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Water-Quality, Bed-Sediment, and Biological Data (October 1997 Through September 1998) and Statistical Summaries of Data for Streams in the Upper Clark Fork Basin, Montana

By Kent A. Dodge, Michelle I. Hornberger, and Robin M. Bouse

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CONVERSION FACTORS AND ABBREVIATED WATER-QUALITY UNITS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.028317	cubic meter per second
foot (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
gallon (gal)	3,785	milliliter (mL)
inch (in.)	25.4	millimeter (mm)
inch (in.)	25,400	micrometer (µm)
mile (mi)	1.609	kilometer
ounce (oz)	28.35	gram (g)
part per million	1	microgram per gram (µg/g)
square mile (mi^2)	2.59	square kilometer
ton per day (ton/d)	907.2	kilogram per day

Temperature can be converted from degrees Celsius (°C) to degrees Fahrenheit (°F) by the equation:

$$°F = 9/5\ (°C) + 32$$

Abbreviated water-quality units used in this report:

µg/g	micrograms per gram
µg/L	micrograms per liter
µg/mL	micrograms per milliliter
µS/cm	microsiemens per centimeter at 25 degrees Celsius
mg/L	milligrams per liter

Water-year definition:

A water year is the 12-month period from October 1 through September 30. It is designated by the calendar year in which it ends.

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ABSTRACT

Water, bed sediment, and biota were sampled in streams from Butte to below Missoula as part of a program to characterize aquatic resources in the upper Clark Fork basin of western Montana. Sampling stations were located on the Clark Fork and major tributaries. Water-quality data were obtained periodically at 15 stations during October 1997 through September 1998 (water year 1998). Data for 15 bed-sediment and 15 biological stations were obtained in August 1998. The primary constituents analyzed were trace elements associated with tailings from historical mining and smelting activities.

Water-quality data include concentrations of selected major ions, trace elements, and suspended sediment in stream samples. Daily values of streamflow, suspended-sediment concentration, and suspended-sediment discharge are given for three stations. Bed-sediment data include trace-element concentrations in the fine-grained and bulk fractions. Biological data include trace-element concentrations in whole-body tissue of aquatic benthic insects. Quality-assurance data are reported for analytical results of water, bed sediment, and biota. Statistical summaries of water-quality, bed-sediment, and biological data are provided for the period of record at each station since 1985.

INTRODUCTION

The Clark Fork originates near Warm Springs in western Montana at the confluence of Silver Bow and Warm Springs Creeks (fig. 1). Along the 148-mi reach of stream from Silver Bow Creek in Butte to the Clark Fork at Milltown Reservoir, six major tributaries enter: Blacktail Creek, Warm Springs Creek, Little Blackfoot River, Flint Creek, Rock Creek, and Blackfoot River. Principal surface-water uses in the 6,000-mi^2 Clark Fork basin above Missoula include irrigation, stock watering, light industry, hydroelectric power generation, and habitat for trout fisheries. Current land uses primarily are cattle production, logging, mining, and recreation. Large-scale mining and smelting had been prevalent land uses in the upper basin for more than one hundred years, but are now largely discontinued.

Deposits of copper, gold, silver, and lead ores were extensively mined, milled, and smelted in the drainages of Silver Bow and Warm Springs Creeks from about 1870 to 1980. Moderate- and small-scale mining also occurred in the basins of most of the major tributaries to the upper Clark Fork. Tailings derived from mineral processing commonly contain large quantities of trace elements such as arsenic, cadmium, copper, lead, and zinc. Tailings have been eroded, mixed with stream sediment, and transported downstream since the late 1800's and redeposited in stream channels, on flood plains, and in the Warm Springs Ponds and Milltown Reservoir. The widely dispersed tailings continue to be eroded, transported, and redeposited along the stream channel and flood plain, especially during high flows. The occurrence of trace elements in elevated concentrations can pose a risk to aquatic biota and human health because they may accumulate to potentially toxic levels.

Concern about the potential toxicity of tailings to aquatic biota and human health has resulted in a comprehensive effort by State, Federal, and private entities to characterize the aquatic resources in the upper Clark Fork basin to guide and monitor remedial cleanup activities. A long-term data base was considered necessary to detect trends over time in order to evaluate the effectiveness of remediation. Water-quality data have been collected by the U.S. Geological Survey (USGS)

[1]U.S. Geological Survey, Menlo Park, Calif.

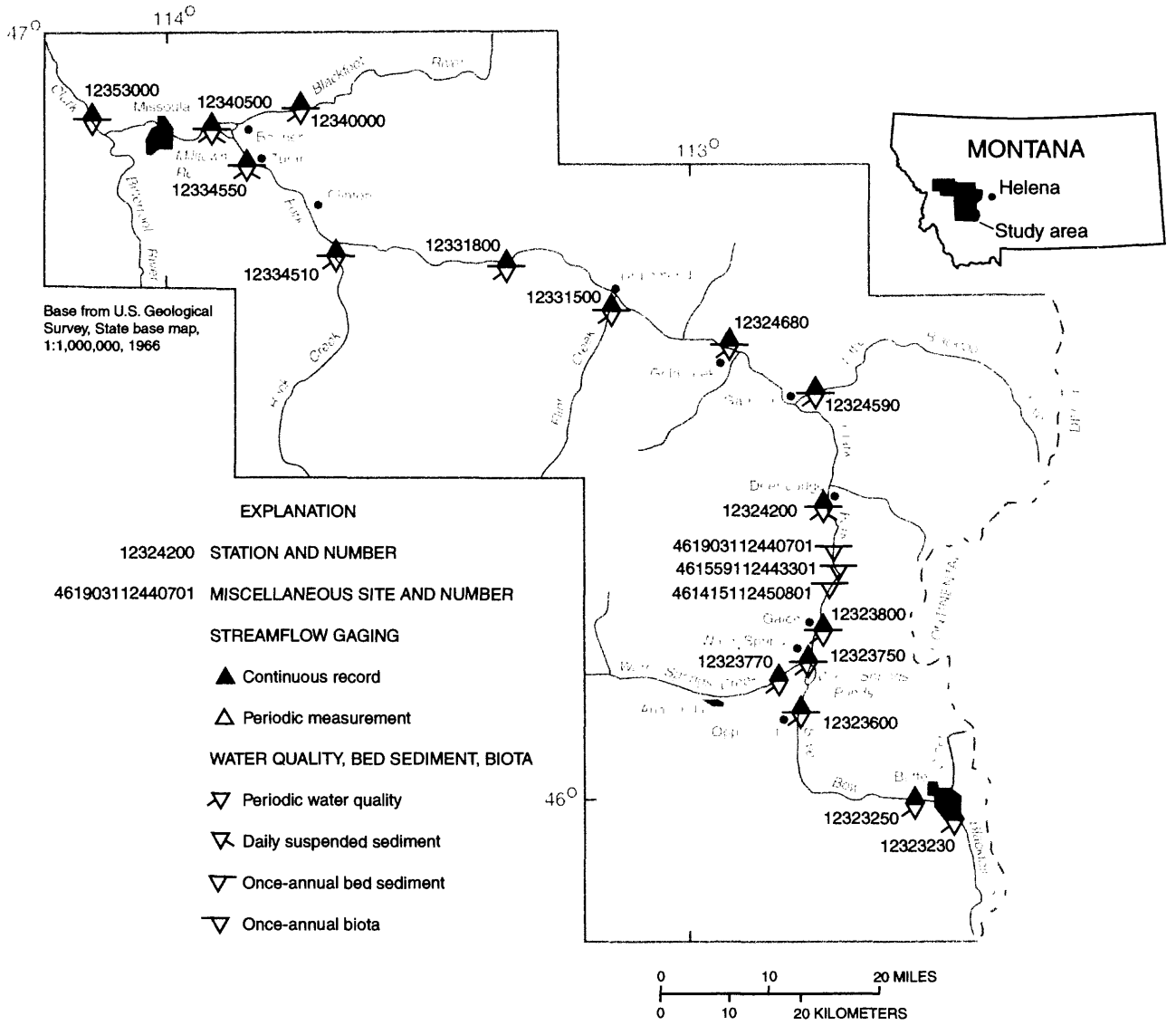

Figure 1. Location of study area.

at selected sites in the upper Clark Fork basin since 1985 (Lambing, 1987, 1988, 1989, 1990, and 1991; Lambing and others, 1994, 1995; and Dodge and others, 1996, 1997). Trace-element data for bed sediment and biota (aquatic benthic insects) have been collected intermittently since 1986 at selected sites as part of studies on bed-sediment contamination and bioaccumulation of metals conducted by the USGS National Research Program (Axtmann and Luoma, 1991; Axtmann and others, 1997; Cain and others, 1992, 1995; Hornberger and others, 1997). In March 1993, an expanded sampling program for water, bed sediment, and biota was implemented in cooperation with the U.S. Environmental Protection Agency to provide systematic, long-term monitoring. In 1996, water-quality and daily sediment sampling in the expanded program was scaled back to a less extensive network and reduced sampling frequency. In 1997, the water-quality network was partially restored to the pre-1996 status (water-quality sampling at the Clark Fork below Missoula was not reactivated) and sampling frequency was increased to better quantify the annual variability in selected constituents.

The purpose of this report is to present water-quality data for 15 stations and trace-element data for

15 bed-sediment and 15 biological stations in the upper Clark Fork basin collected from October 1997 through September 1998 (water year 1998). Quality-assurance data are presented for water quality, bed sediment, and biota. Statistical summaries also are provided for water-quality, bed-sediment, and biological data collected since 1985.

SAMPLING LOCATIONS AND TYPES OF DATA

Sampling stations in the upper Clark Fork basin are located on both the Clark Fork mainstem and major tributaries from Butte to below Missoula (fig. 1). Mainstem sampling sites were selected to divide the upper Clark Fork into reaches of relatively uniform length, with each reach encompassing either a major tributary or depositional environment (Warm Springs Ponds and Milltown Reservoir). Tributaries were sampled to describe water-quality characteristics for major hydrologic sources in the upper basin and to provide reference comparisons to the mainstem for bed sediment and biota. Water-quality data were obtained periodically at 15 stations; daily suspended-sediment data were obtained at 3 of these stations. Data for 15 bed-sediment and 15 biological stations were obtained once-annually (table 1).

A list of properties and constituents analyzed in samples of water, bed sediment, and biota is given in table 2. Results of analyses for water, bed sediment, biota, and associated quality assurance for water year 1998 are listed in tables 4 through 20 at the back of the report. Statistical summaries of water-quality, bed-sediment, and biological data collected between March 1985 and September 1998 are given in tables 21-24 at the back of the report.

Quality assurance of data was maintained through the use of documented procedures designed to provide environmentally representative data. Acceptable performance of the procedures was verified with quality-control samples that were collected systematically to provide a measure of the accuracy, precision, and bias of the environmental data and to identify problems associated with sampling, processing, or analysis.

WATER-QUALITY DATA

Water-quality data consist of measurements of physical properties and concentrations of chemical and physical constituents analyzed in stream samples. Samples were collected 5 to 8 times per year on a schedule designed to describe seasonal and hydrologic variability. In addition, 11 supplemental samples were collected by a contract observer at Clark Fork at Turah Bridge, near Bonner and Clark Fork above Missoula to better define chemical changes and transport during extended high flows, and during the lowering of Milltown Reservoir water levels for dam maintenance.

Methods

Cross-sectional water samples were collected from multiple verticals across the stream using depth- and width-integration methods described by USGS (1977), Knapton (1985), and Edwards and Glysson (1988). These methods provide a vertically and laterally discharge-weighted sample that is representative of the entire flow through the cross section of a stream. Sampling equipment consisted of standard USGS depth-integrating suspended-sediment samplers (DH-48, DH-81, and D-74TM), which are either constructed of plastic or coated with a non-metallic epoxy paint, and equipped with nylon nozzles.

Onsite measurements of water temperature, specific conductance, and pH were made during collection of periodic water-quality samples. Onsite sample processing, including filtration and preservation, was performed according to procedures described by Horowitz and others (1994), Ward and Harr (1990), USGS (1977), and Knapton (1985). Instantaneous streamflow at the time of water sampling was determined at all stations, either by direct measurement or from stage-discharge rating tables (Rantz and others, 1982).

Water samples were analyzed for the constituents listed in table 2 by the USGS National Water Quality Laboratory (NWQL) in Arvada, Colo. The trace elements arsenic, cadmium, copper, iron, lead, manganese, and zinc were analyzed for both dissolved and total-recoverable concentrations. Analytical methods are described by Fishman and Friedman (1989) and Fishman (1993).

Cross-sectional water samples also were collected for analysis of suspended sediment whenever

Table 1. Type and period of data collection at sampling stations in the upper Clark Fork basin, Montana

[Abbreviations: P, present. Symbol: --, no data]

Station number (fig. 1)	Station name	Continuous-record streamflow	Periodic water quality[1]	Daily suspended sediment	Fine-grained bed sediment[2]	Bulk bed sediment[2]	Biota[2]
12323230	Blacktail Creek at Harrison Avenue, at Butte	--	03/93-08/95, 12/96-P	--	--	--	--
12323250	Silver Bow Creek below Blacktail Creek, at Butte	10/83-P	03/93-08/95, 12/96-P	--	--	--	--
12323600	Silver Bow Creek at Opportunity	07/88-P	03/93-08/95, 12/96-P	03/93-09/95	07/92-P	08/93-08/95, 08/97-P	07/92, 08/94, 08/95, 08/97-P
12323750	Silver Bow Creek at Warm Springs	03/72-09/79, 04/93-P	03/93-P	04/93-09/95	07/92-P	08/93, 08/95-P	07/92-P
12323770	Warm Springs Creek at Warm Springs	10/83-P	03/93-P	--	08/95, 08/97	08/95, 08/97	08/95, 08/97
12323800	Clark Fork near Galen	07/88-P	07/88-P	--	08/87, 08/91-P	08/93-P	08/87, 08/91-P
461415112450801	Clark Fork below Lost Creek, near Galen	--	--	--	08/96-P	08/96-P	08/96-P
461559112443301	Clark Fork near Racetrack	--	--	--	08/96-P	08/96-P	08/96-P
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	--	--	--	08/96-P	08/96-P	08/96-P
12324200	Clark Fork at Deer Lodge	10/78-P	03/85-P	03/85-08/86, 04/87-P	08/86, 08/97, 08/90-P	08/93-P	08/86, 08/87, 08/90-P
12324590	Little Blackfoot River near Garrison	10/72-P	03/85-P	--	08/86, 08/87, 08/94, 08/98	08/94, 08/98	08/87, 08/94 08/98
12324680	Clark Fork at Goldcreek	10/77-P	03/93-P	--	07/92-P	08/93-P	07/92-P
12331500	Flint Creek near Drummond	08/90-P	03/85-P	--	08/86, 08/89, 07/92-P	08/93-P	08/86, 07/92-P
12331800	Clark Fork near Drummond	04/93-P	03/93-P	--	08/86, 08/87, 08/91-P	08/93-P	08/86, 08/91-P
12334510	Rock Creek near Clinton	10/72-P	03/85-P	--	08/86, 08/87, 08/89, 08/91-P	08/93-P	08/87, 08/91-P
12334550	Clark Fork at Turah Bridge, near Bonner	03/85-P	03/85-P	03/85-P	08/86, 08/91-P	08/93-P	08/86, 08/91-P
12340000	Blackfoot River near Bonner	10/39-P	03/85-P	07/86-04/87, 06/88-09/95	08/86, 08/87, 08/91, 08/93-96, 08/98	08/93, 08/94	08/86, 08/87, 08/91, 08/93, 08/96, 08/98
12340500	Clark Fork above Missoula	03/29-P	07/86-P	07/86-04/87, 06/88-01/96, 03/96-P	08/97-P	08/97-P	08/97-P
12353000	Clark Fork below Missoula[3]	10/29-P	03/85-09/95	--	08/86, 08/90-P	08/93-P	08/86, 08/90-P

[1]Onsite measurements of physical properties and laboratory analyses of major ions, trace elements, and suspended sediment. Prior to March 1993, laboratory analyses included only trace elements and suspended sediment, with the exception of Clark Fork below Missoula.

[2]Laboratory analyses of trace elements.

[3]Bed sediment and biota sampled about 30 miles downstream from water-quality station to conform to previous sampling location.

Table 2. Properties measured onsite and constituents analyzed in samples of water, bed sediment, and biota from the upper Clark Fork basin, Montana

Water		Bed sediment	Biota
Property	**Constituent**	**Constituent**	**Constituent**
Streamflow	Hardness	Cadmium	Cadmium
Specific conductance	Calcium	Chromium	Chromium
pH	Magnesium	Copper	Copper
Temperature	Arsenic	Iron	Iron
	Cadmium	Lead	Lead
	Copper	Manganese	Manganese
	Iron	Nickel	Nickel
	Lead	Silver	Zinc
	Manganese	Zinc	
	Zinc		
	Suspended sediment		

periodic water-quality samples were collected. These samples were analyzed for suspended-sediment concentration and the percentage of suspended sediment finer than 0.062-mm diameter (silt size and smaller) by the USGS sediment laboratory in Helena, Mont., according to methods described by Guy (1969) and Lambing and Dodge (1993).

At the three daily suspended-sediment stations (table 1), suspended-sediment samples were collected 2 to 9 times per week. These samples were collected by local contracted observers using the depth-integration method at a single vertical near mid-stream. The samples were analyzed for suspended-sediment concentration and were used to determine daily mean suspended-sediment concentrations according to methods described by Porterfield (1972).

Results

Water-quality data for samples collected periodically during October 1997 through September 1998 (water year 1998) are presented in table 4. The types of data include instantaneous streamflow, onsite measurements of water-quality properties, and analytical results for chemical constituents and suspended sediment.

Daily streamflow and suspended-sediment data for water year 1998 at the three daily suspended-sediment stations are given in tables 5 through 7. Monthly descriptive statistics for each parameter are provided along with totals for the annual discharge of water and suspended sediment.

Quality Assurance

Quality-assurance procedures used for the collection and field processing of water-quality samples are described by Horowitz and others (1994), Ward and Harr (1990), Edwards and Glysson (1988), Knapton and Nimick (1991), and Knapton (1985). Standard procedures used by the NWQL for internal sample handling and quality assurance are described by Friedman and Erdmann (1982), Jones (1987), and Pritt and Raese (1992). Quality-assurance procedures used by the Montana District sediment laboratory are described by Lambing and Dodge (1993).

The quality of analytical results reported for water-quality samples was evaluated by quality-control samples that were submitted from the field and analyzed concurrently in the laboratory with routine samples. These quality-control samples consisted of replicates, spikes, and blanks which provide quantitative information on the precision and bias of the overall field and laboratory process. Each type of quality-control sample was submitted at a proportion equivalent to about 5 percent of the total number of water-quality samples. Therefore, the total number of quality-control samples represented about 15 percent of the total number of water-quality samples.

In addition to quality-control samples submitted from the field, internal quality-assurance practices at the NWQL are performed systematically to provide quality control of analytical procedures (Pritt and Raese, 1992). These internal practices include analyses of quality-control samples such as calibration standards, standard reference water samples, replicate samples, deionized-water blanks, or spiked samples at a proportion equivalent to at least 10 percent of the sample load. The NWQL participates in a blind-sample program where standard reference water samples prepared by the USGS Branch of Quality Systems are routinely inserted into the sample line for each analytical method at a frequency proportional to the sample load. The laboratory also participates in external evaluation studies twice-yearly with the U.S. Environmental Protection Agency, the Canadian Center for Inland Water, and the Branch of Quality Systems to assess analytical performance.

Replicate data can be obtained in different ways to provide an assessment of precision (reproducibility) of analytical results. Replicate samples are two or more samples considered to be essentially identical in composition. Replicate samples can be obtained in the field by either repeating the collection process to obtain two or more samples or by splitting a single sample into two or more subsamples which are then analyzed separately (field replicate). Likewise, a single sample can be analyzed two or more times in the laboratory to obtain a measure of analytical variability (laboratory replicate).

Precision of analytical results for field replicates is affected by numerous sources of variability within the field and laboratory environments, including sample collection, sample processing, and sample analysis. To provide data on precision for samples exposed to all sources of variability, chemical-replicate samples were obtained in the field by splitting a composite stream sample. Suspended-sediment replicate samples were obtained in the field by concurrently collecting two independent cross-sectional samples. Analyses of these field replicates indicate the reproducibility of environmental data that are affected by the combined variability potentially introduced by field and laboratory processes.

Analytical precision was evaluated with laboratory replicates, which excluded field sources of variability. Two independent analyses were made of an individual sample selected randomly in the laboratory from the group of samples comprising each analytical run. A separate analysis of the sample was made at the beginning and end of each analytical run to provide information on the reproducibility of laboratory analytical results independent of possible variability caused by field collection and processing of samples.

Spiked samples are used to evaluate the ability of an analytical method to accurately measure a known amount of analyte added to a sample. Because some constituents in stream water can potentially interfere with the analysis of a targeted analyte, it is important to determine whether such effects are causing inaccurate analyses. Deionized-water blanks and aliquots of stream samples were spiked in the laboratory with known amounts of the same trace elements analyzed in water samples. Analyses of spiked blanks indicate if the spiking procedure and analytical method are within control for a water matrix that is presumably free of chemical interference. Analyses of spiked aliquots of stream samples indicate if the chemical matrix of the stream water interferes with the analytical measurement and whether these interferences could contribute significant bias to reported trace-element concentrations for stream samples.

Blank samples of deionized water were routinely analyzed to identify the presence and magnitude of contamination that potentially could bias analytical results. The particular type of blank sample routinely tested was a "field" blank. Field blanks are aliquots of deionized water that are certified as trace-element free and are processed through the sampling equipment used to collect stream samples. These blanks are then subjected to the same processing (sample splitting, filtration, preservation, transportation, and laboratory handling) as stream samples. Blank samples are analyzed for the same constituents as those of stream samples to identify whether any detectable concentrations exist.

All water samples were handled in accordance with chain-of-custody procedures that provide documentation of sample identity, shipment, receipt, and laboratory handling. All samples submitted from a sampling episode were stored and analyzed as a discrete sample group, independent of other samples submitted to the NWQL. Therefore, statistical descriptions of quality-control data generated for this program

are directly applicable to the analytical results for stream samples reported herein.

Data-quality objectives (table 3) were established for water-quality data as part of the study plan for the expanded long-term monitoring program that was initiated in 1993. The objectives identify analytical requirements of detectability and serve as a guide for identifying questionable data by establishing acceptable limits for precision and bias of laboratory results. Comparisons of quality-control data to data-quality objectives are used to evaluate whether sampling and analytical procedures are producing environmentally representative data in a consistent manner. Data that did not meet the objectives were evaluated for acceptability, and corrective action was taken, when appropriate.

The precision of analytical results for a constituent can be determined by estimating a standard deviation of the differences between replicate measurements for several sets of samples. These replicate measurements may consist either of individual analyses of a pair of samples considered to be essentially identical (field replicates) or multiple analyses of an individual sample (laboratory replicates). The differences in concentration between replicate analyses can be used to estimate a standard deviation according to the following equation (Taylor, 1987):

$$S = \sqrt{\frac{\Sigma d^2}{2k}} \quad (1)$$

where

S = standard deviation of the difference in concentration between replicate analyses,
d = difference in concentration between each pair of replicate analyses, and
k = number of pairs of replicate analyses.

Table 3. Data-quality objectives for analyses of water-quality samples collected in the upper Clark Fork basin, Montana

[Abbreviations: µg/L, micrograms per liter; mg/L, milligrams per liter; mm, millimeter. Symbol: --, not determined]

Constituent	Data-quality objectives		
	Detectability	Precision	Bias
	Minimum reporting level	Maximum relative standard deviation of laboratory replicate analyses, in percent	Maximum deviation of spike recovery, in percent
Calcium, dissolved	0.02 mg/L	20	--
Magnesium, dissolved	.01 mg/L	20	--
Arsenic, total recoverable	1 µg/L	20	25
Arsenic, dissolved	1 µg/L	20	25
Cadmium, total recoverable	1 µg/L	20	25
Cadmium, dissolved	.1 µg/L	20	25
Copper, total recoverable	1 µg/L	20	25
Copper, dissolved	1 µg/L	20	25
Iron, total recoverable	10 µg/L	20	25
Iron, dissolved	5 µg/L	20	25
Lead, total recoverable	1 µg/L	20	25
Lead, dissolved	.6 µg/L	20	25
Manganese, total recoverable	10 µg/L	20	25
Manganese, dissolved	2 µg/L	20	25
Zinc, total recoverable	10 µg/L	20	25
Zinc, dissolved	10 µg/L	20	25
Sediment, suspended	1 mg/L	--	--
Sediment, suspended (percent finer than 0.062 mm)	1 percent	--	--

Precision also can be expressed as a relative standard deviation (RSD), in percent, which is computed from the standard deviation and the mean concentration for all the replicate analyses. Expressing precision relative to a mean concentration standardizes comparison of precision among individual constituents. The RSD, in percent, is calculated according to the following equation (Taylor, 1987):

$$RSD = \frac{S}{\bar{x}} \times 100 \qquad (2)$$

where

RSD = relative standard deviation,

S = standard deviation, and

$\bar{x}$ = mean of all replicate concentrations.

Paired analyses of field replicates are presented in table 8. The precision estimated for each constituent based on these paired results, which include both field and laboratory sources of variability, is reported in table 9. Statistics for precision of field-replicate analyses were based on the values reported in table 8, which are rounded to standard USGS reporting levels for the particular constituent and its analytical method (Timme, 1994).

Data-quality objectives for precision are not directly applicable to field replicates because of the inability to determine whether the variability results from field sample collection and processing, or laboratory handling and analysis. However, a statistical calculation of precision for the field replicates is provided in table 9 to illustrate overall reproducibility of environmental data that incorporates both field and laboratory sources of variability. Relative standard deviations estimated from differences in analytical results between field replicates were within 20 percent for all constituents.

Analytical precision for chemical constituents based on replicate laboratory analyses of individual samples, which includes only laboratory sources of variability, is reported in table 10. Statistics for analytical precision of laboratory-replicate analyses are based on unrounded values stored in laboratory data files.

The data-quality objective for analytical precision of laboratory-replicate analyses is a maximum relative standard deviation of 20 percent. Precision estimates for laboratory-replicate analyses (table 10) were within the 20-percent relative standard deviation limit for all constituents, except dissolved lead. The relative standard deviation for dissolved lead (23 percent) barely exceeded the acceptable limit, and was affected primarily by measurements at or below instrument detection limits. The precision data, therefore, indicate acceptable reproducibility for laboratory-replicate analyses for all constituents, with the possible exception of dissolved lead concentrations near the detection limit.

Analyses of an unspiked sample and a spiked aliquot of the same sample provide a measure of the recovery efficiency for the analytical method within the chemical matrix of the sample. Spike recovery, in percent, was calculated using equation 3 (see below).

The data-quality objective for acceptable spike recovery of trace elements in water samples was a maximum deviation of 25 percent from a theoretical 100-percent recovery of added constituent. At the laboratory, a spiked deionized-water blank and a spiked aliquot of a stream sample were prepared and analyzed along with the original unspiked sample. The differences between the spiked and unspiked sample concentrations were determined and used to compute recovery according to equation 3. If the spike recovery for a trace element was outside a range of 75 to 125 percent, the instrument was recalibrated and the entire sample set and spiked samples were reanalyzed for that particular trace element until recoveries were improved to the extent possible. Results of recovery efficiency for individual trace elements in spiked deionized-water blanks and spiked stream samples are presented in tables 11 and 12, respectively.

The mean spike recovery for deionized-water samples spiked with trace elements ranged from 91.5 to 105.4 percent. The mean spike recovery for spiked

$$\text{Spike recovery, in percent} = \frac{\text{spiked sample concentration} - \text{unspiked sample concentration}}{\text{spike concentration}} \times 100 \qquad (3)$$

stream samples ranged from 90.1 to 105.0 percent. The 95-percent confidence intervals (Taylor, 1987) for the mean of spike recovery for each constituent analyzed in stream samples (table 12) did not exceed a 25-percent deviation from an expected 100-percent recovery.

High or low bias is indicated if the confidence interval does not include 100 percent recovery. All laboratory-spiked stream samples (table 12) had confidence intervals for percent recovery that included 100 percent, except for dissolved arsenic. Dissolved arsenic recoveries were slightly low, with the 95-percent confidence interval for spiked stream samples ranging from 85.5 to 94.7 percent. Because the mean spike recoveries met data-quality objectives, no adjustments were made to analytical results for stream samples on the basis of spike recoveries.

Analytical results for field blanks are presented in table 13. A field blank with constituent concentrations equal to or less than the minimum reporting level for the analytical method indicates that the entire process of sample collection, field processing, and laboratory analysis is presumably free of significant contamination. If detectable concentrations in field blanks were equal to or greater than twice the minimum reporting level (typical measurement precision at the detection level), the concentrations were noted during data review. Analytical results from the field blank for the next sample set is evaluated for a consistent trend that may indicate systematic contamination. Sporadic, infrequent exceedances of twice the minimum reporting level probably represent random contamination or instrument calibration error that is not persistent in the process and which is not likely to cause significant positive bias in a long-term record of analytical results. However, if concentrations for a particular constituent exceed twice the minimum reporting level in field blanks from two consecutive field trips, blank samples are collected from individual components of the processing sequence and are submitted for analysis in order to identify the source of contamination.

Constituent concentrations in field blanks were almost always less than the minimum reporting level. There was only one occurrence of a value equaling twice the minimum reporting level (calcium), and there were no occurrences of detectable concentrations for any trace element in two consecutive blank samples. Therefore, the analytical results for field blanks indicate no systematic contamination that would bias the reported water-quality data for stream samples.

BED-SEDIMENT DATA

Bed-sediment data consist of analyses of trace-element concentrations in the fine-grained and bulk (fine plus coarse) fractions of the bed sediment sample. Bed-sediment samples are collected once-annually during low, stable flow conditions to facilitate data comparisons among years.

Methods

Bed-sediment samples were collected in August 1998 using protocols described by E.V. Axtmann (U.S. Geological Survey, written commun., 1994). Samples were collected from the surfaces of streambed deposits in low-velocity areas near the edge of the stream using an acid-washed polypropylene scoop. Whenever possible, samples were collected from both sides of the stream. Three composite samples of fine-grained bed sediment and one composite sample of bulk bed sediment were collected at each site.

Individual samples of fine-grained bed sediment were collected by scooping material from the surfaces of three to five randomly selected deposits along pool or low-velocity areas. The three to five individual samples were combined to form a single composite sample. This collection process was repeated three times to obtain three composite samples. Each composite sample was wet-sieved onsite through a 0.064-mm nylon-mesh sieve using ambient stream water. The fraction of bed sediment in each composite sample that was finer than 0.064 mm was transferred to an acid-washed 500-mL polyethylene bottle and transported to the laboratory on ice.

Individual samples of bulk bed sediment also were collected by scooping material from the surfaces of three to five randomly selected deposits. Because the streambed at most sampling locations is predominantly gravel and cobble, deposits were selected where cobbles and gravel could be excluded from the samples. Bulk bed-sediment samples are not sieved and generally are composed of particles smaller than about 10 mm in diameter. The individual unsieved samples were composited into an acid-washed polyethylene bottle and transported to the laboratory on ice.

Bed-sediment samples were prepared for analysis at the USGS National Research Program laboratory in Menlo Park, Calif. Fine-grained and bulk bed-sediment samples were oven-dried at 60°C and ground using an acid-washed ceramic mortar and pestle. Duplicate aliquots of approximately 0.6 g of sediment from each of the three composite fine-grained bed sediment samples were digested using a hot, concentrated nitric acid reflux according to methods described by Luoma and Bryan (1981). Two aliquots were similarly digested from the single composite sample of bulk bed sediment. After a digestion period of up to several weeks, the aliquots were evaporated to dryness on a hot plate. The dry residue was redissolved with 20 mL of 0.6 N (normal) hydrochloric acid. The reconstituted aliquots then were filtered through a 0.45-µm filter using a syringe and in-line disposable filter cartridge. The filtrate was subsequently diluted to either a 1:5 or 1:10 ratio with 0.6 N hydrochloric acid. These final solutions were submitted to the Geology Department at the University of Montana, Missoula, Mont., to be analyzed for cadmium, chromium, copper, iron, lead, manganese, nickel, silver, and zinc using Inductively Coupled Argon Plasma Emission Spectroscopy (ICAPES).

Results

Concentrations of trace elements measured in samples of fine-grained and bulk bed sediment collected during August 1998 are summarized in tables 14 and 15, respectively. Liquid-phase concentrations, in µg/mL, that were analyzed in the reconstituted aliquots of digested bed sediment were converted to solid-phase concentrations, in µg/g, using the following equation:

$$\mu g/g = \frac{\mu g/mL \times \text{volume of digested sample, in mL}}{\text{dry weight of sample, in g} \times \text{dilution ratio}} \quad (4)$$

The reported solid-phase concentrations in table 14 and 15 are the means of all analyses of replicate aliquots from each composite sample collected at the site. Because the conversion from liquid-phase to solid-phase concentration is dependent on both the dilution ratio and the dry weight of the sample, minimum reporting levels for some trace elements may differ among stations and among years.

Quality Assurance

The protocols for field collection and processing of bed-sediment samples are designed to prevent contamination from metal sources. Non-metallic sampling and processing equipment was acid-washed and rinsed with deionized water prior to the first sample collection. Nylon-mesh sieves were washed in a laboratory-grade detergent and rinsed with deionized water. All equipment was given a final rinse onsite with stream water. Sampling equipment that was reused at each site was rinsed between sites with 10-percent nitric acid, deionized water, and stream water. Separate sieves were used at each site and, therefore, did not require between-site cleaning.

Quality assurance of analytical results for bed sediment included laboratory instrument calibration with standard solutions and analysis of quality-control samples designed to identify the presence and magnitude of bias (E.V. Axtmann, written commun., 1994). Quality-control samples consisted of standard reference materials and procedural blanks. Each type of sample was analyzed in a proportion equivalent to about 10 to 20 percent of the total number of bed-sediment samples.

Standard reference materials (SRM) are commercially prepared materials that have certified concentrations of trace elements. Replicate analyses of standard reference materials are used to indicate the reproducibility of analytical results and the ability of the method to accurately measure a known quantity of a constituent. Recovery efficiency of trace-element analyses of standard reference materials for bed sediment is summarized in table 16. Two standard reference materials consisting of agricultural soils representing low and high concentrations of trace elements were analyzed to test recovery efficiency for a range of concentrations generally similar to those occurring in the upper Clark Fork basin. The digestion process used to analyze bed-sediment samples is not a "total" digestion (does not liberate elements associated with crystalline lattices); therefore, 100-percent recovery may not be achieved for elements strongly bound to the sediment. The percent recovery of trace elements in standard reference materials when using less than a total digestion is useful to indicate which trace elements display strong sediment-binding characteristics and whether analytical recovery is consistent between multiple sets of analyses.

Although data-quality objectives have not been established for bed sediment, percent recoveries are shown in table 16 to illustrate analytical performance. Elements with mean recoveries outside a 25-percent deviation from complete (100 percent) recovery were cadmium, chromium, lead, and silver for the low-concentration range (SRM 2709), and chromium for the high-concentration range (SRM 2711). Chromium had the lowest recovery (63.1 and 68.4 percent) of all the elements. Lead and silver concentrations were not detected in the low-range SRM (2709). The reason for the lack of measurable recoveries is believed to be the result of analyzing concentrations very close to the detection limit, coupled with signal enhancement resulting from matrix interference. Because very few bed-sediment samples have lead and silver concentrations as low as SRM 2709, no adjustments were made to trace-element concentrations in bed-sediment samples on the basis of recovery efficiencies.

Procedural blanks for bed-sediment samples consisted of the same reagents used for sample digestion and reconstitution. Concentrated nitric acid used for sample digestion was heated and evaporated to dryness. After evaporation, 0.6 N hydrochloric acid was added quantitatively to the dry residue to obtain the same dilution ratio as that used in the analysis of bed sediment. Procedural blanks, therefore, represent the same chemical matrix as the reagents used to digest and reconstitute bed-sediment samples. Analytical results for procedural blanks can indicate the presence and magnitude of potential contamination associated with sample handling and analysis in the laboratory environment. Results of trace-element analyses of procedural blanks for bed sediment are in table 17.

Analytical results of procedural blanks are reported as a liquid-phase concentration, in µg/mL, which is equivalent to parts per million. Determination of the significance of a detectable blank concentration is based on the magnitude of the equivalent solid-phase concentration, in µg/g, relative to the ambient concentration of the trace element in bed-sediment samples. Because sample weights of individual aliquots may vary, the relative significance of blank concentrations may differ among samples. If a detectable blank concentration, after conversion to a solid-phase concentration, represents 10 percent or more of the ambient solid-phase concentration, then the blank concentration is subtracted to remove potential contamination bias. Almost all procedural blanks had concentrations less than analytical detection levels. Only iron and zinc were detected in concentrations more than twice the detection level. None of the detectable concentrations in blanks were greater than 10 percent of the ambient concentration. Therefore, no adjustments were made to trace-element concentrations in bed-sediment samples on the basis of procedural blanks.

BIOLOGICAL DATA

Biological data consist of analyses of trace-element concentrations in the whole-body tissue of aquatic benthic insects. Insect samples are collected once-annually at the same sites and dates as bed-sediment samples (table 1), allowing for a direct comparison of annual results.

Methods

Insect samples were collected using protocols described in Hornberger and others (1997). Immature stages of aquatic benthic insects were collected using a large nylon-mesh kick net. A single riffle at each station was sampled repeatedly until an adequate number of individuals was collected to provide sufficient mass for analysis. Targeted taxa for collection were *Hydropsyche* spp., and *Arctopsyche grandis*, Order Trichoptera (caddisflies), and *Claassenia sabulosa*, Order Plecoptera (stoneflies). Samples of each taxon were stored separately, by genus, in acid-washed plastic containers. Containers were kept on ice in the field while the insects were allowed to evacuate the gut contents in ambient stream water for a period of six to eight hours. Excess water then was drained and insects were frozen for transport to the laboratory.

Insect samples were processed and analyzed at the USGS National Research Program laboratory in Menlo Park, Calif. Insects were thawed and rinsed with ultra-pure deionized water to remove particulate matter, then sorted to their lowest possible taxonomic level. When large numbers of specimens were collected from a station, similar-sized individuals were composited into replicate subsamples. Subsamples were placed in tared scintillation vials and oven-dried at 70°C. Subsamples were weighed to obtain a final dry weight and digested by reflux using concentrated nitric acid (Cain and others, 1992). After digestion, insect samples were evaporated to dryness on a hot plate. The dry residue was reconstituted in 0.6 N hydrochloric acid, filtered through a 0.45-µm filter, and

analyzed undiluted by ICAPES for cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc.

Results

Concentrations of trace elements in whole-body tissue of aquatic insects collected during August 1998 are summarized in table 18. The variability in the number of composite samples among species and among sites reflects differences in insect abundance, with the number of composite samples increasing with the relative abundance of insects. Liquid-phase concentrations analyzed in the reconstituted samples were converted to solid-phase concentrations using equation 4. As in bed sediment, minimum reporting levels may differ among sites as a result of variable sample weights. In general, the smaller the biological sample weight (a function of insect abundance), the higher the minimum reporting level. Therefore, higher minimum reporting levels do not necessarily imply a higher trace-element concentration in tissue.

Two species of *Hydropsyche* were collected for this study: *Hydropsyche occidentalis* and *Hydropsyche cockerelli*. Species that could not be positively identified were considered to belong to the *morosa* group and are categorized as *Hydropsyche* spp. or *Hydropsyche morosa* group.

Quality Assurance

The protocols for field collection and processing of biota samples are designed to prevent contamination from metal sources. Non-metallic nets, sampling, and processing equipment were employed in all sample collection. Equipment was acid-washed and rinsed in ultra-pure deionized water prior to the first sample collection. Nets and equipment were thoroughly rinsed in ambient stream water at each new mainstem station. New nets and depuration chambers were used for the tributary stations. Biota samples were collected along an increasing concentration gradient to minimize effects from potential station-to-station carryover contamination.

Quality assurance of analytical results for biota samples included laboratory instrument calibration with standard solutions and analyses of quality-control samples designed to identify the presence and magnitude of bias. Quality-control samples consisted of standard reference material and procedural blanks. Each type of sample was analyzed in a proportion equivalent to about 10 to 20 percent of the total number of biota samples.

Recovery efficiency for trace-element analyses of standard reference material for biota is summarized in table 19. The reference material tested was lobster hepatopancreas. Data-quality objectives have not been established for analytical recovery in biota, but percent recoveries are shown to illustrate analytical performance. Mean recoveries were within 20 percent of complete (100 percent) recovery for all trace metals, except chromium. A slightly low bias is indicated for some constituents (confidence interval does not include 100 percent). Only chromium showed a high bias. Standard reference material concentrations of chromium may have resulted in a high bias because of interelement matrix interference. No adjustments were made to the trace element concentrations for the insect samples on the basis of recovery efficiency.

Results of trace-element analyses of procedural blanks for biota are in table 20. Procedural blanks for biota consisted of the same reagents used to digest and reconstitute tissue of aquatic insects. The blanks were analyzed undiluted at a proportion of one blank per site. Analytical results for blanks indicated no significant contamination bias. With the exception of iron and manganese, most concentrations in the blanks were below detection levels. The detectable concentrations are within the range of instrument variability and are insignificant in relation to the measured concentrations in the insect samples; thus, no adjustments were made to trace-element concentrations in biota.

STATISTICAL SUMMARIES OF DATA

Statistical summaries of water-quality, bed-sediment, and biological data are provided in tables 21-24 for the period of record at each station since 1985. The summaries include the period of record, number of samples, maximum, minimum, mean, and median of concentrations.

Statistical summaries of water-quality data (table 21) are based on results of cross-sectional samples col-

lected periodically by the USGS during the station's period of record. They do not include supplemental single-vertical samples collected by a contract observer at Clark Fork at Turah Bridge and Clark Fork above Missoula during 1997 and 1998. Statistical summaries of bed-sediment (table 22 and 23) and biological data (table 24) are based on results of samples collected once-annually during the indicated years. Because not all stations were sampled for bed sediment and biota every year, these data do not represent a consecutive annual record.

Sample sizes and statistics for bed-sediment data are based on the annual mean concentrations determined from the combined results of composite samples for a given year. Therefore, sample sizes for bed sediment represent the number of years sampled. Sample sizes and statistics for biological data are based on individual analyses for each composite sample collected in individual years rather than the combined annual mean concentration. Biota sample sizes therefore reflect differences in species abundances at each site and among all years. The statistics for biota describe the full range of trace-element concentrations measured among all available composite samples. The abundance of aquatic insects at a particular site in a given year limits the biomass of the sample which, in turn, may result in different taxa analyzed among years or in variable analytical detection limits. Where minimum reporting levels vary among years, statistical summaries are provided only as a general indication of the range of detection.

The presence or absence of insect species at a given site can vary among years and may result in different taxa being analyzed in the long-term period of record. Because *Hydropsyche* insects were not sorted to the species level during 1986-89, statistics for stations sampled during those years are based on the results of all *Hydropsyche* species combined. At some sites, statistics for the *Hydropsyche morosa* group are based on the combined results for two or more species because these samples could not be identified clearly to the species, but had *morosa* characteristics.

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DATA

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998

[Abbreviations: ft^3/s, cubic feet per second; °C, degrees Celsius; e, estimated; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter; mm, millimeter; ton/d, tons per day. Symbols: <, less than minimum reporting level; --, no data]

12323230--BLACKTAIL CREEK AT HARRISON AVENUE, AT BUTTE, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
03...	1005	8.4	271	7.8	3.5	110	30	7.2	3
Mar 1998									
11...	1030	7.6	290	7.9	4.0	120	32	8.4	3
Apr									
14...	1120	17	254	7.8	4.0	97	28	6.8	5
May									
01...	1130	28	187	7.8	8.0	72	21	5.0	7
12...	1145	21	207	7.8	13.5	84	24	5.9	5
[1]29...	0930	20	220	7.9	8.5	90	26	6.3	7
Jun									
26...	0750	44	198	7.8	11.5	83	24	5.7	11
Aug									
21...	1010	6.1	316	7.8	11.5	130	36	8.7	4

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
03...	2	<1	0.5	4	2	570	160	<1
Mar 1998								
11...	2	<1	.1	2	1	320	61	<1
Apr								
14...	4	<1	<.1	6	3	930	420	1
May								
01...	4	<1	<.1	9	5	1,300	480	2
12...	4	<1	<.1	6	4	730	290	1
[1]29...	5	<1	<.1	6	4	630	280	<1
Jun								
26...	7	<1	<.1	12	7	1,200	350	3
Aug								
21...	3	<1	<.1	2	1	260	44	<1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
03...	<0.6	60	42	<10	<10	7	0.16	80
Mar 1998								
11...	<.6	50	38	<10	<10	3	.06	86
Apr								
14...	.6	60	40	<10	<10	9	.41	88
May								
01...	<.6	50	27	<10	<10	17	1.3	80
12...	<.6	50	36	<10	<10	11	.62	82
[1]29...	<.6	50	43	<10	<10	10	.54	79
Jun								
26...	<.6	70	38	10	<10	28	3.3	66
Aug								
21...	<.6	40	32	<10	<10	4	.07	82

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12323250--SILVER BOW CREEK BELOW BLACKTAIL CREEK, AT BUTTE, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
03...	1145	24	470	7.6	7.0	150	43	11	21
Mar 1998									
11...	1130	22	505	7.7	6.5	160	45	12	9
Apr									
14...	0930	40	464	7.5	6.0	160	44	11	8
May									
01...	0920	42	354	7.7	9.0	120	35	8.3	12
12...	1010	38	394	7.6	10.5	130	38	9.4	10
[1]29...	0750	39	393	7.8	9.5	140	41	9.8	19
Jun									
26...	1010	73	335	7.8	11.5	120	35	8.1	13
Aug									
21...	1040	24	535	7.6	14.0	180	52	13	8

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
03...	8	2	.9	150	19	2,000	44	45
Mar 1998								
11...	5	2	1	82	20	650	42	11
Apr								
14...	4	4	4	89	77	640	150	6
May								
01...	6	2	1	68	34	2,300	250	11
12...	6	1	1	55	29	600	100	12
[1]29...	8	3	1	110	34	5,800	110	28
Jun								
26...	8	2	1	82	32	1,300	210	15
Aug								
21...	7	2	2	47	21	250	20	3

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
03...	<.6	500	390	480	320	71	4.6	82
Mar 1998								
11...	<.6	470	430	470	370	16	.95	84
Apr								
14...	1	630	620	960	920	12	1.3	85
May								
01...	.9	440	360	430	370	51	5.8	85
12...	.6	370	360	380	330	13	1.3	89
[1]29...	1	650	480	650	420	405	43	86
Jun								
26...	1	370	350	460	360	28	5.5	94
Aug								
21...	<.6	480	470	570	520	6	.39	86

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12323600--SILVER BOW CREEK AT OPPORTUNITY, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sulfate, dissolved (mg/L)
Nov 1997											
03...	1305	52	429	8.6	4.5	150	45	10	--	--	--
Mar 1998											
11...	1300	39	527	8.5	4.0	170	48	12	--	--	--
Apr											
14...	1335	65	447	8.5	5.0	160	46	10	23	4.8	89
May											
01...	1320	104	294	8.4	12.5	110	31	6.6	14	3.3	51
12...	1340	83	330	8.5	12.0	120	37	7.6	15	3.5	55
28...	1800	98	341	8.2	16.0	130	38	8.1	--	--	--
Jun											
26...	1135	140	305	8.2	11.0	110	33	7.0	--	--	--
Aug											
21...	1245	31	535	8.5	17.5	190	55	13	--	--	--

Date	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)
Nov 1997										
03...	--	--	--	14	7	2	1	140	43	780
Mar 1998										
11...	--	--	--	17	8	2	1	200	37	1,200
Apr										
14...	16	.5	26	16	7	3	2	160	47	990
May										
01...	8.7	.3	23	21	9	1	<.1	130	36	1,500
12...	9.7	.3	22	15	9	1	.5	100	30	740
28...	--	--	--	18	9	2	.9	140	39	980
Jun										
26...	--	--	--	27	10	2	1	260	84	1,900
Aug										
21...	--	--	--	19	9	2	2	230	65	470

Date	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997										
03...	24	17	<.6	550	500	460	280	17	2.4	86
Mar 1998										
11...	10	30	<.6	720	630	610	340	26	2.7	95
Apr										
14...	17	22	.6	700	670	660	420	21	3.7	91
May										
01...	61	31	1	370	259	350	143	62	17	63
12...	26	16	<.6	330	280	270	120	23	5.2	83
28...	46	29	1	420	380	400	190	32	8.5	79
Jun										
26...	120	58	2	480	380	620	320	76	29	61
Aug										
21...	12	14	.6	670	620	540	250	10	.84	84

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sulfate, dissolved (mg/L)
Nov 1997											
03...	1355	77	517	8.3	5.0	210	61	15	--	--	--
Mar 1998											
11...	1350	67	568	8.7	4.0	240	67	17	--	--	--
Apr											
14...	1510	95	506	9.0	7.0	210	60	14	19	4.4	130
May											
05...	0950	207	372	8.8	12.0	140	40	9.3	15	3.6	88
12...	1510	192	358	8.8	15.0	140	40	9.4	15	3.1	83
27...	1720	249	315	9.1	12.5	130	38	8.3	--	--	--
Jun											
26...	1245	292	343	8.9	11.5	140	43	8.7	--	--	--
Aug											
21...	1450	48	475	9.0	17.5	210	60	14	--	--	--

Date	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)
Nov 1997										
03...	--	--	--	17	17	<1	<.1	8	4	160
Mar 1998										
11...	--	--	--	13	10	<1	.2	11	8	140
Apr										
14...	12	.8	12	16	14	<1	<.1	24	9	310
May										
05...	8.8	.6	13	31	21	<1	<.1	25	10	620
12...	8.5	.5	13	24	20	<1	<.1	16	9	250
27...	--	--	--	27	23	<1	<.1	19	7	490
Jun										
26...	--	--	--	29	27	<1	<.1	12	8	280
Aug										
21...	--	--	--	41	39	<1	<.1	10	5	140

Date	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997										
03...	<5	1	<.6	60	32	20	<10	4	.83	93
Mar 1998										
11...	<5	<1	<.6	190	160	40	15	5	.90	51
Apr										
14...	8	3	<.6	210	120	50	<10	8	2.1	86
May										
05...	21	5	<.6	160	63	30	13	28	16	88
12...	16	2	.8	110	55	20	<10	12	6.2	89
27...	24	3	<.6	110	32	30	<10	19	13	85
Jun										
26...	21	1	<.6	210	160	20	<10	10	7.9	83
Aug										
21...	<5	1	<.6	160	58	20	<10	6	.78	90

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12323770--WARM SPRINGS CREEK AT WARM SPRINGS, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sulfate, dissolved (mg/L)
Nov 1997											
03...	1415	97	318	8.5	4.5	150	46	9.1	--	--	--
Apr 1998											
14...	1450	46	370	8.5	5.5	180	54	11	3.8	1.5	54
May											
12...	1445	103	230	8.4	10.5	110	34	6.3	2.2	.9	21
27...	1750	130	180	8.2	10.0	86	27	4.7	--	--	--
Jun											
26...	1345	263	175	8.2	9.0	83	26	4.6	--	--	--
Aug											
21...	1515	16	415	8.5	15.5	200	61	11	--	--	--

Date	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)
Nov 1997										
03...	--	--	--	4	3	<1	<.1	7	1	110
Apr 1998										
14...	1.3	.4	10	4	3	<1	<.1	6	4	90
May										
12...	.7	.3	9.1	5	3	<1	<.1	14	3	250
27...	--	--	--	7	3	<1	<.1	23	4	390
Jun										
26...	--	--	--	8	5	<1	<.1	27	4	480
Aug										
21...	--	--	--	7	7	<1	<.1	4	2	40

Date	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997										
03...	8	<1	<.6	150	130	<10	<10	6	1.6	82
Apr 1998										
14...	6	<1	<.6	190	170	<10	<10	8	.93	70
May										
12...	8	2	<.6	110	66	<10	<10	19	5.3	63
27...	11	4	<.6	120	65	10	<10	24	8.4	76
Jun										
26...	12	3	<.6	90	49	20	<10	30	21	72
Aug										
21...	<5	<1	<.6	200	190	<10	<10	2	.03	75

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12323800--CLARK FORK NEAR GALEN, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sulfate, dissolved (mg/L)
Nov 1997											
03...	1535	170	419	8.9	5.0	190	55	13	--	--	--
Mar 1998											
11...	1455	124	476	8.6	6.0	210	61	14	--	--	--
Apr											
15...	0745	158	471	8.6	4.0	210	61	13	15	3.4	110
May											
05...	1050	303	332	8.5	12.0	140	40	8.6	11	2.9	66
12...	1635	293	314	8.7	14.0	130	38	8.3	10	2.4	62
28...	0700	342	278	8.8	8.0	120	36	7.4	--	--	--
Jun											
26...	1520	533	270	8.7	12.0	110	35	6.7	--	--	--
Aug											
21...	1320	62	477	8.8	17.0	210	63	13	--	--	--

Date	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)
Nov 1997										
03...	--	--	--	10	10	<1	<.1	9	3	120
Mar 1998										
11...	--	--	--	8	8	<1	<.1	10	6	140
Apr										
15...	8.7	.7	12	12	10	<1	<.1	21	8	320
May										
05...	6.0	.4	12	25	16	<1	<.1	55	8	840
12...	5.5	.5	11	18	15	<1	<.1	20	7	300
28...	--	--	--	20	18	<1	<.1	23	6	450
Jun										
26...	--	--	--	22	18	<1	<.1	28	7	550
Aug										
21...	--	--	--	31	31	<1	<.1	10	5	110

Date	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997										
03...	4	<1	<.6	90	70	<10	<10	5	2.3	87
Mar 1998										
11...	<5	<1	<.6	200	160	20	10	4	1.3	90
Apr										
15...	11	2	<.6	250	170	40	<10	8	3.4	87
MAY										
05...	14	7	<.6	260	65	50	<10	44	36	79
12...	14	3	<.6	120	51	20	<10	17	13	76
28...	21	3	<.6	130	44	30	<10	20	18	75
Jun										
26...	16	3	<.6	160	83	30	<10	26	37	65
Aug										
21...	<5	1	.6	130	64	10	<10	7	1.2	76

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12324200--CLARK FORK AT DEER LODGE, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Sodium, dissolved (mg/L)	Potassium, dissolved (mg/L)	Sulfate, dissolved (mg/L)
Nov 1997											
03...	1715	351	458	8.6	5.0	210	60	14	--	--	--
Mar 1998											
11...	1610	252	485	8.6	5.0	220	63	15	--	--	--
Apr											
15...	0905	277	500	8.2	4.5	220	64	14	15	3.3	100
May											
05...	1220	384	385	8.3	13.5	160	47	10	12	3.0	73
13...	0750	292	360	8.1	11.5	150	44	9.5	12	2.8	65
28...	0845	443	330	8.2	9.5	140	42	9.1	--	--	--
Jun											
29...	0840	728	347	8.2	12.5	150	45	9.4	--	--	--
Aug											
21...	1655	86	516	8.5	17.0	220	66	14	--	--	--

Date	Chloride, dissolved (mg/L)	Fluoride, dissolved (mg/L)	Silica, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)
Nov 1997										
03...	--	--	--	10	9	<1	<.1	12	4	200
Mar 1998										
11...	--	--	--	10	7	<1	<.1	21	5	330
Apr										
15...	8.3	.7	15	13	9	<1	<.1	29	7	430
May										
05...	6.3	.5	14	25	14	<1	<.1	79	11	1,400
13...	6.4	.5	14	19	14	<1	<.1	41	10	510
28...	--	--	--	28	19	<1	<.1	90	9	1,400
Jun										
29...	--	--	--	20	16	<1	.1	56	12	840
Aug										
21...	--	--	--	20	19	<1	<.1	10	6	70

Date	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997										
03...	8	1	<.6	60	29	20	<10	10	9.5	80
Mar 1998										
11...	<5	2	<.6	90	50	30	<10	18	12	74
Apr										
15...	8	4	<.6	110	44	40	<10	21	16	63
May										
05...	8	11	<.6	240	23	80	15	69	72	68
13...	11	5	<.6	130	28	40	<10	25	20	79
28...	17	11	<.6	210	25	80	<10	76	91	67
Jun										
29...	17	6	<.6	130	26	50	<10	39	77	66
Aug										
21...	<5	<1	<.6	40	24	<10	<10	5	1.2	81

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
04...	1110	105	275	8.4	12.0	120	36	8.1	5
Apr 1998									
15...	1035	146	240	8.4	4.0	110	32	7.4	4
May									
13...	0915	282	186	8.1	9.0	86	25	5.9	5
28...	1120	332	207	8.2	9.5	97	28	6.5	5
Jun									
29...	1100	515	213	8.2	11.5	96	28	6.5	6
Aug									
21...	1745	68	273	8.5	16.5	120	36	8.2	6

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
04...	4	<1	<.1	1	<1	90	7	<1
Apr 1998								
15...	4	<1	<.1	1	1	180	33	<1
May								
13...	4	<1	<.1	2	2	300	27	<1
28...	5	<1	<.1	2	<1	260	28	<1
Jun								
29...	5	<1	<.1	2	2	340	44	<1
Aug								
21...	6	<1	<.1	<1	<1	40	<5	<1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
04...	<.6	20	5	<10	<10	4	1.1	97
Apr 1998								
15...	<.6	20	7	10	<10	6	2.4	85
May								
13...	<.6	30	10	<10	<10	16	12	74
28...	<.6	20	9	<10	<10	14	13	69
Jun								
29...	<.6	20	11	<10	<10	19	26	63
Aug								
21...	<.6	10	9	<10	<10	4	.73	72

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12324680--CLARK FORK AT GOLDCREEK, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
04...	1020	562	427	8.5	5.5	190	56	13	8
Mar 1998									
12...	0840	416	442	8.3	2.0	200	58	13	10
Apr									
16...	0845	513	421	8.3	4.0	190	54	12	10
May									
05...	1455	903	286	8.4	14.5	120	35	7.7	17
13...	1020	661	287	8.3	11.5	120	36	8.0	12
28...	1330	1,010	290	8.4	11.5	130	37	8.2	18
Jun									
29...	1240	1,620	297	8.3	14.0	130	38	8.3	14
Aug									
24...	0920	281	435	8.3	14.5	190	55	11	13

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
04...	8	<1	<.1	14	3	220	<5	2
Mar 1998								
12...	6	<1	<.1	29	6	410	6	3
Apr								
16...	8	<1	<.1	21	5	350	7	3
May								
05...	9	<1	<.1	43	7	1,200	18	7
13...	9	<1	<.1	35	6	470	13	4
28...	11	<1	<.1	67	8	1,100	14	9
Jun								
29...	10	<1	<.1	38	8	780	24	6
Aug								
24...	11	<1	<.1	12	4	190	<5	1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
04...	<.6	60	21	20	<10	10	15	90
Mar 1998								
12...	<.6	100	41	40	<10	24	27	81
Apr								
16...	<.6	80	25	30	<10	18	25	78
May								
05...	.8	150	14	50	<10	65	158	70
13...	<.6	80	13	30	<10	25	45	77
28...	<.6	140	13	60	<10	61	166	68
Jun								
29...	<.6	100	17	40	<10	43	188	61
Aug								
24...	<.6	60	10	10	<10	11	8.3	87

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12331500--FLINT CREEK NEAR DRUMMOND, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
04...	0910	183	308	8.3	5.0	140	38	12	8
Mar 1998									
12...	0950	111	299	8.5	2.0	140	37	12	9
Apr									
16...	1005	159	285	8.3	4.0	130	35	11	9
May									
05...	1630	274	162	8.4	13.5	70	19	5.3	26
13...	1145	119	214	8.5	10.0	99	27	7.6	12
28...	1540	231	236	8.5	13.5	110	31	8.3	15
Jun									
29...	1430	818	219	8.1	14.0	100	28	7.8	19
Aug									
24...	1015	41	469	8.4	12.0	210	58	17	10

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
04...	6	<1	<.1	2	<1	230	10	4
Mar 1998								
12...	5	<1	<.1	3	<1	290	7	5
Apr								
16...	5	<1	<.1	3	1	480	44	4
May								
05...	7	<1	<.1	9	2	1,000	50	18
13...	6	<1	<.1	3	1	390	19	8
28...	8	<1	<.1	4	1	440	21	9
Jun								
29...	16	<1	<.1	5	3	650	57	6
Aug								
24...	11	<1	<.1	2	<1	100	14	<1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
04...	<.6	70	19	10	<10	13	6.4	82
Mar 1998								
12...	<.6	100	28	20	<10	20	6.0	86
Apr								
16...	<.6	90	21	20	<10	28	12	82
May								
05...	.7	260	22	50	<10	78	58	68
13...	<.6	110	22	20	<10	24	7.7	86
28...	<.6	130	20	20	<10	39	24	63
Jun								
29...	<.6	170	23	30	<10	41	91	66
Aug								
24...	<.6	100	84	<10	<10	5	.55	80

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12331800--CLARK FORK NEAR DRUMMOND, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
04...	0750	884	437	8.4	5.0	200	55	14	9
Mar 1998									
12...	1055	593	457	8.5	4.5	210	58	15	9
Apr									
16...	1130	758	422	8.3	7.0	190	54	13	10
May									
06...	0810	1,200	300	8.1	12.0	130	37	8.5	19
13...	1310	817	331	8.4	13.5	150	42	10	11
Jun									
02...	0845	1,220	367	8.3	12.0	160	47	11	14
29...	1600	3,170	303	8.2	16.0	140	40	9.3	20
Aug									
24...	1150	406	519	8.4	16.5	230	67	16	13

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
04...	8	<1	<.1	12	3	230	<5	2
Mar 1998								
12...	7	<1	<.1	17	4	300	<5	2
Apr								
16...	7	<1	<.1	18	4	400	9	3
May								
06...	9	<1	<.1	46	7	1,300	22	11
13...	10	<1	<.1	23	6	380	8	4
Jun								
02...	12	<1	<.1	30	7	610	11	5
29...	15	<1	.2	57	9	1,600	32	10
Aug								
24...	13	<1	<.1	9	4	130	<5	<1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
04...	<.6	60	12	20	<10	11	26	90
Mar 1998								
12...	<.6	70	25	30	<10	20	32	76
Apr								
16...	.6	80	21	30	<10	33	68	53
May								
06...	<.6	190	10	80	<10	79	256	74
13...	<.6	70	15	30	<10	21	46	84
Jun								
02...	<.6	100	10	40	<10	40	132	66
29...	<.6	160	22	90	<10	115	984	58
Aug								
24...	<.6	50	12	10	<10	10	11	85

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12334510--ROCK CREEK NEAR CLINTON, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
05...	0920	337	134	8.0	3.5	59	15	5.1	<1
Apr 1998									
16...	1255	367	129	8.2	6.0	62	16	5.5	<1
May									
13...	1620	1,760	67	8.0	9.0	32	8.3	2.7	<1
Jun									
02...	1045	1,550	79	8.0	8.5	37	9.8	3.2	<1
30...	1150	1,900	94	8.0	12.5	43	11	3.5	<1
Aug									
24...	1255	355	134	8.4	13.5	61	16	5.2	<1

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
05...	<1	<1	<.1	<1	<1	60	15	<1
Apr 1998								
16...	<1	<1	<.1	<1	<1	80	16	<1
May								
13...	<1	<1	<.1	1	<1	180	36	<1
Jun								
02...	<1	<1	<.1	1	<1	140	35	<1
30...	<1	<1	<.1	2	<1	200	50	<1
Aug								
24...	<1	<1	<.1	<1	<1	70	11	<1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
05...	<.6	<10	3	<10	<10	2	1.8	85
Apr 1998								
16...	<.6	<10	2	<10	<10	4	4.0	78
May								
13...	<.6	<10	2	<10	<10	13	62	58
Jun								
02...	<.6	10	2	<10	<10	9	38	63
30...	<.6	<10	3	<10	<10	13	67	58
Aug								
24...	<.6	<10	4	<10	<10	4	3.8	79

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite ($\mu S/cm$)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable ($\mu g/L$)
Nov 1997									
05...	1045	1,310	361	8.4	5.5	160	46	12	6
Mar 1998									
12...	1300	880	379	8.5	5.0	170	49	13	6
Apr									
16...	1515	1,350	340	8.5	7.5	150	43	11	7
May									
06...	1050	3,110	182	8.1	11.0	77	22	5.5	10
[2]07...	1045	3,130	179	8.0	13.0	75	21	5.4	9
[2]09...	0845	3,340	172	7.8	10.0	74	21	5.3	11
[2]11...	0830	3,090	175	7.9	10.0	75	21	5.4	7
14...	0930	2,630	181	8.1	9.5	80	22	5.9	5
[2]24...	0810	3,500	207	7.9	10.0	91	26	6.4	14
Jun									
02...	1230	3,050	224	8.4	11.0	99	28	7.2	8
[2]19...	1800	4,440	228	8.1	11.0	98	28	7.1	17
[2]21...	0845	7,160	236	8.0	12.0	100	29	7.3	26
[2]22...	1100	6,390	227	8.1	15.0	98	28	6.9	19
[2]23...	0930	6,010	222	8.1	12.0	99	28	7.0	16
[2]25...	1440	5,980	231	8.1	14.0	100	29	7.3	14
[2]27...	1100	7,240	231	8.0	11.0	100	29	7.3	23
[2]30...	0645	5,420	230	8.1	14.0	100	29	7.3	13
30...	1410	5,200	233	8.2	16.5	100	30	7.4	12
Aug									
25...	0915	796	351	8.3	14.0	160	44	11	7

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT. (Continued)

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
05...	6	<1	<.1	8	3	150	<5	<1
Mar 1998								
12...	5	<1	<.1	15	5	160	<5	2
Apr								
16...	5	<1	<.1	14	4	280	8	2
May								
06...	4	<1	<.1	30	4	1,000	33	6
[2]07...	4	<1	<.1	30	6	1,200	26	6
[2]09...	4	<1	<.1	30	5	1,100	23	6
[2]11...	4	<1	<.1	22	4	690	21	4
14...	4	<1	<.1	11	3	300	23	2
[2]24...	6	<1	<.1	73	8	1,700	29	10
Jun								
02...	6	<1	<.1	16	4	390	18	2
[2]19...	7	<1	.2	82	7	2,400	17	13
[2]21...	11	<1	<.1	160	17	4,000	54	23
[2]22...	10	<1	<.1	83	11	2,200	37	12
[2]23...	8	<1	<.1	64	9	1,700	39	9
[2]25...	8	<1	.3	27	9	880	20	4
[2]27...	10	<1	<.1	95	13	3,200	39	16
[2]30...	8	<1	<.1	42	7	1,100	23	6
30...	8	<1	<.1	31	7	870	32	5
Aug								
25...	6	<1	<.1	5	2	100	<5	<1

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT. (Continued)

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
05...	<.6	40	4	10	<10	8	28	89
Mar 1998								
12...	<.6	40	11	20	<10	12	29	82
Apr								
16...	<.6	50	10	20	<10	15	55	81
May								
06...	<.6	130	7	50	<10	81	680	59
[2]07...	<.6	110	<2	50	<10	89	752	--
[2]09...	<.6	100	<2	50	<10	102	920	--
[2]11...	<.6	90	<2	40	<10	53	442	--
14...	<.6	40	6	20	<10	22	156	65
[2]24...	<.6	190	<2	90	<10	127	1,200	--
Jun								
02...	<.6	50	6	20	<10	28	231	65
[2]19...	<.6	240	<2	140	<10	214	2,570	--
[2]21...	<.6	440	3	230	<10	312	6,030	--
[2]22...	<.6	210	3	120	<10	163	2,810	--
[2]23...	<.6	170	4	90	<10	132	2,140	--
[2]25...	<.6	90	<2	40	<10	127	2,050	--
[2]27...	<.6	330	2	170	<10	250	4,890	--
[2]30...	<.6	130	4	60	<10	78	1,140	--
30...	<.6	100	16	50	<10	60	842	69
Aug								
25...	<.6	30	6	<10	<10	8	17	87

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12340000--BLACKFOOT RIVER NEAR BONNER, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Temperature, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)
Nov 1997									
05...	1255	854	265	8.7	6.0	140	34	12	1
Apr 1998									
17...	0800	1,220	206	8.3	6.0	100	27	9.2	<1
May									
06...	1430	4,300	152	8.2	11.0	73	19	6.2	1
14...	1130	3,260	160	8.3	10.0	80	21	6.9	<1
Jun									
02...	1400	3,570	185	8.4	11.5	91	23	7.9	1
30...	1620	4,050	210	8.4	15.5	110	28	8.9	1
Aug									
25...	1115	786	264	8.6	15.0	130	32	12	1

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
05...	1	<1	<.1	<1	<1	50	<5	<1
Apr 1998								
17...	1	<1	<.1	1	<1	140	15	<1
May								
06...	<1	<1	<.1	2	<1	400	12	<1
14...	<1	<1	<.1	1	<1	130	10	<1
Jun								
02...	1	<1	<.1	1	<1	190	10	<1
30...	1	<1	<.1	2	1	360	17	<1
Aug								
25...	1	<1	<.1	<1	<1	50	<5	<1

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
05...	<.6	<10	<2	<10	<10	3	6.9	90
Apr 1998								
17...	<.6	20	4	<10	<10	10	33	85
May								
06...	<.6	40	2	<10	<10	33	383	87
14...	<.6	10	2	<10	<10	11	97	90
Jun								
02...	<.6	20	2	<10	<10	15	145	91
30...	<.6	30	4	<10	<10	28	306	92
Aug								
25...	<.6	<10	2	<10	<10	3	6.4	85

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12340500--CLARK FORK ABOVE MISSOULA, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite ($\mu S/cm$)	pH, onsite (standard units)	Temperatnre, water (°C)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable ($\mu g/L$)
Nov 1997									
05...	1515	2,030	318	8.4	5.5	150	41	12	4
Mar 1998									
12...	1515	1,460	336	8.5	5.0	150	42	12	4
Apr									
17...	1000	2,610	275	8.3	6.5	130	35	10	4
May									
06...	1430	7,670	165	8.2	11.5	74	20	5.9	5
[2]07...	1200	7,620	165	8.0	13.0	76	21	5.9	4
[2]09...	1005	7,730	160	7.8	11.0	73	20	5.7	4
[2]11...	1030	6,990	--	--	11.0	76	21	6.0	4
14...	1310	6,070	173	8.2	10.0	81	22	6.4	3
[2]24...	0945	7,780	190	8.0	10.0	85	23	6.7	6
Jun									
02...	1500	6,810	201	8.4	11.5	94	25	7.5	4
[2]19...	1930	8,700	212	8.1	12.0	98	27	7.6	8
[2]21...	1020	12,600	224	8.1	12.0	100	27	7.8	15
[2]22...	1230	11,600	218	8.2	14.0	99	27	7.7	11
[2]23...	1050	10,700	217	8.2	14.0	100	27	7.9	10
[2]25...	1605	9,890	223	8.1	14.0	100	28	8.0	9
[2]27...	1230	11,800	225	8.1	12.0	100	28	8.1	12
[2]30...	0810	9,350	222	8.1	14.0	100	28	8.0	8
30...	1820	8,960	221	8.3	16.0	100	29	8.0	7
Aug									
25...	1315	1,620	297	8.5	16.5	140	36	11	4

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12340500--CLARK FORK ABOVE MISSOULA, MONT. (Continued)

Date	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
Nov 1997								
05...	4	<1	<.1	5	2	100	<5	<1
Mar 1998								
12...	4	<1	<.1	6	2	90	<5	<1
Apr								
17...	3	<1	<.1	8	2	210	13	2
May								
06...	2	<1	<.1	14	2	600	23	3
[2]07...	3	<1	<.1	14	3	650	18	3
[2]09...	2	<1	<.1	15	3	640	16	2
[2]11...	3	<1	<.1	12	2	470	13	2
14...	2	<1	<.1	8	2	260	17	2
[2]24...	3	<1	<.1	22	4	760	19	3
Jun								
02...	3	<1	<.1	10	2	310	19	1
[2]19...	4	<1	<.1	32	4	1,500	18	6
[2]21...	8	<1	<.1	75	9	2,700	38	12
[2]22...	5	<1	<.1	42	6	2,200	28	8
[2]23...	5	<1	<.1	35	5	1,600	32	7
[2]25...	5	<1	<.1	27	5	1,000	16	4
[2]27...	6	<1	<.1	120	8	1,800	29	9
[2]30...	6	<1	<.1	43	4	1,800	22	7
30...	5	<1	<.1	22	4	670	22	3
Aug								
25...	4	<1	<.1	3	2	80	<5	<1

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1997 through September 1998 (Continued)

12340500--CLARK FORK ABOVE MISSOULA, MONT. (Continued)

Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
Nov 1997								
05...	<.6	30	12	10	<10	5	27	93
Mar 1998								
12...	<.6	40	28	10	<10	5	20	91
Apr								
17...	<.6	60	37	10	<10	12	85	92
May								
06...	<.6	70	22	20	11	40	828	90
[2]07...	<.6	60	<2	20	<10	37	761	--
[2]09...	<.6	60	<2	20	<10	36	751	--
[2]11...	<.6	50	<2	20	<10	26	491	--
14...	<.6	30	14	10	<10	18	295	89
[2]24...	<.6	80	<2	30	<10	42	882	--
Jun								
02...	<.6	40	13	20	<10	21	386	92
[2]19...	<.6	140	<2	50	<10	96	2,260	--
[2]21...	<.6	260	2	120	<10	194	6,600	--
[2]22...	<.6	184	2	70	<10	154	4,820	--
[2]23...	<.6	150	4	60	<10	113	3,260	--
[2]25...	<.6	100	<2	50	<10	70	1,870	--
[2]27...	<.6	180	2	80	<10	120	3,820	--
[2]30...	<.6	170	5	70	<10	52	1,310	--
30...	<.6	70	17	40	<10	45	1,090	84
Aug								
25...	<.6	30	15	<10	<10	6	26	90

[1]Sample for May 29, 1998, was collected during excavation activities in the stream channel a short distance upstream of sampling location.
[2]Supplemental samples collected to better define metals transport through Milltown Reservoir during extended high-water runoff.

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1997 through September 1998

[Abbreviations: ft^3/s, cubic feet per second; e, estimated; mg/L, milligrams per liter; ton/d, tons per day. Symbol: ---, no data]

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1997					
	October			November			December		
1	279	12	9.0	374	17	17	334	13	12
2	281	15	11	353	12	11	325	14	12
3	277	14	10	349	10	9.4	288	16	12
4	280	14	11	351	10	9.5	303	23	19
5	292	12	9.5	351	10	9.5	290	27	21
6	319	11	9.5	344	10	9.3	285	28	22
7	325	12	11	340	10	9.2	281	28	21
8	366	18	18	342	10	9.2	278	28	21
9	353	17	16	345	10	9.3	281	28	21
10	340	16	15	343	10	9.3	271	28	20
11	356	15	14	324	11	9.6	268	27	20
12	366	14	14	315	12	10	267	26	19
13	352	13	12	320	19	16	270	25	18
14	349	11	10	306	27	22	278	24	18
15	350	10	9.5	295	31	25	269	24	17
16	341	9	8.3	300	28	23	279	28	21
17	330	9	8.0	297	23	18	295	30	24
18	324	9	7.9	310	19	16	299	29	23
19	323	9	7.8	320	15	13	274	28	21
20	323	9	7.8	323	13	11	278	26	20
21	318	9	7.7	323	13	11	286	24	19
22	309	9	7.5	323	13	11	273	23	17
23	322	9	7.8	319	13	11	266	22	16
24	338	9	8.2	326	13	11	278	21	16
25	338	10	9.1	337	13	12	269	20	15
26	342	12	11	330	13	12	252	20	14
27	347	13	12	338	13	12	259	23	16
28	346	14	13	331	13	12	251	42	28
29	345	15	14	332	13	12	273	63	46
30	343	16	15	333	13	12	284	59	45
31	370	20	20	---	---	---	272	49	36
TOTAL	10,244	---	344.6	9,894	---	382.3	8,676	---	650
MEAN	330	12	11	330	15	13	280	28	21
MAX	370	20	20	374	31	25	334	63	46
MIN	277	9	7.5	295	10	9.2	251	13	12

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
					1998				
		January			February			March	
1	277	40	30	255	21	14	264	21	15
2	289	34	27	268	20	14	262	20	14
3	299	31	25	267	19	14	269	20	15
4	298	27	22	276	19	14	269	18	13
5	299	23	19	271	20	15	260	18	13
6	277	20	15	267	23	17	254	21	14
7	287	18	14	273	28	21	252	29	20
8	291	21	16	289	29	23	250	25	17
9	e260	27	19	278	24	18	261	25	18
10	e220	31	18	276	20	15	258	23	16
11	e200	33	18	277	17	13	254	22	15
12	e190	34	17	267	17	12	264	22	16
13	e200	36	19	269	17	12	287	41	32
14	e220	37	22	267	17	12	300	52	42
15	234	37	23	264	17	12	316	47	40
16	228	37	23	266	18	13	331	69	62
17	273	36	27	263	18	13	348	65	61
18	296	35	28	266	18	13	334	38	34
19	306	35	29	260	19	13	307	34	28
20	309	34	28	260	19	13	284	32	25
21	299	34	27	263	19	13	279	36	27
22	287	33	26	270	18	13	300	47	38
23	280	33	25	263	17	12	333	46	41
24	283	32	24	258	17	12	360	67	65
25	282	32	24	262	16	11	357	52	50
26	278	32	24	260	16	11	350	43	41
27	277	30	22	255	16	11	340	31	28
28	279	27	20	241	18	12	331	31	28
29	274	25	18	---	---	---	313	25	21
30	277	24	18	---	---	---	304	23	19
31	272	23	17	---	---	---	308	24	20
TOTAL	8,341	---	684	7,451	---	386	9,199	---	888
MEAN	269	31	22	266	19	14	297	34	29
MAX	309	40	30	289	29	23	360	69	65
MIN	190	18	14	241	16	11	250	18	13

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1997 through September 1998 (Continued)

Day	Meau stream-flow (ft^3/s)	Suspeuded sediment		Mean stream-flow (ft^3/s)	Suspended sediment		Mean stream-flow (ft^3/s)	Suspended sediment	
		Mean concen-tratiou (mg/L)	Dis-charge (toa/d)		Mean concen-tratiou (mg/L)	Dis-charge (toa/d)		Mean concen-tration (mg/L)	Dis-charge (toa/d)
				1998					
	April			May			Juue		
1	300	26	21	317	23	20	354	36	34
2	298	26	21	323	39	34	324	24	21
3	291	23	18	348	51	48	328	15	13
4	289	32	25	380	63	65	336	12	11
5	295	24	19	373	61	61	322	13	11
6	303	24	20	368	50	50	300	11	8.9
7	333	37	33	385	45	47	313	15	13
8	334	36	32	402	64	69	363	21	21
9	323	31	27	396	57	61	353	18	17
10	306	25	21	377	47	48	341	19	17
11	305	29	24	360	37	36	377	23	23
12	294	22	17	333	26	23	384	24	25
13	296	24	19	299	25	20	465	45	56
14	286	19	15	298	18	14	531	70	100
15	279	15	11	278	14	11	531	62	89
16	277	19	14	251	14	9.5	539	54	79
17	276	15	11	247	12	8.0	662	71	127
18	269	21	15	239	13	8.4	646	63	110
19	261	23	16	221	8	4.8	725	95	186
20	258	16	11	210	8	4.5	1,050	172	488
21	255	22	15	201	14	7.6	883	115	274
22	253	31	21	331	57	51	803	62	134
23	257	25	17	464	116	145	808	51	111
24	290	47	37	439	57	68	835	55	124
25	322	51	44	410	58	64	834	70	158
26	305	36	30	415	48	54	1,000	79	213
27	296	25	20	465	83	104	968	60	157
28	288	20	16	429	67	78	818	39	86
29	283	19	15	341	26	24	706	37	71
30	294	24	19	335	34	31	628	28	47
31	---	---	---	392	58	61	---	---	---
TOTAL	8,716	---	624	10,627	---	1,329.8	17,527	---	2,824.9
MEAN	291	26	21	343	42	43	584	49	94
MAX	334	51	44	465	116	145	1,050	172	488
MIN	253	15	11	201	8	4.5	300	11	8.9

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	July			August			September		
1	656	48	85	174	19	8.9	116	5	1.6
2	674	60	109	159	20	8.6	114	5	1.5
3	814	105	231	155	16	6.7	110	5	1.5
4	1,090	106	312	141	13	4.9	106	5	1.4
5	909	33	81	151	22	9.0	106	5	1.4
6	784	22	47	159	17	7.3	105	4	1.1
7	696	21	39	176	11	5.2	108	5	1.5
8	619	20	33	153	9	3.7	116	7	2.2
9	621	19	32	137	8	3.0	128	13	4.5
10	586	19	30	134	7	2.5	169	23	10
11	665	26	47	142	5	1.9	198	29	16
12	622	16	27	112	6	1.8	187	27	14
13	561	19	29	97	4	1.0	172	24	11
14	497	13	17	92	4	.99	160	22	9.5
15	454	8	9.8	89	3	.72	155	19	8.0
16	398	6	6.4	86	3	.70	151	17	6.9
17	338	6	5.5	86	3	.70	153	14	5.8
18	304	6	4.9	93	4	1.0	156	12	5.1
19	275	6	4.5	91	6	1.5	153	11	4.5
20	237	6	3.8	85	5	1.1	164	12	5.3
21	217	5	2.9	85	4	.92	175	14	6.6
22	199	5	2.7	90	5	1.2	174	19	8.9
23	189	4	2.0	102	8	2.2	175	19	9.0
24	167	4	1.8	105	9	2.6	178	15	7.2
25	167	3	1.4	109	7	2.1	184	15	7.5
26	152	3	1.2	109	6	1.8	199	16	8.6
27	126	3	1.0	105	5	1.4	202	19	10
28	150	20	8.1	106	5	1.4	204	20	11
29	264	118	84	103	5	1.4	207	20	11
30	211	49	28	102	5	1.4	225	20	12
31	194	21	11	110	5	1.5	---	---	---
TOTAL	13,836	---	1,298.0	3,638	---	89.13	4,750	---	204.6
MEAN	446	26	42	117	8	2.9	158	15	6.8
MAX	1,090	118	312	176	22	9.0	225	29	16
MIN	126	3	1.0	85	3	.70	105	4	1.1

TOTAL FOR WATER YEAR 1998:

STREAMFLOW--112,899 ft^3/s
SEDIMENT DISCHARGE--9,705.33 tons

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1997 through September 1998

[Abbreviations: ft^3/s, cubic feet per second; e, estimated; mg/L, milligrams per liter; ton/d, tons per day. Symbol: ---, no data]

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
					1997				
	October			November			December		
1	1,120	7	21	1,580	18	77	1,080	5	15
2	1,120	7	21	1,440	10	39	1,060	4	11
3	1,150	7	22	1,350	9	33	963	4	10
4	1,190	8	26	1,330	8	29	874	3	7.1
5	1,240	8	27	1,300	8	28	913	3	7.4
6	1,260	8	27	1,280	8	28	900	3	7.3
7	1,350	9	33	1,260	7	24	911	3	7.4
8	1,410	12	46	1,240	6	20	976	4	11
9	1,440	14	54	1,240	5	17	1,030	9	25
10	1,430	13	50	1,240	5	17	957	8	21
11	1,370	11	41	1,200	5	16	926	5	13
12	1,390	9	34	1,110	4	12	873	4	9.4
13	1,370	8	30	1,100	4	12	891	4	9.6
14	1,330	7	25	1,090	4	12	904	4	9.8
15	1,320	7	25	999	5	13	979	5	13
16	1,320	7	25	991	5	13	973	7	18
17	1,320	7	25	1,020	5	14	1,020	8	22
18	1,300	7	25	1,140	5	15	1,010	7	19
19	1,290	6	21	1,130	5	15	939	6	15
20	1,270	6	21	1,130	6	18	874	5	12
21	1,260	5	17	1,120	6	18	900	4	9.7
22	1,240	5	17	1,120	6	18	891	3	7.2
23	1,220	6	20	1,090	6	18	859	2	4.6
24	1,250	6	20	1,100	6	18	845	2	4.6
25	1,250	6	20	1,140	6	18	852	2	4.6
26	1,230	6	20	1,120	6	18	802	2	4.3
27	1,250	6	20	1,080	5	15	819	2	4.4
28	1,250	6	20	1,110	5	15	830	3	6.7
29	1,250	6	20	1,090	5	15	936	10	25
30	1,270	7	24	1,060	5	14	1,010	9	25
31	1,430	15	58	---	---	---	956	9	23
TOTAL	39,890	---	855	35,200	---	619	28,753	---	382.1
MEAN	1,287	8	28	1,173	6	21	928	5	12
MAX	1,440	15	58	1,580	18	77	1,080	10	25
MIN	1,120	5	17	991	4	12	802	2	4.3

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	Jannnry			February			March		
1	916	9	22	834	16	36	799	7	15
2	990	9	24	772	14	29	864	10	23
3	967	8	2i	804	12	26	887	12	29
4	944	8	20	849	11	25	889	11	26
5	9i2	8	20	898	10	24	865	9	21
6	896	8	19	876	11	26	828	8	18
7	844	8	18	890	15	36	795	7	15
8	903	8	20	919	18	45	781	6	13
9	896	7	17	921	18	45	807	9	20
10	e600	7	11	904	17	41	863	14	33
11	e500	6	8.1	895	16	39	858	14	32
12	e500	5	6.8	879	15	36	874	12	28
13	e550	4	5.9	866	14	33	932	18	45
14	e700	4	7.6	865	12	28	1,020	28	77
15	e900	4	9.7	846	11	25	1,090	38	112
16	e1,100	10	30	868	10	23	1,320	94	335
17	e1,200	37	120	853	10	23	1,430	104	402
18	e1,250	31	105	845	10	23	1,280	67	232
19	e1,150	23	71	850	10	23	1,120	36	109
20	1,230	18	60	841	10	23	1,070	29	84
21	1,000	16	43	859	10	23	1,090	32	94
22	927	14	35	879	9	21	1,290	90	313
23	897	12	29	866	8	19	1,870	266	1,340
24	892	10	24	831	8	18	2,610	403	2,840
25	947	9	23	839	8	18	2,640	224	1,600
26	935	8	20	854	8	18	2,020	105	573
27	955	8	21	829	8	18	1,790	59	285
28	945	8	20	800	7	15	1,590	45	193
29	892	8	19	---	---	---	1,440	32	124
30	887	9	22	---	---	---	1,340	26	94
31	931	14	35	---	---	---	1,280	24	83
TOTAL	28,156	---	907.1	24,032	---	759	38,332	---	9,208
MEAN	908	11	29	858	12	27	1,237	59	297
MAX	1,250	37	120	921	18	45	2,640	403	2,840
MIN	500	4	5.9	772	7	15	781	6	13

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	April			May			June		
1	1,290	24	84	2,250	54	328	3,310	47	420
2	1,300	25	88	2,470	66	440	3,050	30	247
3	1,340	26	94	2,660	79	567	2,910	23	181
4	1,430	31	120	2,910	116	911	2,780	21	158
5	1,460	35	138	3,080	104	865	2,610	18	127
6	1,490	32	129	3,140	85	721	2,510	16	108
7	1,550	31	130	3,170	75	642	2,540	23	158
8	1,590	32	137	3,310	82	733	2,580	20	139
9	1,550	30	126	3,390	80	732	2,540	22	151
10	1,510	25	102	3,240	57	499	2,410	17	111
11	1,500	23	93	3,080	42	349	2,490	20	134
12	1,500	23	93	2,860	37	286	2,580	20	139
13	1,470	22	87	2,710	30	220	2,750	23	171
14	1,410	18	69	2,670	23	166	3,040	38	312
15	1,380	15	56	2,650	28	200	3,270	47	415
16	1,350	17	62	2,460	21	139	3,340	45	406
17	1,330	14	50	2,330	19	120	3,420	62	573
18	1,330	16	57	2,360	21	134	3,840	115	1,190
19	1,300	14	49	2,190	17	101	4,180	142	1,600
20	1,290	12	42	2,060	11	61	6,420	390	6,760
21	1,300	13	46	2,100	13	74	7,000	233	4,400
22	1,350	15	55	2,660	40	287	6,400	132	2,280
23	1,470	21	83	3,260	90	792	6,030	105	1,710
24	1,790	47	227	3,480	93	874	5,970	102	1,640
25	2,140	78	451	3,240	54	472	5,930	102	1,630
26	2,040	54	297	3,240	50	437	6,330	98	1,670
27	1,890	39	199	3,640	71	698	7,180	176	3,410
28	1,840	30	149	3,670	67	664	6,720	115	2,090
29	1,900	32	164	3,280	47	416	5,870	72	1,140
30	2,070	46	257	3,110	43	361	5,310	60	860
31	---	---	---	3,380	47	429	---	---	---
TOTAL	46,160	---	3,734	90,050	---	13,718	125,310	---	34,330
MEAN	1,539	28	124	2,905	54	443	4,177	78	1,140
MAX	2,140	78	451	3,670	116	911	7,180	390	6,760
MIN	1,290	12	42	2,060	11	61	2,410	16	108

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	July			August			September		
1	4,980	54	726	1,610	12	52	703	6	11
2	5,070	62	849	1,490	6	24	697	5	9.4
3	4,950	58	775	1,410	6	23	688	5	9.3
4	5,650	132	2,010	1,360	6	22	676	5	9.1
5	6,030	152	2,470	1,290	6	21	673	4	7.3
6	5,200	75	1,050	1,230	6	20	659	4	7.1
7	4,510	57	694	1,200	6	19	655	5	8.8
8	4,050	43	470	1,190	7	22	667	7	13
9	3,830	40	414	1,140	7	22	705	9	17
10	3,620	38	371	1,090	7	21	732	12	24
11	3,560	40	384	1,050	7	20	853	18	41
12	3,530	37	353	994	7	19	881	18	43
13	3,160	32	273	934	6	15	854	13	30
14	2,830	30	229	878	6	14	825	13	29
15	2,610	23	162	831	6	13	810	12	26
16	2,410	19	124	813	6	13	797	12	26
17	2,220	16	96	793	6	13	789	12	26
18	2,070	14	78	790	5	11	788	12	26
19	1,930	9	47	785	5	11	797	13	28
20	1,820	8	39	760	5	10	825	13	29
21	1,710	8	37	743	4	8.0	846	13	30
22	1,640	8	35	758	4	8.2	849	13	30
23	1,570	8	34	766	4	8.3	866	13	30
24	1,520	8	33	801	14	30	862	14	33
25	1,480	8	32	780	6	13	862	14	33
26	1,410	8	30	774	6	13	899	16	39
27	1,360	8	29	754	6	12	934	20	50
28	1,340	8	29	736	6	12	925	18	45
29	1,400	8	30	731	5	9.9	921	15	37
30	1,480	10	40	726	5	9.8	909	14	34
31	1,590	17	73	714	5	9.6	---	---	---
TOTAL	90,530	---	12,016	29,921	---	518.8	23,947	---	781.0
MEAN	2,920	33	388	965	6	17	798	12	26
MAX	6,030	152	2,470	1,610	14	52	934	20	50
MIN	1,340	8	29	714	4	8.0	655	4	7.1

TOTAL FOR WATER YEAR 1998:

STREAMFLOW--600,281 ft^3/sec
SEDIMENT DISCHARGE--77,828 tons

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1997 through September 1998

[Abbreviations: ft^3/s, cubic feet per second; e, estimated; mg/L, milligrams per liter; ton/d, tons per day. Symbol: ---, no data]

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1997					
	October			November			December		
1	1,890	5	26	2,510	9	61	1,830	4	20
2	1,870	6	30	2,360	8	51	1,810	4	20
3	1,890	5	26	2,200	6	36	1,660	3	13
4	1,930	4	21	2,200	5	30	1,480	3	12
5	1,980	4	21	2,160	6	35	1,510	3	12
6	2,040	5	28	2,110	5	28	1,390	3	11
7	2,060	6	33	2,050	4	22	1,360	4	15
8	2,180	7	41	2,040	4	22	1,550	5	21
9	2,180	8	47	2,040	4	22	1,880	5	25
10	2,180	7	41	2,030	4	22	1,750	4	19
11	2,160	6	35	1,960	4	21	1,700	4	18
12	2,170	5	29	1,820	3	15	e1,650	4	18
13	2,100	5	28	1,850	3	15	e1,600	4	17
14	2,040	4	22	1,790	3	14	e1,700	4	18
15	2,040	4	22	1,590	4	17	1,870	4	20
16	2,040	4	22	1,610	5	22	1,820	4	20
17	2,010	4	22	1,770	5	24	1,810	5	24
18	2,080	4	22	1,930	4	21	1,760	4	19
19	2,040	4	22	1,840	4	20	1,660	4	18
20	2,040	4	22	1,880	4	20	1,530	3	12
21	2,000	6	32	1,900	3	15	1,590	3	13
22	1,950	5	26	1,870	3	15	1,580	2	8.5
23	1,930	4	21	1,850	4	20	1,620	2	8.7
24	1,980	4	21	1,810	4	20	1,680	2	9.1
25	2,050	4	22	1,940	5	26	1,530	2	8.3
26	1,980	4	21	1,900	4	21	1,720	2	9.3
27	1,970	4	21	1,860	3	15	1,690	3	14
28	2,000	4	22	1,890	3	15	1,560	3	13
29	2,010	4	22	1,860	3	15	1,710	4	18
30	2,040	4	22	1,810	4	20	1,880	4	20
31	2,300	7	43	---	---	---	1,700	4	18
TOTAL	63,130	---	833	58,430	---	700	51,580	---	491.9
MEAN	2,036	5	27	1,948	4	23	1,664	4	16
MAX	2,300	8	47	2,510	9	61	1,880	5	25
MIN	1,870	4	21	1,590	3	14	1,360	2	8.3

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	January			February			March		
1	1,600	4	17	1,420	3	12	1,350	3	11
2	1,730	4	19	1,300	3	11	1,430	5	19
3	1,680	4	18	1,340	3	11	1,490	7	28
4	1,630	4	18	1,430	3	12	1,520	7	29
5	1,580	5	21	1,510	4	16	1,460	7	28
6	1,620	4	17	1,470	4	16	1,400	5	19
7	1,480	4	16	1,490	4	16	1,350	3	11
8	1,530	3	12	1,540	4	17	1,330	4	14
9	1,410	2	7.6	1,530	4	17	1,370	4	15
10	e1,000	2	5.4	1,500	4	16	1,440	4	16
11	e800	4	8.6	1,500	4	16	1,430	5	19
12	e900	7	17	1,470	4	16	1,440	5	19
13	e1,000	8	22	1,450	4	16	1,500	6	24
14	e1,300	7	25	1,440	4	16	1,630	8	35
15	e1,500	6	24	1,420	4	15	1,700	8	37
16	e1,800	5	24	1,450	4	16	2,030	10	55
17	1,890	4	20	1,430	4	15	2,270	20	123
18	1,900	3	15	1,410	4	15	2,090	21	119
19	1,850	4	20	1,420	4	15	1,820	14	69
20	1,870	5	25	1,410	4	15	1,780	9	43
21	1,850	6	30	1,430	4	15	1,760	8	38
22	1,730	5	23	1,470	4	16	1,970	9	48
23	1,630	4	18	1,450	4	16	2,740	19	141
24	1,590	4	17	1,420	4	15	3,770	55	560
25	1,610	3	13	1,400	4	15	4,110	64	710
26	1,580	3	13	1,430	3	12	3,420	50	462
27	1,580	4	17	1,390	3	11	3,000	29	235
28	1,580	5	21	1,360	3	11	2,730	21	155
29	1,480	5	20	---	---	---	2,520	17	116
30	1,500	4	16	---	---	---	2,300	16	99
31	1,560	3	13	---	---	---	2,270	15	92
TOTAL	47,760	---	552.6	40,280	---	410	62,420	---	3,389
MEAN	1,541	4	18	1,439	4	15	2,014	15	109
MAX	1,900	8	30	1,540	4	17	4,110	64	710
MIN	800	2	5.4	1,300	3	11	1,330	3	11

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	April			May			June		
1	2,270	13	80	5,380	28	407	7,370	28	557
2	2,310	11	69	5,870	31	491	6,900	23	428
3	2,410	11	72	6,270	34	576	6,530	19	335
4	2,550	12	83	7,120	40	769	6,220	21	353
5	2,730	13	96	7,520	43	873	5,770	17	265
6	2,860	15	116	7,650	41	847	5,480	15	222
7	3,050	17	140	7,650	37	764	5,430	15	220
8	3,090	16	133	7,750	34	711	5,350	17	246
9	3,030	15	123	7,850	35	742	5,240	17	241
10	2,970	13	104	7,520	31	629	5,000	14	189
11	2,950	14	112	7,100	26	498	5,150	15	209
12	2,950	14	112	6,560	22	390	5,570	18	271
13	2,910	11	86	6,160	19	316	5,740	17	263
14	2,770	11	82	6,120	18	297	6,160	22	366
15	2,730	10	74	6,030	17	277	6,500	31	544
16	2,670	11	79	5,660	14	214	6,670	28	504
17	2,620	12	85	5,360	14	203	6,850	27	499
18	2,590	11	77	5,560	15	225	7,710	50	1,040
19	2,510	11	75	5,190	12	168	8,370	84	1,900
20	2,490	10	67	4,860	9	118	11,200	226	6,830
21	2,490	11	74	4,910	10	133	12,200	190	6,260
22	2,540	10	69	6,140	17	282	11,800	154	4,910
23	2,830	14	107	7,400	29	579	11,100	112	3,360
24	3,500	16	151	7,700	40	832	10,400	84	2,360
25	4,460	21	253	7,190	33	641	9,910	70	1,870
26	4,470	20	241	7,070	25	477	10,100	72	1,960
27	4,260	18	207	7,870	33	701	11,600	115	3,600
28	4,170	17	191	8,430	41	933	11,200	98	2,960
29	4,430	16	191	7,690	30	623	10,000	65	1,760
30	4,860	19	249	7,180	25	485	9,190	49	1,220
31	---	---	---	7,520	26	528	---	---	---
TOTAL	92,470	---	3,598	208,280	---	15,729	236,710	---	45,742
MEAN	3,082	14	120	6,719	27	507	7,890	57	1,520
MAX	4,860	21	253	8,430	43	933	12,200	226	6,830
MIN	2,270	10	67	4,860	9	118	5,000	14	189

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1997 through September 1998 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment		Mean streamflow (ft^3/s)	Suspended sediment	
		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)		Mean concentration (mg/L)	Discharge (ton/d)
				1998					
	July			August			September		
1	8,570	46	1,060	3,020	8	65	1,420	6	23
2	8,560	49	1,130	2,800	7	53	1,380	5	19
3	8,390	43	974	2,660	7	50	1,370	5	18
4	9,130	66	1,630	2,530	6	41	1,340	5	18
5	9,730	99	2,600	2,450	6	40	1,320	4	14
6	8,710	62	1,460	2,360	6	38	1,320	4	14
7	7,940	43	922	2,280	5	31	1,260	4	14
8	7,320	34	672	2,240	5	30	1,320	4	14
9	6,880	28	520	2,190	5	30	1,370	4	15
10	6,600	27	481	2,080	5	28	1,380	4	15
11	6,530	25	441	2,030	5	27	1,490	7	28
12	6,430	25	434	1,930	5	26	1,560	8	34
13	5,930	25	400	1,810	5	24	1,530	7	29
14	5,460	21	310	1,720	5	23	1,470	6	24
15	5,100	16	220	1,650	4	18	1,420	5	19
16	4,750	12	154	1,590	4	17	1,400	5	19
17	4,450	10	120	1,580	4	17	1,370	5	18
18	4,110	9	100	1,560	4	17	1,380	5	19
19	3,870	9	94	1,540	4	17	1,370	5	18
20	3,630	9	88	1,530	4	17	1,430	4	15
21	3,430	9	83	1,500	4	16	1,380	4	15
22	3,180	8	69	1,510	4	16	1,450	4	16
23	3,120	8	67	1,520	4	16	1,450	4	16
24	3,040	8	66	1,600	4	17	1,410	4	15
25	2,870	7	54	1,610	5	22	1,440	4	16
26	2,810	6	46	1,590	5	21	1,460	4	16
27	2,660	5	36	1,530	5	21	1,500	4	16
28	2,610	4	28	1,500	5	20	1,510	4	16
29	2,680	5	36	1,460	5	20	1,480	5	20
30	2,820	8	61	1,450	5	20	1,450	5	20
31	2,930	11	87	1,440	5	19	---	---	---
TOTAL	164,240	---	14,443	58,260	---	817	42,430	---	553
MEAN	5,298	24	466	1,879	5	26	1,414	5	18
MAX	9,730	99	2,600	3,020	8	65	1,560	8	34
MIN	2,610	4	28	1,440	4	16	1,260	4	14

TOTAL FOR WATER YEAR 1998:

STREAMFLOW--1,125,990 ft3/s
SEDIMENT DISCHARGE--87,258.5 tons

Table 8. Chemical and suspended-sediment analyses of field replicates for water samples, upper Clark Fork basin, Montana

[Abbreviations: µg/L, micrograms per liter; mg/L, milligrams per liter; mm, millimeter. Symbols: <, less than minimum reporting level; --, no data]

Station number	Station name	Date	Time	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)
12323770	Warm Springs Creek at Warm Springs	06-26-98	1345	83	26	4.6	8	5
		06-26-98	1350	83	26	4.6	8	5
12324200	Clark Fork at Deer Lodge	03-11-98	1610	220	63	15	10	7
		03-11-98	1615	220	63	14	9	7
12324590	Little Blackfoot River near Garrison	05-28-98	1120	97	28	6.5	5	5
12324680		05-28-98	1125	97	28	6.6	5	5
12324680	Clark Fork at Goldcreek	04-16-98	0845	190	54	12	10	8
		04-16-98	0850	190	54	12	10	7
12334550	Clark Fork at Turah Bridge, near Bonner	05-06-98	1050	77	22	5.5	10	4
		05-06-98	1055	81	23	5.8	10	4
		08-25-98	0915	160	44	11	7	6
		08-25-98	0920	150	43	11	7	6
12340500	Clark Fork above Missoula	05-14-98	1310	81	22	6.4	3	2
		05-14-98	1315	81	22	6.5	3	2

Station number	Date	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)
12323770	06-26-98	<1	<0.1	27	4	480	12	3
	06-26-98	<1	<.1	25	5	480	11	2
12324200	03-11-98	<1	<.1	21	5	330	<5	2
	03-11-98	<1	<.1	22	5	340	<5	2
12324590	05-28-98	<1	<.1	2	<1	260	28	<1
	05-28-98	<1	<.1	2	1	250	27	<1
12324680	04-16-98	<1	<.1	21	5	350	7	3
	04-16-98	<1	<.1	22	5	340	7	3
12334550	05-06-98	<1	<.1	30	4	1000	33	6
	05-06-98	<1	<.1	30	5	1100	38	6
	08-25-98	<1	<.1	5	2	100	<5	<1
	08-25-98	<1	<.1	5	2	110	<5	<1
12340500	05-14-98	<1	<.1	8	2	260	17	2
	05-14-98	<1	<.1	8	2	250	18	1

Station number	Date	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)	Sediment, suspended (µg/L)	Sediment, suspended, diameter, percent finer than 0.062 mm
12323770	06-26-98	<0.6	90	49	20	<10	30	72
	06-26-98	<.6	100	49	10	<10	29	74
12324200	03-11-98	<.6	90	50	30	<10	18	74
	03-11-98	<.6	100	50	30	11	17	76
12324590	05-28-98	<.6	20	9	<10	<10	14	69
	05-28-98	<.6	20	9	<10	<10	14	64
12324680	04-16-98	<.6	80	25	30	<10	18	78
	04-16-98	<.6	80	25	30	<10	16	78
12334550	05-06-98	<.6	130	7	50	<10	81	59
	05-06-98	<.6	120	11	60	<10	79	59
	08-25-98	<.6	30	6	<10	<10	8	87
	08-25-98	<.6	30	5	10	<10	7	85
12340500	05-14-98	<.6	30	14	10	<10	18	89
	05-14-98	<.6	30	14	10	<10	17	88

Table 9. Precision of chemical and suspended-sediment analyses of field replicates for water samples, upper Clark Fork basin, Montana

[Abbreviations: µg/L, micrograms per liter; mg/L, milligrams per liter; mm, millimeter]

Constituent and reporting unit	Number of replicate pairs	Standard deviation, in units (+/-)	Relative standard deviation, in percent (+/-)
Calcium, dissolved, mg/L	7	0.38	1.0
Magnesium, dissolved, mg/L	7	.28	3.2
Arsenic, total recoverable, µg/L	7	.27	3.6
Arsenic, dissolved, µg/L	7	.27	5.2
Cadmium, total recoverable, µg/L	7	.0	.0
Cadmium, dissolved, µg/L	7	.0	.0
Copper, total recoverable, µg/L	7	.65	4.0
Copper, dissolved, µg/L	7	.40	6.4
Iron, total recoverable, µg/L	7	27	6.8
Iron, dissolved, µg/L	7	1.4	9.5
Lead, total recoverable, µg/L	7	.38	17
Lead, dissolved, µg/L	7	.0	.0
Manganese, total recoverable, µg/L	7	4.6	6.8
Manganese, dissolved, µg/L	7	1.1	4.8
Zinc, total recoverable, µg/L	7	4.0	18
Zinc, dissolved, µg/L	7	.43	7.9
Sediment, suspended, mg/L	7	.93	3.6
Sediment, suspended, percent finer than 0.062 mm	7	1.6	2.2

Table 10. Precision of chemical analyses of laboratory replicates for water samples, upper Clark Fork basin, Montana

[Abbreviations: µg/L, micrograms per liter; mg/L, milligrams per liter]

Constituent and reporting unit	Number of replicate pairs	Standard deviation, in units (+/-)	Relative standard deviation, in percent (+/-)	Within limits of data-quality objective
Calcium, dissolved, mg/L	8	0.25	0.7	Yes
Magnesium, dissolved, mg/L	8	.07	.7	Yes
Arsenic, total recoverable, µg/L	8	.43	6.2	Yes
Arsenic, dissolved, µg/L	8	.12	2.6	Yes
Cadmium, total recoverable, µg/L	8	.02	5.1	Yes
Cadmium, dissolved, µg/L	8	.02	7.5	Yes
Copper, total recoverable, µg/L	8	.55	1.9	Yes
Copper, dissolved, µg/L	8	.59	6.9	Yes
Iron, total recoverable, µg/L	8	2.4	.5	Yes
Iron, dissolved, µg/L	8	1.4	3.0	Yes
Lead, total recoverable, µg/L	8	.17	4.0	Yes
Lead, dissolved, µg/L	8	.07	23	No
Manganese, total recoverable, µg/L	8	1.4	1.1	Yes
Manganese, dissolved, µg/L	8	.82	.8	Yes
Zinc, total recoverable, µg/L	8	1.4	1.3	Yes
Zinc, dissolved, µg/L	8	3.3	6.0	Yes

Table 11. Recovery efficiency for trace-element analyses of laboratory-spiked deionized-water blanks

[Abbreviation: µg/L, micrograms per liter]

Constituent and reporting unit	Number of samples	95-percent confidence interval for spike recovery, in percent	Mean spike recovery, in percent	Within limits of data-quality objective
Arsenic, total recoverable, µg/L	4	99.2-112	105.4	Yes
Arsenic, dissolved, µg/L	4	87.3-95.7	91.5	Yes
Cadmium, total recoverable, µg/L	4	87.0-108	97.4	Yes
Cadmium, dissolved, µg/L	4	93.8-114	104	Yes
Copper, total recoverable, µg/L	4	98.8-108	103.4	Yes
Copper, dissolved, µg/L	4	93.4-107	100.4	Yes
Iron, total recoverable, µg/L	4	90.7-113	101.8	Yes
Iron, dissolved, µg/L	4	89.9-102	95.7	Yes
Lead, total recoverable, µg/L	4	88.8-121	104.8	Yes
Lead, dissolved, µg/L	4	91.8-109	100.2	Yes
Manganese, total recoverable, µg/L	4	94.4-111	102.8	Yes
Manganese, dissolved, µg/L	4	92.1-106	99.0	Yes
Zinc, total recoverable, µg/L	4	86.9-116	101.3	Yes
Zinc, dissolved, µg/L	4	85.9-104	95.2	Yes

Table 12. Recovery efficiency for trace-element analyses of laboratory-spiked stream samples, upper Clark Fork basin, Montana

[Abbreviation: µg/L, micrograms per liter]

Constituent and reporting unit	Number of samples	95-percent confidence interval for spike recovery, in percent	Mean spike recovery, in percent	Within limits of data-quality objective
Arsenic, total recoverable, µg/L	4	95.8-112	104.0	Yes
Arsenic, dissolved, µg/L	4	85.5-94.7	90.1	Yes
Cadmium, total recoverable, µg/L	4	92.7-106	99.5	Yes
Cadmium, dissolved, µg/L	4	97.3-112	104.4	Yes
Copper, total recoverable, µg/L	4	88.4-110	99.1	Yes
Copper, dissolved, µg/L	4	90.6-104	97.2	Yes
Iron, total recoverable, µg/L	4	82.8-112	97.5	Yes
Iron, dissolved, µg/L	4	90.2-113	101.8	Yes
Lead, total recoverable, µg/L	4	92.9-117	105.0	Yes
Lead, dissolved, µg/L	4	94.3-110	102.2	Yes
Manganese, total recoverable, µg/L	4	85.8-113	99.5	Yes
Manganese, dissolved, µg/L	4	98.0-105	101.5	Yes
Zinc, total recoverable, µg/L	4	85.6-112	98.8	Yes
Zinc, dissolved, µg/L	4	89.1-110	99.5	Yes

Table 13. Chemical analyses of field blanks for water samples

[Abbreviations: °C, degrees Celsius; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter. Symbol: <, less than minimum reporting level]

Date	Time	Specific conductance, onsite (µS/cm)	pH, onsite (standard units)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable (µg/L)	Arsenic, dissolved (µg/L)	Cadmium, total recoverable (µg/L)	Cadmium, dissolved (µg/L)	Copper, total recoverable (µg/L)
NOV 1997										
05...	1500	3	5.6	0.02	<0.01	<1	<1	<1	<0.1	<1
MAR 1998										
12...	0700	3	5.7	<.02	<.01	<1	<1	<1	<.1	<1
APR										
16...	1630	3	5.6	<.02	<.01	<1	<1	<1	<.1	<1
MAY										
13...	1400	3	5.7	<.02	<.01	<1	<1	<1	<.1	<1
28...	0950	2	5.5	<.02	<.01	<1	<1	<1	<.1	<1
AUG										
22...	0800	2	5.7	.03	<.01	<1	<1	<1	<.1	<1

Date	Copper, dissolved (µg/L)	Iron, total recoverable (µg/L)	Iron, dissolved (µg/L)	Lead, total recoverable (µg/L)	Lead, dissolved (µg/L)	Manganese, total recoverable (µg/L)	Manganese, dissolved (µg/L)	Zinc, total recoverable (µg/L)	Zinc, dissolved (µg/L)
NOV 1997									
05...	<1	<10	<5	<1	<0.6	<10	<2	<10	<10
MAR 1998									
12...	<1	<10	<5	<1	<.6	<10	<2	<10	<10
APR									
16...	<1	<10	<5	<1	<.6	<10	<2	<10	<10
MAY									
13...	<1	<10	<5	<1	<.6	<10	<2	<10	<10
28...	<1	<10	<5	<1	<.6	<10	<2	<10	<10
AUG									
22...	<1	<10	<5	<1	<.6	<10	<2	<10	<10

Table 14. Trace-element analyses of fine-grained bed sediment, upper Clark Fork basin, Montana, August 1998

[Fine-grained sediment is material less than 0.064 millimeter in diameter. Concentrations are the mean of all analyses for replicate aliquots from each composite sample. Abbreviation: µg/g, micrograms per gram of dry sample weight. Symbol: <, less than]

Station number (fig. 1)	Station name	Number of composite samples	Concentration, in µg/g								
			Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Silver	Zinc
12323600	Silver Bow Creek at Opportunity	3	23.7	32.4	4,220	41,100	797	2,590	16.1	15.2	6,990
12323750	Silver Bow Creek at Warm Springs	3	6.6	34.1	358	27,200	100	3,960	19.1	<3.2	812
12323800	Clark Fork near Galen	3	6.4	31.2	1,090	34,100	145	5,040	19.3	<3.2	1,230
461415112450801	Clark Fork below Lost Creek, near Galen	3	6.8	32.0	1,360	32,700	168	3,980	17.8	4.2	1,280
461559112443301	Clark Fork near Racetrack	3	5.5	30.0	946	31,700	134	3,130	16.7	<3.3	1,030
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	3	4.8	34.1	842	33,700	115	2,680	16.8	3.5	900
12324200	Clark Fork at Deer Lodge	3	5.5	43.9	978	35,300	138	2,240	21.1	4.3	1,050
12324590	Little Blackfoot River near Garrison	3	1.5	52.9	78	30,700	35.6	905	21.9	<1.6	204
12324680	Clark Fork at Goldcreek	3	4.9	48.9	791	30,600	119	1,770	18.6	3.2	1,110
12331500	Flint Creek near Drummond	3	1.8	29.2	56.4	25,700	150	3,090	14.6	5.1	577
12331800	Clark Fork near Drummond	3	3.0	34.0	470	27,000	99	1,910	16.0	<3.2	939
12334510	Rock Creek near Clinton	3	.7	26.1	15	20,600	10	724	13.4	<1.6	53
12334550	Clark Fork at Turah Bridge, near Bonner	3	4.0	31.1	413	24,000	85	2,270	16.3	2.4	909
12340000	Blackfoot River near Bonner	3	.6	25.8	21	20,200	12.8	472	13.4	<1.6	62
12340500	Clark Fork above Missoula	3	2.3	30.6	282	24,300	60	1,290	15.0	<3.2	696
12353000	Clark Fork below Missoula[1]	3	1.9	23.9	156	20,300	41	1,490	12.8	1.6	447

[1]Samples collected about 30 miles downstream from water-quality station to conform to previous sampling location.

Table 15. Trace-element analyses of bulk bed sediment, upper Clark Fork basin, Montana, August 1998

[Bulk bed sediment collected in this study generally is material smaller than about 10 millimeters in diameter. Concentrations are the mean of all analyses for replicate aliquots for each composite sample. Abbreviation: µg/g, micrograms per gram of dry sample weight. Symbol: <, less than]

Station number (fig. 1)	Station name	Number of composite samples	Concentration, in µg/g								
			Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Silver	Zinc
12323600	Silver Bow Creek at Opportunity	1	4.9	11.6	670	20,800	231	741	6.0	3.5	1,740
12323750	Silver Bow Creek at Warm Springs	1	.5	9.2	20	7,200	11	722	4.8	<1.5	93
12323800	Clark Fork near Galen	1	4.8	11.3	250	19,500	158	1,120	5.8	<3.2	677
461415112450801	Clark Fork below Lost Creek, near Galen	1	2.0	13.1	398	17,600	78	1,390	6.7	<3.5	522
461559112443301	Clark Fork near Racetrack	1	2.1	12.7	375	17,900	78	1,680	7.3	<3.2	535
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	1	3.0	20.9	577	25,400	88	1,940	12.8	<3.2	604
12324200	Clark Fork at Deer Lodge	1	2.0	20.7	440	22,900	82	1,160	12.3	<3.2	540
12324590	Little Blackfoot River near Garrison	1	.7	33.2	20	21,000	18	308	15.2	<1.6	86
12324680	Clark Fork at Goldcreek	1	2.0	21.1	243	18,300	55	1,260	10.5	<3.2	623
12331500	Flint Creek near Drummond	1	.9	11.0	20	15,700	96	2,580	5.8	3.5	325
12331800	Clark Fork near Drummond	1	<1.6	20.1	196	16,300	47	1,140	10.4	<3.2	516
12334510	Rock Creek near Clinton	1	<.8	8.8	5	7,270	<10	265	4.5	<1.6	17
12334550	Clark Fork at Turah Bridge, near Bonner	1	2.3	23.4	279	19,100	67	1,470	12.1	2.9	638
12340500	Clark Fork above Missoula	1	<1.6	18.2	129	16,000	30	553	10.3	<3.3	387
12353000	Clark Fork below Missoula[1]	1	<.8	6.0	30	5,830	<10	368	3.8	<1.6	83

[1]Samples collected about 30 miles downstream from water-quality station to conform to previous sampling location.

Table 16. Recovery efficiency for trace-element analyses of standard reference materials for bed sediment

[Abbreviations: µg/g, micrograms per gram of dry sample weight; SRM, standard reference material. Symbol: --, recovery could not be determined because all analyses were less than the analytical detection limit for lead and silver]

Constituent	Number of measurements	Dilution ratio	Certified concentration (µg/g)	Mean SRM recovery (percent)	95-percent confidence interval for SRM recovery (percent)
			SRM sample 2709		
Cadmium	3	1:5	0.4	132	110-153
Chromium	3	1:5	130	68.4	66.0-70.9
Copper	3	1:5	35	86.6	81.3-92.0
Iron	3	1:5	35,000	107	105-110
Lead	3	1:5	19	--	--
Manganese	3	1:5	538	102	99.4-105
Nickel	3	1:5	88	99.7	97.4-102
Silver	3	1:5	.4	--	--
Zinc	3	1:5	106	100	97.6-103
			SRM sample 2711		
Cadmium	3	1:10	41.7	102	101-102
Chromium	3	1:10	47.0	63.1	61.9-64.4
Copper	3	1:10	114	95.9	94.8-97.0
Iron	3	1:10	28,900	90.5	89.8-91.2
Lead	3	1:10	1,160	103	102-103
Manganese	3	1:10	638	87.1	86.8-87.5
Nickel	3	1:10	20.6	90.0	88.6-91.4
Silver	3	1:10	4.6	91.3	83.2-99.4
Zinc	3	1:10	350	95.4	95.2-95.7

Table 17. Trace-element analyses of procedural blanks for bed sediment

[Abbreviation: µg/mL, micrograms per milliliter. Dilution ratio is the proportion of initial volume of concentrated nitric acid used as a digesting reagent to final volume of solution after addition of 0.6 N hydrochloric acid used for reconstituting dried residue. Symbols: <, less than; --, no data]

Sample identification	Dilution ratio	Trace-element concentration, in µg/mL								
		Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Silver	Zinc
A	1:5	<0.005	<0.005	<0.005	0.065	<0.06	<0.005	<0.015	<0.01	0.006
A	1:10	<.005	<.005	<.005	.262	<.06	<.005	<.015	<.01	.021
B	1:5	<.005	<.005	<.005	<.015	<.06	<.005	<.015	<.01	<.005
B	1:10	<.005	<.005	<.005	.026	<.06	<.005	<.015	<.01	<.005
C	1:5	<.005	<.005	<.005	<.015	<.06	<.005	<.015	<.01	<.005
C	1:10	<.005	<.006	<.005	.049	<.06	<.005	<.015	<.01	.016
D	1:5	<.005	<.005	<.005	<.015	<.06	<.005	<.015	<.01	<.005
D	1:10	<.005	<.005	<.009	.028	<.06	<.005	<.015	<.01	.013
E	1:5	<.005	<.005	<.005	<.015	<.06	<.005	<.015	<.01	<.005
E	1:10	<.005	<.005	<.005	<.060	<.06	<.005	<.015	<.01	.017
F	1:5	<.005	<.005	<.005	<.023	<.06	<.005	<.015	<.01	<.005
F	1:10	<.005	<.005	<.005	<.109	<.06	<.005	<.015	<.01	<.014
G	1:5	<.005	<.005	<.005	.015	<.06	<.005	<.015	<.01	<.005
G	1:10	<.005	<.005	<.005	.063	<.06	<.005	<.015	<.01	.012
H	1:5	<.005	<.005	<.005	<.015	<.06	<.005	<.015	<.01	.007
H	1:10	<.005	<.005	<.005	.032	<.06	<.005	<.015	<.01	.034
I	1:5	<.005	<.005	<.005	<.015	<.06	<.005	<.015	<.01	<.005
I	1:10	<.005	<.005	<.005	.070	<.06	<.005	<.015	<.01	.014

Table 18. Trace-element analyses of biota, upper Clark Fork basin, Montana, August 1998

[Analyses are of whole-body tissue of aquatic insects. Composite samples made by combining similar-sized insects of the same species into a sample of sufficient mass for analysis. Concentrations for biota samples composed of two or more composite samples are the means of all analyses. Abbreviations: µg/g, micrograms per gram of dry sample weight. Symbol: <, less than minimum reporting level]

Taxon	Number of composite samples	Concentration, in µg/g							
		Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
12323600 Silver Bow Creek at Opportunity									
Brachycentrus spp.	1	12.5	1.1	592	363	7.9	357	<1.0	687
12323750 Silver Bow Creek at Warm Springs									
Hydropsyche cockerelli	4	.3	.8	28.7	383	2.5	762	.3	16.4
Hydropsyche occidentalis	1	<.9	1.7	22.8	483	<2.8	1,200	1.8	150
12323800 Clark Fork near Galen									
Hydropsyche cockerelli	1	1.5	1.6	49.8	1,160	<7.5	1,760	1.2	180
Hydropsyche occidentalis	4	.7	1.3	51.5	1,110	6.2	1,990	.9	171
461415112450801 Clark Fork below Lost Creek, near Galen									
Hydropsyche occidentalis	4	1.0	1.9	58.6	1,120	7.1	2,130	1.0	188
Hydropsyche spp.	1	1.4	1.7	67.8	1,200	9.7	1,980	1.4	186
461559112443301 Clark Fork near Racetrack									
Hydropsyche cockerelli	1	1.9	2.4	50.5	981	10.5	1,530	1.3	179
Hydropsyche occidentalis	3	.7	1.9	65.4	1,440	9.5	2,080	1.1	211
461903112440701 Clark Fork at Dempsey Creek diversion, near Racetrack									
Hydropsyche occidentalis	4	.8	1.9	82.7	1,550	11.7	2,300	1.4	230
12324200 Clark Fork at Deer Lodge									
Hydropsyche occidentalis	4	1.0	2.1	86.3	1,660	11.3	1,690	1.4	218
12324590 Little Blackfoot River near Garrison									
Arctopsyche grandis	1	.6	1.6	11.2	654	<3.5	533	.4	179
Claassenia sabulosa	1	.5	.9	36.1	319	<1.2	71	.6	202
Hydropsyche occidentalis	1	.3	2.3	15.2	1,340	2.3	554	1.1	137
12324680 Clark Fork at Goldcreek									
Arctopsyche grandis	3	2.3	1.0	35.8	548	3.4	765	.6	185
Claassenia sabulosa	1	1.7	.4	43.6	84.6	<1.3	50.6	<.4	270
Hydropsyche cockerelli	1	1.3	2.0	61.4	1,340	5.8	774	1.8	168
Hydropsyche occidentalis	2	1.4	1.8	63.4	1,310	6.3	1,020	1.9	196
12331500 Flint Creek near Drummond									
Arctopsyche grandis	3	.1	2.0	11.9	1,450	5.1	959	1.2	161
Hydropsyche cockerelli	1	<1.6	4.0	18.1	3,290	16.3	1,230	2.2	181
12331800 Clark Fork near Drummond									
Arctopsyche grandis	1	3.0	1.6	54.7	898	6.2	1,190	1.1	215
Hydropsyche cockerelli	1	2.0	2.9	72.6	1,860	12.8	982	1.8	202
Hydropsyche occidentalis	2	1.2	2.1	69.7	1,570	9.1	1,170	1.2	202

Table 18. Trace-element analyses of biota, upper Clark Fork basin, Montana, August 1998 (Continued)

Taxon	Number of composite samples	Concentration, in µg/g							
		Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
12334510 Rock Creek near Clinton									
Arctopsyche grandis	3	.2	1.3	11.3	774	.7	320	1.0	143
Claassenia sabulosa	1	<.4	.5	33.9	106	.6	39.0	.2	184
Hydropsyche spp.	1	<2.9	2.1	11.6	1,140	<2.9	462	1.9	126
12334550 Clark Fork at Turah Bridge, near Bonner									
Arctopsyche grandis	4	1.7	1.9	40.5	1,190	5.2	724	1.1	211
Claassenia sabulosa	2	1.4	.6	75.6	136	1.3	114	<.2	232
Hydropsyche cockerelli	2	1.1	1.9	46.9	1,240	5.7	602	1.2	163
Hydropsyche occidentalis	2	.9	1.8	47.8	1,150	5.4	662	1.0	174
12340000 Blackfoot River near Bonner									
Arctopsyche grandis	3	.1	1.4	10.8	878	.7	434	.9	136
Claassenia sabulosa	2	.2	.6	53.8	467	.5	85.5	.3	223
Hydropsyche occidentalis	3	<.1	2.4	13.6	1,810	.8	497	1.5	124
12340500 Clark Fork above Missoula									
Arctopsyche grandis	5	.7	1.5	24.4	907	3.2	687	.8	178
Hydropsyche cockerelli	2	1.0	3.2	45.9	2,050	5.6	1,090	1.5	192
Hydropsyche occidentalis	1	1.1	2.8	49.8	2,010	7.1	2,030	2.1	232
12353000 Clark Fork below Missoula[1]									
Arctopsyche grandis	4	1.2	1.6	27.3	991	2.5	710	1.1	166
Claassenia sabulosa	2	1.1	.5	47.8	119	<1.5	101	.2	263
Hydropsyche cockerelli	2	1.0	2.3	37.7	1,600	3.4	651	1.3	156
Hydropsyche occidentalis	2	.9	1.8	31.8	1,240	3.6	814	1.2	155

[1]Samples collected about 30 miles downstream from water-quality station to conform to previous sampling location.

Table 19. Recovery efficiency for trace-element analyses of standard reference material for biota

[Abbreviations: µg/g, micrograms per gram of dry sample weight; SRM, standard reference material]

Constituent	Number of measurements	Certified concentration (µg/g)	Mean SRM recovery (percent)	95-percent confidence interval for SRM recovery (percent)
		SRM sample TORT-2		
Cadmium	12	26.7	95.0	91.4-97.6
Chromium	12	.77	146	138-154
Copper	12	106	93.4	90.3-96.5
Iron	12	105	92.6	87.4-97.8
Lead	[1]4	.35	106	91.0-121
Manganese	12	13.6	89.9	86.4-93.4
Nickel	12	2.5	80.1	76.7-83.5
Zinc	12	180	94.2	90.5-97.9

[1]Eight samples were at or below the analytical detection limits.

Table 20. Trace-element analyses of procedural blanks for biota

[Procedural blanks were not diluted prior to analysis. Abbreviation: µg/mL, micrograms per milliliter. Symbol: <, less than]

Station number	Station name	Dilution ratio	Trace-element concentration, in µg/mL							
			Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Zinc
12323600	Silver Bow Creek at Opportunity	1:1	<0.01	<0.01	<0.03	0.31	<0.1	0.17	<0.01	0.08
12323750	Silver Bow Creek at Warm Springs	1:1	<.01	<.01	<.03	<.10	<.1	<.01	<.01	.07
12323800	Clark Fork near Galen	1:1	<.01	<.01	<.03	.30	<.1	.05	<.01	<.04
461415112450801	Clark Fork below Lost Creek, near Galen	1:1	<.01	<.01	<.03	.60	<.1	.80	<.01	.05
461559112443301	Clark Fork near Racetrack	1:1	<.01	<.01	<.03	.30	<.1	<.01	<.01	<.04
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	1:1	<.01	<.01	<.03	.80	<.1	.16	<.01	<.04
12324200	Clark Fork at Deer Lodge	1:1	<.01	<.01	<.03	<.10	<.1	.02	<.01	<.04
12324590	Little Blackfoot River, near Garrison	1:1	<.01	<.01	<.03	<.10	<.1	.09	<.01	<.04
12324680	Clark Fork at Goldcreek	1:1	<.01	<.01	<.03	<.10	<.1	.08	<.01	<.04
12331500	Flint Creek near Drummond	1:1	<.01	<.01	<.03	.20	<.1	.22	<.01	<.04
12331800	Clark Fork near Drummond	1:1	<.01	<.01	<.03	.30	<.1	.14	<.01	<.04
12334510	Rock Creek near Clinton	1:1	<.01	<.01	<.03	<.10	<.1	<.01	<.01	<.04
12334550	Clark Fork at Turah Bridge, near Bonner	1:1	<.01	<.01	<.03	<.10	<.1	<.01	<.01	<.04
12340000	Blackfoot River near Bonner	1:1	<.01	<.01	<.03	<.10	<.1	<.01	<.01	<.04
12340500	Clark Fork above Missoula	1:1	<.01	<.01	<.03	1.30	<.1	.03	<.01	<.04
12353000	Clark Fork below Missoula	1:1	<.01	<.01	<.03	<.10	<.1	.08	<.01	<.04

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998

[Abbreviations: ft^3/s, cubic feet per second; °C, degrees Celsius; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter; mm, millimeter; ton/d, tons per day. Symbols: <, less than minimum reporting level[1]; --, indicates insufficient data greater than minimum reporting level to compute statistic]

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12323230–BLACKTAIL CREEK AT HARRISON AVENUE, AT BUTTE, MONT.					
Period of record for water-quality data: March 1993-August 1995, December 1996-September 1998					
Streamflow, instantaneous (ft^3/s)	44	156	3.1	19	9.3
Specific conductance, onsite (µS/cm)	44	412	116	251	248
Temperature, water (°C)	44	17.0	2.0	8.1	7.5
pH, onsite (standard units)	44	8.2	7.3	7.8	7.8
Hardness, total (mg/L as $CaCO_3$)	44	140	38	100	100
Calcium, dissolved (mg/L)	44	39	11	28	29
Magnesium, dissolved (mg/L)	44	11	2.7	6.9	6.8
Arsenic, total recoverable (µg/L)	44	18	2	7	6
Arsenic, dissolved (µg/L)	44	13	1	5	4
Cadmium, total recoverable (µg/L)	44	<1	<1	--	<1
Cadmium, dissolved (µg/L)	44	.5	<.1	--	<.1
Copper, total recoverable (µg/L)	44	52	2	9	7
Copper, dissolved (µg/L)	44	10	<1	[2]4	4
Iron, total recoverable (µg/L)	44	4,200	260	895	625
Iron, dissolved (µg/L)	44	480	24	203	195
Lead, total recoverable (µg/L)	44	47	<1	[2]4	1
Lead, dissolved (µg/L)	44	1	<.5	[2].3	<.5
Manganese, total recoverable (µg/L)	44	240	30	66	60
Manganese, dissolved (µg/L)	44	100	17	41	38
Zinc, total recoverable (µg/L)	44	130	<10	[2]13	<10
Zinc, dissolved (µg/L)	44	11	<3	[2]5	<10
Sediment, suspended concentration (mg/L)	44	139	2	20	9
Sediment, suspended discharge (ton/d)	44	59	.04	2.4	.2
Sediment, suspended (percent finer than 0.062 mm)	44	96	50	83	86

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12323250--SILVER BOW CREEK BELOW BLACKTAIL CREEK, AT BUTTE, MONT. **Period of record for water-quality data: March 1993-August 1995, December 1996-September 1998**					
Streamflow, instantaneous (ft^3/s)	44	134	15	35	28
Specific conductance, onsite (µS/cm)	44	691	226	453	464
Temperature, water (°C)	44	17.0	1.5	9.9	9.0
pH, onsite (standard units)	44	7.8	7.2	7.5	7.5
Hardness, total (mg/L as $CaCO_3$)	44	180	66	143	145
Calcium, dissolved (mg/L)	44	52	19	41	42
Magnesium, dissolved (mg/L)	44	13	4.5	10	10
Arsenic, total recoverable (µg/L)	44	45	8	17	14
Arsenic, dissolved (µg/L)	44	13	4	7	8
Cadmium, total recoverable (µg/L)	44	6	1	3	3
Cadmium, dissolved (µg/L)	44	6.2	.5	2.2	2.0
Copper, total recoverable (µg/L)	44	550	47	186	155
Copper, dissolved (µg/L)	44	300	19	81	70
Iron, total recoverable (µg/L)	44	7,400	250	1,600	870
Iron, dissolved (µg/L)	44	270	20	116	110
Lead, total recoverable (µg/L)	44	250	3	30	12
Lead, dissolved (µg/L)	44	2.4	<.5	[2].9	.8
Manganese, total recoverable (µg/L)	44	1,600	320	727	680
Manganese, dissolved (µg/L)	44	1,700	210	658	665
Zinc, total recoverable (µg/L)	44	2,200	350	931	900
Zinc, dissolved (µg/L)	44	2,200	200	761	710
Sediment, suspended concentration (mg/L)	43	405	3	44	16
Sediment, suspended discharge (ton/d)	43	70	.14	5.8	1.3
Sediment, suspended (percent finer than 0.062 mm)	43	94	42	82	86

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12323600--SILVER BOW CREEK AT OPPORTUNITY, MONT.					
Period of record for water-quality data: March 1993-August 1995, December 1996-September 1998					
Streamflow, instantaneous (ft^3/s)	46	361	26	94	62
Specific conductance, onsite (µS/cm)	45	593	202	366	368
Temperature, water (°C)	45	18.0	0.0	8.8	9.0
pH, onsite (standard units)	45	8.9	7.2	8.2	8.2
Hardness, total (mg/L as $CaCO_3$)	45	200	60	130	130
Calcium, dissolved (mg/L)	45	55	18	39	40
Magnesium, dissolved (mg/L)	45	15	3.4	8.3	8.1
Arsenic, total recoverable (µg/L)	45	240	11	34	18
Arsenic, dissolved (µg/L)	45	34	1	10	9
Cadmium, total recoverable (µg/L)	45	49	1	3	2
Cadmium, dissolved (µg/L)	45	41	.1	2.2	1.2
Copper, total recoverable (µg/L)	45	3,900	79	322	160
Copper, dissolved (µg/L)	45	450	25	70	51
Iron, total recoverable (µg/L)	45	24,000	290	2,200	1,000
Iron, dissolved (µg/L)	45	310	3	62	44
Lead, total recoverable (µg/L)	45	650	7	54	21
Lead, dissolved (µg/L)	45	5.1	<.5	[2].9	.6
Manganese, total recoverable (µg/L)	45	10,000	230	826	600
Manganese, dissolved (µg/L)	45	9,300	190	702	500
Zinc, total recoverable (µg/L)	45	15,000	230	907	540
Zinc, dissolved (µg/L)	45	13,000	110	586	310
Sediment, suspended concentration (mg/L)	46	801	6	72	25
Sediment, suspended discharge (ton/d)	46	781	.42	35	4.2
Sediment, suspended (percent finer than 0.062 mm)	46	95	37	75	79

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT. **Period of record for water-quality data: March 1993-September 1998**					
Streamflow, instantaneous (ft^3/s)	52	662	24	185	148
Specific conductance, onsite (µS/cm)	50	614	265	434	431
Temperature, water (°C)	51	22.0	.5	11.0	12.0
pH, onsite (standard units)	50	9.3	8.0	8.8	8.8
Hardness, total (mg/L as $CaCO_3$)	50	260	110	181	175
Calcium, dissolved (mg/L)	50	78	34	53	52
Magnesium, dissolved (mg/L)	50	19	5.9	12	12
Arsenic, total recoverable (µg/L)	50	94	12	27	24
Arsenic, dissolved (µg/L)	50	60	8	22	20
Cadmium, total recoverable (µg/L)	50	<1	<1	--	<1
Cadmium, dissolved (µg/L)	50	.3	<.1	[2].1	<.1
Copper, total recoverable (µg/L)	50	80	8	27	23
Copper, dissolved (µg/L)	50	40	4	13	11
Iron, total recoverable (µg/L)	50	3,000	130	450	350
Iron, dissolved (µg/L)	50	93	<5	[2]18	15
Lead, total recoverable (µg/L)	50	15	<1	[2]3	2
Lead, dissolved (µg/L)	50	1.0	<.5	--	<.5
Manganese, total recoverable (µg/L)	50	600	60	201	165
Manganese, dissolved (µg/L)	50	530	12	127	94
Zinc, total recoverable (µg/L)	50	180	<10	[2]58	45
Zinc, dissolved (µg/L)	50	73	<3	[2]13	9
Sediment, suspended concentration (mg/L)	52	229	2	16	8
Sediment, suspended discharge (ton/d)	52	279	.26	13	2.6
Sediment, suspended (percent finer than 0.062 mm)	51	97	43	81	83

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12323770--WARM SPRINGS CREEK AT WARM SPRINGS, MONT. **Period of record for water quality data: March 1993-September 1998**					
Streamflow, instantaneous (ft^3/s)	34	420	2.8	124	95
Specific conductance, onsite (µS/cm)	33	795	139	304	267
Temperature, water (°C)	34	16.0	.5	8.5	8.8
pH, onsite (standard units)	33	8.6	7.4	8.2	8.3
Hardness, total (mg/L as $CaCO_3$)	33	420	72	149	130
Calcium, dissolved (mg/L)	33	130	22	46	40
Magnesium, dissolved (mg/L)	33	22	3.8	8.6	7.3
Arsenic, total recoverable (µg/L)	33	27	3	9	6
Arsenic, dissolved (µg/L)	33	14	3	5	4
Cadmium, total recoverable (µg/L)	33	<1	<1	--	<1
Cadmium, dissolved (µg/L)	33	<.1	<.1	--	<.1
Copper, total recoverable (µg/L)	33	97	4	26	11
Copper, dissolved (µg/L)	33	16	1	4	3
Iron, total recoverable (µg/L)	33	1,700	40	422	160
Iron, dissolved (µg/L)	33	30	3	11	9
Lead, total recoverable (µg/L)	33	14	<1	[2]3	1
Lead, dissolved (µg/L)	33	1.8	<.5	--	<.5
Manganese, total recoverable (µg/L)	33	1,400	90	278	200
Manganese, dissolved (µg/L)	33	570	43	161	110
Zinc, total recoverable (µg/L)	33	60	<10	[2]15	10
Zinc, dissolved (µg/L)	33	10	<3	[2]3	<10
Sediment, suspended concentration (mg/L)	34	100	2	26	12
Sediment, suspended discharge (ton/d)	33	87	.09	15	3.0
Sediment, suspended (percent finer than 0.062 mm)	34	88	55	75	76

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12323800--CLARK FORK NEAR GALEN, MONT. **Period of record for water-quality data: July 1988-September 1998**					
Streamflow, instantaneous (ft^3/s)	93	1,050	14	233	145
Specific conductance, onsite (µS/cm)	81	720	220	429	435
Temperature, water (°C)	92	22.5	.0	9.5	9.2
pH, onsite (standard units)	80	9.0	7.5	8.4	8.5
Hardness, total (mg/L as $CaCO_3$)	79	370	96	188	190
Calcium, dissolved (mg/L)	79	110	29	56	57
Magnesium, dissolved (mg/L)	79	22	5.5	12	12
Arsenic, total recoverable (µg/L)	79	78	3	21	16
Arsenic, dissolved (µg/L)	79	53	4	15	12
Cadmium, total recoverable (µg/L)	79	3	<1	[2].3	<1
Cadmium, dissolved (µg/L)	79	1	<.1	[2].1	<.1
Copper, total recoverable (µg/L)	78	240	8	40	26
Copper, dissolved (µg/L)	79	50	3	12	9
Iron, total recoverable (µg/L)	79	9,200	90	675	350
Iron, dissolved (µg/L)	79	110	3	18	12
Lead, total recoverable (µg/L)	79	28	<1	[2]5	3
Lead, dissolved (µg/L)	79	3	<.5	[2].3	<.5
Manganese, total recoverable (µg/L)	79	1,400	80	290	230
Manganese, dissolved (µg/L)	79	380	31	126	100
Zinc, total recoverable (µg/L)	79	360	<10	62	50
Zinc, dissolved (µg/L)	79	110	<3	16	11
Sediment, suspended concentration (mg/L)	93	338	2	23	9
Sediment, suspended discharge (ton/d)	93	459	.12	29	2.9
Sediment, suspended (percent finer than 0.062 mm)	92	97	41	78	78

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12324200–CLARK FORK AT DEER LODGE, MONT. **Period of record for water-quality data: March 1985-September 1998**					
Streamflow, instantaneous (ft^3/s)	145	1,920	23	311	229
Specific conductance, onsite (µS/cm)	128	642	242	491	510
Temperature, water (°C)	144	23.0	.0	9.4	10.0
pH, onsite (standard units)	93	8.7	7.4	8.2	8.2
Hardness, total (mg/L as $CaCO_3$)	85	270	100	205	210
Calcium, dissolved (mg/L)	85	81	32	61	62
Magnesium, dissolved (mg/L)	85	18	5.9	13	14
Arsenic, total recoverable (µg/L)	95	220	8	28	18
Arsenic, dissolved (µg/L)	95	39	7	15	13
Cadmium, total recoverable (µg/L)	95	5	<1	[2].6	<1
Cadmium, dissolved (µg/L)	95	2	<.1	[2].1	<1
Copper, total recoverable (µg/L)	94	1,500	10	114	52
Copper, dissolved (µg/L)	95	120	4	14	10
Iron, total recoverable (µg/L)	95	29,000	60	2,250	790
Iron, dissolved (µg/L)	95	190	<3	[2]17	10
Lead, total recoverable (µg/L)	95	200	<1	[2]15	6
Lead, dissolved (µg/L)	95	6	<.5	[2].6	<.6
Manganese, total recoverable (µg/L)	95	4,600	30	332	180
Manganese, dissolved (µg/L)	95	400	1	46	33
Zinc, total recoverable (µg/L)	95	1,700	10	130	70
Zinc, dissolved (µg/L)	95	230	<10	17	13
Sediment, suspended concentration (mg/L)	145	2,250	2	91	25
Sediment, suspended discharge (ton/d)	145	8,690	.29	212	15
Sediment, suspended (percent finer than 0.062 mm)	136	99	40	70	71

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, MONT. **Period of record for water-quality data: March 1985-September 1998**					
Streamflow, instantaneous (ft^3/s)	78	2,080	21	313	186
Specific conductance, onsite (µS/cm)	66	300	120	220	215
Temperature, water (°C)	77	22	.0	7.8	7.0
pH, onsite (standard units)	65	8.5	7.0	8.0	8.0
Hardness, total (mg/L as $CaCO_3$)	60	140	51	101	99
Calcium, dissolved (mg/L)	60	43	14	29	28
Magnesium, dissolved (mg/L)	60	9.4	3.3	6.8	6.8
Arsenic, total recoverable (µg/L)	65	17	4	7	6
Arsenic, dissolved (µg/L)	65	7	3	5	5
Cadmium, total recoverable (µg/L)	65	2	<1	[2].3	<1
Cadmium, dissolved (µg/L)	65	1	<.1	--	<1
Copper, total recoverable (µg/L)	64	45	<1	[2]5	3
Copper, dissolved (µg/L)	65	7	<1	[2]2	2
Iron, total recoverable (µg/L)	65	25,000	20	1,400	310
Iron, dissolved (µg/L)	65	120	<3	[2]37	27
Lead, total recoverable (µg/L)	65	25	<1	[2]3	<5
Lead, dissolved (µg/L)	64	6	<.5	[2].5	<1
Manganese, total recoverable (µg/L)	65	1,100	<10	[2]82	30
Manganese, dissolved (µg/L)	65	30	1	8	8
Zinc, total recoverable (µg/L)	65	140	<10	[2]16	<10
Zinc, dissolved (µg/L)	65	24	<3	[2]4	<10
Sediment, suspended concentration (mg/L)	78	1,410	1	59	10
Sediment, suspended discharge (ton/d)	78	7,920	.08	171	6.6
Sediment, suspended (percent finer than 0.062 mm)	78	97	49	74	78

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12324680--CLARK FORK AT GOLDCREEK MONT. **Period of record for water-quality data: March 1993-September 1998**					
Streamflow, instantaneous (ft^3/s)	51	3,920	87	921	661
Specific conductance, onsite (µS/cm)	50	496	207	360	372
Temperature, water (°C)	51	20.0	.0	9.0	9.0
pH, onsite (standard units)	50	8.7	7.9	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	50	230	86	158	160
Calcium, dissolved (mg/L)	50	68	26	47	49
Magnesium, dissolved (mg/L)	50	15	5.1	10	10
Arsenic, total recoverable (µg/L)	50	75	8	18	14
Arsenic, dissolved (µg/L)	50	20	6	11	10
Cadmium, total recoverable (µg/L)	50	2	<1	--	<1
Cadmium, dissolved (µg/L)	50	.2	<.1	--	<.1
Copper, total recoverable (µg/L)	49	440	8	59	40
Copper, dissolved (µg/L)	49	36	3	9	7
Iron, total recoverable (µg/L)	50	12,000	60	1,300	680
Iron, dissolved (µg/L)	50	100	<3	[2]22	15
Lead, total recoverable (µg/L)	49	73	<1	[2]8	5
Lead, dissolved (µg/L)	49	.8	<.5	--	<.5
Manganese, total recoverable (µg/L)	50	1,100	30	164	125
Manganese, dissolved (µg/L)	50	43	10	21	20
Zinc, total recoverable (µg/L)	50	510	10	69	50
Zinc, dissolved (µg/L)	50	26	<3	[2]9	7
Sediment, suspended concentration (mg/L)	51	752	2	76	2?
Sediment, suspended discharge (ton/d)	51	7,960	.94	397	47
Sediment, suspended (percent finer than 0.062 mm)	51	93	43	74	7?

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12331500--FLINT CREEK NEAR DRUMMOND, MONT. **Period of record for water-quality data: March 1985-September 1998**					
Streamflow, instantaneous (ft^3/s)	100	892	4.2	205	130
Specific conductance, onsite (µS/cm)	89	507	134	291	293
Temperature, water (°C)	98	21.0	.0	8.6	9.0
pH, onsite (standard units)	86	8.8	7.5	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	79	260	59	137	140
Calcium, dissolved (mg/L)	79	73	16	37	37
Magnesium, dissolved (mg/L)	79	20	4.3	11	11
Arsenic, total recoverable (µg/L)	86	57	7	19	15
Arsenic, dissolved (µg/L)	86	20	5	9	8
Cadmium, total recoverable (µg/L)	86	3	<1	[2].2	<1
Cadmium, dissolved (µg/L)	86	.1	<.1	--	<.1
Copper, total recoverable (µg/L)	85	32	1	8	6
Copper, dissolved (µg/L)	86	7	<1	[2]2	2
Iron, total recoverable (µg/L)	86	7,200	70	1,050	580
Iron, dissolved (µg/L)	86	240	3	43	28
Lead, total recoverable (µg/L)	86	87	<1	[2]13	9
Lead, dissolved (µg/L)	86	7	<.5	[2].8	<1
Manganese, total recoverable (µg/L)	86	1,600	50	234	155
Manganese, dissolved (µg/L)	86	120	14	40	34
Zinc, total recoverable (µg/L)	86	290	<10	[2]45	30
Zinc, dissolved (µg/L)	86	27	<3	[2]6	4
Sediment, suspended concentration (mg/L)	100	556	3	57	31
Sediment, suspended discharge (ton/d)	100	904	.03	53	9.6
Sediment, suspended (percent finer than 0.062 mm)	100	98	28	80	84

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12331800--CLARK FORK NEAR DRUMMOND, MONT. **Period of record for water-quality data: March 1993-September 1998**					
Streamflow, instantaneous (ft^3/s)	51	3,860	149	1,290	942
Specific conductance, onsite (µS/cm)	50	630	189	385	401
Temperature, water (°C)	51	21.0	.5	10.0	10.0
pH, onsite (standard units)	50	8.5	7.8	8.3	8.2
Hardness, total (mg/L as $CaCO_3$)	50	300	74	173	180
Calcium, dissolved (mg/L)	50	83	21	50	52
Magnesium, dissolved (mg/L)	50	22	5.2	12	12
Arsenic, total recoverable (µg/L)	50	62	8	19	16
Arsenic, dissolved (µg/L)	50	20	7	11	10
Cadmium, total recoverable (µg/L)	50	2	<1	--	<1
Cadmium, dissolved (µg/L)	50	.2	<.1	--	<.1
Copper, total recoverable (µg/L)	48	360	5	60	33
Copper, dissolved (µg/L)	48	24	1	8	6
Iron, total recoverable (µg/L)	50	8,800	50	1,430	775
Iron, dissolved (µg/L)	50	150	<3	[2]25	11
Lead, total recoverable (µg/L)	46	56	<1	[2]11	6
Lead, dissolved (µg/L)	46	1.2	<.5	[2].3	<.5
Manganese, total recoverable (µg/L)	50	880	20	191	130
Manganese, dissolved (µg/L)	50	50	8	19	16
Zinc, total recoverable (µg/L)	50	490	<10	[2]90	50
Zinc, dissolved (µg/L)	50	21	<3	[2]8	6
Sediment, suspended concentration (mg/L)	51	530	2	89	40
Sediment, suspended discharge (ton/d)	51	4,720	1.9	516	103
Sediment, suspended (percent finer than 0.062 mm)	51	91	38	73	73

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12334510–ROCK CREEK NEAR CLINTON, MONT. **Period of record for water-quality data: March 1985-September 1998**					
Streamflow, instantaneous (ft^3/s)	77	5,060	113	1,040	558
Specific conductance, onsite (µS/cm)	68	155	55	104	94
Temperature, water (°C)	77	18	.0	7.9	8.0
pH, onsite (standard units)	67	8.6	6.9	7.9	7.9
Hardness, total (mg/L as $CaCO_3$)	59	90	22	49	49
Calcium, dissolved (mg/L)	59	23	5.9	13	13
Magnesium, dissolved (mg/L)	59	8.0	1.9	4.2	4.0
Arsenic, total recoverable (µg/L)	65	3	<1	[2].9	<1
Arsenic, dissolved (µg/L)	65	1	<1	[2]1	<1
Cadmium, total recoverable (µg/L)	65	3	<1	[2].4	<1
Cadmium, dissolved (µg/L)	65	1	<.1	--	<1
Copper, total recoverable (µg/L)	63	41	<1	[2]5	2
Copper, dissolved (µg/L)	64	6	<1	[2]1	<1
Iron, total recoverable (µg/L)	65	2,100	20	357	180
Iron, dissolved (µg/L)	65	160	5	38	35
Lead, total recoverable (µg/L)	63	19	<1	[2]2	<5
Lead, dissolved (µg/L)	63	5	<.5	[2].6	<1
Manganese, total recoverable (µg/L)	65	90	<10	[2]18	10
Manganese, dissolved (µg/L)	65	8	<1	[2]2	2
Zinc, total recoverable (µg/L)	65	60	<10	[2]9	<10
Zinc, dissolved (µg/L)	65	15	<3	[2]2	<3
Sediment, suspended concentration (mg/L)	77	223	1	23	6
Sediment, suspended discharge (ton/d)	77	3,050	.31	162	14
Sediment, suspended (percent finer than 0.062 mm)	77	95	35	69	70

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT. **Period of record for water-quality data: March 1985-September 1998**					
Streamflow, instantaneous (ft^3/s)	148	9,560	296	1,930	1,160
Specific conductance, onsite (µS/cm)	123	483	140	309	329
Temperature, water (°C)	147	22.0	.0	9.1	9.5
pH, onsite (standard units)	94	8.7	7.4	8.2	8.2
Hardness, total (mg/L as $CaCO_3$)	84	210	58	135	140
Calcium, dissolved (mg/L)	84	59	17	38	39
Magnesium, dissolved (mg/L)	84	14	3.9	9.5	9.5
Arsenic, total recoverable (µg/L)	93	110	5	12	8
Arsenic, dissolved (µg/L)	93	17	4	6	6
Cadmium, total recoverable (µg/L)	93	4	<1	[2].4	<1
Cadmium, dissolved (µg/L)	93	1	<.1	--	<.1
Copper, total recoverable (µg/L)	91	500	3	49	23
Copper, dissolved (µg/L)	92	25	2	6	5
Iron, total recoverable (µg/L)	93	19,000	60	1,460	550
Iron, dissolved (µg/L)	93	190	<3	[2]28	16
Lead, total recoverable (µg/L)	89	100	<1	[2]11	5
Lead, dissolved (µg/L)	89	7	<.5	[2].5	<1
Manganese, total recoverable (µg/L)	93	2,000	10	168	90
Manganese, dissolved (µg/L)	93	37	1	9	7
Zinc, total recoverable (µg/L)	93	1,100	<10	[2]85	40
Zinc, dissolved (µg/L)	93	39	<3	[2]8	7
Sediment, suspended concentration (mg/L)	148	1,370	2	68	23
Sediment, suspended discharge (ton/d)	148	34,700	3.5	797	66
Sediment, suspended (percent finer than 0.062 mm)	137	98	27	72	72

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12340000--BLACKFOOT RIVER NEAR BONNER, MONT. **Period of record for water-quality data: March 1985-September 1998**					
Streamflow, instantaneous (ft^3/s)	108	13,400	344	2,740	1,280
Specific conductance, onsite (µS/cm)	85	294	130	205	203
Temperature, water (°C)	108	20.5	.0	8.9	9.0
pH, onsite (standard units)	68	8.7	7.5	8.2	8.3
Hardness, total (mg/L as $CaCO_3$)	61	140	55	101	95
Calcium, dissolved (mg/L)	61	37	14	26	24
Magnesium, dissolved (mg/L)	61	13	4.9	8.9	8.4
Arsenic, total recoverable (µg/L)	68	4	<1	[2]1	1
Arsenic, dissolved (µg/L)	68	2	<1	[2].9	<1
Cadmium, total recoverable (µg/L)	68	2	<1	[2].4	<1
Cadmium, dissolved (µg/L)	68	1	<.1	--	<1
Copper, total recoverable (µg/L)	65	34	<1	[2]8	6
Copper, dissolved (µg/L)	66	7	<1	[2]2	1
Iron, total recoverable (µg/L)	68	3,600	20	582	240
Iron, dissolved (µg/L)	68	100	<3	[2]20	13
Lead, total recoverable (µg/L)	64	25	<1	[2]5	2
Lead, dissolved (µg/L)	64	8	<.5	[2]1	<1
Manganese, total recoverable (µg/L)	68	180	<10	[2]38	20
Manganese, dissolved (µg/L)	68	11	<1	[2]3	2
Zinc, total recoverable (µg/L)	68	60	<10	[2]10	<10
Zinc, dissolved (µg/L)	68	15	<3	[2]4	<3
Sediment, suspended concentration (mg/L)	108	271	1	33	9
Sediment, suspended discharge (ton/d)	108	7,670	1.1	607	30
Sediment, suspended (percent finer than 0.062 mm)	106	98	42	79	81

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1998 (Continued)

Property or constituent and reporting unit	Number of samples	Maximum	Minimum	Mean	Median
12340500--CLARK FORK ABOVE MISSOULA, MONT. **Period of record for water-quality data: July 1986-September 1998**					
Streamflow, instantaneous (ft^3/s)	114	21,600	720	4,580	2,360
Specific conductance, onsite (µS/cm)	91	399	145	256	261
Temperature, water (°C)	111	19.5	.0	9.0	8.5
pH, onsite (standard units)	71	8.6	7.9	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	71	170	61	118	120
Calcium, dissolved (mg/L)	71	46	14	32	32
Magnesium, dissolved (mg/L)	71	13	5.3	9.2	9.2
Arsenic, total recoverable (µg/L)	71	69	2	6	4
Arsenic, dissolved (µg/L)	71	9	1	3	3
Cadmium, total recoverable (µg/L)	71	5	<1	--	<1
Cadmium, dissolved (µg/L)	71	.1	<.1	--	<.1
Copper, total recoverable (µg/L)	69	400	2	20	8
Copper, dissolved (µg/L)	70	11	1	3	2
Iron, total recoverable (µg/L)	71	13,000	60	753	270
Iron, dissolved (µg/L)	71	200	<3	[2]25	16
Lead, total recoverable (µg/L)	66	78	<1	[2]4	2
Lead, dissolved (µg/L)	66	1	<.5	[2].6	<.5
Manganese, total recoverable (µg/L)	71	1,100	10	76	50
Manganese, dissolved (µg/L)	71	230	7	19	15
Zinc, total recoverable (µg/L)	71	1,100	<10	[2]39	20
Zinc, dissolved (µg/L)	71	16	<3	[2]5	3
Sediment, suspended concentration (mg/L)	114	824	2	41	10
Sediment, suspended discharge (ton/d)	114	21,900	6.1	1,130	62
Sediment, suspended (percent finer than 0.062 mm)	109	99	44	86	90

[1]Multiple less-than (<) values for an individual constituent are the result of changes in analytical minimum reporting levels during the period of record.
[2]Value is estimated by using a log-probability regression to predict the values of data less than the minimum reporting level (Helsel and Cohn, 1988).

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1998

[Fine-grained bed sediment is material less than 0.064 millimeter in diameter. Concentrations are in micrograms per gram dry weight. Symbols: <, less than minimum reporting level; --, indicates either too few samples (less than three) or insufficient data greater than the minimum reporting level to compute statistic. Number of samples represents the number of years that the constituent was analyzed, with each year represented by a single mean concentration of composite samples]

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12323600--SILVER BOW CREEK AT OPPORTUNITY, MONT.					
Period of record for fine-grained bed-sediment data: 1992-98					
Cadmium	7	42.0	23.7	31.8	29.3
Chromium	6	32.4	23.2	28.1	28.9
Copper	7	6,280	4,220	4,870	4,670
Iron	7	41,200	34,400	39,000	39,700
Lead	7	1,030	752	848	833
Manganese	7	3,940	1,680	2,590	2,460
Nickel	6	21.4	14.5	16.8	16.2
Silver	7	19.6	13.7	16.3	16.4
Zinc	7	10,800	6,850	8,270	8,010
12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT.					
Period of record for fine-grained bed-sediment data: 1992-98					
Cadmium	7	12.2	5.3	7.9	6.7
Chromium	6	34.1	12.8	22.6	23.6
Copper	7	769	259	464	358
Iron	7	27,200	19,500	22,400	20,800
Lead	7	100	58	78	74
Manganese	7	17,700	1,470	6,960	7,230
Nickel	6	19.1	12.5	15.5	15.2
Silver	7	2.1	.3	[1]1.3	[1]1.3
Zinc	7	2,220	620	1,230	845
12323770--WARM SPRINGS CREEK AT WARM SPRINGS, MONT.					
Period of record for fine-grained bed-sediment data: 1995, 1997					
Cadmium	2	3.9	2.6	3.2	--
Chromium	2	33.4	30.8	32.1	--
Copper	2	892	848	870	
Iron	2	22,400	21,900	22,100	--
Lead	2	86	85	86	--
Manganese	2	8,790	2,020	5,400	--
Nickel	2	21.9	17.6	19.8	--
Silver	2	3.7	3.2	3.4	--
Zinc	2	421	372	396	--

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12323800--CLARK FORK NEAR GALEN, MONT.					
Period of record for fine-grained bed-sediment data: 1987, 1991-98					
Cadmium	9	20.1	6.4	11.1	10.5
Chromium	6	33.9	22.1	28.5	30.4
Copper	9	2,300	1,090	1,390	1,230
Iron	9	39,800	22,600	29,900	28,500
Lead	9	235	116	154	145
Manganese	9	15,600	2,780	8,690	8,540
Nickel	6	23.2	17.7	20.0	19.5
Silver	9	5.5	<3.2	[1]3.8	[1]3.7
Zinc	9	3,560	1,160	2,000	1,820
461415112450801--CLARK FORK BELOW LOST CREEK, NEAR GALEN, MONT					
Period of record for fine-grained bed-sediment data: 1996-98					
Cadmium	3	9.0	6.8	8.1	8.4
Chromium	3	34.5	32.0	33.1	32.9
Copper	3	2,050	1,360	1,710	1,730
Iron	3	32,700	30,800	31,600	31,400
Lead	3	197	168	185	190
Manganese	3	5,900	3,540	4,470	3,980
Nickel	3	19.9	17.8	18.8	18.7
Silver	3	7.0	4.2	6.0	6.8
Zinc	3	1,680	1,284	1,470	1,460
461559112443301--CLARK FORK NEAR RACETRACK, MONT.					
Period of record for fine-grained bed-sediment data: 1996-98					
Cadmium	3	8.5	5.5	7.2	7.5
Chromium	3	33.3	30.0	31.1	30.1
Copper	3	1,610	946	1,310	1,370
Iron	3	31,700	29,000	30,200	29,800
Lead	3	155	134	148	153
Manganese	3	3,127	2,390	2,730	2,680
Nickel	3	18.4	16.5	17.2	16.7
Silver	3	6.1	<3.3	[1]4.6	6.0
Zinc	3	1,550	1,030	1,250	1,190
461903112440701--CLARK FORK AT DEMPSEY CREEK DIVERSION, NEAR RACETRACK, MONT.					
Period of record for fine-grained bed-sediment data: 1996-98					
Cadmium	3	8.1	4.8	6.6	6.9
Chromium	3	34.1	28.9	31.4	31.1
Copper	3	1,550	842	1,230	1,280
Iron	3	33,700	28,200	30,700	30,200
Lead	3	152	115	140	152
Manganese	3	3,910	2,630	3,070	2,680
Nickel	3	16.9	15.8	16.5	16.8
Silver	3	6.2	3.5	5.3	6.2
Zinc	3	1,570	900	1,240	1,260

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12324200--CLARK FORK AT DEER LODGE, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 1990-98					
Cadmium	11	9.0	5.1	7.0	7.4
Chromium	6	43.9	19.5	33.2	35.6
Copper	11	4,180	837	1,550	1,210
Iron	11	35,300	22,600	28,600	29,400
Lead	11	242	121	162	159
Manganese	11	6,020	1,460	2,630	2,320
Nickel	6	21.1	15.0	17.5	17.2
Silver	11	7.9	2.4	4.7	4.6
Zinc	11	1,730	977	1,340	1,390
12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 1994, 1998					
Cadmium	4	1.5	.2	.8	.8
Chromium	2	52.9	22.1	37.5	--
Copper	4	85	38	60	59
Iron	4	30,700	16,100	24,200	25,100
Lead	4	53	36	41	38
Manganese	4	2,700	905	1,390	974
Nickel	2	21.9	13.6	17.8	--
Silver	4	.9	<.5	[1].6	[1].6
Zinc	4	204	161	179	175
12324680--CLARK FORK AT GOLDCREEK, MONT.					
Period of record for fine-grained bed-sediment data: 1992-98					
Cadmium	7	6.2	4.9	5.6	5.8
Chromium	6	48.9	31.6	36.9	35.7
Copper	7	1,080	653	840	791
Iron	7	30,600	20,500	25,600	26,400
Lead	7	152	88	114	118
Manganese	7	2,610	1,180	1,980	1,840
Nickel	6	18.6	15.0	17.0	17.1
Silver	7	4.8	2.3	3.6	3.7
Zinc	7	1,320	1,070	1,170	1,160
12331500--FLINT CREEK NEAR DRUMMOND, MONT.					
Period of record for fine-grained bed-sediment data: 1986, 1989, 1992-98					
Cadmium	9	4.5	<1.0	[1]2.6	2.4
Chromium	6	29.2	21.1	25.4	25.2
Copper	9	73	55	62	63
Iron	9	28,100	21,100	24,200	23,600
Lead	9	240	151	182	179
Manganese	9	5,510	2,370	3,710	3,560
Nickel	6	14.9	11.7	13.1	13.0
Silver	8	7.8	5.0	6.3	6.5
Zinc	9	777	577	668	672

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12331800--CLARK FORK NEAR DRUMMOND, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 1991-98					
Cadmium	10	5.4	3.0	4.5	4.6
Chromium	6	35.4	17.0	30.5	33.3
Copper	10	747	469	567	565
Iron	10	27,000	16,500	22,800	23,800
Lead	10	135	83	102	101
Manganese	10	2,780	1,220	1,860	1,890
Nickel	6	16.8	14.0	15.7	15.8
Silver	10	4.7	<3.2	[1]3.0	[1]3.0
Zinc	10	1,230	939	1,090	1,110
12334510--ROCK CREEK NEAR CLINTON, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 89, 1991-98					
Cadmium	11	<.7	<.3	[1].4	[1]<1.0
Chromium	6	27.9	16.5	22.9	23.8
Copper	11	15	3	12	14
Iron	11	21,400	13,100	18,000	18,000
Lead	11	16	<3	[1]7	[1]7
Manganese	11	724	126	398	382
Nickel	6	13.7	10.8	12.5	12.9
Silver	10	.8	<.3	[1].4	[1]<.5
Zinc	11	58	36	48	48
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.					
Period of record for fine-grained bed-sediment data: 1986, 1991-98					
Cadmium	9	5.2	3.1	3.8	3.6
Chromium	6	34.7	15.3	26.2	28.5
Copper	9	635	300	414	356
Iron	9	24,000	15,100	19,900	21,700
Lead	9	115	49	78	74
Manganese	9	2,270	671	1,280	1,260
Nickel	6	16.3	11.6	14.7	16.0
Silver	9	3.9	1.3	2.3	2.4
Zinc	9	1,160	775	925	909
12340000--BLACKFOOT RIVER NEAR BONNER, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 1991, 1993-96, 1998					
Cadmium	8	<1.5	<.3	[1].4	[1]<1.0
Chromium	5	25.8	15.1	20.6	22.0
Copper	8	25	16	21	21
Iron	8	20,200	12,400	16,700	16,900
Lead	8	20	<13	[1]12	11
Manganese	8	672	298	494	492
Nickel	5	13.4	11.7	12.7	12.7
Silver	8	.7	<.3	[1].4	[1]<.5
Zinc	8	73	54	63	62

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12340500–CLARK FORK ABOVE MISSOULA, MONT.					
Period of record for fine-grained bed-sediment data: 1997-98					
Cadmium	2	3.7	2.3	3.0	--
Chromium	2	30.6	28.5	29.6	--
Copper	2	516	282	399	--
Iron	2	24,300	21,800	23,000	--
Lead	2	63	60	61	--
Manganese	2	1,290	1,160	1,220	--
Nickel	2	15.0	14.5	14.8	--
Silver	2	2.9	<3.2	2.2	--
Zinc	2	924	696	810	--
12353000–CLARK FORK BELOW MISSOULA, MONT.[2]					
Period of record for fine-grained bed-sediment data: 1986, 1990-98					
Cadmium	10	2.6	1.1	1.7	1.8
Chromium	6	27.6	18.8	23.1	22.7
Copper	10	293	98	165	147
Iron	10	21,100	14,500	18,800	19,500
Lead	10	58	12	38	36
Manganese	10	2,530	752	1,480	1,310
Nickel	6	14.1	11.8	13.1	13.3
Silver	10	2.1	.4	1.3	1.3
Zinc	10	675	319	434	436

[1]Value determined by arbitrarily substituting one-half of the detection level for censored (<) values, when both uncensored and censored values are used in determining the mean. When all data are below the detection level, the median is determined by ranking the censored values in order of detection level. No mean is reported when all values are below the detection level.

[2]Samples collected about 30 miles downstream from water-quality station to conform to previous sampling location.

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1998

[Bulk bed sediment is material smaller than about 10 mm in diameter. Concentrations are in micrograms per gram dry weight. Symbols: <, less than minimum reporting level; --, indicates either too few samples (less than three) or insufficient data greater than the minimum reporting level to compute statistic. Number of samples represents the number of years that the constituent was analyzed, with each year represented by a single mean concentration of composite samples]

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12323600–SILVER BOW CREEK AT OPPORTUNITY, MONT.					
Period of record for bulk bed-sediment data: 1993-95, 1997-98					
Cadmium	5	12.7	4.9	7.6	6.7
Chromium	5	16.2	9.6	13.0	12.7
Copper	5	1,550	670	961	831
Iron	5	29,300	18,600	23,100	20,800
Lead	5	300	221	252	248
Manganese	5	1,670	504	867	740
Nickel	5	8.9	6.0	6.7	6.0
Silver	5	4.8	3.4	3.9	3.9
Zinc	5	3,420	1,720	2,240	2,050
12323750–SILVER BOW CREEK AT WARM SPRINGS, MONT.					
Period of record for bulk bed-sediment data: 1993, 1995-98					
Cadmium	5	1.7	<1.5	[1]1.0	[1]1.2
Chromium	5	11.8	9.2	10.5	10.1
Copper	5	111	20	65	66
Iron	5	12,300	7,200	10,200	11,000
Lead	5	33	<10	[1]16	11
Manganese	5	884	209	638	722
Nickel	5	9.2	4.8	6.6	5.5
Silver	5	1.3	<.3	[1].7	[1]1.6
Zinc	5	303	93	186	157
12327700–WARM SPRINGS CREEK AT WARM SPRINGS, MONT.					
Period of record for bulk bed-sediment data: 1995, 1997					
Cadmium	2	1.0	<.8	[1].7	--
Chromium	2	11.8	9.7	10.8	--
Copper	2	205	203	204	--
Iron	2	10,900	8,980	9,960	--
Lead	2	34	18	26	--
Manganese	2	2,650	1,220	1,930	--
Nickel	2	7.8	5.7	6.8	--
Silver	2	1.1	.9	1.0	--
Zinc	2	148	146	147	--

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12323800--CLARK FORK NEAR GALEN, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	6.0	1.5	3.5	3.3
Chromium	6	23.0	4.2	13.4	13.1
Copper	6	685	223	404	362
Iron	6	31,300	9,930	20,400	21,000
Lead	6	158	41	80	72
Manganese	6	5,410	900	2,020	1,410
Nickel	6	12.5	4.9	7.9	7.3
Silver	6	1.9	.7	[1]1.4	[1]1.6
Zinc	6	1,280	417	704	665
461415112450801--CLARK FORK BELOW LOST CREEK, NEAR GALEN, MONT					
Period of record for bulk bed-sediment data: 1996-98					
Cadmium	3	3.1	1.9	2.5	2.5
Chromium	3	17.5	12.0	14.2	13.1
Copper	3	763	398	539	455
Iron	3	21,000	16,000	18,100	17,300
Lead	3	104	72	85	78
Manganese	3	1,740	1,260	1,460	1,390
Nickel	3	8.2	6.7	7.6	7.7
Silver	3	2.8	<3.4	[1]2.2	[1]2.1
Zinc	3	787	522	647	632
461559112443301--CLARK FORK NEAR RACETRACK, MONT.					
Period of record for bulk bed-sediment data: 1996-98					
Cadmium	3	3.4	1.9	2.4	2.1
Chromium	3	16.4	12.4	13.8	12.7
Copper	3	594	361	443	375
Iron	3	18,200	16,200	17,400	17,900
Lead	3	87	66	77	78
Manganese	3	1,680	760	1,310	1,500
Nickel	3	9.9	5.5	7.6	7.3
Silver	3	2.6	<3.2	[1]2.0	[1]1.9
Zinc	3	743	472	583	535
461903112440701--CLARK FORK AT DEMPSEY CREEK DIVERSION, NEAR RACETRACK, MONT.					
Period of record for bulk bed-sediment data: 1996-98					
Cadmium	3	3.9	1.8	2.9	3.0
Chromium	3	20.9	16.3	18.2	17.3
Copper	3	651	424	551	577
Iron	3	25,400	20,100	22,100	20,900
Lead	3	89	58	78	88
Manganese	3	1,940	825	1,540	1,860
Nickel	3	12.8	5.5	9.4	10.0
Silver	3	2.8	<3.2	[1]2.1	2.0
Zinc	3	804	448	619	604

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12324200--CLARK FORK AT DEER LODGE, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	3.1	2.0	2.4	2.2
Chromium	6	24.5	12.1	17.7	17.9
Copper	6	691	281	436	412
Iron	6	25,000	13,200	19,100	19,000
Lead	6	85	45	73	78
Manganese	6	2,060	653	1,160	1,040
Nickel	6	12.3	7.7	9.8	10.1
Silver	6	2.8	<.7	[1]1.6	[1]1.5
Zinc	6	777	456	581	564
12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, MONT.					
Period of record for bulk bed-sediment data: 1994, 1998					
Cadmium	2	.7	<1.2	[1].6	--
Chromium	2	33.2	14.7	23.9	--
Copper	2	20	19	20	--
Iron	2	21,000	15,600	18,300	--
Lead	2	18	12	15	--
Manganese	2	420	308	364	--
Nickel	2	15.2	8.6	11.9	--
Silver	2	<1.6	<.7	[1]--	--
Zinc	2	86	73	79	--
12324680--CLARK FORK AT GOLDCREEK, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	5.2	2.0	3.3	2.9
Chromium	6	33.2	17.6	24.2	22.3
Copper	6	858	243	495	421
Iron	6	24,900	15,500	20,000	19,100
Lead	6	86	46	68	72
Manganese	6	2,600	649	1,340	1,230
Nickel	6	15.9	9.1	12.5	12.2
Silver	6	3.7	<.7	[1]2.0	[1]1.6
Zinc	6	1,020	549	749	686
12331500--FLINT CREEK NEAR DRUMMOND, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	3.2	.3	1.4	1.2
Chromium	6	13.9	4.9	10.3	10.9
Copper	6	40	19	28	28
Iron	6	15,700	8,630	13,400	13,900
Lead	6	120	51	85	82
Manganese	6	3,200	1,150	2,300	2,350
Nickel	6	8.0	5.3	6.3	5.9
Silver	6	5.8	3.3	4.5	4.5
Zinc	6	429	190	316	328

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12331800--CLARK FORK NEAR DRUMMOND, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	3.9	<1.6	[1]2.2	[1]1.8
Chromium	6	29.5	13.8	21.7	21.6
Copper	6	605	173	329	256
Iron	6	21,800	14,100	17,600	16,500
Lead	6	78	35	54	53
Manganese	6	1,510	711	1,140	1,180
Nickel	6	14.2	9.0	11.5	10.7
Silver	6	3.5	.5	[1]1.9	[1]1.6
Zinc	6	939	434	653	568
12334510--ROCK CREEK NEAR CLINTON, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	<1.5	<.8	[1]--	[1]<1.0
Chromium	6	14.3	6.6	9.6	8.9
Copper	6	7	4	5	5
Iron	6	11,100	6,380	8,500	8,180
Lead	6	<13	<9.6	[1]5	[1]5
Manganese	6	265	91	190	190
Nickel	6	8.2	4.5	5.8	5.4
Silver	6	<1.6	.1	[1].4	[1].3
Zinc	6	29	16	20	19
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	2.9	.5	[1]1.6	[1]1.7
Chromium	6	23.8	6.9	15.9	16.0
Copper	6	336	75	207	215
Iron	6	19,100	9,530	14,100	13,700
Lead	6	67	21	40	36
Manganese	6	1,470	234	711	451
Nickel	6	14.0	6.4	9.8	9.8
Silver	6	2.9	<.3	[1]1.2	[1].9
Zinc	6	769	281	509	509
12340000--BLACKFOOT RIVER NEAR BONNER, MONT.					
Period of record for bulk bed-sediment data: 1993-94					
Cadmium	2	<1.2	<.8	[1]--	--
Chromium	2	17.7	6.7	12.2	--
Copper	2	19	14	16	--
Iron	2	16,600	10,300	13,400	--
Lead	2	10	8	9	--
Manganese	2	305	179	242	--
Nickel	2	9.8	7.6	8.7	--
Silver	2	<.7	<.5	[1]--	--
Zinc	2	58	33	46	--

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1998 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12340500--CLARK FORK ABOVE MISSOULA, MONT.					
Period of record for bulk bed-sediment data: 1997-98					
Cadmium	2	<1.6	<.8	[1]--	--
Chromium	2	18.2	9.7	14.0	--
Copper	2	129	43	86	--
Iron	2	16,000	11,500	13,700	--
Lead	2	30	7	18	--
Manganese	2	553	228	390	--
Nickel	2	10.3	8.2	9.3	--
Silver	2	<3.3	.6	[1]1.1	--
Zinc	2	387	145	266	--
12353000--CLARK FORK BELOW MISSOULA, MONT.[2]					
Period of record for bulk bed-sediment data: 1993-98					
Cadmium	6	<1.5	<.8	[1].5	[1]<.5
Chromium	6	12.6	4.4	7.5	6.9
Copper	6	77	22	44	39
Iron	6	11,300	5,830	8,200	7,900
Lead	6	19	<10	[1]9	[1]7
Manganese	6	444	223	362	374
Nickel	6	7.1	3.5	5.3	5.2
Silver	6	<1.6	<.3	[1].5	[1].4
Zinc	6	172	83	121	111

[1]Value determined by arbitrarily substituting one-half of the detection level for censored (<) values, when both uncensored and censored values are used in determining the mean and/or median. When all data are below the detection level, the median is determined by ranking the censored values in order of detection level. No mean is reported when all values are below the detection level.

[2]Samples collected about 30 miles downstream from water-quality station to conform to previous sampling location.

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998

[Concentrations are in micrograms per gram dry weight. Symbols: <, less than minimum reporting level; --, indicates either too few samples (less than three) or insufficient data greater than the minimum reporting level to compute statistic, or element not analyzed. Number of composite samples represents the total of all individual composite samples collected for every year that the constituent was analyzed. Values for single samples are arbitrarily listed in the "Mean" column. Because *Hydropsyche* insects were not sorted to the species level during 1986-89, statistics for stations sampled during those years are based on the results of all *Hydropsyche* species combined. At some sites, statistics for the *Hydropsyche morosa* group are based on the combined results for two or more species]

Constituent	Number of composite samples	Maximum	Minimum	Mean	Mediar
12323600--SILVER BOW CREEK AT OPPORTUNITY, MONT.					
Period of record for biological data: 1992, 1994-95, 1997-98					
***Brachycentrus* spp.**					
Cadmium	2	12.5	11.6	12.0	--
Chromium	2	1.1	.7	.9	--
Copper	2	592	587	590	--
Iron	2	363	335	349	--
Lead	2	7.9	7.4	7.6	--
Manganese	2	357	231	294	--
Nickel	2	1.0	<1.0	.8	--
Zinc	2	888	686	787	--
Hydropsyche cockerelli					
Cadmium	5	6.3	4.1	4.9	4.7
Chromium	5	8.0	1.0	3.7	3.1
Copper	5	462	269	365	333
Iron	5	1,180	689	931	953
Lead	5	21.7	19.0	20.3	20.1
Manganese	5	718	180	460	434
Nickel	5	2.1	.7	1.4	1.6
Zinc	5	898	749	818	805
Hydropsyche tana					
Cadmium	6	9.2	4.8	6.8	6.9
Chromium	6	11.5	.9	4.5	1.8
Copper	6	456	10.5	236	298
Iron	6	1,520	857	1,100	1,050
Lead	6	21.0	15.6	18.6	18.3
Manganese	6	969	307	634	675
Nickel	6	1.8	.7	1.4	1.6
Zinc	6	1,070	760	961	1,020
12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT.					
Period of record for biological data: 1992-98					
Hydropsyche cockerelli					
Cadmium	20	2.1	.2	.8	.6
Chromium	20	1.3	.5	.8	.8
Copper	20	96.9	25.1	46.5	42.6
Iron	20	1,240	351	703	733
Lead	20	5.7	.3	3.3	3.0
Manganese	20	2,450	491	997	829
Nickel	20	1.8	.3	.8	.8
Zinc	20	276	118	187	182

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT.--Continued					
Period of record for biological data: 1992-98					
		Hydropsyche occidentalis			
Cadmium	4	1.1	.4	1.3	.9
Chromium	4	.17	.3	1.2	.8
Copper	4	46.5	22.8	33.9	39.4
Iron	4	1,040	372	649	741
Lead	4	<3.6	<2.3	[1]1.6	[1]1.7
Manganese	4	2,250	1,200	1,030	1,960
Nickel	4	1.8	.7	1.3	1.2
Zinc	4	202	149	154	176
		***Hydropsyche* spp.**			
Cadmium	4	2.3	.4	1.1	.9
Chromium	4	1.4	.5	.8	1.2
Copper	4	47.6	34.9	40.9	40.6
Iron	4	773	561	680	693
Lead	4	5.1	1.9	2.9	4.7
Manganese	4	1,100	443	725	678
Nickel	4	1.9	<.4	[1].8	[1].5
Zinc	4	285	141	195	177
12323770--WARM SPRINGS CREEK AT WARM SPRINGS, MONT.					
Period of record for biological data: 1995, 1997					
		Arctopsyche grandis			
Cadmium	2	2.4	2.1	2.2	--
Chromium	2	1.9	1.4	1.6	--
Copper	2	98.8	95.6	97.2	--
Iron	2	1,040	684	862	--
Lead	2	5.6	<6.3	[1]4.4	--
Manganese	2	2,280	1,340	1,810	--
Nickel	2	2.3	1.8	2.0	--
Zinc	2	222	197	210	--
		***Hydropsyche* spp.**			
Cadmium	1	--	--	<9.3	--
Chromium	1	--	--	1.6	--
Copper	1	--	--	94.8	--
Iron	1	--	--	1,150	--
Lead	1	--	--	<16.7	--
Manganese	1	--	--	956	--
Nickel	1	--	--	2.0	--
Zinc	1	--	--	129	--

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12323800--CLARK FORK NEAR GALEN, MONT. **Period of record for biological data: 1987, 1991-98**					
		Hydropsyche cockerelli			
Cadmium	13	2.7	1.3	1.7	1.7
Chromium	13	3.3	.8	1.6	1.4
Copper	13	181	49.8	96.3	97.5
Iron	13	1,510	902	1,200	1,160
Lead	13	11.0	1.2	7.0	7.7
Manganese	13	2,950	1,070	1,960	1,850
Nickel	13	3.1	1.0	1.6	1.3
Zinc	13	299	136	214	216
		***Hydropsyche morosa* group**			
Cadmium	5	3.2	2.4	2.5	2.4
Chromium	5	4.6	1.8	2.6	2.2
Copper	5	185	156	173	175
Iron	5	1,890	1,360	1,510	1,430
Lead	5	12.4	7.1	8.5	7.9
Manganese	5	3,960	2,360	3,500	3,860
Nickel	5	3.6	1.9	2.3	2.1
Zinc	5	349	292	309	303
		Hydropsyche occidentalis			
Cadmium	24	1.7	.7	1.1	1.1
Chromium	24	6.6	.7	1.8	1.5
Copper	24	106	49.2	79.2	78.2
Iron	24	1,920	642	1,190	1,170
Lead	24	13.5	1.6	6.6	6.3
Manganese	24	4,070	1,220	2,400	2,290
Nickel	24	3.5	.8	1.6	1.6
Zinc	24	278	170	200	197
		Hydropsyche tana			
Cadmium	1	--	--	1.5	--
Chromium	1	--	--	1.4	--
Copper	1	--	--	92.9	--
Iron	1	--	--	1,340	--
Lead	1	--	--	9.0	--
Manganese	1	--	--	2,160	--
Nickel	1	--	--	2.1	--
Zinc	1	--	--	206	--
		***Hydropsyche* spp.**			
Cadmium	4	3.5	2.6	3.0	3.0
Chromium	0	--	--	--	--
Copper	4	154	135	148	152
Iron	4	1,540	1,190	1,400	1,450
Lead	4	13.5	10.5	12.2	12.4
Manganese	0	--	--	--	--
Nickel	0	--	--	--	--
Zinc	4	329	279	308	313

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
461415112450801–CLARK FORK BELOW LOST CREEK, NEAR GALEN, MONT.					
Period of record for biological data: 1996-98					
		Hydropsyche cockerelli			
Cadmium	4	2.8	2.2	2.4	2.4
Chromium	4	2.5	1.8	2.1	2.0
Copper	4	147	121	138	142
Iron	4	1,900	1,560	1,760	1,780
Lead	4	14.8	12.1	13.1	12.7
Manganese	4	1,850	1,250	1,590	1,630
Nickel	4	1.9	1.1	1.6	1.6
Zinc	4	250	221	234	233
		Hydropsyche occidentalis			
Cadmium	10	1.8	.9	1.4	1.5
Chromium	10	3.3	1.3	2.0	1.8
Copper	10	157	52.1	105	121
Iron	10	1,920	963	1,410	1,430
Lead	10	12.4	6.6	9.6	10.1
Manganese	10	2,300	1,270	1,890	2,090
Nickel	10	1.7	.9	1.3	1.4
Zinc	10	252	174	220	233
		***Hydropsyche* spp.**			
Cadmium	3	1.8	1.2	1.5	1.4
Chromium	3	2.4	1.5	1.9	1.7
Copper	3	122	67.8	104	121
Iron	3	1,410	1,200	1,320	1,340
Lead	3	20.5	7.2	12.5	9.7
Manganese	3	1,980	799	1,580	1,950
Nickel	3	2.8	1.4	1.9	1.4
Zinc	3	225	179	197	186
461559112443301–CLARK FORK NEAR RACETRACK, MONT.					
Period of record for biological data: 1996-97					
		Hydropsyche cockerelli			
Cadmium	5	1.9	1.1	1.5	1.6
Chromium	5	2.7	.7	1.7	1.4
Copper	5	109	50.5	84.0	91.4
Iron	5	1,370	862	1,100	1,080
Lead	5	10.5	6.1	8.3	8.7
Manganese	5	1,530	646	971	878
Nickel	5	1.4	1.0	1.2	1.3
Zinc	5	199	139	176	179

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
461559112443301--CLARK FORK NEAR RACETRACK, MONT.--Continued					
Period of record for biological data: 1996-98					
		Hydropsyche occidentalis			
Cadmium	9	2.2	.7	1.5	1.5
Chromium	9	2.6	1.5	2.1	2.0
Copper	9	160	64.4	111	107
Iron	9	1,880	1,300	1,540	1,520
Lead	9	11.7	9.7	10.2	10.1
Manganese	9	2,640	1,090	1,760	2,020
Nickel	9	1.7	1.1	1.3	1.2
Zinc	9	255	203	233	230
		***Hydropsyche* spp.**			
Cadmium	1	--	--	1.0	--
Chromium	1	--	--	.7	--
Copper	1	--	--	82.9	--
Iron	1	--	--	1,140	--
Lead	1	--	--	5.7	--
Manganese	1	--	--	910	--
Nickel	1	--	--	1.1	--
Zinc	1	--	--	151	--
461903112440701--CLARK FORK AT DEMPSEY CREEK DIVERSION, NEAR RACETRACK, MONT.					
Period of record for biological data: 1996-98					
		Arctopsyche grandis			
Cadmium	1	--	--	1.7	--
Chromium	1	--	--	<2.4	--
Copper	1	--	--	30.8	--
Iron	1	--	--	340	--
Lead	1	--	--	<14.5	--
Manganese	1	--	--	510	--
Nickel	1	--	--	1.0	--
Zinc	1	--	--	87	--
		Hydropsyche cockerelli			
Cadmium	2	1.6	.9	1.2	--
Chromium	2	1.3	1.0	1.2	--
Copper	2	143	87.6	115	--
Iron	2	1,290	831	1,060	--
Lead	2	8.4	6.8	7.6	--
Manganese	2	697	487	592	--
Nickel	2	1.9	1.6	1.8	--
Zinc	2	180	162	171	--

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
461903112440701--CLARK FORK AT DEMPSEY CREEK DIVERSION, NEAR RACETRACK, MONT.--Continued					
Period of record for biological data: 1996-98					
Hydropsyche occidentalis					
Cadmium	7	1.7	.7	1.2	1.0
Chromium	7	2.0	1.2	1.7	1.8
Copper	7	163	74.9	105	87.5
Iron	7	1,640	1,100	1,440	1,500
Lead	7	12.9	9.7	11.0	10.9
Manganese	7	2,420	826	2,070	2,280
Nickel	7	1.5	1.2	1.3	1.3
Zinc	7	240	222	231	231
***Hydropsyche* spp.**					
Cadmium	2	1.7	1.6	1.6	--
Chromium	2	2.1	1.4	1.8	--
Copper	2	140	104	122	--
Iron	2	1,610	1,070	1,340	--
Lead	2	13.2	10.5	11.8	--
Manganese	2	1,150	638	892	--
Nickel	2	1.6	1.6	1.6	--
Zinc	2	212	191	202	--
12324200--CLARK FORK AT DEER LODGE, MONT.					
Period of record for biological data: 1986-87, 1990-98					
Arctopsyche grandis					
Cadmium	2	2.4	<4.2	[1]2.2	--
Chromium	2	1.0	<1.3	[1].8	--
Copper	2	69.1	34.9	52.0	--
Iron	2	676	537	606	--
Lead	2	<7.8	3.8	[1]3.8	--
Manganese	2	727	380	554	--
Nickel	2	<1.7	<1.3	[1]--	--
Zinc	2	178	140	159	--
Hydropsyche cockerelli					
Cadmium	17	2.3	.8	1.3	1.3
Chromium	17	3.2	.4	1.7	1.9
Copper	17	136	54.7	96.8	102
Iron	17	3,340	490	1,180	1,050
Lead	17	18.2	4.3	8.9	8.9
Manganese	17	1,030	396	683	679
Nickel	17	2.4	.3	1.2	1.1
Zinc	17	391	132	186	184

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12324200--CLARK FORK AT DEER LODGE, MONT.--Continued					
Period of record for biological data: 1986-87, 1990-98					
Hydropsyche occidentalis					
Cadmium	26	2.7	.8	1.3	1.3
Chromium	26	2.6	.6	1.9	2.0
Copper	26	162	49.5	114	111
Iron	26	1,930	558	1,460	1,510
Lead	26	16.2	6.3	11.4	11.1
Manganese	26	2,840	649	1,650	1,740
Nickel	26	12.9	1.0	1.9	1.4
Zinc	26	299	196	235	227
***Hydropsyche* spp.**					
Cadmium	3	2.0	1.2	1.6	1.6
Chromium	0	--	--	--	--
Copper	3	222	103	145	111
Iron	3	2,220	1,110	1,520	1,240
Lead	3	15.0	5.6	8.8	5.7
Manganese	0	--	--	--	--
Nickel	0	--	--	--	--
Zinc	3	203	185	195	197
12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, MONT.					
Period of record for biological data: 1987, 1994, 1998					
Arctopsyche grandis					
Cadmium	10	.5	.2	.3	.3
Chromium	10	1.6	.6	.8	.8
Copper	10	14.0	9.1	11.4	11.5
Iron	10	654	177	284	235
Lead	10	1.3	.5	.8	.8
Manganese	10	596	318	479	496
Nickel	10	.6	.4	.5	.5
Zinc	10	179	113	149	145
Claassenia sabulosa					
Cadmium	5	.5	.1	.3	.2
Chromium	5	.9	.7	.8	.8
Copper	5	36.1	20.0	29.5	31.4
Iron	5	319	98	174	144
Lead	5	<.7	<.4	[1]--	[1]--
Manganese	5	71.0	46.7	57.8	56.7
Nickel	5	.7	.5	.6	.5
Zinc	5	233	191	205	202

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, MONT.--Continued					
Period of record for biological data: 1987, 1994, 1998					
Hydropsyche cockerelli					
Cadmium	1	--	--	.6	--
Chromium	1	--	--	1.6	--
Copper	1	--	--	28.4	--
Iron	1	--	--	478	--
Lead	1	--	--	3.6	--
Manganese	1	--	--	399	--
Nickel	1	--	--	1.2	--
Zinc	1	--	--	123	--
Hydropsyche occidentalis					
Cadmium	2	<.7	.3	.3	--
Chromium	2	2.3	1.3	1.8	--
Copper	2	15.2	15.1	15.2	--
Iron	2	1,340	426	883	--
Lead	2	2.3	<3.7	2.1	--
Manganese	2	554	434	494	--
Nickel	2	1.1	.8	1.0	--
Zinc	2	137	110	124	--
12324680--CLARK FORK AT GOLDCREEK, MONT.					
Period of record for biological data: 1992-98					
Arctopsyche grandis					
Cadmium	17	6.6	1.4	2.4	2.1
Chromium	17	3.3	.8	1.5	1.0
Copper	17	129	28.8	58.7	56.5
Iron	17	2,360	339	888	651
Lead	17	10.9	2.3	4.7	3.8
Manganese	17	1,100	592	802	760
Nickel	17	1.8	.2	.9	.8
Zinc	17	309	165	197	186
Claassenia sabulosa					
Cadmium	13	3.5	.6	1.7	1.7
Chromium	13	1.6	.3	.7	.6
Copper	13	67.7	33.0	53.6	50.6
Iron	13	296	63.0	166	171
Lead	13	1.7	.5	1.0	1.0
Manganese	13	179	50.6	97.0	90.3
Nickel	13	.7	.2	.3	.3
Zinc	13	296	166	246	258

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12324680--CLARK FORK AT GOLDCREEK, MONT.--Continued					
Period of record for biological data: 1992-98					
Hydropsyche cockerelli					
Cadmium	13	2.6	.6	1.7	1.7
Chromium	13	4.7	.7	2.5	2.0
Copper	13	188	33.5	95.4	67.1
Iron	13	3,250	589	1,410	1,340
Lead	13	16.2	4.5	8.5	6.9
Manganese	13	954	538	705	654
Nickel	13	2.3	.6	1.4	1.3
Zinc	13	240	137	194	201
***Hydropsyche morosa* group**					
Cadmium	4	1.7	1.1	1.4	1.4
Chromium	4	1.4	1.3	1.4	1.4
Copper	4	72.9	43.8	60.5	62.7
Iron	4	1,320	612	1,050	1,130
Lead	4	6.9	2.4	4.6	4.6
Manganese	4	1,030	538	804	822
Nickel	4	1.4	.9	1.2	1.2
Zinc	4	190	137	167	170
Hydropsyche occidentalis					
Cadmium	12	1.7	.7	1.2	1.3
Chromium	12	3.9	.4	1.5	1.4
Copper	12	156	26.4	64.9	51.8
Iron	12	2,720	466	1,140	931
Lead	12	15.7	2.9	7.0	6.0
Manganese	12	1,800	530	1,060	984
Nickel	12	2.5	.8	1.3	1.1
Zinc	12	242	97	182	186
12331500--FLINT CREEK NEAR DRUMMOND, MONT.					
Period of record for biological data: 1986, 1992-98					
Arctopsyche grandis					
Cadmium	33	.8	.1	.4	.4
Chromium	33	4.7	.6	1.9	1.8
Copper	33	21.7	8.7	14.9	14.9
Iron	33	2,460	606	1,380	1,380
Lead	33	17.5	3.7	8.7	7.5
Manganese	33	2,480	679	1,470	1,330
Nickel	33	2.7	.6	1.3	1.2
Zinc	33	275	141	198	188

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12331500--FLINT CREEK NEAR DRUMMOND, MONT.--Continued					
Period of record for biological data: 1986, 1992-98					
		Hydropsyche cockerelli			
Cadmium	8	.7	.2	.4	.4
Chromium	8	4.0	1.0	1.8	1.5
Copper	8	28.3	9.5	18.1	18.1
Iron	8	3,290	996	1,780	1,680
Lead	8	17.9	3.1	11.3	12.0
Manganese	8	1,440	401	1,020	1,130
Nickel	8	2.3	.9	1.9	2.2
Zinc	8	193	85	157	180
		Hydropsyche occidentalis			
Cadmium	6	1.0	.2	.6	.6
Chromium	6	17.6	.7	4.6	1.8
Copper	6	26.4	15.1	19.3	18.0
Iron	6	2,550	912	1,720	1,780
Lead	6	29.2	5.8	17.7	19.3
Manganese	6	2,690	1,400	1,860	1,760
Nickel	6	6.9	.8	3.2	2.9
Zinc	6	243	128	182	185
		Hydropsyche tana			
Cadmium	2	<1.2	<.1	[1]--	--
Chromium	2	10.3	.6	5.4	--
Copper	2	16.0	5.4	10.7	--
Iron	2	1,320	729	1,020	--
Lead	2	15.3	5.0	10.2	--
Manganese	2	1,400	1,180	1,290	--
Nickel	2	3.1	.5	1.8	--
Zinc	2	139	107	123	--
12331800--CLARK FORK NEAR DRUMMOND, MONT.					
Period of record for biological data: 1986, 1991-98					
		Arctopsyche grandis			
Cadmium	22	3.8	.7	1.7	1.5
Chromium	22	2.5	.2	1.1	1.0
Copper	22	89.2	18.2	38.8	34.0
Iron	22	1,660	240	671	613
Lead	22	11.8	2.1	5.0	4.3
Manganese	22	2,010	462	861	721
Nickel	22	1.9	.2	.7	.7
Zinc	22	308	142	194	189

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12331800--CLARK FORK NEAR DRUMMOND, MONT.--Continued					
Period of record for biological data: 1986, 1991-98					
Claassenia sabulosa					
Cadmium	27	2.8	.3	1.4	1.4
Chromium	27	3.3	.3	.8	.6
Copper	27	130	18.0	60.4	52.6
Iron	27	290	76.1	138	117
Lead	27	2.2	.2	.8	.8
Manganese	27	270	45.9	128	125
Nickel	27	1.1	.1	.3	.2
Zinc	27	469	140	258	241
Hydropsyche cockerelli					
Cadmium	16	2.3	.7	1.6	1.7
Chromium	16	3.5	.4	1.9	1.7
Copper	16	156	37.9	78.3	68.0
Iron	16	2,500	506	1,350	1,180
Lead	16	15.0	5.1	9.1	8.0
Manganese	16	982	549	760	743
Nickel	16	2.0	.5	1.2	1.1
Zinc	16	240	164	197	195
***Hydropsyche morosa* group**					
Cadmium	6	1.3	1.1	1.2	1.2
Chromium	6	2.8	1.9	2.3	2.2
Copper	6	57.4	50.2	55.2	55.8
Iron	6	1,730	1,380	1,570	1,600
Lead	6	10.8	7.0	8.9	9.0
Manganese	6	1,940	1,260	1,610	1,620
Nickel	6	1.7	1.3	1.5	1.5
Zinc	6	250	227	239	240
Hydropsyche occidentalis					
Cadmium	12	2.0	.7	1.2	1.2
Chromium	12	8.1	.4	2.5	2.1
Copper	12	118	13.3	56.8	54.7
Iron	12	2,060	424	1,240	1,230
Lead	12	13.5	2.9	8.7	8.7
Manganese	12	2,920	619	1,450	1,160
Nickel	12	2.4	.5	1.4	1.5
Zinc	12	283	157	217	212
***Hydropsyche* spp.**					
Cadmium	1	--	--	2.6	--
Chromium	0	--	--	--	--
Copper	1	--	--	85.0	--
Iron	1	--	--	940	--
Lead	1	--	--	9.1	--
Manganese	0	--	--	--	--
Nickel	0	--	--	--	--
Zinc	1	--	--	260	--

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12334510–ROCK CREEK NEAR CLINTON, MONT.					
Period of record for biological data: 1987, 1991-98					
		Arctopsyche grandis			
Cadmium	31	.4	.06	.2	.2
Chromium	31	2.9	.5	1.2	1.0
Copper	31	15.7	4.7	8.7	8.5
Iron	31	991	191	537	546
Lead	31	<2.9	.1	[1].4	[1].4
Manganese	31	454	113	253	227
Nickel	31	1.6	.2	.8	.8
Zinc	31	189	84	127	125
		Claassenia sabulosa			
Cadmium	16	.3	.05	.2	.1
Chromium	16	1.8	.4	.8	.6
Copper	16	40.7	18.1	29.8	30.0
Iron	16	129	49.8	90.7	93.1
Lead	16	1.0	.1	.3	.3
Manganese	16	76.3	15.7	35.0	33.6
Nickel	16	.9	.1	.3	.3
Zinc	16	264	164	205	207
		Hydropsyche cockerelli			
Cadmium	3	<.2	<.2	[1]--	<.2
Chromium	3	1.0	.9	.9	.9
Copper	3	13.1	6.0	8.6	6.6
Iron	3	609	485	530	497
Lead	3	<1.1	<1.1	[1]--	<1.1
Manganese	3	258	192	219	208
Nickel	3	.9	.4	.6	.4
Zinc	3	99	82	89	86
		Hydropsyche occidentalis			
Cadmium	4	<1.0	<.3	[1]--	<.3
Chromium	4	2.4	.9	1.6	.9
Copper	4	17.6	9.6	12.0	10.2
Iron	4	752	520	642	648
Lead	4	6.0	1.2	3.0	1.2
Manganese	4	268	169	228	215
Nickel	4	1.7	.6	1.2	.9
Zinc	4	144	99	121	117

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12334510--ROCK CREEK NEAR CLINTON, MONT.--Continued					
Period of record for biological data: 1987, 1991-98					
		***Hydropsyche* spp.**			
Cadmium	3	.3	<.5	[1].2	.2
Chromium	3	2.1	1.1	1.6	1.7
Copper	3	16.2	11.6	14.3	15.0
Iron	3	1,140	837	1,000	1,030
Lead	3	<3.1	<1.8	[1]--	<2.9
Manganese	3	462	299	399	437
Nickel	3	1.3	.8	1.1	1.1
Zinc	3	135	117	126	126
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.					
Period of record for biological data: 1986, 1991-98					
		Arctopsyche grandis			
Cadmium	29	2.7	.6	1.4	1.5
Chromium	29	4.1	.6	1.7	1.6
Copper	29	125	20.1	41.6	33.8
Iron	29	2,870	420	1,030	867
Lead	29	13.2	2.1	4.5	3.3
Manganese	29	893	351	616	616
Nickel	29	2.6	.4	1.0	.8
Zinc	29	276	152	198	196
		Claassenia sabulosa			
Cadmium	22	2.5	.3	1.2	.9
Chromium	22	2.0	.4	.8	.6
Copper	22	79.2	38.3	57.7	55.6
Iron	22	181	58.6	106	104
Lead	22	1.6	.2	.6	.6
Manganese	22	139	42.0	78.6	69.7
Nickel	22	.6	.1	.2	.2
Zinc	22	283	144	223	232
		Hydropsyche cockerelli			
Cadmium	20	1.7	.6	1.0	.8
Chromium	20	8.0	1.0	2.2	1.7
Copper	20	118	26.4	52.0	42.4
Iron	20	2,530	688	1,260	1,060
Lead	20	12.1	2.2	5.4	4.9
Manganese	20	788	426	580	554
Nickel	20	2.6	.6	1.2	1.1
Zinc	20	228	148	184	180

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.--Continued					
Period of record for biological data: 1986, 1991-98					
***Hydropsyche morosa* group**					
Cadmium	2	1.3	1.1	1.2	--
Chromium	2	4.6	2.4	3.5	--
Copper	2	84.1	26.8	55.4	--
Iron	2	1,800	986	1,390	--
Lead	2	6.6	<7.8	5.2	--
Manganese	2	1,320	537	928	--
Nickel	2	1.7	1.3	1.5	--
Zinc	2	231	171	201	--
Hydropsyche occidentalis					
Cadmium	14	1.8	.3	.9	.8
Chromium	14	3.1	.6	1.8	1.5
Copper	14	102	34.1	48.6	40.5
Iron	14	2,310	472	1,100	975
Lead	14	12.2	3.0	5.7	5.3
Manganese	14	1,510	454	758	665
Nickel	14	1.9	.6	1.0	.9
Zinc	14	235	145	188	177
***Hydropsyche* spp.**					
Cadmium	1	--	--	1.3	--
Chromium	1	--	--	2.4	--
Copper	1	--	--	84.1	--
Iron	1	--	--	1,800	--
Lead	1	--	--	<7.8	--
Manganese	1	--	--	537	--
Nickel	1	--	--	1.3	--
Zinc	1	--	--	171	--
12340000--BLACKFOOT RIVER NEAR BONNER, MONT.					
Period of record for biological data: 1986-87, 1991, 1993, 1996, 1998					
Arctopsyche grandis					
Cadmium	9	.3	<.1	[1].2	[1].2
Chromium	3	1.8	1.2	1.4	1.3
Copper	9	[2]13.4	9.9	11.8	12.0
Iron	9	1,230	108	596	617
Lead	9	2.1	.5	1.2	.9
Manganese	3	517	389	435	398
Nickel	3	1.2	.8	1.0	.9
Zinc	9	[2]143	123	134	135

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12340000--BLACKFOOT RIVER NEAR BONNER, MONT.--Continued					
Period of record for biological data: 1986-87, 1991, 1993, 1996, 1998					
Claassenia sabulosa					
Cadmium	9	[2].2	.1	.1	.1
Chromium	3	.9	.5	.7	.7
Copper	9	88.5	19.0	44.5	41.0
Iron	9	199	68.0	124	114
Lead	9	.6	.4	.5	.6
Manganese	3	127	44.2	74.6	52.6
Nickel	3	.3	.1	.2	.2
Zinc	9	329	117	204	194
Hydropsyche occidentalis					
Cadmium	12	.5	.1	.2	.2
Chromium	12	2.7	.8	1.8	1.7
Copper	12	20.6	12.0	14.6	14.4
Iron	12	1,930	1,050	1,410	1,380
Lead	12	1.9	.8	1.3	1.2
Manganese	12	527	414	472	460
Nickel	12	1.8	.9	1.3	1.2
Zinc	12	150	117	134	130
***Hydropsyche* spp.**					
Cadmium	1	--	--	.6	--
Chromium	1	--	--	1.6	--
Copper	1	--	--	13.9	--
Iron	1	--	--	1,120	--
Lead	1	--	--	2.9	--
Manganese	1	--	--	525	--
Nickel	1	--	--	2.8	--
Zinc	1	--	--	132	--

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12340500--CLARK FORK ABOVE MISSOULA, MONT.					
Period of record for biological data: 1997-98					
Arctopsyche grandis					
Cadmium	8	1.8	.5	1.0	.9
Chromium	8	3.0	1.3	1.7	1.6
Copper	8	77.6	22.3	35.7	26.7
Iron	8	2,340	708	1,200	1,050
Lead	8	6.8	1.2	3.6	3.5
Manganese	8	929	476	701	704
Nickel	8	2.0	.7	1.1	.9
Zinc	8	235	155	181	175
Claassenia sabulosa					
Cadmium	2	2.0	1.7	1.8	--
Chromium	2	1.1	.5	.8	--
Copper	2	51.0	37.8	44.4	--
Iron	2	136	95.3	116	--
Lead	2	<3.8	<1.4	[1]--	--
Manganese	2	111	75.2	93.1	--
Nickel	2	<.9	<.3	[1]--	--
Zinc	2	273	226	250	--
Hydropsyche cockerelli					
Cadmium	5	1.3	1.0	1.1	1.1
Chromium	5	4.1	3.1	3.4	3.3
Copper	5	96.1	45.7	71.9	83.5
Iron	5	3,590	2,040	2,560	2,430
Lead	5	6.3	5.3	5.8	5.9
Manganese	5	1,180	781	930	878
Nickel	5	2.4	1.4	1.9	1.9
Zinc	5	226	191	208	207
Hydropsyche occidentalis					
Cadmium	2	1.1	1.0	1.0	--
Chromium	2	2.9	2.8	2.8	--
Copper	2	76.5	49.8	63.2	--
Iron	2	2,240	2,010	2,120	--
Lead	2	7.7	7.1	7.4	--
Manganese	2	2,030	939	1,480	--
Nickel	2	2.1	1.9	2.0	--
Zinc	2	232	210	221	--
12353000--CLARK FORK BELOW MISSOULA, MONT.[3]					
Period of record for biological data: 1986, 1990-98					
Arctopsyche grandis					
Cadmium	17	1.5	.3	.7	.6
Chromium	17	2.7	.5	1.4	1.4
Copper	17	38.0	9.4	21.0	20.3
Iron	17	1,500	343	779	754
Lead	17	3.2	.9	1.8	1.9
Manganese	17	1,090	511	691	681
Nickel	17	1.6	.4	.9	.9
Zinc	17	184	106	146	145

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1998 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12353000--CLARK FORK BELOW MISSOULA, MONT.[3]--Continued					
Period of record for biological data: 1986, 1990-98					
Claassenia sabulosa					
Cadmium	29	1.3	.2	.6	.5
Chromium	29	1.2	.05	.5	.5
Copper	29	61.5	31.1	46.4	46.5
Iron	29	240	66.6	106	95.0
Lead	29	1.3	.1	.4	.3
Manganese	29	168	48.9	98.6	93.0
Nickel	29	.3	.1	.2	.2
Zinc	29	286	146	206	202
Hydropsyche cockerelli					
Cadmium	26	1.1	.2	.5	.6
Chromium	26	3.4	.8	2.0	1.9
Copper	26	45.7	12.4	30.0	31.0
Iron	26	2,000	645	1,270	1,270
Lead	26	3.6	1.2	2.3	2.3
Manganese	26	1,180	353	709	659
Nickel	26	1.7	.5	1.2	1.3
Zinc	26	172	77.4	145	154
Hydropsyche occidentalis					
Cadmium	11	1.1	.2	.5	.5
Chromium	11	3.5	.2	1.5	1.6
Copper	11	38.2	18.9	26.3	27.6
Iron	11	1,420	482	950	901
Lead	11	4.2	.7	2.2	2.0
Manganese	11	1,460	667	895	834
Nickel	11	2.2	.5	1.1	1.0
Zinc	11	193	116	144	145
***Hydropsyche* spp.**					
Cadmium	1	--	--	.5	--
Chromium	1	--	--	.8	--
Copper	1	--	--	20.8	--
Iron	1	--	--	894	--
Lead	1	--	--	1.1	--
Manganese	1	--	--	756	--
Nickel	1	--	--	1.1	--
Zinc	1	--	--	124	--

[1]Values determined by arbitrarily substituting one-half of the detection level for censored (<) values, when both uncensored and censored values are used in determining the mean. When all data are below the detection level, the median is determined by ranking the censored values in order of detection level. No mean is reported when all values are below the detection level.

[2]Samples collected at alternate sampling site deleted from sample set in 1998 resulted in a lower maximum value thar previously reported at Blackfoot River near Bonner.

[3]Samples collected about 30 miles downstream from water-quality station to conform to previous sampling location.

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