

Water Resources of Beaver Creek National Wild River

Stream Gaging Data from 1993 to 2000 with Summary
Statistics

Jon Kostohrys



Alaska



Cover Photo

Beaver Creek flows past the limestone bluffs at Big Bend on a frosty, autumn morning. (All photos by the author, unless noted)

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Stream Gaging Data from 1993 to 2000 with Summary Statistics

Jon Kostohrys

BLM-Alaska Open File Report 102
September 2005

U. S. Department of the Interior
Bureau of Land Management

Abstract

When Beaver Creek was designated a National Wild River on December 2, 1980, the proposed management objectives included maintaining the pristine, free-flowing condition of the river, optimum and long-term utilization of the fish and wildlife resources, and high-quality primitive recreational opportunities. To support and maintain these values, the BLM initiated a water rights quantification project for that portion of Beaver Creek National Wild River that is in the White Mountains National Recreation Area. This original quantification was the basis for an application for water rights, which was granted by the State of Alaska on May 26, 1989. However, since the streamflow values used in the application were estimated from synthesized mean monthly hydrographs and regional flood-frequency relationships, the State requested that the BLM document the streamflow for a 10-year period prior to any statutory review. BLM began stream gaging at three sites in 1988–1989, and the streamflow data collected through 1992 was published previously. This report includes the data collected from 1993 to 2000, as well as statistical analysis of all data collected from 1988 to 2000. Recommendations from this analysis include submitting an amendment to the original application for an instream flow reservation with the State to reflect the increased streamflow documented in this report; quantification of instream flow at the larger springs, since they appear to contribute an inordinate share of viable over-wintering aquatic habitat; and continued resurveys of the riparian reference sites, as well as snow and climatic monitoring, to document long-term changes in the Wild River corridor. Since it is the primary access for float boating on Beaver Creek, the instream flow also needs to be quantified on lower Nome Creek.

Acknowledgments

Many people have been involved with this project during the decade and a half it has taken to complete. Current BLM staff who participated in the field work, often during difficult winter conditions, included Lon Kelly, Eric Yeager, Collin Cogley, Tim Dupont, Craig McCaa, Randy Tracy, Ed Lee, Randy Goodwin, Sandy Westcott, and Mike Kunz. Former BLM staff included Bunny Sterin, Dick Bouts, Nate Collin, Roger Evans, Rod Everett, Jerry Wyse, Brian Lubinski, Lisa Ragland, Anna McGlinn, Tanja Runkel, Verena Grüner, Eva Weithmann, and George Rogers. Kristine Kosnik and Tim Hammond worked on the GIS analysis and produced the watershed map. Special thanks to contract pilot Sandy Hamilton, whose flying skills brought us back at times when things looked grim. Stan Bloom and Craig McCaa provided a wizard's touch on the entire document.

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Introduction

Beaver Creek was designated a National Wild River on December 2, 1980 when Congress amended the Wild and Scenic Rivers Act (P.L. 90-542) as part of the Alaska National Interest Lands Conservation Act (P.L. 96-487). For Beaver Creek, the management objectives cited in the designation include maintaining the pristine, free-flowing condition of the river, optimum and long-term utilization of the fish and wildlife resources, and high-quality primitive recreational opportunities (USDI 1974). While National Wild and Scenic River status requires that each component be administered to maintain and enhance those values for which it was included in the system, it does not necessarily protect the streamflow of the river.

BLM Manual Section 7250 states that the BLM will cooperate with State governments to protect all water use on public lands, including those identified for Federal reserved and state appropriative water rights. Because wild and scenic river designation does not automatically reserve a specific flow regime, the optimum amount of water necessary to fulfill the primary purpose of the reservation must be determined to define the water rights needs.

The BLM, in its *River Management Plan for the Beaver Creek National Wild River* (USDI 1983), proposed “a reservation of minimum water flows sufficient for public recreation and to support the values for which the area was designated will be determined in cooperation with the Alaska Department of Natural Resources, Division of Land and Water Management.”

In April 1985, BLM initiated a water rights quantification project for that portion of Beaver Creek National Wild River in the White Mountains National Recreation Area (Figure 1). This project culminated in the report, *Water Rights Assessment for Beaver Creek National Wild River, Alaska* (Van Haveren et al. 1987). These streamflow estimates, used in the application for the instream flow reservation, were calculated from mean monthly flows at nearby U.S. Geological Survey (USGS) gaging sites, adjusted by the area exponent of the mean annual discharge and a composite of the regional flood-frequency relationships listed in Parks and Madison (1985).

On May 26, 1989 the Alaska Department of Natural Resources, Division of Land and Water Management (DNR) issued a Certificate of Reservation for Beaver Creek (LAS 11997). The water right issued to BLM by DNR is at three locations on Beaver Creek: Wild River Mile (WRM) 6, WRM 36.5 and WRM 110.5. These mileages are referenced to the designated Wild

River Corridor, which begins at the confluence of Bear and Champion Creeks, WRM 0. In granting this right, the DNR required that this reservation be reviewed at least once every 10 years to determine if the reservation is still needed. Part of this review process includes documentation of the streamflow during the 10-year period. To achieve the best estimates possible for annual streamflow on Beaver Creek, the DNR requested that hydrologic monitoring be done at all three locations noted above and that winter as well as summer flows be determined.

BLM began stream gaging at these sites in 1988–1989, and the streamflow data collected up through 1992 was published in a previous report (Kostohrys and Sterin 1994). The current report includes the data collected from 1993 to 2000, as well as statistical analysis of all data collected from 1988 to 2000. Also included are a number of miscellaneous discharge and water quality measurements that have been made on tributary streams, groundwater springs, and lakes during this period. A riparian survey of channel geometry and bankfull characteristics, done in 2003, is also included. Additional background information can be found in the *Proposed Beaver Creek National Wild River Alaska* (USDI 1974) and *River Management Plan for the Beaver Creek National Wild River* (USDI 1983).

Basin Characteristics

The Beaver Creek watershed is located in east-central interior Alaska. As described in Wahrhaftig (1965), the basin is part of the Yukon-Tanana upland, an area characterized by rounded, even-topped ridges with moderate to gentle side slopes. The wide river valleys, often heavily forested, are separated by more sparsely vegetated, compact rugged mountains 4,000–5,000 feet in altitude (Figure 2). Some of the upland valleys, especially in the vicinity of Cache and Victoria Mountains, the north side of the White Mountains, and Mount Prindle experienced limited alpine glaciation during the Pleistocene (Weber et al. 1988). Streams originating in these areas have typical U-shaped valleys in their upper reaches, while the unglaciated tributaries flow in narrow, V-shaped canyons. The Beaver Creek valley widens downstream within a few miles of the headwaters, but remnants of a prominent terrace, cut by glacial meltwaters, remains evident in a few places, most notably near Big Bend. The flat, alluvium-floored valley contains wide, looping meanders, abandoned cut-off channels (sloughs), and extensive riparian and wetland areas. The floodplain, consisting largely of

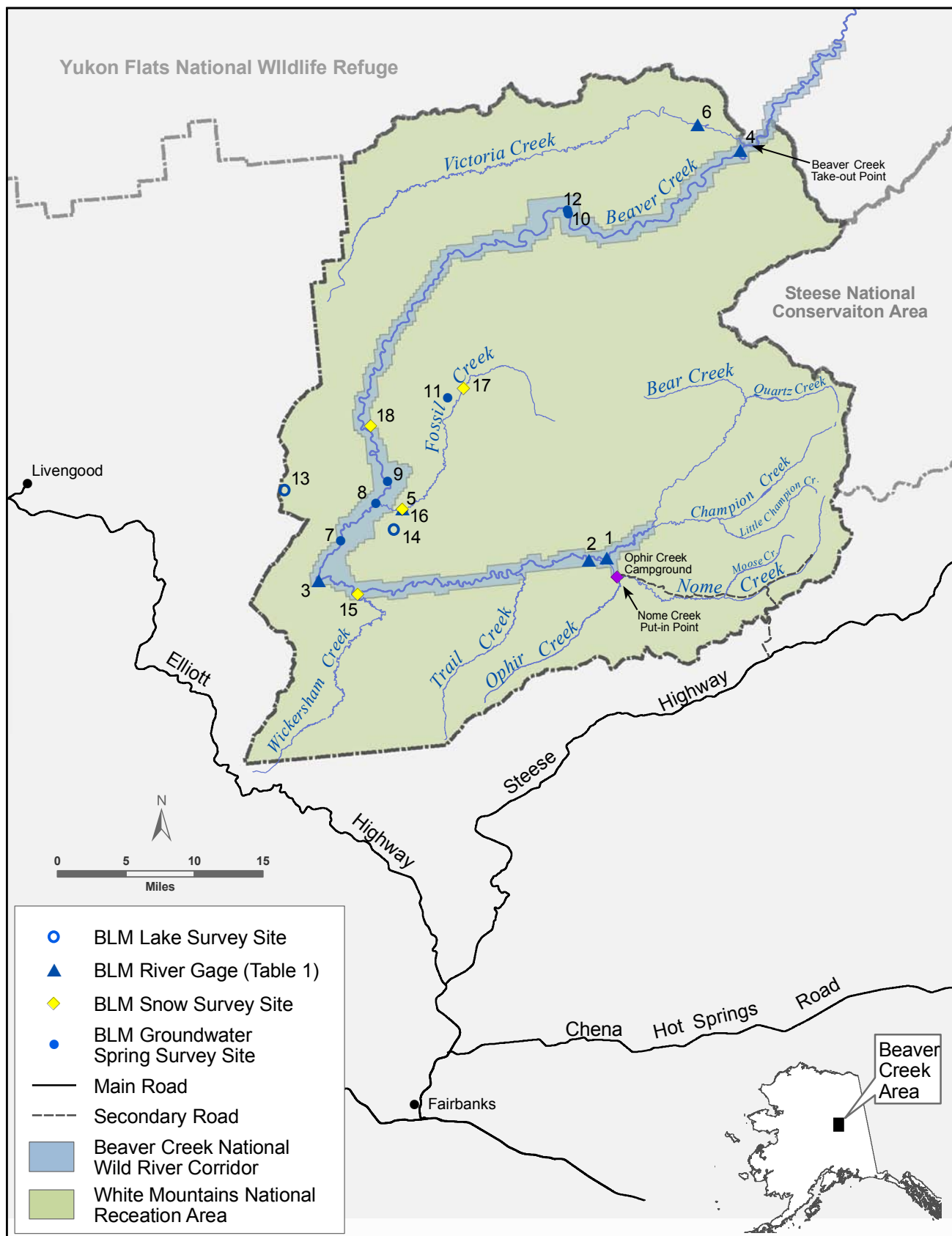


Figure 1. Map of the White Mountains and Beaver Creek area.



Figure 2. The Beaver Creek National Wild River corridor is highlighted by the limestone peaks of the White Mountains. (Photo by Mike Greene)

reworked outwash gravel, silt, and organic materials is poorly drained and often underlain by discontinuous permafrost. Ice wedge polygons are visible in many locations (Weber et al. 1988). The numerous flowing springs that occur in the basin, especially in the area downstream of Big Bend, contribute significantly to winter streamflow. The region is drained ultimately by the Yukon River.

The basin lies in the subpolar continental climatic zone, typified by long, cold winters and short, hot summers. Seasonal temperature extremes range from -70°F to $+90^{\circ}\text{F}$, and variations are great due to surrounding topography. The valley bottoms adjacent to Beaver Creek are often 30° colder than surrounding ridge tops during the winter. Precipitation is also strongly affected by topography. Snowfall is moderate, with an average depth in early April of 29 inches on the ground, about 5.3 inches of water equivalent (USDA 2001). Break-up usually begins in late April to early May, and high streamflow may persist well into June. Periods of low water typically occur in July, while infrequent high flows from rainstorms can occur in August or September. A rain gage operated since 1998 during the summer in Nome Creek, a headwaters tributary of Beaver Creek, recorded an average

of about 12 inches of rainfall for the summer period. Freeze-up on streams often begins at higher elevations in mid- September, although larger streams lower in the basin may remain open until November. Ice cover on streams is usually continuous for the winter, except in the vicinity of springs, and freezing to the bottom of the channel may occur in some places (Figure 3).

Methods

Stream gages were installed by BLM at three primary sites on Beaver Creek (Table 1). The gages were located as near as possible to the locations specified by DNR in LAS 11997. An automated water-level recorder (data logger and pressure transducer) was installed in 1988 at the site above Victoria Creek (WRM 110.5). This gage recorded water level data for the summer periods (generally mid-May to late September). Crest-stage gages were installed in 1989 at the other two sites, at Big Bend (WRM 36.5) and above Nome Creek (WRM 6). These are non-automated gages that record the peak water level whenever it exceeds a pre-set minimum (base) level.

At each visit to the site, both types of gages were surveyed to the referenced elevation (bench) marks and



Figure 3. Beaver Creek is normally ice-covered for most of the winter, but groundwater springs keep a few reaches of the creek open all winter.

to the current water level. Cross-sectional discharge (streamflow) measurements were made using a Price AA current meter to measure water velocity and a top-setting wading rod and tag line to measure depth and width (Figure 4). At least once a year, the stream banks, high-water marks and water surface profiles were surveyed using a level and stadia rod. Multi-cross-section surveys, used to quantify flood peaks, were done with a total-station theodolite (Figure 5). Water-quality readings were taken in-situ with single

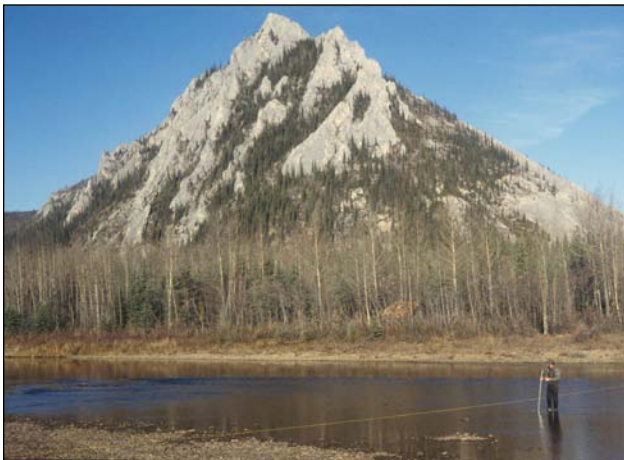


Figure 4. Streamflow measurements are an integral component of the stream gaging process.

parameter meters (Figure 6).

A water level vs. discharge rating was developed by combining the direct discharge measurements (Rantz et al. 1982) and computer-simulated peak flows using the slope-area method (Dalrymple and Benson 1967). These rating curves—actually log-log regression models—were then used to compute discharge from the recorded water level and crest-stage data.

By comparing differences in discharge measurements and peak flows at the three sites using regression analysis, data from the automated gage was used as the independent variable to compute monthly average flows for the non-automated gaging sites (dependent variable). Thomas (1967) states that the nearby gaging station with the most reliable and longest period of streamflow record is to be used as the reference site. During periods when water level data was unavailable, such as during spring break-up, fall freeze-up, or recorder malfunction, the data was estimated from regression analysis with the USGS data from the gage on the Salcha River (USDI 1996 to 2001) as the reference site.

For the winter period, when the water level recording is not possible due to ice formation in the river, under-ice discharge measurements were made at the three primary gaging sites, as nearly simultaneously as possible, two to three times during the winter. These

Table 1. Location of Water Resources Survey Sites in the White Mountains National Recreation Area

Site No.	Stream survey site	Decimal degrees latitude	Decimal degrees longitude	At Wild River Mile	Drainage Area (mi ²)
	Mainstem				
1	Beaver Creek above Nome Creek	65.3895	-147.1067	6.0	219
2	Beaver Creek below Nome Creek	65.3893	-147.1515	7.5	348
3	Beaver Creek At Big Bend	65.3957	-147.8345	36.5	710
4	Beaver Creek at Victoria Creek	65.8015	-146.6578	110.5	1,287
	Tributaries				
5	Fossil Creek below Limestone Gulch	65.4620	-147.6067	NA	80
6	Victoria Creek below Squaw Creek	65.8335	-146.7585	NA	221
	Groundwater Springs				
7	Beaver Creek At Hermans Landing	65.4350	-147.7697	40.5	NA
8	Beaver Creek At Shebals Landing	65.4710	-147.6727	46.7	NA
9	Beaver Creek below Fossil Creek	65.4928	-147.6370	48.5	NA
10	Beaver Creek below Willow Creek	65.7547	-147.1130	89.0	NA
11	Upper Windy Creek	65.5740	-147.4670	NA	NA
12	Unnamed Creek below Willow Creek	65.7580	-147.1130	NA	NA
	Lake survey sites				
13	Colorado Creek Lake	65.4933	-147.8980	NA	NA
14	Borealis Lake	65.4416	-147.6331	NA	NA
	Snow survey sites				
15	Borealis Snow Gage	65.3777	-147.7383	NA	NA
16	Fossil Snow Gage	65.4619	-147.6070	NA	NA
17	Windy Gap Snow Gage	65.5826	-147.4220	NA	NA
18	Wolf Snow Gage	65.5527	-147.6655	NA	NA

measurements were made by drilling a series of holes in the ice to define the cross-section, then measuring the depth and velocity in each hole using a USGS vertical-axis, vane type current meter mounted on a graduated rod (Figure 7).

Accuracy of winter flows is low; as discharge approaches zero, flow measurements become unreliable as the water velocity diminishes below the measuring range of the mechanical meter. Variability in the basin can occur as flows diminish downstream from the headwaters due to storage as ice. Streamflow may cease altogether if additional groundwater sources are not available. A flow measurement at one site may have little relationship to other sites in the basin unless geological conditions remain constant. Flow in unconfined alluvial channels is greater and shows more uniformity than in a basin where bedrock confines the aquifer and groundwater sources are non-continuous (Nelson 1978). Because of these factors, discharges less than about 10 cubic feet per second should be considered estimates.

Once ice and snow cover isolate the stream from precipitation and temperature changes, the flow to the stream recedes uniformly as the water table in the aquifer is lowered by reduction of water volume in the aquifer (Rogers and Armbruster 1990). Where the



Figure 5. While most surveying employed a level and stadia rod, multi-cross-section surveys were often done with a total-station theodolite.

measurements were sufficiently accurate to represent the winter flow conditions, streamflow was computed directly by regressing discharge on time (date) for the periods covered for each site. This assumes that since flow recession curves often take the form of exponential decay, discharge can be expressed as a constant times the initial discharge raised to a negative power of the time interval (Chow et al. 1988).

Where no data was available at any of the sites, i.e., during periods of variable back water from ice, spring break-up, and fall freeze-up, the regression correlation to the USGS Salcha River data set was used as the reference site. Wherever regression equations were used to compute mean monthly discharge, the estimated values have been identified in the tables with italics.

Results and Discussion

Appendix A contains discharge data, listed by site location for each year's data from 1993 to 2000. A summary table at the beginning of each year's data lists maximum, minimum, and mean monthly streamflows computed from a combination of the recorded daily values table, the regression equations determined from winter under-ice measurements, and the comparisons to other sites on Beaver Creek or the Salcha River. A table of the discharge ratings and regression equations used in the computations is also listed for each site.

A mean monthly data summary for the entire period of record, computed for the three Beaver Creek sites, is plotted as an annual hydrograph in Figure 8. An interesting feature is the bimodal nature of the high-flow periods, which can occur during both spring snow melt and late summer rainfall events.



Figure 6. Water-quality readings were taken in-situ with single parameter meters.



Figure 7. Winter discharge measurements were needed to document under-ice flows, critical to over-wintering fish.

As noted earlier (Kostohrys and Sterin 1994), the flow estimates used in the water-rights application, (Van Haveren et al. 1987), significantly under-estimated the actual flows on Beaver Creek. For the data covering the entire period of record from 1988 to 2000, this averaged about 81 percent low (ranging from 19 to 100 percent, Table 2). While the reasons for this are numerous (as discussed in Kostohrys and Sterin 1994) it was the lack of representative, long-term gaging data from the Beaver Creek watershed that ultimately resulted in the significant under-reservation in the water rights application.

Peak flow statistics were computed from the annual peak discharge data, listed in Appendix A by year and site. Using a log- Pearson III flood-frequency relationship, the computed recurrence interval discharges are listed in Table 3. The current values exceeded those used in the original estimates (Van Haveren et al. 1987) derived from regional flood-frequency relationships, by an average of 36% (Table 3) and also those presented in the earlier data report (Kostohrys and Sterin 1994).

Appendix B contains miscellaneous discharge measurements and water quality data at groundwater springs, lakes and rivers, collected intermittently during the period 1989 to 2000, but not previously reported. The most notable is the groundwater spring that discharges into Beaver Creek below Fossil Creek, listed in Table B-1. For this spring, located at WRM 48.5, the winter streamflow showed a much more uniform flow pattern for the period of record, as compared to the higher variability of the winter flows measured at the three primary gaging sites (Table 4). While the maximum and mean values follow similar trends, the

Table 2. Beaver Creek Mean Monthly Discharge Compared to Discharge Used in the Water Rights Application

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Nome Creek WRM 6												
Gaging data from 1989–1999	23	16	11	92	602	573	300	514	551	209	94	39
Estimated data in water rights*	0.1	0.1	0.1	6.6	233	158	77	71	67	13	1.3	0.2
Percent difference	100%	99%	99%	93%	61%	72%	74%	86%	88%	94%	99%	99%
At Big Bend WRM 36.5												
Gaging data from 1989–1999	55	37	27	177	1,454	1,375	682	1,233	1,350	568	203	94
Estimated data in water rights*	0.4	0.4	0.4	29	1,019	691	346	314	295	55	5.9	1.0
Percent difference	99%	99%	98%	84%	30%	50%	49%	75%	78%	90%	97%	99%
Above Victoria Creek WRM 110.5												
Gaging data from 1988–2000	94	65	49	309	2,665	2,213	1,160	1,997	2,144	959	348	157
Estimated data in water rights*	0.9	0.9	0.9	60	2,106	1,428	696	649	609	115	13	1.9
Percent difference	99%	99%	98%	81%	21%	35%	40%	68%	72%	88%	96%	99%

* Van Haveren et al. 1987

ND - Not determined

Table 3. Log Pearson Type III Recurrence-interval (years) and Discharge (cfs) for Beaver Creek from Gaging Data Compared to Water Rights Estimates

	1.5 Years	2 Years	5 Years	10 Years	25 Years	50 Years	100 Years	Mean Annual**
Above Nome Creek WRM 6								
Gaging data from 1989–1999	2,500	3,150	4,470	5,090	5,670	5,980	6,210	249
Estimated data in water rights*	ND	867	ND	2,224	3,318	4,407	5,596	68
Percent difference	ND	72%	ND	56%	41%	26%	10%	73%
At Big Bend WRM 36.5								
Gaging data from 1989–1999	6,500	7,900	11,100	13,000	15,000	16,400	17,600	597
Estimated data in water rights*	ND	3,114	ND	7,037	9,923	12,816	15,603	297
Percent difference	ND	61%	ND	46%	34%	22%	11%	50%
Above Victoria Creek WRM 110.5								
Gaging Data from 1988–2000	9,500	11,500	16,000	18,700	21,800	24,000	26,000	985
Estimated data in water rights*	ND	5,851	ND	12,424	17,040	21,704	25,881	614
Percent difference	ND	49%	ND	34%	22%	10%	0%	38%

* Van Haveren et al. 1987

ND - Not determined

**Gaging data is average of mean monthly values; estimated data used regression equation.

minimum discharge at the spring is 24 times greater. This indicates that these springs may contribute an inordinate share of water to the over-wintering aquatic habitat in the Beaver Creek watershed. The depth of snowpack appears to have a significant impact on the minimum winter flow, as the lowest measured discharges occurred during the lower snow depths, especially when snow is below normal early in the winter. Conversely, the highest winter streamflows were measured during the periods of highest snowfall (Table 4).

The channel geometry data, collected early in the study, was originally intended to determine peak

Table 4. Late Winter Discharge Measurements (cfs) and Snow Depths (in) on Beaver Creek

Stream Site	Maximum	Minimum	Mean
Above Nome Creek WRM 6	22	0	11
At Big Bend WRM 36.5	55	0	27
Above Victoria Creek WRM 110.5	92	1	49
Below Fossil Creek Spring WRM 48.5	69	24	41
Borealis Snow Survey (depth)	47	12	29

discharges and bankfull characteristics. These cross-sections were then compared to riparian surveys done in 2003. This data, summarized in Table 5, is plotted along with the resurveys shown in Appendix C, Figures C-2, C-4, and C-6. The intent of the resurveys was to see if significant erosion or deposition had altered riparian conditions during the study period and if this could be tied to specific events or activities within the corridor. The site at Beaver Creek above Nome Creek (Figure C-2) clearly shows the greatest change as the thalweg, or deepest portion of the stream channel, shifts completely, from the left to the right side of the creek. This is thought to be due to the large number of trees that eroded into this portion of the watershed during the floods from 1994 to 1998. The stream laterally adjusts the hydraulics and sediment flow when the large, woody debris is first deposited, partially buried, and then eventually flushed out of the reach on succeeding high-flow events. This could be the result of normal channel migration or some response to long-term changes in climate or riparian vegetation within the watershed.

While surveying channel cross-sections on lower Beaver and Victoria Creeks, a number of debris avalanche scars were observed on the steep, narrow valley side slopes near Victoria Mountain. A multiple cross-section survey done on a recent avalanche located near the confluence of Victoria and Squaw Creeks

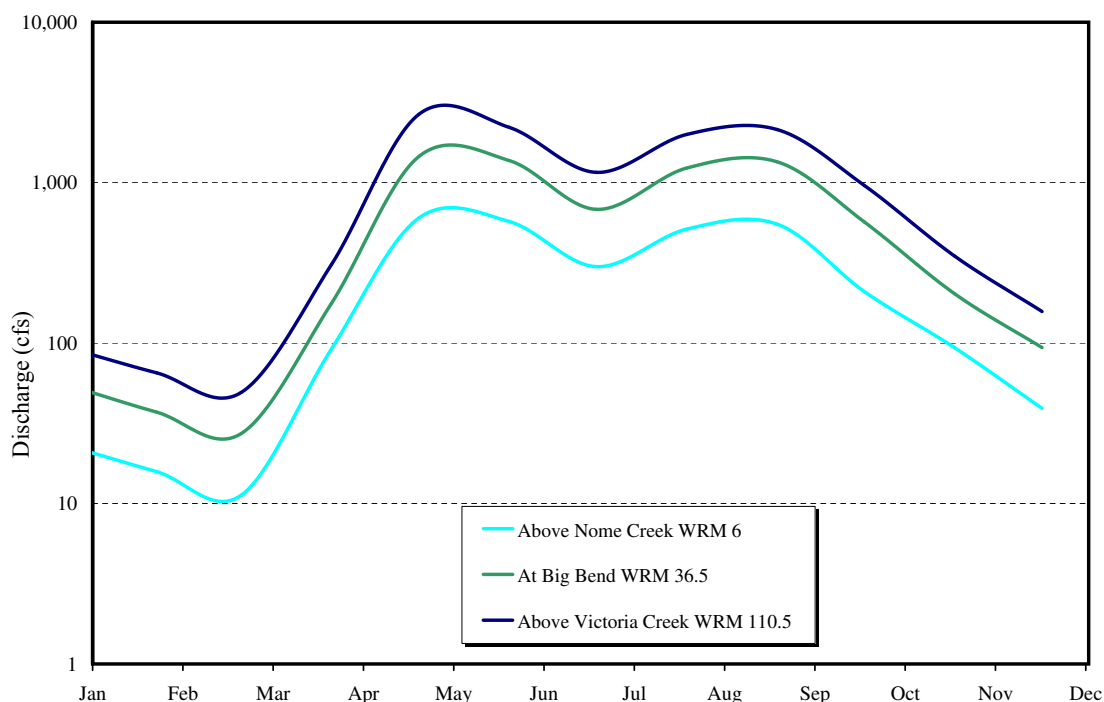


Figure 8. Monthly mean discharge hydrograph for Beaver Creek Basin.

determined that the slide was over a quarter-mile long and ranged in width from about 20 feet near the head to almost 100 feet at the base. Over 2,000 cubic yards of material was eroded from the hillside and subsequently deposited into Victoria Creek (Figure 9).

Recommendations

BLM should request that the DNR Commissioner review the water-rights application for the original three locations on Beaver Creek to reflect the increase in streamflow documented in this report.

Because the springs appear to contribute an inordinate share of viable over-wintering aquatic habitat during extreme low flow in the Beaver Creek watershed, an instream flow reservation for these areas should be quantified and submitted to DNR.

As noted in Van Haveren et al. (1987), Nome Creek is an integral part of the Beaver Creek Wild River, since it is the primary access route and put-in for float boating. The streamflow should be quantified at several points on lower Nome Creek and an instream flow reservation submitted to DNR.

The resurveys of the riparian and channel-morphology sites, as well as snow and climatic monitoring, should be continued to assess long-term riparian and channel geometry changes in the Beaver Creek Wild River corridor.

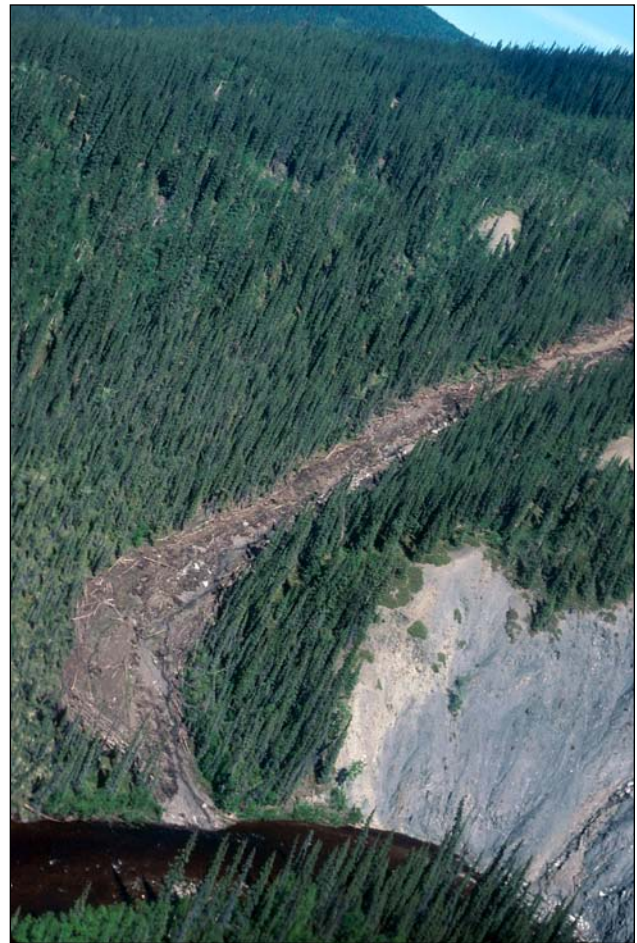


Figure 9. Debris flow observed on Victoria Creek in June 1989. The flow deposited more than 2,000 cubic yards of debris into the creek.

Table 5. Bankfull Channel Characteristics for Beaver Creek and Tributaries

Stream Site	Channel substrate	Bankfull Discharge (cfs)	Bankfull Max. Depth (ft)	Bankfull Mean Depth (ft)	Bankfull Width (ft)	Bankfull Width/Depth	1.5 Year Discharge (cfs)
Beaver Creek Mainstem							
Above Nome Creek WRM 6	Sand, gravel	3,800	5.3	3.4	174	51	2,500
Below Nome Creek WRM 7.5	Gravel	4,000	5.3	3.2	207	65	ND
At Big Bend WRM 36.5	Gravel, cobbles	4,500	6.5	4.3	232	54	6,500
Above Victoria Creek WRM 110.5	Cobbles, boulders	12,000	10.0	7.3	341	47	9,300
Tributaries							
Fossil Creek below Limestone Gulch	Gravel, cobbles	1,500	5.5	2.5	190	76	ND
Victoria Creek below Squaw Creek	Gravel, cobbles	650	4.6	2.6	77	30	1,800

ND - Not determined

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Appendix A. Principal Gaging Site Descriptions and Annual Discharge Data

Beaver Creek above Nome Creek WRM 6



Figure A-1. Looking upstream at the crest-stage gage at Beaver Creek above Nome Creek. The gage was installed in 1989 and discontinued September 1999.

Table A-1. Discharge Measurements for Beaver Creek above Nome Creek WRM 6

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg.Velocity (fps)	Avg.Depth (ft)
03/19/93	ND	22	48	40	0.6	0.8
09/23/93	2.72	694	163	228	3.0	1.4
12/23/93	ND	74	61	91	0.8	1.5
02/08/94	ND	52	60	73	0.7	1.2
03/17/94	ND	21	48	29	0.7	0.6
05/21/94	2.73	778	154	241	3.2	1.6
06/24/94	6.20*	4,000	218	897	4.5	4.1
07/22/94	2.32	339	120	144	2.4	1.2
09/01/94	2.45	530	103	163	3.3	1.6
09/28/94	1.67	165	89	89	1.9	1.0
12/13/94	ND	62	59	70	0.9	1.2
03/09/95	ND	18	38	38	0.5	2.6
05/31/95	1.91	261	77	128	2.1	2.1
07/19/95	2.01	201	74	111	1.8	1.7
09/27/95	3.20	851	108	249	3.5	2.5
11/22/95	ND	91	61	76	1.2	1.1
03/21/96	ND	0	(Creek frozen solid to bottom)			
05/29/96	3.10	597	105	209	1.2	1.1
07/24/96	2.07	121	94	86	1.2	1.1
08/23/96	2.17	213	75	116	1.2	1.1
09/26/96	2.17	202	76	112	1.2	1.1
11/22/96	ND	60	67	62	1.2	1.1
02/03/97	ND	5.7	34	10	0.6	0.3
03/14/97	ND	3.8	30	13	0.3	0.4
05/19/97	3.10	460	81	148	3.1	1.8
08/19/97	2.61	402	82	151	2.7	1.8
09/26/97	2.51	312	80	139	2.2	1.7
11/24/97	ND	74	70	73	1.0	1.0
01/27/98	ND	0	(Creek frozen solid to bottom)			
05/21/98	2.59	351	81	141	2.5	1.7
07/31/98	2.58	314	81	137	2.3	1.7
08/18/98	5.56*	3,800	174	592	6.4	3.4
09/11/98	2.58	324	80	142	2.3	1.8
09/29/98	2.39	309	90	96	3.2	1.1
11/24/98	ND	73	72	67	1.1	0.9
02/23/99	ND	2.9	30	11	0.3	0.4
07/29/99	2.45	281	80	130	2.2	1.6
07/01/03	ND	215	62	104	2.1	1.7

*Slope-area indirect discharge measurement
 ND Not Determined

Table A-2. Peak and minimum discharges (cfs) from 1993 to 1999 for Beaver Creek above Nome Creek WRM 6

Peak Date	Peak discharge	Minimum date	Min. discharge
09/21/93	2,820	03/19/93	22
06/24/94	4,050	03/17/94	48
06/28/95	3,450	03/09/95	18
06/12/96	2,020	03/21/96	0.0
05/05/97	920	03/14/97	3.8
08/18/98	3,800	01/27/98	0.0
08/10/99	1,330	02/23/99	2.9

Table A-3. 1989–1999 Mean Monthly Discharge (cfs) for Beaver Creek above Nome Creek WRM-6

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg. Annual
1989	<i>17</i>	<i>16</i>	<i>16</i>	<i>162</i>	<i>474</i>	<i>920</i>	<i>205</i>	<i>173</i>	<i>155</i>	<i>74</i>	<i>54</i>	<i>39</i>	<i>192</i>
1990	<i>8.1</i>	<i>4.5</i>	<i>3.6</i>	<i>55</i>	<i>461</i>	<i>272</i>	<i>215</i>	<i>275</i>	<i>1,086</i>	<i>244</i>	<i>104</i>	<i>45</i>	<i>231</i>
1991	<i>34</i>	<i>26</i>	<i>19</i>	<i>72</i>	<i>1,195</i>	<i>761</i>	<i>290</i>	<i>971</i>	<i>405</i>	<i>264</i>	<i>107</i>	<i>43</i>	<i>349</i>
1992	<i>32</i>	<i>22</i>	<i>16</i>	<i>165</i>	<i>474</i>	<i>989</i>	<i>224</i>	<i>209</i>	<i>202</i>	<i>85</i>	<i>58</i>	<i>40</i>	<i>210</i>
1993	<i>35</i>	<i>28</i>	<i>23</i>	<i>187</i>	<i>721</i>	<i>508</i>	<i>230</i>	<i>421</i>	<i>1,439</i>	<i>383</i>	<i>166</i>	<i>74</i>	<i>351</i>
1994	<i>61</i>	<i>42</i>	<i>24</i>	<i>132</i>	<i>613</i>	<i>1,344</i>	<i>511</i>	<i>576</i>	<i>321</i>	<i>133</i>	<i>89</i>	<i>60</i>	<i>325</i>
1995	<i>39</i>	<i>25</i>	<i>17</i>	<i>132</i>	<i>741</i>	<i>441</i>	<i>254</i>	<i>917</i>	<i>1,151</i>	<i>415</i>	<i>120</i>	<i>25</i>	<i>356</i>
1996	<i>4.0</i>	<i>1.0</i>	<i>0.0</i>	<i>25</i>	<i>521</i>	<i>351</i>	<i>278</i>	<i>428</i>	<i>345</i>	<i>135</i>	<i>90</i>	<i>29</i>	<i>184</i>
1997	<i>11</i>	<i>5.0</i>	<i>4.0</i>	<i>16</i>	<i>346</i>	<i>178</i>	<i>170</i>	<i>306</i>	<i>312</i>	<i>196</i>	<i>92</i>	<i>8.5</i>	<i>137</i>
1998	<i>0.5</i>	<i>0.0</i>	<i>0.0</i>	<i>35</i>	<i>764</i>	<i>316</i>	<i>683</i>	<i>891</i>	<i>408</i>	<i>205</i>	<i>92</i>	<i>42</i>	<i>286</i>
1999	<i>12</i>	<i>4.0</i>	<i>1.5</i>	<i>31</i>	<i>307</i>	<i>221</i>	<i>235</i>	<i>482</i>	<i>240</i>	<i>167</i>	<i>56</i>	<i>25</i>	<i>148</i>
Mean	<i>23</i>	<i>16</i>	<i>11</i>	<i>92</i>	<i>602</i>	<i>573</i>	<i>300</i>	<i>514</i>	<i>551</i>	<i>209</i>	<i>94</i>	<i>39</i>	<i>252</i>

Figures in italics were estimated from regression analysis of discharge measurements at this gaging site, at other gages on Beaver Creek, or the Salcha River (USGS data).

Beaver Creek at Big Bend WRM 36.5:

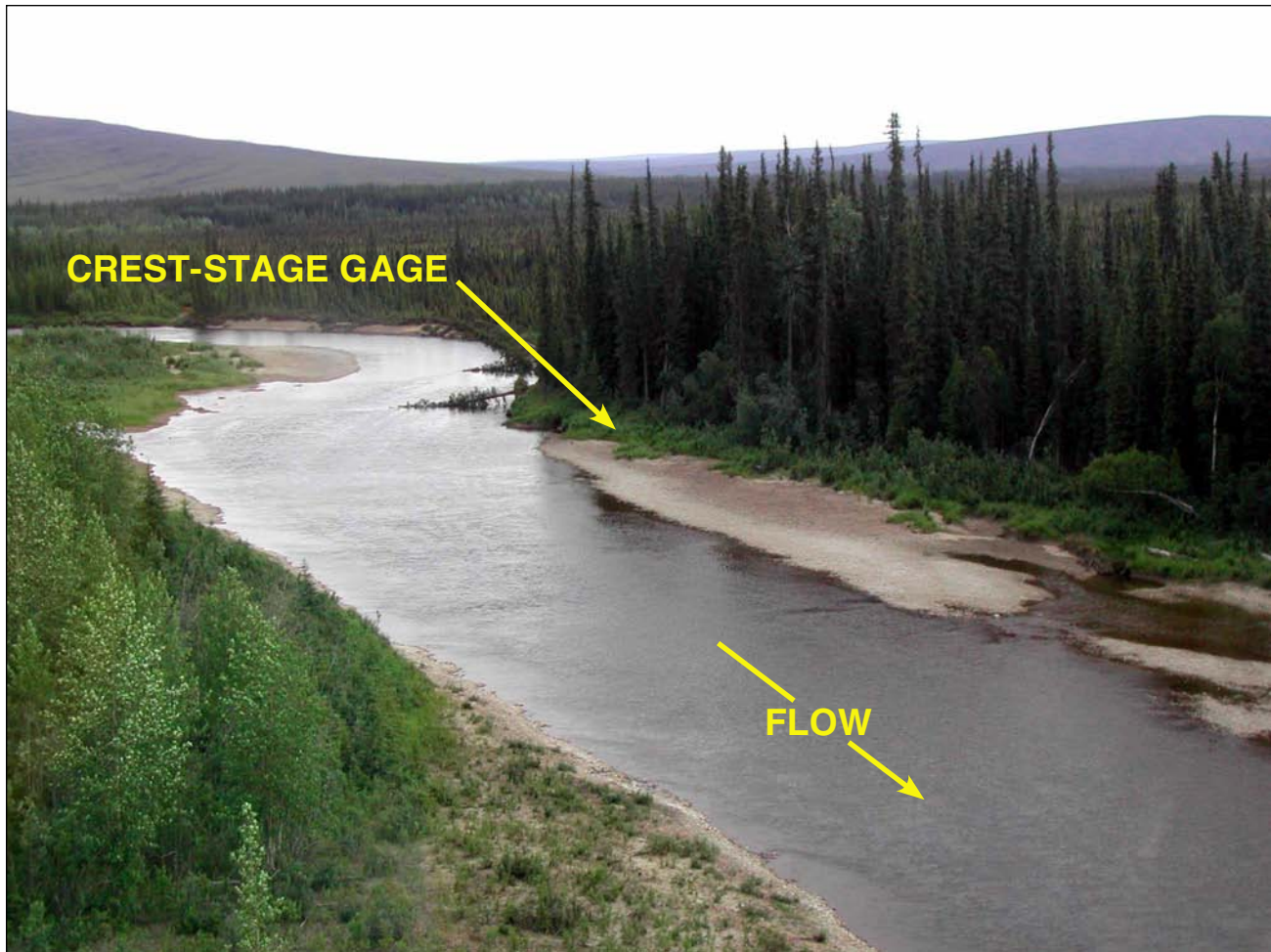


Figure A-2. Looking upstream at the crest-stage gage at Beaver Creek at Big Bend. This site was selected in June 1989, and a crest-stage gage was installed on the left bank. Data was collected until 2000, when the gaging project was discontinued. The gage was removed in July 2003.

Table A-4. Discharge Measurements for Beaver Creek above Big Bend WRM 36.5

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
03/22/93	ND	55	100	209	0.3	2.1
08/16/93	3.24	643	168	343	1.9	2.0
12/01/93	ND	230	135	251	0.9	1.9
02/01/94	ND	90	95	150	0.6	1.6
03/14/94	ND	30	85	71	0.4	0.8
05/21/94	3.94	1,326	260	463	2.9	1.8
06/26/94	9.89*	10,500	260	1,770	5.9	6.8
07/22/94	3.69	945	263	386	2.4	1.5
09/28/94	2.82	390	108	187	2.1	1.7
12/02/94	ND	139	90	125	1.1	1.4
03/19/95	NA	52	75	81	0.6	1.1
05/31/95	3.21	661	152	226	2.9	1.5
07/19/95	2.91	468	148	192	2.4	1.3
11/24/95	NA	140	90	123	1.1	1.4
03/12/96	ND	0	(Creek frozen solid to bottom)			
07/24/96	2.61	343	114	167	2.1	1.5
08/23/96	3.02	517	153	254	2.0	1.7
09/26/96	2.91	516	118	199	2.6	1.7
11/26/96	ND	99	80	98	1.0	1.2
03/25/97	ND	8.8	30	9.9	0.9	0.3
06/06/97	3.34	692	153	243	2.8	1.6
08/19/97	3.86	1,148	160	299	3.8	1.9
09/26/97	3.24	651	148	238	2.7	1.6
11/20/97	ND	133	95	118	1.1	1.2
02/11/98	ND	7.6	75	28	0.3	0.4
03/27/98	ND	0.9	35	6.8	0.1	0.2
05/21/98	3.37	746	155	249	3.0	1.6
09/29/98	3.59	900	170	353	2.5	2.1
12/04/98	ND	95	75	110	0.9	1.5
03/10/99	ND	2.7	22	11	0.2	0.5
09/10/99	3.03	472	107	191	2.5	1.8
07/01/03	2.64	339	102	183	1.9	1.8

ND - Not Determined

Table A-5. Peak and Minimum Discharges (cfs) from 1993 to 1999 for Beaver Creek at Big Bend WRM 36.5

Peak Date	Peak discharge	Minimum date	Minimum discharge
09/21/93	8,560	03/22/93	55
06/24/94	10,500	03/14/94	30
09/01/95	7,900	03/09/95	18
06/12/96	5,380	03/12/96	0.0
05/10/97	3,500	03/25/97	8.8
08/18/98	8,050	03/27/98	0.9
08/10/99	3,670	03/10/99	2.7

Table A-6. 1989–1999 Mean Monthly Discharge (cfs) Beaver Creek at Big Bend WRM 36.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg. Annual
1989	<i>43</i>	<i>41</i>	<i>41</i>	<i>278</i>	<i>1,034</i>	<i>2,032</i>	<i>372</i>	<i>302</i>	<i>264</i>	<i>197</i>	<i>155</i>	<i>100</i>	<i>405</i>
1990	<i>19</i>	<i>17</i>	<i>16</i>	<i>125</i>	<i>998</i>	<i>525</i>	<i>394</i>	<i>533</i>	<i>2,475</i>	<i>563</i>	<i>239</i>	<i>102</i>	<i>500</i>
1991	<i>78</i>	<i>59</i>	<i>45</i>	<i>159</i>	<i>2,777</i>	<i>1,840</i>	<i>569</i>	<i>2,165</i>	<i>853</i>	<i>514</i>	<i>270</i>	<i>142</i>	<i>789</i>
1992	<i>82</i>	<i>56</i>	<i>38</i>	<i>155</i>	<i>1,034</i>	<i>2,218</i>	<i>414</i>	<i>381</i>	<i>366</i>	<i>194</i>	<i>135</i>	<i>123</i>	<i>433</i>
1993	<i>96</i>	<i>74</i>	<i>58</i>	<i>430</i>	<i>1,851</i>	<i>1,267</i>	<i>538</i>	<i>1,033</i>	<i>3,910</i>	<i>1,410</i>	<i>427</i>	<i>186</i>	<i>940</i>
1994	<i>116</i>	<i>59</i>	<i>33</i>	<i>294</i>	<i>1,551</i>	<i>3,631</i>	<i>1,275</i>	<i>1,450</i>	<i>770</i>	<i>298</i>	<i>182</i>	<i>123</i>	<i>815</i>
1995	<i>93</i>	<i>70</i>	<i>54</i>	<i>294</i>	<i>1,905</i>	<i>1,085</i>	<i>597</i>	<i>2,400</i>	<i>3,069</i>	<i>1,490</i>	<i>238</i>	<i>22</i>	<i>943</i>
1996	<i>4.0</i>	<i>1.0</i>	<i>0</i>	<i>49</i>	<i>1,302</i>	<i>847</i>	<i>659</i>	<i>1,050</i>	<i>833</i>	<i>309</i>	<i>133</i>	<i>67</i>	<i>438</i>
1997	<i>36</i>	<i>19</i>	<i>11</i>	<i>29</i>	<i>835</i>	<i>406</i>	<i>387</i>	<i>731</i>	<i>747</i>	<i>376</i>	<i>154</i>	<i>56</i>	<i>316</i>
1998	<i>19</i>	<i>6.5</i>	<i>1.5</i>	<i>69</i>	<i>1,970</i>	<i>756</i>	<i>1,745</i>	<i>2,328</i>	<i>998</i>	<i>522</i>	<i>181</i>	<i>63</i>	<i>722</i>
1999	<i>20</i>	<i>6.5</i>	<i>2.5</i>	<i>62</i>	<i>734</i>	<i>513</i>	<i>548</i>	<i>1,196</i>	<i>561</i>	<i>379</i>	<i>117</i>	<i>48</i>	<i>349</i>
Mean	<i>55</i>	<i>37</i>	<i>27</i>	<i>177</i>	<i>1,454</i>	<i>1,375</i>	<i>682</i>	<i>1,233</i>	<i>1,350</i>	<i>568</i>	<i>203</i>	<i>94</i>	<i>605</i>

Figures in italics were estimated from regression analysis of discharge measurements at this gaging site, at other gages on Beaver Creek, or the Salcha River (USGS data).

Beaver Creek above Victoria Creek WRM 110.5

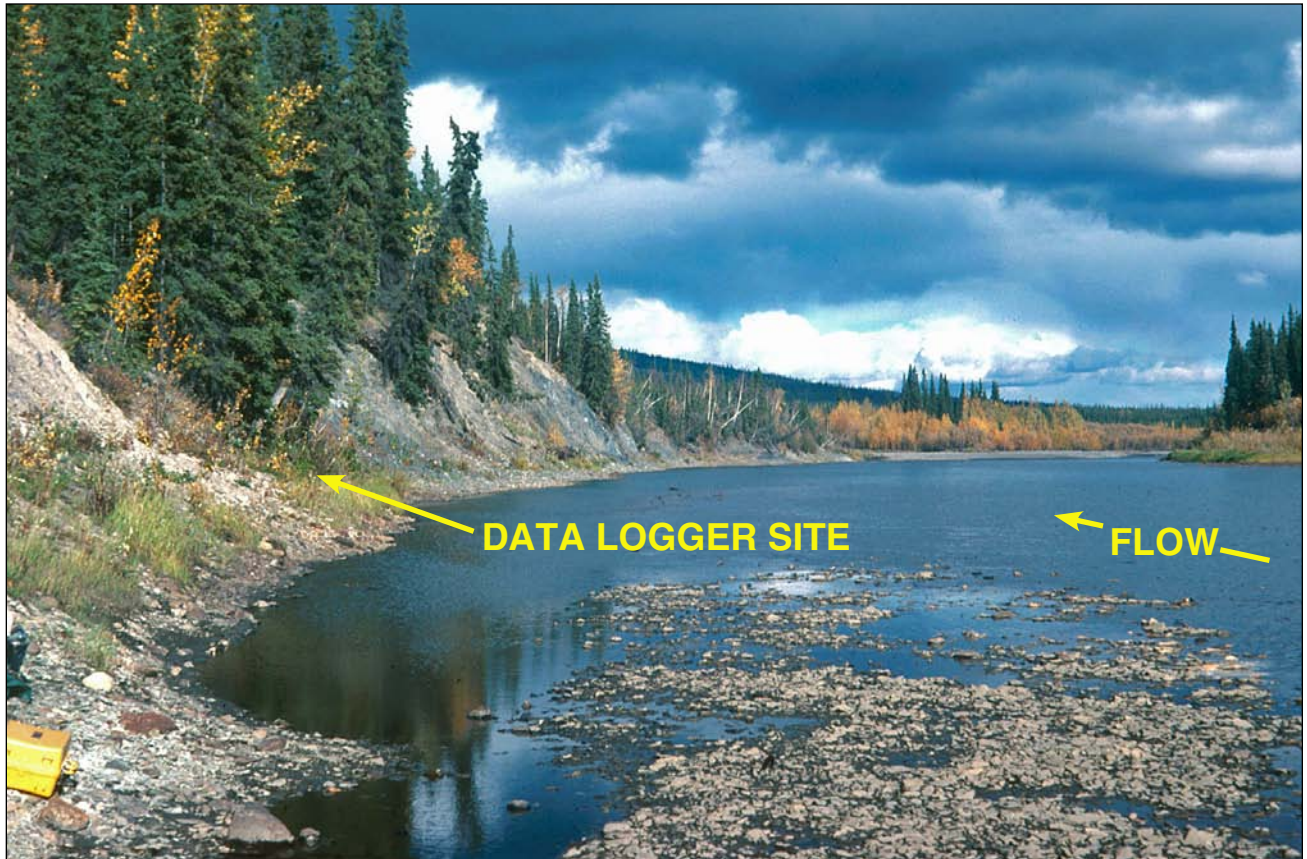


Fig A-3. Looking downstream at the data logger site on Beaver Creek above Victoria Creek. This site was selected in June 1988, and a data logger and pressure transducer gage were installed on the left bank. Data was collected until 2000, when the gaging project was discontinued. The gage was removed in September 2000.

Table A-7. Discharge Measurements for Beaver Creek above Victoria Creek WRM 110.5

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
03/22/93	ND	92	135	133	0.7	1.0
08/16/93	1.85	1,035	227	513	2.0	2.3
12/07/93	ND	349	171	195	1.8	1.1
03/14/94	ND	64	110	61	1.0	0.6
05/21/94	2.85	2,040	228	772	2.6	3.4
06/24/94	9.45*	14,100	353	2,630	5.4	7.5
09/28/94	1.27	631	210	420	1.5	2.0
11/29/94	ND	2,118	100	383	5.5	3.8
03/19/95	ND	74	187	96	0.8	0.5
05/31/95	2.16	1,200	213	538	2.2	2.5
07/19/95	1.75	826	220	454	1.8	2.1
11/24/95	ND	236	125	166	1.4	1.3
03/12/96	ND	1.0	23	7.3	0.1	0.3
07/24/96	1.42	603	214	373	1.6	1.7
08/23/96	1.81	866	219	447	1.9	2.0
09/26/96	1.83	809	214	373	2.2	1.7
11/26/96	ND	160	144	148	1.1	1.0
03/25/97	NA	34	110	40	0.9	0.4
05/19/97	2.74	1,710	215	760	2.3	3.5
09/26/97	2.27	1,230	220	527	2.3	2.4
11/20/97	ND	181	135	235	0.8	1.7
02/11/98	ND	34	120	73	0.5	0.6
04/06/98	ND	41	104	46	0.9	0.4
06/29/98	2.48	1,370	225	577	2.4	2.6
07/31/98	2.32	1,460	220	544	2.7	2.5
09/11/98	4.12	1,660	225	628	2.6	2.8
12/01/98	ND	125	190	169	0.7	0.9
03/10/99	ND	8.5	50	25	0.3	0.5
05/25/99	2.20	1,280	225	530	2.4	2.4
09/28/99	2.23	1,120	221	502	2.2	2.3
12/01/99	ND	125	190	169	0.7	0.9
03/21/00	ND	15	65	35	0.4	0.5
05/25/00	6.47	8,040	258	1,490	5.4	5.8
07/26/00	1.73	713	210	398	1.8	1.9
12/12/00	ND	212	190	260	0.8	1.4
03/12/01	ND	80	170	137	0.6	0.8

*Slope-conveyance indirect discharge measurement

ND - Not Determined

Table A-8. Peak and Minimum Discharges (cfs) from 1993–2000 for Beaver Creek above Victoria Creek WRM 110.5

Peak Date	Peak discharge	Minimum date	Minimum discharge
09/21/93	13,700	03/22/93	92
06/24/94	15,300	03/14/94	64
09/01/95	10,700	03/19/95	74
06/12/96	6,660	03/12/96	1.0
05/10/97	6,560	03/25/97	34
08/18/98	13,700	02/11/98	34
08/10/99	5,290	03/10/99	8.5
08/15/00	10,800	03/21/00	15

Table A-9. 1988–2001 Monthly Mean Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg. Annual
1988						1,920	519	1,764	1,414				
1989	<i>63</i>	<i>56</i>	<i>54</i>	<i>478</i>	2,217	3,113	863	585	409	288	<i>192</i>	<i>120</i>	703
1990	<i>32</i>	<i>28</i>	<i>27</i>	<i>248</i>	2,170	1,318	940	1,338	4,686	<i>967</i>	<i>390</i>	<i>157</i>	1,025
1991	<i>128</i>	<i>96</i>	<i>73</i>	<i>290</i>	5,603	2,980	1,425	3,619	1,950	<i>831</i>	<i>377</i>	<i>171</i>	1,462
1992	<i>123</i>	<i>92</i>	<i>69</i>	<i>508</i>	2,217	3,810	1,005	895	841	<i>311</i>	<i>256</i>	<i>211</i>	862
1993	<i>158</i>	<i>123</i>	<i>97</i>	<i>698</i>	2,611	1,854	855	1,542	5,130	<i>2,880</i>	<i>838</i>	<i>303</i>	1,424
1994	<i>176</i>	<i>103</i>	<i>63</i>	<i>495</i>	2,226	4,799	1,865	2,094	1,182	<i>471</i>	<i>277</i>	<i>187</i>	1,162
1995	<i>138</i>	<i>102</i>	<i>77</i>	<i>495</i>	2,680	1,612	940	3,301	4,123	<i>1,735</i>	<i>370</i>	<i>79</i>	1,304
1996	<i>17</i>	<i>4.0</i>	<i>1.0</i>	<i>99</i>	1,900	1,289	1,028	1,565	1,270	<i>488</i>	<i>214</i>	<i>125</i>	667
1997	<i>83</i>	<i>56</i>	<i>39</i>	<i>61</i>	1,273	663	635	1,128	1,151	<i>634</i>	<i>215</i>	<i>109</i>	504
1998	<i>59</i>	<i>34</i>	<i>38</i>	<i>134</i>	2,762	1,163	2,476	3,212	1,495	<i>903</i>	<i>326</i>	<i>124</i>	1,061
1999	<i>47</i>	<i>18</i>	<i>7.3</i>	<i>121</i>	1,132	820	870	1,760	889	<i>624</i>	<i>216</i>	<i>96</i>	550
2000	<i>53</i>	<i>29</i>	<i>17</i>	<i>75</i>	5,191	3,132	1,015	2,927	2,608	<i>1,380</i>	<i>507</i>	<i>205</i>	1,428
2001	<i>147</i>	<i>106</i>	<i>77</i>										
Mean	<i>94</i>	<i>65</i>	<i>49</i>	<i>309</i>	2,665	2,213	1,160	1,997	2,144	<i>959</i>	<i>348</i>	<i>157</i>	1,013

Figures in italics were estimated from regression analysis of discharge measurements at this gaging site, at other gages on Beaver Creek, or the Salcha River (USGS data).

Table A-10. 1993 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	2,402	01-Jul	1,067	01-Aug	628	01-Sep	1,342
02-May		02-Jun	1,865	02-Jul	1,302	02-Aug	625	02-Sep	4,045
03-May		03-Jun	1,692	03-Jul	1,737	03-Aug	621	03-Sep	8,219
04-May		04-Jun	1,561	04-Jul	1,565	04-Aug	618	04-Sep	8,663
05-May		05-Jun	1,432	05-Jul	1,238	05-Aug	615	05-Sep	6,955
06-May		06-Jun	1,398	06-Jul	1,063	06-Aug	611	06-Sep	5,790
07-May		07-Jun	1,354	07-Jul	986	07-Aug	964	07-Sep	4,877
08-May		08-Jun	1,225	08-Jul	949	08-Aug	1,478	08-Sep	4,075
09-May		09-Jun	1,605	09-Jul	937	09-Aug	2,087	09-Sep	3,558
10-May		10-Jun	1,736	10-Jul	896	10-Aug	1,772	10-Sep	3,191
11-May		11-Jun	1,636	11-Jul	846	11-Aug	1,478	11-Sep	2,883
12-May		12-Jun	2,047	12-Jul	802	12-Aug	1,313	12-Sep	2,658
13-May		13-Jun	2,204	13-Jul	760	13-Aug	1,157	13-Sep	2,489
14-May		14-Jun	1,684	14-Jul	734	14-Aug	1,107	14-Sep	2,418
15-May		15-Jun	1,303	15-Jul	709	15-Aug	1,057	15-Sep	2,602
16-May		16-Jun	1,119	16-Jul	687	16-Aug	1,004	16-Sep	2,563
17-May		17-Jun	1,181	17-Jul	703	17-Aug		17-Sep	2,769
18-May		18-Jun	1,519	18-Jul	706	18-Aug		18-Sep	4,140
19-May		19-Jun	3,105	19-Jul	757	19-Aug		19-Sep	4,173
20-May		20-Jun	4,241	20-Jul	724	20-Aug		20-Sep	8,898
21-May		21-Jun	4,528	21-Jul	700	21-Aug		21-Sep	13,176
22-May		22-Jun	2,997	22-Jul	681	22-Aug		22-Sep	10,681
23-May		23-Jun	1,988	23-Jul	661	23-Aug		23-Sep	7,818
24-May		24-Jun	1,653	24-Jul	645	24-Aug	2,308	24-Sep	
25-May	2,068	25-Jun	1,581	25-Jul	642	25-Aug	2,257	25-Sep	
26-May	2,488	26-Jun	1,516	26-Jul	633	26-Aug	1,943	26-Sep	
27-May	3,156	27-Jun	1,375	27-Jul	625	27-Aug	1,669	27-Sep	
28-May	2,956	28-Jun	1,298	28-Jul	615	28-Aug	1,483	28-Sep	
29-May	2,660	29-Jun	1,236	29-Jul	641	29-Aug	1,318	29-Sep	
30-May	2,488	30-Jun	1,146	30-Jul	631	30-Aug	1,214	30-Sep	
31-May	2,460			31-Jul	628	31-Aug	1,172		
Mean	2,611	Mean	1,854	Mean	855	Mean	1,542	Mean	5,130
Max.	3,156	Max.	4,528	Max.	1,737	Max.	2,308	Max.	13,176
Min.	2,068	Min.	1,119	Min.	615	Min.	1,004	Min.	1,342

Table A-11. 1994 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	1,511	01-Jul	4,228	01-Aug	1,113	01-Sep	2,090
02-May		02-Jun	1,410	02-Jul	3,492	02-Aug	1,025	02-Sep	1,816
03-May		03-Jun	1,311	03-Jul	3,016	03-Aug	989	03-Sep	1,731
04-May		04-Jun	1,215	04-Jul	2,697	04-Aug	979	04-Sep	1,648
05-May		05-Jun	1,160	05-Jul	2,567	05-Aug	952	05-Sep	1,566
06-May		06-Jun	1,200	06-Jul	2,424	06-Aug	901	06-Sep	1,447
07-May		07-Jun	1,165	07-Jul	2,239	07-Aug	1,040	07-Sep	1,359
08-May		08-Jun	1,484	08-Jul	2,103	08-Aug	954	08-Sep	1,273
09-May		09-Jun	2,197	09-Jul	1,853	09-Aug	903	09-Sep	1,235
10-May		10-Jun	2,397	10-Jul	1,664	10-Aug	853	10-Sep	1,214
11-May		11-Jun	2,137	11-Jul	1,553	11-Aug	804	11-Sep	1,176
12-May		12-Jun	1,895	12-Jul	1,422	12-Aug	779	12-Sep	1,121
13-May		13-Jun	1,754	13-Jul	1,330	13-Aug	793	13-Sep	1,093
14-May		14-Jun	1,556	14-Jul	1,364	14-Aug	760	14-Sep	1,065
15-May		15-Jun	1,367	15-Jul	1,341	15-Aug	735	15-Sep	1,012
16-May		16-Jun	1,198	16-Jul	1,250	16-Aug	719	16-Sep	968
17-May		17-Jun	1,169	17-Jul	1,195	17-Aug	770	17-Sep	925
18-May		18-Jun	1,081	18-Jul	1,411	18-Aug	1,035	18-Sep	882
19-May		19-Jun	1,091	19-Jul	1,739	19-Aug	1,190	19-Sep	864
20-May		20-Jun	2,875	20-Jul	1,802	20-Aug	1,353	20-Sep	823
21-May	2730	21-Jun	8,428	21-Jul	2,089	21-Aug	1,240	21-Sep	805
22-May	2631	22-Jun	11,686	22-Jul	1,837	22-Aug	1,357	22-Sep	788
23-May	2564	23-Jun	14,079	23-Jul	1,789	23-Aug	1,758	23-Sep	755
24-May	2539	24-Jun	14,355	24-Jul	1,641	24-Aug	1,735	24-Sep	723
25-May	2,411	25-Jun	11,991	25-Jul	1,480	25-Aug	2,003	25-Sep	699
26-May	2,279	26-Jun	14,027	26-Jul	1,366	26-Aug	3,776	26-Sep	668
27-May	2,150	27-Jun	14,355	27-Jul	1,254	27-Aug	5,679	27-Sep	645
28-May	2,023	28-Jun	11,731	28-Jul	1,185	28-Aug	3,984	28-Sep	614
29-May	1,828	29-Jun	6,925	29-Jul	1,173	29-Aug	3,149	29-Sep	
30-May	1,720	30-Jun	5,231	30-Jul	1,448	30-Aug	2,719	30-Sep	
31-May	1,614			31-Jul	1,395	31-Aug	2,403		
Mean	2,226	Mean	4,799	Mean	1,865	Mean	2,094	Mean	1,182
Max.	2,730	Max.	14,355	Max.	4,228	Max.	5,679	Max.	2,090
Min.	1,614	Min.	1,081	Min.	1,173	Min.	719	Min.	614

Table A-12. 1995 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date		Date	Discharge
01-May		01-Jun	1,130	01-Jul	1,949	01-Aug	650	01-Sep	9,934
02-May		02-Jun	1,136	02-Jul	1,637	02-Aug	639	02-Sep	8,696
03-May		03-Jun	1,315	03-Jul	1,474	03-Aug	618	03-Sep	8,303
04-May		04-Jun	2,096	04-Jul	1,337	04-Aug	596	04-Sep	7,682
05-May		05-Jun	2,771	05-Jul	1,199	05-Aug	645	05-Sep	6,363
06-May		06-Jun	2,059	06-Jul	1,099	06-Aug	747	06-Sep	5,056
07-May		07-Jun	1,579	07-Jul	1,022	07-Aug	983	07-Sep	4,307
08-May		08-Jun	1,303	08-Jul	942	08-Aug	1,163	08-Sep	3,851
09-May		09-Jun	1,146	09-Jul	880	09-Aug	1,254	09-Sep	3,575
10-May		10-Jun	1,085	10-Jul	824	10-Aug	1,119	10-Sep	3,381
11-May		11-Jun	1,090	11-Jul	790	11-Aug	1,144	11-Sep	3,285
12-May		12-Jun	1,047	12-Jul	1,051	12-Aug	1,248	12-Sep	3,519
13-May		13-Jun	960	13-Jul	950	13-Aug	1,363	13-Sep	3,895
14-May		14-Jun	883	14-Jul	916	14-Aug	1,738	14-Sep	3,605
15-May		15-Jun	816	15-Jul	889	15-Aug	3,915	15-Sep	3,368
16-May		16-Jun	771	16-Jul	895	16-Aug	4,854	16-Sep	3,061
17-May		17-Jun	877	17-Jul	937	17-Aug	3,983	17-Sep	2,773
18-May		18-Jun	917	18-Jul	926	18-Aug	3,160	18-Sep	2,534
19-May		19-Jun	889	19-Jul	863	19-Aug	2,651	19-Sep	2,333
20-May		20-Jun	817	20-Jul	775	20-Aug	2,475	20-Sep	2,138
21-May		21-Jun	768	21-Jul	722	21-Aug	2,645	21-Sep	1,986
22-May		22-Jun	790	22-Jul	693	22-Aug	2,810	22-Sep	1,867
23-May		23-Jun	767	23-Jul	661	23-Aug	2,541	23-Sep	1,764
24-May		24-Jun	741	24-Jul	640	24-Aug	2,280	24-Sep	1,683
25-May		25-Jun	748	25-Jul	655	25-Aug	2,170	25-Sep	1,619
26-May		26-Jun	1,921	26-Jul	813	26-Aug	2,372	26-Sep	1,910
27-May		27-Jun	5,388	27-Jul	753	27-Aug	2,528	27-Sep	4,325
28-May		28-Jun	6,328	28-Jul	680	28-Aug	2,301	28-Sep	
29-May		29-Jun	3,675	29-Jul	630	29-Aug	2,021	29-Sep	
30-May		30-Jun	2,559	30-Jul	587	30-Aug	3,878	30-Sep	
31-May	1,196			31-Jul	619	31-Aug	9,538		
Mean		Mean	1,612	Mean	940	Mean	3,301	Mean	4,123
Max.		Max.	6,328	Max.	1,949	Max.	9,538	Max.	9,934
Min.		Min.	741	Min.	587	Min.	2,021	Min.	1,683

Table A-13. 1996 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	1,611	01-Jul	670	01-Aug	548	01-Sep	2,587
02-May		02-Jun	1,587	02-Jul	1,061	02-Aug	676	02-Sep	2,413
03-May		03-Jun	1,418	03-Jul	1,496	03-Aug	1,164	03-Sep	2,065
04-May		04-Jun	1,250	04-Jul	1,265	04-Aug	2,184	04-Sep	1,689
05-May		05-Jun	990	05-Jul	1,043	05-Aug	2,326	05-Sep	1,473
06-May		06-Jun	765	06-Jul	996	06-Aug	1,886	06-Sep	1,329
07-May		07-Jun	669	07-Jul	953	07-Aug	1,510	07-Sep	1,197
08-May		08-Jun	665	08-Jul	1,040	08-Aug	1,330	08-Sep	1,097
09-May		09-Jun	667	09-Jul	831	09-Aug	1,284	09-Sep	1,018
10-May		10-Jun	650	10-Jul	696	10-Aug	2,588	10-Sep	992
11-May		11-Jun	1,214	11-Jul	1,301	11-Aug	5,235	11-Sep	1,060
12-May		12-Jun	5,033	12-Jul	2,703	12-Aug	4,083	12-Sep	1,130
13-May		13-Jun	4,562	13-Jul	1,811	13-Aug	2,889	13-Sep	1,173
14-May		14-Jun	2,696	14-Jul	1,255	14-Aug	2,211	14-Sep	1,176
15-May		15-Jun	1,923	15-Jul	1,032	15-Aug	1,751	15-Sep	1,111
16-May		16-Jun	1,587	16-Jul	1,516	16-Aug	1,494	16-Sep	1,043
17-May		17-Jun	1,407	17-Jul	2,004	17-Aug	1,351	17-Sep	986
18-May		18-Jun	1,269	18-Jul	1,518	18-Aug	1,280	18-Sep	963
19-May		19-Jun	1,213	19-Jul	1,153	19-Aug	1,223	19-Sep	899
20-May		20-Jun	1,055	20-Jul	922	20-Aug	1,151	20-Sep	950
21-May		21-Jun	932	21-Jul	784	21-Aug	1,057	21-Sep	1,065
22-May		22-Jun	834	22-Jul	678	22-Aug	954	22-Sep	1,102
23-May		23-Jun	733	23-Jul	619	23-Aug	899	23-Sep	1,006
24-May		24-Jun	649	24-Jul	580	24-Aug	834	24-Sep	953
25-May		25-Jun	592	25-Jul	543	25-Aug	848	25-Sep	874
26-May		26-Jun	555	26-Jul	499	26-Aug	1,151	26-Sep	836
27-May		27-Jun	536	27-Jul	469	27-Aug	2,650	27-Sep	
28-May		28-Jun	553	28-Jul	446	28-Aug	3,150	28-Sep	
29-May	2,066	29-Jun	539	29-Jul	449	29-Aug	2,563	29-Sep	
30-May	1,953	30-Jun	528	30-Jul	494	30-Aug	2,056	30-Sep	
31-May	1,829			31-Jul	526	31-Aug	2,192		
Mean	1,949	Mean	1,289	Mean	1,028	Mean	1,565	Mean	1,270
Max.	2,066	Max.	5,033	Max.	2,703	Max.	3,150	Max.	2,587
Min.	1,829	Min.	528	Min.	446	Min.	834	Min.	899

Table A-14. 1997 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	829	01-Jul	310	01-Aug	497	01-Sep	1,050
02-May		02-Jun	699	02-Jul	301	02-Aug	472	02-Sep	1,149
03-May		03-Jun	646	03-Jul	296	03-Aug	456	03-Sep	1,212
04-May		04-Jun	709	04-Jul	275	04-Aug	443	04-Sep	1,170
05-May		05-Jun	870	05-Jul	289	05-Aug	446	05-Sep	1,083
06-May		06-Jun	980	06-Jul	308	06-Aug	465	06-Sep	1,015
07-May		07-Jun	1,067	07-Jul	313	07-Aug	472	07-Sep	979
08-May		08-Jun	962	08-Jul	322	08-Aug	520	08-Sep	925
09-May		09-Jun	840	09-Jul	332	09-Aug	562	09-Sep	882
10-May		10-Jun	750	10-Jul	337	10-Aug	575	10-Sep	838
11-May		11-Jun	690	11-Jul	335	11-Aug	592	11-Sep	849
12-May		12-Jun	782	12-Jul	321	12-Aug	594	12-Sep	900
13-May		13-Jun	853	13-Jul	410	13-Aug	612	13-Sep	999
14-May		14-Jun	781	14-Jul	1,380	14-Aug	641	14-Sep	1,069
15-May		15-Jun	809	15-Jul	958	15-Aug	637	15-Sep	1,139
16-May		16-Jun	783	16-Jul	874	16-Aug	698	16-Sep	1,150
17-May		17-Jun	716	17-Jul	761	17-Aug	955	17-Sep	1,083
18-May		18-Jun	643	18-Jul	633	18-Aug	1,425	18-Sep	1,018
19-May	1707	19-Jun	566	19-Jul	618	19-Aug	2,020	19-Sep	1,126
20-May	1650	20-Jun	514	20-Jul	998	20-Aug	1,970	20-Sep	1,456
21-May	1629	21-Jun	488	21-Jul	1,069	21-Aug	1,570	21-Sep	1,868
22-May	1819	22-Jun	462	22-Jul	1,149	22-Aug	1,322	22-Sep	1,794
23-May	1653	23-Jun	456	23-Jul	1,150	23-Aug	1,091	23-Sep	1,506
24-May	1379	24-Jun	524	24-Jul	1,026	24-Aug	900	24-Sep	1,372
25-May	1,136	25-Jun	510	25-Jul	898	25-Aug	842	25-Sep	1,316
26-May	994	26-Jun	473	26-Jul	823	26-Aug	855	26-Sep	1,263
27-May	912	27-Jun	423	27-Jul	731	27-Aug	1,007	27-Sep	
28-May	876	28-Jun	385	28-Jul	662	28-Aug	994	28-Sep	
29-May	902	29-Jun	358	29-Jul	608	29-Aug	944	29-Sep	
30-May	1,002	30-Jun	333	30-Jul	558	30-Aug	977	30-Sep	
31-May	888			31-Jul	515	31-Aug	968		
Mean	1,273	Mean	663	Mean	635	Mean	1,128	Mean	1,151
Max.	1,819	Max.	1,067	Max.	1,380	Max.	2,020	Max.	1,868
Min.	876	Min.	333	Min.	275	Min.	637	Min.	838

Table A-15. 1998 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	1,360	01-Jul	1,065	01-Aug	1,329	01-Sep	2,128
02-May		02-Jun	1,190	02-Jul	2,370	02-Aug	1,234	02-Sep	2,135
03-May		03-Jun	988	03-Jul	2,593	03-Aug	1,145	03-Sep	1,988
04-May		04-Jun	853	04-Jul	2,022	04-Aug	1,147	04-Sep	1,859
05-May		05-Jun	765	05-Jul	1,537	05-Aug	1,406	05-Sep	1,791
06-May		06-Jun	707	06-Jul	1,292	06-Aug	1,460	06-Sep	1,699
07-May		07-Jun	697	07-Jul	3,422	07-Aug	1,611	07-Sep	1,611
08-May		08-Jun	667	08-Jul	5,518	08-Aug	1,942	08-Sep	1,580
09-May		09-Jun	633	09-Jul	7,829	09-Aug	2,050	09-Sep	1,546
10-May		10-Jun	609	10-Jul	4,594	10-Aug	2,672	10-Sep	1,484
11-May		11-Jun	585	11-Jul	4,151	11-Aug	2,858	11-Sep	1,545
12-May		12-Jun	574	12-Jul	4,591	12-Aug	2,644	12-Sep	1,484
13-May		13-Jun	571	13-Jul	3,680	13-Aug	3,204	13-Sep	1,406
14-May		14-Jun	550	14-Jul	2,842	14-Aug	4,161	14-Sep	1,345
15-May		15-Jun	545	15-Jul	2,433	15-Aug	3,068	15-Sep	1,268
16-May		16-Jun	625	16-Jul	1,890	16-Aug	2,969	16-Sep	1,231
17-May		17-Jun	951	17-Jul	1,724	17-Aug	5,515	17-Sep	1,231
18-May		18-Jun	2,053	18-Jul	1,861	18-Aug	11,758	18-Sep	1,343
19-May		19-Jun	2,114	19-Jul	1,992	19-Aug	10,006	19-Sep	1,379
20-May		20-Jun	1,632	20-Jul	2,124	20-Aug	6,076	20-Sep	1,314
21-May	1603	21-Jun	1,370	21-Jul	1,820	21-Aug	4,616	21-Sep	1,250
22-May	1505	22-Jun	1,379	22-Jul	1,411	22-Aug	3,879	22-Sep	1,215
23-May	2787	23-Jun	1,573	23-Jul	1,352	23-Aug	3,786	23-Sep	1,237
24-May	4719	24-Jun	2,426	24-Jul	1,639	24-Aug	3,597	24-Sep	1,237
25-May	2,605	25-Jun	2,053	25-Jul	1,696	25-Aug	3,171	25-Sep	1,283
26-May	2,311	26-Jun	1,681	26-Jul	1,497	26-Aug	2,828	26-Sep	1,469
27-May	4,989	27-Jun	1,544	27-Jul	1,474	27-Aug	2,609	27-Sep	1,472
28-May	4,072	28-Jun	1,671	28-Jul	1,517	28-Aug	2,692	28-Sep	1,421
29-May	2,489	29-Jun	1,435	29-Jul	1,690	29-Aug	2,536	29-Sep	1,398
30-May	1,820	30-Jun	1,076	30-Jul	1,685	30-Aug	2,371	30-Sep	
31-May	1,485			31-Jul	1,451	31-Aug	2,345		
Mean	2,762	Mean	1,163	Mean	2,476	Mean	3,312	Mean	1,495
Max.	4,989	Max.	2,426	Max.	7,829	Max.	11,758	Max.	2,135
Min.	1,485	Min.	545	Min.	1,065	Min.	1,145	Min.	1,215

Table A-16. 1999 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	858	01-Jul	791	01-Aug	1,274	01-Sep	707
02-May		02-Jun	774	02-Jul	638	02-Aug	1,124	02-Sep	685
03-May		03-Jun	721	03-Jul	545	03-Aug	1,006	03-Sep	664
04-May		04-Jun	691	04-Jul	479	04-Aug	934	04-Sep	650
05-May		05-Jun	684	05-Jul	432	05-Aug	878	05-Sep	671
06-May		06-Jun	667	06-Jul	399	06-Aug	785	06-Sep	805
07-May		07-Jun	662	07-Jul	376	07-Aug	804	07-Sep	1,231
08-May		08-Jun	663	08-Jul	354	08-Aug	1,516	08-Sep	1,240
09-May		09-Jun	674	09-Jul	339	09-Aug	3,294	09-Sep	1,117
10-May		10-Jun	672	10-Jul	324	10-Aug	5,056	10-Sep	1,012
11-May		11-Jun	655	11-Jul	309	11-Aug	4,754	11-Sep	940
12-May		12-Jun	652	12-Jul	296	12-Aug	3,407	12-Sep	868
13-May		13-Jun	618	13-Jul	350	13-Aug	2,959	13-Sep	807
14-May		14-Jun	596	14-Jul	365	14-Aug	3,680	14-Sep	766
15-May		15-Jun	572	15-Jul	325	15-Aug	3,480	15-Sep	770
16-May		16-Jun	541	16-Jul	313	16-Aug	2,653	16-Sep	802
17-May		17-Jun	523	17-Jul	504	17-Aug	2,137	17-Sep	987
18-May		18-Jun	577	18-Jul	884	18-Aug	1,779	18-Sep	1,040
19-May		19-Jun	1,728	19-Jul	1,038	19-Aug	1,526	19-Sep	979
20-May		20-Jun	2,292	20-Jul	934	20-Aug	1,347	20-Sep	907
21-May		21-Jun	1,531	21-Jul	824	21-Aug	1,209	21-Sep	850
22-May		22-Jun	1,142	22-Jul	846	22-Aug	1,104	22-Sep	794
23-May		23-Jun	944	23-Jul	1,236	23-Aug	1,008	23-Sep	765
24-May		24-Jun	803	24-Jul	1,676	24-Aug	985	24-Sep	752
25-May	1,054	25-Jun	712	25-Jul	1,629	25-Aug	972	25-Sep	779
26-May	1,166	26-Jun	650	26-Jul	1,493	26-Aug	946	26-Sep	962
27-May	1,232	27-Jun	620	27-Jul	1,723	27-Aug	891	27-Sep	1,174
28-May	1,238	28-Jun	709	28-Jul	2,282	28-Aug	837	28-Sep	1,172
29-May	1,168	29-Jun	723	29-Jul	2,118	29-Aug	774	29-Sep	
30-May	1,094	30-Jun	940	30-Jul	1,708	30-Aug	737	30-Sep	
31-May	973			31-Jul	1,447	31-Aug	707		
Mean.	1,132	Mean	820	Mean	870	Mean	1,760	Mean	889
Max.	1,238	Max.	2,292	Max.	2,282	Max.	5,056	Max.	1,240
Min.	973	Min.	523	Min.	296	Min.	707	Min.	650

Table A-17. 2000 Mean Daily Discharge (cfs) for Beaver Creek above Victoria Creek WRM 110.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	4,824	01-Jul	1,064	01-Aug	626	01-Sep	2,210
02-May		02-Jun	5,279	02-Jul	962	02-Aug	608	02-Sep	2,155
03-May		03-Jun	5,225	03-Jul	912	03-Aug	588	03-Sep	2,380
04-May		04-Jun	5,304	04-Jul	908	04-Aug	569	04-Sep	2,663
05-May		05-Jun	5,167	05-Jul	908	05-Aug	562	05-Sep	2,515
06-May		06-Jun	4,889	06-Jul	849	06-Aug	559	06-Sep	2,316
07-May		07-Jun	4,589	07-Jul	787	07-Aug	575	07-Sep	2,301
08-May		08-Jun	4,187	08-Jul	731	08-Aug	611	08-Sep	2,327
09-May		09-Jun	3,983	09-Jul	700	09-Aug	623	09-Sep	2,486
10-May		10-Jun	4,351	10-Jul	785	10-Aug	613	10-Sep	2,697
11-May		11-Jun	4,660	11-Jul	1,117	11-Aug	616	11-Sep	2,508
12-May		12-Jun	3,779	12-Jul	1,516	12-Aug	649	12-Sep	2,451
13-May		13-Jun	3,026	13-Jul	2,603	13-Aug	1,460	13-Sep	2,671
14-May		14-Jun	3,156	14-Jul	2,496	14-Aug	7,126	14-Sep	2,878
15-May		15-Jun	3,126	15-Jul	1,746	15-Aug	10,216	15-Sep	2,657
16-May		16-Jun	4,206	16-Jul	1,337	16-Aug	6,367	16-Sep	2,467
17-May		17-Jun	4,343	17-Jul	1,114	17-Aug	4,154	17-Sep	2,329
18-May		18-Jun	3,031	18-Jul	969	18-Aug	3,323	18-Sep	2,068
19-May		19-Jun	2,340	19-Jul	914	19-Aug	3,952	19-Sep	1,887
20-May		20-Jun	2,015	20-Jul	952	20-Aug	4,787	20-Sep	1,749
21-May		21-Jun	1,855	21-Jul	908	21-Aug	3,960	21-Sep	1,646
22-May		22-Jun	1,633	22-Jul	847	22-Aug	3,514	22-Sep	1,957
23-May		23-Jun	1,472	23-Jul	802	23-Aug	4,014	23-Sep	3,095
24-May		24-Jun	1,356	24-Jul	753	24-Aug	4,916	24-Sep	4,732
25-May	8,223	25-Jun	1,214	25-Jul	713	25-Aug	4,623	25-Sep	4,421
26-May	7,389	26-Jun	1,086	26-Jul	705	26-Aug	4,605	26-Sep	3,609
27-May	5,276	27-Jun	990	27-Jul	693	27-Aug	4,559	27-Sep	3,199
28-May	4,056	28-Jun	931	28-Jul	687	28-Aug	3,798	28-Sep	2,804
29-May	3,651	29-Jun	934	29-Jul	667	29-Aug	3,127	29-Sep	2,462
30-May	3,701	30-Jun	1,016	30-Jul	654	30-Aug	2,674	30-Sep	
31-May	4,042			31-Jul	651	31-Aug	2,371		
Mean	5,191	Mean	3,132	Mean	1,015	Mean	2,927	Mean	2,608
Max.	8,223	Max.	5,304	Max.	2,603	Max.	10,216	Max.	4,732
Min.	3,651	Min.	931	Min.	651	Min.	559	Min.	1,646

Beaver Creek below Nome Creek WRM 7.5

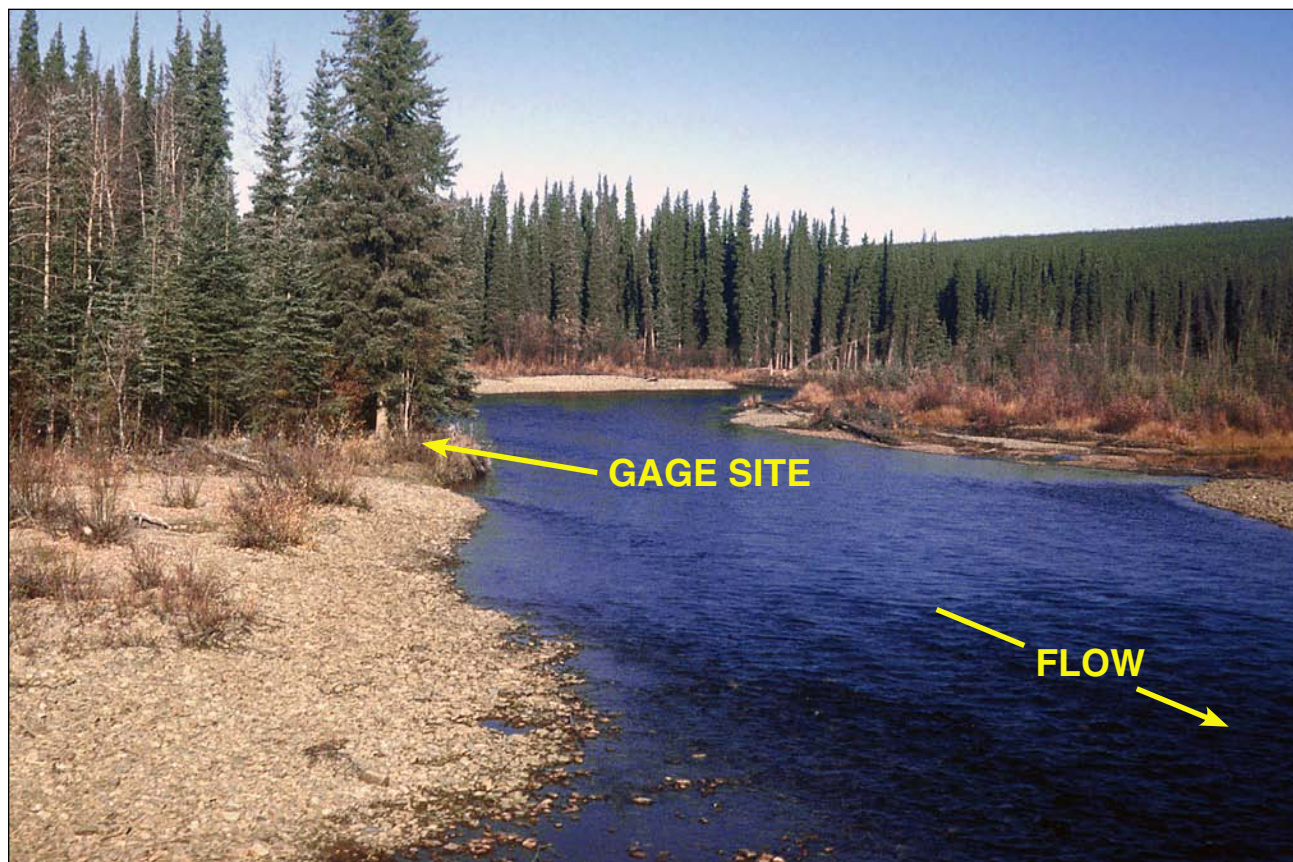


Figure A-4. Looking upstream at Beaver Creek below Nome Creek (WRM 7.5). This site was selected in September 1997. A data logger and pressure transducer gage were installed in June 1998 on the right bank. Data was collected until 2000, when the gaging project was discontinued. The gage was removed in September 2000.

Table A-18. Discharge Measurements for Beaver Creek below Nome Creek WRM 7.5

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
09/26/97	2.73	427	88	145	2.9	1.6
06/28/98	2.57	370	92	149	2.5	1.6
07/31/98	2.75	442	96	168	2.6	1.8
08/17/98	5.70*	5,000	211	738	6.8	3.5
09/11/98	2.80	470	93	175	2.7	1.9
09/29/98	2.67	449	95	171	2.6	1.8
05/25/99	2.72	506	96	174	2.9	1.8
07/29/99	2.72	452	91	164	2.8	1.8
09/10/99	2.37	272	91	138	2.0	1.5
07/01/03	2.33	237	94	127	1.9	1.4

*Slope-conveyance indirect discharge measurement

Table A-19. Peak Discharges (cfs) from 1998 to 2000 for Beaver Creek below Nome Creek WRM 7.5

Date of Peak	Peak discharge
08/18/98	5,000
08/10/99	2,240
08/15/00	4,000

Table A-20. 1998 Mean Daily Discharge (cfs) Beaver Creek below Nome Creek WRM 7.5

June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-Jun		01-Jul	566	01-Aug	420	01-Sep	691
02-Jun		02-Jul	1,434	02-Aug	389	02-Sep	655
03-Jun		03-Jul	733	03-Aug	390	03-Sep	623
04-Jun		04-Jul	527	04-Aug	480	04-Sep	605
05-Jun		05-Jul	441	05-Aug	499	05-Sep	582
06-Jun		06-Jul	430	06-Aug	552	06-Sep	552
07-Jun		07-Jul	868	07-Aug	643	07-Sep	541
08-Jun		08-Jul	2,497	08-Aug	670	08-Sep	529
09-Jun		09-Jul	1,706	09-Aug	818	09-Sep	507
10-Jun		10-Jul	1,262	10-Aug	860	10-Sep	489
11-Jun		11-Jul	1,254	11-Aug	811	11-Sep	472
12-Jun		12-Jul	907	12-Aug	1,239	12-Sep	462
13-Jun		13-Jul	822	13-Aug	1,608	13-Sep	449
14-Jun		14-Jul	730	14-Aug	907	14-Sep	436
15-Jun		15-Jul	625	15-Aug	885	15-Sep	419
16-Jun		16-Jul	549	16-Aug	2,083	16-Sep	438
17-Jun		17-Jul	507	17-Aug	4,324	17-Sep	468
18-Jun		18-Jul	535	18-Aug	3,672	18-Sep	451
19-Jun		19-Jul	554	19-Aug	2,263	19-Sep	434
20-Jun		20-Jul	489	20-Aug	1,783	20-Sep	420
21-Jun		21-Jul	457	21-Aug	1,500	21-Sep	439
22-Jun		22-Jul	438	22-Aug	1,464	22-Sep	450
23-Jun		23-Jul	539	23-Aug	1,391	23-Sep	434
24-Jun		24-Jul	554	24-Aug	1,226	24-Sep	475
25-Jun		25-Jul	487	25-Aug	853	25-Sep	510
26-Jun		26-Jul	479	26-Aug	803	26-Sep	481
27-Jun		27-Jul	493	27-Aug	822	27-Sep	474
28-Jun		28-Jul	552	28-Aug	786	28-Sep	465
29-Jun	374	29-Jul	551	29-Aug	748	29-Sep	446
30-Jun	365	30-Jul	496	30-Aug	741	30-Sep	
		31-Jul	453	31-Aug	689		
Mean	370	Mean	740	Mean	1,172	Mean	496
Max.	374	Max.	2,497	Max.	4,324	Max.	691
Min.	365	Min.	430	Min.	389	Min.	419

Table A-21. 1999 Mean Daily Discharge (cfs) Beaver Creek below Nome Creek WRM 7.5

May		June		July		August		September	
Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge	Date	Discharge
01-May		01-Jun	336	01-Jul	207	01-Aug	288	01-Sep	
02-May		02-Jun	302	02-Jul	169	02-Aug	294	02-Sep	
03-May		03-Jun	323	03-Jul	147	03-Aug	327	03-Sep	
04-May		04-Jun	315	04-Jul	134	04-Aug	284	04-Sep	
05-May		05-Jun	288	05-Jul	125	05-Aug	246	05-Sep	
06-May		06-Jun	277	06-Jul	120	06-Aug	226	06-Sep	
07-May		07-Jun	306	07-Jul	116	07-Aug	348	07-Sep	
08-May		08-Jun	317	08-Jul	111	08-Aug	1,540	08-Sep	
09-May		09-Jun	315	09-Jul	107	09-Aug	1,642	09-Sep	
10-May		10-Jun	321	10-Jul	103	10-Aug	1,880	10-Sep	
11-May		11-Jun	285	11-Jul	98	11-Aug	1,122	11-Sep	
12-May		12-Jun	272	12-Jul	98	12-Aug	788	12-Sep	
13-May		13-Jun	258	13-Jul	100	13-Aug	1,037	13-Sep	
14-May		14-Jun	236	14-Jul	115	14-Aug	1,049	14-Sep	
15-May		15-Jun	212	15-Jul	112	15-Aug	768	15-Sep	
16-May		16-Jun	199	16-Jul	115	16-Aug	627	16-Sep	
17-May		17-Jun	206	17-Jul	222	17-Aug	524	17-Sep	
18-May		18-Jun	867	18-Jul	321	18-Aug	459	18-Sep	
19-May		19-Jun	858	19-Jul	226	19-Aug	417	19-Sep	
20-May		20-Jun	493	20-Jul	192	20-Aug	384	20-Sep	
21-May		21-Jun	370	21-Jul	222	21-Aug	355	21-Sep	
22-May		22-Jun	303	22-Jul	250	22-Aug	331	22-Sep	
23-May		23-Jun	258	23-Jul	512	23-Aug	322	23-Sep	
24-May		24-Jun	226	24-Jul	443	24-Aug	321	24-Sep	
25-May	549	25-Jun	246	25-Jul	387	25-Aug	311	25-Sep	
26-May	629	26-Jun	215	26-Jul	430	26-Aug	291	26-Sep	
27-May	556	27-Jun	184	27-Jul	827	27-Aug	274	27-Sep	
28-May	569	28-Jun	440	28-Jul	590	28-Aug	261	28-Sep	
29-May	532	29-Jun	443	29-Jul	451	29-Aug	251	29-Sep	
30-May	429	30-Jun	283	30-Jul	385	30-Aug	242	30-Sep	
31-May	358			31-Jul	336	31-Aug	232		
Mean	518	Mean	332	Mean	251	Mean	563	Mean.	
Max.	629	Max.	867	Max.	827	Max.	1,880	Max.	
Min.	358	Min.	184	Min.	98	Min.	226	Min.	

Victoria Creek below Squaw Creek



Figure A-5. The site at Victoria Creek below Squaw Creek was selected in September 1989. A crest-stage gage was installed in June 1990 on the right bank. Data was collected until 1995, when the gaging project was discontinued. The gage was removed in September 2000.

Table A-22. Discharge Measurements for Victoria Creek below Squaw Creek

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
06/25/89	9.18*	3,500	95	616	5.7	6.5
10/07/89	2.34	55	43	41	1.3	1.0
09/21/90	2.80	185	72	74	2.5	1.0
09/24/91	2.75	160	65	89	1.8	1.4
09/28/94	2.52	59	66	50	1.2	0.8
07/19/95	2.72	105	70	65	1.6	0.9

*Slope-area indirect discharge measurement

Table A-23. Victoria Creek below Squaw Creek Peak Discharges and Recurrence Intervals

Date	Discharge* (cfs)	Recurrence Interval* (yrs)	Recurrence Interval** (yrs)	Discharge** (cfs)
06/25/89	3,500	13.8	1.5	1,800
09/08/90	1,500	1.2	2	2,070
08/20/91	1,800	1.5	5	2,770
06/01/92	2,900	5.9	10	3,270
09/21/93	2,300	2.6	25	3,930
06/24/94	2,100	2.1	50	4,440
06/28/95	1,400	1.1	100	4,970

* Calculated at gage.

** Calculated from Log Pearson III analysis

Miscellaneous Discharge Data

Table A-24. Discharge Measurements for Fossil Creek above Fossil Gap

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
06/24/94	5.47*	1,700	190	464	3.7	2.4
09/01/94	2.40	94	50	60	1.6	1.2

*Slope-conveyance indirect discharge measurement

Table A-25. Discharge Measurements for Beaver Creek below Yellow Creek

Date	Stage (ft)	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
06/20/96	2.46	1,020	218	363	2.8	1.7
06/30/96	2.10	550	193	245	2.2	1.3
07/24/96	2.16	635	213	302	2.1	1.4

Table A-26. Discharge Regressions Used to Compute Beaver Creek Data

Type of Regression	Parameters			
	m	b	r ²	se
Regressions from Discharge Measurements				
Above Nome Creek WRM 6	2.976	3.028	0.979	0.153
At Big Bend WRM 36.5	2.597	3.437	0.996	0.090
Above Victoria Creek WRM 110.5	1.744	5.661	0.998	0.063
Regressions from Comparative Data				
WRM 6 compared to WRM110.5	1.022	-1.460	0.955	0.294
WRM 36.5 compared to WRM110.5	1.107	-1.188	0.974	0.248
WRM 110.5 compared to Salcha River*	1.352	-3.222	0.900	0.430

m Slope of regression line

b Y-intercept of regression line

r² Coefficient of determination

se Standard error

* USGS data

Appendix B. Discharge and Water Quality Data from Groundwater Springs, Streams, and Lakes

Table B-1. Discharge Measurements for Beaver Creek below Fossil Creek Spring (WRM 48.5)

Date	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
04/02/91	67	125	91	0.7	0.7
03/31/93	69	80	37	1.9	0.5
04/06/94	74	89	121	0.6	1.4
04/19/94	82	87	124	0.7	1.4
04/06/95	49	67	33	1.5	0.5
04/02/96	24	64	28	0.9	0.4
04/02/97	29	62	24	1.2	0.4
02/26/98	25	51	37	0.7	0.7
04/01/98	24	54	20	1.2	0.4
02/25/99	28	40	22	1.3	0.6
04/01/99	26	43	26	1.0	0.6
03/30/00	31	52	24	1.3	0.5
03/01/01	50	69	40	1.3	0.6
02/27/03	49	49	25	2.0	0.5

Table B-2. Discharge Measurements at Miscellaneous Groundwater Spring Sites

Date	Discharge (cfs)	Width (ft)	Area (sq ft)	Avg. Velocity (fps)	Avg. Depth (ft)
Site: Beaver Creek at WRM 40.5 near Hermans Landing					
04/17/96	13	35	11	1.18	0.3
04/09/99	18	37	19	0.95	0.5
Site: Beaver Creek at WRM 46.7 near Shebals Landing					
04/05/95	33	92	26	1.27	0.3
04/02/96	0	(Frozen solid at riffle)			
02/26/98	4.9	40	11	0.45	0.3
Site: Beaver Creek at WRM 89 below Willow Creek					
04/26/96	47	42	28	1.68	0.7
Site: Windy Creek					
04/03/96	0.4	4.0	1.4	0.25	0.3
Site: Unnamed Creek near Willow Creek					
04/26/96	4.7	6.5	2.3	2.04	0.4

Table B-3. Water Quality Readings from Groundwater Springs on Beaver Creek

Spring Site	Date	Air Temp. (°C)	Water Temp. (°C)	Specific Conductance (ms/cm)
Below Fossil Creek WRM 48.5	04/19/94	0	1.2	223
Below Fossil Creek WRM 48.5	04/06/95	0	1.8	194
Below Fossil Creek WRM 48.5	04/02/96	-4	2.2	220
Below Fossil Creek WRM 48.5	04/01/99	-6	2.3	228
Below Fossil Creek WRM 48.5	03/30/00	7	1.8	236
Below Fossil Creek WRM 48.5	03/01/01	-26	0.3	182
Below Fossil Creek WRM 48.5	02/27/03	-11	0.7	192
At Hermans Landing WRM 40.5	04/17/96	3	3.2	208
At Hermans Landing WRM 40.6	04/09/99	-11	2.7	116
At Shebals Landing WRM 46.7	04/05/95	0	0.5	175
Windy Creek	04/08/96	3	3.2	131
Windy Creek	02/28/03	-11	0.7	192
Below Willow Creek WRM 89	04/26/96	-1	0.7	85
Tributary near Willow Creek	04/26/96	-1	4.8	537

Table B-4. Water Quality Readings for Beaver Creek above Victoria Creek WRM 110.5

Date	Air Temp. (°C)	Water Temp. (°C)	Specific Conductance (ms/cm)	Turbidity (NTU)
07/31/98	27	15.5	125	ND
09/28/99	2	1.4	148	1.5
05/25/00	21	4.7	52	65
07/26/00	30	12	134	2
09/29/00	3	0.5	105	1.5

ND - Not determined

Table B-5. Paired Water Quality Readings from Beaver Creek Sites

Stream Site	Date	Water Temp. (°C)	Specific Conductance (ms/cm)	Turbidity NTU
Above Nome Creek WRM 6	07/31/98	11.1	76	ND
Below Nome Creek WRM 7.5	07/31/98	10.6	79	ND
Above Nome Creek WRM 6	09/11/98	6.3	85	ND
Below Nome Creek WRM 7.5	09/11/98	6.2	76	ND
Above Nome Creek WRM 6	09/29/98	2.7	89	ND
Below Nome Creek WRM 7.5	09/29/98	2.6	81	ND
Above Nome Creek WRM 6	05/25/99	5.2	57	1.6
Below Nome Creek WRM 7.5	05/25/99	5.5	57	2.0
Above Nome Creek WRM 6	09/28/99	0.7	102	0.9
Below Nome Creek WRM 7.5	09/28/99	0.8	96	0.6
Above Nome Creek WRM 6	05/25/00	1.8	25	13.3
Below Nome Creek WRM 7.5	05/25/00	2.1	30	15.0
Above Nome Creek WRM 6	07/26/00	8.5	79	0.5
Below Nome Creek WRM 7.5	07/26/00	8.4	80	0.7
Above Nome Creek WRM 6	09/29/00	1.0	74	0.5
Below Nome Creek WRM 7.5	09/30/00	1.0	67	0.5

ND - Not determined

Table B-6. Water Quality of WMNRA Lakes

Lake Site	Date	Depth (ft)	Ice Thickness (ft)	Water Temp. (°C)	Specific Conductance (ms/cm)	Dissolved Oxygen (mg/L)
Colorado Creek Lake*	04/17/90	7	5	0	ND	0.7
Borealis Lake*-NE	09/06/95	6.9	0	6.5	22	ND
Borealis Lake*-SW	09/06/95	4.9	0	6.8	20	ND

ND - Not determined

*Informally named

Appendix C. Channel Geometry

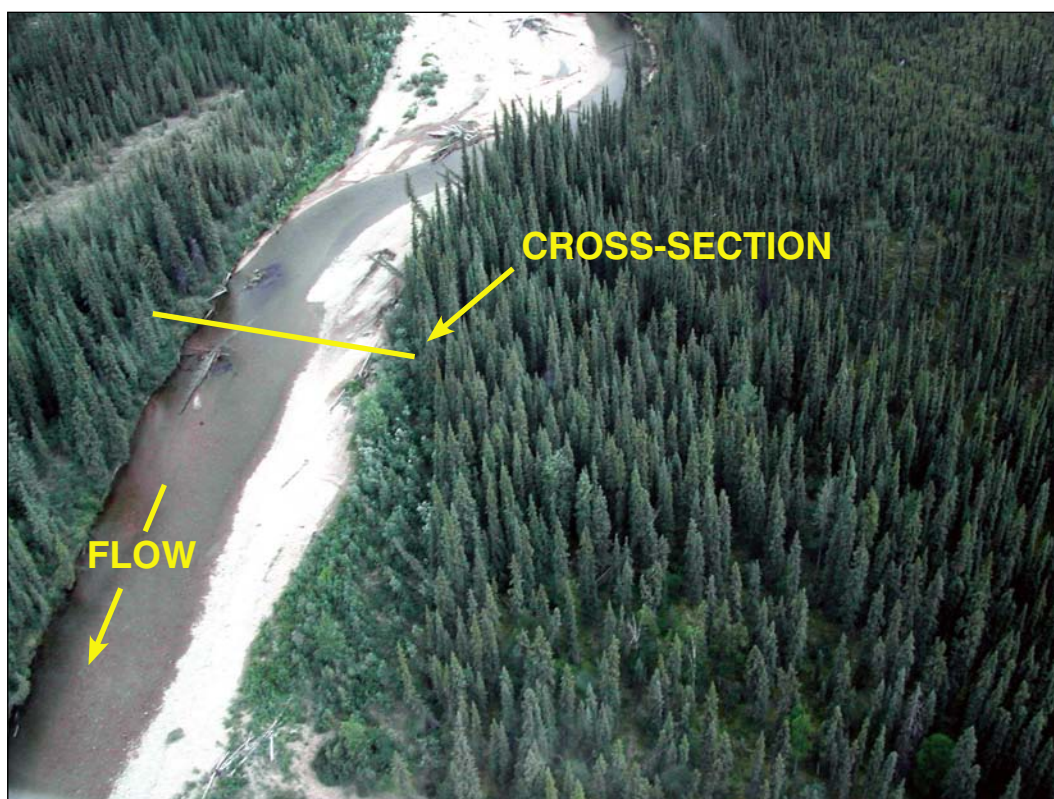


Figure C-1. View of stream channel for Beaver Creek above Nome Creek in July 2003.

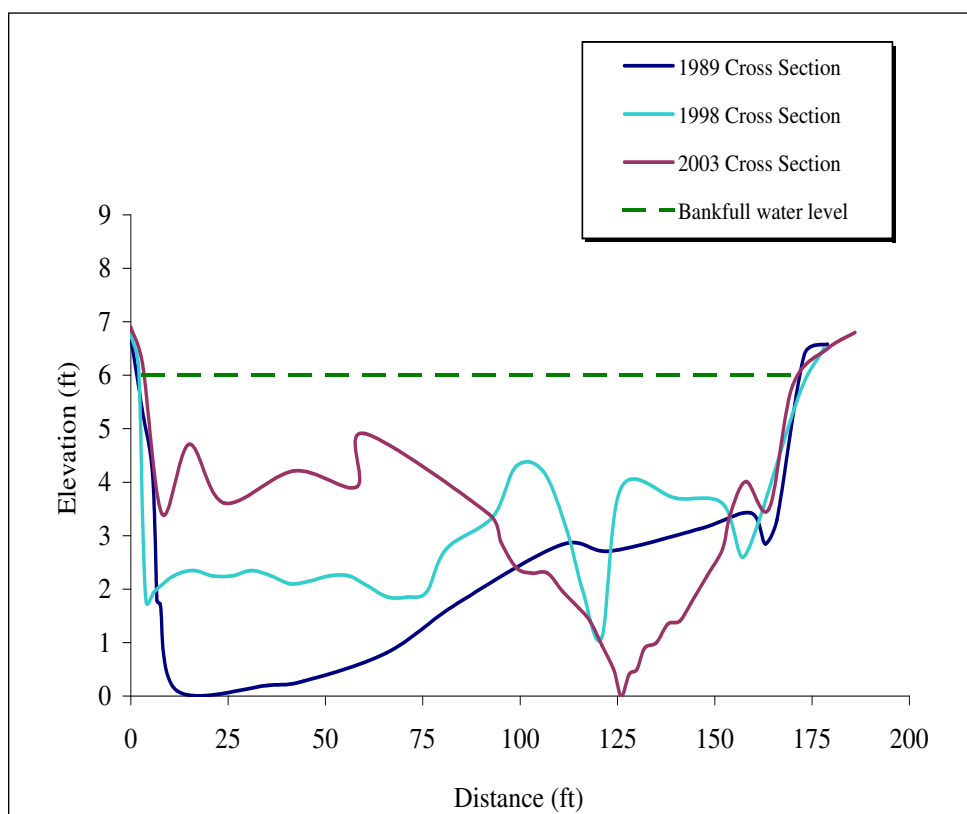


Figure C-2. Channel cross-section for Beaver Creek above Nome Creek (WRM 6). The cross-section has changed radically from the original survey.



Figure C-3. View of stream channel for Beaver Creek below Nome Creek in July 2003.

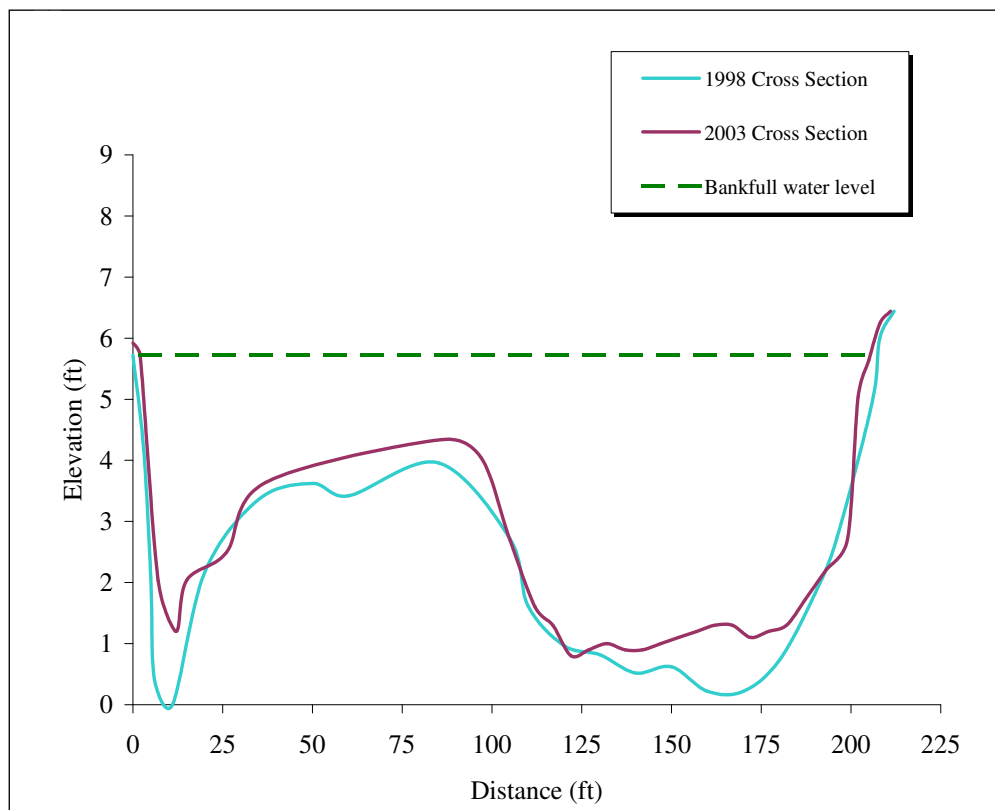


Figure C-4. Channel cross section for Beaver Creek below Nome Creek (WRM 7.5). The cross section has changed only slightly from the original survey.

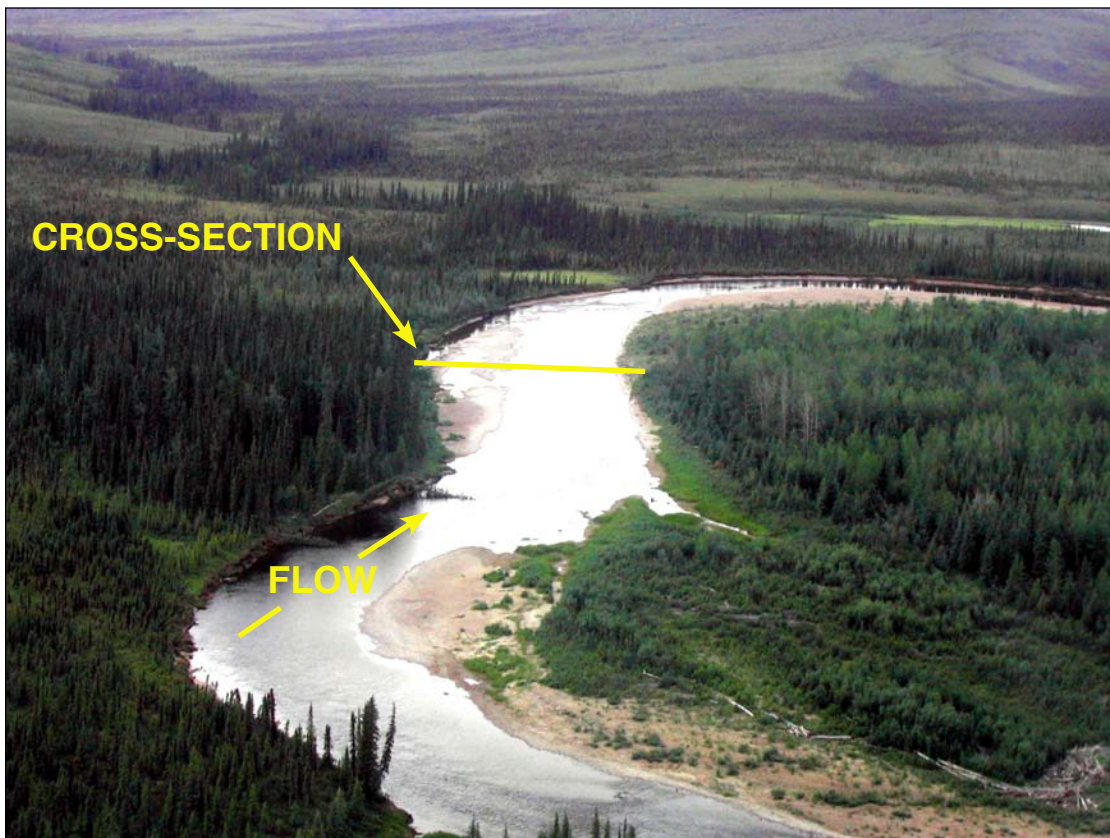


Figure C-5. View of stream channel for Beaver Creek at Big Bend in July 2003.

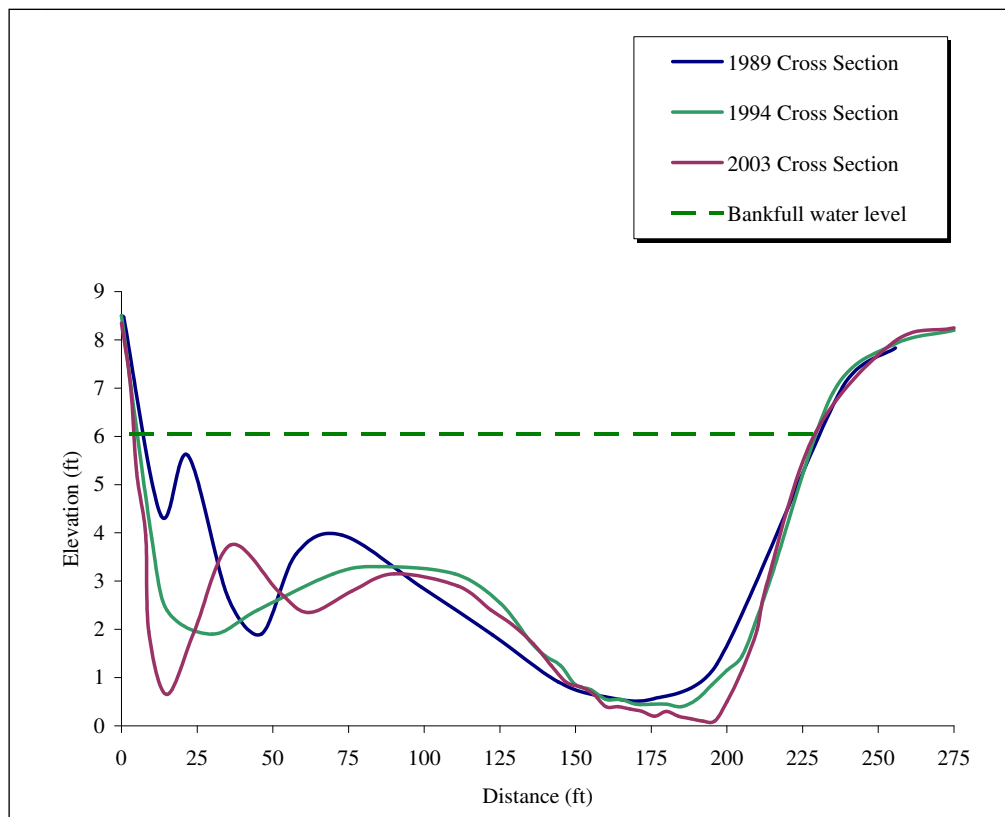


Figure C-6. Channel cross-section for Beaver Creek at Big Bend. The channel has changed only slightly from the original survey.