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HYDROLOGIC RECONNAISSANCE OF THE SHEENJEK RIVER BASIN, ALASKA

by

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PROJECT DESCRIPTION

The Alaska Department of Natural Resources, Division of Mining and Water Management, Alaska Hydrologic Survey (AHS) performed a reconnaissance-level hydrologic investigation of the Sheenjek River and major tributaries in August 1984 and May 1985. This investigation was conducted as part of the Alaska Water Resource Evaluation (AWARE) program to provide estimates of streamflow and flood levels on ungaged streams throughout the State. The purpose of this report is to make previously unpublished data on the flow characteristics and water quality of the Sheenjek River available to the public.

The Sheenjek River drainage basin encompasses 4,788 mi^2 (Selkregg, 1976). It lies within the Porcupine River drainage basin, which is part of the Yukon River System. The river originates in the eastern Brooks Range and flows southward 277 miles to its confluence with the Porcupine River (fig. 1), 23 miles northeast of Fort Yukon. The Sheenjek River drainage basin lies within three distinct physiographic provinces: the moderately high rugged mountains of the Brooks Range, the highlands of the Porcupine Plateau, and the plains and lowlands of the Yukon Flats (Wahrhaftig, 1965). The river is accessible by boat from Fort Yukon via the Porcupine River, and is floatable from headwater tributaries to the mouth during summer months. The Sheenjek River is included in the National Wild and Scenic Rivers System under provisions of the Alaska National Interest Land Conservation Act (ANILCA) of 1980. The upper basin is within the Arctic National Wildlife Refuge, the lower basin within the Yukon Flats National Wildlife Refuge. Thorough descriptions of the river's physical and cultural features are presented in a draft environmental impact statement authored by the U.S. Department of the Interior (1984).

The Sheenjek River is generally a pristine, free-flowing river having very clear water, gravel bottoms, swift currents, cutbanks, and meandering stream channels. Figure 3 shows an elevation profile of the

Sheenjek River and surveyed tributaries. Headwater tributaries are high-gradient streams that descend from 5000 to 7000 ft peaks composed chiefly of Paleozoic limestone, shale, quartzite, slate, and schist (Wahrhaftig, 1965). The mainstem of the Sheenjek River is a low-gradient stream that meanders through tundra in a broad mountain valley. Small thaw lakes are common and permafrost is visible in high cutbanks. Below the East Fork Sheenjek River confluence the river valley is well-drained and surrounded by rolling hills of mixed spruce and birch forest. In this section the river has a braided channel with numerous sand and gravel bars and swift current. Approximately 70 miles above its mouth the river enters the Yukon Flats. The river becomes wider and deeper as it slowly meanders through outwash plains and poorly-drained lowlands. Permafrost underlies most of the lowlands except the river's mainstem, meander channels, and large thaw lakes (Wahrhaftig, 1965).

The climate of the Sheenjek River drainage basin is one of extremes: brief warm summers with long daylight versus extremely cold winters with short daylight. The mean minimum January temperature ranges from -16° F to -28° F, and the mean annual precipitation is approximately 15 inches (Jones and Fahl, 1994).

Alaska Hydrologic Survey personnel floated the river in inflatable boats from the headwaters to its mouth for a reconnaissance survey in August 1984. Stream discharge, stream-channel measurements, and water-quality data were obtained at five mainsteam sites and seven tributary sites (fig. 2).

A late-winter reconnaissance of several sites was accomplished with helicopter access on May 7, 1985. Meltwater flow over an ice-covered reach of the Koness River was measured at site 9 (table 1). Two feet of standing water on ice (attributed to Koness River meltwater) produced an apparent ice dam in the mainstem Sheenjek River at site 10. No late-winter streamflow was measured at tributary #3 (site 11).

Cross-sectional profiles were developed from survey measurements taken in the field (fig. 4). Stream discharge and associated cross-sectional information are recorded in table 1. Bankfull and maximum evident flood discharges, drainage basin characteristics, and estimated flood discharges are shown in table 2. Although the Sheenjek River basin lies within flood-frequency area 5 (Jones and Fahl, 1994), flood-frequency area 3 regression equations were used to estimate flood discharges. Flood discharge estimations for flood-frequency areas 3 and 5 were compared to the maximum known flood discharge (18,000 cfs) for the Sheenjek River near Arctic Village (Jones and Fahl, 1994, p.121). Flood discharges based on flood-frequency area 3 regression equations were comparable to the maximum known flood discharge, whereas flood discharges based on flood-frequency area 5 equations were generally an order of magnitude higher than the maximum known flood discharge.

On-site water-quality measurements taken at the 12 sites are listed in table 3. The Sheenjek River has high quality water, characterized by high concentrations of dissolved oxygen, low turbidity, and basic pH. The relatively high average specific conductance value (248 μS/cm) and alkalinity value (108 mg/L as $CaCO_3$) are indicative of the limestone geology of the drainage basin.

ACKNOWLEDGMENTS

The author thanks Mark Inghram and Roy Ireland (AHS), and Ed Collazzi and Steve Mack (both formerly of AHS) who assisted with field data collection. The author thanks Dorothy Mortenson (Alaska Department of Natural Resources, Land Records Information Section) for generating drainage basin maps. Mark Inghram and Roy Ireland reviewed the report.

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U.S. Department of Interior, 1984, Draft environmental impact statement for the wild and scenic river study, lower Sheenjek River: National Park Service, Alaska Regional Office, Anchorage, Alaska, 109 p.

Wahrhaftig, C., 1965, Physiographic divisions of Alaska: U.S. Geological Survey Professional Paper 482, 52 p.

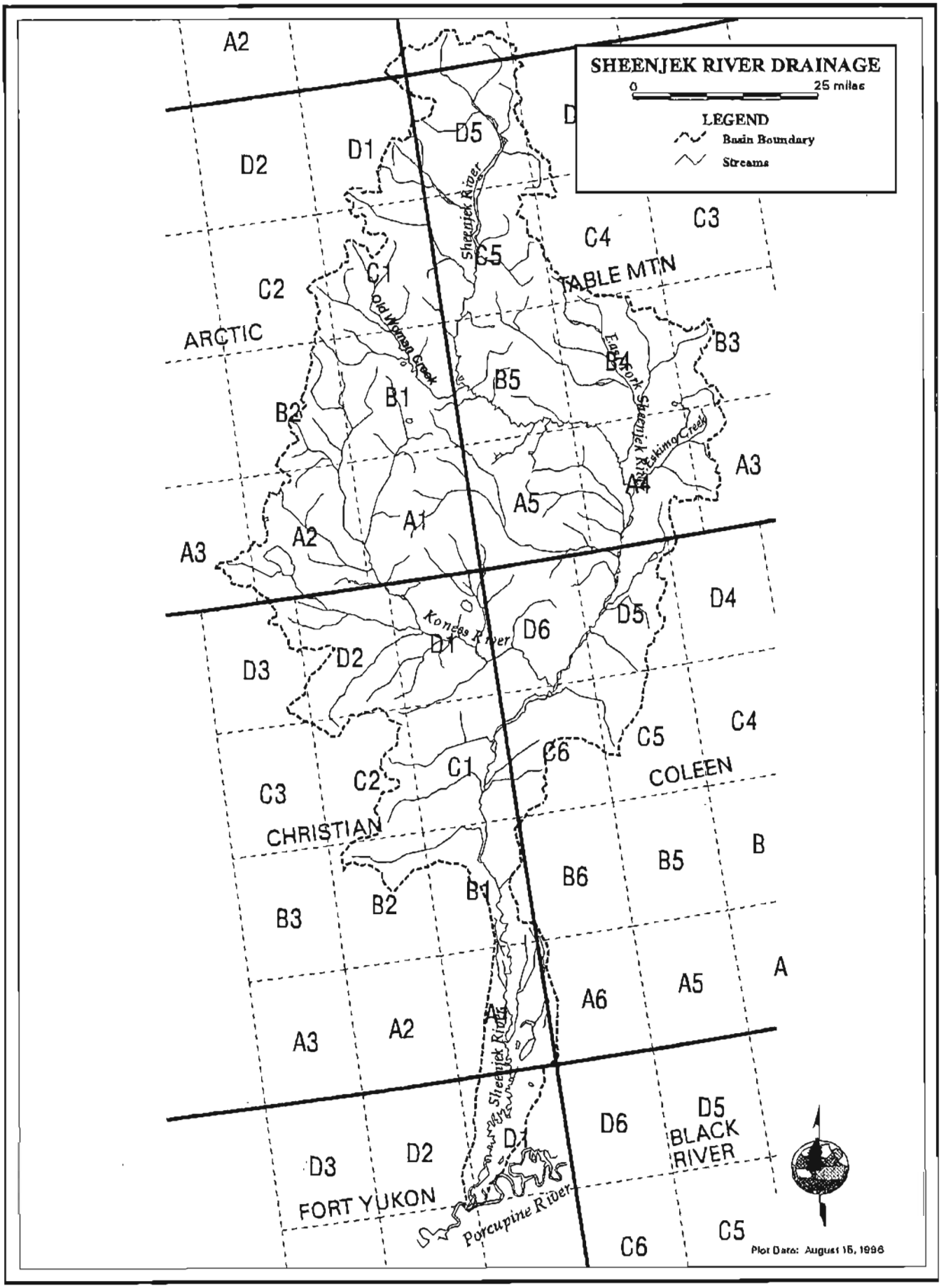

Figure 1. Index of U.S. Geological Survey topographic maps by quadrangle for the Sheenjek River basin.

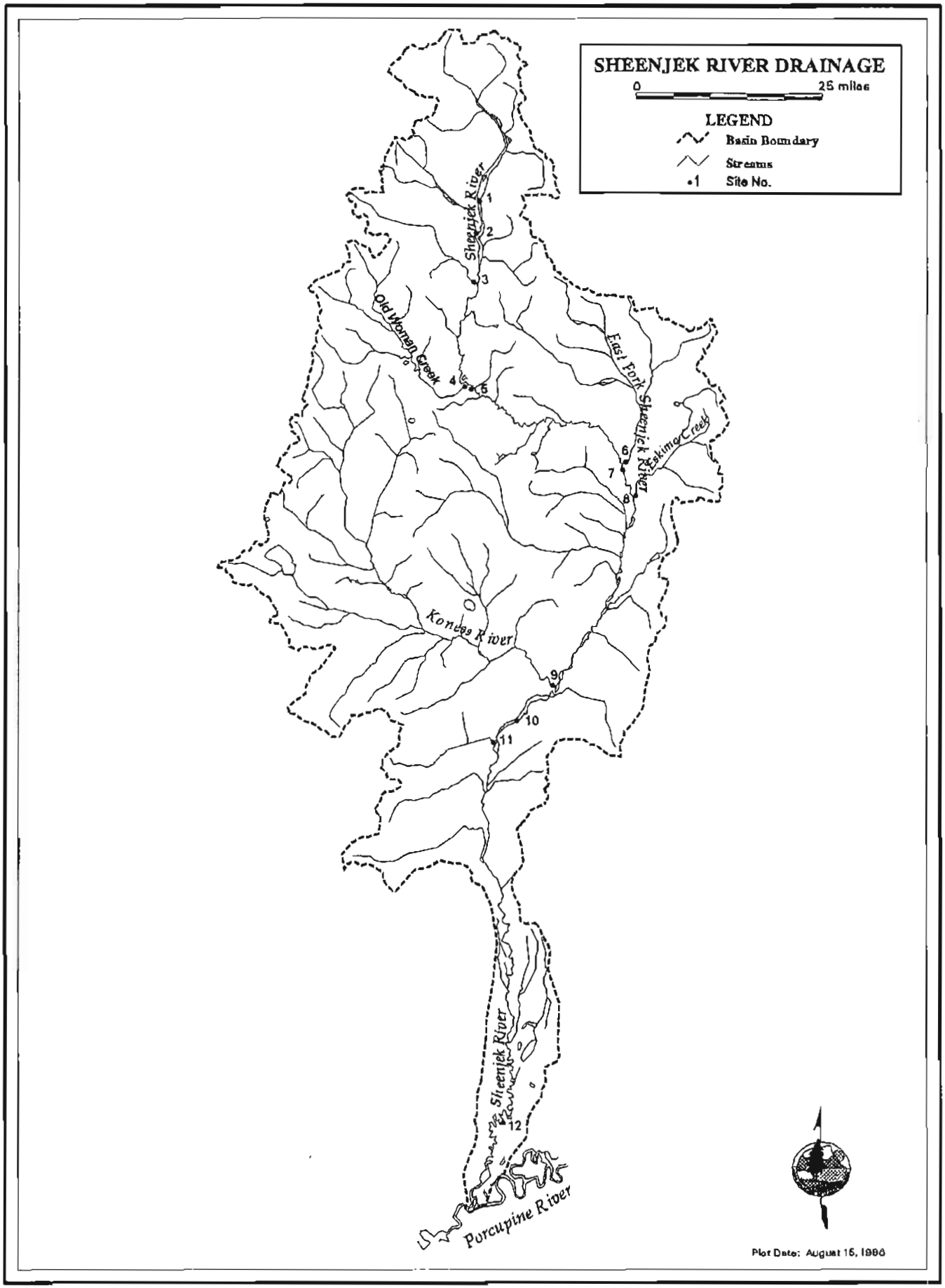

Figure 2. Map of the Sheenjek River basin showing site location and number.

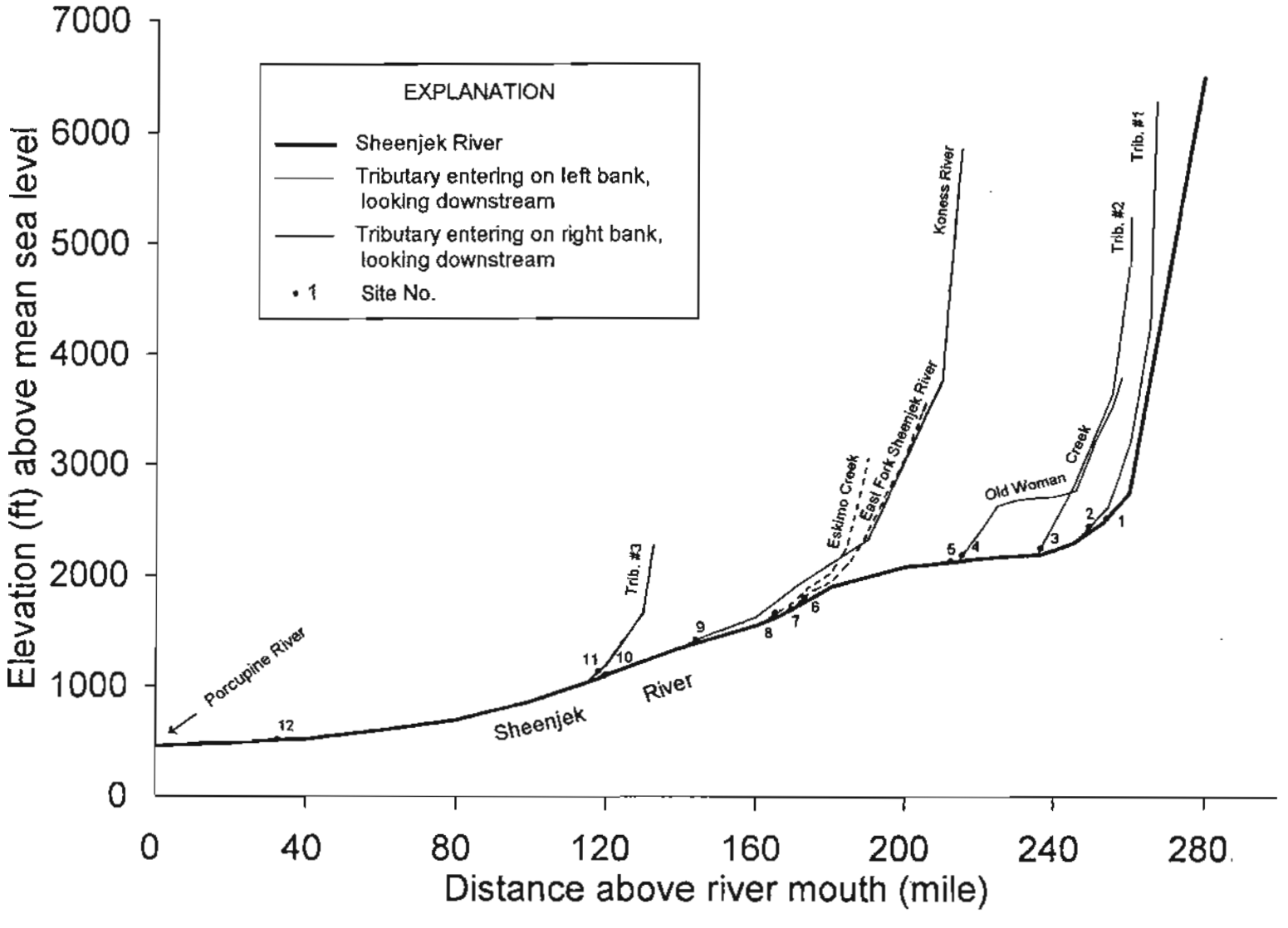

Figure 3. Profile of the Sheenjek River and major tributaries, Alaska.

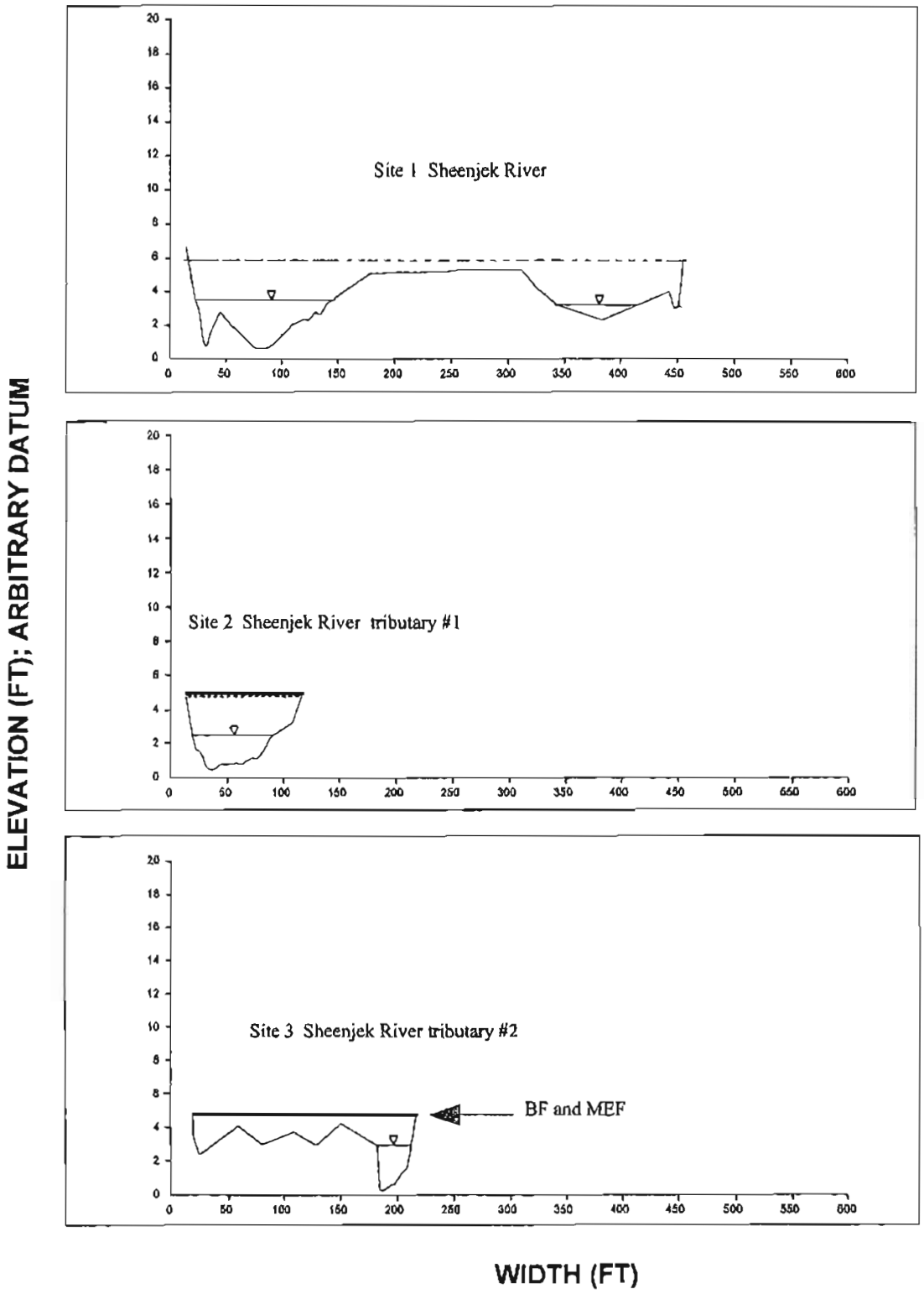

Figure 4. Channel cross-sections of Sheenjek River and surveyed tributaries, as viewed looking downstream, August 1984.

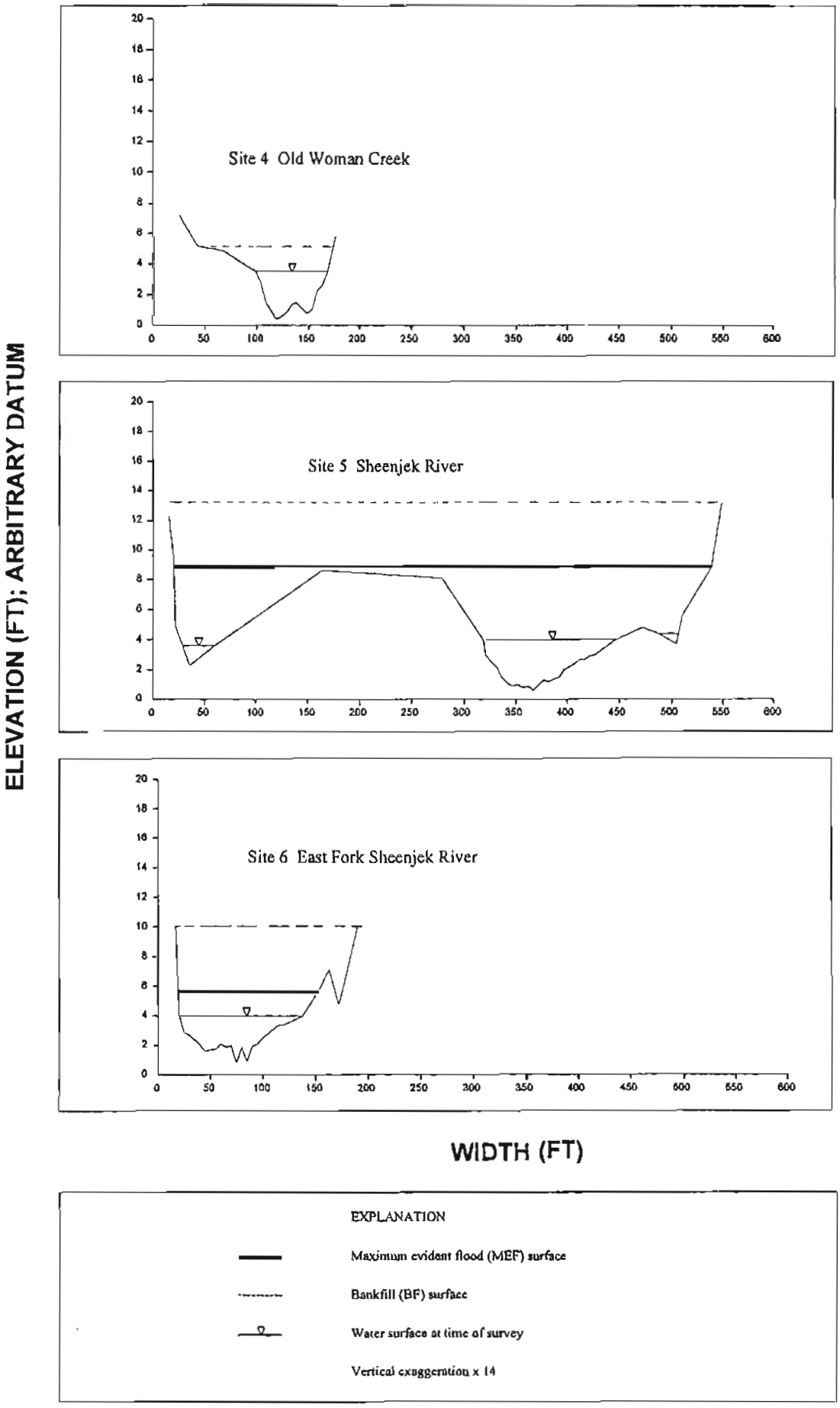

Figure 4. Channel cross-sections of Sheenjek River and surveyed tributaries, as viewed looking downstream, August 1984 -- Continued.

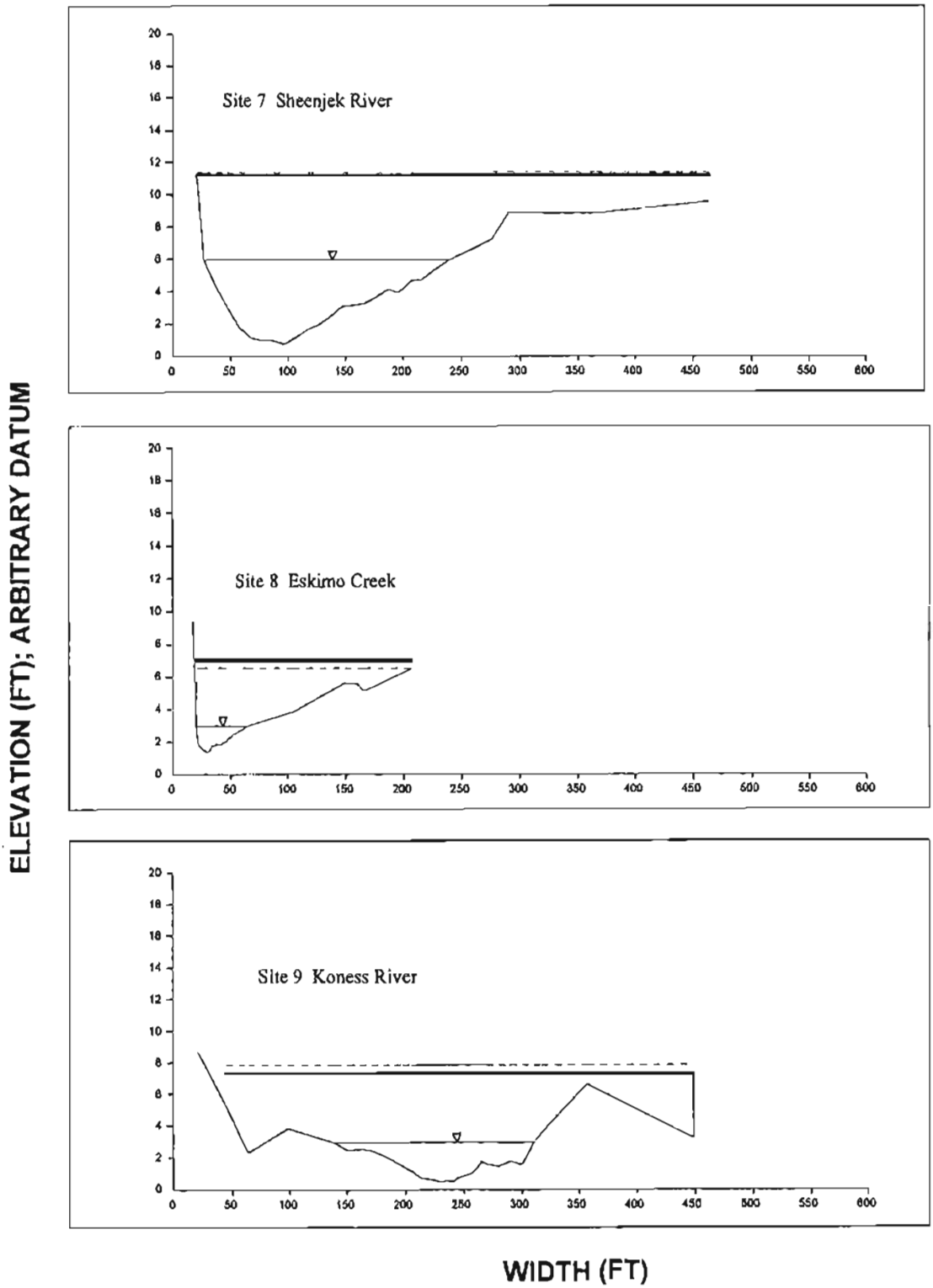

Figure 4. Channel cross-sections of Sheenjek River and surveyed tributaries, as viewed looking downstream, August 1984 -- Continued.

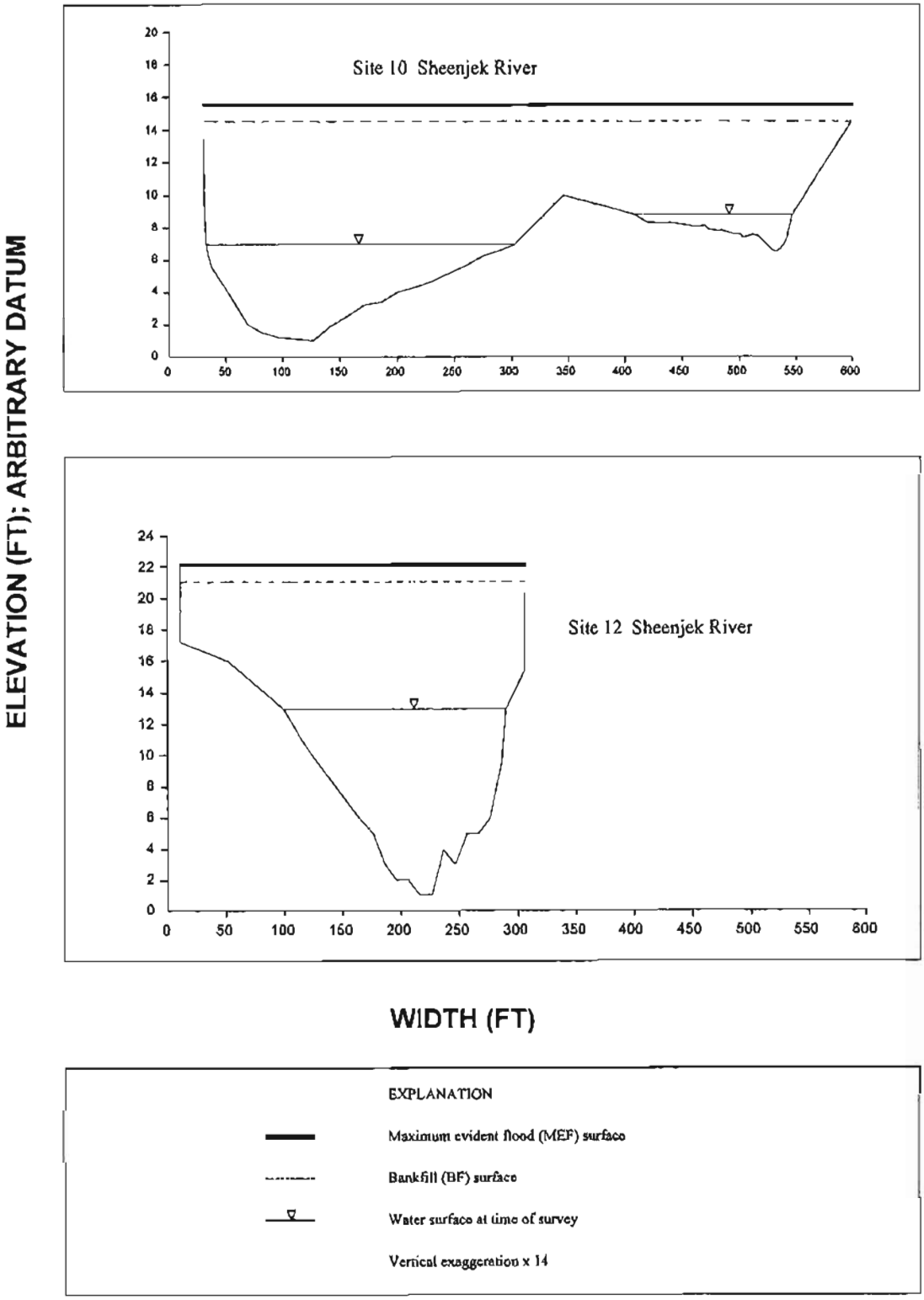

Figure 4. Channel cross-sections of Sheenjek River and surveyed tributaries, as viewed looking downstream, August 1984 -- Continued.

Table 1. Summary of measured discharge and cross-sectional data, Sheenjek River basin, Alaska, 1984 and 1985.

Site No.	Site Description	Date	Time	Slope (ft/ft)	Cross-sectional area (ft^2)	Water-surface width (ft)	Mean depth (ft)	Maximum depth (ft)	Mean velocity (ft/s)	Maximum velocity (ft/s)	Discharge (cfs)	Unit runoff $(cfs)/mi^2$
1	Sheenjek River	8-15-84	1400	0.0011	237	198	1.7	2.9	1.9	2.6	411	1.36
2	Sheenjek River tributary no. 1	8-15-84	1533	0.0002	99	71	1.4	2.0	1.4	2.1	142	1 29
3	Sheenjek River tributary no. 2	8-16-84	1121	0.0012	62	29	2.1	2.7	1.4	2.0	86	0.78
4	Old Woman Creek	8-16-84	1800	0.0005	147	70	2.1	3.1	1.9	2.8	277	1.14
5	Sheenjek River	8-17-84	0845	0.0021	257	128	2.0	3.4	4.2	5.6	1076	1.10
6	East Fork Sheenjek River	8-18-84	0900	0.0052	191	117	1.6	3.2	3.2	4.6	614	1.49
7	Sheenjek River	8-18-84	1157	0.0009	641	213	3.0	5.2	2.9	4.0	1869	1.13
8	Eskimo Creek	8-18-84	1525	0.0025	40	43	0.9	1.6	2.0	2.8	78	0.53
9	Koness River	8-19-84	1326	0.0010	246	172	1 4	2.5	2.5	3.2	617	0.47
		5-07-85	1535	nm	146	107	1.3	3.0	0.26	0.9	56[1]	0.04
10	Sheenjek River	8-19-84	1700	0.0023	1062	408	2.6	6.0	2.7	3.9	2892	0.72
11	Sheenjek River tributary no. 3	8-20-84	0925	nm	56	43	1.3	1.9	1.5	3.6	81	0.88
12	Sheenjek River	8-21-84	1440	0.0001	1382	191	7.2	12	2.1	2.7	2930	0.60

nm = no measurement made.

[1] meltwater from upper reaches flowing over ice; stream probably frozen to bottom.

Table 2. Summary of calculated bankfull and maximum evident flood (MEF) characteristics, basin characteristics, and predicted floods for Sheenjek River basin, Alaska, August 1984.

Site Description	Calculated bankfull characteristics						Calculated MEF Characteristics			Drainage Basin Characteristics [1]					Predicted Flood [2]		
	Cross-sectional area (ft^2)	Water surface width (ft)	Mean depth (ft)	Maximum Depth (ft)	Mean velocity (fps)	Discharge (cfs)	Cross-sectional area (ft^2)	Discharge (cfs)	Unit Runoff (cfs/mi^2)	Area (mi^2)	Mean annual precip (in)	Mean minimum Jan. temp. (°F)	Area of basin forested (%)	Area of basin lakes (%)	Q_2 2-year flood (cfs)	Q_{50} 50-year flood (cfs)	Froude number (8/84 flow)
1. Sheenjek River	1000	440	3.2	5.2	2.2	2235	nm	nm	nm	303	30	-16	0	0	3650	8450	0.24
2. Sheenjek River tributary no. 1	311	103	3.3	4.3	2.4	755	328	818	7.4	110	30	-16	3	0	1530	3980	0.22
3. Sheenjek River tributary no. 2	335	198	2.9	4.5	1.6	525	335	525	4.8	110	25	-18	0	0	1290	3610	0.20
4. Old Woman Creek	295	132	2.9	4.8	2.2	642	nm	nm	nm	243	20	-20	6	0	2150	6030	0.25
5. Sheenjek River	4168	534	9.3	12.6	4168	44273	1870	11903	12.2	975	20	-20	0	0	7320	17450	0.51
6. East Fork Sheenjek River	1111	174	6.5	9.3	8.4	9327	389	1902	4.6	413	15	-24	0	0	2910	8340	0.47
7. Sheenjek River	2429	444	7.3	10.6	4.4	10774	2354	10228	6.2	1650	15	-24	2	0	10820	26540	0.30
8. Eskimo Creek	443	189	3.7	5.1	3.8	1695	538	2330	16.0	146	15	-24	0	0	1275	4025	0.37
9. Koness River	1930	423	5.4	7.4	5.8	11243	1698	9150	7.0	1310	15	-24	24	1	7800	18000	0.40
10. Sheenjek River	4661	570	8.1	13.6	5.8	27275	5231	32981	8.3	3970	12	-25	11	0	19770	46530	0.27
11. Sheenjek River tributary no.3	nm	nm	nm	nm	nm	nm	nm	nm	nm	92	12	-25	38	0	720	2680	nm
12. Sheenjek River	3526	296	12.0	20.1	2.9	10212	3823	11623	2.4	4840	10	-28	25	0	22690	53000	0.14

nm = no measurement made.

[1] drainage area, forested area, and lake area determined by planimetry with USGS topographic maps; mean precipitation and minimum January temperature determined from maps in Jones and Fahl (1994).

[2] discharges calculated using flood frequency area 3 regression equations in Jones and Fahl (1994).

Table 3. On-site water-quality measurements taken in the Sheenjek River basin, August 1984 and May 1985.

Site No.	Site Description	Date	Time	Stream discharge (cfs)	Air Temperature (°C)	Water Temperature (°C)	pH (units)	Specific Conductivity (μS/cm @25°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (percent saturation)	Alkalinity (mg/L as $CaCO_3$)	Turbidity (NTU)
1	Sheenjek River	8-15-84	1400	411	12.7	7.3	8.0	232	12.2	100	92	2.3
2	Sheenjek River tributary no. 1	8-15-84	1630	142	12.0	7.6	8.0	297	11.8	100	120	2.9
3	Sheenjek River tributary no. 2	8-16-84	1130	86	13.5	6.1	7.9	335	12.1	100	138	1.2
4	Old Woman Creek	8-16-84	1800	277	16.5	11.1	7.9	181	11.0	100	66	1.7
5	Sheenjek River	8-17-84	0837	1076	11.0	7.9	8.1	261	12.0	100	111	5.9
6	East Fork Sheenjek River	8-18-84	0900	614	13.0	7.4	8.1	265	12.4	100	134	0.54
7	Sheenjek River	8-18-84	1100	1869	15.5	9.9	8.2	264	12.0	100	122	4.3
8	Eskimo Creek	8-18-84	1430	78	17.0	5.7	7.7	283	12.3	100	150	1.3
9	Koness River	8-19-84	1330	617	17.5	9.7	7.4	112	11.6	100	45	1.4
		5-07-85	1535	56[1]	1.7	1.3	7.9	266	13.4	100	nm	nm
10	Sheenjek River	8-19-84	1700	2892	15.5	10.8	7.8	225	11.5	100	104	3.5
		5-07-85	1625	nm	-1.1	0.3	7.7	264	12.4	91	nm	nm
11	Sheenjek River tributary no.3	8-20-84	0925	81	11.2	7.8	7.2	73	12.4	100	39	1.2
12	Sheenjek River	8-21-84	1440	2930	16.0	11.6	7.8	240	11.1	100	113	3.7

nm = no measurement made.
[1] meltwater from upper reaches flowing over ice; stream probably frozen to bottom.