U.S. Department of the Interior
U.S. Geological Survey

Water-Quality, Biology, and Streambed Sediment Data and Preliminary Geochemical Interpretations for Streams in the Upper Prickly Pear Creek Watershed, Montana, 2000

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U.S. Geological Survey, Geologic Division, Open-File Report 01-280

In cooperation with the U.S. Department of Agriculture-Forest Service

[1] *Denver, Colorado*
[2] *Helena, Montana*
[3] *Jackson, Wyoming*

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CONVERSION FACTORS, ABBREVIATED UNITS, AND ACRONYMS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.028317	cubic meters per second (m^3/s)
foot (ft)	0.3048	meter (m)
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer

Temperature can be converted to degrees Celsius (°C) or degrees Fahrenheit (°F) by the following equations:

$$°C = 5/9\ (°F - 32)$$
$$°F = 9/5\ (°C) + 32$$

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Abbreviated units used in this report:

µg/L micrograms per liter
µm micrometer (micron)
µS/cm microsiemens per centimeter at 25 degrees Celsius
mg/L milligrams per liter
mm millimeter

INTRODUCTION

The upper Prickly Pear Creek watershed encompasses the upstream 15 miles of Prickly Pear Creek, south of Helena, Montana (fig. 1). The headwaters of Prickly Pear Creek and its tributaries (Beavertown Creek, Clancy Creek, Dutchman Creek, Golconda Creek, Lump Gulch, Spring Creek, and Warm Springs Creek) are primarily in the Helena National Forest, whereas the central part of the watershed primarily is within either Bureau of Land Management (BLM) or privately owned property. Three mining districts are in the upper Prickly Pear Creek watershed: Alhambra, Clancy, and Colorado. Numerous prospects, adits, tailings piles, mills, dredge piles, and mines (mostly inactive) are located throughout the watershed.

Hard-rock mining in the upper Prickly Pear Creek watershed began in the 1860s, peaked prior to 1900, and has been sporadic since then (Metesh and others, 1993). Gold, silver, lead, copper, zinc, and arsenic were the primary metals produced (Metesh and others, 1993). Previous investigations have identified large concentrations of metals in parts of Prickly Pear Creek and some of its tributaries ([Montana] Department of Health and Environmental Sciences, 1981; David Stiller and Assoc., OEA Research, 1983; Grotbo and Stiller, 1984; Streamworks, 1984; Olympus Environmental Science and Engineering, Inc., 1998; Harper, 1999; Olympus Technical Services, Inc., 2000). However, these investigations did not address the cumulative effects of mining at a watershed scale.

As part of a cooperative effort with Federal land management agencies, the U.S. Geological Survey (USGS) is currently using an integrated approach to investigate two mining impacted watersheds in the western United States (the Animas River in Colorado and the Boulder River in Montana). These studies provide the USDA-Forest Service (USFS) and USDOI Bureau of Land Management (BLM) scientific data for implementing informed land-management decisions regarding cleanup of abandoned mine lands within each watershed. A similar integrated-science approach will be used to characterize the upper Prickly Pear Creek watershed with respect to water and streambed-sediment chemistry, aquatic biota, and the geologic and geochemical framework. This integrated database and preliminary stream bed-sediment interpretations can be used to identify important pathways of metals movement and biological impacts, thereby guiding resource-management decisions of land management agencies. Watershed-level characterization will facilitate determinations of whether removal of contaminated materials or other cleanup activities are necessary, planning of short- and long-term restoration efforts, and development of a monitoring plan to document cleanup effectiveness.

WATER-QUALITY DATA FOR STREAMS IN THE UPPER PRICKLY PEAR CREEK WATERSHED, MONTANA

By Joanna N. Thamke *and* Sharon L. Gelinas

INTRODUCTION

This section presents hydrologic data that were collected by the in the upper Prickly Pear Creek watershed during the period June through October 2000. Data presented include measurements of streamflow quantity and quality, and quality-assurance data.

A site number is used as the primary identification for sample sites (fig. 1, table 1). This alpha-numeric identification allows cross reference between tables and figures. The alpha character denotes the first letter of the stream name. The numeric characters denote the downstream sequence, beginning at the most upstream site. In addition, each site is assigned an eight-digit or fifteen-digit station-identification number (table 1). Eight-digit station-identification numbers represent the standard USGS numbering system for streamflow-gaging stations or routine streamflow-measurement sites. Fifteen-digit station-identification numbers are used for miscellaneous or temporary surface-water stations. The fifteen-digit numbers represent the approximate latitude and longitude of the site (first 13 digits), plus the sequence number (last 2 digits).

WATER-QUALITY DATA

Water-quality samples were collected at 37 sites (table 1, fig. 1) from June through October 2000. Water-quality data for field parameters (specific conductance, pH), hardness, selected trace elements, and suspended sediment are presented in Appendix 1. Sample sites were located throughout the watershed. Five of the sites (C5, L5, PP-3, PP-5, and WS-3) were sampled periodically as part of a routine sampling program to characterize seasonal variability in water quality, including a more comprehensive analysis of trace element concentrations (Appendix 2).

Sampling and Processing Methods

Composite water samples for measurements of physical properties and analyses of chemical constituents were collected from multiple verticals across the stream using depth- and width-integration methods described by Knapton (1999) and Edwards and Glysson (1999). These methods provide an instantaneous mean discharge-weighted sample that is representative of the entire stream. Sampling equipment consisted of standard USGS depth-integrating suspended samplers (DH-81 and DH-48), which are constructed of plastic or coated with non-metallic epoxy paint, and equipped with a $^{5}/_{16}$-inch nylon nozzle (Edwards and Glysson, 1999). Grab samples were collected when streamflow was too low to allow use of the depth-integrated sampler.

Figure 1. Location of the upper Prickly Pear Creek watershed and sampling site, Montana

Table 1. Water-quality sampling sites in the upper Prickly Pear Creek watershed, Montana, 2000

Site number (fig. 1)	Station identification number	Station name	Altitude (feet)	Latitude d	Latitude m	Latitude s	Longitude d	Longitude m	Longitude s	Topographic map
B-1	462234112014001	Beavertown Creek above Prickly Pear Creek, near Jefferson City	4,642	46	22	34	112	01	50	Jefferson City
C-1	462421112105101	Unnamed tributary above South Fork Quartz Creek, near Jefferson City	6,460	46	24	17	112	10	57	Chessman Reservoir
C-2	462429112080301	Quartz Creek above Clancy Creek, near Jefferson City	5,400	46	24	29	112	08	04	Chessman Reservoir
C-3	462308112082901	Kady Gulch above Clancy Creek, near Jefferson City	5,760	46	23	08	112	08	29	Chessman Reservoir
C-4	462417112070801	Clancy Creek above Quartz Creek, near Jefferson City	5,226	46	24	08	112	07	10	Jefferson City
C-5	462449112064301	Clancy Creek below Quartz Creek, near Jefferson City[1, 2, 3, 4]	5,040	46	24	40	112	06	50	Jefferson City
C-6	06060000	Clancy Creek at Clancy, Mont.	4,223	46	27	57	111	59	08	Clancy
D-1	462500111595901	Dutchman Creek above Prickly Pear Creek, near Jefferson City	4,418	46	25	00	111	59	59	Clancy
G-1	462156112002301	Golconda Creek, above Prickly Pear Creek, near Jefferson City	4,800	46	21	56	112	00	23	Wickes
L-1	462544112122201	Lump Gulch above meadows, near Clancy	6,690	46	25	45	112	12	22	Chessman Reservoir
L-2	462633112122701	Lump Gulch above Nellie Grant Mill, near Clancy	6,960	46	26	29	112	12	23	Chessman Reservoir
L-3a	462603112112101	Lump Gulch tributary 1 below Frohner Meadow, near Clancy [2, 3]	6,480	46	26	03	112	11	21	Chessman Reservoir
L-3b	462612112111501	Lump Gulch tributary 2 below Frohner Meadows, near Clancy [2]	6,480	46	26	12	112	11	16	Chessman Reservoir
L-3c	462609112103201	Lump Gulch above Park Lake, near Clancy [2, 3]	6,200	46	26	07	112	10	36	Chessman Reservoir
L-4	462615112102201	Lump Gulch below Park Lake, near Clancy	6,190	46	26	12	112	10	20	Chessman Reservoir
L-5	462733112062201	Lump Gulch above Corral Gulch, near Clancy[1, 2, 3, 4]	5,120	46	27	27	112	06	24	Jefferson City
L-6	462733112061701	Corral Gulch above Lump Gulch, near Clancy	5,120	46	27	37	112	06	19	Jefferson City
L-7	462840112042701	Lump Gulch above Buffalo Creek, near Clancy [2, 3]	4,640	46	28	39	112	04	30	Jefferson City
L-8	462841112042601	Buffalo Creek above Lump Gulch, near Clancy [3]	4,640	46	28	43	112	04	27	Jefferson City
L-9	462900112020001	Lump Gulch below Little Buffalo Gulch, near Clancy	4,360	46	29	05	112	02	16	Jefferson City
PP-1	462134111582301	Prickly Pear Creek above Golconda Creek, near Jefferson City [2, 3, 4]	5,360	46	21	33	111	58	12	Elkhorn
PP-2	462228112012101	Prickly Pear Creek above Beavertown Creek, near Jefferson City	4,680	46	22	27	112	01	26	Wickes
PP-3	462352112010201	Prickly Pear Creek near Jefferson City[1, 2, 3, 4]	4,480	46	24	07	112	00	52	Jefferson City
PP-4	462718111590501	Prickly Pear Creek at Alhambra RV Park, near Clancy [3]	4,240	46	27	18	111	59	03	Clancy
PP-5	06061500	Prickly Pear Creek near Clancy[1, 2, 3]	4,067	46	31	09	111	56	45	East Helena
S-1	462052112100001	Wood Chute Gulch above Spring Creek, near Jefferson City	6,530	46	20	52	112	10	00	Mt. Thompson
S-1a	462122112094301	Curtain Gulch above Wood Chute Gulch near Jefferson City	6,750	46	21	22	112	09	43	Mt. Thompson

Table 1. Water-quality sampling sites in the upper Prickly Pear Creek watershed, Montana, 2000 (Continued)

Site number (fig. 1)	Station identification number	Station name	Altitude (feet)	Latitude d	Latitude m	Latitude s	Longitude d	Longitude m	Longitude s	Topographic map
S-2	462025112075501	Spring Gulch above Spring Creek, near Jefferson City	5,640	46	20	28	112	07	56	Mt. Thompson
S-3	462234112031201	Spring Creek above Prickly Pear Creek, near Jefferson City	4,800	46	22	35	112	03	48	Jefferson City
S-4	462320112012901	Spring Creek at Jefferson City	4,558	46	23	20	112	01	38	Jefferson City
WS-1	462509111530001	Middle Fork Warm Springs Creek above mines, near Clancy	5,600	46	25	10	111	53	02	Clancy
WS-2	462502111533801	Middle Fork Warm Springs Creek below mines, near Clancy [3]	5,381	46	25	02	111	53	38	Clancy
WS-2a	462504111534901	Middle Fork Warm Springs Creek below tailings, near Clancy	5,295	46	25	04	111	53	49	Clancy
WS-3	462521111552101	Middle Fork Warm Springs Creek near Clancy[1, 3, 4]	4,800	46	25	21	111	55	40	Clancy
WS-4	462528111554301	North Fork Warm Springs Creek above Warm Springs Creek, near Clancy	4,801	46	25	29	111	55	44	Clancy
WS-5	462511111563301	South Fork Warm Springs Creek near Clancy	4,594	46	25	11	111	56	44	Clancy
WS-7	462635111575701	Warm Springs Creek above Prickly Pear Creek, near Clancy [2, 3]	4,500	46	26	33	111	58	01	Clancy

[1]Site sampled periodically as part of routine water quality sampling program.
[2]Site sampled as part of biology sampling program ñ aquatic vegetation.
[3]Site sampled as part of biology sampling program ñ benthic macroinvertebrates.
[4]Site sampled as part of biology sampling program ñ fish tissues.
NOTE: Biofilm (*aufwuchs*) samples also collected from sites PP4 and WS7.

Field measurements of specific conductance, pH, and water temperature were made during sample collection. Samples were processed according to procedures described by Horowitz and others (1994), Ward and Harr (1990), and Knapton (1985). Samples for dissolved constituents were filtered using a 0.45-µm pore size filter. Instantaneous streamflow at the time of sample collection was determined by stage-discharge rating at PP-5 (gage station) and by direct measurement (Rantz and others, 1982) at all other sites.

Laboratory Analysis

Trace elements selected for analysis were similar to those analyzed for another abandoned mine lands study in the Boulder River watershed, Montana. Trace elements in the Boulder River watershed that consistently had concentrations less than the minimum reporting level (Nimick and Cleasby, 2000) were not analyzed. Analysis of an extensive suite of trace elements from five periodic sites in October 2000 confirmed non-detectable concentrations for the omitted elements in the upper Prickly Pear Creek watershed (table 3).

The USGS National Water Quality Laboratory (NWQL) in Denver, Colo., analyzed water samples for trace elements according to methods described by Fishman and Freidman (1989), Patton and Truitt (1992), Faires (1993), Fishman (1993), Hoffman and others (1996), Garbarino and Struzeski (1998), Garbarino (1999), and Jones and Garbarino (1999). The USGS Montana District sediment laboratory in Helena, Mont., analyzed water samples for suspended-sediment concentration and the percentage of suspended sediment finer than 0.062-mm diameter (silt size and smaller) according to methods described by Guy (1969) and Lambing and Dodge (1993).

Quality-Assurance Data

Data-collection and analytical procedures used in this study incorporate practices designed to control, verify, and assess the quality of sample data. Quality-assurance procedures used for the collection and field processing of water-quality samples are described by Knapton (1985), Ward and Harr (1990), Knapton and Nimick (1991), Horowitz and others (1994), and Edwards and Glysson (1999). 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 (1995). The Montana District sediment laboratory uses quality-assurance procedures described by Lambing and Dodge (1993).

Duplicate samples are two samples considered essentially identical in composition. Duplicate samples were obtained in the field by splitting a single sample into two subsamples, which then were analyzed separately. Analyses of field duplicates are presented in Appendix 3.

A blank sample of deionized water was 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. A field blank is an aliquot of deionized water, which is certified as trace element free and is processed through the sampling equipment used to collect stream samples. The blank is then subjected to the same processing (filtration, preservation, transportation, and laboratory handling) as stream samples. The blank sample was analyzed for the same constituents as those of stream samples to identify whether any detectable concentrations exist. Analytical results for a field blank are presented in Appendix 4.

The USGS NWQL collects quality-control data on a continuing basis to evaluate selected analytical methods to determine laboratory reporting levels (LRL's). Accordingly, concentrations are reported as <LRL for samples in which the analyte was either not detected or did not pass identification. Analytes that are detected at concentrations less than LRL and that pass identification criteria are estimated. Estimated concentrations will be noted with a remark code of "E." These data should be used with the understanding that their uncertainty is greater than that of data reported without the "E" remark code.

STREAMBED SEDIMENT DATA AND PRELIMINARY GEOCHEMICAL INTERPRETATION FOR STREAMS IN THE UPPER PRICKLY PEAR CREEK WATERSHED, MONTANA

By Terry L. Klein and David L. Fey

INTRODUCTION

This section presents descriptions of sample sites, geochemical data, and preliminary data interpretations of a streambed sediment sampling program and a reconnaissance dissolved- and suspended- mercury in water survey undertaken in early October 2000. This sampling program was designed to examine the concentrations of ore-related metals in streambed sediment and to understand their sources. The mercury survey was undertaken to determine whether mercury transport was occurring in stream water. The results of re-analyses of streambed sediments from an earlier Department of Energy sampling program by more sensitive methods are also tabulated. These samples were collected during the mid-1970's as part of the National Uranium Resource Evaluation (NURE) program (Aamodt, 1978; Broxton, 1980).

Chemical concentrations in streambed sediments represent: 1) the composition of the underlying bedrock and glacial deposits at and above the sample site 2) input from natural or anthropogenic point sources, for example naturally outcropping mineral deposits, or abandoned or active mines and mills. These sediments represent a time-integrated view of the chemical input from these sources. Stream water chemistry is related to interaction of water with bedrock and its weathering products such as soil and streambed sediment; many of the process are governed by the pH (acidity) and Eh (oxidation potential) of the water. One important intermediate source of metal in water is metal loosely held in colloidal sediment grain coatings such as manganese and iron oxy-hydroxides. These deposits can rapidly interchange metals with water governed by modest changes in water chemistry or during bed sediment transport. Bed sediment composition is also important because it may directly affect the health and metal content of benthic fauna, which are a primary food source for fish.

MINING ACTIVITY

Mining activity in the upper part of Prickly Pear Creek began in 1864 near the headwaters of Clancy Creek (Roby and others, 1960). Since that time metal production has occurred throughout most of the upper Prickly Pear Creek watershed, with most of the metal production taking place during three time periods: 1) 1870-1893; 2) 1900-1930 3); 1940-1960. Recent periods of gold mining have been restricted to the upper Spring Creek drainage (Montana Tunnels) and upper Golconda Creek.

The approximate areas of mining activity are shown in figure 2. The Clancy district includes many mines from near the town of Clancy, westward to the upper part of Lump Gulch. Mines in the district have produced mainly silver, lead, and zinc. Mines in the Warm Springs-Alhambra district are found along Warm Springs Creek and have produced primarily silver and zinc, with minor gold and lead. The Golconda district is a small district located along Golconda Creek that has produced minor amounts of silver, lead and gold. Mines in the Colorado-Wickes district have produced the largest volume of ore. Three types were produced: 1) gold and copper, 2) silver and lead, 3) gold.

Zinc was not typically mined for or recovered prior to flotation technology (circa 1917) and, as a result, zinc may be abundantly present in mine waste piles

Figure 2. Approximate boundaries of mining districts in the upper Prickly Pear Creek drainage watershed.

MINERAL DEPOSITS, SMELTER AND MILL SITES

A number of cultural and natural features within the drainage may potentially affect the chemistry of the streambed sediments and water. These are summarized in figure 3. Seven major mill sites processed ore from multiple sources. These may represent point sources of metals because the tailings material may contain metals remaining after incomplete extraction. This, coupled with the fine grain size makes the tailings particles susceptible to leaching. In addition, many of these older tailings impoundments have been breached during periods of high water flow and their tailings have been distributed downstream as fluvial deposits. A smelter at Wickes operated in the late 1800ís and may represent a potential source of high levels of metals (Roby and others, 1960). Many of the larger streams in the basin were mined for gold placer deposits. While gold placer deposits and the mining methods used to extract them typically are not sources of other metals, the tailings left from mining alter the sediment characteristics and may disrupt the stream courses and local gradients. This may alter the metal concentrations in the streams, due to settling of colloid-trapped metals in reaches of low energy. Several areas in figure 3 are underlain by hydrothermally altered rocks or possibly porphyry copper deposits (Becraft and others, 1963; Tysdale and others, 1996).

The bedrock and streams draining them may contain natural enrichments in copper, molybdenum, lead and zinc that are unrelated to mining activity. When hydrothermal alteration is severe, bedrock is leached of acid-neutralizing minerals and may lose the ability to naturally buffer the acidity of surface water. If these areas are coincident with areas of past mining, then acid mine drainage will not be mitigated as much as in unaltered areas, resulting in potentially higher acidity of streams in these areas.

Figure 3. Cultural and natural features with potential effects on streambed sediment chemistry in the upper Prickly Pear Creek watershed.

GEOLOGIC SETTING

The Prickly Pear Creek watershed lies nearly completely within rocks of the late Cretaceous Boulder batholith (fig. 4) (Becraft, and others, 1963; Smedes, 1966). Minor amounts of Paleozoic and Mesozoic sedimentary rocks are found along the northeast boundary of the watershed. The Butte Quartz Monzonite and related igneous plutonic rocks underlie more than 80% of the watershed; the Elkhorn Mountains Volcanics, a genetically related and geochemically similar sequence of volcanic rocks, comprise most of the remainder. A small enclave of the Eocene Lowland Creek Volcanics of quartz latite composition overlies the Elkhorn Mountains Volcanics in the southwestern part of the watershed. These volcanic rocks and a few scattered small rhyolitic volcanic domes or shallow intrusions of presumed Tertiary-age are also generally similar in bulk chemistry to rocks of the Boulder batholith.

Bedrock geochemistry is a major control on streambed sediment chemistry. The distribution of streambed sediment sample sites is shown in figure 4. Because the composition of about 90% of the bedrock in this watershed is similar, much of the variation in the streambed sediments likely originates from point source natural features such as outcropping mineral deposits or anthropogenic features such as mine and mill sites.

Figure 4. Geologic map of the Prickly Pear Creek watershed showing location of streambed sediment sample sites. Adapted from Tysdale and others (1996).

SAMPLE DISTRIBUTION

The location of 50 steambed sediment samples from the October 2000 sampling program is shown in figures 1 and 4. The locations of the 122 NURE streambed sediment samples found within the basin are shown in figure 5. For reference, the locations of metal mines and prospects are also indicated. In general, most areas of high concentrations of mine workings were sampled in October of 2000, along with some areas with little mining history. Five samples were collected along the main stem of Prickly Pear Creek, twelve samples were collected from Lump Gulch and its tributaries, eleven samples were collected from Clancy Creek and its tributaries, eight samples from Spring Creek and its tributaries, and ten samples were collected from Warm Springs Creek. Two streambed sediment samples were collected from Beavertown Creek, and one each were collected from Dutchman Creek and Golconda Creek.

Figure 5. Location of NURE streambed sediment samples in the upper Prickly Pear Creek watershed

NURE samples were collected from the first and the upper parts of second order streams; none were taken along Prickly Pear Creek except near the headwaters. Many small streams were sampled in the Clancy area. Some of these were sampled at very small intervals in order to evaluate the area for the presence of uranium deposits.

TOTAL AND PARTIAL-DIGESTION METALS

Sample collected in October 2000 were analyzed using two different digestions. A four acid digestion is used to determine the ìtotalî amount of metal in the mineral grains that comprise the sediment and metal present as grain coatings. A weak acid-peroxide partial-digestion is used to determine the amount of loosely held (easily leachable) metals that are present mainly in grain coatings.

The ìtotalî metal values reflect the composition of the mineral grains, the bulk of which represent the rock-forming and resistant minerals from the source area. These total metal values also include the metal found in the less stable grain coatings.

Loosely held metals recovered by the partial-digestion are found primarily in manganese and iron oxy-hydroxide coatings on the sediment grains.

MERCURY IN WATER SURVEY

Seventeen sample sites were selected from the 50 streambed sediment sample locations for reconnaissance mercury in water survey. These sites were chosen to determine whether mercury is transported in water in dissolved form or with finely divided (colloidal) material in Prickly Pear Creek watershed. Several sites were located immediately below each of the major areas of historic mining. Additional sites were located within areas that had been extensively placer mined (see fig. 3).

SAMPLE AND ANALYTICAL PROTOCOL

Data tables

Tabulated field and chemical data from streambed sediments are presented in Appendices 5-9 and as separate Excel spreadsheets. Appendix 5 contains field observations and locations of samples. Locations from the October 2000 sampling program were obtained from Global Positioning System (GPS) readings and transferred to a Geographic Information Systems (GIS) layer. GPS locations used the NAD 27 datum. Digital raster graphics (DRG) topographic maps were then registered to the layer and the locations were checked against the topography for accuracy. Several GPS site locations were revised and reconciled with site locations on the DRG topographic maps based on field observations.

Streambed sediment samples

All samples were collected from the upper part of Prickly Pear Creek and its tributaries (fig. 1). The sample sites are located on the Chessman Reservoir, Clancy, Jefferson City, Wickes, East Helena, Elkhorn and Mt. Thompson, Montana USGS 1:24,000 topographic maps.

An integrated streambed sediment sample was collected from the active alluvial channel at each site by combining 10 to 20 individual sub sites within 15 m (50 ft.) of the plotted site. In the field, each composite sample was sieved through a 2 mm (10 mesh) stainless steel screen, and the minus-2mm fraction retained; the larger fractions were discarded.

Streambed sediment samples were air-dried at ambient room temperature (25^{o}C) and sieved to minus-80-mesh (<0.18mm) prior to laboratory analyses.

Water samples for mercury analysis

Water samples were collected for mercury analyses at seventeen sites. Both filtered and unfiltered samples were collected and preserved in pre-cleaned glass bottles with five percent of a one percent-sodium dichromate/concentrated ultra-pure nitric acid solution. We used a 30 ml disposable syringe mounted with a disposable 0.45 µm filter to collect filtered samples.

Water samples for hardness, alkalinity, and soluble and total iron analyses

Water samples for these parameters were collected and analyzed in the field at selected sites; no samples were returned to the laboratory for additional work.

Sample Analysis

Total- digestion of streambed sediments

The streambed sediment samples were digested with a mixed-acid procedure consisting of HCl, HNO_3, $HClO_4$, and HF. Results are reported for 34 elements analyzed by inductively coupled plasma-atomic emission spectroscopy (ICP-AES) (Crock and others, 1983; Briggs, 1996). This procedure is effective in dissolving most minerals, including silicates, oxides and sulfides; however, resistant or refractory minerals such as zircon, chromite, and some tin oxides are only partially dissolved. Previous investigations using a variety of materials support the completeness of the digestion (Church and others, 1987; Wilson and others, 1994). Limits of determination for the total digestion method are given in table 5 of Fey and others (1999a). A statistical summary of mean values, standard deviations, and median values for four National Institute of Standards and Technology (NIST) standard reference materials (SRM-2704, SRM-2709, SRM-2710, and SRM-2711) analyzed with samples from the Boulder River watershed Abandoned Mine Lands Initiative study is contained in table 6 of Fey and others, (1999a). Comparisons with certified values for these standards (NIST, 1993a, 1993b, 1993c and 1993d) are also in Fey and others, (1999a). The results of these analyses in the upper Prickly Pear Creek watershed are in Appendix 6. Reanalysis of a subset of NURE samples within the basin was completed using this analytical protocol; the results are shown in Appendix 7.

Warm 2M HCl-1 percent H_2O_2 partial-digestion of bed sediments

The use of a partial-digestion enables one to determine concentrations of trace elements bound within different mineral phases, whereas a total-digestion releases all trace elements in a sample (Chao, 1984). The streambed sediments were subjected to a partial-digestion consisting of warm (50^0 C) 2M HCl-1 percent H_2O_2 for three hours with continuous agitation; the leachates were subsequently analyzed by ICP-AES for 32 elements. This partial-digestion releases trace elements associated with hydrous amorphous iron- and manganese-oxide mineral coatings and colloidal particles (Appendix III of Church and others, 1993; Church and others, 1997). Mineral coatings such as those observed in the study area can contain a significant percentage of the trace elements in a sample (Church and others, 1997; Fey and Church, 1998; Fey and others, 1999b; 2000). Analytical limits of determination for the partial-digestion method are shown in table 5 of Fey and others (1999a). A statistical summary of mean values, standard deviations, and median values obtained from the partial-digestion procedure for the same four National Institute of Standards and Technology standard reference materials (SRM-2704, SRM-2709, SRM-2710, and SRM-2711) is in table 8 of Fey and others, (1999a). The results of the partial-digestions analyses are shown in Appendix 8.

Mercury analyses of water samples

In the laboratory, all water samples, both filtered and unfiltered, were mixed with stannous chloride ($SnCl_2$, a reducing agent). Mercury (II) was reduced to Hg^o in a flow injection manifold; mercury vapor was measured using flow injection cold vapor-atomic fluorescence spectrometry (CV-FAAS) (Hageman, 2001). The results of these analyses are shown in Appendix 9.

Field alkalinity measurements of selected water samples

Alkalinity measurements on selected water samples were performed in the field using Chemetrics ampoules, where an acid titrant and a mixed pH indicator are mixed with the sample (APHA, 1995). The results, expressed in ppm calcium carbonate ($CaCO_3$), are in Appendix 5.

Field hardness measurements of selected water samples

Hardness measurements of selected water samples were conducted using a Chemetrics kit. This procedure employs the titration of ethylene-diaminetetraacidic acid (EDTA) with sample water. EDTA forms a colored soluble complex with calcium and magnesium ions (APHA, 1995). The results, expressed in ppm calcium carbonate ($CaCO_3$), are in Appendix 5.

Field measurements of total and soluble iron in selected water samples

A colorimetric method using a Chemetrics kit was used to analyze for iron in field water samples. To measure for total iron, thioglycolic acid is added to the sample, reducing ferric iron (Fe^3) to soluble ferrous iron (Fe^2). The reduced iron reacts with 1,10 phenanthroline to form a red-colored chelate, whose darkness is dependent on the concentration of iron (APHA, 1995). To measure for soluble (Fe^2) iron, the sample is mixed with the 1,10 phenanthroline without adding the thioglycolic acid; thus only the sample's original ferrous iron reacts with the chelating agent, and the ferric iron is not measured. The results, expressed as ppm (mg/L) are in Appendix 5.

Conductivity and pH field measurements of water samples

Conductivity and pH were measured using temperature-compensated instruments calibrated daily with solutions of the appropriate range. The results, expressed as micro-siemens/centimeter (µS/cm) and standard pH units are in Appendix 5.

BACKGROUND SITES

In order to interpret the results of the chemical analysis of the streambed sediments in a regional context, the chemical elements in each sample must be compared to some value that is characteristic of "normal" streambed sediment within the drainage basin. Sample sites for background calculation were chosen from streams that drain areas with little or no mining history and that represent typical bedrock in the basin. Six sites identified during the October 2000 sampling program were used to determine the easily leachable metal background values. Those six sites plus 8-27 sample from the NURE sampling program were used to establish the background values. The variation in number of total sites reflects the difference in the number of elements that were determined at each NURE site. The locations of the background sites are shown in figure 6; medians for these background values are shown in table 2.

Comparison between the analytical methods used for the October 2000 samples and the NURE samples was made. The NURE samples were originally analyzed using neutron activation methods. Twenty-five NURE samples were re-analyzed using the "total" digestion and ICP-AES methods. The results were compared statistically (t-test) for five metals, As, Cd, Cu, Pb, and Zn. As and Cd values were not similar in the comparison of the two analytical methods, whereas, Cu, Pb, and Zn were similar.

Based on the results of the comparison, Cu, Pb and Zn values from both data sets were used to estimate regional background values. Only re-analyzed NURE samples or samples from the October 2000 program were used in estimating background for As and Cd.

Table 2. Median background values of streambed sediments in the upper Prickly Pear Creek watershed. All values are in ppm. Partial-digestion values from October 2000 sampling program only. Total digestion values are from NURE and October 2000 programs.

element	Partial-digestion value	Number of samples	Total digestion value	Number of samples
As	6.6	6	14	15
Cd	1	6	4	16
Cu	15	6	42	33
Pb	12	6	25	30
Zn	80	6	96	15

STREAMBED SEDIMENT METAL CHEMISTRY AND BIOLOGICAL SCREENING LEVELS

The effect of streambed sediments on the ecosystem is complex, and it is difficult to assess their relationship on water chemistry. Streambed sediment chemistry is most directly related to the accumulation of metals by benthic fauna, which represent a food source for many fresh water fish. Sediment influence on water chemistry is more difficult to understand. The silicate and oxide mineral grains that make up most of the bed sediments release small amounts of metals over a long time span during weathering. Thus, high concentrations of those elements in silicate and oxide grains will likely not have a great effect on water chemistry. However, easily leachable metals found in oxy-hydroxide grain coatings can have a marked effect on water chemistry and benthic fauna health. Large releases of metals into water may be induced by changes in water chemistry or flow conditions. Benthic fauna in direct contact with streambed sediment are also probably most affected by the easily leachable metals in oxy-hydroxide coatings because of their high solubility and the ease with which the coatings can be physically released during streambed sediment transport.

Screening-level concentrations of metals in streambed sediments are poorly understood. No standard has yet been adopted by any major environmental agency.

Table 3 summarizes three different standards. The screening-level (SLC) is defined as the highest level of concentration of a metal in streambed sediment that can be tolerated by 95% of the benthic fauna (Jones and others, 1997). The acute effects threshold (AET) is the concentration of a metal in streambed sediment where statistically significant affects always occur in benthic fauna. The consensus-based screening-level concentration (CBSLC) uses an approach where the protective concentrations of metals are determined by a consensus of multiple methodologies (MacDonald and others, 2000). The value of the consensus-based approach is enhanced because multiple methodologies lead to similar conclusions, thereby validating the results. The CBSLC thresholds are used for comparison with the streambed sediment concentrations in the upper Prickly Pear Creek watershed in the following discussion. The populations of As, Cd, Cu, Pb, Zn concentrations in stream bed sediments in the Prickly Pear Creek watershed based on the October 2000 sampling program are summarized in figure 7. Metals in both the partial-digestion and total digestions are represented. The CBSLC and regional background concentration is also shown for each metal.

Figure 6. Locations of background streambed sediment sites, upper Prickly Pear Creek watershed.

Table 3. Summary of provisional streambed sediment screening levels. Concentrations in ppm.

element	SLC range (Jones and others, 1997)	AET range (Jones and others, 1997)	CBSLC (Macdonald and others, 2000
Arsenic	7-12	33-57	33
Cadmium	0.6-1.0	10-12	4.98
Copper	16-34	78-110	149
Lead	30-47	250-400	128
Zinc	120-160	820-1500	459

In the summary below, measured metal concentrations are examined in two ways. The concentrations are expressed in terms of enrichment or depletions relative to the regional background; this represents the sediment site in terms of metal levels relative to non-mineralized bedrock. The metal concentrations are also expressed in terms of the CBSLC level, which relates to the metal concentrations in benthic fauna and fishery health.

Partial-digestion (easily leachable) median values for As and Cd are 4x greater than regional background (fig. 7), Cu is 2x, Pb is 9x, and Zn is 7x greater than regional background. Enrichments relative to median values of the total-digestion analyses are somewhat lower for all elements. Total As is 3x, Cd is 2x, Cu is 1.5x, and Pb and Zn are 5x enriched relative to regional background.

Leachable median values of As, Cd, and Pb are at the CBSLC level and Zn median value is 30 % greater than the CBSLC, whereas Cu is 25% of the CBSLC. In other words, 50% of the sample sites (25 sample sites) are at or exceed the As, Cd, and Pb CBSLC, and more than 50 % of the sites exceed the CBSLC for Zn. For total-digestion analyses, median values of As and Zn exceed the CBSLC by 50%, median values of Cd by 100%, and median values of Cu by 30%. The median total Pb value is at approximately the same level as the CBSLC. For As and Zn, median total value exceeds the CBSLC at 50% of the sample sites. Total Cd values at more than 50% of the sample sites exceed the CBSLC. Median Pb values are at the CBSLC at 50% of the sample sites.

RIBBON MAPS

Preliminary interpretation of the metal distribution in streambed sediments was aided by plotting maps that show the metal values at the samples site. This concentration is carried headward along the stream segment until it is replaced by the value at another site on the segment, or the head of the stream segment is encountered. Thus, a stream segment can be characterized in terms of a metal concentration at a single site, which should approximate an integrated value for the stream above it.

Figure 7. Population summary of base metal concentrations in the upper Prickly Pear Creek watershed. Based on fifty streambed sediment samples taken during October 2000. CBSLC is the consensus-based screening level concentration (MacDonald and others, 2000)

Figures 8 through 12 show the distribution of partial-digestion values for As, Cd, Cu, Pb, and Zn. The value of each element at a site is normalized to the regional background value, which places the metal concentrations in a regional context. The CBSLC value for each element is shown in terms of concentration and its multiple of the regional background illustrates which drainage segments are above the guideline levels for biological effects. Values from the partial-digestion are shown in the following figures because they relate more directly to heavy metal effects on biota and water chemistry. Diagrams constructed using total-digestion values (not shown) show features similar to those for the partial-digestion values.

Figure 8. Arsenic concentrations (partial-digestion) in upper Prickly Pear Creek watershed stream segments normalized to regional background.

Figure 9. Cadmium concentrations (partial-digestion) in upper Prickly Pear Creek watershed stream segments normalized to regional background.

Figure 10. Copper concentrations (partial-digestion) in upper Prickly Pear Creek watershed stream segments normalized to regional background.

Figure 11. Lead concentrations (partial-digestion) in upper Prickly Pear Creek watershed stream segments normalized to regional background.

Figure 12. Zinc concentrations (partial-digestion) in upper Prickly Pear Creek watershed stream segments normalized to regional background.

Streambed sediments in upper Lump Gulch show extreme enrichments relative to background in As, Cd, Pb, and Zn from the Frohner and Nellie Grant mines to the outlets of Frohner Meadows, whereas Cu is moderately enriched (figs. 8-12). Below the meadows, As and Pb decrease to moderate levels at site L-5, whereas Cd and Zn are moderately enriched down to the lowest segment of Lump Gulch sampled.

In the south fork of Quartz Creek, streambed sediments are highly enriched in Cd and Zn with moderate enrichments of As, and Pb. The source of the metals is not known.

In Kady Gulch, Pb and Zn are moderately enriched. Downstream in upper Clancy Creek, near the Gregory mine and mill site, As and Pb are highly enriched in the unnamed southeastern fork below the Gregory mine, whereas downstream of the mill site, just above the junction with Quartz Creek, all metals are highly enriched. Downstream, enrichments in As, Cu, Pb, and Zn at moderate levels are seen to site C-6 near the junction of Clancy Creek and Prickly Pear Creek.

Warm Springs Creek is highly enriched in As, Cd, Pb, and Zn in the area of mining at the headwaters of its central fork. Arsenic levels are highly enriched to sample site WS-7. The lower part of Warm Springs was not sampled. However, the high levels of As enrichment likely continues downstream to Prickly Pear Creek. High Pb and Zn enrichments continue from the mine area to the first major stream junction, below which they are moderately enriched. Cadmium and Cu only show significant enrichment in the area of the mines.

Golconda Creek is moderately enriched in As, Cd, Cu, and Zn. Lead is highly enriched. Contribution of As, Cd, Cu, and Pb from Golconda Creek to upper Prickly

Pear Creek may raise the metal levels in Prickly Pear Creek to slightly to moderately enriched below their junction.

In Beavertown Creek, Zn is highly enriched and Cd and Cu moderately enriched in the lower reach, whereas As is moderately enriched in the upper reach. Lead is moderately enriched throughout Beavertown Creek. High Cu values (24x background) in the NURE total analyses are present in Stagecoach and Copper Gulches, the two southwestern tributaries of upper Beavertown Creek. Partial-digestion data are not available for these sites, so they are not shown in figure 9.

Spring Creek drains a large area that is highly mineralized and extensively mined. Much of the drainage basin is underlain by highly altered bedrock and, as a result, many tributaries and most of its main stem are highly contaminated with metals. The only exceptions are the uppermost segments of the main stem. Comet Creek was not sampled during October 2000 but NURE total analyses show near-regional background levels. Other segments in the middle portion of the main stem were not sampled because either access to sites was not available or the sites lacked appropriate sampling media due to disturbed drainages and cultural effects. The unnamed drainage north of Wickes that drains the Mt. Washington mine shows highly anomalous concentrations of As, Cd, Pb and Zn in NURE total analyses. These results are not shown in Figs. 8-12 because samples from these sites have not been analyzed with the partial-digestion method.

Prickly Pear Creek below Jefferson City is highly enriched in As, Pb and Zn downstream to Alhambra. Cd and Cu are moderately enriched through this stream segment. Much of the enrichment appears to be related to sediments derived from Spring Creek. However, Beavertown Creek may contribute to Cu and Zn enrichment. Some As and perhaps Zn may be contributed to Prickly Pear Creek by Warm Springs Creek near Alhambra. Moderate levels of As, Cu, and Zn enrichment persist below Alhambra to PP-5, the most downstream sample site in the upper Prickly Pear Creek watershed.

The results of the partial-digestion determinations relative to the CBSLC are summarized in Figure 13. Stream segments that contain metal levels at or greater than the CBSLC are indicated. The metals exceeding the screening level are noted for each segment.

Figure 13. Upper Prickly Pear Creek watershed stream segments that exceed CBSLC. Elements that exceed the screening level are noted for each stream segment.

RESULTS OF THE RECONNAISSANCE MERCURY IN WATER SURVEY

Concentrations of mercury in both the filtered and unfiltered water samples are all at or below the analytical detection limit of 0.005 ppb. At samples sites S-1a (upper Spring Creek), S-4 (Spring Creek, above Jefferson City), and B-1 (lower Beavertown Creek), mercury concentrations in unfiltered samples were 0.005 µg/l (fig. 1). In upper Lump Gulch at the outlet to Frohner Meadows (site L-3b), the filtered sample contained 0.006 µg/l whereas the unfiltered sample was below the detection limit. The unfiltered sample should have given a minimum concentration similar to that of the filtered sample. This effect is caused by increased analytical uncertainty near the detection limit.

None of these concentrations in water approaches the 2.4 µg/l maximum stream water concentration or the 0.012 µg/l chronic effects level recommended by the U.S. Environmental Protection Agency (U.S. Environmental Protection Agency, 1992) and therefore is not considered to represent hazardous mercury concentrations.

BIOLOGY DATA FOR STREAMS IN THE UPPER PRICKLY PEAR CREEK WATERSHED, MONTANA

By Aïda M. Farag and Bradley G. Mueller

INTRODUCTION

This section presents biology data that were collected in the upper Prickly Pear Creek watershed during October 2000. Data presented in this section include provisional measurements of metal residues in aquatic vegetation, biofilm (*aufwuchs*) benthic macroinvertebrates, and fish tissues. Specific results of quality assurance data are not yet available.

Site numbers for biology sampling were similar to the alpha-numeric system used for water quality and sediment sampling efforts. The alpha character denotes the first letter of the stream name and the numeric characters denote the downstream sequence, beginning at the most upstream site (fig. 1, table 1). Because multiple biology samples were collected from identical sites, additional numeric designations refer to the individual samples.

BIOLOGY DATA

Biology samples were collected from 14 sites (table 1). Aquatic vegetation was collected from 10 sites, biofilm was collected from 2 sites, benthic macroinvertebrates were collected from 13 sites, and fish tissues were collected from 5 sites. As, Cu, Cd, Pb, and Zn were measured in all samples and reported as µg/g dry weight (Appendix 10). Note: The biology data are presented as uncensored; therefore, some negative numbers appear for As. All of the biology data reported are provisional and the data in Appendix 10 should be viewed as preliminary.

Methods

Sampling methods were similar to those described by Farag et al. (1998). Rocks along the shore were removed from the water and their surface was scraped gently with acid-washed plastic utensils. The aquatic vegetation or biofilm was placed directly in acid-washed plastic vials. For benthos, an area of approximately 6 m^2 was overturned upstream of a 3-mm mesh net. Benthos were removed with plastic or stainless steel forceps and placed in acid-washed vials. The invertebrates were rinsed with site water to remove debris, but they were not allowed time to depurate. Without depuration, the metal concentrations in the invertebrates represent the “dose” of metals received by fish. Fish were collected by electrofishing, fish were pithed and lengths and weights were recorded. Individual fish were placed in plastic bags for whole fish analyses of metals. Fillet, gills, livers, and pyloric caeca were removed from additional fish and each tissue was placed in an acid-washed plastic vial. In the laboratory, fillet, gills, livers, and pyloric caeca from approximately three fish were combined for a composite sample of each tissue. A duplicate sample was measured for every 20 samples (data not reported). All samples were measured with atomic absorption spectroscopy with graphite furnace or flame.

The tissues were dried at 58^{o}C for 48 hours and digested with 30% nitric acid at 76 ^{o}C for 48 hours. Quality control was monitored for all chemical analyses. Instrument calibration was verified by analyzing certified calibration solutions during each instrumental run. These external reference standards were generally within 80% to 120% of the nominal concentrations. All of the sample spikes for tissues were within 80% to 120% recovery. Preparation blanks were prepared to detect potential contamination during the digestion procedure. These preparation blanks generally measured below the detection limit.

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Appendix 1. Physical properties and concentrations of selected major ions and trace elements in water samples collected from streams in the upper Prickly Pear Creek watershed, Montana, 2000.

[Samples collected by the U.S. Geological Survey. ANC, acid-neutralizing capacity determined on unfiltered samples, formerly referred to as alkalinity. Abbreviations: ft^3/s, cubic feet per second; ^0C, degrees Celsius; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25^0C; mg/L, milligrams per liter; mm, millimeters. Symbols: <, less than minimum reporting level; -- no data; E, estimated]

Site number	Date	Time	Discharge (ft^3/s)	Sediment, suspended (mg/L)	Sediment, suspended, diameter (percent finer than 0.062 mm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (^oC)	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	ANC, lab (mg/L as $CaCO_3$)
B-1	10-16-00	1540	0.48	6	72	476	7.9	8.0	190	56	13	--
C-1	10-17-00	1330	0.08	1	78	148	7.9	2.0	62	20	3.0	--
C-2	10-17-00	1210	1.0	2	50	207	8.1	--	91	28	5.2	--
C-3	10-17-00	1600	0.36	11	60	138	8.0	4.0	56	18	2.8	--
C-4	10-17-00	1445	0.10	1	70	248	7.9	7.6	110	33	6.4	--
C-5	06-14-00	1215	1.6	4	83	192	8.1	9.0	82	24	5.2	--
	06-16-00	1400	4.2	8	62	162	8.6	9.5	66	20	4.1	--
	10-17-00	1340	1.3	3	68	224	8.0	7.2	98	29	6.0	66
C-6	10-12-00	1430	0.89	7	40	276	8.1	6.5	110	32	7.9	--
D-1	10-16-00	0945	1.4	2	54	112	8.0	3.5	44	13	2.7	--
G-1	10-16-00	1240	0.51	1	50	105	8.6	5.5	40	13	2.0	--
L-1	06-16-00	1230	2.2	1	78	43	7.7	5.5	18	5.9	.85	--
	10-11-00	1220	0.14	1	60	87	7.3	0.5	35	11	1.6	--
L-2	06-16-00	1045	0.16	2	62	61	8.1	4.0	24	8.0	1.1	--
	10-11-00	1000	0.04	1	47	88	8.4	2.0	35	11	1.5	--
L-3a	06-16-00	1415	0.62	1	67	119	7.2	10.0	41	13	2.0	--
	10-11-00	1345	0.0003	14	97	483	6.3	1.5	210	67	9.2	--
L-3b	06-16-00	1445	1.2	2	83	138	7.2	12.0	47	15	2.2	--
	10-11-00	1630	0.11	1	80	398	6.0	2.0	150	49	6.1	--
L-3c	10-11-00	1450	0.15	2	90	203	6.9	2.0	78	25	3.9	--
L-4	06-16-00	1545	1.8	7	59	89	7.7	12.0	34	10	1.9	--
	10-11-00	1520	0.18	2	57	129	7.1	2.0	49	15	2.8	--

Site number	Date	Time	Discharge (ft^3/s)	Sediment, suspended (mg/L)	Sediment, suspended, diameter (percent finer than 0.062 mm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	ANC, lab (mg/L as $CaCO_3$)
L-5	06-12-00	1415	0.93	1	60	127	8.1	13.0	68	20	4.2	--
	06-16-00	1715	3.9	2	62	114	7.7	11.5	42	12	2.7	--
	10-17-00	0900	1.2	1	88	146	8.1	3.0	59	17	3.8	47
L-6	06-16-00	1800	1.2	28	76	125	7.7	10.0	45	13	3.1	--
	10-17-00	0940	0.35	2	47	331	7.2	3.0	120	36	8.1	--
L-7	06-16-00	1020	7.3	5	84	117	7.8	9.0	44	13	2.9	--
	10-17-00	1120	1.1	4	94	184	7.6	4.5	71	21	4.5	--
L-8	06-16-00	1120	4.5	15	79	226	7.8	9.0	78	23	5.3	--
	10-17-00	1045	0.67	1	75	442	7.3	4.0	170	52	11	--
L-9	06-16-00	1240	11	12	77	172	8.1	10.5	61	18	4.0	--
	10-17-00	1230	2.4	2	71	281	7.8	5.0	110	32	6.9	--
PP-1	10-16-00	1100	3.5	1	64	89	7.9	4.0	37	12	1.8	37
PP-2	10-16-00	1350	4.7	2	70	111	8.3	6.5	44	14	2.3	--
PP-3	06-14-00	1415	3.7	1	45	176	7.9	10.0	49	14	3.2	--
	06-16-00	1640	8.9	6	43	176	7.8	10.5	67	20	4.2	--
	10-16-00	1630	3.3	6	72	213	7.7	8.5	81	24	4.8	49
PP-4	10-12-00	1330	11	6	64	282	8.1	8.0	85	25	5.5	--
PP-5	06-12-00	0920	16	4	98	269	8.3	11.5	91	26	6.3	--
	06-16-00	1745	45	26	64	201	8.1	13.0	70	20	4.8	--
	10-19-00	0945	17	5	73	282	8.1	8.0	97	28	6.4	81
S-1	10-18-00	1040	0.02	3	65	133	8.1	8.5	56	17	3.6	--
S-1a	10-18-00	1300	0.07	21	99	316	7.7	8.0	130	41	6.9	--
S-3	10-19-00	1100	2.4	18	40	603	7.8	8.0	270	85	14	--
S-4	10-16-00	1450	0.04	3	43	521	8.2	9.5	230	72	11	--
WS-1	10-12-00	1050	0.06	4	84	98	8.3	2.5	35	10	2.2	--
WS-2	10-11-00	1100	0.28	2	65	245	8.1	4.5	110	30	7.6	--

Site number	Date	Time	Discharge (ft^3/s)	Sediment, suspended (mg/L)	Sediment, suspended, diameter (percent finer than 0.062 mm)	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature, water (°C)	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	ANC, lab (mg/L as $CaCO_3$)
WS-2a	10-11-00	0930	0.35	5	84	251	8.1	3.5	110	31	7.8	--
WS-3	06-06-00	0700	0.39	--	--	256	7.8	--	--	--	--	--
	06-06-00	1730	0.22	--	--	225	8.1	--	--	--	--	--
	06-14-00	0945	0.48	1	80	231	8.1	9.5	97	27	7.0	--
	06-16-00	1540	1.4	34	57	158	8.4	10.0	62	18	4.4	--
	10-12-00	1215	0.51	5	75	223	7.4	2.0	96	27	6.9	69
WS-4	10-11-00	1500	0.11	1	75	207	8.2	5.5	86	25	6.0	--
WS-5	10-11-00	1345	1.1	1	73	106	7.8	4.0	42	13	2.4	--
WS-7	10-11-00	1215	1.3	14	97	158	7.9	5.0	63	18	4.2	--

Site number	Date	Arsenic, total recoverable (µg/L as As)	Arsenic, dissolved (µg/L as As)	Cadmium, total recoverable (µg/L as Cd)	Cadmium, dissolved (µg/L as Cd)	Copper, total recoverable (µg/L as Cu)	Copper, dissolved (µg/L as Cu)	Lead, total recoverable (µg/L as Pb)	Lead, dissolved (µg/L as Pb)	Zinc, total recoverable (µg/L as Zn)	Zinc, dissolved (µg/L as Zn)
B-1	10-16-00	<1.9	0.4	E 0.09	<0.14	3.9	3.2	<1	0.08	47	48
C-1	10-17-00	<1.9	0.4	0.15	0.16	0.9	0.9	<1	0.05	50	50
C-2	10-17-00	<1.9	0.4	E 0.05	<0.14	<1	1.1	<1	0.08	9.0	7.3
C-3	10-17-00	E 0.9	0.5	E 0.10	<0.14	1.3	1.0	1.6	<0.08	18	11
C-4	10-17-00	37	38	0.78	0.73	3.2	3.1	<1	<0.08	161	159
C-5	06-14-00	7.1	6.2	E 0.10	E 0.10	1.4	1.2	1.2	<1	31	28
	06-16-00	9.9	5.6	0.25	<0.14	3.4	1.4	9.2	<1	50	30
	10-17-00	4.7	3.7	0.12	0.15	1.4	1.2	<1	0.12	24	24
C-6	10-12-00	5.0	4.8	E 0.06	E 0.07	1.6	1.4	<1	0.22	17	15
D-1	10-16-00	<1.9	0.5	<0.11	<0.14	0.9	0.8	<1	<0.08	1.0	1.2
G-1	10-16-00	E 1.0	0.6	0.30	0.20	1.9	1.0	015	1.7	42	35

Site number	Date	Arsenic, total recoverable (µg/L as As)	Arsenic, dissolved (µg/L as As)	Cadmium, total recoverable (µg/L as Cd)	Cadmium, dissolved (µg/L as Cd)	Copper, total recoverable (µg/L as Cu)	Copper, dissolved (µg/L as Cu)	Lead, total recoverable (µg/L as Pb)	Lead, dissolved (µg/L as Pb)	Zinc, total recoverable (µg/L as Zn)	Zinc, dissolved (µg/L as Zn)
L-1	06-16-00	E 1.7	1.4	<0.11	<0.14	2.1	2.5	<1	<1	<4.7	5.6
	10-11-00	<1.9	0.9	<0.11	<0.14	<1	0.8	<1	<0.08	2.6	2.0
L-2	06-16-00	E 1.8	1.4	<0.11	<0.14	1.6	1.7	<1	<1	<2.4	1.4
	10-11-00	<1.9	0.9	<0.11	<0.14	<1	0.6	<1	<0.08	1.6	<1
L-3a	06-16-00	6.3	5.3	6.3	6.9	7.4	8.2	2.1	1.3	1,450	1,570
	10-11-00	9.8	7.8	9.8	9.9	2.7	2.1	<1	<0.08	3,970	4,090
L-3b	06-16-00	15	9.7	13	14	11	11	8.3	3.7	2,650	2,750
	10-11-00	6.0	1.6	47	48	5.8	4.1	4.3	0.19	15,400	15,100
L-3c	10-11-00	<1.9	0.5	3.4	3.0	1.2	1.0	<1	<0.08	1,580	1,560
L-4	06-16-00	3.3	2.1	0.42	0.26	2.3	2.0	<1	<1	158	152
	10-11-00	<1.9	0.9	0.16	E 0.11	1.1	0.9	<1	<0.08	149	150
L-5	06-12-00	<2.6	1.7	0.29	0.31	2.3	2.2	1.0	<1	166	163
	06-16-00	E 1.8	2.6	0.13	E 0.10	1.4	<1	<1	<1	81	<1
	10-17-00	<1.9	0.50	E 0.07	<0.14	<1	0.75	<1	<0.08	30	31
L-6	06-16-00	<2.6	<0.9	<0.11	<0.14	5.0	3.1	<1	<1	<4.0	1.5
	10-17-00	<1.9	0.3	<0.11	<0.14	2.0	1.7	<1	<0.08	2.1	1.2
L-7	06-16-00	<2.6	E 0.7	E 0.08	<0.14	2.1	1.7	<1	<1	55	41
	10-17-00	<1.9	0.6	<0.11	<0.14	1.1	1.0	<1	<0.08	28	30
L-8	06-16-00	<2.6	E 0.5	<0.11	<0.14	7.6	4.3	<1	<1	<3.9	1.3
	10-17-00	<1.9	0.2	<0.11	<0.14	2.9	2.5	<1	<0.08	3.6	2.3
L-9	06-16-00	<2.6	E 0.7	E 0.07	<0.14	4.6	2.5	<1	<1	37	18
	10-17-00	<1.9	0.4	<0.11	<0.14	1.7	1.6	<1	<0.08	15	15
PP-1	10-16-00	<1.9	0.4	<0.11	<0.14	1.1	1.0	<1	<0.08	1.3	1.3
PP-2	10-16-00	<1.9	0.3	E 0.08	<0.14	0.9	0.8	<1	0.10	5.9	5.3
PP-3	06-14-00	<2.6	E 0.8	E 0.07	<0.14	1.2	1.3	<1	<1	48	50
	06-16-00	E 2.1	1.8	0.35	0.36	3.1	2.5	2.4	<1	192	183

Site number	Date	Arsenic, total recoverable (µg/L as As)	Arsenic, dissolved (µg/L as As)	Cadmium, total recoverable (µg/L as Cd)	Cadmium, dissolved (µg/L as Cd)	Copper, total recoverable (µg/L as Cu)	Copper, dissolved (µg/L as Cu)	Lead, total recoverable (µg/L as Pb)	Lead, dissolved (µg/L as Pb)	Zinc, total recoverable (µg/L as Zn)	Zinc, dissolved (µg/L as Zn)
	10-16-00	2.2	1.8	0.42	0.33	3.2	2.2	5.4	0.14	171	173
PP-4	10-12-00	7.0	5.9	0.19	0.19	3.1	2.3	3.1	0.43	72	68
PP-5	06-12-00	5.5	4.7	0.20	E 0.09	2.8	1.8	4.3	<1	73	59
	06-16-00	10	5.0	0.39	<0.14	6.6	2.3	18	<1	91	31
	10-19-00	5.7	4.2	0.17	<0.14	2.8	2.0	4.9	0.40	77	61
S-1	10-18-00	6.0	5.1	<0.11	<0.14	<1	0.4	<1	<0.08	1.6	1.2
S-1a	10-18-00	51	7.6	7.6	4.9	112	5.3	38	E 0.07	1,131	898
S-3	10-19-00	12	4.3	1.3	0.73	5.3	1.9	12	E 0.07	81	68
S-4	10-16-00	14	6.0	1.5	0.53	17	3.8	55	0.45	203	63
WS-1	10-12-00	2.0	1.6	2.4	2.4	4.4	4.1	1.1	.22	21	21
WS-2	10-11-00	32	18	0.50	0.32	1.9	1.0	1.1	E 0.06	175	170
WS-2a	10-11-00	53	35	0.49	0.45	2.5	1.7	4.6	0.09	178	181
WS-3	06-06-00	--	41	--	0.41	--	1.8	--	--	--	141
	06-06-00	--	46	--	0.36	--	1.9	--	--	--	113
	06-14-00	42	39	0.43	0.41	1.9	1.7	2.1	<1	126	129
	06-16-00	87	36	0.89	0.37	6.8	3.4	30	<1	208	125
	10-12-00	53	37	0.37	0.33	2.6	1.2	5.1	<0.08	145	120
WS-4	10-11-00	<1.9	1.0	<0.11	<0.14	1.2	1.1	<1	0.22	<1	<1
WS-5	10-11-00	<1.9	0.5	<0.11	<0.14	<1	0.4	<1	<0.08	<1	<1
WS-7	10-11-00	9.3	8.3	<0.11	<0.14	<1	0.8	<1	E 0.05	22	20

Appendix 2. Concentrations of additional trace elements at periodic water-quality sites in the upper Prickly Pear Creek watershed, Montana, 2000

[Samples collected by the U.S. Geological Survey. Abbreviations: µg/L, micrograms per liter. Symbols: <, less than minimum reporting level; E, estimated]

Site number	Date	Time	Aluminum, total recoverable (µg/L as Al)	Aluminum, dissolved (µg/L as Al)	Antimony, total recoverable (µg/L as Sb)	Antimony, dissolved (µg/L as Sb)	Chromium, total recoverable (µg/L as Cr)
C-5	10-17-00	1340	16	1.1	<0.9	0.14	--
L-5	10-17-00	0900	4.2	<1	<0.9	0.08	--
PP-3	10-16-00	1630	25	<1	<0.9	0.25	E 0.6
PP-5	10-19-00	0945	87	2.5	<0.9	0.50	E 0.7
WS-3	10-12-00	1215	87	1.1	<0.9	0.16	E 0.5

Site number	Date	Chromium, dissolved (µg/L as Cr)	Iron, total recoverable (µg/L as Fe)	Iron, dissolved (µg/L as Fe)	Manganese, total recoverable (µg/L as Mn)	Manganese, dissolved (µg/L as Mn)	Mercury, total recoverable (µg/L as Hg)
C-5	10-17-00	<0.8	67	12	15	11	<00.14
L-5	10-17-00	<0.8	107	23	E 2.8	0.79	<0.14
PP-3	10-16-00	<0.8	53	<10	18	3.7	<0.14
PP-5	10-19-00	E 0.4	288	50	68	34	<0.14
WS-3	10-12-00	<0.8	450	<10	26	3.9	<0.14

Site number	Date	Mercury, dissolved (µg/L as Hg)	Nickel, total recoverable (µg/L as Ni)	Nickel, dissolved (µg/L as Ni)	Silver, total recoverable (µg/L as Ag)	Silver, dissolved (µg/L as Ag)
C-5	10-17-00	<0.23	<1	0.27	<1	<0.16
L-5	10-17-00	<0.23	<1	0.21	<1	<0.16
PP-3	10-16-00	<0.23	<1	0.62	<1	<0.16
PP-5	10-19-00	<0.23	<1	0.39	<1	<0.16
WS-3	10-12-00	<0.23	<1	0.38	<1	<0.16

Appendix 3. Water-quality data for field duplicates, upper Prickly Pear Creek watershed, Montana

[Samples collected by the U.S. Geological Survey. Abbreviations: ^{0}C, degrees Celsius; lab, laboratory; µg/L, micrograms per liter; µS/cm, microsiemen per centimeter at 25^{0}C; mg/L, milligrams per liter. Symbol: <, less than minimum reporting level]

Site number	Date	Time	Specific conductance, lab (µS/cm)	pH, lab (standard units)	Hardness (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)
C-4	10-17-00	1445	257	7.7	110	33	6.4
	10-17-00	1450	254	7.3	110	32	6.3
L-7	10-17-00	1120	185	7.7	71	21	4.5
	10-17-00	1125	186	7.7	70	21	4.5
PP-4	10-12-00	1330	286	7.7	85	25	5.5
	10-12-00	1335	286	7.8	86	25	5.6
WS-3	06-14-00	0945	234	8.1	97	27	7.0
	06-14-00	0950	232	7.9	98	27	7.1

Site number	Date	Arsenic, total recoverable (µg/L as As)	Arsenic, dissolved (µg/L as As)	Cadmium, total recoverable (µg/L as Cd)	Cadmium, dissolved (µg/L as Cd)	Copper, total recoverable (µg/L as Cu)	Copper, dissolved (µg/L as Cu)
C-4	10-17-00	37	38	0.78	0.73	3.2	3.1
	10-17-00	37	38	0.81	0.75	3.3	3.0
L-7	10-17-00	<1.9	0.64	<0.11	<0.14	1.1	0.96
	10-17-00	<1.9	0.64	<0.11	<0.14	<1	0.95
PP-4	10-12-00	7.0	5.9	0.19	0.19	3.1	2.3
	10-12-00	7.0	6.1	0.14	0.21	3.1	2.3
WS-3	06-14-00	42	39	0.43	0.41	1.9	1.7
	06-14-00	43	40	0.45	0.36	1.9	1.7

Site number	Date	Lead, total recoverable (µg/L as Pb)	Lead, dissolved (µg/L as Pb)	Zinc, total recoverable (µg/L as Zn)	Zinc, dissolved (µg/L as Zn)
C-4	10-17-00	<1	<0.08	161	159
	10-17-00	<1	0.14	161	179
L-7	10-17-00	<1	<0.08	28	30
	10-17-00	<1	<0.08	28	34
PP-4	10-12-00	3.1	0.43	72	68
	10-12-00	3.1	0.41	73	68
WS-3	06-14-00	2.1	<1	126	129
	06-14-00	2.0	<1	126	132

Appendix 4. Water-quality data for field blank, upper Prickly Pear Creek watershed, Montana

[Samples collected by the U.S. Geological Survey. Abbreviations: ^{0}C, degrees Celsius; lab, laboratory; µg/L, micrograms per liter; µS/cm, microsiemen per centimeter at 25^{0}C; mg/L, milligrams per liter. Symbols: <, less than minimum reporting level; E, estimated]

Date	Time	Specific conductance, lab (µS/cm)	pH, lab (standard units)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Aluminum, total recoverable (µg/L as Al)	Aluminum, dissolved (µg/L as Al)
10-19-00	0930	E 2	8.0	E 0.01	<0.008	<2	<1

Antimony, total recoverable (µg/L as Sb)	Antimony, dissolved (µg/L as Sb)	Arsenic, total recoverable (µg/L as As)	Arsenic, dissolved (µg/L as As)	Cadmium, total recoverable (µg/L as Cd)	Cadmium, dissolved (µg/L as Cd)	Chromium, dissolved (µg/L as Cr)	Copper, total recoverable (µg/L as Cu)
<0.9	E 0.04	<1.9	<0.18	<0.11	<0.14	<0.8	<1

Copper, dissolved (µg/L as Cu)	Iron, total recoverable (µg/L as Fe)	Iron, dissolved (µg/L as Fe)	Lead, total recoverable (µg/L as Pb)	Lead, dissolved (µg/L as Pb)	Manganese, total recoverable (µg/L as Mn)	Manganese, dissolved (µg/L as Mn)	Mercury, total recoverable (µg/L as Hg)
0.38	<14	<10	<1	0.12	<2.8	<1	<0.14

Mercury, dissolved (µg/L as Hg)	Nickel, total recoverable (µg/L as Ni)	Nickel, dissolved (µg/L as Ni)	Silver, total recoverable (µg/L as Ag)	Silver, dissolved (µg/L as Ag)	Zinc, total recoverable (µg/L as Zn)	Zinc, dissolved (µg/L as Zn)
<0.23	<1	E0.03	<1	<0.16	<1	<1

Appendix 5. Field numbers, site descriptions, sample descriptions, latitude and longitude, and field measurements of streambed sediment localities in the upper Prickly Pear Creek watershed.

[Samples collected October 2000 by David Fey and Terry Klein, USGS. Latitude in north, longitude is west. Conductivity in µS/cm, alkalinity and hardness in ppm ($CaCO_3$), iron measurements in ppm (mg/L)]

Field No.	Site description	Sample Description	latitude degrees	longitude degrees	pH	conductivity	total alkalinity	total hardness	soluble iron	total iron
B-1	Beavertown Creek above Prickly Pear Creek	sand and gravel	46.3760	-112.0306	7.67	135	80	180		0.4
B-100	upper Beavertown Creek	sand	46.3490	-112.0469	7.43	173				
C-1	upper South Fork Quartz Creek	monzonite sand and gravel	46.4047	-112.1824	7.23	115				
C-2	Quartz Creek below North and South Forks	medium sand	46.4080	-112.1344	7.60	192				
C-3	Kady Gulch	coarse and medium sand	46.3856	-112.1414	7.25	183				
C-4	Clancy Creek above Quartz Creek	sand and gravel	46.4023	-112.1194	dry	246				
C-5	Clancy Creek below Quartz Creek	coarse and medium sand	46.4110	-112.1139	7.50	1222				
C-6	Clancy Creek above Prickly Pear Creek	coarse and medium sand	46.4658	-111.9856	7.78	151	90	140	0.0	
C-100	tributary to Clancy Creek from Gregory Mountain	medium sand	46.3889	-112.1186	3.96	142	<50	400	4.0	
C-101	upper Clancy Creek	medium sand	46.3833	-112.1301	7.15	184	<50	105	0.0	
C-102	North Fork Quartz creek above South Fork	sand and gravel	46.4102	-112.1475	7.46	145				
C-103	South Fork Quartz creek above North Fork	sand and gravel, some Mn-oxide	46.4083	-112.1492	7.52	105				
C-104	South Fork Quartz creek	sand and gravel	46.4077	-112.1599	7.56	86	<50	<100	0.0	
D-1	Dutchman Creek above Prickly Pear Creek	medium sand	46.4167	-111.9997	7.32	67				
G-1	Golconda Gulch above Warm Springs Creek	sand and gravel	46.3655	-112.0062	7.45	74				
L-1	south tributary to upper Lump Gulch	sand and gravel	46.4291	-112.2061	6.92	510				
L-2	upper Lump Gulch, above mines	sand	46.4415	-112.2064	6.97	402		<110		0.0
L-3a	north outlet of lower Frohner Meadow	sediment below meadow, Mn-oxide	46.4341	-112.1896	6.27	108				
L-3b	south outlet of lower Frohner Meadow	sediment below meadow	46.4367	-112.1879	6.27	186		230		0.4
L-4	below impoundment on upper Lump Gulch	silt, fine sand, muck	46.4368	-112.1722	6.82	124				
L-4a	above impoundment on upper Lump Gulch	sandy, Fe-oxide	46.4354	-112.1767	6.65	232				
L-5	Lump Gulch above Corral Gulch	sand and gravel	46.4576	-112.1067	6.93	133				
L-6	Corral Gulch above Lump Gulch	coarse sand	46.4602	-112.1053	6.89	270				
L-7	Lump Gulch above Buffalo Creek	sand and grave	46.4775	-112.0749	7.20	180				
L-8	Buffalo Creek above Lump Gulch	sand and gravel	46.4787	-112.0742	7.31	89				

Field No.	Site description	Sample Description	latitude degrees	longitude degrees	pH	conductivity	total alkalinity	total hardness	soluble iron	total iron
L-9	Lump Gulch below Little Buffalo Gulch	sand and gravel	46.4846	-112.0377	7.70	72		100		0.1
L-100	Lump Gulch east of Frohner mine	Sand and gravel	46.4428	-112.1994	6.85	89	<50	<100	0.2	2.0
PP-1	upper Prickly Pear Creek	sand and gravel	46.3590	-111.9730	7.50	72				
PP-2	Prickly Pear Creek above Beavertown Creek	sand and gravel	46.3741	-112.0240	7.45	257	<50	<100	0.0	
PP-3	Prickly Pear Creek between Beavertown and Dutchman Creeks	medium sand	46.4019	-112.0144	7.98	271				
PP-4	Prickly Pear Creek below Warm Springs Creek	medium sand, mod. Fe-oxide	46.4550	-111.9841	7.93	110	80	<100	0.0	
PP-5	Prickly Pear Creek at USGS gauging station	medium sand	46.5192	-111.9458	8.18	270				
S-1	Wood Chute Gulch, upper Spring Creek tributary	medium sand	46.3478	-112.1667	7.51					
S-1a	Curtain Gulch, upper Spring Creek tributary	sand, w/ Fe-oxide coatings	46.3563	-112.1619	7.05	556		150	0.2	9.0
S-2	upper Spring Creek	medium sand from burn area	46.3410	-112.1321	dry	471				
S-3	Spring Creek above Corbin	sand	46.3763	-112.0632	7.50					
S-4	Spring Creek above Jefferson City	sand and gravel, Mn-oxide	46.3889	-112.0272	7.98		80	300		0.0
S-100	Wood Chute Gulch, above Spring Creek	coarse sand, Mn-oxide	46.3477	-112.1377	dry					
S-101	tributary to Spring Creek, above Corbin	sand	46.3815	-112.0806	dry	87				
S-102	tributary to Spring Creek, above Corbin	sand, possible alkali salts	46.3803	-112.0847	dry	226				
WS-1	upper Middle Fork Warm Springs Creek	coarse and medium sand	46.4194	-111.8840	6.86	199				
WS-2	upper Middle Fork Warm Springs Creek	sand and gravel	46.4172	-111.8939	7.95	217	75	120	0.0	
WS-2a	upper Middle Fork Warm Springs Creek	tailings impacted sand	46.4178	-111.8969	7.47	181	125	75	0.0	
WS-3	Middle Fork Warms Springs Creek above North Fork	grus and rhyolite derived sand	46.4226	-111.9277	7.72	90	75	130	0.0	
WS-4	North Fork Warm Springs Creek	sand	46.4246	-111.9290	7.67	137				
WS-5	South Fork Warms Springs Creek	sand and gravel	46.4197	-111.9456	7.58	93				
WS-7	Warm Springs Creek above Prickly Pear Creek	sand and gravel	46.4425	-111.9669	7.70	102	50	<100	0.0	
WS-100	unnamed tributary above upper Middle Fork Warms Springs Creek	sand and gravel, weak Fe-oxide	46.4200	-111.8869	6.45	265				
WS-101	unnamed tributary south of upper Middle Fork Warm Springs Creek	sand	46.4165	-111.8931	6.82					
WS-102	unnamed tributary south of upper Middle Fork Warm Springs Creek	medium and fine sand, some Fe-oxide	46.4166	-111.8922	7.79					
WS-103a	upper Middle Fork Warm Springs Creek	composite fluvial tailings	46.4178	-111.8969	dry					
WS-103b	upper Middle Fork Warm Springs Creek	4 inches of soil over fluvial tailings	46.4178	-111.8969	dry					

Appendix 6. Mixed acid total digestion ICP-AES results from streambed sediments collected October 2000 from the upper Prickly Pear Creek watershed. [Analyzed by David Fey, USGS]

Field No.	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	K %	Mg %	Mn ppm	Mo Ppm	Na %	Ni ppm	P %	Pb ppm	Ti %	Sr ppm	Th ppm	V ppm	Zn ppm
B-1	< 2	7.5	14	820	2	1.8	6	14	36	130	5.6	2.9	0.60	3,900	11	1.7	19	0.13	58	0.26	470	54	130	1,100
B-100	< 2	7.5	15	590	2	2.4	3	14	19	110	3.6	2.7	1.1	1,500	8	1.8	15	0.15	36	0.42	390	32	86	140
C-1	< 2	8.0	44	690	2	2.2	15	23	50	59	6.9	2.4	0.90	4,200	4	1.7	20	0.15	340	0.54	370	33	210	1,800
C-2	< 2	8.4	14	840	2	2.5	5	10	25	21	3.8	2.6	0.81	2,800	2	2.4	13	0.16	63	0.37	510	31	99	580
C-3	< 2	7.6	51	820	2	1.4	12	14	43	50	5.1	3.1	0.78	7,100	4	0.90	21	0.12	230	0.38	290	23	140	1,400
C-4	11	6.9	1,300	790	3	1.4	51	22	60	700	5.8	2.5	0.73	12,000	3	1.0	35	0.16	1,400	0.26	280	15	150	7,400
C-5	< 2	8.1	120	760	2	2.2	8	10	28	63	3.8	2.9	0.72	1,700	< 2	2.2	13	0.14	170	0.32	480	29	110	760
C-6	< 2	8.0	37	700	2	2.4	7	20	44	42	7.0	2.3	0.79	980	< 2	2.2	15	0.16	95	0.34	470	32	210	480
C-100	7	7.4	730	1,000	2	0.76	4	7	30	88	4.3	3.2	0.50	660	< 2	1.6	11	0.09	450	0.24	380	13	66	400
C-101	< 2	7.5	49	890	2	1.5	5	20	60	70	4.8	2.6	1.2	3,200	< 2	0.78	22	0.11	100	0.33	310	10	130	840
C-102	2	8.2	< 10	790	2	2.1	4	12	40	13	5.6	2.1	0.50	880	< 2	2.8	11	0.14	32	0.26	570	17	160	90
C-103	< 2	8.1	49	950	2	2.4	12	18	33	43	5.8	2.7	0.82	8,700	2	1.8	18	0.16	150	0.40	440	33	150	1,800
C-104	< 2	7.6	36	710	2	2.0	12	18	42	53	5.6	2.5	0.80	2,300	3	1.8	16	0.13	180	0.39	420	24	180	1,200
D-1	< 2	7.4	< 10	640	2	2.6	6	21	58	26	8.9	2.0	0.83	700	7	2.3	14	0.17	20	0.43	480	140	280	54
G-1	4	7.3	100	480	2	2.5	8	22	42	55	8.5	2.4	1.1	1,200	6	1.8	15	0.13	840	0.44	310	120	230	600
L-1	< 2	9.3	18	940	2	1.6	3	< 1	12	15	2.2	2.1	0.34	550	< 2	3.0	7	0.06	44	0.18	670	22	50	140
L-2	< 2	8.9	20	900	2	1.9	3	< 1	12	25	2.4	1.9	0.44	810	< 2	2.8	9	0.08	32	0.19	660	16	51	76
L-3a	< 2	8.1	400	1,600	2	1.6	51	30	10	85	4.7	2.0	0.31	17,000	23	2.6	17	0.10	180	0.13	650	11	51	4,600
L-3b	4	6.7	1,600	1,600	3	1.1	170	130	9	290	8.4	1.6	0.26	30,000	8	1.5	40	0.13	660	0.09	380	38	47	12,000
L-4	< 2	7.8	30	660	3	2.2	18	14	29	55	4.6	2.4	0.84	2,600	3	2.2	16	0.13	52	0.38	420	29	120	1,300
L-4a	< 2	9.3	83	970	2	1.9	21	7	11	28	3.8	2.3	0.45	2,400	2	3.1	10	0.09	63	0.20	690	35	57	2,100
L-5	< 2	7.2	28	860	2	2.0	11	35	83	21	13	2.2	0.56	1,300	2	2.4	17	0.14	39	0.27	520	28	400	610
L-6	< 2	8.4	< 10	700	3	2.7	4	11	21	34	4.8	2.6	0.65	1,600	7	2.5	12	0.17	24	0.30	600	39	130	74
L-7	< 2	7.2	16	720	2	2.4	11	44	89	28	14	2.1	0.62	920	2	2.2	18	0.15	40	0.32	460	94	430	510
L-8	< 2	7.2	14	530	2	2.9	4	27	40	50	6.5	2.0	1.0	2,500	13	1.9	17	0.16	17	0.53	440	23	200	110
L-9	< 2	4.9	16	750	< 1	2.2	20	90	210	27	30	1.4	0.66	1,700	3	1.4	34	0.24	18	0.52	290	230	1000	310
L-100	45	7.6	3,900	1,000	3	0.99	110	140	9	400	5.8	1.9	0.27	29,000	9	1.6	33	0.06	4,900	0.09	390	24	44	7,700
PP-1	< 2	7.1	15	590	2	3.4	4	22	130	23	5.4	2.5	2.1	1,200	2	1.8	39	0.16	25	0.60	420	43	160	150
PP-2	< 2	7.2	21	550	2	3.0	5	15	69	29	4.6	2.4	1.3	1,000	2	1.9	20	0.14	120	0.43	410	60	140	240
PP-3	15	5.9	390	620	2	1.5	19	9	39	420	4.6	2.1	0.62	10,000	6	1.2	16	0.11	2,400	0.28	270	30	120	3,300
PP-4	5	7.6	110	620	3	2.3	11	10	25	150	3.8	2.4	0.89	2,800	2	1.9	13	0.12	580	0.35	440	36	100	1,900
PP-5	2	6.6	59	680	2	2.8	12	42	140	71	14	1.8	0.98	2,200	3	1.8	22	0.26	230	0.61	380	150	470	910
S-1	< 2	7.2	55	800	1	1.2	4	20	50	40	4.5	2.6	1.4	1,100	< 2	0.66	18	0.13	68	0.42	250	9	140	180

Field No.	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	K %	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P %	Pb ppm	Ti %	Sr ppm	Th ppm	V ppm	Zn ppm
S-1a	53	6.4	820	800	2	0.76	140	120	38	5,000	10	2.2	0.69	28,000	7	0.35	49	0.13	4,400	0.01	190	24	110	9,200
S-2	< 2	7.8	21	920	2	1.7	3	7	42	24	2.6	2.3	0.77	560	< 2	1.6	14	0.08	39	0.27	490	7	71	110
S-3	< 2	7.7	34	710	2	2.0	12	15	42	51	5.7	2.5	0.80	2,400	3	1.8	16	0.13	180	0.38	420	23	180	1,200
S-4	36	5.0	780	620	2	1.2	52	5	32	960	5.3	1.9	0.48	22,000	4	0.75	16	0.09	5,400	0.17	230	25	110	7,300
S-100	11	7.6	500	720	2	1.4	38	60	63	3,200	7.0	2.0	1.2	9,800	3	0.69	28	0.18	1,100	0.22	240	10	140	2,300
S-101	4	7.7	56	660	2	2.3	9	38	97	330	9.1	2.6	1.3	980	< 2	1.4	25	0.19	240	0.56	320	39	330	600
S-102	5	8.2	46	690	3	1.8	32	40	61	4,700	6.4	2.4	1.1	5,200	2	1.4	31	0.15	570	0.25	370	22	180	4,400
WS-1	< 2	7.6	18	500	2	3.4	7	29	64	25	7.4	2.8	1.8	1,300	< 2	1.9	20	0.13	36	0.71	370	45	270	110
WS-2	< 2	7.0	1,500	500	2	2.6	16	42	36	92	6.5	2.4	1.5	6,100	3	1.4	25	0.14	290	0.60	300	46	170	2,800
WS-2a	< 2	6.3	1,700	440	2	1.6	12	26	47	78	6.5	2.4	0.95	2,800	4	0.99	18	0.11	380	0.49	200	44	200	1,800
WS-3	< 2	7.2	850	490	3	2.2	14	26	52	180	7.1	2.7	1.2	2,100	2	1.4	18	0.14	300	0.61	270	65	230	1,800
WS-4	< 2	7.9	11	520	3	2.3	4	12	28	60	4.2	2.7	1.0	1,000	2	2.2	15	0.12	37	0.42	380	46	120	110
WS-5	< 2	7.0	19	540	2	3.0	6	28	69	21	9.2	1.8	1.4	1,100	< 2	1.8	19	0.15	25	0.65	390	88	300	83
WS-7	< 2	7.1	98	510	2	2.3	5	18	32	27	5.0	2.4	0.98	930	2	1.9	13	0.12	70	0.44	350	39	150	430
WS-100	< 2	7.0	20	540	2	3.0	6	37	84	29	10	2.6	1.8	1,400	2	1.6	23	0.14	44	0.88	280	67	340	150
WS-101	< 2	7.0	26	510	2	3.3	10	41	98	28	12	2.2	2.0	1,600	2	1.7	25	0.19	44	0.96	320	54	440	160
WS-102	4	7.3	2,400	480	3	2.5	22	45	32	120	6.8	2.6	1.6	8,600	6	1.4	30	0.14	450	0.54	320	30	160	4,700
WS-103a	6	6.1	2,400	310	2	0.44	5	2	15	95	2.7	3.0	0.32	400	6	0.54	5	0.08	830	0.22	90	25	69	370
WS-103b	3	6.5	3,000	410	3	1.4	16	26	29	160	4.9	2.6	0.92	2,300	13	0.90	15	0.10	500	0.40	190	29	120	1,300

Appendix 7. Results of NURE streambed sediment sample reanalysis by ICP-AES using mixed acid total digestion from the upper Prickly Pear Creek watershed.

[Analyzed by David Fey, USGS]

Field No	ID	Lat	Long	Al	Ca	Fe	K	Mg	Na	P	Ti	Ag	As	Ba	Be	Cd	Co	Cr	Cu	Li	Mn	Mo	Ni	Pb	Sc	Sr	Th	V	Zn
				%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
300033	1023214	46.4883	-112.06	7.6	3.0	3.2	2.1	1.2	2.2	0.14	0.33	< 2	15	440	2	3	9	22	30	19	810	< 2	13	27	16	400	30	87	92
300040	1023221	46.4928	-112.12	7.9	2.4	2.8	2.2	0.77	2.1	0.11	0.31	< 2	< 10	570	3	3	12	19	98	17	950	24	12	25	12	450	39	82	84
300043	1023224	46.4583	-112.11	7.9	2.0	11	2.4	0.61	2.4	0.13	0.29	< 2	17	840	2	7	30	76	29	18	970	4	17	32	12	490	47	340	160
300049	1023230	46.4375	-112.07	8.0	2.7	11	1.9	0.83	2.6	0.23	0.39	< 2	13	770	2	7	30	78	34	21	700	2	18	22	14	560	71	330	68
300052	1023233	46.3842	-112.11	7.5	0.76	1.7	2.4	0.53	1.8	0.08	0.15	< 2	40	950	2	3	< 1	37	29	25	420	< 2	15	93	5	420	10	40	140
300053	1023234	46.3822	-112.09	8.0	1.0	1.9	2.4	0.67	1.7	0.07	0.18	< 2	13	860	2	2	1	52	26	34	540	< 2	18	53	6	430	10	44	130
300054	1023235	46.3814	-112.08	7.2	2.2	8.2	2.3	1.1	1.3	0.19	0.55	3	60	650	2	9	33	90	340	21	1,200	3	24	220	18	290	31	300	650
300055	1023236	46.3861	-112.06	7.2	2.1	6.9	2.1	1.3	1.3	0.18	0.55	< 2	52	660	2	8	32	62	150	35	1,900	3	22	260	20	290	37	230	450
300061	1023242	46.4214	-112.00	8.2	2.6	5.6	2.3	1.1	2.1	0.24	0.48	< 2	16	680	2	4	19	36	59	37	930	4	18	30	17	410	72	170	100
300062	1023243	46.3997	-112.03	8.0	2.0	4.6	2.2	0.76	2.1	0.15	0.35	< 2	19	790	2	4	10	38	68	33	720	3	14	44	11	450	78	140	140
300069	1023245	46.3728	-112.14	6.9	1.5	6.2	2.1	1.4	0.56	0.12	0.36	3	77	790	2	8	33	76	190	29	7,000	3	32	180	18	270	11	150	1,400
300072	1023248	46.3353	-112.12	8.0	1.9	2.1	2.8	0.77	2.1	0.06	0.23	< 2	55	1,100	2	2	1	47	19	36	480	< 2	15	240	7	640	11	56	120
300079	1023255	46.3436	-112.10	8.2	0.40	7.3	3.2	0.60	0.60	0.15	0.22	< 2	53	640	2	5	7	21	560	13	150	120	10	65	14	200	24	120	69
300080	1023256	46.3600	-112.08	4.9	3.4	11	1.9	1.5	0.32	0.09	0.17	25	16,000	310	1	56	36	27	400	20	7,400	< 2	28	4,200	11	150	8	85	7,600
300081	1023257	46.3556	-112.11	7.4	0.94	3.2	2.6	0.51	1.3	0.09	0.19	60	210	570	2	12	6	29	370	36	1,700	7	10	6,900	8	360	10	54	1,700
300090	1023262	46.3619	-112.11	7.0	3.0	7.7	1.8	1.8	1.4	0.13	0.51	< 2	20	560	2	6	29	52	82	48	1,300	< 2	22	45	24	300	88	240	120
300092	1023264	46.3303	-112.05	5.8	1.4	3.7	1.6	0.92	0.60	0.23	0.29	< 2	39	430	4	4	50	26	390	22	2,100	26	30	76	12	180	25	85	250
300187	1023341	46.3414	-112.05	8.1	1.8	3.5	2.5	0.69	2.1	0.13	0.30	7	490	780	2	8	8	33	190	19	1,400	< 2	13	630	11	450	28	100	1,200
300233	1023363	46.4208	-112.09	7.4	2.7	5.5	2.4	2.8	1.3	0.18	0.50	< 2	15	800	1	4	41	440	110	21	1,500	2	150	27	17	340	6	180	110
300018	2020047	46.4119	-111.94	7.6	3.2	4.8	1.8	1.1	2.4	0.15	0.44	< 2	11	490	2	4	13	45	26	19	850	< 2	19	24	20	420	100	150	64
300066	2020056	46.4133	-111.94	7.2	2.3	4.8	2.0	0.88	2.1	0.15	0.34	< 2	13	660	2	4	13	34	67	28	710	4	14	24	11	520	88	130	69
300342	2020063	46.4011	-111.98	6.6	2.8	4.8	2.0	1.8	1.5	0.18	0.47	< 2	19	580	2	5	20	180	48	25	1,100	< 2	44	58	16	370	22	160	180
300343	2020064	46.3542	-111.95	7.0	3.0	5.0	2.4	1.8	1.7	0.17	0.60	< 2	10	620	2	4	17	180	42	26	1,000	< 2	42	37	17	380	36	160	140
322160	2020491	46.3514	-111.96	8.6	3.6	4.3	2.3	1.2	1.6	0.17	0.45	< 2	15	680	2	4	19	35	51	53	1,200	3	20	42	16	380	38	130	100
300019	2020048	46.4786	-111.98	6.7	3.1	7.7	1.7	1.6	1.7	0.13	0.67	< 2	14	510	2	6	28	78	24	27	1,300	< 2	21	25	24	350	120	270	96

Appendix 8. 2M HCL-1% hydrogen peroxide partial-digestion ICP-AES results from streambed sediments collected October 2000 from the upper Prickly Pear Creek watershed. [Analyzed by David Fey, USGS]

Field No.	Ag/P ppm	Al/P pm	As/P pm	B/P pm	Ba/P pm	Be/P pm	Ca/P pm	Cd/P pm	Co/P pm	Cr/P pm	Cu/P pm	Fe/P pm	K/P pm	Li/P pm	Mg/P pm	Mn/P pm	Mo/P pm	Na/P pm	Ni/P pm	P/P pm	Pb/P pm	Sb/P pm	Si/P pm	Sr/P pm	Ti/P pm	V/P pm	Zn/P pm
B-1	0.3	2,500	8.4	2.1	180	0.51	5,100	4.3	8.7	1.8	85	17,000	780	2.2	1,900	4,000	2.8	84	14	1,300	32	<2	2,200	55	66	13	1,200
B-100	<0.3	3,400	14	1.6	100	0.41	4,900	1.4	7.6	6.3	76	14,000	1,400	4.2	2,700	1,100	2	76	7	1,400	31	<2	1,900	30	240	18	110
C-1	0.8	4,200	16	1.8	100	0.52	5,100	11	9.2	3.5	36	16,000	780	4.5	2,200	3,300	1.1	43	9.5	1,100	280	<2	1,700	29	250	22	1,400
C-2	0.33	3,700	9.9	1.6	170	0.31	5,000	3	6.5	3.7	16	13,000	920	5.1	2,600	2,400	0.74	44	6.4	1,300	50	<2	1,700	25	290	17	470
C-3	0.83	5,200	24	2.3	190	0.9	5,700	9.3	7.9	4.4	35	16,000	1,200	4.5	2,800	6,600	0.65	74	13	980	190	<2	1,800	48	98	19	1,300
C-4	9.3	6,500	840	2.6	200	1.7	5,400	51	14	4.3	640	17,000	1,100	4.4	2,300	11,000	<0.6	68	27	1,200	1300	<2	2,100	50	<2	14	7,200
C-5	0.94	3,800	84	1.5	100	0.34	4,500	6	6.8	3	50	11,000	1,200	5.2	2,600	1,500	<0.6	49	6.7	1,400	170	<2	1,800	20	270	16	780
C-6	0.43	3,200	29	1.3	96	0.26	4,600	2.5	5.4	2.7	43	7,900	1,500	6.1	2,600	700	<0.6	57	5.6	1,400	75	<2	1,500	20	370	15	410
C-100	2.3	3,200	650	2.7	71	0.28	2,000	2.2	6.5	2.1	52	22,000	710	2.8	1,600	540	<0.6	65	4.7	800	390	<2	1,500	13	52	8	270
C-101	1	4,100	13	1.1	80	0.49	3,300	2.1	8.4	6.5	37	12,000	710	3.8	2,600	2,300	<0.6	43	9	650	64	<2	1,300	26	2.5	14	550
C-102	<0.3	2,700	6.3	1.1	75	0.29	3,800	0.73	4.2	2.6	12	8,300	730	4.2	1,800	680	<0.6	40	3.9	1,100	18	<2	1,400	16	210	12	58
C-103	0.78	4,300	32	3	380	0.43	6,700	9.6	11	2.5	30	22,000	810	4.7	2,400	7,800	0.73	46	12	1,500	120	<2	2,200	50	190	21	1,700
C-104	0.81	4,600	17	1.8	130	0.5	5,800	11	9.3	4.1	39	16,000	930	5.1	2,600	2,200	0.74	44	9.4	1,300	190	<2	2,000	33	310	22	1,300
D-1	<0.3	3,100	3.1	0.93	74	<0.2	4,400	0.54	4.6	2.9	14	7,300	1,200	5.7	2,300	250	1	74	3.5	1,700	6.2	<2	1,600	35	360	17	25
G-1	2	3,600	33	1.2	61	0.28	3,700	3.3	5	2.5	31	9,500	990	6	2,300	610	1.1	61	3.9	1,000	580	<2	1,700	26	330	18	480
L-1	<0.3	2,900	12	0.69	120	0.35	3,100	1.3	3	1.9	12	6,800	430	4.1	1,200	480	<0.6	38	2.8	560	26	<2	1,400	31	140	9	100
L-2	<0.3	3,800	16	1.2	110	0.38	4,900	1	4.1	3.1	19	8,000	600	6.4	1,600	740	<0.6	51	4	550	20	<2	1,500	61	87	12	49
L-3a	1.1	3,100	400	2.8	930	0.68	4,000	58	36	<0.3	83	34,000	410	3.7	1,000	17,000	16	40	17	860	170	<2	2,200	70	<2	13	5,100
L-3b	2.9	5,200	1,400	5	900	2.3	4,200	160	98	<0.3	260	59,000	330	2	460	23,000	3.3	61	35	840	550	<2	2,200	73	<2	15	9,800
L-4	<0.3	3,700	25	1.8	150	0.56	4,200	14	5.6	2.3	29	11,000	1,300	6.1	2,200	2,000	0.6	58	6.6	980	38	<2	1,800	29	310	15	1,100
L-4a	0.35	3,400	78	2.9	200	0.41	3,400	20	12	0.6	23	25,000	590	4.9	1,800	2,500	0.93	50	6.7	940	50	<2	1,800	30	140	14	2,200
L-5	<0.3	3,000	14	1.2	130	0.23	4,200	3.8	6.6	2.6	18	11,000	1,000	6.1	2,400	1,200	<0.6	45	5.2	1,600	30	<2	1,700	21	330	16	660
L-6	<0.3	2,800	7	1.6	130	0.36	6,400	0.84	7.8	1.9	21	10,000	980	4.1	2,100	1,400	3.6	55	6.2	1,900	11	<2	1,700	35	160	14	47
L-7	<0.3	1,900	5.9	0.75	65	<0.2	3,400	2	3.5	1.8	15	5,900	730	3.6	1,500	500	0.66	39	3.5	1,200	20	<2	1,200	14	180	9.9	380
L-8	<0.3	2,900	6.6	1.6	110	0.41	4,400	1.1	13	2	34	11,000	1,400	3.3	2,000	2,000	5	72	8	1,400	12	<2	1,600	33	220	17	110
L-9	<0.3	2,700	8	1.4	100	0.26	5,400	3.2	7.2	3.4	22	8,800	1,200	4.6	1,900	1,000	2.2	90	6.7	2,200	17	<2	1,600	23	260	18	300
L-100	23	7,700	2,600	2	420	1.9	2,800	100	120	<0.3	310	29,000	370	4.2	410	24,000	3.6	40	30	350	4,200	<2	2,000	54	<2	4.4	6,800
PP-1	<0.3	4,800	5.1	1.2	59	0.2	5,100	1.2	5.5	18	15	9,200	1,400	10	3,800	310	<0.6	67	11	1,600	13	<2	2,000	29	700	24	88
PP-2	0.37	3,300	9.5	1.2	51	0.2	5,200	1.6	3.7	7.1	19	6,700	910	5.8	2,800	400	0.74	72	5.4	1,200	80	<2	1,500	28	350	16	180
PP-3	9.9	2,200	160	1.2	100	0.36	3,100	13	2.5	2.7	200	11,000	650	2.6	1,400	7,900	2.2	46	7.8	880	2,000	2.1	1,300	20	<2	13	2,500

Field No.	Ag/P pm	Al/P pm	As/P pm	B/P pm	Ba/P pm	Be/P pm	Ca/P pm	Cd/P pm	Co/P pm	Cr/P pm	Cu/P pm	Fe/P pm	K/P pm	Li/P pm	Mg/P pm	Mn/P pm	Mo/P pm	Na/P pm	Ni/P pm	P/P pm	Pb/P pm	Sb/P pm	Si/P pm	Sr/P pm	Ti/P pm	V/P pm	Zn/P pm
PP-4	3.5	3,200	72	1.7	100	0.97	4,700	7.6	5	3.4	84	10,000	1,300	5.8	2,500	2,600	0.87	110	5.6	1,500	590	<2	1,800	34	270	17	1,500
PP-5	1.4	2,500	31	1.3	85	0.36	5,700	2.8	3.3	3.3	34	7,100	1,100	4.9	2,000	1,500	0.62	78	4.7	2,200	210	<2	1,500	24	250	13	720
S-1	0.32	5,900	20	1.4	85	0.32	4,800	1.6	7.5	8.8	42	10,000	1,500	8.4	4,400	720	<0.6	75	6.8	1,100	52	<2	2,100	31	90	24	120
S-1a	39	6,200	450	5.2	100	1.2	3,700	140	95	<0.3	4,800	59,000	1,200	3.2	960	23,000	0.6	160	44	900	2,600	37	6,600	49	<2	12	8,700
S-2	<0.3	5,900	16	1.2	100	0.97	6,400	1.2	4.9	11	20	7,400	1,400	5.2	3,200	420	<0.6	81	6.4	610	23	<2	1,700	47	330	13	80
S-3	2.7	2,600	270	1.7	110	0.44	3,900	19	8.2	3.6	120	12,000	800	2.6	1,600	2,900	1.2	88	11	1,100	810	<2	1,600	40	27	12	1,000
S-4	32	2,400	450	2.2	210	0.74	6,200	47	<0.3	2.4	600	20,000	600	2.1	1,700	20,000	1.6	65	11	860	5,400	12	2,200	60	<2	8.4	6,600
S-100	8.9	10,000	370	2.3	120	0.95	4,300	38	41	7.7	2,900	27,000	1,600	9.4	3,900	9,100	<0.6	79	16	1,200	820	<2	2,100	35	<2	23	2,000
S-101	3.2	5,300	25	3.9	120	0.47	8,200	3.4	12	7	190	16,000	2,400	7.3	4,400	560	<0.6	76	10	1,800	210	<2	2,200	39	390	32	420
S-102	4	7,000	21	2.1	120	1.2	5,600	31	30	5.9	4,500	17,000	1,300	6.1	3,900	5,100	<0.6	100	21	1,400	480	<2	2,500	61	<2	21	4,300
WS-1	<0.3	5,600	20	1.8	65	0.26	4,800	1.2	8.3	5.5	13	14,000	2,300	12	4,500	500	<0.6	60	7.1	1,100	26	<2	2,600	24	880	37	82
WS-2	1.8	5,100	1,100	2.6	130	0.81	5,600	14	23	2	66	21,000	2,500	12	4,100	5,700	1.4	78	16	1,300	260	<2	2,600	38	650	28	2,900
WS-2a	1.5	3,000	1,200	1.9	82	0.64	4,000	9.3	11	4	61	17,000	1,300	5.4	2,200	2,300	2	61	8.5	980	330	<2	1,800	24	320	20	1,700
WS-3	0.77	3,100	530	1.8	70	0.68	3,400	9	7.6	3.2	39	12,000	1,300	5.8	2,300	1,200	0.94	50	7.4	960	200	<2	1,800	16	410	18	1,500
WS-4	<0.3	3,100	4.4	1.1	74	0.55	3,200	0.73	5.5	2.1	22	6,900	1,600	5.8	2,300	490	<0.6	46	4.6	800	17	<2	1,600	15	440	14	46
WS-5	<0.3	4,100	5.9	1.4	77	0.2	5,000	0.78	5.2	4.4	13	9,900	1,300	7	2,900	240	0.6	87	4.7	1,400	9	<2	1,700	29	490	26	35
WS-7	1.1	3,300	74	1.2	77	0.33	4,000	2.3	5.3	3.2	19	9,300	1,500	6.4	2,700	480	<0.6	60	4.9	1,200	41	<2	1,700	19	520	21	360
WS-100	<0.3	5,500	26	1.9	80	0.33	5,000	1.7	8.6	5.9	22	14,000	2,200	10	4,300	640	0.65	54	7.8	1,200	48	<2	2,400	24	780	35	110
WS-101	<0.3	4,800	8.2	1.8	63	0.23	4,400	0.95	6.8	4.2	12	11,000	1,900	12	3,600	440	<0.6	52	5.6	1,000	27	<2	2,200	24	770	28	62
WS-102	2.2	5,000	1,700	3	120	1	5,400	20	29	1.9	83	26,000	2,400	11	3,700	8100	1.8	85	21	1,300	380	<2	2,800	43	570	26	4,700
WS-103a	3	800	1,800	1.5	32	0.33	1,200	3	3.3	2	67	15,000	400	0.92	430	300	2.7	21	2.1		690	<2	860	3	74	6.7	250
WS-103b	2.5	3,700	2,800	3	82	0.93	3,600	16	19	4.1	150	25,000	1,300	5.5	2,100	2,200	2.5	53	8.4	920	480	<2	1,900	28	280	24	1,400

Appendix 9. Mercury in water, filtered and unfiltered samples by CV-FAAS from upper Prickly Pear Creek watershed.

[Samples collected by Terry Klein, USGS, in October 2000 and analyzed by James Crock, USGS. Detection limit is 0.005 µg/l]

Field Number	Sample Type	Hg, ppb	Field Number	Sample Type	Hg, µg/l
L-3b-F	water, filtered	0.006	WS-3-F	water, filtered	<0.005
L-3b-U	water, unfiltered	<0.005	WS-3-U	water, unfiltered	<0.005
L-2-F	water, filtered	<0.005	WS-2a-U	water, unfiltered	<0.005
L-2-U	water, unfiltered	<0.005	WS-2a-F	water, filtered	<0.005
L-9-U	water, unfiltered	<0.005	WS-2-U	water, unfiltered	<0.005
L-9-F	water, filtered	<0.005	WS-2-F	water, filtered	<0.005
S-1a-U	water, unfiltered	0.005	BL-1000	blank water, filtered	<0.005
S-1a-F	water, filtered	<0.005	BL-000	Blank water, unfiltered	<0.005
S-4-F	water, filtered	<0.005	BL-1002	blank water, filtered	<0.005
S-4-U	water, unfiltered	0.005			
B-1-U	water, unfiltered	0.005			
B-1-F	water, filtered	<0.005			
C-100-F	water, filtered	<0.005			
C-100-U	water, unfiltered	<0.005			
C-101-U	water, unfiltered	<0.005			
C-101-F	water, filtered	<0.005			
PP-4-U	water, unfiltered	<0.005			
PP-4-F	water, filtered	<0.005			
C-104-U	water, unfiltered	<0.005			
C-104-F	water, filtered	<0.005			
C-6-U	water, unfiltered	<0.005			
C-6-F	water, filtered	<0.005			
PP-2-U	water, unfiltered	<0.005			
PP-2-F	water, filtered	<0.005			
L-100-F	water, filtered	<0.005			
L-100-U	water, unfiltered	<0.005			
WS-7-U	water, unfiltered	<0.005			
WS-7-F	water, filtered	<0.005			

Appendix 10. Provisional biology data from streams in the upper Prickly Pear Creek watershed, Montana, 2000. All measurements are as µg/g dry weight. BIO=biofilm, FIL=filet, INV=benthic macroinvertebrates, PC=pyloric caeca, WF = Whole Fish.

Aquatic Vegetation, Biofilm, and Benthic Macroinvertebrates

Site ID	Date	Sample ID	Type	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
WS3	10/2/00	WS3-INV-1	INV	35.16	3.63	44.82	21.70	0.67
WS3	10/2/00	WS3-INV-2	INV	53.64	4.24	38.40	27.10	0.68
WS3	10/2/00	WS3-INV-3	INV	79.46	7.38	40.16	38.00	0.71
WS3	10/2/00	WS3-INV-4	INV	34.80	4.33	49.80	18.90	0.65
WS3	10/2/00	No Biofilm	BIO					
WS3	10/2/00	No Biofilm	BIO					
WS3	10/2/00	No Biofilm	BIO					
WS3	10/2/00	No Biofilm	BIO					
WS3	10/5/00	No Plants	PL					
WS3	10/5/00	No Plants	PL					
WS3	10/5/00	No Plants	PL					
WS3	10/5/00	No Plants	PL					
PP1	10/5/00	PP1-INV-1	INV	2.36	1.23	15.12	2.18	0.22
PP1	10/5/00	PP1-INV-2	INV	0.31	1.19	17.08	1.29	0.19
PP1	10/5/00	PP1-INV-3	INV	-1.05	1.15	18.92	1.20	0.20
PP1	10/5/00	PP1-INV-4	INV	-0.73	1.05	20.59	0.97	0.19
PP1	10/5/00	No Biofilm	BIO					
PP1	10/5/00	No Biofilm	BIO					
PP1	10/5/00	No Biofilm	BIO					
PP1	10/5/00	No Biofilm	BIO					
PP1	10/5/00	PP1-PL-1	PL	3.11	1.24	9.89	7.14	0.06
PP1	10/5/00	PP1-PL-2	PL	6.17	1.38	16.75	10.67	0.11
PP1	10/5/00	PP1-PL-3	PL	4.03	1.82	13.65	9.16	0.07
PP1	10/5/00	PP1-PL-4	PL	2.93	0.82	11.52	8.03	0.06
PP3	10/3/00	PP3-INV-1	INV	27.49	7.98	119.76	281.00	1.65
PP3	10/3/00	PP3-INV-2	INV	13.21	7.06	85.52	157.00	1.18
PP3	10/3/00	PP3-INV-3	INV	56.38	10.5	181.85	493.00	2.47
PP3	10/3/00	PP3-INV-4	INV	10.94	12.4	50.40	109.00	0.99
PP3	10/3/00	No Biofilm	BIO					
PP3	10/3/00	No Biofilm	BIO					
PP3	10/3/00	No Biofilm	BIO					
PP3	10/3/00	No Biofilm	BIO					
PP3	10/3/00	PP3-PL-1	PL	136.75	27.70	255.81	761.25	3.95
PP3	10/3/00	PP3-PL-2	PL	82.10	21.50	223.66	727.33	3.35
PP3	10/3/00	PP3-PL-3	PL	110.76	22.40	184.53	733.42	2.71
PP3	10/3/00	PP3-PL-4	PL	65.86	27.50	145.72	563.28	3.31
PP5	10/6/00	PP5-INV-1	INV	7.42	1.63	38.49	34.70	0.65
PP5	10/6/00	PP5-INV-2	INV	7.74	2.27	43.63	41.80	0.79
PP5	10/6/00	PP5-INV-3	INV	7.61	1.98	39.30	54.60	0.64
PP5	10/6/00	PP5-INV-4	INV	10.68	1.98	51.68	54.80	0.81
PP5	10/6/00	PP5-INV-5	INV					
PP5	10/6/00	PP5-INV-6	INV	11.58	2.31	44.66	62.50	0.73
PP5	10/6/00	PP5-INV-7	INV	8.45	1.71	42.19	39.80	0.73
PP5	10/6/00	PP5-INV-8	INV	13.18	2.23	55.75	56.60	0.81
PP5	10/6/00	No Biofilm	BIO					
PP5	10/6/00	No Biofilm	BIO					
PP5	10/6/00	No Biofilm	BIO					
PP5	10/6/00	No Biofilm	BIO					
PP5	10/6/00	PP5-PL-1	PL	38.37	10.6	40.16	169.45	3.07
PP5	10/6/00	PP5-PL-2	PL	62.75	26.6	85.92	279.79	6.22
PP5	10/6/00	PP5-PL-3	PL	55.78	14.8	84.54	254.00	5.93

Site ID	Date	Sample ID	Type	mg As	mg Cd	mg Cu	mg Pb	mg Zn
PP5	10/6/00	PP5-PL-4	PL	49.18	17.7	63.08	197.78	5.41
C5	10/5/00	C5-INV-1	INV	12.79	2.81	36.67	16.80	0.34
C5	10/5/00	C5-INV-2	INV	14.71	5.53	42.94	37.20	0.64
C5	10/5/00	C5-INV-3	INV	13.75	2.93	32.21	15.40	0.36
C5	10/5/00	C5-INV-4	INV	19.73	3.03	36.53	25.30	0.43
C5	10/5/00	No Biofilm	BIO					
C5	10/5/00	No Biofilm	BIO					
C5	10/5/00	No Biofilm	BIO					
C5	10/5/00	No Biofilm	BIO					
C5	10/5/00	C5-PL-1	PL	115.75	7.62	49.23	133.32	1.20
C5	10/5/00	C5-PL-2	PL	255.45	14.8	81.50	210.73	2.05
C5	10/5/00	C5-PL-3	PL	195.47	16.1	78.65	188.19	2.55
C5	10/5/00	C5-PL-4	PL	169.19	17.9	74.02	174.23	2.63
L5	10/6/00	L5-INV-1	INV	0.89	1.49	29.78	2.11	0.62
L5	10/6/00	L5-INV-2	INV	4.40	2.85	35.75	3.56	1.07
L5	10/6/00	L5-INV-3	INV	1.38	7.74	32.52	1.53	0.88
L5	10/6/00	L5-INV-4	INV	4.31	5.14	29.49	3.64	0.93
L5	10/6/00	No Biofilm	BIO					
L5	10/6/00	No Biofilm	BIO					
L5	10/6/00	No Biofilm	BIO					
L5	10/6/00	No Biofilm	BIO					
L5	10/6/00	L5-PL-1	PL	17.19	5.34	20.54	13.42	1.57
L5	10/6/00	L5-PL-2	PL	13.81	2.95	15.47	15.38	0.95
L5	10/6/00	L5-PL-3	PL	31.81	8.6	26.74	18.53	2.09
L5	10/6/00	L5-PL-4	PL	21.63	5.2	20.15	11.94	1.70
L5	10/6/00	L5-PL-5	PL					
L5	10/6/00	L5-PL-6	PL	27.58	5.07	24.18	18.65	1.66
L5	10/6/00	L5-PL-7	PL	16.32	2.92	15.27	14.29	0.80
L5	10/6/00	L5-PL-8	PL	20.45	4.86	20.94	12.55	1.71
L5	10/6/00	L5-PL-9	PL	18.82	5.55	20.43	12.10	1.73
L5	10/6/00	L5-PL-10	PL					
WS7	10/3/00	WS7-INV-1	INV	9.46	1.95	38.32	16.50	0.38
WS7	10/3/00	WS7-INV-2	INV	17.24	2.43	38.17	11.30	0.37
WS7	10/3/00	WS7-INV-3	INV	10.70	1.72	42.63	7.31	0.37
WS7	10/3/00	WS7-INV-4	INV	8.18	1.25	32.93	4.58	0.38
WS7	10/3/00	WS7-BIO-1	BIO	75.55	1.12	12.92	35.07	0.29
WS7	10/3/00	WS7-BIO-2	BIO	248.14	1.01	8.74	24.86	0.20
WS7	10/3/00	WS7-BIO-3	BIO	30.36	1.07	7.69	18.52	0.14
WS7	10/3/00	WS7-BIO-4	BIO	48.56	1.2	8.97	22.45	0.21
WS7	10/5/00	WS7-PL-1	PL	207.42	3.24	34.01	100.16	0.54
WS7	10/5/00	WS7-PL-2	PL	103.03	4.03	21.11	45.62	0.78
WS7	10/5/00	WS7-PL-3	PL	107.98	2.96	20.64	41.76	0.74
WS7	10/5/00	WS7-PL-4	PL	106.48	3.41	22.96	47.19	0.81
PP4	10/3/00	PP4-INV-1	INV	8.63	3.13	29.52	35.80	0.63
PP4	10/3/00	PP4-INV-2	INV	13.47	3.07	39.81	34.60	0.76
PP4	10/3/00	PP4-INV-3	INV	11.47	3.53	41.77	37.60	0.73
PP4	10/3/00	PP4-INV-4	INV	15.68	3	47.55	61.40	0.78
PP4	10/3/00	PP4-BIO-1	BIO	53.37	16.2	109.00	368.00	4.18
PP4	10/3/00	PP4-BIO-2	BIO	53.78	22.6	128.00	414.00	3.64
PP4	10/3/00	PP4-BIO-3	BIO	65.27	17.3	134.00	396.00	3.82
PP4	10/3/00	PP4-BIO-4	BIO	58.40	15.1	120.00	381.00	3.45

Site ID	Date	Sample ID	Type	µg As	µg Cd	µg Cu	µg Pb	µg Zn
PP4	10/3/00	No Plants	PL					
PP4	10/3/00	No Plants	PL					
PP4	10/3/00	No Plants	PL					
PP4	10/3/00	No Plants	PL					
WS2	10/3/00	WS2-INV-1	INV	94.78	6	34.92	18.80	0.99
WS2	10/3/00	WS2-INV-2	INV	107.26	5.72	31.61	17.90	0.92
WS2	10/3/00	WS2-INV-3	INV	244.84	5.79	33.53	37.10	0.99
WS2	10/3/00	WS2-INV-4	INV	157.70	4.72	35.12	24.20	1.00
WS2	10/3/00	No Biofilm	BIO					
WS2	10/3/00	No Biofilm	BIO					
WS2	10/3/00	No Biofilm	BIO					
WS2	10/3/00	No Biofilm	BIO					
WS2	10/3/00	No Plants	PL					
WS2	10/3/00	No Plants	PL					
WS2	10/3/00	No Plants	PL					
WS2	10/3/00	No Plants	PL					
L8	10/4/00	L8-INV-1	INV	4.28	3.74	22.91	3.52	0.27
L8	10/4/00	L8-INV-2	INV	2.31	3.46	22.33	3.42	0.24
L8	10/4/00	No sample	INV					
L8	10/4/00	No sample	INV					
L8	10/4/00	No Biofilm	BIO					
L8	10/4/00	No Biofilm	BIO					
L8	10/4/00	No Biofilm	BIO					
L8	10/4/00	No Biofilm	BIO					
L8	10/4/00	No Plants	PL					
L8	10/4/00	No Plants	PL					
L8	10/4/00	No Plants	PL					
L8	10/4/00	No Plants	PL					
L7	10/4/00	L7-INV-1	INV	1.61	3.89	32.41	1.45	0.47
L7	10/4/00	L7-INV-2	INV	3.37	9.07	31.12	1.46	0.55
L7	10/4/00	L7-INV-3	INV	2.55	6.68	30.69	1.32	0.58
L7	10/4/00	L7-INV-4	INV	1.42	3.21	33.33	1.16	0.56
L7	10/4/00	No Biofilm	BIO					
L7	10/4/00	No Biofilm	BIO					
L7	10/4/00	No Biofilm	BIO					
L7	10/4/00	No Biofilm	BIO					
L7	10/5/00	L7-PL-1	PL	9.01	2.66	22.73	13.52	0.96
L7	10/5/00	L7-PL-2	PL	4.32	2	15.67	7.52	0.78
L7	10/5/00	L7-PL-3	PL	7.90	2.02	19.32	12.24	0.82
L7	10/5/00	L7-PL-4	PL	9.96	2.32	20.42	10.71	0.81
L3W	10/4/00	L3W-INV-1	INV	25.32	6.51	31.94	29.60	0.88
L3W	10/4/00	L3W-INV-2	INV	5.59	5.89	21.74	7.51	0.70
L3W	10/4/00	L3W-INV-3	INV	3.37	39.1	21.19	4.98	0.45
L3W	10/4/00	L3W-INV-4	INV	7.07	3.83	21.39	6.04	0.72
L3W	10/4/00	No Biofilm	BIO					
L3W	10/4/00	No Biofilm	BIO					
L3W	10/4/00	No Biofilm	BIO					
L3W	10/4/00	No Biofilm	BIO					
L3W	10/5/00	L3W-PL-1	PL	59.09	27.4	20.03	45.32	3.30
L3W	10/5/00	L3W-PL-2	PL	78.51	22.9	18.10	59.52	3.61
L3W	10/5/00	L3W-PL-3	PL	31.84	12.7	14.45	29.86	1.66
L3W	10/5/00	L3W-PL-4	PL	76.28	22.5	21.93	65.95	3.11
L3E	10/4/00	L3E-INV-1	INV	302.43	119	148.42	139.00	4.48
L3E	10/4/00	No inverts	INV					

Site ID	Date	Sample ID	Type	μg As	μg Cd	μg Cu	μg Pb	μg Zn
L3E	10/4/00	No inverts	INV					
L3E	10/4/00	No inverts	INV					
L3E	10/4/00	No Biofilm	BIO					
L3E	10/4/00	No Biofilm	BIO					
L3E	10/4/00	No Biofilm	BIO					
L3E	10/4/00	No Biofilm	BIO					
L3E	10/5/00	L3E-PL-1	PL	1,232.02	268	204.24	450.25	34.01
L3E	10/5/00	L3E-PL-2	PL	1,797.37	243	242.40	614.56	31.60
L3E	10/5/00	L3E-PL-3	PL	1,116.76	167	172.52	352.76	20.39
L3E	10/5/00	L3E-PL-4	PL	1,124.29	173	166.64	316.28	25.15
L3C	10/26/00	L3C-INV-1	INV	21.99	26	33.20	14.50	2.43
L3C	10/26/00	L3C-INV-2	INV	32.87	21.3	35.82	23.70	3.05
L3C	10/26/00	No inverts	INV					
L3C	10/26/00	No inverts	INV					
L3C	10/26/00	No Biofilm	BIO					
L3C	10/26/00	No Biofilm	BIO					
L3C	10/26/00	No Biofilm	BIO					
L3C	10/26/00	No Biofilm	BIO					
L3C	10/26/00	L3C-PL-1	PL	111.35	47.9	50.45	72.08	10.10
L3C	10/26/00	L3C-PL-2	PL	95.89	46.9	49.88	56.34	10.10
L3C	10/26/00	L3C-PL-3	PL	96.79	44.7	45.92	58.70	9.76
L3C	10/26/00	L3C-PL-4	PL	125.00	54.6	52.27	68.66	10.89

Individual Tissues

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
WS3	10/19/00	Brook	M	14	23	Gill						
WS3	10/19/00	Brook	M	15	26	Gill	PP-WS3-B1G	0.80	11.3	3.27	0.86	0.43
WS3	10/19/00	Brook	M	15	26	Gill						
WS3	10/19/00	Brook	-	11.5	9	Gill						
WS3	10/19/00	Brook	-	11.5	12	Gill						
WS3	10/19/00	Brook	F	13	17	Gill	PP-WS3-B2G	4.59	11.7	3.16	1.33	0.45
WS3	10/19/00	Brook	M	18.5	43	Gill						
WS3	10/19/00	Brook	F	12	13	Gill						
WS3	10/19/00	Brook	-	13	18	Gill						
WS3	10/19/00	Brook	M	13.5	20	Gill	PP-WS3-B3G	5.38	12.5	2.85	0.98	0.55
WS3	10/19/00	Brook	M	14.5	24	Gill						
WS3	10/19/00	Brook	F	13	17	Gill						
WS3	10/19/00	Brook	F	13	18	Gill						
WS3	10/19/00	Brook	F	13.5	21	Gill	PP-WS3-B4G	4.81	12	3.13	5.49	0.50
WS3	10/19/00	Brook	F	15	24	Gill						
WS3	10/19/00	Brook	M	14	23	Liver						
WS3	10/19/00	Brook	M	15	26	Liver	PP-WS3-B1L	0.73	12.4	191.78	1.25	0.34
WS3	10/19/00	Brook	M	15	26	Liver						
WS3	10/19/00	Brook	-	11.5	9	Liver						
WS3	10/19/00	Brook	-	11.5	12	Liver						
WS3	10/19/00	Brook	F	13	17	Liver	PR-WS3-B2L	0.42	14.6	78.00	0.41	0.27
WS3	10/19/00	Brook	M	18.5	43	Liver						
WS3	10/19/00	Brook	F	12	13	Liver						
WS3	10/19/00	Brook	-	13	18	Liver						
WS3	10/19/00	Brook	M	13.5	20	Liver	PP-WS3-B3L	3.35	14.6	174.30	0.24	0.31
WS3	10/19/00	Brook	M	14.5	24	Liver						
WS3	10/19/00	Brook	F	13	17	Liver						
WS3	10/19/00	Brook	F	13	18	Liver						
WS3	10/19/00	Brook	F	13.5	21	Liver	PP-WS3-B4L	11.58	25.4	265.20	0.56	0.38
WS3	10/19/00	Brook	F	15	24	Liver						
WS3	10/19/00	Brook	M	14	23	PC						
WS3	10/19/00	Brook	M	15	26	PC	PP-WS3-B1P	75.18	10.5	10.07	10.30	0.52
WS3	10/19/00	Brook	M	15	26	PC						
WS3	10/19/00	Brook	-	11.5	9	PC						
WS3	10/19/00	Brook	-	11.5	12	PC						
WS3	10/19/00	Brook	F	13	17	PC	PP-WS3-B2P	12.04	10.8	4.09	3.59	0.42
WS3	10/19/00	Brook	M	18.5	43	PC						

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
WS3	10/19/00	Brook	F	12	13	PC						
WS3	10/19/00	Brook	-	13	18	PC						
WS3	10/19/00	Brook	M	13.5	20	PC	PP-WS3-B3P	49.86	17.3	6.19	26.10	0.36
WS3	10/19/00	Brook	M	14.5	24	PC						
WS3	10/19/00	Brook	F	13	17	PC						
WS3	10/19/00	Brook	F	13	18	PC						
WS3	10/19/00	Brook	F	13.5	21	PC	PP-WS3-B4P	18.27	14.9	4.40	16.10	0.36
WS3	10/19/00	Brook	F	15	24	PC						
WS3	10/19/00	Brook	M	14	23	FIL						
WS3	10/19/00	Brook	M	15	26	FIL	PP-WS3-B1F	0.90	1.27	4.70	13.60	0.45
WS3	10/19/00	Brook	M	15	26	FIL						
WS3	10/19/00	Brook	-	11.5	9	FIL						
WS3	10/19/00	Brook	-	11.5	12	FIL						
WS3	10/19/00	Brook	F	13	17	FIL	PP-WS3-B2F	0.73	0.52	2.11	1.23	0.53
WS3	10/19/00	Brook	M	18.5	43	FIL						
WS3	10/19/00	Brook	F	12	13	FIL						
WS3	10/19/00	Brook	-	13	18	FIL						
WS3	10/19/00	Brook	M	13.5	20	FIL	PP-WS3-B3F	1.95	0.43	1.55	0.65	0.45
WS3	10/19/00	Brook	M	14.5	24	FIL						
WS3	10/19/00	Brook	F	13	17	FIL						
WS3	10/19/00	Brook	F	13	18	FIL						
WS3	10/19/00	Brook	F	13.5	21	FIL	PP-WS3-B4F	3.05	0.4	1.43	-0.03	0.29
WS3	10/19/00	Brook	F	15	24	FIL						
PP1	10/18/00	Brook	F	15.5	30	Gill						
PP1	10/18/00	Brook	F	17	40	Gill	PP-PP1-B1G	-0.45	0.10	2.09	0.29	0.07
PP1	10/18/00	Brook	M	20	74	Gill						
PP1	10/18/00	Brook	F	14.5	24	Gill						
PP1	10/18/00	Brook	M	18	52	Gill	PP-PP1-B2G	-0.95	0.13	2.27	0.19	0.07
PP1	10/18/00	Brook	M	20	69	Gill						
PP1	10/18/00	Brook	F	16	31	Gill						
PP1	10/18/00	Brook	F	18	45	Gill	PP-PP1-B3G	-2.33	0.96	2.21	0.37	0.09
PP1	10/18/00	Brook	M	20	68	Gill						
PP1	10/18/00	Brook	M	17	37	Gill						
PP1	10/18/00	Brook	F	18.5	47	Gill	PP-PP1-B4G	3.43	0.27	2.21	0.06	0.18
PP1	10/18/00	Brook	F	19.5	61	Gill						

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
PP1	10/18/00	Brook	F	17	38	Gill						
PP1	10/18/00	Brook	F	19	52	Gill	PP-PP1-B5G	0.15	0.14	2.52	0.64	0.10
PP1	10/18/00	Brook	M	18	54	Gill						
PP1	10/18/00	Brook	F	15.5	30	Liver						
PP1	10/18/00	Brook	F	17	40	Liver	PP-PP1-B1L	4.79	5.04	6.95	0.16	0.29
PP1	10/18/00	Brook	M	20	74	Liver						
PP1	10/18/00	Brook	F	14.5	24	Liver						
PP1	10/18/00	Brook	M	18	52	Liver	PP-PP1-B2L	1.66	2.87	6.85	0.18	0.34
PP1	10/18/00	Brook	M	20	69	Liver						
PP1	10/18/00	Brook	F	16	31	Liver						
PP1	10/18/00	Brook	F	18	45	Liver	PP-PP1-B3L	0.79	4.77	9.29	-0.17	0.35
PP1	10/18/00	Brook	M	20	68	Liver						
PP1	10/18/00	Brook	M	17	37	Liver						
PP1	10/18/00	Brook	F	18.5	47	Liver	PP-PP1-B4L	3.30	3.47	7.89	0.17	0.41
PP1	10/18/00	Brook	F	19.5	61	Liver						
PP1	10/18/00	Brook	F	17	38	Liver						
PP1	10/18/00	Brook	F	19	52	Liver	PP-PP1-B5L	2.90	3.99	6.13	0.94	0.30
PP1	10/18/00	Brook	M	18	54	Liver						
PP1	10/18/00	Brook	F	15.5	30	PC						
PP1	10/18/00	Brook	F	17	40	PC	PP-PP1-B1P	1.66	3.2	47.30	0.16	0.13
PP1	10/18/00	Brook	M	20	74	PC						
PP1	10/18/00	Brook	F	14.5	24	PC						
PP1	10/18/00	Brook	M	18	52	PC	PP-PP1-B2P	0.37	3.01	85.00	0.08	0.16
PP1	10/18/00	Brook	M	20	69	PC						
PP1	10/18/00	Brook	F	16	31	PC						
PP1	10/18/00	Brook	F	18	45	PC	PP-PP1-B3P	2.73	4.66	62.00	0.49	0.19
PP1	10/18/00	Brook	M	20	68	PC						
PP1	10/18/00	Brook	M	17	37	PC						
PP1	10/18/00	Brook	F	18.5	47	PC	PP-PP1-B4P	1.22	5.29	84.03	0.10	0.17
PP1	10/18/00	Brook	F	19.5	61	PC						
PP1	10/18/00	Brook	F	17	38	PC						
PP1	10/18/00	Brook	F	19	52	PC	PP-PP1-B5P	-1.04	4.14	32.49	0.01	0.20
PP1	10/18/00	Brook	M	18	54	PC						
PP1	10/18/00	Brook	F	15.5	30	FIL						
PP1	10/18/00	Brook	F	17	40	FIL	PP-PP1-B1F	-0.13	1.67	3.16	0.68	0.25
PP1	10/18/00	Brook	M	20	74	FIL						

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
PP1	10/18/00	Brook	F	14.5	24	FIL						
PP1	10/18/00	Brook	M	18	52	FIL	PP-PP1-B2F	-1.82	6.89	5.12	0.64	0.31
PP1	10/18/00	Brook	M	20	69	FIL						
PP1	10/18/00	Brook	F	16	31	FIL						
PP1	10/18/00	Brook	F	18	45	FIL	PP-PP1-B3F	-3.78	1.1	3.11	87.00	0.29
PP1	10/18/00	Brook	M	20	68	FIL						
PP1	10/18/00	Brook	M	17	37	FIL						
PP1	10/18/00	Brook	F	18.5	47	FIL	PP-PP1-B4F	-0.27	2.57	16.74	1.95	0.30
PP1	10/18/00	Brook	F	19.5	61	FIL						
PP1	10/18/00	Brook	F	17	38	FIL						
PP1	10/18/00	Brook	F	19	52	FIL	PP-PP1-B5F	2.82	1.6	5.10	0.27	0.20
PP1	10/18/00	Brook	M	18	54	FIL						
PP3	10/25/00	Brook	F	16	34	Gill						
PP3	10/25/00	Brook	F	17	50	Gill	PP-PP3-B1G	5.07	9.61	3.75	12.60	0.49
PP3	10/25/00	Brook	M	21.5	83	Gill	PP-PP3-B2G	4.23	6.83	6.55	10.90	0.42
PP3	10/25/00	Brook	F	23.5	92	Gill	PP-PP3-B3G	5.71	9.05	5.16	32.00	0.65
PP3	10/25/00	Brook	F	24	101	Gill	PP-PP3-B4G	0.03	5.19	3.36	14.00	0.35
PP3	10/25/00	Brook	F	16	34	Liver						
PP3	10/25/00	Brook	F	17	50	Liver	PP-PP3-B1L	1.20	3.83	68.79	2.02	0.19
PP3	10/25/00	Brook	M	21.5	83	Liver	PP-PP3-B2L	-1.65	5.27	307.39	8.32	0.26
PP3	10/25/00	Brook	F	23.5	92	Liver	PP-PP3-B3L	-0.37	20.5	1414.67	31.60	0.34
PP3	10/25/00	Brook	F	24	101	Liver	PP-PP3-B4L	0.29	16.8	476.12	34.80	0.41
PP3	10/25/00	Brook	F	16	34	PC						
PP3	10/25/00	Brook	F	17	50	PC	PP-PP3-B1P	8.75	22.8	11.48	55.20	0.61
PP3	10/25/00	Brook	M	21.5	83	PC	PP-PP3-B2P	5.71	7.03	6.72	18.80	0.37
PP3	10/25/00	Brook	F	23.5	92	PC	PP-PP3-B3P	4.19	9.09	11.27	15.60	0.41
PP3	10/25/00	Brook	F	24	101	PC	PP-PP3-B4P	7.61	10.6	18.71	30.40	0.53
PP3	10/25/00	Brook	F	16	34	FIL						
PP3	10/25/00	Brook	F	17	50	FIL	PP-PP3-B1F	-1.35	0.17	2.40	0.88	0.13
PP5	10/25/00	Brook	M	21.5	83	FIL	PP-PP3-B2F	-3.77	0.29	1.83	0.37	0.23
PP5	10/25/00	Brook	F	23.5	92	FIL	PP-PP3-B3F	-1.24	0.33	2.06	8.29	0.24
PP3	10/25/00	Brook	F	24	101	FIL	PP-PP3-B4F	0.11	1.29	11.80	1.01	0.34

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
PP5	10/25/00	RBT	M	23.5	119	Gill	PP-PP5-RB1G	3.11	1.32	2.61	4.46	1.01
PP5	10/25/00	RBT	F	24.5	139	Gill	PP-PP5-RB2G	1.51	5.05	3.24	11.60	0.87
PP5	10/25/00	RBT	F	25	143	Gill	PP-PP5-RB3G	2.52	5.36	4.75	2.82	2.51
PP5	10/25/00	RBT	F	25.5	145	Gill	PP-PP5-RB4G	1.58	7.71	4.12	3.30	3.04
PP5	10/25/00	RBT	F	27	204	Gill	PP-PP5-RB5G	2.55	2.98	3.51	6.31	1.65
PP5	10/25/00	RBT	M	23.5	119	Liver	PP-PP5-RB1L	-0.83	2.87	381.13	1.87	0.15
PP5	10/25/00	RBT	F	24.5	139	Liver	PP-PP5-RB2L	0.14	3.22	175.13	1.41	0.13
PP5	10/25/00	RBT	F	25	143	Liver	PP-PP5-RB3L	0.40	4.05	195.94	1.31	0.11
PP5	10/25/00	RBT	F	25.5	145	Liver	PP-PP5-RB4L	0.45	5.64	216.72	1.19	0.19
PP5	10/25/00	RBT	F	27	204	Liver	PP-PP5-RB5L	-0.97	1.87	125.60	1.10	0.08
PP5	10/25/00	RBT	M	23.5	119	PC	PP-PP5-RB1P	9.62	3.05	26.15	6.06	1.68
PP5	10/25/00	RBT	F	24.5	139	PC	PP-PP5-RB2P	10.16	5.22	16.25	11.50	1.44
PP5	10/25/00	RBT	F	25	143	PC	PP-PP5-RB3P	5.09	4.89	9.35	3.76	0.90
PP5	10/25/00	RBT	F	25.5	145	PC	PP-PP5-RB4P	8.53	4.19	23.85	4.76	2.64
PP5	10/25/00	RBT	F	27	204	PC	PP-PP5-RB5P	8.10	2.72	15.15	8.03	0.66
PP5	10/25/00	RBT	M	23.5	119	FIL	PP-PP5-RB1F	-0.96	0.62	3.75	1.78	0.08
PP5	10/25/00	RBT	F	24.5	139	FIL	PP-PP5-RB2F	0.06	0.27	2.48	0.89	0.14
PP5	10/25/00	RBT	F	25	143	FIL	PP-PP5-RB3F	-0.49	0.4	2.94	0.27	0.16
PP5	10/25/00	RBT	F	25.5	145	FIL	PP-PP5-RB4F	-1.63	0.24	1.58	-0.06	0.15
PP5	10/25/00	RBT	F	27	204	FIL	PP-PP5-RB5F	1.17	0.11	2.42	0.29	0.11
C5	10/24/00	Brook	-	11	12	Gill						
C5	10/24/00	Brook	F	22.5	92	Gill	PP-C5-B1G	-1.30	7.85	19.95	5.20	0.31
C5	10/24/00	Brook	-	12	13	Gill						
C5	10/24/00	Brook	M	21.5	83	Gill	PP-C5-B2G	-1.24	5.32	5.39	5.28	0.27
C5	10/24/00	Brook	F	12	14	Gill						
C5	10/24/00	Brook	M	13	15	Gill	PP-C5-B3G	-3.59	7.16	4.21	4.27	0.29
C5	10/24/00	Brook	F	21	70	Gill						
C5	10/24/00	Brook	-	11.5	16	Gill						
C5	10/24/00	Brook	M	13.5	22	Gill						
C5	10/24/00	Brook	-	14.5	25	Gill	PP-C5-B4G	-2.50	5.76	4.98	3.47	0.35
C5	10/24/00	Brook	M	14	25	Gill						
C5	10/24/00	Brook	M	13	19	Gill						
C5	10/24/00	Brook	F	13	20	Gill						
C5	10/24/00	Brook	-	14.5	24	Gill	PP-C5-B5G	-1.44	6.97	4.14	2.13	0.47

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
C5	10/24/00	Brook	F	14.5	25	Gill						
C5	10/24/00	Brook	-	11	12	Liver						
C5	10/24/00	Brook	F	22.5	92	Liver	PP-C5-B1L	1.01	6.04	55.26	0.70	0.17
C5	10/24/00	Brook	-	12	13	Liver						
C5	10/24/00	Brook	M	21.5	83	Liver	PP-C5-B2L	14.28	7.98	67.70	0.67	0.15
C5	10/24/00	Brook	F	12	14	Liver						
C5	10/24/00	Brook	M	13	15	Liver	PP-C5-B3L	3.85	17.6	435.00	4.46	0.26
C5	10/24/00	Brook	F	21	70	Liver						
C5	10/24/00	Brook	-	11.5	16	Liver						
C5	10/24/00	Brook	M	13.5	22	Liver						
C5	10/24/00	Brook	-	14.5	25	Liver	PP-C5-B4L	4.33	2.86	58.14	0.30	0.17
C5	10/24/00	Brook	M	14	25	Liver						
C5	10/24/00	Brook	M	13	19	Liver						
C5	10/24/00	Brook	F	13	20	Liver						
C5	10/24/00	Brook	-	14.5	24	Liver	PP-C5-B5L	1.81	5.7	52.39	0.72	0.15
C5	10/24/00	Brook	F	14.5	25	Liver						
C5	10/24/00	Brook	-	11	12	PC						
C5	10/24/00	Brook	F	22.5	92	PC	PP-C5-B1P	5.34	2.24	4.33	1.66	0.37
C5	10/24/00	Brook	-	12	13	PC						
C5	10/24/00	Brook	M	21.5	83	PC	PP-C5-B2P	4.16	7.65	8.22	1.92	0.80
C5	10/24/00	Brook	F	12	14	PC						
C5	10/24/00	Brook	M	13	15	PC	PP-C5-B3P	3.41	6.76	4.05	4.91	0.40
C5	10/24/00	Brook	F	21	70	PC						
C5	10/24/00	Brook	-	11.5	16	PC						
C5	10/24/00	Brook	M	13.5	22	PC						
C5	10/24/00	Brook	-	14.5	25	PC	PP-C5-B4P	15.89	2.59	6.24	2.52	0.62
C5	10/24/00	Brook	M	14	25	PC						
C5	10/24/00	Brook	M	13	19	PC						
C5	10/24/00	Brook	F	13	20	PC						
C5	10/24/00	Brook	-	14.5	24	PC	PP-C5-B5P	4.38	2.08	6.21	0.78	0.44
C5	10/24/00	Brook	F	14.5	25	PC						
C5	10/24/00	Brook	-	11	12	FIL						
C5	10/24/00	Brook	F	22.5	92	FIL	PP-C5-B1F	-1.94	0.21	1.61	0.97	0.09
C5	10/24/00	Brook	-	12	13	FIL						
C5	10/24/00	Brook	M	21.5	83	FIL	PP-C5-B2F	-1.23	0.29	3.19	0.56	0.14
C5	10/24/00	Brook	F	12	14	FIL						
C5	10/24/00	Brook	M	13	15	FIL	PP-C5-B3F	-0.64	0.29	3.21	1.82	0.14

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
C5	10/24/00	Brook	F	21	70	FIL						
C5	10/24/00	Brook	-	11.5	16	FIL						
C5	10/24/00	Brook	M	13.5	22	FIL						
C5	10/24/00	Brook	-	14.5	25	FIL	PP-C5-B4F	-1.90	0.1	2.00	0.71	0.08
C5	10/24/00	Brook	M	14	25	FIL						
C5	10/24/00	Brook	M	13	19	FIL						
C5	10/24/00	Brook	F	13	20	FIL						
C5	10/24/00	Brook	-	14.5	24	FIL	PP-C5-B5F	-2.22	0.42	1.47	0.63	0.08
C5	10/24/00	Brook	F	14.5	25	FIL						
L5	10/17/00	Brook	M	13	15	Gill						
L5	10/17/00	Brook	-	16.5	31	Gill	PP-L5-B1G	-4.87	3.22	4.57	2.03	0.38
L5	10/17/00	Brook	M	16.5	39	Gill						
L5	10/17/00	Brook	-	13.5	18	Gill						
L5	10/17/00	Brook	M	14	29	Gill	PP-L5-B2G	-3.28	3.74	5.28	0.99	0.30
L5	10/17/00	Brook	M	16.5	39	Gill						
L5	10/17/00	Brook	-	14	20	Gill						
L5	10/17/00	Brook	M	16	29	Gill	PP-L5-B3G	-5.55	2.95	5.40	1.11	0.31
L5	10/17/00	Brook	M	17	38	Gill						
L5	10/17/00	Brook	M	14	23	Gill						
L5	10/17/00	Brook	M	14.5	28	Gill	PP-L5-B4G	-2.45	2.71	4.14	0.78	0.33
L5	10/17/00	Brook	M	17	34	Gill						
L5	10/17/00	Brook	M	15	28	Gill						
L5	10/17/00	Brook	M	15.5	31	Gill	PP-L5-B5G	1.46	3.12	4.39	3.56	0.43
L5	10/17/00	Brook	M	16	33	Gill						
L5	10/17/00	Brook	M	13	15	Liver						
L5	10/17/00	Brook	-	16.5	31	Liver	PP-L5-B1L	2.11	5.75	67.73	0.67	0.10
L5	10/17/00	Brook	M	16.5	39	Liver						
L5	10/17/00	Brook	-	13.5	18	Liver						
L5	10/17/00	Brook	M	14	29	Liver	PP-L5-B2L	1.42	7.22	57.38	1.14	0.20
L5	10/17/00	Brook	M	16.5	39	Liver						
L5	10/17/00	Brook	-	14	20	Liver						
L5	10/17/00	Brook	M	16	29	Liver	PP-L5-B3L	1.75	3.74	110.53	1.58	0.23
L5	10/17/00	Brook	M	17	38	Liver						
L5	10/17/00	Brook	M	14	23	Liver						
L5	10/17/00	Brook	M	14.5	28	Liver	PP-L5-B4L	2.25	4.24	60.35	4.65	0.13
L5	10/17/00	Brook	M	17	34	Liver						
L5	10/17/00	Brook	M	15	28	Liver						

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Type	New Id	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
L5	10/17/00	Brook	M	15.5	31	Liver	PP-L5-B5L	2.36	7.61	136.38	0.02	0.20
L5	10/17/00	Brook	M	16	33	Liver						
L5	10/17/00	Brook	M	13	15	PC						
L5	10/17/00	Brook	-	16.5	31	PC	PP-L5-B1P	-2.70	10.9	23.88	56.90	0.88
L5	10/17/00	Brook	M	16.5	39	PC						
L5	10/17/00	Brook	-	13.5	18	PC						
L5	10/17/00	Brook	M	14	29	PC	PP-L5-B2P	1.77	10.4	5.50	0.13	0.41
L5	10/17/00	Brook	M	16.5	39	PC						
L5	10/17/00	Brook	-	14	20	PC						
L5	10/17/00	Brook	M	16	29	PC	PP-L5-B3P	2.61	269	6.82	0.72	0.38
L5	10/17/00	Brook	M	17	38	PC						
L5	10/17/00	Brook	M	14	23	PC						
L5	10/17/00	Brook	M	14.5	28	PC	PP-L5-B4P	0.10	4.71	7.28	0.24	0.33
L5	10/17/00	Brook	M	17	34	PC						
L5	10/17/00	Brook	M	15	28	PC						
L5	10/17/00	Brook	M	15.5	31	PC	PP-L5-B5P	2.57	4.26	7.35	0.04	0.45
L5	10/17/00	Brook	M	16	33	PC						
L5	10/17/00	Brook	M	13	15	FIL						
L5	10/17/00	Brook	-	16.5	31	FIL	PP-L5-B1F	-1.85	0.1	1.86	1.23	0.13
L5	10/17/00	Brook	M	16.5	39	FIL						
L5	10/17/00	Brook	-	13.5	18	FIL						
L5	10/17/00	Brook	M	14	29	FIL	PP-L5-B2F	-0.06	0.25	1.94	1.57	0.21
L5	10/17/00	Brook	M	16.5	39	FIL						
L5	10/17/00	Brook	-	14	20	FIL						
L5	10/17/00	Brook	M	16	29	FIL	PP-L5-B3F	-0.19	0.15	1.52	0.61	0.20
L5	10/17/00	Brook	M	17	38	FIL						
L5	10/17/00	Brook	M	14	23	FIL						
L5	10/17/00	Brook	M	14.5	28	FIL	PP-L5-B4F	-2.59	0.65	2.35	0.60	0.17
L5	10/17/00	Brook	M	17	34	FIL						
L5	10/17/00	Brook	M	15	28	FIL						
L5	10/17/00	Brook	M	15.5	31	FIL	PP-L5-B5F	-0.72	0.44	2.11	2.92	0.20
L5	10/17/00	Brook	M	16	33	FIL						

Whole Fish

Site ID	Date	Species	Sex	L(cm)	wt(gm)	Sample ID	Type	µg As/g	µg Cd/g	µg Cu/g	µg Pb/g	µg Zn/g
WS3	10/19/00	Brook		13	16	WS3-WF-1	WF	5.47	3.26	12.48	3.12	0.46
WS3	10/19/00	Brook		13.5	21	WS3-WF-2	WF	4.03	3	41.22	1.60	0.30
WS3	10/19/00	Brook		14	22	WS3-WF-3	WF	4.83	1.66	9.04	2.48	0.43
WS3	10/19/00	Brook		12.5	15	WS3-WF-4	WF	4.75	1.74	44.10	1.68	0.33
WS3	10/19/00	Brook		12.5	14	WS3-WF-5	WF	3.09	3	49.60	1.37	0.64
PP1	10/18/00	Brook	M	22	102	PP1-WF-1	WF	0.06	0.33	3.30	0.55	0.09
PP1	10/18/00	Brook	F	20	72	PP1-WF-2	WF	-0.69	0.49	16.98	0.02	0.11
PP1	10/18/00	Brook		13.5	22	PP1-WF-3	WF	0.06	0.39	8.57	0.10	0.12
PP1	10/18/00	Brook		17	38	PP1-WF-4	WF	-0.25	0.59	33.03	0.17	0.08
PP1	10/18/00	Brook		17	38	PP1-WF-5	WF	1.76	0.73	41.55	0.12	0.11
PP3	10/25/00	Brook		16.5	41	PP3-WF-1	WF	0.03	0.61	4.03	3.50	0.21
PP3	10/25/00	Brook		17.5	56	PP3-WF-2	WF	0.03	0.68	17.79	3.32	0.24
PP3	10/25/00	Brook		18	58	PP3-WF-3	WF	0.24	0.83	12.72	3.67	0.33
PP3	10/25/00	Brook		10	8	PP3-WF-4	WF	5.34	1.32	32.24	20.30	0.30
PP3	10/25/00	Brook		9.5	6	PP3-WF-5	WF	1.58	0.66	15.19	0.61	0.17
PP5	10/25/00	RBT		19	63	PP5-WF-1	WF	0.99	0.21	9.95	2.24	0.15
PP5	10/25/00	RBT		21.5	84	PP5-WF-2	WF	0.84	0.4	14.15	22.80	0.22
PP5	10/25/00	RBT		24	124	PP5-WF-3	WF	0.78	0.22	7.05	1.79	0.10
PP5	10/25/00	RBT		19.5	65	PP5-WF-4	WF	1.62	0.19	6.05	2.67	0.20
PP5	10/25/00	RBT		?	?	PP5-WF-5	WF	2.32	0.3	17.90	4.67	0.23
C5	10/24/00	Brook		13	19	C5-WF-1	WF	2.33	0.79	16.81	3.22	0.16
C5	10/24/00	Brook		16	32	C5-WF-2	WF	0.49	0.59	14.62	4.36	0.15
C5	10/24/00	Brook		13.5	19	C5-WF-3	WF	2.83	0.5	10.02	0.69	0.14
C5	10/24/00	Brook		11.5	13	C5-WF-4	WF	3.77	0.66	21.16	0.88	0.10
C5	10/24/00	Brook		12.5	15	C5-WF-5	WF	-1.22	0.42	11.17	0.68	0.15
L5	10/17/00	Brook		13.5	17	L5-WF-1	WF	0.41	0.54	10.62	0.13	0.40
L5	10/17/00	Brook		14.5	22	L5-WF-2	WF	-0.02	0.86	15.59	0.36	0.35
L5	10/17/00	Brook		14.5	23	L5-WF-3	WF	-1.14	0.98	31.50	-0.09	0.39
L5	10/17/00	Brook		13.5	19	L5-WF-4	WF	0.06	1.85	83.82	0.46	0.42
L5	10/17/00	Brook		14	20	L5-WF-5	WF	1.20	1.25	12.76	0.34	0.55