0.13	0.19	0.30	---	0.14	0.14
d_{16}	.17	.29	.46	.07	.18	.20
d_{35}	.22	.47	.97	.14	.23	.26
d_{50}	.26	4.8	8.2	.25	.27	.30
d_{65}	.29	9.6	12	.33	.32	.34
d_{84}	.35	20	20	3.0	.43	.43
d_{90}	.39	27	24	10	.49	.48
d_{95}	.43	35	30	17	36	8.5

Table 30.--Statistical data for particle-size distribution of bedload sediment, Tanana River at lower end Goose Island

[Particle diameter (mm) at given percent-finer parameter]

Percent finer parameter	Main channel					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
d_{5}	0.17	0.19	0.11	0.13	0.15	0.15
d_{16}	.24	.37	.17	.18	.19	.20
d_{35}	.37	9.0	.25	.24	.25	.26
d_{50}	.48	13	.43	.30	.28	.29
d_{65}	7.9	18	8.1	.38	.31	.32
d_{84}	22	28	17	3.0	.37	.38
d_{90}	34	33	18	13	.40	.41
d_{95}	38	38	20	18	.44	.45

Table 30.--Continued

Percent finer parameter	North channel					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
d_{5}	0.15	0.10	0.13	0.18	0.15	0.16
d_{16}	.20	.14	.19	.23	.21	.22
d_{35}	.28	.18	.98	.42	.26	.28
d_{50}	.36	.21	5.4	4.8	.29	.31
d_{65}	.46	.25	9.0	10	.32	.35
d_{84}	15	.37	16	18	.37	.43
d_{90}	17	.45	20	19	.40	.47
d_{95}	20	3.6	25	21	.44	1.3

Percent finer parameter	Composite channels					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
d_{5}	0.16	0.14	0.12	0.13	0.15	0.15
d_{16}	.22	.20	.18	.18	.20	.21
d_{35}	.33	.41	.34	.24	.25	.27
d_{50}	.43	8.5	4.8	.31	.28	.30
d_{65}	5.4	14	8.8	.41	.31	.33
d_{84}	17	24	17	8.2	.37	.40
d_{90}	27	30	20	16	.40	.43
d_{95}	36	36	24	19	.44	.48

Table 31.--Statistical data for particle-size distribution of bedload sediment, Tanana River at upper end Goose Island

[Particle diameter (mm) at given percent-finer parameter]

Percent finer parameter	Main channel					
	06-03-82	06-29-82	07-21-82	08-10-82	09-10-82	09-29-82
d_5	0.18	0.23	0.13	0.19	0.16	0.18
d_{16}	.26	.45	.18	.37	.22	.25
d_{35}	.35	8.1	.24	7.9	.29	.34
d_{50}	.43	13	.31	13	.35	.42
d_{65}	2.4	17	.43	17	.42	1.1
d_{84}	9.5	19	12	23	4.7	13
d_{90}	12	21	19	25	10	16
d_{95}	17	23	30	30	16	19

Table 32.--Statistical data for particle-size distribution of bedload sediment, Tanana River near North Pole

[Particle diameter (mm) at given percent-finer parameter]

Percent finer parameter	North channel					
	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
d_5	0.20	0.16	0.14	0.21	0.28	0.22
d_{16}	.35	.22	.18	.31	.36	.30
d_{35}	6.5	.29	.23	.43	.46	.39
d_{50}	15	.33	.28	2.3	3.1	.46
d_{65}	24	.38	.36	15	11	2.0
d_{84}	36	.48	4.0	39	20	34
d_{90}	39	8.4	21	48	23	37
d_{95}	43	30	34	63	28	42

Table 32.--Continued

Percent finer parameter	South channel					
	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
d_5	0.15	0.19	0.11	0.20	0.20	0.25
d_{16}	.21	.25	.17	.36	.27	.31
d_{35}	.30	1.5	.25	5.2	.32	.38
d_{50}	.36	5.6	4.1	9.2	.35	.43
d_{65}	.43	9.1	8.8	14	.40	.49
d_{84}	15	16	13	22	.47	33
d_{90}	18	18	15	26	.78	36
d_{95}	20	20	18	32	14	40

Percent finer parameter	Composite channels					
	06-07-82	06-30-82	07-22-82	08-11-82	09-09-82	09-30-82
d_5	0.18	0.16	0.13	0.20	0.26	0.23
d_{16}	.27	.22	.18	.31	.33	.31
d_{35}	.44	.29	.24	.46	.42	.39
d_{50}	8.1	.34	.31	6.0	.49	.46
d_{65}	18	.40	.43	14	8.0	1.6
d_{84}	33	.99	12	34	18	34
d_{90}	36	11	18	43	22	37
d_{95}	41	28	30	56	27	41

Table 33.--Statistical data for particle-size distribution of bedload sediment, Tanana River above Chena River Floodway

[Particle diameter (mm) at given percent-finer parameter]

Percent finer parameter	North channel					
	06-08-82	07-09-82	07-22-82	08-12-82	09-09-82	09-30-82
d_{5}	0.16	0.13	0.14	0.17	0.18	0.20
d_{16}	.25	.17	.21	.26	.25	.27
d_{35}	.39	.21	.34	.42	.30	.31
d_{50}	3.7	.24	.47	6.5	.33	.34
d_{65}	11	.27	16	13	.37	.37
d_{84}	25	.33	31	22	.44	.43
d_{90}	33	.35	35	26	.48	.46
d_{95}	38	.39	39	33	16	.55

Percent finer parameter	South channel				
	06-08-82	07-22-82	08-12-82	09-09-82	09-30-82
d_{5}	0.13	0.13	0.27	0.19	0.14
d_{16}	.17	.17	.34	.26	.17
d_{35}	.22	.23	.43	.31	.21
d_{50}	.26	.34	.49	.34	.23
d_{65}	.32	4.5	.65	.38	.28
d_{84}	.43	10	8.4	.45	.40
d_{90}	.49	12	17	.49	.47
d_{95}	8.5	16	19	8.8	18

Table 33.--Continued

Percent finer parameter	Composite channels				
	06-08-82	07-22-82	08-12-82	09-09-82	09-30-82
d_5	0.15	0.13	0.20	0.18	0.17
d_{16}	.22	.20	.30	.25	.22
d_{35}	.34	.30	.42	.30	.27
d_{50}	.45	.44	.54	.34	.31
d_{65}	8.5	9.1	4.2	.37	.35
d_{84}	21	24	18	.45	.42
d_{90}	31	32	22	.48	.46
d_{95}	37	37	27	16	.85

Table 34.--Composite size distribution (transport-rate weighted) of bedload sediment, Tanana River

[In percent by weight]

Particle size (mm)	Byers Island		Fairbanks		Lower end Goose Island		Upper end Goose Island		North Pole		Chena River Floodway	
	Percent retained	Percent finer	Percent retained	Percent finer	Percent retained	Percent finer	Percent retained	Percent finer	Percent retained	Percent finer	Percent retained	Percent finer
128	---	---	---	---	---	---	---	---	---	100	---	---
64	---	100	---	100	---	100	---	100	1.2	98.8	---	100
32	0.6	99.4	4.6	95.4	3.2	96.8	1.3	98.7	10.9	87.9	6.3	93.7
16	6.8	92.6	11.6	83.9	11.4	85.4	16.5	82.2	12.5	75.4	13.6	80.1
8	3.7	88.9	15.9	67.9	13.0	72.4	15.4	66.8	10.4	65.0	10.1	70.0
4	1.9	87.0	7.6	60.3	7.9	64.5	7.7	59.1	6.0	59.0	3.9	66.1
2	.6	86.4	2.5	57.8	2.3	62.2	1.8	57.3	1.3	57.7	1.0	65.1
1	.5	85.9	.9	56.9	.5	61.7	1.0	56.3	1.4	56.3	.4	64.7
.5	.8	85.1	6.3	50.6	.7	61.0	1.4	54.9	1.7	54.6	5.0	59.7
.25	36.7	48.4	31.5	19.1	31.8	29.2	35.7	19.2	39.9	14.7	40.0	19.7
.125	42.5	5.9	15.7	3.4	25.8	3.4	17.5	1.7	13.3	1.4	17.5	2.2
.062	5.2	.7	2.4	1.0	2.8	.6	1.4	.3	1.2	.2	1.9	.3
< .062	.7	0	1.0	0	.6	0	.3	0	.2	0	.3	0

Particle-size statistics

[Particle diameter (mm) at given percent-finer parameter]

Percent-finer parameter	Byers Island	Fairbanks	Lower end Goose Island	Upper end Goose Island	North Pole	Chena River Floodway
d_{5}	0.12	0.14	0.14	0.16	0.17	0.16
d_{16}	.16	.23	.20	.23	.26	.23
d_{25}	.19	.29	.23	.29	.31	.28
d_{35}	.21	.37	.29	.35	.37	.34
d_{50}	.26	.50	.40	.46	.47	.43
d_{65}	.33	6.1	4.2	6.8	7.9	1.6
d_{75}	.40	11	9.0	11	16	11
d_{84}	.49	16	15	17	25	19
d_{90}	9.7	21	20	19	34	25
d_{95}	18	31	27	23	43	34

Table 35.--Sediment transport in the Tanana River at Fairbanks, 1982 water year

			Sediment-Transport Rate					Sediment Loads					
			Suspended		Bedload			Suspended			Bedload		
Equaled or exceed (m^3/s)	Number of days	Percent of time	Equaled or exceeded (Mg/d)	Average (Mg/d)	Equaled or exceeded (Mg/d)	Average (Mg/d)	Ratio avg. bedload to avg. suspended (percent)	Increment (Mg)	Cumulative (Mg)	Cumulative percentage of annual load	Increment (Mg)	Cumulative (Mg)	Cumulative percentage of annual load
1,900	1	0.3	494,000	---	1,670	---	0.3	494,000	494,000	1.9	1,670	1,670	0.7
1,880	1	0.5	482,000	---	1,650	---	.3	482,000	976,000	3.7	1,650	3,320	1.5
1,860	1	0.8	470,000	---	1,640	---	.3	470,000	1,450,000	5.6	1,650	4,960	2.2
1,780	1	1.1	425,000	---	1,590	---	.4	425,000	1,870,000	7.2	1,590	6,550	2.9
1,760	2	1.6	414,000	---	1,570	---	.4	828,000	2,700,000	10.3	3,140	9,690	4.3
1,740	3	2.5	403,000	---	1,560	---	.4	1,210,000	3,910,000	15.0	4,680	14,400	6.3
1,700	3	3.3	382,000	---	1,530	---	.4	1,150,000	5,060,000	19.4	4,590	19,000	8.4
1,680	3	4.1	372,000	---	1,520	---	.4	1,120,000	6,180,000	23.7	4,560	23,500	10.4
1,660	2	4.7	362,000	---	1,500	---	.4	724,000	6,900,000	26.4	3,000	26,500	11.7
1,620	1	4.9	342,000	---	1,480	---	.4	342,000	7,250,000	27.8	1,480	28,000	12.3
1,600	2	5.5	332,000	---	1,460	---	.4	664,000	7,910,000	30.3	2,920	30,900	13.6
1,550	2	6.0	309,000	---	1,430	---	.5	618,000	8,530,000	32.7	2,860	33,800	14.9
1,500	3	6.8	286,000	---	1,390	---	.5	858,000	9,390,000	36.0	4,170	38,000	16.7
1,450	2	7.4	265,000	---	1,360	---	.5	530,000	9,920,000	38.0	2,720	40,700	17.9
1,400	3	8.2	244,000	---	1,320	---	.5	732,000	10,600,000	40.6	3,960	44,600	19.6
1,350	2	8.8	225,000	---	1,280	---	.6	450,000	11,100,000	42.5	2,560	47,200	20.8
1,300	6	10.4	206,000	216,000	1,250	1,270	.6	1,300,000	12,400,000	47.5	7,620	54,800	24.1
1,250	6	12.1	188,000	197,000	1,210	1,230	.6	1,180,000	13,600,000	52.1	7,380	62,200	27.4
1,200	8	14.2	171,000	180,000	1,170	1,190	.7	1,440,000	15,000,000	57.5	9,520	71,700	31.6
1,150	14	18.1	155,000	163,000	1,140	1,160	.7	2,280,000	17,300,000	66.3	16,200	87,900	38.7
1,100	21	23.8	140,000	148,000	1,100	1,120	.8	3,110,000	20,400,000	78.2	23,500	111,000	48.9
1,050	10	26.6	126,000	133,000	1,060	1,080	.8	1,330,000	21,700,000	83.1	10,800	122,000	53.7
1,000	12	29.9	112,000	119,000	1,020	1,040	.9	1,430,000	23,200,000	88.9	12,500	135,000	59.5
800	11	32.9	67,200	89,600	860	940	1.0	986,000	24,200,000	92.7	10,300	145,000	63.9
600	21	38.6	34,600	50,900	690	775	1.5	1,070,000	25,200,000	96.6	16,300	161,000	70.9
400	5	40.0	13,600	24,100	506	598	2.5	121,000	25,300,000	96.9	2,990	164,000	72.2
300	34	49.3	6,990	10,300	406	456	4.4	350,000	25,700,000	98.5	15,500	180,000	79.3
200	21	55.1	2,740	4,870	298	352	7.2	102,000	25,800,000	98.9	7,390	187,000	82.4
150	77	76.2	1,410	2,080	239	269	---	160,000	26,000,000	99.6	20,700	208,000	91.6
120	87	100.0	844	1,130	202	221	---	98,300	26,100,000	100.0	19,200	227,000	100.0