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Water-Quality, Bed-Sediment, and Biological Data (October 1998 Through September 1999) and Statistical Summaries of Data for Streams in the Upper Clark Fork Basin, Montana

By Kent A. Dodge, Michelle I. Hornberger, and
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CONVERSION FACTORS, ABBREVIATED WATER-QUALITY UNITS, AND ACRONYMS

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.

Acronyms used in the report:

ICAPES	Inductively Coupled Argon Plasma Emission Spectroscopy
LRL	laboratory reporting levels
LT-MDL	long-term method detection levels
NWQL	USGS National Water Quality Laboratory, Denver, Colo.
RSD	relative standard deviation
SRM	standard reference material
USGS	U.S. Geological Survey

Water-Quality, Bed-Sediment, and Biological Data (October 1998 through September 1999) and Statistical Summaries of Data for Streams in the Upper Clark Fork Basin, Montana

By Kent A. Dodge, Michelle I. Hornberger[1], *and* Carlos Primo C. David[1]

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 1998 through September 1999 (water year 1999). Data for 16 bed-sediment and 15 biological stations were obtained in August 1999. 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 can 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) 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, 1998, 1999). Trace-element data for bed sediment and biota (aquatic benthic insects) have

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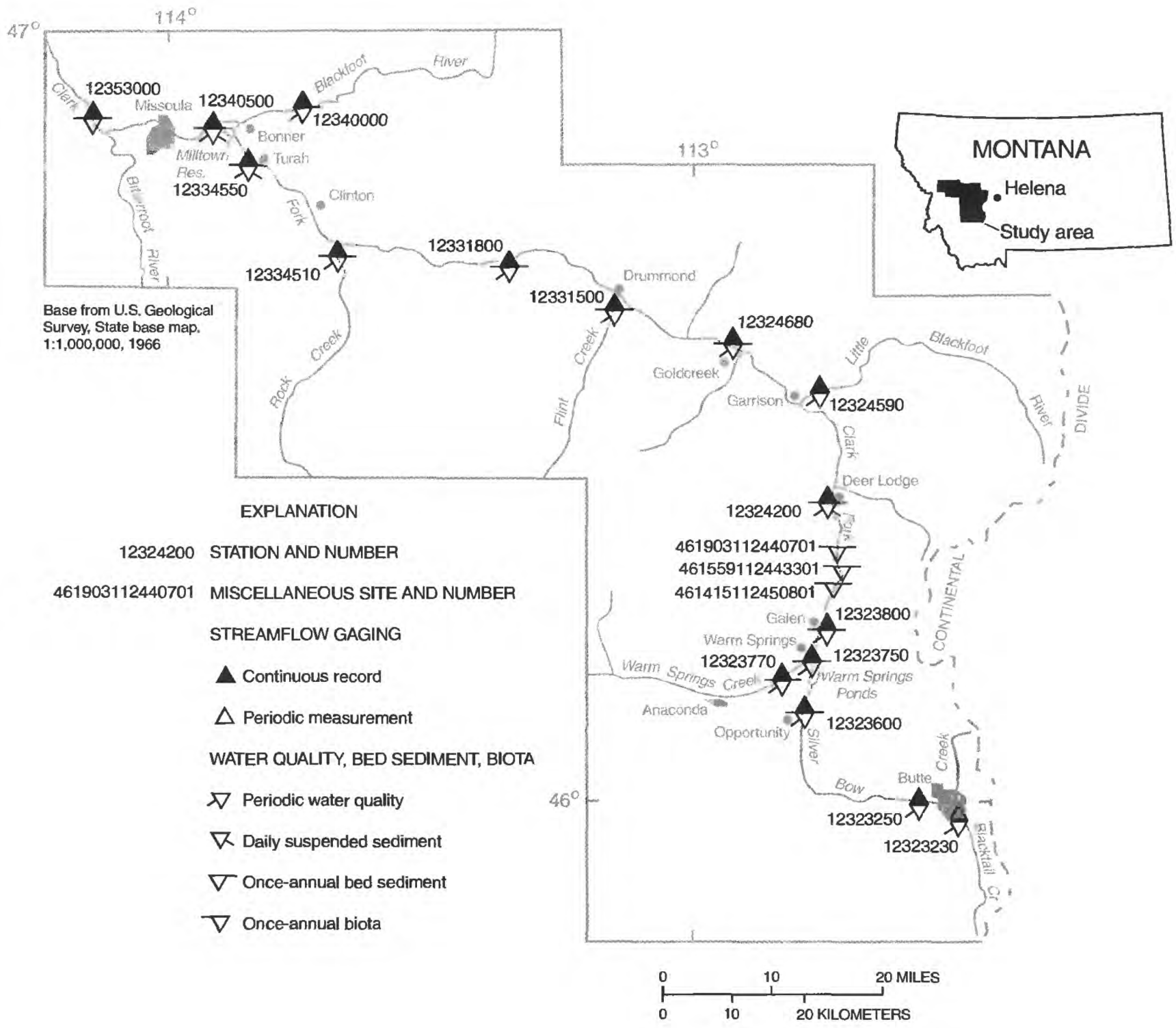

Figure 1. Location of study area.

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 seasonal and annual variability in selected constituents.

The purpose of this report is to present water-quality data for 15 stations and trace-element data for 16 bed-sediment and 15 biological stations in the upper Clark Fork basin collected from October 1998 through September 1999 (water year 1999). 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 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. Trace-element data for 16 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 1999 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 1999 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 6 to 8 times per year on a schedule designed to describe seasonal and hydrologic variability. In addition, supplemental samples were collected by a contract observer at Clark Fork at Turah Bridge, near Bonner (11 samples), Blackfoot River near Bonner (4 samples), and Clark Fork above Missoula (13 samples) to better define changes in trace-element concentrations 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 (1999). 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), 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 Denver, 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 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).

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, 08/99	08/95, 08/97, 08/99	08/95, 08/97, 08/99
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-P	08/93, 08/94, 08/99	08/86, 08/87, 08/91, 08/93, 08/96, 08/98
12340500	Clark Fork above Missoula	03/29-P	07/86-P[3]	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[4]	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]Prior to October 1989, water-quality data for Clark Fork above Missoula only included suspended-sediment data.
[4]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		

At the three daily suspended-sediment stations (table 1), suspended-sediment samples were collected 2 to 8 times per week. These samples were collected by local contract 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 1998 through September 1999 (water year 1999) 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 1999 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 (1999), 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.

Changes in analytical methods during the year resulted in the modification of the minimum reporting levels for total-recoverable cadmium, total-recoverable iron, total-recoverable and dissolved manganese, and total-recoverable and dissolved zinc. Because these changes occurred part way through the year, the minimum reporting levels for these constituents are represented as a range of detectability in table 3. The minimum reporting levels for dissolved magnesium, dissolved iron, and dissolved lead also changed, but near the beginning of the year; therefore, these minimum reporting levels remained constant throughout the year.

During water year 1999, the NWQL began implementation of a new, statistically based convention for establishing reporting levels and for reporting low-concentration data (Childress and others, 1999). Quality-control data are collected on a continuing basis to determine long-term method detection levels (LT-MDLs) and laboratory reporting levels (LRLs). These values are re-evaluated each year and, consequently, may change from year to year. The methods are designed to limit the possible occurrence of a false positive or false negative error to 1 percent or less. Accordingly, concentrations are reported as <LRL for samples in which the analyte was either not detected or did not pass identification criteria. Analytes that are detected at concentrations between the LT-MDL and LRL and that pass identification criteria are estimated. Estimated concentrations are noted with a remark code of "E." These data need to be used with the understanding that their uncertainty is greater than that of data reported without the "E" remark code.

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 dif-

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
	Laboratory 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	.004 mg/L	20	--
Arsenic, total recoverable	1 µg/L	20	25
Arsenic, dissolved	1 µg/L	20	25
Cadmium, total recoverable	.1-1 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	10-14 µg/L	20	25
Iron, dissolved	10 µg/L	20	25
Lead, total recoverable	1 µg/L	20	25
Lead, dissolved	.5 µg/L	20	25
Manganese, total recoverable	3-10 µg/L	20	25
Manganese, dissolved	1-4 µg/L	20	25
Zinc, total recoverable	10-40 µg/L	20	25
Zinc, dissolved	1-20 µg/L	20	25
Sediment, suspended	1 mg/L	--	--
Sediment, suspended (percent finer than 0.062 mm)	1 percent	--	--

ferences 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.

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):

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

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 12 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 zinc. The exceedance of dissolved zinc was a result of poor comparison in 3 of the 10 laboratory replicate sample sets. The poor precision data for dissolved zinc was random and showed no systematic patterns.

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 93.3 to 108.9 percent. The mean spike recovery for spiked stream samples ranged from 96.2 to 105.2 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.

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

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. 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 laboratory reporting level (LRL) 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 LRL (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 LRL 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 LRL 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 LRL. There was only one occurrence of a value exceeding twice the minimum reporting level (iron), 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 1999 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 two composite samples 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 were not sieved and generally were 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 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 1999 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, U.S. Geological Survey, 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 (SRMs) are commercially prepared materials that have certified concentrations of trace elements. Replicate analyses of SRMs 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 SRMs for bed sediment is summarized in table 16. Two SRMs 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 SRMs 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 and chromium for the low-concentration range (SRM 2709), and chromium for the high-concentration range (SRM 2711). Silver was below the analytical detection limit in the low-range SRM (2709). Chromium recovery was consistently low for both SRM 2709 and 2711 (65.6 and 57.9 percent, respectively). The reason for the lack of measurable recover-

ies is believed to be the result of analyzing concentrations very close to the detection limit, coupled with signal enhancement resulting from matrix interference. 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 copper in one procedural blank sample slightly exceeded the calculated limit of detection. 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., *Brachycentrus* spp., and *Arctopsyche grandis* of the Order Trichoptera (caddisflies), and *Claassenia sabulosa* of the Order Plecoptera (stoneflies). Samples of each taxon were stored separately, by genus, in acid-washed plastic containers. Samples were frozen with dry ice within 1 hour of collection in a small amount of ambient river water. In previous years (1986-98), benthic insects were depurated for a period of 6-8 hours in an effort to evacuate gut contents. In 1998, a comparison of samples collected using both methods showed no significant difference in metal concentrations in benthic insects, with the exception of copper. Average copper concentrations in depurated samples were 8-25 percent lower than samples frozen within one hour of collection (M.I. Hornberger, unpub. data, 2000). The change in the field protocol minimizes the chance of metal loss through cell membranes and is consistent with methods established by Cain and Luoma (1998).

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 1999 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 with 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 targeted for collection in this study due to their occurrence at most, but not all, sites: *Hydropsyche occidentalis* and *Hydropsyche cockerelli*. *Hydropsyche* 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. *Arctopsyche grandis* and *Claasenia sabulosa* also were collected, where available, to represent additional insect taxa that are fairly widely distributed in the upper Clark Fork basin.

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 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 a SRM 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 the SRM 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 10 percent of complete (100 percent) recovery for all trace metals, except chromium. A slightly low bias (confidence interval does not include 100 percent) is indicated for manganese and nickel and a slightly high bias is indicated for cadmium and lead. A higher bias was shown for chromium, which may have resulted 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, all 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 1986. 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 collected 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 near Bonner, Blackfoot River near Bonner, and Clark Fork above Missoula from 1997 to 1999. Inclusion of supplemental sample results would disproportionately skew the long-term statistics at these three sites relative to the other sites in

the network. 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 1998 through September 1999

[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 laboratory 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 1998									
17...	0835	8.2	286	7.9	4.5	110	32	7.8	2
FEB 1999									
22...	1000	6.1	294	8.2	3.0	120	34	8.4	2
APR									
27...	1020	14	236	8.0	7.0	93	27	6.5	4
MAY									
12...	1425	15	231	8.1	9.5	89	26	6.2	4
30...	1015	31	185	7.7	6.5	73	21	5.0	8
JUN									
22...	0845	13	237	7.8	11.5	97	28	6.7	7
AUG									
12...	1115	8.3	283	8.1	12.5	110	31	7.6	5

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 1998								
17...	2	<1	<0.1	2	2	260	100	<1
FEB 1999								
22...	2	<1	<.1	2	1	250	42	<1
APR								
27...	2	<1	.1	8	3	814	200	5
MAY								
12...	3	<1	<.1	5	3	471	180	<1
30...	5	<1	<.1	14	5	1,280	260	3
JUN								
22...	6	<1	<.1	5	4	861	330	<1
AUG								
12...	3	<1	<.1	6	3	449	100	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 1998								
17...	<0.5	40	40	<10	<20	2	0.04	59
FEB 1999								
22...	<.5	40	38	<10	<20	5	.08	94
APR								
27...	.5	60	35	E21	<20	39	1.5	92
MAY								
12...	<.5	41	29	<40	<20	4	.16	97
30...	<.5	110	62	<40	<20	29	2.4	81
JUN								
22...	<.5	92	71	<40	<20	8	.28	93
AUG								
12...	<.5	51	39	<40	3	8	18	84

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

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

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite ($\mu S/cm$)	pH, onsite (standard units)	Temperature, water (^oC)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable ($\mu g/L$)
NOV 1998									
17...	1000	28	503	7.6	7.0	160	46	12	10
FEB 1999									
22...	1115	21	514	7.6	6.0	170	47	12	10
APR									
27...	1135	30	422	7.7	10.0	140	40	10	9
MAY									
12...	1340	30	414	7.8	10.5	140	39	9.7	8
30...	1150	75	300	7.7	8.5	110	31	7.4	20
JUN									
22...	1015	29	447	7.6	14.0	150	42	10	11
AUG									
12...	1145	30	457	7.7	16.0	150	44	11	11

Date	Arsenic, dissolved ($\mu g/L$)	Cadmium, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
17...	6	2	2	73	14	650	35	9
FEB 1999								
22...	6	2	.9	82	12	820	34	10
APR								
27...	6	<1	.7	41	13	670	74	5
MAY								
12...	7	<1	.7	40	14	583	72	4
30...	13	2	.9	130	51	1,330	120	20
JUN								
22...	9	1	1	41	19	549	81	3
AUG								
12...	8	1	1	55	33	335	23	5

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
17...	<.5	440	410	540	500	14	1.1	88
FEB 1999								
22...	<.5	410	390	500	430	20	1.1	82
APR								
27...	<.5	419	390	254	210	13	1.1	85
MAY								
12...	<.5	409	390	265	220	11	.89	84
30...	.9	358	300	352	240	35	7.1	83
JUN								
22...	<.5	520	510	398	370	6	.47	94
AUG								
12...	<.5	245	234	396	337	6	.49	98

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

12323600--SILVER BOW CREEK AT OPPORTUNITY, 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 1998									
17...	1120	45	486	8.4	2.5	170	50	11	14
FEB 1999									
22...	1245	36	517	8.2	1.5	180	54	12	19
APR									
27...	1245	72	348	8.8	10.5	130	38	8.2	16
MAY									
12...	1220	67	369	8.6	9.5	130	39	8.4	12
30...	1330	189	330	8.0	5.0	130	38	7.4	120
JUN									
04...	0940	207	266	7.9	8.5	98	30	5.6	60
22...	1125	88	329	8.3	11.5	130	38	7.8	13
AUG									
12...	1345	37	369	8.9	18.0	130	38	8.2	32

Date	Arsenic, dissolved ($\mu g/L$)	Cadmium, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
17...	8	2	1	100	37	490	10	12
FEB 1999								
22...	10	2	2	160	32	910	E9	22
APR								
27...	9	1	.5	96	44	782	26	15
MAY								
12...	10	1	.6	83	34	608	22	10
30...	11	7	.9	1,200	61	9,320	100	310
JUN								
04...	10	4	1	620	62	4,990	120	130
22...	9	<1	.7	80	34	478	19	9
AUG								
12...	14	2	.9	340	63	1,490	15	49

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
17...	<.5	490	470	530	430	9	1.1	86
FEB 1999								
22...	<.5	570	520	560	430	21	2.0	87
APR								
27...	<.5	359	280	250	100	19	3.7	91
MAY								
12...	<.5	386	330	260	130	13	2.4	93
30...	2	1,690	650	1,720	290	491	251	53
JUN								
04...	3	884	420	1,000	290	196	110	47
22...	<.5	314	280	237	160	13	3.1	74
AUG								
12...	.5	598	430	533	94	32	3.2	94

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

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

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite ($\mu S/cm$)	pH, onsite (standard units)	Temperature, water (^oC)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable ($\mu g/L$)
NOV 1998									
17...	1250	74	535	8.9	3.5	220	62	16	19
FEB 1999									
22...	1325	59	602	8.8	3.5	250	73	17	13
APR									
27...	1345	112	427	8.5	12.0	160	47	11	25
MAY									
11...	0950	128	425	8.4	7.0	160	45	11	22
27...	1530	263	287	8.8	15.0	110	31	7.5	38
JUN									
10...	1040	288	306	9.0	8.0	120	35	7.9	27
22...	1320	252	249	9.1	13.0	97	28	6.6	26
AUG									
13...	1115	53	425	9.3	17.0	180	51	12	32

Date	Arsenic, dissolved ($\mu g/L$)	Cadmium, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
17...	15	<1	<.1	6	4	170	<10	<1
FEB 1999								
22...	11	<1	<.1	13	7	170	<10	<1
APR								
27...	21	<1	<.1	13	6	368	19	2
MAY								
11...	22	<1	<.1	11	5	312	19	2
27...	28	<1	<.1	22	7	909	35	5
JUN								
10...	23	<1	<.1	14	8	269	22	2
22...	25	<1	<.1	11	7	206	24	1
AUG								
13...	32	<1	<.1	5	3	137	19	<1

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
17...	<.5	90	40	10	<20	3	0.60	91
FEB 1999								
22...	<.5	200	120	40	E17	5	.80	82
APR								
27...	<.5	183	120	E30	<20	12	3.6	95
MAY								
11...	<.5	111	76	<40	E8	10	3.5	92
27...	<.5	120	34	E23	<20	44	31	86
JUN								
10...	<.5	135	97	<40	<20	7	5.4	86
22...	<.5	145	73	<40	<20	7	4.8	87
AUG								
13...	<.5	121	58	<40	2	3	.43	87

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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)	Arsenic, total recoverable (µg/L)
NOV 1998									
17..	1220	53	342	8.6	3.0	160	50	9.9	4
APR 1999									
27...	1430	48	338	8.5	11.0	160	49	10	5
MAY									
27...	1430	230	156	8.2	10.5	72	22	3.9	12
JUN									
10...	1125	116	228	8.2	7.0	110	33	6.2	5
22...	1210	246	144	8.0	9.5	66	20	3.6	5
AUG									
12...	1415	47	266	8.7	15.0	120	37	7.1	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 1998								
17...	2	<1	<.1	2	2	40	E7	<1
APR 1999								
27...	4	<1	<.1	9	2	122	E7	<1
MAY								
27...	6	<1	<.1	61	5	1,070	15	6
JUN								
10...	4	<1	<.1	12	2	218	12	1
22...	4	<1	<.1	19	3	461	11	2
AUG								
12...	5	<1	<.1	8	2	84	13	<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 1998								
17..	<.5	210	210	<10	<20	2	29	79
APR 1999								
27..	<.5	231	170	<40	<20	8	1.0	78
MAY								
27...	<.5	273	61	E29	<20	62	39	71
JUN								
10...	<.5	131	97	<40	<20	11	3.4	68
22...	<.5	93	41	<40	<20	24	16	57
AUG								
12...	<.5	110	80	<40	<1	4	.51	74

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

12323800--CLARK FORK NEAR GALEN, 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 1998									
17...	1355	124	460	8.8	4.0	190	55	13	12
FEB 1999									
22...	1420	113	517	8.7	4.5	230	66	15	9
APR									
27...	1520	158	398	8.7	12.0	170	48	11	18
MAY									
11...	1040	183	401	8.5	8.0	160	48	11	17
27...	1345	499	229	8.4	12.0	94	28	5.9	31
JUN									
10...	1155	435	286	8.8	9.0	120	34	7.3	22
22...	1415	522	197	8.8	12.5	81	24	5.1	17
AUG									
13...	1145	91	373	8.8	15.0	160	48	10	20

Date	Arsenic, dissolved ($\mu g/L$)	Cadminm, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
17...	9	<1	<.1	5	3	110	<10	<1
FEB 1999								
22...	7	<1	<.1	12	5	140	<10	<1
APR								
27...	15	<1	.1	15	5	296	E8	2
MAY								
11...	17	<1	<.1	15	5	294	12	2
27...	17	<1	<.1	71	7	1,480	25	9
JUN								
10...	17	<1	<.1	17	6	293	13	2
22...	14	<1	<.1	19	5	355	16	2
AUG								
13...	19	<1	<.1	12	3	190	14	1

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
17...	<.5	120	89	<10	<20	3	1.0	86
FEB 1999								
22...	<.5	200	150	20	<20	5	1.5	84
APR								
27...	<.5	179	89	<40	<20	10	4.3	83
MAY								
11...	<.5	139	82	E25	<20	10	4.9	84
27...	<.5	303	51	56	<20	77	104	73
JUN								
10...	<.5	130	75	<40	<20	18	21	50
22...	<.5	116	40	<40	<20	16	23	66
AUG								
13...	<.5	143	54	<40	2	8	2.0	83

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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)	Arsenic, total recoverable (µg/L)
NOV 1998									
17...	1505	286	473	8.4	4.0	210	60	14	12
FEB 1999									
22...	1540	225	502	8.6	4.0	230	67	15	9
APR									
27...	1625	250	454	8.9	12.5	200	57	13	14
MAY									
11...	1200	281	460	8.6	8.5	200	57	13	14
27...	1230	506	286	8.0	14.0	120	34	7.4	56
JUN									
10...	0910	500	341	8.2	9.0	140	42	9.2	27
22...	1600	684	234	8.3	14.5	95	28	6.0	20
AUG									
13...	1340	132	467	8.6	17.0	200	59	13	20

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 1998								
17...	9	<1	<.1	16	4	280	<10	2
FEB 1999								
22...	7	<1	.1	16	5	220	<10	2
APR								
27...	12	<1	<.1	20	7	339	<10	2
MAY								
11...	13	<1	<.1	24	6	408	<10	3
27...	19	1	<.1	260	11	3,750	23	31
JUN								
10...	17	<1	<.1	59	10	904	16	8
22...	15	<1	<.1	70	10	927	18	7
AUG								
13...	18	<1	<.1	32	7	377	E7	4

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 1998								
17...	<.5	70	24	20	<20	15	12	60
FEB 1999								
22...	<.5	91	51	30	<10	15	9.1	72
APR								
27...	<.5	77	25	E27	<20	14	9.4	69
MAY								
11...	<.5	97	33	E36	E8	18	14	73
27...	<.5	582	47	188	<20	219	299	67
JUN								
10...	<.5	159	23	E38	<20	48	65	59
22...	<.5	132	16	51	<20	53	98	48
AUG								
13...	<.5	147	22	E38	5	25	8.9	90

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

12324590--LITTLE BLACKFOOT RIVER NEAR GARRISON, 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 1998									
17...	1610	83	277	8.4	3.5	130	36	8.5	5
APR 1999									
27...	1725	208	206	8.4	10.5	91	26	6.2	5
MAY									
24...	1820	455	168	8.2	16.5	75	22	5.0	8
JUN									
04...	1130	852	186	8.0	9.5	82	24	5.5	9
23...	1730	208	238	8.3	18.0	110	31	7.2	5
AUG									
10...	1045	54	289	8.5	16.0	140	39	9.0	6

Date	Arsenic, dissolved ($\mu g/L$)	Cadmium, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
17...	3	<1	<.1	<1	1	60	<10	<1
APR 1999								
27...	5	<1	<.1	3	1	367	56	<1
MAY								
24...	5	<1	<.1	5	2	1,290	41	3
JUN								
04...	6	<1	<.1	6	3	1,950	90	4
23...	6	<1	<.1	2	1	120	14	<1
AUG								
10...	6	<1	<.1	2	<1	92	13	<1

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
17...	<.5	<10	5	<10	<20	3	.67	83
APR 1999								
27...	<.5	27	7	<40	<20	14	7.9	85
MAY								
24...	<.5	78	8	<40	<20	84	103	56
JUN								
04...	<.5	104	10	<40	<20	120	276	51
23...	<.5	16	10	<40	<20	7	3.9	91
AUG								
10...	<.5	21	12	<40	<1	4	.58	87

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998									
18...	0810	466	436	8.2	2.5	190	55	12	10
FEB 1999									
23...	0830	350	458	8.5	1.5	200	59	13	8
APR									
28...	0820	575	369	8.2	8.5	160	47	11	12
MAY									
11...	1300	620	357	8.6	9.5	150	44	10	10
27...	1105	1,180	237	8.1	12.0	100	29	6.4	25
JUN									
07...	1455	1,720	251	8.2	12.5	110	31	6.7	18
22...	1800	1,080	266	8.4	16.0	110	33	7.2	16
AUG									
13...	1430	248	406	8.7	18.5	170	51	11	12

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 1998								
18...	7	<1	<.1	17	3	270	<10	2
FEB 1999								
23...	6	<1	<.1	16	4	230	<10	1
APR								
28...	7	<1	.1	35	4	725	13	4
MAY								
11...	8	<1	<.1	19	4	426	E8	2
27...	13	<1	<.1	100	6	2,240	33	15
JUN								
07...	11	<1	<.1	48	8	1,140	29	7
22...	12	<1	<.1	47	8	725	15	5
AUG								
13...	11	<1	<.1	16	6	209	E5	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 1998								
18...	<.5	70	16	20	<20	12	15	81
FEB 1999								
23...	<.5	70	33	20	E13	11	10	83
APR								
28...	<.5	111	21	<40	<20	38	59	83
MAY								
11...	<.5	68	12	E23	<20	22	37	81
27...	<.5	299	12	102	<20	126	401	75
JUN								
07...	<.5	129	12	44	<20	72	334	51
22...	<.5	109	10	48	<20	41	120	60
AUG								
13...	<.5	78	10	E21	2	11	7.4	86

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998									
18...	0915	174	324	8.4	3.0	150	39	12	8
FEB 1999									
23...	0940	E120	307	8.6	1.5	140	39	12	8
APR									
28...	0930	E240	214	8.3	7.0	96	25	8.0	51
MAY									
11...	1405	156	251	8.7	10.0	110	30	9.2	13
27...	0955	253	146	8.3	8.0	65	18	4.8	19
JUN									
07...	1540	324	206	8.2	11.0	96	26	7.3	20
23...	1620	172	265	8.6	17.0	120	33	9.1	13
AUG									
10...	1610	35	434	8.8	20.5	200	55	16	12

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 1998								
18...	5	<1	<.1	1	1	160	<10	2
FEB 1999								
23...	6	<1	<.1	2	<1	180	E8	2
APR								
28...	9	<1	.1	14	3	1,970	91	32
MAY								
11...	7	<1	<.1	6	2	565	51	8
27...	7	<1	<.1	7	2	803	52	14
JUN								
07...	7	<1	<.1	5	2	685	27	14
23...	8	<1	<.1	4	2	297	42	5
AUG								
10...	11	<1	<.1	3	1	133	E10	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 1998								
18...	<.5	60	20	<10	<20	8	3.8	86
FEB 1999								
23...	<.5	60	15	<10	<20	8	2.6	90
APR								
28...	.7	405	29	74	<20	133	86	86
MAY								
11...	.6	124	23	E25	<20	29	12	90
27...	.5	192	19	40	<20	51	35	80
JUN								
07...	.5	210	19	E34	<20	55	48	59
23...	<.5	104	28	<40	E8	19	8.8	74
AUG								
10...	<.5	88	53	<40	4	7	.66	89

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

12331800--CLARK FORK NEAR DRUMMOND, MONT.

Date	Time	Streamflow, instantaneous (ft^3/s)	Specific conductance, onsite ($\mu S/cm$)	pH, onsite (standard units)	Temperature, water (^oC)	Hardness, total (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L)	Magnesium, dissolved (mg/L)	Arsenic, total recoverable ($\mu g/L$)
NOV 1998									
18...	1020	755	454	8.3	4.5	200	56	14	10
FEB 1999									
24...	0945	542	463	8.4	3.5	210	61	15	8
APR									
28...	1030	883	363	8.2	9.5	160	45	11	20
MAY									
11...	1505	842	384	8.5	11.0	170	49	12	11
27...	0810	1,340	281	8.1	12.5	120	34	8.1	28
JUN									
07...	1415	2,330	276	8.2	11.5	120	35	8.0	22
23...	1500	1,390	320	8.4	17.0	140	41	9.4	15
AUG									
13...	1615	412	513	8.5	18.0	240	67	17	13

Date	Arsenic, dissolved ($\mu g/L$)	Cadmium, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
18...	7	<1	<.1	13	3	220	<10	2
FEB 1999								
24...	7	<1	<.1	12	4	200	E5	2
APR								
28...	8	<1	<.1	34	4	1,040	20	11
MAY								
11...	10	<1	<.1	23	5	515	E8	3
27...	13	<1	<.1	100	6	2,360	30	18
JUN								
07...	11	<1	<.1	71	9	1,790	26	13
23...	14	<1	<.1	37	8	695	11	4
AUG								
13...	13	<1	<.1	19	5	373	<10	3

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, suspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
18...	<.5	70	10	20	<20	11	22	87
FEB 1999								
24...	<.5	50	20	20	<20	13	19	73
APR								
28...	<.5	172	13	43	<20	63	150	80
MAY								
11...	<.5	82	13	E25	<20	29	66	78
27...	<.5	337	10	142	<20	143	517	82
JUN								
07...	<.5	219	12	96	E8	122	768	56
23...	<.5	96	11	44	<20	38	143	63
AUG								
13...	<.5	128	8	E34	3	25	28	89

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

12334510--ROCK CREEK NEAR CLINTON, 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 1998									
18..	1145	252	142	8.5	4.0	63	16	5.6	<1
APR 1999									
28...	1245	1,000	85	8.2	6.0	37	9.4	3.3	<1
MAY									
26...	1045	3,040	53	7.8	9.0	23	6.0	1.9	1
JUN									
09...	1320	2,190	68	7.8	7.0	30	7.8	2.5	<1
23...	1310	1,730	81	8.0	12.0	37	9.7	3.0	<1
AUG									
13...	1720	358	133	8.8	15.5	61	16	5.1	<1

Date	Arsenic, dissolved ($\mu g/L$)	Cadmium, total recoverable ($\mu g/L$)	Cadmium, dissolved ($\mu g/L$)	Copper, total recoverable ($\mu g/L$)	Copper, dissolved ($\mu g/L$)	Iron, total recoverable ($\mu g/L$)	Iron, dissolved ($\mu g/L$)	Lead, total recoverable ($\mu g/L$)
NOV 1998								
18...	<1	<1	<.1	<1	<1	30	E6	<1
APR 1999								
28...	<1	<1	<.1	3	2	389	94	<1
MAY								
26...	<1	<1	<.1	3	<1	1,340	74	1
JUN								
09...	<1	<1	<.1	2	1	189	48	<1
23..	<1	<1	<.1	1	<1	147	33	<1
AUG								
13...	<1	<1	<.1	<1	<1	35	11	<1

Date	Lead, dissolved ($\mu g/L$)	Manganese, total recoverable ($\mu g/L$)	Manganese, dissolved ($\mu g/L$)	Zinc, total recoverable ($\mu g/L$)	Zinc, dissolved ($\mu g/L$)	Sediment, snspended (mg/L)	Sediment discharge, suspended (ton/d)	Sediment, suspended (percent finer than 0.062 mm)
NOV 1998								
18...	<.5	<10	<4	<10	<20	2	1.4	62
APR 1999								
28..	<.5	16	E2	<40	<20	20	54	71
MAY								
26...	<.5	64	4	<40	<20	205	1,680	35
JUN								
09...	<.5	9	E3	<40	E7	14	83	55
23..	<.5	7	E3	<40	<20	9	42	69
AUG								
13...	<.5	3	1	<40	2	2	1.9	70

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998									
18...	1350	1,070	373	8.6	5.0	160	46	12	7
FEB 1999									
24...	1120	820	380	8.6	4.0	170	48	12	6
APR									
28...	1445	2,100	227	8.2	8.0	100	28	7.6	8
MAY									
12...	0905	1,780	268	8.4	8.5	120	32	8.6	6
[1]25...	1025	3,360	160	7.9	13.0	68	19	4.9	10
[1]26...	0900	3,940	143	7.8	12.0	62	17	4.5	10
26...	1250	4,030	141	8.1	12.0	59	16	4.3	11
[1]28...	0825	4,330	138	7.8	11.0	60	17	4.4	9
JUN									
[1]02...	1100	4,630	163	8.1	11.0	70	20	5.0	11
[1]04...	1020	6,410	153	7.7	10.0	65	19	4.5	16
[1]07...	0900	5,360	164	7.8	9.0	69	20	4.9	10
07...	1210	5,310	165	8.1	9.5	70	20	5.0	12
[1]09...	0905	4,560	184	8.0	8.0	82	23	5.9	9
23...	1120	3,380	192	8.3	13.0	84	24	6.0	7
AUG									
10...	1330	648	329	8.8	19.5	140	40	11	6
[1]15...	1220	831	346	8.5	15.0	160	44	12	8
[1]19...	1030	730	360	8.4	18.0	160	45	12	8
[1]22...	0800	639	360	8.3	15.0	160	45	12	8
[1]25...	0945	596	360	8.4	15.0	160	45	12	7

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998								
18...	5	<1	<.1	8	3	150	<10	1
FEB 1999								
24...	5	<1	<.1	7	3	100	<10	<1
APR								
28...	5	<1	<.1	22	4	773	49	5
MAY								
12...	5	<1	<.1	13	3	313	16	2
[1]25...	4	<1	<.1	57	4	2,010	32	9
[1]26...	5	<1	<.1	61	5	2,680	45	12
26...	5	<1	<.1	60	4	2,010	51	10
[1]28...	5	<1	<.1	46	5	1,720	46	8
JUN								
[1]02...	6	<1	<.1	59	6	1,540	32	9
[1]04...	6	<1	<.1	92	9	3,450	49	17
[1]07...	6	<1	<.1	47	7	1,420	31	8
07...	6	<1	<.1	40	6	1,130	37	7
[1]09...	6	<1	<.1	40	6	1,060	24	13
23...	5	<1	<.1	19	4	389	21	2
AUG								
10...	6	<1	<.1	6	3	53	<10	<1
[1]15...	7	<.1	<.1	12	3	189	<10	1
[1]19...	8	<.1	<.1	12	3	150	<10	1
[1]22...	7	<.1	<.1	9	3	127	<10	E.8
[1]25...	8	<.1	<.1	7	3	84	<10	E.5

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998								
18...	<.5	40	E3	10	<20	9	26	93
FEB 1999								
24...	<.5	20	7	10	<20	7	15	84
APR								
28...	<.5	90	9	E38	<20	52	295	66
MAY								
12...	<.5	46	5	<40	<20	18	87	84
[1]25...	<.5	194	1	87	4	133	1,210	--
[1]26...	<.5	261	2	113	4	220	2,340	--
26...	<.5	224	14	264	<20	196	2,130	52
[1]28...	<.5	172	3	73	3	142	1,660	--
JUN								
[1]02...	<.5	157	3	81	5	101	1,260	--
[1]04...	<.5	326	2	143	6	320	5,540	--
[1]07...	<.5	144	3	64	6	105	1,520	--
07...	<.5	129	9	68	<20	82	1,180	62
[1]09...	<.5	104	4	60	5	78	960	--
23...	<.5	48	6	<40	<20	24	219	65
AUG								
10...	<.5	19	4	<40	2	5	8.7	70
[1]15...	<.5	56	<1	<31	2	12	27	--
[1]19...	<.5	47	1	E19	2	10	20	--
[1]22...	<.5	40	<1	<31	3	10	17	--
[1]25...	<.5	28	<1	<31	2	6	9.7	--

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998									
18..	1600	634	276	8.7	4.5	130	33	12	<1
APR 1999									
29...	0810	3,900	163	8.3	6.0	80	21	7.0	<1
MAY									
26...	1435	8,990	139	8.5	10.0	70	18	5.7	3
JUN									
09...	0920	5,800	171	8.2	8.5	86	22	7.3	1
23...	0745	5,310	160	8.2	11.0	81	21	6.9	<1
AUG									
15...	1010	990	255	8.7	13.5	130	33	11	1
[1]15...	1340	990	249	8.6	15.0	130	32	12	1
[1]19...	1130	862	259	8.5	18.0	130	33	12	1
[1]22...	0915	794	260	8.5	16.0	130	33	12	1
[1]25...	1125	750	260	8.5	16.0	130	33	12	2

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 1998								
18...	<1	<1	.1	<1	<1	60	<10	<1
APR 1999								
29...	<1	<1	<.1	2	<1	338	35	<1
MAY								
26...	<1	<1	<.1	13	2	2,410	47	4
JUN								
09...	1	<1	<.1	2	1	416	18	<1
23...	1	<1	<.1	3	2	307	14	<1
AUG								
15...	<1	<1	<.1	<1	<1	45	E6	<1
[1]15...	<1	<.1	<.1	<1	<1	47	<10	1
[1]19...	1	<.1	<.1	<1	<1	32	<10	<1
[1]22...	<1	<.1	<.1	<1	<1	34	<10	<1
[1]25...	<1	<.1	<.1	<1	<1	25	<10	<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 1998								
18...	<.5	<10	E2	<10	<20	4	6.8	82
APR 1999								
29...	<.5	31	E2	<40	<20	25	263	85
MAY								
26...	<.5	165	5	<40	<20	265	6,430	77
JUN								
09...	<.5	30	3	<40	<20	36	564	85
23...	<.5	20	E2	<40	<20	28	401	76
AUG								
15...	<.5	7	1	<40	<1	4	11	80
[1]15...	<.5	7	<1	<31	<1	2	5.3	--
[1]19...	<.5	6	<1	<31	<1	3	7.0	--
[1]22...	<.5	7	<1	<31	<1	3	6.4	--
[1]25...	<.5	5	<1	<31	<1	2	4.1	--

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (Continued)

12340500--CLARK FORK ABOVE MISSOULA, 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 1998									
19...	0900	1,700	330	8.4	4.0	150	41	12	5
FEB 1999									
24...	1350	1,090	326	8.6	4.0	150	41	12	4
APR									
29...	0940	5,880	188	8.2	6.5	88	23	7.2	4
MAY									
11...	1730	4,710	212	8.5	9.0	99	26	8.1	2
[1]25...	1155	11,000	157	8.0	13.0	75	20	6.0	4
[1]26...	1115	12,900	146	8.1	12.0	70	19	5.5	5
26...	1610	13,400	142	8.1	12.0	68	18	5.4	5
[1]28...	1135	12,600	146	8.0	12.0	70	19	5.6	5
JUN									
[1]02...	1300	11,200	164	8.1	11.0	76	21	6.1	5
[1]04...	1245	14,200	156	7.7	11.0	72	20	5.6	8
[1]07...	1130	12,400	164	7.8	10.0	76	20	6.0	5
09...	1055	10,300	177	8.3	8.5	83	22	6.6	5
[1]09...	1200	10,300	177	8.1	12.0	84	23	6.7	4
23...	0915	8,580	173	8.2	12.0	81	22	6.5	3
AUG									
15...	1150	1,870	293	8.7	14.5	140	36	11	4
[1]15...	1515	1,830	293	8.4	15.0	140	37	12	5
[1]19...	1245	1,610	303	8.4	20.0	140	38	12	5
[1]22...	1045	1,450	300	8.5	18.0	140	37	12	5
[1]24...	1110	1,460	299	8.4	17.0	140	37	12	5
[1]25...	1240	920	306	8.2	18.0	140	38	12	7
[1]27...	1120	1,330	299	8.6	19.0	140	37	12	5

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998								
19...	4	<1	<.1	4	2	100	<10	<1
FEB 1999								
24...	3	<1	<.1	4	2	80	E6	<1
APR								
29...	1	<1	.1	8	3	414	46	2
MAY								
11...	2	<1	<.1	6	2	204	15	<1
[1]25...	3	<1	<.1	19	3	1,570	23	4
[1]26...	3	<1	<.1	20	2	2,050	34	5
26...	2	<1	<.1	22	2	2,200	49	5
[1]28...	3	<1	<.1	20	3	1,450	32	4
JUN								
[1]02...	3	<1	<.1	32	3	912	23	4
[1]04...	3	<1	<.1	50	5	1,860	29	8
[1]07...	3	<1	<.1	25	4	970	23	4
09...	3	<1	<.1	18	4	607	24	3
[1]09...	3	<1	<.1	32	4	709	19	4
23...	2	<1	<.1	11	3	392	50	2
AUG								
15...	3	<1	<.1	7	3	110	E7	<1
[1]15...	4	<.1	<.1	5	2	107	<10	<1
[1]19...	4	<.1	<.1	6	2	138	<10	E.8
[1]22...	5	<.1	<.1	6	2	163	<10	E.7
[1]24...	4	<.1	<.1	8	1	210	E6	1
[1]25...	5	.4	<.1	25	2	601	<10	9
[1]27...	4	<.1	<.1	3	1	71	<10	<1

Table 4. Water-quality data for the upper Clark Fork basin, Montana, October 1998 through September 1999 (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 1998								
19...	<.5	30	13	<10	<20	5	23	95
FEB 1999								
24..	<.5	40	36	<10	E7	3	8.8	95
APR								
29..	<.5	47	12	<40	<20	25	397	92
MAY								
11..	<.5	26	13	<40	<20	13	165	92
[1]25..	<.5	126	1	E28	1	110	3,270	--
[1]26..	<.5	153	2	E33	1	154	5,360	--
26..	<.5	176	15	40	<20	200	7,240	85
[1]28...	<.5	110	3	E30	1	109	3,710	--
JUN								
[1]02...	<.5	84	4	42	2	60	1,810	--
[1]04...	<.5	169	1	82	4	128	4,910	--
[1]07...	<.5	82	3	E37	3	68	2,280	--
09...	<.5	66	9	E22	<20	43	1,200	83
[1]09...	<.5	62	4	E34	3	42	1,170	--
23...	<.5	39	11	<40	<20	28	649	89
AUG								
15...	<.5	24	11	<40	1	9	45	95
[1]15...	<.5	23	<1	<31	1	6	30	--
[1]19...	<.5	46	<1	<31	<1	8	35	--
[1]22...	<.5	49	1	<31	2	9	35	--
[1]24...	<.5	57	6	<31	1	13	51	--
[1]25...	<.5	156	1	32	2	32	79	--
[1]27...	<.5	26	<1	<31	<1	8	29	--

[1]Supplemental samples collected to better define changes in trace-element concentrations and transport during extended high flows, and during the lowering of Milltown Reservoir water levels for dam maintenance.

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1998 through September 1999

[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)
					1998				
		October			November			December	
1	225	20	12	248	11	7.4	248	16	11
2	240	25	16	248	11	7.4	248	17	11
3	252	29	20	253	11	7.5	252	19	13
4	258	29	20	255	11	7.6	250	21	14
5	257	27	19	258	13	9.1	230	21	13
6	272	36	26	273	16	12	221	21	13
7	269	21	15	270	17	12	222	20	12
8	264	21	15	277	18	13	217	20	12
9	261	21	15	291	18	14	225	20	12
10	272	22	16	304	19	16	222	20	12
11	289	22	17	290	20	16	232	20	13
12	272	22	16	297	20	16	244	20	13
13	281	22	17	300	23	19	254	20	14
14	282	21	16	321	25	22	262	20	14
15	288	20	16	313	25	21	246	20	13
16	283	17	13	293	20	16	246	20	13
17	274	15	11	286	16	12	252	20	14
18	272	14	10	300	16	13	230	19	12
19	269	14	10	300	16	13	163	19	8.4
20	265	15	11	291	16	13	149	20	8.0
21	265	18	13	295	16	13	e140	22	8.3
22	265	19	14	315	16	14	e140	22	8.3
23	260	18	13	302	17	14	e150	21	8.5
24	252	16	11	300	16	13	e150	19	7.7
25	255	13	9.0	290	16	13	e160	17	7.3
26	258	11	7.7	276	15	11	175	16	7.6
27	257	11	7.6	254	15	10	198	17	9.1
28	257	11	7.6	251	15	10	215	23	13
29	254	14	9.6	257	16	11	241	30	20
30	251	11	7.5	253	16	11	276	30	22
31	249	11	7.4	---	---	---	259	30	21
TOTAL	8,168	---	418.4	8,461	---	387.0	6,717	---	378.2
MEAN	263	19	13	282	17	13	217	21	12
MAX	289	36	26	321	25	22	276	30	22
MIN	225	11	7.4	248	11	7.4	140	16	7.3

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1998 through September 1999 (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)
					1999				
	January			February			March		
1	260	30	21	e220	20	12	280	62	47
2	259	30	21	220	20	12	241	30	20
3	e230	31	19	248	28	19	227	18	11
4	242	33	22	227	23	14	206	20	11
5	253	37	25	234	21	13	206	21	12
6	260	39	27	225	23	14	216	24	14
7	256	38	26	231	28	17	213	22	13
8	248	35	23	230	31	19	210	26	15
9	247	30	20	242	29	19	217	23	13
10	251	25	17	248	26	17	221	24	14
11	266	21	15	236	25	16	224	29	18
12	264	20	14	246	25	17	221	21	13
13	257	19	13	262	25	18	226	24	15
14	255	19	13	237	25	16	239	26	17
15	266	19	14	231	25	16	247	33	22
16	257	20	14	232	25	16	250	34	23
17	248	20	13	233	24	15	236	24	15
18	249	20	13	230	22	14	234	31	20
19	252	20	14	232	20	13	244	32	21
20	252	19	13	226	18	11	248	40	27
21	251	18	12	228	16	9 8	250	40	27
22	245	17	11	228	17	10	271	54	40
23	241	16	10	234	19	12	286	55	42
24	236	17	11	243	24	16	290	52	41
25	230	24	15	267	24	17	305	69	57
26	237	36	23	268	22	16	305	59	49
27	238	35	22	246	23	15	298	42	34
28	250	30	20	265	28	20	280	32	24
29	242	26	17	---	---	---	281	34	26
30	251	23	16	---	---	---	274	36	27
31	234	21	13	---	---	---	271	34	25
TOTAL	7,727	---	527	6,669	---	423.8	7,717	---	753
MEAN	249	25	17	238	23	15	249	35	24
MAX	266	39	27	268	31	20	305	69	57
MIN	230	16	10	220	16	9.8	206	18	11

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1998 through September 1999 (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)
				1999					
	April			May			June		
1	249	25	17	273	22	16	606	85	139
2	238	27	17	280	18	14	620	90	151
3	246	27	18	292	22	17	681	102	188
4	243	24	16	303	39	32	796	112	241
5	238	23	15	289	23	18	773	90	188
6	232	24	15	274	20	15	703	80	152
7	226	22	13	266	22	16	655	75	133
8	226	21	13	258	18	13	614	61	101
9	223	22	13	274	18	13	585	50	79
10	219	19	11	287	18	14	491	46	61
11	218	20	12	280	18	14	429	37	43
12	217	25	15	265	16	11	390	34	36
13	214	19	11	258	16	11	376	34	35
14	210	18	10	245	14	9.3	390	39	41
15	212	20	11	241	16	10	444	61	73
16	212	20	11	245	17	11	525	79	112
17	214	22	13	238	16	10	641	97	168
18	215	17	9.9	230	16	9.9	697	95	179
19	219	16	9.5	253	24	16	738	94	187
20	220	18	11	262	27	19	725	80	157
21	245	23	15	278	31	23	649	58	102
22	246	21	14	324	70	61	660	51	91
23	244	15	9.9	363	90	88	618	46	77
24	240	16	10	333	70	63	540	39	57
25	237	12	7.7	352	92	87	508	36	49
26	237	11	7.0	408	135	149	492	34	45
27	249	13	8.7	483	205	267	437	26	31
28	278	29	22	488	150	198	396	18	19
29	281	20	15	547	160	236	360	12	12
30	276	22	16	733	230	455	346	11	10
31	---	---	---	690	135	252	---	---	---
TOTAL	7,024	---	386.7	10,312	---	2,168.2	16,885	---	2,957
MEAN	234	20	13	333	57	70	563	59	99
MAX	281	29	22	733	230	455	796	112	241
MIN	210	11	7.0	230	14	9.3	346	11	10

Table 5. Daily streamflow and suspended-sediment data for Clark Fork at Deer Lodge, Montana, October 1998 through September 1999 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment: Mean concentration (mg/L)	Suspended sediment: Discharge (ton/d)	Mean streamflow (ft^3/s)	Suspended sediment: Mean concentration (mg/L)	Suspended sediment: Discharge (ton/d)	Mean streamflow (ft^3/s)	Suspended sediment: Mean concentration (mg/L)	Suspended sediment: Discharge (ton/d)
				1999					
	July			August			September		
1	351	11	10	52	7	.98	118	8	2.5
2	327	10	8.8	57	16	2.5	122	8	2.6
3	307	9	7.5	62	18	3.0	135	9	3.3
4	288	7	5.4	68	21	3.9	153	9	3.7
5	274	5	3.7	97	49	13	166	9	4.0
6	247	5	3.3	81	9	2.0	161	8	3.5
7	228	6	3.7	82	8	1.8	157	8	3.4
8	217	6	3.5	78	7	1.5	160	8	3.5
9	207	5	2.8	74	6	1.2	165	7	3.1
10	192	5	2.6	75	5	1.0	165	7	3.1
11	181	5	2.4	80	7	1.5	150	8	3.2
12	173	6	2.8	113	19	5.8	153	10	4.1
13	156	6	2.5	126	23	7.8	160	14	6.0
14	143	6	2.3	116	14	4.4	157	15	6.4
15	124	5	1.7	111	13	3.9	157	13	5.5
16	121	4	1.3	110	13	3.9	150	11	4.5
17	121	3	.98	107	13	3.8	150	10	4.1
18	121	4	1.3	101	12	3.3	156	10	4.2
19	110	4	1.2	96	12	3.1	163	10	4.4
20	103	5	1.4	91	11	2.7	162	11	4.8
21	104	6	1.7	91	10	2.5	154	14	5.8
22	95	5	1.3	99	10	2.7	151	18	7.3
23	88	4	.95	96	9	2.3	144	14	5.4
24	78	4	.84	97	9	2.4	132	10	3.6
25	78	3	.63	102	7	1.9	145	9	3.5
26	74	3	.60	101	7	1.9	150	10	4.1
27	67	3	.54	95	7	1.8	154	11	4.6
28	63	4	.68	100	9	2.4	160	11	4.8
29	63	4	.68	117	10	3.2	166	12	5.4
30	63	3	.51	107	8	2.3	163	12	5.3
31	59	4	.64	112	8	2.4	----	----	----
TOTAL	4,823	----	78.25	2,894	----	96.88	4,579	----	129.7
MEAN	156	5	2.5	93.4	12	3.1	153	10	4.3
MAX	351	11	10	126	49	13	166	18	7.3
MIN	59	3	.51	52	5	.98	118	7	2.5

TOTAL FOR WATER YEAR 1999:

STREAMFLOW---91,976 ft^3/s
SEDIMENT DISCHARGE---8,704.13 tons

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1998 through September 1999

[Abbreviations: ft^3/s, cubic feet per second; 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)
					1998				
	October			November			December		
1	955	12	31	990	5	13	1,080	7	20
2	982	11	29	996	5	13	1,090	8	24
3	1,030	11	31	998	5	13	1,130	8	24
4	1,050	11	31	998	4	11	1,110	7	21
5	1,060	11	31	989	4	11	1,050	5	14
6	1,050	11	31	996	3	8.1	942	4	10
7	1,060	12	34	1,000	3	8.1	896	5	12
8	1,050	13	37	1,010	5	14	906	5	12
9	1,050	16	45	1,020	6	17	895	5	12
10	1,090	18	53	1,020	7	19	831	5	11
11	1,150	19	59	1,010	8	22	828	7	16
12	1,130	18	55	1,000	10	27	963	8	21
13	1,110	18	54	1,050	13	37	963	8	21
14	1,110	16	48	1,100	14	42	973	8	21
15	1,130	14	43	1,120	13	39	955	8	21
16	1,150	12	37	1,110	10	30	927	8	20
17	1,120	10	30	1,090	9	26	943	8	20
18	1,100	9	27	1,080	9	26	1,000	8	22
19	1,090	8	24	1,080	9	26	743	8	16
20	1,090	8	24	1,060	9	26	350	9	8.5
21	1,100	8	24	1,070	10	29	200	10	5.4
22	1,090	9	26	1,250	16	54	300	12	9.7
23	1,080	9	26	1,230	14	46	400	14	15
24	1,080	8	23	1,200	11	36	500	10	14
25	1,060	8	23	1,170	10	32	600	8	13
26	1,050	8	23	1,150	9	28	700	56	106
27	1,040	8	22	1,130	9	27	750	52	105
28	1,030	7	19	1,110	9	27	800	50	108
29	1,010	5	14	1,090	8	24	850	50	115
30	1,010	5	14	1,080	8	23	950	37	95
31	1,000	5	14	---	---	---	1,060	27	77
TOTAL	33,107	---	982	32,197	---	754.2	25,685	---	1,009.6
MEAN	1,068	11	32	1,073	8	25	829	15	33
MAX	1,150	19	59	1,250	16	54	1,130	56	115
MIN	955	5	14	989	3	8.1	200	4	5.4

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1998 through September 1999 (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)
					1999				
		January			February			March	
1	1,010	10	27	800	12	26	1,430	207	799
2	963	8	21	807	10	22	1,280	75	259
3	923	8	20	806	10	22	1,120	30	91
4	850	8	18	817	9	20	1,020	19	52
5	938	8	20	796	9	19	917	13	32
6	996	8	22	794	9	19	884	10	24
7	1,020	9	25	818	9	20	842	10	23
8	990	10	27	817	9	20	875	11	26
9	959	15	39	812	9	20	880	12	29
10	957	21	54	750	8	16	888	11	26
11	1,010	26	71	700	8	15	885	10	24
12	1,080	28	82	707	7	13	868	10	23
13	1,020	26	72	725	6	12	869	12	28
14	963	24	62	807	5	11	957	18	47
15	1,000	22	59	813	5	11	1,130	30	92
16	1,040	20	56	771	6	12	1,330	50	180
17	972	19	50	794	8	17	1,240	37	124
18	940	17	43	789	8	17	1,130	23	70
19	927	15	38	776	6	13	1,190	30	96
20	915	14	35	775	5	10	1,370	46	170
21	907	12	29	760	5	10	1,560	67	282
22	885	11	26	762	5	10	1,770	100	478
23	850	10	23	798	5	11	1,790	84	406
24	750	9	18	811	5	11	1,720	62	288
25	700	8	15	949	22	56	1,760	60	285
26	750	7	14	1,010	25	68	1,880	76	386
27	819	8	18	930	20	50	1,860	60	301
28	763	10	21	911	28	69	1,660	33	148
29	794	12	26	---	---	---	1,540	30	125
30	785	12	25	---	---	---	1,500	24	97
31	807	13	28	---	---	---	1,430	21	81
TOTAL	28,283	---	1,084	22,605	---	620	39,575	---	5,092
MEAN	912	14	35	807	10	22	1,277	41	164
MAX	1,080	28	82	1,010	28	69	1,880	207	799
MIN	700	7	14	700	5	10	842	10	23

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1998 through September 1999 (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)
				1999					
	April			May			June		
1	1,360	20	73	1,890	33	168	4,570	82	1,010
2	1,290	17	59	1,940	32	168	4,630	75	938
3	1,250	17	57	1,990	32	172	5,050	98	1,340
4	1,240	17	57	1,990	30	161	6,340	212	3,630
5	1,210	14	46	1,920	28	145	6,440	166	2,890
6	1,170	12	38	1,830	22	109	5,930	123	1,970
7	1,140	10	31	1,800	21	102	5,310	84	1,200
8	1,140	11	34	1,820	18	88	4,810	64	831
9	1,160	11	34	1,830	19	94	4,510	59	718
10	1,170	10	32	1,840	18	89	4,020	48	521
11	1,180	9	29	1,820	18	88	3,530	44	419
12	1,190	8	26	1,790	19	92	3,210	40	347
13	1,200	10	32	1,770	18	86	3,070	37	307
14	1,210	12	39	1,710	13	60	3,180	39	335
15	1,230	11	37	1,610	11	48	3,420	40	369
16	1,230	12	40	1,560	10	42	3,750	50	506
17	1,250	16	54	1,570	11	47	4,240	72	824
18	1,340	18	65	1,590	11	47	4,260	65	748
19	1,520	34	140	1,780	16	77	4,170	59	664
20	1,790	56	271	1,980	26	139	4,020	51	554
21	1,930	58	302	2,120	39	223	3,740	42	424
22	1,880	43	218	2,380	47	302	3,520	29	276
23	1,780	35	168	2,610	55	388	3,390	26	238
24	1,720	28	130	2,900	81	634	3,070	27	224
25	1,720	27	125	3,430	116	1,070	2,960	25	200
26	1,820	31	152	4,130	178	1,980	2,870	21	163
27	1,960	45	238	4,540	148	1,810	2,630	20	142
28	2,070	57	319	4,440	107	1,280	2,430	16	105
29	2,040	50	275	4,610	110	1,370	2,210	12	72
30	1,950	34	179	5,390	186	2,710	2,110	13	74
31	---	---	---	5,160	138	1,920	---	---	---
TOTAL	44,140	---	3,300	77,740	---	15,709	117,390	---	22,039
MEAN	1,471	24	110	2,508	52	507	3,913	58	735
MAX	2,070	58	319	5,390	186	2,710	6,440	212	3,630
MIN	1,140	8	26	1,560	10	42	2,110	12	72

Table 6. Daily streamflow and suspended-sediment data for Clark Fork at Turah Bridge, near Bonner, Montana, October 1998 through September 1999 (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)
				1999					
	July			August			September		
1	2,130	13	75	635	2	3.4	669	9	16
2	2,100	11	62	616	2	3.3	658	10	18
3	2,020	11	60	638	2	3.4	679	10	18
4	1,950	9	47	654	3	5.3	735	10	20
5	1,880	8	41	683	3	5.5	747	10	20
6	1,790	7	34	729	3	5.9	732	9	18
7	1,710	7	32	734	3	5.9	711	8	15
8	1,620	6	26	714	4	7.7	688	7	13
9	1,550	5	21	654	4	7.1	679	7	13
10	1,480	4	16	643	4	6.9	673	7	13
11	1,410	4	15	638	4	6.9	657	6	11
12	1,340	4	14	692	5	9.3	647	6	10
13	1,280	4	14	791	10	21	641	6	10
14	1,230	4	13	833	11	25	645	6	10
15	1,190	4	13	834	12	27	649	6	11
16	1,150	4	12	828	13	29	656	6	11
17	1,130	3	9.2	785	10	21	645	6	10
18	1,120	3	9.1	752	9	18	634	5	8.6
19	1,100	3	8.9	733	10	20	637	5	8.6
20	1,070	3	8.7	700	8	15	649	5	8.8
21	1,060	3	8.6	661	8	14	638	5	8.6
22	1,050	3	8.5	635	9	15	617	5	8.3
23	1,010	3	8.2	621	7	12	597	5	8.1
24	963	3	7.8	602	6	9.8	579	5	7.8
25	945	3	7.7	619	6	10	571	5	7.7
26	903	3	7.3	625	6	10	591	5	8.0
27	859	3	7.0	595	6	9.6	615	5	8.3
28	813	3	6.6	601	7	11	627	5	8.5
29	766	3	6.2	629	9	15	645	5	8.7
30	728	2	3.9	646	9	16	677	5	9.1
31	674	2	3.6	653	9	16	---	---	---
TOTAL	40,021	---	606.3	21,173	---	385.0	19,588	---	346.1
MEAN	1,291	5	20	683	7	12	653	6	12
MAX	2,130	13	75	834	13	29	747	10	20
MIN	674	2	3.6	595	2	3.3	571	5	7.7

TOTAL FOR WATER YEAR 1999:

STREAMFLOW--501,504 ft^3/s
SEDIMENT DISCHARGE--51,927.2 tons

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1998 through September 1999

[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)
					1998				
	October			November			December		
1	1,460	6	24	1,540	4	17	1,770	5	24
2	1,500	6	24	1,540	4	17	1,790	5	24
3	1,540	5	21	1,560	4	17	1,850	5	25
4	1,570	5	21	1,550	3	13	1,830	4	20
5	1,600	5	22	1,530	3	12	1,760	4	19
6	1,580	4	17	1,560	3	13	1,590	5	21
7	1,570	5	21	1,560	3	13	1,550	5	21
8	1,560	5	21	1,580	3	13	1,560	5	21
9	1,560	5	21	1,570	3	13	1,520	4	16
10	1,600	6	26	1,540	4	17	1,420	4	15
11	1,690	6	27	1,560	5	21	1,430	5	19
12	1,710	6	28	1,520	5	21	1,560	6	25
13	1,670	7	32	1,580	6	26	1,570	7	30
14	1,680	7	32	1,700	6	28	1,570	6	25
15	1,670	7	32	1,780	6	29	1,550	6	25
16	1,680	7	32	1,780	6	29	1,500	5	20
17	1,680	7	32	1,730	5	23	1,530	5	21
18	1,670	6	27	1,720	5	23	1,520	4	16
19	1,640	6	27	1,680	5	23	e1,050	4	11
20	1,620	5	22	1,660	5	22	e600	4	6.5
21	1,610	5	22	1,660	5	22	e500	4	5.4
22	1,610	5	22	1,880	6	30	e450	3	3.6
23	1,600	5	22	1,940	6	31	e550	3	4.5
24	1,610	5	22	1,920	5	26	e700	3	5.7
25	1,600	5	22	1,850	5	25	e900	4	9.7
26	1,590	5	21	1,800	5	24	e1,100	7	21
27	1,580	5	21	1,780	5	24	e1,300	10	35
28	1,580	5	21	1,820	6	29	e1,400	9	34
29	1,570	5	21	1,830	6	30	e1,600	8	35
30	1,560	4	17	1,790	6	29	e1,700	6	28
31	1,560	4	17	---	---	---	e1,800	6	29
TOTAL	49,720	---	737	50,510	---	660	42,520	---	615 4
MEAN	1,604	5	24	1,684	5	22	1,372	5	20
MAX	1,710	7	32	1,940	6	31	1,850	10	35
MIN	1,460	4	17	1,520	3	12	450	3	3 6

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1998 through September 1999 (Continued)

Day	Mean streamflow (ft^3/s)	Suspended sediment: Mean concentration (mg/L)	Suspended sediment: Discharge (ton/d)	Mean streamflow (ft^3/s)	Suspended sediment: Mean concentration (mg/L)	Suspended sediment: Discharge (ton/d)	Mean streamflow (ft^3/s)	Suspended sediment: Mean concentration (mg/L)	Suspended sediment: Discharge (ton/d)
				1999					
	January			February			March		
1	e1,900	4	21	1,430	4	15	1,940	18	94
2	e1,800	3	15	1,380	4	15	1,890	33	168
3	1,610	2	8.7	1,370	4	15	1,750	12	57
4	1,520	3	12	1,370	4	15	1,680	7	32
5	1,570	5	21	1,370	3	11	1,510	6	24
6	1,630	4	18	1,330	4	14	1,460	5	20
7	1,670	4	18	1,380	4	15	1,410	4	15
8	1,610	4	17	1,350	4	15	1,450	7	27
9	1,590	4	17	1,350	4	15	1,420	6	23
10	1,570	4	17	1,350	4	15	1,430	5	19
11	1,690	6	27	1,300	3	11	1,440	6	23
12	1,680	8	36	1,170	2	6.3	1,430	4	15
13	1,650	9	40	1,210	2	6.5	1,420	5	19
14	1,620	8	35	1,340	3	11	1,500	6	24
15	1,640	8	35	1,340	3	11	1,690	7	32
16	1,680	8	36	1,300	4	14	2,000	10	54
17	1,660	8	36	1,340	4	14	2,280	16	98
18	1,600	8	35	1,320	4	14	1,940	12	63
19	1,550	9	38	1,310	3	11	1,900	11	56
20	1,540	9	37	1,320	3	11	2,120	17	97
21	1,520	10	41	1,300	3	11	2,650	17	122
22	1,470	9	36	1,310	3	11	3,150	27	230
23	1,460	8	32	1,360	3	11	3,330	29	261
24	1,350	6	22	1,330	3	11	3,210	21	182
25	1,180	4	13	1,470	3	12	3,230	17	148
26	1,190	4	13	1,550	4	17	3,630	23	225
27	1,330	4	14	1,460	6	24	3,720	24	241
28	1,450	4	16	1,500	7	28	3,390	17	156
29	1,430	3	12	---	---	---	3,190	14	121
30	1,550	4	17	---	---	---	3,050	14	115
31	1,430	4	15	---	---	---	2,970	14	112
TOTAL	48,140	---	750.7	37,910	---	379.8	69,180	---	2,873
MEAN	1,553	6	24	1,354	4	14	2,232	13	93
MAX	1,900	10	41	1,550	7	28	3,720	33	261
MIN	1,180	2	8.7	1,170	2	6.3	1,410	4	15

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1998 through September 1999 (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)
				1999					
	April			May			June		
1	2,810	12	91	5,340	19	274	11,500	63	1,960
2	2,620	10	71	5,340	18	260	11,200	59	1,780
3	2,570	10	69	5,460	18	265	11,900	65	2,090
4	2,510	9	61	5,430	17	249	14,000	118	4,460
5	2,430	7	46	5,250	16	227	14,400	114	4,430
6	2,340	7	44	4,950	14	187	13,500	90	3,280
7	2,350	7	44	4,860	14	184	12,300	68	2,260
8	2,370	8	51	4,880	10	132	11,100	50	1,500
9	2,470	7	47	4,900	12	159	10,300	43	1,200
10	2,430	6	39	4,890	12	158	9,300	39	979
11	2,320	6	38	4,790	12	155	8,400	32	726
12	2,380	7	45	4,640	13	163	7,790	27	568
13	2,450	8	53	4,560	13	160	7,560	24	490
14	2,570	8	56	4,380	12	142	7,870	25	531
15	2,650	8	57	4,210	10	114	8,760	32	757
16	2,640	8	57	4,150	11	123	9,530	40	1,030
17	2,760	9	67	4,160	10	112	10,400	48	1,350
18	3,010	10	81	4,330	10	117	10,500	50	1,420
19	3,520	13	124	4,840	12	157	10,400	49	1,380
20	4,420	18	215	5,540	18	269	10,200	41	1,130
21	4,940	23	307	6,210	29	486	9,510	36	924
22	4,900	21	278	7,230	41	800	8,940	29	700
23	4,720	17	217	7,960	53	1,140	8,590	26	603
24	4,610	16	199	9,020	65	1,580	7,910	25	534
25	4,710	17	216	10,800	110	3,210	7,770	22	462
26	5,120	20	276	13,000	162	5,690	7,650	22	454
27	5,710	23	355	13,500	140	5,100	6,900	20	373
28	6,110	26	429	13,100	108	3,820	6,270	16	271
29	5,970	24	387	13,000	93	3,260	5,820	12	189
30	5,600	20	302	13,500	105	3,830	5,620	14	212
31	---	---	---	12,700	96	3,290	---	---	---
TOTAL	106,010	---	4,322	216,920	---	35,813	285,890	---	38,043
MEAN	3,534	13	144	6,997	41	1,160	9,530	43	1,270
MAX	6,110	26	429	13,500	162	5,690	14,400	118	4,460
MIN	2,320	6	38	4,150	10	112	5,620	12	189

Table 7. Daily streamflow and suspended-sediment data for Clark Fork above Missoula, Montana, October 1998 through September 1999 (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)
				1999					
	July			August			September		
1	5,890	14	223	1,730	6	28	1,420	6	23
2	5,900	14	223	1,710	6	28	1,400	6	23
3	5,610	14	212	1,690	7	32	1,420	7	27
4	5,290	12	171	1,680	7	32	1,500	7	28
5	5,030	12	163	1,680	7	32	1,530	8	33
6	4,710	10	127	1,710	8	37	1,530	8	33
7	4,500	7	85	1,740	8	38	1,480	8	32
8	4,290	6	69	1,730	8	37	1,360	7	26
9	4,100	8	89	1,610	8	35	1,380	6	22
10	3,950	9	96	1,580	8	34	1,340	6	22
11	3,710	10	100	1,550	8	33	1,350	5	18
12	3,540	10	96	1,580	8	34	1,340	5	18
13	3,430	11	102	1,780	7	34	1,290	5	17
14	3,290	9	80	1,810	7	34	1,340	5	18
15	3,120	7	59	1,820	8	39	1,330	6	22
16	3,020	6	49	1,830	7	35	1,330	6	22
17	2,930	6	47	1,780	7	34	1,300	6	21
18	2,810	6	46	1,700	8	37	1,290	6	21
19	2,720	6	44	1,630	9	40	1,260	6	20
20	2,650	6	43	1,600	9	39	1,290	6	21
21	2,530	6	41	1,510	9	37	1,300	7	25
22	2,530	6	41	1,500	9	36	1,260	7	24
23	2,410	5	33	1,450	12	47	1,250	7	24
24	2,250	5	30	1,430	13	50	1,190	6	19
25	2,260	5	31	1,290	19	66	1,200	6	19
26	2,200	6	36	1,220	10	33	1,240	5	17
27	2,110	6	34	1,250	7	24	1,280	5	17
28	2,010	6	33	1,400	5	19	1,290	5	17
29	1,940	6	31	1,340	5	18	1,290	5	17
30	1,870	6	30	1,410	5	19	1,320	4	14
31	1,800	5	24	1,380	6	22	---	---	---
TOTAL	104,400	---	2,488	49,120	---	1,063	40,100	---	660
MEAN	3,368	8	80	1,585	8	34	1,337	6	22
MAX	5,900	14	223	1,830	19	66	1,530	8	33
MIN	1,800	5	24	1,220	5	18	1,190	4	14

TOTAL FOR WATER YEAR 1999:

STREAMFLOW--1,100,420 ft^3/s
SEDIMENT DISCHARGE--88,404.9 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 laboratory reporting level]

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)
12323230	Blacktail Creek at Harrison Avenue, at Butte	04-27-99	1020	93	27	6.5	4	2
		04-27-99	1025	94	27	6.6	4	4
12323770	Warm Springs Creek at Warm Springs	06-22-99	1210	66	20	3.6	5	4
		06-22-99	1215	67	21	3.7	5	3
12324200	Clark Fork at Deer Lodge	02-22-99	1540	230	67	15	9	7
		02-22-99	1545	220	66	15	9	7
12331800	Clark Fork near Drummond	08-13-99	1615	240	67	17	13	13
		08-13-99	1620	230	66	16	14	13
12334550	Clark Fork at Turah Bridge, near Bonner	05-12-99	0905	120	32	8.6	6	5
		05-12-99	0910	120	32	8.6	6	5
12340500	Clark Fork above Missoula	05-26-99	1610	68	18	5.4	5	2
		05-26-99	1615	68	18	5.4	6	3

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)
12323230	04-27-99	<1	0.1	8	3	810	200	5
	04-27-99	<1	<.1	8	3	810	210	5
12323770	06-22-99	<1	<.1	19	3	460	11	2
	06-22-99	<1	<.1	20	3	380	12	2
12324200	02-22-99	<1	<.1	16	5	220	<10	2
	02-22-99	<1	<1	18	4	260	<10	2
12331800	08-13-99	<1	<.1	19	5	370	<10	3
	08-13-99	<1	<.1	18	5	360	<10	3
12334550	05-12-99	<1	<.1	13	3	310	16	2
	05-12-99	<1	<.1	12	3	320	18	2
12340500	05-26-99	<1	<.1	22	2	2,200	49	5
	05-26-99	<1	<.1	22	2	2,400	45	6

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
12323230	04-27-99	.5	60	35	21	<20	39	92
	04-27-99	<.5	60	36	<40	<20	41	92
12323770	06-22-99	<.5	93	41	<40	<20	24	57
	06-22-99	<.5	94	41	<40	<20	23	59
12324200	02-22-99	<.5	91	51	30	<10	15	72
	02-22-99	<.5	90	52	20	9	16	74
12331800	08-13-99	<.5	130	8	34	3	25	89
	08-13-99	<.5	130	8	30	3	25	86
12334550	05-12-99	<.5	46	5	<40	<20	18	84
	05-12-99	<.5	49	6	<40	<20	19	82
12340500	05-26-99	<.5	180	15	40	<20	200	85
	05-26-99	<.5	180	14	36	<20	201	84

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	6	0.50	1.3
Magnesium, dissolved, mg/L	6	.29	3.1
Arsenic, total recoverable, µg/L	6	.41	5.7
Arsenic, dissolved, µg/L	6	.71	12
Cadmium, total recoverable, µg/L	6	.0	.0
Cadmium, dissolved, µg/L	6	.0	.0
Copper, total recoverable, µg/L	6	.76	4.7
Copper, dissolved, µg/L	6	.29	8.5
Iron, total recoverable, µg/L	6	63	8.5
Iron, dissolved, µg/L	6	3.2	6.3
Lead, total recoverable, µg/L	6	.29	8.9
Lead, dissolved, µg/L	6	.0	.0
Manganese, total recoverable, µg/L	6	.96	1.0
Manganese, dissolved, µg/L	6	.58	2.2
Zinc, total recoverable, µg/L	6	3.3	10
Zinc, dissolved, µg/L	6	.29	1.8
Sediment, suspended, mg/L	6	.82	1.5
Sediment, suspended, percent finer than 0.062 mm	6	1.4	1.7

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	10	0.16	0.5	Yes
Magnesium, dissolved, mg/L	10	.12	1.6	Yes
Arsenic, total recoverable, µg/L	10	.44	5.6	Yes
Arsenic, dissolved, µg/L	10	.25	4.1	Yes
Cadmium, total recoverable, µg/L	10	.02	16	Yes
Cadmium, dissolved, µg/L	10	.00	<.1	Yes
Copper, total recoverable, µg/L	10	.43	3.8	Yes
Copper, dissolved, µg/L	10	.34	9.9	Yes
Iron, total recoverable, µg/L	10	5.6	.9	Yes
Iron, dissolved, µg/L	10	.73	.8	Yes
Lead, total recoverable, µg/L	10	.23	10	Yes
Lead, dissolved, µg/L	10	.00	<.1	Yes
Manganese, total recoverable, µg/L	10	.64	.8	Yes
Manganese, dissolved, µg/L	10	.31	.9	Yes
Zinc, total recoverable, µg/L	10	3.0	18	Yes
Zinc, dissolved, µg/L	10	.89	36	[1]No

[1]Statistics calculated using laboratory reporting level for values less than the detection capability of the instrument.

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	5	97.8-108	102.9	Yes
Arsenic, dissolved, µg/L	5	95.4-122	108.9	Yes
Cadmium, total recoverable, µg/L	5	99.9-107	103.4	Yes
Cadmium, dissolved, µg/L	5	92.6-109	100.9	Yes
Copper, total recoverable, µg/L	5	102-108	105.0	Yes
Copper, dissolved, µg/L	5	99.5-116	107.5	Yes
Iron, total recoverable, µg/L	5	94.3-101	97.7	Yes
Iron, dissolved, µg/L	5	90.0-103	96.5	Yes
Lead, total recoverable, µg/L	5	85.2-107	96.2	Yes
Lead, dissolved, µg/L	5	87.9-107	97.4	Yes
Manganese, total recoverable, µg/L	5	91.8-100	96.0	Yes
Manganese, dissolved, µg/L	5	86.3-106	95.9	Yes
Zinc, total recoverable, µg/L	5	88.9-97.7	93.3	Yes
Zinc, dissolved, µg/L	5	92.9-101	96.9	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	5	96.4-111	103.6	Yes
Arsenic, dissolved, µg/L	5	97.5-113	105.2	Yes
Cadmium, total recoverable, µg/L	5	100-106	103.0	Yes
Cadmium, dissolved, µg/L	5	92.4-113	102.6	Yes
Copper, total recoverable, µg/L	5	97.5-104	100.5	Yes
Copper, dissolved, µg/L	5	89.1-116	102.7	Yes
Iron, total recoverable, µg/L	5	93.5-101	97.2	Yes
Iron, dissolved, µg/L	5	90.6-109	99.9	Yes
Lead, total recoverable, µg/L	5	93.7-108	101.1	Yes
Lead, dissolved, µg/L	5	94.0-106	100.2	Yes
Manganese, total recoverable, µg/L	5	92.8-107	99.8	Yes
Manganese, dissolved, µg/L	5	89.3-108	98.8	Yes
Zinc, total recoverable, µg/L	5	91.1-101	96.2	Yes
Zinc, dissolved, µg/L	5	95.7-102	98.6	Yes

Table 13. Chemical analyses of field blanks for water samples

[Abbreviations: °C, degrees Celsius; µg/L, micrograms per liter; E, estimated; µS/cm, microsiemens per centimeter at 25 °C; mg/L, milligrams per liter. Symbol: <, less than laboratory 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 1998										
17...	1800	3	5.5	E0.01	E0.002	<1	<1	<1	<0.1	<1
FEB 1999										
22...	1800	2	5.6	E.02	E.003	<1	<1	<1	<.1	<1
APR										
28...	1600	3	5.4	E.01	E.002	<1	<1	<1	<.1	<1
MAY										
11...	1700	2	5.5	<.02	<.004	<1	<1	<1	<.1	<1
27...	0845	3	5.6	E.02	.006	<1	<1	<1	<.1	<1
JUN										
10...	0900	2	5.6	E.01	<.004	<1	<1	<1	<.1	<1
23...	0700	2	5.7	E.01	E.002	<1	<1	<1	<.1	<1
AUG										
13...	1245	2	6.2	.01	E.002	<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 1998									
17...	<1	<10	<10	<1	<0.5	<10	<4	<10	<20
FEB 1999									
22...	<1	<10	<10	<1	<.5	<10	<3	<10	<20
APR									
28...	<1	<14	<10	<1	<.5	<3	<3	<40	<20
MAY									
11...	<1	<14	<10	<1	<.5	<3	<3	<40	<20
27...	<1	<14	<10	<1	<.5	<3	<3	<40	<20
JUN									
10...	<1	<14	<10	<1	<.5	<3	<3	<40	<20
23...	<1	<14	<10	<1	<.5	<3	<3	<40	<20
AUG									
13...	<1	36	<10	<1	<.5	<3	<1	<40	<1

Table 14. Trace-element analyses of fine-grained bed sediment, upper Clark Fork basin, Montana, August 1999

[Fine-grained sediment is material less than 0.064 millimeter in diameter. Reported 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	26.5	24.8	5,970	34,600	852	2,200	14.2	18.9	6,600
12323750	Silver Bow Creek at Warm Springs	3	4.5	23.6	223	20,000	62	3,100	15.7	1.6	686
12323770	Warm Springs Creek at Warm Springs	3	1.3	27.5	779	20,600	85	6,030	19.6	3.1	396
12323800	Clark Fork near Galen	3	4.0	27.0	991	26,800	136	6,330	19.0	3.6	1,120
461415112450801	Clark Fork below Lost Creek, near Galen	3	6.5	27.5	1,440	31,700	174	5,000	18.7	5.6	1,490
461559112443301	Clark Fork near Racetrack	3	5.0	24.9	1,390	28,600	186	4,030	17.0	4.8	1,430
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	3	4.3	26.4	766	28,300	117	1,810	15.1	2.7	907
12324200	Clark Fork at Deer Lodge	3	4.4	32.5	1,070	30,200	150	4,910	20.1	4.5	1,320
12324680	Clark Fork at Goldcreek	3	3.5	29.4	780	25,300	119	1,660	15.9	3.2	1,080
12331500	Flint Creek near Drummond	3	<.2	20.4	63	23,400	162	4,570	12.7	5.8	650
12331800	Clark Fork near Drummond	3	2.6	27.0	491	23,200	94	1,740	15.0	2.3	947
12334510	Rock Creek near Clinton	3	<.2	20.3	16	19,300	15	478	14.8	<.4	47
12334550	Clark Fork at Turah Bridge, near Bonner	3	3.9	27.7	479	24,400	102	1,080	19.1	1.0	1,080
12340000	Blackfoot River near Bonner	3	<.2	21.6	27	20,100	19	544	14.3	<.4	67
12340500	Clark Fork above Missoula	3	1.5	20.8	219	20,400	47	1,370	15.8	.8	547
12353000	Clark Fork below Missoula[1]	3	1.2	17.2	141	17,300	41	1,080	12.5	.4	380

[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 1999

[Bulk bed sediment collected in this study generally is material smaller than about 10 millimeters in diameter. Reported concentrations are the mean of all analyses for replicate aliquots of 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	2	4.2	11.8	902	18,300	198	748	6.5	3.2	1,730
12323750	Silver Bow Creek at Warm Springs	2	<.9	9.1	30	9,600	10	1,000	5.4	<.8	131
12323770	Warm Springs Creek at Warm Springs	2	<.9	12.0	238	12,700	38	2,440	8.5	<.8	275
12323800	Clark Fork near Galen	2	<.9	15.0	318	20,600	48	1,900	6.9	.9	477
461415112450801	Clark Fork below Lost Creek, near Galen	2	<.9	9.3	238	12,600	41	1,290	4.2	.8	365
461559112443301	Clark Fork near Racetrack	2	<.9	14.7	440	19,700	76	1,280	6.5	1.4	626
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	2	1.5	13.0	244	16,400	47	876	6.5	<.8	368
12324200	Clark Fork at Deer Lodge	2	1.0	15.3	356	16,300	61	709	8.4	.9	471
12324680	Clark Fork at Goldcreek	2	1.1	17.9	278	16,000	48	554	9.2	.6	525
12331500	Flint Creek near Drummond	2	<.2	6.5	18	10,100	63	1,800	4.5	4.1	220
12331800	Clark Fork near Drummond	2	1.0	16.7	223	15,200	50	949	9.8	.7	603
12334510	Rock Creek near Clinton	2	<.2	6.4	3	5,290	<3	72	3.6	<.4	10
12334550	Clark Fork at Turah Bridge, near Bonner	2	.4	10.1	84	9,270	22	299	6.7	<.4	271
1234000	Blackfoot River near Bonner	2	<.2	8.7	12	11,500	6	207	7.5	<.4	34
12340500	Clark Fork above Missoula	2	.4	10.2	72	13,800	18	810	9.2	<.4	263
12353000	Clark Fork below Missoula[1]	2	<.2	6.8	16	8,420	6	150	3.9	<.4	58

[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	6	1:5	0.4	133.9	83.5-184
Chromium	6	1:5	130	65.6	61.2-70.0
Copper	6	1:5	35	90.0	85.8-94.2
Iron	6	1:5	35,000	88.0	85.7-90.3
Lead	6	1:5	19	87.0	82.2-91.8
Manganese	6	1:5	538	94.0	91.2-96.8
Nickel	6	1:5	88	87.9	85.9-89.9
Silver	6	1:5	.4	--	--
Zinc	6	1:5	106	95.0	89.4-100
			SRM sample 2711		
Cadmium	6	1:10	41.7	98.5	97.1-99.9
Chromium	6	1:10	47.0	57.9	54.9-60.9
Copper	6	1:10	114	95.9	93.2-98.6
Iron	6	1:10	28,900	83.0	81.1-84.9
Lead	6	1:10	1,160	95.6	94.1-97.1
Manganese	6	1:10	638	85.1	83.9-86.3
Nickel	6	1:10	20.6	91.8	85.9-97.7
Silver	6	1:10	4.6	76.9	73.8-80.0
Zinc	6	1:10	350	100.9	92.3-109.5

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]

Station number	Station name	Dilution ratio	Trace-element concentration, in µg/mL								
			Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Silver	Zinc
12323600	Silver Bow Creek at Opportunity	1:10	<0.005	<0.004	<0.008	<0.37	<0.018	<0.036	<0.007	<0.002	<0.020
12323750	Silver Bow Creek at Warm Springs	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12323770	Warm Springs Creek at Warm Springs	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12323800	Clark Fork near Galen	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
461415112450801	Clark Fork below Lost Creek, near Galen	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
461559112443301	Clark Fork near Racetrack	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12324200	Clark Fork at Deer Lodge	1:10	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12324680	Clark Fork at Goldcreek	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12331500	Flint Creek near Drummond	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12331800	Clark Fork near Drummond	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12334510	Rock Creek near Clinton	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12334550	Clark Fork at Turah Bridge, near Bonner	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12340000	Blackfoot River near Bonner	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12340500	Clark Fork above Missoula	1:5	<.005	<.004	<.008	<.37	<.018	<.036	<.007	<.002	<.020
12353000	Clark Fork below Missoula	1:5	<.005	<.004	.010	<.37	<.018	<.036	<.007	<.002	<.020

Table 18. Trace-element analyses of biota, upper Clark Fork basin, Montana, August 1999

[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	5.8	0.7	846	730	17.9	503	1.9	629
12323750 Silver Bow Creek at Warm Springs									
Hydropsyche cockerelli	1	<.4	<.4	22.4	453	<2.1	657	<1.7	115
Hydropsyche occidentalis	5	.2	1.0	28.9	761	3.7	1,690	.9	174
12323770 Warm Springs Creek at Warm Springs									
Arctopsyche grandis	1	1.9	2.9	102	872	<8.7	1,800	<7.0	180
Hydropsyche occidentalis	2	.7	3.2	182	2,010	7.4	2,440	3.2	169
12323800 Clark Fork near Galen									
Hydropsyche cockerelli	1	1.4	1.5	48.7	816	6.3	1,370	<4.3	155
Hydropsyche occidentalis	4	.7	1.4	67.5	1,100	6.1	1,950	1.3	178
461415112450801 Clark Fork below Lost Creek, near Galen									
Hydropsyche cockerelli	1	2.3	1.0	48.8	706	<3.0	1,230	<2.4	151
Hydropsyche occidentalis	4	1.1	1.7	93.6	1,380	10.0	3,240	1.5	254
Hydropsyche spp.	1	1.3	1.0	45.1	533	4.1	1,230	<1.6	143
461559112443301 Clark Fork near Racetrack									
Hydropsyche cockerelli	1	<2.2	2.2	50.0	846	<10.9	1,690	<8.7	155
Hydropsyche occidentalis	2	.8	1.3	64.1	1,190	6.7	3,220	1.3	194
461903112440701 Clark Fork at Dempsey Creek diversion, near Racetrack									
Hydropsyche occidentalis	5	1.0	1.8	88.3	1,530	11.8	3,610	1.7	277
12324200 Clark Fork at Deer Lodge									
Hydropsyche cockerelli	1	1.8	1.6	57.4	977	<7.6	772	2.2	134
Hydropsyche occidentalis	4	1.2	1.5	94.3	1,190	7.7	1,640	1.6	216
12324680 Clark Fork at Goldcreek									
Arctopsyche grandis	4	4.1	1.2	54.6	518	4.0	1,020	.6	306
Claassenia sabulosa	2	.7	.8	69.0	223	1.2	125	.4	255
Hydropsyche cockerelli	1	2.4	1.8	58.6	1,080	5.7	900	1.2	206
Hydropsyche occidentalis	2	1.7	1.7	64.6	1,070	6.2	1,290	1.0	228
12331500 Flint Creek near Drummond									
Arctopsyche grandis	2	.5	1.6	16.1	1,260	9.1	1,530	1.6	202
Hydropsyche spp.	1	<.3	1.4	12.5	1,440	4.5	1,320	1.3	130
12331800 Clark Fork near Drummond									
Arctopsyche grandis	2	1.9	1.2	36.8	614	3.6	1,120	<1.2	220
Claassenia sabulosa	3	1.6	1.2	106	335	1.9	343	.5	368
Hydropsyche cockerelli	2	1.0	1.3	43.8	927	2.4	784	1.3	142
Hydropsyche occidentalis	2	1.2	2.1	57.6	1,300	8.8	1,860	1.7	249

Table 18. Trace-element analyses of biota, upper Clark Fork basin, Montana, August 1999 (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	1	.3	.8	8.1	471	<1.4	152	1.1	101
12334550 Clark Fork at Tnrah Bridge, near Bonner									
Arctopsyche grandis	3	1.5	2.2	48.5	1,310	5.1	713	1.7	229
Claassenia sabulosa	1	1.0	.4	39.3	90	.6	66	<.3	196
Hydropsyche cockerelli	1	1.0	2.5	62.6	1,510	5.8	651	1.6	220
Hydropsyche occidentalis	2	1.1	2.3	56.6	1,370	6.1	744	1.5	227
12340500 Clark Fork above Missoula									
Arctopsyche grandis	3	.8	1.7	40.0	1,070	2.8	988	1.4	200
Claassenia sabulosa	2	.8	.9	51.5	218	.5	122	<.8	249
Hydropsyche cockerelli	1	.8	2.1	40.4	1,900	<2.7	931	2.3	156
Hydropsyche occidentalis	2	.7	3.2	51.3	2,300	5.5	2,370	2.3	230
12353000 Clark Fork below Missoula[1]									
Arctopsyche grandis	3	1.2	1.7	27.7	987	2.0	833	1.1	201
Claassenia sabulosa	2	.8	.6	62.5	152	.5	115	<.4	251
Hydropsyche cockerelli	2	.7	2.2	38.4	1,560	2.7	841	1.5	167
Hydropsyche occidentalis	2	.5	1.5	25.1	1,000	1.9	682	8	134

[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	102	101-104
Chromium	12	.77	156	155-156
Copper	12	106	101	97.1-104
Iron	12	105	100	94.5-106
Lead	[1]4	.35	108	108-109
Manganese	12	13.6	97.2	96.6-97.7
Nickel	12	2.5	96.0	95.9-96.1
Zinc	12	180	103	93.7-112

[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	<0.10	<0.05	<0.03	<0.04	<0.04
12323750	Silver Bow Creek at Warm Springs	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
12323770	Warm Springs Creek at Warm Springs	1:1	<.01	<.01	<.03	.37	<.05	<.03	<.04	<.04
12323800	Clark Fork near Galen	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
461415112450801	Clark Fork below Lost Creek, near Galen	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
461559112443301	Clark Fork near Racetrack	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
461903112440701	Clark Fork at Dempsey Creek diversion, near Racetrack	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
12324200	Clark Fork at Deer Lodge	1:1	<.01	<.01	<.03	<.57	<.05	<.03	<.04	<.04
12324680	Clark Fork at Goldcreek	1:1	<.01	<.01	<.03	.45	<.05	<.03	<.04	<.04
12331500	Flint Creek near Drummond	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
12331800	Clark Fork near Drummond	1:1	<.01	<.01	<.03	.17	<.05	<.03	<.04	<.04
12334510	Rock Creek near Clinton	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
12334550	Clark Fork at Turah Bridge, near Bonner	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
12340500	Clark Fork above Missoula	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04
12353000	Clark Fork below Missoula	1:1	<.01	<.01	<.03	<.10	<.05	<.03	<.04	<.04

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999

[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 laboratory 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 1999					
Streamflow, instantaneous (ft^3/s)	51	156	3.1	19	9.3
Specific conductance, onsite (µS/cm)	51	412	116	251	245
Temperature, water (°C)	51	17.0	2.0	8.0	7.0
pH, onsite (standard units)	51	8.2	7.3	7.8	7.8
Hardness, total (mg/L as $CaCO_3$)	51	140	38	100	100
Calcium, dissolved (mg/L)	51	39	11	28	29
Magnesium, dissolved (mg/L)	51	11	2.7	6.9	6.7
Arsenic, total recoverable (µg/L)	51	18	2	7	6
Arsenic, dissolved (µg/L)	51	13	1	4	4
Cadmium, total recoverable (µg/L)	51	<1	<1	--	<1
Cadmium, dissolved (µg/L)	51	.5	<.1	--	<.1
Copper, total recoverable (µg/L)	51	52	2	8	6
Copper, dissolved (µg/L)	51	10	<1	[2]4	4
Iron, total recoverable (µg/L)	51	4,200	250	858	620
Iron, dissolved (µg/L)	51	480	24	199	190
Lead, total recoverable (µg/L)	51	47	<1	[2]3	1
Lead, dissolved (µg/L)	51	1	<.5	[2].3	<.5
Manganese, total recoverable (µg/L)	51	240	30	65	60
Manganese, dissolved (µg/L)	51	100	17	42	39
Zinc, total recoverable (µg/L)	51	130	<10	[2]12	<10
Zinc, dissolved (µg/L)	51	11	<3	[2]4	<20
Sediment, suspended concentration (mg/L)	51	139	2	19	8
Sediment, suspended discharge (ton/d)	51	59	.04	2.2	.2
Sediment, suspended (percent finer than 0.062 mm)	51	97	50	83	86

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999					
Streamflow, instantaneous (ft^3/s)	51	134	15	35	29
Specific conductance, onsite (µS/cm)	51	691	226	451	460
Temperature, water (°C)	51	17.0	1.5	9.9	9.0
pH, onsite (standard units)	51	7.8	7.2	7.5	7.5
Hardness, total (mg/L as $CaCO_3$)	51	180	66	143	150
Calcium, dissolved (mg/L)	51	52	19	41	42
Magnesium, dissolved (mg/L)	51	13	4.5	10	10
Arsenic, total recoverable (µg/L)	51	45	8	16	14
Arsenic, dissolved (µg/L)	51	13	4	7	7
Cadmium, total recoverable (µg/L)	51	6	1	3	2
Cadmium, dissolved (µg/L)	51	6.2	.5	2.1	1.6
Copper, total recoverable (µg/L)	51	550	40	169	150
Copper, dissolved (µg/L)	51	300	12	73	60
Iron, total recoverable (µg/L)	51	7,400	250	1,480	820
Iron, dissolved (µg/L)	51	270	20	108	100
Lead, total recoverable (µg/L)	51	250	3	27	11
Lead, dissolved (µg/L)	51	2.4	<.5	[2].8	.6
Manganese, total recoverable (µg/L)	51	1,600	245	682	670
Manganese, dissolved (µg/L)	51	1,700	210	619	630
Zinc, total recoverable (µg/L)	51	2,200	254	856	790
Zinc, dissolved (µg/L)	51	2,200	200	702	600
Sediment, suspended concentration (mg/L)	50	405	3	40	16
Sediment, suspended discharge (ton/d)	50	70	.14	5.2	1.2
Sediment, suspended (percent finer than 0.062 mm)	50	98	42	83	86

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999					
Streamflow, instantaneous (ft^3/s)	54	361	26	94	64
Specific conductance, onsite (µS/cm)	53	593	202	368	368
Temperature, water (°C)	53	18.0	0.0	8.8	9.0
pH, onsite (standard units)	53	8.9	7.2	8.3	8.2
Hardness, total (mg/L as $CaCO_3$)	53	200	60	131	130
Calcium, dissolved (mg/L)	53	55	18	39	39
Magnesium, dissolved (mg/L)	53	15	3.4	8.3	8.2
Arsenic, total recoverable (µg/L)	53	240	11	34	18
Arsenic, dissolved (µg/L)	53	34	1	10	9
Cadmium, total recoverable (µg/L)	53	49	1	3	2
Cadmium, dissolved (µg/L)	53	41	.1	2.0	1.2
Copper, total recoverable (µg/L)	53	3,900	79	324	160
Copper, dissolved (µg/L)	53	450	25	66	51
Iron, total recoverable (µg/L)	53	24,000	290	2,230	990
Iron, dissolved (µg/L)	53	310	3	59	33
Lead, total recoverable (µg/L)	53	650	7	56	21
Lead, dissolved (µg/L)	53	5.1	<.5	[2].8	.5
Manganese, total recoverable (µg/L)	53	10,000	230	801	598
Manganese, dissolved (µg/L)	53	9,300	190	660	490
Zinc, total recoverable (µg/L)	53	15,000	230	866	533
Zinc, dissolved (µg/L)	53	13,000	94	534	290
Sediment, suspended concentration (mg/L)	54	801	6	76	24
Sediment, suspended discharge (ton/d)	54	781	.42	37	3.7
Sediment, suspended (percent finer than 0.062 mm)	54	95	37	76	79

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	60	662	24	181	141
Specific conductance, onsite (µS/cm)	58	614	249	430	426
Temperature, water (°C)	59	22.0	.5	10.8	12.0
pH, onsite (standard units)	58	9.3	8.0	8.8	8.8
Hardness, total (mg/L as $CaCO_3$)	58	260	97	179	170
Calcium, dissolved (mg/L)	58	78	28	52	50
Magnesium, dissolved (mg/L)	58	19	5.9	12	11
Arsenic, total recoverable (µg/L)	58	94	12	27	24
Arsenic, dissolved (µg/L)	58	60	8	22	21
Cadmium, total recoverable (µg/L)	58	<1	<1	--	<1
Cadmium, dissolved (µg/L)	58	.3	<.1	[2].1	<.1
Copper, total recoverable (µg/L)	58	80	5	25	21
Copper, dissolved (µg/L)	58	40	3	12	10
Iron, total recoverable (µg/L)	58	3,000	130	431	340
Iron, dissolved (µg/L)	58	93	<5	[2]18	15
Lead, total recoverable (µg/L)	58	15	<1	[2]3	2
Lead, dissolved (µg/L)	58	1.0	<.5	--	<.5
Manganese, total recoverable (µg/L)	58	600	60	192	155
Manganese, dissolved (µg/L)	58	530	12	120	86
Zinc, total recoverable (µg/L)	58	180	<10	[2]53	40
Zinc, dissolved (µg/L)	58	73	<3	[2]12	7
Sediment, suspended concentration (mg/L)	60	229	2	15	8
Sediment, suspended discharge (ton/d)	60	279	.26	12	2.6
Sediment, suspended (percent finer than 0.062 mm)	59	97	43	82	85

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	40	420	2.8	124	95
Specific conductance, onsite (µS/cm)	39	795	139	295	266
Temperature. water (°C)	40	16.0	.5	8.6	9.0
pH, onsite (standard units)	39	8.7	7.4	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	39	420	66	144	130
Calcium, dissolved (mg/L)	39	130	20	44	39
Magnesium, dissolved (mg/L)	39	22	3.6	8.3	7.3
Arsenic, total recoverable (µg/L)	39	27	3	8	6
Arsenic, dissolved (µg/L)	39	14	2	5	4
Cadmium, total recoverable (µg/L)	39	<1	<1	--	<1
Cadmium, dissolved (µg/L)	39	<.1	<.1	--	<.1
Copper, total recoverable (µg/L)	39	97	2	25	11
Copper, dissolved (µg/L)	39	16	1	4	3
Iron, total recoverable (µg/L)	39	1,700	40	408	160
Iron, dissolved (µg/L)	39	30	3	11	10
Lead, total recoverable (µg/L)	39	14	<1	[2]3	1
Lead, dissolved (µg/L)	39	1.8	<.5	--	<.5
Manganese, total recoverable (µg/L)	39	1,400	90	261	200
Manganese, dissolved (µg/L)	39	570	41	153	110
Zinc, total recoverable (µg/L)	39	60	<10	[2]15	<40
Zinc, dissolved (µg/L)	39	10	<1	[2]3	<10
Sediment, suspended concentration (mg/L)	40	100	2	25	11
Sediment, suspended discharge (ton/d)	39	87	.09	14	3.0
Sediment, suspended (percent finer than 0.062 mm)	40	88	55	75	76

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	101	1,050	14	235	149
Specific conductance, onsite (µS/cm)	89	720	197	422	423
Temperature, water (°C)	100	22.5	0.0	9.5	9.2
pH, onsite (standard units)	88	9.0	7.5	8.5	8.5
Hardness, total (mg/L as $CaCO_3$)	87	370	81	185	180
Calcium, dissolved (mg/L)	87	110	24	55	54
Magnesium, dissolved (mg/L)	87	22	5.1	12	11
Arsenic, total recoverable (µg/L)	87	78	3	21	17
Arsenic, dissolved (µg/L)	87	53	4	15	13
Cadmium, total recoverable (µg/L)	87	3	<1	[2].3	<1
Cadmium, dissolved (µg/L)	87	1	<.1	[2].1	<.1
Copper, total recoverable (µg/L)	86	240	5	38	24
Copper, dissolved (µg/L)	87	50	3	11	9
Iron, total recoverable (µg/L)	87	9,200	90	649	330
Iron, dissolved (µg/L)	87	110	<3	[2]18	12
Lead, total recoverable (µg/L)	87	28	<1	[2]4	2
Lead, dissolved (µg/L)	87	3	<.5	[2].3	<.5
Manganese, total recoverable (µg/L)	87	1,400	80	279	200
Manganese, dissolved (µg/L)	87	380	31	121	89
Zinc, total recoverable (µg/L)	87	360	<10	[2]59	50
Zinc, dissolved (µg/L)	87	110	<3	[2]15	10
Sediment, suspended concentration (mg/L)	101	338	2	23	10
Sediment, suspended discharge (ton/d)	101	459	.12	28	3.3
Sediment, suspended (percent finer than 0.062 mm)	100	97	41	78	78

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	153	1,920	23	313	231
Specific conductance, onsite (µS/cm)	136	642	234	485	505
Temperature, water (°C)	152	23.0	0.0	9.4	10.0
pH, onsite (standard units)	101	8.9	7.4	8.2	8.2
Hardness, total (mg/L as $CaCO_3$)	93	270	95	202	210
Calcium, dissolved (mg/L)	93	81	28	60	61
Magnesium, dissolved (mg/L)	93	18	5.9	13	13
Arsenic, total recoverable (µg/L)	103	220	8	28	18
Arsenic, dissolved (µg/L)	103	39	7	15	13
Cadmium, total recoverable (µg/L)	103	5	<1	[2].6	<1
Cadmium, dissolved (µg/L)	103	2	<.1	[2].1	<1
Copper, total recoverable (µg/L)	102	1,500	10	110	51
Copper, dissolved (µg/L)	103	120	4	13	10
Iron, total recoverable (µg/L)	103	29,000	60	2,150	780
Iron, dissolved (µg/L)	103	190	<3	[2]17	10
Lead, total recoverable (µg/L)	103	200	<1	[2]14	5
Lead, dissolved (µg/L)	103	6	<.5	[2].5	<.6
Manganese, total recoverable (µg/L)	103	4,600	30	319	180
Manganese, dissolved (µg/L)	103	400	1	44	32
Zinc, total recoverable (µg/L)	103	1,700	10	124	70
Zinc, dissolved (µg/L)	103	230	<10	[2]16	11
Sediment, suspended concentration (mg/L)	153	2,250	2	89	25
Sediment, suspended discharge (ton/d)	153	8,690	.29	205	15
Sediment, suspended (percent finer than 0.062 mm)	144	99	40	70	70

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999					
Streamflow, instantaneous (ft^3/s)	84	2,080	21	313	198
Specific conductance, onsite (µS/cm)	72	300	120	221	215
Temperature, water (°C)	83	22	0.0	8.1	8.0
pH, onsite (standard units)	71	8.5	7.0	8.0	8.1
Hardness, total (mg/L as $CaCO_3$)	66	140	51	101	99
Calcium, dissolved (mg/L)	66	43	14	29	28
Magnesium, dissolved (mg/L)	66	9.4	3.3	6.8	6.8
Arsenic, total recoverable (µg/L)	71	17	4	7	6
Arsenic, dissolved (µg/L)	71	7	3	5	5
Cadmium, total recoverable (µg/L)	71	2	<1	[2].3	<1
Cadmium, dissolved (µg/L)	71	1	<.1	--	<.1
Copper, total recoverable (µg/L)	70	45	<1	[2]5	3
Copper, dissolved (µg/L)	71	7	<1	[2]2	2
Iron, total recoverable (µg/L)	71	25.000	20	1,330	310
Iron, dissolved (µg/L)	71	120	<3	[2]37	27
Lead, total recoverable (µg/L)	71	25	<1	[2]3	<5
Lead, dissolved (µg/L)	70	6	<.5	[2].5	<.6
Manganese, total recoverable (µg/L)	71	1,100	<10	[2]79	30
Manganese, dissolved (µg/L)	71	30	1	9	8
Zinc, total recoverable (µg/L)	71	140	<10	[2]15	<10
Zinc, dissolved (µg/L)	71	24	<1	[2]4	<20
Sediment, suspended concentration (mg/L)	84	1,410	1	58	10
Sediment, suspended discharge (ton/d)	84	7,920	.08	163	6.6
Sediment, suspended (percent finer than 0.062 mm)	84	97	49	74	78

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	59	3,920	87	902	620
Specific conductance, onsite (µS/cm)	58	496	207	358	368
Temperature, water (°C)	59	20.0	0.0	9.1	9.5
pH, onsite (standard units)	58	8.7	7.9	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	58	230	86	157	160
Calcium, dissolved (mg/L)	58	68	26	46	48
Magnesium, dissolved (mg/L)	58	15	5.1	10	10
Arsenic, total recoverable (µg/L)	58	75	8	18	14
Arsenic, dissolved (µg/L)	58	20	6	10	10
Cadmium, total recoverable (µg/L)	58	2	<1	--	<1
Cadmium, dissolved (µg/L)	58	.2	<.1	--	<.1
Copper, total recoverable (µg/L)	57	440	8	56	38
Copper, dissolved (µg/L)	57	36	3	8	7
Iron, total recoverable (µg/L)	58	12,000	60	1,220	680
Iron, dissolved (µg/L)	58	100	<3	[2]21	14
Lead, total recoverable (µg/L)	57	73	<1	[2]8	5
Lead, dissolved (µg/L)	57	.8	<.5	--	<.5
Manganese, total recoverable (µg/L)	58	1,100	30	157	116
Manganese, dissolved (µg/L)	58	43	10	21	20
Zinc, total recoverable (µg/L)	58	510	10	65	49
Zinc, dissolved (µg/L)	58	26	<3	[2]8	5
Sediment, suspended concentration (mg/L)	59	752	2	71	28
Sediment, suspended discharge (ton/d)	59	7,960	.94	360	47
Sediment, suspended (percent finer than 0.062 mm)	59	93	43	74	78

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	108	892	4.2	203	138
Specific conductance, onsite (µS/cm)	97	507	134	289	290
Temperature, water (°C)	106	21.0	0.0	8.7	9.0
pH, onsite (standard units)	94	8.8	7.5	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	87	260	59	136	140
Calcium, dissolved (mg/L)	87	73	16	37	37
Magnesium, dissolved (mg/L)	87	20	4.3	11	11
Arsenic, total recoverable (µg/L)	94	57	7	19	15
Arsenic, dissolved (µg/L)	94	20	5	9	8
Cadmium, total recoverable (µg/L)	94	3	<1	[2].2	<1
Cadmium, dissolved (µg/L)	94	.1	<.1	--	<.1
Copper, total recoverable (µg/L)	93	32	1	7	5
Copper, dissolved (µg/L)	94	7	<1	[2]2	2
Iron, total recoverable (µg/L)	94	7,200	70	1,020	572
Iron, dissolved (µg/L)	94	240	3	43	28
Lead, total recoverable (µg/L)	94	87	<1	[2]13	8
Lead, dissolved (µg/L)	94	7	<.5	[2].8	<1
Manganese, total recoverable (µg/L)	94	1,600	50	227	150
Manganese, dissolved (µg/L)	94	120	14	39	34
Zinc, total recoverable (µg/L)	94	290	<10	[2]43	30
Zinc, dissolved (µg/L)	94	27	<3	[2]6	3
Sediment, suspended concentration (mg/L)	108	556	3	55	30
Sediment, suspended discharge (ton/d)	106	904	.03	51	9.6
Sediment, suspended (percent finer than 0.062 mm)	108	98	28	80	84

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	59	3,860	149	1,260	907
Specific conductance, onsite (µS/cm)	58	630	189	384	392
Temperature, water (°C)	59	21.0	.5	10.1	11.0
pH, onsite (standard units)	58	8.5	7.8	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	58	300	74	173	180
Calcium, dissolved (mg/L)	58	83	21	50	52
Magnesium, dissolved (mg/L)	58	22	5.2	12	12
Arsenic, total recoverable (µg/L)	58	62	8	19	16
Arsenic, dissolved (µg/L)	58	20	7	11	10
Cadmium, total recoverable (µg/L)	58	2	<1	--	<1
Cadmium, dissolved (µg/L)	58	.2	<.1	--	<.1
Copper, total recoverable (µg/L)	56	360	5	56	33
Copper, dissolved (µg/L)	56	21	1	7	6
Iron, total recoverable (µg/L)	58	8,800	50	1,360	698
Iron, dissolved (µg/L)	58	150	<3	[2]23	11
Lead, total recoverable (µg/L)	54	56	<1	[2]11	5
Lead, dissolved (µg/L)	54	1.2	<.5	[2].3	<.5
Manganese, total recoverable (µg/L)	58	880	20	184	129
Manganese, dissolved (µg/L)	58	50	8	18	15
Zinc, total recoverable (µg/L)	58	490	<10	[2]85	50
Zinc, dissolved (µg/L)	58	21	<3	[2]8	6
Sediment, suspended concentration (mg/L)	59	530	2	85	40
Sediment, suspended discharge (ton/d)	59	4,720	1.9	475	103
Sediment, suspended (percent finer than 0.062 mm)	59	91	38	73	74

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	83	5,060	113	1,060	660
Specific conductance, onsite (µS/cm)	74	155	53	103	94
Temperature, water (°C)	83	18	0.0	8.0	8.0
pH, onsite (standard units)	73	8.8	6.9	7.9	7.9
Hardness, total (mg/L as $CaCO_3$)	65	90	22	48	43
Calcium, dissolved (mg/L)	65	23	5.9	13	11
Magnesium, dissolved (mg/L)	65	8.8	1.9	4.1	3.7
Arsenic, total recoverable (µg/L)	71	3	<1	[2].9	<1
Arsenic, dissolved (µg/L)	71	1	<1	[2]1	<1
Cadmium, total recoverable (µg/L)	71	3	<1	[2].4	<1
Cadmium, dissolved (µg/L)	71	1	<.1	--	<.1
Copper, total recoverable (µg/L)	69	41	<1	[2]4	2
Copper, dissolved (µg/L)	70	6	<1	[2]1	<1
Iron, total recoverable (µg/L)	71	2,100	20	357	180
Iron, dissolved (µg/L)	71	160	5	39	35
Lead, total recoverable (µg/L)	69	19	<1	[2]2	<5
Lead, dissolved (µg/L)	69	5	<.5	[2].6	<.6
Manganese, total recoverable (µg/L)	71	90	<10	[2]18	10
Manganese, dissolved (µg/L)	71	8	<1	[2]2	2
Zinc, total recoverable (µg/L)	71	60	<10	[2]9	<10
Zinc, dissolved (µg/L)	71	15	<3	[2]3	<3
Sediment, suspended concentration (mg/L)	83	223	1	25	7
Sediment, suspended discharge (ton/d)	83	3,050	.31	172	16
Sediment, suspended (percent finer than 0.062 mm)	83	95	35	69	69

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	156	9,560	296	1,950	1,170
Specific conductance, onsite (µS/cm)	131	483	140	306	327
Temperature, water (°C)	155	22.0	0.0	9.1	9.5
pH, onsite (standard units)	102	8.8	7.4	8.2	8.2
Hardness, total (mg/L as $CaCO_3$)	92	210	58	133	135
Calcium, dissolved (mg/L)	92	59	16	37	38
Magnesium, dissolved (mg/L)	92	14	3.9	9.4	9.4
Arsenic, total recoverable (µg/L)	101	110	5	11	8
Arsenic, dissolved (µg/L)	101	17	4	6	5
Cadmium, total recoverable (µg/L)	101	4	<1	[2].4	<1
Cadmium, dissolved (µg/L)	101	1	<.1	--	<.1
Copper, total recoverable (µg/L)	99	500	3	46	23
Copper, dissolved (µg/L)	100	25	2	6	4
Iron, total recoverable (µg/L)	101	19,000	53	1,400	530
Iron, dissolved (µg/L)	101	190	<3	[2]27	16
Lead, total recoverable (µg/L)	97	100	<1	[2]10	5
Lead, dissolved (µg/L)	97	7	<.5	[2].4	<.6
Manganese, total recoverable (µg/L)	101	2,000	10	161	90
Manganese, dissolved (µg/L)	101	37	1	9	7
Zinc, total recoverable (µg/L)	101	1,100	<10	[2]83	40
Zinc, dissolved (µg/L)	101	39	<3	[2]8	6
Sediment, suspended concentration (mg/L)	156	1,370	2	67	23
Sediment, suspended discharge (ton/d)	156	34,700	3.5	781	67
Sediment, suspended (percent finer than 0.062 mm)	145	98	27	72	72

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	114	13,400	344	2,820	1,340
Specific conductance, onsite (µS/cm)	91	294	130	204	200
Temperature, water (°C)	114	20.5	0.0	8.9	9.0
pH, onsite (standard units)	74	8.7	7.5	8.2	8.3
Hardness, total (mg/L as $CaCO_3$)	67	140	55	100	94
Calcium, dissolved (mg/L)	67	37	14	26	24
Magnesium, dissolved (mg/L)	67	13	4.9	8.8	8.3
Arsenic, total recoverable (µg/L)	74	4	<1	[2]1	1
Arsenic, dissolved (µg/L)	74	2	<1	[2].9	<1
Cadmium, total recoverable (µg/L)	74	2	<1	[2].4	<1
Cadmium, dissolved (µg/L)	74	1	<.1	--	<.1
Copper, total recoverable (µg/L)	71	34	<1	[2]7	5
Copper, dissolved (µg/L)	72	7	<1	[2]2	1
Iron, total recoverable (µg/L)	74	3,600	20	583	250
Iron, dissolved (µg/L)	74	100	<3	[2]20	14
Lead, total recoverable (µg/L)	70	25	<1	[2]4	1
Lead, dissolved (µg/L)	70	8	<.5	[2]1	<1
Manganese, total recoverable (µg/L)	74	180	<10	[2]38	20
Manganese, dissolved (µg/L)	74	11	<1	[2]3	2
Zinc, total recoverable (µg/L)	74	60	<10	[2]10	<10
Zinc, dissolved (µg/L)	74	15	<1	[2]3	<10
Sediment, suspended concentration (mg/L)	114	271	1	35	10
Sediment, suspended discharge (ton/d)	114	7,670	1.1	642	31
Sediment, suspended (percent finer than 0.062 mm)	112	98	42	79	81

Table 21. Statistical summary of water-quality data for the upper Clark Fork basin, Montana, March 1985 through September 1999 (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 1999**					
Streamflow, instantaneous (ft^3/s)	122	21,600	720	4,670	2,380
Specific conductance, onsite (µS/cm)	99	399	142	254	261
Temperature, water (°C)	119	19.5	0.0	9.0	8.5
pH, onsite (standard units)	79	8.7	7.9	8.3	8.3
Hardness, total (mg/L as $CaCO_3$)	79	170	61	117	120
Calcium, dissolved (mg/L)	79	46	14	31	32
Magnesium, dissolved (mg/L)	79	13	5.3	9.2	9.2
Arsenic, total recoverable (µg/L)	79	69	2	6	4
Arsenic, dissolved (µg/L)	79	9	1	3	3
Cadmium, total recoverable (µg/L)	79	5	<1	--	<1
Cadmium, dissolved (µg/L)	79	.1	<.1	--	<.1
Copper, total recoverable (µg/L)	77	400	2	19	8
Copper, dissolved (µg/L)	78	11	1	3	2
Iron, total recoverable (µg/L)	79	13,000	60	728	270
Iron, dissolved (µg/L)	79	200	<3	[2]25	16
Lead, total recoverable (µg/L)	74	78	<1	[2]4	2
Lead, dissolved (µg/L)	74	1	<.5	[2].6	<.5
Manganese, total recoverable (µg/L)	79	1,100	10	74	40
Manganese, dissolved (µg/L)	79	230	7	19	15
Zinc, total recoverable (µg/L)	79	1,100	<10	[2]37	20
Zinc, dissolved (µg/L)	79	16	<3	[2]5	3
Sediment, suspended concentration (mg/L)	122	824	2	41	12
Sediment, suspended discharge (ton/d)	122	21,900	6.1	1,130	66
Sediment, suspended (percent finer than 0.062 mm)	117	99	44	86	90

[1]Multiple less-than (<) values for an individual constituent are the result of changes in analytical laboratory 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 laboratory 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 1999

[Fine-grained bed sediment is material less than 0.064 millimeter in diameter. Reported concentrations are in micrograms per gram dry weight. Symbols: <, less than minimum reporting level; --, indicates 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: 1992-99					
Cadmium	8	42.0	23.7	31.1	28.2
Chromium	7	32.4	23.2	27.6	27.6
Copper	8	6,280	4,220	5,010	4,740
Iron	8	41,200	34,400	38,400	39.000
Lead	8	1,030	752	848	833
Manganese	8	3,940	1.680	2,540	2,440
Nickel	7	21.4	14.2	16.4	16.1
Silver	8	19.6	13.7	16.6	16.8
Zinc	8	10,800	6,660	8,060	7,570
12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT.					
Period of record for fine-grained bed-sediment data: 1992-99					
Cadmium	8	12.2	4.5	7.5	6.7
Chromium	7	34.1	12.8	22.7	23.6
Copper	8	769	223	434	351
Iron	8	27,200	19,500	22,100	20,800
Lead	8	100	58	76	74
Manganese	8	17,700	1,470	6,480	5,590
Nickel	7	19.1	12.5	15.5	15.7
Silver	8	2.1	.3	[1]1.4	[1]1.4
Zinc	8	2,220	620	1,160	830
12323770--WARM SPRINGS CREEK AT WARM SPRINGS, MONT.					
Period of record for fine-grained bed-sediment data: 1995, 1997					
Cadmium	3	3.9	1.3	2.6	2.6
Chromium	3	33.4	27.5	30.6	30.8
Copper	3	892	779	840	848
Iron	3	22,400	20,600	21,600	21,900
Lead	3	86	85	85	85
Manganese	3	8,790	2,020	5,610	6.030
Nickel	3	21.9	17.6	19.7	19.6
Silver	3	3.7	3.1	3.3	3.2
Zinc	3	421	372	396	396

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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, 1991-99					
Cadmium	10	20.1	4.0	10.4	9.2
Chromium	7	33.9	22.1	28.3	29.9
Copper	10	2,300	991	1,350	1,230
Iron	10	39,800	22,600	29,600	28,400
Lead	10	235	116	152	144
Manganese	10	15,600	2,780	8,460	7,440
Nickel	7	23.2	17.7	19.8	19.3
Silver	10	5.5	<3.2	[1]3.8	[1]3.7
Zinc	10	3,560	1,120	1,920	1,600
461415112450801--CLARK FORK BELOW LOST CREEK, NEAR GALEN, MONT					
Period of record for fine-grained bed-sediment data: 1996-99					
Cadmium	4	9.0	6.5	7.7	7.6
Chromium	4	34.5	27.5	31.7	32.5
Copper	4	2,050	1,360	1,650	1,580
Iron	4	32,700	30,800	31,600	31,600
Lead	4	197	168	182	182
Manganese	4	5,900	3,540	4,600	4,490
Nickel	4	19.9	17.8	18.8	18.7
Silver	4	7.0	4.2	5.9	6.2
Zinc	4	1,680	1,280	1,480	1,470
461559112443301--CLARK FORK NEAR RACETRACK, MONT.					
Period of record for fine-grained bed-sediment data: 1996-99					
Cadmium	4	8.5	5.0	6.6	6.5
Chromium	4	33.3	24.9	29.6	30.0
Copper	4	1,610	946	1,330	1,380
Iron	4	31,700	28,600	29,800	29,400
Lead	4	186	134	157	154
Manganese	4	4,030	2,390	3,060	2,900
Nickel	4	18.4	16.5	17.1	16.8
Silver	4	6.1	<3.3	[1]4.6	[1]5.4
Zinc	4	1,550	1,030	1,300	1,310
461903112440701--CLARK FORK AT DEMPSEY CREEK DIVERSION, NEAR RACETRACK, MONT.					
Period of record for fine-grained bed-sediment data: 1996-99					
Cadmium	4	8.1	4.3	6.0	5.9
Chromium	4	34.1	26.4	30.1	30.0
Copper	4	1,550	766	1,110	1,060
Iron	4	33,700	28,200	30,100	29,200
Lead	4	152	115	134	134
Manganese	4	3,910	1,810	2,760	2,660
Nickel	4	16.9	15.1	16.1	16.3
Silver	4	6.2	2.7	4.7	4.9
Zinc	4	1,570	900	1,160	1,080

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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, 1990-99					
Cadmium	12	9.0	4.4	6.8	6.8
Chromium	7	43.9	19.5	33.1	35.4
Copper	12	4,180	837	1,510	1,140
Iron	12	35,300	22,600	28,700	29,500
Lead	12	242	121	161	157
Manganese	12	6,020	1,460	2,820	2,380
Nickel	7	21.1	15.0	17.8	17.6
Silver	12	7.9	2.4	4.7	4.5
Zinc	12	1,730	977	1,340	1,350
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: 1992-99					
Cadmium	8	6.2	3.5	5.4	5.7
Chromium	7	48.9	29.4	35.8	34.5
Copper	8	1,080	653	833	786
Iron	8	30,600	20,500	25,900	25,800
Lead	8	152	88	114	119
Manganese	8	2,610	1,180	1,940	1,810
Nickel	7	18.6	15.0	16.8	17.0
Silver	8	4.8	2.3	3.5	3.5
Zinc	8	1,320	1,070	1,160	1,140
12331500--FLINT CREEK NEAR DRUMMOND, MONT.					
Period of record for fine-grained bed-sediment data: 1986, 1989, 1992-99					
Cadmium	10	4.5	<.2	[1]2.3	[1]2.4
Chromium	7	29.2	20.4	24.7	24.3
Copper	10	73	55	62	63
Iron	10	28,100	21,100	24,100	23,500
Lead	10	240	150	180	176
Manganese	10	5,510	2,370	3,790	3,740
Nickel	7	14.9	11.7	13.1	12.7
Silver	9	7.8	5.0	6.3	6.4
Zinc	10	777	577	666	661

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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, 1991-99					
Cadmium	11	5.4	2.6	4.4	4.3
Chromium	7	35.4	17.0	30.0	32.6
Copper	11	747	469	560	551
Iron	11	27,000	16,500	22,900	23,800
Lead	11	135	83	101	99
Manganese	11	2,780	1,220	1,850	1,880
Nickel	7	16.8	15.6	15.6	15.7
Silver	11	4.7	<3.2	[1]3.0	[1]2.9
Zinc	11	1,230	939	1,080	1,100
12334510--ROCK CREEK NEAR CLINTON, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 1989, 1991-99					
Cadmium	12	<1.5	<.2	[1]--	[1]<.8
Chromium	7	27.9	16.5	22.6	21.4
Copper	12	16	3	12	14
Iron	12	21,400	13,100	18,100	18,500
Lead	12	16	<3	[1]8	[1]8
Manganese	12	724	126	405	403
Nickel	7	14.8	10.8	12.9	13.0
Silver	11	.8	<.3	[1].4	[1]<.5
Zinc	12	58	36	48	48
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.					
Period of record for fine-grained bed-sediment data: 1986, 1991-99					
Cadmium	10	5.2	3.1	3.8	3.7
Chromium	7	34.7	15.3	26.4	27.7
Copper	10	635	300	420	384
Iron	10	24,400	15,100	20,400	22,000
Lead	10	115	49	80	80
Manganese	10	2,270	671	1,260	1,200
Nickel	7	19.1	11.6	15.3	16.2
Silver	10	3.9	1.0	2.2	2.2
Zinc	10	1,160	775	941	913
12340000--BLACKFOOT RIVER NEAR BONNER, MONT.					
Period of record for fine-grained bed-sediment data: 1986-87, 1991, 1993-96, 1998-99					
Cadmium	9	<1.5	<.2	[1]--	[1]<.7
Chromium	6	25.8	15.1	20.7	21.8
Copper	9	27	16	22	21
Iron	9	20,200	17,100	17,100	18,100
Lead	9	20	<13	[1]12	[1]11
Manganese	9	672	298	500	497
Nickel	6	14.3	11.7	13.0	13.0
Silver	9	.7	<.3	[1].4	[1]<.5
Zinc	9	73	54	63	63

Table 22. Statistical summary of fine-grained bed-sediment data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12340500--CLARK FORK ABOVE MISSOULA, MONT.					
Period of record for fine-grained bed-sediment data: 1997-99					
Cadmium	3	3.7	1.5	2.5	2.3
Chromium	3	30.6	20.8	26.6	28.5
Copper	3	516	219	339	282
Iron	3	24,300	20,400	22,200	21,800
Lead	3	63	47	57	60
Manganese	3	1,370	1,160	1,270	1,290
Nickel	3	15.8	14.5	15.1	15.0
Silver	2	2.9	<3.2	[1]1.8	[1].8
Zinc	3	924	547	722	696
12353000--CLARK FORK BELOW MISSOULA, MONT.[2]					
Period of record for fine-grained bed-sediment data: 1986, 1990-99					
Cadmium	11	2.6	1.1	1.7	1.8
Chromium	7	27.6	17.2	22.2	21.5
Copper	11	293	98	163	141
Iron	11	21,100	14,500	18,600	19,500
Lead	11	58	12	38	38
Manganese	11	2,530	752	1,440	1,270
Nickel	7	14.1	11.8	13.0	13.3
Silver	11	2.1	.4	1.2	1.3
Zinc	11	675	319	430	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 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 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1999

[Bulk bed sediment is material smaller than about 10 mm in diameter. Reported concentrations are in micrograms per gram dry weight. Symbols: <, less than minimum reporting level; --, indicates 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, 1997-99					
Cadmium	6	12.7	4.2	7.1	6.1
Chromium	6	16.2	9.6	12.8	12.3
Copper	6	1,550	670	951	867
Iron	6	29,300	18,300	22,300	20,200
Lead	6	300	198	243	240
Manganese	6	1,670	504	847	743
Nickel	6	8.9	6.0	6.7	6.3
Silver	6	4.8	3.2	3.8	3.7
Zinc	6	3,420	1,720	2,160	1,900
12323750--SILVER BOW CREEK AT WARM SPRINGS, MONT.					
Period of record for bulk bed-sediment data: 1993, 1995-99					
Cadmium	6	1.7	<0.9	[1]1.0	[1].9
Chromium	6	11.8	9.1	10.3	10.0
Copper	6	111	20	59	54
Iron	6	12,300	7,200	10,100	10,300
Lead	6	33	<10	[1]15	[1]11
Manganese	6	1,000	209	698	776
Nickel	6	9.2	4.8	6.4	5.5
Silver	6	1.3	<.3	[1].5	[1].6
Zinc	6	303	93	177	147
12327700--WARM SPRINGS CREEK AT WARM SPRINGS, MONT.					
Period of record for bulk bed-sediment data: 1995, 1997, 1999					
Cadmium	3	1.0	<.8	[1].6	[1]<.9
Chromium	3	12.0	9.7	11.2	11.8
Copper	3	238	203	215	205
Iron	3	12,700	8,980	10,900	10,900
Lead	3	38	18	30	34
Manganese	3	2,650	1,220	2,100	2,440
Nickel	3	8.5	5.7	7.3	7.8
Silver	3	1.1	<.8	[1].8	[1].9
Zinc	3	275	146	190	148

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1999 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12323800--CLARK FORK NEAR GALEN, MONT.					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	6.0	<.9	[1]3.0	[1]2.6
Chromium	7	23.0	4.2	13.6	14.8
Copper	7	685	223	392	318
Iron	7	31,300	9,930	20,400	20,600
Lead	7	158	41	76	64
Manganese	7	5,410	900	2,000	1,540
Nickel	7	12.5	4.9	7.7	6.9
Silver	7	1.9	.7	[1]1.3	[1]1.6
Zinc	7	1,280	417	671	653
461415112450801--CLARK FORK BELOW LOST CREEK, NEAR GALEN, MONT					
Period of record for bulk bed-sediment data: 1996-99					
Cadmium	4	3.1	<.9	[1]2.0	[1]2.2
Chromium	4	17.5	9.3	13.0	12.5
Copper	4	763	238	463	426
Iron	4	21,000	12,600	16,700	16.600
Lead	4	104	41	74	75
Manganese	4	1,740	1,260	1,420	1,340
Nickel	4	8.2	4.2	6.7	7.2
Silver	4	2.8	<3.4	[1]1.9	[1]1.9
Zinc	4	787	365	577	577
461559112443301--CLARK FORK NEAR RACETRACK, MONT.					
Period of record for bulk bed-sediment data: 1996-99					
Cadmium	4	3.4	<.9	[1]2.0	[1]2.0
Chromium	4	16.4	12.4	14.0	13.7
Copper	4	594	361	442	407
Iron	4	19,700	16,200	18,000	18,000
Lead	4	87	66	77	77
Manganese	4	1.680	759	1,300	1,390
Nickel	4	9.9	5.5	7.3	6.9
Silver	4	2.6	<3.2	[1]1.9	[1]1.7
Zinc	4	743	472	594	581
461903112440701--CLARK FORK AT DEMPSEY CREEK DIVERSION, NEAR RACETRACK, MONT.					
Period of record for bulk bed-sediment data: 1996-99					
Cadmium	4	3.9	1.5	2.5	2.4
Chromium	4	20.9	13.0	16.9	16.8
Copper	4	651	244	474	501
Iron	4	25,400	16,400	20,700	20,500
Lead	4	89	47	70	73
Manganese	4	1,940	825	1,380	1,360
Nickel	4	12.8	5.5	8.7	8.2
Silver	4	2.8	<.8	[1]1.7	[1]1.8
Zinc	4	804	368	556	526

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1999 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12324200--CLARK FORK AT DEER LODGE, MONT.					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	3.1	1.0	2.2	2.1
Chromium	7	24.5	12.1	17.4	16.1
Copper	7	691	281	424	383
Iron	7	25,000	13,200	18,700	17,900
Lead	7	85	45	71	74
Manganese	7	2,060	653	1,090	1,020
Nickel	7	12.3	7.7	9.6	10.1
Silver	7	2.8	<.7	[1]1.5	[1]1.6
Zinc	7	777	456	565	529
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: 1993-99					
Cadmium	7	5.2	1.1	3.0	2.4
Chromium	7	33.2	17.6	23.3	21.1
Copper	7	858	243	464	370
Iron	7	24,900	15,500	19,400	18,600
Lead	7	86	46	65	71
Manganese	7	2,600	554	1,220	1,191
Nickel	7	15.9	9.1	12.0	12.0
Silver	7	3.7	<.7	[1]1.8	[1]1.6
Zinc	7	1,020	525	717	676
12331500--FLINT CREEK NEAR DRUMMOND, MONT.					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	3.2	<.2	[1]1.2	[1].9
Chromium	7	13.9	4.9	9.8	10.7
Copper	7	40	18	27	25
Iron	7	15,700	8,630	12,900	13,400
Lead	7	120	51	82	80
Manganese	7	3,200	1,150	2,230	2,240
Nickel	7	8.0	4.5	6.0	5.9
Silver	7	5.8	3.3	4.4	4.1
Zinc	7	429	190	302	325

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1999 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12331800--CLARK FORK NEAR DRUMMOND, MONT.					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	3.9	<1.6	[1]2.0	[1]1.8
Chromium	7	29.5	13.8	21.0	20.1
Copper	7	605	173	314	235
Iron	7	21,800	14,100	17,200	16,300
Lead	7	78	35	53	50
Manganese	7	1,510	711	1.110	1.140
Nickel	7	14.2	9.0	11.2	10.4
Silver	7	3.5	.5	[1]1.7	[1]1.6
Zinc	7	939	434	646	603
12334510--ROCK CREEK NEAR CLINTON, MONT.					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	<1.5	<.2	[1]--	[1]<.8
Chromium	7	14.3	6.4	9.1	8.8
Copper	7	7	3	5	5
Iron	7	11,100	5,290	8.040	7.410
Lead	7	<13	<3	[1]5	[1]5
Manganese	7	265	72	170	186
Nickel	7	8.2	3.6	5.5	5.1
Silver	7	<1.6	.1	[1].3	[1].3
Zinc	7	29	10	18	17
12334550--CLARK FORK AT TURAH BRIDGE, NEAR BONNER, MONT.					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	2.9	.4	[1]1.4	[1]1.6
Chromium	7	23.8	6.9	15.1	15.5
Copper	7	336	75	189	182
Iron	7	19,100	9,270	13,400	13,200
Lead	7	67	21	37	35
Manganese	7	1,470	234	650	414
Nickel	7	14.0	6.4	9.4	8.8
Silver	7	2.9	<.3	[1]1.0	[1].4
Zinc	7	769	271	475	508
12340000--BLACKFOOT RIVER NEAR BONNER, MONT.					
Period of record for bulk bed-sediment data: 1993-94					
Cadmium	3	<1.2	<.2	[1]--	[1]<.8
Chromium	3	17.7	6.7	11.0	8.7
Copper	3	19	12	15	14
Iron	3	16,600	10,300	12,800	11,500
Lead	3	10	6	8	8
Manganese	3	305	179	230	207
Nickel	3	9.8	7.5	8.3	7.6
Silver	3	<.7	<.4	[1]--	[1]<.5
Zinc	3	58	33	42	34

Table 23. Statistical summary of bulk bed-sediment data for the upper Clark Fork basin, Montana, August 1993 through August 1999 (Continued)

Constituent	Number of samples	Maximum	Minimum	Mean	Median
12340500--CLARK FORK ABOVE MISSOULA, MONT.					
Period of record for bulk bed-sediment data: 1997-99					
Cadmium	3	<1.6	.4	[1].5	<.8
Chromium	3	18.2	9.7	12.7	10.2
Copper	3	129	43	81	72
Iron	3	16,000	11,500	13,800	13,800
Lead	3	30	7	18	18
Manganese	3	810	228	530	553
Nickel	3	10.3	8.2	9.2	9.2
Silver	3	<3.3	<.4	[1].8	[1].6
Zinc	3	387	145	265	263
12353000--CLARK FORK BELOW MISSOULA, MONT.[2]					
Period of record for bulk bed-sediment data: 1993-99					
Cadmium	7	<1.5	<.2	[1].5	[1]<.5
Chromium	7	12.6	4.4	7.4	6.8
Copper	7	77	16	40	30
Iron	7	11.300	5,830	8,230	8,420
Lead	7	19	<10	[1]8	[1]6
Manganese	7	444	150	332	368
Nickel	7	7.1	3.5	5.1	4.5
Silver	7	<1.6	<.3	[1].4	[1].4
Zinc	7	172	58	112	101

[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 1999

[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	Median
12323600--SILVER BOW CREEK AT OPPORTUNITY, MONT.					
Period of record for biological data: 1992, 1994-95, 1997-99					
		***Brachycentrus* spp.**			
Cadmium	3	12.5	5.8	10.0	11.6
Chromium	3	1.1	.7	.8	.7
Copper	3	846	587	675	592
Iron	3	730	335	476	363
Lead	3	17.9	7.4	11.1	7.9
Manganese	3	503	231	364	357
Nickel	3	1.9	<.1	1.0	1.0
Zinc	3	888	629	735	687
		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: 1992-99					
		Hydropsyche cockerelli			
Cadmium	21	2.1	.2	.8	.6
Chromium	21	1.3	.5	.8	.8
Copper	21	96.9	22.4	45.4	42.5
Iron	21	1,240	351	691	732
Lead	21	5.7	.3	3.3	3.0
Manganese	21	2,450	491	981	828
Nickel	21	1.8	.3	.8	.8
Zinc	21	276	115	184	174

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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: 1992-99					
		Hydropsyche occidentalis			
Cadmium	9	1.1	.2	.5	.3
Chromium	9	1.7	.3	.9	.9
Copper	9	46.5	22.8	32.4	29.7
Iron	9	1,040	372	744	764
Lead	9	4.3	<2.3	[1]3.4	[1]3.6
Manganese	9	2,250	1,200	1,760	1,780
Nickel	9	1.8	.7	1.1	1.0
Zinc	9	202	149	175	174
		***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, 1999					
		Arctopsyche grandis			
Cadmium	3	2.4	1.9	2.2	2.1
Chromium	3	2.9	1.4	2.0	1.8
Copper	3	102	95.6	98.9	98.8
Iron	3	1,040	684	866	872
Lead	3	5.6	<6.3	[1]4.4	<8.7
Manganese	3	2,280	1,340	1,810	1,800
Nickel	3	<7.0	1.8	[1]2.5	2.3
Zinc	3	222	180	200	197
		Hydropsyche occidentalis			
Cadmium	2	.8	.7	.8	--
Chromium	2	3.2	3.2	3.2	--
Copper	2	183	181	182	--
Iron	2	2,070	1,950	2,010	--
Lead	2	8.2	6.7	7.4	--
Manganese	2	2,480	2,400	2,440	--
Nickel	2	3.3	3.0	3.2	--
Zinc	2	172	166	169	--
		***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 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12323800--CLARK FORK NEAR GALEN, MONT.					
Period of record for biological data: 1987, 1991-99					
		Hydropsyche cockerelli			
Cadmium	14	2.7	1.3	1.7	1.6
Chromium	14	3.3	.8	1.6	1.5
Copper	14	181	48.7	92.9	91.9
Iron	14	1,510	816	1,170	1,160
Lead	14	11.0	1.2	7.0	7.7
Manganese	14	2,950	1,070	1,920	1,840
Nickel	14	3.1	1.0	1.6	1.3
Zinc	14	299	136	209	210
		***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	28	1.7	.6	1.1	1.0
Chromium	28	6.6	.7	1.7	1.4
Copper	28	106	49.2	77.5	74.5
Iron	28	1,920	642	1,180	1,140
Lead	28	13.5	1.6	6.5	6.2
Manganese	28	4,070	1,220	2,340	2,170
Nickel	28	3.5	.8	1.5	1.4
Zinc	28	278	170	197	193
		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 1999 (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: 1996-99					
		Hydropsyche cockerelli			
Cadmium	5	2.8	2.2	2.4	2.3
Chromium	5	2.5	1.0	1.9	2.0
Copper	5	147	48.8	120	141
Iron	5	1,900	706	1,550	1,730
Lead	5	14.8	12.1	13.1	12.7
Manganese	5	1,850	1,230	1,520	1,590
Nickel	5	1.9	1.1	1.6	1.6
Zinc	5	250	151	218	231
		Hydropsyche occidentalis			
Cadmium	14	1.8	.9	1.3	1.6
Chromium	14	3.3	1.3	1.9	1.9
Copper	14	157	52.1	102	120
Iron	14	1,920	963	1,400	1,520
Lead	14	12.4	6.6	9.7	11.5
Manganese	14	3,440	1,270	2,280	1,850
Nickel	14	1.7	.9	1.3	1.5
Zinc	14	283	174	230	231
		***Hydropsyche* spp.**			
Cadmium	4	1.8	1.2	1.4	1.4
Chromium	4	2.4	.9	1.6	1.6
Copper	4	122	45.1	89.0	94.3
Iron	4	1,410	533	1,120	1,270
Lead	4	20.5	4.1	10.4	8.5
Manganese	4	1,980	799	1,490	1,590
Nickel	4	2.8	1.4	1.9	1.4
Zinc	4	225	143	183	183
461559112443301--CLARK FORK NEAR RACETRACK, MONT.					
Period of record for biological data: 1996-99					
		Hydropsyche cockerelli			
Cadmium	6	1.9	1.1	1.5	1.6
Chromium	6	2.7	.7	1.8	1.8
Copper	6	109	50.0	78.3	81.0
Iron	6	1,370	846	1,060	1,030
Lead	6	10.5	6.1	8.3	8.7
Manganese	6	1,690	646	1,090	963
Nickel	6	1.4	1.0	1.2	1.3
Zinc	6	199	139	172	177

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
461559112443301--CLARK FORK NEAR RACETRACK, MONT. --Continued					
Period of record for biological data: 1996-99					
		Hydropsyche occidentalis			
Cadmium	11	2.2	.7	1.3	1.4
Chromium	11	2.6	1.1	1.9	2.0
Copper	11	160	59.5	103	93.5
Iron	11	1,880	1,030	1,470	1,450
Lead	11	11.7	4.3	9.6	9.7
Manganese	11	3,480	1,090	2,030	2,100
Nickel	11	1.7	1.1	1.3	1.2
Zinc	11	255	181	225	229
		***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: 1996-99					
		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 1999 (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: 1996-99					
		Hydropsyche occidentalis			
Cadmium	12	1.7	.7	1.1	1.0
Chromium	12	2.0	1.2	1.7	1.8
Copper	12	163	74.9	98.1	87.1
Iron	12	1,660	1,100	1,480	1,500
Lead	12	13.8	9.7	11.3	11.3
Manganese	12	3,990	826	2,710	2,370
Nickel	12	2.4	1.2	1.5	1.4
Zinc	12	292	222	250	238
		***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, 1990-99					
		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	18	2.3	.8	1.4	1.3
Chromium	18	3.2	.4	1.7	1.8
Copper	18	136	54.7	94.6	100
Iron	18	3,340	490	1,170	1,050
Lead	18	18.2	4.3	9.4	8.9
Manganese	18	1,030	396	689	686
Nickel	18	2.4	.3	1.3	1.3
Zinc	18	391	132	183	180

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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, 1990-99					
		Hydropsyche occidentalis			
Cadmium	30	2.7	.8	1.3	1.3
Chromium	30	2.6	.6	1.9	1.9
Copper	30	162	49.5	111	110
Iron	30	1,930	558	1,420	1,460
Lead	30	16.2	3.5	10.9	10.8
Manganese	30	2,840	649	1,650	1,720
Nickel	30	12.9	1.0	1.9	1.5
Zinc	30	299	166	233	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	<1.2	<.4	[1]--	[1]<.6
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 1999 (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: 1992-99					
		Arctopsyche grandis			
Cadmium	21	6.6	1.4	2.7	2.5
Chromium	21	3.3	.8	1.4	1.0
Copper	21	129	28.8	57.9	55.6
Iron	21	2,360	339	817	610
Lead	21	10.9	2.3	4.5	3.7
Manganese	21	1,220	592	843	842
Nickel	21	1.8	.2	.8	.7
Zinc	21	326	165	217	190
		Claassenia sabulosa			
Cadmium	15	3.5	.6	1.6	1.1
Chromium	15	1.6	.3	.7	.6
Copper	15	81.7	33.0	55.7	56.2
Iron	15	296	63.0	174	178
Lead	15	1.7	.5	1.0	1.1
Manganese	15	179	50.6	101	91.6
Nickel	15	.7	.2	.3	.3
Zinc	15	296	166	247	258

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana. August 1986 through August 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12324680--CLARK FORK AT GOLDCREEK, MONT.--Continued					
Period of record for biological data: 1992-99					
Hydropsyche cockerelli					
Cadmium	14	2.6	.6	1.8	1.8
Chromium	14	4.7	.7	2.5	2.0
Copper	14	188	33.5	92.8	66.9
Iron	14	3,250	589	1,390	1,210
Lead	14	16.2	4.5	8.3	6.5
Manganese	14	954	538	719	670
Nickel	14	2.3	.6	1.4	1.3
Zinc	14	240	137	195	204
***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	14	1.7	.7	1.3	1.4
Chromium	14	3.9	.4	1.5	1.5
Copper	14	156	26.4	64.8	58.4
Iron	14	2,720	466	1,130	1,040
Lead	14	15.7	2.9	6.9	6.0
Manganese	14	1,800	530	1,090	1,020
Nickel	14	2.5	.8	1.2	1.1
Zinc	14	242	97	189	190
12331500--FLINT CREEK NEAR DRUMMOND, MONT.					
Period of record for biological data: 1986, 1992-99					
Arctopsyche grandis					
Cadmium	35	.8	.1	.4	.4
Chromium	35	4.7	.6	1.9	1.8
Copper	35	21.7	8.7	15.0	15.0
Iron	35	2,460	606	1,370	1,330
Lead	35	17.5	3.7	8.8	7.8
Manganese	35	2,480	679	1,470	1,340
Nickel	35	2.7	.6	1.3	1.3
Zinc	35	275	141	198	188

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12331500--FLINT CREEK NEAR DRUMMOND, MONT.--Continued					
Period of record for biological data: 1986, 1992-99					
		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* spp.**			
Cadmium	1	--	--	<.3	--
Chromium	1	--	--	1.4	--
Copper	1	--	--	12.5	--
Iron	1	--	--	1,440	--
Lead	1	--	--	4.5	--
Manganese	1	--	--	1,320	--
Nickel	1	--	--	1.3	--
Zinc	1	--	--	130	--
		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, 1991-99					
		Arctopsyche grandis			
Cadmium	24	3.8	.7	1.7	1.5
Chromium	24	2.5	.2	1.1	1.0
Copper	24	89.2	18.2	38.7	35.1
Iron	24	1,660	240	666	613
Lead	24	11.8	2.1	4.9	4.2
Manganese	24	2,010	462	884	736
Nickel	24	1.9	.2	.7	.7
Zinc	24	308	142	196	190

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12331800--CLARK FORK NEAR DRUMMOND, MONT.--Continued					
Period of record for biological data: 1986, 1991-99					
Claassenia sabulosa					
Cadmium	27	2.8	.3	1.4	1.5
Chromium	27	3.3	.3	.8	.6
Copper	27	130	18.0	66.7	63.2
Iron	27	380	76.0	161	127
Lead	27	2.9	.2	1.0	.8
Manganese	27	410	45.9	156	144
Nickel	27	1.1	.1	.3	.2
Zinc	27	469	140	271	248
Hydropsyche cockerelli					
Cadmium	18	2.3	.7	1.5	1.6
Chromium	18	3.5	.4	1.9	1.7
Copper	18	156	37.2	74.2	63.1
Iron	18	2,500	506	1,300	1,030
Lead	18	15.0	5.1	9.1	8.0
Manganese	18	982	549	762	753
Nickel	18	2.0	.5	1.2	1.2
Zinc	18	240	134	191	191
***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	14	2.0	.7	1.2	1.2
Chromium	14	8.1	.4	2.4	2.1
Copper	14	118	13.3	56.9	55.7
Iron	14	2,060	424	1,240	1,300
Lead	14	13.5	2.9	8.8	8.7
Manganese	14	2,920	619	1,510	1,210
Nickel	14	2.4	.5	1.4	1.6
Zinc	14	283	157	221	222
***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 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12334510--ROCK CREEK NEAR CLINTON, MONT.					
Period of record for biological data: 1987, 1991-99					
Arctopsyche grandis					
Cadmium	32	.4	.06	.2	.2
Chromium	32	2.9	.5	1.2	1.0
Copper	32	15.7	4.7	8.6	8.3
Iron	32	991	191	517	464
Lead	32	<2.9	.1	[1].4	[1].4
Manganese	32	454	113	249	226
Nickel	32	1.6	.2	.8	.9
Zinc	32	189	84	127	124
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 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12334510--ROCK CREEK NEAR CLINTON, MONT.--Continued					
Period of record for biological data: 1987, 1991-99					
***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, 1991-99					
Arctopsyche grandis					
Cadmium	32	2.7	.6	1.4	1.5
Chromium	32	4.1	.6	1.8	1.7
Copper	32	125	20.1	42.2	34.1
Iron	32	2,870	420	1,060	908
Lead	32	13.2	2.1	4.5	3.7
Manganese	32	893	351	625	625
Nickel	32	2.6	.4	1.1	.9
Zinc	32	276	152	201	197
Claassenia sabulosa					
Cadmium	23	2.5	.3	1.2	.9
Chromium	23	2.0	.4	.7	.6
Copper	23	79.2	38.3	56.9	54.4
Iron	23	181	58.6	105	102
Lead	23	1.6	.2	.6	.6
Manganese	23	139	42.0	78.1	69.6
Nickel	23	.6	.1	.2	.1
Zinc	23	283	144	221	230
Hydropsyche cockerelli					
Cadmium	21	1.7	.6	1.0	.9
Chromium	21	8.0	1.0	2.2	1.7
Copper	21	118	26.4	52.0	42.5
Iron	21	2,530	688	1,280	1,060
Lead	21	12.1	2.2	5.4	5.0
Manganese	21	788	426	584	560
Nickel	21	2.6	.6	1.2	1.2
Zinc	21	228	148	186	180

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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, 1991-99					
***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	16	1.8	.3	.9	.9
Chromium	16	3.1	.6	1.8	1.6
Copper	16	102	34.1	49.6	42.2
Iron	16	2,310	472	1,140	1,010
Lead	16	12.2	3.0	6.1	5.4
Manganese	16	1,510	454	756	672
Nickel	16	1.9	.6	1.1	1.0
Zinc	16	235	145	192	183
***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	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	143	123	134	135

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (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	.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 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12340500--CLARK FORK ABOVE MISSOULA, MONT.					
Period of record for biological data: 1997-99					
		Arctopsyche grandis			
Cadmium	11	1.8	.5	.9	.8
Chromium	11	3.0	1.3	1.7	1.7
Copper	11	77.6	22.3	36.9	36.8
Iron	11	2,340	708	1,160	1,050
Lead	11	6.8	1.2	3.3	3.3
Manganese	11	1,040	476	779	782
Nickel	11	2.0	.7	1.2	1.2
Zinc	11	235	155	187	177
		Claassenia sabulosa			
Cadmium	4	2.0	.6	1.3	1.3
Chromium	4	1.1	.4	.8	.9
Copper	4	61.9	37.8	47.9	46.0
Iron	4	246	95.0	167	163
Lead	4	3.1	.5	[1]1.4	[1].5
Manganese	4	136	75.2	107	109
Nickel	4	<1.3	<.3	[1]--	[1]<.7
Zinc	4	307	191	250	250
		Hydropsyche cockerelli			
Cadmium	6	1.3	.8	1.0	1.0
Chromium	6	4.1	2.1	3.2	3.2
Copper	6	96.1	40.4	66.6	64.7
Iron	6	3,590	1,900	2,450	2,250
Lead	6	6.3	5.3	5.8	5.9
Manganese	6	1,180	781	930	904
Nickel	6	2.4	1.4	2.0	2.1
Zinc	6	226	156	199	200
		Hydropsyche occidentalis			
Cadmium	4	1.1	.7	.9	.9
Chromium	4	3.2	2.8	3.0	3.0
Copper	4	76.5	46.5	57.2	52.9
Iron	4	2,400	2,010	2,220	2,220
Lead	4	7.7	5.0	6.5	6.6
Manganese	4	2,460	939	1,930	2,160
Nickel	4	2.3	1.9	2.1	2.2
Zinc	4	232	210	225	230
12353000--CLARK FORK BELOW MISSOULA, MONT.[2]					
Period of record for biological data: 1986, 1990-99					
		Arctopsyche grandis			
Cadmium	20	1.5	.3	.8	.8
Chromium	20	2.7	.5	1.4	1.4
Copper	20	38.0	9.4	22.0	20.3
Iron	20	1,500	343	810	832
Lead	20	3.2	.9	1.9	1.9
Manganese	20	1,090	511	713	710
Nickel	20	1.6	.4	.9	.9
Zinc	20	217	106	154	148

Table 24. Statistical summary of biological data for the upper Clark Fork basin, Montana, August 1986 through August 1999 (Continued)

Constituent	Number of composite samples	Maximum	Minimum	Mean	Median
12353000--CLARK FORK BELOW MISSOULA, MONT.[2]--Continued					
Period of record for biological data: 1986, 1990-99					
Claassenia sabulosa					
Cadmium	31	1.3	.2	.6	.6
Chromium	31	1.2	.05	.5	.5
Copper	31	66.4	31.1	47.5	47.1
Iron	31	240	66.6	109	101
Lead	31	1.3	.1	.4	.4
Manganese	31	168	48.9	99.9	99.3
Nickel	31	.3	.1	.2	.2
Zinc	31	286	146	209	203
Hydropsyche cockerelli					
Cadmium	28	1.1	.2	.5	.6
Chromium	28	3.4	.8	2.0	2.0
Copper	28	45.7	12.4	30.6	34.2
Iron	28	2,000	645	1,300	1,320
Lead	28	3.6	1.2	2.3	2.4
Manganese	28	1,180	353	720	663
Nickel	28	1.7	.5	1.2	1.3
Zinc	28	172	77.4	147	156
Hydropsyche occidentalis					
Cadmium	13	1.1	.2	.5	.5
Chromium	13	3.5	.2	1.5	1.6
Copper	13	38.2	18.9	26.1	27.6
Iron	13	1,420	482	959	1,000
Lead	13	4.2	.7	2.2	1.9
Manganese	13	1,460	575	859	812
Nickel	13	2.2	.5	1.0	.9
Zinc	13	193	112	142	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 and 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.