HYDRAULIC AND CHANNEL CHARACTERISTICS OF SELECTED STREAMS IN THE KANTISHNA HILLS AREA, DENALI NATAIONAL PARK AND PRESERVE, ALASKA, 1982-84

By James L. Van Maanen and Gary L. Solin

U.S. GEOLOGICAL SURVEY

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DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

District Chief
U.S. Geological Survey
Water Resources Division
4230 University Drive, Suite 201
Anchorage, Alaska 99508-4664

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CONVERSION TABLE

For readers who may prefer to use metric (International System) units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound unit	by	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square inch (in^2)	6.452	square centimeter (cm^2)
cubic foot per second (ft^3/s)	0.028317	cubic meter per second (m^3/s)

NOTES

RIGHT AND LEFT BANKS: These terms describe the streambanks as viewed looking downstream.

NUMBERING OF CROSS SECTIONS: Cross sections are numbered consecutively in a downstream order.

THALWEG: Thalweg is the line connecting the lowest or deepest points along a streambed, whether under water or not.

CONTOUR INTERVAL: Topographic contours on plan views are referenced to arbitrary datum.

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ABSTRACT

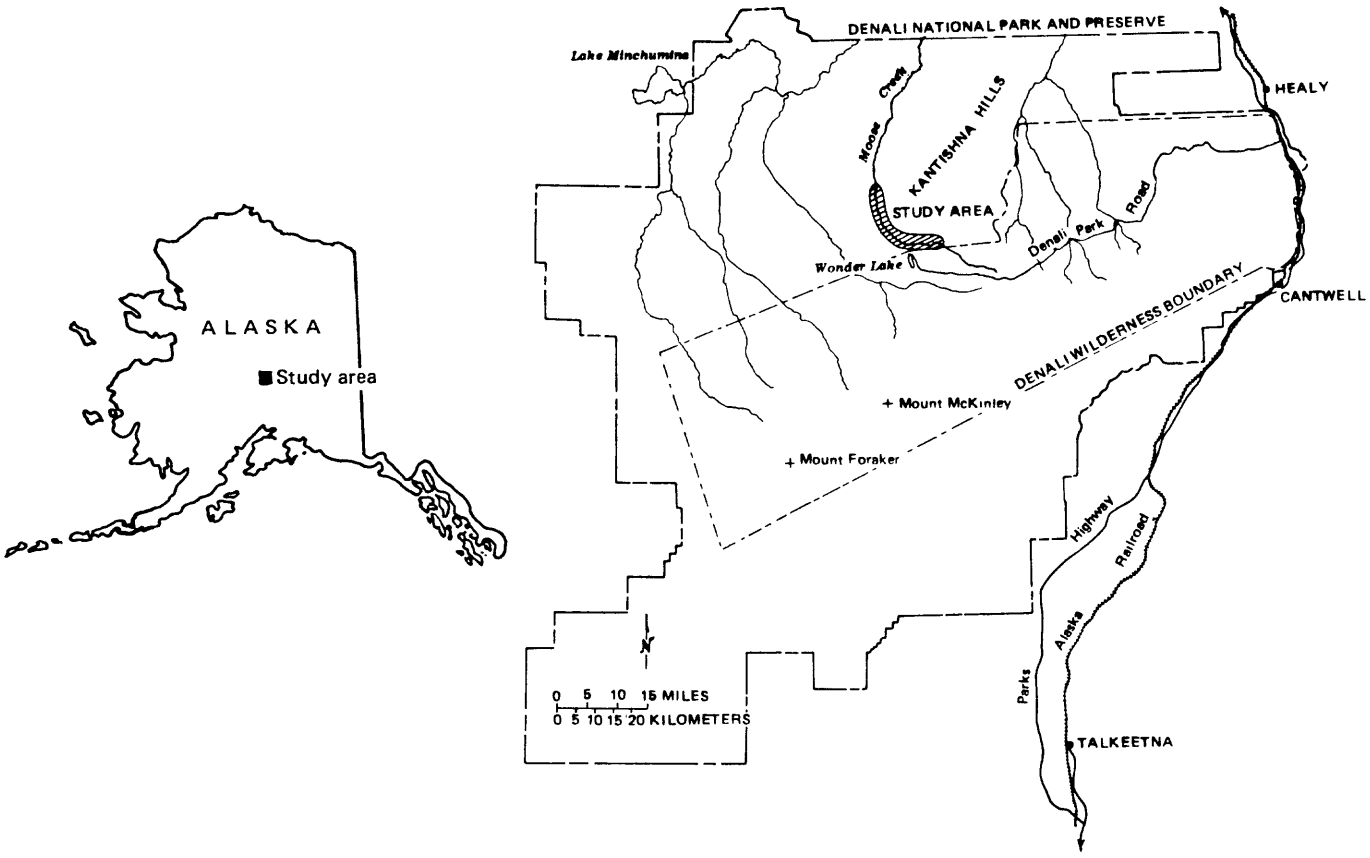
The Kantishna Hills area of the Denali National Park and Preserve contains extensive placer gold deposits. In order to develop plans for the management of this natural resource, and to assess the effects of placer mining on aquatic systems, a documentation of the physical characteristics of the streams in the area is needed.

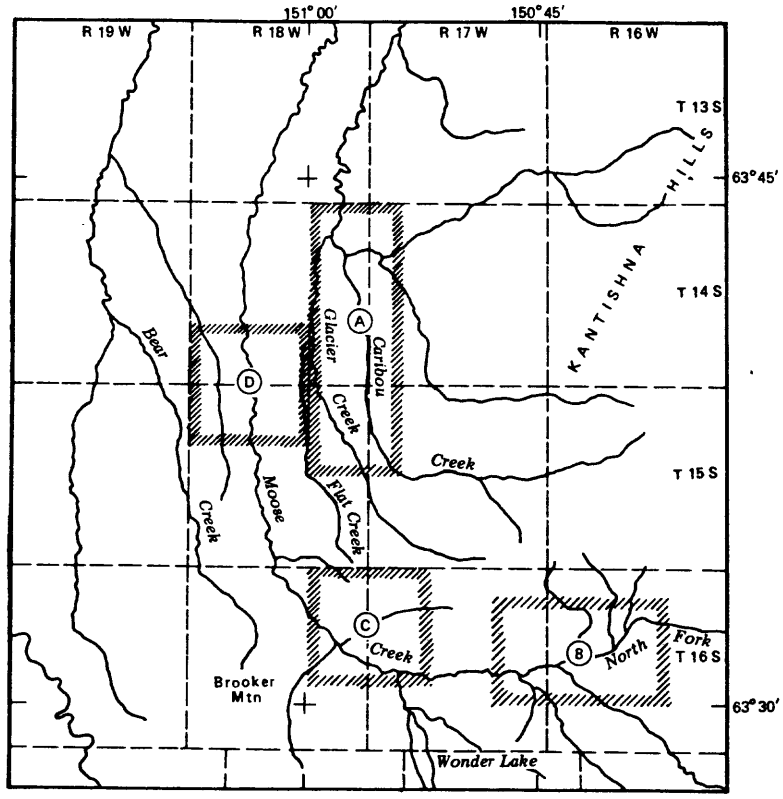
Channel morphology, streamflow and streambed composition data were collected at 14 stream reaches in the Kantishna Hills area in September 1982 and in June, July, August, and September of 1983 and 1984. The reaches selected include locations of historical and current mining activity and locations which are undisturbed. The data indicate only minor differences in the physical properties of the streams in mined and unmined drainage basins. The composition of streambeds below mined areas tended to consist of finer sized particles and exhibited less variation in mean particle size than streambeds in unmined basins. This may be due in part to the natural sorting of material in stream channels because mined areas, and thus study reaches below them, tended to be located relatively farther downstream (nearer the stream mouth) than were study reaches in basins where no mining has occurred. Changes in the physical properties of the streams which could be directly attributed to mining activity were noted at only one location, Rainy Creek near Kantishna, where the stream had been diverted from its natural channel by the construction of settling ponds.

INTRODUCTION

The Kantishna Hills is a group of low-lying hills located directly north of the boundary of the former Mount McKinley National Park, and is now located within Denali National Park and Preserve (map 1). There are more than 200 placer mining claims in the Kantishna Hills area. The National Park Service is concerned that placer mining activity could result in changes in streambed composition, either by erosion or deposition, that would adversely affect fish and wildlife habitat in streams. In order to evaluate the potential effect of placer mining on aquatic systems in the Kantishna Hills as part of the development of alternative mineral management plans, the National Park Service requested that the U.S Geological Survey collect data on the physical properties of streams in the area.

The objective of the Geological Survey's data-collection program was to document current streamflow characteristics, channel morphology, and streambed composition of selected streams in the Kantishna Hills. The compilation and presentation of those data in graphs and tables in this report provide a basis for determining subsequent changes due to man's activity or natural processes.





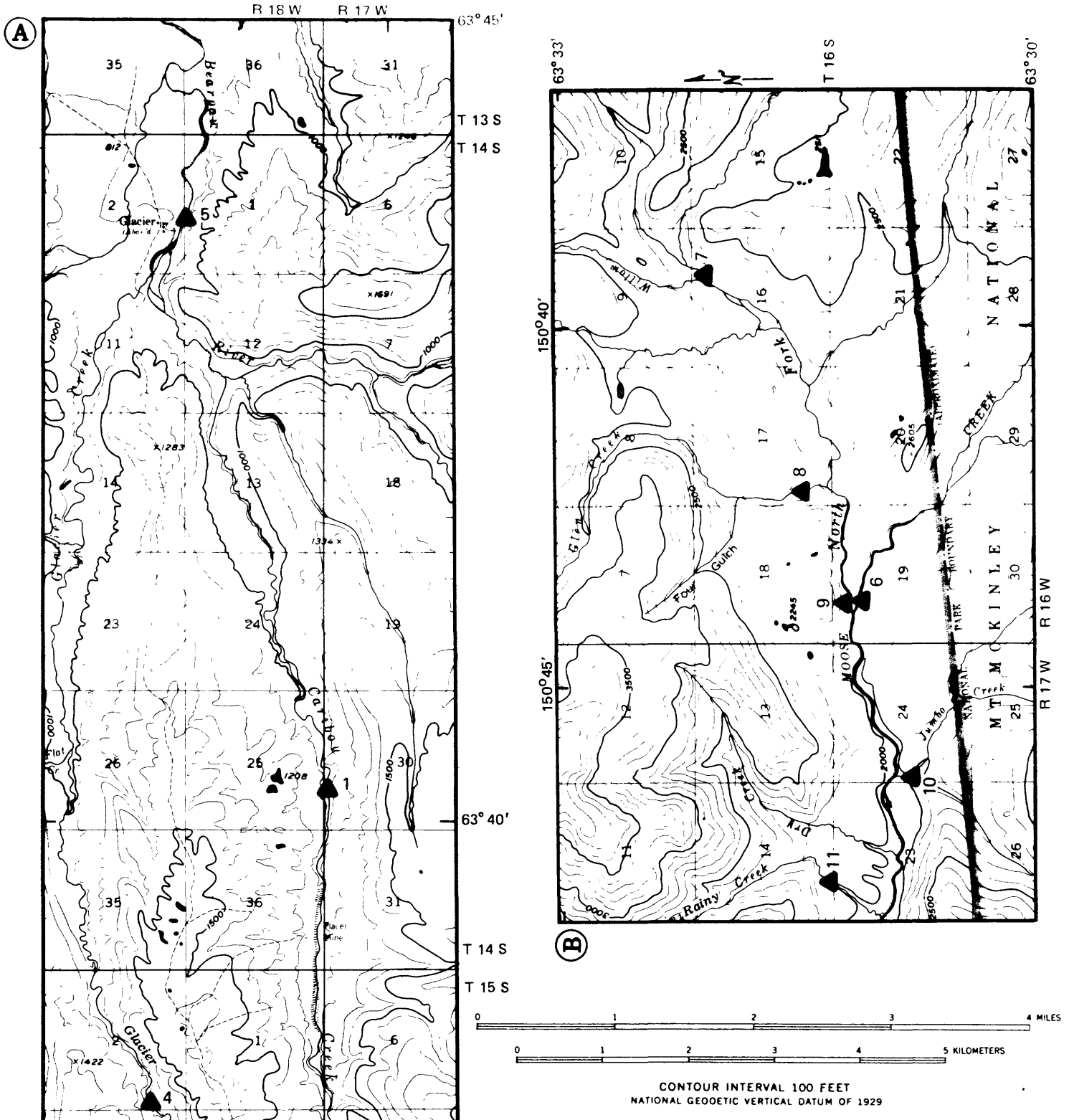
Map 1.--Location of study area and index to reach location maps.

DATA COLLECTION AND METHODS

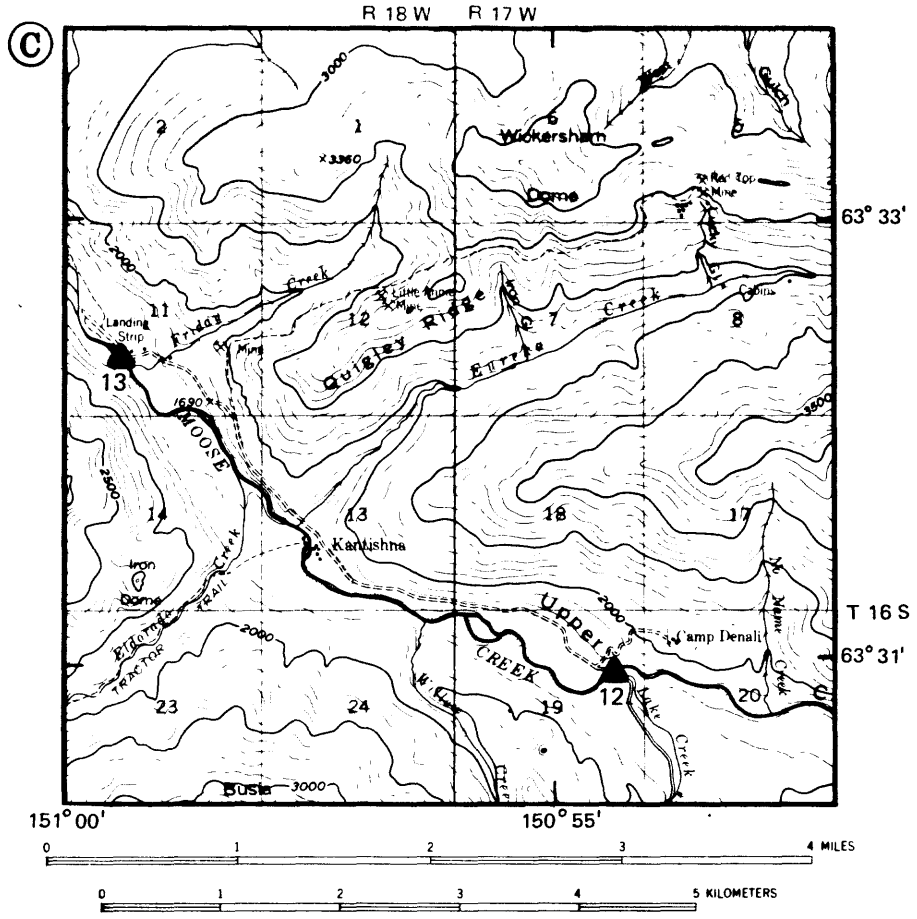
Data collection began in September 1982 and was concluded in September 1984. Study reaches were established at 14 sites in the Kantishna Hills area (map 2). Two reaches were established in 1982, ten in 1983 and two in 1984. The study reach locations were selected on the basis of field reconnaissance and National Park Service needs. Reaches were selected so that streamflow events and changing sediment loads would be reflected by adjustment of channel configuration and streambed composition. Reaches in canyons and those containing many large boulders or bedrock were avoided. Where possible, straight or nearly straight, single channel reaches containing well-defined pool and riffle sequences, and cross sections that could be waded at higher flows were selected. Study reaches were numbered in downstream order with reach 1 being the most upstream reach. Reaches include locations with current or historical mining activity and locations which are undisturbed by mining.

Channel study reaches on streams in the Kantishna Hills area, Denali National Park and Preserve

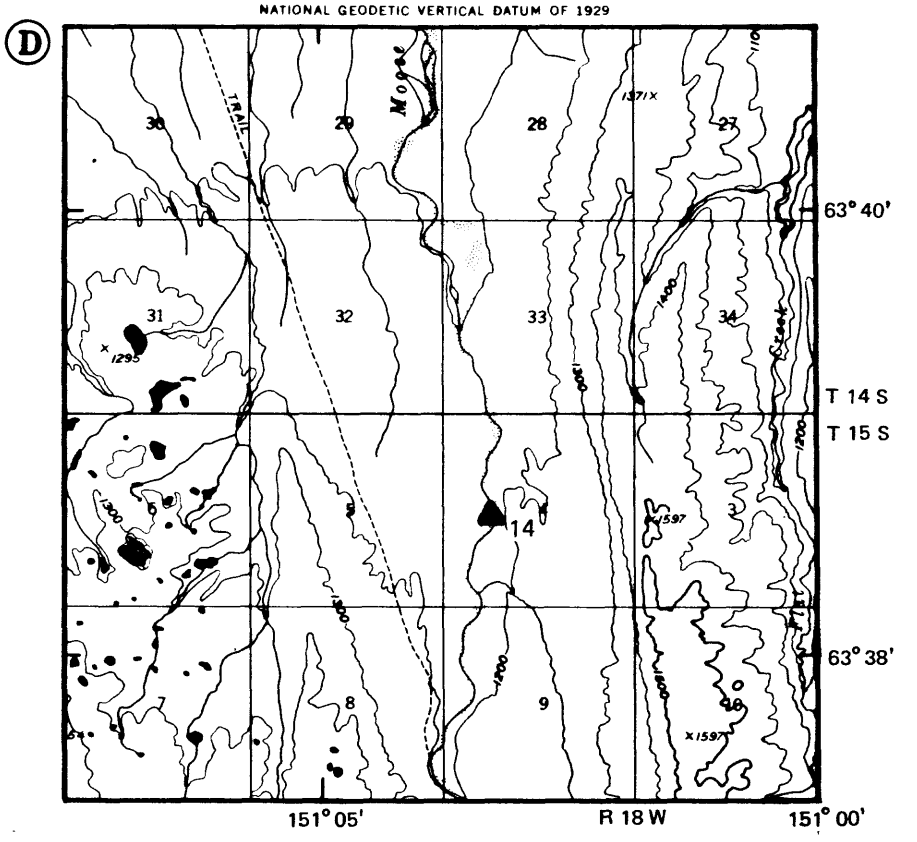
Reach No.	Reach name and location	Date established	No. of cross sections	Mining in basin	Type of gage
1	Caribou Creek near Kantishna	6/30/83	3	Yes	None
2	Glacier Creek near airstrip near Kantishna	7/23/84	3	Yes	None
3	Glacier Creek Pond near Kantishna	9/18/84	0	Yes	None
4	Glacier Creek near Kantishna	7/27/83	4	Yes	None
5	Bearpaw River near Kantishna	7/28/83	3	Yes	None
6	Moose Creek above North Fork Moose Creek near Kantishna	6/25/83	4	No	Crest stage
7	North Fork Moose Creek above Willow Creek near Kantishna	6/27/83	4	No	None
8	Glen Creek near Kantishna	6/26/83	3	Yes	Crest stage
9	North Fork Moose Creek near mouth near Kantishna	6/26/83	4	Yes	None
10	Jumbo Creek near Kantishna	6/27/83	3	No	None
11	Rainy Creek near Kantishna	9/9/82 6/24/83	3 1-2	Yes	None
12	Moose Creek near Kantishna	7/1/83	0	Yes	Staff
13	Moose Creek below Friday Creek near Kantishna	9/10/82 6/23/83	5 1-4	Yes	Crest stage
14	Moose Creek below Lower Canyon near Kantiehna	6/28/83	3	Yes	None



Map 2A-2B.--Locations for Reaches 1 through 11 (Index to maps on map 1).



CONTOUR INTERVAL 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



Map 2C-2D.--Locations for Reaches 12, 13 and 14 (Index to maps on map 1).

Measurements of water stage and stream discharge made at the study reaches were used to develop stage-discharge relations. Crest-stage gages were located at reaches 6, 8, and 13 for determination of peak stage. Peak stage at other reaches was determined from a survey of high-water marks when possible. A staff gage was installed at reach 12 and stage readings were made periodically. The staff gage readings at reach 12 were used to estimate mean daily discharges, which provide an index of the magnitude and variability of streamflow from the Kantishna Hills. Peak stage data were used to estimate peak flows at the various reaches.

Transit-stadia surveys were made to determine channel geometry at 13 of the selected reaches. Permanent reference marks were established at an arbitrary datum for use in subsequent surveys. Streambed elevations were determined along three or four cross sections at most reaches and (or) at other locations in the reach. The survey points were referenced horizontally and vertically to the permanent reference marks. All surveys in a given reach were referenced to the same arbitrary vertical datum.

Streambed composition was determined by particle counts of coarse material (4-2048 mm) and by sieve analysis of samples of finer material (0.062-256 mm). Particle counts were made using a method proposed by Wolman (1954). Bed material samples were collected from a surface area of 100 in^2 using a 10-inch square template to confine the material to the required sampling area. Separate bed material samples were collected from the bed surface (armored layer) and the bed subsurface (from below the armored layer to a depth of 3 in.).

Most of this report consists of tables, graphs, and a brief discussion of the data collected at each reach; a sketch map of each reach; and photographs of selected reaches.

SUMMARY AND CONCLUSIONS

Observations made over the 2-year study period showed no significant differences between stream channel configurations in mined and unmined drainage basins in the Kantishna Hills area. Variations in streambed elevation indicated by level surveys were within the limits expected for alluvial channels. The one exception was reach 11, Rainy Creek near Kantishna, where mining activity had diverted the stream from its natural channel and a new channel was being formed in the vegetated area on the left bank, resulting in considerable erosion of soil and damage to vegetation.

Particle count data indicated that the average mean particle size tended to be finer in mined drainage basins (34 mm) compared to non-mined basins (65 mm). There was also less variation in the mean particle size in mined reaches (average variation 24 mm) versus unmined reaches (average variation 46 mm). These differences between mined and unmined drainages may be due, however, to the natural downstream sorting of material in stream channels, since mined study reaches tended to be located farther downstream in the drainage basin.

Sieve analyses of bed material indicated the periodic deposition of fine material (<4 mm) at several of the study reaches. The deposition and subsequent scour of this fine material was noted in both mined and unmined reaches. The

difference in particle-size distribution between surface and subsurface layers in the streambed had some variation at both mined and unmined reaches. The surface layer tends to be coarser than the subsurface layer due to the winnowing of fine material and the tendency for larger particles to be forced to the surface during deposition (Leopold and others, 1954). Thus, the presence of surface material finer than subsurface material at a particular site may indicate either recent deposition, or an increase in the supply of fine material to the stream, or a lack of coarse material available for transport.

Bed material samples collected at study reaches with mining activity in the basin had an average silt-clay (<0.062 mm) content of 1.8 percent and an average sand (0.062-1.0 mm) content of 16.4 percent. Samples collected in unmined basins had an average silt-clay content of 0.5 percent and an average sand content of 8.1 percent. Study reaches in mined basins had average silt-clay contents which ranged from 0.1 percent to 4.4 percent and average sand contents ranging from 2.6 percent to 31.5 percent. Reaches in unmined basins had an average silt-clay content ranging from 0 percent to 1.3 percent and average sand contents from 3.0 percent to 17.3 percent. [It should be noted that bed material samples were collected only where the absence of very coarse material made such sampling possible and thus bed material data is not statistically representative of the entire study reach.]

SUGGESTIONS FOR ADDITIONAL STUDY

Future studies conducted to assess the effects of mining on aquatic systems would benefit from data that could be obtained through efforts concentrated on a smaller number of selected reaches. Continuous streamflow records are needed to relate changes in channel configuration and bed elevation to sediment transport, erosion and deposition. Suspended sediment and statistically representative fine (<4 mm) bed material data would also be valuable in drawing comparisons between mined and unmined stream reaches.

SELECTED REFERENCES

Leopold, L.B., Wolman, M.G., and Miller, J.R., 1964, Fluvial sediment processes in geomorphology: W.H. Freeman and Co., p. 210-212.

National Park Service, 1983, Draft Environmental Impact Statement -- Denali National Park and Preserve, Kantishna Hills/Dunkle Mine Area, Alaska: 215 p.

Wolman, M.G., 1954, A method of sampling coarse river bed material: Transactions of the American Geophysical Union, v. 35, no. 6, p. 951-956.

page 9 follows

STUDY REACH 1: CARIBOU CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°40'07", Long 150°55'59", in SW¼SW¼ Sec. 30, T.14S., R.17W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 3.2 mi upstream from mouth, 4.3 mi south of Glacier, and 9.9 mi north of Kantishna.

Three cross sections were established at 80-foot intervals within a total reach length of approximately 160 ft. The reach is mostly riffles and is about 60 ft wide. Vegetation on both banks consists of small trees and brush. Very little change in channel configuration was noted during the study period.

Particle-size data for 1983 showed no significant changes. Particle-count data for July 3, 1984 indicated a decrease in particle size throughout the reach; bed material samples collected on this date showed a finer surface layer and a coarser subsurface layer than did previous samples. However, the particle-size data for samples collected on the next visit to the reach on September 17, 1984 showed a distribution consistent with the 1983 samples, which indicated that the change noted in July 1984 was a temporary condition.

Table 1A.-- Summary of data collected: Reach 1

Date	Meas. disch. (ft^3/s)	Peak data Stage (ft)	Peak data Disch. (ft^3/s)	Cross section No.	Cross section Survey	Particle-size data Particle count	Particle-size data Bed material samples
6/30/83	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
8/10/83	130	95.09	1,660	1	Yes	Yes	None
		94.97	---	2	Yes	Yes	None
		93.90	---	3	Yes	Yes	None
7/3/84	---	93.93	295	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	None
		---	---	3	Yes	Yes	Surf-subsurf
9/17/84	62.7	93.63	159	1	Yes	Yes	Surf-subsurf
		93.92	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	Surf-subsurf

Table 1B.-- Particle count data: Reach 1

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024
June 30, 1983	1	7	8	18	39	65	86	97	100	--
	2	9	10	14	28	57	81	98	100	--
	3	--	6	9	20	45	76	96	99	100
Aug. 10, 1983	1	--	3	11	46	75	90	97	100	--
	2	--	--	5	28	54	74	90	100	--
	3	--	1	7	27	54	73	90	98	100
July 3, 1984	1	20	39	58	71	76	82	96	100	--
	3	5	14	30	51	63	71	90	99	100
Sept. 17, 1984	1	9	14	21	40	61	87	99	100	--
	3	4	8	20	38	61	82	96	100	--

Table 1C.--Bed material sample analysis data: Reach 1

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 30, 1983	1	65	Surface	--	--	1	2	2	2	3	4	10	24	83	100
	1	65	Subsurf	1	1	3	17	17	23	28	40	56	75	83	100
July 3, 1984	1	80	Surface	--	--	1	3	5	6	8	12	20	38	63	100
	1	80	Subsurf	--	--	2	4	9	11	15	21	29	43	59	100
	3	160	Surface	--	--	--	1	2	4	7	12	23	40	67	100
	3	160	Subsurf	--	--	2	6	10	14	21	32	45	73	100	--
Sept. 17, 1984	1	80	Surface	--	--	--	--	1	2	3	6	14	29	40	100
	1	80	Subsurf	--	1	2	6	13	21	29	42	59	88	100	--
	3	160	Surface	--	--	--	--	--	--	1	2	16	63	100	--
	3	160	Subsurf	--	1	3	6	12	13	18	28	49	79	100	--

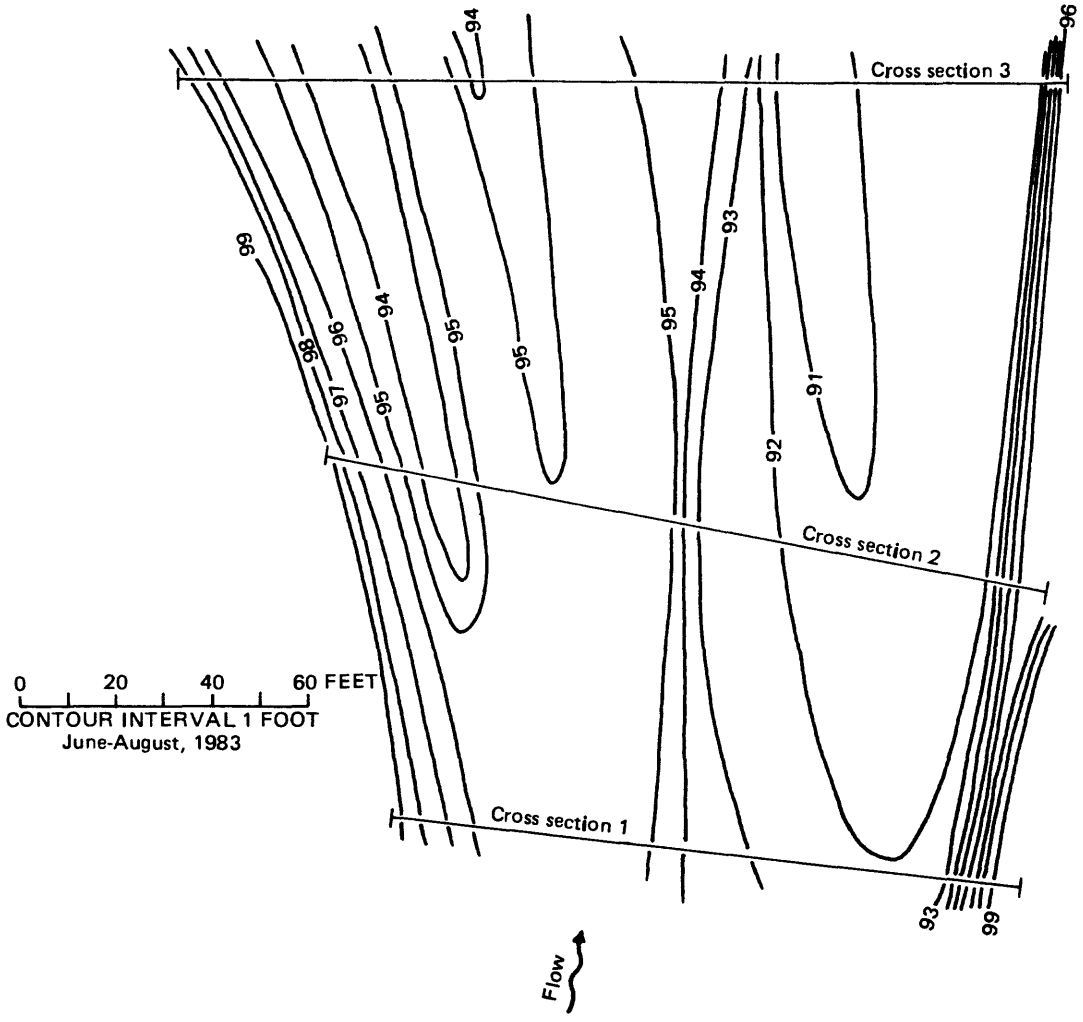


Figure 1A.--Plan view and location of cross sections at study reach 1: Caribou Creek near Kantishna.

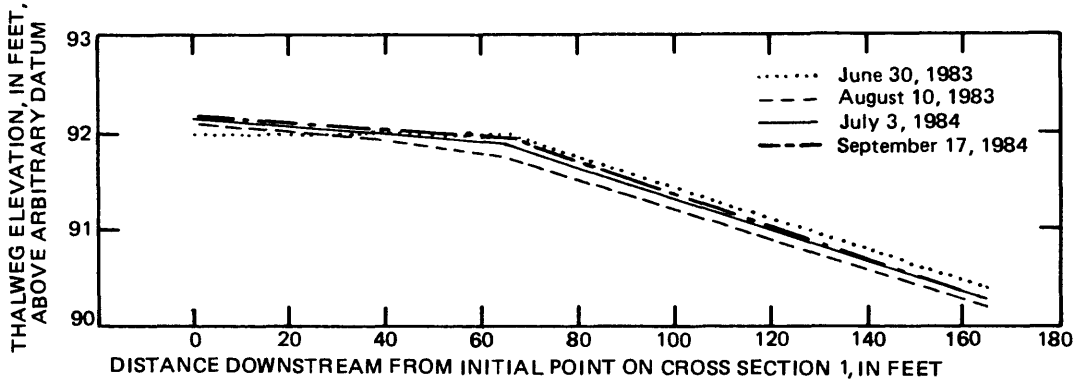


Figure 1B.--Thalweg profile at study reach 1: Caribou Creek near Kantishna.

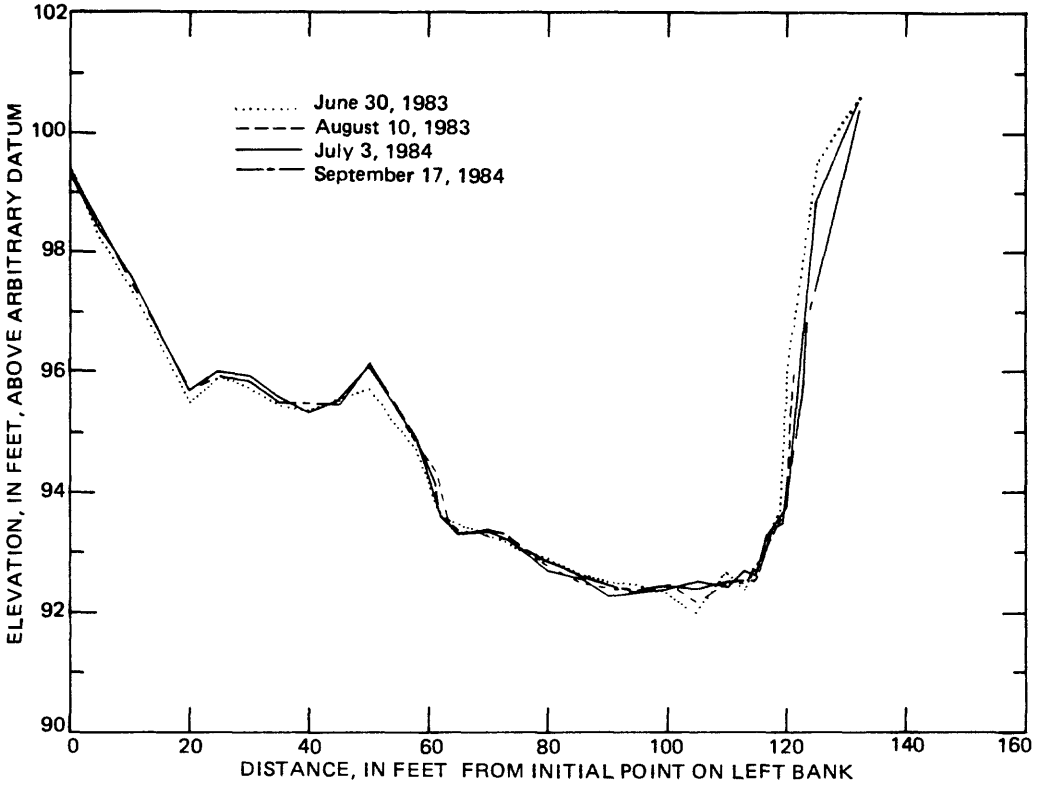


Figure 1C.--Cross section 1 at study reach 1: Caribou Creek near Kantishna.

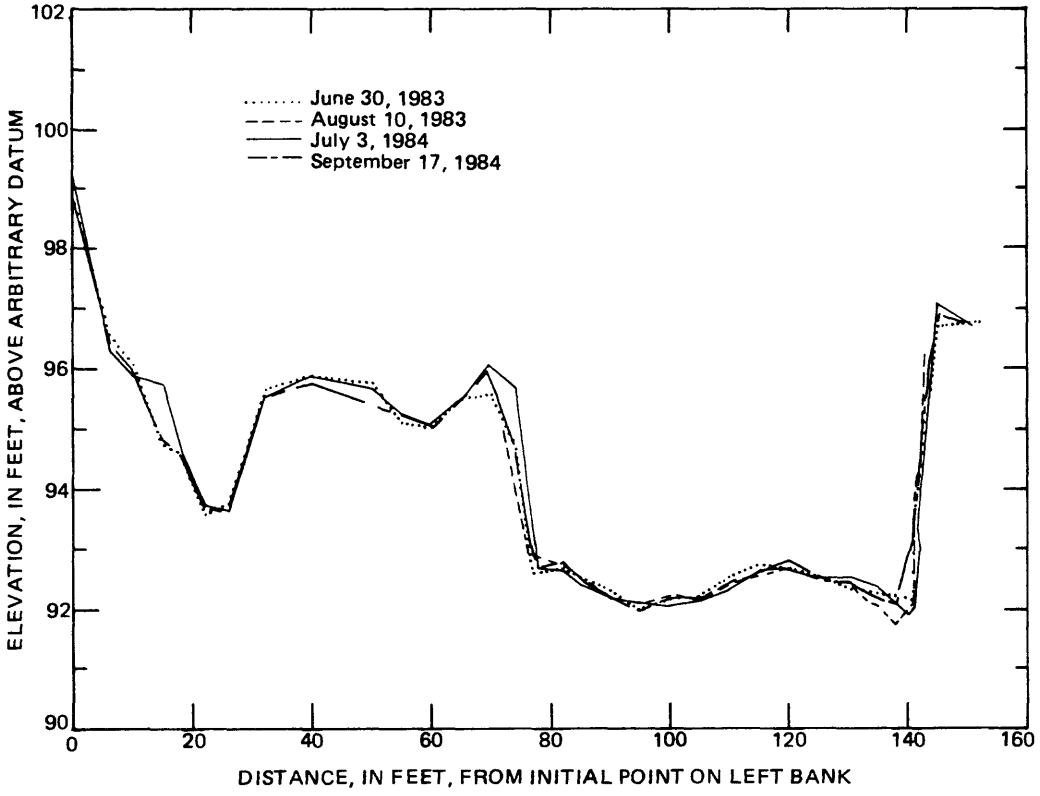


Figure 1D.--Cross section 2 at study reach 1: Caribou Creek near Kantishna.

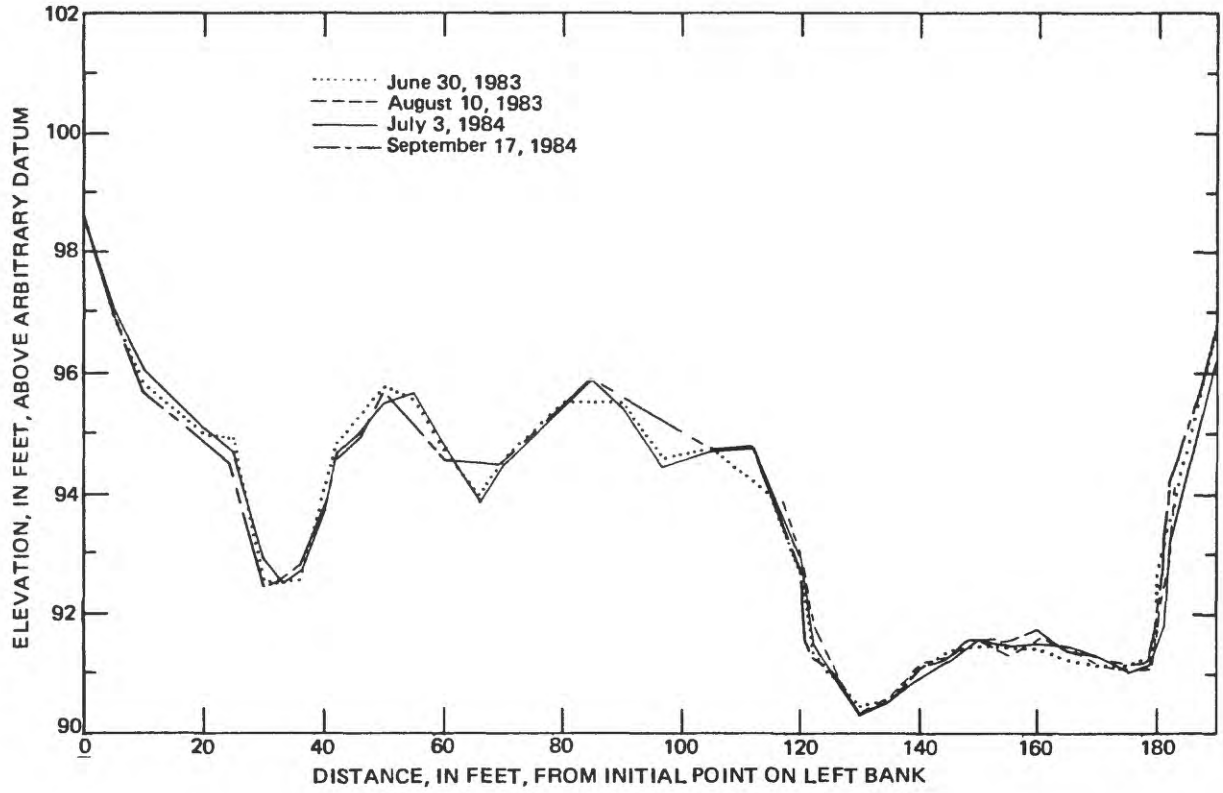


Figure 1E.--Cross section 3 at study reach 1: Caribou Creek near Kantishna.

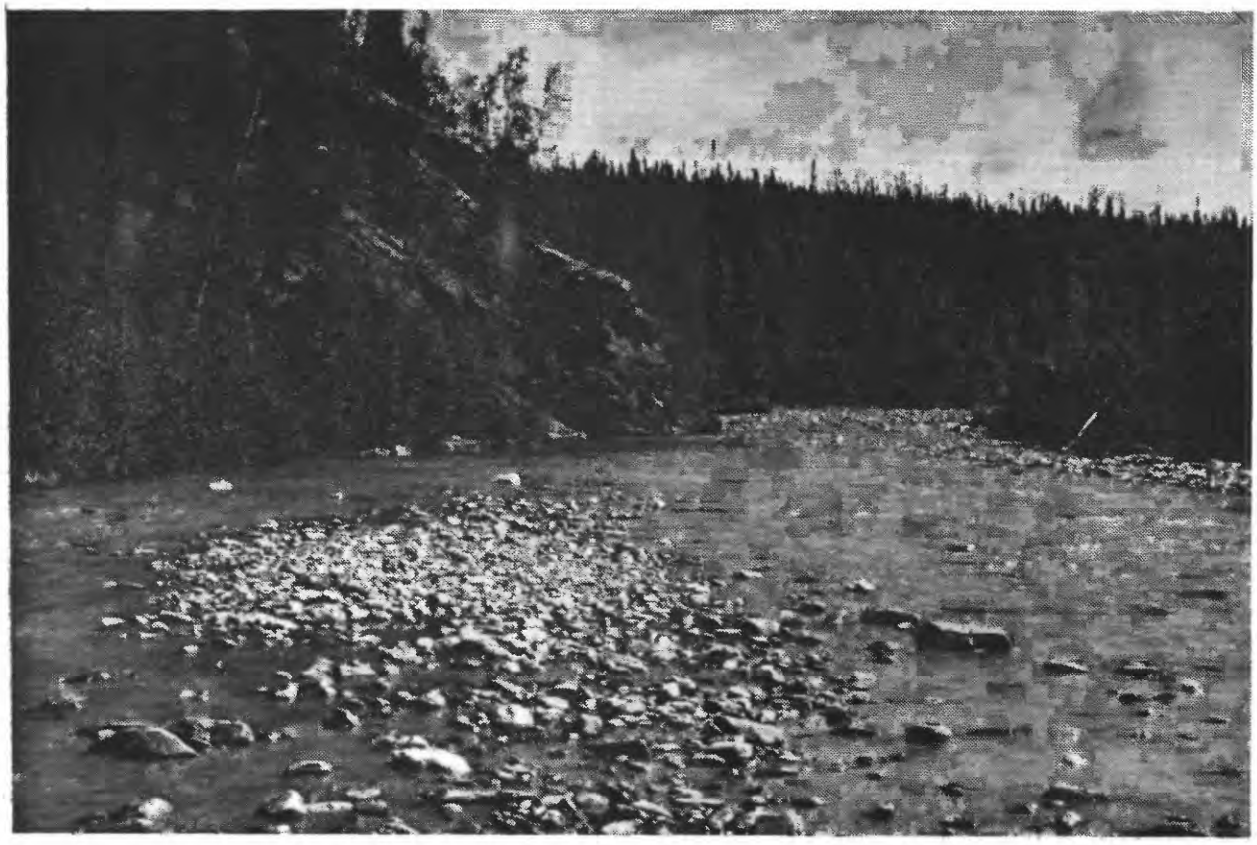


Figure 1F.--View upstream from cross section 3, June 30, 1983.

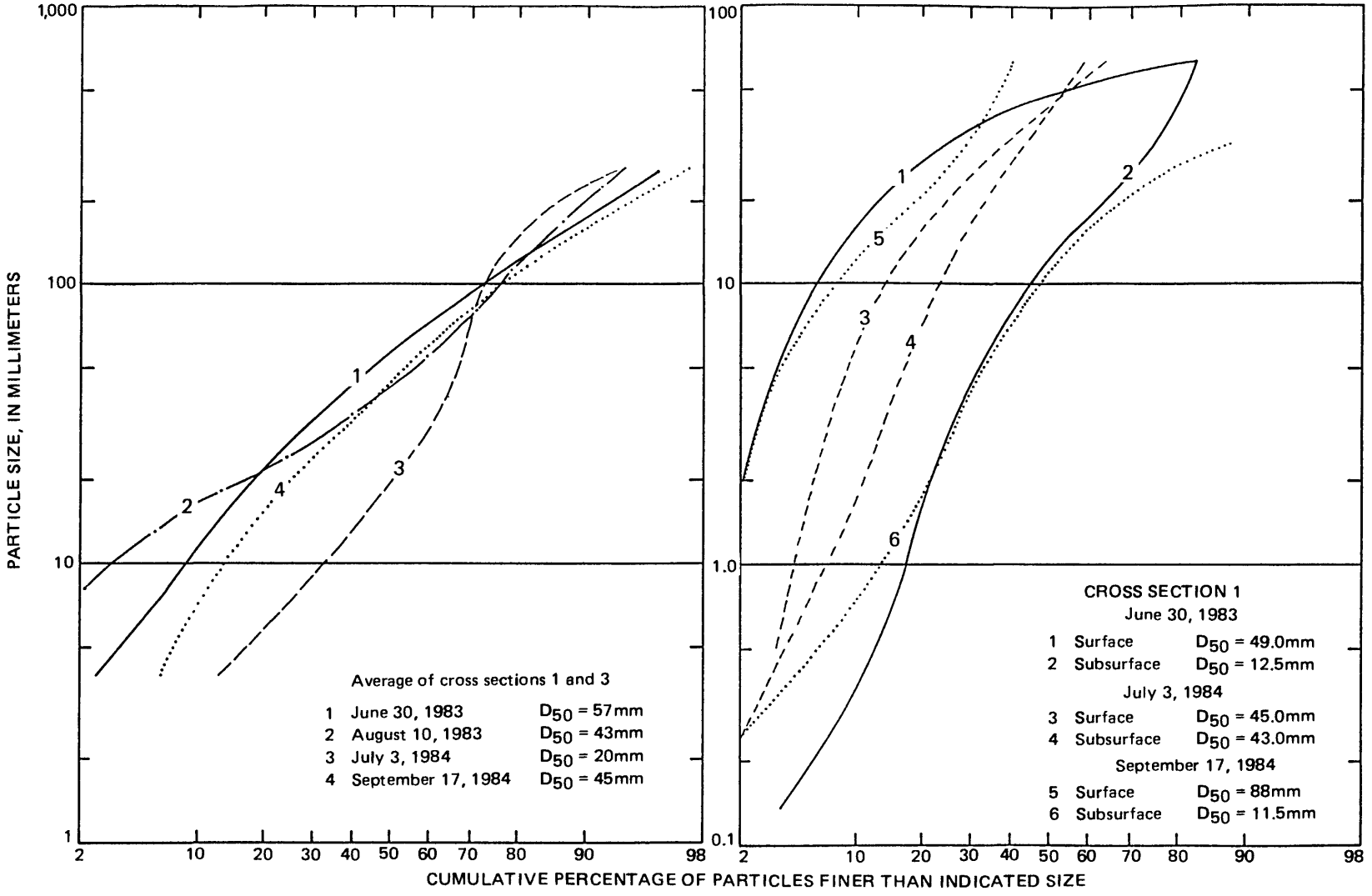


Figure 1G.--Particle-size distribution (particle-count method) of bed material at study reach 1: Caribou Creek near Kantishna.

Figure 1H.--Particle-size distribution (sieve analysis) of bed material at study reach 1: Caribou Creek near Kantishna.

STUDY REACH 2: GLACIER CREEK NEAR AIRSTRIP NEAR KANTISHNA

LOCATION.--- Lat 63°37'03", Long 150°56'42", in SW¼NE¼, Sec.13, T.15S., R.18W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 4.3 mi upstream from Flat Creek, 7.2 mi upstream from mouth, 7.7 mi south of Glacier, and 6.3 mi north of Kantishna.

The established reach is approximately 340 ft long. On the two dates of channel surveys at this reach, July 22 and September 16, 1984, flow was in two channels separated by a well-established bar. The streambed was being actively mined during the study period. The second survey showed a minor amount of scour in the left bank channel at cross section 1 and a small amount of fill in the left channel at cross sections 2 and 3. The right bank channel showed very little change in the 2 months between the surveys, and the reach as a whole experienced no significant change in channel configuration.

The two sets of particle-count data indicated only minor changes in the size distribution within each channel, although the right channel contained coarser material than the left channel. There was considerable variation in the size distribution of bed material samples from both channels, indicating the movement of fine (<256 mm) material through the reach.

Table 2A.--Summary of data collected: Reach 2

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
7/22-23/84	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	None
		---	---	3	Yes	Yes	Surf-subsurf
9/18/84	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	None
		92.56	---	3	Yes	Yes	Surf-subsurf

Table 2B.--Particle count data: Reach 2
[ch, channel]

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 1	2	4	8	16	32	64	128	256
July 23, 1984	1 Left ch.	80	80	80	83	90	96	98	100	--
	1 Right ch.	29	29	29	32	32	48	77	87	100
	1 Average	66	66	66	70	75	84	92	96	100
	3 Left ch.	75	75	75	84	94	100	--	--	--
	3 Right ch.	22	22	22	26	30	50	74	93	100
	3 Average	52	52	52	58	66	78	88	97	100
Sept. 16, 1984	1 Left ch.	57	57	60	67	85	98	98	99	100
	1 Right ch.	32	36	36	39	48	55	58	71	100
	1 Average	51	52	53	60	76	87	88	92	100
	3 Left ch.	66	66	72	83	98	100	--	--	--
	3 Right ch.	24	24	24	26	30	41	59	74	100
	3 Average	47	47	50	57	67	73	81	88	100

Table 2C.--Bed material sample analysis data: Reach 2

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
July 23, 1984	1	90	Surface	--	--	1	3	7	9	12	19	35	78	100	--
	1	90	Subsurf	--	1	4	13	29	36	44	54	64	88	100	--
	1	363	Surface	--	1	2	5	10	14	19	27	44	60	100	--
	1	363	Subsurf	--	1	3	7	18	26	34	46	60	74	90	100
	3	12	Surface	13	48	89	100	--	--	--	--	--	--	--	--
	3	12	Subsurf	10	44	92	100	--	--	--	--	--	--	--	--
	3	235	Surface	--	--	--	1	2	3	4	7	15	33	81	100
	3	235	Subsurf	--	--	1	2	6	8	11	16	23	33	47	100
Sept. 16, 1984	1	90	Surface	--	1	3	11	24	30	40	55	76	94	100	--
	1	90	Subsurf	--	1	2	6	14	17	26	41	72	100	--	--
	1	365	Surface	--	--	--	--	--	1	1	3	5	8	59	100
	1	365	Subsurf	--	--	--	1	3	5	8	14	19	28	55	100
	3	15	Surface	8	35	84	99	100	--	--	--	--	--	--	--
	3	24	Surface	3	8	16	23	32	46	62	85	100	--	--	--
	3	24	Subsurf	8	23	44	58	67	76	86	95	99	100	--	--
	3	235	Surface		1	2	4	7	9	12	15	21	40	100	--
	3	235	Subsurf	1	1	3	6	13	16	22	30	38	56	100	--

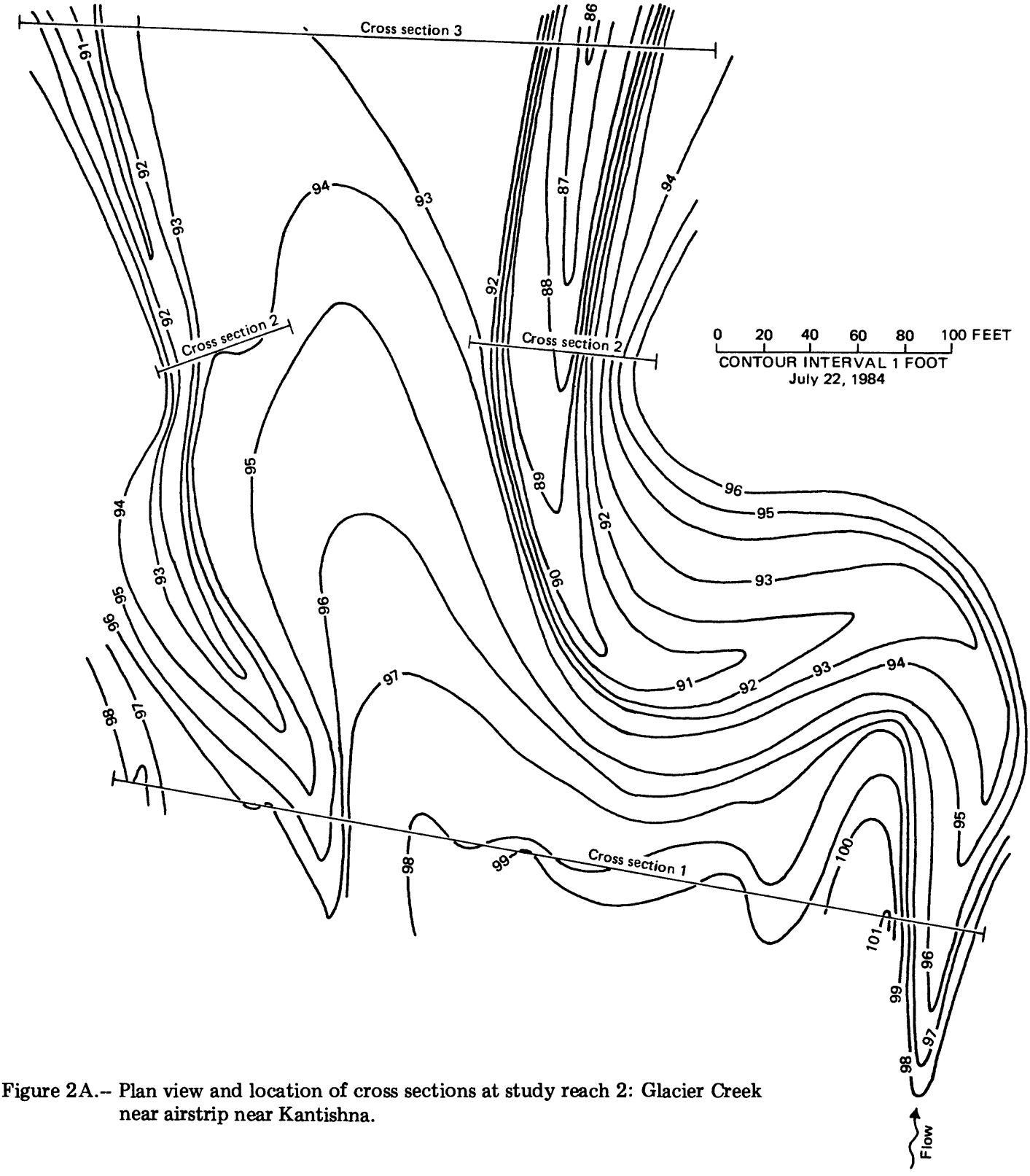


Figure 2A.-- Plan view and location of cross sections at study reach 2: Glacier Creek near airstrip near Kantishna.

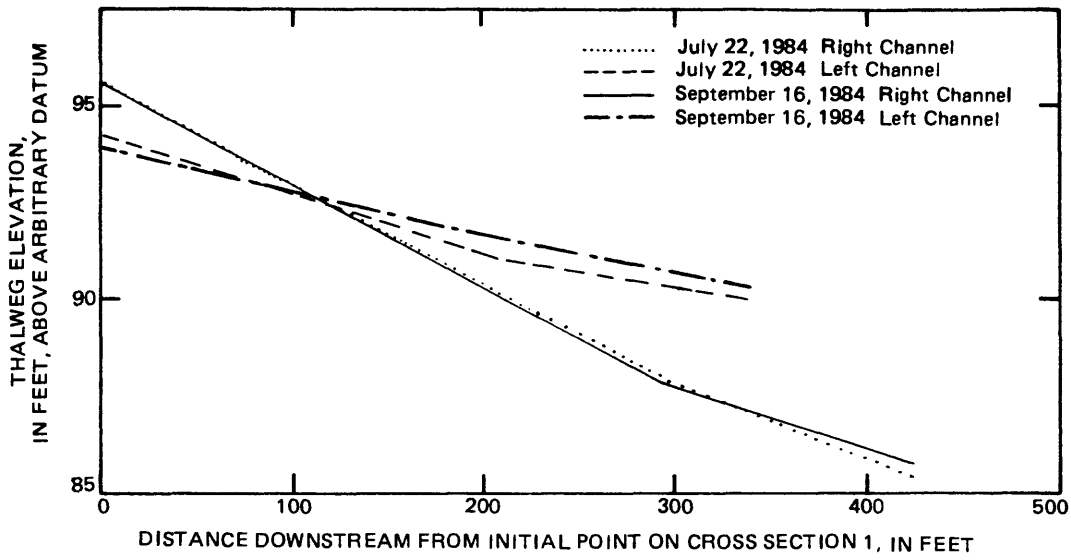


Figure 2B.--Thalweg profile at study reach 2: Glacier Creek near airstrip near Kantishna.

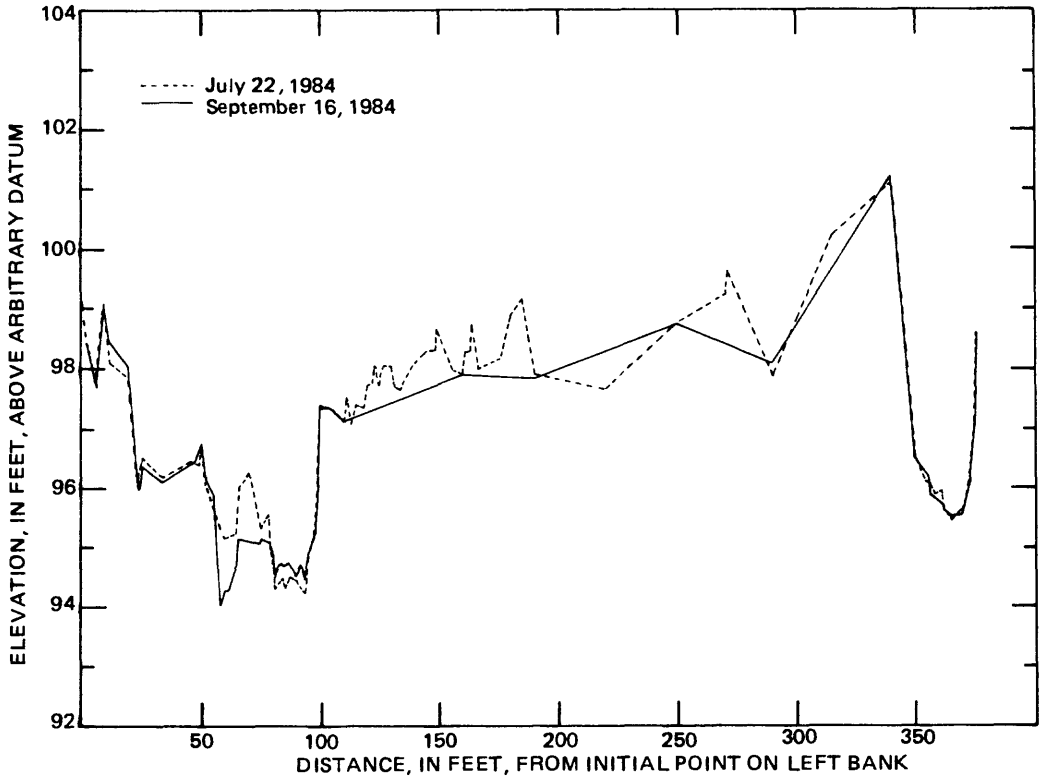


Figure 2C.--Cross section 1 at study reach 2: Glacier Creek near airstrip near Kantishna.

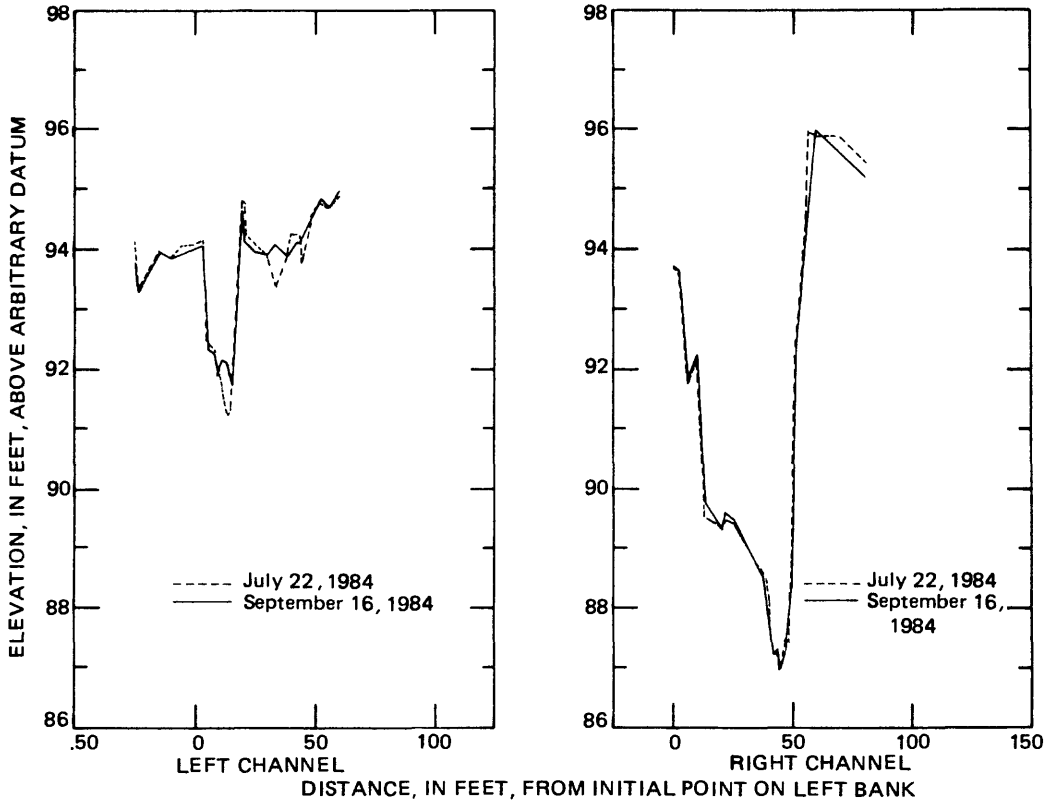


Figure 2D.--Cross section 2 at study reach 2: Glacier Creek near airstrip near Kantishna.

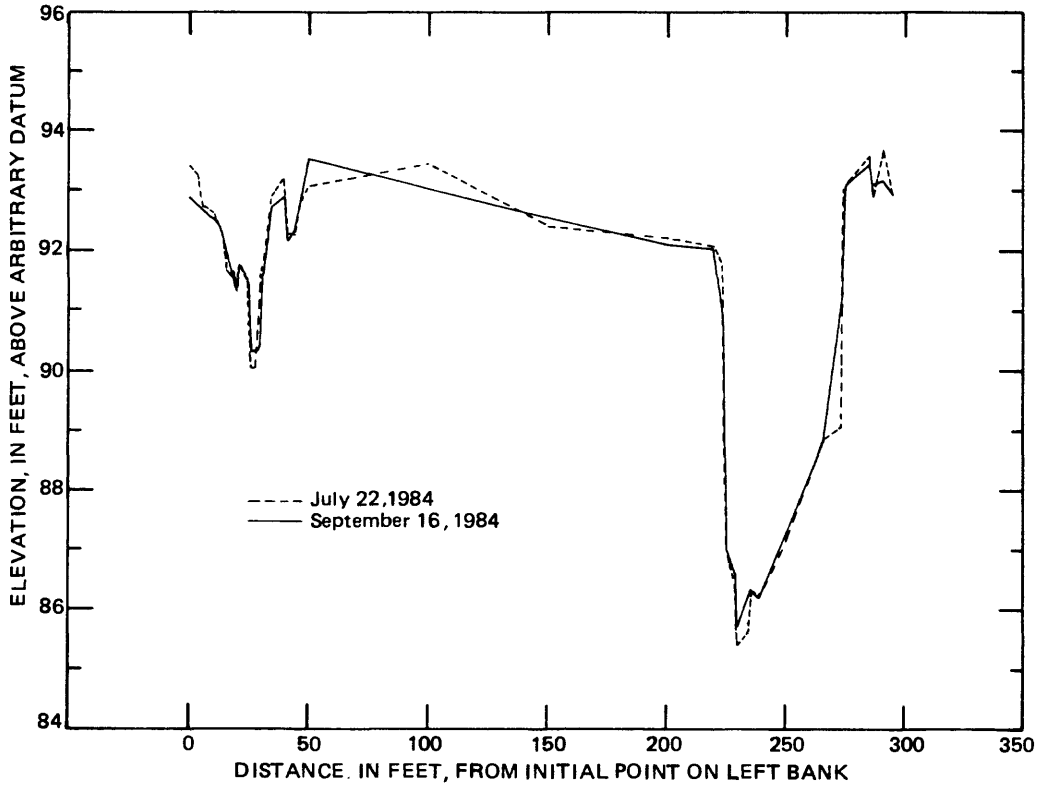


Figure 2E.--Cross section 3 at study reach 2: Glacier Creek near airstrip near Kantishna.

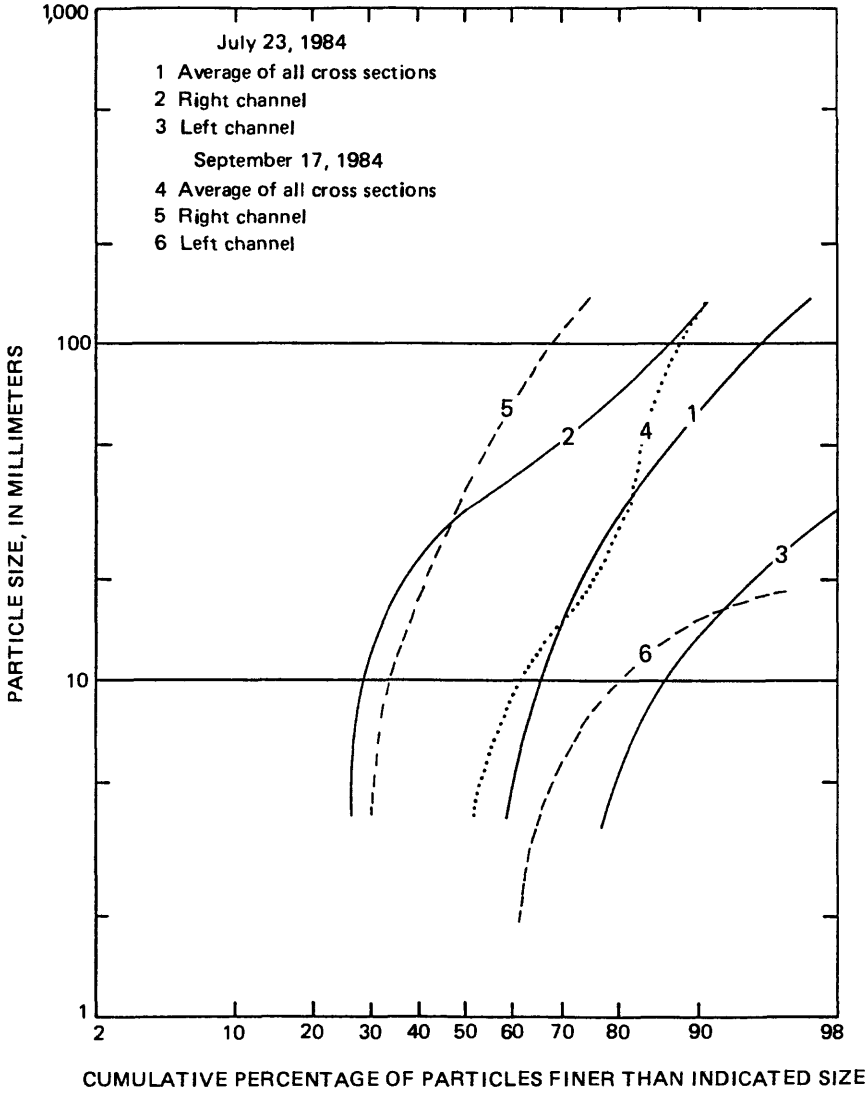


Figure 2F.--Particle-size distribution (particle-count method) of bed material at study reach 2: Glacier Creek near airstrip near Kantishna.

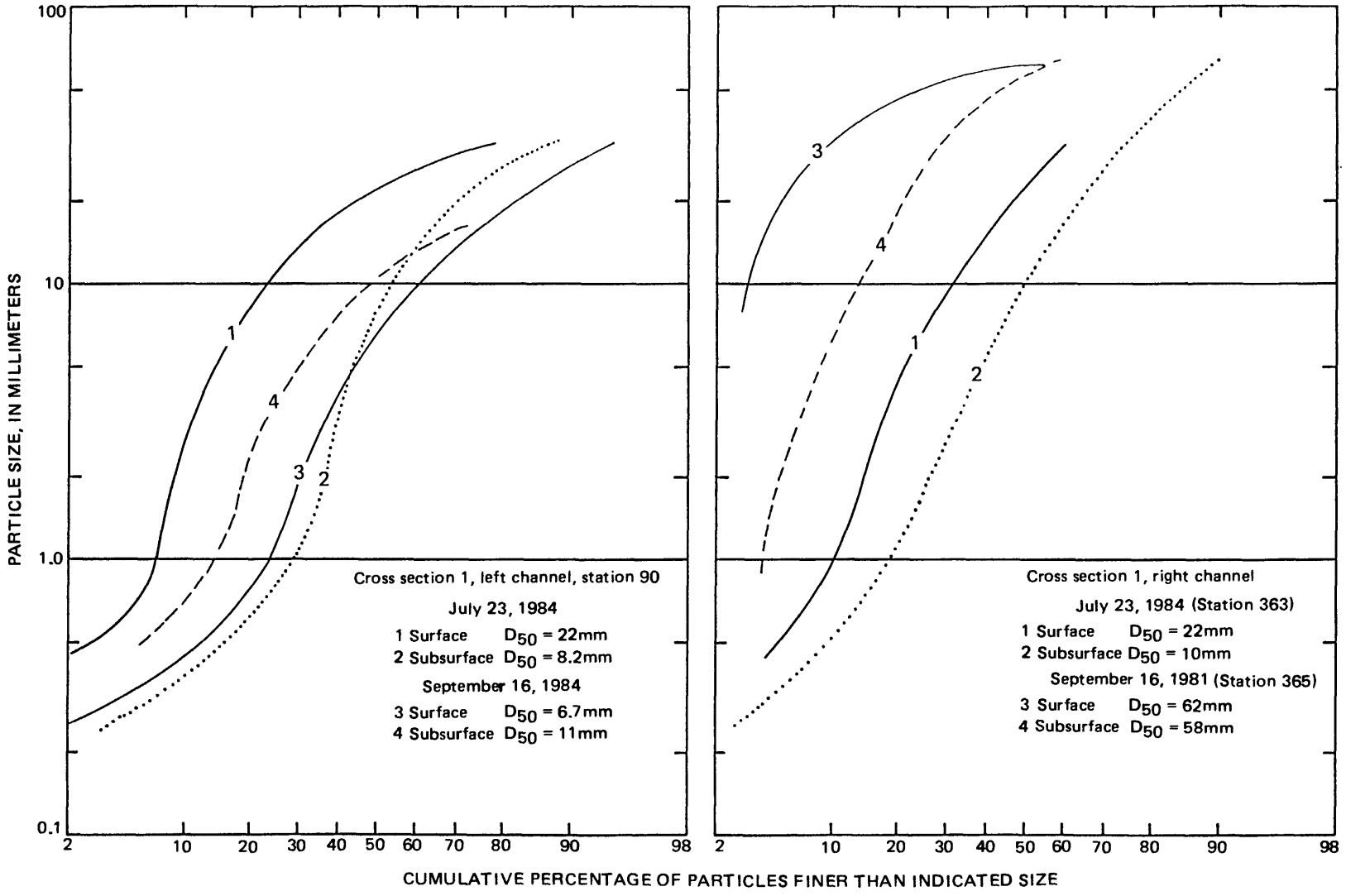


Figure 2G.-- Particle-size distribution (sieve analysis) of bed material at study reach 2: Glacier Creek near airstrip near Kantishna.

Figure 2H.--Particle-size distribution (sieve analysis) of bed material at study reach 2: Glacier Creek near airstrip near Kantishna.

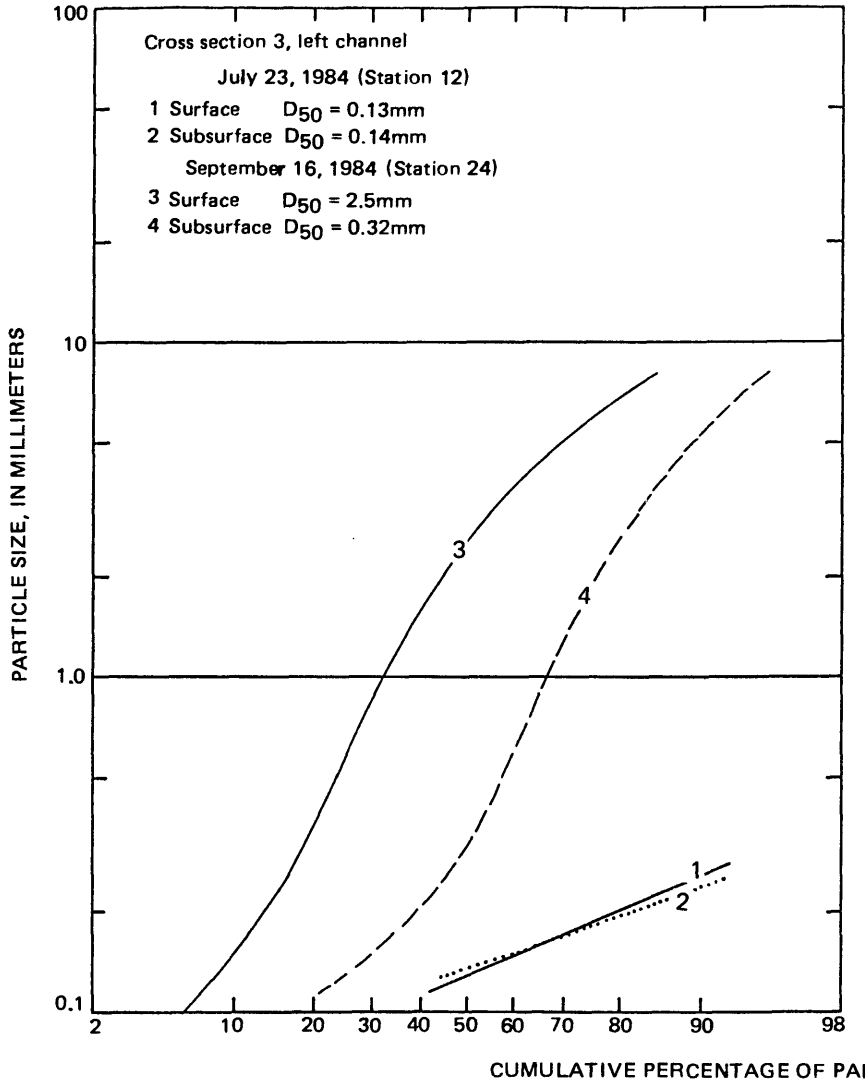


Figure 2I.- Particle-size distribution (sieve analysis) of bed material at study reach 2: Glacier Creek near airstrip near Kantishna.

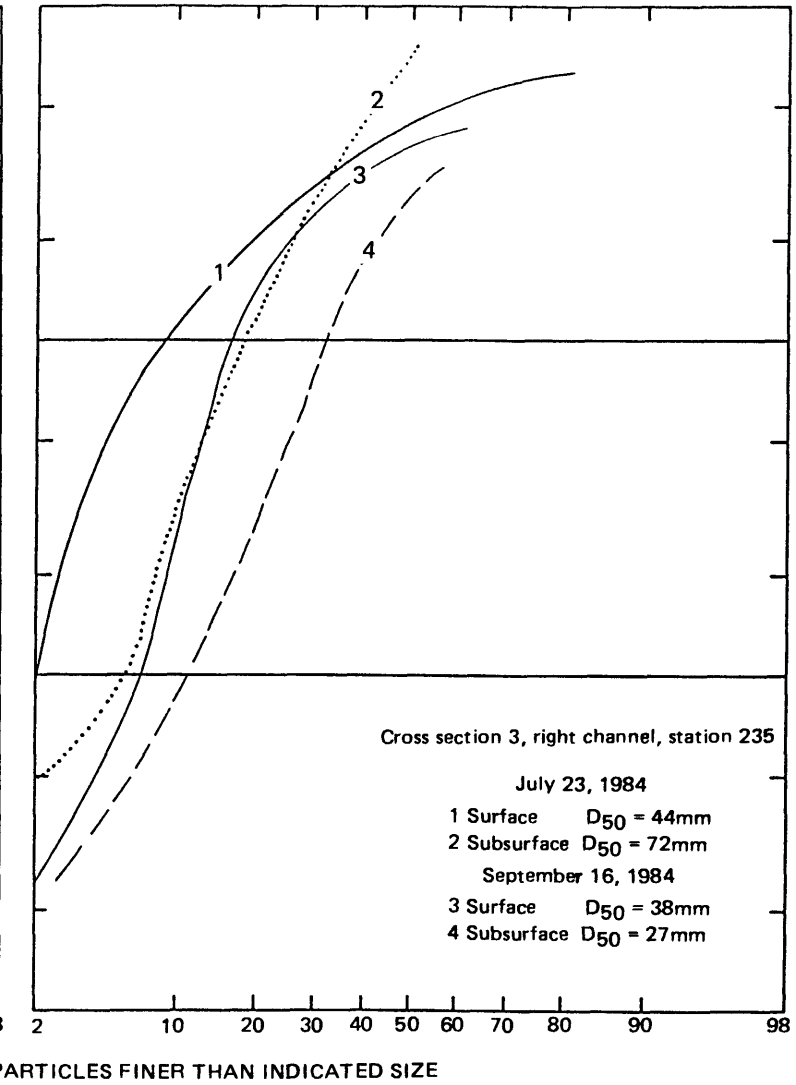


Figure 2J.-- Particle-size distribution (sieve analysis) of bed material at study reach 2: Glacier Creek near airstrip near Kantishna.

STUDY REACH 3: GLACIER CREEK POND NEAR KANTISHNA

LOCATION.--- Lat 63°37'13", Long 150°57'01", in NW¼NE¼, Sec.13, T.15S., R.18W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 4.0 mi upstream from Flat Creek, 7.0 mi upstream from mouth, 7.5 mi south of Glacier, and 6.5 mi north of Kantishna.

Reach 3 is a settling pond located between study reaches 2 and 4. Only one survey of the pond area was made. Analysis of bed material samples indicated the presence of fine material in the streambed upstream of the pond coffer dam, and that bed material became progressively coarser with distance downstream from the pond.

Table 3A.--Summary of data collected: Reach 3

Date	Location in reach (fig. 3A)	Bed material sample data	
		Surface	Subsurface
Sept. 18, 1984	BB	Yes	Yes
	K	Yes	No
	M	Yes	No
	T	Yes	No

Table 3B.--Bed material sample analysis data: Reach 3

Date of collection	Sampling point	Sampling station (in feet from reference mark)	Bed material (sieve analysis) Percent finer than size indicated, in millimeters											
			0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
Sept. 18, 1984	BB	Surface	1	2	3	4	5	5	6	7	9	26	100	--
	BB	Subsurf	1	2	4	6	12	13	17	23	33	51	76	100
	K	Surface	1	2	12	34	60	69	87	98	100	--	--	--
	M	Surface	21	45	84	99	100	--	--	--	--	--	--	--
	T	Surface	1	3	5	9	19	22	28	36	46	62	88	100

Surveyed Point	Elevation
RM 1	225.00
RM 2	218.43
A	220.67
B	218.91
C	219.50
D	219.32
E	219.46
F	218.69
G	220.31
H	218.01
I	219.72
J	220.10
K	219.57
L	219.36
M	218.52
N	218.40
O	218.36
P	218.95
Q	219.38
R	218.96
S	219.12
T	222.42
U	219.89
V	221.07
W	221.49
X	214.39
Y	214.38
Z	213.07
AA	214.03
BB	213.84
CC	212.49

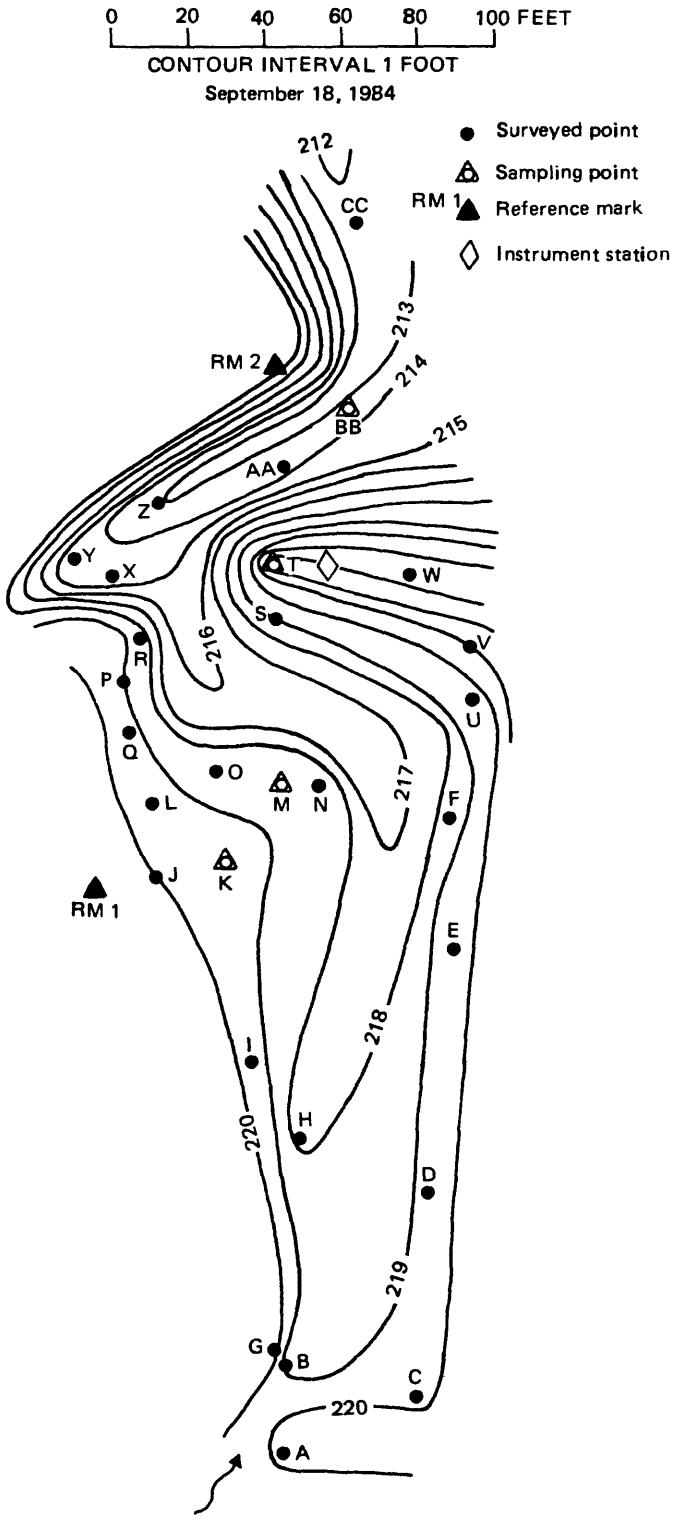


Figure 3A.--Plan view of study reach 3: Glacier Creek Pond near Kantishna.

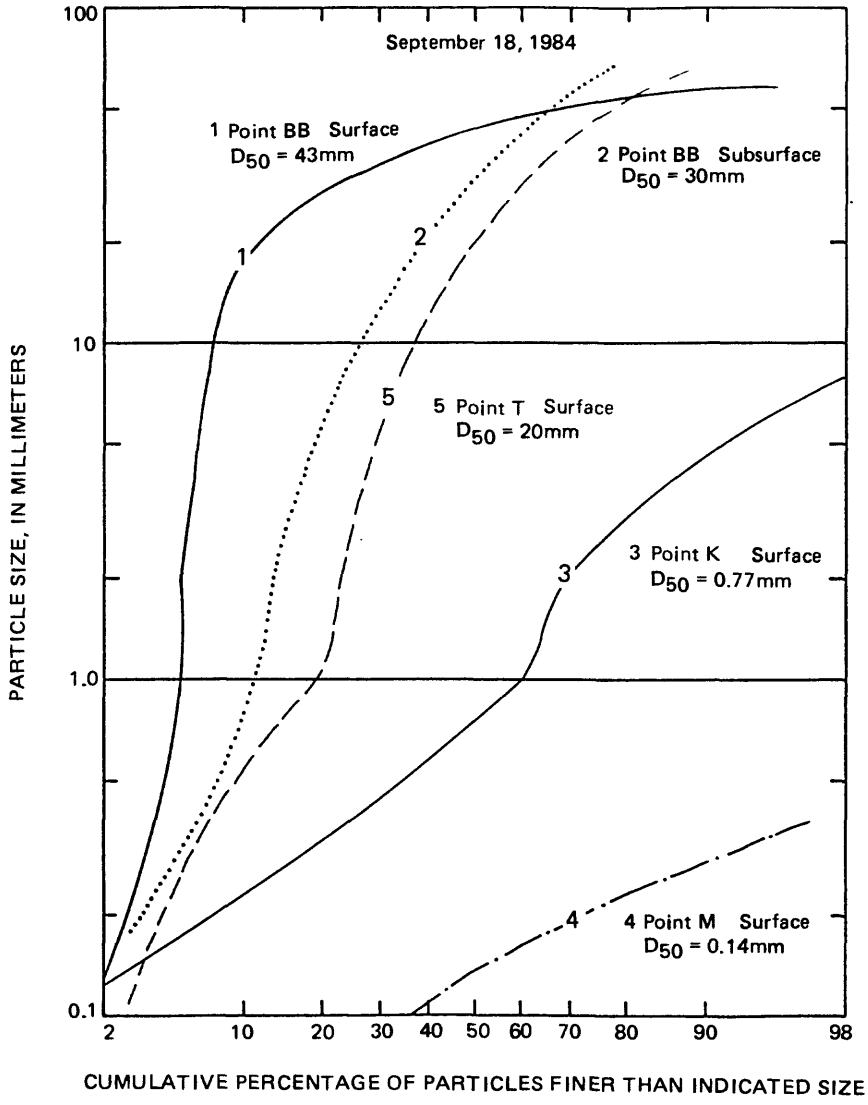


Figure 3B.--Particle-size distribution (sieve analysis) of bed material: Glacier Creek Pond near Kantishna.

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STUDY REACH 4: GLACIER CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°38'14", Long 150°58'31", in SW¼SE¼ Sec.2, T.15S., R.18W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 2.6 mi upstream from Flat Creek, 6.0 mi upstream from mouth, 6.4 mi south of Glacier, and 7.8 mi north of Kantishna.

Four cross sections were established in reach 4, which has a total length of approximately 250 ft. The channel bends to the right (moving downstream) throughout the reach and pool-riffle sequences are repeated along the entire reach. Channel width averages about 50 ft between vegetated banks. The left bank is steep and slumping, while the right bank slopes gently to thick brush and small trees bordering the active channel. Cross-section surveys showed no changes in channel configuration, but indicated a slight aggradation of the lower end of the reach over the study period.

Particle-count data showed that the streambed particle size became progressively coarser during the period of data collection.

Table 4A.--Summary of data collected: Reach 4

Date	Meas. disch. (ft^3/s)	Peak data Stage (ft)	Peak data Disch. (ft^3/s)	Cross section No.	Cross section Survey	Particle-size data Particle count	Particle-size data Bed material samples
7/27/83	18.0	---	---	1	Yes	Yes	None
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	None
7/2/84	6.79	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf
9/15-9/16/84	22.0	145.55	---	1	Yes	Yes	Surf-subsurf
		143.87	---	2	Yes	Yes	None
		142.60	---	3	Yes	Yes	Surf-subsurf
		141.87	380	4	Yes	Yes	Surf-subsurf

Table 4B.--Particle count data: Reach 4

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512
July 27, 1983	1	38	42	47	62	86	97	100	--
	2	33	40	49	66	83	96	99	100
	3	12	18	29	54	75	91	98	100
	4	30	34	41	62	87	96	100	--
July 2, 1984	1	24	28	36	52	79	95	100	--
	2	19	25	34	44	66	86	98	100
	3	17	20	29	43	67	92	100	--
	4	30	32	45	70	92	98	100	--
Sept. 15, 1984	1	19	22	37	50	73	95	98	100
	2	19	19	25	43	68	91	99	100
	3	11	16	27	41	74	92	99	100
	4	22	32	41	62	86	97	99	100

Table 4C.--Bed material sample analysis data: Reach 4

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
July 2, 1984	1	45	Surface	--	--	--	--	--	1	1	3	11	49	100	--
	1	45	Subsurf	--	--	1	3	10	14	20	33	46	70	100	--
	4	20	Surface	--	--	1	3	6	7	8	10	14	25	63	100
	4	20	Subsurf	--	1	3	8	14	17	22	30	46	66	88	100
Sept. 15, 1984	1	45	Surface	--	--	--	--	--	--	--	--	2	6	38	100
	1	45	Subsurf	--	1	2	3	13	17	24	35	51	72	78	100
	3	60	Surface	15	31	40	42	44	44	45	47	52	80	100	--
	3	60	Subsurf	8	16	19	25	30	33	35	38	46	65	87	100
	4	20	Surface	--	--	--	--	--	--	--	--	1	5	43	100
	4	20	Subsurf	--	1	2	4	7	11	15	22	33	56	65	100

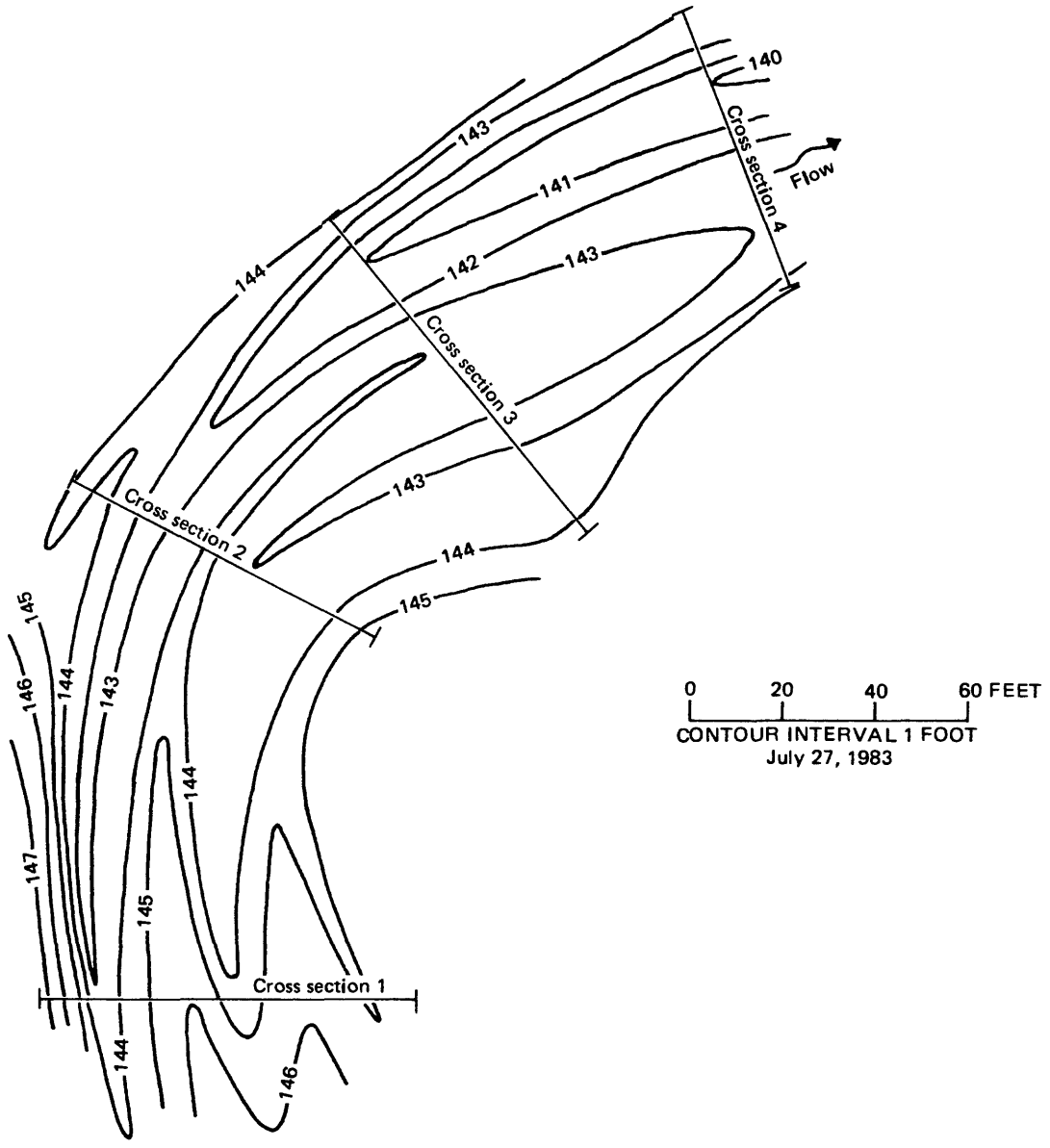


Figure 4A.--Plan view and location of cross sections at study reach 4: Glacier Creek near Kantishna.

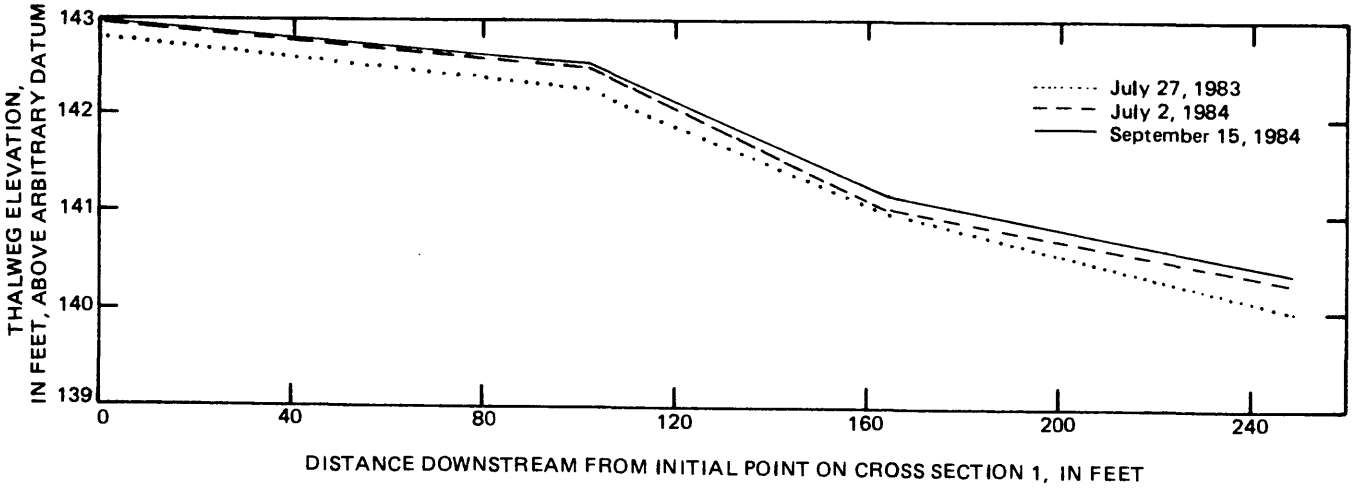


Figure 4B.--Thalweg profile at study reach 4: Glacier Creek near Kantishna.

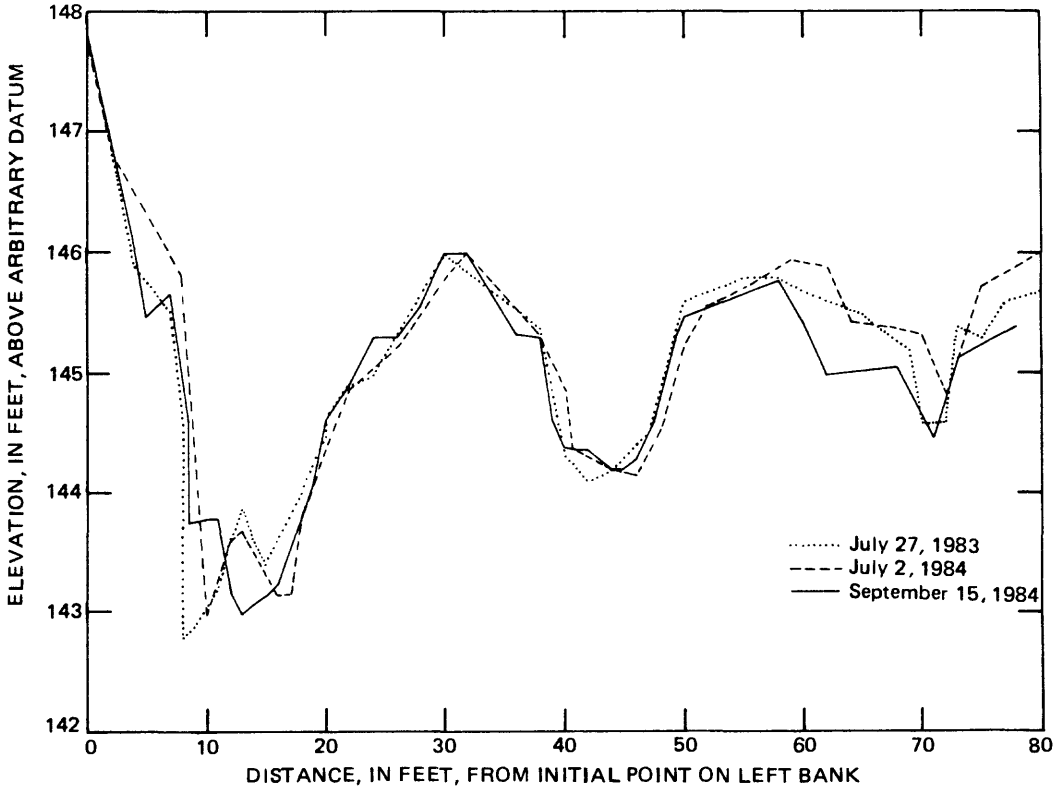


Figure 4C.--Cross section 1 at study reach 4: Glacier Creek near Kantishna.

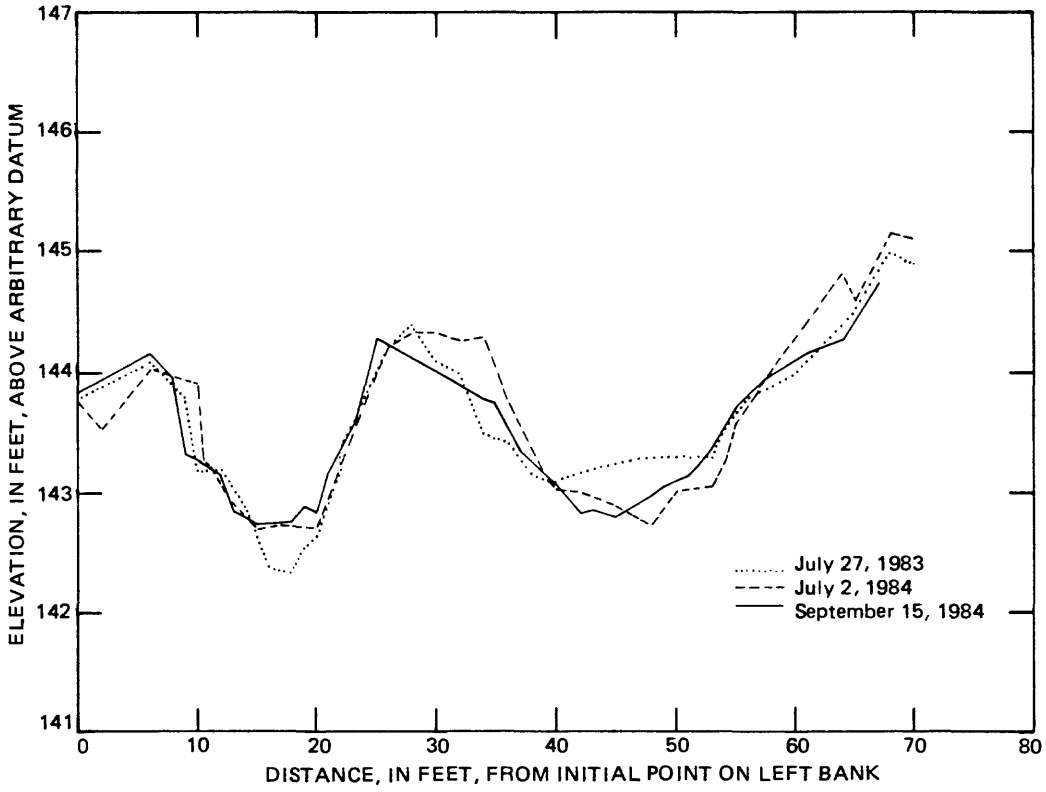


Figure 4D.--Cross section 2 at study reach 4: Glacier Creek near Kantishna.

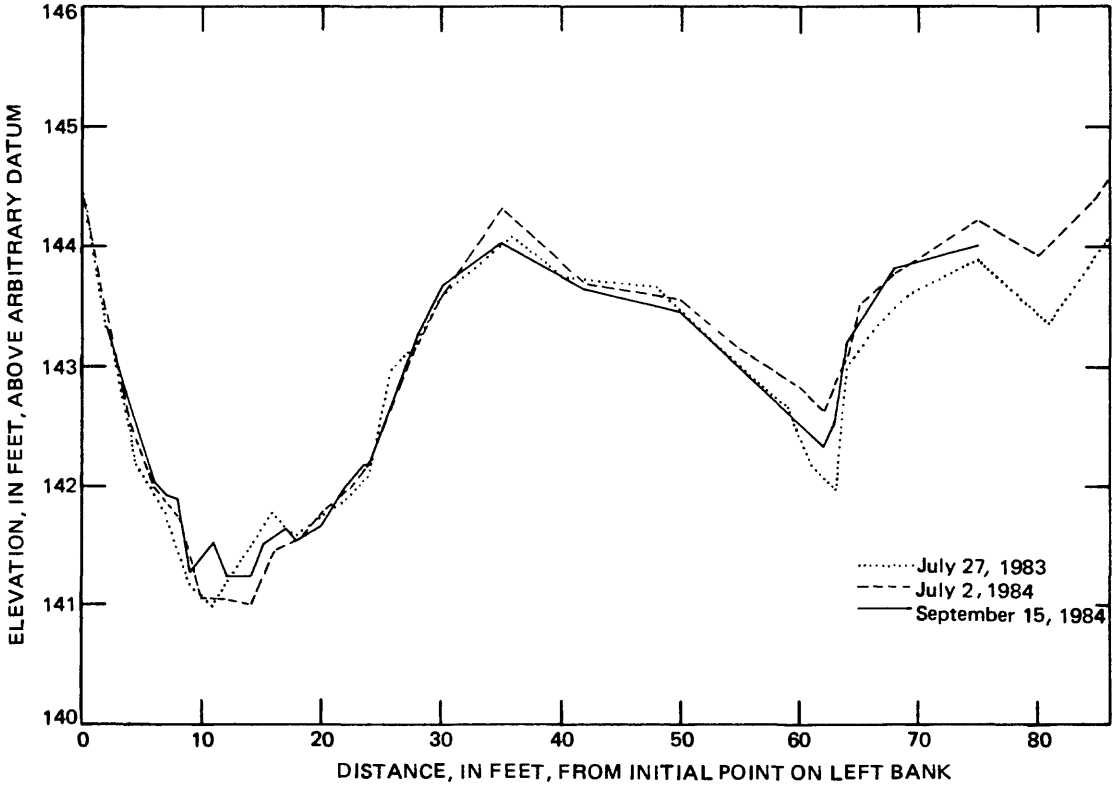


Figure 4E.--Cross section 3 at study reach 4: Glacier Creek near Kantishna.

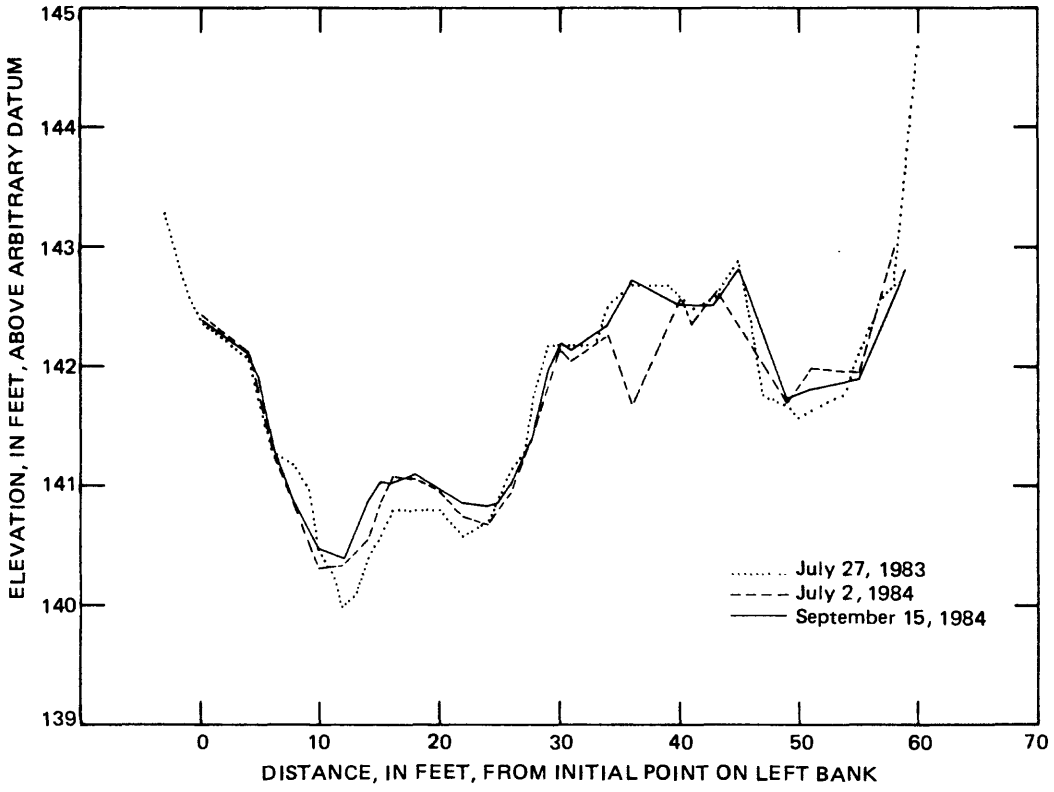


Figure 4F.--Cross section 4 at study reach 4: Glacier Creek near Kantishna.

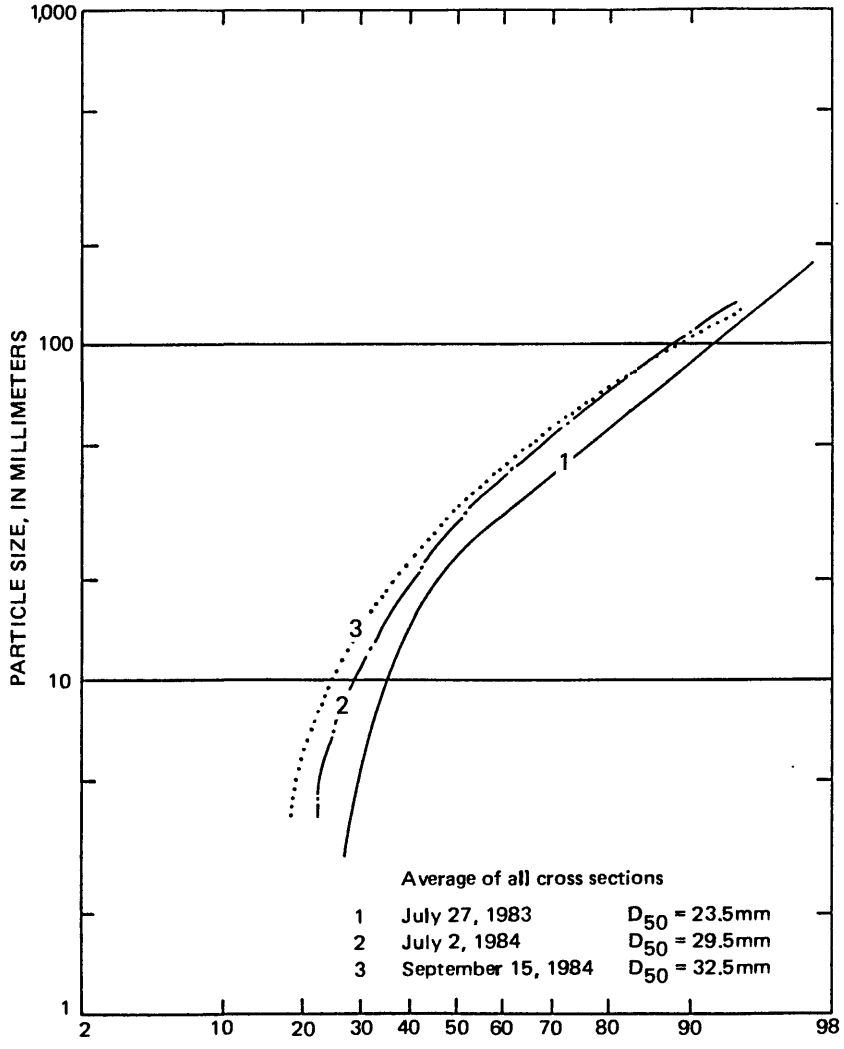
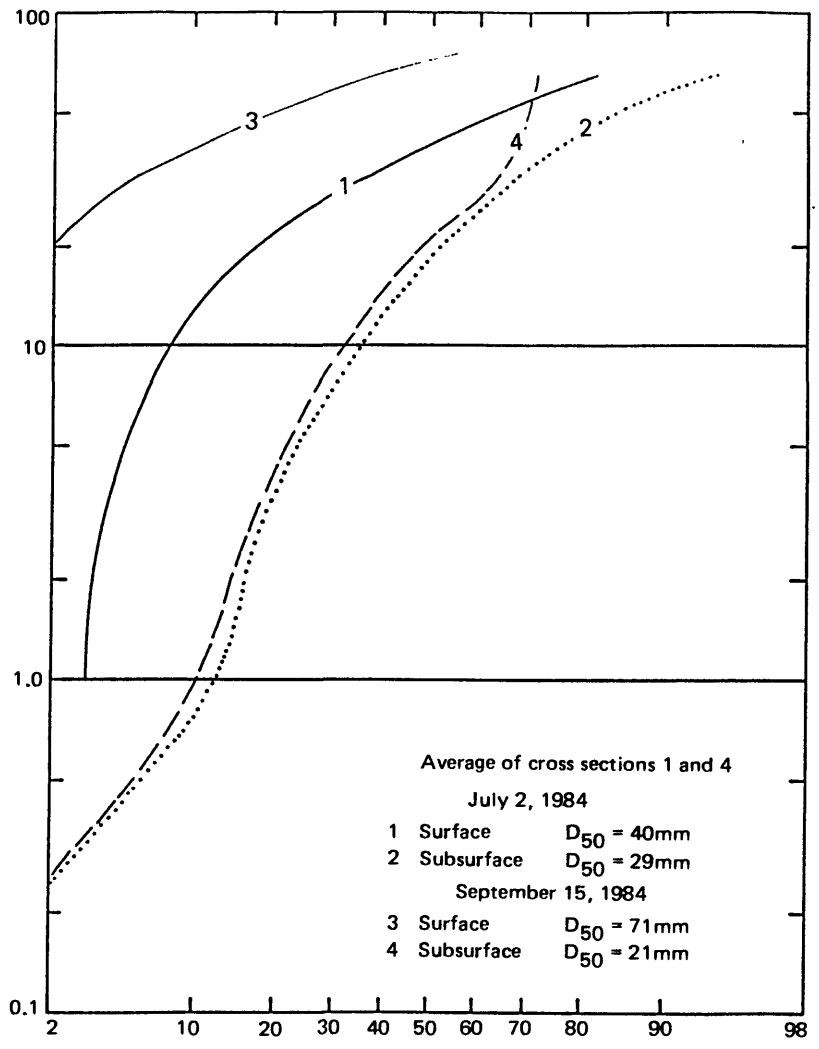


Figure 4G.--Particle-size distribution (particle-count method) of bed material at study reach 4: Glacier Creek near Kantishna.



CUMULATIVE PERCENTAGE OF PARTICLES FINER THAN INDICATED SIZE

Figure 4H.--Particle-size distribution (sieve analysis) of bed material at study reach 4: Glacier Creek near Kantishna.

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STUDY REACH 5: BEARPAW RIVER NEAR KANTISHNA

LOCATION.--- Lat 63°43'44", Long 150°57'58", in NW¼SW¼ Sec.1, T.14S., R.18W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.4 mi downstream from Glacier Creek, and 14.1 mi north of Kantishna.

Reach 5 includes three cross sections at 160-foot intervals for a total reach length of 320 ft. The left bank is nearly vertical, and the right bank gently sloping. Both banks are covered by trees and dense, small shrubs. Channel width averages 250 ft between the vegetated banks. Cross-section surveys defined no changes in channel configuration, although minor changes in thalweg elevation were noted in all cross sections.

Particle-count data indicated a trend of decreasing mean particle size over the study period. Sieve analysis of bed material samples showed a large variation in particle size between different locations within the reach, with the right bank containing generally finer material than the left bank. For a given location (station on a cross section), however, most analyses indicated a very minor increase in particle size between the two sampling dates.

Table 5A.-- Summary of data collected: Reach 5

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
7/28/83	---	---	---	1	Yes	Yes	None
		185.4	6,400	2	Yes	No	None
		---	---	3	Yes	Yes	None
6/30/84	312	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	Surf-subsurf
8/11/84	494	---	---	1	Yes	Yes	Surf-subsurf
		182.24	810	2	Yes	Yes	None
		---	---	3	Yes	Yes	Surf-subsurf

Table 5B.-- Particle count data: Reach 5

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024
July 28, 1983	1	9	15	24	44	71	88	97	98	100
	3	36	38	43	67	89	97	100	--	--
June 30, 1984	1	12	20	30	45	70	89	99	100	--
	2	36	44	50	60	78	90	98	100	--
	3	48	52	58	67	75	88	99	100	--
Aug. 11, 1984	1	28	37	54	69	85	96	99	100	--
	2	43	48	63	80	91	98	100	--	--
	3	56	56	61	68	83	95	100	--	--

Table 5C.--Bed material sample analysis data: Reach 5

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 30, 1984	1	70	Surface	--	--	--	--	1	1	1	1	4	17	45	100
	1	70	Subsurf	--	--	1	6	22	27	32	40	56	84	100	--
	1	100	Surface	--	--	1	1	2	4	4	4	5	7	17	100
	1	100	Subsurf	1	2	4	10	26	31	36	45	60	78	100	--
	3	75	Surface	--	--	--	--	--	--	--	--	2	18	37	100
	3	75	Subsurf			1	4	14	16	19	24	35	59	69	100
	3	190	Surface	2	7	23	42	52	52	53	53	56	77	100	--
	3	190	Subsurf	1	3	10	27	40	42	46	52	61	78	100	--
Aug. 11, 1984	1	70	Surface	--	--	--	--	--	--	--	--	1	3	6	100
	1	70	Subsurf	--	--	1	5	16	19	23	31	44	59	100	--
	1	100	Surface	--	--	--	--	--	--	--	--	1	12	39	100
	1	100	Subsurf	--	--	2	5	11	13	16	20	26	37	47	100
	3	75	Surface	--	--	--	--	--	--	--	--	--	2	23	100
	3	75	Subsurf	--	--	1	4	11	13	15	20	32	60	100	--
	3	190	Surface	12	37	50	52	54	54	54	54	64	64	100	--
	3	190	Subsurf	4	10	18	28	40	42	46	54	66	84	100	--

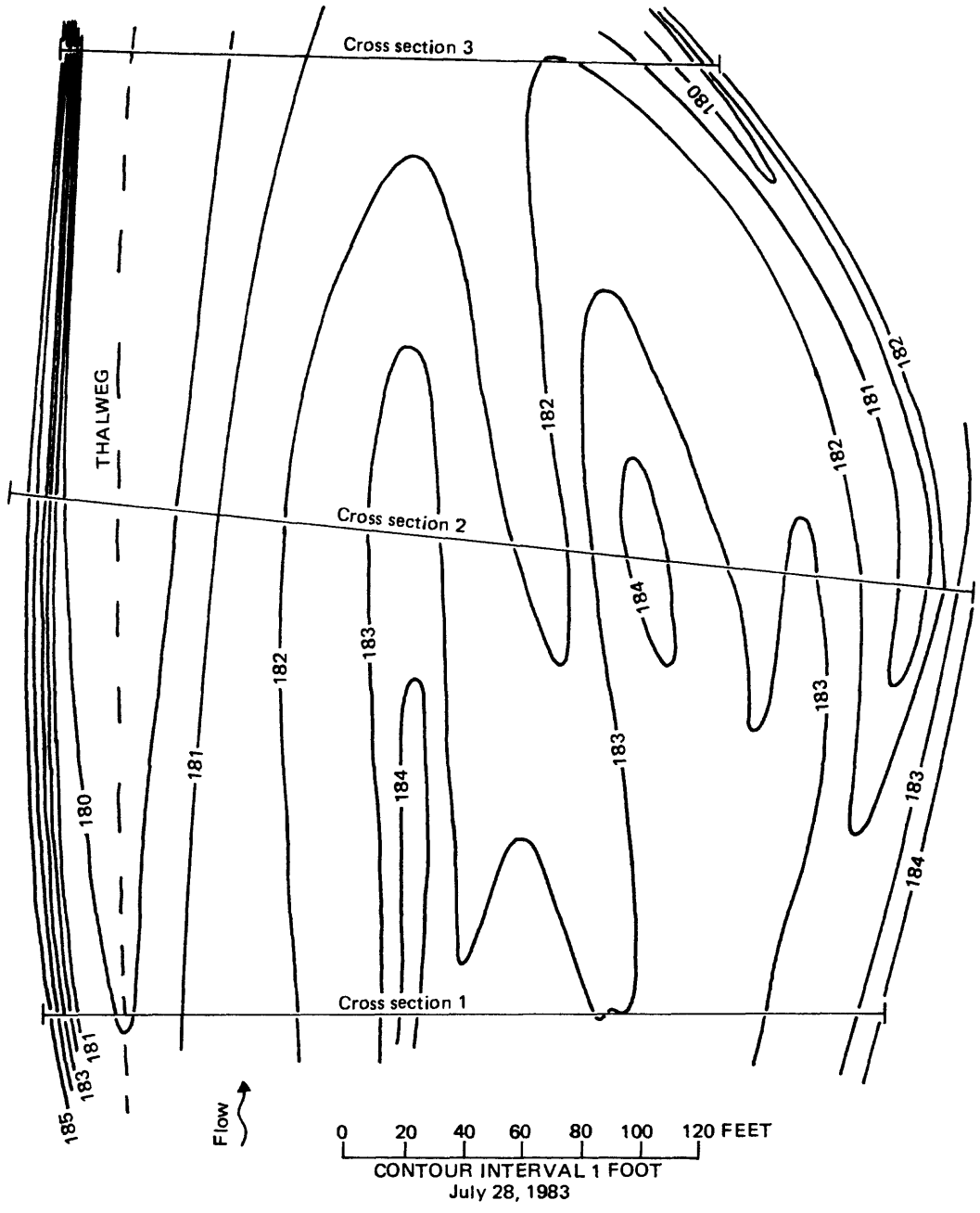

Figure 5A.--Plan view and location of cross sections at study reach 5: Bearpaw River near Kantishna.

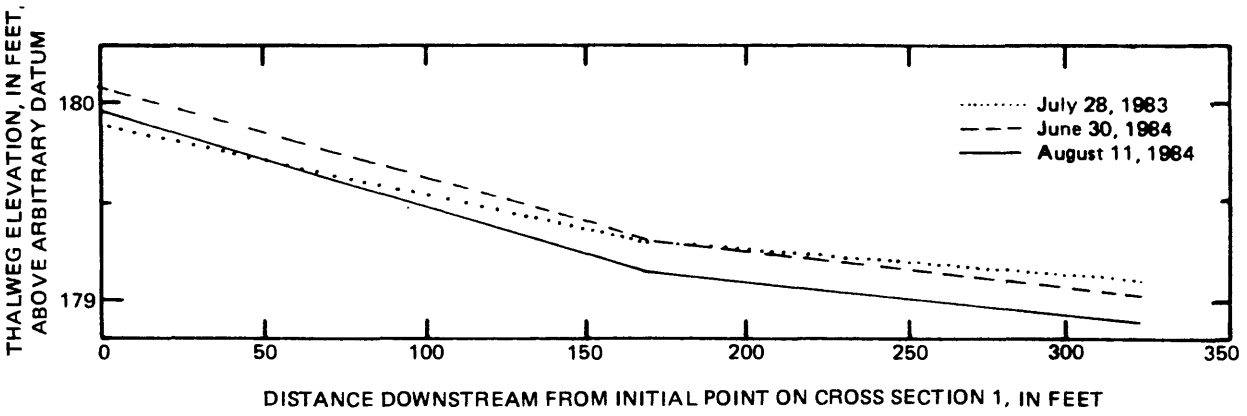

Figure 5B.--Thalweg profile at study reach 5: Bearpaw River near Kantishna.

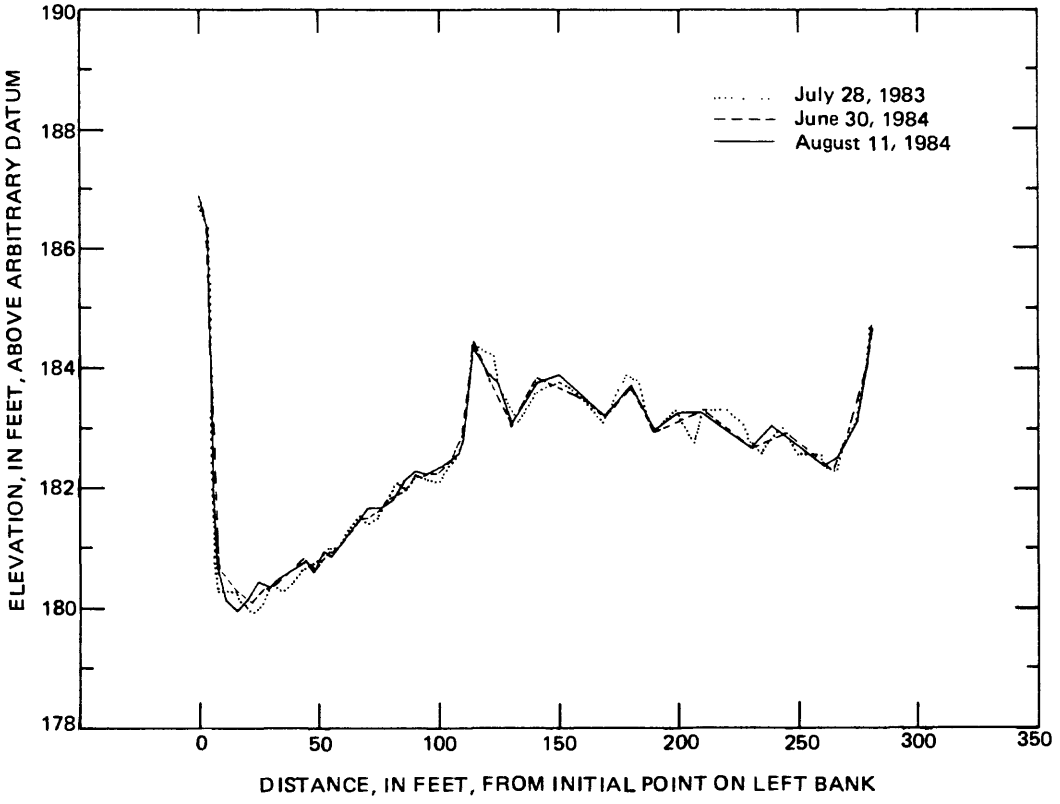

Figure 5C.--Cross section 1 at study reach 5: Bearpaw River near Kantishna.

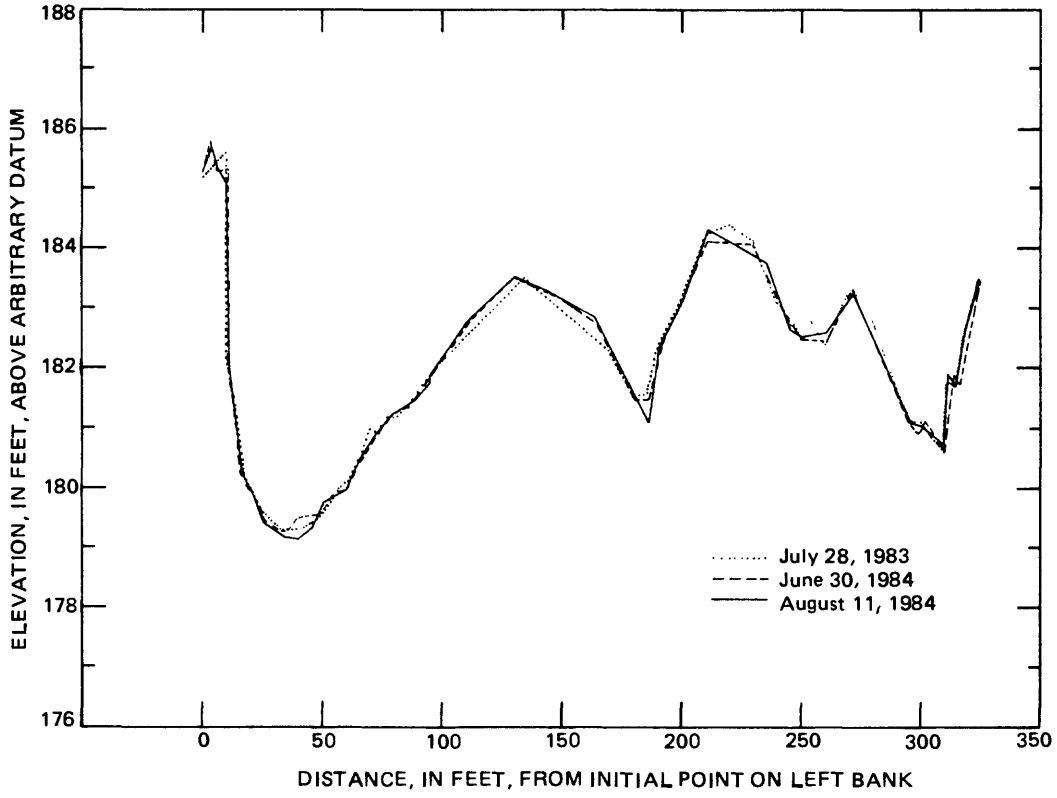

Figure 5D.--Cross section 2 at study reach 5: Bearpaw River near Kantishna.

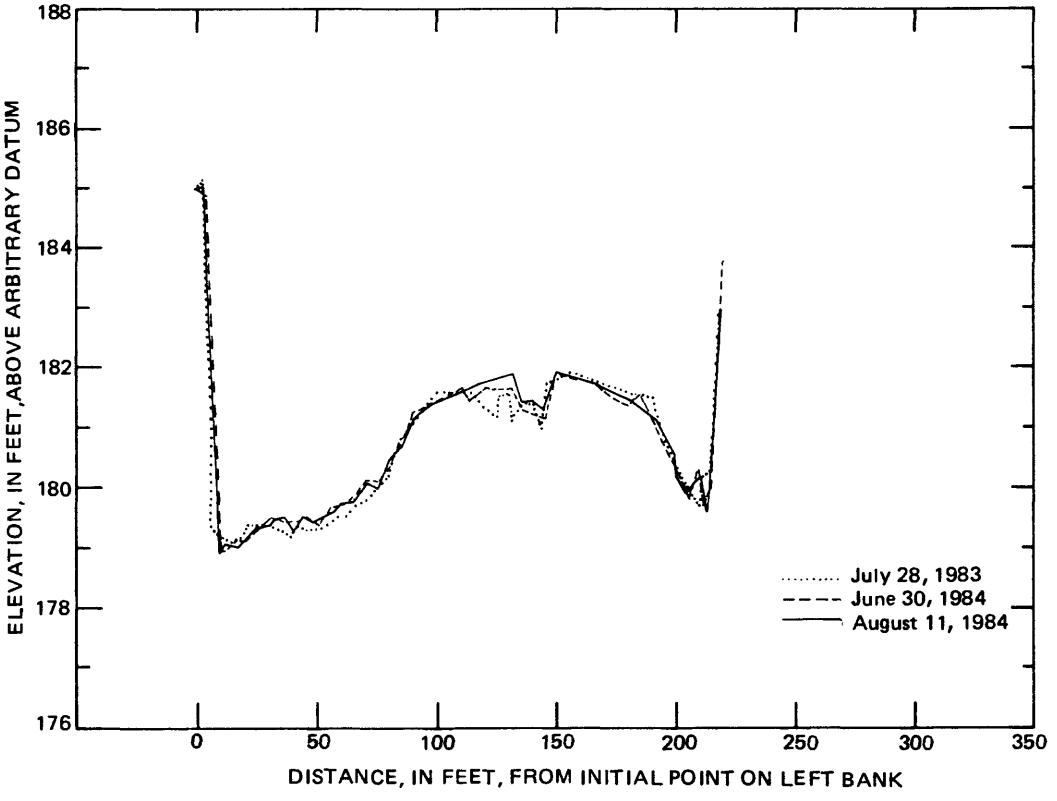

Figure 5E.--Cross section 3 at study reach 5: Bearpaw River near Kantishna.

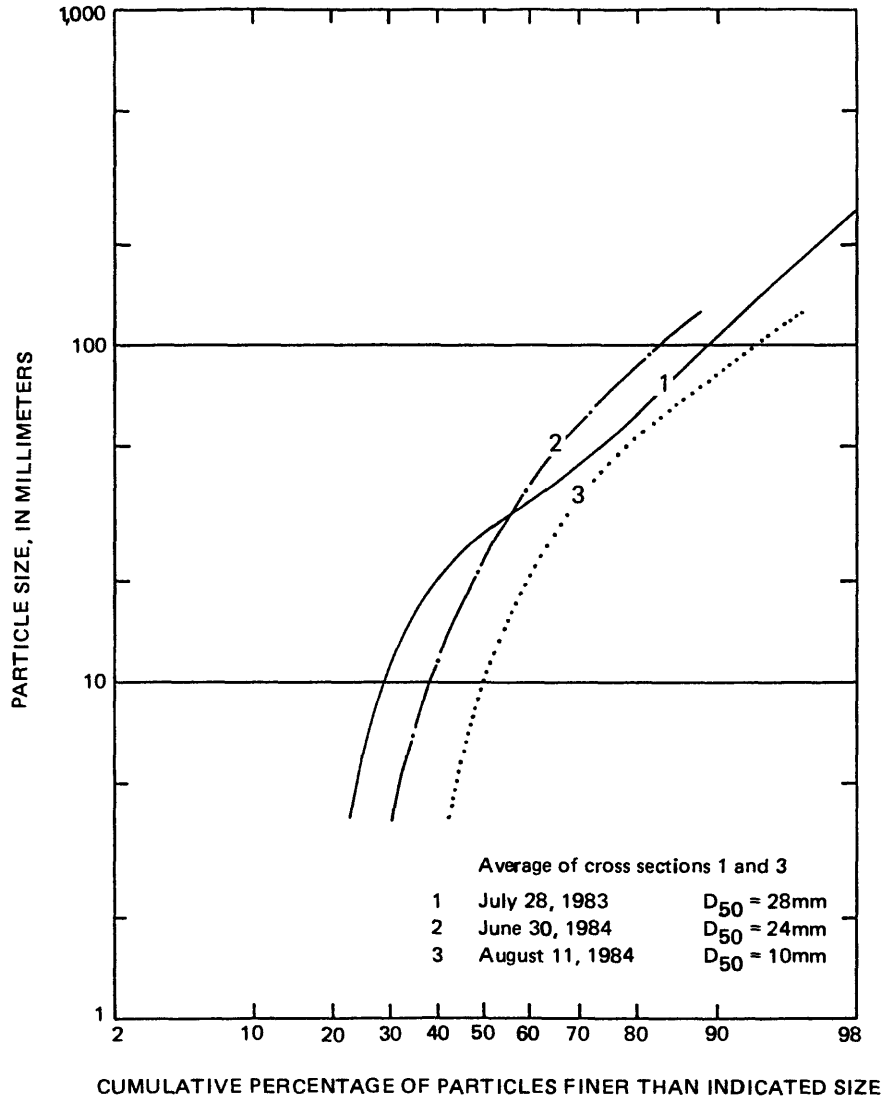

Figure 5F.--Particle-size distribution (particle-count method) of bed material at study reach 5: Bearpaw River near Kantishna.

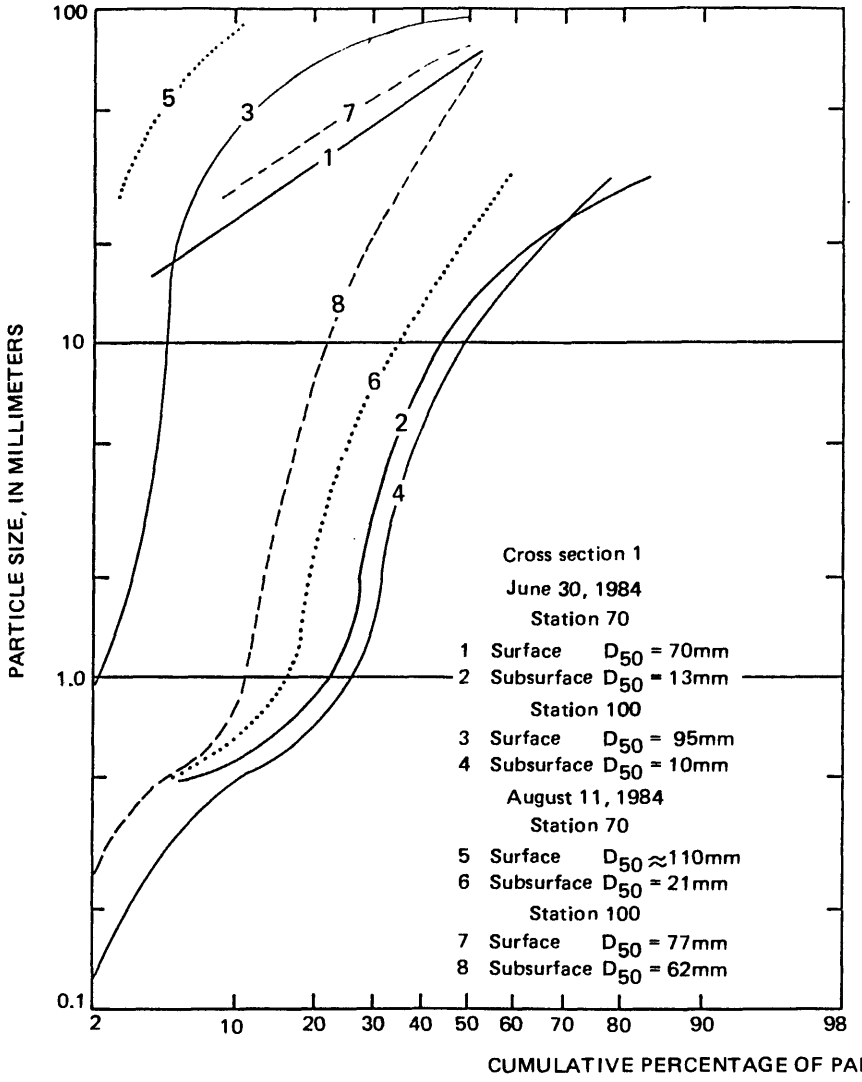

Figure 5G.--Particle-size distribution (sieve analysis) of bed material at study reach 5: Bearpaw River near Kantishna.

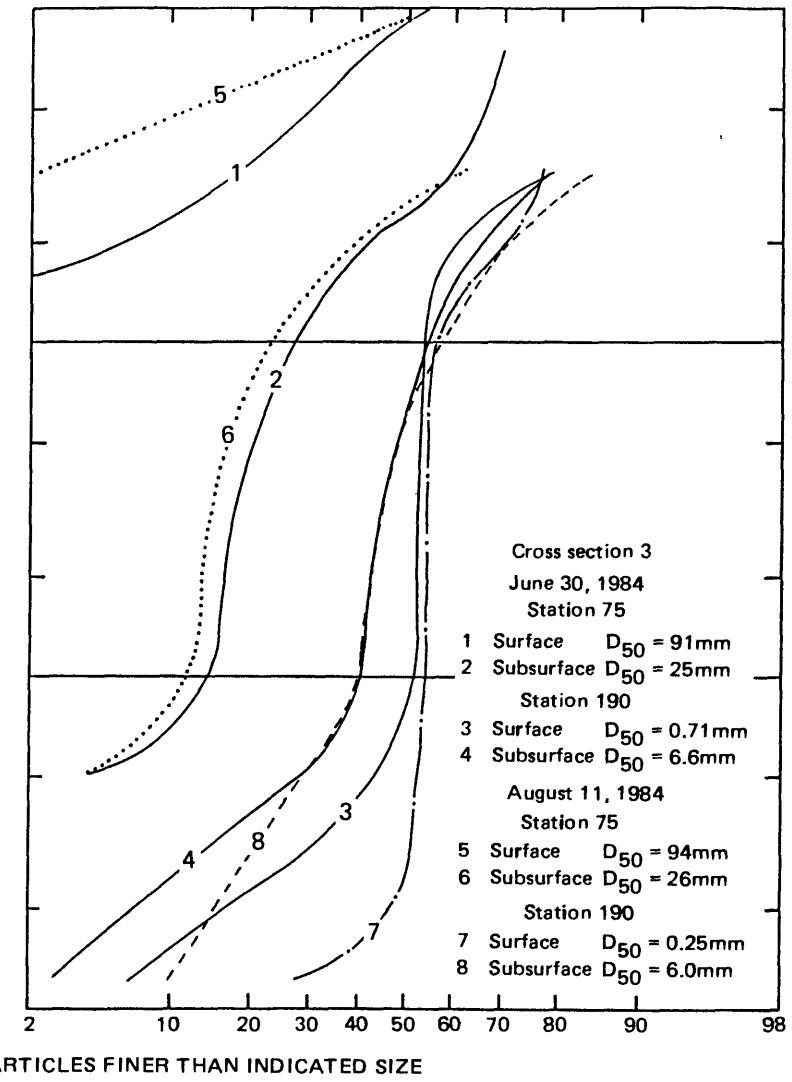

Figure 5H.--Particle-size distribution (sieve analysis) of bed material at study reach 5: Bearpaw River near Kantishna.

STUDY REACH 6: MOOSE CREEK ABOVE NORTH FORK MOOSE CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°31'05", Long 150°43'44", in NE¼NW¼ Sec.19, T.16S., R.16W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 800 ft upstream from North Fork Moose Creek, and 7.2 mi east of Kantishna.

Reach 6 is 305 ft long; the channel is contracting for the entire length. Four cross sections were established at approximately 100-foot intervals. Channel width between vegetated banks decreases downstream from about 150 ft at cross section 1 to about 70 ft at cross section 4. Cross sections 1 and 2 have gently sloping banks with well-defined flood channels. Flow is in multiple channels at sections 1 and 2. Cross sections 3 and 4 have gently sloping left banks and are confined by steep bedrock on their right banks. Flow is in one channel at sections 3 and 4. Cross section surveys showed no changes in channel configuration, but did indicate movement of material in all cross sections and approximately 1 ft of fill in the right bank channel of cross section 2.

Bed material size was coarser (d50=37mm) at the time of the initial particle count, June 25, 1983, than for subsequent samples (d50=24-27mm). Sieve analysis of bed material samples showed considerable variation in size distribution between sampling points within the reach. There was also a large variation in the composition of samples collected at the same point over the study period, indicating the movement of fine (<128mm) material in the channel.

Table 6A.--Summary of data collected: Reach 6
[CSG, crest-stage gage]

Date	Meas. disch. (ft^3/s)	Peak data: Stage (ft)	Peak data: Disch. (ft^3/s)	Cross section: No.	Cross section: Survey	Particle-size data: Particle count	Particle-size data: Bed material samples
6/25/83	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	None
6/30/83	32.6	95.57	70	3 CSG	No	No	None
7/26/83	---	95.98	182	3 CSG	No	No	None
7/29/83	82.2	---	---	---	No	No	None
9/16/83	114	99.88	---	1	Yes	Yes	Surf-subsurf
		98.65	---	2	Yes	Yes	None
		96.82	760	3	Yes	Yes	None
		95.70	---	4	Yes	Yes	None
6/28/84	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	Surf-subsurf
		---	---	3	Yes	No	None
		---	---	4	Yes	No	Surf-subsurf
7/2/84	49.6	97.62	2,100	3 CSG	No	Yes	None
		---	---	4	No	Yes	None
7/24/84	---	96.18	275	3 CSG	No	No	None
8/13/84	75.4	96.43	420	3 CSG	No	No	None
9/13-14 /84	80.3	99.81	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	Surf-subsurf
		95.72	103	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf

Table 6B.--Particle count data: Reach 6

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024	2048
June 25, 1983	1	--	5	21	47	64	87	98	100	--	--
	2	20	31	52	63	84	93	99	100	--	--
	3	10	16	25	43	64	80	93	99	99	100
	4	5	7	11	33	58	80	93	100	--	--
Sept. 16, 1983	1	28	34	42	55	72	83	96	100	--	--
	2	33	41	51	69	76	85	97	100	--	--
	3	27	33	45	57	71	82	95	97	98	100
	4	7	11	24	49	71	85	96	99	100	--
June 28, 1984	1	30	37	49	58	65	77	91	100	--	--
	2	24	42	53	66	79	88	98	100	--	--
	3	22	30	40	51	68	75	90	97	98	100
	4	8	18	24	43	60	77	96	99	100	--
Sept. 13, 1984	1	35	36	48	67	80	89	98	100	--	--
Sept. 14, 1984	2	14	25	40	60	83	91	97	100	--	--
	3	26	29	36	50	73	83	96	98	98	100
	4	16	20	28	43	63	86	94	100	--	--

Table 6C.--Bed material sample analysis data: Reach 6

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 25, 1983	1	140	Surface	--	--	--	--	--	--	--	--	4	15	59	100
	1	140	Subsurf	1	2	3	7	14	21	27	38	54	77	100	--
Sept. 16, 1983	1	140	Surface	--	--	--	1	1	2	2	2	8	19	69	100
	1	140	Subsurf	2	4	16	25	32	37	44	59	76	100	--	--
June 28, 1984	1	130	Surface	4	13	26	31	32	33	33	33	34	34	43	100
	1	130	Subsurf	4	15	27	33	36	37	39	42	50	66	88	100
	1	140	Surface	--	--	--	1	1	2	2	2	4	14	47	100
	1	140	Subsurf	1	3	5	11	22	27	32	41	58	75	100	--
	2	130	Surface	--	--	--	--	--	--	--	2	4	12	28	100
	2	130	Subsurf	--	--	--	1	3	7	13	22	39	63	73	100
	4	40	Surface	--	--	--	1	2	3	5	11	31	90	100	--
	4	40	Subsurf	--	--	2	8	20	26	33	46	65	94	100	--
Sept. 13, 1984	1	130	Surface	--	--	--	1	2	4	6	9	15	32	66	100
	1	130	Subsurf	10	36	68	73	73	73	73	73	73	73	75	100
	2	130	Surface	7	27	95	100	--	--	--	--	--	--	--	--
	2	130	Subsurf	--	--	1	4	9	17	28	44	65	86	100	--
Sept. 14, 1984	4	27	Surface	--	--	--	--	--	--	--	--	1	3	31	100
	4	27	Subsurf	--	--	1	4	9	17	25	37	54	80	92	100
	4	38	Surface	--	1	2	3	5	5	6	8	12	36	100	--
	4	38	Subsurf	1	2	4	8	16	18	24	32	45	62	84	100

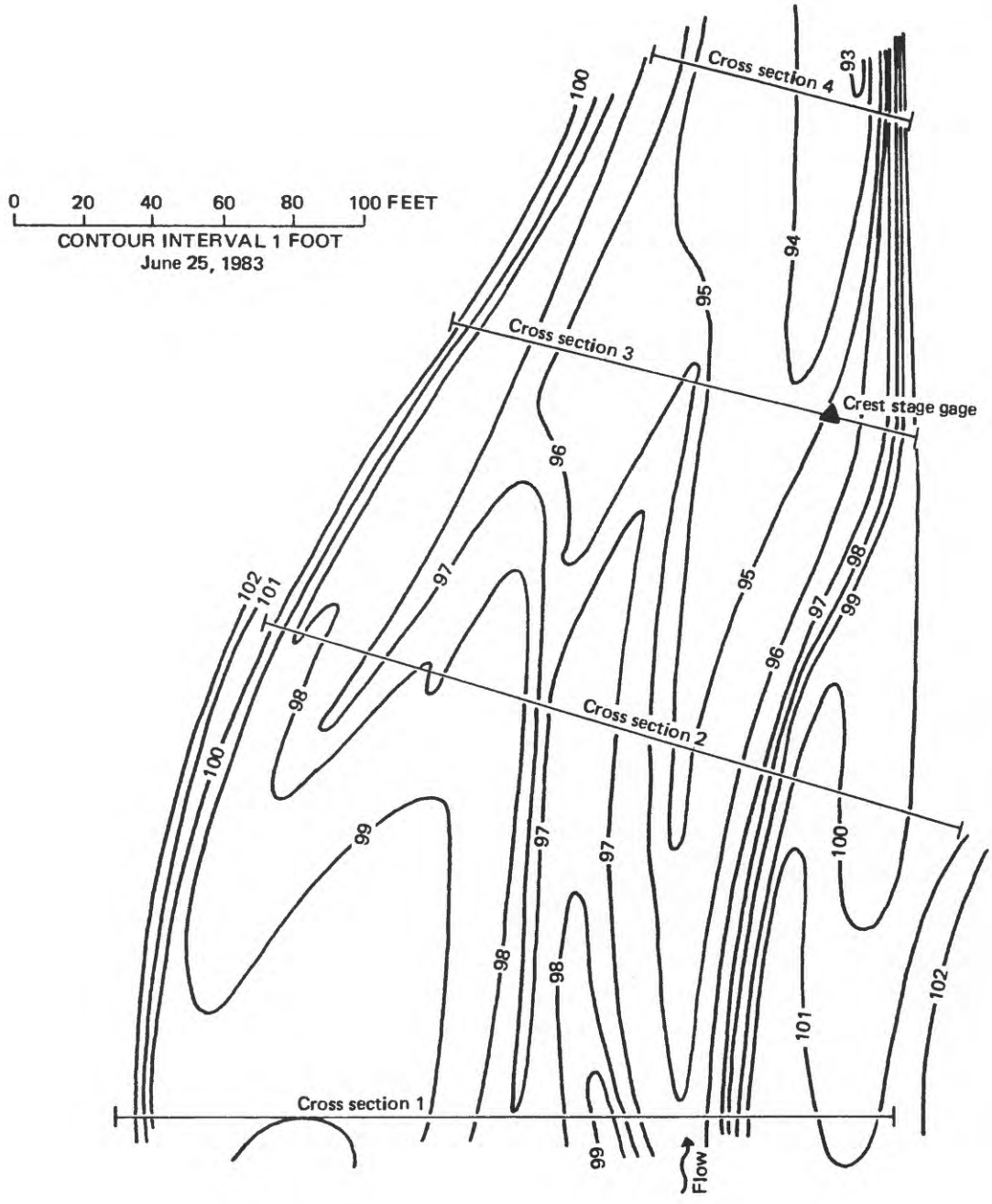

Figure 6A.--Plan view and location of cross sections at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

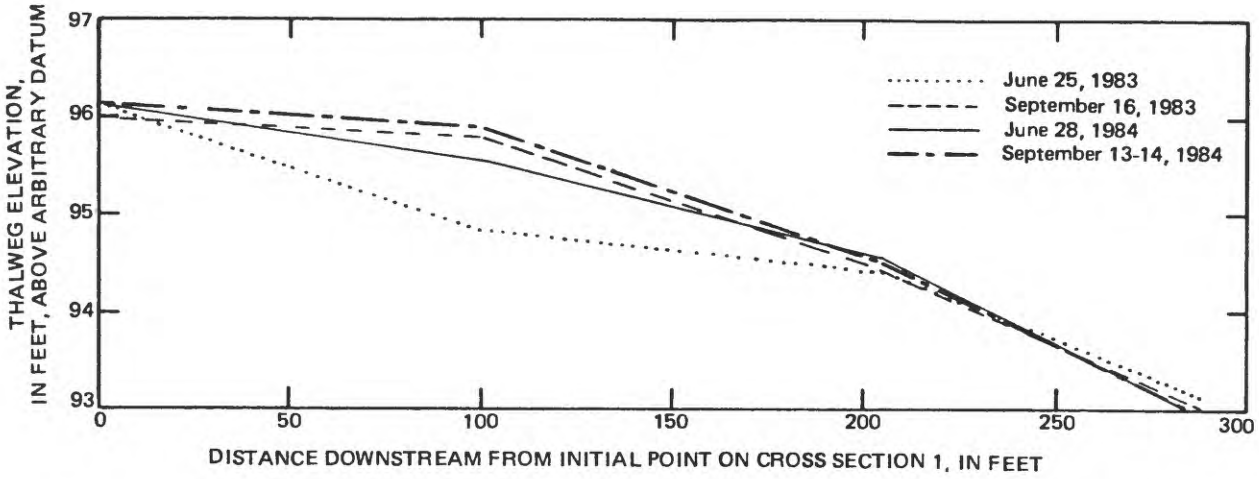

Figure 6B.--Thalweg profile at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

Figure 6C.--View downstream from cross section 1, June 25, 1983.

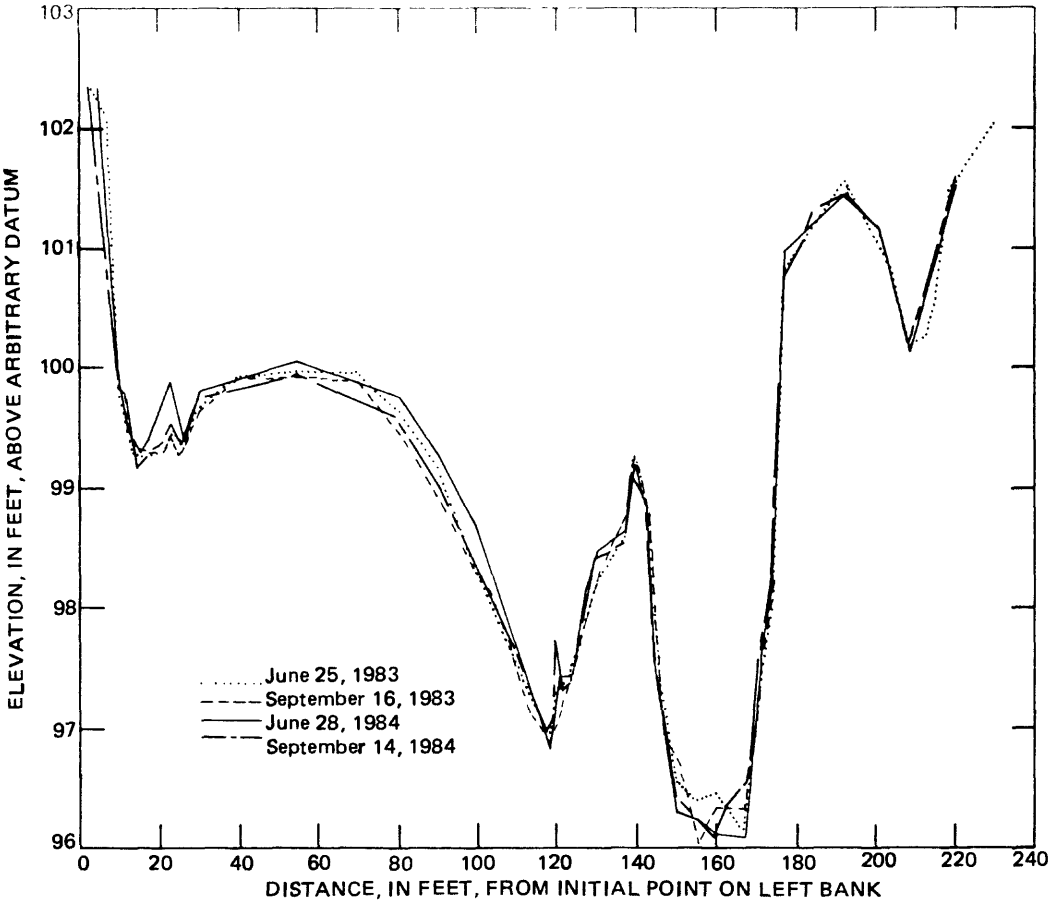

Figure 6D.--Cross section 1 at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

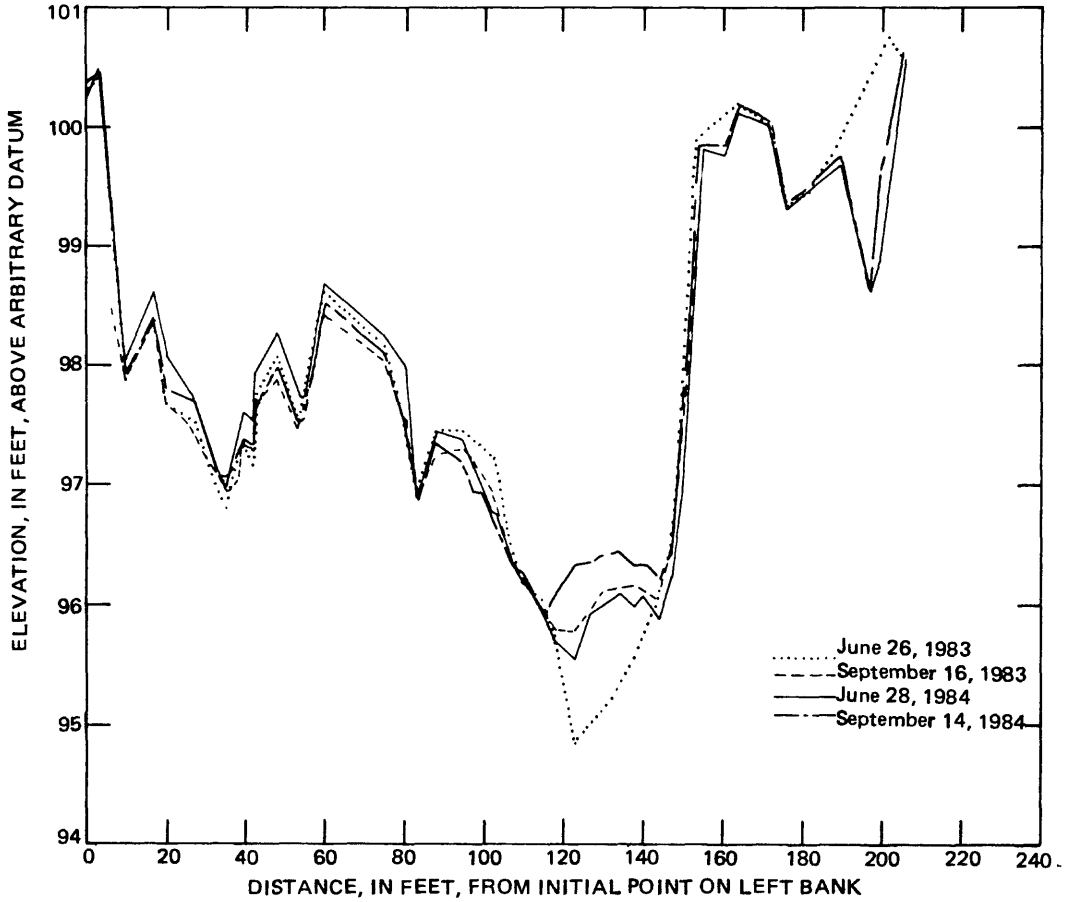

Figure 6E.--Cross section 2 at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

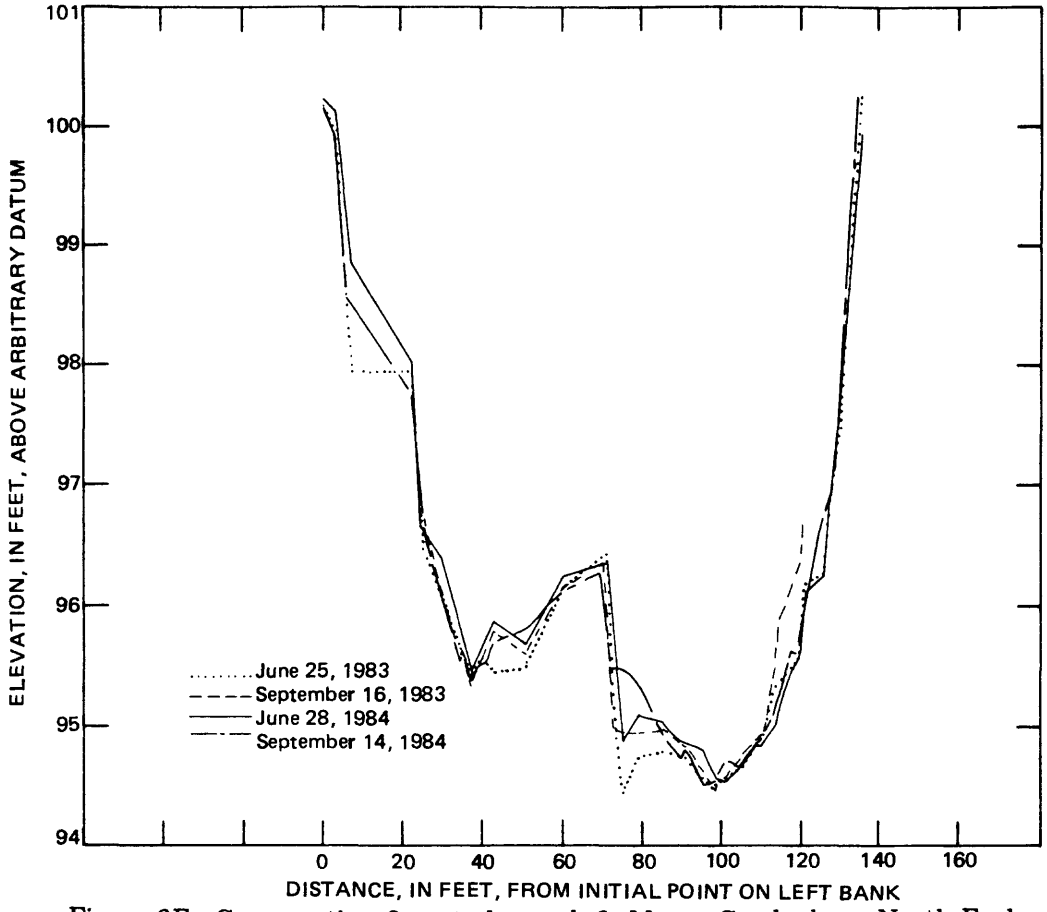

Figure 6F.--Cross section 3 at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

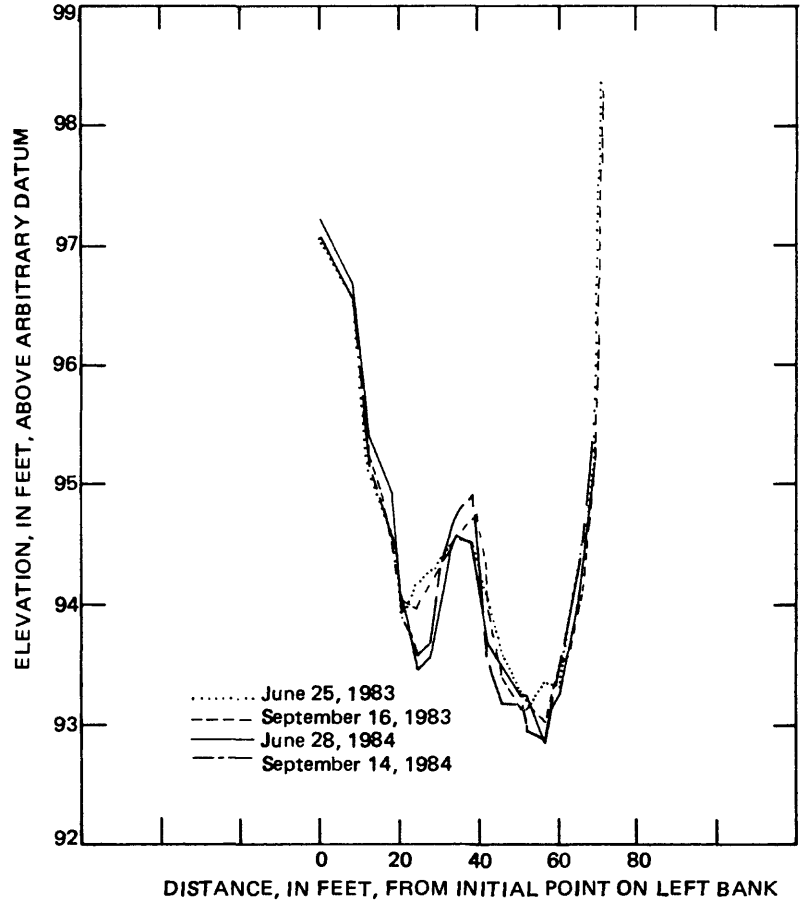

Figure 6G.--Cross section 4 at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

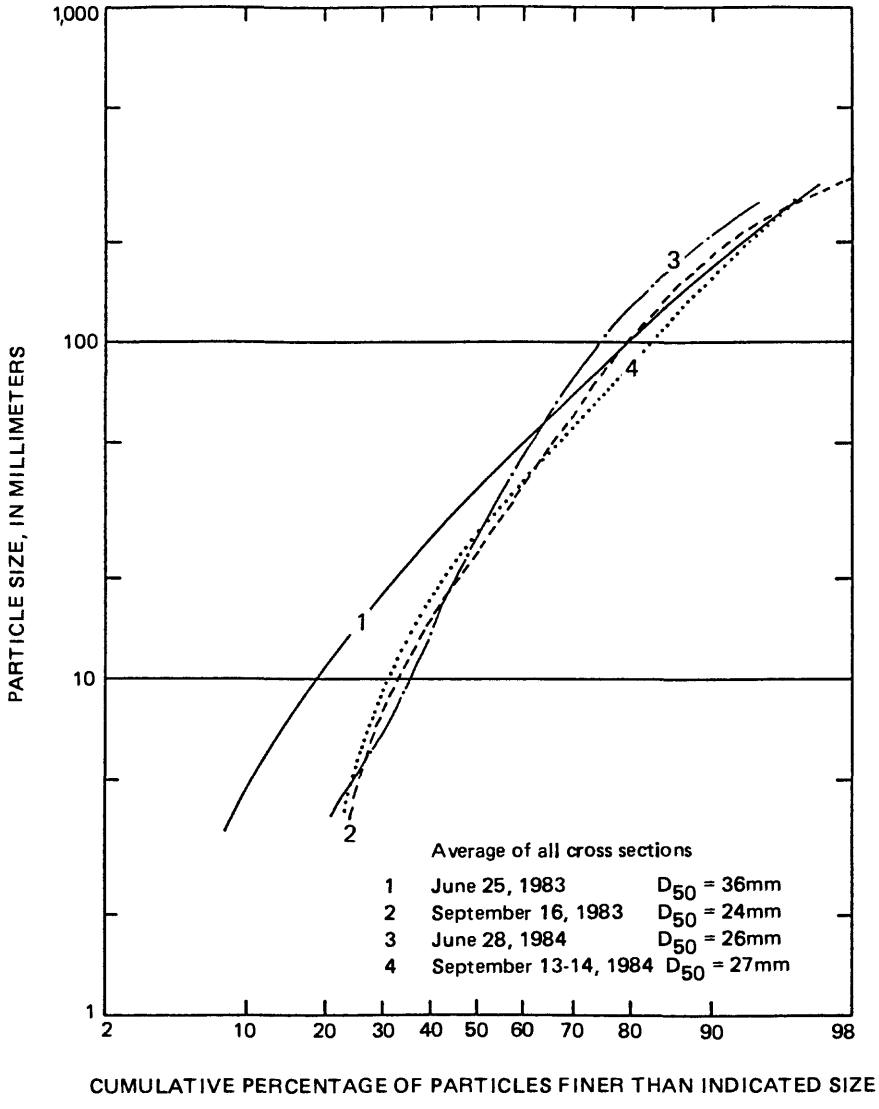

Figure 6H.--Particle-size distribution (particle-count method) of bed material at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

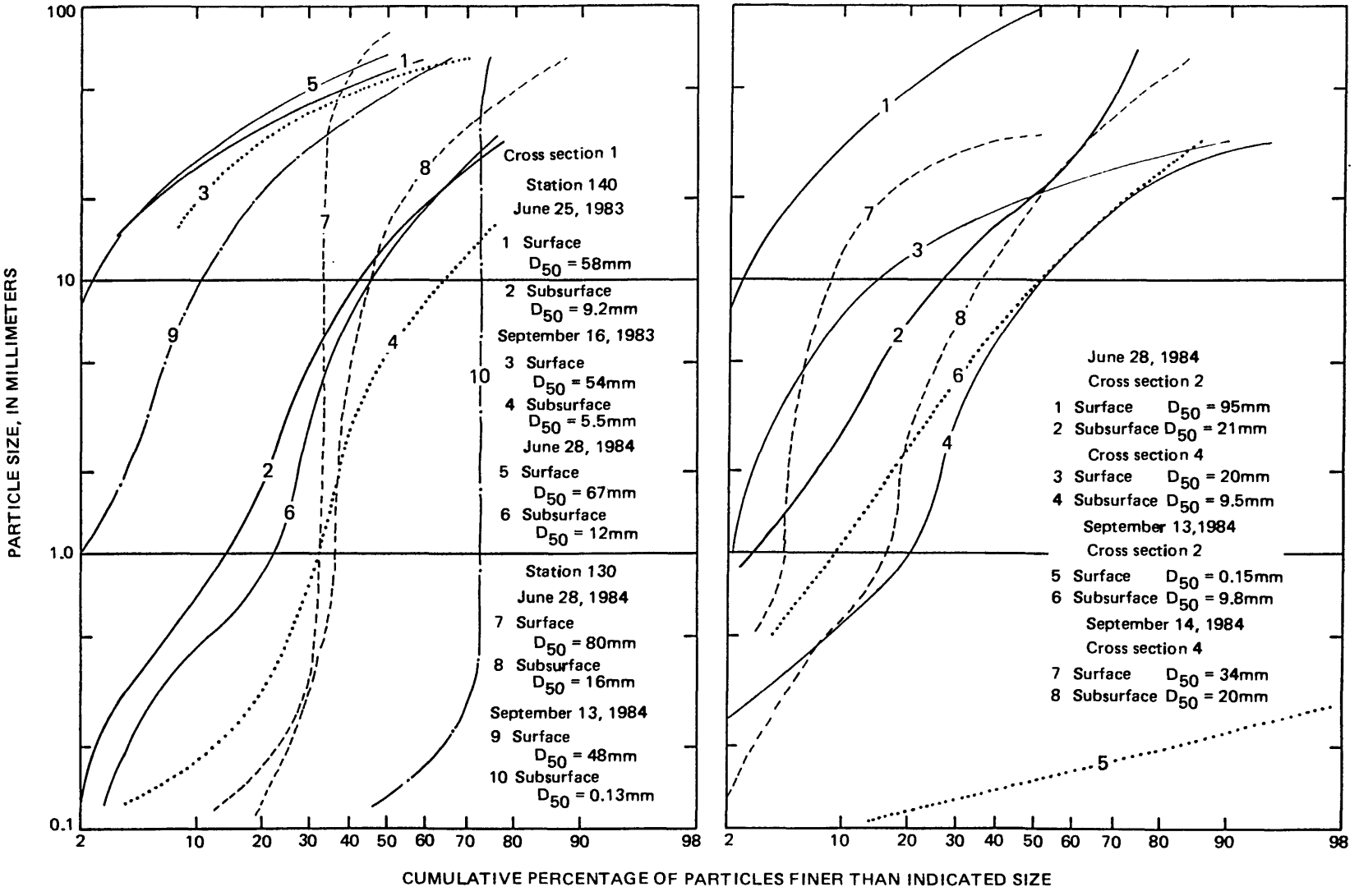

Figure 6I.--Particle-size distribution (sieve analysis) of bed material at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

Figure 6J.--Particle-size distribution (sieve analysis) of bed material at study reach 6: Moose Creek above North Fork Moose Creek near Kantishna.

STUDY REACH 7: NORTH FORK MOOSE CREEK ABOVE WILLOW CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°32'05", Long 150°39'16", in NW¼NE¼ Sec.16, T.16S., R.16W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.1 mi upstream from Willow Creek, and 9.4 mi east of Kantishna.

Four cross sections were established between 90 and 100 ft apart over a total reach length of 330 ft. Banks are steep and well defined with bedrock exposed throughout the reach. Channel width averages about 40 ft between vegetated banks. Channel surveys defined no changes in channel configuration although some movement of the bed material was evident.

Particle-count data indicate that the bed material was slightly coarser (d50=130mm) in 1984 than in 1983 (d50=62-72mm). Sieve analysis data are insufficient to evaluate any change in bed material sample size distribution.

Table 7A.-- Summary of data collected: Reach 7

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
6/27/83	30.1	100.90	650	1	Yes	Yes	None
		99.71	375	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf
8/10/83	---	---	---	1	Yes	Yes	None
		---	---	2	No	Yes	None
		97.39	275	3	No	Yes	None
		---	---	4	No	No	None
7/21/84	184	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	No	None
		---	---	4	Yes	No	None

Table 7B.-- Particle count data: Reach 7

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024	2048
June 27, 1983	1	1	4	13	29	48	72	91	98	100	--
	2	6	8	11	33	58	66	80	94	99	100
	3	2	3	6	17	34	60	88	98	100	--
	4	--	8	16	36	52	70	86	93	100	--
Aug. 10, 1983	1	1	3	11	26	52	71	91	95	100	--
July 21, 1984	1	2	2	6	16	28	55	86	94	100	--
	2	--	--	--	4	17	41	82	95	100	--

Table 7C.--Bed material sample analysis data: Reach 7

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 27, 1983	4	50	Surface	--	--	--	--	--	--	--	--	1	6	19	100
	4	50	Subsurf	--	--	--	7	7	11	15	22	35	64	100	--
July 21, 1984	1	40	Surface	--	--	--	--	--	1	2	5	14	33	55	100
	1	40	Subsurf	--	--	--	1	5	9	16	29	48	72	77	100

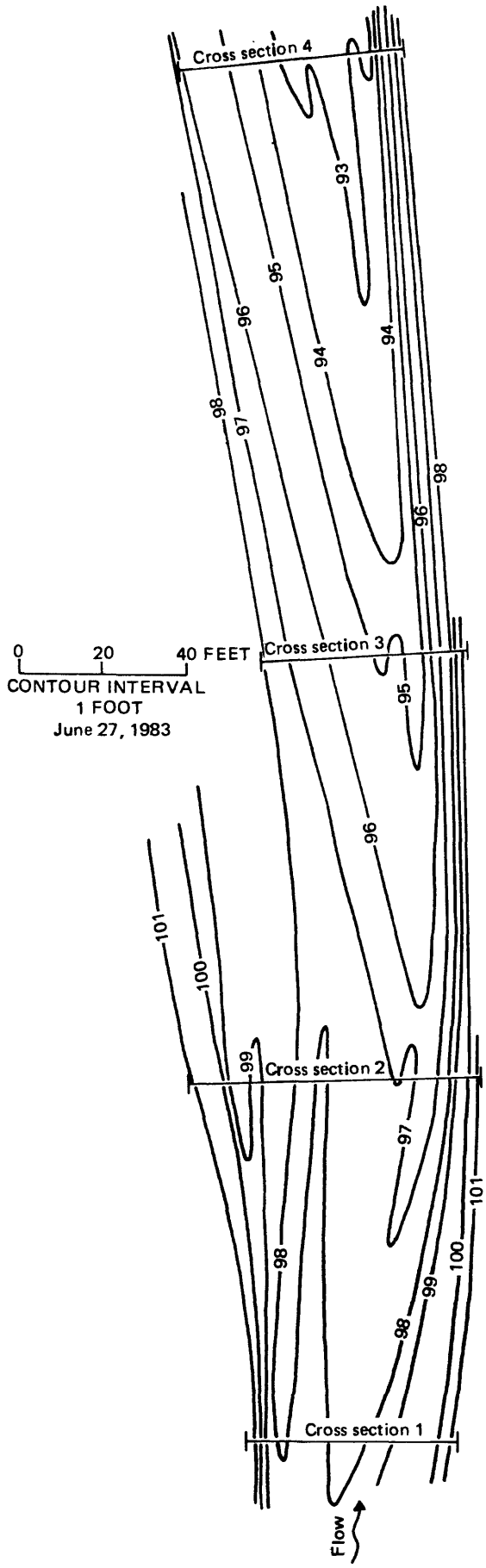

Figure 7A.--Plan view and location of cross sections at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

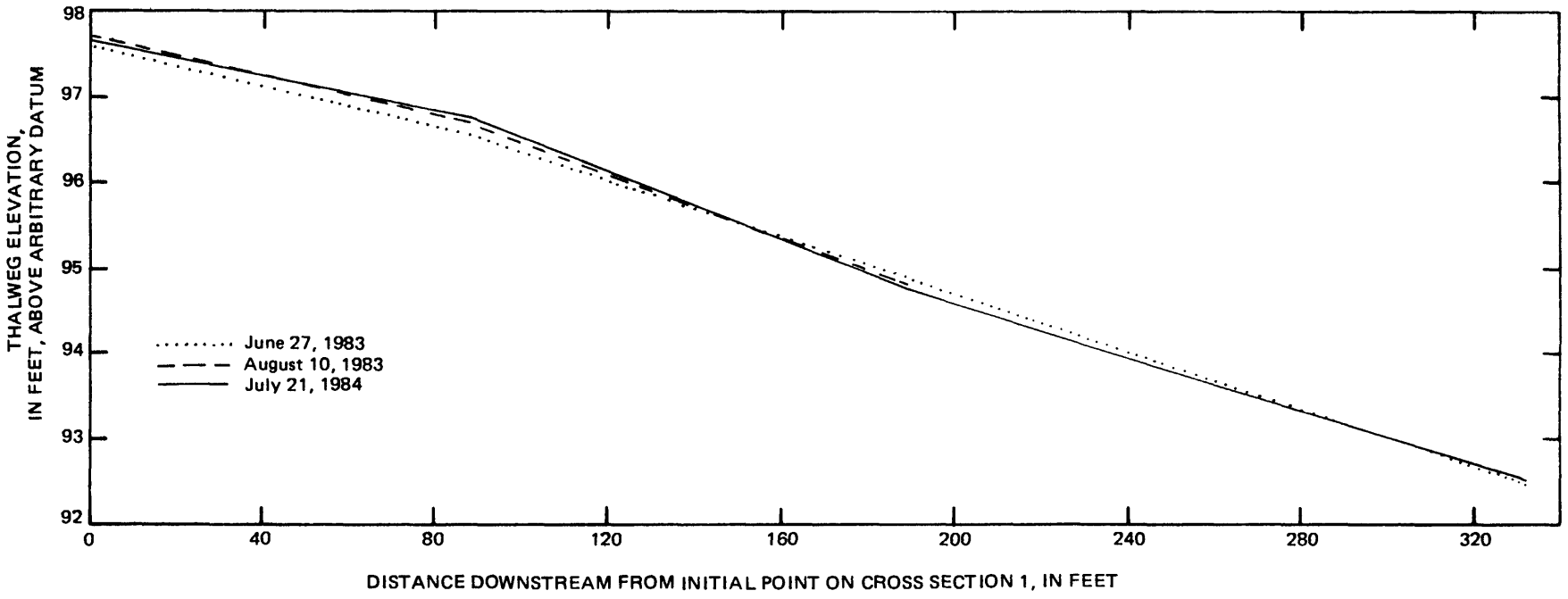

Figure 7B.--Thalweg profile at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

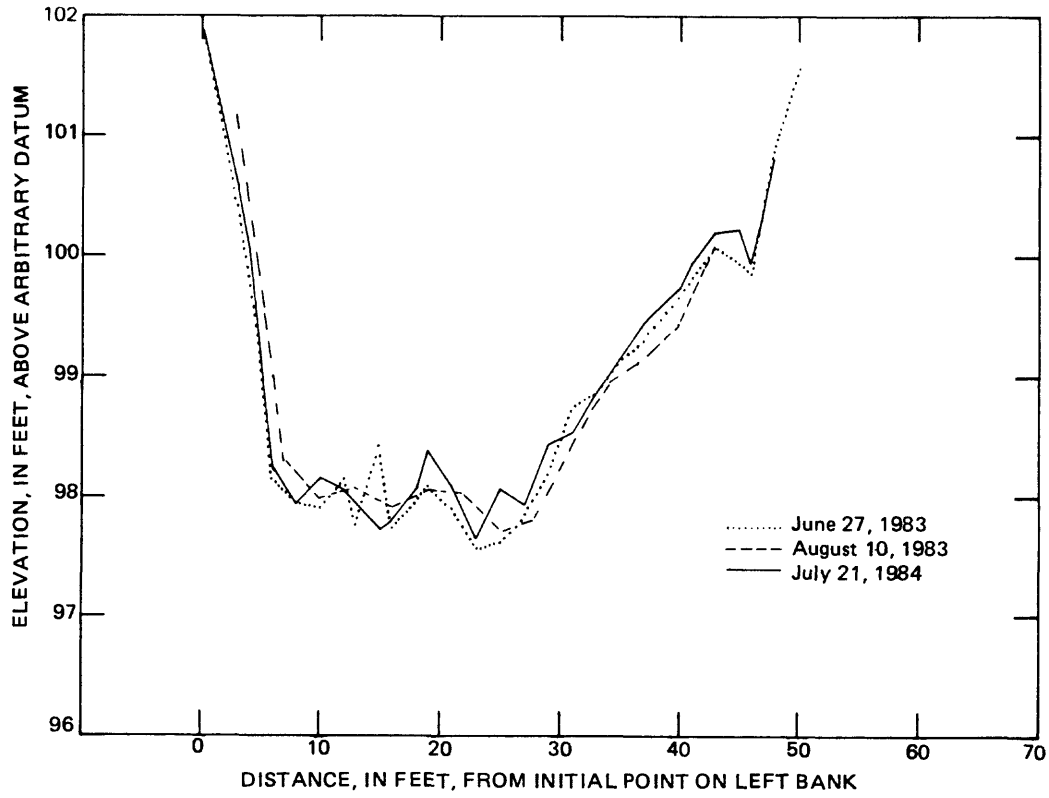

Figure 7C.--Cross section 1 at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

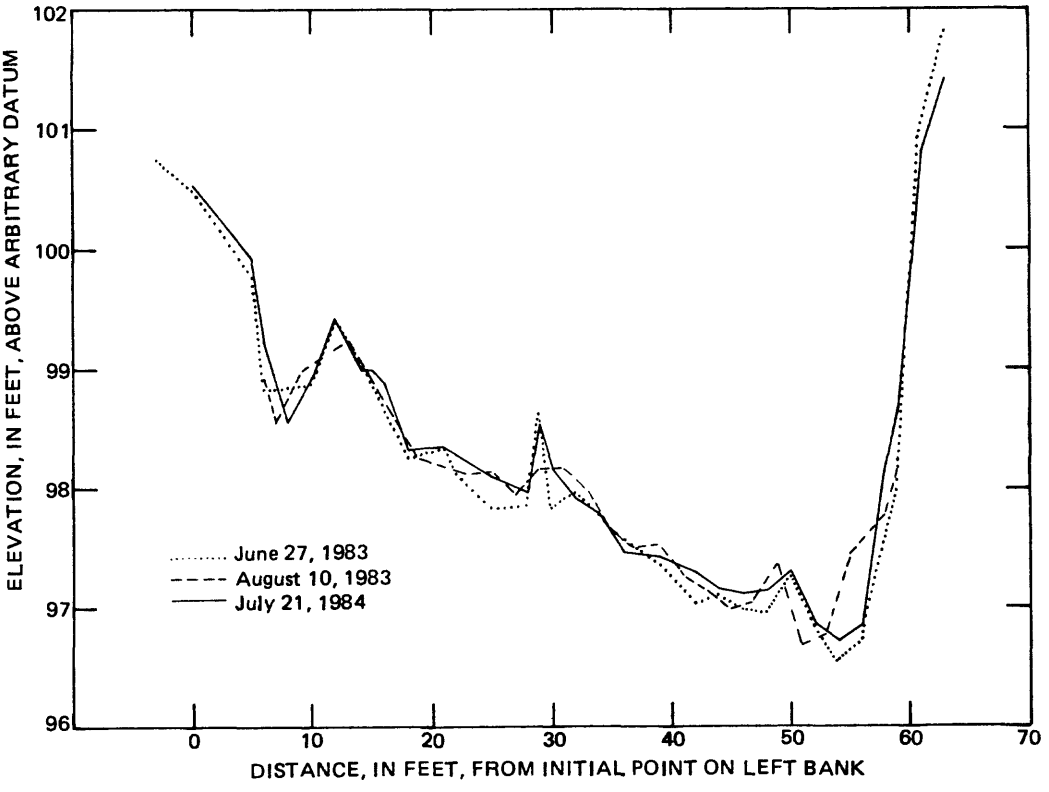

Figure 7D.--Cross section 2 at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

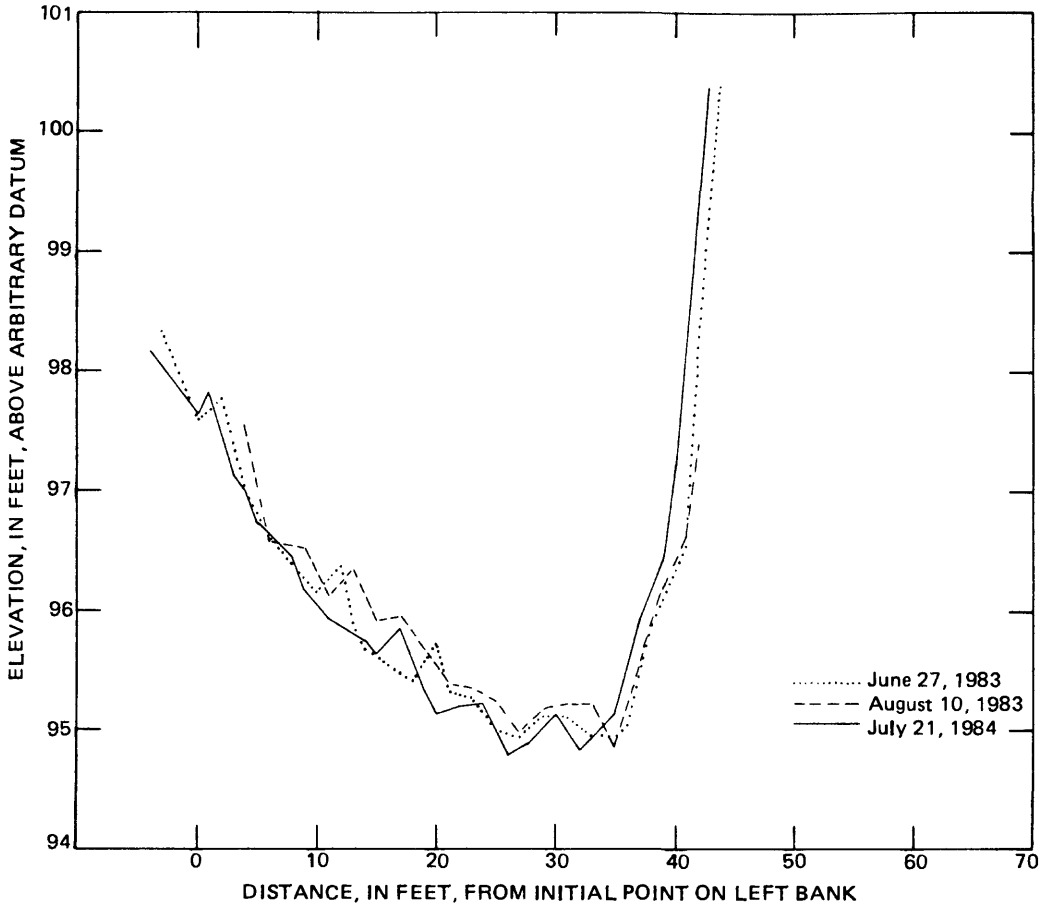

Figure 7E.--Cross section 3 at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

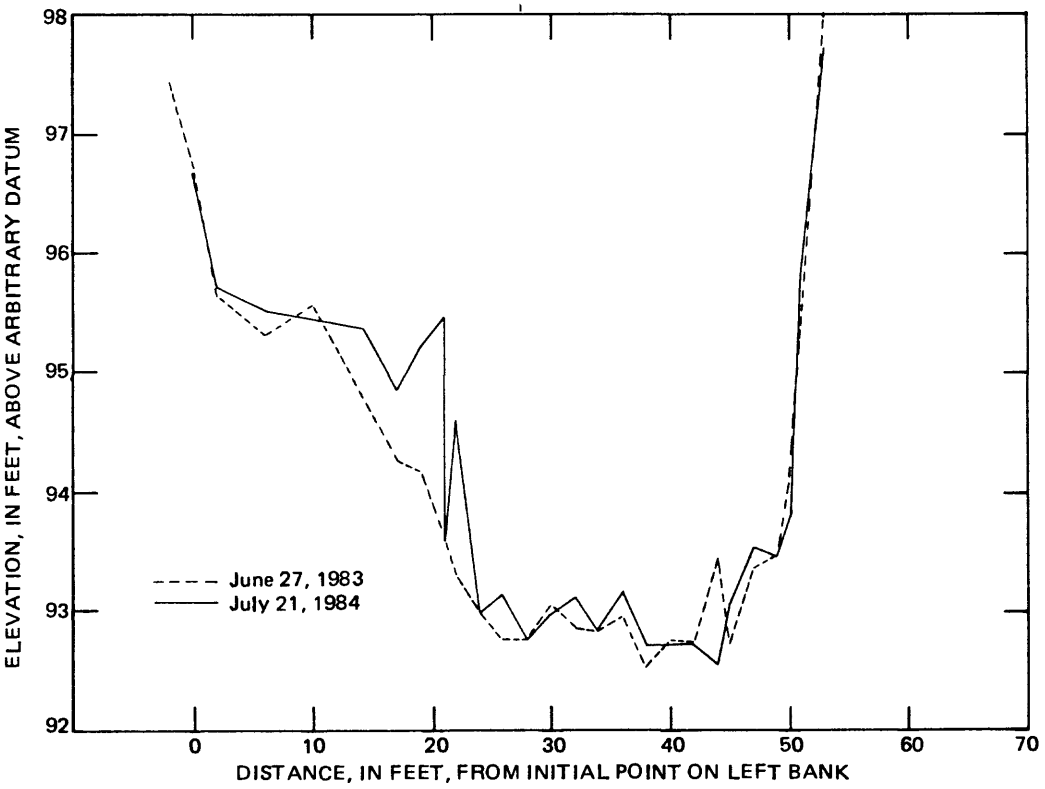

Figure 7F.--Cross section 4 at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

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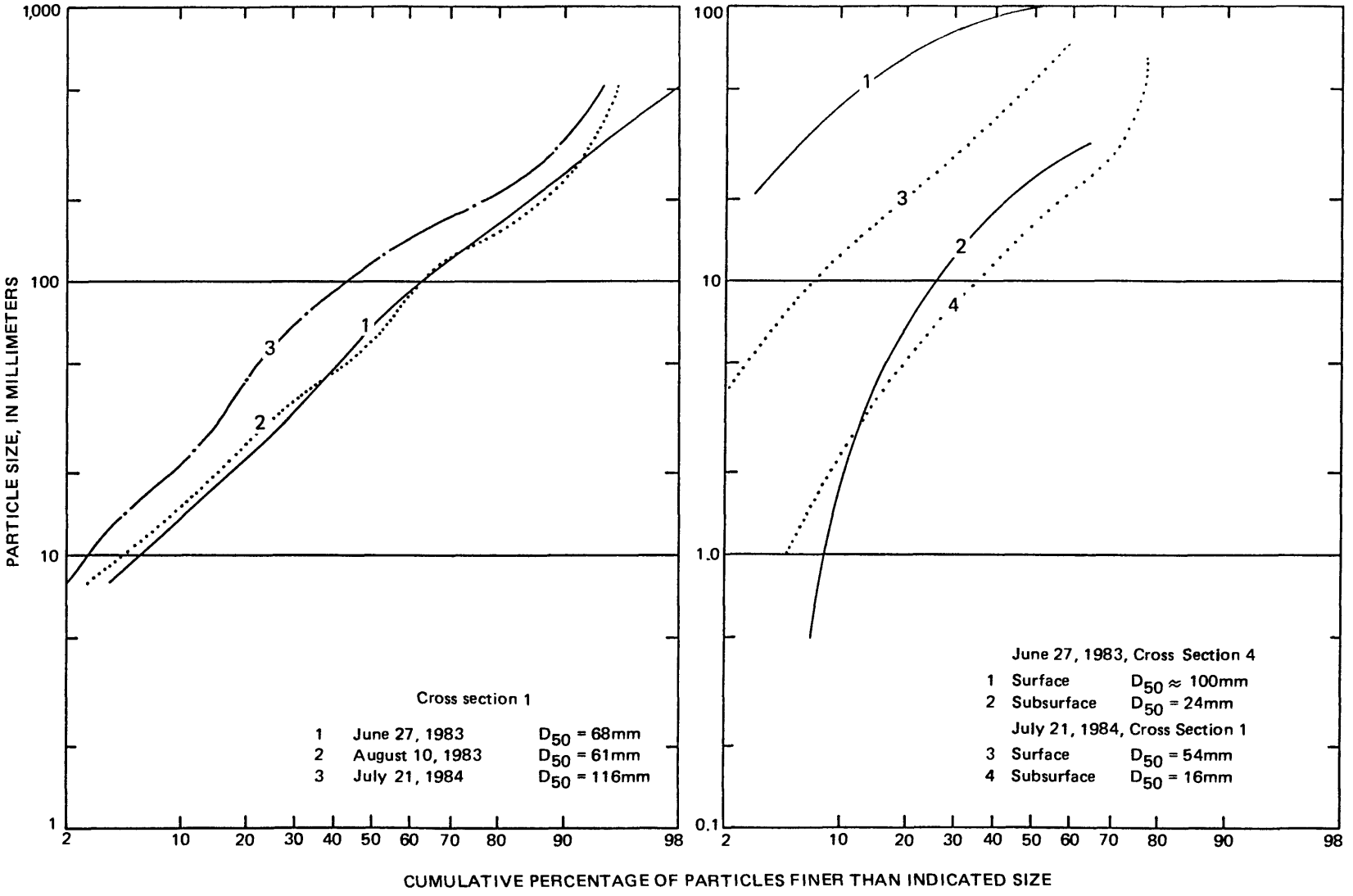


Figure 7G.--Particle-size distribution (particle-count method) of bed material at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

Figure 7H.--Particle-size distribution (sieve analysis) of bed material at study reach 7: North Fork Moose Creek above Willow Creek near Kantishna.

STUDY REACH 8: GLEN CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°31'30", Long 150°42'18", in NW¼SW¼ Sec.17, T.16S., R.16W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.25 mi upstream from mouth, and 7.8 mi east of Kantishna.

Three cross sections were established at about 100-foot intervals for a total reach length of 200 ft. The reach is a contracting one that has three channels at cross section 1, and a single channel downstream at cross sections 2 and 3. Channel width averages about 40 ft between vegetated banks. Abandoned settling ponds are present approximately 500 ft upstream from the reach and a tailings pile is located on the right bank at cross section 3. Changes in channel configuration during the study period were insignificant. Cross-section surveys indicated scour, and subsequently, deposition of approximately 1.5 ft of material between the left bank and center channels of cross section 1. Minor amounts of scour and fill took place at the thalweg of all cross sections.

Particle-count data showed very little change except for a slightly finer (d50=19mm versus d50=25mm) mean size in 1984 than in 1983. Sieve analysis of bed material samples showed the deposition of fine (d50=0.12mm) material between June 1983 and June 1984, but the material was no longer present in September 1984.

A rain gage was installed near this reach during the 1984 field season. Rainfall data are shown on table 8D.

Table 8A.--Summary of data collected: Reach 8
[CSG, crest-stage gage]

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
6/26/83	---	---	---	1	Yes	No	None
		---	---	2	Yes	No	None
		---	---	3	Yes	No	None
6/30/83	8.23	---	---	1	No	Yes	None
		---	---	2	No	No	None
		---	---	3	No	Yes	Surf-subsurf
7/26/83	---	88.83	65	3 CSG	No	No	None
7/29/83	18.7	88.67	33	3 CSG	No	No	None
9/15/83	23.0	94.03	---	1	Yes	Yes	None
		90.98	---	2	Yes	No	None
		89.72	660	3 CSG	Yes	Yes	None
6/29/84	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	None
		---	---	3	Yes	Yes	Surf-subsurf
7/24/84		88.85	71	3 CSG	No	No	None
8/13/84	17.3	89.46	390	3 CSG	No	No	None
9/14/84	17.2	94.14	---	1	Yes	Yes	Surf-subsurf
		91.56	---	2	Yes	No	None
		88.88	79	3 CSG	Yes	Yes	Surf-subsurf

Table 8B.-- Particle count data: Reach 8

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024
June 30, 1983	1	18	24	36	50	74	87	94	98	100
	3	21	28	45	63	82	88	95	99	100
Sept. 15, 1983	1	31	35	42	58	69	81	97	99	100
	3	35	38	44	52	67	88	94	98	100
June 29, 1984	1	26	34	42	53	69	83	95	99	100
	3	38	47	54	61	75	84	96	98	100
Sept. 14, 1984	1	45	49	54	60	74	85	92	100	--
	3	38	40	42	57	74	91	97	100	--

Table 8C.--Bed material sample analysis data: Reach 8

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 30, 1983	3	20	Surface	1	1	2	3	4	4	7	10	25	46	100	--
	3	20	Subsurf	2	5	10	16	22	27	34	46	61	76	77	100
June 29, 1984	1	75	Surface	1	1	2	3	4	5	6	8	10	26	40	100
	1	75	Subsurf	--	2	5	9	18	25	33	42	56	80	90	100
	3	18	Surface	15	50	90	99	100	--	--	--	--	--	--	--
	3	18	Subsurf	21	58	90	99	100	--	--	--	--	--	--	--
Sept. 14, 1984	1	75	Surface	1	2	3	5	7	8	9	11	15	24	31	100
	1	75	Subsurf	2	4	7	12	18	23	26	30	43	75	100	--
	3	19	Surface	--	--	--	--	1	1	2	4	11	31	100	--
	3	19	Subsurf	1	2	4	10	17	24	33	47	65	86	100	--

Table 8D.-- Rainfall in the Kantishna Hills area near Reach 8, June to September 1984
[Data in inches; Tr, trace]

Day	June	July	August	September
1	-	0.00	0.03	Tr
2	-	.06	.04	0.00
3	-	.42	.03	.00
4	-	.25	.21	.00
5	-	.06	.11	.00
6	-	.17	.01	.00
7	-	.06	.00	.00
8	-	.11	.00	.00
9	-	.03	.60	.00
10	-	.00	.06	.00
11	-	.08	.02	Tr
12	-	.23	.00	.00
13	-	.00	.00	.00
14	-	.07	.00	.00
15	-	.00	.00	.00
16	-	.00	.00	.00
17	-	.04	.04	.00
18	-	.16	.03	-
19	-	.00	.53	-
20	-	.61	.00	-
21	-	.55	.00	-
22	-	Tr	.06	-
23	-	.00	.20	-
24	-	.00	.02	-
25	-	1.32	.98	-
26	-	.86	.58	-
27	-	.18	.00	-
28	-	.09	.00	-
29	-	.13	.00	-
30	.00	.02	.00	-
31	----	.00	.01	----

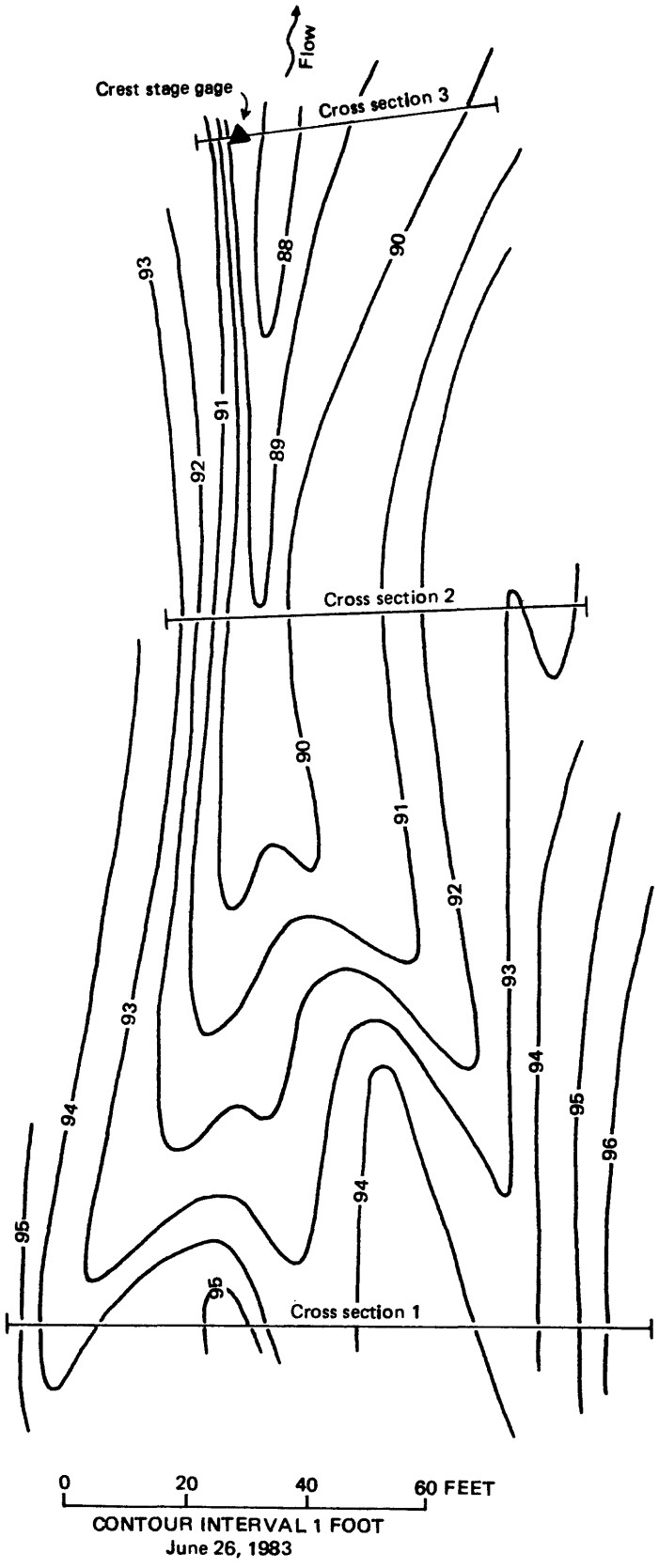


Figure 8A.--Plan view and location of cross sections at study reach 8: Glen Creek near Kantishna.

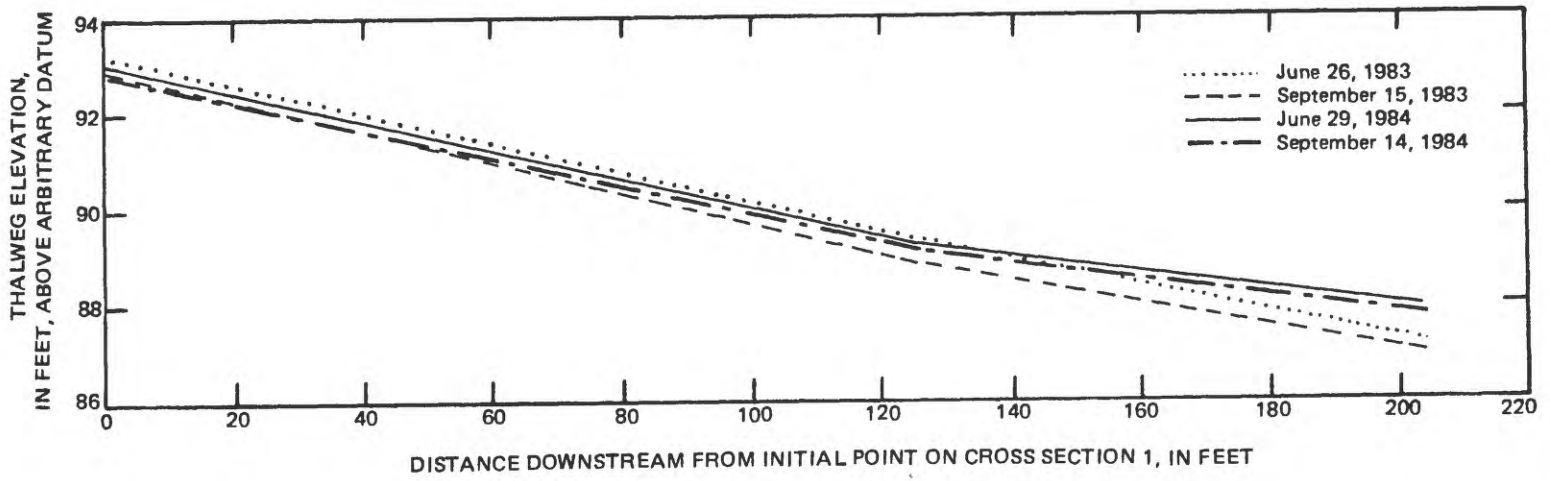


Figure 8B.--Thalweg profile at study reach 8: Glen Creek near Kantishna.

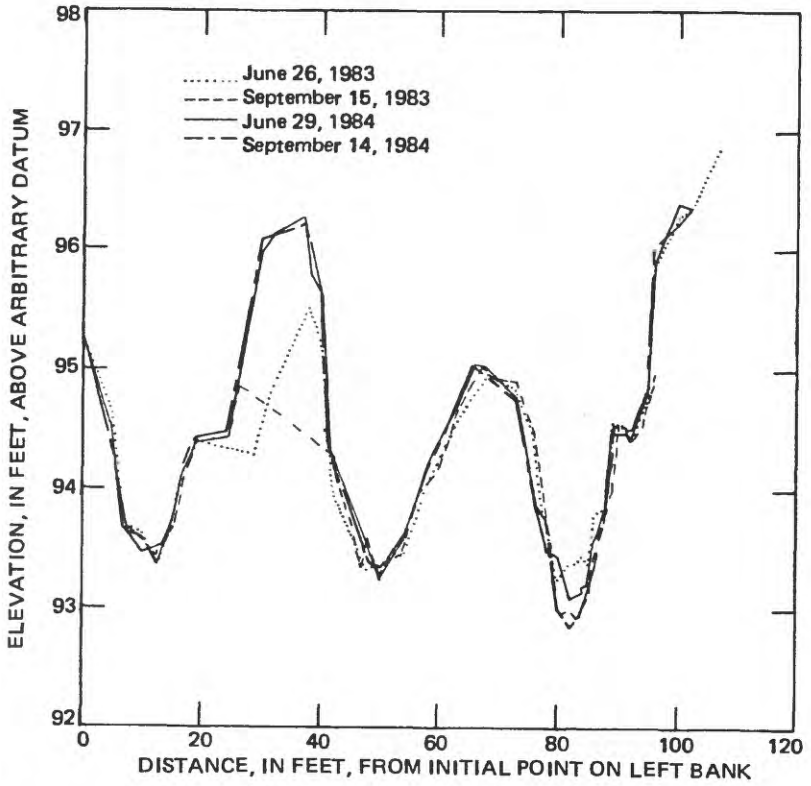


Figure 8C.--Cross section 1 at study reach 8: Glen Creek near Kantishna.

Figure 8D.--View downstream from cross section 1, July 26, 1983.

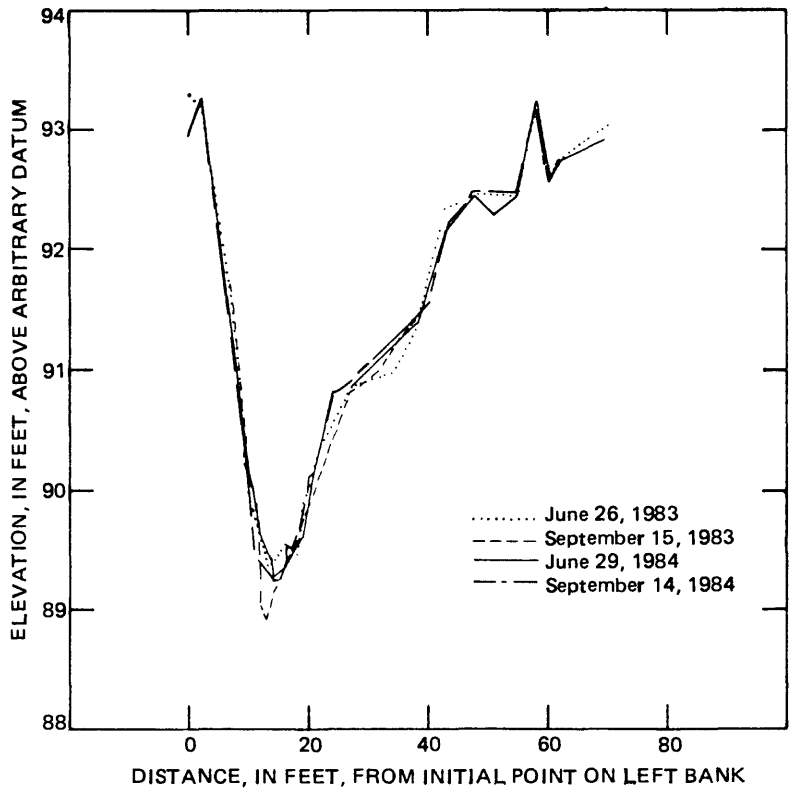


Figure 8E.--Cross section 2 at study reach 8: Glen Creek near Kantishna.

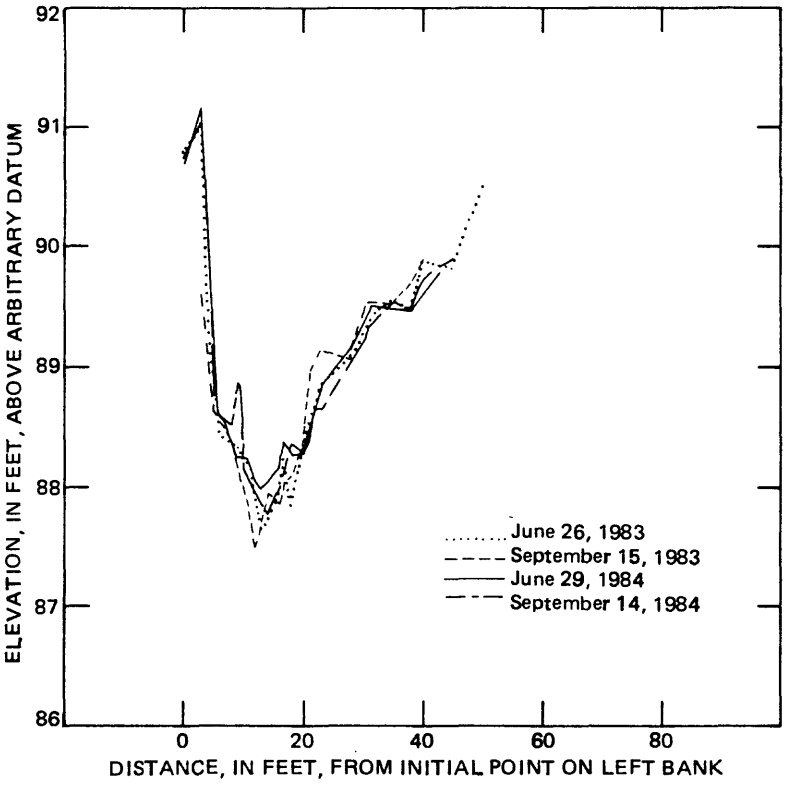


Figure 8F.--Cross section 3 at study reach 8: Glen Creek near Kantishna.

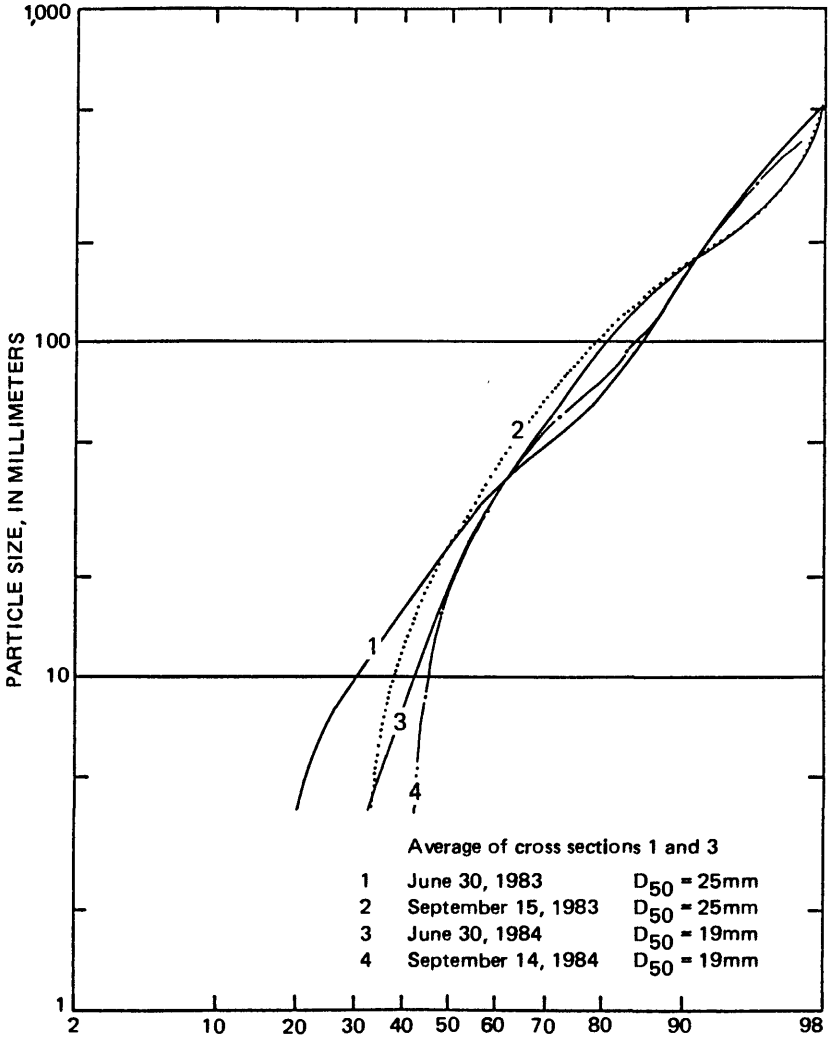


Figure 8G.--Particle-size distribution (particle-count method) of bed material at study reach 8: Glen Creek near Kantishna.

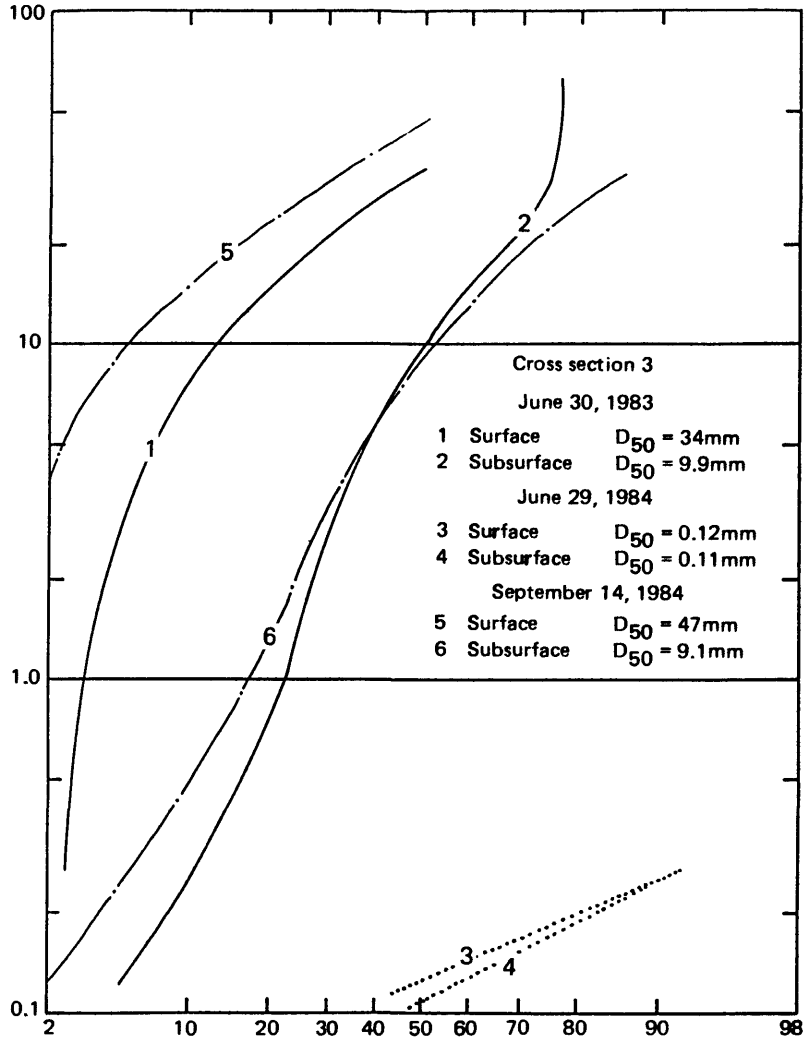


Figure 8H.--Particle-size distribution (sieve analysis) of bed material at study reach 8: Glen Creek near Kantishna.

CUMULATIVE PERCENTAGE OF PARTICLES FINER THAN INDICATED SIZE

STUDY REACH 9: NORTH FORK MOOSE CREEK NEAR MOUTH NEAR KANTISHNA

LOCATION.--- Lat 63°31'09", Long 150°43'48", in NE¼NW¼ Sec.19, T.16S., R.16W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.1 mi upstream from mouth, and 7.0 mi east of Kantishna.

Reach 9 has a total length of 420 ft with four cross sections spaced approximately 140 ft apart. The channel has a slight bend to the left throughout the reach. The left bank has a gradual slope with shrub and grass cover. The right bank is a bedrock cliff. The reach has an average width of 80 ft between vegetated banks. Cross section surveys indicated no changes in channel configuration over the period of data collection. The channel survey on September 15, 1983 indicated an overall slight scour in the reach compared to the initial survey on June 26, 1983. Surveys in June and September 1984 showed channel elevations similar to those of the initial survey.

Bed material particle counts and sieve analysis of bed material samples indicated considerable variation in the particle-size distribution, especially in cross section 4, where surface bed material was noticeably finer in 1984.

Table 9A.--Summary of data collected: Reach 9

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
6/26/83	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf
6/30/83	47.5	---	---	---	No	No	None
7/26/83	---	97.62	210	3	No	No	None
7/29/83	103	---	---	---	No	No	None
9/15-16 /83	136	101.36	---	1	Yes	Yes	None
		100.22	---	2	Yes	No	None
		98.61	920	3	Yes	Yes	None
		97.84	---	4	Yes	Yes	None
6/27-28 /84	---	---	---	1	Yes	Yes	Surf-subsurf
		98.74	---	2	Yes	Yes	None
		97.57	190	3	Yes	Yes	None
		97.02	---	4	Yes	Yes	Surf-subsurf
8/13/84	106	---	---	---	No	No	None
9/13-14	89	101.17	---	1	Yes	Yes	Surf-subsurf
		99.65	---	2	Yes	Yes	None
		98.39	690	3	Yes	Yes	None
		97.74	---	4	Yes	Yes	Surf-subsurf

Table 9B.--Particle count data: Reach 9

Date of collection	Cross section	Bed material (particle count) Percent finar than aize indicated, in millimeters 4	8	16	32	64	128	256	512	1024	2048
June 26, 1983	1	3	5	11	33	56	80	92	100	--	--
	2	17	28	42	53	67	73	86	97	100	--
	3	18	31	50	63	71	78	89	97	100	--
	4	2	6	16	49	70	84	96	100	--	--
Sept. 16, 1983	1	10	12	17	24	40	67	85	97	100	--
Sept. 16, 1983	3	18	30	45	59	67	74	89	98	100	--
	4	11	19	32	50	62	79	92	100	--	--
June 27, 1984	1	12	19	30	36	50	69	89	97	100	--
	2	39	46	54	64	74	80	90	99	100	--
	3	25	43	61	64	68	76	90	98	99	100
	4	13	28	48	64	70	81	90	100	--	--
Sept. 13, 1984	1	13	13	19	33	54	72	94	99	100	--
	2	11	13	14	21	41	61	78	98	100	--
	3	9	12	19	48	60	76	86	98	100	--
	4	16	21	34	50	61	80	96	99	100	--

Table 9C.--Bed material sample analysis data: Reach 9

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 26, 1983	1	60	Surface	2	3	4	7	7	8	8	10	12	24	57	100
	1	60	Subsurf	2	4	8	14	19	23	28	38	53	69	75	100
	4	60	Surface	2	4	6	10	10	13	14	19	28	53	75	100
	4	60	Subsurf	2	4	8	15	25	33	36	47	64	84	100	--
June 27, 1984	1	58	Surface	3	6	7	8	8	8	8	9	11	14	44	100
	1	58	Subsurf	1	2	5	8	10	11	14	22	33	52	71	100
June 28, 1984	4	60	Surface	--	1	3	6	12	16	26	47	90	100	--	--
	4	60	Subsurf	1	4	8	14	26	34	44	59	83	91	100	--
Sept. 13, 1984	1	57	Surface	--	--	--	1	1	1	1	1	3	14	50	100
	1	57	Subsurf	1	2	4	8	11	14	20	30	50	74	100	--
	4	60	Surface	1	2	3	6	12	14	26	51	87	100	--	--
	4	60	Subsurf	1	1	4	8	19	22	33	50	72	90	100	--

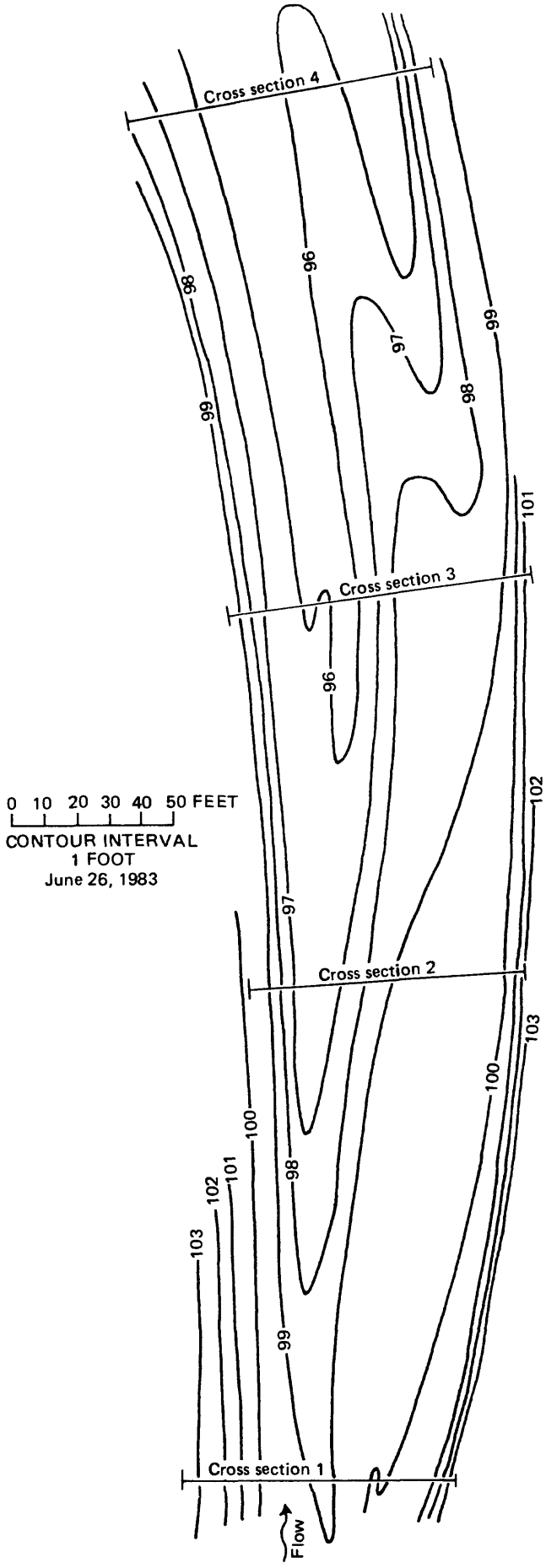


Figure 9A.-- Plan view and location of cross sections at study reach 9: North Fork Moose Creek near mouth near Kantishna.

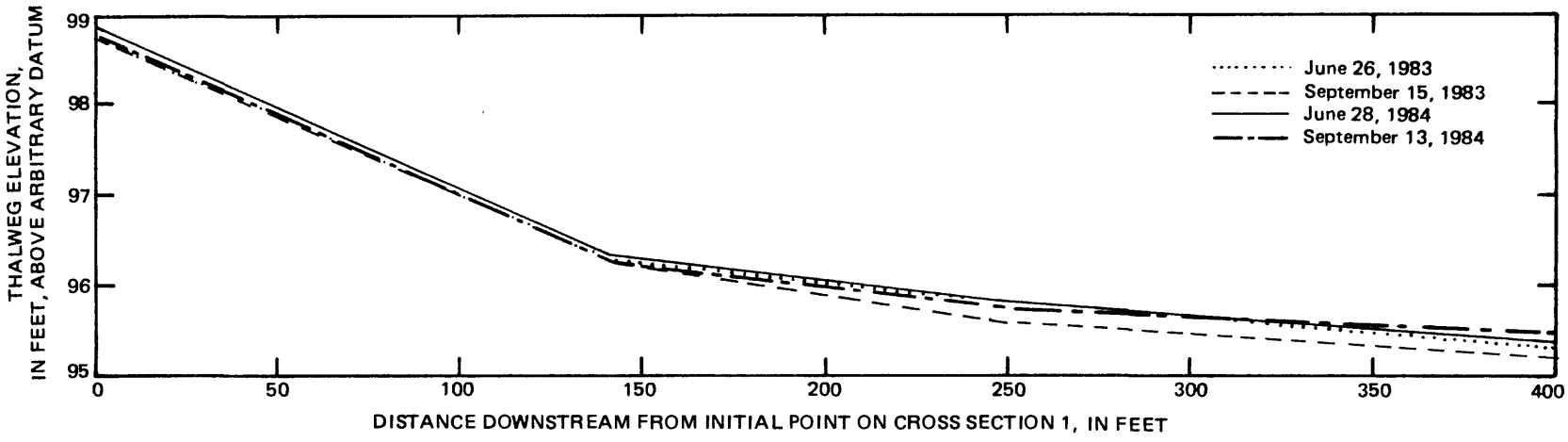


Figure 9B.--Thalweg profile at study reach 9: North Fork Moose Creek near mouth near Kantishna.

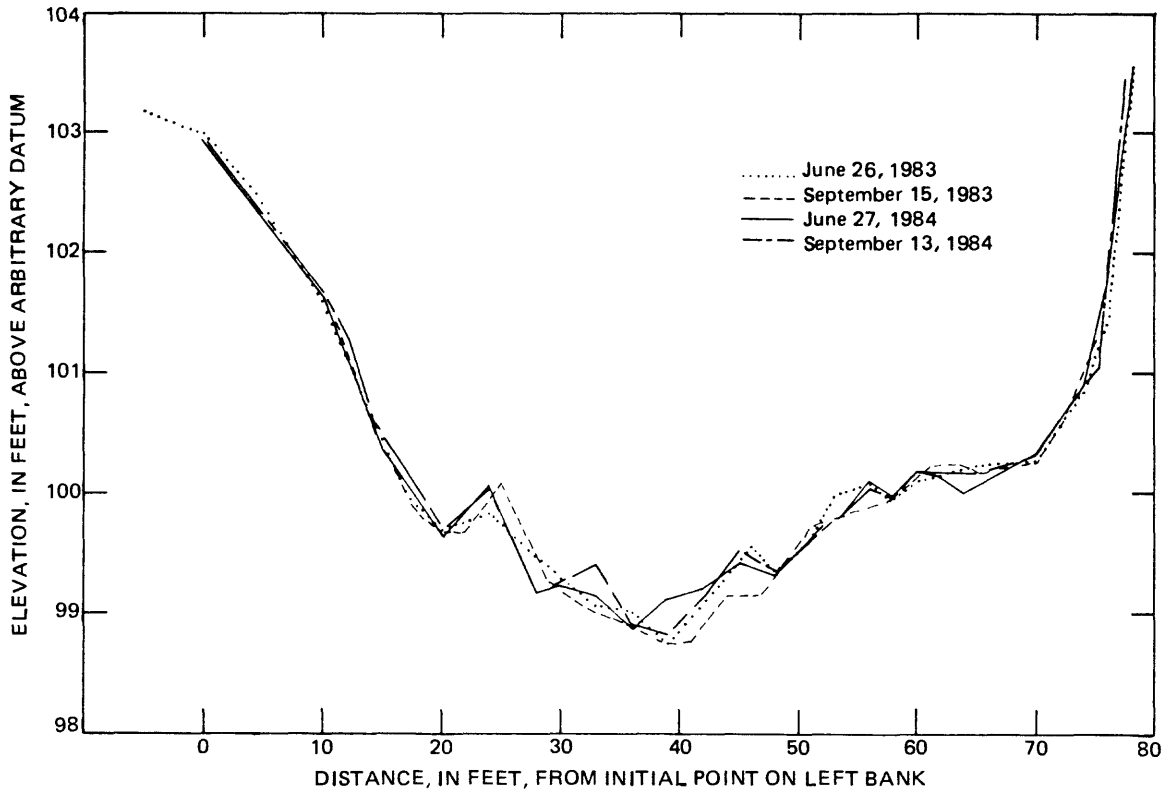


Figure 9C.--Cross section 1 at study reach 9: North Fork Moose Creek near mouth near Kantishna.

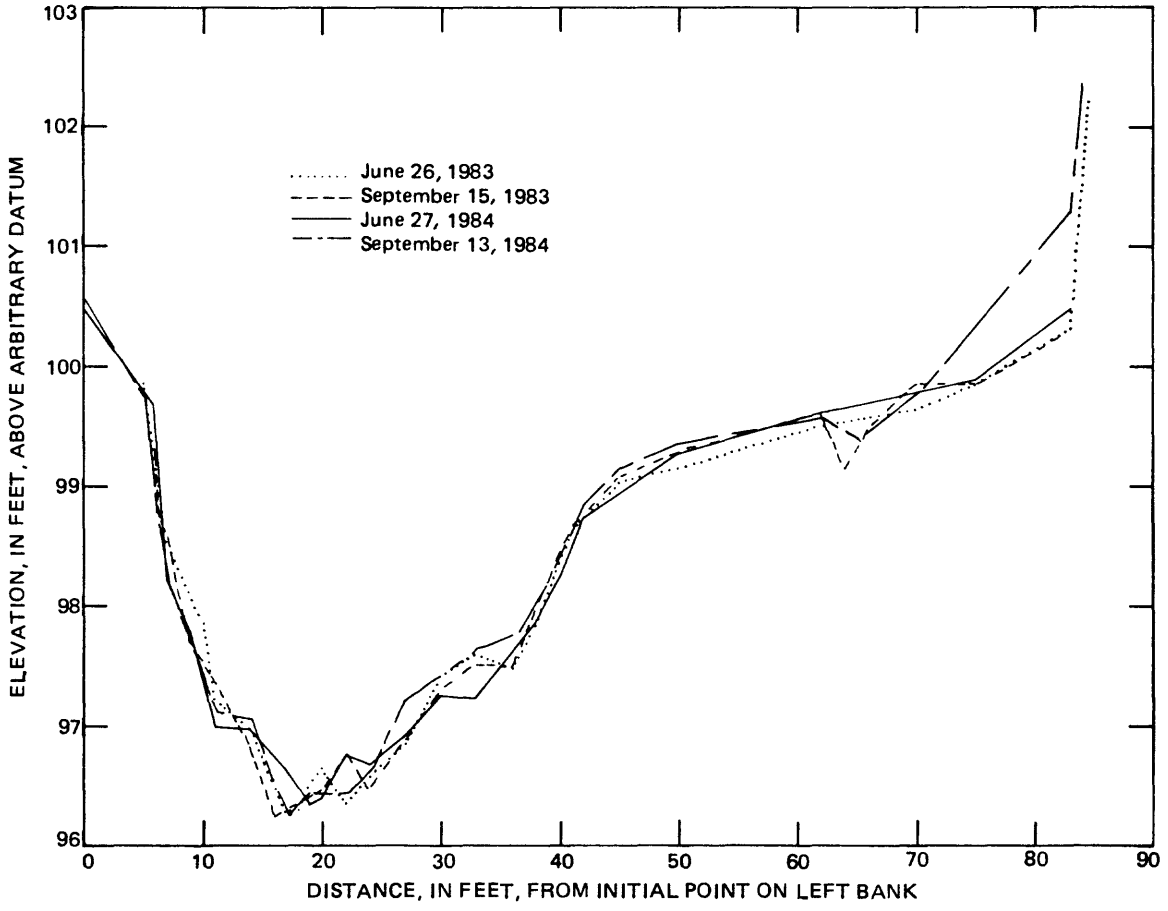


Figure 9D.--Cross section 2 at study reach 9: North Fork Moose Creek near mouth near Kantishna.

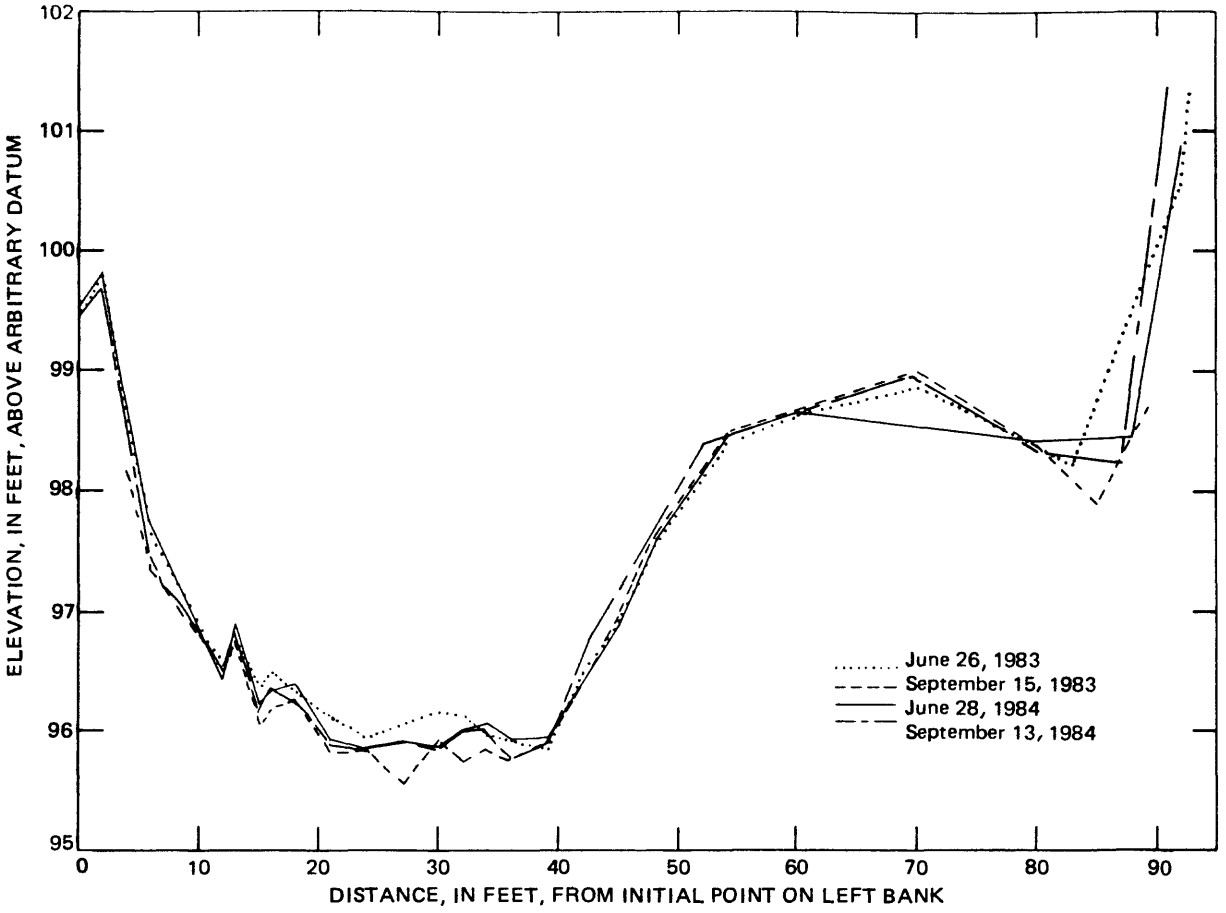


Figure 9E.--Cross section 3 at study reach 9: North Fork Moose Creek near mouth near Kantishna.

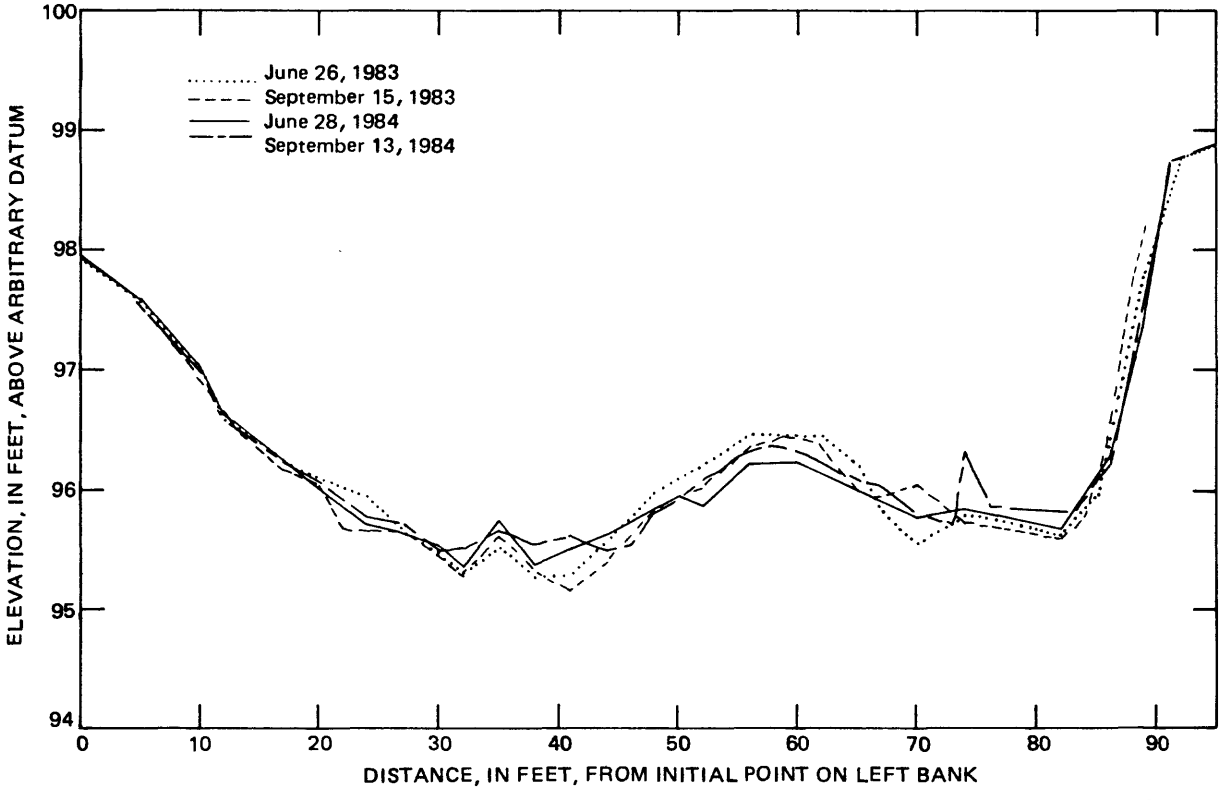


Figure 9F.--Cross section 4 at study reach 9: North Fork Moose Creek near mouth near Kantishna.

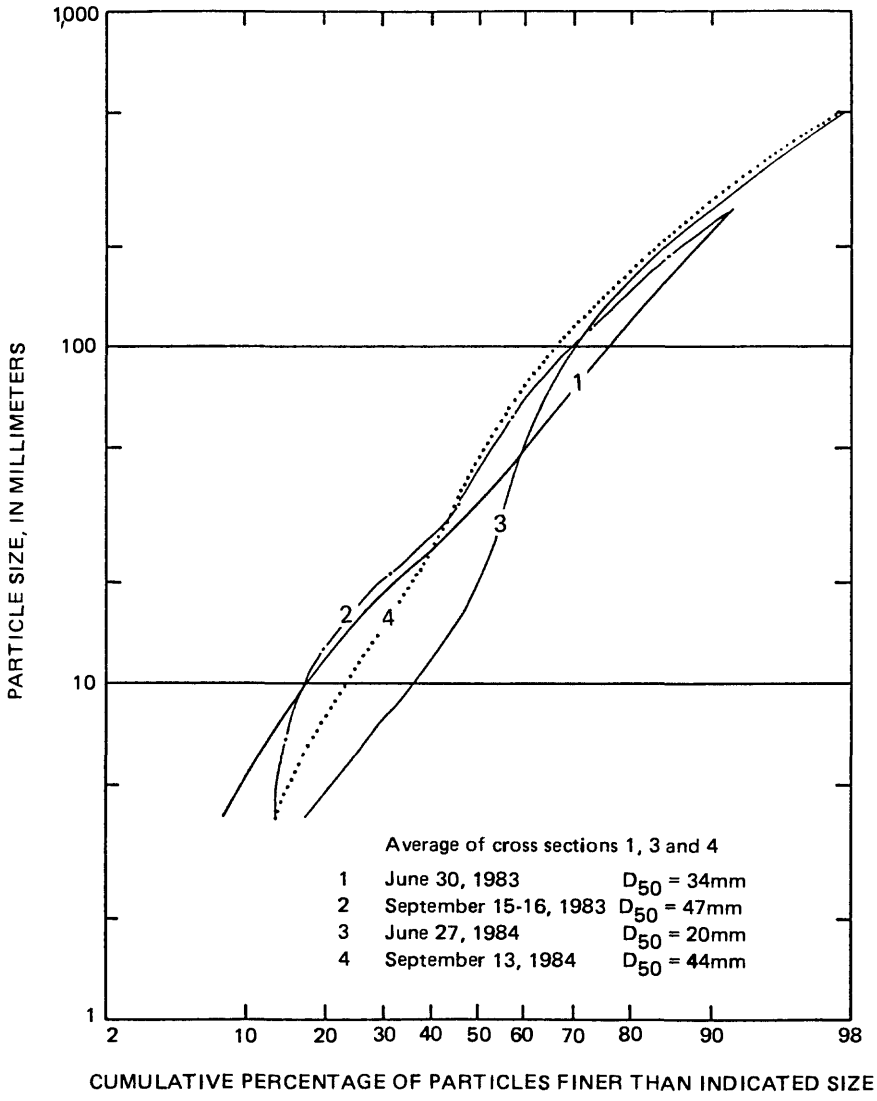


Figure 9G.--Particle-size distribution (particle-count method) of bed material at study reach 9: North Fork Moose Creek near mouth near Kantishna.

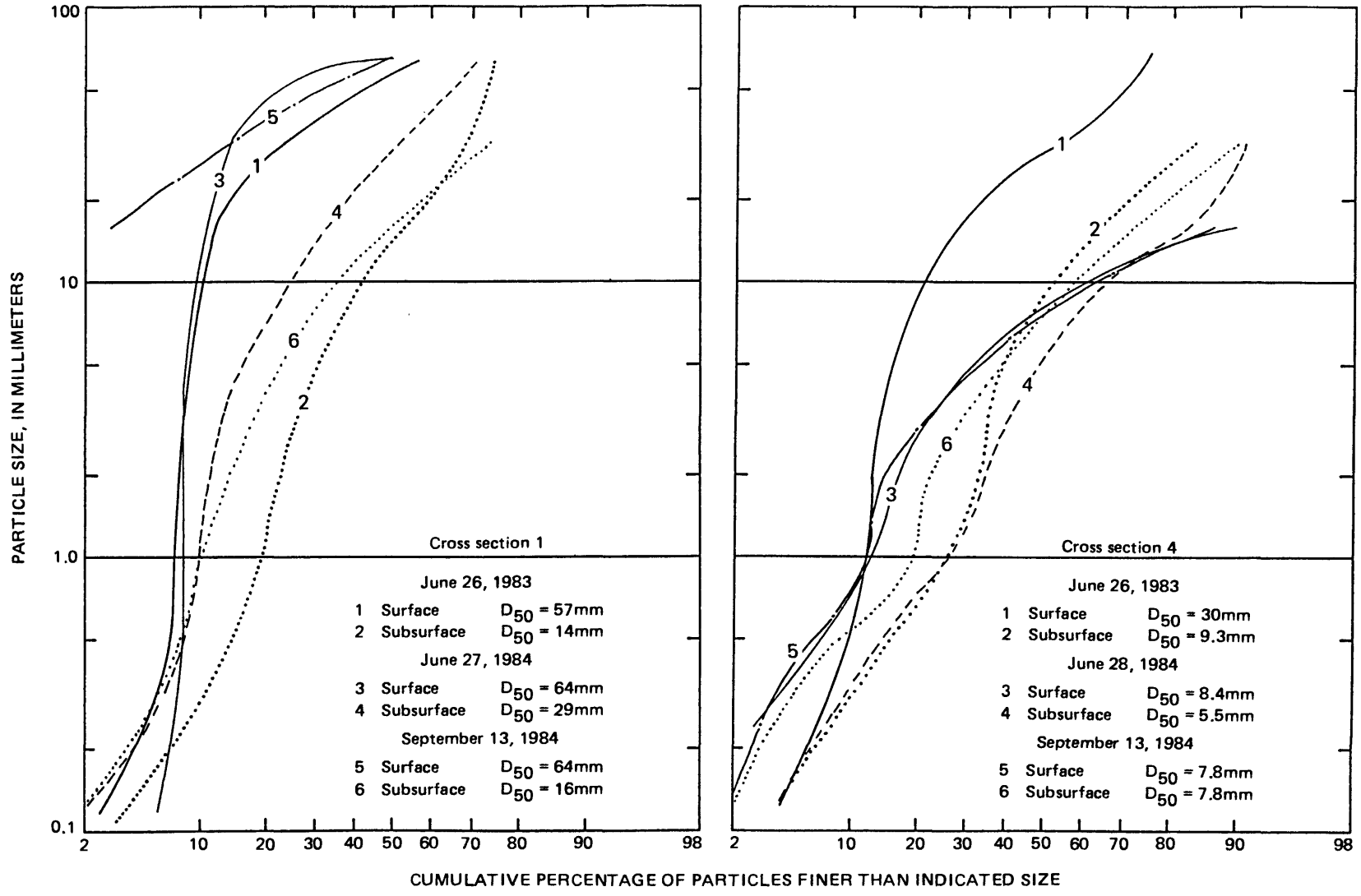


Figure 9H.--Particle-size distribution (sieve analysis) of bed material at study reach 9: North Fork Moose Creek near mouth near Kantishna.

Figure 9I.--Particle-size distribution (sieve analysis) of bed material at study reach 9, North Fork Moose Creek near mouth near Kantishna.

STUDY REACH 10: JUMBO CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°30'47", Long 150°46'16", in NW¼SW¼ Sec.24, T.16S., R.17W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.1 mi upstream from mouth, and 5.8 mi east of Kantishna.

Reach 10 has a length of 190 ft and is an expanding reach. Three cross sections were established at 95-foot intervals. Both banks of the channel between bedrock outcrops are lined with brush. Channel width averages 40 ft. Consecutive cross-section surveys showed alternating scour and fill in sections 2 and 3, and a slight overall fill in section 1. There was no change in channel configuration during the study.

Particle-count data showed minor variations but no significant changes in bed material composition. The sieve analyses results, however, did indicate a trend toward finer material.

Table 10A.-- Summary of data collected: Reach 10

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
6/29/83	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	None
		---	---	3	Yes	Yes	None
7/29/83	8.33	---	---	---	No	No	None
9/14/83	18.8	100.95	---	1	Yes	Yes	None
		97.71	59	2	Yes	No	None
		95.72	---	3	Yes	Yes	None
6/26/84	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	Surf-subsurf
		95.03	---	3	Yes	Yes	None
8/10/84	---	100.51	---	1	Yes	Yes	Surf-subsurf
		97.22	32	2	Yes	No	None
		95.03	---	3	Yes	Yes	Surf-subsurf
8/13/84	9.15	---	---	---	No	No	None

Table 10B.-- Particle count data: Reach 10

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024	2048
June 29, 1983	1	--	3	15	34	53	65	81	95	98	100
	3	3	6	13	31	54	70	88	98	100	--
Sept. 14, 1983	1	--	--	1	7	17	47	75	94	100	--
	3	4	9	15	28	45	61	82	98	100	--
June 26, 1984	1	2	10	12	22	40	67	79	94	99	100
	3	6	14	24	39	56	71	90	99	100	--
Aug. 10, 1984	1	16	16	16	16	36	53	83	94	99	100
	3	4	9	15	32	53	71	91	100	--	--

Table 10C.--Bed material sample analysis data: Reach 10

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 29, 1983	1	30	Surface	--	--	--	1	1	1	1	1	3	10	25	100
	1	30	Subsurf	1	1	1	4	11	22	28	43	62	82	100	--
June 26, 1984	1	30	Surface	--	--	--	--	--	--	--	1	6	21	61	100
	1	30	Subsurf	--	--	--	1	6	13	25	41	61	78	100	--
	2	30	Surface	--	--	--	1	1	1	1	3	9	47	100	--
	2	30	Subsurf	--	--	1	1	8	17	28	44	62	76	86	100
Aug. 10, 1984	1	30	Surface	--	--	--	--	--	1	1	3	9	44	100	--
	1	30	Subsurf	--	--	1	2	14	25	40	58	76	100	--	--
	3	25	Surface	--	--	--	--	--	--	--	1	3	8	12	100
	3	25	Subsurf	--	--	--	--	--	1	4	12	26	51	55	100

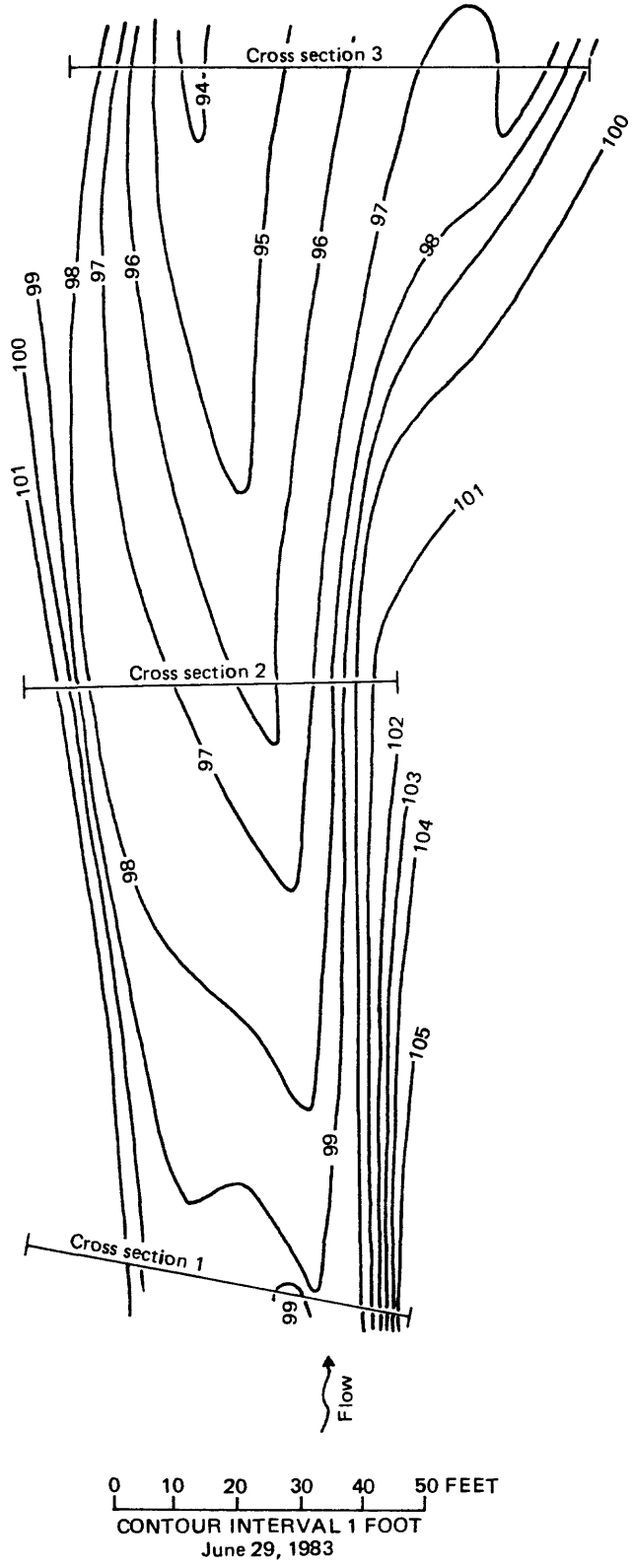


Figure 10A.--Plan view and location of cross sections at study reach 10: Jumbo Creek near Kantishna.

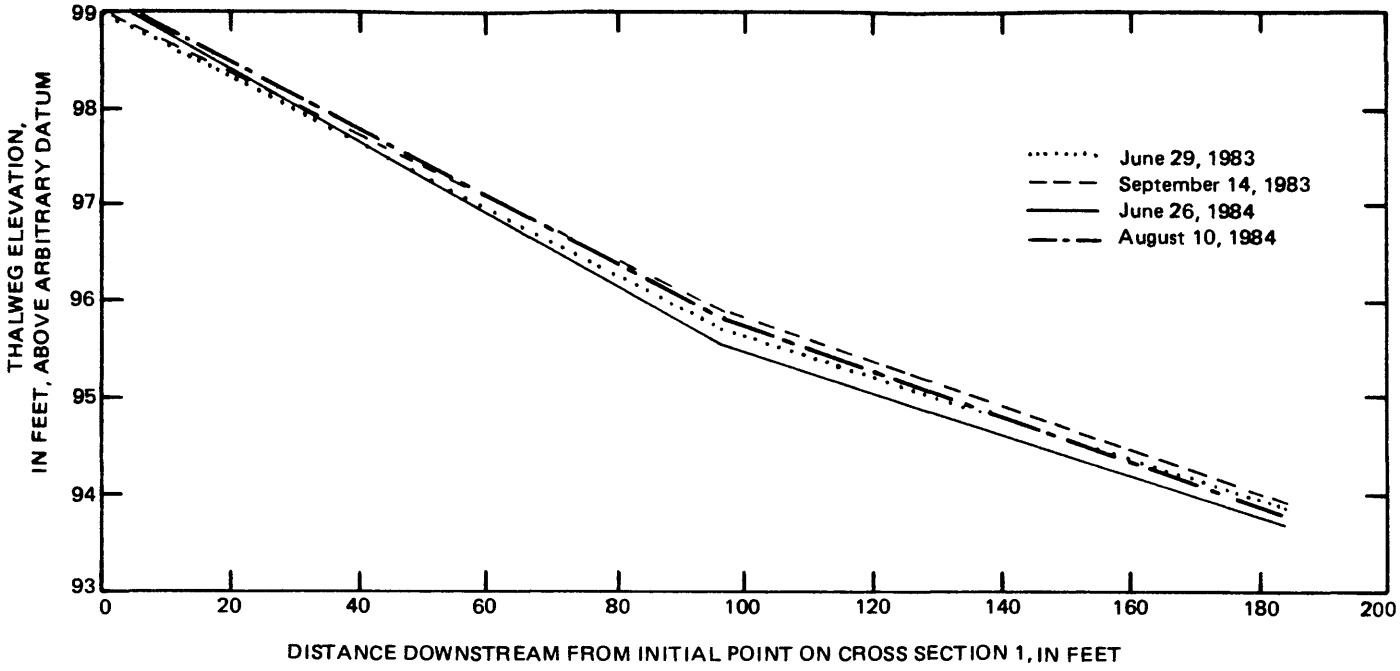


Figure 10B.--Thalweg profile at study reach 10. Jumbo Creek near Kantishna.

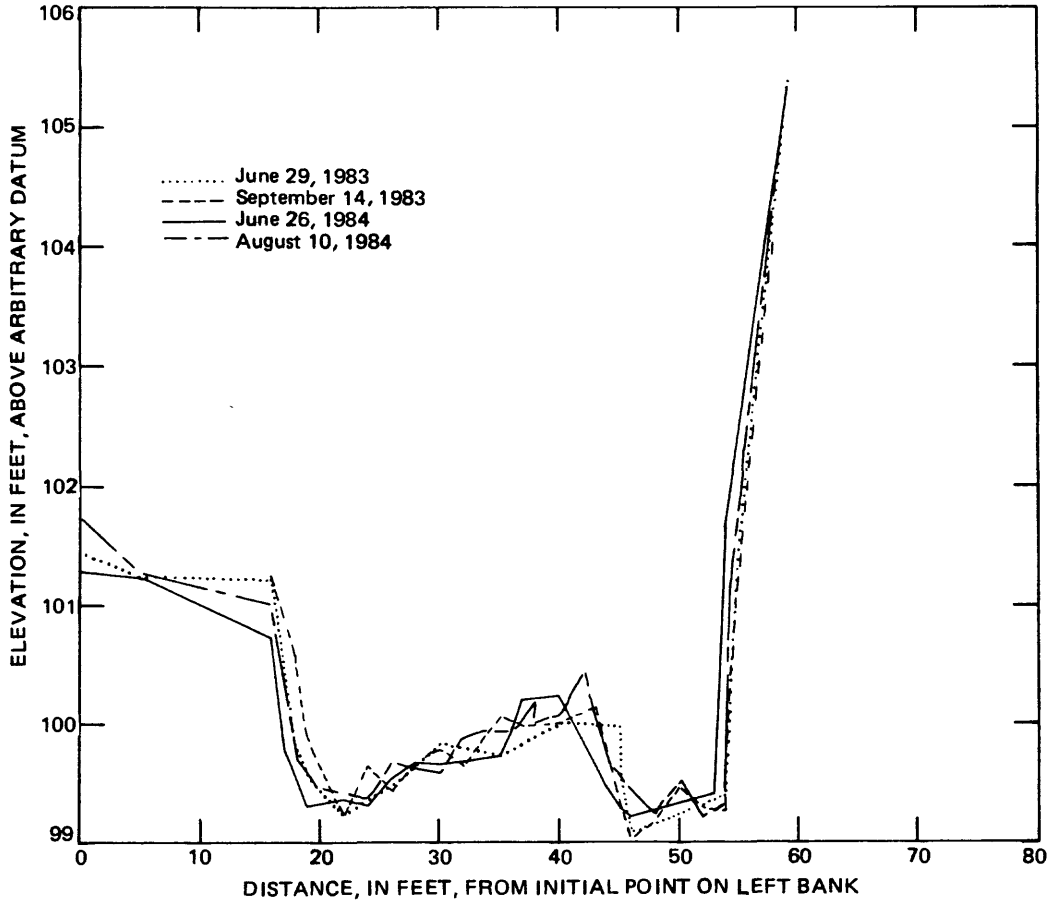


Figure 10C.--Cross section 1 at study reach 10: Jumbo Creek near Kantishna.

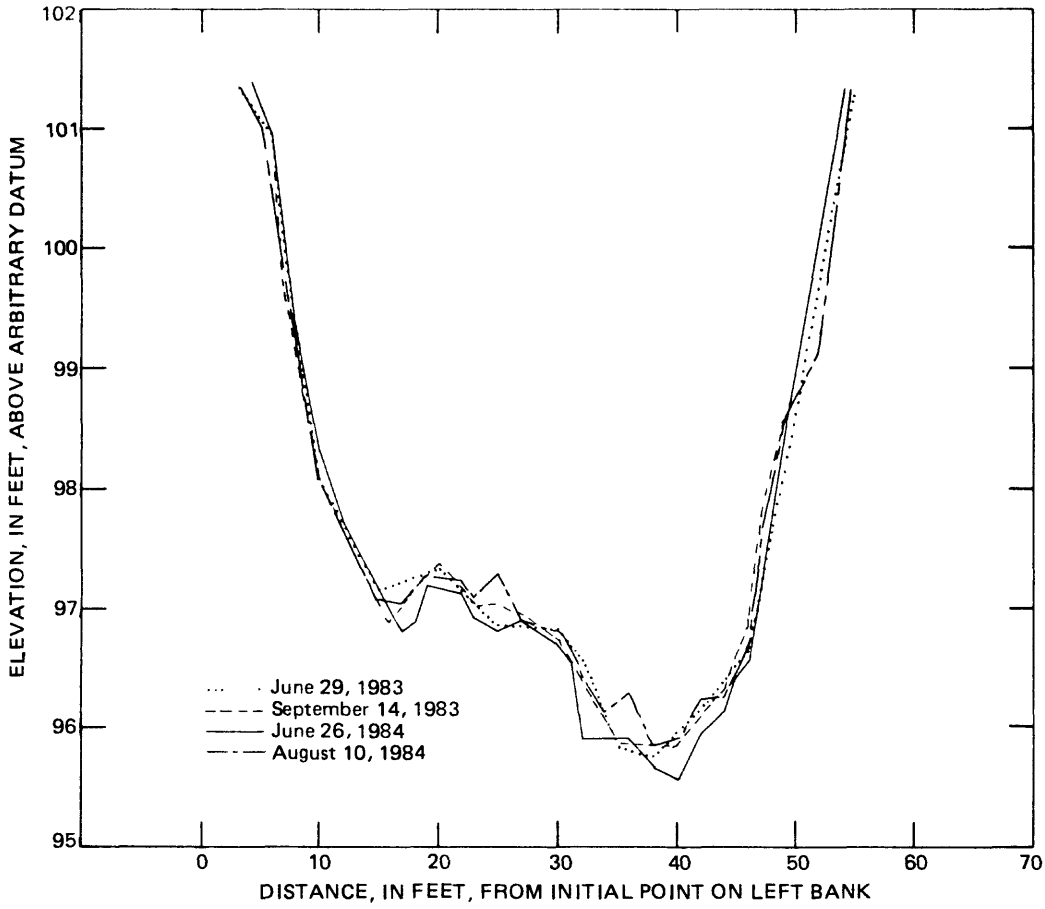


Figure 10D.--Cross section 2 at study reach 10: Jumbo Creek near Kantishna.

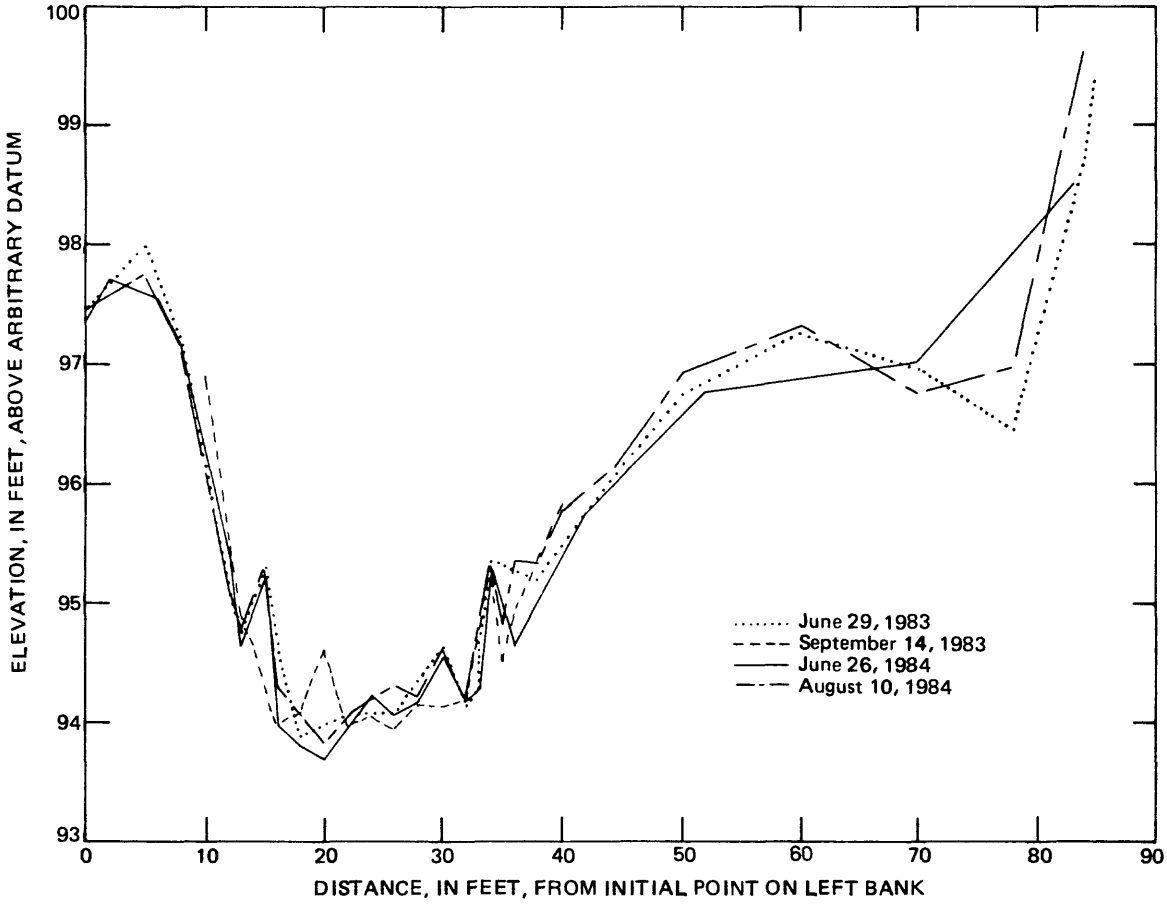


Figure 10E.--Cross section 3 at study reach 10: Jumbo Creek near Kantishna.

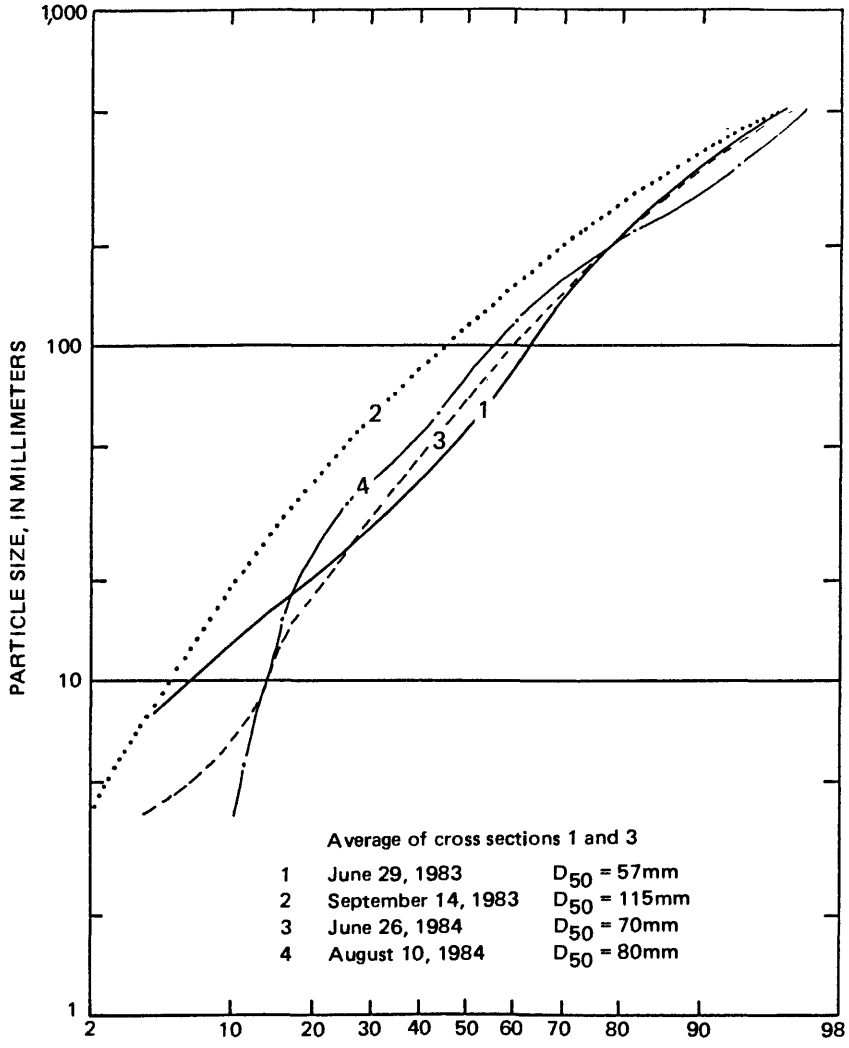
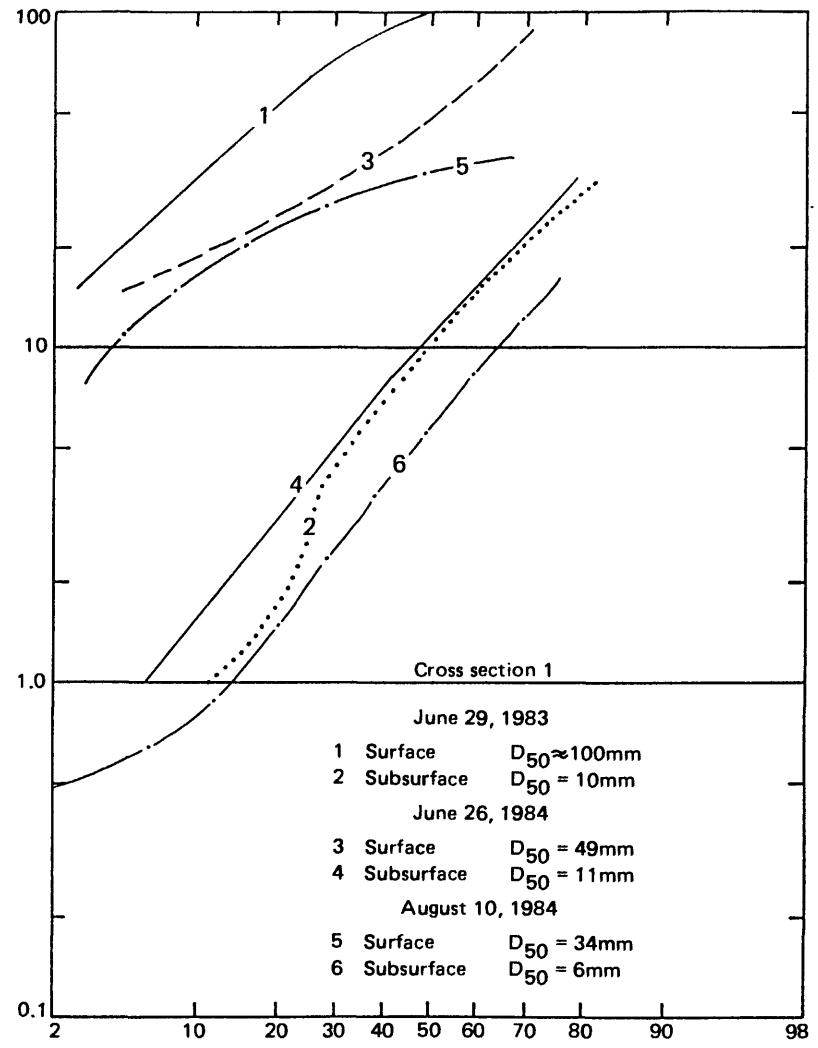


Figure 10F.--Particle-size distribution (particle-count method) of bed material at study reach 10: Jumbo Creek near Kantishna.



CUMULATIVE PERCENTAGE OF PARTICLES FINER THAN INDICATED SIZE

Figure 10G.--Particle-size distribution (sieve analysis) of bed material at study reach 10: Jumbo Creek near Kantishna.

STUDY REACH 11: RAINY CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°31'17", Long 150°47'44", in SE¼SW¼ Sec.14, T.16S., R.17W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.5 mi upstream from mouth, and 5.0 mi east of Kantishna.

Study reach 11, approximately 100 ft long, lies downstream from two abandoned settling ponds. The ponds have diverted a substantial amount of the stream's flow from the natural channel onto the left bank, creating a new channel about 25 ft to the left (west) of the former stream course. Flow in the new channel originates at the left bank settling pond and meanders through heavy brush and large trees along the left bank. The new channel was eroding material along its course and tree roots are exposed along its path.

Three cross sections were established in the reach. Cross sections 1 and 3 cover the total width of the reach, while cross section 2 spans only the original stream channel. Cross-section surveys indicate considerable movement of material on the left bank as the water flowing from the left bank settling pond travels through the vegetation and cuts a new channel. The original stream channel on the right bank is filling, probably due to the reduction in flow.

Particle counts of the bed material indicate that the mean bed material size at the time of the initial count, July 1, 1983, was coarser (d50=32mm) than that at the time of subsequent counts (d50=2.5mm-12mm). Sieve analysis of bed material samples showed no significant changes between the two sampling dates in 1983, and that surface material was finer in 1984. Analyses of subsurface material indicated very minor differences between the two years.

Table 11A.--Summary of data collected: Reach 11

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
9/9/83	---	---	---	3	Yes	No	None
6/24/83	---	---	---	1	Yes	No	None
		---	---	2	Yes	No	None
		---	---	3	Yes	No	None
7/1/83	---	---	---	1	No	Yes	Surf-subsurf
8/12/83	---	---	---	1	Yes	No	Surf-subsurf
		---	---	2	No	No	None
		---	---	3	Yes	No	None
9/14/83	---	---	---	1	Yes	Yes	None
		---	---	2	Yes	No	None
		---	---	3	Yes	No	None
6/27/84	---	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	No	None
		---	---	3	Yes	Yes	Surf-subsurf
8/10/84	---	102.07	---	1	Yes	Yes	Surf-subsurf
		98.50	---	2	Yes	No	None
		97.05	---	3	Yes	Yes	Surf-subsurf

Table 11B.-- Particle count data: Reach 11

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024
July 1, 1983	1	19	29	38	50	67	77	90	98	100
Sept. 14, 1983	1	52	55	60	70	80	85	98	100	--
June 27, 1984	1	43	56	62	72	79	86	97	100	--
	3	41	52	63	74	78	82	100	--	--
Aug. 10, 1984	1	43	45	57	71	78	79	97	100	--
	3	36	43	50	79	86	86	100	--	--

Table 11C.--Bed material sample analysis data: Reach 11

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0	256.0
July 1, 1983	1	40	Surface	--	--	--	--	--	--	--	--	--	2	24	100	--
	1	40	Subsurf	--	1	1	4	6	11	18	30	49	77	100	--	--
	1	80	Surface	--	--	--	--	--	--	--	--	--	--	29	100	--
	1	80	Subsurf	--	--	--	--	--	1	1	4	10	37	100	--	--
Aug. 12, 1983	1	41	Surface	--	--	--	--	--	--	--	--	1	7	22	100	--
	1	41	Subsurf	1	1	1	3	4	8	12	23	42	68	100	--	--
June 27, 1984	1	40	Surface	--	--	--	--	--	1	1	4	12	38	86	100	--
	1	40	Subsurf	1	2	3	4	10	15	24	37	59	82	100	--	--
	3	95	Surface	--	--	--	--	--	--	--	--	1	13	48	100	--
	3	95	Subsurf	--	--	1	8	3	5	9	18	32	58	87	100	--
Aug. 10, 1984	1	40	Surface	--	--	--	--	--	--	--	--	4	13	60	100	--
	1	40	Subsurf	1	2	3	5	8	12	17	31	51	90	100	--	--
	3	93	Surface	--	--	--	--	--	--	--	--	--	3	22	30	100
	3	93	Subsurf	--	1	3	5	8	10	15	22	35	61	100	--	--

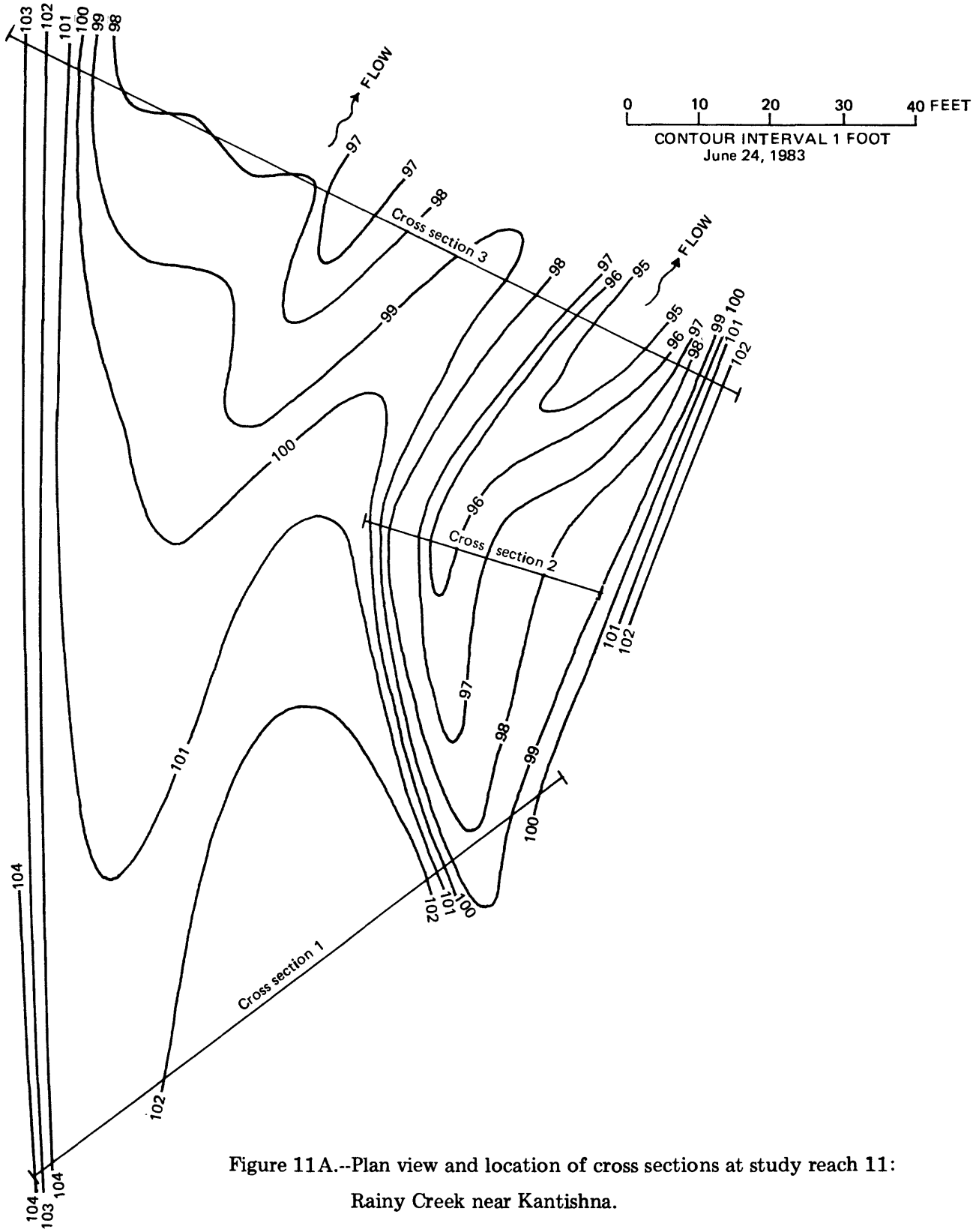


Figure 11A.--Plan view and location of cross sections at study reach 11: Rainy Creek near Kantishna.

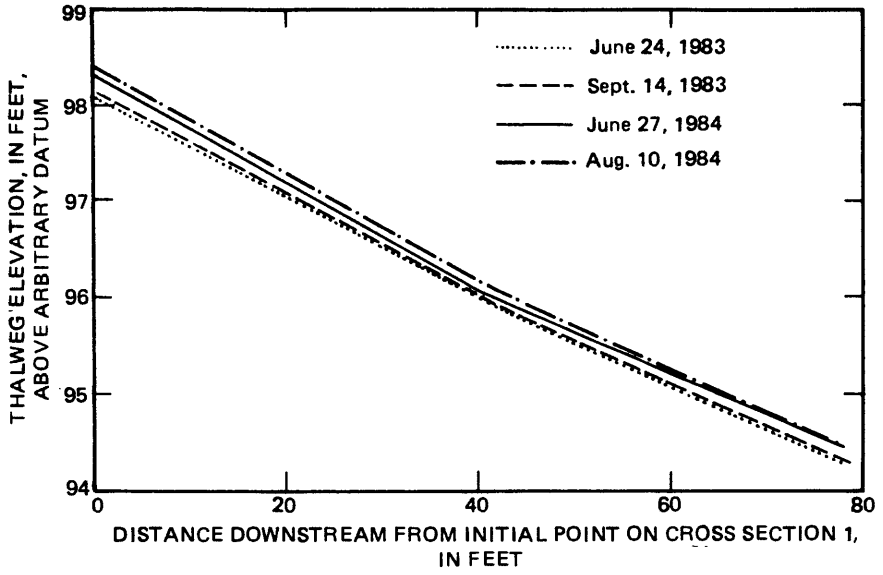


Figure 11B.--Thalweg profile at study reach 11: Rainy Creek near Kantishna.

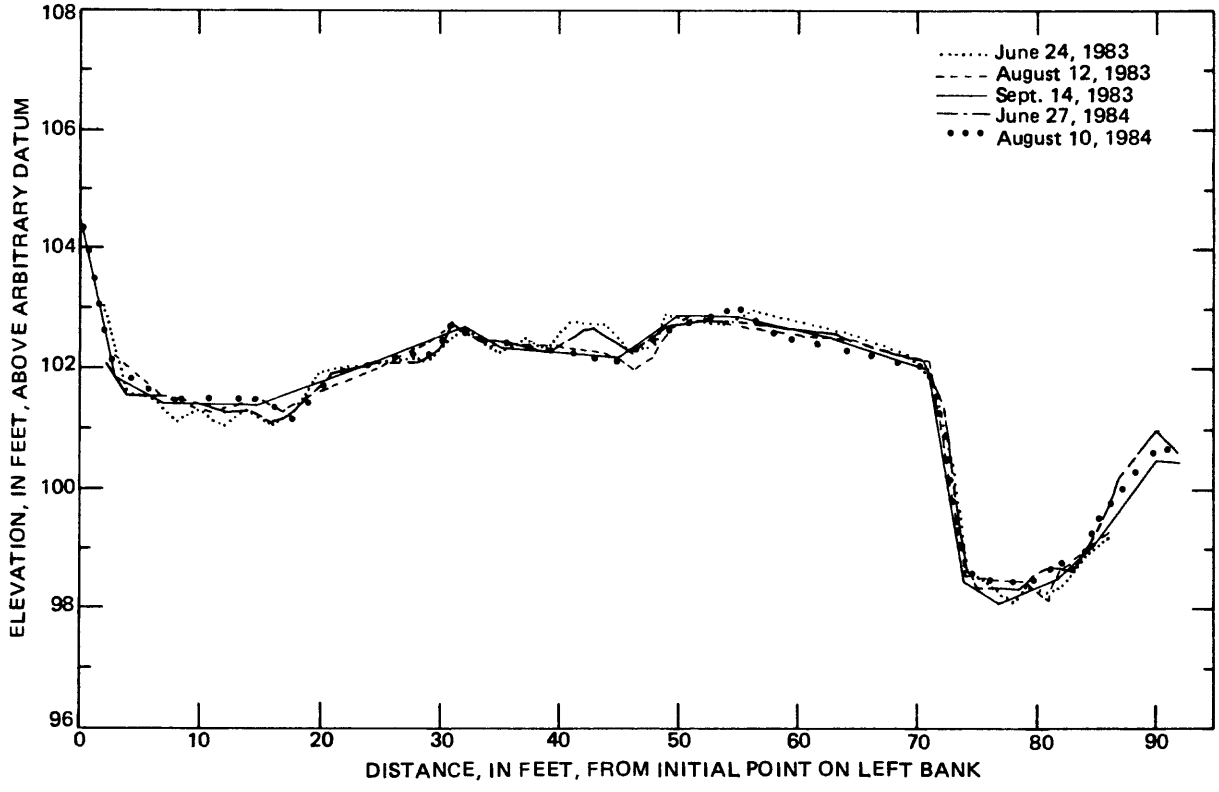


Figure 11C.--Cross section 1 at study reach 11: Rainy Creek near Kantishna.

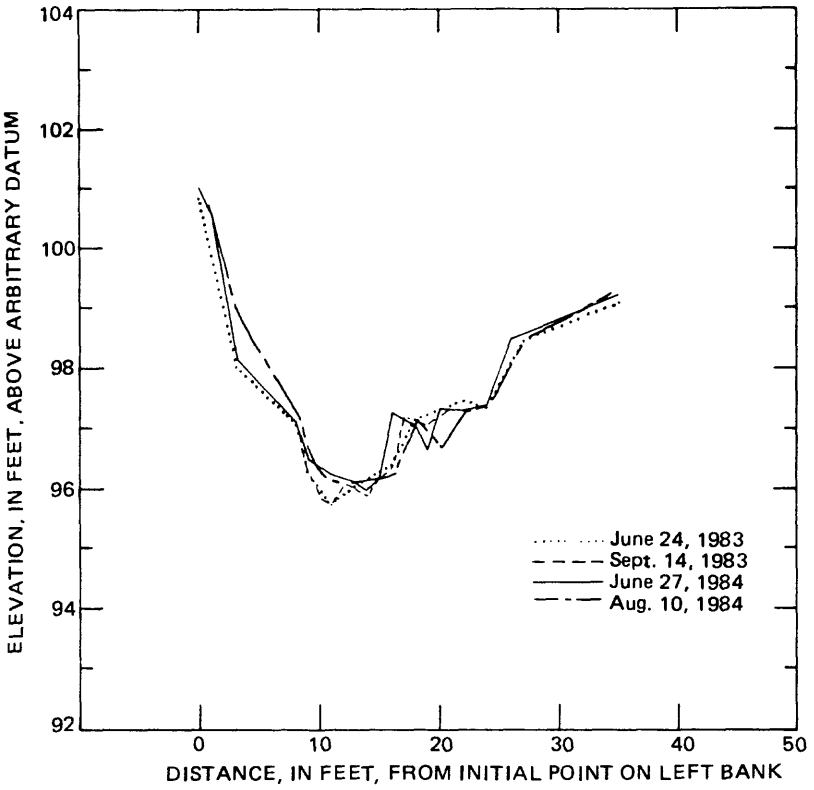


Figure 11D.--Cross section 2 at study reach 11: Rainy Creek near Kantishna.

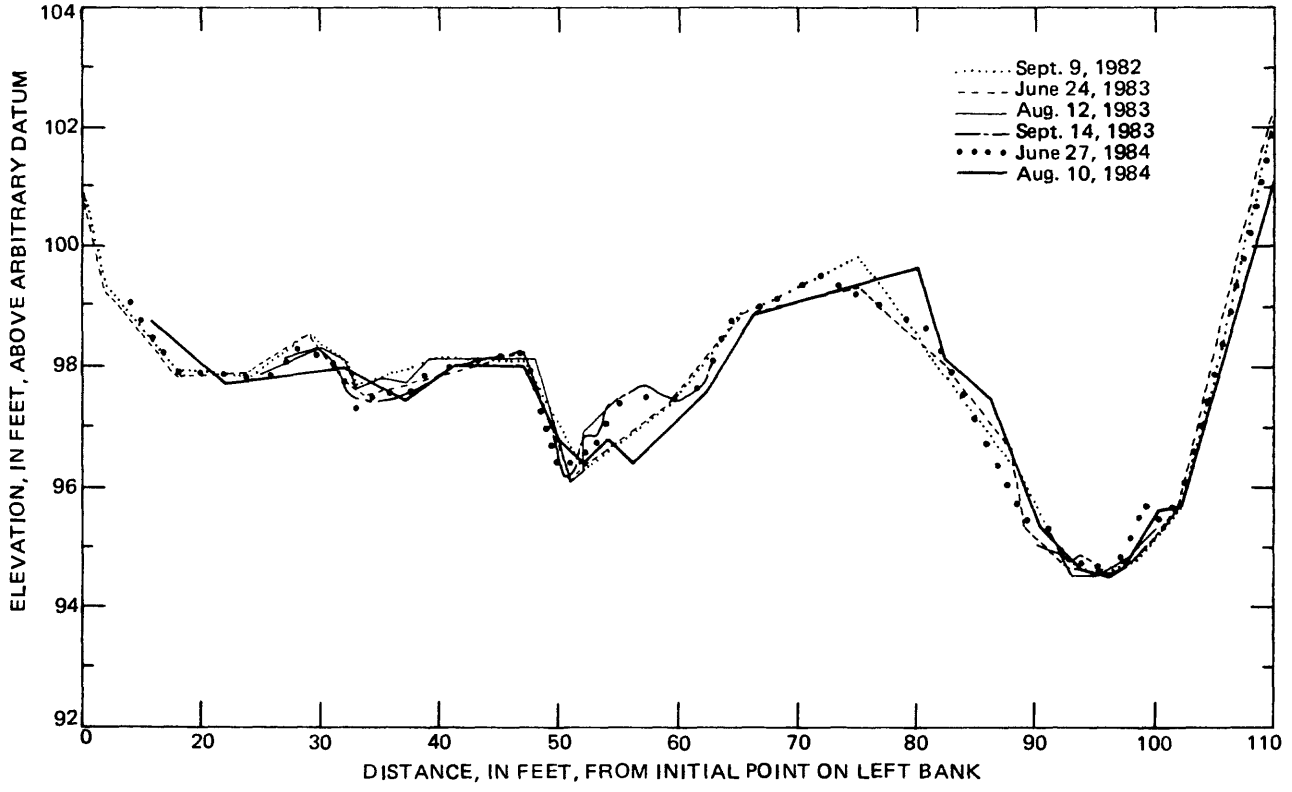


Figure 11E.--Cross section 3 at study reach 11: Rainy Creek near Kantishna.

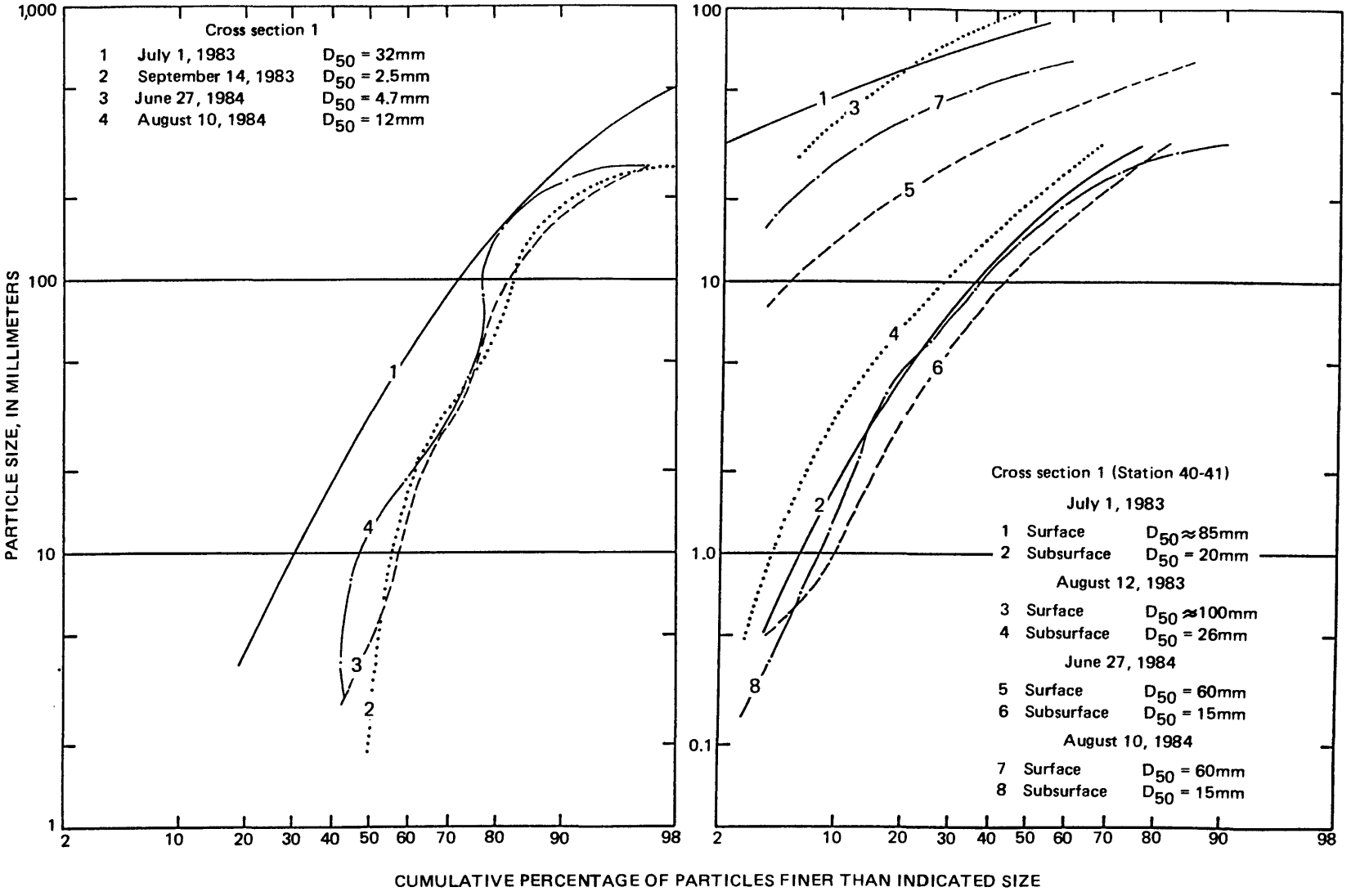


Figure 11F.--Particle-size distribution (particle-count method) of bed material at study reach 11: Rainy Creek near Kantishna.

Figure 11G.--Particle-size distribution (sieve analysis) of bed material at study reach 11: Rainy Creek near Kantishna.

STUDY REACH 12: MOOSE CREEK NEAR KANTISHNA

LOCATION.---Lat 63°31'00", Long 150°54'26", in SE¼NE¼ Sec.19, T.16S., R.17W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 30 ft downstream from Lake Creek and 1.7 mi east of Kantishna.

No cross sections were established at this site. A staff gage was installed on the upstream side of the bridge across Moose Creek. A stage discharge relation was developed for the staff gage on the basis of stream discharge measurements made at the site. This relation was used to compute stream discharge at the time of periodic staff gage readings.

Table 12A.--Summary of discharge measurements: Reach 12

Meas. No.	Date	Stage (ft)	Discharge (ft^3/s)
1	June 30, 1983	0.96	129
2	July 27, 1983	1.36	262
3	July 29, 1983	1.33	245
4	Aug. 9, 1983	1.59	357
5	June 30, 1984	1.22	181
6	July 21, 1984	1.87	489
7	Aug. 12, 1984	1.46	250
8	Sept. 15, 1984	1.29	207

Table 12B.--Periodic staff gage readings and computed discharges in 1983: Reach 12

Day	June		July		August		September	
	Stage (ft)	Disch. (ft^3/s)	Stage (ft)	Disch. (ft^3/s)	Stage (ft)	Disch. (ft^3/s)	Stage (ft)	Disch. (ft^3/s)
1	--	--	0.94	122	1.28	230	--	--
2	--	--	1.01	142	--	--	--	--
3	--	--	.92	117	1.21	206	--	--
4	--	--	.90	111	1.55	335	--	--
5	--	--	.98	133	--	--	--	--
6	--	--	1.13	179	--	--	--	--
7	--	--	1.16	189	--	--	--	--
8	--	--	--	--	--	--	--	--
9	--	--	--	--	1.58	348	--	--
10	--	--	--	--	1.48	306	--	--
11	--	--	--	--	1.58	348	--	--
12	--	--	--	--	1.70	402	--	--
13	--	--	1.18	196	1.58	348	1.68	393
14	--	--	1.12	176	--	--	1.66	384
15	--	--	1.06	157	--	--	1.64	374
16	--	--	1.04	151	--	--	1.60	357
17	--	--	1.48	306	1.72	411	1.58	348
18	--	--	1.66	384	1.84	469	--	--
19	--	--	1.52	323	2.98	1,200	--	--
20	--	--	1.44	290	--	--	--	--
21	--	--	1.34	252	--	--	--	--
22	--	--	--	--	--	--	--	--
23	0.89	109	--	--	--	--	--	--
24	.87	104	--	--	2.20	664	--	--
25	.85	99	--	--	--	--	--	--
26	.79	84	1.27	226	--	--	--	--
27	.85	99	1.42	283	--	--	--	--
28	--	--	1.30	237	--	--	--	--
29	.89	109	1.30	237	1.90	499	--	--
30	.99	136	--	--	2.27	709	--	--
31	--	--	--	--	--	--	--	--

Table 12C.--Periodic staff gage readings and computed discharges in 1984: Reach 12

Date	Stage (ft)	Discharge (ft^3/s)
June 26	1.08	136
27	1.40	241
28	1.38	234
29	1.16	160
30	1.17	164
July 1	1.06	130
2	1.06	130
3	1.32	216
20	1.14	157
21	1.92	510
22	1.58	323
23	1.40	244
24	1.38	237
Aug. 10	1.56	306
11	1.47	271
12	1.43	256
13	1.42	252
Sept. 15	1.29	206
17	1.26	196

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STUDY REACH 13: MOOSE CREEK BELOW FRIDAY CREEK NEAR KANTISHNA

LOCATION.--- Lat 63°32'24", Long 150°59'29", in NW¼SW¼ Sec.11, T.16S., R.18W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 0.1 mi downstream from Friday Creek, and 1.4 mi northwest of Kantishna.

There are five cross sections at study reach 13; total reach length is approximately 1,800 ft. Cross sections 1 through 4, spaced at 120-foot intervals, were established in 1983. Cross section 5, located 1,440 ft downstream from cross section 4 was established in 1982. Channel width averages 80 ft between vegetated banks, with a total average reach width of 230 ft. Cross-section surveys indicated very minor change in channel geometry during the study period. Cross sections 3 and 5 did show minor changes in streambed elevation, indicating some movement of bed material.

Particle-count data collected in cross sections 1 to 4 showed virtually no changes in bed material composition. Sieve analysis of bed material samples collected at cross section 1 showed no net change during the study. However, the sample collected on July 23, 1984 had a finer surface layer and a coarser subsurface layer than the other samples.

Table 13A.--Summary of data collected: Reach 13
[CSG, crest-stage gage]

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
9/2/82	---	79.42	---	5	Yes	No	None
6/23-24 /83	---	---	---	1	Yes	Yes	Surf-subsurf
		91.21	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surface
		77.73	---	5	Yes	No	None
6/30/83	156	---	---	3	No	No	None
7/26/83	---	91.16	570	3 CSG	No	No	None
7/29/83	249	90.86	360	3 CSG	No	No	None
8/9/83	---	91.25	650	3 CSG	No	No	None
		---	---	5	Yes	No	None
8/11/83	365	91.03	470	3 CSG	No	No	None
9/16-17 /83	---	94.34	---	1	Yes	No	None
		92.66	---	2	Yes	No	None
		92.73	3,350	3 CSG	Yes	No	None
		91.56	---	4	Yes	Yes	None
		77.83	---	5	Yes	No	None
6/29/84	---	---	---	5	Yes	No	None
7/2/84	---	93.76	7,800	3 CSG	No	No	None
7/20-24 /84		---	---	1	Yes	Yes	Surf-subsurf
		91.86	---	2	Yes	Yes	None
	266	91.34	730	3 CSG	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf
8/10/84	---	92.07	1,700	3 CSG	No	No	None
8/13/84	246	---	---	---	No	No	None
9/12-16 /84	235	93.73	---	1	Yes	Yes	Surf-subsurf
		92.56	---	2	Yes	Yes	None
		92.02	1,650	3 CSG	Yes	Yes	None
		91.56	---	4	Yes	Yes	Surf-subsurf
		---	---	5	Yes	No	None

Table 13B.-- Particle count data: Reach 13

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024	2048
June 23, 1983	1	10	14	26	40	48	71	93	99	100	--
	2	14	18	26	37	50	62	83	95	99	100
	3	14	21	31	38	54	74	94	99	100	--
	4	5	9	22	39	52	73	91	98	100	--
Sept. 17, 1983	4	--	1	9	19	33	52	79	93	99	100
July 20, 1984	1	24	25	29	42	53	74	92	98	99	100
	2	30	31	40	53	65	78	95	98	100	--
July 24, 1984	3	10	12	16	31	47	70	90	99	100	--
	4	7	12	14	33	57	76	91	98	100	--
Sept. 12, 1984	1	24	24	32	45	65	80	98	100	--	--
	2	27	27	30	38	45	64	82	96	100	--
	3	14	16	26	32	52	65	82	95	100	--
	4	13	13	19	30	32	39	62	86	97	100

Table 13C.--Bed material sample analysis data: Reach 13

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0
June 23, 1983	1	55	Surface	--	1	1	3	3	4	4	5	7	18	41	100
	1	55	Subsurf	2	4	6	20	26	34	39	50	66	87	100	--
June 24, 1983	4	90	Surface	11	39	74	97	100	--	--	--	--	--	--	--
July 23, 1984	1	55	Surface	--	--	--	1	3	4	6	11	27	53	100	--
	1	55	Subsurf	--	--	1	5	14	18	22	28	40	49	53	100
	1	75	Surface	1	1	2	4	5	5	6	6	9	20	26	100
	1	75	Subsurf	2	5	9	17	28	32	38	46	56	70	100	--
July 27, 1984	4	30	Surface	--	--	--	--	--	1	3	7	18	38	46	100
	4	30	Subsurf	--	--	1	4	10	16	24	36	51	71	100	--
	4	90	Surface	--	1	2	4	4	4	4	5	7	10	53	100
	4	90	Subsurf	1	3	9	19	25	27	30	37	48	65	100	--
Sept. 12, 1984	1	55	Surface	--	--	--	1	2	3	4	7	16	49	76	100
	1	55	Subsurf	--	1	2	8	26	30	37	46	62	78	100	--
	1	75	Surface	3	5	7	10	12	13	14	17	26	58	100	--
	1	75	Subsurf	1	3	4	9	14	16	19	25	34	44	55	100
	4	30	Surface	--	--	--	1	3	6	11	18	28	44	52	100
	4	30	Subsurf	--	--	1	3	9	13	21	31	43	57	68	100

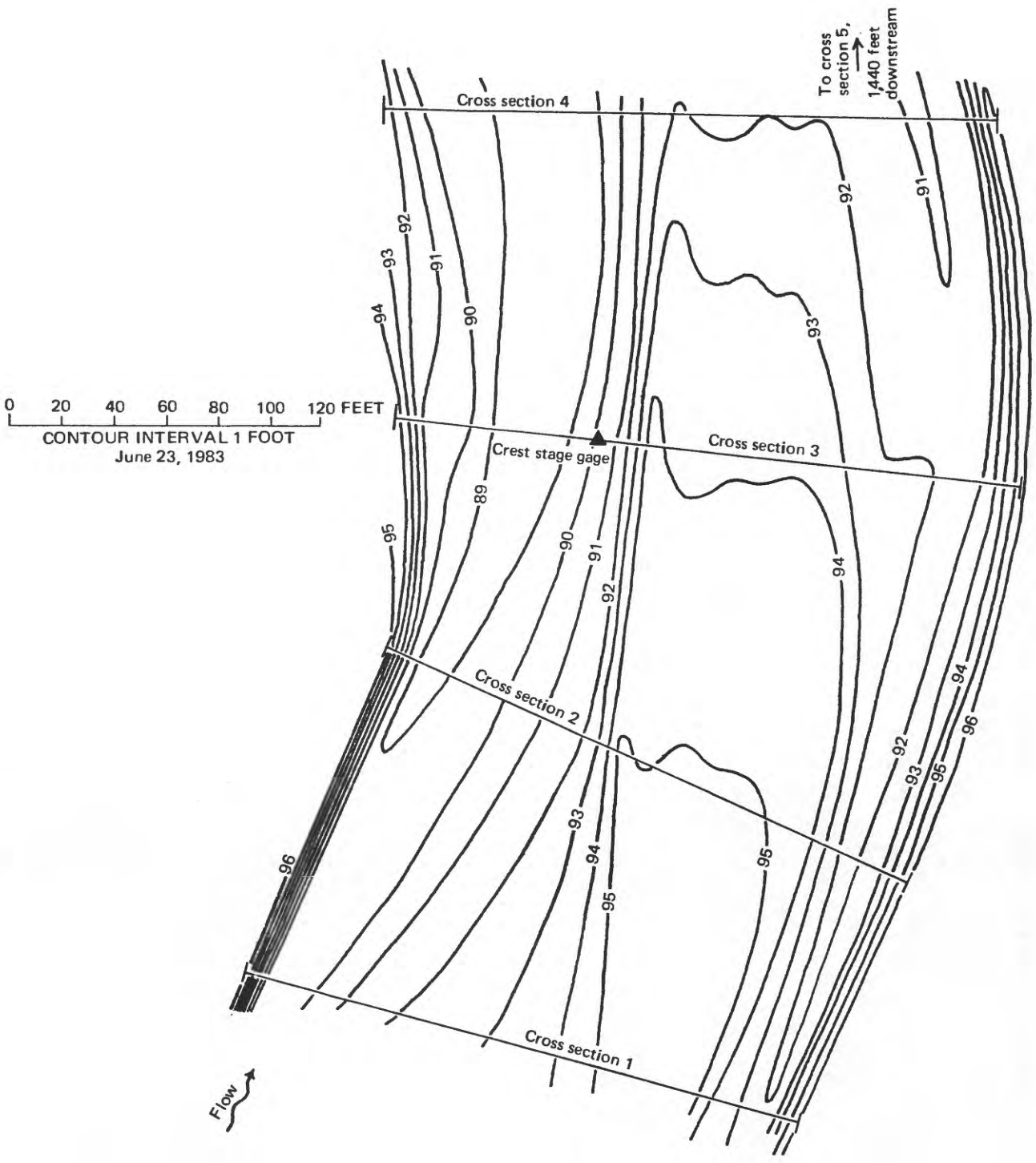

Figure 13A.-- Plan view and location of cross sections at study reach 13: Moose Creek below Friday Creek near Kantishna.

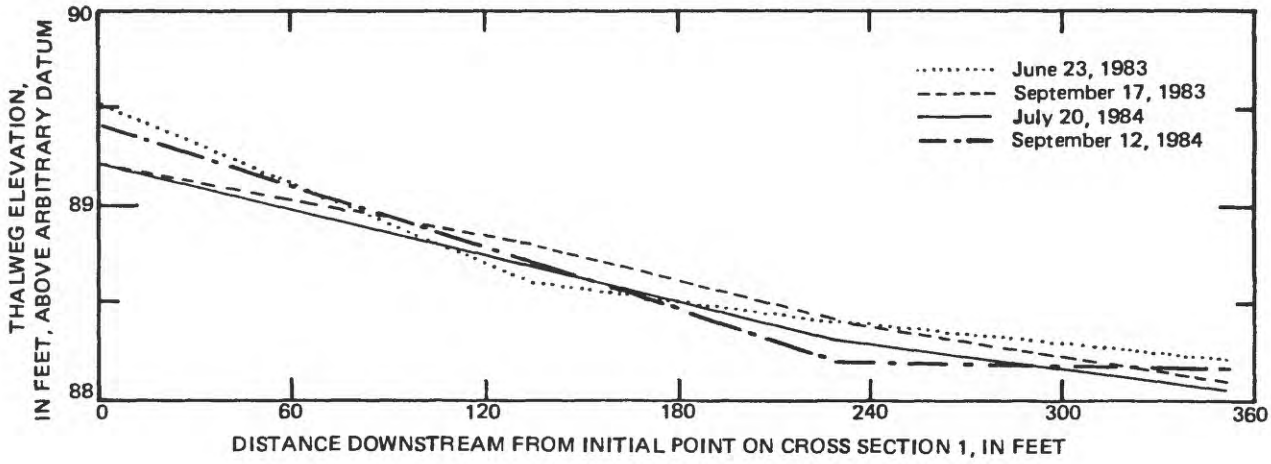

Figure 13B.--Thalweg profile at study reach 13: Moose Creek below Friday Creek near Kantishna.

Figure 13C.--View downstream from cross section 1, June 24, 1983.

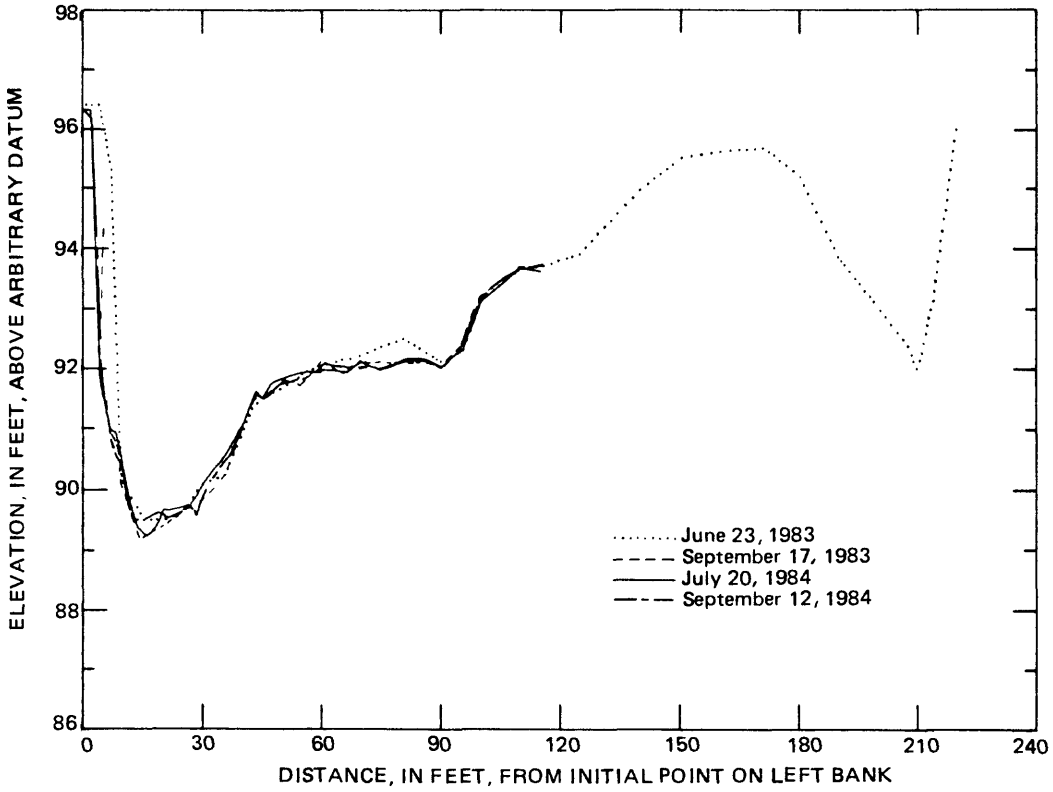

Figure 13D.--Cross section 1 at study reach 13: Moose Creek below Friday Creek near Kantishna.

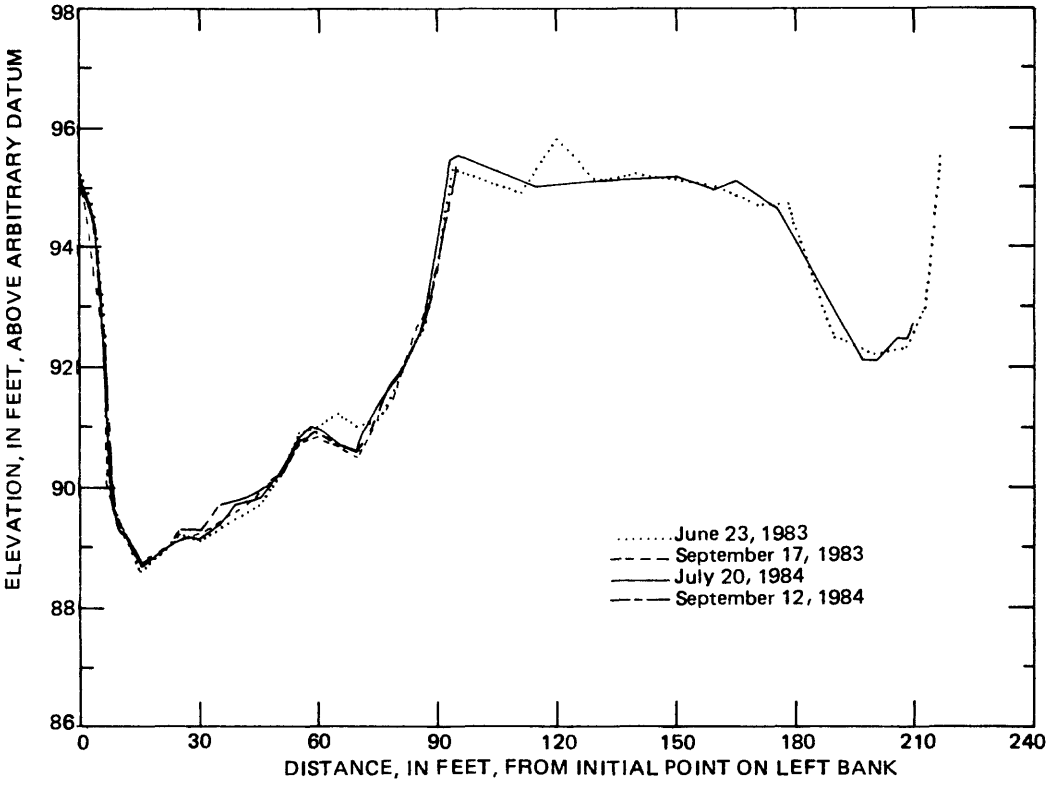

Figure 13E.--Cross section 2 at study reach 13: Moose Creek below Friday Creek near Kantishna.

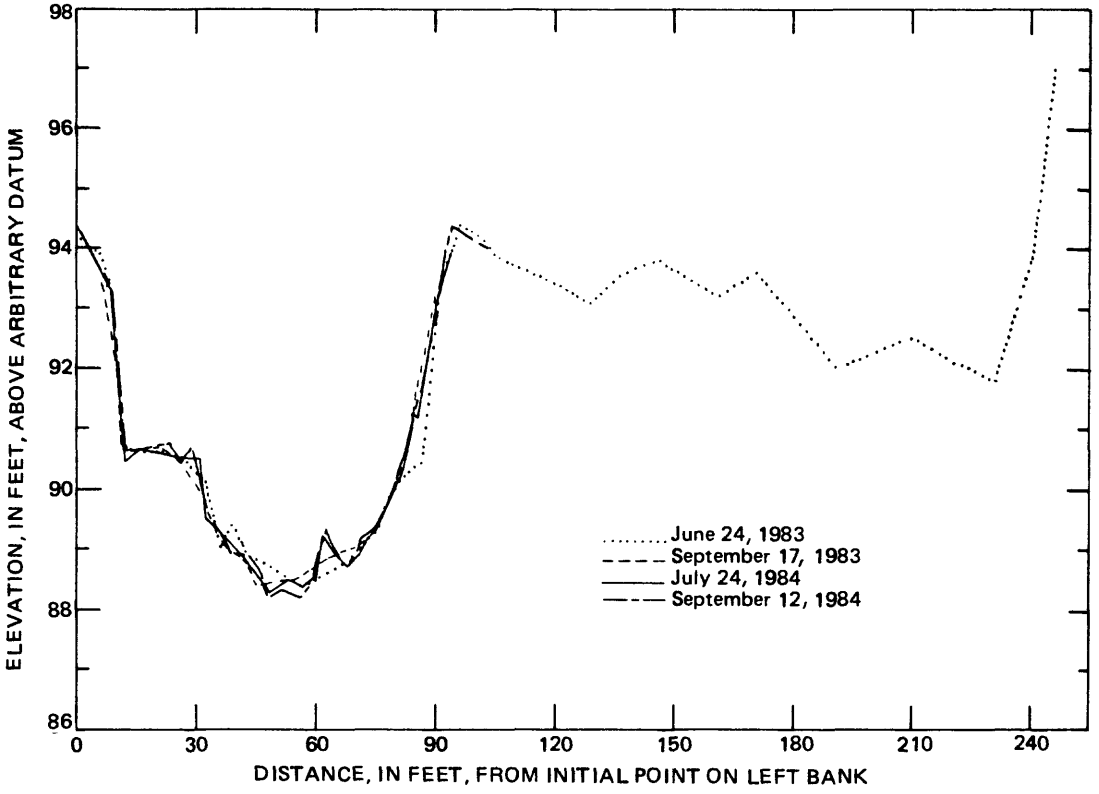

Figure 13F.--Cross section 3 at study reach 13: Moose Creek below Friday Creek near Kantishna.

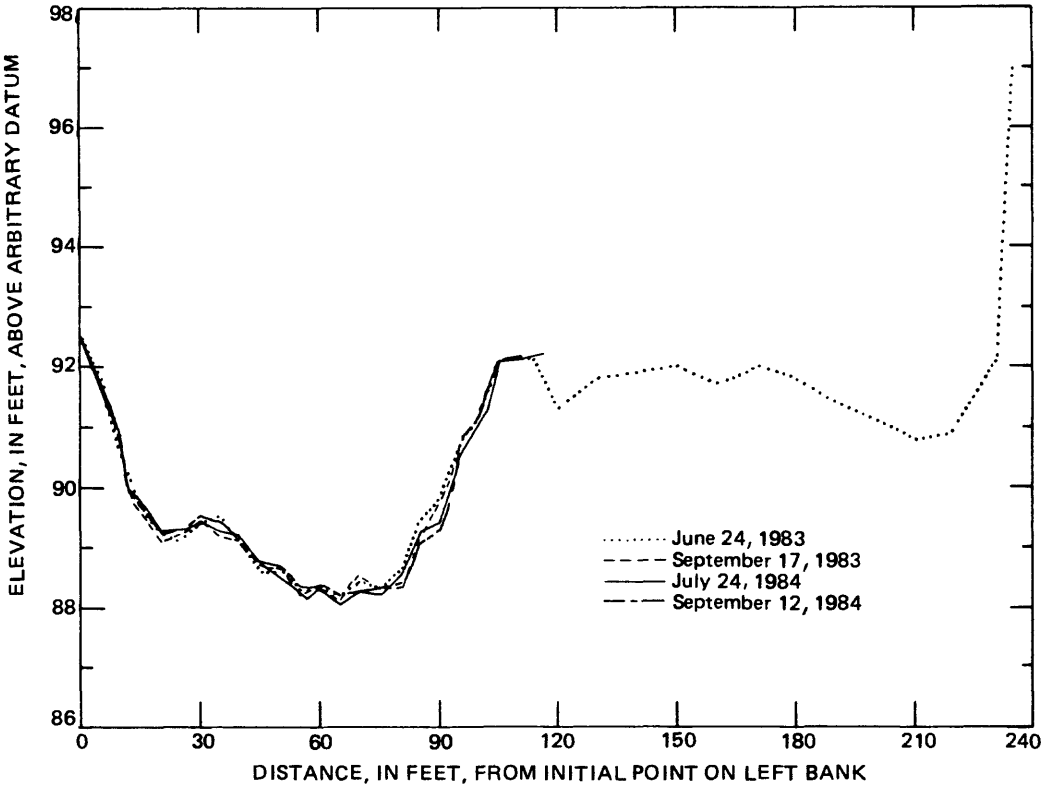

Figure 13G.--Cross section 4 at study reach 13: Moose Creek below Friday Creek near Kantishna.

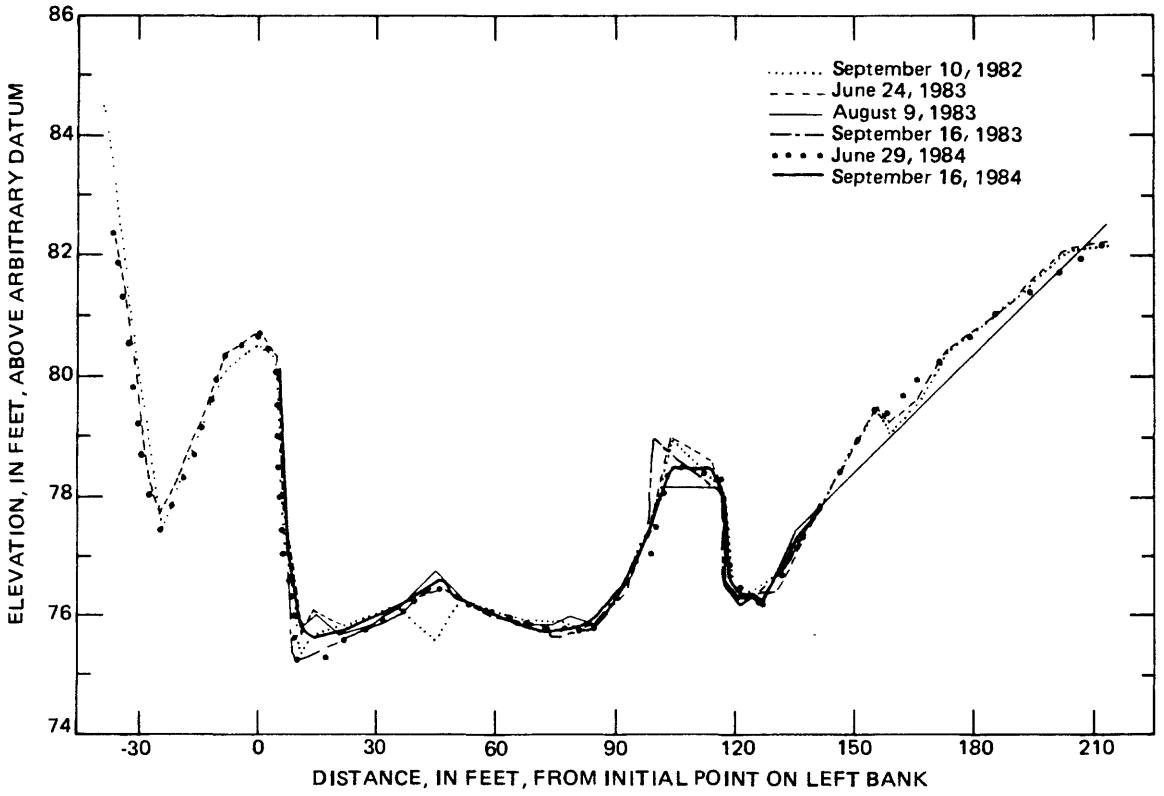

Figure 13H.--Cross section 5 at study reach 13: Moose Creek below Friday Creek near Kantishna.

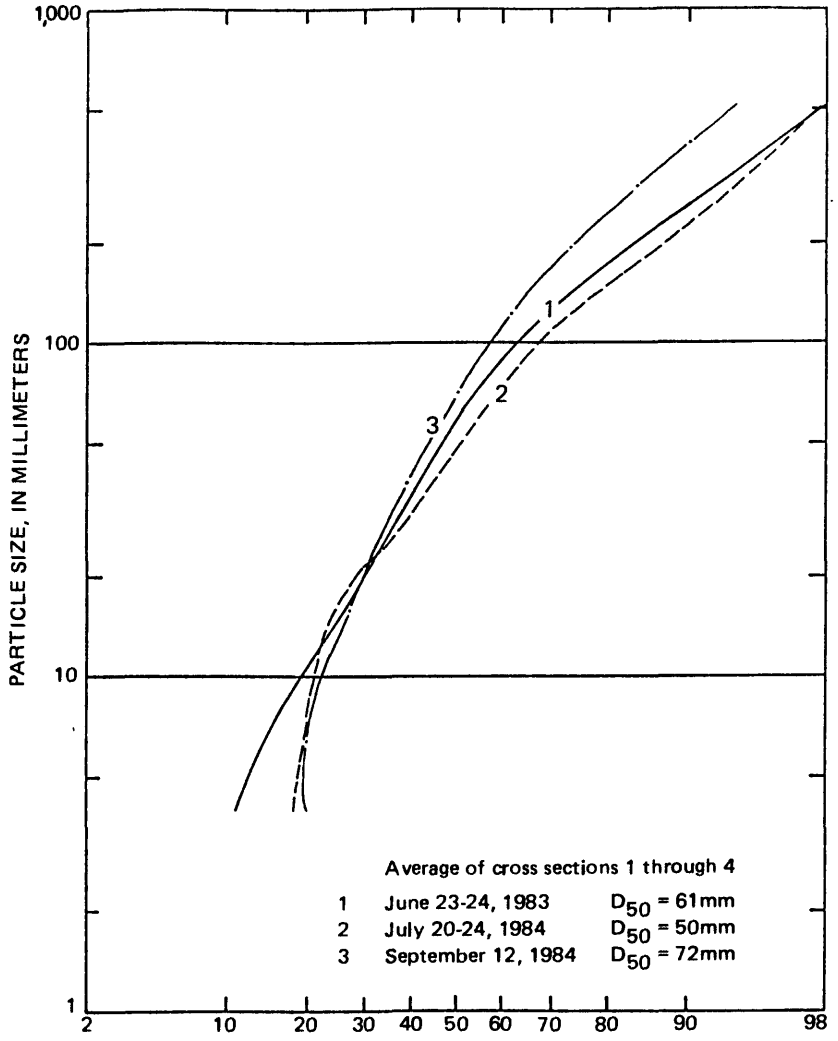

Figure 13I.--Particle-size distribution (particle-count method) of bed material at study reach 13: Moose Creek below Friday Creek near Kantishna.

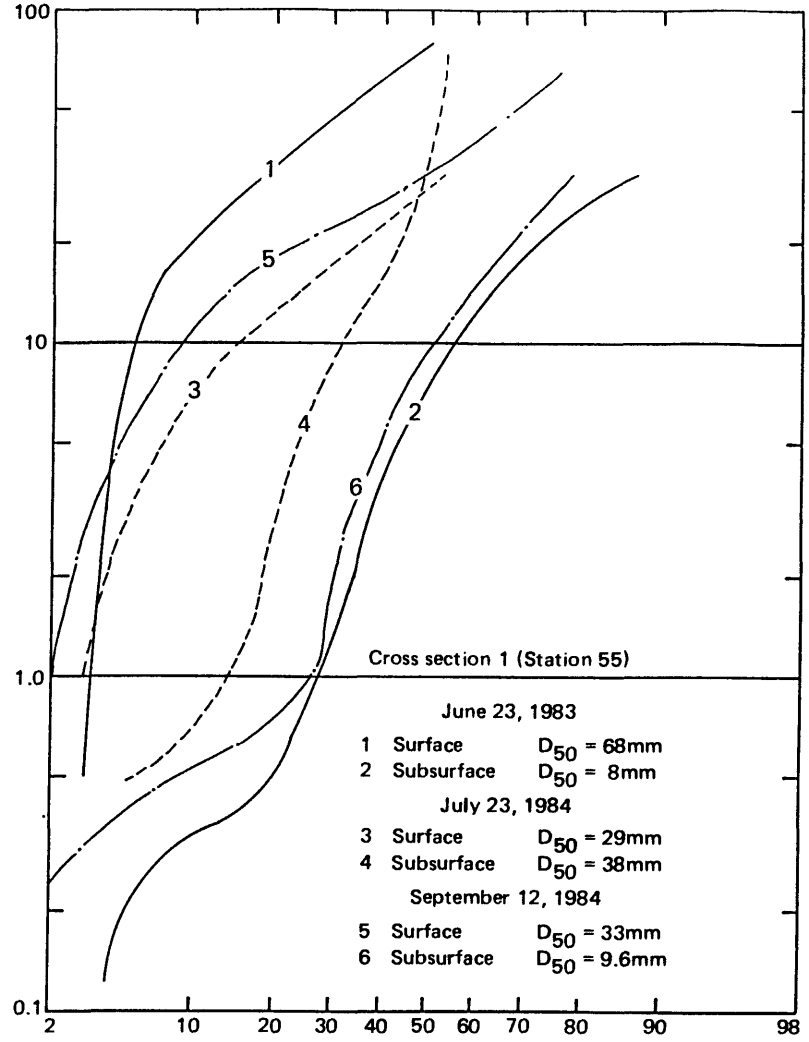

Figure 13J.--Particle-size distribution (sieve analysis) of bed material at study reach 13: Moose Creek below Friday Creek near Kantishna.

STUDY REACH 14: MOOSE CREEK BELOW LOWER CANYON NEAR KANTISHNA

LOCATION.--- Lat 63°38'35", Long 151°03'15", in NE¼SW¼ Sec.4, T.15S., R.18W., Hydrologic Unit 19030000, in Denali National Park and Preserve, 4.6 mi downstream from Canyon Creek, and 8.6 mi north of Kantishna.

Four cross sections were established at about 120-foot intervals over a total reach length of 500 ft. There are two channels throughout the reach. A wide overflow section on the right (east) side of the active channel was surveyed in reaches 1, 2, and 3. The active channel is approximately 100 ft wide between vegetated banks. Cross section surveys indicated no significant changes in channel configuration, but some movement of the bed was evident.

Particle count and bed material sieve analysis data showed no changes in the overall bed material. Movement of fine (<0.5mm) bed material was noted as the finer material was alternately deposited and scoured at various locations within the reach.

Table 14A.--Summary of data collected: Reach 14

Date	Meas. disch. (ft^3/s)	Peak data		Cross section		Particle-size data	
		Stage (ft)	Disch. (ft^3/s)	No.	Survey	Particle count	Bed material samples
6/28/83	113	---	---	1	Yes	Yes	None
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf
8/11/83	326	98.72	---	1	Yes	Yes	Surf-subsurf
		97.51	970	2	Yes	Yes	None
		97.05	---	3	Yes	Yes	None
		95.89	---	4	Yes	Yes	Surf-subsurf
7/1/84	180	---	---	1	Yes	Yes	Surf-subsurf
		---	---	2	Yes	Yes	None
		---	---	3	Yes	Yes	None
		---	---	4	Yes	Yes	Surf-subsurf
8/12/84	287	99.70	---	1	Yes	Yes	Surf-subsurf
		99.56	8,000	2	Yes	Yes	None
		---	---	3	No	Yes	None
		---	---	4	No	Yes	Surf-subsurf

Table 14B.--Particle count data: Reach 14

Date of collection	Cross section	Bed material (particle count) Percent finer than size indicated, in millimeters 4	8	16	32	64	128	256	512	1024
June 28, 1983	1	17	18	24	38	60	75	96	99	100
	2	11	18	24	50	73	85	96	100	--
	3	18	23	31	47	66	84	98	100	--
	4	23	29	35	52	65	81	96	100	--
Aug. 11, 1983	1	20	21	24	31	47	66	86	99	100
	2	16	18	27	45	71	85	98	100	--
	4	30	30	35	51	60	78	96	100	--
July 1, 1984	1	20	24	32	41	52	68	95	100	--
	2	26	32	44	53	69	79	94	100	--
	3	32	36	43	52	64	76	96	100	--
	4	44	44	49	55	65	74	88	100	--
Aug. 12, 1984	1	14	15	18	22	40	63	79	97	100
	2	28	28	38	50	66	84	97	100	--
	3	30	30	35	43	53	74	94	100	--
	4	48	48	49	55	63	78	96	100	--

Table 14C.--Bed material sample analysis data: Reach 14

Date of collection	Cross section	Sampling station (in feet from reference mark)	Sample type	Bed material (sieve analysis) Percent finer than size indicated, in millimeters 0.062	0.125	0.25	0.50	1.0	2.0	4.0	8.0	16.0	32.0	64.0	128.0	256.0
June 28, 1983	4	70	Surface	1	1	2	3	3	3	4	4	4	9	41	100	--
	4	70	Subsurf	2	4	8	15	21	24	26	29	36	53	61	100	--
Aug. 11, 1983	1	55	Surface	--	--	1	1	2	2	2	2	2	3	15	100	--
	1	55	Subsurf	2	4	10	22	27	31	36	46	56	84	100	--	--
	1	60	Surface	21	47	81	99	100	--	--	--	--	--	--	--	--
	1	60	Subsurf	13	36	63	78	80	81	82	82	83	85	100	--	--
	4	30	Surface	1	2	3	4	4	4	5	5	7	31	56	100	--
	4	30	Subsurf	2	3	5	15	21	26	30	41	55	73	88	100	--
July 1, 1984	1	55	Surface	--	--	1	2	2	2	2	2	4	11	21	100	--
	1	55	Subsurf	1	3	6	12	16	18	21	26	33	47	68	100	--
	1	70	Surface	--	--	--	--	--	--	--	1	1	3	52	100	--
	1	70	Subsurf	--	1	4	12	24	31	41	52	65	80	100	--	--
	4	30	Surface	3	9	25	86	100	--	--	--	--	--	--	--	--
	4	30	Subsurf	--	--	1	2	4	4	5	5	8	18	35	100	--
	4	70	Surface	1	3	19	88	100	--	--	--	--	--	--	--	--
	4	70	Subsurf		1	3	11	21	24	27	33	44	57	70	100	--
Aug. 12, 1984	1	55	Surface	1	1	2	3	4	4	4	5	5	6	23	100	--
	1	55	Subsurf	3	9	18	25	27	28	30	32	35	47	84	100	--
	1	70	Surface	--	--	--	--	--	--	--	1	1	3	12	12	100
	1	70	Subsurf	--	1	3	7	15	20	27	36	47	66	88	100	--
	4	30	Surface	16	33	57	93	99	100	--	--	--	--	--	--	--
	4	30	Subsurf	2	6	26	87	95	95	96	96	96	98	100	--	--

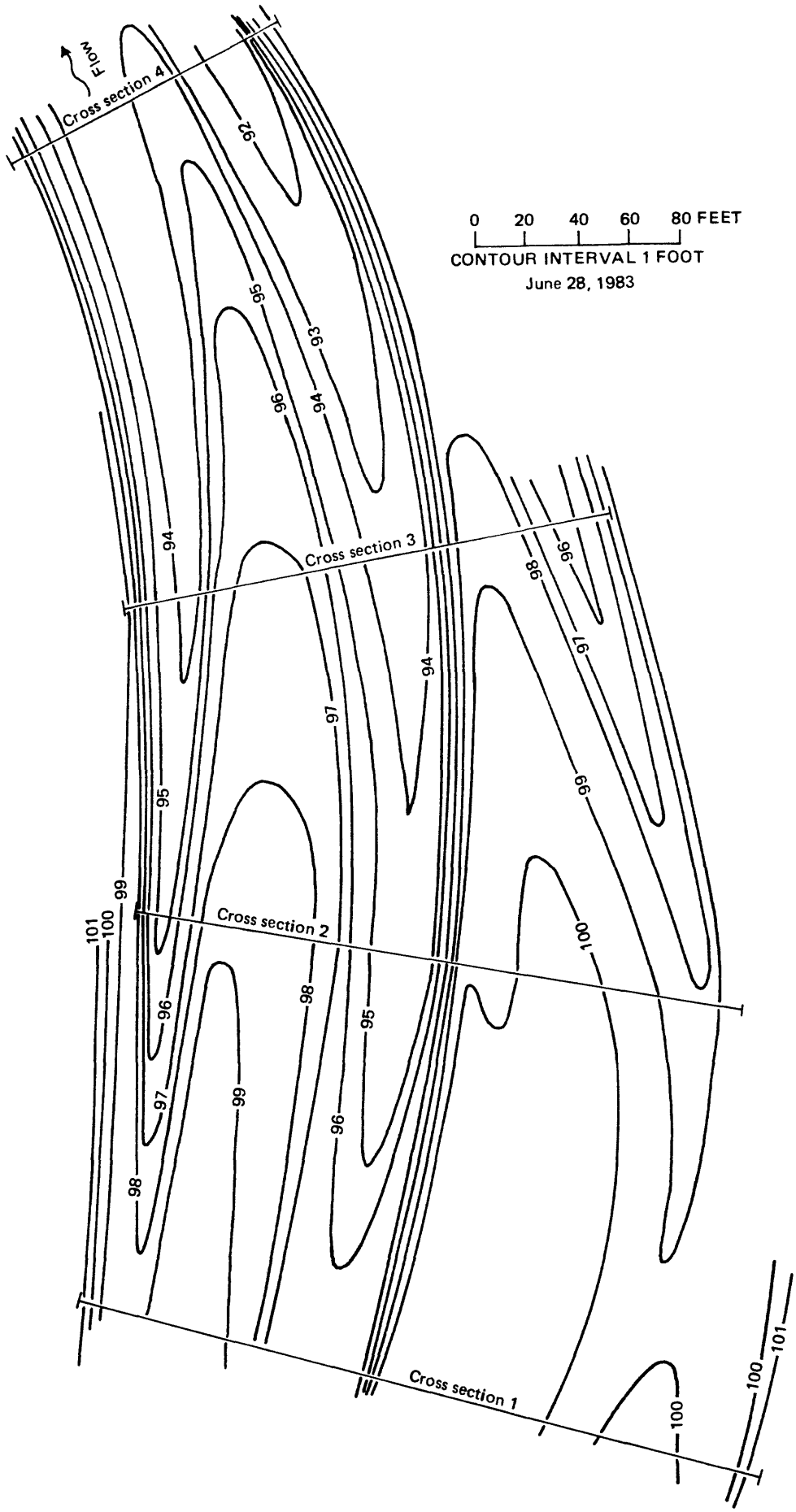

Figure 14A.--Plan view and location of cross sections at study reach 14: Moose Creek below Lower Canyon near Kantishna.

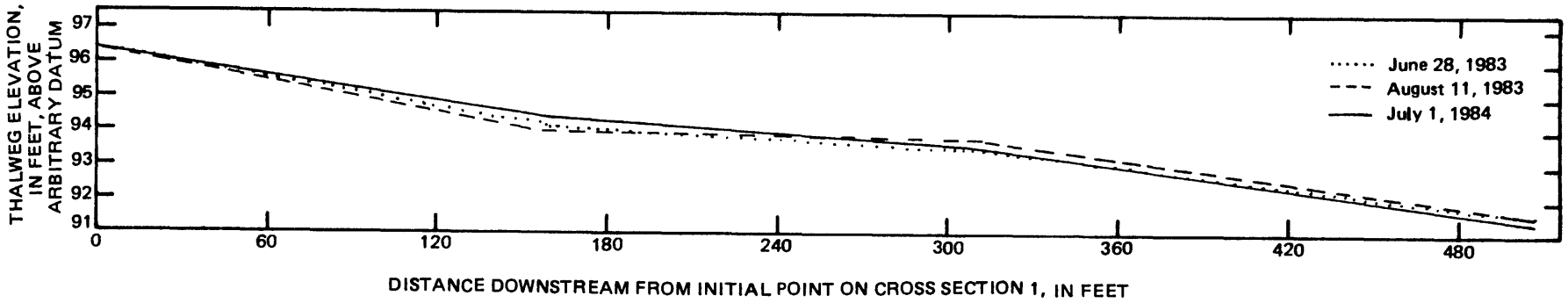

Figure 14B.--Thalweg profile at study reach 14: Moose Creek below Lower Canyon near Kantishna.

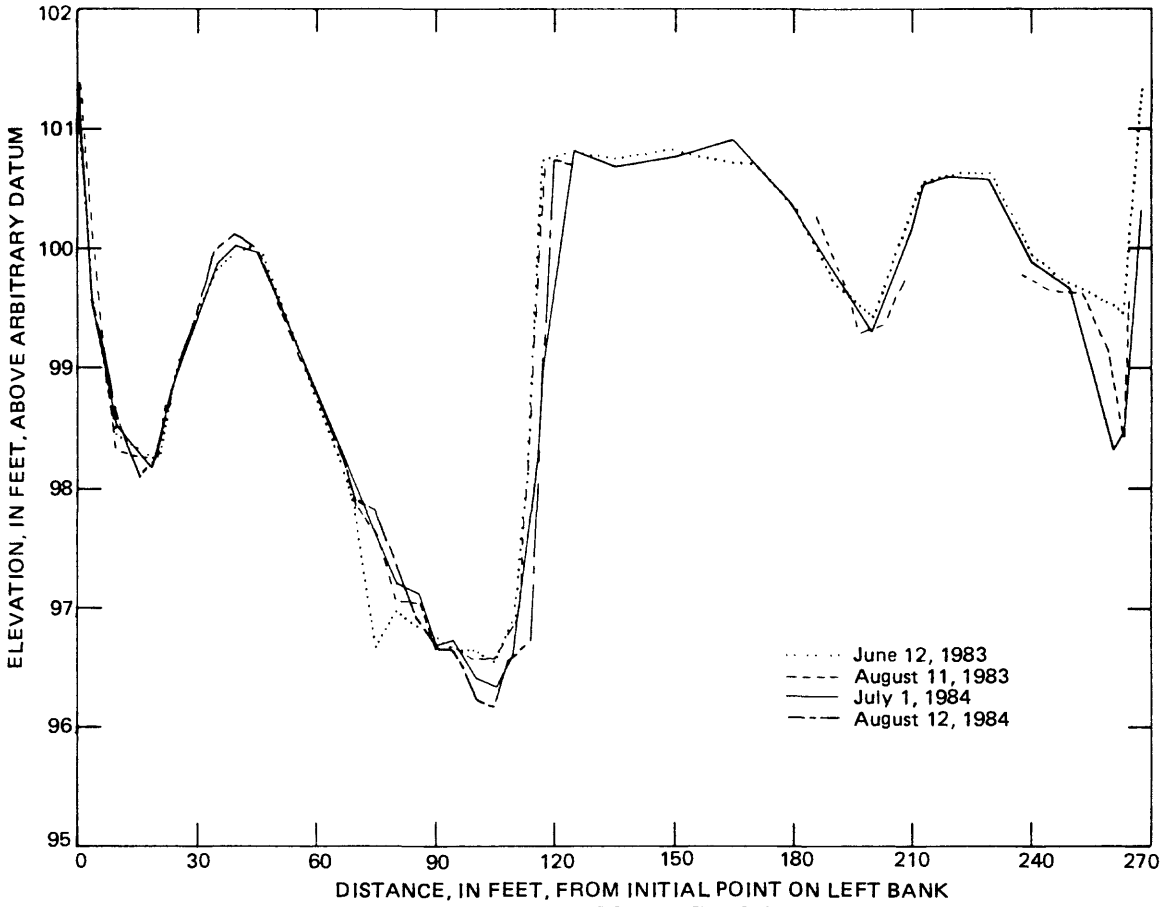

Figure 14C.--Cross section 1 at study reach 14: Moose Creek below Lower Canyon near Kantishna.

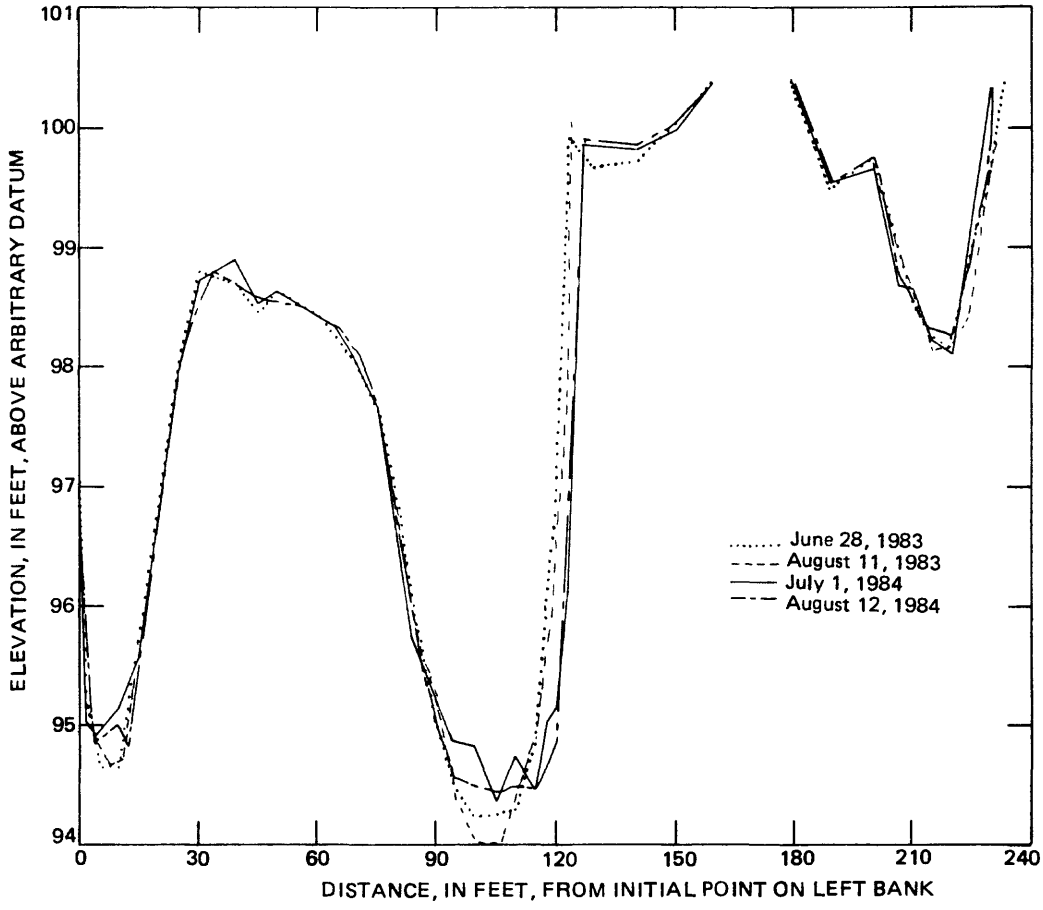

Figure 14D.--Cross section 2 at study reach 14: Moose Creek below Lower Canyon near Kantishna.

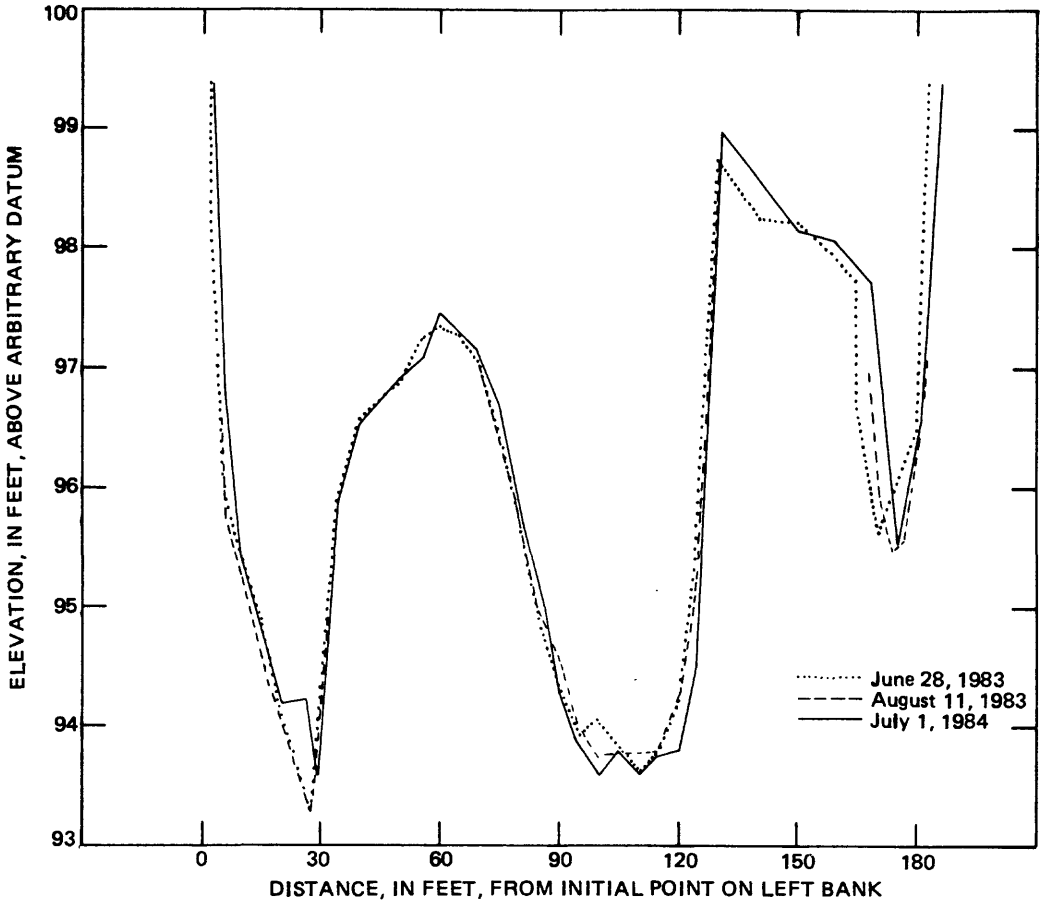

Figure 14E.--Cross section 3 at study reach 14: Moose Creek below Lower Canyon near Kantishna.

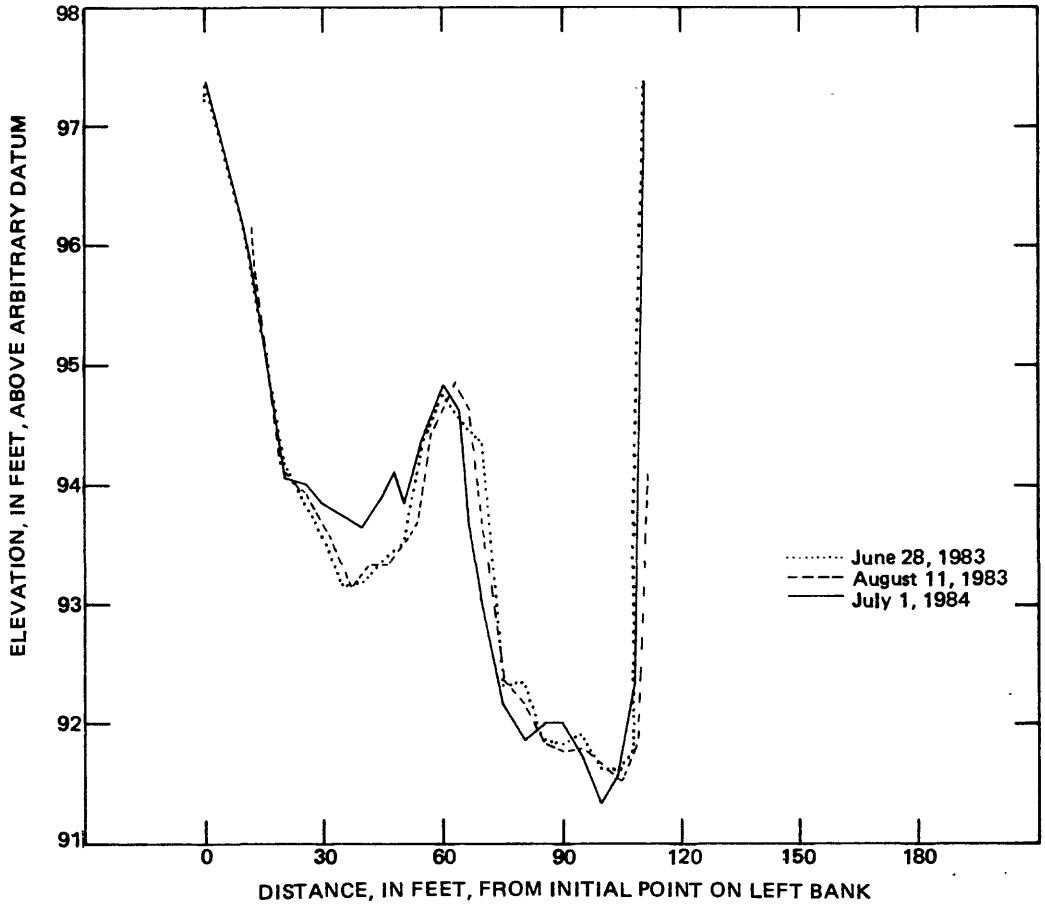

Figure 14F.--Cross section 4 at study reach 14: Moose Creek below Lower Canyon near Kantishna.

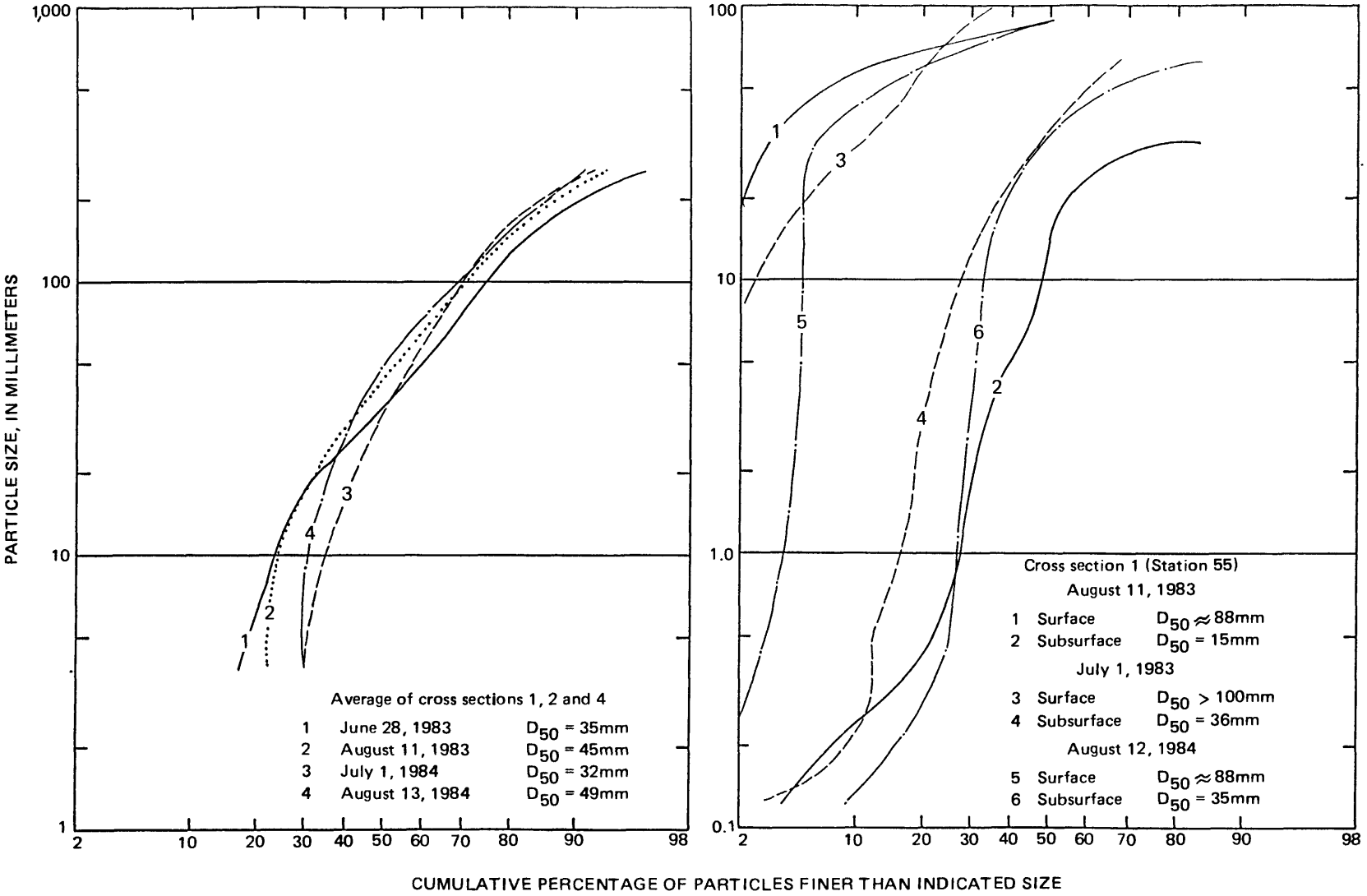

Figure 14G.--Particle-size distribution (particle-count method) of bed material at study reach 14: Moose Creek below Lower Canyon near Kantishna.

Figure 14H.--Particle-size distribution (sieve analysis) of bed material at study reach 14: Moose Creek below Lower Canyon near Kantishna.