STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

Steve Cowper, *Governor*

Judith M. Brady, *Commissioner*

Robert B. Forbes, *Director and State Geologist*

April 1988

This report in a preliminary publication of DOGS. The author is solely responsible for its content and will appreciate candid comments on the accuracy of the data as well as suggestions to improve the report.

Report of Investigations 88-7

HYDROLOGIC INVESTIGATIONS OF WATER QUALITY IN SELECTED PLACER MINING AREAS IN INTERIOR ALASKA, SUMMER 1986

by

Stephen F. Mack

and

Mary Moorman

STATE OF ALASKA
Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

According to Alaska Statute 41, the Alaska Division of Geological and Geophysical Surveys is charged with conducting 'geological and geophysical surveys to determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources; the locations and supplies of ground water and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and shall conduct such other surveys and investigations as will advance knowledge of the geology of Alaska.'

In addition, the Division of Geological and Geophysical Surveys shall collect, record, evaluate, and distribute data on the quantity, quality, and location of underground, surface, and coastal water of the state; publish or have published data on the water of the state and require that the results and findings of surveys of water quality, quantity, and location be filed; require that water-well contractors file basic water and aquifer data, including but not limited to well location, estimated elevation, well-driller's logs, pumping tests, flow measurements, and water-quality determinations; accept and spend funds for the purposes of this section, AS 41.08.017 and 41.08.035, and enter into agreements with individuals, public or private agencies, communities, private industry, and state and federal agencies; collect, record, evaluate, archive, and distribute data on seismic events and engineering geology of the state; and identify and inform public officials and industry about potential seismic hazards that might affect development in the state.

Administrative functions are performed under the direction of the Director, who maintains his office in Fairbanks. The locations of DGGS offices are listed below:

- 794 University Avenue
  (Suite 200)
  Fairbanks, Alaska 99709
  (907)474-7147

- 400 Willoughby Avenue
  (3rd floor)
  Juneau, Alaska 99801
  (907) 465-2533

- 18225 Fish Hatchery Road
  P.O. Box 772116
  Eagle River, Alaska 99577
  (907) 696-0070

This report is for sale by DGGS for $5.00. DGGS publications may be inspected at the following locations. Mail orders should be addressed to the Fairbanks office.

- 794 University Avenue
  (Suite 200)
  Fairbanks, Alaska 99709

- 400 Willoughby Avenue
  (3rd floor)
  Juneau, Alaska 99801

- U.S. Geological Survey
  Public Information Office
  701 C Street
  Anchorage, Alaska 99513

- Information Specialist
  U.S. Geological Survey
  4230 University Drive, Room 101
  Anchorage, Alaska 99508

CONTENTS

FIGURES

TABLES

CONTENTS (con.>

HYDROLOGIC INVESTIGATIONS OF WATER QUALITY IN SELECTED PLACER MINING AREAS IN INTERIOR ALASKA, SUMMER 1986

by
Stephen F. Mack[1] and Mary Moorman[1]

ABSTRACT

This report presents and discusses turbidity, total suspended solids (TSS), settleable solids, and stream discharge data collected and analyzed as part of the interagency placer mining research project during the 1986 field season.

Twelve sites in the Birch Creek drainage and one site on Faith Creek (in cooperation with the Alaska Department of Fish and Game) were monitored throughout the summer of 1986. At six sites automatic samplers and continuous water level recorders enabled estimation of daily averages for turbidity, TSS, discharge, and sediment load-- the product of TSS and discharge.

During a seven-day period in late July-early August, a short reach of Mammoth Creek was intensively monitored to examine the sediment contributions from individual mines and from channel resuspension.

Results are presented from a limited number of samples collected outside the Birch Creek drainage and Faith Creek at state waysides, villages participating in the Village Water Quality Monitoring program, and from the Tolovana above mining sites.

Season-long monitoring showed sediment and discharge levels at important locations in the Birch Creek drainage and at Faith Creek. Use of automated equipment enabled sampling and monitoring during infrequent storm events and allowed estimation of daily averages throughout the field season. Results indicated decreased turbidity and sediment loads since monitoring began in 1984, but mined streams still had turbidity concentrations and sediment loads far larger than unmined streams.

Paired TSS and turbidity data from 1986 indicated that equations developed from data collected in 1985 and earlier do not predict well. Multiple regressions, using turbidity and discharge to predict TSS, did improve the coefficient of determination (r^2) and equation standard error of estimate over a simple regression, using only turbidity to predict TSS, but the improvement was not sufficient to abandon collection of TSS.

The Mammoth Creek Intensive Study illustrated the advantage of control of water use. Mining operations that discharged less water had less of an impact on the stream sediment load.

[1]Division of Geological and Geophysical Surveys, 794 University Avenue, Suite 200, Fairbanks, Alaska 99709 (Mr. Mack's current address is Regional Water Board, 431 Prater Way, P.O. Box 857, Sparks, NV 89432).

INTRODUCTION

Data presented and discussed here were collected and analyzed by Alaska Division of Geological and Geophysical Surveys (DGGS) and assisting agencies during the 1986 field season as part of the interagency Placer Mining Research Project. The work done in 1986 was a continuation of the water quality monitoring of placer-mined streams, principally small streams in the Birch Creek drainage, during 1984 and 1985, reported in Mack and Moorman (1986). That report contains a more detailed description of the study area.

The goal of the 1986 season was to continue the monitoring done in the previous two years, using automated sampling equipment and water level recorders as available. DGGS monitored in 1986 the same sites in the Birch Creek drainage that were monitored in previous years, excepting that sites on Porcupine Creek at the road crossing and Bonanza Creek below mining were dropped and the site on Birch Creek above Twelvemile Creek was added. Automatic samplers and continuous water level recorders were placed at Birch Creek at the Steese Highway Bridge, Crooked Creek above mouth, Mammoth Creek at Steese Highway, and Birch Creek above Twelvemile Creek. An automatic water sampler was also placed at Boulder Creek at the U.S. Geological Survey (USGS) gage to supplement readings from the USGS water level recorder already in place at this site. Monitoring was not continued at two discharge sites at mining operations from 1984-85, because the miners had moved their operations. Locations of sampling sites in the Birch Creek drainage are shown in figure 1.

Samples from the automated samplers were analyzed for turbidity and total suspended solids; those from non-automated sites, for turbidity only. At each visit to both automated and non-automated sites, samples were collected for settleable solids determination.

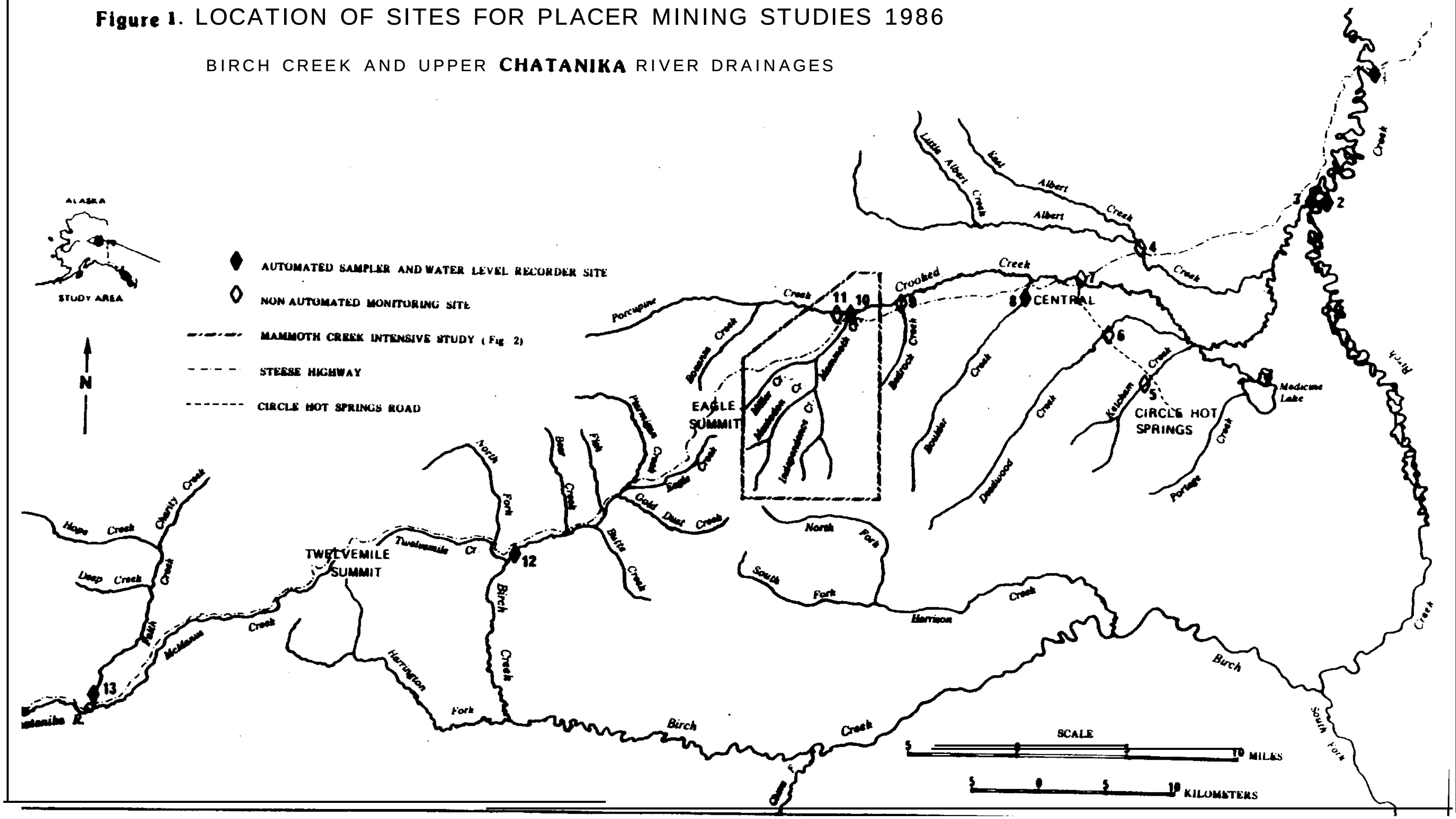
The large number of paired TSS-turbidity observations from the automatic samplers afforded a good opportunity to test equations for predicting TSS from turbidity which were developed from data collected in 1985 and earlier (Mack, 1986). These data also were used to develop multiple regression equations using turbidity and discharge to predict TSS as suggested in Mack (1986).

The 1984-85 monitoring raised the question of how much turbidity, TSS and settleable solids in mined streams was directly attributable to mining effluent discharge and how much to resuspension of sediment on the channel bottom. To address this question, more intensive monitoring of mined streams, including sampling above and below individual mining operations, was needed. With the assistance of the Alaska Division of Mining, intensive sampling of a five-mile reach of upper Mammoth Creek and its tributaries was conducted during a seven-day period from July 29 through August 3, 1986 (referred to herein as the Mammoth Creek Intensive Study). Study sites are identified in figure 2.

Outside the Birch Creek and Faith Creek drainages, work was more limited in 1986 than in 1984-85. Results are reported from samples collected by the Alaska Division of Parks and Outdoor Recreation at sites in Alaska state

Figure 1. LOCATION OF SITES FOR PLACER MINING STUDIES 1986

BIRCH CREEK AND UPPER **CHATANIKA** RIVER DRAINAGES



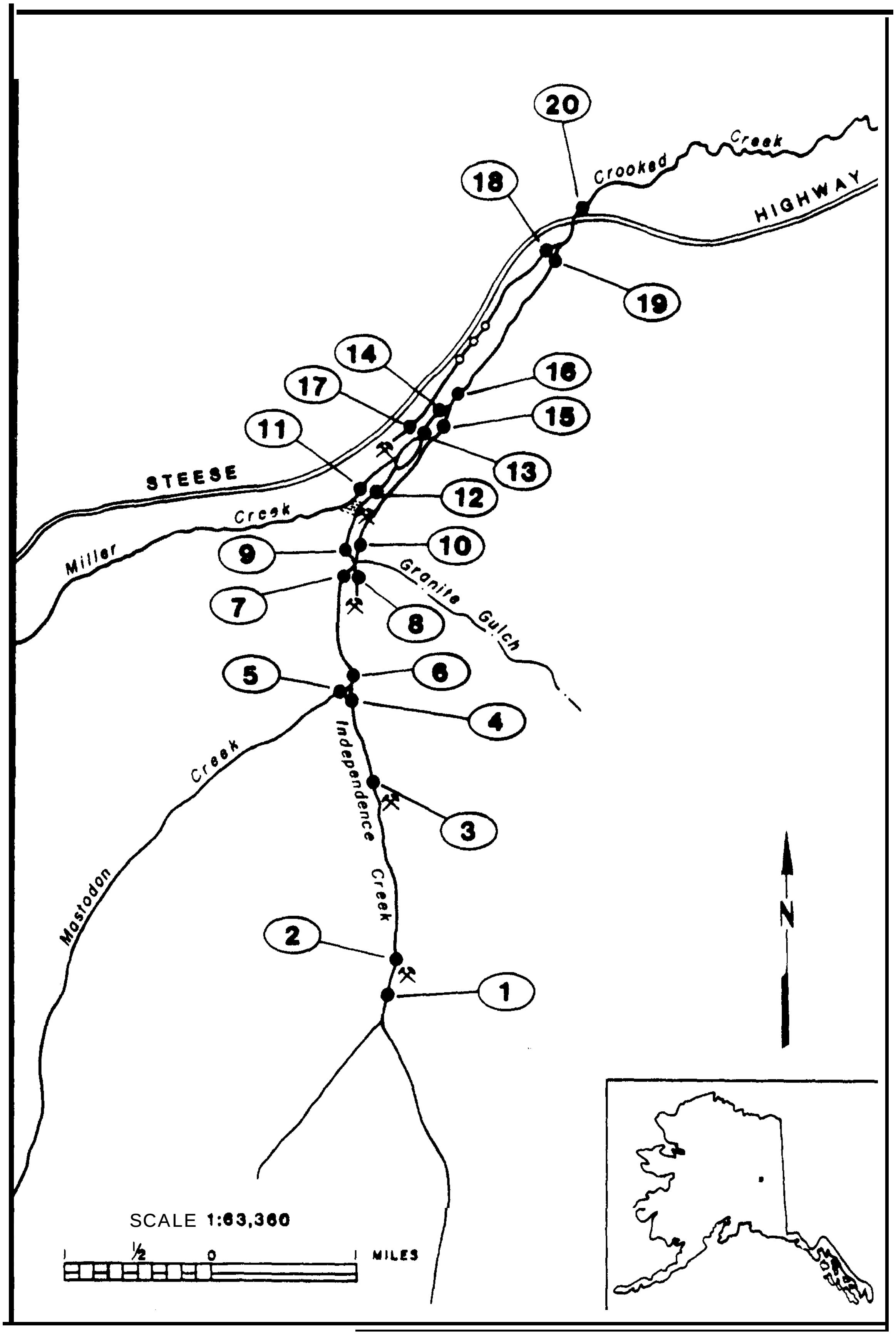


Figure 2. Location of sites for Mammoth Creek Intensive Study.

parks and from rural villages under the Village Water Quality Monitoring program.

METHODS

Turbidity, Total Suspended Solids, and Settleable Solids

Analyses of turbidity, TSS, and settleable solids were conducted in the field and in the DGGS hydrology lab located in the Water Research Center on the University of Alask-Fairbanks campus. Methods used were from American Public Health Association (APHA)-American Water Works Association (AWWA)-Water Pollution Control Federation (WPCF) "Standard Methods for the Examination of Water and Wastewater," and procedures outlined in user manuals of certain instrumentation (APHA, 1985). The lab is a participant in U.S. Environmental Protection Agency (EPA) analytical quality assurance studies.

Samples for these analyses were collected from automated samplers or by grab methods in well-mixed reaches at sampling sites. When automated samplers were employed, the intake hose for the sampler was installed at a well-mixed location in the stream at mid-depth with the hose nozzle pointing upstream. At Birch Creek above Twelvemile Creek, Birch Creek at the Steese Highway Bridge, Crooked Creek above its confluence with Birch Creek, and Mammoth Creek at the Steese Highway, the automated samplers were programmed to composite into one bottle four samples taken six hours apart each day. At Faith Creek the automated sampler was programmed to take discrete samples every six hours. Samples from the Village Water Quality Monitoring project were collected by village residents and mailed to the DGGS lab in Styrofoam mailers.

Most turbidity determinations were done in the lab, because it served as a receiving point for samples coming in from more than one collecting agency, and because some of the more turbid samples required several serial dilutions to bring their turbidity down to readable levels. A Turner Designs Model 40 laboratory turbidimeter and a Hach model 16800 portable turbidimeter were used.

Total suspended solids samples were filtered through prewashed, dried and weighed glass fiber filters, according to EPA specifications. The size of the aliquot was dependent upon the amount of material suspended, but ranged from 25 ml to several liters.

Settleable solids were measured in the field by using Imhoff cones with a detection limit of 0.1 ml/L and following standard procedures (APHA, 1985).

Statistical techniques used in the development of linear regression models for predicting TSS from turbidity and multiple regression models for predicting TSS from turbidity and discharge were performed on the University of Alaska-Fairbanks VAX computer using the GLM (general linear model) procedure of the SAS statistical package (SAS, 1985a, 1985b). Turbidity, TSS and discharge data were transformed into base-10 logarithms with all analyses done on transformed data. The procedures used are explained in more detail in Mack (1986) and standard statistical texts (for example, Neter, Wasserman, and Kutner, 1985).

To establish predictive value of the models based on 1985 data (reported in Mack, 1986) as well as models developed in the present report (from 1986 data), the 1986 data were applied to the equations from Mack (1986). Z scores were then developed by subtracting the predicted TSS from the reported TSS and dividing by the equation's standard error of estimate (as reported in Mack, 1986). The Z score gives a relative measure, in multiples of the standard error of estimate, of the difference between predicted value and reported value.

Discharge

Velocities used to calculate discharge in most cases were measured with a Marsh McBirney Model 201 Flowmeter. At Birch Creek at the Steese Highway Bridge, velocities were measured from the bridge using a Price AA meter suspended from a hand line. Where depth was greater than 2.5 ft, velocities were measured at 0.2 and at 0.8 of depth from the surface. At depths less than 2.5 ft, velocities were measured at 0.6 of depth from the surface. Discharges were calculated using the standard midpoint method (TJSDOI, 1981) from at least 20 velocity measurements taken across the stream cross section where width permitted (most cases).

Staff gage locations were chosen on the basis of easy access, that is, close to Steese Highway, Circle Hot Springs Road, or other road access. Turbidity monitoring sites also were chosen sufficiently downstream of any mining site or tributary so that the stream was well mixed at the sampling site. At each location the specific site was chosen by looking for a cross section that would provide the most change in stage for change in stream discharge and the least turbulence around the staff gage. Water surface levels were recorded by staff gage whenever agency personnel were in the vicinity.

At Birch Creek above Twelvemile Creek, Birch Creek at the Steese Highway Bridge, Crooked Creek above its confluence with Birch Creek, Mammoth Creek at the Steese Highway, and Faith Creek at the Steese Highway, continuous water surface levels were recorded with Omnidata DP320 Stream Stage Recorders. The DP320 is a small, battery-operated device with a submersible pressure transducer which measures and records water levels between 0 and 10 ft, to the nearest .01 ft. Water level data are stored in a solid-state memory, called a data storage module. At all sites, the water level recorders monitored water levels at 30-minute intervals.

Rating curves were developed for each site by taking at least four discharge measurements each field season at different water levels throughout the season. The rating curves were then used to estimate discharge from observed or recorded staff gage water levels.

Sediment Load and Turbidity Index Load

Sediment load is calculated by multiplying discharge (in cfs) by TSS (in mg/L) and a constant (0.0027) to put the units into tons per day. Turbidity index load is calculated by multiplying discharge (in cfs) by turbidity, in nephelometric turbidity units (NTLJ). In this report, the product is divided by 1000 to show results at the same order of magnitude as sediment load. The units for turbidity index load (TIL) are KNTU-cfs, where 'K' represents 1000.

Mammoth Creek Intensive Study

Mammoth Creek was chosen as a study area because of its road access and proximity to placer operations, and also because it has a relatively compact stream reach. Twenty sampling sites were set, at locations above and below all mine sites, and at all important surface water inflow points. Travel times between sampling points were estimated from distances between map points and average measured stream velocities. A sampling schedule, based on these travel times, was established to attempt to monitor a slug of water as it passed through the system. Four samples were collected each day at each site, one sample every four hours during the day. At three sites, automated samplers were used to collect backup samples and to collect samples through the night.

Discharge was monitored by observing staff gages set at each site and taking discharge measurements at 1-2 day intervals; 2-3 measurements were taken at each site over the total study time. Because observed water levels and measured discharges at each site varied little, the discharges reported in the results section are averages of the measured discharges.

RESULTS AND DISCUSSION

Turbidity, TSS, and Settleable Solids in Birch Creek Drainage Streams

Results from the season-long monitoring of turbidity, TSS, and settleable solids from sites in the Birch Creek drainage are presented in appendix A (automated sites) and appendix B (non-automated sites).

Comparisons of monthly average turbidity at all sites monitored this year to averages from previous years are presented in table 1. Two cautions should be observed when viewing this table. First, all non-automated site values are averages of a limited number of discrete samples. Second, at the 1986 automated sites, 1985 values are from averages of discrete samples, while the 1986 results are averages of cornposited samples and include daily variation as well as a sampling of a wider range of flows. At sites far downstream from mining, such as Birch Creek at the Steese Highway Bridge, or on unmined streams, daily variation may not be important; however, at sites close to mining, it may.

Average turbidity at monitoring sites on mined streams was generally less in 1986 than in previous years, although average turbidity monitored at unmined streams was much higher in 1986, reflecting the higher flows observed, and average turbidity was also higher at Birch Creek at the Steese

Table 1. Summary of turbidity values from samples collected in Birch Creek Basin.

Location	Year	Jun (NTU)	Jul (NTU)	Aug (NTU)	Sep (NTU)	Avg chng from previous years (%)
Data from grab samples						
Albert at Steese	86	20.9	22.5	0.60	2.3	
Bedrock at Steese	84			1.4	0.5	
	85	1.10	0.30	0.90	0.4	-31.6
	86	1.65	2.96	0.77	1.2	143.5
Crooked at Central	84			880		696
	85	236	658	390	181	-63.8
	86	113	151	70.4	297	-56.9
Deadwood at CHSR	84			1400	640	
	85	999	676	495	253	-63.3
	86	39.3	53.8	37.9	141	-88.8
Ketchem at CHSR	84			3210	152	
	85	160	1070	989	1190	-35.2
	86	115	122	140	786	-65.9
Porcupine above mouth	85		95	410	370	
	86	59.4	123	40.7	515	-22.4
Data from automatic samplers						
Birch above 12Mile	86	255	201	237	251	
Birch at Bridge	85	47	23	35	18	
	86	79	110	6.3	19.1	74.3
Crooked above mouth	85	105	88	172	59	
	86	118	65	36.3	84.4	-28.4
Boulder near Steese	85		0.8	0.8	0.6	
	86	3.93	4.02	1.75	1.4	225.9
Mammoth at Steese	84			585	986	
	85	285	340	401	370	-50.9
	86	240	195	265	518	-12.8

Highway Bridge, the furthermost downstream sampling site in the Birch Creek drainage. These results should be interpreted keeping in mind that 1986 data are from an automatic sampler which collected samples during flood events as well as normal flows, whereas 1985 data are from discrete grab samples, and high flow events were missed during 1985. The Birch Creek at Steese Highway sampling site is far enough downstream from active mining that discharge has a relatively greater effect on turbidity levels there than it does at the sites farther upstream.

Total suspended solids (TSS) analyses of samples from the automated samplers at Birch Creek above Twelvemile Creek, Birch Creek at the Steese Highway Bridge, Crooked Creek above mouth, Mammoth Creek at the Steese Highway, and Boulder Creek above the USGS gage are presented in appendix A. TSS and turbidity analyses measure different aspects of the same physical characteristic: suspended material in water. Turbidity, as measured by nephelometric techniques, describes the reflective characteristics of particles, and TSS measures the physical mass of the particles. Turbidity is a state enforcement standard and is an important measure, because high turbidity levels, as well as being aesthetically displeasing, have been associated with fish mortality. High TSS levels also have been associated with damage to fish. Measurement of TSS is useful to management because, when combined with discharge data, it translates into physical sediment loads. Measuring TSS is a more complicated, time-consuming, and expensive procedure than measuring turbidity. If turbidity measurements could be used to predict TSS levels, a great deal of effort and expense could be saved.

During the winter of 1985-86, all TSS and turbidity data reported to date by researchers working with placer mining topics in Alaska were collected to see if one regression equation could be used to predict TSS from turbidity in streams affected by mining (Mack, 1986). That investigation determined that the regression equations from different basins and streams, and from different sites on a single stream, were often statistically different; therefore, all data should not be forced into one equation. The paired turbidity-TSS data collected in 1986 in the Birch Creek drainage were used to test the equations from Mack (1986), which had been developed from data collected in 1985 and earlier at the same sample sites.

Using turbidity data from appendix A, and the appropriate equation derived from the 1985 data, TSS values were predicted, and then compared to reported TSS values. Table 2 presents the mean Z score and Z score standard deviation at each site. Ideally the mean should be near zero and the standard deviation should be less than one. Only at Birch Creek above Twelvemile is the mean close to zero, and nowhere is the standard deviation below one, demonstrating that the equations developed with data collected in 1985 and earlier do not predict well with 1986 data.

Mack (1986) suggested a multiple regression equation using turbidity and a flow component--either velocity or discharge--to predict TSS, as an improvement over the simple turbidity-TSS regression. To test this, multiple regression equations using turbidity and discharge to predict TSS were developed from the data collected in 1986. The resulting equations were compared to simple regression equations developed from the same data and

Table 2. Z Score Results. Z scores = (reported TSS - predicted TSS)/standard error of estimate.

	Mean	S.D.
1985 simple regression equations (using turbidity to predict TSS) tested on 1986 data		
Birch above 12Mile	-0.12	3.42
Birch at Bridge	1.69	1.25
Crooked above mouth	1.56	1.92
Mammoth at Steese	3.37	5.32
1986 multiple regression equations (using turbidity and discharge to predict TSS) tested on 1985 data		
Birch at Bridge	-2.16	0.68
Crooked above mouth	-1.90	1.21
Mammoth at Steese	-0.68	0.36

tested on 1985 data, using Z scores as described above. The equations are presented in table 3, and the Z score results are presented in table 2.

The results suggest that multiple regression equations using turbidity and discharge to predict TSS are not reliable enough to abandon collection of TSS data. The multiple regression equations improve the coefficient of determination and standard error of estimate (SEE) in two of three instances, but when tested against each groups of data (as in table 2), may not accurately or precisely predict TSS.

The settleable solids data collected in 1986 are presented in appendix C. Approximately twenty percent of the samples collected in streams affected by mining and tested for settleable solid levels registered 0.2 ml/L or greater. High settleable solids appear to be more a result of high flows than effluent discharges from individual mining operations. Figure 3 shows the relationship of settleable solids levels to average and median turbidity values. No strong pattern exists between turbidity and settleable solids at our sampling sites.

Settleable solids are larger particles that settle out in an Imhoff cone in one hour; velocities associated with high flow events cause more such particles to be suspended in the water column. Figure 4 shows the relationship of settleable solids to stream velocity. Higher average and median velocities are associated with higher settleable solids levels. The high correlation with velocity and the low correlation with turbidity demonstrate that high levels of settleable solids at our sampling sites are attributable more to non-point sources of sediment than to discharges from individual mining operations.

Table 3. Multiple regression results using 1986 data fitted to the following equation:

$$Y = a * X_1^{b} * X_2^{c}$$

where Y = TSS, X_1 = turbidity, X2 = discharge, a is a constant, and b and c are exponents; n is the number of observations.

Location	n	a	b	c	r^2	SEE
Birch above 12Mile	111	2.51	0.833		0.386	0.237
	111	0.212	0.812	0.565	0.630	0.184
Birch at Bridge	17	1.79	1.351		0.787	0.286
	17	0.009		1.26	0.630	0.377
	17	0.82	1.22	0.155	0.789	0.294
Crooked above mouth	44	2.54	1.03		0.577	0.270
	44	0.29	0.710	0.570	0.703	0.229
Mammoth above Steese	118	2.08	0.790		0.356	0.309
	118	0.23	0.927	0.656	0.564	0.255

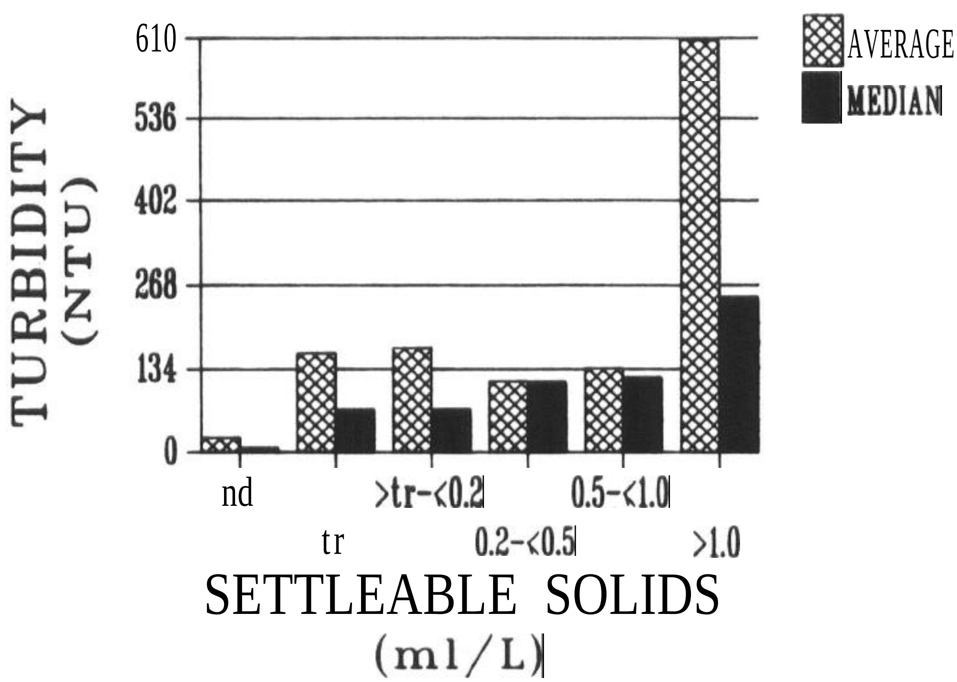


Figure 3. Turbidity-settleable solids relationship.

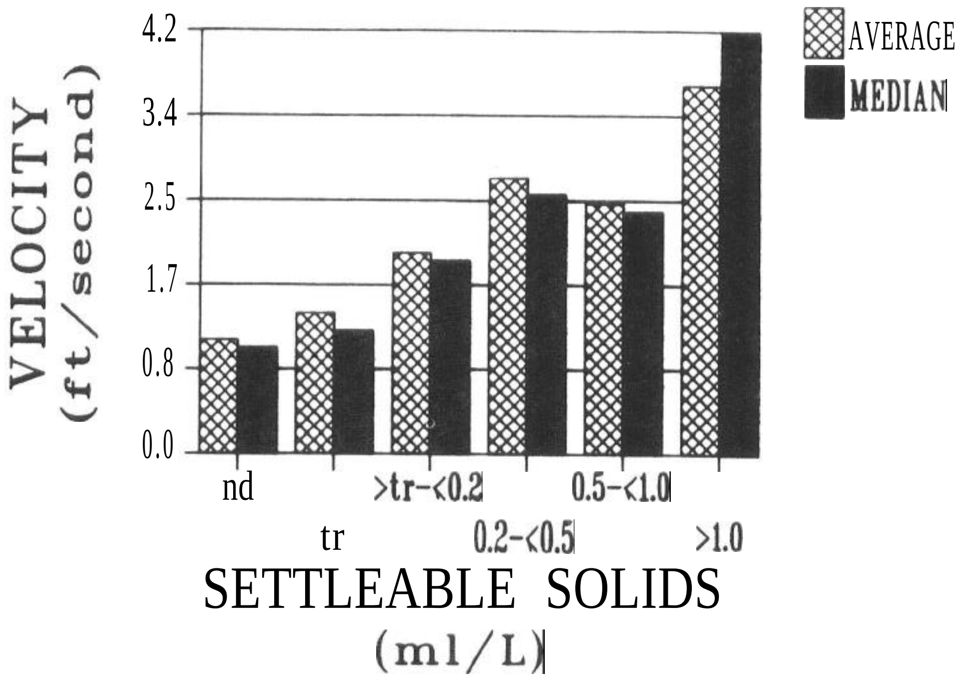


Figure 4. Velocity-settleable solids relationship.

Discharge

Discharge estimates at the sampling sites are presented with water quality data in appendices A and B, and in tabular form for the automated sites in appendix D. Summaries of monthly averages of the past three years appear in table 4. In general, 1986 was a drier year than 1985. At Boulder Creek, a site gaged by the U.S. Geological Survey, discharge averaged 47 percent less in 1986 than 1985; the 1986 average at Boulder Creek was 15 percent lower than the 19-year average. The automated sites show less of a difference. However, at Mammoth Creek the 1985 record was not continuous in June and early July, and two large flow events were missed. Recorders at Birch Creek at the Bridge and Crooked Creek above the mouth were inoperable during August and September of 1986; data from those months are therefore not included in the percentage of change calculations for those locations in table 4.

Sediment Loads and Turbidity Index Loads

Sediment loads indicate the total amount of sediment carried by a stream. Table 5 shows monthly averages at sites where samples for TSS were taken in 1986. Birch Creek at Steese Highway Bridge is the farthest downstream site and is below all mining activity. It has the largest monthly sediment load averages. In the Birch Creek basin most mining takes place either above the mouth of Crooked Creek or on Birch Creek above Twelvemile Creek. The combined average sediment loads from those two sites should approximate the load at the Birch Creek at the Bridge site. However, the load at that site is much greater than the sum of the upper two sites, which

Table 4. Summary of discharge values: monthly averages of daily discharge in cfs.

Location	Year	June	July	Aug	Sep	Avg change from previous year (%)
		Averages of discrete observations				
Albert at Steese	86	170	52.6	3.6	32.1	
Bedrock at Steese	84			1.5	3.1	
	85	22.6	2.4	8.1	13.2	363
	86	9.9	22.7	1.5	4.5	-16.6
Crooked at Central	84			40.0	52.7	
	85	246	65.9	88.8	162	171
	86	251	147	37.2	65.1	-11.1
Deadwood at CHSR	84			8.6	11.7	
	85	53.7	16.3	18.1	33.0	152
	86	35.2	17.4	5.1	6.7	-46.8
Ketchem at CHSR	84			2.7	4.5	
	85	19.4	6.0	9.8	18.1	288
	86	15.9	5.2	1.6	2.6	-52.5
'Porcupine above mouth	85	140	17.5	40.1	64.7	
	86	61.7	22.6	11.7	22.4	-53.6
		Averages of continuous observations				
Birch above 12Mile	86	207	125	71.2	76.5	
Birch at Bridge	85	4600"	1710[a]	1930[a]	3790[a]	
	86	3730	2370	700[a]	828[a]	-3.3
Crooked above mouth	85	703	505	267	524	
	86	809	436	71.7[a]	115[a]	3.1
Boulder near Steese	84	76.4	23.9	5.5	3.6	
	85	70.2	36.5	11.0	25.1	30.5
	86	33.3	24.8	7.9	9.3	-47.3
	19-yr avg	42.6	17.5	15.3	11.4	15.3
Mammoth at Steese	84			20.2[a]	19.8[a]	
	85	93.6[a]	23.3[a]	25.4	46.4	79.5
	86	82.1	42.7	21.9	27.2	-7.8
Faith at Steese	86	107	80.4	294	149	

[a]Continuous record interrupted by minor discontinuities.

Table 5. Sediment loads associated with placer mining (monthly averages in tons per day).

Location	June	July	Aug	Sep
Birch above 12Mile	420	79.2	40.2	48.3
Birch at Bridge	7270	1450	nd[a]	567[b]
Crooked above Mouth	1600	268	47.9[b]	101[b]
Boulder near Steese	2.65	1.89	0.30	0.14
Mammoth at Steese	171	27.3	36.2	65.8
Faith at Steese	57.2	31.3	548	57.9

[a] No data--equipment not working.
[b] Averages of discrete samples and observations.

indicates that much of the lower Birch Creek sediment load last summer was picked up from the channel bottom. Measurements indicate that, of the two main placer mining areas in the Birch Creek drainage--Crooked Creek and Birch Creek above Twelvemile Creek, mining in the Crooked Creek drainage contributed approximately twice as much total sediment load to Birch Creek in 1986 as did mining in the Birch Creek drainage above Twelvemile Creek.

The impact of mining on streams in the Birch Creek drainage can be judged by comparing the sediment loads of Mammoth and Boulder Creeks, two neighboring creeks of similar size. Mammoth Creek is mined and has an area of '42 mi^2. Boulder Creek (33 mi^2) is presently unmined (although mining has historically occurred there), and has 78 percent of the area of the Mammoth Creek, but only two percent of the sediment load.

Data from Faith Creek demonstrate the effect flood events can have on sediment loads. The largest flood of the summer in Faith Creek occurred August 21-22, 1986. The average sediment load for that month was 548 tons per day. However, if the load estimates from August 21-22, (15,700 tons) are subtracted, the average drops to 44.8 tons per day for the month of August, similar to the averages of the other months. At the other sites, flood events did not have as dramatic an effect on the averages.

Sediment load is a good measure for determining if mining pollution has decreased during the past three years of data collection, because it measures the total amount of sediment moved by a stream against the typical amount of sediment in a standard volume of stream water. The extensive TSS data needed to accurately calculate sediment load can only be collected by automated sampler; therefore, the automatic sampler sites were our sole source of data during the 1986 summer,

Table 6 shows monthly average turbidity index loads (TIL) at the sites monitored over the past three years. At most sites affected by mining, TIL has decreased each year. The extent of the decrease is more apparent when

Table 6. Turbidity index loads for Birch Creek drainage, June-Sept. 1984-86, in KNTU-cfs.

Location	Year	June	July	Aug	Sep	Avg change from previous year (X)
		Averages of discrete observations				
Albert at Steese	86	3.6	0.60	0.002	0.074	
Bedrock at Steese	84			0.002	0.002	
	85	0.025	0.001	0.007	0.005	244
	86	0.016	0.090	0.001	0.005	196
Crooked at Central	84			35.2	36.7	
	85	58.1	43.4	34.6	29.3	-11.0
	86	28.4	22.2	2.6	193	49.1
Deadwood at CHSR	84			12.0	7.5	
	85	53.6	11.0	9.0	8.3	-11.4
	86	1.4	0.9	0.2	0.9	-95.8
Ketchem at CHSR	84			8.7	0.7	
	85	3.1	6.4	9.7	21.5	234
	86	1.8	0.6	0.2	2.0	-88.4
Porcupine above Mouth	85		1.7	16.4	23.9	
	86	3.7	2.8	0.5	11.5	-64.8
		Averages of continuous observations				
Birch above 12Mile	86	52.8	25.1	16.9	19.2	
Birch at Bridge	85	216[a]	39.3[a]	67.6[a]	68.2[a]	
	86	295	261		15.8[a]	13.0
Crooked above Mouth	85	73.8[a]	44.4[a]	45.9[a]	30. 9[a]	
	86	95.5	28.3	2.6	9.7[a]	-30.2
Boulder near Steese	85		0.029[a]	0.009[a]	0.015[a]	
	86	0.13	0.10	0.014	0.013	138
Mammoth at Steese	84			11.8[a]	19.6[a]	
	85	26.7[a]	7.9[a]	10.2[a]	17.2[a]	-12.9
	86	19.7	8.3	5.8	14.1	-22.6

[a]Continuous record interrupted by minor discontinuities.

compared to results at sites unaffected by mining (Bedrock and Boulder Creeks), which show substantial increases. One explanation for this phenomenon is that increases in non-point source sedimentation (evidenced from the unmined streams) seem to mask the decrease in point source sedimentation (mine effluent). Thus, turbidity from point sources may be decreasing more than is indicated by the monitoring, although the TIL for unmined streams is so small that only a small fluctuation in turbidity results in a large percentage change. Data in table 6 support the assumption that large decreases in TIL for streams affected by mining will be necessary before they fall within the TIL ranges of unmined streams.

The value of automated samplers and water level recorders was demonstrated during the 1986 monitoring. Use of automated equipment allowed sampling during extreme events and development of a continuous record throughout the summer, which was a significant advance from the techniques of previous years. The equipment is not foolproof: beavers chewed through several transducer lines and intake hoses, a bear attacked a sampler at one location, transducers and batteries failed, and at times the correct buttons were not pushed. However, without the -automatic equipment the record would be much less complete, and the flood data from 1986 would not have been collected.

Mammoth Creek Intensive Study

Results of individual sampling during the Mammoth Creek Intensive Study are presented in appendix F, and appendix H describes the specifics of each mining operation within the study reach. The study period can be characterized by fairly stable conditions. No precipitation fell immediately before or during the sampling period, and creek water levels remained relatively unchanged. Mining operations were constant except for one mine site where the operator moved in during the sampling period. Because of these relatively stable conditions, it was possible to combine data in appendix E to accurately reflect average conditions during the study period (fig. 5 and table 7).

Independence Creek, one of the headwater tributaries of Mammoth Creek, starts as a small, crystal-clear stream with low TSS values (site 1 in table 7 and fig. 5). After the first mine site (GAM), where recycling methods with low effluent discharge were used, TSS rose noticeably (site 2). The creek was still a fairly clear stream at this point. Below the second mine site (May), the TSS and sediment load almost doubled (site 3). The May operation moved in during the sampling period and was never in a production mode during the sampling period. Independence stayed near the TSS and load levels of site 3 until it met Mastodon Creek (site 5) to form Mammoth Creek. The clear water of Mastodon Creek diluted Independence Creek, and TSS concentration dropped appreciably (from 360 mg/L to 120 mg/L) at site 6.

Mammoth Creek next passed by the third mine site (Loud), where the operator used recycling methods. During the sampling period, little effluent from the Loud operation entered Mammoth Creek (site 8). Below the Loud operation, Mammoth Creek was diverted into two channels of about equal size.

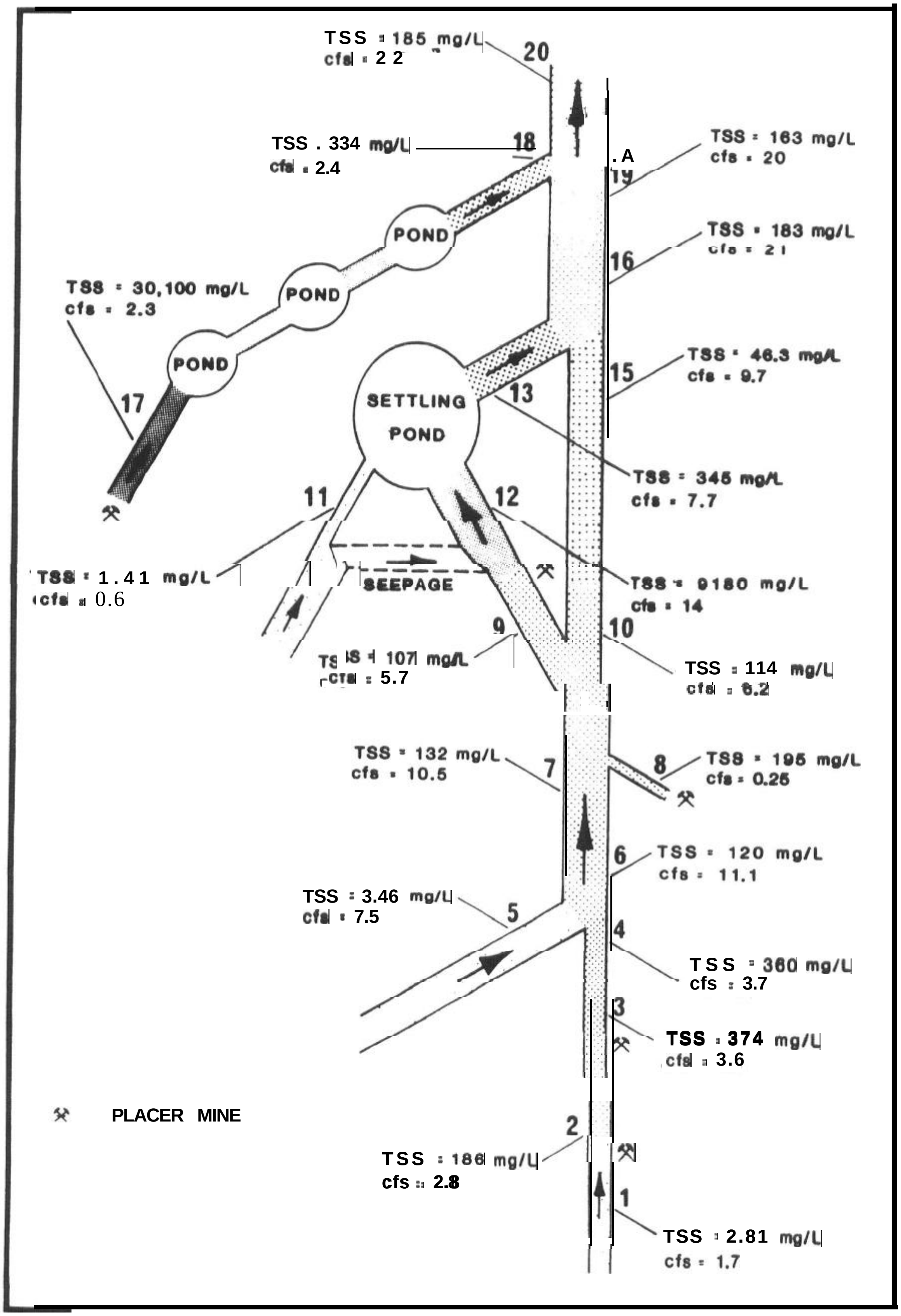


Figure 5. Schematic diagram of intensive study results, Mammoth Creek, Alaska, 7/30-8/1/86.

Table 7. Average discharge, turbidity, TSS, and sediment load from Mammoth Creek Intensive Study, July 30-August 1, 1986.

Site	Turbidity (NTU)	TSS (mg/l)	Discharge (cfs)	Load tons/day	TIL[a] (KNTU-cfs)
1 Indepndnce ab GAM	0.5	2.81	1.7	0.013	0.001
2 Indepndnce b GAM	151	186	2.9	1.46	0.44
3 Indepndnce b May	279	374	3.6	3.64	1.00
4 Indepndnce ab mth	248	360	3.7	3.60	0.92
5 Mastodon ab mth	2.2	3.45	7.5	0.070	0.02
6 Mammoth at head	111	120	11.1	3.60	1.23
7 Mammoth ab L eff	124	132	10.5	3.74	1.30
8 Loud Effluent	432	195	0.25	0.13	0.11
9 AV Diversion	69	107	5.7	1.65	0.39
10 Mammoth b AVdiv	106	114	6.2	1.91	0.66
11 Miller ab Rd	0.51	1.41	0.5	0.002	0.000
12 AV eff ab Rd	3525	9180	14[b]	347	49.4
13 AV eff b pond	433	345	7.7	7.17	3.33
14 AV eff ab Mammoth	388	284	7.7	5.90	2.99
15 Mammoth ab AV eff	75	46.3	9.7	1.21	0.73
16 Mammoth b AV eff	255	183	21	10.4	5.36
17 Dugas b sluice	14000	30100	2.3	187	32.2
18 Dugas ab Mammoth	527	334	2.4	2.16	1.26
19 Mammoth ab Dugas	230	163	20	8.8	4.60
20 Mammoth at Steese	260	185	22	11.0	5.72

[a] TIL (turbidity index load): product of turbidity and discharge divided by 1000.

[b] Approximately 7 cfs is seepage from Miller Creek through tailings.

The left channel (site 9) was used for process water at the fourth mine site (Alaska Ventures), and the right channel (site 10) was a bypass.

Below Alaska Ventures the left channel of Mammoth Creek became a tail race leading into the Alaska Ventures settling pond. Above the sampling site (12), ~7 cfs from Miller Creek seeped through tailings piles into the tail race channel, effectively doubling the flow. The portion of Miller Creek that did not seep into the tail race was diverted into the settling pond to bypass the fifth mine site (Dugas). Even though the settling pond removes most of the load of the tail race, the load below the settling pond (site 13) was much larger than above the Alaska Ventures mining operation (site 9).

The right, bypass channel (site 15) of Mammoth Creek lost some of its load above its confluence with the Alaska Ventures settling pond effluent (deposition?) and increased its flow by over 50 percent. Below its confluence with the settling pond effluent (site 16), Mammoth Creek is more than the sum of its parts: near this area inflow was occurring from several overland, and, perhaps, ground-water sources. Fourteen cfs were entering the Alaska Ventures settling pond; only 10 cfs were measured leaving by surface outlets-- the settling pond effluent, 7.7 cfs, and Dugas mine operation, 2.3 cfs. Assuming the settling pond was at a steady state, four cfs must be lost to ground-water outflow which probably finds its way to the Mammoth Creek main channel.

The Dugas mine operation obtains water from seepage through the Alaska Ventures settling pond. Effluent travels via a long channel through three small settling ponds, and from there to Mammoth Creek just above the Steese Highway bridge. The downstream point of the Study was Mammoth Creek at the Steese Highway Bridge (site 20), where the TSS concentration was 185 mg/L and the average sediment load was 11 tpd. Of this, approximately 0.12 tpd came from the measured clear-water tributaries (Independence, Mastodon and Miller Creeks) that make up most of the flow in Mammoth Creek, 3.6 tpd from the first three mine operations, 5.2 tpd from Alaska Ventures, and 2.2 tpd from Dugas. During the study period, deposition in the channel averaged 2 tpd.

The above description used sediment loads--the product of TSS and discharge--in the discussion of the sediment balance. Turbidity index loads (the product of turbidity and discharge) used in the same manner would have achieved the same result.

One of the objectives of the study was to examine changes in settleable solids among the study reach. Because of the normal-to-low flows in Mammoth Creek and the treatment efforts of the miners, settleable solids levels at all locations, except directly below sluicing, were mostly in the trace range, below the lower detection limit of an Imhoff cone (see appendix E). This illustrates a problem with using settleable solids as a guideline for managing sediment-laden effluent discharges: samples below the lower detection limit can still contain significant and varying amounts of sediment.

The most obvious lesson from the data is that lower total water use results in lower loads added to the stream. For example, if Miller Creek could have been routed away from the Alaska Ventures settling pond, sediment levels in Mammoth Creek would have been measurably lower. The increased flow through the pond decreased the settling efficiency of the pond and resulted in higher settling pond effluent discharges. The operators who released less water had less impact on the stream.

It should be noted that mine effluent was not the only impact on stream sediment loads during the study period. No sluicing was occurring at the second mine site, yet turbidity and TSS values were elevated, most likely from dirt work involved in setting up the mining operation.

The average sediment load at the Steese Highway site for the study period (11 tpd) was low compared to the average for the summer (75 tpd). Much of this difference can be attributed to high flows in June. However, in September, when no large storms occurred and flows were normal and steady through the month, sediment load at the Steese Highway bridge site averaged 66 tpd.

An increase of this magnitude indicates a change in mining practices in late summer from those observed during the study period.

Supplementary Data

Appendix F lists data from samples collected by ADF&G during 1985 and 1986 and analyzed in the DGGS laboratory. These data are mostly from samples collected at an automated sampler located on Faith Creek and other sites in the upper Chatanika drainage, Goldstream Creek, as well as from spring breakup. ADF&G has used these data for interpretive reports published elsewhere and for internal reports and memorandum. The data are published here to ensure availability to the public.

Appendix G lists data from two short term, multi-agency, multi-site samplings in the Birch Creek drainage, and data from samples collected outside the Birch Creek drainage.

Fewer samples *were* collected in 1986 by the Alaska Division of Parks and Outdoor Recreation than in previous years. The results for the three sites sampled show low turbidity levels in most instances.

The lack of response from the Village Water Quality Monitoring program was disappointing. Sample bottles and mailers had been provided for Evansville, Tanana, Birch Creek Village, and Minto. Only Evansville sent back *more* than one sample. If this program is to provide useful information, samples must be sent in at least weekly during the summer. Results from the Koyukuk River at Evansville showed some high turbidity readings; most of the samples were from early in the summer and may reflect high flows from spring breakup.

ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of Shirley Liss who helped with sample collection and analysis, discharge measurements, and other field and laboratory work.

REFERENCES CITED

Alaska Department of Environmental Conservation, 1979, Water *quality* standards: Alaska Water Quality Pollution Control Program, Juneau, Alaska, 34 p.

American Public Health Association (APHA), 1985, Standard methods for the examination of water and wastewater, Sixteenth Edition, Washington, D.C., 1268 p.

Mack, Stephen F., 1986, Using turbidity to predict total suspended solids in mined streams in interior Alaska: Alaska Division of Geological and Geophysical Surveys, Public-data File 86-84.

Mack, Stephen F. and Mary A. Moorman, 1986, Hydrologic and water-quality investigations related to the occurrence of placer mining in interior Alaska, Summers 1984-85: Alaska Division of Geological and Geophysical Surveys, Public-data File 86-16.

Neter, John, Wasserman, William, and Michael H. Kutner, 1985, Applied linear statistical models (2d ed.): Homewood, Illinois, Richard D. Irwin, Inc., 1127 p.

SAS Institute, Inc., 1985a, SAS users's guide--basics (1985 ed.): SAS Institute, Cary, North Carolina, 921 p.

SAS Institute, Inc., 1985b, SAS users's guide--statistics (1985 ed.): SAS Institute, Cary, North Carolina, 584 p.

Appendix A. Data from automatic samplers in Birch Creek drainage.

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Birch ab 12mile	060586	1630	310		208	
Birch ab 12mile	060686		350	1030	164	457
Birch ab 12mile	060786		320	559	150	226
Birch ab 12mile	060886		320	476	130	167
Birch ab 12mile	060986		240	348	176	166
Birch ab 12mile	061086		600	1080	229	668
Birch ab 12mile	061186		130	337	211	192
Birch ab 12mile	061286		340	852	436	1003
Birch ab 12mile	061386		160	552	269	401
Birch ab 12mile	061486		150	340	143	131
Birch ab 12mile	061586		260	359	95.8	92.9
Birch ab 12mile	061686		190	277	55.0	41.1
Birch ab 12mile	061686	1448	160	211		
Birch ab 12mile	061786		110	491	43.7	57.9
Birch ab 12mile	061886		210	275	59.7	44.4
Birch ab 12mile	061986		390	1390	354	1330
Birch ab 12mile	062086		320	1280	286	989
Birch ab 12mile	062186		210	833	290	651
Birch ab 12mile	062286		190	577	286	446
Birch ab 12mile	062386		260	1210	460	1503
Birch ab 12mile	062486		330	987	440	1173
Birch ab 12mile	062586		180	545	245	361
Birch ab 12mile	062586	1520	200	390		
Birch ab 12mile	062686		100	308	177	147
Birch ab 12mile	062786		150	190	145	74.5
Birch ab 12mile	062886		330	294	126	100
Birch ab 12mile	062986		180	125	106	35.6
Birch ab 12mile	063086		400	164	101	44.6
Birch ab 12mile	070186		500	506	161	220
Birch ab 12mile	070286		150	147	135	53.7
Birch ab 12mile	070386		160	122	113	37.3
Birch ab 12mile	070486		160	92.2	110	27.4
Birch ab 12mile	070586		230	139	98.7	37.0
Birch ab 12mile	070686		150	57	81.2	12.5
Birch ab 12mile	070786		190	106	70.1	20.1
Birch ab 12mile	070886		220	129	63.1	22.0
Birch ab 12mile	070886	1250	240	137		
Birch ab 12mile	070986		250	178	72.9	35.1
Birch ab 12mile	071086		290	181	70.8	34.6
birch ab 12mile	071186		260	223	90.3	54.3
Birch ab 12mile	071286		230	128	141	48.7
Birch ab 12mile	071386		200	269	115	83.7
Birch ab 12mile	071486		340	199	102	55.0
Birch ab 12mile	071586		450	260	86.4	60.7
Birch ab 12mile	071686		500	208	74.0	41.5
Birch ab 12mile	071786		550	331	67.0	59.9

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Birch ab 12mile	071886		600	404	62.9	68.7
Birch ab 12mile	071986		550	326	69.8	61.4
Birch ab 12mile	072086		550	876	255	603
Birch ab 12mile	072186		200	282	251	191
Birch ab 12mile	072286		150	172	216	100
Birch ab 12mile	072386		60	61.8	142	23.6
Birch ab 12mile	072386	1250	40	38.2		
Birch ab 12mile	072486		75	86.7	118	27.7
Birch ab 12mile	072586		170	133	106	37.9
Birch ab 12mile	072686		220	215	136	79.1
Birch ab 12mile	072786		140	234	235	149
Birch ab 12mile	072886		95	118	235	74.9
Birch ab 12mile	072986		180	141	148	56.3
Birch ab 12mile	073086		160	122	122	40.1
Birch ab 12mile	073186		170	138	112	41.6
Birch ab 12mile	080186		330	309	110	92.0
Birch ab 12mile	080286		290	259	104	72.4
Birch ab 12mile	080386		260	209	89.2	50.3
Birch ab 12mile	080486		230	191	78.1	40.3
Birch ab 12mile	080586		360	298	71.5	57.5
Birch ab 12mile	080686		400	311	65.4	54.9
Birch ab 12mile	080786		450	401	58.0	62.8
Birch ab 12mile	080886		230	94	53.8	13.6
Birch ab 12mile	080986		150	73.3	50.1	9.9
Birch ab 12mile	081086		100	73.3	43.0	8.5
Birch ab 12mile	081186		190	121	42.9	14.0
Birch ab 12mile	081286		140	85.7	38.6	8.9
Birch ab 12mile	081386		230	150	36.7	14.9
Birch ab 12mile	081486		400	392	35.2	37.2
Birch ab 12mile	081586		200	126	31.9	10.9
Birch ab 12mile	081686		260	181	31.9	15.6
Birch ab 12mile	081786		170	97.2	31.5	8.3
Birch ab 12mile	081886		130	78.7	30.7	6.5
Birch ab 12mile	081986		160	163	28.7	12.6
Birch ab 12mile	082086		290	214	30.9	17.9
Birch ab 12mile	082086	1245	290	214		
Birch ab 12mile	082186		200	180	74.0	36.0
Birch ab 12mile	082286		340	355	130	125
Birch ab 12mile	082386		340	343	111	103
Birch ab 12mile	082486		290	285	95.9	73.8
Birch ab 12mile	082586		230	170	82.3	37.8
Birch ab 12mile	082686		290	214	75.5	43.6
Birch ab 12mile	082786		290	232	72.1	45.2
Birch ab 12mile	082886		200	206	125	69.4
Birch ab 12mile	082986		95	84.1	142	32.3
Birch ab 12mile	083086		100	73.8	123	24.6
Birch ab 12mile	083186		230	150	114	46.0

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Birch ab 12mile	090186		240	151	102	41.6
Birch ab 12mile	090286		260	174	94.8	44.5
Birch ab 12mile	090386		210	164	87.1	38.6
Birch ab 12mile	090486		380	301	76.1	61.9
Birch ab 12mile	090586		450	331	70.6	63.1
Birch ab 12mile	090686		280	222	65.6	39.3
Birch ab 12mile	090786		400	260	59.8	42.0
Birch ab 12mile	090886		380	275	64.2	47.6
Birch ab 12mile	090986		350	268	98.3	71.1
Birch ab 12mile	091086		450	364	91.5	90.0
Birch ab 12mile	091086	1215	330	291		
Birch ab 12mile	091186		450	399	86.0	92.7
Birch ab 12mile	091286		340	325	78.5	68.9
Birch ab 12mile	091386		290	286	72.6	56.0
Birch ab 12mile	091486		320	344	63.2	58.7
Birch ab 12mile	091586		320	354	63.0	60.2
Birch ab 12mile	091686		230	181	65.5	32.0
Birch ab 12mile	091786		300	224	68.4	41.4
Birch ab 12mile	091886		190	164	98.0	43.4
Birch ab 12mile	091986		180	199	80.0	43.0
Birch ab 12mile	092086		170	175	81.6	38.6
Birch ab 12mile	092186		39	58	77.6	12.1
Birch ab 12mile	092286		110	153	72.8	30.1
Birch ab 12mile	092386		150	206	66.8	37.1
Birch ab 12mile	092486		140	190	60.7	31.1
Birch ab 12mile	092586		55	121	67.5	22.1
Birch ab 12mile	092586	1800	60	145		
Birch at bridge	052386		18	160	1380	596
Birch at bridge	052386	1500	14			
Birch at bridge	052486		18	143		
Birch at bridge	052586		14	86.3		
Birch at bridge	052686		23	176		
Birch at bridge	052786		37	290		
Birch at bridge	052886		23	162		
Birch at bridge	052986		9.8	48.8		
Birch at bridge	053086		9.7	32.6		
Birch at bridge	053186		23	99.2		
Birch at bridge	060186		40	305		
Birch at bridge	060286		110	806		
Birch at bridge	060386		110	696		
Birch at bridge	060686	1040	20		1880	
Birch at bridge	061786	1555	14		1220	
Birch at bridge	062086		160	1220	9030	29745
Birch at bridge	062186		180	840	8860	20094
Birch at bridge	062286		65	318	5270	4525
Birch at bridge	062386		45	343	5080	4705

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Birch at bridge	062486		80	587	10700	16958
Birch at bridge	062486	1300	130	1060		
Birch at bridge	062586	1045	80	584	11100	17502
Birch at bridge	062686		40	415	4830	5412
Birch at bridge	062786		28	250	2800	1890
Birch at bridge	062886		18	182	1940	953
Birch at bridge	070286		90	660	4640	8268
Birch at bridge	070386		60	600	2390	3872
Birch at bridge	070986	1350	9.1	23	785	48.8
Birch at bridge	071186		28	381	1570	1615
Birch at bridge	071286		55	424	6830	7819
Birch at bridge	071386		27	176	6190	2941
Birch at bridge	072186		110	749		
Birch at bridge	072286		80	325		
Birch at bridge	072386		24	280		
Birch at bridge	072386	1710	23	272	2820	2071
Birch at bridge	072486		13	76.4		
Birch at bridge	072886		13	80.3		
Birch at bridge	072986		34	448		
Birch at bridge	073086		18	141		
Birch at bridge	073186		8.0	58.6		
Birch at bridge	082186	1015	6.3	3.78	700	7.1
Birch at bridge	090986	1115			804	
Birch at bridge	091086		19	33.7		
Birch at bridge	091186		24	54.2		
Birch at bridge	091286		23	25.1		
Birch at bridge	091386		23	23.3		
Birch at bridge	091486		20	43.8		
Birch at bridge	091586		18	55.4		
Birch at bridge	091686		17			
Birch at bridge	091786		10	26.1		
Birch at bridge	091886		15	27.8		
Birch at bridge	091986		14	64.8		
Birch at bridge	092086		12	4.00		
Birch at bridge	092186		16	17.0		
Birch at bridge	092286		19	144		
Birch at bridge	092386		28	170		
Birch at bridge	092486		15	57.3		
Birch at bridge	092586		33	84.6		
Birch at bridge	092586	1305	17	67.3	853	155
Boulder at gage	052386	1745	3.7			
Boulder at gage	060586	1927	3.4			
Boulder at gage	061886	1200				
Boulder at gage	061986		16	140		
Boulder at gage	062086		10	78.3		
Boulder at gage	062186		3.7	38.2		

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Boulder at gage	062286		3.2	14.4		
Boulder at gage	062486		2.6	27.8		
Boulder at gage	062486	1755	3.3	13.2		
Boulder at gage	062586		2.1	18.0		
Boulder at gage	062686		1.9	10.5		
Boulder at gage	062786		1.0	5.0		
Boulder at gage	062886		0.9	4.3		
Boulder at gage	062986		0.8	1.6		
Boulder at gage	063086		0.7	2.1		
Boulder at gage	070186		32	291		
Boulder at gage	070286		8.7	66.4		
Boulder at gage	070386		2.9	37.8		
Boulder at gage	070486		3.4	20.2		
Boulder at gage	070586		1.9	9.3		
Boulder at gage	070686		2.1	6.0		
Boulder at gage	070786		1.7	5.5		
Boulder at gage	070886	1555	0.7	2.0		
Boulder at gage	070986		20	90.9		
Boulder at gage	070986	0950	4.9			
Boulder at gage	070986	1750	16			
Boulder at gage	071086		6.5	44.8		
Boulder at gage	071086	1030	2.3			
Boulder at gage	071186		9.6	85.1		
Boulder at gage	071286		5.9	49.0		
Boulder at gage	071386		2.6	14.7		
Boulder at gage	071486		1.5	9.4		
Boulder at gage	071586		1.2	6.4		
Boulder at gage	071686		1.1	1.2		
Boulder at gage	071786		0.8	1.2		
Boulder at gage	071886		1.0	1.9		
Boulder at gage	071986		0.6			
Boulder at gage	072086		0.7	1.6		
Boulder at gage	072186		2.7	13.1		
Boulder at gage	072286		1.0	4.4		
Boulder at gage	072386		0.8	2.8		
Boulder at gage	072386	1530	1.4	5.4		
Boulder at gage	072486		2.1			
Boulder at gage	072586		1.7	10.0		
Boulder at gage	072686		1.3	5.6		
Boulder at gage	072786		1.2	13.9		
Boulder at gage	072886		1.8	10.1		
Boulder at gage	072986		2.2	5.6		
Boulder at gage	073086		0.8	3.3		
Boulder at gage	073186		4.2	26.9		
Boulder at gage	080186		2.2	9.9		
Boulder at gage	080286		2.4	11.2		
Boulder at gage	080386		1.1	3.2		

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Boulder at gage	080486		0.7	3.4		
Boulder at gage	080586		1.4	5.5		
Boulder at gage	080686		0.6	3.5		
Boulder at gage	080786		2.0	16.7		
Boulder at gage	080886		1.1	2.6		
Boulder at gage	080986		0.6	2.8		
Boulder at gage	081086		0.8	2.0		
Boulder at gage	081186		0.7	2.0		
Boulder at gage	081286		1.0	6.2		
Boulder at gage	081386		0.6	6.9		
Boulder at gage	081486		0.7	9.6		
Boulder at gage	081586		0.6	4.9		
Boulder at gage	081686		0.9	7.2		
Boulder at gage	081786		1.0	2.3		
Boulder at gage	081886		0.8	24.6		
Boulder at gage	081986		0.6	3.6		
Boulder at gage	082086		0.9	19.0		
Boulder at gage	082086	1600	0.6	0.8		
Boulder at gage	082186		2.8	11.3		
Boulder at gage	082286		0.6	5.3		
Boulder at gage	082386		2.1	13.4		
Boulder at gage	082486		0.7	3.0		
Boulder at gage	082586		0.8	4.3		
Boulder at gage	082686		0.8	3.5		
Boulder at gage	082786		0.7	1.9		
Boulder at gage	082886		2.4	21.2		
Boulder at gage	082986		12	115		
Boulder at gage	083086		9.3	88.4		
Boulder at gage	083186		4.2	36.5		
Boulder at gage	090186		2.0	15.1		
Boulder at gage	090286		1.3	8.9		
Boulder at gage	090386		0.9	6.9		
Boulder at gage	090486		1.0	4.7		
Boulder at gage	090586		0.5	3.1		
Boulder at gage	090686		0.7	3.7		
Boulder at gage	090786		1.0	4.6		
Boulder at gage	090886		1.3	4.9		
Boulder at gage	090986		1.1	4.3		
Boulder at gage	090986	1820	1.0	1.3		
Boulder at gage	092586	1555	4.6	64.6		
Crooked ab mouth	052386	1650	25			
Crooked ab mouth	060686	1250	75			
Crooked ab mouth	061786	1045	34		235	
Crooked ab mouth	061886		56	311	635	533
Crooked ab mouth	061986		170	669	1590	2872
Crooked ab mouth	062086		270	1380	1290	4807

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Crooked ab mouth	062186		220	893	899	2167
Crooked ab mouth	062286		130	660	895	1595
Crooked ab mouth	062386		120	651	1860	3269
Crooked ab mouth	062486		100	514	1380	1915
Crooked ab mouth	062586		230	576	793	1234
Crooked ab mouth	062586	1135	120	590		
Crooked ab mouth	062686		35	330	578	515
Crooked ab mouth	062886		31	126	384	131
Crooked ab mouth	062986		25	100	332	90
Crooked ab mouth	063086		22	73	523	103
Crooked ab mouth	070186		19	72.4	726	142
Crooked ab mouth	070286		5.5	376	504	512
Crooked ab mouth	070386		50	333	390	351
Crooked ab mouth	070486		40	143	343	132
Crooked ab mouth	070586		33	103	289	80
Crooked ab mouth	070686		38	95.1	236	61
Crooked ab mouth	070786		35	85.7	200	46
Crooked ab mouth	070886		28	94.7	239	61
Crooked ab mouth	070986		40	158	467	199
Crooked ab mouth	070986	1100	36	87.5		
Crooked ab mouth	071086		200	504	600	817
Crooked ab mouth	071186		130	714	755	1455
Crooked ab mouth	071286		130	804	632	1372
Crooked ab mouth	071386		75	326	503	443
Crooked ab mouth	071486		40	184	413	205
Crooked ab mouth	071586		45	135	343	125
Crooked ab mouth	071686		38	85.1	295	67.8
Crooked ab mouth	071786		24	66.1	237	42.4
Crooked ab mouth	071886		33	77.7	196	41.2
Crooked ab mouth	071986		40	78.5	242	51.2
Crooked ab mouth	072086		75	124	1218	408
Crooked ab mouth	072186		90	201	769	417
Crooked ab mouth	072286		110	149	495	199
Crooked ab mouth	072386		85	102	336	92.5
Crooked ab mouth	072386	1800	65	80.6		
Crooked ab mouth	072486		75	234	251	159
Crooked ab mouth	072586		75	95.4	209	53.7
Crooked ab mouth	072686		90	102	472	130
Crooked ab mouth	072786		90	82.3	660	147
Crooked ab mouth	072886		100	85.7	479	111
Crooked ab mouth	072986		55	88.7	339	81.2
Crooked ab mouth	073086		25	56	255	38.6
Crooked ab mouth	073186		25	50.9		
Crooked ab mouth	080186		34	46		
Crooked ab mouth	080286		33	45.8		
Crooked ab mouth	080386		55	64.5		
Crooked ab mouth	080486		55	123		

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Crooked ab mouth	080586		32	59.5		
Crooked ab mouth	082186	1400	24	16.5	71.7	3.2
Crooked ab mouth	082286		32	88.8		
Crooked ab mouth	082386		39	104		
Crooked ab mouth	082486		23	50.0		
Crooked ab mouth	090986	1310	120	255	114	78.5
Crooked ab mouth	091086		90	69.6		
Crooked ab mouth	091186		95	69.2		
Crooked ab mouth	091286		85	72		
Crooked ab mouth	091386		75	46.7		
Crooked ab mouth	091486		85	68.5		
Crooked ab mouth	091586		90	60.8		
Crooked ab mouth	091686		85	50.6		
Crooked ab mouth	091786		110	66.2		
Crooked ab mouth	091886		70	43.3		
Crooked ab mouth	091986		65	35.8		
Crooked ab mouth	092086		75	43.4		
Crooked ab mouth	092186		95	69.4		
Crooked ab mouth	092286		90	70.1		
Crooked ab mouth	092386		90	60.9		
Crooked ab mouth	092486		100	70.6		
Crooked ab mouth	092586	1400	65	66.5	115	20.6
Mammoth at Steese	052386		65	438	39.9	47.2
Mammoth at Steese	052386	1135	40			
Mammoth at Steese	052486		70	551	31.4	46.7
Mammoth at Steese	052586		110	886	35.8	85.6
Mammoth at Steese	052686		95	649	39.8	69.7
Mammoth at Steese	052786		120	898	37.0	89.7
Mammoth at Steese	052886		120	765	29.0	59.8
Mammoth at Steese	052986		170	1001	28.7	77.7
Mammoth at Steese	053086		190	1228	43.6	144.6
Mammoth at Steese	060186		450	2397	95.2	616.3
Mammoth at Steese	060286		350	1443	106.8	416.1
Mammoth at Steese	060386		280	720	94.5	183.7
Mammoth at Steese	060486		330	939	81.7	207.0
Mammoth at Steese	060586		600	2400	94.2	610.3
Mammoth at Steese	060586	1750	950	3180		
Mammoth at Steese	060686		55	215	108.1	62.7
Mammoth at Steese	060786		120	560	85.9	129.8
Mammoth at Steese	060886		140	598	87.9	142.0
Mammoth at Steese	060986		170	500	109.5	147.9
Mammoth at Steese	061086		370	1320	83.1	296.3
Mammoth at Steese	061186		370	787	58.4	124.1
Mammoth at Steese	061286		270	1090	130.4	383.9
Mammoth at Steese	061386		250	577	91.1	141.9
Mammoth at Steese	061486		290	479	55.9	72.2

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Mammoth at Steese	061586		200	346	36.8	34.4
Mammoth at Steese	061686		550	955	24.2	62.5
Mammoth at Steese	061686	1730	180	207		
Mammoth at Steese	061786		180	238	15.9	10.2
Mammoth at Steese	061886		270	204	15.9	8.8
Mammoth at Steese	061986		340	750	94.4	191
Mammoth at Steese	062086		110	426	134.4	155
Mammoth at Steese	062186		450	1200	135.3	438
Mammoth at Steese	062286		110	314	97.5	82.7
Mammoth at Steese	062386		100	519	142.2	199
Mammoth at Steese	062386	1305	150	620		
Mammoth at Steese	062486		85	628	156.2	265
Mammoth at Steese	062586		50	160	93.8	40.5
Mammoth at Steese	062586	1400	70			
Mammoth at Steese	062686		110	114	62.4	24.3
Mammoth at Steese	062786		140	150	52.8	21.4
Mammoth at Steese	062886		130	159	45.0	19.3
Mammoth at Steese	062986		75	82.8	36.1	8.1
Mammoth at Steese	063086		280	233	36.1	22.7
Mammoth at Steese	070186		230	449	118.5	144
Mammoth at Steese	070286		130	201	91.0	49.4
Mammoth at Steese	070386		230	245	60.9	40.3
Mammoth at Steese	070486		300	329	44.1	39.2
Mammoth at Steese	070586		270	205	38.9	21.5
Mammoth at Steese	070686		280	192	35.3	18.3
Mammoth at Steese	070786		270	169	30.8	14.1
Mammoth at Steese	070886		220	143	62.1	24.0
Mammoth at Steese	070886	1445	180	89		
Mammoth at Steese	070986		160	478	70.6	91.1
Mammoth at Steese	070986	0930	140			
Mammoth at Steese	070986	1730	150			
Mammoth at Steese	071086		150	314	50.5	42.8
Mammoth at Steese	071086	1045	110			
Mammoth at Steese	071186		140	244	41.6	27.4
Mammoth at Steese	071286		100	298	44.5	35.8
Mammoth at Steese	071386		75	116	39.0	12.2
Mammoth at Steese	071486		40	61	33.9	5.6
Mammoth at Steese	071586		130	84.9	32.6	7.5
Mammoth at Steese	071686		210	128	29.3	10.1
Mammoth at Steese	071786		260	159	27.3	11.7
Mammoth at Steese	071886		250	142	23.9	9.2
Mammoth at Steese	071986		130	64.5	22.6	3.9
Mammoth at Steese	072086		100	104	29.6	8.3
Mammoth at Steese	072186		190	281	47.8	36.3
Mammoth at Steese	072286		280	357	43.8	42.2
Mammoth at Steese	072386		310	247	37.9	25.3
Mammoth at Steese	072386	1420	250	196		

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Mammoth at Steese	072486		290	243	31.1	20.4
Mammoth at Steese	072586		250	174	29.3	13.8
Mammoth at Steese	072686		110	107	32.7	9.4
Mammoth at Steese	072786		90	179	38.5	18.6
Mammoth at Steese	072886		110	126	39.3	13.4
Mammoth at Steese	072986		240	208	35.0	19.7
Mammoth at Steese	073086		310	217	31.0	18.2
Mammoth at Steese	073186		250	185	28.9	14.4
Mammoth at Steese	080186		210	152	25.5	10.5
Mammoth at Steese	080286		150	110	24.6	7.3
Mammoth at Steese	080386		140	83.4	24.7	5.6
Mammoth at Steese	080486		180	173	23.8	11.1
Mammoth at Steese	080586		200	193	20.7	10.8
Mammoth at Steese	080686		220	197	20.4	10.8
Mammoth at Steese	080786		220	187	19.7	9.9
Mammoth at Steese	080886		220	192	18.9	9.8
Mammoth at Steese	080986		240	187	19.2	9.7
Mammoth at Steese	081086		260	221	18.4	11.0
Mammoth at Steese	081186		250	169	18.1	8.3
Mammoth at Steese	081286		320	234	16.4	10.3
Mammoth at Steese	081386		310	240	14.8	9.6
Mammoth at Steese	081486		320	264	16.5	11.7
Mammoth at Steese	081586		220	175	12.3	5.8
Mammoth at Steese	081686		180	131	10.5	3.7
Mammoth at Steese	081786		160	115	11.9	3.7
Mammoth at Steese	081886		240	186	11.7	5.9
Mammoth at Steese	081986		250	185	10.4	5.2
Mammoth at Steese	082086		210	164	10.9	4.8
Mammoth at Steese	082086	1430	180	143		
Mammoth at Steese	082186		250	203	14.2	7.8
Mammoth at Steese	082286		250	207	19.5	10.9
Mammoth at Steese	082386		310	295	25.3	20.2
Mammoth at Steese	082486		310	314	25.1	21.3
Mammoth at Steese	082586		320	289	24.2	18.9
Mammoth at Steese	082686		400	348	23.2	21.8
Mammoth at Steese	082786		380	308	22.7	18.9
Mammoth at Steese	082886		340	262	26.4	18.7
Mammoth at Steese	082986		450	457	54.0	66.6
Mammoth at Steese	083086		500	4360	53.0	624
Mammoth at Steese	083186		230	1160	41.1	129
Mammoth at Steese	090186		260	641	34.9	60.4
Mammoth at Steese	090286		280	551	29.0	43.2
Mammoth at Steese	090386		190	439	29.5	35.0
Mammoth at Steese	090486		160	372	23.1	23.2
Mammoth at Steese	090586		310	695	22.0	41.4
Mammoth at Steese	090686		400	563	21.0	32.0
Mammoth at Steese	090786		650	795	21.6	46.3

Appendix A (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Discharge (cfs)	Sediment load (tpd)
Mammoth at Steese	090886		550	591	24.4	38.9
Mammoth at Steese	090886		270	296		
Mammoth at Steese	090886	1600	240	241		
Mammoth at Steese	090986		550	955	26.0	67.0
Mammoth at Steese	091086		340	465	25.3	31.7
Mammoth at Steese	09 1086	1035	270			
Mammoth at Steese	091186		550	989	26.3	70.3
Mammoth at Steese	091286		700	825	26.5	59.0
Mammoth at Steese	09 1386		600	891	20.6	49.6
Mammoth at Steese	091486		650	580	21.0	32.9
Mammoth at Steese	09 1586		400	796	25.0	53.7
Mammoth at Steese	091686		160	205	29.5	16.3
Mammoth at Steese	091786		85	131	32.0	11.3
Mammoth at Steese	091886		110	164	33.4	14.8
Mammoth at Steese	091986		330	753	35.5	72.2
Mammoth at Steese	092086		350	802	36.4	78.9
Mammoth at Steese	092186		550	934	29.8	75.3
Mammoth at Steese	092286		650	1090	29.8	87.6
Mammoth at Steese	09 2386		750	1630	27.6	121
Mammoth at Steese	092486		1300	3360	26.5	240
Mammoth at Steese	092586	1650	2300	4070	22.1	243

Appendix B. Data from non-automatic monitoring sites, Birch Creek drainage.

Location	Date	Time	Turbidity (NTU)	Discharge (cfs)
Birch ab CC	062586	1215	50	
Birch ab CC	070986	1300	4.6	
Birch ab CC	082186	1455	2.3	
Birch ab CC	090986	1640	4.5	
Birch ab CC	092586	1420	50	
Albert at Steese	060686	1335	1.3	21.7
Albert at Steese	061786	1650	2.6	42.7
Albert at Steese	062386	1647	65	336
Albert at Steese	062486	1215	50	237
Albert at Steese	062486	1735		213
Albert at Steese	062586	0945	5.2	168
Albert at Steese	070886	1720	1.5	9.07
Albert at Steese	070986	1035	16	47.7
Albert at Steese	070986	1625	110	112
Albert at Steese	071086	0910	24	154
Albert at Steese	072386	1855	2.0	14.6
Albert at Steese	072886	1955	0.7	22.4
Albert at Steese	073186	0847	0.7	9.07
Albert at Steese	080186	0850	0.6	7.19
Albert at Steese	082086	1644		no flow
Albert at Steese	090886	1715	1.3	17.4
Albert at Steese	090986	0910	25	52.9
Albert at Steese	091086	0940	6.2	47.7
Albert at Steese	092586	1500	1.7	10.3
Bedrock at cg	052386	1330	1.1	ice
Bedrock at cg	060586	1820	2.3	16.4
Bedrock at cg	060686	1408	3.1	8.75
Bedrock at cg	061686	1818	2.4	2.10
Bedrock at cg	061886	1300	0.6	1.89
Bedrock at cg	062386	1630	1.8	22.3
Bedrock at cg	062586	1355	0.9	7.77
Bedrock at cg	070886	1520	1.5	2.21
Bedrock at cg	070986	0935	7.1	45.5
Bedrock at cg	070986	1740	8.3	63.8
Bedrock at cg	071086	1040	2.3	33.8
Bedrock at cg	072386	1915	0.5	3.58
Bedrock at cg	072886	1755	0.5	6.33
Bedrock at cg	073186	0936	0.5	3.42
Bedrock at cg	080186	0921	0.3	2.83
Bedrock at cg	082086	1530	1.0	0.72
Bedrock at cg	082186	1630	1.0	0.87
Bedrock at cg	090886	1650	0.4	4.11
Bedrock at cg	091086	1025	2.1	6.33
Bedrock at cg	092586	1210	1.1	2.97

Appendix B (con.)

Location	Date	Time	Turbidity (NTU)	Discharge (cfs)
Crooked at Cen	052386	1430	55	114
Crooked at Cen	060586	1933	65	186
Crooked at Cen	060686	0955	220	249
Crooked at Cen	060686	1345		221
Crooked at Cen	061686	1910	80	83.6
Crooked at Cen	061786	0830	37	54.8
Crooked at Cen	061786	1810		61.0
Crooked at Cen	061886	0920	100	57.2
Crooked at Cen	062386	1640	190	514
Crooked at Cen	062486	1025	190	536
Crooked at Cen	062486	1740		433
Crooked at Cen	062586	0935	55	293
Crooked at Cen	070886	1710	230	61.0
Crooked at Cen	070986	1025	130	325
Crooked at Cen	070986	1704	160	433
Crooked at Cen	071086	0900	140	278
Crooked at Cen	072386	1903	300	85.2
Crooked at Cen	072886	1810	27	119
Crooked at Cen	072986	0858	70	101
Crooked at Cen	073086	0850	150	85.2
Crooked at Cen	073186	0855	150	63.6
Crooked at Cen	080186	0855	70	63.3
Crooked at Cen	080386	1500		46.6
Crooked at Cen	082086	1655	95	17.2
Crooked at Cen	082186	1546	120	21.3
Crooked at Cen	090886	1705	150	50.0
Crooked at Cen	090986	1725	220	80.6
Crooked at Cen	091086	0950	140	85.2
Crooked at Cen	092586	1510	650	44.5
Deadwood at CHSR	052386	1410	180	169
Deadwood at CHSR	060586	1940	110	44.0
Deadwood at CHSR	060686	0945	40	38.7
Deadwood at CHSR	061686	1900	9.0	11.9
Deadwood at CHSR	061786	1840	14	9.69
Deadwood at CHSR	061886	0930	7.8	7.81
Deadwood at CHSR	062386	1700	70	60.8
Deadwood at CHSR	062486	1000	27	71.5
Deadwood at CHSR	062586	0930	25	37.5
Deadwood at CHSR	070886	1700	3.6	6.96
Deadwood at CHSR	070986	1010	6.8	10.7
Deadwood at CHSR	070986	1815	80	12.4
Deadwood at CHSR	071086	0950	14	24.6
Deadwood at CHSR	072386	1622	100	20.2
Deadwood at CHSR	072886	1815	2G	23.6
Deadwood at CHSR	072986	0850	70	20.2
Deadwood at CHSR	073086	0840	80	13.0

Appendix B (con.)

Location	Date	Time	Turbidity (NTU)	Discharge (cfs)
Deadwood at CHSR	073186	0836	110	19.4
Deadwood at CHSR	080186	0838	90	9.69
Deadwood at CHSR	080386	1455	8.8	3.90
Deadwood at CHSR	082086	1740	31	2.89
Deadwood at CHSR	082186	1600	24	3.90
Deadwood at CHSR	090886	1750	21	3.90
Deadwood at CHSR	090986	1745	55	8.72
Deadwood at CHSR	09 1086	1005	95	7.38
Deadwood at CHSR	092586	1530	390	6.96
Ketchem at CHSR	052386	1400	160	3.90
Ketchem at CHSR	060586	1947	160	8.14
Ketchem at CHSR	060686	0940	120	12.0
Ketchem at CHSR	061686	1855	140	0.95
Ketchem at CHSR	061786	1835	80	1.32
Ketchem at CHSR	061886	0955	140	0.51
Ketchem at CHSR	062386	1705	90	46.8
Ketchem at CHSR	062486	0955	100	36.6
Ketchem at CHSR	062586	0920	130	21.1
Ketchem at CHSR	070886	1655	160	2.25
Ketchem at CHSR	070986	1005	140	3.41
Ketchem at CHSR	070986	1810	130	4.43
Ketchem at CHSR	071086	0930	90	3.41
Ketchem at CHSR	072386	1615	95	4.43
Ketchem at CHSR	072886	1820	110	8.62
Ketchem at CHSR	072986	0845	100	9.12
Ketchem at CHSR	073086	0830	150	5.70
Ketchem at CHSR	073186	0830	130	4.43
Ketchem at CHSR	080186	0830	170	2.98
Ketchem at CHSR	080386	1450		1.32
Ketchem at CHSR	082086	1730	200	0.88
Ketchem at CHSR	082186	1555	200	1.32
Ketchem at CHSR	090886	1730	1000	1.22
Ketchem at CHSR	090986	1740	1200	3.90
Ketchem at CHSR	091086	1000	800	2.98
Ketchem at CHSR	092586	1525	160	2.25
Porcupine ab mth	052386	1320	55	40.0
Porcupine ab mth	060586	1740	65	79.0
Porcupine ab mth	061886	1310	28	24.2
Porcupine ab mth	062586	1405	50	82.0
Porcupine ab mth	070886	1425	26	12.6
Porcupine ab mth	070986	0920	190	22.9
Porcupine ab mth	070986	1725	70	44.0
Porcupine ab mth	071086	1052	90	38.1
Porcupine ab mth	072386	1930	500	19.0
Porcupine ab mth	072886	1710	14	51.5

Appendix B (con.)

Location	Date	Time	Turbidity (NTU)	Discharge (cfs)
Porcupine ab mth	073086	1435	12	21.5
Porcupine ab mth	073186		65	4.15
Porcupine ab mth	080186	1205	100	17.8
Porcupine ab mth	082086	1500	5.6	7.49
Porcupine ab mth	082186	1645	13	9.66
Porcupine ab mth	090886	1635	60	16.2
Porcupine ab mth	091086	1115	120	45.0
Porcupine ab mth	092586	1715	1400	20.9

Appendix C. Settleable solids data from all sources by site.

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Birch ab 12mile	060586	1630	310		1.1
Birch ab 12mile	061686	1448	160	211	tr
Birch ab 12mile	062586	1520	200	390	0.22
Birch ab 12mile	070886	1250	240	137	tr
Birch ab 12mile	072386	1250	40	38.2	tr
Birch ab 12mile	082086	1245	290	214	tr
Birch ab 12mile	091086	1215	330	291	tr
Birch ab 12mile	092586	1800	60	145	0.05
Birch ab CC	062586	1215	50		0.4
Birch ab CC	070986	1300	4.6		nd
Birch ab CC	082186	1455	2.3		nd
Birch ab CC	090986	1640	4.5		nd
Birch at bridge	052386	1500	14		nd
Birch at bridge	060386		90	264	0.55
Birch at bridge	060386		85	235	0.6
Birch at bridge	060686	1040	20		0.05
Birch at bridge	061786	1555	14		tr
Birch at bridge	062486	1300	130	1060	2.0
Birch at bridge	062586	1045	80	584	0.8
Birch at bridge	070986	1350	9.1	23	tr
Birch at bridge	072386	1710	23	272	tr
Birch at bridge	082186	1015	6.3	3.78	nd
Birch at bridge	090986	1115			nd
Birch ab clums f	062486	1500	95	311	0.35
Birch ab harriss	062486	1500	95	310	0.2
Birch at butte	062486	1300	350	889	0.7
Birch at harring	062486	1345	140	392	0.4
Butte ab mth	062486	1300	270	1570	2.0
Eagle at glddust	062486	1300	450	962	0.7
Gold Dust ab mth	062486	1300	140	472	0.4
Harrison ab mth	062486	1500	50	251	0.3
Indepndnce a GAM	072986	1255	0.8	3.44	nd
Indepndnce a GAM	073086	0915	0.9	12.6	tr
Indepndnce a GAM	073086	1258	0.4	0.85	tr
Indepndnce a GAM	073186	0908	0.4	0.9	nd

Appendix C (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Indepndnce a GAM	073186	1300	0.3	1.05	tr
Indepndnce a GAM	073186	1700	0.5	0.63	tr
Indepndnce a GAM	080186	0900	0.3	0.75	nd
Indepndnce a GAM	080186	1300	0.7	1.79	nd
Indepndnce a GAM	080386	1540	0.7	4.45	
Indepndnce b GAM	073086	0935	50	41	tr
Indepndnce b GAM	073086	1307	37	32.1	tr
Indepndnce b GAM	073086	1713	370	469	tr
Indepndnce b GAM	073186	0916	65	46	tr
Indepndnce b GAM	073186	1307	70	71.7	tr
Indepndnce b GAM	073186	1709	420	480	tr
Indepndnce b GAM	080186	0907	90	66.1	tr
Indepndnce b may	073186	1105	55	89.1	tr
Indepndnce b may	073186	1346	33	29.3	tr
Indepndnce b may	073186	1745	55	70	tr
Indepndnce b may	080186	0945	37	27.3	tr
Indepndnce b may	080186	1345	900	1610	
Indepndnce a mth	072986	1548	3.7	5.94	tr
Indepndnce a mth	073086	1124	31	14.3	nd
Indepndnce a mth	073086	1502	380	397	0.1
Indepndnce a mth	073086	1859	45	43.4	tr
Indepndnce a mth	073186	1102	130	160	0.08
Indepndnce a mth	073186	1502	20	20	nd
Indepndnce a mth	073186	1902	55	57.5	tr
Indepndnce a mth	080186	1100	33	29.6	tr
Indepndnce a mth	080186	1503	1000	1590	2.0
Mastodon a mth	072986	1548	2.1	5	tr
Mastodon a mth	073086	1127	2.1	4.69	tr
Mastodon a mth	073086	1500	2.7	5.11	nd
Mastodon a mth	073086	1903	2.7	2.25	nd
Mastodon a mth	073186	1104	2.1	2.46	nd
Mastodon a mth	073186	1525	2.4	2.08	tr
Mastodon a mth	073186	1903	2.2	4.39	tr
Mastodon a mth	080186	1102	2.4	4.16	nd
Mastodon a mth	080186	1504	2.1	2.08	tr
Mammoth at head	072986	1548	3.2	9.01	tr
Mammoth at head	073086	1125	14	18.3	tr
Mammoth at head	073086	1459	210	245	tr
Mammoth at head	073086	1900	34	31.8	tr
Mammoth at head	073186	1102	80	124	tr
Mammoth at head	073186	1500	19	24.8	tr
Mammoth at head	073186	1901	33	32.8	tr

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Mammoth at head	080186	1100	25	20.6	tr
Mammoth at head	080186	1507	700	926	1.0
Mammoth ab 1 eff	072986	1750	9.1	7.73	0.05
Mammoth ab 1 eff	073086	1203	9.0	18	tr
Mammoth ab 1 eff	073086	1538	150	194	0.05
Mammoth ab 1 eff	073086	1945	10	10.2	tr
Mammoth ab 1 eff	073186	1538	45	103	0.05
Mammoth ab 1 eff	073186	1936	110	418	0.4
Mammoth ab 1 eff	080186	1136	11	14	tr
Mammoth ab 1 eff	080186	1520	310	57.6	.55
Loud effluent	0 73086	1202	450	261	tr
Loud effluent	073086	1534	500	171	tr
Loud effluent	0 73086	1941	450	153	nd
Loud effluent	073186	1130	330	102	tr
Loud effluent	073186	1534	310	81.9	nd
Loud effluent	073186	1932	260	63.8	tr
Loud effluent	080186	1139	190	52.9	tr
Loud effluent	080186	1523	190	52.2	tr
AV diversion	072986	1548	13	14.7	tr
AV diversion	073086	1208	9.5	7.06	tr
AV diversion	073086	1537	170	151	tr
AV diversion	073086	1945	17	12.4	tr
AV diversion	073186	1135	35	40.1	tr
AV diversion	073186	1538	36	72.5	0.05
AV diversion	073 186	1936	37	91.6	0.05
AV diversion	080186	1141	16	15.8	tr
AV diversion	080186	1520	290	556	0.6
Mammoth b AV div	073086	1208	26	24.1	tr
Mammoth b AV div	073086	1534	120	142	tr
Mammoth b AV div	073086	1943	23	21	tr
Mammoth b AV div	073186	1132	38	46.5	tr
Mammoth b AV div	073186	1536	40	116	0.05
Mammoth b AV div	073186	1932	26	57.1	0.05
Mammoth b AV div	080186	1136	21	18.1	tr
Mammoth b AV div	080186	1518	280	498	0.5
AV eff ab rd	073086	1300	2500	8640	13
AV eff ab rd	073086	1800	3800	14100	27
AV eff ab rd	073 186	0900			4.2
AV eff ab rd	073186	1220	7380	18500	49
AV eff ab rd	073186	1620	3590	9680	28
AV eff ab rd	080186	1230	6980	19500	41

Appendix C (con.>

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Miller ab rd	073086	1230	0.6	2.7	nd
Miller ab rd	073086	1800	0.5	1.21	nd
Miller ab rd	073186	0855	0.4	0.86	tr
Miller ab rd	073186	1620	0.5	0.32	nd
Miller ab rd	080186	0850	0.6	0.36	nd
Miller ab rd	080186	1230	0.5	0.45	nd
Miller #2	062486		39	148	0.05
AV eff b pond	073086	0940	450	337	0.05
AV eff b pond	073086	1330	500	386	tr
AV eff b pond	073086	1805	600	526	tr
AV eff b pond	073186	0915	360	276	tr
AV eff b pond	073186	1245	420	334	tr
AV eff b pond	073186	1630	550	477	tr
AV eff b pond	080186	0912	290	212	tr
AV eff b pond	080186	1255	260	215	tr
AV eff a Mammoth	073086	1030	430	309	tr
AV eff a Mammoth	073086	1350	500	375	0.05
AV eff a Mammoth	073086	1825	550	430	tr
AV eff a Mammoth	073186	0945	350	235	tr
AV eff a Mammoth	073186	1320	390	277	tr
AV eff a Mammoth	073186	1705	390	287	tr
AV eff a Mammoth	080186	0935	230	163	tr
Mammoth ab AVeff	073086	1045	85	48.5	tr
Mammoth ab AVeff	073086	1350	70	36.8	tr
Mammoth ab AVeff	073086	1825	150	108	tr
Mammoth ab AVeff	073186	0945	75	40.1	tr
Mammoth ab AVeff	073186	1310	70	46.5	tr
Mammoth ab AVeff	073186	1705	50	38.9	tr
Mammoth ab AVeff	080186	1005	55	27.3	tr
Mammoth ab AVeff	080186	1315	45	24.6	tr
Mammoth b AV eff	073086	1115	300	197	tr
Mammoth b AV eff	073086	1400	330	220	tr
Mammoth b AV eff	073086	1830	410	296	tr
Mammoth b AV eff	073186	0950	240	152	tr
Mammoth b AV eff	073186	1340	230	170	tr
Mammoth b AV eff	073186	1700	250	203	tr
Mammoth b AV eff	080186	0940	140	112	tr
Mammoth b AV eff	080186	1325	140	112	tr
dugas b sluice	073086	0950	950	3900	3.5
dugas b sluice	073086	1330	18900	36400	82
dugas b sluice	073086	1805	14600	34000	97

Appendix C (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
dugas b sluice	073186	0910	17100	33600	92
dugas b sluice	073186	1245	17900	35400	98
dugas b sluice	073186	1635	16800	33000	120
dugas b sluice	080186	0915	12900	27000	69
dugas b sluice	080186	1355	13100	37500	80
Dugas eff ab mam	073086	1350	550	319	tr
Dugas eff ab mam	073086	1805	600	422	tr
Dugas eff ab mam	073186	1025	550	308	tr
Dugas eff ab mam	073186	1400	650	458	tr
Dugas eff ab mam	080186	1005	550	247	tr
Dugas eff ab mam	080186	1400	400	256	tr
Mammoth ab Dugas	073086	1335	210	136	tr
Mammoth ab Dugas	073086	1805	290	273	0.05
Mammoth ab Dugas	073186	1800	220	177	tr
Mammoth at Steese	052386	1135	40		0.1
Mammoth at Steese	060386		200		1.1
Mammoth at Steese	060386		250	777	1.0
Mammoth at Steese	060586	1750	950	3180	3.5
Mammoth at Steese	061686	1730	180	207	0.1
Mammoth at Steese	062386	1305	150	620	0.8
Mammoth at Steese	062586	1400	70		0.05
Mammoth at Steese	070886	1445	180	89	tr
Mammoth at Steese	070986	0930	140		tr
Mammoth at Steese	070986	1730	150		0.1
Mammoth at Steese	071086	1045	110		0.2
Mammoth at Steese	072386	1420	250	196	tr
Mammoth at Steese	073086	1430	300	204	tr
Mammoth at Steese	073086	1830	310	213	tr
Mammoth at Steese	073186	1030	240	152	tr
Mammoth at Steese	073186	1430	240	162	tr
Mammoth at Steese	073186	2230	240	235	tr
Mammoth at Steese	080186	0230	240	166	tr
Mammoth at Steese	080186	0630	210	149	tr
Mammoth at Steese	080186	1030	170	118	tr
Mammoth at Steese	082086	1430	180	143	tr
Mammoth at Steese	090886	1600	240	241	tr
Mammoth at Steese	091086	1035	270		0.05
Mammoth at Steese	092586	1650	2300	4070	6.7
Mammoth #3	062486	1438	38	208	0.1
Mammoth #5	062486	1438	40	134	0.1

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Porcupine ab mth	052386	1320	55		0.1
Porcupine ab mth	060386		70	191	0.3
Porcupine ab mth	060386		80	206	0.4
Porcupine ab mth	060586	1740	65		0.3
Porcupine ab mth	060686	1540	120		0.3
Porcupine ab mth	061786	0830	70	134	tr
Porcupine ab mth	062586	1405	50		
Porcupine ab mth	070886	1425	26		nd
Porcupine ab mth	070986	0920	190		tr
Porcupine ab mth	070986	1725	70		0.1
Porcupine ab mth	071086	1052	90		tr
Porcupine ab mth	072386	1930	500		0.10
Porcupine ab mth	082086	1500	5.6		nd
Porcupine ab mth	082186	1645	13		tr
Porcupine ab mth	090886	1635	60		tr
Porcupine ab mth	091086	1115	120		0.5
Porcupine ab mth	092586	1715	1400		0.1
Bedrock at cg	060386		0.6	3.6	nd
Bedrock at cg	060386		1.5	0.8	nd
Bedrock at cg	052386	1330	1.1		nd
Bedrock at cg	060586	1820	2.3		tr
Bedrock at cg	061686	1818	2.4		nd
Bedrock at cg	061886	1300	0.6		nd
Bedrock at cg	070886	1520	1.5		nd
Bedrock at cg	070986	0935	7.1		tr
Bedrock at cg	070986	1740	8.3		.05
Bedrock at cg	071086	1040	2.3		tr
Bedrock at cg	072386	1915	0.5		nd
Bedrock at cg	082086	1530	1.0		nd
Bedrock at cg	082186	1630	1.0		tr
Bedrock at cg	090886	1650	0.4		nd
Bedrock at cg	091086	1025	2.1		nd
Boulder at gage	060386		3.6	11.2	nd
Boulder at gage	060386		3.6	9.9	nd
Boulder at gage	060586	1927	3.4		tr
Boulder at gage	062486	1755	3.3	13.2	tr
Boulder at gage	070886	1555	0.7	1.95	nd
Boulder at gage	070986	0950	4.9		nd
Boulder at gage	070986	1750	16		0.15
Boulder at gage	071086	1030	2.3		tr
Boulder at gage	072386	1530	1.4	5.44	tr
Boulder at gage	082086	1600	0.6	0.81	nd
Boulder at gage	090986	1820	1.0	1.28	nd

Appendix C (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Crooked at Cen	052386	1430	55		nd
Crooked at Cen	060386		85	151	0.2
Crooked at Cen	060386		110	165	0.1
Crooked at Cen	060586	1933	65		tr
Crooked at Cen	060686	0955	220		0.45
Crooked at Cen	061686	1910	80		tr
Crooked at Cen	061786	0830	37		tr
Crooked at Cen	061886	0920	100		tr
Crooked at Cen	062386	1640	190		1.5
Crooked at Cen	062486	1025	190		1.3
Crooked at Cen	062586	0935	55		0.3
Crooked at Cen	070886	1710	230		tr
Crooked at Cen	070986	1025	130		0.3
Crooked at Cen	070986	1704	160		0.4
Crooked at Cen	071086	0900	140		0.15
Crooked at Cen	072386	1903	300		tr
Crooked at Cen	082086	1655	95		nd
Crooked at Cen	082186	1546	120		tr
Crooked at Cen	090886	1705	150		tr
Crooked at Cen	090986	1725	220		0.1
Crooked at Cen	091086	0950	140		0.05
Crooked at Cen	092586	1510	650		0.05
Deadwood at CHSR	052386	1410	180		0.8
Deadwood at CHSR	060386		65	190	0.6
Deadwood at CHSR	060386		60	391	0.65
Deadwood at CHSR	060586	1940	110		0.5
Deadwood at CHSR	060686	0945	40		0.15
Deadwood at CHSR	061686	1900	9.0		tr
Deadwood at CHSR	061786	1840	14		tr
Deadwood at CHSR	062386	1700	70		0.4
Deadwood at CHSR	062486	1000	27		0.1
Deadwood at CHSR	062586	0930	25		0.1
Deadwood at CHSR	070886	1700	3.6		tr
Deadwood at CHSR	070986	1010	6.8		nd
Deadwood at CHSR	070986	1815	80		.05
Deadwood at CHSR	071086	0950	14		0.05
Deadwood at CHSR	072386	1622	100		tr
Deadwood at CHSR	082086	1740	31		tr
Deadwood at CHSR	082186	1600	24		nd
Deadwood at CHSR	090886	1750	21		nd
Deadwood at CHSR	090986	1745	55		tr
Deadwood at CHSR	091086	1005	95		tr
Deadwood at CHSR	092586	1530	390		tr
Deadwood ab mine	060386		60	301	0.75
Deadwood ab mine	060386		60	376	0.8

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Ketchem a CHSR	052386	1400	160		0.6
Ketchem a CHSR	060386		95	335	0.6
Ketchem a CHSR	060386		90	333	0.5
Ketchem a CHSR	060586	1947	160		0.1
Ketchem a CHSR	060686	0940	120		0.2
Ketchem a CHSR	061686	1855	140		tr
Ketchem a CHSR	061786	1835	80		nd
Ketchem a CHSR	061886	0955	140		nd
Ketchem a CHSR	062386	1705	90		0.3
Ketchem a CHSR	062486	0955	100		0.25
Ketchem a CHSR	062586	0920	130		0.2
Ketchem a CHSR	070886	1655	160		tr
Ketchem a CHSR	070986	1005	140		tr
Ketchem a CHSR	070986	1810	130		tr
Ketchem a CHSR	071086	0930	90		0.05
Ketchem a CHSR	072386	1615	95		tr
Ketchem a CHSR	082086	1730	200		tr
Ketchem a CHSR	082186	1555	200		tr
Ketchem a CHSR	090886	1730	1000		tr
Ketchem a CHSR	090986	1740	1200		tr
Ketchem a CHSR	091086	1000	800		tr
Ketchem a CHSR	092586	1525	160		tr
Portage a Mdcn Lk	062486	1000	65	119	tr
Albert at Steese	060686	1335	1.3		nd
Albert at Steese	061786	1650	2.6		nd
Albert at Steese	062386	1647	65		0.15
Albert at Steese	062486	1215	50		0.1
Albert at Steese	062586	0945	5.2		0.15
Albert at Steese	070886	1720	1.5		nd
Albert at Steese	070986	1035	16		tr
Albert at Steese	070986	1625	110		0.5
Albert at Steese	071086	0910	24		0.3
Albert at Steese	072386	1855	2.0		nd
Albert at Steese	090886	1715	1.3		tr
Albert at Steese	090986	0910	25		0.1
Albert at Steese	091086	0940	6.2		tr
Crooked ab mouth	052386	1650	25		nd
Crooked ab mouth	060686	1250	75		tr
Crooked ab mouth	061786	1045	34		tr
Crooked ab mouth	062586	1135	120	590	0.65
Crooked ab mouth	070986	1100	36	87.5	0.1
Crooked ab mouth	072386	1800	65	80.6	tr
Crooked ab mouth	082186	1400	24	16.5	nd
Crooked ab mouth	090986	1310	120	255	tr

Appendix C (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Chena river 1	052086	1417	8.8	114	0.3
Chena river 2	052086	1510	5.7	17.5	0.05
Cripple Creek	052086	1516	50	233	0.5
Little Chena	052086	1415	14	64.9	0.2
Livengood Creek	052086	1125	170	524	0.55
Tatalina river	052086	1205	1.4	3.6	tr
Tolovana river	052086	1145	1.9	9.8	tr
Tolovana river2	052086	1035	9.3	24.8	0.05
WF Tolovana r.	052086	1002	1.6	6	tr
First Chance	090586		7.3	6.8	tr
Flume a steese	090586		2.5	2.38	nd
Gilmore a trk st	090586		1100	722	tr
Gilmore Creek	052086	1345	75	98.8	0.15
Goldstream a br	090586		180	129	0.05
Goldstream a gsr	090586		330	261	0.1
Goldstream a scr	090586		31	36.2	tr
Goldstream a she	090586		120	64	tr
Goldstream Creek	052086	1350	210	524	1.1
Pedro a 1st chnc	090586		330	201	tr
Pedro a gld pan	090586		110	84	nd
Steamboat a stee	090586		26	282	0.3
McManus Cr	060686		1.4	11.4	tr
Deep ab Dale	060686		1.7	2.63	nd
Deep at Faith	060686		120	351	0.25

Appendix C (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Deep lmi us	060686		100	613	0.8
Deep at fcr	060686		140	832	1.1
Faith a low rd	060686		18	88.6	0.05
Faith ab deep cr	060686		18	85.4	0.05
Faith b deep cr	060686		13	90.7	tr
Faith at rd cross	060286		40	151	0.25
Faith at rd cross	060286		35	147	0.1
Faith at Steese	052386	1930	110		1.0
Faith at Steese	060286		70	306	0.5
Faith at Steese	070886	1123	26		tr
Faith at Steese	072386	2031	60		0.05
Faith at Steese	082186	1940			2.75
Faith at Steese	090886	1210	5.6		tr
Faith at Steese	091086	1535			tr
Faith at Steese	092586	1925	22	11.7	tr
Chatanika a 39m	052086	1320	5.1	32	0.1
Chatanika a 39m	060686		14	11.4	tr
Chatanika a 55m	060686		10	42.2	tr

Appendix D. Discharge data from automated sites, 1986.

Faith Creek above the Steese Highway

Discharge in cubic feet per second

Drainage area: 61.0

Extremes: maximum = 1580 minimum = 30.9

Average: 143

Day	June	July	August	September
1		59.8		165
2		51.1		159
3		58.2		159
4		49.8		154
5		44.5		144
6		45.2		133
7		39.6		
8		39.6		138
9		40.0		154
10		40.9		148
11		41.8		143
12		53.2		138
13		42.6		134
14		40.8		127
15		39.4		124
16	97.3	36.0		124
17	85.7	35.4		125
18	87.5	58.9		170
19	118	76.2		164
20	86.4	358	50	166
21	91.9	253	750	194
22	132	152	662	170
23	123	193	352	157
24	304		273	146
25	136		242	136
26	93.3		215	
27	76.1		199	
28	67.0		208	
29	57.2		205	
30	53.5		192	
31			176	
Month Avg	107	80.4	294	149

Mammoth Creek at the Steese Highway
Discharge in cubic feet per second
Drainage area: 41.5 mi^2
Extremes: maximum = 423 minimum = 9.19
Average: 43.6

Day	May	June	July	August	September
1		95.2	118	25.5	34.9
2		107	91.0	24.6	29.0
3		94.5	60.9	24.7	29.5
4		81.7	44.1	23.8	23.1
5		94.2	38.9	20.7	22.0
6		108	35.3	20.4	21.0
7		85.9	30.8	19.7	21.6
8		87.9	62.1	18.9	24.4
9		110	70.6	19.2	26.0
10		83.1	50.5	18.4	25.3
11		58.4	41.6	18.1	26.3
12		130	44.5	16.4	26.5
13		91.1	39.0	14.8	20.6
14		55.9	33.9	16.5	21.0
15		36.8	32.6	12.3	25.0
16		24.2	29.3	10.5	29.5
17		15.9	27.3	11.9	32.0
18		15.9	23.9	11.7	33.4
19		94.4	22.6	10.4	35.5
20		134	29.6	10.9	36.4
21		135	47.8	14.2	29.8
22		97.5	43.8	19.5	29.8
23	39.9	142	37.9	25.3	27.6
24	31.4	156	31.1	25.1	26.5
25	35.8	93.8	29.3	24.2	22.1
26	39.8	62.4	32.7	23.2	
27	37.0	52.8	38.5	22.7	
28	29.0	45.0	39.3	26.4	
29	28.7	36.1	35.0	54.0	
30	43.6	36.1	31.0	53.0	
31	69.8		28.9	41.1	
Month Avg	39.4	82.1	42.7	21.9	27.2

Appendix D (con.)

Birch Creek above Twelvemile Creek
Discharge in cubic feet per second
Drainage area: 85.4 mi^2
Extremes: maximum = 645 minimum = 24.3
Average: 118

Day	June	July	August	September
1		161	110	102
2		135	104	94.8
3		113	89.2	87.1
4		110	78.1	76.1
5	208	98.7	71.5	70.6
6	164	81.2	65.4	65.6
7	150	70.1	58.0	59.8
8	130	63.1	53.8	64.2
9	176	72.9	50.1	98.3
10	229	70.8	43.0	91.5
11	211	90.3	42.9	86.0
12	436	141	38.6	78.5
13	269	115	36.7	72.6
14	143	102	35.2	63.2
15	95.8	86.4	31.9	63.0
16	55.0	74.0	31.9	65.5
17	43.7	67.0	31.5	68.4
18	59.7	62.9	30.7	98.0
19	354	69.8	28.7	80.0
20	286	255	30.9	81.6
21	290	251	74.0	77.6
22	286	216	130	72.8
23	460	142	111	66.8
24	440	118	95.9	60.7
25	245	106	82.3	67.5
26	177	136	75.5	
27	145	235	72.1	
28	126	235	125	
29	106	148	142	
30	101	122	123	
31		112	114	
Month Avg	207	125	71.2	76.5

Crooked Creek above mouth
Discharge in cubic feet per second
Drainage area: 510 mi^2
Extremes: maximum = 2200 minimum = 71.5
Average: 561 - does not include flows observed in August and September

Day	June	July	August	September
1		726		
2		504		
3		390		
4		343		
5		289		
6		236		
7		200		
8		239		
9		467		114
10		600		
11		755		
12		632		
13		503		
14		413		
15		343		
16	279	295		
17	235	237		
18	635	196		
19	1590	242		
20	1290	1220		
21	899	769	71.7	
22	895	495		
23	1860	336		
24	1380	251		
25	793	209		115
26	578	472		
27	462	660		
28	384	479		
29	332	339		
30	523	255		
31				
Month Avg	809	436		

Appendix D (con.)

Birch Creek above Bridge

Discharge in cubic feet per second

Drainage area: 2150 mi^2

Extremes: maximum = 11100 minimum = 700

Average: 3125 - does not include flows observed in August and September

Day	June	July	August	September
1		1810		
2		4640		
3		2390		
4		1580		
5		1280		
6	1880	1060		
7	1870	904		
8	1640	809		
9	1500	785		804
10	1440	1040		
11	2460	1570		
12	3640	6830		
13	5120	6190		
14	3600	5740		
15	2200	2490		
16	1570	1130		
17	1220	1670		
18	1000	1780		
19	1720	1890		
20	9030	1840		
21	8860		700	
22	5270			
23	5080			
24	10700			
25	11100			853
26	4830			
27	2800			
28	1940			
29	1490			
30	1220			
31				
Month Avg	3730	2370		

Appendix E. Data from Mammoth Creek intensive study, July 29-August 3, 1986.

Location	Loc no.	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Indepndnce a GAM	1	072986	1255	0.8	3.44	nd
Indepndnce a GAM	1	072986	1843	0.8	3.55	
Indepndnce a GAM	1	073086	0915	0.9	12.6	tr
Indepndnce a GAM	1	073086	1258	0.4	0.85	tr
lndepndnce a GAM	1	073086	1700	0.4	0.86	nd
Indepndnce a GAM	1	073186	0908	0.4	0.9	nd
Indepndnce a GAM	1	073186	1300	0.3	1.05	tr
Indepndnce a GAM	I	073186	1700	0.5	0.63	tr
Indepndnce a GAM	1	080186	0900	0.3	0.75	nd
Indepndnce a GAM	1	080186	1300	0.7	1.79	nd
Indepndnce a GAM	1	080386	1540	0.7	4.45	
Indepndnce b GAM	2	072986	1340	20	65	
Indepndnce b GAM	2	072986	1850	420	696	
Indepndnce b GAM	2	073086	0935	50	41	tr
Indepndnce b GAM	2	073086	1307	37	32.1	tr
Indepndnce b GAM	2	073086	1713	370	469	tr
Indepndnce b GAM	2	073186	0916	65	46	tr
Indepndnce b GAM	2	073186	1307	70	71.7	tr
Indepndnce b GAM	2	073186	1709	400	480	tr
Indepndnce b GAM	2	080186	0907	90	66.1	tr
Indepndnce b GAM	2	080186	1308	110	74.1	
Indepndnce b GAM	2	080386	1600	17	10.5	
Indepndnce b may	3	073186	1105	55	89.1	tr
Indepndnce b may	3	073186	1346	33	29.3	tr
Indepndnce b may	3	073186	1745	55	70	tr
Indepndnce b may	3	080186	0945	37	27.3	tr
Indepndnce b may	3	080186	1345	900	1610	
Indepndnce b may	3	080386	1850	600	421	
Indepndnce a mth	4	072986	1548	3.7	5.94	tr
Indepndnce a mth	4	073086	1124	31	14.3	nd
Indepndnce a mth	4	073086	1502	380	397	0.1
Indepndnce a mth	4	073086	1859	40	43.4	0.02
Indepndnce a mth	4	073186	1102	130	160	0.08
Indepndnce a mth	4	073186	1502	20	20	nd
Indepndnce a mth	4	073186	1902	55	57.5	tr
Indepndnce a mth	4	080186	1100	33	29.6	tr
Indepndnce a mth	4	080186	1420	800	2020	
Indepndnce a mth	4	080186	1500	1000	1640	
Indepndnce a mth	4	080186	1503	1000	1590	2.0
Indepndnce a mth	4	080186	1900	300	281	
Indepndnce a mth	4	080186	2300	300	235	
Indepndnce a mth	4	080286	0300	160	131	
Indepndnce a mth	4	080286	0700	95	77.5	
Indepndnce a mth	4	080286	1100	70	72.7	

Appendix E (con.)

Location	Loc no.	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Indepndnce a mth	4	080286	1500	350	252	
Indepndnce a mth	4	080286	1900	750	451	
Indepndnce a mth	4	080286	2300	450	292	
Indepndnce a mth	4	080386	0300	650	263	
Indepndnce a mth	4	080386	0700	800	599	
Indepndnce a mth	4	080386	1100	1000	731	
Indepndnce a mth	4	080386	1500	1300	924	
Indepndnce a mth	4	080386	1640	1000	688	3.1
Mastodon a mth	5	072986	1548	2.1	5	tr
Mastodon a mth	5	073086	1127	2.1	4.69	tr
Mastodon a mth	5	073086	1500	2.7	5.11	nd
Mastodon a mth	5	073086	1903	2.7	2.25	nd
Mastodon a mth	5	073186	1104	2.1	2.46	nd
Mastodon a mth	5	073186	1525	2.4	2.08	tr
Mastodon a mth	5	073186	1903	2.2	4.39	tr
Mastodon a mth	5	080186	1102	2.4	4.16	nd
Mastodon a mth	5	080186	1504	2.1	2.08	tr
Mastodon a mth	5	080386	1640	1.6	2.27	
Mammoth at head	6	072986	1548	3.2	9.01	tr
Mammoth at head	6	073086	1125	14	18.3	tr
Mammoth at head	6	073086	1459	201	245	tr
Mammoth at head	6	073086	1900	34	31.8	tr
Mammoth at head	6	073186	1102	80	,124	tr
Mammoth at head	6	073186	1500	19	24.8	tr
Mammoth at head	6	073186	1901	33	32.8	tr
Mammoth at head	6	080186	1100	25	20.6	tr
Mammoth at head	6	080186	1507	700	926	1.0
Mammoth at head	6	080386	1640	340	241	
Mammoth at headi*	6	073086	0330	25	27.9	
Mammoth at head	6	073086	1530	450	480	
Mammoth at head	6	073086	1900	26	28.3	tr
Mammoth at head	6	073086	2300	85	127	tr
Mammoth at head	6	073186	0300	140	143	tr
Mammoth at head	6	073186	0700	15	13	tr
Mammoth at head	6	073186	1100	65	82.5	tr
Mammoth at head	6	073186	1500	8.5	7.54	tr
Mammoth at head	6	073186	1900	23	28.2	tr
Mammoth at head	6	073186	2300	36	40	tr
Mammoth at head	6	080186	0300	75	55.2	tr
Mammoth at head	6	080186	0700	20	12.5	tr
Mammoth ab 1 eff	7	072986	1750	9.1	7.73	0.05

*'i' indicates samples collected in automated sampler.

Appendix E (con.)

Location	Loc no.	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Mammoth ab 1 eff	7	073086	1203	9.0	18	tr
Mammoth ab 1 eff	7	073086	1538	150	194	0.05
Mammoth ab 1 eff	7	073086	1945	10	10.2	tr
Mammoth ab 1 eff	7	073186	1135	30	67.5	
Mammoth ab 1 eff	7	073186	1538	45	103	0.05
Mammoth ab 1 eff	7	073186	1936	110	418	0.4
Mammoth ab 1 eff	7	080186	1136	11	14	tr
Mammoth ab 1 eff	7	080186	1520	310	57.6	.55
Mammoth ab 1 eff	7	080386	1530	550	433	
Loud effluent	8	072986	1615	1100	736	
Loud effluent	8	073086	1202	450	261	tr
Loud effluent	8	073086	1534	500	171	tr
Loud effluent	8	073086	1941	450	153	nd
Loud effluent	8	073186	1130	330	102	tr
Loud effluent	8	073186	1534	310	81.9	nd
Loud effluent	8	073186	1932	260	63.8	tr
Loud effluent	8	080186	1139	190	52.9	tr
Loud effluent	8	080186	1523	190	52.2	tr
Loud effluent	8	080386	1530	500	279	
AV diversion	9	072986	1548	13	14.7	tr
AV diversion	9	073086	1208	9.5	7.06	tr
AV diversion	9	073086	1537	170	151	tr
AV diversion	9	073086	1945	17	12.4	tr
AV diversion	9	073186	1135	35	40.1	tr
AV diversion	9	073186	1538	36	72.5	0.05
AV diversion	9	073186	1936	37	91.6	0.05
AV diversion	9	080186	1141	16	15.8	tr
AV diversion	9	080186	1520	290	556	0.6
Mammoth b AV div	10	072986	1610	95	88.2	
Mammoth b AV div	10	073086	1208	26	24.1	tr
Mammoth b AV div	10	073086	1534	120	142	tr
Mammoth b AV div	10	073086	1943	23	21	tr
Mammoth b AV div	10	073186	1132	38	46.5	tr
Mammoth b AV div	10	073186	1536	40	116	0.05
Mammoth b AV div	10	073186	1932	27	57.1	0.05
Mammoth b AV div	10	080186	1136	21	18.1	
Mammoth b AV div	10	080186	1518	280	498	O'S
Mammoth b AVdivi*	10	072986	2030	85	85.7	
Mammoth b AVdivi	10	073086	0430	37	30.3	
Mammoth b AVdivi	10	073086	1030	32	31.4	
Mammoth b AVdivi	10	073086	1630	150	191	

*'i' indicates samples collected by automated sampler.

Appendix E (con.)

Location	Loc no.	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Mammoth b AVdivi	10	073086	1930	31	32.9	
Mammoth b AVdivi	10	073086	2330	38	40	
Mammoth b AVdivi	10	073186	0330	75	80.4	
Mammoth b AVdivi	10	073186	0730	24	27	
Mammoth b AVdivi	10	073186	1130	36	50.2	
Mammoth b AVdivi	10	073186	1530	39	95.7	
Mammoth b AVdivi	10	073186	1930	80	265	tr
Mammoth b AVdivi	10	073186	2330	37	49.8	tr
Mammoth b AVdivi	10	080186	0330	84	51.4	tr
Mammoth b AVdivi	10	080186	0730	23	19.7	tr
Mammoth b AVdivi	10	080186	1130	24	27.8	tr
Mammoth b AVdivi	10	080186	1530	260	375	
Mammoth b AVdivi	10	080186	1930	43	55.8	
Mammoth b AVdivi	10	080186	2330	85	78.9	
Mammoth b AVdivi	10	080286	0330	65	56.4	
Mammoth b AVdivi	10	080286	0730	150	130	
Mammoth b AVdivi	10	080286	1530	270	200	
Mammoth b AVdivi	10	080286	1930	210	158	
Mammoth b AVdivi	10	080286	2330	150	103	
Mammoth b AVdivi	10	080386	0330	180	129	
Mammoth b AVdivi	10	080386	0730	200	140	
Mammoth b AVdivi	10	080386	1130	260	238	
Mammoth b AVdivi	10	080386	1530	500	415	
Miller ab rd	11	073086	1230	0.6	2.7	nd
Miller ab rd	11	073086	1800	0.5	1.21	nd
Miller ab rd	11	073186	0855	0.4	0.86	tr
Miller ab rd	11	073186	1255	0.5	3.96	
Miller ab rd	11	073186	1620	0.5	0.32	nd
Miller ab rd	11	080186	0850	0.6	0.36	nd
Miller ab rd	11	080186	1230	0.5	0.45	nd
AV eff ab rd	12	073086	0900	3400	10600	
AV eff ab rd	12	073086	1300	2500	8640	13
AV eff ab rd	12	073086	1800	3800	14100	27
AV eff ab rd	12	073086	1915	85	1410	
AV eff ab rd	12	073186	0900			4.2
AV eff ab rd	12	073186	1220	7400	18500	49
AV eff ab rd	12	073186	1620	3600	9680	28
AV eff ab rd	12	080186	0850	550	212	
AV eff ab rd	12	080186	1230	7000	19500	41
AV eff b pond	13	073086	0940	450	337	0.05
AV eff b pond	13	073086	1330	500	386	tr
AV eff b pond	13	073086	1805	600	526	tr
AV eff b pond	13	073186	0915	360	276	tr
AV eff b pond	13	073186	1245	4200	334	tr

Appendix E (con.)

Location	Loc no.	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
AV eff b pond	13	073186	1630	550	477	tr
AV eff b pond	13	080186	0912	290	212	tr
AV eff b pond	13	080186	1255	260	215	tr
AV eff a Mammoth	14	073086	1030	450	309	tr
AV eff a Mammoth	14	073086	1350	500	375	0.05
AV eff a Mammoth	14	073086	1825	550	430	tr
AV eff a Mammoth	14	073186	0945	350	235	tr
AV eff a Mammoth	14	073186	1320	390	277	tr
AV eff a Mammoth	14	073186	1705	390	287	tr
AV eff a Mammoth	14	080186	0935	230	163	tr
AV eff a Mammoth	14	080186	1320	250	198	
Mammoth ab AVeff	15	073086	1045	85	48.5	tr
Mammoth ab AVeff	15	073086	1350	70	36.8	tr
Mammoth ab AVeff	15	073086	1825	150	108	tr
Mammoth ab AVeff	15	073186	0945	75	40.1	tr
Mammoth ab AVeff	15	073186	1310	70	46.5	tr
Mammoth ab AVeff	15	073186	1705	50	38.9	tr
Mammoth ab AVeff	15	080186	1005	55	27.3	tr
Mammoth ab AVeff	15	080186	1315	45	24.6	tr
Mammoth b AV eff	16	073086	1115	300	197	tr
Mammoth b AV eff	16	073086	1400	330	220	tr
Mammoth b AV eff	16	073086	1830	400	296	tr
Mammoth b AV eff	16	073186	0950	240	152	tr
Mammoth b AV eff	16	073186	1340	230	170	tr
Mammoth b AV eff	16	073186	1700	250	203	tr
Mammoth b AV eff	16	080186	0940	140	112	tr
Mammoth b AV eff	16	080186	1325	140	112	tr
Dugas b sluice	17	073086	0950	1000	3900	3.5
Dugas b sluice	17	073086	1330	18900	36400	82
Dugas b sluice	17	073086	1805	14600	34000	97
Dugas b sluice	17	073186	0910	17100	33600	92
Dugas b sluice	17	073186	1245	17900	35400	98
Dugas b sluice	17	073186	1635	16800	33000	120
Dugas b sluice	17	080186	0915	12900	27000	69
Dugas b sluice	17	080186	1355	13100	37500	80
Dugas ab 1st pnd	17	073196	1230	12800	33100	
Dugas b 1st pnd	17	073186	1250	5400	7370	
Dugas ab 2nd pnd	17	073186	1305	7300	10700	
Dugas b 2nd pnd	17	073186		1000	560	
Dugas b 3rd pnd	17	073186	1335	800	560	

Appendix E (con.)

Location	Loc no.	Date	Time	Turbidity (NTU)	TSS (mg/L)	Set. solids (ml/L)
Dugas eff ab mam	18	073086	1350	550	319	tr
Dugas eff ab mam	18	073086	1805	600	422	tr
Dugas eff ab mam	18	073186	1025	550	308	tr
Dugas eff ab mam	18	073186	1400	650	458	tr
Dugas eff ab mam	18	073186	1800	550	329	
Dugas eff ab mam	18	080186	1005	400	247	tr
Dugas eff ab mam	18	080186	1400	400	256	tr
Mammoth ab Dugas	19	073086	1335	210	136	tr
Mammoth ab Dugas	19	073086	1805	290	273	0.05
Mammoth ab Dugas	19	073186	1800	220	177	tr
Mammoth a steese	20	072986	2030	370	257	
Mammoth a steese	20	073086	0230	320	233	
Mammoth a steese	20	073086	0830	250	179	
Mammoth a steese	20	073086	1430	300	204	tr
Mammoth a steese	20	073086	1830	300	213	tr
Mammoth a steese	20	073086	2230	350	255	
Mammoth a steese	20	073186	0230	300	202	
Mammoth a steese	20	073186	0630	280	195	
Mammoth a steese	20	073186	1030	240	152	tr
Mammoth a steese	20	073186	1430	240	162	tr
Mammoth a steese	20	073186	1830	210	162	tr
Mammoth a steese	20	073186	2230	240	235	tr
Mammoth a steese	20	080186	0230	240	166	tr
Mammoth a steese	20	080186	0630	210	149	tr
Mammoth a steese	20	080186	1030	170	118	tr
Mammoth a steese	20	080186	1430	180	124	
Mammoth a steese	20	080186	1830	220	187	
Mammoth a steese	20	080186	2230	240	168	
Mammoth a steese	20	080286	0230	180	142	
Mammoth a steese	20	080286	0630	180	117	
Mammoth a steese	20	080286	1030	130	84.4	
Mammoth a steese	20	080286	1430	140	110	
Mammoth a steese	20	080286	1830	140	96.4	
Mammoth a steese	20	080286	2230	140	96.4	
Mammoth a steese	20	080386	0230	130	81.9	
Mammoth a steese	20	080386	0630	190	73.2	
Mammoth a steese	20	080386	1030	110	73.6	
Mammoth a steese	20	080386	1430	120	88.5	
Mammoth a steese	20	080386	1555	130	100	
Big G, Deadwood	25	080386	1233	400	395	
Cacy recycle	25	080286	1030	12300	12700	
Loud cyclone	25	080386	1800	16700	3190	

Appendix F. Data collected by ADF&G.

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
A. Faith Creek at Steese				
Faith at Steese	052386	1930	110	
Faith at Steese	060286	1100	50	319
Faith at Steese	060286	1500	60	443
Faith at Steese	060286	2100	95	637
Faith at Steese	060386	0300	75	490
Faith at Steese	060386	0900	24	271
Faith at Steese	060386	1500	40	325
Faith at Steese	060386	2100	50	297
Faith at Steese	060486	0300	37	238
Faith at Steese	060486	0900	21	149
Faith at Steese	060486	1500	28	174
Faith at Steese	060486	2100	60	316
Faith at Steese	060586	0300	34	235
Faith at Steese	060586	0900	19	145
Faith at Steese	060586	1500	30	137
Faith at Steese	060586	2100	65	326
Faith at Steese	060686	0300	55	339
Faith at Steese	060686	0900	28	222
Faith at Steese	061686	1345	7.9	
Faith at Steese	061986	1200	15	111
Faith at Steese	061986	1800	7.0	32.1
Faith at Steese	062086	0000	4.7	20.0
Faith at Steese	062086	0600	4.4	17.6
Faith at Steese	062086	1200	3.2	13.0
Faith at Steese	062086	1800	3.4	9.3
Faith at Steese	062186	0000	4.0	12.5
Faith at Steese	062186	0600	4.7	12.2
Faith at Steese	062186	1200	4.2	6.1
Faith at Steese	062186	1800	7.2	20.2
Faith at Steese	062286	0000	34	122
Faith at Steese	062286	0600	23	71.7
Faith at Steese	062286	1200	17	56.6
Faith at Steese	062286	1800	10	44.4
Faith at Steese	062386	0000	8.7	30.7
Faith at Steese	062386	0600	15	21.7
Faith at Steese	062386	1200	21	27.4
Faith at Steese	062386	1800	30	34.2
Faith at Steese	062486	0000	500	1890
Faith at Steese	062486	0600	280	1160
Faith at Steese	062486	1200	180	812
Faith at Steese	062486	1800	120	345
Faith at Steese	062586	0000	61	494
Faith at Steese	062586	0600	58	231
Faith at Steese	062586	1200	45	195
Faith at Steese	062586	1800	45	337

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Faith at Steese	062686	0000	45	208
Faith at Steese	062686	0600	30	114
Faith at Steese	062686	1200	30	80.2
Faith at Steese	062686	1800	34	90.0
Faith at Steese	062786	0100	40	78.6
Faith at Steese	062786	0600	45	78.2
Faith at Steese	062786	1200	60	91.6
Faith at Steese	062786	1800	50	75.0
Faith at Steese	062886	0000	85	102
Faith at Steese	062886	0600	65	75.2
Faith at Steese	062886	1200	60	80.8
Faith at Steese	062886	1800	26	44.9
Faith at Steese	062986	0000	15	33.0
Faith at Steese	062986	0600	10	19.2
Faith at Steese	062986	1200	8.5	19.8
Faith at Steese	062986	1800	8.3	18.8
Faith at Steese	063086	0000	7.4	12.8
Faith at Steese	063086	0600	5.2	11.8
Faith at Steese	063086	1200	12	16.8
Faith at Steese	063086	1800	14	17.0
Faith at Steese	070186	0000	14	14.4
Faith at Steese	070186	0600	11	12.7
Faith at Steese	070186	1200	18	20.0
Faith at Steese	070186	1800	21	17.5
Faith at Steese	070286	0000	23	25.5
Faith at Steese	070286	0600	23	14.2
Faith at Steese	070286	1200	36	37.4
Faith at Steese	070286	1800	28	37.9
Faith at Steese	070386	0000	28	35.8
Faith at Steese	070386	0600	45	57.0
Faith at Steese	070386	1200	35	40.3
Faith at Steese	070386	1800	27	31.7
Faith at Steese	070486	0000	30	34.4
Faith at Steese	070486	0600	29	38.8
Faith at Steese	070486	1200	45	49.2
Faith at Steese	070486	1800	40	43.6
Faith at Steese	070586	0000	16	67.0
Faith at Steese	070586	0600	9.7	10.5
Faith at Steese	070586	1200	8.9	26.9
Faith at Steese	070586	1800	11	10.0
Faith at Steese	070686	0000	19	18.2
Faith at Steese	070686	0600	19	14.6
Faith at Steese	070686	1200	19	6.0
Faith at Steese	070686	1800	28	15.4
Faith at Steese	070886	1123	26	
Faith at Steese	071586	1800	40	30.4
Faith at Steese	071686	0000	45	22.2

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Faith at Steese	071686	0600	50	21.4
Faith at Steese	071686	1200	39	21.8
Faith at Steese	071686	1800	38	14.4
Faith at Steese	071786	0000	260	186
Faith at Steese	071786	0600	450	451
Faith at Steese	071786	1200	60	49.1
Faith at Steese	071786	1800	250	149
Faith at Steese	071886	0000	200	118
Faith at Steese	071886	0600	450	313
Faith at Steese	071886	1200	600	620
Faith at Steese	071886	1800	90	162
Faith at Steese	071986	0000	32	62.6
Faith at Steese	071986	0600	300	301
Faith at Steese	071986	1200	500	423
Faith at Steese	071986	1800	85	124
Faith at Steese	072086	0000	550	1510
Faith at Steese	072086	0600	200	1040
Faith at Steese	072086	1200	260	1300
Faith at Steese	072086	1800	120	671
Faith at Steese	072186	0000	75	438
Faith at Steese	072186	0600	75	343
Faith at Steese	072186	1200	50	333
Faith at Steese	072186	1800	45	340
Faith at Steese	072286	0000	35	261
Faith at Steese	072386	2031	60	
Faith at Steese	072486	1200	50	
Faith at Steese	072586	0000	38	296
Faith at Steese	072586	0600	34	58.2
Faith at Steese	072586	1200	29	39.9
Faith at Steese	072586	1800	25	34.5
Faith at Steese	072686	0000	23	27.4
Faith at Steese	072686	0600	21	26.6
Faith at Steese	072686	1200	15	21.4
Faith at Steese	072686	1800	15	22.0
Faith at Steese	072786	0000	32	74.8
Faith at Steese	072786	0600	75	122
Faith at Steese	072786	1200	22	81.3
Faith at Steese	072786	1800	13	46.8
Faith at Steese	072886	0000	14	36.9
Faith at Steese	072886	0600	17	70.3
Faith at Steese	072886	1200	13	22.7
Faith at Steese	072886	1800	14	20.0
Faith at Steese	072986	0000	16	21.4
Faith at Steese	072986	0600	24	24.9
Faith at Steese	072986	1200	18	17.6
Faith at Steese	072986	1800	19	17.2
Faith at Steese	073086	0000	20	17.4

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Faith at Steese	073086	0600	26	19.8
Faith at Steese	073086	1200	25	17.2
Faith at Steese	073086	1800	23	17.8
Faith at Steese	073186	0000	32	21.2
Faith at Steese	073186	0600	34	31.0
Faith at Steese	073186	1200	32	39.5
Faith at Steese	073186	1800	27	28.2
Faith at Steese	080186	0000	32	60.7
Faith at Steese	080186	0600	50	199
Faith at Steese	080186	1200	34	133
Faith at Steese	080186	1800	50	479
Faith at Steese	080286	0000	60	407
Faith at Steese	080286	0600	60	294
Faith at Steese	080286	1200	70	485
Faith at Steese	080286	1800	65	452
Faith at Steese	080386	0000	45	251
Faith at Steese	080386	0600	31	100
Faith at Steese	080686	1800	7.4	47.4
Faith at Steese	080786	0000	17	110
Faith at Steese	080786	0600	18	84.8
Faith at Steese	080786	1200	13	80.3
Faith at Steese	080786	1800	13	86.3
Faith at Steese	080886	0000	13	72.2
Faith at Steese	080886	0600	13	63.7
Faith at Steese	080886	1200	9.4	52.0
Faith at Steese	080886	1800	12	55.9
Faith at Steese	080986	0000	11	49.8
Faith at Steese	080986	0600	9.5	44.3
Faith at Steese	080986	1200	9.2	31.8
Faith at Steese	080986	1800	9.9	37.8
Faith at Steese	081086	0000	12	38.0
Faith at Steese	081086	0600	9.2	38.2
Faith at Steese	081086	1200	14	27.6
Faith at Steese	081086	1800	14	32.5
Faith at Steese	081186	0000	23	33.7
Faith at Steese	081186	0600	23	36.5
Faith at Steese	081186	1200	35	52.4
Faith at Steese	081186	1800	40	53.4
Faith at Steese	081286	0000	35	45.7
Faith at Steese	081286	0600	24	35.0
Faith at Steese	081286	1200	39	47.1
Faith at Steese	081286	1800	31	41.9
Faith at Steese	081386	0000	55	52.8
Faith at Steese	081386	0600	55	55.4
Faith at Steese	081386	1200	40	40.6
Faith at Steese	081486	1700	50	104
Faith at Steese	081586	0000	50	50.5

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Faith at Steese	081586	0600	50	49.5
Faith at Steese	081586	1200	45	42.4
Faith at Steese	081586	1800	60	51.2
Faith at Steese	081686	0000	45	36.6
Faith at Steese	081686	0600	15	16.7
Faith at Steese	081686	1200	26	20.7
Faith at Steese	081686	1800	29	32.8
Faith at Steese	081786	0000	50	43.5
Faith at Steese	081786	0600	55	43.5
Faith at Steese	081786	1800	45	42.9
Faith at Steese	081886	0000	26	34.7
Faith at Steese	081886	0600	35	23.1
Faith at Steese	081886	1200	21	31.6
Faith at Steese	081886	1800	11	25.3
Faith at Steese	081986	0000	11	13.3
Faith at Steese	081986	0600	20	19.2
Faith at Steese	081986	1200	33	34.9
Faith at Steese	081986	1800	40	45.0
Faith at Steese	082086	0000	37	35.1
Faith at Steese	082086	0600	25	25.8
Faith at Steese	082086	1200	19	19.6
Faith at Steese	082086	1800	36	80.3
Faith at Steese	082186	0000	220	1360
Faith at Steese	082186	0600	340	3180
Faith at Steese	082186	1200	2900	25300
Faith at Steese	082186	1815	420	2180
Faith at Steese	082286	0000	3000	31600
Faith at Steese	082286	0600	1600	18500
Faith at Steese	082286	1745	2100	21700
Faith at Steese	082886	1800	50	1950
Faith at Steese	082986	0000	36	574
Faith at Steese	082986	0600	19	270
Faith at Steese	082986	1200	15	169
Faith at Steese	082986	1800	15	153
Faith at Steese	083086	0000	21	134
Faith at Steese	083086	0600	22	126
Faith at Steese	083086	1200	22	156
Faith at Steese	083086	1800	31	490
Faith at Steese	083186	0000	40	620
Faith at Steese	083186	0600	32	339
Faith at Steese	083186	1200	40	526
Faith at Steese	083186	1800	50	1030
Faith at Steese	090186	0000	60	1230
Faith at Steese	090186	0600	60	475
Faith at Steese	090186	1200	45	967
Faith at Steese	090186	1800	40	152
Faith at Steese	090286	0000	31	59.1

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Faith at Steese	090286	0600	24	53.7
Faith at Steese	090286	1200	26	39.1
Faith at Steese	090286	1800	36	147
Faith at Steese	090386	0000	38	556
Faith at Steese	090386	0600	45	818
Faith at Steese	090386	1200	34	552
Faith at Steese	090486	1800	24	337
Faith at Steese	090586	0000	23	107
Faith at Steese	090586	0600	16	30.2
Faith at Steese	090586	1200	10	41.5
Faith at Steese	090586	1800	8.0	43.6
Faith at Steese	090686	0000	10	28.0
Faith at Steese	090686	0600	8.0	28.2
Faith at Steese	090686	1200	7.1	51.9
Faith at Steese	090686	1800	8.9	40.7
Faith at Steese	090786	0000	9.0	12.9
Faith at Steese	090786	0600	7.8	10.4
Faith at Steese	090786	1200	7.4	17.0
Faith at Steese	090786	1800	9.0	19.8
Faith at Steese	090886	0000	9.4	17.0
Faith at Steese	090886	0600	7.7	11.9
Faith at Steese	090886	1200	7.5	11.2
Faith at Steese	090886	1210	5.6	
Faith at Steese	090886	1800	13	23.0
Faith at Steese	090986	0000	12	15.7
Faith at Steese	090986	0600	8.8	18.0
Faith at Steese	090986	1200	10	33.5
Faith at Steese	090986	1800	7.1	18.0
Faith at Steese	091086	0000	8.6	11.4
Faith at Steese	091086	0600	8.8	18.1
Faith at Steese	091086	1800	6.2	10.1
Faith at Steese	091186	0000	6.4	10.0
Faith at Steese	091186	0600	6.5	8.1
Faith at Steese	091186	1200	5.4	7.5
Faith at Steese	091186	1800	6.2	9.1
Faith at Steese	091286	0000	8.1	6.9
Faith at Steese	091286	0600	6.8	6.5
Faith at Steese	092586	1925	22	11.7
B. Other Chatanika Creek Drainage Data				
McManus ab Faith	072486	1200	1.2	nd
Chatanika Cr at Sourdgh	072486	1300	21	10.4
Chatanika at 39m	072486	1330	4.9	2.92
Faith b final pond	090486			15.8
Faith at final seepage	090486			49.7
Faith ab Kop pond	090486	1255		1280

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Faith at rd crossing	090486	1348		28.3
Faith at road	090486	1415		16.3
C. Data for Goldstream valley sites, 1986				
First Chance Cr	090586		7.3	6.8
Flume a Steese	090586		2.5	2.38
Goldstream a Std Cr Rd	090586		31.3	36.2
Goldstream a Std Cr Rd	092686		90	61.8
Goldstream a Sheep Cr Rd	090586		120	64
Goldstream a Sheep Cr Rd	09 2685	1145	260	202
Goldstream a Sheep Cr Rd	092685	1800	260	175
Goldstream a Sheep Cr Rd	092686		230	138
Goldstream a Sheep Cr Rd	092785	0000	250	124
Goldstream a Sheep Cr Rd	092786	0600	260	174
Goldstream a Sheep Cr Rd	092786	1200	270	186
Goldstream a Sheep Cr Rd	092786	1800	290	232
Goldstream a Sheep Cr Rd	092886	0000	280	202
Goldstream a Sheep Cr Rd	092886	0600	250	170
Goldstream a Sheep Cr Rd	092886	1200	250	169
Goldstream a Sheep Cr Rd	092886	1800	260	161
Goldstream a Sheep Cr Rd	092986	0000	250	174
Goldstream a Sheep Cr Rd	092986	0600	250	146
Goldstream a Sheep Cr Rd	092986	1200	240	166
Goldstream a Sheep Cr Rd	092986	1800	240	160
Goldstream a Sheep Cr Rd	093086	0000	240	148
Goldstream a Sheep Cr Rd	093086	0600	230	144
Goldstream a Sheep Cr Rd	093086	1200	230	152
Goldstream a Sheep Cr Rd	093086	1800	220	143
Goldstream a Sheep Cr Rd	100186	0000	210	130
Goldstream a Sheep Cr Rd	100186	0600	210	128
Goldstream a Sheep Cr Rd	100186	1200	210	131
Goldstream a Sheep Cr Rd	100186	1800	210	135
Goldstream a Sheep Cr Rd	100286	0000	220	155
Goldstream a Sheep Cr Rd	100286	0600	230	151
Goldstream a Sheep Cr Rd	100286	1200	230	167
Goldstream a Sheep Cr Rd	100286	1800	240	154
Goldstream a Sheep Cr Rd	100386	0000	230	151
Goldstream a Sheep Cr Rd	100386	0600	240	215
Goldstream Creek	052086	1350	210	524
Goldstream a Ballaine Rd	090586		180	129
Goldstream a Gdstrm Cr R	090586		330	261

Appendix F (con.)

Location	Date	Time	Turbidity (NTU)	TSS (mg/l)
Pedro a Gld Pan Site	090586		110	84
Pedro a Gld Pan Site	092685		65	57.1
Pedro a 1st Chnc Cr	090586		330	201
Pedro Automatic Sample	092685	1040	80	79.6
Pedro Automatic Sample	092685	1800	360	428
Pedro Automatic Sample	092785	0000	800	824
Gilmore Cr	052086	1345	75	98.8
Gilmore a trk st	090586		1200	722
Steamboat Cr a Steese	090586		26	282

D. Break Up Samples

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	SS (ml/L)
WF Tolovana R.	052086	1002	1.6	6	tr
Tolovana River 2	052086	1035	9.3	24.8	0.05
Livengood Creek	052086	1125	170	524	0.55
Tolovana River	052086	1145	1.9	9.8	tr
Tatalina River	052086	1205	1.4	3.6	tr
Chatanika River	052086	1320	5.1	32	0.1
Gilmore Creek	052086	1345	75	98.8	0.15
Goldstream Creek	052086	1350	210	524	1.1
Little Chena	052086	1415	14	64.9	0.2
Chena River 1	052086	1417	8.8	114	0.3
Chena River 2	052086	1510	5.7	17.5	0.05
Cripple Creek	052086	1516	50	233	0.5
Chatanika a 39m	060686		14	11.4	tr
Chatanika a 55m	060686		10	42.2	tr
Deep ab Dale	060686		1.7	2.63	nd
Deep at Faith	060686		120	351	0.25
Faith a low rd	060686		18	88.6	0.05
Faith ab deep cr	060686		18	85.4	0.05
McManus Cr	060686		1.4	11.4	tr
Deep Cr lmi us	060686		100	613	0.8
Deep Cr at FCR	060686		140	832	1.1
Faith b Deep Cr	060686		13	90.7	tr

Appendix G. Miscellaneous data.

A. Data collected by DEC, June 5-6, 1986

Location	Date	Turbidity (NTU)	TSS (mg/L)
Birch at Bridge	060386	90	264
Birch at Bridge	060386	85	235
Deadwood a Chsr	060386	65	190
Deadwood ab Mine	060386	60	376
Bedrock	060386	0.6	3.6
Bedrock	060386	1.5	0.8
Boulder at Gage	060386	3.6	11.2
Boulder at Gage	060386	3.6	9.9
Crooked a Cen	060386	85	151
Crooked a Cen	060386	110	165
Deadwood a Chsr	060386	60	391
Deadwood ab Mine	060386	60	301
Faith a Steese	060286	70	306
Ketchem a Chsr	060386	95	335
Ketchem a Chsr	060386	90	333
Mammoth a Steese	060386	200	
Mammoth a Steese	060386	250	777
Porcupine a Mth	060386	70	191
Porcupine a Mth	060386	80	206
Faith a rd cross	060286	40	151
Faith a rd cross	060286	35	147

B. Data from ADF&G and DOM Helicopter flyover of Birch Creek

Location	Date	Time	Turbidity (NTU)	TSS (mg/L)	SS (ml/L)
Birch ab Clums F	062486	1500	95	311	0.35
Birch ab Harriss	062486	1500	95	310	0.2
Birch at Butte	062486	1300	350	889	0.7
Birch at Harring	062486	1345	140	392	0.4
Butte a mth	062486	1300	270	1570	2.0
Clums fk a Birch	062486	1400	14	83	
Eagle at Glddust	062486	1300	450	962	0.7
Gold Dust ab mth	062486	1300	140	472	0.4
Harrington fk	062486	1345	11	59	
Harrison a mth	062486	1500	50	251	0.3
Mammoth #3	062486	1438	38	208	0.1
Mammoth #5	062486	1438	40	134	0.1
Miller #2	062486		39	148	0.05
Portage Cr a ml	062486	1000	65	119	tr

C. Turbidity data from Tolovana River above mining

Location	Date	Turbidity (NTU)	TSS (mg/L)
Tolovana ab Wilber	061386	1130	26
Tolovana ab Wilber	061486	1030	12
Tolovana ab Wilber	062086		5.9
Tolovana ab Wilber	062686		49
Tolovana ab Wilber	072386	1530	3.0
Tolovana ab Wilber	072786	1650	13
Tolovana ab Wilber	072886	1715	3.3
Tolovana ab Wilber	073086	1700	20
Tolovana ab Wilber	073186	1000	190
Tolovana ab Wilber	073186	2200	75
Tolovana ab Wilber	080186	0900	55
Tolovana ab Wilber	080286	0930	70
Tolovana ab Wilber	080386	1130	9.8
Tolovana ab Wilber	080486	1730	5.8
Tolovana ab Wilber	080586	0900	4.8
Tolovana ab Wilber	080686	1900	3.1
Tolovana b Wilber	073186	1000	210

D. Turbidity data collected by Division of Parks

Location	Date	Time	Turbidity (NTU)
Chena a 39m CHSR	060886	2025	0.6
Chena a 39m CHSR	061186	2030	3.0
Chena a 39m CHSR	061486	2125	1.8
Chena a 39m CHSR	061686	2030	1
Chena a 39m CHSR	061886	2100	3.5
Chena a 39m CHSR	062186	1900	5.3
Chena a 39m CHSR	062286	2130	1.5
Chena a 39m CHSR	062386	2045	29
Chena a 39m CHSR	062486	1950	23
Chena a 39m CHSR	062586	1830	6.5
Chena a 39m CHSR	062886	1830	1.1
Chena a 39m CHSR	062986	2030	0.7
Chena a 39m CHSR	070486	1800	0.5
Chena a 39m CHSR	070586	1900	0.8
Chena a 39m CHSR	071586	0905	0.5
Chena a 39m CHSR	071686	1845	1.1
Chena a 39m CHSR	071986	0930	5.9
Chena a 39m CHSR	072086	0900	65
Chatanika at llm	060686	0830	4
Chatanika at llm	060786	2100	4.3

Location	Date	Time	Turbidity (NTU)
Chatanika at 11m	060886	1700	12
Chatanika at 11m	061086	1320	8.2
Chatanika at 11m	061186	1330	80
Chatanika at 11m	061486	2125	6.4
Chatanika at 11m	061686	1300	3.1
Chatanika at 11m	061886	1330	3.3
Chatanika at 11m	062186	1400	1.6
Chatanika at 11m	062886	1500	1.6
Chatanika at 11m	070686	1930	1.4
Chatanika at 11m	071286	0934	2.9
Chatanika at 39m	060786	1445	7.1
Chatanika at 39m	061386	2130	6.3
Chatanika at 39m	061486	1950	5.9
Chatanika at 39m	062286	1300	2.1
Chatanika at 39m	062586	1400	18
Chatanika at 39m	062786	2045	1.9
Chatanika at 39m	070386	1915	1.2
Chatanika at 39m	070586	2205	2.2
Chatanika at 39m	071186	0930	1.2
Chatanika at 39m	072586	0930	1.4

E. Turbidity data from rural villages

Location	Date	Time	Turbidity (NTU)
Birch at BCV	053086	1600	7.9
Koyukuk at Evnsvl	060686	0830	130
Koyukuk at Evnsvl	061086	0800	230
Koyukuk at Evnsvl	061286	0800	210
Koyukuk at Evnsvl	061686	0800	100
Koyukuk at Evnsvl	061786	0800	65
Koyukuk at Evnsvl	061886	0800	70
Koyukuk at Evnsvl	062386	0800	17
Koyukuk at Evnsvl	062486	0800	27
Koyukuk at Evnsvl	062586	0800	210
Koyukuk at Evnsvl	062686	0800	190
Koyukuk at Evnsvl	062686	0800	50
Koyukuk at Evnsvl	070286	0800	2.8
Koyukuk at Evnsvl	070786	0700	1.3
Koyukuk at Evnsvl	071486	0800	14
Koyukuk at Evnsvl	072186	0700	5.8
Koyukuk at Evnsvl	080486	0800	110
Koyukuk at Evnsvl	101486	0800	5.0
Tozitna River	062486	1533	4.1

Appendix H. Description of mining operations in Mammoth Creek intensive study.

Information in this appendix was prepared by Judd Peterson, Alaska Division of Mining.

1. Great American Mining (GAM)

Location: Independence Creek

Description of operation: Cat pushes to one 3/4 yard drag line which feeds trommel/sluice setup. Tailing and oversize are pushed to tailings piles by cat.

Water useage of wash plant: 2,100-2,200 gallons per minute (gpm)

Hours of operation per day: 10

Cubic yards process per hour: 100

Percent recycle: 100

Treatment system: GAM uses a presettling pond at the start of tails race just below the trommel. From there all effluent goes into one large settling pond with a divider between the inflow and the pump suction line. Sole discharge is seepage into Independence Creek.

2. Don May

Location: Independence Creek

Cubic yards process per hour: Operation did not run while study was being conducted. He started sluicing a few days after the finish of the sampling period.

3. Dick Loud

Location: Mammoth Creek below Mastodon Creek

Description of operation: Two D-9 cats push pay to drag line which feeds double deck vibratory screen and punch plate wash plant. Oversize is fed onto a staking conveyor. Sluice tailings (1/2 inch minus) are fed to a large hopper and sand screw assembly for dewatering.

Water usage of wash plant: 1,840 gpm to plant from pump in recycle pond. In addition, 350 gpm is pumped to wash plant from cyclones. 370 gpm of makeup water is pumped into the recycle pond from Mammoth Creek.

Cubic yards process per hour: 100-150

Percent recycle: 100 percent through use of sand screw and cyclones.

Treatment system: He constructed a 100 percent recycle setup that he hoped would put all of the 1/2 inch minus solids on the tailings piles by use of a slurry discharge line from the cyclones. He found out that the cyclones would not separate out minus 200 mesh solids which ended up in his plastic lined recycle pond. The pond silted up completely after processing 40,000 cubic yards of pay and had to be mucked out with a dragline. He discovered that the recycle system needed thirty percent makeup water. The problem became what to do with the thirty percent of the process water he needed to be rid of. He lost some of this through seepage loss into Mammoth Creek. The rest was pumped into a slurry line onto the tailings piles.

4. Alaska Ventures

Location: Mammoth Creek above Miller Creek

Description of operation: Operation uses caterpillars to rip and push pay to a three yard backhoe.

Water usage of wash plant: 1,620 gpm

Cubic yards process per hour: 270

Percent recycle: none

Treatment system: One very large pond located approximately 1/2 mile below plant. This pond is approximately 600-800' by 150-200'. The dam at the lower end is approximately 15 feet high. Outflow from this pond is by pipe discharge and seepage. Effluent flows from there in a channel cut through old mine tailings before discharge into Mammoth Creek.

5. Dugas

Location: Mammoth Creek below Miller Creek

Description of operation: A rubber tired caterpillar is used to push pay to a hopper which has a conveyor feed to the top of a single deck'vibratory screen wash plant and sluice box. Tails and oversize are hauled to tailings piles with a 966 loader.

Water usage of wash plant: unknown

Cubic yards process per hour: 75

Percent recycle: none

Treatment system: From the end of the sluice box, the tails race extends down the left limit of the Mammoth Creek valley for about 3/4 mile to the first pond. This pond is an old cut, approximately 600' by 150' in size. The lower end of the cut is dammed to back up the water. This dam has no surface overflow and all discharge is by seepage at the base of the dam. From there the effluent runs into another old cut about 500' by 150'. This cut has no dam at the lower end but water is impounded by the depression of the cut. From here the effluent flows into a third old cut about 1000 feet downstream. This pond is about 300' by 150'. Outflow from this pond is seepage flow into a long (400'), narrow (10-50') pond with a dam at the end. Overflow from this pond flows into a series of 5 shallow pan ponds 25-50' in diameter spread over a distance of 1500 feet. These ponds are built on old leveled tailings. Discharge from these ponds flows onto the plain of Mammoth Creek. This is a long reach (approximately 2,000 feet) of vegetative filtration and shallow creek flow before the discharge reaches Mammoth Creek. Total length of this treatment system is approximately 2 miles.

Appendix I. Specific locations of study sites.

Map No.	Site Name	Full Name	MTRS Description
1	Birch A brdg	Birch Creek at Steese Hwy Bridge	50 ft above bridge on left bank in SE¼, NE¼, sec 1, T10N, R16E, FM
2	Birch ab CC	Birch Creek above Crooked Creek	100 ft above confluence with Crooked Creek in NW¼, NW¼, sec 9 T9N, R16E, FM
3	Crooked a Mth	Crooked Creek above mouth	1/4 mile above confluence with Birch Cr on left bank in NE¼, NE¼, sec 8, T9N, R16E, FM
4	Albert	Albert Creek at Steese Highway	At the steese Highway Bridge in NW¼, SW¼, sec 19, T9N, R15E, FM
5	Ketchem a CHSR	Ketchem Creek at the Circle Hot Springs Road	100 ft above bridge on right bank in SE¼, NE¼, sec 20, T8N, R15E, FM
6	Deadwood a CHSR	Deadwood Creek at the Circle Hot Springs Road	At the bridge on right bank in NE¼, NE¼, sec 12 T8N, R14E, FM
7	Crooked a Cen	Crooked Creek at Central	Above bridge on left bank in SW¼, SE¼, sec 27, T9N, R14E, FM
8	Boulder a gage	Boulder Creek above the USGS gage	Above USGS gage in SW¼, NW¼, sec 32, T9N, R14E, FM
9	Bedrock	Bedrock Creek below BLM Campground	200 ft below campground in SW¼, SW¼, sec 32, T9N, R13E, FM
10	Mammoth a Steese	Mammoth Creek at the Steese Hwy bridge	50 ft below bridge on right bank in SE¼, NE¼, sec 1, T8N, R13E, FM
11	Porcupine a mth	Porcupine above confluence with Mammoth Creek	3/4 mile above confluence on right bank in NW¼, NE¼, sec 1, T8N R12E, FM

Appendix I (con.)

Map No.	Site Name	Full Name	MTKS Description
12	Birch ab 12mile	Birch Creek above Twelvemile Creek	1/4 mile above confluence in SW¼, NW¼, sec 33, T7N, R10E, FM
13	Faith a Steese	Faith Creek at Steese Hwy	Above bridge in SE¼, NE¼, sec 6, T5N, R7E, FM